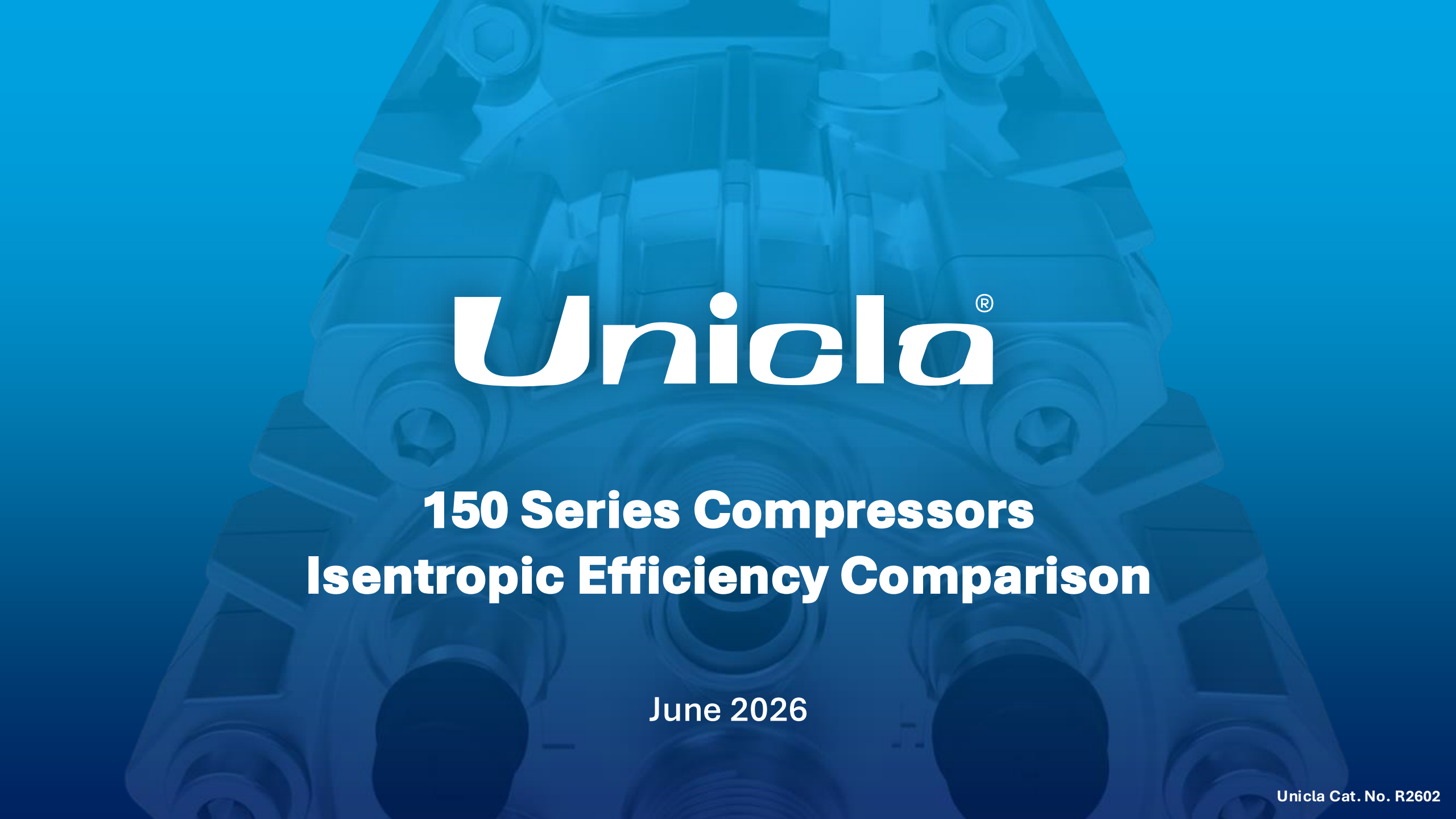


150 Series Compressors
Isentropic Efficiency Comparison

June 2026

Unicla Cat. No. R2602

Introduction

- Unicla eDrive technology incorporates a new approach to compressor and electric motor cooling. This test is validation of the planned improvements made by the Unicla engineering team when eDrive design first began in 2018.
- The technology is based non-refrigerant cooling of the electric motor that utilizes a new patented air-cooling jacket integrated into the stator housing.
- The compressor working assembly incorporates the traditional Unicla 10-cylinder 145cc swashplate and piston operation with added cooling tubes and fins to reduce the discharge refrigerant vapour temperature before exiting the compressor to the condenser.
- This test compares the capacity, performance and efficiency a new eDrive UD150 to a traditional Unicla belt drive (oDrive) 150 series compressor.
- The results show the eDrive UD150 achieved a higher than expected improvement in isentropic efficiency, capacity, and COP.
- Immediate advantages for HVAC engineers and system integrators are reduced heat load on the condenser and a cooler running compressor to reduce oil fatigue and stress on other components.
- These efficiency benefits in combination with Unicla eDrive firmware, eConnect and eControl, deliver extended life expectancy and reduced life cycle costs (LCC), and reduced life cycle climate potential (LCCP).

Testing Facility and Accreditation

- Unicla Australasia and SuperTest Australia facility located at 14 Motorway Circuit, Ormeau, QLD 4208, providing comprehensive compressor testing capabilities [1]
- NATA accreditation to ISO/IEC 17025 establishes structured framework for quality results with traceability, comparability, and international recognition through ILAC and APAC MRA agreements
- Testing ensures technical proficiency, measurement precision, process impartiality, and customer confidence through internationally recognized accreditation standards

Accreditation No. 21121

Since 11/10/23 [1]

ISO/IEC 17025

Test Laboratory Standard [1]

ILAC & APAC MRA

International Recognition [1]

Test Purpose and Methodology

- Test compares Unicla eDrive UD150 with integrated electric motor versus oDrive UX150 belt-driven open drive configuration [1]
- SuperTest's in-house calorimeter measures capacity and isentropic efficiency using PID-controlled water-cooled condensers.
- Standardised conditions – underJIS requirements: 1.81 bar suction, 15.2 bar discharge, 10K superheat, 5K subcooling at 1850 rpm for direct comparison

R134a
Refrigerant used [1]

1850 rpm
Test speed [1]

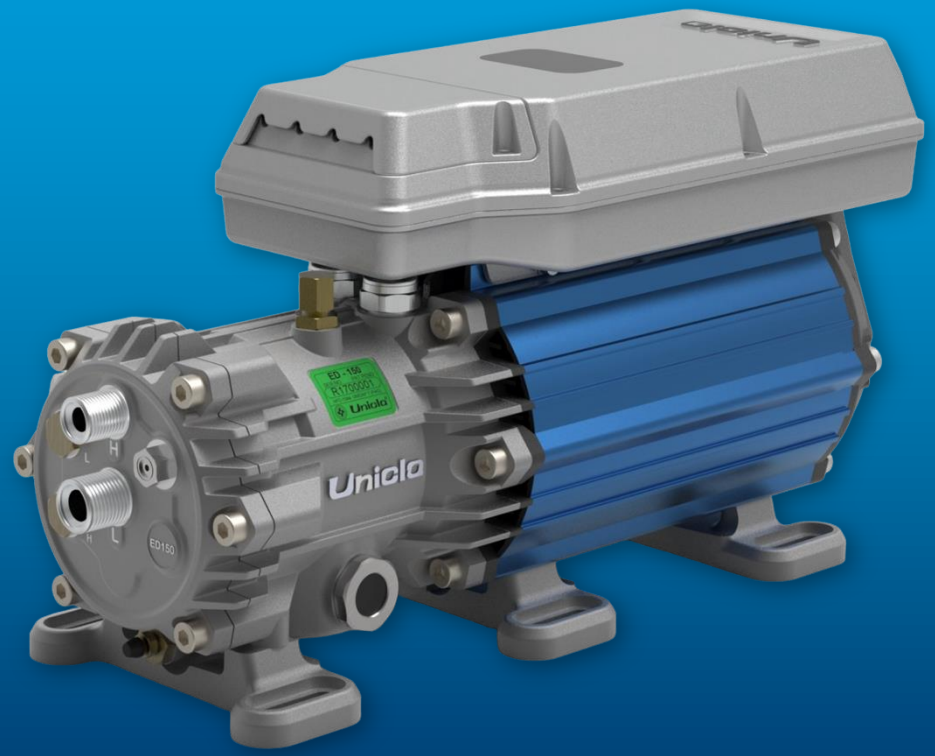
10K/5K
Superheat/Subcooling [1]

Calorimeter System Overview

- Calorimeter controls discharge and suction pressure as well as superheat and subcooling using PID-controlled systems with variable flow water-cooled condensers and sub-cool condenser with integrated heater [1]
- Evaporator coil immersed in refrigerant R514a (Opteon XP30) provides necessary heat load, with adjacent heater controlling output to create different load conditions throughout testing cycle [1]
- System measures mass flow rate of refrigerant and torque values at predefined conditions, enabling calculation of compressor capacity through capacity graphs and pressure-enthalpy diagrams [1]
- Discharge pressure controlled by water-cooled condenser, suction pressure by evaporator and internal heater, superheat by proportional thermal expansion valve, subcooling by sub-cool condenser

eDrive UD150 Technology

- eDrive UD150 incorporates Unicla 10-cylinder 145cc swashplate with Unicla 3000W brushless and sensor less DC motor (BLDC), utilizing patented technology for motor control and cooling [1]
- Integrated cooling fan actively cools motor and compressor, enabling superior thermal management for improved efficiency over open-drive designs [1]
- Compatible with R134a, R404A, R513a, R452a, R1234yf refrigerants, with voltage options for 48V, 72V, 400V, 600V, or 800V DC applications [1]
- Test unit operates at 72V DC with 1850 rpm maximum speed, representing typical parameters for mobile air conditioning and transport refrigeration



eDrive UD150 and oDrive UX150 Test Configuration

- Test conditions established with R134a, target discharge pressure of 15.2 bar gauge at 58.42°C, and suction pressure of 1.81 bar gauge at -1°C [1]
- Both tests demonstrated excellent control precision
- UD150 test achieved 15.18 bar gauge discharge at 58.41°C and 1.80 bar gauge suction at -1.15°C [1]
- UX150 test achieved 15.23 bar gauge discharge pressure at 58.55°C and 1.85 bar gauge suction pressure at -0.59°C [1]
- Maintained 10K superheat and 5K subcooling at 1850 rpm throughout testing for consistent performance measurement

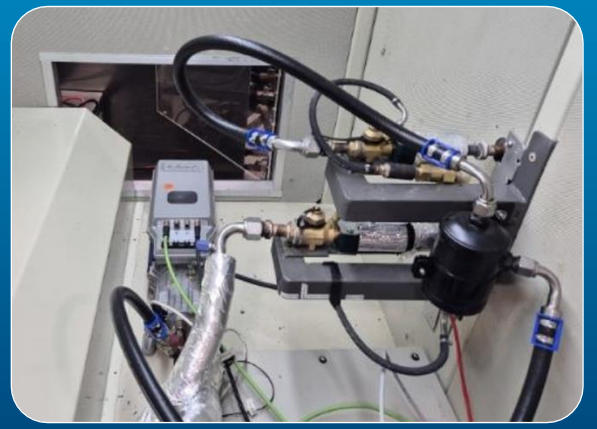
1850 rpm
Compressor speed [1]

15.18 bar
Discharge at 58.41°C [1]

1.8 bar
Suction at -1.15°C [1]

15.23 bar
Discharge at 58.55°C [1]

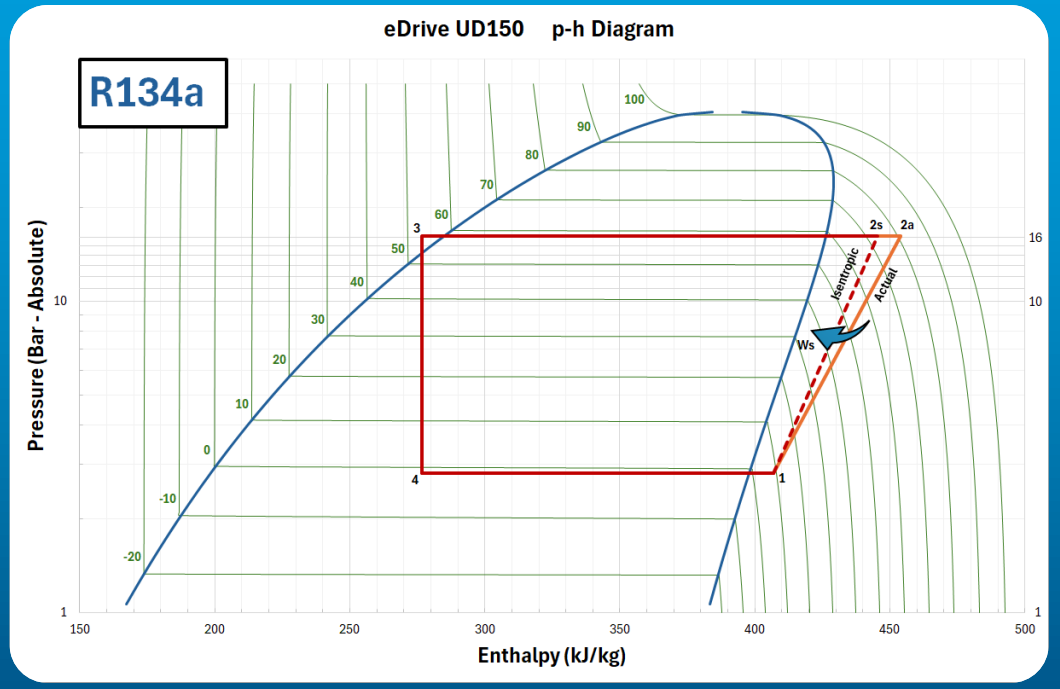
1.85 bar
Suction at -0.59°C [1]



UD150 **UX150**

Compressors under test in the calorimeter mounting compartment

eDrive UD150 Performance Results



- Pressure-enthalpy diagram shows refrigeration cycle with 5.37 kW compressor, 7.17 kW condenser, and 5.26 kW cooling capacity [1]
- Isentropic efficiency calculated at 82% using η = (h2s - h1)/(h2a - h1) × 100%, demonstrating excellent thermodynamic performance [1]

eDrive UD150 isentropic efficiency calculation [1]

$$\eta = \frac{h2s - h1}{h2a - h1} 100\% = \frac{445.3 - 406.8}{453.7 - 406.8} 100\% = 82\%$$

eDrive UD150 Performance Metrics

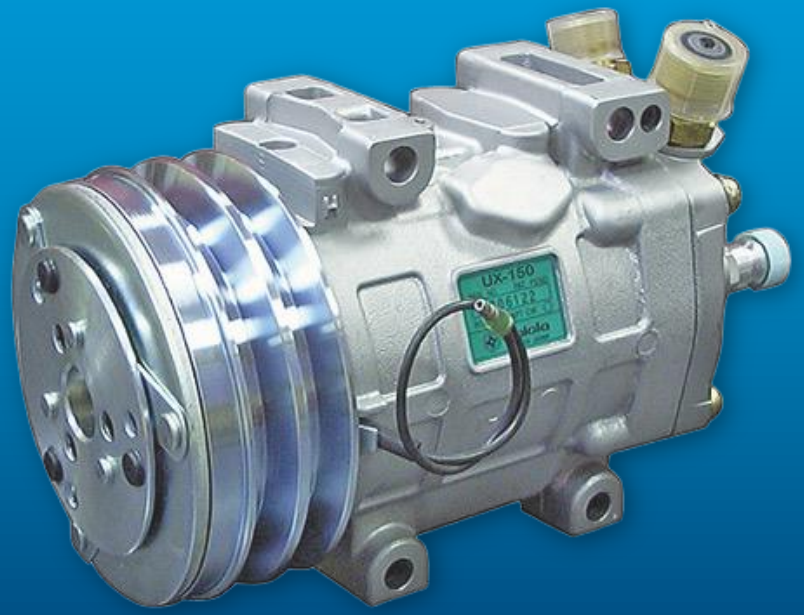
Metric	Value
Compressor Capacity	5.37 kW
Condenser Capacity	7.17 kW
Cooling Capacity	5.26 kW
Isentropic Efficiency	82%
Power Consumption	2.55 kW
COP	2.10

Source: Unicla_UD150_UX150_isentropic_efficiency_V1.docx

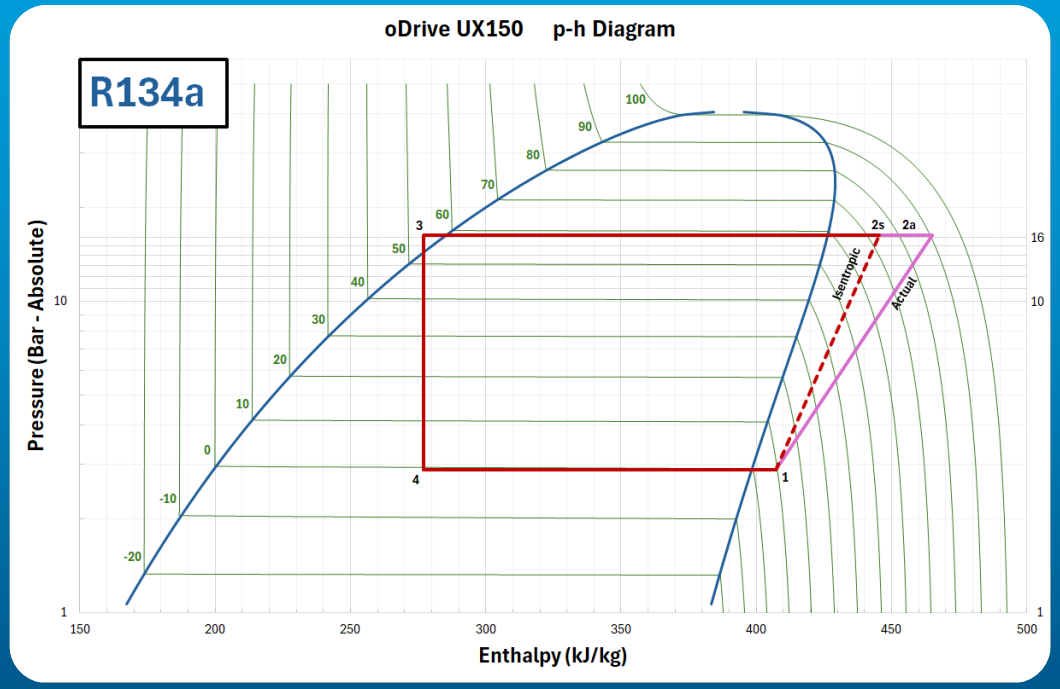
- System achieves coefficient of performance of 2.10 with 2.55 kW power consumption [1]

eDrive UD150 Technology

- oDrive UX150 incorporates identical Unicla 10-cylinder 145cc swashplate working assembly as UD150 but utilizes standard Unicla crankcase without special cooling features of eDrive models [1]
- Open drive belt-driven configuration suitable for mobile air conditioning and transport refrigeration with extremely quiet and smooth operation plus high volumetric efficiency through all revolution ranges [1]
- Compressor operates in both clockwise and counterclockwise rotation with typical rpm range of 750-6000 rpm in most applications, tested at 1850 rpm for direct comparison with eDrive model [1]



oDrive UX150 Performance Results



- Pressure-enthalpy diagram demonstrates compressor capacity of 4.54 kW, condenser capacity of 6.45 kW under standardized conditions [1]
- Isentropic efficiency calculated at 66%

oDrive UX150 isentropic efficiency calculation [1]

$$\eta = \frac{h2s - h1}{h2a - h1} 100\% = \frac{445.3 - 407.2}{464.8 - 407.2} 100\% = 66\%$$

eDrive UD150 Performance Metrics

Metric	Value
Compressor Capacity	4.54 kW
Condenser Capacity	6.45 kW
Cooling Capacity	4.47 kW
Isentropic Efficiency	66%
Power Consumption	3.10 kW
COP	1.46

Source: Unicla_UD150_UX150_isentropic_efficiency_V1.docx

- System achieves with COP of 1.46 and power consumption of 3.10 kW

Comparative Performance Results

+24%
Isentropic efficiency improvement [1]

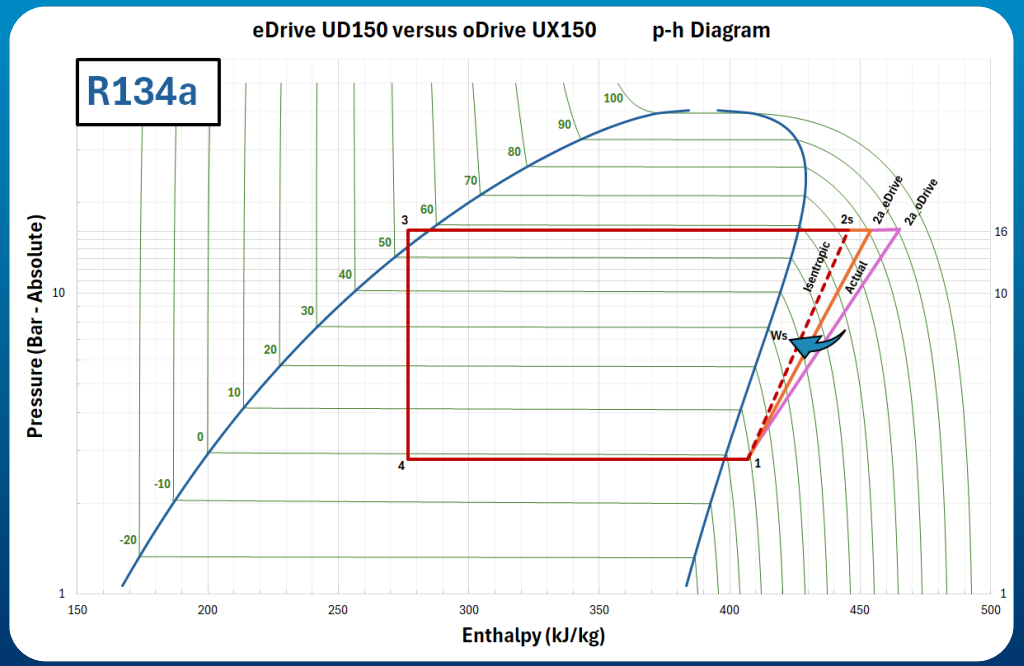
+ 18.2%
Compressor capacity improvement [1]

-17.7%
Reduction in power consumption [1]

+43.7%
COP Enhancement [1]

Metric	eDrive	oDrive	Difference
Compressor Capacity	5.37 kW	4.54 kW	+18.2
Condenser Capacity	7.17 kW	6.45 kW	+11.2
Cooling Capacity	5.26 kW	4.47 kW	+17.8
Isentropic Efficiency	82%	66%	+24.0
Power Consumption	2.55 kW	3.10 kW	-17.7
COP	2.10	1.46	+43.7

- eDrive UD150 delivers 18.2% higher compressor capacity, 11.2% greater condenser capacity, and 17.8% improved cooling capacity [1]
- Integrated cooling fans lower discharge temperatures from 90.5°C to 80.2°C, enabling 82% isentropic efficiency versus 66% which is a 24% improvement
- Power consumption reduced 17.7% while COP improves 43.7%, demonstrating superior energy efficiency



p-h Diagram showing both the eDrive UD150 and the oDrive UX150.

References

[1] UTR-235-B_Unicla_UD150_UX150_isentropic_efficiency_V1.docx

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