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Hygrothermal performance of building equipment and industrial installations — Calculation of water vapour diffusion — Cold pipe insulation systems

Performance hygrothermique des équipements de bâtiments et installations industrielles — Calcul de la diffusion de vapeur d'eau — Systèmes d'isolation de tuyauteries froides

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 2, *Calculation methods*.

This second edition cancels and replaces the first edition (ISO 15758:2004), which has been technically revised. The main changes are the following:

— in Clause 5, b), the alternative of using annual mean temperature and vapour pressure has been removed;

— the method of calculation given in 6.3 has been changed such that the total amount of condensation water in the whole pipe system is calculated based only on the outermost tangent to the saturation pressure, p_{sat};

— Figure 1 has been modified;

— the example given in A.3 has been changed;

— in Annex B, an explanation of the system with capacity for drying has been added;

— references have been added to the Bibliography.

Introduction

If the thermal insulation of a cold pipe system is not completely water vapour tight, there will be a flow of water vapour from the warm environment to the surface of the pipe, whenever the temperature of the surface of the cold pipe is below the dew point of the ambient air. This flow of water vapour leads to an interstitial condensation in the insulation layer and/or dew formation on the surface of the pipe itself. Interstitial condensation may cause the insulation material to deteriorate and dew formation on the surface of a metal pipe may cause corrosion over time. If the temperature is below 0 °C ice will be formed and the methods of this standard will not apply.

In period, when the dew point of the ambient air is higher than the temperature of the outer surface of the insulation, surface condensation will occur. This is dealt with in ISO 12241.

Different measures are available to control water vapour transfer and reduce the amount of condensation. The following are normally applied:

a) Installation of a vapour retarder;

b) Use of insulation materials with a high water vapour resistance factor (low permeability);

c) Use of a vapour retarder and a capillary active fabric to continuously remove condensed water from the pipe surface to the environment; see Annex B for an example.

Which protection measure is chosen depends on the ambient climate, the temperature of the medium in the pipe and the water vapour diffusion resistance of the insulation layer. The success of any system is strongly dependent on workmanship and maintenance. In any case anti-corrosion measures should be applied to a metal pipe in severe conditions.

The expected economic lifetime of an insulation system, assuming a maximum acceptable accumulated moisture content, can be calculated using the methods in this standard.

Hygrothermal performance of building equipment and industrial installations — Calculation of water vapour diffusion — Cold pipe insulation systems

1 Scope

This International Standard specifies a method for calculating the density of the water vapour flow rate in cold pipe insulation systems, and the total amount of water diffused into the insulation over time. The calculation method presupposes that water vapour can only migrate into the insulation system by diffusion, with no contribution from airflow. It also assumes the use of homogeneous, isotropic insulation materials so that the water vapour partial pressure is constant at all points equidistant from the axis of the pipe.

This International Standard is applicable when the temperature of the medium in the pipe is above 0 °C. It applies to pipes inside buildings as well as in the open air.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9346, *Hygrothermal performance of buildings and building materials — Physical quantities for mass transfer — Vocabulary*

ISO 12241, *Thermal insulation for building equipment and industrial installations — Calculation rules*

ISO 12572, *Hygrothermal performance of building materials and products — Determination of water vapour transmission properties*

ISO 13788, *Hygrothermal performance of building components and building elements — Internal surface temperature to avoid critical surface humidity and interstitial condensation — Calculation methods*

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in ISO 9346, ISO 12572 and ISO 13788, and the following terms, definitions and symbols (see Table 1) apply.

3.1
exposed moist area
surface area of a capillary active fabric that is exposed to the ambient atmosphere

3.2
vapour retarder
material with high resistance to the flow of water vapour

3.3
corrected water vapour diffusion equivalent air layer thickness
thickness of an imaginary plane layer with μ =1, and an area of πD_j which has the same diffusion resistance as the layer j with $\mu = \mu_j$

Note 1 to entry: See Formula (18).