



PILKINGTON

Optical Glass

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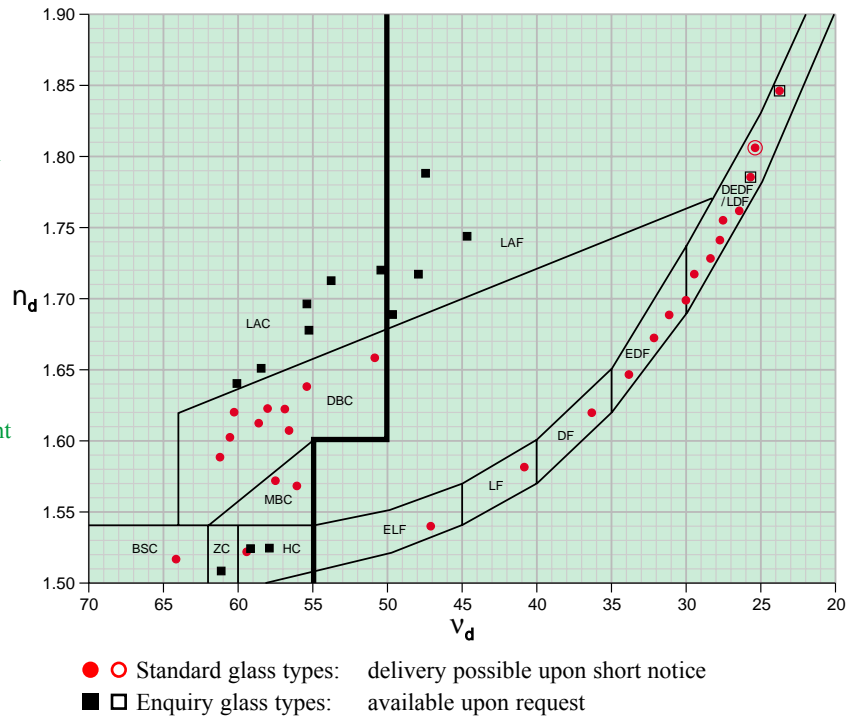




# 1 Types of optical glass

The Abbé diagram below illustrates the range of Pilkington optical glass types available.

|      |                          |
|------|--------------------------|
| BSC  | Borosilicate crown       |
| ZC   | Zinc crown               |
| HC   | Hard crown               |
| MBC  | Medium barium crown      |
| DBC  | Dense barium crown       |
| ELF  | Extra light flint        |
| LF   | Light flint              |
| DF   | Dense flint              |
| EDF  | Extra dense flint        |
| DEDF | Double extra dense flint |
| LDF  | Low density flint        |
| LAC  | Lanthanum crown          |
| LAF  | Lanthanum flint          |



Explanation of Pilkington glass code convention:

BSC517642A

|          |  |
|----------|--|
| BSC      | <u>Boro</u> <u>Silicate</u> <u>Crown</u> |
| 517      | $n_d = 1.517$                            |
| 642      | $v_d = 64.2$                             |
| A/B/C... | glass version                            |

Quality control of  
raw materials



Alternative naming conventions are also used within the optical glass industry.  
The nearest equivalents to Pilkington glass types are listed in the following tables:

### Standard glass types

| Pilkington  | Schott | Hoya     | Ohara   |
|-------------|--------|----------|---------|
| BSC517642B  | N-BK7  | BSC7     | S-BSL7  |
| HC522595A   | N-K5   | –        | S-NSL5  |
| MBC569561A  | N-BAK4 | BAC4     | S-BAL14 |
| MBC573576A  | N-BAK1 | –        | S-BAL11 |
| DBC589613A  | N-SK5  | BACD5    | S-BAL35 |
| DBC603606A  | N-SK14 | BACD14   | S-BSM14 |
| DBC607567A  | N-SK2  | BACD2    | S-BSM2  |
| DBC613586A  | N-SK4  | BACD4    | S-BSM4  |
| DBC620603A  | N-SK16 | BACD16   | S-BSM16 |
| DBC623569A  | N-SK10 | E-BACD10 | S-BSM10 |
| DBC623581A  | N-SK15 | BACD15   | S-BSM15 |
| DBC639554A  | N-SK18 | BACD18   | S-BSM18 |
| DBC658509A  | N-SSK5 | BACED5   | S-BSM25 |
| ELF541472A  | LLF2   | FEL2     | PBL2    |
| LF581409A   | LF5    | FL5      | PBL25   |
| DF620364A   | F2     | F2       | PBM2    |
| EDF648339A  | SF2    | FD2      | PBM22   |
| EDF673322A  | SF5    | FD5      | PBM25   |
| EDF689312A  | SF8    | FD8      | PBM28   |
| EDF699301A  | SF15   | FD15     | PBM35   |
| DEDF717295A | SF1    | FD1      | PBH1    |
| DEDF728284A | SF10   | FD10     | PBH10   |
| DEDF741278A | SF13   | FD13     | PBH13   |
| DEDF755276A | SF4    | FD4      | PBH4    |
| DEDF762265A | SF14   | FD14     | PBH14   |
| DEDF785258A | SF11   | FD11     | PBH11   |
| DEDF805254A | SF6    | FD6      | PBH6    |
| DEDF847238A | SF57   | FDS9     | PBH53   |
| LDF805254A  | SFL6   | FD60     | TIH6    |

### Enquiry glass types

| Pilkington | Schott  | Hoya   | Ohara   |
|------------|---------|--------|---------|
| ZC508612A  | ZK7     | –      | –       |
| HC524592A  | –       | –      | –       |
| HC525579A  | –       | –      | –       |
| LAC641601B | N-LAK21 | LACL60 | S-BSM81 |
| LAC652585B | N-LAK7  | LAC7   | S-LAL7  |
| LAC678552B | N-LAK12 | LAC12  | S-LAL12 |
| LAC691547B | N-LAK9  | LAC9   | S-LAL9  |
| LAC697554B | N-LAK14 | LAC14  | S-LAL14 |
| LAC713538B | N-LAK8  | LAC8   | S-LAL8  |
| LAC720504B | N-LAK10 | LAC10  | S-LAL10 |
| LAF689497A | N-LAF23 | –      | –       |
| LAF717480B | N-LAF3  | LAF3   | S-LAM3  |
| LAF744447B | N-LAF2  | LAF2   | S-LAM2  |
| LAF788475B | N-LAF21 | TAF4   | S-LAH64 |
| LDF785258A | SFL11   | FD110  | TIH11   |
| LDF847238A | SFL57   | FDS90  | TIH53   |

Pilkington welcomes enquires for glass types not listed above.

A number of traditional glasses obtain their combination of properties by the presence of lead and/or arsenic oxides within the glass. Where appropriate, absence of these chemicals is indicated. All Pilkington optical glass is manufactured without the use of raw materials containing cadmium or thorium.

## 2 Optical properties

### 2.1 Refractive index

Wavelengths of  
spectral lines and  
refractive index  
designation

| Index        | $\lambda$ [nm] | Source                   |
|--------------|----------------|--------------------------|
| $n_{2325.4}$ | 2325.4         | Infrared mercury line    |
| $n_{1970.1}$ | 1970.1         | Infrared mercury line    |
| $n_{1529.6}$ | 1529.6         | Infrared mercury line    |
| $n_{1060.0}$ | 1060.0         | Neodymium glass laser    |
| $n_i$        | 1014.0         | Infrared mercury line    |
| $n_s$        | 852.1          | Infrared cesium line     |
| $n_{A'}$     | 768.2          | Infrared potassium line  |
| $n_r$        | 706.5          | Red helium line          |
| $n_C$        | 656.3          | Red hydrogen line        |
| $n_{C'}$     | 643.9          | Red cadmium line         |
| $n_{632.8}$  | 632.8          | He-Ne glass laser        |
| $n_D$        | 589.3          | Yellow sodium line       |
| $n_d$        | 587.6          | Yellow helium line       |
| $n_e$        | 546.1          | Green mercury line       |
| $n_F$        | 486.1          | Blue hydrogen line       |
| $n_{F'}$     | 480.0          | Blue cadmium line        |
| $n_g$        | 435.8          | Blue mercury line        |
| $n_h$        | 404.7          | Violet mercury line      |
| $n_i$        | 365.0          | Ultraviolet mercury line |
| $n_{334.1}$  | 334.1          | Ultraviolet mercury line |
| $n_{312.6}$  | 312.6          | Ultraviolet mercury line |
| $n_{296.7}$  | 296.7          | Ultraviolet mercury line |
| $n_{280.4}$  | 280.4          | Ultraviolet mercury line |
| $n_{248.3}$  | 248.3          | Ultraviolet mercury line |

The Cauchy dispersion formula may be used to calculate refractive indices not tabulated above, to an accuracy of five decimal places. Note – wavelength ( $\lambda$ ) in microns.

Cauchy dispersion  
formula

$$n_{\lambda}^2 = A_0 + A_1\lambda^2 + A_2\lambda^{-2} + A_3\lambda^{-4} + A_4\lambda^{-6} + A_5\lambda^{-8}$$

### 2.1.1 Partial dispersions/Secondary spectrum

Relative partial dispersion between two wavelengths (x and y) relative to either of the mean dispersions is defined as:

Definition of partial dispersions

$$P_{x,y} = \frac{n_x - n_y}{n_F - n_C} \quad , \quad P'_{x,y} = \frac{n_x - n_y}{n_{F'} - n_{C'}}$$

According to Abbé, “normal” glasses will exhibit a relationship between constringence and any given partial dispersion of the form (where a & b are constants):

Variation of partial dispersions with constringence (normal glasses)

$$P_{x,y} = a_{x,y} + b_{x,y} \cdot v_d$$

$\Delta P_{x,y}$  indicates the deviation of a glass’ true partial dispersion from the “normal” line, based on K7 and F2 glass types.

### 2.1.2 Temperature coefficients of refractive index

Both absolute values (in vacuum) and relative values (at atmospheric pressure) are tabulated.

## 2.2 Transmittance

### 2.2.1 Internal transmittance

Internal transmittance values are quoted for paths of 5,10 and 25mm. Tabulated values are typical of Pilkington production.

Pilkington should be informed of any specific internal transmittance requirements prior to order.

Internal transmittance follows the Beer Lambert law which allows the calculation of transmission ( $\tau$ ) at any path length (d) not tabulated as below:

Beer Lambert relationship for transmittance

$$\frac{\log \tau_{i1}}{\log \tau_{i2}} = \frac{d_1}{d_2}$$

Note – reflection losses will occur at surfaces. Reflection losses (R) at each surface being related to refractive index (n) as follows:

Variation of reflection losses with refractive index

$$R = \frac{(n-1)^2}{(n+1)^2}$$



Measurement of  
transmittance by  
spectrophotometer



### 2.2.2 Colour code

This code indicates the position of the UV cut off for each glass type. The two digits indicate for a 10mm pathlength the wavelength at which transmission (including reflection losses) is equal to 80% and 5% respectively. The actual wavelength values are rounded to 10nm and the units figure omitted.

### 3 Chemical resistance

Stability of polished glass surfaces in a number of aggressive environments is measured to ISO standards.

#### 3.1 Acid resistance

Measured according to ISO8424 (1996).

The digits preceding the decimal point refer to the following table, which gives a measure of the time taken to remove a 0.1µm layer from the surface of a solid (bulk) sample at 25°C.

##### Acid resistance grades

|                       |      |        |      |       |      |     |      |       |      |
|-----------------------|------|--------|------|-------|------|-----|------|-------|------|
| Acid resistance       | 1    | 2      | 3    | 4     | 5    | 5   | 51   | 52    | 53   |
| pH value              | 0.3  | 0.3    | 0.3  | 0.3   | 0.3  | 4.6 | 4.6  | 4.6   | 4.6  |
| Hours to remove 0.1µm | >100 | 10-100 | 1-10 | 0.1-1 | <0.1 | >10 | 1-10 | 0.1-1 | <0.1 |

Note – two different acids are used dependant on whether the glass is strongly resistant to attack or not.

#### 3.2 Alkali resistance

Measured according to ISO10629 (1996).

The digits preceding the decimal point refer to the table below which gives a measure of the time taken to remove a 0.1µm layer from the surface of a solid (bulk) sample at 50°C in a solution of pH=12.

#### 3.3 Phosphate resistance

Measured according to ISO9689 (1990).

As with the alkali resistance test, but using phosphate containing alkaline solution of pH=10.

##### Alkali and phosphate resistance grades

|                             |    |     |        |       |
|-----------------------------|----|-----|--------|-------|
| Alkali/phosphate resistance | 1  | 2   | 3      | 4     |
| Hours to remove 0.1µm       | >4 | 1-4 | 0.25-1 | <0.25 |

#### 3.4 Surface appearance

Those digits following the decimal point for the acid, alkali and phosphate tests relate to the surface appearance following attack. The higher this figure the more apparent the attack.

##### Acid, alkali and phosphate surface appearance grades

|   |  |
|---|--|
| 0 | No damage visible                              |
| 1 | Uneven surface                                 |
| 2 | Interference colours visible                   |
| 3 | A firmly adhered white layer present           |
| 4 | Loosely adherent (thicker) white layer present |

### 3.5 Climatic resistance

Measured according to ISO13384 (1997).

This figure indicates the increase in haze apparent in a polished sample after being exposed to a saturated water vapour atmosphere cycling between 40°C and 50°C.

Resistance classes are defined as follows:

Climatic resistance  
grades

| Climatic resistance             | 1     | 2      | 3      | 4  |
|---------------------------------|-------|--------|--------|----|
| Increase in haze ( $\Delta H$ ) | <0.3% | 0.3-1% | 1-2% > | 2% |

Optical strip glass forming



## 4 Mechanical properties

### 4.1 Knoop hardness ( $H_K$ )

Knoop hardness is measured by an indentation method using a polished diamond pyramidal indenting tool. A force of 0.1kg is applied for twenty seconds.

### 4.2 Abrasion hardness ( $F_A$ )

This comparative measure relates the quantity of glass removed from a standard test piece during a polishing operation. All results are relative to Pilkington glass BSC517642 and abrasion hardness is defined by the relationship:

Definition of abrasion  
hardness

$$F_A = 100 \cdot \left( \frac{\text{Volume loss of sample}}{\text{Volume loss of standard}} \right)$$

#### 4.3 Young's modulus (E)

Young's modulus, or elastic modulus, is measured from the longitudinal resonance of a test rod as described within the Transactions of the British Ceramics Society volume 67 (11) p515 (1968).

#### 4.4 Modulus of rigidity (G)

Modulus of Rigidity, or shear modulus, is measured from the torsional resonance of a test rod as described within the Transactions of the British Ceramics Society volume 67 (11) p515 (1968).

#### 4.5 Poisson's ratio ( $\mu$ )

Poisson's ratio is calculated from the elastic and shear moduli using the relationship:

Relationship between  
elastic constants

$$\mu = \frac{E}{2G} - 1$$

#### 4.6 Stress optical coefficient

Within annealed glass any residual stresses are apparent as birefringence. Dividing the birefringence (nm/cm) by the stress optic coefficient gives the residual stress (kgf/cm<sup>2</sup>).

Assessment of visual colour



#### 4.7 Specific gravity ( $\rho$ )

Specific gravity is measured by the Archimedes method and is typical for each glass type. Note – specific gravity values may vary in the second decimal place depending on the heat treatment of optical glasses. Quoted values are for samples cooled at 60°C/day.

### 5 Thermal properties

#### 5.1 Strain point

Measured according to ISO7884/7 (1987).

The strain point is the temperature at which the glass has a viscosity of  $10^{14.5}$  poise. In practical terms, below this temperature the glass must be considered as an elastic solid in its response to stress.

#### 5.2 Annealing point

Measured according to ISO7884/7 (1987).

The annealing point is the temperature at which the glass has a viscosity of  $10^{13.0}$  poise. Optical components should not be heated to within 200°C of this point to prevent changes in optical properties (as discussed under annealing factor).

#### 5.3 Transformation temperature ( $T_g$ )

Measured according to ISO7884/8 (1987).

According to this method the temperature at which the change in slope of the thermal expansion curve occurs is taken as the transformation temperature.

#### 5.4 Yield point ( $A_y$ )

The yield point is defined as the maximum point on the thermal expansion curve, where the rate of distortion of the sample due to the measuring force exceeds the rate of thermal expansion. The point obtained is specific to the apparatus and conditions used.

#### 5.5 Softening point

Measured according to ISO7884/3 (1987).

The softening point is the temperature at which the glass has a viscosity of  $10^{7.65}$  poise, this indicates the point at which a glass article is likely to deform under its own weight.



## 5.6 Annealing factor (F) for $n_d$

Pilkington will always quote a cooling rate ( $R_0$ ) along with any optical data. For glass heated above  $T_g$  and cooled at a rate  $R$  the effect on  $n_d$  in the 4th decimal place is given by the relationship:

Relationship between  
cooling rate and  
refractive index

$$\Delta n_d = F \cdot \log_{10} \frac{R_0}{R}$$

Unless indicated otherwise  $v_d$  should be recalculated using the new value of  $n_d$ . Where a value of  $F_v$  is quoted on the data sheet the following equation should be used to calculate  $v_d$ .

Relationship between  
cooling rate and Abbé  
number

$$\Delta v_d = F_v \cdot \log_{10} \frac{R_0}{R}$$

## 5.7 Co-efficient of thermal expansion

Measured according to ISO7991 (1987).

Figures are quoted for two ranges of temperature to account for the room temperature value and the non-linearity observed at higher temperatures.

## 5.8 Specific heat capacity ( $c_p$ )

The mean isobaric specific heat capacity (20°C – 400°C) is listed as measured from the heat transfer of hot glass in a liquid calorimeter at 20°C.

## 5.9 Thermal conductivity ( $\lambda$ )

Measured according to BS1902 section 5.5 (1991).

The thermal conductivities shown, apply for a single hot face glass temperature of 90°C.

# 6 Other information

## 6.1 Optical properties release

All consignments of Pilkington optical glass are shipped with an optical properties release sheet. This document assigns the glass a melt number. Any glass with this identifier will have properties within the stated tolerances for  $n_d$  and  $v_d$  as listed on the release sheet when the glass is annealed at the rate stated on the sheet. Refer to the section on annealing factor for the effect of other heat treatments on optical properties.

## 6.2 Refractive index tolerances

Pilkington generally works to customer specific refractive index tolerances.

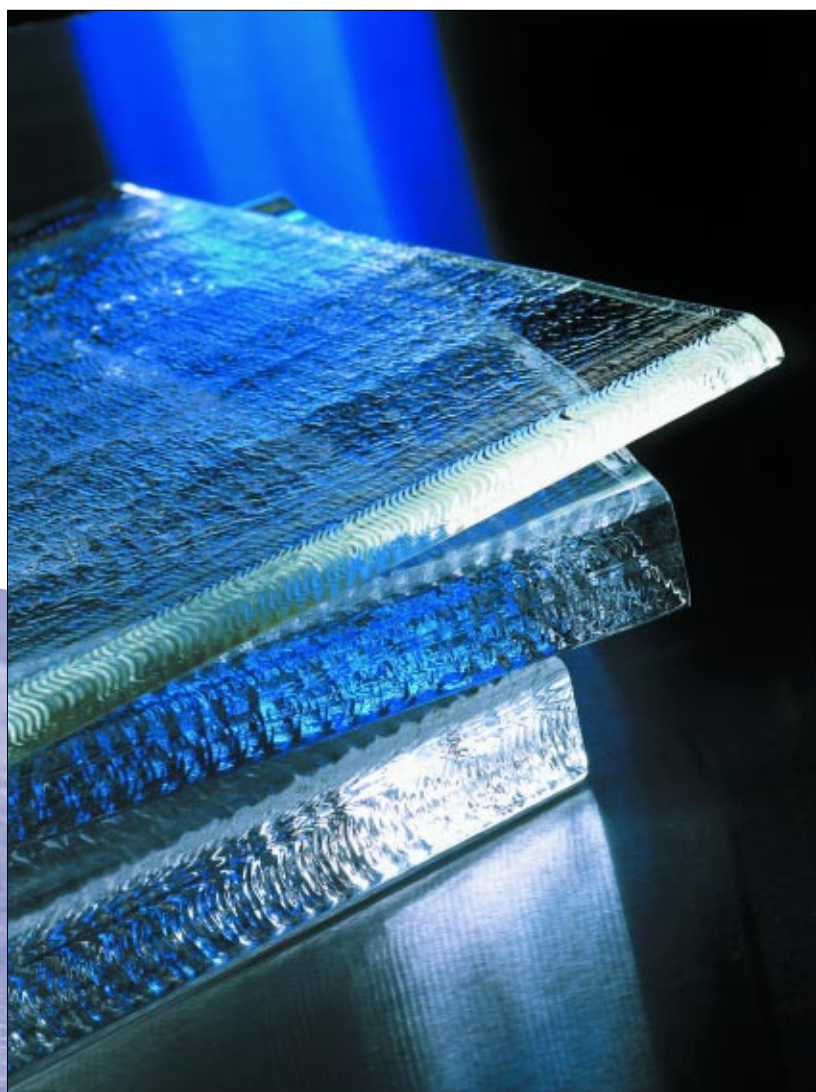
Pilkington's standard tolerances allowed on overall refractive index ( $n_d$ ) and within a melt are  $\pm 0.00050$  and  $\pm 0.00010$  respectively.

Pilkington should be informed of any specific index requirements prior to order.

## 6.3 Form of supply

All optical glass is available from Pilkington in the form of raw cast strip. Size may vary by glass type but is typically:

|           |  |
|-----------|--|
| Length    | 400mm  |
| Width     | 230mm – 250mm (certain glass types can be rolled to 1000mm or wider) |
| Thickness | 7mm – 45mm (certain glass types are available at 45 – 100mm)         |



#### 6.4 Transmittance and colour variation

Tabulated transmittance values are typical for each glass type.

Pilkington's standard colour code tolerance is  $\pm 10\text{nm}$  of the stated values for each glass type.

Pilkington should be informed of any specific transmittance requirements prior to order.

#### 6.5 Inclusion quality

Pilkington endeavour to make optical glass as free from inclusions as possible. However, occasional isolated bubbles or inclusions may be encountered.

Pilkington's standard supply of optical glass considers inclusions (including bubbles) within the size range  $0.06\text{mm} - 0.25\text{mm}$ . A maximum count of 0.6 inclusions are allowed per  $100\text{cm}^3$  with a maximum cross sectional area of  $0.029\text{mm}^2$ .

Pilkington should be informed of any specific inclusion quality requirements prior to order.

#### 6.6 Stress birefringence

Typically, Pilkington optical glass is supplied with a residual stress birefringence of  $100\text{nm/cm}$  or lower. This is generally adequate for all hot and cold working.

Pilkington should be informed of any specific annealing requirements prior to order.

#### 6.7 Vein quality

Vein grading is quoted in two directions within the strip. Examination through the cut ends and the thickness determine the edge and flat quality respectively. Edge quality is normalised to  $100\text{mm}$  path length and is the prime measure of vein quality. Pilkington grades relative to various international standards are listed below:

##### Equivalent vein grades

| Pilkington | BS4301 | DIN3140 | MIL-STD 1748 | JOGIS 11 |
|------------|--------|---------|--------------|----------|
| A          | 2/i    | 2/0     | A            | 1        |
| B          | 2/ii   | 2/1     | B            |          |

Pilkington should be informed of any specific vein quality requirements prior to order.

## Standard glass types

|                                  |   |   |
|----------------------------------|---|---|
| EDF689312<br>(Pb/As containing)  | → | <b>EDF689312A</b><br>(New naming convention)  |
| EDF699301<br>(Pb/As containing)  | → | <b>EDF699301A</b><br>(New naming convention)  |
| DEDF717295<br>(Pb/As containing) | → | <b>DEDF717295A</b><br>(New naming convention) |
| DEDF728284<br>(Pb/As containing) | → | <b>DEDF728284A</b><br>(New naming convention) |
| DEDF741278<br>(Pb/As containing) | → | <b>DEDF741278A</b><br>(New naming convention) |
| DEDF755276<br>(Pb/As containing) | → | <b>DEDF755276A</b><br>(New naming convention) |
| DEDF762265<br>(Pb/As containing) | → | <b>DEDF762265A</b><br>(New naming convention) |
| DEDF785258<br>(Pb/As containing) | → | <b>DEDF785258A</b><br>(New naming convention) |
| DEDF805254<br>(Pb/As containing) | → | <b>DEDF805254A</b><br>(New naming convention) |
| DEDF847238<br>(Pb/As containing) | → | <b>DEDF847238A</b><br>(New naming convention) |
| LDF805254<br>(As containing)     | → | <b>LDF805254A</b><br>(New naming convention)  |

## Pilkington glass version evolution

### Standard glass types

|                                 |   |                                       |   |                                       |   |                                       |
|---------------------------------|---|---------------------------------------|---|---------------------------------------|---|---------------------------------------|
| BSC517642<br>(As containing)    | → | BSC517642A<br>(New naming convention) | → | BSC517642B<br>(As free)               |   |                                       |
| HC522A<br>(As free)             | → |                                       |   | HC522595A<br>(New naming convention)  |   |                                       |
| MBC569561<br>(Pb/As containing) | → | MBCF569561<br>(As containing)         | → | MBC569A<br>(As free)                  | → | MBC569561A<br>(New naming convention) |
| MBC573A<br>(Pb/As free)         | → |                                       |   | MBC573576A<br>(New naming convention) |   |                                       |
| DBC589613<br>(As containing)    | → | DBC589A<br>(As free)                  | → | DBC589613A<br>(New naming convention) |   |                                       |
| DBC603606<br>(As containing)    | → | DBC603A<br>(As free)                  | → | DBC603606A<br>(New naming convention) |   |                                       |
| DBC607567<br>(As containing)    | → | DBC607A<br>(As free)                  | → | DBC607567A<br>(New naming convention) |   |                                       |
| DBC613586<br>(Pb/As containing) | → | DBC613A<br>(As free)                  | → | DBC613B<br>(Pb free)                  | → | DBC613586A<br>(New naming convention) |
| DBC620603<br>(As containing)    | → | DBC620A<br>(As free)                  | → | DBC620603A<br>(New naming convention) |   |                                       |
| DBC623569<br>(As containing)    | → | DBC623A<br>(As free)                  | → | DBC623569A<br>(New naming convention) |   |                                       |
| DBCT623581<br>(As containing)   | → | DBCT623A<br>(As free)                 | → | DBC623581A<br>(New naming convention) |   |                                       |
| DBC639554<br>(As containing)    | → | DBC639A<br>(As free)                  | → | DBC639554A<br>(New naming convention) |   |                                       |
| DBC658509<br>(As containing)    | → | DBC658A<br>(As free)                  | → | DBC658509A<br>(New naming convention) |   |                                       |
| ELF541472<br>(Pb/As containing) | → |                                       |   | ELF541472A<br>(New naming convention) |   |                                       |
| LF581409<br>(Pb/As containing)  | → |                                       |   | LF581409A<br>(New naming convention)  |   |                                       |
| DF620364<br>(Pb/As containing)  | → |                                       |   | DF620364A<br>(New naming convention)  |   |                                       |
| EDF648339<br>(Pb/As containing) | → |                                       |   | EDF648339A<br>(New naming convention) |   |                                       |
| EDF673322<br>(Pb/As containing) | → |                                       |   | EDF673322A<br>(New naming convention) |   |                                       |



## N-BK7

Issue number 1001-01

|                   |           |
|-------------------|-----------|
| ECO               | PbAs free |
| $n_d$             | 1.51680   |
| $n_F - n_C$       | 0.008054  |
| $v_d$             | 64.17     |
| $n_e$             | 1.51873   |
| $v_e$             | 63.93     |
| $n_{F'} - n_{C'}$ | 0.008114  |

## Refractive indices

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.48943 |
| $n_{1970.1}$ | 1970.1         | 1.49495 |
| $n_{1529.6}$ | 1529.6         | 1.50084 |
| $n_{1060.0}$ | 1060.0         | 1.50666 |
| $n_t$        | 1014.0         | 1.50729 |
| $n_s$        | 852.1          | 1.50980 |
| $n_{A'}$     | 768.2          | 1.51143 |
| $n_r$        | 706.5          | 1.51289 |
| $n_C$        | 656.3          | 1.51432 |
| $n_{C'}$     | 643.9          | 1.51472 |
| $n_{632.8}$  | 632.8          | 1.51509 |
| $n_D$        | 589.3          | 1.51673 |
| $n_d$        | 587.6          | 1.51680 |
| $n_e$        | 546.1          | 1.51873 |
| $n_F$        | 486.1          | 1.52238 |
| $n_{F'}$     | 480.0          | 1.52283 |
| $n_g$        | 435.8          | 1.52669 |
| $n_h$        | 404.7          | 1.53024 |
| $n_i$        | 365.0          | 1.53628 |
| $n_{334.1}$  | 334.1          | 1.54281 |
| $n_{312.6}$  | 312.6          | 1.54882 |
| $n_{296.7}$  | 296.7          | 1.55442 |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

### Temperature coefficients of refractive index

|          | dn/dT relative [ $10^{-6} \cdot K^{-1}$ ] |       |     |     |     |     |     |
|----------|---|-------|-----|-----|-----|-----|-----|
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 2.8                                       | 2.9   | 2.9 | 3.0 | 3.3 | 3.5 | 4.1 |
| -20/0    | 2.9                                       | 3.0   | 3.0 | 3.1 | 3.4 | 3.6 | 4.3 |
| 0/+20    | 3.0                                       | 3.0   | 3.1 | 3.2 | 3.5 | 3.8 | 4.4 |
| +20/+40  | 3.1                                       | 3.1   | 3.2 | 3.3 | 3.6 | 3.9 | 4.6 |
| +40/+60  | 3.2                                       | 3.2   | 3.3 | 3.4 | 3.7 | 4.0 | 4.7 |
| +60/+80  | 3.3                                       | 3.3   | 3.4 | 3.5 | 3.8 | 4.1 | 4.9 |
| +80/+100 | 3.4                                       | 3.4   | 3.5 | 3.6 | 4.0 | 4.3 | 5.0 |
|          | dn/dT absolute [ $10^{-6} \cdot K^{-1}$ ] |       |     |     |     |     |     |
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 0.8                                       | 0.8   | 0.9 | 1.0 | 1.2 | 1.4 | 2.0 |
| -20/0    | 1.2                                       | 1.2   | 1.3 | 1.4 | 1.6 | 1.8 | 2.4 |
| 0/+20    | 1.5                                       | 1.5   | 1.6 | 1.7 | 2.0 | 2.2 | 2.8 |
| +20/+40  | 1.8                                       | 1.8   | 1.9 | 2.0 | 2.3 | 2.5 | 3.2 |
| +40/+60  | 2.0                                       | 2.1   | 2.2 | 2.3 | 2.5 | 2.8 | 3.5 |
| +60/+80  | 2.3                                       | 2.3   | 2.4 | 2.5 | 2.8 | 3.1 | 3.8 |
| +80/+100 | 2.5                                       | 2.5   | 2.6 | 2.7 | 3.0 | 3.3 | 4.1 |

## Dispersion constants

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.2720316                  |
| $A_1$ | $-1.0278046 \cdot 10^{-2}$ |
| $A_2$ | $1.0532184 \cdot 10^{-2}$  |
| $A_3$ | $2.3038239 \cdot 10^{-4}$  |
| $A_4$ | $-1.1910889 \cdot 10^{-5}$ |
| $A_5$ | $7.9082994 \cdot 10^{-7}$  |

### Relative partial dispersions

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.8736 |
| $P_{C,A'}$  | 0.3591 |
| $P_{d,C}$   | 0.3079 |
| $P_{e,C}$   | 0.5467 |
| $P_{g,d}$   | 1.2275 |
| $P_{g,F}$   | 0.5348 |
| $P_{h,g}$   | 0.4414 |
| $P_{i,g}$   | 1.1910 |
| $P'_{C,t}$  | 0.9161 |
| $P'_{e,C'}$ | 0.4937 |
| $P'_{F',e}$ | 0.5063 |
| $P'_{i,F'}$ | 1.6572 |

### Deviation of relative partial dispersions from normal line

|                   |          |
|-------------------|----------|
| $\Delta P_{C,t}$  | 0.0237   |
| $\Delta P_{C,A'}$ | - 0.0046 |
| $\Delta P_{g,d}$  | -0.0019  |
| $\Delta P_{g,F}$  | 0.0014   |
| $\Delta P_{i,q}$  | 0.0053   |

## Remarks

[illegible]

### Internal transmittance

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.920        | 0.846         | 0.659         |
| 1970.1         | 0.977        | 0.954         | 0.889         |
| 1800.0         | 0.986        | 0.971         | 0.930         |
| 1600.0         | 0.992        | 0.985         | 0.963         |
| 1529.6         | 0.993        | 0.986         | 0.965         |
| 1200.0         | 0.994        | 0.988         | 0.971         |
| 1060.0         | 0.994        | 0.988         | 0.971         |
| 800.0          | 0.994        | 0.989         | 0.973         |
| 700.0          | 0.998        | 0.995         | 0.988         |
| 660.0          | 0.997        | 0.995         | 0.987         |
| 640.0          | 0.997        | 0.994         | 0.986         |
| 620.0          | 0.997        | 0.995         | 0.987         |
| 600.0          | 0.998        | 0.996         | 0.989         |
| 580.0          | 0.998        | 0.996         | 0.991         |
| 546.1          | 0.998        | 0.997         | 0.992         |
| 500.0          | 0.998        | 0.996         | 0.990         |
| 480.0          | 0.998        | 0.996         | 0.989         |
| 460.0          | 0.997        | 0.995         | 0.987         |
| 440.0          | 0.996        | 0.992         | 0.981         |
| 435.8          | 0.996        | 0.993         | 0.981         |
| 420.0          | 0.996        | 0.993         | 0.982         |
| 404.7          | 0.997        | 0.993         | 0.983         |
| 400.0          | 0.996        | 0.992         | 0.981         |
| 390.0          | 0.993        | 0.986         | 0.965         |
| 380.0          | 0.985        | 0.970         | 0.926         |
| 370.0          | 0.982        | 0.965         | 0.915         |
| 365.0          | 0.978        | 0.956         | 0.895         |
| 360.0          | 0.970        | 0.940         | 0.857         |
| 350.0          | 0.939        | 0.882         | 0.730         |
| 340.0          | 0.878        | 0.771         | 0.521         |
| 334.1          | 0.817        | 0.667         | 0.363         |
| 330.0          | 0.760        | 0.578         | 0.254         |
| 320.0          | 0.685        | 0.469         | 0.150         |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

**Colour code**

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 35/31 |
|----------------------------|-------|

## Chemical properties

|                      |     |
|----------------------|-----|
| Acid resistance      | 1.0 |
| Alkali resistance    | 1.0 |
| Climatic resistance  | 1   |
| Phosphate resistance | 1.0 |

## Mechanical properties

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 562  |
| Abrasion hardness ( $F_A$ )                                   | 95   |
| Young's modulus ( $E$ ) [GPa]                                 | 83.4 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 34.4 |
| Poisson ratio ( $\mu$ )                                       | 0.21 |
| Stress optical coefficient                                    | 2.84 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 2.50 |

## Thermal properties

|  |            |      |
|--|------------|------|
| Strain point (T10 <sup>4.5</sup> ) [°C]  | 528        |      |
| Annealing point (T10 <sup>13.0</sup> ) [°C]                                    | 565        |      |
| Yield point (A <sub>y</sub> ) [°C]   | 632        |      |
| Transformation temperature (T <sub>g</sub> ) [°C]                              | 574        |      |
| Softening point (T10 <sup>7.65</sup> ) [°C]                                    | 733        |      |
| Annealing factor (F) for n <sub>d</sub>  | 10.3       |      |
| Co-efficient of thermal expansion (α) [10 <sup>-6</sup> K <sup>-1</sup> ]      | -30/+70°C  | 6.89 |
|  | +20/+300°C | 7.90 |
| Specific heat capacity (c <sub>p</sub> ) [J·g <sup>-1</sup> ·K <sup>-1</sup> ] | 0.889      |      |
| Thermal conductivity (λ) [W·m <sup>-1</sup> ·K <sup>-1</sup> ]                 | 0.437      |      |

## N-K5

Issue number 1001-01

ECO AsPb Free

 $n_d$  1.52250
$$n_E - n_G = 0.008784$$
$$v_d = 59.48$$
 $n_e$  1.52459
$$v_e = 59.21$$
$$n_{F'} - n_{G'} \quad 0.008859$$

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.49659 |
| $n_{1970.1}$ | 1970.1         | 1.50137 |
| $n_{1529.6}$ | 1529.6         | 1.50656 |
| $n_{1060.0}$ | 1060.0         | 1.51194 |
| $n_t$        | 1014.0         | 1.51255 |
| $n_s$        | 852.1          | 1.51506 |
| $n_{A'}$     | 768.2          | 1.51675 |
| $n_r$        | 706.5          | 1.51829 |
| $n_c$        | 656.3          | 1.51982 |
| $n_{c'}$     | 643.9          | 1.52025 |
| $n_{632.8}$  | 632.8          | 1.52064 |
| $n_D$        | 589.3          | 1.52242 |
| $n_d$        | 587.6          | 1.52250 |
| $n_e$        | 546.1          | 1.52459 |
| $n_F$        | 486.1          | 1.52861 |
| $n_{F'}$     | 480.0          | 1.52911 |
| $n_g$        | 435.8          | 1.53337 |
| $n_h$        | 404.7          | 1.53732 |
| $n_i$        | 365.0          | 1.54407 |
| $n_{334.1}$  | 334.1          | 1.55144 |
| $n_{312.6}$  | 312.6          | 1.55831 |
| $n_{296.7}$  | 296.7          | 1.56479 |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [10 <sup>-6</sup> ·K <sup>-1</sup> ] |       |     |     |     |     |     |
|----------|---|-------|-----|-----|-----|-----|-----|
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 2.3   | 2.4   | 2.4 | 2.6 | 2.9 | 3.2 | 4.0 |
| -20/0    | 2.4   | 2.4   | 2.5 | 2.6 | 2.9 | 3.2 | 4.1 |
| 0/+20    | 2.4   | 2.4   | 2.6 | 2.7 | 3.0 | 3.3 | 4.2 |
| +20/+40  | 2.5   | 2.5   | 2.6 | 2.8 | 3.1 | 3.4 | 4.3 |
| +40/+60  | 2.5   | 2.5   | 2.7 | 2.8 | 3.1 | 3.5 | 4.4 |
| +60/+80  | 2.5   | 2.6   | 2.7 | 2.9 | 3.2 | 3.6 | 4.5 |
| +80/+100 | 2.6   | 2.6   | 2.8 | 2.9 | 3.3 | 3.6 | 4.7 |
|          | dn/dT absolute [10 <sup>-6</sup> ·K <sup>-1</sup> ] |       |     |     |     |     |     |
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 0.3   | 0.3   | 0.4 | 0.5 | 0.8 | 1.1 | 1.8 |
| -20/0    | 0.6   | 0.7   | 0.7 | 0.9 | 1.2 | 1.4 | 2.3 |
| 0/+20    | 0.9   | 0.9   | 1.0 | 1.2 | 1.5 | 1.8 | 2.6 |
| +20/+40  | 1.1   | 1.2   | 1.3 | 1.4 | 1.7 | 2.0 | 2.9 |
| +40/+60  | 1.3   | 1.4   | 1.5 | 1.6 | 2.0 | 2.3 | 3.2 |
| +60/+80  | 1.5   | 1.5   | 1.7 | 1.8 | 2.2 | 2.5 | 3.5 |
| +80/+100 | 1.7   | 1.7   | 1.9 | 2.0 | 2.3 | 2.7 | 3.7 |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.2853811                  |
| $A_1$ | $-8.8281665 \cdot 10^{-3}$ |
| $A_2$ | $1.1546738 \cdot 10^{-2}$  |
| $A_3$ | $3.0979439 \cdot 10^{-4}$  |
| $A_4$ | $-1.9490306 \cdot 10^{-5}$ |
| $A_5$ | $1.2837080 \cdot 10^{-6}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.8275 |
| $P_{C,A'}$  | 0.3489 |
| $P_{d,C}$   | 0.3048 |
| $P_{e,C}$   | 0.5434 |
| $P_{g,d}$   | 1.2377 |
| $P_{g,F}$   | 0.5421 |
| $P_{h,g}$   | 0.4498 |
| $P_{i,g}$   | 1.2182 |
| $P'_{C',t}$ | 0.8686 |
| $P'_{e,C'}$ | 0.4906 |
| $P'_{F',e}$ | 0.5094 |
| $P'_{i,F'}$ | 1.6890 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0002 |
| $\Delta P_{C,A'}$ | 0.0001  |
| $\Delta P_{g,d}$  | -0.0018 |
| $\Delta P_{g,F}$  | -0.0019 |
| $\Delta P_{i,g}$  | -0.0069 |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.930        | 0.865         | 0.695         |
| 1970.1         | 0.973        | 0.947         | 0.872         |
| 1800.0         | 0.985        | 0.970         | 0.926         |
| 1600.0         | 0.994        | 0.988         | 0.969         |
| 1529.6         | 0.994        | 0.989         | 0.973         |
| 1200.0         | 0.995        | 0.990         | 0.975         |
| 1060.0         | 0.995        | 0.990         | 0.975         |
| 800.0          | 0.997        | 0.993         | 0.984         |
| 700.0          | 0.998        | 0.995         | 0.988         |
| 660.0          | 0.997        | 0.995         | 0.987         |
| 640.0          | 0.998        | 0.995         | 0.988         |
| 620.0          | 0.998        | 0.996         | 0.989         |
| 600.0          | 0.998        | 0.996         | 0.990         |
| 580.0          | 0.998        | 0.997         | 0.992         |
| 546.1          | 0.999        | 0.997         | 0.993         |
| 500.0          | 0.999        | 0.997         | 0.993         |
| 480.0          | 0.998        | 0.996         | 0.990         |
| 460.0          | 0.997        | 0.995         | 0.987         |
| 440.0          | 0.997        | 0.993         | 0.983         |
| 435.8          | 0.997        | 0.993         | 0.983         |
| 420.0          | 0.997        | 0.993         | 0.983         |
| 404.7          | 0.997        | 0.993         | 0.983         |
| 400.0          | 0.996        | 0.992         | 0.981         |
| 390.0          | 0.994        | 0.987         | 0.968         |
| 380.0          | 0.988        | 0.975         | 0.939         |
| 370.0          | 0.985        | 0.969         | 0.925         |
| 365.0          | 0.981        | 0.962         | 0.907         |
| 360.0          | 0.973        | 0.946         | 0.871         |
| 350.0          | 0.947        | 0.896         | 0.760         |
| 340.0          | 0.889        | 0.791         | 0.556         |
| 334.1          | 0.832        | 0.692         | 0.398         |
| 330.0          | 0.782        | 0.612         | 0.293         |
| 320.0          | 0.694        | 0.481         | 0.161         |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 34/31 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 1.0 |
| Alkali resistance    | 1.0 |
| Climatic resistance  | 1   |
| Phosphate resistance | 1.0 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 513  |
| Abrasion hardness ( $F_A$ )                                   | 100  |
| Young's modulus ( $E$ ) [GPa]                                 | 76.2 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 31.4 |
| Poisson ratio ( $\mu$ )                                       | 0.21 |
| Stress optical coefficient                                    | 2.66 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 2.54 |

|   |                             |      |
|---|-----------------------------|------|
| Strain point ( $T_{10}^{14.5}$ ) [ $^{\circ}\text{C}$ ]                               | 484                         |      |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            | 535                         |      |
| Yield point ( $A_1$ ) [ $^{\circ}\text{C}$ ]  | 604                         |      |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           | 532                         |      |
| Softening point ( $T_{10}^{7.65}$ ) [ $^{\circ}\text{C}$ ]                            | 709                         |      |
| Annealing factor (F) for $n_d$  | 5.6                         |      |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 7.99 |
|   | +20/+300 $^{\circ}\text{C}$ | 9.18 |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   | 1.103                       |      |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] | 0.258                       |      |

## N-BAK4

Issue number 1001-01

ECO AsPb Free

|                   |          |
|-------------------|----------|
| $n_d$             | 1.56883  |
| $n_F - n_C$       | 0.010135 |
| $v_d$             | 56.13    |
| $n_e$             | 1.57124  |
| $v_e$             | 55.85    |
| $n_{F'} - n_{C'}$ | 0.010228 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.54101 |
| $n_{1970.1}$ | 1970.1         | 1.54587 |
| $n_{1529.6}$ | 1529.6         | 1.55120 |
| $n_{1060.0}$ | 1060.0         | 1.55692 |
| $n_t$        | 1014.0         | 1.55759 |
| $n_s$        | 852.1          | 1.56037 |
| $n_{A'}$     | 768.2          | 1.56228 |
| $n_r$        | 706.5          | 1.56402 |
| $n_C$        | 656.3          | 1.56576 |
| $n_{C'}$     | 643.9          | 1.56625 |
| $n_{632.8}$  | 632.8          | 1.56670 |
| $n_D$        | 589.3          | 1.56874 |
| $n_d$        | 587.6          | 1.56883 |
| $n_e$        | 546.1          | 1.57124 |
| $n_F$        | 486.1          | 1.57589 |
| $n_{F'}$     | 480.0          | 1.57648 |
| $n_g$        | 435.8          | 1.58146 |
| $n_h$        | 404.7          | 1.58610 |
| $n_i$        | 365.0          | 1.59407 |
| $n_{334.1}$  | 334.1          | 1.60277 |
| $n_{312.6}$  | 312.6          | 1.61080 |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [ $10^{-6} \cdot \text{K}^{-1}$ ] |       |     |     |     |     |     |
|----------|--|-------|-----|-----|-----|-----|-----|
| °C       | C'   | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 3.3  | 3.4   | 3.5 | 3.6 | 4.0 | 4.3 | 5.3 |
| -20/0    | 3.4  | 3.5   | 3.6 | 3.7 | 4.1 | 4.5 | 5.5 |
| 0/+20    | 3.5  | 3.5   | 3.7 | 3.8 | 4.2 | 4.6 | 5.7 |
| +20/+40  | 3.6  | 3.6   | 3.8 | 3.9 | 4.3 | 4.7 | 5.8 |
| +40/+60  | 3.7  | 3.7   | 3.8 | 4.0 | 4.4 | 4.8 | 6.0 |
| +60/+80  | 3.7  | 3.8   | 3.9 | 4.1 | 4.5 | 5.0 | 6.2 |
| +80/+100 | 3.8  | 3.9   | 4.0 | 4.2 | 4.6 | 5.1 | 6.3 |
|          | dn/dT absolute [ $10^{-6} \cdot \text{K}^{-1}$ ] |       |     |     |     |     |     |
| °C       | C'   | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 1.2  | 1.3   | 1.4 | 1.5 | 1.9 | 2.2 | 3.1 |
| -20/0    | 1.6  | 1.6   | 1.8 | 1.9 | 2.3 | 2.6 | 3.6 |
| 0/+20    | 1.9  | 2.0   | 2.1 | 2.3 | 2.6 | 3.0 | 4.0 |
| +20/+40  | 2.2  | 2.3   | 2.4 | 2.6 | 2.9 | 3.3 | 4.4 |
| +40/+60  | 2.5  | 2.5   | 2.6 | 2.8 | 3.2 | 3.6 | 4.7 |
| +60/+80  | 2.7  | 2.7   | 2.9 | 3.0 | 3.5 | 3.9 | 5.0 |
| +80/+100 | 2.9  | 2.9   | 3.1 | 3.3 | 3.7 | 4.1 | 5.3 |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.4216153                  |
| $A_1$ | $-9.1561189 \cdot 10^{-3}$ |
| $A_2$ | $1.4022793 \cdot 10^{-2}$  |
| $A_3$ | $2.5247075 \cdot 10^{-4}$  |
| $A_4$ | $3.7236538 \cdot 10^{-7}$  |
| $A_5$ | $3.3083410 \cdot 10^{-7}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.8064 |
| $P_{C,A'}$  | 0.3438 |
| $P_{d,C}$   | 0.3028 |
| $P_{e,C}$   | 0.5410 |
| $P_{g,d}$   | 1.2459 |
| $P_{g,F}$   | 0.5487 |
| $P_{h,g}$   | 0.4582 |
| $P_{i,g}$   | 1.2449 |
| $P'_{C,t}$  | 0.8468 |
| $P'_{e,C'}$ | 0.4884 |
| $P'_{F',e}$ | 0.5116 |
| $P'_{i,F'}$ | 1.7206 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0053 |
| $\Delta P_{C,A'}$ | -0.0009 |
| $\Delta P_{g,d}$  | -0.0008 |
| $\Delta P_{g,F}$  | -0.0010 |
| $\Delta P_{j,n}$  | -0.0085 |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.952        | 0.906         | 0.782         |
| 1970.1         | 0.985        | 0.971         | 0.929         |
| 1800.0         | 0.991        | 0.983         | 0.957         |
| 1600.0         | 0.997        | 0.995         | 0.987         |
| 1529.6         | 0.998        | 0.996         | 0.990         |
| 1200.0         | 0.999        | 0.999         | 0.999         |
| 1060.0         | 0.999        | 0.999         | 0.999         |
| 800.0          | 0.999        | 0.999         | 0.998         |
| 700.0          | 0.999        | 0.999         | 0.998         |
| 660.0          | 0.999        | 0.998         | 0.995         |
| 640.0          | 0.999        | 0.998         | 0.995         |
| 620.0          | 0.999        | 0.998         | 0.995         |
| 600.0          | 0.999        | 0.998         | 0.995         |
| 580.0          | 0.999        | 0.998         | 0.996         |
| 546.1          | 0.999        | 0.998         | 0.996         |
| 500.0          | 0.999        | 0.998         | 0.994         |
| 480.0          | 0.998        | 0.997         | 0.991         |
| 460.0          | 0.998        | 0.996         | 0.990         |
| 440.0          | 0.998        | 0.995         | 0.989         |
| 435.8          | 0.998        | 0.995         | 0.988         |
| 420.0          | 0.997        | 0.995         | 0.987         |
| 404.7          | 0.996        | 0.992         | 0.980         |
| 400.0          | 0.995        | 0.991         | 0.977         |
| 390.0          | 0.991        | 0.983         | 0.957         |
| 380.0          | 0.982        | 0.965         | 0.915         |
| 370.0          | 0.966        | 0.932         | 0.839         |
| 365.0          | 0.950        | 0.903         | 0.775         |
| 360.0          | 0.929        | 0.863         | 0.693         |
| 350.0          | 0.855        | 0.731         | 0.458         |
| 340.0          | 0.713        | 0.508         | 0.184         |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 36/32 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 1.2 |
| Alkali resistance    | 1.0 |
| Climatic resistance  | 1   |
| Phosphate resistance | 2.1 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 529  |
| Abrasion hardness ( $F_A$ )                                   | 125  |
| Young's modulus ( $E$ ) [GPa]                                 | 78.1 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 31.1 |
| Poisson ratio ( $\mu$ )                                       | 0.26 |
| Stress optical coefficient                                    | 3.02 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 3.06 |

| Thermal properties   |            |       |
|--|------------|-------|
| Strain point (T10 <sup>14.5</sup> ) [°C]                                       |            | 525   |
| Annealing point (T10 <sup>13.0</sup> ) [°C]                                    |            | 562   |
| Yield point (A <sub>y</sub> ) [°C]   |            | 624   |
| Transformation temperature (T <sub>g</sub> ) [°C]                              |            | 579   |
| Softening point (T10 <sup>7.68</sup> ) [°C]                                    |            | 720   |
| Annealing factor (F) for n <sub>d</sub>  |            | 9.9   |
| Co-efficient of thermal expansion (α) [10 <sup>-6</sup> K <sup>-1</sup> ]      | -30/+70°C  | 7.14  |
|  | +20/+300°C | 8.11  |
| Specific heat capacity (c <sub>p</sub> ) [J·g <sup>-1</sup> ·K <sup>-1</sup> ] |            | 0.894 |
| Thermal conductivity (λ) [W·m <sup>-1</sup> ·K <sup>-1</sup> ]                 |            | 0.280 |

## N-BAK1

Issue number 1001-01

ECO      AsPb Free

 $n_d$  1.57250
$$n_F - n_G \quad 0.009948$$

|       |       |
|-------|-------|
| $V_d$ | 57.55 |
|-------|-------|

|       |         |
|-------|---------|
| $n_o$ | 1.57487 |
|-------|---------|

|       |       |
|-------|-------|
| $v_o$ | 57.24 |
|-------|-------|

$$n_{F'} - n_{C'} = 0.010043$$

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.54536 |
| $n_{1970.1}$ | 1970.1         | 1.55007 |
| $n_{1529.6}$ | 1529.6         | 1.55524 |
| $n_{1060.0}$ | 1060.0         | 1.56081 |
| $n_t$        | 1014.0         | 1.56146 |
| $n_s$        | 852.1          | 1.56419 |
| $n_{A'}$     | 768.2          | 1.56606 |
| $n_r$        | 706.5          | 1.56777 |
| $n_C$        | 656.3          | 1.56948 |
| $n_{C'}$     | 643.9          | 1.56996 |
| $n_{632.8}$  | 632.8          | 1.57041 |
| $n_D$        | 589.3          | 1.57241 |
| $n_d$        | 587.6          | 1.57250 |
| $n_e$        | 546.1          | 1.57487 |
| $n_F$        | 486.1          | 1.57943 |
| $n_{F'}$     | 480.0          | 1.58000 |
| $n_g$        | 435.8          | 1.58488 |
| $n_h$        | 404.7          | 1.58941 |
| $n_i$        | 365.0          | 1.59716 |
| $n_{334.1}$  | 334.1          | 1.60557 |
| $n_{312.6}$  | 312.6          | 1.61331 |
| $n_{296.7}$  | 296.7          | 1.62047 |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [ $10^{-6} \cdot \text{K}^{-1}$ ] |       |     |     |     |     |     |
|----------|--|-------|-----|-----|-----|-----|-----|
| °C       | C'   | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 2.4  | 2.4   | 2.5 | 2.6 | 2.9 | 3.3 | 4.1 |
| -20/0    | 2.4  | 2.5   | 2.6 | 2.7 | 3.0 | 3.4 | 4.3 |
| 0/+20    | 2.5  | 2.5   | 2.6 | 2.8 | 3.1 | 3.5 | 4.4 |
| +20/+40  | 2.6  | 2.6   | 2.7 | 2.9 | 3.2 | 3.6 | 4.6 |
| +40/+60  | 2.6  | 2.7   | 2.8 | 3.0 | 3.4 | 3.7 | 4.7 |
| +60/+80  | 2.7  | 2.7   | 2.9 | 3.1 | 3.5 | 3.8 | 4.9 |
| +80/+100 | 2.8  | 2.8   | 3.0 | 3.2 | 3.6 | 4.0 | 5.1 |
|          | dn/dT absolute [ $10^{-6} \cdot \text{K}^{-1}$ ] |       |     |     |     |     |     |
| °C       | C'   | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 0.2  | 0.3   | 0.4 | 0.5 | 0.8 | 1.1 | 1.9 |
| -20/0    | 0.6  | 0.6   | 0.7 | 0.9 | 1.2 | 1.5 | 2.4 |
| 0/+20    | 0.9  | 1.0   | 1.1 | 1.2 | 1.6 | 1.9 | 2.8 |
| +20/+40  | 1.2  | 1.2   | 1.4 | 1.5 | 1.9 | 2.2 | 3.2 |
| +40/+60  | 1.4  | 1.5   | 1.6 | 1.8 | 2.1 | 2.5 | 3.5 |
| +60/+80  | 1.7  | 1.7   | 1.8 | 2.0 | 2.4 | 2.7 | 3.8 |
| +80/+100 | 1.8  | 1.9   | 2.0 | 2.2 | 2.6 | 3.0 | 4.1 |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.4335980                  |
| $A_1$ | $-8.8787773 \cdot 10^{-3}$ |
| $A_2$ | $1.3818422 \cdot 10^{-2}$  |
| $A_3$ | $2.7070465 \cdot 10^{-4}$  |
| $A_4$ | $-4.8903218 \cdot 10^{-6}$ |
| $A_5$ | $5.0356722 \cdot 10^{-7}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.8062 |
| $P_{C,A'}$  | 0.3442 |
| $P_{d,C}$   | 0.3032 |
| $P_{e,C}$   | 0.5417 |
| $P_{g,d}$   | 1.2443 |
| $P_{g,F}$   | 0.5471 |
| $P_{h,g}$   | 0.4554 |
| $P_{i,g}$   | 1.2343 |
| $P'_{C,t}$  | 0.8463 |
| $P'_{e,C'}$ | 0.4889 |
| $P'_{F',e}$ | 0.5111 |
| $P'_{i,F'}$ | 1.7079 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0123 |
| $\Delta P_{C,A'}$ | -0.0022 |
| $\Delta P_{g,d}$  | 0.0007  |
| $\Delta P_{g,F}$  | -0.0002 |
| $\Delta P_{j,n}$  | -0.0071 |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.941        | 0.886         | 0.739         |
| 1970.1         | 0.980        | 0.960         | 0.903         |
| 1800.0         | 0.988        | 0.977         | 0.943         |
| 1600.0         | 0.996        | 0.992         | 0.980         |
| 1529.6         | 0.997        | 0.994         | 0.985         |
| 1200.0         | 0.999        | 0.998         | 0.995         |
| 1060.0         | 0.999        | 0.998         | 0.995         |
| 800.0          | 0.999        | 0.998         | 0.996         |
| 700.0          | 0.999        | 0.998         | 0.996         |
| 660.0          | 0.999        | 0.997         | 0.993         |
| 640.0          | 0.998        | 0.997         | 0.992         |
| 620.0          | 0.999        | 0.997         | 0.993         |
| 600.0          | 0.999        | 0.997         | 0.993         |
| 580.0          | 0.999        | 0.997         | 0.994         |
| 546.1          | 0.999        | 0.997         | 0.993         |
| 500.0          | 0.998        | 0.997         | 0.992         |
| 480.0          | 0.998        | 0.996         | 0.989         |
| 460.0          | 0.997        | 0.995         | 0.987         |
| 440.0          | 0.997        | 0.995         | 0.986         |
| 435.8          | 0.997        | 0.994         | 0.986         |
| 420.0          | 0.998        | 0.996         | 0.990         |
| 404.7          | 0.998        | 0.996         | 0.991         |
| 400.0          | 0.998        | 0.997         | 0.992         |
| 390.0          | 0.997        | 0.994         | 0.985         |
| 380.0          | 0.995        | 0.991         | 0.977         |
| 370.0          | 0.993        | 0.987         | 0.967         |
| 365.0          | 0.992        | 0.984         | 0.960         |
| 360.0          | 0.989        | 0.978         | 0.946         |
| 350.0          | 0.979        | 0.959         | 0.901         |
| 340.0          | 0.959        | 0.919         | 0.810         |
| 334.1          | 0.938        | 0.881         | 0.728         |
| 330.0          | 0.920        | 0.847         | 0.660         |
| 320.0          | 0.847        | 0.718         | 0.437         |
| 310.0          | 0.789        | 0.623         | 0.306         |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 35/31 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 3.2 |
| Alkali resistance    | 1.2 |
| Climatic resistance  | 1   |
| Phosphate resistance | 2.1 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 502  |
| Abrasion hardness ( $F_A$ )                                   | 145  |
| Young's modulus ( $E$ ) [GPa]                                 | 76.0 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 30.1 |
| Poisson ratio ( $\mu$ )                                       | 0.26 |
| Stress optical coefficient                                    | 2.69 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 3.17 |

|   |                             |      |
|---|-----------------------------|------|
| Strain point ( $T_{10}^{4.5}$ ) [ $^{\circ}\text{C}$ ]                                | 544                         |      |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            | 583                         |      |
| Yield point ( $A_1$ ) [ $^{\circ}\text{C}$ ]  | 644                         |      |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           | 605                         |      |
| Softening point ( $T_{10}^{7.65}$ ) [ $^{\circ}\text{C}$ ]                            | 749                         |      |
| Annealing factor (F) for $n_d$  | 9.1                         |      |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 7.44 |
|   | +20/+300 $^{\circ}\text{C}$ | 8.29 |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   | 0.729                       |      |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] | 0.362                       |      |

## N-SK5

Issue number 1001-01

|                   |           |
|-------------------|-----------|
| ECO               | PbAs free |
| $n_d$             | 1.58913   |
| $n_F - n_C$       | 0.009615  |
| $v_d$             | 61.27     |
| $n_e$             | 1.59142   |
| $v_e$             | 61.07     |
| $n_{F'} - n_{C'}$ | 0.009685  |

## Refractive indices

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.55926 |
| $n_{1970.1}$ | 1970.1         | 1.56496 |
| $n_{1529.6}$ | 1529.6         | 1.57112 |
| $n_{1060.0}$ | 1060.0         | 1.57739 |
| $n_t$        | 1014.0         | 1.57808 |
| $n_s$        | 852.1          | 1.58091 |
| $n_{A'}$     | 768.2          | 1.58280 |
| $n_r$        | 706.5          | 1.58451 |
| $n_C$        | 656.3          | 1.58619 |
| $n_{C'}$     | 643.9          | 1.58666 |
| $n_{632.8}$  | 632.8          | 1.58709 |
| $n_D$        | 589.3          | 1.58904 |
| $n_d$        | 587.6          | 1.58913 |
| $n_e$        | 546.1          | 1.59142 |
| $n_F$        | 486.1          | 1.59580 |
| $n_{F'}$     | 480.0          | 1.59634 |
| $n_g$        | 435.8          | 1.60098 |
| $n_h$        | 404.7          | 1.60526 |
| $n_i$        | 365.0          | 1.61254 |
| $n_{334.1}$  | 334.1          | 1.62040 |
| $n_{312.6}$  | 312.6          | 1.62759 |
| $n_{296.7}$  | 296.7          | 1.63425 |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

### Temperature coefficients of refractive index

|          | dn/dT relative [ $10^{-6} \cdot K^{-1}$ ] |       |     |     |     |     |     |
|----------|---|-------|-----|-----|-----|-----|-----|
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 3.3                                       | 3.3   | 3.4 | 3.5 | 3.7 | 4.0 | 4.6 |
| -20/0    | 3.4                                       | 3.4   | 3.5 | 3.6 | 3.9 | 4.1 | 4.8 |
| 0/+20    | 3.5                                       | 3.5   | 3.6 | 3.7 | 4.0 | 4.3 | 5.0 |
| +20/+40  | 3.6                                       | 3.6   | 3.7 | 3.9 | 4.2 | 4.4 | 5.2 |
| +40/+60  | 3.8                                       | 3.8   | 3.9 | 4.0 | 4.3 | 4.6 | 5.4 |
| +60/+80  | 3.9                                       | 3.9   | 4.0 | 4.1 | 4.4 | 4.7 | 5.5 |
| +80/+100 | 4.0                                       | 4.0   | 4.1 | 4.3 | 4.6 | 4.9 | 5.7 |
|          | dn/dT absolute [ $10^{-6} \cdot K^{-1}$ ] |       |     |     |     |     |     |
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 1.1                                       | 1.2   | 1.2 | 1.3 | 1.5 | 1.8 | 2.4 |
| -20/0    | 1.6                                       | 1.6   | 1.7 | 1.8 | 2.0 | 2.2 | 2.9 |
| 0/+20    | 1.9                                       | 2.0   | 2.0 | 2.2 | 2.4 | 2.7 | 3.3 |
| +20/+40  | 2.3                                       | 2.3   | 2.4 | 2.5 | 2.8 | 3.0 | 3.7 |
| +40/+60  | 2.5                                       | 2.5   | 2.6 | 2.8 | 3.1 | 3.3 | 4.1 |
| +60/+80  | 2.8                                       | 2.8   | 2.9 | 3.1 | 3.3 | 3.6 | 4.4 |
| +80/+100 | 3.0                                       | 3.0   | 3.2 | 3.3 | 3.6 | 3.9 | 4.7 |

## Dispersion constants

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.4885494                  |
| $A_1$ | $-1.1045050 \cdot 10^{-2}$ |
| $A_2$ | $1.3230840 \cdot 10^{-2}$  |
| $A_3$ | $3.0106619 \cdot 10^{-4}$  |
| $A_4$ | $-1.3257692 \cdot 10^{-5}$ |
| $A_5$ | $8.0918062 \cdot 10^{-7}$  |

### Relative partial dispersions

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.8433 |
| $P_{C,A'}$  | 0.3522 |
| $P_{d,C}$   | 0.3056 |
| $P_{e,C}$   | 0.5441 |
| $P_{g,d}$   | 1.2327 |
| $P_{g,F}$   | 0.5389 |
| $P_{h,g}$   | 0.4457 |
| $P_{i,g}$   | 1.2029 |
| $P'_{C,t}$  | 0.8857 |
| $P'_{e,C'}$ | 0.4917 |
| $P'_{F',e}$ | 0.5083 |
| $P'_{i,F'}$ | 1.6730 |

### Deviation of relative partial dispersions from normal line

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | 0.0072  |
| $\Delta P_{C,A'}$ | 0.0013  |
| $\Delta P_{g,d}$  | -0.0028 |
| $\Delta P_{g,F}$  | -0.0022 |
| $\Delta P_{j,n}$  | -0.0072 |

## Remarks

[illegible]

### Internal transmittance

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.911        | 0.830         | 0.628         |
| 1970.1         | 0.981        | 0.962         | 0.907         |
| 1800.0         | 0.989        | 0.979         | 0.948         |
| 1600.0         | 0.995        | 0.989         | 0.973         |
| 1529.6         | 0.995        | 0.990         | 0.975         |
| 1200.0         | 0.999        | 0.997         | 0.993         |
| 1060.0         | 0.998        | 0.997         | 0.992         |
| 800.0          | 0.999        | 0.997         | 0.993         |
| 700.0          | 0.999        | 0.997         | 0.993         |
| 660.0          | 0.998        | 0.997         | 0.992         |
| 640.0          | 0.998        | 0.997         | 0.991         |
| 620.0          | 0.998        | 0.997         | 0.992         |
| 600.0          | 0.998        | 0.997         | 0.992         |
| 580.0          | 0.999        | 0.997         | 0.993         |
| 546.1          | 0.999        | 0.998         | 0.994         |
| 500.0          | 0.998        | 0.997         | 0.992         |
| 480.0          | 0.998        | 0.996         | 0.989         |
| 460.0          | 0.997        | 0.995         | 0.987         |
| 440.0          | 0.997        | 0.994         | 0.984         |
| 435.8          | 0.997        | 0.994         | 0.985         |
| 420.0          | 0.997        | 0.994         | 0.985         |
| 404.7          | 0.996        | 0.993         | 0.982         |
| 400.0          | 0.996        | 0.992         | 0.979         |
| 390.0          | 0.993        | 0.987         | 0.968         |
| 380.0          | 0.990        | 0.979         | 0.949         |
| 370.0          | 0.983        | 0.966         | 0.916         |
| 365.0          | 0.977        | 0.955         | 0.890         |
| 360.0          | 0.968        | 0.938         | 0.852         |
| 350.0          | 0.944        | 0.890         | 0.748         |
| 340.0          | 0.898        | 0.807         | 0.584         |
| 334.1          | 0.858        | 0.736         | 0.464         |
| 330.0          | 0.824        | 0.678         | 0.379         |
| 320.0          | 0.722        | 0.521         | 0.196         |
| 310.0          | 0.705        | 0.497         | 0.174         |
| 300.0          |              |               |               |

**Colour code**

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 35/30 |
|----------------------------|-------|

## Chemical properties

|                      |      |
|----------------------|------|
| Acid resistance      | 52.0 |
| Alkali resistance    | 2.0  |
| Climatic resistance  | 3    |
| Phosphate resistance | 2.3  |

## Mechanical properties

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 577  |
| Abrasion hardness ( $F_A$ )                                   | 120  |
| Young's modulus ( $E$ ) [GPa]                                 | 84.5 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 33.0 |
| Poisson ratio ( $\mu$ )                                       | 0.28 |
| Stress optical coefficient                                    | 2.33 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 3.27 |

## Thermal properties

|  |            |      |
|--|------------|------|
| Strain point (T10 <sup>4.5</sup> ) [°C]  | 594        |      |
| Annealing point (T10 <sup>13.0</sup> ) [°C]                                    | 628        |      |
| Yield point (A <sub>y</sub> ) [°C]   | 689        |      |
| Transformation temperature (T <sub>g</sub> ) [°C]                              | 653        |      |
| Softening point (T10 <sup>7.65</sup> ) [°C]                                    | 758        |      |
| Annealing factor (F) for n <sub>d</sub>  | 11.3       |      |
| Co-efficient of thermal expansion (α) [10 <sup>-6</sup> K <sup>-1</sup> ]      | -30/+70°C  | 5.58 |
|  | +20/+300°C | 6.43 |
| Specific heat capacity (c <sub>p</sub> ) [J·g <sup>-1</sup> ·K <sup>-1</sup> ] | 0.801      |      |
| Thermal conductivity (λ) [W·m <sup>-1</sup> ·K <sup>-1</sup> ]                 | 0.310      |      |



## N-SK14

Issue number 1001-01

|                   |           |
|-------------------|-----------|
| ECO               | PbAs free |
| $n_d$             | 1.60311   |
| $n_F - n_C$       | 0.009952  |
| $v_d$             | 60.60     |
| $n_e$             | 1.60548   |
| $v_e$             | 60.34     |
| $n_{F'} - n_{C'}$ | 0.010034  |

## Refractive indices

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.57292 |
| $n_{1970.1}$ | 1970.1         | 1.57860 |
| $n_{1529.6}$ | 1529.6         | 1.58474 |
| $n_{1060.0}$ | 1060.0         | 1.59105 |
| $n_t$        | 1014.0         | 1.59175 |
| $n_s$        | 852.1          | 1.59464 |
| $n_{A'}$     | 768.2          | 1.59658 |
| $n_r$        | 706.5          | 1.59833 |
| $n_C$        | 656.3          | 1.60007 |
| $n_{C'}$     | 643.9          | 1.60056 |
| $n_{632.8}$  | 632.8          | 1.60101 |
| $n_D$        | 589.3          | 1.60302 |
| $n_d$        | 587.6          | 1.60311 |
| $n_e$        | 546.1          | 1.60548 |
| $n_F$        | 486.1          | 1.61003 |
| $n_{F'}$     | 480.0          | 1.61059 |
| $n_g$        | 435.8          | 1.61540 |
| $n_h$        | 404.7          | 1.61986 |
| $n_i$        | 365.0          | 1.62745 |
| $n_{334.1}$  | 334.1          | 1.63568 |
| $n_{312.6}$  | 312.6          | 1.64328 |
| $n_{296.7}$  | 296.7          | 1.65038 |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

### Temperature coefficients of refractive index

|          | dn/dT relative [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |     |     |     |
|----------|---|-------|-----|-----|-----|-----|-----|
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 2.6   | 2.6   | 2.7 | 2.8 | 3.1 | 3.3 | 4.0 |
| -20/0    | 2.7   | 2.7   | 2.8 | 2.9 | 3.2 | 3.5 | 4.2 |
| 0/+20    | 2.8   | 2.8   | 2.9 | 3.0 | 3.3 | 3.6 | 4.4 |
| +20/+40  | 2.9   | 2.9   | 3.0 | 3.1 | 3.4 | 3.7 | 4.5 |
| +40/+60  | 3.0   | 3.0   | 3.1 | 3.2 | 3.6 | 3.9 | 4.7 |
| +60/+80  | 3.1   | 3.1   | 3.2 | 3.4 | 3.7 | 4.0 | 4.9 |
| +80/+100 | 3.2   | 3.2   | 3.3 | 3.5 | 3.8 | 4.1 | 5.1 |
|          | dn/dT absolute [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |     |     |     |
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 0.4   | 0.5   | 0.5 | 0.6 | 0.9 | 1.1 | 1.8 |
| -20/0    | 0.8   | 0.9   | 0.9 | 1.1 | 1.3 | 1.6 | 2.3 |
| 0/+20    | 1.2   | 1.2   | 1.3 | 1.4 | 1.7 | 2.0 | 2.7 |
| +20/+40  | 1.5   | 1.5   | 1.6 | 1.7 | 2.0 | 2.3 | 3.1 |
| +40/+60  | 1.8   | 1.8   | 1.9 | 2.0 | 2.3 | 2.6 | 3.4 |
| +60/+80  | 2.0   | 2.0   | 2.1 | 2.3 | 2.6 | 2.9 | 3.8 |
| +80/+100 | 2.2   | 2.2   | 2.3 | 2.5 | 2.8 | 3.1 | 4.0 |

## Dispersion constants

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.5313409                  |
| $A_1$ | $-1.1064493 \cdot 10^{-2}$ |
| $A_2$ | $1.3772767 \cdot 10^{-2}$  |
| $A_3$ | $3.4888877 \cdot 10^{-4}$  |
| $A_4$ | $-1.9268436 \cdot 10^{-5}$ |
| $A_5$ | $1.2101782 \cdot 10^{-6}$  |

### Relative partial dispersions

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.8360 |
| $P_{C,A'}$  | 0.3508 |
| $P_{d,C}$   | 0.3053 |
| $P_{e,C}$   | 0.5439 |
| $P_{g,d}$   | 1.2354 |
| $P_{g,F}$   | 0.5405 |
| $P_{h,g}$   | 0.4476 |
| $P_{i,g}$   | 1.2100 |
| $P'_{C,t}$  | 0.8775 |
| $P'_{e,C'}$ | 0.4912 |
| $P'_{F',e}$ | 0.5088 |
| $P'_{i,F'}$ | 1.6800 |

### Deviation of relative partial dispersions from normal line

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | 0.0030  |
| $\Delta P_{C,A'}$ | 0.0006  |
| $\Delta P_{g,d}$  | -0.0016 |
| $\Delta P_{g,F}$  | -0.0016 |
| $\Delta P_{i,q}$  | -0.0057 |

## Remarks

[illegible]

### Internal transmittance

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.922        | 0.850         | 0.665         |
| 1970.1         | 0.980        | 0.960         | 0.902         |
| 1800.0         | 0.988        | 0.975         | 0.939         |
| 1600.0         | 0.994        | 0.989         | 0.972         |
| 1529.6         | 0.995        | 0.990         | 0.975         |
| 1200.0         | 0.998        | 0.996         | 0.990         |
| 1060.0         | 0.998        | 0.996         | 0.989         |
| 800.0          | 0.998        | 0.996         | 0.989         |
| 700.0          | 0.998        | 0.997         | 0.991         |
| 660.0          | 0.998        | 0.996         | 0.989         |
| 640.0          | 0.998        | 0.995         | 0.988         |
| 620.0          | 0.998        | 0.995         | 0.988         |
| 600.0          | 0.998        | 0.996         | 0.989         |
| 580.0          | 0.998        | 0.996         | 0.990         |
| 546.1          | 0.998        | 0.996         | 0.990         |
| 500.0          | 0.998        | 0.995         | 0.988         |
| 480.0          | 0.997        | 0.994         | 0.985         |
| 460.0          | 0.996        | 0.993         | 0.982         |
| 440.0          | 0.996        | 0.992         | 0.980         |
| 435.8          | 0.996        | 0.992         | 0.980         |
| 420.0          | 0.996        | 0.992         | 0.981         |
| 404.7          | 0.996        | 0.991         | 0.978         |
| 400.0          | 0.995        | 0.990         | 0.974         |
| 390.0          | 0.993        | 0.985         | 0.963         |
| 380.0          | 0.989        | 0.977         | 0.944         |
| 370.0          | 0.982        | 0.964         | 0.912         |
| 365.0          | 0.976        | 0.952         | 0.885         |
| 360.0          | 0.968        | 0.936         | 0.848         |
| 350.0          |              |               |               |
| 340.0          |              |               |               |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

**Colour code**

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 35/30 |
|----------------------------|-------|

## Chemical properties

|                      |      |
|----------------------|------|
| Acid resistance      | 52.0 |
| Alkali resistance    | 2.0  |
| Climatic resistance  | 3    |
| Phosphate resistance | 3.0  |

## Mechanical properties

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 563  |
| Abrasion hardness ( $F_A$ )                                   | 135  |
| Young's modulus ( $E$ ) [GPa]                                 | 87.9 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 35.3 |
| Poisson ratio ( $\mu$ )                                       | 0.25 |
| Stress optical coefficient                                    | 2.04 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 3.42 |

## Thermal properties

|  |            |      |
|--|------------|------|
| Strain point (T10 <sup>4.5</sup> ) [°C]  | 604        |      |
| Annealing point (T10 <sup>13.0</sup> ) [°C]                                    | 639        |      |
| Yield point (A <sub>y</sub> ) [°C]   | 698        |      |
| Transformation temperature (T <sub>g</sub> ) [°C]                              | 650        |      |
| Softening point (T10 <sup>7.65</sup> ) [°C]                                    | 766        |      |
| Annealing factor (F) for n <sub>d</sub>  | 13.0       |      |
| Co-efficient of thermal expansion (α) [10 <sup>-6</sup> K <sup>-1</sup> ]      | -30/+70°C  | 5.99 |
|  | +20/+300°C | 6.93 |
| Specific heat capacity (c <sub>p</sub> ) [J·g <sup>-1</sup> ·K <sup>-1</sup> ] | 0.735      |      |
| Thermal conductivity (λ) [W·m <sup>-1</sup> ·K <sup>-1</sup> ]                 | 0.311      |      |

## N-SK2

Issue number 1001-01

|               |           |
|---------------|-----------|
| ECO           | PbAs free |
| $n_d$         | 1.60738   |
| $n_F - n_C$   | 0.010721  |
| $v_d$         | 56.65     |
| $n_e$         | 1.60994   |
| $v_e$         | 56.33     |
| $n_F' - n_C'$ | 0.010827  |

## Refractive indices

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.57905 |
| $n_{1970.1}$ | 1970.1         | 1.58383 |
| $n_{1529.6}$ | 1529.6         | 1.58912 |
| $n_{1060.0}$ | 1060.0         | 1.59490 |
| $n_t$        | 1014.0         | 1.59558 |
| $n_s$        | 852.1          | 1.59847 |
| $n_{A'}$     | 768.2          | 1.60046 |
| $n_r$        | 706.5          | 1.60230 |
| $n_C$        | 656.3          | 1.60414 |
| $n_{C'}$     | 643.9          | 1.60465 |
| $n_{632.8}$  | 632.8          | 1.60513 |
| $n_D$        | 589.3          | 1.60729 |
| $n_d$        | 587.6          | 1.60738 |
| $n_e$        | 546.1          | 1.60994 |
| $n_F$        | 486.1          | 1.61487 |
| $n_{F'}$     | 480.0          | 1.61548 |
| $n_g$        | 435.8          | 1.62074 |
| $n_h$        | 404.7          | 1.62563 |
| $n_i$        | 365.0          | 1.63400 |
| $n_{334.1}$  | 334.1          | 1.64311 |
| $n_{312.6}$  | 312.6          | 1.65150 |
| $n_{296.7}$  | 296.7          | 1.65931 |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

### Temperature coefficients of refractive index

|          | dn/dT relative [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |     |     |     |
|----------|---|-------|-----|-----|-----|-----|-----|
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 3.7   | 3.7   | 3.8 | 4.0 | 4.3 | 4.7 | 5.6 |
| -20/0    | 3.8   | 3.8   | 3.9 | 4.1 | 4.4 | 4.8 | 5.8 |
| 0/+20    | 3.9   | 3.9   | 4.0 | 4.2 | 4.6 | 4.9 | 5.9 |
| +20/+40  | 4.0   | 4.0   | 4.1 | 4.3 | 4.7 | 5.1 | 6.1 |
| +40/+60  | 4.0   | 4.1   | 4.2 | 4.4 | 4.8 | 5.2 | 6.3 |
| +60/+80  | 4.1   | 4.2   | 4.3 | 4.5 | 4.9 | 5.3 | 6.5 |
| +80/+100 | 4.2   | 4.3   | 4.4 | 4.6 | 5.0 | 5.5 | 6.6 |
|          | dn/dT absolute [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |     |     |     |
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 1.5   | 1.5   | 1.6 | 1.8 | 2.1 | 2.4 | 3.3 |
| -20/0    | 1.9   | 1.9   | 2.1 | 2.2 | 2.6 | 2.9 | 3.8 |
| 0/+20    | 2.3   | 2.3   | 2.4 | 2.6 | 2.9 | 3.3 | 4.3 |
| +20/+40  | 2.6   | 2.6   | 2.7 | 2.9 | 3.3 | 3.6 | 4.7 |
| +40/+60  | 2.8   | 2.8   | 3.0 | 3.2 | 3.5 | 3.9 | 5.0 |
| +60/+80  | 3.0   | 3.1   | 3.2 | 3.4 | 3.8 | 4.2 | 5.3 |
| +80/+100 | 3.3   | 3.3   | 3.4 | 3.6 | 4.0 | 4.5 | 5.6 |

### Dispersion constants

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.5402116                  |
| $A_1$ | $-9.1804338 \cdot 10^{-3}$ |
| $A_2$ | $1.5230157 \cdot 10^{-2}$  |
| $A_3$ | $3.2054470 \cdot 10^{-4}$  |
| $A_4$ | $9.0390277 \cdot 10^{-6}$  |
| $A_5$ | $7.6725105 \cdot 10^{-7}$  |

### Relative partial dispersions

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.7980 |
| $P_{C,A'}$  | 0.3426 |
| $P_{d,C}$   | 0.3028 |
| $P_{e,C}$   | 0.5414 |
| $P_{g,d}$   | 1.2458 |
| $P_{g,F}$   | 0.5480 |
| $P_{h,g}$   | 0.4563 |
| $P_{i,g}$   | 1.2370 |
| $P'_{C,t}$  | 0.8378 |
| $P'_{e,C'}$ | 0.4884 |
| $P'_{F',e}$ | 0.5116 |
| $P'_{i,F'}$ | 1.7108 |

### Deviation of relative partial dispersions from normal line

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0162 |
| $\Delta P_{C,A'}$ | -0.0028 |
| $\Delta P_{g,d}$  | 0.0003  |
| $\Delta P_{g,F}$  | -0.0008 |
| $\Delta P_{j,n}$  | -0.0120 |

## Remarks

[illegible]

### Internal transmittance

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.938        | 0.880         | 0.726         |
| 1970.1         | 0.986        | 0.973         | 0.934         |
| 1800.0         | 0.992        | 0.984         | 0.961         |
| 1600.0         | 0.997        | 0.993         | 0.984         |
| 1529.6         | 0.997        | 0.994         | 0.986         |
| 1200.0         | 0.999        | 0.997         | 0.993         |
| 1060.0         | 0.998        | 0.997         | 0.992         |
| 800.0          | 0.998        | 0.997         | 0.992         |
| 700.0          | 0.999        | 0.997         | 0.994         |
| 660.0          | 0.998        | 0.997         | 0.991         |
| 640.0          | 0.998        | 0.996         | 0.991         |
| 620.0          | 0.998        | 0.996         | 0.991         |
| 600.0          | 0.998        | 0.997         | 0.992         |
| 580.0          | 0.999        | 0.997         | 0.993         |
| 546.1          | 0.998        | 0.997         | 0.992         |
| 500.0          | 0.998        | 0.996         | 0.990         |
| 480.0          | 0.998        | 0.995         | 0.988         |
| 460.0          | 0.997        | 0.994         | 0.985         |
| 440.0          | 0.997        | 0.993         | 0.983         |
| 435.8          | 0.997        | 0.994         | 0.984         |
| 420.0          | 0.997        | 0.994         | 0.985         |
| 404.7          | 0.997        | 0.994         | 0.985         |
| 400.0          | 0.997        | 0.993         | 0.983         |
| 390.0          | 0.995        | 0.990         | 0.974         |
| 380.0          | 0.992        | 0.985         | 0.962         |
| 370.0          | 0.988        | 0.975         | 0.940         |
| 365.0          | 0.984        | 0.967         | 0.920         |
| 360.0          | 0.978        | 0.956         | 0.894         |
| 350.0          | 0.959        | 0.921         | 0.813         |
| 340.0          | 0.925        | 0.856         | 0.679         |
| 334.1          | 0.893        | 0.797         | 0.566         |
| 330.0          | 0.865        | 0.748         | 0.484         |
| 320.0          | 0.783        | 0.613         | 0.295         |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

**Colour code**

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 35/30 |
|----------------------------|-------|

## Chemical properties

|                      |      |
|----------------------|------|
| Acid resistance      | 51.2 |
| Alkali resistance    | 1.1  |
| Climatic resistance  | 1    |
| Phosphate resistance | 2.1  |

## Mechanical properties

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 507  |
| Abrasion hardness ( $F_A$ )                                   | 160  |
| Young's modulus ( $E$ ) [GPa]                                 | 78.5 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 31.1 |
| Poisson ratio ( $\mu$ )                                       | 0.26 |
| Stress optical coefficient                                    | 2.27 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 3.54 |

## Thermal properties

|  |            |      |
|--|------------|------|
| Strain point (T10 <sup>14.5</sup> ) [°C]                                       | 601        |      |
| Annealing point (T10 <sup>13.0</sup> ) [°C]                                    | 644        |      |
| Yield point (A <sub>y</sub> ) [°C]   | 707        |      |
| Transformation temperature (T <sub>g</sub> ) [°C]                              | 647        |      |
| Softening point (T10 <sup>7.65</sup> ) [°C]                                    | 800        |      |
| Annealing factor (F) for n <sub>d</sub>  | 10.1       |      |
| Co-efficient of thermal expansion (α) [10 <sup>-6</sup> K <sup>-1</sup> ]      | -30/+70°C  | 6.24 |
|  | +20/+300°C | 7.12 |
| Specific heat capacity (c <sub>p</sub> ) [J·g <sup>-1</sup> ·K <sup>-1</sup> ] | 0.686      |      |
| Thermal conductivity (λ) [W·m <sup>-1</sup> ·K <sup>-1</sup> ]                 | 0.297      |      |

## N-SK4

Issue number 1001-01

ECO PbAs free

|                   |          |
|-------------------|----------|
| $n_d$             | 1.61272  |
| $n_F - n_C$       | 0.010451 |
| $v_d$             | 58.63    |
| $n_e$             | 1.61521  |
| $v_e$             | 58.32    |
| $n_{F'} - n_{C'}$ | 0.010550 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.58334 |
| $n_{1970.1}$ | 1970.1         | 1.58855 |
| $n_{1529.6}$ | 1529.6         | 1.59426 |
| $n_{1060.0}$ | 1060.0         | 1.60032 |
| $n_i$        | 1014.0         | 1.60102 |
| $n_s$        | 852.1          | 1.60393 |
| $n_{A'}$     | 768.2          | 1.60592 |
| $n_r$        | 706.5          | 1.60773 |
| $n_C$        | 656.3          | 1.60954 |
| $n_{C'}$     | 643.9          | 1.61004 |
| $n_{632.8}$  | 632.8          | 1.61052 |
| $n_D$        | 589.3          | 1.61262 |
| $n_d$        | 587.6          | 1.61272 |
| $n_e$        | 546.1          | 1.61521 |
| $n_F$        | 486.1          | 1.62000 |
| $n_{F'}$     | 480.0          | 1.62059 |
| $n_g$        | 435.8          | 1.62569 |
| $n_h$        | 404.7          | 1.63042 |
| $n_i$        | 365.0          | 1.63849 |
| $n_{334.1}$  | 334.1          | 1.64724 |
| $n_{312.6}$  | 312.6          | 1.65527 |
| $n_{296.7}$  | 296.7          | 1.66269 |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [ $10^{-6} \cdot K^{-1}$ ] |       |     |     |     |     |     |
|----------|---|-------|-----|-----|-----|-----|-----|
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 2.4                                       | 2.5   | 2.6 | 2.7 | 3.0 | 3.3 | 4.1 |
| -20/0    | 2.5                                       | 2.5   | 2.6 | 2.8 | 3.1 | 3.4 | 4.2 |
| 0/+20    | 2.6                                       | 2.6   | 2.7 | 2.9 | 3.2 | 3.5 | 4.4 |
| +20/+40  | 2.7                                       | 2.7   | 2.8 | 3.0 | 3.3 | 3.6 | 4.5 |
| +40/+60  | 2.7                                       | 2.8   | 2.9 | 3.1 | 3.4 | 3.7 | 4.7 |
| +60/+80  | 2.8                                       | 2.9   | 3.0 | 3.1 | 3.5 | 3.9 | 4.8 |
| +80/+100 | 2.9                                       | 2.9   | 3.1 | 3.2 | 3.6 | 4.0 | 5.0 |
|          | dn/dT absolute [ $10^{-6} \cdot K^{-1}$ ] |       |     |     |     |     |     |
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 0.3                                       | 0.3   | 0.4 | 0.5 | 0.8 | 1.0 | 1.8 |
| -20/0    | 0.7                                       | 0.7   | 0.8 | 0.9 | 1.2 | 1.5 | 2.3 |
| 0/+20    | 1.0                                       | 1.0   | 1.1 | 1.3 | 1.6 | 1.9 | 2.7 |
| +20/+40  | 1.3                                       | 1.3   | 1.4 | 1.6 | 1.9 | 2.2 | 3.1 |
| +40/+60  | 1.5                                       | 1.5   | 1.7 | 1.8 | 2.1 | 2.5 | 3.4 |
| +60/+80  | 1.7                                       | 1.8   | 1.9 | 2.0 | 2.4 | 2.7 | 3.7 |
| +80/+100 | 1.9                                       | 2.0   | 2.1 | 2.2 | 2.6 | 3.0 | 4.0 |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.5589546                  |
| $A_1$ | $-1.0126313 \cdot 10^{-2}$ |
| $A_2$ | $1.4848827 \cdot 10^{-2}$  |
| $A_3$ | $3.0218924 \cdot 10^{-4}$  |
| $A_4$ | $-8.2369170 \cdot 10^{-6}$ |
| $A_5$ | $6.5344266 \cdot 10^{-7}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.8151 |
| $P_{C,A'}$  | 0.3464 |
| $P_{d,C}$   | 0.3040 |
| $P_{e,C}$   | 0.5426 |
| $P_{g,d}$   | 1.2417 |
| $P_{g,F}$   | 0.5449 |
| $P_{h,g}$   | 0.4527 |
| $P_{i,g}$   | 1.2249 |
| $P'_{C,t}$  | 0.8554 |
| $P'_{e,C'}$ | 0.4896 |
| $P'_{F',e}$ | 0.5104 |
| $P'_{i,F'}$ | 1.6968 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0085 |
| $\Delta P_{C,A'}$ | -0.0014 |
| $\Delta P_{g,d}$  | 0.0004  |
| $\Delta P_{g,F}$  | -0.0006 |
| $\Delta P_{j,n}$  | -0.0074 |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.938        | 0.880         | 0.726         |
| 1970.1         | 0.982        | 0.965         | 0.915         |
| 1800.0         | 0.990        | 0.980         | 0.950         |
| 1600.0         | 0.996        | 0.992         | 0.980         |
| 1529.6         | 0.997        | 0.993         | 0.984         |
| 1200.0         | 0.999        | 0.998         | 0.996         |
| 1060.0         | 0.999        | 0.998         | 0.995         |
| 800.0          | 0.999        | 0.998         | 0.996         |
| 700.0          | 0.999        | 0.998         | 0.995         |
| 660.0          | 0.998        | 0.997         | 0.992         |
| 640.0          | 0.998        | 0.996         | 0.991         |
| 620.0          | 0.998        | 0.996         | 0.991         |
| 600.0          | 0.998        | 0.997         | 0.991         |
| 580.0          | 0.998        | 0.997         | 0.992         |
| 546.1          | 0.998        | 0.997         | 0.992         |
| 500.0          | 0.998        | 0.995         | 0.989         |
| 480.0          | 0.997        | 0.994         | 0.986         |
| 460.0          | 0.996        | 0.992         | 0.981         |
| 440.0          | 0.996        | 0.992         | 0.980         |
| 435.8          | 0.996        | 0.992         | 0.980         |
| 420.0          | 0.996        | 0.993         | 0.982         |
| 404.7          | 0.996        | 0.992         | 0.981         |
| 400.0          | 0.996        | 0.991         | 0.978         |
| 390.0          | 0.993        | 0.987         | 0.968         |
| 380.0          | 0.990        | 0.980         | 0.951         |
| 370.0          | 0.983        | 0.967         | 0.919         |
| 365.0          | 0.978        | 0.956         | 0.894         |
| 360.0          | 0.971        | 0.942         | 0.862         |
| 350.0          | 0.946        | 0.895         | 0.758         |
| 340.0          | 0.903        | 0.815         | 0.600         |
| 334.1          | 0.863        | 0.745         | 0.480         |
| 330.0          | 0.832        | 0.691         | 0.398         |
| 320.0          | 0.760        | 0.578         | 0.254         |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 36/31 |
|----------------------------|-------|

|                      |      |
|----------------------|------|
| Acid resistance      | 52.0 |
| Alkali resistance    | 2.0  |
| Climatic resistance  | 1    |
| Phosphate resistance | 2.0  |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 566  |
| Abrasion hardness ( $F_A$ )                                   | 150  |
| Young's modulus ( $E$ ) [GPa]                                 | 84.4 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 33.2 |
| Poisson ratio ( $\mu$ )                                       | 0.27 |
| Stress optical coefficient                                    | 1.92 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 3.56 |

|  |            |      |
|--|------------|------|
| Strain point (T10 <sup>4.5</sup> ) [°C]  | 603        |      |
| Annealing point (T10 <sup>13.0</sup> ) [°C]                                    | 637        |      |
| Yield point (A <sub>1</sub> ) [°C]   | 697        |      |
| Transformation temperature (T <sub>g</sub> ) [°C]                              | 661        |      |
| Softening point (T10 <sup>7.65</sup> ) [°C]                                    | 766        |      |
| Annealing factor (F) for n <sub>d</sub>  | 12.0       |      |
| Co-efficient of thermal expansion (α) [10 <sup>-6</sup> K <sup>-1</sup> ]      | -30/+70°C  | 6.56 |
|  | +20/+300°C | 7.45 |
| Specific heat capacity (c <sub>p</sub> ) [J·g <sup>-1</sup> ·K <sup>-1</sup> ] | 0.676      |      |
| Thermal conductivity (λ) [W·m <sup>-1</sup> ·K <sup>-1</sup> ]                 | 0.281      |      |

## N-SK16

Issue number 1001-01

|                   |           |
|-------------------|-----------|
| ECO               | PbAs free |
| $n_d$             | 1.62041   |
| $n_F - n_C$       | 0.010284  |
| $v_d$             | 60.33     |
| $n_e$             | 1.62286   |
| $v_e$             | 60.04     |
| $n_{F'} - n_{C'}$ | 0.010374  |

## Refractive indices

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.59000 |
| $n_{1970.1}$ | 1970.1         | 1.59561 |
| $n_{1529.6}$ | 1529.6         | 1.60170 |
| $n_{1060.0}$ | 1060.0         | 1.60803 |
| $n_t$        | 1014.0         | 1.60874 |
| $n_s$        | 852.1          | 1.61169 |
| $n_{A'}$     | 768.2          | 1.61368 |
| $n_r$        | 706.5          | 1.61548 |
| $n_C$        | 656.3          | 1.61727 |
| $n_{C'}$     | 643.9          | 1.61777 |
| $n_{632.8}$  | 632.8          | 1.61824 |
| $n_D$        | 589.3          | 1.62031 |
| $n_d$        | 587.6          | 1.62041 |
| $n_e$        | 546.1          | 1.62286 |
| $n_F$        | 486.1          | 1.62756 |
| $n_{F'}$     | 480.0          | 1.62814 |
| $n_g$        | 435.8          | 1.63313 |
| $n_h$        | 404.7          | 1.63775 |
| $n_i$        | 365.0          | 1.64561 |
| $n_{334.1}$  | 334.1          | 1.65413 |
| $n_{312.6}$  | 312.6          | 1.66198 |
| $n_{296.7}$  | 296.7          | 1.66930 |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

### Temperature coefficients of refractive index

|          | dn/dT relative [ $10^{-6} \cdot K^{-1}$ ] |       |      |      |      |     |     |
|----------|---|-------|------|------|------|-----|-----|
| °C       | C'  | 632.8 | D    | e    | F'   | g   | i   |
| -40/-20  | 1.7                                       | 1.7   | 1.8  | 1.9  | 2.1  | 2.4 | 3.1 |
| -20/0    | 1.7                                       | 1.8   | 1.8  | 2.0  | 2.3  | 2.5 | 3.3 |
| 0/+20    | 1.8                                       | 1.8   | 1.9  | 2.1  | 2.4  | 2.6 | 3.4 |
| +20/+40  | 1.9                                       | 1.9   | 2.0  | 2.2  | 2.5  | 2.8 | 3.6 |
| +40/+60  | 2.0                                       | 2.0   | 2.1  | 2.3  | 2.6  | 2.9 | 3.7 |
| +60/+80  | 2.1                                       | 2.1   | 2.2  | 2.4  | 2.7  | 3.0 | 3.9 |
| +80/+100 | 2.2                                       | 2.2   | 2.3  | 2.4  | 2.8  | 3.1 | 4.0 |
|          | dn/dT absolute [ $10^{-6} \cdot K^{-1}$ ] |       |      |      |      |     |     |
| °C       | C'  | 632.8 | D    | e    | F'   | g   | i   |
| -40/-20  | -0.5                                      | -0.5  | -0.4 | -0.3 | -0.1 | 0.2 | 0.8 |
| -20/0    | -0.1                                      | -0.1  | 0.0  | 0.1  | 0.4  | 0.6 | 1.3 |
| 0/+20    | 0.2                                       | 0.2   | 0.3  | 0.5  | 0.7  | 1.0 | 1.7 |
| +20/+40  | 0.5                                       | 0.5   | 0.6  | 0.8  | 1.0  | 1.3 | 2.1 |
| +40/+60  | 0.8                                       | 0.8   | 0.9  | 1.0  | 1.3  | 1.6 | 2.4 |
| +60/+80  | 1.0                                       | 1.0   | 1.1  | 1.3  | 1.6  | 1.9 | 2.7 |
| +80/+100 | 1.2                                       | 1.2   | 1.3  | 1.5  | 1.8  | 2.1 | 3.0 |

## Dispersion constants

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.5849619                  |
| $A_1$ | $-1.1013963 \cdot 10^{-2}$ |
| $A_2$ | $1.4506218 \cdot 10^{-2}$  |
| $A_3$ | $3.4082999 \cdot 10^{-4}$  |
| $A_4$ | $-1.6422140 \cdot 10^{-5}$ |
| $A_5$ | $1.0728589 \cdot 10^{-6}$  |

### Relative partial dispersions

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.8291 |
| $P_{C,A'}$  | 0.3494 |
| $P_{d,C}$   | 0.3050 |
| $P_{e,C}$   | 0.5436 |
| $P_{g,d}$   | 1.2372 |
| $P_{g,F}$   | 0.5417 |
| $P_{h,g}$   | 0.4489 |
| $P_{i,g}$   | 1.2135 |
| $P'_{C,t}$  | 0.8701 |
| $P'_{e,C'}$ | 0.4907 |
| $P'_{F',e}$ | 0.5092 |
| $P'_{i,F'}$ | 1.6837 |

### Deviation of relative partial dispersions from normal line

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0025 |
| $\Delta P_{C,A'}$ | -0.0004 |
| $\Delta P_{g,d}$  | -0.0005 |
| $\Delta P_{g,F}$  | -0.0009 |
| $\Delta P_{i,q}$  | -0.0045 |

## Remarks

[illegible]

### Internal transmittance

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.930        | 0.864         | 0.695         |
| 1970.1         | 0.980        | 0.961         | 0.905         |
| 1800.0         | 0.989        | 0.978         | 0.947         |
| 1600.0         | 0.995        | 0.991         | 0.978         |
| 1529.6         | 0.996        | 0.992         | 0.981         |
| 1200.0         | 0.999        | 0.998         | 0.995         |
| 1060.0         | 0.999        | 0.998         | 0.995         |
| 800.0          | 0.999        | 0.997         | 0.994         |
| 700.0          | 0.998        | 0.997         | 0.992         |
| 660.0          | 0.998        | 0.995         | 0.988         |
| 640.0          | 0.997        | 0.995         | 0.987         |
| 620.0          | 0.997        | 0.995         | 0.987         |
| 600.0          | 0.998        | 0.995         | 0.988         |
| 580.0          | 0.998        | 0.996         | 0.989         |
| 546.1          | 0.998        | 0.996         | 0.990         |
| 500.0          | 0.997        | 0.994         | 0.986         |
| 480.0          | 0.996        | 0.993         | 0.981         |
| 460.0          | 0.995        | 0.990         | 0.976         |
| 440.0          | 0.995        | 0.989         | 0.973         |
| 435.8          | 0.995        | 0.989         | 0.973         |
| 420.0          | 0.995        | 0.990         | 0.976         |
| 404.7          | 0.995        | 0.990         | 0.975         |
| 400.0          | 0.994        | 0.989         | 0.972         |
| 390.0          | 0.991        | 0.983         | 0.957         |
| 380.0          | 0.987        | 0.974         | 0.936         |
| 370.0          | 0.977        | 0.955         | 0.891         |
| 365.0          | 0.969        | 0.940         | 0.856         |
| 360.0          | 0.958        | 0.919         | 0.809         |
| 350.0          | 0.926        | 0.858         | 0.681         |
| 340.0          | 0.867        | 0.752         | 0.490         |
| 334.1          | 0.817        | 0.667         | 0.363         |
| 330.0          | 0.777        | 0.604         | 0.283         |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

**Colour code**

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 36/30 |
|----------------------------|-------|

## Chemical properties

|                      |      |
|----------------------|------|
| Acid resistance      | 2.1  |
| Alkali resistance    | 53.1 |
| Climatic resistance  |      |
| Phosphate resistance | 4.1  |

## Mechanical properties

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  |      |
| Abrasion hardness ( $F_A$ )                                   | 155  |
| Young's modulus ( $E$ ) [GPa]                                 |      |
| Modulus of rigidity ( $G$ ) [GPa]                             |      |
| Poisson ratio ( $\mu$ )                                       |      |
| Stress optical coefficient                                    |      |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 3.61 |

## Thermal properties

|  |            |      |
|--|------------|------|
| Strain point (T10 <sup>14.5</sup> ) [°C]                                       |            |      |
| Annealing point (T10 <sup>13.0</sup> ) [°C]                                    |            |      |
| Yield point (A <sub>1</sub> ) [°C]   |            |      |
| Transformation temperature (T <sub>g</sub> ) [°C]                              |            |      |
| Softening point (T10 <sup>7.65</sup> ) [°C]                                    |            |      |
| Annealing factor (F) for n <sub>d</sub>  |            | 12.9 |
| Co-efficient of thermal expansion (α) [10 <sup>-6</sup> K <sup>-1</sup> ]      | -30/+70°C  |      |
|  | +20/+300°C |      |
| Specific heat capacity (c <sub>p</sub> ) [J·g <sup>-1</sup> ·K <sup>-1</sup> ] |            |      |
| Thermal conductivity (λ) [W·m <sup>-1</sup> ·K <sup>-1</sup> ]                 |            |      |

## N-SK10

Issue number 1001-01

ECO AsPb Free

|                   |          |
|-------------------|----------|
| $n_d$             | 1.62280  |
| $n_F - n_C$       | 0.010945 |
| $v_d$             | 56.90    |
| $n_e$             | 1.62541  |
| $v_e$             | 56.63    |
| $n_{F'} - n_{C'}$ | 0.011043 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.59344 |
| $n_{1970.1}$ | 1970.1         | 1.59846 |
| $n_{1529.6}$ | 1529.6         | 1.60400 |
| $n_{1060.0}$ | 1060.0         | 1.61001 |
| $n_i$        | 1014.0         | 1.61072 |
| $n_s$        | 852.1          | 1.61369 |
| $n_{A'}$     | 768.2          | 1.61573 |
| $n_r$        | 706.5          | 1.61761 |
| $n_C$        | 656.3          | 1.61949 |
| $n_{C'}$     | 643.9          | 1.62001 |
| $n_{632.8}$  | 632.8          | 1.62051 |
| $n_D$        | 589.3          | 1.62270 |
| $n_d$        | 587.6          | 1.62280 |
| $n_e$        | 546.1          | 1.62541 |
| $n_F$        | 486.1          | 1.63043 |
| $n_{F'}$     | 480.0          | 1.63106 |
| $n_g$        | 435.8          | 1.63642 |
| $n_h$        | 404.7          | 1.64140 |
| $n_i$        | 365.0          | 1.64994 |
| $n_{334.1}$  | 334.1          | 1.65924 |
| $n_{312.6}$  | 312.6          | 1.66785 |
| $n_{296.7}$  | 296.7          | 1.67588 |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |     |     |     |
|----------|---|-------|-----|-----|-----|-----|-----|
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 2.3   | 2.3   | 2.4 | 2.6 | 2.9 | 3.2 | 4.1 |
| -20/0    | 2.3   | 2.4   | 2.5 | 2.6 | 3.0 | 3.3 | 4.2 |
| 0/+20    | 2.4   | 2.4   | 2.6 | 2.7 | 3.1 | 3.4 | 4.4 |
| +20/+40  | 2.5   | 2.5   | 2.6 | 2.8 | 3.2 | 3.5 | 4.5 |
| +40/+60  | 2.6   | 2.6   | 2.7 | 2.9 | 3.3 | 3.7 | 4.7 |
| +60/+80  | 2.6   | 2.7   | 2.8 | 3.0 | 3.4 | 3.8 | 4.9 |
| +80/+100 | 2.7   | 2.7   | 2.9 | 3.1 | 3.5 | 3.9 | 5.0 |
|          | dn/dT absolute [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |     |     |     |
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 0.1   | 0.1   | 0.2 | 0.4 | 0.7 | 1.0 | 1.8 |
| -20/0    | 0.5   | 0.5   | 0.6 | 0.8 | 1.1 | 1.4 | 2.3 |
| 0/+20    | 0.8   | 0.8   | 0.9 | 1.1 | 1.4 | 1.8 | 2.7 |
| +20/+40  | 1.1   | 1.1   | 1.2 | 1.4 | 1.7 | 2.1 | 3.1 |
| +40/+60  | 1.3   | 1.3   | 1.5 | 1.6 | 2.0 | 2.4 | 3.4 |
| +60/+80  | 1.5   | 1.6   | 1.7 | 1.9 | 2.3 | 2.7 | 3.7 |
| +80/+100 | 1.7   | 1.7   | 1.9 | 2.1 | 2.5 | 2.9 | 4.0 |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.5889276E                 |
| $A_1$ | $-9.7628853 \cdot 10^{-3}$ |
| $A_2$ | $1.5633659 \cdot 10^{-2}$  |
| $A_3$ | $3.4015696 \cdot 10^{-4}$  |
| $A_4$ | $-1.1383837 \cdot 10^{-5}$ |
| $A_5$ | $9.4301007 \cdot 10^{-7}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.8014 |
| $P_{C,A'}$  | 0.3432 |
| $P_{d,C}$   | 0.3028 |
| $P_{e,C}$   | 0.5412 |
| $P_{g,d}$   | 1.2441 |
| $P_{g,F}$   | 0.5470 |
| $P_{h,g}$   | 0.4555 |
| $P_{i,g}$   | 1.2354 |
| $P'_{C,t}$  | 0.8419 |
| $P'_{e,C'}$ | 0.4887 |
| $P'_{F',e}$ | 0.5113 |
| $P'_{i,F'}$ | 1.7099 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0140 |
| $\Delta P_{C,A'}$ | -0.0025 |
| $\Delta P_{g,d}$  | -0.0009 |
| $\Delta P_{g,F}$  | -0.0014 |
| $\Delta P_{i,q}$  | -0.0115 |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.938        | 0.880         | 0.725         |
| 1970.1         | 0.981        | 0.963         | 0.909         |
| 1800.0         | 0.989        | 0.978         | 0.946         |
| 1600.0         | 0.996        | 0.992         | 0.979         |
| 1529.6         | 0.996        | 0.993         | 0.983         |
| 1200.0         | 0.999        | 0.998         | 0.994         |
| 1060.0         | 0.999        | 0.997         | 0.993         |
| 800.0          | 0.999        | 0.998         | 0.996         |
| 700.0          | 0.999        | 0.998         | 0.995         |
| 660.0          | 0.998        | 0.996         | 0.991         |
| 640.0          | 0.998        | 0.996         | 0.989         |
| 620.0          | 0.998        | 0.996         | 0.990         |
| 600.0          | 0.998        | 0.996         | 0.990         |
| 580.0          | 0.998        | 0.996         | 0.991         |
| 546.1          | 0.998        | 0.996         | 0.990         |
| 500.0          | 0.997        | 0.994         | 0.986         |
| 480.0          | 0.996        | 0.992         | 0.981         |
| 460.0          | 0.995        | 0.991         | 0.977         |
| 440.0          | 0.995        | 0.990         | 0.974         |
| 435.8          | 0.995        | 0.990         | 0.974         |
| 420.0          | 0.995        | 0.991         | 0.978         |
| 404.7          | 0.996        | 0.991         | 0.978         |
| 400.0          | 0.995        | 0.990         | 0.976         |
| 390.0          | 0.993        | 0.987         | 0.967         |
| 380.0          | 0.990        | 0.979         | 0.949         |
| 370.0          | 0.983        | 0.966         | 0.917         |
| 365.0          | 0.977        | 0.955         | 0.892         |
| 360.0          | 0.970        | 0.941         | 0.858         |
| 350.0          | 0.945        | 0.893         | 0.753         |
| 340.0          | 0.901        | 0.811         | 0.592         |
| 334.1          | 0.861        | 0.741         | 0.473         |
| 330.0          | 0.829        | 0.687         | 0.392         |
| 320.0          | 0.764        | 0.583         | 0.260         |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 36/31 |
|----------------------------|-------|

|                      |      |
|----------------------|------|
| Acid resistance      | 52.0 |
| Alkali resistance    | 2.0  |
| Climatic resistance  | 3    |
| Phosphate resistance | 3.2  |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 529  |
| Abrasion hardness ( $F_A$ )                                   | 165  |
| Young's modulus ( $E$ ) [GPa]                                 | 82.8 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 32.8 |
| Poisson ratio ( $\mu$ )                                       | 0.26 |
| Stress optical coefficient                                    | 1.86 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 3.66 |

|   |                             |      |
|---|-----------------------------|------|
| Strain point ( $T_{10}^{14.5}$ ) [ $^{\circ}\text{C}$ ]                               | 582                         |      |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            | 620                         |      |
| Yield point ( $A_f$ ) [ $^{\circ}\text{C}$ ]  | 680                         |      |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           | 636                         |      |
| Softening point ( $T_{10}^{7.65}$ ) [ $^{\circ}\text{C}$ ]                            | 751                         |      |
| Annealing factor (F) for $n_d$  | 11.8                        |      |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 6.96 |
|   | +20/+300 $^{\circ}\text{C}$ | 7.88 |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   | 0.701                       |      |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] | 0.288                       |      |



## N-SK15

Issue number 1001-01

|                   |           |
|-------------------|-----------|
| ECO               | PbAs free |
| $n_d$             | 1.62299   |
| $n_F - n_C$       | 0.010731  |
| $v_d$             | 58.06     |
| $n_e$             | 1.62555   |
| $v_e$             | 57.77     |
| $n_{F'} - n_{C'}$ | 0.010828  |

## Refractive indices

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.59126 |
| $n_{1970.1}$ | 1970.1         | 1.59712 |
| $n_{1529.6}$ | 1529.6         | 1.60348 |
| $n_{1060.0}$ | 1060.0         | 1.61009 |
| $n_t$        | 1014.0         | 1.61083 |
| $n_s$        | 852.1          | 1.61390 |
| $n_{A'}$     | 768.2          | 1.61597 |
| $n_r$        | 706.5          | 1.61785 |
| $n_C$        | 656.3          | 1.61972 |
| $n_{C'}$     | 643.9          | 1.62024 |
| $n_{632.8}$  | 632.8          | 1.62073 |
| $n_D$        | 589.3          | 1.62289 |
| $n_d$        | 587.6          | 1.62299 |
| $n_e$        | 546.1          | 1.62555 |
| $n_F$        | 486.1          | 1.63046 |
| $n_{F'}$     | 480.0          | 1.63107 |
| $n_g$        | 435.8          | 1.63629 |
| $n_h$        | 404.7          | 1.64113 |
| $n_i$        | 365.0          | 1.64938 |
| $n_{334.1}$  | 334.1          | 1.65833 |
| $n_{312.6}$  | 312.6          | 1.66656 |
| $n_{296.7}$  | 296.7          | 1.67418 |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

### Temperature coefficients of refractive index

|          | dn/dT relative [ $10^{-6} \cdot K^{-1}$ ] |       |     |     |     |     |     |
|----------|---|-------|-----|-----|-----|-----|-----|
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 3.0                                       | 3.1   | 3.2 | 3.3 | 3.6 | 3.8 | 4.6 |
| -20/0    | 3.1                                       | 3.2   | 3.2 | 3.4 | 3.7 | 4.0 | 4.8 |
| 0/+20    | 3.2                                       | 3.2   | 3.3 | 3.5 | 3.8 | 4.1 | 4.9 |
| +20/+40  | 3.3                                       | 3.3   | 3.4 | 3.6 | 3.9 | 4.2 | 5.1 |
| +40/+60  | 3.4                                       | 3.4   | 3.5 | 3.7 | 4.0 | 4.4 | 5.3 |
| +60/+80  | 3.5                                       | 3.5   | 3.6 | 3.8 | 4.1 | 4.5 | 5.4 |
| +80/+100 | 3.6                                       | 3.6   | 3.7 | 3.9 | 4.2 | 4.6 | 5.6 |
|          | dn/dT absolute [ $10^{-6} \cdot K^{-1}$ ] |       |     |     |     |     |     |
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 0.9                                       | 0.9   | 1.0 | 1.1 | 1.3 | 1.6 | 2.3 |
| -20/0    | 1.3                                       | 1.3   | 1.4 | 1.5 | 1.8 | 2.1 | 2.8 |
| 0/+20    | 1.6                                       | 1.6   | 1.7 | 1.9 | 2.2 | 2.4 | 3.3 |
| +20/+40  | 1.9                                       | 1.9   | 2.0 | 2.2 | 2.5 | 2.8 | 3.6 |
| +40/+60  | 2.1                                       | 2.2   | 2.3 | 2.4 | 2.8 | 3.1 | 4.0 |
| +60/+80  | 2.4                                       | 2.4   | 2.5 | 2.7 | 3.0 | 3.4 | 4.3 |
| +80/+100 | 2.6                                       | 2.6   | 2.7 | 2.9 | 3.2 | 3.6 | 4.6 |

## Dispersion constants

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.5915751                  |
| $A_1$ | $-1.1519832 \cdot 10^{-2}$ |
| $A_2$ | $1.5152815 \cdot 10^{-2}$  |
| $A_3$ | $3.3493422 \cdot 10^{-4}$  |
| $A_4$ | $-1.1055855 \cdot 10^{-5}$ |
| $A_5$ | $7.9163512 \cdot 10^{-7}$  |

### Relative partial dispersions

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.8282 |
| $P_{C,A'}$  | 0.3489 |
| $P_{d,C}$   | 0.3047 |
| $P_{e,C}$   | 0.5433 |
| $P_{g,d}$   | 1.2393 |
| $P_{g,F}$   | 0.5434 |
| $P_{h,g}$   | 0.4511 |
| $P_{i,g}$   | 1.2206 |
| $P'_{C,t}$  | 0.8689 |
| $P'_{e,C'}$ | 0.4903 |
| $P'_{F',e}$ | 0.5097 |
| $P'_{i,F'}$ | 1.6918 |

### Deviation of relative partial dispersions from normal line

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | 0.0073  |
| $\Delta P_{C,A'}$ | 0.0019  |
| $\Delta P_{g,d}$  | -0.0032 |
| $\Delta P_{g,F}$  | -0.0031 |
| $\Delta P_{i,q}$  | -0.0166 |

## Remarks

[illegible]

### Internal transmittance

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.935        | 0.875         | 0.716         |
| 1970.1         | 0.983        | 0.967         | 0.920         |
| 1800.0         | 0.991        | 0.982         | 0.955         |
| 1600.0         | 0.996        | 0.992         | 0.980         |
| 1529.6         | 0.996        | 0.993         | 0.982         |
| 1200.0         | 0.999        | 0.999         | 0.997         |
| 1060.0         | 0.999        | 0.999         | 0.997         |
| 800.0          | 0.999        | 0.998         | 0.995         |
| 700.0          | 0.999        | 0.998         | 0.994         |
| 660.0          | 0.998        | 0.996         | 0.990         |
| 640.0          | 0.998        | 0.996         | 0.990         |
| 620.0          | 0.998        | 0.996         | 0.990         |
| 600.0          | 0.998        | 0.996         | 0.990         |
| 580.0          | 0.998        | 0.997         | 0.992         |
| 546.1          | 0.998        | 0.997         | 0.992         |
| 500.0          | 0.998        | 0.996         | 0.989         |
| 480.0          | 0.997        | 0.994         | 0.985         |
| 460.0          | 0.996        | 0.992         | 0.981         |
| 440.0          | 0.996        | 0.991         | 0.978         |
| 435.8          | 0.996        | 0.991         | 0.978         |
| 420.0          | 0.996        | 0.992         | 0.981         |
| 404.7          | 0.996        | 0.992         | 0.981         |
| 400.0          | 0.996        | 0.992         | 0.979         |
| 390.0          | 0.994        | 0.989         | 0.972         |
| 380.0          | 0.991        | 0.982         | 0.957         |
| 370.0          | 0.985        | 0.971         | 0.928         |
| 365.0          | 0.980        | 0.960         | 0.903         |
| 360.0          | 0.973        | 0.946         | 0.871         |
| 350.0          | 0.951        | 0.904         | 0.777         |
| 340.0          | 0.910        | 0.828         | 0.624         |
| 334.1          | 0.872        | 0.761         | 0.506         |
| 330.0          | 0.842        | 0.708         | 0.422         |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

**Colour code**

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 36/31 |
|----------------------------|-------|

## Chemical properties

|                      |      |
|----------------------|------|
| Acid resistance      | 52.0 |
| Alkali resistance    | 1.0  |
| Climatic resistance  | 1    |
| Phosphate resistance | 2.2  |

## Mechanical properties

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 594  |
| Abrasion hardness ( $F_A$ )                                   | 140  |
| Young's modulus ( $E$ ) [GPa]                                 | 92.5 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 36.8 |
| Poisson ratio ( $\mu$ )                                       | 0.26 |
| Stress optical coefficient                                    | 2.08 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 3.46 |

## Thermal properties

|  |            |      |
|--|------------|------|
| Strain point (T10 <sup>4.5</sup> ) [°C]  | 613        |      |
| Annealing point (T10 <sup>13.0</sup> ) [°C]                                    | 647        |      |
| Yield point (A <sub>y</sub> ) [°C]   | 707        |      |
| Transformation temperature (T <sub>g</sub> ) [°C]                              | 665        |      |
| Softening point (T10 <sup>7.65</sup> ) [°C]                                    | 772        |      |
| Annealing factor (F) for n <sub>d</sub>  | 12.7       |      |
| Co-efficient of thermal expansion (α) [10 <sup>-6</sup> K <sup>-1</sup> ]      | -30/+70°C  | 5.93 |
|  | +20/+300°C | 6.92 |
| Specific heat capacity (c <sub>p</sub> ) [J·g <sup>-1</sup> ·K <sup>-1</sup> ] | 0.817      |      |
| Thermal conductivity (λ) [W·m <sup>-1</sup> ·K <sup>-1</sup> ]                 | 0.334      |      |

## N-SK18

Issue number 1001-01

|                   |           |
|-------------------|-----------|
| ECO               | PbAs free |
| $n_d$             | 1.63854   |
| $n_F - n_C$       | 0.011521  |
| $v_d$             | 55.42     |
| $n_e$             | 1.64128   |
| $v_e$             | 55.12     |
| $n_{F'} - n_{C'}$ | 0.011633  |

## Refractive indices

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.60736 |
| $n_{1970.1}$ | 1970.1         | 1.61276 |
| $n_{1529.6}$ | 1529.6         | 1.61869 |
| $n_{1060.0}$ | 1060.0         | 1.62507 |
| $n_t$        | 1014.0         | 1.62582 |
| $n_s$        | 852.1          | 1.62895 |
| $n_{A'}$     | 768.2          | 1.63110 |
| $n_r$        | 706.5          | 1.63308 |
| $n_C$        | 656.3          | 1.63505 |
| $n_{C'}$     | 643.9          | 1.63561 |
| $n_{632.8}$  | 632.8          | 1.63612 |
| $n_D$        | 589.3          | 1.63844 |
| $n_d$        | 587.6          | 1.63854 |
| $n_e$        | 546.1          | 1.64128 |
| $n_F$        | 486.1          | 1.64658 |
| $n_{F'}$     | 480.0          | 1.64724 |
| $n_g$        | 435.8          | 1.65291 |
| $n_h$        | 404.7          | 1.65821 |
| $n_i$        | 365.0          | 1.66736 |
| $n_{334.1}$  | 334.1          | 1.67745 |
| $n_{312.6}$  | 312.6          |         |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

### Temperature coefficients of refractive index

|          | dn/dT relative [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |      |      |      |     |     |
|----------|---|-------|------|------|------|-----|-----|
| °C       | C'  | 632.8 | D    | e    | F'   | g   | i   |
| -40/-20  | 1.6   | 1.6   | 1.7  | 1.9  | 2.2  | 2.5 | 3.5 |
| -20/0    | 1.7   | 1.7   | 1.8  | 2.0  | 2.3  | 2.7 | 3.7 |
| 0/+20    | 1.7   | 1.8   | 1.9  | 2.1  | 2.4  | 2.8 | 3.8 |
| +20/+40  | 1.8   | 1.8   | 2.0  | 2.1  | 2.5  | 2.9 | 4.0 |
| +40/+60  | 1.9   | 1.9   | 2.1  | 2.2  | 2.6  | 3.0 | 4.2 |
| +60/+80  | 2.0   | 2.0   | 2.1  | 2.3  | 2.7  | 3.1 | 4.3 |
| +80/+100 | 2.0   | 2.1   | 2.2  | 2.4  | 2.8  | 3.3 | 4.5 |
|          | dn/dT absolute [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |      |      |      |     |     |
| °C       | C'  | 632.8 | D    | e    | F'   | g   | i   |
| -40/-20  | -0.6  | -0.6  | -0.5 | -0.4 | -0.1 | 0.3 | 1.2 |
| -20/0    | -0.2  | -0.2  | -0.1 | 0.1  | 0.3  | 0.7 | 1.7 |
| 0/+20    | 0.1   | 0.1   | 0.3  | 0.4  | 0.7  | 1.1 | 2.1 |
| +20/+40  | 0.4   | 0.4   | 0.5  | 0.7  | 1.0  | 1.4 | 2.5 |
| +40/+60  | 0.6   | 0.7   | 0.8  | 1.0  | 1.3  | 1.7 | 2.9 |
| +60/+80  | 0.9   | 0.9   | 1.0  | 1.2  | 1.5  | 2.0 | 3.2 |
| +80/+100 | 1.0   | 1.1   | 1.2  | 1.4  | 1.8  | 2.2 | 3.5 |

## Dispersion constants

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.6378493                  |
| $A_1$ | $-1.0595429 \cdot 10^{-2}$ |
| $A_2$ | $1.6423767 \cdot 10^{-2}$  |
| $A_3$ | $3.9418371 \cdot 10^{-4}$  |
| $A_4$ | $-1.5078743 \cdot 10^{-5}$ |
| $A_5$ | $1.4341763 \cdot 10^{-6}$  |

### Relative partial dispersions

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.8014 |
| $P_{C,A'}$  | 0.3428 |
| $P_{d,C}$   | 0.3026 |
| $P_{e,C}$   | 0.5409 |
| $P_{g,d}$   | 1.2478 |
| $P_{g,F}$   | 0.5499 |
| $P_{h,g}$   | 0.4601 |
| $P_{i,g}$   | 1.2537 |
| $P'_{C,t}$  | 0.8412 |
| $P'_{e,C'}$ | 0.4881 |
| $P'_{F,e}$  | 0.5119 |
| $P'_{i,F'}$ | 1.7294 |

### Deviation of relative partial dispersions from normal line

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0070 |
| $\Delta P_{C,A'}$ | -0.0011 |
| $\Delta P_{g,d}$  | -0.0004 |
| $\Delta P_{g,F}$  | -0.0010 |
| $\Delta P_{i,q}$  | -0.0056 |

## Remarks

[illegible]

### Internal transmittance

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.931        | 0.867         | 0.700         |
| 1970.1         | 0.978        | 0.956         | 0.893         |
| 1800.0         | 0.987        | 0.973         | 0.934         |
| 1600.0         | 0.994        | 0.989         | 0.973         |
| 1529.6         | 0.995        | 0.991         | 0.977         |
| 1200.0         | 0.998        | 0.996         | 0.991         |
| 1060.0         | 0.998        | 0.996         | 0.991         |
| 800.0          | 0.998        | 0.996         | 0.990         |
| 700.0          | 0.998        | 0.996         | 0.989         |
| 660.0          | 0.997        | 0.994         | 0.985         |
| 640.0          | 0.997        | 0.993         | 0.983         |
| 620.0          | 0.997        | 0.994         | 0.984         |
| 600.0          | 0.997        | 0.994         | 0.984         |
| 580.0          | 0.997        | 0.995         | 0.987         |
| 546.1          | 0.997        | 0.995         | 0.987         |
| 500.0          | 0.997        | 0.993         | 0.983         |
| 480.0          | 0.995        | 0.991         | 0.977         |
| 460.0          | 0.994        | 0.988         | 0.970         |
| 440.0          | 0.992        | 0.984         | 0.961         |
| 435.8          | 0.992        | 0.983         | 0.959         |
| 420.0          | 0.990        | 0.979         | 0.949         |
| 404.7          | 0.982        | 0.964         | 0.912         |
| 400.0          | 0.977        | 0.955         | 0.891         |
| 390.0          | 0.960        | 0.922         | 0.816         |
| 380.0          | 0.927        | 0.860         | 0.685         |
| 370.0          | 0.864        | 0.746         | 0.481         |
| 365.0          | 0.814        | 0.663         | 0.358         |
| 360.0          | 0.747        | 0.558         | 0.232         |
| 350.0          | 0.621        | 0.386         | 0.092         |
| 340.0          | 0.623        | 0.388         | 0.094         |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

**Colour code**

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 38/34 |
|----------------------------|-------|

## Chemical properties

|                      |      |
|----------------------|------|
| Acid resistance      | 52.2 |
| Alkali resistance    | 2.0  |
| Climatic resistance  | 4    |
| Phosphate resistance | 3.2  |

## Mechanical properties

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 542  |
| Abrasion hardness ( $F_A$ )                                   | 170  |
| Young's modulus ( $E$ ) [GPa]                                 | 88.6 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 35.4 |
| Poisson ratio ( $\mu$ )                                       | 0.25 |
| Stress optical coefficient                                    | 1.71 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 3.70 |

## Thermal properties

|  |            |      |
|--|------------|------|
| Strain point (T10 <sup>14.5</sup> ) [°C]                                       | 595        |      |
| Annealing point (T10 <sup>13.0</sup> ) [°C]                                    | 630        |      |
| Yield point (A <sub>y</sub> ) [°C]   | 691        |      |
| Transformation temperature (T <sub>g</sub> ) [°C]                              | 653        |      |
| Softening point (T10 <sup>7.65</sup> ) [°C]                                    | 748        |      |
| Annealing factor (F) for n <sub>d</sub>  | 13.8       |      |
| Co-efficient of thermal expansion (α) [10 <sup>-6</sup> K <sup>-1</sup> ]      | -30/+70°C  | 7.10 |
|  | +20/+300°C | 8.09 |
| Specific heat capacity (c <sub>p</sub> ) [J·g <sup>-1</sup> ·K <sup>-1</sup> ] | 0.666      |      |
| Thermal conductivity (λ) [W·m <sup>-1</sup> ·K <sup>-1</sup> ]                 | 0.246      |      |

## N-SSK5

Issue number 1001-01

|                   |           |
|-------------------|-----------|
| ECO               | PbAs free |
| $n_d$             | 1.65844   |
| $n_F - n_C$       | 0.012940  |
| $v_d$             | 50.88     |
| $n_e$             | 1.66152   |
| $v_e$             | 50.60     |
| $n_{F'} - n_{C'}$ | 0.013074  |

## Refractive indices

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.62653 |
| $n_{1970.1}$ | 1970.1         | 1.63161 |
| $n_{1529.6}$ | 1529.6         | 1.63730 |
| $n_{1060.0}$ | 1060.0         | 1.64372 |
| $n_t$        | 1014.0         | 1.64450 |
| $n_s$        | 852.1          | 1.64784 |
| $n_{A'}$     | 768.2          | 1.65019 |
| $n_r$        | 706.5          | 1.65236 |
| $n_C$        | 656.3          | 1.65455 |
| $n_{C'}$     | 643.9          | 1.65516 |
| $n_{632.8}$  | 632.8          | 1.65574 |
| $n_D$        | 589.3          | 1.65832 |
| $n_d$        | 587.6          | 1.65844 |
| $n_e$        | 546.1          | 1.66152 |
| $n_F$        | 486.1          | 1.66749 |
| $n_{F'}$     | 480.0          | 1.66824 |
| $n_g$        | 435.8          | 1.67467 |
| $n_h$        | 404.7          | 1.68070 |
| $n_i$        | 365.0          | 1.69113 |
| $n_{334.1}$  | 334.1          | 1.70264 |
| $n_{312.6}$  | 312.6          |         |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

### Temperature coefficients of refractive index

|          | dn/dT relative [ $10^{-6} \cdot K^{-1}$ ] |       |     |     |     |     |     |
|----------|---|-------|-----|-----|-----|-----|-----|
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 3.5                                       | 3.6   | 3.7 | 3.9 | 4.4 | 4.8 | 6.1 |
| -20/0    | 3.6                                       | 3.6   | 3.8 | 4.0 | 4.5 | 4.9 | 6.2 |
| 0/+20    | 3.7                                       | 3.7   | 3.9 | 4.1 | 4.6 | 5.0 | 6.4 |
| +20/+40  | 3.7                                       | 3.8   | 3.9 | 4.2 | 4.6 | 5.2 | 6.6 |
| +40/+60  | 3.8                                       | 3.8   | 4.0 | 4.2 | 4.7 | 5.3 | 6.8 |
| +60/+80  | 3.9                                       | 3.9   | 4.1 | 4.3 | 4.8 | 5.4 | 6.9 |
| +80/+100 | 3.9                                       | 4.0   | 4.1 | 4.4 | 4.9 | 5.5 | 7.1 |
|          | dn/dT absolute [ $10^{-6} \cdot K^{-1}$ ] |       |     |     |     |     |     |
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 1.3                                       | 1.3   | 1.5 | 1.7 | 2.1 | 2.5 | 3.7 |
| -20/0    | 1.7                                       | 1.7   | 1.9 | 2.1 | 2.5 | 3.0 | 4.2 |
| 0/+20    | 2.0                                       | 2.1   | 2.2 | 2.4 | 2.9 | 3.3 | 4.7 |
| +20/+40  | 2.3                                       | 2.3   | 2.5 | 2.7 | 3.2 | 3.7 | 5.1 |
| +40/+60  | 2.5                                       | 2.6   | 2.7 | 3.0 | 3.5 | 4.0 | 5.4 |
| +60/+80  | 2.7                                       | 2.8   | 3.0 | 3.2 | 3.7 | 4.2 | 5.8 |
| +80/+100 | 2.9                                       | 3.0   | 3.1 | 3.4 | 3.9 | 4.5 | 6.1 |

## Dispersion constants

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.6958930                  |
| $A_1$ | $-9.9470683 \cdot 10^{-3}$ |
| $A_2$ | $1.8836128 \cdot 10^{-2}$  |
| $A_3$ | $4.1680841 \cdot 10^{-4}$  |
| $A_4$ | $-7.1485021 \cdot 10^{-6}$ |
| $A_5$ | $1.1104193 \cdot 10^{-6}$  |

### Relative partial dispersions

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.7767 |
| $P_{C,A'}$  | 0.3372 |
| $P_{d,C}$   | 0.3007 |
| $P_{e,C}$   | 0.5388 |
| $P_{g,d}$   | 1.2544 |
| $P_{g,F}$   | 0.5549 |
| $P_{h,g}$   | 0.4659 |
| $P_{i,g}$   | 1.2718 |
| $P'_{C,t}$  | 0.8159 |
| $P'_{e,C'}$ | 0.4862 |
| $P'_{F,e}$  | 0.5138 |
| $P'_{i,F'}$ | 1.7508 |

### Deviation of relative partial dispersions from normal line

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0101 |
| $\Delta P_{C,A'}$ | -0.0012 |
| $\Delta P_{g,d}$  | -0.0035 |
| $\Delta P_{g,F}$  | -0.0036 |
| $\Delta P_{i,q}$  | -0.0258 |

## Remarks

[illegible]

### Internal transmittance

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.960        | 0.921         | 0.815         |
| 1970.1         | 0.986        | 0.972         | 0.932         |
| 1800.0         | 0.992        | 0.984         | 0.960         |
| 1600.0         | 0.996        | 0.992         | 0.981         |
| 1529.6         | 0.997        | 0.993         | 0.984         |
| 1200.0         | 0.999        | 0.998         | 0.994         |
| 1060.0         | 0.999        | 0.997         | 0.993         |
| 800.0          | 0.998        | 0.995         | 0.989         |
| 700.0          | 0.998        | 0.996         | 0.989         |
| 660.0          | 0.997        | 0.993         | 0.984         |
| 640.0          | 0.996        | 0.993         | 0.983         |
| 620.0          | 0.997        | 0.993         | 0.983         |
| 600.0          | 0.997        | 0.994         | 0.984         |
| 580.0          | 0.997        | 0.995         | 0.987         |
| 546.1          | 0.997        | 0.995         | 0.987         |
| 500.0          | 0.995        | 0.990         | 0.976         |
| 480.0          | 0.993        | 0.987         | 0.968         |
| 460.0          | 0.990        | 0.981         | 0.953         |
| 440.0          | 0.986        | 0.973         | 0.934         |
| 435.8          | 0.985        | 0.971         | 0.928         |
| 420.0          | 0.983        | 0.967         | 0.919         |
| 404.7          | 0.980        | 0.960         | 0.904         |
| 400.0          | 0.978        | 0.956         | 0.893         |
| 390.0          | 0.967        | 0.935         | 0.844         |
| 380.0          | 0.943        | 0.889         | 0.744         |
| 370.0          | 0.898        | 0.807         | 0.584         |
| 365.0          | 0.862        | 0.743         | 0.476         |
| 360.0          | 0.813        | 0.662         | 0.356         |
| 350.0          | 0.671        | 0.450         | 0.136         |
| 340.0          | 0.578        | 0.334         | 0.065         |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

**Colour code**

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 38/33 |
|----------------------------|-------|

## Chemical properties

|                      |      |
|----------------------|------|
| Acid resistance      | 52.2 |
| Alkali resistance    | 1.2  |
| Climatic resistance  | 1    |
| Phosphate resistance | 2.1  |

## Mechanical properties

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 569  |
| Abrasion hardness ( $F_A$ )                                   | 150  |
| Young's modulus ( $E$ ) [GPa]                                 | 86.0 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 36.8 |
| Poisson ratio ( $\mu$ )                                       | 0.17 |
| Stress optical coefficient                                    | 2.18 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 3.56 |

## Thermal properties

|  |            |      |
|--|------------|------|
| Strain point (T10 <sup>14.5</sup> ) [°C]                                       | 605        |      |
| Annealing point (T10 <sup>13.0</sup> ) [°C]                                    | 642        |      |
| Yield point (A <sub>y</sub> ) [°C]   | 703        |      |
| Transformation temperature (T <sub>g</sub> ) [°C]                              | 662        |      |
| Softening point (T10 <sup>7.65</sup> ) [°C]                                    | 784        |      |
| Annealing factor (F) for n <sub>d</sub>  | 10.7       |      |
| Co-efficient of thermal expansion (α) [10 <sup>-6</sup> K <sup>-1</sup> ]      | -30/+70°C  | 7.03 |
|  | +20/+300°C | 8.04 |
| Specific heat capacity (c <sub>p</sub> ) [J·g <sup>-1</sup> ·K <sup>-1</sup> ] | 0.763      |      |
| Thermal conductivity (λ) [W·m <sup>-1</sup> ·K <sup>-1</sup> ]                 | 0.315      |      |

## LLF2

Issue number 1001-01

ECO

|                   |          |
|-------------------|----------|
| $n_d$             | 1.54072  |
| $n_F - n_C$       | 0.011464 |
| $v_d$             | 47.17    |
| $n_e$             | 1.54344  |
| $v_e$             | 46.88    |
| $n_{F'} - n_{C'}$ | 0.011593 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.51195 |
| $n_{1970.1}$ | 1970.1         | 1.51668 |
| $n_{1529.6}$ | 1529.6         | 1.52192 |
| $n_{1060.0}$ | 1060.0         | 1.52773 |
| $n_t$        | 1014.0         | 1.52843 |
| $n_s$        | 852.1          | 1.53139 |
| $n_{A'}$     | 768.2          | 1.53345 |
| $n_r$        | 706.5          | 1.53536 |
| $n_C$        | 656.3          | 1.53729 |
| $n_{C'}$     | 643.9          | 1.53783 |
| $n_{632.8}$  | 632.8          | 1.53834 |
| $n_D$        | 589.3          | 1.54062 |
| $n_d$        | 587.6          | 1.54072 |
| $n_e$        | 546.1          | 1.54344 |
| $n_F$        | 486.1          | 1.54875 |
| $n_{F'}$     | 480.0          | 1.54942 |
| $n_g$        | 435.8          | 1.55521 |
| $n_h$        | 404.7          | 1.56069 |
| $n_i$        | 365.0          | 1.57034 |
| $n_{334.1}$  | 334.1          | 1.58127 |
| $n_{312.6}$  | 312.6          | 1.59181 |
| $n_{296.7}$  | 296.7          | 1.60202 |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |     |     |      |
|----------|---|-------|-----|-----|-----|-----|------|
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i    |
| -40/-20  | 3.7   | 3.7   | 4.0 | 4.4 | 5.2 | 6.1 | 9.0  |
| -20/0    | 3.9   | 3.9   | 4.2 | 4.6 | 5.4 | 6.4 | 9.4  |
| 0/+20    | 4.0   | 4.1   | 4.4 | 4.8 | 5.7 | 6.6 | 9.8  |
| +20/+40  | 4.2   | 4.3   | 4.6 | 5.0 | 5.9 | 6.9 | 10.2 |
| +40/+60  | 4.4   | 4.5   | 4.8 | 5.2 | 6.2 | 7.2 | 10.6 |
| +60/+80  | 4.6   | 4.7   | 5.0 | 5.4 | 6.4 | 7.5 | 11.0 |
| +80/+100 | 4.8   | 4.9   | 5.2 | 5.6 | 6.6 | 7.8 | 11.4 |
|          | dn/dT absolute [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |     |     |      |
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i    |
| -40/-20  | 1.6   | 1.6   | 1.9 | 2.3 | 3.1 | 3.9 | 6.8  |
| -20/0    | 2.1   | 2.1   | 2.4 | 2.8 | 3.6 | 4.5 | 7.5  |
| 0/+20    | 2.5   | 2.6   | 2.9 | 3.2 | 4.1 | 5.1 | 8.2  |
| +20/+40  | 2.9   | 3.0   | 3.3 | 3.7 | 4.6 | 5.5 | 8.8  |
| +40/+60  | 3.2   | 3.3   | 3.6 | 4.0 | 5.0 | 6.0 | 9.4  |
| +60/+80  | 3.6   | 3.6   | 3.9 | 4.4 | 5.3 | 6.4 | 9.9  |
| +80/+100 | 3.9   | 3.9   | 4.3 | 4.7 | 5.7 | 6.8 | 10.4 |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.3300496                  |
| $A_1$ | $-8.6626799 \cdot 10^{-3}$ |
| $A_2$ | $1.4963095 \cdot 10^{-2}$  |
| $A_3$ | $4.2043820 \cdot 10^{-4}$  |
| $A_4$ | $-9.6401866 \cdot 10^{-6}$ |
| $A_5$ | $1.6268434 \cdot 10^{-6}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.7730 |
| $P_{C,A'}$  | 0.3348 |
| $P_{d,C}$   | 0.2992 |
| $P_{e,C}$   | 0.5369 |
| $P_{g,d}$   | 1.2640 |
| $P_{g,F}$   | 0.5629 |
| $P_{h,g}$   | 0.4783 |
| $P_{i,g}$   | 1.3200 |
| $P'_{C,t}$  | 0.8112 |
| $P'_{e,C'}$ | 0.4842 |
| $P'_{F',e}$ | 0.5158 |
| $P'_{i,F'}$ | 1.8043 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | 0.0038  |
| $\Delta P_{C,A'}$ | 0.0009  |
| $\Delta P_{g,d}$  | -0.0020 |
| $\Delta P_{g,F}$  | -0.0019 |
| $\Delta P_{j,n}$  | -0.0090 |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.918        | 0.842         | 0.650         |
| 1970.1         | 0.964        | 0.930         | 0.833         |
| 1800.0         | 0.983        | 0.967         | 0.920         |
| 1600.0         | 0.996        | 0.992         | 0.981         |
| 1529.6         | 0.998        | 0.995         | 0.988         |
| 1200.0         | 0.999        | 0.999         | 0.997         |
| 1060.0         | 0.999        | 0.999         | 0.997         |
| 800.0          | 0.999        | 0.999         | 0.996         |
| 700.0          | 0.999        | 0.998         | 0.995         |
| 660.0          | 0.999        | 0.997         | 0.993         |
| 640.0          | 0.999        | 0.997         | 0.993         |
| 620.0          | 0.999        | 0.997         | 0.993         |
| 600.0          | 0.999        | 0.998         | 0.994         |
| 580.0          | 0.999        | 0.998         | 0.995         |
| 546.1          | 0.999        | 0.998         | 0.995         |
| 500.0          | 0.999        | 0.998         | 0.994         |
| 480.0          | 0.999        | 0.997         | 0.993         |
| 460.0          | 0.998        | 0.997         | 0.992         |
| 440.0          | 0.998        | 0.996         | 0.991         |
| 435.8          | 0.998        | 0.996         | 0.991         |
| 420.0          | 0.999        | 0.997         | 0.993         |
| 404.7          | 0.999        | 0.998         | 0.995         |
| 400.0          | 0.999        | 0.998         | 0.995         |
| 390.0          | 0.998        | 0.997         | 0.992         |
| 380.0          | 0.997        | 0.994         | 0.985         |
| 370.0          | 0.997        | 0.994         | 0.985         |
| 365.0          | 0.997        | 0.993         | 0.983         |
| 360.0          | 0.995        | 0.991         | 0.977         |
| 350.0          | 0.992        | 0.984         | 0.960         |
| 340.0          | 0.980        | 0.961         | 0.905         |
| 334.1          | 0.966        | 0.932         | 0.839         |
| 330.0          | 0.949        | 0.901         | 0.770         |
| 320.0          | 0.862        | 0.743         | 0.477         |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 34/31 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 1.0 |
| Alkali resistance    | 1.0 |
| Climatic resistance  | 1   |
| Phosphate resistance | 1.0 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 411  |
| Abrasion hardness ( $F_A$ )                                   | 130  |
| Young's modulus ( $E$ ) [GPa]                                 | 60.3 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 26.5 |
| Poisson ratio ( $\mu$ )                                       | 0.14 |
| Stress optical coefficient                                    | 3.03 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 3.23 |

|   |                             |      |
|---|-----------------------------|------|
| Strain point ( $T_{10}^{14.5}$ ) [ $^{\circ}\text{C}$ ]                               | 389                         |      |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            | 428                         |      |
| Yield point ( $A_f$ ) [ $^{\circ}\text{C}$ ]  | 492                         |      |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           | 427                         |      |
| Softening point ( $T_{10}^{7.65}$ ) [ $^{\circ}\text{C}$ ]                            | 626                         |      |
| Annealing factor (F) for $n_d$  | 4.6                         |      |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 8.10 |
|   | +20/+300 $^{\circ}\text{C}$ | 9.08 |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   | 0.828                       |      |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] | 0.190                       |      |

## LF5

Issue number 1001-01

ECO

|                   |          |
|-------------------|----------|
| $n_d$             | 1.58144  |
| $n_F - n_C$       | 0.014233 |
| $v_d$             | 40.85    |
| $n_e$             | 1.58482  |
| $v_e$             | 40.60    |
| $n_{F'} - n_{C'}$ | 0.014405 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.54967 |
| $n_{1970.1}$ | 1970.1         | 1.55436 |
| $n_{1529.6}$ | 1529.6         | 1.55967 |
| $n_{1060.0}$ | 1060.0         | 1.56591 |
| $n_i$        | 1014.0         | 1.56670 |
| $n_s$        | 852.1          | 1.57013 |
| $n_{A'}$     | 768.2          | 1.57258 |
| $n_r$        | 706.5          | 1.57489 |
| $n_C$        | 656.3          | 1.57723 |
| $n_{C'}$     | 643.9          | 1.57789 |
| $n_{632.8}$  | 632.8          | 1.57852 |
| $n_D$        | 589.3          | 1.58132 |
| $n_d$        | 587.6          | 1.58144 |
| $n_e$        | 546.1          | 1.58482 |
| $n_F$        | 486.1          | 1.59146 |
| $n_{F'}$     | 480.0          | 1.59230 |
| $n_g$        | 435.8          | 1.59961 |
| $n_h$        | 404.7          | 1.60663 |
| $n_i$        | 365.0          | 1.61916 |
| $n_{334.1}$  | 334.1          | 1.63372 |
| $n_{312.6}$  | 312.6          | 1.64812 |
| $n_{296.7}$  | 296.7          | 1.66242 |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [ $10^{-6} \cdot K^{-1}$ ] |       |     |     |     |     |     |
|----------|---|-------|-----|-----|-----|-----|-----|
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 2.2                                       | 2.2   | 2.5 | 2.7 | 3.3 | 4.0 | 6.0 |
| -20/0    | 2.3                                       | 2.3   | 2.6 | 2.8 | 3.5 | 4.1 | 6.3 |
| 0/+20    | 2.4                                       | 2.5   | 2.7 | 3.0 | 3.6 | 4.3 | 6.5 |
| +20/+40  | 2.5                                       | 2.6   | 2.8 | 3.1 | 3.7 | 4.5 | 6.8 |
| +40/+60  | 2.6                                       | 2.7   | 2.9 | 3.2 | 3.9 | 4.6 | 7.0 |
| +60/+80  | 2.7                                       | 2.8   | 3.0 | 3.3 | 4.0 | 4.8 | 7.3 |
| +80/+100 | 2.8                                       | 2.9   | 3.0 | 3.4 | 4.2 | 5.0 | 7.5 |
|          | dn/dT absolute [ $10^{-6} \cdot K^{-1}$ ] |       |     |     |     |     |     |
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i   |
| -40/-20  | 0.1                                       | 0.1   | 0.4 | 0.6 | 1.1 | 1.8 | 3.8 |
| -20/0    | 0.5                                       | 0.5   | 0.8 | 1.0 | 1.6 | 2.3 | 4.4 |
| 0/+20    | 0.8                                       | 0.9   | 1.1 | 1.4 | 2.0 | 2.7 | 4.9 |
| +20/+40  | 1.1                                       | 1.2   | 1.4 | 1.7 | 2.3 | 3.1 | 5.3 |
| +40/+60  | 1.4                                       | 1.4   | 1.7 | 2.0 | 2.7 | 3.4 | 5.8 |
| +60/+80  | 1.6                                       | 1.7   | 1.9 | 2.2 | 2.9 | 3.7 | 6.2 |
| +80/+100 | 1.9                                       | 1.9   | 2.1 | 2.5 | 3.2 | 4.0 | 6.5 |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.4446277                  |
| $A_1$ | $-8.6229853 \cdot 10^{-3}$ |
| $A_2$ | $1.8709250 \cdot 10^{-2}$  |
| $A_3$ | $6.4451439 \cdot 10^{-4}$  |
| $A_4$ | $-2.1589941 \cdot 10^{-5}$ |
| $A_5$ | $3.3466868 \cdot 10^{-6}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.7398 |
| $P_{C,A'}$  | 0.3265 |
| $P_{d,C}$   | 0.2961 |
| $P_{e,C}$   | 0.5333 |
| $P_{g,d}$   | 1.2766 |
| $P_{g,F}$   | 0.5731 |
| $P_{h,g}$   | 0.4926 |
| $P_{i,g}$   | 1.3736 |
| $P'_{C',t}$ | 0.7770 |
| $P'_{e,C'}$ | 0.4809 |
| $P'_{F',e}$ | 0.5191 |
| $P'_{i,F'}$ | 1.8651 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | 0.0006  |
| $\Delta P_{C,A'}$ | 0.0003  |
| $\Delta P_{g,d}$  | -0.0029 |
| $\Delta P_{g,F}$  | -0.0024 |
| $\Delta P_{i,q}$  | -0.0086 |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.939        | 0.882         | 0.730         |
| 1970.1         | 0.973        | 0.947         | 0.873         |
| 1800.0         | 0.987        | 0.974         | 0.937         |
| 1600.0         | 0.997        | 0.994         | 0.985         |
| 1529.6         | 0.998        | 0.996         | 0.991         |
| 1200.0         | 0.999        | 0.999         | 0.998         |
| 1060.0         | 0.999        | 0.999         | 0.998         |
| 800.0          | 0.999        | 0.999         | 0.998         |
| 700.0          | 0.999        | 0.999         | 0.997         |
| 660.0          | 0.999        | 0.998         | 0.996         |
| 640.0          | 0.999        | 0.998         | 0.996         |
| 620.0          | 0.999        | 0.999         | 0.997         |
| 600.0          | 0.999        | 0.999         | 0.997         |
| 580.0          | 0.999        | 0.999         | 0.997         |
| 546.1          | 0.999        | 0.999         | 0.998         |
| 500.0          | 0.999        | 0.999         | 0.996         |
| 480.0          | 0.999        | 0.998         | 0.995         |
| 460.0          | 0.999        | 0.998         | 0.995         |
| 440.0          | 0.999        | 0.997         | 0.993         |
| 435.8          | 0.998        | 0.997         | 0.992         |
| 420.0          | 0.999        | 0.997         | 0.993         |
| 404.7          | 0.999        | 0.997         | 0.993         |
| 400.0          | 0.999        | 0.997         | 0.993         |
| 390.0          | 0.997        | 0.995         | 0.987         |
| 380.0          | 0.995        | 0.991         | 0.977         |
| 370.0          | 0.994        | 0.988         | 0.971         |
| 365.0          | 0.993        | 0.985         | 0.964         |
| 360.0          | 0.990        | 0.980         | 0.951         |
| 350.0          | 0.979        | 0.959         | 0.900         |
| 340.0          | 0.949        | 0.901         | 0.770         |
| 334.1          | 0.909        | 0.827         | 0.622         |
| 330.0          | 0.868        | 0.754         | 0.493         |
| 320.0          | 0.819        | 0.671         | 0.368         |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 34/31 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 2.0 |
| Alkali resistance    | 1.0 |
| Climatic resistance  | 1   |
| Phosphate resistance | 2.0 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 421  |
| Abrasion hardness ( $F_A$ )                                   | 140  |
| Young's modulus ( $E$ ) [GPa]                                 | 59.1 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 25.1 |
| Poisson ratio ( $\mu$ )                                       | 0.18 |
| Stress optical coefficient                                    | 2.85 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 2.87 |

|   |                             |       |
|---|-----------------------------|-------|
| Strain point ( $T_{10}^{14.5}$ ) [ $^{\circ}\text{C}$ ]                               | 377                         |       |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            | 412                         |       |
| Yield point ( $A_f$ ) [ $^{\circ}\text{C}$ ]  | 475                         |       |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           | 417                         |       |
| Softening point ( $T_{10}^{7.65}$ ) [ $^{\circ}\text{C}$ ]                            | 583                         |       |
| Annealing factor (F) for $n_d$  | 4.2                         |       |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 8.89  |
|   | +20/+300 $^{\circ}\text{C}$ | 10.08 |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   | 0.779                       |       |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] | 0.427                       |       |



## F2

Issue number 1001-01

ECO

—

 $n_d$  1.62004
$$n_E - n_G = 0.017050$$
$$V_d = 36.37$$
 $n_e$  1.62408
$$v_e = 36.12$$
$$n_{F'} - n_{G'} = 0.017280$$
 $\lambda$  [nm]

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.58518 |
| $n_{1970.1}$ | 1970.1         | 1.58985 |
| $n_{1529.6}$ | 1529.6         | 1.59525 |
| $n_{1060.0}$ | 1060.0         | 1.60196 |
| $n_t$        | 1014.0         | 1.60283 |
| $n_s$        | 852.1          | 1.60674 |
| $n_{A'}$     | 768.2          | 1.60958 |
| $n_r$        | 706.5          | 1.61227 |
| $n_C$        | 656.3          | 1.61504 |
| $n_{C'}$     | 643.9          | 1.61582 |
| $n_{632.8}$  | 632.8          | 1.61656 |
| $n_D$        | 589.3          | 1.61989 |
| $n_d$        | 587.6          | 1.62004 |
| $n_e$        | 546.1          | 1.62408 |
| $n_F$        | 486.1          | 1.63208 |
| $n_{F'}$     | 480.0          | 1.63310 |
| $n_g$        | 435.8          | 1.64202 |
| $n_h$        | 404.7          | 1.65065 |
| $n_i$        | 365.0          | 1.66628 |
| $n_{334.1}$  | 334.1          | 1.68474 |
| $n_{312.6}$  | 312.6          | 1.70330 |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

 $\text{dn/dT relative } [10^{-6} \cdot \text{K}^{-1}]$ 

|          | dn/dT relative [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |      |     |     |     |     |
|----------|---|-------|------|-----|-----|-----|-----|
| °C       | C'  | 632.8 | D    | e   | F'  | g   | i   |
| -40/-20  | 2.0   | 2.0   | 2.1  | 2.3 | 2.7 | 3.2 | 4.6 |
| -20/0    | 2.0   | 2.1   | 2.2  | 2.4 | 2.9 | 3.3 | 4.8 |
| 0/+20    | 2.1   | 2.2   | 2.3  | 2.5 | 3.0 | 3.5 | 4.9 |
| +20/+40  | 2.2   | 2.2   | 2.4  | 2.6 | 3.1 | 3.6 | 5.1 |
| +40/+60  | 2.3   | 2.3   | 2.5  | 2.7 | 3.2 | 3.7 | 5.3 |
| +60/+80  | 2.4   | 2.4   | 2.6  | 2.8 | 3.3 | 3.8 | 5.5 |
| +80/+100 | 2.4   | 2.5   | 2.7  | 2.9 | 3.4 | 4.0 | 5.7 |
|          | dn/dT absolute [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |      |     |     |     |     |
| °C       | C'  | 632.8 | D    | e   | F'  | g   | i   |
| -40/-20  | -0.2  | -0.2  | -0.1 | 0.1 | 0.5 | 0.9 | 2.3 |
| -20/0    | 0.2   | 0.2   | 0.3  | 0.5 | 1.0 | 1.4 | 2.8 |
| 0/+20    | 0.5   | 0.5   | 0.7  | 0.9 | 1.3 | 1.8 | 3.2 |
| +20/+40  | 0.8   | 0.8   | 1.0  | 1.2 | 1.7 | 2.1 | 3.6 |
| +40/+60  | 1.1   | 1.1   | 1.2  | 1.5 | 1.9 | 2.4 | 4.0 |
| +60/+80  | 1.3   | 1.3   | 1.5  | 1.7 | 2.2 | 2.7 | 4.3 |
| +80/+100 | 1.5   | 1.5   | 1.7  | 1.9 | 2.4 | 3.0 | 4.6 |

|       |            |
|-------|------------|
| $A_0$ | 2.5552054  |
| $A_1$ | -8.6205092 |
| $A_2$ | 2.2547765  |
| $A_3$ | 8.7146250  |
| $A_4$ | -2.7370738 |
| $A_5$ | 4.9410668  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.7157 |
| $P_{C,A'}$  | 0.3202 |
| $P_{d,C}$   | 0.2936 |
| $P_{e,C}$   | 0.5305 |
| $P_{g,d}$   | 1.2889 |
| $P_{g,F}$   | 0.5827 |
| $P_{h,g}$   | 0.5060 |
| $P_{i,g}$   | 1.4229 |
| $P'_{C',t}$ | 0.7516 |
| $P'_{e,C'}$ | 0.4781 |
| $P'_{F',e}$ | 0.5219 |
| $P'_{i,F'}$ | 1.9198 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,i}$  | -0.0022 |
| $\Delta P_{C,A'}$ | -0.0006 |
| $\Delta P_{g,d}$  | -0.0003 |
| $\Delta P_{g,F}$  | -0.0003 |
| $\Delta P_{i,g}$  | 0.0029  |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.944        | 0.890         | 0.748         |
| 1970.1         | 0.976        | 0.953         | 0.886         |
| 1800.0         | 0.987        | 0.974         | 0.936         |
| 1600.0         | 0.997        | 0.994         | 0.985         |
| 1529.6         | 0.998        | 0.996         | 0.991         |
| 1200.0         | 0.999        | 0.999         | 0.999         |
| 1060.0         | 0.999        | 0.999         | 0.999         |
| 800.0          | 0.999        | 0.999         | 0.999         |
| 700.0          | 0.999        | 0.999         | 0.997         |
| 660.0          | 0.999        | 0.998         | 0.994         |
| 640.0          | 0.999        | 0.998         | 0.994         |
| 620.0          | 0.999        | 0.998         | 0.995         |
| 600.0          | 0.999        | 0.998         | 0.996         |
| 580.0          | 0.999        | 0.999         | 0.996         |
| 546.1          | 0.999        | 0.998         | 0.996         |
| 500.0          | 0.999        | 0.997         | 0.994         |
| 480.0          | 0.998        | 0.997         | 0.992         |
| 460.0          | 0.998        | 0.996         | 0.990         |
| 440.0          | 0.997        | 0.995         | 0.986         |
| 435.8          | 0.997        | 0.995         | 0.986         |
| 420.0          | 0.997        | 0.994         | 0.984         |
| 404.7          | 0.996        | 0.991         | 0.978         |
| 400.0          | 0.995        | 0.990         | 0.976         |
| 390.0          | 0.992        | 0.984         | 0.961         |
| 380.0          | 0.987        | 0.973         | 0.934         |
| 370.0          | 0.980        | 0.961         | 0.905         |
| 365.0          | 0.974        | 0.949         | 0.877         |
| 360.0          | 0.965        | 0.931         | 0.837         |
| 350.0          | 0.930        | 0.865         | 0.695         |
| 340.0          | 0.841        | 0.707         | 0.420         |
| 334.1          | 0.761        | 0.580         | 0.256         |
| 330.0          | 0.754        | 0.568         | 0.243         |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 36/32 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 1.2 |
| Alkali resistance    | 1.0 |
| Climatic resistance  | 1   |
| Phosphate resistance | 2.1 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 417  |
| Abrasion hardness ( $F_A$ )                                   | 145  |
| Young's modulus (E) [GPa]                                     | 57.7 |
| Modulus of rigidity (G) [GPa]                                 | 24.3 |
| Poisson ratio ( $\mu$ )                                       | 0.19 |
| Stress optical coefficient                                    | 2.77 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 3.61 |

|  |            |       |
|--|------------|-------|
| Strain point (T10 <sup>14.5</sup> ) [°C]                                       |            | 384   |
| Annealing point (T10 <sup>13.0</sup> ) [°C]                                    |            | 419   |
| Yield point (A <sub>1</sub> ) [°C]   |            | 478   |
| Transformation temperature (T <sub>9</sub> ) [°C]                              |            | 432   |
| Softening point (T10 <sup>7.65</sup> ) [°C]                                    |            | 580   |
| Annealing factor (F) for n <sub>d</sub>  |            | 4.5   |
| Co-efficient of thermal expansion (α) [10 <sup>-6</sup> K <sup>-1</sup> ]      | -30/+70°C  | 8.49  |
|  | +20/+300°C | 9.37  |
| Specific heat capacity (c <sub>p</sub> ) [J·g <sup>-1</sup> ·K <sup>-1</sup> ] |            | 0.746 |
| Thermal conductivity (λ) [W·m <sup>-1</sup> ·K <sup>-1</sup> ]                 |            | 0.312 |



## SF2

Issue number 1001-01

ECO

|               |          |
|---------------|----------|
| $n_d$         | 1.64769  |
| $n_F - n_C$   | 0.019135 |
| $v_d$         | 33.85    |
| $n_e$         | 1.65222  |
| $v_e$         | 33.59    |
| $n_F' - n_C'$ | 0.019415 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.61025 |
| $n_{1970.1}$ | 1970.1         | 1.61497 |
| $n_{1529.6}$ | 1529.6         | 1.62052 |
| $n_{1060.0}$ | 1060.0         | 1.62764 |
| $n_t$        | 1014.0         | 1.62860 |
| $n_s$        | 852.1          | 1.63288 |
| $n_{A'}$     | 768.2          | 1.63602 |
| $n_r$        | 706.5          | 1.63902 |
| $n_C$        | 656.3          | 1.64209 |
| $n_{C'}$     | 643.9          | 1.64297 |
| $n_{632.8}$  | 632.8          | 1.64379 |
| $n_D$        | 589.3          | 1.64752 |
| $n_d$        | 587.6          | 1.64769 |
| $n_e$        | 546.1          | 1.65222 |
| $n_F$        | 486.1          | 1.66123 |
| $n_{F'}$     | 480.0          | 1.66238 |
| $n_g$        | 435.8          | 1.67250 |
| $n_h$        | 404.7          | 1.68234 |
| $n_i$        | 365.0          | 1.70030 |
| $n_{334.1}$  | 334.1          | 1.72162 |
| $n_{312.6}$  | 312.6          |         |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |     |     |      |
|----------|---|-------|-----|-----|-----|-----|------|
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i    |
| -40/-20  | 3.2   | 3.2   | 3.6 | 4.0 | 5.0 | 6.1 | 9.8  |
| -20/0    | 3.4   | 3.5   | 3.8 | 4.2 | 5.3 | 6.4 | 10.3 |
| 0/+20    | 3.6   | 3.7   | 4.1 | 4.5 | 5.6 | 6.7 | 10.8 |
| +20/+40  | 3.9   | 4.0   | 4.3 | 4.8 | 5.9 | 7.1 | 11.3 |
| +40/+60  | 4.1   | 4.2   | 4.6 | 5.0 | 6.2 | 7.4 | 11.8 |
| +60/+80  | 4.4   | 4.4   | 4.8 | 5.3 | 6.5 | 7.8 | 12.3 |
| +80/+100 | 4.6   | 4.7   | 5.1 | 5.6 | 6.8 | 8.1 | 12.8 |
|          | dn/dT absolute [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |     |     |      |
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i    |
| -40/-20  | 1.0   | 1.0   | 1.3 | 1.7 | 2.7 | 3.8 | 7.5  |
| -20/0    | 1.5   | 1.6   | 1.9 | 2.3 | 3.3 | 4.4 | 8.3  |
| 0/+20    | 2.0   | 2.1   | 2.4 | 2.9 | 3.9 | 5.1 | 9.1  |
| +20/+40  | 2.5   | 2.5   | 2.9 | 3.3 | 4.4 | 5.6 | 9.8  |
| +40/+60  | 2.9   | 2.9   | 3.3 | 3.8 | 4.9 | 6.1 | 10.4 |
| +60/+80  | 3.2   | 3.3   | 3.7 | 4.2 | 5.3 | 6.6 | 11.1 |
| +80/+100 | 3.6   | 3.7   | 4.1 | 4.6 | 5.8 | 7.1 | 11.7 |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.6352620                  |
| $A_1$ | $-8.7267314 \cdot 10^{-3}$ |
| $A_2$ | $2.5926090 \cdot 10^{-2}$  |
| $A_3$ | $8.6656026 \cdot 10^{-4}$  |
| $A_4$ | $-3.0238726 \cdot 10^{-6}$ |
| $A_5$ | $4.6661020 \cdot 10^{-6}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.7053 |
| $P_{C,A'}$  | 0.3174 |
| $P_{d,C}$   | 0.2924 |
| $P_{e,C}$   | 0.5292 |
| $P_{g,d}$   | 1.2966 |
| $P_{g,F}$   | 0.5888 |
| $P_{h,g}$   | 0.5146 |
| $P_{i,g}$   | 1.4530 |
| $P'_{C,t}$  | 0.7403 |
| $P'_{e,C'}$ | 0.4765 |
| $P'_{F',e}$ | 0.5235 |
| $P'_{i,F'}$ | 1.9530 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0006 |
| $\Delta P_{C,A'}$ | -0.0004 |
| $\Delta P_{g,d}$  | 0.0020  |
| $\Delta P_{g,F}$  | 0.0015  |
| $\Delta P_{j,n}$  | 0.0118  |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.949        | 0.901         | 0.772         |
| 1970.1         | 0.978        | 0.956         | 0.893         |
| 1800.0         | 0.986        | 0.973         | 0.933         |
| 1600.0         | 0.997        | 0.994         | 0.984         |
| 1529.6         | 0.998        | 0.996         | 0.991         |
| 1200.0         | 0.999        | 0.999         | 0.999         |
| 1060.0         | 0.999        | 0.999         | 0.999         |
| 800.0          | 0.999        | 0.999         | 0.999         |
| 700.0          | 0.999        | 0.999         | 0.997         |
| 660.0          | 0.999        | 0.998         | 0.994         |
| 640.0          | 0.999        | 0.998         | 0.994         |
| 620.0          | 0.999        | 0.998         | 0.995         |
| 600.0          | 0.999        | 0.998         | 0.995         |
| 580.0          | 0.999        | 0.998         | 0.996         |
| 546.1          | 0.999        | 0.998         | 0.995         |
| 500.0          | 0.998        | 0.997         | 0.992         |
| 480.0          | 0.998        | 0.996         | 0.990         |
| 460.0          | 0.997        | 0.994         | 0.986         |
| 440.0          | 0.996        | 0.992         | 0.981         |
| 435.8          | 0.996        | 0.992         | 0.980         |
| 420.0          | 0.994        | 0.989         | 0.972         |
| 404.7          | 0.991        | 0.983         | 0.957         |
| 400.0          | 0.990        | 0.980         | 0.950         |
| 390.0          | 0.984        | 0.969         | 0.923         |
| 380.0          | 0.975        | 0.950         | 0.880         |
| 370.0          | 0.959        | 0.919         | 0.809         |
| 365.0          | 0.943        | 0.890         | 0.747         |
| 360.0          | 0.919        | 0.844         | 0.654         |
| 350.0          | 0.816        | 0.666         | 0.362         |
| 340.0          | 0.694        | 0.481         | 0.160         |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 37/33 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 2.2 |
| Alkali resistance    | 1.0 |
| Climatic resistance  | 1   |
| Phosphate resistance | 2.0 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 376  |
| Abrasion hardness ( $F_A$ )                                   | 155  |
| Young's modulus ( $E$ ) [GPa]                                 | 54.6 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 22.1 |
| Poisson ratio ( $\mu$ )                                       | 0.23 |
| Stress optical coefficient                                    | 2.59 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 3.86 |

|   |                             |      |
|---|-----------------------------|------|
| Strain point ( $T_{10}^{14.5}$ ) [ $^{\circ}\text{C}$ ]                               | 406                         |      |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            | 445                         |      |
| Yield point ( $A_f$ ) [ $^{\circ}\text{C}$ ]  | 502                         |      |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           | 454                         |      |
| Softening point ( $T_{10}^{7.65}$ ) [ $^{\circ}\text{C}$ ]                            | 608                         |      |
| Annealing factor (F) for $n_d$  | 5.9                         |      |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 8.44 |
|   | +20/+300 $^{\circ}\text{C}$ | 8.88 |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   | 0.612                       |      |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] | 0.307                       |      |

## SF5

Issue number 1001-01

ECO

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|                   |          |
|-------------------|----------|
| $n_d$             | 1.67270  |
| $n_F - n_C$       | 0.020884 |
| $v_d$             | 32.21    |
| $n_e$             | 1.67765  |
| $v_e$             | 31.95    |
| $n_{F'} - n_{C'}$ | 0.021209 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.63291 |
| $n_{1970.1}$ | 1970.1         | 1.63812 |
| $n_{1529.6}$ | 1529.6         | 1.64411 |
| $n_{1060.0}$ | 1060.0         | 1.65149 |
| $n_t$        | 1014.0         | 1.65247 |
| $n_s$        | 852.1          | 1.65688 |
| $n_{A'}$     | 768.2          | 1.66017 |
| $n_r$        | 706.5          | 1.66335 |
| $n_C$        | 656.3          | 1.66664 |
| $n_{C'}$     | 643.9          | 1.66759 |
| $n_{632.8}$  | 632.8          | 1.66848 |
| $n_D$        | 589.3          | 1.67252 |
| $n_d$        | 587.6          | 1.67270 |
| $n_e$        | 546.1          | 1.67765 |
| $n_F$        | 486.1          | 1.68753 |
| $n_{F'}$     | 480.0          | 1.68879 |
| $n_g$        | 435.8          | 1.69990 |
| $n_h$        | 404.7          | 1.71074 |
| $n_i$        | 365.0          | 1.73087 |
| $n_{334.1}$  | 334.1          | 1.75594 |
| $n_{312.6}$  | 312.6          |         |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |     |     |      |
|----------|---|-------|-----|-----|-----|-----|------|
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i    |
| -40/-20  | 3.5   | 3.6   | 4.0 | 4.4 | 5.6 | 6.8 | 11.2 |
| -20/0    | 3.7   | 3.8   | 4.2 | 4.7 | 5.8 | 7.1 | 11.7 |
| 0/+20    | 3.9   | 4.0   | 4.4 | 4.9 | 6.1 | 7.5 | 12.2 |
| +20/+40  | 4.1   | 4.2   | 4.6 | 5.1 | 6.4 | 7.8 | 12.7 |
| +40/+60  | 4.3   | 4.4   | 4.8 | 5.4 | 6.7 | 8.1 | 13.2 |
| +60/+80  | 4.5   | 4.6   | 5.1 | 5.6 | 6.9 | 8.4 | 13.7 |
| +80/+100 | 4.7   | 4.8   | 5.3 | 5.8 | 7.2 | 8.7 | 14.2 |
|          | dn/dT absolute [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |     |     |      |
| °C       | C'  | 632.8 | D   | e   | F'  | g   | i    |
| -40/-20  | 1.3   | 1.3   | 1.7 | 2.1 | 3.2 | 4.5 | 8.8  |
| -20/0    | 1.8   | 1.9   | 2.2 | 2.7 | 3.9 | 5.1 | 9.7  |
| 0/+20    | 2.3   | 2.3   | 2.7 | 3.2 | 4.4 | 5.7 | 10.4 |
| +20/+40  | 2.7   | 2.8   | 3.2 | 3.7 | 4.9 | 6.3 | 11.1 |
| +40/+60  | 3.1   | 3.1   | 3.6 | 4.1 | 5.4 | 6.8 | 11.8 |
| +60/+80  | 3.4   | 3.5   | 3.9 | 4.5 | 5.8 | 7.3 | 12.5 |
| +80/+100 | 3.7   | 3.8   | 4.3 | 4.8 | 6.2 | 7.7 | 13.1 |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.7163828                  |
| $A_1$ | $-1.0036185 \cdot 10^{-2}$ |
| $A_2$ | $2.2584735 \cdot 10^{-2}$  |
| $A_3$ | $3.0563276 \cdot 10^{-3}$  |
| $A_4$ | $-3.1470190 \cdot 10^{-4}$ |
| $A_5$ | $2.2773405 \cdot 10^{-5}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.6787 |
| $P_{C,A'}$  | 0.3099 |
| $P_{d,C}$   | 0.2902 |
| $P_{e,C}$   | 0.5271 |
| $P_{g,d}$   | 1.3021 |
| $P_{g,F}$   | 0.5921 |
| $P_{h,g}$   | 0.5194 |
| $P_{i,g}$   | 1.4833 |
| $P'_{C',t}$ | 0.7128 |
| $P'_{e,C'}$ | 0.4746 |
| $P'_{F',e}$ | 0.5254 |
| $P'_{i,F'}$ | 1.9840 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0194 |
| $\Delta P_{C,A'}$ | -0.0059 |
| $\Delta P_{g,d}$  | 0.0040  |
| $\Delta P_{g,F}$  | 0.0021  |
| $\Delta P_{j,n}$  | 0.0283  |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.946        | 0.895         | 0.759         |
| 1970.1         | 0.976        | 0.952         | 0.885         |
| 1800.0         | 0.985        | 0.970         | 0.928         |
| 1600.0         | 0.996        | 0.993         | 0.982         |
| 1529.6         | 0.998        | 0.996         | 0.989         |
| 1200.0         | 0.999        | 0.999         | 0.999         |
| 1060.0         | 0.999        | 0.999         | 0.999         |
| 800.0          | 0.999        | 0.999         | 0.999         |
| 700.0          | 0.999        | 0.999         | 0.998         |
| 660.0          | 0.999        | 0.998         | 0.995         |
| 640.0          | 0.999        | 0.998         | 0.995         |
| 620.0          | 0.999        | 0.998         | 0.996         |
| 600.0          | 0.999        | 0.998         | 0.996         |
| 580.0          | 0.999        | 0.999         | 0.996         |
| 546.1          | 0.999        | 0.999         | 0.996         |
| 500.0          | 0.999        | 0.997         | 0.994         |
| 480.0          | 0.998        | 0.997         | 0.992         |
| 460.0          | 0.997        | 0.995         | 0.987         |
| 440.0          | 0.996        | 0.993         | 0.981         |
| 435.8          | 0.996        | 0.992         | 0.980         |
| 420.0          | 0.994        | 0.988         | 0.971         |
| 404.7          | 0.991        | 0.981         | 0.954         |
| 400.0          | 0.989        | 0.978         | 0.946         |
| 390.0          | 0.982        | 0.964         | 0.913         |
| 380.0          | 0.971        | 0.942         | 0.862         |
| 370.0          | 0.952        | 0.905         | 0.780         |
| 365.0          | 0.935        | 0.873         | 0.713         |
| 360.0          | 0.908        | 0.824         | 0.617         |
| 350.0          | 0.800        | 0.640         | 0.327         |
| 340.0          | 0.667        | 0.444         | 0.132         |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 38/34 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 1.0 |
| Alkali resistance    | 1.0 |
| Climatic resistance  | 1   |
| Phosphate resistance | 3.0 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 378  |
| Abrasion hardness ( $F_A$ )                                   | 170  |
| Young's modulus ( $E$ ) [GPa]                                 | 56.0 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 22.8 |
| Poisson ratio ( $\mu$ )                                       | 0.22 |
| Stress optical coefficient                                    | 2.37 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 4.07 |

|  |            |      |
|--|------------|------|
| Strain point ( $T_{10}^{14.5}$ ) [°C]                                | 379        |      |
| Annealing point ( $T_{10}^{13.0}$ ) [°C]                             | 413        |      |
| Yield point ( $A_f$ ) [°C]   | 471        |      |
| Transformation temperature ( $T_g$ ) [°C]                            | 429        |      |
| Softening point ( $T_{10}^{7.65}$ ) [°C]                             | 578        |      |
| Annealing factor (F) for $n_d$                                       | 5.8        |      |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}K^{-1}$ ]   | -30/+70°C  | 8.74 |
|  | +20/+300°C | 9.46 |
| Specific heat capacity ( $c_p$ ) [ $J \cdot g^{-1} \cdot K^{-1}$ ]   | 0.578      |      |
| Thermal conductivity ( $\lambda$ ) [ $W \cdot m^{-1} \cdot K^{-1}$ ] | 0.364      |      |

## SF8

Issue number 1001-01

ECO

|                   |          |
|-------------------|----------|
| $n_d$             | 1.68893  |
| $n_F - n_C$       | 0.022098 |
| $v_d$             | 31.18    |
| $n_e$             | 1.69416  |
| $v_e$             | 30.95    |
| $n_{F'} - n_{C'}$ | 0.022429 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.64829 |
| $n_{1970.1}$ | 1970.1         | 1.65299 |
| $n_{1529.6}$ | 1529.6         | 1.65862 |
| $n_{1060.0}$ | 1060.0         | 1.66620 |
| $n_t$        | 1014.0         | 1.66724 |
| $n_s$        | 852.1          | 1.67201 |
| $n_{A'}$     | 768.2          | 1.67556 |
| $n_r$        | 706.5          | 1.67898 |
| $n_C$        | 656.3          | 1.68250 |
| $n_{C'}$     | 643.9          | 1.68350 |
| $n_{632.8}$  | 632.8          | 1.68445 |
| $n_D$        | 589.3          | 1.68874 |
| $n_d$        | 587.6          | 1.68893 |
| $n_e$        | 546.1          | 1.69416 |
| $n_F$        | 486.1          | 1.70459 |
| $n_{F'}$     | 480.0          | 1.70593 |
| $n_g$        | 435.8          | 1.71770 |
| $n_h$        | 404.7          | 1.72924 |
| $n_i$        | 365.0          | 1.75052 |
| $n_{334.1}$  | 334.1          | 1.77636 |
| $n_{312.6}$  | 312.6          |         |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [ $10^{-6} \cdot \text{K}^{-1}$ ] |       |     |     |      |      |      |
|----------|--|-------|-----|-----|------|------|------|
| °C       | C'   | 632.8 | D   | e   | F'   | g    | i    |
| -40/-20  | 6.2  | 6.3   | 6.7 | 7.2 | 8.5  | 10.0 | 15.1 |
| -20/0    | 6.4  | 6.5   | 7.0 | 7.5 | 8.8  | 10.3 | 15.6 |
| 0/+20    | 6.7  | 6.8   | 7.2 | 7.8 | 9.2  | 10.7 | 16.1 |
| +20/+40  | 7.0  | 7.1   | 7.5 | 8.1 | 9.5  | 11.1 | 16.6 |
| +40/+60  | 7.2  | 7.3   | 7.8 | 8.4 | 9.8  | 11.5 | 17.1 |
| +60/+80  | 7.5  | 7.6   | 8.0 | 8.7 | 10.2 | 11.9 | 17.6 |
| +80/+100 | 7.7  | 7.8   | 8.3 | 9.0 | 10.5 | 12.2 | 18.1 |
|          | dn/dT absolute [ $10^{-6} \cdot \text{K}^{-1}$ ] |       |     |     |      |      |      |
| °C       | C'   | 632.8 | D   | e   | F'   | g    | i    |
| -40/-20  | 3.9  | 4.0   | 4.4 | 4.9 | 6.2  | 7.6  | 12.7 |
| -20/0    | 4.5  | 4.6   | 5.0 | 5.5 | 6.9  | 8.3  | 13.5 |
| 0/+20    | 5.0  | 5.1   | 5.5 | 6.1 | 7.5  | 9.0  | 14.3 |
| +20/+40  | 5.5  | 5.6   | 6.0 | 6.6 | 8.0  | 9.6  | 15.0 |
| +40/+60  | 5.9  | 6.0   | 6.5 | 7.1 | 8.5  | 10.1 | 15.7 |
| +60/+80  | 6.3  | 6.4   | 6.9 | 7.5 | 9.0  | 10.7 | 16.4 |
| +80/+100 | 6.7  | 6.8   | 7.3 | 8.0 | 9.5  | 11.2 | 17.0 |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.7583957                  |
| $A_1$ | $-8.7090372 \cdot 10^{-3}$ |
| $A_2$ | $2.9838622 \cdot 10^{-2}$  |
| $A_3$ | $1.3576169 \cdot 10^{-3}$  |
| $A_4$ | $-5.8782191 \cdot 10^{-5}$ |
| $A_5$ | $9.9370172 \cdot 10^{-6}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.6903 |
| $P_{C,A'}$  | 0.3137 |
| $P_{d,C}$   | 0.2911 |
| $P_{e,C}$   | 0.5277 |
| $P_{g,d}$   | 1.3021 |
| $P_{g,F}$   | 0.5932 |
| $P_{h,g}$   | 0.5219 |
| $P_{i,g}$   | 1.4853 |
| $P'_{C,t}$  | 0.7248 |
| $P'_{e,C'}$ | 0.4751 |
| $P'_{F',e}$ | 0.5249 |
| $P'_{i,F'}$ | 1.9882 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0030 |
| $\Delta P_{C,A'}$ | -0.0008 |
| $\Delta P_{g,d}$  | 0.0018  |
| $\Delta P_{g,F}$  | 0.0015  |
| $\Delta P_{i,q}$  | 0.0215  |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.967        | 0.935         | 0.845         |
| 1970.1         | 0.987        | 0.974         | 0.936         |
| 1800.0         | 0.991        | 0.983         | 0.958         |
| 1600.0         | 0.998        | 0.996         | 0.989         |
| 1529.6         | 0.999        | 0.997         | 0.993         |
| 1200.0         | 0.999        | 0.999         | 0.999         |
| 1060.0         | 0.999        | 0.999         | 0.999         |
| 800.0          | 0.999        | 0.999         | 0.999         |
| 700.0          | 0.999        | 0.999         | 0.998         |
| 660.0          | 0.999        | 0.998         | 0.995         |
| 640.0          | 0.999        | 0.998         | 0.996         |
| 620.0          | 0.999        | 0.998         | 0.996         |
| 600.0          | 0.999        | 0.999         | 0.997         |
| 580.0          | 0.999        | 0.999         | 0.997         |
| 546.1          | 0.999        | 0.999         | 0.997         |
| 500.0          | 0.999        | 0.997         | 0.993         |
| 480.0          | 0.998        | 0.996         | 0.990         |
| 460.0          | 0.997        | 0.994         | 0.984         |
| 440.0          | 0.995        | 0.990         | 0.976         |
| 435.8          | 0.995        | 0.989         | 0.973         |
| 420.0          | 0.992        | 0.984         | 0.961         |
| 404.7          | 0.986        | 0.972         | 0.931         |
| 400.0          | 0.983        | 0.966         | 0.917         |
| 390.0          | 0.972        | 0.945         | 0.868         |
| 380.0          | 0.952        | 0.906         | 0.781         |
| 370.0          | 0.915        | 0.837         | 0.640         |
| 365.0          | 0.881        | 0.776         | 0.530         |
| 360.0          | 0.829        | 0.687         | 0.391         |
| 350.0          | 0.652        | 0.425         | 0.118         |
| 340.0          |              |               |               |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 39/34 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 2.2 |
| Alkali resistance    | 1.0 |
| Climatic resistance  | 1   |
| Phosphate resistance | 2.0 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 386  |
| Abrasion hardness ( $F_A$ )                                   | 155  |
| Young's modulus ( $E$ ) [GPa]                                 | 57.4 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 23.4 |
| Poisson ratio ( $\mu$ )                                       | 0.23 |
| Stress optical coefficient                                    | 2.13 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 4.24 |

|   |                             |      |
|---|-----------------------------|------|
| Strain point ( $T_{10}^{14.5}$ ) [ $^{\circ}\text{C}$ ]                               | 401                         |      |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            | 437                         |      |
| Yield point ( $A_f$ ) [ $^{\circ}\text{C}$ ]  | 499                         |      |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           | 439                         |      |
| Softening point ( $T_{10}^{7.65}$ ) [ $^{\circ}\text{C}$ ]                            | 591                         |      |
| Annealing factor (F) for $n_d$  | 5.6                         |      |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 7.37 |
|   | +20/+300 $^{\circ}\text{C}$ | 7.88 |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   | 0.563                       |      |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] | 0.323                       |      |

## SF15

Issue number 1001-01

ECO

|               |          |
|---------------|----------|
| $n_d$         | 1.69895  |
| $n_F - n_C$   | 0.023246 |
| $v_d$         | 30.07    |
| $n_e$         | 1.70444  |
| $v_e$         | 29.82    |
| $n_F' - n_C'$ | 0.023621 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.65619 |
| $n_{1970.1}$ | 1970.1         | 1.66120 |
| $n_{1529.6}$ | 1529.6         | 1.66718 |
| $n_{1060.0}$ | 1060.0         | 1.67517 |
| $n_t$        | 1014.0         | 1.67627 |
| $n_s$        | 852.1          | 1.68125 |
| $n_{A'}$     | 768.2          | 1.68496 |
| $n_r$        | 706.5          | 1.68853 |
| $n_C$        | 656.3          | 1.69221 |
| $n_{C'}$     | 643.9          | 1.69326 |
| $n_{632.8}$  | 632.8          | 1.69425 |
| $n_D$        | 589.3          | 1.69874 |
| $n_d$        | 587.6          | 1.69895 |
| $n_e$        | 546.1          | 1.70444 |
| $n_F$        | 486.1          | 1.71546 |
| $n_{F'}$     | 480.0          | 1.71688 |
| $n_g$        | 435.8          | 1.72941 |
| $n_h$        | 404.7          | 1.74178 |
| $n_i$        | 365.0          | 1.76479 |
| $n_{334.1}$  | 334.1          |         |
| $n_{312.6}$  | 312.6          |         |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [ $10^{-6} \cdot \text{K}^{-1}$ ] |       |     |     |     |      |   |
|----------|--|-------|-----|-----|-----|------|---|
| °C       | C'   | 632.8 | D   | e   | F'  | g    | i |
| -40/-20  | 4.9  | 4.9   | 5.3 | 5.9 | 7.1 | 8.5  |   |
| -20/0    | 5.1  | 5.2   | 5.6 | 6.1 | 7.4 | 8.9  |   |
| 0/+20    | 5.3  | 5.4   | 5.8 | 6.3 | 7.7 | 9.2  |   |
| +20/+40  | 5.5  | 5.6   | 6.0 | 6.6 | 8.0 | 9.6  |   |
| +40/+60  | 5.7  | 5.8   | 6.2 | 6.8 | 8.3 | 9.9  |   |
| +60/+80  | 5.9  | 6.0   | 6.4 | 7.1 | 8.5 | 10.3 |   |
| +80/+100 | 6.1  | 6.2   | 6.6 | 7.3 | 8.8 | 10.6 |   |
|          | dn/dT absolute [ $10^{-6} \cdot \text{K}^{-1}$ ] |       |     |     |     |      |   |
| °C       | C'   | 632.8 | D   | e   | F'  | g    | i |
| -40/-20  | 2.6  | 2.7   | 3.0 | 3.5 | 4.8 | 6.2  |   |
| -20/0    | 3.1  | 3.2   | 3.6 | 4.1 | 5.4 | 6.8  |   |
| 0/+20    | 3.6  | 3.7   | 4.1 | 4.6 | 6.0 | 7.5  |   |
| +20/+40  | 4.0  | 4.1   | 4.5 | 5.1 | 6.5 | 8.0  |   |
| +40/+60  | 4.4  | 4.5   | 4.9 | 5.5 | 6.9 | 8.6  |   |
| +60/+80  | 4.7  | 4.8   | 5.3 | 5.9 | 7.4 | 9.1  |   |
| +80/+100 | 5.1  | 5.2   | 5.6 | 6.3 | 7.8 | 9.5  |   |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.7878195                  |
| $A_1$ | $-9.3752142 \cdot 10^{-3}$ |
| $A_2$ | $3.1296548 \cdot 10^{-2}$  |
| $A_3$ | $1.3369151 \cdot 10^{-3}$  |
| $A_4$ | $-2.8848908 \cdot 10^{-5}$ |
| $A_5$ | $9.4243618 \cdot 10^{-6}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.6858 |
| $P_{C,A'}$  | 0.3117 |
| $P_{d,C}$   | 0.2899 |
| $P_{e,C}$   | 0.5263 |
| $P_{g,d}$   | 1.3107 |
| $P_{g,F}$   | 0.6002 |
| $P_{h,g}$   | 0.5320 |
| $P_{i,g}$   | 1.5217 |
| $P'_{C,t}$  | 0.7194 |
| $P'_{e,C'}$ | 0.4734 |
| $P'_{F',e}$ | 0.5266 |
| $P'_{i,F'}$ | 2.0282 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0022 |
| $\Delta P_{C,A'}$ | -0.0015 |
| $\Delta P_{g,d}$  | 0.0080  |
| $\Delta P_{g,F}$  | 0.0066  |
| $\Delta P_{i,q}$  | 0.0486  |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.963        | 0.927         | 0.828         |
| 1970.1         | 0.985        | 0.969         | 0.925         |
| 1800.0         | 0.990        | 0.980         | 0.952         |
| 1600.0         | 0.997        | 0.995         | 0.987         |
| 1529.6         | 0.998        | 0.997         | 0.991         |
| 1200.0         | 0.999        | 0.999         | 0.999         |
| 1060.0         | 0.999        | 0.999         | 0.999         |
| 800.0          | 0.999        | 0.999         | 0.999         |
| 700.0          | 0.999        | 0.998         | 0.996         |
| 660.0          | 0.999        | 0.997         | 0.993         |
| 640.0          | 0.999        | 0.997         | 0.993         |
| 620.0          | 0.999        | 0.998         | 0.994         |
| 600.0          | 0.999        | 0.998         | 0.995         |
| 580.0          | 0.999        | 0.998         | 0.995         |
| 546.1          | 0.999        | 0.998         | 0.995         |
| 500.0          | 0.998        | 0.996         | 0.990         |
| 480.0          | 0.997        | 0.994         | 0.986         |
| 460.0          | 0.996        | 0.991         | 0.979         |
| 440.0          | 0.993        | 0.986         | 0.966         |
| 435.8          | 0.992        | 0.984         | 0.960         |
| 420.0          | 0.985        | 0.970         | 0.926         |
| 404.7          | 0.956        | 0.914         | 0.799         |
| 400.0          | 0.939        | 0.882         | 0.730         |
| 390.0          | 0.857        | 0.735         | 0.464         |
| 380.0          | 0.672        | 0.452         | 0.137         |
| 370.0          | 0.624        | 0.389         | 0.095         |
| 365.0          |              |               |               |
| 360.0          |              |               |               |
| 350.0          |              |               |               |
| 340.0          |              |               |               |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 40/37 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 1.0 |
| Alkali resistance    | 1.0 |
| Climatic resistance  | 1   |
| Phosphate resistance | 2.1 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 402  |
| Abrasion hardness ( $F_A$ )                                   | 175  |
| Young's modulus ( $E$ ) [GPa]                                 | 62.1 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 24.9 |
| Poisson ratio ( $\mu$ )                                       | 0.25 |
| Stress optical coefficient                                    | 2.21 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 4.05 |

|   |                             |      |
|---|-----------------------------|------|
| Strain point ( $T_{10}^{14.5}$ ) [ $^{\circ}\text{C}$ ]                               | 403                         |      |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            | 443                         |      |
| Yield point ( $A_f$ ) [ $^{\circ}\text{C}$ ]  | 498                         |      |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           | 453                         |      |
| Softening point ( $T_{10}^{7.65}$ ) [ $^{\circ}\text{C}$ ]                            | 587                         |      |
| Annealing factor (F) for $n_d$  | 11.0                        |      |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 7.87 |
|   | +20/+300 $^{\circ}\text{C}$ | 8.66 |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   | 0.610                       |      |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] | 0.333                       |      |

## SF1

Issue number 1001-01

ECO

—

|                   |          |
|-------------------|----------|
| $n_d$             | 1.71736  |
| $n_F - n_C$       | 0.024307 |
| $v_d$             | 29.51    |
| $n_e$             | 1.72311  |
| $v_e$             | 29.29    |
| $n_{F'} - n_{C'}$ | 0.024686 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.67378 |
| $n_{1970.1}$ | 1970.1         | 1.67866 |
| $n_{1529.6}$ | 1529.6         | 1.68456 |
| $n_{1060.0}$ | 1060.0         | 1.69263 |
| $n_t$        | 1014.0         | 1.69375 |
| $n_s$        | 852.1          | 1.69891 |
| $n_{A'}$     | 768.2          | 1.70276 |
| $n_r$        | 706.5          | 1.70648 |
| $n_C$        | 656.3          | 1.71032 |
| $n_{C'}$     | 643.9          | 1.71142 |
| $n_{632.8}$  | 632.8          | 1.71245 |
| $n_D$        | 589.3          | 1.71715 |
| $n_d$        | 587.6          | 1.71736 |
| $n_e$        | 546.1          | 1.72311 |
| $n_F$        | 486.1          | 1.73462 |
| $n_{F'}$     | 480.0          | 1.73610 |
| $n_g$        | 435.8          | 1.74918 |
| $n_h$        | 404.7          | 1.76205 |
| $n_i$        | 365.0          | 1.78595 |
| $n_{334.1}$  | 334.1          | 1.81513 |
| $n_{312.6}$  | 312.6          |         |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [ $10^{-6} \cdot \text{K}^{-1}$ ] |       |     |     |      |      |      |
|----------|--|-------|-----|-----|------|------|------|
| °C       | C'   | 632.8 | D   | e   | F'   | g    | i    |
| -40/-20  | 5.8  | 5.9   | 6.4 | 7.0 | 8.4  | 10.1 | 16.5 |
| -20/0    | 6.0  | 6.1   | 6.6 | 7.2 | 8.7  | 10.4 | 16.1 |
| 0/+20    | 6.2  | 6.3   | 6.8 | 7.5 | 9.0  | 10.8 | 15.7 |
| +20/+40  | 6.4  | 6.5   | 7.0 | 7.7 | 9.3  | 11.1 | 15.3 |
| +40/+60  | 6.6  | 6.7   | 7.3 | 8.0 | 9.6  | 11.5 | 14.8 |
| +60/+80  | 6.8  | 6.9   | 7.5 | 8.2 | 9.9  | 11.8 | 14.4 |
| +80/+100 | 7.0  | 7.1   | 7.7 | 8.5 | 10.2 | 12.2 | 14.0 |
|          | dn/dT absolute [ $10^{-6} \cdot \text{K}^{-1}$ ] |       |     |     |      |      |      |
| °C       | C'   | 632.8 | D   | e   | F'   | g    | i    |
| -40/-20  | 3.5  | 3.6   | 4.1 | 4.6 | 6.1  | 7.7  | 14.1 |
| -20/0    | 4.1  | 4.2   | 4.6 | 5.2 | 6.7  | 8.4  | 14.0 |
| 0/+20    | 4.5  | 4.6   | 5.1 | 5.7 | 7.3  | 9.0  | 13.9 |
| +20/+40  | 4.9  | 5.1   | 5.6 | 6.2 | 7.8  | 9.6  | 13.7 |
| +40/+60  | 5.3  | 5.4   | 6.0 | 6.6 | 8.3  | 10.1 | 13.4 |
| +60/+80  | 5.7  | 5.8   | 6.3 | 7.0 | 8.7  | 10.6 | 13.2 |
| +80/+100 | 6.0  | 6.1   | 6.7 | 7.4 | 9.1  | 11.1 | 12.9 |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.8447823                  |
| $A_1$ | $-9.1311141 \cdot 10^{-3}$ |
| $A_2$ | $3.2879412 \cdot 10^{-2}$  |
| $A_3$ | $1.5559114 \cdot 10^{-3}$  |
| $A_4$ | $-5.6526559 \cdot 10^{-5}$ |
| $A_5$ | $1.1202214 \cdot 10^{-5}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.6815 |
| $P_{C,A'}$  | 0.3110 |
| $P_{d,C}$   | 0.2898 |
| $P_{e,C}$   | 0.5262 |
| $P_{g,d}$   | 1.3087 |
| $P_{g,F}$   | 0.5986 |
| $P_{h,g}$   | 0.5296 |
| $P_{i,g}$   | 1.5130 |
| $P'_{C,t}$  | 0.7156 |
| $P'_{e,C'}$ | 0.4736 |
| $P'_{F',e}$ | 0.5264 |
| $P'_{i,F'}$ | 2.0193 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0038 |
| $\Delta P_{C,A'}$ | -0.0015 |
| $\Delta P_{g,d}$  | 0.0048  |
| $\Delta P_{g,F}$  | 0.0041  |
| $\Delta P_{j,n}$  | 0.0353  |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.965        | 0.932         | 0.838         |
| 1970.1         | 0.985        | 0.971         | 0.928         |
| 1800.0         | 0.991        | 0.981         | 0.954         |
| 1600.0         | 0.998        | 0.996         | 0.990         |
| 1529.6         | 0.999        | 0.998         | 0.994         |
| 1200.0         | 0.999        | 0.999         | 0.999         |
| 1060.0         | 0.999        | 0.999         | 0.999         |
| 800.0          | 0.999        | 0.999         | 0.999         |
| 700.0          | 0.999        | 0.999         | 0.998         |
| 660.0          | 0.999        | 0.998         | 0.996         |
| 640.0          | 0.999        | 0.998         | 0.996         |
| 620.0          | 0.999        | 0.999         | 0.997         |
| 600.0          | 0.999        | 0.999         | 0.997         |
| 580.0          | 0.999        | 0.998         | 0.996         |
| 546.1          | 0.999        | 0.999         | 0.996         |
| 500.0          | 0.999        | 0.997         | 0.993         |
| 480.0          | 0.998        | 0.996         | 0.991         |
| 460.0          | 0.997        | 0.995         | 0.986         |
| 440.0          | 0.995        | 0.991         | 0.978         |
| 435.8          | 0.995        | 0.990         | 0.974         |
| 420.0          | 0.992        | 0.984         | 0.961         |
| 404.7          | 0.986        | 0.971         | 0.930         |
| 400.0          | 0.983        | 0.966         | 0.917         |
| 390.0          | 0.972        | 0.945         | 0.868         |
| 380.0          | 0.953        | 0.908         | 0.787         |
| 370.0          | 0.916        | 0.839         | 0.645         |
| 365.0          | 0.882        | 0.778         | 0.533         |
| 360.0          | 0.828        | 0.686         | 0.389         |
| 350.0          | 0.653        | 0.427         | 0.119         |
| 340.0          |              |               |               |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 39/34 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 3.2 |
| Alkali resistance    | 1.0 |
| Climatic resistance  | 1   |
| Phosphate resistance | 3.1 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 375  |
| Abrasion hardness ( $F_A$ )                                   | 180  |
| Young's modulus ( $E$ ) [GPa]                                 | 56.3 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 22.9 |
| Poisson ratio ( $\mu$ )                                       | 0.23 |
| Stress optical coefficient                                    | 1.78 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 4.46 |

|   |                             |       |
|---|-----------------------------|-------|
| Strain point ( $T_{10}^{14.5}$ ) [ $^{\circ}\text{C}$ ]                               |                             | 378   |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            |                             | 412   |
| Yield point ( $A_1$ ) [ $^{\circ}\text{C}$ ]  |                             | 472   |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           |                             | 422   |
| Softening point ( $T_{10}^{7.65}$ ) [ $^{\circ}\text{C}$ ]                            |                             | 565   |
| Annealing factor (F) for $n_d$  |                             | 5.9   |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 8.08  |
|   | +20/+300 $^{\circ}\text{C}$ | 8.92  |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   |                             | 0.523 |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] |                             | 0.327 |



## SF10

Issue number 1001-01

ECO

|                   |          |
|-------------------|----------|
| $n_d$             | 1.72825  |
| $n_F - n_C$       | 0.025634 |
| $v_d$             | 28.41    |
| $n_e$             | 1.73430  |
| $v_e$             | 28.19    |
| $n_{F'} - n_{C'}$ | 0.026052 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.68255 |
| $n_{1970.1}$ | 1970.1         | 1.68765 |
| $n_{1529.6}$ | 1529.6         | 1.69382 |
| $n_{1060.0}$ | 1060.0         | 1.70227 |
| $n_t$        | 1014.0         | 1.70346 |
| $n_s$        | 852.1          | 1.70886 |
| $n_{A'}$     | 768.2          | 1.71291 |
| $n_r$        | 706.5          | 1.71681 |
| $n_C$        | 656.3          | 1.72084 |
| $n_{C'}$     | 643.9          | 1.72200 |
| $n_{632.8}$  | 632.8          | 1.72308 |
| $n_D$        | 589.3          | 1.72802 |
| $n_d$        | 587.6          | 1.72825 |
| $n_e$        | 546.1          | 1.73430 |
| $n_F$        | 486.1          | 1.74648 |
| $n_{F'}$     | 480.0          | 1.74805 |
| $n_g$        | 435.8          | 1.76198 |
| $n_h$        | 404.7          | 1.77579 |
| $n_i$        | 365.0          | 1.80168 |
| $n_{334.1}$  | 334.1          |         |
| $n_{312.6}$  | 312.6          |         |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |      |      |   |
|----------|---|-------|-----|-----|------|------|---|
| °C       | C'  | 632.8 | D   | e   | F'   | g    | i |
| -40/-20  | 6.1   | 6.2   | 6.7 | 7.3 | 8.7  | 10.4 |   |
| -20/0    | 6.3   | 6.4   | 6.9 | 7.5 | 9.0  | 10.7 |   |
| 0/+20    | 6.5   | 6.6   | 7.1 | 7.8 | 9.3  | 11.1 |   |
| +20/+40  | 6.7   | 6.8   | 7.3 | 8.0 | 9.6  | 11.5 |   |
| +40/+60  | 7.0   | 7.1   | 7.6 | 8.3 | 9.9  | 11.9 |   |
| +60/+80  | 7.2   | 7.3   | 7.8 | 8.5 | 10.2 | 12.2 |   |
| +80/+100 | 7.4   | 7.5   | 8.0 | 8.8 | 10.5 | 12.6 |   |
|          | dn/dT absolute [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |      |      |   |
| °C       | C'  | 632.8 | D   | e   | F'   | g    | i |
| -40/-20  | 3.8   | 3.9   | 4.3 | 4.9 | 6.3  | 7.9  |   |
| -20/0    | 4.3   | 4.4   | 4.9 | 5.5 | 7.0  | 8.7  |   |
| 0/+20    | 4.8   | 4.9   | 5.4 | 6.0 | 7.6  | 9.3  |   |
| +20/+40  | 5.2   | 5.4   | 5.8 | 6.5 | 8.1  | 9.9  |   |
| +40/+60  | 5.6   | 5.7   | 6.3 | 6.9 | 8.6  | 10.5 |   |
| +60/+80  | 6.0   | 6.1   | 6.6 | 7.3 | 9.0  | 11.0 |   |
| +80/+100 | 6.3   | 6.4   | 7.0 | 7.7 | 9.5  | 11.5 |   |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.8761537                  |
| $A_1$ | $-9.5635028 \cdot 10^{-3}$ |
| $A_2$ | $3.5024296 \cdot 10^{-2}$  |
| $A_3$ | $1.4706451 \cdot 10^{-3}$  |
| $A_4$ | $-2.4811339 \cdot 10^{-5}$ |
| $A_5$ | $1.1334039 \cdot 10^{-5}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.6783 |
| $P_{C,A'}$  | 0.3095 |
| $P_{d,C}$   | 0.2889 |
| $P_{e,C}$   | 0.5249 |
| $P_{g,d}$   | 1.3158 |
| $P_{g,F}$   | 0.6046 |
| $P_{h,g}$   | 0.5390 |
| $P_{i,g}$   | 1.5490 |
| $P'_{C,t}$  | 0.7117 |
| $P'_{e,C'}$ | 0.4723 |
| $P'_{F',e}$ | 0.5277 |
| $P'_{i,F'}$ | 2.0588 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0018 |
| $\Delta P_{C,A'}$ | -0.0017 |
| $\Delta P_{g,d}$  | 0.0095  |
| $\Delta P_{g,F}$  | 0.0082  |
| $\Delta P_{i,q}$  | 0.0620  |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.959        | 0.920         | 0.812         |
| 1970.1         | 0.985        | 0.969         | 0.925         |
| 1800.0         | 0.990        | 0.980         | 0.952         |
| 1600.0         | 0.998        | 0.995         | 0.988         |
| 1529.6         | 0.999        | 0.997         | 0.993         |
| 1200.0         | 0.999        | 0.999         | 0.999         |
| 1060.0         | 0.999        | 0.999         | 0.999         |
| 800.0          | 0.999        | 0.999         | 0.999         |
| 700.0          | 0.999        | 0.999         | 0.997         |
| 660.0          | 0.999        | 0.998         | 0.994         |
| 640.0          | 0.999        | 0.997         | 0.994         |
| 620.0          | 0.999        | 0.998         | 0.994         |
| 600.0          | 0.999        | 0.998         | 0.995         |
| 580.0          | 0.999        | 0.998         | 0.996         |
| 546.1          | 0.999        | 0.998         | 0.996         |
| 500.0          | 0.998        | 0.996         | 0.990         |
| 480.0          | 0.997        | 0.994         | 0.984         |
| 460.0          | 0.995        | 0.990         | 0.975         |
| 440.0          | 0.991        | 0.982         | 0.957         |
| 435.8          | 0.989        | 0.979         | 0.947         |
| 420.0          | 0.977        | 0.954         | 0.890         |
| 404.7          | 0.927        | 0.860         | 0.686         |
| 400.0          | 0.899        | 0.809         | 0.588         |
| 390.0          | 0.767        | 0.589         | 0.266         |
| 380.0          | 0.564        | 0.318         | 0.057         |
| 370.0          |              |               |               |
| 365.0          |              |               |               |
| 360.0          |              |               |               |
| 350.0          |              |               |               |
| 340.0          |              |               |               |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 42/37 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 1.0 |
| Alkali resistance    | 1.0 |
| Climatic resistance  | 1   |
| Phosphate resistance | 2.0 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 414  |
| Abrasion hardness ( $F_A$ )                                   | 175  |
| Young's modulus ( $E$ ) [GPa]                                 | 63.6 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 26.2 |
| Poisson ratio ( $\mu$ )                                       | 0.21 |
| Stress optical coefficient                                    | 1.88 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 4.27 |

|   |                             |      |
|---|-----------------------------|------|
| Strain point ( $T_{10}^{14.5}$ ) [ $^{\circ}\text{C}$ ]                               | 414                         |      |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            | 447                         |      |
| Yield point ( $A_1$ ) [ $^{\circ}\text{C}$ ]  | 501                         |      |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           | 463                         |      |
| Softening point ( $T_{10}^{7.65}$ ) [ $^{\circ}\text{C}$ ]                            | 579                         |      |
| Annealing factor (F) for $n_d$  | 11.0                        |      |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 7.55 |
|   | +20/+300 $^{\circ}\text{C}$ | 8.36 |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   | 0.580                       |      |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] | 0.449                       |      |



## SF13

Issue number 1001-01

ECO

|                   |          |
|-------------------|----------|
| $n_d$             | 1.74077  |
| $n_F - n_C$       | 0.026655 |
| $v_d$             | 27.79    |
| $n_e$             | 1.74707  |
| $v_e$             | 27.58    |
| $n_{F'} - n_{C'}$ | 0.027083 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.69403 |
| $n_{1970.1}$ | 1970.1         | 1.69909 |
| $n_{1529.6}$ | 1529.6         | 1.70525 |
| $n_{1060.0}$ | 1060.0         | 1.71384 |
| $n_t$        | 1014.0         | 1.71506 |
| $n_s$        | 852.1          | 1.72063 |
| $n_{A'}$     | 768.2          | 1.72482 |
| $n_r$        | 706.5          | 1.72887 |
| $n_C$        | 656.3          | 1.73307 |
| $n_{C'}$     | 643.9          | 1.73427 |
| $n_{632.8}$  | 632.8          | 1.73540 |
| $n_D$        | 589.3          | 1.74054 |
| $n_d$        | 587.6          | 1.74077 |
| $n_e$        | 546.1          | 1.74707 |
| $n_F$        | 486.1          | 1.75972 |
| $n_{F'}$     | 480.0          | 1.76135 |
| $n_g$        | 435.8          | 1.77578 |
| $n_h$        | 404.7          | 1.79007 |
| $n_i$        | 365.0          | 1.81682 |
| $n_{334.1}$  | 334.1          |         |
| $n_{312.6}$  | 312.6          |         |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [ $10^{-6} \cdot \text{K}^{-1}$ ] |       |     |     |      |      |   |
|----------|--|-------|-----|-----|------|------|---|
| °C       | C'   | 632.8 | D   | e   | F'   | g    | i |
| -40/-20  | 5.4  | 5.5   | 6.0 | 6.6 | 8.2  | 10.0 |   |
| -20/0    | 5.6  | 5.7   | 6.2 | 6.9 | 8.5  | 10.4 |   |
| 0/+20    | 5.8  | 6.0   | 6.5 | 7.2 | 8.9  | 10.8 |   |
| +20/+40  | 6.1  | 6.2   | 6.7 | 7.4 | 9.2  | 11.2 |   |
| +40/+60  | 6.3  | 6.4   | 7.0 | 7.7 | 9.5  | 11.6 |   |
| +60/+80  | 6.5  | 6.6   | 7.2 | 8.0 | 9.9  | 12.0 |   |
| +80/+100 | 6.7  | 6.9   | 7.4 | 8.3 | 10.2 | 12.4 |   |
|          | dn/dT absolute [ $10^{-6} \cdot \text{K}^{-1}$ ] |       |     |     |      |      |   |
| °C       | C'   | 632.8 | D   | e   | F'   | g    | i |
| -40/-20  | 3.1  | 3.2   | 3.6 | 4.3 | 5.8  | 7.6  |   |
| -20/0    | 3.6  | 3.7   | 4.2 | 4.9 | 6.5  | 8.4  |   |
| 0/+20    | 4.1  | 4.2   | 4.7 | 5.4 | 7.1  | 9.0  |   |
| +20/+40  | 4.6  | 4.7   | 5.2 | 5.9 | 7.7  | 9.7  |   |
| +40/+60  | 5.0  | 5.1   | 5.6 | 6.4 | 8.2  | 10.3 |   |
| +60/+80  | 5.3  | 5.5   | 6.0 | 6.8 | 8.7  | 10.8 |   |
| +80/+100 | 5.7  | 5.8   | 6.4 | 7.2 | 9.1  | 11.3 |   |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.9142613                  |
| $A_1$ | $-9.4827751 \cdot 10^{-3}$ |
| $A_2$ | $3.6260093 \cdot 10^{-2}$  |
| $A_3$ | $1.7879183 \cdot 10^{-3}$  |
| $A_4$ | $-7.1530300 \cdot 10^{-5}$ |
| $A_5$ | $1.4254407 \cdot 10^{-5}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.6757 |
| $P_{C,A'}$  | 0.3093 |
| $P_{d,C}$   | 0.2891 |
| $P_{e,C}$   | 0.5252 |
| $P_{g,d}$   | 1.3135 |
| $P_{g,F}$   | 0.6026 |
| $P_{h,g}$   | 0.5360 |
| $P_{i,g}$   | 1.5396 |
| $P'_{C,t}$  | 0.7094 |
| $P'_{e,C'}$ | 0.4726 |
| $P'_{F',e}$ | 0.5274 |
| $P'_{i,F'}$ | 2.0482 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0014 |
| $\Delta P_{C,A'}$ | -0.0011 |
| $\Delta P_{g,d}$  | 0.0059  |
| $\Delta P_{g,F}$  | 0.0052  |
| $\Delta P_{j,n}$  | 0.0473  |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.960        | 0.921         | 0.814         |
| 1970.1         | 0.982        | 0.964         | 0.912         |
| 1800.0         | 0.988        | 0.977         | 0.944         |
| 1600.0         | 0.997        | 0.994         | 0.985         |
| 1529.6         | 0.998        | 0.996         | 0.990         |
| 1200.0         | 0.999        | 0.999         | 0.999         |
| 1060.0         | 0.999        | 0.999         | 0.999         |
| 800.0          | 0.999        | 0.999         | 0.996         |
| 700.0          | 0.999        | 0.998         | 0.995         |
| 660.0          | 0.999        | 0.997         | 0.993         |
| 640.0          | 0.999        | 0.997         | 0.993         |
| 620.0          | 0.999        | 0.997         | 0.994         |
| 600.0          | 0.999        | 0.998         | 0.994         |
| 580.0          | 0.999        | 0.998         | 0.995         |
| 546.1          | 0.999        | 0.998         | 0.994         |
| 500.0          | 0.998        | 0.996         | 0.990         |
| 480.0          | 0.997        | 0.994         | 0.985         |
| 460.0          | 0.995        | 0.990         | 0.975         |
| 440.0          | 0.991        | 0.983         | 0.958         |
| 435.8          | 0.990        | 0.980         | 0.951         |
| 420.0          | 0.982        | 0.964         | 0.913         |
| 404.7          | 0.956        | 0.913         | 0.797         |
| 400.0          | 0.942        | 0.887         | 0.740         |
| 390.0          | 0.875        | 0.766         | 0.513         |
| 380.0          | 0.721        | 0.520         | 0.195         |
| 370.0          | 0.614        | 0.377         | 0.087         |
| 365.0          |              |               |               |
| 360.0          |              |               |               |
| 350.0          |              |               |               |
| 340.0          |              |               |               |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 42/37 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 2.2 |
| Alkali resistance    | 1.2 |
| Climatic resistance  | 1   |
| Phosphate resistance | 2.3 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 379  |
| Abrasion hardness ( $F_A$ )                                   | 200  |
| Young's modulus ( $E$ ) [GPa]                                 | 58.6 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 23.9 |
| Poisson ratio ( $\mu$ )                                       | 0.23 |
| Stress optical coefficient                                    | 1.63 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 4.52 |

|   |                             |      |
|---|-----------------------------|------|
| Strain point ( $T_{10}^{14.5}$ ) [ $^{\circ}\text{C}$ ]                               | 378                         |      |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            | 413                         |      |
| Yield point ( $A_f$ ) [ $^{\circ}\text{C}$ ]  | 471                         |      |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           | 421                         |      |
| Softening point ( $T_{10}^{7.65}$ ) [ $^{\circ}\text{C}$ ]                            | 549                         |      |
| Annealing factor (F) for $n_d$  | 8.3                         |      |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 8.46 |
|   | +20/+300 $^{\circ}\text{C}$ | 9.25 |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   | 0.544                       |      |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] | 0.322                       |      |

## SF4

Issue number 1001-01

ECO

|                   |          |
|-------------------|----------|
| $n_d$             | 1.75520  |
| $n_F - n_C$       | 0.027383 |
| $v_d$             | 27.58    |
| $n_e$             | 1.76166  |
| $v_e$             | 27.39    |
| $n_{F'} - n_{C'}$ | 0.027805 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.70805 |
| $n_{1970.1}$ | 1970.1         | 1.71298 |
| $n_{1529.6}$ | 1529.6         | 1.71905 |
| $n_{1060.0}$ | 1060.0         | 1.72766 |
| $n_t$        | 1014.0         | 1.72889 |
| $n_s$        | 852.1          | 1.73457 |
| $n_{A'}$     | 768.2          | 1.73885 |
| $n_r$        | 706.5          | 1.74300 |
| $n_C$        | 656.3          | 1.74730 |
| $n_{C'}$     | 643.9          | 1.74853 |
| $n_{632.8}$  | 632.8          | 1.74969 |
| $n_D$        | 589.3          | 1.75497 |
| $n_d$        | 587.6          | 1.75520 |
| $n_e$        | 546.1          | 1.76167 |
| $n_F$        | 486.1          | 1.77468 |
| $n_{F'}$     | 480.0          | 1.77635 |
| $n_g$        | 435.8          | 1.79120 |
| $n_h$        | 404.7          | 1.80589 |
| $n_i$        | 365.0          | 1.83335 |
| $n_{334.1}$  | 334.1          |         |
| $n_{312.6}$  | 312.6          |         |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |      |      |   |
|----------|---|-------|-----|-----|------|------|---|
| °C       | C'  | 632.8 | D   | e   | F'   | g    | i |
| -40/-20  | 6.7   | 6.8   | 7.3 | 8.1 | 9.8  | 11.8 |   |
| -20/0    | 6.9   | 7.1   | 7.6 | 8.4 | 10.2 | 12.3 |   |
| 0/+20    | 7.2   | 7.3   | 7.9 | 8.7 | 10.6 | 12.7 |   |
| +20/+40  | 7.5   | 7.6   | 8.2 | 9.0 | 10.9 | 13.2 |   |
| +40/+60  | 7.7   | 7.9   | 8.4 | 9.3 | 11.3 | 13.6 |   |
| +60/+80  | 8.0   | 8.1   | 8.7 | 9.6 | 11.7 | 14.1 |   |
| +80/+100 | 8.3   | 8.4   | 9.0 | 9.9 | 12.1 | 14.5 |   |
|          | dn/dT absolute [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |     |     |      |      |   |
| °C       | C'  | 632.8 | D   | e   | F'   | g    | i |
| -40/-20  | 4.3   | 4.4   | 4.9 | 5.7 | 7.4  | 9.4  |   |
| -20/0    | 4.9   | 5.0   | 5.6 | 6.3 | 8.1  | 10.2 |   |
| 0/+20    | 5.5   | 5.6   | 6.1 | 6.9 | 8.8  | 10.9 |   |
| +20/+40  | 5.9   | 6.1   | 6.7 | 7.5 | 9.4  | 11.6 |   |
| +40/+60  | 6.4   | 6.5   | 7.1 | 8.0 | 9.9  | 12.2 |   |
| +60/+80  | 6.8   | 6.9   | 7.5 | 8.4 | 10.5 | 12.8 |   |
| +80/+100 | 7.2   | 7.3   | 7.9 | 8.9 | 11.0 | 13.4 |   |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.9603174                  |
| $A_1$ | $-9.2288620 \cdot 10^{-3}$ |
| $A_2$ | $3.7582426 \cdot 10^{-2}$  |
| $A_3$ | $1.8256618 \cdot 10^{-3}$  |
| $A_4$ | $-6.3806873 \cdot 10^{-5}$ |
| $A_5$ | $1.3921544 \cdot 10^{-5}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.6722 |
| $P_{C,A'}$  | 0.3084 |
| $P_{d,C}$   | 0.2888 |
| $P_{e,C}$   | 0.5249 |
| $P_{g,d}$   | 1.3145 |
| $P_{g,F}$   | 0.6033 |
| $P_{h,g}$   | 0.5365 |
| $P_{i,g}$   | 1.5395 |
| $P'_{C',t}$ | 0.7063 |
| $P'_{e,C'}$ | 0.4727 |
| $P'_{F',e}$ | 0.5281 |
| $P'_{i,F'}$ | 2.0500 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0039 |
| $\Delta P_{C,A'}$ | -0.0017 |
| $\Delta P_{g,d}$  | 0.0064  |
| $\Delta P_{g,F}$  | 0.0055  |
| $\Delta P_{i,n}$  | 0.0455  |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.967        | 0.934         | 0.844         |
| 1970.1         | 0.985        | 0.969         | 0.925         |
| 1800.0         | 0.990        | 0.980         | 0.952         |
| 1600.0         | 0.997        | 0.994         | 0.986         |
| 1529.6         | 0.998        | 0.996         | 0.990         |
| 1200.0         | 0.999        | 0.999         | 0.998         |
| 1060.0         | 0.999        | 0.999         | 0.998         |
| 800.0          | 0.999        | 0.998         | 0.996         |
| 700.0          | 0.999        | 0.998         | 0.994         |
| 660.0          | 0.999        | 0.997         | 0.993         |
| 640.0          | 0.998        | 0.997         | 0.992         |
| 620.0          | 0.999        | 0.997         | 0.993         |
| 600.0          | 0.999        | 0.997         | 0.994         |
| 580.0          | 0.999        | 0.998         | 0.994         |
| 546.1          | 0.999        | 0.998         | 0.994         |
| 500.0          | 0.998        | 0.996         | 0.989         |
| 480.0          | 0.997        | 0.994         | 0.985         |
| 460.0          | 0.995        | 0.990         | 0.976         |
| 440.0          | 0.992        | 0.984         | 0.960         |
| 435.8          | 0.990        | 0.981         | 0.953         |
| 420.0          | 0.984        | 0.968         | 0.922         |
| 404.7          | 0.968        | 0.936         | 0.848         |
| 400.0          | 0.961        | 0.923         | 0.819         |
| 390.0          | 0.935        | 0.874         | 0.714         |
| 380.0          | 0.889        | 0.791         | 0.556         |
| 370.0          | 0.800        | 0.640         | 0.328         |
| 365.0          | 0.724        | 0.524         | 0.199         |
| 360.0          | 0.635        | 0.403         | 0.103         |
| 350.0          |              |               |               |
| 340.0          |              |               |               |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 41/35 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 4.2 |
| Alkali resistance    | 1.0 |
| Climatic resistance  | 1   |
| Phosphate resistance | 3.3 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 365  |
| Abrasion hardness ( $F_A$ )                                   | 195  |
| Young's modulus ( $E$ ) [GPa]                                 | 56.0 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 22.6 |
| Poisson ratio ( $\mu$ )                                       | 0.24 |
| Stress optical coefficient                                    | 1.29 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 4.79 |

|   |                             |      |
|---|-----------------------------|------|
| Strain point ( $T_{10}^{14.5}$ ) [ $^{\circ}\text{C}$ ]                               | 380                         |      |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            | 413                         |      |
| Yield point ( $A_1$ ) [ $^{\circ}\text{C}$ ]  | 460                         |      |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           | 421                         |      |
| Softening point ( $T_{10}^{6.65}$ ) [ $^{\circ}\text{C}$ ]                            | 541                         |      |
| Annealing factor (F) for $n_d$  | 6.1                         |      |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 8.17 |
|   | +20/+300 $^{\circ}\text{C}$ | 8.91 |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   | 0.580                       |      |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] | 0.352                       |      |

## SF14

Issue number 1001-01

ECO

|                |          |
|----------------|----------|
| $n_d$          | 1.76182  |
| $n_F - n_C$    | 0.028718 |
| $v_d$          | 26.53    |
| $n_e$          | 1.76860  |
| $v_e$          | 26.31    |
| $n_F - n_{C'}$ | 0.029210 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.70605 |
| $n_{1970.1}$ | 1970.1         | 1.71381 |
| $n_{1529.6}$ | 1529.6         | 1.72259 |
| $n_{1060.0}$ | 1060.0         | 1.73300 |
| $n_t$        | 1014.0         | 1.73435 |
| $n_s$        | 852.1          | 1.74036 |
| $n_{A'}$     | 768.2          | 1.74482 |
| $n_r$        | 706.5          | 1.74911 |
| $n_C$        | 656.3          | 1.75358 |
| $n_{C'}$     | 643.9          | 1.75486 |
| $n_{632.8}$  | 632.8          | 1.75607 |
| $n_D$        | 589.3          | 1.76157 |
| $n_d$        | 587.6          | 1.76182 |
| $n_e$        | 546.1          | 1.76860 |
| $n_F$        | 486.1          | 1.78230 |
| $n_{F'}$     | 480.0          | 1.78407 |
| $n_g$        | 435.8          | 1.79986 |
| $n_h$        | 404.7          | 1.81571 |
| $n_i$        | 365.0          |         |
| $n_{334.1}$  | 334.1          |         |
| $n_{312.6}$  | 312.6          |         |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [ $10^{-6} \cdot K^{-1}$ ] |       |      |      |      |      |   |
|----------|---|-------|------|------|------|------|---|
| °C       | C'  | 632.8 | D    | e    | F'   | g    | i |
| -40/-20  | 8.5                                       | 8.6   | 9.2  | 9.9  | 11.6 | 13.6 |   |
| -20/0    | 8.7                                       | 8.9   | 9.4  | 10.2 | 12.0 | 14.1 |   |
| 0/+20    | 9.0                                       | 9.1   | 9.7  | 10.5 | 12.3 | 14.6 |   |
| +20/+40  | 9.2                                       | 9.4   | 10.0 | 10.8 | 12.7 | 15.0 |   |
| +40/+60  | 9.5                                       | 9.6   | 10.2 | 11.1 | 13.1 | 15.5 |   |
| +60/+80  | 9.7                                       | 9.9   | 10.5 | 11.4 | 13.4 | 15.9 |   |
| +80/+100 | 10.0                                      | 10.1  | 10.8 | 11.7 | 13.8 | 16.4 |   |
|          | dn/dT absolute [ $10^{-6} \cdot K^{-1}$ ] |       |      |      |      |      |   |
| °C       | C'  | 632.8 | D    | e    | F'   | g    | i |
| -40/-20  | 6.1                                       | 6.2   | 6.8  | 7.5  | 9.2  | 11.2 |   |
| -20/0    | 6.7                                       | 6.8   | 7.4  | 8.1  | 9.9  | 12.0 |   |
| 0/+20    | 7.2                                       | 7.4   | 7.9  | 8.7  | 10.5 | 12.7 |   |
| +20/+40  | 7.7                                       | 7.8   | 8.4  | 9.2  | 11.1 | 13.4 |   |
| +40/+60  | 8.2                                       | 8.3   | 8.9  | 9.7  | 11.7 | 14.1 |   |
| +60/+80  | 8.6                                       | 8.7   | 9.3  | 10.2 | 12.2 | 14.7 |   |
| +80/+100 | 8.9                                       | 9.1   | 9.7  | 10.6 | 12.7 | 15.3 |   |

|       |                            |
|-------|----------------------------|
| $A_0$ | 2.9905317                  |
| $A_1$ | $-1.5856344 \cdot 10^{-2}$ |
| $A_2$ | $3.0539491 \cdot 10^{-2}$  |
| $A_3$ | $4.6960564 \cdot 10^{-3}$  |
| $A_4$ | $-4.8784529 \cdot 10^{-4}$ |
| $A_5$ | $4.1948509 \cdot 10^{-5}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.6696 |
| $P_{C,A'}$  | 0.3051 |
| $P_{d,C}$   | 0.2871 |
| $P_{e,C}$   | 0.5230 |
| $P_{g,d}$   | 1.3244 |
| $P_{g,F}$   | 0.6114 |
| $P_{h,g}$   | 0.5521 |
| $P_{i,g}$   | 1.6190 |
| $P'_{C,t}$  | 0.7022 |
| $P'_{e,C'}$ | 0.4704 |
| $P'_{F',e}$ | 0.5296 |
| $P'_{i,F'}$ | 2.1321 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0015 |
| $\Delta P_{C,A'}$ | -0.0038 |
| $\Delta P_{g,d}$  | 0.0140  |
| $\Delta P_{g,F}$  | 0.0118  |
| $\Delta P_{i,q}$  | 0.1161  |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.967        | 0.934         | 0.844         |
| 1970.1         | 0.989        | 0.978         | 0.946         |
| 1800.0         | 0.992        | 0.985         | 0.963         |
| 1600.0         | 0.997        | 0.995         | 0.987         |
| 1529.6         | 0.998        | 0.996         | 0.989         |
| 1200.0         | 0.999        | 0.999         | 0.999         |
| 1060.0         | 0.999        | 0.999         | 0.999         |
| 800.0          | 0.999        | 0.998         | 0.995         |
| 700.0          | 0.998        | 0.996         | 0.991         |
| 660.0          | 0.997        | 0.995         | 0.987         |
| 640.0          | 0.997        | 0.994         | 0.986         |
| 620.0          | 0.997        | 0.995         | 0.987         |
| 600.0          | 0.998        | 0.995         | 0.988         |
| 580.0          | 0.998        | 0.996         | 0.989         |
| 546.1          | 0.997        | 0.995         | 0.987         |
| 500.0          | 0.995        | 0.991         | 0.977         |
| 480.0          | 0.993        | 0.986         | 0.966         |
| 460.0          | 0.989        | 0.978         | 0.947         |
| 440.0          | 0.980        | 0.961         | 0.906         |
| 435.8          | 0.976        | 0.953         | 0.886         |
| 420.0          | 0.949        | 0.901         | 0.771         |
| 404.7          | 0.850        | 0.723         | 0.444         |
| 400.0          | 0.797        | 0.636         | 0.322         |
| 390.0          | 0.608        | 0.370         | 0.083         |
| 380.0          |              |               |               |
| 370.0          |              |               |               |
| 365.0          |              |               |               |
| 360.0          |              |               |               |
| 350.0          |              |               |               |
| 340.0          |              |               |               |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 43/38 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 1.0 |
| Alkali resistance    | 1.2 |
| Climatic resistance  | 1   |
| Phosphate resistance | 1.3 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 411  |
| Abrasion hardness ( $F_A$ )                                   | 175  |
| Young's modulus ( $E$ ) [GPa]                                 | 64.7 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 26.4 |
| Poisson ratio ( $\mu$ )                                       | 0.23 |
| Stress optical coefficient                                    | 1.55 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 4.55 |

|   |                             |      |
|---|-----------------------------|------|
| Strain point ( $T_{10}^{14.5}$ ) [ $^{\circ}\text{C}$ ]                               | 434                         |      |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            | 468                         |      |
| Yield point ( $A_1$ ) [ $^{\circ}\text{C}$ ]  | 524                         |      |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           | 484                         |      |
| Softening point ( $T_{10}^{7.65}$ ) [ $^{\circ}\text{C}$ ]                            | 602                         |      |
| Annealing factor (F) for $n_d$  | 9.9                         |      |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 6.72 |
|   | +20/+300 $^{\circ}\text{C}$ | 7.43 |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   | 0.540                       |      |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] | 0.275                       |      |

## SF11

Issue number 1001-01

ECO

|                   |          |
|-------------------|----------|
| $n_d$             | 1.78472  |
| $n_F - n_C$       | 0.030468 |
| $v_d$             | 25.76    |
| $n_e$             | 1.79190  |
| $v_e$             | 25.55    |
| $n_{F'} - n_{C'}$ | 0.030991 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.73323 |
| $n_{1970.1}$ | 1970.1         | 1.73852 |
| $n_{1529.6}$ | 1529.6         | 1.74506 |
| $n_{1060.0}$ | 1060.0         | 1.75442 |
| $n_i$        | 1014.0         | 1.75577 |
| $n_s$        | 852.1          | 1.76198 |
| $n_{A'}$     | 768.2          | 1.76668 |
| $n_r$        | 706.5          | 1.77124 |
| $n_C$        | 656.3          | 1.77598 |
| $n_{C'}$     | 643.9          | 1.77734 |
| $n_{632.8}$  | 632.8          | 1.77862 |
| $n_D$        | 589.3          | 1.78446 |
| $n_d$        | 587.6          | 1.78472 |
| $n_e$        | 546.1          | 1.79190 |
| $n_F$        | 486.1          | 1.80644 |
| $n_{F'}$     | 480.0          | 1.80833 |
| $n_g$        | 435.8          | 1.82513 |
| $n_h$        | 404.7          | 1.84195 |
| $n_i$        | 365.0          |         |
| $n_{334.1}$  | 334.1          |         |
| $n_{312.6}$  | 312.6          |         |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [ $10^{-6} \cdot \text{K}^{-1}$ ] |       |      |      |      |      |   |
|----------|--|-------|------|------|------|------|---|
| °C       | C'   | 632.8 | D    | e    | F'   | g    | i |
| -40/-20  | 8.3  | 8.4   | 9.0  | 9.8  | 11.7 | 13.9 |   |
| -20/0    | 8.6  | 8.7   | 9.3  | 10.1 | 12.1 | 14.4 |   |
| 0/+20    | 8.8  | 9.0   | 9.6  | 10.4 | 12.5 | 14.9 |   |
| +20/+40  | 9.1  | 9.2   | 9.9  | 10.8 | 12.9 | 15.4 |   |
| +40/+60  | 9.4  | 9.5   | 10.2 | 11.1 | 13.3 | 15.9 |   |
| +60/+80  | 9.6  | 9.8   | 10.5 | 11.4 | 13.7 | 16.4 |   |
| +80/+100 | 9.9  | 10.1  | 10.8 | 11.7 | 14.1 | 16.9 |   |
|          | dn/dT absolute [ $10^{-6} \cdot \text{K}^{-1}$ ] |       |      |      |      |      |   |
| °C       | C'   | 632.8 | D    | e    | F'   | g    | i |
| -40/-20  | 5.9  | 6.0   | 6.6  | 7.4  | 9.2  | 11.4 |   |
| -20/0    | 6.5  | 6.7   | 7.2  | 8.0  | 10.0 | 12.3 |   |
| 0/+20    | 7.1  | 7.2   | 7.8  | 8.6  | 10.7 | 13.1 |   |
| +20/+40  | 7.6  | 7.7   | 8.3  | 9.2  | 11.3 | 13.8 |   |
| +40/+60  | 8.0  | 8.2   | 8.8  | 9.7  | 11.9 | 14.5 |   |
| +60/+80  | 8.4  | 8.6   | 9.3  | 10.2 | 12.4 | 15.1 |   |
| +80/+100 | 8.8  | 9.0   | 9.7  | 10.6 | 13.0 | 15.8 |   |

|       |                            |
|-------|----------------------------|
| $A_0$ | 3.0504310                  |
| $A_1$ | $-1.0017056 \cdot 10^{-2}$ |
| $A_2$ | $4.1840912 \cdot 10^{-2}$  |
| $A_3$ | $2.0398391 \cdot 10^{-3}$  |
| $A_4$ | $-5.4073779 \cdot 10^{-5}$ |
| $A_5$ | $1.7776534 \cdot 10^{-5}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.6633 |
| $P_{C,A'}$  | 0.3051 |
| $P_{d,C}$   | 0.2869 |
| $P_{e,C}$   | 0.5226 |
| $P_{g,d}$   | 1.3262 |
| $P_{g,F}$   | 0.6132 |
| $P_{h,g}$   | 0.5522 |
| $P_{i,g}$   | 1.6014 |
| $P'_{C',t}$ | 0.6959 |
| $P'_{e,C'}$ | 0.4700 |
| $P'_{F',e}$ | 0.5300 |
| $P'_{i,F'}$ | 2.1164 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0042 |
| $\Delta P_{C,A'}$ | -0.0028 |
| $\Delta P_{g,d}$  | 0.0143  |
| $\Delta P_{g,F}$  | 0.0123  |
| $\Delta P_{i,q}$  | 0.0920  |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.972        | 0.945         | 0.868         |
| 1970.1         | 0.989        | 0.978         | 0.946         |
| 1800.0         | 0.992        | 0.983         | 0.959         |
| 1600.0         | 0.998        | 0.995         | 0.988         |
| 1529.6         | 0.998        | 0.996         | 0.991         |
| 1200.0         | 0.999        | 0.999         | 0.999         |
| 1060.0         | 0.999        | 0.999         | 0.998         |
| 800.0          | 0.999        | 0.999         | 0.996         |
| 700.0          | 0.998        | 0.996         | 0.990         |
| 660.0          | 0.997        | 0.995         | 0.987         |
| 640.0          | 0.997        | 0.995         | 0.987         |
| 620.0          | 0.997        | 0.995         | 0.987         |
| 600.0          | 0.998        | 0.996         | 0.989         |
| 580.0          | 0.998        | 0.996         | 0.991         |
| 546.1          | 0.998        | 0.996         | 0.990         |
| 500.0          | 0.996        | 0.992         | 0.980         |
| 480.0          | 0.994        | 0.988         | 0.970         |
| 460.0          | 0.990        | 0.981         | 0.952         |
| 440.0          | 0.982        | 0.965         | 0.914         |
| 435.8          | 0.978        | 0.957         | 0.897         |
| 420.0          | 0.954        | 0.911         | 0.791         |
| 404.7          | 0.865        | 0.748         | 0.483         |
| 400.0          | 0.818        | 0.669         | 0.365         |
| 390.0          | 0.677        | 0.458         | 0.142         |
| 380.0          |              |               |               |
| 370.0          |              |               |               |
| 365.0          |              |               |               |
| 360.0          |              |               |               |
| 350.0          |              |               |               |
| 340.0          |              |               |               |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 43/38 |
|----------------------------|-------|

|                      |     |
|----------------------|-----|
| Acid resistance      | 2.2 |
| Alkali resistance    | 1.2 |
| Climatic resistance  | 1   |
| Phosphate resistance | 2.1 |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 399  |
| Abrasion hardness ( $F_A$ )                                   | 185  |
| Young's modulus ( $E$ ) [GPa]                                 | 62.5 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 25.3 |
| Poisson ratio ( $\mu$ )                                       | 0.24 |
| Stress optical coefficient                                    | 1.37 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 4.76 |

|   |                             |      |
|---|-----------------------------|------|
| Strain point ( $T_{10}^{14.5}$ ) [ $^{\circ}\text{C}$ ]                               | 416                         |      |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            | 453                         |      |
| Yield point ( $A_f$ ) [ $^{\circ}\text{C}$ ]  | 506                         |      |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           | 458                         |      |
| Softening point ( $T_{10}^{7.65}$ ) [ $^{\circ}\text{C}$ ]                            | 582                         |      |
| Annealing factor (F) for $n_d$  | 10.6                        |      |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 7.07 |
|   | +20/+300 $^{\circ}\text{C}$ | 7.82 |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   | 0.492                       |      |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] | 0.316                       |      |

## SF6

Issue number 1001-01

ECO

—

 $n_d$ 

1.80518

$$n_E - n_G$$

0.031660

 $v_d$ 

25.43

 $n_e$ 

1.81265

 $v_e$ 

25.24

$$n_{F'} - n_{G'}$$

0.032192

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.75282 |
| $n_{1970.1}$ | 1970.1         | 1.75789 |
| $n_{1529.6}$ | 1529.6         | 1.76428 |
| $n_{1060.0}$ | 1060.0         | 1.77374 |
| $n_t$        | 1014.0         | 1.77512 |
| $n_s$        | 852.1          | 1.78154 |
| $n_{A'}$     | 768.2          | 1.78642 |
| $n_r$        | 706.5          | 1.79116 |
| $n_c$        | 656.3          | 1.79609 |
| $n_{c'}$     | 643.9          | 1.79750 |
| $n_{632.8}$  | 632.8          | 1.79883 |
| $n_d$        | 589.3          | 1.80490 |
| $n_d$        | 587.6          | 1.80518 |
| $n_e$        | 546.1          | 1.81265 |
| $n_f$        | 486.1          | 1.82774 |
| $n_{f'}$     | 480.0          | 1.82969 |
| $n_g$        | 435.8          | 1.84703 |
| $n_h$        | 404.7          | 1.86426 |
| $n_i$        | 365.0          | 1.89645 |
| $n_{334.1}$  | 334.1          |         |
| $n_{312.6}$  | 312.6          |         |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [10 <sup>-6</sup> ·K <sup>-1</sup> ] |       |      |      |      |     |   |
|----------|---|-------|------|------|------|-----|---|
| °C       | C'  | 632.8 | D    | e    | F'   | g   | i |
| -40/-20  | 0.1   | 0.2   | 0.6  | 1.1  | 2.3  | 3.8 |   |
| -20/0    | 0.2   | 0.3   | 0.7  | 1.2  | 2.6  | 4.2 |   |
| 0/+20    | 0.3   | 0.4   | 0.8  | 1.4  | 2.8  | 4.5 |   |
| +20/+40  | 0.4   | 0.5   | 1.0  | 1.6  | 3.1  | 4.9 |   |
| +40/+60  | 0.6   | 0.6   | 1.1  | 1.7  | 3.3  | 5.2 |   |
| +60/+80  | 0.7   | 0.8   | 1.3  | 1.9  | 3.6  | 5.6 |   |
| +80/+100 | 0.8   | 0.9   | 1.4  | 2.1  | 3.8  | 5.9 |   |
|          | dn/dT absolute [10 <sup>-6</sup> ·K <sup>-1</sup> ] |       |      |      |      |     |   |
| °C       | C'  | 632.8 | D    | e    | F'   | g   | i |
| -40/-20  | -2.3  | -2.2  | -1.9 | -1.4 | -0.2 | 1.3 |   |
| -20/0    | -1.9  | -1.8  | -1.4 | -0.9 | 0.4  | 2.0 |   |
| 0/+20    | -1.5  | -1.4  | -1.0 | -0.4 | 1.0  | 2.7 |   |
| +20/+40  | -1.1  | -1.0  | -0.6 | 0.0  | 1.5  | 3.3 |   |
| +40/+60  | -0.8  | -0.7  | -0.3 | 0.3  | 1.9  | 3.8 |   |
| +60/+80  | -0.6  | -0.5  | 0.1  | 0.7  | 2.3  | 4.3 |   |
| +80/+100 | -0.3  | -0.2  | 0.3  | 1.0  | 2.7  | 4.8 |   |

|       |                            |
|-------|----------------------------|
| $A_0$ | 3.1153185                  |
| $A_1$ | $-9.4931689 \cdot 10^{-3}$ |
| $A_2$ | $4.5040100 \cdot 10^{-2}$  |
| $A_3$ | $1.7566082 \cdot 10^{-3}$  |
| $A_4$ | $2.8048271 \cdot 10^{-5}$  |
| $A_5$ | $1.0593131 \cdot 10^{-5}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.6622 |
| $P_{C,A'}$  | 0.3053 |
| $P_{d,C}$   | 0.2872 |
| $P_{e,C}$   | 0.5230 |
| $P_{g,d}$   | 1.3220 |
| $P_{g,F}$   | 0.6094 |
| $P_{h,g}$   | 0.5440 |
| $P_{i,g}$   | 1.5607 |
| $P'_{C',t}$ | 0.6951 |
| $P'_{e,C'}$ | 0.4705 |
| $P'_{F',e}$ | 0.5295 |
| $P'_{i,F'}$ | 2.0737 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0037 |
| $\Delta P_{C,A'}$ | -0.0023 |
| $\Delta P_{g,d}$  | 0.0093  |
| $\Delta P_{g,F}$  | 0.0079  |
| $\Delta P_{i,q}$  | 0.0486  |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.971        | 0.943         | 0.863         |
| 1970.1         | 0.987        | 0.975         | 0.938         |
| 1800.0         | 0.992        | 0.984         | 0.960         |
| 1600.0         | 0.998        | 0.997         | 0.992         |
| 1529.6         | 0.999        | 0.998         | 0.996         |
| 1200.0         | 0.999        | 0.999         | 0.999         |
| 1060.0         | 0.999        | 0.999         | 0.999         |
| 800.0          | 0.999        | 0.999         | 0.999         |
| 700.0          | 0.999        | 0.999         | 0.997         |
| 660.0          | 0.999        | 0.998         | 0.995         |
| 640.0          | 0.999        | 0.998         | 0.995         |
| 620.0          | 0.999        | 0.998         | 0.995         |
| 600.0          | 0.999        | 0.998         | 0.996         |
| 580.0          | 0.999        | 0.999         | 0.996         |
| 546.1          | 0.999        | 0.998         | 0.996         |
| 500.0          | 0.998        | 0.996         | 0.990         |
| 480.0          | 0.997        | 0.993         | 0.983         |
| 460.0          | 0.994        | 0.988         | 0.971         |
| 440.0          | 0.988        | 0.976         | 0.942         |
| 435.8          | 0.986        | 0.972         | 0.931         |
| 420.0          | 0.972        | 0.946         | 0.870         |
| 404.7          | 0.940        | 0.884         | 0.736         |
| 400.0          | 0.927        | 0.859         | 0.684         |
| 390.0          | 0.876        | 0.767         | 0.514         |
| 380.0          | 0.783        | 0.614         | 0.295         |
| 370.0          | 0.633        | 0.401         | 0.102         |
| 365.0          | 0.609        | 0.371         | 0.084         |
| 360.0          |              |               |               |
| 350.0          |              |               |               |
| 340.0          |              |               |               |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 42/36 |
|----------------------------|-------|

|                      |      |
|----------------------|------|
| Acid resistance      | 52.2 |
| Alkali resistance    | 1.0  |
| Climatic resistance  | 1    |
| Phosphate resistance | 3.3  |

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 341  |
| Abrasion hardness ( $F_A$ )                                   | 220  |
| Young's modulus ( $E$ ) [GPa]                                 | 54.5 |
| Modulus of rigidity ( $G$ ) [GPa]                             | 21.9 |
| Poisson ratio ( $\mu$ )                                       | 0.24 |
| Stress optical coefficient                                    | 0.63 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 5.19 |

|   |                             |      |
|---|-----------------------------|------|
| Strain point ( $T_{10}^{14.5}$ ) [ $^{\circ}\text{C}$ ]                               | 392                         |      |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            | 423                         |      |
| Yield point ( $A_1$ ) [ $^{\circ}\text{C}$ ]  | 472                         |      |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           | 436                         |      |
| Softening point ( $T_{10}^{7.65}$ ) [ $^{\circ}\text{C}$ ]                            | 550                         |      |
| Annealing factor (F) for $n_d$  | 6.3                         |      |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 8.09 |
|   | +20/+300 $^{\circ}\text{C}$ | 8.79 |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   | 0.477                       |      |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] | 0.256                       |      |



## SF57

Issue number 1001-01

ECO

|                   |          |
|-------------------|----------|
| $n_d$             | 1.84666  |
| $n_F - n_C$       | 0.035534 |
| $v_d$             | 23.83    |
| $n_e$             | 1.85504  |
| $v_e$             | 23.64    |
| $n_{F'} - n_{C'}$ | 0.036164 |

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.79047 |
| $n_{1970.1}$ | 1970.1         | 1.79547 |
| $n_{1529.6}$ | 1529.6         | 1.80190 |
| $n_{1060.0}$ | 1060.0         | 1.81188 |
| $n_t$        | 1014.0         | 1.81337 |
| $n_s$        | 852.1          | 1.82039 |
| $n_{A'}$     | 768.2          | 1.82577 |
| $n_r$        | 706.5          | 1.83102 |
| $n_C$        | 656.3          | 1.83651 |
| $n_{C'}$     | 643.9          | 1.83808 |
| $n_{632.8}$  | 632.8          | 1.83957 |
| $n_D$        | 589.3          | 1.84636 |
| $n_d$        | 587.6          | 1.84667 |
| $n_e$        | 546.1          | 1.85504 |
| $n_F$        | 486.1          | 1.87204 |
| $n_{F'}$     | 480.0          | 1.87425 |
| $n_g$        | 435.8          | 1.89394 |
| $n_h$        | 404.7          | 1.91368 |
| $n_i$        | 365.0          | 1.95114 |
| $n_{334.1}$  | 334.1          |         |
| $n_{312.6}$  | 312.6          |         |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

|          | dn/dT relative [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |      |      |      |      |   |
|----------|---|-------|------|------|------|------|---|
| °C       | C'  | 632.8 | D    | e    | F'   | g    | i |
| -40/-20  | 9.5   | 9.7   | 10.5 | 11.6 | 14.3 | 17.5 |   |
| -20/0    | 9.9   | 10.1  | 10.9 | 12.0 | 14.8 | 18.1 |   |
| 0/+20    | 10.2  | 10.4  | 11.3 | 12.5 | 15.3 | 18.7 |   |
| +20/+40  | 10.6  | 10.8  | 11.7 | 12.9 | 15.8 | 19.4 |   |
| +40/+60  | 10.9  | 11.1  | 12.1 | 13.3 | 16.4 | 20.0 |   |
| +60/+80  | 11.3  | 11.5  | 12.4 | 13.7 | 16.9 | 20.6 |   |
| +80/+100 | 11.6  | 11.8  | 12.8 | 14.1 | 17.4 | 21.2 |   |
|          | dn/dT absolute [10 <sup>-6</sup> .K <sup>-1</sup> ] |       |      |      |      |      |   |
| °C       | C'  | 632.8 | D    | e    | F'   | g    | i |
| -40/-20  | 7.1   | 7.2   | 8.0  | 9.1  | 11.8 | 14.9 |   |
| -20/0    | 7.8   | 7.9   | 8.8  | 9.9  | 12.6 | 15.9 |   |
| 0/+20    | 8.4   | 8.6   | 9.4  | 10.6 | 13.5 | 16.8 |   |
| +20/+40  | 9.0   | 9.2   | 10.1 | 11.3 | 14.2 | 17.7 |   |
| +40/+60  | 9.5   | 9.7   | 10.6 | 11.9 | 14.9 | 18.5 |   |
| +60/+80  | 10.0  | 10.2  | 11.2 | 12.4 | 15.6 | 19.3 |   |
| +80/+100 | 10.5  | 10.7  | 11.7 | 13.0 | 16.2 | 20.1 |   |

|       |                            |
|-------|----------------------------|
| $A_0$ | 3.2465734                  |
| $A_1$ | $-9.2795154 \cdot 10^{-3}$ |
| $A_2$ | $5.0392367 \cdot 10^{-2}$  |
| $A_3$ | $2.4254376 \cdot 10^{-3}$  |
| $A_4$ | $-3.7171977 \cdot 10^{-5}$ |
| $A_5$ | $1.9689671 \cdot 10^{-5}$  |

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.6511 |
| $P_{C,A'}$  | 0.3022 |
| $P_{d,C}$   | 0.2859 |
| $P_{e,C}$   | 0.5215 |
| $P_{g,d}$   | 1.3304 |
| $P_{g,F}$   | 0.6163 |
| $P_{h,g}$   | 0.5555 |
| $P_{i,g}$   | 1.6096 |
| $P'_{C',t}$ | 0.6833 |
| $P'_{e,C'}$ | 0.4688 |
| $P'_{F',e}$ | 0.5312 |
| $P'_{i,F'}$ | 2.1261 |

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | -0.0073 |
| $\Delta P_{C,A'}$ | -0.0035 |
| $\Delta P_{g,d}$  | 0.0143  |
| $\Delta P_{g,F}$  | 0.0122  |
| $\Delta P_{j,n}$  | 0.0840  |

[illegible]

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.974        | 0.948         | 0.875         |
| 1970.1         | 0.987        | 0.974         | 0.937         |
| 1800.0         | 0.992        | 0.983         | 0.959         |
| 1600.0         | 0.998        | 0.995         | 0.988         |
| 1529.6         | 0.998        | 0.997         | 0.992         |
| 1200.0         | 0.999        | 0.999         | 0.999         |
| 1060.0         | 0.999        | 0.999         | 0.998         |
| 800.0          | 0.999        | 0.999         | 0.996         |
| 700.0          | 0.999        | 0.998         | 0.994         |
| 660.0          | 0.998        | 0.996         | 0.991         |
| 640.0          | 0.998        | 0.996         | 0.991         |
| 620.0          | 0.998        | 0.997         | 0.992         |
| 600.0          | 0.998        | 0.997         | 0.992         |
| 580.0          | 0.999        | 0.997         | 0.993         |
| 546.1          | 0.998        | 0.997         | 0.992         |
| 500.0          | 0.997        | 0.994         | 0.985         |
| 480.0          | 0.995        | 0.990         | 0.975         |
| 460.0          | 0.990        | 0.981         | 0.953         |
| 440.0          | 0.980        | 0.960         | 0.904         |
| 435.8          | 0.976        | 0.952         | 0.884         |
| 420.0          | 0.952        | 0.906         | 0.782         |
| 404.7          | 0.896        | 0.803         | 0.578         |
| 400.0          | 0.873        | 0.761         | 0.506         |
| 390.0          | 0.787        | 0.619         | 0.301         |
| 380.0          | 0.649        | 0.421         | 0.115         |
| 370.0          | 0.635        | 0.403         | 0.103         |
| 365.0          |              |               |               |
| 360.0          |              |               |               |
| 350.0          |              |               |               |
| 340.0          |              |               |               |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 44/37 |
|----------------------------|-------|

|                      |      |
|----------------------|------|
| Acid resistance      | 52.2 |
| Alkali resistance    | 2.2  |
| Climatic resistance  | 1    |
| Phosphate resistance | 4.2  |

|   |       |
|---|-------|
| Knoop hardness ( $H_K$ ) [ $\text{kgf}\cdot\text{mm}^{-2}$ ]  | 317   |
| Abrasion hardness ( $F_A$ )                                   | 240   |
| Young's modulus ( $E$ ) [GPa]                                 | 53.5  |
| Modulus of rigidity ( $G$ ) [GPa]                             | 23.7  |
| Poisson ratio ( $\mu$ )                                       | 0.13  |
| Stress optical coefficient                                    | 0.026 |
| Specific gravity ( $\rho$ ) [ $\text{g}\cdot\text{cm}^{-3}$ ] | 5.50  |

|   |                             |      |
|---|-----------------------------|------|
| Strain point ( $T_{10}^{14.5}$ ) [ $^{\circ}\text{C}$ ]                               | 375                         |      |
| Annealing point ( $T_{10}^{13.0}$ ) [ $^{\circ}\text{C}$ ]                            | 404                         |      |
| Yield point ( $A_f$ ) [ $^{\circ}\text{C}$ ]  | 446                         |      |
| Transformation temperature ( $T_g$ ) [ $^{\circ}\text{C}$ ]                           | 413                         |      |
| Softening point ( $T_{10}^{7.65}$ ) [ $^{\circ}\text{C}$ ]                            | 518                         |      |
| Annealing factor (F) for $n_d$  | 6.4                         |      |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6}\text{K}^{-1}$ ]             | -30/+70 $^{\circ}\text{C}$  | 8.30 |
|   | +20/+300 $^{\circ}\text{C}$ | 9.21 |
| Specific heat capacity ( $c_p$ ) [ $\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$ ]   | 0.437                       |      |
| Thermal conductivity ( $\lambda$ ) [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ] | 0.249                       |      |





## LDF805254A

## SFL6

Issue number 1001-01

|             |          |
|-------------|----------|
| ECO         | Pb Free  |
| $n_d$       | 1.80518  |
| $n_F - n_C$ | 0.031660 |
| $v_d$       | 25.43    |
| $n_e$       | 1.81264  |
| $v_e$       | 25.23    |
| $n_F - n_C$ | 0.032211 |

## Refractive indices

|              | $\lambda$ [nm] |         |
|--------------|----------------|---------|
| $n_{2325.4}$ | 2325.4         | 1.74965 |
| $n_{1970.1}$ | 1970.1         | 1.75583 |
| $n_{1529.6}$ | 1529.6         | 1.76329 |
| $n_{1060.0}$ | 1060.0         | 1.77351 |
| $n_t$        | 1014.0         | 1.77494 |
| $n_s$        | 852.1          | 1.78150 |
| $n_{A'}$     | 768.2          | 1.78642 |
| $n_r$        | 706.5          | 1.79117 |
| $n_C$        | 656.3          | 1.79610 |
| $n_{C'}$     | 643.9          | 1.79751 |
| $n_{632.8}$  | 632.8          | 1.79884 |
| $n_D$        | 589.3          | 1.80491 |
| $n_d$        | 587.6          | 1.80518 |
| $n_e$        | 546.1          | 1.81264 |
| $n_F$        | 486.1          | 1.82776 |
| $n_{F'}$     | 480.0          | 1.82972 |
| $n_g$        | 435.8          | 1.84722 |
| $n_h$        | 404.7          | 1.86479 |
| $n_i$        | 365.0          | 1.89824 |
| $n_{334.1}$  | 334.1          |         |
| $n_{312.6}$  | 312.6          |         |
| $n_{296.7}$  | 296.7          |         |
| $n_{280.4}$  | 280.4          |         |
| $n_{248.3}$  | 248.3          |         |

## Temperature coefficients of refractive index

| dn/dT relative [ $10^{-6} \cdot K^{-1}$ ] |      |       |      |      |      |      |   |
|---|------|-------|------|------|------|------|---|
| $^{\circ}C$                               | C'   | 632.8 | D    | e    | F'   | g    | i |
| -40/-20                                   | 8.4  | 8.5   | 9.2  | 10.1 | 12.4 | 15.0 |   |
| -20/0                                     | 8.7  | 8.8   | 9.5  | 10.5 | 12.8 | 15.5 |   |
| 0/+20                                     | 9.0  | 9.1   | 9.8  | 10.8 | 13.2 | 16.0 |   |
| +20/+40                                   | 9.3  | 9.4   | 10.2 | 11.2 | 13.7 | 16.5 |   |
| +40/+60                                   | 9.6  | 9.7   | 10.5 | 11.6 | 14.1 | 17.1 |   |
| +60/+80                                   | 9.9  | 10.1  | 10.8 | 11.9 | 14.5 | 17.6 |   |
| +80/+100                                  | 10.2 | 10.4  | 11.2 | 12.3 | 15.0 | 18.1 |   |
| dn/dT absolute [ $10^{-6} \cdot K^{-1}$ ] |      |       |      |      |      |      |   |
| $^{\circ}C$                               | C'   | 632.8 | D    | e    | F'   | g    | i |
| -40/-20                                   | 5.9  | 6.1   | 6.8  | 7.7  | 9.9  | 12.4 |   |
| -20/0                                     | 6.6  | 6.7   | 7.4  | 8.4  | 10.7 | 13.3 |   |
| 0/+20                                     | 7.2  | 7.3   | 8.0  | 9.0  | 11.4 | 14.2 |   |
| +20/+40                                   | 7.7  | 7.9   | 8.6  | 9.6  | 12.1 | 14.9 |   |
| +40/+60                                   | 8.2  | 8.4   | 9.1  | 10.2 | 12.7 | 15.6 |   |
| +60/+80                                   | 8.7  | 8.8   | 9.6  | 10.7 | 13.3 | 16.3 |   |
| +80/+100                                  | 9.1  | 9.3   | 10.1 | 11.2 | 13.8 | 17.0 |   |

## Dispersion constants

|       |                            |
|-------|----------------------------|
| $A_0$ | 3.1182841                  |
| $A_1$ | $-1.2050860 \cdot 10^{-2}$ |
| $A_2$ | $4.3803751 \cdot 10^{-2}$  |
| $A_3$ | $2.0576629 \cdot 10^{-3}$  |
| $A_4$ | $-3.5363540 \cdot 10^{-5}$ |
| $A_5$ | $1.7937602 \cdot 10^{-5}$  |

## Relative partial dispersions

|             |        |
|-------------|--------|
| $P_{C,t}$   | 0.6682 |
| $P_{C,A'}$  | 0.3058 |
| $P_{d,C}$   | 0.2869 |
| $P_{e,C}$   | 0.5225 |
| $P_{g,d}$   | 1.3280 |
| $P_{g,F}$   | 0.6148 |
| $P_{h,g}$   | 0.5549 |
| $P_{i,g}$   | 1.6113 |
| $P'_{C,t}$  | 0.7006 |
| $P'_{e,C'}$ | 0.4697 |
| $P'_{F,e}$  | 0.5303 |
| $P'_{i,F'}$ | 2.1272 |

## Deviation of relative partial dispersions from normal line

|                   |         |
|-------------------|---------|
| $\Delta P_{C,t}$  | 0.0022  |
| $\Delta P_{C,A'}$ | -0.0018 |
| $\Delta P_{g,d}$  | 0.0153  |
| $\Delta P_{g,F}$  | 0.0134  |
| $\Delta P_{i,g}$  | 0.0992  |

## Remarks

To calculate change of  $v_d$  with cooling rate use a value of  $F_v = -0.054$

## Internal transmittance

| $\lambda$ [nm] | $\tau_i$ 5mm | $\tau_i$ 10mm | $\tau_i$ 25mm |
|----------------|--------------|---------------|---------------|
| 2200.0         | 0.957        | 0.915         | 0.802         |
| 1970.1         | 0.978        | 0.957         | 0.897         |
| 1800.0         | 0.986        | 0.972         | 0.932         |
| 1600.0         | 0.996        | 0.992         | 0.980         |
| 1529.6         | 0.997        | 0.994         | 0.985         |
| 1200.0         | 0.999        | 0.999         | 0.997         |
| 1060.0         | 0.999        | 0.998         | 0.996         |
| 800.0          | 0.999        | 0.998         | 0.994         |
| 700.0          | 0.996        | 0.992         | 0.981         |
| 660.0          | 0.994        | 0.989         | 0.973         |
| 640.0          | 0.994        | 0.989         | 0.972         |
| 620.0          | 0.995        | 0.989         | 0.973         |
| 600.0          | 0.995        | 0.990         | 0.975         |
| 580.0          | 0.995        | 0.990         | 0.976         |
| 546.1          | 0.994        | 0.988         | 0.969         |
| 500.0          | 0.988        | 0.977         | 0.943         |
| 480.0          | 0.985        | 0.970         | 0.927         |
| 460.0          | 0.981        | 0.962         | 0.908         |
| 440.0          | 0.977        | 0.954         | 0.888         |
| 435.8          | 0.975        | 0.951         | 0.881         |
| 420.0          | 0.967        | 0.935         | 0.846         |
| 404.7          | 0.944        | 0.892         | 0.752         |
| 400.0          | 0.933        | 0.871         | 0.709         |
| 390.0          | 0.883        | 0.779         | 0.536         |
| 380.0          | 0.756        | 0.572         | 0.247         |
| 370.0          | 0.581        | 0.338         | 0.066         |
| 365.0          |              |               |               |
| 360.0          |              |               |               |
| 350.0          |              |               |               |
| 340.0          |              |               |               |
| 334.1          |              |               |               |
| 330.0          |              |               |               |
| 320.0          |              |               |               |
| 310.0          |              |               |               |
| 300.0          |              |               |               |

## Colour code

|                            |       |
|----------------------------|-------|
| $\lambda_{80} / \lambda_5$ | 44/37 |
|----------------------------|-------|

## Chemical properties

|                      |     |
|----------------------|-----|
| Acid resistance      | 2.0 |
| Alkali resistance    | 1.0 |
| Climatic resistance  | 1   |
| Phosphate resistance | 1.0 |

## Mechanical properties

|   |      |
|---|------|
| Knoop hardness ( $H_K$ ) [ $kgf \cdot mm^{-2}$ ]  | 531  |
| Abrasion hardness ( $F_A$ )                       | 190  |
| Young's modulus (E) [GPa]                         | 92.2 |
| Modulus of rigidity (G) [GPa]                     | 36.8 |
| Poisson ratio ( $\mu$ )                           | 0.25 |
| Stress optical coefficient                        | 2.74 |
| Specific gravity ( $\rho$ ) [ $g \cdot cm^{-3}$ ] | 3.37 |

## Thermal properties

|  |  |
|--|--|
| Strain point ( $T_{10^{14.5}}$ ) [ $^{\circ}C$ ]                     | 550  |
| Annealing point ( $T_{10^{13.0}}$ ) [ $^{\circ}C$ ]                  | 580  |
| Yield point ( $A_f$ ) [ $^{\circ}C$ ]                                | 627  |
| Transformation temperature ( $T_g$ ) [ $^{\circ}C$ ]                 | 592  |
| Softening point ( $T_{10^{7.65}}$ ) [ $^{\circ}C$ ]                  | 687  |
| Annealing factor (F) for $n_d$                                       | 23.9   |
| Co-efficient of thermal expansion ( $\alpha$ ) [ $10^{-6} K^{-1}$ ]  | -30/+70 $^{\circ}C$ 9.07<br>+20/+300 $^{\circ}C$ 10.51 |
| Specific heat capacity ( $c_p$ ) [ $J \cdot g^{-1} \cdot K^{-1}$ ]   | 0.809  |
| Thermal conductivity ( $\lambda$ ) [ $W \cdot m^{-1} \cdot K^{-1}$ ] | 0.492  |