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INTERNATIONAL STANDARD

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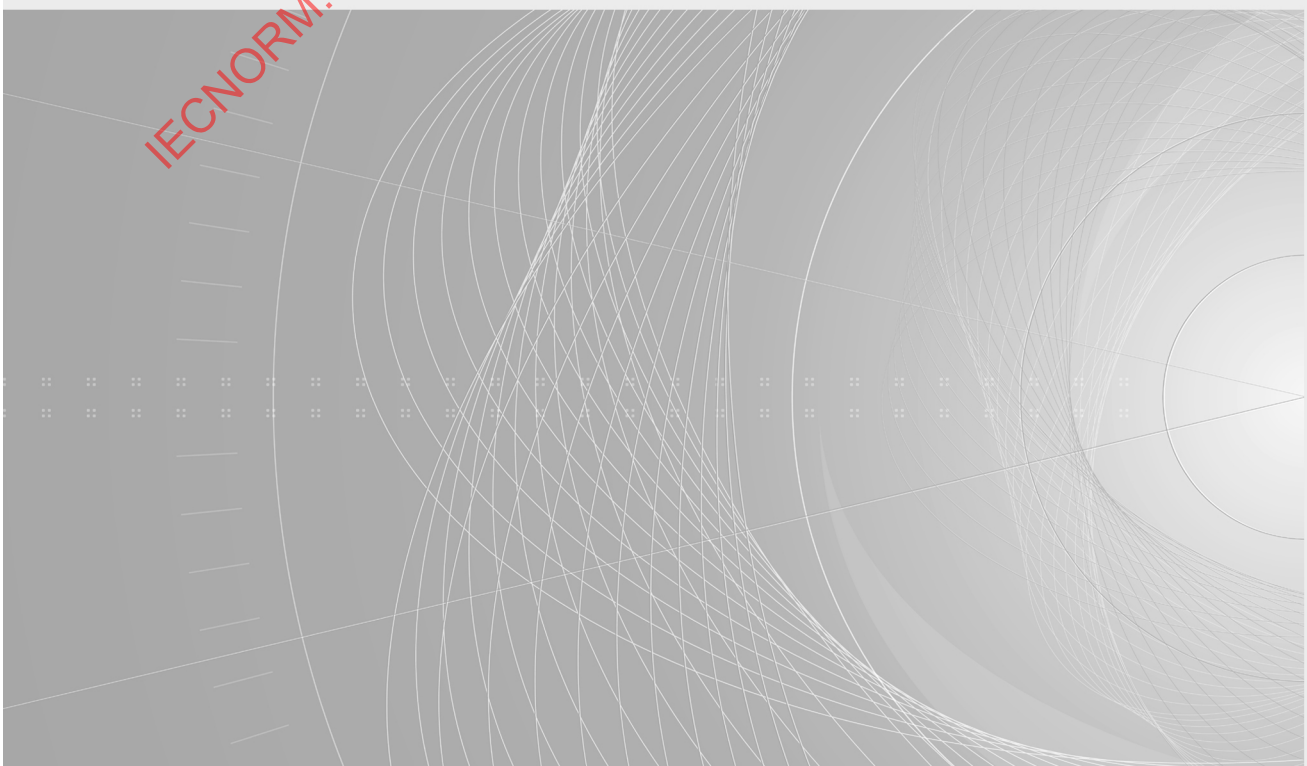
Metallic communication cable test methods – Part 4-12: Electromagnetic compatibility (EMC) – Coupling attenuation or screening attenuation of connecting hardware – Absorbing clamp method



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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International Standard IEC 62153-4-12 has been prepared by IEC technical committee 46: Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories.

The text of this standard is based on the following documents:

CDV	Report on voting
46/312/CDV	46/328/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication is to be read in conjunction with IEC 62153-4-5 (2006).

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 62153 series, under the general title: *Metallic communication cable test methods*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version may be issued at a later date.

IMPORTANT – The "colour inside" logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.

METALLIC COMMUNICATION CABLE TEST METHODS –

Part 4-12: Electromagnetic compatibility (EMC) – Coupling attenuation or screening attenuation of connecting hardware – Absorbing clamp method

1 Scope

This part of IEC 62153 details the method of test to determine the coupling attenuation or screening attenuation for connecting hardware used in analogue and digital communication systems. The test method details means to test one part of a connecting hardware (e. g. wall outlet or plug alone) as well as testing a mated pair of connecting hardware.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-726, *International Electrotechnical Vocabulary – Chapter 726: Transmission lines and waveguides*

IEC 61196-1, *Coaxial communication cables – Part 1: Generic specification – General, definitions and requirements*

IEC 62153-4-5:2006, *Metallic communication cables test methods – Part 4-5: Electromagnetic compatibility (EMC) – Coupling or screening attenuation – Absorbing clamp method*

ITU-T Recommendation G.117:1996, *Transmission aspects of unbalance about earth*

ITU-T Recommendation O.9:1999, *Measuring arrangements to assess the degree of unbalance about earth*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-726 and IEC 61196-1 apply.

In this document, connecting hardware is defined as a complete connecting device including compensating or matching networks (if any), connectors and cable terminations.

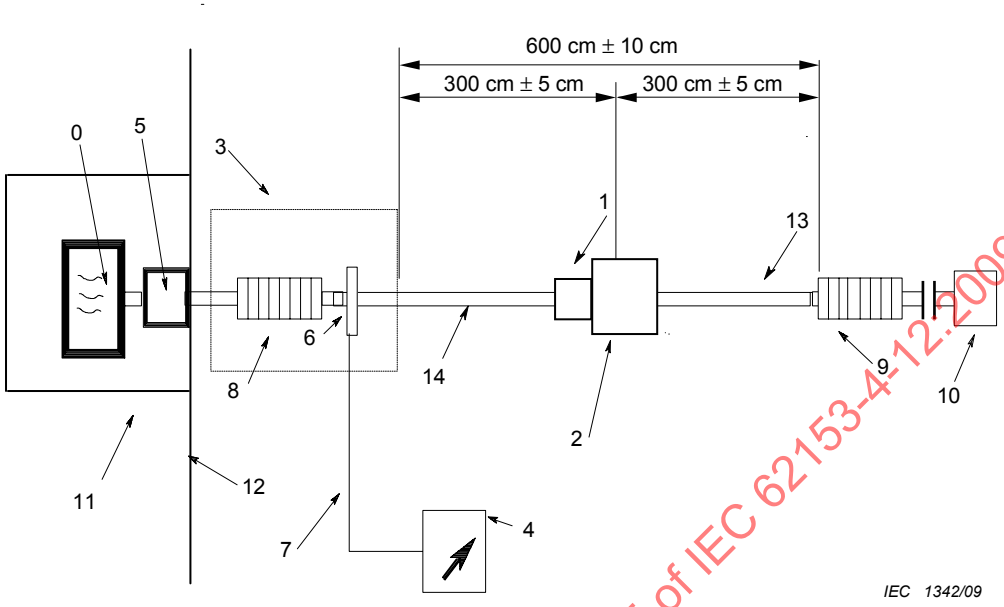
4 Test method

4.1 Equipment

4.1.1 General

See 5.1.1 of IEC 62153-4-5, and Figure 1 below.

The connecting hardware under test shall be terminated using the termination method and a cable type for which it is constructed. If only one part of the connecting hardware is under test, a test head shall be used to mate the part under test.



Key

0 signal generator, output impedance Z_0

1 connecting hardware under test, nominal characteristic impedance Z_1

2 outer circuit of connecting hardware under test, impedance Z_2

3 absorbing clamp, impedance Z_3

4 measuring receiver

5 balun (if applicable)

6 current transformer of the clamp

7 measuring receiver cable (use the same in measurement and calibration)

8 absorber (ferrite tube) of the clamp, operational attenuation > 10 dB

9 absorber (or second clamp), operational attenuation > 10 dB

10 termination of the far end extension cable terminating the connecting hardware

11 shield of signal generator and balun if needed for high dynamic range

12 reflector plate

13 extension cable terminating the connecting hardware at far end

14 extension cable terminating the test head or connecting hardware at near end

Figure 1 – Measurement of surface wave at near end of connecting hardware

4.1.2 Balun requirements

For measurement of balanced connecting hardware, a means for generating balanced signals shall be provided. If the generator is unbalanced, this may be performed by the use of a balun or 180° power splitter.

The minimum requirements for this device are specified in Table 1.

The attenuation of the balun shall be kept as low as possible because it will limit the dynamic range of the coupling attenuation or screening attenuation measurements.

Table 1 – Balun performance characteristics (30 MHz to 1 GHz)

Parameter	Value
Impedance, primary[a]	50 Ω (unbalanced)
Impedance, secondary[b]	100 Ω or 150 Ω (balanced)
Operational attenuation[d] (including matching pads if used)	≤ 10 dB
Return loss, bi-directional	≥ 6 dB
Power rating	To accommodate the power of the generator and amplifier (if applicable)
Output signal balance[c]	≥ 50 dB from 30 MHz to 100 MHz ≥ 30 dB from 100 MHz to 1 GHz

[a] Primary impedance may differ, if necessary, to accommodate analyzer outputs other than 50 Ω.

[b] Balanced outputs of the test baluns shall be matched to the nominal impedance of the balanced terminating cable pair. 100 Ω shall be used for termination of 120 Ω cabling.

[c] Measured per ITU-T Recommendations G.117 and O.9.

[d] The operational attenuation of a balun shall be mathematically deduced from 3 operational attenuation measurements with 3 baluns back-to-back.

4.1.3 Test head and extension cable requirements

4.1.3.1 General requirements

Unscreened balanced test heads (if applicable) and extension cables shall be used for testing unscreened, balanced connecting hardware. Screened balanced test heads (if applicable) and extension cables shall be used for testing screened, balanced connecting hardware. Unbalanced (coaxial) test heads (if applicable) and extension cables shall be used for testing unbalanced connecting hardware.

The electrical transmission performance including electromagnetic screening and unbalance attenuation of the test head (if applicable) and the extension cable shall be better or equal to the performance of the connecting hardware under test. The choice of the extension cable should assure the minimum operational attenuation and reflection loss of the set-up possible.

The extension cables shall have the same nominal characteristic impedance as the connecting hardware under test. The velocity of propagation for the two extension cables, terminating the connecting hardware, shall be similar (same type of insulation, for example foamed or solid). The operational attenuation of the near end terminating cable including test head (if applicable) shall be less than 1 dB up to 100 MHz.

The extension cables shall have a balance (when measuring balanced patch cords) and shall have a screen (when measuring screened patch cords) as good as possible.

4.1.3.2 Testing one part of connecting hardware

Testing one part of connecting hardware requires a test head which mates the connecting hardware under test.

The test head, the extension cable and the connection between test head and the extension cable shall have a balance or screening or balance and screening as good as can be obtained. To further enhance the measurement sensitivity, the connection between the test head and the extension cable may be improved, since it does not form part of the device under test. It is not allowed to improve the contact between the test head and the connecting hardware under test. In addition, it is not allowed to improve the connection between the connecting hardware under test and the extension cable, as this termination is part of the test. The measurement sensitivity shall

be 6 dB better than the specified requirement limit for the connecting hardware under test. See 4.4.2.1 for determination of the measurement sensitivity.

In case of doubt regarding the interoperability between the test head and the connecting hardware under test, it is recommended to use the mating connecting hardware specified or advised by the supplier of the connecting hardware under test.

4.1.3.3 Testing of a mated pair of connecting hardware

Testing of a mated pair of connecting hardware is performed by terminating the connecting hardware with extension cables as defined in 4.1.1.

No improvements of the terminations in excess of those specified by the manufacturer are allowed as these terminations are parts of the test.

For screened cables, the far end termination could already be included into the test head. In that way, the quality of the extension cable is not critical with respect to the test results.

4.1.4 Impedance matching

When measuring connecting hardware with another characteristic impedance than the impedance of the test system, impedance matching is only required when the return loss is less than 10 dB. The error that is introduced by the mismatch is maximum ± 0,5 dB and thus negligible compared to the typical accuracy of the absorbing clamp test method.

4.2 Test sample

4.2.1 Length of the extension cables

The extension cable at the near end of the set-up (close to the reflector plate) shall be 4 m ± 0,1 m. The extension cable at the far end of the test set-up shall be 10 m ± 0,1 m.

4.2.2 Tested length

The effective test length of the test specimen is limited by the absorbing clamp and the ferrite tube, as shown in Figure 1. This length shall be 600 cm ± 10 cm.

4.2.3 Preparation of extension cable and test head

The diameter of the extension cables must be selected to allow insertion in the bore of the absorbing clamp.

When a special type of socket interface is specified for termination of the connecting hardware such interface shall be used in the test head in question.

4.2.4 Balanced connecting hardware

4.2.4.1 General

Differential and common mode termination is required for each pair at the far end of the extension cable, see Figure 2.

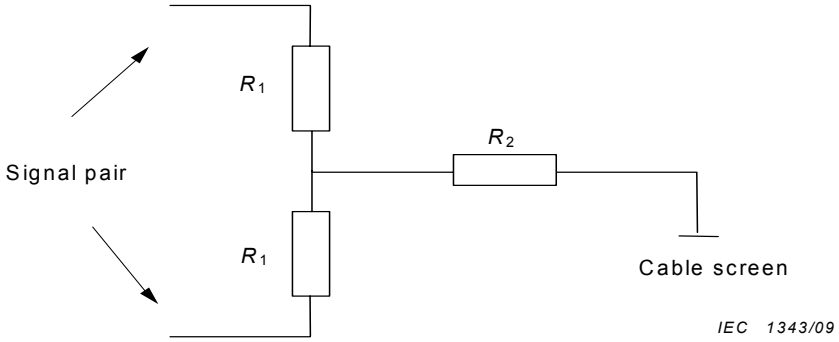


Figure 2 – Termination of extension cables

The values of the R_1 resistors shall be one half the nominal characteristic impedance of the extension cable.

NOTE For 100 Ω balanced cabling, the common mode impedance will be equal to 25 Ω when R_2 is short circuited. The common mode impedance of the termination may vary from 25 Ω (R_2=0 Ω) to 100 Ω (R_2=75 Ω).

In case of screened cables, the terminating resistors shall be screened.

The centre taps of the terminations shall be connected together. In the case of screened cables, the centre taps shall be connected to the screens.

4.2.4.2 Multi-conductor connecting hardware

Under consideration.

4.2.4.3 Coaxial connecting hardware

The far end extension cable shall be terminated with its nominal characteristic impedance.

4.3 Calibration procedure

See 5.3 of IEC 62153-4-5.

4.4 Test set-up

4.4.1 General

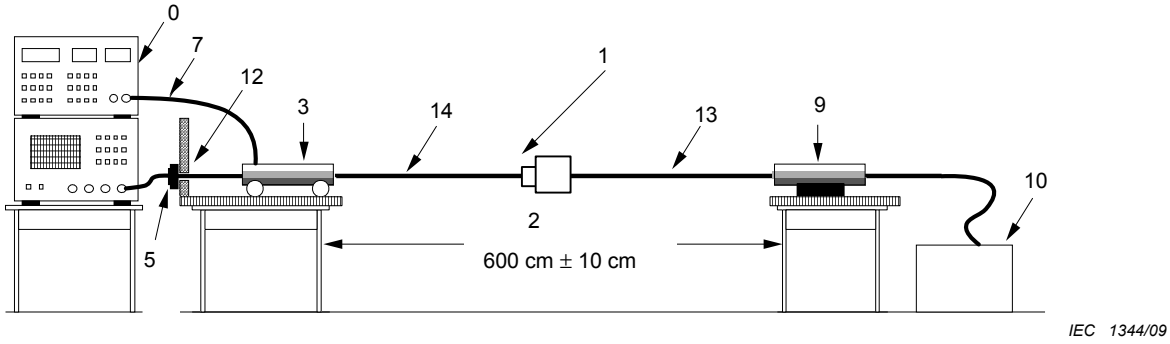
See 5.4 of IEC 62153-4-5.

As shown on Figure 3, the near end coupling attenuation or screening attenuation test set-up is as follows.

The absorbing clamp is placed on a non-metallic test support with the sensor side maximum 50 mm from the edge of the test support and 300 cm ± 5 cm from the surface of the connecting hardware.

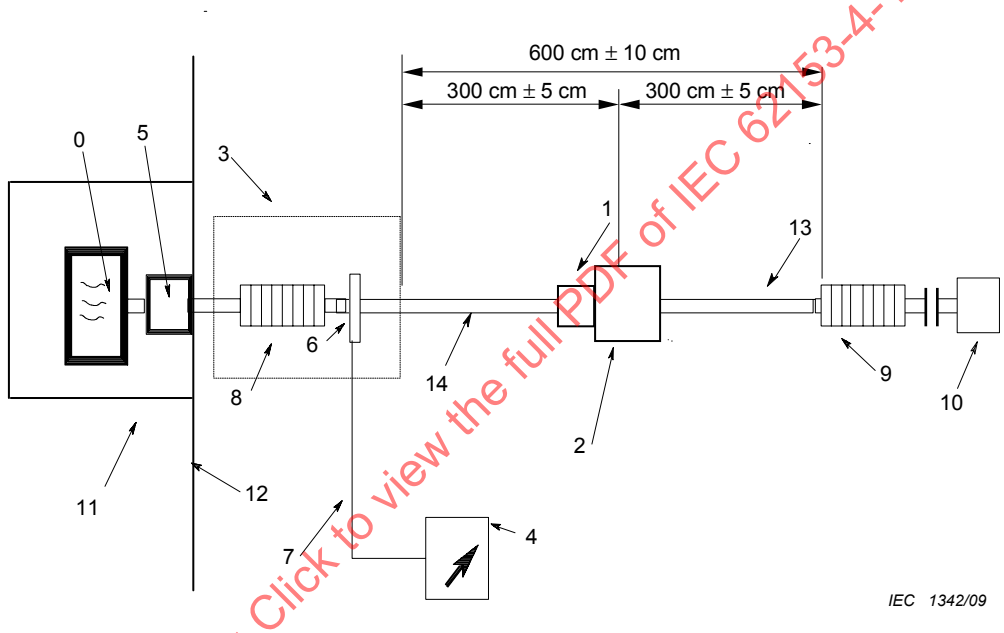
The absorber is placed on a non-metallic test support positioned maximum 50 mm from the edge of the support. The distance between the absorbing clamp and the absorber shall be 600 cm ± 10 cm (see 4.2.2).

The cabling in the tested length shall be suspended in free air. The minimum distance to any metallic or non-metallic objects shall be 60 cm.



NOTE The identification of the keys is given in Figure 1.

Figure 3 – Test set-up for a near end measurement of connecting hardware



NOTE The identification of the keys is given in Figure 1.

Figure 4 – Test set-up for a near end measurement of connecting hardware

Figure 3 and Figure 4 show near end measurements. For far end measurements, the positions of the absorbing clamp and the absorbers are interchanged.

4.4.2 Test set-up verification

4.4.2.1 Determination of measurement sensitivity of the set-up

Before measurements are performed, the measurement sensitivity of the test set-up shall be determined.

The best value (measurement sensitivity) of coupling attenuation or screening attenuation, which can be measured by the set-up, is dependent of the properties of the test-head (if applicable) and the extension cables.

The measurement sensitivity for measuring one part of a connecting hardware shall be determined by measuring the coupling or screening attenuation of the test head mated with a set-

up validation connector. The set-up validation connector shall be either unscreened or screened, balanced or unbalanced in accordance with the connecting hardware under test.

The measurement sensitivity for measuring mated pair connecting hardware shall be determined by measuring the coupling attenuation or screening attenuation of the extension cable.

Measurement sensitivity shall be measured according to 4.5 and expressed according to Clause 5.

It is advisable to optimise the set-up to get the highest possible measurement sensitivity. This is done by selecting well balanced, well screened or well balanced and screened test head, extension cables and set-up validation connector.

4.4.2.2 Verification of test set-up calibration

See 5.4.1 of IEC 62153-4-5.

4.4.2.3 Pulling force on connecting hardware

The maximum pulling force shall be 20 N.

4.5 Measuring procedure

The coupling or screening attenuation of the patch cord under test is measured as described in 5.6 of IEC 62153-4-5.

5 Expression of test results

See Clause 6 of IEC 62153-4-5.

6 Test report

6.1 General

If the measurement sensitivity is 6 dB higher than the measured coupling or screening attenuation, the measured value shall be reported as the test result. Otherwise the report shall state that the coupling or screening attenuation of the connecting hardware under test is equal to or better than the measured coupling or screening attenuation.

The screening or coupling attenuation normally increases with frequency.

If required in the relevant connecting hardware specification, the worst case (near end or far end measurement) recording of a_c versus frequency in any specified frequency range shall be reported.

6.2 Evaluation of test results

For both unbalanced and balanced connecting hardware, the worst case value, A, expressed in dB, may be deduced by superimposing a boundary curve on the plotted coupling attenuation results. The boundary curve should be adjusted vertically until it intersects the first valley in the coupling attenuation results. The boundary curve is derived as follows:

For 30 MHz ≤ f ≤ 100 MHz:

$A = A_{result}$

For 100 MHz ≤ f ≤ 1 000 MHz:

$$A = A_{result} - 20 \times \log_{10}\left(\frac{f}{100}\right)$$

where

f is the frequency expressed in MHz;

A_{result} is given by the coupling attenuation corresponding to the first valley.

See examples in Figures 5, 6 and 7.

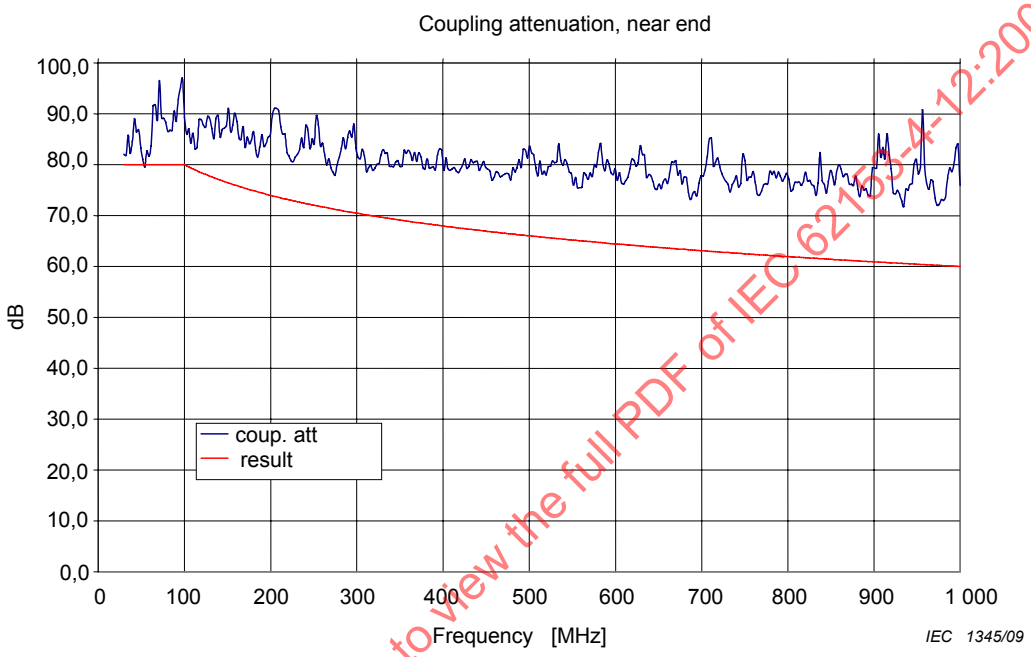


Figure 5 – Typical measurement of screened connecting hardware