To: 3P Customers and Business Partners

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New International Cable Specification

The main international specification for solid copper communication cables has been updated. This 2nd edition IEC 61156-5 has just been published and will reflect cable requirements necessary to support the latest technical developments of data transmission. The new cable types Cat. 6_A and Cat. 7_A are included together with the well experienced and earlier specified Cat. 5e, Cat. 6 and Cat. 7. The standard also focuses on the EMC related performance parameters now having major significance for high speed cabling, and the conductor resistance and temperature characteristics necessary to support the new and more demanding power over ethernet applications.

Since last summer we had the similar cable requirements included in ANSI/TIA/EIA-568-B.2-10, but the Cat. 7 and Cat. 7A cables are not recognised by TIA/EIA. Consequently this 2nd edition IEC 61156-5 is the first standard to specify Cat. 7_A performance.

The present 3P Newsletter is intended as an introduction to the new cable specification which I believe will form the basis of most cabling requirements in the next few years. Of course this will apply together with the ANSI/TIA/EIA-568-B.2-10 (to be integrated in ANSI/TIA/EIA-568-C.2) and later published new and updated CENELEC standards.

1. General Content of 2nd Edition IEC 61156-5

Generation of the new cable specifications in both IEC, TIA/EIA and CENELEC has been made necessary from the higher bit rates being specified by IEEE. 10 Gigabit Ethernet gave birth to alien crosstalk as a major transmission parameter and at the same time signal to noise ratio (ACR) lost its earlier ultimate importance for setting the maximum bandwidth of high speed cabling. Other important developments in this period were increased application of balanced cabling in

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industrial environments and the continued increase in power supply over balanced copper cabling. These developments are reflected by the new cable standard.

2. Discussion of Individual Cable Performance Parameters

I have especially focused on the following main points in this new edition of IEC 61156-5:

A: **Cat. 7_A cables** are specified for the first time. This cable type will normally be x/FTP type (individually screened pairs/PIMF) and have a bandwidth of 1000 MHz.

B: **Alien crosstalk** is being specified for Cat. 6_A and Cat. 7_A. However, at the same time it is informed that no measurements of alien crosstalk are required **for screened cables** if the EMC performance is better than a certain limit value (i.e. coupling attenuation of 55 dB @ 100 MHz). This is normally not demanding for screened cables and alien crosstalk is therefore only an issue for very badly screened cables. (The text in this section of the standard might be misunderstood if it is not realised that alien crosstalk is always a measurement issue for unscreened cables, even if they are better than the limit value of coupling attenaution)

C: EMC related parameters are having high attention and concerns the main parameter **coupling attenuation**, which include the performance sum of balance and any screening. Furthermore, near end balance as **TCL**, far end balance as **ELTCTL** and screening performance as **transfer impedance** are also included. Both coupling attenuation and balance equally well apply for both unscreened and screened cables. This is in contrary to the ISO/IEC and probably the future ANSI/TIA/EIA-568-C.2 specification where coupling attenuation is treated as specific for screened cables and balance as specific for unscreened cables. The decision to treat unscreened and screened equally is in my opinion technically correct and will provide better technical understanding and definition of performance.

D: The standard covers a wide range of EMC performance levels. It includes three **Types** of coupling attenuation, two **Levels** of near end balance (TCL) and two **Grades** of screening performance (transfer impedance). In this way the standard can cover the full normal range of cable categories and unscreening / screening without excluding any technology. Reference to the IEC 61156-5 standard must therefore contain information about which Type, Level and Grade of cable is required as it is done in the coming amendment 2 to 2nd edition ISO/IEC 11801.

E: **Impedance** is specified in a new way compared with the first edition of the standard. Either impedance **or** return loss requirements need to be passed. Impedance requirements are defined based on a function which for instance does not give the Cat. 5e well known traditional 100 ± 15 Ω requirements. The solution is fundamentally more correct, but is also less user friendly as the programming of the automatic testers needs to be updated for impedance. The other alternative, return loss measurement, stays unchanged. However, the smoothed (mean input) impedance requirement is missing and until it is re-instated as a requirement, I strongly recommend that the requirement of 100 ± 5 Ω @ 100 MHz should be maintained as a cable requirement.

F: **Length of cable** under test is specified to be 100 m. It should be noted that this is in

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contradiction with common tradition on the market to measure drums or boxes (usually 305 m or longer). Measurement of customer drums or boxes makes good sense as cutting of 100 m lengths could mean scrapping of cable and also because measurements on cable in packaging are more easy and faster to make. However, it does affect the performance if one measures drums and boxes. You get different and often worse results for cable in drums and boxes, and one needs to know how to separate packaging and installed cable performance when evaluating results.

G: **Low frequency performance** under 4,0 MHz is generally for information only. This means that you measure the performance in the full bandwidth, but that any deviation below 4,0 MHz may be disregarded. This makes good sense. The low frequency performance is having minor significance and is critical for certain parameters, especially attenuation and return loss of x/FTP cables. Most cable requirements have grown from the nature of unscreened cables, which may be quite different from screened. As an example screened cable will have significantly better attenuation at medium and higher frequency, but to comply with the unimportant very low frequency requirements would mean unneccessarily expensive cables. More copper for higher diameter conductors would be needed to comply with the unscreened cable requirements below 4,0 MHz. It would certainly become some very expensive and unneccessary $1/10^{th}$ of dB's here. The 4,0 MHz exception rule applies for attenuation, return loss, NEXT, FEXT, propagation delay and delay skew.

H: **Resistance unbalance** is now specified both within a pair (max. 2 %) and between pairs (max. 4 % pair to pair). This has become significant as power over ethernet requires more closely specified resistance unbalance.

I: **Capacitance unbalance** is specified to max. 1600 pF/km. 3P has the experience that capacitance unbalance close to 1600 pF/km will likely cause balance failure. It is therefore strongly recommended to aim for max. 1000 pF/km.

J: **Cat. 5e attenuation** includes two sets of limits depending on how the cable is used, i.e. with TIA/EIA style cords (+20 % attenuation) or ISO/IEC & CENELEC style cords (+50 % attenuation). This reflects that the Cat. 5e cable requirements are different in the two families of standards and the IEC 61156-5 therefore includes requirements of both specifications. This is of course a complication as you may not know how cables are applied by the end user. The safe way taken by 3P is to use the worst case of the two specifications.

K: The **MICE requirements** are not included in the standard, i.e. except for EMC requirements where the coupling attenuation types correspond to E_1 (for Type 3), E_2 (for Type 2) and E_3 (for Type 1). However, you will not find MICE requirements identified or mentioned in this standard, but only in IEC 61156-5-1. I should maybe remind you that MICE is the environmental classification used to identify performance when used in more agressive mechanical (M), ingress (I), climatic (C) and EMC (E) environments.

L: The **temperature** definition is more complex in this standard. Due to power over ethernet temperature will normally mean conductor temperature as this temperature is the one decisive for attenuation performance. The temperature in the environment of the cable may be much lower than on the conductors as some internal heating will come from any power on the cable.

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A 15°C increase in conductor temperature could be expected worst-case compared with outside cable temperature.

M: **Conductor material** is specified to be solid annealed copper. I appreciate that "sophisticated" and financially attractive conductor materials like steel or copper coated aluminium are found on the market. I can not strongly enough warn against the risks of using non specified conductor materials. Cost savings could be like "pissing your pants". You save money here and now, but you have a big risk of long term connectivity failure. Before accepting such cables you should as a minimum carefully evaluate compliance of cable performance and also long term reliability of cable to connecting hardware connection.

3. Market Developments

The 2nd edition IEC 61156-5 standard does not favour any categories or technologies. It puts forward in a flexible way requirements for all horizontal cable types up till and including 1000 MHz. However, generally it reflects that performance requirements are growing, for instance by defining new parameters (alien crosstalk), higher performance level (near end balance) and higher bandwidth (Category 6_A and 7_A). In this way it paints a clear picture of where we are going.

This confirms my expectations that cable technology is continuosly and slowly moving towards screened, due to the better protection of screened cables towards external disturbances (alien crosstalk and EMC). This is both due to the higher bandwith required and installation in more noisy environments causing higher significance of disturbances. x/FTP cables will become still more popular for Cat. 6A as it will provide good performance without great difficulties of production once the technology is mastered. Cat. 7_A cables are not well known in the market, but should be a good alternative to Cat. 7 as technology is the same and performance is higher. Still the market suffers from so many variants of the x/FTP cable (Cat. 7, Cat. 7_A, Home and 1200 MHz "Cat. 8"). Parallel existence of the two optional styles of connectors also slow down, but will not stop, development of this cable technology.

Yours sincerely,
3P Third Party Testing

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