DANISH
TECHNOLOGICAL
INSTITUTE

TEST REPORT

Report no.:
300-KLAB-15-007

Product:
Type: Split air to air heat pump
Electrolux: GWH09TB-K3DHE5H

Customer:
Electrolux

Date:
7 April 2015

Consultants:
Kamalathasan Arumugam & Lasse Søe

Energy and Climate
Refrigeration and Heat Pump Technology

DANAK

TEST Reg. no. 300

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TEST REPORT

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Report no.:	300-KLAB-15-007	Init.:	LAS/JGW
File no.:		Enclosures:	0

Customer:	Contact person:	Anette Hald
	Company:	Electrolux
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Component:	Brand:	Electrolux
	Type:	Split air to air heat pump
	Model:	GWH09TB-K3DHE5H
	Series no.:	4G57040000004
Dates	Component tested:	February 2015

Procedure: EN 14825:2013 and EN 14511:2013 part 1, 2 and 3. Test procedure calorimeter room method.

Remarks: The unit was delivered by the customer. Installation and setting of the unit's control system was done according to the manufacturer's instructions.

Conditions: Accredited testing was carried out in compliance with the current guidelines laid down by DANAK (Danish Laboratory Accreditation Scheme), please see www.danak.dk, and in compliance with Danish Technological Institute's General Terms and Conditions regarding Commissioned Work Accepted by Danish Technological Institute, February 2013.

The test results apply to the tested products only.

Division/Centre: Danish Technological Institute
Energy and Climate
Refrigeration Laboratory, Aarhus

Date:

Signature:

Kamalathasan Arumugam
B.Sc. Engineer

Signature co-reader:

Lasse Søe
Head of laboratory

Objective

The objective of this report is to verify the declared energy class in both heating and cooling mode and to provide performance characteristics of the product in terms of the Seasonal Coefficient of Performance (SCOP) and Seasonal Energy Efficiency Ratio (SEER) according to EN 14825:2013. In order to calculate the SCOP and SEER, tests were carried out at the part load conditions stated below. Furthermore, the power consumption was measured at standby mode, thermostat off mode, off mode and crankcase heater mode.

Reference Heating Season Average

Part load conditions for reference SCOP and reference $SCOP_{on}$ calculation of air-to-air heat pumps for the reference heating season "A" = average.

Heating season "A" average				
	Part load ratio	Part load ratio %	Outdoor air dry bulb (wet bulb) °C	Indoor air dry bulb °C
A	(-7-16)/(Tdesignh -16)	88	-7(-8)	20
B	(+2-16)/(Tdesignh -16)	54	2(1)	20
C	(+7-16)/(Tdesignh -16)	35	7(6)	20
D	(+12-16)/(Tdesignh -16)	15	12(11)	20
E	(TOL-16)/(Tdesignh -16)		TOL	20
F	(Tbivalent-16)/(Tdesignh -16)		Tbivalent	20

Tdesignh = -10°C (reference design temperature at reference heating season average)

Tbivalent = -7°C (lowest outdoor temperature point at which the heat pump has a capacity which enables it to meet 100 % of the heating demand)

TOL = -10°C. In order to have the correct heating capacity supplied by the heat pump at the lowest bin temperature for average climate zone, -10°C was chosen as TOL. This ensures the most correct SCOP value.

Reference Heating Season Colder

Part load conditions for reference SCOP and reference $SCOP_{on}$ calculation of air-to-air heat pumps for the reference heating season "C" = Colder.

Heating season "C" average				
	Part load ratio	Part load ratio %	Outdoor air dry bulb (wet bulb) °C	Indoor air dry bulb °C
A	(-7-16)/(Tdesignh -16)	61	-7(-8)	20
B	(+2-16)/(Tdesignh -16)	37	2(1)	20
C	(+7-16)/(Tdesignh -16)	24	7(6)	20
D	(+12-16)/(Tdesignh -16)	11	12(11)	20
G	(-15-16)/(Tdesignh -16)	82	-15	20
E	(TOL-16)/(Tdesignh -16)		TOL	20
F	(Tbivalent-16)/(Tdesignh -16)		Tbivalent	20

Tdesignh = -22°C (reference design temperature at reference heating season colder)

Tbivalent = -10°C (lowest outdoor temperature point at which the heat pump has a capacity which enables it to meet 100 % of the heating demand)

TOL = -22°C. In order to have the correct heating capacity supplied by the heat pump at the lowest bin temperature for colder climate zone, -22°C was chosen as TOL. This ensures the most correct SCOP value

Reference Cooling Season

Part load conditions for reference SEER and reference $SEER_{on}$ calculation of air-to-air air conditioners for the reference cooling season.

	Part load ratio	Part load ratio %	Outdoor air dry bulb °C	Indoor air dry bulb (wet bulb) °C
A	(35-16)/(Tdesignc -16)	100	35	27(19)
B	(30-16)/(Tdesignc -16)	74	30	27(19)
C	(25-16)/(Tdesignc -16)	47	25	27(19)
D	(20-16)/(Tdesignc -16)	21	20	27(19)

Tdesignc = 35°C (reference design temperature at cooling mode)

Main Test Results (Cooling and Average)

Type:				Single split air to air heat pump			
Brand:				Electrolux			
Model:				GWH09TB-K3DHE5H			
Serial no.:				4G57040000004			
Production year:				n.a			
Refrigerant type:				R410A			
Refrigerant charge:				1.2kg			
Function (indicate if present)				If function includes heating: Indicate the heating season the information relates to. Indicated values should relate to one heating season at a time. Include at least the heating season 'Average'			
				Average		Yes	
Cooling		Yes		Warmer		No	
Heating		Yes		Colder		No	
Item	symbol	value	unit	Item	symbol	value	unit
Declared by manufacture design load				Declared by manufacture seasonal efficiency			
cooling	Pdesignc	x.x	kW	cooling	SEER	x.x	-
heating/Average	Pdesignh	x.x	kW	heating/Average	SCOP	x.x	-
heating/Warmer	Pdesignh	x.x	kW	heating/Warmer	SCOP	x.x	-
heating/Colder	Pdesignh	x.x	kW	heating/Colder	SCOP	x.x	-
Measured design load				Measured on & reference seasonal efficiency			
cooling	Pdesignc	2.6	kW	cooling	SEERon/SEERref	8.55/8.08	-
heating/Average	Pdesignh*	2.92	kW	heating/Average	SCOPon/SCOPref	4.98/4.97	-
heating/Warmer	Pdesignh	x.x	kW	heating/Warmer	SCOPon/SCOPref	x.x	-
heating/Colder	Pdesignh	x.x	kW	heating/Colder	SCOPon/SCOPref	x.x	-
Measured capacity cooling, at indoor temperature 27(19)°C and outdoor temperatuer Tj				Measured energy efficiency ratio, at indoor termperature 27(19)°C and outdoor temperature Tj			
Tj=35°C	Pc	2.6	kW	Tj=35°C	EER	4.49	-
Tj=30°C	Pc	1.96	kW	Tj=30°C	EER	7.12	-
Tj=25°C	Pc	1.12	kW	Tj=25°C	EER	9.72	-
Tj=20°C	Pc	1.14	kW	Tj=20°C	EER	12.54	-
Measured capacity for heating/Average season, at indoor temperature 20°C and outdoor temperature Tj				Measured coefficient of performance/Average season, at indoor temperature 20°C and outdoor temperature Tj			
Tj=-10°C	Ph	2.68	kW	Tj=-10°C	COP	2.95	-
Tj=-7°C	Ph	2.58	kW	Tj=-7°C	COP	3.30	-
Tj=2°C	Ph	1.62	kW	Tj=2°C	COP	5.10	-
Tj=7°C	Ph	1.12	kW	Tj=7°C	COP	6.13	-
Tj=12°C	Ph	1.09	kW	Tj=12°C	COP	7.39	-
Tj=bivalent temperature	Ph	2.58	kW	Tj=bivalent temperature	COP	3.30	-
Tj=operating limit	Ph	2.68	kW	Tj=operating limit	COP	2.95	-
Bivalent temperature				Operating limit temperature			
heating/Average	Tbiv	-7	°C	heating/Average	Tol	-10	°C
heating/Warmer	Tbiv	x	°C	heating/Warmer	Tol	x	°C
heating/Colder	Tbiv	x	°C	heating/Colder	Tol	x	°C
Cycling interval capacity				Cycling interval efficiency			
for cooling	Pcycc	x.x	kW	for cooling	EERcyc	x.x	-
for heating	Pcych	x.x	kW	for heating	COPcyc	x.x	-
Measured degradation co-efficient				Applied degradation co-efficient			
cooling	Cdc	x.x	-	heating	Cdh	0.25	-
Electric power input in power modes other than 'activ mode' - heating/cooling mode				Annual electricity consumption including off, standby, thermostat and crankcase heater mode			
off mode	Poff	1/1	W	cooling	Qce	113	kWh/a
standby mode	Psb	1/1	W	heating/Average	Qhe	822	kWh/a
thermostat-off mode	Pto	11/20	W	heating/Warmer	Qhe	x	kWh/a
crankcase heater mode	Pck	1/1	W	heating/Colder	Qhe	x	kWh/a
Capacity control				Other items			
fixed		No		Sound power level (indoor/outdoor)	Lwa	x.x/x.x	dB(A)
staged		No		Global warming potential	GWP	x	kgCO2 eq.
variable		Yes		Rated air flow (indoor/outdoor)	-	x/x	m3/h

Note: * Calculated by means of the heating capacity measured at t_bivalent

Main Test Results (Colder)

Type:				Single split air to air heat pump			
Brand:				Electrolux			
Model:				GWH09TB-K3DHE5H			
Serial no.:				4G57040000004			
Production year:				n.a			
Refrigerant type:				R410A			
Refrigerant charge:				1.2kg			
Function (indicate if present)				If function includes heating: Indicate the heating season the information relates to. Indicated values should relate to one heating season at a time. Include at least the heating season 'Average'			
				Average	No		
Cooling	No			Warmer	No		
Heating	Yes			Colder	Yes		
Item	symbol	value	unit	Item	symbol	value	unit
Declared by manufacture design load				Declared by manufacture seasonal efficiency			
cooling	Pdesignc	x.x	kW	cooling	SEER	x.x	-
heating/Average	Pdesignh	x.x	kW	heating/Average	SCOP	x.x	-
heating/Warmer	Pdesignh	x.x	kW	heating/Warmer	SCOP	x.x	-
heating/Colder	Pdesignh	x.x	kW	heating/Colder	SCOP	x.x	-
Measured design load				Measured on & reference seasonal efficiency			
cooling	Pdesignc	x.x	kW	cooling	SEERon/SEERref	x.x	-
heating/Average	Pdesignh	x.x	kW	heating/Average	SCOPon/SCOPref	x.x	-
heating/Warmer	Pdesignh	x.x	kW	heating/Warmer	SCOPon/SCOPref	x.x	-
heating/Colder	Pdesignh*	3.67	kW	heating/Colder	SCOPon/SCOPref	3.85/3.85	-
Measured capacity cooling, at indoor temperature 27(19)°C and outdoor temperatuer Tj				Measured energy efficiency ratio, at indoor termperature 27(19)°C and outdoor temperature Tj			
Tj=35°C	Pc	x.x	kW	Tj=35°C	EER	x.x	-
Tj=30°C	Pc	x.x	kW	Tj=30°C	EER	x.x	-
Tj=25°C	Pc	x.x	kW	Tj=25°C	EER	x.x	-
Tj=20°C	Pc	x.x	kW	Tj=20°C	EER	x.x	-
Measured capacity for heating/Colder season, at indoor temperature 20°C and outdoor temperature Tj				Measured coefficient of performance/Colder season, at indoor temperature 20°C and outdoor temperature Tj			
Tj=-22°C	Ph	1.55	kW	Tj=-22°C	COP	2.01	-
Tj=-15°C	Ph	2.20	kW	Tj=-15°C	COP	2.59	-
Tj=-10°C	Ph	2.51	kW	Tj=-10°C	COP	2.99	-
Tj=-7°C	Ph	2.26	kW	Tj=-7°C	COP	3.20	-
Tj=2°C	Ph	1.42	kW	Tj=2°C	COP	5.14	-
Tj=7°C	Ph	0.93	kW	Tj=7°C	COP	5.96	-
Tj=12°C	Ph	1.09	kW	Tj=12°C	COP	7.39	-
Tj=bivalent temperature	Ph	2.51	kW	Tj=bivalent temperature	COP	2.99	-
Tj=operating limit	Ph	1.55	kW	Tj=operating limit	COP	2.01	-
Bivalent temperature				Operating limit temperature			
heating/Average	Tbiv	x	°C	heating/Average	Tol	x	°C
heating/Warmer	Tbiv	x	°C	heating/Warmer	Tol	x	°C
heating/Colder	Tbiv	-10	°C	heating/Colder	Tol	-22	°C
Cycling interval capacity				Cycling interval efficiency			
for cooling	Pcycc	x.x	kW	for cooling	EERcyc	x.x	-
for heating	Pcych	x.x	kW	for heating	COPcyc	x.x	-
Measured degradation co-efficient				Applied degradation co-efficient			
cooling	Cdc	x.x	-	heating	Cdh	0.25	-
Electric power input in power modes other than 'activ mode' - heating				Annual electricity consumption including off, standby, thermostat and crankcase heater mode			
off mode	Poff	1	W	cooling	Qce	x.x	kWh/a
standby mode	Psb	1	W	heating/Average	Qhe	1335	kWh/a
thermostat-off mode	Pto	11	W	heating/Warmer	Qhe	x	kWh/a
crankcase heater mode	Pck	1	W	heating/Colder	Qhe	x	kWh/a
Capacity control				Other items			
fixed	No			Sound power level (indoor/outdoor)	Lwa	x.x/x.x	dB(A)
staged	No			Global warming potential	GWP	x	kgCO2 eq.
variable	Yes			Rated air flow (indoor/outdoor)	-	x/x	m3/h

Note: * Calculated by means of the heating capacity measured at t_bivalent

Calculation of $SCOP_{on}$ and reference SCOP (Heating, Average)

The calculation of SCOP is based on the measured values shown in the table containing the main test results. If the measured heating capacity of the heat pump is within ±10 % of the heat demand at the different part loads, the heat demand covered by the heat pump is set equal to the heat demand according to EN14825, chapter 7.4.2.2.

Data for SCOP calculation

	Outdoor air	Part load ratio	Part load	Measured capacity	COP at measured capacity COPm	Degradation coefficient Cd	Capacity ratio CR	COP at part load COPpl
	[°C]	[%]	[kW]	[kW]	[-]	[-]	[-]	[-]
A	-7	88	2.58	2.58	3.30	0.25	1.00	3.30
B	2	54	1.57	1.62	5.10	0.25	1.00	5.10
C	7	35	1.01	1.12	6.13	0.25	0.91	5.99
D	12	15	0.45	1.09	7.39	0.25	0.41	6.31
E(TOL)	-10	100	2.92	2.68	2.95	0.25	1.00	2.95
F(Bivalent)	-7	88	2.58	2.58	3.30	0.25	1.00	3.30

	Hours	Power input measured	Power input applied for SCOP calculation	Annual energy input
	[h]	[W]	[W]	[kWh]
Thermostat Off mode	179	11	10	1.84
Off mode	0	1	1	0.00
Crankcase Heater	179	1	0	0.00
Standby mode	0	1	1	0.00
			Total	1.84

Note: Prior to the SCOP calculation, the power consumption during standby mode is deducted from both the thermostat off mode and the crankcase heater mode, according to EN14825:2013.

Heating Mode - Reference Heating Season Average

	Outdoor temperature (dry bulb)	Hours	Heat demand	Heat demand covered by heat pump	Electrical back up heater	COP(pl)	Annual heat demand	Annual energy input including electrical back up heater
	Tj	hj	Ph(Tj)		elbu(Tj)		hj x Ph(TJ)	
	[°C]	[h]	[kW]	[kW]	[kW]	[-]	[kWh]	[kWh]
E(TOL)	-10	1	2.92	2.68	0.25	2.95	2.92	1.15
	-9	25	2.81	2.64	0.16	3.07	70.19	25.64
	-8	23	2.70	2.61	0.08	3.18	61.99	20.76
A and F(bivalent)	-7	24	2.58	2.58	0.00	3.30	61.99	18.79
	-6	27	2.47	2.47	0.00	3.50	66.71	19.06
	-5	68	2.36	2.36	0.00	3.70	160.38	43.34
	-4	91	2.25	2.25	0.00	3.90	204.40	52.41
	-3	89	2.13	2.13	0.00	4.10	189.91	46.32
	-2	165	2.02	2.02	0.00	4.30	333.55	77.57
	-1	173	1.91	1.91	0.00	4.50	330.30	73.40
	0	240	1.80	1.80	0.00	4.70	431.26	91.76
	1	280	1.68	1.68	0.00	4.90	471.69	96.26
B	2	320	1.57	1.57	0.00	5.10	503.14	98.65
	3	357	1.46	1.46	0.00	5.28	521.22	98.77
	4	356	1.35	1.35	0.00	5.45	479.78	87.96
	5	303	1.24	1.24	0.00	5.63	374.32	66.47
	6	330	1.12	1.12	0.00	5.81	370.62	63.81
C	7	326	1.01	1.01	0.00	5.99	329.51	55.05
	8	348	0.90	0.90	0.00	6.05	312.66	51.68
	9	335	0.79	0.79	0.00	6.11	263.36	43.08
	10	315	0.67	0.67	0.00	6.18	212.26	34.36
	11	215	0.56	0.56	0.00	6.24	120.73	19.34
D	12	169	0.45	0.45	0.00	6.31	75.92	12.04
	13	151	0.34	0.34	0.00	6.37	50.88	7.99
	14	105	0.22	0.22	0.00	6.43	23.58	3.67
	15	74	0.11	0.11	0.00	6.50	8.31	1.28
						Total	6031.60	1210.62
							SCOP_on	4.98
							SCOP_ref	4.97

Equation for the calculation of reference SCOP valid for reversible split air-to-air heat pumps and air conditioners:

$$SCOP = \frac{P_{designh} \times H_{he}}{\frac{P_{designh} \times H_{he}}{SCOP_{on}} + H_{TO} \times P_{TO} + H_{SB} \times P_{SB} + H_{CK} \times P_{CK} + H_{OFF} \times P_{OFF}}$$

Where:

For the reference heating season average:

$P_{designh}$ = Heating load of the building at design temperature, kW

H_{he} = Number of equivalent heating hours (1400), h

H_{TO}, H_{SB}, H_{CK}, H_{OFF} = Number of hours for which the unit is considered to work in thermostat off mode (179h), standby mode (0h), crankcase heater mode (179h) and off mode (0h), respectively

P_{TO}, P_{SB}, P_{CK}, P_{OFF} = Electricity consumption during thermostat off mode, standby mode, crankcase heater mode and off mode, kW, respectively

For the reference heating season colder:

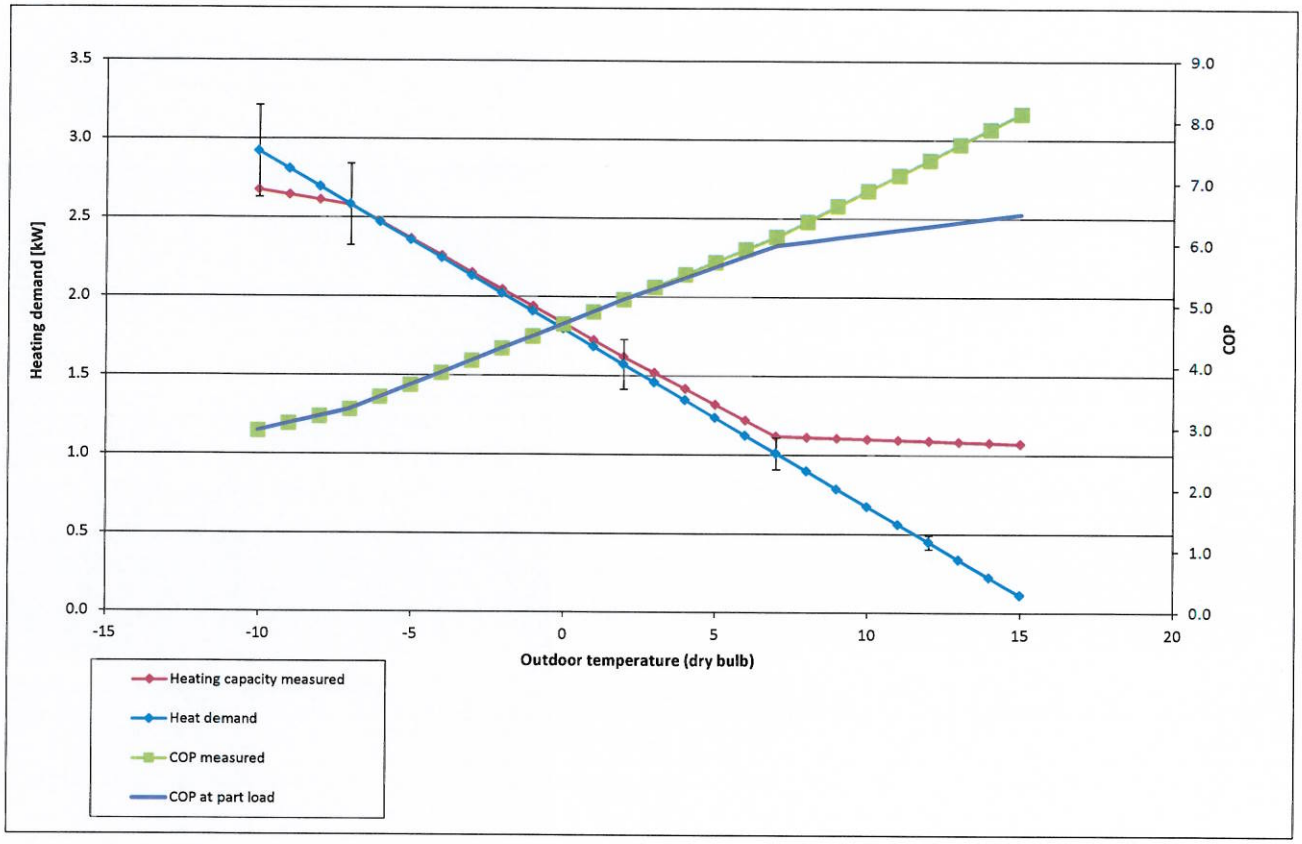
$P_{designh}$ = Heating load of the building at design temperature, kW

H_{he} = Number of equivalent heating hours (2100), h

H_{TO}, H_{SB}, H_{CK}, H_{OFF} = Number of hours for which the unit is considered to work in thermostat off mode (131h), standby mode (0h), crankcase heater mode (131h) and off mode (0h), respectively

P_{TO}, P_{SB}, P_{CK}, P_{OFF} = Electricity consumption during thermostat off mode, standby mode, crankcase heater mode and off mode, kW, respectively

Reference Heat Demand and Measured Part Load Capacity of the Heat Pump Season Average



The heating capacity of the heat pump was adjusted by means of the inverter in order to fit within 10 % of the reference heat demand. For part load conditions above 10 % of the heating demand, a degradation factor is applied to the measured COP. For part load conditions below 10 % of the heating demand, electrical heating is applied to reach the full heating demand. The corrected COP is illustrated in the diagram as 'COP at part load'.

Calculation of $SCOP_{on}$ and reference SCOP (Heating, Colder)

The calculation of SCOP is based on the measured values shown in the table containing the main test results. If the measured heating capacity of the heat pump is within ±10 % of the heat demand at the different part loads, the heat demand covered by the heat pump is set equal to the heat demand according to EN14825, chapter 7.4.2.2.

Data for SCOP calculation

	Outdoor air	Part load ratio	Part load	Measured capacity	COP at measured capacity COPm	Degradation coefficient Cd	Capacity ratio CR	COP at part load COPpl
	[°C]	[%]	[kW]	[kW]	[-]	[-]	[-]	[-]
A	-7	61	2.22	2.26	3.20	0.25	1.00	3.20
B	2	37	1.35	1.42	5.14	0.25	1.00	5.14
C	7	24	0.87	0.93	5.96	0.25	1.00	5.96
D	12	11	0.39	1.09	7.39	0.25	0.36	6.20
E(TOL)	-22	100	3.67	1.55	2.01	0.25	1.00	2.01
F(Bivalent)	-10	68	2.51	2.51	2.99	0.25	1.00	2.99
G	-15	82	2.99	2.20	2.59	0.25	1.00	2.59

	Hours	Power input measured	Power input applied for SCOP calculation	Annual energy input
	[h]	[W]	[W]	[kWh]
Thermostat Off mode	131	11	10	1.31
Off mode	0	1	1	0.00
Crankcase Heater	131	1	0	0.00
Standby mode	0	1	1	0.00
			Total	1.31

Note: Prior to the SCOP calculation, the power consumption during standby mode is deducted from both the thermostat off mode and the crankcase heater mode, according to EN14825:2013.

Heating Mode - Reference Heating Season Colder

	Outdoor temperature (dry bulb)	Hours	Heat demand	Heat demand covered by heat pump	Electrical back up heater	COP(pl)	Annual heat demand	Annual energy input including electrical back up heater
	Tj	hj	Ph(Tj)		elbu(Tj)		hj x Ph(TJ)	
	[°C]	[h]	[kW]	[kW]	[kW]	[-]	[kWh]	[kWh]
E(TOL)	-22	1	3.67	1.55	2.12	2.01	3.67	2.89
	-21	6	3.57	1.64	1.93	2.09	21.44	16.29
	-20	13	3.48	1.74	1.74	2.18	45.20	33.00
	-19	17	3.38	1.83	1.55	2.26	57.46	40.14
	-18	19	3.28	1.92	1.36	2.34	62.39	41.47
	-17	26	3.19	2.01	1.17	2.42	82.86	52.09
	-16	39	3.09	2.11	0.98	2.51	120.53	71.13
G	-15	41	2.99	2.20	0.79	2.59	122.75	67.38
	-14	35	2.90	2.26	0.64	2.67	101.41	51.88
	-13	52	2.80	2.33	0.48	2.75	145.64	68.72
	-12	37	2.70	2.39	0.32	2.83	100.06	42.95
	-11	41	2.61	2.45	0.16	2.91	106.91	41.01
F(bivalent)	-10	43	2.51	2.51	0.00	2.99	107.98	36.11
	-9	54	2.41	2.41	0.00	3.06	130.38	42.61
	-8	90	2.32	2.32	0.00	3.13	208.61	66.65
A	-7	125	2.22	2.22	0.00	3.20	277.66	86.77
	-6	169	2.12	2.12	0.00	3.42	359.08	105.13
	-5	195	2.03	2.03	0.00	3.63	395.49	108.92
	-4	278	1.93	1.93	0.00	3.85	536.98	139.60
	-3	306	1.84	1.84	0.00	4.06	561.51	138.23
	-2	454	1.74	1.74	0.00	4.28	789.24	184.50
	-1	385	1.64	1.64	0.00	4.49	632.11	140.68
	0	490	1.55	1.55	0.00	4.71	757.18	160.80
	1	533	1.45	1.45	0.00	4.92	772.15	156.80
B	2	380	1.35	1.35	0.00	5.14	513.80	99.96
	3	228	1.26	1.26	0.00	5.30	286.26	53.97
	4	261	1.16	1.16	0.00	5.47	302.49	55.32
	5	279	1.06	1.06	0.00	5.63	296.40	52.63
	6	229	0.97	0.97	0.00	5.80	221.17	38.16
C	7	269	0.87	0.87	0.00	5.96	233.82	39.23
	8	233	0.77	0.77	0.00	6.01	180.02	29.96
	9	230	0.68	0.68	0.00	6.06	155.49	25.68
	10	243	0.58	0.58	0.00	6.10	140.81	23.07
	11	191	0.48	0.48	0.00	6.15	92.23	14.99
D	12	146	0.39	0.39	0.00	6.20	56.40	9.10
	13	150	0.29	0.29	0.00	6.25	43.46	6.96
	14	97	0.19	0.19	0.00	6.29	18.74	2.98
	15	61	0.10	0.10	0.00	6.34	5.89	0.93
						Total	9045.68	2348.68
							SCOP_on	3.85
							SCOP_ref	3.85

Equation for the calculation of reference SCOP valid for reversible split air-to-air heat pumps and air conditioners:

$$SCOP = \frac{P_{designh} \times H_{he}}{\frac{P_{designh} \times H_{he}}{SCOP_{on}} + H_{TO} \times P_{TO} + H_{SB} \times P_{SB} + H_{CK} \times P_{CK} + H_{OFF} \times P_{OFF}}$$

Where:

For the reference heating season average:

$P_{designh}$ = Heating load of the building at design temperature, kW

H_{he} = Number of equivalent heating hours (1400), h

H_{TO}, H_{SB}, H_{CK}, H_{OFF} = Number of hours for which the unit is considered to work in thermostat off mode (179h), standby mode (0h), crankcase heater mode (179h) and off mode (0h), respectively

P_{TO}, P_{SB}, P_{CK}, P_{OFF} = Electricity consumption during thermostat off mode, standby mode, crankcase heater mode and off mode, kW, respectively

For the reference heating season colder:

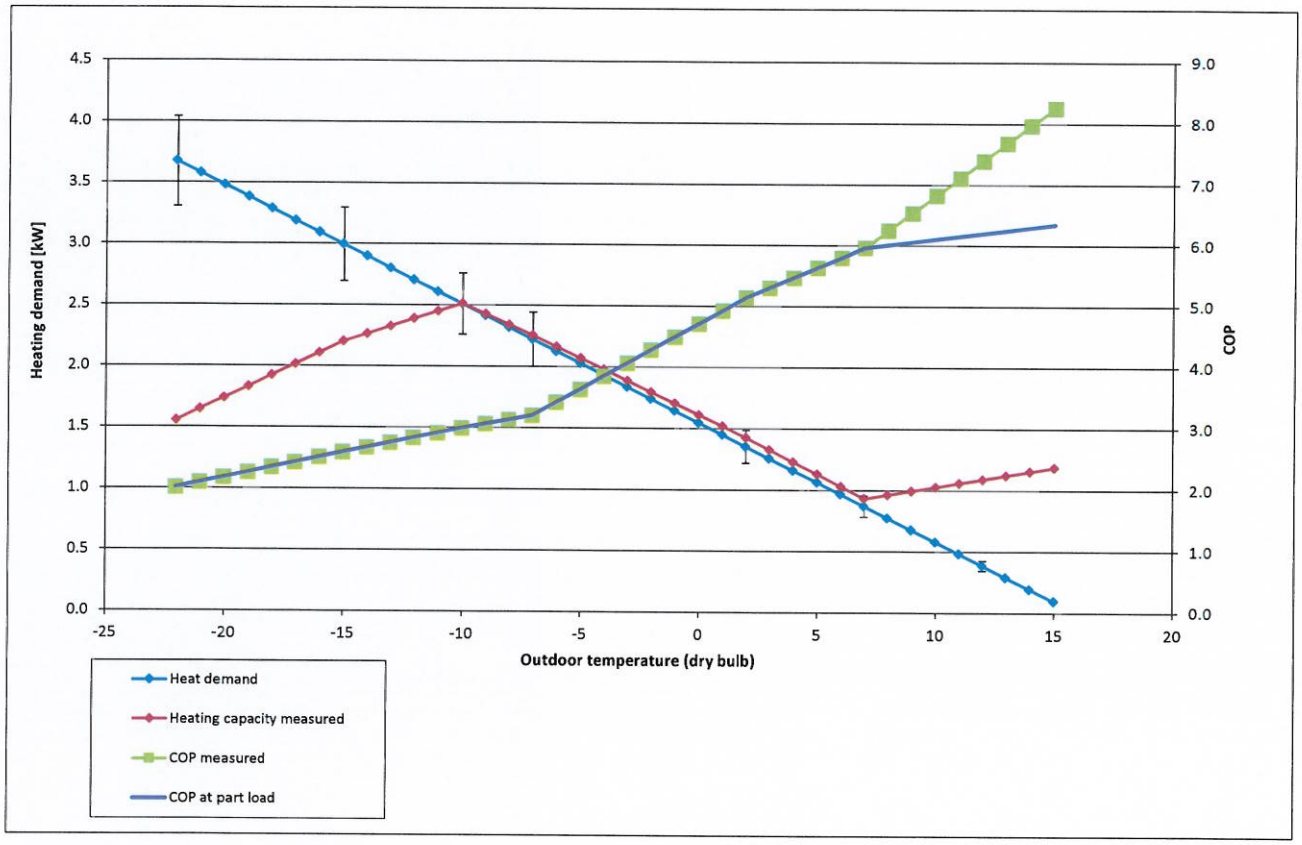
$P_{designh}$ = Heating load of the building at design temperature, kW

H_{he} = Number of equivalent heating hours (2100), h

H_{TO}, H_{SB}, H_{CK}, H_{OFF} = Number of hours for which the unit is considered to work in thermostat off mode (131h), standby mode (0h), crankcase heater mode (131h) and off mode (0h), respectively

P_{TO}, P_{SB}, P_{CK}, P_{OFF} = Electricity consumption during thermostat off mode, standby mode, crankcase heater mode and off mode, kW, respectively

Reference Heat Demand and Measured Part Load Capacity of the Heat Pump Season Colder



The heating capacity of the heat pump was adjusted by means of the inverter in order to fit within 10 % of the reference heat demand. For part load conditions above 10 % of the heating demand, a degradation factor is applied to the measured COP. For part load conditions below 10 % of the heating demand, electrical heating is applied to reach the full heating demand. The corrected COP is illustrated in the diagram as 'COP at part load'.

Calculation of $SEER_{on}$ and reference SEER

Cooling Mode

The calculation of SEER is based on the measured values shown in the table containing the main test results. If the measured cooling capacity of the air conditioner is within ±10 % of the cooling demand at the different part loads, the cooling demand covered by the air conditioner is set equal to the cooling demand according to EN14825, chapter 7.4.2.2.

Data for SEER calculation

	Outdoor air	Part load ratio	Part load	Measured capacity	EER at measured capacity EERm	Degradation coefficient Cd	Capacity ratio CR	EER at part load EERpl
	[°C]	[%]	[kW]	[kW]	[-]	[-]	[-]	[-]
A	35	1900	2.60	2.60	4.49	0.25	1.00	4.49
B	30	1400	1.92	1.96	7.12	0.25	1.00	7.12
C	25	900	1.23	1.12	9.72	0.25	1.00	9.72
D	20	400	0.55	1.14	12.54	0.25	0.48	10.92

	Hours	Power input measured	Power input applied for EER calculation	Annual energy input
	[h]	[W]	[W]	[kWh]
Thermostat Off mode	221	20	19	4.09
Off mode	0	1	1	0.00
Crankcase Heater	2672	1	0	0.00
Standby mode	2142	1	1	2.14
			Total	6.23

Note: Prior to the SEER calculation, the power consumption during standby mode is deducted from both the thermostat off mode and the crankcase heater mode, according to EN14825:2013.

Cooling Mode

	Outdoor temperature (dry bulb)	Hours	Cooling demand	Cooling capacity	EER(pl)	Annual cooling demand	Annual energy input
	Tj	hj	Ph(Tj)			hj x Ph(TJ)	
	[°C]	[h]	[kW]	[kW]	[-]	[kWh]	[kWh]
	17	205	0.14	1.14	10.92	28.05	2.57
	18	227	0.27	1.14	10.92	62.13	5.69
	19	225	0.41	1.14	10.92	92.37	8.46
D	20	225	0.55	1.14	10.92	123.16	11.28
	21	216	0.68	1.13	10.68	147.79	13.84
	22	215	0.82	1.13	10.44	176.53	16.91
	23	218	0.96	1.13	10.20	208.82	20.48
	24	197	1.09	1.12	9.96	215.66	21.65
C	25	178	1.23	1.12	9.72	219.22	22.55
	26	158	1.37	1.29	9.20	216.21	23.50
	27	137	1.51	1.46	8.68	206.22	23.76
	28	109	1.64	1.62	8.16	178.99	21.93
	29	88	1.78	1.79	7.64	156.55	20.49
B	30	63	1.92	1.96	7.12	120.69	16.95
	31	39	2.05	2.09	6.59	80.05	12.14
	32	31	2.19	2.22	6.07	67.87	11.19
	33	24	2.33	2.35	5.54	55.83	10.07
	34	17	2.46	2.47	5.02	41.87	8.35
A	35	13	2.60	2.60	4.49	33.80	7.53
	36	9	2.74	2.73	4.49	24.63	5.49
	37	4	2.87	2.86	4.49	11.49	2.56
	38	3	3.01	2.99	4.49	9.03	2.01
	39	1	3.15	3.12	4.49	3.15	0.70
	40	0	3.28	3.25	4.49	0.00	0.00
					Total	2480.13	290.12
						SEER_on	8.55
						SEER_ref	8.08

Equation for the calculation of reference SEER valid for reversible split air-to-air heat pumps and air conditioners:

$$SEER = \frac{Q_c \times H_{ce}}{\frac{Q_c \times H_{ce}}{SEER_{on}} + H_{TO} \times P_{TO} + H_{SB} \times P_{SB} + H_{CK} \times P_{CK} + H_{OFF} \times P_{OFF}}$$

Where:

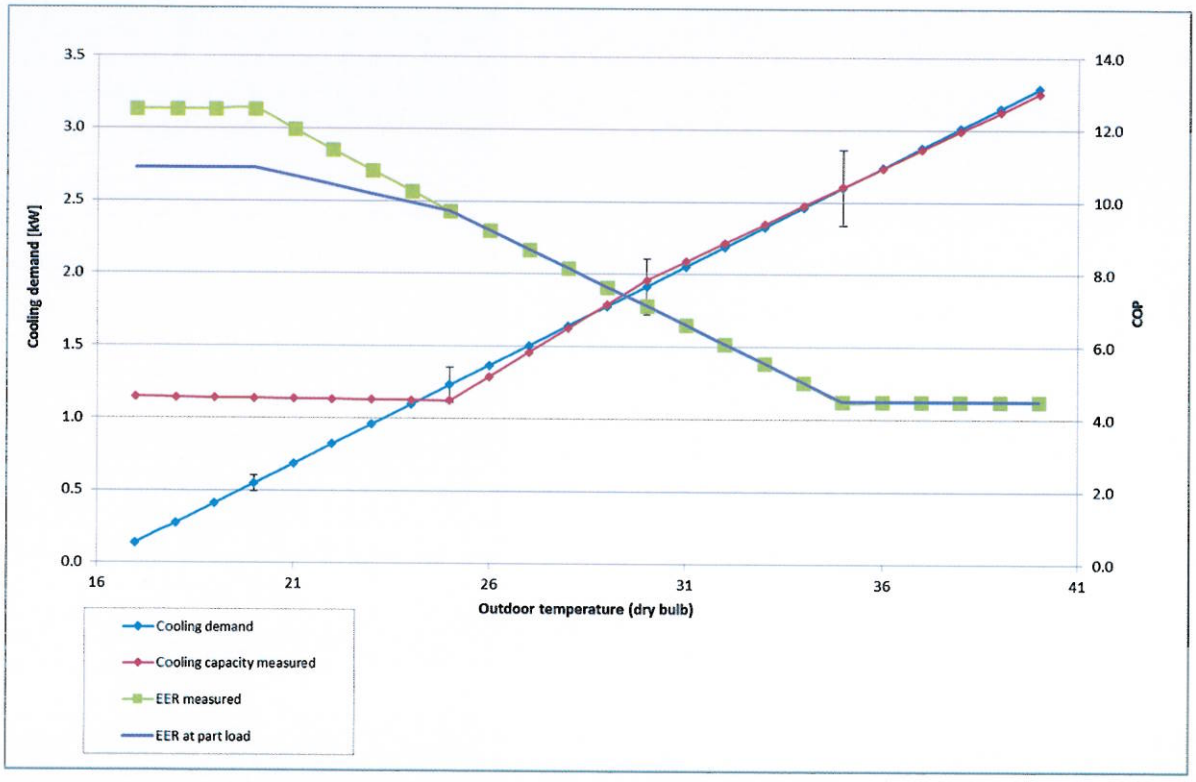
$P_{designc}$ = Cooling load of the building at design temperature, kW

H_{he} = Number of equivalent cooling hours (350), h

H_{TO}, H_{SB}, H_{CK}, H_{OFF} = Number of hours for which the unit is considered to work in thermostat off mode (221h), standby mode (2142h), crankcase heater mode (2672h) and off mode (0h), respectively

P_{TO}, P_{SB}, P_{CK}, P_{OFF} = Electricity consumption during thermostat off mode, standby mode, crankcase heater mode and off mode, kW, respectively

Reference Cooling Demand and Measured Part Load Capacity of the Air Conditioner



The cooling capacity of the air conditioner was adjusted by means of the inverter in order to fit within 10 % of the reference cooling demand. For test conditions that are not within the 10 %, a degradation factor is applied to the measured EER. The corrected EER is illustrated in the diagram as 'EER at part load'.

Indoor Unit

Outdoor Unit

Rating Plate – indoor unit

Rating Plate – outdoor unit