

Laser Speckle Evaluation



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SP4K-C and Harkness-Screens evaluation

Series 4 Barco projectors: Explore the world of smart laser cinema projectors and discover future-proof technology and outstanding image quality. Delight moviegoers on every occasion.

Harkness screen technology: For over 90 years, we've been at the forefront of technology providing cinema screens and events screens that enhance every projection experience.



Speckle & test

- Laser speckle is an interference pattern which can affect all laser projectors, and to a different degree. It is more pronounced on RGB projectors. This can cause a subjectively 'disruptive' viewing experience for cinema goers. Projector manufacturers mitigate these effects in different ways and to different degrees. This can be done within the projector and sometimes additionally by vibrating the screen. Speckle is also influenced by the type of screen surface the image is projected on

Test setup

- Tested in cinema conditions
- Fixed screen sample size: **2.4 x 1.25m** without any screen vibration mechanism
- White point chromaticity and light were adjusted according to **SMPTE st0431-1-2006** for each sample
- The projector was setup to **14fL**. Differences in light levels affect the perceived speckle
- The calibration was done using **Qalif Ultimate v3.5**

Screens samples

Coated silver screens:

Clarus XC 290
Clarus XC 220
Clarus XC 170
Spectral 240
Precision White (PWT) 2.0
Precision White (PWT) 1.4

Coated White Gain screens

Perlux HiWhite 220
Perlux HiWhite 180
Perlux HiWhite 140

Non coated screen

Matt Plus

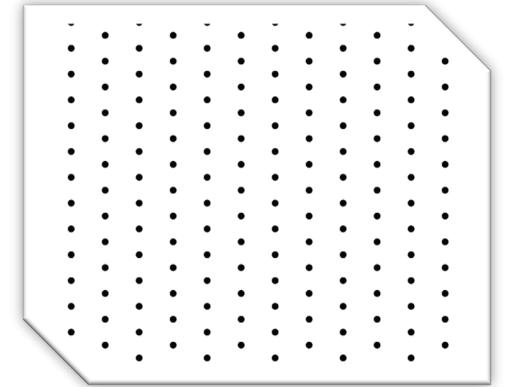
Clarus XC: Next generation passive 3D silver screen technology with a whiter looking surface and improved brightness uniformity above Spectral.

Spectral 240: Considered by cinema exhibitors the optimum 3D projection silver screen surface for passive 3D application using polarized light.

Precision White: Combines RealD coating technology with Harkness' state-of-the-art screen engineering and manufacturing techniques to form a premium offering for RealD Customers.

Perlux HiWhite: Next generation white gain screen surface technology. Considered by leading cinema exhibitors to be the premium surface for 2D and active 3D movies.

Matt Plus: Is a versatile screen surface intended for a variety of auditoria utilising a proprietary PVC based material by Harkness. Engineered to completely mitigate laser speckle using phase, angular and polarisation diversity and provides the base product for all other Harkness screen surfaces.



All samples used Digital Perf

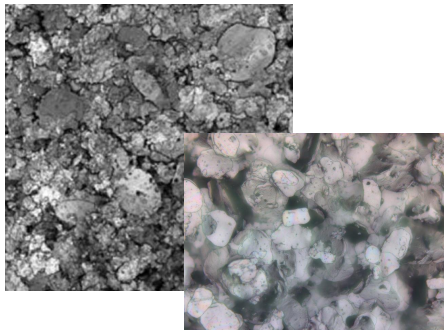
Screens types explained

Screen surfaces have different coating properties which affect reflected light distribution. Premium screen surfaces and lower gain variants typically have wider viewing angles which allow for improved brightness uniformity and can positively affect how speckle is perceived.

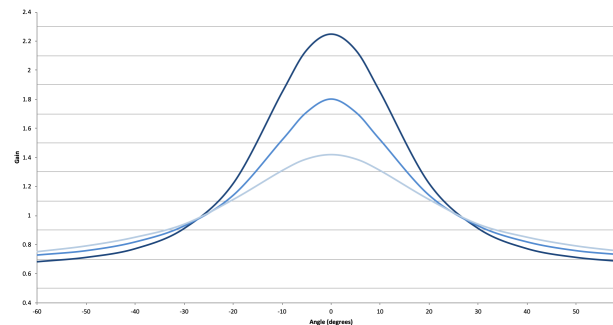
- Matt Plus
- Perlux HiWhite
- Spectral
- Clarus XC
- Precision White Technology

- Non-coated Harkness proprietary PVC
- Premium white gain screen
- Entry level silver screen
- Premium Harkness silver screen
- Premium+ RealD - Harkness silver screen

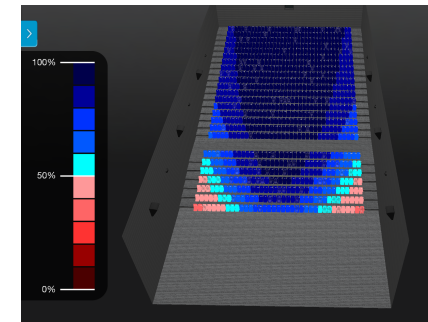
Unique screen coatings



Specific Screen gain characteristics



Auditorium viewing angles performance



All screen type are unique and there is often more than one suitable option per auditorium according to light, geometry and technology.

Visual Inspection - Distance

- The perceived speckle level was rated at three distances from the screen to simulate three viewers position within an auditorium to 2, 4 and 6 times the screen height. Those distances will be called (Front, Middle and Rear)

Front → 2 times the screen height

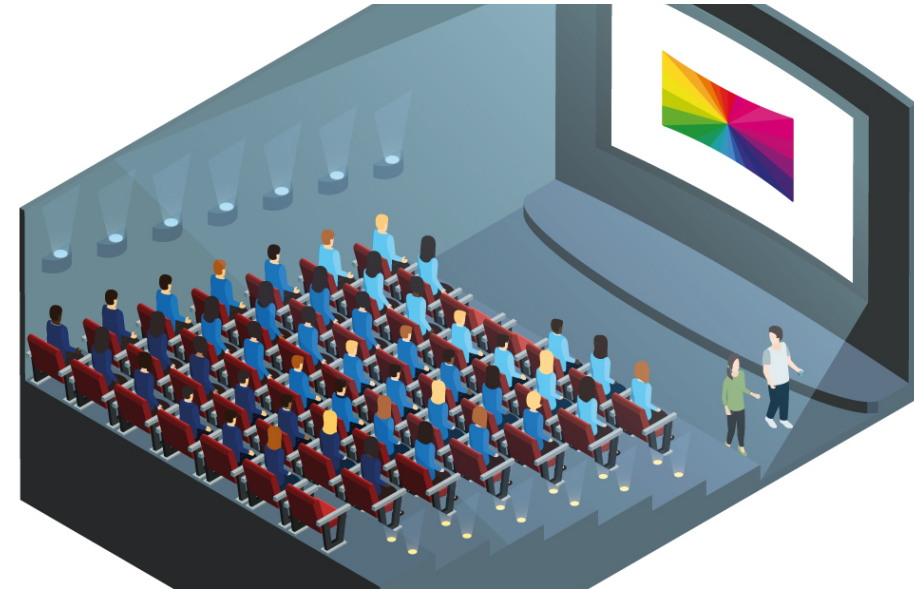
Covers 20% available seats

Middle → 4 times the screen height

Covers 50% available seats

Rear → 6 times the screen height

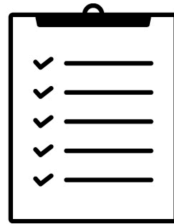
Covers 30% available seats



- Typically moviegoers have a preference for the centre and rear of the seating area. The centre is also where the technician sits to calibrate the experience
- Speckle was rated with projected movie content at each defined position for each screen surface
- Movie content with a mix of light and dark scenes provided a realistic impression of what a moviegoer might experience

Visual Inspection - Scoring

- For each location and projected image or white light the speckle was rated by a number between 0 and 3.5 for each screen:



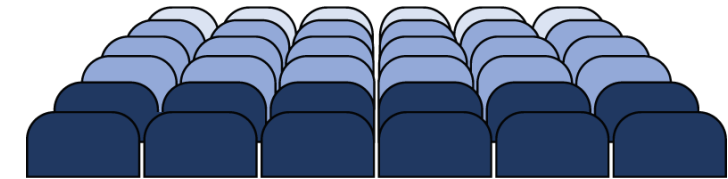
0	Not visible
1	Barely visible
2	Noticeable
3 +	Obvious

- Each individual's eye is a perception factor, although most will agree what is good and what is bad
- Each evaluator was given a results sheet to confidentially complete, results were only compared at the end of the trial

Results overview (by screen family)

0	Not visible
1	Barely visible
2	Noticeable
3+	Obvious

Screen Type	Front	Middle	Rear
Spectral 240	2.3	1.9	1.6
Clarus 290	2.6	2.1	1.7
Clarus 220	2.4	1.8	1.5
Clarus 170	2.1	1.8	1.4
Perlux HiWhite 220	1.8	1.4	1.0
Perlux HiWhite 180	1.4	1.0	0.6
Perlux HiWhite 140	1.1	0.9	0.4
PWT 200	2.6	2.1	1.5
PWT 140	2.1	1.6	1.1
Matt Plus	0.0	0.0	0.0

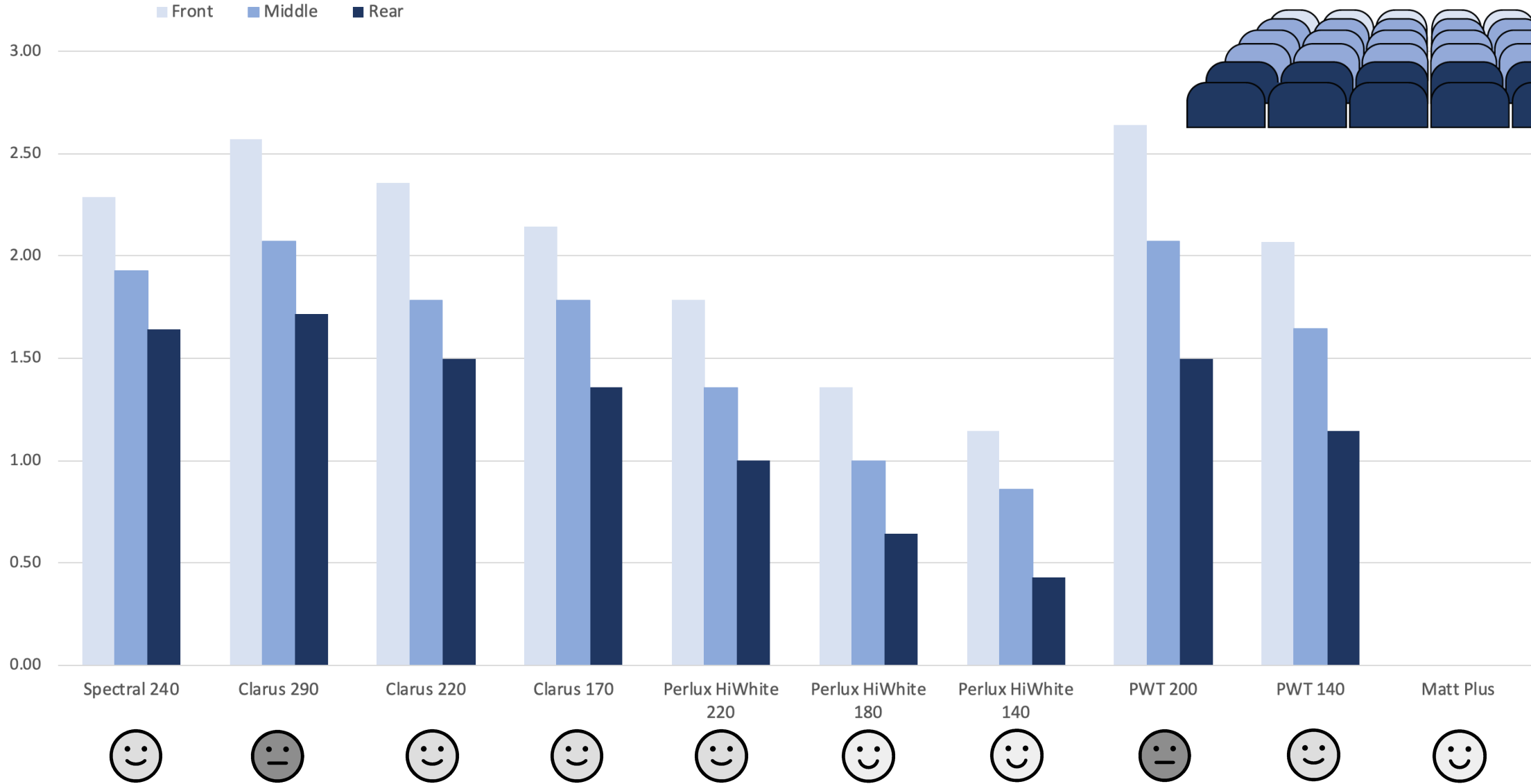
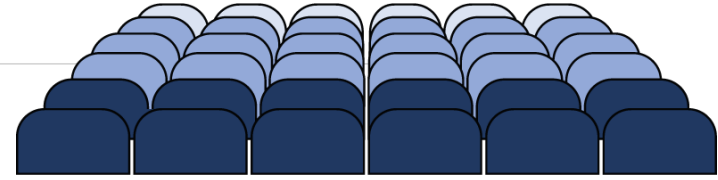


Laser speckle is visually very subjective and distance from the screen surface to the observer is a perception factor . Geometry of the theatre affects the closest and average viewer distance and this should be considered when selecting the correct projector and screen combination.

RGB laser technology in the cinema industry has improved considerably since the earliest RGB projectors, where scores of 3+ would have been much more common.

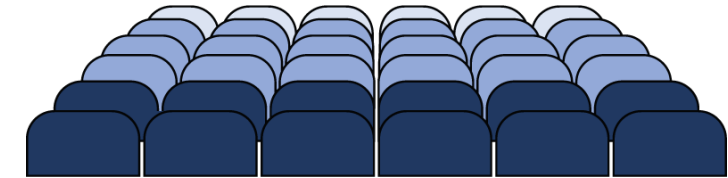
Visual Inspection - Scoring

0	Not visible
1	Barely visible
2	Noticeable
3+	Obvious



White vs Silver screens

0	Not visible
1	Barely visible
2	Noticeable
3+	Obvious



Silver screens

Screen Type	Front	Middle	Rear
Clarus 290	2.6	2.1	1.7
Spectral 240	2.3	1.9	1.6
Clarus 220	2.4	1.8	1.5
PWT 200	2.6	2.1	1.5
Clarus 170	2.1	1.8	1.4
PWT 140	2.1	1.6	1.1

White screens

Screen Type	Front	Middle	Rear
Perluxe HiWhite 220	1.8	1.4	1
Perluxe HiWhite 180	1.4	1	0.6
Perluxe HiWhite 140	1.1	0.9	0.4
Matt Plus	0.0	0.0	0.0

White gain screens looked very acceptable even when speckle was perceived compared to silver screen surfaces. Higher gain silver screens required caution at closer viewing distances.

Suggested guidance

- Visual perception of laser speckle is subjective and the viewers' distance from the screen is one of the key factors
- Typical theatres shapes can be categorized into two main groups, long and short auditoriums:
 - Long auditoriums often have more people seated further away from the screen
 - Short auditoriums often have more people seated closer to the screen
- All white screens looked exceptionally good considering both auditorium shape
- Silver screens also worked well, however caution may be required at closer viewing situations particularly with the highest gain variants

