

## Mastering of HD/HDR and UHD/HDR Productions

When producing HDR content for ZDF, the following guidelines and specifications must be followed. The basis for HDR mastering is the [ITU-R BT.2100](#) recommendation in its latest version.

Color grading must be performed using a Class 1 HDR reference monitor in a viewing environment conforming to ITU-R BT.2100 Table 3.

Minimum Requirements for an HDR Reference Monitor:

<b>Color Space</b>	ITU-R BT.2020 oder P3 (BT.2020 transfer matrix)*
<b>Whitepoint</b>	D65
<b>EOTF</b>	Hybrid Log Gamma (HLG System Gamma: 1.2) / ST-2084 PQ
<b>Black Level</b>	$\leq 0.005 \text{ cd/m}^2$
<b>Peak Luminance</b>	$\geq 1000 \text{ cd/m}^2$

*\* To avoid misrepresentations on end-user devices (clipping, hue-shifts), it is recommended to use a P3 D65 subset.*

Requirements for Viewing Environment:

<b>Luminance of surround</b>	5 cd/m <sup>2</sup>
<b>Whitepoint</b>	D65
<b>Viewing Distance</b>	3.2 * picture height (HD), 1.6 to 3.2 * picture height (UHD)

It is recommended, especially if a PQ workflow with subsequent conversion to HLG is preferred, to add the HDR leader as follows at the beginning of the process:

At start-timecode 09:59:56:00 with a duration of 3 seconds, followed by 1 second of black. The production thus begins at timecode 10:00:00:00.

HDR color grading should be performed on the original material and not on the rendered SDR version. It should utilize the advantages of extended dynamic range and color space to achieve a noticeable improvement over the SDR version, provided this aligns with the creative directives. If this is not the case, HDR mastering should be avoided.

For purely white text elements (subtitles, credits, etc.), luminance levels must be at least 75% IRE (203 cd/m<sup>2</sup> on a 1000 cd/m<sup>2</sup> monitor); depending on the background, the brightness of the text should be adjusted so that it is depicted in pure white, without over-brightening. This rule also applies to the white elements in content branding or broadcaster logo.

For content branding logos, the Content Branding Logo HDR Stylesheet of ZDF applies.

In general, the recommendations from the ITU Report [ITU-R BT.2408](#) must be observed.

Deliveries must follow ZDF's in-house standard for HDR productions:

	<b>HD</b>	<b>UHD</b>
<b>Container</b>	MXF OP1a (SMPTE 377)	MXF OP1a (SMPTE 377)
<b>Codec</b>	XAVC Intra Class 100	XAVC Intra Class 300 VBR
<b>Resolution</b>	1920 x 1080	3840 x 2160
<b>Frame Rate</b>	50 fps	50 fps
<b>Chroma Subsampling</b>	4:2:2	4:2:2
<b>Bit Depth</b>	10 bit	10 bit
<b>Scan Type</b>	Progressive	Progressive
<b>EOTF</b>	HLG (ITU-R BT.2100)	HLG (ITU-R BT.2100)
<b>Peak Luminance</b>	1000 nits	1000 nits
<b>Colour Space</b>	ITU-R BT.2020	ITU-R BT.2020

The software MXFRead enables file validation.

Deliveries with deviating file specifications (e.g., EOTF: PQ ST.2084) can be arranged after consultation with the responsible material coordinator or production management and in accordance with the contractually agreed material specifications, provided that a further processing is planned (e.g. productions in the original language).