



Specification PTC 222: 1999

Telecom Requirements

for Customer Premises Cable

**(2 or 4 pairs, with 0.5 mm
conductors)**

Access Standards
Telecom Corporation of New Zealand Limited
Wellington
New Zealand

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RELATED DOCUMENTS

PTC 100	Telecom Permit to Connect : General Conditions
PTC 103	Code of Practice for Customer Premises Wiring
AS 1049	Telecommunications cables - insulation and sheath- polyethylene
AS 1125	Conductors in insulated electric cables and flexible cords
AS 2700S	Colour standards for general purposes
AS/NZS 3080	Telecommunications installations - Integrated telecommunications cabling systems for commercial premises
AS 3081 - 2	Telecommunications installations - Twisted pair cables for telecommunications applications
AS/NZS 3086	Telecommunications installations - Integrated telecommunications cabling systems for small office/home office premises
AS 3147	Approval and Test specification - electric cables - thermoplastic - insulated for working voltages up to and including 0.6/1 kV
BS 5099	Spark Testing of Electric Cables
IEC 189	Low frequency cables and wires with pvc insulation and pvc sheath
IEC 189-1	Part 1: general test and measuring methods
IEC 304	Standard colours for insulation for low frequency cables and wires
ANSI/IEEE Std. 455-1976	Standard Test Procedure for Measuring Longitudinal Balance of Telephone Equipment Operating in the Voice Band
EIA/TIA 568A	Commercial Building Telecommunications Cabling Standard

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FOREWORD

This Specification is issued by Telecom to define requirements for the unshielded twisted pair (UTP) cable to be used for residential type customer premises telecommunications wiring connected to the Telecom network. Cable meeting these requirements will permit compliance with Telecom Code of Practice PTC 103: 1998.

In preparing this Specification, Telecom recognises the rapid developments in telecommunications access technologies and increasing and extensive customer use of telephone lines for Fax and data including Internet access.

This specification provides requirements for a 2 pair cable for use in Telecom standard 2-wire installations and a 4 pair cable for Small Office Home Office (SOHO) installations. 0.5 mm diameter copper conductors are specified for both types. These cables offer improved high frequency performance relative to the earlier 3-pair cable with 0.4 mm diameter conductors (typically regarded as "Category 1" cable).

The minimum electrical performance requirements contained in this specification are equivalent to either "Category 3" or "Category 5", both of which are now "industry standards". This will ensure that complying cable can be widely sourced.

Cable confirmed by formal manufacturer's certification to comply with this Specification is eligible for the granting of a Telecom Telepermit. Only cable which is accepted by Telecom to comply with its Specifications is allowed to bear a Telecom "Telepermit" label.

Use of cable to this Specification will ensure compatibility with the insulation displacement connectors in sockets (telecommunications outlets) and other terminating hardware specified by Telecom. Such hardware is also marked with Telecom's "Telepermit" label.

Two pair cable manufactured to this Specification is intended for all new 2-wire installations and extensions, and additional lines. However, the earlier cable to Telecom specification PTC 204 is likely to remain in use for an interim period for extensions to some earlier 3-wire systems.

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1 SCOPE

1.1 Cable types

(1) This specification defines Telecom minimum requirements for unshielded, twisted pair (UTP) polymer insulated, Poly Vinyl Chloride (PVC) sheathed cable for customer premises wiring applications in accordance with Telecom Code of Practice PTC 103:1998.

(2) This cable is intended only for use within a building. For the purposes of this specification, non-plenum cable is satisfactory. There is no requirement for the cable sheathing to be halogen-free, or for the cable to have any specific "Reduced Flame Propagation" or "Reduced Fire Hazard" classification.

- *PVC-sheathed power and lighting cable is almost universally used in New Zealand homes. As such, there is little justification for the relatively small amount of telecommunications cable in such installations to be halogen-free or to have special fire-ratings.*

(3) The 2 pair cable covered in this Specification aligns with the internationally accepted standards for "Category 3" and the 4 pair cable aligns with "Category 5" cable. Both cables provide a significantly higher transmission performance than the 3-pair 0.4 mm cable previously specified by Telecom for general premises wiring applications. The new "general purpose" type used by Telecom is expected to be used in the majority of residential installations.

(4) 4-pair cable to the full Category 5 performance rating is specified for use by those customers requiring the additional features of Small Office Home Office (SOHO) installations as specified in PTC 103:1998 (to AS/NZS 3086:1996).

1.2 Test and acceptance criteria

This Specification covers performance requirements, which will usually be verified by compliance statements issued by the cable manufacturer or some recognised independent testing agency. Testing parameters are dealt with in the referenced Standards.

1.3 Format

(1) Those aspects of this Specification which are regarded as mandatory are printed in plain type with each paragraph shaded, as shown.

(2) All mandatory and other clauses which form part of this Specification are formally numbered.

(3) Comments and recommendations which are added only as indications of the best means of compliance are shown in italics in smaller type. Each is preceded with a "•" symbol, but without numbering. For example:

- *PVC-sheathed power and lighting cable is almost universally used in New Zealand homes. As such, there is little justification for the relatively small amount of telecommunications cable in such installations to be halogen-free or to have special fire-ratings.*

2 GENERAL

2.1 Background

(1) Telecom has been considering a change from 0.4 mm to 0.5 mm conductors for its customer premises telephone cabling for some time because the heavier gauge is more robust and there is a lower risk of breakage. Such a change also gives the opportunity to improve transmission performance. The main problem with such a change is the risk of mixed gauges being connected in the earlier 3-wire jackpoints, of which there are around 4 million in service. Should customers use two different wire gauges in the same slot of an insulation displacement connector, the reliability of the termination is seriously compromised.

(2) The introduction of 2-wire jackpoints, with their capability to terminate up to three different wire gauges, overcame this mixed gauge termination problem. As a result, 0.5 mm cable could be re-introduced for residential wiring.

(3) The international commercial building cabling standard (ISO/IEC 11801) has been adopted in New Zealand as AS/NZS 3080, in place of the North American Standard EIA/TIA 568A, which was previously in wide use and was, essentially, the de facto standard. These standards provide for three different classes of transmission performance, which are referred to as "Category 3", "Category 4" and "Category 5".

(4) 4-pair "Category 5" performance cable is now almost universally used for new commercial cabling installations in New Zealand. Its use is appropriate for SOHO installations to AS/NZS 3086:1996. However, its additional cost is not justified for most Telecom residential customers, whose needs are less demanding.

(5) Since most customers' do not need 4-pair "Category 5" cable, Telecom has introduced a 2-pair cable with 0.5 mm conductors, providing performance somewhat better than the standard Cat 3 cable. The new Telecom cable is intended initially for voice frequency applications. It is more than adequate for all current PSTN-based services, but it will no doubt be used for new broadband services as and when they come on stream.

(6) Some customers, especially those building new homes and having sophisticated needs, will no doubt choose to install a SOHO system utilising standard 4-pair Category 5 cable, despite its additional cost. This Specification also covers such cable, so that it can be lawfully used in residential premises for wiring which is to be connected to the Telecom network.

3 CONDUCTORS

This Section applies to both 2-pair and 4-pair cables.

3.1 Material

(1) Each conductor in the cable shall consist of a bright, scale-free solid wire of commercially pure annealed copper, smoothly drawn, circular in section, uniform in quality and free from all defects.

- *Tinned conductors are acceptable.*

(2) Each conductor shall have a nominal diameter of either 0.50 or 0.51 mm and an average resistance at 20 °C not exceeding the limit stated in Tables 1 and 2.

- *These options provide for both 24 AWG (0.51 mm) cable manufactured to the North American standard, and 0.5 mm cable manufactured to the international standard.*

4 INSULATION

This Section applies to both 2-pair and 4-pair cables.

4.1 Material

Each conductor shall be uniformly covered with a suitable solid (not foamed) thermoplastic insulating material. Pigmented polyolefins shall meet all the requirements of IEC 304.

4.2 Thickness

The radial thickness of the insulation shall be such that the electrical requirements of this Specification are satisfied, with the overall diameter over the insulation not exceeding 1.4 mm.

- *This restriction relates to the capacity of the Krone insulation displacement connectors used in jackpoints manufactured to Telecom PTC requirements.*

4.3 Colours

The colour of the insulation used for each conductor shall closely approximate the standard colours of PVC insulation depicted in AS 2700S. The actual colours to be used shall be as follows:-

(a) 2-pair cable

Pair 1	Blue	Blue-White
Pair 2	Orange	Orange-White

(b) 4-pair cable

Pair 1	Blue	Blue-White or White
Pair 2	Orange	Orange-White or White
Pair 3	Green	Green-White or White
Pair 4	Brown	Brown-White or White

- *Telecom wishes to keep to the internationally standardised colour coding for cable to PTC 222 and so ensure that installers can easily distinguish between the earlier 0.4 mm conductor cable and the 0.5 mm cable to this specification. This is best achieved by having two completely different sets of colours.*

- *Note that in (a) above, Telecom now mandates striped rather than plain white colouring of mates to help ensure that installers retain pair integrity when using the 2 pair general purpose cable, for which each pair has relatively few twists per metre. Such cabling is often installed by home handypersons, rather than professional cablers.*

- *Telecom also has a strong preference for striped rather than plain white colouring of mates in 4-pair cable. Again, the aim is to help ensure that installers and maintainers will be able to retain pair integrity, which can be far more critical in applications demanding the performance of category 5 cabling.*

4.4 Spark testing

The insulation shall have successfully withstood a spark test to IEC 189-1, such that there shall be no bare wire and no more than 3 pinholes in any 1000 m length of wire.

5 CABLE CONSTRUCTION

This Section applies to both 2-pair and 4-pair versions.

5.1 Pairing

Two conductors insulated as described in clause 4 shall be uniformly twisted together to form each pair. The lay lengths shall be chosen to meet the requirements of Table 1 for general purpose cable or the requirements of Table 2 for Category 5 4-pair cable.

5.2 Cable lay

The individually twisted pairs of conductors shall be formed into a compact and symmetrical cable. Subject to conformance with the required electrical performance characteristics of Table 1, there is no formal requirement for the individual pairs of the 2-pair cable to be laid with a twist.

5.3 Sheathing

(1) The cable shall be sheathed with general purpose sheathing grade PVC which shall meet the requirements of IEC 189.

(2) The PVC sheath shall be completely free from pinholes, joints, mended places and other defects.

(3) The nominal radial thickness of the PVC shall be 0.5 mm and shall have adequate mechanical strength and elasticity. These properties shall stay constant during the service life of the cable.

(4) The sheath shall fit closely to the core of the cable, but shall not adhere to the insulation of the conductors.

- *For Telecom's own applications, the overall dimension across the sheath of the 2-pair cable shall not exceed 4.9 mm. This allows the use of the staple guns currently in service. These use a 5 mm width staple.*
- *Staples should not be used with Category 5 cable, as there is risk of deformation and impairment of the electrical performance.*
- *The preferred sheath colours for 2-pair cable are cream, white or grey, but the colour chosen does not form part of this Specification.*
- *The preferred sheath colour for 4-pair Cat 5 cable is specified in AS/NZS 3080 as Harbour Blue, in accordance with AS 2700S, but the colour chosen does not form part of this Specification. For residential use, where the cable may be clipped to a wall surface, the preferred colours are grey, cream or white.*

5.4 Bending radius

(1) The minimum acceptable bending radius for installation purposes shall be not greater than 4 times the maximum dimension of the cable sheath.

(2) The minimum acceptable bending radius for pulling in purposes shall be not greater than 8 times the maximum dimension of the cable sheath.

5.5 Pulling strength

The cable shall be capable of withstanding a pull of at least 50 N for 2-pair and 100 N for 4-pair cable.

5.6 Shielding

For the avoidance of doubt, shielded cables are not eligible for the grant of a Telepermit under the terms of this Specification.

6 PERFORMANCE REQUIREMENTS

6.1 Standards

The following Tables summarise the performance requirements of Category 3 and Category 5 cables, as published in ISO/IEC 11801: 1995 and AS/NZS 3080: 1996. This data is provided for ease of reference, but manufacturers are advised to refer to the original Standards for further details.

6.2 General purpose cable for residential type applications

(1) To be eligible for the grant of a Telepermit under the terms of this Specification, for “general purpose cable”, cable performance shall comply with Table 1 below.

(2) Telecom’s minimum requirements for a 2-pair “general purpose” cable listed in Table 1 are commonly defined as “Category 3” in the above Standards. Any 2 pair cables certified to meet the higher Category 4 or Category 5 performance requirements are acceptable for Telepermit purposes, subject to compliance with the other requirements contained in this Specification.

Cable Characteristics @ 20°C	Units	MHz	Value
Characteristic Impedance	Ω	0.064	125 \pm 25
		≥ 1	100 \pm 15
Max DC conductor loop resistance	$\Omega/100$ m	d.c.	19.2
Resistance unbalance	%	d.c.	3
Minimum d.c. insulation resistance	M Ω .km	d.c.	150
Nominal Phase Velocity of propagation		1	0.4 C
		10	0.6 C
		100	NA
Minimum Near End Crosstalk Loss	dB @ 100 m	0.772	43
		1	41
		4	32
		8	26
		16	23
Maximum Capacitance Unbalance to ground	pF/km	0.001	3400
Dielectric strength conductor to conductor		d.c.	1kV/1 min or 2.5 kV/2 s
		a.c.	700 V/1 min or 1.7 kV/2s
Minimum Structural Return Loss	dB/100m	1 to <10	12
		10 to <16	10
Maximum Attenuation	dB/100 m	0.064	0.9
		0.256	1.3
		0.512	1.8
		0.772	2.2
		1	2.6
		4	5.6
		10	9.8
		16	13.1

Table 1 Electrical Characteristics for General Purpose Cable

6.3 4-pair “Category 5” cable for residential type SOHO applications

To be eligible for the grant of a Telepermit under the terms of this Specification, for 4-pair “Category 5” cable, cable performance shall comply with Table 2, which lists performance characteristics in accordance with the above-quoted Standards.

Cable Characteristics @ 20°C	Units	MHz	Value
Characteristic Impedance	Ω	0.064	125 \pm 25
		≥ 1	100 \pm 15
Max DC conductor loop resistance	$\Omega/100$ m	d.c.	19.2
Resistance unbalance	%	d.c.	3
Minimum d.c. insulation resistance	M Ω .km	d.c.	150
Nominal Phase Velocity of propagation		1	0.4 C
		10	0.6 C
		100	0.65C
Minimum Near End Crosstalk Loss	dB @ 100 m	0.772	64
		1	62
		4	53
		8	47
		16	44
		20	42
		31.25	40
		62.5	35
		100	32
Minimum Longitudinal Conversion Loss	dB	0.064	43
Maximum Capacitance Unbalance to ground	pF/km	0.001	3400
Dielectric strength conductor to conductor		d.c.	1kV for 1 min or 2.5 kV for 2 s
		a.c.	700 V for 1 min or 1.7 kV for 2s
Minimum Structural Return Loss	dB/100m	1 to <10	23
		10 to < 16	23
		16 to < 20	23
		20 to 100	23 - log (f-20)
Maximum Attenuation	dB/100 m	0.064	0.8
		0.256	1.1
		0.512	1.5
		0.772	1.8
		1	2.1
		4	4.3
		10	6.6
		16	8.2
		20	9.2
		31.25	11.8
		62.5	17.1
		100	22.0

Table 2 Electrical Characteristics for “Category 5” 4-pair Cable

6.4 Other pair combinations

(1) Two pair cables to Category 3, 4 or 5 standards are all eligible for a Telepermit for “general purpose” residential type applications.

(2) Four pair cables to Category 3, 4 or 5 standards are all eligible for a Telepermit for residential type SOHO applications. Telecom however, recommends the use of Category 5 cable for all SOHO applications.

- *Cables Telepermitted for SOHO applications are not Telepermitted for general purpose residential type applications. The reason for this is that use of 4 pair cables is not appropriate to Telecom's 2-wire system.*

7 CABLE MARKING

7.1 Need for Marking

All cable sheaths shall be marked in English, at intervals of not more than 2 m, with the following information:

- (a) The manufacturer's name, trade mark or registered mark, and
- (b) The manufacturer's product designation or part number, sufficient to identify the cable concerned, and
- (c) The performance category of the cable (e.g., Cat 3 or Cat 5)

- *There is no mandatory requirement for length markings on sheaths. This is a matter for the supplier to decide. Where length markings are provided, these will generally be at much closer intervals than 2 m.*
- *There is no mandatory requirement for marking the Telepermit number on sheaths. This is a matter for the supplier to decide.*

7.2 Type of Marking

The marking on the sheath shall be legible and durable under normal installation and service conditions.

- *While the marking needs to meet the above requirements, it must be appreciated that such cable may be clipped to wall surfaces in existing buildings where pre-wiring or concealed wiring is not practicable. As such, there may be a need to avoid strong contrasts between the colour used for the marking and the actual sheath colour.*

7.3 Advice to Telecom

The Telepermit applicant shall advise Telecom of the method of marking and of any recognised National Standards which apply to the marks used.

8 PACKING AND MARKING OF PACKS

8.1 Bulk packs

(1) The cable shall be packed in such a manner as to maintain the cable in a good condition during transit, in storage and, preferably, also while it is being installed at the workplace.

(2) The length of cable in metres shall be clearly marked on each reel or package.

(3) The manufacturer's name, cable designation number or description shall be clearly shown on each reel or package.

(4) The Telecom "Telepermit" label shall be marked on the reel or package. The Telepermit label will show the performance category of the cable concerned. e.g., "General Purpose" or "Category 5 for Small Office Home Office applications"

(5) To avoid problems caused by the incorrect connection of pre-wired cables to the Telecom network, each bulk packs (reel or drum) should bear an advisory note to the following effect:-

"The Blue and Blue-white wires should always be used for the first line in a new installation. This pair will be connected to the network unless clear instructions are given to use other pair(s). Incorrect connection will inconvenience the customer and may lead to additional charges".

- *It is assumed that the majority of bulk packs will normally be sold only to the trade.*
- *The Orange and Orange-White pair are to be used where there is a second line or where the customer requires Fast Internet service.*
- *Installation contractors will usually be aware of the differences between the various types of cable and the need to avoid mixed gauge terminations on 3-wire jackpoints. As such, it will not generally be necessary to mark the drums or reels with any warnings relating to the need to avoid terminating mixed gauges on 3-wire jackpoints. However, where the supplier is willing to provide such warnings, this will assist Telecom in reducing the number of potential service problems and help the installer avoid any liability for subsequent warranty claims.*

8.2 Retail packs

(1) Cable will also be supplied to retail customers, many of whom will carry out their own wiring installation work, but not be aware of the differences between the various types of cable and the need to avoid mixed gauge terminations on 3-wire jackpoints.

(2) The Telecom "Telepermit" label shall be marked on the reel or package. The Telepermit label will show the performance category of the cable concerned. e.g., "General Purpose" or "Category 5 for Small Office Home Office applications"

(3) Where cable is made up into retail packs or sold in kits along with a jackpoint, a terminating tool, clips, etc, suppliers are advised to include clear warnings relating to the need to avoid terminating mixed gauges on 3-wire jackpoints. This will assist Telecom to maintain the reliability of its network services and help the persons concerned avoid subsequent service problems.

(4) It is recommended that such warnings be along the following lines:-

CAUTION

This cable is intended for use with sockets marked "2" (either at the bottom right corner of the faceplate or on the shutter).

Always use the blue and white wires for the first exchange line.

Many existing installations use the earlier 3-wire sockets (the bottom right corner of the faceplate is either unmarked or marked "M", "S" or "E"). Do NOT use this cable to connect over thinner wires (0.4 mm diameter) on such sockets, as this may cause service problems.

NOTE: 0.4 mm wires usually have the wire colours red, white, green and blue. Orange and black wires may also be used.

**UNDER NO CIRCUMSTANCES SHALL THIS CABLE BE
CONNECTED TO MAINS VOLTAGE POWER SUPPLIES**

9 QUALITY ASSURANCE

9.1 Service reliability

Under the terms of the premises wiring maintenance services offered by Telecom, Telecom is likely to be involved in maintaining or repairing cable supplied by other parties to its customers. As such, Telecom is anxious to ensure that cable will prove reliable in service and that there will not be any unreasonable level of faults caused by manufacturing defects.

9.2 Quality System

(1) Applicants shall supply evidence that a Quality System is applied by the factory in producing the cable concerned. This evidence shall include a copy of a quality accreditation certificate in accordance with ISO 9000, ISO 9002, etc.

(2) Where available, any accreditation or approval to supply these products, as issued by another Telecommunications Administration, should also be supplied.

10 TELEPERMIT SUPPORTING DATA

10.1 Test Information to be submitted

(1) The cable will normally be tested as part of the manufacturing process by the manufacturer, who will certify that the requirements of this Specification are being complied with before releasing the product from the factory.

(2) In all cases, either the manufacturer's test information or the manufacturer's formally published product data sheets shall be submitted to verify compliance with this specification.

• *Performance information should be given in the format of Tables 1 and 2, as applicable. Data is also required on the materials used, their dimensions and physical attributes so that full compliance with this specification can be verified.*

10.2 Sample

Suppliers applying for certification for the first time shall submit a sample of not less than 100 metres in length, together with test and measurement results

10.3 Telecom confirmation

Telecom reserves the right to test the sample of cable submitted by the Telepermit applicant to confirm to its own satisfaction that the specification has been complied with. In addition, Telecom reserves the right to test samples of cable obtained on the local market to ensure that the product is consistent with the test results and assurances given by the Telepermit applicant. Such tests may be carried out by a third party.

10.4 Additional supporting evidence

Where such information is likely to support any application for a Telepermit, the applicant is invited to provide details of additional tests carried out as part of the normal manufacturing process.

10.5 Ongoing compliance

(1) Telecom may, at its discretion, require the manufacturer to regularly submit copies of test results or arrange for periodic verification of the test information by an independent testing laboratory.

(2) Telecom reserves the right to decline to grant a Telepermit where it considers there is inadequate evidence of the manufacturer's ability to ensure continuing compliance with this Specification.

(3) Telecom reserves the right to cancel a Telepermit granted to a manufacturer where it considers there is evidence that product offered for sale in New Zealand does not comply with this Specification or the conditions applicable to the grant of that Telepermit.

END OF SPECIFICATION PTC 222