dnp denmark white paper on Supernova technology & the difference between the two Supernova film types:

Purpose:

The purpose of this white paper is to list and discuss – from a technical and application point of view - the differences between the two different Supernova film types that we are using in the dnp Supernova Screen product portfolio.

Active vs. passive light reflection:

The dnp Supernova Screen product line comprises the world's first lens based optical front projection screens that significantly improves contrast ratios in the final image not only under ambient light conditions but also noticeable in dark rooms. Based on highly sophisticated optical lens technology that actively battles the impact of ambient light we call this new technology for "active light reflection".

Standard white or gray front projection screens, uncoated or coated, either angular- or retro-reflective, bounce back *(diffuse)* all competing incoming light, i.e. projected light, ambient light, light from a candle or from a window, equally into the room. We call it "passive light reflection".

Active light filters:

Supernova screen technology is based on optical filters, actively reflecting projected light from the front while absorbing and filtering out ambient room light from above the screen. DNP's extensive knowledge, based on more than 20 years of innovative experience in optical rear projection technology, allows us to implement optical lens technology into front projection. The optical lens system enables the screen to actively filter ambient light as the screen will only accept and reflect light coming from a source in front of the screen. As such the Supernova screen is unaffected by ambient light in most environments providing high contrast images in areas where standard projection screens can not be used.

Over many years of research dnp has developed a highly efficient light reflector, incorporated in the 0.3mm thin Supernova screen material with the effect that more light coming through the lens system is being reflected back to the viewer – providing the screen with potentially higher gain than competitive screens with the same contrast and viewing angles.

Neutral & accurate color reproduction:

A special neutral black tint, developed by DNP, has been added to the material that does not affect or change the colour balance of the image at all. True neutral colours including black and white are re-created with no colour shift at any viewing angle. This is important as black is not a projected 'colour'. Black represents the absence of light as no digital lamp based projector is able to project black. This leaves it up to the screen to be the active factor in creating deep black levels and high contrast ratios. Every screen tint will have a negative effect on accurate colours reproduction. It will make it hard, if not impossible to correctly colour calibrate the projector.

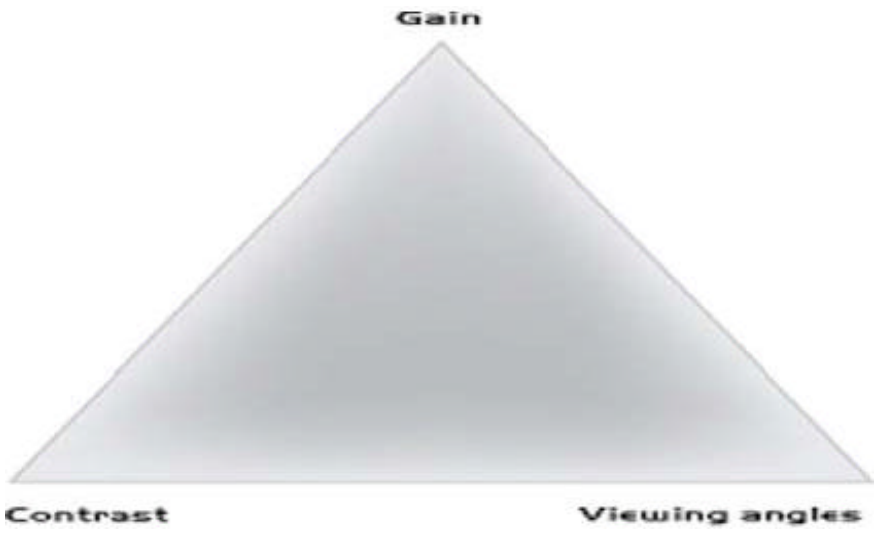
Usually a dark tint leads to very low screen gain. Not so with Supernova! With the reflector's higher gain potential dnp is able to tint the Supernova Screen much darker than normal front projection screens but without dropping the gain. This way Supernova provides neutral, vivid and rich color reproduction of the highest contrast with deeper black and excellent gray scale even in brightly lit rooms.

The Invisible Screen:
DNP Supernova incorporates a specially designed front surface hard-coating providing high quality poster-like images with no shin or any artifacts and no visible screen structure. The hard-coating makes the screen very scratch resistant and thus easy to handle.

By combining all above mentioned elements into one screen Supernova stands out above all other screen in the market place with very unique features.

By the laws of physics all screens including Supernova have to find a balance between the 3 major key elements of:

1) Gain
2) Viewing angles/uniformity
3) Contrast



Based on our vast industry experience we designed two different models for different applications:

- With one model we are focusing on **contrast and gain** enabling users to create a projection system with a relatively cost effective low ANSI Lumen projector to still get the good ambient light rejection and contrast ratios

- With a second model we are focusing on **contrast and viewing angles** enabling users to create extreme wide seating arrangements, soft edge blending and tiling of screens together.

These two different models are created by changing and adjusting the 3 key screen components: The reflective layer, the front coating and the black tint.

Contrast is Key:

Image contrast in both projection systems – front and rear - is calculated the same way:

$$\text{Image contrast ratio} = \frac{B + R}{\frac{B}{C} + R} :1$$

In this equation:

B = Image brightness controlled by the projector's light output, the screen gain and the image size [NIT]

R = The amount of ambient light reflected back to the viewer by the screen [NIT]

C = The projector contrast measured according to the ISO standard [-]

In 98% of all projection systems B will be larger than R leading to the result that if C has a certain size then the equation is dominated by R when you are in a room with ambient light.

Occasionally in a dark room R will be very small and as such C plays a more important role. However, using Supernova in dark environments the screen still provides the best contrast ratios and thus the best grey-scale and best color saturation compared with any other screen.

We will illustrate this by making two typical calculations, one example for a bright room and another one for a dark room:

Bright room calculation example – Supernova Screen in the contrast + gain version:

100" Supernova One Screen in 4:3 aspect ratio (2032mm * 1524mm)
3500 Ansi Lumen projector
Projector contrast ratio – real life – 100:1 (A very good projector)
400 Lux on-screen brightness from ambient light alone
Surface reflectance factor of Supernova One in contrast & gain version = 2,95% of ambient light
Gain of Supernova One in contrast & gain version = 2,0

Image brightness B = gain*Lumens/(screen area * pi) = 2*3500/(2,032*1,524 * 3,1415) = 720 NIT
Reflected ambient light in the front surface of the screen = R = 0,0295*400 = 11,8 NIT

Image contrast ratio = (720+11,8) / ((720/100)+11,8) = **38,5:1**

Bright room calculation example – Supernova in the contrast + viewing angle version:

100" Supernova Infinity in 4:3 aspect ratio (2032mm * 1524mm)
3500 Ansi Lumen projector
Projector contrast ratio – real life – 100:1 (A very good projector)
400 Lux on-screen brightness from ambient light alone
Surface reflectance factor of Supernova One in contrast & viewing angle version= 2,5% of ambient light
Gain of Supernova One in contrast & viewing angle version = 0,8

Image brightness B = gain*Lumens/(screen area * pi) = 0,8*3500/(2,032*1,524 * 3,1415) = 288 NIT
Reflected ambient light in the front surface of the screen = R = 0,025*400 = 10 NIT

Image contrast ratio = (288+10) / ((288/100)+10) = **23,1:1**

Bright room calculation example – Standard matt white front projection screen:

100" standard matt white front projection screen in 4:3 aspect ratio (2032mm * 1524mm)
3500 Ansi Lumen projector
Projector contrast ratio – real life – 100:1 (A very good projector)
400 Lux on-screen brightness from ambient light alone
Surface reflectance factor of a standard matt white screen = 43% of ambient light
Gain of standard matt white screen = 1,0

Image brightness B = gain*Lumens/(screen area * pi) = 1*3500/(2,032*1,524 * 3,1415) = 360 NIT
Reflected ambient light in the front surface of the screen = R = 0,43*400 = 172 NIT

Image contrast ratio = (360+172) / ((360/100)+172) = **3,0:1**

Dark room calculation example – Supernova screen in the contrast + gain version:

100" Supernova One Screen in 4:3 aspect ratio (2032mm * 1524mm)
2000 Ansi Lumen projector
Projector contrast ratio – real life – 100:1 (A very good projector)
10 Lux on-screen brightness from ambient light alone
Surface reflectance factor of Supernova One in contrast & gain version = 2,95% of ambient light
Gain of Supernova One in contrast & gain version = 2,0

Image brightness B = gain*Lumens/(screen area * pi) = 2*2000/(2,032*1,524 * 3,1415) = 411 NIT
Reflected ambient light in the front surface of the screen = R = 0,0295*10 = 0,295 NIT

Image contrast ratio = (411+0,295) / ((411/100)+0,295) = **93,4:1**

Dark room calculation example – Supernova in the contrast + viewing angle version:

100" Supernova Infinity in 4:3 aspect ratio (2032mm * 1524mm)
2000 Ansi Lumen projector
Projector contrast ratio – real life – 100:1 (A very good projector)
10 Lux on-screen brightness from ambient light alone
Surface reflectance factor of Supernova One in contrast & viewing angle version= 2,5% of ambient light
Gain of Supernova One in contrast & viewing angle version = 0,8

Image brightness B = gain*Lumens/(screen area * pi) = 0,8*2000/(2,032*1,524 * 3,1415) = 165 NIT
Reflected ambient light in the front surface of the screen = R = 0,025*10 = 0,25 NIT

Image contrast ratio = (165+0,25) / ((165/100)+0,25) = **87,0:1**

Dark room calculation example – Standard matt white front projection screen:

100" standard matt white front screen in 4:3 aspect ratio (2032mm * 1524mm)
2000 Ansi Lumen projector
Projector contrast ratio – real life – 100:1 (A very good projector)
10 Lux on-screen brightness from ambient light alone
Surface reflectance factor of a standard matt white screen = 43% of ambient light
Gain of a standard matt white screen = 1,0

Image brightness B = gain*Lumens/(screen area * pi) = 1*2000/(2,032*1,524 * 3,1415) = 206 NIT
Reflected ambient light in the front surface of the screen = R = 0,43*10 = 4,3 NIT

Image contrast ratio = (206+4,3) / ((206/100)+4,3) = **33,0:1**

Result overview of contrast of different screens in two environments with specific conditions:

Screen type	Bright room	Dark room
Supernova in contrast & gain version	38,5	93,4
Supernova in contrast + viewing angles version	23,1	87,0
Standard matt white front screen	3,0	33,0

Contrast is key as the human eye will only accept images with a certain amount of contrast to be good. Empirical studies show that below 15:1 in contrast ratio in the final image is not acceptable to the human eye. Furthermore contrast above 20:1 is regarded to be good bye the human eye.

With Supernova dnp is the first projection screen manufacturer breaking the 20:1 contrast barrier under normal ambient light conditions.

Questions:

Should there be any questions to the data or explanations in this document please do not hesitate to contact:

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Technical specifications for the two Supernova film types:

Supernova Specifications

Screen Type	Max size	Max Image Width	Max Image Height	Minimum LTR	Maximum LTR
Supernova film type	Diagonal inch	[MM] / ["]	[MM] / ["]	-	-
High contrast & Gain	120" (16:9)	2657 mm / 104.6"	1525mm / 60.0"	1,8:1	8
High contrast & viewing angles	120" (16:9)	2657 mm / 104.6"	1525 mm / 60.0"	1,5:1	8

Screen Type	Film Thickness	Peak Gain	Lenticular Pitch	Horizhontal Half gain angle	Vertical Half gain Angle
Supernova film type	[MM] / ["]	-	[MM] / ["]	[°]	[°]
High contrast & Gain	0,35 mm / 0.014"	2,0	0,065 mm / 0,0026"	20	10
High contrast & viewing angles	0,29 mm / 0.0114"	0,8	0,065 mm / 0,0026"	85	12

Screen Type	Soft edge blending	Soft edge blending	ISF Approval	Tiling possibility	Curving possibility
Supernova film type	Horizontal	Vertical	-	-	-
High contrast & Gain	No	No	No	No	Yes
High contrast & viewing angles	Yes	No	Yes	Yes	Yes

Screen Type	Rolling possibility	Fit with nornmal projector	Fit with normal projctor	Fit with powerfull projector	Fit with powerfull projctor
Supernova film type	-	Bright room	Dark room	Bright room	Dark room
High contrast & Gain	No	Yes	Yes	Yes	No
High contrast & viewing angles	Yes	No	Yes	Yes	Yes