

International Telecommunication Union

**ITU-R**  
Radiocommunication Sector of ITU

**Report ITU-R BT.2245-3**  
(10/2017)

**HDTV and UHD TV including HDR-TV test  
materials for assessment of picture quality**

**BT Series**  
**Broadcasting service**  
**(television)**



International  
Telecommunication  
Union

## Foreword

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|-----------|--|
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| <b>BR</b> | Recording for production, archival and play-out; film for television                 |
| <b>BS</b> | Broadcasting service (sound)   |
| <b>BT</b> | <b>Broadcasting service (television)</b>   |
| <b>F</b>  | Fixed service  |
| <b>M</b>  | Mobile, radiodetermination, amateur and related satellite services                   |
| <b>P</b>  | Radiowave propagation  |
| <b>RA</b> | Radio astronomy  |
| <b>RS</b> | Remote sensing systems   |
| <b>S</b>  | Fixed-satellite service  |
| <b>SA</b> | Space applications and meteorology   |
| <b>SF</b> | Frequency sharing and coordination between fixed-satellite and fixed service systems |
| <b>SM</b> | Spectrum management  |

*Note: This ITU-R Report was approved in English by the Study Group under the procedure detailed in Resolution ITU-R 1.*

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## REPORT ITU-R BT.2245-3

**HDTV and UHDTV including HDR-TV test materials  
for assessment of picture quality**

(Question ITU-R 81-1/6)

(2011-2014-2016-2017)

**Introduction**

This Report contains lists of HDTV, UHDTV including HDR-TV test materials and related information for assessment of picture quality of television systems. This Report is informatively referred to by Recommendation ITU-R BT.1210.

## TABLE OF CONTENTS

|   | <i>Page</i> |
|---|-------------|
| 1 Test materials of high definition television (HDTV) .....   | 3           |
| 2 Test materials of ultra-high definition television (UHDTV), HDR-TV and high definition television (HDTV) .....  | 19          |
| Annex 1 – Supplementary information on test materials.....  | 21          |
| 1 HDTV test materials for the 1 920×1 080/59.94/I, 4:4:4 and 4:2:2, 10-bit and 1 920×1 080/59.94/P, 4:2:2, 10-bit formats listed in Tables 1-2 and 1-3..... | 21          |
| 1.1 Image characteristics .....   | 21          |
| 1.2 Production conditions .....   | 22          |
| 1.3 Status for use of test materials .....  | 22          |
| 2 HDTV test materials for the 1 920 × 1 080/50/I, 4:2:2, 10-bit formats listed in Tables 1 to 4 .....   | 22          |
| 2.1 Image characteristics .....   | 22          |
| 2.2 Production conditions .....   | 23          |
| 2.3 Status for use of test materials .....  | 24          |
| 3 UHDTV/HDTV test materials listed in Table 5 .....   | 24          |
| 4 UHDTV and HDR-TV test materials listed in Table 6 .....   | 26          |
| Attachment 1 to Annex 1 – Thumbnails of the HDTV test materials.....  | 27          |
| Attachment 2 to Annex 1 – Attributes to be evaluated .....  | 45          |
| Annex 2 – Choice of statistics that can serve to characterize materials .....   | 53          |

|  | <i>Page</i> |
|--|-------------|
| 1 Introduction .....   | 53          |
| 2 Statistics of test materials .....                                     | 53          |
| 2.1 Entropy of PCM data .....  | 53          |
| 2.2 AC energy .....  | 53          |
| 2.3 Spectral entropy .....   | 54          |
| 2.4 Motion vector.....   | 54          |
| 2.5 Motion-compensated prediction error power .....                      | 55          |
| 2.6 Criticality by rate-buffer occupancy method .....                    | 55          |
| 2.7 Criticality by fixed quantizer method .....                          | 55          |
| Annex 3 – Status for use of test materials.....                          | 59          |
| Annex 4 – File formats for test materials.....                           | 59          |
| 1 TIFF file for HDTV RGB 4:4:4 (10 bits) .....                           | 59          |
| 2 YUV file for HDTV YC <sub>B</sub> C <sub>R</sub> 4:2:2 (10 bits) ..... | 60          |
| 3 Raw file for UHD TV RGB 4:4:4 (12 bits) .....                          | 63          |

## 1 Test materials of high definition television (HDTV)

TABLE 1  
1 920×1 080 HDTV still pictures

| Scene No. | Title                | Contents  | Representative of                | Attributes to be examined  | Motion | Source | Statistic                   | Copyright status | Delivery format  | Provider name |
|-----------|----------------------|---|----------------------------------|--|--------|--------|-----------------------------|------------------|------------------|---------------|
| 1         | Woman                | Bust shot of a woman with a red flower against uniform background                     | Studio still portrait            | False contour, Y/C phase difference<br>Flesh tint and texture reproduction | Still  | Slide  | See Attachment 1 to Annex 2 | See Annex 3      | Slide/<br>CD-ROM | ITE           |
| 2         | Yacht harbour        | Long shot of a yacht harbour with highly detailed yachts                              | Outdoor still                    | Waveform distortion<br>Aliasing<br>Sharpness                               | Still  | Slide  | See Attachment 1 to Annex 2 | See Annex 3      | Slide/<br>CD-ROM | ITE           |
| 3         | Sweaters and bag     | Loose shot of sweaters, towels of various colours, a leather bag, metal pitcher, etc. | Studio still<br>Textured objects | Texture reproduction<br>Lustre   | Still  | Slide  | See Attachment 1 to Annex 2 | See Annex 3      | Slide/<br>CD-ROM | ITE           |
| 4         | Eiffel tower         | Long shot of Eiffel tower and landscape of Paris behind it                            | Outdoor still                    | Resolution<br>Sensation of reality   | Still  | Slide  | See Attachment 1 to Annex 2 | See Annex 3      | Slide/<br>CD-ROM | ITE           |
| 5         | A hat shop           | Scene of a stall and a couple talking beside it                                       | Drama                            | Gray scale reproduction<br>Interlace artefacts                             | Still  | Slide  | See Attachment 1 to Annex 2 | See Annex 3      | Slide/<br>CD-ROM | ITE           |
| 6         | A couple in the snow | Loose contre-jour shot, of a couple facing each other in the snow                     | Contre-jour scene                | Gray scale reproduction<br>Uniformity<br>Large area flicker                | Still  | Slide  | See Attachment 1 to Annex 2 | See Annex 3      | Slide/<br>CD-ROM | ITE           |
| 7         | Guide board          | Full shot of a guide board written in various kinds of characters of different sizes  | Outdoor still                    | Waveform distortion<br>Registration legibility                             | Still  | Slide  | See Attachment 1 to Annex 2 | See Annex 3      | Slide/<br>CD-ROM | ITE           |
| 8         | Tulip garden         | Wide shot of a garden with red and yellow tulips of various sizes                     | Highly saturated colours         | Chrominance/luminance resolution<br>Colour reproduction                    | Still  | Slide  | See Attachment 1 to Annex 2 | See Annex 3      | Slide/<br>CD-ROM | ITE           |
| 9         | Chromakey            | A woman sitting against blue back with detailed flowers                               | Chromakey                        | Chromakey process<br>False contour   | Still  | Slide  | See Attachment 1 to Annex 2 | See Annex 3      | Slide/<br>CD-ROM | ITE           |

ITE: The Institute of Image Information and Television Engineers, 3-5-8 Shibakoen, Minato-ku, Tokyo 105-0011, Japan, Phone: +81 3 3432 4677, Fax: +81 3 3432 4675, E-mail: [ite@ite.or.jp](mailto:ite@ite.or.jp).  
(Distributor: NHK Engineering Service, Inc., 1-10-11 Kinuta, Setagaya-ku, Tokyo 157-8540 Japan, Phone: +81 3 5494 2400, Fax: +81 3 5494 2152, <http://www.nes.or.jp/en/index.html>)

TABLE 2

1 920×1 080/59.94/I, 4:4:4 and 4:2:2, 10-bit HDTV pictures (see Annex 1)

| Scene No. | Title                           | Content  | Representative of            | Attributes to be examined  | Camera motion          | Source | Copyright status | Delivery format                   | Provider name |
|-----------|---------------------------------|--|------------------------------|--|------------------------|--------|------------------|-----------------------------------|---------------|
| 101       | Ginkgo trees                    | Loose shot of roadside trees and tight shot of green leaves            | Outdoor shooting<br>dissolve | Digital coding<br>Motion reproduction<br>Resolution                                    | Dolly in/<br>dolly out | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 102       | Truck train                     | Pan shot of a passing colourful truck train                            | Outdoor shooting             | Standard conversion<br>Motion reproduction<br>Colour reproduction<br>Texture           | Pan                    | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 103       | Cosmos flowers                  | Pan up shot of waving flowers and pan shot of a strolling woman        | Outdoor shooting             | Colour reproduction<br>Digital coding<br>Resolution                                    | Pan up/Pan             | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 104       | Red leaves (pan up)             | Pan up shot from a strolling woman to red leaves under collared leaves | Outdoor shooting             | Colour reproduction<br>Digital coding<br>Resolution                                    | Pan up                 | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 105       | Sunlight through leaves         | Pan down shot from sunlight through red leaves to a Japanese garden    | Outdoor shooting<br>Subtitle | Colour reproduction<br>Digital coding<br>Motion reproduction<br>Resolution<br>Contrast | Pan down               | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 106       | Red leaves (pan down)           | Pan down shot from red leaves to a strolling woman                     | Outdoor shooting             | Colour reproduction<br>Digital coding<br>Resolution                                    | Pan down               | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 107       | Woman at harbour (circle dolly) | Circle dolly shot of a woman at a harbour                              | Outdoor shooting<br>Subtitle | Motion reproduction<br>Skin colour   | Circle dolly           | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 108       | Fountain (follow)               | Follow shot of a strolling woman at a fountain                         | Outdoor shooting             | Digital coding<br>Motion reproduction<br>Skin colour                                   | Follow                 | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 109       | Fountain (dolly)                | Dolly shot of a strolling woman at a fountain                          | Outdoor shooting<br>Subtitle | Digital coding<br>Motion reproduction  | Dolly                  | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 110       | Studio concert (confetti)       | Dolly shot of a music concert under varying lighting in confetti       | Music                        | Digital coding<br>Resolution<br>Gray scale reproduction<br>Colour reproduction         | Dolly                  | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |

TABLE 2 (continued)

| Scene No. | Title                                  | Content   | Representative of            | Attributes to be examined  | Camera motion       | Source | Copyright status | Delivery format                   | Provider name |
|-----------|--|---|------------------------------|--|---------------------|--------|------------------|-----------------------------------|---------------|
| 111       | Studio concert                         | Dolly shots of a series of performers at a music concert under varying lighting | Music                        | Digital coding<br>Gray scale reproduction<br>Colour reproduction     | Dolly               | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 112       | Drama set (day)                        | Dolly and tight shots of a woman entering and leaving a Japanese living room    | Drama                        | Standards conversion<br>Resolution<br>Colour reproduction<br>Texture | Dolly/follow        | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 113       | Drama set (night)                      | Follow shot of a woman passing in front of a Japanese lantern at night          | Drama                        | Contrast<br>Texture<br>Noise reduction                               | Follow              | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 114       | Basketball                             | Long shot of a basketball game with spectators (1/100 s shutter)                | Sports<br>Subtitle           | Standards conversion<br>Digital coding<br>Motion reproduction        | Pan                 | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 115       | Evening scene (zoom out)               | Zoom out shot from a Ferris wheel in the evening                                | Outdoor shooting             | Standards conversion<br>Resolution<br>Gray scale reproduction        | Zoom out            | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 116       | Evening scene (fixed)                  | A Ferris wheel and high-rise buildings in the evening                           | Outdoor shooting<br>Subtitle | Gray scale reproduction<br>Motion reproduction                       | Fixed               | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 117       | Night scene (fixed)                    | A Ferris wheel and high-rise buildings at night                                 | Outdoor shooting<br>Subtitle | Gray scale reproduction<br>Contrast<br>Noise reduction               | Fixed               | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 118       | Horse racing (dirt)                    | Long and tight shots of racehorses on a dirt course.                            | Outdoor shooting             | Digital coding<br>Motion reproduction                                | Pan                 | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 119       | Horse racing (turf)                    | Long shot of racehorses on a grass course                                       | Outdoor shooting             | Digital coding<br>Motion reproduction                                | Pan                 | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 120       | Woman at harbour (dolly in, zoom back) | Dolly in, zoom back shot of a woman at a harbour                                | Outdoor shooting             | Skin colour<br>Texture   | Dolly in, zoom back | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 121       | Torch bearer                           | Follow shot of torchbearers running at a track corner                           | Outdoor shooting             | Digital coding<br>Standards conversion<br>Resolution                 | Follow              | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 122       | Children's dance                       | Tight shot of children dancing on the grass of an athletic field                | Outdoor shooting             | Digital coding<br>Resolution<br>Texture                              | Pan                 | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |

TABLE 2 (continued)

| Scene No. | Title                                      | Content  | Representative of | Attributes to be examined   | Camera motion | Source | Copyright status | Delivery format                   | Provider name |
|-----------|--|--|-------------------|---|---------------|--------|------------------|-----------------------------------|---------------|
| 123       | Children's dance (loose shot)              | Loose shot of children dancing on the grass                        | Sports            | Digital coding<br>Resolution<br>Texture   | Pan           | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 124       | March                                      | Pan up from athletes to the audience                               | Sports            | Digital coding<br>Resolution  | Pan up        | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 125       | Marathon (pan up)                          | Pan up shot of crowds of marathon runners                          | Sports            | Digital coding<br>Resolution  | Pan up        | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 126       | Marathon (fixed)                           | Tight shot of crowds of marathon runners                           | Sports            | Digital coding<br>Resolution  | Fixed         | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 151       | Rotating disk 59.94/I                      | A rotating disk with still pictures at 59.94/I                     | Studio production | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution<br>Legibility | Fixed         | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 152       | Rotating disk 59.94/I with 1/120 s shutter | A rotating disk with still pictures at 59.94/I (1/120 s shutter)   | Studio production | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution<br>Legibility | Fixed         | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 153*      | Rotating disk 50/I                         | A rotating disk with still pictures at 50/I (normal shutter speed) | Studio production | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution<br>Legibility | Fixed         | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 154*      | Rotating disk 50/I with 1/100 s shutter    | A rotating disk with still pictures at 50/I (1/100 s shutter)      | Studio production | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution<br>Legibility | Fixed         | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 155       | Pendulum 59.94/I                           | Pendulum (normal shutter speed)                                    | Studio production | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution               | Fixed         | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |



TABLE 2 (continued)

| Scene No. | Title                                 | Content  | Representative of                     | Attributes to be examined  | Camera motion     | Source | Copyright status | Delivery format                   | Provider name |
|-----------|---------------------------------------|--|---------------------------------------|--|-------------------|--------|------------------|-----------------------------------|---------------|
| 156       | Pendulum 59.94/I with 1/120 s shutter | Pendulum (1/120 s shutter)   | Studio production                     | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution  | Fixed             | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 157*      | Pendulum 50/I                         | Pendulum shot at 50/I (normal shutter speed)                             | Studio production                     | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution  | Fixed             | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 158*      | Pendulum 50/I with 1/100 s shutter    | Pendulum shot at 50/I (1/100 s shutter)                                  | Studio production                     | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution  | Fixed             | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 159       | Colourful world A                     | Toy train passing through colourful objects                              | Studio production                     | Digital coding<br>Texture<br>Resolution<br>Legibility<br>Colour reproduction | Pan, fixed        | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 160       | Colourful world B                     | Pan shots of colourful objects.  | Studio production                     | Digital coding<br>Texture<br>Resolution<br>Colour reproduction               | Pan               | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 161       | Black dress                           | A woman dressed in black walks in front of a white wall and a black wall | Studio production                     | Gray scale reproduction<br>Contrast<br>Skin colour                           | Pan follow, fixed | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 162       | White dress                           | A woman dressed in white walks in front of a black wall and a white wall | Studio production                     | Gray scale reproduction<br>Contrast<br>Skin colour                           | Pan follow, fixed | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 163       | Woman with bouquet                    | Close shot of a woman with bouquet                                       | Studio production                     | Contrast<br>Skin colour  | Fixed             | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 164       | Flash photography                     | A woman under continuous flash lights                                    | Studio production                     | Digital coding<br>Standards conversion                                       | Fixed             | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 165       | Fountain (chromakey)                  | Mixing a woman and fountains by chromakey                                | Studio production<br>Outdoor shooting | Digital coding<br>Motion reproduction<br>Skin colour                         | Fixed             | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |

TABLE 2 (*end*)

| Scene No. | Title                            | Content  | Representative of | Attributes to be examined                     | Camera motion | Source | Copyright status | Delivery format                   | Provider name |
|-----------|----------------------------------|--|-------------------|---|---------------|--------|------------------|-----------------------------------|---------------|
| 166       | Night port (camera gain: normal) | Zoom out from a night port (normal camera gain)  | Outdoor shooting  | Digital coding<br>Contrast<br>Noise reduction | Zoom out      | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 167       | Night port (camera gain: +6 dB)  | Zoom out from a night port (camera gain: +6 dB)  | Outdoor shooting  | Digital coding<br>Contrast<br>Noise reduction | Zoom out      | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 168       | Night port (camera gain: +12 dB) | Zoom out from a night port (camera gain: +12 dB) | Outdoor shooting  | Digital coding<br>Contrast<br>Noise reduction | Zoom out      | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |
| 169       | Glasses                          | Pouring drinks into glasses                      | Studio production | Colour reproduction                           | Pan/fixed     | Camera | See Annex 3      | Consecutively numbered TIFF files | ITE           |

\* The field frequency is 50 Hz.

TABLE 3

1 920×1 080/59.94/P, 4:2:2, 10-bit HDTV pictures (see Annex 1)

| Scene No. | Title                           | Content  | Representative of            | Attributes to be examined  | Camera motion          | Source | Copyright status | Delivery format                  | Provider name |
|-----------|---------------------------------|--|------------------------------|--|------------------------|--------|------------------|----------------------------------|---------------|
| 201       | Ginkgo trees                    | Loose shot of roadside trees and tight shot of green leaves            | Outdoor shooting<br>Dissolve | Digital coding<br>Motion reproduction<br>Resolution                                    | Dolly in/<br>dolly out | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 202       | Truck train                     | Pan shot of a passing colourful truck train                            | Outdoor shooting             | Standard conversion<br>Motion reproduction<br>Colour reproduction<br>Texture           | Pan                    | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 203       | Cosmos flowers                  | Pan up shot of waving flowers and pan shot of a strolling woman        | Outdoor shooting             | Colour reproduction<br>Digital coding<br>Resolution                                    | Pan up/pan             | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 204       | Red leaves (pan up)             | Pan up shot from a strolling woman to red leaves under collared leaves | Outdoor shooting             | Colour reproduction<br>Digital coding<br>Resolution                                    | Pan up                 | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 205       | Sunlight through leaves         | Pan down shot from sunlight through red leaves to a Japanese garden    | Outdoor shooting<br>Subtitle | Colour reproduction<br>Digital coding<br>Motion reproduction<br>Resolution<br>Contrast | Pan down               | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 206       | Red leaves (pan down)           | Pan down shot from red leaves to a strolling woman                     | Outdoor shooting             | Colour reproduction<br>Digital coding<br>Resolution                                    | Pan down               | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 207       | Woman at harbour (circle dolly) | Circle dolly shot of a woman at a harbour                              | Outdoor shooting<br>Subtitle | Motion reproduction<br>Skin colour   | Circle dolly           | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 208       | Fountain (follow)               | Follow shot of a strolling woman at a fountain                         | Outdoor shooting             | Digital coding<br>Motion reproduction<br>Skin colour                                   | Follow                 | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 209       | Fountain (dolly)                | Dolly shot of a strolling woman at a fountain,                         | Outdoor shooting<br>Subtitle | Digital coding<br>Motion reproduction  | Dolly                  | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 210       | Studio concert (confetti)       | Dolly shot of a music concert under varying lighting in confetti       | Music                        | Digital coding<br>Resolution<br>Gray scale reproduction<br>Colour reproduction         | Dolly                  | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |

TABLE 3 (continued)

| Scene No. | Title                                      | Content   | Representative of            | Attributes to be examined   | Camera motion | Source | Copyright status | Delivery format                  | Provider name |
|-----------|--|---|------------------------------|---|---------------|--------|------------------|----------------------------------|---------------|
| 211       | Studio concert                             | Dolly shots of a series of performers at a music concert under varying lighting | Music                        | Digital coding<br>Gray scale reproduction<br>Colour reproduction                          | Dolly         | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 212       | Drama set (day)                            | Dolly and tight shots of a woman entering and leaving a Japanese living room    | Drama                        | Standards conversion<br>Resolution<br>Colour reproduction<br>Texture                      | Dolly/follow  | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 213       | Drama set (night)                          | Follow shot of a woman passing in front of a Japanese lantern at night          | Drama                        | Contrast<br>Texture<br>Noise Reduction  | Follow        | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 214       | Basketball                                 | Long shot of a basketball game with spectators (1/100 s shutter)                | Sports<br>Subtitle           | Standards conversion<br>Digital coding<br>Motion reproduction                             | Pan           | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 215       | Twilight scene (zoom out)                  | Zoom out shot from a Ferris wheel in the evening                                | Outdoor shooting             | Standards conversion<br>Resolution<br>Gray scale reproduction                             | Zoom out      | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 216       | Twilight scene (fixed)                     | A Ferris wheel and high-rise buildings in the evening                           | Outdoor shooting<br>Subtitle | Gray scale reproduction<br>Motion reproduction  | Fixed         | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 217       | Night scene (fixed)                        | A Ferris wheel and high-rise buildings at night                                 | Outdoor shooting<br>Subtitle | Gray scale reproduction<br>Contrast<br>Noise reduction                                    | Fixed         | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 218       | Horse racing (dirt)                        | Long and tight shots of racehorses on a dirt course.                            | Outdoor shooting             | Digital coding<br>Motion reproduction   | Pan           | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 251       | Rotating disk 59.94/P                      | A rotating disk attached with still pictures (normal shutter speed)             | Studio production            | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution<br>Legibility | Fixed         | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 252       | Rotating disk 59.94/P with 1/120 s shutter | A rotating disk attached with still pictures (1/120 s shutter)                  | Studio production            | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution<br>Legibility | Fixed         | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |

TABLE 3 (continued)

| Scene No. | Title                                  | Content  | Representative of | Attributes to be examined   | Camera motion     | Source | Copyright status | Delivery format                  | Provider name |
|-----------|--|--|-------------------|---|-------------------|--------|------------------|----------------------------------|---------------|
| 253*      | Rotating disk 24/P                     | A rotating disk attached with still pictures shot at 24/P (normal shutter speed) | Studio production | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution<br>Legibility | Fixed             | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 254*      | Rotating disk 24/P with 1/48 s shutter | A rotating disk attached with still pictures shot at 24/P (1/48 s shutter)       | Studio production | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution<br>Legibility | Fixed             | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 255       | Pendulum 59.94/P                       | Pendulum (normal shutter speed)  | Studio production | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution               | Fixed             | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 256       | Pendulum 59.94/P with 1/120 s shutter  | Pendulum (1/120 s shutter)   | Studio production | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution               | Fixed             | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 257*      | Pendulum 24/P                          | Pendulum shot at 24/P (normal shutter speed)                                     | Studio production | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution               | Fixed             | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 258*      | Pendulum 24/P with 1/48 s shutter      | Pendulum shot at 24/P (1/48 s shutter)   | Studio production | Digital coding<br>Standards conversion<br>Motion reproduction<br>Resolution               | Fixed             | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 259       | Colourful world A                      | Toy train passing through colourful objects                                      | Studio production | Digital coding<br>Texture<br>Resolution<br>Legibility<br>Colour reproduction              | Pan, fixed        | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 260       | Colourful world B                      | Pan shots of colourful objects   | Studio production | Digital coding<br>Texture<br>Resolution<br>Colour reproduction                            | Pan               | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 261       | Black dress                            | A woman dressed in black walks in front of a white wall and a black wall         | Studio production | Gray scale reproduction<br>Contrast<br>Skin colour  | Pan follow, fixed | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |

TABLE 3 (end)

| Scene No. | Title                | Content  | Representative of                     | Attributes to be examined                            | Camera motion     | Source | Copyright status | Delivery format                  | Provider name |
|-----------|----------------------|--|---------------------------------------|--|-------------------|--------|------------------|----------------------------------|---------------|
| 262       | White dress          | A woman dressed in white walks in front of a black wall and a white wall | Studio production                     | Gray scale reproduction<br>Contrast<br>Skin colour   | Pan follow, fixed | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 263       | Woman with bouquet   | Close shot of a woman with bouquet                                       | Studio production                     | Contrast<br>Skin colour                              | Fixed             | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 264       | Flash photography    | A woman under continuous flash lights                                    | Studio production                     | Digital coding<br>Standards conversion               | Fixed             | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |
| 265       | Fountain (chromakey) | Mixing a woman and fountains by chromakey                                | Studio production<br>Outdoor shooting | Digital coding<br>Motion reproduction<br>Skin colour | Fixed             | Camera | See Annex 3      | Consecutively numbered YUV files | ITE           |

\* The frame frequency is 24 Hz.

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TABLE 4

1 920 × 1 080/50/I, 4:2:2, 10-bit HDTV pictures (see Annex 1)

| Scene No. | Title                | Content  | Representative of | Attributes to be examined                           | Camera motion       | Source  | Copyright status | Delivery format                   | Provider name |
|-----------|----------------------|--|-------------------|---|---------------------|---------|------------------|-----------------------------------|---------------|
| 301       | Harvest wheat fields | Spacious wheat fields  | Outdoor shooting  | Resolution<br>Digital coding                        | Pan                 | Camera1 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 302       | Crossroad            | Shopping street with crowded people and transformations                | Outdoor shooting  | Motion reproduction                                 | Pan follow<br>Fixed | Camera1 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 303       | Basketball game      | Basketball game  | Sports            | Motion reproduction<br>Digital coding               | Fixed<br>Pan        | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 304       | Beijing opera        | Beijing opera actresses and actors in costume with bright rich colours | Drama             | Digital coding<br>Resolution<br>Colour reproduction | Fixed               | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 305       | Bicycle race         | The starting and one thrust of the bicycle race                        | Sports            | Digital coding<br>Motion reproduction               | Fixed<br>Pan follow | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 306       | Equestrianism        | Scene of the equestrianism   | Sports            | Digital coding<br>Motion reproduction               | Fixed<br>Pan follow | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 307       | Football game        | Scene of a football game   | Sports            | Digital coding<br>Motion reproduction               | Fixed<br>Pan follow | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 308       | Swimming             | Scene of a swimming game   | Sports            | Digital coding<br>Motion reproduction               | Fixed<br>Pan follow | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 309       | Water polo game      | Scene of a water polo game   | Sports            | Digital coding<br>Motion reproduction               | Fixed<br>Pan follow | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |

TABLE 4 (continued)

| Scene No. | Title                              | Content   | Representative of | Attributes to be examined                                    | Camera motion    | Source   | Copyright status | Delivery format                   | Provider name |
|-----------|------------------------------------|---|-------------------|--|------------------|----------|------------------|-----------------------------------|---------------|
| 310       | Synchronized swimming              | Scene of a synchronized swimming game   | Sports            | Digital coding<br>Motion reproduction                        | Fixed<br>Zoom in | Camera2  | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 311       | Folk dance                         | Scene of dancing and singing actresses with fresh colourful dresses             | Studio            | Digital coding<br>Motion reproduction                        | Fixed            | Camera2  | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 312       | Scrolling characters               | Scrolling to top characters and dancing   | Studio production | Digital coding<br>Motion reproduction<br>Resolution          | Fixed            | Camera2  | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 313       | Scrolling characters               | Scrolling to left characters and dancing  | Studio production | Digital coding<br>Motion reproduction<br>Resolution          | Fixed            | Camera2  | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 314       | The silk dancing team              | Parade of people dancing with ribbon belts in square matrix.                    | Outdoor shooting  | Digital coding<br>Motion reproduction<br>Colour reproduction | Fixed<br>Pan     | Camera2  | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 315       | Northwest Waist drum dancing teams | Yangko dance and waist drum in parade   | Outdoor shooting  | Digital coding<br>Motion reproduction<br>Colour reproduction | Fixed<br>Pan     | Camera2  | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 316       | Fireworks                          | Fireworks and cheering and dancing people celebrating national day during night | Outdoor shooting  | Digital coding   | Fixed            | Camera2  | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 317       | Effects                            | Film clips of a drama party   | Effects           | Digital coding<br>Colour reproduction                        | --               | Computer | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 318       | 3d animations                      | Animations  | Animations        | Digital coding<br>colour reproduction                        | --               | Computer | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |



TABLE 4 (continued)

| Scene No. | Title                | Content   | Representative of | Attributes to be examined                           | Camera motion            | Source  | Copyright status | Delivery format                   | Provider name |
|-----------|----------------------|---|-------------------|---|--------------------------|---------|------------------|-----------------------------------|---------------|
| 351       | Skin colour of lady1 | A lady with flowers and fruits  | Studio            | Skin colour<br>Colour reproduction<br>Texture       | Fixed                    | Camera1 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 352       | Chromakey (portrait) | A half-length lady portrait in front, with colourful fruits and glass container on the right side. The background is with standard blue colour.       | Studio            | Chromakey<br>Colour reproduction                    | Fixed                    | Camera1 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 353       | Chromakey (scene)1   | On a table with its cloth, there are glass vase, glass fishbowl, colourful wool ball and smog. Above all these, there is a dangling rolling birdcage. | Studio            | Chromakey   | Zoom in                  | Camera1 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 354       | Rotating birdcage1   | The background is standard blue colour. There is a plush toy bird in the rolling birdcage.  | Studio            | Chromakey<br>Motion reproduction                    | Zoom out                 | Camera1 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 355       | Nine-dragon screen   | A relief screen with nine-dragon in traditional china style   | Outdoor shooting  | Resolution  | Pan                      | Camera1 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 356       | Flower garden        | A tour bus travelling in the garden with detailed rich colours  | Outdoor shooting  | Digital coding<br>Resolution<br>Colour reproduction | Pan follow<br>Fixed      | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 357       | Field of flowers     | Brightening red flowers and golden flowers on the up and down hills   | Outdoor shooting  | Resolution<br>Colour reproduction                   | Pan                      | Camera1 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 358       | Amusement park       | People whirling up and down in the amusement park--- typical scene of this spot   | Outdoor shooting  | Digital coding<br>Motion reproduction               | Fixed<br>Zoom in and out | Camera1 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |

TABLE 4 (continued)

| Scene No. | Title  | Content  | Representative of                | Attributes to be examined                   | Camera motion   | Source  | Copyright status | Delivery format                   | Provider name |
|-----------|--|--|----------------------------------|---|-----------------|---------|------------------|-----------------------------------|---------------|
| 359       | City plaza                                   | Actresses wearing dresses with stripe walking in the city plaza with crisscross style  | Outdoor shooting                 | Resolution<br>Standards conversion          | Pan follow      | Camera1 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 360       | Skiing                                       | Sportsmen with bright-coloured ski suit in the ski field   | Sports                           | Motion reproduction<br>Luminance level      | Pan follow      | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 361       | Hebei bangzi                                 | Performance of opera of china  | Studio production                | Colour reproduction                         | Pan follow      | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 362       | Hebei Bangzi with noises<br>( $S/N = 65$ dB) | Adding noise of $S/N = 65$ dB to the above scene   | Noise, signal<br>Processing      | Performance of digital signal<br>Processing | Pan follow      | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 363       | Hebei Bangzi with noises<br>( $S/N = 53$ dB) | Adding noise of $S/N = 53$ dB to the above scene   | Noise, signal<br>Processing      | Performance of digital signal<br>Processing | Pan follow      | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 364       | Hebei Bangzi with noises<br>( $S/N = 45$ dB) | Adding noise of $S/N = 45$ dB to the above scene   | Noise, signal<br>Processing      | Performance of digital signal<br>Processing | Pan follow      | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 365       | Textiles and Household articles              | Textiles of cotton, linen and wool; product of leather, glass, plastic and wood.   | Studio still<br>Textured objects | Texture reproduction                        | Still           | Camera2 | See Annex 3      | TIFF file                         | CCTV&A<br>BP  |
| 366       | Food and containers                          | Vegetables, fruits, bread, porcelain, metalwork, etc.  | Studio still                     | Texture reproduction                        | Still           | Camera2 | See Annex 3      | TIFF file                         | CCTV&A<br>BP  |
| 367       | Rotating birdcage2                           | The background is with standard blue colour. There is a plush toy bird and two porcelain containers in the rolling birdcage. | Studio                           | Chromakey<br>Motion reproduction            | Zoom in and out | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |

TABLE 4 (continued)

| Scene No. | Title                            | Content  | Representative of | Attributes to be examined         | Camera motion | Source  | Copyright status | Delivery format                   | Provider name |
|-----------|----------------------------------|--|-------------------|-----------------------------------|---------------|---------|------------------|-----------------------------------|---------------|
| 368       | Flowerbed                        | Flowers on the stairs  | Outdoor shooting  | Colour resolution                 | Pan slow      | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A BP     |
| 369       | Rotating disc (speed 1)          | A rotating disk attached with still pictures   | Circle motion     | Motion reproduction<br>Resolution | Fixed         | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A BP     |
| 370       | Rotating disc (speed 2)          | Idem. Increased speed  | Circle motion     | Motion reproduction<br>Resolution | Fixed         | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A BP     |
| 371       | Rotating disc (speed 3)          | Idem. Increased speed  | Circle motion     | Motion reproduction<br>Resolution | Fixed         | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A BP     |
| 372       | Dialogue in a Studio             | A scene of a woman with a scarf of slender stripe and a male host with thin check suit in the studio. The background is rich in colour and detail. | Studio            | Resolution<br>Digital coding      | Zoom in       | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A BP     |
| 373       | Beijing Opera actress and Noises | Entropy of the picture changes with the varying noises   | Studio production | Digital coding                    | Zoom in       | Camera2 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A BP     |
| 374       | Autumn leaves                    | Yellow leaves playing in fall wind   | Outdoor shooting  | Motion reproduction               | Fixed         | Camera3 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A BP     |
| 375       | Roses                            | Roses of various colours under small and tiny water mist   | Studio            | Digital coding                    | Fixed         | Camera4 | See Annex 3      | Consecutively numbered TIFF files | CCTV&A BP     |

TABLE 4 (end)

| Scene No. | Title                | Content   | Representative of | Attributes to be examined         | Camera motion | Source   | Copyright status | Delivery format                   | Provider name |
|-----------|----------------------|---|-------------------|-----------------------------------|---------------|----------|------------------|-----------------------------------|---------------|
| 376       | Skin colour of lady2 | Lady portrait in half-length, emphasizing face skin. There are fresh flowers on the right side. | Studio            | Resolution<br>Colour reproduction | Fixed         | Camera4  | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 377       | Horizontal title     | Horizontal crawling characters  | Studio production | Resolution                        | --            | Computer | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 378       | Vertical title       | Vertical crawling characters  | Studio production | Resolution                        | --            | Computer | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |
| 379       | Flying title         | Flying characters   | Studio production | Resolution                        | --            | Computer | See Annex 3      | Consecutively numbered TIFF files | CCTV&A<br>BP  |

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## 2 Test materials of ultra-high definition television (UHDTV), HDR-TV and high definition television (HDTV)

TABLE 5  
7 680 × 4 320 (8k), 3 840 × 2 160 (4K), 1 920 × 1 080 (2K) still pictures

| Scene No. | Title        | Content   | Camera motion | Source | Attributes to be examined   | Copyright status | Delivery format                     | Provider name |
|-----------|--------------|---|---------------|--------|-----------------------------|------------------|-------------------------------------|---------------|
| 1         | Books        | Many books on bookshelves                                 | Still         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Raw file (8K, 4K)<br>Tiff file (2K) | ITE           |
| 2         | MusicBox     | Antique music boxes                                       | Still         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Raw file (8K, 4K)<br>Tiff file (2K) | ITE           |
| 3         | Moss         | Japanese moss garden                                      | Still         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Raw file (8K, 4K)<br>Tiff file (2K) | ITE           |
| 4         | Kimono       | Japanese traditional garment                              | Still         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Raw file (8K, 4K)<br>Tiff file (2K) | ITE           |
| 5         | StainedGlass | Hand painted stained glass                                | Still         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Raw file (8K, 4K)<br>Tiff file (2K) | ITE           |
| 6         | Butterflies  | Colourful butterflies                                     | Still         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Raw file (8K, 4K)<br>Tiff file (2K) | ITE           |
| 7         | ChromaKey    | A doll, a model ship, and small flowers against blue back | Still         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Raw file (8K, 4K)<br>Tiff file (2K) | ITE           |
| 8         | Sea          | Emerald green sea   | Still         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Raw file (8K, 4K)<br>Tiff file (2K) | ITE           |
| 9         | Flowers      | Colourful real flowers                                    | Still         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Raw file (8K, 4K)<br>Tiff file (2K) | ITE           |
| 10        | Ship         | Sailing vessel  | Still         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Raw file (8K, 4K)<br>Tiff file (2K) | ITE           |

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TABLE 6

3840 × 2160/50/P, 4:4:4, 16-bit UHDTV pictures

(These materials can be used for HDR-TV test. The necessary information can be found in Annex 1 Tables 18 to 20)

| Scene No. | Title                                  | Content  | Camera motion | Source | Attributes to be examined   | Copyright status | Delivery format | Provider name |
|-----------|--|--|---------------|--------|-----------------------------|------------------|-----------------|---------------|
| 1         | The scene outside of the steel factory | A worker wearing high saturation colour work clothes looks outside the steel factory.                            | Fixed         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Tiff files (4K) | CCTV&ABP      |
| 2         | The scene inside of the steel factory  | Steel factory view and a worker wearing high saturation colour work clothes.                                     | Pan slow      | Camera | See Attachment 2 to Annex 1 | Annex 3          | Tiff files (4K) | CCTV&ABP      |
| 3         | Still object                           | On a table with its cloth, there are glass vase, metal work and chinaware. There is a shelves back of the table. | Fixed         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Tiff files (4K) | CCTV&ABP      |
| 4         | Coffee shop                            | A girl reading in the coffee shop  | Fixed         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Tiff files (4K) | CCTV&ABP      |
| 5         | Street of the town in the night        | Several children with lantern play in the street of the town   | Fixed         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Tiff files (4K) | CCTV&ABP      |
| 6         | Colourful lantern                      | Some colourful lanterns in the night   | Fixed         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Tiff files (4K) | CCTV&ABP      |
| 7         | Moth orchid                            | Bright-coloured Moth orchid  | Fixed         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Tiff files (4K) | CCTV&ABP      |
| 8         | Fresh flowers                          | Colourful fresh flowers  | Fixed         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Tiff files (4K) | CCTV&ABP      |
| 9         | Dance                                  | Several dancers dance on the stage   | Fixed         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Tiff files (4K) | CCTV&ABP      |
| 10        | Bamboo                                 | Bamboo wavering in the sky   | Zoom          | Camera | See Attachment 2 to Annex 1 | Annex 3          | Tiff files (4K) | CCTV&ABP      |
| 11        | Girls dance by the river side          | Girls dance by the river side  | Fixed         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Tiff files (4K) | CCTV&ABP      |
| 12        | Skin colour                            | A girl in national costume   | Fixed         | Camera | See Attachment 2 to Annex 1 | Annex 3          | Tiff files (4K) | CCTV&ABP      |
| 13        | A sightseeing boat in the night        | A sightseeing boat in the Huangpu River at night   | Pan slow      | Camera | See Attachment 2 to Annex 1 | Annex 3          | Tiff files (4K) | CCTV&ABP      |

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## Annex 1

### Supplementary information on test materials

#### 1 HDTV test materials for the 1 920×1 080/59.94/I, 4:4:4 and 4:2:2, 10-bit and 1 920×1 080/59.94/P, 4:2:2, 10-bit formats listed in Tables 1-2 and 1-3

##### 1.1 Image characteristics

Table 7 summarizes the characteristics of the new test materials. The materials are categorized into three series. “Materials A” are 1 920×1 080/59.94/I, 4:4:4, 10-bit format including four sequences at 50/I. “Materials B” are 1 920×1 080/59.94/P, 4:2:2, 10-bit format including four sequences at 24/P. “Materials C” are 1 920×1 080/59.94/I, 4:2:2, 10-bit down-sampled format from “Materials A”.

The materials for each series contain two types of scenes according to the purpose of usage for evaluation, i.e. “attribute-general” or “attribute-specific”. “Attribute-general” materials are similar to typical broadcast programme content, and “attribute-specific” materials are for specific evaluations.

TABLE 7

**Image characteristics**

| Series              | Materials A                           | Materials B                           | Materials C                           |
|---------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| Video standard      | Part 2 of Rec. ITU-R BT.709           |                                       |                                       |
| Number of pixels    | 1 920×1 080                           |                                       |                                       |
| Bit depth           | 10-bit                                |                                       |                                       |
| Signal format       | RGB                                   | Y <sub>C</sub> B <sub>C</sub> R       | Y <sub>C</sub> B <sub>C</sub> R       |
| Colour sampling     | 4:4:4                                 | 4:2:2 <sup>(3)</sup>                  | 4:2:2 <sup>(1)</sup>                  |
| Scanning            | Interlace                             | Progressive                           | Interlace                             |
| Frame rate          | 29.97 Hz (59.94/I) <sup>(2)</sup>     | 59.94 Hz (59.94/P) <sup>(3)</sup>     | 29.97 Hz (59.94/I) <sup>(4)</sup>     |
| File format         | Consecutively numbered<br>TIFF files  | Consecutively numbered<br>YUV files   | Consecutively numbered<br>TIFF files  |
| Duration            | Title (1 s) + Test<br>Sequence (15 s) | Title (1 s) + Test<br>Sequence (15 s) | Title (1 s) + Test<br>Sequence (15 s) |
| Number of files     | 480 (400 for 50/I)                    | 960 (384 for 24/P)                    | 480 (400 for 50/I)                    |
| Number of sequences | 45                                    |                                       | 45                                    |
|                     | General: 26                           | Specific: 19                          | General: 26   Specific: 19            |
| List of sequences   | Table 2                               |                                       | Table 2                               |

<sup>(1)</sup> Down-sampled from Materials A.

<sup>(2)</sup> Including four sequences at 50/I, 4:4:4.

<sup>(3)</sup> Including four sequences at 24/P, 4:4:4.

<sup>(4)</sup> Including four sequences at 50/I, 4:2:2.

## 1.2 Production conditions

### 1.2.1 Equipment used for test materials

Table 8 lists the equipment used for shooting and recording test materials.

TABLE 8  
Equipment used for shooting and recording

|                 |   |
|-----------------|---|
| <b>Camera</b>   | HDTV camera (HDC-1500, Sony), see Table 9                         |
| <b>Lens</b>     | Cinema lens (Canon or Fujinon)                                    |
| <b>Recorder</b> | Uncompressed HDTV hard disk recorder (HR-7401, ASTRODESIGN, Inc.) |

TABLE 9  
Camera specifications

|                                   |  |
|-----------------------------------|--|
| <b>Pickup device</b>              | Three 2/3-inch type 2.2-megapixel HD progressive CCD                                     |
| <b>Effective picture elements</b> | 1 920 (H) × 1 080 (V)  |
| <b>Built-in filters</b>           | ND: clear, 1/4 ND, 1/8 ND, 1/16 ND, 1/64 ND<br>CC: cross, 3 200K, 4 300K, 6 300K, 8 000K |
| <b>Sensitivity</b>                | F10 at 2 000 lx (3 200K, 89.9% reflectance)  |
| <b>Signal-to-noise ratio</b>      | 54 dB (Typical)  |
| <b>Horizontal resolution</b>      | 1 000 TV lines   |
| <b>Registration</b>               | Within 0.02% (all zones, without lens)   |

### 1.2.2 Scrolling subtitle

Sequences indicating “Subtitles” in the column “Representative of” in Table 3 contain superimposed scrolling-subtitles. The speed of scrolling is 300 pixels/s vertically and 600 pixels/s horizontally.

## 1.3 Status for use of test materials

Usage restrictions fall under the category of “commercially restricted” as described in Annex 3.

## 2 HDTV test materials for the 1 920 × 1 080/50/I, 4:2:2, 10-bit formats listed in Tables 1 to 4

### 2.1 Image characteristics

Table 10 summarizes the characteristics of the new test materials. 1 920 × 1 080/50/I, 4:2:2, 10-bit format.

The materials for each series contain two types of scenes according to the purpose of usage for evaluation, i.e. “attribute-general” or “attribute-specific”. “Attribute-general” materials are similar to typical broadcast programme content, and “attribute-specific” materials are for specific evaluations.



TABLE 10

**Image characteristics**

|                     |                                   |             |
|---------------------|-----------------------------------|-------------|
| Video standard      | Recommendation ITU-R BT.709       |             |
| Number of pixels    | 1 920 × 1 080                     |             |
| Bit depth           | 10-bit                            |             |
| Signal format       | $Y C_B C_R$                       |             |
| Colour sampling     | 4:2:2                             |             |
| Scanning            | Interlace                         |             |
| Frame rate          | 25 Hz (50/I)                      |             |
| File format         | Consecutively numbered TIFF files |             |
| Duration            | Test sequence (10 s~48 s)         |             |
| Number of files     | 250~1 200                         |             |
| Number of sequences | 47                                |             |
|                     | General:19                        | Specific:28 |
| List of sequences   | Table 4                           |             |

**2.2 Production conditions****2.2.1 Equipment used for test materials**

Table 11 lists the equipment used for shooting and recording test materials.

TABLE 11

**Equipment used for shooting and recording**

|                 |   |
|-----------------|---|
| <b>Camera</b>   | HDTV camera1 (SRW-9000, Sony), see Table 12<br>HDTV camera2 (HDC-F950, Sony), see Table 13<br>HDTV camera3 (HDW-750P, Sony), see Table 14<br>HDTV camera4 (ARRI D21, RED ONE), see Table 15 |
| <b>Lens</b>     | Cinema lens (Canon or Fujinon)  |
| <b>Recorder</b> | Uncompressed HDTV hard disk recorder (JiuHeCheng, Inc.)   |

TABLE 12

**Camera1 specifications**

|                                   |  |
|-----------------------------------|--|
| <b>Pickup device</b>              | Three 2/3-inch type 2.2-megapixel HD progressive CCD                               |
| <b>Effective picture elements</b> | 1 920 (H) × 1 080 (V)  |
| <b>Built-in filters</b>           | ND: clear, 1/2ND, 1/4 ND, 1/16 ND, 1/64 ND<br>CC: cross, 3 200 K, 4 300 K, 6 300 K |
| <b>Sensitivity</b>                | —  |
| <b>S/N</b>                        | 55 dB (Typical)  |
| <b>Horizontal resolution</b>      | 1 000 TV lines   |
| <b>Registration</b>               | Within 0.02% (all zones, without lens)   |

TABLE 13

**Camera2 specifications**

|                                   |  |
|-----------------------------------|--|
| <b>Pickup device</b>              | Three 2/3-inch type 2.2-megapixel FIT CCD  |
| <b>Effective picture elements</b> | 1 920 (H) × 1 080 (V)  |
| <b>Built-in filters</b>           | ND: clear, 1/4 ND, 1/8 ND, 1/16 ND, 1/64 ND<br>CC: cross, 3 200 K, 4 300 K, 6 300 K, 8 000 K |
| <b>Sensitivity</b>                | F10 at 2 000 lx (3 200 K, 89.9% reflectance)   |
| <b>S/N</b>                        | 54 dB (Typical)  |
| <b>Horizontal resolution</b>      | 1 000 TV lines   |
| <b>Registration</b>               | Within 0.02% (all zones, without lens)   |

TABLE 14

**Camera3 specifications**

|                                   |   |
|-----------------------------------|---|
| <b>Pickup device</b>              | Three 2/3-inch type 2.2-megapixel FIT CCD                                   |
| <b>Effective picture elements</b> | 1 920 (H) × 1 080 (V)   |
| <b>Built-in filters</b>           | ND: clear, 1/4 ND, 1/16 ND, 1/64 ND<br>CC: cross, 3 200 K, 4 300 K, 6 300 K |
| <b>Sensitivity</b>                | F10 at 2 000 lx (3 200 K, 89.9% reflectance)                                |
| <b>S/N</b>                        | 54 dB (Typical)   |
| <b>Horizontal resolution</b>      | 1 000 TV lines  |
| <b>Registration</b>               | Within 0.02% (all zones, without lens)                                      |

TABLE 15

**Camera4 specifications**

|                                   |  |
|-----------------------------------|--|
| <b>Pickup device</b>              | Single Super 35 mm type 6.2-megapixel progressive CMOS |
| <b>Effective picture elements</b> | 1 920 (H) × 1 080 (V)                                  |
| <b>Sensitivity</b>                | ISO 100-500 base ISO 200                               |
| <b>Horizontal resolution</b>      | 1 440 TV lines   |

**2.3 Status for use of test materials**

Usage restrictions fall under the category of “commercially restricted” as described in Annex 3.

**3 UHDTV/HDTV test materials listed in Table 5**

The test materials are provided in three formats: UHDTV formats specified in Recommendation ITU-R BT.2020 with 7 680 × 4 320 pixels and 3 840 × 2 160 pixels and HDTV format specified in Recommendation ITU-R BT.709 with 1 920 × 1 080 pixels. The specifications of each format are listed in Table 16.

TABLE 16

**Format specifications**

| <b>Resolution</b>                     | <b>UHDTV<br/>(Rec. ITU-R BT.2020)</b> |                        | <b>HDTV<br/>(Rec. ITU-R BT.709)</b> |
|---------------------------------------|---------------------------------------|------------------------|-------------------------------------|
| Image size<br>(horizontal × vertical) | 7 680 × 4 320<br>pixel                | 3 840 × 2 160<br>pixel | 1 920 × 1 080 pixel                 |
| Aspect ratio                          | 16:9 (square pixel)                   |                        |                                     |
| Sampling ratio                        | RGB 4:4:4                             |                        |                                     |
| Bit depth                             | 12 bits for each colour signal        |                        | 10 bits for each colour<br>signal   |
| Quantization                          | Rec. ITU-R BT.2020                    |                        | Rec. ITU-R BT.709                   |
| System colourimetry                   | Rec. ITU-R BT.2020                    |                        | Rec. ITU-R BT.709                   |
| File format                           | 12 bit RAW                            |                        | 16 bit TIFF                         |

A digital single-lens reflex camera H4D-200MS from Hasselblad was used to shoot the test materials. Table 17 shows the specifications. The camera provides both single shot mode and multi shot mode. Single shot mode is a shooting mode which is used in standard single-sensor cameras with the Bayer type colour filter. The colour pixel information is obtained by interpolating process called demosaicing performed to the pixel values containing either R, G, or B information. Whereas a multi shot mode obtains the corresponding pixel values of every colour information of each pixel by shooting the image for 4 times accurately shifting the CCD sensor by one pixel on vertical and horizontal directions. Multi shot mode can obtain faithful colour information without any false colour, however, it is only applicable to still objects.

The camera native images were trimmed to 7 680 × 4 320 pixels and developed in the Recommendation ITU-R BT.2020 colour space by a raw converter software (Hasselblad Phocus ver. 8.1). The downscaling of the 3 840 × 2 160 and 1 920 × 1 080 images were also processed by the same converter software. The Rec. ITU-R BT.2020 RGB values of 1 920 × 1 080 images was transformed to the Rec. ITU-R BT.709 RGB values by a 3 × 3 matrix multiplication and then clipped to the range's extremes.

It should be noted that the 3 840 × 2 160 and 1 920 × 1 080 images were produced from oversampled images but the 7 680 × 4 320 images are constrained by the camera performance currently available. It is desirable that the 7 680 × 4 320 images are also produced from oversampled images in the future.

TABLE 17

**Camera specifications**

|                   | Hasselblad H4D-200MS           |
|-------------------|--------------------------------|
| Image sensor      | CCD (49.1 × 36.7 mm)           |
| Effective pixels  | 8 176 × 6 132 pixel            |
| Colour definition | 16 bits                        |
| Shooting mode     | Single shot, 4-shot and 6-shot |
| ISO speed range   | ISO 50, 100, 200, 400 and 800  |
| Shutter speed     | 128 seconds to 1/800 second    |

#### 4 UHDTV and HDR-TV test materials listed in Table 6

Table 18 summarizes the characteristics of the new test materials.  $3840 \times 2160/50/P$ , 4:4:4, 16-bit format.

The materials are produced from RAW files. The files are processed by PQ1000 curve and HLG curve.

TABLE 18

##### Format specifications

| Resolution                                   | UHDTV (Rec. ITU-R BT.2100)        |
|--|-----------------------------------|
| Image size<br>(horizontal $\times$ vertical) | 3 840 $\times$ 2 160 pixel        |
| Aspect ratio                                 | 16:9 (square pixel)               |
| Sampling ratio                               | RGB 4:4:4                         |
| Bit depth                                    | 16bits for each colour signal     |
| System colourimetry                          | Rec. ITU-R BT.2020                |
| File format                                  | Consecutively numbered TIFF files |
| EOTF / Peak Brightness                       | PQ/1000nit, HLG                   |

TABLE 19

##### Equipment used for shooting, recording and colour grading

|                       |  |
|-----------------------|--|
| Camera                | 4K Camera (PMW-F55, Sony), see Table 20                                  |
| Lens                  | Cinema lens (ARRI/ZEISS Master Prime)                                    |
| Recorder              | RAW Recorder Unit (AXS-R5, Sony)   |
| Picture Monitor       | Multi Waveform Monitor (BVM-X300,Sony)                                   |
| Waveform Monitor      | Multi Waveform Monitor (LV 5490, LEADER)                                 |
| Colour Grading System | Colour Grading System (DaVinci Resolve Studio V.12.5, Blackmagic Design) |

TABLE 20

##### Camera specifications

|                            |  |
|----------------------------|--|
| Pickup device              | Single Super 35mm type 8.9-megapixel progressive CMOS              |
| Effective picture elements | 4 096 (H) $\times$ 2 160 (V)                                       |
| Built-in filters           | ND: clear, 0.9(1/4 ND), 1.8 (1/64 ND)<br>CC: 3 200K, 4 300K, 5500K |
| Sensitivity                | ISO 320-5000,base1250  |
| Shutter speed              | 1/24 seconds to 1/6000 second                                      |

## Attachment 1 to Annex 1

### Thumbnails of the HDTV test materials

TABLE 21

**Test materials for HDTV 1920 × 1080/59.94/I, 4:4:4 and 4:2:2, 10-bit format  
(attribute-general)**









| Scene No. | Title                              | Thumbnail  |
|-----------|------------------------------------|--|
| 101       | Ginkgo trees                       |    |
| 102       | Truck train                        |    |
| 103       | Cosmos flowers                     |   |
| 104       | Red leaves (pan up)                |  |
| 105       | Sunlight through leaves            |  |
| 106       | Red leaves (pan down)              |  |
| 107       | Woman at harbour<br>(circle dolly) |  |
| 108       | Fountain (follow)                  |  |

TABLE 21 (continued)

| Scene No. | Title                     | Thumbnail  |
|-----------|---------------------------|--|
| 109       | Fountain (dolly)          |    |
| 110       | Studio concert (confetti) |    |
| 111       | Studio concert            |    |
| 112       | Drama set (day)           |    |
| 113       | Drama set (night)         |   |
| 114       | Basketball                |  |
| 115       | Evening scene (zoom out)  |  |
| 116       | Evening scene (fixed)     |  |
| 117       | Night scene (fixed)       |  |
| 118       | Horse racing (dirt)       |  |

TABLE 21 (end)








| Scene No. | Title                                     | Thumbnail  |
|-----------|---|--|
| 119       | Horse racing (turf)                       |    |
| 120       | Woman at harbour<br>(dolly in, zoom back) |    |
| 121       | Torch bearer                              |    |
| 122       | Children's dance                          |    |
| 123       | Children's dance<br>(loose shot)          |   |
| 124       | March                                     |  |
| 125       | Marathon (pan up)                         |  |
| 126       | Marathon (fixed)                          |  |

TABLE 22

Test materials for HDTV 1920 × 1080/59.94/I, 4:4:4 and 4:2:2, 10-bit format (attribute-specific)

| Scene No. | Title   | Thumbnail |
|-----------|---|-----------|
| 151       | Rotating disk 59.94/I                         |           |
| 152       | Rotating disk 59.94/I with 1/120 sec. shutter |           |
| 153       | Rotating disk 50/I                            |           |
| 154       | Rotating disk 50/I with 1/100 sec. shutter    |           |
| 155       | Pendulum 59.94/I                              |           |
| 156       | Pendulum 59.94/I with 1/120 sec. shutter      |           |
| 157       | Pendulum 50/I                                 |           |
| 158       | Pendulum 50/I with 1/100 sec. shutter         |           |
| 159       | Colourful world A                             |           |
| 160       | Colourful world B                             |           |



TABLE 22 (continued)

| Scene No. | Title                               | Thumbnail  |
|-----------|-------------------------------------|--|
| 161       | Black dress                         |    |
| 162       | White dress                         |    |
| 163       | Woman with bouquet                  |    |
| 164       | Flash photography                   |   |
| 165       | Fountain (chromakey)                |  |
| 166       | Night port<br>(camera gain: normal) |  |
| 167       | Night port<br>(camera gain: +6 dB)  |  |
| 168       | Night port<br>(camera gain: +12 dB) |  |
| 169       | Glasses                             |  |

TABLE 23

Test materials for HDTV 1 920 × 1 080/59.94/P, 4:2:2, 10-bit format (attribute-general)

| Scene No. | Title                           | Thumbnail  |
|-----------|---------------------------------|--|
| 201       | Ginkgo trees                    |    |
| 202       | Truck train                     |    |
| 203       | Cosmos flowers                  |    |
| 204       | Red leaves (pan up)             |   |
| 205       | Sunlight through leaves         |  |
| 206       | Red leaves (pan down)           |  |
| 207       | Woman at harbour (circle dolly) |  |
| 208       | Fountain (follow)               |  |
| 209       | Fountain (dolly)                |  |
| 210       | Studio concert (confetti)       |  |

TABLE 23 (continued)








| Scene No. | Title                     | Thumbnail  |
|-----------|---------------------------|--|
| 211       | Studio concert            |    |
| 212       | Drama set (day)           |    |
| 213       | Drama set (night)         |    |
| 214       | Basketball                |    |
| 215       | Twilight scene (zoom out) |   |
| 216       | Twilight scene (fixed)    |  |
| 217       | Night scene (fixed)       |  |
| 218       | Horse racing (dirt)       |  |

TABLE 24

## Test materials for HDTV 1 920 × 1 080/59.94/P, 4:2:2, 10-bit format (attribute-specific)

| Scene No. | Title   | Thumbnail |
|-----------|---|-----------|
| 251       | Rotating disk 59.94/P                         |           |
| 252       | Rotating disk 59.94/P with 1/120 sec. shutter |           |
| 253       | Rotating disk 24/P                            |           |
| 254       | Rotating disk 24/P with 1/48 sec. shutter     |           |
| 255       | Pendulum 59.94/P                              |           |
| 256       | Pendulum 59.94/P with 1/120 sec. shutter      |           |
| 257       | Pendulum 24/P                                 |           |
| 258       | Pendulum 24/P with 1/48 sec. shutter          |           |
| 259       | Colourful world A                             |           |
| 260       | Colourful world B                             |           |

TABLE 24 (end)


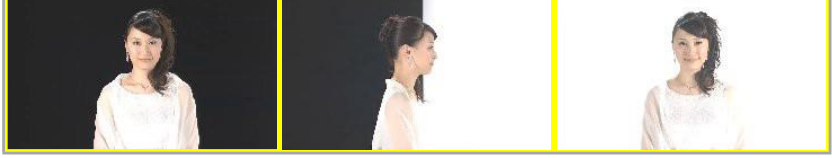



| Scene No. | Title                | Thumbnail  |
|-----------|----------------------|--|
| 261       | Black dress          |    |
| 262       | White dress          |    |
| 263       | Woman with bouquet   |    |
| 264       | Flash photography    |   |
| 265       | Fountain (chromakey) |  |

TABLE 25

Test materials for HDTV 1 920 × 1 080/50/I, 4:2:2, 10-bit format (attribute-general)

| Scene No. | Title                 | Thumbnail  |
|-----------|-----------------------|--|
| 301       | Harvest wheat fields  |    |
| 302       | Crossroad             |    |
| 303       | Basketball game       |    |
| 304       | Beijing Opera         |    |
| 305       | Bicycle race          |   |
| 306       | Equestrianism         |  |
| 307       | Football game         |  |
| 308       | Swimming              |  |
| 309       | Water polo game       |  |
| 310       | Synchronized swimming |  |
| 311       | Folk dance            |  |

TABLE 25 (end)

| Scene No. | Title                              | Thumbnail  |
|-----------|------------------------------------|--|
| 312       | Scrolling characters               |    |
| 313       | Scrolling characters               |    |
| 314       | The silk dancing team              |    |
| 315       | Northwest Waist drum dancing teams |    |
| 316       | Fireworks                          |   |
| 317       | Effects                            |  |
| 318       | 3D Animations                      |  |

TABLE 26

## Test materials for HDTV 1 920 × 1 080/50/I, 4:2:2, 10-bit format (attribute-specific)












| Scene No. | Title                | Thumbnail  |
|-----------|----------------------|--|
| 351       | Skin colour of lady  |    |
| 352       | Chromakey (portrait) |    |
| 353       | Chromakey (scene)    |    |
| 354       | Rotating birdcage    |    |
| 355       | Nine-dragon screen   |   |
| 356       | Flower garden        |  |
| 357       | Field of flowers     |  |
| 358       | Amusement park       |  |
| 359       | City plaza           |  |
| 360       | Skiing               |  |
| 361       | Hebei Bangzi         |  |



TABLE 26 (continued)












| Scene No. | Title                                     | Thumbnail  |
|-----------|---|--|
| 362       | Hebei Bangzi with noises<br>(S/N = 65 dB) |    |
| 363       | Hebei Bangzi with noises<br>(S/N = 53 dB) |    |
| 364       | Hebei Bangzi with noises<br>(S/N = 45 dB) |    |
| 365       | Textiles and household articles           |    |
| 366       | Food and containers                       |   |
| 367       | Rotating birdcage                         |  |
| 368       | Flowerbed                                 |  |
| 369       | Rotating disc (speed 1)                   |  |
| 370       | Rotating disc (speed 2)                   |  |
| 371       | Rotating disc (speed 3)                   |  |
| 372       | Dialogue in a Studio                      |  |

TABLE 26 (end)

| Scene No. | Title                            | Thumbnail  |
|-----------|----------------------------------|--|
| 373       | Beijing Opera actress and noises |    |
| 374       | Autumn leaves                    |    |
| 375       | Roses                            |    |
| 376       | Skin colour of lady              |    |
| 377       | Horizontal title                 |   |
| 378       | Vertical title                   |  |
| 379       | Flying title                     |  |

TABLE 27  
Test materials for UHDTV/HDTV

| Scene No. | Title        | Thumbnail  | Chromaticity distribution   |
|-----------|--------------|--|---|
| 1         | Books        |    |    |
| 2         | MusicBox     |    |    |
| 3         | Moss         |   |   |
| 4         | Kimono       |  |  |
| 5         | StainedGlass |  |  |

TABLE 27 (end)

| Scene No. | Title       | Thumbnail  | Chromaticity distribution   |
|-----------|-------------|--|---|
| 6         | Butterflies |    |    |
| 7         | ChromaKey   |    |    |
| 8         | Sea         |   |   |
| 9         | Flowers     |  |  |
| 10        | Ship        |  |  |

TABLE 28

## Test materials for 3 840 × 2 160/50/P, 4:4:4, 16-bit UHD TV pictures







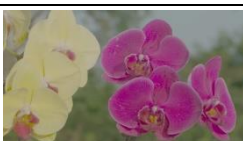

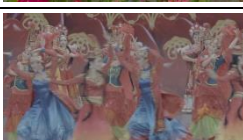
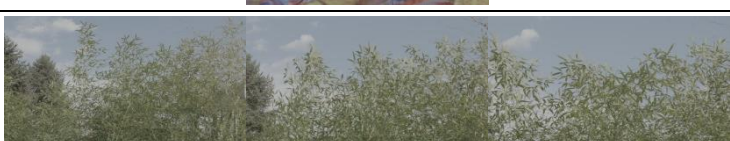
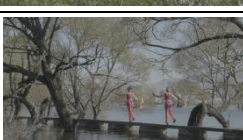
| Scene No. | Title                                  | Thumbnail  |
|-----------|--|--|
| 1         | The scene outside of the steel factory |    |
| 2         | The scene inside of the steel factory  |    |
| 3         | Still object                           |    |
| 4         | Coffee shop                            |    |
| 5         | Street of the town in the night        |   |
| 6         | Colourful lantern                      |  |
| 7         | Moth orchid                            |  |
| 8         | Fresh flowers                          |  |
| 9         | Dance                                  |  |
| 10        | Bamboo                                 |  |
| 11        | Girls dance by the river side          |  |

TABLE 28 (end)

| Scene No. | Title                           | Thumbnail  |
|-----------|---------------------------------|--|
| 12        | Skin colour                     |  |
| 13        | A sightseeing boat in the night |  |



TABLE 29 (*end*)

1 920 × 1 080/59.94/I, 4:4:4, 10-bit HDTV pictures (see Table 2)

| Scene no. / Attributes  | 151 | 152 | 153* | 154* | 155 | 156 | 157* | 158* | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 |
|-------------------------|-----|-----|------|------|-----|-----|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Digital coding          | √   | √   | √    | √    | √   | √   | √    | √    | √   | √   |     |     |     | √   | √   | √   | √   | √   |     |
| Standards conversion    | √   | √   | √    | √    | √   | √   | √    | √    |     |     |     |     |     | √   |     |     |     |     |     |
| Motion reproduction     | √   | √   | √    | √    | √   | √   | √    | √    |     |     |     |     |     |     | √   |     |     |     |     |
| Resolution              | √   | √   | √    | √    | √   | √   | √    | √    | √   |     |     |     |     |     |     |     |     |     |     |
| Gray-scale reproduction |     |     |      |      |     |     |      |      |     |     | √   | √   |     |     |     |     |     |     |     |
| Contrast                |     |     |      |      |     |     |      |      |     |     | √   | √   | √   |     |     | √   | √   | √   |     |
| Colour reproduction     |     |     |      |      |     |     |      |      | √   | √   |     |     |     |     |     |     |     |     | √   |
| Skin colour             |     |     |      |      |     |     |      |      |     |     | √   | √   | √   |     | √   |     |     |     |     |
| False contour           |     |     |      |      |     |     |      |      |     |     |     |     |     |     |     |     |     |     |     |
| Texture                 |     |     |      |      |     |     |      |      | √   | √   |     |     |     |     |     |     |     |     |     |
| Noise reduction         |     |     |      |      |     |     |      |      |     |     |     |     |     |     |     | √   | √   | √   |     |
| Legibility              | √   | √   | √    | √    |     |     |      |      | √   | √   |     |     |     |     |     |     |     |     |     |

\* The field frequency is 50 Hz.





TABLE 30 (*end*)

1 920 × 1 080/59.94/P, 4:2:2, 10-bit HDTV pictures (see Table 3)

| Scene no. / Attributes  | 251 | 252 | 253* | 254* | 255 | 256 | 257* | 258* | 259 | 260 | 261 | 262 | 263 | 264 | 265 |
|-------------------------|-----|-----|------|------|-----|-----|------|------|-----|-----|-----|-----|-----|-----|-----|
| Digital coding          | √   | √   | √    | √    | √   | √   | √    | √    | √   | √   |     |     |     | √   | √   |
| Standards conversion    | √   | √   | √    | √    | √   | √   | √    | √    |     |     |     |     |     | √   |     |
| Motion reproduction     | √   | √   | √    | √    | √   | √   | √    | √    |     |     |     |     |     |     | √   |
| Resolution              | √   | √   | √    | √    | √   | √   | √    | √    | √   |     |     |     |     |     |     |
| Gray-scale reproduction |     |     |      |      |     |     |      |      |     |     | √   | √   |     |     |     |
| Contrast                |     |     |      |      |     |     |      |      |     |     | √   | √   | √   |     |     |
| Colour reproduction     |     |     |      |      |     |     |      |      | √   | √   |     |     |     |     |     |
| Skin colour             |     |     |      |      |     |     |      |      |     |     | √   | √   | √   |     | √   |
| False contour           |     |     |      |      |     |     |      |      |     |     |     |     |     |     |     |
| Texture                 |     |     |      |      |     |     |      |      | √   | √   |     |     |     |     |     |
| Noise reduction         |     |     |      |      |     |     |      |      |     |     |     |     |     |     |     |
| Legibility              | √   | √   | √    | √    |     |     |      |      | √   | √   |     |     |     |     |     |

\* The frame frequency is 24 Hz.







TABLE 32

Test materials for UHD TV/HDTV (see Table 5)

| No.                     | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
|-------------------------|----|----|----|----|----|----|----|----|----|----|
| Image resolution        | ** | ** |    | ** | *  | ** | ** |    | *  | *  |
| Gray-scale reproduction |    | *  |    |    | ** | ** |    | ** |    | *  |
| Colour reproduction     |    |    | *  | ** | ** | ** |    | *  | ** |    |
| Digital coding          | ** |    | *  | *  |    |    | ** |    |    |    |
| Readability             | ** | *  |    |    | *  |    |    |    |    |    |
| Sense of presence       |    |    | ** | ** | *  |    |    | *  |    | ** |
| Wide-colour-gamut       |    |    |    |    | ** | ** |    | ** | ** |    |

\*\* Highly recommended.

\* Recommended.

TABLE 33

3 840 × 2 160/50/P, 4:4:4, 16-bit UHD TV pictures (see Table 6)

| Attributes              | Scene no.      | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|-------------------------|----------------|---|---|---|---|---|---|---|---|---|----|----|----|----|
|                         | Digital coding |   |   |   |   |   |   |   |   |   | √  | √  | √  |    |
| Motion reproduction     |                |   |   |   |   |   |   |   |   | √ | √  | √  |    | √  |
| Resolution              |                | √ |   | √ | √ | √ |   |   |   | √ |    |    |    | √  |
| Gray-scale reproduction |                | √ | √ |   | √ |   |   |   |   |   |    |    |    |    |
| Colour reproduction     |                |   |   | √ |   |   | √ | √ |   |   |    |    | √  |    |
| Skin colour             |                |   |   |   |   |   |   |   |   |   |    |    | √  |    |
| Wide-colour-gamut       |                |   |   |   |   |   |   | √ | √ |   |    |    |    |    |

## Annex 2

### Choice of statistics that can serve to characterize materials

#### 1 Introduction

Many test sequences for subjective assessment are described in this Report, and have been used in various evaluation tests. These sequences contain many different attributes as a whole, while each sequence provides a few attributes. It is important in actual evaluation tests to choose the sequences suitable for the test purposes. Statistics are useful in choosing proper sequences for the assessment purpose, as well as in analysing the quality degradation of the system to be evaluated.

In selecting the statistics described below, it is considered that there are increasing opportunities to conduct the evaluation tests of digital bit-rate reduction systems, the picture quality of which is generally sensitive to the picture contents, and therefore proper test materials must be used in the evaluation tests.

#### 2 Statistics of test materials

##### 2.1 Entropy of PCM data

This entropy,  $E$ , represents the amount of information of a picture. It is defined by equation (1):

$$E = - \sum_{i=I_{min}}^{I_{max}} P(i) \times \log_2 P(i) \quad \text{bit/pixel} \quad (1)$$

where:

$I_{min}$ : minimum level of the video signal

$I_{max}$ : maximum level of the video signal

$P(i)$ : probability occurrence for the video signal level  $i$ .

##### 2.2 AC energy

This represents the degree of picture activity, such as fineness, and is defined to be the square sum of the DCT coefficients except for the DC coefficient, as shown below:

$$AC = \left[ \frac{1}{N} \sum_{k=1}^N ac_k \right] / AC_{max} \quad (2)$$

where:

$$ac_k = \sum_{m=0}^7 \sum_{n=0}^7 C(m,n)^2 - C(0,0)^2$$

and  $C(m, n)$  denotes the DCT coefficients and  $N$  the number of blocks in a field (or frame).  $AC_{max}$  is a normalizing factor and the theoretically maximum value of AC energy is taken here, which is

obtained with such a picture that a half area within a block is black and the rest of the area within the block is white.

AC energy is calculated under several conditions, i.e. intra/inter-frame/field. Figure 1a) shows examples of the AC energy for intra-frame (frame DCT) and field DCT with motion-compensated frame difference (field DCT-MCFD).

### 2.3 Spectral entropy

This represents the degree of randomness of the DCT coefficients, and is useful to estimate the necessary bit rate of a DCT-based bit reduction system. It is defined by equation (3):

$$SE = \frac{1}{N} \sum_{k=1}^N (se_k)^2 \quad (3)$$

where:

$$se_k = - \sum_{m=0}^7 \sum_{n=0}^7 \frac{|C(m,n)|}{A} \log_2 \left[ \frac{|C(m,n)|}{A} \right]$$

$$A = \sum_{m=0}^7 \sum_{n=0}^7 |C(m,n)|$$

Spectral entropy is calculated under several conditions, i.e. intra/inter-frame/field. Figure 1b) shows examples of the spectral entropy.

### 2.4 Motion vector

This represents a motion of an object by a two-dimensional parameter on a block-by-block basis. Block matching is one of the commonly used methods for motion estimation.

To express the degree of motion of the picture, two kinds of statistics are used, i.e. mean magnitude of the vectors averaged over a frame/field and standard deviation within the frame/field. They are calculated separately in horizontal and vertical directions as follows:

$$\mu_X = \frac{1}{N} \sum_{k=1}^N |X_k| \quad \text{and} \quad \mu_Y = \frac{1}{N} \sum_{k=1}^N |Y_k| \quad (4)$$

$$\sigma_X^2 = \left[ \frac{1}{N} \sum_{k=1}^N X_k^2 \right] - \mu_X^2 \quad \text{and} \quad \sigma_Y^2 = \left[ \frac{1}{N} \sum_{k=1}^N Y_k^2 \right] - \mu_Y^2 \quad (5)$$

where:

- $X_k$  and  $Y_k$ : horizontal and vertical components of the vector in a block
- $\mu_X$  and  $\mu_Y$ : mean magnitude of  $X_k$  and  $Y_k$  averaged over a field
- $\sigma_X$  and  $\sigma_Y$ : standard deviation of  $X_k$  and  $Y_k$ , respectively.



The mean magnitudes represent the degree of motions as a whole, while the standard deviations represent the degree of non-uniform motions.

Figures 1c) and 1d) show examples of the motion vector, calculated using block matching.

## 2.5 Motion-compensated prediction error power

The motion-compensated frame/field-difference signal, i.e. prediction error, is expressed by equation (6):

$$e_k(x, y) = f_0(x, y) - f_1(x - u_k, y - v_k) \quad (6)$$

where  $e_k(*)$ ,  $f_0(*)$  and  $f_1(*)$  denote the motion-compensated frame/field-difference signal in the  $k$ -th block, the current frame/field signal, and the previous frame/field signal, respectively, while  $u_k$  and  $v_k$  the horizontal and vertical components of motion vector in the block.

The power of the prediction error,  $EP$ , is defined to be the mean square value of the difference signals as follows:

$$EP = \frac{1}{N} \sum_{k=1}^N ep_k \quad (7)$$

where:

$$ep_k = \frac{1}{X \times Y} \sum_{x=1}^X \sum_{y=1}^Y e(x, y)^2$$

$X$  and  $Y$  denote horizontal and vertical sizes of a block.

This statistic value could be useful to estimate whether the sequence is critical for a bit reduction system using motion compensation.

Figure 1e) shows an example of the motion-compensated prediction error power.

## 2.6 Criticality by rate-buffer occupancy method

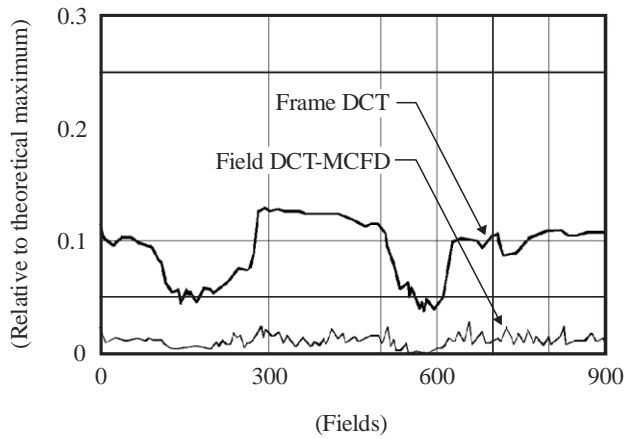
The Independent Television Commission of the United Kingdom and the EBU conducted a study on criticality under the RACE MOSAIC project. The MPEG-1 + coding algorithm with subjectively optimized quantizers was used to measure the criticality of broadcast programmes and test sequences. The criticality was calculated by means of a parallel processing computer using the rate-buffer occupancy, and was expressed in terms of bit/pixel. An example of criticality measurement is shown in Fig. 2.

## 2.7 Criticality by fixed quantizer method

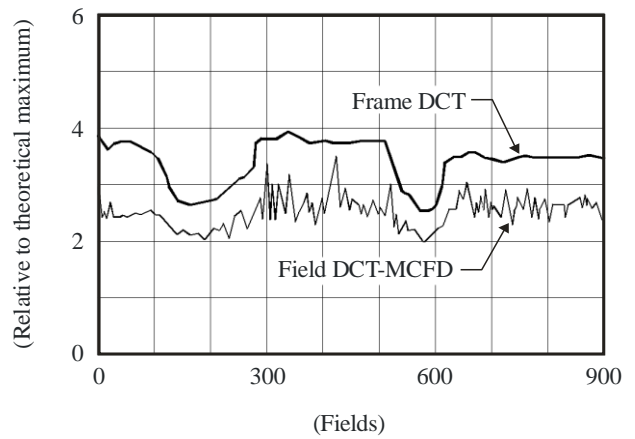
This criticality is defined as “the number of output bits per pixel from MPEG-2 encoder with a fixed quantizer”. The quantizer characteristics are linear and comply with the MPEG-2 standard. The parameter value of “quantizer\_scale” gives a quantizer step closely related to picture quality.

FIGURE 1

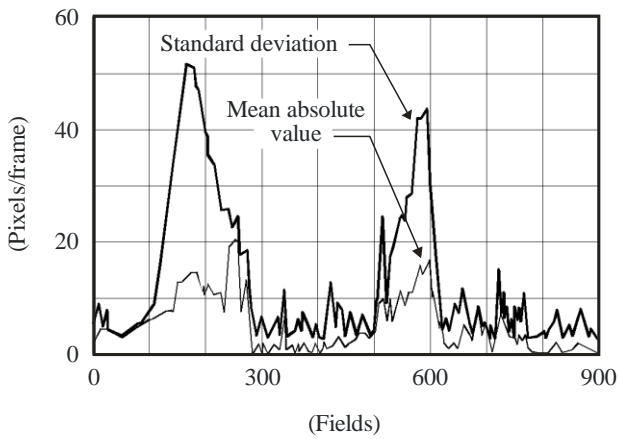
Example of statistics of motion sequences



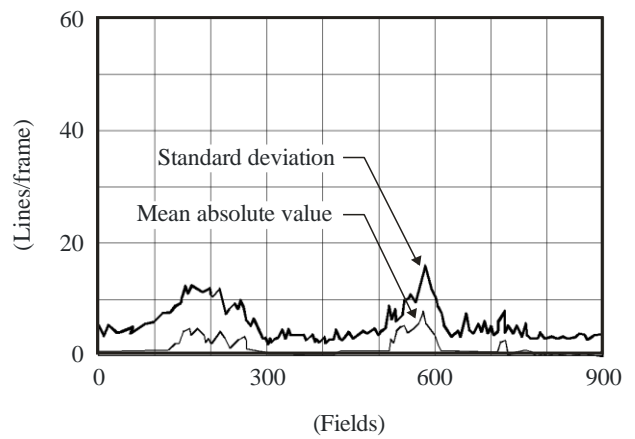
a) AC energy



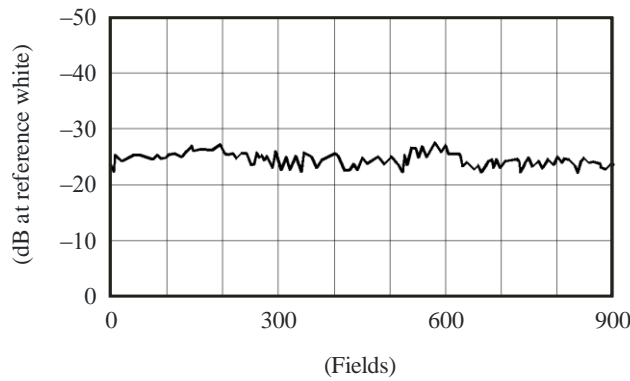
b) Spectral entropy



c) Motion vector (horizontal)



d) Motion vector (vertical)



e) Motion-compensated interframe prediction errors

NOTE 1 – The results are shown only for the luminance signals of the scene “Soccer action”. The ordinate of each chart indicates the statistic value, and the abscissa the field number, counting from the beginning of the sequence (900 fields correspond to 15 s). It can be seen that there are two large horizontal motions around the field numbers 200 and 600, which suppress fine detail components due to the integration effect of the camera, resulting in reduced AC energy and spectral entropy.

Examples of the criticality are shown in Fig. 3. The criticality was measured in each frame under the following condition: quantizer\_scale = 12 (q\_scale\_code = 6 and q\_scale\_type = 0), field-based forward prediction and intra macroblock refreshment with a cycle of 0.5 s. Figure 3a) shows the fluctuation of the criticality over a 5 s interval. The criticality distribution of broadcast television programmes was measured on an NHK channel for one week, a total of 130 h, from 15 through 22 February 1995. In the measurement, composite NTSC signals were converted into component Y/C signals. The frequency of occurrence of the criticality for television programmes was calculated every  $5 \times 10^{-3}$  bit/pixel. The criticality distribution for different programme genres is shown in Fig. 3b). Sports programmes are relatively critical, while drama programmes are less critical. The statistical distribution of the criticality for overall television programmes is shown in Fig. 3c). This Figure also shows the criticality for test sequences.

FIGURE 2  
Criticality measurement result of rate-buffer occupancy method

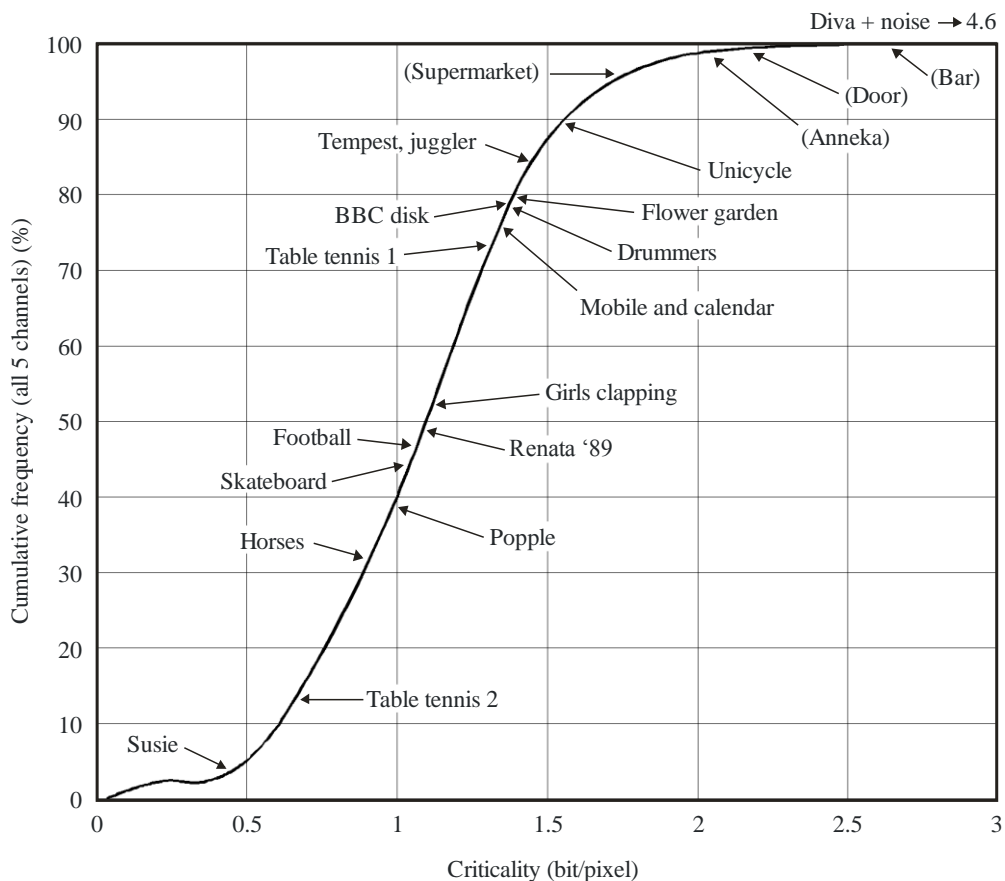
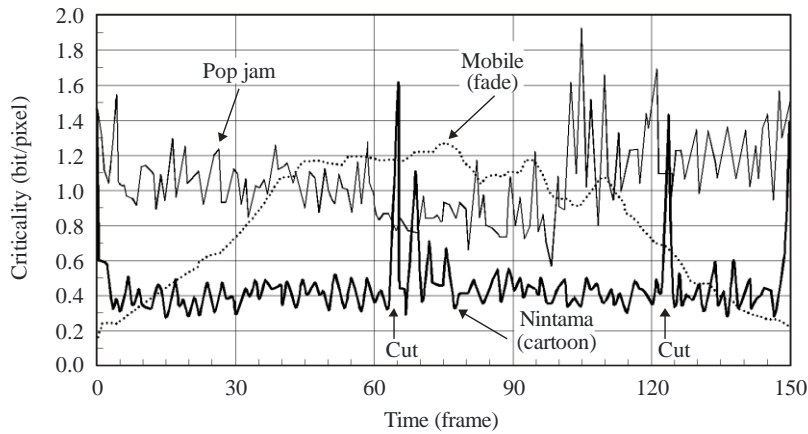
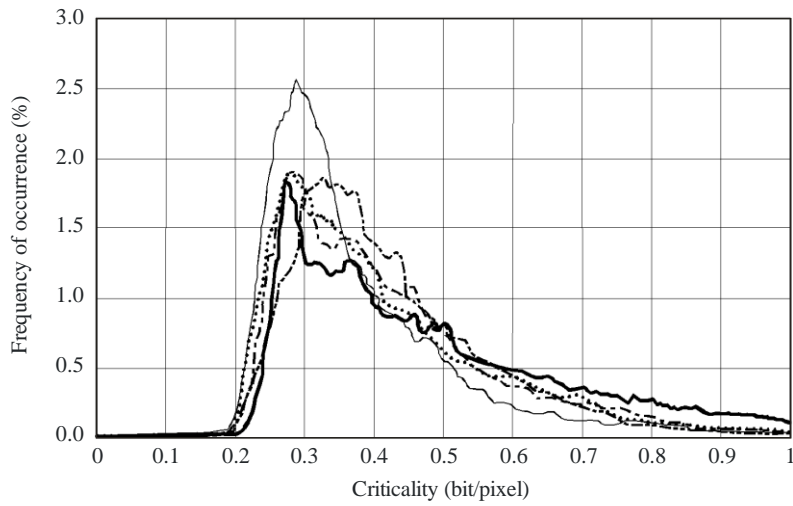


FIGURE 3

Criticality measurement results of fixed quantizer method

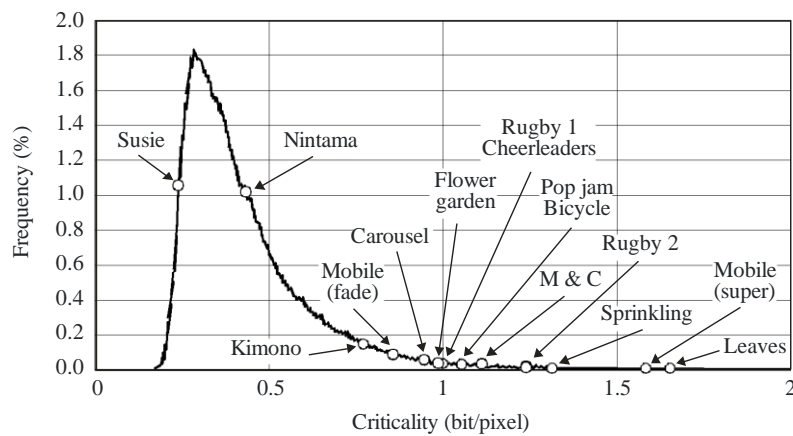


a) Fluctuation of criticality for 5 s interval



b) Criticality distribution for classified television programmes

— Drama      ..... Culture      -.-.- Variety  
 - - - News      — Sports



c) Distribution of criticality for television programmes and criticality of test sequences

q\_scale\_code = 6

## Annex 3

### Status for use of test materials

Use of the test materials described in Tables 1, 2, 3 and 4 is restricted to the following purposes.

- a) Technical evaluations, including:
  - research and development of equipment and systems;
  - testing of equipment during development and production processes;
  - testing of transmission conditions for broadcasting and telecommunication;
  - maintenance of equipment.
- b) Technical demonstrations, including:
  - presentations at technical conferences and workshops;
  - presentation of performance and functionality of equipment at exhibitions.

Inclusion in commercial products and promotional demonstration of commercial products are not permitted.

NOTE 1 – Usage restrictions as proposed above can be considered as falling under the following category:

#### Commercial restricted

The test materials may be used for research projects, to verify equipment specifications, and public demonstrations of commercial products. Inclusion in commercial products is not allowed. Reproductions for distribution may only be made by the copyright holder or authorized distributor.

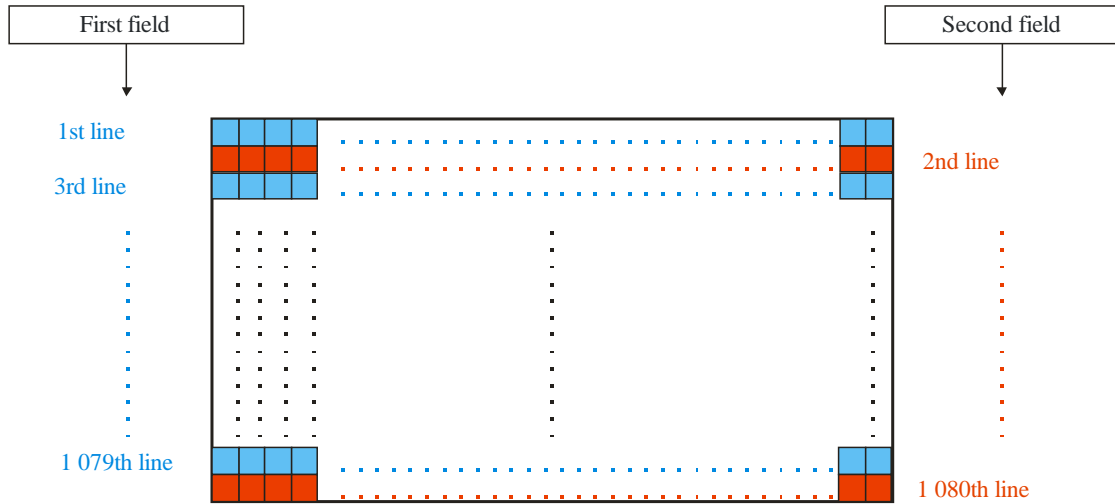
## Annex 4

### File formats for test materials

#### 1 TIFF file for HDTV RGB 4:4:4 (10 bits)

The video data of two interlaced video fields are combined once into a frame and then recorded in a single Tagged Image File Format (TIFF) file (specified by Adobe Developers Association). Consequently, each file contains the TIFF header and tag information as well as pixel data of the full image size (1 920 × 1 080 pixels, RGB). The number of files corresponds to the video length. The first field in each frame is mapped into odd lines (including the first line of the frame data) and the second one is mapped into even lines. This is the so called “top field first” and is illustrated in Fig. 4.

FIGURE 4  
Structure of video data



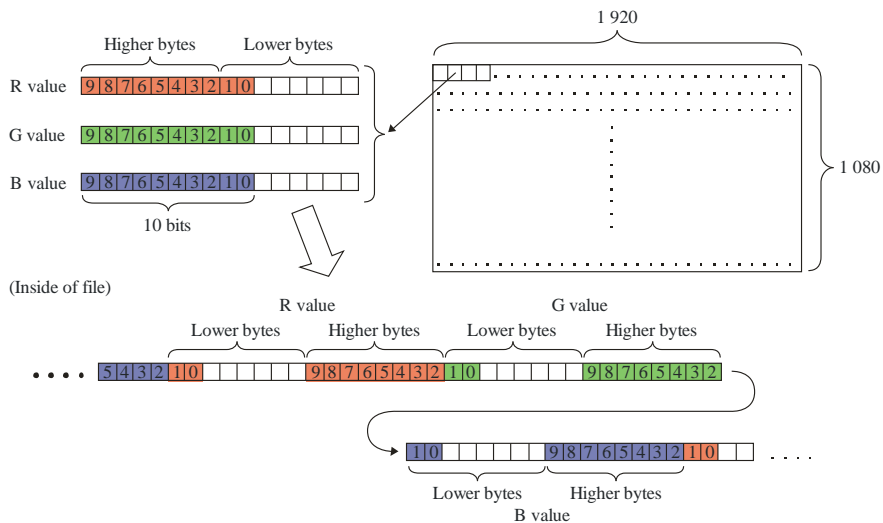
Report BT.2245-04

Pixel values of RGB components in the TIFF file are treated as 16-bit integers. Since the actual pixel value only has 10 bit depth, it is stored in the higher 10 bits of the 16-bit integer and the remaining 6 bits are set to “0”.

Byte order in the TIFF file is low-to-high (little endian). The arrangement of pixel data in the file is illustrated in Fig. 5.

Filename is formatted as “sXXX\_NNNNN.tif” where XXX means a three digit scene number while NNNNNN indicates a six digit frame number.

FIGURE 5  
Data arrangement for RGB 4:4:4 (10 bits)



Report BT.2245-05

## 2 YUV file for HDTV YC<sub>B</sub>C<sub>R</sub> 4:2:2 (10 bits)

Video data of full image size (1 920 × 1 080 pixels and YC<sub>B</sub>C<sub>R</sub>) are stored in a single file without header or timing information.

































Two video fields are combined into a frame for interlaced video content before it is stored into the file. See Fig. 4 for the video data structure.

The Y component of video data contains  $1\,920 \times 1\,080$  samples as seen in Fig. 6 while each of the  $C_B$  and  $C_R$  components has  $960 \times 1\,080$  samples. The horizontal positions of  $C_B$  and  $C_R$  samples are aligned to those of odd samples in the Y component.

Sample values in the file are arranged in order of  $C_B$ , Y,  $C_R$ , Y, ... Three 10-bit sample values are stored in the higher 30 bits of a 4 byte (32 bits) integer and the remaining lower 2 bits are set to "0". As a result, 12 data samples within six pixels, i.e. 6 Y samples and 3 pairs of  $C_B$  and  $C_R$  samples, are packed into the sixteen byte data in the file shown in Fig. 7.

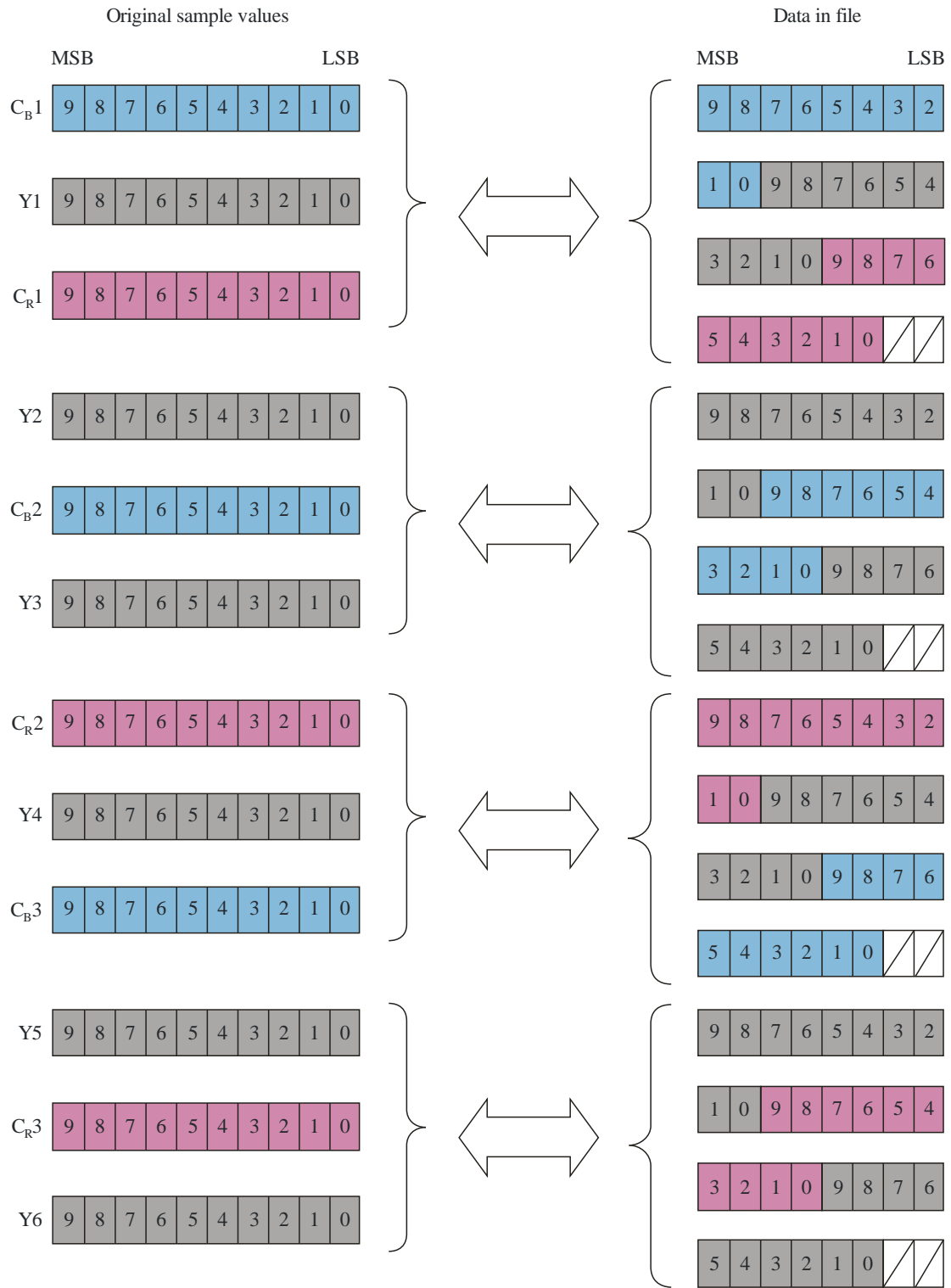
Filename is formatted as "sXXX\_NNNNN.yuv10" where XXX means the three digit scene number while NNNNNN indicates the six digit frame number.

FIGURE 6  
Sampling positions in frame

|   |   |   |   |   |   |     |   |   |
|---|---|---|---|---|---|-----|---|---|
| <br>Y1,1<br>$C_B$ 1,1<br>$C_R$ 1,1               | <br>Y1,2       | <br>Y1,3<br>$C_B$ 1,2<br>$C_R$ 1,2               | <br>Y1,4       | <br>Y1,5<br>$C_B$ 1,3<br>$C_R$ 1,3               | <br>Y1,6       | ... | <br>Y1,1 919<br>$C_B$ 1,960<br>$C_R$ 1,960               | <br>Y1,1 920       |
| <br>Y2,1<br>$C_B$ 2,1<br>$C_R$ 2,1              | <br>Y2,2      | <br>Y2,3<br>$C_B$ 2,2<br>$C_R$ 2,2              | <br>Y2,4      | <br>Y2,5<br>$C_B$ 2,3<br>$C_R$ 2,3              | <br>Y2,6      | ... | <br>Y2,1 919<br>$C_B$ 2,960<br>$C_R$ 2,960              | <br>Y2,1 920      |
| <br>Y3,1<br>$C_B$ 3,1<br>$C_R$ 3,1             | <br>Y3,2     | <br>Y3,3<br>$C_B$ 3,1<br>$C_R$ 3,1             | <br>Y3,4     | <br>Y3,5<br>$C_B$ 3,3<br>$C_R$ 3,3             | <br>Y3,6     | ... | <br>Y3,1 919<br>$C_B$ 3,960<br>$C_R$ 3,960             | <br>Y3,1 920     |
| •   | •   | •   | •   | •   | •   | •   | •   | •   |
| •   | •   | •   | •   | •   | •   | •   | •   | •   |
| •   | •   | •   | •   | •   | •   | •   | •   | •   |
| •   | •   | •   | •   | •   | •   | •   | •   | •   |
| •   | •   | •   | •   | •   | •   | •   | •   | •   |
| <br>Y1 080,1<br>$C_B$ 1 080,1<br>$C_R$ 1 080,1 | <br>Y1 080,2 | <br>Y1 080,3<br>$C_B$ 1 080,2<br>$C_R$ 1 080,2 | <br>Y1 080,4 | <br>Y1 080,5<br>$C_B$ 1 080,3<br>$C_R$ 1 080,3 | <br>Y1 080,6 | ... | <br>Y1 080,1 919<br>$C_B$ 1 080,960<br>$C_R$ 1 080,960 | <br>Y1 080,1 920 |

 : Y samples       :  $C_B$  and  $C_R$  samples

FIGURE 7  
Data arrangement for YC<sub>B</sub>C<sub>R</sub> 4:2:2 (10 bits)





**3 Raw file for UHDTV RGB 4:4:4 (12 bits)**

Figure 8 illustrates the file formats. Each 8K or 4K image consists of three raw files separated by the colour channel. The size of each raw file is 66 355 200 bytes for 8K images and 16 588 800 bytes for 4K images, respectively, using 2 bytes in the big-endian format for each pixel. The 2K images are individually recorded in an uncompressed 16 bit TIFF format. The size of each file is 12 441 600 bytes for 2K images with the header information. The six least significant digits are zero-padded.

