

Schedule - 5 Direct Cool Refrigerator

1. Scope: This scheme specifies the energy labelling requirements for electric mains powered Direct Cool refrigerating appliance of the vapour compression type intended for household and similar use being manufactures, imported, or sold in India.

2. Normative Reference: This Schedule shall be read in conjunction with IS 1476 (Part-I): 2000 with all amendments.

3. Terms and Definitions: For the purposes of this schedule, the definitions given in IS 1476 (Part-I): 2000 with all amendments and those below apply. The definitions below take preference over the ones in the above mentioned standards.

3.1 Direct Cool (DC) Appliance: These are the refrigerators with or without crisper, ice making or frozen food storage compartments and are NOT cooled by internal forced air circulation. Cooling is primarily obtained by natural convection only. However some products may have fan to avoid internal condensation but not to claim as frost free.

3.2 Projected Annual Energy Consumption (PAEC): The estimated energy used by a single unit during one year's use. This is calculated from Tested Energy Consumption (E_t). (Units: kWh/Year)

3.3 Tested Energy Consumption (E_t): The value of energy consumption as determined by IS 1476 (Part-I): 2000 with all amendments. This is calculated for a period of 24 hours. (Units: Wh)

3.4 Comparative Energy Consumption (CEC): The nominal energy consumption of a model of refrigerating appliance. It is based on the $PAEC_{av}$ of the model. The CEC appears on the energy label. (Units: kWh/Year)

3.5 Total Adjusted Storage Volume for Direct Cool ($V_{adj_tot_dc}$): The rated storage volume of a compartment adjusted to compensate for heat loadings on spaces which are at temperature other than that of fresh food type space.

NOTE: The adjusted volume shall be calculated on the basis of the STORAGE VOLUME of each compartment.

3.6 Star Rating: The number of stars displayed on the energy label. The available stars are between a minimum of one and a maximum of five shown in one star interval. The star rating is calculated from the Star Rating Band. The Star Rating determination will vary for different

models based on the storage volume. (No units)

3.7 Star Rating Band: The Star Rating Band is a range of energy efficiency (kWh/Year) which is arrived by calculations and is used for determining the number of stars displayed on the energy label.

3.8 Label Period: means the validity period of the electricity consumption under the energy labelling plan specified in the schedule.

4. Family of models: It is the range of models of one particular brand, to which a single set of test reports is applicable and where each of the models has the same relevant physical characteristics, comparative energy consumption, and energy efficiency rating and performance characteristics. The term 'model' is synonymous with 'family of models'.

5. Eligibility Criteria:

5.1 Pull Down Test: The appliance shall meet the requirements set out in of IS 1476 (Part-I): 2000 with all amendments and manufacturer will be required to declare the Refrigerator pull down period for the model.

Note: Exception to IS 1476 (Part-I):2000 with all amendments are:-

- (a) Room ambient temperature shall consider 43 ± 0.5 ° C.
- (b) The refrigerator inside Target Temperature for Freezer Compartment shall consider -8 ° C.
- (c) Temperature sensors location in the freezer compartment shall comply with clause 7.5 of IS 15750:2006.

6. Testing Guidelines

6.1 Test Procedure: The testing code and procedure for Direct Cool Refrigerator shall be as per IS 1476 (Part-I): 2000 with all amendments.

6.2. Test Parameter:

6.2.1 Energy Consumption: The Energy Consumption of the Direct Cool refrigerator shall be tested as per IS 1476 (Part-I): 2000 with all amendments.

Note: Exception to IS 1476 (Part-I): 2000 with all amendments are:-

- a. The room ambient temperature shall consider 32 ± 0.5 ° C.
- b. The refrigerator inside Target Temperature for Freezer Compartment shall consider -6 ° C &for fresh food Compartment shall consider 3 ° C
- c. Temperature sensors location in the freezer compartment shall comply with clause 7.5 of IS 15750: 2006.

d. Energy consumption shall be calculated as defined in Annexure 1.

6.2.2 Number of tests per unit: Each unit shall be tested with sufficient test runs to enable a valid E_t to be determined for that unit. This determination shall be documented in a test report containing the test result for all test runs used to derive E_t (refer Annexure 1).

6.2.3 Rated Volume: Storage volume of the appliance shall meet the requirements as defined in IS 1476 (Part-I): 2000 with all amendments.

Note: Gross Volume shall also be calculated by the same method as defined for the storage volume (i.e., by geometric method).

6.3 Tolerance: The tolerance limit for the volume (storage & gross) and pull-down shall be as defined in IS 1476 (Part-I): 2000 with all amendments.

6.4 Sample Size: For the purpose of determining the CEC of a model for labeling, three separate units of the nominated model shall be tested for energy consumption in accordance with IS 1476 (Part-I): 2000 with all amendments.

6.5 Rounding: the number shall be rounded to the nearest whole number as IS 2:1960, reaffirmed 2000, Edition 2.3. The values of PAEC, $PAEC_{av}$, CEC, Gross & storage volume and Star Rating Band shall be rounded to the nearest whole number as IS 2:1960, reaffirmed 2000, Edition 2.3.

6.6 Energy Labeling Plan: The star rating parameters k_{dc} (Constant Multiplier (kWh/litre/Year)) & c_{dc} (Constant Fixed Allowance (kWh/Year)) shall be obtained from TABLE 2.1 / 2.2, depending on the year of Manufacturing/import/assembling

S.No	Product Manufactured	Table to be used
1	1st January 2015 to 31st December 2016	2.1
2	1st January 2017 to 31st December 2018	2.2

The following equation shall be used to determine the Star Rating Bands for a particular model:

$$\text{Star Rating Band (SRB)}_{dc} = k_{dc} * V_{adj_tot_dc} + c_{dc}$$

Where,

k_{dc} = Constant Multiplier (kWh/litre/Year)

$V_{adj_tot_dc}$ = Total Adjusted Storage Volume for direct cool (litre)

c_{dc} = Constant Fixed Allowance (kWh/Year)

TABLE 2.1: Star Rating Band valid from 1st January 2015 to 31st December 2016

Star rating band	Comparative Energy Consumption (CEC) Criteria
1 Star *	$0.413* V_{adj_tot_dc} + 346 \leq CEC < 0.516* V_{adj_tot_dc} + 432$
2 Star **	$0.33* V_{adj_tot_dc} + 277 \leq CEC < 0.413* V_{adj_tot_dc} + 346$
3 Star ***	$0.264* V_{adj_tot_dc} + 221 \leq CEC < 0.33* V_{adj_tot_dc} + 277$
4 Star ****	$0.211* V_{adj_tot_dc} + 177 \leq CEC < 0.264* V_{adj_tot_dc} + 221$
5 Star *****	$CEC < 0.211* V_{adj_tot_dc} + 177$

TABLE 2.2: Star Rating Band valid from 01st January 2017 to 31st December 2018

Star rating band	Comparative Energy Consumption (CEC) Criteria
1 Star *	$0.264* V_{adj_tot_dc} + 221 \leq CEC < 0.33* V_{adj_tot_dc} + 277$
2 Star **	$0.211* V_{adj_tot_dc} + 177 \leq CEC < 0.264* V_{adj_tot_dc} + 221$
3 Star ***	$0.169* V_{adj_tot_dc} + 141 \leq CEC < 0.211* V_{adj_tot_dc} + 177$
4 Star ****	$0.135* V_{adj_tot_dc} + 113 \leq CEC < 0.169* V_{adj_tot_dc} + 141$
5 Star *****	$CEC < 0.135* V_{adj_tot_dc} + 113$

The above equation provides for the value of the various Star Rating Bands for a particular model.

The CEC of the model as **determined from 6.9** will be compared with the various Star Rating Bands as given in the above tables. There is no tolerance for the Star Rating Bands. All tested products must meet minimum threshold of each Star Rating Band. The scope for manufacturing tolerance and other variations shall be accounted for when determining the Star Rating.

6.7 ENERGY LABEL VALIDITY (i.e., for CHECK & CHALLENGE TESTING): the comparative energy consumption (CEC) value shall be accepted as valid, when each unit tested the measured energy consumption i.e., projected annual energy consumption (PAEC) shall be less than or equal to 1.1 of the declared comparative energy consumption. There is no tolerance for Star Rating Band, projected annual energy consumption (PAEC) must meet minimum threshold of Star Rating Band.

6.8 Projected Annual Energy Consumption (PAEC): The process consists of measuring the tested energy consumption (E_t) (IS 1476 (Part-I): 2000 with all amendments), of each unit tested, then calculating the projected annual energy consumption (PAEC) of the unit.

$$PAEC = E_t * 365/1000 \text{ (kWh/Year)}$$

E_t = tested energy consumption expressed in Wh per 24 hours, rounded to the nearest whole number as IS 2:1960, reaffirmed 2000, Edition 2.3.

After testing three or more separate units the separate values of PAEC shall be averaged and referred to as $PAEC_{av}$.

6.9 COMPARATIVE ENERGY CONSUMPTION (CEC): The CEC for a model shall not be less than the average PAEC value i.e., $PAEC_{av}$ (the number shall be rounded to the nearest whole number as IS 2:1960, reaffirmed 2000, Edition 2.3) for the three (or more) units which are tested to determine the label particulars. The CEC shall be an integer in units of kWh/Year. The CEC and Total Adjusted Storage Volume for Direct Cool refrigerator ($V_{adj_tot_dc}$) shall be used to determine the Star Rating Band and Star Rating of the model.

6.10 TOTAL ADJUSTED STORAGE VOLUME FOR Direct Cool ($V_{adj_tot_dc}$):

Fresh Food Compartment Target Temperature = +3 Degree Celsius

Freezer Compartment Target Temperature = - 6 Degree Celsius

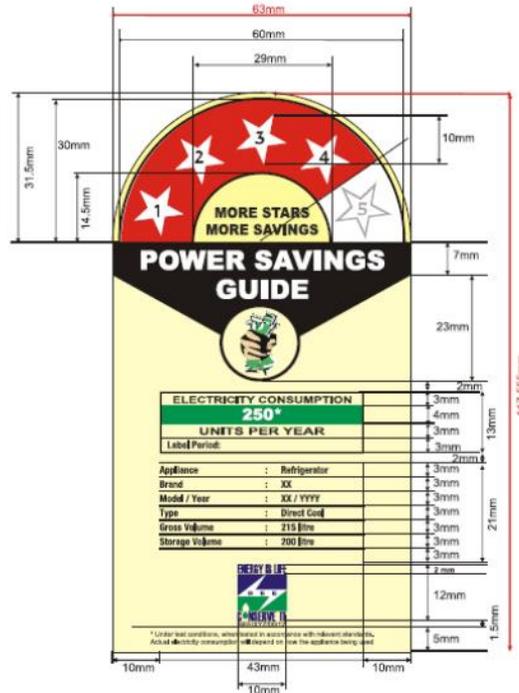
$$\begin{aligned} \text{Adjusted Volume Factor} &= (\text{Test room Temperature} - \text{Freezer Temperature}) / (\text{Test room} \\ &\quad \text{Temperature} - \text{Fresh Food Temperature}) \\ &= [32 - (-6)] / [(32 - 3)] \\ &= 1.31 \end{aligned}$$

Total Adjusted Volume for Direct Cool refrigerator ($V_{adj_tot_dc}$)

$$= \text{Fresh Food Storage Volume} + 1.31 * \text{Freezer Storage Volume}$$

7. Manner of display for BEE star label :

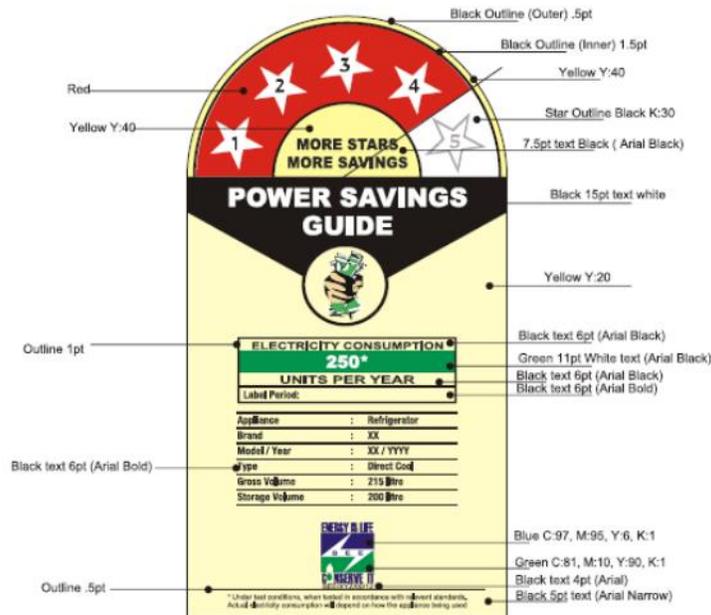
7.1 Material & Dimension of Label: The label shall be self -adhesive and shall be designed as set out in sample label.



7.2 Color scheme of label: The label shall be printed as per the following specification in the following colors on a white background:

- Red: Pantone warm red
- Yellow: Pantone 116
- Black: Pantone Black
- Green: Pantone 340

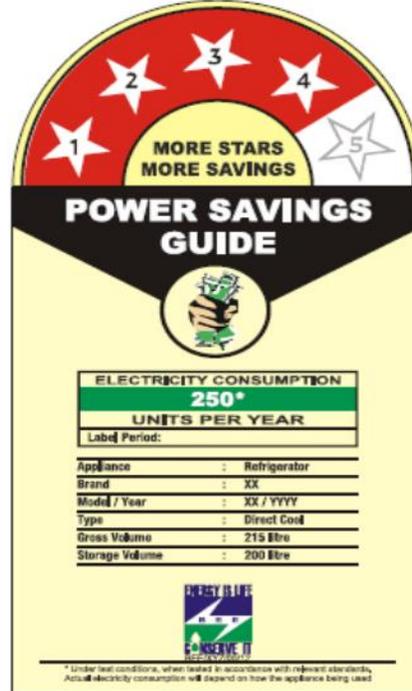
Note: The color tone at the background of Electricity Consumption Display (Green) will be similar as followed for the Bureau of Energy Efficiency Logo.



The following colour scheme for Bureau’s logo, namely:-

- a. BLUE – Hue(H)-239o Saturation(S):64% Brightness(B):59%
- b. Luminance or lightness(L) :28, chromatic components -a:24 b:54
- c. Red(R):54 Green(G):55 Blue(B):151
- d. Cyan(C):97% Magenta(M):95% Yellow(Y):6% Black(K):1%
- e. Web colour code - #363797
- f. GREEN – Hue(H)-150o Saturation(S):10% Brightness(B):67%
- g. Luminance or lightness(L) :61, chromatic components -a:-53 b:32
- h. Red(R):0 Green(G):170 Blue(B):87
- i. Cyan(C):81% Magenta(M):10% Yellow(Y):90% Black(K):1%
- j. Web colour code - #00AA56;

7.3 Sample label: An example of a printed energy label for a refrigerating appliance is shown in following label.



7.4 Position of label (Placement): On every direct cool refrigerator, shall be displayed label at the point of sale and such label shall be affixed on the direct cool refrigerator in the following manner, namely:-

- (a) self-adhesive label affixed on the front side of the upper right portion of direct cool refrigerator;
- (b) self-adhesive label affixed on the front side of the carton box.

7.5 Content of Label: The label will mention the following:

- (a) the logo of the Bureau of Energy Efficiency;
- (b) name of manufacturer or importer and brand;
- (c) appliance type;
- (d) rated Gross Volume;
- (e) rated Storage Volume;
- (f) model number and year of manufacturing or import;
- (g) unique series code;
- (h) electricity consumption in units per year;
- (i) star level; and
- (j) label period.

8. Fees

8.1 Security Deposit: The user of label with respect to each equipment shall deposit a security fee of Rs 1 lakh (**for large scale industries**) or twenty five thousand (**for small and medium scale industries**) along with the application for seeking authority to use label.

8.2 Model Registration fee: This fee is payable on application for assignment of authority is Rs. 2000 (One thousand only)

8.3 Renewal fee: This is payable on application for model renewal of authority is Rs. 500 (Five hundred only).

8.4 Labeling fee: For affixation of label on each piece of Direct Cool (DC) refrigerator is Rs. 5 (Five only)

Calculation of Energy Consumption (Interpolation method): Tested energy consumption (E_t) shall be determined either by directly from the results of a single test run during which the temperatures of all the compartments of the appliance are at or below the target temperatures. As not every appliance is capable of operating at this condition, the practical optimum (E_t) of a test appliance is to be calculated through a linear interpolation method where measured temperatures lie both above and below their target temperatures and either;

- (i) both points lie within $\pm 2^\circ\text{C}$ of the target temperature for each compartment; or
- (ii) one point lies within $\pm 1^\circ\text{C}$ of the target temperature for that compartment and one point lies within $\pm 4^\circ\text{C}$ of the target temperature of other compartment

The interpolation shall be performed according to one of two methods as follows:

(a) Linear interpolation for one compartment:

TABLE 1 : Test Results used to Interpolate for two control settings

Control setting	Compartment Temperature	Energy consumption
Setting 1	t1	E1
Setting 2	t2	E2
Target temperature	Tx	Result to be calculated = Ex

The calculated energy consumption E_x is given by the equation.

$$\text{.....L(1)}$$

Where,

- t1 = measured compartment temperature for point 1
- t2 = measured compartment temperature for point 2
- tx = target temperature for the compartment for energy consumption determination
- E1 = measured energy consumption of the appliance at point 1
- E2 = measured energy consumption of the appliance at point 2
- Ex = calculated energy consumption of the appliance at the target temperature tx

(b) Linear interpolation for more than one compartment:

- (i) Nominate each relevant compartment as compartment A, B, C etc.

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- (ii) Applying Equation L(1) to each compartment, calculate the energy consumption of the appliance at the target temperature of each compartment i.e. E_{xA} , E_{xB} , E_{xC} etc.
- (iii) The tested energy consumption (E_t) is the maximum value of all E_{xA} , E_{xB} , E_{xC} etc.

Annexure B: Form for reporting the test results

The results of tests shall be reported as per IS 1476 (Part-I): 2000 with all amendments with the relevant sections from the mentioned appendix applicable and will clearly mention the gross volume and the storage volume.

1. Details of household Direct cool refrigerator.

- (i) Brand:
- (ii) Type:
- (iii) Model name:
- (iv) Rated voltage:
- (v) Rated Gross Volume:
- (vi) Rated Storage Volume:
- (vii) Rated Electricity Consumption:

2. Test summary

- (i) Complete a separate copy of this page for each test type, as applicable
- (ii) Date of test:
- (iii) Test officer:
- (iv) Test type:
- (v) Nominal test condition;
- (vi) Test Standard:
- (vii) Energy Consumption Test Report(to be submitted for each unit tested):

Ambient test conditions:

Observations and Results:

Parameters	Specification	Observation	
		Warm	Cold
Temperature of Freezer Compartment(F1)			
Temperature of Freezer Compartment(F2)			
Temperature of Freezer Compartment(F3)			
Temperature of Freezer Compartment(F4)			
Temperature of Freezer Compartment(F5)			
Average Temperature of			

Parameters	Specification	Observation	
		Warm	Cold
Freezer Compartment			
Temperature of Fresh Food Compartment (R 2/3h)			
Temperature of Fresh Food Compartment(R 1/3h)			
Temperature of Fresh Food Compartment(R-25mm)			
Average Temperature of Fresh Food Compartment			
Temperature of Crisper Compartment			
Energy Meter Reading(Wh)			
Time elapsed(minutes)			
Energy Consumption rate per day (Wh/Day)			
Energy Consumption(Fresh Food Compartment) at Target Temperature(Wh/Day)			
Energy Consumption(Freezer Compartment) at Target Temperature(Wh/Day)			
Energy Consumption/Day at Target Temperature(Wh/Day)			
Yearly Energy Consumption(kWh/year)			

(viii.) The Pull down temperature test report (to be submitted for each unit tested):
Ambient test condition:

Observations and Results:

Parameters	Specification	Observation- Temp ° C (Degree Celsius) / Time (minutes)
Temperature of Freezer Compartment(F1)		
Temperature of Freezer Compartment(F2)		
Temperature of Freezer Compartment(F3)		
Temperature of Freezer Compartment(F4)		
Temperature of Freezer Compartment(F5)		
Average Temperature of Freezer Compartment.		
Temperature of Chiller Compartment		
Temperature of Fresh Food Compartment(R 2/3h)		
Temperature of Fresh Food Compartment(R 1/3h)		
Temperature of Fresh Food Compartment(R-25mm)		
Average Temperature of Fresh Food Compartment		
Temperature of Crisper Compartment		
Tempera ture Control/thermostat Setting (Fresh Food Compartment)		
Pull down time (freezer compartment)		
Pull down time (fresh food compartment)		

(ix)The gross and storage volume test report (to be submitted for each unit tested):



Gross Volume (in litre)		
Freezer Compartment	Fresh Food Compartment	Total

Storage Volume (in litre)		
Freezer Compartment	Fresh Food Compartment	Total

Total Adjusted Storage Volume: