

## भारतीय मानक ब्यूरो

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*भारतीय मानक मसौदा*

**फर्नेस प्रतिष्ठानों, स्टीम बॉयलरों, औद्योगिक भट्टियों और चिमनियों को सुखाना, प्री-हीटिंग और चालू करना — सिफ़ारिशें**

*(आईएस 14492 का पहला पुनरीक्षण)*

*Draft Indian Standard*

**Drying, Pre-Heating and Commissioning of Furnace Installations, Steam Boilers, Industrial Kilns and Chimneys — Recommendations**

*(First Revision of IS 14492)*

ICS 25.180.20

Industrial Fuel-Fired Furnaces  
Sectional Committee, MTD 26

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### FOREWORD

*(Formal clauses will be added later)*

This standard was originally published in 1997. This revision has been brought out to bring the standard in the latest style and format of the Indian Standards. In addition to this, references clause has been updated.

Furnace installations, steam boilers, industrial kilns and chimneys used for various industrial applications, after installation are required to be dried and pre-heated before they are commissioned for the intended use. This standard outlines various precautions to be taken with regard to necessary work and the entire installation before putting to use.

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*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Draft Indian Standard*

**Drying, Pre-Heating and Commissioning of Furnace Installations,  
Steam Boilers, Industrial Kilns and Chimneys — Recommendations**  
(*First Revision*)

## **1 SCOPE**

This standard outlines the recommendations for the drying pre-heating and commissioning of furnace installations, steam boilers, industrial kilns and chimneys.

**1.1** This standard does not cover chemical furnaces.

## **2 REFERENCES**

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

| <i>IS No.</i>                   | <i>Title</i>  |
|---------------------------------|---|
| IS 1649 : 1962                  | Code of practice for design and construction of flues, chimneys for domestic heating appliances ( <i>first revision</i> ) |
| IS 8849 : 2024/<br>13574 : 2015 | ISO Industrial Furnaces and Associated Processing Equipment — Vocabulary ( <i>second revision</i> )                       |

## **3 TERMINOLOGY**

For the purpose of this standard, the following definitions in addition to those given in IS 8849 shall apply.

### **3.1 Furnaces**

Furnace installations according to this standard are installations in which various types of fuels are burnt. They also include the fuels and waste gas channels or pipes.

### **3.2 Steam Boilers**

Steam boilers are vessels or arrangements of pipes in which steam or hot water is produced.

### **3.3 Industrial Kilns**

Industrial kilns as per this standard are all technological process equipment in which a material is treated with heat.

### **3.4 Chimneys**

Chimneys for the purpose of this standard are all structures conforming to or designed according to IS 1649.

### **3.5 Drying**

Drying according to this standard is the process by which harmful moisture is removed from the masonry.

### **3.6 Pre-heating (Starting Up)**

This is the process by which an installation is heated up to the service temperature.

### **3.7 Commissioning**

Commissioning is the point of time at which the installation begins its intended service fully or partially.

### **3.8 Masonry**

For the purpose of this standard, masonry shall mean all parts made of inorganic, non-metallic substances. The specifications contained in this standard for masonry apply correspondingly also for reinforced concrete, concrete and monolithic structural masses.

## **4 GENERAL**

**4.1** Newly erected masonry in furnace installations, steam boilers, industrial kilns, waste gas ducts, chimneys and also repair masonry at these installations shall be dried before they are started up either for the first time or subsequent to shut down for any reason.

**4.2** The period of drying depends on the size, the type, and the thickness of the masonry, the materials used in the construction and their moisture content. The life of the masonry and the operations reliability of the installations depend on how properly the drying has been carried out. The supplier/manufacturer should, therefore provide a suitable heating curve suggesting rate of temperature rise, duration of soak and the total drying period.

**4.3** For drying, hot air or combustible gases can be used. Sometimes steam or hot water in the pipe lines of steam boilers is also used for this purpose.

**4.4** Before starting the drying it must be checked whether the installation to be dried meets with the relevant safety requirements.

**4.5** The drying fire shall be so arranged that the difference in heating is not much. If required the endangered portions shall be shielded off.

**4.6** The moisture required for the setting of the mortar, concrete or ramming clay should not be removed by too rapid drying.

**4.7** When drying and starting up the furnace the temperature should be increased slowly. In this process care should be taken to see that the heat reaches all the parts of the installation fairly uniformly.

**4.8** During the process of drying of the masonry of installations in which there is danger of corrosion or damage due to action of moisture, necessary precautions should be taken into consideration.

**4.9** If the installation is not put into operation immediately after the drying, a fresh drying may be necessary before commissioning it.

**4.10** It is advisable to monitor by measurements the temperature of the drying gas.

**4.11** All equipment items of the furnace installation which are required for drying shall be provided before the start with the required safety system.

**4.12** If during the drying and starting up, work is carried out in the region of the furnace installation, the waste gases shall be led away in such a manner that there is no danger to the working personnel.

**4.13** For properly leading away the drying gases and the generated steam, suitable measures shall be taken. It must be observed that steel structures like steel recuperators that come into contact with the waste gas are more likely to corrode.

**4.14** A suitable technical staff of the manufacturer or of the installing agency shall supervise the drying, the starting up and commissioning of the installation. After the drying, it shall be checked whether the masonry has sufficiently dried in all parts. If necessary the drying shall be continued.

**4.14.1** Additionally for the drying, starting up and commissioning the special requirements of the supplier shall be met.

## **5 DRYING AND COMMISSIONING OF STEAM BOILER**

**5.1** To obtain a slow drying of the masonry and to prevent harmful steam pressure, the temperature of the refractory walls on the fire side shall be 80°C in the first 2 days of the drying. From the third to the fifth day the temperature on the refractory walls shall be slowly increased up to 150°C. From the sixth day onward this temperature shall be maintained over the entire period of drying.

**5.2** The period of drying depends on the inside wall area and the wall thickness. An approximate empirical correlation between drying period inside wall area and the wall thickness is given in Table 1.

**Table 1 Drying Period for Steam Boilers**  
(Clause 5.2)

| Sl No. | Inside wall area<br>of the Installation<br>m <sup>2</sup> | Drying Period in Days for Wall Thickness |                             |             |
|--------|---|--|-----------------------------|-------------|
|        |   | Up to 300 mm                             | Over 300 mm<br>up to 450 mm | Over 450 mm |
| (1)    | (2)   | (3)                                      | (4)                         | (5)         |
| i)     | Upto 100  | 10                                       | 12                          | 14          |
| ii)    | Over 100 up to 500  | 12                                       | 14                          | 16          |
| iii)   | Over 500 up to 1000                                       | 14                                       | 16                          | 18          |

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|     |                      |    |    |    |
|-----|----------------------|----|----|----|
| iv) | Over 1000 up to 1500 | 16 | 18 | 20 |
| v)  | Over 1500 up to 2500 | 18 | 20 | 22 |

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NOTE – However drying period should actually be decided based on the recommendations of the supplier/manufacturer.

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**5.3** The drying shall be carried out according to the type of the steam boilers, namely:

- a) for coal dust, oil and gas firing with a pipe system with hot water or steam on the refractory walls,
- b) for grate firing with wood, briquette or coal fire which is open and correspondingly distributed over the grate.
- c) for grate firing with a pipe system lying on the refractory walls (for example in the case of refuse incinerators) combined with open fire for the free surface of the refractory walls and, if possible, with steam or hot water for the refractory walls covered with a pipe system.

**5.4** For the period of drying, the plate lining shall be so placed that the water can escape. The lower joint of the plate should be welded only after the drying. In the case of return shafts it is recommended, that the individual joints should not be welded all round pressure tight, with spaces equally distributed over the periphery left unwelded to permit the water to escape (so called skip welding).

**5.5** For removing the cold air masses in the lower part of the firing, where possible, a fire shall be maintained below the funnel outlet during the entire period of drying.

**5.6** The waste gas shutting device and also the explosion flaps or entry doors directly below the boiler top shall be kept open during the drying.

**5.7** Sufficient air should be passed through to entrain the water seeping from the masonry.

**5.8** In the case of steam boilers with fusion firing the fusion chamber mass shall be brought in only after the drying of the masonry and after rinsing and cleaning operations at high temperatures can be adopted for drying the masonry. The fuse chamber mass brought in should be dried with the steam or hot water directed through the pipe system. Here the temperature in the pipe system shall be 80°C for 4 to 6 hours. Finally, for a further 3 to 4 hours in the temperature should be increased to 150°C to 160°C. The installation should then be started up and fully put into service. Any recommendations of the manufacturer of fuse chamber masses shall be observed.

**5.9** If the walling in (embedding) is enclosed by an inner welded plate lining or a pipe wall and an outer plate lining, this should be taken into account in the drying period. Clauses **5.1**, **5.2**, **5.3** and **5.4** apply with the provision that the drying period is correspondingly lengthened. The drying period depends on the wall area and the wall thickness. An approximate empirical relationship is given in Table 2.

**Table 2 Drying Period for Steam Boilers with External and Internal Plate Lining**  
(Clause 5.9)

| Sl No. | Inside wall area<br>of the Plant<br>m <sup>2</sup> | Drying Period in Days for Wall Thickness |                             |             |
|--------|--|--|-----------------------------|-------------|
|        |  | Up to 300 mm                             | Over 300 mm<br>up to 450 mm | Over 450 mm |
| (1)    | (2)  | (3)                                      | (4)                         | (5)         |
| i)     | Upto 100   | 16                                       | 24                          | 28          |
| ii)    | Over 100 up to 500                                 | 18                                       | 26                          | 30          |
| iii)   | Over 500 up to 1000                                | 20                                       | 28                          | 32          |
| iv)    | Over 1000 up to 1500                               | 22                                       | 30                          | 34          |
| v)     | Over 1500 up to 2500                               | 24                                       | 32                          | 36          |

**5.10** In the case of lining of the return shaft through which the hot flue gases are sucked from the fire room to the drying of the coal, the drying should be done in relation with the drying of the embedding of the steam boilers. A heat source with air feed should be provided below each shaft for the period of the drying of the installation. This heat source and air feed shall be as per the dimensions of the return shaft.

## **6 DRYING, PREHEATING AND COMMISSIONING OF INDUSTRIAL FURNACES AND KILNS**

To obtain a slow drying of the masonry and to prevent harmful gas pressure, the following steps should be taken:

- a) Air drying for 24 h;
- b) Slowly raise the temperature to 80°C at the rate of 20°C/h and hold for 24 h minimum;
- c) Raise the temperature to 150°C at the rate of 20°C/h and hold for 24 h minimum;
- d) Raise the temperature to 500-550°C at the rate of 50°C/h and hold for 24 h minimum;
- e) Raise the temperature to 750-800°C at the rate of 100°C/h and hold for 48 h minimum; and
- f) Raise the temperature to working temperature at the rate of 100°C/h.

NOTE — However drying period should actually be decided based on the recommendations of the supplier/manufacturer.

## **7 DRYING OF CHIMNEYS**

### **7.1 General**

Each chimney, except steel chimneys without lining, shall be dried. The period of drying and drying temperature depend on the design and prescribed operating temperature. The higher the operating (service) temperature the more thorough should be the drying. The general guidelines on drying of chimneys are given in Table 3.

**7.1.1** The drying should be continued till all the masonry is exposed to a temperature of over 80°C and it is assured that they no longer contain any damaging moisture. Provisions of 4.6 should be specially complied with.

**7.1.2** The drying temperature should be so chosen that in the parts of the masonry which still contain moisture there is no harmful steam generation.

**7.2 Drying Process**

**7.2.1 Natural Drying**

In the case of hot and dry weather, natural drying takes place even during the construction work. It shall be determined in each case, separately whether such natural drying is sufficient. In the case of high heated hot chimneys and hot chimneys the natural drying is not sufficient.

**7.2.2 Artificial Drying**

**7.2.2.1** The artificial drying should be resorted to if the natural drying is not sufficient because of the chimney design, the intended operating temperature and the climatic and weather conditions during the construction period and till the chimney is taken in service.

**7.2.2.2** For drying the shaft masonry that is not protected by lining and the lining masonry, the drying shall proceed in such a way that during the first two days the temperature of the drying gases at the foot of the chimney is raised slowly till 80°C. The gas temperature is then raised during the next two days to 120°C and this temperature should be continuously maintained for a period of ten days. The introduced heat quantity should be according to the chimney size. A partial covering of the chimney is recommended.

**Table 3 Recommendations for the Drying of Chimneys**  
*(Clause 7.1)*

| Types of Chimney   | Cold Chimneys with Operating Temperature $\leq 100^{\circ}\text{C}$<br><i>Max</i>                         | Moderately Heated Hot Chimneys with Operating Temperature   | Strongly Heated Hot Chimneys with Operating Temperature $200-300^{\circ}\text{C}$ | Hot Chimneys with Operating Temperature Above $300^{\circ}\text{C}$               |   |
|--|---|---|---|---|---|
| (1)  | (2)   | (3)   | (4)   | (5)   |   |
| Chimneys without lining and with partial lining<br><br>Chimneys with lining till mouth without ventilated intermediate space | Only natural drying as per <b>7.2.1</b> and heating to service temperature as per <b>7.2.2.3</b> required | Only drying required as per <b>7.2.2.1</b> followed by increasing the drying temperature till service temperature as per <b>7.2.2.3</b> is achieved | Drying as per <b>7.2.2.1</b> followed by as per <b>7.2.2.2</b>                    | Drying as per <b>7.2.2.1</b> followed by as per <b>7.2.2.2</b> and <b>7.2.2.3</b> | Drying as per <b>7.2.2.1</b> followed by as per <b>7.2.2</b> and <b>7.2.2.3</b> |

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|--|----|--|---|--|
| Chimneys with lining till mouth with ventilated intermediate space | -- | Drying as per <b>7.2.2.1</b> followed by as per <b>7.2.2.3</b> | Drying as per <b>7.2.2.1</b> followed by increase of temperature at 25°C/24 h till service temperature is reached | Drying as per <b>7.2.2.1</b> followed by as per <b>7.2.2.3</b> |
|--|----|--|---|--|

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**7.2.2.3** For the drying of the shaft masonry protected by lining, the following procedure is applicable.

When the drying temperatures are as per **7.2.2.2**, the rise being effected within a further 12 days in the case of unventilated intermediate space and within a further 10 days in the case of ventilated intermediate space. Within a further 4 days the drying temperature should then be raised to 200°C.

**7.2.2.4** If the provided service temperature is higher than the temperature used for drying, then, after drying, the gas temperature should be increased uniformly by 25°C per 24 hour till the service temperature is obtained.

**7.2.2.5** If the commissioning is done after sufficient natural drying, the temperature of the gas should be raised at the rate of 25°C/24 hours till the service temperature is reached.

**7.2.2.6** If the commissioning does not immediately follow the finishing of the constructions, measures shall be taken to protect the chimney against the weather.

**7.2.2.6.1** If there is a danger that by delaying the drying damage may result, the drying shall be done immediately after finishing the construction. Before commissioning the procedure as given in **4.9** shall, then, be followed.