What is ASPECT RATIO and When Should You Use It?

A Guide for Video Editors and Motion Designers

What is Aspect Ratio?  When should a person use 4:3 or 16:9?  What is the difference between HD and Standard TV?  Which format is best for a client or project?

This document was originally created to make the workplace more efficient at my job.  Now it exists for your reading pleasure.  If you apply the rules or recommendations below when creating and/or bidding projects for school or for clients you will save time and money.

Recommendations for Developers:

- RULE # 1: Create all animations and videos in WIDESCREEN format (16:9) whether or not the client requests it (Typically 864 x 486 with square pixels but can also be 720p or 1080p if done in HD).
- RULE # 2: Keep the important action in the middle square of the screen (within the 4:3 space).
- RULE # 3: RENDER in HD when time allows (720p which is 1280 x 720 or 1080p which is 1920 x 1080).
- RULE # 4: Always use SQUARE PIXELS.  Do not use 0.9 or 1.33 or 1.2 pixel aspect ratios (this is different from display or screen aspect ratios).

Recommendations for Sales:

- RECOMMENDATION # 1: Find out what the specific delivery of the animation or video will be.  Will it be shown at a trade show?  Will it be put on a Web site?  Will it be included in a Flash interface on a CD-ROM?  Do they want it on a looping DVD?
- RECOMMENDATION # 2: Find out if the project will need to be re-purposed in the future for other delivery.  For example, will the CD-ROM Flash interface need to be re-purposed to a looping DVD for a trade show or training meeting?
- RECOMMENDATION # 3: Find out what type of media it will be played on.  For example, will it be played on an HDTV (16:9), a standard TV (4:3)?  With what type of player?  An actual DVD player or a computer?

NOTE:  This information applies mostly to videos and animations.  It is NOT as applicable to Web Design and/or Flash interfaces unless videos or animations will be embedded into them.
What is Aspect Ratio?

The aspect ratio of an image is its width divided by its height.

The **two** main aspect ratios to be concerned about are **4:3** (1.33:1) and **16:9** (1.78:1).

- Usually pronounced “four-by-three”
- 4 parts wide by 3 parts tall
- Used primarily for standard definition TVs (SDTV)
- Typical pixel resolutions include **720 x 480** (with non-square pixels) or **720 x 540** and sometimes **640 x 480**
- Computer monitors generally use a 4:3 aspect ratio with a pixel resolution of **1024 x 768** or higher

- Usually pronounced “sixteen-by-nine”
- 16 parts wide by 9 parts tall
- Used primarily for high definition TVs (HDTV)
- Typical pixel resolutions include **864 x 486** (not HD), **1280 x 720** (HD 720p), or **1920 x 1080** (HD 1080i/p)
- 16:9 is also referred to as **WIDESCREEN**
- Computer monitors sometimes use a 16:9 aspect ratio

How Does it Look?

A 4:3 picture will look cropped and square but it will fill the screen on a standard definition television. Less of a shot is seen in 4:3.

A 16:9 picture is also referred to as **widescreen** and gives a more natural panoramic view of a scene. It will fill the screen on a widescreen television or on an HDTV. More of a shot is seen in 16:9.

**NOTE:** Neither 4:3 nor 16:9 aspect ratios are limited to one type of television or format. Also, each of these aspect ratios applies to multiple screen sizes or resolutions. However, depending on the size and/or resolution of the screen, these different formats may cause black bars to appear on the top and bottom or sides of the screen to compensate for the aspect ratio. See below for more info.
HDTV vs. SDTV

There are two types of televisions that we need to know about: Standard Definition (SD) and High Definition (HD).

**Standard Definition TV (SDTV)**
- Typically uses a 4:3 aspect ratio
  - 4 parts wide by 3 parts tall
- A square looking picture
- Uses varying resolutions such as 640 x 480, 720 x 486, 720 x 540, and 720 x 480
  - These may not necessarily be perfect 4:3 ratios, but an SDTV will stretch or squash the pixels (called pixel aspect ratio) or they will crop the edges of the picture to make it fit on the screen.
- Can be referred to as 480i or 480p (interlaced or progressive frames)
- **IMPORTANT:** Takes less time to render a video or animation in this aspect ratio but it **cannot** be re-purposed to 16:9 without re-rendering.

**High Definition TV (HDTV)**
- Uses a 16:9 aspect ratio
  - 16 parts wide by 9 parts tall
- A more rectangular panoramic looking picture
- Uses 3 resolutions
  - 720p (1280 x 720 with progressive frames)
  - 1080i (1920 x 1080 with interlaced frames)
  - 1080p (1920 x 1080 with progressive frames)
- **IMPORTANT:** Takes more time to render a video or animation in this aspect ratio especially if done in HD.

**NOTE:** Each of these can play both 4:3 and 16:9 at varying resolutions, however native is best because it will fill the screen and not create the black bars on the sides or on the top and bottom.
NOTE: Just because an SDTV is natively a 4:3 aspect ratio does not mean that it can’t play a video that was made in 16:9 or widescreen. Similarly, an HDTV is not limited to showing 16:9 videos.

**Letterboxing**
When a 16:9 video is shown in a 4:3 television or computer monitor there are black bars at the top and bottom. This is called **letterboxing**.

Notice that the black bars on the top and bottom allow a 16:9 picture to show on a 4:3 television. Though this may feel like you are getting less picture, you are actually seeing the entire widescreen shot, giving you more picture that is just smaller.

**Pillar boxing**
When a 4:3 video is shown on a 16:9 (widescreen) television or on an HDTV (also 16:9), black bars appear on the sides. This is called **pillar boxing**.

The black bars on the sides allow a 4:3 picture to show on a 16:9 television.
Windowboxing
Occasionally a video will be originally created in 16:9 and then converted to 4:3 for a standard TV (causing the letterbox bars to appear on the top and bottom). But then that 4:3 video is shown on a 16:9 TV, causing the black bars to appear on the top and bottom AND on the left and right. This is called windowboxing.

Black bars appear on the sides and on the top and bottom. Obviously this is not recommended.

What is Resolution?
Resolution is the height and width of an image and it is not limited to a specific aspect ratio or size. For videos and animations, resolution is measured in pixels. A pixel is a tiny square of color that is the smallest element of a digital picture or video frame, but that’s probably more than you need to know.

The point is different standards of televisions do use specific resolutions to match aspect ratios. A 16:9 resolution would need to equate to 16 parts wide by 9 parts tall. An example of this would be an image that is 1600 pixels wide by 900 pixels tall.

Resolutions we should use:

<table>
<thead>
<tr>
<th>Media</th>
<th>Native Aspect Ratio</th>
<th>Native Resolution (Square Pixels)</th>
<th>Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDTV</td>
<td>4:3</td>
<td>720 x 540 or 720 x 480 (non-square)</td>
<td>DVD, VHS, Computer</td>
</tr>
<tr>
<td>Widescreen SDTV</td>
<td>16:9</td>
<td>864 x 486 (Used often)</td>
<td>DVD, VHS, Computer</td>
</tr>
<tr>
<td>HDTV</td>
<td>16:9</td>
<td>1280 x 720 (Recommended) or 1920 x 1080 (Full HD)</td>
<td>DVD, Blu-Ray, Computer</td>
</tr>
<tr>
<td>Computer</td>
<td>N/A</td>
<td>Usually 1024 x 768 but depends on final delivery</td>
<td>CD-ROM, DVD-ROM, Web, Flash Interface, etc.</td>
</tr>
</tbody>
</table>
NOTE: The larger the image, the longer it takes to render because each additional pixel added onto a picture requires a computer to process that much more color per frame of video. A typical video contains **30 frames or pictures PER SECOND!**

NOTE: You’ll notice that full HD contains many more pixels than the other resolutions; therefore, a video or animation rendered in full HD requires much more computer processor power and much more time to render a single frame. Remember, a video or animation contains 30 pictures of that resolution per second.

<table>
<thead>
<tr>
<th>Up Front Render Time</th>
<th>Pixels per Frame</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least</td>
<td>388,800</td>
<td>Sometimes called “480i” or “480p.” Render time is minimal, but a file done in 4:3 <strong>cannot</strong> be re-purposed for a widescreen display without having to re-render it (which takes more time).</td>
</tr>
<tr>
<td>More</td>
<td>418,904</td>
<td>“Poor man’s widescreen.” This does not require much more render time than 480i/p and it can easily be re-purposed to 4:3.</td>
</tr>
<tr>
<td>More</td>
<td>921,600</td>
<td>Sometimes called “720p.” Lowest HD resolution. Should be used the most when rendering. Can be re-purposed to other formats more easily than SD widescreen.</td>
</tr>
<tr>
<td>Most</td>
<td>2,073,600</td>
<td>Sometimes called “1080i” or “1080p.” Highest HD resolution. It would be ideal to render in this resolution in order to save time later. The easiest format to re-purpose.</td>
</tr>
</tbody>
</table>

NOTE: It takes 5 times longer to render a single frame in full HD than it does to render that same frame in normal SD or widescreen SD resolutions. However, it is best to render in full HD because it will take less time to re-purpose from full HD to a smaller resolution. It takes more time to re-purpose from a lower resolution to a higher resolution. Also, it takes just over half as much time to render in low HD as it does to render in SD widescreen.