

# REFERENCE LEVEL GUIDELINES FOR PQ (BT.2100)

## Summary

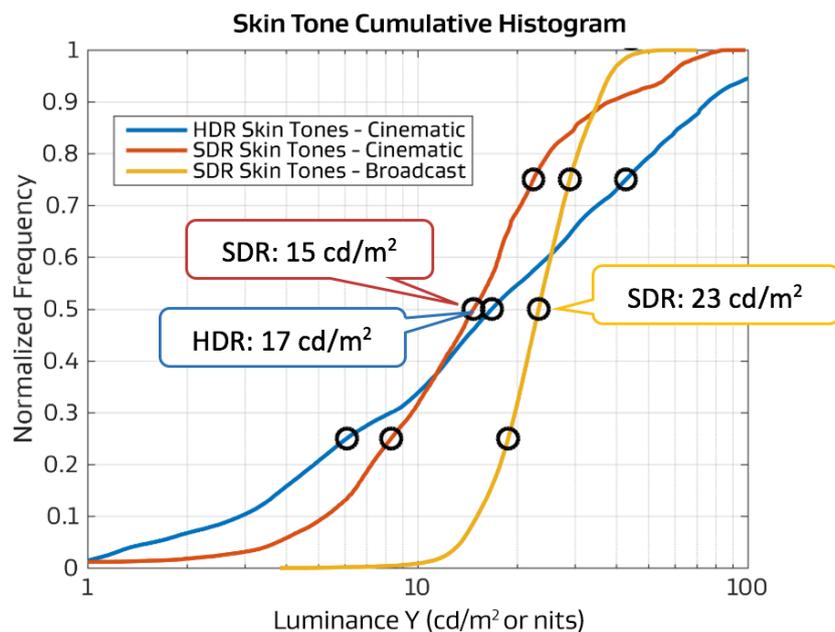
To establish consistency in PQ HDR content production, a reference level of 34% of PQ full scale (corresponding to a display luminance of 17 cd/m<sup>2</sup>) is suggested for the indoor capture of an 18% grey card. If a grey card is not available, suggested skin tone and diffuse white levels for indoor scenes are 38% and 54%, of full scale PQ, respectively. Higher levels are suggested for outdoor scenes.

## Details

To allow for consistency between PQ HDR productions, a tentative reference level is given for consistently setting brightness levels in PQ HDR content. To select the optimum indoor reference level, skin tones from both broadcast content and home cinema release content were analysed. The indoor SDR broadcast content was manually segmented for well-exposed (Caucasian) skin tones and was analysed assuming a BT.1886 reference monitor with 100 cd/m<sup>2</sup> reference white and BT.709 colour primaries. A sampling of the images analysed (courtesy of SVT and FOX) is shown below:



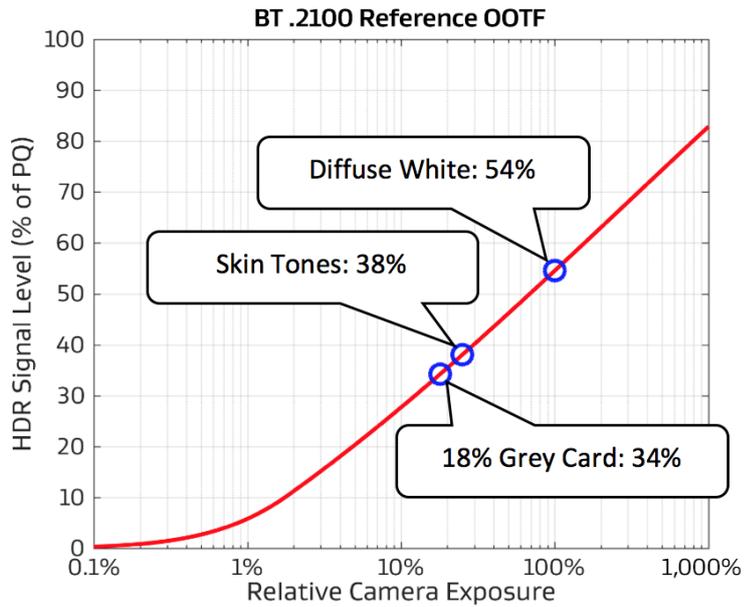
Due to the scarcity of HDR broadcast content currently available, in order to compare HDR and SDR content, the same analysis was completed utilizing HDR and SDR graded indoor scenes from cinematic content for home distribution. The cumulative histogram is given below.



For cinematic content for the home, HDR Caucasian skin tones are very similar to SDR skin tones (17 cd/m<sup>2</sup> compared to 15 cd/m<sup>2</sup>), but the standard deviation is larger. Extrapolating from this, it is hypothesized that indoor Caucasian skin tones in HDR broadcast will average 26 cd/m<sup>2</sup> with a larger deviation than SDR broadcast. The 26 cd/m<sup>2</sup> value maps to 38% of full scale in PQ space (or 38%PQ).

Utilizing skin tones as a reference level is, of course, not satisfactory because they vary widely across ethnicities and environments. To achieve consistency, an 18% grey card may be used instead to calibrate camera exposure. To convert from Caucasian skin tone brightness and its 38%PQ level to find the %PQ level of an 18% grey card, a database of 340 measured samples of skin tones (Sun, Fairchild) was used to determine skin tone reflectance levels. This database shows that Caucasian skin tones have a reflectivity of 25% of that of a diffuse white object (white card).

Using the BT.2100 reference PQ OOTF, 26 cd/m<sup>2</sup> may be related to relative scene exposure. Then the 25% and 18% reflectivity relationship may be used to solve for the appropriate 18% grey card level: 17 cd/m<sup>2</sup> on a PQ reference display or 34% on the PQ scale. This is the suggested luminance for the grey card anchor in HDR broadcast content for indoor scenes. If Caucasian skin tone or diffuse white is more readily available during production, 38% and 54% respectively may be used as a reference.



By segmenting HDR indoor and outdoor scenes, it was found that outdoor skin tones are an average of 1.7 stops brighter than indoor skin tones. Assuming a 1.7 stop increase in brightness from an indoor to outdoor scene, the exposure for an 18% grey card outdoors would be set to 45 %PQ.

The table below summarizes Dolby’s current (and considered tentative) recommendations on settings of an 18% grey card, Caucasian faces, and diffuse white objects in terms of both PQ value (percentage of full scale) and reference display brightness.

	INDOOR		OUTDOOR	
	cd/m <sup>2</sup>	%PQ	cd/m <sup>2</sup>	%PQ
18% Grey Card	17	34	57	45
Caucasian	26	38	85	49
Diffuse White	140	54	425	66

The levels shown in this document should be considered tentative and starting points. More experience with HDR in broadcast is needed to settle on final values to be recommended.