

Thoughts On Constructing A Home Theater

by Gordon R Bachlund, P E

I. INTRODUCTION

The previous tutorial, "Collecting Basics," attempted to collocate data useful to beginning film collectors as well as to veteran film collectors looking for a single source of information. The present tutorial discusses building a real home film theatre.

I found loads of useful information by following www.film-center.com forums and Brad Miller's www.film-tech.com forums. Also, I profited from my own prior experience in the biz, and especially from having the assistance of an experienced theatre technician friend, Tim Dulin, who kindly proofread and made valuable suggestions.

I hope you find it both interesting and useful.

II. Retrospective

Since the early days of the motion picture, studio executives, directors and stars have enjoyed private screening rooms in their homes. Recall the silent film screening scene in Norma Desmond's opulent residence in Billy Wilder's 1950 classic "Sunset Boulevard," and you can easily imagine what the private screening rooms of the era might have been like.

Even today, many film personalities have screening facilities in their homes, and sometimes even their offices, so they can enjoy their craft at their leisure with their families and friends. Of course, these folks neither construct their own facilities nor even operate the equipment. Rather, they engage the services of design specialists and cinema equipment dealers, and hire union projectionists. The majority of such screening rooms have changeover booths! For some examples, go to www.maxandassociates.com and click on "screening rooms." (This site also has a used equipment listing.)

In addition, private commercial screening rooms are to be found which those in the business without such facilities at home can rent to host small gatherings and view their favorite films. For some examples, go to www.film-tech.com and click on "pictures" and "Sunset Screening Rooms" and "Rowley Screening Room." Even the prestigious Academy of Motion Picture Arts and Sciences Theatres in Hollywood can be rented for private screenings, should you wish to soar with the movers and shakers. The 1,012-seat Samuel Goldwyn Theatre runs about \$3,000 for one night, while the 67-seat Academy Little Theatre runs about \$600. If you're interested, visit www.oscar.org and click on "information" and "rental facilities."

Back to reality, today's "home theatres" range from 8 and 16mm collectors' home screening facilities to 35mm and even 70mm home showplaces capable of accommodating dozens of guests, complete with the latest in projection and sound. For a wonderful example of a bedroom conversion into an excellent home theatre, go to www.geocities.com/Hollywood/Hills/2428, and click on "cinema."

You as a collector will inevitably gravitate toward a niche that suits you, and you can plan and execute a home theatre within your constraints of budget and taste that will fit your needs.

We will begin by addressing some questions that will guide you to your optimum home theatre design solution.

III. DECISIONS TO MAKE

CHOICE OF "GAUGE"

The "narrow" (as opposed to "wide" 35mm and up) gauge films probably had their genesis in early "home movies" that probably began to appear shortly after Eastman's and Edison's inventions spawned the nickelodeons. I recall reading of 35mm "home movie" films of an African safari made by Mr. Eastman during these early days. By the mid 1920s (judging from Bell & Howell "Filmo" ads in copies of National Geographic of that time) 16mm had gained a foothold in the market. By the time I was a lad in the late 1940s, my family was well into 8mm home movies, but these were of lesser picture quality than the 16mm format which our more affluent relatives used. For a definitive tutorial on gauges, visit www.xs4all.nl/~wichm/cinemat.html and click on "100 years of film sizes."

For a variety of reasons, 16mm became the popular choice for educational films and non-theatrical prints of feature films, to say nothing of TV stations which, prior to the advent of video recording equipment, used film for everything from commercials to prime time shows to late night movies! Also, in the late 1960s airline in-flight movies became popular and utilized 16mm prints. In fact, the MARC lamp that some "auditorium" style projectors utilized in the 1970s and 1980s was developed by General Electric for the in-flight projector market. The AMC chain even experimented with 16mm for small theatres, using the venerable Eastman 25 projector as a foundation. A few military base theatres today use 16mm, though most use 35mm.

Film libraries that catered to schools' and institutions' 16mm needs proliferated during the late 1940s and 1950s, but few remain in business. Probably the largest left today are Swank (www.swank.com) and Kit Parker (www.kitparker.com). In case you didn't know, you can rent the films you want to screen but cannot find in the collectors' market, though such rentals are not cheap

Arguably, the most popular film medium today for the home enthusiast is 16mm. Within this format can be found feature films in both "flat," "scope" and "adapted scope" formats. Also popular is the 8mm format which has improved since the early days of "home movies" with the addition of Super 8 and magnetic sound. Other "narrow gauges" evolved over the years, but are rarely found today.

Collecting 35mm films is a newer hobby. Probably inspired by film celebrities' home theatres (and these celebrities' propensity for acquiring prints for their personal use), and propelled by a desire to emulate the full theatrical picture and sound experience at home, 35mm collecting is a growing field.

In many cases, the sources of prints may be questionable, but the same is often true in the 16mm arena. Thus, collectors need to remain circumspect and maintain a low profile since they are involved with the "intellectual property" of studios that is in most cases protected by copyright laws.

Ironically, it is sometimes collectors who provide source material for the restoration of classic motion pictures, often by the same studios that failed to properly protect those very classics! For you Latin scholars, and with apologies to MGM, I call this studio attitude "Ars Gratia Pecuniæ."

As you will recall from "Collecting Basics," a 1,600' reel of 16mm film at sound speed provides about 44 minutes of entertainment. Thus, most feature films will fit on two or three reels, and the reels are

relatively small (7/8" wide by 13-3/4" in diameter), light in weight and easy to store. (You may wish to re-visit "Collecting Basics" for storage hints.)

On the other hand, a 2,000' reel of 35mm film provides about 20 minutes of running time. Most feature films require five or six reels, and the reels weigh about 8 pounds each, so a feature film may weigh 40 to 50 pounds. And, when put up on 6,000' reels, each reel may weigh about 25 pounds. (A 2,000' 35mm reel is 1-7/8" wide by 15" diameter, while a 6,000' 35mm reel is 24" in diameter, and a 12,000' reel is 38" in diameter.)

A reel of 70mm film, assuming 5 perforation format, may run about 20 minutes and weigh 20 pounds or more. Even an empty 70mm reel weighs nearly as much as a full 35mm reel, and is 3-1/4" wide by 22" in diameter!

At the other end of the spectrum, 8mm film is about half the physical size and weight of 16mm.

Weights impact not only the cost of shipping, but also the effort required to handle the film. To save weight and reels, many collectors store and ship their 35mm films on cores. On the other hand, many like myself prefer to store films on reels and in steel or fiberglass "transit cases" (you know, the containers in which films are delivered to theatres). The safe handling of film on cores requires the use of "split reels" which are an added expense, but well worth it when compared to the aggravation of a reel on a core slipping off the core and into a jumbled heap on the floor!

Many collectors zero in on one film size, while some, such as the writer, collect both 16mm and 35mm. A few collectors also deal in 70mm.

So, there are several "gauges" from which to choose, and these will impact your equipment choices.

CHOICE OF PRESENTATION

Now we must consider whether to provide for showing a feature film continuously or allowing for reel breaks. If you screen your films infrequently, you need read no further, as your needs may be satisfied by a single portable projector and a portable screen. Many collectors find this arrangement eminently adequate, for the attraction is, in the final analysis, the big clear picture on the big screen (as opposed to a "pixel-ated" television image).

If you lean toward more frequent screenings where reel changes may become an annoyance, you can employ (1) two projectors and perform changeovers, as we described in "Collecting Basics," or (2) a single projector with large reel capability, such as a 16mm professional machine fitted for 5,000' or 6,000' reels, or (3) a single projector with a platter or reel tower. In the 16mm arena, Eiki makes a device that holds a 6,000' supply reel and a 6,000' take-up reel. This sits behind the projector and the film is routed over rollers that are installed on the projector reel spindles. In the 35mm arena, many manufacturers make platters that can hold three hours or more of film and enable a single projector to be used. There is also a tower arrangement that utilizes horizontal 12,000' reels that is popular in Europe, although at least one collector in the US, Greg Mueller, uses one. Go to <http://users.silverlink.net/~mueller> and "movie stuff" and check out Greg's excellent home theatre. And, Brad Miller set up a platter for 16mm use in a small theater. Go to www.film-tech.com and "pictures" and "16mm on a platter – you bet!!!".

Your choice of presentation will determine what you will need in terms of funds, space and determination, to say nothing of a patient spouse.

IV. A GUIDE TO EQUIPMENT

INTERMITTENT MOVEMENTS

Before we discuss projectors, a brief look at the heart of the projector is in order. This is the mechanism used to pull the film, frame by frame, past the aperture plate.

All but the most expensive professional 16mm projectors utilize a "claw" with teeth that engage with the sprocket holes and pull the film down "intermittently." The problem here is that 16mm film has but one sprocket hole per frame, the teeth are not necessarily the full width of the sprocket hole, and most projectors employ only two teeth. If the lower loop is lost due to torn sprocket holes, resulting in the film being pulled continuously through the gate, these teeth will likely do what any teeth worthy of the name would do – chew up the film.

However, 35mm projectors and most theatrical 16mm machines utilize a "sprocket" wheel whose teeth engage fully with the film's sprocket holes. The intermittent sprocket is driven by a "Geneva movement" that employs a precision-machined star and cam arrangement to effect the intermittent turning of the sprocket. This results in steadier pictures and more positive film control than many claw type movements.

Since the proper functioning of the intermittent movement is vital to the steadiness of the projected image, it must be cared for meticulously. If you have a Geneva type movement, check the oil level while you are cleaning the projector prior to each showing. If you have a claw movement, be sure that all motion points are properly lubed as recommended by the manufacturer. The last thing you want is intermittent problems while running a show.

PROJECTORS – 16MM

In the 16mm arena, there are many choices, ranging from the economical single portable projector, to a pair of pricey portable "auditorium style" projectors equipped for changeover operation, to a very pricey theatrical machine equipped for 6,000-foot reels. Used projector costs range from well under \$100 or so for portables, \$500 or more each for auditorium machines, and up to \$15,000 and more for the very best of the theatrical machines. Quite a range! Don't be afraid of 16mm changeover operation if you can find a pair of suitable machines. All it takes is timing (countdown) leaders and cue marks as previously discussed in "Collecting Basics," and changeover operation can be challenging and fun. Go to www.iceco.com and check out available used and even new JAN (military) 16mm projectors with changeover capability. Also, used equipment is often advertised in the collector's monthly magazine, "Big Reel" (phone 800-258-0929) and on forums like the fcls. Finally, don't overlook www.e-bay.com as a source for 16mm equipment.

Some "auditorium" type 16mm projectors in the 1950s were made with arc lamps. If you are lucky enough to find a "Filmoarc" (Bell & Howell) or an Amproarc or similar machine, you will have loads of fun and be able to project a very satisfying picture. Carbons are still available and likely to be so for quite some time.

Within the 16mm community you will hear arguments about the relative merits of self-threading machines, slot-load machines, and manually-threaded machines. The bottom line, however, is the "film handler." A sloppy uncaring "projectionist" given a new print and the finest available equipment will inevitably screw up, while a caring and careful student of film handling can usually take an old print and adequate equipment and produce a fine show.

Sadly, the growing popularity of the VCR in the 1970s sounded the death knell for much of the 16mm market which, as earlier noted, was tied heavily to educational films for schools, and to in-flight movies. Today, few schools have any film equipment, but rather rely on VCRs and TV monitors. Even high school auditoriums with 16mm projection capability are few and far between, most relying on projection TV. It goes without saying, then, that only a few firms today manufacture 16mm projection equipment, so any equipment purchased used is liable to present the user with spare parts problems. On the bright side, many dealers and collectors still have spare parts available, or have ideas for improvising when the need arises. An e-mail request for help on a forum like fcls will almost always yield results.

PROJECTORS – 35MM

In the 35mm (and up) arena, one may use a single projector and endure the multiple reel changes, or a pair of machines arranged for changeover operation, or a single machine and platter like the megaplex theaters. DeVry made "portable" 35mm equipment for years and examples are usually available. One enterprising chap used to sell remanufactured Simplex "standard" projector heads with small Ballantyne soundheads mounted on an engine stand for portability and fitted with 6,000-foot reel arms and an incandescent lamphouse for about \$1,000. (Most feature films will fit on two 6,000' reels, thereby requiring only one reel change.) Cinema equipment dealers today have a growing surplus of used equipment, the unfortunate legacy of the major chains having overbuilt, the state-of-the-art having advanced rapidly, and the movie-goers' taste having been whetted for the latest, the biggest, and the loudest. Find the cinema equipment dealers in your area and talk with them about used equipment. A little "bargaining" never hurts. Arguably, 35mm projection equipment is pricey, but the image quality is excellent, and some good deals may be found in the classified ads of the theatre industry monthly magazine "Box Office" (www.boxoffice.com) and on forums like the fcls and film-tech.

Not to be overlooked is how gentle the projector head is on the film. Opinions vary, of course, but the writer believes that Norelco/Kinoton projectors are the easiest on film. Whether you are looking at an old Simplex "standard" head (nearly indestructible), or a newer Simplex (Super, E-7 or X-L) head, or a Holmes or Brenkert or Motiograph or Century or Ballantyne, or even an imported machine like Kinoton, Cinemeccanica, Bauer or Prevost, determine if the head has been rebuilt and what warranty may be available from the rebuilder. If the head has a curved gate, so much the better as it will help maintain focus. With the plethora of multi-screen house closings, you may run across a newer machine, perhaps even a lamphouse "console" and projector combination. Many smaller houses employed 1000-watt xenon consoles fitted with an open frame combination projector and sound head that, while noisier than many, will provide good service in a home theatre, and 1000 watts is an ideal lamp size for most home theatres. Try to find one with a single-phase lamphouse power supply unless you are fortunate enough to have three-phase electric service in your home or are willing to buy a phase converter.

If you utilize a "non-console" setup, a good investment is a sturdy steel base such as the monsters made by Simplex and others, and available new from Strong (www.strong-cinema.com). The soundhead (and drive motor) bolts to the base, the projector head bolts to the soundhead, and a "shelf" is provided behind the projector head for a lamphouse, and the lamphouse power supply can sit on the

floor below. Then, you can use 2,000' magazines or install Kelmar 6,000' reel arms (www.kelmarsystems.com). The 6,000' arms will come in handy for platter operation.

CHOICE OF LAMPHOUSES

Most prefer xenon lamphouses, but don't be afraid, whether in the interest of economy or antiquity, to use carbon arc lamps. While carbons are not in general motion picture use in the US, they are still made, both for the overseas market and for the remaining carbon arc follow spots in use, and even projector lamphouses in a few older theaters and private screening rooms. In the old days, motor-generators were used to power carbon arc lamphouses, but these were big and power hungry. If you inherit arc lamps, try to find solid state power supplies, and remember that a heavy-duty adjustable rheostat or resistance grid must be used in series with the lamp so that the power supply does not see a "short circuit" when you strike the lamp (momentarily bring the carbons together to start the arc), as well as to adjust the current. How I could reminisce about arc lamps, but instead I'll just ask you to go to www.film-tech.com and "pictures" and "Byrd Theatre." These pictures say it all! As to continuing availability of carbons, go to www.marbleco.com. Marble sells booth supplies of all sorts, including carbons.

You will very likely be using xenon, so several important basic caveats are in order:

- - **Do not handle the quartz (glass) part of the lamp.** Handle the lamp only by the metal parts.
- - **Do wear protective eyeware and clothing.** Xenon lamps can explode if mishandled.
- - **Never look directly at the arc.** The UV radiation can damage your eyes just like looking directly at the sun.

If at all possible, have a technician service your xenon lamphouses. A few dollars thus spent beats a visit to the emergency room.

On the other hand, your projector may utilize an incandescent lamphouse. Among the older incandescent lamps, whose short life tends to be a disadvantage, 1,000 watts was the practical maximum, and color temperature was a bit too "warm" for most folks' taste. Later projectors utilize more modern low-voltage lamps, the lower voltage affording a smaller, more easily focussed filament, as well as line-voltage tungsten-halogen reflector lamps, with excellent results.

Of course, you can always convert a projector to different light source. In the early days of xenon, Kneisley Electric produced conversion kits to retrofit a xenon lamp and igniter (the high-voltage power supply that strikes the arc) into a carbon arc lamphouse. Here again, the help of a technician will save much potential grief.

As to size, the lamp in your projector should be adequate to illuminate your screen, with no film in the gate, to a level of 16 foot-lamberts, the SMPTE standard. The illuminance level is a function of the lamp (wattage) and of the projector (shutter), the lens (speed), the throw (distance to the screen), and the reflectance of the screen. It would be folly to expect a 250-watt incandescent lamp to provide

adequate picture brightness on a 10' wide screen, and it would be wasteful to use a 2000-watt xenon lamp on a 10' wide screen, as well as make the picture potentially uncomfortable to watch. Try to match the equipment in your home theater so that your viewing experience is the best possible within the constraints of budget and reality. Here again, the help of a technician with the required measuring equipment will prove helpful. While testing for screen illuminance, be sure to limit the time you are projecting with no film in the gate as the heat can be detrimental to the lens' health.

EXTENDED PLAY EQUIPMENT

As noted before, the use of a platter or other extended play equipment permits a single pricey 35mm projector to show a full feature film, with shorts and trailers, without a break.

The platter concept was conceived by Kinoton in Germany in the late 1960s, and a US version was produced by Potts in the early 1970s. By the 1980s other US manufacturers were marketing platters, and this, along with the proliferation of xenon lamphouses, was the genesis of the multi-screen frenzy that ultimately put many real projectionists out to pasture. History aside, the fact remains that a used platter at \$1,000 more or less is cheaper than a second 35mm projector (with soundhead and lamphouse) at \$2,500 more or less.

Used platters are available at cinema equipment dealers. If you are clever in electronics, you can download your platter's manual (go to www.film-tech.com and click on "manuals") and do your own servicing. However, you will need a tachometer to time it, so obtaining one that is operable or paying the dealer to tune it up is not a bad idea. The idea is that the film is wound onto the supply platter, using an accompanying make-up table, around a removable take-up ring that surrounds the feed control ("brain"). After the film is loaded, the take-up ring is removed and placed on the take-up platter. Then, the film is routed through the feed control and through a series of guidance rollers to the projector and back to the platter, where it is routed to the take-up platter by way of a return (control) arm. As the film is pulled through the "brain," a rotating variable-density filter, placed between an LED light source and a solar cell, is actuated. The solar cell output is amplified and modulates the speed of the supply platter's drive motor to feed the film. The return arm functions in the same manner and modulates the take-up platter's drive motor. If all things are properly adjusted, the platters gently feed and take up the film with no "hunting" or other perturbation. Recall the 16mm platter pictures you saw earlier. They depict such a film guidance system. If you decide to go with a platter, the assistance of a technician during installation and start-up is suggested, as the positioning of the guidance system rollers and the final adjustments of the platter are critical. However, once your platter and projector are working as a team, and once you are fully familiar with their operation, you will enjoy countless hours of interruption-free screenings.

The tower system pictures that you viewed earlier represent another approach the extended play of films. The large reels, though appearing unwieldy, are handy for storing entire feature films.

However, ways also exist to similarly store entire feature films on platters. The films may be "clamped" and moved short distances, or can be made up on Goldberg's "Show Shipper" system reels. While expensive, these reels enable making up the prints for the platter on your rewind bench, obviating the need for the usual make-up table, and they make moving or storing your prints flat on shelves a snap. Ask your local cinema equipment dealer about the Goldberg "Show Shipper."

FILM CLEANING EQUIPMENT

The use of FilmGuard liquid in conjunction with FilmGuard cleaning media and Kelmar's "dry-media" cleaners, will afford many benefits to the collector (go to www.film-tech.com and click on "film cleaning"). In addition to cleaning and lubricating the film, resulting in cleaner projector gates and an improved image, the liquid coating is an anti-static agent, and static on film can cause serious platter feed malfunctions. Given that most 35mm prints today are on polyester stock that has incredibly high tensile strength, a film jam at the platter can have potentially disastrous results. Please give this your most serious consideration.

SOUND EQUIPMENT

While 16mm portable equipment is usually complete with a sound reproducer, amplifier and speaker, most 35mm equipment is not. In most cases, the soundhead is a discrete component, and may or may not be of the same manufacture as the projector head. In all cases, the processors, amplifiers, speakers, etc. are discrete components.

A fact worth remembering is that, when threading, there must be a distance of 21 frames (35mm) or 26 frames (16mm) between the picture aperture and the sound lens, so the lower loop must be adjusted accordingly and always be the same lest the picture and sound be out of synch like a badly dubbed Kung Fu movie.

The basic format is the mono (one channel) optical soundtrack. The first successful stereo (multi-channel) film was Disney's "Fantasia" in 1939, which utilized a second (non picture) film with multiple optical sound tracks run through an interlocked second multi-channel sound head. It was a remarkable feat for its time, but the added booth equipment and speakers made it a cumbersome system, largely relegated to "road show" presentations in major theatres, since no booths were permanently equipped for it.

Not much happened in sound thereafter until the 1950s, and the following brief history is offered as a prelude to your decision on sound equipment choices.

Magnetic Sound and Stereo

The advent of magnetic wire recorders in the 1950s and magnetic tape recorders in the 1960s revolutionized the audio recording industry. Applying the same medium to film, by the addition of a magnetic sound track, was a logical choice, although it required additional processing (the optical processing of the film and the processing of the magnetic track), as well as new magnetic soundheads on projectors along with the accompanying processors and other equipment.

The great showman Mike Todd and his associates (later the Todd-AO Corporation) developed a new 70mm process involving a curved screen and 6-track stereo sound recorded and played back magnetically. The first film to be made with this process was Rodgers and Hammerstein's "Oklahoma," and it received the 1955 Oscar for best sound. Todd-AO continued to flourish in the 1950s and 1960s with other major motion pictures.

The magnetic soundheads were installed between the top of the projector head and the upper magazine, and were nicknamed "penthouses" as a result of their lofty location atop the projector.

Magnetic sound continues to be the medium of choice in the 70mm and 8mm arena, and is to be found to a limited degree in 16mm. And, Todd-AO continues to serve the industry in the areas of video services and post production.

Optical Sound and Dolby Stereo

Ray Dolby developed a sophisticated new form of audio compression and expansion which dramatically reduced the background hiss inherent in tape recordings, and Dolby Laboratories was born. This was the Dolby A system, soon followed by Dolby B, and these afforded significant improvements in audio tape recording technology. By the early 1970s Dolby cassette tapes were growing in popularity.

Dolby turned its attention to cinema sound in the 1960s, and applied Type A noise reduction to the optical sound track with promising results, albeit mono. Meanwhile, multi channel magnetic recording had come of age. However, the cost of a release print with magnetic sound was significantly greater than the cost of an equivalent optical print, which drove Dolby to develop in 1965 an optical release print format originally identified as "Dolby Stereo" that afforded left, center and right screen channels, plus a "surround" channel for ambient sound and special effects. This same print could be played on the older mono equipment also, enabling a single print to fill both needs, but when played with Dolby equipment and multi-channel sound, the result was spectacular, especially with processor outputs for subwoofers. Moreover, optical sound equipment required less maintenance than magnetic equipment (playback head wear, etc.).

The next milestone was "Dolby SR" in 1986, which endures today as the state-of-the-art in analog sound systems, followed more recently by "Dolby SRD" in which a digital optical track is placed on the print along with the analog optical track, affording a print that can be played on older mono equipment, or analog equipment, or the newer digital equipment.

Digital Sound and DTS Stereo

As audiences' ears were becoming accustomed to significant advances in the home entertainment market, theater sound systems, to remain at the cutting edge, countered with a new system (DTS, named for Digital Theater Systems) that afforded left, center and right channels at the screen, plus left and right surround channels, and a subwoofer channel. This system utilizes CD ROMs for the digital sound, synchronized to the film through an optical sound track timecode. DTS requires a special processor that incorporates a CD player.

The DTS system is practically fail safe. The system reads the timecode on the film and plays the correct sound from the CD for each frame of the film. Thus, edits and non-digital trailers are automatically accommodated. In addition, the system checks a keyed serial number in the film timecode against the CD ROM to ensure that the correct sound track is being played.

Again, as with Dolby SR and SRD, a single print can be used. Just be sure you have the CD disc and the required equipment if you want to enjoy the DTS digital sound.

Sony SDDS

Sony Dynamic Digital Sound (SDDS) added center-left and center-right channels for a total of seven! Impressive, yes, but some say the SDDS equipment is maintenance intensive, and it is costly. Not really home theatre stuff, yet quite a departure from the granddaddy mono optical sound that served us from 1927 through the 70s!

Now, back to reality, if you have a 16mm projection system, its integral sound reproducer and amplifier should be more than adequate, but, if you want to upgrade, Smart Theatre Systems makes a "stereo generator" that simulates right, center and left outputs and surround outputs from a mono source.

If you have a 35mm projection system with a mono sound head, whether with an older photoelectric cell or a newer solar cell, congratulations! It will probably provide better sound than any but the best of the 16mm systems. Still, it is possible to swap components and upgrade to stereo if you have the money and inclination. Aftermarket stereo solar cells are available, and soundhead conversions are best adjusted and fine tuned by a technician with the proper instruments. For optimum results, however, consider going for the ultimate – a reverse scan stereo analog soundhead, and, if you are very wealthy, a DTS processor. If DTS CD disc availability is a source of concern, a combination reverse scan optical (SR) and digital (SRD) soundhead can be had, and probably represents the best system for any 35mm home theatre. Ah, to win the Lottery!

If you have a stereo sound head, a Dolby stereo processor is needed, along with the related amplifiers and speakers. A used Dolby CP-50, old by theater standards but quite nice for home theatre optical sound use, will cost you under \$1,000. (Compare this with the cost of a new state-of-the-art CP650 at about \$7,000!) Two used two-channel amplifiers will run about \$300 each. These will give you a remarkable system with the right speakers. You can add another amplifier and a subwoofer and have truly spectacular home theatre sound.

If you wish to add DTS capability, a used DTS-6 processor may run up to \$2,000 or more depending on condition.

A potential fly in the ointment for collectors in the near future is the planned switch to a cyan sound track that will require a red light source. There are after-market exciter lamp replacements that utilize red LEDs, so the switch to cyan is possible, but the results are less spectacular than a new reverse scan soundhead. Of course, after-market reverse scan soundheads already use red LEDs, and may be found for less than \$2,000.

RACK

I am not referring to an instrument of torture, but to a vertical frame that contains your sound equipment. Many megaplexes utilize open racks, and some use enclosed racks. I prefer an open rack because it's cheaper and the equipment tends to run cooler. You would be wise to install processors, booth monitors, etc., at a convenient operating height, and to install the amplifiers at the bottom where their weight will help afford stability. A "power strip" fixed to the inside of the rack makes it easy to plug in rack-mounted equipment. If the total power draw of the rack-mounted equipment exceeds 1,000 watts, two or more power strips on separate circuits would be appropriate. Some prefer to have their amplifiers on separate circuits in any event.

A typical sound rack will include a stereo processor, perhaps a DTS reader, exciter power supplies (or LED power supplies and stereo solar cell pre-amps), a booth monitor (speaker with amp and volume control and a selector switch so you can check all channels individually if desired), amplifiers, etc.

When interconnecting rack-mounted equipment and connecting such equipment to the soundheads, be sure to use high quality shielded cable such as Belden 8451, and keep low-level audio lines well separated from power wiring.

Again, the help of a technician, unless you are really at home with electronics and audio, will pay rich dividends. He will have the expertise and test equipment to perform the so-called "A Chain" (booth sound adjustments such as soundheads, processors, amplifiers, etc.) and "B Chain" (house sound adjustments such as speaker balance, etc.) alignments.

REWIND BENCH

If you have a 16mm booth, the projectors have rewind capability, but, even so, a bench with a pair of hand rewinds is a useful accessory. You can mount an Ecco applicator between them to clean your films and it is a handy place to make splices and to apply Perfix tape over torn sprocket holes. Also, a viewer is a handy 16mm rewind bench accessory.

If you have a 35mm booth I recommend a theatrical rewind bench with a modern motorized rewind system so that you can handle any size reels up to 6,000' and even the big Goldberg "Show Shipper" reels. Note that 16mm reels are built for 5/16" spindles, while 35mm reels may be built for 5/16" spindles **or** 1/2" spindles, and all 70mm reels are designed for 1/2" spindles. A theatrical rewind like the Kelmar will have accessories that adapt to either spindle size, thereby making the rewind quite versatile. Also, if you have only 5/16" spindles and come across a reel designed for a 1/2" spindle, Strong makes a spindle adapter that permits use of such reels on a 5/16" spindle.

A lighted inspection window is a handy accessory in any rewind bench, so much so that most platter makeup tables have them. They make it easy to inspect for frame line match when splicing, checking and/or making cue marks, etc. A piece of ground or opal glass or white translucent plastic, say 2" by 3" and set flush in an opening in the table, illuminated by a 6-watt lamp (a plug-in night light works fine) installed beneath is all that is required.

In the "old days," a compartmentalized film cabinet was located under the rewind bench with drawers for each reel of film that made up the show. These separated the nitrate film reels to prevent spread of fire and were a safety accessory just like the magazines on the projectors.

Today, some rewind benches have horizontal angles welded into place to hold reels vertically beneath the bench, and these can be handy.

OTHER BOOTH ACCESSORIES

A set of "house" reels is a good investment. Changeover booths always had a set of cast aluminum reels that were used during the play of a film, since the "exchange reels" upon which films were shipped were sheet steel affairs, often showing signs of abuse, though more fragile plastic reels are now more commonly used. With the coming of xenon, many theatres added reel arms to accommodate 6,000' reels, purchased "house" 6,000' reels, and made up the show on two reels requiring but a single changeover.

Most platter manufacturers suggest making up films on 6,000' reels and utilize the make-up table to feed these reels onto the platter, requiring but a single splice at the platter. The latest handy dandy booth accessory, though, is the "Show Shipper" reel made by Goldberg Brothers. This 12,000' booth reel enables the entire show to be made up at the rewind bench, and is designed so that the entire show can be safely transported!

If you store your films on cores, and use reels rather than a platter, you may want to acquire multiple split reels for ease of handling.

Even in the 16mm arena, good sturdy metal "house" reels will prove useful, even if you store your films on plastic reels. Remember, a 6,000' 16mm reel, if your equipment can handle it, can hold a lot of film!

Don't hesitate to discard any reel that is warped or damaged as its use could damage the film! If a reel's sides rub against the film, that reel, if not readily repairable, should be relegated unhesitatingly to the scrap bin.

A splicer for each gauge of film you will work with is required. We discussed splicers under "Collecting Basics." You cannot buy too expensive a splicer. A cheap splicer or a badly used good splicer will remind you of its frailties every time a splice runs through your projector!

Since you may have several lenses to keep track of, a wall-mounted cabinet for lenses is a good idea. While many projectionists store their lenses on open shelves, atop wiring gutters and even on port ledges, the best storage is a closed cabinet where they will remain clean and less likely to fall to the floor with heartrending results.

If you have many trailers, daters, etc., on cores, a wall-mounted shelf is a handy device to have. And, a dedicated cabinet for projector cleaning and lubricating supplies, spare parts and maintenance manuals is not a bad idea.

Speaking of manuals, I would again remind you that can download manuals (go to www.film-center.com and click on "equipment manuals," and to www.film-tech.com and click on "manuals") through the courtesy of Sheldon Harris and Brad Miller and a host of generous contributors, chief among them a very knowledgeable professional, Ken Layton. Get to know the manuals appropriate to your equipment, and always perform preventive maintenance as recommended. Get to know where to look for troubleshooting hints. It pays to be prepared.

Lastly, a cue maker is a handy device if you are running a changeover booth. Most cinema equipment dealers will order one for you. They are available for 16mm too!

SPEAKERS

Whatever your sound system, pay special attention to the greatest potential weak link – the speakers. Use the best speakers you can afford to get the most from your sound equipment. A sub-woofer and surround channels will add startling realism. In today's highly competitive megaplex business, theater owners spend really big bucks to give their customers a thrilling entertainment experience and to keep them coming back for more (though they pay little more than "minimum wage" to their film handlers). Similarly, your home screening room equipment will give you the most pleasure if it is equipped to deliver a commensurate thrill to you and your friends.

The basic speakers, assuming a stereo system, should be identical left, center and right "stage" speakers, ideally located behind an acoustically transparent projection screen so that your audience is tricked into believing that the source of the sound is the actors on the screen. While cinema equipment dealers are good choices for most used equipment, unless you have a large budget I recommend you shop for your "stage" speakers in the home stereo market. Be sure they are three-way systems capable of handling 100 watts each or more. Once you are set up for "blockbuster" sound, you don't want to discover distortion due to speaker overload! Ideally, "stage" speaker response should be nearly flat (+/- 3db) from 45 Hz to 12 kHz, and on the order of +/- 10db from 30 Hz to 20 kHz. However, specs are one thing and your ears are quite another. Listen to the speakers you are considering and go with what sounds really good to you. Try to audition your speakers in a demo facility about the same size as your home theatre, preferably with similar acoustical treatment. Cinema speakers usually use 15" woofers with large magnets and wide excursion cones capable of moving massive quantities of air. Since your home theatre will be smaller volumetrically than a small cinema, smaller woofers will probably serve your needs, but drive the speakers you are considering at or higher than the maximum volume you intend to play them at home, and let your ear decide.

Surround speakers from cinema equipment dealers are another matter. They are relatively small and inexpensive, and with two on each side wall of your home theatre you will be treated to impressive surround sound.

When you shop for a subwoofer, again visit the home stereo market. You should not need a "powered" speaker as you will probably have a dedicated channel in your system for the subwoofer. Response should be no less than +/- 3db from 38 Hz to 100 Hz, and +/- 10db from 28 Hz to 500 Hz, and the speaker should be capable of handling several hundred watts. Placement of the subwoofer is not critical. Low frequency sound is not directional, so your subwoofer can be placed wherever it is out of the way.

A final step after installation will be to discover the source of all the sympathetic vibrations that are inevitable, and mitigate them. This is likely to pit you and your home theatre speakers against your wife's bric-a-brac cabinet, but you must prevail!

THE SCREEN

We are all familiar with the roll-up portable screens used in classrooms, and the type of screens that the family's vacation slides are projected on. Such screens will work nicely in an informal screening situation. What you need is a white surface, perhaps reflectorized to enhance the apparent brightness of the image, though dimming that image if you are sitting to the side.

A home theatre's design will dictate screen requirements. Can a fixed screen be installed, or must it be rolled up when not in use? I will assume that your home theatre space can support a fixed screen.

Screen materials vary. Some collectors use simple, readily available material like white Formica and report good results. Manufactured screens offer multiple material choices, from several grades matte white to a reflectorized silver. Then comes the question of perforations. If you install your speakers behind the screen, which is ideal in most instances, a perforated, acoustically transparent, screen is in order, but regular perforated screens, when viewed up close, are annoying since the perforations are visible. A firm in England (www.harknesshall.com) has the answer, a so-called "mini-perf" screen whose perforations are but 0.5mm in diameter. It may be viewed from as close as 5 feet without

annoyance from the perforations. Remember, however, that a perforated screen will have lower reflectance than its non-perforated brother.

Screen mounting systems vary, but, for good results, use a "lace and grommet" screen securely and evenly lashed to a substantial frame. Unistrut channel is useful for constructing such a frame, as all the required fittings are readily available (go to www.unistrut.com) from the Home Depot and similar builders' supply houses. Alternatives include rigid pipe frames. Be sure the frame material does not abrade the lacing cord.

Dressing the screen with masking is important. The masking material or movable masking curtains should be a non-reflective black material such as "duvateen," and should be so adjusted that the fuzzy outline of the projected image "bleeds" into the masking, yielding a sharp cutoff between picture and masking. Movable masking can be adjusted manually or controlled by motor operators from the booth. This is an element of good showmanship, and aperture plates can be carefully filed to create the ideal "fit" of the projected image and the screen.

For the ultimate in showmanship, consider a motor-operated "title curtain" in front of the screen. With automation, the curtain lights may be controlled to fade down and up as the curtain opens and closes. Used motor-driven moveable masking and curtain operators are generally available.

BOOTH AMENITIES

For those who would like to maximize their enjoyment by doing little or nothing in the booth while screening, automation, as noted above, is an idea worth considering. Many cinema equipment dealers have various forms of used and new automation equipment from the simplest using a time switch like your washing machine cycle control to elaborate devices using PLCs.

In the best of worlds, imagine yourself pressing a single button in your home theatre that causes (1) the house lights to dim, (2) the projector to start with the screen masking preset to the format of the film to be shown, (3) the title curtain to open, and (4) the curtain lights to dim. At the end of the show, (1) the curtain closes as (2) the curtain lights come up, (3) the house lights come up and (4) the projector shuts off and non-synch music begins. A dream? Not necessarily. With ingenuity and luck, you can have all this - and even more!

EQUIPMENT MAINTENANCE

Last, but definitely not least, protect your investment by providing proper maintenance. Check the oil level in your intermittent movements daily. Provide proper lubrication as recommended by the equipment manufacturers. And, keep the equipment and booth clean. Why risk damaging a beloved print by running it through dirty equipment? A few minutes of prevention can avoid hours of remorse.

V. CONSTRUCTING YOUR THEATER

THE BOOTH

Ideally, the projection booth floor will be higher than screening room floor so that your audience does not inadvertently interrupt your show with their silhouettes when they stand up or walk about. A height difference of 3 feet would be good if attainable, since that would place the centerline of the projector ports at 7 feet above the screening room floor.

Ceiling height must be considered. While a low (<7 feet) ceiling might be adequate for older 35mm equipment with 2000' magazines, the use of 6,000' reel arms and penthouse (above the projector head) sound reproducers require greater height, while the use of a platter might permit a lower ceiling height. Consider your equipment's operating height requirements when planning your booth.

The "windows" through which the image is projected and through which the projectionist watches the film are called "port holes" or "ports." In the old days, there was a projection port and a viewing port for each projector. In today's megaplexes a single large port often serves both purposes. You can purchase prefabricated ports ready to build into your wall from Goldberg Brothers, from Cinema Products Sales (www.cinprod.com), and from Kelmar, or you may construct your own. Ports are available that are THX rated, and so provide absolute minimum sound transmission. The most important element is the port glass. It must not distort the image, so ordinary glazing will not do. Goldberg, Cinema Products Sales and others sell optical glass for this purpose. The glass is usually placed at an angle with respect to the projected light beam to offset undesirable reflections, and it must be easily and safely removable for cleaning. Usually the projection ports are 48" from the floor to the centerline of the port, and the viewing ports are 60". In yesterday's multiple projector booths, the projector ports were on 3' to 4' centers. You need to consider working space between your equipment for ease of threading and servicing. However, don't place the equipment too far apart. Remember that projectors offset from a line perpendicular to the center of the screen will produce a "keystone" effect and result in difficulty maintaining focus across the width of the screen. If you are into 35mm or 16mm "professional" equipment you may need to plan the ports based on the height of the equipment's lens (48" may do, or you may need to adjust). If you are into 16mm portable equipment, you may wish to consider a built-in projector table in front of the port, or use an "audio-visual" cart with locking casters (or the casters removed) as a stand.

The front wall (between the booth and the "house") should include insulation to mitigate sound propagation through the wall. A "double stud" type of construction, while yielding a thicker wall, will materially reduce sound transmission.

The booth floor deserves special consideration. When you visit some megaplex booths you will see signs that read "walk softly" or words to that effect. What these signs are really saying is that the booth floor is resilient, probably laid up on wooden framing, and that heavy footsteps can cause the projectors to shake with unpleasant results on the screen. When you construct your booth, consider the weight of the equipment and provide a **rigid** floor that is capable of supporting the load. 35mm equipment especially can weigh hundreds of pounds. Those wonderful Norelco AA 35-70mm machines weigh close to 1,500 pounds.

Another consideration is the seismic zone in which you live. The Uniform Building Code includes a map that indicates seismic zones across the US. If you live in a zone 4, or even 3, area, consider bolting your projection equipment to the floor (alter final alignment, of course) and bolting your rack to the wall. And, don't forget other furnishings and appliances around the house that could be bounced around during an earthquake.

As to floor covering, some favor carpeting like most megaplex booths, but carpeting can lead to static buildup which can aggravate the buildup of dust on lenses and port glass, and cause feed problems on platters. I favor a hard floor such as battleship linoleum (**that** certainly dates me!) or floor tile, as it is easier to clean. A projection booth and projection equipment must always be kept immaculately clean!

Carpeting does have a place in the booth, however. If you carpet the walls, you will find that much booth noise is absorbed and less is transmitted into the "house." You may wish to not cover the front wall (with the ports), but excellent results may be obtained from covering the remaining three walls. And, an acoustical tile ceiling is always a good idea.

The walls and ceiling should be painted with a non-reflective finish, preferably a muted color like gray, in order to prevent any reflected light from leaking through the ports and into the house.

Your booth should be designed for the maximum complement of equipment you plan to use. If your plans include a platter, be sure to allow working room for the platter (a big footprint) and the portable make-up table. In any event, a good rewind bench, as noted before, is a must. Film storage racks are a good idea, unless your library is located elsewhere in your house. Be sure you have room to get around in the booth without bumping into anything. You cannot oversize a projection booth!

Also, don't overlook the need for adequate electrical capacity and ventilation or air conditioning. Each 16mm projector should have a dedicated circuit, and each 35mm projector should have two dedicated 120-volt circuits, one for the projector and one for the lamphouse power supply, and larger power supplies may require a 240-volt circuit. A dedicated subpanel in your projection booth, say a 12-circuit 120/240-volt panel with a 50- or 70- ampere main breaker, will serve you well. Some lamphouse power supplies are designed for 208-volts, three-phase. If you have only single-phase service, you can get converters that provide three-phase power from a single-phase source, but don't fail to account for their inefficiency when sizing your electrical system.

Following the practice of a bygone age, you might consider wiring gutter (cable trough) run horizontally along the front wall of the booth as a means of getting power to your projectors. If it is mounted at a convenient height, motor switches and changeover pushbuttons can be installed in the face of the gutter, with "twistlock" receptacles in the bottom into which to plug projector power cords.

Another smaller gutter could enclose sound and other low-level wiring, affording certain separation of sound and power circuits.

Lighting is an often overlooked subject. Consider having two levels of light, with fluorescent ceiling fixtures to provide 50 foot-candles or so for equipment maintenance and cleaning and booth cleaning, and incandescent lights, perhaps on a dimmer switch, to illuminate the working areas of the booth around the equipment. Those nifty little "MR" reflector spot lamps can provide ample light for threading the equipment, at the same time directing so that it does not escape through the ports and annoy the audience.

As to the need for air conditioning, it has been my experience that the life of electronic components is shortened by high ambient temperatures, as is the patience of projectionists. And, if you store film in your booth, maintaining a relatively constant low ambient temperature will enhance film life. A 1- to 1-1/2-ton through-the-wall type of room air conditioner should serve nicely, set to deliver some outside air (which the booth exhaust will carry away).

Finally, provide a small booth exhaust fan to the exterior, with simple ducting arranged so that each xenon or carbon arc lamphouse may be connected by flexible duct to the exhaust system. This will help keep the booth a little cooler and will enhance lamp life, while, in the case of carbon arcs, it will also vent combustion gases and particulates outside.

THE HOUSE

Moving on, your home theatre viewing space must be of such dimensions that it can accommodate an adequately sized screen, a reasonable "throw" (the distance from the projector to the screen), and seating. Some enthusiasts acquire and install used theater seats, while many prefer the informality of sofas and chairs. A rectangular space is ideal, and the screen width, which is necessarily a function of room width, must consider what formats you intend to screen.

Many collectors screen multiple formats, so a screen with moveable masking is desirable so that all formats may be accommodated, but this will require multiple lenses. It gets complicated, but the rewards are worth it. International Cinema Equipment in Miami (www.iceco.com) sells a neat slide rule that calculates focal lengths and screen sizes for multiple formats for 16mm and 35mm, and the price (less than \$30) is reasonable. Also, you can download several useful computer programs (go to www.film-tech.com and "manuals" and "miscellaneous programs") including lens calculators.

ADA COMPLIANCE

While this may be the last of your immediate concerns, do consider your friends and family members who may have disabilities or may be confined to wheelchairs, and try to accommodate them in your home theatre design.

HOUSE AMENITIES

Lastly, may I ask you to recall the delicious aroma of popcorn that titillated your senses when you entered your favorite movie theater? There is no reason not to include plans for refreshments in your home theatre planning. Most of the professional industry screening rooms you visited on the web earlier have adjacent bars where adult beverages and snacks can be served to augment the enjoyment of the show. However, even a bowl of fresh microwave popcorn and a canned soda on a table in front of you as you watch your favorite movie will minimize those trips to the kitchen.

Whatever your budget, whatever your preferred film format, however extensive your collection, treat yourself to all the amenities you can afford to help you, your family and your friends enjoy your new hobby!

VI. SHOWING FILMS

SAFETY FILM CAVEAT

This brief discussion presumes the use of safety film only.

Remember that nitrate film requires approved projectors in approved booths. Such booths were of fire-proof construction with self-closing fire doors, the ports were equipped with steel fire shutters that would drop automatically in the event of a booth fire, and a toilet and lavatory were provided to ensure that the projectionist could remain in the booth at all times when films were being run. The projectors were equipped with magazines for the upper and lower reels, as well as fire roller mechanisms to prevent a fire starting at the projector gate from spreading to the film in the magazines. In addition, films were stored in metal cabinets, and even the motor-driven rewind was enclosed in a steel cabinet.

A few such booths still exist, largely in retrospective theatres, universities and archival facilities, but the hardware to build one today would have to be custom fabricated or salvaged from an old theatre, all at considerable expense. Also, today's projection and film handling equipment is totally inappropriate for use with nitrate film, so older equipment would have to be acquired and rebuilt.

If in doubt, look for the words SAFETY FILM along the edge of the film stock. If the film is 35mm and these words do not appear, do not use the film. Return it to a steel container and either donate it to an archival institution equipped to handle it or seek professional help in disposing of it.

You would do well to recall the nitrate film fire and its consequences as portrayed in the 1989 Italian film "Cinema Paradiso." These scenes were very much true to life!

GOOD PROJECTION PRACTICES AND SHOWMANSHIP

These subjects are covered in the following tutorial.

VII. FINAL THOUGHTS

If you're still with me, you may be thinking, "Gee, there's a lot to this home theatre business!" Yes, there is, but if you ease yourself into it slowly, you will be pleasantly surprised how fast you learn. Don't be afraid to ask questions. There is no such thing as a dumb question, but there are a lot of dumb answers, so get several opinions, consider the sources, and go with those that make sense to you. As a start, go to www.fcls.com and enter the "Film Collectors Forum" discussions. These are segregated by "gauge" for your convenience, and there's even one on video. Also, go to www.film-tech.com and click on "Forums." There are a lot of people just like you who range from neophytes to experts, including professional projectionists and technicians, and through these forum discussions you will learn much as well as have a place to pose your questions. Remember, everyone started from scratch!

Also, visit some projection booths in your area. While some will rebuff you, in a few you will find knowledgeable and friendly people who will welcome you, answer your questions and provide guidance.

Finally, I cannot stress too strongly the desirability of visiting your local cinema equipment dealers. Many deal in 16mm as well as 35mm and 70mm. Most will offer friendly assistance and will be willing to bargain. As noted earlier, the plethora of multi-screen closings can only add to the availability of good used equipment.

Lastly, as your home theatre evolves, why don't you e-mail scanned photos so your fellow collectors can enjoy your progress and the final results of your effort? Sheldon would welcome your pictures, and we'd all enjoy seeing them.

Good luck!

APPENDIX

MORE USEFUL WEB SITES

In addition to the web sites sprinkled throughout the foregoing text, here are some more that might prove interesting. Go surfing!

www.christieinc.com – Christie consoles and projectors, Cypress, CA

www.dolby.com - Dolby (need I say more?), San Francisco, CA

www.dtsonline.com – DTS stuff, naturally, Agoura Hills, CA

www.kodak.com – Mr. Eastman's progeny

www.edwalk.com – Parts for older projectors, Chicago, IL

www.jblpro.com – JBL speakers, Northridge, CA

www.qscaudio.com – QSC amplifiers, Costa Mesa, CA

www.schneideroptics.com – Lenses, Hauppauge, NY

www.getgts.com – New and used equipment (good prices!), Salt Lake City, UT

www.cinprod.com – Equipment, booth supplies, ports, Nashville, TN

www.alangordon.com – New and used equipment, Hollywood, CA

www.nteequip.com – New and used equipment, neat picture gallery, Wendell, ID

www.uslinc.com – New and used equipment, San Luis Obispo, CA

www.blsi.com – New and used equipment (Norelco/Kinoton/Bauer), Boston, MA

www.ncsco.com – New and used equipment, Southfield, MI; Eden, NC

www.entequip.com – New and used equipment, New York, NY

www.cinequip.com – New and used equipment, Portland, OR

www.rsem.com – New and used equipment (good prices!), Tehachapi, CA

www.iceco.com – New and used equipment, and nifty home theatre supplies including poster boxes and frames, lighting sconces, signage, popcorn carts, candy cases, more, Miami, FL

www.widescreenreview.com – Magazine with home (TV) theatre articles and useful audio equipment news and reviews

There are many more websites to explore as you will soon discover. Check both www.film-center.com and www.film-tech.com and click on "links." In addition, "Boxoffice" magazine lists all advertiser's websites in the advertiser's index. You will discover a veritable treasure trove of information and ideas!

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## **MY HOME THEATER**

My own home theater is still under construction, since such a project is very time consuming. It has a separate projection booth with a dedicated electrical load center panel to feed equipment loads, including a through-the-wall air conditioner and humidifier. The all-Norelco booth is arranged for 35mm changeover or platter operation, and includes the following equipment:

- Two Norelco 35mm FP-20 projectors (as modified by MagnaTech to be reverse as well as forward running) with changeover capability, reverse scan LED sound reproducers, 6,000-foot reel capability, and Christie 1,000-watt xenon lamphouses
- One Norelco 16mm FP-16 projector (as modified to a model ERE-2184 for studio use) with changeover capability, , 6,000-foot reel capability, and a Christie 1,000-watt xenon lamphouse
- One sound rack
  - - One Dolby CP50 stereo processor
    - One Smart SG1130B stereo generator for 16mm "faux stereo"
    - One Smart MN520 booth monitor
    - Three Smart TA242 two channel audio amplifiers (left-center-right front, left-right surround, and subwoofer outputs)
- Kelmar automation and two-channel dimmer
- One Christie AW3 platter and make-up table
- One Kelmar rewind bench
- One film storage rack
- Kelmar cleaners installed and used with FilmGuard on all projectors