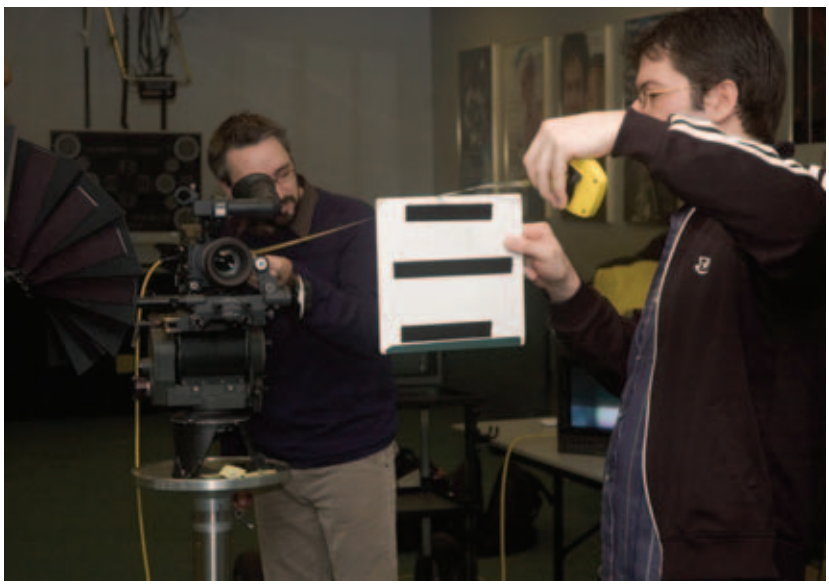
EVERYTHING IS ILLUMINATED

EXPERIMENTS WITH THE JVC HZ-CA13U PL-MOUNT CINE LENS ADAPTER

We have witnessed a revolution in digital cinematography over the past few years. Features once reserved for $100,000+ professional digital cameras have found their way into camcorders priced under $10,000. Most of the tools required for the long-sought-after "film look" (24p, HD recording, cine gamma and knee control) are now finally in the hands of the low-budget filmmaker. Unfortunately, as the overall size and price tag of digital camcorders shrinks, so does the physical CCD size. A typical HDV camcorder might contain three 1/3-inch CCDs with an imaging area roughly just 6mm diagonal. The side effect of a smaller chip size with available lenses is an almost uncontrollably deep depth of field (DoF.) This "feature" of very small CCD camcorders excludes them from being serious contenders for feature film or dramatic television work.



Adjusting the backfocus

With the lenses and apertures that are available, the best option for controlling DoF seems to be a cine lens adapter.

From the home-built versions that sell for a few hundred dollars to the very professionally engineered P+S Technik Mini35, these adapters all utilize the exact same concept. An image is projected by a cine lens or SLR photo lens onto a focusing screen or ground glass equivalent in size to 35mm or 16mm. The projected image is then "re-photographed" with a relay lens connected to the 1/3-inch CCD camera.

These adapters are increasing in popularity with budget-minded filmmakers and music video cinematographers.

There are a few things to consider when using a typical cine lens adapter. First of all, the ground glass/focus screens utilized in most systems have a light loss averaging at least two stops. This means more light or faster lenses will always be required for interior scenes. Secondly, the grain is usually visible in the ground glass/focus screen; therefore, most adapters employ a rotating or oscillating system to scatter the grain pattern, requiring battery power and sometimes creating audible noise.

Finally, the majority of the cine lens adapters on the market require the use of the camcorder's lens in macro mode to relay the image to the CCDs. Some systems, like the Mini35, have their own proprietary relay lens. Either way, this usually means very long lens assemblies.

PURE OPTICAL SOLUTION The ground glass/focusing screen seems to be the common weak link in these systems. So what would happen if it were taken out of the optical path?

STATS

FEATURES:
The JVC HZ-CA13U optional PL-mount lens adapter for the 1/3-inch bayonet mount of the company's ProHD line of HDV camcorders will be available at NAB this month. The adapter enables the use of 16mm film prime lenses with a PL mount and retains the angle of view and depth of field characteristics of 16mm film. Loss of transmittance is less than half a stop.

MSRP: $4,395

WEB SITE: http://pro.jvc.com

The engineers at JVC have answered that question with the development and release of the HZ-CA13U PL-mount cine lens adapter, which is designed to attach directly to the 1/3-inch bayonet mount on the JVC ProHD line of HDV camcorders. It is not dissimilar in design to the Angenieux/Zeiss CLA 35 HD cine lens adapter. This new cine lens adapter has no ground glass/focusing screen. Cine lenses attached to the industry-standard PL mount focus an aerial image on a "virtual focal plane" at the standard 52mm flange distance, maintaining the angle of view and CoC/DoF characteristics of 16mm film. Eleven optical elements in the adapter then reduce the size of the aerial image to that of the 1/3-inch CCD.

The lack of a ground glass/focus screen means that almost all of the light captured by the cine lens is transmitted to the CCDs. (I'm told that the actual loss in transmittance is less than half a stop.) This is a huge advantage over the ground glass-based competition for shooting in low light. There is no added grain to worry about and no extra power required.

I first crossed paths with this lens adapter at NAB '06. At that time, the product was still in development. I honestly must say that I didn't have very high expectations at that time, mostly because I didn't understand how the concept could possibly work. Skip ahead to Sundance 2007, where JVC had the prototype finished and on display at HD House. I informally tested the prototype on Main Street in Park City. The only PL lens focal length available was 16mm, but the quick results impressed me so much that I volunteered to do a full array of tests on the device.

JVC also loaned me a GY-HD250 for the test. The GY-HD200 and GY-HD250 cameras have a built-in "image flip" option that allows upright image orientation recording required by most lens adapters. As soon as I had the camera and adapter in my hands, I contacted Clairmont Camera and arranged a test of their lenses with their Samuelson depth of field charts. With the help of my friend and fellow cinematographer Brad Smith, I spent two days testing every prime lens I could get my hands on. Cooke S4s, Zeiss Ultra Primes and "Super Speeds," even Clairmont anamorphics—we tested them all.

FIELD OF VIEW/ANGLE OF VIEW We found that the HZ-CA13U has an equivalent angle of view of standard 16mm. The fact that JVC chose a 16mm frame size aerial image will come as a surprise to most because the trend tends to be 35mm for all of the other cine lens adapters. I was disappointed

85mm Zeiss Ultra Prime mounted on the JVC HZ-CA13U and HD250

when I first read the spec; however, I now realize that this is a calculated move on JVC's part. There is an abundance of standard PL 16mm lenses available around the world. From film schools to rental houses, it won't be hard to find a half-decent set of 16mm-format primes somewhere in your part of the world. Of course, any PL prime or accessory (35mm or 16mm format) will work with the adapter.

SHARPNESS AND VIGNETTING I tested sharpness on every available focal length from 9.5mm to 85mm, in both 16mm and 35mm format lenses. All of the primes in the 12mm to 85mm range showed exceptional edge-to-edge sharpness, at least as good as the Fujinon 13x3.5 video zoom I used as the benchmark. The 9.5mm Zeiss showed a slight loss of sharpness in the corners, but nothing out of the ordinary. There was hardly any visible vignetting on any of the lenses we tested.

CHROMATIC ABERRATION AND WHITE SHADING CA (chromatic aberration) is a big problem with 1/3-inch 3-CCD HD cameras. Absolute precision is required in the optics to avoid CA. JVC ProHD owners who use the "stock" 16x lens know all too well about the green/magenta fringing common with "entry-level" lenses.

I expected to see some CA fringing, and I was surprised at how little actually showed up considering these lenses were never designed for use on a 3-CCD system. The Cooke S4 lenses fared the best, with the Zeiss Ultra Primes coming in a close second. The Zeiss Super Speeds (35mm and 16mm format) and Zeiss t/2.1 lenses all performed almost as well. The wider lenses presented more CA near the edges, but all of the longer focal lengths (16mm-85mm) performed quite well.

White shading (green/magenta cast at top/bottom of image) is now very easy to calibrate with the custom white balance menu in the HD200 or HD250. Each lens series did require a slightly different white shading adjustment, but they were consistent. The Cooke S4 lenses consistently had the "truest" color cast.

DEPTH OF FIELD CHARACTERISTICS We spent the most time testing depth of field of every focal length and aperture. Depth of field is a subjective concept of what portions of an image are considered to be acceptably "sharp." My primary goal was to determine if I could still use the data in the DoF charts in the *American Cinematographer Manual* with the HZ-CA13U.

THE TESTS

We tested angle of view, transmittance, sharpness, chromatic aberration and depth of field characteristics of primes on the adapter and compared the results to a standard 1/3-inch video zoom lens and a Super 16 ARRI SR3.

The Samuelson DoF charts rendered enough data for me to determine that the CoC (0.0015mm) and DoF characteristics of the aerial image seem to be equivalent to 16mm format. We also rolled film on the SR3 using the exact same lenses for comparison.

I then spent an afternoon comparing the frame grabs to my DoF charts and confirmed the promised capabilities of the adapter.

WHAT IF I WANT AN EVEN SHORTER DOF? As an added bonus, we also tried some Clairmont anamorphic lenses. The depth of field characteristics are the same with any given focal length of a spherical or anamorphic lens. However, since the anamorphics have such a wide horizontal angle of view, longer focal lengths can be used, which results in a shorter depth of field at the same horizontal angle of view. Since most HD cameras capture a 1.78:1 (16:9) frame, an anamorphic yields an equivalent of a super-wide 3.15:1 ratio. Left/right cropping would be necessary to bring it back down to a 2.35:1 ratio.

COMPARISON WITH 1/3-INCH VIDEO ZOOM After my initial tests, I borrowed a set of t/2.1 Zeiss lenses (35mm format) from Clairmont and spent a few days conducting practical tests. The first was to demonstrate the differences between a typical 1/3-inch video zoom and a PL prime mounted to the HZ-CA13U.

I used my custom-built 3D rig to shoot some side-by-side tests. As demonstrated in the photo, the length of the HZ-CA13U with a Zeiss prime is the same as the standard Fujinon 16x5.5 zoom lens!

I found there to be a considerable difference in DoF between 1/3-inch and 16mm.

I tested a 9.5mm, 12mm, 16mm, 24mm, 32mm and 50mm in this configuration.

FEATURES: BACKFOCUS

The first challenge we faced was properly backfocusing the HZ-CA13U. Backfocusing (relay focusing) is important with lens adapters, but the traditional designs allow for the relay to be focused on the grain of the ground glass. Since the HZ-CA13U has no ground glass, we had to develop a better plan. Our first instinct was to pop in and then use a 10-100mm Zeiss zoom lens on the adapter and and then use a traditional backfocusing technique with a Siemens Star.

This worked fine, but who wants to rent and bring a zoom lens on every shoot just to set the backfocus?

We tried a few different techniques and eventually decided that using a long prime (50mm or 85mm), setting focus on the lens barrel to an exact distance (say 15 or 30 feet) and then backfocusing on the Siemens Star at that distance seemed to work well. The only caveats are that you must have an HD monitor on set and you must ensure that your lens' flange depth is set correctly in prep. Clairmont maintains its lenses to a very high standard, but beware if you are brushing the dust from some old lenses at your film school.

The camera mount and adapter will both be sensitive to temperature changes, so it will be important to maintain a reliable backfocus regimen when changing locations and let the camera warm up before setting backfocus.

The HZ-CA13U appears to be very well built. It has just two moving parts: a PL-mount lock and the backfocus knob. The prototype didn't have a focal plane marking, but JVC has assured me that the production models will have markings scribed into the barrel. It didn't have a hook for the measuring tape, either, but I set a lens rod support at the focal plane to hook on to.

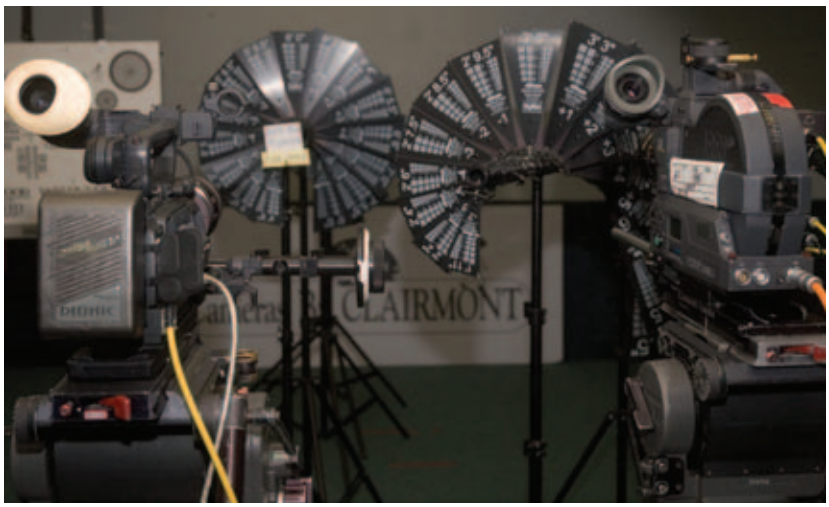
The backfocus adjustment on the prototype seemed to be very sensitive to small changes. JVC tells me that it will be "geared down" in the production model.

The length from mount to mount is just under 5.5 in., and the adapter weighs less than 2 lb. However, I recommend using a lens support for the adapter to avoid putting too much stress on the camera's bayonet mount.

THE REAL WORLD The last phase of my test was to actually shoot something as I would with Super 16. My friend Nathan Fleet volunteered to be my subject. He's a musician, so I decided to shoot a simple performance video for him. On my way to the shoot, I stopped at my dealer to pick up some tape stock and ran into Richard Comely, the inventor of the Comely DV Crane. He carries a DV crane in his trunk at all times, and he quickly volunteered to tag along for a couple of hours.

We mounted the camera rig to the DV Crane and set up the first shot with the 9.5mm lens. I didn't have a means to power the HD monitor at the location, so I attempted to backfocus with just the viewfinder. The method described early on seemed to work, except for the wide shot with the 9.5mm. It looked sharp in the viewfinder but was a little soft when I checked the dailies. Next time I'll be sure to bring along the HD monitor!

I used the DV Crane for about four setups and then switched to handheld. I tried a bunch of different focal lengths, but I'd have to say that my favorite is the 16mm. It has a nice short DoF at 3 or 4 feet, t/2.8, but is still wide enough to shoot a nice medium shot.



Depth of field chart comparison

We shot for a total of three hours with just a two-person crew and an iPod for playback. The system performed well, especially considering it was -17°C (1°F) with the wind chill, which is about 17°C below the suggested operating temperature of the HD250!

PRACTICAL APPLICATION I shot all of the material in 720/60p for a 60fps over-cranked effect. Nathan had sped up his song 250 percent for playback, and everything held perfect sync when the footage was played back at 24p.

I conducted a lot of rack focusing with the Zeiss lenses and, as expected, there was practically no breathing at all.

After watching some of the dailies, something occurred to me: I had just shot a music video in three hours, in HD, with cine lenses, no film stock, and only one Mini DV tape! The 56 minutes of tape I shot at 60p turned into 145 minutes when slowed to 24p.

I started crunching the numbers and realized that if I had shot the same amount of footage on Super 16, I would have required more than 5,000 feet of stock (13 x 400-foot rolls).

At $190/roll, stock would have cost about $2,500, processing would have cost around $1,000, and best-light telecine transfer to HDCAM would have taken at least four hours at $500/hour plus the cost of transfer tape stock. The suggested HZ-CA13U price is $4,399. That's $1,000 less than I would have blown in one afternoon on a music video shot on Super 16. Not bad at all!

JVC GY-HD250 with HZ-CA13U mounted to a Comely DV Crane