

Vervangt NEN-EN 14705:2003 Ontw.

Nederlandse norm

NEN-EN 14705 (en)

Warmtewisselaars - Meetmethoden en
onderzoek van thermische eigenschappen van
natte koeltorens

Heat exchangers - Method of measurement and evaluation of
thermal performances of wet cooling towers

ICS 27.060.30; 27.200

juli 2005

Als Nederlandse norm is aanvaard:
- EN 14705:2005, IDT

VOORBEELD
Preview

Normcommissie 349 186 "Veiligheidselzen gasgestookte installaties"

Apart from exceptions provided by the law, nothing from this publication may be duplicated and/or published by means of photocopy, microfilm, storage in computer files or otherwise, which also applies to full or partial processing, without the written consent of the Netherlands Standardization Institute.

The Netherlands Standardization Institute shall, with the exclusion of any other beneficiary, collect payments owed by third parties for duplication and/or act in and out of law, where this authority is not transferred or falls by right to the Reproduction Rights Foundation.

Auteursrecht voorbehouden. Behoudens uitzondering door de wet gesteld mag zonder schriftelijke toestemming van het Nederlands Normalisatie-instituut niets uit deze uitgave worden verveelvoudigd en/of openbaar gemaakt door middel van fotokopie, microfilm, opslag in computerbestanden of anderszins, hetgeen ook van toepassing is op gehele of gedeeltelijke bewerking.

Het Nederlands Normalisatie-instituut is met uitsluiting van ieder ander gerechtigd de door derden verschuldigde vergoedingen voor verveelvoudiging te innen en/of daartoe in en buiten rechte op te treden, voor zover deze bevoegdheid niet is overgedragen c.q. rechtens toekomt aan de Stichting Reprorecht.

Although the utmost care has been taken with this publication, errors and omissions cannot be entirely excluded. The Netherlands Standardization Institute and/or the members of the committees therefore accept no liability, not even for direct or indirect damage, occurring due to or in relation with the application of publications issued by the Netherlands Standardization Institute.

Hoewel bij deze uitgave de uiterste zorg is nagestreefd, kunnen fouten en onvolledigheden niet geheel worden uitgesloten. Het Nederlands Normalisatie-instituut en/of de leden van de commissies aanvaardden derhalve geen enkele aansprakelijkheid, ook niet voor directe of indirecte schade, ontstaan door of verband houdend met toepassing van door het Nederlands Normalisatie-instituut gepubliceerde uitgaven.

Nederlands voorwoord

Voor de in deze norm vermelde normatieve verwijzingen bestaan in Nederland de volgende equivalenten:

<u>vermelde norm</u>	<u>Nederlandse norm</u>	<u>titel</u>
EN 306	NEN-EN 306	Warmtewisselaars - Methoden voor het meten van de parameters nodig voor het bepalen van de werkingskenmerken (en)
EN 872	NEN-EN 872	Water - Bepaling van het gehalte aan zwevende stof - Methode door filtratie over glasvezelfilters (en)
EN 60751	NEN 10751	Temperatuuropmeter met platinaweerstand voor industrieel gebruik (en,fr)
EN ISO 5167-1	NEN-EN-ISO 5167-1	Metingen van gas- en vloeistofstromen in leidingen met volledige stroming en een cirkelvormige doorsnede met gebruik van drukverschilmeters - Deel 1: Algemene principes en voorwaarden (en)
ISO 1438-1	-	-
ISO 2975-3	-	-
ISO/TR 3313	NPR-ISO/TR 3313	Debietmetingen van vloeistofstromen in gesloten leidingen - Leidraad voor de effecten van stromingspulsaties op stromingsmeetinstrumenten (en)

Copyright
Preview

ICS 27.060.30; 27.200

English version

Heat exchangers - Method of measurement and evaluation of thermal performances of wet cooling towers

Echangeurs de chaleur - Méthode de mesure et évaluation des performances thermiques des aérorefrigérants humides

Wärmeaustauscher - Verfahren zur Messung und Bewertung der wärmetechnischen Leistungsdaten von Nasskühltürmen

This European Standard was approved by CEN on 24 March 2005.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Contents	page
Foreword	3
1 Scope	4
2 Normative references	4
3 Terms, definitions and symbols	5
3.1 Terms and definitions	5
3.2 Symbols	7
4 Performance tests – General	11
5 Guarantee	12
5.1 General	12
5.2 Guarantee documents	12
5.3 Validity conditions for measurements	13
6 Test procedure	15
6.1 Test parameters	15
6.2 Quantities to be measured	15
6.3 Quantities to be determined	17
6.4 Measurements and calculation of the mean quantities	17
6.5 Arrangement of measuring devices	24
6.6 Measuring apparatus	29
7 Conducting the performance tests	30
7.1 Definition of a test	30
7.2 Duration of the test	31
8 Calculation methods	34
8.1 General	34
8.2 Methods	34
9 Evaluation of thermal performances	38
9.1 General	38
9.2 Basic thermal performance test evaluation	38
9.3 Extended thermal performance test evaluation	39
10 Test tolerance	47
10.1 General	47
10.2 Error created by non-measurable systematic deviations of operating parameters	47
Annex A (informative) Performance curves	50
Annex B (normative) Requirements concerning the measuring apparatus used for the tests	54
Annex C (normative) Calculation of the evaporated water flow rate	56
Annex D (normative) Reminders on error calculations	59
Annex E (normative) Cold water temperature correction for heat added by pump	61
Bibliography	62

1 Scope

This European Standard specifies requirements, test methods and acceptance tests for thermal performances pumping head verification of wet cooling towers and plume abatement for wet/dry cooling towers.

This European Standard is applicable to natural draught wet cooling towers (see in 3.1.2.2) fan assisted natural draught cooling tower (see 3.1.2.3), wet/dry cooling towers (see 3.1.2.4) and "Mechanical draught cooling towers", except series ones.

It specifies the test methods, the apparatus required, the limitation of errors and the method for results examination.

The acceptance testing covers the verification of the thermal performance data and pumping head of the cooling tower as 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.

Deviations from the rules laid down below as well as additions need special agreement between purchaser and supplier and should be documented.

This standard does not apply to mechanical draught series wet cooling towers which are dealt with in EN 13741.

NOTE Terms like "design", "values", "guarantee" and "acceptance" used in this standard should be understood in a technical but not in a legal or commercial sense.

2 Normative references

The following referenced 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.

EN 306, *Heat exchangers - Methods of measuring the parameters necessary for establishing the performance*

EN 872, *Water quality - Determination of suspended solids - Method by filtration through glass fibre filters*

EN 60751, *Industrial platinum resistance thermometer sensors (IEC 60751:1983 + A1:1986)*

EN ISO 5167-1, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full - Part 1: General principles and requirements (ISO 5167-1:2003)*

ISO 1438-1, *Water flow measurement in open channels using weirs and Venturi flumes - Part 1: Thin-plate weirs*

ISO 2975-3, *Measurement of water flow in closed conduits - Tracer methods - Part 3: Constant rate injection method using radioactive tracers*

ISO/TR 3313, *Measurement of fluid flow in closed conduits - Guidelines on the effects of flow pulsations on flow-measurement instruments*

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

cooling tower

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

3.1.2

wet cooling tower

cooling tower in which the heat exchange between the water and the air is achieved by a direct contact

3.1.2.1

mechanical draught wet cooling tower

wet cooling tower where the air circulation is produced by a fan

3.1.2.1.1

series type mechanical draught wet cooling tower

mechanical draught 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 tests evaluation over the defined range of operating conditions

3.1.2.1.2

non series type mechanical draught wet cooling tower

mechanical draught 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

3.1.2.2

natural draught cooling tower

wet cooling tower where the air circulation is produced only by a density difference between the cold air outside the cooling tower and the hot air inside

3.1.2.3

fan assisted natural draught cooling tower

natural draught cooling tower with the addition of fan to boost the draught

3.1.2.4

wet/dry cooling tower (reduced plume cooling tower)

cooling tower comprising two parts. In the first part, the heat exchange between the water and the air is achieved by direct contact and through a tight wall in the second part

3.1.2.4.1

reduced plume wet/dry cooling tower

wet/dry cooling tower designed for plume abatement

3.1.2.4.2

water conservation wet/dry cooling tower

wet/dry cooling tower designed for water conservation

3.1.3

air flow

total quantity of air, including associated water vapour flowing through the tower

3.1.3.1

counterflow

where air and water flows are in opposite direction in the filling

3.1.3.2

cross flow

where air flows perpendicular to the water in the filling

3.1.4

ambient wet (dry) bulb temperature

wet (dry) bulb temperature of air measured windward of the tower and free from the influence of the tower

3.1.5

approach

difference between recooled water temperature and inlet air wet bulb temperature

3.1.6

inlet water flow

quantity of hot water flowing into the tower

3.1.7

cold water basin

device underlying the tower to receive the recooled water from the tower and direct its flow to the suction line or sump

3.1.8

cooling range

difference between the hot water temperature and the recooled water temperature

NOTE The term "range" is also applied to this definition, but is regarded as a non-preferred term.

3.1.9

drift loss

water lost from the tower as liquid droplets with the same chemical characteristics as the circulating water, entrained in the outlet air

3.1.10

heat load

rate of heat to be removed from the water within the tower

3.1.11

hot water temperature

temperature of inlet water

3.1.12

inlet air wet (dry) bulb temperatures

average wet (dry) bulb temperatures of the inlet air; including any recirculation effect

3.1.13

make-up

water added to the circulating water system to compensate for water loss from the system by evaporation, drift, purge and leakage

3.1.14

purge (blow down)

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

3.1.15

recooled water temperature

average temperature of the water at the cold water basin discharge excluding the effect of any make-up entering the basin or at the exhaust of the exchanger for wet/dry cooling tower

3.1.16

recirculation

portion of the outlet air that re-enters the tower

3.1.17

interference

intake of outlet air of adjacent cooling towers

3.1.18

tower pumping head

total head of water required at the inlet to the tower, to deliver the inlet water through the distribution system

3.1.19

surfacic flow

inlet water flow expressed in quantity per unit of plan packing area of the tower

3.1.20

wet (dry) bulb temperature

the temperature indicated by an adequately ventilated and wetted (non-wetted) thermometer in the shade and (where applicable) protected from any radiation effect

3.1.21

atmospheric gradient

air dry bulb temperature variation with altitude expressed in degree Celsius per 100 m

3.2 Symbols

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

Copyright
Preview

Table 1

Symbols	Designated parameters	Units
A	Transfer surface per unit of volume	m^{-1}
a	Angle of an elbow	degree
ap	Approach ($t_c - t_w$)	K
C	Heat coefficient	-
CEV	Evaporation coefficient related to the difference in water content	$kg \cdot m^{-2} \cdot s^{-1}$
C_F	Load loss coefficient	-
CFV	Evaporation coefficient related to the difference in water content	$kg \cdot m^{-2} \cdot s^{-1}$
C_s	Specific water consumption	$kg \cdot J^{-1}$
c_{pa}	Mass heat capacity of the air at constant pressure	$J \cdot kg^{-1} \cdot K^{-1}$
c_{pe}	Mass heat capacity of the water	$J \cdot kg^{-1} \cdot K^{-1}$
c_{pv}	Mass heat capacity of the vapour at constant pressure	$J \cdot kg^{-1} \cdot K^{-1}$
D_{10}	Direction of the reference wind in relation to the north	degree
d	Hydraulic diameter	m
F_p	Fan motor power	kW
F_{pG}	Guaranteed fan motor power	kW
g	Gravity acceleration	$m \cdot s^{-2}$
H	Draught height	m
h	Mass enthalpy of the air	$J \cdot kg^{-1}$
h_1	Mass enthalpy of the air at the air inlet calculated from p_a , t_s and φ	$J \cdot kg^{-1}$
h_2	Mass enthalpy of the saturated hot air at the air outlet downstream from the drift eliminators	$J \cdot kg^{-1}$
h_s	Mass enthalpy of the saturated moist air at the water temperature	$J \cdot kg^{-1}$
h_{s1}, h_{s2}	Mass enthalpy of the saturated moist air at the water temperature with 1 = inlet, 2 = outlet	$J \cdot kg^{-1}$
k	Number of tests	
$\frac{KAV}{q_{me}}$	Merkel number	
L_{vt}	Water vaporization latent heat at temperature t	$J \cdot kg^{-1}$
m	Circulating water volume flow rate at the cooling tower inlet	$m^3 \cdot s^{-1}$
m_b	Calculated blow-down water volume flow rate	$m^3 \cdot s^{-1}$
m_{bm}	Measured blow-down water volume flow rate	$m^3 \cdot s^{-1}$

(to be continued)

Bestelformulier

NEN

Stuur naar:

NEN Standards Products & Services
t.a.v. afdeling Klantenservice
Antwoordnummer 10214
2600 WB Delft

NEN Standards Products & Services

Postbus 5059
2600 GB Delft

Vlinderweg 6
2623 AX Delft

T (015) 2 690 390
F (015) 2 690 271

www.nen.nl/normshop

Ja, ik bestel

__ ex. NEN-EN 14705:2005 en Warmtewisselaars - Meetmethoden en onderzoek van thermische eigenschappen van natte koeltorens € 86.00

Wilt u deze norm in PDF-formaat? Deze bestelt u eenvoudig via www.nen.nl/normshop

Gratis e-mailnieuwsbrieven

Wilt u op de hoogte blijven van de laatste ontwikkelingen op het gebied van normen, normalisatie en regelgeving? Neem dan een gratis abonnement op een van onze e-mailnieuwsbrieven. www.nen.nl/nieuwsbrieven

Retourneren

Fax: (015) 2 690 271
E-mail: klantenservice@nen.nl
Post: NEN Standards Products & Services,
t.a.v. afdeling Klantenservice
Antwoordnummer 10214,
2600 WB Delft
(geen postzegel nodig).

Gegevens

Bedrijf / Instelling _____

T.a.v. _____ O M O V

E-mail _____

Klantnummer NEN _____

Uw ordernummer _____ BTW nummer _____

Postbus / Adres _____

Postcode _____ Plaats _____

Telefoon _____ Fax _____

Factuuradres (indien dit afwijkt van bovenstaand adres)

Postbus / Adres _____

Postcode _____ Plaats _____

Datum _____ Handtekening _____

Voorwaarden

- De prijzen zijn geldig tot 31 december 2016, tenzij anders aangegeven.
- Alle prijzen zijn excl. btw, verzend- en handelingskosten en onder voorbehoud bij o.m. ISO- en IEC-normen.
- Bestelt u via de normshop een pdf, dan betaalt u geen handeling en verzendkosten.
- Meer informatie: telefoon (015) 2 690 391, dagelijks van 8.30 tot 17.00 uur.
- Wijzigingen en typfouten in teksten en prijsinformatie voorbehouden.
- U kunt onze algemene voorwaarden terugvinden op: www.nen.nl/leveringsvoorwaarden.