



# Peltier vs Compressor

the comparison of two heating and  
cooling technologies

# PELTIER VS COMPRESSOR | INTRODUCTION

Two technologies used in climate chambers for heating/cooling will be discussed today:

## PELTIER TECHNOLOGY



## COMPRESSOR TECHNOLOGY

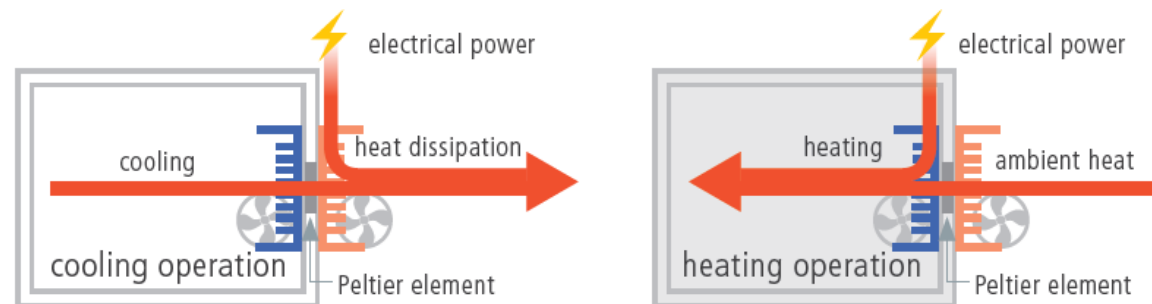


1. Difference between the two technologies
2. Advantages and disadvantages
3. Ideal cooling unit for laboratory applications

## PELTIER VS COMPRESSOR | PELTIER PRINCIPLES

In 1834 **Jean Peltier** (French physicist) discovered the Peltier effect based on the Seebeck effect.

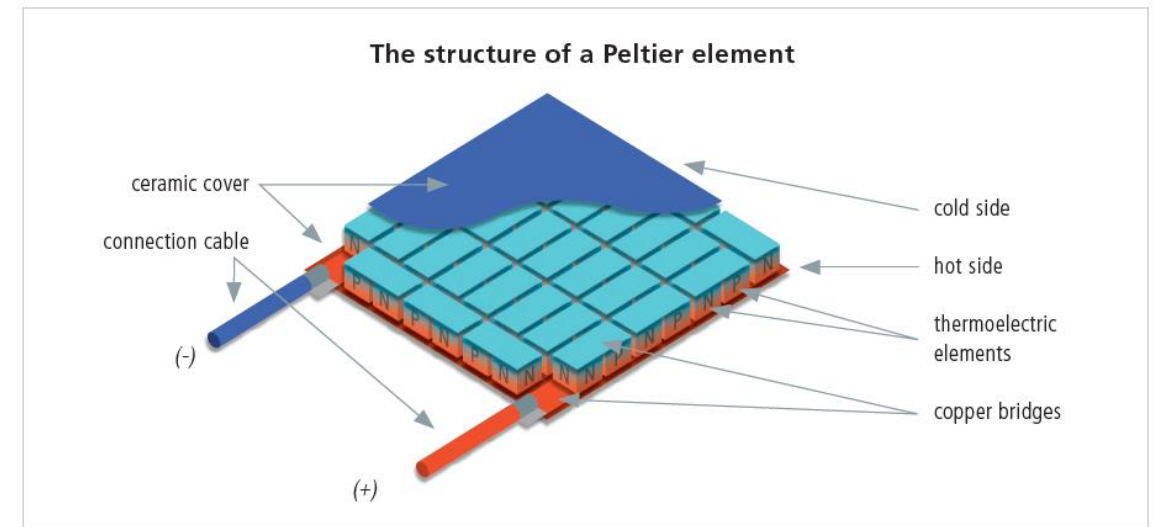
**Working principle:** In an electrical circuit, a temperature difference is created at the contact points of two differently conducting materials – one side becomes **cold**, the other side **warm**.



Commercially successful applications only emerged with the development of the semiconductors. Their resistance decreases with increasing temperature and conductivity increases. In modern thermocouples, predominantly differently doped semiconductors are used.

# PELTIER VS COMPRESSOR | FUNCTIONAL PRINCIPLE OF A PELTIER ELEMENT

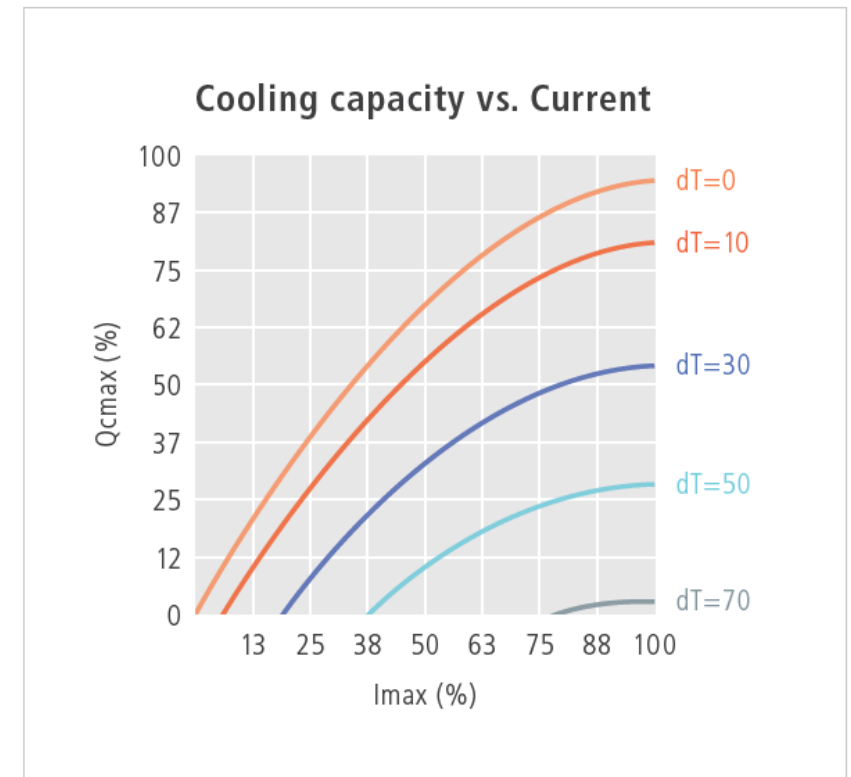
- Peltier element works like a heat pump
- Energy is pumped from the cold to the hot side
- Waste heat expelled on the hot side is the result of the electrical energy supplied and the cooling capacity
- By reversing the polarity of the current, the hot and cold sides can be reversed
- When direct current flows through the Peltier element, a temperature difference builds up
- The cold side of the Peltier element extracts from the environment and releases it to the opposite side



# PELTIER VS COMPRESSOR | COOLING CAPACITY OF A PELTIER ELEMENT

The actual cooling capacity is reduced

1. due to the lost heat (increases quadratically with the current intensity).
2. due to the heat reflux to the cold side (proportional to the thermal conductivity of the material and the temperature difference).



# PELTIER VS COMPRESSOR | STRUCTURE OF A PELTIER ELEMENT

Peltier units are integrated into cooling units.

The waste heat must be removed as efficiently as possible.

This is done with demand-controlled internal/ external fans and a sufficiently dimensioned cooling element.

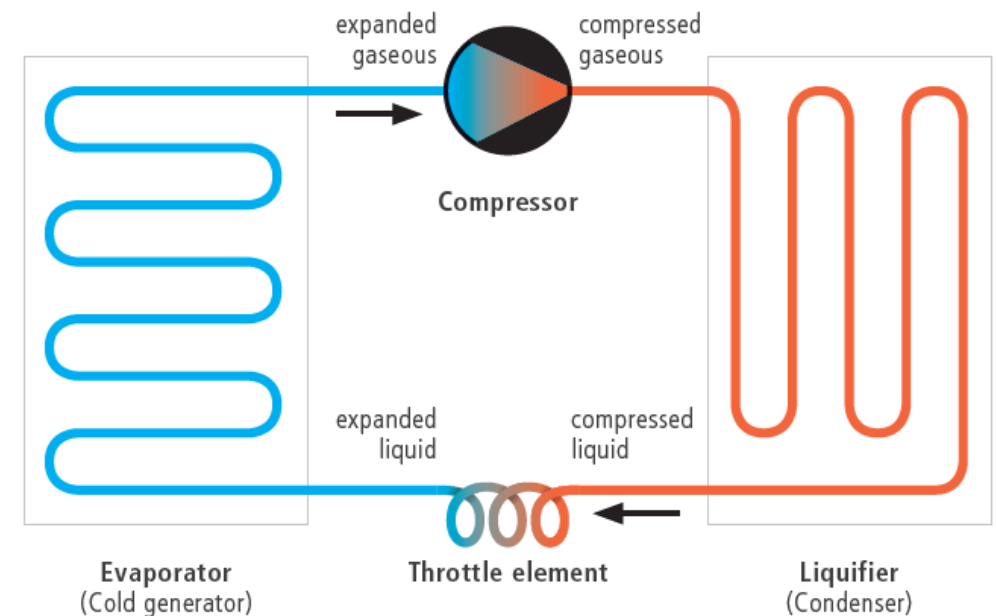
## Objectives achieved:

- avoid overheating of the Peltier elements
- optimize efficiency
- enable greatest possible temperature difference between the cold and hot sides



# PELTIER VS COMPRESSOR | FUNCTIONAL PRINCIPLE OF A REFRIGERATION MACHINE

- Thermal energy required during transition from the liquid to the gaseous aggregate state
- Refrigerant circulates through the machine piping system
- Refrigerant absorbs heat from introduced sampled or food in the evaporator
- Compressor compresses the refrigerant under high pressure
- Condenser on the exterior of the unit releases heat to the environment
- Refrigerant cools down and changes into liquid state
- Pressure is reduced again in the throttle valve
- Boiling point drops and process starts again



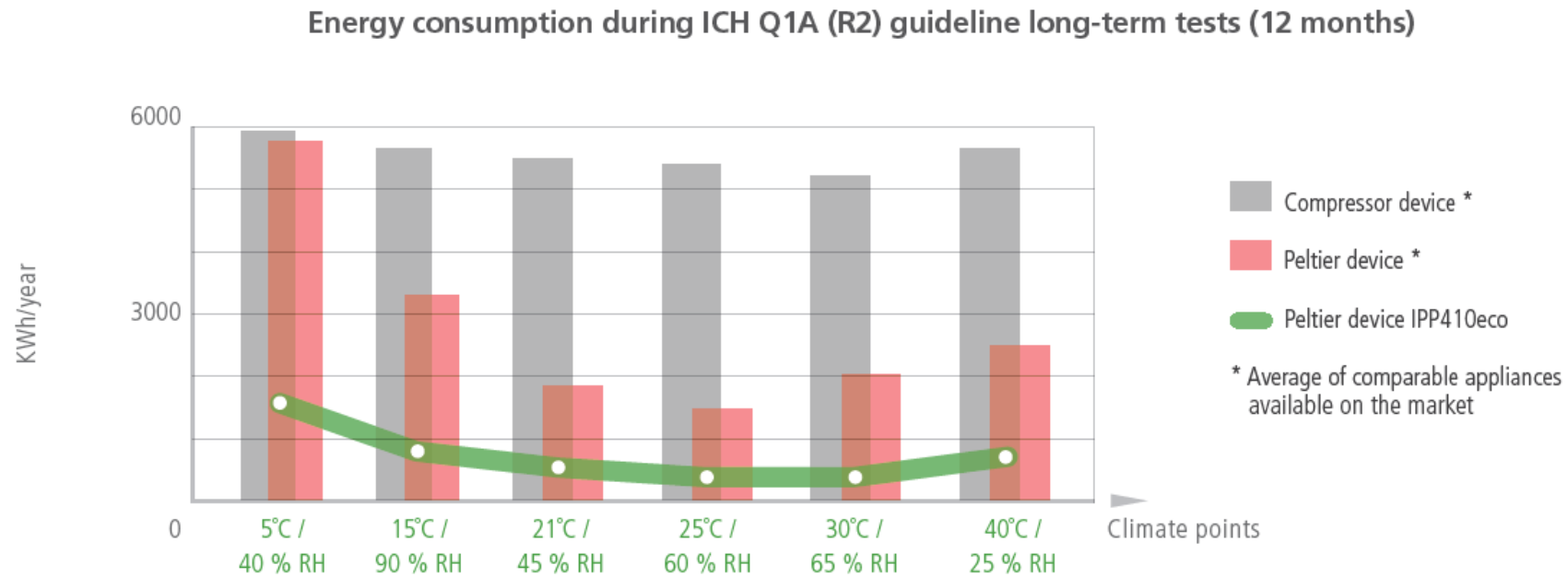
## PELTIER VS COMPRESSOR | PELTIER TECHNOLOGY FOR LABORATORY APPLICATIONS

- Peltier for heating and cooling in cooled incubator and climate chamber
- No air exchange between the chamber and the environment
- Condensation during the cooling process occurs on the heat sink – not somewhere in the chamber
- Fans integrated in the Peltier elements (inside and outside of the chamber) ensure rapid transport of energy and optimal temperature distribution
- HPPeco and IPPeco appliances launched beginning of 2021 expand energy-efficient operation across the entire temperature range





# PELTIER VS COMPRESSOR | PELTIER TECHNOLOGY FOR LABORATORY APPLICATIONS



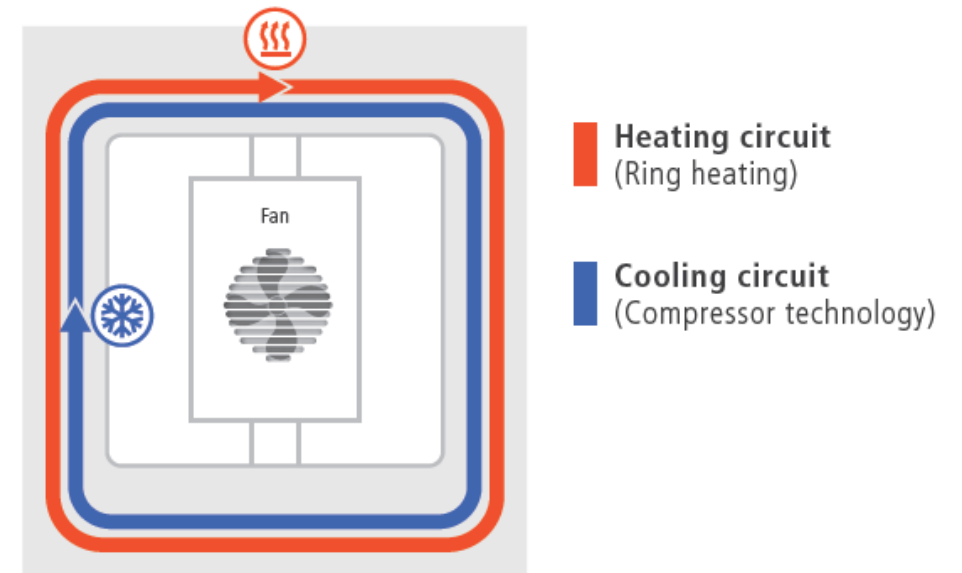
Comparison of energy consumption of Memmert constant climate chambers HPPeco with Advanced Peltier Technology (introduced in 2021) with comparable appliances on the market.

## PELTIER VS COMPRESSOR | ADVANTAGES OF PELTIER TECHNOLOGY

- ✓ More compact since no additional installation space needed for refrigeration machine.
- ✓ Almost vibration-free and very low-noise.
- ✓ Lack of refrigerant is much more climate friendly.
- ✓ No more need for a dedicated heat source.
- ✓ Temperature cycles can be run with the same heating-cooling unit.
- ✓ Reacts immediately and without cooling medium as everything is electrically operated with extreme high accuracy.

# PELTIER VS COMPRESSOR | COMPRESSOR TECHNOLOGY FOR LABORATORY APPLICATIONS

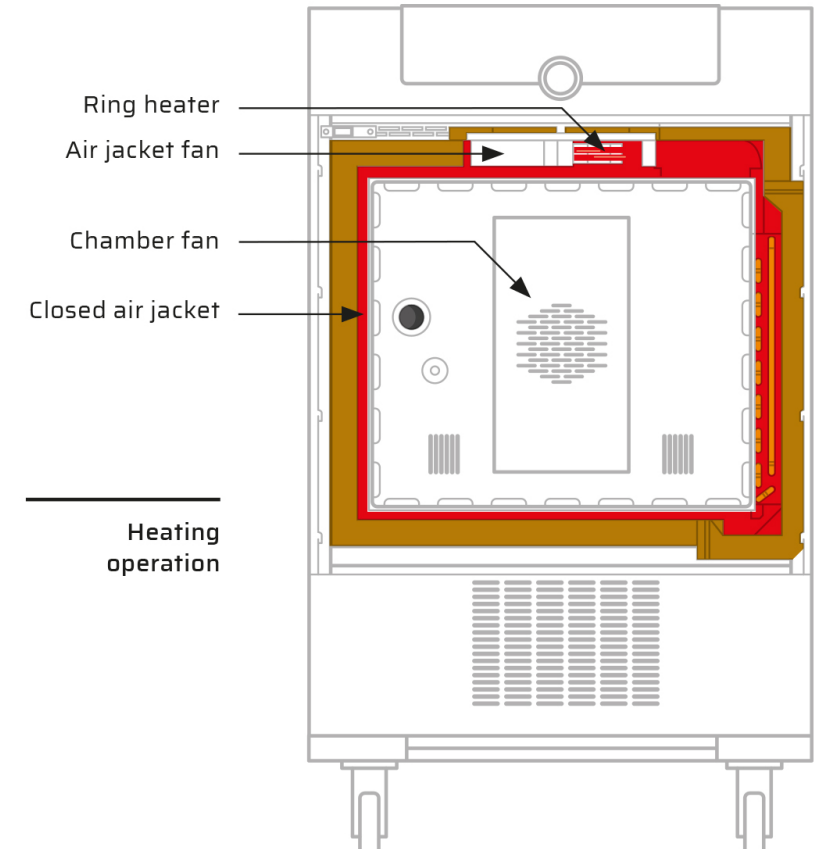
- Memmert cooled incubator ICP and climate chamber ICH have a closed system
- Arrangement of the cooling unit and heating in a circulating air jacket prevents the occurrence of „hot and cold spots“ as well as dehumidification of the working space
- Defrosting cycles counteract the icing up of the evaporator
- Targeted and controlled dehumidification takes place in the climate chamber via Peltier humidity traps on the rear wall



Air jacket temperature control system in the Memmert cooled incubator ICP and climate chamber ICH

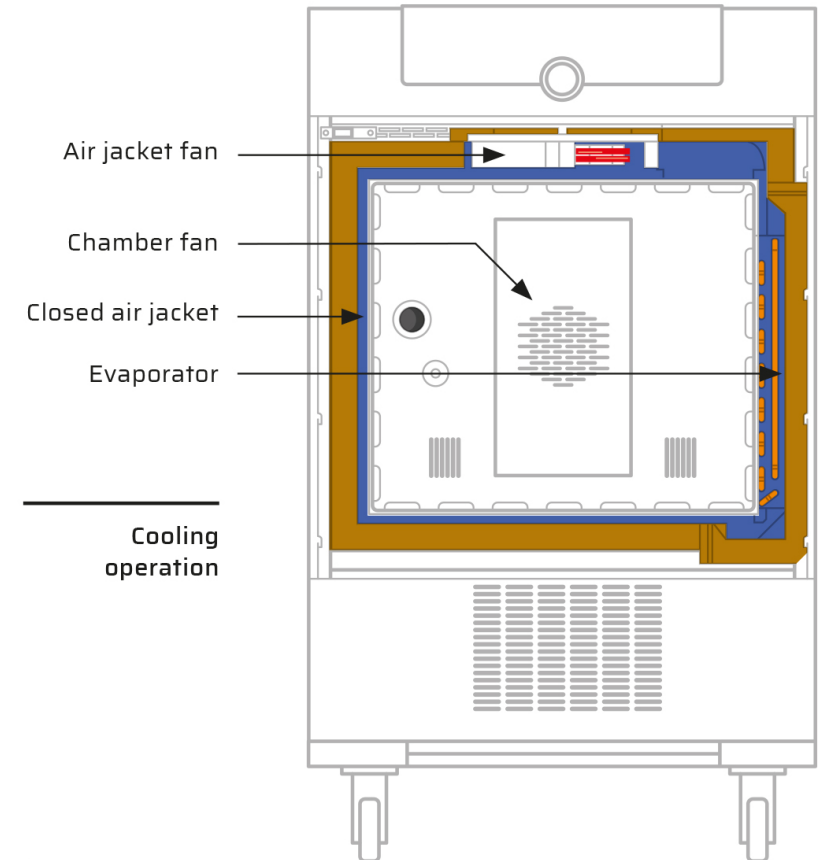
# PELTIER VS COMPRESSOR | AIR JACKET TEMPERATURE CONTROL SYSTEM

- ✓ Closed air jacket
  - Large-area all-round heating
  - Very good temperature distribution
  - Prevention of hot/ cold spots
  - No contact between the medium and the heating chamber
  - Adjustable recirculation fan
- ✓ Identical conditions for all samples in the entire interior



# PELTIER VS COMPRESSOR | AIR JACKET TEMPERATURE CONTROL SYSTEM

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## PELTIER VS COMPRESSOR | ADVANTAGES OF COMPRESSOR TECHNOLOGY

- ✓ Higher heat compensation (specially while frequently opening the door, additional heat emission from load) unlike the Peltier-cooled unit
- ✓ Especially designed for applications introducing heat into the working space, i. e. electronic assemblies or halogen lamps

## PELTIER VS COMPRESSOR | DECIDING FACTORS

- ✓ Temperature homogeneity and consistency
- ✓ Heating and recovery time
- ✓ Low sound pollution and noise level
- ✓ Ambient temperature and temperature range
- ✓ Refrigerant and global warming consideration
- ✓ Service and maintenance

