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**NB/T 20437-2017**

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**Specification for test of concrete in nuclear power engineering**

核电工程混凝土试验、检验规程

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## Foreword

This document was issued on 1 April 2017 by the National Energy Administration of the PRC and takes effect on 1 October 2017.

It is a NB/T standard: recommended rather than compulsory, but it is the text a Chinese reviewer applies when assessing a submission.

It is classified under ICS 27.120.20, Chinese classification F65.

This standard was drafted in accordance with the rules given in GB/T 1.1-2009.

This standard was proposed by the Nuclear Power Standardization Technical Committee of the energy industry.

This standard is under the jurisdiction of the Nuclear Industry Standardization Institute.

Responsible drafting organizations: China Nuclear Industry 24 Construction Co., Ltd., China Nuclear Power Engineering Co., Ltd. (CGN), China Nuclear Industry Huaxing Construction Co., Ltd. and Sichuan Zhonghe Airuite Engineering Testing Co., Ltd.

Participating drafting organizations: China Nuclear Concrete Co., Ltd. and China Nuclear Huatai Construction Company.

## 1 Scope

NB/T 20437-2017 sets out how concrete is tested and inspected on nuclear power plant

construction. Concrete in a nuclear plant carries more than load: the containment, the reactor building and the spent fuel structures must perform for sixty years under temperature, radiation and, in some cases, pressure, so the evidence that the concrete as placed matches the concrete as designed is itself a safety record. The specification sets the scope and applies to ordinary concrete, with self-compacting and radiation shielding concrete able to follow it as a reference. It gives the normative references and the terms, then the tests on fresh concrete: sampling, slump and slump flow, temperature, setting time, bleeding under normal conditions and under pressure, density, and air content with the calibration of the apparatus. Physical and mechanical testing follows - the making and curing of specimens, dry density, compressive strength on cubes and cylinders, splitting and flexural tensile strength, and the modulus of elasticity. Durability testing covers water penetration, chloride ion permeability, carbonation, freeze-thaw resistance and shrinkage; thermal testing covers adiabatic temperature rise, thermal conductivity, specific heat and thermal diffusivity; and the remaining inspection chapters cover the in-situ testing of the structure. For each test the apparatus, the procedure, the calculation and the reporting are specified. Note that the Chinese title covers inspection as well as testing, which the printed English omits.

This standard specifies the test methods for fresh concrete, the test methods for the mechanical properties of concrete, the test methods for the long-term performance and durability of concrete, and the test methods for the thermophysical parameters of concrete used during the construction of nuclear power projects.

This standard applies to the performance testing and inspection of ordinary concrete during the construction of nuclear power projects. The test and inspection methods for special concretes such as self-compacting concrete and radiation shielding concrete may be carried out with reference to this standard.

## 2 Normative references

The following documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 176 Methods for chemical analysis of cement

GB/T 2611 General technical requirements for testing machines

GB/T 3159 Hydraulic universal testing machines

GB/T 8077 Methods for testing uniformity of concrete admixtures

GB/T 11896 Water quality - Determination of chloride - Silver nitrate titration method

GB/T 14684 Sand for construction

GB/T 50080 Standard for test method of performance on ordinary fresh concrete

JGJ 55 Specification for mix proportion design of ordinary concrete

JG 237 Moulds for concrete test specimens

JG/T 243 Freeze-thaw test apparatus for concrete

JG/T 245 Vibrating table for concrete tests

JG/T 247 Carbonation test chamber for concrete

JG/T 248 Slump cone for concrete

JG/T 249 Impermeability tester for concrete

JG/T 261 Chloride ion electric flux tester for concrete

JG/T 262 Chloride ion diffusion coefficient tester for concrete

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 air content: the percentage of air contained in a unit volume of fresh concrete.

3.2 bleeding: the phenomenon in which water seeps out at the upper surface of freshly mixed concrete in a static state.

3.3 pressure bleeding: the phenomenon in which mixing water seeps out of freshly mixed concrete under a certain pressure.

3.4 compressive modulus of elasticity: the stress required to produce a unit deformation when a concrete prism or cylinder specimen is subjected to a certain axial compressive load.

3.5 resistance to freezing and thawing: the ability of concrete to resist freeze-thaw cycles.

3.6 resistance to hydraulic pressure: the ability of concrete to resist a certain water pressure.

3.7 Poisson's ratio: the ratio of the transverse deformation to the longitudinal deformation of a concrete specimen under a certain pressure.

### 4 Tests on the properties of fresh concrete

4.1 Sampling and preparation of samples. 4.1.1 Sampling: samples of fresh concrete shall be representative.

4.1.1 a) Concrete samples should be taken from the truck mixer; when several tests are to be performed at the same time, the concrete required shall be taken from the same truck.

Before sampling, not less than 20 L of concrete should first be discarded; the quantity sampled shall be more than 1.5 times the quantity required for the tests and should not be less than 20 L.

4.1.1 b) If the slump of the concrete is greater than 160 mm, the drum of the truck mixer shall be rotated rapidly for 5 to 10 revolutions before sampling; the whole sampling process shall be completed within 10 min.

4.1.1 c) The time from the completion of sampling to the start of the property tests should not exceed 5 min.

4.1.1 d) Concrete should be sampled at the placing location. When sampling is carried out elsewhere, it shall be justified by testing.

4.1.2 a) When fresh concrete is prepared in the laboratory, the laboratory temperature during mixing shall be kept at 20 degrees C plus or minus 5 degrees C, and the temperature of all materials shall be consistent with the laboratory temperature. When concrete used under simulated construction conditions is required, the temperature of the raw materials should be consistent with that at the construction site.

4.1.2 b) When concrete is mixed in the laboratory, the quantities of materials shall be measured by mass. Weighing accuracy: plus or minus 1 per cent for aggregates; plus or minus 0.5 per cent for water, cement, supplementary cementitious materials and admixtures.

4.1.2 c) The preparation of fresh concrete in the laboratory shall comply with the relevant provisions of JGJ 55.

4.1.2 d) The time from the completion of sample preparation to the start of the property tests should not exceed 5 min.

4.2.1 Slump and slump flow test: this method applies to the determination of the consistency of fresh concrete with a maximum aggregate size not greater than 40 mm and a slump not less than 10 mm.

4.2.2 The slump cone used for the slump and slump flow tests shall comply with the relevant technical requirements of JG/T 248.

4.2.3 The base plate used for the slump and slump flow tests should be made of hard stainless steel or another hard non-absorbent material, as shown in Figure 1 (a 1000 mm square plate marked with concentric circles of diameter 200 mm, 300 mm, 500 mm, 600 mm, 700 mm, 800 mm and 900 mm; unit: mm).

4.2.4 a) Moisten the slump cone and the base plate; there shall be no free water on the inner wall of the cone or on the plate. Place the base plate on a firm horizontal surface, place the cone at the centre of the plate and stand on the foot pedals on both sides, so that the cone remains in a fixed position while being filled.