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Industrial furnaces and associated processing equipment — Method of measuring energy balance and calculating efficiency —

Part 1: General methodology

Fours industriels et équipements associés — Méthode de mesure du bilan énergétique et de calcul de l'efficacité —

Partie 1: Méthode générale

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Pour accélérer la distribution, le présent document est distribué tel qu'il est parvenu du secrétariat du comité. Le travail de rédaction et de composition de texte sera effectué au Secrétariat central de l'ISO au stade de publication.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13579-1 was prepared by Technical Committee ISO/TC 244, *Industrial furnaces and associated thermal processing equipment*, Subcommittee SC , .

ISO 13579 consists of the following parts, under the general title *Industrial furnaces and associated processing equipment — Method of measuring energy balance and calculating efficiency*:

— *Part 1: General methodology*

— *Part 2: Reheating furnaces for steel*

— *Part 3: Batch type aluminium melting furnaces*

— *Part 4: Furnaces with protective or reactive atmosphere*

Introduction

Prevention of global warming is an imminent issue which needs to be solved in the world scale. For this purpose, it is necessary not only to reduce the energy consumption dramatically, but also to assure everyone's convenient and comfortable daily life.

It is critical to use energy as efficiently as possible to fulfil these requirements.

Although industrial furnaces play an important role to maintain everyone's life, on the other hand, consume large amount of energy at the same time. In order to solve the abovementioned issues, it is very important to establish an international standard which specifies energy efficiency of industrial furnaces in a reasonable manner, to control energy consumption by using the collected measurement data based on the standard, and to improve the efficiency. Furthermore, this standard may be applied as a fair guideline to utilize CDM which has been developed as one of Kyoto Mechanisms for measures to prevent global warming.

All calculations within this standard are based on the location of equipment at the reference conditions.

NOTE For equipment intended to be installed other than the sea level the impact of the elevation should be calculated for that location.

Symbols used in this part 1 of this standard and all the annexes attached this part are given in Annex A together with their meanings and units.

Industrial furnaces and associated processing equipment — Method of measuring energy balance and calculating efficiency —

Part 1:
General methodology

1 Scope

This Part 1 of ISO 13579 specifies general methodology of measuring energy balance and calculating efficiency of the process involving industrial furnaces and associated thermal processing equipment as designed by the furnace manufacturers. This general methodology includes:

Measurement methods,

Calculations (general calculation) and

Evaluation report.

This standard is excluding any efficiencies related to the process itself outside of the industrial furnaces and associated thermal processing equipment. (e.g. in a rolling mill process, the reheating furnace shall be the only part covered by this standard.)

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.

ISO 13574, Industrial furnaces and associated thermal processing equipment — Vocabulary

3 Terms and definitions

The terms and definitions used in this International Standard are defined in ISO 13574, Industrial furnaces and associated thermal processing equipment — Vocabulary.

4 Basic principles

4.1 General

Area of energy balance measurement shall be determined.

NOTE An example of determination of the area of energy balance measurement is shown in Figure 1.

The following aspects shall be included in the energy balance measurement:

a) Energy input;

— "Fuel equivalent energy" as specified in 4.2.2;

— "Other energy input" as specified in 4.2.3;

b) Energy output;

— "Thermal energy output" as specified in 6.2.5;

— "Energy used in electrical auxiliary equipment" as specified in 6.2.6;

— "Energy for generation of utilities" as specified in 6.2.7;

— "Electrical generation loss" as specified in 6.2.8.

Determine energy input and energy output which goes into and comes out of the area of energy balance based on the measurement data.

The total energy input into the area shall balance the total energy output from the area.

Result of energy balance measurement is required to be summarized into energy input and energy output in an energy balance sheet with necessary information such as equipment summary, measurement condition and measurement data.

Thermal energy balance and electrical generation may be created as subcategories. See 6.3 and 6.4.

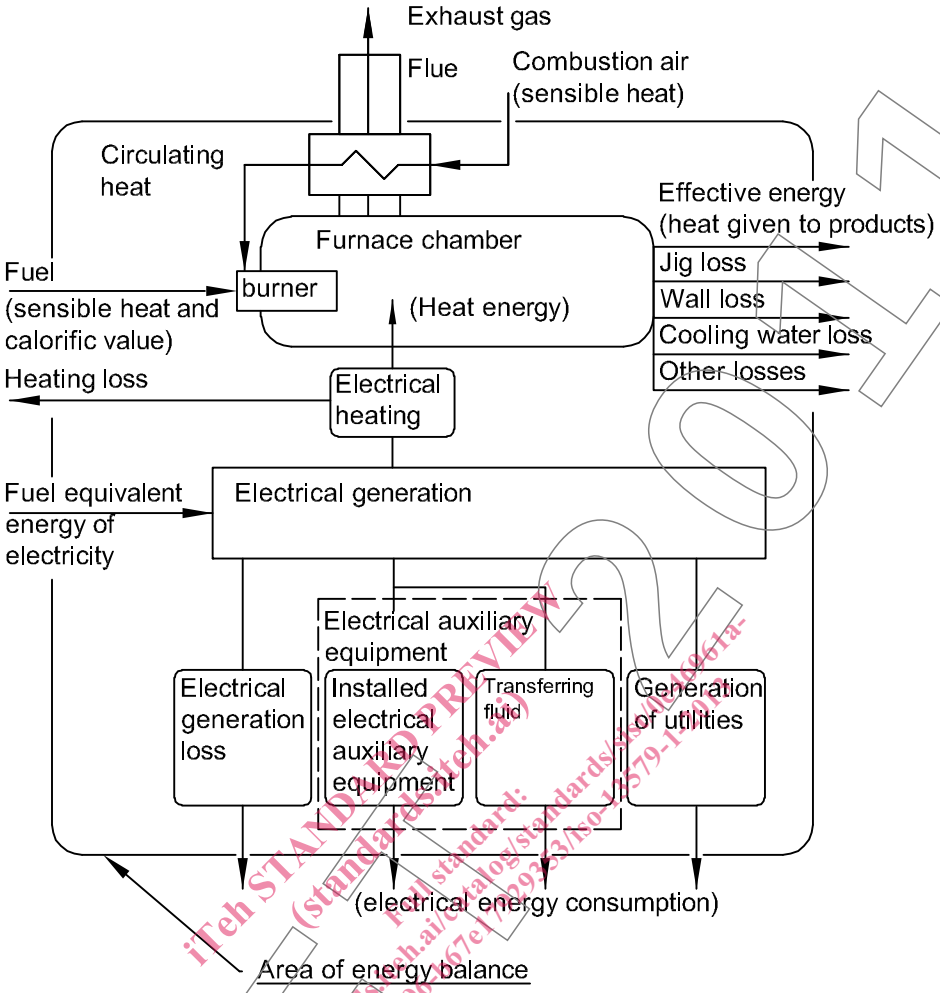

Figure 1 — Example of determination of the area of energy balance measurement

4.2 Sankey diagram

Sankey diagram is useful tool to represent input and output energy flow. (See Figure 2)

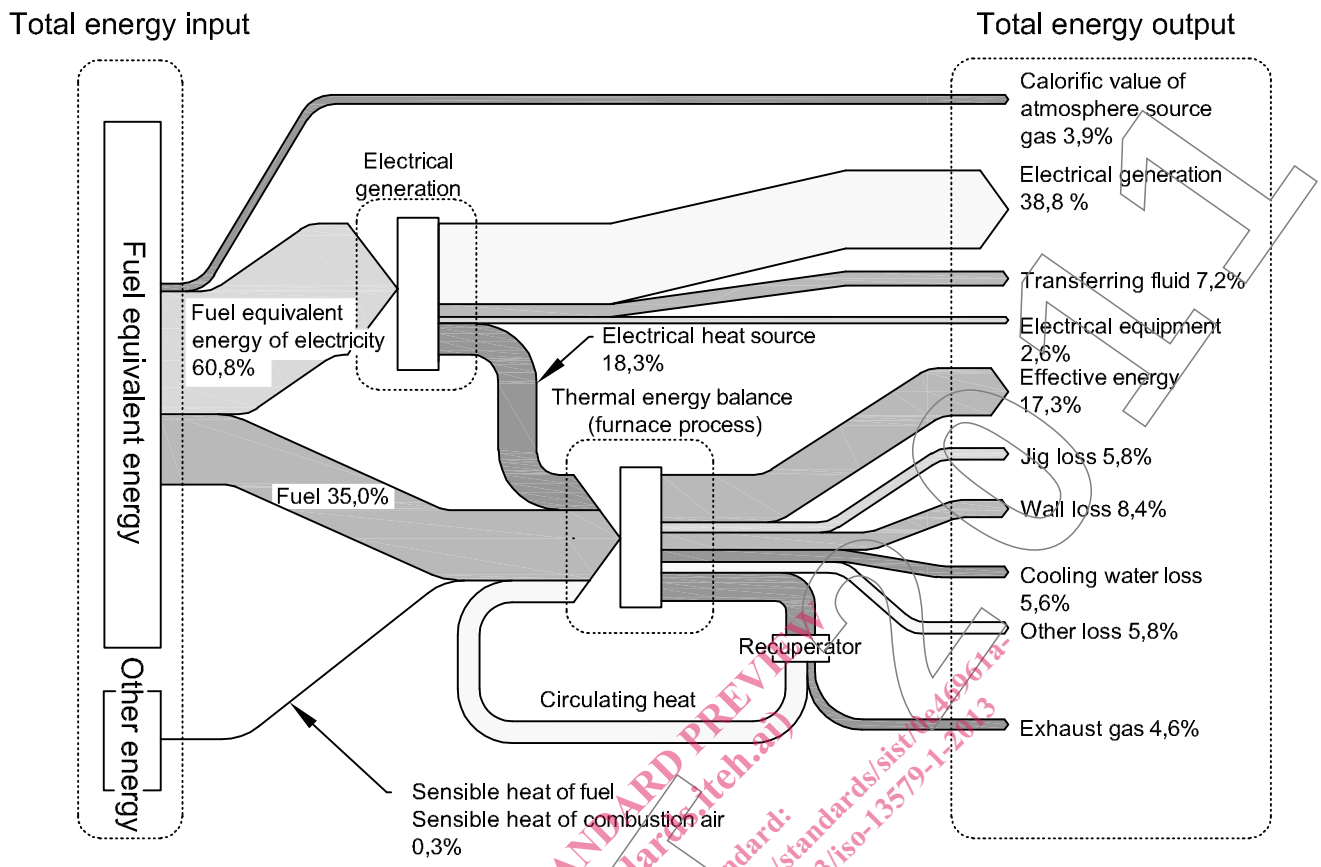

Figure 2 — Example of sankey diagram of energy flow of a industrial furnace

4.3 Process Heating Assessment Survey Tool (PHAST)

Developed by the US De partment of Energy, the softw are “Process Heating Assessment and Survey Tool” (PHAST) provides an i ntroduction to p rocess heating methods and tools to improve the rmal efficiency of heating equipment. The tool is used to survey process heating equipment that uses fuel, steam, or electri city, and identify the most en ergy-intensive equipment. Users can also perform an energy (he at) balance on selected equipment (furnaces) to identify and reduce non-productive energy use, compare performance of the furnace under various operating conditions and test "what-if" scenarios”.

The thermal energy calculation function may be used as a tool which supplements the calculation specified in this standard such as:

— Sensible heat of material (effective energy);

— Jig loss:

— Calculations related to combustion;

— Sensible heat of atmosphere gas;

— Wall loss;

— Heat loss of radiation from furnace opening;

— Cooling water loss.

— Exhaust gas losses

NOTE About PHAST: http://www1.eere.energy.gov/industry/bestpractices/software_phast.html

5 Basic condition of measurement and calculation

5.1 State of furnace

Subject furnaces shall be in the normal operation and:

— In the case of continuous furnaces, the temperature and through put shall be in the steady state considered in the design calculation

— In the case of batch furnaces, the temperature cycle and through put shall be as considered in the design calculation.

Nomal operation condition is generally based on nominal condition stipulated in the specification. But in the case of no specified condition it may defined by supplier e.g. 2/3 of design through put.

5.2 Duration of measurement

In the case of continuous furnaces, the duration of energy balance measurement should be at least twice as long as the time the products stay in furnafce chamber.

In the case of batch furnaces, calculation shall be performed per 1 batch.

5.3 Unit of specific energy consumption

kilo Joule per 1 ton (1 000 kg) of products (kJ/t products) shall be used as the basic unit of specific energy consumption unless otherwise specified.

5.4 Reference condition

The reference conditions shall be 0 degree C (273,15 Kelvin) and 0,101 325 MPa unless otherwise specified.

5.5 Unit of volume

Values of volume expressed in this standard shall be volume under the reference condition specified in 5.4 unless otherwise specified.

The unit of volume under the reference condition shall be expressed as "m^3(n)" unless otherwise specified.

5.6 Fuel

The unit quantity of fuel is:

— 1 kg in the case of liquid fuel or

— 1 m^3(n) in the case of gaseous fuel.

In this standard, net calorific value of fuel is used as a calorific value.

