N24
Gesellschaft für Nachrichten
und Zeitgeschehen mbH
Postfach 040424
10062 Berlin

**Technical Guidelines
Playout und Broadcast Services**

N24

Technical Guidelines

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The purpose of these Guidelines is to ensure that N24 - Gesellschaft für Nachrichten und Zeitgeschehen mbH (called N24 in the following) can obtain broadcasting material of a sufficient technical standard and of the best quality and can carry out an automated flow of materials.
They have been agreed with our playout service-provider and are binding for every supply of material. All changes must be in writing and must be signed off by both sides.

This document describes the technical standards that must be met by all externally supplied programme elements as well as those produced in-house.

All material that N24 accepts for production, broadcasting and/or further processing, as well as material that it produces itself, must be delivered in an accepted format, along with all necessary metadata and according to the established technical quality requirements.

In terms of their essential technical details, the values specified in these Guidelines meet the recommendations of the European Broadcasting Union (UER/EBU) as well as those of the cited institutions.

If an external or internal supplier wishes to deviate from the following Guidelines for good reason, he must negotiate this BEFOREHAND with N24 or commissioned third party companies and clearly mark this fact on the accompanying documents for the material. Notes in the accompanying documents/ metadata must be provided even if a production intentionally violates these Guidelines over a longer period of time.

If the technical standards fail to be observed, and if this causes the quality check conducted by N24 GmbH or its representatives to produce a negative result, the contractually agreed and/or statutory legal consequences shall apply (including those stipulated by this Guideline).

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1. General technical requirements

The section below summarises all requirements relating to the quality and condition of the delivered material. In principle, all delivered material must be free from technical errors and be delivered on/in the best available medium/file. It is assumed that a complete quality check is run on any delivered material and its medium prior to delivery. If the standards are not met in full, the material automatically fails the technical quality check conducted by N24, and the contractually agreed and/or statutory legal consequences shall apply.

1.1. Video signal level and colour spaces

When producing content, care must be taken to ensure that no impermissible signal level combinations occur, thereby remaining within the legal colour space.

1.1.1. Permissible and valid SD signal levels

In general, digitally generated or digitised vision signals must meet the coding parameters according to ITU-R BT.601. All delivered video images must meet the current EBU specifications for PAL B/G video without correction. There should not be any invalid signal levels in the content (e.g. super black).
Video levels must meet the EBU recommendation NR. 10 and ITU-R 624-2; i.e. no levels may occur outside the range of 0-100% luminance or 10-100% chrominance. The white level should not exceed 700mv (component signals), and the black level should not extend below 0V (DC). The programme luminance in neither white nor black should be excessively clipped.
If an offset of 350mV was set, the R-Y and B-Y colour difference signals should not exceed a level of 700mV or fall below 0mV.
Active picture information must extend from line 23 to line 310 in the first field and from line 336 to line 623 in the second field. For example, the diamond display on the WFM-601 (Tektronix measuring device) can provide a reliable control.
The technical validity of the signals can be seen right away. In addition to the VITC information, there should also be vertical blanking information.

1.1.2. Permissible and valid HD signal levels

In general, digitally generated or digitised vision signals must meet the coding parameters according to ITU-R BT.709-5. During down-conversion, all delivered video images must meet the latest EBU specifications for PAL B/G video without correction. There should not be any invalid signal levels in the content (e.g. super black).

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1.2. Picture aspect ratio

The picture aspect ratio must be consistently maintained and indicated upon delivery of the material. The possible picture aspect ratios for SD and HD material are defined below. A distinction is made between the actual technical picture size (pixel size) and the displayed screen content (display aspect ratio).

1.2.1. SD picture aspect ratio

N24's broadcasting format is 16:9. If material is supplied for compelling reasons in another picture aspect ratio, this must be approved by N24.
The technical size of the active picture is 720x576 non-square pixels or 768x576 square pixels; no other sizes will be accepted.

If material is delivered in unacceptable formats, we may (if possible) convert the material to the programme format for a charge and at the expense of the supplier without prior notice. Other contractual and/or legal claims remain unaffected thereby.

1.2.2. HD picture aspect ratio

The technical size of the active picture is 1920x1080 square pixels; no other sizes will be accepted. SD productions that were subsequently "up-converted" to HD will not be accepted.
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If material is delivered in unacceptable formats, we may (if possible) convert the material to the programme format for a charge and at the expense of the supplier without prior notice. Other contractual and/or legal claims remain unaffected thereby.

1.2.3. Centre of interest

To ensure that the centre of interest is displayed on the screen, safety margins of 5% safe action and another 5% safe title (in relation to the transmitted picture) must be maintained on all sides.

1.3. Frame rate and field sequence

Only a frame rate of 50 fields (SD/HD) will be accepted. A shot change of a vision signal to be recorded must begin with Field 1 (see EBU Recommendation R62). In general, the correct field sequence must be maintained for all equipment involved in a production (mixer, synchronizer, etc.). For the production of programme material, the time for all editing equipment must be set so that the added and inserted picture material begins with Field 1 of a frame (Field 1 is defined in ITU Report 624 for system B, G/PAL).

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When recording from a film scanner, the beginning of a new film frame must coincide with the beginning of Field 1 of the TV signal.
When a file is delivered, the convention of upper or top field first must be maintained.

1.4. Avoiding flickering pictures

Flickering or twinkling images and certain types of repetitive optical patterns can cause photosensitive epilepsy (PSE) in susceptible viewers and must be avoided. At least nine individual images must be positioned between two sparkling or flashing images, and any regular prominent patterns (such as bars or spirals) that cover large areas of the picture must be avoided.

1.5. General audio requirements

N24 broadcasts in stereo. Broadcasting sound must be supplied in stereo (L+R). The stereo must be 100% mono-compatible.
If material is only available in mono, the signal must be recorded on both channels. The material must be marked accordingly.

Correlation degrees

Signal	Correlation degree	Acceptance
Mono	1	left channel =right channel
Stereo	0,3 .. 0,7	Optimum
de-correlated	0	not acceptable
Stereo, negative Korrelation	-0,3 .. 0,7	only short term*)
Mono (gegenphasig)	-1	not acceptable

*) The correlation degree may be negative in short-term. If the correlation degree mainly is negative a phase error is assumed and has to be corrected.

The sound on the medium should not contain noise suppression, pre-equalisation or data reduction. If it does, these changes must be noted in the metadata.
All sound tracks must be synchronised precisely with each other and lip-synchronised with the visual content according to EBU R83.
All effects that can be heard in the programme sound must be contained in full in the IS (M&E) sound.

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1.6. Audio signal level

As of the 31.08.2012 the levels of the analogue and digital audio signals have to be loudness normalized according to the ITU-R BS.1770-rules 2 and EBU R128.

Accordingly, an audio signal is described by the following properties:

1. the "exact" maximum peak level (maximum true peak level)
2. The program loudness
   The over the duration of a program or associated program part such as Commercial or trailer integrated loudness of the duration of a program (program) or associated program part such as Commercial or trailer integrated loudness.
   The program loudness level is the resulting value (in LUFS).

3. loudness range, LRA:
   The value describes the distribution of loudness levels within a program (conceptually similar to the dynamic program)

1.6.1. Full-scale digital audio signals (maximum peak)

To control the maximum peak level of a continuous audio signal measurement of the true peak level is recommended.
This "real" maximum true peak level is determined by multiple oversampling and is therefore generally higher than the level of a conventional measurement (according to EBU R68) with 10 ms integration time.

The true peak level must not exceed a maximum of -1 DBTP (based on the digital full scale of 0 dBFS).
The measurement of the true peak level must be made in accordance with ITU-R BS.1770-2.

The calibration of signal lines should be done at -18 dBFS @ 1 kHz

1.6.2 Loudness normalized levelling (program loudness)

The audio leveling has to be made with loudness meters in "EBU Mode".
The algorithm of the loudness measurement is defined in EBU Tech Doc 3341.

The loudness is measured in LU (loudness units, relative measure of loudness).
The reference to the dB scale is 1 dB: 1 LU is equivalent to 1 dBr

The absolute reference for digital full scale level is specified in LUFS (loudness units full scale).

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The "EBU Mode" provides three different slots for the loudness measurement

No	Name	short	slot
1	momentary loudness	„M"	400 ms
2	short-term loudness	„S"	3 s
3	integrated loudness	„I"	variable measurement (Start, Stop), refers to the measured program length

The average program loudness (integrated loudness) is determined by these values according to EBU R128 over the entire duration of the program part and given in LU or LUFS with an accuracy of 1/10 LU.
The target level for the program loudness has to be -23.0 LUFS. The deviation must not exceed ± 1 LU.

1.6.3 Loudness Range- LRA

The loudness range (LRA) describes the distribution of loudness levels within a program and is similar to the dynamic of a program.
In order to avoid extreme differences in loudness in short programs like commercials it is recommended to limit the maximum Momentary Loudness to 400 ms respectively the maximum Short Term-Loudness at 3 s.
Der Lautheitsbereich (loudness range- LRA) beschreibt die Verteilung der Lautheitspegel innerhalb eines Programms und ist begrifflich vergleichbar mit der Programmdynamik.
Um bei sehr kurzen Programmen wie z.B. Werbespots möglicherweise auftretende extreme Lautheitssprünge zu begrenzen, wird statt der Programmlautheit der maximalen Wert der Momentary Loudness (400 ms) bzw. die maximale Short Term-Loudness (3 s) begrenzt.

Level	Max. Value for program shorter than 10 min
momentary Loudness	-15 LUFS (+8 LU)
short term Loudness	-20 LUFS (+3 LU)

These Levels are according to the Practical Guidelines (EBU Tech 3343), Cha. 10.1 Commercials (Advertisements) and Trailers.

For detailed information about EBU R128 refer to http://tech.ebu.ch/loudness

EBU Tech 3341 Metering specification ('EBU mode')
EBU Tech 3342 Loudness Range descriptor
EBU Tech 3343 Practical Guidelines
EBU Tech 3344 Distribution Guidelines

Refer: Appendix A - Specifications for Loudness Adjustment N24

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1.7. Track assignment

1.7.1 Delivery of Content with up to 8 Tracks

Track 1 – PGM Mix L	Track 5 - Dolby E PGM
Track 2 – PGM Mix R	Track 6 - Dolby E PGM
Track 3 – IT (M&E) L	Track 7 - Dolby E Original
Track 4 – IT (M&E) R	Track 8 - Dolby E Original

The delivery of a Dolby E Mix is optional and will not be used in the playout of N24. It will be stored in the Archive for optional future use.

1.7.2. Synchronisation of foreign-language productions

For programmes delivered for German synchronisation, the original-language track (e.g. English) must also be supplied.
With the speech recordings, not only does the technical quality need to be maintained, but optimum lip synchronisation must also be ensured.

1.8. Time codes (TC)

All programmes (tape, file, other formats) must be delivered with EBU time codes in 25 frames per second (fps).
The time must be incremented steadily and continuously. The time code value may only be used once per medium / content. The time code may not exceed zero at any time.
Time code jumps are only permitted with original tapes or live broadcast recordings (e.g. sport with "Real time TC". There may be no TC fragment of another recording at the start of the tape.

The use of non-specified signalising bits must be set at "0".
It may happen that the medium has to be copied, losing the original time information at the supplier's expense.

1.8.1. Longitudinal time code (LTC)

The longitudinal time code (LTC) is a time code that includes all time data for video signals: date, hours, minutes, seconds and frames. It is picture-specific and consists of an item of audio information that can be stored on magnetic tape.
The 80-bit time code must comply with the specifications provided in DIN IEC 461 and EBU document Tech. 3097 and be recorded on the track specified for this purpose in the format used.

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1.8.2. Time code in the vertical blanking (VITC)

With some recording formats, the VITC makes it possible to read the time code with a frozen image or slow motion. It should be used only in connection with the LTC and must have identical values for a television signal frame. The 90-bit time code must comply with the specifications provided in DIN IEC 461 and EBU document Tech. 3097. Lines 19 + 21/332 + 334 of the vertical blanking must contain the VITC.

1.8.3. TC for the programme beginning

All material delivered to N24 must begin with the time codes listed below. Exceptions are allowed only for good reason and must be clearly noted in the metadata.

1.8.3.1. Tape-based

The programme begins at TC 10:00:00:00 as standard. All delivered material begins at TC 10:00:00:00, i.e. the technical leader begins at TC 9:58:00:00

1.8.3.2. File-based

The time code must always begin at 00:00:00:00 for delivered files.

1.9. Technical leader

To ensure the best possible adjustment of the replay machine to the magnetic tape to be played, a technical leader must be recorded at the beginning of each medium. The technical leader must be recorded with the most suitable machine for the production. Unused soundtracks should not contain a technical leader (test tone).

1.9.1. Technical leader specifications

The technical leader consists of 1 minute 30 seconds of colour bar and a test tone of 1kHz @ -18 dBFS on all occupied audio tracks followed by 20 seconds of identification leader with silence. This is followed by 10 seconds of black with silence.
The TC starts at 09:58:00:00, which means that the programme starts at TC 10:00:00:00.
After the programme, there is at least 30 seconds of black. It is important that there is no empty tape before the technical leader, i.e. a time code can be read from the start of the tape.
The maximum audio and video levels should not exceed the maximum levels of the technical leader.
The colour bar signal has 75% colour saturation and luminance level (ITU Recommendations 469 and 471).

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Test tone signals must be coherent and in phase (i.e. they must come from the same source).
The identification leader (slate or info panel) contains all metadata needed to identify the programme.
If the supplied programme is split over several tapes, each tape must contain a technical leader.

1.9.2. Identification leader specifications

The identification leader (slate or info panel) should contain the following information, which must match the metadata on the VTR card:
- Producer/supplier
- Series/production title
- Season number
- Episode title
- Episode number
- Material ID
- Length (h:mm:ss:ff)
- Display aspect ratio (16:9 or 4:3)
- Broadcasting format and standard
- Precise picture aspect ratio (e.g. 1:2.25)
- Audio Levels according to EBU R128 / Program loudness

1.10. Delivery standards

Metadata must be included with each medium so that the medium can always be identified. This can be done in the form of a VTR card or a metadata file. The superimposition of characters in the technical leader is also mandatory. The media and metadata must always be delivered and/or stored together.

1.10.1. Delivery standards for tape and other media

Tapes must be brand new and of master quality suitable for transmission. They must be submitted rewound and in a suitable storage box. Write protection must be activated. The labelling must be identical on the media and media box. The labels must be placed only in the area provided for labels on the medium. In principle, media must be shipped and stored in the containers provider for this purpose by the manufacturer. These containers must also be suitable for archiving. If a programme is delivered on multiple tapes, the same type of media must be used for each file. Each storage medium should contain no more than one programme episode. Media containing more than one episode will not be accepted. Exceptions are collective tapes for delivering commercial subjects or trailers.

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1.10.2. Delivery standards (file)

Every file that is delivered or transmitted must be free from viruses. The picture content in the files must meet the Technical Guidelines (resolution, coding, colour space). The file name should not contain any special characters and must comply with the material ID.
The file delivery workflow must be clarified in advance with the department or the editorial team and is subject to prior approval by N24.
The delivered File must not contain a technical leader. Start of file and start of program has to be identical. The delivery of an XDCAM cartridge will be treated as a file delivery. A digital VTR card must be created sent by the material supplier for each file delivery. The format has to be agreed by N24.

1.10.3 Quality assurance and documentation

The entire duration of the prepared medium must be checked. For each transmission-ready material delivered, conformity with the guidelines must be confirmed in a check report, metadata or on a VTR card.
All special features must be noted on the VTR card or in the check report/metadata file, including precise time code details. Any defects already present in the source material must be clearly stated on the VTR card or in the check report/metadata file, including precise time code details, in order to avoid queries.

1.10.4 Loudness normalized delivery

After the 31.8.2012 all productions have to be delivered according to the EBU guideline R128. The delivered material has to be marked according to the used guideline EBU R128. The loudness also has to be mentioned in the metadata if applicable.

2. Technical quality check

N24 reserves the right to subject received material to an automatic quality check. The main focus of the check is on whether the programme is suitable for broadcasting and further processing and whether it meets the essential quality requirements.
The technical quality check conducted upon feed-in is based on clear parameters that are directly related to the delivery standards described in this document.
N24 reserves the right to reject delivered material that does **not** meet the standards described in this document.

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3. Material identification on delivery

3.1. Minimum set of metadata for programme material
- Licensor
- Programme title
- TC at programme start
- Duration with end credits and neutral backgrounds and scenes
- Description of audio contents with track and channel assignments for each element
- Used audio guideline (EBU R68 or EBU R128)
- TC start and duration for each programme element, if segmented
- Display aspect ratio
- SD TV standard (PAL/NTSC/SECAM)
- HD format (e.g. 1080i/25)
- Subtitle language, if provided
- Neutral background provided (y/n)
- Performing rights notice (GEMA) / music list

3.2. Minimum set of metadata for other material

- Title
- Production company/
- programme supplier
- Production date / time
- Display aspect ratio (e.g. 4:3/16:9/1:1.66/1:1.85/1:2.0/1:2.25)
- SD TV standard (PAL/NTSC/SECAM)
- HD format (e.g.1080i/25)
- Type of material (master / clean / dub)
- Start TC programme
- Duration (DUR) in h:mm:ss.ff
- Audio standard (e.g. mute/mono/stereo/multichannel)
- Used audio guideline (EBU R68 or EBU R128)
- detailed usage of audio channels 1 – 8
- Data reduction used (e.g. DV, IMX30, DNxHD 180, MPEG-2 etc.)
- Content ID (if known beforehand)

4. Programme and production formats

4.1. Formats for the delivery of programme material

In general N24 differs between programme and production material.
Programme material is used directly for broadcasting and therefore has to match the
technical guidelines of N24.
Production material is used for postproduction and or producing News Bulletins.

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If a producer wants to deliver a format, which is not mentioned in the technical guidelines of N24, an agreement has to be made between the production company and N24.

With the delivery N24 gets the permission to store a digital copy of the material. For internal browsing a low res copy will also be create. This copy is used by authorised personal only.

4.1.1. Tape, disk and data medium formats

4.1.1.1 Digital Betacam

Video: PAL in 16:9 anamorphotic, Field Dominanz 1 according to Guidelines ITU - R BT.601/656
Audio: digital as AES/EBU, up to 4 tracks (Routing according to chapter 1.7), Samplerate 48 kHz, 16 Bit

4.1.1.2 HDCAM

Video: HDCAM 1080i/25 according to ITU-R BT.709
Audio: digital as AES/EBU, up to 8 tracks (Routing according to chapter 1.7), Samplerate 48 kHz, 16 Bit.

4.1.2. File formats

All filebased workflows will deliver onto N24 FTP Servers. Every Deliverer gets his own personalised account. The data will be transferred over the public internet without any encryption.

In order to keep very tight schedules in the news department, N24 is based on mainly automated workflows. In order to keep a high level of production security, N24 and the Deliverer will undertake tests and agreement regarding protokolls, fileformats, names, metadata, etc.

4.1.2.1 SD – Fileformate

MXF GC OP1a according to SMPTE 386M GC-D10 (IMX30) with up to 8 tracks according to SMPTE 282M PCM (Routing according to 1.7) with 48 kHz samplingrate at 16 Bit

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4.1.2.2 HD – Fileformate

MXF GC OP1a with MPEG HD422 according to SMPTE RDD09-2009 (1080i/25, MPEG-2 422P@HL, Long GOP) with up to 8 tracks according to SMPTE 282M PCM (Routing according to 1.7) with 48 kHz samplingrate at 16 Bit

4.2. Formats for the delivery of production material

Production material refers to all material that is used for further processing and producing new programme material. Examples of production material are:

- All raw material, such as material from shooting
- Agency material
- User-generated content

In addition to the file and tape formats already listed, the following formats are accepted for production.

Any supplier who wishes to deliver a format that does not meet the specifications of these Technical Guidelines must reach a written agreement with N24.

5. Special requirements for production quality

5.1. Studio production

5.1.1. Requirements

To achieve the best possible vision and sound quality, the video, audio and acoustic arrangements must be agreed between those responsible for the direction, production and technical sections before shooting begins, for example in a technical production planning meeting.

5.1.2. Vision quality

Cameras and lenses must be of transmission quality.
Cameras are expected to have a sensor size of 2/3" (never smaller than ½"). All shooting and post-production work must be based on digital video component systems. When shooting, bear in mind that the contrast range must not exceed 40:1, since a picture can only be transmitted in our television system with a limited range of tonal values.
In studio productions, the lighting contrast ratio, i.e. the ratio of key light plus the fill-in light to the fill-in light alone should not exceed 2:1. The reflectance of black picture

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elements should not be less than 3% and that of white elements not more than 60%.
The relatively dark reference white (60% reflectance) is necessary for good gradation in the transmission of skin tones.
Whenever possible, each shot should include areas of reference white and reference black amounting to at least 1% of the total picture area. Too low a brightness difference between the foreground and background (less than 1.5:1) spoils the impression of depth.

Excessive areas of black or condensed highlights must be avoided.
To avoid interference patterns in the television picture, there should be no fine patterns on the scenery or costumes. Fine patterns are, for example, regular stripes or checks with a high degree of contrast.

Shiny objects occupying more than 0.2% of the picture area should be rendered matt in order to avoid over-modulation effects. When self-illuminated objects appear in the shot, care must be taken to remain within the specified maximum contrast range.

Colours must be rendered realistically, particularly where skin tones are concerned.
Colouration must be consistent, particularly between edits and scene transitions.
There should be no visible artefacts or noise effects due to digital conversion and no analogue pictures or compression. Special care must be taken to avoid compression chains, which can result from multiple conversion or coding.
There should be no visible film scratches, spots, dirt flecks or excessive graininess in the picture.
If artistic effects or innovative programme techniques are used that can affect the perceived vision quality, this must be agreed on in advance with the programme client (person responsible for the programme). A record of this agreement must be submitted together with the delivered programme in order to ensure that the programme does not fail the quality check for this reason.

5.1.3. Sound quality in studio production

Audio material must have good sound quality and be easy to understand. This means it must be free of distortion, humming, rustling, rattling, cross-talk, hissing, whining, fluctuating synchronism and other interference signals.
There should be no muting (silence) or test tones within the programme; exceptions (such as removal of adult language) must be documented.
Dialogue must be easy to hear within the overall programme mix (regardless of whether the audio is a mono, stereo, surround-sound or 5.1 recording); special attention must be paid to background effects and background music. Keep in mind that many viewers have trouble making out programme dialogue if it is not distinguished clearly enough from the background sound. Speech intelligibility and audibility come first.
The use of audio compression must be minimised and used to ensure a dynamic range suitable for television transmission according to the EBU Guideline R128.
Equipment used to measure Peak Levels (PPM/QPPM) are not suitable to measure loudness according to EBU R128 and therefore must not be used.

There must be no perceptible lip synchronism errors between the audio dialogue and the video images (unless speech synchronism is involved).

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The EBU is of the opinion that an audio-levelling paradigm is needed based on loudness measurement. This is described in EBU Technical Recommendation R 128. In addition to the average loudness of a programme ('Programme Loudness') the EBU recommends that the measures 'Loudness Range' and 'Maximum True Peak Level' be used for the normalisation of audio signals and to comply with the technical limits of the complete signal chain as well as the aesthetic needs of each programme/station depending on the genre(s) and the target audience.

As loudness is not physical measureable but subjective the method of metering audio needs to be adjusted. Therefore loudness metering in the so-called 'EBU Mode' should be used.

5.2. TV filming and film production

All commissioned programmes in all categories are delivered exclusively in wide-screen format: 16:9 with full height (FHA format). No other wide-screen formats will be accepted.

The programme must be shot with a native wide-screen camera and should not be converted from the video recordings of a 4:3 camera. The entire television film production chain must use a format suitable for 16:9 broadcasting. Wider picture formats are not acceptable for commissioned productions (although they are permitted for licensed programmes that were originally shown in the cinema).

Super-16 film productions are not always acceptable for HD delivery, and any planned use of super-16 for HD production must be agreed on with the programme client and N24 before production begins.

Television films are produced with 25 frames per second (fps) in a permissible picture size. The film material must be suitable for television. In particular, the following must be considered:

- Film characteristic curve
- Transmittable density range
- Definition (modulation depth, modulation transfer)
- Signal-to-noise ratio (film grain noise)
- Colour balance

The positive material must be of low contrast and suitable for the TV contrast range. During film scanning, care must be taken to ensure that the resulting video is free from visible errors such as scratches, stripes, spots and flecks of dirt.

If the film material is available in 24 frames per second, it must be scanned at 25 fps. In this case, the sound must be synchronous and pitch-corrected with phase stability when delivered.

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5.2.1. Neutral background graphics

In the case of licensed programmes delivered in the original language (such as English), neutral, textless background graphics must be provided for each graphic/text element in the main programme, including the main title sequence. The neutral background images must contain all background shots for each graphic or text segment and extend to the next clean transition edit at both ends.

When producing programmes licensed for sale, a neutral, textless background graphic must be provided for each graphic/text element in the main programme, including the main title sequence.

These must be provided at the end of the main programme content, separated by at least 30 seconds of black without sound. Each neutral background should ideally be preceded by an ID panel that indicates the time code position of the shot within the programme.

5.3. Film scanning

Films must be scanned with a digital scanner (state of the art – not more than 10 years old). If a "wet gate unit" is available, it should be used. Every programme must be scanned with scene-by-scene colour correction. "On-the-fly" corrections will not be accepted.

A high-end system (e.g. Da Vinci) and corresponding reference monitor must be used for scene-by-scene colour correction. Up-conversions are not allowed during scanning either.

HD content must be scanned on native HD film scanners in 1080i/25 format. Only scans that were recorded directly in the accepted master formats or on IT systems without data reduction will be accepted.

5.4. Outside broadcasts

5.4.1. Video transmission

Video transmissions via the fixed network, satellite or networks like ATM must meet the requirements of FTZ [155 R 157].

Accepted standards are:

Standard	Profile	Bit rate
ETSI	G.703	34 Mbit/s
DVB-MPEG2	4:2:0MP@ML	4-15 Mbit/s
DVB-MPEG2	4:2:2MP@ML	8-45 Mbit/s
MPEG-4 AVC (HD)	MP@L4, HP@L4	Max. 20 Mbit/s
MPEG-2 (HD)	MP@HL, 422@HL	Max. 50 Mbit/s (MP@HL) Max. 90 Mbit/s (422@HL)

The standard selected must be agreed in writing between the producer and N24.

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5.4.2. Audio transmission

The level of analogue sound signals must be adjusted with the reference tone at -9dB in relation to a line level of +6dBu (100%).
The level of digital sound signals must be adjusted with -18dBFS (see Section 1.6 Audio signal level).
The loudness normalization has to be done according to the guideline EBU R128.

The sound channel assignment must be agreed between the producer and N24.
Care must be taken to ensure that the sound remains lip-synchronised with the video content, particularly if the audio and video are transmitted through different lines.

5.4.3. Post-production

Generally, care should be taken to minimise the number of encoding and decoding processes.
All programmes should be post-produced decompressed or using systems with data rates of at least 30 MBit/s for SD and 50 Mbit LongGOP for HD. Video sampling should be 4:4:4 or 4:2:2.
Acceptable video compression codecs include MPEG-2 (IMX) and DNxHD.

Offline processing is acceptable under any compression rate if the video undergoes subsequent online processing. A technical leader must be recorded or rendered before the beginning of the programme.
For transmission tapes/transmission elements, the programme must begin at time code 10:00:00:00. The time code for the start of the programme must be noted on the VTR card or in the metadata. Each recording must end with at least 30s of black level without sound.

5.4.4. Noise reduction systems

The resolution of the original material should not be excessively impaired by the use of noise reduction systems. Slight graininess is preferable to a flat picture. Excessive detail emphasis should also be avoided. We recommend processing the material carefully scene by scene, which must be logged in the check report or the metadata.

5.4.5. Segmentation and editing

If a production is split between multiple media, each medium must have a correct technical leader.
A transmission tape/medium should not contain more than one complete production or programme. In this sense, each episode of a series is also considered to be a complete production.
Programmes should normally be delivered as individual, non-segmented units. If a production consists of multiple media, the same media type must be used.

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Editing must also be carried out so that it does not cause audio, video or synchronisation problems. The field sequence must be maintained. The edits are made in the first field of a frame.
The number of copy and transcoding operations must be minimised to obtain high-quality transmission material.

5.4.6. Permissible error rates for digital recording formats

The condition of the replay channels is usually indicated by a so-called "channel condition indicator" on the control panel. The three coloured indicator lamps indicate the following operating conditions:

- Green: The replay channels are in good condition. Very low error rate. All tape faults can be corrected.
- Yellow: There is an increased error rate on one or more replay channels. All tape faults can still be corrected, but there may already be a problem.
- Red: There is too high an error rate on one or more replay channels. All faults can no longer be corrected. Concealment is used.

Warning: The condition switches from yellow to red with a small safety margin before the concealment actually takes effect.
Under normal circumstances, only the green indicator should be lit during a replay sequence.
Brief illumination of the yellow lamp is not critical, since all errors are corrected. Longer or continuous illumination of the yellow lamp, or even the red lamp, should not occur.

It is therefore necessary to monitor the error rate during each recording session of a production (by separate-head monitoring, if necessary). The error logger of the machine used must be monitored during each production step, and errors must be documented.

Warning: In digital sound recording systems, the yellow lamp indicates a higher error rate and shows that concealment is already taking place.
In general, no concealment at all should take place during sound recording.

5.4.7. Sound quality

Due to reduced quality caused by cascading effects, no data reduction may be used throughout the entire sound production chain.
The use of low-quality MP3 files (data rate less than 128 KBit/s) is also unacceptable.
The sound pick-up and recording must be of a quality that corresponds to current professional studio techniques and be structured, as far as possible, to match the picture content in a meaningful manner.
There should be no unintentional change in the acoustic atmosphere, and the mixed sound must be properly balanced throughout.

The original dynamics has to follow the allowed loudness range of the EBU R128, which is specified in the EBU document Tech 3342

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Typical values for loudness are:
- small   LRA < 5 LU
- medium   LRA ~ 10 LU
- large   LRA > 5 LU

A single production has to have a program loudness of the target value of -23 LUFS
Care must be taken to a fair and balanced broadcasting mixing ratio.

5.4.8. Sound level

Digital recordings have to be levelled according to the EBU Guideline R128.

5.4.9. Degree of correlation

In the production of stereophonic programmes, it is very important to make sure that a compatible monophonic version can be provided. This is checked at the mixing station and not at the 90° filter. For the maximum permissible phase difference on replay, the following values stated in ITU-Rec. 408-6 apply:

Frequency range	Phase angle	Degree of correlation (r)
250 Hz to 4 kHz	15°	0.96
40 Hz	30°	0.86
10 kHz	30°	0.86