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TECHNICAL REPORT

Fibre optic interconnecting devices and passive components –
Part 02: Report of round robin test results on SC plug style fixed attenuators

colour inside

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Fibre optic interconnecting devices and passive components – Part 02: Report of round robin test results on SC plug style fixed attenuators

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS –

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FOREWORD

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IEC 62627-02, which is a technical report, has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
86B/2941/DTR	86B/2993/RVC

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

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

A list of all parts of the IEC 62627 series, published under the general title *Fibre optic interconnecting devices and passive components,* can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability 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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS –

Part 02: Report of round robin test results on SC plug style fixed attenuators

1 Scope

This part of IEC 62627 reports the measurement results of two round robin test programs each carried out on SC/PC and SC/APC plug style fixed attenuators. The work was initiated at Cenelec TC 86BXA in June 2003 in order to get a clear understanding on the accuracy and repeatability of the spectral attenuation loss measurements on fixed attenuators.

Out of these results recommendations are made for attenuation tolerance values that can be used in the performance standards.

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 61300-3-2, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-2: Examinations and measurements – Polarization dependent loss in a single-mode fibre optic device*

IEC 61300-3-4, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-4: Examinations and measurements – Attenuation*

IEC 61300-3-7, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-7: Examinations and measurements – Wavelength dependence of attenuation and return loss of single mode components*

IEC 61754-4, *Fibre optic connector interfaces – Part 4: Type SC connector family*

IEC 61755-1, *Fibre optic connector optical interfaces – Part 1: Optical interfaces for single mode non-dispersion shifted fibres – General and guidance*

3 Background

While preparing a product specification for SC plug style fixed attenuators, members of the Cenelec TC86BXA reported unexpected large and wavelength dependent variations in the attenuation. Also poor performance was seen in the mating durability test.

At the same time, several customer complaints were reported from operators that used plug style attenuators on active transceivers.

In order to understand these issues a round robin test was organised among various test laboratories.

4 Conclusions

4.1 Attenuation measurements with reference connectors

The attenuation measurement results of the SC plug style fixed attenuators with reference connectors reported in Clause 5 show larger than expected variations for spectral attenuation, especially in the 1 310 nm window. When taking the performance criteria used to purchase these fixed attenuators being:

– attenuators with nominal attenuation value ≤ 5 dB: tolerance level of 0,5 dB.

– attenuators with nominal attenuation value > 5 dB: tolerance level of 10 % on nominal value.

Only 9 of the 18 SC/PC attenuators would pass all the 7 participating laboratories and only 12 of the 18 SC/APC attenuators would pass 5 test laboratories.

Physical phenomena like modal noise interference largely influence the repeatability of results, even when the measurements are performed with reference connectors and reference adapters.

Wideband source measurements with LED source and power meter proved high uniformity of results obscuring the unwanted effects of modal noise. All the attenuators passed the tight criteria of measurements against reference plugs when the attenuation measurements were made according to IEC 61300-3-4 with LED light source at 1 310 nm and 1 550 nm.

Following realistic performance criteria for the wavelength dependent attenuation measured with reference connectors are therefore suggested:

– attenuators with nominal attenuation value ≤ 5 dB: tolerance level of 0,75 dB.

– attenuators with nominal attenuation value > 5 dB: tolerance level of 15 % on nominal attenuation value.

4.2 Attenuation measurements with grade B connectors

In random mating conditions using connectors with attenuation grade B (as defined in IEC 61755-1), the variations in wavelength dependent attenuation becomes much larger, especially in the 1 310 nm region. Spectral loss values up to 19 dB are reported for a 15 dB attenuator. When taking the performance requirements used to purchase these fixed attenuators, the pass/fail results for random mated measurements would allow only 6 of the 18 attenuators to pass the 5 participating test laboratories.

4.3 Polarisation dependent loss

PDL measurement results also show a larger variation of values for measurements in the 1310 nm window.

4.4 Mechanical interface

The non reproducibility of the spectral attenuation measurements indicated possible mechanical interface issues. Thorough analysis of mechanical behaviour of “plug-attenuator-adapter-plug” and “transceiver-attenuator-plug” configurations was done. The relevant dimensions H_m and H_f of parameter H in the type SC connector mechanical interface standard IEC 61754-4 were checked in worst case situations. Main conclusion is that there is no room for additional tolerances in the existing interface standard for the SC connector and adapter. SC plug style attenuators should be made with fixed values for parameters H_f and H_m without any tolerance range.

The functional performance of the SC plug style attenuators can not be assured at this time. With the dimensions and tolerances in the current IEC 61754-4 mechanical interface documents for the SC connector and adapter, it is **not possible** to make a plug style attenuator which guarantees intermateability in all applications.

Additionally, active transceivers with fixed ferrule **should never be** connected with a plug style attenuator made according to the relevant IEC 61754-4 mechanical interface.

5 Test results

5.1 Round robin test results of SC/PC plug style attenuator

5.1.1 SC/PC plug style attenuator test samples

In total 18 SC/PC plug style fixed attenuators were collected for this round robin test:

– attenuators with nominal attenuation of 15 dB (labelled 1, 2, 3, 4, 5 and 6)

– attenuators with nominal attenuation of 5 dB (labelled 7, 8, 9, 10, 11 and 12)

– 6 attenuators with nominal attenuation of 1 dB (labelled 13, 14, 15, 16, 17 and 18)

The attenuators were obtained from various suppliers. The operating principle of all devices is based on the use of attenuating fibre.

The performance grade of these attenuators was defined as:

Operating wavelength range: 1 260 nm – 1 360 nm and 1 460 nm – 1 580 nm

Attenuation tolerance: 0,5 dB for attenuators ≤ 5 dB, 10 % of nominal attenuation value for attenuators > 5 dB

5.1.2 Test method

5.1.2.1 Spectral attenuation loss (according to IEC 61300-3-7)

For the ease of the data processing the measured values were reported for the discrete wavelengths: 1 260, 1 280, 1 310, 1 330, 1 360, 1 460, 1 490, 1 520, 1 550, 1 570 and 1 580 nm. The spectral width was 2 nm. Some laboratories also reported values with a spectral width of 10 nm. Each lab performed the measurements with 2 sets of reference connectors and adapters:

– measurements with common reference connectors and adapter (same references for all the test laboratories),

– measurements with own lab reference connectors and adapter.

Uncertainty of each loss measurement at the above mentioned wavelength range was better than 0,1 dB.

5.1.2.2 Polarisation dependent loss (PDL) (according to IEC 61300-3-2, option 1)

PDL was measured at 1 310 nm and 1 550 nm, with common reference plugs. Selected measurements method was “all states method”. The accuracy of each PDL measurement was better than 0,1 dB.

5.1.3 Test laboratories involved in RRT on SC/PC plug style attenuators

The following laboratories were involved in this round robin test (in alphabetic order):

– Adamant Kogyo Co., Ltd. (Japan)

– Diamond (Switzerland)

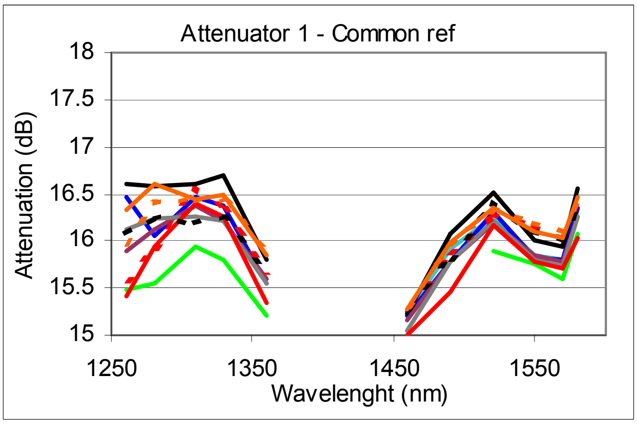
– Huber and Suhner (Switzerland)

– Telekomunikacja Polska (Poland)

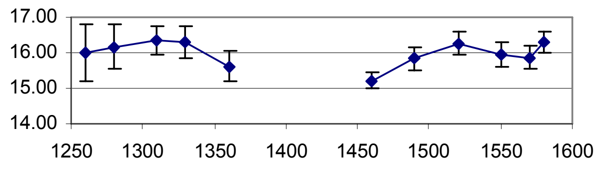
– TILab (Telecom Italia Laboratories) (Italy)
– Tyco Electronics-AMP (the Netherlands)
– Tyco Electronics-Raychem (Belgium)

5.1.4 Measurement results of SC/PC plug style attenuators

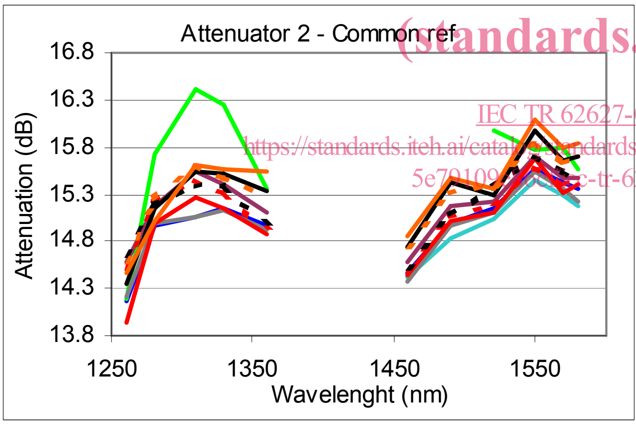
An overview of all spectral attenuation measurements per attenuator is given in Figures 1, 2 and 3. The detailed measurement results for each individual laboratory can be found in Annex A.



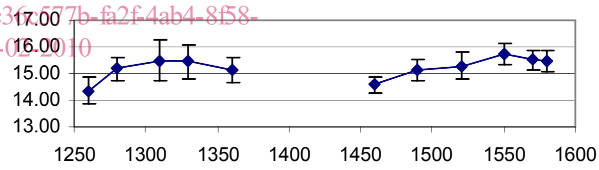
a) Attenuator 1 – Common reference



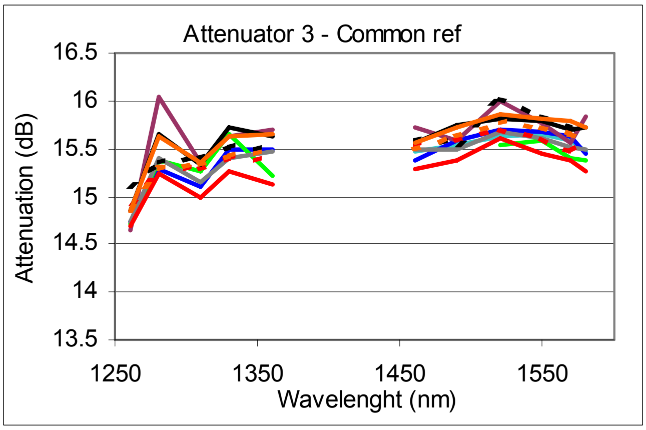
b) Average ± 2σ of attenuator 1



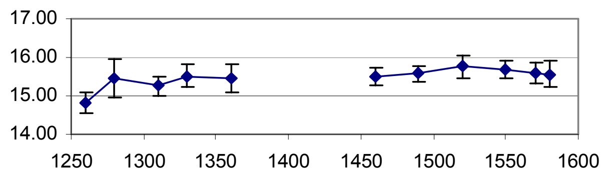
c) Attenuator 2 – Common reference



d) Average ± 2σ of attenuator 2

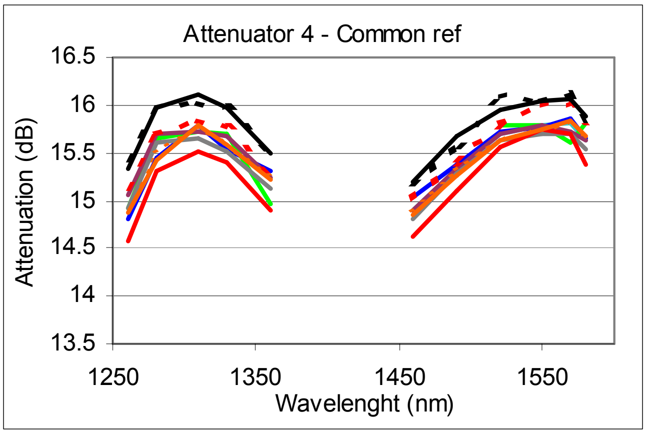


e) Attenuator 3 – Common reference

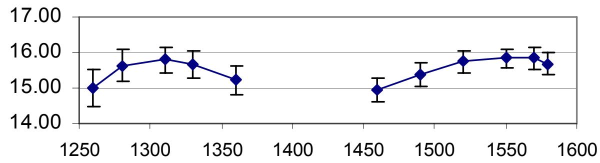


f) Average ± 2σ of attenuator 3

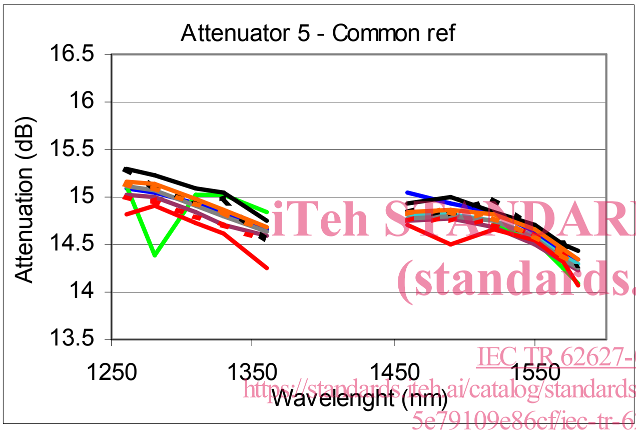
Figure 1 – 15 dB attenuators – All lab. results – Common reference



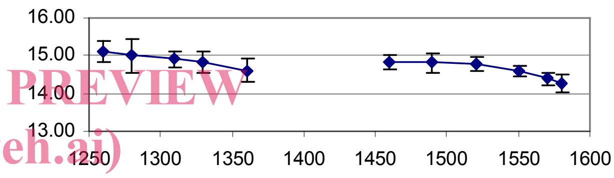
g) Attenuator 4 – Common reference



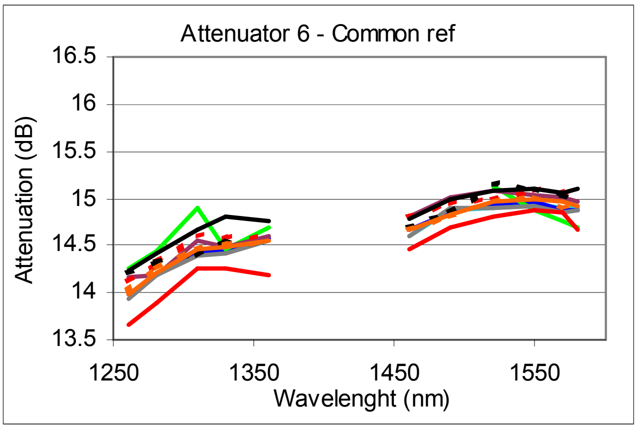
h) Average ± 2σ of attenuator 4



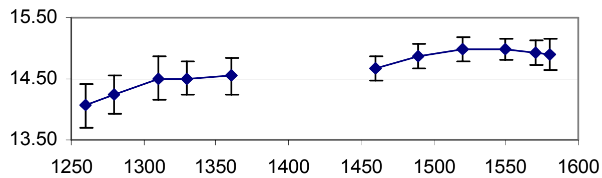
i) Attenuator 5 – Common reference



j) Average ± 2σ of attenuator 5

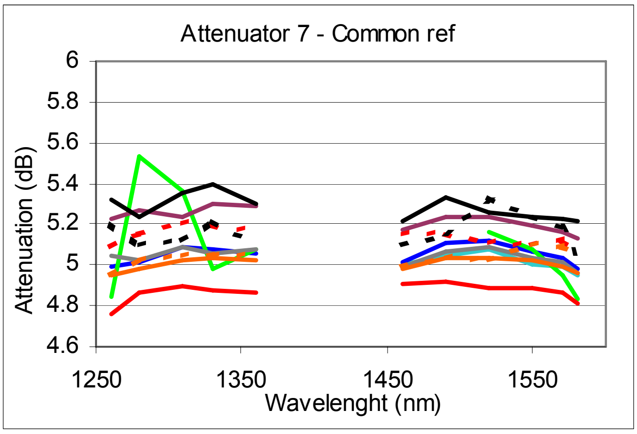


k) Attenuator 6 – Common reference

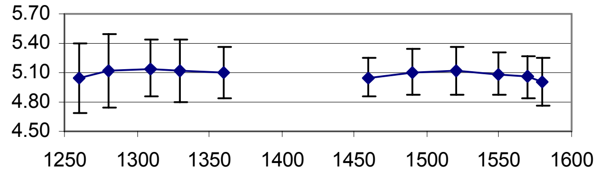


l) Average ± 2σ of attenuator 6

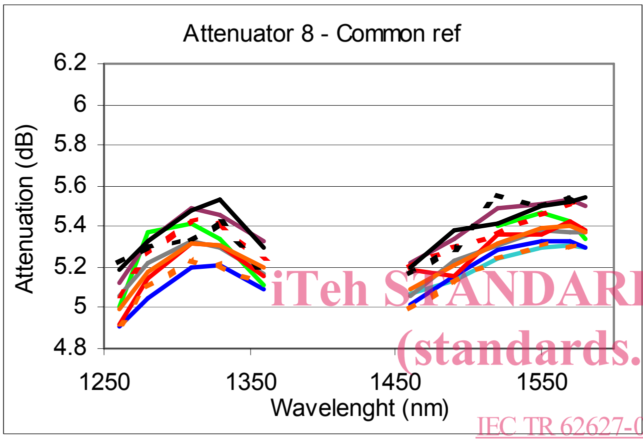
Figure 1 – 15 dB attenuators – All lab. results – Common reference *(continued)*



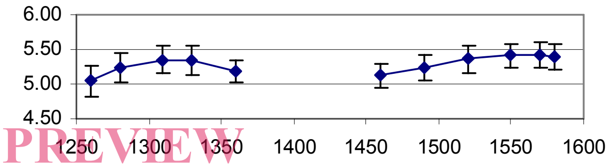
a) **Attenuator 7 – Common reference**



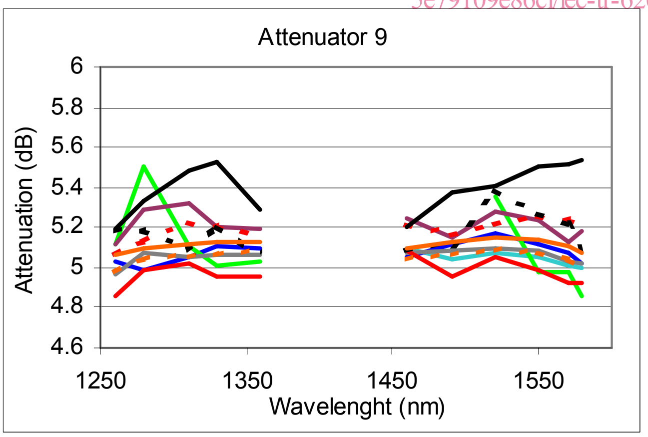
b) **Average ± 2σ of attenuator 7**



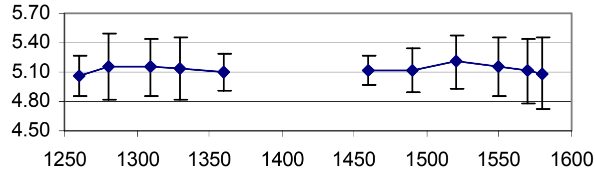
c) **Attenuator 8 – Common reference**



d) **Average ± 2σ of attenuator 8**

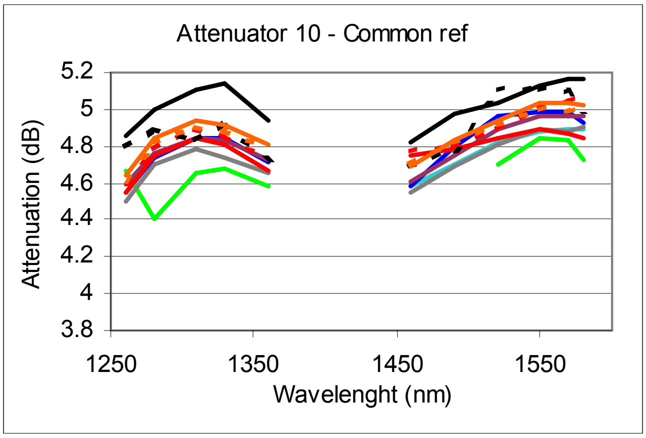


e) **Attenuator 9 – Common reference**

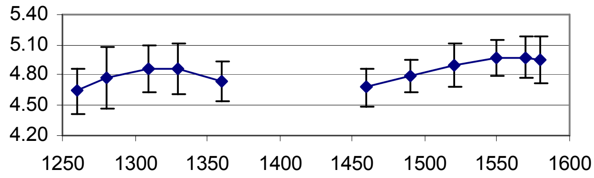


f) **Average ± 2σ of attenuator 9**

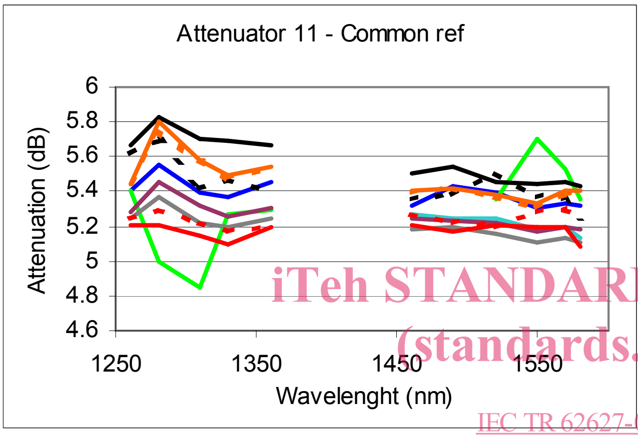
Figure 2 – 5 dB attenuators – All lab. results



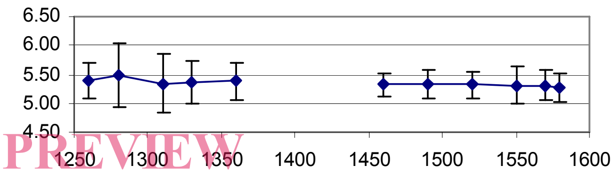
g) **Attenuator 10 – Common reference**



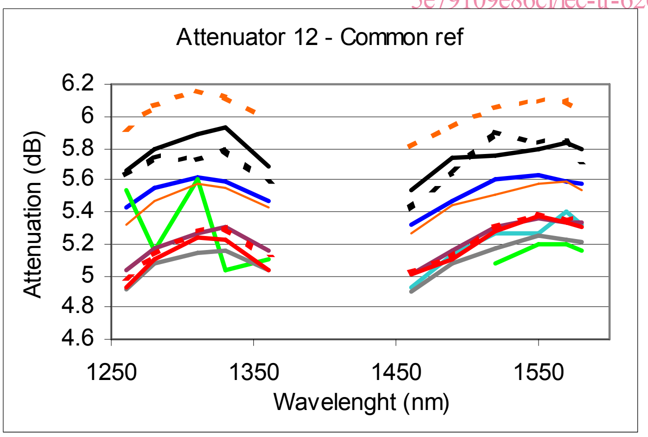
h) **Average ± 2σ of attenuator 10**



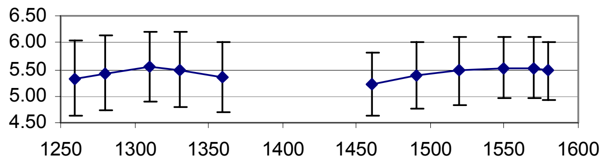
i) **Attenuator 11 – Common reference**



j) **Average ± 2σ of attenuator 11**

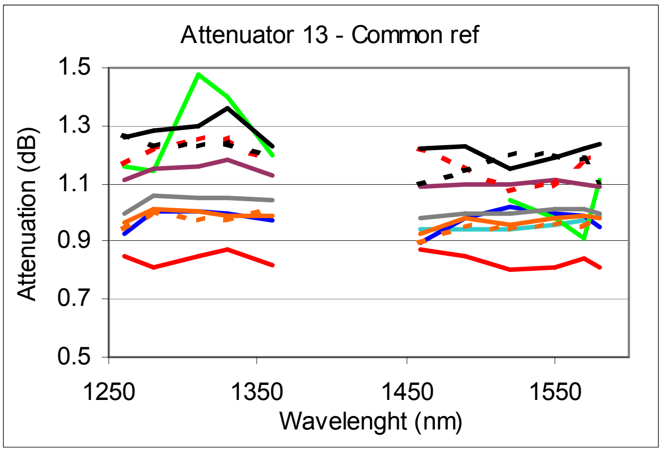


k) **Attenuator 12 – Common reference**

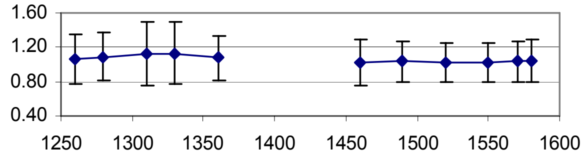


l) **Average ± 2σ of attenuator 12**

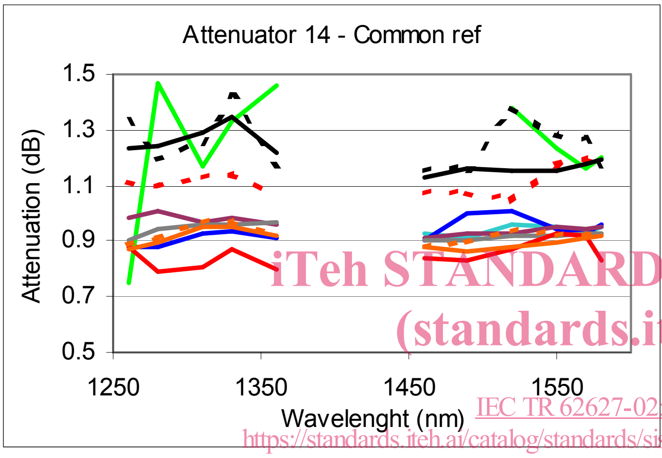
Figure 2 – 5 dB attenuators – All lab. results *(continued)*



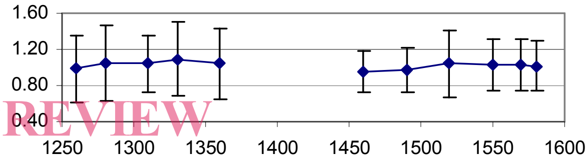
a) **Attenuator 13 – Common reference**



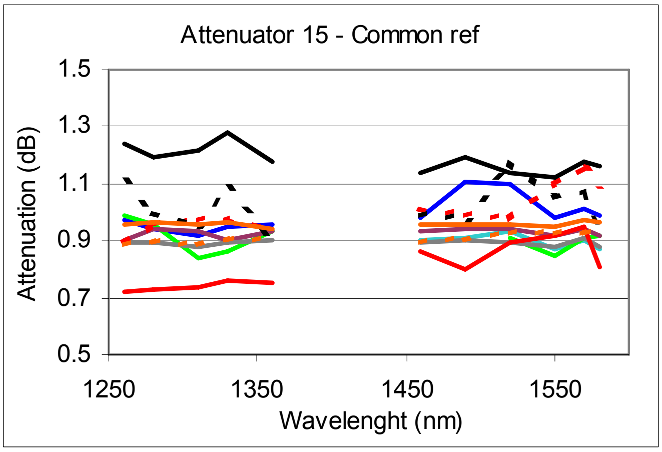
b) **Average ± 2σ of attenuator 13**



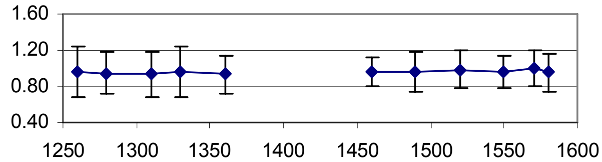
c) **Attenuator 14 – Common reference**



d) **Average ± 2σ of attenuator 14**



e) **Attenuator 14 – Common reference**



f) **Average ± 2σ of attenuator 14**

Figure 3 – 1 dB attenuators – All lab. results