

BUREAU OF INDIAN STANDARDS

DRAFT FOR COMMENTS ONLY

(Not to be reproduced without the permission of BIS or used as an Indian Standard)

भारतीय मानक मसौदा

**अनाज भंडारण के लिए सीलबंद साइलो -
सीलिंग की आवश्यकताएँ**

Draft Indian Standard

**SEALED SILOS FOR STORAGE OF FOODGRAINS – SEALING
REQUIREMENTS**

ICS No. 55.220; 67.060

Foodgrains, Allied Products, and Other Agricultural
Produce Sectional Committee, FAD 16

Last Date of Comments
12 December 2024

FOREWORD

(Formal Clause would be added later)

The establishment of effective and reliable storage solutions for foodgrains is of paramount importance for India. Sealed silos represent an advanced storage solution designed to provide an airtight environment, ensuring that fumigation is effective to prevent insect infestation of stored foodgrains. In a country where post-harvest losses due to inadequate storage infrastructure are significant, the implementation of sealed silos stands as a vital step forward.

This standard outlines the essential requirements for sealed silos, including structural, design, and performance criteria necessary for airtightness. Compliance with these standards will not only enhance the quality and longevity of stored grains but also support India's commitment to economic stability, environmental sustainability, and enhanced food security. By implementing comprehensive guidelines for sealed silo construction and maintenance, we can strengthen the nation's grain storage infrastructure, fostering resilience and sustainability within the agricultural sector.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (second revision)'.

1 SCOPE

This Standard covers the basic requirements for sealed silos (or airtight/gastight silos) for storage of foodgrains.

2 REFERENCE

The following standards contain provision which through reference in this text, constitutes provision of this standard. At the time of publication, the edition indicated were valid. All standards are subject to revision and parties to agreements based on this standard is encouraged to investigate the possibility of applying the most recent edition of the standard indicated below:

<i>IS No.</i>	<i>Title</i>
IS 5503 (Part 1) : 1969	General requirements for silos for grain storage: Part 1 Constructional requirements
IS 6151 (Part 1) : 2020	Storage management code Part 1 Terminology (<i>first revision</i>)
IS 6151 (Part 2) : 1971	Storage management code: Part 2 General care in handling and storage of agricultural produce and inputs
IS 7247 (Part 3) : 2023	Fumigation of agricultural produce — Code of practice Part 3 Aluminium phosphide (Phosphine) (<i>first revision</i>)
IS 7247 (Part 5) : 2023	Fumigation of agricultural produce — Code of practice Part 5 General requirements (<i>first revision</i>)

3 TERMINOLOGIES

For the purpose of this Standard, following definition, in addition to definitions mentioned in IS 6151 (Part 1) shall apply:

3.1 Sealed Silos

A sealed silo is a structure that meets the gas sealing requirements as specified in 4.4 and used for the purpose of safe storage of foodgrains prior to fumigation.

NOTE – A sealed silo may be opened for aeration and/or ventilation.

4 REQUIREMENTS

4.1. All sealed silos, for the purpose of insect control using phosphine [*see* IS 7247 (Part 3)] or any other permissible fumigant, for fumigation [*see* IS 7247 (Part 5)] shall be structurally designed to meet the sealing requirements specified in 4.4.

4.2 All vents of sealed silos including motorised exhaust vents shall be sealed. All sidewall sheet joints, roof sheet joints, eave joints, peak cap joints, aeration fan suction openings, manholes, sidewall doors etc., shall be sealed properly to ensure no gas leakage.

4.3 The silo shall be equipped with piping and manifold to fix manometer and pressure relief valve to conduct half life pressure test. The operating pressure for the relief valve shall comply with the requirements specified in **4.4**.

4.4 A sealed silo, together with its relief valve, shall be designed to remain sealed from the atmosphere within the minimum pressure range of ± 500 pascal gauge pressure. In case of old silos, all sealed silos shall be able to maintain gas pressure for three minutes and, in case of new silos, all sealed silos shall be able to maintain gas pressure for five minutes, when tested as per method specified in Annex A.

NOTE - Old Silos refer to storage structures that have previously been used to store food grains. New Silos are brand-new storage structures that have never been used for grain storage before.

4.5 All seals, including structural seals, inlets, outlets, shall ventilators, aeration, fumigation etc. shall be designed to pass the pressure test, specified in Annex A, when the silo is empty, partially filled, fully loaded and after annual maintenance. This hold of pressure inside the silo reduces the loss and dilution of fumigant gas like phosphine.

4.6 A comprehensive report documenting the test results, as per **A-5** should be readily available.

4.7 The appropriate pressure relief valve and piping arrangement may be fitted with silo wall for application of pressure and to monitor while performing pressure test. The pressure may be applied to the silo using an air compressor through an appropriate valve installed on the sidewall or through an aeration fan fitted with the silo. The closed loop system for fumigation can also be used for applying the pressure and monitoring it during the test. The real time pressure can be measured using U tube manometer or appropriately calibrated pressure measurement device.

4.8 The structural design of the sealed silo shall meet design procedures for calculations of loads, permissible stresses, analysis of forces etc. to meet the customer requirements and local conditions, as decided between purchaser and the manufacturer.

4.9 The silo shall be designed to meet all the structural loads (stored grain, loading and unloading forces, wind forces, seismic loads etc.) and to maintain their integrity during the life of the structure.

5 MAINTENANCE OF SEALED SILOS

5.1 The proper maintenance of sealed silos is essential to ensure the quality and safety of stored foodgrains. Maintenance guidelines outlined in Annex B shall be followed for this purpose.

ANNEX A
PRESSURE TEST
(Clauses 4.4 and 4.5)

A-1 GENERAL

The methods for pressure testing sealed silos verifies that the silo achieves the level of airtightness specified in **5.2.1** essential for effective pest control using phosphine gas and any other suitable fumigant.

A-2 PRINCIPLE

The Half-Life Pressure Decay Test measures the airtightness of a sealed silo by evaluating the rate at which gas escapes from the structure. The principle behind this test is that the amount of gas escaping (or gas loss) is directly proportional to the level of leakiness of silos.

A-3 APPARATUS

- a) Stopwatch with accuracy of seconds;
- b) Air compressor or the equivalent;
- c) Pressure relief valve;
- d) Air inlet valve; and
- e) Oil type manometer or any other pressure gauge.

A-4 PROCEDURE

Fill the oil in the manometer with the recommended oil (suggested by the manufacturer). Increase the pressure inside the silo according to the manufacturer's recommendations until the difference in oil levels in the adjacent manometer tubes (one tube connected to the silo and the other open to the environment) reaches at least 25 mm. Cut off the air supply and carefully observe the oil levels in the oil type manometer. Measure the time it takes for the pressure inside the silo to drop to half its initial pressure. This can be determined by either observing a 12 mm decrease in oil level in the adjacent manometer tubes; or a 250 Pa drop in the pressure reading on a manometer.

NOTES –

- 1) A suitable pressure gauge may also be used instead of the manometer. In such a case monitoring of the pressure gauge connected to the silo and recording the time it takes for the reading to drop to 50 % of its initial value (approximately 250 Pa), should be measured.
- 2) Ensure that the correct oil is used in pressure gauge and the manufacturer's instructions for your specific pressure gauge is followed.

A-5 REPORT

The test report shall contain the following:

- a) Name and signature of the testing personnel;
- b) Date of the test;
- c) References to this standard; and
- d) Test results.

A-6 PRECAUTIONS

A-6.1 For accurate and reliable results, the pressure test shall be conducted under stable atmospheric conditions, characterized by:

- i) **Limited temperature fluctuations** – Avoid testing during periods of extreme heat, as this can cause rapid gas expansion within the silo.
- ii) **Minimal or no wind** – Ideal conditions involve calm winds or light breezes.

ANNEX B
GUIDELINES FOR MAINTENANCE OF SEALED SILOS
(Clause 5.1)

S.No.	Activity	Tasks
i)	Regular Inspection	<ul style="list-style-type: none"> - Conduct visual inspections regularly for both the exterior and interior of the silo. - Check for signs of damage, corrosion, or wear and tear. - Inspect seals, gaskets, and joints to ensure their integrity.
ii)	Cleaning	<ul style="list-style-type: none"> - Regularly clean the interior to eliminate residue, dust, or foreign materials. - Ensure thorough cleaning, especially in corners and at the bottom, using appropriate equipment and following safety protocols.
iii)	Seal Integrity	<ul style="list-style-type: none"> - Inspect the rubber seal on upper hatches and out loading points for damage before each filling. - Promptly replace the seal if any damage, such as perishing or physical breakage, is identified. - Inspection is mandatory before every filling operation.
iv)	Pressure Relief Valve Maintenance	<ul style="list-style-type: none"> - Ensure the pressure relief valve is in good condition. - For oil bath-type valves, maintain the oil level consistently at the centre line. - Regular checks and maintenance are necessary.
v)	Structural Integrity	<ul style="list-style-type: none"> - Monitor the structural integrity, including walls, roof, and foundation. - Address issues like cracks or deformities promptly to prevent structural failure.
vi)	Emergency Preparedness	<ul style="list-style-type: none"> - Develop and regularly review emergency response plans for scenarios such as leaks, fires, or structural failures. - Ensure all personnel are well-trained in emergency procedures.
vii)	Documentation	<ul style="list-style-type: none"> - Maintain comprehensive records of maintenance activities, inspections, and repairs. - Document storage conditions and any encountered issues for future reference.