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SPECIFICATION FOR STEEL TANKS FOR STORAGE OF MOLASSES

(*First Revision*)

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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Indian Standard

SPECIFICATION FOR STEEL TANKS FOR STORAGE OF MOLASSES

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 13 June 1980, after the draft finalized by the Sugar Industry Sectional Committee had been approved by the Agricultural and Food Products Division Council.

0.2 Molasses, which is often referred to a waste product of sugar factories, is an important raw material for distilleries producing alcohol. Storage of molasses without deterioration is important. Presently, molasses is being stored in many places in *kaccha* or pucca masonry tanks with or without roofs where molasses is likely to get diluted with and have losses due to seepage and contamination leading to its deterioration. Construction of molasses tanks, preferably of steel, is of marked importance in arresting the deterioration and wastage of molasses. This standard gives the specification of steel tanks for efficient storage of molasses.

0.3 This standard is intended chiefly to cover the technical provisions relating to the construction of covered mild steel tanks for storage of molasses.

0.4 This standard was first published in 1969. In the present revision, the format has been changed and the requirements of uniformity and recommendatory nature have been appended to the essential requirements to enable better implementation of the standard. In this revision, the provision of peripheral vertcial columns has been deleted and molasses tanks with higher capacities have been included, besides incorporation of Amendment No. 1, issued to the earlier version.

0.4.1 The recommendations on location of the steel tanks in case of sugar factories and construction of a cement concrete or masonry platform are given in Appendix A for guidance.

0.5 References may be made to the following documents for details of design and fabrication of the steel tanks for storage of molasses:

IS : 803-1962 Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tanks.

BS : 2654 : Part I-1956 Vertical mild steel welded storage tanks with butt-welded shells for the petroleum industry: Part I Design and fabrication. British Standards Institution.

API STD 650, Sixth Edition — 1978 Welded steel tanks for oil storage. American Petroleum Institute.

0.6 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 : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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1. SCOPE

1.1 This standard covers the requirements of materials, recommended volumes and dimensions, method of construction, and testing of mild steel tanks for storage of molasses in sugar factories.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definition shall apply.

2.1 Cane Molasses — The mother liquor left over after the recovery of sugar in the vacuum pan process (*see* IS : 1162-1958†).

3. VOLUMES AND DIMENSIONS

3.1 The diameter and height of the molasses storage tanks usually depends upon the size of the ground area available and the volume of molasses required to be stored. Table 1 gives the recommended volumes and dimensions of tanks for storage of molasses.

NOTE 1 — The height of the tank shall be determined taking into consideration the soil bearing capacity and the cost of making foundation suitable for the recommended height.

NOTE 2 — The volume of tanks for storing molasses for a sugar factory of cane crushing capacity 1 250 tonnes per day may be calculated as given in **A-3**.

*Rules for rounding off numerical values (*revised*).
†Specification for cane molasses.

TABLE 1 RECOMENDED VOLUMES AND DIMENSIONS FOR STEEL TANKS FOR STORAGE OF MOLASSES

(*Clause* 3.1)

Total Volume	Approx. Effective Volume	Diameter	Height	Bottom Plate	Thickness of Steel Plates							
					1st Course	2nd Course	3rd Course	4th Course	5th Course	6th Course	Last 2 Courses	Roof*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
m^3	m^3	m	m		mm	mm	mm	mm	mm	mm	mm	mm
1 250	1 150	14	8·00	10	12	12	10	8	6	6	6	5
1 500	1 400	15	8·50	10	12	12	10	8	6	6	6	5
2 000	1 850	16	9·75	10	12	12	10	8	6	6	6	5
2 500	2 350	18	9·75	10	12	12	10	8	6	6	6	5
3 000	2 850	20	9·75	10	12	12	12	10	8	6	6	5
3 500	3 200	21	9·75	10	12	12	12	10	8	6	6	5
4 000	3 800	23	9·75	10	12	12	12	10	8	6	6	5
4 500	4 150	24	9·75	12	14	14	12	10	8	6	6	5
5 400	4 900	28	9·60	12	16	14	12	10	8	6	6	5
7 000	6 300	31	9·60	12	16	14	12	10	8	6	6	5
8 000	7 200	34	9·60	12	18	16	14	12	10	8	6	5

*In coastal or heavy rainfall areas the thickness of the roof plates should be 6 mm.

4. MATERIALS

4.1 The tank for storage of molasses shall be built from mild steel plates (*see* IS : 226-1975*).

4.2 Thickness of the steel plates used in the bottom, shell and roof shall be as given in Table 1 [*see* IS : 1730 (Part I)-1974†].

5. FABRICATION

5.1 All joints shall be seam or butt welded. The welded joints shall be sound and finished smooth inside and shall be water-tight. The bottom plates shall be V-grooved and welded with butt welding. Mild steel strip 60 mm wide and 6 mm thick shall be provided over the welds.

5.1.1 The permissible stresses for welds and welded connections shall conform to values given in IS : 816-1969‡.

5.2 Suitable radial trusses shall also be employed for support of the roof of the tank (*see* Fig. 1), which may directly be supported on the shell plates with a curb angle at the roof level all around.

5.3 Centre Column — Two channels ISMC 300 or ISMC 225 at right angles to each other with suitable saddle at the base shall be provided.

5.4 The permissible stresses for the bottom, shell and roof of the tank shall be in accordance with the appropriate clauses of IS : 800-1962§.

5.5 The tank shall be designed with due consideration to the wind loads, which shall be in accordance with IS : 875-1964‖.

6. FITTINGS AND ACCESSORIES

6.1 The tank shall be fitted with the following accessories and fittings and shall be provided with suitable openings for fittings as described in **6.1.1** to **6.1.14** and shown in Fig. 1.

6.1.1 *Outlet* — The outlet shall be of steel with a minimum diameter of 15 cm and shall be located on the first course of the tank 15 cm above the bottom. The suction for pumping molasses should be from the side of the tank.

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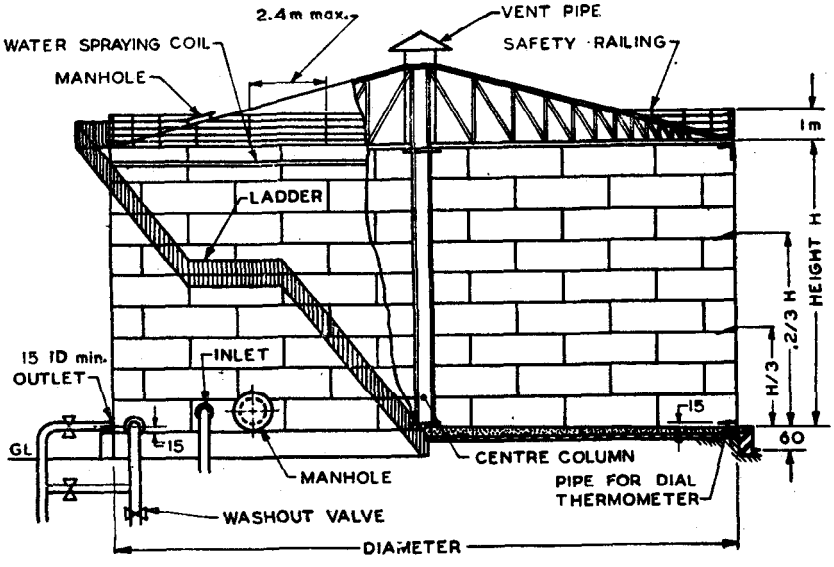
*Specification for structural steel (standard quality) (*fifth revision*).

†Dimensions for steel plate, sheet and strip for structural and general engineering purposes: Part I Plate (*first revision*).

‡Code of practice for use of metal arc welding for general construction in mild steel (*first revision*).

§Code of practice for use of structural steel in general building construction (*revised*).

‖Code of practice for structural safety of buildings: Loading standards (*revised*).



All dimensions in millimetres.

FIG. 1 DETAILS OF THE STEEL TANK FOR STORAGE OF MOLASSES

6.1.2 *Outlet Discharge Valve* — A sluice valve, preferably of stainless steel, shall be fitted to the outlet opening. It is desirable to have two valves in series.

6.1.3 *Drainage or Wash Out Valve* — A tank shall be provided with a sluice valve fitted at the bottom of the tank and also connected to the outlet (*see* **6.1.1** and Fig. 1).

6.1.4 *Inlet* — The inlet of molasses shall preferably be at the bottom (*see* Fig. 1) unless the molasses is discharged through an overhead pipe line in which case the molasses should not be allowed to fall from a height as in doing so a lot of air gets occluded, which is not desirable. Instead, the pipe may be held tangential to the inside of the wall about a metre from the top. The inlet shall be fitted with a non-return valve followed by a sluice valve.

6.1.5 *Indicator Thermometer* — The tank shall be provided with at least three 15-cm dial thermometers, one about 0·15 m from the bottom, other at one-third height and the third at two-thirds height of the tank. The

pockets for inserting the bulb of the thermometer shall be pipes of 25 mm diameter and 1 m length filled with oil. The pocket pipes should be fitted to the joints for support, wherever possible.

6.1.6 *Manhole* — Two manholes having diameter of 45 to 60 cm shall be located one on the top and other on the side bottom of the tank (*see* Fig. 1). A suitable attachment shall be provided to securly hold the man-way door in position through a suitable bracket. A bolt with nut attachment shall be fitted to hold the bracket in position, alternatively, a loose cover with lifting handle may be provided. The manhole covers shall be water-tight.

6.1.7 *Safety Railing* — A safety railing, preferably around the roof of the tank but at least in the quadrant of the manhole shall be provided. The railing shall be of the height of 1 m. The maximum distance between two railing posts shall be 2·4 m (*see* Fig. 1).

6.1.8 *Vent Pipe or Chimney* — A vent pipe or chimney shall be provided at the centre of the roof for venting out of the gas (*see* Fig. 1). For large size tank over 16 m diameter, more than one vent pipe may be provided. The mouth of the vent pipe shall be suitably protected with with wire netting.

6.1.9 A 25 mm drip cock shall be provided at the outlet for sampling purposes.

6.1.10 *Water Spraying Coil* — Provision of a perforated water spraying coil 25 mm in diameter shall be made all round outside the tank. The direction of the perforations shall be such that the water flows along the sides of the tank (*see* Fig. 1).

6.1.11 *Painting* — The tank shall be suitably painted on the outside and with anti-corrosive paint on the inside. The roof, and the supporting trusses and the top strake may be painted inside also.

6.1.12 *Ladder* — The tank shall be provided with a ladder of sturdy construction and design and made of aluminium alloy or mild steel painted or otherwise made rustproof. The ladder shall be provided with suitable guard.

6.1.13 The tank may be provided with a suitable level indicator.

6.1.14 All openings in the tank shall be so made that there is no possibility of accumulation of liquid or other foreign matter and the entrances are protected against dust, insects, and other extraneous materials. All component parts shall be capable of being cleaned and inspected in position or by dismantling, if necessary.

7. TANK TESTING

7.1 The tank shall not leak when tested by the following method.

7.1.1 *Bottom Testing*

7.1.1.1 After the bottom and at least the bottom courses of shell plates have been welded, the bottom shall be tested by pumping air beneath the bottom plates to a pressure just sufficient to lift them off the foundation and in any case of not less than 100 mm H_2O gauge. The pressure shall be held by the construction of a temporary dam of clay or other suitable material around the tank periphery. Soap suds or other suitable material shall be applied to all joints for the detection of leaks.

7.1.1.2 Subject to the agreement of the purchaser, molasses may be used instead of air and soap suds to test for leaks.

7.1.1.3 Alternatively, the bottom seams may be tested by the vacuum-box method.

7.1.2 *Shell Testing*

7.1.2.1 The shells of tanks shall be tested after the completion of the roof. Wherever possible, testing shall be by filling the tank with water to the level of the top course.

7.1.2.2 Where local conditions are such that testing with water is impractical, the tank shall be testing by painting or spraying all joints on the inside with a highly penetrating oil and noting any leaks.

7.1.3 *Repair of Leaks*

7.1.3.1 All leaks detected during testing shall be repaired to the satisfaction of the purchaser and on completion, the entire tank shall be tight and free from leaks.

7.1.3.2 In the joints between roof plates only, pinhole leaks may be repaired by mechanical caulking. However, where there is any indication of considerable porosity the leaks shall be sealed by laying down an additional layer of weld metal over the porous section.

7.1.3.3 In all other joints, whether between shell plates or bottom plates or both, leaks shall be required only by welding, if necessary, after first cutting out the defective part.

7.1.3.4 When the tank is filled with water for testing, defects in the shell joints shall be repaired with the water level at least 300 mm below the joint being repaired.

7.1.3.5 No welding shall be done on any tank unless all lines connecting thereto have been completely blanked off. No repairs shall be attempted on tanks while filled with molasses, nor any tanks which have contained molasses until the tank has been emptied, cleaned and gas freed in a safe manner. No repairs shall be attempted by erector on a tank which has contained molasses except in a manner approved in writing by the purchaser, and in the presence of the purchaser's inspector.

8. MARKING

8.1 The tank shall be marked legibly and permanently with the following particulars:

a) Tank number, and
b) Volume of the tank in m^3.

8.1.1 Each tank may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

APPENDIX A

(*Clauses* 0.4.1 *and* 3.1)

DETAILS OF LOCATION, CONSTRUCTION OF PLATFORM AND CALCULATION OF VOLUME OF STEEL TANKS FOR STORAGE OF MOLASSES

A-1. LOCATION

A-1.1 The tank shall be adjacent to the factory to facilitate easy transport of molasses to the tank. The tank, as far as possible, should be away from sugar godowns, spray ponds and effluent drains.

A-1.2 The general location of the tank is indicated in Fig. 2.

A-2. CONSTRUCTION OF PLATFORM OR PLINTH

A-2.1 It is necessary that tanks are built on good foundations. Details of a typical foundation normally adopted are shown in Fig. 3, where soil conditions are adverse, care should be taken to design the foundation properly such that no subsidence takes place.

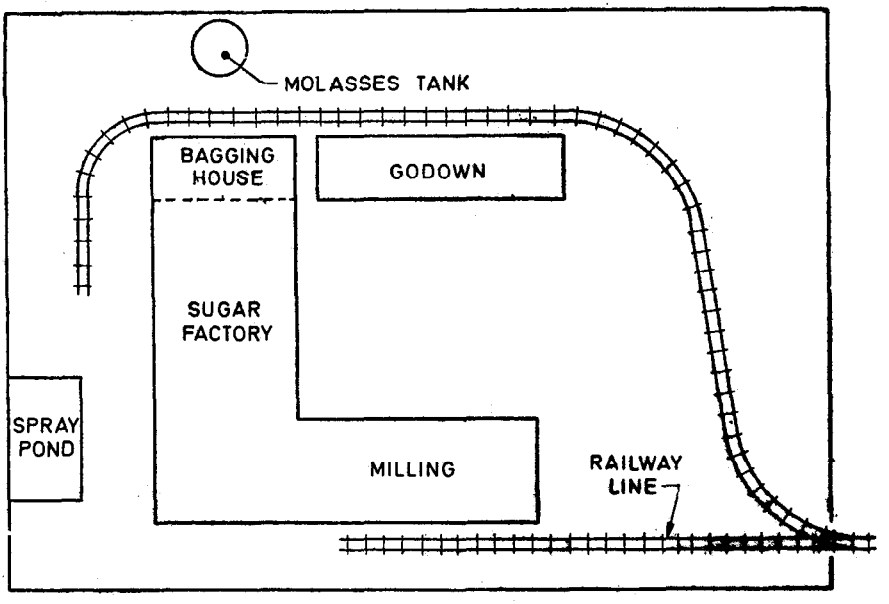
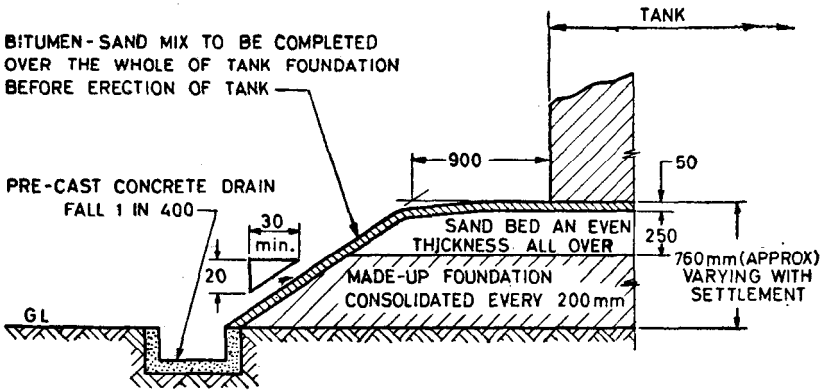


FIG. 2 GENERAL LOCATION OF A STEEL TANK FOR STORAGE OF MOLASSES

A-3. CALCULATION OF VOLUMES OF TANKS

A-3.1 The volume of the tanks for storing molasses for a factory of 1 250 tonnes per day cane crushing capacity may be calculated as follows. The required volume for different factories with varying cane crushing capacities may be calculated accordingly:

a) Average molasses production, percent cane	4·0
b) Average duration of season in days	140
c) Total molasses production in tonnes for the season	7 000
d) Volume of molasses in litres/tonne at 90° Brix	708
e) Volume of molasses in m^3 produced in the season	4 955
f) Add 10 percent for foam, in m^3	496
g) Total gross volume in m^3 available for storage	5 451 or 5 500
h) Recommended number of tanks	2 (*see* Note 1 under 3.1)



Bitumen-Sand or Road-Tar Mix — In preparing this bitumen-sand mix it is necessary for the engineer-in-charge to make sure that the mix used gives the desired result, that is, a layer which is as waterproof as possible but at the same time sufficiently firm to carry the necessary traffic and to permit the welding of the bottom plates. To obtain this result it is generally necessary to make one or two trial mixes and it is emphasized that the preparation of this surface should be given good supervision.

All dimensions in millimetres.

FIG. 3 TYPICAL SECTION OF FOUNDATION FOR VERTICAL TANKS

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