

**Test results 31.08.2001**

## **Comparison of 14 professional refrigerators and freezers**

### **Refrigerators:**

- Alpeninos EO6NOD1C
- Foster PREM G600H
- Gram K 600 OPCHHA
- Polaris STN 70 STD
- Porkka Future Plus C 732
- Porkka Future Plus M 732
- Porkka Future C 730
- Porkka Future Plus C 722

### **Freezers:**

- Alpeninos EO6COD1C
- Foster PREM G 600L
- Gram F 600 OPCHHA
- Polaris SA BT 70
- Porkka Future Plus F 732
- Porkka Future Plus F 730



## TEST REPORT

### ORDER

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**Purpose:** The purpose of the test was to compare the energy consumption, volumes and noise of eight refrigerators and six freezers for professional use.

### TEST OBJECTS

Porkka Finland Oy ordered the appliances from the manufacturers. The appliances were delivered directly from the production lines.

#### Refrigerators

Technical information of the refrigerators informed by the manufacturer's (rating plates).

Brand	Model	Serial number	Power	Temperature range	Refrigerant
Alpeninos	EO6NOD1C	03600017 PNC 9733728070 03	375 W	-4°C...+8°C	R 134 a 240 g
Foster	PREM G600H	E 5064840	349 W	±0°C...+8°C	R 134 a 350 g Insulation gas HCFC 141 b
Gram	K 600 OPCHHA	Part no 125-0511 Serie no 61/12	423 W	-5°C...+12°C	R 134 a 230 g
Polaris	STN 70 STD	0083005	323 W	±0°C...+10°C	R 134 a 360 g
Porkka	Future Plus C 732	Type 9011193 No 200107-104384.001	334 W	+1°C...+12°C	R 134 a 375 g
Porkka	Future Plus M 732	Type 9011207 No 200107-104385.001	396 W	-5°C...+12°C	R 134 a 240 g
Porkka	Future Plus C 730	Type FUO730C- SS1RS1P No 200124-107750.001	334 W	-1°C...+12°C	R 134 a 375 g
Porkka	Future C 722	Type FUO722C- WS2RS1P No 200116-106138.001	334 W	+1°C...+12°C	R 134 a 375 g



## Freezers

Technical information of the freezers informed by the manufacturer's (rating plates).

Brand	Model	Serial number	Power	Temperature range	Refrigerant
Alpeninos	EO6COD1C	04200008 PNC 9733728079 04	610 W	-15°C...-24°	R 404 a 270 g
Foster	PREM G600L	E 5064853	709 W	-15°C...-25°C	R 404 a 420 g Insulation gas HCFC 141 b
Gram	F 600 OPCHHA	Part no 125-0519 Serie no 61/12 Prod.no 014734	666 W	-5°C...-25°C	R 404 a 300 g
Polaris	SA BT 70	0078826	355 W	-18°C...-21°C	R 404 a 290 g
Porkka	Future Plus F 732	Type 9011196 No 200107-104508.001	560 W	-18°C...-26°C	R 404 a 350 g
Porkka	Future Plus F 730	Type FUO730F- SS1RS1P No 200127-107751.001	560 W	-15°C...-26°C	R 404 a 350 g

## THE CONTENTS OF THE TEST AND THE TESTING PERIOD

The test consisted of measurements of the storage temperatures and energy consumption under the conditions specified in the relevant standards. The noises of the appliances were measured as noise pressure level. Laboratory Checklist and the test details are given in annex 1.

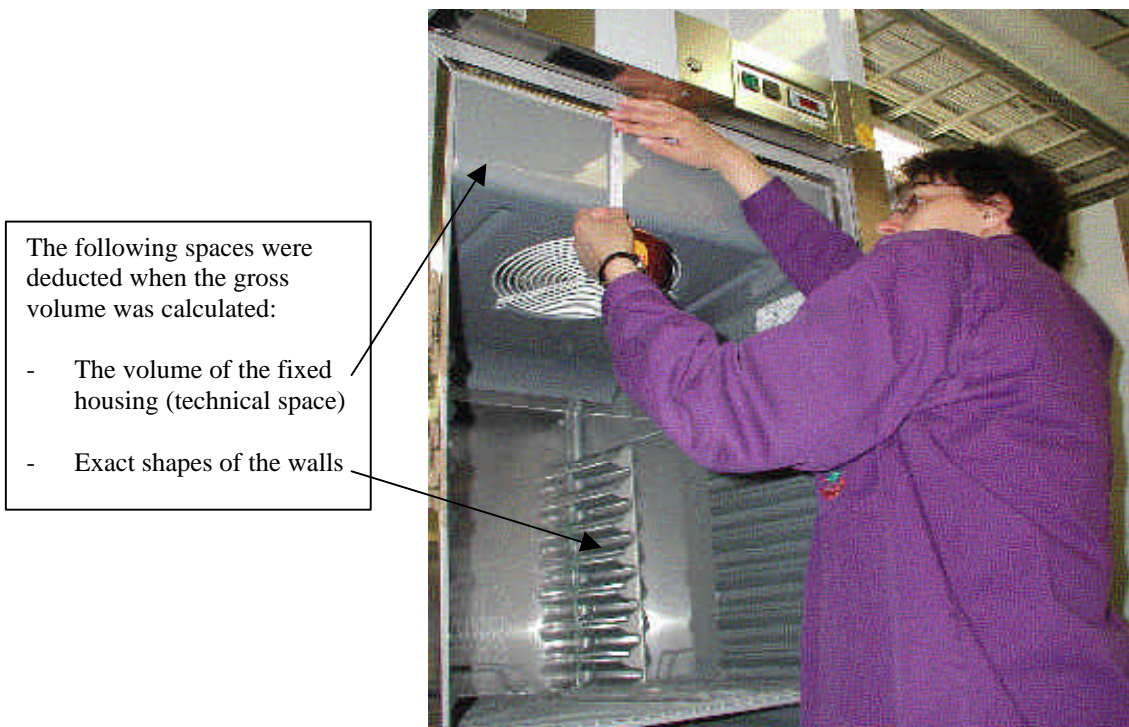
The tests were carried out in TTS institute's Research and Training Centre which is located in Rajamäki, Finland. The testing period was 5.3. - 31.08.2001.

## THE RESULTS OF MEASUREMENTS FOR GROSS AND STORAGE VOLUMES

The gross and storage (net) volumes were measured according to the standards ISO 7371, ISO 8561, clause 7.2.1. The details of the measurements are given in annex 2.

When measuring the gross volume, internal fittings (shelves, partitions, containers, evaporators, thermostats and/or interior light housings) shall be considered as not being in place.

Instead the gross volume includes the exact shapes of the walls if they have depressions or projections. If cooling is effected by forced air, any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories is also deducted, (picture 1).



Picture 1. If cooling is effected by forced air, any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories is deducted when the gross volume is calculated. There is Polaris STN 70 STD on the picture.

## Refrigerators

For the determination of storage volumes, the total volume of devices and of spaces considered unusable for the storage of food shall be deducted from the gross volume, etc:

- the volume of the evaporator space
- the volume of any housings (such interior lights, thermostats etc.)
- the volume of shelves, partitions, retainers and other accessories whose wall thickness is greater than 13 mm.

The results of measurements for refrigerators are given in table 1.

Table 1. The gross and storage volumes for the refrigerators

Supplier's trade mark	Gross volume, (dm <sup>3</sup> )	Storage volume, dm <sup>3</sup>
Alpeninos EO6NOD1C	587	455
Foster PREM G600H	600	450
Gram K 600 OPCHHA	535	409
Polaris STN 70 STD	528	431
Porkka Future Plus C 732	573	453
Porkka Future Plus M 732	573	453
Porkka Future Plus C 730	581	465
Porkka Future C 722	573	453

## Freezers

For the determination of storage volumes, the total volume of devices and of spaces considered unusable for the storage of food is deducted from the gross volume, etc:

- the volume of spaces situated outside any load limit (natural or marked by the manufacturer), (picture 2).
- the volume of all fixed components within the load limits
- the volume of spaces which will be kept free for the good performance of the refrigerating system, (picture 3).
- the volume of all removable parts which are stated by the manufacturer as necessary for the proper functioning of the appliance, except shelves and partitions whose thickness is not greater than 13 mm
- the volume rendered unusable by the use of removable parts (for example shelves) necessary for obtaining satisfactory thermal and mechanical characteristics

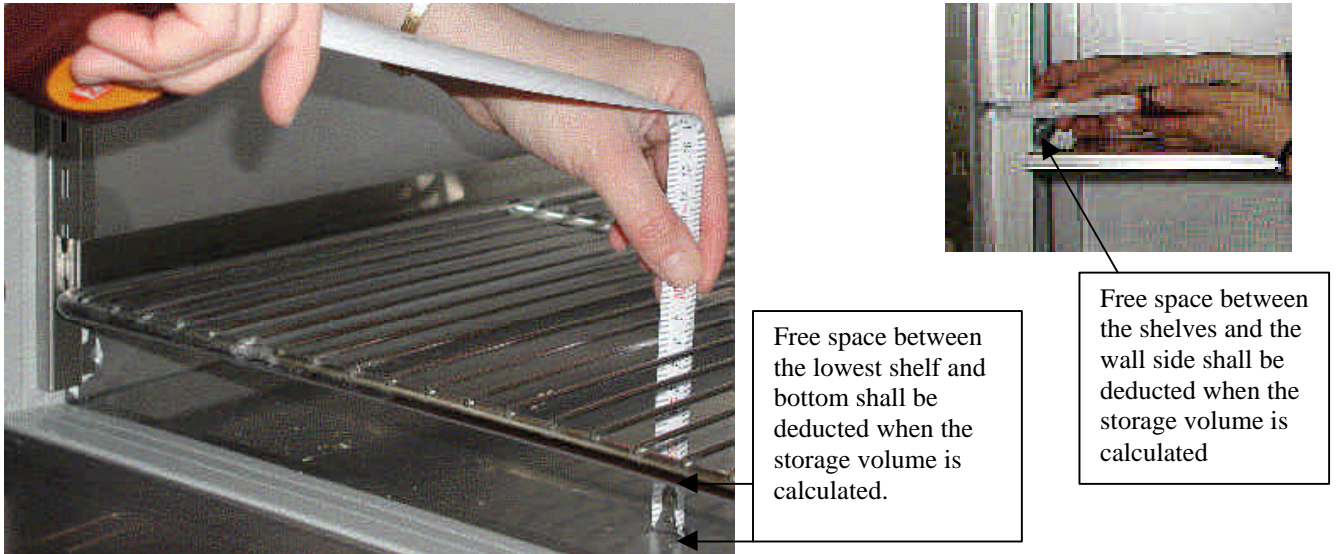
The results of measurements for freezers are given in table 2.

Table 2. The results of gross and storage volumes for the freezers.

Supplier's trade mark	Gross volume, (dm <sup>3</sup> )	Storage volume, (dm <sup>3</sup> )
Alpeninos EO6COD1C	587	437
Foster PREM G600L	600	450
Gram F 600 OPCHHA	535	409
Polaris SA BT 70	549	435
Porkka Future Plus F 732	573	453
Porkka Future Plus F 730	581	465



Picture 2. The load limits were marked by the manufacturers of Porkka and Alpeninos.



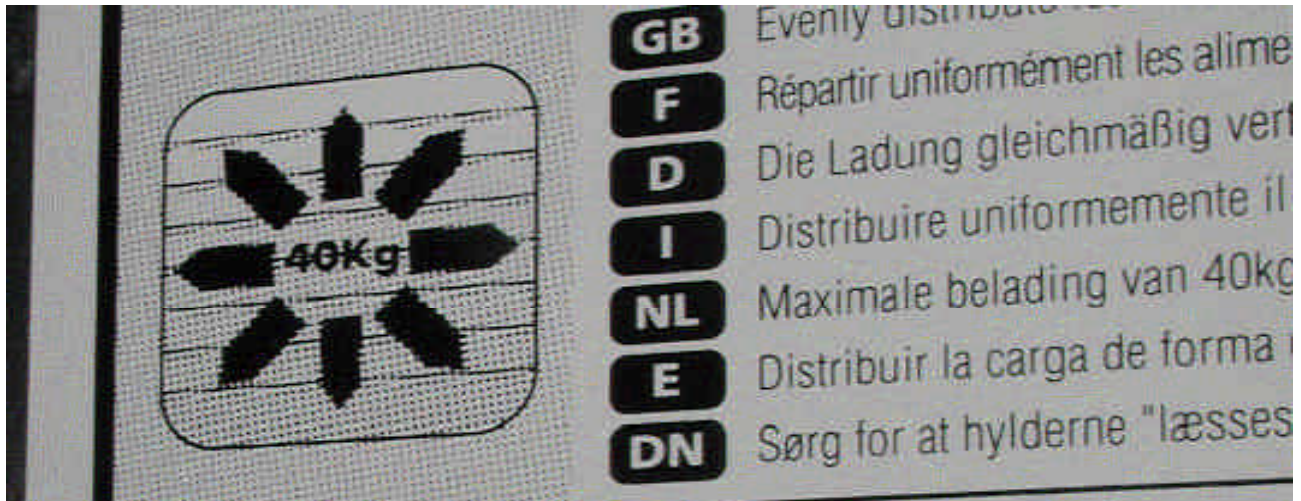
Picture 3. The volume of spaces which will be kept free for the good performance of the refrigerating system shall be deducted from the gross volume when the storage volume is calculated.

**THE RESULTS OF MEASUREMENTS FOR STORAGE TEMPERATURES AND THE ENERGY CONSUMPTION**

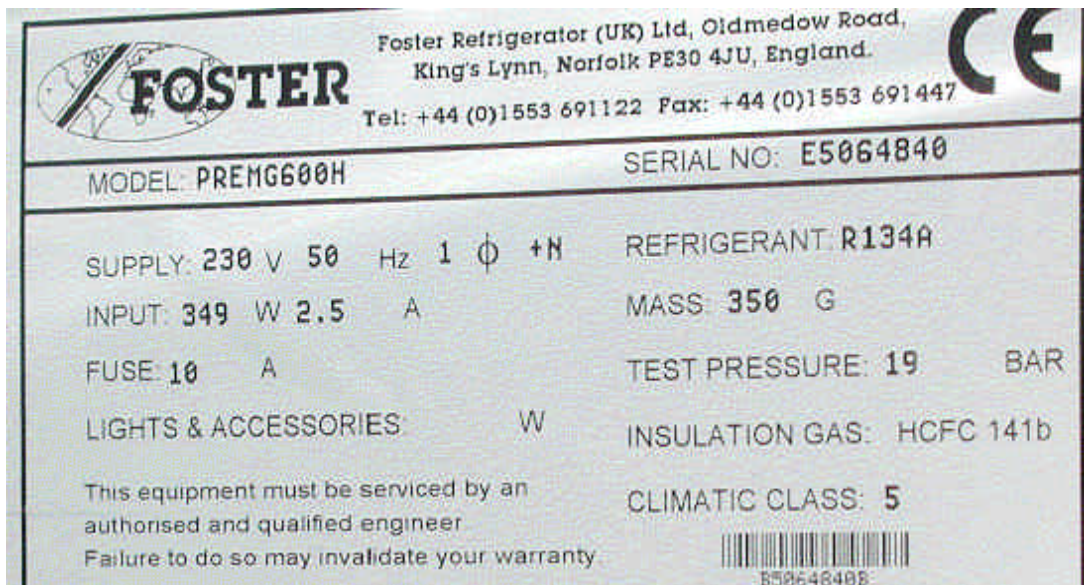
The energy consumption of the appliances were carried out in two different ambient temperatures, +25°C and +32°C. The results are given in tables 3, 4 and 5 (pages 10 – 12). The position of the measuring points for the refrigerators are given in annex 3 and the details of the loading plans for the freezers are shown in annex 4 (see also pictures 4 and 5 below).



Pictures 4 and 5.  
 On the left: The position of the measuring points for the refrigerator (Porkka M 732)  
 On the right: The loading situation of the freezer (Alpeninos EO6COD1C)



Picture 6. There is a notice on the door of refrigerator Foster PREMG600H and freezer Foster PREM G600L: Evenly distribute the load (max 40 kg per shelf or 160 kg per full door section).



Picture 7. The insulation gas of refrigerator Foster PREMG600H and freezer Foster PREM G600L was HCFC 141 b which has been forbidden in Finland since 2000.

## NOISE OF THE APPLIANCES

The acoustic noise of the appliances were measured in TTS's test laboratory where the environmental conditions were comparable with professional use (background noise was 34,2 dB (A)). The noises were measured as noise pressure level by noise measuring meter Brüel & Kjaer, type 2204.

The distance between the appliance and the measuring device was one meter, and the measuring height from the floor was 1,6 meters, (picture 7). The measurements were performed during the normal cycle of the appliance. It is necessary to mention that these noise results cannot be compared with reference materials but only with each other. The results are shown in table 5.

Table 5. The noise pressure levels of the appliances

Refrigerators	Noise, dB (A)	Freezers	Noise, dB (A)
Alpeninos EO6NOD1C	57,5	Alpeninos EO6COD1C	54,3
Foster PREM G600H	50,7	Foster PREM G600L	57,8
Gram K 600 OPCHHA	48,6	Gram F 600 OPCHHA	48,2
Polaris STN 70 STD	49,7	Polaris SA BT 70	52,1
Porkka Future Plus C 732	50,1	Porkka Future Plus F 732	49,3
Porkka Future Plus M 732	50,1	Porkka Future Plus F 730	49,2
Porkka Future Plus C 730	49,3	-	
Porkka Future C 722	49,2	-	

Background noise 35 dB (A)



Picture 7. The distance between the appliance and the measuring device was one meter, and the measuring height from the floor was 1,6 meters.



## REFERENCE STANDARDS

### EN 153:1995

Methods of measuring the energy consumption of electric mains operated household refrigerators, frozen food storage cabinets, food freezers and their combinations, together with associated characteristics. 6 pages.

### ISO 7371:1995

Household refrigerating appliances - Refrigerators with or without low-temperature compartment - Characteristics and test methods. 47 s.

### ISO 5155:1995

Household refrigerating appliances – Frozen food Storage cabinets and food freezers – Characteristics and test methods. 39 pages.

### ISO/DIS 8561.2:1995

Household frost free refrigerating appliances – Refrigerators, refrigerator-freezers, frozen food storage cabinets and Food freezers cooled by internal forced air circulation - Characteristics and test methods. 51 s.

## Appendices

- Annex 1: Laboratory Checklist, details
- Annex 2: Measurements of gross and net volumes, drawings
- Annex 3: The position of measuring points for the refrigerators, drawings
- Annex 4: Loading plans for the freezers, drawings

Rajamäki 31.08.2001

TTS Institute  
Department of Home Economics

Chief research scientist

Anneli Reisbacka

Research Officer

Tarja Marjomaa

**Table 3.** The energy consumption and running time of the refrigerators in two different ambient temperatures (+25°C / +32°C). Internal average temperature +2°C.

Supplier's trade mark - gross / storage volume	Ambient temperature +25°C						Ambient temperature +32°C					
	kWh/d	kWh/100 volume litre		Running time			kWh/d	kWh/100 volume litre		Running time		
gross volume, calculated consumption		storage volume, calculated consumption	cycles/d	hour/d	%/d	gross volume, calculated consumption		storage volume, calculated consumption	cycles/d	hour/d	%/d	
Alpeninos EO6NOD1C - 587 / 455 dm <sup>3</sup>	2.72 kWh	0.46 kWh	0.60 kWh	64 cycles	5.94 h	25 %	3.20 kWh	0.55 kWh	0.70 kWh	68 cycles	7.41 h	31 %
Foster PREM G600H - 600 / 450 dm <sup>3</sup>	3.15 kWh	0.53 kWh	0.70 kWh	210 cycles	7.05 h	29 %	3.95 kWh	0.66 kWh	0.88 kWh	161 cycles	9.63 h	40 %
Gram K 600 OPCHHA - 535 / 409 dm <sup>3</sup>	5.36 kWh	1.00 kWh	1.31 kWh	40 cycles	9.56 h	40 %	6.24 kWh	1.17 kWh	1.53 kWh	34 cycles	11.98 h	50 %
Polaris STN 70 STD - 528 / 431 dm <sup>3</sup>	3.81 kWh	0.72 kWh	0.88 kWh	194 cycles	8.45 h	35 %	4.71 kWh	0.89 kWh	1.09 kWh	197 cycles	11.03 h	46 %
Porkka Future Plus C 732 and Future C722 - 573 / 453 dm <sup>3</sup>	2.37 kWh	0.41 kWh	0.52 kWh	152 cycles	6.26 h	26 %	3.14 kWh	0.55 kWh	0.69 kWh/d	173 cycles	8.53 h	36 %
Porkka Future Plus C 730 - 581 / 465 dm <sup>3</sup>	2.13 kWh	0.37 kWh	0.46 kWh	129 cycles	5.40 h	23 %	2.87 kWh	0.49 kWh	0.62 kWh/d	152 cycles	7.51 h	31 %
Porkka Future Plus M 732 - 573 / 453 dm <sup>3</sup>	2.36 kWh	0.41 kWh	0.52 kWh	140 cycles	5.31 h	22 %	3.23 kWh	0.56 kWh	0.71 kWh	151 cycles	7.07 h	29 %

**Table 4.** The energy consumption and running time of the freezers in ambient temperature +25°C. The warmest test package was at least –18°C.

Supplier's trade mark - gross / storage volume	Ambient temperature +25°C							
	Test packages <sup>(1)</sup> - maximum load	Energy consumption		Energy consumption		Running time		
		kWh / max. loading	kWh / 100 kg frozen packages	kWh/ 100 gross volume litre	kWh/100 storage volume litre	cycles/d	hour/d	%/d
Alpeninos EO6COD1C - 587 / 437 dm <sup>3</sup>	184 kg	8.23 kWh	4.47 kWh	1.40 kWh	1.88 kWh	146 cycles	12.87 h	54 %
Foster PREM G600L - 600 / 450 dm <sup>3</sup>	160 kg <sup>(2)</sup>	10.08 kWh	6.30 kWh	1.68 kWh	2.24 kWh	113 cycles	11.43 h	48 %
Gram F 600 OPCHHA - 535 / 409 dm <sup>3</sup>	252 kg	9.11 kWh	3.62 kWh	1.70 kWh	2.23 kWh	7 cycles	12.47 h	52 %
Polaris SA BT 70 - 549 / 435 dm <sup>3</sup>	220 kg	11.07 kWh	5.03 kWh	2.02 kWh	2.54 kWh	344 cycles	16.16 h	67 %
Porkka Future Plus F 730 - 581 / 465 dm <sup>3</sup>	300 kg	9.14 kWh	3.05 kWh	1.57 kWh	1.97 kWh	241 cycles	15.71 h	65 %
Porkka Future Plus F 732 - 573 / 453 dm <sup>3</sup>	296 kg	8.15 kWh	2.75 kWh	1.42 kWh	1.80 kWh	111 cycles	14.08 h	59 %

<sup>(1)</sup> The freezers were loaded according to the standards with as many test packages as they can hold. The measuring packages were placed where the highest temperatures were expected to be. The temperature of the warmest test package was at least –18°C. The appliances were loaded in accordance with the manufacturer's instructions taking notice of marked load limits etc. Reference standards: ISO 5155, ISO/DIS 8561.2.

<sup>(2)</sup> The instructions for use noticed: Evenly distribute the load, max 40 kg per shelf or 160 kg per full door section.

**Table 5.** Energy consumption and running time of the freezers in ambient temperature +32°C. The warmest test package was at least –18°C.

Supplier's trade mark - gross / storage volume	Ambient temperature +32 C							
	Test packages <sup>1</sup> - maximum load	Energy consumption		Energy consumption		Running time		
		kWh / max. loading	kWh / 100 kg frozen packages	kWh/ 100 gross volume litre	kWh/100 storage volume litre	cycles/d	hour/d	%/d
Alpeninos EO6COD1C - 587 / 437 dm <sup>3</sup>	184 kg	9.43 kWh	5.13 kWh	1.61 kWh	2.16 kWh	139 cycles	13.07 h	54 %
Foster PREM G600L - 600 / 450 dm <sup>3</sup>	160 kg ( <sup>2</sup> )	12.64 kWh	7.90 kWh	2.11 kWh	2.81 kWh	77 cycles	15.25 h	64 %
Gram F 600 OPCHHA - 535 / 409 dm <sup>3</sup>	252 kg	11.07 kWh	4.39 kWh	2.06 kWh	2.71 kWh	6 cycles	14.87 h	62 %
Polaris SA BT 70 - 549 / 435 dm <sup>3</sup>	220 kg	12.90 kWh	5.86 kWh	2.35 kWh	2.97 kWh	204 cycles	19.61 h	82 %
Porkka Future Plus F 730 - 581 / 465 dm <sup>3</sup>	300 kg	10.16 kWh	3.39 kWh	1.75 kWh	2.18 kWh	216 cycles	20.10 h	84 %
Porkka Future Plus F 732 - 573 / 453 dm <sup>3</sup>	296 kg	9.41 kWh	3.18 kWh	1.64 kWh	2.08 kWh	86 cycles	17.76 h	74 %

<sup>1</sup> The freezers were loaded according to the standards with as many test packages as they can hold. The measuring packages were placed where the highest temperatures were expected to be. The temperature of the warmest test package was at least –18°C. The appliances were loaded in accordance with the manufacturer's instructions taking notice of marked load limits etc. Reference standards: ISO 5155, ISO/DIS 8561.2.

<sup>2</sup> The instructions for use noticed: Evenly distribute the load, max 40 kg per shelf or 160 kg per full door section.

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Laboratory Checklist: 5.3.-31.8.2001

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**1. Laboratory details**

Laboratory name	TTS Institute, Department of Home Economics
Name of laboratory manager	The responsible person of the project Anneli Reisbacka, chief research scientist  Practical tests Tarja Marjomaa, research officer Arja Rytönen, research officer

**2. Instrumentation**

Test room size	Height: 2400 mm Width: 2000 mm Length: 3250 mm 15,6 dm <sup>3</sup>
Number of test rooms - number of appliances per testroom	2 2
Test room temperature range	+10 - +50°C (during the tests +25°C and +32°C)
Test room air flow (hor/vert)	Vertical air conditioning
Test room air speed - at air temp. sensor locations	Air temperature sensors in the test room: - 3 measuring points  Test room air speed (have been measured in the empty test room): - point 1 0,05 - 0,1 m/s - point 2 0,1 m/s - point 3 0,05 - 0,1 m/s  (Meter: Kane-May Ltd. KM 4003)
Test room's RH set point	Test room humidity: - setting range 15 - 90 %  <b>During the tests: 50%</b>
Test room lighting during the test	Lights off
Power source Voltage	230 volt, stabled (voltage regulator ±1 %)
Power source Frequency	50 Hz

Temperature sensors (type)	T-type, copper - constant thermo couple (in the geometrical centre of the copper cylinder)
Calibration frequency	1 year (depending on the number of the tests)
kWh meter (type)	<p><b>kWh meter 1:</b>  Manufactured by Waldsee Electronic  Model LVM 617  Serial number 200960</p> <p><b>kWh meter 2:</b>  Manufactured by Waldsee Electronic  Model LVM 617  Serial number 200961</p> <p><b>kWh meter 3:</b>  Manufactured by Waldsee Electronic  Model LVM 210  Serial number 104.183</p> <p><b>kWh meter 4:</b>  Manufactured by Waldsee Electronic  Model LVM 210  Serial number 404.181</p>
Calibration frequency	1 - 2 years (depending on the number of the tests)

Test package type & “brand”	BRONI REEB, Germany										
Test package production date	1997 and 1999										
Calibration method	<ul style="list-style-type: none"> <li>- Visual check (shapes, colour, size etc.)</li> <li>- Dimensional check; linear dimensions and weight (prior to freezing)</li> </ul>										
Calibration frequency	Visual checking before every use Dimensional measurements as necessary										
For 10 random 1kg packages:	-----										
Weight (g)	973	992	1031	1002	1018	1019	1022	1029	1072	996	
Width (mm)	104	108	111	115	119	120	110	108	102	101	
Length (mm)	200	202	202	203	207	209	209	212	216	198	
Height (mm)	46	48	48	47	46	48	49	48	47	46	
Data acquisition system (description)	The measuring data is collected by data loggers, transferred to PC, transformed into Excel format. <b>Software:</b> DALITE configuration and monitoring software : 1995										

Data sampling frequency	<ul style="list-style-type: none"> <li>- Monitoring (reading) every 20th second</li> <li>Log frequency every 240 seconds (recording of average of 12 readings)</li> </ul>
# of data channels per object.	<p><b>For a refrigerator:</b></p> <ul style="list-style-type: none"> <li>- Alpeninos</li> <li>- Foster PREM G600H</li> <li>- Gram K 600 OPCHHA</li> <li>- Polaris STN 70 STD</li> <li>- Porkka Future Plus C 732</li> <li>- Porkka Future Plus M 732</li> <li>- Porkka Future Plus C 730</li> <li>- Porkka Future C 722</li> <li>- 5 channels for internal temperatures of the refrigerator</li> <li>- 1 channel for energy consumption</li> <li>- 2 channels for ambient temperature</li> </ul> <p><b>For a freezer:</b></p> <ul style="list-style-type: none"> <li>- Alpeninos</li> <li>- Foster PREM G600L</li> <li>- Gram F 600 OPCHHA</li> <li>- Polaris SA BT 70</li> <li>- Porkka Future Plus F 732</li> <li>- Porkka Future Plus C 730</li> <li>- 8 channels for a freezer (measuring test packages)</li> <li>- 1 channel for energy consumption</li> <li>- 2 channels for ambient temperature</li> </ul>
Additional data collection for parameters not prescribed - running time	<p>Running time meter: KMK 3600</p> <ul style="list-style-type: none"> <li>- Alpeninos EO6NOD1C, refrigerator</li> <li>- Foster PREM G600H, refrigerator</li> <li>- Polaris STN 70 STD, refrigerator</li> <li>- Polaris SA BT 70, freezer</li> <li>- Porkka Future Plus C 732, refrigerator</li> <li>- Porkka Future Plus M 732, refrigerator</li> <li>- Porkka Future Plus F 732, freezer</li> <li>- Porkka Future Plus C 730, refrigerator</li> <li>- Porkka Future C 722 refrigerator</li> <li>- Porkka Future Plus F 730 refrigerator</li> </ul> <p>Plotter: Yokokawa 308120, -7/MIX30/E</p> <ul style="list-style-type: none"> <li>- Alpeninos EO6COD1C, freezer</li> <li>- Foster PREM G600L, freezer</li> <li>- Gram F 600 OPCHHA, freezer</li> <li>- Gram K 600 OPCHHA, refrigerator</li> </ul>

Volume measurement (description)	According to standards: ISO 7371, clause 7 (for a refrigerator) ISO 5155, clause 7 (for a freezer) ISO/DIS 8561.2
Instrument type	Mechanical tape measure, sliding gauge, right angle gauge
Acoustic noise measurement and instrument type	The noise were measured as noise pressure level by noise measuring meter Brüel & Kjaer, type 2204. The distance between appliance and measuring device was one meter and the measuring height from the floor was 1,6 meter.

### 3. Installation procedure by TTS

When an appliance arrives, it goes through the "receive checking" which consists of:

- identify checking (type and serial numbers, rating plate, energy label which is pasted to the appliance, instructions for installation and use, other documents by manufacturer etc).
- visual checking
- preliminary tests

The appliance is installed in the test room and set up according to the manufacturers instructions and the standard. The temperature sensors of the refrigerators are placed on their points and connected to the data logger. The freezers are loaded with test packages and "measure packages" according to the manufacturers loading plan or standard.

The empty appliance shall be operated for at least 24 hours before the test to reach stability.

Platform (height)	No used	
Partitions (size & colour)	<b>Side partitions:</b> No used <b>Back wall:</b> No used	
Positioning of test object ■ distance from back wall ■ distance from side partitions	<b>All appliances:</b> - contact with the back wall by the "stops" (all appliances had the "stops").	
Ambient temperature sensors (number, type and positions)	<b>All appliances:</b> 1 ambient sensor in front of each appliance - 1200 mm height above the floor (a half height of test room) - 350 mm apart from appliance  <b>Type:</b> T-type copper-constant thermo couple wire with copper cylinder	
Sealing of refrigerator door (method of sealing)	Tape	
Loading plans by the manufacturers was used	Refrigerator -	Freezer -

#### ***4. Testing procedure by TTS***

The thermostat is adjusted to a position which is likely to give right storage temperatures (refrigerator avg. temperature +2°C, warmest test package in the freezer -18°C). First stable operating period lasts at least 24 hours after the acceptable setting of the thermostat. The data loggers are collecting and recording all the temperatures and energy consumption. At the same time the instantaneous temperatures are checked on the computer display. (Software: Dalite configuration and monitoring software).

If the internal temperatures (period 24 h) in the appliances are too cold or warm, the thermostat setting is changed and test is repeated again from the beginning to the end.

After the stable operating condition has been reached according to the standard, the actual measurements will be started.

The test period is 24 hours. The test data is collected and recorded by data loggers. Part of the test results is also reported manually (position of the thermostat setting, interesting attentions etc.).

The test will be completed when the reference temperatures have been reached and there is no need for interpolating.

If necessary the thermostat of the appliance is adjusted for the higher / lower position and the testing process will be repeated again. In the case of two tests the results shall be interpolated according to the standard.

#### ***5. Reporting procedure by TTS***

The measuring data is transferred to PC and transformed into Excel format. The data information will be treated by Excel software (min, max, avg. temperatures, energy consumption and draw schedules and diagrams etc.). The test results will be saved for five years.

The final test report shall comprise at least the measurements and test results of the following:

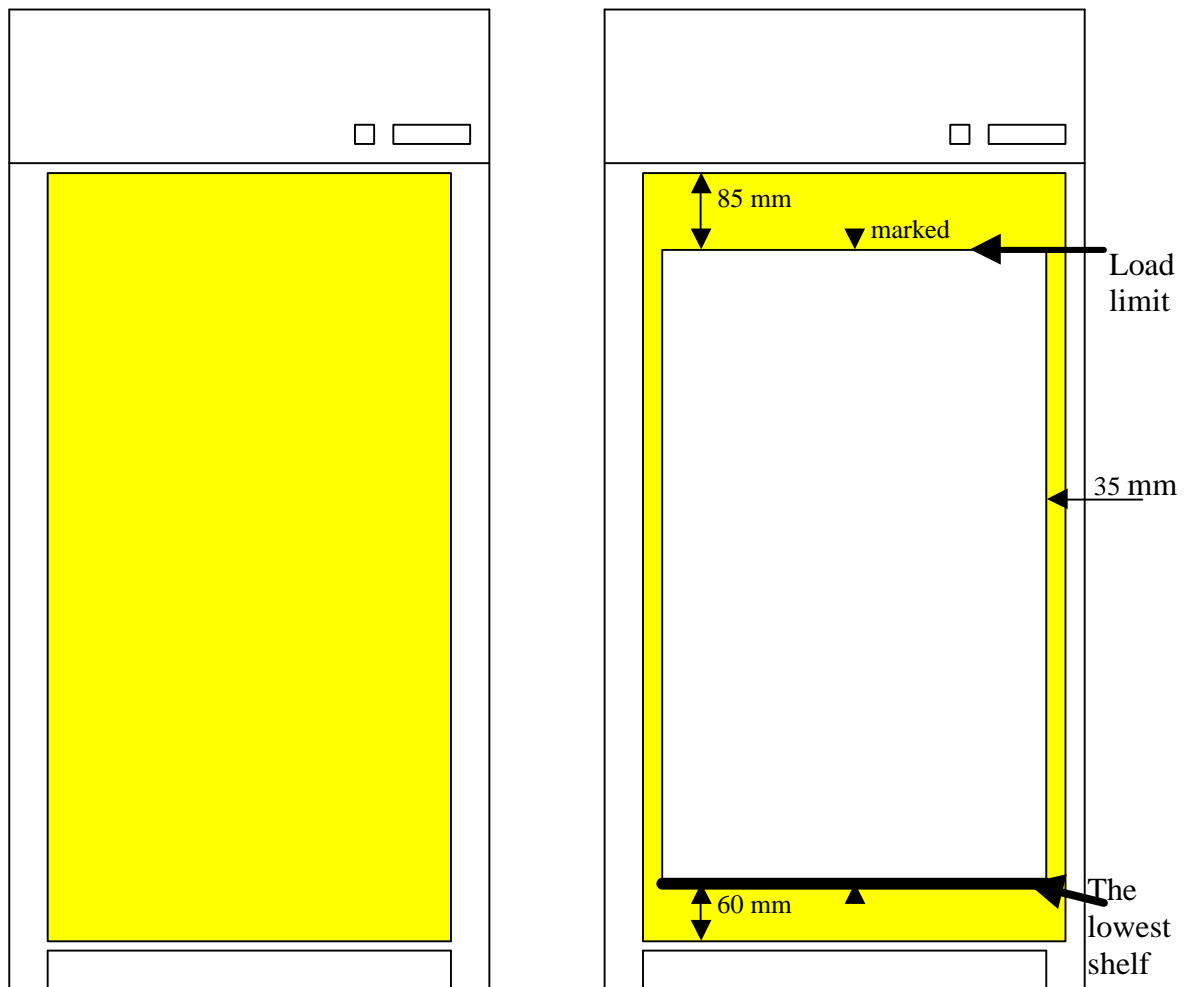
- the identification of the appliance, trade-mark, model designation, serial number etc.
- the total gross volume and the storage volume
- storage temperatures, energy consumption (ambient temperature +25°C and +32°C).
- noise, if applicable
- temperature rise test and freezing test, if applicable

**PORKKA FUTURE PLUS C 732 and PORKKA FUTURE C 722**

Refrigerator, temperature range +1°C...+12°C

When the gross volume is determined, internal fittings such as shelves, partitions, containers, evaporators, thermostat and/or interior light housings shall be considered as **not being in place**.

The gross volume shall take into account the **exact shapes of the walls** if they contain depressions or projections. If cooling is **effected by forced air**, any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories shall also be deducted (ISO 7371, ISO 8561, clause 7.2.1).

**Gross volume**

Width 610 mm  
 Depth 655 mm  
 Height 1435 mm

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**573.35 dm<sup>3</sup>**
**Storage volume**

Width 540 mm  
 Depth 650 mm } the area of shelf  
 Height 1290 mm

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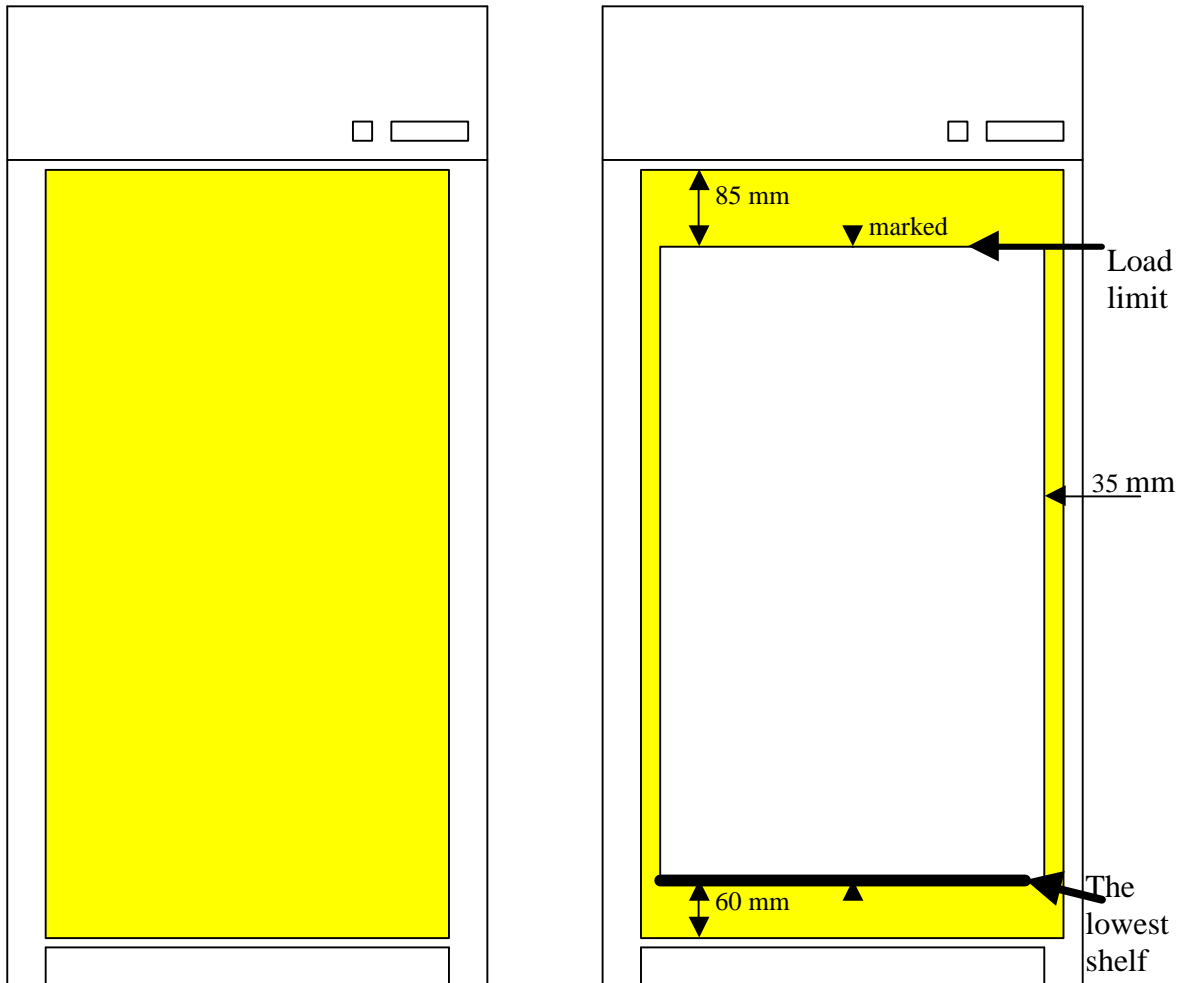
**452.79 dm<sup>3</sup>**

**PORKKA FUTURE PLUS C 730**  
Refrigerator, temperature range +1°C...+12°C

and **PORKKA FUTURE PLUS F 730**  
Freezer, temperature range -15°C...-26°C

When the gross volume is determined, internal fittings such as shelves, partitions, containers, evaporators, thermostat and/or interior light housings shall be considered as **not being in place**.

The gross volume shall take into account the **exact shapes of the walls** if they contain depressions or projections. If cooling is **effected by forced air**, any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories shall also be deducted (ISO 7371, ISO 8561, clause 7.2.1).



**Gross volume**

Width 730 mm  
Depth 555 mm  
Heigh 1435 mm

=====

**581.39 dm<sup>3</sup>**

**Storage volume**

Width 650 mm  
Depth 555 mm  
Heigh 1290 mm

} the area of shelf

=====

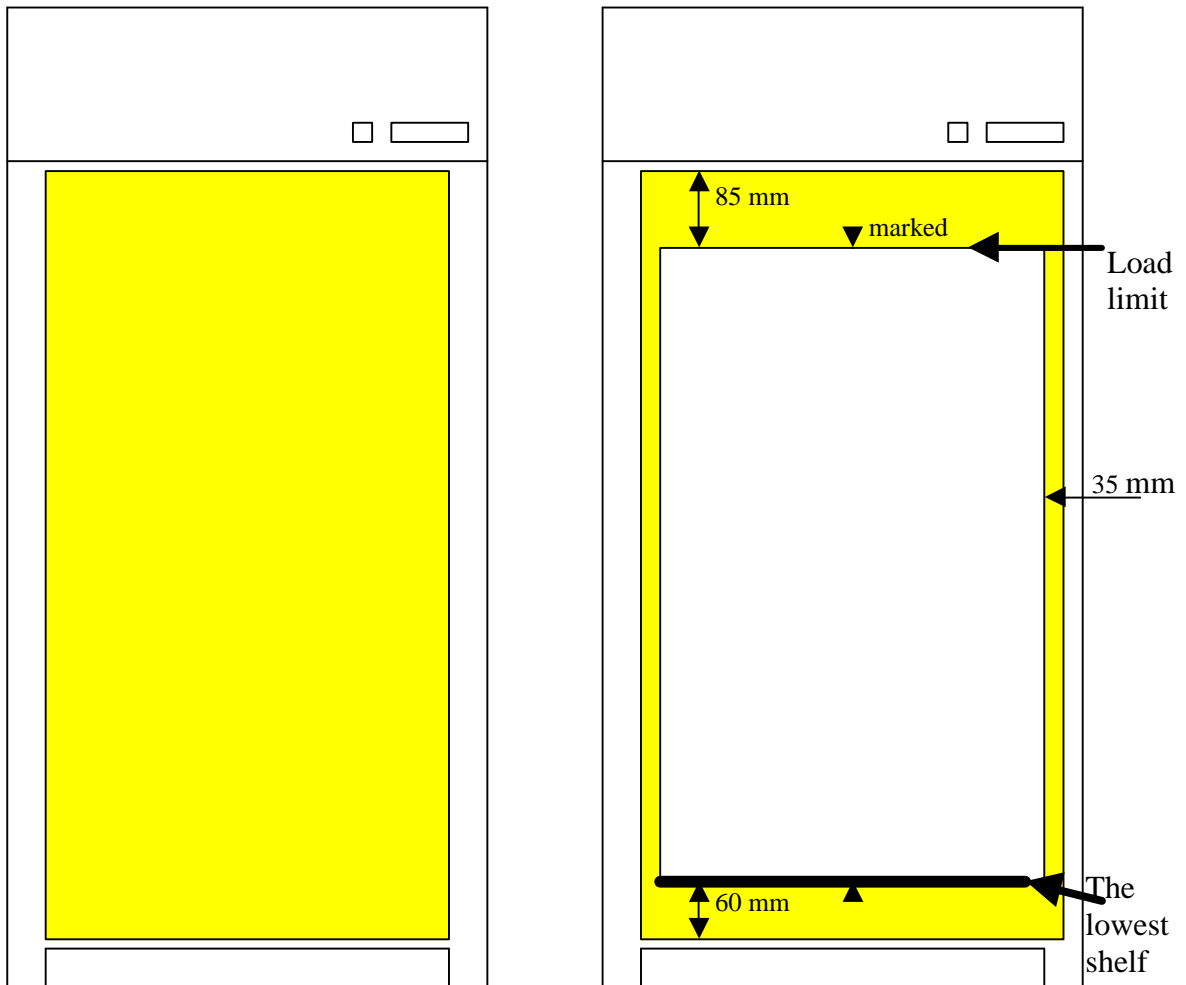
**465.37 dm<sup>3</sup>**

**PORKKA FUTURE PLUS M 732**

Refrigerator, temperature range -5°C...+12°C

When the gross volume is determined, internal fittings such as shelves, partitions, containers, evaporators, thermostat and/or interior light housings shall be considered as **not being in place**.

The gross volume shall take into account the **exact shapes of the walls** if they contain depressions or projections. If cooling is **effected by forced air**, any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories shall also be deducted (ISO 7371, ISO 8561, clause 7.2.1).

**Gross volume**

Width 610 mm  
 Depth 655 mm  
 Height 1435 mm

---

**573.35 dm<sup>3</sup>**
**Storage volume**

Width 540 mm  
 Depth 650 mm  
 Height 1290 mm

---

**452.79 dm<sup>3</sup>**

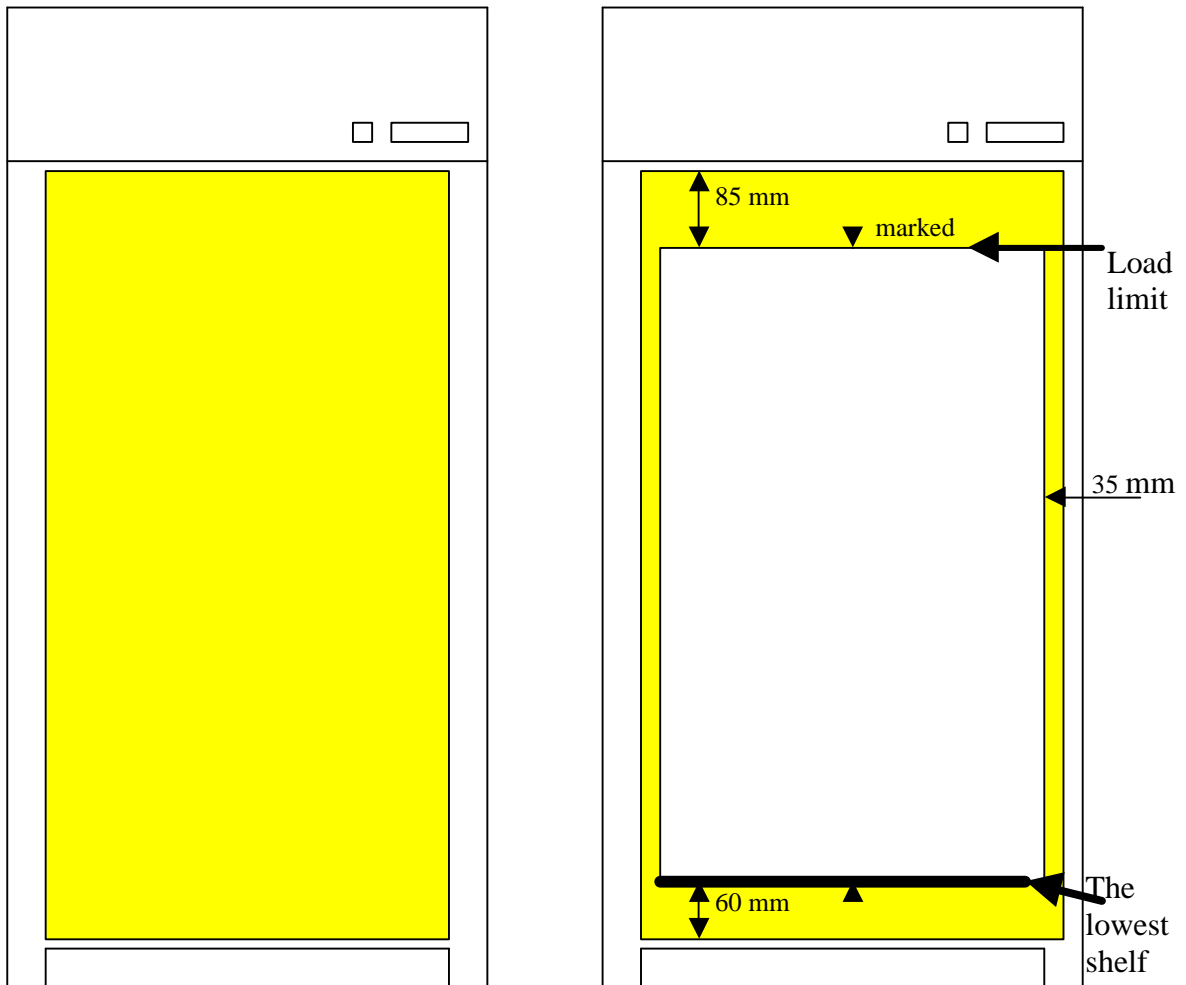
} the area of shelf

**PORKKA FUTURE PLUS F 732**

Freezer, temperature range -18°C...-26°C

When the gross volume is determined, internal fittings such as shelves, partitions, containers, evaporators, thermostat and/or interior light housings shall be considered as **not being in place**.

The gross volume shall take into account the **exact shapes of the walls** if they contain depressions or projections. If cooling is **effected by forced air**, any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories shall also be deducted (ISO 7371, ISO 8561, clause 7.2.1).

**Gross volume**

Width 610 mm  
 Depth 655 mm  
 Height 1435 mm

---

**573.35 dm<sup>3</sup>**
**Storage volume**

Width 540 mm  
 Depth 650 mm  
 Height 1290 mm

---

**452.79 dm<sup>3</sup>**

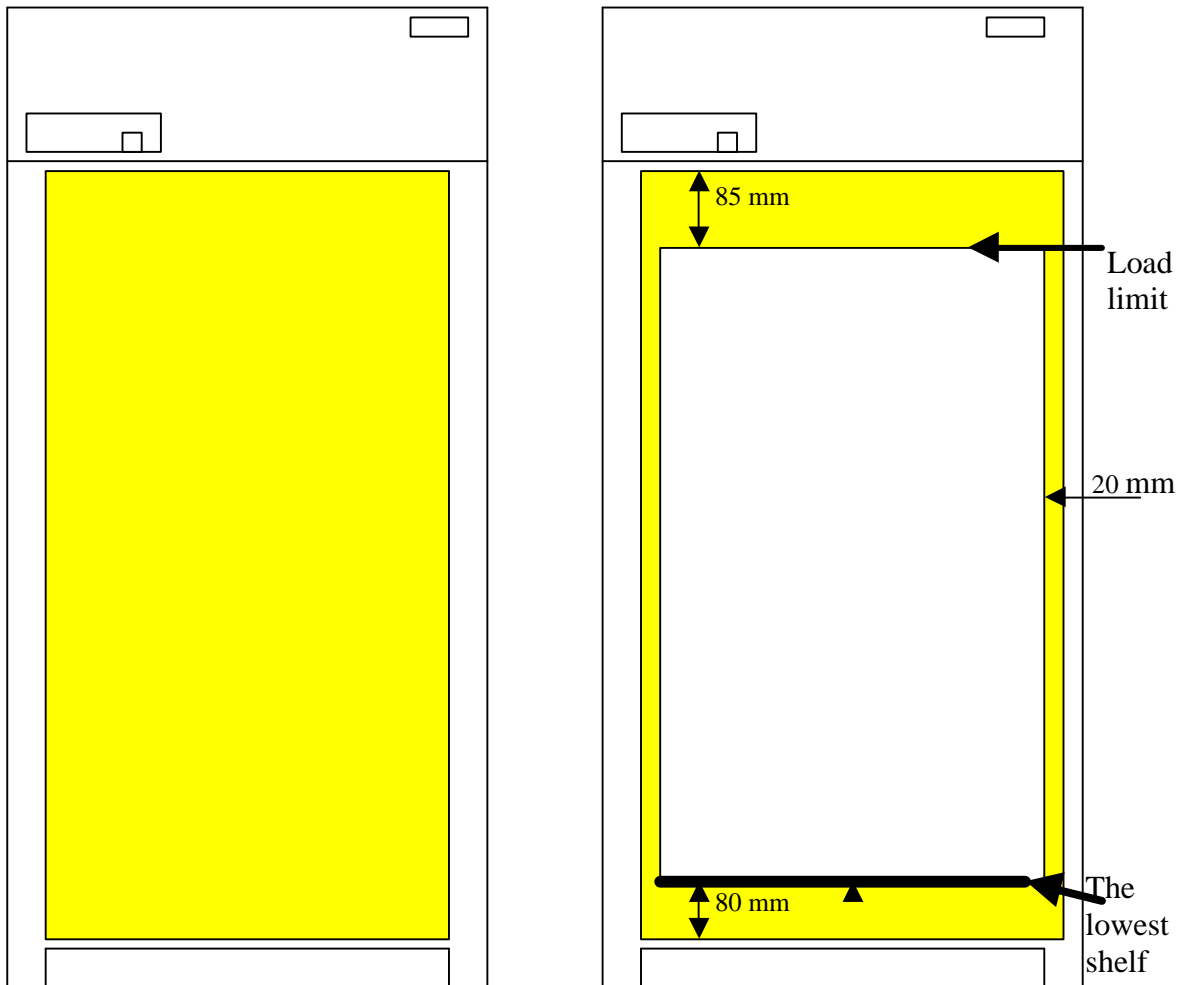
} the area of shelf

**GRAM K 600 OPCHHA**

Refrigerator, temperature range -5°C...+12°C

When the gross volume is determined, internal fittings such as shelves, partitions, containers, evaporators, thermostat and/or interior light housings shall be considered as **not being in place**.

The gross volume shall take into account the **exact shapes of the walls** if they contain depressions or projections. If cooling is **effected by forced air**, any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories shall also be deducted (ISO 7371, ISO 8561, clause 7.2.1).

**Gross volume**

Width	575 mm
Depth	695 mm
Height	1340 mm

---

**535.49 dm<sup>3</sup>**
**Storage volume**

Width	535 mm	} (the area of shelf)
Depth	650 mm	
Height	1175 mm	

---

**408.60 dm<sup>3</sup>**

Notes, instructions for use:

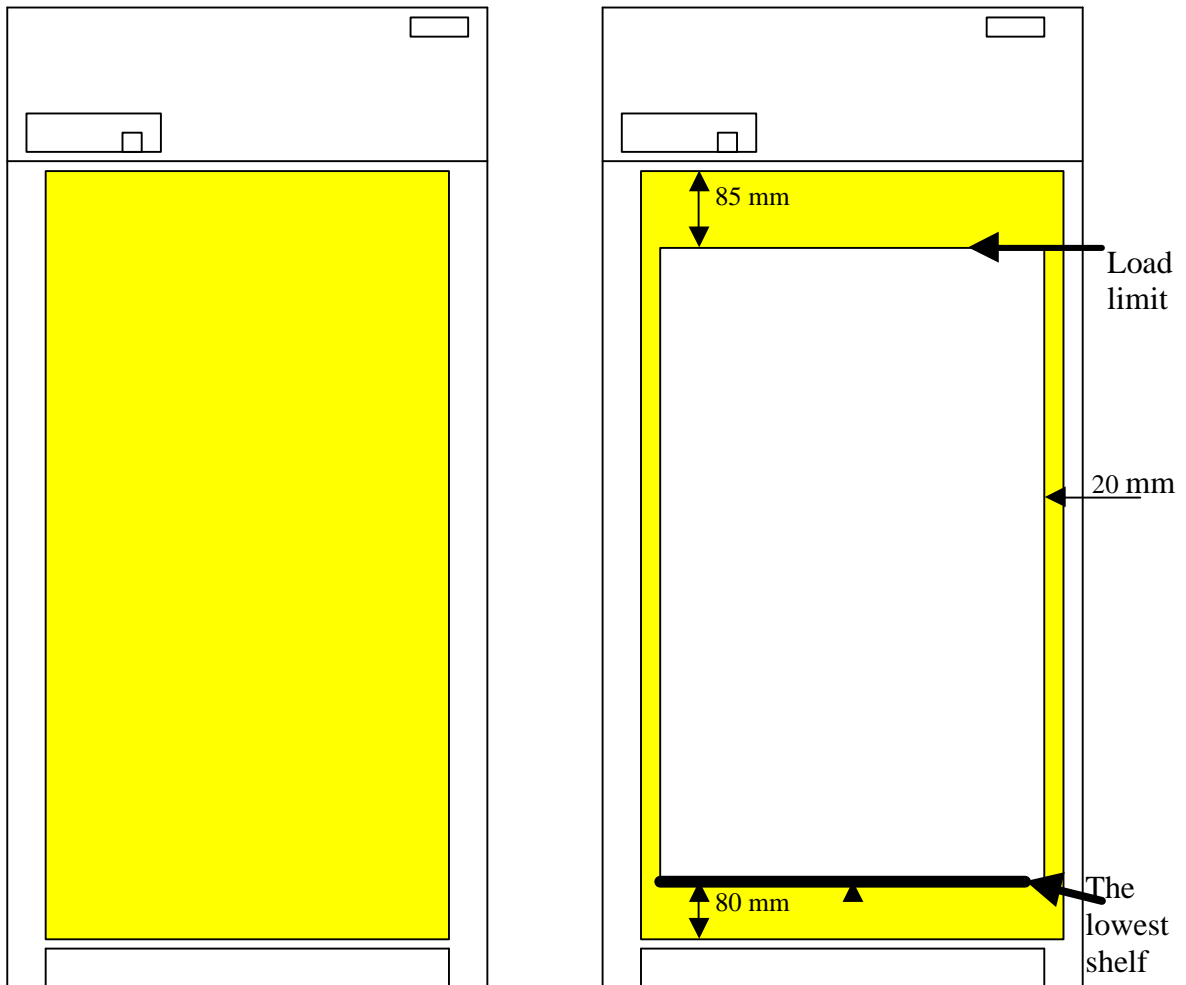
- To ensure correct and efficient air flow in the cabinet, products should always be stored on shelves or trays, and never placed directly on the floor pan.

**GRAM F 600 OPCHHA**

Freezer, temperature range -5°C...-25°C

When the gross volume is determined, internal fittings such as shelves, partitions, containers, evaporators, thermostat and/or interior light housings shall be considered as **not being in place**.

The gross volume shall take into account the **exact shapes of the walls** if they contain depressions or projections. If cooling is **effected by forced air**, any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories shall also be deducted (ISO 7371, ISO 8561, clause 7.2.1).

**Gross volume**

Width	575 mm
Depth	695 mm
Height	1340 mm

---

**535.49 dm<sup>3</sup>**
**Storage volume**

Width	535 mm	} (the area of shelf)
Depth	650 mm	
Height	1175 mm	

---

**408.60 dm<sup>3</sup>**

Notes, instructions for use:

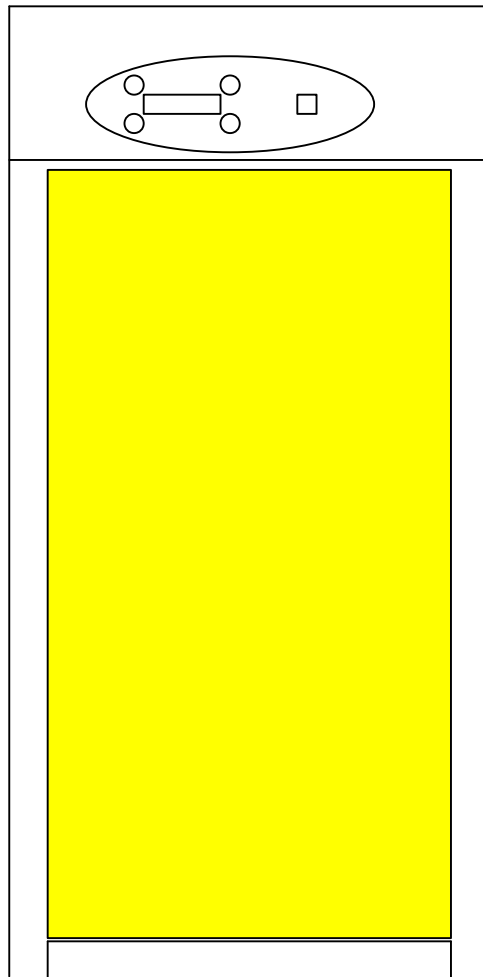
- To ensure correct and efficient air flow in the cabinet, products should always be stored on shelves or trays, and never placed directly on the floor pan.

**FOSTER PREM G600L**

Freezer, temperature range -15°C...-25°C

When the gross volume is determined, internal fittings such as shelves, partitions, containers, evaporators, thermostat and/or interior light housings shall be considered as **not being in place**.

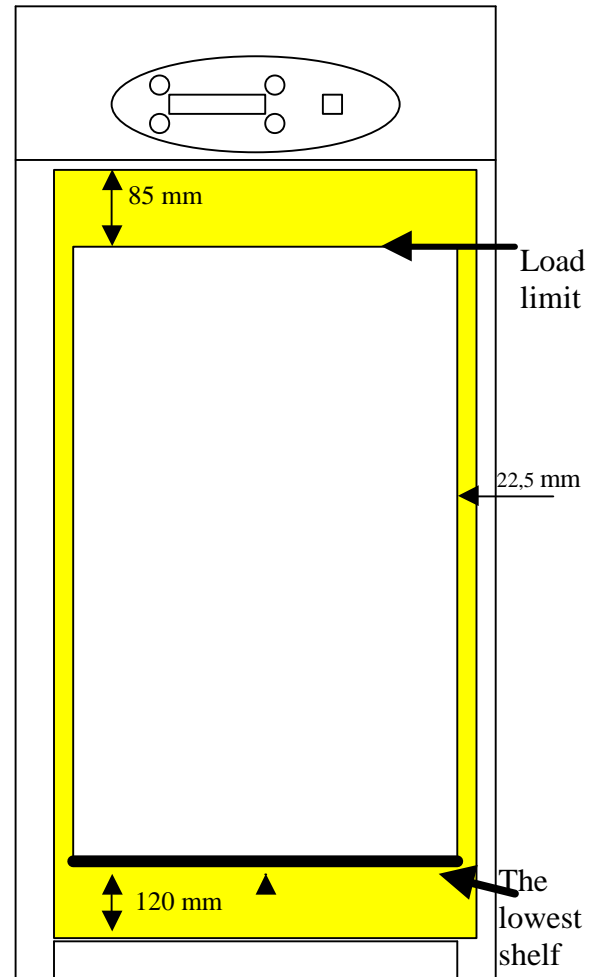
The gross volume shall take into account the **exact shapes of the walls** if they contain depressions or projections. If cooling is **effected by forced air**, any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories shall also be deducted (ISO 7371, ISO 8561, clause 7.2.1).

**Gross volume**

Width      580 mm  
 Depth     685 mm  
 Height    1510 mm

=====

**599.92 dm<sup>3</sup>**

**Storage volume**

Width      530 mm  
 Depth     650 mm } the area of shelf  
 Height    1305 mm

=====

**449.57 dm<sup>3</sup>**

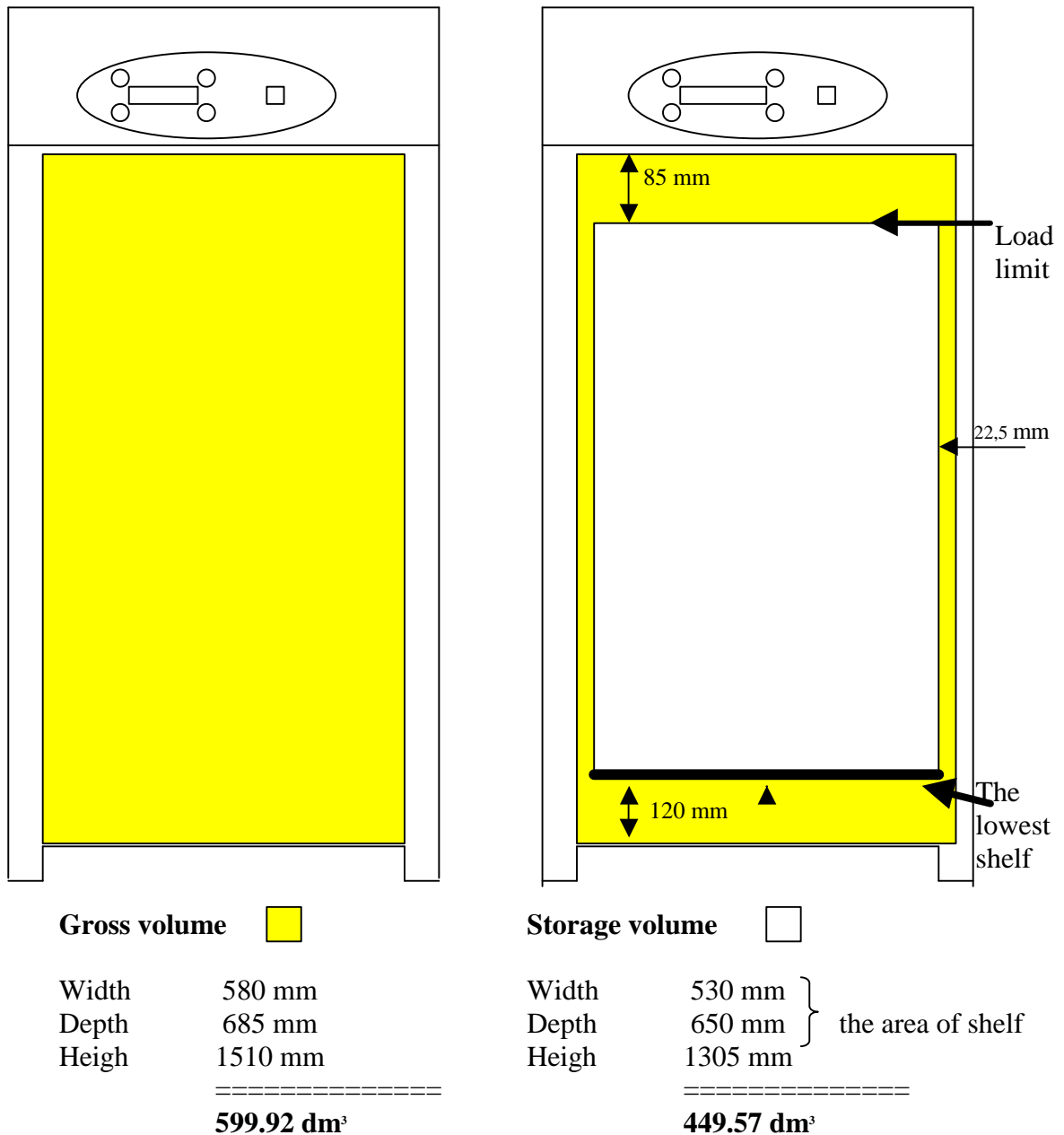
Notes, instructions for use:

- Evenly distribute the load (max 40 kg per shelf or 160 kg per full door section).
- Do not stack product on the base of the cabinet.

**FOSTER PREM G600H**Refrigerator, temperature range  $\pm 0\text{ }^{\circ}\text{C} \dots + 8\text{ }^{\circ}\text{C}$ 

When the gross volume is determined, internal fittings such as shelves, partitions, containers, evaporators, thermostat and/or interior light housings shall be considered as **not being in place**.

The gross volume shall take into account the **exact shapes of the walls** if they contain depressions or projections. If cooling is **effected by forced air**, any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories shall also be deducted (ISO 7371, ISO 8561, clause 7.2.1).



Notes, instructions for use:

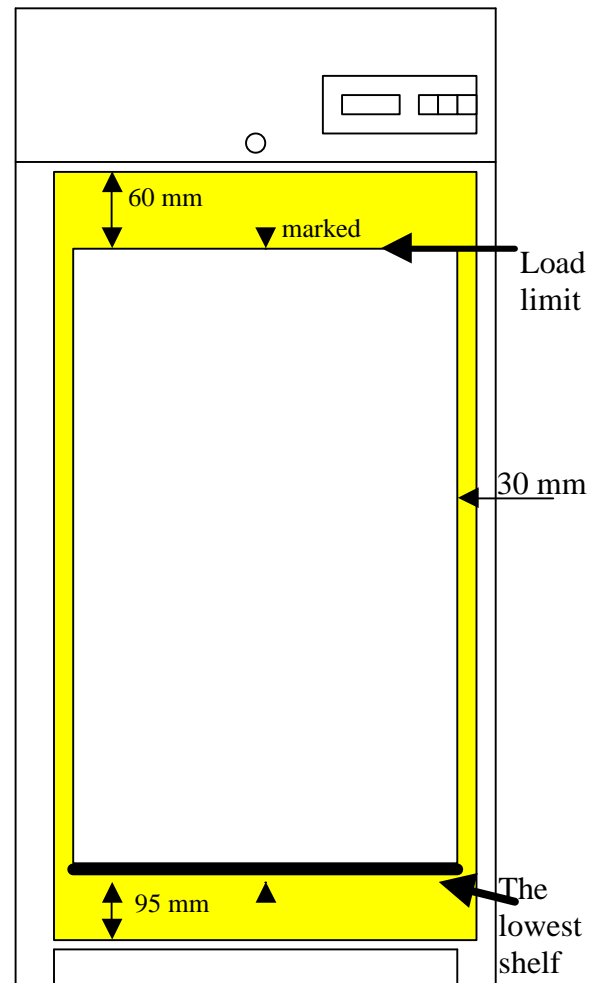
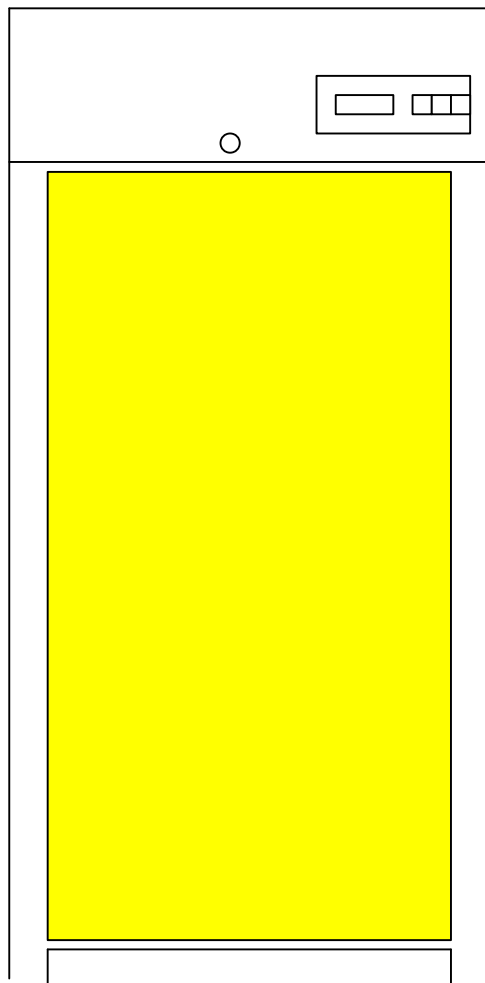
- Evenly distribute the load (max 40 kg per shelf or 160 kg per full door section).
- Do not stack product on the base of the cabinet.

**ALPENINOS EO6NOD1C**

Refrigerator, temperature range - 4 °C...+ 8 °C

When the gross volume is determined, internal fittings such as shelves, partitions, containers, evaporators, thermostat and/or interior light housings shall be considered as **not being in place**.

The gross volume shall take into account the **exact shapes of the walls** if they contain depressions or projections. If cooling is **effected by forced air**, any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories shall also be deducted (ISO 7371, ISO 8561, clause 7.2.1).

**Gross volume** 

Width        600 mm  
 Depth        675 mm  
 Height       1450 mm

=====

**587.25 dm<sup>3</sup>**

**Storage volume** 

Width        540 mm  
 Depth        650 mm } the area of shelf  
 Height       1295 mm

=====

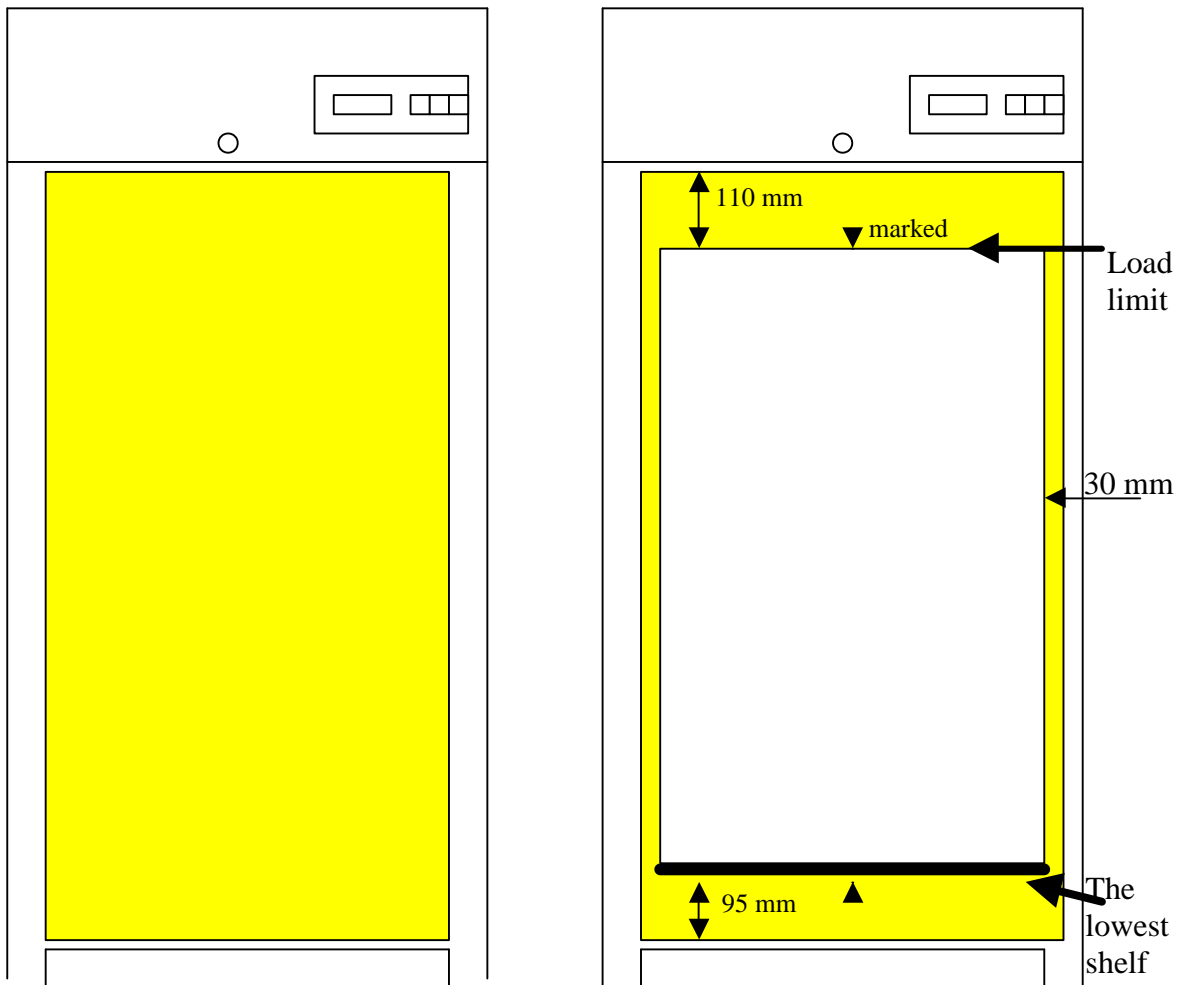
**454.54 dm<sup>3</sup>**

**ALPENINOS EO6COD1C**

Freezer, temperature range -15°C...-24°C

When the gross volume is determined, internal fittings such as shelves, partitions, containers, evaporators, thermostat and/or interior light housings shall be considered as **not being in place**.

The gross volume shall take into account the **exact shapes of the walls** if they contain depressions or projections. If cooling is **effected by forced air**, any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories shall also be deducted (ISO 7371, ISO 8561, clause 7.2.1).

**Gross volume** 

Width        600 mm  
 Depth        675 mm  
 Height       1450 mm

=====

**587.25 dm<sup>3</sup>**

**Storage volume** 

Width        540 mm  
 Depth        650 mm } the area of shelf  
 Height       1245 mm

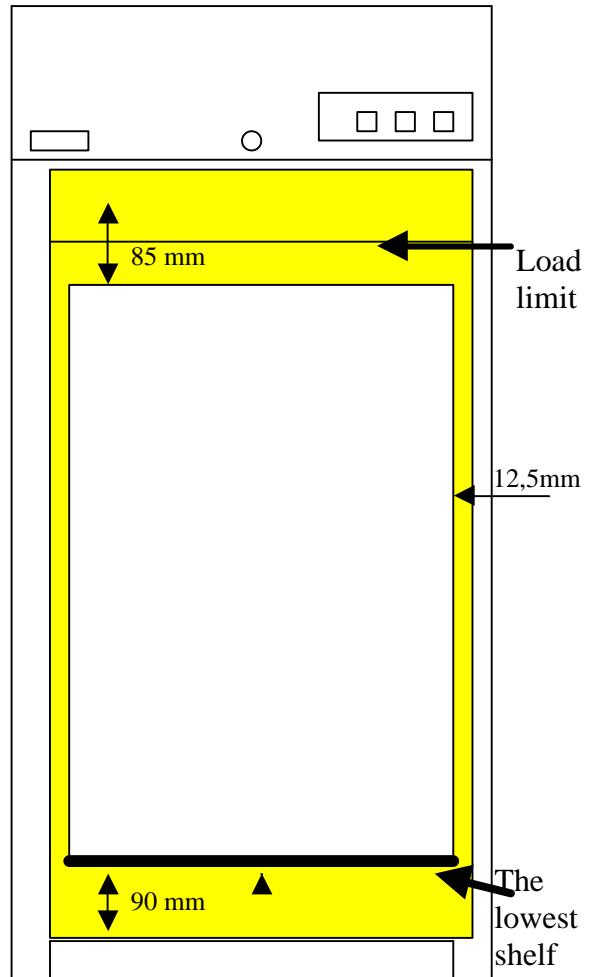
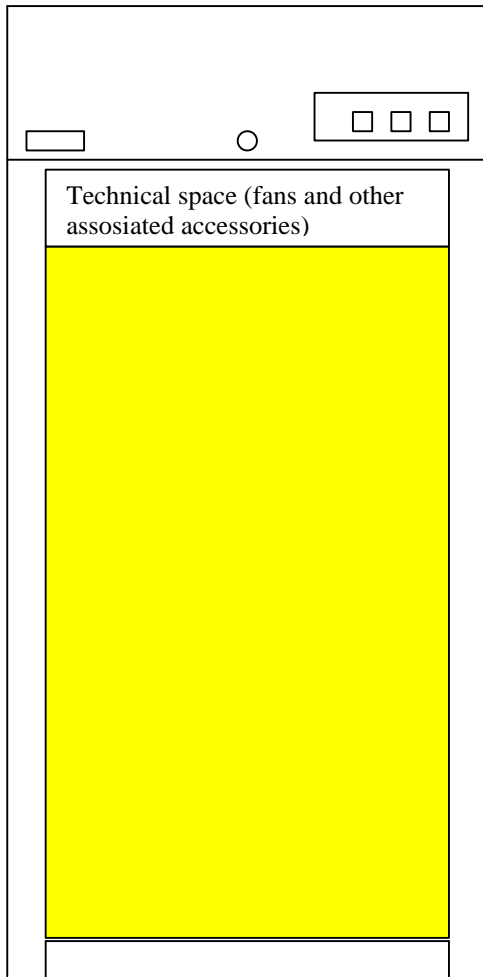
=====

**436.99 dm<sup>3</sup>**

**POLARIS STN 70 STD**, Refrigerator, temperature range  $\pm 0^{\circ}\text{C} \dots +10^{\circ}\text{C}$

When the gross volume is determined, internal fittings such as shelves, partitions, containers, evaporators, thermostat and/or interior light housings shall be considered as **not being in place**.

The gross volume shall take into account the **exact shapes of the walls** if they contain depressions or projections. If cooling is **effected by forced air**, any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories shall also be deducted (ISO 7371, ISO 8561, clause 7.2.1).



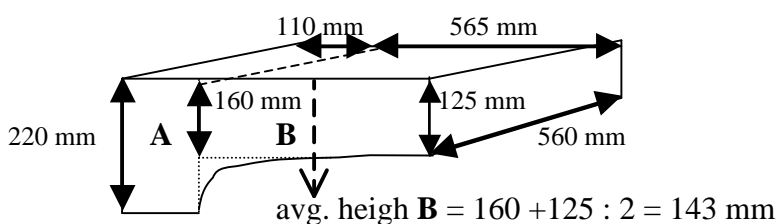
<b>Gross volume</b>	<span style="display: inline-block; width: 15px; height: 15px; background-color: yellow; border: 1px solid black;"></span>
Width	560 mm
Depth	680 mm
Heigh	1540 mm
=====	
<b>586.43 dm<sup>3</sup></b>	

<b>Storage volume</b>	<span style="display: inline-block; width: 15px; height: 15px; border: 1px solid black;"></span>
Width	535 mm
Depth	650 mm
Heigh	1240 mm
=====	
<b>431.21 dm<sup>3</sup></b>	

} the area of shelf

$586.43 - 431.21 = 155.22 \text{ dm}^3$

**Technical space, sideview:**



**Volume of the technical space:**

**A:**  $2.20 \times 1.10 \times 5.6 = 13.55 \text{ dm}^3$   
**B:**  $1.43 \times 5.65 \times 5.6 = 45.24 \text{ dm}^3$

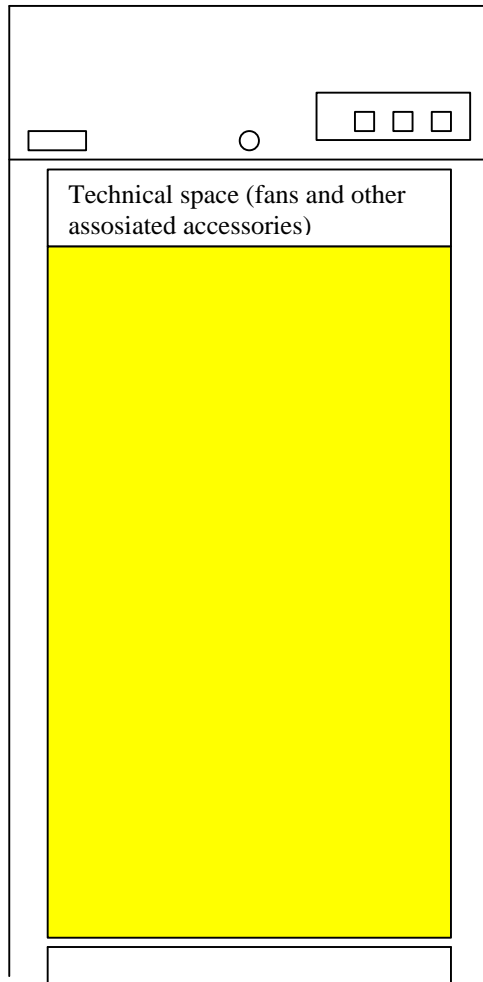
=====

sum **58.79 dm<sup>3</sup>**

**POLARIS SA BT 70**, Freezer, temperature range -18°C...-21°C

When the gross volume is determined, internal fittings such as shelves, partitions, containers, evaporators, thermostat and/or interior light housings shall be considered as **not being in place**.

The gross volume shall take into account the **exact shapes of the walls** if they contain depressions or projections. If cooling is **effected by forced air**, any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories shall also be deducted (ISO 7371, ISO 8561, clause 7.2.1).



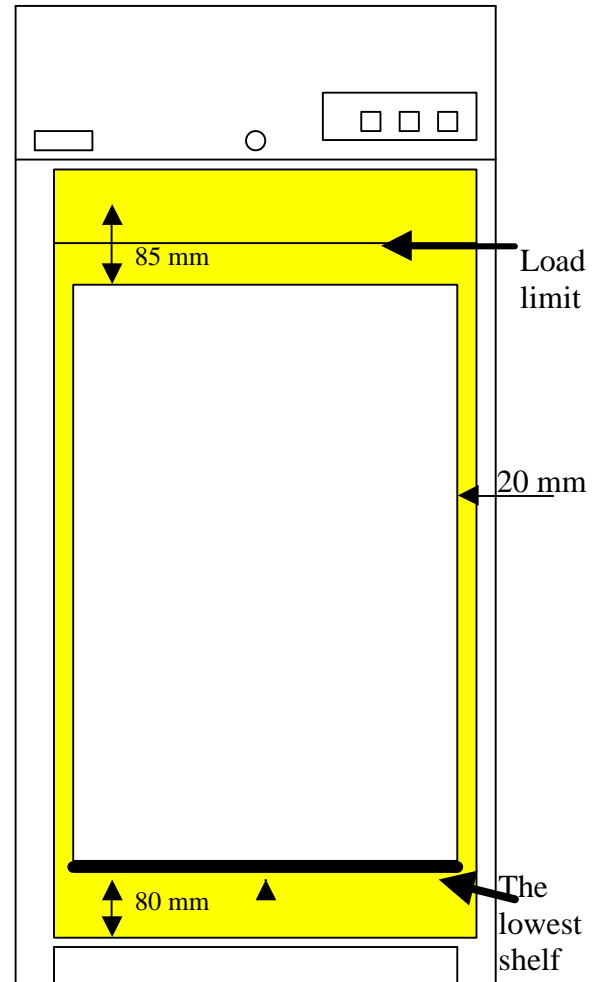
**Gross volume**

Width 580 mm  
Depth 680 mm  
Height 1540 mm

=====

607.37 dm<sup>3</sup>

607.37 - 58.6 = **548.77 dm<sup>3</sup>**



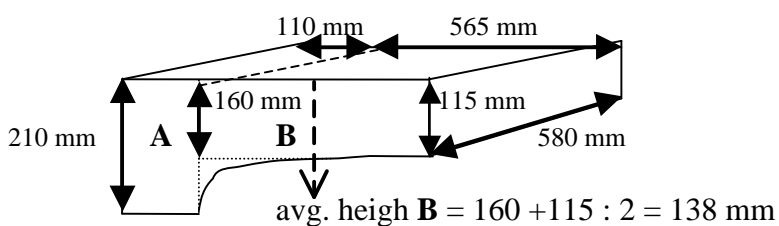
**Storage volume**

Width 540 mm  
Depth 650 mm } the area of shelf  
Height 1240 mm

=====

**435.24 dm<sup>3</sup>**

**Technical space, sideview:**



**Volume of the technical space:**

**A:** 2.10 x 1.10 x 5.8 = 13.4 dm<sup>3</sup>

**B:** 1.38 x 5.65 x 5.8 = 45.2 dm<sup>3</sup>

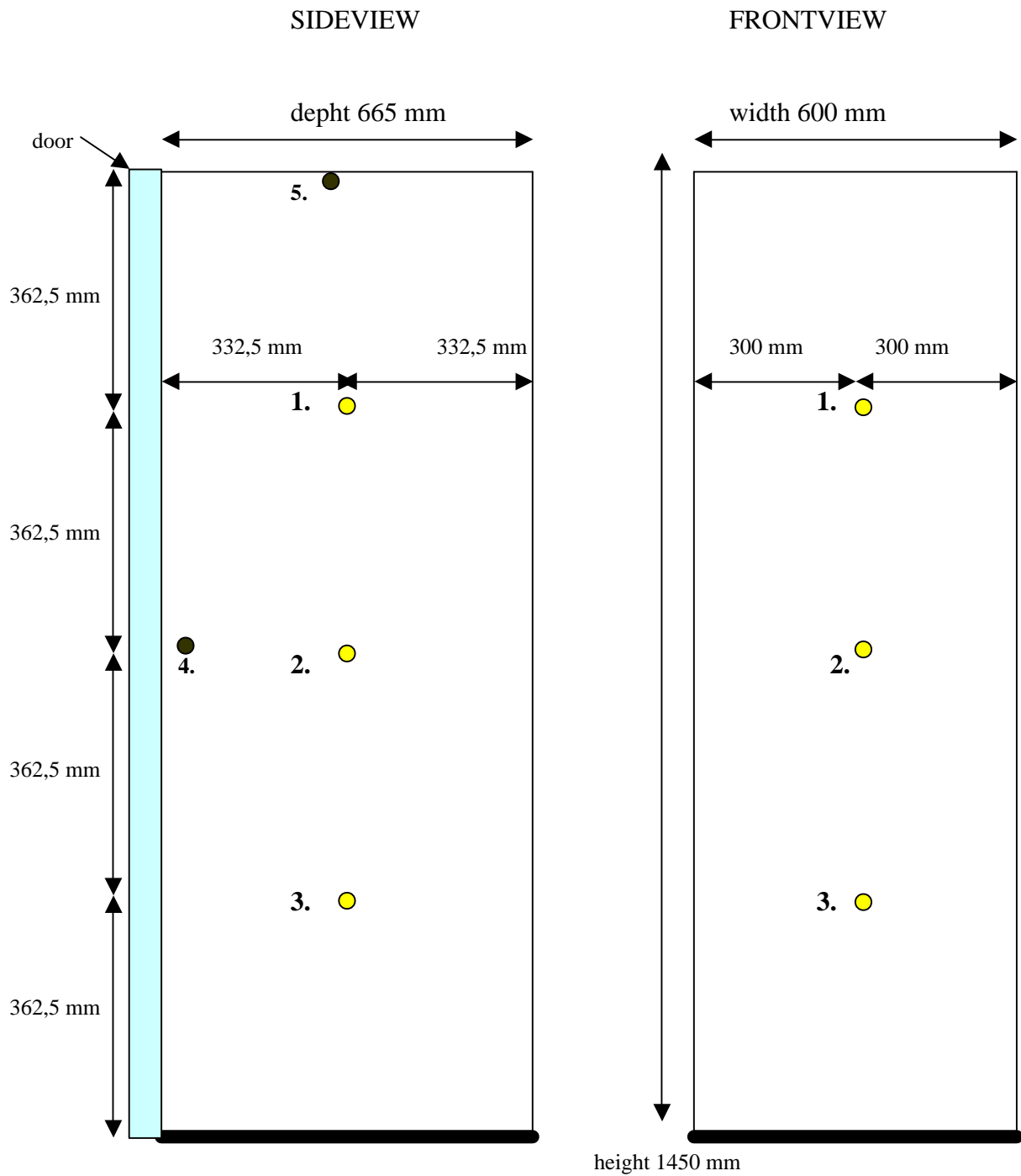
=====

sum **58.6 dm<sup>3</sup>**

The arrangements of the measuring points

### ALPENINOS EO6NOD1C REFRIGERATOR

-4°C...+8°C



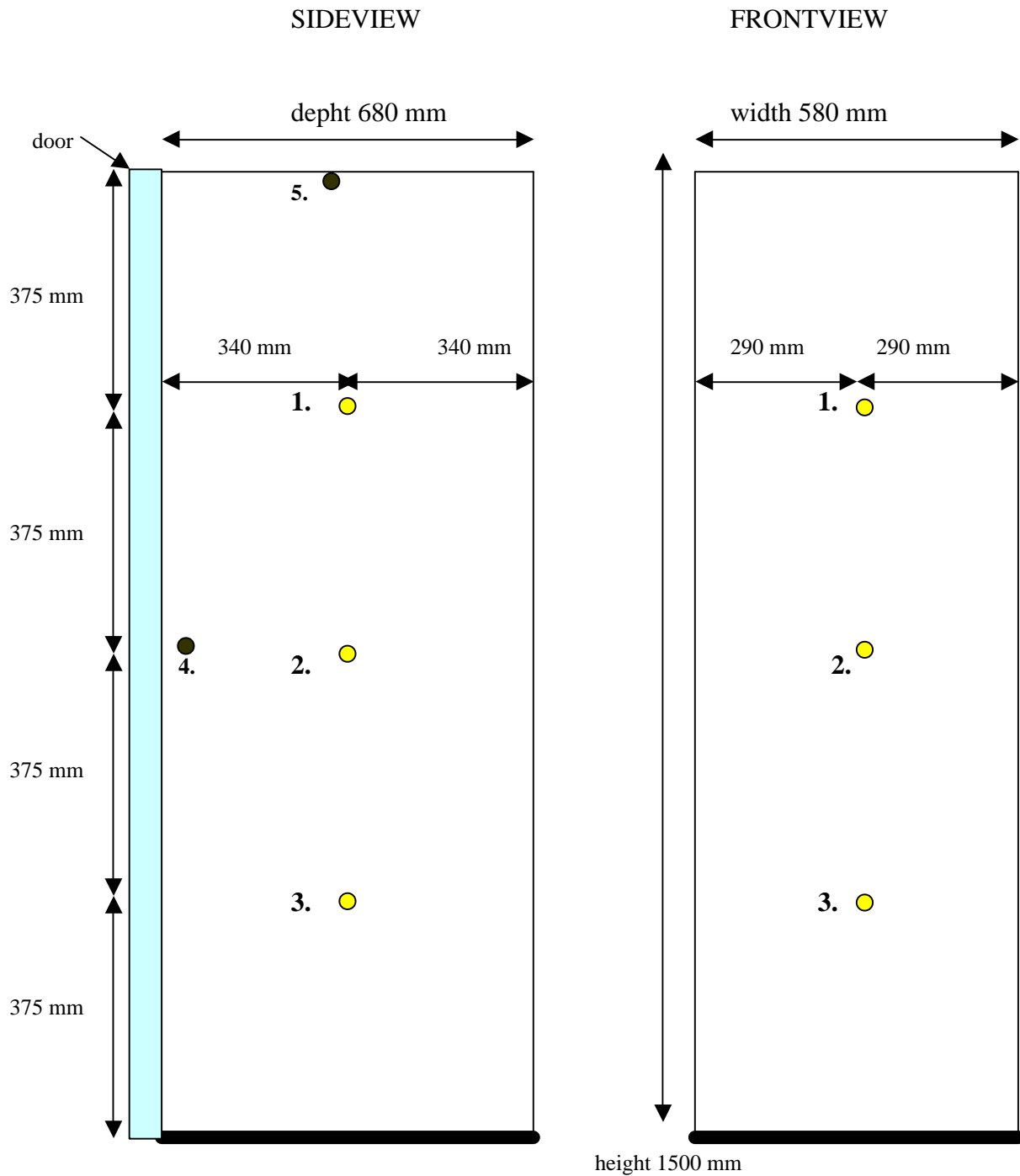
total height (indoors) 1450 mm

The average temperature of the refrigerator = arithmetical average of the mean temperature points 1,2 and 3 (the arithmetical average of the extreme values at these points 1,2 and 3 during the measuring period).

The arrangements of the measuring points

### FOSTER PREM G600H REFRIGERATOR

$\pm 0^{\circ}\text{C} \dots +8^{\circ}\text{C}$

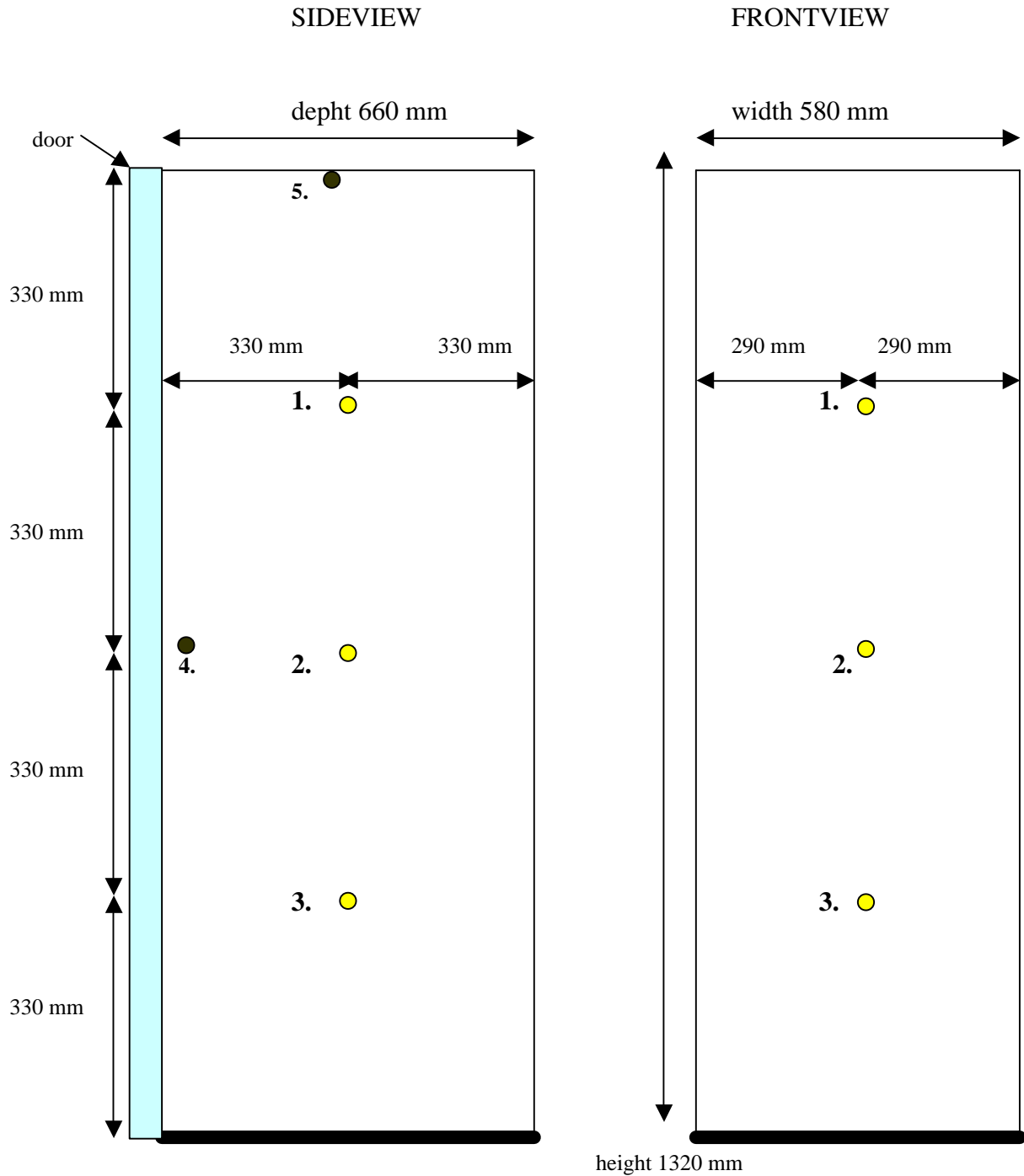


total height (indoors) 1500 mm

The average temperature of the refrigerator = arithmetical average of the mean temperature points 1,2 and 3 (the aritmetical average of the extreme values at these points 1, 2 and 3 during the measuring period).

The arrangements of the measuring points

**GRAM K 600 OPCHHA REFRIGERATOR**  
-5°C...+12°C

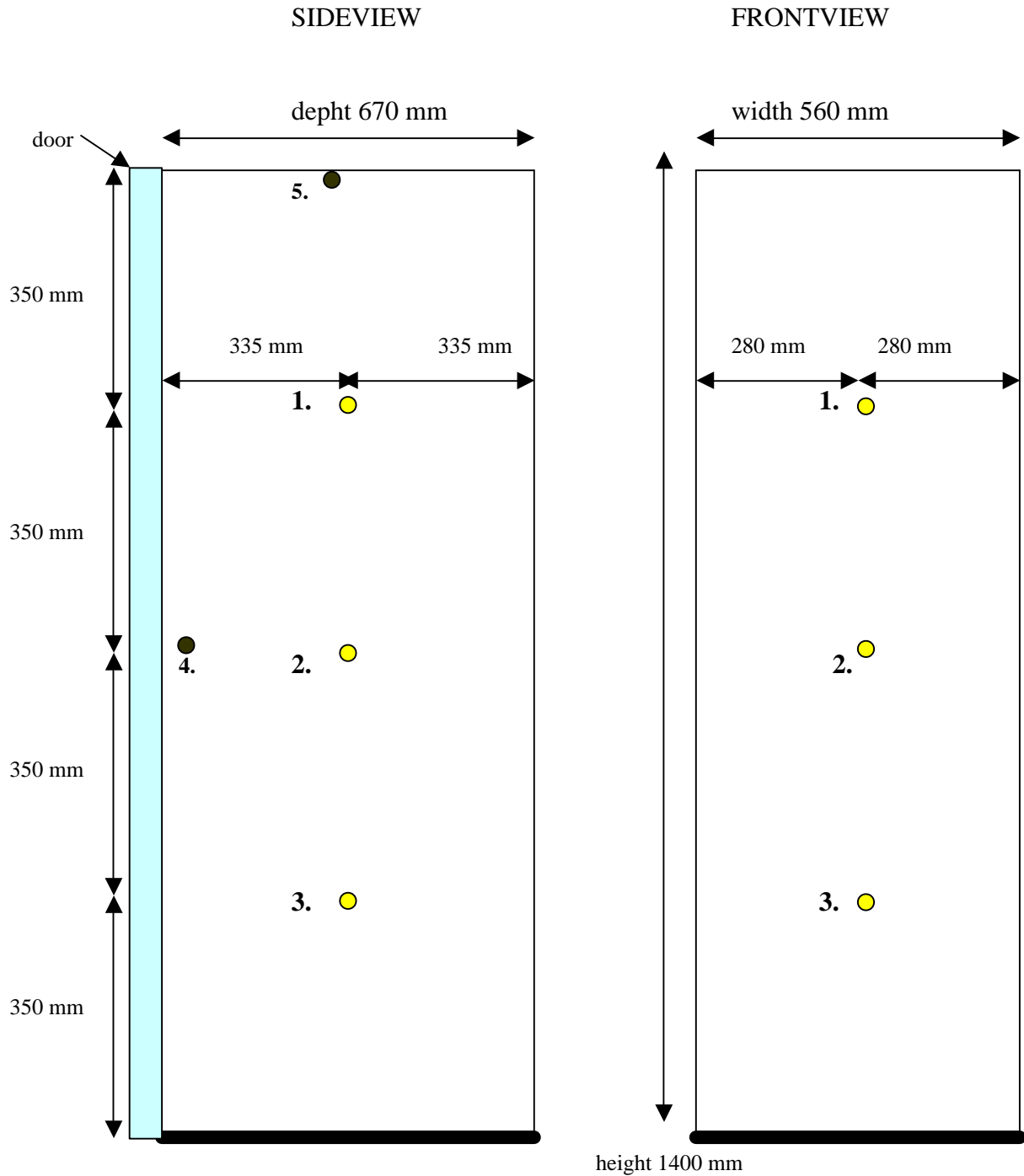


total height (indoors) 1320 mm

The average temperature of the refrigerator = arithmetical average of the mean temperature points 1,2 and 3 (the aritmetical average of the extreme values at these points 1, 2 and 3 during the measuring period).

The arrangements of the measuring points

**POLARIS STN 70 STD REFRIGERATOR**  
 $\pm 0^{\circ}\text{C} \dots +10^{\circ}\text{C}$



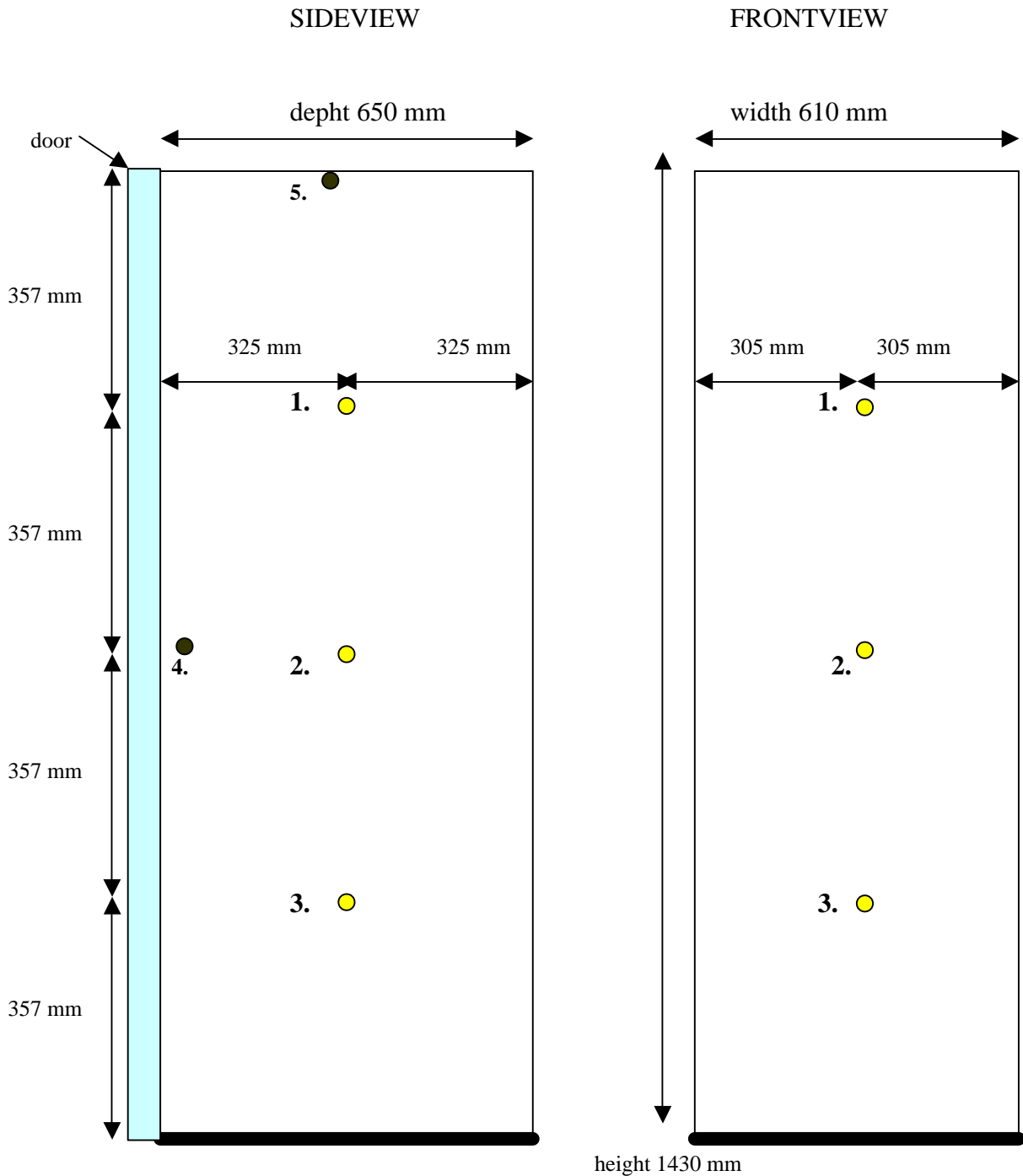
total height (indoors) 1400 mm

The average temperature of the refrigerator = arithmetical average of the mean temperature points 1,2 and 3 (the aritmetical average of the extreme values at these points 1, 2 and 3 during the measuring period).

The arrangements of the measuring points

**PORKKA FUTURE PLUS C732** and  
Refrigerator +1°C...+12°C

**PORKKA FUTURE C 722**  
Refrigerator +1°C...+12°C

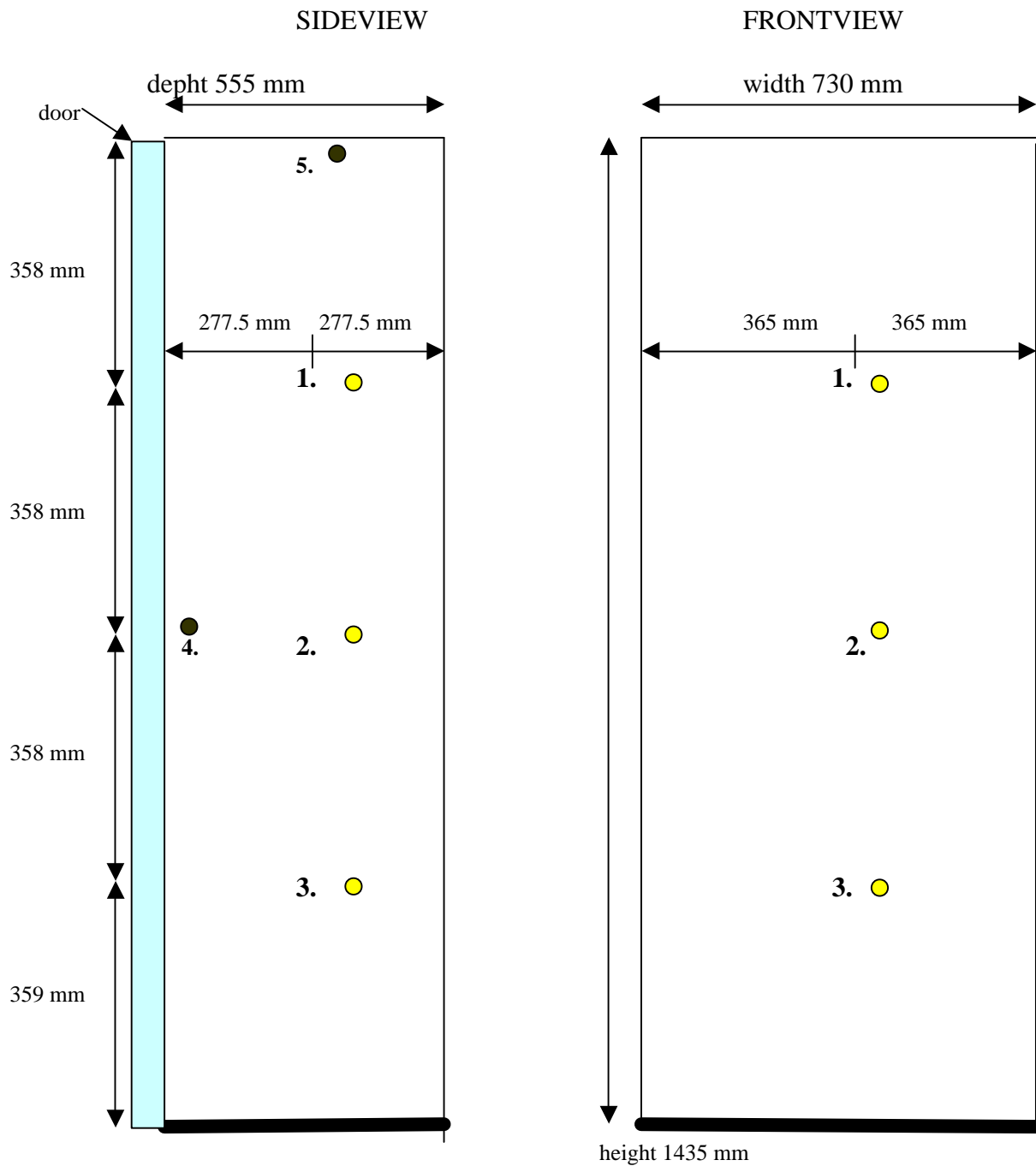


total height (indoors) 1428 mm

The average temperature of the refrigerator = arithmetical average of the mean temperature points 1,2 and 3 (the arithmetical average of the extreme values at these points 1,2 and 3 during the measuring period).

The arrangements of the measuring points

**PORKKA FUTURE PLUS C 730 REFRIGERATOR**  
+1°C...+12°C



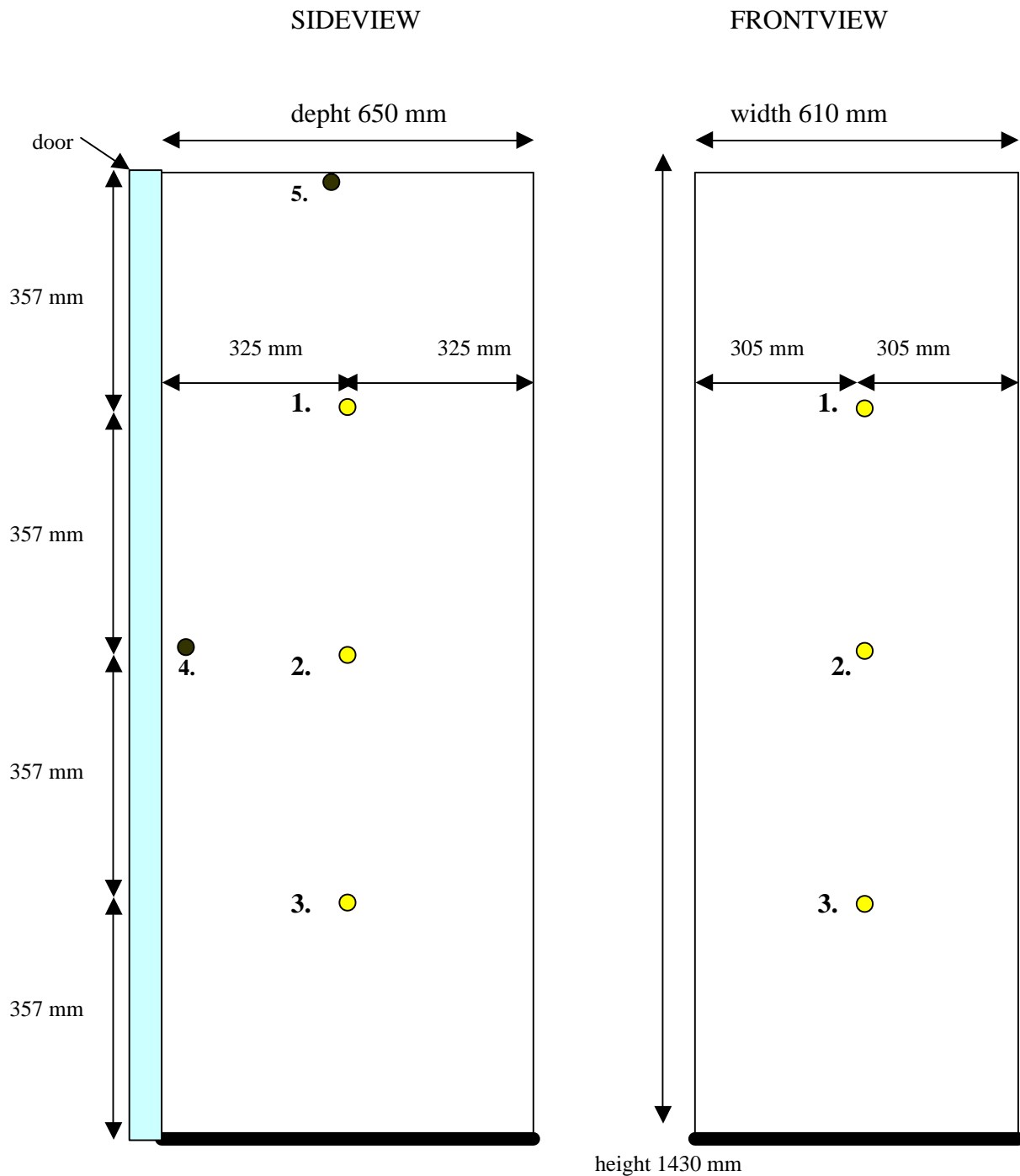
total height (indoors) 1435 mm

The average temperature of the refrigerator = arithmetical average of the mean temperature points 1,2 and 3 (the arithmetical average of the extreme values at these points 1,2 and 3 during the measuring period).

The arrangements of the measuring points

### PORKKA FUTURE PLUS M 732 REFRIGERATOR

-5°C...+12°C



total height (indoors) 1428 mm

The average temperature of the refrigerator = arithmetical average of the mean temperature points 1,2 and 3 (the arithmetical average of the extreme values at these points 1, 2 and 3 during the measuring period).

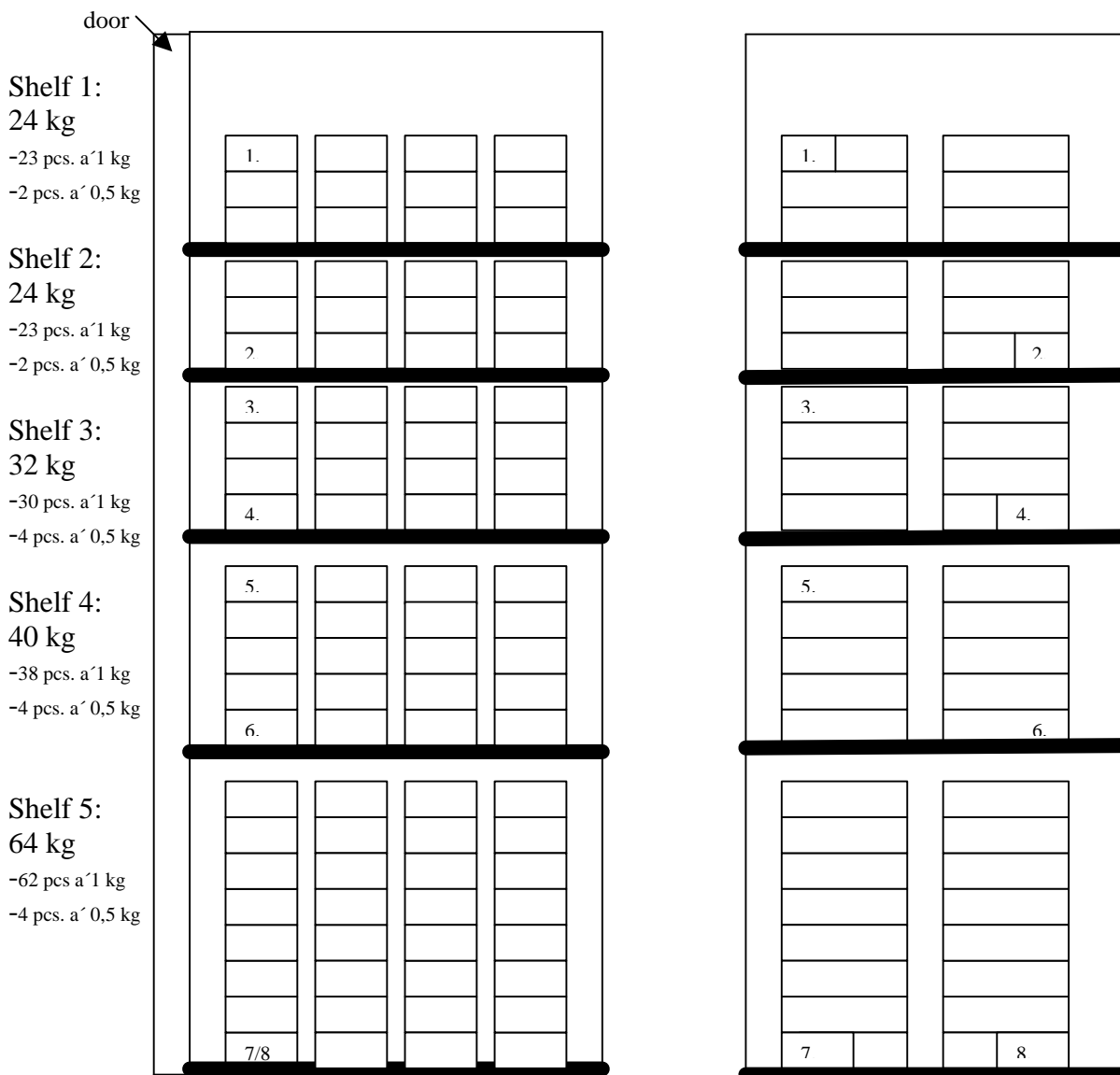
The arrangements of the test packages

### ALPENINOS EO6COD1C FREEZER

-15°C...-24°C

Sideview

Frontview



=====  
**Total load 184 kg**

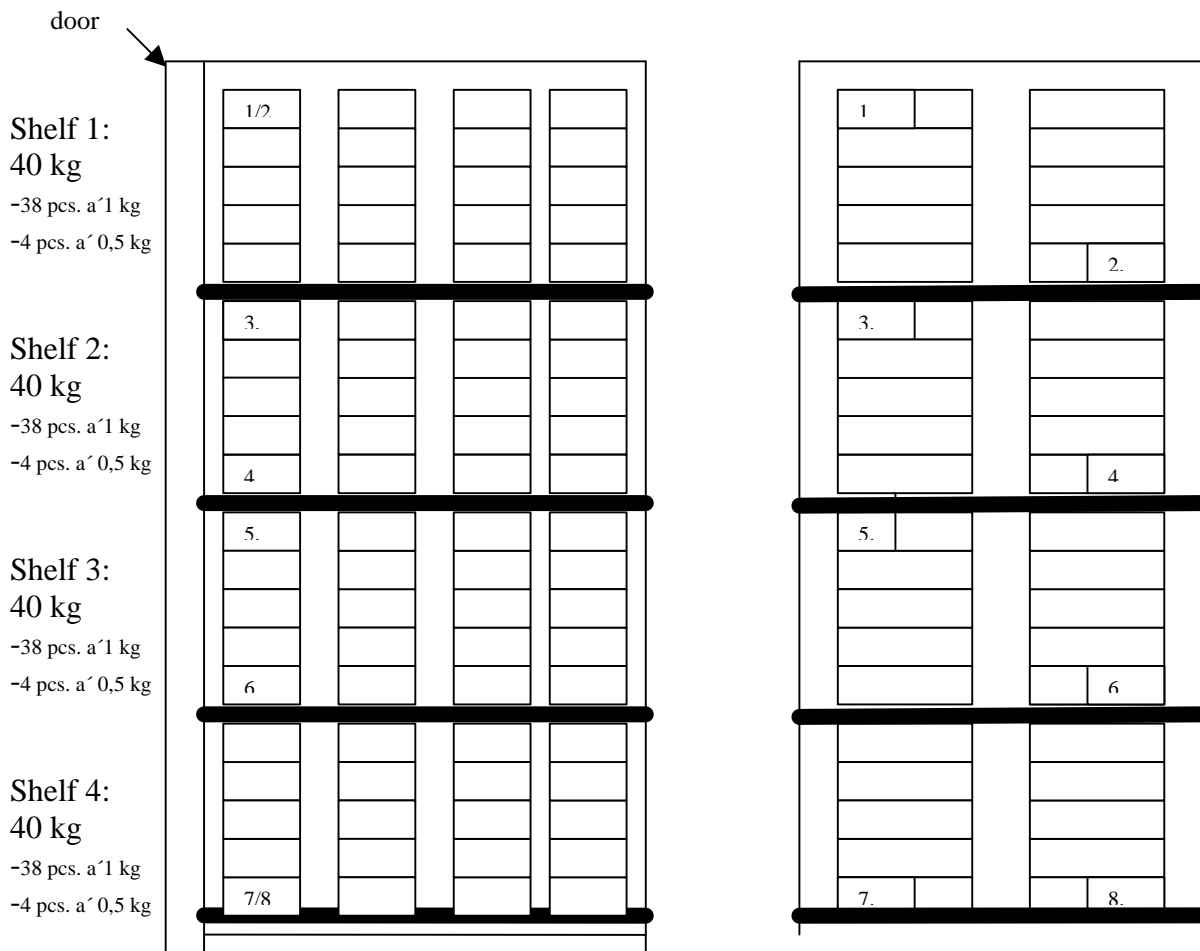
The arrangements of the test packages (according manufacturer)

### FOSTER PREM G600L FREEZER

-15°C...-25°C

Sideview

Frontview



=====  
**Total load 160 kg**

The arrangements of the test packages

### GRAM F 600 FREEZER

-5°C...-25°C

**Sideview**

**Frontview**

door

Shelf 1

48,00 kg

-46 pcs. a'1 kg

-4 pcs. a' 0,5 kg

Shelf 2:

48,00 kg

-46 pcs. a'1 kg

-4 pcs. a' 0,5 kg

Shelf 3:

60 kg

-58 pcs. a'1 kg

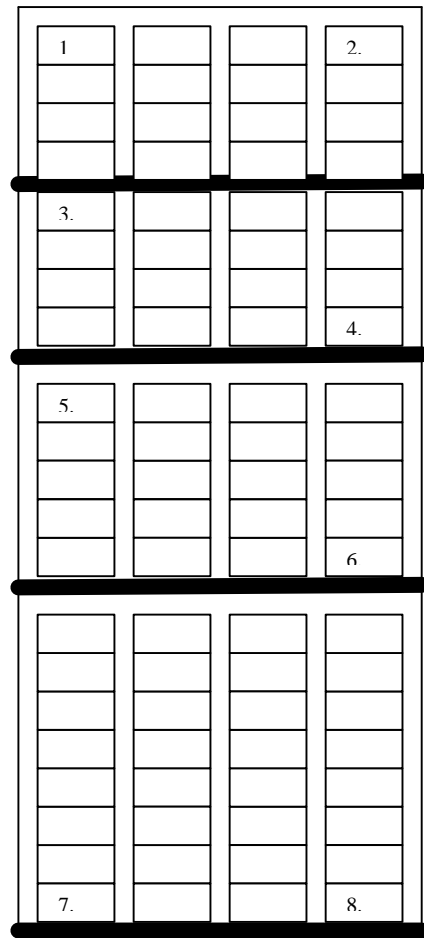
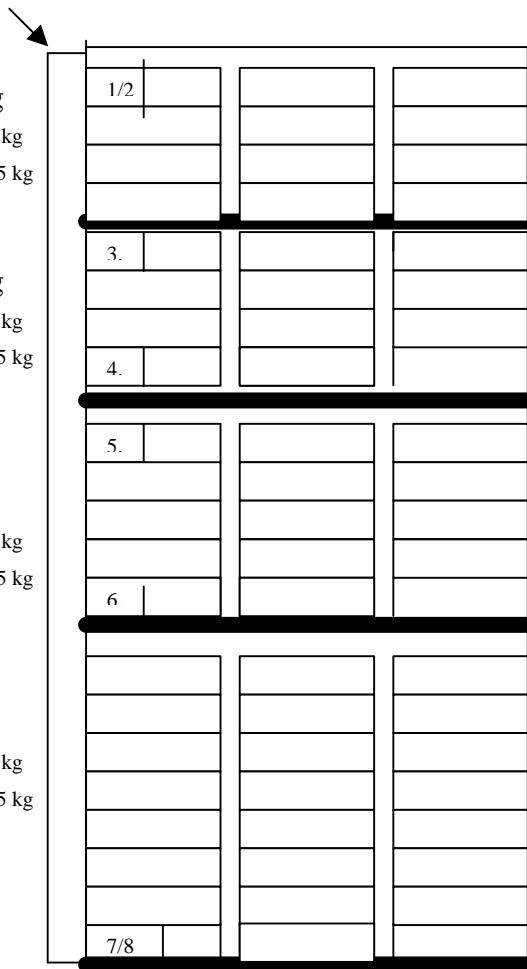
-4 pcs. a' 0,5 kg

Shelf 4:

96 kg

-94 pcs. a'1 kg

-4 pcs. a' 0,5 kg



=====  
**Total load 252 kg**

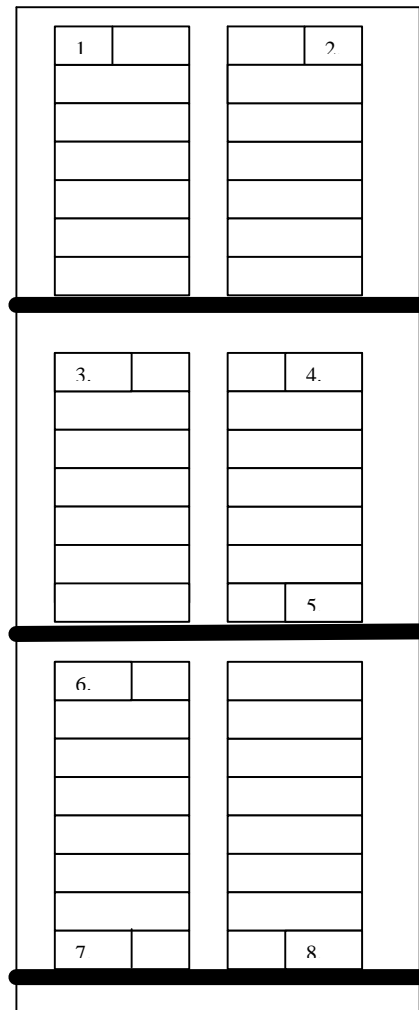
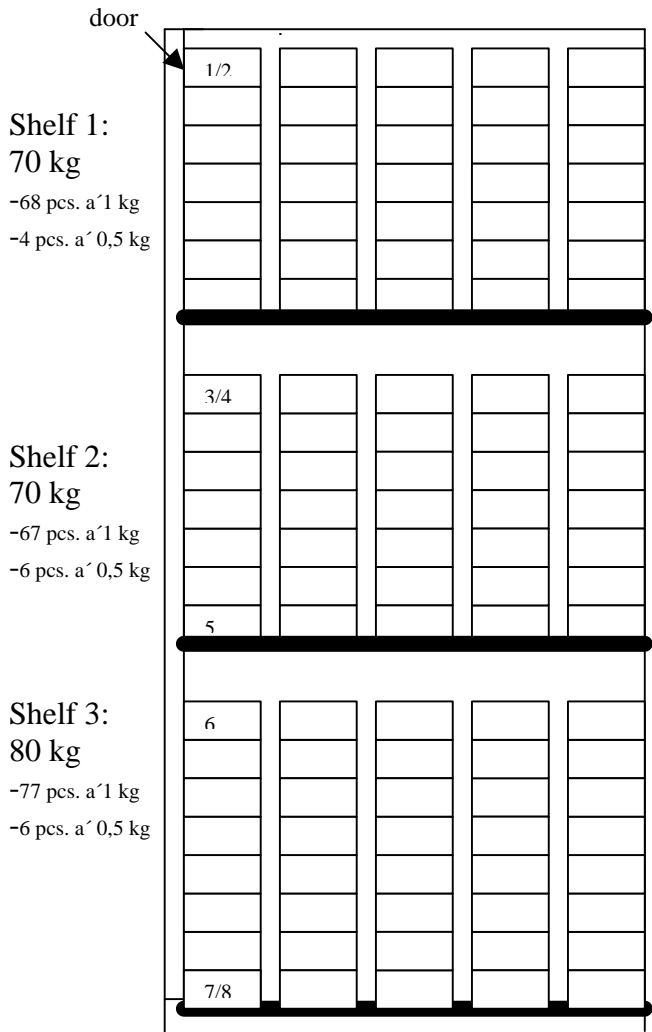
The arrangements of the test packages

**POLARIS SA BT 70 FREEZER**

-18°C...-21°C

Sideview

Frontview



=====

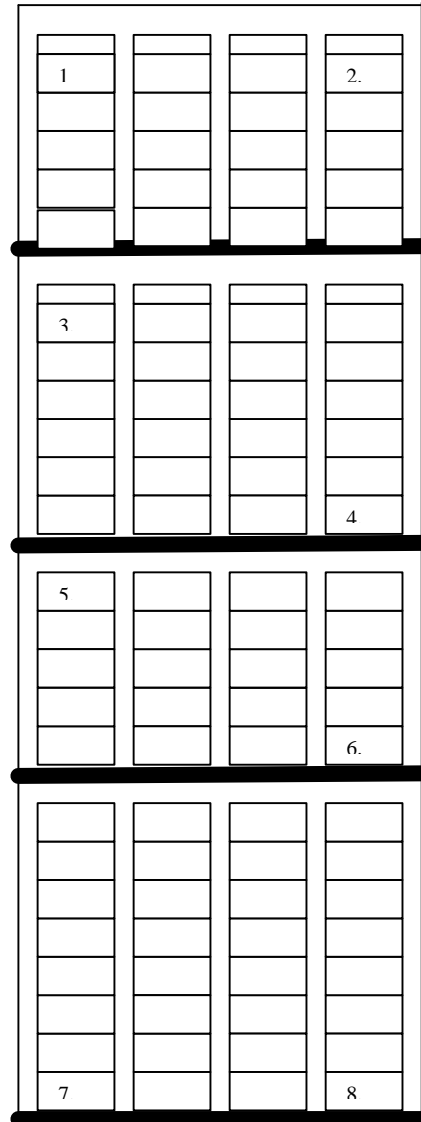
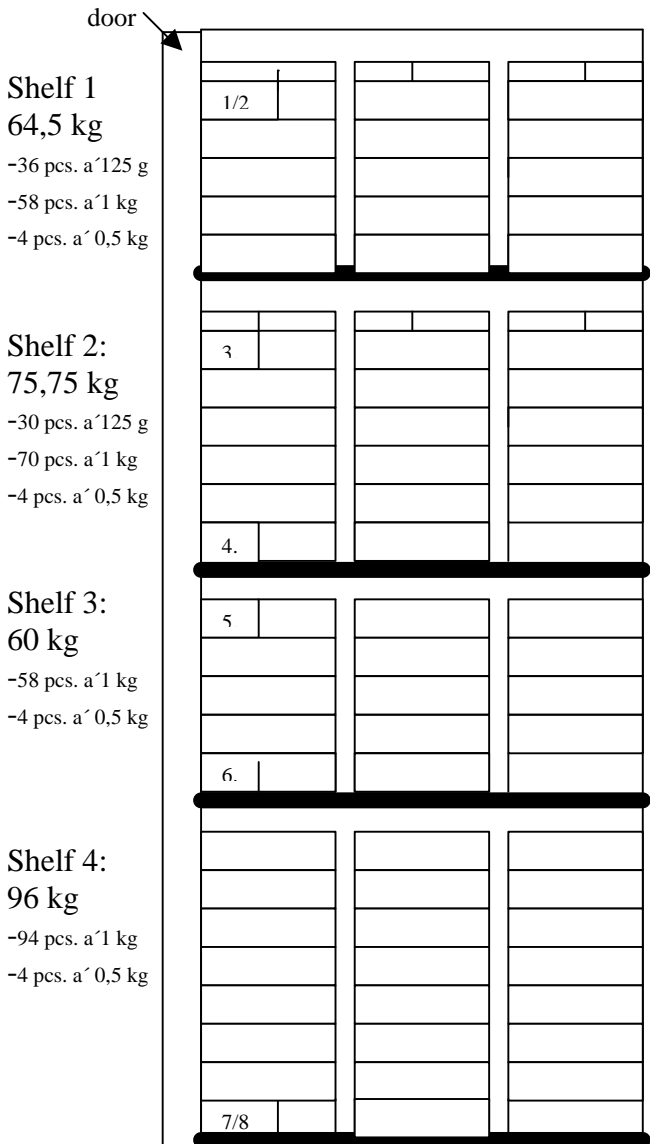
**Total load 220,00 kg**

The arrangements of the test packages

**PORKKA FUTURE PLUS F 732 FREEZER**  
 -18°C...-26°C

Sideview

Frontview



=====  
**Total load 296,25 kg**

The arrangements of the test packages

**PORKKA FUTURE PLUS F 730 FREEZER**

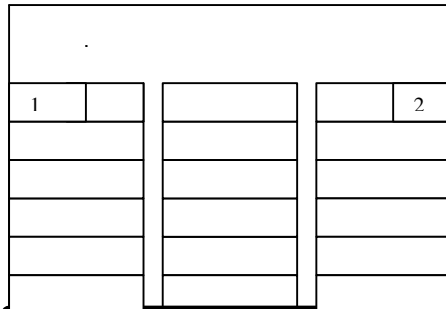
-15°C...-26°C

Frontview

Sideview  
oyi

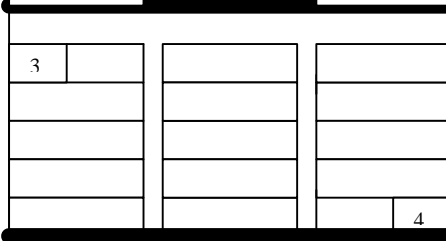
Shelf 1  
72,00 kg

-70 pcs a´1 kg  
-4 pcs a´ 0,5 kg



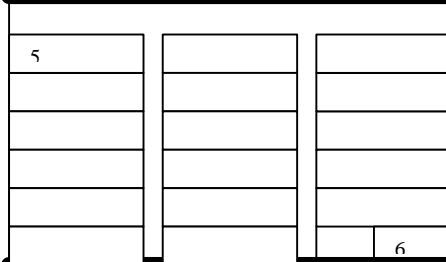
Shelf 2:  
60,00 kg

-58 pcs a´1 kg  
-4 pcs a´ 0,5 kg



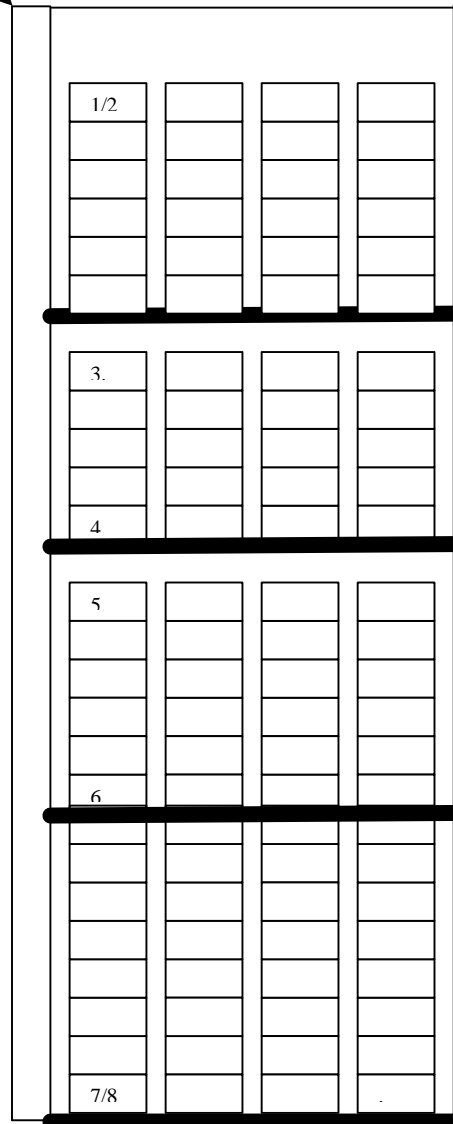
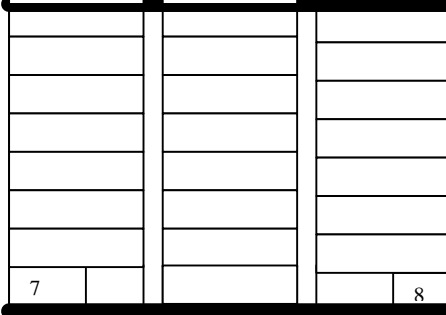
Shelf 3:  
72,00 kg

-70 pcs a´1 kg  
-4 pcs a´ 0,5 kg



Shelf 4:  
96 kg

-94 pcs a´1 kg  
-4 pcs a´ 0,5 kg



=====

**Total load 300,00 kg**

# **The impact of the structural air circulation systems of refrigeration appliances on condensing air temperature in operating conditions**

**28.06.2001**

Refrigerators:	Foster PREM G600H Porkka Future Plus C 732
Freezers:	Foster PREM G600L Porkka Future Plus F 732

***Purpose:***

*The purpose of the tests was to assess the performance under institutional kitchen conditions of refrigeration appliances manufactured for professional use by Porkka Finland Oy. In the performance test, the operation of Porkka's Future Plus C732 refrigerator and F732 freezer was compared with the operation of Foster's PREM G600H refrigerator and PREM G600L freezer, which are of equal size but operate in the standard way.*

*In the refrigeration appliances of the Porkka Future Plus series, the condensing air of the refrigeration unit is drawn from the lower part of the appliance through a filter into an air duct in the rear wall of the appliance and through the duct on to a condenser on top of the appliance. The condensing air used by the appliances that operate in the standard way is the air around the refrigeration unit on top of the appliance where the air is warmer than the heavier cold air that sinks towards the floor.*



## **Background information on the kitchen of the Food Centre and the location of the appliances in the kitchen**

The refrigeration appliances were located in the institutional kitchen of the Food Centre of the TTS Institute Adult Education Centre. The area of the kitchen is 144m<sup>2</sup> and the volume 430m<sup>3</sup>. Besides the kitchen, the Food Centre includes two lunchrooms, staff facilities and walk-in cold rooms (40m<sup>2</sup> = 6+1 rooms). The refrigeration appliances in the cold room are connected to the central machinery system. The appliances used as the kitchen's daily storage operate on their own machinery. The appliances included in this observation study temporarily replaced those normally used as daily storage. The Foster appliances were surveyed during 18–29 May 2001 and the Porkka appliances during 6–15 June 2001.

The kitchen is ventilated with an exhaust air machine, which draws heated air from the cooking and washing units. Intake air comes through central ventilation. The plan of the kitchen, where the tested appliances have been marked, is attached as Appendix 5.

The Food Centre has been planned for 500 people. During the survey, a total of 150–220 portions were sold daily. The annual average is 3,900 portions. The Food Centre is open from 7.30am to 2.30pm (Fridays to 1.30pm), and food is sold throughout the opening hours. The busiest times are breakfast, mid-morning coffee, lunch (11am–1pm) and afternoon coffee. The kitchen has four full-time employees.

## **Comparing refrigeration appliances in operating conditions**

The results gained in operating conditions can be used to compare appliances with different air circulation systems as regards temperature changes in their air circulation, which was the main purpose of this survey.

The results are based on the temperatures during the operation of the appliance refrigeration unit. Temperatures during idle hours were not considered (Tables 1 and 2).

Porkka Future Plus refrigeration appliances draw the condenser's intake air from underneath the appliance. In the tests, the air drawn from underneath the Porkka Future Plus C 732 was on average 1.45°C warmer when arriving in the condenser than when arriving in the intake duct of the appliance close to the floor (Table 1).

In the Future Plus F 732 freezer, the air arriving in the condenser warmed by approximately 0.1°C in the intake duct (Table 2). The air above the appliances was approximately 3°C warmer above the cooler and 4.4°C warmer above the freezer than the condensing air arriving in the condenser through the intake duct.

The Foster PREM G600H draws the air to the condenser from around the appliance. In the tests, the air arriving in the appliance's condenser was approximately 8.6°C warmer than the air underneath the appliance. The intake air around the condenser of the Foster PREM G600L freezer was 10.11°C warmer than the air underneath the appliance. Figure 1 shows the operation of the Porkka Future Plus freezer in a typical situation depicting the conditions in a professional kitchen.



## Conclusion

In the tests, the air arriving in the condensers of the Porkka Future Plus C 732 refrigerator and the Porkka Future Plus F 732 freezer was approximately 7.2°C cooler than the condensing air of the traditional Foster Prem G600H refrigerator and PREM G600L freezer (temperature of operational environment +20...+24°C). During the testing period of the Foster refrigeration appliances, the air temperature in the kitchen was a few degrees lower than when testing the Porkka appliances, which has to be considered when comparing the results. Detailed results are shown in Tables 1 and 2 as well as in Appendices 1, 2, 3 and 4.

A commensurable comparison between these two types of appliance that differ in their air circulation systems was not possible within the framework of this survey. The operating conditions during the testing periods of the two types were not similar, the loads on the appliance varied, the doors were opened a different number of times and, in particular, the testing periods were too short to draw conclusions.

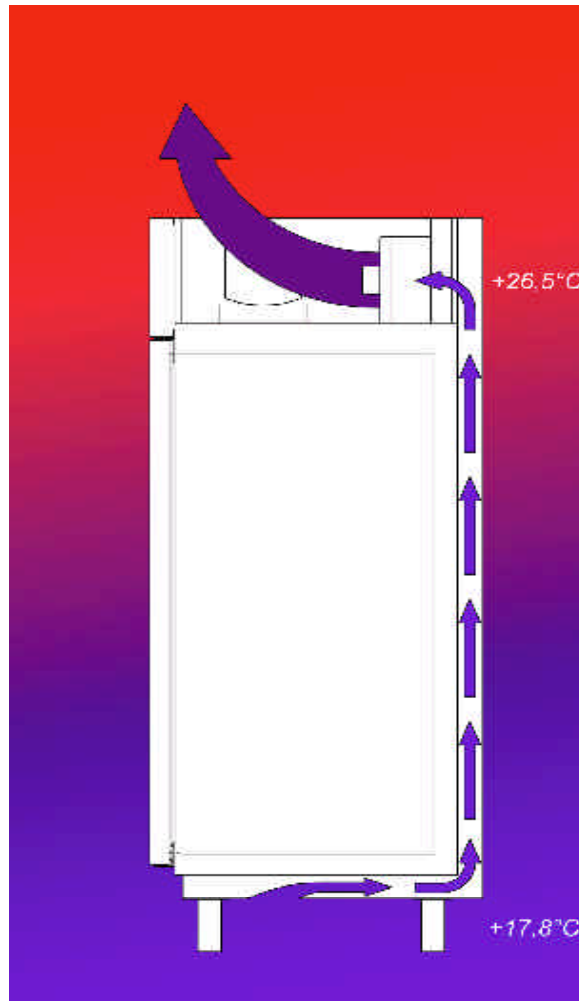
**Table 1.** Comparing the operation of refrigeration appliances under operational conditions. (*Temperatures based on the temperatures measured during the operation of the appliance's refrigeration unit*).

Measuring period, 12 h	Porkka Future Plus C 732	Foster PREM G600H
	Appendix 1	Appendix 2
Testing day	12 June 2001	28 May 2001
Time	6am–6pm	6am–6pm
Average temperature of air arriving in condenser	21.49°C	28.71°C
Average temperature of air layer underneath appliance; distance from floor 10cm	20.04°C	20.11°C
<i>remainder of temperatures</i>	<i>1.45°C</i>	<i>8.60°C</i>
Average temperature of air layer above appliance; distance from top of appliance 20cm	24.5°C	24.2°C



**Table 2.** Comparing the operation of freezers under operational conditions.  
 (Temperatures based on the temperatures measured during the operation of the appliance's refrigeration unit).

Measuring period, 12 h	Porkka Future Plus F 732	Foster PREM G600L
		Appendix 3
Testing day	12 June 2001	28 May 2001
Time	6am–6pm	6am–6pm
Average temperature of air arriving in condenser	20.78°C	28.05°C
Average temperature of air layer underneath appliance; distance from floor 10cm	20.72°C	17.94°C
<i>remainder of temperatures</i>	<i>0.1°C</i>	<i>10.11°C</i>
Average temperature of air layer above appliance; distance from top of appliance 20cm	25.2°C	-°C



**Figure 1.** The operation of Porkka Future Plus refrigeration appliances in a typical situation depicting the conditions in a professional kitchen.



## ORDER

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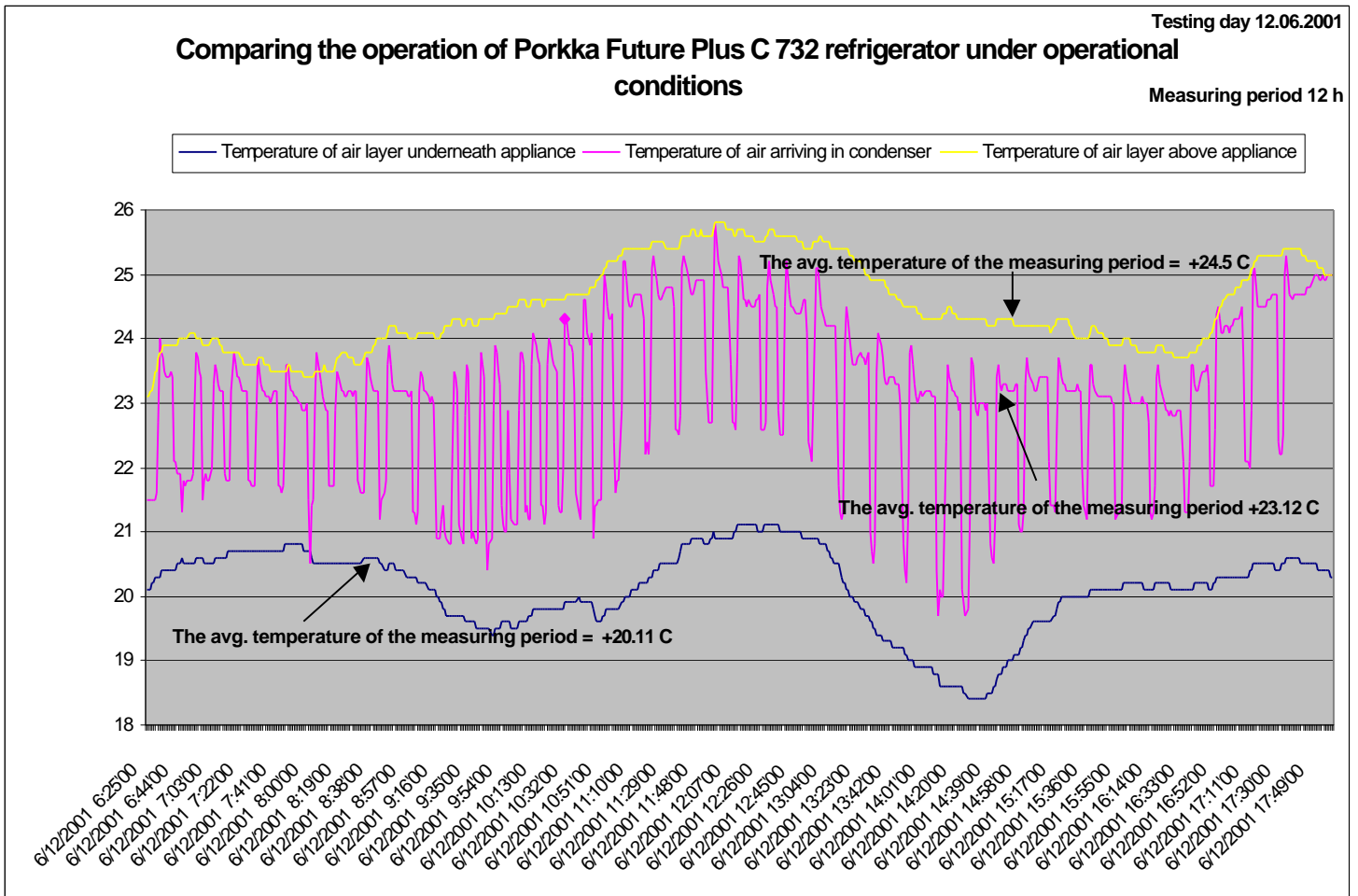
Tarja Marjomaa



## APPENDIX 1

### Comparing the operation of refrigerator Porkka Future Plus C 732 under operational conditions.

Measuring period 12.06.2001

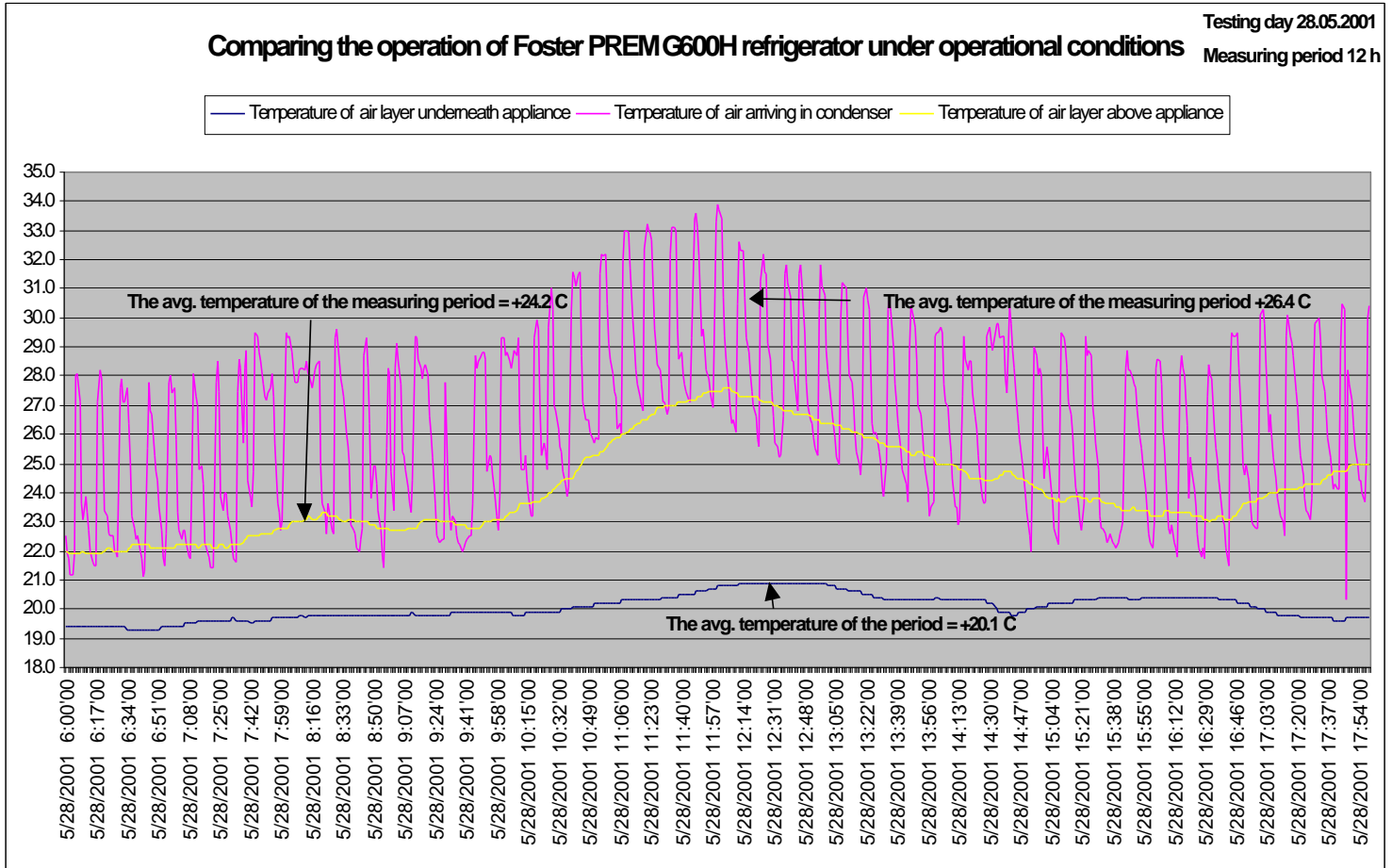




## APPENDIX 2

### Comparing the operation of refrigerator Foster PREM G600H under operational conditions.

Measuring period 28.05.2001

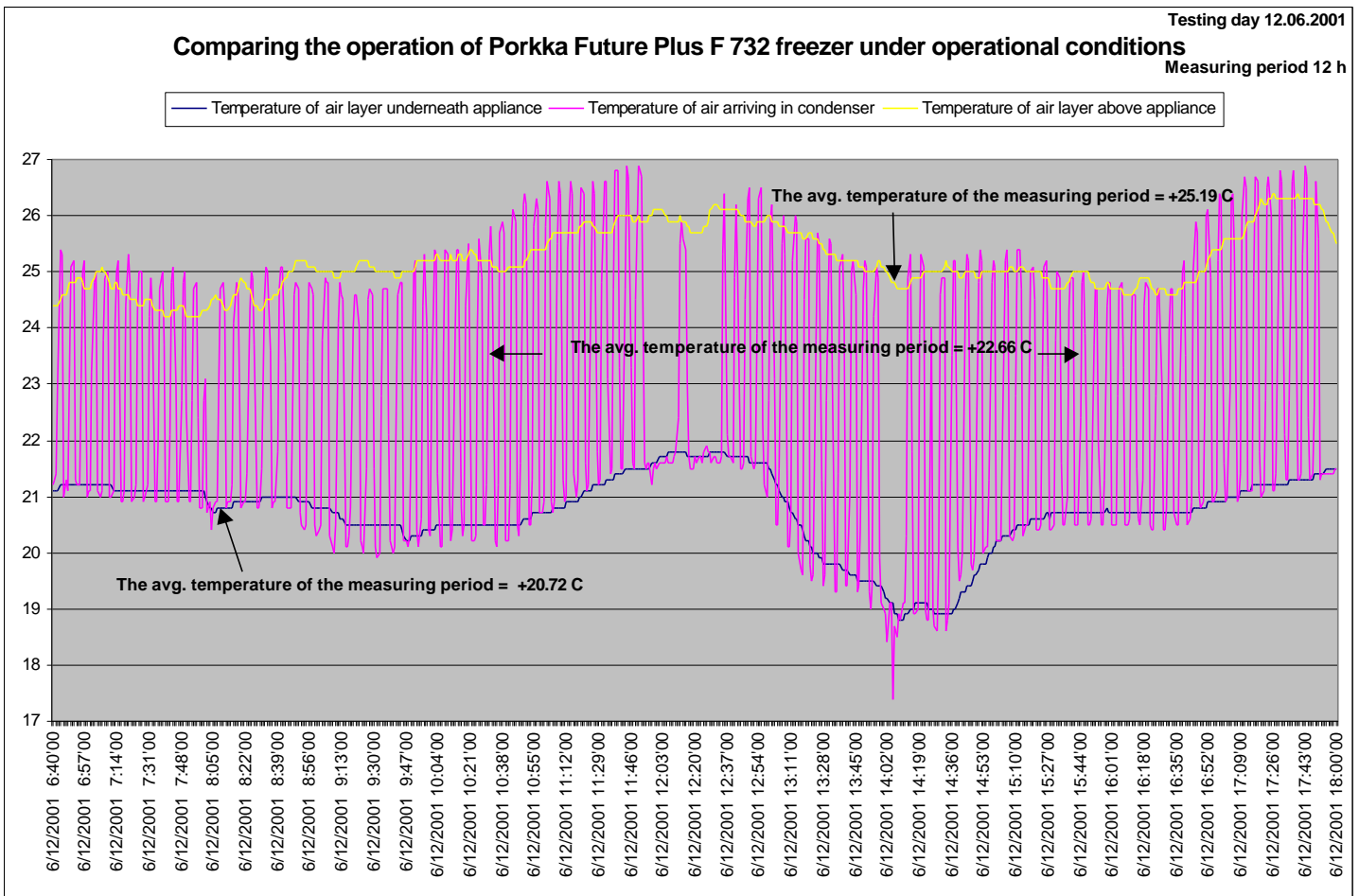




### APPENDIX 3

## Comparing the operation of freezer Porkka Future Plus F 732 under operational conditions.

Measuring period 12.06.2001





## APPENDIX 4

### Comparing the operation of freezer Foster PREM G600L under operational conditions.

Measuring period 28.05.2001

