Video Basics Camera Workshop 2

Thrown together by David Tamés
September 29, 2021

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ARTD 2380 Video Basics

This presentation remains a work-in-progress. If you have any comments or suggestions for improvement, please email them to d.tames@northeastern.edu

Table of Contents

Workshop 1

1. What's in the kit?

2. Identifying parts and controls

3. Getting started with the a7iii

Table of Contents

Workshop 1

1. What's in the kit?

2. Identifying parts and controls

3. Getting started with the a7iii

4. Using the a7iii in movie mode with manual exposure

Workshop 2 — Movie Mode / Manual

Basic camera configuration (refer to slides from workshop 1)

Configure the camera:

1. Basic operation

2. Format the SD card(s)

3. Set the date and time

and now… MOVIE MODE!

What is frame rate?

Image: 35-mm black&white movie film negative stock on the core by Runner161 (CC BY-SA 3.0), https://en.wikipedia.org/wiki/35_mm_movie_film#/media/
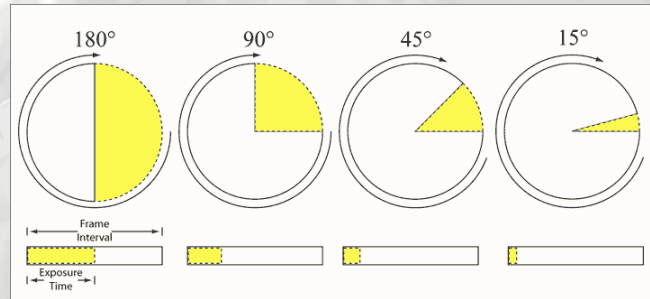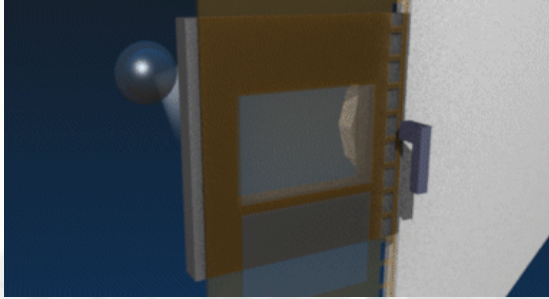
What is frame rate?

Frame rate (designated in frames per second or FPS) is the rate (frequency) at which consecutive frames (images) are captured by a camera or displayed by a playback system. While temporal sensitivity and resolution of human vision varies between individuals and depends on the characteristics of the visual stimulus, roughly, a frame rate above 12 or fps are required to perceive the individual frames as movement, and a frame rate above 24 or so fps are required for the movement to appear smooth.

What is frame rate?

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The cinema standard of 24 fps was a trade-off between smooth motion and film consumption. The standard 1/48 shutter speed is the result of a 180° rotating shutter. While the shutter blade covers the gate, the camera advances the film to the next frame. The frame is exposed while the shutter does not cover the gate. Higher shutter speeds are achieved by adjusting the shutter angle, with an effect on both exposure and motion blur, however, 180° became the standard and along with it motion blur of moving objects and/or camera movement due to 1/48 shutter speed, resulting in a major factor of the "film look."

Animation: Joram van Hartingsveldt (CC BY-SA 3.0), https://en.wikipedia.org/wiki/Rotary_disc_shutter#/media/File:Moviecam_schematic_animation.gif
Diagram: plowboylifestyle (CC BY-SA 3.0), https://en.wikipedia.org/wiki/File:ShutterAngle.png

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**13. Choose the Record Settings
For Video:**
(Camera 2 => Movie1 (1/9)
=> **File Format**)

24p
- "film look"
- Motion blur
- Use 1/50 shutter* (a7iii can't do 1/48)

30p
- "video look"
- Motion blur similar, but less than 24p
- Use 1/60 shutter*

60p
- "real look"
- Less motion blur
- Use 1/125 shutter* (a7iii can't do 1/120)

120p
- "hyper-real look"
- Very little motion blur
- Use 1/250 shutter* (a7iii can't do 1/240)

* P mode will adjust the shutter speed as needed to maintain proper exposure without considering standard shutter speeds for each frame rate, that's why we eventually want to work in movie mode.

What is a video recording format?

A recording format (or file format) is a scheme for storing digital video and audio data. This almost always involves some form of compression to reduce the file size. The data file is structured with a container format (e.g. MP4) with the video data encoded using a coding format (e.g. H.264) along with the audio data encoded using an audio coding format (e.g. AAC). The container may also contain metadata such as title, date, and production data. The coded video and audio inside the container (not the metadata) is called the essence.

- Codec
- Data rate
- Resolution
- Frame rate
- Scan
- Color Sampling

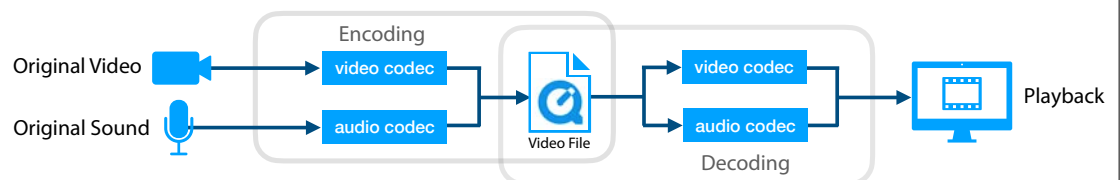---

- Codec
- Data rate
- Resolution
- Frame rate
- Scan
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Codec. Software or hardware that can decode and encode compressed video or audio. Two major flavors: lossy or lossless (no loss of quality). Two key approaches: intra-frame (works on a per-frame basis, a.k.a. i-frame) and inter-frame (works across groups of frames, more efficient but with more artifacts). **H.264** is a lossy inter-frame codec widely-used for both acquisition and distribution (streaming). **Apple ProRes** is a virtually lossless intra-frame codec widely used in postproduction.

Bottom line: choose the highest quality codec your camera offers for acquisition of important work.

Original Video → Encoding video codec → Video File → video codec → Playback
Original Sound → audio codec → → audio codec → Decoding

What is a video recording format?

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| Codec |
| Data rate |
| Resolution |
| Frame rate |
| Scan |
| Color Sampling |

Data rate (a.k.a. bit-rate): The quantity of data per second of video or audio, often expressed megabits per second, or Mb/sec or simply M. For example, when using the XAVC S HD codec on the Sony a7iii at 24fps, the data rate is 50Mb/sec. This means that every minute of video will require 375.00 MB (megabytes) of storage (a byte is 8 bits).

Bottom line: choose the codec with the highest data rate for better quality if that is a priority for your work.

| Codec |
| Data rate |
| Resolution |
| Frame rate |
| Scan |
| Color Sampling |

Resolution: The size of an image, usually in pixels, e.g. high definition frame consists of 1920 pixels horizontally and 1080 pixels vertically. The term is also used to describe the amount of detail in an image, higher pixel resolution equals more detail.

Bottom line: choose the highest resolution your camera offers for the acquisition of important work. Shooting 4K when editing in HD provides flexibility in reframing shots.

What is a video recording format?

A recording format (or file format) is a scheme for storing digital video and audio data. This almost always involves some form of compression to reduce the file size. The data file is structured with a container format (e.g. MP4) with the video data encoded using a coding format (e.g. H.264) along with the audio data encoded using an audio coding format (e.g. AAC). The container may also contain metadata such as title, date, and production data. The coded video and audio inside the container (not the metadata) is called the essence.

| Codec |
| Data rate |
| Resolution |
| Frame rate |
| Scan |
| Color Sampling |

Frame Rate: The number of individual frames per second (fps) recorded by the camera. 24p, 30p, 60p each provide a distinctive look due to the image refresh rate and motion blur, they offer creative options, it's not that one is better than the other (on the a7iii, use 24p w/ 1/50 shutter speed for a cinematic look, 30p w/ 1/60 shutter speed for a video look, and 60p w/ 1/125 shutter speed for a hyper-real look).

Bottom line: Choose the frame rate based on the look you want to achieve. For assignment in this class use 24p w/ 1/50 shutter speed unless you specifically want a different look based on creative choices.

What is a video recording format?

| Codec |
| Data rate |
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| Scan |
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Scan: The scan may be progressive or interlaced. Progressive scan refers to recording or displaying lines (rows) of pixels progressively (1, 2, 3, 4, 5 ...) in contrast to interlaced scanning, consisting of two fields: the first field (lines 1, 3, 5, 7 …) and then a second field (lines 2, 4, 6, 8, …), this Interlaced video method with 60 fields per second (30 frames per second) is referred to as 60i and has lost dominance as progressive formats like 24p, 30p, and 60p offer higher image quality without interlaced artifacts. If your camera is capable of interlaced scanning, avoid it! The problem with interlaced scanning is illustrated in the CD / Interlacing video by Captain Delusion.

Bottom line: choose a progressive scan format if you have a choice between interlaced and progressive.

What is a video recording format?

A recording format (or file format) is a scheme for storing digital video and audio data. This almost always involves some form of compression to reduce the file size. The data file is structured with a container format (e.g. MP4) with the video data encoded using a coding format (e.g. H.264) along with the audio data encoded using an audio coding format (e.g. AAC). The container may also contain metadata such as title, date, and production data. The coded video and audio inside the container (not the metadata) is called the essence.

- Codec
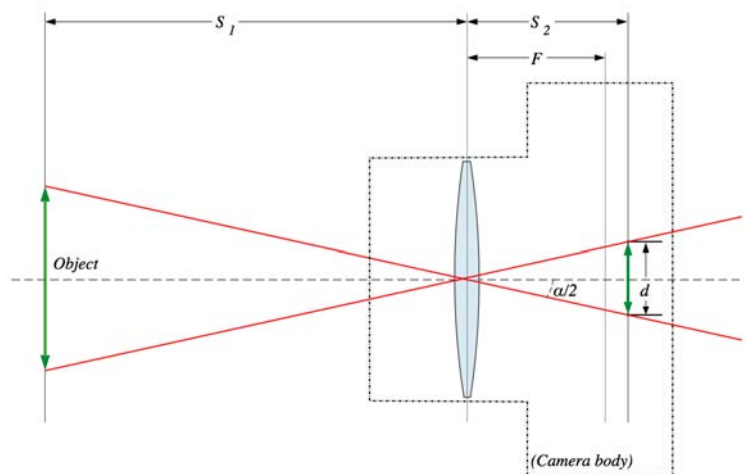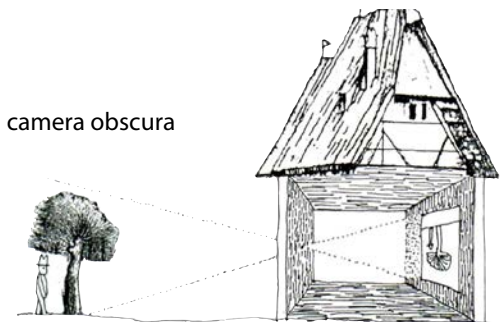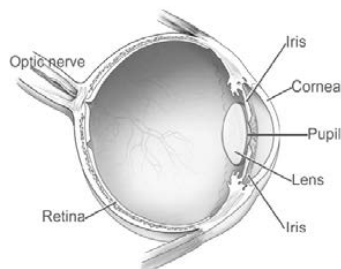- Data rate
- Resolution
- Frame rate
- Scan
- Color Sampling

Color sampling: The reduction of color resolution in digital video in order to save storage and bandwidth. The color components are compressed by sampling them at a lower rate than the brightness (luminance). Since color information is discarded, processing the image during postproduction will reveal subsampling artifacts that include color noise and banding. In addition, the bit-depth is often reduced (e.g. the camera may perform 12-bit color processing internally, but will store color data using 8 bits in the recorded output).
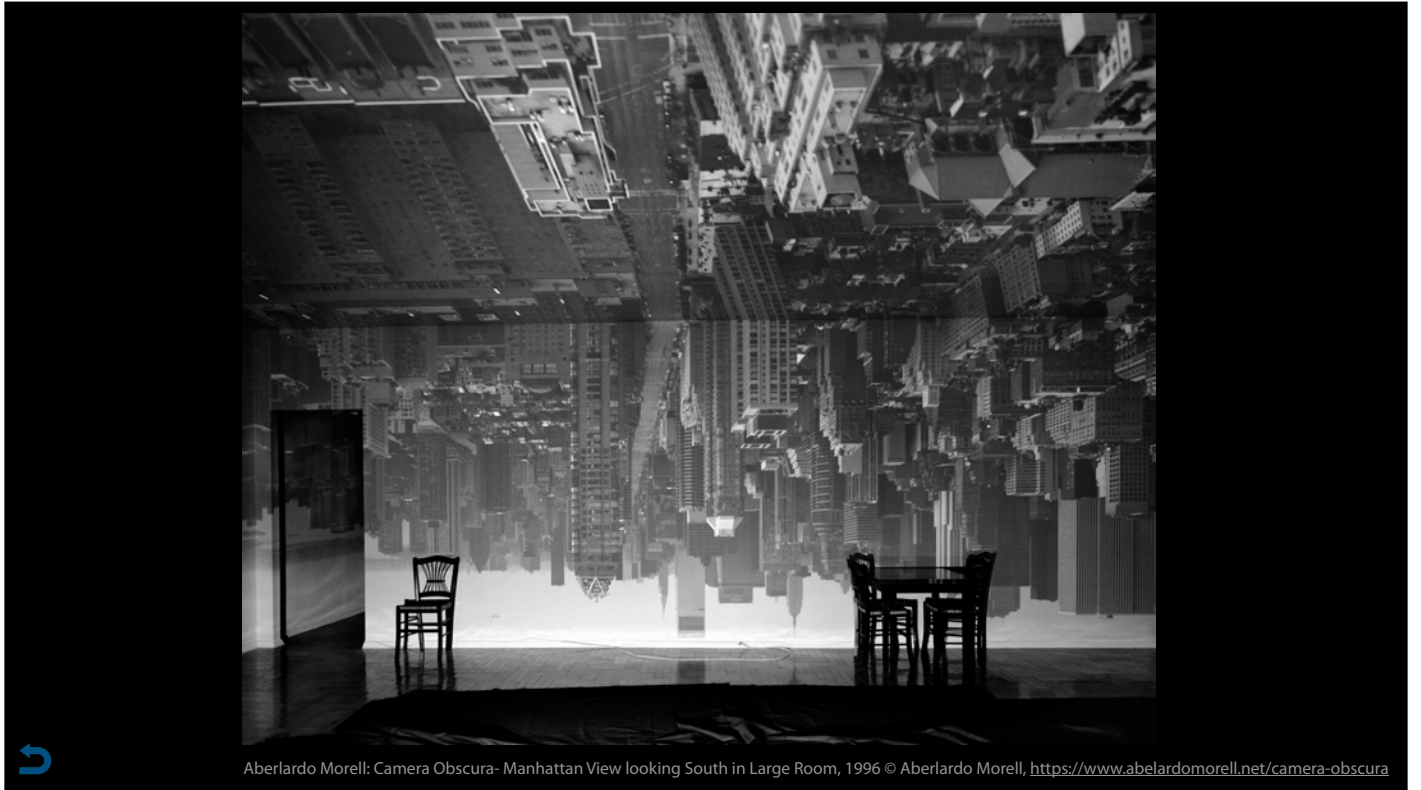
Bottom line: If your camera offers a choice, select the best color quality settings in order to have have more flexibility when color correcting and color grading in postproduction.

What is a camera?

camera obscura

Aberlardo Morell: Camera Obscura- Manhattan View looking South in Large Room, 1996 © Aberlardo Morell, https://www.abelardomorell.net/camera-obscura

What is a camera?

Camera image from Wikipedia
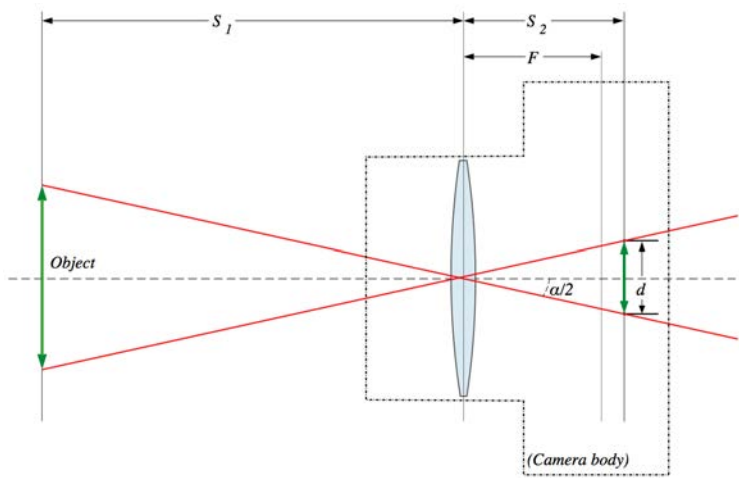
Using the a7iii in movie mode with manual exposure

1. **Set the camera to Movie Mode (a.k.a. Video Mode) by setting the mode dial to** 🎬

   - In Movie Mode, aperture and shutter speed are set manually for complete creative control over the image

   Leave this on 0, unlike program mode, now you'll be using manual control of aperture, ISO, and ND filters to control exposure (keeping shutter speed fixed at 1/50)

Using the a7iii in movie mode with manual exposure

2. **Set the Exposure Mode to Manual** (Camera 2 => Movie1 (1/9) => Exposure Mode: Manual Exposure)

   Exposure Modes

   Manual
   Aperture and shutter speed are set manually for complete creative control over the image

   Program Auto
   Aperture and shutter speed set automatically by the a7iii, while other settings can be adjusted manually

   Aperture Priority
   Adjust aperture manually (to control both exposure and focus range or background blur) and the a7iii will select the shutter speed automatically.

   Shutter Priority
   Adjust shutter manually (to control both exposure and motion blur) and the a7iii will select the shutter speed automatically.

Using the a7iii in movie mode with manual exposure

3. Set resolution and frame rate
(just like we did in the Getting Started session)

(Camera 2 => Movie1 => File Format: HD or 4K)

(Camera 2 => Movie1 => Record Settings: 24p 50M)

Standards for this course:

XAVC S/H.264 HD or XAVC S/H.264 4K
- **HD** (1920 x 1080) or
- **UHD** 4K (3840 x 2160) for higher resolution

24p
- "film look"
- Motion blur
- **Use 1/50 shutter speed**

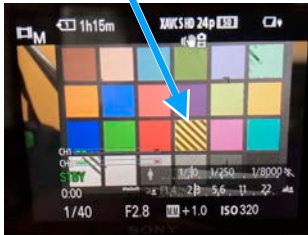
Using the a7iii in movie mode with manual exposure

4. Enable Zebras to aid in exposure adjustment
(Camera 2 => Display/Auto Review1 (6/9) => Zebra Setting)

Using the a7iii in movie mode with manual exposure

4. **Enable Zebras to aid in exposure adjustment (Camera 2 => Display/Auto Review1 (6/9) => Zebra Setting)**

areas that exceed the exposure threshold you've set will have zebra stripes over them (in this case 90 IRE)

Zebra Setting

1

Zebra Display	On
Zebra Level	90

Luminance values
- **100 -** White, no textural detail
- **90 -** Brightest highlight area with textural details
- **70 -** Highlight areas with textural detail
- **50 -** Middle of the tonal scale (e.g. 18% grey)

In this example, the Zebra is set to 85, and no zebras are showing, therefore, all elements of the scene are below 85 on the 0 (black) to 100 (white) luminance scale.
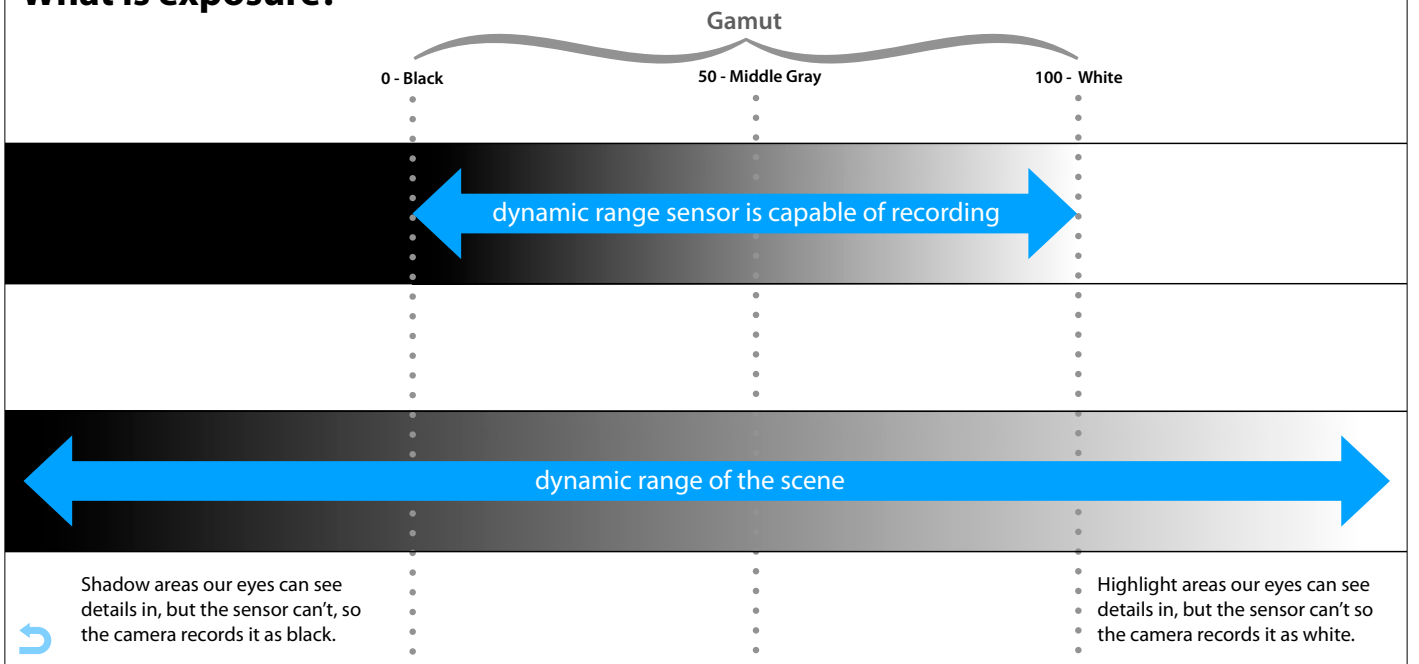
Zebra Level

85

75
80
85
90
95

STBY   ◄►Select ● Enter MENU Cancel

5. **Now you have manual control over exposure** by adjusting: **a** the aperture dial, **b** the shutter speed dial (though you'll want to keep this at 1/50 for "normal" motion blur), and **c** ISO sensitivity via the multi-function dial
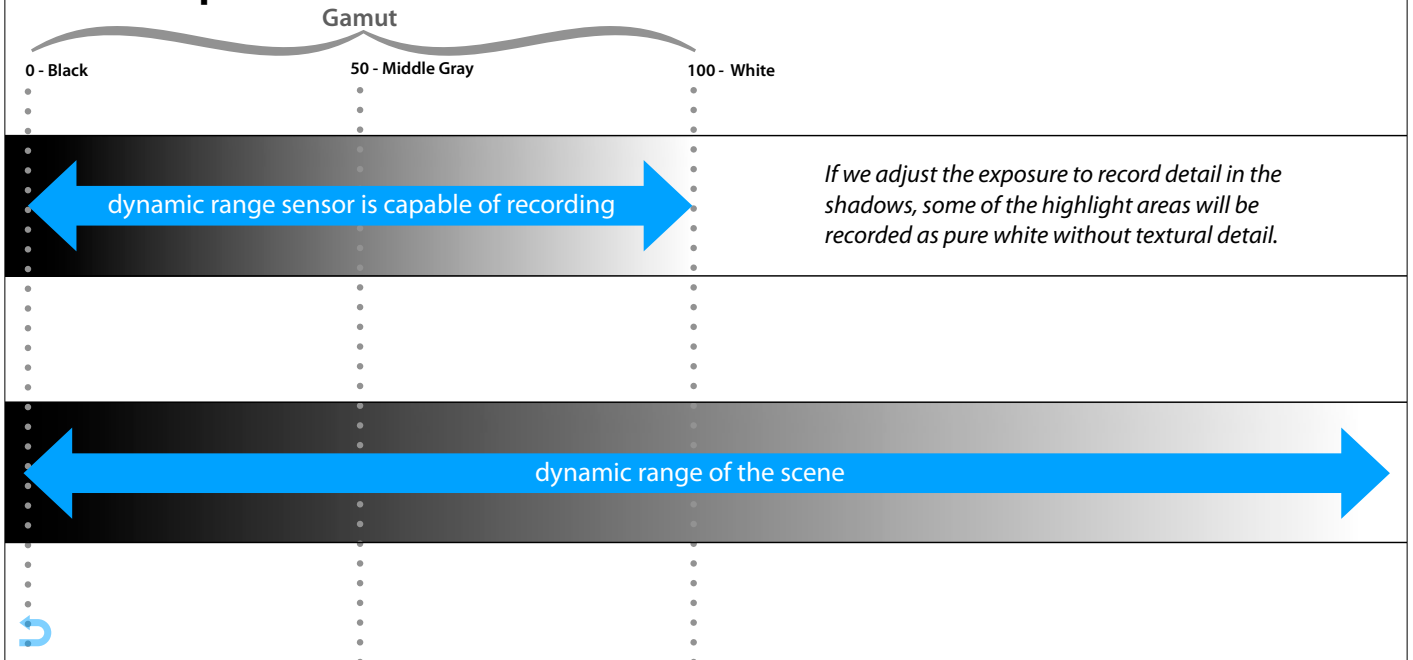
a

b

c

zebra

shutter   aperture   ISO

1/40   F2.8   +1.0   ISO 320

exposure according to built-in exposure meter

What is exposure?

Gamut

0 - Black   50 - Middle Gray   100 - White

dynamic range sensor is capable of recording

dynamic range of the scene

Shadow areas our eyes can see details in, but the sensor can't, so the camera records it as black.

Highlight areas our eyes can see details in, but the sensor can't so the camera records it as white.

What is exposure?

Gamut

0 - Black   50 - Middle Gray   100 - White

dynamic range sensor is capable of recording

If we adjust the exposure to record detail in the shadows, some of the highlight areas will be recorded as pure white without textural detail.

dynamic range of the scene

What is exposure?

Gamut

0 - Black   50 - Middle Gray   100 - White

If we adjust the exposure to record detail in the highlights, some of the shadow areas will be recorded as pure black without textural detail.

dynamic range sensor is capable of recording

dynamic range of the scene
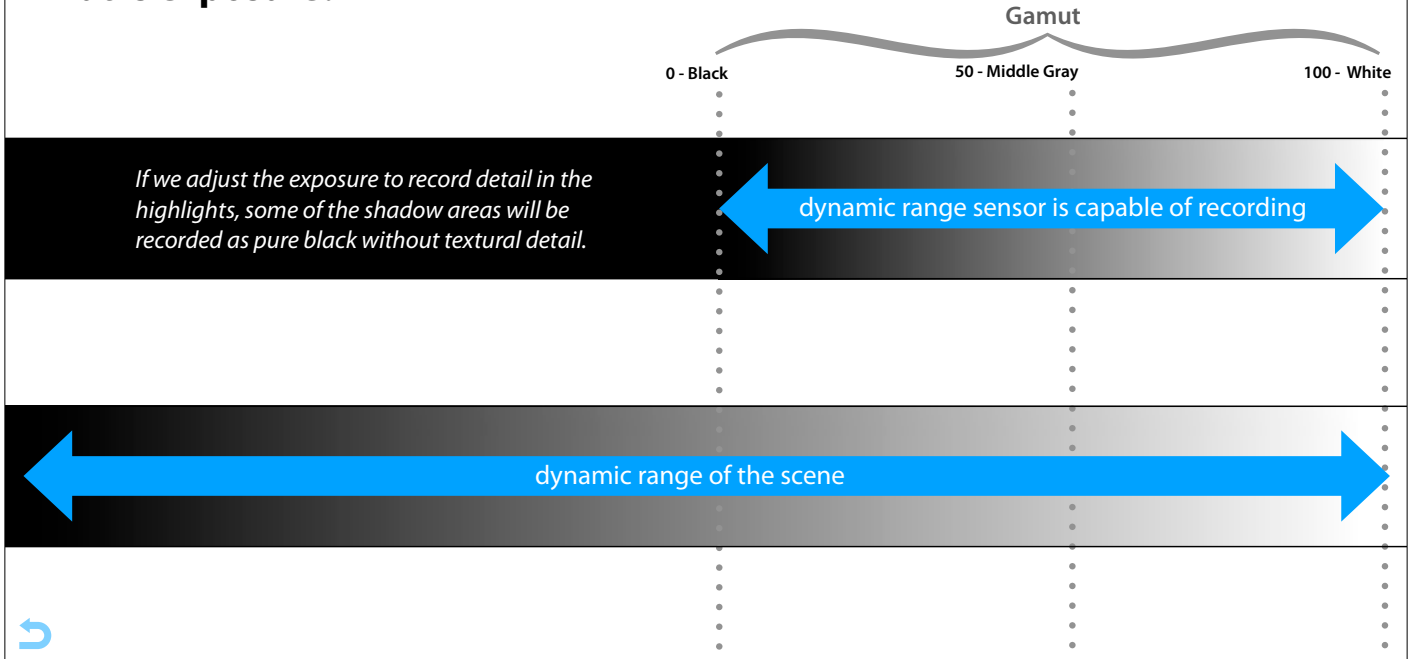
Using the a7iii in movie mode with manual exposure

What is good exposure?

(PD)

See also ColorChecker, https://en.wikipedia.org/wiki/ColorChecker
See Color Checker, Calibrite, https://calibrite.com/us/product/colorchecker-classic/

Dark skin reference   Light skin reference
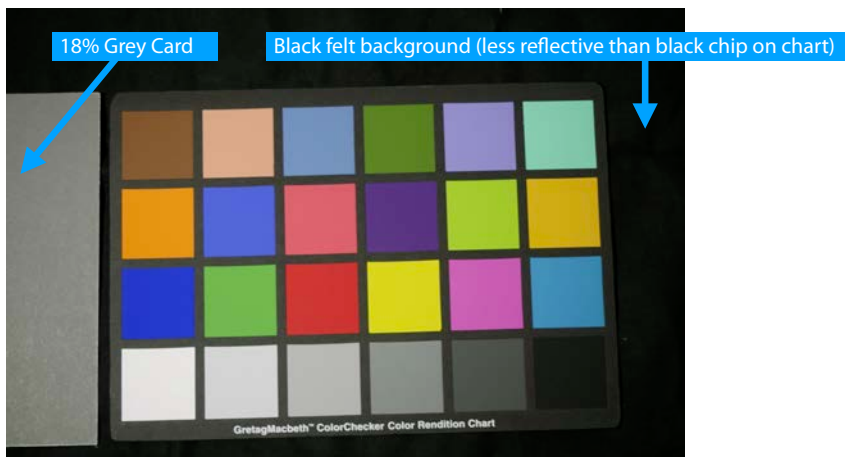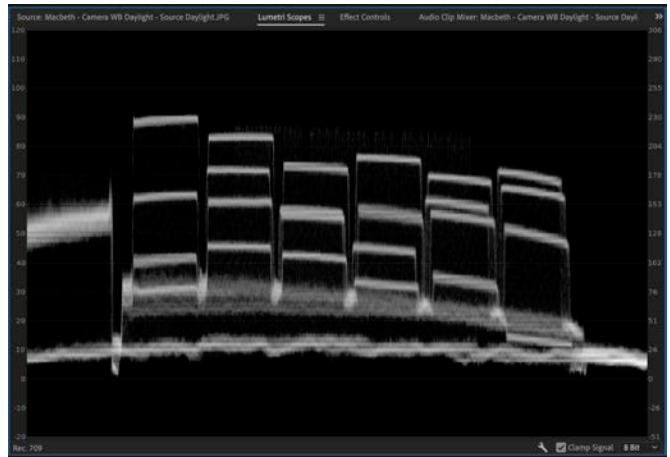
White   Black
Very Light Grey   Dark Grey
Light Grey   18% Middle Grey

Software Support:
- Adobe Photoshop and Adobe Lightroom via a free plugin
- Black Magic Design DaVinci Resolve for color grading
- 3DLUT Creator
- and others

Using the a7iii in movie mode with manual exposure
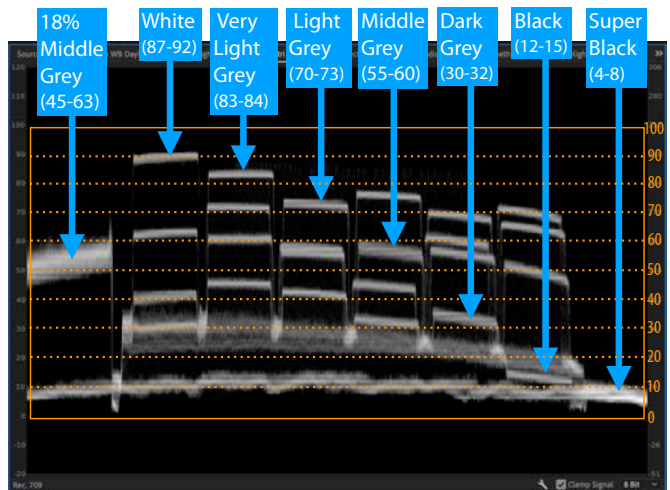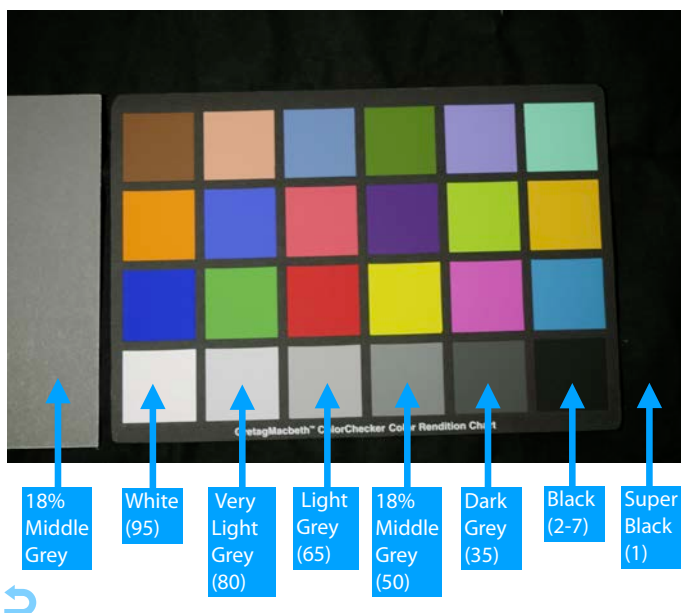
What is good exposure?

18% Grey Card   Black felt background (less reflective than black chip on chart)

Using the a7iii in movie mode with manual exposure

What is good exposure?

18% Grey Card — Black felt (less reflective than black chip on chart)

18% Middle Grey

White (95)

Very Light Grey (80)

Light Grey (65)

18% Middle Grey (50)

Dark Grey (35)

Black (2-7)

Super Black (1)

Waveform Monitor
shows luminance component of the video
signal, may be found in external monitors
and Lumetri Scopes in Premiere Pro

18% Middle Grey (45-63)

White (87-92)

Very Light Grey (83-84)

Light Grey (70-73)

Middle Grey (55-60)

Dark Grey (30-32)

Black (12-15)

Super Black (4-8)

18% Middle Grey

White (95)

Very Light Grey (80)

Light Grey (65)

18% Middle Grey (50)

Dark Grey (35)

Black (2-7)

Super Black (1)

Waveform Monitor
shows luminance component of the video
signal, may be found in external monitors
and Lumetri Scopes in Premiere Pro

What is good exposure?

zebra indicator (zebra set to 90)

18% reflectance (middle gray) patch

| 2 stops under | 1 stop under | about right | 1 stop over | 2 stops over |

According to an exposure meter, a good exposure is when a surface with 18% reflectance in the scene is reproduced in the middle of the tonal scale (50)

In terms of creative vision, good exposure is whatever produces the image you are looking for.

What is focal length?

Prime lens: A lens with a fixed focal length.

Zoom lens: a lens with a variable focal length.

Focus ring

Sigma 24-70mm f/2.8 Zoom Lens

Auto/Manual Focus Switch

Zoom ring

What is focal length?

f_{wide} f_{normal} $f_{telephoto}$
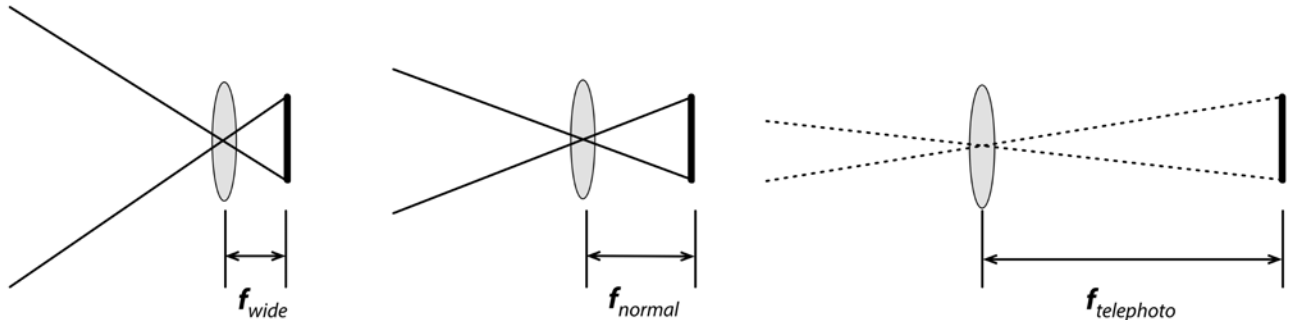
The **focal length** of a lens is the distance between the optical center of the lens and the image sensor where the subject is in focus, usually stated in millimeters. The focal length of the lens determines:
- field of view (a.k.a. angle of view),
- perspective,
- depth of field, and
- motion blur, as a result of camera movement (depending on angular velocity, higher for longer focal lengths)

Focal length and angle of view

18mm   24mm   35mm

55mm   85mm   105mm

135mm   200mm   300mm
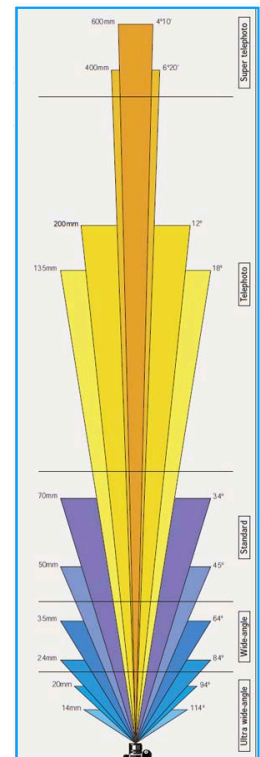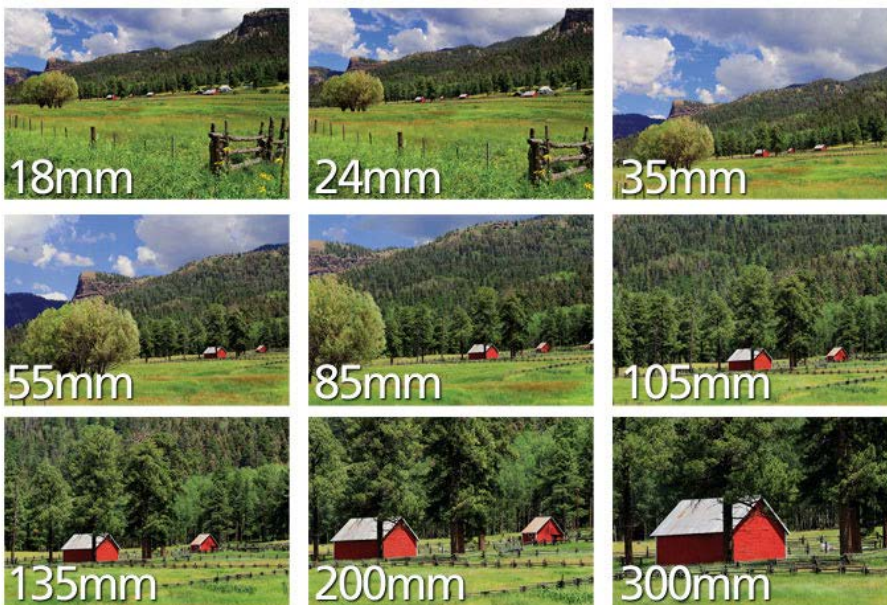
Image source: Nikon USA

Using the a7iii in movie mode with manual exposure

Focal length and angle of view and perspective

24mm

50mm
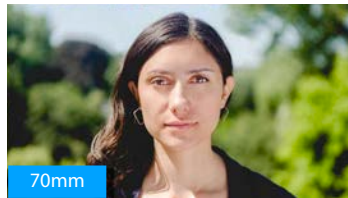
70mm

The Sigma 24-70mm f/2.8 zoom lens covers this range

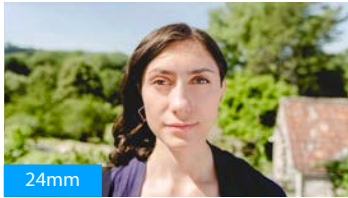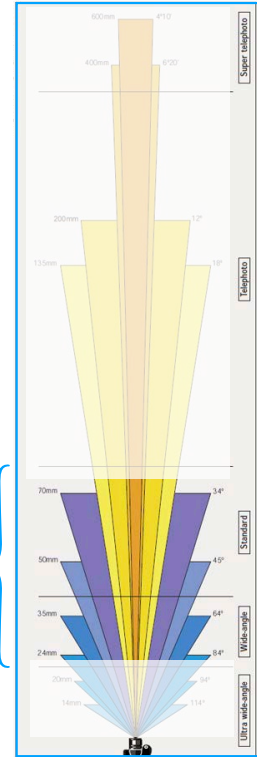## Using the a7iii in movie mode with manual exposure

Focal length and angle of view and perspective

A **normal lens** reproduces a field of view and perspective that appears "natural" to a human observer. In addition to angle of view differences, wide-angle lenses exhibit depth expansion while telephoto lenses exhibit depth compression, both introducing noticeable distortion in comparison to a normal lens.

Focal length and angle of view and perspective

Images by Dan Vojtěch, http://www.danvojtech.cz

Focal length and angle of view and perspective

Images by Dan Vojtěch, http://www.danvojtech.cz

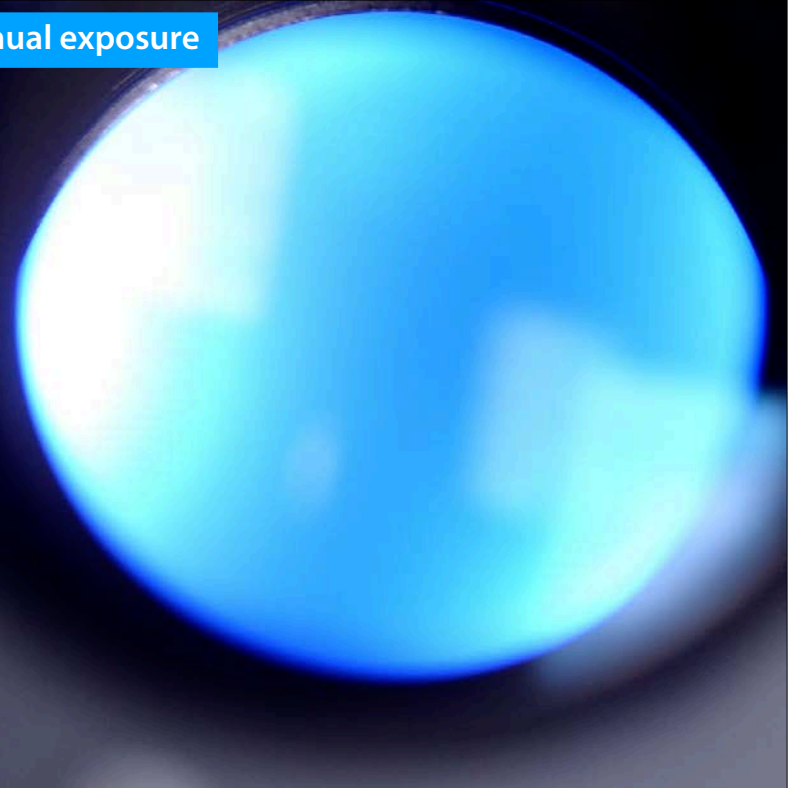## What is aperture?

aperture dial

aperture setting

F 2.8

The amount of light captured by a lens is proportional to the area of the aperture, related via the f-number:

$$N = f / D$$

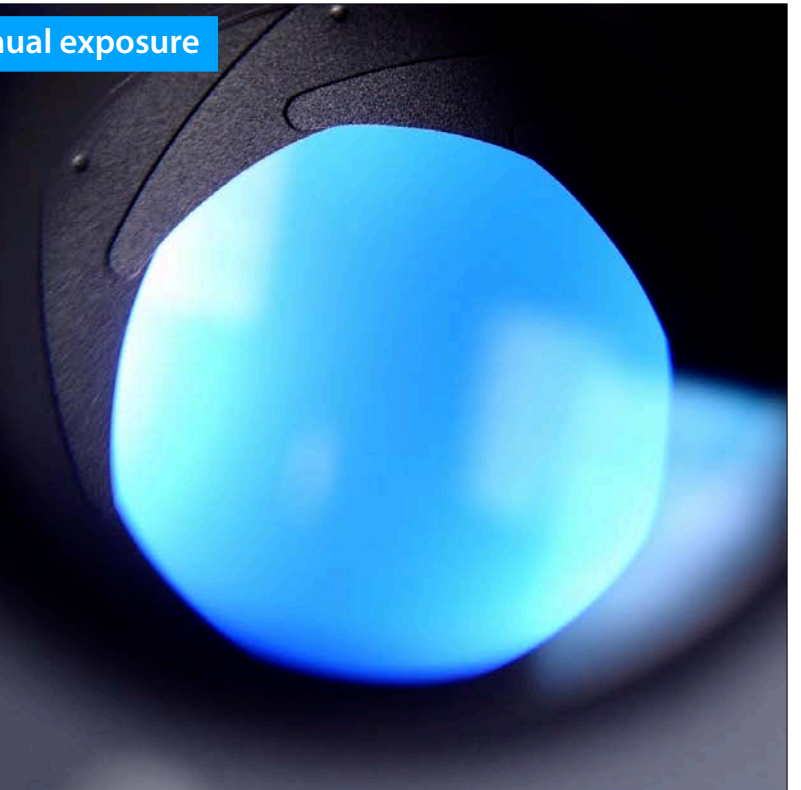with focal length f and aperture diameter D, this is why we end up with the funny numbers like f/2.8

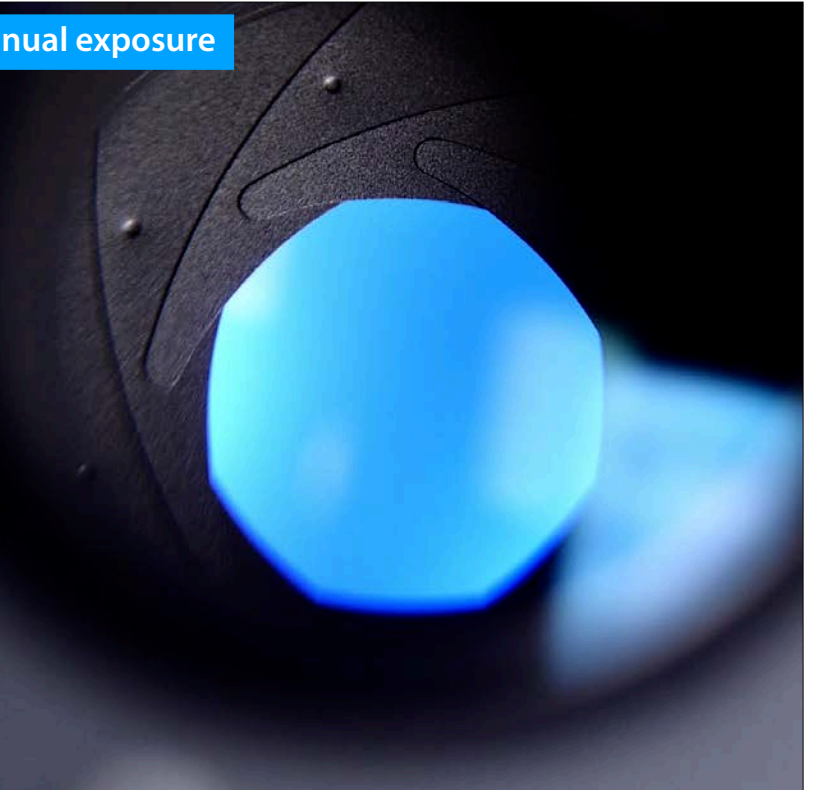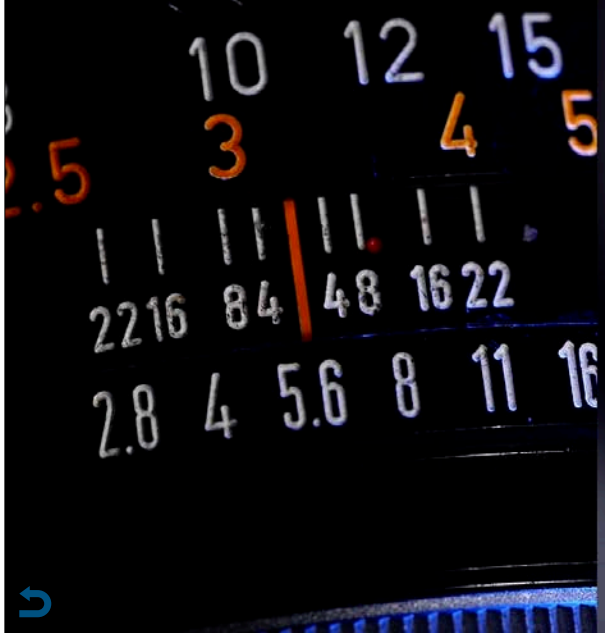**Using the a7iii in movie mode with manual exposure**

What is aperture?

10   12   15
3   4   5
2.5
2216 84 | 48 1622
2.8 4 5.6 8
mm

Using the a7iii in movie mode with manual exposure

What is aperture?

10   12   15
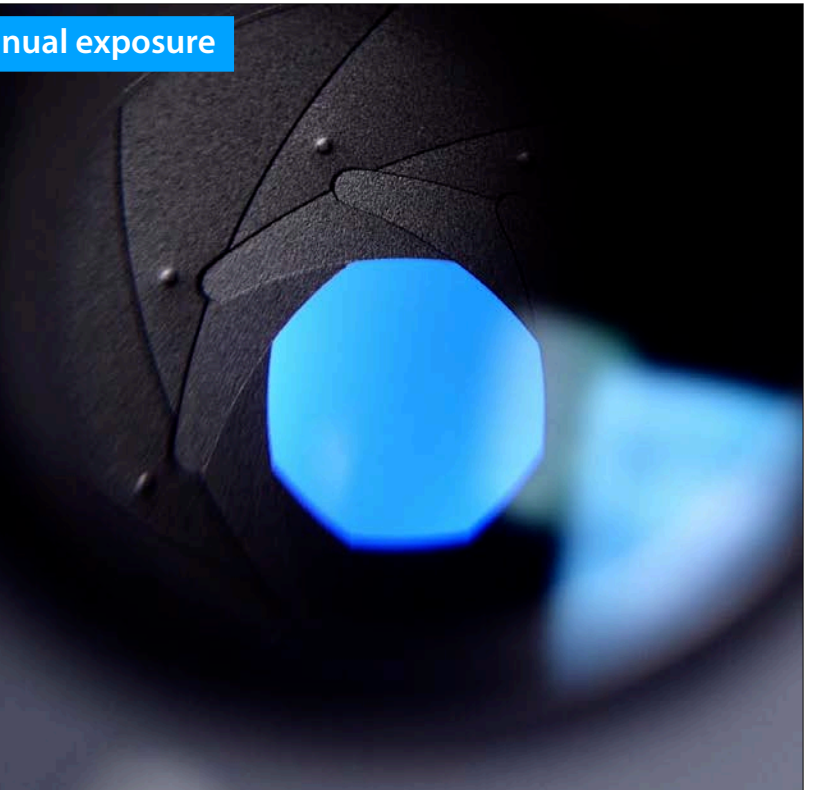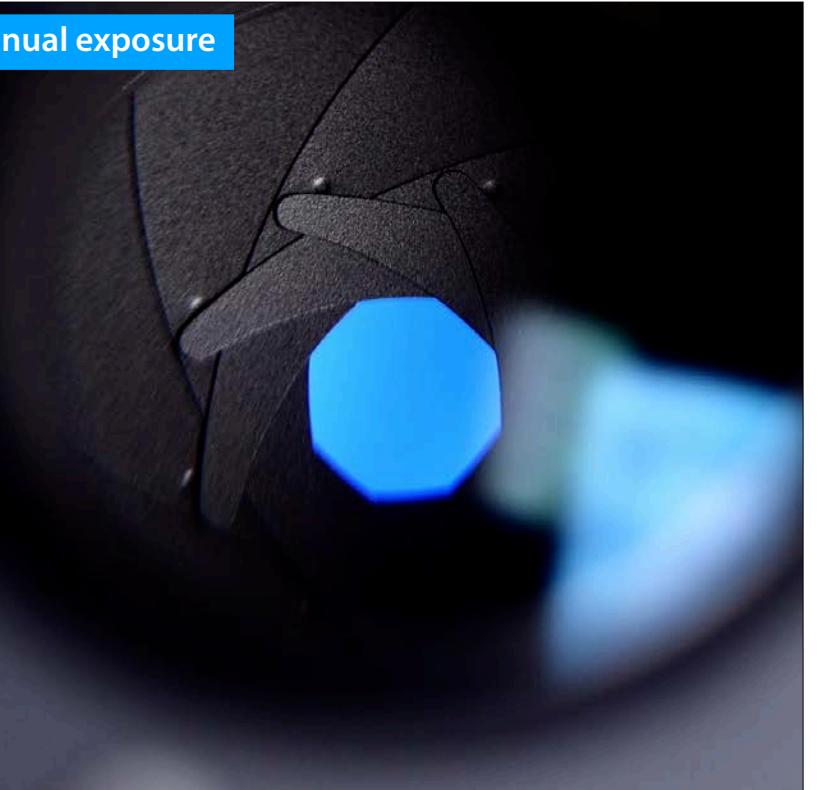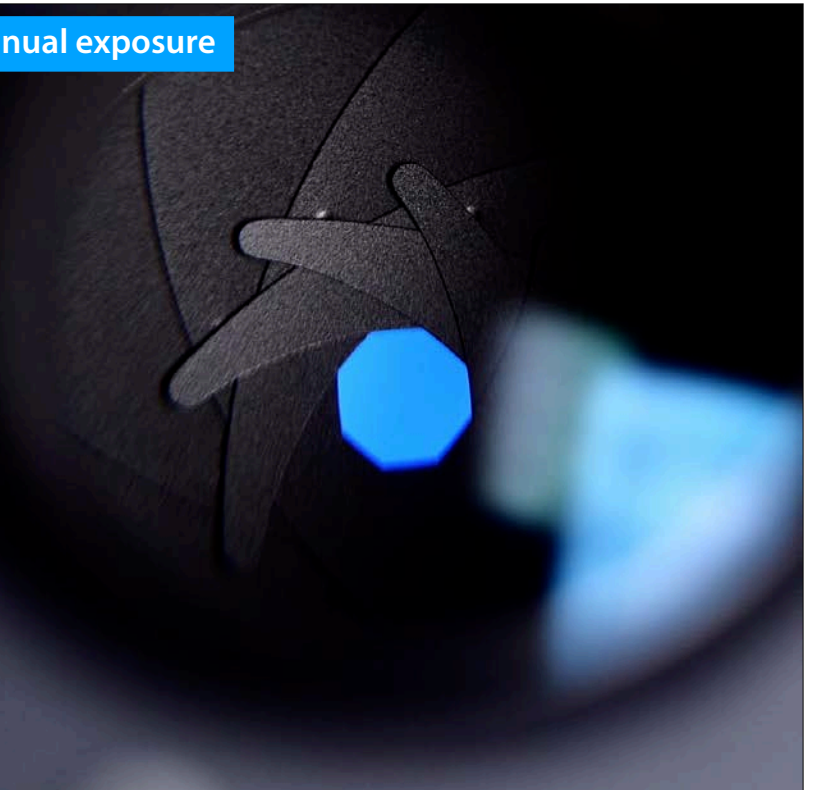3   4   5
2.5
2216 84 | 48 1622
2.8 4 5.6 8 11
n

Using the a7iii in movie mode with manual exposure

What is aperture?

Using the a7iii in movie mode with manual exposure
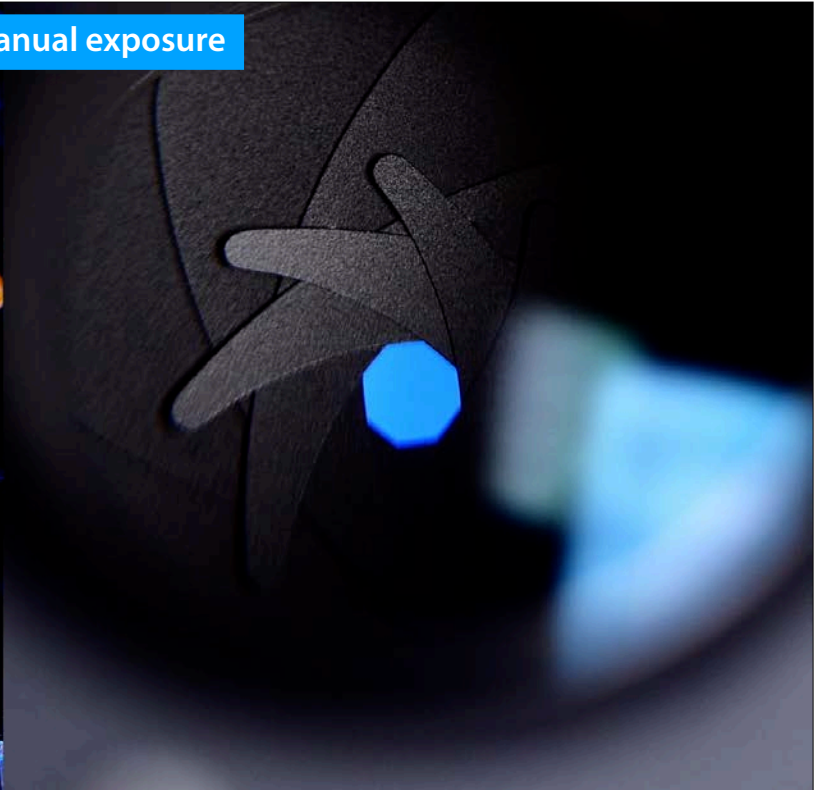
What is aperture?

What is aperture?

What is aperture?

f/1.4   f/2   f/2.8   f/4   f/5.6   f/8   f/11   f/16
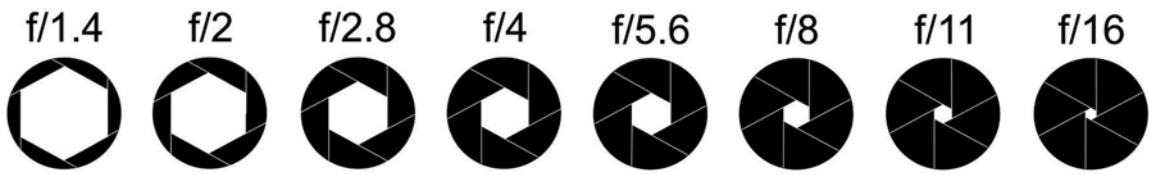
Large Aperture
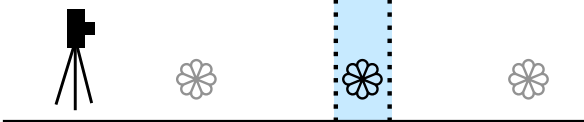
Small Aperture

The **aperture** has an effect on both exposure and depth of field.

f-stop (a.k.a. f-number) the ratio of the lens focal length to the diameter of the entrance pupil.

Depth of field is a function of three factors: focal length of the lens, the aperture, and the focus setting.

Large apertures yields shallow depth of field while **smaller apertures** yield greater depth of field.

Using the a7iii in movie mode with manual exposure

Large Aperture

Sterling Recycling Center, David Tamés

Using the a7iii in movie mode with manual exposure

Small Aperture

Deep Focus, Dustin Gooding, https://www.flickr.com/photos/dustingooding/5452807754/

What is shutter speed?

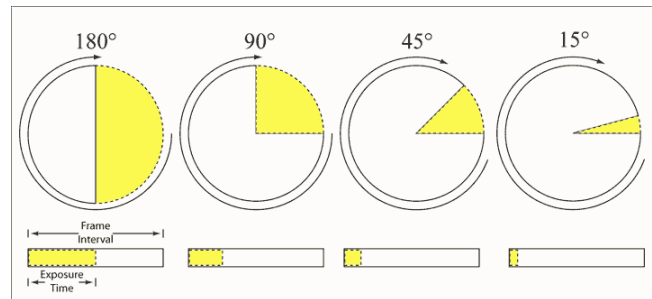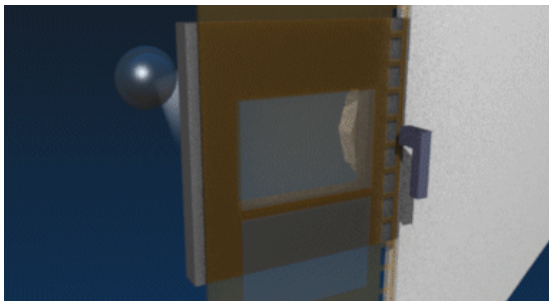The length of time that the sensor inside the camera is exposed to light when exposing a frame (video) or image (photography). The amount of light that reaches the sensor is proportional to the exposure time. 1/100 will let half as much light reach the sensor as 1/50.

shutter speed setting

shutter speed adjustment

Shutter speed, frame rate, and motion blur

Frame rate (designated in frames per second or FPS) is the rate (frequency) at which consecutive frames (images) are captured by a camera or displayed by a playback system. While temporal sensitivity and resolution of human vision varies between individuals and depends on the characteristics of the visual stimulus, roughly, a frame rate above 12 or fps are required to perceive the individual frames as movement, and a frame rate above 24 or so fps are required for the movement to appear smooth.
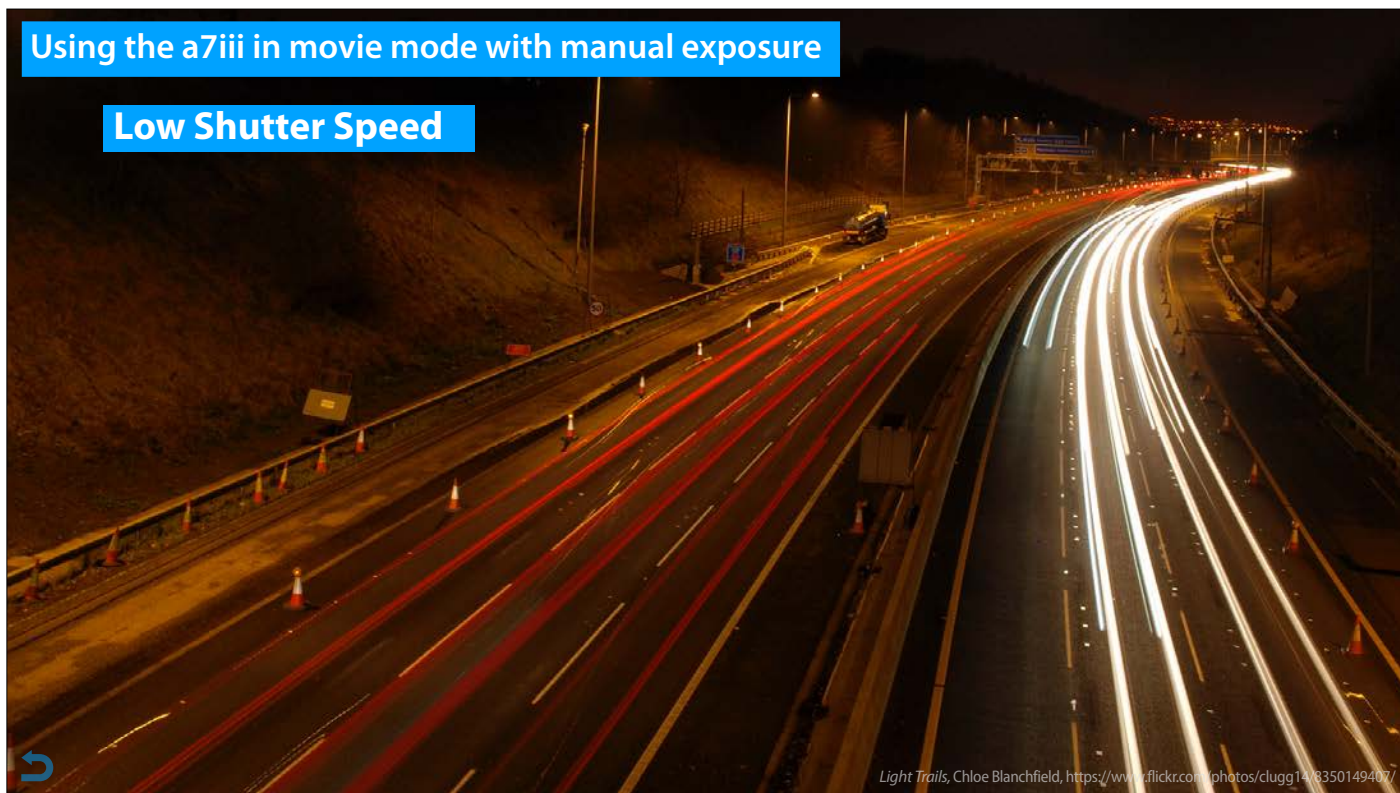

The cinema standard of 24 fps was a trade-off between smooth motion and film consumption. The standard 1/48 shutter speed is the result of a 180° rotating shutter. While the shutter blade covers the gate, the camera advances the film to the next frame. The frame is exposed while the shutter does not cover the gate. Higher shutter speeds are achieved by adjusting the shutter angle, with an effect on both exposure and motion blur, however, 180° became the standard and along with it motion blur of moving objects and/or camera movement due to 1/48 shutter speed, resulting in a major factor of the "film look."

Animation: Joram van Hartingsveldt (CC BY-SA 3.0), https://en.wikipedia.org/wiki/Rotary_disc_shutter#/media/File:Moviecam_schematic_animation.gif
Diagram: plowboylifestyle (CC BY-SA 3.0), https://en.wikipedia.org/wiki/File:ShutterAngle.png

Using the a7iii in movie mode with manual exposure

Low Shutter Speed

Light Trails, Chloe Blanchfield, https://www.flickr.com/photos/clugg14/8350149407/

Using the a7iii in movie mode with manual exposure

High Shutter Speed

Strawberry Spash! Chloe Blanchfield, https://www.flickr.com/photos/clugg14/7280322584/
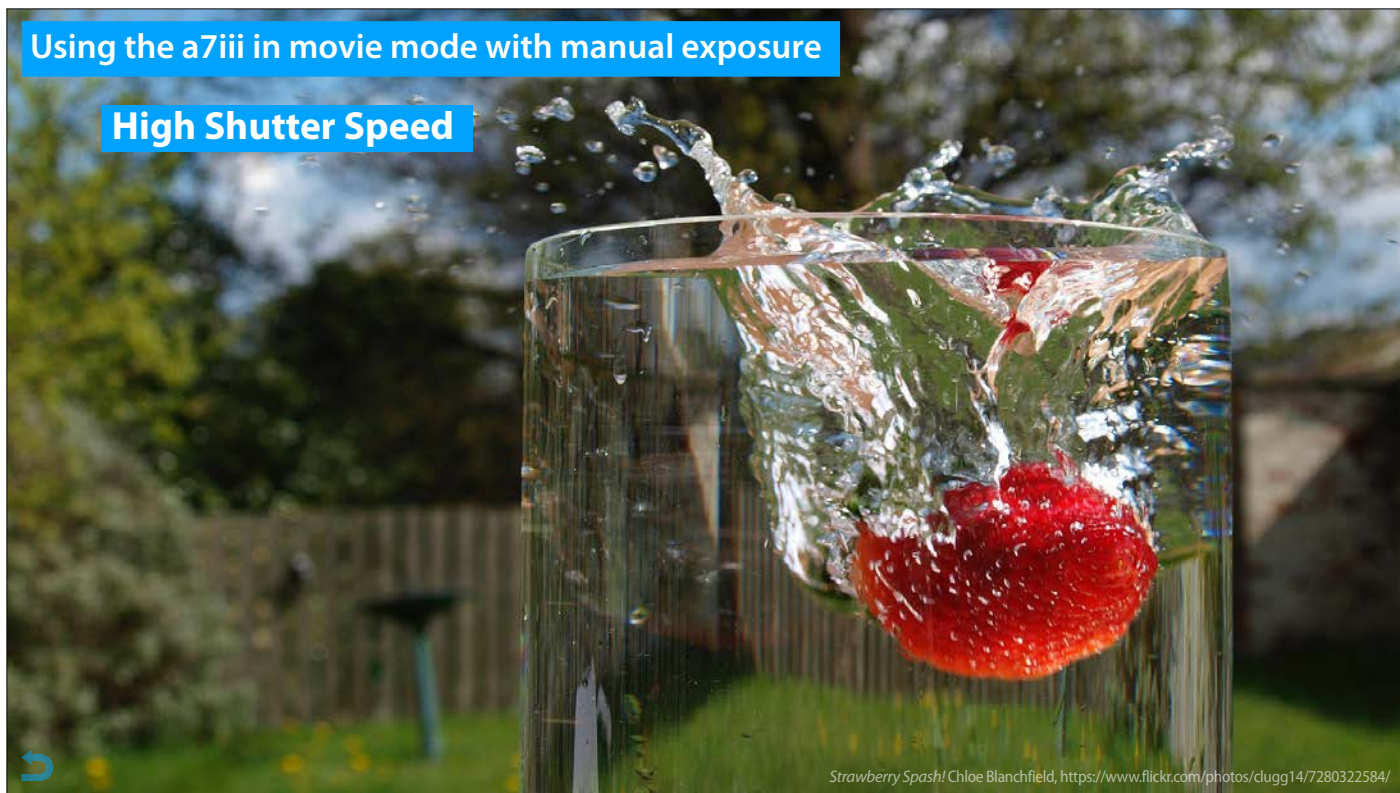
Shutter speed, frame rate, and motion blur

24p
- "film look"
- Motion blur
- Use 1/50 shutter* (a7iii can't do 1/48)

30p
- "video look"
- Motion blur similar, but less than 24p
- Use 1/60 shutter*

60p
- "real look"
- Less motion blur
- Use 1/125 shutter* (a7iii can't do 1/120)

120p
- "hyper-real look"
- Very little motion blur
- Use 1/250 shutter* (a7iii can't do 1/240)

Record Setting

60P 50	60p 50M	
60P 25	60p 25M	
30P 50	30p 50M	frame rate
30P 16	30p 16M	
24P 50	24p 50M	
120P 100	120p 100M	
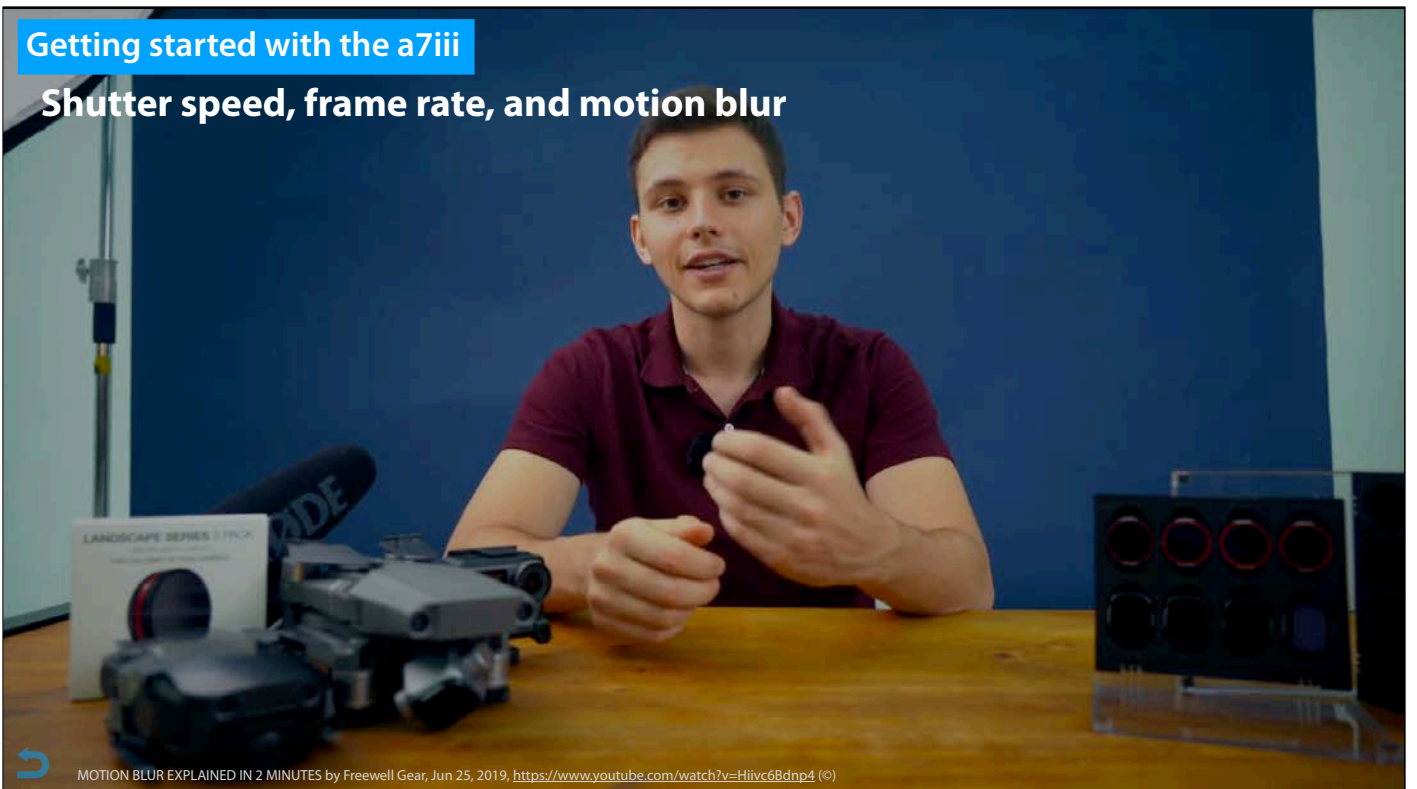
Shutter speed, frame rate, and motion blur

Rule of thumb: Set shutter speed to 2x frame rate for "natural" motion blur (e.g. at 24 fps set shutter speed to 1/48)
(Note: Sony a7iii can't do 1/48 so 1/50 is as close as we can get)

Less   **Motion Blur**   More

Look: *   "hyper-real"   "real" **   "cine"

| 1/1000 | 1/500 | **1/240 (120 fps)** | **1/120 (60 fps)** | **1/60 (30 fps)** | 1/30 | 1/15 | 1/8 | 1/4 | 1/2 |

1/48 (24 fps)

Less   Exposure   More
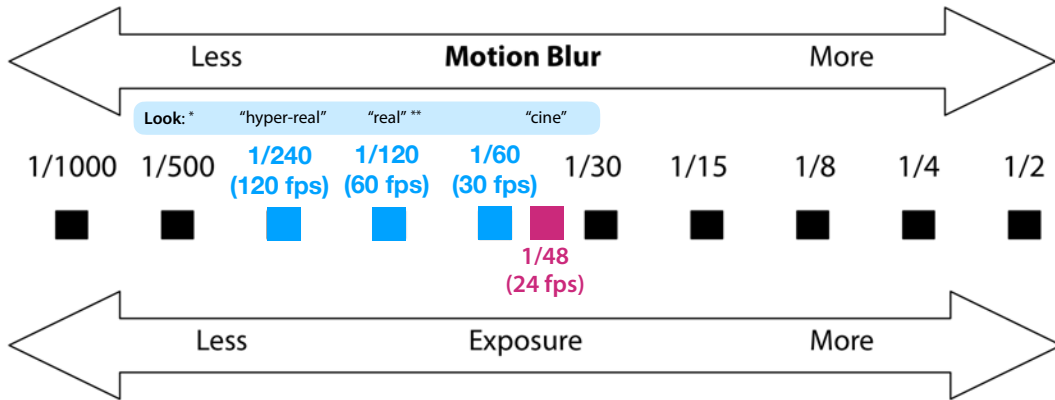
Each step represents one stop difference in exposure (1/2 or double)

* The "look" is a result of image refresh rate and motion blur, it is a perceptual phenomena, we perceive higher frame-rate acquisition/display as more "real"
** 60i (interlaced) video (60 fields/sec, 30 frames/sec) provides the "real look" while 30p video looks more like the cine look.

What is ISO Sensitivity?

Sensitivity to light as a numerical value.

ISO Sensitivity

- Standard set by the International Organization for Standardization (ISO) representing sensitivity to light specified as a number
- A higher number indicates a higher sensitivity and a greater ability to capture light
- Double the number indicates double the sensitivity, half the number represents half the sensitivity
- The higher the sensitivity, the higher the noise level, sensors vary greatly in their noise levels
- Traditional film emulsions have ISO sensitivities in the 25 to 500 range; current digital sensors have much higher sensitivity
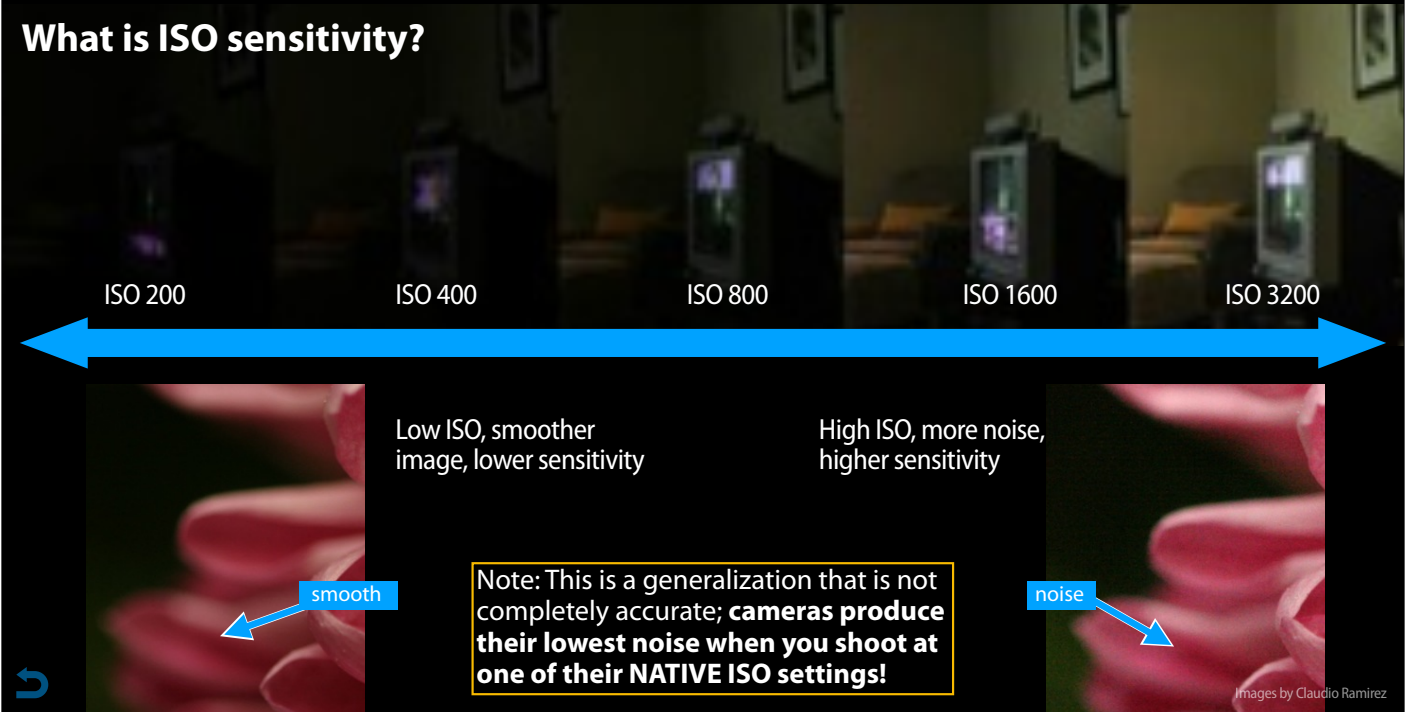

Press here to change ISO setting

ISO setting

Leave this alone when working in manual.

What is ISO sensitivity?

ISO 200   ISO 400   ISO 800   ISO 1600   ISO 3200

Low ISO, smoother image, lower sensitivity

High ISO, more noise, higher sensitivity

smooth

Note: This is a generalization that is not completely accurate; **cameras produce their lowest noise when you shoot at one of their NATIVE ISO settings!**
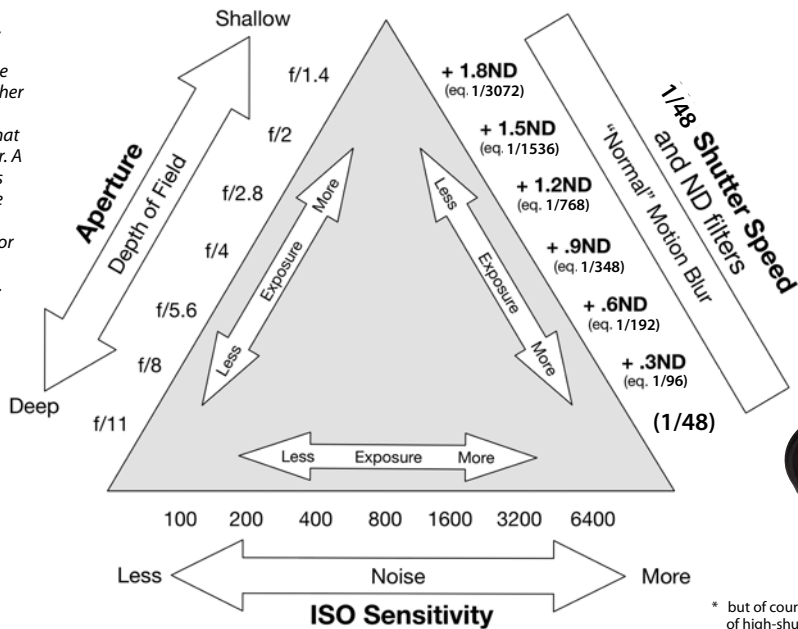
noise

Images by Claudio Ramirez

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5. **Now you have manual control over exposure** by adjusting: **a** the aperture dial, **b** the shutter speed dial (though you'll want to keep this at 1/50 for "normal" motion blur), and **c** **ISO sensitivity via the multi-function dial**

shutter speed setting   aperture setting   ISO setting

1/50   F 2.8   ±0.0   ISO 2000

REMINDER: Try to shoot with the camera's NATIVE ISO setting as this setting will exhibit the least amount of noise

Using the a7iii in movie mode with manual exposure

### Exposure triangle (for **video** recording at 24 fps (1/48) shutter speed)

The shutter speed, the lens aperture, and the luminance of the scene together determine the amount of light that reaches the sensor. A proper exposure is determined by the amount of light reaching the sensor the sensor's sensitivity to light.

Shallow

f/1.4

f/2

f/2.8

f/4

f/5.6

f/8

f/11

Deep

Aperture

Depth of Field

More Exposure

Less Exposure

Less Exposure More

+ **1.8ND** (eq. 1/3072)

+ **1.5ND** (eq. 1/1536)

+ **1.2ND** (eq. 1/768)

+ **.9ND** (eq. 1/348)

+ **.6ND** (eq. 1/192)

+ **.3ND** (eq. 1/96)

(1/48)

1/48 Shutter Speed and ND filters

"Normal" Motion Blur

Less Exposure More

100 200 400 800 1600 3200 6400

Less Noise More

ISO Sensitivity

aperture

⚠ when shooting 24p, set to shutter to 1/50 and don't change it!*

Use ND Filter kit instead of closing down aperture in order to maintain desired DOF

- ND8 (3 Stop)
- ND64 (6 Stop)
- ND1000 (10 Stop)
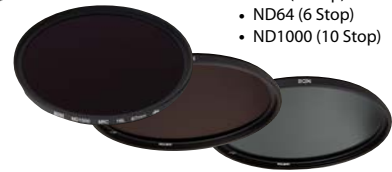
* but of course, there are always exceptions to the rule, you may want the stutter of high-shutter speeds or the excess motion blur of slower shutter speeds!

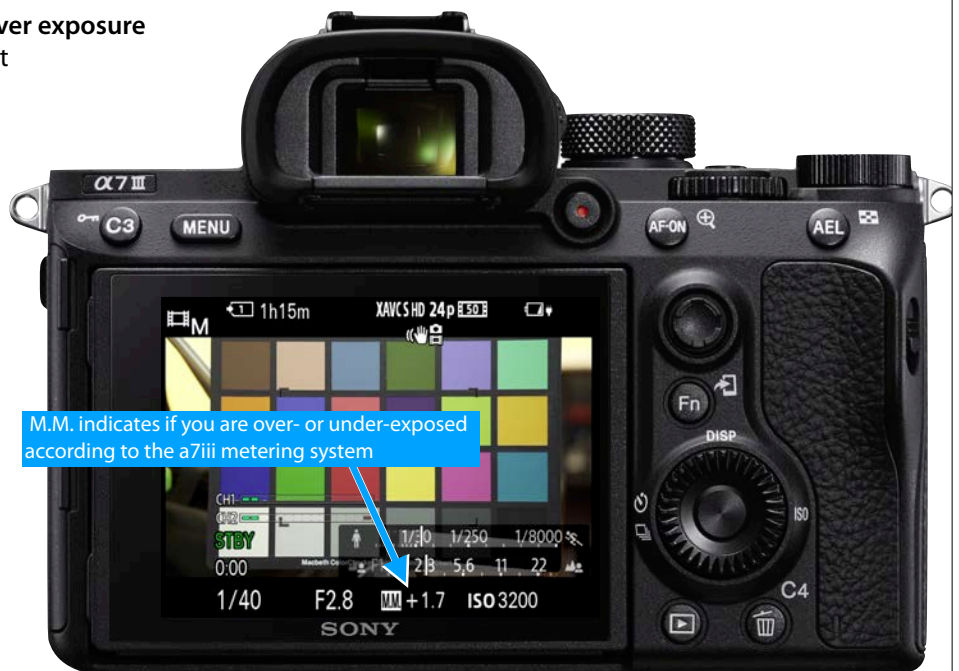## Using the a7iii in movie mode with manual exposure

5. **Now you have manual control over exposure** to help you determine the right exposure, use these tools:

- **Zebras**
- Internal Meter

(there is also a histogram available)

areas that exceed the exposure threshold you've set will have zebra stripes over them (in this case 90 IRE)

M.M. indicates if you are over- or under-exposed according to the a7iii metering system

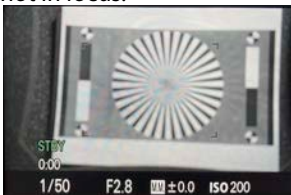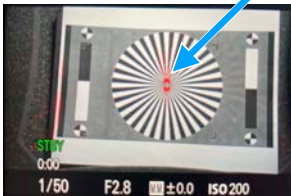## Using the a7iii in movie mode with manual exposure

6. **For maximum creative control, set focus manuall**y, to help you do this, **enable peaking**, a focusing aid that indicates areas of high contrast

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6. **For maximum creative control, set focus manuall**y, to help you do this, **enable peaking**, a focusing aid that indicates areas of high contrast; (Camera 1 => Focus Assist (13/14) => Peaking Level => Peaking Setting => Peaking Display: On); then set Level and Color
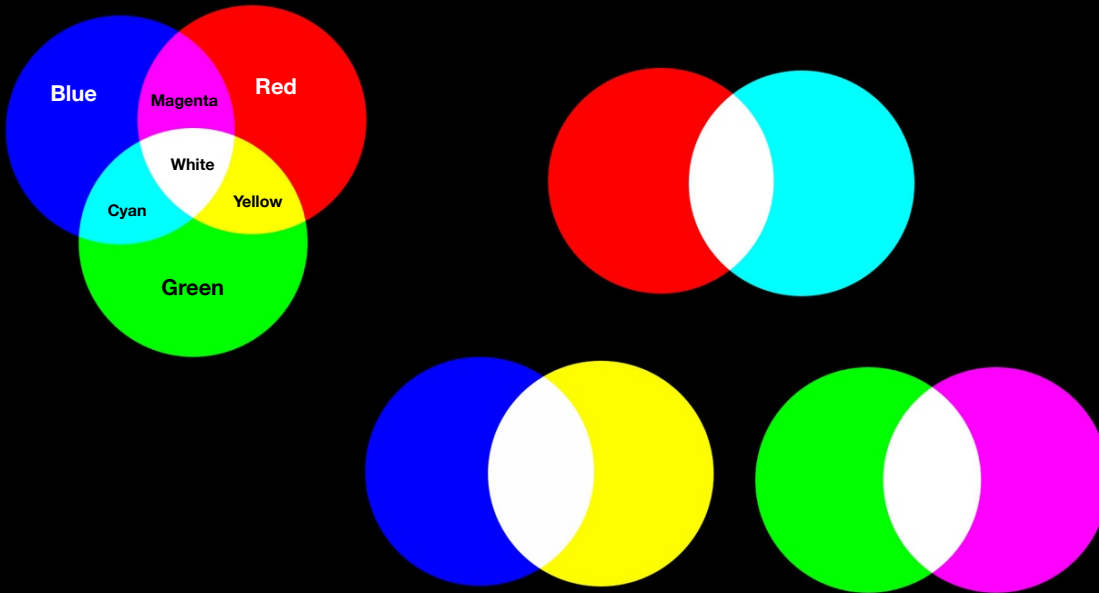
not in focus:

in focus:

peaking

Level is a sensitivity setting; "low" will only highlighting areas of very high contrast while "high" will highlight more, lower contrast areas
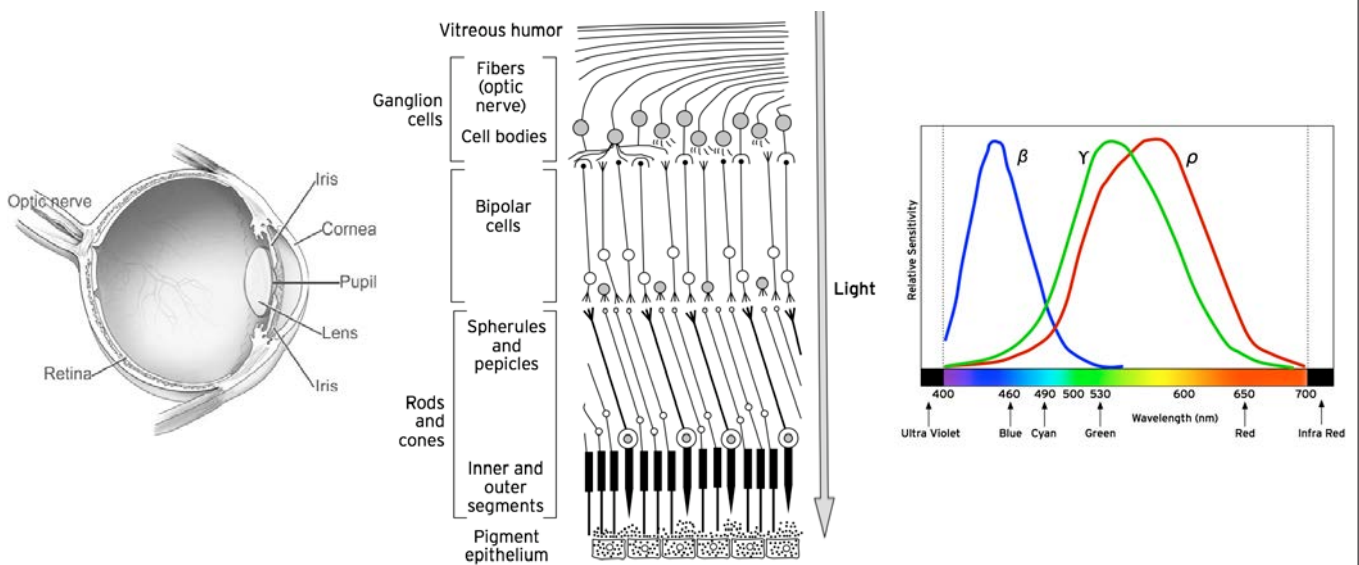
Quick review of the additive color model

color vision

Based in part on Light and Color by By R. Daniel Overheim and David L. Wagner (Wiley, 1982)
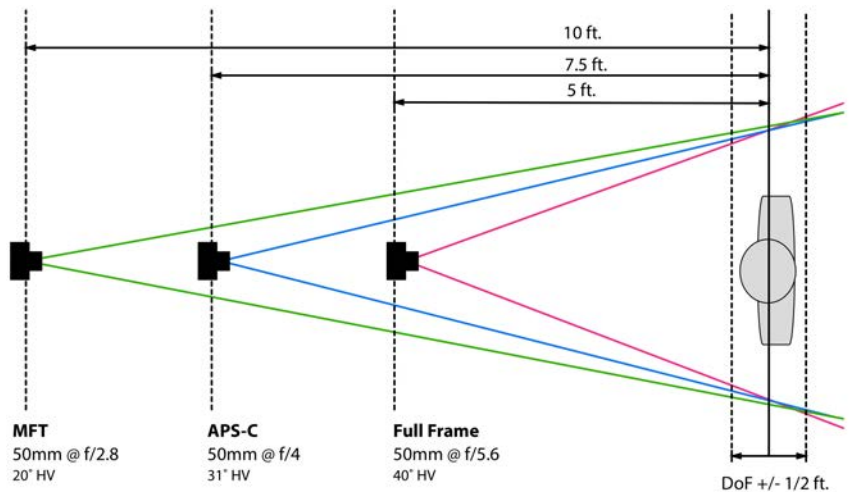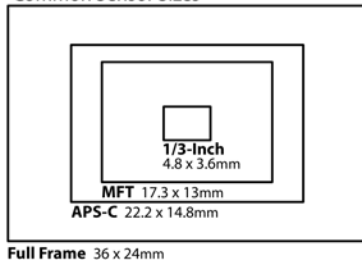
How digital cameras record a color image
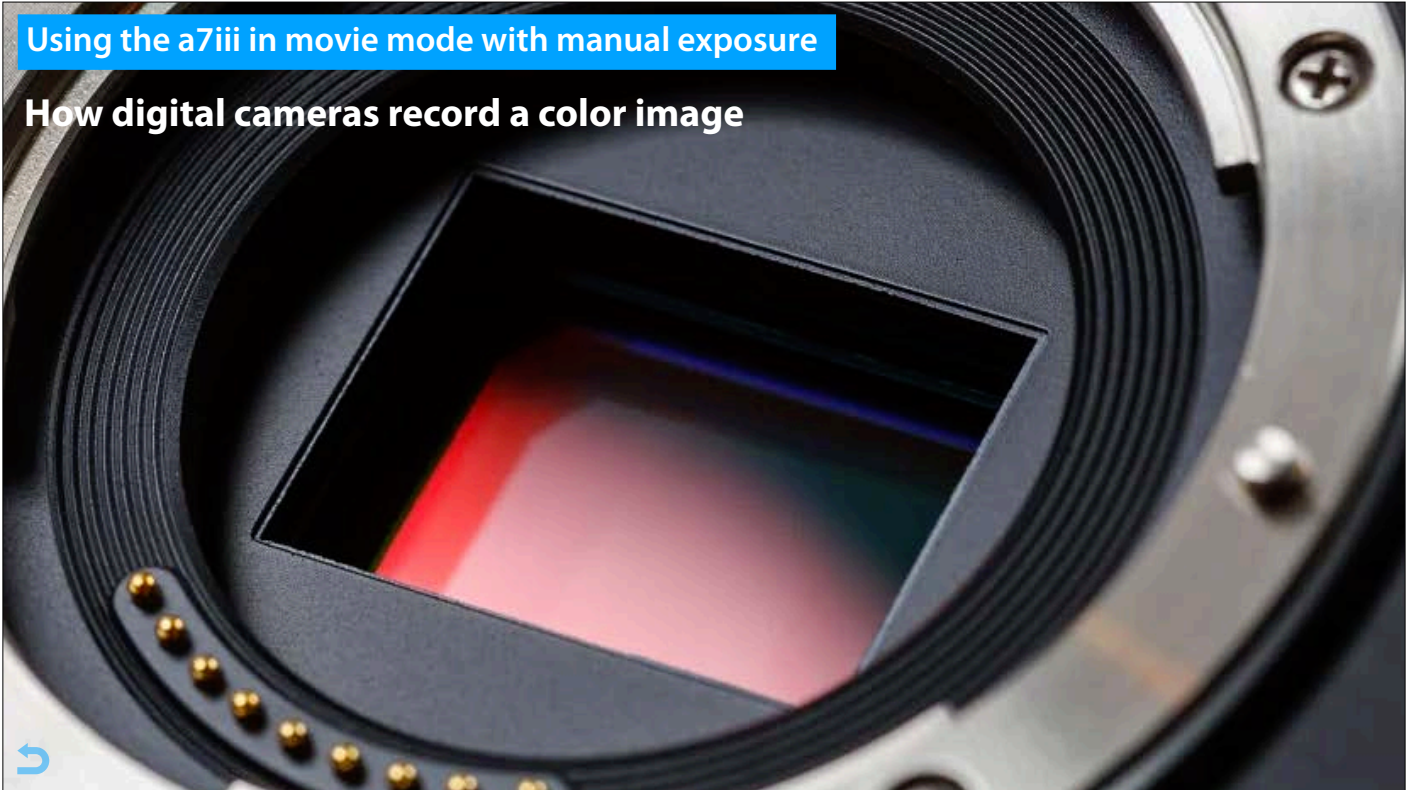
Sensor size comparison

Sensor size does not have an effect on depth-of-field, however, what we consider a "normal" lens is determined by sensor size, therefore, a "normal" lens for a camera with a Micro Four-Thirds (MFT) sensor like the Panasonic GH5 is **25mm**, while a "normal" lens for a **full-frame** camera like the Sony a7iii is **50mm.** What full-frame cameras make possible in comparison to smaller sensor counterparts is shorter camera to subject distances when shallow depth of field is required. There is more to this, of course …

Common Sensor Sizes

1/3-Inch 4.8 x 3.6mm
MFT 17.3 x 13mm
APS-C 22.2 x 14.8mm
Full Frame 36 x 24mm

10 ft.
7.5 ft.
5 ft.

MFT
50mm @ f/2.8
20° HV

APS-C
50mm @ f/4
31° HV

Full Frame
50mm @ f/5.6
40° HV

DoF +/- 1/2 ft.

See the Depth of Field Calculator at http://www.dofmaster.com/dofjs.html

How digital cameras record a color image

Original scene

camera **projects** image onto sensor (each pixel sensor has a color filter over it)

Bayer pattern image

image is **color coded** with Bayer filter colors based on response of each pixel sensor

Color coded image with Bayer filter colors

interpolation of missing color information reconstructs the original image

Final RGB image

Incoming light

Filter layer

Sensor array

Resulting pattern

Bayer patterns by Cburnett (CC BY-SA 3.0), https://en.wikipedia.org/wiki/Bayer_filter#/media/File:Bayer_pattern_on_sensor.svg and https://en.wikipedia.org/wiki/Bayer_filter#/media/File:Bayer_pattern_on_sensor_profile.svg
RGB image by Cmglee (CC BY-SA 3.0), https://commons.wikimedia.org/wiki/File:Colorful_spring_garden_Bayer.png

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What is color temperature?

The **color temperature** of a light source describes the spectral response of a source that is on the line from reddish/orange via yellow to more or less white to blueish white light in units of K (degrees Kelvin).*

Spectral Response of common light sources

Northern Sky Light

Tungsten Lighting

Sun

HMI Lighting

Fluorescent Lighting

Relative Intensity

Wavelength (nm)
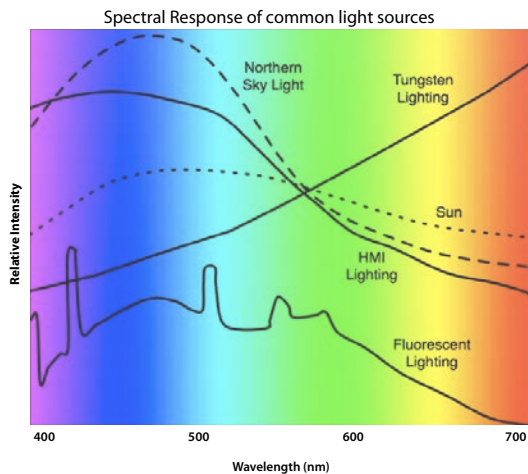
°Kelvin	Natural Light Sources		Artificial Light Sources	
10,000°				
9,000°	Summer Skylight	9,500° to 30,000°		
	Hazy sunlight	9,000°		
8,000°	Partly Cloudy Sky	8,000° to 10,000°		
	Average summer shade	8,000°		
7,000°				
	Light summer shade	7,100°		
	Average Summer Sky w/ blue skylight	6,500°		
6,000°	Overcast sky	6,000°		
	Direct Mid-summer Sunlight	5,800°	HMI Lamp	5,600°
	Summer sunlight at noon	5,400°	Daylight Balanced Fluorescent (Chroma 50)	5,500°
5,000°				
	Early morning & late afternoon sunlight	4,300°	Daylight Blue Photoflood Lamp	4,280°
4,000°				
	One hour after sunrise	3,500°	Photoflood Lamp	3,400°
			Tungsten Halogen bulb	3,200°
3,000°			Tungsten Balanced Fluorescent (Ultra 32)	3,200°
			Domestic electric light bulb	2,900°
2,000°	Sunrise or Sunset	2,000°	Candle Flame	1,850°
			Match Flame	1,700°
1,000°				

*This measure is derived from the Kelvin temperature given off by a "black body radiator" as it is heated (a theoretical lamp filament); 0° K = -273.15° C.

Based in part on *Light and Color* by By R. Daniel Overheim and David L. Wagner (Wiley, 1982)

What is white balance?
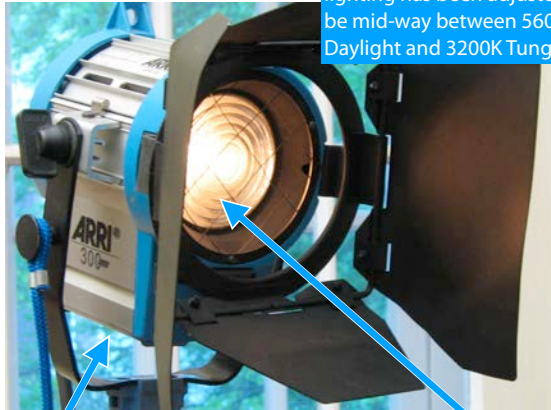
In this image, ambient lighting has been adjusted to be mid-way between 5600K Daylight and 3200K Tungsten.
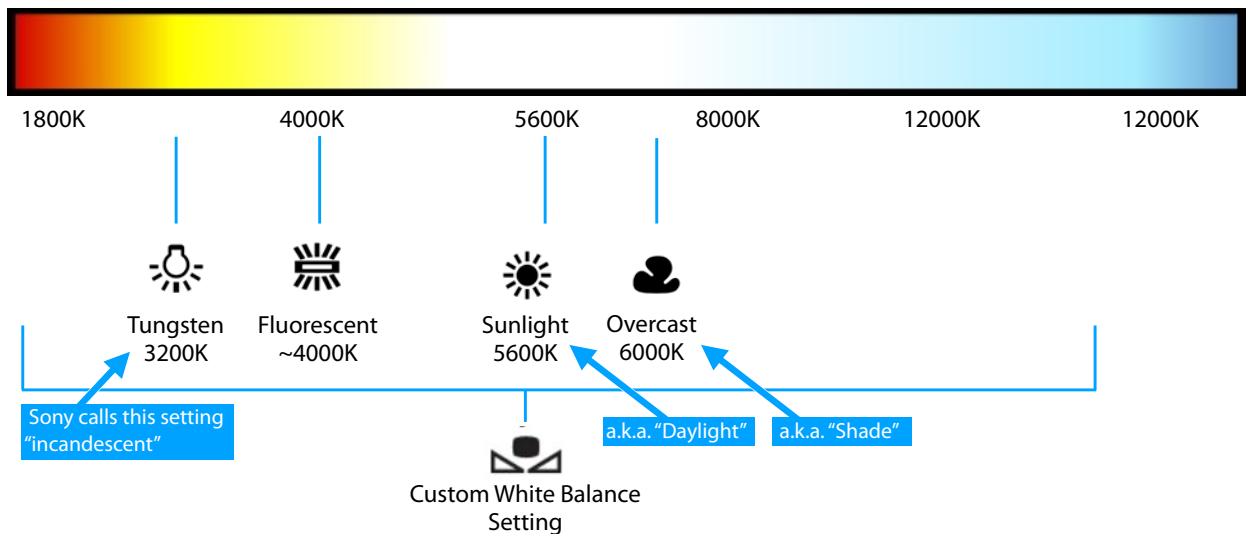
Daylight background

3200K Tungsten Light Source

The camera does not know what combination of red, green, and blue values should be rendered as white, so we need to "White Balance" the camera to tell it. This offers much better color rendering than auto white balance.

Color temperature and white balance settings common to digital cameras

1800K	4000K	5600K	8000K	12000K	12000K

Tungsten 3200K

Fluorescent ~4000K

Sunlight 5600K

Overcast 6000K

Sony calls this setting "incandescent"

a.k.a. "Daylight"

a.k.a. "Shade"

Custom White Balance Setting

Using the a7iii in movie mode with manual exposure

7. **Set the white balance for better color rendition** ⬓SET

white chip does not look white

current WB setting

Using the a7iii in movie mode with manual exposure

7. **Set the white balance for better color rendition** ⬓SET
   a. Press **Fn** to bring up the Function Menu scroll to the White Balance tile
   b. Select White Balance

Using the a7iii in movie mode with manual exposure

7. **Set the white balance for better color rendition** 🠾SET
   a. Press **Fn** to bring up the Function Menu scroll to the White Balance tile
   b. Select White Balance
   c. Scroll to Custom Setup and then press the Multi-Function select button

---

Using the a7iii in movie mode with manual exposure

7. **Set the white balance for better color rendition** 🠾SET
   a. Press **Fn** to bring up the Function Menu scroll to the White Balance tile
   b. Select White Balance
   c. Scroll to Custom Setup and then press the Multi-Function select button
   d. Place a white reference card in the scene and then press the Multi-Function select button to set the White Balance

Using the a7iii in movie mode with manual exposure

7. **Set the white balance for better color rendition** ⌲SET
   a. Press **Fn** to bring up the Function Menu scroll to the White Balance tile
   b. Select White Balance
   c. Scroll to Custom Setup and then press the Multi-Function select button
   d. Place a white reference card in the scene and then press the Multi-Function select button to set the White Balance
   e. Choose a register to store the setting, then press Multi-Function select button to store it

Custom
Select register

🖐1 5500K   A-B: 0   G-M: 0

current setting in register

selected register (Custom 1, 2, or 3)

3200K   A-B: 0   G-M: 0

our new setting

◆▶Select ●Enter

e

Using the a7iii in movie mode with manual exposure

7. **Set the white balance for better color rendition** ⌲SET
   a. Press **Fn** to bring up the Function Menu scroll to the White Balance tile
   b. Select White Balance
   c. Scroll to Custom Setup and then press the Multi-Function select button
   d. Place a white reference card in the scene and then press the Multi-Function select button to set the White Balance
   e. Choose a register to store the setting, then press Multi-Function select button to store it
   f. White balance set and stored in a register

2h41m   XAVC S HD 24p ISO   23%

M

white chip is now white!

3200K

AF-C

CH1
CH2
STBY

AF ON
PP6 0:00

D-R OFF

Std.
±0±0±0

OFF

1/50   F2.8   ±0.0   ISO 200

7. **Set the white balance for better color rendition** ⊾✎SET

White Balance Presets and Settings

		Fluorescent	
☀	Daylight		
🏠	Shade	💡−1	Warm White
☁	Cloudy	💡0	Cool White
		💡+1	Day White
💡	Incandescent	💡+2	Daylight

🐟 Underwater Auto

AWB Automatic White Balance

AWB☾ AWB (Priority Set: Ambience)

AWB☀ AWB (Priority Set: White)

Ⓚ⊘ Manual setting

⊾✎ Use setting saved in Custom 1/2/3

Custom WB preset in use

Color Temperature Setting

Using a reference chart to understand color rendition
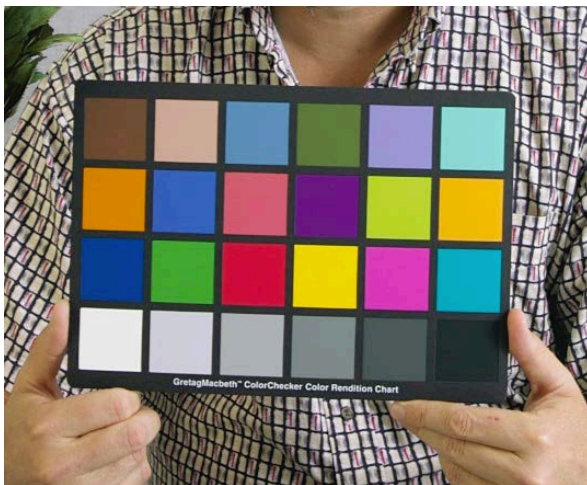
(PD)
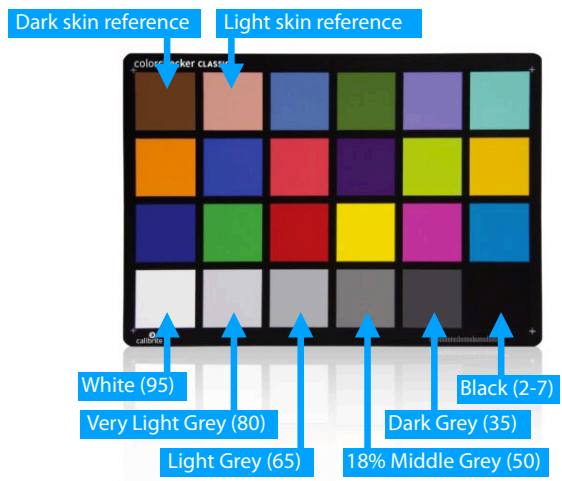
Dark skin reference   Light skin reference

White (95)

Very Light Grey (80)

Light Grey (65)

Dark Grey (35)

18% Middle Grey (50)

Black (2-7)

Software Support:
- Adobe Photoshop and Adobe Lightroom via a free plugin
- Black Magic Design DaVinci Resolve for color grading
- 3DLUT Creator
- and others

See also ColorChecker, https://en.wikipedia.org/wiki/ColorChecker
See Color Checker, Calibrite, https://calibrite.com/us/product/colorchecker-classic/

8. Picture profiles

***FOR THIS WORKSHOP SHOOT
WITHOUT A PICTURE PROFILE***

PP1: [Movie] gamma
PP2: [Still] gamma
PP3: natural color tone
using [ITU709] gamma
PP4: color tone ITU709 standard
PP5: [Cine1] gamma
PP6: [Cine2] gamma
PP7: [S-Log2] gamma
PP8: [S-Log3] gamma and [S-Gamut3.Cine]
PP9: [S-Log3] gamma and [S-Gamut3] HDR recording
using [HLG2] gamma

Color/WB/Img. Processing ◂12/14▸
White Balance — Auto
Priority Set in AWB — Standard
DRO/Auto HDR — Off
Creative Style — Standard
Picture Effect — Off
Picture Profile — PP8

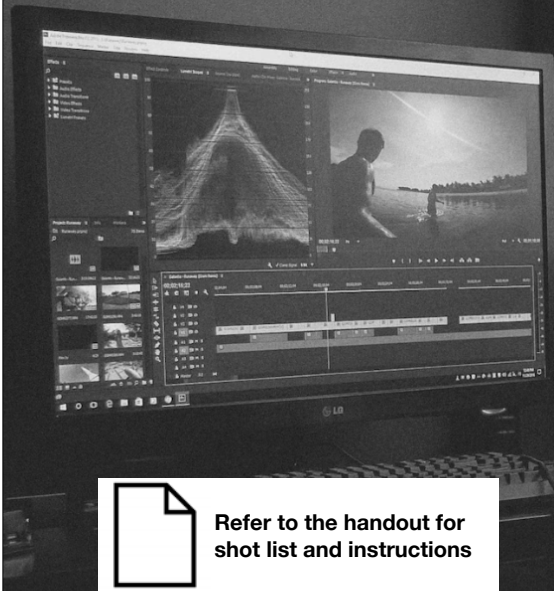CHOOSE **OFF**

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9. Record video, experiment, and keep notes!

Notes:
- In Movie Mode audio levels are manually adjusted
- Image stabilization is enabled by default
- Camera may be powered via USB-C as well as battery
- Recording in progress indicated by REC on the LCD, otherwise it is STBY

Turn off the camera when not shooting to conserve battery power

5%

card selected
current mode
recording settings
2h41m XAVC S HD 24p
23%

time remaining on SD card
battery/power status

recording indicator
audio level meters
image stabilization status

recording time
STBY
0:00

1/50 F2.8 ±0.0 ISO 200

ISO Sensitivity

Shutter speed (make sure it is set to 1/50 for 24p recording)

aperture

exposure (according to the built-in meter)

Hands-on Activity

Refer to the handout for shot list and instructions

1. Shooting (keep a log)
2. Review footage
3. Select the best clips
4. Assemble and export a sequence
5. View and comment on sequences

Camera Reference

Sony a7iii resources

Sony a7iii Camera Settings (PDF) (Sheffield Hallam University, **https://connect2.shu.ac.uk/self-help/cmcbookings/forms/Sony_A7III_Settings_Guide.pdf**

Sony a7iii Instruction Manual (PDF)
https://tinyurl.com/sony-a7iii-manual

Sony a7iii Camera Help Guide
https://helpguide.sony.net/ilc/1720/v1/en/index.html

Sony Help Guide for Creators
https://helpguide.sony.net/di/pp/v1/en/index.html
Covers Picture Profiles