Datum:2008 Juli

DIN xxxx

Energieverbrauchsmessungen für Heißluftgeräte und Heißluftdämpfer

Measurement of energy consumption for convectional ovens

Élément introductif — Élément central — Élément complémentaire

Vorgesehen als Ersatz für
DIN 9999-9:YYYY-MM

Dokument-Typ: 183BNorm
Dokument-Untertyp:
Dokumentstufe: 189BVorlage
Dokumentsprache: D

W:\Upphandling\Kriterier\Energi\Storkök\Kriteriedokument\BK\erik_kommer att flyttas\msr_storkok_Bilaga4_Standard_ugnar_FNH_2009.doc 222BSTD Version 2.2

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Vorwort

Beginn der Gültigkeit

Diese Norm gilt ab [Datum].

Dieses Dokument enthält

Der FNH –Arbeitsausschuss "Großküchengeräte" hat im Rahmen seiner Normungarbeiten, durch die alle wesentlichen Großküchengeräte erfasst sind, das vorliegende Dokument erarbeitet.

Dieses Dokument beinhaltet Festlegungen zu Methodik von Energieverbrauchsmessungen von convectional ovens, die dem heutigen Stand der Technik entsprechen.

1 Scope

This standard applies to convectional ovens in commercial kitchens and other food processing facilities, which are intended for commercial use in type and construction. It does not apply to household appliances.

This standard defines requirements to the measurement of energy- and water consumption as well as sensible and latent heat emission.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

DIN 18866:2002, *Equipment for commercial kitchens - Convection ovens and convection steamers - Requirements and testing*

EN 15181:2007, *Measuring method of the energy consumption of gas fired ovens*

EN 50304/EN 60350:2007, *Electric cooking ranges, hobs, ovens and grills for household use - Methods for measuring performance*

DIN 66075-7:1977, *Catering equipment; openings for insertion elements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in clause 3 of DIN 18866:2002 apply. In addition the following apply

3.1 Sensible Heat

3.2 Latent Heat

To be extended

4 List of measurements

4.1 Heating-up time

Measurement of Heating- up time (6)

4.2 Energy- and water consumption in an empty appliance

Measurement of energy- and water consumption in an empty appliance (sensible heat emission) (6.3)

4.3 Energy- und water consumption with a loaded appliance in dry-heat mode

Measurement of energy- und water consumption with a loaded appliance in dry-heat mode (7)

4.4 Energy- und water consumption with a loaded appliance in steam mode

Measurement of energy- und water consumption with a loaded appliance in steam mode (8)

5 General conditions for measurements

5.1 General

According to good laboratory practice, before installation, it shall be checked that the appliance is free from any damage.
For the measuring system of the temperature an accuracy of ± 2,5 K has to be given.

The manufacturer's instructions regarding installation of the oven shall be followed.

Unless otherwise specified, measurements are conducted under the following conditions:

5.2 Ambient temperature

The tests are carried out in a substantially draught-free room in which the ambient temperature is maintained at (23 + 2) °C during the complete test.

NOTE A change in the ambient temperature of the room during the test could affect the results. Care should be taken during the conduct of the test to ensure that the ambient temperature is as steady as possible.

5.3 Electrical supply

The supply voltage shall be maintained at 230 ± 5 V. The supply frequency shall be at 50Hz ± 1.

5.4 Water supply

The static water supply pressure in the water supply shall be 3 bar (± 0,3 bar).

The water supply temperature shall not exceed 23 °C.

5.5 Test gases and test pressures

The appliance is supplied with G 20, with a composition of at least 95% methane, at normal pressure.
If the appliance is not designed to use G20 as a reference gas, the appliance is supplied at the normal pressure with one of the reference gases corresponding to its category.

5.6 Instrumentation

The used instrumentation has to be able to measure to the following parameters with the stated accuracy:

The auxiliary electrical energy shall be accurate to + 1.5% or + 10 W, whatever is greater (highest).

The measurement of the voltage shall be accurate to ± 0,5 %.

The measurement of the frequency shall be accurate to ± 0,5 %.

The measurements of mass shall be accurate to ± 3 g.

The measurements of time shall be accurate to ± 5 s.

Information on water- and gas pressure has to be added.

6 Measurement of heating-up phase

6.1 General

The empty appliance is in a non-operative mode. The appliance temperature is (23 ± 2) °C. The test is carried out in the dry-heat mode with default setting.

6.2 Heating-up time

The empty appliance is in a non-operative mode. In the appliance is a chrome-nickel-steel grid (1/1 GN) in the middle rack rail (middle of cooking chamber).

The appliance temperature is (23 ± 2) °C.

The tests are carried out in dry-heat mode with default setting without demist.

For measuring the temperature an external instrument (Ni-Cr/Ni 0,3 mm Thermocouple) is used. The pilot is positioned in the centre of the inserted grid.

The heating-up time is measured from the start-up of the empty appliance in non-operative mode till a temperature difference of + 130 K, which equals the temperature of the cooking chamber in non-operative mode + 130 K.

6.3 Operation of empty appliance

Subsequent to 6.2 the empty appliance with the chrome-nickel-steel grid (1/1 GN) in the middle of the cooking chamber is heated up to (160 ± 4) °C and held at this temperature for one hour. Following the appliance is held at (160 ± 4) °C for an additional hour. The temperature has to be measured in the geometric middle of the cooking chamber (not at the display panel) and has to be adjusted if necessary.

The energy consumption in the second hour is measured to establish the sensible heat loss of the appliance.

7 Energy- und water consumption under load in dry-heat mode

7.1 General

The measurements are carried out subsequently to 6.3 in the warm appliance at (160 ± 4) °C in dry-heat mode without demist.

Measurements are done with a external measuring instrument.

7.2 Dry-heat mode

The appliance is loaded with wet Hipor-Stones.

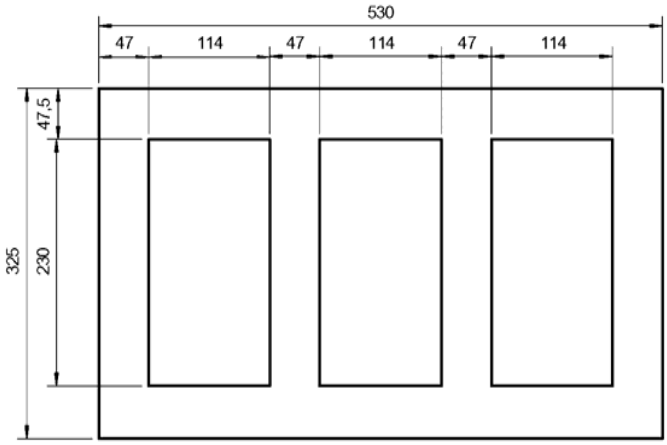
Supplier: Skamol Europe GmbH

Promenadenstr 1
D-41460 Neuss
www.skamol.com

The Stones have a dimension of 230 x 114 x 64 mm at 920g ± 75g dry weight. Before the test, the stones are soaked with cold water (Temperatur 15-20 °C). They are watered until no air bubbles leak out of the stones anymore. The water capacity constitutes ca. 1000g per Stein.

The load constitutes 6 kg per 1/1 GN grid. The total weight of the stones should be 6kg x # of used rack rails. Only every second rack rail is used. The tolerance of the total amout of Hipor-Stones is ± 1 kg. If this tolerance is exceeded or undercut, one Stone (or respectively ½ stone) has to be taken out or added to the top or bottom rack rail.

Test arrangement of HIPOR- Stones



Anordnung der HIPOR Steine
auf einem GN 1/1 Rost

The central stone in the middle rack rail is fitted with thermostat probe in the geometric centre of the stone. The hole for the thermostat probe is drilled in the middle of the biggest plane of the stone to a depth of 32mm ± 2mm. Thermocouple wires are favoured to avoid heat input through the wires. The whole is closed with silicon, the junction between stone and the probe has to be sealed. As silicon has a lower heat conductivity than the wet stone, the risk of a measuring error through heat input through the sealed of whole can be excluded.

The heating up time is measured from when the stones reach a temperature of (23°C ±2K) until a temperature difference of + 60 K has been reached. The maximal end temperature shall not exceed 85 °C.

In this time:

— time until temperature difference is reached in minutes;

— energy-consumption in kWh;

— water consumption in Litre;

— weight difference of the stone (start wet/ end dry) in kg

are measured

The temperature of the wastewater shall not exceed 80°C and has to be measured in a fore filled siphon with a minimum clearance of 0,5 m from the appliance.

NOTE If the grid has a differing weight (delta m) the difference in absorbed energy is measured under consideration of weight difference, heat capacity of stainless steel (0,47kJ/kgK) and the temperature difference. The energy-difference has to be added or sub ducted form the measured energy consumption. The influence on the total amount of energy consumption is calculated in accordance to formula 1.

Fomel 1

deltaQRost=deltam*c*deltaT

Q= Qtotal + deltaQgrid

Deltam= mass difference of grid from 1,2 kg

deltaQgrid= difference of absorbed energy compared to grid of 1,2 kg

Qtotal= measured total energy consumption

C= specific heat capacity

DeltaT= Difference of Temperature during heating-up phase

8 Energy- und water consumption under load in steam mode

8.1 General

The test is carried out after at least 1 hour cool down time while the appliance is open after Test 7.2 or with a cold appliance.

8.2 Heating-up and energy consumption in an empty appliance

The test consists of 10 minutes heating-up time in steam mode (respectively 100% moisture) und 99°C. The energy consumption is measured in this time.

If a steam generator exists, the energy consumption of one heating up of the steam producer has to be measured and added to the energy consumption of the appliance.

8.3 Steaming under load

The appliance is loaded with a GN 1/1 container without a lid of 60 mm depth. The weight of the container should be 1,3 kg. The container is filled with 3 litre of water (GN 2/3 containers with 2l). The water temperature is (23 ± 2) °C.

NOTE If the grid has a differing weight (delta m) the difference in absorbed energy is measured under consideration of weight difference, heat capacity of stainless steel (0,47kJ/kgK) and the temperature difference. The energy-difference has to be added or sub ducted form the measured energy consumption. The influence on the total amount of energy consumption is calculated in accordance to formula 1.

NOTE Number of containers: The appliances are loaded according to the rating with GN containers, even if the cooking chamber capacity might be higher (e.g. 10 x 1/1 appliances with 10 containers and 12 x 2/1 appliances with 24 containers). Regarding the relevant appliance size, the suiting GN-container is used.

The middle container is fit up with an external temperature probe in the centre of the container. The sensor has to be completely covered in water and shall not touch the bottom of the container.

The appliance is run in the steam mode (respectively 100% moisture) and 99°C. The heating up time is measured from reaching water temperature a temperature of (23°C ±2K) until a temperature difference of + 60 K has been reached. The maximal end temperature shall not exceed 85 °C.

In this time

— time until temperature difference is reached in minutes;

— energy-consumption in kWh;

— water consumption in Litre;;

are measured.

The temperature of the wastewater shall not exceed 80°C and has to be measured in a fore filled siphon with a minimum clearance of 0,5 m from the appliance.

Anhang A

Method to measure the latent heat output

The empty appliance is heated up to 180°C and is loaded afterwards.

The appliance is loaded with fresh chicken legs (4 - 8 °C). The load constitutes of 2 kg per 1/1 GN grid. The total weight is:

2 kg x # of rack rails

Every rack rail is used. The tolerance is ± 300 g of the total weight of the load. If this tolerance is exceeded or undercut, one chicken leg has to be taken out or added to the top or bottom rack rail.

The loaded appliance is run for 15 minutes at 180 °C without demist and additional 15 minutes at 180°C dry-heat mode with (60% +/- 10) demist or an equal operation mode.

In this time

- energy-consumption in kWh;
- water consumption in Litre;
- amount of condensate on litres temperature in °C;
- weight loss of chicken legs.

are measured.

The generated condensate is collected with the condensation pipe (see picture 1) and the amount of condensate is measured. The temperature of condensate shall not exceed 30°C. The latent heat can be measured with the following formula:

Qlat = mcond * 2258,19 kJ/kg * (h/3600)

Qlat = latent heat output in kWh

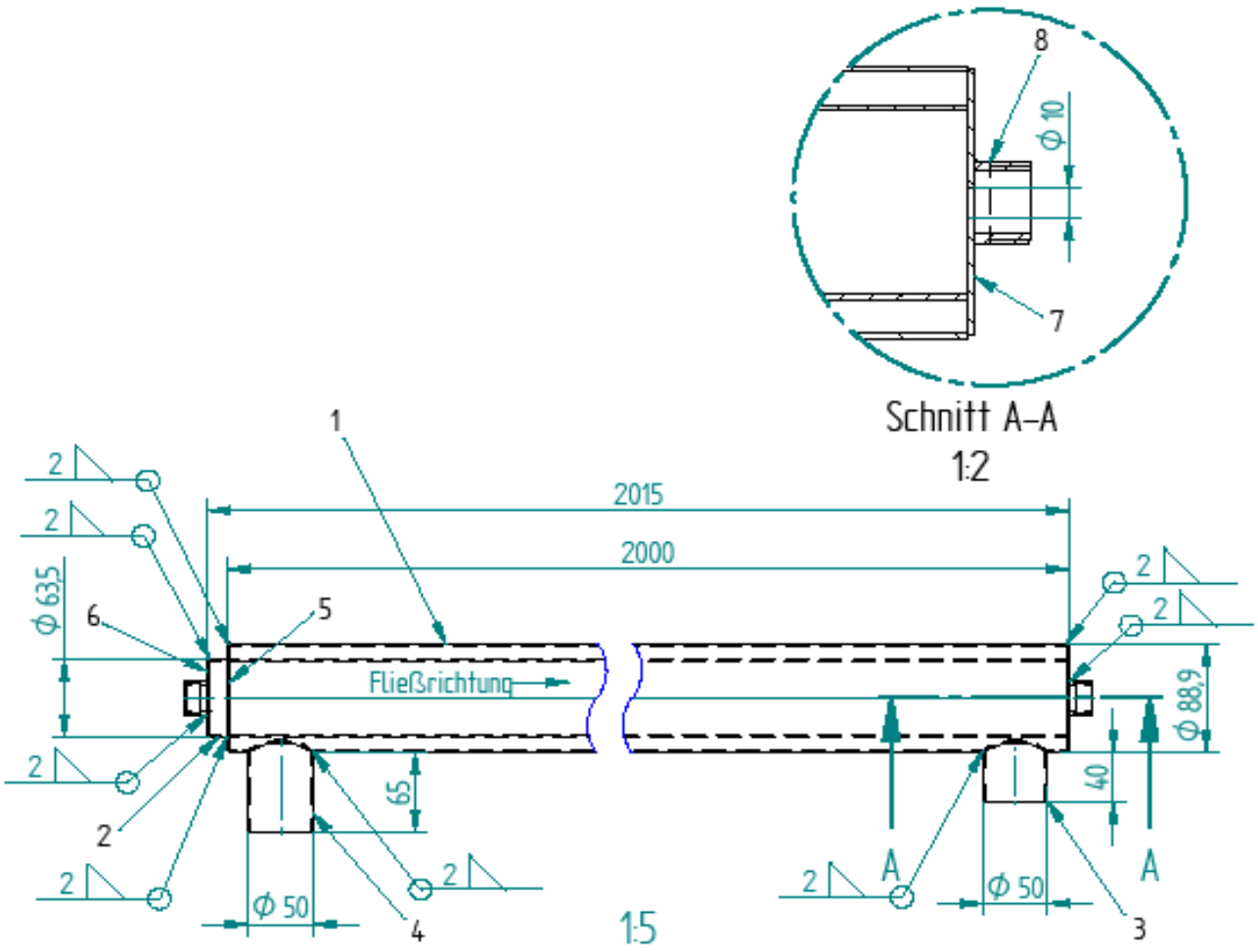
2258,19 kJ/kg = condensation enthalpy

Mcond= mass of condensate in kg

Vst= Volume of steam

Vwa= Volume of water

Vst= Vwa * 1694,3



Pos	Benennung	Material	Anzahl
1	Rohr Ø 88,9x2 1996 mm lang	1,4301	1
2	Rohr Ø 63,5x2 2011mm lang	1,4301	1
3	Rohr Ø 50x2 49 mm lang	1,4301	1
4	Rohr Ø 50x2 74 mm lang	1,4301	1
5	Deckel Ø86,9xØ63,6x2	1,4301	1
6	Deckel Ø61,5xØ22x2	1,4301	1
7	Deckel Ø86,9xØ10x2	1,4301	1
8	Gewindeflansch 3/4" (Wasseranschluß)	1,4301	2

Dimensioning of condensation pipe

Bibliography