Introduction

Companies and organizations of every size, in every industry and on every continent are turning to ORC – Organic Rankine Cycle systems – to both improve the economics of their business and help reduce their CO_2 footprint which can lead to climate change. Honeywell is offering a high-quality working fluid with significant benefits for overall efficiency.

Benefits

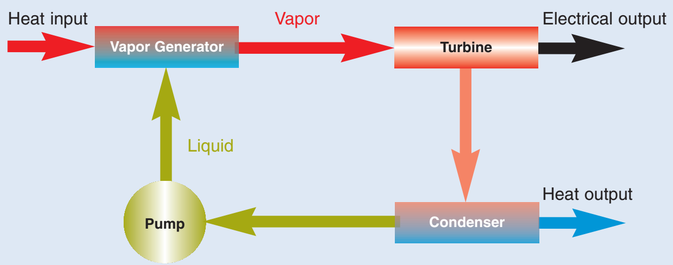
- Maximizes ORC cycle efficiency and system economics
- Non-flammable
- Favorable toxicological profile

Economical Way of Reducing CO_2 Emissions

Converting low temperature heat to energy is good business and good for the environment. ORC systems:

- Generate power from renewable heat sources, e.g. geothermal and solar, directly increasing the amount of renewable energy and reducing CO_2 emissions
- Generate power from waste heat that offsets grid consumption, reducing CO_2 emissions
- Generate power that is CO_2 free – no fuel consumed in cycle
- Are leak tight, eliminating direct chemical contribution to global warming as a result of working fluid emissions
- Use an organic working fluid to recover heat
- Are built to last, often for decades

Typical ORC Configuration



Low Temperature Heat and Waste Heat Recovery

While many organizations and industries have been focused on recovering high temperature heat, many are now seeking to recover waste heat from even lower temperature sources (60–300°C), and ORC has been selected as a highly effective technology for recovering this heat and converting it to electrical power.

Genetron 245fa has the most favorable properties for low temperature heat recovery systems. Its thermodynamic properties are different than HFCs typically used in refrigeration.

Safety

Unlike a number of alternative working fluids, e.g. hydrocarbons, Genetron 245fa has low toxicity and is non-flammable. This maximizes the benefits of ORC systems by:

- Driving ORC penetration through better economics than systems containing flammable fluids
- Driving wider acceptability and implementation of ORC across multiple end use environments

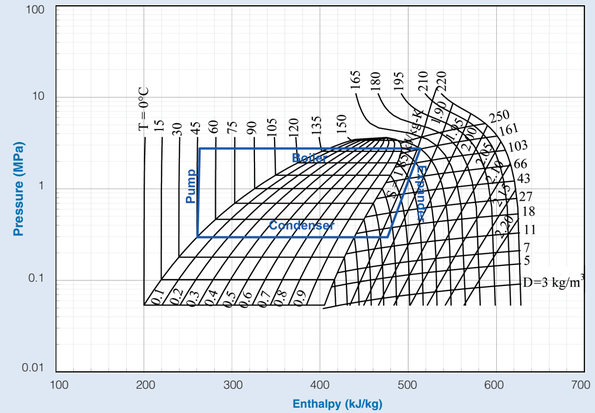
Economics

Higher ORC cycle efficiency compared with alternatives increases power generation and improves your payback on investment.

- Genetron 245fa thermodynamic properties reduce ORC size/costs, and lower investment cost to the end user
- Non-flammability can lead to substantial reduction in end user investment costs compared with flammable alternatives
  - ATEX assessment, resultant safety measures, insurance
  - Many end users cannot accept an ORC with a flammable heat transfer fluid

Genetron 245fa minimizes end user investment and maximizes return on investment

Genetron 245fa Pressure Enthalpy Diagram with ORC cycle



Cycle Conditions

Pump Efficiency 75% Expander Efficiency 85% Boiler Exit Temp 150°C Condenser Temp 45°C Boiler Pressure 2.758 MPa

Genetron 245fa Physical Properties

Chemical Name	1,1,1,3,3,-pentafluoropropane
Molecular Formula	$CF_3CH_2CHF_2$
Flash Point	None by ASTM
Boiling point °C at 1.01 bar	15.3°C / 59.5°F
Freezing Point °C at 1.01 bar	-107°C / -160°F
Liquid Heat Capacity kJ/kg K	1.36
Vapor Heat Capacity at constant pressure 1.01 bar kJ/kg K	0.8931

Stability

Laboratory tests indicate Genetron 245fa to have a high degree of thermal and hydrolytic stability. Sealed tube thermal stability tests were conducted at 260°C for four weeks. When tested alone under these conditions, Genetron 245fa purity was relatively unchanged. In sealed tube studies the material showed no signs of decomposition after six weeks of exposure to temperatures ranging from 75°C to 200°C in the presence and absence of water (at 300 ppm) and in the presence and absence of metals (3003 aluminum and/or 316 stainless steel).

A separate study was also conducted with cold rolled steel rod exposed to Genetron 245fa in the presence and absence of air and water for a period of two to six weeks at temperatures ranging from 25°C to 100°C. Again, Genetron 245fa did not show any signs of decomposition. The presence of metals, air, moisture and lubricant can influence stability and, as a result, thermal stability should be evaluated for the conditions of application.

Compatibility

Honeywell has carried out materials testing to evaluate the compatibility of common materials of construction with Genetron 245fa. The evaluations are based on 14-, 30- and 90-day testing results. The evaluations also consider static and dynamic conditions and the intended applications of the materials.

There may be some neoprene and nitrile rubber formulations as well as perfluoroelastomer compounds that may be acceptable for specific applications. Elastomer compatibility should be evaluated at the conditions of use.

Plastics Compatibility	
Polyethylene	Satisfactory
Polypropylene	Satisfactory
PTFE	Satisfactory
PVDF	Satisfactory
Nylon	Satisfactory
PFA	Satisfactory

Elastomer Compatibility	
Perfluoro-elastomer	Unsatisfactory
Fluoroelastomer	Unsatisfactory
Nitrile rubber	Unsatisfactory
Neoprene	Unsatisfactory
EPDM	Unsatisfactory
HNBR	Unsatisfactory
Epichlorohydrin	Unsatisfactory
Butyl rubber	Satisfactory
Urethane	Satisfactory
TFE encapsulated viton	Satisfactory

Storage and Handling

Genetron 245fa should be stored in a cool, well-ventilated area. The material should only be stored in an approved cylinder. Please consult Honeywell's Technical Service Department prior to storage of the material in anything other than its original shipping cylinder to ensure the new container meets all safety requirements. The container and its fittings should be protected from physical damage. The container should not be punctured or dropped, or exposed to open flames, excessive heat or direct sunlight. The container's valves should be tightly closed after use and when the container is empty.

Genetron 245fa should not be mixed with either air or oxygen at pressures above atmospheric. If pressurization is required in your application, the use of nitrogen is recommended.

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Honeywell

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Honeywell

LOW TEMPERATURE HEAT RECOVERY
WITH GENETRON 245FA

Working Fluid for ORC Systems