Heating Test at Household Refrigerator Type URG-129 Base Standard Nasional Indonesia (SNI) 04-6292.2.24-2001 for Safety Requirement

Ali Musyafa[1], Faisal W., [2], Ya'Umar[3], Heri Justiono[4]

Department of Engineering Physics, Sepuluh Nopember Institute of Technology, Surabaya, INDONESIA.

[1] musyafa@ep.its.ac.id

ABSTRACT

Electrical appliance safety assurance is needed. In the electrical equipment in refrigerator URG-129 brand UCD Indonesian products required test activities increase the heat to determine the feasibility of the use. Standards referenced in the testing technique are the Indonesian National Standard (SNI-04-6292.2.24). The test results showed that the level of flatness of the temperature distribution occurs in the working area (2.8 ± 0.5) ° C to (10.8 ± 0.4) ° C and when setting thermostat in normal position with the cooling load of ± 16 liters. Ice maker room temperature refrigerant URG-129 is always above 0 ° C, then refrigerator not qualify heating test. Setting thermostat on hree conditions, normal, cold and very cold, refrigerator cannot meet the test SNI requirement, ice maker refrigerator room temperature is always above 0 ° C.

Keywords: Heating test, refrigerators, Indonesian National Standard, passed the test

INTRODUCTION

Safety products for consumers are an important condition that must be considered and must be filled in world trade. It is test requirements applicable to the product type URG-128 refrigerant which is one of the products of household electrical appliances which use very broad. There are dangers that arise as a result of non-fulfillment of U standards of product safety, among others, an environmental improvement due to external heat (electric voltage supply) and external conditions (temperature and relative humidity of the installation space), excessive loading, and placement in the location of the minimum air circulation (corner space). The target to be addressed is to test the danger on the product not to place the product to be marketed in the form of URG-129 refrigerant. The product must pass the test to meet the standard requirements imposed test electrical equipment in Indonesia, SNI 04-6292.2.24. 2001.

These research activities are intended to know the temperature distribution is in this part of inside and on the outside of the refrigerator models of URG-129. Knowing the value of the temperature measurement uncertainty. Comparing the test data with values tolerated in safety testing in accordance with ISO 04-6292.2.24. 2001. Further recommends whether the refrigerator URG-129 has passed the test based on ISO 04-6292.2.24 heating.

MATERIAL AND METHODS

Phase studies employed include literature studies testing the concept of heat gain, electrical systems in refrigeration type URG-129, test equipment and specifications. Further preparation and measurement of environmental conditioning to meet the requirements of the test. Test activities performed by measuring the temperature inside and sheath roared back refrigerator begin start-up to shut-down the different loading conditions. Further analysis of

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the data obtained from the measurement followed by measurement uncertainty calculations, create reports and conclusions.

Heating test conducted following the test phase which has been available in the guidance document 04-6292.2.24-2001 SNI. The document contains the following requirements when the test conditions testing activities conducted under the following conditions; Temperature test chamber has a temperature (20-30) °C, System operated under normal conditions, supply voltage applied normal operating voltage of 220 volts, test carried out in their corner. During temperature test changes continuously monitored space. The process variables that must be measured during the test activity is; measure the temperature at the unit tests and the test object envelop, install with adhesive thermocouple sensor at a distance 10-20 millimeters from the tip.

Instruments used in the test temperature are thermocouple type k. with a sensitivity of 45 µV / ° C, with ± 0.75% in accuracy measurement. Probe thermocouple has range (-20-1000) o C with accuracy of ± 5% of reading for temperature range (-20-0) ° C, and ± 1% for temperature readings (0-400) ^{c}ob Test equipment used consisted of the main tools and aids in the form of a millimeter along thermocouple jack, Thermo-Hygrometer, insulation paper and plastic insulation and a stop watch, a test chamber made of wood and electrical power supply with a voltage of 220 V and 50 Hz frequency. Electric voltage regulator. Condition of controller test environment in ambient refrigeration so that the system is able to isolate noise when testing. The ambient temperature is maintained (27 ± 2) ° C and relative humidity is at (70 ± 5) % RH.

Measurement Uncertainty

Uncertainty of measurement is a range of values between the measurement results therein lays the true value of the measured. Calculate the uncertainty of type A (UA) performed statistically from measurements. Type a measurement uncertainty obtained from the formula,

$U_a = \frac{SD}{\sqrt{n}}$ Calculating the degrees of freedom of type A (V_A), $V_a = n-1$ .... (1)

Measurement uncertainty obtained from a data type B non-statistical (UB). Next calculate the degrees of freedom of each uncertainty type B (VB) is then calculate the uncertainty combination (Uc) with the formula,

$$U_C = \sqrt{U_A{}^2 + U_{B_1} + ... + U_{B_n}} \quad \text{............... (2)}$$

The calculation of the degree of effective (Veff) follow the following formulation

$$V_{eff} = \frac{U_C^4(y)}{\sum_{i=1}^{n} \frac{C_i^4 U^4(x_i)}{V_1}} = \frac{U_C^4}{\frac{U_A^4}{V_A} + \frac{U_{B1}^4}{V_{B1}} + ... + \frac{U_{Bn}^4}{V_{Bn}}} \quad \text{............... (3)}$$

Having obtained Veff. Furthermore, the value specified in% confidence level, the value of coverage and value factor Uexpan, (Uexp) = k x UC. Followed test report generation. Uncertainty type A standard statistical methods were evaluated premises, type A uncertainty characteristics include: results of repeated measurements (X1, X2, X3, ... Xn) and the average value of the measurement results.

$$(\bar{X}) = \sum_{i=1}^{n} \frac{X_i}{n}, \quad (\bar{X}) = \text{Value rate} \text{ .... (4)}$$

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$\sum x_i$ = Total value of the sampling

n = The number of data collection

Standard deviation is calculated using the equation S(X).

$$S\,(X_i) = \sqrt{\frac{\sum_{i=1}^{n}(x-\bar{x})^2}{(n-1)}} \quad \ldots\ldots\ldots\ldots\ldots (5)$$

Experimental Standard deviation of the mean (ESDM) or often referred to as Standard Uncertainty for type A (U_A).

$$ESDM = UA = \frac{S(X_i)}{\sqrt{n}} \quad \ldots\ldots\ldots\ldots\ldots (6)$$

Degrees of Freedom (v) always calculation with uncertainty type an if documentation.

$$v = n - 1 \quad \ldots\ldots\ldots\ldots\ldots (7)$$

Regression Linear Yi = $a + bx_i$ and every monitoring, $Y_i = a + bx_i + e_i$ componen for calculation uncertainty type A2. Procedure tio minimize amount quadratge of deviation. Amount of error between regresion line states in SSR.

$$SSR = \sum_{i=1}^{n} e_i^{\,2} = \sum_{i=1}^{n} \left(y_i - a - bx_i\right)^2 \quad \ldots\ldots\ldots\ldots\ldots (8)$$

Where,
SSR: Sum square of the residuals

yi: Measurement of data
a, b: Constants,

xi: Setting
the distribution of data around the curve can be explained by a variation Var which can be calculated by the equation:

$$\mathrm{Var} = \frac{\mathrm{SSR}}{\mathrm{V}} \quad \ldots\ldots\ldots\ldots\ldots (9)$$

Test preparation

Performances of equipment that must be considered in the testing activities are as follows; Refrigerator test object URG-129 must be heated with members voltage power supply AC 220 V and a frequency of 50 Hz for 24 hours. Measuring instrument has been provided with a complete, compatible and has a measurement range advice. Each measuring instrument used with information specification data necessary for calculating the uncertainty of measurement such as accuracy and resolution. Stationery for tagging or important information in the worksheet as well as the availability of the carrying capacity as the test chamber was ready, stop watch, the availability of such a test load of bottled water, fruit and eggs and the specimen is well known, this part of the inside and outside this part of refrigerant had marked the position of the measuring point.

Specifications work pieces in test, Functionality and usability part refrigerator URG-129 were identified as shown in Figure 1 with the following sections:

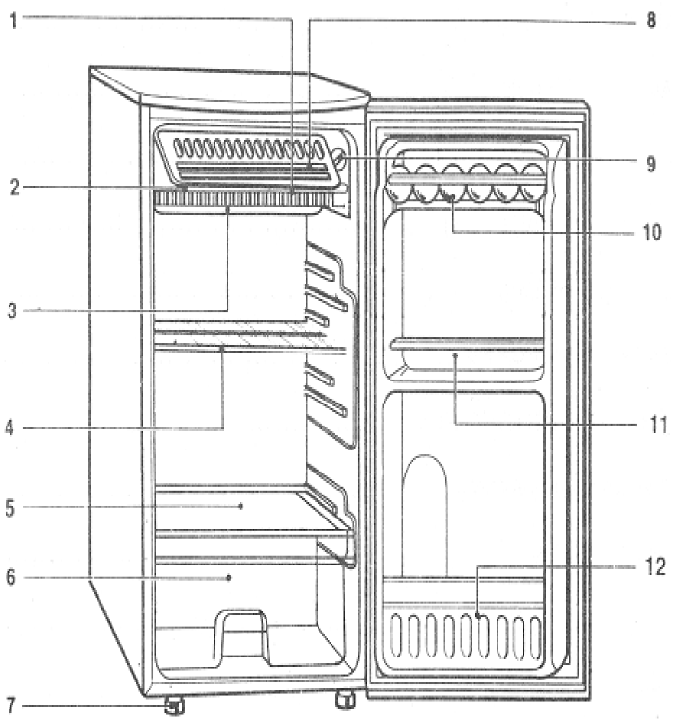

Figure 2. Components of refrigerator URG-129

1. Ice cube tray that serves as an ice maker.
2. Evaporator serves as the main room laying the ice tray.
3. Scalper water, for relocation ice linkage on the evaporator so as not to wet the shelf space. most do not have the volume (1 mm x evaporator surface area)
4. Shelves food storage, to put the groceries either liquid or solid.
5. The glass shelves, serves to place foodstuffs (solid lighter).
6. Place the vegetable drawer is made of glass and sash used to safe fruits and vegetables.
7. Foot regulator flatness can be rotated to the top or bottom, to maintain a stable position of refrigerator order not to falter.
8. Doors freezing chamber, made of glass and hollow to keep the room temperature stability ice maker.
9. Button temperature change (thermostat) in the form of rotary knob to adjust the position of Refrigerator temperature in the cold position, normal, or at least cold, melting ice and stop.
10. The storage of eggs, there are six containers that hold eggs egg shape.
11. Versatile place to store drinks CAIE, 600 mile liter sized bottles.
12. Place the bottle to store beverages in bottles with a volume of 1.5 liters.

Phase testing process follows the following sequence:

a. Placing on the test specimen corner or chamber, the placement should be as close as possible or within less than 5 cm.

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b. Fill the food storage space as well as space ice maker with water, fruit, eggs and water in accordance with the capacity of ice mold.

c. Set the thermostat knob refrigerator the normal position.

d. Placing the thermocouple probe location was determined in the planning, the ice maker space in five locations, the food shelf 9 measuring point, vegetable storage space measuring point 5, at the door with 5 shelves measuring point, the outer body casing refrigerator nine measuring point and the coating of compressor motors as much as 5 points.

e. Record of data display from the meters have been installed after the state achieved stare, it takes approximately 60 minutes and the data will not change exceed the value of 1 K.

f. Monitoring of the changes in temperature and visually observing the work piece directly.

g. Take note of changes in temperature and environmental conditions in the test chamber.

h. Repeat this step to increase the load to 25 liters and change set points in the cold position.

i. Repeat the above steps with the charging load on the inside of the room refrigerator of 10 liters and reposition thermostat on a very cold position.

Testing Procedure

Outline of Mechanical tests carried out in stages as follows

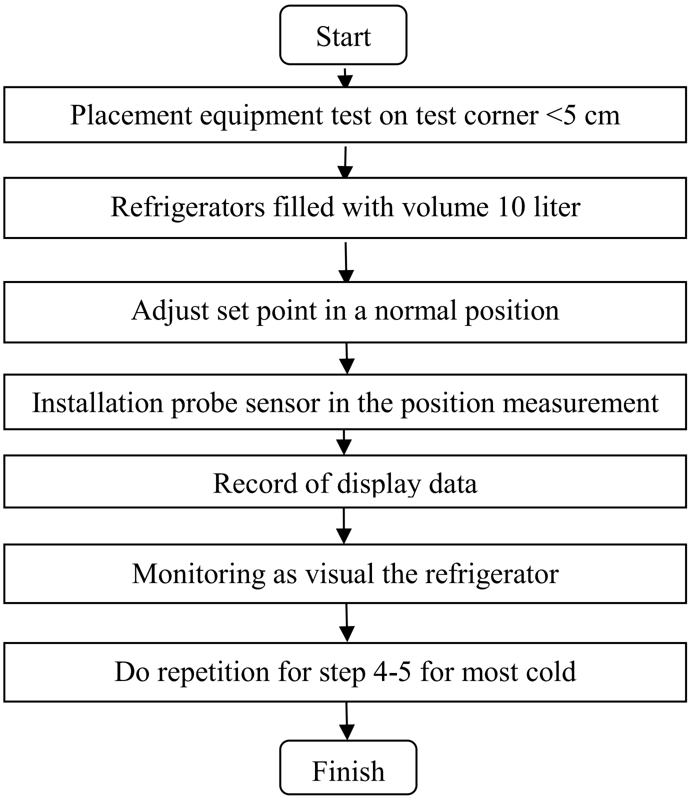

Figure 2. Procedure of refrigerator testing

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RESULTS AND DISCUSSION

Having obtained the test data, the calculated uncertainty type A, the uncertainty due to random effects. Having obtained the value of the uncertainty of the whole activity of the test, take the value of the greatest uncertainty, the largest value as the limit of the warranty, so the smaller the value of uncertainty certainly qualify. Next calculated value derived from the uncertainty of type A2 temperature range, through multiple regression and residual theory and uncertainty of type A2 can be obtained. Calculated value of the uncertainty type B, obtained from test equipment specifications, UB1 type of resolution measuring devices, UB2 type of accuracy of measuring instruments, UB3 type of external environmental factors and the type UB4 ambient temperature uncertainty value derived from the internal environment of the electric power supply (voltage variation) .

Measurement uncertainty component obtained following the formulation as follows;

- Calculation of measurement uncertainty due to repeated readings.

  ESDM= $U_a = \frac{S(X_i)}{\sqrt{n}}$, $U_A = (SD/\sqrt{5}) = 1.4\ ^oC$

- Calculate measurement uncertainty of sum square residual

  $$U_{A2} = \sqrt{\frac{SSR}{v-n}} = 0.35^oC$$

- Calculating measurement uncertainty of resolution measuring devices (digital),

  $$U_{STD} = U_{B1} = (0.5/\sqrt{3})x1^oC = 0.3^oC$$

- Calculating measurement uncertainty of the accuracy of measuring instruments,

  $$U_{STD} = U_{B2} = (0.01/\sqrt{3})x1^oC = 0.006^oC$$

- Calculate measurements uncertainty of changes in environmental temperature

  $$U_{STD} = U_{B3} = (0.4/\sqrt{6})x1^oC = 0.16^oC$$

- Calculating measurement uncertainty of changes in the electric power supply,

  $$U_{STD} = U_{B4} = (10\%/\sqrt{6}) = 0.04^oC$$

Furthermore, presented in Table uncertainty budget to facilitate observation.

Table 1 (Part-I). Uncertainty budget for setting the thermostat to normal conditions Uncertainty Budget (Normal condition)

No	*Source Uncertainty*	*Type*	U_i	U_{value}	*Prob.Dist.*	*Con.Fac*	U_{STD}	V_i
1.	Repeatability	A	$U_1(T)$	1.40 ^oC	T-Student	1	1.400 ^oC	8
2.	SSR	A	$U_2(T)$	0.35 ^oC	T-Student	1	0.350 ^oC	7
3.	Resolution	B	$U_1(T)$	1 ^oC	Rectang.	√3	0.300 ^oC	∞
4.	Accuration	B	$U_2(T)$	0.01 ^oC	Rectang.	√3	0.006 ^oC	∞

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Table 1 (Part-II). Uncertainty budget for setting the thermostat to normal conditions Uncertainty Budget (Normal condition)

No	*Source Uncertainty*	*Type*	U_i	U_{value}	*Prob.Dist.*	*Con.Fac*	U_{STD}	V_i
5.	Ambient Temperature	B	$U_3(T)$	0.40 °C	Triangulair	√6	0.160 °C	∞
6.	Voltage Fluctuation	B	$U_4(V)$	0.10 V	Triangulair	√6	0.040 V	∞
		Uncertainty Combine (U_C)					1.50 °C	
		Degrees of Freedom Effective , V_{eff}					10	
		Confidence Level , CL					95 %	
		Coverage Factor, k					2.23	
		Uncertainty Expanded, $U_{exp.}$					3.34 °C	

In the same way the uncertainty budget calculation for cold thermostat

Table 2. Uncertainty budget for the thermostat setting cold conditions Uncertainty Budget Cold condition)

No	*Source Uncertainty*	*Type*	U_i	U_{value}	*Prob.Distr.*	*Con.Fac*	U_{STD}	V_i
1.	Repeatability	A	$U_1(T)$	0.70 °C	T-Student	1	0.700 °C	8
2.	SSR	A	$U_2(T)$	0.18 °C	T-Student	1	0.180 °C	7
3.	Resolution	B	$U_1(T)$	1 °C	Rectang.	√3	0.300 °C	∞
4.	Accusation	B	$U_2(T)$	0.01 °C	Rectang.	√3	0.006 °C	∞
5.	Ambient Temperature	B	$U_3(T)$	0.40 °C	Triangular	√6	0.160 °C	∞
6.	Voltage fluctuation	B	$U_4(V)$	0.10 V	Triangular	√6	0.040 V	∞
		Uncertainty Combine (U_C)					0.800 °C	
		Degrees of Freedom Effective , V_{eff}					10	
		Confidence Level , CL					95 %	
		Coverage Factor, k					2.23	
		Uncertainty Expanded, $U_{exp.}$					1.78 °C	

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In the same calculated uncertainty budget for setting thermostat very cold

Table 3. Uncertainty budget for the thermostat setting is very cold conditions Uncertainty Budget (very cold condition)

No	*Source Uncertainty*	*Type*	U_i	U_{value}	*Prob.Distr.*	*Con.Fac*	U_{STD}	V_i
1.	Repeatability	A	$U_1(T)$	0.70 °C	T-Student	1	0.400 °C	6
2.	SSR	A	$U_2(T)$	0.18 °C	T-Student	1	0.050 °C	5
3.	Resolution	B	$U_1(T)$	1 °C	Rectang.	√3	0.300 °C	∞
4.	Accuration	B	$U_2(T)$	0.01 °C	Rectang.	√3	0.006 °C	∞
5.	Ambient Temperature	B	$U_3(T)$	0.40 °C	Triangular	√6	0.160 °C	∞
6.	Voltage Fluctuation	B	$U_4(V)$	0.10 V	Triangular	√6	0.040 V	∞
			Uncertainty Combine (U_C)				0.5 °C	
			Degrees of Freedom Effective , V_{eff}				10	
			Confidence Level , CL				95 %	
			Coverage Factor, k				2.06	
			Uncertainty Expanded, $U_{exp.}$				1.03 °C	

Compare the test results to the test standard normal conditions with 16 liter load, voltage 220 V AC, (27.5 ± 1.0) ° C, RH. = (65 ± 5)%. Steady state load ± 2 liter ice room.

Table 4. Comparison of test results and the Standard test for the thermostat setting Normal conditions

No.	*Parameter*	*Standard*	*Testing*	*Conform*	*Non Conf.*
1.	Seal Compound	not melt	not melt	√	
2.	The Formation of Ice	<= 24 hr	<= 24 hr	√	
3.	Defrosting System	Be at work	Be at work	√	
4.	In Addition to Room	0°C<=T<=18°C	(6.8-3.3)°C <=T<= (10.6 +3.3.)°C	√	
5.	Room Temperature Ice Cubes	T<= 0°C	T= (6.8-3.3)°C		√
6.	Sheath Compressor Motor	T<=(150-7) °C	T=10.6 +3.3)°C	√	

Comparison of test results with standard test for the coldest conditions with a 16 liter load, voltage (220 ± 20) V AC, (27.5 ± 1.0) ° C, relative humidity = (65 ± 5) %. Steady state with a load of ± 2 liter ice chamber.

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Table 5. Comparison of test results and the Standard Test for the thermostat condition Very cold

No.	*Parameter*	*Standard*	*Testing*	*Conform*	*Non Conf.*
1.	Seal Compound	not melt	not melt	√	
2.	The Formation of Ice	<= 24 hr	<= 24 hr	√	
3.	Defrosting System	Be at work	Be at work	√	
4.	In Addition to Room	0oC<=T<=(15-2)co	(16.0-3.3) co <=T<=(25.5 +3.3.)co		√
5.	Room Temperature Ice Cubes	T<= 0oC	T= (2.8-3.3)oC		√
6.	Sheath Compressor Motor	T<=(150-7) oC	T=76.0 +3.3)oC	√	

CONCLUSSION

Ice maker room temperature value is always above 0 C for the overall position of the thermostat setting (cold, normal and cold at all) so that the specimen does not meet test standards. Flatness level temperature distribution occurs best when cheated in the range (2.8 ± 0.5 °C to (10.8 ± 0.4) °C when setting the thermostat is in the normal position for 16 liter cooling load. Level flatness worst temperature distribution occurs when the range (2.6 ± 0.4 °C to (25.8 ± 0.2) °C when the thermostat settings are at the cold for 25 liter cooling load. Zone lowest temperature to be higher in the refrigerator URG-129 in sequence are: ice chamber (2.7 ± 0.1) °C, the food shelf (8.2 ± 0.3) °C, shelf bottles (9.6 ± 1.9) °C, vegetables and fruits space (11.4 ± 1.0) °C and egg rack (13.2 ± 2.4) °C, so that Refrigerator not meet the test requirements of ISO 04-6292.2.24-2001 reference

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