

Translated English of Chinese Standard: GB/T40803-2021

www.ChineseStandard.net → Buy True-PDF → Auto-delivery.

Sales@ChineseStandard.net

GB

NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA

ICS 25.020

CCS J 30

GB 40803-2021

Machining process - Method for energy efficiency evaluation

机械加工过程 能量效率评价方法

Issued on: October 11, 2021

Implemented on: May 01, 2022

**Issued by: State Administration for Market Regulation;
Standardization Administration of the People's Republic of China.**

Table of Contents

FOREWORD	3
1 Scope	4
2 Normative references.....	4
3 Terms and definitions.....	4
4 Evaluation index system	6
5 Obtaining methods of evaluation indexes.....	6
6 Evaluation procedure and requirements	10
7 Requirements for the preparation of the evaluation report	13
Appendix A (Informative) Example of energy efficiency evaluation of the machining processes.....	14

Machining process - Method for energy efficiency evaluation

1 Scope

This document specifies the energy efficiency evaluation index system, index obtaining method, evaluation procedure and evaluation report preparation in the machining process.

This document applies to the energy efficiency evaluation of metal cutting machine tools in the machining process; the energy efficiency evaluation of other machining processes can be implemented with reference to this document.

2 Normative references

The contents of the following documents constitute the indispensable clauses of this document through normative references in the text. For dated references, only the version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB/T 4863, General terminology of machine-building technology

GB/T 6477, Metal-cutting machine tools - Terminology

GB/T 40799, Machining process - Test methods for essential energy efficiency data

3 Terms and definitions

Terms and definitions determined by GB/T 4863, GB/T 6477 and GB/T 40799, and the following ones are applicable to this document.

3.1

specific energy consumption

The ratio of the total energy consumption in the machining process to the effective output.

Note: The effective output can be expressed by the material removal volume or the number of qualified workpieces.

3.2

specific energy consumption per workpiece

Energy consumption in standby period, energy consumption in idling period, energy consumption in cutting period and energy consumption for material removal shall be detected and obtained according to the methods that are specified in GB/T 40799.

5.2 Obtaining method of effective energy utilization ratio

According to the method that is specified in GB/T 40799, obtain the total energy consumption in the machining process and the energy consumption for material removal; calculate the effective energy utilization ratio according to Formula (1).

$$\eta_t = \frac{E_{mr}}{E_t} \dots\dots\dots (1)$$

Where:

η_t – the effective energy utilization ratio in the machining process, expressed in %;

E_{mr} – the energy consumption for material removal in the machining process, in kilowatt-hours (kW·h);

E_t – the total energy consumption in the machining process, in kilowatt-hours (kW·h).

5.3 Obtaining method of specific energy consumption per workpiece

According to the method that is specified in GB/T 40799, obtain the total energy consumption in the machining process; count the number of qualified workpieces in the machining process; calculate the specific energy consumption per workpiece according to Formula (2).

$$S_N = \frac{E_t}{N} \dots\dots\dots (2)$$

Where:

S_N – the specific energy consumption per workpiece in the machining process, in kilowatt-hours per piece (kW·h/piece);

N – the number of qualified workpieces (pieces) in the machining process.

5.4 Obtaining method of specific energy consumption per volume of cutting material

According to the method that is specified in GB/T 40799, obtain the total energy consumption in the machining process, and calculate the specific energy consumption per volume of cutting material according to Formula (3).

$$S_v = \frac{E_t}{V} \dots\dots\dots (3)$$

Where:

S_v – the specific energy consumption per volume of cutting material in the machining process, in kilowatt-hours per cubic meter ($\text{kW}\cdot\text{h}/\text{m}^3$);

V – the material removal volume in the machining process, which can be obtained by accumulating the material removal volume of each qualified workpiece, in cubic meters (m^3).

Where, the obtaining method of the material removal volume of a single qualified workpiece is as follows:

- a) Use the geometric calculation method or the drainage method to obtain the volume of the qualified workpiece before and after machining; obtain the material removal volume of a single workpiece by calculating the volume difference between the two;
- b) Measure the mass of a qualified workpiece before and after machining, respectively, by the weighing method; calculate the material removal volume of a single workpiece according to Formula (4).

$$V_i = \frac{W_0 - W_1}{\rho} \dots\dots\dots (4)$$

Where:

V_i – the material removal volume of a single workpiece, in cubic meters (m^3);

W_0 – the mass of the qualified workpiece before machining, in kilograms (kg);

W_1 – the mass of the qualified workpiece after machining, in kilograms (kg);

ρ – the material density of the removal material of the qualified workpiece, in kilograms per cubic meter (kg/m^3).

5.5 Obtaining method of standby energy consumption ratio

According to the method that is specified in GB/T 40799, obtain the total energy consumption in the machining process and the energy consumption in standby period; calculate the standby energy consumption ratio according to Formula (5).

$$\gamma_{st} = \frac{E_{st}}{E_t} \dots\dots\dots (5)$$

Where:

γ_{st} – the standby energy consumption ratio in the machining process, expressed in %;

- The selected machining process belongs to the complete machining process of one or more workpieces processed by the machine tool;
- The workpieces to be machined have the same specifications.

After the machining process is selected, the processing time period, machine tool model and workpiece model of the selected machining process shall be recorded.

6.3 Selection of evaluation indexes

6.3.1 According to the evaluation requirements, select the energy efficiency evaluation indexes of the machining process.

6.3.2 To evaluate the comprehensive energy efficiency of the machining process, one or more comprehensive evaluation indexes shall be selected from the effective energy utilization ratio, specific energy consumption per workpiece and specific energy consumption per volume of cutting material. Where:

- When evaluating the overall energy efficiency of different machine tools in processing the same workpiece, give priority to the specific energy consumption per workpiece;
- When evaluating the overall energy efficiency of the machine tool in processing different materials, give priority to the specific energy consumption per volume of cutting material;
- When evaluating the overall energy efficiency of the two machining processes with large differences (such as different machine tools and workpiece specifications), give priority to the effective energy utilization ratio.

6.3.3 To evaluate the energy efficiency of a single item in the machining process, the single evaluation indexes shall be selected according to the following principles:

- When evaluating the energy efficiency of the standby process, select the energy consumption in standby period and the standby energy consumption ratio;
- When evaluating the energy efficiency of the idling process, select the energy consumption in idling period and the idling energy consumption ratio;
- When evaluating the energy efficiency of the cutting process, select the energy consumption in cutting period and the cutting energy consumption ratio;
- When evaluating the selection of cutting parameters in the cutting process, select the energy consumption for material removal and the cutting energy utilization ratio.

6.4 Formulate a reference value for the evaluation index

6.4.1 The reference value of the evaluation index is the basic reference for quantifying the energy efficiency gap and guiding the optimization of energy efficiency in the energy efficiency evaluation process, which can be formulated according to the reference method and the test method.

6.4.2 Reference method. If the energy consumption limit standard of the machining process and the advanced energy efficiency value of the same machining process in the industry have been published, refer to the energy consumption limit standard and the advanced value of the industry to select the reference value for the evaluation index.

6.4.3 Test method. Formulate a reference value for the evaluation index through an actual test. The specific steps are as follows:

- a) Select a section of machining process. Among them, the selected machining process shall meet the requirements that the machine tool does not fail during machining, the workpieces to be machined have the same specifications and are all qualified parts, and the number of qualified workpieces is not less than 3;
- b) According to the method that is described in Chapter 5, obtain the calculated value of the energy efficiency evaluation index in the machining process of each qualified workpiece;
- c) Rank the calculated values of each evaluation index in the machining process of each qualified workpiece in descending order;
- d) Select the maximum value in the ranking as the maximum reference value of the evaluation index; select the minimum value in the ranking as the minimum reference value of the evaluation index.
- e) For the four indexes of energy consumption in standby period, energy consumption in idling period, energy consumption in cutting period and energy consumption for material removal, the reference value is the product of the reference value of the evaluation index of a single workpiece and the number of qualified workpieces in the machining process to be evaluated.

See A.3 for a specific example.

6.5 Obtain the calculated value of the evaluation index

According to the method that is specified in Chapter 5, obtain the calculated value of the energy efficiency evaluation index of the machining process. At the same time, the obtaining process of the calculated value of the evaluation index shall meet the requirements of GB/T 40799.

6.6 Determine the evaluation results

Compare the calculated value of each evaluation index with its reference value, to determine the evaluation result. Where:

This is an excerpt of the PDF (Some pages are marked off intentionally)

Full-copy PDF can be purchased from 1 of 2 websites:

1. <https://www.ChineseStandard.us>

- SEARCH the standard ID, such as GB 4943.1-2022.
- Select your country (currency), for example: USA (USD); Germany (Euro).
- Full-copy of PDF (text-editable, true-PDF) can be downloaded in 9 seconds.
- Tax invoice can be downloaded in 9 seconds.
- Receiving emails in 9 seconds (with download links).

2. <https://www.ChineseStandard.net>

- SEARCH the standard ID, such as GB 4943.1-2022.
- Add to cart. Only accept USD (other currencies - <https://www.ChineseStandard.us>).
- Full-copy of PDF (text-editable, true-PDF) can be downloaded in 9 seconds.
- Receiving emails in 9 seconds (with PDFs attached, invoice and download links).

Translated by: Field Test Asia Pte. Ltd. (Incorporated & taxed in Singapore. Tax ID: 201302277C)

About Us (Goodwill, Policies, Fair Trading...): <https://www.chinesestandard.net/AboutUs.aspx>

Contact: Wayne Zheng, Sales@ChineseStandard.net

Linkin: <https://www.linkedin.com/in/waynezhengwenrui/>

----- The End -----