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# LUMINOUS T GRADE

## TECHNICAL DATA

*The values of this document are typical laboratory averages and they are intending to serve as guides only.*
*These data are based on the documents, information and data now available and may be changed without notice when new knowledge or information is acquired*

## 1) Optical properties

### 1-1) Spectral attenuation (visible wavelength)

Grade : T Grade (500μm、750μm、1000μm)

Method : 52m-2m cut-back

Incidental angle : 0.15rad.

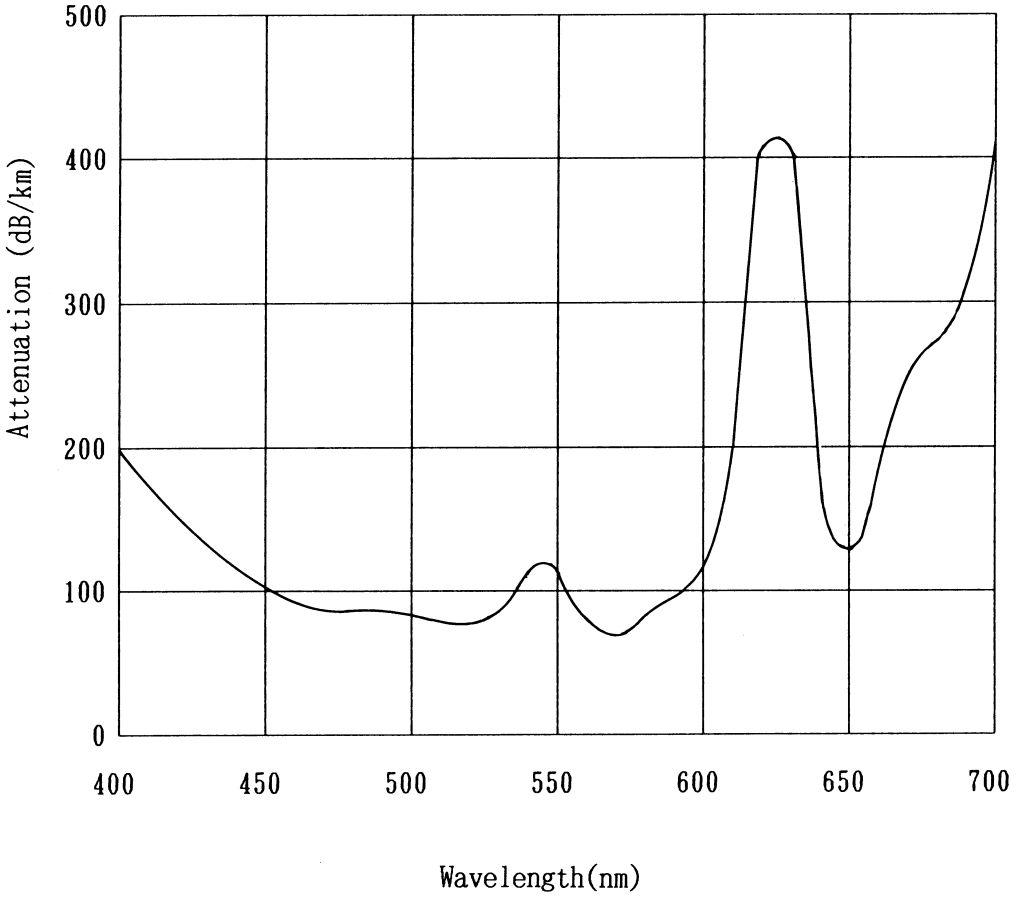



Figure 1-1-1 Spectral attenuation of Luminous (visible wavelength)

1-2) Spectral attenuation (infrared wavelength)

Grade : T Grade (500μm、750μm、1000μm)

Method : 5m-1m cut-back

Incidental angle : 0.15rad.

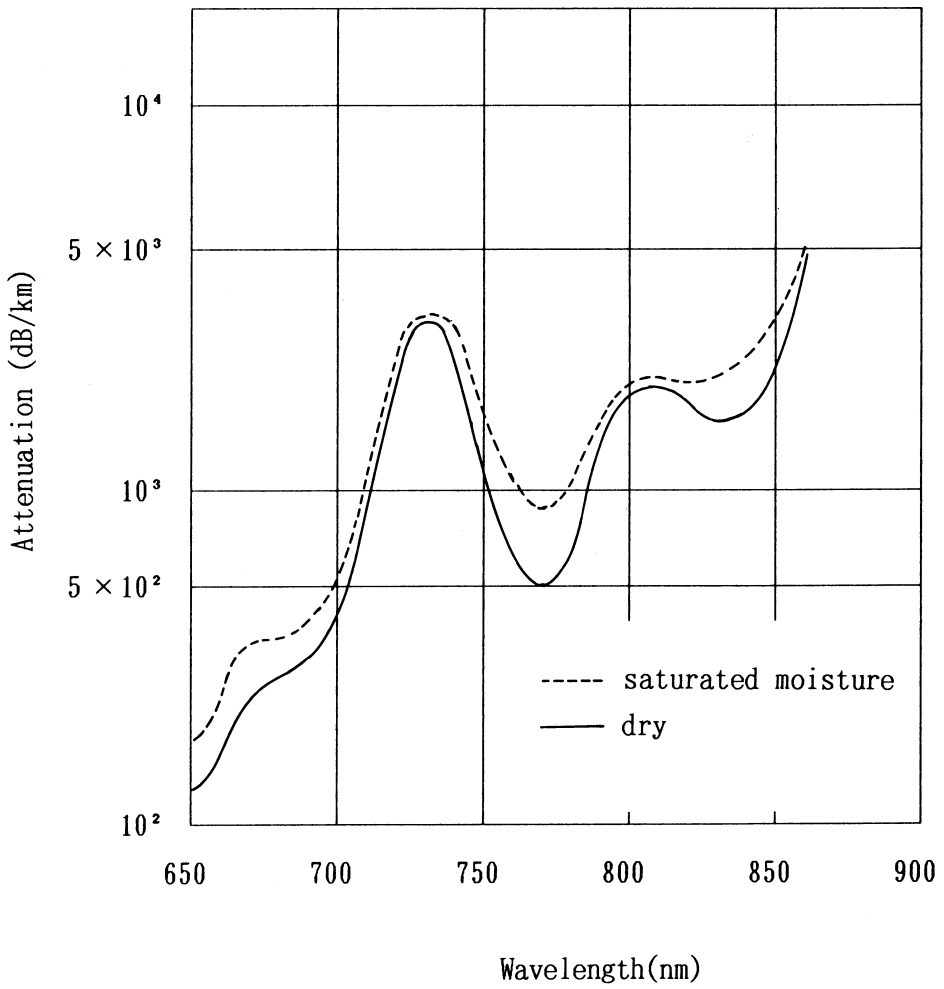



Figure 1-2-1 Spectral attenuation of Luminous (infrared wavelength)

1-3) Optical power characteristics

Grade : TC1000

Method : The face end of the fiver is fixed at a distance of 1m from the light source and the optical power of different lengths of fiber is then measured.

Length of fiber : 2m、10m、20m、50m、100m、150m、200m

Light source : LED(A) 670nm

LED(B) 657nm

LED(C) 569nm

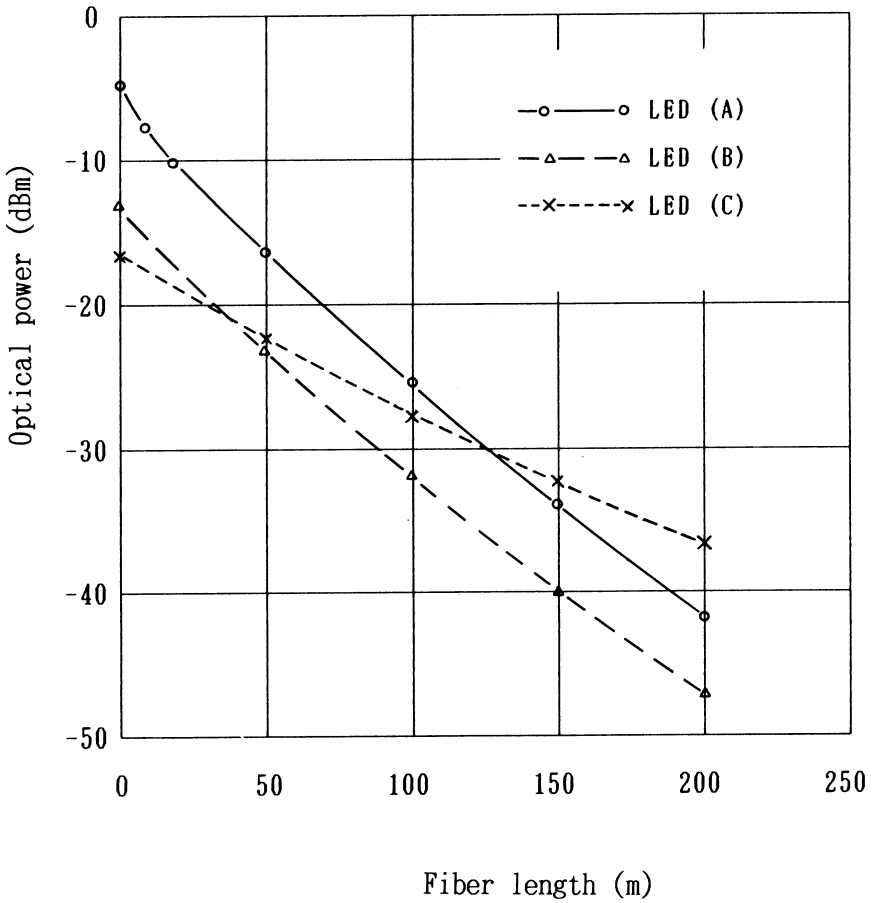



Figure 1-3-1 Optical power characteristic on LED

## 1-4) Characteristics of light transmission from a LED source

Grade : TC1000

Method : ① The face end of the fiber is kept at a distance of 1m from the light source and the optical power is measured as the face end of the fiber is moved horizontally across the face of the power source, as in X direction in the figure.

② The face end of the fiber is placed at the center of the light source and the optical power is then measured as the face end is withdrawn away from the light source, as in Z direction in the figure.

Fiber length : 1.6m

Light source : LED 660nm

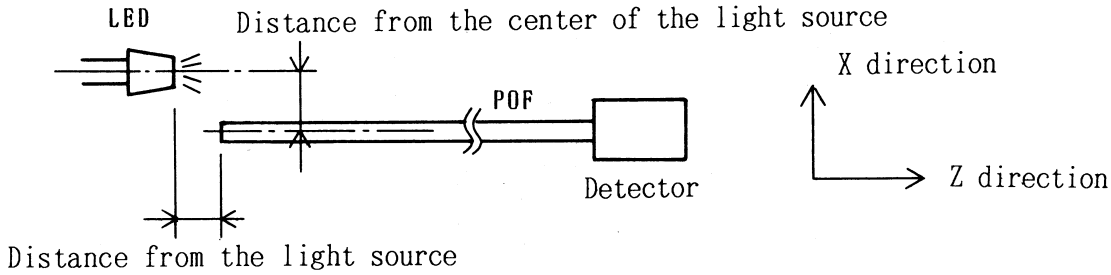
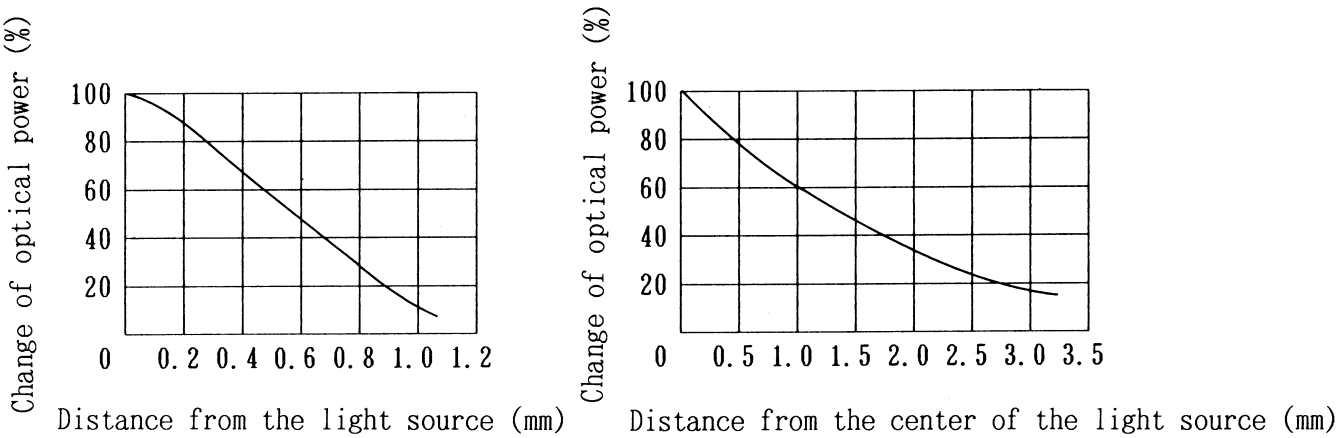



Figure 1-4-1 Measurement method




(a) Distance from the light source (b) Distance from the center of the light source

Above graphs differ depending on type of LED used

Figure 1-4-2 Charatenstics of light transmission from a LED source

## 2) Physical properties

### 2-1) Tensile stress and elongation

Method : ASTM D 638

Velocity of tensile stress ···· 100mm/min.

Table 2-1-1 Tensile stress and elongation

| | | Grade | Tensile stress | | Elongation |
|---|---|---|---|---|---|
| | | | kg/fiber | kg/cm$^2$ | % |
| Bare fiber | | TB-500 | 2.4 | 1200 | 60 and more |
| | | TB-750 | 5.0 | 1100 | 70 and more |
| | | TB-1000 | 8.4 | 1100 | 80 and more |
| Cord | Single core cord | TC-500 | 3.6 | — | 70 and more |
| | | TC-500-15 | 4.5 | — | 70 and more |
| | | TC-750 | 7.5 | — | 80 and more |
| | | TC-1000 | 12.5 | — | 90 and more |
| | Dual core cord | TC-500W | 9.0 | — | 70 and more |
| | | TC-1000W | 24.0 | — | 90 and more |

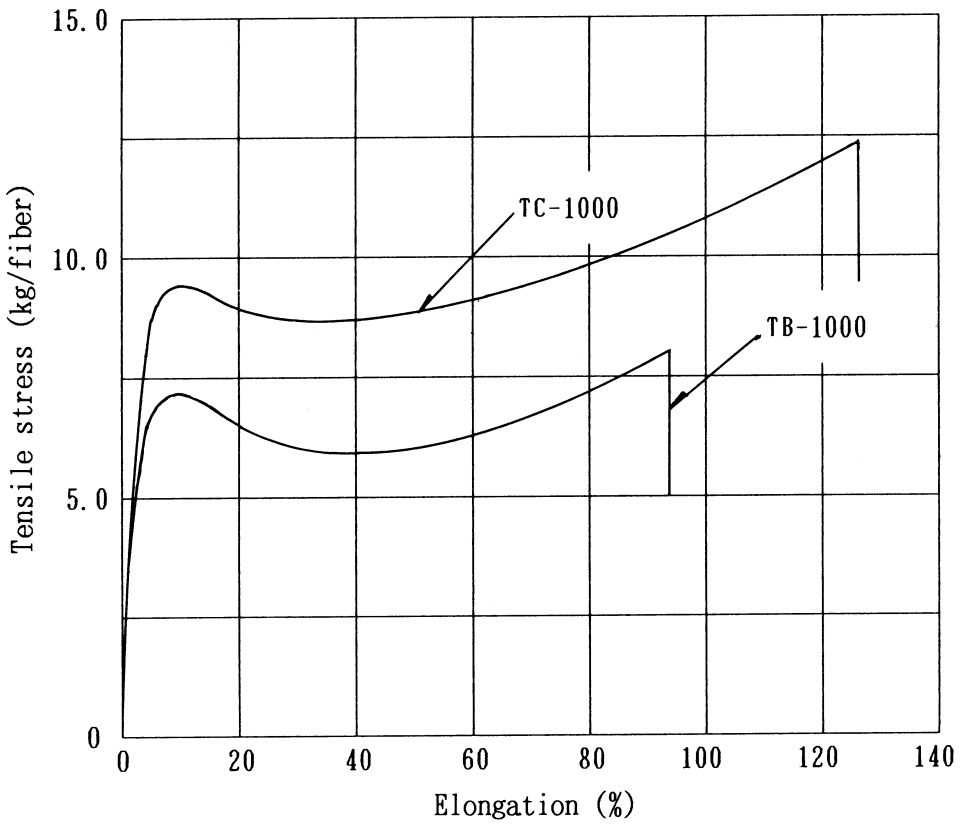



Figure 2-1-1 Tensile stress and elogation

## 3) Mechanical properties

### 3-1) Resistance to repeated bending (bending radius 50mm)

Grade : TC1000

Method : The fiber, which is fixed to the testing apparatus, is subjected to repeated bending and its attenuation is measured.

Angle of bending : 90°

Rate of bending : 2.5 turns/sec

Fiber length : 2m (Bending point : 1.9m from the light source)

Light source : 660nmLED

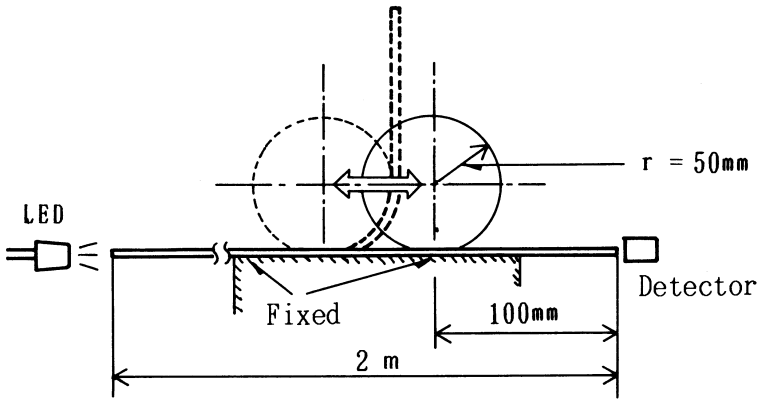



Figure 3-1-1 Measurement method

Table 3-1-1 Measurement (bending rading 50mm)

( Unit dB )

| Number of bends | $1\times10^4$ | $3\times10^4$ | $5\times10^4$ | $1\times10^5$ | $3\times10^5$ | $5\times10^5$ |
|---|---|---|---|---|---|---|
| Change in optical power | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

3-2) Resistance to repeated bending (bending radius 5mm)

Grade : TC1000、TC500

Method : The fiber is subjected to repeated bending by means of weight, and the retention of optical power (transmission rote) of the fiber is measured.

Angle of bending : 120°

Rate of bending : 0.5 strokes/sec.

Fiber length : 3m (bending point : 2m from the light source)

Light source : 650nm

Weight : TC-1000 ···· 500g

TC-500 ···· 125g

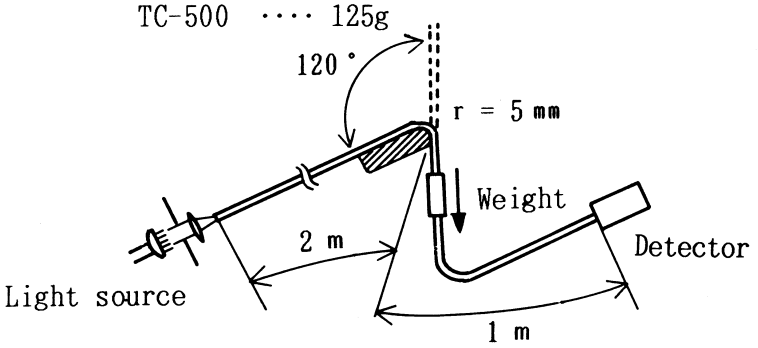



Figure 3-2-1 Measurement method

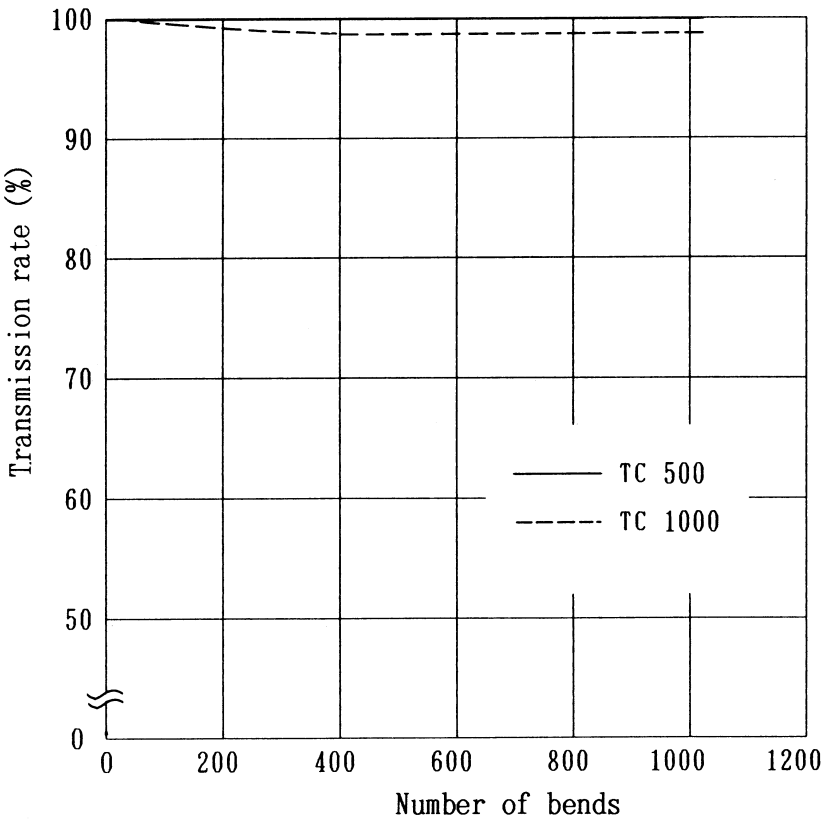



Figure 3-2-2 Resistance to repeated bending (Bending radius 5mm)

3-3) Resistance to repeated twisting

| | |
|---|---|
| Grade | : TC1000、TC1000W |
| Method | : The fiber, which is fixed by chucks, is subjected to repeated twists and its attenuation is measured. |
| Angle of twisting | : 270° |
| Rate of twisting | : 2.5 stroke/sec. |
| Chuck-to-chuck distance | : 100mm |
| Fiber length | : 2m |
| Light source | : 650nm、660nm LED |

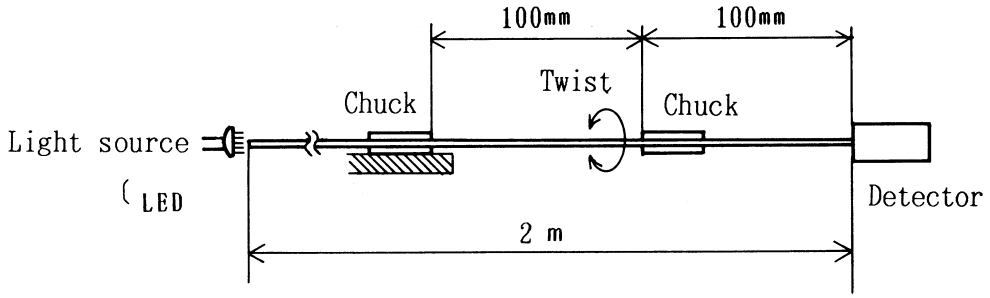



Figure 3-3-1 Measurement method

Table 3-3-1 Twist test result

( Unit dB )

| Nunber of twists | $1\times10^4$ | $3\times10^4$ | $5\times10^4$ | $1\times10^5$ | $3\times10^5$ | $5\times10^5$ |
|---|---|---|---|---|---|---|
| Attenuation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

3-4) Resistance to twisting strength

Grade : TC1000

Method : The fiber, which is fixed by chucks, is given twists and its attenuation is measured .

Chuck-to-chuck distance : 1m

Fiber length : 3m

Light source : 660nm LED

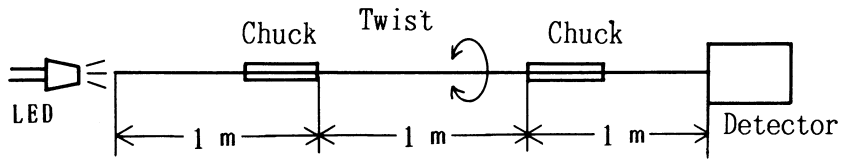



Figure 3-4-1 Measurement method

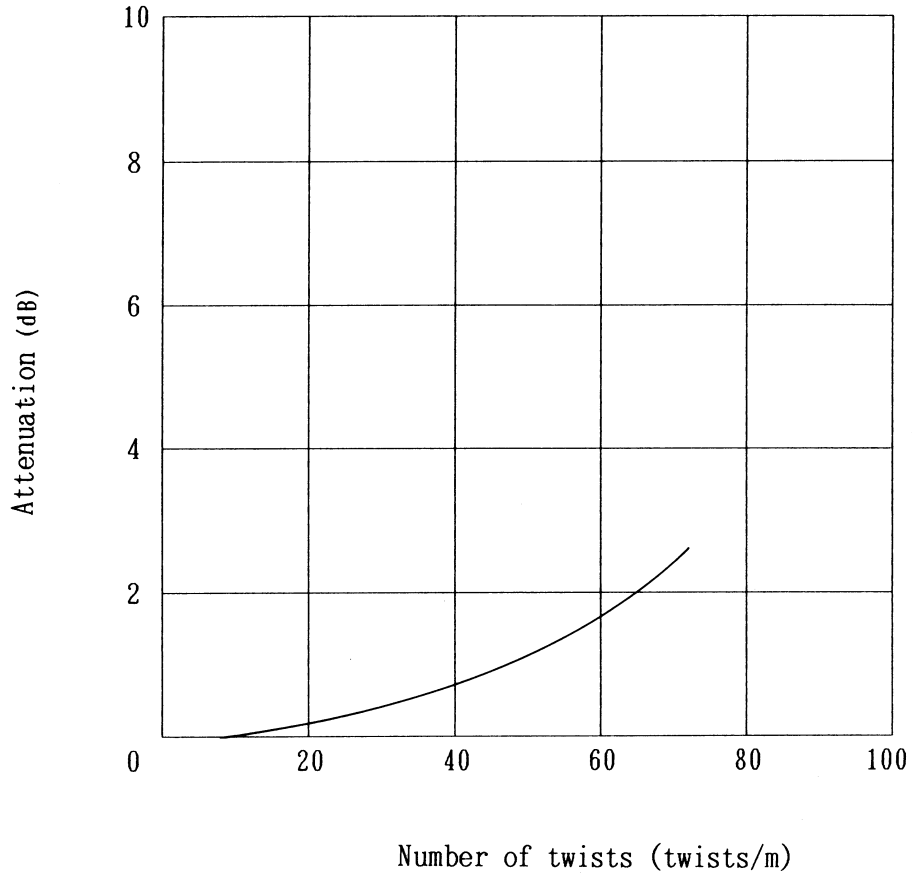



Figure 3-4-2 Resistance to twisting strength

3-5) Resistance to curvature (90° no weight)

Grade : T Grade (500μm、750μm、1000μm)

Method : The fiber is curved around the inside of the board and the retention of the optical power(transmission rate) of the fiber is measured

Fiber length : 5m (curve point : 2m from light source)

Light source : 660nm LED

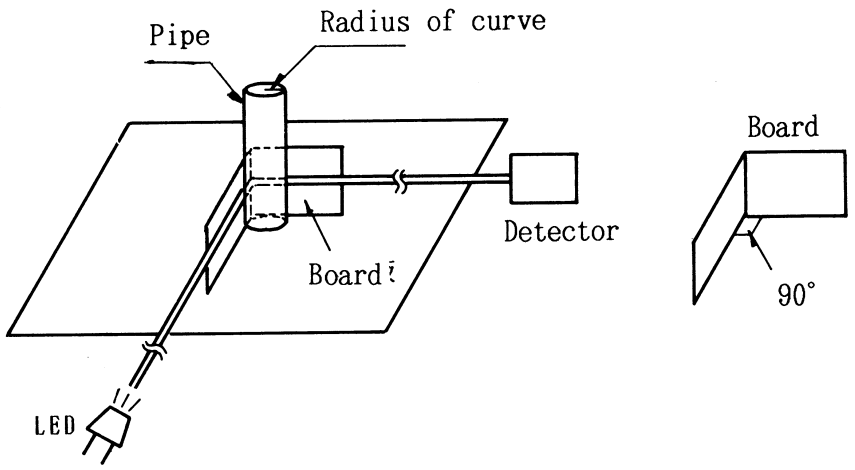



Figure 3-5-1 Measurement method

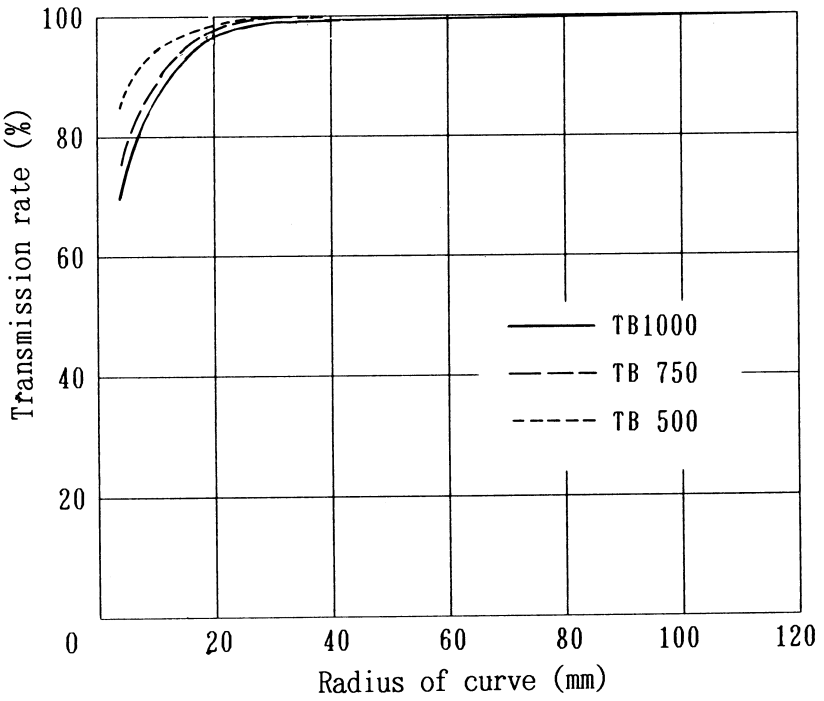



Figure 3-5-2 Resistance to curvatur (no weight)

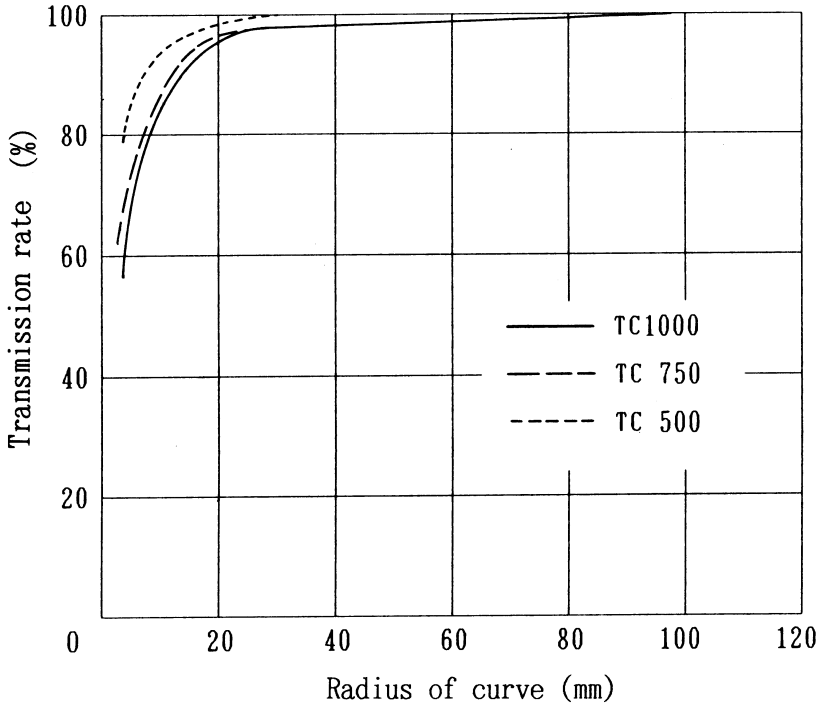



Figure 3-5-3 Resistance to curve (no weight)

3-6) Resistance to curvature (90° weight)

Grade : TC1000、TC750

Method : The fiber, which is curved with the board, is subjected to loading by 500g weight and its transmission rate is measured.

Fiber length :5m (curve point : 2m from the light source)

Light source : 660nm LED

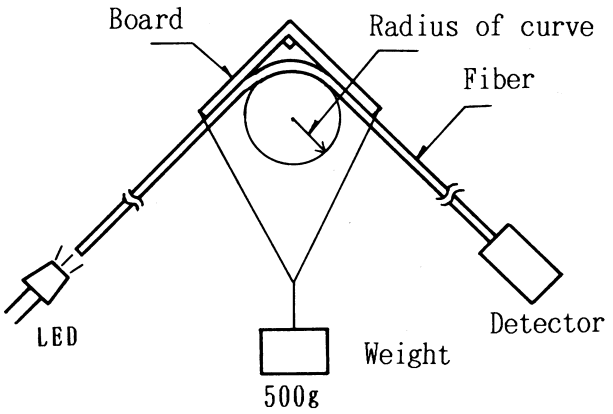



Figure 3-5-1 Measurement method

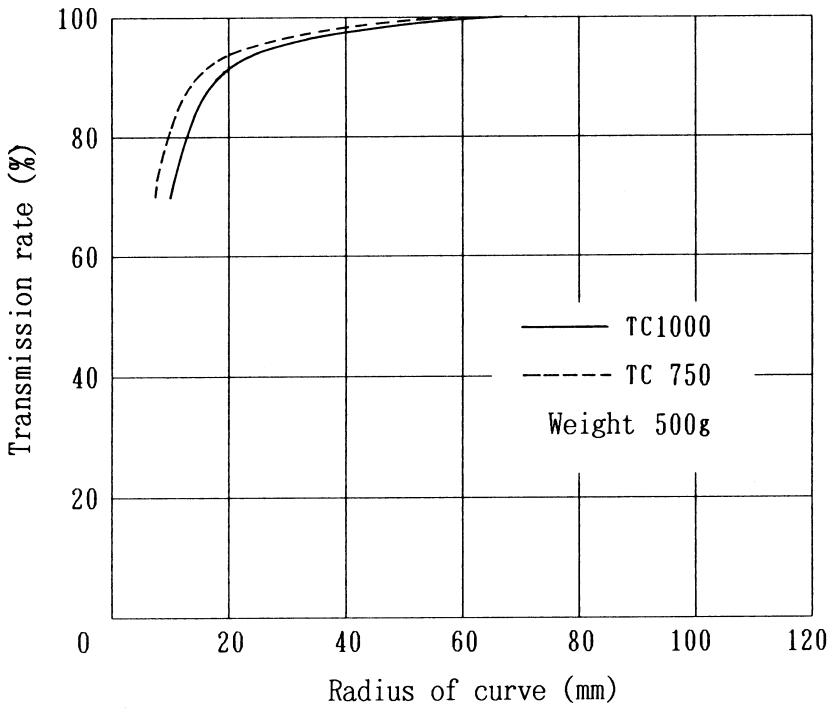



Figure 3-5-2 Resistance to curvature (no weight)

3-7) Resistance to winding

Grade : TC1000

Method : The fiver is wound around the inside of the pipe, and its attenuation is measured.

Fiber length, Radius of pipe, Number of winding' : Figure 3-7-1

Light source : 660nm LED

Table 3-7-1 Condition

| Fiber length (m) | 10 | 10 | 60 | 60 |
|---|---|---|---|---|
| Radius of wind (mm) | 10 | 15 | 50 | 100 |
| Number of winds | 50 | 50 | 80 | 80 |

Radius : the inside radius of the pipe

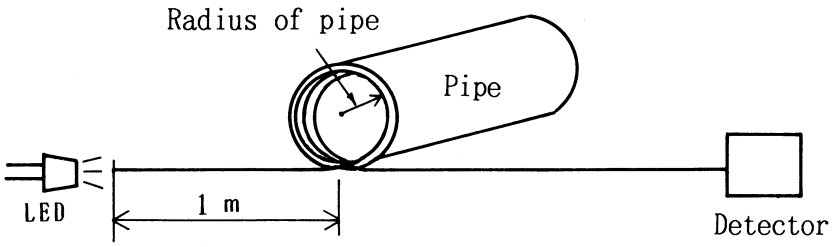
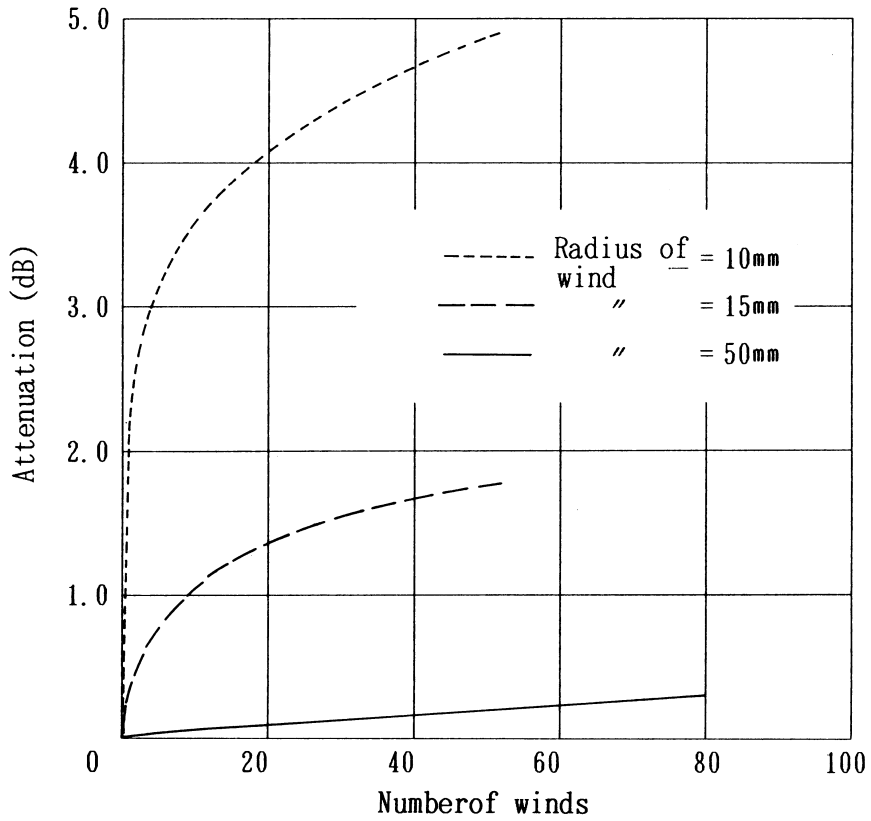



Figure 3-7-1 Measurement method




( In the case of a 100mm radius, the attenuation is same as the case of 50mm )

Figure 3-7-2 Resistance to winding

3-8) Resistance to compressive load

Grade : TC1000

Method : The fiber is subjected to a condition of compression and then absence of compression each for 120 seconds intervals, and its attenuation is measured.

Load : 35、70、105kg

Width of loading : 50mm

Number of loading : 3times

Fiber length : 3m (compression point : 2m from the light source)

Light source : 660nm LED

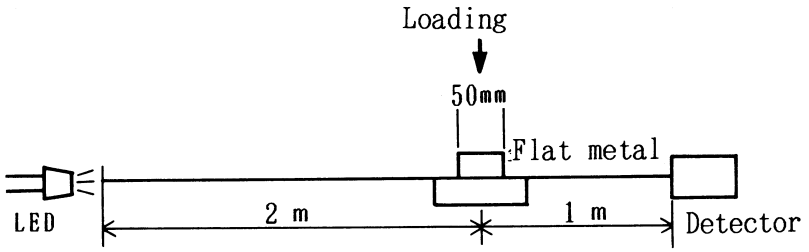



Figure 3-8-1 Measurement method

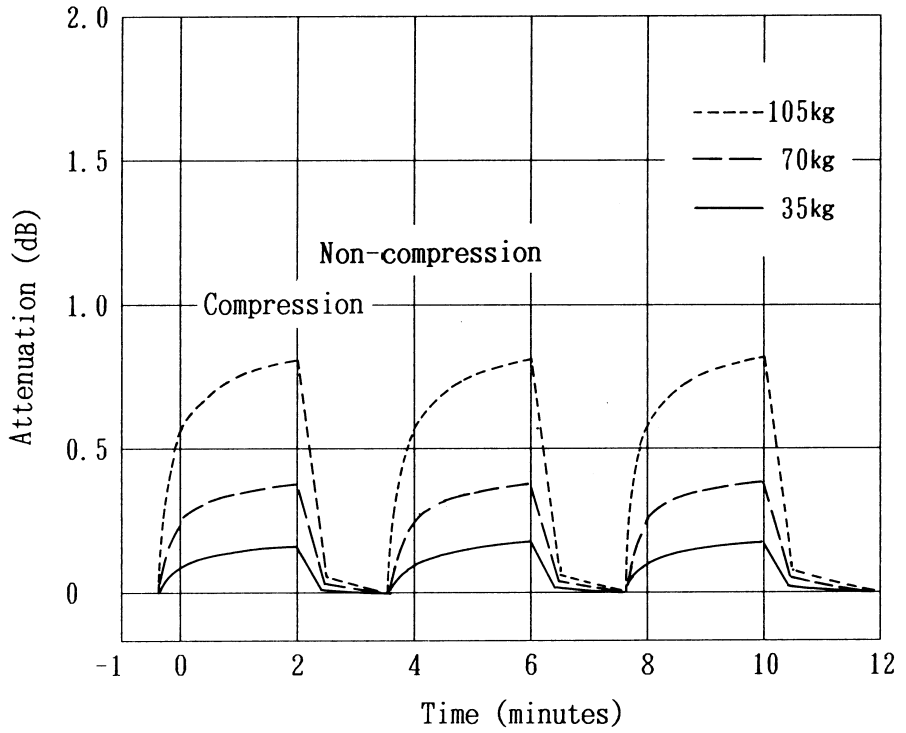



Figure 3-8-2 Resistance to compression

3-9) Resistance to drop impact

Grade : TC1000

Method : A weight is dropped onto a solid half ball of metal affixed to the fiber and the attenuation of the fiber is measured.

Load : 1.0kg

Fiber length : 3m (the point of drop impact : 2m from the light source)

Light source : 660nm LED

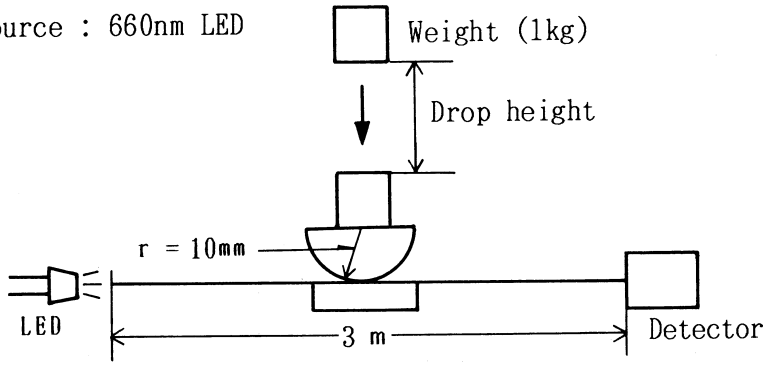



Figure 3-9-1 Measurement method

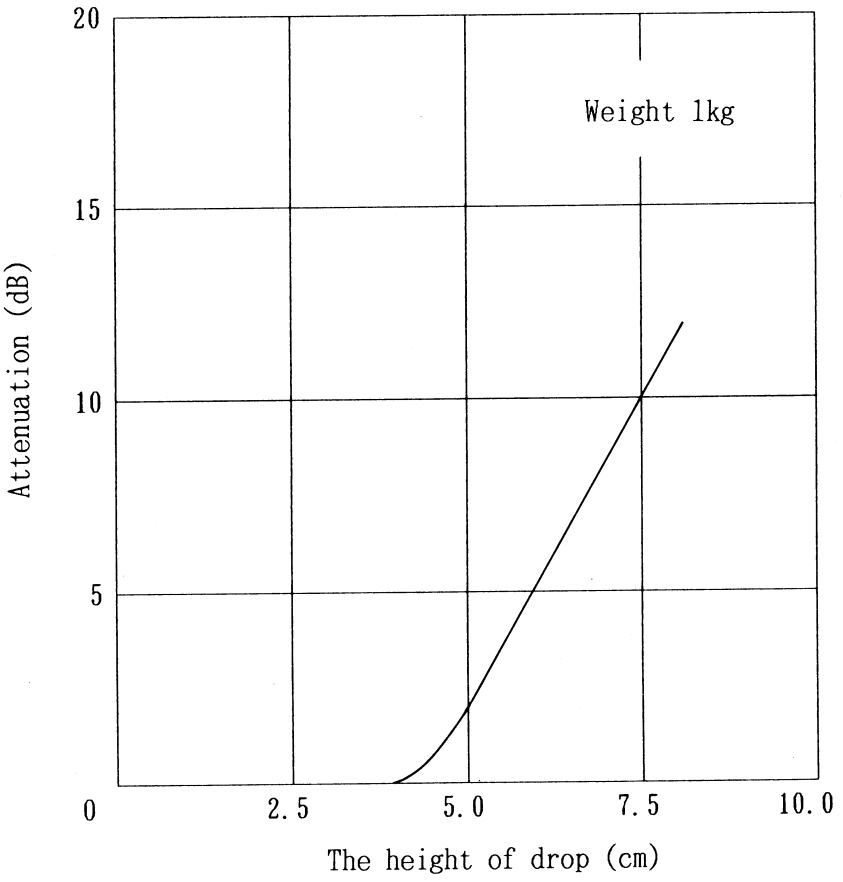



Figure 3-9-2 Resistance to drop impact

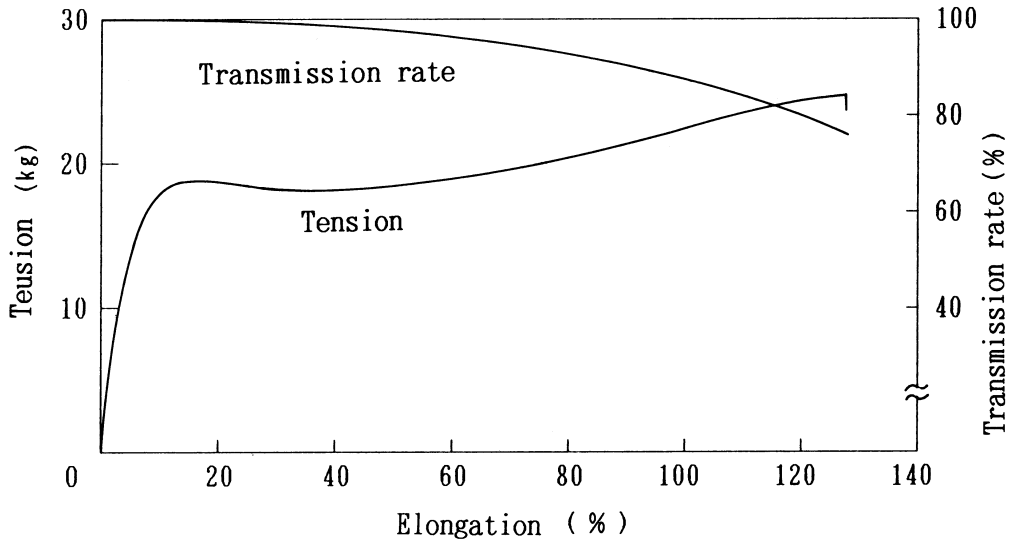
## 3－10）　Transmission rate under stress conditions

Grade　　:　TC1000W、TC1000

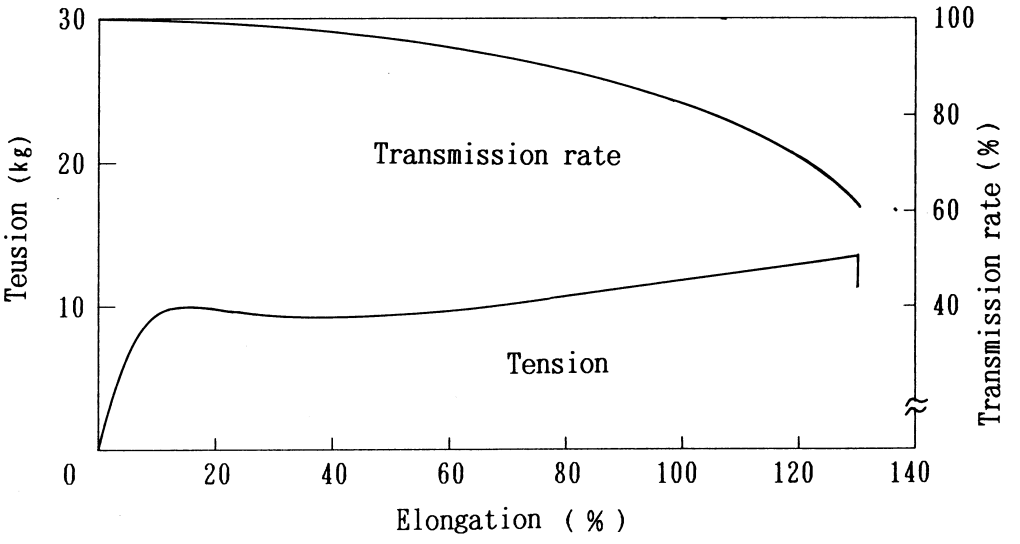
Method　　: The fiber is subjected to tension in accordance with the method of 2-1, and its transmission rate is measured

Fiber length : 10m ( Chuck-to-chuck distance:10cm, tensile stress-2m from light source

Light source　: 660nm LED




(a)　TC1000W




(b)　TC1000

Figure 3-10-1 Transmission rate under stress conditions

## 4) Thermal properties

### 4-1) Resistance to high temperature (dry)

Grade : TC1000

Method : A test sample of fiber (a) 52m, a test sample of fiber (b) 2m (For measurement of attenuation) and test sanple (c) 1m(for measurement of heat shrinkage) are rounded in bundles of 1m radius, and are put on the flat table in the dry heat room for hours, and change of attenuation are then measured.
The attenuation is calculated under the following formula, after the length of test samples (a, b, c) are adjusted on the basis of the shrinkage of test sample (c).

$$\text{Attenuation} = 10000 \times \frac{1}{\alpha - \beta} \text{Log} \frac{B}{A} \quad (\text{db/km})$$

$\alpha$、$\beta$ : Fiber length (test samples a, b) after adjusted
A、B : Optical power (test samples a, b)

Temperature : 85°C

Light source : 650nm

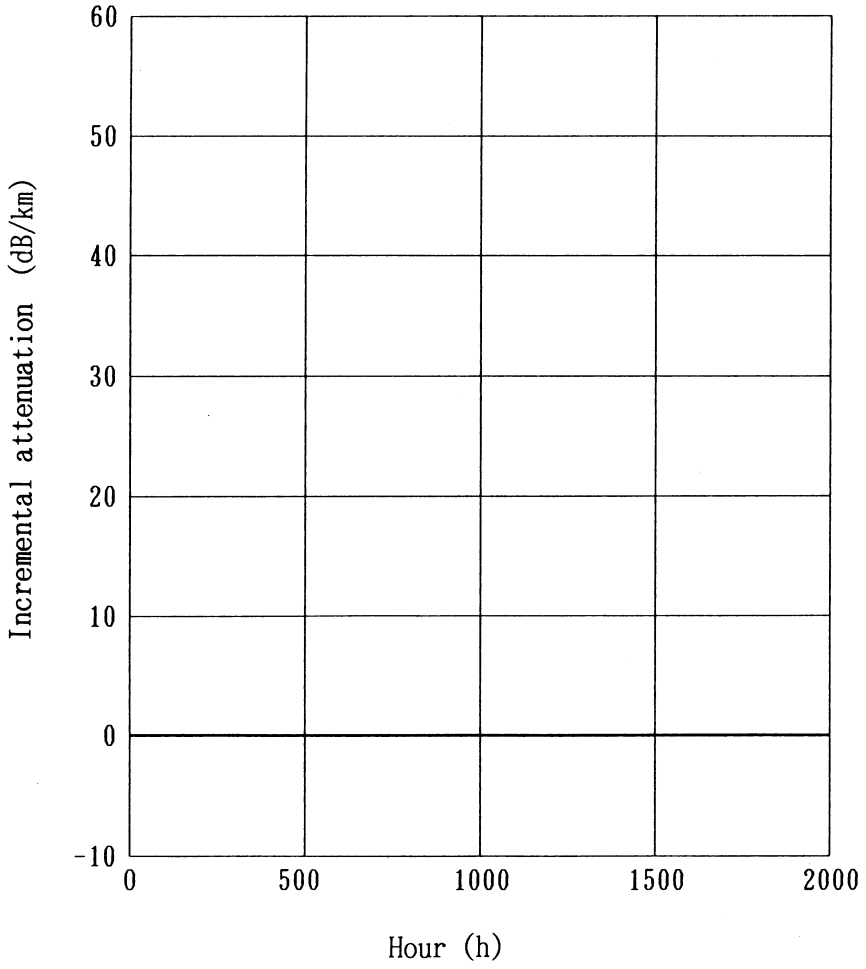



Figure 4-1-1 Resistance to high temperature 85°C (dry)

4-2) Resistance to low temperature (dry)

Grade : TC1000

Method : Same as 4-1)

Temperature : -40°C

Light source : 650nm

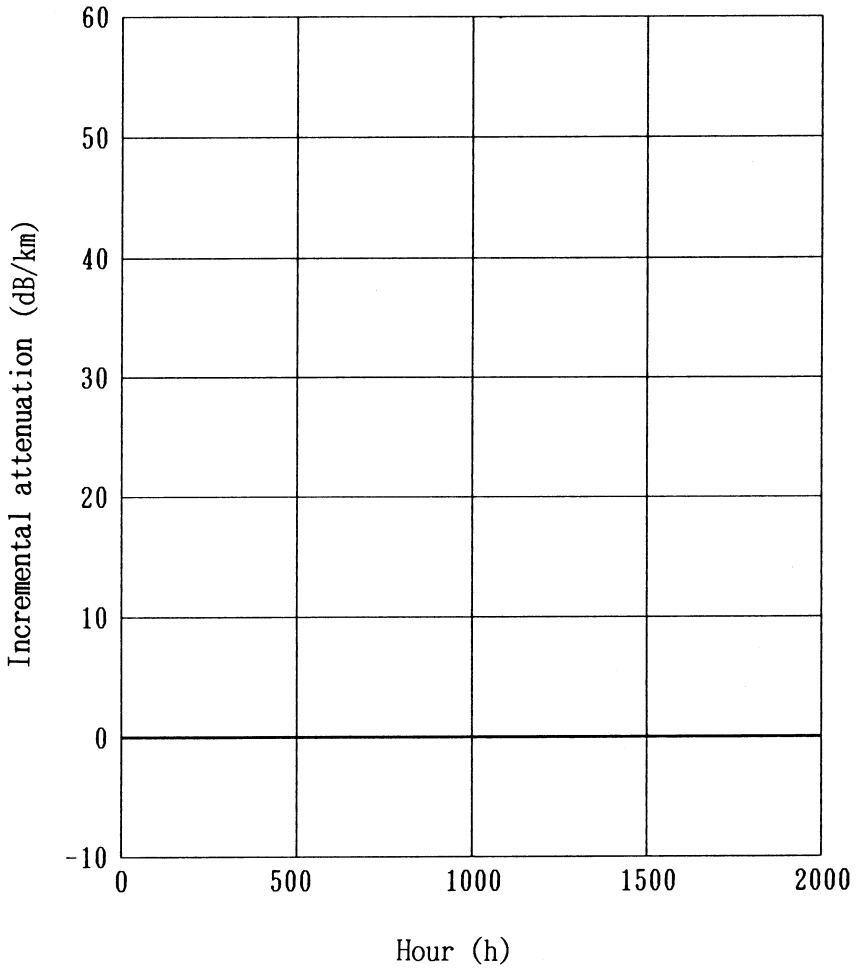



Figure 4-2-1 Resistance to low temperature -40°C (dry)

4-3) Resistance to high temperature (wet)

Grade : TC1000

Method : Same as 4-1)

Temperature : 85°C

Wet condition : 95%RH

Light source : 650nm

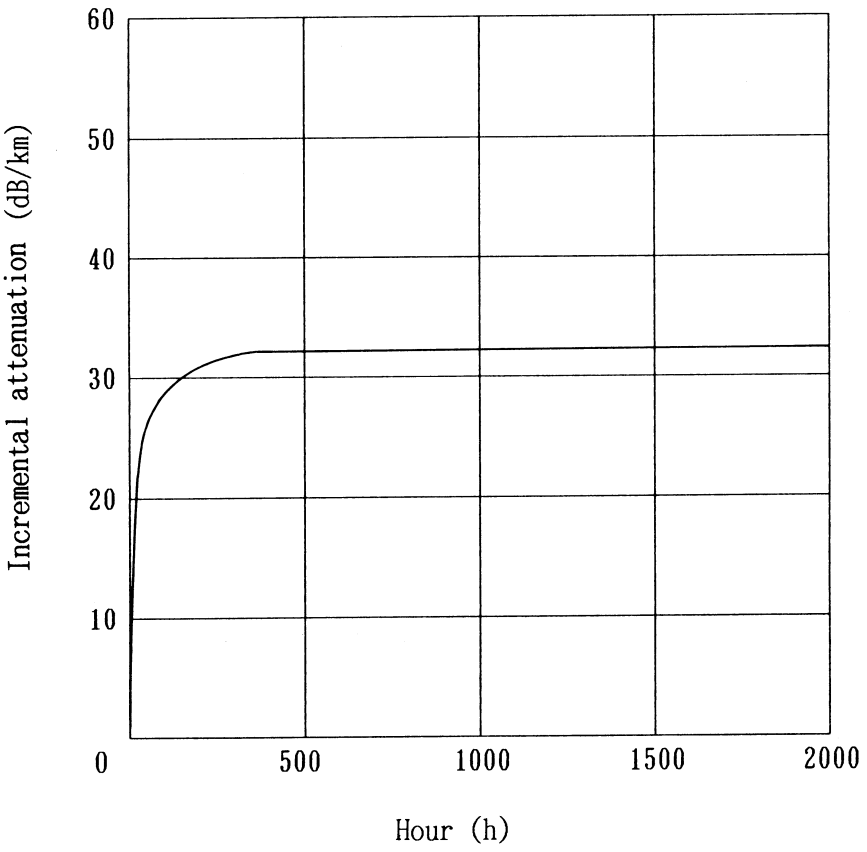



Figure 4-3-1 Resistance to high temperature (wet)

4-4) Resistance to thermal impact

Grade : TC1000

Method The fiber is subjected to thermal impacts (-40°C:75minutes ⇄ 85°C:75 minutes), and its attenuation is measured. Test samples, and calculation formula are the same as in 4-1

Light source : 650nm

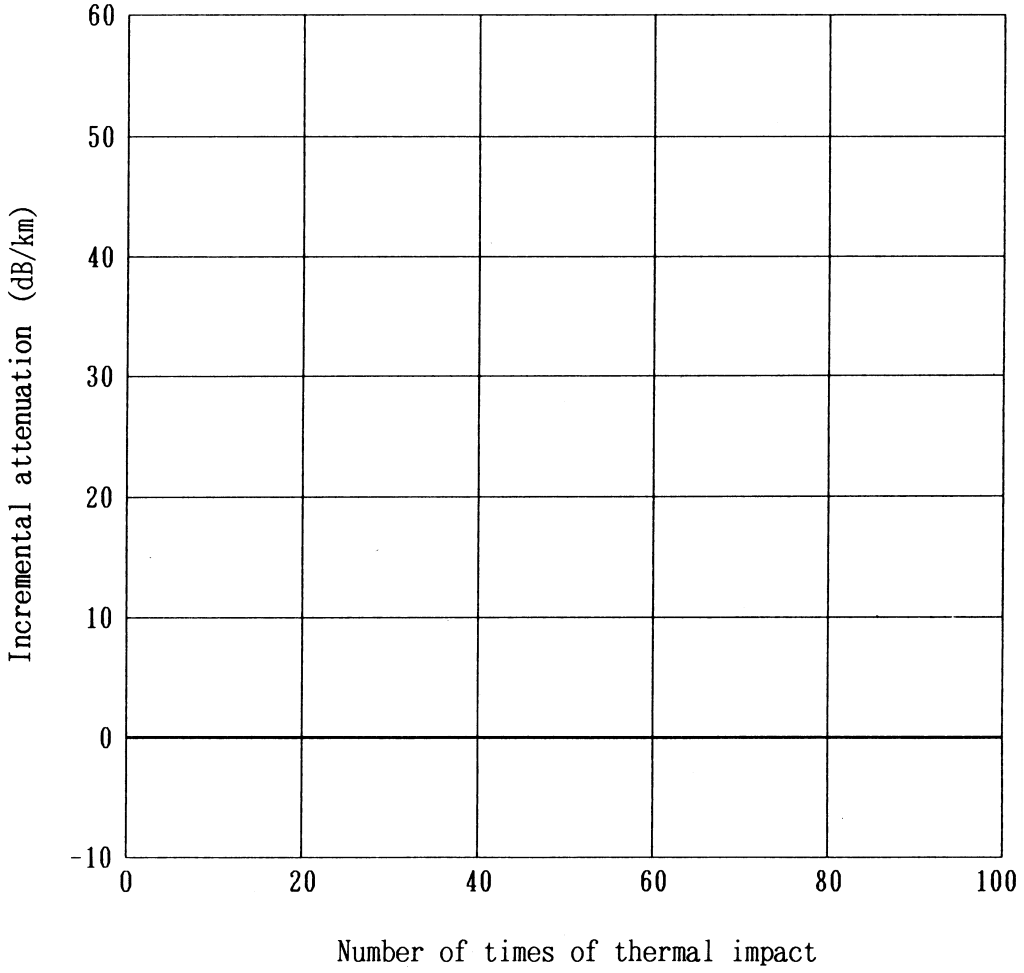



Figure 4-4-1 Resistance to thermal impact

4-5) Heat shrinkage / temperature

Grade : TC1000

Method : Fiber of 100cm is put in a dry heat room for 1 hour, and its length is checked.

$$\text{Rate of heat shrinkage} = \frac{A\ (cm)}{100.0\ (cm)} \times 100\ (\%)$$

A : Fiber length after 1 hour.

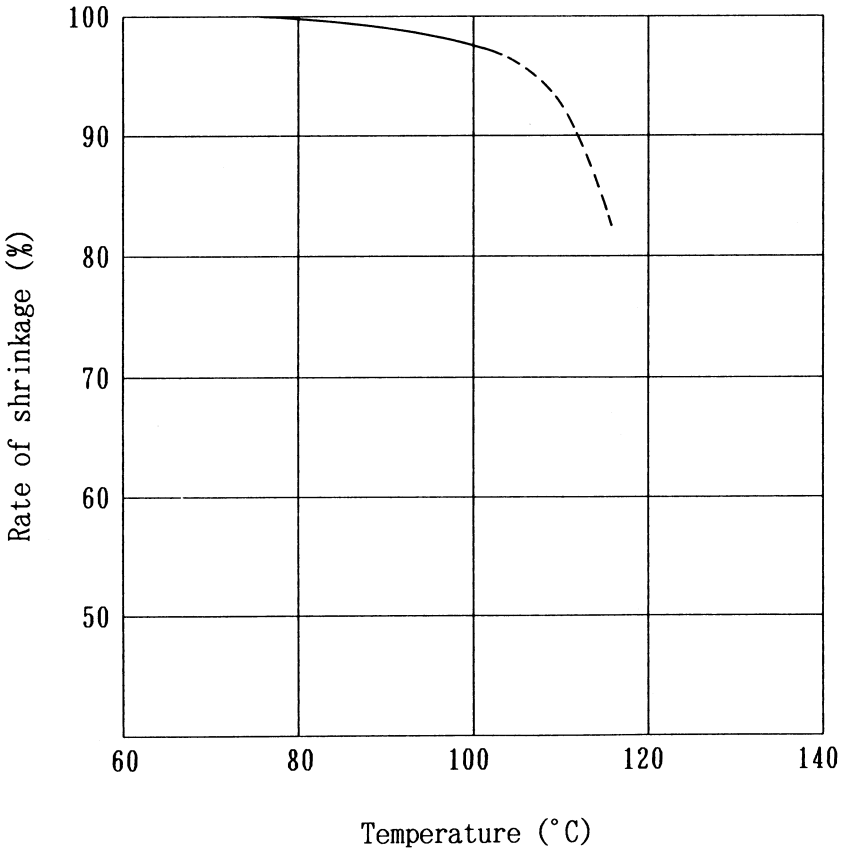



Figure 4-5-1 Heat shrinkage / temperature

4-6) Heat shrinkage / moisture

Grade : TC1000

Method : Fiber of 100cm is put in a room of 85°C-95°%RH, and its length is checked.

$$\text{Rate of heat shrinkage} = \frac{A\ (cm)}{100.0\ (cm)} \times 100\ (\%)$$

A : Fiber length after 1 hour.

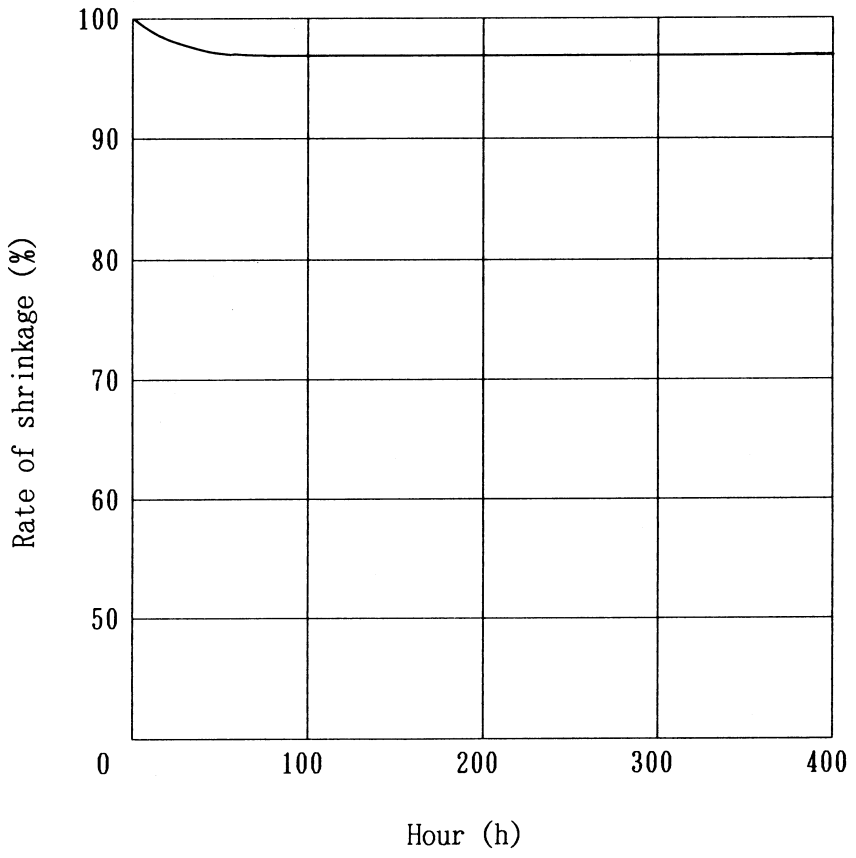



Figure 4-6-1 Heat shrinkage / mouisture

4-7) Protrusion from and retraction into the jacket on thermal impact

Grade TC1000W、TC1000、TC500W、TC500

Method The fiber is subjected to thermal impacts (-40°C:75minutes ⇄ 85°C: 75 minutes. and protrusion from and retraction into the jacket is measured

Fiber length : 2m

Table 4-7-1 Protrusion from and retraction into the jacket on thermal impact

(Unit : mm)

| Number of times (thermal impact) | 0 | 20 | 100 |
|---|---|---|---|
| TC-1000W | 0.0 | ±0.1 | ±0.2 |
| TC-1000 | 0.0 | ±0.1 | ±0.2 |
| TC-500W | 0.0 | ±0.1 | ±0.2 |
| TC-500 | 0.0 | ±0.1 | ±0.2 |

+ : The protrusion of the bare fibers from the jacket

- : The retraction of the bare fibers into the jacket