

Thermal performance acceptance testing of mechanical draught series wet cooling towers

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British Standard

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National foreword

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- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
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Thermal performance acceptance testing of mechanical draught series wet cooling towers

Essais de réception des performances thermiques des
aéroréfrigérants humides à tirage mécanique et fabriqués
en série

Wärmetechnische Abnahmeprüfung an zwangsbelüfteten
standardisierten Nasskühltürmen

This European Standard was approved by CEN on 1 October 2003.

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Foreword

This document (EN 13741:2003) has been prepared by Technical Committee CEN/TC 110 "Heat Exchangers", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2004, and conflicting national standards shall be withdrawn at the latest by June 2004.

Annexes A, B and C are informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies requirements, test method and acceptance tests for thermal performance of mechanical draught series cooling towers.

This European Standard is applicable to series type wet cooling towers as defined in 3.1.

The acceptance testing covers the verification of the thermal and hydraulic performance data of the cooling tower selected from the product line (see 3.1) and specified in the contract between the supplier and the purchaser. If these tests are required then this should be recognized at the time of the contract, as additional fittings, and preparations for the test may be required.

A methodology to calculate the test tolerance is included in this standard. The contract should specify whether this methodology shall be used for the assessment of the test results or not.

Legal and commercial consequences that might result from achieving or not achieving the contractually agreed performance are not part of this European Standard.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

Not applicable.

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1

air flow rate

total amount of dry air and associated water vapour moving through the cooling tower

3.1.2

approach

difference between cold water temperature and the inlet wet bulb temperature

3.1.3

approach deviation

deviation between the design approach and the measured (adjusted) approach

3.1.4

barometric pressure

atmospheric pressure at the test site

3.1.5

basin

open structure located beneath the cooling tower for collecting the circulating water and directing it to the sump or suction line of the circulating pump

3.1.6

basin curb

top elevation of the tower basin

usually the datum from which the tower elevations are measured.

3.1.7

blow-down

water discharged from the system to control the concentration of salts or other impurities in the circulating water

3.1.8

cell

smallest subdivision of the tower, bounded by exterior walls and partition walls, which can function as an independent unit. Each cell may have one or more fans or stacks and one or more distribution systems

3.1.9

cold water temperature

average temperature of the water entering or leaving the tower basin. In the case where the measurement is downstream of the basin or the pump, corrections are needed for the effects of the pump, and any other make up water blow down or heat sources entering the basin

3.1.10

cooling range

difference between the temperature of the water entering the distribution system and the cold water temperature

3.1.11

cooling tower

apparatus in which water is cooled down by heat exchange with ambient air

3.1.12

drift eliminator

the assemblies downstream of the heat transfer media, which serve to reduce the drift loss

3.1.13

drift loss

portion of the water flow rate lost from the tower in form of fine droplets mechanically entrained in the discharge air stream, commonly expressed as mass per unit time or a percentage of the circulating water flow rate. It is independent of water lost from evaporation

3.1.14

dry bulb temperature

temperature of an air-vapour mixture indicated by a thermometer with a clean, dry sensing element that is shielded from radiation effects. May be further categorised as either:

- a) ambient dry bulb temperature: the dry bulb temperature of air measured windward of the tower and free from influence of the tower
- b) entering dry bulb temperature: the dry bulb temperature of the air entering the tower, including the effect of any recirculation and/or interference

3.1.15**fan power**

power consumed by the fan driver, including the indication whether the efficiency of the driver is included or not

3.1.16**make up**

water added to the system to replace the water lost by evaporation, drift blowdown and leakage

3.1.17**mechanical draught cooling tower**

cooling tower where the air circulation is produced by a fan. May further be categorized as either:

forced draught: the fan is located in the entering air stream

induced draught: the fan is located in the discharge air stream

3.1.18**non series type wet cooling tower**

wet cooling tower, the design of which is project dependent, and for which the performance data and test evaluation at specific operating conditions may be subject to agreement

3.1.19**open circuit (wet) cooling tower**

cooling tower wherein the process fluid is warm water which is cooled by the transfer of mass and heat through direct contact with atmospheric air

3.1.20**pump head**

sum of static head and dynamic head from the contractual interface to the discharge of the distribution system to the atmosphere

3.1.21**relative humidity**

ratio of the mole fraction of water vapour in a given air sample to the mole fraction of water vapour in a sample of saturated air at the same temperature and pressure, usually expressed as percentage

3.1.22**series type wet cooling tower**

wet cooling tower, the design of which is fixed and described in the manufacturer's catalogue and for which the performance data are available, which allows test evaluation over a defined range of operating conditions

3.1.23**test period**

time duration where readings or recordings of every measurement have to be averaged, and test period results may be calculated

3.1.24**test readings**

individual sets of data recorded at regular intervals for each instrument or measurement point required

3.1.25**thermal lag**

time interval before the temperature of the water leaving the influence of the cooling air is detected at the point of cold water temperature measurement

3.1.26

water flow rate

quantity of warm water flowing into the open cooling tower

3.1.27

water loading

water quantity expressed as quantity per unit of fill plan area of the tower

3.1.28

wet bulb temperature

temperature of air, which when properly measured approximates the temperature of adiabatic saturation. May further be categorised as either:

ambient wet bulb temperature: the wet bulb temperature of air measured windward of the tower and free from influence of the tower

entering wet bulb temperature: the wet bulb temperature of the air entering the tower, including the effect of any recirculation and/or interference

NOTE Terms like « guarantee » « values » and « acceptance » used in this standard are understood in a technical but not in a legal or commercial sense.

3.2 Symbols

For the purposes of this European Standard, the symbols of Table 1 apply.

Table 1 — Symbols

Symbols	Designated parameters	Units
t_w	Wet bulb temperature	°C
t_{wG}	Guaranteed wet bulb temperature	°C
t_{wk}	Wet bulb temperature measured at reading k	°C
t_h	Hot water temperature	°C
t_{hk}	Hot water temperature measured at reading k	°C
t_c	Cold water temperature	°C
t_{cg}	Guaranteed cold water temperature	°C
t_{ck}	Cold water temperature at reading k	°C
t_{cfk}	Face value of cold water temperature at conditions found at reading k from performance curves	°C
t_m	Temperature of the make up water	°C
z	Range ($t_h - t_c$)	K
z_G	Guaranteed range	K
z_k	Range calculated for reading k ($t_{hk} - t_{ck}$)	K
t_p	Temperature increase due to pump energy	K
t_k	Difference between measured cold water temperature (t_{ck}) and face value (t_{cfk}) for reading k	K
t_a	Arithmetic average of all t_k	K
k	Reading indication	
m	Hot water flow	l/s
m_G	Guaranteed hot water flow	l/s
m_k	Hot water flow measured at reading k	l/s
m_m	Make up water flow	l/s
m_b	Blow down water flow	l/s
F_P	Fan motor power	kW
F_{PG}	Guaranteed fan motor power	KW
p_h	Pump discharge pressure	kPa
p_c	Pump suction pressure	kPa
p_{si}	Static pressure at contractual tower inlet	kPa
p_{di}	Dynamic pressure at contractual tower inlet	kPa
gh_i	Gravity pressure contractual inlet	KPa
p_{so}	Static pressure at contractual outlet	kPa
p_{do}	Dynamic pressure at contractual outlet	kPa
gh_o	Gravity pressure at contractual outlet	kPa
H	Difference between contractual inlet and outlet gravity terms	kPa
p_{io}	Total pressure difference between contractual tower inlet and outlet	kPa

(to be continued)