LETTER OF COMPLIANCE - ECO DESIGN

Process and comfort chillers compliant with Directive 2009/125/EC

Manufacturer
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Declaration:

We hereby declare compliance that our standard chiller series mCHILLER follow the scope of the ECO design requirements according to the following EU-commission regulations:

- Regulation 2015/1095 for medium temperatures (-8°C).
- Regulation 2016/2281 for high temperatures (7°C).

As the manufacturer, we take full responsibility for the conformity of all products considered in the Data section of this document according to Directive 2009/125/EC.

Zaventem, 1st of July 2022

Mr. Jan Boone
Executive Director

Preconditions:

- EER values are calculated with mCHILLER selection software MPT v2.5.12 which operate with tolerances according to EN 12900:2013.
- SEPR and SEER values are calculated according to EN 14825:2019. Considered degradation coefficient = 0.9 for part load and the capacity control is variable.
- Pressure losses at suction and discharge line is applied in calculation.
- Superheat as 0 °C and subcooling as 0.0 °C is applied in calculation.
- Secondary refrigerant is ethylene glycol and water mixture at low and medium temperature chiller calculations and water at high temperature chiller calculations.
- Power consumption for sec. refrigerant pumps is included according to EN 14511-3:2018, Annex G.4.
- All mCHILLER products consist of liquid heated evaporator and water- or air-cooled condenser.

According to the directives that define the Eco-Design, the minimum Seasonal Energy Performance Ratio (SEPR) for various cases are showcased in tables 1 and 2. The distribution of Electricity consumption during high temperature operation of the various mCHILLER products over bins of outdoor temperatures can be seen in figure 1. Figure 2 shows the distribution of EER over the same bins of outdoor temperatures.

Legal limits of 2016/2281 - minimum SEPR (TIER 1) Refrigerant : Ammonia R717 (GWP<150)			
	High Temperature (7 °C)		
	<400 kW	>400 kW / <1500 kW	>1500 kW
Water Cooled	7.00	8.00	8.50
Air Cooled	5.00	5.50	

Table 1: TIER 1 Legal Limits

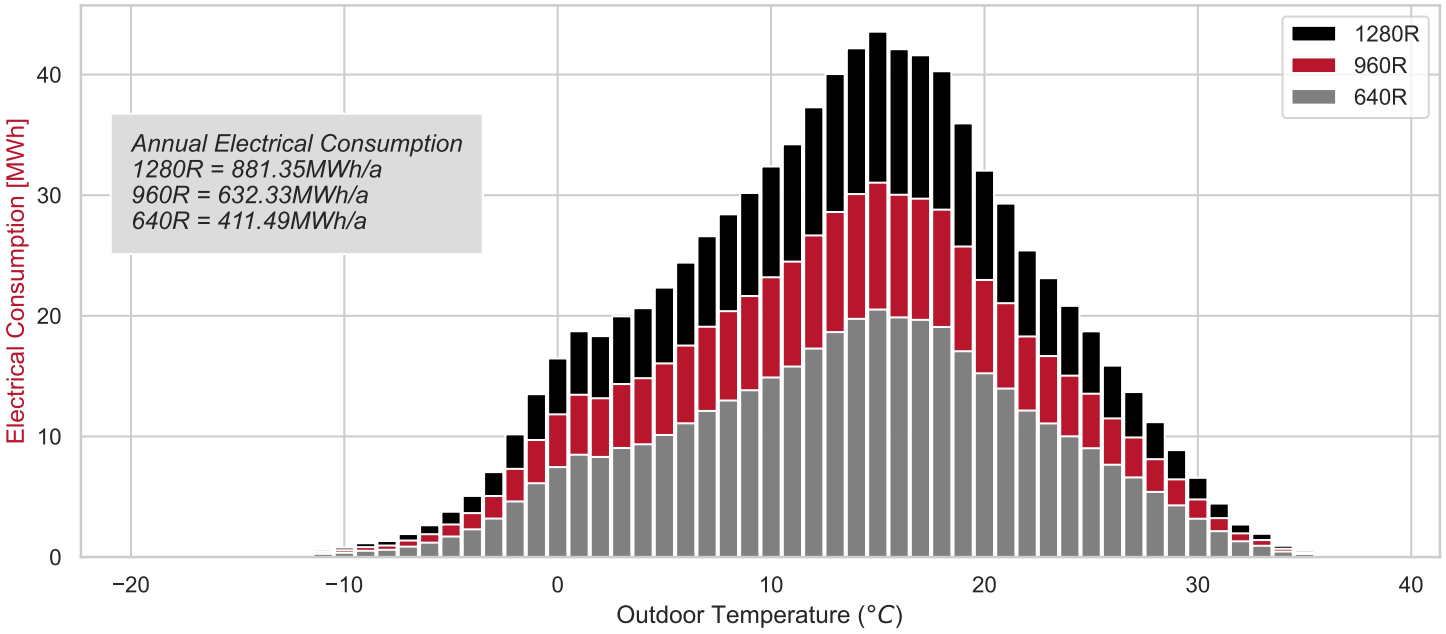

Figure 1: Distribution of Electricity Consumption (High Temperature (7 °C))

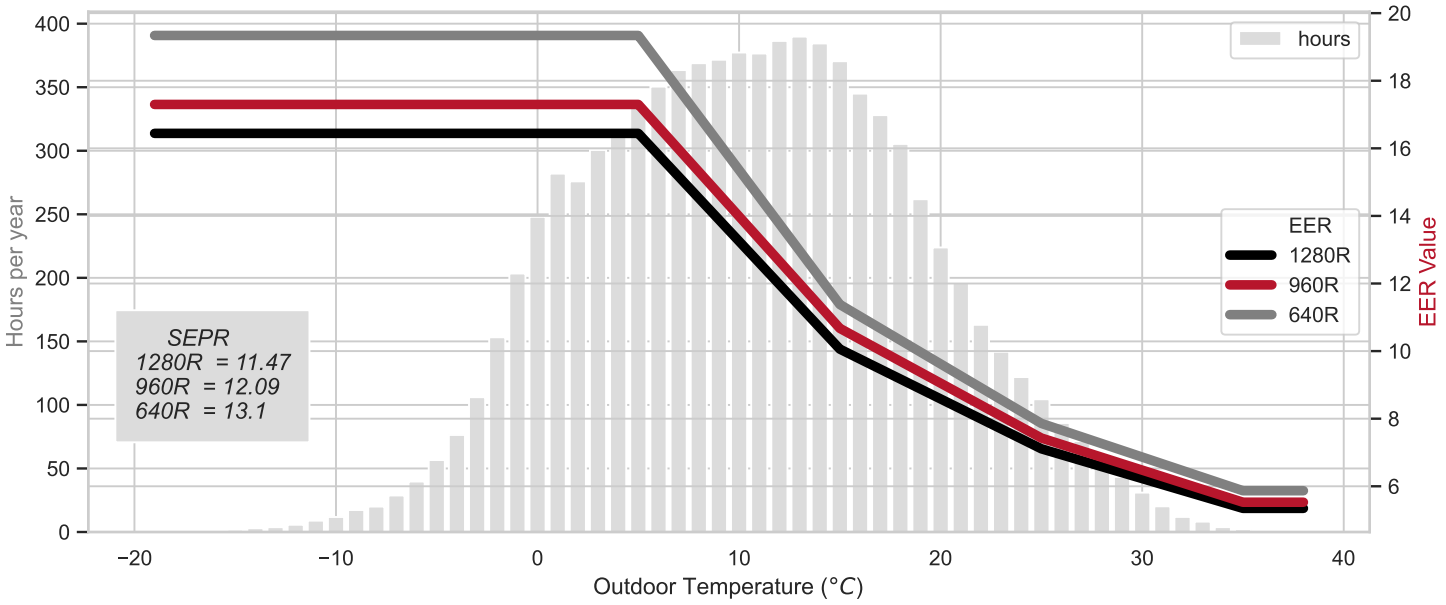

Figure 2: Distribution of EER (High Temperature (7 °C))

The distribution of Electricity consumption during medium temperature operation of the various mCHILLER products over bins of outdoor temperatures can be seen in figure 3. Figure 4 shows the distribution of EER over the same bins of outdoor temperatures.

Legal limits of 2015/1095 - minimum SEPR (TIER 2) Refrigerant : Ammonia R717 (GWP<150)		
	Medium Temperature (-8 ° C)	
	<300 kW	>300 kW
Water Cooled	3.29	4.37
Air Cooled	2.58	3.22

Table 2: TIER 2 Legal Limits

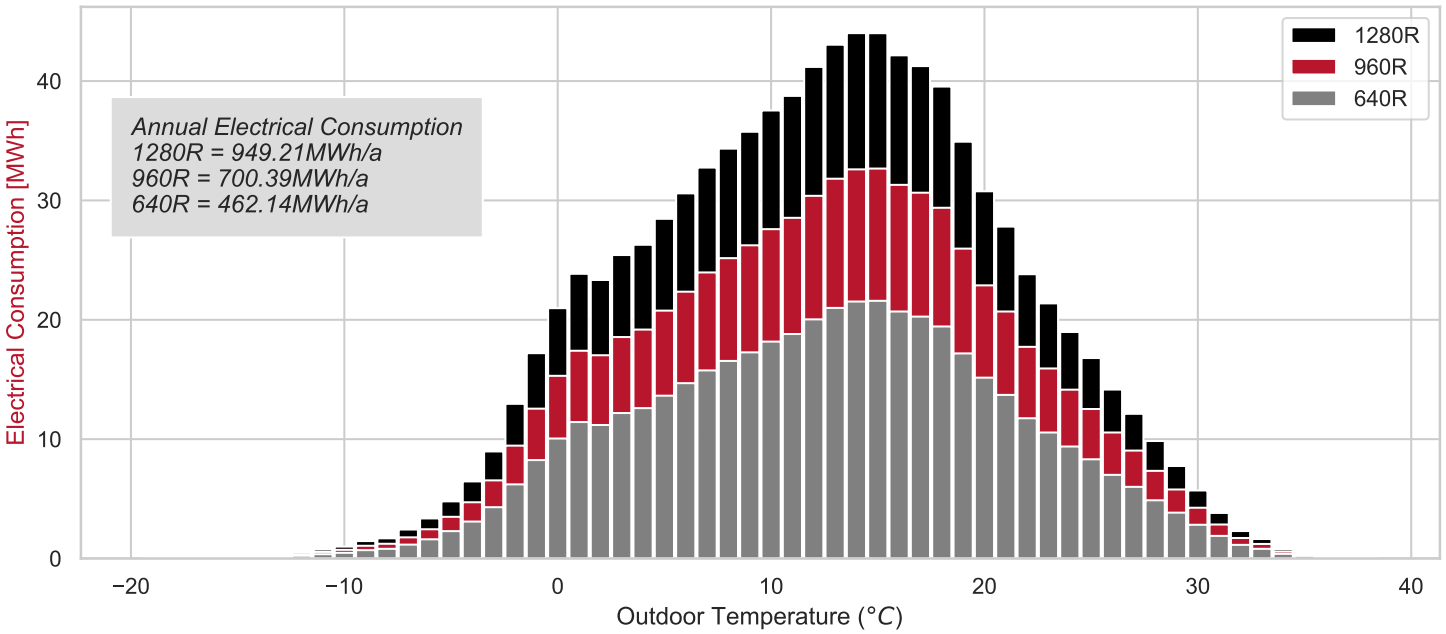

Figure 3: Distribution of Electricity Consumption (Medium Temperature (-8 °C))

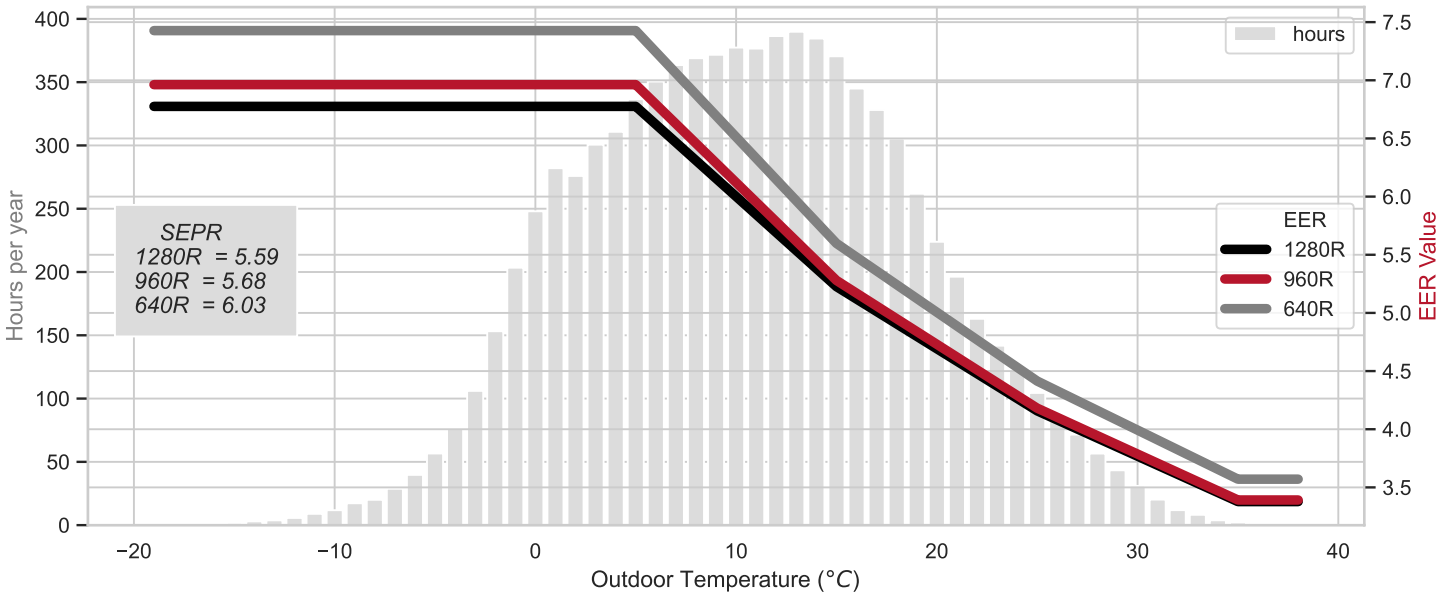

Figure 4: Distribution of EER (Medium Temperature (-8 °C))

Technical Datasheet

All mCHILLER models use Ammonia (R717) as the refrigerant. The products run with variable capacity control. *(For more information regarding the rating points and conditions, please refer to the standard EN 14825:2019 and the EU commission regulation 2015/1095 and 2016/2281.)*

Keywords :

- SEPR - Seasonal Energy Performance Ratio ($\frac{\text{Annual refrigeration demand}}{\text{Annual electricity consumption}}$)
- GWP - Global Warming Potential
- Q_c = Cooling Capacity
- P = Total Power consumption
- EER = Energy Efficiency Ratio ($\frac{\text{Cooling Capacity}}{\text{Total Power Consumption}}$)

mCHILLER FUGU 1280R : High Temperature (7 °C)

Type :	Reciprocating < 1500 kW	Operating Conditions :	High Temp (7 °C)
Degradation Coefficient (C_{dc}) :	0.90	Type of condensing :	Water-cooled
SEPR :	11.47	Capacity Control :	Variable
Annual electrical consumption :	881.35 MWh/a	GWP [kg CO_2 eq.] :	0.00
Conditions	Qc [kW]	P [kW]	EER
Rating point A	1364.57	255.23	5.35
Rating point B	1269.22	178.55	7.11
Rating point C	1187.78	118.09	10.06
Rating point D	1092.06	66.42	16.44

mCHILLER FUGU 1280R : Medium Temperature (-8 °C)

Type :	Reciprocating > 300 kW	Operating Conditions :	Medium Temp (-8 °C)
Degradation Coefficient (C_{dc}) :	0.90	Type of condensing :	Water-cooled
SEPR :	5.59	Capacity Control :	Variable
Annual electrical consumption :	949.21 MWh/a	GWP [kg CO_2 eq.] :	0.00
Conditions	Qc [kW]	P [kW]	EER
Rating point A	716.35	212.07	3.38
Rating point B	666.62	160.32	4.16
Rating point C	623.28	119.26	5.23
Rating point D	573.2	84.6	6.78

mCHILLER FUGU 960R : High Temperature (7 °C)

Type :	Reciprocating < 1500 kW	Operating Conditions :	High Temp (7 °C)
Degradation Coefficient (C_{dc}) :	0.90	Type of condensing :	Water-cooled
SEPR :	12.09	Capacity Control :	Variable
Annual electrical consumption :	632.33 MWh/a	GWP [kg CO_2 eq.] :	0.00
Conditions	Qc [kW]	P [kW]	EER
Rating point A	1031.74	186.65	5.53
Rating point B	960.4	129.31	7.43
Rating point C	897.75	84.12	10.67
Rating point D	826.02	47.75	17.3

mCHILLER FUGU 960R : Medium Temperature (-8 °C)

Type :	Reciprocating > 300 kW	Operating Conditions :	Medium Temp (-8 °C)
Degradation Coefficient (C_{dc}) :	0.90	Type of condensing :	Water-cooled
SEPR :	5.68	Capacity Control :	Variable
Annual electrical consumption :	700.39 MWh/a	GWP [kg CO_2 eq.] :	0.00
Conditions	Qc [kW]	P [kW]	EER
Rating point A	537.16	158.38	3.39
Rating point B	499.95	119.57	4.18
Rating point C	467.7	88.59	5.28
Rating point D	430.08	61.77	6.96

mCHILLER FUGU 640R : High Temperature (7 °C)

Type :	Reciprocating < 1500 kW	Operating Conditions :	High Temp (7 °C)
Degradation Coefficient (C_{dc}) :	0.90	Type of condensing :	Water-cooled
SEPR :	13.1	Capacity Control :	Variable
Annual electrical consumption :	411.49 MWh/a	GWP [kg CO_2 eq.] :	0.00
Conditions	Qc [kW]	P [kW]	EER
Rating point A	727.25	123.92	5.87
Rating point B	676.89	86.13	7.86
Rating point C	632.74	55.61	11.38
Rating point D	582.2	30.1	19.34

mCHILLER FUGU 640R : Medium Temperature (-8 °C)

Type :	Reciprocating < 300 kW	Operating Conditions :	Medium Temp (-8 °C)
Degradation Coefficient (C_{dc}) :	0.90	Type of condensing :	Water-cooled
SEPR :	6.03	Capacity Control :	Variable
Annual electrical consumption :	462.14 MWh/a	GWP [kg CO_2 eq.] :	0.00
Conditions	Qc [kW]	P [kW]	EER
Rating point A	376.39	105.41	3.57
Rating point B	350.19	79.33	4.41
Rating point C	327.57	58.52	5.6
Rating point D	301.16	40.55	7.43

Comfort Chiller Application

The mCHILLER series can also be used in comfort chiller applications. The Eco-design directives suggest the following limits for comfort chiller applications shown in table 3.

Legal limits of 2016/2281 - minimum seasonal space cooling energy efficiency (%)			
Type	Driver of Compressor	Rated Capacity	η_{sc}
Air-to-water	Electric motor	<400 kW	161
Air-to-water	Electric motor	>400 kW	179
Water-to-water	Electric motor	<400 kW	200
Water-to-water	Electric motor	>400 kW and <1500 kW	252
Water-to-water	Electric motor	>1500 kW	272
Air-to-water	Internal combustion engine	>400 kW	154

Table 3

The Seasonal Space Cooling energy efficiency is related to Seasonal Energy Efficiency Ratio (SEER) with the following equation :

$$SEER = \eta_{sc} \times CC$$

CC is the conversion coefficient ($CC = 2.5$) which reflects the estimated 40% average EU generation efficiency as established in Annex IV of Directive 2012/27/EU of the European Parliament.

The table in figure 5 indicates the SEER value of the mCHILLER product line and the legal limit it should exceed to comply with the Eco-design directive.

Model :	Capacity [kW]	SEER	Legal Limit
FUGU 1280R	1364.57	9.36	6.3
FUGU 960R	1031.74	9.74	6.3
FUGU 640R	727.25	10.48	6.3

Figure 5: SEER value of mCHILLER products and legal limits.

mCHILLER FUGU 1280R : comfort chiller application

Model	FUGU 1280R	Outdoor side heat exchanger	Water/Brine
Indoor side heat exchanger	Water	Type	Compressor driven vapour compression
Driver of Compressor	Electric motor	Degradation Coefficent (C_{dc})	0.90
Rated Cooling Capacity [kW]	1364.57	Seasonal Space Cooling Efficiency (η_{sc})	363.53%
Outdoor Temperature	Declared Cooling Capacity [kW]	P [kW]	EER
+ 35 °C	1364.57	230.66	5.92
+ 30 °C	1010.64	128.73	7.85
+ 25 °C	642.57	59.98	10.71
+ 20 °C	286.94	19.42	14.77
Off Mode Consumption [kW]	0.0	Crankcase heater mode [kW]	0.5
Thermostat-off mode [kW]	0.5	Standby mode [kW]	0.5
Sound Level [dB]	100	GWP of refrigerant [kg CO_2 eq]	0.0
Water/Brine flow rate [m^3/h]	234.39	Standard Rating conditions used	Low temperature application

mCHILLER FUGU 960R : comfort chiller application

Model	FUGU 960R	Outdoor side heat exchanger	Water/Brine
Indoor side heat exchanger	Water	Type	Compressor driven vapour compression
Driver of Compressor	Electric motor	Degradation Coefficent (C_{dc})	0.90
Rated Cooling Capacity [kW]	1031.74	Seasonal Space Cooling Efficiency (η_{sc})	382.75%
Outdoor Temperature	Declared Cooling Capacity [kW]	P [kW]	EER
+ 35 °C	1031.74	171.27	6.02
+ 30 °C	764.01	96.37	7.93
+ 25 °C	485.19	44.84	10.82
+ 20 °C	217.04	13.33	16.29
Off Mode Consumption [kW]	0.0	Crankcase heater mode [kW]	0.5
Thermostat-off mode [kW]	0.5	Standby mode [kW]	0.5
Sound Level [dB]	100	GWP of refrigerant [kg CO_2 eq]	0.0
Water/Brine flow rate [m^3/h]	177.22	Standard Rating conditions used	Low temperature application

mCHILLER FUGU 640R : comfort chiller application

Model	FUGU 640R	Outdoor side heat exchanger	Water/Brine
Indoor side heat exchanger	Water	Type	Compressor driven vapour compression
Driver of Compressor	Electric motor	Degradation Coefficent (C_{dc})	0.90
Rated Cooling Capacity [kW]	727.25	Seasonal Space Cooling Efficiency (η_{sc})	410.64%
Outdoor Temperature	Declared Cooling Capacity [kW]	P [kW]	EER
+ 35 °C	727.25	112.93	6.44
+ 30 °C	538.75	64.25	8.38
+ 25 °C	342.43	29.52	11.6
+ 20 °C	153.16	8.35	18.34
Off Mode Consumption [kW]	0.0	Crankcase heater mode [kW]	0.5
Thermostat-off mode [kW]	0.5	Standby mode [kW]	0.5
Sound Level [dB]	100	GWP of refrigerant [kg CO_2 eq]	0.0
Water/Brine flow rate [m^3/h]	124.92	Standard Rating conditions used	Low temperature application

mCHILLER SERIES - Sustainable Innovation

The mCHILLER series is a MAYEKAWA plug-and-play compact standard solution with a strong focus on energy consumption and the perfect balance between durability and simplicity. The mCHILLER series is designed with ammonia as natural refrigerant, which gives the highest energy efficiency and the best sustainable solution. The mCHILLER series provides a high level of safety with a low ammonia charge. It has been designed for easy and simple installation and a long lifespan.