



## Comms Cabling Regulations & Standards Update

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### **Installation of Conduit for Customer Cabling**

**by  
ACMA**

There is some confusion in the telecommunications cabling industry about the colour and use of conduit used for housing communications cabling in indoor and outdoor situations.

#### **Colour of Conduit**

In most countries including Australia, standard colours are used to identify hazardous services provided in conduits. The Australian Standard AS-1345: 1995 *Identification of the contents of pipes conduits and ducts* is (based on international standards) and specifies the relevant colours for hazardous services.

Table 1 in AS-1345: 1995 provides a list of the designated colours for hazardous services. This information is reproduced in Table 1 AS/ACIF S009: 2006 (page 34), see below

### **Table 1**

**AS/ACIF S009: 2006**  
**Conduit colours in accordance with AS 1345 – 1995**  
**Associated with a hazardous service**

| Colour                 | Associated hazardous service          |
|------------------------|---------------------------------------|
| orange                 | electrical power                      |
| yellow or yellow-ochre | fuel, process, toxic or medical gases |
| silver grey            | steam                                 |
| brown                  | flammable and combustible liquids     |
| violet                 | acids and alkalis                     |
| light blue             | compressed air                        |

Conduits that contain telecommunications cables shall not be of a colour specified in Table 1. This restriction applies in all indoor and outdoor locations (e.g. cabling providers shall not install conduit marked for electrical use).

**Outdoor telecommunications conduit colour**

Non-metallic conduit for all outdoor use shall be coloured white or contain an indelible or durable continuous white stripe which is incorporated as part of the manufacturing process. Conduit must also be legibly and durably marked 'COMMUNICATIONS'.

Hazardous conduit is not to be painted white and then used by cabling providers for installing outdoor customer cabling.

**Indoor telecommunications conduit colour**

The current standards AS/ACIF TS 008-2001 *Requirements for authorised cabling products* and AS/ACIF S008: 2006 *Requirements for customer cabling products* do not specify a colour for indoor conduit. Conduit can be any colour provided it is not a hazardous colour, see Table 1.

However, the availability of white conduit has increased with most suppliers now stocking a large range of white conduit sizes that are labelled as communication conduit. The use of white conduit indoors is not mandatory but is encouraged mainly due to white being the international standard colour assigned to communications. If used, white conduit will reduce confusion as to the purpose of what cabling the conduit contains.

**Outdoor underground installations using conduit**

Customer cabling installed underground shall not be enclosed in a conduit of a hazardous colour, except in the following three cases:

(a) Such parts of the conduit that are fully encased in concrete or inaccessible under structural concrete, in which case the ends of the conduit shall be made white in a durable manner and the conduit used exclusively for telecommunications cabling.

(b) Conduit that does not contain a HV circuit and which is subducted by the cabling provider in a continuous run of insulating conduit complying with AS/ACIF S008 and IPX8 of AS 60529 in which the customer cable shall be enclosed.

(c) A customer cable that does not contain electrically conductive elements which may be directly installed, or subducted in insulating conduit that is not a prohibited colour, in an existing conduit containing a service listed in Table 1 in which case the cable shall be labelled at all access points with a suitable warning that it may contain a hazardous light.

Note 1: The exception of item (a) is based upon the rationale that subsequent access to the conduit between the existing ends of the conduit would be inhibited by the physical difficulty in doing so, and that the misleading colour of the conduit would therefore be unlikely to represent a safety hazard to cabling providers wanting to access a cable in the conduit.

Note 2: The exception of items (b) and (c) are subject to the requirements of the relevant utility for any other service contained in the conduit and are based on the rationale that the enveloping conduit identifies the other enclosed service, not the telecommunications service that also happens to be enclosed or subducted in the enveloping conduit.

Note 3: To avoid doubt, item (b) precludes any customer cable containing electrically conductive elements from being installed or subducted with HV circuits under any circumstances. Item (b) also applies even if the conduit is empty. In such cases, this provides some protection if a hazardous service is subsequently installed in the conduit, plus effectively incurs a cost penalty for not installing the correct colour of conduit for telecommunications cabling in the first place. However, it also allows the installation of a large enveloper conduit of a colour identified in Table 1 for subducting of several services between draw points.

Note 4: See also S009:2006 Clause 18.3 for use of conduit for underground customer cabling.

Note 5: Access points described in Item (c) that are damp and contain electrical cables (e.g. underground electrical pits or access holes) may be hazardous to cabling providers, due to electrical leakage from power cables or joints, and should only be accessed by suitably qualified persons.

#### Outdoor surface cabling installations using conduit

Where any outdoor surface cable is installed in a location exposed to direct sunlight

- (a) the exposed parts of the cable shall be manufactured of UV resistant material; or
- (b) the cable shall be mechanically protected from exposure to UV radiation by suitable means (e.g. conduit)

### **Public roadways or footpaths installations using conduit**

Underground cable installed under a public footway or roadway shall be:

- (a) enclosed in compliant conduit at a minimum depth of 450mm; or
- (b) covered by a white marking tape which includes lettering to identify the service and which complies with AS/NZS 2468.1 1995 and is installed a minimum of 100mm above the cable

### **Aerial cabling installations using conduit**

Customer cable installed as aerial cabling shall meet the requirements of AS/ACIF S008 for UV resistance unless the entire length of the cable is protected against exposure to direct sunlight, e.g. totally enclosed in suitable conduit.

For the complete details refer to the *Wiring Rules AS/ACIF S009: 2006* and *AS/ACIF S008: 2006 Requirements for Customer Cabling Products*, see resource details below.

### **Resource details:**

- [Australian Standard: Requirements for Customer Cabling Products? AS/ACIF S008:2006](#)
- [Australian Standard: Installation requirements for customer cabling \(Wiring Rules\)? AS/ACIF S009:2006](#)
- [ACMA technical information](#)

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## TECHNICAL by Milcom Communications P/L

Continuing on from last months article let's look further at Voice Grade Data Modems. Whilst these have some major limitations they have some great advantages. Let's compare them:

| <b>Advantages</b>   | <b>Disadvantages</b>  |
|---|---|
| <ul style="list-style-type: none"> <li>• Can connect to a standard telephone line anywhere in the world</li> <li>• Connection is easy</li> <li>• Cost of modems is very low</li> <li>• Many to many connections are available just like a phone, you call any one as long as you know there phone number</li> <li>• There are more than 700 Million fixed telephone lines around the world</li> </ul> | <ul style="list-style-type: none"> <li>• Speed is restricted by the bandwidth of the telephone line, this being 300 to 3,400Hz.</li> <li>• Maximum speed is typically 48Kbps</li> <li>• Best performance is achieve at 33.6Kbps (speed vs error free transmission)</li> </ul> |

Voice grade modems presently transmit robustly up to 33.6 kbps over a plain old telephone service (POTS). This is a huge improvement from only twenty years ago when the limit was around 1.2 kbps. As at this point in time the highest transfer rate on a POTS is considered to be 54 kbps.

Keeping in mind that the voice grade bandwidth available on POTS does not exceed 3.3 kHz this is impressive and only possible due to advances in technology. Modems like V.34 achieve 10 bits per Hertz of bandwidth, a great figure that pushes the throughput to the upper limits. In addition to this the V.34 modem transmits and receives simultaneously, in the same band.

These modems are only possible because of the advances in:

1. Algorithms
2. Digital signal processing
3. Semiconductor technology

### ALGORITHMS

Algorithms are mathematical processes that allow us to convert the number of bits required to be transmitted into a smaller number of bits. For example, the actual bit rate possible on a POTS is 2400bps, so we need to reduce the bit rate from 54Kbps to 2400.

To do this, a mathematical process can be applied where we take for example 10 bits of data and convert them into two bits of information that needs to be transmitted.

This mathematical process must be able to compress the 10 bits into two bits and allow the receiver to then convert the 2 bits back to the original data stream without error.

### DIGITAL SIGNAL PROCESSING

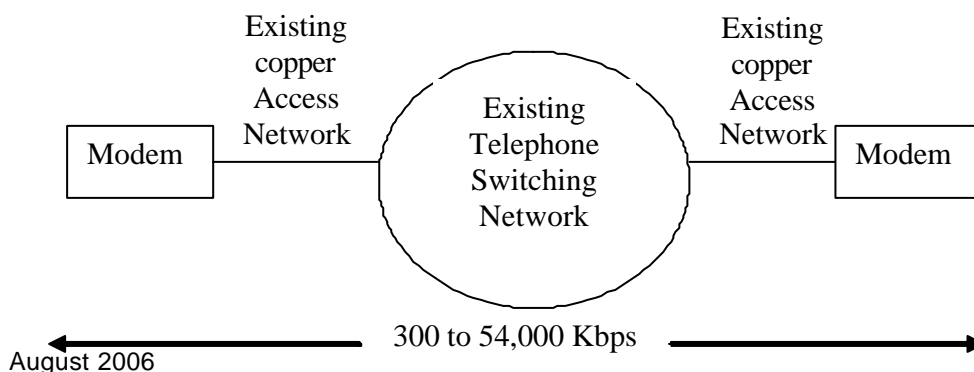
Whilst we all think of digital as being totally different from analogue it's not quite that simple. Digital is really a subset of analogue. Analogue signals can vary infinitely in frequency and amplitude. Digital signals have defined discrete steps, but still retain many of the characteristics of analogue.

When you transmit a digital signal for example at 2400bits per second you are actually transmitting many sine waves simultaneously that when combined, create the digital signal. When you transmit sine waves of different frequencies and amplitude they travel via the cables at different speed so even though they leave simultaneously they arrive at the receiver at different times. Therefore the electronics has to cater for the differential in propagation between different frequencies. This is what we refer to as digital signal processing. As always there is more to this story but here we are only trying to give you an overview.

### SEMI CONDUCTOR TECHNOLOGY

The main improvement in semi conductor technology has been the ability to process more instructions in a short period of time. If we go back to our improved algorithm where we convert 10 bits into 2 bits we need to be able to receive all 10 bits into a chip set before making a decision on what it should be converted to. Then we have to send it out before we have to repeat the process with the next 10 bits. If you imagine an incoming bit stream of 54Kbps the electronics need to process each group of 10 bits 5400 times every second.

Voice grade modems operate at the customer's end of telephone lines and transmit signals through the existing telephone switching network without alteration. The network treats them exactly like voice signals. This has been their singular power, that despite rather slow speeds compared to today's demands, they can be connected immediately anywhere a telephone line exists, and there are nearly 700 million such locations around the world.



The bandwidth limitation placed on the modem to modem communications is due to the design of the “existing telephone switching network” and not the access network. So if we can by pass the existing switched networks speed could be much higher.

Copper access lines can pass frequencies into MHz region which means much higher data rates but this we will look at in the next article.

In the meantime if you have any questions please don't hesitate to contact Milcom on 1300 369 320.