

**Colour stimuli of just noticeable colour thresholds ( $p=50\%$ ) in 3 directions**

| number<br>Colour<br>series | Colour stimuli<br>colour values<br>y x y | Colour stimuli differences at threshold<br>-WN $\Delta x$ -GR $\Delta y$ -BY $\Delta z$ $\Delta y$ | notes<br>experimental<br>series |
|----------------------------|------------------------------------------|----------------------------------------------------------------------------------------------------|---------------------------------|
| 0 WPN                      | 196.9 0.3986 0.4175 1.19                 | -0.0011 0.0009 -0.0016 -0.0014                                                                     | WN, GR, BY                      |
| 1 WPN                      | 74.13 0.3919 0.4139 0.41                 | -0.0012 0.0011 -0.0016 -0.0013                                                                     | grey surround                   |
| 2 WPN                      | 34.31 0.3926 0.4144 0.18                 | -0.0013 0.0011 -0.0017 -0.0015                                                                     | CIE data no. 03                 |
| 3 WPN                      | 17.69 0.3973 0.4153 0.09                 | -0.0016 0.0013 -0.002 -0.0017                                                                      | with white                      |
| 4 WPN                      | 9.15 0.4052 0.4185 0.07                  | -0.0017 0.0015 -0.0029 -0.0024                                                                     | border                          |
| 5 WPN                      | 4.65 0.4159 0.4226 0.05                  | -0.0023 0.002 -0.0042 -0.0036                                                                      |                                 |
| 6 WPN                      | 3.14 0.386 0.4113 0.04                   | -0.0027 0.0022 -0.0039 -0.0034                                                                     |                                 |
| 7 GDR                      | 14.96 0.1198 0.3961 0.06                 | -0.0061 0.003 -0.0012 -0.0022                                                                      | WN, GR, BY                      |
| 8 GDR                      | 15.71 0.2422 0.3728 0.06                 | -0.0037 0.0021 -0.0013 -0.0016                                                                     | grey surround                   |
| 9 GDR                      | 16.52 0.321 0.3578 0.06                  | -0.0017 0.001 -0.0016 -0.0013                                                                      | CIE data no. 09                 |
| 10 GDR                     | 16.96 0.4598 0.2388 0.07                 | -0.0022 0.0011 -0.0022 -0.001                                                                      | with white                      |
| 11 GDR                     | 17.17 0.485 0.2119 0.09                  | -0.002 0.0009 -0.0026 -0.001                                                                       | border                          |
| 12 BDY                     | 17.29 0.2497 0.2914 0.07                 | -0.0018 0.0008 -0.0011 -0.0009                                                                     | WN, GR, BY                      |
| 13 BDY                     | 17.26 0.2877 0.3257 0.06                 | -0.0017 0.0009 -0.0013 -0.0011                                                                     | grey surround                   |
| 14 BDY                     | 16.44 0.3232 0.3593 0.06                 | -0.0016 0.001 -0.0014 -0.0013                                                                      | CIE data no. 14                 |
| 15 BDY                     | 17.72 0.4338 0.4529 0.05                 | -0.002 0.0019 -0.0026 -0.0024                                                                      | with white                      |
| 16 BDY                     | 18.46 0.4841 0.4968 0.05                 | -0.002 0.0025 -0.0037 -0.0032                                                                      | border                          |

Samples: bright white (W, no. 0), dark black (S, no. 10), White (W, no. 11), Black (N, no. 21)  
Green (G-T (turquois), no. 22), Red (R-M (magenta), no. 32), Blue (B, no. 33), Yellow (Y, no. 43)  
Source: BAM Research Report no. 115 (1985), Tables 5.40;1 to 11

**Colour stimuli of just noticeable colour thresholds ( $p=50\%$ ) in WN direction**

| number<br>Colour<br>series | CIELAB differences<br>lightness, chroma, $\Sigma$<br>$\Delta L^*$ $\Delta a^*$ $\Delta b^*$ $\Delta E^*$ | LABJND differences<br>lightness, chroma, $\Sigma$<br>$\Delta L^*$ $\Delta a^*$ $\Delta b^*$ $\Delta E^*$ | colour differences<br>other formulae<br>CMC/C94 C00 | notes<br>experimental<br>series |
|----------------------------|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------|
| 0 WPN                      | 0.29 0.0 0.0 0.29 1.13 0.0 0.0 1.13                                                                      | 0.14 0.29 0.13                                                                                           | 0.14 0.29 0.13                                      | WN, GR, BY                      |
| 1 WPN                      | 0.19 0.0 0.0 0.19 1.0 0.0 0.0 1.0                                                                        | 0.1 0.19 0.12                                                                                            | 0.1 0.19 0.12                                       | grey surround                   |
| 2 WPN                      | 0.14 0.0 0.0 0.14 0.91 0.0 0.0 0.91                                                                      | 0.09 0.14 0.11                                                                                           | 0.09 0.14 0.11                                      | CIE data no. 03                 |
| 3 WPN                      | 0.12 0.0 0.0 0.12 0.9 0.0 0.0 0.9                                                                        | 0.09 0.12 0.12                                                                                           | 0.09 0.12 0.12                                      | with white                      |
| 4 WPN                      | 0.15 -0.01 -0.01 0.15 1.25 -0.03 -0.02 1.25                                                              | 0.14 0.15 0.12                                                                                           | 0.14 0.15 0.12                                      | border                          |
| 5 WPN                      | 0.15 -0.02 -0.03 0.15 1.27 -0.04 -0.04 1.27                                                              | 0.19 0.15 0.11                                                                                           | 0.19 0.15 0.11                                      |                                 |
| 6 WPN                      | 0.19 0.0 0.02 0.19 1.55 0.0 0.04 1.55                                                                    | 0.28 0.19 0.13                                                                                           | 0.28 0.19 0.13                                      |                                 |
| 7 GDR                      | 0.09 0.46 0.03 0.47 0.74 0.21 0.12 0.78                                                                  | 0.16 0.13 0.13                                                                                           | 0.16 0.13 0.13                                      | WN, GR, BY                      |
| 8 GDR                      | 0.09 0.11 0.01 0.14 0.71 0.12 0.04 0.1                                                                   | 0.1 0.1 0.1                                                                                              | 0.1 0.1 0.1                                         | grey surround                   |
| 9 GDR                      | 0.08 0.0 0.0 0.08 0.68 0.0 0.0 0.68                                                                      | 0.07 0.08 0.08                                                                                           | 0.07 0.08 0.08                                      | CIE data no. 09                 |
| 10 GDR                     | 0.1 -0.17 0.04 0.2 0.76 -0.27 0.16 0.82                                                                  | 0.09 0.1 0.1                                                                                             | 0.09 0.1 0.1                                        | with white                      |
| 11 GDR                     | 0.11 -0.25 0.06 0.28 0.84 -0.35 0.25 0.95                                                                | 0.11 0.12 0.12                                                                                           | 0.11 0.12 0.12                                      | border                          |
| 12 BDY                     | 0.08 0.0 0.03 0.09 0.65 0.0 0.17 0.67                                                                    | 0.07 0.08 0.08                                                                                           | 0.07 0.08 0.08                                      | WN, GR, BY                      |
| 13 BDY                     | 0.07 0.0 0.01 0.07 0.56 0.0 0.07 0.56                                                                    | 0.06 0.07 0.07                                                                                           | 0.06 0.07 0.07                                      | grey surround                   |
| 14 BDY                     | 0.07 0.0 0.0 0.07 0.59 0.0 0.0 0.59                                                                      | 0.06 0.07 0.07                                                                                           | 0.06 0.07 0.07                                      | CIE data no. 14                 |
| 15 BDY                     | 0.07 -0.01 -0.17 0.19 0.55 -0.03 -0.16 0.57                                                              | 0.09 0.09 0.09                                                                                           | 0.09 0.09 0.09                                      | with white                      |
| 16 BDY                     | 0.07 -0.01 -0.8 0.8 0.53 -0.02 -0.18 0.56                                                                | 0.27 0.2 0.2                                                                                             | 0.27 0.2 0.2                                        | border                          |

mean standard deviation 0.21 0.17 0.27 0.06 0.05 0.02

Source: BAM Research Report no. 115 (1985), Tables 5.40;1 to 11; LABJND0.8; 1.4; 1.1

**Colour stimuli of just noticeable colour thresholds ( $p=50\%$ ) in GR direction**

| number<br>Colour<br>series | CIELAB differences<br>lightness, chroma, $\Sigma$<br>$\Delta L^*$ $\Delta a^*$ $\Delta b^*$ $\Delta E^*$ | LABJND differences<br>lightness, chroma, $\Sigma$<br>$\Delta L^*$ $\Delta a^*$ $\Delta b^*$ $\Delta E^*$ | colour differences<br>other formulae<br>CMC/C94 C00 | notes<br>experimental<br>series |
|----------------------------|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------|
| 0 WPN                      | 0.01 -1.13 0.1 1.13 0.04 -0.76 0.06 0.77                                                                 | 1.59 1.08 1.62                                                                                           | 1.59 1.08 1.62                                      | WN, GR, BY                      |
| 1 WPN                      | 0.0 -0.9 0.1 0.9 0.05 -0.82 0.07 0.82                                                                    | 1.18 0.85 1.25                                                                                           | 1.18 0.85 1.25                                      | grey surround                   |
| 2 WPN                      | 0.0 -0.75 0.08 0.75 0.05 -0.85 0.08 0.85                                                                 | 1.0 0.72 1.07                                                                                            | 1.0 0.72 1.07                                       | CIE data no. 03                 |
| 3 WPN                      | 0.01 -0.71 0.06 0.71 0.08 -0.93 0.06 0.94                                                                | 1.01 0.69 1.03                                                                                           | 1.01 0.69 1.03                                      | with white                      |
| 4 WPN                      | 0.0 -0.62 0.07 0.62 0.0 -0.89 0.08 0.9                                                                   | 0.84 0.59 0.87                                                                                           | 0.84 0.59 0.87                                      | border                          |
| 5 WPN                      | 0.0 -0.64 0.07 0.64 0.0 -0.94 0.08 0.94                                                                  | 0.89 0.6 0.88                                                                                            | 0.89 0.6 0.88                                       |                                 |
| 6 WPN                      | 0.0 -0.66 0.06 0.67 0.0 -0.93 0.08 0.93                                                                  | 0.89 0.64 0.84                                                                                           | 0.89 0.64 0.84                                      |                                 |
| 7 GDR                      | 0.01 -3.6 0.04 3.6 0.1 -1.33 0.1 1.34                                                                    | 1.16 0.81 0.8                                                                                            | 1.16 0.81 0.8                                       | WN, GR, BY                      |
| 8 GDR                      | 0.01 -1.69 0.05 1.69 0.1 -1.37 0.13 1.38                                                                 | 0.89 0.78 0.79                                                                                           | 0.89 0.78 0.79                                      | grey surround                   |
| 9 GDR                      | 0.01 -0.78 0.02 0.78 0.08 -0.99 0.06 0.99                                                                | 1.13 0.77 1.12                                                                                           | 1.13 0.77 1.12                                      | CIE data no. 09                 |
| 10 GDR                     | 0.01 -1.1 0.03 1.1 0.09 -1.02 0.09 1.03                                                                  | 0.37 0.24 0.24                                                                                           | 0.37 0.24 0.24                                      | with white                      |
| 11 GDR                     | 0.02 -1.1 0.03 1.1 0.18 -0.93 0.11 0.96                                                                  | 0.34 0.2 0.2                                                                                             | 0.34 0.2 0.2                                        | border                          |
| 12 BDY                     | 0.01 -0.94 0.01 0.94 0.09 -1.09 0.03 1.1                                                                 | 0.8 0.68 0.75                                                                                            | 0.8 0.68 0.75                                       | WN, GR, BY                      |
| 13 BDY                     | 0.01 -0.8 0.02 0.8 0.09 -0.97 0.06 0.98                                                                  | 0.95 0.67 0.94                                                                                           | 0.95 0.67 0.94                                      | grey surround                   |
| 14 BDY                     | 0.0 -0.7 0.03 0.7 0.0 -0.89 0.07 0.89                                                                    | 1.07 0.7 1.02                                                                                            | 1.07 0.7 1.02                                       | CIE data no. 14                 |
| 15 BDY                     | 0.01 -0.86 0.11 0.86 0.09 -1.06 0.07 1.07                                                                | 0.78 0.55 0.65                                                                                           | 0.78 0.55 0.65                                      | with white                      |
| 16 BDY                     | 0.01 -0.92 0.4 1.01 0.07 -1.13 0.08 1.14                                                                 | 0.64 0.46 0.58                                                                                           | 0.64 0.46 0.58                                      | border                          |

mean standard deviation 1.06 0.68 1.0 0.51 0.65 0.87 0.15 0.28 0.2 0.33

Source: BAM Research Report no. 115 (1985), Tables 5.40;1 to 11; LABJND0.8; 1.4; 1.1

**Colour stimuli of just noticeable colour thresholds ( $p=50\%$ ) in BY direction**

| number<br>Colour<br>series | CIELAB differences<br>lightness, chroma, $\Sigma$<br>$\Delta L^*$ $\Delta a^*$ $\Delta b^*$ $\Delta E^*$ | LABJND differences<br>lightness, chroma, $\Sigma$<br>$\Delta L^*$ $\Delta a^*$ $\Delta b^*$ $\Delta E^*$ | colour differences<br>other formulae<br>CMC/C94 C00 | notes<br>experimental<br>series |
|----------------------------|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------|
| 0 WPN                      | 0.0 -0.14 -1.75 1.75 0.03 -0.09 -0.96 0.97                                                               | 2.49 1.71 1.71                                                                                           | 2.49 1.71 1.71                                      | WN, GR, BY                      |
| 1 WPN                      | 0.0 -0.1 -1.16 1.16 0.05 -0.09 -0.89 0.89                                                                | 1.4 1.02 1.0                                                                                             | 1.4 1.02 1.0                                        | grey surround                   |
| 2 WPN                      | 0.0 -0.08 -1.01 1.02 0.05 -0.09 -0.96 0.97                                                               | 1.32 0.93 0.91                                                                                           | 1.32 0.93 0.91                                      | CIE data no. 03                 |
| 3 WPN                      | 0.0 -0.08 -0.94 0.95 0.0 -0.11 -1.02 1.03                                                                | 1.4 0.93 0.92                                                                                            | 1.4 0.93 0.92                                       | with white                      |
| 4 WPN                      | 0.0 -0.09 -1.08 1.08 0.0 -0.13 -1.23 1.24                                                                | 1.43 1.01 1.02                                                                                           | 1.43 1.01 1.02                                      | border                          |
| 5 WPN                      | 0.0 -0.1 -1.31 1.32 0.0 -0.15 -1.4 1.41                                                                  | 1.55 1.12 1.15                                                                                           | 1.55 1.12 1.15                                      |                                 |
| 6 WPN                      | 0.0 -0.08 -0.97 0.98 0.0 -0.12 -1.19 1.2                                                                 | 1.29 0.9 0.89                                                                                            | 1.29 0.9 0.89                                       |                                 |
| 7 GDR                      | 0.0 -0.25 -0.51 0.57 0.0 -0.09 -1.23 1.24                                                                | 0.22 0.22 0.22                                                                                           | 0.22 0.22 0.22                                      | WN, GR, BY                      |
| 8 GDR                      | 0.0 -0.11 -0.46 0.47 0.0 -0.09 -1.05 1.05                                                                | 0.3 0.31 0.31                                                                                            | 0.3 0.31 0.31                                       | grey surround                   |
| 9 GDR                      | 0.0 -0.09 -0.48 0.49 0.0 -0.12 -1.06 1.07                                                                | 0.71 0.48 0.48                                                                                           | 0.71 0.48 0.48                                      | CIE data no. 09                 |
| 10 GDR                     | 0.01 -0.07 -0.63 0.63 0.09 -0.08 -1.48 1.49                                                              | 0.54 0.28 0.23                                                                                           | 0.54 0.28 0.23                                      | with white                      |
| 11 GDR                     | 0.01 -0.08 -0.74 0.75 0.08 -0.08 -1.78 1.79                                                              | 0.58 0.29 0.23                                                                                           | 0.58 0.29 0.23                                      | border                          |
| 12 BDY                     | 0.0 -0.09 -0.36 0.37 0.0 -0.1 -0.87 0.88                                                                 | 0.2 0.17 0.17                                                                                            | 0.2 0.17 0.17                                       | WN, GR, BY                      |
| 13 BDY                     | 0.0 -0.1 -0.42 0.44 0.0 -0.13 -0.99 1.0                                                                  | 0.34 0.28 0.29                                                                                           | 0.34 0.28 0.29                                      | grey surround                   |
| 14 BDY                     | 0.0 -0.09 -0.45 0.46 0.0 -0.11 -0.98 0.99                                                                | 0.69 0.45 0.46                                                                                           | 0.69 0.45 0.46                                      | CIE data no. 14                 |
| 15 BDY                     | 0.0 -0.08 -1.24 1.24 0.0 -0.1 -0.91 0.91                                                                 | 0.54 0.45 0.45                                                                                           | 0.54 0.45 0.45                                      | with white                      |
| 16 BDY                     | 0.01 -0.11 -4.84 4.85 0.07 -0.14 -0.97 0.99                                                              | 1.59 1.1 1.14                                                                                            | 1.59 1.1 1.14                                       | border                          |

mean standard deviation 1.09 1.01 1.12 0.98 0.69 0.68 0.23 0.61 0.42 0.43

Source: BAM Research Report no. 115 (1985), Tables 5.40;1 to 11; LABJND0.8; 1.4; 1.1

TUB-test chart WE80; Colour thresholds data  
RI experiments: Series WPN, GDR, BDY in directions WN, GR, BY; LABJND0.8; 1.4; 1.1

input: w/rgb/cmyk -> w/rgb/cmyk-