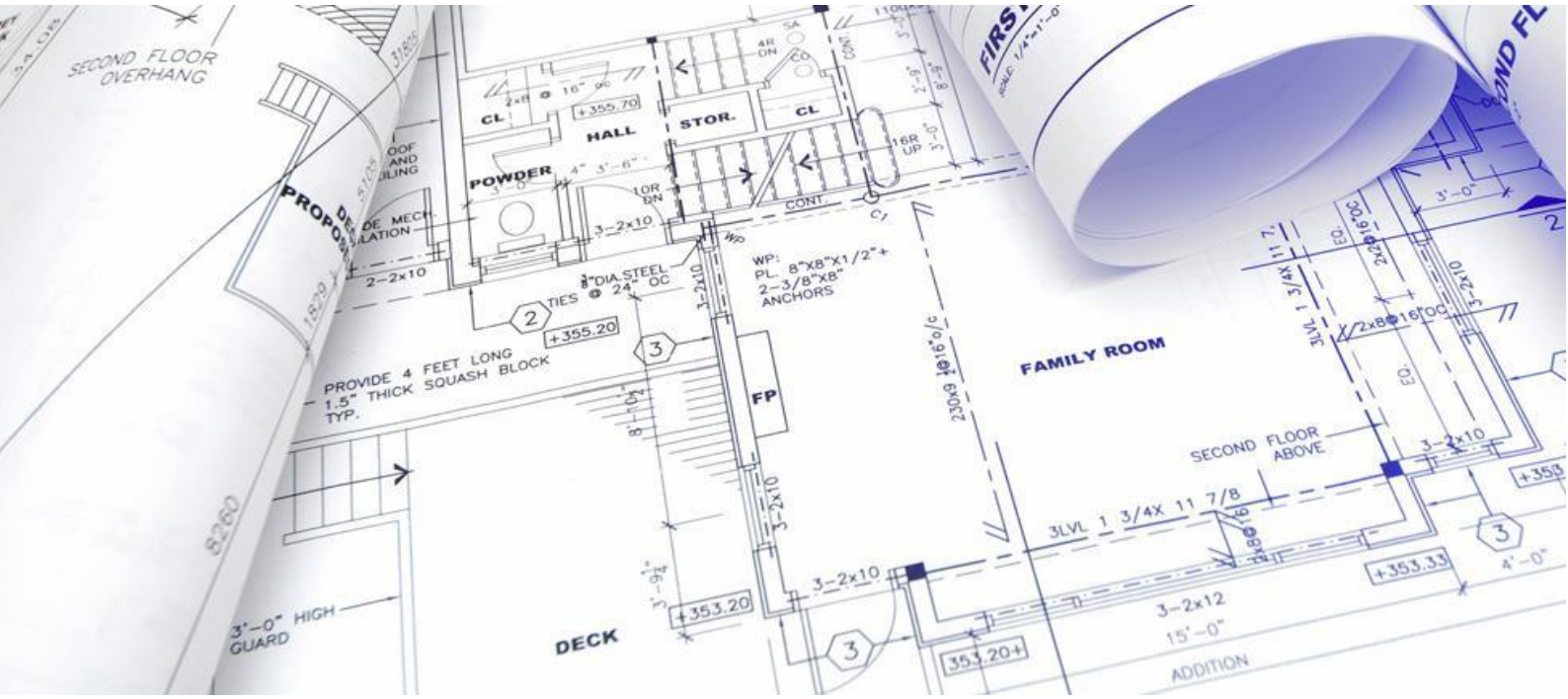
Wide Format Scanner Buyer´s Guide



The wide format scanner market has changed dramatically over the last few years. Improvements in color and grayscale image quality, actual scanner speed and file processing times allow users to be more productive and realize initial return on investment much faster. Wide format scanner manufacturers now also incorporate more options and accessories, further broadening the choices customers can make.

This **Wide Format Scanner Buyer´s Guide** will hopefully assist in making the proper choice in your first wide format scanner acquisition, or help you find the right fit for upgrading existing systems.

Version History	Date
First draft	01.04.2013
Enhanced version, added drawings for CCD and CIS scanners	07.11.2013
Updated to include information on newer products	15.10.2014
Newer products update, remove productivity comparison	05.05.2022
Updated	01.04.2025

Table of Contents

This document is divided into two sections; questions to ask when considering a wide format scanner purchase, and technical considerations. Many of the technical terms and their explanation can also be verified in Wikipedia and other sources and we explicitly encourage the reader to verify our statements. If you want a very short overview about the most important things to consider, only read the highlighted comment (example below)

Conclusions, general guidelines and best practices, highlighted comment

Questions

Determine your business model.

Why are you considering purchasing a wide format scanner or upgrading your present equipment? Do you need to address a growing archive of large documents and recover valuable space in your office environment? Are there job sets in hard copy that need to be shared online by workgroups? Do you provide scanning services for your customers, either in your office or theirs (facilities management)?

How important is scanning speed? Can you get by with color scanning at about 1 inch per second (ips) or do you need to scan at up to 12ips for faster job turnaround? These are important factors to consider and are dependent on your scanning volume. Bottlenecks can become a reality if the scanning volume is very high and the scanning speed is low.

Identify what types of documents need to be scanned. GIS maps? Engineering drawings? Color and black and white photos? Framed art and posters? Newspapers and magazines? Other bound documents? Mostly color scanning vs. mostly black and white?

Understanding your document types is important since some scanner models are not well suited for certain types of files. Also, the type of media the document is actually printed on will play a role in making the right choice. Mylar/plastic materials will not feed reliably through some sheetfeed scanners because of the paper path design. This will also hold true for thinner and more fragile media types, such as newspaper materials.

Remember, not everything is on regular bond paper.

Determine ease of installation and configuration. What is required to properly install the scanner? Do you need to provide an external PC workstation for the software and connecting it to the network? How easy is it to set up a shared folder for the scans? How many steps are needed to set up scan-to-print capabilities? Will you be able to print to a variety of printers on the network?

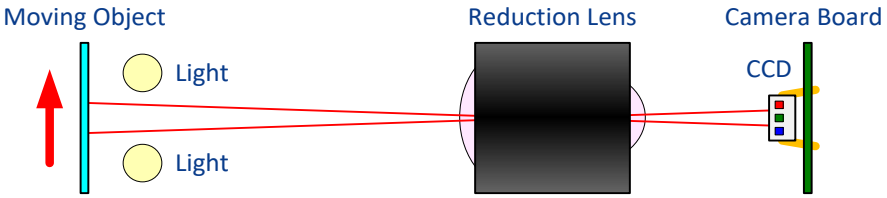
Determine who needs to use the scanner. Is the device user-friendly for even the occasional or novice operator? Can scanner defaults be set up and saved to streamline the process? Can the scanner be set up for job templates, remote scanning from and to iPad and Android devices for immediate retrieval and mobile use of the scanned files?

Finally, determine what is important to you beyond the scanner itself. How important are technical support, extended warranty programs, regular product updates such as firmware, etc.? Also, if the environment is important to you, choosing a scanner product that offers instant-on or fast warm-up and shutdown will help with minimizing energy waste.

CIS or CCD

CCD Based Scanners

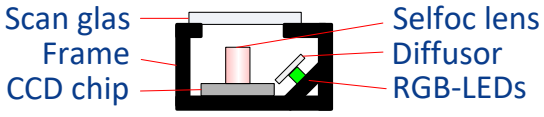
CCD based scanners have linear sensors capturing red, green and blue lines one after the other from a document illuminated with white light. The image is reduced by a reduction lens and projected on the linear CCD sensor. The object (document) is moving in synchronization with the exposure of the CCD elements. The red element will capture an image followed by a green element and a blue element. After the computer has shifted these lines in the correct order, the image will consist of RGB values at the full resolution without any Bayer pattern artifacts.



CIS Based Scanners (Entry Level Consumer Quality)

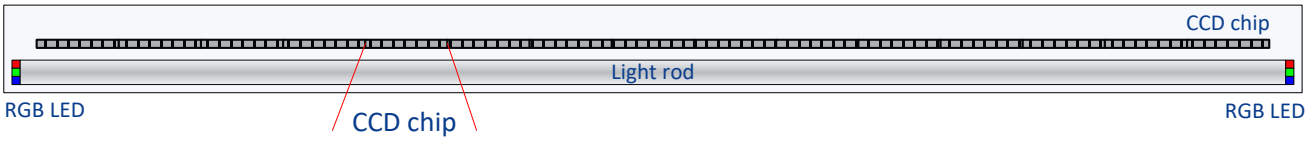
Entry level scanners use sensors with CIS technology. The CCD is combined with a 1:1 Selfoc lens at a very close distance and an LED based illumination system, all assembled into a compact module. These modules are quite inexpensive and are produced in very high quantities for the flatbed consumer scanner market. The diagram to the right shows a cross section of a typical sensor found in wide format scanners. The lower diagram shows the same CIS module from the scanning side. The module consists of many individual CCD chips of 200-300 pixels each, which are butted side to side to form a long CCD line of typically 210mm (suitable for A4).

Single Light CIS Module (CNL)



The light on these consumer level CIS modules is emitted through a light rod which carries a three color LED on each end. The light rod has cavities in varying distance, which are responsible for emitting the light, to ensure a somewhat even distribution over the length of the module.

Single side RGB LED lights CIS (f.e. CNL)



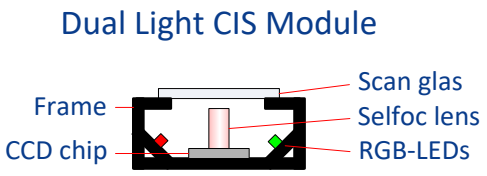
The LEDs are pulsed in a way that three exposures are made under the illumination of each color. These will be compiled into a single line of RGB pixels afterwards. Details about the design of a CIS sensor can be found on the Internet.

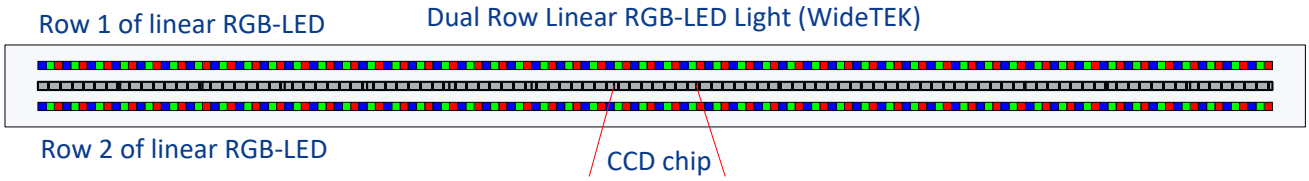
LED illumination typically has no warm up time but introduces some color artifacts because LED illumination systems typically consist of a red, a green and a blue LED that are each switched on for the duration of 1/3 of a scan line. This produces colored edges on black and white originals because each color image is taken from a slightly different position. Image Access uses advanced bilinear interpolation to reduce this effect and make it virtually invisible.

Most consumer level CIS modules have an LED illumination only on one side across the width, which amplifies all wrinkles and other surface distortions and produces good images only if the document surface is very even. This amplification effect can be reduced to a certain degree if a diffusor is used. The marketing department of a well-known wide format scanner vendor calls this "dual diffusion" hiding the fact, that their modules only have "single side illumination"

CIS Based Scanners (Professional Quality)

To overcome the problems with consumer level CIS modules, Image Access developed a new CIS module which has two rows of red, green and blue LEDs across the width of the module. The diagram to the right shows a cross-section of these CIS modules. Since they are completely symmetrical, there are no shadows visible even if documents are wrinkled or otherwise uneven.





The high quality LEDs used in WideTEK scanners also overcome another deficit CIS scanners have had over CCD scanners, the smaller color gamut. Our CIS scanners come very close to our CCD scanners with respect to color fidelity and gamut.

One issue remains and is a fundamental difference between the two technologies. The depth of focus of CIS sensors is very small, usually a fraction of a millimeter. This makes it mandatory to guide the original document against the scanning glass surface, resulting in all of the issues one can easily imagine: dirt, dust and scratches all degrade the image quality and can harm the original.

Which is better?

There are many rumors about which technology is the better one and it depends on who is actually behind the rumor. This guide tries to be as unbiased as possible, therefore we will clarify a couple of rumors in a way which probably all vendors would agree to.

Rumor: CCD based scanners have to stitch documents from multiple cameras together which needs to be corrected and can produce all kind of artifacts. CIS based scanners do not experience this problem.

Truth: **Incorrect!** CCD based scanners use multiple cameras aligned side by side and the images have to be stitched together. Thermal drift, mechanical stress and other factors make it mandatory to correct the stitch from time to time using a high quality, expensive test target. Image Access CCD scanners use a patented test target printed on glass which is used to correct the stitching position every minute eliminating the various influences.

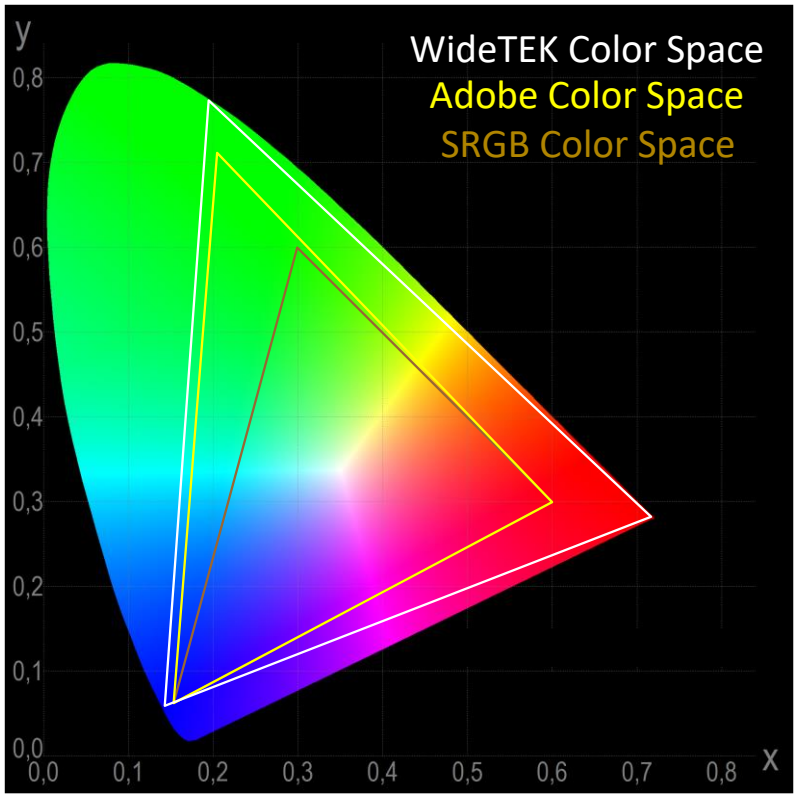
Most CIS scanners use six or more CIS modules that are staggered in the transport direction and overlap in the stitching area. They experience the stitching issue in the other direction (the transport direction) compared to CCD based scanners. Since the CIS modules all consist of many hundred individual sensor chips which are butted side by side, they also have a fixed stitching pattern which results from the last pixel being smaller at the edges of an individual chip. And this does not change even if a vendor claims to have built a single line CIS module.

All wide format scanners use multiple CCDs or CIS modules and stitching is inherent. What really counts is the ease and precision of the correction process.

Rumor: CCD based scanners have a lot wider gamut than CIS scanners.

Truth: **Correct with most vendors!** CCD based scanners use cameras with **light filters** for red, green and blue. CIS scanners use red, green and blue **LEDs** for illumination. The quality of the color filters is better than the quality of the LED light and therefore the gamut is wider with CCD scanners.

Truth: **Incorrect with WideTEK CIS scanners!** WideTEK CIS scanners like the WT24F, WT36CL, WT48CL and the WT60CL use very high quality RGB LEDs across the full length of the CIS module and on both sides. The resulting color gamut is very close to the one typically found in CCD based scanners.



This diagram shows a typical WideTEK scanner color space, an Adobe RGB color space and a sRGB color space. The sRGB color space is the most widely used one in today´s IT world although the wider Adobe RGB space becomes more popular with the availability of wide gamut TFT screens.

Each color space is defined via three coordinates in the color space, therefore if forms a triangle.

Monitors, scanners and printers are not ideal in the real world and it is very likely that the reader of this document has a monitor with an sRGB or wide gamut Adobe RGB color space. If so all colors outside the corresponding triangle do not appear any different than inside the triangle.

The triangle defines the color space, it defines all colors which can be reproduced. Colors with a chromatic value (x/y) which is located outside of the triangle are matched to a color inside the triangle.

If quality is of utmost importance, a CCD based scanner is a better choice with most vendors. If you purchase a WideTEK scanner, the color gamut is almost the same.

Rumor: CCD based scanners have a lot higher focal depth than CIS scanners.

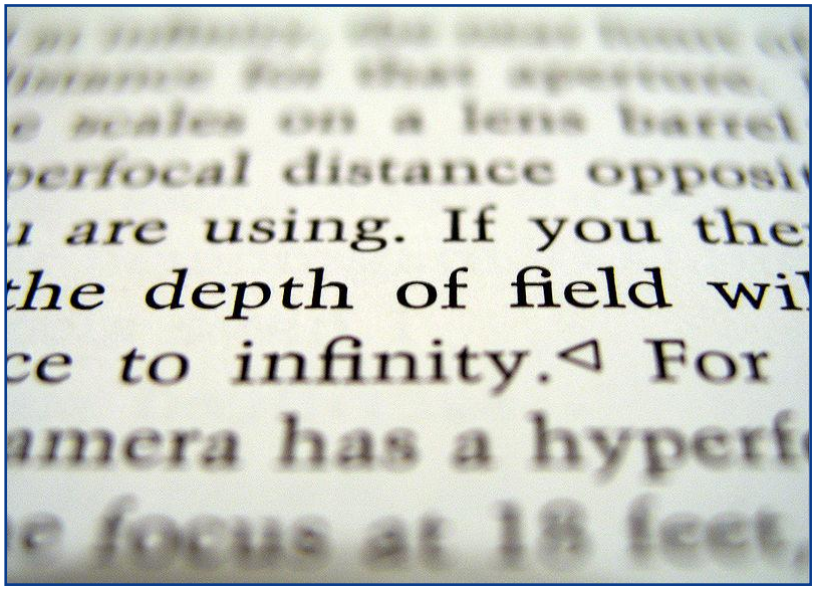
Truth: **Correct!** The difference is a factor of 10 or more. The focal depth of a CIS scanner is not more than 0.2mm, which equals the thickness of two sheets of normal copier paper. This means that the document has to be pressed against the glass flat significantly, limiting the variety of media which can be reliably fed through a CIS scanner.

If you need to run newspaper, blueprints, drawings with stiff edges, cardboard quality documents or even Mylars through your scanner, buy a CCD model.

Scanner Resolution

But what is resolution and how much resolution do I need?

This is one of the most confusing topics in the wide format scanner market and the following chapter intends to explain the unbiased truth from a technical approach.



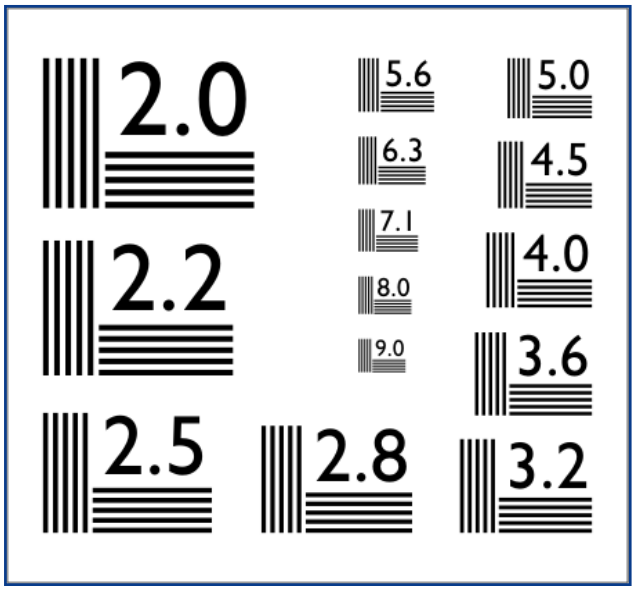
Most confusing is the fact that the term "resolution" in the digital world does not describe the system resolution anymore but rather the geometric resolution of the optical elements, typically the CCD elements. The picture to the left has the same geometric resolution of 300dpi at the top and bottom as well as in the middle.

Clearly the capability to "resolve details" is good in the middle but bad above and below the focal plane.

A widely accepted way of determining the real system resolution is using resolution test charts of various kinds. One of the most popular and easy to use is the one shown below. This line pair test target is found to be a part on many other test targets like the CSTT test target from Image Access or the UTT (Universal Test Target) www.universaltesttarget.com

The target consists of various patches of five black lines separated by four white lines in various sizes. The number 2.0 for example, means that there are two line pairs (two black ones and two white ones) per mm.

To determine the overall system resolution, you should try to count the number of black lines in the various patches. Take the number of the patch at which you can still count five black lines. Multiply this number by 70 and you have computed the system resolution.



Example: On a WideTEK 36, you can typically read five lines at the patch with the number 8,0. Multiplied by 70 the system resolution of this 600dpi scanner is 560dpi which is very close to the achievable maximum.

The next question is, how much resolution do I really need for my jobs?

The following table shows the necessary resolution for various types of materials. If the scan has to be stored in black & white, a higher resolution is necessary to achieve good results.

Material	Color	Black & White
Quality control of printing processes	600 - 1200dpi	-
High resolution GIS maps	400 - 600dpi	600dpi
High quality prints and posters	300 - 600dpi	400 - 600dpi
Printed maps	300 - 400dpi	400 - 600dpi
Engineering drawings from CAD	300 - 400dpi	400 - 600dpi
Engineering drawings, hand drawn	200 - 300dpi	300 - 400dpi
Blueprints	200 - 300dpi	300 - 400dpi
Color and black and white photos	150 - 300dpi	-
Newspapers	150 – 200dpi	200 – 300dpi

600dpi resolution is enough for a wide format scanner for almost every application.

More important is whether the real system resolution is close to the resolution in the data sheet of the product you are considering. There are very few cases where 1200dpi resolution is justified but you should be aware of the enormous file size and the very low speed associated with this resolution.

Interpolated Resolution

Interpolation means that the values of pixel positions not visible to the scanner are interpolated from the values of their neighbors. If the real resolution is 600dpi and the interpolated resolution is 1200dpi then 3 out of 4 pixels are interpolated (computed) and only one out of four is a real pixel.

While this may still be justified, it becomes complete nonsense at 9600dpi. At this level you will have one real pixel neighboring 255 computed pixels. If a scanner vendor tries to sell you on 9600dpi, ask him to scan a 21x or a 42x microfilm on his wide format scanner and wait for the excuses for not being able to read anything.

Color or Black & White

Black & white scanners are less expensive than color scanners therefore you might be tempted to save the extra money necessary to buy a color scanner. But can you be sure not to have to do a color job in the future? These days, copy jobs are still mostly black & white because color printers are more expensive and significantly slower, but can you afford to tell the customer that you can deliver only black & white PDFs? If so, you will not find a product from Image Access since we only produce full color scanners. Our CCD scanners always scan in full color and convert the image to grayscale or black & white afterwards, using the correct photometric parameters to achieve a perfect result. Our CIS scanners use photometrically balanced red, green and blue LEDs to achieve the best results possible.

Gray scale image quality from a color scanner is better than from a monochrome unit.

Bits, Density and Noise

Probably the greatest misconception about scanner technology is the one about bit depth per color, also called color resolution. The first thing to remember is that bit depth and dynamic range are NOT the same thing. They are going to sound much the same, but they are not. This difference will be explained in the following chapter. Most scanners have at least 30 bits color depth now, and many have 36, 42 or 48 bits. More bits are required to hold numeric values containing better dynamic range. While the two factors are often associated, there is also a second requirement. High-quality, low-noise CCD and electronics (i.e., expensive) are needed for better dynamic range. The fact that a scanner claims to have 48 bits of color depth has nothing to do with its real optical density. It only means that 16 bit A/D converters are used.

The following table shows the theoretical maximum density for various bit depths. If these values are found in a scanner specification sheet, it is safe to disregard them completely because they only specify the size of the container, not the content.

Total Bits	Binary steps	Max Density (no noise)	Max Density (1bit noise)
30	1024	3.0	2.7
36	4096	3.6	3.3
42	16384	4.2	3.9
48	65536	4.8	4.5

Real world density ranges are a lot lower than expected. The following table lists density ranges for various materials:

Material	Max Density	Bits
Newspaper print	< 1.8	24
Reflective photographic paper	2.0	24
Best print on paper	2.6	24
Best film transparencies	3.2	32

The message is clear: 36 bits of resolution can hold all numerical values necessary to represent the density range found with the best film transparencies. A bigger container, 42 or 48 bits, is a waste, especially because handling more data slows down every system. Some systems may use more than 36bit resolution to allow brightness and gamma correction in software in a later processing step but this does not mean that the density will also increase.

Far more important than the color depth is the noise level of the system. Modern wide format scanners have line cameras with large pixels up to 10*10µm, which can collect many photons before they saturate. More photons mean less noise. The old saying "bigger is better" fully applies to CCD elements.

36bit color resolution is more than enough for a wide format scanner.

Anything above 36bit color resolution might look attractive in a brochure but is useless and slows down the scanner. More important are the illumination level and the pixel size.

Light Source

There is a fundamental difference between CIS based scanners and CCD based scanners with respect to the light source. Because of this difference, they are addressed in two chapters.

CIS Scanners

A CIS scanner has three independent light sources formed out of two or more red, green and blue LEDs. These LEDs are pulsed in a way that three exposures are made under the illumination of each color. These will be composed to a single line of RGB pixels afterwards. Details about the design of a CIS sensor can be found on the Internet.

The simple and cheap CIS modules used in $200 desktop scanners have only two LEDs per color on the ends of a light guide made of plastic. This light guide distributes the light across the scanning element and illuminates the document at an angle of 45°. This is sufficient if the document is not wrinkled and lies perfectly flat on the glass plate. But a light source from only one side not only illuminates the surface but also produces shadows if the surface is not perfectly even.

With these kind of CIS modules, if you have to scan documents that are not in perfect shape, you will see every wrinkle or other surface distortion such as shadows or fine lines in the scan. The CIS modules developed by Image Access not only cover a larger span than other vendors (12"), but they also have RGB-LEDs feeding two light guides. The surface of the document is illuminated very evenly and wrinkles and other distortions are invisible.

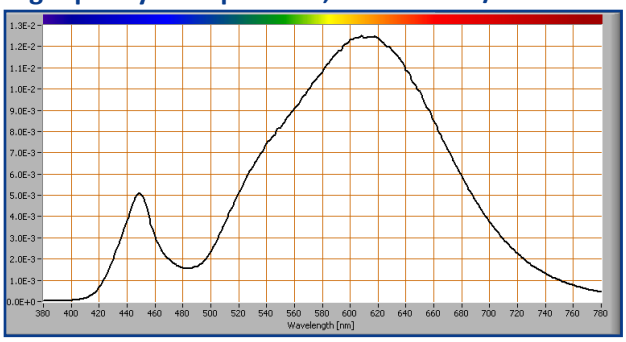
CCD Scanners

CCD scanners work differently. They have CCD sensors capturing red, green and blue lines one after the other from a document illuminated with white light. The quality of the white light determines the quality of the scan. Before white LEDs became available as a light source, wide format scanner vendors used fluorescent lamps for this purpose. The disadvantages of fluorescent lamps are many and because of these disadvantages, nearly no scanner vendor uses them anymore.

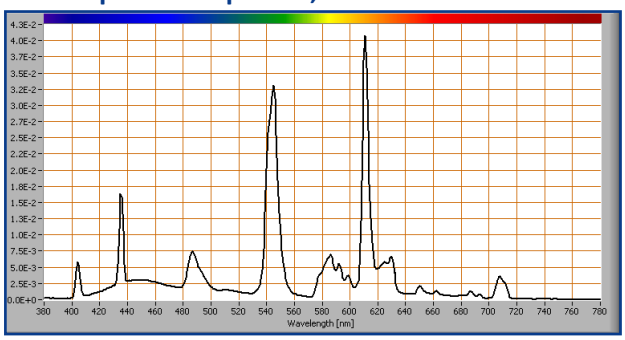
One major difference is the color quality. The best tri-band fluorescent lamps with a CRI > 95 are optimized for the highest lumen output and not for the response curve of the CCD elements. These tubes are emitting peaks in the green, red and blue area of the spectrum trying to get the most lumens per watt.

The spectral response curve of a high quality LED is much more uniform and does not leave out as many mixed colors as the fluorescent lamps do.

High quality LED spectrum, WideTEK 36/48



Fluorescent lamp of a competitor, CRI > 95



There are more factors to consider. Power consumption and warm up times contribute significantly to the power consumption. Although the difference during scanning is already at more than 3:7 due to wattage, the real picture unfolds during idle time. Scanners with fluorescent lamps leave their lamps on as long as power is on, wasting energy at a rate of 90% and more of the daily usage.

The following table summarizes the main differences.

Property	LED	Fluorescent
Useful lifetime	50,000h	5,000h
Energy consumption	10W	70W
Dual side illumination	yes	no
Warm up time	< 0.1 second	> 30 minutes
Included in warranty	yes	never

High quality LED light is the future. Do not invest in power hungry, short lived tubes.

Connectivity

Would you expect to find a USB 3.0 port on a high speed laser printer or a wide format printer you just bought for $5,000?

Almost everyone would expect to find a TCP/IP network connection running at least at 1GB/s. Modern, state-of-the-art printers communicate via standard networks, they receive print data and commands and can even send mails to notify an administrator of a problem.

Why do we still find expensive wide format scanners on the market that have to interface to an external PC via an USB 3.0 port, with its limited cable length and missing routing capability?

Maybe the sales rep of one of these vendors can explain this to you, we cannot.

The following table lists the properties of various connection standards found in the wide format scanner industry. Because network scanners send compressed data over the network and not raw data as USB scanners do, their effective speed is appr. 5-10 times higher than USB based devices.

Connection Standard	Typical data rate	Max. cable length	Routing
1000BASE-T, Gigabit Ethernet	1.500 MB/s	100m	yes
USB 3.0	300 MB/s	2m	no
USB 3.0 with xDTR	300 MB/s	2m	no

Buy a network scanner, do not invest in scanners with consumer level USB 3.0 connections.

The Gigabit Ethernet based Scan2Net® platform is the technological foundation of all WideTEK® and Bookeye® scanners from Image Access. It replaces the proprietary scanner drivers and software that traditional scanners require with the fastest common, nonproprietary inter-device connection available: TCP/IP over Ethernet. With network interface speeds much higher than USB, Scan2Net® devices are able to reach unrivaled performance at very low connectivity cost.

What else do I have to purchase in order to start scanning?

One of the most obvious options is a floorstand. Most scanners can be purchased without it, therefore be sure that price comparisons are made correctly - with or without the floor stand. If you buy a WideTEK® scanner, you are ready to go. Unpack the scanner, power it up, assign an IP address and scan. WideTEK® scanners have a built in PC running a real time Linux based operating system, dedicated to scanner specific imaging and mechanical control tasks, maximizing scanning speeds and performance. Since all Scan2Net® scanners are real network scanners with TCP/IP protocol and a web server build in, they can be seamlessly operated via any browser, mobile devices like iPads and Androids or even mobile phones.

Your scanner still runs on a USB port?

You need to connect to a PC, another $2,000 investment including screen and software. The brochures of these vendors do not explicitly tell you this and the sales rep will tell you that you can use the necessary PC for other purposes than scanning and therefore it´s cost should not be part of the scanner budget but this approach ignores reality. Once a PC is connected to the scanner, it will most likely not be used for much more than operating the scanner. The PC has to be managed, updated and the OS (Windows 7, 8, 9, 10) will probably change a couple of times over the PC's lifetime.

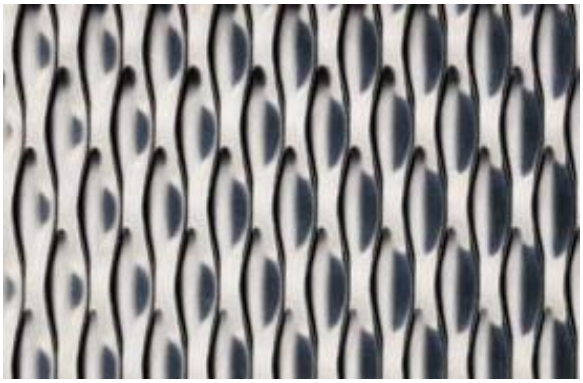
Quality and Reliability

A production scanner must be built to last, which is obvious to everyone. But can you expect similar durability from a scanner which is used for only a couple of scans per day?

A major factor is the design of the paper path. The worst design with respect to durability uses plastic parts. They wear down visibly after a couple of hundred scans. Highly abrasive documents like old blueprints and sepias speed up this process even more.

Other scanners use coated metal in the paper path. If the metal has a flat surface, a lot of friction can exist if the air between the document and the metal guide is gone. The document sticks to the surface, skew and paper jam are the result. If the metal surface also has imprints such as for the various paper sizes, you can expect that some of them will no longer be readable after a certain amount of time.

A textured stainless steel surface with no paint, imprints, etc. is the best solution. It is very long lasting, easy to clean and does not place any stress on the scanned documents. The stainless steel surface does not accumulate static electricity either, because is it conductive.
The surface is not flat but textured in such a way that thousands of air pockets form during transport. These air pockets avoid having documents with a smooth surface stick to the scanning bed or to the transport area, which greatly reduces the risk of skew, slip and paper jams.



Paper path	Durability	Friction	Conductivity	Cleaning
Textured stainless steel	**very good**	**very low**	**very good**	**very easy**
Coated / painted flat steel	limited	medium	poor	difficult
Anodized aluminum	good	medium	no	easy
Plastic	poor	high	no	very difficult

Select a scanner with a paper path made of stainless steel for reliability and durability.

All WideTEK® scanners have a paper path made only of textured stainless steel, glass and anodized aluminum, including in the CIS based scanners WideTEK® 36CL and WideTEK® 48CL.

Total Cost of Ownership

What are the real costs to purchase and operate my scanner over a couple of years?

This question is probably one of the most important ones for the customer. Vendors have the tendency not to want to talk about this in detail. Use this simple check list to identify hidden costs.

Scanner	Floor-stand	PC included	Software included	Extended Warranty	Incl. glass, rollers
Any WideTEK® scanner	optional	yes	yes	optional	optional
WideTEK® scanner bundle	**included**	**yes**	**yes**	**included**	**yes**
Scanner X					

If you are ready to purchase a scanner and are looking around at what various vendors have to offer, don´t be fooled by what may seem to be a remarkably low price tag. Often vendors quote you only the bottom line price of the scanner itself but leave out the additional costs of hardware PCs, floorstands, paper baskets, software and accessories which are required to operate the scanner properly. Costs accrued later in the life of a scanner for consumables and spare parts are almost never a part of the sales discussion. All of these costs together make up the Total Cost of Ownership (TCO) of a scanner and should be considered before making a purchasing decision.

In order to lower the total cost of ownership of an Image Access scanner, we offer an all-encompassing Extended Warranty Program for the first years of a scanner´s life and up to five years. The Extended Warranty Program guarantees all parts free of charge. This offer applies to any WideTEK® or Bookeye® scanner if used at a rate of up to 10,000 scans per month. Image Access´ new Extended Warranty Program ensures a protected investment at no additional cost. You can read more about the Extended Warranty Program here.

Competitors have similar warranty programs and offerings but they all exclude glass plates, lamps, transport and pressure rollers or other consumables. This means that the total cost of ownership for the scanner over its lifetime is considerably higher than the purchase price, when taking the cost of all spare parts into consideration. What might look like a low initial price tag can be deceiving. Replacement parts and consumables increase the total cost of ownership significantly.

Before you buy, evaluate the Total Cost of Ownership and check warranty programs.

Wide Format Scanner Technology Comparison

Property	CCD (WideTEK)	CIS (WideTEK)	CIS (Other)
Speed	Very high	High	Low
Focal depth	3 - 5mm	0,3mm	0,1mm
Dual side illumination	Yes	Yes	No
Color gamut	Very wide	Wide	Narrow
Stitching	2D required	1D required	1D required
Plain paper with folds	Folds not visible	Folds not visible	Folds visible
Newspaper scans	Easy	Reasonable	Very difficult
Wrinkled or torn documents	Reasonable	Very difficult	Not possible
Lamp lifetime (typ.)	50.000h	50.000h	20.000h
Price	High	Low	Lowest
Included in warranty	Yes	Yes	No

Conclusion

There is not one single scanner, one single vendor or one single technology that fits all your needs. If you have read this guide carefully, you will have enough arguments and knowledge to talk to any sales representative with confidence. It is our goal to enable you to make educated decisions and we appreciate the time you took to understand the fundamentals of wide format scanning, even if you decide not to buy a product from Image Access.

Thank You!