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UNIDO Contract No. 97/001
UNIDO Project No. MP/CPR/96/087

Final Report

February 1st, 1999

1. Summary

After start-up of mass-production in the modified factory with the modified products pilot customer and independent laboratories reconfirmed the achievement of the conversion targets.

With this the project is successfully completed.

2. Work performed after start-up of modified plant

The modified plant started quantity production in November for selected pilot customers.

2.1 Haier

1000 compressors of QD 88 Y and more than 1000 pieces of QD 100 Y were delivered to Haier in Qindao, first part already in September.

More the 2000 pieces of QD 123 Y were also shipped to Haier.

Laboratory and field tests of Haier were successfull.

2.2 Wanbao

Samples of all models were delivered to Wanbao factory in Guangzhou for qualification. Positive test results werde confirmed in laboratory test reports by Wanbao.

2.3 dkk

Samples from first production month were shipped to dkk to cross-check the test data obtained from Chinese Standard Test Centre.

Results fully confirmed the previous measurement data.

(see attachment)

Test – Report

Measuring Calorimeter – R600a

Compressors: QD69Y, QD81Y, QD100Y, QD135Y

performed by dkk

UNIDO Project: Dongbei

Date: 1999-01-20

1. **Design**

Hermetic compressor for household refrigerators
Refrigerant: R600a
220V/50Hz
Climate class: N
Application: LST

QD68Y to QD100Y with run capacitor
QD135 without run capacitor

2. **Conditions**

ASHRAE conditions:

to -25 °C, -23,3 °C, -15 °C

$t_a = t_{gl} = 32{,}2$ °C

$t_f = 54{,}5$ °C $t_{fl} = 32{,}2$ °C

static ventilation

220V/ 50Hz

3. **Conversion target**

I. Cooling Capacity R600a corresponds the range of 100 to 200 W

II. COP not less than 1,3 W/W [ASHRAE rated point -23,3 °C]

4 **Results**

4.1 **Calorimeter**

The data of the calorimeter measuring are summarized in the tables QD69Y to QD135Y.
Furthermore all values are shown in the protocols of calorimeter measuring.

The cooling capacity is between 100 W and 200W. The designed target has been reached and even exceeded.

The compressor QD135Y was not delivered with run capacitor. The other models have the run capacitor with 3 µF whereby the input power will be decreased. This improvement is to be seen in conjunction with an adjustment of the motor. The high efficiency motor improves therefore also the COP.

The COP values moves in a range from 1,35 W/W to 1,47 W/W at the ASHRAE rated point.

The conversion has been performed successfull of all models.

Proposal for the rated values Qo [W], P_1 [W], COP [W/W]

	Qo [W]	P_1 [W]	COP [W/W]
QD69Y	102	79	1,29
QD81Y	125	95	1,31
QD100Y	165	115	1,43
QD135Y	200	145	1,38

The QD88Y and the QD123Y have been rated in a former report. (see behind)
Meanwhile Dongbei has improved the performance data of QD 88Y by adding a run capacitor.

4.2 **Start test**

The start of the compressors have been rated in conjunction with the measuring of the sweep voltage.

The sweep voltage is the measuring value where the compressor motor is just before he stop.

The compressor has constant and stable conditions of temperature and pressure.

	Uk [V]
QD69Y	95
QD81Y	115
QD100Y	112
QD135Y	113

All compressors have a large reserve to the rated voltage and therefore the start reaction is sure.

Date

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Date 27.01.1999

Annex

List of abbreviations
Verzeichnis der Abkürzungen

Data Calorimeter

to	[°C]	Verdampfungstemperatur	Evaporating temperature
Qo	[W]	Kälteleistung	Cooling Capacity
P1	[W]	Leistungsaufnahme	Input Power
COP	[WW]	Leistungszahl	Coefficient of Performance
Uk	[V]	Kippspannung	Sweep Voltage
I1	[A]	Betriebsstrom	Operating Current
Qvol	[W/cm³]	volumetrische Kälteleistung	vol. Cooling Capacity
tw	[°C]	Wicklungstemperatur	winding temperature
t_{g3}	[°C]	Druckstutzentemperatur	Discharge pipe temperature
t_{sch}	[°C]	Temperatur unter Schutzkappe	Temperature behind elec.casing
t_{ko}	[°C]	Temp. Kapsel oben	Temperature Casing top
t_{ku}	[°C]	Temp. Kapsel unten	Temperature Casing bottom
n	[°C]	Drehzahl	Revolution per minute
t_f	[°C]	Verflüssigungstemperatur	Condensing temperature
t_{fl}	[°C]	Unterkühlungstemperatur	Temperature of subcooled liquid
t_a	[°C]	Umgebungstemperatur	Ambient temperature
t_{g1}	[°C]	Sauggastemperatur	Suction gas temperature

General Data

R12	Kältemittel Dichlordifluormrthan	Refrigerant
R600a	Kältemittel Isobutan	Refrigerant
LST	niedriges Anlaufmoment	low starting torque

Calorimeter Data

Date: 1999-01-19

Q/Ri

TYPE:	QD 69Y		
Design:	run capacitor,R600a	Conditions:	220V/50Hz
Refrigerant:	R600a		ASHRAE
Recording:	qd69y dongbei 0199		
Start:	0199		

Compr.No.	to	Ventilation	Qo	P1	COP	Uk	I_1	Qvol	tw	tg_3	tsch	tko	tku	n	remarks
	°C		W	W	W/W	V	A	W/cm³	°C	°C	°C	°C	°C	1/s	
981686	-25	static	96,3	74,2	1,30	92	0,45	-	85,4	57,5	64,5	60,5	64,0	49,3	
981686	-23,3	static	104,7	77,5	1,35	95	0,46	-	86,4	58,0	65,5	61,5	64,0	49,3	
981686	-15	static	179,5	97,5	1,84	105	0,55	-	84,4	69,0	66,0	62,0	63,0	49	

Calorimeter Data

Date: 1999-01-19

Q/Ri

TYPE:	QD 81Y
Design:	run capacitor,R600a
Conditions:	220V/50Hz
Refrigerant:	R600a
	ASHRAE
Recording:	qd81y dongbei 0199
Start:	0199

Compr.No.	to	Ventilation	Qo	P1	COP	Uk	I_1	Qvol	tw	tg_3	tsch	tko	tku	n	remarks
	°C		W	W	W/W	V	A	W/cm³	°C	°C	°C	°C	°C	1/s	
981068	-25	static	114,3	88,3	1,29	100	0,52	-	97,5	63,5	64,0	61,5	62,0	49,1	
981068	-23,3	static	128,6	94,5	1,36	115	0,54	-	96,4	67,1	64,0	62,0	60,0	49,1	
981068	-15	static	208,1	115,2	1,81	128	0,63	-	94,4	76,3	65,5	63,0	59,0	48,9	

Calorimeter Data

Date: 1999-01-19

Q/Ri

TYPE:	QD 100Y		
Design:	run capacitor,R600a	Conditions:	220V/50Hz
Refrigerant:	R600a		ASHRAE
Recording:	qd100y dongbei 0199		
Start:	0199		

Compr.No.	to	Ventilation	Qo	P1	COP	Uk	I_1	Qvol	tw	tg_3	tsch	tko	tku	n	remarks
	°C		W	W	W/W	V	A	W/cm³	°C	°C	°C	°C	°C	1/s	
981684	-25	static	155,0	108,0	1,43	110	0,58	-	90,9	70,8	66,6	65,5	65,0	48,9	
981684	-23,3	static	166,8	113,8	1,47	112	0,6	-	91,9	72,7	68,5	65,5	63,5	48,9	
981684	-15	static	270,6	145,5	1,86	128	0,74	-	87,8	80,7	63,0	67,0	62,0	48,6	

Calorimeter Data

Date: 1999-01-19

Q/Ri

TYPE:	QD 135Y		
Design:	without run capacitor,R600a	Conditions:	220V/50Hz
Refrigerant:	R600a		ASHRAE
Recording:	qd135y dongbei 0199		
Start:	0199		

Compr.No.	to	Ventilation	Qo	P1	COP	Uk	I_1	Qvol	tw	tg_3	tsch	tko	tku	n	remarks
	°C		W	W	W/W	V	A	W/cm³	°C	°C	°C	°C	°C	1/s	
981688	-25	static	187,0	139,0	1,35	113	0,95	-	92,6	83,3	71,0	68,0	60,0	48,7	
981688	-23,3	static	204,0	145,0	1,41	120	0,98	-	89,8	84,2	71,0	69,0	64,0	48,6	
981688	-15	static	324,1	187	1,73	135	1,13	-	87,1	91,1	70,5	68,5	61,5	48,1	

Protocol 1

Compressor data collected on 15.01.99

Compressor type	: QD69Y	Compressor No. :	981686
Variant	: sample Dongbei		
Design	: R600a		
Remarks	: with run capacitor		
Recording	: qd69y dongbei 0199		

Calorimeter Data

Conditions

				Measuring date	15.01.1999	
				Worker	we	
Operating Current	[V]	:	220,0	Ventilation	static	
Condensing temperature	[°C]	:	55,0	Frequency	[Hz]	: 50
Ambient temperature	[°C]	:	32,0	Liquid subcooled to	[°C]	: 55
tg2 Outlet calorimeter	[°C]	:	32,0	tg1 Suction pipe	[°C]	: 32
				tf2 on valve	[°C]	: 32
3. Evaporating temperature	[°C]	:	-23,3	R cold	[Ohm]	: 13,25
Cooling capacity	[W]	:	86,0	R warm	[Ohm]	: 15,95
Input power	[W]	:	77,5	Constant heating V	[V]	: 0
COP	[W/W]	:	1,11	Constant heating C	[A]	: 0
Sweep voltage	[V]	:	95	Constant heating P	[W]	: 25
Current	[A]	:	0,465	Switch heating start	[time]	: 9.59
Vol. Cooling Capacity	[W/cm³]	:		Switch heating end	[time]	: 11.02
Winding temperature	[°C]	:	86,4	Switch heating duration	[s]	: 3808
Discharge pipe temperature	[°C]	:	58	Real power counter start	[KWh]	: 5,3982
Temperature behind elec. casing	[°C]	:	65,5	Real power counter end	[KWh]	: 5,4825
Temperatur casing top	[°C]	:	61,5	Energy consumption	[KWh]	: 0,0843
Temperature casing bottom	[°C]	:	64,0	Energy consumption	[Ws]	: 303480
Revolution per minute	[1/s]	:	49,3	Heating power	[W]	: 79,695
Heating power total	[W]	:	104,7	factor	[-]	: 0,8215
Heating power total	[kcal/h]	:	90,04	Viscosity	[cSt]	: -

Compressor data collected on 15.01.99

Compressor type	: QD69Y	Compressor No. :	981686
Variant	: sample Dongbei		
Design	: R600a		
Remarks	: with run capacitor		
Recording	: qd69y dongbei 0199		

Conditions like above listed

				Measuring date	15.01.1999	
				Worker	we	
2. Evaporating temperature	[°C]	:	-25,0	R cold	[Ohm]	: 13,25
Cooling capacity	[W]	:	79,4	R warm	[Ohm]	: 15,9
Input power	[W]	:	74,2	Constant heating V	[V]	: 0
COP	[W/W]	:	1,07	Constant heating C	[A]	: 0
Sweep voltage	[V]	:	92	Constant heating P	[W]	: 20
Current	[A]	:	0,455	Switch heating start	[time]	: 15.00
Vol. Cooling Capacity	[W/cm³]	:		Switch heating end	[time]	: 16.02
Winding temperature	[°C]	:	85,4	Switch heating duration	[s]	: 3655
Discharge pipe temperature	[°C]	:	57,5	Real power counter start	[KWh]	: 5,779
Temperature behind elec. casing	[°C]	:	64,5	Real power counter end	[KWh]	: 5,8568
Temperatur casing top	[°C]	:	60,5	Energy consumption	[KWh]	: 0,0778
Temperature casing bottom	[°C]	:	64,0	Energy consumption	[Ws]	: 280080
Revolution per minute	[1/s]	:	49,3	Heating power	[W]	: 76,629
Heating power total	[W]	:	96,63	factor	[-]	: 0,8216
Heating power total	[kcal/h]	:	83,1	Viscosity	[cSt]	: -

Protocol 2

Compressor data collected on 15.01.99

Compressor type	: QD69Y	Compressor No. :	981686
Variant	: sample Dongbei		
Design	: R600a		
Remarks	: with run capacitor		
Recording	: qd69y dongbei 0199		

Calorimeter Data

Conditions

			Measuring date	15.01.1999		
			Worker	we		
Operating Current	[V]	: 220,0	Ventilation	static		
Condensing temperature	[°C]	: 55,0	Frequency	[Hz]	:	50
Ambient temperature	[°C]	: 32,0	Liquid subcooled to	[°C]	:	55
tg2 Outlet calorimeter	[°C]	: 32,0	tg1 Suction pipe	[°C]	:	32
			tf2 on valve	[°C]	:	32
3. Evaporating temperature	[°C]	: -15,0	R cold	[Ohm]	:	13,05
Cooling capacity	[W]	: 170,9	R warm	[Ohm]	:	16,1
Input power	[W]	: 115,2	Constant heating V	[V]	:	0
COP	[W/W]	: 1,48	Constant heating C	[A]	:	0
Sweep voltage	[V]	: 128	Constant heating P	[W]	:	25
Current	[A]	: 0,63	Switch heating start	[time]	:	9.59
Vol. Cooling Capacity	[W/cm³]	:	Switch heating end	[time]	:	11.02
Winding temperature	[°C]	: 94,4	Switch heating duration	[s]	:	3808
Discharge pipe temperature	[°C]	: 76,3	Real power counter start	[KWh]	:	5,3982
Temperature behind elec. casing	[°C]	: 65,5	Real power counter end	[KWh]	:	5,4825
Temperatur casing top	[°C]	: 63,0	Energy consumption	[KWh]	:	0,0843
Temperature casing bottom	[°C]	: 59,0	Energy consumption	[Ws]	:	303480
Revolution per minute	[1/s]	: 48,9	Heating power	[W]	:	79,695
Heating power total	[W]	: 208,14	factor	[-]	:	0,8215
Heating power total	[kcal/h]	: 179	Viscosity	[cSt]	:	-

Protocol 3

Compressor data collected on 14.01.99

Compressor type	: QD81Y	Compressor No. :	981068
Variant	: sample Dongbei		
Design	: R600a		
Remarks	: with run capacitor		

Recording : qd81y dongbei 0199

Calorimeter Data

Conditions

Operating Current	[V]	:	220,0	Measuring date		14.01.1999
Condensing temperature	[°C]	:	55,0	Worker		we
Ambient temperature	[°C]	:	32,0	Ventilation		static
tg2 Outlet calorimeter	[°C]	:	32,0	Frequency	[Hz]	: 50
				Liquid subcooled to	[°C]	: 55
1. Evaporating temperature	[°C]	:	-23,3	tg1 Suction pipe	[°C]	: 32
Cooling capacity	[W]	:	105,6	tf2 on valve	[°C]	: 32
Input power	[W]	:	94,5	R cold	[Ohm]	: 13,05
COP	[W/W]	:	1,12	R warm	[Ohm]	: 16,2
Sweep voltage	[V]	:	115	Constant heating V	[V]	: 0
Current	[A]	:	0,54	Constant heating C	[A]	: 0
Vol. Cooling Capacity	[W/cm³]	:		Constant heating P	[W]	: 56,5
Winding temperature	[°C]	:	96,4	Switch heating start	[time]	: 10. 33
Discharge pipe temperature	[°C]	:	67,1	Switch heating end	[time]	: 11. 34
Temperature behind elec. casing	[°C]	:	64,0	Switch heating duration	[s]	: 3687
Temperatur casing top	[°C]	:	62,0	Real power counter start	[KWh]	: 4,8318
Temperature casing bottom	[°C]	:	60,0	Real power counter end	[KWh]	: 4,9056
Revolution per minute	[1/s]	:	49,1	Energy consumption	[KWh]	: 0,0738
Heating power total	[W]	:	128,56	Energy consumption	[Ws]	: 265680
Heating power total	[kcal/h]	:	110,56	Heating power	[W]	: 72,059
				factor	[-]	: 0,8215
				Viscosity	[cSt]	: -

Compressor data

Compressor type	: QD81Y	Compressor No. :	981068
Variant	: sample Dongbei		
Design	: R600a		
Remarks	: with run capacitor		

Recording : qd81y dongbei 0199

Calorimeter Data

Conditions like above listed

				Measuring date		14.01.1999
				Worker		we
2. Evaporating temperature	[°C]	:	-25,0	R cold	[Ohm]	: 13,05
Cooling capacity	[W]	:	93,9	R warm	[Ohm]	: 16,25
Input power	[W]	:	88,3	Constant heating V	[V]	: 0
COP	[W/W]	:	1,06	Constant heating C	[A]	: 0
Sweep voltage	[V]	:	100	Constant heating P	[W]	: 39
Current	[A]	:	0,52	Switch heating start	[time]	: 14 .24
Vol. Cooling Capacity	[W/cm³]	:		Switch heating end	[time]	: 15 .25
Winding temperature	[°C]	:	97,5	Switch heating duration	[s]	: 3686
Discharge pipe temperature	[°C]	:	63,5	Real power counter start	[KWh]	: 5,1154
Temperature behind elec. casing	[°C]	:	64,0	Real power counter end	[KWh]	: 5,1925
Temperatur casing top	[°C]	:	61,5	Energy consumption	[KWh]	: 0,0771
Temperature casing bottom	[°C]	:	62,0	Energy consumption	[Ws]	: 277560
Revolution per minute	[1/s]	:	49,1	Heating power	[W]	: 75,301
Heating power total	[W]	:	114,3	factor	[-]	: 0,8216
Heating power total	[kcal/h]	:	98,3	Viscosity	[cSt]	: -

Protocol 4

Compressor data collected on 14.01.99

Compressor type	: QD81Y	Compressor No. :	981068
Variant	: sample Dongbei		
Design	: R600a		
Remarks	: with run capacitor		

Recording : qd81y dongbei 0199

Calorimeter Data

Conditions

				Measuring date	14.01.1999	
				Worker	we	
Operating Current	[V]	:	220,0	Ventilation	static	
Condensing temperature	[°C]	:	55,0	Frequency	[Hz]	: 50
Ambient temperature	[°C]	:	32,0	Liquid subcooled to	[°C]	: 55
tg2 Outlet calorimeter	[°C]	:	32,0	tg1 Suction pipe	[°C]	: 32
				tf2 on valve	[°C]	: 32
3. Evaporating temperature	[°C]	:	-15,0	R cold	[Ohm]	: 13,05
Cooling capacity	[W]	:	170,9	R warm	[Ohm]	: 16,1
Input power	[W]	:	115,2	Constant heating V	[V]	: 0
COP	[W/W]	:	1,48	Constant heating C	[A]	: 0
Sweep voltage	[V]	:	128	Constant heating P	[W]	: 134
Current	[A]	:	0,63	Switch heating start	[time]	: 12.38
Vol. Cooling Capacity	[W/cm³]	:		Switch heating end	[time]	: 13.38
Winding temperature	[°C]	:	94,4	Switch heating duration	[s]	: 3632
Discharge pipe temperature	[°C]	:	76,3	Real power counter start	[KWh]	: 4,9823
Temperature behind elec. casing	[°C]	:	65,5	Real power counter end	[KWh]	: 5,0571
Temperatur casing top	[°C]	:	63,0	Energy consumption	[KWh]	: 0,0748
Temperature casing bottom	[°C]	:	59,0	Energy consumption	[Ws]	: 269280
Revolution per minute	[1/s]	:	48,9	Heating power	[W]	: 74,141
Heating power total	[W]	:	208,14	factor	[-]	: 0,8212
Heating power total	[kcal/h]	:	179	Viscosity	[cSt]	: -

Protocol 5

Compressor data collected on 18.01.99

Compressor type	: QD100Y	Compressor No. :	981684
Variant	: sample Dongbei		
Design	: R600a		
Remarks	: with run capacitor		

Recording : qd100y dongbei 0199

Calorimeter Data

Conditions				Measuring date	18.01.1999	
				Worker	we	
Operating Current	[V]	:	220,0	Ventilation	static	
Condensing temperature	[°C]	:	55,0	Frequency	[Hz]	: 50
Ambient temperature	[°C]	:	32,0	Liquid subcooled to	[°C]	: 55
tg2 Outlet calorimeter	[°C]	:	32,0	tg1 Suction pipe	[°C]	: 32
				tf2 on valve	[°C]	: 32
3. Evaporating temperature	[°C]	:	-23,3	R cold	[Ohm]	: 13,15
Cooling capacity	[W]	:	137,0	R warm	[Ohm]	: 16,1
Input power	[W]	:	113,8	Constant heating V	[V]	: 0
COP	[W/W]	:	1,20	Constant heating C	[A]	: 0
Sweep voltage	[V]	:	112	Constant heating P	[W]	: 90
Current	[A]	:	0,6	Switch heating start	[time]	: 10.07
Vol. Cooling Capacity	[W/cm³]	:		Switch heating end	[time]	: 11.09
Winding temperature	[°C]	:	91,9	Switch heating duration	[s]	: 3712
Discharge pipe temperature	[°C]	:	72,7	Real power counter start	[KWh]	: 6,0409
Temperature behind elec. casing	[°C]	:	68,5	Real power counter end	[KWh]	: 6,1201
Temperatur casing top	[°C]	:	65,5	Energy consumption	[KWh]	: 0,0792
Temperature casing bottom	[°C]	:	63,5	Energy consumption	[Ws]	: 285120
Revolution per minute	[1/s]	:	48,9	Heating power	[W]	: 76,81
Heating power total	[W]	:	166,81	factor	[-]	: 0,8215
Heating power total	[kcal/h]	:	143,46	Viscosity	[cSt]	: -

Compressor data collected on 18.01.99

Compressor type	: QD100Y	Compressor No. :	981684
Variant	: sample Dongbei		
Design	: R600a		
Remarks	: with run capacitor		

Recording : qd100y dongbei 0199

Conditions like above listed

				Measuring date	18.01.1999	
				Worker	we	
2. Evaporating temperature	[°C]	:	-25,0	R cold	[Ohm]	: 13,15
Cooling capacity	[W]	:	127,3	R warm	[Ohm]	: 16,05
Input power	[W]	:	108,0	Constant heating V	[V]	: 0
COP	[W/W]	:	1,18	Constant heating C	[A]	: 0
Sweep voltage	[V]	:	110	Constant heating P	[W]	: 72,5
Current	[A]	:	0,58	Switch heating start	[time]	: 14.29
Vol. Cooling Capacity	[W/cm³]	:		Switch heating end	[time]	: 15.35
Winding temperature	[°C]	:	90,9	Switch heating duration	[s]	: 3946
Discharge pipe temperature	[°C]	:	70,8	Real power counter start	[KWh]	: 6,3942
Temperature behind elec. casing	[°C]	:	66,6	Real power counter end	[KWh]	: 6,4846
Temperatur casing top	[°C]	:	65,5	Energy consumption	[KWh]	: 0,0904
Temperature casing bottom	[°C]	:	65,0	Energy consumption	[Ws]	: 325440
Revolution per minute	[1/s]	:	48,9	Heating power	[W]	: 82,473
Heating power total	[W]	:	154,97	factor	[-]	: 0,8216
Heating power total	[kcal/h]	:	133,27	Viscosity	[cSt]	: -

Protocol 6

Compressor data collected on 18.01.99

Compressor type	: QD100Y	Compressor No. :	981684
Variant	: sample Dongbei		
Design	: R600a		
Remarks	: with run capacitor		
Recording	: qd100y dongbei 0199		

Calorimeter Data

Conditions

				Measuring date	18.01.1999	
				Worker	we	
Operating Current	[V]	:	220,0	Ventilation	static	
Condensing temperature	[°C]	:	55,0	Frequency	[Hz]	: 50
Ambient temperature	[°C]	:	32,0	Liquid subcooled to	[°C]	: 55
tg2 Outlet calorimeter	[°C]	:	32,0	tg1 Suction pipe	[°C]	: 32
				tf2 on valve	[°C]	: 32
3. Evaporating temperature	[°C]	:	-15,0	R cold	[Ohm]	: 13,15
Cooling capacity	[W]	:	222,2	R warm	[Ohm]	: 15,9
Input power	[W]	:	145,5	Constant heating V	[V]	: 0
COP	[W/W]	:	1,53	Constant heating C	[A]	: 0
Sweep voltage	[V]	:	128	Constant heating P	[W]	: 195
Current	[A]	:	0,74	Switch heating start	[time]	: 12.41
Vol. Cooling Capacity	[W/cm³]	:		Switch heating end	[time]	: 13.41
Winding temperature	[°C]	:	87,8	Switch heating duration	[s]	: 3603
Discharge pipe temperature	[°C]	:	80,7	Real power counter start	[KWh]	: 6,2627
Temperature behind elec. casing	[°C]	:	63,0	Real power counter end	[KWh]	: 6,3384
Temperatur casing top	[°C]	:	67,0	Energy consumption	[KWh]	: 0,0757
Temperature casing bottom	[°C]	:	62,0	Energy consumption	[Ws]	: 272520
Revolution per minute	[1/s]	:	48,6	Heating power	[W]	: 75,637
Heating power total	[W]	:	270,64	factor	[-]	: 0,8212
Heating power total	[kcal/h]	:	232,75	Viscosity	[cSt]	: -

Protocol 7

Compressor data collected on 13.01.99

Compressor type	: QD135Y	Compressor No. :	981688
Variant	: sample Dongbei		
Design	: R600a		
Remarks	: without run capacitor		

Recording : qd135y dongbei 0199

Calorimeter Data

Conditions

			Measuring date	13.01.1999		
			Worker	we		
Operating Current	[V]	: 220,0	Ventilation	static		
Condensing temperature	[°C]	: 55,0	Frequency	[Hz]	:	50
Ambient temperature	[°C]	: 32,0	Liquid subcooled to	[°C]	:	55
tg2 Outlet calorimeter	[°C]	: 32,0	tg1 Suction pipe	[°C]	:	32
			tf2 on valve	[°C]	:	32
1. Evaporating temperature	[°C]	: -23,3	R cold	[Ohm]	:	9,7
Cooling capacity	[W]	: 167,5	R warm	[Ohm]	:	11,8
Input power	[W]	: 145,0	Constant heating V	[V]	:	0
COP	[W/W]	: 1,15	Constant heating C	[A]	:	0
Sweep voltage	[V]	: 120	Constant heating P	[W]	:	125,5
Current	[A]	: 0,98	Switch heating start	[time]	:	10 .05
Vol. Cooling Capacity	[W/cm³]	:	Switch heating end	[time]	:	11 .06
Winding temperature	[°C]	: 89,8	Switch heating duration	[s]	:	3662
Discharge pipe temperature	[°C]	: 84,2	Real power counter start	[KWh]	:	4,1191
Temperature behind elec. casing	[°C]	: 71,0	Real power counter end	[KWh]	:	4,1989
Temperatur casing top	[°C]	: 69,0	Energy consumption	[KWh]	:	0,0798
Temperature casing bottom	[°C]	: 64,0	Energy consumption	[Ws]	:	287280
Revolution per minute	[1/s]	: 48,6	Heating power	[W]	:	78,449
Heating power total	[W]	: 203,95	factor	[-]	:	0,8212
Heating power total	[kcal/h]	: 175,4	Viscosity	[cSt]	:	-

Compressor data

Compressor type	: QD135Y	Compressor No. :	981688
Variant	: sample Dongbei		
Design	: R600a		
Remarks	: without run capacitor		

Recording : qd135y dongbei 0199

Calorimeter Data

Conditions like above listed

			Measuring date	13.01.1999		
			Worker	we		
2. Evaporating temperature	[°C]	: -25,0	R cold	[Ohm]	:	9,7
Cooling capacity	[W]	: 153,6	R warm	[Ohm]	:	11,9
Input power	[W]	: 139,0	Constant heating V	[V]	:	0
COP	[W/W]	: 1,11	Constant heating C	[A]	:	0
Sweep voltage	[V]	: 113	Constant heating P	[W]	:	112
Current	[A]	: 0,955	Switch heating start	[time]	:	15.00
Vol. Cooling Capacity	[W/cm³]	:	Switch heating end	[time]	:	16.02
Winding temperature	[°C]	: 92,6	Switch heating duration	[s]	:	3693
Discharge pipe temperature	[°C]	: 83,3	Real power counter start	[KWh]	:	4,517
Temperature behind elec. casing	[°C]	: 71,0	Real power counter end	[KWh]	:	4,5939
Temperatur casing top	[°C]	: 68,0	Energy consumption	[KWh]	:	0,0769
Temperature casing bottom	[°C]	: 60,0	Energy consumption	[Ws]	:	276840
Revolution per minute	[1/s]	: 48,7	Heating power	[W]	:	74,963
Heating power total	[W]	: 186,96	factor	[-]	:	0,8216
Heating power total	[kcal/h]	: 160,79	Viscosity	[cSt]	:	-

Compressor data collected on 13.01.99

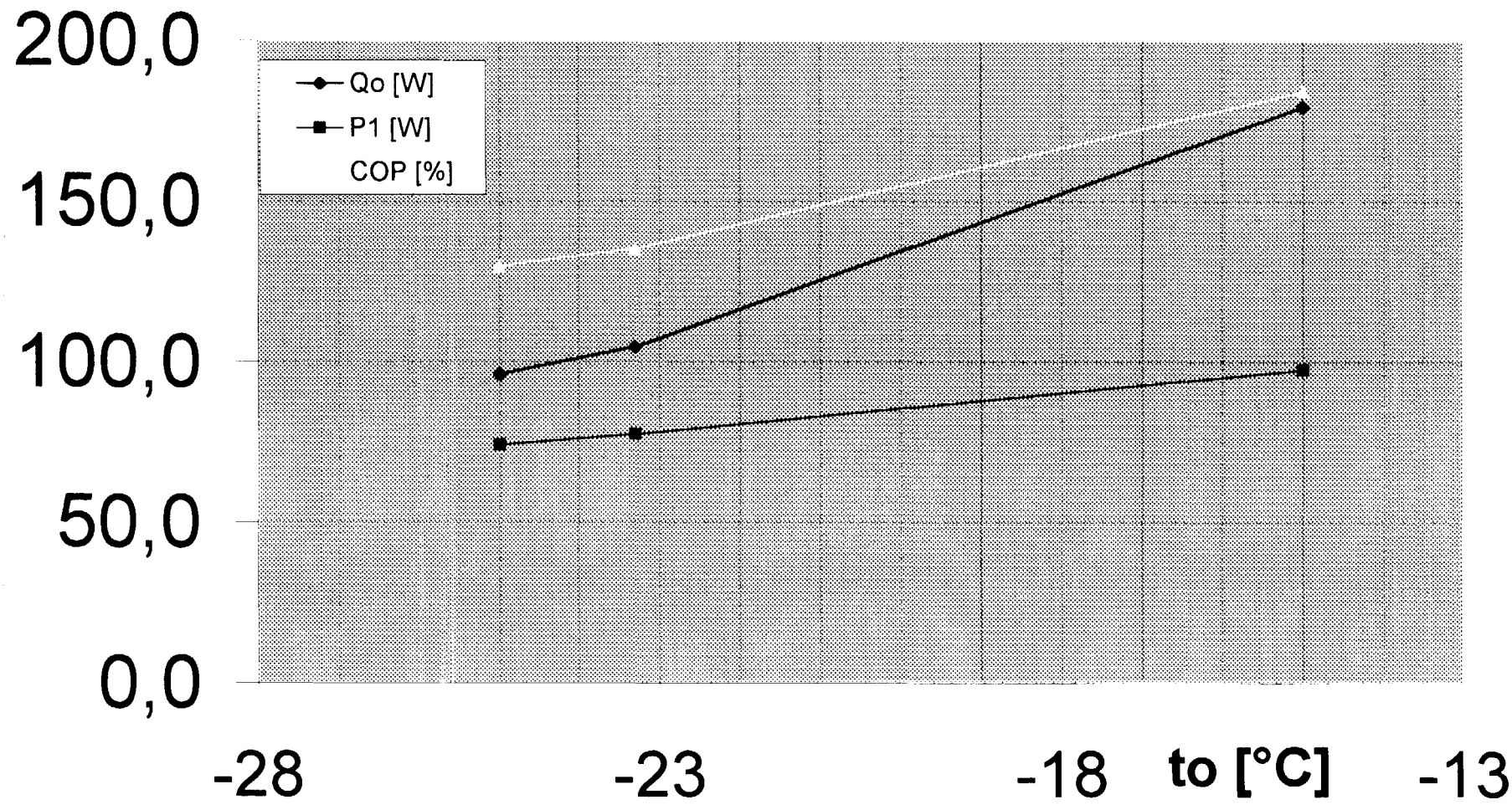
Compressor type	: QD135Y	Compressor No. :	981688
Variant	: sample Dongbei		
Design	: R600a		
Remarks	: without run capacitor		

Recording : qd135y dongbei 0199

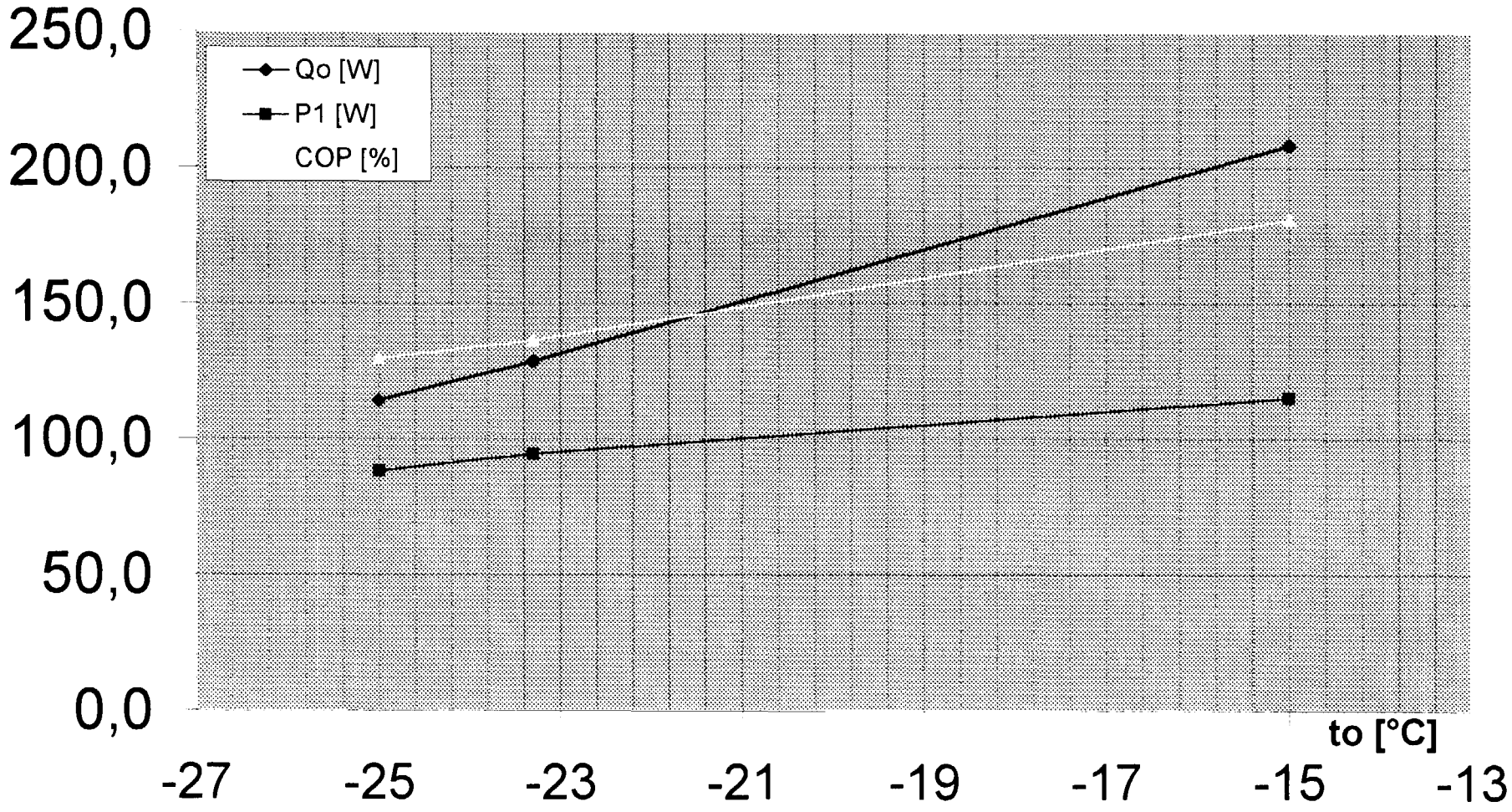
Calorimeter Data

Conditions						
				Measuring date	13.01.1999	
				Worker	we	
Operating Current	[V]	:	220,0	Ventilation	static	
Condensing temperature	[°C]	:	55,0	Frequency	[Hz]	: 50
Ambient temperature	[°C]	:	32,0	Liquid subcooled to	[°C]	: 55
tg2 Outlet calorimeter	[°C]	:	32,0	tg1 Suction pipe	[°C]	: 32
				tf2 on valve	[°C]	: 32
3. Evaporating temperature	[°C]	:	-15,0	R cold	[Ohm]	: 9,7
Cooling capacity	[W]	:	266,1	R warm	[Ohm]	: 11,7
Input power	[W]	:	187,0	Constant heating V	[V]	: 0
COP	[W/W]	:	1,42	Constant heating C	[A]	: 0
Sweep voltage	[V]	:	135	Constant heating P	[W]	: 245
Current	[A]	:	1,13	Switch heating start	[time]	: 12.51
Vol. Cooling Capacity	[W/cm³]	:		Switch heating end	[time]	: 13.54
Winding temperature	[°C]	:	87,1	Switch heating duration	[s]	: 3760
Discharge pipe temperature	[°C]	:	91,1	Real power counter start	[KWh]	: 4,3575
Temperature behind elec. casing	[°C]	:	70,5	Real power counter end	[KWh]	: 4,4401
Temperatur casing top	[°C]	:	68,5	Energy consumption	[KWh]	: 0,0826
Temperature casing bottom	[°C]	:	61,5	Energy consumption	[Ws]	: 297360
Revolution per minute	[1/s]	:	48,1	Heating power	[W]	: 79,085
Heating power total	[W]	:	324,09	factor	[-]	: 0,8216
Heating power total	[kcal/h]	:	278,72	Viscosity	[cSt]	: -

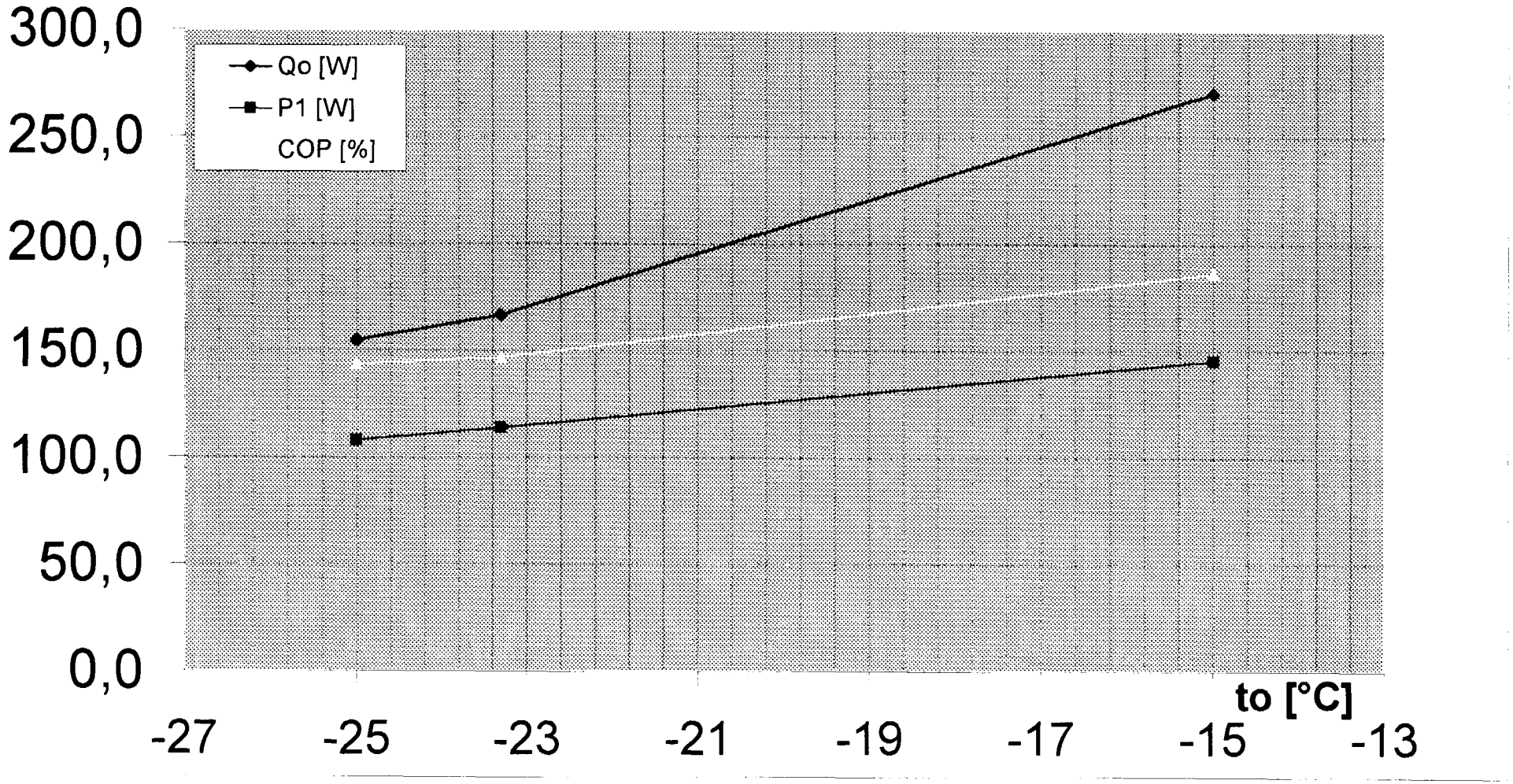
Calorimeter data QD69Y - Dongbei



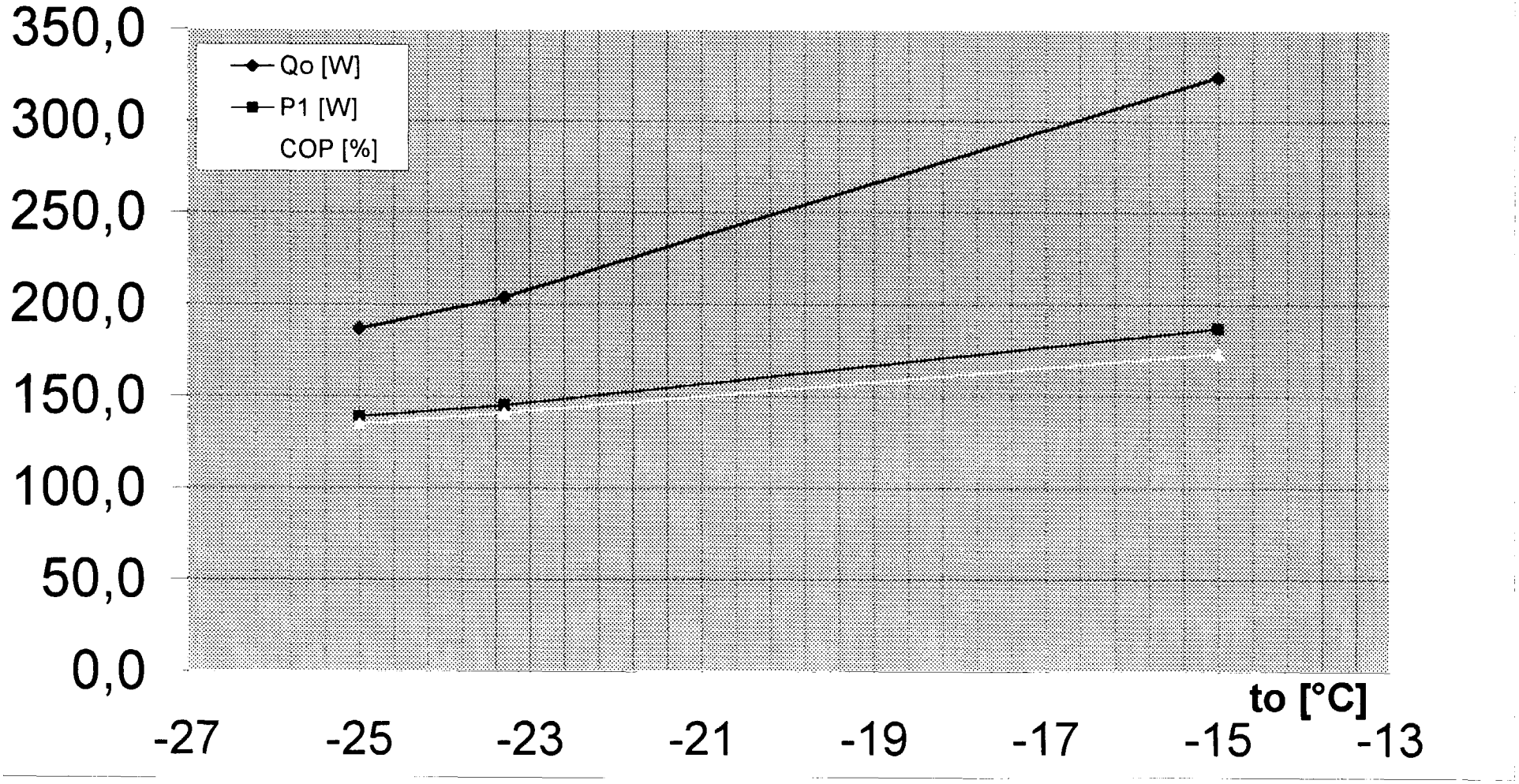
Calorimeter data QD81Y - Dongbei

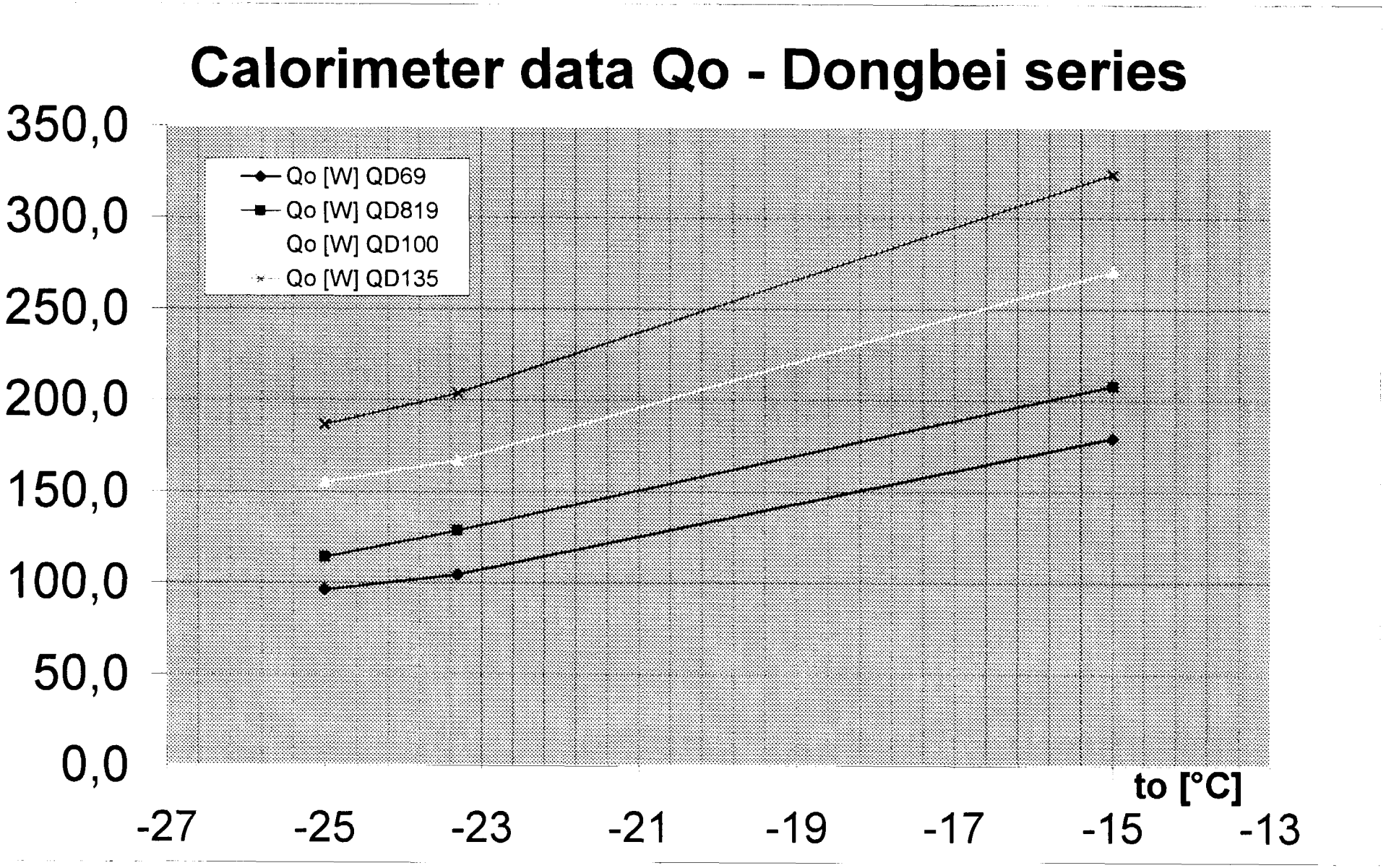


Calorimeter data QD100Y - Dongbei

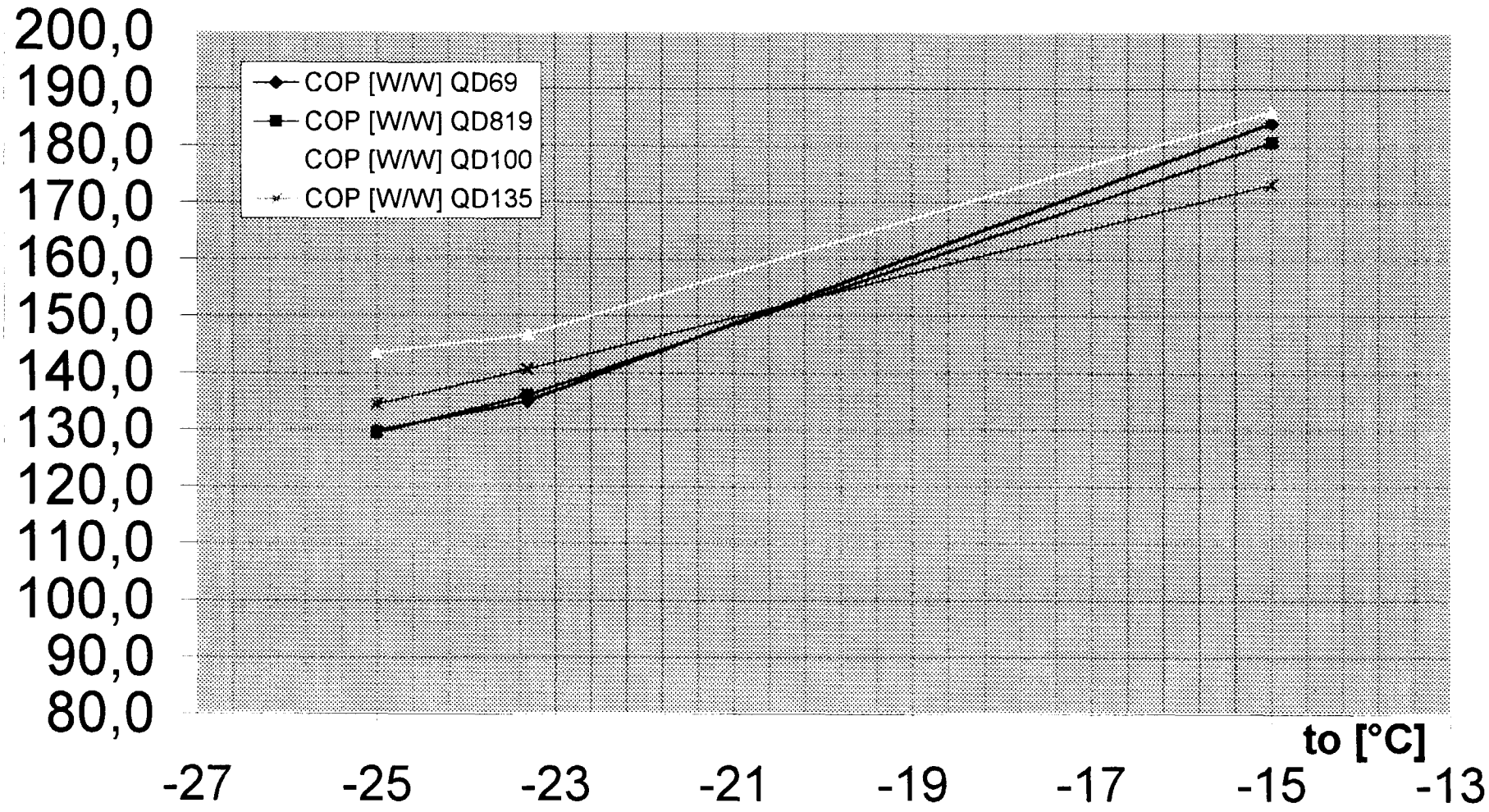


Calorimeter data QD135Y - Dongbei




Calorimeter data Qo - Dongbei series
350,0
300,0
250,0
200,0
150,0
100,0
50,0
0,0
Qo [W] QD69
Qo [W] QD819
Qo [W] QD100
Qo [W] QD135
to [°C]
-27
-25
-23
-21
-19
-17
-15
-13

Calorimeter data COP - Dongbei series



Test – Report

Measuring Calorimeter – R600a

performed by dkk

Compressor Type: - QD 88Y

- QD 123Y

Producer of the Compressor: Dongbei

Date: 1998-08-20

Results:

Comparison between Measuring Dongbei - dkk

Calorimeter Measuring :

Conditions: Evaporating temperature t_o = -23,3°C

Condensing temperature t_f = 54,4°C

Temperature of subcooled liquid t_{fl} = 32,2°C

Suction temperature t_{gl} = 32,2°C

Ambient temperature t_a = 32,2°C

		QD 88Y 970627 I-26931		QD 123Y 970648 I-070584	
		Dongbei	dkk	Dongbei	dkk
Qo	[W]	145,7	144,7	197,9	187,0
P1	[W]	118,6	123,0	146,4	139,8
COP	[W/W]	1,22	1,18	1,35	1,34
I	[A]	0,92	0,97	1,06	1,06
tw	[°C]	90,7	95,8	87,4	86,1
t_{KO}	[°C]		72		73,0
t_{KU}	[°C]	67	67	61	63,0
t_{Sch}	[°C]		77,5		75,0
t_{g3}	[°C]		73,5		81,7
Uk	[V]		117		115
Qvol	[W/cm³]		15,5		15,2
n	[min⁻¹]	2920	2922	2910	2934

The tolerance between the measurings (dkk-Dongbei) of the Cooling Capacity,Input Power and COP are not greater than 3,6 % at QD 88Y.

The Cooling Capacity of the QD 123 Y differ by 5,8 %. The other values shows a acceptable correspondence.

The detailed design of the compressors are not known.

Annex 1

List of abbreviations
Verzeichnis der Abkürzungen

Data Calorimeter

to	Verdampfungstemperatur	Evaporating temperature
Qo	Kälteleistung	Cooling Capacity
P1	Leistungsaufnahme	Input Power
COP	Leistungszahl	Coefficient of Performance
Uk	Kippspannung	Sweep Voltage
I1	Betriebsstrom	Operating Current
Qvol	volumetrische Kälteleistung	vol. Cooling Capacity
tw	Wicklungstemperatur	winding temperature
tg3	Druckstutzentemperatur	Discharge pipe temperature
tsch	Temperatur unter Schutzkappe	Temperature behind elec.casing
tko	Temp. Kapsel oben	Temperature Casing top
tku	Temp. Kapsel unten	Temperature Casing bottom
n	Drehzahl	Revolution per minute
tf	Verflüssigungstemperatur	Condensing temperature
tfl	Unterkühlungstemperatur	Temperature of subcooled liquid
ta	Umgebungstemperatur	Ambient temperature
tg1	Sauggastemperatur	Suction gas temperature