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Radio Standards Specification

AM Broadcasting Transmitting Equipment

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1. Intent

- 1.1 This specification sets requirements for the type-approval of AM broadcasting transmitting equipment. Transmitting equipment type-approved under this specification are considered technically suitable which a Broadcasting Certificate is required in accordance with the provisions of the *Radiocommunications Act*.
- 1.2 The standards comprising the type-approval requirements of this specification are divided into two
 - Sections 3 to 6 contain the general equipment standards and the minimum emission standards for transmitting equipment. Compliance with these standards shall be supported by an engineering certificate in accordance with Radio Standards Procedure 100 (RSP-100).
 - Annex A contains the performance standards recognized by the industry to ensure quality operation. Compliance with the standards of Annex A shall be supported by a statement certifying that the submission of test results for these performance measurements is not required but the results shall be available.

Applications for type-approval shall be supported by the necessary documentation showing compliance with this specification and the annex.

2. General

- 2.1 This specification covers the transmitting equipment proper: namely from audio input terminals to separate R.F. amplifiers and filters.
- 2.2 The transmitting equipment shall be capable of meeting the standards in this specification on any day for which it is designed to operate.
- 2.3 Notwithstanding the fact that a particular piece of equipment meets this specification, the Department may require adjustments be made to the equipment wherever it causes interference within the meaning of the Act.
- 2.4 In the event that the equipment fails to function during type-approval tests under this specification, the tests shall be repeated after the trouble has been corrected.
- 2.5 Applicants seeking type-approval of equipment under this specification shall satisfy the Department that the equipment actually meets this specification.
- 2.6 The Department reserves the right to revise this specification.

3. Standard Test Conditions

- 3.1 **Definition** - Standard test conditions are those conditions which shall apply to a transmitting equipment under its minimum requirements. These conditions apply unless otherwise specified. Where no special conditions are specified, they shall be those specified by the manufacturer for normal operation, and these shall be stated in the test report.
- 3.2 **Standard Test Voltage** - Shall be one of the rated power supply voltages specified by the manufacturer.
- 3.3 **Standard Temperature** - Shall be 20 degrees C plus or minus 5 degrees C. Actual temperature shall be stated in the test report.
- 3.4 **Standard Test Load** - Shall have a resistive impedance characteristic and be capable of dissipating the maximum power of the transmitting equipment. At the test frequency, the resistive component of the test load shall be within 10% of the power the transmitting equipment was designed to operate. The reactive component of the test load shall not vary more than ± 10 kHz from the test frequency.
- 3.5 **Standard Test Frequencies** - Shall be the carrier frequency of the channel for which the transmitting equipment is designed to operate. For transmitting equipment capable of operating on any one channel in 535 - 1705 kHz band, the test frequencies shall be near each end of the band. The test frequencies shall be specified in the test report.

- 3.6 **Standard Test Input Signal** - The standard audio test signal shall be a 400-Hz sine wave.
- 3.7 **Standard Test Equipment** - All measurements shall be made with instruments having sufficient accuracy such that no appreciable error occurs due to test equipment in the measurements of the transmitter under test.
- 3.8 **Standard Test Set-up** - Unless otherwise specified, all tests shall be made with the carrier at rated power with the standard test input signal.
- 3.9 **Warm-up Time** - The transmitting equipment and test equipment shall be switched on at least 30 minutes unless otherwise stated.

4. Transmitting Equipment Standards

- 4.1 **Transmission System** - An AM broadcasting transmitting equipment consists of all the apparatus necessary to convert an input signal to an amplitude modulated R.F. carrier at a channel frequency in the 535 to 1 705 kHz range.
- 4.2 **Type of Emission** - The designation of modulation and emission refers to the manner in which the carrier is transmitted. The transmitting equipment shall produce A3EGN emission.
- 4.3 **Carrier Frequency Adjustment** - The transmitting equipment shall be capable of operation in accordance with the standards on any channel in the specified carrier frequency range without change in construction or replacement of components. Provision shall be made for trimming the carrier frequency to the assigned frequency.
- 4.4 **Power Supply Rating** - The A.C. voltage input shall be single phase or three phases, at a frequency of 50 or 60 Hz and maximum kVA requirements shall be indicated on the transmitting equipment.
- 4.5 **Phase-to-Phase Loading** - The transmitting equipment, if rated above 10 kVA input, shall present a balanced load on the mains such that the current in each phase shall be within 10% of the average of the three currents.

5. Equipment Requirements

- 5.1 **Design** - Transmitting equipment shall be designed according to good current engineering practice.
- 5.2 **Nameplate** - There shall be securely fastened to each transmitting equipment in a conspicuous external location a nameplate permanently marked thereon, the type-approval number, the manufacturer's name, name and rating of the equipment with sufficient other information to identify the unit completely. All other units associated with it shall be similarly marked.
- 5.3 **Protection of Personnel** - The transmitting equipment shall be so constructed that all hazardous components are either enclosed, or protected from accidental contact by personnel. The transmitting equipment enclosure shall be designed to ensure personnel safety during operation.
- 5.4 **Equipment Changes and Modifications** - Any major design or equipment changes outside the replacement of components by equivalent parts made to an approved equipment will void the approval unless notified in writing to the authority. The notification must provide information demonstrating that the modification provides equal or improved performance.

6. Minimum R.F. Performance Standards

6.1 Power Output Rating

- 6.1.1 **Definition** - The power output rating of a transmitting equipment is the carrier power at which the equipment may be operated into the test load.
- 6.1.2 **Method of Measurement** - The carrier shall be continuously modulated with the standard test signal at a level producing 50% modulation for a period of 3 hours followed immediately by 95% modulation. The output power shall be connected to the standard test load. The output power of the carrier shall be measured by a measuring device. The method shall be described in the test report.
- 6.1.3 **Standard** - The standard rating of power output for the transmitting equipment shall be as specified by the manufacturer. The transmitting equipment shall be capable of delivering the standard output rating. For transmitting equipment rated below 10 kW or the standard output rating plus 6% for transmitting equipment rated above 10 kW, the transmitting equipment shall be capable of being adjusted to deliver the rated power output above or below rated value.
 - 6.1.3.1 The test report shall state the power output limits over which the transmitting equipment meets the specification.

6.2 Modulation Capability

6.2.1 **Definition** - Modulation capability is the extent to which the carrier can be modulated.

6.2.2 **Method of Measurement** - Using an oscilloscope, spectrum analyzer, modulation monitor, or method, the modulation capability shall be measured. The method shall be described in the

6.2.3 **Minimum Standard**

6.2.3.1 **Minimum Standard (Monophonic Operation)** - The transmitting equipment shall be capable of modulation to 95% on positive and negative peaks at any carrier frequency.

6.2.3.2 **Minimum Standard (Stereophonic Operation)** - The transmitting equipment shall be capable of amplitude modulation to 85% on positive and negative peaks and capable of phase modulation to 71.5% radians (71.5%) at any carrier frequency within the broadcast band.

6.3 Carrier Frequency Stability

6.3.1 **Definition** - The carrier frequency stability is the ability of the transmitter to maintain a measured

6.3.2 **Method of Measurement** - After a warm-up period of one hour at rated A.C. input voltage, measure the carrier frequency at one minute intervals during a period of fifteen minutes. From those measurements determine the average carrier frequency for the carrier. Then at temperatures of 5° C and 45° C measure the operating frequency at 85% and 115% modulation. A period of 30 minutes should be allowed to enable the unit under test to achieve thermal stability before performing the measurements.

Where it is not practical to subject the complete transmitting equipment to the specified test and separately measure the stability of the frequency-determining elements of the transmitter under test, the transmitter shall be tested under the conditions specified in 6.3.3.

6.3.3 **Minimum Standard** - The frequency stability of the carrier shall remain within 10 Hz of the

6.4 Carrier Level Shift

6.4.1 **Definition** - The carrier level shift is the change in average carrier amplitude during modulation.

6.4.2 **Method of Measurement** - Carrier level shift shall be measured by a suitable modulation monitor.

6.4.3 **Minimum Standard** - The carrier level shift for 95% modulation shall not exceed 5%.

6.5 Spurious Emissions

6.5.1 **Definition** - Spurious emissions are radio frequency signals appearing at the transmitting equipment at frequencies other than the specified carrier frequency and modulation products.

6.5.2 **Method of Measurement** - The transmitting equipment shall be operated into the standard test load at rated power. The carrier shall be modulated with the standard test input signal at 95% modulation. Measure all spurious emissions up to the third harmonic of the carrier frequency. The voltage of the spurious emissions shall be measured with a frequency selective instrument. The attenuation versus frequency characteristics of the power meter used for this test shall be known over the range of frequencies involved. Record all spurious outputs that are more than 20 dB below the values in 6.5.3.

6.5.3 **Minimum Standard** - Spurious emissions of the transmitting equipment shall not exceed the following table:

Spurious Emission	Maximum Value
(a) between 15 kHz and 30 kHz from carrier frequency	-25 dB*

- (b) more than 30 kHz and up to and including 75 kHz and up to and from the carrier frequency -43 dB^*
- (c) more than 75 kHz from the carrier frequency $(-43 + 10 \log P)^*$ or -80 dB^* whichever is the higher signal level $P = \text{power}$

* Referred to the power level of the unmodulated carrier.

In addition, when the oscillator crystal is removed or deactivated, spurious radiation at any carrier frequency shall be no greater than the value specified in (c) above.

6.6 Cabinet Radiation

- 6.6.1 **Definition** - Cabinet radiation is any emission from the transmitting equipment housing or a normal output port.
- 6.6.2 **Method of Measurement** - The transmitting equipment shall be operated at rated power output antenna, located alternately at a known distance between three and ten metres from at least one side of the equipment (i.e. front, back, left- or right-hand side), shall be connected to a calibrated field strength meter. Field strength measurements shall be made of all emissions (including the fundamental frequency) up to the third harmonic of the carrier frequency. For the measurement, the receiving antenna and the maximum received field shall be noted (allowance shall be made for antenna and the measuring equipment). Using the free space formula below, calculate the reference field strength.

$$E = \sqrt{P/r} \text{ volts per metre}$$

Where P is the rated output power in watts and r is the distance in metres.

- 6.6.3 **Minimum Standard** - Emissions at any frequency shall be at least 54 dB below the calculated reference level. Any radiation weaker than 70 dB below the reference level need not be recorded.

6.7 Occupied Bandwidth Stereo Operation

- 6.7.1 **Definition** - The bandwidth occupied by the carrier and associated modulation products shall be measured at the specified limits.
- 6.7.2 **Methods of Measurement** - Measurement of the occupied bandwidth shall be conducted using a test signal. The test signal shall consist of a white noise source with USASI (United States Standard for AM Stereo) weighting. The weighting is produced by filtering white noise with a 100 Hz, 6 dB per octave per octave low-pass network. The USASI noise signal is then passed through a pulser circuit. The average amplitude of the noise signal is set to 20 dB at the output of the pulser.

The pulser shall operate at a frequency of 2.5 Hz with a duty cycle of 12.5%. The noise test signal shall be passed through the transmitting equipment through a network providing a modified 75-microsecond pre-emphasis. The pre-emphasis is a modified 75-microsecond curve with a high-frequency break point at 10 kHz. The pre-emphasis is followed by a low-pass filter providing attenuation of 15 dB at 10 kHz, 30 dB at 10.5 kHz, 40 dB at 11 kHz. The noise source is split into two channels left and right that have identical spectral distribution. The ratio of L+R (sum information) to L-R (difference information) is adjusted to 3:1.

A suitable swept frequency R.F. spectrum analyser shall be used to measure the spectrum of the test signal. The analyser shall consist of:

- 300-Hz resolution bandwidth;
- 5, 10 or 20-kHz/horizontal division (as appropriate);
- 10 dB/vertical division;
- Reference: Carrier peak;
- Peak Hold: 10-minute duration.

Using the appropriate scan width, measure the emission within ± 30 kHz of the carrier.

- 6.7.3 **Minimum Standard** - Emissions from stereophonic AM transmitting equipment consisting of modulation products shall be confined to frequencies within ± 15 kHz of the carrier. Emissions between 15 kHz and up to 30 kHz shall be attenuated at least 25 dB below the level of the unmodulated carrier.

6.8 Unwanted Emissions

- 6.8.1 **Definition** - Unwanted emissions are emissions on a frequency or frequencies outside the occupied band from the modulation process but exclude spurious emissions.
- 6.8.2 **Method of Measurement** - Using the same set-up as in paragraph 6.7.2 and the appropriate method, measure the emissions within ± 100 kHz of the carrier.
- 6.8.3 **Minimum Standard** - Any emissions appearing on a frequency removed by more than 30 kHz from the carrier shall be attenuated at least:
- (a) 35 dB below the level of the unmodulated carrier for any frequency more than 30 kHz from the carrier.
 - (b) $43 + 10 \log P$ (power in watts) dB or 80 dB, whichever is the lesser attenuation, below the level of the unmodulated carrier for any frequency more than 75 kHz from the carrier.

Issued under the Authority of the
Minister of Communications

ORIGINAL SIGNED BY G.R. BEGLEY

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Director General
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Annex A

Performance Standards

A.1 Audio Performance Standards (Monophonic)

A.1.1 Audio Input Impedance

A.1.1.1 **Standard** - The audio input impedance shall be a nominal 600 ohms balanced to ground. Additional nominal impedance may also be used as specified by the manufacturer.

A.1.2 Audio Input Level for 95% Modulation

A.1.2.1 **Definition** - The audio input level for 95% modulation is the audio input, expressed in dBm, necessary to obtain 95% modulation of the carrier, on both positive and negative peaks.

A.1.2.2 **Method of Measurement** - The standard test signal shall be adjusted to produce 95% modulation. This level shall be recorded.

A.1.2.3 **Standard** - The standard audio input level for 95% modulation shall be +10 dBm \pm 2 dB.

A.1.3 Audio Frequency Response

A.1.3.1 **Definition** - The audio frequency response is the ratio of input voltages relative to the output in dB, required to maintain a constant percentage of modulation across the audio frequency range.

A.1.3.2 **Method of Measurement** - The standard test setup shall be used. The audio input to maintain modulation levels of 25, 50 and 85% shall be determined at a sufficient number of points from 50 Hz to 10 kHz to enable a curve to be plotted for each modulation level.

A.1.3.3 **Minimum Standard** - The audio frequency response curve shall be entirely within the limits in figure A.1 for each modulation level.

A.1.4 Audio Frequency Harmonic Distortion

A.1.4.1 **Definition** - The audio frequency harmonic distortion is the harmonic content of the audio output of the transmitter.

A.1.4.2 **Method of Measurement** - The audio frequency harmonic distortion shall be measured by measuring a sample of the R.F. output of the transmitting equipment and feeding this to a wave analyzer. If an average-reading instrument is used, it will be necessary to take into account possible phase relations of the harmonics. The audio frequency distortion shall be measured at 50, 1000 and 10 000 Hz and at 25, 50 and 85% modulation respectively.

A.1.4.3 **Minimum Standard** - The audio frequency distortion, including all harmonics up to 24 000 Hz, shall not exceed 3% from 50 Hz to 10 000 Hz.

A.1.5 Audio Frequency Intermodulation Distortion

A.1.5.1 **Definition** - The audio frequency intermodulation distortion is the non-linear signal components of the audio output of the transmitting equipment resulting in modulation components equal to the sums and differences of the input signal.

A.1.5.2 **Method of Measurement** - A test signal consisting of a 60-Hz and a 7-kHz sine wave with an amplitude ratio of 4:1 respectively shall be applied to the transmitting equipment and the audio frequency intermodulation distortion shall be measured by demodulating a sample of the audio output.

equipment and feeding this to a wave analyser or suitable distortion meter. The distortion shall be measured at 100% and 85% modulation.

- A.1.5.3 **Minimum Standard** - The rms audio frequency intermodulation distortion shall not exceed the larger of the two test signals.

A.1.6 Carrier Hum and Noise

- A.1.6.1 **Definition** - The carrier hum and noise level is the ratio, expressed in dB, of the value of the hum and noise component at 100% modulation of the carrier envelope to the value of residual amplitude when the carrier is unmodulated.

- A.1.6.2 **Method of Measurement** - Measurement of the carrier hum and noise level may be made by connecting an AM detector coupled to the output of the transmitting equipment. The output of the detector shall be connected through a low-pass filter to a distortion and noise meter. Readings shall be taken without modulation but with a resistance equal to the audio input impedance.

- A.1.6.3 **Minimum Standard** - The measured level of all hum and noise components appearing on the carrier shall be at least 55 dB below 100% modulation.

A.2 Audio Performance Standards (Stereophonic)

A.2.1 Audio Input Level

A.2.1.1 **Minimum Standard** - The standard audio input level for 85% modulation shall be +10 c

A.2.2 Audio Frequency Response

A.2.2.1 **Definition** - The audio frequency response is the ratio of the input voltages relative to expressed in dB, required to maintain a constant percentage of modulation across the

A.2.2.2 **Method of Measurement** - The output of the transmitting equipment shall be sampled v demodulator with audio outputs for the Left and Right channels. Constant modulation maintaining constant output levels from the test demodulator. The audio input level t levels of 25, 50, and 85% shall be determined over the frequency range 50 Hz to 10 k channels.

A.2.2.3 **Minimum Standard** - The frequency response of either the left or right channel shall re response at 1 000 Hz over the frequency range between 50 Hz and 10 kHz under all c right stereophonic channel up to 85%.

A.2.3 Harmonic Distortion

A.2.3.1 **Method of Measurement** - Using the method of paragraph A.1.4.2, measure the harmon each of the left and right channels.

A.2.3.2 **Minimum Standard** - The total harmonic distortion including harmonics up to 20 000 F in either the left or right channel shall not exceed 5% in the frequency range 50 Hz to modulation up to 85%.

A.2.4 Channel Balance

A.2.4.1 **Definition** - The channel balance is the difference in output level of the left and right c

A.2.4.2 **Method of Measurement** - The channel balance shall be determined by comparing the i in section A.2.2.

A.2.4.3 **Minimum Standard** - The balance between the response in the left and right channels i from 50 Hz to 10 000 Hz at all levels of modulation up to 85%.

A.2.5 Intermodulation Distortion

A.2.5.1 **Method of Measurement** - Using the method of paragraph A.1.5.2 with the stereo test c measure the intermodulation distortion in the left and right channels.

A.2.5.2 **Minimum Standard** - The rms audio frequency intermodulation distortion in either the shall not exceed 4% referenced to the larger of the two test signals.

A.2.6 Carrier Hum and Noise

A.2.6.1 **Definition** - Carrier hum and noise is the ratio in dB of a reference signal modulation l modulation level caused by hum and noise components.

A.2.6.2 **Method of Measurement** - Measurement of the carrier hum and noise level may be ma stereo test demodulator coupled to the output of the transmitting equipment. The outj through a 10-kHz low-pass filter to a distortion and noise meter. Readings shall be ma

modulation of 85% and without modulation but with the audio input terminated with impedance. The measurement shall be made in each of the left and right channels.

- A.2.6.3 **Minimum Standard** - The level of hum and noise in either the left or right channel for 10 000 Hz shall be at least 48 dB below the reference level for 100% modulation at 10 000 Hz.

A.2.7 Stereophonic Separation

- A.2.7.1 **Definition** - The ratio in dB of the output of the left (or right) channel due to a signal to the output of the right (or left) channel due to the same signal.

- A.2.7.2 **Method of Measurement** - Input a test signal to the left channel only at a level equivalent to 85% modulation. Measure the demodulated output of the left and right channels and determine the ratio at frequencies from 400 Hz to 10 000 Hz. Repeat the above with the test signal applied to the right channel.

- A.2.7.3 **Minimum Standard** - The separation between the left and right channels shall be at least 30 dB in the frequency range from 400 Hz to 10 000 Hz at all levels of modulation up to 85%.

A.2.8 Crosstalk

- A.2.8.1 **Definition** - An undesired signal occurring in the sum channel from modulation of the difference channel or occurring in the difference channel from modulation of the sum channel.

- A.2.8.2 **Method of Measurement** - Using the standard test signals (L = R) to produce 85% modulation in the L+R channel, measure the components of the signal appearing in the L-R channel. Repeat with the test signal (L = -R) to produce 85% modulation in the L-R channel and measure the components appearing in the L+R channel.

- A.2.8.3 **Minimum Standard** - The sum channel (L+R) to the difference channel (L-R) crosstalk and the difference channel (L-R) to the sum channel (L+R) crosstalk shall be at least 30 dB below the reference level at 1 000 Hz.

A.2.9 Monophonic Compatibility

- A.2.9.1 **Definition** - Monophonic compatibility is defined as the compatible reception of stereophonic signals by a monophonic receiver with envelope detection.

- A.2.9.2 **Method of Measurement** - Using a test demodulator set for monophonic operation, measure the audio frequency response, audio frequency harmonic distortion, and carrier hum and noise level. The respective test methods of paragraphs A.2.2.2, A.2.3.2 and A.2.6.2 shall be used. The test demodulator shall be derived from an envelope detector with wideband response.

- A.2.9.3 **Minimum Standard - Audio Frequency Response** - The audio frequency response shall remain within 2 dB of the response at 1 000 Hz over the frequency range from 50 Hz to 20 000 Hz with 85% modulation of the stereophonic system up to 85%.

- A.2.9.4 **Minimum Standard - Audio Frequency Harmonic Distortion** - The total harmonic distortion including harmonics up to 20 000 Hz shall not exceed 5% over the frequency range from 50 Hz to 20 000 Hz under all conditions of modulation of the stereophonic system up to 85%.

- A.2.9.5 **Minimum Standard - Carrier Hum and Noise** - The level of all hum and noise for audio frequencies below 10 000 Hz shall be at least 55 dB below the reference level for 100%

