



Subject 444

October 14, 2010

TO: Subscribers to UL's Performance Verification Services for:

 Communications Cable (DUZX)
 Data Transmission Cable Verified in Accordance With National or International
 Specifications (DVBI)

SUBJECT: Revised Testing and Follow-Up Service Requirements for UL's LAN Performance Verification
 Programs

This bulletin will serve as the testing and Follow-Up Service reference document for all of UL's LAN Performance Verification Programs. It will provide Subscribers with policy information related to the following issues:

- A. Consolidation of all UL cable-related LAN Performance Verification Programs and bulletins into this reference document;
- B. The incorporation of the Industry File Review requirements related to Bi-Directional, Screening Attenuation and Coupling Attenuation Testing and consolidation of LAN Performance Verification product categories (Effective Date of January 31, 2012);
- C. The New Work Testing and Follow-Up Service requirements applicable to all of UL's LAN Performance Verification Programs, including the above Effective Date requirements;
- D. Labeling and Surface Marking Requirements and the new Holographic Labeling requirement (Effective Date of October 1, 2010).

This bulletin will be updated as needed, when new or revised requirements are introduced into UL's LAN Performance Verification Programs. This bulletin can be accessed at www.ul.com/standards

A. CONSOLIDATED REFERENCE DOCUMENT

UL presently offers LAN Performance Verification Programs to the Performance Standards shown below:

1. ANSI/TIA-568C.2, "Balanced Twisted-Pair Telecommunications Cabling and Components Standards" (otherwise known as the "UL Performance Category Program");
2. ISO/IEC 11801, "Information Technology - Generic Cabling for Customer Premises". Cables that bear the surface mark for this standard, have had the cable performance evaluated to requirements as stated in IEC

61156-5, "Multi-Core and Symmetrical Pair/Quad Cables for Digital Communications – Part 5: Symmetrical Pair Quad Cables with Transmission Characteristics up to 1,000 MHz-Horizontal Floor wiring – Sectional Specification."

3. NEMA WC 66, "Performance Standard for Category 6 and 7 100 Ohm Shielded and Unshielded Twisted Pair Cables".
4. NEMA WC63.1, "Performance Standard for Twisted Pair Premise Voice and Data Communications Cables". (For Category 3, 5 and 5E Cables)
5. BS EN 50173-1, "Information Technology – Generic Cabling Systems – Part 1: General Requirements". Cables that bear this surface mark for this standard, have had the cable performance evaluated to requirements as stated in EN 50288-1, "Multi-Element Metallic Cables Used in Analogue and Digital Communication and Control - Part 1: Generic Specification".
6. Any other Industry or Proprietary Performance Standard requested by Subscribers and within the testing capabilities of UL's Performance Verification Laboratory.

The testing and Follow-Up Service requirements for each of the above Programs are defined in Item C of this bulletin. It is the responsibility of the Subscriber to purchase and maintain subscription services for the applicable Performance Standard(s) that their product was evaluated.

Since these testing and Follow-Up Service requirements have been incorporated into this document, the following UL Bulletins are now considered obsolete and replaced by this bulletin:

Bulletin Date	Subject	UL LAN Performance Verification Service Covered by the Bulletin
July 28, 2008	Test and Follow-Up Service Requirements for the Optional Qualification of 100-Ohm Twisted-Pair Constructions of Listed Communication Cable Types for Data-Transmission Performance-Category Markings	Products that are "Listed and Verified" as well as products that are "Verified-Only" to the "UL Performance Category Program" (ANSI/TIA-568C.2)
June 9, 1999	Test and Follow-Up Service Requirements for the Optional Qualification of Data-Transmission Cables Verified in Accordance with the Performance Standard for Category 6 and 7 100-Ohm Shielded and Unshielded Twisted-Pair Cables, NEMA Standard No. WC 66-1999	Products that are "Listed and Verified" as well as products that are "Verified-Only" to the "NEMA WC 66" Program
January 6, 1997	Test and Follow-Up Service Requirements for Data-Transmission Cables VERIFIED (CLASSIFIED) ONLY to the Data-Transmission Performance Requirements in a National Specification such as Commercial Building Telecommunications Category Standard (TIA/EIA-568-A) or in an International Specification such as Information Technology – Generic Cabling for Customer Premises (ISO/IEC 11801)	Products that are "Verified-Only" to an applicable Performance Standard
October 9, 1996	Test and Follow-Up Service Requirements for Data-Transmission Cables Classified (Verified) in Accordance With Information Technology – Generic Cabling for Customer Premises ISO/IEC 11801 Specification	Products that are "Listed and Verified" as well as products that are "Verified-Only" to the "ISO/IEC11801" Program

B. INDUSTRY FILE REVIEW – JANUARY 31, 2012 EFFECTIVE DATE

The following will summarize the Testing and Follow-Up Service changes being introduced into UL's LAN Performance Verification Programs, as part of the January 31, 2012 Industry File Review. The requirements were announced in UL's Subject 444 Bulletin dated March 31, 2010. **UL's Performance Verification Laboratory is presently capable of conducting all tests associated with this Industry File Review.**

1. Screening Attenuation, Coupling Attenuation and Bi-Directional Testing requirements have been introduced, as applicable, into the Standards shown Items A1 – A5 above. These revised testing requirements prompted the need for the Industry File Review. Illustration 1 provides a summary of the new testing requirements associated with this Industry File Review, the applicable Performance Standards and Standard clauses. These requirements have also been included in Appendix A of this document since they will become permanent testing requirements for the UL Performance Category / ANSI/TIA-568C.2 Program after the January 31, 2012 Effective Date.
2. All UL LAN Verification content in our Subscribers' Communications Cable (DUZX) and / or Data Transmission Cable (DVBI) Follow-Up Service Procedures will be merged into one Follow-Up Service Procedure, under the DVBI category. This will allow for all UL Verified cable products to be under one UL category. For those Subscribers that already have a DVBI File, UL will transfer the descriptive reports for cables that are covered under the DUZX Listing and Verification Program into the DVBI File. For those Subscribers that do not have a DVBI File, a new File Number will be established for the DVBI category. UL will release updated Guide Information Pages for the DUZX and DVBI categories incorporating these changes after January 31, 2012. Draft DVBI Guide text is attached for your reference in Illustration 2.
3. Subscribers will be requested to confirm the withdrawal of LAN Verification content from their File(s) now considered obsolete by Industry (e.g. – IBM, Thomas and Betts ALL LAN, UL Performance Categories 1,2 and 4, etc.).
4. Bi-Directional Testing will be required for all performance categories described in this bulletin as part of the Manufacturer's Test Program portion of the Follow-Up Program (Item C.4.c of this bulletin). As a result, during the sample submittal phase of the Industry File Review (Phase 2), Subscribers will also need to provide an updated (written) Proprietary Test Program (PIP), which confirms their ability to conduct Bi-Directional Testing on a production-line basis, for the affected Performance Standard. Products will not be considered in compliance with the new and revised requirements under the Industry File Review until the updated PIP is reviewed and approved by UL. This will also include verification of the test capability at the factory. The UL Representative will verify compliance with this plan during their routine Follow-Up Inspection visits.
5. Category 5 cables cannot reference the ANSI/TIA-568C.2 Standard. Category 5 cables intended to bear a UL Verification Mark (label) and Verification surface markings can only be Verified under the "UL Performance Category Program". Any surface print reference to TIA/EIA-568B or ANSI/TIA-568C.2 is prohibited.

It is the responsibility of the Subscriber to familiarize themselves with the new testing requirements in these Standards.

As part of Phase 1 of the Industry File Review, all Subscribers have been contacted by UL and informed as to whether or not their products are affected or unaffected by the Industry File Review. Subscribers have the option of submitting products for qualification under existing requirements or the new requirements, which go into effect on January 31, 2012. Subscribers who choose to qualify products to current requirements must eventually submit their products for evaluation to the new requirements and complete the product evaluation process by January 31, 2012, or in order to have continued authorization to use the UL Mark.

C. NEW WORK TESTING AND FOLLOW-UP SERVICE REQUIREMENTS

1. Purpose and Scope

The purpose of UL's LAN Verification Program is to provide a third-party evaluation of data cables to categories of performance that are useful to system-design consultants, cable distributors, system users, cable manufacturers, and equipment manufacturers. The program covers determination of the performance category of cables as single components of data-transmission systems. The final acceptability of a particular cable for a specific data system needs to be determined by the system designer taking into account variables such as installation practices, cable length, connected equipment, and the operating environment. The applicable "performance category" is marked on the cable.

The number of categories and the criteria for each category are based on established and developing industry Performance Standards and are subject to revision as requirements change.

UL Listed Cables Also Verified for Performance

Listed cables, which have been investigated for use in accordance with ANSI/NFPA 70, "National Electrical Code", can also be evaluated for transmission performance to the applicable LAN Performance Verification Programs described in Items A1 – A5 above. These Listed cables are covered under the Communications Cable (DUZX) category. LAN Performance Verification is an optional service available for UL Listed Communication Cables.

A UL Listing for the cable is mandatory for participating in the "UL Performance Category Program" (Item A1 above).

Non-Listed Cables Verified for Performance

Non-Listed cables are for use where ANSI/NFPA 70, "National Electrical Code" code does not apply. They are intended for installation / use in countries other than the United States where the National Electric Code (NEC) is not applicable. These cables can be evaluated for transmission performance. These products will be covered under the Data Transmission Cable Verified in Accordance With National or International Specifications (DVBI) category.

DUZX and DVBI Guide Information Pages

After January 31, 2012, the DVBI Guide Information Page will identify both the "Listing and Verification" Service as well as the "Verification-Only" Service. In addition, the DUZX Guide Information Page will no longer reference these LAN Verification Services after January 31, 2012. Prior to this date, the Listing Information for DUZX will be revised to indicate the cables that comply with the new requirements.

2. Cable Construction

UL's LAN Performance Verification Programs apply to 100-ohm twisted pairs that are cabled and then jacketed as data cables.

UL Listed Communications Cables and non-Listed Data Transmission Cables are eligible if they consist of one of the following:

- a. A jacketed unshielded and shielded (ScTP/FTP/STP) cable assembly of one (1) or more 100-ohm twisted pairs of 24 through 22 AWG solid copper metal coated or are not metal coated.
- b. A jacketed unshielded and shielded (ScTP/FTP/STP) cable patch cable containing 24 through 26 AWG stranded copper conductors that are metal coated or are not metal coated.

- c. Patch cables containing 24 AWG stranded copper conductors that are untinned or tinned or otherwise metal-coated or are not metal-coated.
- d. HYBRID CABLES - Two or more jacketed members that are cabled together and then covered by an overall jacket.
- e. BUNDLED CABLES - Two (2) or more jacketed members bound by a binder tape or thread, or laid flat and parallel joined by an interconnecting web.

BUNDLED CONSTRUCTION A – This construction consists of two (2) or more jacketed members, laid parallel and joined by a web. Each member functions as a separate cable and is assigned a separate performance category, which may or may not be the same performance category as the other members of the cable.

BUNDLED CONSTRUCTION B – This construction consists of two (2) or more fully surface printed, finished jacketed members that are cabled together and then held with a binder tape applied helically around the cable. This bundled construction is not to contain any “Bundled Construction A” members. Each member is assigned a separate performance category, which may or may not be the same performance category as the other members of the cable.

- f. BACKBONE CABLES – Two (2) or more non-jacketed members that are cabled together and then covered by an overall jacket. Each non-jacketed member consists of four(4) or more twisted insulated conductors, 24 through 22 AWG solid copper metal coated or are not metal coated, optionally bound by a thread/tape.

3. Testing Requirements and Methods

It is the responsibility of the Subscriber to purchase and maintain subscription services for the applicable Performance Standard(s) and to assure that the cable is designed to meet the requirement of the applicable standard.

In order for a manufacturer to apply the UL Performance Verification Mark (label) and Verification surface markings, their UL cables must be qualified to the applicable Performance Standard.

- a. For products evaluated to the UL Performance Category Program (ANSI/TIA-568C.2), all testing requirements are shown in Appendix A. All testing requirements are currently in effect, except for those items annotated as ‘Effective Date January 31, 2012’.

The UL Performance Category Program (ANSI/TIA-568C.2) testing requirements for Hybrid and Bundled Cables are as follows:

HYBRID CONSTRUCTION A – Performance requirements are defined on page 9.

BUNDLED CONSTRUCTION A – Performance requirements are defined on page 9.

BUNDLED CONSTRUCTION B – Performance requirements are defined on page 9.

- b. For products evaluated to *ISO/IEC 11801*, *NEMA WC66*, *NEMA WC63.1*, and *BSEN 50173-1*, UL will test to the requirements currently specified in these Standards. All testing requirements are currently in effect, except for those items shown in *Illustration 1*, which are effective January 31, 2012. *Illustration 1* provides a summary of these Industry File Review requirements, the applicable Performance Standards and Standard clauses.

UL’s test methods are performed in accordance with the applicable Performance Standard and the American Society for Testing and Materials Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable, ASTM D 4566 (Latest Revision).

One sample length, consisting of one (1) or more UTP pairs, at least 100 meters (328 feet, 1 inch) long or 110 meters (360.89 feet) long for ScTP/FTP/STP cables of Category 3, 5, 5E, 6 and 6A cables, is to be subjected to each of the tests indicated below for the category. Additionally, for category 6A cables, another seven (7) reels of cable each containing at least 100 meters will need to be supplied in order to perform alien test measurements. Sample lengths are to be tested off-reel at room temperature for Categories 3, 5, 5E, 6 and 6A and additionally at elevated temperatures for Categories 3, 5, 5E, 6 and 6A.

At a room temperature of $20^{\circ}\text{C} \pm 3^{\circ}\text{C}$ and a relative humidity of $50 \pm 5\%$, the lengths are to be suspended in the air in long, very narrow loops without crossovers. The cable in the loops is to be at least 4 inches from any partition or other room surface. Adjacent turns of the loops are to be at least 1 inch apart.

For testing at elevated temperatures, a 100 meter sample, loosely coiled off-reel, is to be placed in a circulating-air oven at 40°C and 60°C . A portion of the cable not to exceed 2 meters in length (6 feet, 6 inches) is to be brought out of the oven and connected to the measuring apparatus.

During the New Work Investigation, the Subscriber is required to submit their internal inspection program, known as the Proprietary Inspection Program (PIP), for ensuring compliance of various parameters (for example, Near-End Crosstalk, Insertion Loss, Return Loss, and Structural Return Loss) with the specifications for each Category. The PIP shall also include an identification of the apparatus used for conducting these tests, the calibration interval of this equipment, and the internal procedures (document numbers) used by the manufacturer to conduct the individual tests. If acceptable, the manufacturer's inspection program shall be incorporated into the Follow-Up Service Procedure. Compliance with this plan will be checked by the UL Representative during Follow-Up Inspection visits.

During the New Work Investigation, each manufacturing location authorized for a given Subscriber is qualified individually, through a submittal of initial production samples selected by the UL Representative, as well as a review and approval of the manufacturer's PIP.

4. Follow-Up Program Elements

The Follow-Up Program for UL's LAN Verification Services is documented in the form of Follow-Up and Inspection Instructions (FUII) or Procedure Appendices, as applicable for each LAN Verification Program. **After January 31, 2012, one consolidated Follow-Up Program will be issued by UL covering all LAN Verification Services.**

The Follow-Up Program elements include:

- a. Unannounced factory inspection visits and verification that the product complies with construction and transmission performance requirements;
- b. Verification that the Subscriber is in compliance with their Proprietary Inspection Program (PIP) and is conducting production-line testing in accordance with requirements (Item c);
- c. A minimum production-line sampling program of one (1) reel for every twenty (20) master reels of cable produced, with the footage of the master reels not exceeding 300,000 feet.
- d. Quarterly sample selections for Follow-Up Testing at UL;
- e. Market Surveillance Program;
- f. Procedure in the event of continued nonconformance and Increased Monitoring Program.

D. LABELING AND SURFACE MARKING REQUIREMENTS (OCTOBER 1, 2010 EFFECTIVE DATE)

UL's June 1, 2010 Subscriber Bulletin (*Illustration 3*) introduces a new Holographic Labeling requirement for all of UL's LAN Performance Verification Services, effective October 1, 2010. Please refer to this bulletin for all label ordering information.

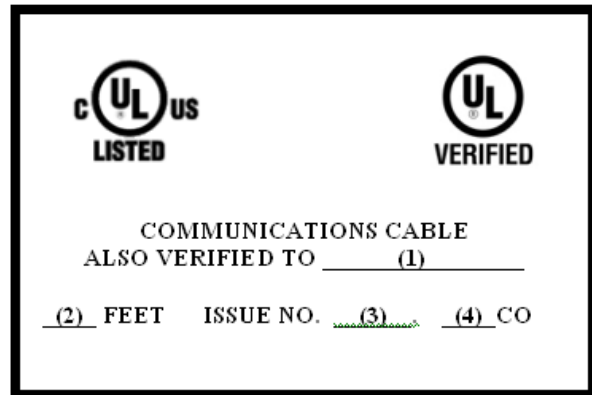
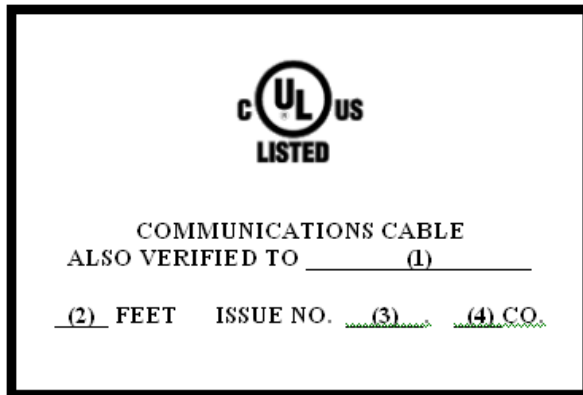
At least one label shall be furnished with each coil or reel. The footage represented by the Verification Mark (Label) shall be approximately the same as the number of feet of cable + /- 5 percent on the reel or coil. Subscribers may not use the Verification Mark until UL has authorized its use.

The specific performance category (e.g. Category 5e, 6, etc.) is not required to appear in the Verification Mark (Label) text. This applies to all LAN Performance Verification Programs. Subscribers will be required to reference the specific Performance Category in the Engineering Markings supplied with each reel (the tags, cartons, etc.). In addition, the specific Performance Category will be required to appear in the cable surface print legend.

It is acceptable to use the draft Guide Information Page for DVBI (*Illustration 2*) as a reference for the Verification Mark (Label) and surface printing requirements.

1. UL Listed Cables Also Verified for Performance – Labeling and Surface Printing

At their option, Subscribers may reference the Verification authorization in text form, as shown in the label format on the left, or also include the UL Verification Logo, as shown in the label format on the right. The Label on the left side may be purchased as a Standard Holographic Label (also see below). Orders for Standard Labels may be made directly to a UL Label Center or through an on-line from available through the following website <http://www.ul.com/global/eng/pages/corporate/aboutul/ulmarks/labelorders/>:



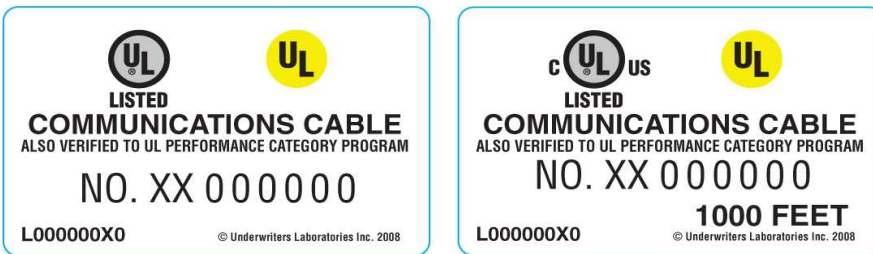
Note 1 – The applicable Performance Standard (e.g. “UL Performance Category Program”, “ISO/IEC11801”, “NEMA WC 66”, etc.) authorized for the Subscriber. A reference to “ANSI/TIA-568C.2” may also be included in the label artwork for the UL Performance Category Program for all Categories except Category 5.

Note 2 – The supporting UL Label Center can provide information related to the available denominations. Nondenominational Label authorization is also available to Subscribers whose production record controls have been evaluated and Procedure authorized as a means for UL Service Charge billing.

Note 3 – The unique issue or serial number assigned by the UL Label Center for the purpose of controlling the UL Mark.

Note 4 – The company name, logo, trademark, or other identification acceptable to UL, which relates to the identity of the Verified company must be provided if Combination (custom) labels are ordered. The requirement for identifying “The Verified Co.” does not apply for Standard labels purchased through UL.

For UL’s Performance Verification Category Program, Standard Labels are available as shown below:



The surface printing information required as part of the UL Listing (including the Listee and manufacturer identification) shall be provided in the surface print legend. In addition, as part of the applicable UL LAN Verification Program, the following information shall also be included in the surface print legend:

“Verified (UL) Category X [PERFORMANCE STANDARD]”

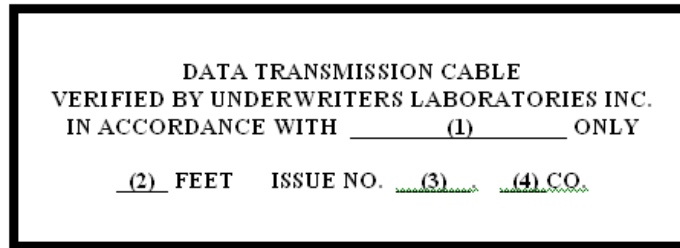
- The word “Category” may be abbreviated to “Cat”;
- For stranded conductors, the words “Patch Cable” shall immediately follow the performance category number (e.g. – Category 6 Patch Cable);
- For Backbone Cable, the words “Backbone Cable” shall immediately follow the performance category number (e.g. – Category 5E Backbone Cable);
- X' is the performance category that the particular cable complies with (e.g. – Cat 5e, 6, etc.);
- [PERFORMANCE STANDARD] is the applicable Performance Standard the product was evaluated against. Examples include “UL Performance Category Program”, “ANSI/TIA-568C.2”, “ISO/IEC11801”, “NEMA WC 66”, etc. or another Procedure authorized Standard;
- Under the UL Performance Category Program, the references to “UL Performance Category Program” as the Performance Standard are not required in the surface print legend;
- Under the UL Performance Category Program, references to “ANSI/TIA-568C.2” may be added in the surface print, to further indicate the applicable test standard. The reference to “ANSI/TIA-568C.2” is prohibited, however, for Category 5 products.

The UL logo in parentheses must appear twice in the surface print (once for the Listing Service with surface print legend in accordance to UL444 **and** once for the Verification Service, surface print as shown above), to show that the product was both Listed and Verified by UL and to prevent any product acceptance issues in the field.

In the past, the practice has been to describe UL Listed products, which are also “Verified” for performance, under the File Number for Communications Cable CCN DUZX. In the Communications Cable CCN DUZX File number, multiple volumes would exist. Typically, Volume one described cables that have been Listed to UL444 and subsequent volume numbers would describe products Verified to performance standards. With the consolidation of all Listed/Verified products under the CCN DVBI, the use of only one “E” number to identify the Applicant is required on the surface print. The “E” number to be used for Listed/Verified products must be that of the corresponding Listing under Communications Cable CCN DUZX.

2. Non-Listed Cables Verified for Performance – Labeling and Surface Printing

The UL Logo (UL in a circle with the two letters offset at a 30 angle from one another) will no longer be permitted in the label artwork.



Note 1 – The applicable Performance Standard (e.g. “UL Performance Category Program”, “ISO/IEC11801”, “NEMA WC 66”, etc.) authorized for the Subscriber. A reference to “ANSI/TIA-568C.2” may also be included in the label artwork for the UL Performance Category Program for all Categories except Category 5.

Note 2 – The supporting UL Label Center can provide information related to the available denominations. Nondenominational Label authorization is also available to Subscribers whose production record controls have been evaluated and Procedure authorized as a means for UL Service Charge billing.

Note 3 – The unique issue or serial number assigned by the UL Label Center for the purpose of controlling the UL Mark.

Note 4 – The company name, logo, trademark, or other identification acceptable to UL, which relates to the identity of the Verified company must be provided if Combination (custom) labels are ordered. The requirement for identifying “The Verified Co.” does not apply for Standard labels purchased through UL.

In addition to the Listee and manufacturer identification, these cables shall bear the following legend, or the shorter version in the examples below:

" XYZ CO VERIFIED BY UNDERWRITERS LABORATORIES INC IN ACCORDANCE WITH CATEGORY X [Patch Cable, if applicable] ONLY" where 'X' is the performance category that the particular cable complies with (e.g. – Cat 5e, 6, etc.)

" XYZ CO VERIFIED BY UNDERWRITERS LABORATORIES INC IN ACCORDANCE WITH CATEGORY X [Backbone Cable, if applicable] ONLY" where 'X' is the performance category that the particular cable complies with (e.g. – Cat 5e, 6, etc.)

- These cables are prohibited from bearing the UL Logo [(UL) or UL – in a circle] in the surface-print legend
- "UNDERWRITERS LABORATORIES INC" may be shortened to "UND LAB INC" but shall not be abbreviated as "UL" or shown as "(UL)"
- The word “Category” may be abbreviated to “Cat”
- [PERFORMANCE STANDARD] is “UL Performance Category Program”, “ANSI/TIA-568C.2”, “ISO/IEC11801”, “NEMA WC 66”, etc. or another Procedure authorized Standard.

Examples of the abbreviated surface-print legends are as follows:

“XYZ CO VERIFIED BY UND LAB INC IN ACCORDANCE WITH CAT X [PERFORMANCE STANDARD] ONLY”

“XYZ CO VERIFIED BY UND LAB INC ONLY TO [PERFORMANCE STANDARD] CAT X”

These cables are prohibited from bearing any reference to a National Electrical Code cable type designation (e.g. CMP, CMR, CM, CMX, etc.) in the entire length of the surface print legend (in both the UL and non-UL portions of the surface print).

3. Labeling and Surface Marking of Hybrid and Bundled Cables

HYBRID CONSTRUCTION – This construction consists of two or more jacketed members that are cabled together and then covered by an overall jacket. Each member is assigned a separate performance category, which may or may not be the same performance category as the other members of the cable. The jacket of each member in this

construction shall be surface printed with the performance category marking for the appropriate category. In addition, the overall jacket shall have a performance category marking for each member contained in the cable. However, the quantity of each performance category is not required to appear in the overall jacket surface print. Each category is to be identified on the tag/reel markings along with its associated construction (e.g., "Category 3 - 2pr 24 AWG CMP"). It is not necessary to provide the quantity of each category contained within this mixed-category construction.

BUNDLED CONSTRUCTION A - This construction consists of two or more jacketed members, laid parallel and joined by a web. Each member functions as a separate cable and is assigned a separate performance category, which may or may not be the same performance category as the other members of the cable. The jacket of each member in this construction shall be surface printed with the performance category marking for the appropriate category. If each member within this parallel construction is the same performance category, the surface marking text needs to be applied to only one member. Each category is to be identified on the tag/reel markings along with its associated construction (e.g., "Category 3 - 2pr 24 AWG CMP"). It is not necessary to provide the quantity of each category contained within this mixed-category construction.

BUNDLED CONSTRUCTION B - This construction consists of two (2) or more fully surface printed, finished jacketed members that are cabled together and then held with a binder tape applied helically around the cable. A Construction C cable is not to contain Construction A members. Each member is assigned a separate performance category, which may or may not be the same performance category as the other members of the cable. The jacket of each member in this construction shall be surface printed with the performance category marking for the appropriate category. It is intended that the verification marking (label) applied to the reel/tag will account for the total footage of cable (members) within the assembly, and not the total length of the assembly - that is, in a cable containing three 1000-foot lengths, 3000 feet of verification markings (labels) are to be applied to the reel/tag. Each category is to be identified on the tag/reel markings along with its associated construction (e.g., "Category 3 - 2pr 24 AWG CMP"). It is not necessary to provide the quantity of each category contained within this mixed-category construction.

BACKBONE CABLE CONSTRUCTION – This construction consists of two (2) or more non-jacketed members that are cabled together and then covered by an overall jacket. Each non-jacketed member consists of four(4) or more twisted insulated conductors, 24 through 22 AWG solid copper metal coated or are not metal coated, optionally bound by a thread/tape. There are no special labelling requirements for this construction. Standard labels shall be applied as those that are applied to either:jacketed unshielded and shielded (ScTP/FTP/STP) cable assembly of one (1) or more 100-ohm twisted pairs of 24 through 22 AWG solid copper untinned or tinned or otherwise metal-coated conductors or jacketed unshielded and shielded (ScTP/FTP/STP) cable patch cable containing 24 through 26 AWG stranded copper conductors that are metal coated or are not metal coated.

Any questions regarding this bulletin can be referred to either of the undersigned. Thank you for your participation in UL's Performance Verification Programs.

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APPENDIX A - UNDERWRITERS LABORATORIES INC TECHNICAL REQUIREMENTS**TEST PROGRAM FOR QUALIFYING 100-OHM UNSHIELDED (UTP) & SHIELDED (ScTP/FTP/STP) TWISTED-PAIR CABLES**

FOR DATA-TRANSMISSION PERFORMANCE-CATEGORY MARKINGS IN ACCORDANCE TO ANSI/TIA 568-C.2

CATEGORY 3	
Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)	
Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)	
MAXIMUM D-C RESISTANCE Ohms/100m at 20°C	The resistance of any conductor shall not exceed 9.38 Ohms per 100 meters
Solid metal coated or non metal coated	See ASTM D 4566 regarding adjustment of the values of resistance read at temperatures other than 20°C.
MAXIMUM D-C RESISTANCE ohms/100m at 20°C	The resistance of any conductor shall not exceed 14 Ohms per 100 meters
Stranded metal coated or non metal coated	See ASTM D 4566 regarding adjustment of the values of resistance read at temperatures other than 20°C.
MAXIMUM D-C RESISTANCE UNBALANCE	5
Percent	
MAXIMUM PR-TO-GND CAPACITANCE UNBALANCE pF/100m	330
MAXIMUM MUTUAL CAPACITANCE at 1 KHz nF/100m	6.6
CHARACTERISTIC (Fitted) IMPEDANCE AT 1.0 – 16.0 MHz ohms	100 Minimum: 85 Maximum: 115
MINIMUM STRUCTURAL RETURN LOSS (SRL) dB	1.0 ≤ f _{MHz} ≤ 10.0: 12 10.0 ≤ f _{MHz} ≤ 16.0: 12 – 10 log ₁₀ (f/10.0)

CATEGORY 3				
Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)				
Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)				
MAXIMUM INSERTION LOSS FOR ANY PAIR (IL) dB/100m at 20°C <ul style="list-style-type: none"> • De-rating factor of 1.2 is applied to IL formula above for 24 through 22 AWG stranded conductor cables. • Elevated temperature testing for UTP/ScTP/FTP/STP not required. 	$0.772 \leq f_{\text{MHz}} \leq 16.0: \text{IL}_f \leq 2.32(f)^{1/2} + 0.238(f)$			
		Solid 24 through 22 AWG	Stranded 22 AWG through 26 AWG	These discrete values are only for formula cross-reference checking. Use swept frequency for limit calculation
	772 kHz	2.2	2.7	
	1.0 MHz	2.6	3.1	
	4.0	5.6	6.7	
	8.0	8.5	10.2	
	10.0	9.7	11.7	
	16.0	13.1	15.7	

CATEGORY 3				
Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)				
Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)				
MINIMUM WORST-PAIR NEAR-END CROSSTALK (NEXT) dB at 20°C for a minimum length of 100 meters of any pair combination Per ASTM D 4566 – For cables employing 5 or more pairs, the Power Sum Near-End Crosstalk (PSNEXT) limits are also to be calculated for uncorrelated disturbing pairs using the individual pair-to-pair crosstalk measurements at all of the measurement frequencies. Use the NEXT formula shown here.	$0.772 \leq f_{\text{MHz}} \leq 16.0: \text{NEXT}_f \leq 23.2 - 15 \log_{10}(f/16)$			
	772 kHz	43.0	These discrete values are only for formula cross-reference checking. Use swept frequency for limit calculation.	
	1.0 MHz	41.3		
	4.0	32.3		
	8.0	27.8		
	10.0	26.3		
	16.0	23.2		
	Hybrid/bundled cables are to comply with the Power Sum NEXT loss requirements stated for Category 3 on page A13.			
MAXIMUM PROPAGATION DELAY (PD) – 4-pair cables only ns/100m at 20°C, 40°C, 60°C	$1.0 \leq f_{\text{MHz}} \leq 16.0: \text{PD} \leq 534 + 36/(f)^{1/2} =$			570 max at 1.0 MHz 545 max at 10.0 MHz 543 max at 16.0 MHz

<p>MAXIMUM PROPAGATION DELAY SKEW (PDS) – 4-pair cables only ns/100m at 20°C, 40°C, 60°C</p> <p>Propagation delay skew between all pair combinations is not to vary more than ±10 ns from the 20°C results when measured at 40°C and 60°C.</p>	1.0 through 16.0 MHz: 45						
<p>MAXIMUM SURFACE TRANSFER IMPEDANCE (STI) mΩ/meter</p> <p>(For shielded cable only)</p>	1.0 ≤ f _{MHz} ≤ 16.0: Z _{Tcable} ≤ 10f						
	<table> <tr> <td>1.0 MHz:</td> <td>50</td> </tr> <tr> <td>10.0</td> <td>100</td> </tr> <tr> <td>16.0</td> <td>160</td> </tr> </table>	1.0 MHz:	50	10.0	100	16.0	160
1.0 MHz:	50						
10.0	100						
16.0	160						

Table Continued

CATEGORY 5 Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP) Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)	
<p>MAXIMUM D-C RESISTANCE ohms/100m at 20°C solid bare or metal-coated or non metal-coated</p>	The resistance of any conductor shall not exceed 9.38 Ohms per 100 meters
	See ASTM D 4566 regarding adjustment of the values of resistance read at temperatures other than 20°C.
<p>MAXIMUM D-C RESISTANCE ohms/100m at 20°C Stranded bare or metal-coated or non metal-coated</p>	The resistance of any conductor shall not exceed 14 Ohms per 100 meters
	See ASTM D 4566 regarding adjustment of the values of resistance read at temperatures other than 20°C.
<p>MAXIMUM D-C RESISTANCE UNBALANCE Percent</p>	5
<p>MAXIMUM PR-TO-GND CAPACITANCE UNBALANCE pF/100m</p>	330

CHARACTERISTIC (Fitted) IMPEDANCE AT 1.0 – 100 MHz ohms	100 Minimum: 85 Maximum: 115	
MINIMUM STRUCTURAL RETURN LOSS (SRL) dB	1.0 ≤ f _{MHz} ≤ 20.0: 23 20.0 ≤ f _{MHz} ≤ 100.0: SRL _f ≤ 23 – 10 log ₁₀ (f/20.0)	
	25.0 MHz: 22 31.25 21 62.5 18 100.0 16	These discrete values are only for formula cross reference checking. Use swept frequency for limit calculation

Table Continued

CATEGORY 5					
Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)					
Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)					
MAXIMUM INSERTION LOSS FOR ANY PAIR (IL) dB/100m at 20°C <ul style="list-style-type: none"> De-rating factor of 1.2 is applied to solid conductor IL formula above for 24 through 22 AWG stranded conductor cables. For solid conductor UTP cable elevated temperature testing: Limit is to be increased by 8 percent for measurements of 40°C and 24 percent for measurements at 60°C. Elevated temperature testing is not required for ScTP/FTP/STP cable. Elevated temperature testing is not required for Category 5 stranded conductor cable. 	0.772 ≤ f _{MHz} ≤ 100.0: IL _f ≤ 1.967(f) ^{1/2} + 0.023(f) + 0.050(f) ^{1/2} (Solid conductor)				
		Solid 24 through 22 AWG	Stranded 22 AWG through 26 AWG	(For engineering purposes only)	
		772 kHz	1.8	2.2	These discrete values are only for formula cross-reference checking. Use swept frequency for limit calculation
		1.0 MHz	2.0	2.4	
		4.0	4.1	4.9	
		8.0	5.8	6.9	
		10.0	6.5	7.8	
		16.0	8.2	9.9	
		20.0	9.3	11.1	
		25.0	10.4	12.5	
		31.25	11.7	14.1	
	62.5	17.0	20.4		
	100.0	22.0	26.4		

MINIMUM WORST-PAIR NEAR-END CROSSTALK (NEXT) dB at 20°C for a minimum length of 100 meters of any pair combination Per ASTM D 4566 – For cables employing 5 or more pairs, the Power Sum Near-End Crosstalk (PSNEXT) limits are also to be calculated for uncorrelated disturbing pairs using the individual pair-to-pair crosstalk measurements at all of the measurement frequencies. Use the NEXT formula shown here.	0.772 ≤ f _{MHz} ≤ 100.0: NEXT _f ≤ 32 - 15 log ₁₀ (f/100)	
	772 kHz 64 1.0 MHz 62 4.0 53 8.0 48 10.0 47 16.0 44 20.0 42 25.0 41 31.25 39 62.5 35 100.0 32	These discrete values are only for formula cross reference checking. Use swept frequency for limit calculation.
Hybrid/bundled cables are to comply with the Power Sum NEXT loss requirements stated for Category 5 on page A13.		
MAXIMUM PROPAGATION DELAY (PD) – 4-pair cables only ns/100m at 20°C	1.0 ≤ f _{MHz} ≤ 100.0: PD ≤ 534 + 36/(f) ^{1/2} =	570 max at 1.0 MHz 545 max at 10.0 MHz 538 max at 100.0 MHz

Table Continued

CATEGORY 5 Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP) Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)		
MAXIMUM PROPAGATION DELAY SKEW (PDS) – 4-pair cables only ns/100m at 20°, 40°C and 60°C Propagation delay skew between all pair combinations is not to vary more than ±10 ns from the 20°C results when measured at 40°C and 60°C.	1.0 through 100.0 MHz: 45	
MAXIMUM SURFACE TRANSFER IMPEDANCE (STI) mΩ/meter (For shielded cable only)	1.0 ≤ f _{MHz} ≤ 100 Z _{Tcable} ≤ 10f	
	1.0 MHz: 50 4.0 50 8.0 80 10.0 100 16.0 160 20.0 200 25.0 250 31.25 312.5 62.5 625 100.0 1000	These discrete values are only for formula cross-reference checking. Use swept frequency for limit calculation Calculations that result in STI values less than 50 mΩ/meter shall revert to a requirement of 50 mΩ/meter minimum.

CATEGORY 5E	
Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)	
Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)	
MAXIMUM D-C RESISTANCE ohms/100m at 20°C solid bare or metal-coated or non metal-coated	The resistance of any conductor shall not exceed 9.38 Ohms per 100 meters
	See ASTM D 4566 regarding adjustment of the values of resistance read at temperatures other than 20°C.
MAXIMUM D-C RESISTANCE ohms/100m at 20°C Stranded bare or metal-coated or non metal- coated	The resistance of any conductor shall not exceed 14 Ohms per 100 meters
	See ASTM D 4566 regarding adjustment of the values of resistance read at temperatures other than 20°C.
MAXIMUM D-C RESISTANCE UNBALANCE Percent	5
MAXIMUM PR-TO-GND CAPACITANCE UNBALANCE pF/100m	330
MAXIMUM MUTUAL CAPACITANCE at 1 KHz nF/100m	5.6
MINIMUM RETURN LOSS (RL) dB	(SOLID CONDUCTOR) 1.0 ≤ f _{MHz} < 10.0: RL ≥ 20 + 5.0 log ₁₀ (f) 10.0 ≤ f _{MHz} < 20.0: RL ≥ 25 20.0 ≤ f _{MHz} ≤ 100.0: RL ≥ 25 - 7.0 log ₁₀ (f/20)
	(STRANDED CONDUCTOR) 1.0 ≤ f _{MHz} < 10.0: RL ≥ 20 + 5.0 log ₁₀ (f) 10.0 ≤ f _{MHz} < 20.0: RL ≥ 25 20.0 ≤ f _{MHz} ≤ 100.0: RL ≥ 25 - 8.6 log ₁₀ (f/20)

Table Continued

CATEGORY 5E																																					
Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)																																					
Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)																																					
MAXIMUM INSERTION LOSS FOR ANY PAIR (IL) dB/100m at 20°C <ul style="list-style-type: none"> • De-rating factor of 1.2 is applied to solid conductor IL formula above for 26 through 22 AWG stranded conductor cables. • For solid conductor UTP cable elevated temperature testing: Limit is to be increased by 8 percent for measurements of 40°C and 24 percent for measurements at 60°C as applied to the solid conductor IL formula. • For solid conductor ScTP/FTP/STP cable elevated temperature testing: Limit is to be increased by 4 percent for measurements of 40°C and 8 percent for measurements at 60°C as applied to the solid conductor IL formula. • Elevated temperature testing is not required for Category 5E stranded conductor cable. 	$1.0 \leq f_{\text{MHz}} \leq 100.0: \text{IL}_f \leq 1.967(f)^{1/2} + 0.023(f) + 0.050(f)^{1/2}$ (Solid conductor)																																				
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;"></th> <th style="width: 35%; text-align: center;">Solid 24 through 22 AWG</th> <th style="width: 35%; text-align: center;">Stranded 22 AWG through 26 AWG</th> <th style="width: 15%;"></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.0 MHz</td> <td style="text-align: center;">2.0</td> <td style="text-align: center;">2.4</td> <td rowspan="10" style="vertical-align: middle; text-align: center;"> These discrete values are only for formula cross reference checking. Use swept frequency for limit calculation </td> </tr> <tr><td style="text-align: center;">4.0</td><td style="text-align: center;">4.1</td><td style="text-align: center;">4.9</td></tr> <tr><td style="text-align: center;">8.0</td><td style="text-align: center;">5.8</td><td style="text-align: center;">6.9</td></tr> <tr><td style="text-align: center;">10.0</td><td style="text-align: center;">6.5</td><td style="text-align: center;">7.8</td></tr> <tr><td style="text-align: center;">16.0</td><td style="text-align: center;">8.2</td><td style="text-align: center;">9.9</td></tr> <tr><td style="text-align: center;">20.0</td><td style="text-align: center;">9.3</td><td style="text-align: center;">11.1</td></tr> <tr><td style="text-align: center;">25.0</td><td style="text-align: center;">10.4</td><td style="text-align: center;">12.5</td></tr> <tr><td style="text-align: center;">31.25</td><td style="text-align: center;">11.7</td><td style="text-align: center;">14.1</td></tr> <tr><td style="text-align: center;">62.5</td><td style="text-align: center;">17.0</td><td style="text-align: center;">20.4</td></tr> <tr><td style="text-align: center;">100.0</td><td style="text-align: center;">22.0</td><td style="text-align: center;">26.4</td></tr> </tbody> </table>		Solid 24 through 22 AWG	Stranded 22 AWG through 26 AWG		1.0 MHz	2.0	2.4	These discrete values are only for formula cross reference checking. Use swept frequency for limit calculation	4.0	4.1	4.9	8.0	5.8	6.9	10.0	6.5	7.8	16.0	8.2	9.9	20.0	9.3	11.1	25.0	10.4	12.5	31.25	11.7	14.1	62.5	17.0	20.4	100.0	22.0	26.4	
	Solid 24 through 22 AWG	Stranded 22 AWG through 26 AWG																																			
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MINIMUM WORST-PAIR NEAR-END CROSSTALK (NEXT) dB at 20°C for a minimum length of 100 meters of any pair combination	$1.0 \leq f_{\text{MHz}} \leq 100.0: \text{NEXT}_f \geq 35.3 - 15 \log_{10}(f/100)$																																				
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr><td style="text-align: center;">1.0 MHz</td><td style="text-align: center;">65.3</td><td rowspan="10" style="vertical-align: middle; text-align: center;"> These discrete values are only for formula cross reference checking. Use swept frequency for limit calculation. </td></tr> <tr><td style="text-align: center;">4.0</td><td style="text-align: center;">56.3</td></tr> <tr><td style="text-align: center;">8.0</td><td style="text-align: center;">51.8</td></tr> <tr><td style="text-align: center;">10.0</td><td style="text-align: center;">50.3</td></tr> <tr><td style="text-align: center;">16.0</td><td style="text-align: center;">47.3</td></tr> <tr><td style="text-align: center;">20.0</td><td style="text-align: center;">45.8</td></tr> <tr><td style="text-align: center;">25.0</td><td style="text-align: center;">44.3</td></tr> <tr><td style="text-align: center;">31.25</td><td style="text-align: center;">42.9</td></tr> <tr><td style="text-align: center;">62.5</td><td style="text-align: center;">36.4</td></tr> <tr><td style="text-align: center;">100.0</td><td style="text-align: center;">35.3</td></tr> </tbody> </table>	1.0 MHz	65.3	These discrete values are only for formula cross reference checking. Use swept frequency for limit calculation.	4.0	56.3	8.0	51.8	10.0	50.3	16.0	47.3	20.0	45.8	25.0	44.3	31.25	42.9	62.5	36.4	100.0	35.3															
1.0 MHz	65.3	These discrete values are only for formula cross reference checking. Use swept frequency for limit calculation.																																			
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31.25	42.9																																				
62.5	36.4																																				
100.0	35.3																																				
Hybrid/bundled cables are to comply with the Power Sum NEXT loss requirements stated for Category 5E on page A14.																																					

Table Continued

CATEGORY 5E			
Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)			
Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)			
MINIMUM POWER SUM NEAR-END CROSSTALK (PSNEXT) dB Per ASTM D 4566 FEXT Measurement Procedure – The Power Sum Near-End Crosstalk (PSNEXT) limits are to be calculated for uncorrelated disturbing pairs using the individual pair-to-pair crosstalk measurements at all of the measurement frequencies	$1.0 \leq f_{\text{MHz}} \leq 100.0$: $\text{PSNEXT}_f \geq 32.3 - 15 \log_{10}(f/100)$		
	1.0 MHz	62.3	These discrete values are only for formula cross reference checking. Use swept frequency for limit calculation.
	4.0	53.3	
	8.0	48.8	
	10.0	47.3	
	16.0	44.2	
	20.0	42.8	
	25.0	41.3	
	31.25	39.9	
	62.5	35.4	
100.0	32.3		
MINIMUM ATTENUATION-TO-CROSSTALK RATIO FAR (ACRF) [Formally designated EQUAL LEVEL FAR-END CROSSTALK (ELFEXT)] dB Per ASTM D 4566 FEXT Measurement Procedure – ACRF is the difference between the measured FAR-END Crosstalk (FEXT) and the attenuation of the disturbed pair at all of the measurement frequencies	$1.0 \leq f_{\text{MHz}} \leq 100.0$: $\text{ACRF}_f \geq 23.8 - 20 \log_{10}(f/100)$		
	1.0 MHz	63.8	These discrete values are only for formula cross reference checking. Use swept frequency for limit calculation.
	4.0	51.8	
	8.0	45.7	
	10.0	43.8	
	16.0	39.7	
	20.0	37.8	
	25.0	35.8	
	31.25	33.9	
	62.5	27.9	
100.0	23.8		

CATEGORY 5E																						
Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)																						
Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)																						
<p>MINIMUM POWER SUM ATTENUATION-TO-CROSSTALK RATIO FAR (PSACRF) [Formally designated POWER SUM EQUAL LEVEL FAR-END CROSSTALK (PSELFEXT)]</p> <p>dB</p> <p>Per ASTM D 4566 FEXT Measurement Procedure – ACRF is the difference between the calculated Power Sum FAR-END Crosstalk (FEXT) and the attenuation of the disturbed pair at all of the measurement frequencies</p>	<p>$1.0 \leq f_{\text{MHz}} \leq 100.0$: $\text{PSACRF}_f \leq 20.8 - 20 \log_{10}(f/100)$</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">1.0 MHz</td> <td style="width: 50%; text-align: right;">60.8</td> </tr> <tr> <td>4.0</td> <td style="text-align: right;">48.8</td> </tr> <tr> <td>8.0</td> <td style="text-align: right;">42.7</td> </tr> <tr> <td>10.0</td> <td style="text-align: right;">40.8</td> </tr> <tr> <td>16.0</td> <td style="text-align: right;">36.7</td> </tr> <tr> <td>20.0</td> <td style="text-align: right;">34.8</td> </tr> <tr> <td>25.0</td> <td style="text-align: right;">32.8</td> </tr> <tr> <td>31.25</td> <td style="text-align: right;">30.9</td> </tr> <tr> <td>62.5</td> <td style="text-align: right;">24.9</td> </tr> <tr> <td>100.0</td> <td style="text-align: right;">20.8</td> </tr> </table>	1.0 MHz	60.8	4.0	48.8	8.0	42.7	10.0	40.8	16.0	36.7	20.0	34.8	25.0	32.8	31.25	30.9	62.5	24.9	100.0	20.8	<p>These discrete values are only for formula cross reference checking.</p> <p>Use swept frequency for limit calculation.</p>
1.0 MHz	60.8																					
4.0	48.8																					
8.0	42.7																					
10.0	40.8																					
16.0	36.7																					
20.0	34.8																					
25.0	32.8																					
31.25	30.9																					
62.5	24.9																					
100.0	20.8																					
<p>MAXIMUM PROPAGATION DELAY (PD) – 4-pair cables only</p> <p>ns/100m at 20°C</p>	<p>$1.0 \leq f_{\text{MHz}} \leq 100.0$: $\text{PD} = 534 + 36/(f)^{1/2} =$</p>	<p>570 max at 1.0 MHz 545 max at 10.0 MHz 538 max at 100.0 MHz</p>																				
<p>MAXIMUM PROPAGATION DELAY SKEW (PDS) – 4-pair cables only</p> <p>ns/100m at 20°C, 40°C and 60°C</p> <p>Propagation delay skew between all pair combinations is not to vary more than ±10 ns from the 20°C results when measured at 40°C and 60°C.</p>	<p>1.0 through 100.0 MHz: 45</p>	<p>MAXIMUM PROPAGATION DELAY SKEW (PDS) – 4-pair cables only</p> <p>ns/100m at 20°C, 40°C and 60°C</p> <p>Propagation delay skew between all pair combinations is not to vary more than ±10 ns from the 20°C results when measured at 40°C and 60°C.</p>																				

CATEGORY 5E		
Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)		
Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)		
MINIMUM COUPLING ATTENUATION DB (For shielded cable only)	$1.0 \leq f_{\text{MHz}} < 30.0$: n/s $30.0 \leq f_{\text{MHz}} < 100.0$: $CA \geq 55 - 20 \log_{10}(f/100)$	These discrete values are only for formula cross-reference checking. Use swept frequency for limit calculation. N/s = Not Specified
	1.0 MHz n/s	
	4.0 n/s	
	8.0 n/s	
	10.0 n/s	
	16.0 n/s	
	20.0 n/s	
	25.0 n/s	
	30.0 55	
	31.25 55	
	62.5 55	
	100.0 55	
MAXIMUM SURFACE TRANSFER IMPEDANCE (STI) mΩ/meter (For shielded cable only)	$1.0 \leq f_{\text{MHz}} \leq 100.0$: $Z_{\text{Tcable}} = 10f$	
	1.0 MHz: 50	These discrete values are only for formula cross-reference checking. Use swept frequency for limit calculation.
	4.0 50	
	8.0 80	
	10.0 100	
	16.0 160	
	20.0 200	
	25.0 250	
	31.25 312.5	
	62.5 625	
	100.0 1000	

CATEGORY 6 Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP) Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)	
MAXIMUM D-C RESISTANCE Ohms/100m at 20°C Solid metal coated or non metal coated	The resistance of any conductor shall not exceed 9.38 Ohms per 100 meters See ASTM D 4566 regarding adjustment of the values of resistance read at temperatures other than 20°C.
MAXIMUM D-C RESISTANCE ohms/100m at 20°C Stranded metal coated or non metal coated	The resistance of any conductor shall not exceed 14 Ohms per 100 meters See ASTM D 4566 regarding adjustment of the values of resistance read at temperatures other than 20°C.
MAXIMUM D-C RESISTANCE UNBALANCE Percent	5
MAXIMUM PR-TO-GND CAPACITANCE UNBALANCE pF/100m	330
MAXIMUM MUTUAL CAPACITANCE at 1 KHz nF/100m	5.6

CATEGORY 6 Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP) Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)				
<p>MAXIMUM INSERTION (ATTENUATION) LOSS FOR ANY PAIR (IL) dB/100m at 20°C</p> <ul style="list-style-type: none"> De-rating factor of 1.2 is applied to solid conductor IL formula above for 26 through 22 AWG stranded conductor cables. For solid conductor UTP cable elevated temperature testing: Limit is to be increased by 8 percent for measurements at 40°C and 24 percent for measurements at 60°C as applied to the solid conductor IL formula. For solid conductor ScTP/FTP/STP cable elevated temperature testing: Limit is to be increased by 4 percent for measurements at 40°C and 8 percent for measurements at 60°C as applied to the solid conductor IL formula. For UTP stranded conductor cable elevated temperature testing: Limit is to be increased by 8 percent for measurements at 40°C and 24 percent for measurements at 60°C as applied to the stranded conductor IL formula. For ScTP/FTP/STP stranded conductor cable elevated temperature testing: Limit is to be increased by 4 percent for measurements at 40°C and 8 percent for measurements at 60°C as applied to the stranded conductor IL formula. 	$1.0 \leq f_{\text{MHz}} \leq 250.0: IL_f \leq 1.808(f)^{1/2} + 0.017(f) + 0.200/(f)^{1/2}$ (Solid conductor)			
	$1.0 \leq f_{\text{MHz}} \leq 250.0: IL_f \leq 1.2 \times \text{Insertion loss for solid conductor (stranded conductor)}$			
		Solid 24 through 22 AWG	Stranded 22 through 26 AWG	
1.0 MHz	2.0	2.4		
4.0	3.8	4.5		
8.0	5.3	6.4		
10.0	6.0	7.1		
16.0	7.6	9.1		
20.0	8.5	10.2		
25.0	9.5	11.4		
31.25	10.7	12.8		
62.5	15.4	18.5		
100.0	19.8	23.8		
200.0	29.0	34.8		
250.0	32.9	39.4		

Table Continued

CATEGORY 6																												
Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)																												
Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)																												
MINIMUM WORST-PAIR NEAR-END CROSSTALK (NEXT)	$1.0 \leq f_{\text{MHz}} \leq 250.0$: $\text{NEXT}_f \geq 44.3 - 15 \log_{10}(f/100)$																											
dB at 20°C for a minimum length of 100 meters of any pair combination	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 50%;">1.0 MHz</td><td style="width: 50%;">74.3</td></tr> <tr><td>4.0</td><td>65.3</td></tr> <tr><td>8.0</td><td>60.8</td></tr> <tr><td>10.0</td><td>59.3</td></tr> <tr><td>16.0</td><td>56.2</td></tr> <tr><td>20.0</td><td>54.8</td></tr> <tr><td>25.0</td><td>53.3</td></tr> <tr><td>31.25</td><td>51.9</td></tr> <tr><td>62.5</td><td>47.4</td></tr> <tr><td>100.0</td><td>44.3</td></tr> <tr><td>200.0</td><td>39.8</td></tr> <tr><td>250.0</td><td>38.3</td></tr> </table>	1.0 MHz	74.3	4.0	65.3	8.0	60.8	10.0	59.3	16.0	56.2	20.0	54.8	25.0	53.3	31.25	51.9	62.5	47.4	100.0	44.3	200.0	39.8	250.0	38.3	<p>These discrete values are only for formula cross reference checking.</p> <p>Use swept frequency for limit calculation.</p>		
1.0 MHz	74.3																											
4.0	65.3																											
8.0	60.8																											
10.0	59.3																											
16.0	56.2																											
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25.0	53.3																											
31.25	51.9																											
62.5	47.4																											
100.0	44.3																											
200.0	39.8																											
250.0	38.3																											
Hybrid/bundled cables are to comply with the Power Sum NEXT loss requirements stated for Category 6 on page A14.																												
MINIMUM POWER SUM NEAR-END CROSSTALK (PSNEXT)	$1.0 \leq f_{\text{MHz}} \leq 250.0$: $\text{PSNEXT}_f \geq 42.3 - 15 \log_{10}(f/100)$																											
dB	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 50%;">1.0 MHz</td><td style="width: 50%;"></td></tr> <tr><td>4.0</td><td>72.3</td></tr> <tr><td>8.0</td><td>63.3</td></tr> <tr><td>10.0</td><td>58.8</td></tr> <tr><td>16.0</td><td>57.3</td></tr> <tr><td>20.0</td><td>54.2</td></tr> <tr><td>25.0</td><td>52.8</td></tr> <tr><td>31.25</td><td>51.3</td></tr> <tr><td>62.5</td><td>49.9</td></tr> <tr><td>100.0</td><td>45.4</td></tr> <tr><td>200.0</td><td>42.3</td></tr> <tr><td>250.0</td><td>37.8</td></tr> <tr><td></td><td>36.3</td></tr> </table>	1.0 MHz		4.0	72.3	8.0	63.3	10.0	58.8	16.0	57.3	20.0	54.2	25.0	52.8	31.25	51.3	62.5	49.9	100.0	45.4	200.0	42.3	250.0	37.8		36.3	<p>These discrete values are only for formula cross reference checking.</p> <p>Use swept frequency for limit calculation.</p>
1.0 MHz																												
4.0	72.3																											
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62.5	49.9																											
100.0	45.4																											
200.0	42.3																											
250.0	37.8																											
	36.3																											
Per ASTM D 4566 FEXT Measurement Procedure – The Power Sum Near-End Crosstalk (PSNEXT) limits are to be calculated for uncorrelated disturbing pairs using the individual pair-to-pair crosstalk measurements at all of the measurement frequencies																												

Table Continued

CATEGORY 6		
Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)		
Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)		
MINIMUM ATTENUATION-TO-CROSSTALK RATIO FAR (ACRF) [Formally designated EQUAL LEVEL FAR-END CROSSTALK (ELFEXT)] dB Per ASTM D 4566 FEXT Measurement Procedure – ELFEXT is the difference between the measured Far-End Crosstalk (FEXT) and the measured attenuation of the disturbed pair at all of the measurement frequencies	$1.0 \leq f_{\text{MHz}} \leq 250.0$: $\text{ACRF}_f \geq 27.8 - 20 \log_{10}(f/100)$	
	1.0 MHz	67.8
	4.0	55.8
	8.0	49.7
	10.0	47.8
	16.0	43.7
	20.0	41.8
	25.0	39.8
	31.25	37.9
	62.5	31.9
	100.0	27.8
	200.0	21.8
	250.0	19.8
MINIMUM POWER SUM ATTENUATION-TO-CROSSTALK RATIO FAR (PSACRF) [Formally designated POWER SUM EQUAL LEVEL FAR-END CROSSTALK (PSELFEXT)] dB/100m Measurement Precaution – For accurate and consistent results, use a 100-meter unreeled length and maintain wire polarity (tip and ring).	$1.0 \leq f_{\text{MHz}} \leq 250.0$: $\text{PSACRF}_f \geq 24.8 - 20 \log_{10}(f/100)$	
	1.0 MHz	64.8
	4.0	52.8
	8.0	46.7
	10.0	44.8
	16.0	40.7
	20.0	38.8
	25.0	36.8
	31.25	34.9
	62.5	28.9
	100.0	24.8
	200.0	18.8
	250.0	16.8
MINIMUM RETURN LOSS (RL) dB	$1.0 \leq f_{\text{MHz}} < 10.0$: $\text{RL} \geq 20 + 5.0 \log_{10}(f)$	
	$10.0 \leq f_{\text{MHz}} < 20.0$: $\text{RL} \geq 25$ (SOLID CONDUCTOR)	
	$20.0 \leq f_{\text{MHz}} \leq 250.0$: $\text{RL} \geq 25 - 7.0 \log_{10}(f/20)$	
	$1.0 \leq f_{\text{MHz}} < 10.0$: $\text{RL} \geq 20 + 5.0 \log_{10}(f)$	
	$10.0 \leq f_{\text{MHz}} < 20.0$: $\text{RL} \geq 25$ (STRANDED CONDUCTOR)	
	$20.0 \leq f_{\text{MHz}} \leq 250.0$: $\text{RL} \geq 25 - 8.6 \log_{10}(f/20)$	

Table Continued

CATEGORY 6																										
Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)																										
Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)																										
MAXIMUM PROPAGATION DELAY (PD) – 4-pair cables only ns/100m at 20°C	$1.0 \leq f_{\text{MHz}} \leq 250.0$: $\text{PD} \leq 534 + 36/(f)^{1/2} =$	570 max at 1.0 MHz 545 max at 10.0 MHz 538 max at 100.0 MHz 536 max at 250.0 MHz																								
MAXIMUM PROPAGATION DELAY SKEW (PDS) – 4-pair cables only ns/100m at 20°C, 40°C and 60°C. Propagation delay skew between all pair combinations is not to vary more than ± 10 ns from the 20°C results when measured at 40°C and 60°C.	1.0 through 250.0 MHz: 45																									
MINIMUM TRANSVERSE CONVERSATION LOSS (TCL) [Formally Designated Longitudinal Conversation Loss (LCL)] dB	$1.0 \leq f_{\text{MHz}} \leq 250$ $\text{TCL} \leq 30 - 10 \log(f/100)$	<table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr><td>1.0 MHz</td><td>40</td></tr> <tr><td>4.0</td><td>40</td></tr> <tr><td>8.0</td><td>40</td></tr> <tr><td>10.0</td><td>40</td></tr> <tr><td>16.0</td><td>38</td></tr> <tr><td>20.0</td><td>37</td></tr> <tr><td>25.0</td><td>36</td></tr> <tr><td>31.25</td><td>35.1</td></tr> <tr><td>62.5</td><td>32.0</td></tr> <tr><td>100.0</td><td>30.0</td></tr> <tr><td>200.0</td><td>27.0</td></tr> <tr><td>250.0</td><td>26.0</td></tr> </tbody> </table>	1.0 MHz	40	4.0	40	8.0	40	10.0	40	16.0	38	20.0	37	25.0	36	31.25	35.1	62.5	32.0	100.0	30.0	200.0	27.0	250.0	26.0
1.0 MHz	40																									
4.0	40																									
8.0	40																									
10.0	40																									
16.0	38																									
20.0	37																									
25.0	36																									
31.25	35.1																									
62.5	32.0																									
100.0	30.0																									
200.0	27.0																									
250.0	26.0																									

Table Continued

CATEGORY 6 Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP) Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)		
MINIMUM EQUAL LEVEL TRANSVERSE CONVERSATION LOSS (ELTCTL) dB	$1.0 \leq f_{\text{MHz}} < 30.0$: ELTCTL $\geq 35 - 20.0 \log_{10}(f)$ $30.0 \leq f_{\text{MHz}} < 250.0$: ELTCTL = Not Specified	
	1.0 MHz 4.0 8.0 10.0 16.0 20.0 25.0 30.0	35.0 23.0 16.9 15.0 10.9 9.0 7.0 5.5
CATEGORY 6 Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP) Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)		
MINIMUM COUPLING ATTENUATION dB (For shielded cable only)	$1.0 \leq f_{\text{MHz}} < 30.0$: n/s $30.0 \leq f_{\text{MHz}} < 250.0$: CA $\geq 55 - 20 \log_{10}(f/100)$	
	1.0 MHz 4.0 8.0 10.0 16.0 20.0 26.0 30.0 31.25 62.5 100 200 250	n/s n/s n/s n/s n/s n/s n/s 55 55 55 49 47
		These discrete values are only for formula cross-reference checking. Use swept frequency for limit calculation. Calculations that result in values greater than 55 dB, shall revert to a requirement of 55 dB.

<p>MAXIMUM SURFACE TRANSFER IMPEDANCE (STI)</p>	$1.0 \leq f_{\text{MHz}} \leq 100.0: Z_{\text{cable}} \leq 10f$																					
<p>mΩ/meter</p> <p>(For shielded cable only)</p>	<table> <tr><td>1.0 MHz:</td><td>50</td></tr> <tr><td>4.0</td><td>50</td></tr> <tr><td>8.0</td><td>80</td></tr> <tr><td>10.0</td><td>100</td></tr> <tr><td>16.0</td><td>160</td></tr> <tr><td>20.0</td><td>200</td></tr> <tr><td>25.0</td><td>250</td></tr> <tr><td>31.25</td><td>312.5</td></tr> <tr><td>62.5</td><td>625</td></tr> <tr><td>100.0</td><td>1000</td></tr> </table>	1.0 MHz:	50	4.0	50	8.0	80	10.0	100	16.0	160	20.0	200	25.0	250	31.25	312.5	62.5	625	100.0	1000	<p>These discrete values are only for formula cross-reference checking.</p> <p>Use swept frequency for limit calculation.</p>
1.0 MHz:	50																					
4.0	50																					
8.0	80																					
10.0	100																					
16.0	160																					
20.0	200																					
25.0	250																					
31.25	312.5																					
62.5	625																					
100.0	1000																					

Category 6A

**Solid Conductor 24 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)
Stranded Conductor 26 through 22 AWG Unshielded (UTP) and Shielded (ScTP/FTP/STP)**

- Insertion Loss $\leq 1.82 \sqrt{f} + 0.0091f + 0.25/\sqrt{f}$ dB (Solid conductor)
- Insertion Loss $\leq 1.2 \times$ Insertion loss for solid conductor (stranded conductor)
 - 1) For elevated temperature testing of UTP solid & stranded conductor cable the Limit is to be increased by 8 percent for measurements at 40°C and 24 percent for measurements at 60°C as applied to the above applicable IL formula;
For elevated temperature testing of ScTP/FTP/STP solid & stranded conductor cable the Limit is to be increased by 4 percent for measurements at 40°C and 8 percent for measurements at 60°C as applied to the above applicable IL formula;
- Pair to Pair Near End Crosstalk Loss (NEXT) $\geq -44.3-15\log(f/100)$ dB
- Power Sum NEXT (PSNEXT) $\geq -42.3-15\log(f/100)$ dB
- Attenuation to Crosstalk Ratio Far (ACRF) [a.k.a ELFEXT] $\geq -27.8-20\log(f/100)$ dB
- Power Sum Attenuation to Crosstalk Ratio Far (PSACRF) [a.k.a PSELFEXT] $\geq -24.8-20\log(f/100)$ dB
- Return Loss (Solid Conductor Cable): $1 \leq f < 10 \geq 20+5\log(f)$ dB, $10 \leq f < 20 \geq 25$ dB, $20 \leq f \leq 500 = 25-7\log(f/20)$ dB
Return Loss (Stranded Conductor Cable): $1 \leq f < 10 \geq 20+5\log(f)$ dB, $10 \leq f < 20 \geq 25$ dB, $20 \leq f \leq 500 = 25-8.6\log(f/20)$ dB

MHz	Insertion Loss dB	NEXT dB	PSNEXT dB	ACRF dB	PSACRF dB	RL dB	RL (Stranded Conductor Cable) dB
0.772	----	----	----	----	----	----	----
1	2.1	74.3	72.3	67.8	64.8	20.0	20.0
4	3.8	65.3	63.3	55.8	52.8	23.0	23.0
8	5.3	60.8	58.8	49.7	46.7	24.5	24.5
10	5.9	59.3	57.3	47.8	44.8	25.0	25.0
16	7.5	56.2	54.2	43.7	40.7	25.0	25.0
20	8.4	54.8	52.8	41.8	38.8	25.0	25.0
25	9.4	53.3	51.3	39.8	36.8	24.3	24.2
31.25	10.5	51.9	49.9	37.9	34.9	23.6	23.3
62.5	15.0	47.4	45.4	31.9	28.9	21.5	20.7
100	19.1	44.3	42.3	27.8	24.8	20.1	19.0
200	27.6	39.8	37.8	21.8	18.8	18.0	16.4
250	31.1	38.3	36.3	19.8	16.8	17.3	15.6
300	34.3	37.1	35.1	18.3	15.3	16.8	14.9
400	40.1	35.3	33.3	15.8	12.8	15.9	13.8
500	45.3	33.8	31.8	13.8	10.8	15.2	13.0

Category 6A Con't

- Propagation Delay: $\leq 534 + 36/\sqrt{f}$ ns/100m
 - Propagation Delay Skew – For all frequencies from 1 to 500 MHz shall not exceed 45 ns at 20C, 40C and 60C. Propagation Delay Skew between all pairs shall not vary more than ± 10 ns
 - Transverse Conversion Loss (TCL): $\geq -30-10\log(f/100)$ dB
 - Equal Level Transverse Conversion Transfer Loss (ELTCTL): $1 \leq f < 30 \geq -35-20\log(f/100)$ dB
 - DC Resistance Unbalance – The resistance unbalanced between the two conductors of any cable shall not exceed 4 %.
DC Resistance (solid metal-coated or non metal-coated) - The resistance of any conductor shall not exceed 9.38 Ohms per 100 meters.
DC Resistance (stranded metal-coated or non metal-coated) - The resistance of any conductor shall not exceed 14 Ohms per 100 meters.
Mutual Capacitance (Maximum) – 5.6 nF per 100 meter
 - Capacitance Unbalanced (Maximum) – 330 nF per 100 meter
 - Coupling Attenuation (Maximum – for shielded cable only) $1.0 \leq f_{\text{MHz}} \leq 30.0$: n/s $30.0 \leq f_{\text{MHz}} \leq 500.0$: $CA \leq 55 - 20 \log_{10}(f/100)$
 - Surface Transfer Impedance (STI) (Minimum) - $1.0 \leq f_{\text{MHz}} \leq 100.0$: $Z_{\text{Tcable}} = 10f$
(Calculations that result in STI values less than 50 m Ω /m shall revert to a requirement of 50 m Ω /m minimum)
 - Power Sum Alien NEXT (PSANEXT) $\geq -62.5-15\log(f/100)$ dB
 - Power Sum Alien Attenuation to Crosstalk Ratio Far (PSAACRF) $\geq -38.2-20\log(f/100)$ dB
- n/s = Not Specified

MHz	Propagation Delay ns	Propagation Delay Skew ns	TCL dB	ELTCL dB	Coupling Attenuation dB	STI m Ω /m	PSANEXT dB	PSAACRF dB
0.772	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s
1	570	45	40.0	35.0	n/s	50	67.0	67.0
4	552	45	40.0	23.0	n/s	50	67.0	66.2
8	547	45	40.0	16.9	n/s	50	67.0	60.1
10	545	45	40.0	15.0	n/s	100	67.0	58.2
16	543	45	38.0	10.9	n/s	160	67.0	54.1
20	542	45	37.0	9.0	n/s	200	67.0	52.2
25	541	45	36.0	7.0	n/s	250	67.0	50.2
31.25	540	45	35.1	5.5	55.0	312.5	67.0	48.3
62.5	539	45	32.0	n/s	55.0	625	65.6	42.3
100	538	45	30.0	n/s	55.0	1000	62.5	38.2
200	537	45	27.0	n/s	49.0	n/s	58.0	32.2
250	536	45	26.0	n/s	47.0	n/s	56.5	30.2
300	536	45	25.2	n/s	45.5	n/s	55.3	28.7
400	536	45	24.0	n/s	43.0	n/s	53.5	26.2
500	536	45	23.0	n/s	41.0	n/s	52.0	24.2

HYBRID CABLE CONSTRUCTION (see construction & marking requirements on Page 9)

These cables consist of two or more jacketed members, of the same or different categories, covered with an overall jacket. Specified for Category 3, 5, 5E and 6 cables only.

BUNDLED CABLE CONSTRUCTIONS (see construction & marking requirements on Page 9 (Constructions A and B))

These cables consist of two or more jacketed members, of the same or different categories, bound together by a binder tape or thread, or laid flat and parallel joined by an interconnecting web. Specified for Category 3, 5, 5E and 6 cables only.

Category 3, 5 & 5E hybrid/bundled cables shall comply with the Power Sum NEXT loss requirements for any disturbed pair and all pairs external to that pair's jacket within the cable. In addition, each jacketed member shall comply with the specified performance requirements for that individual member, in addition to the following:

$$\text{NEXT}_f = \text{NEXT} (0.772) - 15 \log_{10}(f/0.772) \text{ [Category 3 hybrid/bundled cables]}$$

$$\text{NEXT}_f = \text{NEXT} (100) - 15 \log_{10}(f/100) \text{ [Category 5 hybrid/bundled cables]}$$

$$\text{NEXT}_f = \text{NEXT} (100) - 15 \log_{10}(f/100) \text{ [Category 5E hybrid/bundled cables]}$$

Using the above formula, the hybrid/bundled Power Sum NEXT loss shall be 3 dB better than the specified pair-to-pair NEXT loss throughout the range of frequencies noted below for the Category. Calculated Power Sum values that are greater than 65 dB shall not be used to determine power sum compliance.

Category 3 Cables (772 kHz through 16.0 MHz)

The PSNEXT value shall be $26.2 - 15 \log_{10}(f/0.772)$ dB.

Category 5 Cables (772 kHz through 100.0 MHz)

The PSNEXT value shall be $35 - 15 \log_{10}(f/0.772)$ dB

Category 5E Cables (1.0 MHz through 100.0 MHz)

The PSNEXT value shall be $26.2 - 15 \log_{10}(f/0.772)$ dB

Category 6 hybrid/bundled cables shall comply with the Category 6 transmission requirements specified in this bulletin. Additionally, hybrid/bundled cables shall comply with the total power sum NEXT loss for any disturbed pair from all pairs internal and external to that pair's jacket within the hybrid/bundled cable, through the range of frequencies noted below for the category, shall not exceed the values using the following formula:

$$\text{PSNEXT}_{\text{hybrid/bundled, all pairs}} \geq 41.1 - 15 \log (f/100)$$

Near-end crosstalk (NEXT) measurements shall be determined using the following formula:

$$\text{NEXT} \geq 44.3 - 15 \log (f/100)$$

Category 6 cables (1.0 through 250.0 MHz)

Calculated PSNEXT loss limit that exceeds 65 dB shall revert to a limit of 65 dB.

BACKBONE CABLE CONSTRUCTION (see construction & marking requirements on Page 10)

Backbone cables shall meet the transmission performance requirements as specified for 100-Ohm unshielded (UTP) & shielded (ScTP/FTP/STP) twisted pair horizontal Category 3, 5, 5E, 6 and 6A CABLES with the exception to the requirements as specified below.

In cases where backbone cables consist of 25-pair groups, PSNEXT shall be determined for each 25 pr binder group. PSNEXT loss requirements shall not be applied between 25 pair binder groups.

Insertion Loss (IL) – Elevated temperature testing is not required.

Near End Crosstalk (Next) Loss – As shown below:

Performance Category	Frequency (MHz)	Minimum Near End Crosstalk, NEXT (dB)
3	$1.0 \leq f_{\text{MHz}} \leq 16.0$	Not Specified
5	$1.0 \leq f_{\text{MHz}} \leq 100.0$	$32 - 15 \log(f/100)$
5E	$1.0 \leq f_{\text{MHz}} \leq 100.0$	$35.3 - 15 \log(f/100)$
6	$1.0 \leq f_{\text{MHz}} \leq 250.0$	$44.3 - 15 \log(f/100)$
6A	$1.0 \leq f_{\text{MHz}} \leq 500.0$	$44.3 - 15 \log(f/100)$

Near End Crosstalk (NEXT) Loss shall be measured for all adjacent 4 pair combinations in accordance with ASTM D4566 for all frequencies as shown above. Multipair backbone cables are evaluated in 4 pair groups. For 25 pair and multiple of 25 pair binder groups, the 25th pair shall comply with all other test parameters when used within any 4 pair group. In the case of multiple 25 pair binder groups, NEXT Loss shall be tested for each 25 pair binder group only without NEXT Loss requirements between binder groups.

Power Sum Near End Crosstalk (PSNext) Loss – As shown below:

Performance Category	Frequency (MHz)	Minimum Near End Crosstalk, NEXT (dB)
3	$1.0 \leq f_{\text{MHz}} \leq 16.0$	$23 - 15 \log(f/16)$
5	$1.0 \leq f_{\text{MHz}} \leq 100.0$	$32 - 15 \log_{10}(f/100)$
5E	$1.0 \leq f_{\text{MHz}} \leq 100.0$	$32.3 - 15 \log(f/100)$
6 (For four (4) pr. Cables only)	$1.0 \leq f_{\text{MHz}} \leq 250.0$	$42.3 - 15 \log(f/100)$
6A (For four (4) pr. Cables only)	$1.0 \leq f_{\text{MHz}} \leq 500.0$	$42.3 - 15 \log(f/100)$

In the case of multiple 25 pair binder groups, PSNEXT Loss shall be tested for each 25 pair binder group only without PSNEXT Loss requirements between binder groups.

Attenuation to Crosstalk Far (ACRF) – As shown below:

Performance Category	Frequency (MHz)	Minimum Near End Crosstalk, NEXT (dB)
3	$1.0 \leq f_{\text{MHz}} \leq 16.0$	Not Specified
5	$1.0 \leq f_{\text{MHz}} \leq 100.0$	Not Specified
5E	$1.0 \leq f_{\text{MHz}} \leq 100.0$	$23.8 - 20\log(f/100)$
6	$1.0 \leq f_{\text{MHz}} \leq 250.0$	$27.8 - 20\log(f/100)$
6A	$1.0 \leq f_{\text{MHz}} \leq 500.0$	$27.8 - 20\log(f/100)$

Far End Crosstalk (FEXT) Loss shall be measured for all adjacent 4 pair combinations in accordance with ASTM D4566 for all frequencies as shown above. Multi pair backbone cables are evaluated in 4 pair groups. For 25 pair and multiple of 25 pair binder groups, the 25th pair shall comply with all other test parameters when used within any 4 pair group. In the case of multiple 25 pair binder groups, FEXT Loss shall be tested for each 25 pair binder group only without FEXT Loss requirements between binder groups and ACRF shall be calculated subtracting the insertion loss of the disturbed pair of the backbone cable from the FEXT Loss.

Power Sum Attenuation to Crosstalk Far (ACRF) – As shown below:

Performance Category	Frequency (MHz)	Minimum Near End Crosstalk, NEXT (dB)
3	$1.0 \leq f_{\text{MHz}} \leq 16.0$	Not Specified
5	$1.0 \leq f_{\text{MHz}} \leq 100.0$	Not Specified
5E	$1.0 \leq f_{\text{MHz}} \leq 100.0$	$20.8 - 20\log(f/100)$
6 (For four (4) pr. Cables only)	$1.0 \leq f_{\text{MHz}} \leq 250.0$	$24.8 - 20\log(f/100)$
6A (For four (4) pr. Cables only)	$1.0 \leq f_{\text{MHz}} \leq 500.0$	$24.8 - 20\log(f/100)$

In the case of multiple 25 pair binder groups, PSFEXT Loss shall be tested for each 25 pair binder group only without PSFEXT Loss requirements between binder groups.

Propagation Delay – As shown Below:

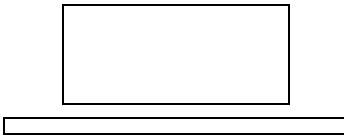
Performance Category	Frequency (MHz)	Propagation Delay (dB)
3	$1.0 \leq f_{\text{MHz}} \leq 16.0$	Not Specified
5	$1.0 \leq f_{\text{MHz}} \leq 100.0$	Not Specified
5E	$1.0 \leq f_{\text{MHz}} \leq 100.0$	$534 + 36/\sqrt{f}$
6 (For four (4) pr. Cables only)	$1.0 \leq f_{\text{MHz}} \leq 250.0$	$534 + 36/\sqrt{f}$
6A (For four (4) pr. Cables only)	$1.0 \leq f_{\text{MHz}} \leq 500.0$	$534 + 36/\sqrt{f}$

Propagation Delay Skew – As shown Below:

Performance Category	Frequency (MHz)	Propagation Delay Skew, (ns)
3	$1.0 \leq f_{\text{MHz}} \leq 16.0$	Not Specified
5	$1.0 \leq f_{\text{MHz}} \leq 100.0$	Not Specified
5E	$1.0 \leq f_{\text{MHz}} \leq 100.0$	45
6 (For four (4) pr. Cables only)	$1.0 \leq f_{\text{MHz}} \leq 250.0$	45
6A (For four (4) pr. Cables only)	$1.0 \leq f_{\text{MHz}} \leq 500.0$	45

Illustration 1 - SUMMARY OF REQUIREMENTS

Verification Program	Testing Requirement(s)	Applicable Standard Clause
1. Are products Verified by UL to UL Performance Category Program / ANSI/TIA-568?	<p>a. <u>Shielded and Unshielded</u> products require Bi-directional Testing for the Return Loss, internal Near End CrossTalk (NEXT), internal Power Sum Near End Crosstalk (PSNEXT), Transverse Conversion Loss (TCL) and Equal Level Transverse Conversion Transfer Loss (ELTCTL) tests.</p> <p>b. <u>Shielded</u> products require Coupling Attenuation Testing.</p>	<p>a. 568C.2 - Annex C</p> <p>b. 568C.2 - Paragraph 6.4.17</p>
2. Are products Verified by UL to UL Performance Categories 1, 2 or 4?	a. Considered by Industry to be an obsolete Performance Verification testing service. If the Subscriber has published UL Verifications for these products, <u>the Subscriber will be required to confirm their intention to withdraw UL Verification for these products in writing.</u>	N/A
3. Are products Verified by UL to ISO/IEC 11801, Standard for Information Technology - Generic Cabling for Customer Premises dated 09/2002, and Amendment 1 dated 04/2008?	a. <u>Shielded and Unshielded</u> products require Coupling Attenuation Testing and Bi-directional Testing for all performance tests specified in the Standard.	a. ISO11801 – Cable test method standard IEC61156-1, paragraph 6.3.4.3; cable test requirement standard IEC61156-5
4. Are products Verified by UL to BSEN50173-1 Standard for Information Technology – Generic Cabling Systems – Part 1: General Requirements dated 01/2007?	<p>a. <u>Shielded</u> products require Coupling Attenuation, Screening Attenuation Testing and Bi-directional Testing for the Return Loss, internal Near End CrossTalk (NEXT), internal Power Sum Near End Crosstalk (PSNEXT), Transverse Conversion Loss (TCL) and Equal Level Transverse. Conversion Transfer Loss (ELTCTL) tests.</p> <p>b. <u>Unshielded</u> products require Coupling Attenuation Testing and Bi-directional Testing for the Return Loss, internal Near End CrossTalk (NEXT), internal Power Sum Near End Crosstalk (PSNEXT), Transverse Conversion Loss (TCL) and Equal Level Transverse. Conversion Transfer Loss (ELTCTL) tests.</p>	<p>a. BSEN50173 – Cable test method standard BSEN50289-1-6 through 11; cable test requirement standard BSEN50288-2-1 (Cat 5E/5), 50288-5-1 (Cat 6) & 50288-4-1 (Cat 7)</p> <p>b. BSEN50173 – Cable test method standard BSEN50289-1-6 through 11; cable test requirement standard BSEN50288-3-1 (Cat 5E/5), 50288-6-1 (Cat 6)</p>
5. Are products Verified by UL to IBM Cabling System Technical Interface Specification (Standard and Extended “A” Types 1, 2, 6, 8 & 9)	a. Considered by Industry to be an obsolete Performance Verification testing service. If the Subscriber has published UL Verifications for these products, <u>the Subscriber will be required to confirm their intention to withdraw UL Verification for these products in writing.</u>	N/A
6. Are products Verified by UL to the Thomas & Betts 100-Ohm ALLAN Cable Interconnection System Specification?	a. Considered by Industry to be an obsolete Performance Verification testing service. If the Subscriber has published UL Verifications for these products, <u>the Subscriber will be required to confirm their intention to withdraw UL Verification for these products in writing.</u>	N/A
7. Are products Verified by UL to NEMA WC66, Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pair Cables dated 01/01/2001, and Errata dated 1/28/2003?	a. <u>Shielded and Unshielded</u> products require Bi-directional Testing for all performance tests specified in the Standard.	NEMA WC66
8. Are products Verified by UL to NEMA WC63.1, Performance Standard for Twisted Pair Premise Voice and Data Communications Cable dated 01/01/2005?	a. <u>Shielded and Unshielded</u> products require Bi-directional Testing for all performance tests specified in the Standard.	NEMA WC63.1

Illustration 2 – DRAFT DBVI GUIDE TEXT

DVBI.Guide Info
Local Area Network (LAN) Cable Verified for Transmission
Performance in Accordance with National or International
Specifications

[View Listings](#)

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[LIS Home Page](#)

[Corporate Home Page](#)

Local Area Network (LAN) Cable Verified for Transmission Performance in Accordance with National or International Specifications

[See General Information for Local Area Network \(LAN\) Cable Verified for Transmission Performance in Accordance with National or International Specifications](#)

Date

GENERAL

This category covers local area network cable whose signal transmission characteristics have been determined to be in accordance with one of the specifications shown below or other national or international data transmission performance specifications.

Both "Listed" and "Non-Listed" local area network cables can be evaluated for data transmission performance.

Listed Cables - Listed cables have also been investigated in accordance with the Standard for Communications Cables, UL444 (e.g. – as Type CMP, CMR, CM, CMX, etc.) and for use in accordance with ANSI/NFPA 70, "National Electrical Code". For additional information, see Communications Cable ([DUZX](#)).

Non-Listed Cables – Non-Listed cables have not been investigated in accordance with the Standard for Communications Cables, UL444 and are for use where ANSI/NFPA 70, "National Electrical Code" does not apply. These cables have only been evaluated for data transmission performance.

ADDITIONAL INFORMATION

For additional information, see Electrical Equipment for Use in Ordinary Locations ([AALZ](#)).

REQUIREMENTS AND SURFACE PRINT MARKINGS

Listed and Verified Cables

Listed cable, employing a solid conductor, that is additionally marked "Verified (UL) Category 3, 5, 5E, 6 or 6A [including latest draft number if applicable]" has been evaluated in accordance with ANSI/TIA-568C.2, "Balanced Twisted-Pair Telecommunications Cabling and Components Standards". Listed cable, employing a stranded conductor, is marked "Verified (UL) Category 3, 5, 5E, 6 or 6A [including latest draft number if applicable] Patch Cable".

Listed cable, employing a solid conductor, that is additionally marked "Verified (UL) Category 5e, 6, 6A or 7 ISO/IEC 11801" has been evaluated in accordance with ISO/IEC 11801, "Information Technology - Generic Cabling for Customer Premises". Cables that bear this surface mark have had the cable performance evaluated to requirements as stated in IEC 61156-5, "Multi-Core and Symmetrical Pair/Quad Cables for Digital Communications - Part 5: Symmetrical Pair/Quad Cables with Transmission Characteristics up to 1,000 MHz-Horizontal Floor Wiring - Sectional Specification". Listed cable, employing a stranded conductor, is marked "Verified (UL) Category 5e, 6, 6A or 7 Patch Cable ISO/IEC 11801".

Listed cable, employing a solid conductor, that is additionally marked "Verified (UL) Category 6 or 7 NEMA WC66" has been evaluated in accordance with NEMA WC66, "Performance Standard for Category 6 and 7 100 Ohm Shielded and Unshielded Twisted Pair Cable." Listed cable, employing a stranded conductor, is marked "Verified (UL) Category 6 or 7 Patch Cable NEMA WC66".

Listed cable, employing a solid conductor, that is additionally marked "Verified (UL) Category 3, 5 or 5E NEMA WC63.1" has been evaluated in accordance with NEMA WC63.1, "Performance Standard for Twisted Pair Premise Voice and Data Communications Cables." Listed cable, employing a stranded conductor, is marked "Verified (UL) Category 3, 5 or 5E Patch Cable NEMA WC63.1."

Listed cable, employing a solid conductor, that is additionally marked "Verified (UL) Category 5, 6 or 7 BS EN 50173-1" has been evaluated in accordance with BSEN 50173-1, "Information Technology – Generic Cabling Systems – Part 1: General Requirements". Cables that bear this surface mark have had the cable performance evaluated to requirements as stated in EN 50288-1, "Multi-Element Metallic Cables Used in Analogue and Digital Communication and Control - Part 1: Generic Specification". Listed cable, employing a stranded conductor, is marked "Verified (UL) Category 5, 6 or 7 Patch Cable BS EN 50173-1"

Listed cable that is additionally marked "Verified (UL) In Accordance With [Specification name and/or number]" complies with the requirements of the transmission performance specification referenced in this marking.

Verified Only (Non-Listed) Cables

This cable is marked as noted below to indicate compliance to the referenced specification. The UL symbol (either the "UL in a circle symbol" or "(UL)") cannot be used in place of "Underwriters Laboratories Inc." in the statement. Non-Listed cable employing a solid conductor and investigated to ANSI/TIA-568.C.2 "Balanced Twisted-Pair Telecommunications Cabling and Components Standards" is marked "Verified by Underwriters Laboratories Inc. in Accordance with Category 3, 5E, 6 or 6A ANSI/TIA-568.C.2 [including latest draft number, if applicable] Only". This print legend may be abbreviated as "Verified by Und Lab Inc. Only to ANSI/TIA-568.C.2 Cat 3, 5E, 6 or 6A". Non-Listed cable employing a stranded conductor is marked "Verified by Underwriters Laboratories Inc. in Accordance with Category 3, 5E, 6 or 6A Patch Cable ANSI/TIA-568.C.2 [including latest draft number, if applicable] Only". This print legend may be abbreviated as "Verified by Und Lab Inc. Only to ANSI/TIA-568.C.2 Cat 3, 5E, 6 or 6A Patch Cable".

Non-Listed cable employing a solid conductor and investigated to ISO/IEC 11801, "Information Technology - Generic Cabling for Customer Premises" is marked "Verified by Underwriters Laboratories Inc. in Accordance with Category 5e, 6, 6A or 7 ISO/IEC 11801 Only". This print legend may be abbreviated as "Verified by Und Lab Inc Only to ISO/IEC 11801 Category 5e, 6, 6A or 7". Cables that bear this surface mark have had the cable performance evaluated to requirements as stated in IEC 61156-5, "Multi-Core and Symmetrical Pair/Quad Cables for Digital Communications - Part 5: Symmetrical Pair/Quad Cables with Transmission Characteristics up to 1,000 MHz- Horizontal Floor Wiring - Sectional Specification". Non-Listed cable employing a stranded conductor is marked "Verified by Underwriters Laboratories Inc. in Accordance with Category 5e, 6, 6A or 7 Patch Cable ISO/IEC 11801 Only". This print legend may be abbreviated "Verified by Und Lab Inc Only to ISO/IEC 11801 Category 5e, 6, 6A or 7 Patch Cable".

Non-Listed cable employing a solid conductor and investigated to NEMA WC 66, "Performance Standard for Category 6 and 7 100 Ohm Shielded and Unshielded Twisted Pair Cables," is marked "Verified by Underwriters Laboratories Inc. in Accordance with Category 6 or 7 NEMA WC 66 Only". This print legend may be abbreviated as "Verified by Und Lab Inc Only to NEMA WC 66 Category 6 or 7". Non-Listed cable employing a stranded conductor is marked "Verified by Underwriters Laboratories Inc. in Accordance with Category 6 or 7 Patch Cable NEMA WC 66 Only". This print legend may be abbreviated as "Verified by Und Lab Inc Only to NEMA WC 66 Category 6 or 7 Patch Cable".

Non-Listed cable employing a solid conductor and investigated to NEMA WC63.1, "Performance Standard for Twisted Pair Premise Voice and Data Communications Cables" is marked "Verified by Underwriters Laboratories Inc. in Accordance with Category 3, 5 or 5E NEMA WC 63.1 Only". This print legend may be abbreviated as "Verified by Und Lab Inc. Only to NEMA WC 63.1 Category 3, 5 or 5E".

Non-Listed cable employing a stranded conductor is marked "Verified by Underwriters Laboratories Inc. in Accordance with Category 3, 5 or 5E Patch Cable NEMA WC 63.1 Only". This print legend may be abbreviated as "Verified by Und Lab Inc. Only to NEMA WC 63.1 Category 3, 5 or 5E Patch Cable".

Non-Listed cable employing a solid conductor and investigated to BS EN 50173-1, "Information Technology – Generic Cabling Systems – Part 1: General Requirements" is marked "Verified by Underwriters Laboratories Inc. in Accordance with Category 5, 6 or 7 BS EN 50173-1 Only". This print legend may be abbreviated as "Verified by

Und Lab Inc. Only to BS EN 50173-1 Category 5, 6 or 7". Cables that bear this surface mark have had the cable performance evaluated to requirements as stated in EN 50288-1, "Multi-Element Metallic Cables Used in Analogue and Digital Communication and Control - Part 1: Generic Specification". Non-Listed cable employing a stranded conductor is marked "Verified by Underwriters Laboratories Inc. in Accordance with Category 5, 6 or 7 Patch Cable BS EN 50173-1 Only". This print legend may be abbreviated "Verified by Und Lab Inc. Only to BS EN 50173-1 Category 5, 6 or 7 Patch Cable".

Non-Listed cable that is marked "Verified by Underwriters Laboratories Inc. in Accordance with [Specification name and/or number & category performance number] Only" complies with the requirements of the transmission performance specification referenced in this marking. This print legend may be abbreviated as "Verified by Und Lab Inc Only to [Specification name and/or number & category performance number]".

UL MARK

Listed and Verified Cables

The required surface markings on the product, as described above and the Listing Mark of Underwriters Laboratories Inc. on the attached tag, the reel, or the smallest unit container in which the product is packaged is the only method provided by UL to identify products manufactured under its Listing and Follow-Up Service. Since these cables are Listed under the Communications Cable (DUZX) product category, the Communications Cable Listing Mark is used and this Mark will also include the text "Verified in Accordance with [Specification name and/or number]".

Verified Only (Non-Listed) Cables

The required surface markings on the product, as described above and the Verification Mark of Underwriters Laboratories Inc. on the attached tag, the reel, or the smallest unit container in which the product is packaged is the only method provided by UL to identify products manufactured under its Verification and Follow-Up Service. The Verification Mark for these products includes the UL symbol (as illustrated in the Introduction of this Directory) together with the word "VERIFIED," a control number, the product name "Data Transmission Cable" and the Specification name and/or number.

UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. UL shall not incur any obligation or liability for any loss, expense or damages, including incidental or consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Guide Information.

Cutoff

LOOK FOR VERIFICATION MARK

UL Cutoff

Directory: ELECCONST

[UL Listed and Classified Products](#)[UL Recognized Components](#)[Products Certified for Canada](#)

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The appearance of a company's name or product in this database does not in itself assure that products so identified have been manufactured under UL's Follow-Up Service. Only those products bearing the UL Verification Mark should be considered to be Verified and covered under UL's Follow-Up Service. Always look for the Mark on the product.

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Illustration 3 – UL’s June 1, 2010 Holographic Labeling Subscribers Bulletin

Subjects 13, 444, 1424, 1425, 1655, 1651, 1690, 2250 and 2261
 Page 1 of 5
 June 1, 2010

TO: Subscribers to UL’s Certification Services for:

Communications Cable (DUZX / DUZX7)
 Communications Cable Verified to UL Performance Category Program (DUZX)
 Data Transmission Cable Verified in Accordance With National or International Specifications (DVBI)
 Community Antenna Television Cable (DVCS)
 Data Processing Cable (EMRB)
 Non-Power-Limited Fire-Alarm Cable (HNHT)
 Power-Limited Fire-Alarm Cable (HNIR / HNIR7)
 Instrumentation Tray Cable (NYTT)
 Network Powered Broadband Communications Cable (PWIP)
 Optical Fiber Cable (QAYK / QAYK7)
 Power Limited Circuit Cable (QPTZ)
 Plenum Cable Compounds (QMTM2) – For Information Only

SUBJECT: UL’s Mark Integrity Program for Telecommunications Cables

The purpose of this bulletin is to inform UL Subscribers of the revisions made to the proposed requirements affecting the Mark Integrity (Follow-Up) Programs for the above product categories based on Industry’s response. The program elements proposed in our January 4, 2010 Bulletin were discussed during Industry Forums which were held in the US and China. Comments were received at the forum and from individual subscribers. The revised program described in this Bulletin incorporates some of the suggested changes requested by Industry.

The implementation timeframe for each new requirement is provided in the details below.

I. Holographic Listing Marks and October 1, 2010 Effective Date

To further enhance the integrity of the UL Mark, UL is introducing a holographic label requirement for the product categories shown above. This requirement will become effective October 1, 2010. The use of these special holographic labels has proven to be an effective tool in deterring counterfeit products from entering the marketplace. The number of labels, format, and effective date were revised based on comments received from Industry.

On and after October 1, 2010 all UL Marks for the above product categories (except for Plenum Cable Compounds (QMTM2)) will be printed on special UL holographic material. Of course, you may order and begin using UL holographic labels prior to the October 1, 2010 effective date, if you so choose. To ensure delivery of custom hologram labels by October 1, orders should be placed by Aug 15, 2010. Standard label orders should be placed by September 15 to ensure arrival by October 1, 2010.

There will be unique holographic labels for each of the product categories (CCN’s) noted above. UL Label Centers will stock Standard hologram labels in several of the categories in the more popular denominations. Subscribers will also be able to order Combination (custom) labels printed on holographic label material, through UL’s vendor of holographic labels after a successful review and approval of the label artwork by one of UL’s Label Centers.

Subjects 13, 444, 1424, 1425, 1655, 1651, 1690 and 2261
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 June 1, 2010

The requirements for engineering marking information on the tag or reel and the methods for applying these markings remain unchanged. UL will be working with the user community such as Distributors, and authorities having jurisdiction (AHJ's) to assist in the understanding of the holographic label and the importance of looking for the UL Label.

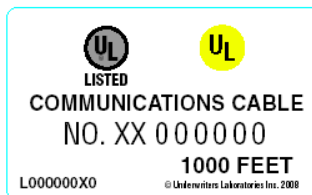
The introduction of a holographic label requirement will mean that Subscribers who have been authorized by UL to print their own UL Listing Marks at their factory or order them from any UL authorized label supplier must discontinue this practice of obtaining UL Marks. As a convenience to Subscribers, UL will make Standard holographic labels available in several of the above product categories. Any Subscribers who are currently authorized by UL to use nondenominational labels will continue to be authorized to use holographic nondenominational labels and Standard holographic nondenominational labels will also be made available. Subscribers who are interested in using nondenominational labels will need to contact their local UL Label Center to arrange for an assessment of their production record keeping system and their process for control of the UL Mark. These requests will be evaluated on a case-by-case basis.

The LAN Performance Verification Services under DUZX and DVBI will also be included in this Holographic Labeling requirement due to the intended end-use of these products, the construction similarities and the fact that Listing and Verification Follow-Up Service Procedures cross-reference each other.

The label usage will continually be monitored and future enhancements may be made to the requirements where determined necessary.

Ordering Hologram Labels

UL will stock Standard hologram labels in several of the categories in the more popular denominations. You may visit UL's website at <http://www.ul.com/global/eng/pages/corporate/aboutul/ulmarks/labelorders/> to see the types and denominations available. Orders for UL Standard labels may be made directly to a UL Label Center or through an on-line form at the above website. Standard labels will take the form as shown below.



Combination (custom) hologram labels can be ordered in any of the above product categories in the denomination needed for your production. Combination labels will contain in addition to the Listing Mark, Company specific information such as your Company name, file number, type designation, etc. Combination labels must be purchased through UL's designated printer of holographic labels. The attached Appendix details how to order Combination holographic labels. Payment for the printing and shipping costs associated with the Labels will be made directly to the printer. This is separate from the cost associated with UL's Follow-Up fees that are invoiced directly by UL.

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Destruction of Obsolete Labels

In order to effectively transition by October 1, 2010, to the UL Marks printed on hologram material, all unused UL Marks that will become obsolete as the result of the introduction of the new hologram label will need to be destroyed on or before October 1, 2010. UL field representatives will be monitoring the destruction of these labels. There will be no refunds or replacements for labels destroyed as a result of this policy. Manufacturers can eliminate the need for the destruction of current UL Marks by minimizing current inventories and converting as soon as possible to the new holographic UL labels.

Questions relating to the ordering of UL holographic labels may be directed to any UL Label Center. Contact information may be found at the above mentioned website.

II. Establishment of “Compound Material Groupings” and Analytical Program – Effective Date to be Determined

a) Establishment of “Compound Material Groupings”

“Compound Material Groupings” will be established on an ongoing basis, based upon identified combinations of jacket and individual conductor insulation compound designations, by grade and manufacturer (i.e. jacket material grade X from Mfr A and insulation material grade Y from Mfr. B). For Follow-Up testing purposes, a construction made from a particular combination (family grouping) will be considered to represent all constructions made with the same jacket and individual conductor insulation compound materials (same family). This list will be maintained in the UL File with the reference dates of the analytical data described below.

b) Analytical Program

All authorized Plenum, Riser, and Vertical Tray cable constructions will be subjected to an analytical program on an ongoing basis. The analytical program will consist of the Infrared Analysis (IR) and Elemental Analysis of the jacket and individual conductor insulation taken from extruded cable as well as a Cone Calorimeter on the finished cable. This information will be used to predict the performance of the finished cable in Large Scale Flame test (LSFT) scenarios and will be a contributing factor for future verification of cables. Optical Fiber Cables will only need to have their jacket materials subjected to the analytical program.

If a jacket/insulation material had not been subjected to an analytical program either during the new work submittal or under UL's FUS program within three years from the date of this Bulletin, the authorization for the use of UL's Certification Marks will be suspended for the entire compound material grouping of cables until samples are selected.

A separate UL Standards communication will be released by UL providing Subscribers with details related to the above.

New Work Project Submittals

Any new Plenum, Riser or Vertical Tray cable New Work Projects, the finished cable will need to be subjected to the analytical program described in item IIb above. The reference data will be identified in the cable's UL File and will serve as the basis for comparison under the UL FUS Program.

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Follow-Up Sample Selections

To create and maintain the compound material grouping and to conduct the analytical program, the following samples shall be selected. These samples are in addition to the sample selections currently required and described in the FUII pages,

A ten-foot (approximately three meters) sample of extruded riser, plenum or vertical tray cable will be selected during routine visits by the UL Field Representative. The sample selections tested will not exceed a maximum of eight samples a year. The samples will be subjected to the analytical test program noted in Item IIb above. The sample selections will be rotated such that samples from each compound material grouping are selected over a three-year period. If a particular compound material grouping is not selected within this timeframe, authorization for the use of UL's Certification Marks may be suspended for the entire compound material grouping until samples can be selected. The Subscribers should feel free to contact the UL Representative when there is a production run of a particular compound material grouping so that there will be no delays in production.

- a) Should the results of the analytical testing indicate a failure to comply with the Large Scale Flame test, the authorization for the use of UL's Certification Marks will be suspended for the entire compound material grouping. A sample of a representative cable will be required for the large-scale flame testing as well as any other FUS tests deemed necessary. If acceptable results are obtained on these samples, the use of the UL Certification Marks may again be authorized, an analytical program will be conducted on these samples and the results will be placed in your UL File as indicated above.
- b) Should the results of the analytical testing support compliance with the Large Scale Flame test, no further testing would be required. The results of the analytical program will be documented for future reference.

III. UL Market Survey Program

Market Surveys are currently an integral part of UL's Follow-Up Programs for Safety Certification and LAN Verification Services. UL staff purchase UL labeled products from Retailers or Distributors to assure the ongoing compliance of UL Labeled products in the field. The Market Survey will become a permanent element of the Follow-Up Programs for the above categories and is contingent upon the ability to purchase UL Listed cables from a cross-section of the client base.

Effective upon the date of this Bulletin, **when requested**, subscribers will be expected to provide the names of their distributor(s) to UL. You will be contacted by UL for this information by a separate communication. Please note that as part of your continued certification, it will be mandatory to provide this information and failure to cooperate may result in further action on your File.

Subscribers at the forums had indicated that they were concerned with the confidentiality of the information. As discussed at the forums, this information will remain proprietary just as any other information provided to UL.

Once this distributor / customer information is provided, UL will have access to telecom cable products manufactured by all Listees in these categories. The Market Survey will be conducted by UL on an ongoing basis (as opposed to a fixed frequency). Each of our purchases from distribution will sample a much broader cross-section of the client base and rely primarily on analytical testing to predict the fire / smoke performance of finished cables.

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The jacket and insulation materials of purchased cables would be subject to analytical testing described in IIb above, to identify material composition consistent with cable fire / smoke performance requirements. If the results of the analytical testing indicate a failure to comply with the Large Scale Flame test, another sample of the same cable of sufficient length will be purchased from the distributor as part of a Product Incident Report (PIR) (previously know as a Field Report) and subjected to large scale fire testing, as well as any other Follow-Up Tests determined necessary. If acceptable test results are obtained, no further action would be required.

If unacceptable results are obtained, the authorization for the use of UL's Certification Marks will be suspended for the entire compound material grouping of cables. Depending on the significance of the nonconformance, additional action will need to be taken which may result in the withdrawal of the File. At a minimum, a suitable root cause analysis and corrective action will be needed. After the appropriate corrective action plan is put into place, the manufacturer will need to provide samples for the large-scale flame testing as well as any other tests deemed necessary including analytical testing. If acceptable results are obtained, the use of UL's Certification Marks for the compound material grouping may again be authorized. The costs for the tests due to a nonconformance will be billed back to the Applicant.

As described in Item I of this Bulletin, the evidence of UL Listing is the UL Holographic Listing Mark (Label) and the UL Logo "(UL)" in the surface print, which is mandatory. If a Subscriber's cables are purchased from distribution and found to bear the UL Logo in the surface print, without the Holographic Listing Mark on the reel / package, immediate action will be taken by UL, which may include taking possession of the UL Mark inventory, withdrawal of the Listing and consideration of a Public Notice.

IV. Minimum Inspection Frequency – Effective October 1, 2010

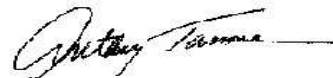
The minimum inspection frequency for the subject categories will be four times a year regardless of the production level or the number of Labels used.

V. UL Marking on the Cable

As indicated in the published Guide Card for these products, "The UL symbol on the product and the Listing Mark of Underwriters Laboratories Inc. on the attached tag, the reel, or the smallest unit container in which the product is packaged is the only method provided by UL to identify products manufactured under its Listing and Follow-Up Service." On the product means that the UL symbol shall appear on the surface print of the cable. The UL symbol can be either the complete UL in a circle, or can be the letters "UL" in parenthesis "(UL)". Based on the above, it is important to remind subscribers that the surface printing of the UL Certification Mark on the wire insulation or jacketed material is **only** permissible when the accompanying reel or smallest unit container is also provided with the UL Listing Mark. Should it be determined (either as a result of a UL FUS inspection visit or through the manufacturer's own control procedures), that the cable is no longer eligible to have the UL Certification Mark applied to the product, then it will be necessary to ensure that any surface printing referencing UL is removed. Even in situations where the manufacturer may claim the product complies with the requirements yet they wish to ship the product without the UL Certification Markings applied, then any surface printing referencing UL must be removed.

Any questions regarding the above can be directed to the undersigned. Thank you for your cooperation with our Follow-Up Services Program.

UNDERWRITERS LABORATORIES INC.



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APPENDIX

ORDERING UL COMBINATION (CUSTOM) HOLOGRAPHIC LABELS

UL holographic labels may only be ordered through UL's vendor identified below. This is necessary so that proper controls are in place for both the manufacture and release of all UL holographic labels and to assure that these controls are maintained.

To order your custom UL holographic labels send your label order directly to:

The Label Printers
1710 N. Landmark Rd.
Aurora, IL 60506-1148

Phone: (630) 897-6970

(800) 229-9549

Fax: (630) 897-2801

www.thelabelprinters.com

Please include your telephone, fax and email address on your order. An invoice will be sent to you from The Label Printers to cover the printing and shipping charges. You may be required to pay prior to the production of your order. Please contact The Label Printers directly for more information.

A copy of your label order must also be sent concurrently to a UL Label Center for the authorization and assignment of the serials that will appear on the finished labels. Contact information for UL's Label Centers may be found on UL's website located at:

<http://www.ul.com/global/eng/pages/corporate/aboutul/ulmarks/?set-cookie=true>

Your order to The Label Printers must include a label layout design, the quantity of labels being ordered, your label Part number, the type of Mark desired (i.e. UL symbol for the USA certification or the c-UL-us symbol for both Canada and the USA), the UL File No., factory location where the labels will be used and other information as required, such as the label denomination, i.e. 500 FT, 1000 FT, etc.

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