

Macro and Focus Stacking

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Macro (Wikipedia)

- **Macro photography** is extreme close-up photography, usually of very small subjects, in which the size of the subject in the photograph is greater than life size. By some definitions, a macro photograph is one in which the size of the subject on the negative or image sensor is life size or greater. However in other uses it refers to a finished photograph of a subject at greater than life size.

Life Size



Macro Hardware

- Regular lens with “macro” capability
 - Close-up adapter
 - Screw-on adapter
 - Regular lens with a reversed lens used as a close-up lens
 - Extension tubes
 - Macro lens
- Reversed lens
 - Bellows

Require more advanced techniques

 - Manual focus
 - Stop-down metering
 - Adapters
 - Some modern cameras have issues if a proper lens is not attached

Regular “Macro” Zoom Lens

- Pros: You probably already have one
- Cons: It has low magnification



~ 0.25X

Close-up Adapter

- Screws on front of lens like a filter
- Many are low quality
- Most are prone to Chromatic Aberration

Close-up Lens



Close-up Lens Example

55mm Lens with
+4 Close-up Lens



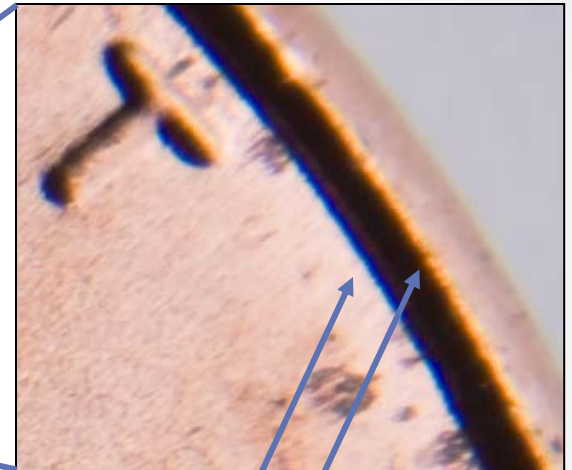
~ 0.5X

Close-up Lens Example

55mm Lens with
+10 Close-up Lens



~ 0.7X

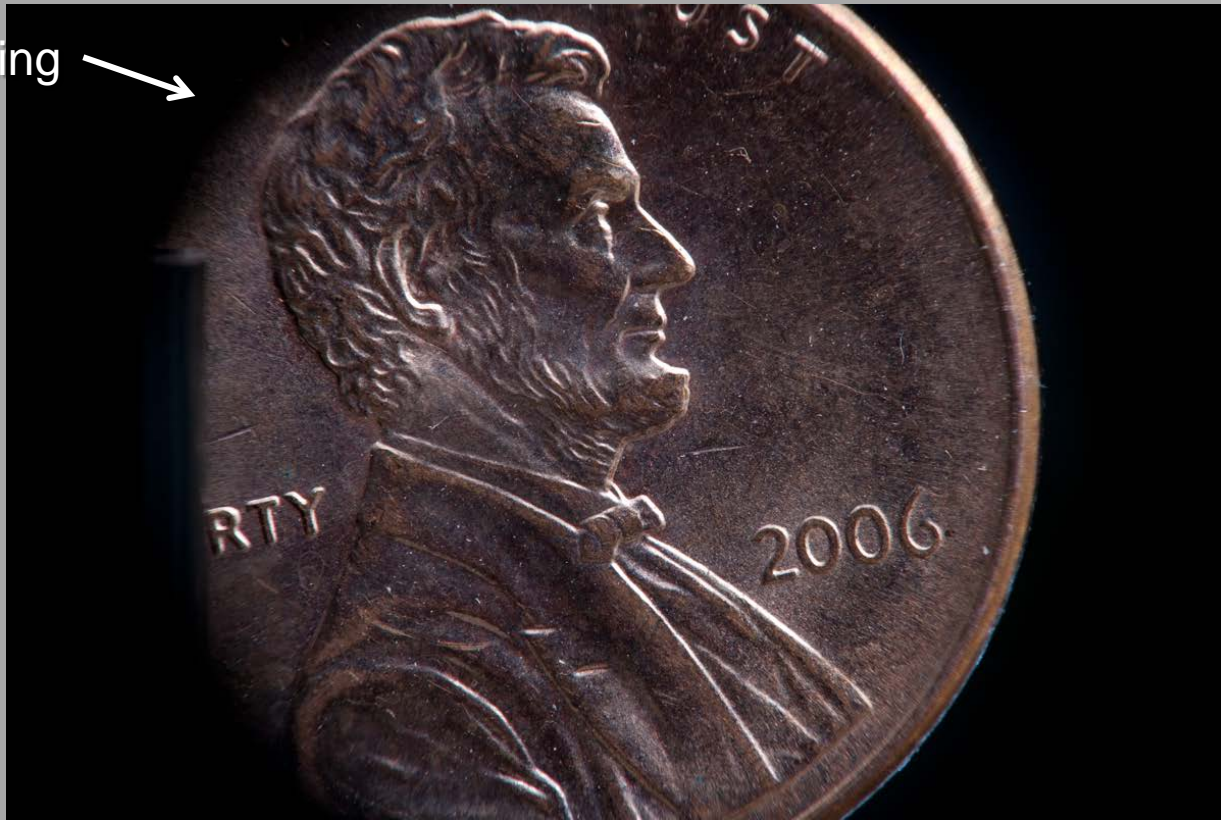


Chromatic
Aberration
(Color fringing)

Close-up Lens Example

50mm Lens with a 2nd 50mm reversed lens used as Close-up Lens

Vignetting



~ 1X

Extension Tubes

- Can extend the range of your macro lens
- Or, reduce the minimum focusing distance of a regular lens
- Disadvantage - each extension distance will have a limited magnification range



Tube only, no glass

Extension Tube Example

50mm f/1.8 with
25mm extension



~ 0.5X
(focus at infinity)

Small magnification
range is inconvenient



~ 0.7X
(focus at minimum)

Extension Tube Example

400mm with 25mm
extension



Minimum focus
distance
reduced from
6 ft to 4 ft

$\sim 0.3X$
(focus at minimum)

Canon Macro Lenses

Lens	Min Magnification*	Max Magnification	Comments	Cost (B&H)
EF 50mm f/2.5	0	0.5		\$299
EF-S 60mm f/2.8	0	1	EF-S Only	\$469
EF 100mm f/2.8	0	1		\$599
EF 100mm f/2.8 IS	0	1	Image Stabilized	\$1049
EF 180mm f/3.5	0	1	Long working distance	\$1579
MP-E 65mm f/2.8	1	5	Manual focus, very high magnification	\$1049

* 0 = will focus to infinity

Canon 100mm Macro Lens



Macro Lens Example



0.5X



1X

Reverse Adapter



Camera Mount

Filter Threads

Lens Used Backwards
(Vivitar 28mm, mount is
irrelevant, it isn't used)



Lens must allow
manual adjustment
of aperture, old
manual lenses work
good

Reversed Lens Example

50mm Lens reversed
(old Minolta MD manual focus)



~ 0.7X

Reversed Lens Example

28mm Lens reversed
(old Vivitar manual focus)

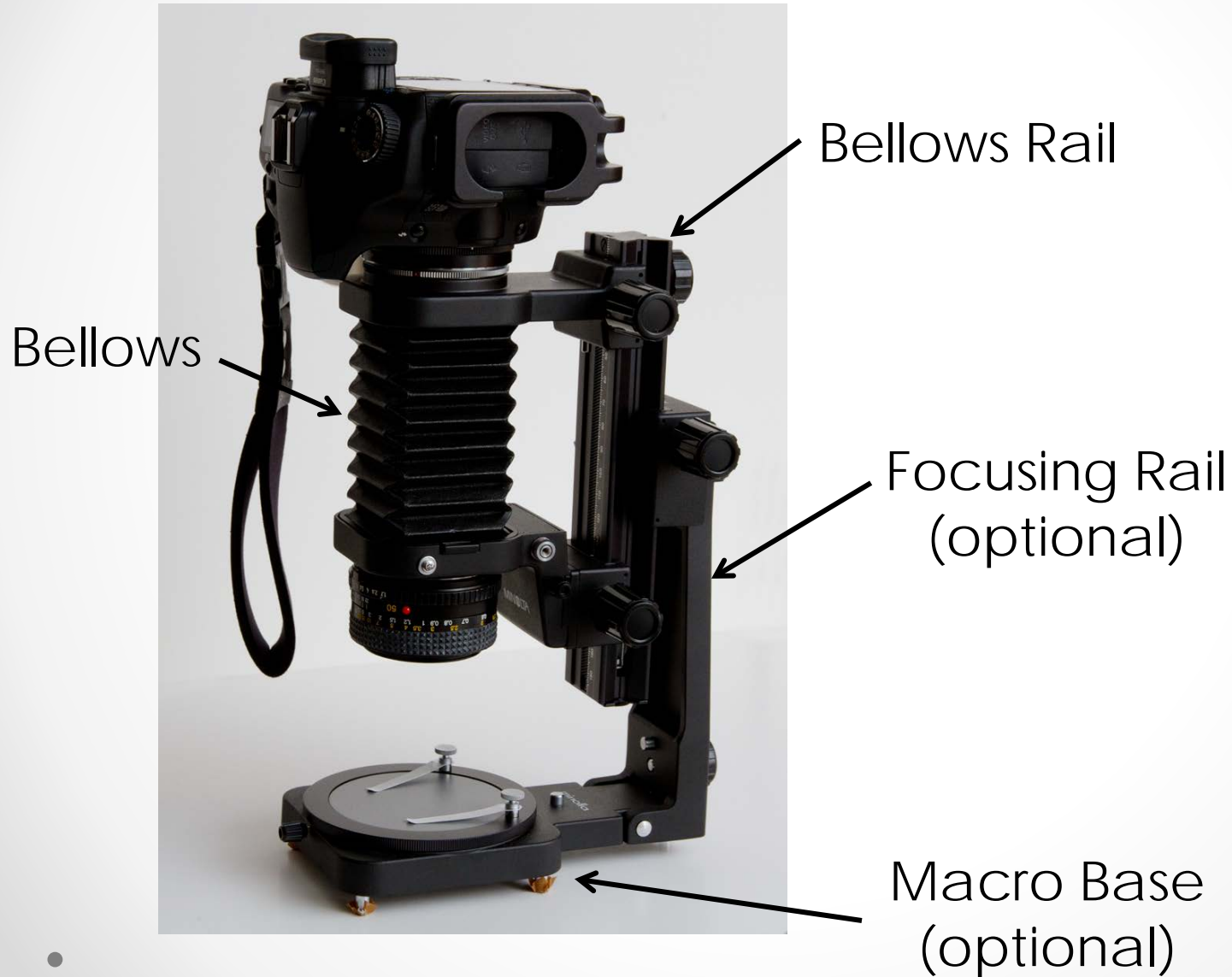


~ 2X

Bellows

- Adjustable extension
- Not common with modern cameras
 - To properly couple an electronic lens is expensive
- Used on ebay
 - Manual stop-down of lens
 - Old camera to modern camera adapter
- New on ebay
 - Will not have electronic lens coupling
 - Manual stop-down of lens
 - Old lens to modern camera adapter

Bellows



Used Bellows

- A good condition old model can be found for a reasonable price if you do lots of research and have lots of patience
- My Setup:
 - Minolta Auto Bellows III (Auto Bellows IV is less capable but cheaper)
 - Bellows Focusing Rail
 - Bellows Copy Stand
 - EOS to Minolta MD Adapter
 - Minolta MD 50mm f/1.7 lens
 - Vivitar 28mm old manual focus lens (used reversed)

Bellows Example



~ 1X
(40mm extension)

Bellows with Standard
50mm Lens



~ 3X
(140mm extension)

Bellows Example

28mm Lens Reversed



~ 6X
(140mm extension)

Macro Lighting

- Natural or Continuous Light
 - Often requires tripod for long exposures
 - Lens extension can cause several stops of lost light
- Flash
 - On-camera flash is often blocked by lens
 - Off-camera recommended
 - Sync Cord 😞
 - Many cheap RF remotes are now available 😊
 - I use Yongnuo RF-602
 - Newer version is Yongnuo RF-603

Macro Lighting

- Diffuser
 - Tissue paper
 - Thin translucent plastic
 - Piece cut from a gallon milk jug
 - Rosco "Tough Rolux"
- Reflector
 - White foamcore
 - Business card

Focus Stacking (Wikipedia)

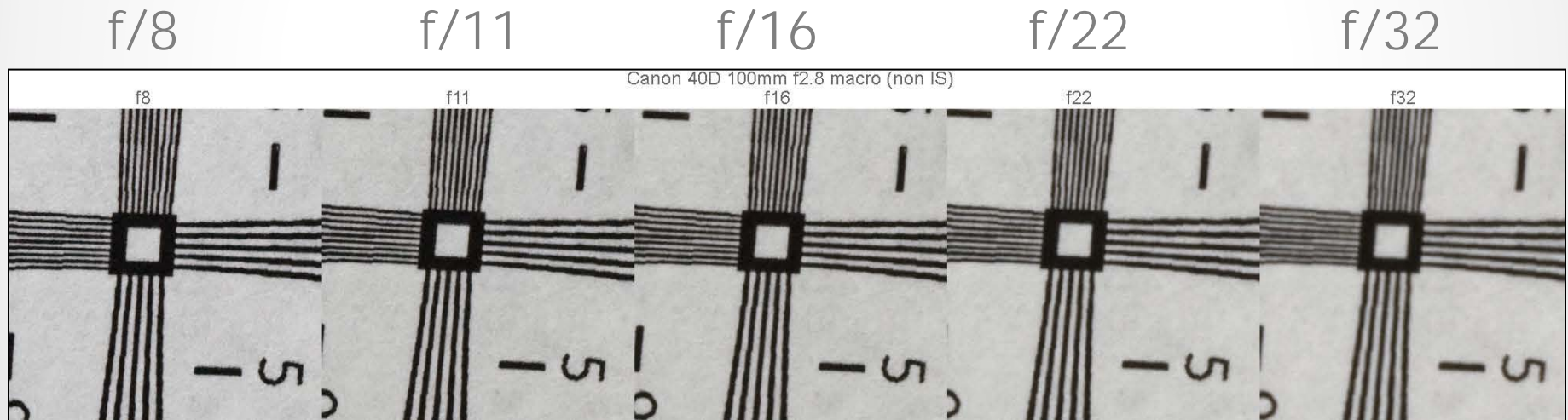
- **Focus stacking** is a digital image processing technique which combines multiple images taken at different focus distances to give a resulting image with a greater depth of field (DOF) than any of the individual source images.

Focus Stacking

- Shoot multiple images at different focus points
- Avoid diffraction limited apertures
 - Normally use f/8 or f/11
- Two Methods of varying focus
 - Change focus on camera
 - Move camera slightly (necessary at high magnifications)
- Merge images with special software

Diffraction

- Light is a wave and waves are dispersed when they travel through small holes



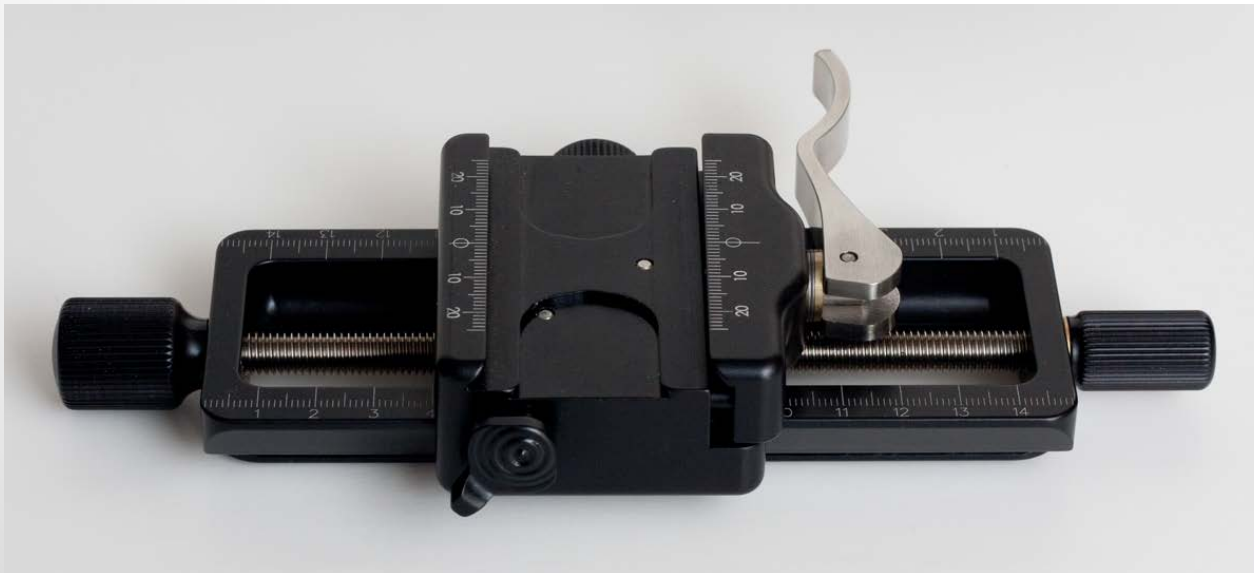
Focusing Rail

- Really Right Stuff
 - Excellent quality but expensive
- Novoflex
 - Excellent quality but expensive
- Generic Brands
 - Unknown quality but inexpensive
- Ebay New - "Chinese" Stores
 - Unknown quality but inexpensive
- Ebay Used
 - Nikon PG-2 (modified)
 - ???

Focusing Rails



Nikon PG-2
(Modified)



Really Right Stuff
(uses dovetail
quick release)

Focus Stacking Software

 en.wikipedia.org/wiki/Focus_stacking

Focus stacking software

	Name	Primary author	Platform	License
→	Adobe Photoshop ^[8] CS4, CS5, CS6	Adobe	Windows, Mac OS X	Proprietary
	ImageFocus Stacking software	Euromex Microscopes Holland	Windows	Proprietary, 30-day trial
	ALE	David Hilvert	Linux, Windows	GPL
	CombineZ	Alan Hadley	Windows	GPL
	Deep Focus module for QuickPHOTO	PROMICRA	Windows	Proprietary, time-unlimited trial
	Enfuse (combined with align_image_stack or similar)	Andrew Mihal and hugin development team	Multiplatform	GPL
	Extended Depth of Field plugin for ImageJ	Alex Prudencio, Jesse Berent and Daniel Sage	Multi-platform (Java)	Free for use for research purposes
→	Helicon Focus	Danylo Kozub	Windows, Mac OS X	Proprietary, 30-day trial
	Image Pro Plus	Media Cybernetics	Windows	Proprietary
	Macnification	Peter Schols	Mac OS X	Proprietary, 30-day trial
	MacroFusion , GUI for Enfuse	Dariusz Duma	Linux	GPL v2
	PhotoAcute Studio	Almalence Inc	Windows, Mac OS X, Linux	Proprietary, time-unlimited trial
	PICOLAY	Heribert Cypionka	Windows	Freeware
	Stack Focuser plugin for ImageJ	Michael Umorin	Multi-platform (Java)	GPL
	Tufuse	Max Lyons	Windows	Freeware
	Zeiss Axiovision	Carl Zeiss AG	Windows	
→	Zerene Stacker	Rik Littlefield	Windows, Mac OS X, Linux	Proprietary, 30-day trial

Photoshop

- Align + Blend can be used to focus stack
- Requires CS4 or later

Helicon Focus

- Rated best in 2011 review
 - Many others now available
- Has 3 Algorithm Options
 - No guidelines as to which is best
 - Manual says “experiment”
 - I had issues when using selective focus
- “Pro” version allows manual selection of best focused areas

$f/22$

Poor Depth of Field



f/11 - Image 1



2



3



4



5



6



7

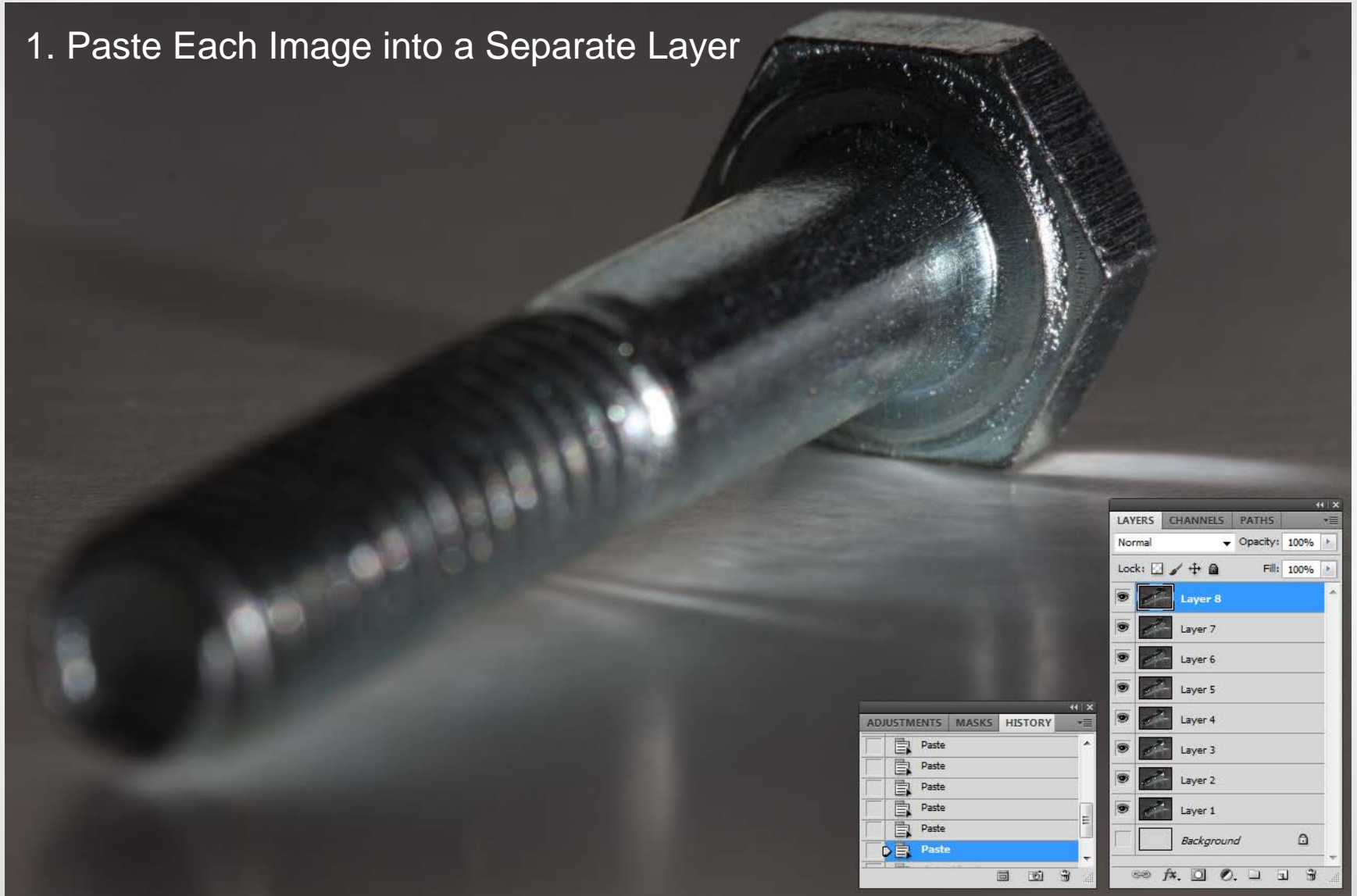


8



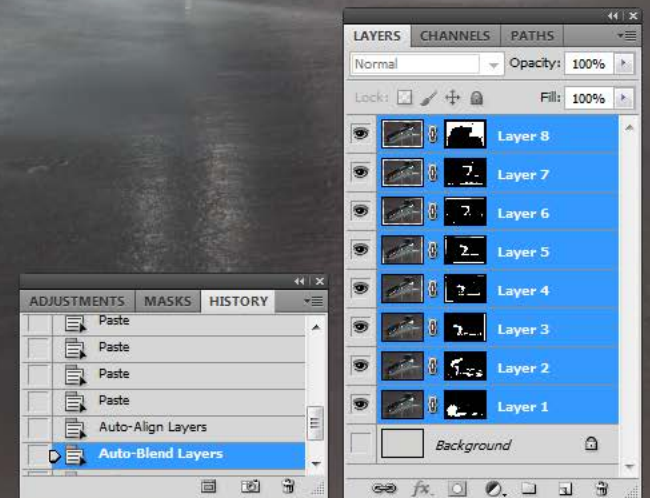
Stacking with Photoshop

1. Paste Each Image into a Separate Layer



Stacking with Photoshop

2. Select all Layers (shift click)
3. Edit -> Auto-Align Layers
Projection: Auto
4. Edit -> Auto-Blend Layers
Blend Method: Stack Images



Photoshop - Align/Blend



Helicon Focus - Stacked



Image 1



Image 2



Image 3



Image 4



Helicon Focus - Stacked



Helicon Focus – Option B



Helicon Focus - Option A



Helicon Focus – Option C



Photoshop – Align/Blend

