Heat Damage To Prints: Part I

New theater construction emphasizes "wall to wall" images on screens that often exceed fifty feet in width. Only five years ago, the average xenon bulb power was 2000 watts. Today, power levels of 4000 watts are common, with some theaters using as many as 7000 watts to project 3' mm film onto 80 foot screens.

Focusing all that power through a postage-stamp size piece of film can cause problems ranging from image flutter and focus drift to permanent print damage like blistering, scorching, fading and dye migration. In our years of studying the effects of excessive heat on film, Kodak has identified three major areas of concern: improper or non- existent use of heat filters, excessive bulb current, and maladjustment of bulb focus causing a "hot spot."

Heat Filters

Use of efficient heat filters is recommended for all projectors and is mandatory for any lamp larger than 2000 watts. Aluminized, silver, or rhodium surfaced reflectors without heat filtration are intended only for specialized applications and should not be used for theaters. Xenon bulbs emit a large amount of their energy in the infrared portion of the spectrum. Excess infrared energy absorbed by the film is a major source of heat damage, especially with black-and-white prints (silver grains absorb more infrared energy than color dyes).

An efficient heat filter removes most of the damaging infrared energy produced by the lamp. Most heat filters rely on diachronic coatings on the reflector, making it reflect visible light and absorb infrared energy. Consoles with vertically-mounted bulbs usually use a flat diachronic mirror set at a 45-degree angle, which reflects visible light to the aperture and transmits the unwanted infrared energy to a heat sink.

The efficiency of heat filters varies among manufacturers, and is affected by the age and condition of the dichroic coatings. When purchasing new lamphouses, compare the efficiency of the heat filter system in rejecting unwanted ultraviolet and infrared energy. Always keep the surface of the mirror and heat filters clean and dust free, using the cleaning procedures recommended by the manufacturer. Dichroic coatings are very fragile and easily damaged if cleaned improperly. Heat filters with obviously worn, pitted,

or damaged dichroic coatings should be replaced. Do not remove heat filters or use reflectors with no heat protection, even to get a bit more light on the screen. You'll get a bit more light-and a lot more heat damage

Bulb Power

The wattage of the xenon bulb has an obvious correlation with the available light output and the potential for heat damage. Although film damage was possible with a 2000-watt bulb, it usually was associated with insufficient heat filtration and gross misalignment of the lamp focus, causing a "hot spot." With bulbs over 4000 watts, film damage is likely to occur with any misalignment of the lamp focus or with poor heat filtration. Running a lamp higher than its rated current range will greatly reduce bulb life, risk catastrophic failure (explosion), void the warranty, and increase the amount of heat. The slight increase in light is not worth it. A good practice is to set up a new bulb to produce the desired screen luminance and uniformity at slightly less than the rated current, and then increase bulb current as the bulb ages and becomes less efficient. DO NOT EXCEED THE MAXIMUM RATED CURRENT.

Illumination Uniformity

Alignment and focus of the lamp are important to achieve good uniformity of illumination on the screen and avoid "hot spot" damage to the film. Focusing the lamp to achieve a bright spot at the center of the screen, with significant fall-off at the sides and edges, not only produces a non-uniform picture but also concentrates the energy of the lamp on a small portion of the film, greatly increasing the risk of heat damage.

Carefully align the lamphouse following the manufacturer's instructions. Alignment tools usually use special jigs and a string or laser to assure optical alignment of the bulb, reflector, aperture and projector lens. The distance between the reflector and film aperture should be set to the exact specification. After the bulb is installed, position and focus should be set to achieve symmetrical distribution of the light and uniform illumination of the film aperture. In no instance should the bulb focus be set to deliberately produce a "hot spot," resulting in less than 75% screen luminance uniformity. Bulb position and focus should be checked periodically and each time the bulb is rotated or replaced. If you lack either training or tools, leave the job to a qualified service technician.

Other Factors

Theaters using large lamps should consider additional equipment that will improve the quality of the screen image. Curved film gates gently curve the film, making it more rigid, reducing focus flutter and improving focus uniformity across the image. Air pressure stabilizers (e.g., Century Cine-Focus) claim to improve focus stability. High-pressure air jets have sometimes been used to cool the film. Water-cooled gates keep the film trap rails and aperture cooler, increasing operator comfort (no burned fingers during threading), and minimizing heat-induced frictional changes that could cause unsteadiness and increase film wear. We have seen rare occasions where film damage occurred when the film contacted very hot metal components in the gate. Some lamphouses (e.g., Christie "Reference" Console) have automatic lamp focus that redistributes the focus pattern to optimize illumination of flat and scope apertures.

See Part 2 of "Heat Damage To Prints"

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