Technical Specifications for High Definition Program Acceptance

Revision 4.0 – March 30th, 2012

Prepared by the CBC/Radio-Canada Working Group on HD Standards

Revision History

Versions	Date	Modifications	
1.9u	July 28th, 2005	Initial release that specifies Technical Specifications for HD Program Acceptance.	
2.0	August 10th,2006	Section 4	Remove the requirement to deliver an SD copy on a separate media along with the HD program.
		Section 6.2	Review audio track allocation to include a stereo mix on channels 7 and 8, and specify tracks 11 and 12 for described video.
3.0	January, 2009	Section 6.3.3	• Use the new ITU-R BS.1770 algorithm to measure the audio loudness • On the LM100, set the dialogue intelligence option to OFF • Add a +/- 1dB tolerance to the loudness target • Specify that if a stereo program is supplied on track 1 and 2, the loudness level will be measure on both left and right channels. • Add an explanatory note to explain why CBC/Radio-Canada does not impose a loudness measurement on all channels.
3.1	July, 2011	Section 6.1.1	Add a note regarding the generation of a stereo mix.
		Section 6.3.3	Correction of a loudness unit error for the dialogue loudness level. The loudness value is given in LKFS and not in dBFS.
		Section 6.5	Modify the AC-3 RF mode metadata parameter from Light to Standard.
		Section 12	Indicate the members of the initial working group that have now retired from CBC/Radio-Canada.
4.0	March, 2012	All sections	• Re-structure document to add file-based specifications for file media delivery. • Update document with new technology requirements (loudness, AFD) and new standard references.

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1 Scope

The standards defined in this document apply to all high definition programs, program blocks, commercials, and other high definition television content provided to the English and French networks of CBC/Radio-Canada for broadcast.

These standards apply to HD programs delivered on tape and by file transfer.

2 Introduction

CBC/Radio-Canada has a mission to adopt and promote the best possible practices in high definition (HD) production and broadcasting so as to deliver high definition programming of optimum quality to its audience. We want to ensure that these services be appreciated to their full potential, to rapidly increase the interest of viewers.

CBC/Radio-Canada's policy further states that audio and video signals broadcast by owned stations or distributed to affiliate stations must meet Industry Canada technical specifications and recommendations.

In addition, CBC/Radio-Canada is actively involved in the development of various technical standards for TV production and broadcasting, namely SMPTE, IEEE, ITU and AES. It is therefore CBC/Radio-Canada's policy to support the use of these standards, in the field of high definition television (HDTV) amongst others, in order to facilitate HD material exchange between the various members of the production community, so as to harmonize and optimize audiences' HDTV viewing and listening experiences.

This document is intended for all those who work at producing HD content for broadcast on the English and French services of CBC/Radio-Canada. We trust that it will serve as an aid in selecting proper parameters and as a guide to adapting their production techniques to create HD content that meets our standards and hence benefits the public.

The standards described in this document are also intended to serve as a reference to CBC/Radio-Canada personnel who review and approve the technical quality of HD programs.

Because HDTV is by nature and by definition an electronic medium of superior quality to conventional or standard definition television (SDTV), CBC/Radio-Canada considers that subjective quality requirements must be accordingly and significantly more stringent for HDTV than for SDTV, if we are to take full advantage of the new medium's stricter technical specifications and the corresponding gains in image and sound quality, and in turn allow the audience to enjoy its full benefits.

3 Terminology

The following terminology is used in the document.

HD:	This term is used for native high definition productions, live, on tape or on file, carrying high definition signals. It is also used to designate broadcasting on the CBC/Radio-Canada digital TV network in high definition mode.
SD:	This term is used for native standard definition productions, live, on tape or on file, carrying standard definition signals. It encompasses analog and digital signals and formats. It is also used to designate broadcasting on the CBC/Radio-Canada conventional television (SDTV) network.
Anamorphic 16:9 SD:	Component digital video format having a 16:9 aspect ratio made of 720 x 480 rectangular pixels that can be recorded and processed as a regular 4:3 SD signal. Sometimes referred to as “full screen 16:9 SD.”
Resizing/Rescaling:	These terms describe the key process in any aspect ratio converter. It involves converting video information represented by a certain number of pixels into a different number of pixels.
AFD:	Active Format Description. This parameter describes a video picture in terms of the aspect ratio and other characteristics of the active image within a coded frame. For example, an active image excludes bars in letterbox and pillarbox modes (Ref: SMPTE 2016-1 - Definitions).
Loudness:	A perceptual quantity; the magnitude of the physiological effect produced when a sound stimulates the ear (Ref: ATSC Rec. A/85). The loudness level is given in LKFS units.
Dialog level:	The loudness, in LKFS units, of the anchor element of a program. The term “Dialog Level” is based on dialog’s widespread use as the anchor for mixing of content and historically, it was felt that for most programs, dialog would be the anchor element. (Ref: ATSC Rec. A/85).
Dialnorm:	An AC-3 metadata parameter, numerically equal to the absolute value of the encoded audio content loudness (typically of the average spoken dialogue for long form content and integrated loudness on all channels for short form content).

Average Program Loudness:	The integrated loudness over the duration of a program, measured on all channels of the program (except LFE). The definition of the word “program” is also used to refer to advertisements, bumpers and other interstitials.
Lo/Ro:	(Left Only / Right Only). Conventional stereo signal.
Dolby Digital™: (AC3)	Dolby coding technology that can deliver 1- to 5.1-channel audio programs in a variety of configurations, intended for distribution to the consumer through SD/HD digital television broadcast. Unlike Dolby E, this technology is not suitable for multiple coding cycles.
MXF:	Acronym for Material eXchange Format. MXF is an open standard file interchange format conceived for wrapping audio/video content (essences), associated data and metadata.
QuickTime:	QuickTime is a proprietary file interchange format used for audio/video material and metadata produced by Avid and Apple production systems. QuickTime is used to “wrap” various formats of digital video, pictures, and sound.

4 General HD Technical Specifications for Media Delivery

4.1 Video

4.1.1 Image Format

The image format shall be 1920 x 1080 pixels and compliant with the SMPTE ST 274-2008 standard.

The sampling structure shall be 4:2:2 with 10-bit quantizing. These image specifications should be preserved as much as possible throughout the complete production process.

4.1.2 Frame Rate

The video frame rate shall be 29.97 frames per second, 2:1 interlaced (59.94 fields per second) noted as 29.97i. The exact value of this frame rate is given by 30 / 1.001. The corresponding video format is defined in the SMPTE ST 274-2008 standard Table 1, line 5.

Any show or program originally shot at another frame rate, such as 23.98p, 25p or 25i shall be made available to CBC/Radio-Canada in two forms : in its original frame rate and also converted to 29.97i.

4.1.3 Digital Signal Characteristics

The Y component signal shall have a nominal bandwidth of 30 MHz and Cr/Cb signals shall have a bandwidth nominally half that of the associated Y signal. These bandwidth limitations imply that digital video signal transitions from black to white level or vice versa must not create visible overshoot after conversion to analog (References: SMPTE ST 274M-section 8.3 and EBU Tech.3283-section 2.1.1).

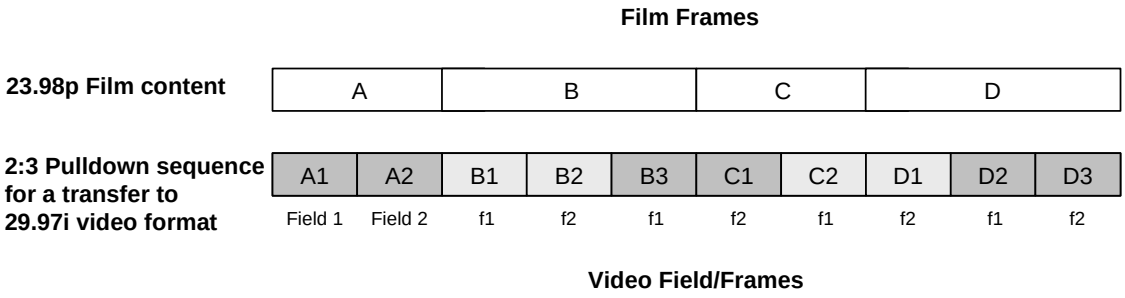
4.1.4 Field Dominance

The HD interlaced video format shall have a Field 1 dominance (upper field). This means that the first field captured, stamped or output is a Field 1. Cuts in material must happen on frame boundaries (i.e. between field 2 and field 1).

4.1.5 2:3 Pulldown

The 2:3 pulldown (commonly referred to as 3:2 pulldown), used to convert 4 film frames into 5 video frames, shall be as described in SMPTE recommendation RP 197-2003.

If 4 film frames are represented as A, B, C, D, the pulldown sequence of the video fields generated from them shall be:



This 2:3 sequence shall be respected not only for transfers on telecines but also for frame rate conversions performed with any other system (standard converters, non-linear editing systems, etc.). It will ensure a fluid perception of movements.

4.1.6 Subjective Quality Assessment

Because HDTV is by nature and by definition an electronic medium of superior quality to conventional or standard definition television (SDTV), CBC/Radio-Canada considers that subjective quality requirements must be accordingly and significantly more stringent.

The image quality of HD programs provided shall be evaluated according to the five-point scale suggested in the International Telecommunication Union ITU-R BT-500 standard, Section 4.1.5.1:

Rating	Impairments	Quality
5	Imperceptible	Excellent
4	Perceptible but not annoying	Good
3	Slightly annoying	Fair
2	Annoying	Poor
1	Very annoying	Bad

Programs should meet the criteria for a 5 rating. Exceptionally, on program portions including, for example, archival material, the minimum acceptable quality shall be a 3 rating.

4.1.7 Safe Action and Title Areas

CBC/Radio-Canada recommends, in accordance with SMPTE standard ST 2046-2:2009, that:

- the main action be framed inside a central zone of height 90% and width 90% of the full HD picture;
- all titles be framed inside a central zone of height 80% by width 80% of the full HD picture.

4.1.8 Active format Description (AFD)

TV programs are often made of a mix of original 16:9 and up-converted 4:3 aspect ratio materials. These programs are distributed through a TV channel to viewers equipped with 4:3 or 16:9 aspect ratio receivers. To ensure an optimum display of each picture on a given TV receiver, an AFD information is inserted by the broadcaster and carried with each program to the TV receiver that will automatically choose the right display format for each material. This AFD information provides the recommended display format to each TV receiver.

To ensure an automatic image aspect ratio conversion, an AFD data value must be assigned to each HD program as described in the SMPTE ST 2016-1 standard. This AFD information must be inserted in the vertical ancillary data space of the HD-SDI interfacing signal as per the SMPTE ST 2016-3 standard and recorded along with the program material.

A correct AFD value shall be assigned to all HD programs delivered to Radio-Canada French Services and to CBC English Services, as shown below:

French Services

Original HD program	Program AFD codes	Intended display format after downconversion to SD
Full Screen Image (entire picture protected)	1010	Letter Box
Full Screen Image (no picture area protected)	1000	Letter Box
Pillarbox Image	1001	Center Cut

English Services

Original HD program	Program AFD codes	Intended display format after downconversion to SD
Full Screen Image (entire picture protected)	1010	Letter Box
Full Screen Image (essential 4:3 area)	1111	Center Cut
Pillarbox Image	1001	Center Cut

AFD Codes Explanatory notes

- AFD=1111 (15) indicates that the original HD program was shot for a full frame image that has a 4:3 area of essential information and will be center-cut during conversion to SD.
- AFD=1010 (10) means that the original HD program was shot for a full frame image with the entire picture area protected and will be down-converted in letterbox format.
- AFD=1001 (9) indicates that the HD program originates from upconverted 4:3 SD images (displayed in HD as a pillarbox) and has a 4:3 area of information that will be center-cut during conversion to SD.
- AFD=1000 (8) means that the original HD program was shot for a full frame image with no picture area protection and can be down-converted in letterbox format. This AFD value is often used as a default mode.

4.1.9 Use of Original SD Material

Use of native SD visual sequences, including NTSC, PAL or SECAM analog video, or ITU-R BT.601 digital video, is accepted only in special cases; for example, insertion of archival material. The producer shall inform CBC/Radio-Canada of, among other things, the total anticipated length of up-converted SD video material to be inserted into the HD program, and clearly justify its use. Any use of SD sequences in an HD program shall be approved beforehand by CBC/Radio-Canada.

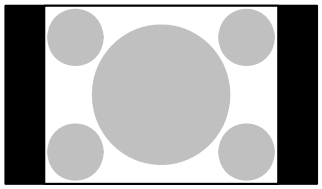
Note: When original 4:3 SD materials are converted to 16:9 HD for insertion in an HD program, an SD- to-HD converter with an appropriate performance must be used to ensure a clean resizing of the images is performed (no defect on all picture edges and no Closed Captions signal on top of active picture area).

4.1.9.1 4:3 SD Material

When the use of 4:3 SD material is essential and has been approved by CBC/Radio-Canada, the pillarbox aspect ratio conversion shall be used. Care must be taken to remove EIA608 closed captioning signals from lines 21 and 284 of the SD frames before conversion.

During SD to HD up-conversion:

- No alteration of horizontal versus vertical proportions (geometric distortion) shall be tolerated. Conversion by horizontal stretching is therefore prohibited.
- Care must be taken to ensure that the main elements of the original 4:3 composition (e.g., principal action, graphic) are preserved.
- Converted materials must have the appropriate AFD value, as shown in the figure below.



Pillarbox display
AFD = 1001 (9)

- Dark areas are inside the displayed 16:9 frame.

4.1.9.2 16:9 SD Material

When the use of 16:9 SD material is essential and has been authorized by CBC/Radio-Canada, the aspect ratio conversion shall be such that the 16:9 SD image be enlarged to fill the 16:9 HD frame.

When both anamorphic and letterboxed 16:9 SD materials are available, CBC/Radio-Canada recommends using the anamorphic material as the source for up-conversion in preference to letterbox.

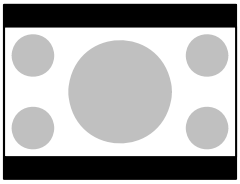
In all cases of SD to HD up-conversion:

- No alteration of horizontal versus vertical proportions (geometric distortion) shall be tolerated.
- Converted materials must have the appropriate AFD value, as shown in figures below.

Explanatory note

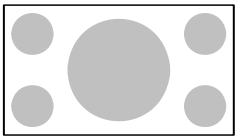
Two 16:9 SD video formats are commonly encountered: letterboxed and anamorphic.

- Letterboxed 16:9 SD consists of a 16x9 picture contained entirely within a 4:3 frame filled at top and bottom with bars, usually black.



16:9 SD image letterboxed for display on 4:3 SD display monitors (before upconversion to HD).

- Black bars are added on the top and bottom of the 16x9 active image.
- AFD = 1010 (10)



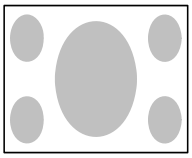
Full 16:9 SD image displayed on a 16:9 HD monitor (after upconversion to HD).

- AFD = 1000 (8)

When up-converting to HD, it requires vertical and horizontal proportional rescaling (zoom). The vertical rescaling generates 1080 lines from the 360 lines of the original image.

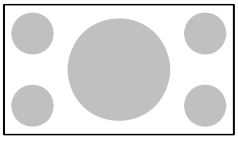
For SD presentation, this format does not need aspect ratio conversion.

- Anamorphic 16:9 SD designates a standard definition component digital video format of 720x480 rectangular pixels, shot with 16:9 cameras and to be displayed on 16:9 capable monitors, but designed to be carried on a regular 270Mbps SDI feed and recordable on most standard definition VCRs. It is sometimes referred to as “full screen 16:9 SD.” When erroneously viewed on 4:3 monitors, images appear compressed horizontally.



Anamorphic 16:9 SD Image before up-conversion, erroneously viewed on a 4:3 display monitor.

- AFD = 1000 (8)



Full frame 16:9 HD picture before and after up-conversion, viewed on a 16:9 display monitor.

- AFD = 1000 (8)

When up-converting to HD, anamorphic requires vertical and horizontal “rescaling.” However, the vertical rescaling is smaller than for the letterbox: the 1080 HD lines are generated from the 480 lines of the original image, yielding a better vertical resolution than with letterbox, hence our preference for it.

For SD presentation, anamorphic 16:9 SD requires conversion to letterboxed 16:9 SD.

4.1.10 Film-originated Material

When movies and other productions shot on film or using digital technologies equivalent to film are converted to HD and delivered to CBC/Radio-Canada for broadcast, the aspect ratio conversion shall preserve the complete original picture area. Therefore, “pan and scan” is not accepted.

The scanned area on 35mm film shall be in accordance with SMPTE ST 96M-2004, Table 2. The appropriate aspect ratio conversion mode shall be selected according to the following table:

Original Film Aspect Ratio	Aspect Ratio Conversion Mode for 16:9
1.78 (16:9)	Equivalent
1.85	Letterbox
2.39 *	Letterbox

In all cases, no alteration of the original horizontal/vertical proportions (geometric distortion) shall be tolerated.

Any movie or other production originally shot on film or using digital technologies equivalent to film at a frame rate of 23.98p, or 25p shall be made available to CBC/Radio-Canada in its original format and also converted to 29.97i.

4.1.10.1 Credits

All credits shown in vertical scroll shall be produced in a way that makes them clearly readable when viewed at a frame rate of 29.97i and be free of judder or blur. These elements shall be created in 1080 29.97i.

Any program shot at 23.98p or 25p shall not include credit rolls. Credit information shall be displayed on separate pages.

4.1.11 Consumer Formats

Use of visual sequences acquired using consumer format equipment is usually not accepted within HD programs unless particular circumstances warrant its use; for example, shooting in confined spaces or in high-risk conditions (e.g., war zone, stunt work). Any use of consumer formats shall be declared by the producer prior to the signing of the contract with CBC/Radio-Canada and shall be accepted only in cases of absolute necessity.

* This production aspect ratio is often mislabeled “2.35”.

4.2 Audio

CBC/Radio-Canada reserves the right to reject productions that do not meet the criteria described herein. Unless otherwise specified in the document, the term “program” also includes the commercial.

4.2.1 Versions

CBC/Radio-Canada recommends producing HD programs with 5.1 multichannel audio. Programs provided on HD media shall be delivered with discrete audio channels. If the producer cannot provide a 5.1 multichannel audio mix, a stereo mix will be accepted. Requirements for the two networks are different regarding program delivery:

- For the **English Services**, the main 5.1 (or stereo) program mix and the Described Video mix are required on the HD media.
- For the **French Services**, productions shall include:
    - The main 5.1 (or stereo) program mix;
    - A second stereo mix (Lo/Ro). It is required for internal needs. It shall meet CBC/Radio-Canada’s SD audio standard for reference levels and dynamic range.
    - A Described Video mix.

Notes:

- When producing a 5.1 program mix, it is very important to monitor its stereo downmix version for compatibility. The stereo signal will be generated by using the metadata (downmix coefficients) shown in section 4.2.9 of this document.
- Any use of stereo mix sequences up-converted to a 5.1 mix in a program shall be approved beforehand by CBC/Radio-Canada.
- Section 4.2.8 summarizes the audio specifications for HD and SD distributions.

4.2.2 Audio Format

The digital audio format must be compliant with AES-3 standard, with a resolution of 24 bits and at a 48 kHz sampling rate. The recording should contain, for all the channels excluding the LFE channel, the full transmittable audio bandwidth (20 Hz to 20 kHz). Exceptions may be made; examples include archive material or material gathered necessarily under adverse conditions. If the digital audio content is only available with a resolution of 20 bits, it must be approved beforehand by CBC/Radio-Canada.

For 5.1 programs, the LFE channel audio content shall be different from those of the main channels and limited to effects at very low frequencies to avoid any phase or cancellation problems during playback by the consumer devices. Additionally, the LFE channel frequency content shall remain between 20Hz and 120Hz since this channel is band limited at the AC3 coding stage.

4.2.3 Stereo and Mono Compatibility

When producing a 5.1 program mix, it is very important to monitor its stereo downmix version for compatibility. The stereo signal will be generated by using the metadata (downmix coefficients) shown in section 4.2.9 of this document. Please note that the LFE channel is not included in the downmix.

It is also important to monitor de loudness of the downmix because it may vary from the loudness of the original 5.1 mix. Some elements have a direct impact on the loudness difference like the correlation between the centre channel and the left and right channels, the relative loudness of the rear channels versus the front channels, the use or not of some channels, etc.

Mono compatibility of programs shall be guaranteed at all times.

4.2.4 Described Video

CBC/Radio-Canada is acquiring external material including Described Video (DV) content, and possesses the infrastructure to include this service with the on-air presentation program.

The Described Video channels are a stereo mix derived from the main program to which descriptive commentary is added. The audio level of these channels shall be similar to the main program level and comply with the loudness specifications described in section 4.2.8.4.

Important notes:

- English Services use tracks 7 and 8 for a stereo DV mix. French Services use tracks 11 and 12 for this signal.
- For program materials delivered to English Services, if a DV mix is not provided, then a stereo mix must appear on DV tracks (7-8).

4.2.5 Subjective Quality

The audio program shall be produced with reproduction in a domestic environment in mind.

- The entire audio program shall be of superior quality, free of all noise and interference (buzz, hum, distortion, excessive sibilance)
- The entire audio program shall have an acceptable dynamic range. A compression rate sufficiently high to adversely affect the sound quality shall not be accepted.
- The tone shall be natural and pleasant.
- Dialogue must remain intelligible throughout the entire audio program.
- Audio-video synchronization shall be maintained throughout the program. The maximum tolerable misalignment of sound and picture shall be ± 16.6 ms (+ or - one field at 29.97 fps).
- The described video level shall be similar to the main program level.

4.2.6 Subjective Quality Assessment

In addition to having to meet the criteria listed in Section 4.2.5, submitted programs shall be evaluated according to the five-point scale of the International Telecommunication Union (ITU-R BS.1284-1) as indicated in the following table:

Rating	Impairments	Quality
5	Imperceptible	Excellent
4	Perceptible but not annoying	Good
3	Slightly annoying	Fair
2	Annoying	Poor
1	Very annoying	Bad

Programs should meet the criteria for a 5 rating. The minimum acceptable quality for all program types shall be that of a 3 rating with rare exceptions, for example, in the case where program segments contain archival clips.

4.2.7 Audio Channel Allocation

CBC/Radio-Canada recommends production of HD programs with multichannel audio. Content on HD media shall be delivered with discrete audio channels.

Any provider who cannot deliver program material with the expected audio format shall inform CBC/Radio-Canada about the said material and have it approved. Additional fees shall be charged for format conversion.

The channel allocation nomenclature shall be compliant with the SMPTE ST 320:1999 standard:

L	Left	MS	Mono Surround
R	Right	MS (-3dB)	Mono Surround at –3dB
C	Center	Lo	Left only
LFE	Low Frequency Effect	Ro	Right only
LS	Left Surround	F	Freely usable
RS	Right Surround	U	Unused / Unassigned
M	Mono	DV	Described Video (not defined in SMPTE ST 320M)

Programs shall be identified using one of the following audio format labels:

- Multi-channel discrete
- Stereo
- Mono

The producer has two audio track allocation options depending on the program version he plans to deliver to CBC/Radio-Canada: either multichannel 5.1 sound, or stereo. CBC/Radio-Canada strongly recommends the multichannel 5.1 production mode. The audio track allocation shall be:

For English Services:

Tracks	Channel 5.1 Program	Channel Stereo Program
1	L	Lo
2	R	Ro
3	C	U
4	LFE	U
5	LS	U
6	RS	U
7	**DV**	**DV**
8	**DV**	**DV**

For French Services:

Tracks	Channel 5.1 Program	Channel Stereo Program
1	L	Lo
2	R	Ro
3	C	U
4	LFE	U
5	LS	U
6	RS	U
7	Lo (always required)	Lo (always required)
8	Ro (always required)	Ro (always required)
9	F	F
10	F	F
11	**DV**	**DV**
12	**DV**	**DV**

Unused tracks shall be free of any signal. The track identification shall be clearly indicated on the label.

It is important to note that in the stereo program mode for the French Services:

- The signals L and R must be present on tracks 1 and 2, as well as on tracks 7 and 8. The tracks 1 and 2 will be used for the HD broadcast, the tracks 7 and 8 may be used for internal needs.
- The stereo audio version on tracks 7 and 8 shall meet reference levels and dynamic range described in section 4.2.8 of this document.

4.2.8 Audio Level and Dynamic Range for HD and SD Distributions

4.2.8.1 Standard Reference Level

The CBC/Radio-Canada Television reference level is set at –20dBFS as defined in SMPTE recommended practice RP 155-2004. It corresponds to an alignment level of +4dBu and shall be consistent with the recorded program.

4.2.8.2 Maximum True Peak Level

The maximum true peak value can be accurately measured by oversampling peak meters. It shall be -2 dBTP during production, as defined in ATSC Document A/85, as of 25 July 2011 and measured with a meter compliant with ITU-R BS.1770-2. Guidelines for accurate peak level measurements are described in ITU-R BS.1770-2 Annex 2.

4.2.8.3 Program Loudness

Viewers watching television programmes often get annoyed when the audio loudness jumps at every commercial break, between programs or between TV channels. A reliable and consistent method for measuring program loudness is needed. Several standards have been recently developed to answer this need.

CBC/Radio-Canada requires that all submitted programs be produced to meet the loudness specifications described in section 4.2.8.4 below.

4.2.8.4 Loudness Level Measurements

The audio signal measured using a broadcast loudness meter[1] having the ITU-R BS.1770-2[2] compliant algorithm shall meet the following criteria:

- For a program:
  - The **dialogue loudness level** measured on all channels[3] at representative sections of anchor element (typically dialogue level) shall be -**24LKFS +/- 1LU**;
  - The **integrated loudness** measured on all channels for the complete program duration should not exceed **-24LKFS +/-2LU**.
- For a commercial:
  - The **integrated loudness** measured on all channels for the complete commercial duration should not exceed **-24LKFS +/-1LU**.

Additionally:

- The whole program shall be consistent and shall not contain dynamic excursions that could hamper listening comfort.
- No compromise shall be accepted with regard to dialogue intelligibility;
- The measurement difference between the integrated loudness of the 5.1 mix and its downmix (and/or DV mix) should remain acceptable (refer to section 4.2.3 for additional details).

[1] The ITU-R BS.1771-1 recommendation describes the loudness meter requirements.

[2] The initial ITU-R BS.1770-1 recommendation was defining an ungated loudness measurement algorithm, It has been superseded by the BS.1770-2 recommendation that adds both an absolute gate of -70LKFS and a -10dB relative gate to the loudness measurement algorithm.

[3] The ITU- R BS.1770-2 recommendation (July 25, 2011) specifies that the overall program loudness value should include the input of all channels (except the LFE channel).

4.2.8.5 Dynamic Range and Maximum Level for SD Distribution

The program dynamic range allowed for analog broadcast transmission is 10dB with reference to the alignment level. No peak must exceed – 10dBFS (instantaneous measure: rise time 0 ms, fall time 200 ms). Peaks will be limited to +14dBu on the analog distribution network.

4.2.9 Metadata Parameters Encoded for On-Air Broadcast

CBC/Radio-Canada uses static metadata parameters for broadcast. For this reason, production must be fully compliant with the parameters described in the table below. Prior to broadcast of programs on the HD broadcast network, the metadata parameters in the Dolby Digital (AC3) encoder will be set as follows:

- The integrated loudness value of each program is inserted in the "Dialog Level" metadata parameter. It is set statically at the transmission stage.
- Additionally, the table provides information about the stereo mix characteristics (Center and Surround levels) for the purpose of monitoring the stereo mix compatibility at the time the 5.1 mix is generated. Metadata parameters for Profile 2.0 are used for the Described Video signals.
- The metadata parameters will be set with the following values:

Parameter	**Profile 5.1**	**Profile 2.0**
Dialog Level (dialnorm)	*–24 LKFS*	*–24 LKFS*
Channel Mode	*3 / 2*	*2 / 0*
LFE Channel	*Enable*	*Disable*
Bitstream Mode	*Main Complete*	*Main Complete*
Line Mode Profile	*Film Light*	*Film Light*
RF Mode Profile	*Film Standard*	*Film Standard*
RF Overmodulation Protection	*Disable*	*Disable*
Center Downmix Lev	*0.707 (-3dB)*	*N /A*
Surround Downmix Lev	*0.707 (-3dB)*	*N /A*
Dolby Surround Mode	*Not Dolby Surround*	*Not Dolby Surround*
Audio Prod Info	*No*	*No*
Mix Level	*N /A*	*N /A*
Room type	*N /A*	*N /A*
Copyright	*Yes*	*Yes*
Original Bitstream	*Yes*	*Yes*
Preferred Stereo Downmix	*Lo/Ro preferred*	*N /A*
Lt/Rt Center Downmix Level	*N/A*	*N /A*
Lt/Rt Surround Downmix Level	*N/A*	*N /A*
Lo/Ro Center Downmix Level	*0.707 (-3dB)*	*N /A*
Lo/Ro Surround Downmix Level	*0.707 (-3dB)*	*N /A*
Dolby Surround EX Mode	*Not Surround EX*	*N /A*
A/D Converter type	*Standard*	*Standard*
DC Filter	*Enable*	*Enable*
Lowpass Filter	*Enable*	*Enable*
LFE Lowpass Filter	*Enable*	*N /A*
Surround 3 dB Attenuation	*Disable*	*N /A*
Surround Phase Shift	*Disable*	*N /A*

4.3 Time Code

- The time code (as per SMPTE standard ST 12-1:2008) shall be present and continuous from the beginning of the leader up to the end of the trailer (see section 4.5).
- The time code value shall be 10:00:00:00 (hh:mm:ss:ff) at the first frame of the program.
- The time code shall be of drop frame type to ensure that it remains synchronous with real time. It is important to pay particular attention to drop frame when a program is transferred from 23.98 or 24 frames/seconds to 29.97 frames/seconds.

Note: In order to move between the nominal 23.976 and 29.97 frames-per- second formats in a unique way, it is recommended that the video frames of the 23.976 Fps material with the time code frame number zero be converted to an A frame, as described in SMPTE ST 12-1:2008. In addition, the SMPTE ST 318 recommends that these A frames be aligned with the field identified by the Field 1 pulse of the 10 field sequence described in this SMPTE standard document.

4.4 Closed Captions

The closed captions shall be of EIA 608 line 21 type (CC) encapsulated into EIA 708 data, in compliance with the EIA 708 standard. This requirement is necessary because most HDTV receivers in use at this time can only decode EIA 608 captions encapsulated into EIA 708 (and not pure 708 data packets).

CBC/Radio-Canada's reference device for verification of CC integrity is the Evertz 7760CCM-HD closed caption decoder.

No EIA 608 type of closed caption signal, as usually found on line 21 in SD video, shall be present in the HD video signal, either in the active video area or in the vertical interval. Lines 21 and 584 (the top lines of the active picture area) of the HD video signal shall carry picture information (Y Cb Cr values).

4.5 Program Structure

HD programs or commercials shall include leaders and trailers as described in the following table:

Time code (at start)	**Duration** (seconds)	**Audio**	**Video**	**Tape/File**
----	10 (minimum)	Silence	Black	Leader
09:58:10:00	10	Silence	Black	
09:58:20:00	10	Vocal ID/Pink Noise	SMPTE RP 219 HD colour bars	
09:58:30:00	60	Reference tones		
09:59:30:00	20	Silence	Slate	
09:59:50:00	8		Black	
09:59:58:00	1 frame	1 kHz @ reference level	SMPTE RP 219 HD colour bars	
09:59:58:01	2	Silence	Black	
10:00:00:00	----	Program Segment # 1	Program Segment # 1	----
----	2	Silence	Black	----
----	----	Program Segment # 2	Program Segment # 2	----
----	2	Silence	Black	----
----	----	Program Segment # 3	Program Segment # 3	----
----	20	Silence	Black	Trailer

4.5.1 Leader structure

4.5.1.1 Colour Bars

The colour bars, in HD 16:9 format, shall be compliant with the SMPTE recommended practice RP 219-2002. The colour bars should be generated from a test generator in the edit suite that produced the final edit, and to which the edit suite has been calibrated. The colour bars must not be generated by the internal test generator of the recording VCR.

4.5.1.2 Vocal Track Identification

The recording shall include a vocal identification of the audio tracks. This identification, to last 10 seconds in all, shall precede the test tones. It shall be clear, precise and sequential, such that track allocation is easily identifiable.

Vocal identification shall be followed by a short pink noise burst at the reference level on each channel.

4.5.1.3 Audio Test Tones

A reference tone shall be present before the start of the program material; it shall be in phase and be on all audio channels used for the program, including the stereo mix on tracks 7 and 8 (for French Services), and described video (tracks 7-8 for English Services and 11-12 for French Services).

The CBC/Radio-Canada Television reference level is set at –20dBFS as defined in the SMPTE recommended practice RP155-2004. It corresponds to an alignment level of +4dBu.

The reference tone level shall be consistent with the recorded program.

The test tone shall be 1 kHz on all channels. The length of the test tones shall be 60 seconds. A 28-second period of silence shall follow the test tones.

Unused channels shall be silent.

4.5.1.4 Slate

The slates shall include the following information:

- Program title
- Series name and episode title/number
- Producer's name and contact
- Program length (H:M:S)
- Main program audio type (mono, stereo, multichannel)
- Audio track allocation (including DV)
- CC (English) or STC (French) closed captions (Yes, No)
- Segment #1 start Time Code
- Segment #2 start Time Code
- Segment #3 start Time Code, etc.
- Original aspect ratio (4:3 or 16:9)
- Downconversion aspect ratio preference (AFD value, as specified in section 4.1.8)
- Audio reference level (-20 or -18 dBFS)
- Integrated loudness value (-24 or -23 LKFS)
- Described video (Yes, No).

4.5.1.5 Audio/Video Synchronization

The audio/video synchronization signals shall be composed of a one-frame long of colour bars and 1-kHz tone at the reference level.

4.5.2 Program Segmentation

First program segment must start at timecode 10:00:00:00. Additional program segments must be separated by 2 seconds of black/silence.

5 HD Content Tape Delivery Specifications

5.1 Technical Compliance

All HD video tape content must conform to the General HD Technical Specifications set forth in section 4 above.

5.2 Delivery Media

CBC/Radio-Canada requires that the HD material be provided on Sony HDCAM SR™ videotape.

5.3 Video

5.3.1 Frame Rate

As specified in section 4.1.2, CBC/Radio-Canada will only accept tapes recorded at 29.97i.

5.3.2 AFD data

This AFD information must be inserted in the VANC data area of the HD-SDI digital video signal, as described in section 4.1.8.

5.3.3 Film-originated Material

As specified in Section 4.1.10, any movie or other production originally shot on film or using digital technologies equivalent to film at a frame rate of 23.98p, or 25p shall be made available to CBC/Radio-Canada in two forms : in its original format and also converted to 29.97i.

5.4 Audio

5.4.1 Audio Format

The audio format shall meet the characteristics indicated in sections 4.2.1 and 4.2.2.

5.4.2 Audio Track Allocation

The audio track allocation shall be indicated as per section 4.2.7.

5.5 Time Code

- Both Longitudinal Time Codes (LTC) and Ancillary Time Codes (ATC) shall be recorded on tape and meet specifications indicated in section 4.3 above.
- The Longitudinal Time Codes (LTC) and Ancillary Time Codes (ATC) shall be identical during the whole recording.
- The Ancillary Time Code data is inserted in the VANC area of the digital video signal (as per SMPTE ST 12M-2:2008). The Ancillary Time Code is referred as VITC in the HDCAM SR.
- Long programs delivered on multiple tapes shall use different time code for each part starting on the next whole hour (e.g. 11:00:00:00, 12:00:00:00, etc.).

5.6 Closed Captions

The Closed captions (CC) data described in section 4.4 above shall be present and encoded as EIA-608/ EIA-708 data into the VANC area of the digital video signal (as per SMPTE ST 334M-1:2007 standard) recorded on the tape. CBC/Radio Canada requires that line 9 be used to insert Closed Captions data.

5.7 Labelling

All videotapes shall be properly labelled on both the cassette and the container.

5.7.1 Cassette Label

The **cassette label** shall indicate the slate information described in section 4.5.1.5.

5.7.2 Container Label

The **container label** shall indicate the slate information described in section 4.5.1.5.

5.7.3 Video Format Identification

The video format recorded on tape shall be identified using the following notation:

LLLL S FF
where:

	Number of active **l**ines per frame	**S**can mode	**Frame** rate (Not field rate)
	LLLL	**S**	**FF**
Possible Values	**1080**	**i**	23.98
			25
		p	**29.97**
			50
		sf	59.94

The range of possible values is indicated for informative purposes only. As specified in sections 4.1.1 and 4.1.2, the HD video format accepted by CBC/Radio-Canada is **1080 i 29.97**.

6 HD Content File Delivery Specifications

CBC/Radio-Canada strongly encourages all program providers to use electronic file delivery methods to benefit from a guaranteed delivery, a safe and error-free content processing.

This section describes the delivery standards and practices that apply to content digitally delivered as a file for presentation.

6.1 Technical Compliance

All HD video file content must conform to the General HD Technical Specifications set forth in section 4 above.

6.2 Content Delivery

Program providers shall contact CBC/Radio-Canada for information about the delivery method.

CBC/Radio-Canada general terms and conditions apply to this type of delivery.

6.2.1 Computer File Specifications

Program content shall be packaged in a computer file as compressed image and sound data. The program file extension shall correspond to the container used (for example, .mxf, .mov, etc.).

A separate XML computer file containing descriptive information (metadata) about the program shall accompany each program file. This data file shall have a .xml extension and comply with XML 1.0 Specification produced by the World Wide Web Consortium (W3C)[1].

Both files shall have the same name.

6.2.2 File Naming Convention

CBC/Radio-Canada is currently developing a document specifying the structure of the file names to be used by the English and French services.

Program suppliers should contact CBC/Radio-Canada to get information about the file name convention to use.

[1] Complete XML specifications can be found at : http://www.w3.org/TR/2000/REC-xml-20001006

6.2.3 XML File Content

The XML file shall contain the slate information described in section 4.5.1.5. This information is used for media asset management and by editing systems. An XML file example is given in section 9- Annex.

6.3 Source Profile

6.3.1 Containers

Any of the following container formats is acceptable:

- MXF OP1a, per SMPTE ST 378:2004 standard. MXF files shall be closed as per SMPTE ST 377-1:2011 standard definition - section 5.2.4.
- QuickTime.

6.3.2 Video File Format

6.3.2.1 Resolution and Frame Rate

The video resolution and frame rate shall be:

- 1920 x 1080 @ 29.97i
- Any show or program originally shot at another frame rate, such as 23.98p, 25p or 25i shall be made available to CBC/Radio-Canada in two forms : in its original frame rate and also converted to 29.97i (reference section 4.1.2).
- The video file shall meet the field dominance specification described in section 4.1.4.

6.3.2.2 Encoding

Any of the following encoded files is acceptable:

- XDCAM HD 422 @ 50 Mbps
- Apple ProRes 422 @ 117 to 147 Mbps
- Avid DnXHD @ 115 to 145 Mbps, as per SMPTE ST 2019-1 and -3, ST 2026, and ST 2028 standards.

Other file types will be considered by prior agreement only.

6.3.3 Audio File Format

Any of the following encoding file formats is acceptable:

- Uncompressed, 4-, 8-, 12-, or 16-channel audio, 24 bit @48 kHz, BWF, mapped into an MXF generic container (as per SMPTE ST 382:2007 standard). All audio channels must be contained within 1 MXF track.
- Linear PCM, 1152kbps, 48kHz, 24 bits wrapped in a QuickTime movie file (please contact CBC/Radio-Canada for recommended version).

Other file types will be considered by prior agreement only.

6.3.4 AFD Data

As the AFD value is constant for the duration of the Picture Track of the MXF file, the AFD value must be encoded in the Picture Descriptor of the Header Metadata, which is inserted in the MXF file, as per SMPTE standard ST-377-1:2011, section G.2.5.

This AFD information must also be marked in the XML file.

6.3.5 Film-originated Material

As specified in Section 4.1.10, any movie or other production originally shot on film or using digital technologies equivalent to film at a frame rate of 23.98p, or 25p shall be made available to CBC/Radio-Canada in two forms: in its original format and also converted to 29.97i.

6.4 File Quality

All programs must not have any video or audio impairments such as digital and colorimetry errors, compression or encoding artifacts, etc.

6.5 Time Code

- The file shall be provided with an uninterrupted ascending time code as defined by the Time Code Track in the Material Package of the MXF file, per standard SMPTE ST 377-1:2011.
- A Time Code track shall also be present within any QuickTime file.
- The Time Code data must conform to the technical specifications described in section 4.3 above.

6.6 Closed Captions

The Closed captions (CC) data described in section 4.4 above shall be present and provided as follows:

- EIA-608/ EIA-708 data shall be carried in a SMPTE ST 334-1/2:2007 compliant ANC packet within a SMPTE ST 436:2006-compliant VBI/ANC Generic Container Element, using 8-bit encoding. This process complies with the AMWA AS-03 and AS-11 file formats.
- With QuickTime, a separate CC file shall be provided and the associated Time Code shall match the video Time Code.
- At a 23.98fps frame rate, the CC must be formatted for a 29.97fps Drop Frame Time Code.

6.7 Program structure

The program structure shall meet the specifications described in section 4.5.

6.8 Labelling

As explained in section 5.7.3, the video format recorded on file shall be identified using the following notation:

1080 i 29.97

The audio channel labelling shall comply with requirements described in section 4.2.7 of this document.

7 Right of Refusal

CBC/Radio-Canada reserves the right to reject any production that fails to meet the specifications described in this document.

8 CBC/Radio-Canada working group on HD standards

This document was written with the collaboration of people from various departments within CBC/Radio-Canada. We acknowledge the contribution of the working group members of the following departments for their valuable input:

BE/MO&T:	Broadcast Engineering/Media Operation & Technology
DP&BD:	Digital Programming and Business Development, CBC
IM/PRC:	Ingenierie Medias/Production Radio-Canada
MO&T:	Media Operations & Technology
NBT:	New Broadcast Technologies
PRC:	Productions Radio-Canada

Annex A - XML File Submission Example

Values indicated in the file below are examples. They shall always meet specifications described in this document. The file example below indicates the audio track allocation required for a content submitted to the English Services. Please refer to section 4.2.8 for more details on the audio track allocation.

Note: Letters with accents such as é, è, ë, ö etc. must not be used.

```
<?xml version="1.0" encoding="utf-8" ?>
<SLATE_DATA>
        <Program_title>Show name</Program_title>
        <Series_name>xxxx</Series_name>
        <Episode_title>title</Episode_title>
        <Episode_number>number</Episode_number>
        <Producer_name>name</Producer_name>
        <Producer_contact>contact</Producer_contact>
        <!-- Program length in H:M:S-->
        <Program_length>00:00:00</Program_length>
        <!-- Main program audio type (mono, stereo, multichannel)-->
        <Main_program_audio_type>multichannel</Main_program_audio_type>
        <!-- Audio track allocation (including DV)-->
        <Audio_track_allocation>
                <Audio_track_1>L</Audio_track_1>
                <Audio_track_2>R</Audio_track_2>
                <Audio_track_3>C</Audio_track_3>
                <Audio_track_4>LFE</Audio_track_4>
                <Audio_track_5>LS</Audio_track_5>
                <Audio_track_6>RS</Audio_track_6>
                <Audio_track_7>DV</Audio_track_7>
                <Audio_track_8>DV</Audio_track_8>
        </Audio_track_allocation>
        <!--Closed Captions presence (Yes, No)-->
        <Closed_Captions>Yes</Closed_Captions>
        <Segment_1_Time_Code>00:00:00:00</Segment_1_Time_Code>
        <Segment_2_Time_Code>00:00:00:00</Segment_2_Time_Code>
        <Segment_3_Time_Code>00:00:00:00</Segment_3_Time_Code>
        <!-- Original aspect ratio (4:3 or 16:9)-->
        <Original_aspect_ratio>4:3</Original_aspect_ratio>
        <!-- Downconversion aspect ratio preference (AFD value)-->
        <Downconversion_aspect_ratio_preference>1010</Downconversion_aspect_ratio_preference>
        <!--Audio reference level (-20 or -18 dBFS)-->
        <Audio_reference_level>-20</Audio_reference_level>
        <!-- Integrated loudness value (-24 or -23 LKFS)-->
        <Integrated_loudness_value>-24</Integrated_loudness_value>
        <!-- Described video (Yes, No)-->
        <Described_video>Yes</Described_video>
</SLATE_DATA>
```