Overview of Chinese performance standard

Revision of GB 12021.2 --- final version on Feb 09, 2015

- **Main difference to last version Jan. 2015**
  - Bonus for no-frost compartment extended to all compartments with forced airflow of frost free appliance
  - Bonus for no-frost compartment with forced airflow kept 1.5
  - Cancelled the separated bonus for transparent glass door but combined it into through in automatic ice-maker Sr: for the appliance type 1,2,3,4 with transparent glass door, if the size more than 50%: 1.5; for the appliance type 5,6,7,8,9 with transparent glass door, if the size more than 25%: 1.1
  - Added the definition of no frost appliance: all compartments are automatically defrosted with automatic disposal of the defrosted water and at least one compartment is cooled by a frost free system
  - Added the definition of door: the door which has proper sealing and can access the food staff in appliance

Content:

- General overview of new standard draft (final version)
- Main difference to current energy standard

General overview of new standard draft 4th edition

The Following 10 types are covered by new draft:

No.	Type of appliance	No.	Type of appliance
1	Refrigerator no star	6	Frozen food storage cabinet
2	Refrigerator *	7	Chest refrigerator-freezer
3	Refrigerator **	8	Chest freezer
4	Refrigerator ***	9	Upright freezer
5	Refrigerator-freezer	10	Wine cooler

Determination of energy efficiency grade

- For refrigerator-freezer (type 5):

EEC 1	$\eta s \leq 25\%$	&	$\eta t \leq 50\%$
EEC 2	$25\% < \eta s \leq 35\%$	&	$50\% < \eta t \leq 60\%$
EEC 3	$35\% < \eta s \leq 50\%$	&	$60\% < \eta t \leq 70\%$
EEC 4	$50\% < \eta s \leq 60\%$	&	$70\% < \eta t \leq 80\%$
EEC 5	$60\% < \eta s \leq 70\%$	&	$80\% < \eta t \leq 90\%$

ηs = Standard energy efficiency index; ηt = Total energy efficiency index

For other types, energy efficiency grade only determinated by the standard energy efficiency index ηs

- Wine cooler (type 10):

EEC 1	$\eta s \leq 55\%$
EEC 2	$55\% < \eta s \leq 70\%$
EEC 3	$70\% < \eta s \leq 80\%$
EEC 4	$80\% < \eta s \leq 90\%$
EEC 5	$90\% < \eta s \leq 100\%$

ηs = Standard energy efficiency index

- Chest refrigerator-freezer (type 7):

EEC 1	$\eta s \leq 35\%$
EEC 2	$35\% < \eta s \leq 45\%$
EEC 3	$45\% < \eta s \leq 55\%$
EEC 4	$55\% < \eta s \leq 65\%$
EEC 5	$65\% < \eta s \leq 75\%$

ηs = Standard energy efficiency index

- For other types of appliance (type 1, 2, 3, 4, 6, 8, 9):

EEC 1	$\eta s \leq 45\%$
EEC 2	$45\% < \eta s \leq 55\%$
EEC 3	$55\% < \eta s \leq 65\%$
EEC 4	$65\% < \eta s \leq 75\%$
EEC 5	$75\% < \eta s \leq 85\%$

ηs = Standard energy efficiency index

The Energy consumption limitation Emax is defined as follows:

No.	Type of appliance	Energy limitation value E_{max} [kWh/24h]
1	Refrigerator no star	$0.85*(0.221 * V_{adj} + 233 + CH + Dc)* S_r / 365$
2	Refrigerator *	$0.85*(0.611 * V_{adj} + 181 + CH + Dc)* S_r / 365$
3	Refrigerator **	$0.85*(0.428 * V_{adj} + 233 + CH + Dc)* S_r / 365$
4	Refrigerator ***	$0.85*(0.624 * V_{adj} + 223 + CH + Dc)* S_r / 365$
5	Refrigerator-freezer	$0.7*(0.697 * V_{adj} + 272 + CH + Dc)* S_r / 365$
6	Frozen food storage cabinet	$0.85*(0.530 * V_{adj} + 190 + CH + Dc)* S_r / 365$
7	Chest refrigerator-freezer	$0.75*(0.697 * V_{adj} + 272 + CH + Dc)* S_r / 365$
8	Chest freezer	$0.85*(0.567 * V_{adj} + 205 + CH + Dc)* S_r / 365$
9	Upright freezer	$0.85*(0.539 * V_{adj} + 315 + CH + Dc)* S_r / 365$
10	Wine cooler	$(0.233 * V_{adj} + 245 + CH + Dc)* S_r / 365$

Note: Appliances with an Energy consumption more than E_{max} are not allowed to be sold.

- **Calculation of Standard Energy Efficiency Index ηs:**

$\eta s = Es / ((M * Vadj + N + CH + Dc) * Sr / 365) * 100\%$

Es = the measurement standard value of energy consumption of the appliance

Calculation of Vadj :

$$V_{adj} = \sum_{Compartments} (Vc \times Fc \times Wc \times CC \times BI)$$

Definition of Wc :

Compartment type	Cooler	Cellar	Chiller	Ice comp.	0-star	1-star	2-star	3-star	freezer	Wine cooler
Tc (°C)	4	12	2	0	0	-6	-12	-18	-18	12
Wc	1.00	0.65	1.15	1.25	1.25	1.55	1.85	2.15	2.15	0.65

- **If the compartment type is not included in above table, then Wc calculation as below:**

$$W_c = \frac{(25 - Tc)}{20}$$

Thereof:

M, N: depends on the type of appliance

CH: factor for variable temp. compartments which include chiller function > 15 l: 50 kWh; variable temp. compartment include cooler, chiller and 3-star freezer function, volume > 15l: 100kWh; otherwise 0;

Sr: factor for net volume of refrigerator more than 400 l and with through-in automatic ice-maker: 1.1; otherwise 1.0. For the appliance type 1,2,3,4 with transparent glass door, if the size more than 50%: 1.5; ; otherwise 1.0. For the appliance type 5,6,7,8,9 with transparent glass door, if the size more than 25%: 1.1; otherwise1.0

Dc: correction factor for appliance doors ≥ 4, Dc = 50, otherwise 0

Fc: correction factor for no-frost appliance with forced air flow 1.5, otherwise 1.0

CC: correction factor for climate class ST: 1.1, and climate class T: 1.2, otherwise 1.0

BI: correction factor for built-in appliance 1.2, otherwise 1.0

- **Calculation of Standard value of energy consumption Es:**

Es = [(Edaily,16°C * Day16°C + Edaily,32°C * Day32°C)+ Eaux] / 365

Edaily,16°C: measurement result of energy consumption under 16°C and stable condition

Edaily,32°C: measurement result of energy consumption under 32°C and stable condition

Eaux : Energy consumption of specified auxiliaries (not include tank type automatic icemaker)

Day16°C = 192 days

Day32°C = 173 days

- **Calculation of Total Energy Efficiency Index η_t:**

$$\eta_t = E_t / ((M * V_{adj} + N + CH + D_c) * S_r / 365) * 100\%$$

E_t = the measurement total value of energy consumption of the appliance

Calculation of V_{adj} :

$$V_{adj} = \sum_{Compartments} (Vc \times Wc \times Fc \times CC \times BI)$$

M, N: depends on the type of appliance

CH: factor for variable temp. compartments which include chiller function > 15 l: 50 kWh; variable temp. compartment include cooler, chiller and 3-star freezer function, volume > 15l: 100kWh; otherwise 0;

S_r: factor for net volume of refrigerator ≤ 100 l, or net volume more than 400 l and with through-in automatic ice-maker: 1.1; otherwise 1.0. For the appliance type 1,2,3,4 with transparent glass door, if the size more than 50%: 1.5;

otherwise 1.0. For the appliance type 5,6,7,8,9 with transparent glass door, if the size more than 25%: 1.1;otherwise1.0

Dc: correction factor for appliance doors ≥ 4, Dc = 50, otherwise 0

Fc: correction factor for no-frost appliance with forced air flow 1.5, otherwise 1.0

CC: correction factor for climate class ST: 1.1, and climate class T: 1.2, otherwise 1.0

BI: correction factor for built-in appliance 1.2, otherwise 1.0

- **Calculation of Total value of energy consumption Et:**

$Et = [(E_{daily,16°C} * Day_{16°C} + E_{daily,32°C} * Day_{32°C}) + E_{aux1} + b \times E_{aux2} + \Delta E_{processing,annual}] / 365$

$E_{daily,16°C}$: measurement result of energy consumption under 16°C and stable condition

$E_{daily,32°C}$: measurement result of energy consumption under 32°C and stable condition

$E_{aux\ 1}$: Energy consumption of specified auxiliarie: anti-condensation heater

$E_{aux\ 2}$: Energy consumption of specified auxiliarie: tank type automatic icemaker; b=0

$\Delta E_{processing,annual}$: Annual energy increase of load processing

$\Delta E_{processing,annual} = \Delta E_{processing,16°C} * Day_{16°C} + \Delta E_{processing,32°C} * Day_{32°C}$

$$\Delta E_{processing,ambient} = \frac{E_{input-normal}}{Efficiency_{load,ambient}} \times a$$

$E_{input\text{-}normal}$: heat energy removed from compartments

$Efficiency_{load,ambient}$: the load processing efficiency at the specified ambient temperature;

a=1

The values of M and N are given in the following table:

No.	Type of appliance	M	N
1	Refrigerator no star	0.221	233
2	Refrigerator *	0.611	181
3	Refrigerator **	0.428	233
4	Refrigerator ***	0.624	223
5	Refrigerator-freezer	0.697	272
6	Frozen food storage cabinet	0.530	190
7	Chest refrigerator-freezer	0.697	272
8	Chest freezer	0.567	205
9	Upright freezer	0.539	315
10	Wine cooler	0.233	245

Main difference to current energy standard

- Application scope was extended to built-in appliance, wine cooler and household appliance with transparent glass door
- Volume measurement refers to new IEC 62552 version
- Measurement method is changed: refer to GB8059 new draft (new IEC 62552 FDIS version, unload test under 16°C & 32°C)
- Fridge temperature changed to 4°C
- Added bonus 50 kWh for multi-door appliance (if doors ≥ 4)
- Added bonus 100 kWh for wide variable temp. compartment which include cooler, chiller and 3-star temp. zone
- Additional correction factor 1.5 for appliance type 1,2,3,4 with transparent glass door if the size more than 50%; additional correction factor 1.1 for appliance type 5,6,7,8,9 with transparent glass door if the size more than 25%.
- No-frost appliance with forced airflow compartment bonus 1.5
- Added bonus 1.2 for built-in appliance (same as EU standard)
- Measurement result of EEI should not be more than declaration 5%, volume not more than 3%

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