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# ITU-T

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STANDARDIZATION SECTOR
OF ITU

# L.41

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SERIES L: CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

## Maintenance wavelength on fibres carrying signals

ITU-T Recommendation L.41

(Formerly CCITT Recommendation)

**ITU-T Recommendation L.41**

# Maintenance wavelength on fibres carrying signals


## Summary

This ITU-T Recommendation assigns the wavelengths for fibre identification, fault location and maintenance monitoring that may be used to manage the physical plant. The maintenance wavelength assignment has a close relationship with the transmission wavelength assignment selected by Study Group 15.



## Source

ITU-T Recommendation L.41 was prepared by ITU-T Study Group 6 (1997-2000) and approved under the WTSC Resolution 1 procedure on 12 May 2000.

## FOREWORD

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The approval of ITU-T Recommendations is covered by the procedure laid down in WTSC Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

## NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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**ITU-T Recommendation L.41**

# Maintenance wavelength on fibres carrying signals

## 1 Scope

This ITU-T Recommendation deals with maintenance wavelength on fibres carrying signals without in-line optical amplifiers.

ITU-T Recommendation L.25 "*Optical fibre cable network maintenance*" defines comprehensive guidelines to maintain optical fibre and suitable wavelength should be used for preventive maintenance as defined by this Recommendation.

Maintenance systems which use wavelengths in a vacant window of optical fibre carrying signals are being operated currently and it should be taken into account that in-service maintenance of optical fibre should not interfere with the normal operation and expected performance of the information channels.

## 2 In-service maintenance

In-service maintenance of optical fibre should be done in such a way that it does not interfere with the normal operation and expected performance of the information channels. Wavelength for in-service maintenance, as shown in Table 1, should be used.

**Table 1/L.41 – Maintenance wavelength assignment**

| | 1310 nm-window | 1550 nm-window | 1625 nm-window[b)] | 1650 nm-window[a), b)] |
|---|---|---|---|---|
| **Case 1** | Active | Vacant or maintenance | Vacant or maintenance | Vacant or maintenance |
| **Case 2** | Vacant or maintenance | Active | Vacant or maintenance | Vacant or maintenance |
| **Case 3** | Active | Active | Vacant or maintenance | Vacant or maintenance |
| **Case 4** | Active or vacant | Active | Active | Vacant or Maintenance |

a) When there is no optical light (nominally below −60 dBm) from the OTDR laser at all wavelengths equal to or below the maximum client signal wavelength (see Case 4) at the point "R", it is not necessary to consider interference with transmission.

b) These OTDR wavelengths are suitable only for systems with client signals at wavelengths less than 1565 nm. Applicability for client signals at longer wavelength is under study.

**Case 1**: This usually applies to single mode fibre. Transmission system uses only 1310 nm-window.

**Case 2**: This usually applies to dispersion shifted fibre. Transmission system uses only 1550 nm-window.

**Case 3**: This usually applies to single mode fibre. Transmission system uses two or more wavelengths in 1310 nm-window and 1550 nm-window.

**Case 4**: The maximum transmission wavelength is under study in Study Group 15, but is limited to less than or equal to 1625 nm.

Wavelength is independent of types of fibre (single mode fibre or dispersion shifted fibre).

## APPENDIX I

## Remarks on the way for in-service maintenance of optical fibres

**Loss**: The optical interfaces are defined at points S (source) and R (receive). Point of presence should be after the point S and before the point R, therefore, the coupling/filtering function loss will be counted as part of the physical plant.

**Receive cross-talk**: Even with filtering, the special characteristics of the light source from maintenance equipment are broad enough to allow the possibility of cross-talk or other similar impairment to the service bearing signals. The combination of its spectral characteristic and filter requirements might well be best limited by a requirement to the effect of: the total amount of residual optical power at point R shall be less than −XX dBm at all wavelengths below the maximum operating wavelength of YY.

**Average optical power**: For the time intervals during which OTDR pulses are present, it will contribute to the effective average optical power. It is presumed, but should be verified, that the OTDR contribution to the total is low enough to avoid concerns about fibre non-linearities, safety concerns, or error detection circuits.

Items should correspond with transmission systems characteristics:

- Optical characteristics of light sources from maintenance equipment (power, wavelength, FWHM of its spectrum, modulation frequency of the light source, OTDR's pulsewidth and repetition cycle).
- Allowing for light power at points R and S.

## APPENDIX II

## Japanese consideration for selecting maintenance wavelength

### II.1 Present Japanese maintenance wavelength

**Trunk networks**:

| | Communication | Maintenance |
|---|---|---|
| **Case A** | 1310 nm | 1550 nm |
| **Case B** | 1550 nm<br>(Distance < 80 km) | 1310 nm (Testing and monitoring)<br>1650 nm (Fibre identification) |
| **Case C** | 1550 nm<br>(Distance < 160 km) | 1550 nm (Testing for post-fault and after installation)<br>1650 nm (Fibre identification and monitoring) |

**Access networks**:

| | Communication | Maintenance |
|---|---|---|
| **Case D** | 1310 nm | 1550 nm |
| **Case E** | 1310 nm and 1550 nm | 1650 nm |

## II.2 Reason

### II.2.1 Laser diode (LD) market

1310 nm and 1550 nm LD markets are big while for other LDs the market is small. Because a lot of transmission systems use 1310 nm or 1550 nm LD, the use of 1310 nm or 1550 nm wavelength for optical fibre maintenance support systems would be economical.

### II.2.2 Filter

In cases A, B and D, the wavelength difference between communication light and maintenance light is 240 nm. Filters have the characteristics as shown in Figure II.1. There is no problem for insulation. Transmission systems use 1310 nm or 1550 nm wavelength. Therefore, the 1550 nm or 1310 nm wavelength for optical fibre maintenance should be used, except fibre identification.

In cases C and E, we need 70-100 nm wavelength differences at least, according to the filter characteristics. For manufacturing, we had better keep the difference 100 nm. In these cases, the popular type specification of the insulation loss is 30 dB. And that of the cheapest type is 20 dB.

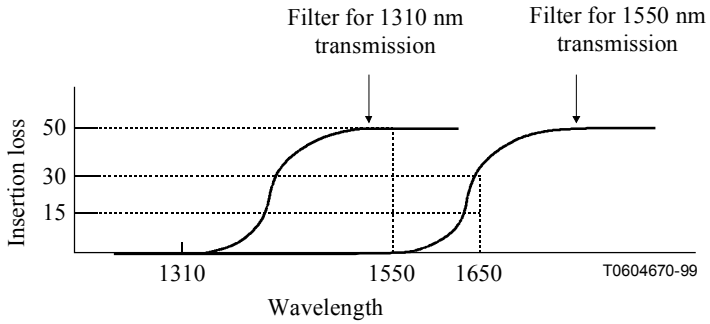


**Figure II.1/L.41 – Characteristics of filter**

There are a few LDs in a central office but a lot of filters are installed in front of ONU and OLT. Optical fibre maintenance support systems do not represent a big LD market. The LD market for wavelengths other than 1310 nm or 1550 nm is small, even if the optical fibre maintenance wavelength is recommended. When choosing the optical fibre maintenance wavelength, it is better to consider the filter specification in preference to LDs and transmission system specification for total system cost. Therefore, the 1650 nm wavelength should be chosen for cases C and E.

### II.2.3 Fibre identification

A fibre is identified by bending. Fibre identification tools detect leaked maintenance light without interfering with the transmission. Therefore, the wavelength difference between the transmission light and the maintenance wavelength is necessary.

In cases A, D and E, the insertion loss specification of the tool is less than 0.5 dB at 1310 nm and less than 2.5 dB at 1550 nm when the tool bends a fibre. In cases B and C, the loss specification is less than 0.5 dB at 1550 nm.

## II.3 Direction for the future

### II.3.1 LD market

Optical fibre maintenance support systems cannot represent a big market for LD so LDs, of wavelengths other than 1310 nm or 1550 nm, will remain in the minority in the future.

### II.3.2 Filter

Fibre grating technique is under development. The fibre grating characteristics are shown in Figure II.2. If we get these characteristics, we do not need 100 nm-wavelength difference any longer.

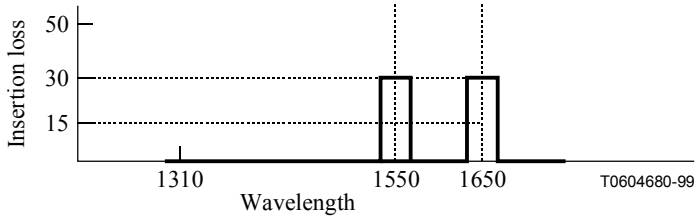


**Figure II.2/L.41 – Characteristics of grating**

### II.3.3 Fibre identification and handling

If fibre gratings can be used, the wavelength differences between transmission light and maintenance light for fibre identification will be needed. Therefore, long wavelength should be used as much as possible. An optical fibre loss wavelength trace is shown in Figure II.3. According to this figure, 1650 nm wavelength is the longest wavelength.

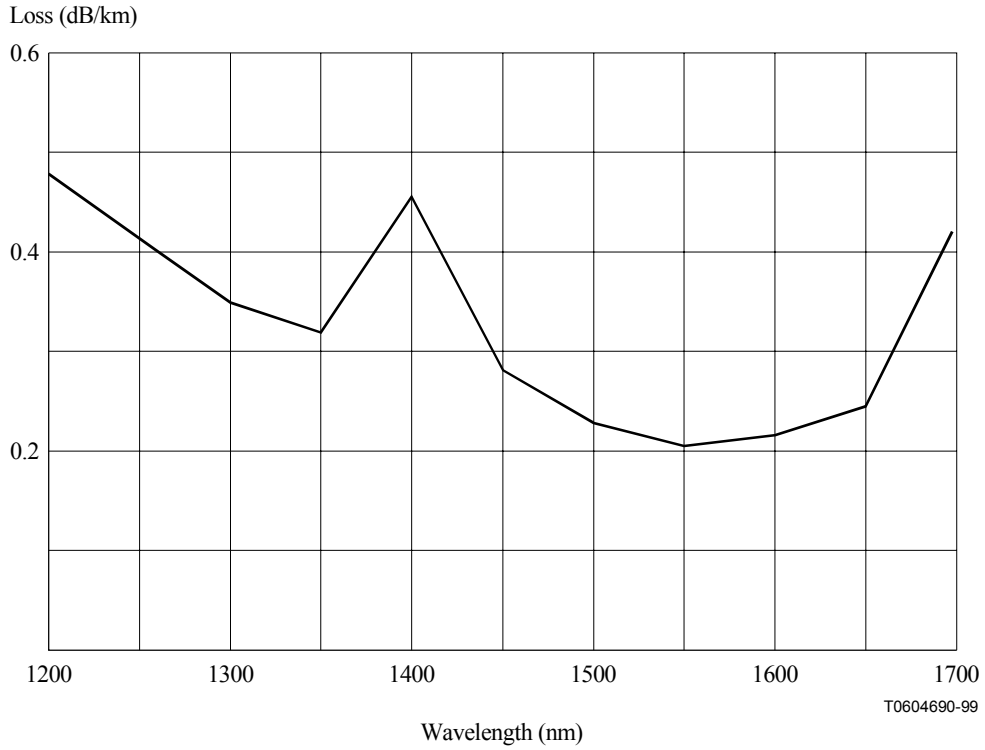


**Figure II.3/L.41 – Loss wavelength trace**

## II.4 Result

Considering the filter specification and fibre identification, the longer the wavelength, the better. Considering the fibre characteristics, it would be preferable to use from 1310 nm to 1650 nm. So therefore, the 1650 nm wavelength would be used.

## APPENDIX III

### Information of bending loss for considering the wavelength assigned

This ITU-T Recommendation shows optical fibre bending characteristics, which is an important element for assigning wavelength, based on Japanese experience.

Optical fibre maintenance functions, especially fibre handling and fibre identification, are essential for maintaining fibres in the field. Operators have to handle fibres in central offices and manholes. They need to identify fibres with a clip-on power meter. The clip-on power meter has to bend a fibre in order to detect leaking identification light. The insertion loss specification of an existing tool for single mode fibres is less than 0.5 dB at 1310 nm and less than 2.5 dB at 1550 nm, when the tool bends a fibre. The loss specification of an existing tool for dispersion shifted fibres is less than 0.5 dB at 1550 nm. The handling loss is usually bigger than bending loss for identification.

Figure III.1 shows the fibre general characteristics for bending. It shows that the longer the wavelength, the bigger the loss. So when long wavelength light is used for transmission, it is easy to change loss of fibre. Transmission systems have to be designed taking into consideration loss change. It is difficult to determine the value of loss change. At least 5 dB or more would be necessary for 1550 nm in the case of single mode fibre.

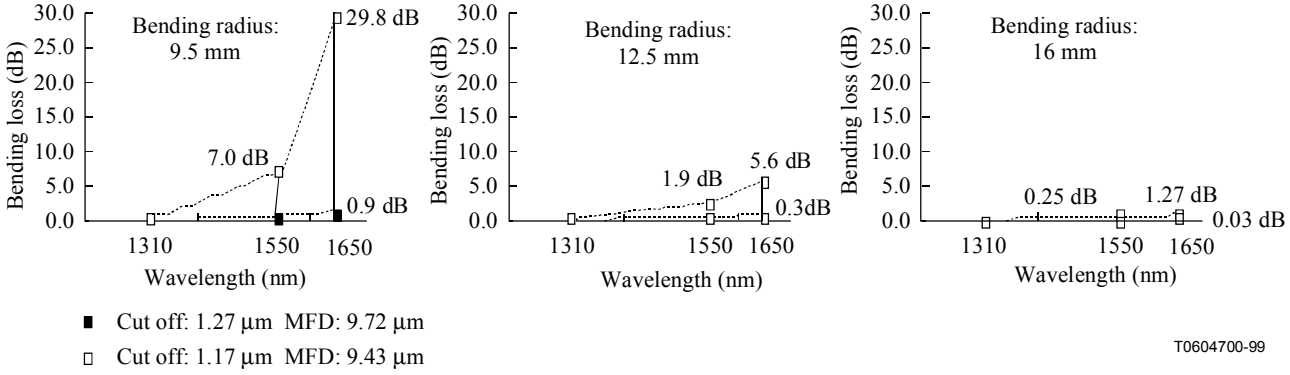


**Figure III.1/L.41 – Bending characteristics**

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