



Test method T222

Indirect tensile strength of rock drill core
(‘Brazil’ or splitting test)

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Revision Summary

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Note that Roads and Maritime Services is hereafter referred to as 'RMS'.

The most recent revision to Test method T222 (other than minor editorial changes) are indicated by a vertical line in the margin as shown here.

Test method T222

Indirect tensile strength of rock drill core ('Brazil' or splitting test)

1. Scope

This test method describes the procedure for determining the indirect tensile strength of rock drill cores. This test method is based on the procedure described in Australian Standard 1012.10 for concrete cylinders.

The method is applicable to cores of various diameters provided the length of core is at least twice the diameter. Refer Paper 6 of the Proceedings of Conference on the Production, Properties and Testing of Aggregates, UNSW, 1976.

2. Apparatus

- (a) A grade 'A' testing machine, meeting the requirements defined in AS B128, "Verification of Testing Machines", for the relevant ranges of compression loads. This testing machine shall also conform to the requirements of AS 1012.10 Clause 2.1 (a) to (f) inclusive
- (b) A thermostatically controlled oven with good air circulation, capable of maintaining a temperature within the range of 105°C to 110°C
- (c) A suitable testing jig to ensure that the specimen can be located centrally on the lower platen of the testing machine, with bearing strips aligned in a vertical plane passing through the axis of the specimen. It shall not constrain the specimen, the platens or plates while a load is being applied
- (d) Two bearing strips of tempered grade hardboard free from imperfections, approximately 5 mm thick, 25 mm wide and at least as long as the testing jib, are required for each specimen. The bearing strips are aligned in the testing jib above and below the specimen. Bearing strips shall not be re-used
- (e) A supplementary bearing bar or plate with a width of at least 50 mm; a thickness not less than the distance from the edge of the platen to the end of the specimen, or where the upper platen is longer than the test jib a thickness of approximately 20 mm; and a length of at least the length of the specimen

Each bearing surface of the bar or plate should not depart from a plane by more than 0.1 mm. Each bar and plate should be used so that the load is applied over the entire length of the specimen.

The bearing surfaces should be parallel within one degree

- (f) Rock cutting saw with a blade of at least 180 mm diameter
- (g) Apparatus for immersion of core in sodium sulphate namely:
 - (i) Baskets of suitable mesh to contain the test specimen during immersion in the test solution and during drying. The baskets shall be perforated in such a manner as to permit free access to the test solution and drainage of the solution without loss of the specimen
 - (ii) Sealed or stoppered containers for storage of the test solution before use
 - (iii) Containers for the test solution in which the test samples are immersed. The capacity of the containers shall be at least five times the volume occupied by the test sample
 - (iv) Water bath fitted with temperature control apparatus to maintain the test solution in the containers at a temperature of $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$
 - (v) Hydrometer, A 20/20 hydrometer complying with the requirements of AS 2026
- (h) A water bath of sufficient dimensions that the specimens of core may be completely immersed to a depth of at least 50 mm

- (i) Vernier callipers, micrometers or dial-gauge apparatus suitable to measure the critical dimensions to an accuracy of 0.2 mm

3. Preparation of Test Solution

(If required in accordance with Clause 4)

- (a) Dissolve sodium sulphate in clear tap water in the proportions of either 215 g of the anhydrous salt, or 450 g of the decahydrate (“Gaubert Salt”), per litre of water. The liquid may be heated and stirred in order to assist solution
- (b) When all the salt has dissolved, cool the solution to 23°C, stirring at regular intervals during cooling, and allow it to stand at 23°C ± 2°C for at least 24 hours
- (c) At the end of this period, the density of the solution, as measured at 23°C by a 20/20 hydrometer, should be within the range of 1.155 to 1.170 g/mL

Note:

- (i) If the density is above 1.170g/mL, sufficient water may be added to reduce the density to the required figure. Water should be added in small amounts, followed by vigorous stirring, and the solution allowed to rest for at least two hours before a final determination of density is made.
- (ii) If the density is below 1.155 m/mL, additional salt must be added and brought into the solution by heating and stirring. In this case, the temperature must be brought back to 23°C, and the whole solution allowed to stand at that temperature for at least four hours before a final determination of the density is made.
- (d) The solution must be filtered if any cloudiness is apparent. It must be discarded if it is unduly discoloured.
- (e) A fresh batch of solution is required for each test, and it is discarded at the completion of the test. Any solution stored before use should be stored in a sealed or stoppered container to prevent evaporation.

4. Test Portions

Select two adjoining unbroken specimens of the recovered drill core from the particular depths of interest. The specimens should be slightly longer than twice the core diameter.

If the material is proposed for use as aggregate a third specimen should be selected for pre-treatment by immersion in a sodium sulphate solution.

4.1 Pre-treatment of Test Portions

Cut each end of the core specimen so that the ends are smooth and within 3° of perpendicular to the longitudinal axis and so that the specimen length (L) is twice the diameter (D).

- (a) Take one specimen and dry to constant mass at a temperature within the range of 105°C to 110°C.
- (b) Take a second specimen and bring to the saturated surface dry condition as follows:
 - (i) Wash the test specimen thoroughly to remove dust or any other coatings from the surface of the particles.
 - (ii) Immerse the specimen in distilled water for a period of not less than 72 hours.
 - (iii) At the end of this period and immediately prior to testing drain off the water and roll the specimen in a large absorbent cloth.
 - (iv) Continue the procedure of rolling and wiping. Take care to minimise evaporation until all visible films of water have been removed but the surface of the specimen still appear to be damp.
- (c) Take the third specimen where appropriate, and subject it to five cycles of immersion in a sodium sulphate solution as follows:
 - (i) Immerse the specimen in the prepared sodium sulphate for a period of between 16 and 18 hours, in such a manner that the solution covers the specimen to a minimum depth of 15

mm. Cover the containers to avoid contamination. Maintain the solution at a temperature of 23°C for the full period of immersion (See Clause 9, Technique).

- (ii) After immersion, remove the test sample and container and permit to drain for 10-20 minutes and place in an oven at 105°C to 110°C. After drying to constant mass allow the specimen to cool to room temperature.
- (iii) Repeat the above cycle a further four times. Discard the test solution after five cycles.
- (iv) After completion of the final cycle allow the specimen to cool to room temperature and wash free of sulphate solution as determined by the reaction of the wash water to barium chloride.
- (v) Dry the specimen to constant mass at 105°C to 110°C, cool to room temperature immediately prior to test

5. Procedure

- (a) Determine the diameter to the nearest 0.2 mm of each test specimen by averaging three diameters measured near the ends and middle of the specimen. Determine the length to the nearest 1 mm by averaging at least two length measurements made along the lines in contact with the bearing strips.
- (b) Align a hardboard bearing strip in the lower portion of the test jib, followed by the dried untreated specimen. Align the other bearing strip on top of the specimen, in the upper part of the jig. Where necessary position so that the specimen is centred over the low platen
- (c) Apply a small initial load and remove any side constraint.
- (d) Apply, without shock, a continuously increasing load at a constant rate of 1.5 ± 0.15 MPa indirect tensile stress per minute until failure of the specimen occurs. Record the maximum applied load indicated by the testing machine at failure. Note the appearance, type and number of fracture surfaces at failure.
- (e) Repeat the above procedure for the saturated, surface dry specimen and when applicable the sodium sulphate treated specimen.

6. Calculations

Calculate the indirect tensile strength of each specimen as follows:

$$T = \frac{2000P}{\pi LD} \text{ MPa}$$

Where

T = indirect tensile strength

P = maximum applied force indicated by the testing machine in kilonewtons (kN)

L = length of specimen (mm)

D = diameter of specimen (mm)

7. Reporting

- (a) Report the indirect tensile strength of the dried specimen to the nearest 0.05 MPa.
- (b) Report the indirect tensile strength of the saturated surface dry specimen to the nearest 0.05 MPa.
- (c) Report the indirect tensile strength of the sodium sulphate treated specimen (where appropriate) to the nearest 0.05 MPa.
- (d) Report the dimensions of each specimen.
- (e) Report the appearance, number and type of fracture surfaces at failure for each specimen.

8. Techniques

Where the specimen is to be treated with sodium sulphate as set out in Clause 5 (c) the following arrangements should be adopted:

- (i) A convenient arrangement is to immerse the test sample in the solution at about 4 pm and remove it at 9 am the following morning. Drying then takes place between 9 am and 4 pm which usually allows sufficient time for adequate drying.
- (ii) During weekends or holidays, test samples should be allowed to stand at room temperature, suitably covered to prevent contamination. The test sample is re-immersed when an uninterrupted cycle can be completed.