

Start Camera Physics – Operating Reality

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In the interest of settling issues with the use of a start-camera monitor, I am providing the following data. I have made statements that are in question and I admit that I made them based on too many years of a highly-technical professional career. I will try to provide technical data that will hopefully explain the camera's true capability.

The main controversy that concerns most boaters is the term **DELAY**. The concern seems to be that the boats are traveling so fast that it is thought that the camera can't possibly capture the real-time event of a **START** that is supposed to occur when the clock strikes Midnight or "0". According to normal race-start protocols, no part of a vehicle should be past the start-line when the "0" is displayed on the clock.

Human Eye Visual Retention: Let's use this as a point of reference since everything in the picture taking action must be faster than the eye. The human eye and brain retain a visual impression for about 1/30th of a second. This ability to retain an image is known as "persistence of vision". The CD's eyes take 0.033 seconds or **33 milliseconds** to obtain a new image, 33 milliseconds is a long time in photography.

Camera Triggering: When the clock displays "0", an internal clock relay closes two contacts that cause the two wire connection at the camera remote shoot connection to go from open to zero ohms (resistance). Since electrical signals, or lack there of (resistance changes), travel at the speed of light, there is no real-time perceptible delay in camera firing (capturing the picture), **0 milliseconds**. Compared to the human eye, the camera has already captured the true image before the brain is aware that the "0" has been displayed.

Image Capture Processor: The Canon 10D used in the Brandon club start-camera has a maximum shutter speed (capture) of 1/4000th of a second. That equates to 0.00025 seconds, or **.25 milliseconds**. It seems safe to say that the CMOS chip in the camera must be fast enough to capture the image in at least that time or better. That is what keeps it from being fuzzy. Even if the shutter speed is 1/200th, the CMOS capture speed is the same. It is a finite value.

Image storage: With the image captured, realistically at T-0, the camera stores the image taken at the absolute "0" time point for the start. The storage takes approximately .33 seconds to the memory chip and camera internal display and out the VGA port to the monitor. That is approximately 24' of boat travel.

Boat Movement: Let's examine the elements of time in relation to the action of boat travel versus the Competition Director's visual observation.

@ 50mph X 5280'/mile = 264,000 Feet / Hr - **Distance**

÷ (60min/hr X 60sec/min) = 3600sec or 73.3 Feet / Second - **Speed**

X .033sec (eye image capture time) = 2.4 feet

@ 50mph:

CD eye capture time equates to 2.4' (feet) of boat travel

Camera capture time equates to 0.018 (feet) of boat travel

Summary: Hence, the concern for delay time in using the monitored image to support the CD's observation has no foundation. Clearly the camera can't entirely replace the CD for race calling, but, it can back him up or cause him to reverse the call. Again, the camera takes real-time as-it-happens very accurately and consistently, and as we all know, "A picture is worth a thousand words."

The CD has several seconds to make a call of "jumped line" so the camera image is displayed on the monitor with time to spare and it is never wrong. The camera doesn't blink, wink, smile, **OR argue**.