Commission Supérieure Technique de l'Image et du Son **[French Image and Sound Superior Technical Commission]**

Fédération Nationale des Cinémas Français **[National Federation of French Cinemas]**

TECHNICAL GUIDE

FOR THE PROJECTION BOOTH IN DIGITAL CINEMA

Instructions for a successful installation

in your cinema

This guide to installing digital cinema projection was written by the CST - ***Commission Supérieure Technique de l'Image et du Son*** and FNCF ***- Fédération Nationale des Cinémas Français*** during 2010

The **EDCF - European Digital Cinema Forum** saw that this was the best practical guide to installing digital projection that has been written and would be invaluable to exhibitors. EDCF requested the opportunity to translate this document from its original French into English to allow as wide a circulation as possible within the cinema industry.

This guide has been prepared by one of the most important organisations for exhibitors in Europe and by a technical organisation specialising in the cinema industry; this guarantees that answers are given to all the questions that exhibitors might wish to ask.

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PREFACE

This document is the result of co-operation between the *Commission Supérieure Technique de l'Image et du Son* [French Image and Sound Superior Technical Commission] and the *Fédération Nationale des Cinémas Français* [National Federation of French Cinemas].

It aims at providing assistance in compiling the specifications for your digital projection equipment. It exclusively focuses on technical questions and does not address the economic, financial and political dimensions of digital cinema.

Although it does not claim to be complete, this guide intends to be as complete as possible to assist you with planning your installation. The latter has to meet in France the AFNOR NF S27-100 standard *("Salle de projection électronique de type cinéma numérique"* ["Electronic projection room of the type digital cinema"]), the ISO standard which is about to be published as well as several other recommendations that are in force (DCI, CST, SMPTE). There is no device or brand that is privileged here.

Together, we have to successfully make this important transition which is the most demanding challenge our industry has to meet since, at the beginning of the 1930s, cinema progressed from silent films to films with sound. Although more than 2,100 screens are equipped in France today (i.e. 40% of the total screens count) – one of the most rapidly growing d-cinema market in the world - this challenge is far from being accomplished. We have now been working on this transition for more than ten years in order to make it happen under the best possible conditions for the cinemas – all cinemas, regardless of their size, their type, their programming, their location etc.

We continue to work with the objective that the exhibition business as a whole will succeed in its transition towards digital cinema under the best possible conditions while keeping in mind the diversity of cinemas and diversity of content.

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1st PART – EQUIPPING THE PROJECTION BOOTH

In this part, we will have a look at the environment in which the digital projection system will be installed. Actually, more recent projection booths were not necessarily designed for a double projection system. The booths that are equipped or were formerly equipped with two reel systems are more suitable for a transition to digital. The others sometimes have to be rearranged. Some adjustments have to be made to ensure optimal projection quality, maintain technical standards, comfortable working and ensure the safety of the material.

I. Booth space required

To accommodate the new digital equipment, the projection booth has to undergo some changes and these should be well prepared to ensure that the workplace remains comfortable and practical.

a. The digital projector

The digital projector is the new device that comes into your projection booth. It is essential to provide it with a position that gives you the ability to work easily all around it and ensures the right operating conditions. In no instance, should you make compromises concerning any alterations required.

Today, it is essential that the projection booths provide enough space to take up two projectors, one 35 mm and one digital projector. In order to correctly assess the floor surface required for this digital projector, one has to know that it will require the same space as a 35 mm system. The projector will be installed on a frame that is either a specific table or the pedestal of the projector itself (the rectifier is often integrated in this pedestal).

Please find below the various possibilities you could meet when installing your digital projection system:

Case no. 1: *You have sufficient space in your projection booth for the following reasons:*

- You are equipped with two projection systems: In this case, you replace one of the two systems in order to free some space for the digital projector.
- One of the two systems, 35 or 16 mm (or even 70 mm!) was already removed from the booth a long time ago.
- Your booth is up-to-date and you have already taken the space for the digital projector into account.

In case you have to remove one of your two 35 mm systems, you have to:

- Check which system to remove in order to optimize the position and the installation point of each of the two projectors. The lens system is not necessarily centred on the digital projector; this decentralisation of the lens on the projector can actually, for technical reasons, change the plan you had regarding the position of each of the machines. As the aim is to centre the lens, the projector will require a little bit more

space on the left-hand or right-hand side in order to be well positioned.

- If you still work with a two reel system (600 or 1,800 m), you have to purchase the system that is required to unwind the film (high capacity spool system, vertical or horizontal) as well as film rollers to secure the film path from the spool system to the projector. Maybe you also have to think of modifying the overall fittings of the booth.

- Do not count on the other 35 mm system as a back-up projector!

***Case no. 2**: You have no space in your booth for the following reasons:*

- You only have one 35 mm system and only one projection porthole. Consequently, one of the following solutions has to be considered:

    - Create the portholes required for the projection as well as for viewing. Make sure you have authorisation to modify the wall separating the booth from the auditorium, and that the new holes will not affect the structure of the building.

    - Enlarge the projection window in order to create a large glass window. In this case, you have to pay attention to the stray light that this window may bring into the auditorium. You also have to pay attention to potential audio interference between booth and auditorium that such a glass window may create. The larger the glass the more risk there is that interference increases!

    - Maybe slightly reposition the 35 mm projector (and, consequently, re-cut the projection mask) in order to avoid the digital projector being too much off-axis.

    - In some cases, consider putting the projectors on a rail system so that they can be moved more easily (see § “positioning of the projector“).

    - Maybe you have to abandon 35 mm projection. But please be careful! Not all films are currently available in digital format, so please check your programming in detail before taking this decision.

- You cannot create a second projection porthole:

    - You have to put the projectors on a rail system provided there is enough place beside the projectors.

    - As a last resort you have to part with the 35 mm projector. But be careful! This needs to be looked at in detail since this decision should not have any negative effects on the smooth running of your programming! Therefore, you have to study very precisely if all the films programmed are available in digital format before deciding to remove the 35 mm projector.

If a projection porthole (or glass window) has to be created, it has to meet the following criteria:

- The minimum size of the new projection porthole will be the same as the 35 mm porthole (visible glass surface of 40 x 30 cm).

- It is preferable that the window frames can be opened in order to facilitate the

maintenance of the two sides of the window.

- The glass must be without optical faults, neither as far as geometry nor as far as colorimetry are concerned. The use of glass whose surface and density are treated is recommended. You have to use an extra white glass with anti-reflecting coating; this avoids any losses due to absorption of 10 % of the luminous flux. Be careful: some glasses may cause problems with 3D passive polarized light.

- Portholes that are installed in booths serving several auditoria have to meet the security standards, especially as far as fire resistance is concerned (resistance of half an hour). This precondition does not apply to booths that only serve one auditorium. Nevertheless, certain 3D projection systems may stipulate by contract a certain standard for the projection porthole. You have to specify this point when choosing the equipment.

In some cases, the projection porthole will need to be larger:

- In case of a thick wall and an off-centre position of the digital projector.

- If you have to move the projector backwards in order to add another system (lens or certain 3D solutions).

In any case, you have to make sure that there is enough space left around the digital and the 35mm projectors to allow easy maintenance of the two systems. It would be a pity if the machines (projectors or other devices in the booth) had to be moved to carry out preventative or curative maintenance work and if there was a risk that the relevant parameters for a good picture on the screen needed to be re-set.

b. The rectifier of the digital projector

As in 35 mm projection, a rectifier is required to power the lamp.

- If the rectifier is integrated in the projector or in the pedestal of the projector, you do not have to find additional space for it.

- If the rectifier is an additional device, you have to find a place for it for the following reasons:

    - Often, it cannot be integrated within the table serving as a pedestal for the projector.

    - It has to have good air circulation to be cooled perfectly.

    - The projectionist needs to access its safety switch, if available.

    - Its maintenance has to be simplified.

    - It is strongly recommended not to place it directly on the floor in order to avoid an accumulation of dust.

c. One additional technical rack per site

With all this new equipment, an additional rack per site is required for your digital equipment. Make sure that you have enough space for it.

This 19'' rack (19 inches), which should be as tall as possible, serves to take up the central library, the different Ethernet switches*[1] or any other equipment required for your digital installation.

A ventilated rack is suitable in any case. Install it in such a way so that its interior can easily be accessed to simplify any work on the cabling and connections. This rack does not necessarily have to be located in the booth but make sure that all devices can be connected to it (See § "Network").

[Footnote [1] *The terms and abbreviations marked with a * are defined in the terminology annexed to this guide.]*

II. Power supply

Despite of its high importance, mains power distribution is often neglected. Have your mains power distribution inspected and checked.

Your electrical control cabinet has to be modified for one of the following reasons:

- **There is one additional projection system in your booth.**
  In this case, you have to consider its power requirements – three-phase or single phase – as well as the power distribution to all its peripheral devices.
- **The electric power supply has to be reorganized and a re-equilibration of the phases has to be carried out.**
  If you had a 35 mm projector with a three-phase power supply you have to re-equilibrate the phases to ensure a correct distribution in case the digital projector model only requires a single-phase power supply.
- **Certain devices have to be left switched on permanently.**
  Use separates breakers on the same phase. That way, the general power switch can stays on while some devices can be switched off using their independent breaker.

Depending on the manufacturer, the projectors and the lamps they use, the electric power supply may vary. The following table gives you an idea of the electric power supply that has to be considered:

Lamp power	Power required for the projector
1 kW - 2 kW	single-phase - 200 / 240 V - 16 A
2 kW - 3 kW	single-phase - 200 / 240 V - 20 A
2 kW - 4 kW	single-phase - 200 / 240 V - 26 A
3 kW - 4 kW	three-phase - 400 V - 28 A
2 kW - 6.5 kW	three-phase - 400 V - 32 A

In any case you have to consult the technical specifications of each projector.

Use a 16 A or 20 A single-phase terminal strip in the pedestal of the projector (that is one of the duties of your installer). It serves to connect the server, the *scaler**, the different monitors, 3D systems, etc. **All these peripheral devices have to be on the same phase as the sound system to avoid any audio interference.** For practical reasons, you can opt for a power supply with power sockets; in this case, you have to make sure that they are protected by a 30 mA protection device.

You also have to provide for a service connection for the technical rack mentioned earlier, wherever it may be located in the cinema. Provide for a service connection of 20A single-phase.

In territories, in which problems with the electric power supply occur frequently (for example local power-cuts in the mountains) or to prevent an unscheduled deletion by the server**, it may be necessary to invest in an uninterruptible power supply (UPS)** that maintains the electric current for several minutes. This UPS can be installed in all types of booths.

The UPS can turn out to be useful for the server and for a potential rack. The cost of a UPS ensuring the power supply for the machines is not too high. It is advisable to install a UPS that is recommended by the manufacturer of the server or the library system.

III. The air extractors for the lamphouse

Extractors are often listed as an option in the quotations. So do not forget to add them to your order!

The hot air produced by the projection lamphouses must always be extracted to the outside of the building. This is not new and you have to be very careful regarding this exhaust air. The correct exhaust of the hot air ensures a longer service life of your equipment as well as better ageing characteristics of your lamps and an optimized functional capability of your installation.

You have to correctly calibrate the flow of the exhaust air in accordance with the lamp power (or the max. lamp power allowed for the lamphouse - see table hereafter).

In general, projector lamphouses require an exhaust air flow between 400 m^3/h (minimum required for bulbs up to 3 kW) and 1,200 m^3/h for bulbs over 6 kW.

Have the exhaust duct carefully checked (at the exit of the lamphouse) in each of the ventilation channels that serve the exhaust air of your projector (35 mm and digital).

It is recommended not to fix the extractor directly to the projector since the vibrations created by the rotation of the ventilation system might disturb the micro-mirrors*. It is therefore better to move it further away in the pipe system. Although being moved, the extractor has to remain accessible to ensure its maintenance (cleaning, replacement in case of failure).

Please be careful not to circulate air from one lamphouse to another. You might have to equip your system with a check valve in order to avoid an accumulation of hot air from one lamphouse to the other. Refrain from installing a manual selection valve as it should be possible that the two lamphouses are switched on while being extracted at the same time. It is preferable to connect this extractor to the same electrical protection as the projector. Certain projectors are equipped with a security device; the latter has to be aspirated to make it possible to start the machine. Other projectors do not have this security device.

The diameter most commonly required for such exhaust air is 201 mm (80''). These details have to be specified when choosing the projector. You have to discuss this issue with your ventilation company well in advance of your project in order to guarantee that you can extract the volumes required.

Please note: The data indicated in the manufacturers' documentation in view of the exhaust air volumes are often stated in CFM *(Cubic Feet per Minute - ft^3/mn)*. In France, however, we are used to working with volumes in m^3/h. The table below may help you to convert this data and to determine the exhaust air volume required:

CFM ft³ / mn	m³ / h (rounded values)	LAMP POWER (in Watts)
1	1.699	-
235	600	2,000
350	600	3,000
470	800	4,000
600	1,020	6,000
706	1,200	7,000

It is also very important to observe the cooling-off period of the lamps at the end of the screening (it is the same as for 35 mm lamphouses). In general, a time release (by counting or flashing of the indicator lights) indicates the time required. The cooling-off period is the same that applies to 35 mm lamphouses.

Please pay attention to this point: you will significantly increase the service life of your lamps as well as of your equipment and respect the conditions of your warranty.

IV. Air-conditioning of the projection booth

If projectionists are sensitive to excessive heat in the booth, this applies even more to the machines! Therefore, air-conditioning of the projection booths is a necessity!

The projectors currently on sale in the market switch to default mode if the temperature in the projector exceeds around 37°C. This switching to a degraded mode may be indicated in a

number of ways, from a simple warning message to a complete stop of the projection in case of excessively high temperatures. The manufacturers recommend a temperature in the booth not exceeding 30°C during operation.

This digital projection system consisting of numerous electronic cards is after all very heat-sensitive. The compactness of the machines, the additional heat produced by the electronic equipment, careful treatment of the heat of the electronic equipment are parameters for which you have to take precautions.

A system that air-conditions the booth and that maintains a constant temperature is mandatory.

As we have seen before, the heat produced by the lamp is significant. If a digital projection system is added to a 35 mm system this produces considerable heat in the booth. Please keep in mind that with a projection lamphouse from 1,000 W to 7,000 W you can heat a surface from a small bathroom up to a room of 25m²! Therefore, you have to reduce the temperature in the booth in order to avoid disruption to the operation.

2nd PART - THE TOOLS OF DIGITAL PROJECTION

Technically speaking, digital projection does not radically change classic film projection even though the mechanical projector head has been replaced by a digital head, the film spool by a hard disk drive and the platter system by a server. We have already paid utmost attention to these points in order to ensure that the projection quality practically remains the same. Of course, the picture is not visible on its photosensitive carrier anymore: It is from now on quantified in binary mode in files. This picture is going to be created on a matrix and be illuminated in the same way as we do it in celluloid.

To make digital projection work, you need the following devices in your booth:

- A digital cinema projector.
- A digital cinema server.
- A suitable lens system.
- A 3D system, if applicable.
- If required, a converter that allows you to show alternative content with the digital cinema projector (this equipment can of course be moved from screen to screen).
- One (or more) libraries to store the films. This is independent and may be located anywhere in the cinema as long as it is connected to the booth network.
- A central supervisory system allowing a centralized management of all booths (it is located in the main booth).
- An extranet network to connect all machines in all booths with each other.
- All playback systems (servers or additional content playback systems) will be connected to the audio rack. In many cases, you will have to add a digital / analogue audio converter.

Although the aim here is not to describe the mode of operation of the digital projection system in detail, various issues will be particularly addressed in order to choose the different devices correctly. Furthermore, all settings to which you have to pay attention to ensure optimal projection conditions will be listed.

I. The projector

As your choice of today will directly influence your picture of tomorrow, it is important to correctly choose your projector depending on the field of application you would like to use it in. A digital cinema projector remains after all a cinema projector! To choose the projector model it is essential that it is correctly adapted to the size of the screen that it has to illuminate and to the field of application (potential 3D projection).

The system that provides for implementing digital projection is a projector whose task is to transform digital data of the picture into light that appears on the screen. This system has to meet certain criteria as far as both its design and its settings are concerned. The parameters are the ones described in this document.

Today, there are two competing technologies in the market that are capable of implementing digital cinema projection in compliance with the criteria stipulated by the DCI* recommendations, the AFNOR* NF S27-100 standard in France and the ISO standards.

These technologies are:

- DLP* (Digital Light Processing) technology, developed by Texas Instruments.
- SXRD* (Silicon Crystal [X-tal] Reflective Display) technology, developed by Sony.

The different criteria defined in the document do not consider the technology deployed in the projector. **One has to remain free to use any technology as long as it meets the requirements as stated in the ISO standard.**

Historically, the recommendations and standards were fixed to a certain number of criteria aimed at defining the quality of digital projection as the minimum equivalent to the one in 35 mm (on positive film). The minimum resolution that has served to define digital cinema projection since 2003 is called “2K“*, this means 2,048 pixels per line (horizontal) by 1,080 lines (vertical).

One picture element or pixel is the smallest element of the picture. Consequently, a picture is created by a linear array of pixels; it is no longer created by non-linear and randomized silver salts as on a photochemical carrier.

Even if the SXRD technology (Sony) only exists for 4K* (although it also allows playing 2K), the DLP technology (Texas Instruments) has been marketed in 2K until now. When this guide was edited, a 4K matrix was being launched and marketed for the beginning of 2011.

The standard specifies that the minimum resolution that must be observed is 2K.

However, the notions regarding resolution remain subjective. Although 2K is defined as being at least equivalent to 35 mm, 4K is not equivalent to 70 mm! And as 70 mm was only of interest for large screens it might be the same for 4K.

- Consequently, 2K resolution remains sufficient.

- The choice of an upgradable system is possible. Make sure that the projector you buy can be upgraded.

One has to know that there are, in 2K, two sizes of DLP matrices. The size of the matrix is indicated by its diagonal line:

- The 1.2'' matrix: Historically, this is the first 2K matrix. As it is larger, it fits the projectors that are designed for all screen sizes. Today, it is used in projectors that are capable of accepting the 4K matrix (that has a diagonal line of 1.38'') at the beginning of 2011.

- The 0.98'' matrix: It fits projectors for which there is a limit regarding the screen width they can illuminate. Actually, the matrix 0.98'' does not support lamps above 3 or 4 kW which limits the picture size projected. Texas Instruments have not made an announcement about a 4K 0.98" matrix.

1'' (inch) is equal to 25.4 millimetres. For the sake of explanation, the diagonal line of a photogram in 1.85 is around 0.94''.

The projection system must at least meet the following criteria:

- Have a tri-DMD* head when it relies on Texas Instruments technology.
  A DLP Cinema projector obligatorily has to have 3 matrices - mono DMD is not possible.

- Have a tri-SXRD head when it relies on Sony technology.
  An SXRD Cinema projector obligatorily has to have 3 matrices - mono SXRD is not possible.

- Have a minimum resolution of 2K.
  This is the minimum resolution to be comparable to 35 mm projection.

- Be "FIPS 2*" certified in terms of security.
  This is the security standard required by the Majors and defined in DCI specifications.

- Take up a *Media Block*.
  The picture must only be processed in the projector. This is a part of the security protocol.

- Play 3D in *triple flash* on the whole surface of its matrix.
  You have to avoid *double flash* which might be offered to you (above all in the second-hand market): it has got a certain number of inadequacies and will disappear in time.

- Be HDCP* compatible.
  It's a security system for digital play back of Blu-Ray disks. Please note that some projectors are not HDCP compatible: in this case, it is possible to carry out an upgrade but this is not free of charge.

- Manage the colour spaces X'Y'Z', YCxCz, YCbCr and RGB.
  These are different colour spaces required for the settings to play 2D, 3D and video content on a digital projector.

The quantity and the quality of the illumination are aspects that you should pay utmost attention to as far as the choice of your future projection system

is concerned.

Different projector models are available depending on the maximum screen widths they can be used for and, consequently, the type of lamps they use. Please bear in mind that if you would like to screen in 3D, a change in the lamp power must be possible. This point will be addressed in § “3D“.
The related choices affect above all the environment of the projector and the way to operate it. These different parameters should be explained by your integrator to assist you in making your choice.

a. Operating interfaces

It is essential that an operating interface is taken into account to operate and manage your projector correctly. It is important to choose the appropriate tools depending on the model in question.

All projectors include a control panel allowing operation of the principal functions (format change, operating the shutter, igniting / switching off the Xenon bulb, focus, zoom and shift* [optical decentralisation of the picture, settings explained in § “Positioning of the projector”]).

The way to “enter into” the settings, the maintenance or the different parameters of the machine, vary from one brand to another, even from one model to another. Certain projectors have internal software that is integrated into the machine and can be displayed by connection to a computer; others have a basic remote control that does not provide for an overall display of the parameters; yet others can only manage the machine completely by means of software that has to be installed on a computer or on a touch panel (that may also be quoted for together with the projector).

These different operating and interface modes are not an option. It is required to equip yourself with the following:

- Either a touch panel that may be an optional extra.
- Or a computer that can easily be connected to the projector.
- Or management software and its potential license.

These elements are necessary to operate the machine (for example, when a new lamp is indicated during the changing of the bulb, during the alignment procedure of the lamp, the verification of the temperature in connection with the different parts of the projector, etc.).

In any case, the projector should be operated by means of a computer that is connected to the network or via a laptop. However, it must be in the same address plan of the internet protocol (IP plan) as the projector.

For certain projector models, if you do not want to change the IP plan between the daily use of your computer and the operation of your projector, connect yourself to the latter by means of a serial port or an interface which allows the memorizing of the different IP addresses that you would like to use.

b. Projection lenses

You have to choose the focal length correctly and decide whether or not to use an anamorphic lens.

Unlike 35 mm projectors, there is no turret on a digital projector but a zoom lens.

Therefore, it will be necessary that this lens can project images on your screen:

- Either in “full height“ (for picture formats smaller than 1.90).
- Or in “full width” (for picture formats bigger than 1.90).

The ratio 1.90 is the ratio of the different DLP and SXRD matrices. It is obtained by dividing the number of pixels per line (2,048 or 4,096) by the number of lines (1,080 or 2,160). All images are created on the matrix as if the latter were a screen. Consequently, depending on their ratios, they do not occupy the total surface of the matrix.

The CinemaScope image is the image for which one essential question arises: Do you have to add a hypergonar or an anamorphic lens to project it as in 35 mm? You have to know that the use of an anamorphic lens and the complete illumination of the matrix allow a reduction in the loss of light of your projection. However, for economic reasons, the decision is often made against this kind of lens. You really have to look at this subject in detail. The different standards and recommendations do not set any condition with regard to the projection of a CinemaScope picture. The CinemaScope file, as we will see in the following paragraph, is supplied on the DCP* with a picture of 2,048 x 858 pixels. The loss of light on the matrix is therefore significant (this is due to the fact that there are a large number of unused pixels). This loss of light is in the order of 21%. By resizing this image electronically to the height of the matrix, it regains the total number of pixels and recovers the total amount of light reflected by the matrix. The solution with anamorphic lenses is recommended for screen widths that are difficult to illuminate, i.e. from a width of 15 meters (45 feet) upwards. That way, with these dimensions, it is much easier to meet the illumination criteria required, even if the anamorphic consumes 4 to 5 % of the light. By using an anamorphic lens, the gain of light is therefore in the order of 15%.

You have to know that the anamorphic coefficient in digital cinema is 1.26. This coefficient is the relation between the ratio of the CinemaScope picture (2.39) and that of the matrix (1.90), or the ratio between 1,080 and 858.

To calculate the focal length (that actually is a magnification factor), you have to divide the throw distance by the width of the projected image and for both formats 1.85 and 2.39. Therefore we have:

Focal length = Throw distance / width of the PROJECTED picture

Each projector is at least equipped with a zoom; there are some precautions to take in order to obtain the best lens configuration.

The manual zoom allows you to configure the projector with the equivalent of a prime lens. It becomes the equivalent of a 35 mm prime lens from the moment when it is adjusted once and for all. This lens configuration does not change.

The manual zoom is only possible:

- If your screen is in 1.90 or 1.85 format and the screen width is not too important in order to avoid risking a too great loss of light.
- If it is equipped with an anamorphic lens for screens with the ratio 2.39 (or 2.35).
- If it is equipped with a *wide converter* (a solution currently proposed by one of the manufacturers): this is a lens with a zoom coefficient of 1.26 (in both, the vertical and the horizontal line). It plays the role of an adaptor of the focal length. It allows the change from 1.85 format to 2.39 format without changing the value of the primary zoom and avoids electronic resizing of the picture. Nevertheless, this procedure increases the pixel size and absorbs around 25% of light.

	ADVANTAGES	**DISADVANTAGES**
MANUAL ZOOM set with fixed focal length	- rapid format changes - one single setting	- difficult to use for Scope screens - can only be used in this configuration on screens in 1.85 format
MANUAL ZOOM + SECOND LENS (hypergonar or *wide converter*)	- can be used for screens of all formats - allows to regain light on the matrix in Scope format (with hypergonar) and to abide to the standards and recommendations - avoids electronic resizing from 1.85 to 2.39	- slower format changes to ensure the positioning of the second lens - to make sure that there is the same optical alignment for all formats - to make sure that the setting is done via the prime lens THEN via the second lens - additional investment costs - RealD and MasterImage 3D solutions are not possible

If you decide not to take the hypergonar lens, you have to make sure that your lens is motorized in order to be able to carry out format changes by making use of the maximum surface of the matrix at the same time.

The motorized zoom allows format changes without a second lens. Please note! Motorized lenses are an option with certain projectors. Please pay careful attention when choosing this option as it depends on the model of projector.

	ADVANTAGES	DISADVANTAGES
MOTORIZED ZOOM	- memorizing the settings for each format - works with all 3D systems - does not necessarily require a second lens (hypergonar lens)	- risks significant loss of light in Scope (-21%) - slow format changes (= 15 s) - risks of a slight *shift* between formats

There are two precautions to be taken with regard to the settings of your lenses:

- ***The shift*** (this point will be addressed in more detail in § "Positioning of the projector").
- ***Resizing**:** This practice is prohibited in the ISO standard. This possibility, managed by the Texas Instruments projection head, allowed screening in 1.85 at a height of 2.39. This setting was used when the lenses and their mounts were not motorized and the option of a second lens was not used. This meant that only 61% of the matrix for 1.85 was used (and 38% of the light but also of resolution were lost) as the two formats were only projected on 858 lines. We also noticed numerous faults in the display due to resizing of the information on fewer pixels.

Resizing for flat formats has therefore to be avoided completely. You should not let yourself be persuaded to use this display method that aims at keeping the same focal settings and saving time during the format changes because it is detrimental to the picture quality.
On the other hand, we have seen that the electronic resizing of the picture is of course allowed for the transition of the ratio 2.39 to the ratio 1.90 in view of the addition of a hypergonar lens for the projection of a Scope image.

II. The settings of the projector

You have to take your time during the setup of the projector and make sure that these are configured correctly. Fine-tuned settings are no luxury!

Today, digital projection offers a certain number of undeniable advantages in comparison to 35 mm as far as the projection quality is concerned. To preserve these advantages the different technical parameters have to be configured correctly.

*a. Image resolution and masking**

Your installer has to parameterize ALL formats to correctly display all films that will be screened. Insist on the creation and the settings of all ratios!

As we have seen before, the minimum picture resolution in digital projection is called "2K". Consequently, the projector should allow the projection of images whose minimum resolution of the matrix has got 2,048 pixels per line (horizontal) and 1,080 lines (vertical).

Although it is common in digital cinema to talk only about the formats Flat (1.85) and CinemaScope (2.39), the digital projector is capable of projecting any common format. Classic films are converted into digital and put on screen (*Lola Montès*, *Pierrot le Fou*, *Mr. Hulot's Holiday* to name only a few of the films that have been restored and screened in digital). These films with ratios other than Flat and Scope must not be subject to alterations (e.g. keystone or parallax corrections) in their projected frame.

The *masking* is the equivalent of the aperture plate filing in 35 mm. This operation is necessary to allow the display of an image that is perfectly adapted to the screen frame while being perfectly rectangular within it. The *masking* allows the correction of the frame of the image projected depending on the position of the projector in relation to the screen.

Depending on the high angle or low angle position of the projector in relation to the screen, one notices a keystone distortion effect; with horizontal decentralisation of the projector in relation to the screen, one notices in this case a parallax error. These faults can, unfortunately, coexist! They have to be masked!

The CST test patterns are tools required for the format settings. The alignment and the control of the projection will only be ensured with these test patterns.

Picture format	2K Resolution	4K Resolution
1.33 (silent film or 4 / 3 in video)	1,440 x 1,080	2,872 x 2,160
1.37 (standard format)	1,480 x 1,080	2,959 x 2,160
1.66 (panoramic format)	1,792 x 1,080	3,585 x 2,160
1.78 (16 / 9 video)	1,920 x 1,080	3,844 x 2,160
1.85 (panoramic format)	1,998 x 1,080	3,996 x 2,160
2.39 (Scope format - solution with digital resizing)	2,048 x 858	4,096 x 1,714
2.39 (Scope format - solution with anamorphic 1.26)	2,048 x 1,080	4,096 x 2,160

Please note: We are only allowed to mask a maximum of 2 % of the outer edges of the image. One has to arrange it in such a way that the physical position of the projector only allows cropping up to this maximum percentage.

b. Positioning of the projector

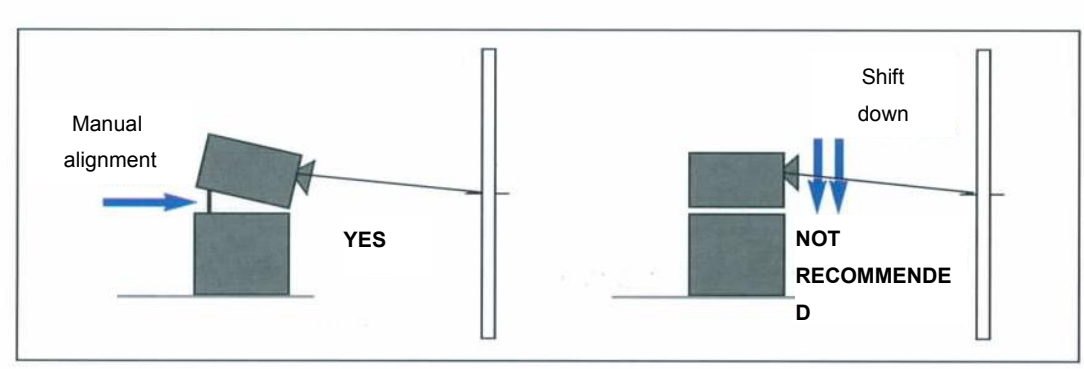
You have to optimize the positioning of the projector to ensure the best possible illumination of the image, to reduce geometric distortions and to guarantee optimum sharpness of the pictures.

The mount on which the projection lens is placed is equipped with setting rails that allow a decentralisation (horizontal or vertical) in relation to the image created on the matrix. This optical decentralisation is called *shift*.

Although the lens shift ensures that the geometric deformation of the picture is reduced, it comes with a certain number of weak points. For the following reasons you should make sure that the *shift* is positioned at zero on its mount.

We know that, in order to obtain the best light output, the optical projection axis has to go through the centre of the lens.

If an optical decentralisation of the image is used during the installation, a significant loss of light can be observed as the projection axis will not be straight any longer. As everything is done to optimize the light level, it would be a pity to reduce these efforts! Significant deviations in illumination can be quickly noticed on the screen and the standard might not be met.



Source: CST

A significant *shift* also risks causing a deformation of the picture due to using the edge of the lens; this fault is called “vignetting“.
Attention has to be paid to the correct positioning of the projector in order to avoid using the *shift*. Only a shift that enables the fine-tuning of the settings or that is aimed at avoiding specific architectural configurations (thickness of the wall of the booth, etc) is allowed.

The positioning of the projector has to be carried out while paying utmost attention to the fact that the centring of the different formats (with or without an additional lens) is perfect for all of them as it is already the case for the lens turret in 35 mm.

Moreover, in case the projector is not positioned on the axis, a sharpness difference may be

visible on the screen. The different lens mounts are equipped with *Scheimpflug** angle adjustment (correction of parallelism); this allows the placing of the lens a little bit more in parallel to the screen than it is and to regain a little bit of overall sharpness. **Do not hesitate to ask your installer to carry out this setting. Please note: it does not compensate for any geometrical faults.**

If your projector is really too far away from the axis of the screen, and you cannot create a second projection porthole and you do not wish to abandon your 35 mm projector, do not hesitate to make your machines mobile by putting them on tracks.

c. Image luminance

The luminance of all images, in all projection formats, has to be calibrated at 48 cd/m². The projector has to be able to deliver this luminance.

The image luminance is standardized at 48 cd/m² measured at the centre of the projected image. The luminance difference between the edge and the centre of the image must not exceed 25 %. It is very important to stick to this optimal setting.

When choosing the projector, you have to make sure that the model you select produces enough light to get the correct luminance value.

Although the tolerances of the standard are wide (from 25 to 60 cd/m²), you have to prefer the value of 48 cd/m² at the centre of the image for all formats. Today, on all projectors, it is very easy to fill in the intensity parameter for each 2D or 3D format. Please use this functionality, it is worth the effort.

The uniformity of the illumination has to be controlled and adjusted on a regular basis. For optimal uniformity the maximum luminance has to be in the centre of the image and not on one of the edges.

In order to calibrate the light uniformity, an automatic solution is proposed in the projector (with a sensor control in the projector). It produces a setting that is often good to readjust. A uniformity measurement will be very important to control this setting and to fine-tune it where necessary.

When choosing your projector, you have to pay utmost attention to the fact that it respects the image luminance in all formats in both 2D and 3D configurations.

As 3D projection is very light-consuming (see § “3D - stereoscopic projection“) you really have to make sure that the lamp power of the projector is determined to provide the relevant light output required for the chosen 3D projection system.

It is recommended for stereoscopic projection to have a machine that allows you to obtain a luminance that may vary from 110 to 150 cd/m² (value measured in white and without the 3D system).

Nevertheless, for screens with a width of over 15 meters, it is difficult to achieve these ideal conditions - above all in 3D. The systems will be enhanced as far as the absorption of light is concerned and will allow the screening of all our pictures regardless of the screen size with standardized values in.

d. Colorimetry

Colorimetric settings are too often neglected! However, they are essential for the quality of your projection. Ask your installer to make these settings.

With digital projection, the quality criteria regarding colorimetry can be identical in the calibration room and in the screening room. But everything depends on the quality of the settings of your installations.

The AFNOR standard sets the reference value of the white point at 48 cd/m² with the data in the CIE diagram in x = 0.314 and y = 0.351 (+/-1 %). This value of the white point is obtained after a colorimetric setting has been carried out in reflected light. Consequently, it takes the characteristics of the lamphouse, the quality of the lens, the position of the zoom, the quality of the projection porthole, the quality of the screen cloth, the colour of the walls and the stray light ratio into consideration.

Several colorimetric settings have to be carried out during the installation of the projector. The files resulting from this are called MCGD* (Measured Colour Gamut Data).

Requirements:

- A file for Scope images.
- A file for so-called Flat images, each of the two formats adopts a different lens configuration.

Each of the two colorimetric files has to be performed for images that are projected in 2D and 3D. In the case of 3D projection, colorimetry adapted to the system in use has to be carried out with the system running (macro* 3D, lens system switched on, activated glasses, etc.). The different 3D systems will be described in § “3D - stereoscopic projection“.

A spectrophotometer is used to carry out this kind of settings. Due to the high costs of this device you will not have it in the booth. Your integrator will be able to carry out these settings.

In France, the CST is equipped with devices and software that allow controlling these parameters. Verification by the CST, after the installation in your booth is highly recommended.

e. Convergence

The position of the matrix in relation to the projector head may have moved creating a convergence fault with the superimposition of the colours. You have to have checked the correct settings of the convergence parameters.

Convergence is the setting that allows perfect superimposition of the coloured images created by each of the three matrices in the projector head.

A convergence fault causes edge colourings on the pixels. This can be seen very clearly on a black and white picture, for example, as colour fringing on the edges.

It is highly recommended to verify the convergence during installation.

3rd PART - PLAYBACK AND STORAGE SYSTEMS AND THEIR SECURITY

Having described the projection system, we will now have a close look at the playback and storage systems for films. These devices remain of primary importance and, just as for the projector, you have to pay utmost attention to them.

I. The server

The server, that is also called SMS* (Screen Management System), is the management tool for digital cinema content for each of your auditoria.

Being capable of storing several films (at the most 5 films on a server with a capacity of 1 To and around ten films on 2 To), the server provides the interface that allows the play out of a film and to ensure its security (in combination with the projector).

Certain projector models integrate the *Media Block* of the server that manages the decompression, the decrypting and, hence, the security of the image inside the projector. The projector alone manages the whole image part of your digital projection system. Nevertheless, a server is also useful for the equipment since it allows to locally store the films that are to be played out; any other development is also possible to allows you manage your distribution system from the server.

Locally, the server allows you to:

- Manage the compilation of a programme (playlist*).
- Manage and programme the shows (schedule).
- Receive and store content.
- Manage content.
- Eventually, manage the environment of the booth for a complete screening.

The current storage capacity of servers is limited. This limit is increasing thanks to the evolution of the storage systems (hard disk drives), thanks to better IT management of these storage systems and thanks to the reduction of costs allowing hard disk drives with higher storage capacity and performance.

If you have multiple programming, you can store a certain number of films on the server. Nevertheless, it cannot be the best solution to use the server as a storage place in the long run.

It is better to have a storage library, from which you can pick and choose without, as on the server, worrying that it is performing a playout and transferring content. **Actually, you should avoid making content transfers on a server that is playing content at the same time. This is a solution that should only be considered in an emergency situation with last-minute programming.**

II. The library

As a real storage and management tool, a library is useful to avoid overloading the servers.

The library, that is also called “central library“, is a server on which we can store dozens of films (the number depends on its size). It can also be connected to the ingest servers which enable you to receive content *via* ADSL, optical fibre or satellite, different types of content that are to be screened (films, advertising spots, trailers, etc.).

Your library has to be left switched on permanently, 24/24 hours, for example, to be able to receive content in the night, to programme the transfer of copies, etc.

It has to be integrated in a rack that is well ventilated and, if possible, in a place in which the noise of the fans will not disturb the users next to it.

Of course, it will also have to be integrated into the intranet network of your booths to enable content transfers and will have to be connected to at least one of the secured transfer solutions from outside the cinema.

Do not hesitate to use multiple e-mail accounts, as long as they are free of charge, depending on the number and the size of the content that are transferred to them.

Clarify this commercial aspect with each content distributor.

III. The Theatre Management System

The TMS* (Theatre Management System), allows you to program and schedule the shows as well as monitor and control all devices. This can be done remotely as the TMS is connected via network to the various equipment installed in all booths.

The TMS allows you to:

- Operate the different devices in the booth.
- Programme and manage all shows.
- Manage the content of your servers or your libraries.
- Check the configuration and status of the equipment.
- Localize any malfunctions.
- Manage digital signage.
- Etc.

The TMS is the further development of the current central monitoring systems and / or the projection room automation systems. If the booths are equipped with an automation system, the installer has to check if the TMS can be integrated into this system. It has to be made possible to interface the TMS with any kind of automation, no matter if it is IT-based, electronic, with diodes, etc. This condition has to be ensured in order to avoid having to change all the

material that operates both, the projection system and the complete environment of the booth (security system, dimmers of the auditoria, screen curtains, etc.).

All playback systems have to be updated on a regular basis in order to enhance the performance and to meet the specifications in force.

In order to be sure that there will be no problem with the updates and the further development of the machines, it is better to specify by means of a contract with your installer that the updates will be applied for several years. By doing so, you will have a security regarding the further development and the continuity of your machines.

IV. Security

a. Certificates

A solution has to be found in the booth to facilitate KDM management.

Every server has a certificate (the official key that is required to identify the machine). This certificate is one of the pieces required to create a KDM (***** *Key Delivery Message*). The projectors also have such a certificate. The latter will be really useful in cases where the *Media Block* of the server is integrated into the projector.

Keep your server certificates in an appropriate place (small computer file that is handed out to you during the installation); the distributors may ask you for them.

A film is encrypted in order to ensure that the file transferred is not modified (regarding both, the sequence of the images and the sound information, subtitles, etc.) nor being “fished” (piracy) when forwarding it. This KDM is required to open the encrypted, protected film file. With its assistance you will be able to open:

- A CPL* (film version in digital cinema).
- On a given server.
- For a certain period of time. This time period represents what has been negotiated with your distributor when finalizing the programme. There is no limit regarding the number of screenings done during the time period for which the key is valid. A screening will not be interrupted if the KDM expires after the screening has started. However, it will not be possible to play the film again when this screening is over.

A key can only be decoded by the server for which it is intended. Please note: If the keys are zipped (compressed), a decompression tool has to be installed

on your computer.

To manage KDMs in a team it is recommended:

- To create a specific e-mail address intended for receiving the KDMs for your cinema. Each member of the booth staff has to have access to it.
- To establish a process allowing everybody to be up to date regarding the correct reception of the keys, their correct ingest* as well as their validity dates (for example, by using a white board in the booth). More generally speaking, it is important to be strict regarding the management of the KDMs (establish an online directory of files per auditorium, per film, per validity date).

b. Software and firmware versions

Please make sure with your integrator that all of your equipment will be maintained up to date with the latest software and firmware versions.

Taking the further development of the machines and the rules of interoperability of the whole equipment into account, it may be necessary to carry out some updates on your machines (on the servers, the projectors or any other equipment in your booth). It is important to make sure with your installer by means of a contract that the updates will be carried out. A missing update can very easily hinder you from playing the film correctly.

It is recommended that the projectionist staff keeps a record up to date of the equipment as a whole (software, firmware, IP addresses, etc.).

c. Security and network

You have to pay utmost intention that no intrusion from outside is permitted on the machines. Moreover, you have to make sure that the machines are connected properly in order to meet their safety regulations.

All points with regards to the security of the network will be described in more detail in the chapter dealing with the network.

4th PART - ADDITIONAL TOOLS

The tools that are named here “additional” are tools without which neither the projectors nor the servers would be able to carry out screenings. From the projector lamp to the screen via the sound rack, and above all 3D, the elements that are treated hereunder are fundamental.

I. The lamp

You have to choose the lamp power correctly to make the best use of the illumination capacities of the projector.

The Xenon bulb is the technology that is still employed in the different projection lamphouses. The choice of its power is very important with respect to the image luminance. The table below gives you an idea of the potential screen widths in 2D depending on the lamp power.

LAMP POWER (in Watts)	MAX. SCREEN WIDTH IN 2D (in m)	SERVICE LIFE (warranty - in hours)
1,800	8	1,750
2,000	10	2,400
3,000	13	1,500
4,500	17	1,000
6,000	20	600
6,500	20	500

Table not exhaustive. The warranties are given as an indication. They vary by several hours depending on the lamp brand used.

You have to:

- Avoid varying the lamp current to modify the light output. Significant variations in the lamp current make the arc unstable and cause flickering on screen. **A variation of the power level is only possible within the permitted power ranges, indicated by the lamp manufacturer.**

- Avoid setting a lower lamp power in the projector. The lamp’s service life will only be reduced and flickering problems will be visible more rapidly.

- Avoid defocusing the lamp in relation to the mirror to reduce excessive luminance. This alters light uniformity, and across the screen, luminance differences become noticeable. This defocusing can also cause overheating inside the projector.

Generally speaking, a lamp that is incorrectly used will give poor performance and will see it's lifetime seriously reduced. If you re-consider this issue in the long run, it allows you to finally save some money.

Moreover, exceeding the service life of the lamps as described above raises the following problems:

- Risk of explosion of the lamp and, consequently, loss of the guarantee. The guarantee of the lamp manufacturer does not cover any damages caused by an explosion in the projector. The potential third party investor does also not bear these costs.
- Visible reduction of the brightness.
- Colorimetry is not maintained.
- Flickering: The arc loses its stability due to significant wear of the electrodes. The flickering is extremely visible in digital projection since no mechanical part masks this fault.

Please note: Certain technical specifications of the projector manufacturers may be somewhat misleading. The values indicated during light measurement (values indicated in lumens) are very often carried out on screens with a gain factor (in general 1.8). We will discuss the specifications of gain factors in § "The screen". The determination of the lamp power essentially depends on the screen surface it has to illuminate.

The choice of the bulb model

You have to check this with your installer in order to optimize the choice of the right lamp to use in the lamphouse of your projector.

There are two categories of lamps:

- Proprietary lamps (ultra-short arc lamps): Proprietary lamps are lamps that are especially designed for and adapted to one (or more) digital projector model(s). They allow optimizing the light output but they have the disadvantage that they do not have a long service life (in any case shorter than lamps with similar power in 35 mm).
- Generic lamps (short arc or long arc lamps): Generic lamps are the ones that are used in lamphouses of 35 mm projectors. These lamps have evolved in recent years, pushed by the appearance of specific lamps. Although their light output seems to be less optimized, their service life is, in return, well above those of the proprietary lamps.

Nevertheless, one has to know that nearly all the lamps fit in nearly all projector models. You really have to check this in detail with your integrator to determine which kind of lamp will be most suitable for your installation.

This check has to take the following points into consideration:

- The possible adaptation of the lamp to your projector model. This point is mandatory. Certain projector models only accept a certain type of bulb.

- The power output of the lamp. This essential point allows you, in certain cases, to solve luminance problems. A lamp with a lower output may actually suit your installation.
- The service life of the bulb. The lower the lamp power the higher its service life.
- The costs of the bulb. In general, a generic lamp is less costly than a proprietary lamp.

The choice of the bulb has therefore to be a compromise of the points mentioned above. For this reason, you will have to establish a final list of all the lamps that could be installed in your projector to allow you to make your choice.

II. The screen

You really have to consider carefully the choice of your screen material. If your screen is a bit old, it may be interesting to consider replacing it. Furthermore, certain 3D solutions require a particular screen type.

A screen does not have any particular specifications for digital cinema. However, it still has to be perforated to let the sound pass through it. There are several types of perforations: The perforations called standard (in general a hole of 1 mm diameter placed every 5 mm) and micro-perforations (the holes are much finer [0.5 mm] and placed every 3 or 4 mm).

Micro-perforated screens are more convenient for all our screenings. They have to be preferred when the replacement of the current screen is considered. You can take the opportunity of the migration to digital projection to change a screen that is a bit old, yellow and / or dusty. The luminance of the pictures can only get better!

Type of screen	Gain factor	Characteristics
Matt white	90 to 140%	Ideal performance: Reflects as much light as it receives Directionality adapted to the needs of cinema and video Exists in perforated or micro-perforated solution
Coated	140 to 180%	Higher performance in the axis (useful to illuminate large surfaces) Exists in perforated or micro-perforated solutions
Silver	> 240%	Very high performance in the axis Type of screen required for certain 3D solutions

Please note that gain (coated or silver) screens have got one disadvantage: The higher the gain factor, the more the directionality is important and, consequently, a less uniform illumination will be obtained. In the same way, each type of screen has got its own inconveniences in colorimetry that the eye may perceive but that are difficult to quantify. Depending on the directionality of the screen a certain number of faults appear:

- The colorimetry differs as soon as we depart from the projection axis.
- The reflected light creates a light point that is called “hot spot“, on the axis of the light beam. This hot spot position vary depending on the viewing axis of the spectator, hence his seat in the auditorium.
- Uniform illumination will no longer be possible as there are luminance differences from one seat to the other.

Due to the nature of its coating based on aluminium paint, the silver screen is more sensitive than classic screens. The storage prior to the installation has to be made in a place having a certain temperature (neither too cold, nor too hot). It must be preserved from thermal shocks. It is also advisable to carry out a test, in the presence of the installer, at the end of the screen installation by projecting a white picture in order to detect potential faults (black spots, scratches, etc.). It also makes sense that the exhibitors notify their teams – especially the receptionists – about the sensitiveness of these screens to various actions (finger prints from the spectators, for example).

III. The sound system

It is mandatory to have a sound system that is at least capable of playing in 5.1. If that is not the case, then the mono or SR sound system must be converted to 5.1.

The number of sound channels that are used in digital cinema today amounts to 6 (5.1). The sound reproduction system must at least handle 4 stage channels (Left, Centre, Right, Subwoofer) and 2 surround channels (Left and Right). **The connections of each of the surround speakers have to be independently led back up to the booth in order to be able to respond to future developments (7.1 for example).**

Digital projection facilitates the screening of films with audio-description: If you would like to provide this facility, you have to study the technical solutions that allow transmitting this sound channel in the auditorium.

In order to reproduce the sound in digital cinema correctly you have to:

- Add a digital / analogue converter if the processor does not have it.
- Change the sound processor or additionally equip it in such a way that it can process the 6 channels required.
- Add the amplifiers required.
- Add the loudspeakers required in the auditorium.

- Think of the cabling for the new channels.

If the sound system is already capable of reproducing digital sound in 35 mm (Dolby Digital, DTS, SDDS), you only have to add a digital / analogue audio converter to the processor. The converter enables you:

- To convert digital sound from the server in such a way that it is processed as analogue sound in the B chain.
- To simply manage, for certain models, the audio delay. It is important to note that the image processing time in the Texas Instruments projection head amounts to 2 frames.
- To act as a *switch* and eventually connect a DTS reader that is already equipped with 6 external input channels.
- To connect, for certain models, external digital sources (Blu-Ray in optical fibre, HD-Cam in AES, DVD in SPDIF for example, etc.).
- Some models allow Dolby E (HD video sources) or AC3 decoding; others don‘t.

When the 35mm projector has definitely been removed, the choice of the processor can be made among models exclusively dedicated to digital cinema.

As in digital cinema the sound is not compressed at all, its dynamic can be very important. Aged Sound system may suffer damage; a complete check for refitting may be necessary to make sure the system has the capacity to correctly reproduce Digital sound tracks.

The server installation is the perfect occasion to have the following points checked:

- **The identification as well as the allocation of all channels.**
- **the B chain equalization.**

IV. The scaler

To play back audio-visual content that is neither digital cinema content nor HD digital video sources, a scaler (converter) is required. The scaler allows you to:

- Convert analogue sources to digital and output them on a DVI connector that can be plugged in the projector. Projectors use this input for alternative content.
- Connect different types of video players.
- Manage the interlacing display (as the digital projector only accepts the progressive display).
- Screen images with frame rates other than with 24 or 48 frames per second.
- Digitally upscale images whose resolution is lower than HD (1,920 x 1,080) so that they do not appear too small on the screen.

The *scaler* has to be at least capable of taking up the following devices:

OUTPUT DEVICE	POSSIBLE INPUT CONNECTIONS TO THE SCALER
Computer SD	VGA, DVI, RGBHV
Computer HD	DVI
Blu-Ray	DVI or component
Game pad	DVI or component
DVD	Composite, Y/C – S-VHS
VHS player	Composite, S-VHS, component
DVCAM	SDI
HDCAM	HD-SDI, SDI, component
HDCAM SR	HD-SDI
Beta SP	Component / composite / Y/C / YUV
Digi Beta	SDI / component

All players whose connection is already DVI or HD-SDI can be connected straight to the projector. Nevertheless, there are two points that must be observed:

- Make sure that specific macros are created for these players.
- In the case of a Blu-Ray player, ensure the projector and the *scaler* are HDCP compatible.

It is necessary to prepare a kit of various video and audio adaptors since all the players that are susceptible to be connected to the scaler use different connector types.

You have to assess the image processing times of the *scaler* depending on the video format and use this value in the audio interface or the audio processor to delay the sound accordingly.

If you plan to receive contents via satellite transmission, a dish must be installed. The installation of a dish whose diameter exceeds 1 meter or whose installation device size exceeds 4 meters are subject to registration with the local authority. If the reflector's diameter is less than 1 meter and if the size of the installation device is less than 4 meters then no registration is required. Please note: In case of an installation at a protected site (listed site,

monuments), additional formalities will be necessary (in France, report of an architect from the “Bâtiments de France”). Finally, the installation of a dish in a multiple dwelling unit requires the approval of the co-proprietors that cannot prohibit the installation but may impose preconditions aiming at hiding the dish as much as possible by painting it or by setting up a requirement to keep it at a certain distance from the edge of the roof.

V. 3D - stereoscopic projection

a. Luminance

You have to adapt the lamp power, or even the projector model, depending on the width of the picture to be screened in 3D.

The different solutions available today for 3D projection are very light consuming. To get sufficient luminance through the glasses of the system you are going to use, you have to obtain a luminance from 110 to 150cd/m² with the CST reference test pattern. That way you will get, behind the glasses, around16 cd/m², that is admissible conditions.

To obtain the maximum possible light, you have various options:

- Change the bulb each time you switch from 2D to 3D mode and use for instance a 6kW bulb in 3D and 4kW one in 2D.
- “Oversize” the projector at the time of its purchase so that you are not limited with regard to the lamp power.
- Eventually opt for double projection (with two projectors), the only solution today which ensures enough light for screens wider than 15 meters.
- Eventually change the screen and install a screen with a higher gain factor (up to 140% maximum).

Today, certain auditoriums have chosen a silver screen that is required for the 3D solutions of RealD, Sony or MasterImage. The inconveniences regarding the usage of such kind of screen mentioned earlier are not as irritating as they can be in 2D because they are compensated by the polarization of the filter added to the projector and by the polarization of the glasses. For this reason, it is may be preferable to dedicate the use an auditorium equipped with a silver screen to 3D projection.

b. Colorimetry

Specific colorimetric files have to be created for the 3D image.

In the previous text we have already explained in detail the colorimetric parameters that have to be observed for a 2D projection. The same parameters apply for 3D!

The colorimetric settings have to be setup depending on the technical parameters of each of the systems that may be used. These settings allow compensation for the chromatic aberrations that are induced by the glasses, the filters, etc.

Make sure that the settings have been carried out perfectly in order to obtain, as in 2D, a white point with coordinates x = 0.314 and y = 0.351 in the CIE diagram.

As in 2D, the verification of the white point is done by means of the CST reference test pattern.

c. 3D parameters

It is mandatory that the following specifications are parameterized in the projector.

Orientation of the images:

It has to be ensured that the pictures are projected in the correct sense (left picture for the left eye and right picture for the right eye).

In case of an inversion, depth and stream will be inversed and our vision system will be strongly affected.

Triple flash:

The projectors have to be configured in triple flash without resizing.

The frequency on which digital 3D pictures must be projected (for the Texas Instruments solution) is 144 Hz. Each of the images will hence be seen 3 times by each eye in turn. This is called *triple flash*. This frequency must be met in any case!

Moreover, the projectors have to be capable of showing 3D *triple flash* without resizing the picture displayed on the matrix. If the frequency is only 96 Hz *(double flash)* the flow of movements will be reduced by this (judder).

If the image is resized in order to play *triple flash* a significant reduction of luminance will be noted.

Dark time and output delay:

These parameters must imperatively be adjusted and checked to perfectly reproduce the right 3D dimension of the picture.

In order to ensure a perfect display without stressing your brain, two parameters have to be adjusted: the *dark time* and the *output delay*.

These parameters are given by the manufacturers of the systems. They have to be optimised on the spot. The following adjustments have to be made:

- *Dark time:* This is the time period (in milliseconds) in the dark between the appearances of a picture in each of your eyes. A wrong setting of the *dark time* causes phantom pictures. These images are created because of too long an impression of the images on the retina; that way, one of the two eyes can see a little bit of the picture intended for the other eye.

- *Output delay:* This is the time delay (in milliseconds) of synchronisation between the dark period and the appearance of the picture. Wrong setting of the *output delay* will alter the image nuances.

- These parameters have to be adjusted and checked with the assistance of the CST test patterns.

- The “CDG 3D” test pattern is not only useful to check the 3D frame but also to ensure that the right image is sent to the right eye.

- The “BDM” test pattern serves to verify the *dark time* and the *output delay.*

Type	Name	Glasses	Add-on	Screen type	Easiness of operation	Complexity of the installation
Polarizing	REALD	Passive polarized	ZSCREEN REALD XL	Silver	Glasses sold to the spectators Good luminance in the centre To meet with gain screen	Uniform illumination and colorimetry cannot be ensured 3D system for use in one auditorium
Infitec (interference filter technology)	DOLBY	Passive filter	Filter wheel	Matt white or gain	Glasses washable in machine Anti-theft tag on the glasses	Handling of the glasses 3D system for use in one auditorium Training for installation required Light consuming
Active	XPAND	Active	Infrared system	Matt white or gain	Quick and easy installation Movable system that can be used in several auditoria Colorimetry simple to carry out	Handling of the glasses
Active	E3S	Active	Infrared system	Matt white or gain	Quick and easy installation Movable system that can be used in several auditoria Colorimetry simple to carry out	Handling of the glasses
Polarizing	MASTERIMAGE	Passive polarized	Rotating filter	Silver	Glasses are sold to the spectator Good luminance in the centre Works with gain screen Semi-movable system	Uniform illumination and colorimetry cannot be ensured 3D system for use in one auditorium
Polarizing	SONY	Passive polarized	Double lens	Silver	No dark time and output delay problems	Uniform illumination and colorimetry cannot be ensured 3D system dedicated to an auditorium

Table not exhaustive

5th PART - THE NETWORK

The network is a very important component in a digital installation. The network will be highly solicited for transferring content from a central storage to a booth or between booths; it will also be used by the Theatre Management System to control the shows and will allow remote access to the various devices. Therefore, utmost attention has to be paid to this equipment although it seems to be invisible.

I. Fire protection

Have your digital equipment connected to the security system of the auditorium. Your installation has to remain compliant to the fire protection standards in force.

It is mandatory that the digital projection system is connected to the security system of the auditorium. In case of an involuntary interruption of the screening, be it caused by a projector or a server issue, the house lights must lit; the audience must not be left in the dark.

- **A fault during the screening has to activate the auditorium lighting and to stop the screening.**
- **In return, the activation of a fire alarm must stop the screening and activate the auditorium lighting (even in the case of an alternative content).**

II. The internet network

It is essential for you to have high-speed internet access.

From now on, your cinema (and more precisely the projection booth) will have to be equipped with an ADSL connection for various reasons:

- In case you entered into a contract with a third party investor. Above all, he requires a connection with your equipment to upload the logs*.
- In case you opted for a maintenance agreement, to grant the *helpdesk* an access to the machines.
- Eventually, to receive content in virtual form.
- To simply receive the KDMs (via e-mail) for the films you will show.

An ADSL box will be required for the internet access. Any internet service provider can offer you a contract if you do not already have one. Connected to a *switch*, this box provides for the connection of all machines to the internet.

To make sure that the internet network has only limited access to your intranet network you have to add a firewall between your ADSL line and the intranet network of the cinema. That way, intrusions in your internal network will be difficult.

III. The intranet network

The intranet network is very important. Have a detailed study conducted especially for your screens in order to optimize the installation, the cable routing, the cable lengths; this will help achieving the best performance for your data transfers.

To remember, the intranet network is the total of the internal network connections in your building.

a. The wired network

The intranet network of your cinema has to connect all machines with each other. The intranet network and the wired network of your projection booth (or of your cinema), have to remain independent of the internet (for example ADSL).

It is mandatory that the connection between the server and the projector is direct and does not go via a *switch* or other intermediate device. If, for one reason or another, a switch breaks down, the secured connection between the server and the projector will no longer be secured which may lead to an interruption of the screening.

In order to get optimum transfer rate between machines various precautions have to be made.

It is essential that:

- The installation is carried out with all specifications required for each of the connections (cable or optical fibre).
- The maximum lengths are kept to depending on the category of the connection (optical fibre or cable categories - see table hereafter).
- The lengths have to be the real cable length and not the distance between two booths or the pieces of equipment.

This network should provide for:

- Connecting all servers to the central library.
- Connecting all servers among themselves.
- Connecting all servers and projectors to the ADSL in order to ensure access to the *helpdesk* or to allow uploading the logs.
- Connecting the whole equipment (servers, projectors, sound processors, converters, central library/-ies, programming system, maybe scaler) to the booths management system.

This network, and what will circulate in it, has to be considered in detail. It is recommended s to avoid mixing data and commands in order to avoid overloading the network and risking a reduction in bandwidth. This means that each of your booths has to be at least equipped with two RJ 45 connections:

- The first one is required for content transfer and for data exchange between the servers and the libraries.
- The second one is used by the automation system to control the devices.

Remember that the third connection is the connection between the server and the projector.

Depending on their roles, the *switches* will have to match the maximum theoretical bit rate. In general, the main switch of the cinema must be able to handle transfers at 10 Gbits/s.

Category	**Max. length of the cable (between the *switch* and the device connected)**	**Capacity**
Category 5	100 m	100 Mbits/s
Category 6 **Category 6a**	100 m **56 m**	1 Gbit/s **10 Gbits/s**
Category 7 (Category in course of standardization)	**100 m**	**10 Gbits/s**

	Maximal length of fibre (in km)	**Capacity**
Standard Fibre (G 652)	1,000	2.5 Gbits/s
	60	10 Gbits/s
	3	40 Gbits/s

The network cabling as a whole has to be checked. **The capacities have to be tested and adhered to in order to guarantee the Gbits connections. The installation will eventually develop 10 Gbits.** The simple fact that the machines can establish communication with each other does not mean that the installation is optimal.

It may be good to hand over this task (i.e. the installation) to a company specialized in network systems.

b. Wi-Fi

A Wi-Fi connection must not be left active permanently.

The Wi-Fi enables the wireless connection of several devices. A Wi-Fi connection is convenient to remain mobile (wireless) in a building and at the same time have easy access to all the machines.

However, one has to be aware of the risks that this kind of connection brings. A Wi-Fi access, even if it is perfectly protected, can be hacked. For example, it could be possible for a spectator to gain from his phone access to any device. Therefore, there are high risks to leave the Wi-Fi switched on permanently.

Therefore, it is recommended for the Wi-Fi:

- If it is a mobile access point, that is only connected when required during the maintenance and the settings.
- If you opt for a fixed Wi-Fi connection, that you are able to turn it on and off in order to avoid leaving it connected permanently.

IV. The IP plan

You really have to consider carefully your IP plan (Internet Protocol). Make sure that this plan is not conflicting with the addressing plan of the whole cinema equipment (PC box office, PC office, etc.).

Each device attached to your network will have a fixed IP to distinguish it from the other pieces of equipment according to a well determined addressing plan.

- If you entered into a contract with a third party investor, the latter will offer you IP addresses of your machines in order to ensure remote monitoring.
- If you are bound by a maintenance agreement, the addresses will also have to be indicated correctly so that the *helpdesk* will be able to log on the machines without difficulties.
- If you log yourself on to different sites, the adoption of one single plan makes it easier for you to have access to the supervision of all machines from one single point.

For all these reasons, this plan has to be thought through carefully and it has to be mature in order to make it a real tool and not an informatics ordeal! A well determined IP plan allows you to create a real network between screens that are far away from each other from a geographical point of view. The management will be much easier with it.

6th PART - MAINTENANCE

Even more than in the field of 35 mm, maintenance is fundamental and of utmost importance. Both, the service life of the devices and the insurance of a high quality projection depend on its strictness. In no case it should be underestimated or neglected.

I. Maintenance agreement and warranty of the devices

In general, the devices have got a warranty of one year on parts and labour and two years on spare parts.
In view of the high purchasing costs of these materials it is highly recommended to consider an extension of the warranty.
In the framework of a financing agreement, the third party investors or collectors grant a warranty of 10 years on parts and labour.

You also have to check with your integrator the idea of a maintenance agreement. This contract may also be asked for by your financing entity. This agreement has to cover the following services:

- An intervention within the shortest possible reaction times while providing parts and labour.
- *Helpdesk* assistance, 24/7.
- Free software and firmware updates for all devices related to the digital projection.
- A yearly maintenance visit.

Every additional installation related to the digital projection (for example the network) has to stick to the same rules. Nothing should undermine the smooth workflow of your digital operation.

II. Preventive maintenance

Great care and regular maintenance are mandatory. It is about the lifetime of your equipment as well as the quality of the projection.

Contrary to numerous prevailing ideas, digital cinema equipment requires considerable preventive maintenance and has to be monitored constantly.

Please find below a list of tasks that have to be carried out on a regular basis:

Once a week - minimum once a month

- Monitor the service lives of the lamps and replace them in good time.
- After changing a lamp, check and adjust the luminance, the uniform illumination and eventually re-adjust the colour settings.
- If you have a light meter, check the luminance values for all formats on a regular basis.
- Clean the elliptical mirror, the catathermic filters, the deflecting mirrors, provided they are accessible.
- Regularly clean the lenses and the projection window
- Regularly clean (max. every two weeks) the filters:
    - of the projector,
    - of the server,
    - of the rectifier, as the case may be,
    - of the whole IT system.
- Remove the dust from the interior of the server (extractors, dust on the surface on the cards) on a regular basis. It aims at limiting overheating of the machine.
- Check the pressure of the cooling liquid of the projector.
- Manage the different storage places of the servers and the libraries.

Minimum once a year

- Change the cooling liquid of the projector (if it needs a change).
- Have a complete maintenance of the machine carried out (checking of all formats, 3D systems, luminance values, colorimetry, complete dust removal, alignment, if required, checking of the sound system, etc.).
- Check the electrical connections. An electrical breakdown is sometimes caused by faulty connections!

It also has to be ensured that the *software* and *firmware* versions of the machines are up-to-date. The software is frequently updated in order to optimize the operability of the devices and to have them further developed. Regularly ask your installer as to which versions have to be installed in your machines.

III. Curative maintenance

In order to limit faults, the risk of breakdowns, the risk of breakage of the material and, consequently the risk of cancellation of shows, it is better to treat the machines with utmost care. Moreover, bad treatment or careless maintenance of the machine and its accessories or operator’s errors may not be covered by the warranty. So please pay attention to the treatment of the devices!

7th PART - ANNEXES

I. Terms

2K: This is the minimum resolution considered for digital cinema projection. 2,048 pixels is the horizontal resolution and 1,080 the vertical resolution (or the number of lines). This means that the picture, in full resolution, consists of 2,211,840 pixels and appears in a ratio of 1.90.

4K: In a 4K matrix there are four times more pixels than in a 2K matrix. This means that the number of pixels is doubled in the width (4,096) and in the height (2,160). The ratio remains the same (1.90).

AFNOR: Agence Française de Normalisation. Its main mission is to be the central authority of the French standardization system. Its task is to anticipate the necessity of standards and to ensure their constant adaptation to the markets (French source: AFNOR).

Certificate: Digital document that establishes the identity of the digital projection equipment used in each booth. Projectors and servers have a certificate. The certificate is necessary to create the security key.

CPL: Composition PlayList. All information required for the preparation of a *playlist* of any kind of content - films, short films, trailers, advertising spots, etc. It is the compilation of all elements and metadata that constitute the work on spools (equivalent to the ones that are distributed in 35 mm). On them, you can find the number of images per spool, the equivalent file for the sound, potential subtitles. This final list defines how the film (the “composition“) has to be played out and defines the tracks that have to be selected (order, synchronisation, etc.). The projectionist will look for the CPL in the list of contents existing on the server to compile his programme.

DCI: Digital Cinema Initiatives. Founded in 2002, this consortium is a joint venture of the seven Major Studios in Hollywood (Disney, Fox, MGM, Paramount, Sony, Universal and Warner Bros.). As international standards were not provided for at the very beginning of digital cinema, the DCI created a technical recommendation in July 2005. This recommendation defines the criteria concerning the quality of projection as well as the criteria concerning the security of transmission paths of digital content. This recommendation served as a basis for the AFNOR NF S27-100 standard (“electronic projection room of the type digital cinema“) published in France in July 2006; it also served as a basis for the edition of the ISO standard.

DCP: Digital Cinema Package. Refers to media that contain digital files for projection. The DCP can be stored on a hard disk drive or supplied in virtual form. It is a series of files that contain the film and all relevant information for its projection. These files are the result of encoding the source files, of encrypting to protect all their data and of packaging the images and the sound on “spools”.

DLP: Digital Light Processing. Describes the technology established by Texas Instruments in 1987 that allows the electronic treatment of the signal. DLP Cinema is a technology that has even better performance that allows to increase both, the contrast ratio and the brightness.

DMD: Digital Micromirror Device. This is the matrix (2K in digital cinema) that contains microscopic micromirrors. Based on semi-conductor technology, it has the advantage that it is completely digital and can directly react to the digital flux. The very small space between the micromirrors and the rapid execution of their orientation movements ensures to lose only a minimum of light and to regain the complete range from black to white.

Dual link: This means the HD-SDI double connection that links the server to the projector by two co-axial BNC cables. It is necessary because of the capacity required for the transfer of information.

e-Sata: External Serial Advanced Technology Attachment. Data transfer protocol from external hard disk drives. Allows a transfer speed that is twice as fast as in real time.

FIPS: Federal Information Processing Standards. Federal American standards of information processing procedure.

HDCP: High-Bandwidth Digital Content Protection. Protection of high definition digital content. Restricts the usage of high definition connections in order to disable copying of the data.

Ingest: This means the process of transferring the content from an external source (hard disk drive, DVD, central library, etc.) to the server or the central library.

KDM: Key Delivery Message. This is the security key. It is materialized by an electronic file of very small size and can be sent by e-mail, on a USB stick, forwarded by a NOC, etc. In principle, it contains three types of information: the decryption key of the protected content, the period of time during which the file imported to the server can be used and the identification of the equipment on which it is allowed to show the content (thanks to the certificates of the machines).

Lens file: This is the adjustment file for the lens configuration. It takes the focal (zoom) ratio, the positions shift and focus into consideration.

LOGS: *Logs* are automatic registrations of events concerning the operation of the machines. These events concern either technical information with regard to the projection equipment (potential technical breakdowns, content management, technical characteristics of the different commands achieved or not, monitoring of the temperatures, etc.), or information about the conditions regarding the film screenings in the auditorium (time at which the films are shown, time of import and deleting of files, etc.).

Macro: This is an internal channel in the digital projector that allows to determine a sequence of settings and events. The macro regroups all the specific settings for each picture format, 2D or 3D, for films or alternative content, etc. There, one finds such information as “framing” of the screen, colour space, image processing (video or cinema), lamp control, etc. One can also put here automatic actions as switching on / off the Xenon bulb, stop of the test pattern during the projection of content or even the activation of a specific port of the projector to control an additional device.

Masking: The *masking* is the equivalent to the aperture plate filing in 35 mm.

Matrix: This means the surface on which the digital image is being created.

MCGD: Measured Colour Gamut Data. This means the file with the colorimetric data of the projector. These data take the characteristics of all the elements that interfere on the luminous flux (projection lens(es), porthole, screen, etc.) into consideration.

Micromirrors: The micromirrors correspond to one pixel on the matrix. Each of them represents one element of the picture.

NOC: Network Operations Centre. This means an online support centre. This *helpdesk* allows for taking care of the machines remotely in order to carry out a repair, to update the software, to assist the projectionists in case of a problem. The NOC acts as a preventive and curative action centre and provides operational assistance.

Playlist: This is the compilation of the programme that is to be screened.

Resizing: This means an electronic resizing of the picture on the matrix.

Scaler: This is an electronic system designed to provide for adjusting a picture to the right size. For example, a DVD picture with a resolution of 720 x 576 would be small in a 2K matrix. The scaler, thanks to an interpolation, will adjust it to the right size so that it covers the most important surface of the matrix while keeping its aspect ratio.

Scheimpflug: The Scheimpflug principle is as follows: “If the three planes [image / lens / screen] are in parallel, the sharpness is ensured on the whole picture surface. If one of the three planes is inclined, the sharpness on the whole picture surface is only ensured if the planes intersect in one and the same straight line“. Hence, the Scheimpflug principle consists in keeping the three planes at a maximum in parallel.

Screen file: This is the file that contains the information of the *masking*. The s*creen file* is the equivalent of the aperture plate in 35 mm. The macro (or channel) is equipped with this file to correctly display the picture.

Shift: Decentralization of the picture in the projection lens. This decentralization can be horizontal or vertical.

SMS: Screen Management System. This is the digital cinema server. A server is installed in each of the auditoria which are equipped with a digital projector. It allows local storage (after import via hard disk drive or in completely virtual form via the ADSL network or an optical fibre) and operation of digital contents that are to be screened. A relevant certificate is associated to each server and that is required to create a KDM. The security level of the server is very important to avoid any risk of piracy of the files that it contains. Additionally, the server may serve as a management tool for the automated systems (operation of the auditorium light, the curtains, etc.) or even the adjustment of certain parameters of the projector.

Switch: It allows to connect several networks that belong to the same physical network with each other.

SXRD: Silicon X-tal Reflective Display. This is the method used by Sony, relying on a reflective LCD technology, for its technology of 4K projectors.

TMS: Theatre Management System. This is the control centre. Being linked to the central library and to all existing servers in the cinema, the TMS allows a remote operation of each

individual server, to compile the programme for each screen, to transfer content from the library to the servers and to operate the automation system.

VPN: Virtual Private Network. This is the connection that allows a remote access between the *helpdesk* and the projection booth. The VPN is an extension of the intranet network; it works by means of interconnections between private networks via a “tunnel” system between the networks. This system allows maintaining the security of the different networks.

Watermarking: This is the type of technology used to mark the copies in a sophisticated manner that is imperceptible by the naked eye. The information date, time and place are embedded in the images of the film in order to reinforce the security and to limit piracy. The watermarking system is either integrated in the Media Block of the server or in the one of the projector.

XYZ (or X’Y’Z’ as defined by the SMPTE): Colour range defined in 1931 by the *Commission Internationale de l’Eclairage*, an international commission responsible for photometry and colorimetry. It is the range used for digital content encoded in JPEG 2000. The triangle represented by X, Y and Z allows to obtain all of the most intense spectral colours and, consequently, to perfectly match all colour nuances that can be perceived by the human eye.

II. Summary of the AFNOR NF S27-100 standard

a. Definition

The following general definition often applies:

Digital cinema projection: Electronic projection of a digital signal and meeting at least the minimum criteria defined in the standard.

b. Dimensional characteristics

The provisions of the AFNOR NF S27-001 standard "*Caractéristiques dimensionnelles des salles de spectacle cinématographique*" [Dimensional characteristics of cinema auditoriums] apply to digital cinema screens.

c. Technical specifications

The technical specifications considered in the standard include the characteristics of the equipment installed in the booth as well as the limitations the projection has to deal with due to the specific conditions in the auditorium (especially stray light).

Subject	Standardized value	Tolerance
Image luminance	48 cd/m²	25 to 60 cd/m²
Luminance difference	≤ 25%	...
Horizontal resolution	≥ 2,048 pixels	≤ 2%
Vertical resolution	≥ 1,080 pixels	≤ 2%
Contrast ratio (ratio of the illumination values white / black)	≥ 1,200	
Residual stray light ratio	< 1%	in the centre
Chromatic data of white point 90% of the picture surface	X = 0.314 Y = 0.351	± 1%
Colour space	Red: x = 0.680; y = 0.320 Green: x = 0.265; y = 0.690 Blue: x =0.150; y = 0.060	
Playback sources	The cinema screens have at least to be equipped with a source player allowing to produce pictures in the minimum format: Minimum resolution: 2,048 x 1,080 - Clocking: 24 p and 48 p Depth of colorimetric analysis: 12 bits, 4:4:4, RVB or X'Y'Z'	

III. “Checklist”

The following checklist (which is not exhaustive) summarizes the different technical issues to which you have to pay attention regarding the digital installation.

Name of the cinema	
Auditorium number	
Number of seats	
Throw distance	
Floor surface available in the projection booth for the digital projection equipment	
Size and format of screen	
Picture size in Flat	
Picture size in Scope	
Type and gain factor of screen	
Age of the screen	
Size of projection porthole	
Position of the projection porthole in relation to the floor	
Depth of the projection porthole	
Horizontal shift of the projector	
Sound pre-processor	
Sound processor	
6-channel analogue input connector	
Number of sound channels	
Converter required	
Distance from rack to digital projector	
Power supply	
Type of automation in 35 mm	

ADSL available	
Cinema network	
Access to projection booth (lift, stairs)	
Narrowest door	
Available space in the projection booth	
Repositioning of 35 mm (frame, 35 mm projector, etc.)	
Extraction / Duct	
Air-conditioning	
3D system	

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