

Australian/New Zealand Standard®

Methods of test for PVC pipes and fittings

Method 14: Method for determination of the light transmission of pipe

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee PL/21 on Unplasticized PVC Pipe.

METHOD

1 SCOPE This Method sets out a procedure for determining the diffuse light transmission of pipe.

2 RELEVANCE OF TEST This test is used to determine the ability of PVC pipe to resist the penetration of light which could otherwise lead to the possible growth of algae in a water supply pipe.

3 PRINCIPLE The light transmitted through a section of pipe and registered by a photocell is calculated as a percentage of the light transmitted without the pipe in position.

4 APPARATUS The following apparatus (see Figures 1 and 2) is required:

- (a) *Light source*—mounted into an apparatus with a matt white interior (mass of movable part approximately 500 g) so that the test specimen is evenly illuminated with light from the visible part of the spectrum (see Note 1).
- (b) *A photocell (see Note 2)*—mounted so that it receives only light that has passed through the test specimen when the test specimen is in position. The photocell should be sensitive to light mainly in the visible part of the spectrum.
- (c) *A measuring device (see Note 3)*—that applies a suitable load resistance to the photocell, thus ensuring a linear response, and enables measurements from 100% down to 0.02% transmission.
- (d) *Neutral density filters*—Numbers 0.1, 0.5, 1, 2, 3 and 4.

Other methods which can be shown to provide an accuracy of the same or a higher degree may be used.

NOTES:

- 1 A 12 V 18 W tungsten filament globe (connected to a 12 V regulated power supply) in conjunction with translucent acrylic diffusers and a tungsten to daylight filter have been found suitable. This combination was found to illuminate the test specimen evenly at light levels that did not saturate the photocell when the test specimen was not present.
- 2 Megatron type M (45 mm diameter) has been found to be suitable.

- 3 A suitable circuit for this device is shown in Figure 2. This circuit is designed for the megatron Type M photocell and thus applies a load resistance of less than 100 ohms to ensure a linear response.

The multimeter connected for measurements should have at least $3\frac{1}{2}$ digits, 20 V, 2 V and 200 mV ranges and have an accuracy of $\pm 0.1\%$ of the reading + 1 digit.

5 PREPARATION OF TEST SPECIMENS The test specimen shall be a section of pipe approximately 80 mm $\times$ 80 mm $\times$ thickness of the pipe. It shall be split and heated for approximately 15 min (or until soft enough to flatten) in a hot air oven maintained at $150 \pm 5^\circ\text{C}$. It shall then be pressed flat between two plates but not so that it is thinner than the thinnest part of the pipe wall section. With a small-sized pipe, where a test specimen of the required size cannot be obtained, as large a test specimen as possible shall be used and the photocell shall be masked by reducing its effective diameter.

Three test specimens are required for each test.

6 REFERENCE SPECIMENS Each reference specimen shall be opaque and of the same wall thickness as the test specimen with a hole 55 ± 1 mm in diameter cut in the centre.

7 PROCEDURE The procedure shall be as follows:

- (a) Place a piece of opaque material (approximately 80 mm $\times$ 80 mm) on the neoprene seal, turn on the light source and the measuring device. Allow it to stabilize for at least 5 min. Adjust the circuit so that the meter reads zero on the 20 V, 2 V and 200 mV scales.

NOTE: A piece of matt black aluminium is suitable.

- (b) Remove the opaque material and replace it with a reference specimen. Allow the meter to stabilize and then set it using the 100% knob so that it reads approximately 10 V on the 20 V scale. Record this reading.
- (c) Remove the reference specimen and replace it with a test specimen. Record the reading indicated on the meter as I_1 . If the value is near zero on the 20 V scale, change to a more sensitive scale (either 2 V or 200 mV).
- (d) Remove the test specimen and replace it with the reference specimen and record the reading on the 20 V scale of the meter.
- (e) Subsequent test specimens should be tested by repeating Steps (b), (c) and (d).
- (f) Zero testing as in Step (a) should be carried out at intervals of not greater than 30 minutes during each use of the apparatus.
- (g) If test specimens are not being continuously tested, the opaque material should be placed in the test specimen position when no test specimen is present to stop fatigue of the photocell.

8 CALCULATION OF LIGHT TRANSMISSION Light transmission shall be calculated as follows:

- (a) Calculate the average of the two meter readings recorded in Clauses 7(b) and (d) and record as I_0 .
- (b) Using the reading from Clause 7(c), calculate the measured percentage light transmission of the specimen under test using the expression $(I_1/I_0) \times 100$, and correct according to the calibration curve (see Clause 9) to provide the corrected light transmission value of the test specimen.

9 CALIBRATION CURVE The accuracy of the apparatus should be checked by calibrating the readings obtained with those predicted by neutral density filters numbers 0.1, 0.5, 1, 2, 3 and 4. This will provide a calibration curve similar to that shown in Figure 3. The accuracy of the neutral density filters numbers 1, 2, 3 and 4 should be known by obtaining specially calibrated filters or by calibrating them with a spectrophotometer. The calibration curve should be checked each day on which the apparatus is in use by taking a meter reading with the neutral density filter of optical density 2.

NOTE: Particular care should be taken of gelatin type filters by only exposing them to light for as short a time as necessary, and ensuring that they are not scratched and are stored in a dark cool position.

A new calibration curve shall be established if there is any change in the apparatus or measuring circuit, or if the meter reading with the No. 2 optical density filter in place varies by more than $\pm 6\%$ from the original reading, i.e. if the original transmission level is 1 % then the reading should be in the range 0.94% to 1.06% transmission. If only the No. 2 optical density filter reading differs from the original readings, then this filter shall be replaced.

10 REPORT The following information shall be reported:

- (a) The complete identification of the pipe tested.
- (b) The mean corrected percentage light transmission reported as the light transmission through the pipe wall.
- (c) Reference to this test method, i.e. AS/NZS 1462.14.