

**INDUSTRY STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

MT/T 593.5-2011

**Artificial frozen soil physics mechanics performance test. Part
5: Artificial frozen soil tri-axial shear test method**

人工冻土物理力学性能试验 第5部分：人工冻土三轴剪切强度试验方法
(English Translation)

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1 Scope

This Part of MT/T 593 specifies the instruments and equipment, specimens, basic requirements, test procedures, as well as calculations and plotting methods for multi-specimen and single-specimen triaxial compression tests on artificially frozen soil.

This Part is applicable to the testing and calculation of triaxial compressive strength parameters for frozen undisturbed soil and frozen remolded soil.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document;

for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

MT/T 593.1 Artificial frozen soil physics mechanics performance test - Part 1.

Artificial frozen soil experiment sample and specimen preparation method

MT/T 593.3 Artificial frozen soil physics mechanics performance test - Part 3.

Consolidation under hydrostatic pressure for artificial frozen soil test method

MT/T 593.4 Artificial frozen soil physics mechanics performance test - Part 4.

Artificial frozen soil uniaxial compression strength test method

3 Terms and definitions

The following terms and definitions apply to this document.

3.1

Tri-axial shear test

A process involving the application of axial compressive stress (principal stress difference $\sigma_1 - \sigma_3$) under various constant confining pressures (i.e., minor principal stress $\sigma_2 = \sigma_3$), subjecting the specimen to shear until failure occurs.

4 Instruments and equipment for testing

4.1

Triaxial compression tester (as shown in Figure 1). Features adjustable strain rates; maximum axial load of 200 kN; confining pressure of 6 MPa (suitable for soil burial depths < 300 m), 12 MPa (suitable for soil burial depths < 700 m), or 20 MPa (suitable for soil burial depths < 1200 m), with a fluctuation tolerance not exceeding 10 kPa.

4.2

Stress and deformation test components. Pressure transducer (range. 0 kN ~ 200 kN; accuracy. 1%); displacement transducer (axial range. 0 mm ~ 50 mm; accuracy. 1%); automatic data acquisition system, etc.

4.3

Temperature sensor. Range. -40 °C ~ +40 °C; accuracy. 0.2 °C.

4.4

Cooling and temperature control equipment.

4.5

Equipment for testing moisture content and density of test specimens.

Figure 1 -- Low-temperature triaxial compression tester

5 Test specimens

5.1

Frozen undisturbed soil specimens and frozen remolded soil specimens shall be used; their preparation methods shall be carried out in accordance with the provisions of Clauses 6.2.2 and 6.2.3 in MT/T 593.1.

5.2

Test specifications shall be consistent with the specimen specification which is used in MT/T 593.4.

5.3

Number of specimens. 1 (for single-specimen staged loading) or 3 ~ 4 (for multi-specimen loading).

6 Basic requirements

6.1

The test shall be conducted at the specified test temperature.

6.2

The temperature fluctuation shall be less than or equal to ± 0.2 °C.

6.3

If only one test temperature is required, -10 °C shall be selected; if multiple test temperatures are required, -10 °C shall be included among them; if there are special requirements, other test temperatures may be selected.

6.4

Prior to the test, all instruments and equipment used for the test shall be properly calibrated.

7.1.1 Verify the source, identification number, density, moisture content of the specimens; record these details in the Table provided in Appendix A.

7.1.2 Based on the hydrostatic pressure of the stratum from which the specimen was taken, which is calculated as $0.013H$, where H represents the depth of the soil layer under test in meters (m), determine three levels of confining pressure values. ($0.013H$

- 1) MPa, ($0.013H$) MPa, ($0.013H + 1$) MPa; or ($0.013H$) MPa, ($0.013H + 1$) MPa, ($0.013H + 2$) MPa (when the depth is less than 120 m).

7.1.3 Perform specimen consolidation, in accordance with steps 7.1 ~ 7.7 of MT/T 593.3.

7.1.4 The axial strain rate shall be taken as 1%/min.

7.1.5 Start the triaxial testing apparatus; take readings from the volume change

measuring device; during the test, the fluctuation in confining pressure shall not exceed ± 10 kPa.

7.1.6 During the initial stage of the test, take one reading each of the axial load and deformation for every 0.3% ~ 0.4% increment in specimen strain. When the strain reaches 3%, subsequent readings shall be taken for every 0.6% ~ 0.7% increment in axial strain. Volume changes shall be continuously recorded by the volume change measurement device. If the specimen is particularly hard and brittle, or exceptionally soft and weak, the frequency of readings may be increased or decreased accordingly.

7.1.7 When the axial stress ceases to increase, continue loading until the axial strain increases by an additional 3% ~ 5%. If the pressure transducer reading shows no significant change during this period, continue the test until the axial strain reaches 20%; record the final values of the load and deformation.

7.1.8 Upon completion of the test, remove the axial load and confining pressure.

Describe the shape of the specimen after failure; determine the moisture content and density of the specimen following the test.

7.1.9 For the remaining specimens, conduct the tests under different confining pressures

in accordance with the procedures specified in Clauses 7.1.1 ~ 7.1.8.

7.2 Single-specimen staged loading triaxial shear test

7.2.1

Proceed in accordance with the procedures specified in Clauses 7.1.1 ~ 7.1.6.

7.2.2 Stop loading, when the load value approaches stability (i.e., the principal stress

difference is less than 5 kPa) or when yielding just begins to occur after the axial strain has reached the elastic limit. Record the load and axial deformation values.

7.2.3 Remove the axial load; apply the second level of confining pressure. Once

consolidation has stabilized, proceed in accordance with the procedures specified in Clauses 7.1.4 ~ 7.1.6 and 7.2.2.