TEST REPORT

BLT reference number: 048/06 BLT approval number: 028/07

Pellet burner
PELLEMATIC PE64

Applicant and manufacturer:
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Identifikations-
nummer: 112

The BLT Wieselburg is an accredited burner test centre issued with identification number 112 according to accreditation law BGBl. no. 468/1992. The quality management system is compliant with the requirements of ÖVE/ÖNORM EN ISOIEC 17 025.

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The test results detailed in this test report exclusively refer to the test piece specified in the chapter "Boiler plate information".

The test report must be published only literally and unabridged.
Exceptions must be authorized by FJ-BLT.

Authorized translation
In the event of doubt, the German original shall prevail

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APPLIED STANDARDS

[1]	ÖNORM EN 303-5:1999	Heating boilers for solid fuels, hand and automatically stoked, nominal heat output of up to 300 kW.
[2]	ÖNORM EN 304:2005	Heating boilers. Test code for heating boilers for atomising oil burners
[3]	ÖNORM EN 267:1999	Forced draught oil burners - Definitions, requirements, testing, marking
[4]	ÖNORM M 7135:2000	Compressed wood and compressed bark in natural state - Pellets and briquettes - Requirements and test specifications
[5]	DIN 4702-1:1990	Central heating boilers - Terms, requirements, testing, marking
[6]	DIN 4702-2:1990	Central heating boilers - Test code

1 DESCRIPTION

1.1 General

The tested pellet burner PELLEMATIC PE64 manufactured by ÖkoFEN Forschungs- und Entwicklungs Ges.m.b.H. with a nominal heat output of 64.0 kW comprises a storage container, a fuel feeding system with integrated fire protection valve, the burner including burner plate, the flame pipe and the attached pipe heat exchanger with cleaning springs. The burner is equipped with electric ignition, an automatic cleaning system for the heat exchanger, a speed-controlled combustion fan, a draught fan and a microprocessor control system with associated switches and sensors.

A sheet metal storage container was used to perform the tests. An extraction screw transports the fuel through the entry pipe with integrated burn-back ball valve to the stoker screw. The stoker screw is driven by a gear motor and transports the fuel from below onto the heat-resistant steel burner plate. The fuel is ignited by an electric heating cartridge. The burner is regulated by a system using a combustion fan, a draught fan, the boiler temperature sensor and the combustion chamber temperature and pressure sensors to control the heat output. A radial fan directs the combustion air as the primary air flow through the fuel and as a secondary air flow to the fuel gas via a post-combustion ring in the flame pipe. The combustion gases then exit the flame pipe and flow into the heat exchanger. The heat exchanger is automatically cleaned by internal cleaning springs actuated by a motor. The ash from the heat exchanger and burner is collected in an ash drawer below the burner plate. The combustion chamber and heat exchanger are thermally insulated from the outside.

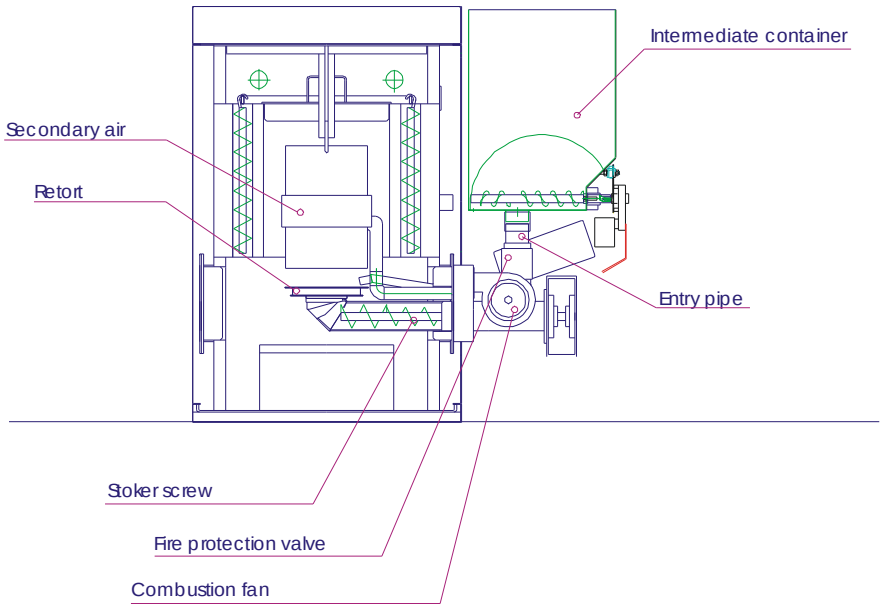
The ignition process is monitored by measuring the combustion chamber temperature. Once ignition has been successful, the control system switches to heating mode and controls the heat output level according to the required heat output. The fuel and combustion air quantities are preset for various heat output levels and then regulated during operation according to the boiler temperature and combustion chamber temperature.

1.2 Boiler plate information

ÖkoFEN HEIZTECHNIK
Mühlgasse 9, A-4132 Lembach
Tel.: 0043 7286 7450 Fax: DW 10

Type	Pellematic64	Herstellernummer	64	
Baujahr	2007	Nennwärmeleistung	64,0	KW
Brennstoffwärmelstg. bei Nennwärmelstg.			68,3	KW
max. Betriebstemperatur	90°C	max. Betriebsdruck	3 bar	
zul. Brennstoff	Holzpellets	Wasserinhalt	135 Lt.	
Elektroanschluß	230V, 50 Hz, 6 A, 503 W			

1.3 Diagram of the burner



1.4 Technical data

Parameter – Overall dimensions of burner	Value	Unit
Overall length including burner and intermediate container	1300	mm
Overall depth including flue gas pipe connection	1160	mm
Overall height	1550	mm
Diameter of flue gas pipe	150	mm
Height to centre of flue gas pipe	1050	mm
Flow/return connection	2	"
Water capacity	135	l
Emptying outlet	¾	"
Thickness of sheets exposed to fire (stainless steel)	2	mm
Thermal insulation	60 – 200	mm
Total weight (boiler + burner + storage container)	586	kg

Source: Measurements by BLT Wieselburg

Parameter – Storage container (testbed)	Value	Unit
Container diameter	390	mm
Container height	1060	mm

Source: Measurements by BLT Wieselburg

2 TESTS AND RESULTS

Measurements were taken to determine the heat output, boiler efficiency (direct method), flue gas composition, flue gas temperature in the measuring section, feed pressure (draught), emission characteristics and electrical power consumption. The surface temperatures were measured at nominal heat output and stationary operation; this allowed the surface losses to be estimated.

The measurement equipment and measurement method correspond to ÖNORM EN 303-5:1999, ÖNORM EN 304:2005 and EN 267:1999. The measurement accuracy and measurement uncertainty are stated in documented procedures for verification in the quality management manual issued by the Federal Institute of Agricultural Engineering (Bundesanstalt für Landtechnik).

2.1 Test setup – measurement methods

BOILER TEST RIG WITH HEAT EXCHANGER: Heat output measurement by directly measuring the amount of water circulated through the heating circuit and its temperature increase (DIN 4702-2:1990).

FLUE GAS EXTRACTION through a vertical measuring section, generating the feed pressure using a flue pipe, diameter 200 mm, height above ground level 9 m, feed pressure limited by draught limiting flap.

HEAT OUTPUT MEASUREMENT: Determining the mass flow using the Coriolis mass flow meter PROMASS 63 F from Endress & Hauser, as well as the water temperatures at the boiler flow/return using a Pt 100 resistance thermometer, 1/3 DIN, calibrated as a pair.

FLUE GAS TEMPERATURE in the measuring section using a measurement system with 5 Pt 100 resistance thermometers.

FEED PRESSURE: Differential pressure transducer (Delta-P P92K), measurement range 0 – 100 Pa.

WATER-SIDE RESISTANCE: Differential pressure transducer with ceramic measurement membranes, DELTABAR S PMD 70 from Endress & Hauser.

CARBON DIOXIDE AND CARBON MONOXIDE CONTENT: Non-dispersive infrared gas analyser NGA 2000 from Emerson; carbon dioxide: lowest measurement range 0 – 5 %, highest measurement range 0 – 20 %; carbon monoxide: CO Low - lowest measurement range 0 – 50 ppm, highest measurement range 0 – 2500 ppm, CO High - lowest measurement range 0 – 1.0 %, highest measurement range 0 – 10 %; measured in dry flue gas.

DUST CONTENT: Measuring device for gravimetric determination of total dust by company Paul Gothe GmbH with nominal suction quantity of 6 m^3/h, dust separation on stuffed quartz wool filter; filter is located directly after sampling probe and elbow, determination of partial flow volume by dry gas meter and upstream drying tower. Sampling point for determination of dust content is arranged directly after measuring section.

CONTENT OF ORGANIC GASEOUS SUBSTANCES: Flame ionisation detector from JUM, Type VE 5; samples taken via heated filter and heated pipe (thermostatically controlled to 180 °C); measured in damp flue gas.

NITROGEN MONOXIDE CONTENT: Gas analyser from ECO PHYSICS, Type CLD 700 El-ht; chemiluminescent measurement principle, samples taken via heated filter and heated pipe; gas cooler; measured in dry flue gas.

ELECTRICAL POWER CONSUMPTION Modular energy meter ULYS ETD from ENERDIS, three-phase 100-400 with a measurement accuracy for active energy corresponding to IEC 61036/EN61036 Cl.1. Maximum resolution of the pulse output: 0.1 Wh.

Power Analyzer Norma 4000 with 3 Power Phase PP40 and following specifications:
8 measuring ranges for voltage (0.3 / 1 / 3 / 10 / 100 / 300 / 1,000 V), 6 measuring ranges for current (30 – 100 mA – 0.3 – 1 – 3 -10 A). Basic accuracy amount to +/- 0.1 % of measured value and +/- 0.1 % of measuring range, sampling rate 341 kHz, bandwidth for voltage 3 MHz.

DATA LOGGING using TopMessage data logging system from Delphin Technologie AG, sampling interval 1 second, average value determined from 10 measurements, average data stored to media.

2.2 Performance of heating tests

HEAT OUTPUT: Measurements were carried out in accordance with ÖNORM EN 303-5:1999 at nominal and minimum heat output respectively (≤ 30 % of the nominal heat output). The nominal heat output measurements were performed after the burner had been operated for at least 3 hours in the nominal heat output range. The measurements themselves were taken over a test period of at least 6 hours. The efficiency was calculated by taking into account the heat stored in the boiler water.

EMISSIONS: Carbon dioxide, carbon monoxide, organic carbon and nitrogen oxide values were averaged over the whole test duration. When determining the dust content, the extraction time per filter was limited to 30 minutes. The dust content was determined from 6 half-hourly averages, evenly distributed over the test duration. Calibration gases were used to check the gas analysers before and after every test period.

SETTINGS: The declared measurements relate to reproducible tests using optimised settings. The settings were made during preliminary tests based on manufacturer recommendations. The aim was to maximise the carbon dioxide content whilst at the same time minimising the carbon monoxide content.

FUEL: The measurements were performed with wood pellets compliant to ÖNORM M 7135:2000, having a diameter of 6 mm and a water content of 7.9 % and 7.7 %. The water content, the ash content and gross calorific value were measured; the average values for the basic chemical data relating to the water and ash-free substances as well as the calorific value were taken from ÖNORM M 7132:1998.

FUNCTION CHECK of the temperature controller, safety temperature limiter and monitor as well as a functional check to verify the rapid shutdown of the burner system. The measurements were performed as specified in 5.13 and 5.14 of ÖNORM EN 303-5:1999.

2.3 Interpretation of emission measurements

The emission measurements were analysed by calculating the complete flue gas analysis using the carbon monoxide and carbon dioxide content averaged over the measurement period together with the fuel composition data. The speed of the flue gas at the measuring point was calculated from the flue gas volume and taking into account the pressure and temperature.

The organic gas substances content was measured in the damp flue gas; the emissions were then converted for dry flue gas conditions and declared as organic carbon. The nitrogen oxide content was measured in the dry flue gas and declared as NO_2.

2.4 Investigatory heating tests with wood pellets at nominal heat output

Number of test:	HKA_1453
Name of boiler:	Pellet burner PELLEMATIC PE64
Nominal heat output:	64 kW

		Minimum value	Average value	Maximum value
Test conditions				
Start of test:			2007-01-16 07:21	
End of test:			2007-01-16 13:21	
Test duration:			06:00	
Ambient temperature:	°C	19.9	20.4	21.8
Outside temperature:	°C	-1.0	1.0	3.4
Air pressure:	mbar		999	
Test fuel, heat input				
Test fuel	Wood pellets 07_0220			
Water content	kg/kg		0.079	
Ash content	kg/kg		0.010	
Carbon content	kg/kg		0.463	
Hydrogen content	kg/kg		0.056	
Oxygen content	kg/kg		0.392	
Calorific value of anhydrous and ash-free substance	MJ/kg		19.0	
Calorific value of test fuel	MJ/kg		17.1	
Applied fuel quantity	kg		90.3	
Hourly fuel quantity	kg/h		15.1	
Fuel heat input	kW		71.6	
Heat output, efficiency				
Water circulation	kg/h	2715.7	2742.9	2769.1
Flow temperature	°C	51.5	51.6	51.8
Return temperature	°C	71.1	72.6	74.2
Temperature difference	K	19.6	21.0	22.6
Heat output in the boiler circuit	kW		67.0	
Utilisation	%		104.6	
Boiler efficiency	%		93.6	
Measured values flue gas measuring section				
Flue gas temperature	°C	127.7	128.7	130.5
Manometric pressure (draught)	Pa	8.5	10.6	12.7
Carbon dioxide	%	12.5	14.1	15.5
Carbon monoxide	ppm	26.1	76.6	1192.6
Organic gaseous substances	ppm	0.6	1.0	11.1
Nitrogen monoxide	ppm	101.7	131.6	160.9

2.4.1 Emission measurements

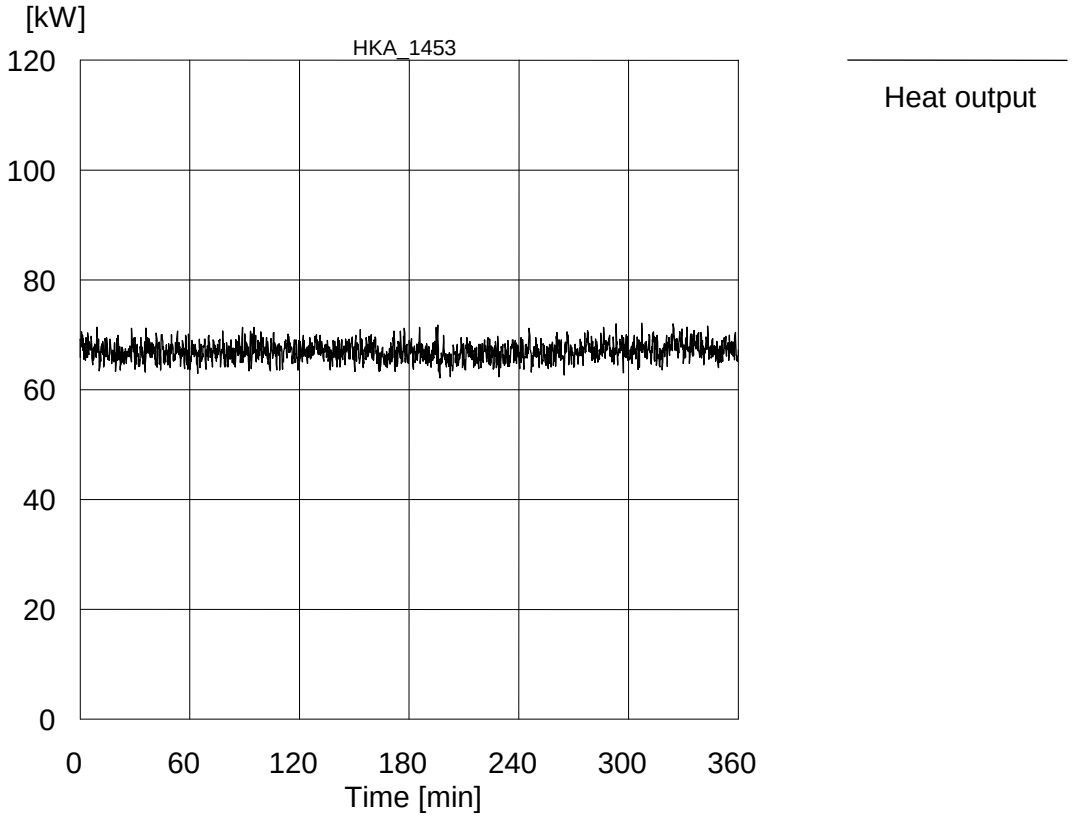
Measurement results test: HKA_1453
(Calculation depending on CO_2-measurement)

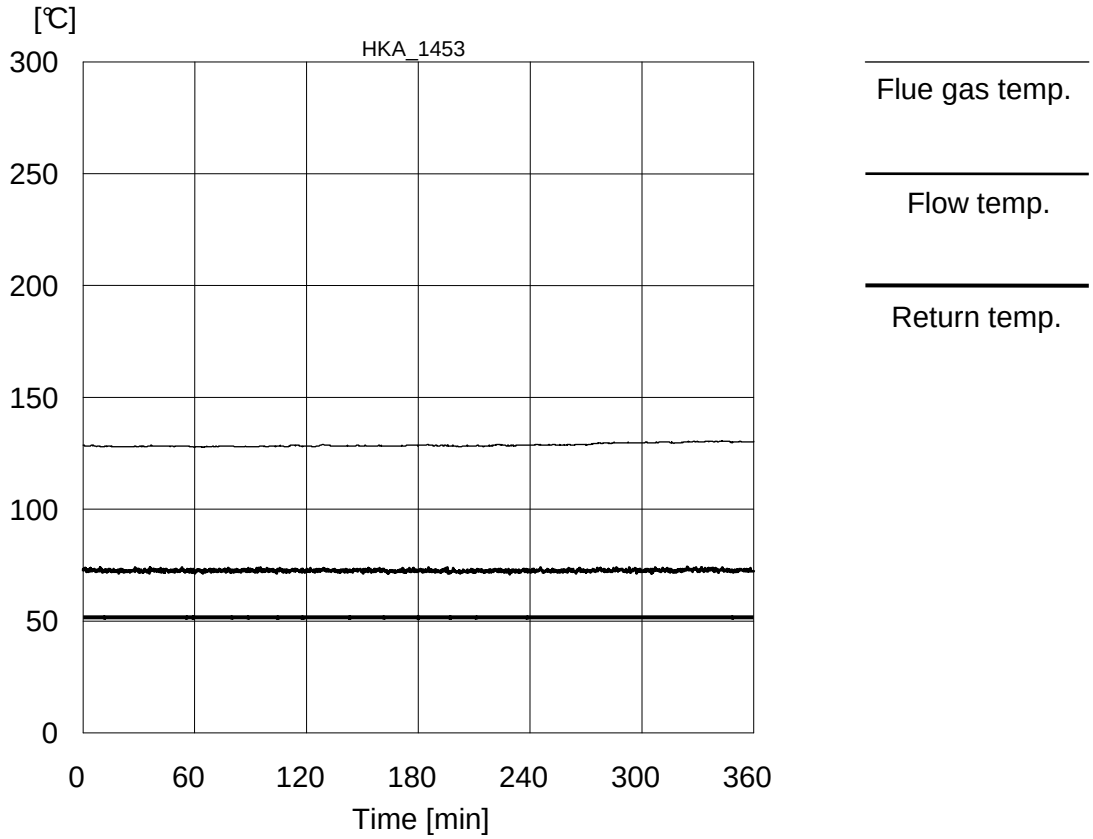
Suction start:	hh:mm	07:22	08:20	09:20	10:20	11:20	12:20
Suction period:	min	30	30	30	30	30	30
Suctioned gas sample:	m^3	0.421	0.481	0.450	0.480	0.442	0.460
Measured CO_2-content:	%	14.0	14.1	14.1	13.9	14.0	14.2
Calculated O_2-content:	%	6.4	6.4	6.3	6.5	6.4	6.2
Density of gas sample:							
Dry gas	kg/Nm^3	1.36	1.36	1.36	1.36	1.36	1.36
Humid gas	kg/Nm^3	1.30	1.30	1.30	1.30	1.30	1.30
Water content	g/Nm^3	84.8	84.9	85.3	84.3	84.8	85.7
Flue mass flow:							
Dry gas	kg/kg	8.4	8.4	8.3	8.4	8.4	8.3
Velocity:							
at sampling point	m/s	2.43	2.42	2.41	2.44	2.43	2.41
at probe head	m/s	1.82	2.06	1.95	2.08	1.90	1.98
Dust content:							
separated	mg	9.4	10.3	9.5	8.9	9.8	9.5
separated relating to sample volume	mg/Nm^3	27.1	26.3	25.4	22.4	27.0	25.2

2.4.2 Evaluation

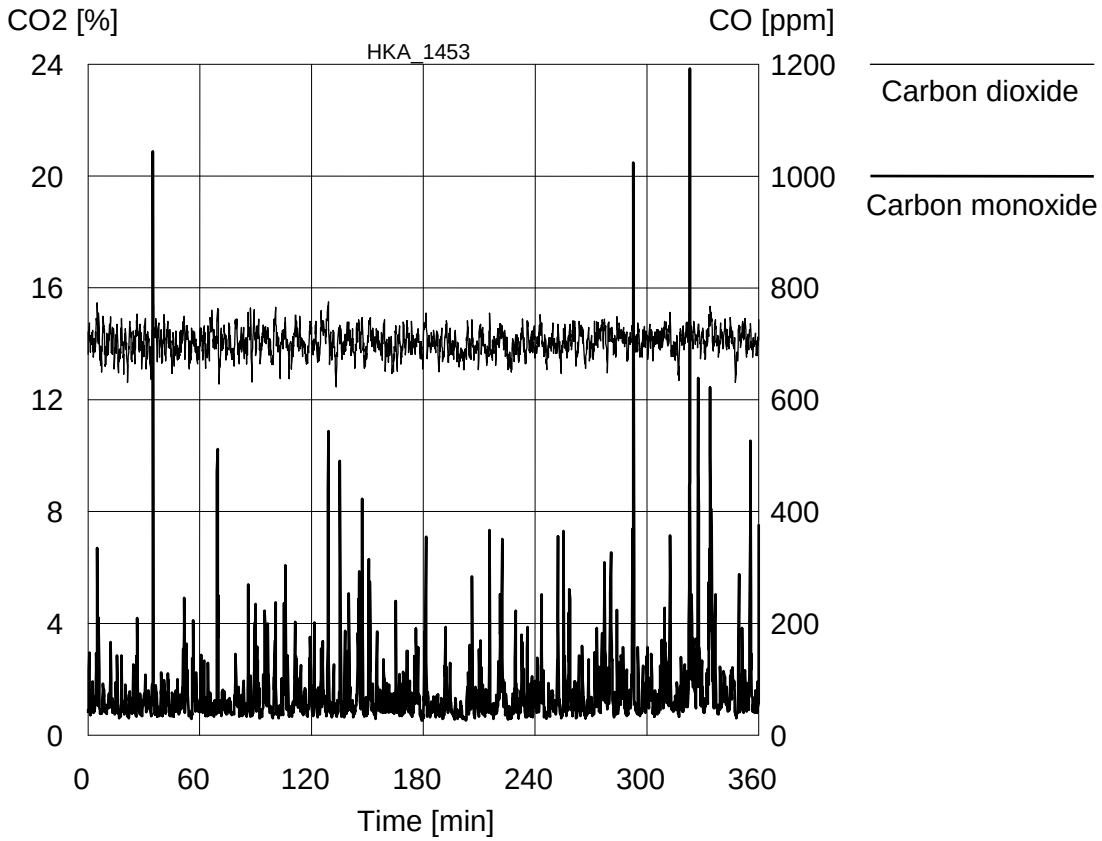
	relating to applied energy	relating to O_2-content of	
		10 %	13 %
	mg/MJ	mg/Nm^3	mg/Nm^3
Dust	9	19	14
Carbon monoxide (CO)	34	72	52
Organic gaseous substances(OGC)	<1	1	1
Nitrogen oxides (NO_x)	97	204	148

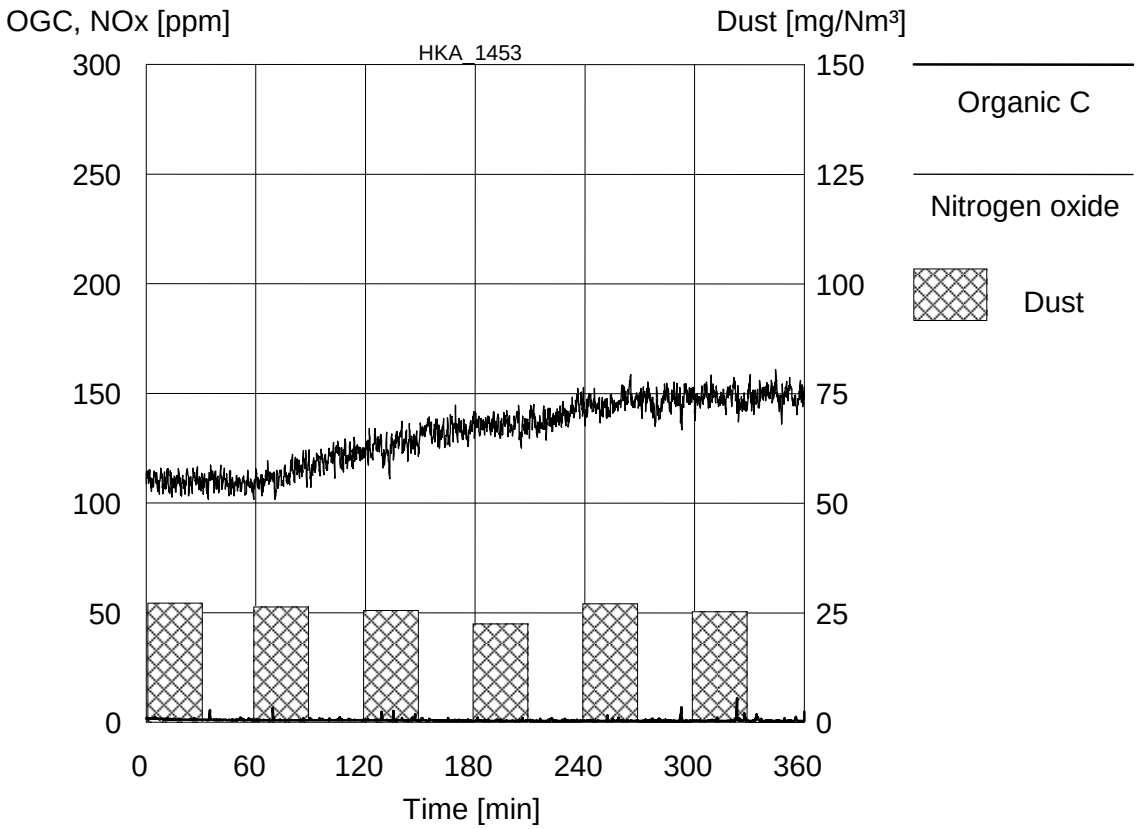
2.4.3 Output-related measurements





2.4.4 Flue gas composition





2.5 Investigatory heating tests with wood pellets at minimum heat output

Number of test:	HKA_1454			
Name of boiler:	Pellet burner PELLEMATIC PE64			
Nominal heat output:	64 kW			
		Minimum value	Average value	Maximum value
Test conditions				
Start of test:			2007-01-17 08:55	
End of test:			2007-01-17 14:56	
Test duration:			06:01	
Ambient temperature:	°C	20.0	20.2	21.1
Outside temperature:	°C	1.8	4.9	6.8
Air pressure:	mbar		998	
Test fuel, heat input				
Test fuel	Wood pellets 07_0220			
Water content	kg/kg		0.077	
Ash content	kg/kg		0.010	
Carbon content	kg/kg		0.464	
Hydrogen content	kg/kg		0.057	
Oxygen content	kg/kg		0.392	
Calorific value of anhydrous and ash-free substance	MJ/kg		19.0	
Calorific value of fuel	MJ/kg		17.2	
Applied fuel quantity	kg		25.6	
Hourly fuel quantity	kg/h		4.3	
Fuel heat input	kW		20.2	
Heat output, efficiency				
Water circulation	kg/h	809.0	814.3	820.4
Flow temperature	°C	52.2	52.2	52.3
Return temperature	°C	71.1	71.7	72.6
Temperature difference	K	18.9	19.5	20.3
Heat output in the boiler circuit	kW		18.5	
Utilisation	%		28.9	
Boiler efficiency	%		91.2	
Measured values flue gas measuring section				
Flue gas temperature	°C	83.1	83.6	84.2
Manometric pressure (draught)	Pa	6.4	7.9	11.0
Carbon dioxide	%	5.5	6.5	7.6
Carbon monoxide	ppm	40.7	93.2	183.6
Organic gaseous substances	ppm	0.6	0.9	1.3
Nitrogen monoxide	ppm	39.1	48.0	61.3

2.5.1 Emission measurements

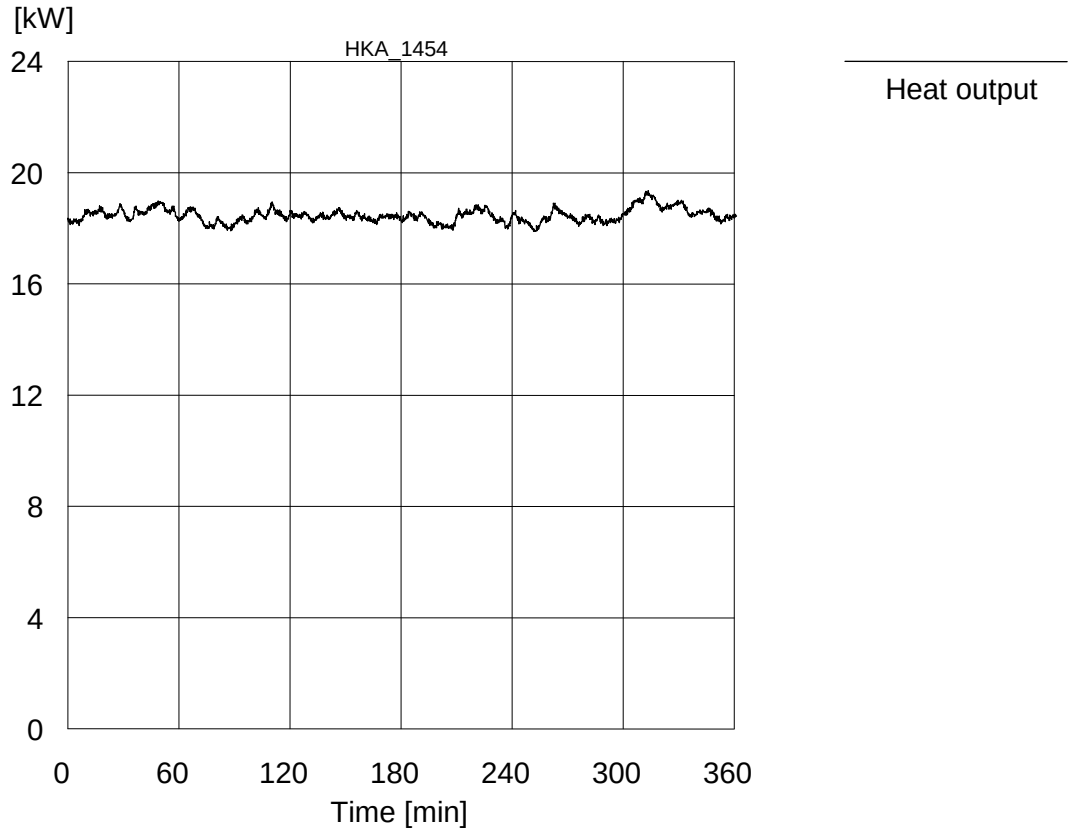
Measurement results test: HKA_1454
(Calculation depending on CO_2-measurement)

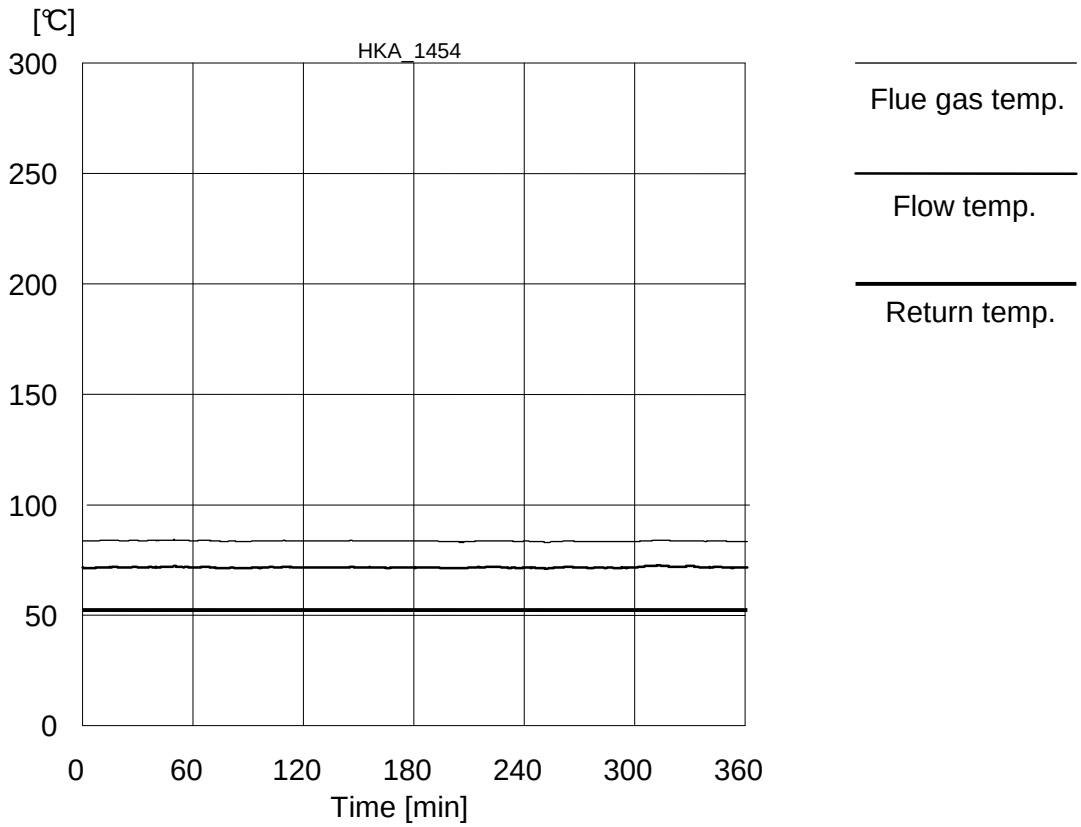
Suction start:	hh:mm	08:56	09:55	10:55	11:55	12:55	13:55
Suction period:	min	30	30	30	30	35	30
Suctioned gas sample:	m^3	0.423	0.455	0.437	0.458	0.588	0.464
Measured CO_2-content:	%	6.4	6.3	6.4	6.4	6.4	6.7
Calculated O_2-content:	%	14.3	14.4	14.3	14.3	14.3	14.0
Density of Gas sample:							
Dry gas	kg/Nm^3	1.32	1.32	1.32	1.32	1.32	1.32
Humid gas	kg/Nm^3	1.29	1.29	1.29	1.29	1.29	1.29
Water content	g/Nm^3	41.1	40.6	41.1	41.0	41.1	43.0
Flue mass flow:							
Dry gas	kg/kg	17.7	18.0	17.8	17.8	17.8	17.0
Velocity:							
at sampling point	m/s	1.26	1.27	1.26	1.26	1.26	1.20
at probe head	m/s	0.78	0.84	0.81	0.85	0.92	0.85
Dust content:							
separated	mg	10.4	5.2	6.0	2.7	5.6	4.7
separated relating to sample volume	mg/Nm^3	29.9	14.0	16.5	7.2	11.7	12.3

2.5.2 Evaluation

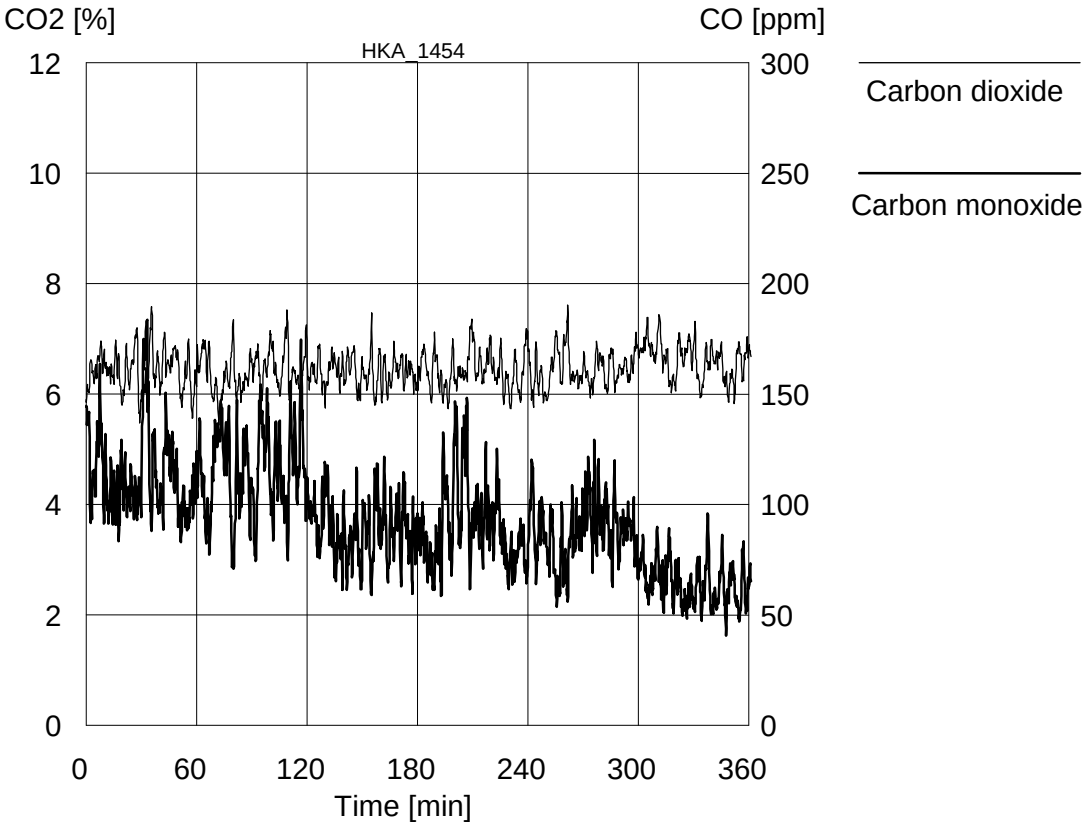
	relating to applied energy	relating to O_2-content of	
		10 %	13 %
	mg/MJ	mg/Nm^3	mg/Nm^3
Dust	12	25	18
Carbon monoxide (CO)	91	191	139
Organic gaseous substances (OGC)	1	2	2
Nitrogen oxides (NO_x)	78	163	119

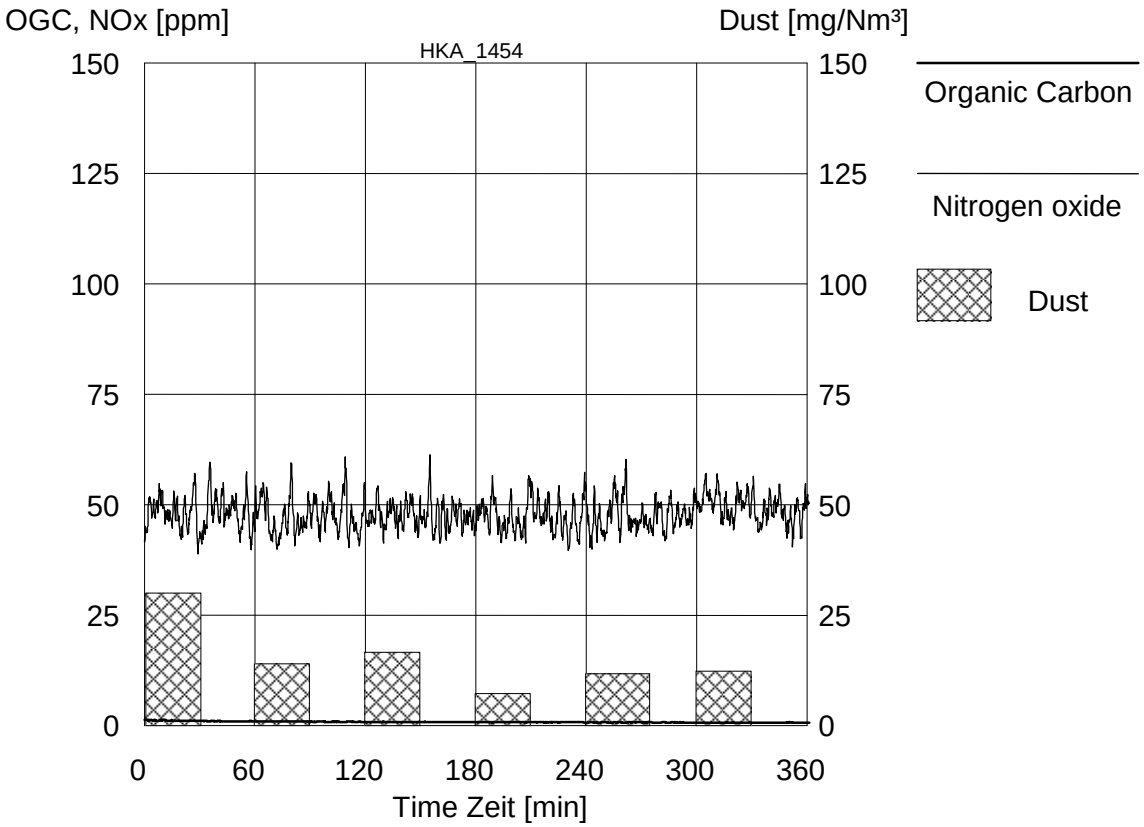
2.5.3 Output-related measurements





2.5.4 Flue gas composition





2.6 Surface losses

The heat loss through the boiler surface is determined using DIN 4702-2:1990 based on radiation coefficients and arrangements of technical surfaces (according to Nusselt). Temperatures were measured at 53 points on the boiler surface during the test at nominal heat output. The measurement results are shown in the following table and the table of measurements in appendix 5.2:

Parameter	Value	Unit
Test number	HKA_1453	
Ambient temperature	20	℃
Flow temperature	73	℃
Flue gas temperature	127	℃
Heat output in the boiler circuit	67.0	kW
Radiation losses from boiler	0.30	kW
Percentage loss at nominal heat output	0.5	%

The surface temperature of the handle on the combustion chamber/ash door is 4 K above the ambient temperature.

2.7 Water-side resistance of boiler

The water-side resistance was determined for the flow rates at nominal heat output which occurred at temperature differences of 10 K and 20 K.

Flow rate	Temperature difference	Water temperature	Differential pressure
[kg/h]	[K]	[℃]	[mbar]
2740	20	22.2	18.4
5490	10	20.5	69.0

2.8 Electrical power consumption

2.8.1 Average electrical power consumption at nominal heat output, minimum heat output, during standby position and ignition

Operating status	Fuel	Meas. duration	Electrical energy	Average electrical power consumption	Percentage of nominal heat output
		[min]	[Wh]	[W]	[%]
Nominal heat output	Wood pellets	360	1284	214	0.3
Minimum heat output		361	444	74	0.1
Standby position		60	4.8	4.8	
Ignition procedure		31	155	300	

2.8.2 Electrical power consumption of main loads

Load	Power [W]
Drive motor – stoker screw	101
Drive motor – extraction screw	54
Induced draught fan	48
Combustion fan (primary/secondary air)	71
Ignition rod	263
Heat exchanger cleaning motor	48

Remark: Single components were measured including control circuit.

3 SUMMARY OF RESULTS

3.1 Heating tests

The PELLEMATIC PE64 pellet burner from ÖkoFEN Forschungs- und Entwicklungs Ges.m.b.H. with a nominal heat output of 64.0 kW, was tested in the power range 18.5 kW – 67.0 kW using wood pellets compliant to ÖNORM M 7135:2000 having a diameter of 6 mm and a water content of 7.9 % and 7.7 %.

Since the boiler flue gas temperature is less than 160 K above room temperature at nominal heat output, the boiler manufacturer shall make recommendations, in accordance with ÖNORM EN 303-5:1999, regarding the flue installation in order to ensure sufficient draught and to prevent sooting up of the chimney and condensation.

The results of the emission measurements are as follows:

		Nominal heat output			Minimum heat output:		
Test fuel	[-]	**Wood pellets**					
Water content	[%]	7.9			7.7		
Heat output	[kW]	67.0			18.5		
Fuel heat input	[kW]	71.6			20.2		
Flue mass flow	[kg/h]	134.4			77.5		
Load	[%]	104.6			28.9		
Flue gas temperature	[℃]	128.7			83.6		
Boiler efficiency	[%]	93.6			91.2		
Carbon dioxide	[%]	14.1			6.5		
		[mg/MJ] 1)	[mg/m^3] 2)	[mg/m^3] 3)	**[mg/MJ] 1)**	[mg/m^3] 2)	[mg/m^3] 3)
Dust		**9**	19	14	**12**	25	18
Carbon monoxide		**34**	72	52	**91**	191	139
Organic carbon		**<1**	1	1	**1**	2	2
Nitrogen oxides		**97**	204	148	**78**	163	119

1) Emission values in mg/MJ (relating to the applied energy), subject to legal requirements in Austria.
2) Emission values in mg/m^3 (relating to 10 % O_2, 1013 mbar, dry flue gas), corresponding to ÖNORM EN 303-5:1999.
3) Emission values in mg/m^3 (relating to 13 % O_2, 1013 mbar, dry flue gas), corresponding to various domestic and international requirements.

3.2 Function check of the temperature controller / safety temperature limiter on the boiler

The functional check of the temperature controller and safety temperature limiter and monitor on the boiler was performed in accordance with section 5.13 of ÖNORM EN 303-5. The requirements were fulfilled.

3.3 Function check to verify the rapid shutdown of the burner system

Since the tested PELLEMATIC PE64 pellet burner from ÖkoFEN Forschungs- und Entwicklungs Ges.m.b.H. is not equipped with a device to dissipate the residual heat as described in section 4.1.5.11.3 of ÖNORM EN 303-5, the operating and fault conditions associated with a power outage and sudden loss of heat extraction were simulated to satisfy the definition of a burner system with a rapid shutdown facility.

No dangerous operating conditions arose with either the water system or the burner during the course of the checks on the temperature controller, safety temperature limiter and rapid shutdown facility.

4 ASSESSMENT

Based on the test results, one can hereby confirm that the

Pellet burner PELLEMATIC PE64
from
ÖkoFEN Forschungs- und Entwicklungs Ges.m.b.H.,

fulfils the requirements governed by the agreements in Art. 15 a BV-G relating to **"Protective measures for small burners"** (1998) and **"Saving energy"** (1995).

For the
factual correctness:

Amtsdirektor Dipl.-HLFL-Ing.
Leopold Lasselsberger m.p.

For the
report and tests:

Ing.
Harald Baumgartner m.p.

Head of the
accredited test centre:

Hofrat Dipl.-Ing. Dr.
Johann Schrottmaier m.p.

Wieselburg, 27/04/05

5 APPENDIX

5.1 Legal requirements (for information only)

Legal requirements relating to small burner systems for biogenous fuels in Austria

Agreement according to Art. 15 a B-VG concerning an amendment to the agreement according to Art. 15 a B-VG relating to protective measures for small burners (1998)

Small solid fuel burners should not exceed the following emission limits:

Solid fuel burners		Emission limits [mg/MJ]			
		CO	NO_x	OGC	Dust
Manually loaded	Biogenous fuels	1100	150*)	80	60
	Fossil fuels	1100	100	80	60
Automatically loaded	Biogenous fuels	500**)	150*)	40	60
	Fossil fuels	500	100	40	40

*) The NOx limit only applies to wood burners.
**) This limit value can be exceeded by 50 % during partial load operation at 30 % of nominal output.

Energy saving agreement according to Art. 15 a B-VG

The efficiency of small solid fuel burners should not fall below the following values:

Small burners used for solid fuel central heating:	
Manually loaded	
up to 10 kW	73 %
> 10 to 200 kW	(65.3 + 7.7 log Pn) %
> 200 kW	83 %
Automatically loaded	
up to 10 kW	76 %
> 10 to 200 kW	(68.3 + 7.7 log Pn) %
> 200 kW	86 %

These federal requirements are implemented in local state law.

5.2 Surface temperature measurement points

KESSELFABRIKAT: ÖkoFEN KESSELTYPE: Pelletsfeuerung PELLEMATIC PE 64

MESSPUNKT BEZ.	POSITIONSBESCHREIBUNG DES BEDIENUNGSGRIFFES	MATERIAL (ME / PO / KU)	TEMP. [°C]	MESSPUNKT BEZ.	POSITIONSBESCHREIBUNG DES BEDIENUNGSGRIFFES	MATERIAL (ME / PO / KU)	TEMP. [°C]
Z1	Griff - Aschentür	ME	23,5	Z3			
Z2				Z4			

MESS NR.	MESS FLÄCHE	TEMP. [°C]	MESS NR.	MESS FLÄCHE	TEMP. [°C]	MESS. NR.	MESS FLÄCHE	TEMP. [°C]	MESS NR.	MESS FLÄCH E	TEMP. [°C]	MESS NR.	MESS FLÄCHE	TEMP. [°C]	MESS NR.	MESS FLÄCHE	TEMP. [°C]
1	A1	23,6	21	E1	23,1	41	I 1	25,0	61	M1	30,0	61	Q1		61	U1	
2	A2	24,2	22	E2	21,5	42	I 2	23,5	62	M2		62	Q2		62	U2	
3	A3	23,6	23	E3	20,5	43	I 3	23,0	63	M3		63	Q3		63	U3	
4	A4	23,6	24	E4		44	I 4		64	M4		64	Q4		64	U4	
5	A5	23,7	25	E5		45	I 5		65	M5		65	Q5		65	U5	
	Mittelwert	**23,7**		Mittelwert	**21,7**		Mittelwert	**23,8**		Mittelwert	**30,0**		Mittelwert			Mittelwert	
6	B1	25,0	26	F1	22,9	46	J1	34,3	66	N1		66	R1		66	V1	
7	B2	26,4	27	F2	22,9	47	J2	30,9	67	N2		67	R2		67	V2	
8	B3	24,8	28	F3	21,3	48	J3	23,1	68	N3		68	R3		68	V3	
9	B4	24,7	29	F4	21,2	49	J4	22,4	69	N4		69	R4		69	V4	
10	B5	25,6	30	F5	20,5	50	J5	21,7	70	N5		70	R5		70	V5	
	Mittelwert	**25,3**		Mittelwert	**21,8**		Mittelwert	**26,5**		Mittelwert			Mittelwert			Mittelwert	
11	C1	27,8	31	G1	22,8	51	K1	25,1	71	O1		71	S1		71	W1	
12	C2	29,1	32	G2	22,0	52	K2	24,5	72	O2		72	S2		72	W2	
13	C3	23,5	33	G3	21,0	53	K3	26,0	73	O3		73	S3		73	W3	
14	C4	23,9	34	G4		54	K4	28,6	74	O4		74	S4		74	W4	
15	C5	26,4	35	G5		55	K5	27,5	75	O5		75	S5		75	W5	
	Mittelwert	**26,1**		Mittelwert	**21,9**		Mittelwert	**26,3**		Mittelwert			Mittelwert			Mittelwert	
16	D1	24,3	36	H1	23,2	56	L1	29,9	76	P1		76	T1		76	X1	
17	D2	24,7	37	H2	23,6	57	L2	34,5	77	P2		77	T2		77	X2	
18	D3	24,7	38	H3	24,1	58	L3	36,4	78	P3		78	T3		78	X3	
19	D4	23,5	39	H4		59	L4	35,0	79	P4		79	T4		79	X4	
20	D5	23,5	40	H5		60	L5	36,7	80	P5		80	T5		80	X5	
	Mittelwert	**24,1**		Mittelwert	**23,6**		Mittelwert	**34,5**		Mittelwert			Mittelwert			Mittelwert	

L1...L5 Floor area