SECTION

1

THE PROJECTED IMAGE FORMAT

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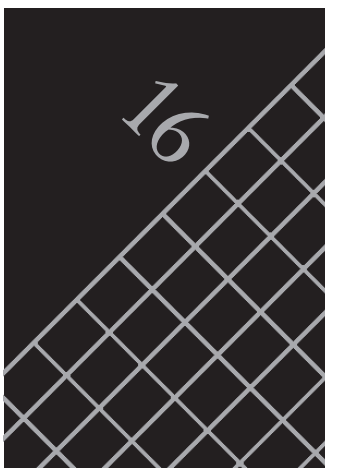
Kim Milliken, of Da-Lite Screen Company and founder of Optixx Screen Systems, spent more than 25 years in the audiovisual industry. He is best known for his commitment to educating the industry with a level of intelligence and sophistication that remains unparalleled.



The reason that virtually all projected image formats are wider than they are high presumably has to do with the configuration of our own eyes as a side-by-side pair. It seems a perfectly natural tendency for image content producers to want to frame a scene horizontally. Nevertheless, although the photographic process was well established previously, professional film widths and frame sizes were not standardized until the early 1900s when 35mm was accepted as the standard size in both the United States and Europe. Images were framed in an approximate 4:3 ratio of width to height, and this shape, adopted by the Academy of Motion Picture Arts and Sciences in 1927, became established as the "Academy" format. Each frame measured 0.825" wide by 0.600" high and spanned four sprocket holes on the film.

Another useful way to express this relationship between an image's width and height or, as is often said, its "aspect ratio," is to use a single number that is the quotient of the larger number divided by the smaller. Thus, 4:3 = I.33, for example.

How TV images acquired their shape

Since 1.33 was the principal aspect ratio of the motion picture industry, the designers of early television in the 1940s realized that if their medium's aspect ratio was kept the same, they could broadcast movies without any significant loss in frame size.

It is also true that when the developers of commercial television decided that its bandwidth couldn't afford to be more than 6 MHz and that its vertical resolution had to be at least 525 lines, something very close to a 1.33 maximum screen width popped out of the calculations as a mandated default.

And finally, the squarer 1.33 aspect ratio worked well to minimize the TV medium's bandwidth and resolution disadvantage relative to film. Since image detail all but disappears in the coarseness of televised wide-shots, TV content typically is shot as sequences of multiple close-up and tight-shot cuts; that way subject detail still can be seen in the medium's lower resolution. This technique rewards the vertical, "portrait" aspect of the picture.

Other aspect ratios used in film

Notice that the 4:3 genesis had nothing to do with how visually pleasing images in this aspect ratio actually are. In fact there isn't anything intrinsically appealing about 4:3 pictures beyond atonement for television's limitations. That is why the movie industry, which at first regarded television as a major threat to its revenues, was quick to develop a whole series of wide, panoramic screen shapes including Cinerama® (2.76:I), CinemaScope® (2.35:I), 70mm (2.05:I) and the currently familiar Panavision® (1.85:1)—-the prevalent "letterbox" ratio. Any of these wide-screen formats is a better approximation of the human visual field than the boxy, nearly square shape of a TV screen. Moreover, film's superior resolution and "landscape" aspect preserved subject detail in wide-shots and made possible the "two-shot" classic in film production, in which people speak to one another in the same frame. This technique was virtually nonexistent in TV content production.

Aspect ratios used with computers

Although computer-generated displays have gone through a long series of desktop resolution increases, with one exception their aspect ratio has remained 4:3. The exception, "Workstation"

format, had an aspect ratio of 1,280:1,024 or 5:4 (1.25:1). This format was squarer than the 4:3 standard and originally was intended for engineering applications such as CAD/CAM. A less rectangular 5:4 aspect ratio was deemed more suitable for design work.

The aspect ratio for computer images was 4:3 for a simple reason: Their display technology already existed in that shape. Personal computers followed television by about 35 years, but the CRT (cathode ray tube) display screens providing the visual interfaces for these two markets were virtually identical (their differences being mostly electronic). Rather than heap the cost of redeveloping CRT production onto the fledgling computer industry, its pioneers made the proper choice of simply keeping with the 4:3 TV tube standard.

The HDTV format

To understand the thinking that went into development of HDTV (high definition television), we need to appreciate that its aspect ratio, 16:9, tells only half its story. The other half is the tale of its resolution.

U.S. television nominally has 525 lines of resolution (PAL, or Phase Alternate Line, system supports 625). To avoid seeing these raster lines, we're supposed to sit seven screen heights back from an NTSC (National Television System Committee) display. That suggests that the proper viewing distance for a 27" diagonal screen is about 9.5'. From the "seven screen heights" number we also can determine that the image we're watching will occupy only 10 degrees within our horizontal field of view.

Now let's look at the HDTV picture (Figure 1-1).

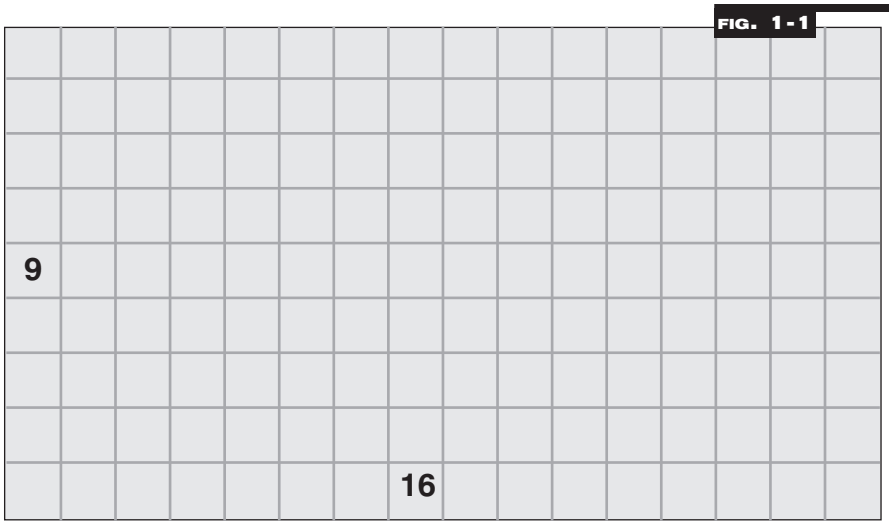


FIG. 1-1 16:9 aspect ratio

First of all, we notice that its aspect ratio has gotten much wider. 4:3 has jumped to 16:9 (in film nomenclature 1.33:1 has become 1.78:1). In addition it has twice as many lines vertically (1,080). This statistic is a little misleading because the overall resolution of HDTV is not two times better than NTSC; it's more than five times better. Video resolution is established by the total available pixels inside a display. That number is calculated by multiplying the vertical lines times the horizontal frequency. Hence, if there are just over 350,000 pixels on today's NTSC screens; there are just over 2 million on an HDTV display.

At that resolution in the 16:9 aspect ratio, how far back should a person sit? The answer is three screen heights. And at a viewing distance of 3 screen heights, the screen fills fully 30 degrees of our horizontal field-of-view.

These numbers are significant because the designers of HDTV appreciated "that a wider aspect ratio coupled with improved picture quality would provide the viewer far more involvement with the program. It was determined by exhaustive research and testing that a 30-degree field of vision would not only excite the central portion of the human visual system, but the peripheral vision as well, that gives a very heightened experience of reality to the viewer…." [1]

Other, independently conducted research showed that "the human visual system is clearly divided by two functions—the ability to see detail better in the central area and the ability to see motion in the peripheral.[2] Thus, if video were ever going to match the impact of movies, it needed, quite literally, to change its image.

16:9 displays in professional AV

As the confluence of the various projection media continues, the ultimate dominance of high resolution, 16:9 projection systems is certain. The major obstacle that exists as of this writing is the projector manufacturers' reluctance to make the commitment to hardware that can display 1,920 x 1,080 (or 1080i HDTV) native resolution. When that threshold is crossed, the superiority of 16:9 over 4:3 will be recognized universally.

However, it should be considered that, since the dominant force in the AV projector industry market continues to be its portable sector, and since this sector is linked closely to the portable computer market, the 16:9 HD format must first be adopted by the manufacturers of the computers feeding signals to the AV projectors. A projector that can display 1,920 x 1,080 is of no use to anyone unless this signal format can be provided easily.

Other historical aspect ratios for visual displays

In the history of projected images, various formats have evolved to serve differing needs in the instructional and entertainment arenas. Table 1-1 shows the parameters of these historical formats. Newer formats are covered in other sections.