1955 No. 292

The Wireless Telegraphy (Control of Interference from Refrigerators) Regulations, 1955

Made - - - -	23*rd February*, 1955
Laid before Parliament	1*st March*, 1955
Coming into Operation	1*st September*, 1955

I, The Right Honourable Herbrand Edward Dundonald Brassey Earl De La Warr, Her Majesty's Postmaster-General, by virtue of the power vested in me by section ten of the Wireless Telegraphy Act 1949(a) and of every other power enabling me in this behalf, do hereby make the following Regulations, that is to say:—

1.—(1) In these regulations, except so far as the contrary is provided or the context otherwise requires, the following expressions have the meanings hereby respectively assigned to them:—

"electric supply line terminals" in relation to a refrigerator means the terminals or other points of connection on or in the refrigerator which are designed to connect it with a source of electric power;

"refrigerator" means apparatus used or designed to be used for the purpose of refrigeration which, or any part of which, generates or is liable to generate fortuitously electro-magnetic energy at frequencies of three million megacycles or less per second when it is in operation, and includes any switchgear forming part of or directly associated with that apparatus whereby the apparatus is made to operate and to cease from operating;

"suppressor" means a piece of equipment designed to reduce the electro-magnetic energy injected into any electric line by the apparatus to which that piece of equipment is fitted when the apparatus is operating;

expressions used in the Schedule hereto have the meanings respectively assigned to them in Part I of the said Schedule;

and other expressions have the same meaning as they have in the Wireless Telegraphy Act 1949.

(2) The Interpretation Act 1889(b) applies to the interpretation of these regulations as it applies to the interpretation of an Act of Parliament.

Manufacturers, Assemblers and Importers

2. The requirement referred to in regulation three shall be complied with in the case of any refrigerator if, on or after the date on which these regulations come into operation, it is to be sold otherwise than for export, or offered or advertised for sale otherwise than for export, or let on hire or offered or advertised for letting on hire, by any person who in the United Kingdom

(a) 12, 13 & 14 Geo. 6. c. 54. (b) 52 & 53 Vict. c. 63.

in the course of business manufactures or assembles refrigerators, or who in the course of business imports refrigerators into the United Kingdom:

Provided that this regulation shall not apply in the case of a refrigerator designed to be used exclusively in a vessel, vehicle or aircraft and to obtain its power supply solely therefrom.

Requirement

3. The requirement hereinbefore referred to is that the refrigerator shall be so designed, constructed and assembled, and that such precautions shall be taken in relation to it (by means of the fitting of a suppressor or otherwise), as to ensure that the voltage of electro-magnetic energy at the electric supply line terminals of the refrigerator, as measured and computed in accordance with regulation four, shall not exceed:—

(*a*) seven hundred and fifty microvolts where the measurement is made at any frequency between forty and seventy megacycles per second;

(*b*) one thousand five hundred microvolts where the measurement is made at any frequency between two hundred kilocycles per second and one thousand six hundred and five kilocycles per second.

Voltage measurement

4.—(1) For the purpose of measuring and computing the voltage of electromagnetic energy at the frequencies mentioned in paragraph (*a*) of regulation three, the refrigerator shall be tested by means of measuring apparatus of the description and having the physical and electrical characteristics and performance set out in Part 2 of the Schedule hereto, and for the purpose of measuring and computing the said voltage at the frequencies mentioned in paragraph (*b*) of regulation three the refrigerator shall be tested by means of measuring apparatus of the description and having the physical and electrical characteristics and performance set out in Part 3 of the said Schedule.

(2) The tests shall be made by the method and under the conditions set out in Part 4 of the said Schedule.

(3) The said voltage shall be computed as provided in Part 4 of the said Schedule from the readings afforded by the measuring apparatus while the refrigerator is operating.

Citation and commencement

5.—(1) These regulations may be cited as "The Wireless Telegraphy (Control of Interference from Refrigerators) Regulations 1955".

(2) These regulations shall come into operation on the 1st day of September, 1955.

Dated this 23rd day of February, 1955.

De La Warr,
Her Majesty's Postmaster-General.

THE SCHEDULE

PART 1

Definition of expressions used in the Schedule

Voltage and e.m.f.

References to the voltage or e.m.f. of a sinewave are reference to its effective or root mean square value.

Decibel

The term "decibel" (abbreviated db) expresses the logarithmic ratio of two voltages or e.m.f.'s. The ratio of two voltages V_1 and V_2 expressed in decibels is 20 times the logarithm to the base 10 of $\frac{V_1}{V_2}$ i.e. $20 \log_{10} \frac{V_1}{V_2}$.

Applied Voltage

The voltage applied to the input terminals of the measuring apparatus.

Reference deflection

The deflection of the needle of the indicating meter of the valve-voltmeter to a mark at the middle of the scale of the meter.

Tuned frequency

The mid-frequency of the band of frequencies for which the measuring apparatus is tuned to accept the applied voltage.

Intermediate frequency

The mid-frequency of the band of frequencies for which the intermediate frequency amplifier of the measuring apparatus is tuned to accept the voltage applied to it.

Image frequency

The frequency, not being the tuned frequency, which combines with the fundamental frequency of the beating oscillator to produce the intermediate frequency.

Terminal voltage calibration constant

The number of decibels that must be added to the reading of the measuring apparatus, when a measurement of terminal voltage is made as prescribed, to give the terminal voltage in decibels above one microvolt.

PART 2

Description and specification of characteristics and performance of measuring apparatus for use in the frequency range 40 to 70 Mc/s

1. *General description*

(1) The measuring apparatus shall be a calibrated radio receiver, designed for the measurement of radio frequency noise voltages. The receiver shall be of the superheterodyne type and comprise a radio-frequency (R.F.) amplifier, a frequency changer, an intermediate frequency (I.F.) amplifier and an output valve-voltmeter. Attenuators calibrated in decibels (db), shall be provided in the input circuits of both R.F. and I.F. amplifiers. The indicating meter of the valve-voltmeter shall have a scale provided with zero and full-scale marks and a reference deflection mark at mid-scale. The measuring apparatus shall be calibrated in terms of a known sinewave voltage at its input terminals. Facilities shall be provided so that, whenever a measurement is to be made, the gain of the receiver of the measuring apparatus may be set to the gain used when it was calibrated.

(2) For the purpose of terminal voltage tests, resistive networks shall be provided, one for connection between each electric supply line terminal (other than that to which the measuring apparatus is to be connected) and earth via an isolating condenser. An isolating condenser shall also be provided for connection between the measuring apparatus and the supply line terminal to be tested. Each resistive network shall have a resistance of 75 ohms ($\pm$ 15 ohms) and a phase angle not exceeding 30°. Each isolating condenser shall have an impedance of less than 5 ohms at the frequencies

at which the measurements are to be made. An unbalance/balance transformer may be inserted in the connection between the appropriate isolating condenser and the measuring apparatus, and if so any loss caused by it shall be included in the calibration of the measuring apparatus.

(3) For the purpose of terminal voltage tests, reactors having an impedance of not less than 500 ohms at the frequencies at which the measurements are to be made shall be provided for insertion between the electric supply line terminals of the refrigerator and the supply lines. Filters may be inserted between the reactors and the supply lines if required for reducing noise voltages present on the supply lines.

2. *Performance characteristics*

(1) *Accuracy of setting frequency*

The receiver shall be capable of being set, to an accuracy of ± 1 per cent., to receive any frequency within its range.

(2) *Voltage sensitivity and accuracy*

At any frequency within the range of the measuring apparatus, values of sinewave voltage greater than 20 microvolts shall be measurable to an accuracy of ± 1 db.

(3) *Attenuators*

The attenuators shall be so constructed and disposed that no performance characteristic of the set, apart from gain, is significantly affected by variations in their settings.

(4) *Overload characteristic*

With the measuring apparatus adjusted to give reference deflection of the meter for an applied sinewave voltage of any value between 20 microvolts and 100 millivolts, the sinewave voltage measured at the input of the valve-voltmeter shall be proportional to the applied voltage within ± 1 db up to a voltage 40 db above that producing reference deflection.

(5) *Overall frequency characteristic*

The variation with frequency of an applied sinewave voltage to produce a constant voltage at the input to the valve-voltmeter, when no alteration is made to the tuning of the measuring apparatus, shall not exceed the limits of the marked area of Figure 1.

(6) *Frequency characteristics of the radio-frequency amplifier*

The increase of an applied sinewave voltage needed to produce a constant voltage at the control grid of the frequency changer valve shall be not less than 6 db when the frequency of the applied voltage is varied from the tuned frequency by ± 2·5 Mc/s.

(7) *Spurious responses*

The applied sinewave voltage of the tuned frequency which produces reference deflection of the meter shall be at least 80 db lower than the applied voltage at any other frequency which combines with a harmonic and not the fundamental frequency of the local oscillator to produce reference deflection.

(8) *Image frequency response*

The ratio of the applied sinewave voltages which produce reference deflection at the image frequency and at the tuned frequency respectively shall be at least 40 db.

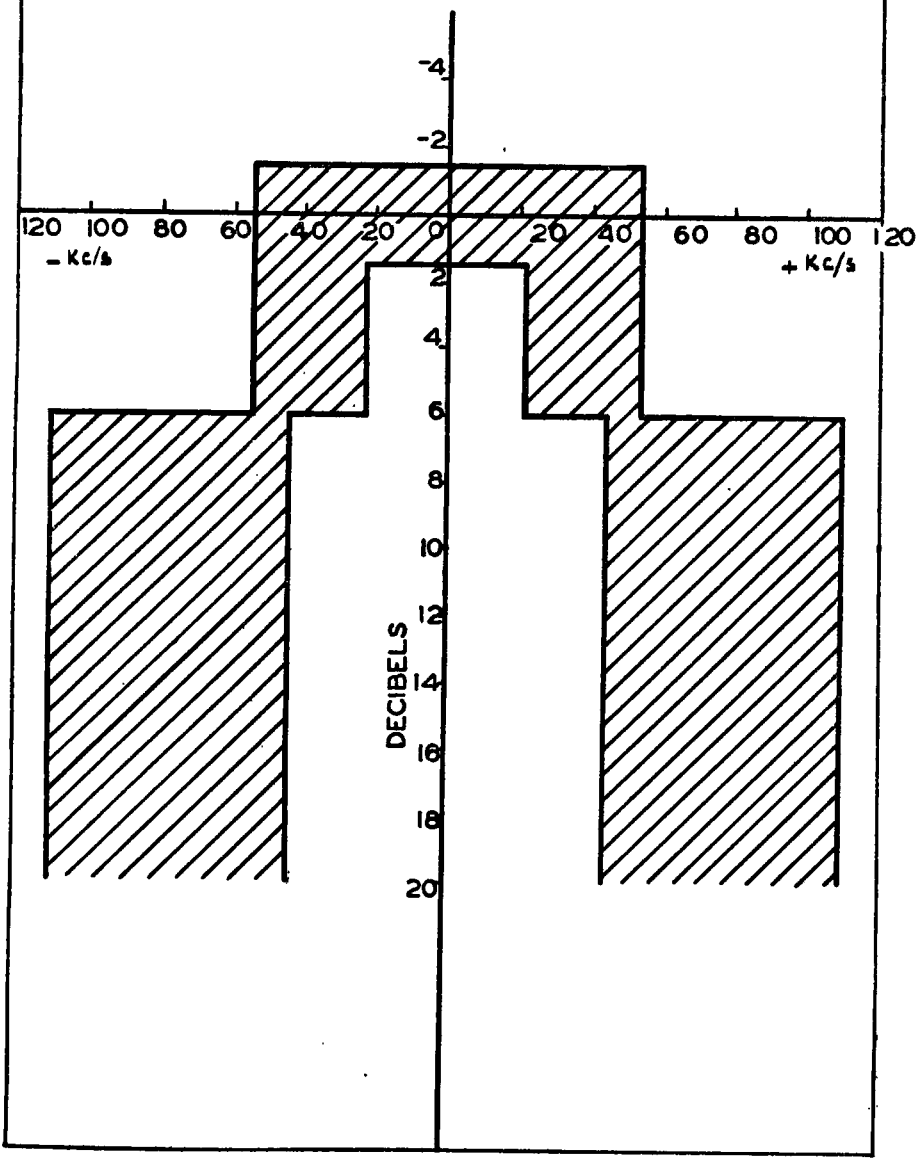
(9) *Intermediate frequency response*

The ratio of the applied sinewave voltages which produce reference deflection at the intermediate frequency and at the tuned frequency respectively shall be at least 40 db.

(10) *Screening*

The overall screening shall be such that, with the receiver tuned to any frequency within its range and the gain of the receiver adjusted to that used for that frequency when the measuring apparatus was calibrated, the change in the I.F. attenuator setting required to return the meter to reference deflection when an external electromagnetic field of that frequency and of a strength of 86 db above 1 microvolt per metre is switched on shall not exceed 1 db. This requirement shall be met for all orientations of the measuring apparatus. For this test screening covers may be placed over the input terminals.

FIG. 1 OVERALL FREQUENCY CHARACTERISTIC OF MEASURING APPARATUS – SCHEDULE PART 2, PARA. 2 (5)



3. *Input circuit*

The impedance at the input terminals of the measuring apparatus shall be balanced and shall have a value of 75 ± 15 ohms and a phase angle within the limits ± 20° at any frequency within the range of the measuring apparatus.

4. *Output circuit (valve-voltmeter)*

(1) *Linearity*

The performance of the rectifier and of any associated circuits of the valve-voltmeter shall be such that the current through the indicating meter is linearly related to the sinewave voltage input to the rectifier, to within ± 10 per cent. of that voltage, for all values of input voltage from 0·5 to 2·5 times the value producing reference deflection.

The application to the input of the rectifier of the sinewave voltage which produces reference deflection shall cause an increase of 1·75 volts ± 10 per cent. in the steady voltage across the rectifier load.

The increase in the sinewave voltage at the input of the rectifier required to increase the meter reading from reference deflection to full-scale deflection shall be not less than 5·5 db, nor more than 6·5 db.

(2) *Charge time-constant*

A sinusoidal voltage of frequency equal to the intermediate frequency, which when continuously applied to the input terminals of the intermediate frequency amplifier produces reference deflection, shall, when suddenly applied at the same point, cause the change of voltage across the output circuit of the rectifier to reach 0·63 times the final value of the change of voltage in not less than 0·8 milliseconds and not more than 1·2 milliseconds.

In this test, the input terminals of the I.F. amplifier shall be disconnected from the preceding circuits of the measuring apparatus.

(3) *Discharge time-constant*

The time taken for the current in the meter circuit to decrease by 0·63 times its initial value after an applied voltage as specified in 4 (2) above is suddenly removed shall be not less than 450 milliseconds and not more than 550 milliseconds.

(4) *Indicating meter*

The indicating meter shall be of the permanent magnet moving-coil type in which the deflection of the needle is directly proportional to the current passing through the meter. Under the conditions of use of the measuring apparatus the damping of the meter shall be such that, when a current of a value which produces a final steady full-scale deflection is suddenly applied to the meter, the time of rise to 80 per cent. of full-scale deflection is not less than 240 milliseconds and not more than 360 milliseconds and the overswing is less than 5 per cent. of the full-scale deflection.

5. *General requirements*

(1) *Gain setting*

The accuracy of adjustment of the measuring apparatus shall be such that two successive measurements of any given input voltage (having a value within the range of measurement of the apparatus), between which any adjustment of the operating controls may be made, shall not differ by more than 1 db.

(2) *Monitoring*

Provision shall be made for aural presentation of the receiver output for monitoring purposes.

PART 3

Description and specification of characteristics and performance of measuring apparatus for use in the frequency range 200 *to* 1605 *kc/s*

1. *General description*

(1) The measuring apparatus shall be a calibrated radio receiver designed for the measurement of radio frequency noise voltages. The receiver shall be of the super-heterodyne type and comprise a radio-frequency (R.F.) amplifier, a frequency-changer, an intermediate-frequency (I.F.) amplifier and an output valve-voltmeter. One or more stepped or continuously-variable attenuators, calibrated in decibels (db), shall be provided, either wholly in the input circuit of the R.F. amplifier, or distributed between the input circuits of the R.F. and I.F. amplifiers. If any of the attenuators are continuously-variable, the indicating meter of the valve-voltmeter

shall have a scale provided with zero and full-scale marks and a reference deflection mark at mid scale. If none of the attenuators is continuously-variable, the indicating meter of the valve-voltmeter shall have a scale provided with zero and full-scale marks and calibrated in steps of 1 db, covering a range at least equal to the smallest step on the attenuator(s). The measuring apparatus shall be calibrated in terms of a known sinewave voltage applied across the 75 ohm resistive network mentioned in in the next sub-paragraph and the input circuit of the measuring apparatus, the two being connected in series. Facilities shall be provided so that, whenever a measurement is to be made, the gain of the receiver of the measuring apparatus may be set to the gain used when it was calibrated.

(2) For the purpose of terminal voltage tests, resistive networks shall be provided, one for connection between the electric supply line terminal to be tested and one terminal of the input circuit of the measuring apparatus via an isolating condenser, and one for connection between each other electric supply line terminal and earth via an isolating condenser. The former resistive network shall have a resistance of 75 ohms ($\pm$ 15 ohms) and a phase angle not exceeding 30°. Each of the latter resistive networks shall have a resistance of 150 ohms ($\pm$ 30 ohms) and a phase angle not exceeding 30°. Each isolating condenser shall have an impedance of less than 10 ohms at the frequencies at which the measurements are to be made.

(3) For the purpose of terminal voltage tests, reactors having an impedance of not less than 1,000 ohms at the frequencies at which the measurements are to be made shall be provided for insertion between the electric supply line terminal of the refrigerator and the electric supply lines. Filters may be inserted between the reactors and the supply lines if required for reducing noise voltages present on the supply lines.

2. *Performance characteristics*

(1) *Accuracy of setting frequency*

The receiver shall be capable of being set, to an accuracy of $\pm$ 1 per cent., to receive any frequency within its range.

(2) *Voltage sensitivity and accuracy*

At any frequency within the range of the measuring apparatus values of sinewave voltage greater than 4 microvolts shall be measurable to an accuracy of $\pm$ 1 db.

(3) *Attenuators*

The attenuators shall be so constructed and disposed that no performance characteristic of the set, apart from gain, is significantly affected by variations in their settings.

(4) *Overload characteristic*

With the measuring apparatus adjusted to give full scale deflection of the meter for an applied sinewave voltage of any value between 4 microvolts and 40 millivolts, the sinewave voltage measured at the input of the valve-voltmeter shall be proportional to the applied voltage within $\pm$ 1 db up to a voltage 20 db above that producing full scale deflection of the meter.

(5) *Overall frequency characteristic*

The variation with frequency of an applied sinewave voltage to produce a constant voltage at the input to the valve-voltmeter, when no alteration is made to the tuning of the measuring apparatus, shall not exceed the limits of the marked area of Figure 2.

(6) *Frequency characteristic of the input circuit*

The acceptance bandwidth of the input circuits prior to the first valve when measured at the input terminals shall be not greater than the tuned frequency for an attenuation of 20 db relative to the response at the tuned frequency.

(7) *Frequency characteristic of the radio frequency amplifier*

The acceptance bandwidth of the signal frequency circuits prior to the frequency changer valve when measured at the input terminals shall not be greater than the intermediate frequency for an attenuation of 20 db relative to the response at the tuned frequency.

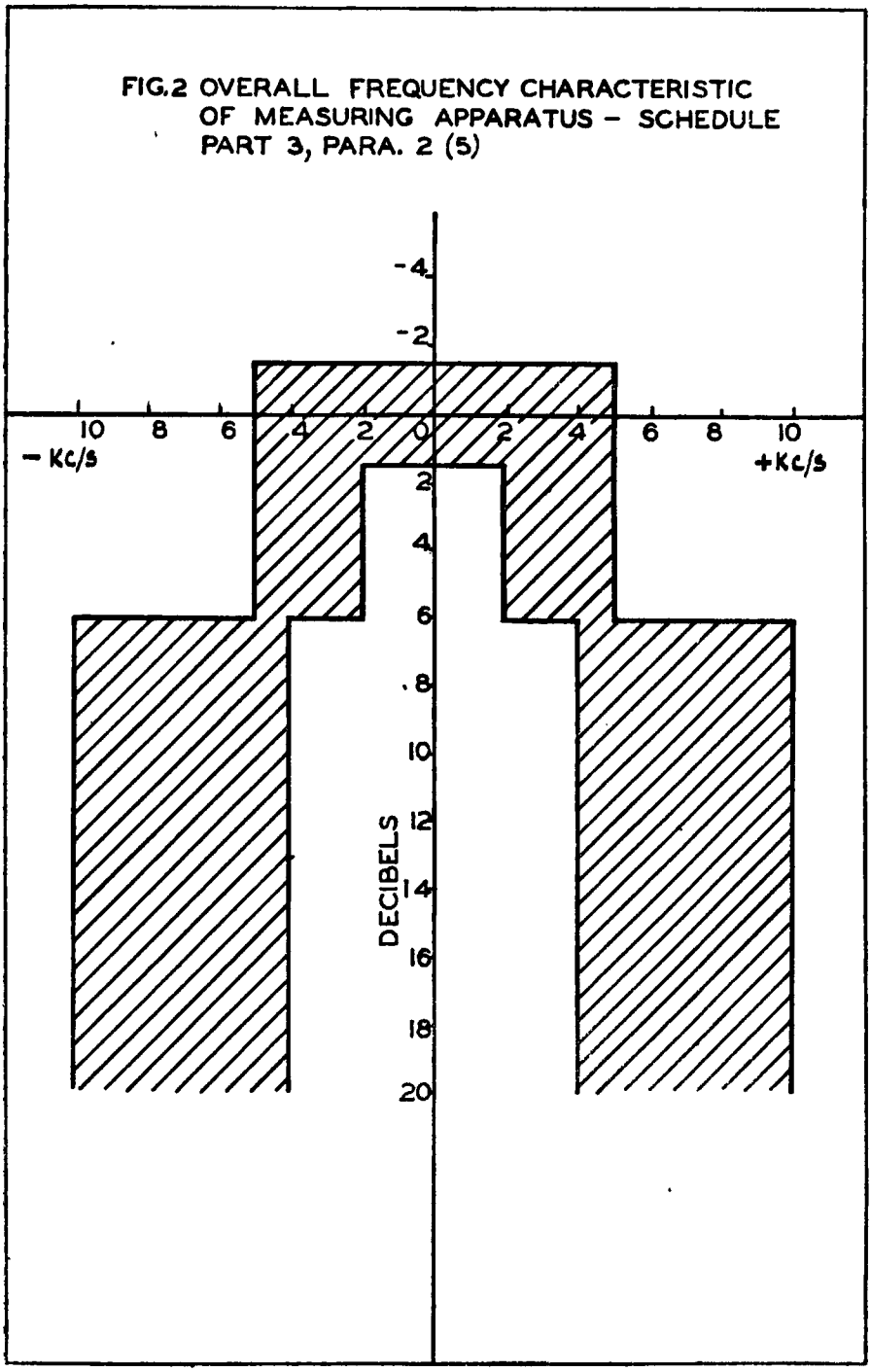


FIG. 2 OVERALL FREQUENCY CHARACTERISTIC OF MEASURING APPARATUS – SCHEDULE PART 3, PARA. 2 (5)

(8) *Spurious responses*

The applied sinewave voltage of the tuned frequency which produces full scale deflection of the meter shall be at least 80 db lower than the applied voltage at any other frequency which combines with a harmonic and not the fundamental frequency of the local oscillator to produce full scale deflection.

(9) *Image frequency response*

The ratio of the applied sinewave voltages which produce full scale deflection of the meter at the image frequency and at the tuned frequency respectively shall be at least 40 db.

(10) *Intermediate frequency response*

The ratio of the applied sinewave voltages which produce full scale deflection of the meter at the intermediate frequency and at the tuned frequency shall be at least:

(*a*) 40 db where the tuned frequency differs from the intermediate frequency by more than 250 kc/s.

(*b*) 20 db where the tuned frequency differs from the intermediate frequency by more than 150 kc/s but not more than 250 kc/s.

(11) *Screening*

The overall screening shall be such that, with the receiver tuned to any frequency within its range and the gain of the receiver adjusted to that used for that frequency when the measuring apparatus was calibrated, the meter indication shall not vary by more than 1 db when an electromagnetic field of that frequency and of a strength of 30 millivolts per metre is switched on.

3. *Input circuit*

The impedance at the input terminals of the measuring apparatus shall be unbalanced and have a value of 75 ohms $\pm$ 15 ohms and a phase angle within the limits $\pm$ 10 degrees of any frequency within the range of the measuring apparatus.

4. *Output circuit* (*valve-voltmeter*)

(1) *Linearity*

The performance of the rectifier and of any associated circuits of the valve-voltmeter shall be such that the current through the indicating meter is linearly related to the sinewave voltage input to the rectifier, to within $\pm$ 10 per cent. of that voltage, for all values of input voltage from 0·3 to 4 times the value producing full scale deflection of the meter.

The application to the input of the rectifier of the sinewave voltage which produces full scale deflection shall cause an increase of 5·5 volts $\pm$ 10 per cent. in the steady voltage across the rectifier load.

(2) *Charge time constant*

A sinusoidal voltage of frequency equal to the intermediate frequency, which when continuously applied to the input terminals of the intermediate frequency amplifier produces full scale deflection of the meter, shall, when suddenly applied at the same point, cause the change of voltage across the output circuit of the rectifier to reach 0·63 times the final value of the change of voltage in not less than 0·8 milliseconds and not more than 1·2 milliseconds.

In this test, the input terminals of the I.F. amplifier shall be disconnected from the preceding circuits of the measuring apparatus.

(3) *Discharge time constant*

The time taken for the current in the meter circuit to decrease by 0·63 times its initial value after an applied voltage as specified in 4 (2) above is suddenly removed shall be not less than 450 milliseconds and not more than 550 milliseconds.

(4) *Indicating meter*

The indicating meter shall be of the permanent-magnet moving-coil type in which the deflection of the needle is directly proportional to the current passing through the meter. Under the conditions of use of the measuring apparatus the damping of the meter shall be such that, when a current of a value which produces a final steady full-scale deflection is suddenly applied to the meter, the time of rise to 80 per cent. of full scale deflection is not less than 240 milliseconds and not more than 360 milliseconds and the overswing is less than 5 per cent. of the full-scale deflection.

5. *General requirements*

(1) *Gain setting*

The accuracy of adjustment of the measuring apparatus shall be such that two successive measurements of any given input voltage (having a value within the range of measurement of the apparatus), between which any adjustments of the operating controls may be made, shall not differ by more than 1 db.

(2) *Monitoring*

Provision shall be made for the aural presentation of the receiver output for monitoring purposes.

PART 4

Method and conditions of testing

1. *Connection of refrigerator to electric supply lines*

The electric supply line terminals of the refrigerator under test shall be connected with the resistive networks mentioned in paragraph 1 (2) of Part 2 or Part 3 (as the case may be) of the Schedule, and, through the reactors (and, if required, the filters) mentioned in paragraph 1 (3) of Part 2 or Part 3 (as the case may be) of the Schedule, with the electric supply lines as mentioned in those paragraphs. The leads between the electric supply line terminals and the reactors shall be as short as is practicable and unscreened. The frame of the refrigerator shall be earthed. The layout and wiring of the refrigerator shall not be altered more than is necessary to comply with this Part of the Schedule.

2. *Preliminary adjustment of measuring apparatus*

The receiver of the measuring apparatus shall be connected with an appropriate source of electricity supply, the attenuator(s) shall be set at maximum loss, and the zero control of the valve-voltmeter shall be adjusted to bring the needle of the indicating meter to the zero mark. The receiver shall be tuned to the frequency, as indicated by the main tuning dial calibrations, at which it is desired to test, and its gain shall be set to that used when the measuring apparatus was calibrated.

3. *Input connection of measuring apparatus*

(1) Where the measuring apparatus being used is that described in Part 2 of the Schedule, one of the receiver input terminals of the measuring apparatus shall be connected with one of the electric supply line terminals of the refrigerator, and the other receiver input terminal shall be connected to earth. The other electric supply line terminals shall be connected to earth through the 75 ohms resistive networks mentioned in paragraph 1 (2) of Part 2.

(2) Where the measuring apparatus being used is that described in Part 3 of the Schedule, one of the receiver input terminals of the measuring apparatus shall be connected with one of the electric supply line terminals of the refrigerator through the 75 ohms resistive network mentioned in paragraph 1 (2) of Part 3, and the other receiver input terminal shall be connected to earth. The other supply line terminals shall be connected to earth through the 150 ohms resistive networks mentioned in that paragraph.

(3) The shortest practicable length of unscreened connecting lead shall be used.

4. *Making the measurement*

(1) The R.F. amplifier tuning of the receiver shall be trimmed to give maximum deflection of the meter needle.

(2) Where the measuring apparatus being used is that described in Part 2 of the Schedule, the attenuators shall then be adjusted to bring the meter needle to the reference deflection mark, the R.F. attenuator being adjusted so that the I.F. attenuator is set to the lowest possible value in excess of 10 db.

(3) Where the measuring apparatus being used is that described in Part 3 of the Schedule, the attenuator(s) shall be adjusted to bring the meter needle to the reference deflection mark if a continuously-variable attenuator is fitted, or otherwise on to the calibrated part of the scale.

5. *Interpretation of results*

The voltage between the electric supply line terminal of the refrigerator with which the receiver is connected and earth, expressed in decibels above 1 microvolt, will be given by the sum (*a*) of the reading(s) of the attenuator(s), (*b*) the calibration constant (if any) appropriate to the frequency at which the measurement is being made, and (*c*) the reading of the meter, if calibrated in decibels.

If the result obtained is x decibels, the voltage expressed in microvolts is given by the antilog to the base 10 of $\frac{x}{20}$.

6. *Tests*

A set of tests shall be made in each case, as follows:—

(*a*) A check test made while the refrigerator is not operating.

(*b*) A main test which shall include readings taken while the refrigerator motor or heater is operating and at times when the switchgear of the refrigerator is bringing the motor or heater into and out of operation.

(*c*) A further check test as mentioned in (*a*).

This set of tests shall be made first with the receiver connected with one of the electric supply line terminals of the refrigerator, and shall be repeated with the receiver connected with the other (or each of the others) of such terminals.

7. If a click (as opposed to a buzz of appreciable duration) is heard in the monitoring loudspeaker or earphones at any time when the switchgear of the refrigerator is bringing the motor or heater into or out of operation, then provided that not more than one further click is heard during the period of two seconds immediately following the first, the readings of the measuring apparatus appearing within that period of two seconds shall be disregarded for the purpose of these regulations.

8. If the maximum reading obtained on any main test exceeds the maximum reading obtained on either of the check tests made next before or next after that main test by at least 10 db, the readings obtained on that main test are to be regarded as not materially affected by extraneous noise or signals. Otherwise the readings obtained on that main test are to be regarded as materially affected by extraneous noise or signals, and the results of that main test shall be disregarded for the purpose of these regulations.

EXPLANATORY NOTE

(This Note is not part of the Regulations, but is intended to indicate their general purport.)

These Regulations prescribe the requirement to be complied with in relation to refrigerators for the purpose of ensuring that they will not cause undue interference with wireless telegraphy.

The Regulations apply to all refrigerators (with certain exceptions) which, on or after the 1st September, 1955, are to be sold or offered or advertised for sale (except for export) or let on hire or offered or advertised for letting on hire by manufacturers, assemblers or importers in the course of their business within the United Kingdom. In respect of such refrigerators manufacturers, assemblers and importers are required from that date to comply with regulation 3.

The requirement is prescribed in terms of the maximum permitted voltage of electro-magnetic energy within specified frequencies at the supply line terminals. Regulation 4 and the Schedule set out the method of measuring the terminal voltage, the conditions under which tests are to be made, and the description and specification of the measuring apparatus.