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Spectrum Management

Broadcasting Equipment Technical Standard

Technical Standards and Requirements for AM Broadcasting Transmitters

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Canada

Purpose

This document contains the technical standards and requirements for the issuance of a Technical Acceptance Certificate (TAC) for AM broadcasting transmitters.

A certificate issued for equipment classified as type approved or as technically acceptable before the coming into force of these technical standards and requirements is considered to be a valid and subsisting TAC.

A Technical Acceptance Certificate is not required for equipment manufactured or imported solely for re-export, prototyping, demonstration, exhibition or testing purposes.

Table of Contents

1. General

1.1 The standards and requirements in this document are the pre-requisite conditions for the issuance of a Technical Acceptance Certificate (TAC) for AM broadcasting transmitters.

1.2 Those seeking to obtain a Technical Acceptance Certificate for AM broadcasting transmitters shall, at their own expense, carry out the required tests and send to the Department a certification submission and an engineering brief prepared in accordance with *Broadcasting Equipment Standards Procedure 100 (BESP-100)*.

1.3 The engineering brief, signed by a professional engineer licensed by a provincial association, shall demonstrate that the equipment meets the technical standards in this document.

1.4 Notwithstanding the fact that a radio apparatus meets all applicable requirements, the Department reserves the right to require that adjustments be made to the equipment should it cause interference.

1.5 Any major design or component changes, other than the replacement of defective components by equivalent parts, will void the approval unless notified to and approved by the Department.

1.6 This document replaces *RSS-150, Issue 2*.

2. Testing and Labelling

2.1 Sections 3 to 6 contain the general equipment standards and the emission standards which relate to the radiated signal of the AM transmitting equipment. Compliance to the standards of these sections shall be supported by an engineering brief stating measurement results in accordance with *Broadcasting Equipment Standards Procedure 100 (BESP-100)*.

2.2 **Annex A** contains the performance standards recognized by the industry to ensure quality operation of AM broadcasting equipment. Compliance with the standards of **Annex A** shall be supported by a statement certifying that the equipment meets the standards. The submission of test results for these performance measurements is not required but the results shall be kept on file by the applicant.

2.3 This document covers the transmitting equipment proper: namely from audio input terminals to the output terminals including any separate RF amplifiers and filters.

2.4 In the event that the equipment fails to function during the certification tests, all tests affected by the failure shall be repeated after the fault has been corrected.

2.5 The transmitting equipment shall be capable of meeting the standards in this document on any AM channel and at the rated power output for which it is designed to operate.

2.6 Each certified broadcasting equipment must display in a conspicuous location:

(a) the manufacturer's name, trade or brand name (if different from the manufacturer's name);
(b) the model identification;
(c) the serial number;
(d) the Technical Acceptance Certificate number;
(e) the name of the certification assignee.

2.7 The identification label must be indelible, tamper-resistant and affixed permanently or stamped in such a manner as not to be removable except by destruction or defacing.

3. Standard Test Conditions

3.1 Definition

Standard test conditions are those conditions which shall apply to a transmitting equipment while it is being tested for minimum requirements. These conditions apply unless otherwise specified. Where no special conditions are called for in the tests, the conditions shall be those specified by the manufacturer for normal operation, and these shall be stated in the test report.

3.2 Standard Test Voltage

Standard test voltage shall be one of the rated power supply voltages specified by the manufacturer.

3.3 Standard Temperature

Standard temperature shall be 20^{o} C + 5^{o} C. The temperature shall be recorded in the test report.

3.4 Standard Test Load

Standard test load shall have a resistive impedance characteristic and be capable of dissipating the output power of the transmitting equipment. At the test frequency, the resistive component of the test load shall be within 5% of the load impedance into which the transmitting equipment was designed to operate. The reactive component of the test load shall not be greater than 5% of the resistive component over the range of ±10 kHz from the test frequency.

3.5 Standard Test Frequencies

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 - 1,705 kHz band, tests shall be made on two channels, one 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 to ensure 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 output and modulated 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 before any test is started, unless otherwise stated.

4. Transmitting Equipment Standards

4.1 Transmission System

An AM broadcasting transmitting equipment consists of all the apparatus necessary to convert the audio input signal to an amplitude modulated RF carrier at a channel frequency in the 535 to 1,705 kHz frequency band.

4.2 Type of Emission

The designation of modulation and emission refers to the manner in which the carrier is modulated and transmitted. The transmitting equipment shall produce A3EGN emission.

4.3 Carrier Frequency Adjustment

The transmitting equipment shall be capable of operation in accordance with these standards on any channel in the specified carrier frequency range without change in construction other than changing frequency determining components. Provision shall be made for trimming the carrier frequency to the assigned frequency under normal operating conditions.

4.4 Power Supply Rating

The AC voltage input shall be single phase or three phase, at a frequency of 60 Hz. Voltage, frequency 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 to the AC 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

Labelling shall be according to the requirements in 2.6.

5.3 Protection of Personnel

The transmitting equipment shall be so constructed that all hazardous components are totally enclosed, or protected from accidental contact by personnel. The transmitting equipment enclosure shall be sufficient to provide adequate personnel safety during operation.

5.4 Equipment Changes and Modifications

Any major design or equipment changes outside the replacement of defective components by equivalent parts made to an approved equipment will void the approval unless notified to and approved by the Department. The notification must provide information demonstrating that the modification provides equal or improved transmitting equipment performance.

6. RF Carrier 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 transmitting equipment may be operated into the test load.

6.1.2 Method of Measurement

The carrier shall be continuously modulated with the standard test input signal at a level producing 50% modulation for a period of 3 hours followed immediately by 95% modulation for a period of 5 minutes. The output shall be connected to the standard test load. The output power of the carrier shall be measured by using a suitable power measuring device. The method shall be described in the test report.

6.1.3 Standard

6.1.3.1 The standard rating of power output for the transmitting equipment shall be as specified by the individual manufacturer. The transmitting equipment shall be capable of delivering the standard output rating plus 10% for transmitting equipment rated below 10 kW or the standard output rating plus 6% for transmitting equipment rated 10 kW or above. The transmitting equipment shall be capable of being adjusted to deliver the rated power output when the AC input voltage is 5% above or below rated value.

6.1.3.2 The test report shall state the power output limits over which the transmitting equipment complies with this document.

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 analyser, modulation monitor, or any other suitable method, the modulation capability shall be measured. The method shall be described in the test report.

6.2.3 Standard

6.2.3.1 Standard (Monophonic Operation)

The transmitting equipment shall be capable of modulation to 95% on positive and negative peaks at any carrier frequency within the broadcast band.

6.2.3.2 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 1.25 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 mean standard test frequency.

6.3.2 Method of Measurement

6.3.2.1 After a warm-up period of one hour at rated AC input voltage, measure the frequency of the carrier at one minute intervals during a period of fifteen minutes. From those measurements determine the mean test frequency for the carrier. Then at temperatures of 5°C and 45°C measure the operating frequency at supply voltages of 85, 100 and 115%. A period of 30 minutes should be allowed to enable the unit under test to achieve temperature stability before performing the measurements.

6.3.2.2 Where it is not practical to subject the complete transmitting equipment to the specified test conditions, it is permissible to isolate and separately measure the stability of the frequency-determining elements of the transmitting equipment under the specified conditions.

6.3.3 Standard

The frequency stability of the carrier shall remain within 10 Hz of the mean test frequency.

6.4 Carrier Level Shift

6.4.1 Definition

The carrier level shift is the change in average carrier amplitude during modulation expressed as a percentage.

6.4.2 Method of Measurement

Carrier level shift shall be measured by a suitable modulation monitor.

6.4.3 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 output terminals on 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. Using a sampling device measure all spurious emissions up to the third harmonic of the carrier frequency. The voltage of the emission shall be measured with a frequency selective instrument. The attenuation versus frequency characteristics of the power sampling device and the load used in this test shall be known over the range of frequencies involved. Record all spurious outputs in dB relative to rated power except those more than 20 dB below the values in 6.5.3.

6.5.3 Standard

Spurious emissions of the transmitting equipment shall not exceed the values given in the following table:

	Spurious Emission	Maximum Value
(a)	between 15 kHz and 30 kHz from the carrier frequency	-25 dB*
(b)	more than 30 kHz and up to and including 75 kHz from the carrier frequency	-35 dB*

(c)	more than 75 kHz from the carrier frequency	-(43 + 10 log P)* or - 80 dB* whichever is the higher signal level P = power in watts

* Referred to the power level of the unmodulated carrier.

In addition, when the oscillator crystal is removed or deactivated, spurious radiation at any frequency including the assigned 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 enclosure from sources other than a normal output port.

6.6.2 Method of Measurement

The transmitting equipment shall be operated at rated power output. A receiving antenna, located alternately at a known distance between three and ten metres from at least three sides of the transmitting equipment (i.e. front, back, left or right hand side), shall be connected to a calibrated field strength metre or frequency selective voltmeter. Field strength measurements shall be made of all emissions (including the fundamental and harmonics of the carrier frequency) up the third harmonic of the carrier frequency. For the measurement, the receiving antenna shall be rotated in all three planes and the maximum received field shall be noted (allowance shall be made for antenna factor and transmission line loss of the measuring equipment). Using the free space formula below, calculate the reference field strength.

$$E = 7\sqrt{P} / r \quad \text{volts per metre}$$

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

6.6.3 Standard

Emissions at any frequency shall be at least 54 dB below the calculated field strength reference level. Any radiation weaker than 70 dB below the reference level need not be recorded.

6.7 Occupied Bandwidth

6.7.1 Definition

The bandwidth occupied by the carrier and associated modulation products such that they fall within the specified limits.

6.7.2 Methods of Measurement

Measurement of the occupied bandwidth shall be conducted using a standard noise test signal. The test signal shall consist of a white noise source with USASI (United States of America Standards Institute) weighting. The weighting is produced by filtering white noise with a 100 Hz, 6 dB per octave high pass network and a 320 Hz, 6 dB per octave low pass network. The USASI noise signal is then passed through a pulser circuit wherein the ratio of the peak to 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 from the pulser shall be input to the transmitting equipment through a network providing a modified 75 microsecond preemphasis and a 10 kHz low pass filter. The preemphasis is a modified 75 microsecond curve with a high frequency break point at 8,700 Hz. The low pass filter is a sharp cutoff filter providing attenuation of 15 dB at 10 kHz, 30 dB at 10.5 kHz, 40 dB at 11 kHz and 50 dB at 15 kHz and greater. The noise source is split into two channels left and right that have identical spectral distributions. The individual level of each channel is adjusted to obtain the ratio of L + R (sum information) to L - R (difference information) of 3 dB (i.e. a ratio of 1.4 to 1).

A suitable swept frequency RF spectrum analyser shall be used to measure the spectrum emissions. The spectrum analyser setup shall consist of:

(a) 300 Hz resolution bandwidth;
(b) 5, 10 or 20 kHz/horizontal division (as appropriate);
(c) 10 dB/vertical division;
(d) Reference: Carrier peak;
(e) Peak hold: 10 minutes duration.

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

6.7.3 Standard

Emissions from a stereophonic AM transmitting equipment consisting of the carrier and associated modulation products shall be confined to frequencies within ±15 kHz of the carrier. Emissions appearing on any frequency more than 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 bandwidth which result from the modulation process but exclude spurious emissions.

6.8.2 Method of Measurement

Using the same setup as in paragraph 6.7.2 and the appropriate scan width, measure the emissions within ±100 kHz of the carrier.

6.8.3 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 and up to 75 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.

Annex A

Technical 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, at all audio frequencies. 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 (0 dBm = 1 mW), 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 and this level shall be recorded.

A.1.2.3 Standard

The standard audio input level for 95% modulation shall be +10 dBm ±2 dBm.

A.1.3 Audio Frequency Response

A.1.3.1 Definition

The audio frequency response is the ratio of input voltages relative to the voltage at 400 Hz, expressed 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 set up shall be used. The audio input to maintain constant modulation levels of 25, 50 and 85% shall be determined at a sufficient number of points over the frequency range 50 Hz to 10 kHz to enable a curve to be plotted for each modulation level.

A.1.3.3 Standard

The audio frequency response curve shall be entirely within the unshaded area of the limits in **Figure A1** 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 signal contributed by the transmitter.

A.1.4.2 Method of Measurement

The audio frequency harmonic distortion shall be measured by demodulating a sample of the RF output of the transmitting equipment and feeding this to a wave analyser or distortion metre. If an average-reading instrument is used, it will be necessary to take into account possible errors due to the relative phase relations of the harmonics. The audio frequency distortion shall be measured at 50, 100, 400, 1,000, 2,500, 5,000, 7,500 and 10,000 Hz and at 25, 50 and 85% modulation respectively.

A.1.4.3 Standard

The audio frequency distortion, including all harmonics up to 24 kHz 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 nonlinear signal contributed by the transmitting equipment resulting in modulation components equal to the sums and differences of integral multiples of a complex audio input signal.

A.1.5.2 Method of Measurement

A test signal consisting of a 60 Hz and a 7 kHz sine wave with a relative amplitude ratio of 4:1 respectively shall be applied to the transmitting equipment audio input terminals. The audio frequency intermodulation distortion shall be measured by demodulating a sample of the RF output of the transmitting equipment and feeding this to a wave analyser or suitable distortion metre. The distortion shall be measured at 25, 50 and 85% modulation.

A.1.5.3 Standard

The RMS audio frequency intermodulation distortion shall not exceed 4% referenced to 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 amplitude modulation component at 100% modulation of the carrier envelope to the value of residual amplitude modulation component when the carrier is unmodulated.

A.1.6.2 Method of Measurement

Measurement of the carrier hum and noise level may be made by the use of an AM detector coupled to the output of the transmitting equipment. The output of the detector shall be fed through a 10 kHz low pass filter to a distortion and noise metre. Readings shall be without modulation but with the audio input terminated with a resistance equal to the audio input impedance.

A.1.6.3 Standard

The measured level of all hum and noise components appearing as modulation 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 Standard

The standard audio input level for 85% modulation shall be +10 dBm ±2 dBm.

A.2.2 Audio Frequency Response

A.2.2.1 Definition

The audio frequency response is the ratio of the input voltages relative to the voltage at 1,000 Hz, expressed in dB, required to maintain a constant percentage of modulation across the audio frequency range.

A.2.2.2 Method of Measurement

The output of the transmitting equipment shall be sampled with a stereo test demodulator with audio outputs for the left and right channels. Constant modulation levels shall be established by maintaining constant output levels from the test demodulator. The audio input level to maintain constant modulation levels of 25, 50, and 85% shall be determined over the frequency range 50 Hz to 10 kHz for each of the left and right channels.

A.2.2.3 Standard

The frequency response of either the left or right channel shall remain within 2 dB of the response at 1,000 Hz over the frequency range between 50 Hz and 10 kHz under all conditions of modulation of the left or 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 harmonic distortion in each of the left and right channels.

A.2.3.2 Standard

The total harmonic distortion including harmonics up to 20,000 Hz measured separately in either the left or right channel shall not exceed 5% in the frequency range 50 Hz to 10,000 Hz under all conditions of 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 channels for equal inputs.

A.2.4.2 Method of Measurement

The channel balance shall be determined by comparing the response obtained in section A.2.2.

A.2.4.3 Standard

The balance between the response in the left and right channels shall be within 1 dB 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 demodulator measure the intermodulation distortion in the left and right channels.

A.2.5.2 Standard

The RMS audio frequency intermodulation distortion in either the left or right channel 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 level to the residual 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 made by the use of the stereo test demodulator coupled to the output of the transmitting equipment. The output of the demodulator shall be fed through a 10 kHz low pass filter to a distortion and noise metre. Readings shall be made of the output with standard test modulation of 85% and without modulation but with the audio input terminated with a resistance equal to the audio input impedance. The measurement shall be made in each of the left and right channels.

A.2.6.3 Standard

The level of hum and noise in either the left or right channel for audio frequencies below 10,000 Hz shall be at least 48 dB below the reference level for 100% modulation at 1,000 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 intended for that channel 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 separation for the range of frequencies from 400 Hz to 10,000 Hz. Repeat the above with the test signal applied only to the right channel.

A.2.7.3 Standard

The separation between the left and right channels shall be at least 20 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 that 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 only in the L + R channel, measure the components of the signal appearing in the L - R channel. Repeat the procedure with test signals (L = R) to produce 85% modulation in the L - R channel and measure the components of the signal appearing in the L + R channel.

A.2.8.3 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) inverse crosstalk shall be at least 30 dB below the reference level for 100 % modulation at 1,000 Hz.

A.2.9 Monophonic Compatibility

A.2.9.1 Definition

Monophonic compatibility is defined as the compatible reception of stereophonic transmissions on 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 at the monophonic audio output of the demodulator. The respective test methods of paragraphs A.2.2.2, A.2.3.2 and A.2.6.2 may be used. The output of the demodulator shall be derived from an envelope detector with wideband response.

A.2.9.3 Standard-Audio Frequency Response

The frequency response shall remain within 2 dB of the response at 1,000 Hz over the frequency range from 50 Hz to 10,000 Hz under all conditions of modulation of the stereophonic system up to 85%.

A.2.9.4 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 10,000 Hz under all conditions of modulation of the stereophonic system up to 85%.

A.2.9.5 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% modulation at 1,000 Hz.

FIGURE A.1

APPENDIX A