



ATMO
sphere

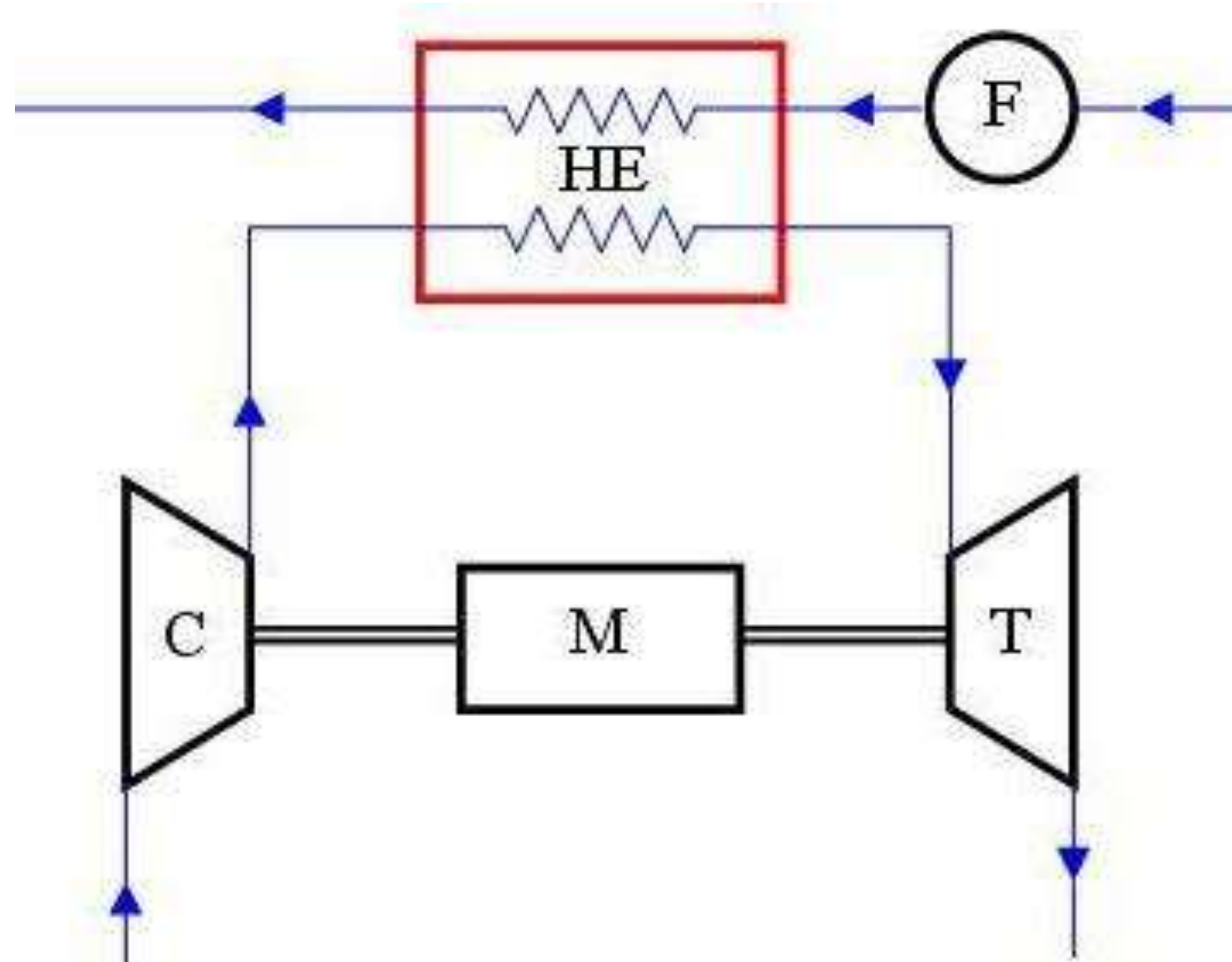
Vartan Petrosyants

***Absolutely Ecologically Pure Climate
Control System Based on Air Turbo
Technology for Vehicle and Stationary
Applications***

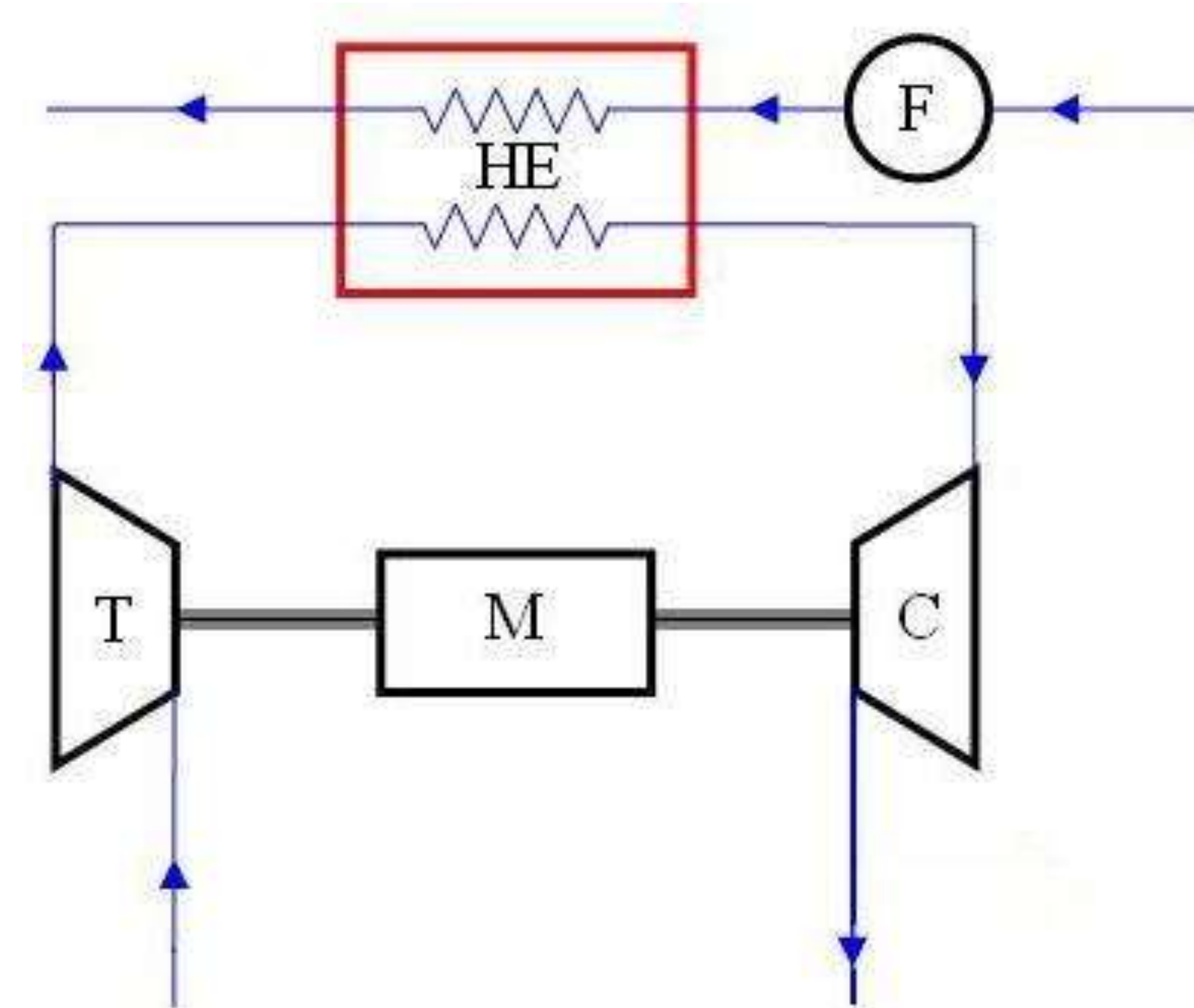
Air-cycle Turbo Technology (ATT) was created for new generation of eco-friendly HVAC systems, using air as refrigerant and no oil. The ATT is designed for heating, ventilation, air conditioning of buildings, production and storage facilities, vehicles (such as railway cars). The ATT is a fully variable system, working in summer ($T_a = +10 \dots 50^\circ\text{C}$) as an air conditioner, and in winter ($T_a = +7 \dots -40^\circ\text{C}$) as a heat pump. All ATT heating modes use only electrical energy, although some combinations with other sources of heat are also possible.

ATT is based on the classical cycles:

Overpressure Bryton cycle



Subpressure Martinovsky cycle



ATT advantages over other systems:

1) Fully environmentally friendly (air is a refrigerant and no oil is used).

The absence of freon is especially important for vehicles (for example, passenger railway cars) due to the potential for refrigerant leakage in conventional air conditioners/heat pumps caused by vibration and shock loads.

2) High energy efficiency with a low coefficient of recirculation. During cold periods, the COP_h is 2.6 ...3.3 in the temperature range +7...-40°C; in warm periods, the COP_c is 1.1 ...1.35 in the temperature range +20...+40°C. **Both AC and HP are realized with simultaneous ventilation and fresh air delivering can be reached up to 100%.**

3) Full variability of operation under any weather conditions with high quality of air in a cooled (heated) indoor area (20...24°C, fresh air 50...100%; relative humidity in summer is 30 ...60 %).

4) No vibrations and acceptable noise level.

5) Low specific weight and dimensions.

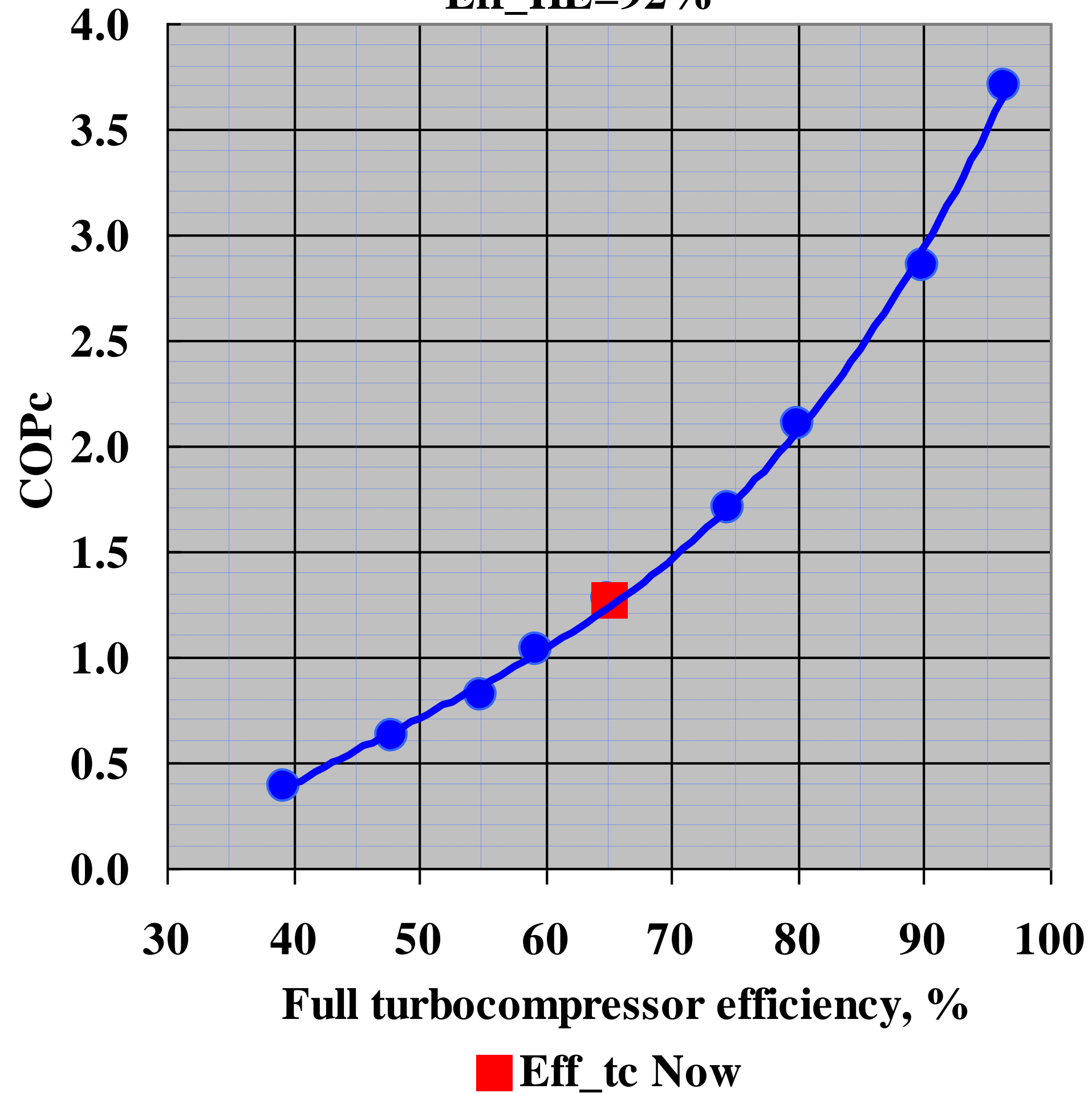
6) Easy service.

7) Low operating costs. Only air filters must be changed from time-to-time.

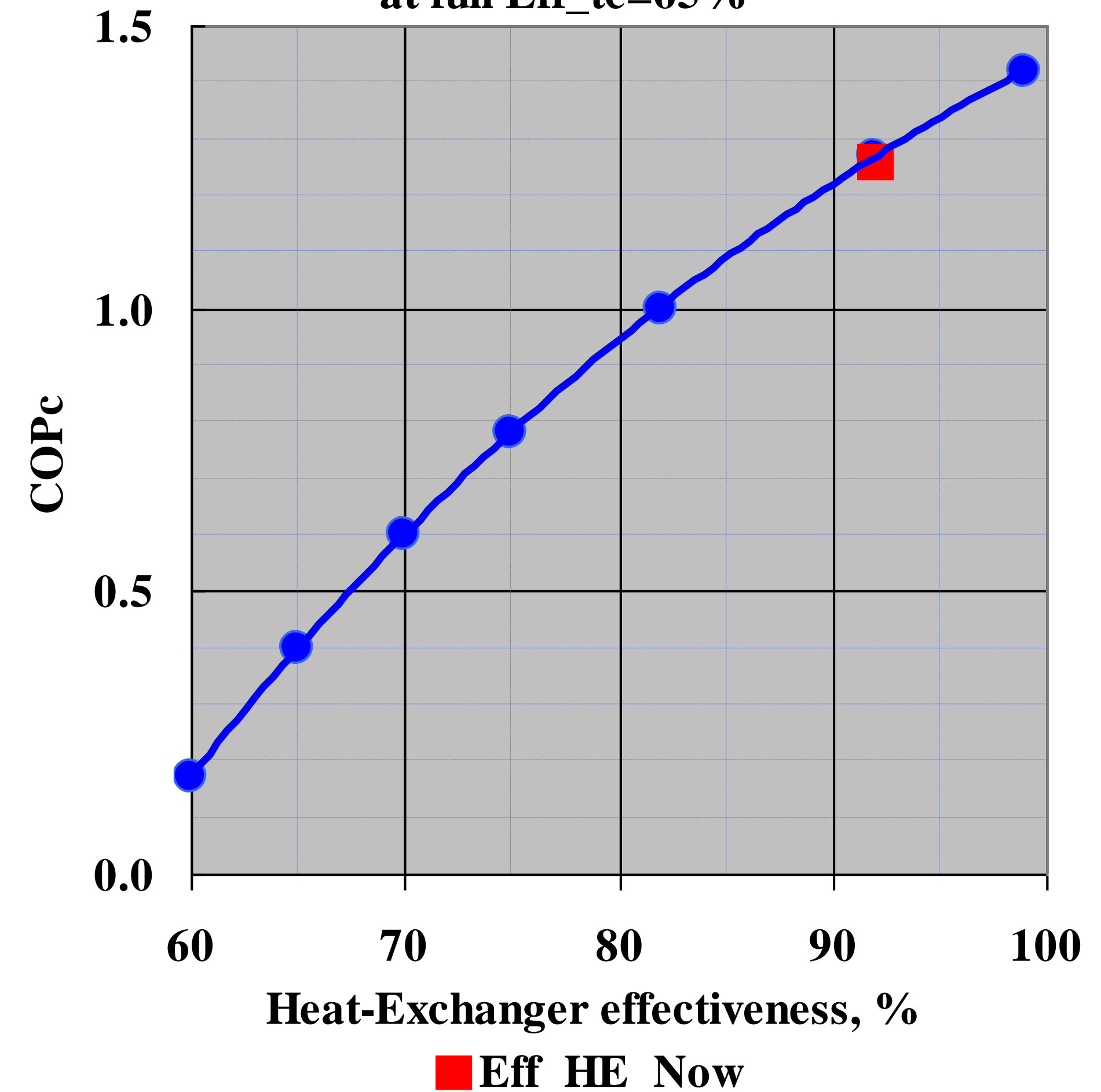


Influence of turbocompressor and heat-exchanger efficiencies on effectiveness of ATT AC cycle ($T_{amb}=40^{\circ}C$)

ATT AC cycle $COP_c=f(Eff_{tk})$ at
Eff_{HE}=92%

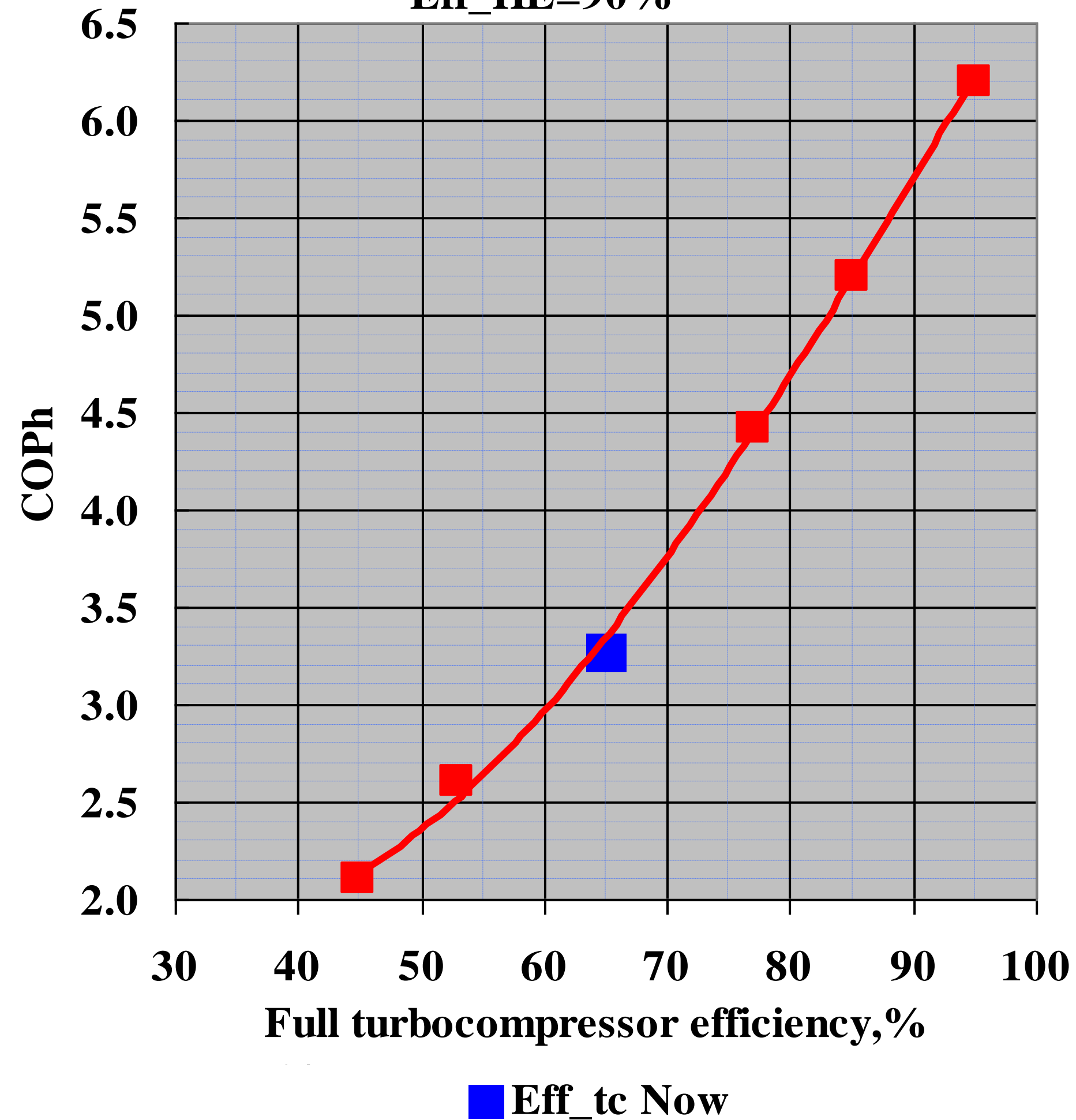


ATT AC cycle $COP_c=f(Eff_{HE})$
at full Eff_{tc}=65%

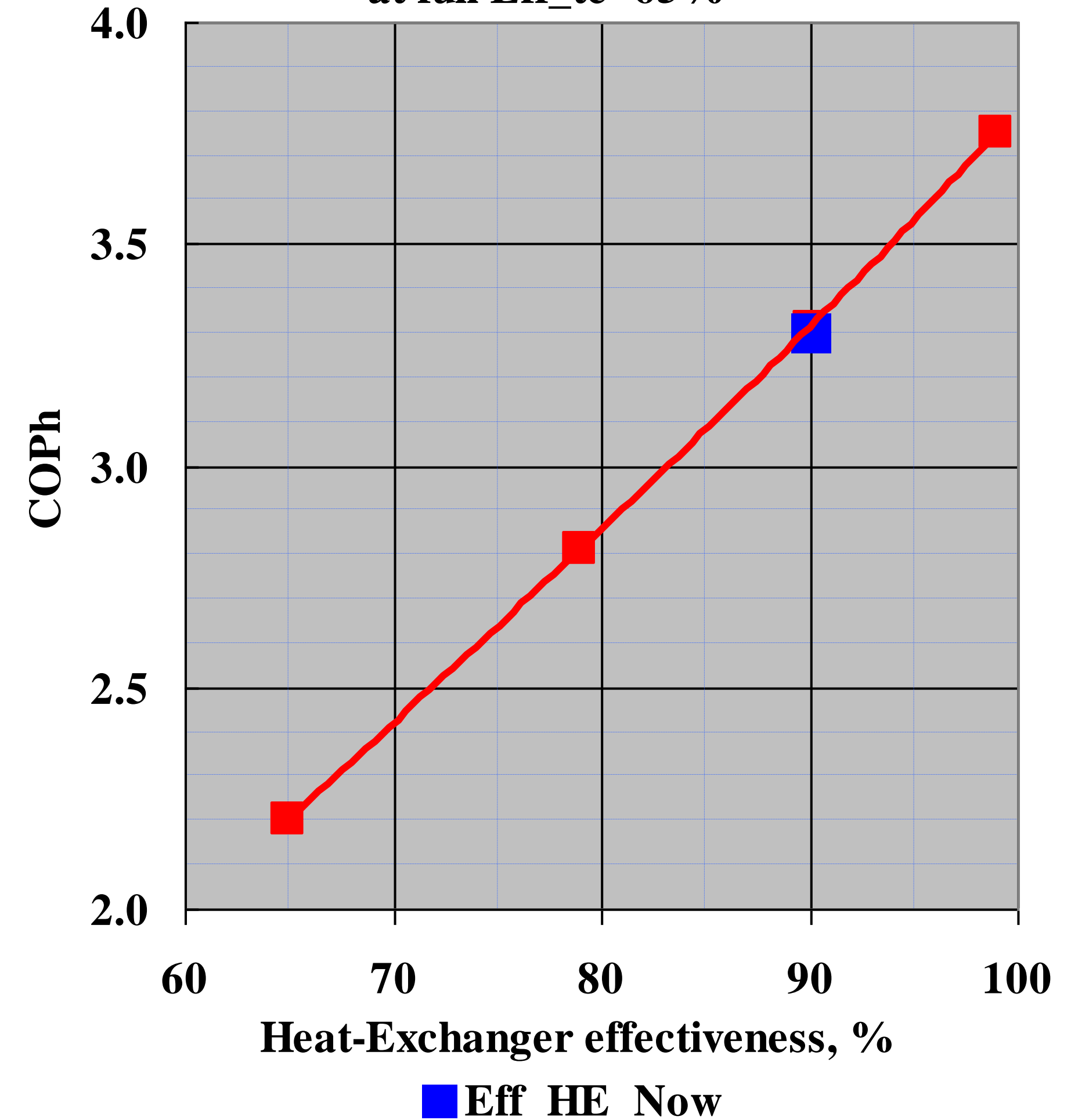


Influence of turbocompressor and heat-exchanger efficiency on effectiveness of ATT HP cycle ($T_{amb} = -20^{\circ}\text{C}$)

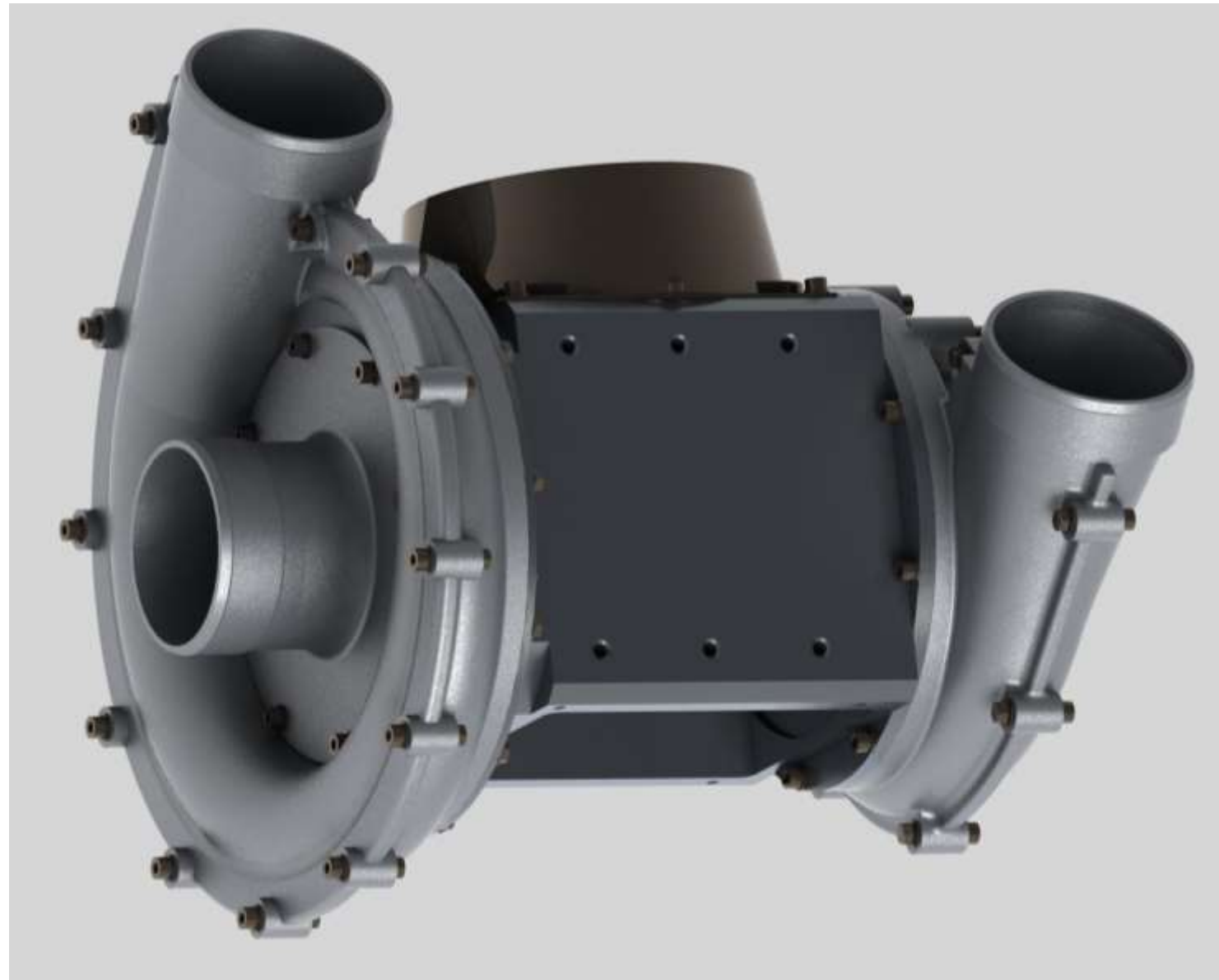
ATT HP cycle $\text{COP}_h = f(\text{Eff}_{tk})$ at $\text{Eff}_{HE} = 90\%$



ATT HP cycle $\text{COP}_h = f(\text{Eff}_{HE})$ at full $\text{Eff}_{tc} = 65\%$



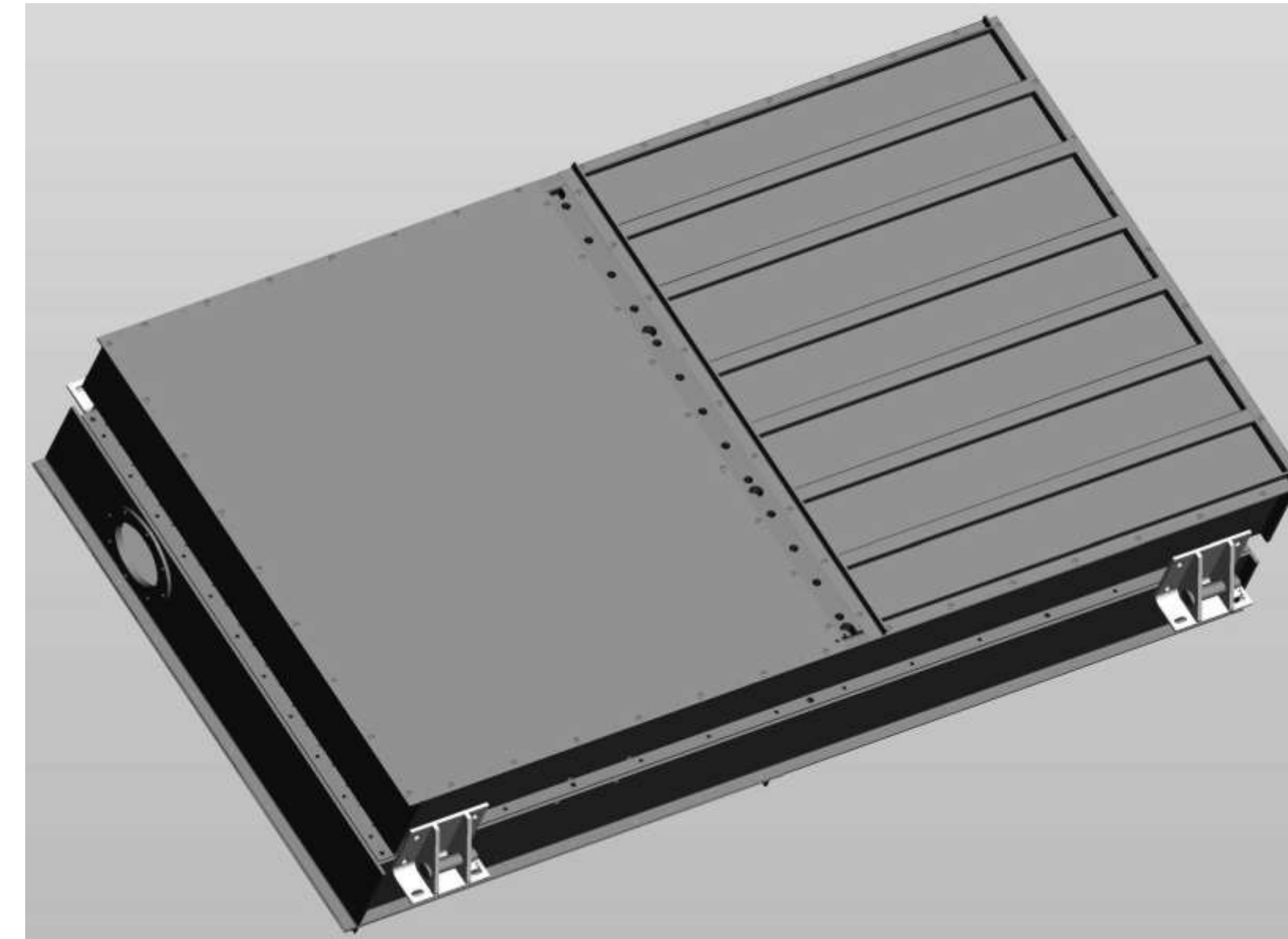
Turbocompressor with built-in high speed electric motor



Parameters :

1. Flow capacity..... 700-3500 nm³/h
2. Pressure ratio..... 1,1-2,5
3. Shaft speed..... 12-33 000 rpm
4. Shaft power..... 3-18 KW
5. TDR..... > 55%
6. Gas-dynamic efficiency..... 70-73%
7. HS induction EM efficiency at nominal motor with 92% efficiency at nominal..... 92%
8. Bearings..... air gas-dynamic

Air-to-Air Heat-Exchanger



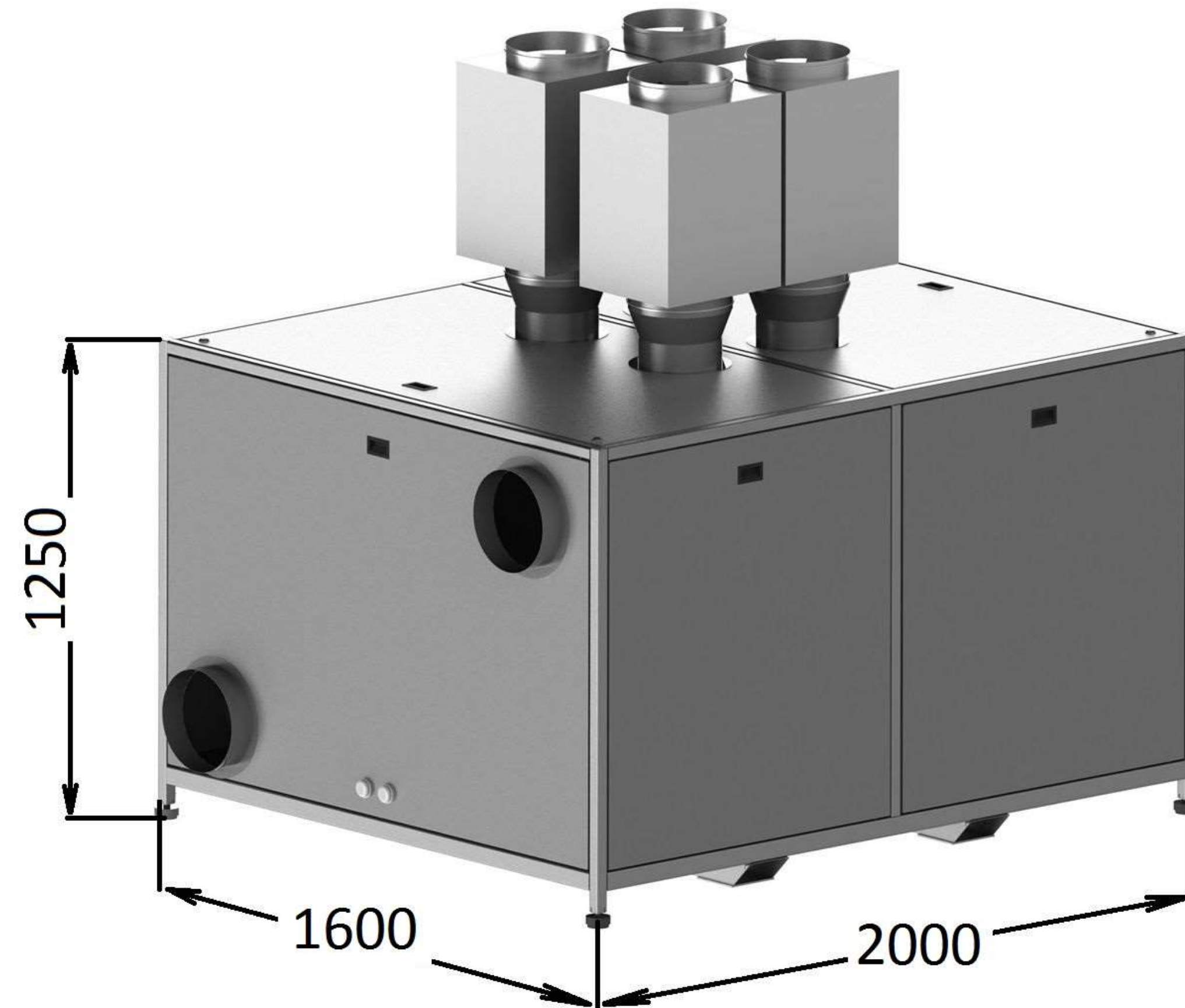
Parameters :

1. Flow capacity by each streams..... 700...3500 nm³/h
2. Permissible temperature range..... -50....+120 °C
3. Permissible maximum pressure 2,5 bar
4. Heat Effectiveness at equal flows..... 82%.
Maximum value at flow ratio 2,0..... 97%
5. Pressure losses..... <=700 Pa

Parameters of ATT-30/60 for vehicle and stationary applications

1. Outdoor temperature, °C	+10..40/+7...-40
2. Outdoor relative humidity, %	5...100
3. Cooling/heating capacity (summer/winter), kW	2...27/5...65
4. Air supply to premises (including 50...100% fresh), m³/h	1200...3500
5. Temperature of air supplied to premises (summer/winter) , °C	>=7/25...50
6. Temperature of air in premises (summer/winter), °C	22...27/18...24
7. Relative humidity of air in premises (summer/winter),%	30...60/>=15

ATT-30/60 for stationary premises application



ATT-30/60 for children's sports complex



Sport Hall (SH)

- Volume - 7000 m³
- Average heat transfer coefficient $k=0,5 \text{ W}/(\text{m}^2 \cdot ^\circ\text{C})$
- Number of ATT -2 units for cooling and 1 for heating

Swimming Pool (SP)

- Volume - 7500 m³
- Swimming pool mirror =400 m²
- Average heat transfer coefficient $k=0,35 \text{ W}/(\text{m}^2 \cdot ^\circ\text{C})$
- Number of ATT-1 unit as a HP with drying function and 1 recuperator (RC)

Parameters	Summer	Winter
Functions (SH/SP)	HVAC/-	HVAC/HV+Drying
Outdoor temperature/Relative humidity, °C/%	+36/30	-23/80
Cooling/Heating Capacity (SH/SP), KW	50/-	65/(65+65RC)
Indoor temperature(SH/SP), °C	≤ 24 /-	18/29...30
Indoor humidity (SH/SP), %	30...60/-	30...60/<65
Total flow capacity (SH/SP), nm ³ /h	4500	3300/3300+3300(RC)
Fresh air delivering (SH/SP), nm ³ /h	3500	3300/3300+3300(RC)
Temperature of air supplied to premises, °C	12	45
Working seasons	1	Start now



Workshop for testing railway bearings

- Volume - 2750 m³
- Average heat transfer coefficient $k=0,3 \text{ W}/(\text{m}^2 \cdot ^\circ\text{C})$
- Number of ATT -1 unit for cooling and heating

Parameters	Summer	Winter
Functions	AC+V	H+V
Outdoor temperature/Relative humidity, °C/%	+36/30	-23/80
Cooling/Heating Capacity, KW	27	60
Indoor temperature (SH/SP), °C	≤ 26	20...22
Indoor humidity (SH/SP), %	30...60	>15
Total flow capacity, nm ³ /h	2300	3000
Fresh air delivering, nm ³ /h	1000	1500
Temperature of air supplied to premises, °C	12	45
Working years	5	5

ATT-30/60RC for rail car application





AIR-CYCLE TURBO TECHNOLOGY

Our slogan is energy saving and ecological purity



ATT Advantages over Conventional AC for Railway Car

- ATT is 100% environmentally friendly heating and cooling machine without any harmful refrigerants and oil
- ATT provides air conditioning and heating of a railway car, withstanding any weather conditions
- ATT's heating COP – 2.6....3.3 and cooling COP - 1.1....1.35 in all ambient temperature ranges. Estimated average annual electrical power consumption of a railway car is to be reduced by 20...30% compared with conventional climate control systems.
- ATT can provide up to 100% fresh air delivering into a car without losing efficiency.
- Estimated reduction of the weight of passenger railcar is about 4 tones compared with conventional AC plus electrical water boiler.
- Compared with conventional AC/HP, the ATT requires significantly lower maintenance and operating costs.



ATMO
sphere

Thank you very much!

