

Light Reflectance of Patterned Multi-Coloured Carpets

While the FACT SHEET CIAL 2019 titled “Light Reflectance” contains information about carpets in medium to dark plain shades, this FACT SHEET provides information about light reflectance of contract or commercial carpet (textile floor coverings) in a multi person use installation where the carpet colour-ways are patterned and, where individual colours within the pattern have been selected considering (a) design aspects (both carpet & building), (b) appearance retention properties, (c) cleaning maintenance and (d) the comfort and safety of visitors and, occupiers of the building.

Safety is important in the design of workplaces and public spaces to aid the visually impaired. For example, furniture, floors, floor coverings, walls and doors should have clearly differing colours or be in contrast to one another, and highlight any changes in surface levels safely.

Light reflectance is an important aspect of all interior surfaces & finishes and as a fit-out material, it is for carpet it is a necessary requirement when planning area lighting as well providing, as required, visual harmony or visual contrast as part of the interior design.

Light Reflectance Value (LRV) is a measurement commonly used in interior decorating and design and CIAL determined that British Standard – **BS8493:2008+A1:2010 Light Reflectance Value (LRV) of a Surface – Method of Test** is an appropriate method for determining the spectral reflectance of carpets using a spectrophotometer (*Reference: opaque coverings with a yielding pile e.g. carpet and, multi-coloured surfaces. The apparatus shall be capable of measuring LRV to a precision compatible with the reproducibility of 1 unit ΔE CIE $L^*a^*b^*$*).

BS 8493:2008 measures the LRV of the specimen using CIE Tristimulus Y10 (The tristimulus values of a colour are the amounts of three primary colours in a three-component colour model and the measured light reflectance is defined by the tristimulus value Y), Illuminant D65 (Standard daylight illuminant) and the 10° colorimetric observer (Standard observation angle).

Light reflectance denotes the percentage of visible light reflected by a surface, weighted for the sensitivity to light of the human eye. Light reflectance values range from 0 (no reflectance) to 100 (absolute reflectance). For example, an LRV of 10 means the surface in question reflects 10% of the light striking it and the higher the LRV, the more light the carpet will reflect and the less artificial light will be needed. A colour difference is visible when a change of LRV of (+/- 1) occurs.

Carpets in plain or multi-colours, pattern variety and pile textures very rarely reach either end of the LRV spectrum and while high LRVs are in many instances the primary aim in the flooring industry and with interior design consultants as this means a lesser level of artificial light is required. This is seen to provide an advantage to assist (i) “green” initiatives, (ii) lower energy costs and (iii) the interior fit-out cost budget.

Energy efficiency is a major consideration when designing interiors and electrical appliances and lighting have improved significantly in terms of providing low consumption options.

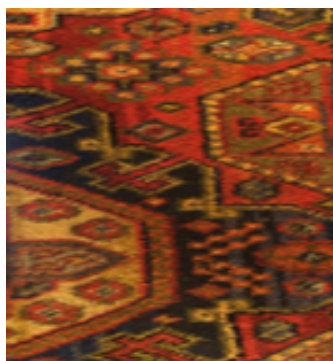
The light reflectance value of the large surfaces within an interior can also contribute significantly to energy savings in modern interiors i.e. the more light that the walls, floor and ceiling can reflect back into the space, the less artificial light will be required.

Modern commercial interiors may feature lighting which adjusts constantly to maintain requirements within the minimum consumption level and with open plan together with the absence of certain ceiling constructions previously considered to be necessary, carpets have become more significant when considering light reflection and additionally, the thermal and acoustic properties they bring to the interiors environment.

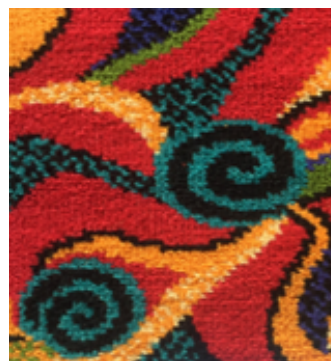
However, use-surfaces in light colours require increased cleaning maintenance resulting in increased cost and higher energy consumption. For carpets, while mid-range plain shades may often be considered the best in theory, the carpets with higher visual colour contrast within the pattern/design can provide an adequate light reflectance value with the additional benefit of better visual appearance retention.

A range of four Axminster (Ax) woven carpets (Sample References AX #1, AX#2,AX#3,AX#4) with pile fibre content of 80% Wool/ 20% Polyamide (3 x cut pile & 1 x cut/loop pile) meeting the criteria of Contract Heavy Duty/ Contract Extra Heavy Duty according to the Australian Carpet Classification Scheme (ACCS) were chosen as examples of products often installed in cinemas, pubs, clubs, hotels, lift lobbies and high-person-number offices where there is a heavy/very heavy density of person traffic and due to the area layout, defined traffic path ways.

Reference Samples (Original)



#1 – Axminster Cut Pile



#3 – Axminster Cut Pile



#2 – Axminster Cut Loop

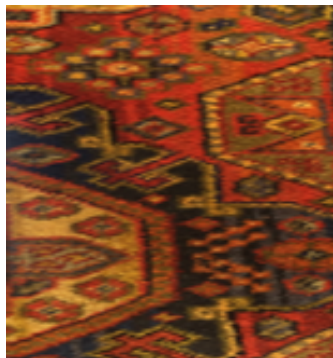


#4 – Axminster Cut Pile

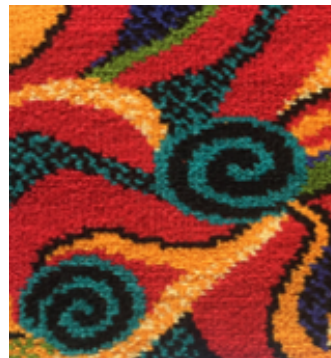
As the light reflectance was believed to change due to the effect of traffic passages and the effect of tracked-in and airborne soiling introduced into and on to the floor covering, a sequence of assessments were conducted.

- (a) On the reference samples as supplied: determination of LRV and L-value (L-value or L* – the colour depth used to calculate visual contrast) using BS8493:2008+A1:2010 Light Reflectance Value (LRV) of a Surface – Method of Test
- (b) Using the Hexapod Appearance Retention Assessment apparatus & test method Woolmark TM247, the Hexapod cycles of 5,000 (to view the progression of structure change) and 8,000 (correlation 3-4 years with traffic volume of 5,500 passages per week) were undertaken and LRV measured
- (c) Laboratory Soiling using the test method Woolmark TM267 followed by LRV measurement

LRV & L-value Measurement Points



#1: 102 measurement points LRV=6.32; L=29.72



#3: 54 measurement points LRV=9.98; L=34.13



#2: 24 measurement points LRV=11.73; L=40.75



#4: 24 measurement points LRV=4.41; L=24.64

Carpet Sample Reference	C/ Pile AX#1	C/L Pile AX#2	C/Pile AX#3	C/Pile AX#4
Original LRV/ Measurement Points	6.32/102	11.74/24	9.98/54	4.41/24
Original L-value/ Measurement Points	29.72/102	40.75/24	34.13/54	24.6/24

Effect on LRV of Walking Passages Using Hexapod 8,000 Cycles*

ORIGINAL

HEXAPOD 8,000 CYCLES



#2: Before & After Hexapod 8,000 cycles

#3: Before & After Hexapod 8,000 cycles

Change of LRV due to traffic passages - a normal loss of Pile Thickness caused by cut pile tuft ends losing some tuft definition and loop pile tufts flattening-off on loop top.

Both changes to the cut pile & the loop pile tufts consolidate the carpet structure and reflect more light (LRV 11.74 to 17.49).

ORIGINAL

HEXAPOD 8,000 CYCLES



#4: Before & After Hexapod 8,000 cycles

#4: Before & After Hexapod 8,000 cycles

Change of LRV due to traffic passages – a normal loss of Pile Thickness caused by cut pile tuft ends losing some tuft definition.

Changes to the cut pile tufts consolidate the carpet structure and reflect more light (LRV 4.41 to 7.51).

NOTE:

* Hexapod 8,000 cycles is correlated to use of the carpet for 3-4 years at a traffic density of 5,500 passages per week

ORIGINAL

HEXAPOD 8,000 CYCLES



#3: Before & After Hexapod 8,000 cycles

Change of LRV due to traffic passages – a normal loss of Pile Thickness caused by cut pile tuft ends losing some tuft definition.

Changes to the cut pile tufts consolidate the carpet structure and reflect more light (LRV 9.98 to 13.18).

ORIGINAL

HEXAPOD 8,000 CYCLES

ORIGINAL



#1: Before & After Hexapod 8,000 cycles

Change of LRV due to traffic passages – a normal loss of Pile Thickness caused by cut pile tuft ends losing some tuft definition.

Changes to the cut pile tufts consolidate the carpet structure and reflect more light (LRV 6.32 to 11.65).

NOTE:

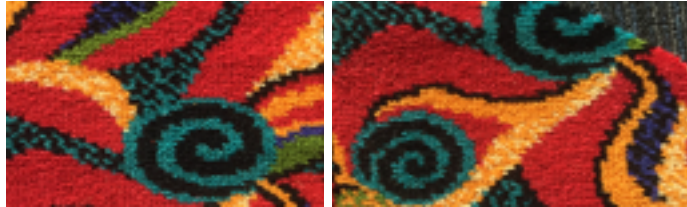
* Hexapod 8,000 cycles is correlated to use of the carpet for 3-4 years at a traffic density of 5,500 passages per week

Carpet Sample Reference	C/ Pile AX#1	C/L Pile AX#2	C/Pile AX#3	C/Pile AX#4
Original LRV/ Measurement Points	6.32/102	11.74/24	9.98/54	4.41/24
Original L-value/ Measurement Points	29.72/102	40.75/24	34.13/54	24.6/24
Hexapod 5,000 cycles LRV/ Measurement Points	9.49/48	16.83/24	8.26/24	7.39/24
Hexapod 5,000 cycles L-value/ Measurement Points	36.04/48	48.01/24	32.80/24	32.18/24
Hexapod 8,000 cycles LRV/ Measurement Points	11.65/48	17.49/24	13.18/24	7.51/24
Hexapod 8,000 cycles L-value/ Measurement Points	39.41/48	48.85/24	40.85/24	32.55/24

Effect of Soiling on LRV

ORIGINAL

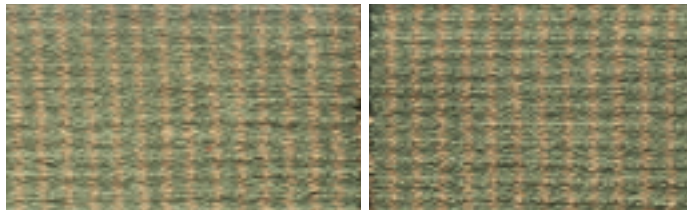
SOILED



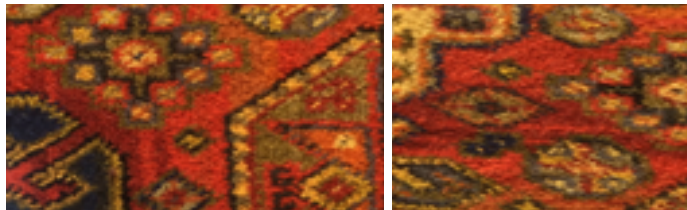
#3 LRV difference: 1.31



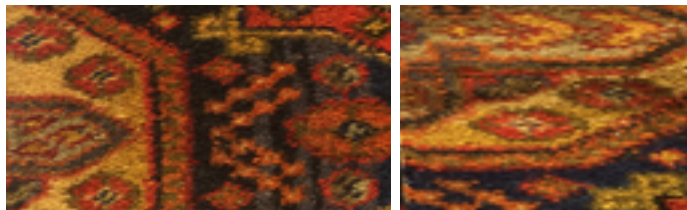
#4 LRV difference: 1.68



#2 LRV difference: 0.38



#1 Pattern View 1



#1 Pattern View 2

'Averaged' LRV
difference: 0.29

Carpets Sample Reference	C/ Pile AX#1	C/L Pile AX#2	C/Pile AX#3	C/Pile AX#4
Original LRV/ Measurement Points	6.32/102	11.74/24	9.98/54	4.41/24
Original L-value/ Measurement Points	29.72/102	40.75/24	34.13/54	24.6/24
Hexapod 5,000 cycles LRV/ Measurement Points	9.49/48	16.83/24	8.26/24	7.39/24
Hexapod 5,000 cycles L-value/ Measurement Points	36.04/48	48.01/24	32.80/24	32.18/24
Hexapod 8,000 cycles LRV/ Measurement Points	11.65/48	17.49/24	13.18/24	7.51/24
Hexapod 8,000 cycles L-value/ Measurement Points	39.41/48	48.85/24	40.85/24	32.55/24
Soiling LRV/ Assessment Points	6.61/48	12.12/24	8.67/48	6.09/24
Soiling L-value/ Assessment Points	30.07/48	41.39/24	32.46/48	29.25/24

By combining the LRV results for HEXAPOD 8,000 CYCLES and SOILING and then comparing this result to the ORIGINAL LRV provides an estimate (shown in Table 1) of the change of LRV over a period of 3-4 years at a traffic volume of 5,500 passages per week.

Table 1: Estimated Change of LRV

Carpet Sample Reference & Comparison	C/ Pile AX#1	C/L Pile AX#2	C/Pile AX#3	C/Pile AX#4
(a) Original LRV	6.32	11.74	9.98/9.98	4.41
(b) Hexapod 8,000 cycles LRV	11.65	17.49	13.18/13.18	7.51
(c) Soiling LRV & Original LRV Difference	0.29	0.38	-1.31/0.00	1.68
(d) Change in Carpet LRV = (b)+(c)-(d)	5.62	6.13	1.89*/3.20*	4.78
Assessment of Change in Carpet LDV				
Appearing Lighter in Colour Overall	Lighter	Lighter	- / -	Lighter
Little Visible LRV Change	-	-	YES / -	-
Moderate Visible LRV Change	YES	YES	- / YES	YES
Appearing Lighter in Depth	Lighter	Lighter	- / -	Lighter
Little Visible Change	-	-	YES / -	-
Moderate Visible Change	YES	YES	- / YES	YES

NOTE:

* While the change in Carpet LRV of 1.89 suggests a visible change of colour as LRV is greater than 1.0, there appears to be Minimal Visible Change when considering the Hexapod and Soiling LRV results together.

Consideration of only the Hexapod result shows a **Moderate Visible Change** of 3.20 in LRV.

LRV & Cleaning Maintenance

To maintain the light reflectance and appearance retention properties of patterned multi-coloured carpets, a suitable cleaning maintenance program needs to be undertaken in accordance with the soiling level description/person passages per week (refer Table 2).

Table 2: Cleaning Maintenance program with Installation & Soiling Level Descriptions/Person Passages per Week (Traffic Volume).

Carpeted areas description (Commercial)	Soiling level description/Person passages/week* (Traffic Volume)	Suggested maintenance program	Suggested maintenance program	Minimum frequency
Executive offices	Light/ Less than 2,999 passages per week	Vacuum traffic areas Full vacuum Spot and stain removal Low Moisture Surface Maintenance clean High Moisture Periodic/Corrective clean	3 times per week 2 times per week Daily – as soon as possible Every 9 months Every 18 months	2 times per week Weekly Daily— as soon as possible Every 18 months Every 36 months
Clerical offices, hospital wards, and hotel bedrooms	Medium/ 3,000 – 6,999 passages per week	Vacuum traffic areas Full vacuum Spot and stain removal Low Moisture Surface Maintenance clean High Moisture Periodic/Corrective clean	4 times per week 3 times per week Daily— as soon as possible Every 6 months Every 12 months	3 times per week 2 times per week Daily— as soon as possible Every 12 month Every 24 months
Corridors and foyers, large offices with high visitor numbers, ground floor shops, hotel lounges, kindergartens, and school classrooms	Heavy/ 7,000 – 14,999 passages per week	Vacuum traffic areas Full vacuum Spot and stain removal Low Moisture Surface Maintenance clean High Moisture Periodic/Corrective clean	Daily Daily Daily— as soon as possible Every 3 months Every 6 months	2 times per week 3 times per week Daily— as soon as possible Every 6 months Every 12 months
Restaurants, school corridors, and hospital public areas, other public areas such as cinemas, pubs and clubs	Very Heavy/ More than 15,000 passages per week	Full vacuum Spot and stain removal Low Moisture Surface Maintenance clean High Moisture Periodic/Corrective clean	Daily Daily— as soon as possible Monthly Every 3 months	Daily Daily— as soon as possible Every 2 months Every 6 months

NOTE:

- (i) (*) Person passages/week* – One Person Passage = one person passing once through any specific area
- (ii) CIAL 2020 FACT SHEET “Carpets in Residential and Commercial Installations” is an information source where regularly asked questions about carpet maintenance cleaning in residential and commercial installations are answered.

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