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PEOPLE'S REPUBLIC OF CHINA**

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**Guide for the energy efficiency assessment of the electric arc
furnace process**

电弧炉工序能效评估导则

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Table of Contents

- 1 Scope
- 2 Normative references
- 3 Terms and definitions
- 4 Basic principles...
- 5 Assessment steps...
- 6 Boundary and energy consumption statistical range
- 7 Baseline energy consumption
 - 7.1 Baseline conditions
- 8 Actual energy consumption...
- 9 Energy efficiency index...
- 10 Energy efficiency analysis...
- 11 Energy efficiency optimization measures

1 Scope

China's national guide to assessing the energy efficiency of electric arc furnace steelmaking. It specifies the terms and definitions, the basic principles, the assessment steps, the boundary and scope of energy consumption accounting, and the indicators. The electric arc furnace melts scrap with an arc struck between graphite electrodes and the charge, and it is the second route to steel alongside the blast furnace and converter. Its energy accounting is more intricate than it first appears, because electricity is not its only input: oxygen is injected, carbon is added, natural gas burners assist the melt, and the chemical energy those release can be a third of the total. So an assessment that counts only the kilowatt hours will rank a furnace that burns a lot of gas as efficient. The boundary question is equally consequential, since scrap preheating, off-gas heat recovery and the fume extraction plant may or may not be inside it, and they are where the differences between plants now lie.

This Standard specifies the terms and definitions, basic principles, assessment steps, boundary and energy consumption statistical range, baseline energy consumption, actual energy consumption, energy efficiency index, energy efficiency analysis, and energy efficiency optimization measures for energy efficiency assessment of electric arc furnace process. This Standard applies to energy efficiency assessment and energy-saving potential analysis of electric arc furnace process in iron and steel enterprises.

2 Normative references

The following documents are indispensable for the application of this document. For the dated references, only the editions with the dates indicated are applicable to this document. For the undated references, the latest edition (including all the amendments) are applicable to this document.

GB 17167 General principle for equipping and managing of the measuring instrument of energy in organization of energy using

GB/T 21368 Specification for equipping and managing of measuring instrument of energy in the iron and steel industry

GB/T 23331 Energy management systems - Requirements

GB/T 28924 Guides for calculating energy efficiency index of an iron and steel enterprise

YB/T 4662 Guides for energy efficiency assessment of iron and steel enterprise

3 Terms and definitions

The terms and definitions defined in GB/T 23331, GB/T 28924, YB/T 4662 apply to this document.

6 Boundary and energy consumption statistical range

6.1 Process boundary division The electric arc furnace process boundary starts with the input of raw materials (scrap steel, cold pig iron, direct reduced iron, molten iron, etc.), energy, and energy-consuming working medium, and ends with the output of final product molten steel, by-product slag, and externally-supplied steam. See Appendix A for the boundary division of electric arc furnace process.

6.2 Energy consumption statistical range The statistical range of the energy consumption of electric arc furnace process is as follows:

- a) Electric arc furnace smelting, including electric arc furnace body, scrap steel preheating and baking system, raw material supply system, flue gas treatment system, second and third dust removal system, steel slag treatment system (excluding steel slag post-treatment), water treatment system, and ladle baking system, etc.;
- b) Include auxiliary production systems such as machine repair, inspection, test, measurement, transportation, production management and scheduling systems, heating or cooling, lighting, storage;
- c) Contain the loss of all kinds of energy in the electric arc furnace process interface. The above energy consumption statistical range shall deduct the steam recovered and supplied externally. It does not include energy consumed by facilities (such as canteens and

lounges, etc.) that are not related to production and are used for living purposes. It does not include refining outside the furnace and continuous casting process.

7.1 Baseline conditions

7.1.1 The baseline conditions are a number of measurable factors that have a greater impact on the baseline energy consumption and may be divided into objective factors and subjective factors.

7.1.2 Objective factors refer to factors beyond the control of the process that are affected by inherent conditions outside the process boundary; mainly refer during statistical reporting period, etc.;

b) Raw material conditions, including the amount and composition of scrap steel, molten iron, and cold pig iron, temperature of molten iron, etc.;

c) Product conditions, including steel type, molten steel composition, tapping temperature, etc.;

d) Consumption of energy and energy-consuming working medium, such as consumption of circulating water, electricity, compressed air, oxygen, nitrogen, argon, natural gas, gas, steam, etc.;

e) Waste heat recovery, such as recovery steam parameters, scrap steel preheating parameters, etc.;

f) Parameters of major energy-consuming units and important energy-consuming equipment, such as the main parameters of electric arc furnace body, scrap steel preheating and baking, flue gas treatment, secondary dust removal, water treatment, ladle baking and other systems;

g) Ambient temperature.

8.2 Principles for valuing of conversion standard coal coefficient for energy and energy-consuming working medium

8.2.1 The actual fuel energy consumed by energy-using organizations shall, based on its low calorific value, be converted into standard coal. For those not measured, refer to Table B.1 in Appendix B.

8.2.2 Steam shall, based on its enthalpy value, be converted into standard coal. Refer to Table B.2.

8.2.3 For conversion of energy-consuming working medium to standard coal, refer to Table B.3.

8.2.4 The conversion relationship between standard coal and heat is $1 \text{ kgce} = 29307.6 \text{ kJ}$.

8.2.5 The electric power conversion standard coal coefficient takes the equivalent value,

i.e., 1 kW - h=0.1229 kgce.

11 Energy efficiency optimization measures

The electric arc furnace process can use, but not limited to, the following energy efficiency optimization measures:

- a) Improve the level of energy management and process operations;
- b) Ultra-high power electric arc furnace technology;
- c) Continuous feeding operation technology;