

Topic: 1080p & High Speed HDMI  
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## Introduction

To date, the primary concern for an installer of HDMI cables has been to have them work reliably at 1080p, with little regard for anything more. However that’s no longer quite enough, with the advent of 3D and the coming of 4K video. The new HDMI cable labelling rules should add clarity, but cables which previously carried the ubiquitous and unofficial label ‘1080p’ are now commonly being labelled ‘High Speed’, as if it’s just a new term for the same thing. **IT’S NOT!** In this paper we’ll take a look at the difference.

## The 1080p legacy

One HUGE misconception in today’s market is that 1080p support and ‘High Speed’ are the same thing. For example, some reports in the media have suggested that a ‘Standard’ cable is tested at 720p/1080i, and ‘High Speed’ is tested at 1080p. This seems logical given the legacy, but it is simply **WRONG**. Regular 1080p (60Hz) produces a data rate of around 4.45Gbps, whereas High Speed HDMI permits up to a blistering 10.2Gbps. These are clearly NOT the same thing. To help put it into perspective, High Speed HDMI supports up to **425 times** the maximum potential data rate of “super fast” ADSL2+ internet, real time, with *no* buffering.

What people really want to know now is whether a 1080p capable HDMI cable will still work if, for example, we start to see 1080p-60 3D alternate frame (effectively 120Hz), namely for gaming, or even 4k video (shorthand for 4k x 2k-24p). Both of these formats would require a data rate approaching **9Gbps** – double that of current 1080p-60 video. New generation devices, or possibly even a firmware update to existing devices, could easily and quickly make hardware compatible. In reality most current HDMI cable installations over 5m or so will actually be what we now know as a Standard HDMI cable (for lack of previous official labels), being used at double its certified level; a.k.a. 1080p. They may appear to work fine at this, but are highly unlikely to support anything more.

These new high end video formats will not be for everyone, but for those new installations where potential interest exists, installing the right HDMI cable NOW will far more likely avoid grief for you in the future. But herein lies the challenge; it means installing a cable now that will support features that you can’t yet even test! Fortunately the answer is simple –High Speed HDMI.

## HDMI cable ‘speed’

Here’s a background of the HDMI cable compliance test levels;

HDMI 1.1-1.2 2003-2006	HDMI 1.3 2006-2010	HDMI 1.4 2010~
<b>2.22 Gbps</b> (720p/1080i)	<b>2.22 Gbps</b> ‘Category 1’	<b>2.22 Gbps</b> (Cat 1) ‘Standard’
-	<b>10.2 Gbps</b> ‘Category 2’	<b>10.2 Gbps</b> (Cat 2) ‘High Speed’
-	-	Either w/ Optional HEC



The HDMI 1.1-1.2 CTS (Compliance Test Specification) tested cables to one relatively low level, being for 720p/1080i broadcast HD support. By 2006, 1080p was becoming common, with recognition that it had a lot more scope for development and future scalability. At that time HDMI Licensing could have introduced a CTS at 4.45Gbps to cater for 1080p and nothing more (which we'd probably now be calling *Mid Speed*), but clearly we would have needed yet another higher level in time. Imagine **three** speed levels now? There's already enough resistance to having two!! So with this foresight, in 2006 HDMI introduced a very high level cable speed test @ 10.2Gbps, which they called 'Category 2', whilst retaining the original 2.22Gbps test, logically calling it 'Category 1'. Cat.2 allowed for more than double the data clock of regular 1080p, catering for Deep Color and other eventualities.

Interestingly, you'll also see that there's **no** change in cable speeds from HDMI 1.3 to 1.4. In fact, they're even still called Category 1 & Category 2 in the lab, just overlaid with more user friendly labels at market level. The only physical changes to the HDMI cable as part of the 1.4 specification was the addition of the *optional* HDMI Ethernet Channel (HEC), and two new connectors – "D" micro & "E" automotive – to cater for extended market applications (smart phone/portables & in-car, respectively).

Summary of compliant HDMI 'Speed' applications;

- **Standard HDMI** (Cat.1) – 1080p-24fps (2D) & broadcast HD resolutions up to 720p/1080i, including all mandated broadcast 3D formats (side-by-side, top & bottom). Non-compliant applications by individual trial only – commonly 1080p-50/60 2D & 1080p-24 3D
- **High Speed HDMI** (Cat.2) – ALL formats as defined by the HDMI specification. This includes up to 1080p-60 2D @ 16 bit/channel (48 bit) color, 1080p-24 3D @ 8 bit color, and 4k x 2k 24p video. Also potential for currently non-mandated 1080p-60 3D format. Non-compliant applications – none yet.

Here's two more little known facts;

1. **Category 2 actually tested the cable in two modes** – Passive (without sink EQ) @ 4.95Gbps, and Active (with sink/receiver EQ) @ 10.2Gbps. For simplicity, I'll only refer to 'High Speed' herein as 10.2Gbps, as the sink EQ is almost universally used these days,
2. **The HDMI cable labels 'Standard' and 'High Speed' are not new.** They were first introduced to accompany the release of HDMI 1.3 back in 2006, but only as *optional* labels to help simplify the otherwise technical jargon '1.3 Category 1' & '1.3 Category 2' respectively. Few brands employed these optional labels, instead focusing on the popular market expectation of 1080p support, only about a third of the way between Standard & High Speed data rates. As such, ignorance of the two actual cable compliance levels became more widespread, fuelling today's prevailing confusion.

### **HDMI cable labelling**

The formerly *optional* cable labels –**Standard HDMI** and **High Speed HDMI** - have been upgraded to mandatory status with the 2009 HDMI Trademark & Logo Guidelines, enforceable from November 2010. No longer will cables be able to be labelled by ANY version number to date, as this is and has NEVER been an indicator of a cable's support capability. For example, a short HDMI cable that was manufactured back in 2004 (that is, v1.1 era), if resubmitted to ATC for testing today, could well be certified "High Speed" under the very latest HDMI CTS. Contrary to popular belief, not that much has really changed.

The quoting of HDMI versions or referencing cables with many numeric 'Gbps' speeds seems to make model differentiation within a brand easy, right? Sure it does, but that doesn't mean it's actually true! The new HDMI cable labelling rules level the playing field, at least in terms of speed. From now there are just two



speeds, either with or without the new HDMI Ethernet Channel (HEC). Simple. There are even new mandated graphics to be used on packaging, so there's no hiding behind marketing ooga booga. Where a cable is properly and honestly labelled, it forces the vendor to market their differentiation based on good old fashioned quality and integrity. Cable build, engineering and materials, along with on-screen and audio performance does certainly still vary between cable examples, over and above the HDMI minimum compliance spec. However that's a topic for another White Paper.

The only thing the new labelling rules does NOT comprehensively address – nor can it, really - is to ensure that a cable that is labelled as High Speed is indeed what it claims to be. Anything other amounts to false advertising. It is, after all, very easy to simply write “High Speed” on any cable.

### **HDMI cable testing**

Michael Schaller, former Director of Compliance for HDMI Licensing, LLC, says “To better understand the importance of the CTS testing, it would help to first understand the compliance testing process. As an approved HDMI Adopter (manufacturer), you must submit your first product (source, sink, repeater, or cable) to an Approved Test Center (ATC). The purpose of submitting a test sample is to ensure that your interpretation and implementation are within the requirements of the HDMI Specification. If the product passes the requirements as stated in the CTS, the Adopter will receive an ATC Certificate as well as the passing test report. Refer [http://www.hdmi.org/manufacturer/testing\\_policies.aspx](http://www.hdmi.org/manufacturer/testing_policies.aspx)

Well, this sounds simple enough, but there is more – and this is where things can get interesting. Once the certificate and test report has been issued, the Adopter can now “self-test” all future products as long as they have: a) the required equipment, b) the technical expertise to do so.”

So, there's three common ways to test a cable;

- **HDMI Compliance Test** – Standard or High Speed - tested in official HDMI ATC and measured on several hundred thousand dollars' worth of lab equipment. Tested for pre-defined data rate eye pattern 'opening', including time & amplitude jitter tolerances and insertion losses, as well as capacitance build up across multiple pin pairs, resistance and attenuation, compliant DC voltage delivery, EDID & hot plug capability, as well as physical connector dimensions. I've taken the liberty to summarize in no particular order, just to give you an idea of the level of complexity involved! If you want more technical information, read the CTS!
- **High Speed support test** – Eye pattern or Bit Error Rate test only to determine if a cable can fundamentally pass 10.2Gbps, without consideration of all other tests performed by HDMI ATC.
- **1080p support test** – plug it in and try it @ 1080p

Which of the above is most comprehensive? Obvious, huh? I may not be popular for saying this, but I've personally visited many HDMI cable factories in Asia where an in-house “High Speed Test Lab” turns out to comprise a Sony PS3 and an LCD TV. Yup, they plug in a cable, and if it works at 1080p, it's deemed by its maker to be High Speed! I'm throwing a lifeline to some false advertisers here, a legitimate excuse for their perhaps unintentional ignorance – they may think their cables are High Speed based on their suppliers telling them so, but that doesn't always mean they actually are. There are of course also many very good HDMI Adopter manufacturers that very much know what they're doing, but as HDMI has become so highly commoditized with cables available in any supermarket or hardware store, picking good cables from bad, and compliant from non-compliant, has admittedly become harder.

Cable certificates from one of HDMI's Authorised Test Centers (ATCs) are a good place to start, but in most cases a cable vendor/brand has their cables made by a contract manufacturer which holds the HDMI



Adopter status independently. Such certificates are a Licensing and Standards level check more so than at market level. However where a certificate *is* made available, this provides unambiguous proof of compliance, In such cases take note of the tested length of the cable, as the certificate only covers up to that length, not longer.

## HDMI cable lengths

Even in the same brand and model of HDMI cable, each available length will be slightly different in performance and speed characteristic, with the longer lengths having progressively higher resistance, capacitance, skew and insertion loss (among other things), and resultantly, less speed capability. It is standard practice to make cables thicker as they get longer, to help minimize such losses, but still it rolls off very quickly due to the VERY high data rates involved. Example: take a 5m and a 7m HDMI cable in the same series, both 28AWG. Which would have higher resistance and insertion losses than the other? Of course - the 7m. But what if the 7m is upgraded to a thicker 26AWG, and the 5m left at 28AWG? Which is better then? Not sure? Just one change, one variable and suddenly there's doubt. You know that thicker would undoubtedly make the 7m better, but as to how it then compares to the 5m – who knows without a lab test?

Even with the design and manufacturing advances that have been made, some things are still simply impossible as long as the laws of physics reign true. Every cable length has a practical limit, and it drops off pretty quickly! The better the overall quality of a cable, the longer it's High Speed length capability will be. As longer invariably means thicker in a passive cable, here's a guide of some common passive cable limits per gauge (AWG), the lesser number in each range being approximate for most market examples, the higher number being for applicable more premium cables;

- 32AWG High Speed to <1.0 - 1.5m
- 30AWG High Speed to approx 2.5m - 3.5m
- 28AWG High Speed to approx 3.5m - 5.0m
- 26AWG High Speed to approx 5.0m - 6.5m
- 24AWG High Speed to approx 7.0m – 8.0m, up to 10m in rare examples

It is important to note that the HDMI specification does not define length limits for cables. These figures are broad guides only, based on my own research and observations. They are certainly not absolute. The use of some ultra-premium materials, geometry and advanced termination techniques could potentially produce slightly better results again. Conversely there will be plenty of examples of cables that perform to a measurably lesser degree, or not even compliant at all. The use of active technologies may produce a whole different set of length capabilities – the above list is for full passive examples only, a first-pass guide for you to determine if a cable that you're considering even has the initial makings of a High Speed cable.

## Conclusion

Unlike the average White Paper, I think this one may raise more questions than answers for you! However I felt the need to draw attention to the seemingly growing phenomenon of HDMI cables being called High Speed, unqualified, as a direct replacement for the old "1080p" label. I don't necessarily believe there's malicious intent by the culprits, rather many think that High Speed is just the new required term for 1080p, and "Standard", well that's just not sexy at all, is it? So, the facts;

- 1080p and High Speed are not the same thing. The latter is more than double the data rate
- **Standard HDMI** is compliant for 720p/1080i, also commonly used for entry level 1080p applications
- **High Speed HDMI** is compliant for 1080p, frame alternate 3D, and 4k x 2k video applications



...and the confusion - just because a cable claims to be High Speed, it doesn't necessarily mean that it is!

HDMI Licensing, LLC are, amongst other things, working tirelessly to promote proper, honest and transparent labelling of HDMI cables. But it is a constant battle. In time they WILL catch up with those whom are mislabelling products, but in the interim you are advised to apply some due diligence in your choice of HDMI cables. If you want to avoid being caught out later by installing a cable that (you find out the hard way) is NOT High Speed, embark on learning more NOW. HDMI's official global website has loads of installer info available at [http://www.hdmi.org/learningcenter/installer\\_training.aspx](http://www.hdmi.org/learningcenter/installer_training.aspx) (CEDIA CEU's are even applicable). Further to this, CEDIA are in 2010 putting together a "HDMI Best Practices" Committee and training course, and Quantum Data have authored a HDMI installer course, which will debut at CEDIA Expo 2010. Above all, the integrity and honesty, and your trust in your HDMI cable vendor should provide you the right result. Just ask the right questions.

