Refrigerator and Air conditioner Testing in the Republic of Korea

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Energy Labeling Program

- “Regulations on Appliance Energy Efficiency Standards Setting and Rating Labeling” issued on August 1992
- Revised six times on 1993, 1994, 1995, 1996 ,1999, 2000
- 9 items
  - Electric Refrigerator , Electric Air-Conditioner , ballast, Electric Washing Machine, incandescent lamp, fluorescent lamp, ballast lamp, Passenger Car, Household gas boiler

- The followings are considered to be added in the future
  - compact gas boiler(2002), electric radiant heaters (2001), electric water heaters(not fixed), dishwasher(2001), compact fluorescent lamp 36W (2002) etc.

Refrigerator

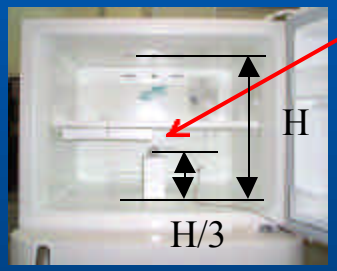
- Scope
  - KS C 9305-1999 covers household electric refrigerators of storage volume 1000 L or less
  - and, the rated power consumption of compression type machine is less than 500W
  - with compression type refrigerating machine and storage cabinet integrated in one body

- Definition
  - Refrigerator
  - Refrigerator-Freezer
  - Freezer (None Applicable)

Ambient Temperature	Compartment	One star	Two star	Three star and four star
30±1 °C 75±5 %	Mean Freezer load temperature	-6±0.5 °C	-12±0.5 °C	-18±0.5 °C
	Mean Refrigerator load temperature	3±0.5 °C	3±0.5 °C	3±0.5 °C

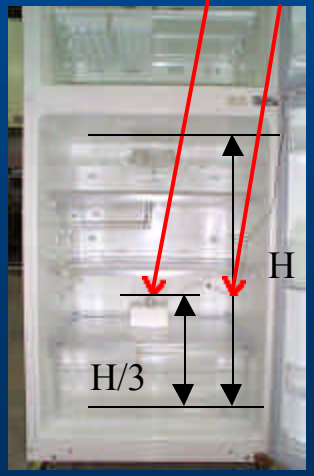
Table 1. Classification of Freezing compartment

- Electric power Consumption test
  - Test conditions
    - Ambient temperature
      - 30?1 , 75? 5%
  - Measurement point



t_1 = -18?0.5 at H/3

t_2 = 3?0.5 at H/3



– Test Method

- Basically measured Electrical energy consumption per 24 hr.
- Defrosting starts at the beginning
- At least two defrost cycles automatically within 24hr ? Electrical energy consumption per 24 hr.
- If defrost is not carried out 2 times automatically within 24hr ? Measured electrical energy consumption per 48 hr.
- If defrost is not carried out 2 times automatically within 48hr ? Measured electrical energy consumption per 72 hr.
- No load in both compartments

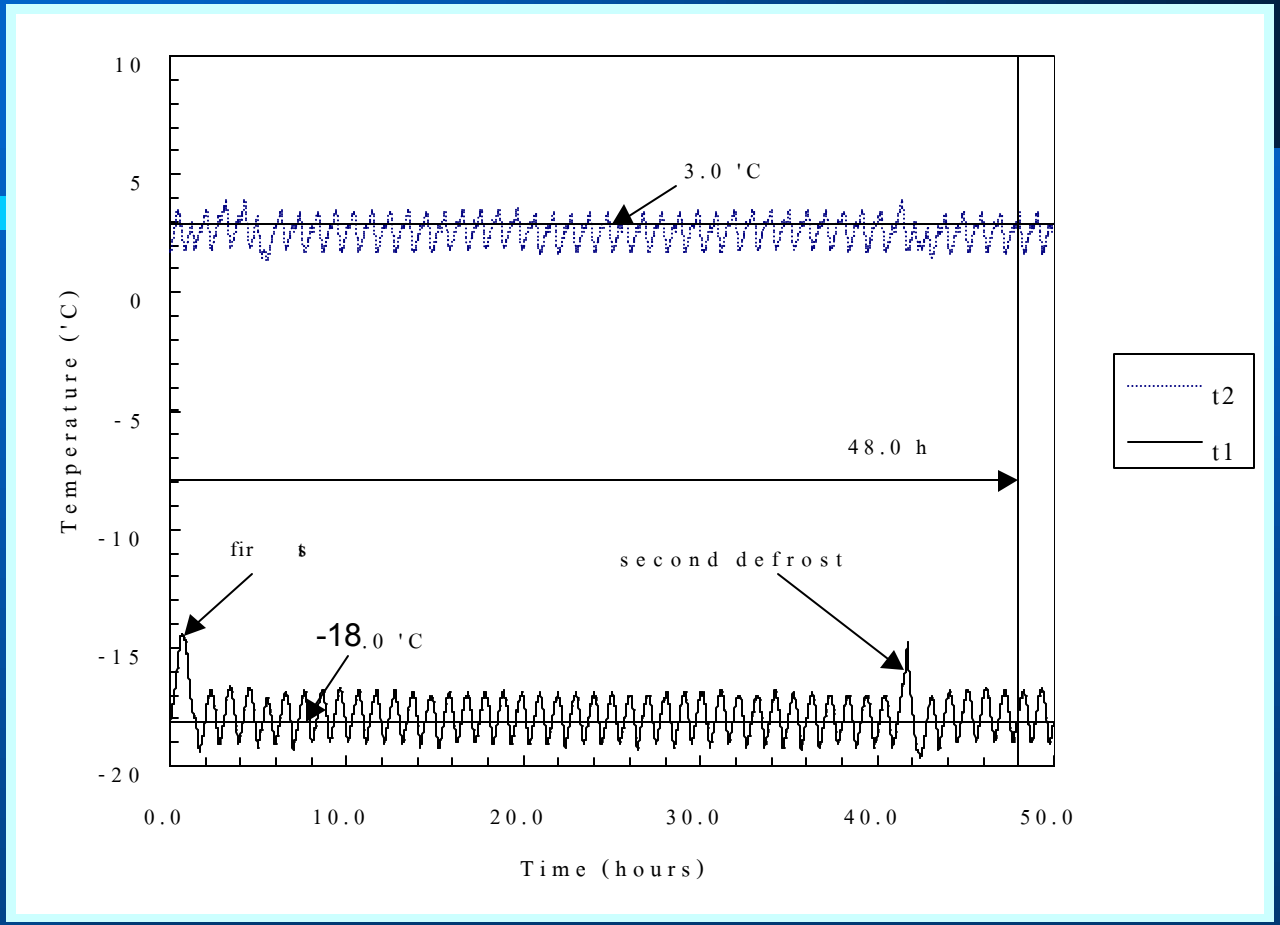
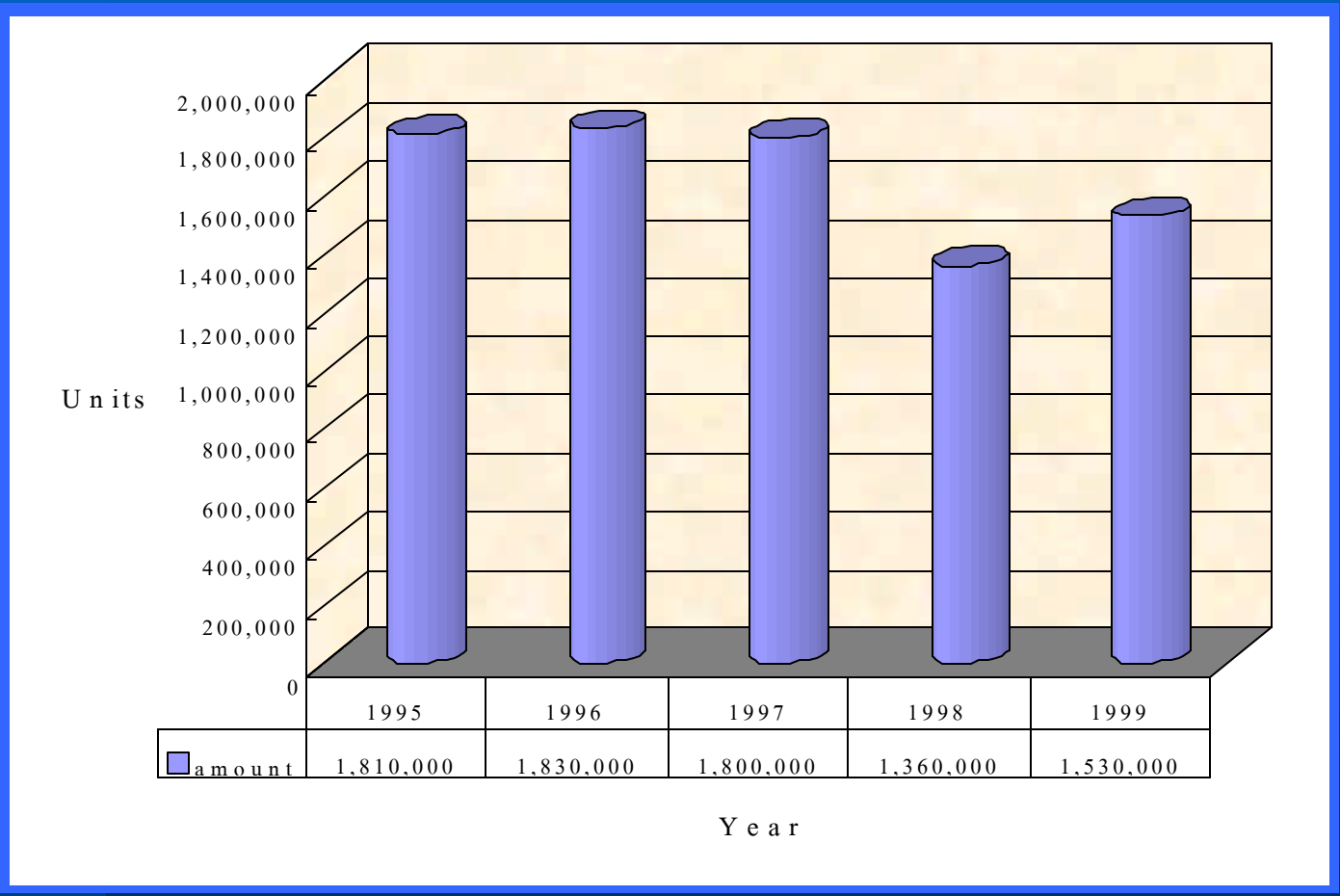


Figure 2. Example of an operating cycle of a frost-free refrigerator-freezer

- Determination of Electric Power Consumption
  - $W_y = W_d \times 365$
  - $W_{my} = W_y / 12$
    - W_y : annual electrical energy consumption (kWh/year)
    - W_d : daily electrical energy consumption (kWh/day)
    - W_{my}: monthly electrical energy consumption (kWh/month)

Market


2,000,000
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Units
1995
1996
1997
1998
1999
amount
1,810,000
1,830,000
1,800,000
1,360,000
1,530,000
Year

New Features

- KS C 9321 “Electrical storage box for Kimchi”
- Over 1 million Units in 2000

- Features : Volume 91 liter
- Power consumption : 20 kWh/month
- Energy Efficiency Grade : 1st

Air Conditioner

- Scope
  - room air conditioners of integral type (compressor refrigerating unit, fans, etc are accommodated in a cabinet) or separate type (compressor refrigerating unit, fans, etc are accommodated in two cabinet) with a rated power consumption for cooling not exceeding 7.5kW and with cooling capacity 17.5kW or less.

- Definition
  - Cooling capacity
    - rated cooling capacity
    - normal cooling capacity
  - Cooling power consumption
    - rated cooling power consumption
    - normal cooling power consumption
  - Cooling energy efficiency ratio

$$EER = \frac{Q_c}{P_c}\left\{\frac{0.86Q_c}{P_c}\right\}$$

  - Cooling seasonal performance factor

$$CSPF = \frac{\sum Q_c}{\sum P_c}\left\{\frac{0.86\sum Q_c}{\sum P_c}\right\}$$

  - Power quantity consumption per month during cooling season

- Classification
  - Classification by Function
    - Cooling only.
    - Cooling and dehumidity control, combined use.
    - Cooling, heating by heat pump, combined use.
    - Cooling, dehumidifying and heating by heat pump, combined use.
    - Cooling, heating by electric resistance heater, combined use.
    - Cooling, dehumidifying and heating by electric resistance, heater combined use.
  - Classification by construction of Unit
    - Integrated type
    - Separate type
  - Classification by Cooling Method of Condense
    - Air-cooled type
    - Water-cooled type
  - Classification by Rated cooling capacity

- Energy Efficiency Test
  - Test condition

Conditions for Cooling Capacity	Indoor		Outdoor			
			Air cooling type		Water cooling type	
	Dry Bulb °C	Wet Bulb °C	Dry Bulb °C	Wet Bulb °C	Inlet °C	Outlet °C
KS	27 ± 0.3	19.5 ± 0.2	35± 0.3	24 ± 0.2	30 ± 0.3	35 ± 0.3
CNC	27 ± 1	19.5 ± 0.5	35± 1	24 ± 0.5	30 ± 0.2	35 ± 0.2
JIS	27 ± 1	19.0 ± 0.5	35± 1	24 ± 0.5	30 ± 0.3	35 ± 0.3
ISO(T-1)	27 ± 1	19.0 ± 0.5	35± 1	24 ± 0.5	30 ± 0.2	35 ± 0.2
SAA	27 ± 1	19.0 ± 0.5	35± 1	24 ± 0.5	30 ± 0.2	35 ± 0.2

Table 2. Test Condition

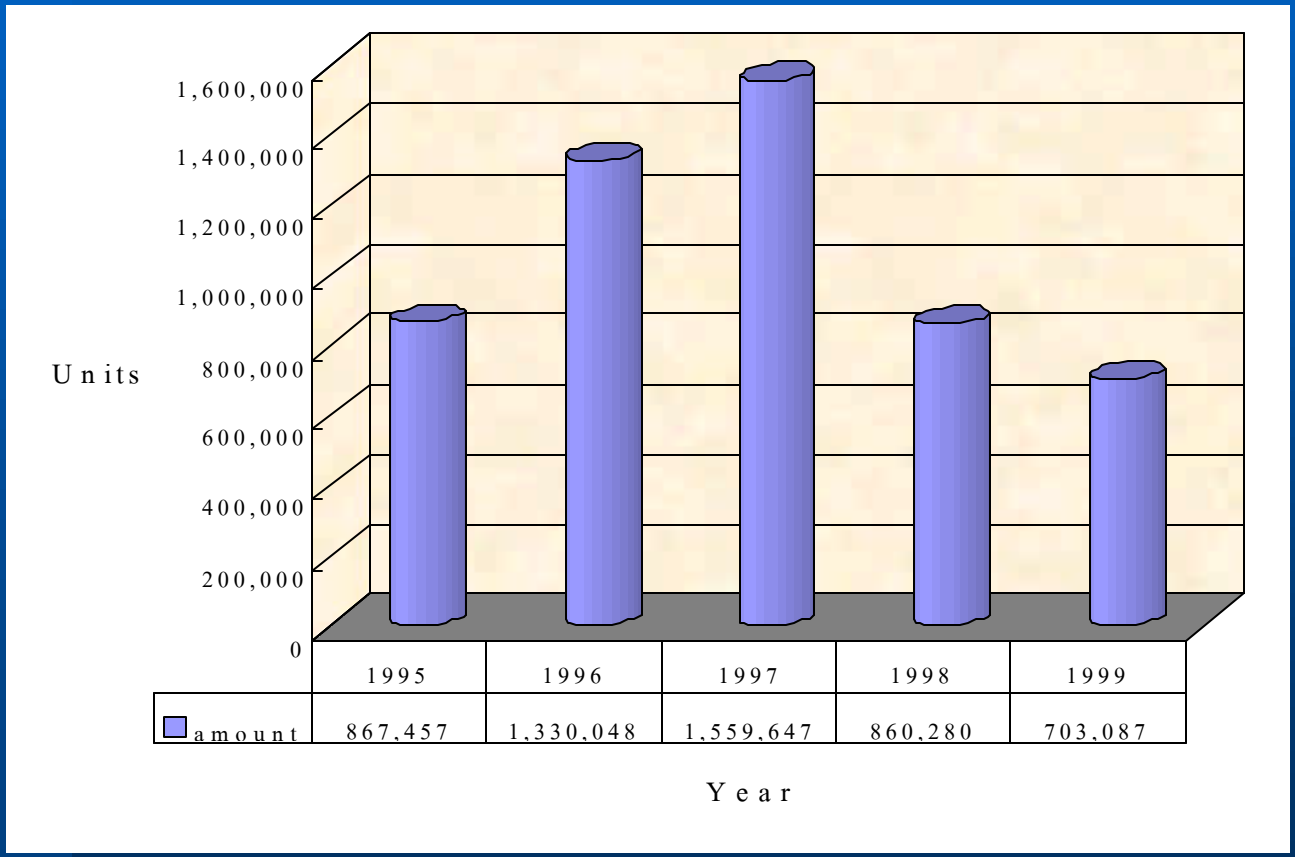
– Cooling capacity test

- Testing in the calorimeter room

- Determination of monthly Energy consumption
  - Electrical energy consumption shall be determined by rounding off the first place of decimal of the value in accordance with KS A 0021
  - Two samples shall be tested, and the mean shall be applied.
  - Monthly electrical energy consumption (kWh/month)
    - W_{mv}=W x 12(hr) x 0.6(operation rate) x 30(days)
    - W : electrical energy consumption (W)
    - W_{my}: monthly electrical energy consumption (kWh/month)

- Determination of Energy Efficiency Ratio
  - Energy efficiency ratio shall be determined by rounding off the third place of decimal of the value in accordance with KS A 0021.
  - Energy efficiency Ratio (W/W)
    - EER=C/H
    - C : Cooling capacity (kcal/h or W)
    - H : Energy consumption (W)
  - Note : Above standards are only available to room air-conditioner with a constant speed compressor

Market


1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Units
1995
1996
1997
1998
1999
amount
867,457
1,330,048
1,559,647
860,280
703,087
Year

Year	High Efficiency Air Conditioner
1992	-
1993	92.3
1994	98.5
1995	97.0
1996	95.6
1997	93.1
1998	91.5
1999	92.0
2000	97.1

Table 10. Market share of high energy efficiency Air conditioner

- Split air conditioner

- Package air conditioner

Thank you….