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Replacing GB/T 9061-1988

General Specifications for Metal-Cutting Machines Tools

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Table of Contents

Foreword.....	3
Introduction.....	5
1 Scope.....	6
2 Normative References.....	6
3 Technical requirements	8
3.1 Type, Name and Parameters	8
3.2 Layout and Shaping	9
3.3 Performance and Construction	9
3.4 Accessory and Tools	9
3.5 Electrical System	9
3.6 Numerical Control System	9
3.7 Hydraulic, Pneumatic, Cooling and Lubricating System	10
3.8 Measuring Device	10
3.9 Safety and Health	10
3.10 Life-span	10
3.11 Label	10
3.12 Accompanying Technical Document	11
3.13 Processing Quality	11
3.14 Assembly Quality	11
3.15 Appearance Quality	11
4 Inspection and Acceptance.....	13
4.1 General Description	13
4.2 General Requirements	14
4.3 Appearance Inspection	14
4.4 Accessory and Instrument Inspection	15
4.5 Parametric Test (Sampling inspection)	15
4.6 Idle-running Test of Machine Tools	15
4.7 Load Test of Machine Tools	18
4.8 Accuracy Test of Machine Tools	20
4.9 Miscellaneous.....	21
5 Packing	21
6 Manufacturer's Guarantee	21
Appendix A (Normative) Method to Determine Steady Temperature and Temperature Rise of Main shaft Bearing	22
Appendix B (Informative) Test for Maximum Torsion Moment of Machine Tool Main Drive System and Approximate Calculation Method	24
Appendix C (Informative) Test for Maximum Cutting Resistance of Machine Tool and Approximate Calculation Method	25

Foreword

This Standard replaces GB/T 9061-1988 “General Specifications for Metal-Cutting Machine Tools”. This revision compiles in accordance with GB/T 1.1-2000 “Directives for Standardization - Part 1: Rules for the Structure and Abstract of Standards”. Standard construction and technical content have been adjusted and modified; specification is more specific; the operability of this Standard has been improved.

Compared with GB/T 9061-1988, the main revisions in this Standard are as follows:

- In accordance with the requirements specified in GB/T 1.1, “Contents”, “Foreword” and “Introduction” are added. Article expression of this Standard meets the requirements; literal phrasing is concise and definite; content, format and diagrams are modified according to drafting rules;
- The construction of this Standard is adjusted, with the cancellation of previous standard’s Chapter 4, “Quality of Processing and Assembling” and chapter 5, “Quality of Appearance”, which are merged into Chapter 3 of this Standard. The original heading, “Basic Requirements”, is changed to “Technical Requirements”. Chapter 6 in the previous standard is changed to Chapter 4 in this Standard, with the original heading “Acceptance Inspection” changed to “Inspection and Acceptance”. “Technical Requirements” and “Inspection and Acceptance” are highlighted as two main compositions in this Standard;
- The heading of Chapter 1, “Subject Content and Application Scope”, is changed to “Scope”; and the expression of application scope in the previous standard is modified so as to definite the applicable limits and objects;
- “Numerical Control System” is added to Chapter 3 in this Standard; correspondingly “Numerical Control System” is added in Chapter 4;
- For technical requirements related to people’s health and safety that belong to content of compulsory standard, 3.8 “safety and healthy” in the previous standard has been revised significantly (see 3.9 in this edition) in accordance with principle of direct quote;
- Referencing to overseas advanced standards, and considering domestic manufacturing level at the present and principles of improving products quality, the continuous running time of numerical control machine in 6.6.10

Introduction

This Standard replaces GB/T 9061-1988 “General Specifications for Metal-Cutting Machine Tools”. This Standard is compiled in accordance with requirements specified in GB/T 1.1-2000; in addition, the standard construction and technical content are adjusted and enhanced as well. The previous edition of GB/T 9061-1988 is JB 2278-78 “General Specifications for Metal-Cutting Machine” that was issued by the former Ministry of Machine Industry, which has been implemented for 15 years. GB/T 9061 is the general specification (also called general standard) for fundamental and common quality requirements of machine tool. The technical requirements related to product design, manufacturing, inspection and acceptance are relatively systematic and complete. It promotes the development of machine tool’s product quality standard system, and plays a vital role in upgrading the manufacturing technology level and product quality.

GB/T 9061, together with different kinds of product-technology conditions of machine tool (also called sub standards) that were formulated for supplementary and specific purposes, constitutes the technical basis to evaluate the product quality.

General Specifications for Metal-Cutting Machine Tools

1 Scope

This Standard specifies both the fundamental and common technical requirements of metal-cutting machine tool (hereinafter referred to as machine tool, including modular machine tool and machine tool accessories).

This Standard is applicable to machine tool's design, manufacturing, inspection and acceptance. According to service performance and construction, different kinds of machine tools may compile corresponding product-technology standards, and make supplements to technology index, evaluation methods and inspection projects.

2 Normative References

The following normative documents contain provisions which, through reference in this Standard, constitute provisions of this Standard. For dated reference, subsequent modifications (excluding corrigendum) or revisions of these publications do not apply. However, all parties coming to an agreement according to this Standard are encouraged to study whether the latest edition of these documents is applicable. For undated references, the latest edition of the normative document referred to applies.

GB/T 191-2000 Packaging - Pictorial Marking for Handling of Goods (eqv ISO 780: 1997)

GB/T 3167 – 1993 Symbols for indications appearing on machine tools (neq ISO 7000: 1984)

GB/T 3168-1993 Numerical control of machine - Symbols (neq ISO 2972: 1979)

GB 5226.1 Safety of machinery - Electrical equipment of machines - Part 1: General requirements (GB 5226.1-2002/IEC 60204-1: 2000)

GB/T 6477.1-1986 Terminology for metal-cutting machine tools - Basic terminology

GB/T 6477.2-1986 Terminology for metal-cutting machine tools; Modular machine tools and transfer lines

GB/T 6477.16-1986 Terminology for metal-cutting machine tools - Machine tool accessory

GB/T 6576-2002 Machine tools - Lubrication systems (ISO 5170: 1977, MOD)

GB/T 7932-200 Pneumatic fluid power-General rules relating to systems (ISO 4414: 1998, idt)

GB/T 13306-1991 Plates

GB/T 13574 1992 Metal-cutting machine tools - Test code for static rigidity

GB/T 15375-1994 Metal-cutting machine tools - Method of type designation

GB 15760 Metal-cutting machine tools - General safeguarding specification (GB 15760-2004)

GB/T 16768-1997 Metal-cutting machine tools - Measurement method for vibration

GB/T 16769-1997 Metal-cutting machine tools - Measurement method of sound pressure level

JB/T 2326-1994 machine tool accessory - Method of model compilation

JB/T 3051-1999 Numerical control of machines - Axis and motion nomenclature (eqv ISO 841: 1974)

JB/T 3207-1991 Machine tool accessory - General specification of product package

JB/T 3997-1994 Grey iron castings of metal-cutting machine tools-technical conditions

JB/T 4168-1999 Modular machine tools - Method of model compilation

JB/T 8356.1-1996 Machine tool package - Technical conditions

JB/T 8356.2-1996 Packing box of machine tools

JB/T 8832-2001 General requirements for numerical control systems of machine tools

JB/T 9872-1999 Metal-cutting machine tools - General specification for mechanical processing parts

JB/T 9873-1999 Metal-cutting machine tools - General requirements for welding parts

JB/T 9874-1999 Metal-cutting machine tools - General specification for assembly

JB/T 9875-1999 Metal-cutting machine tools - Compilation of accompanying technical document

JB/T 9877-1999 Metal-cutting machine tools - Determination of cleanliness

JB/T 9935-1999 Machine tool accessory - Compilation of accompanying technical document

JB/T 10051-1999 Hydraulic system general specifications for metal-cutting machine tools

JB/T 8356.2-1996 Machine tool- packing box

JB/T 8832-2001 General requirements for numerical control systems of machine tools

JB/T 9872-1999 Metal-cutting machine tools-general specification for mechanical processing parts

JB/T 9873-1999 Metal-cutting machine tools - General requirements for welding parts

JB/T 9874-1999 Metal-cutting machine tools - General specification for assembly

JB/T 9875-1999 Metal-cutting machine tools - Compilation of accompanying technical document

JB/T 9877-1999 Metal-cutting machine tools - Determination of cleanliness

JB/T 9935-1999 Machine tool accessory - Compilation of accompanying technical document

JB/T 10051-1999 Hydraulic system general specifications for metal-cutting machine tools

3 Technical requirements

3.1 Type, Name and Parameters

The type and name of the machine tool shall be compiled and presented in accordance with the relevant requirements specified in GB/T 15375, GB/T 6477.1, GB/T 6477.2, GB/T 6477.16, JB/T 4168 and JB/T 2326. Coordinate and motion direction of numerically controlled machine tool should be in accordance with the requirements specified in JB/T 3051. Parameters of machine tools should be in

specified in JB/T 8832.

3.7 Hydraulic, Pneumatic, Cooling and Lubricating System

3.7.1 Hydraulic system of the machine tool shall meet the provisions specified in JB/T 10051.

3.7.2 Pneumatic system of the machine tool shall meet the requirements specified in GB/T 7932.

3.7.3 Cooling system of machine tool shall ensure a sufficient and reliable cooling.

3.7.4 Lubricating system of machine tool shall meet the requirements specified in GB/T 6576.

3.7.5 The hydraulic, pneumatic, cooling and lubricating system of machine tool, together with other components, shall not leak (seep) oil, water, or air. The cutting coolant shall not be flow into hydraulic system or lubricating system.

3.8 Measuring Device

The measuring device of both machine tool and accessory shall be accurate and reliable; the readout part, with a clear viewing field, is convenient for operation and observation.

3.9 Safety and Health

It shall adopt safety precaution for the parts in machine tool that may cause damage to personal health or equipment. The safety protection of machine tool shall meet the specifications in GB 15760 or other related standards.

3.10 Life-span

3.10.1 Wear-proof shall be adopted for the important and easy-to-wear rail pair of machine tool, and meet the requirements specified in related standard.

3.10.2 Major parts such as main shaft, screw rod, worm gear, high speed and heavy duty gear of machine tool shall also adopt the corresponding measures so as to increase the life-span.

3.10.3 Protective device should be adopt at the positions easy to be worn by dust, such as main shaft, guide track, screw rod of machine tool.

3.11 Label

Product label on machine tool shall meet the relevant requirements specified in GB/T 13306. Contents on the label shall be correct and meet relevant regulations, with

measuring value of temperature-rise no greater than 5°C.

4.6.2.2 The temperature rise test of hydraulic system shall meet the requirements specified in JB/T 10051. For the machine tool of which the main movement acts as reciprocation, the steady temperature of movement-pieces guide-track shall be inspected in the highest speed. The value of temperature and temperature rise of bearing or heat source in other important positions shall meet the requirements specified in related standard and technical document.

4.6.3 Inspection (sampling inspection) of main movement and feed movement

Inspect the accuracy of main movement speed and speed of feed (amount), as well as the fast-moving speed (or time). The operating mechanism of machine tool shall be stable and reliable in every speed condition.

4.6.4 Motion test

The operation test of machine tool shall contain the following contents:

- a) Inspect the flexibility and reliability of starting, stopping (including braking, reversing and inching) and operating in a proper speed. Generally the repeated motions are not less than 10 times;
- b) Inspect the flexibility and reliability of the alignment and operation of automatic mechanism (including automatic cycle mechanism);
- c) Repeatedly change the speed of main movement and feed movement; and inspect the stability and reliability of speed shifting mechanism, and the indicated accuracy;
- d) Inspect the flexibility and reliability of the operation of transposition, positioning and dividing mechanism;
- e) Inspect the flexibility and reliability of adjusting mechanism, gripping mechanism, readout indicator and other auxiliary equipment;
- f) Inspect the flexibility and reliability of loading and unloading work-pieces, cutting tools and accessories;
- g) For the accompanying accessories having transmission relationship with machine tool, it shall perform connection commissioning; and the interrelationship shall be inspected to see whether meeting the design requirement;
- h) Inspect the operation's flexibility and reliability of other control mechanism;
- i) Inspect the reversal idle-running-amount of flywheel having scale division and

the operating force of flywheel and handgrip, which shall meet the specifications in related standards.

Note: Except the above inspections, the operation test to numerically controlled machine tool shall also be performed in accordance with related standards and technical documents.

4.6.5 Inspections of safe guard and safety device

Inspect the readiness and reliability of safe guard and safety device. The safe guard and safety device shall meet the specifications in related standards such as GB 15760.

4.6.6 Noise inspection

The noise pressure level of machine tool is measured in idle-running condition. The measuring method shall meet the requirements specified in GB/T 16769, and the measuring result shall meet the requirements specified in GB 15760.

4.6.7 Idle-running-power test (sampling test)

Inspect the idle-running power when the idle-running power of all level of speeds of machine tool's main movement mechanism become steady. For machine tool of which the feed movement and main movement are separated, the idle-running power of feed system shall be inspected if necessary.

Note: When inspecting the idle-running power, the power consumed by the motor itself shall be deducted. However, When the motor installed directly in the main shaft (self-propulsion main shaft), the power consumed by motor itself is not deducted. The index of idle-running power is specified according to specific standards of different types of machine tools.

4.6.8 Inspection of electrical system

Electrical system of machine tool shall meet the specifications in related standards such as GB 5226.1. Inspect the working performance and check whether it passes muster.

4.6.9 Inspection of numerical control system

The numerical control system of machine tool shall meet the requirements specified in JB/T 8832. Inspect the reliability and stability when connected with the host machine.

4.6.10 Inspection of hydraulic, pneumatic, cooling and lubricating system

Hydraulic, pneumatic, cooling and lubricating system shall meet the requirements specified in 3.7.

4.6.11 Inspection of measuring device

for maximum torsion moment of machine tool main drive system as well as the approximate calculation method is detailed in Appendix B.

For mass produced machine tools, the test may be conducted under $\frac{2}{3}$ the maximum torsion moment, but the sampling test for the maximum torsion moment and 25% exceeding the maximum torsion moment in a short time shall be conducted regularly.

4.7.3 Machine cutting resistance test

The cutting resistance test includes:

- a) Test for the maximum resistance to cutting;
- b) Test of machine tool with 25% larger than the maximum cutting resistance in a short time (except numerical control machine tools).

In the test, select cutting tool with proper geometric parameter as well as a proper rotational speed in the rotational speed range less than or equal to the calculated rotational speed; change the feed amount and the cutting depth by step to make the machine tool reach the required cutting resistance; inspect whether the movement mechanism and transmission mechanisms of the machine tool drive is flexible and reliable. The test for maximum cutting resistance of machine tool as well as approximate calculation method is detailed in Appendix C.

For mass produced machine tools, the test may be conducted under $\frac{2}{3}$ the maximum cutting resistance, but the sampling test for the maximum cutting resistance and 25% exceeding maximum cutting resistance in a short time shall be conducted regularly.

4.7.4 Test of the main drive system of a machine tool reaching the maximum power (sampling test)

Select proper processing mode, specimen (material and size), cutting tool (material and geometric parameter), common feed-amount and cutting speed according to the type of the machine tool; gradually change the cutting depth to make the machine tool reach the maximum power (generally, the rated capacity of the motor); and inspect whether all parts of the machine tool work under stable working state and whether the metal-cutting rate and the electrical system are reliable.

Note 1: The maximum power refers to rated power of the main motor equipped in a machine tool, but the designed maximum power. If the maximum power test for some machine tool can be conducted under only the calculated power specified in the design, it shall be indicated in the machine tool operation instructions; in this case, the test may be conducted under the calculated power as specified in the design.

It shall be tested according to the requirements of the relevant standard, and the vibration measurement method shall meet the requirements of GB/T 16768.

4.8.5 Stiffness test (sampling)

It shall be tested according to the requirements of the relevant standard, and the static stiffness test shall meet the requirements of GB/T 13574.

4.8.6 Heat distortion test (sampling)

It shall be tested according to the requirements of the relevant standard.

4.8.7 Other accuracy tests

It shall be tested according to the requirements of the relevant technical documents.

Notes: The machine tool that requires not all test items as specified in Section 4.8 may be executed according to relevant standard and technical documents.

4.9 Miscellaneous

It may be executed according to relevant content of technical requirements in purchasing contract.

5 Packing

5.1 Machine tools must be treated with rust prevention before being packed.

5.2 The packing container of whole-set exit-factory machine tool shall be accompanied with a set of technical documents. For complicated machine tool, two sets of operation instructions shall be provided.

5.3 The packing for machine tools shall meet the requirements of GB/T 191, JB/T 8356.1, JB/T 8356.2, and JB/T 3207.

6 Manufacturer's Guarantee

Upon meeting the requirements in machine tool transportation, storage, installing, debugging, repair and maintenance as well as complying with the service instructions, the manufacturer shall be responsible for repair, return and exchange where the machine tool is damaged or out of service due to the reasons like poor design, manufacturing or package quality within one year after the user receives the product.

Appendix A (Normative)

Method to Determine Steady Temperature and Temperature

Rise of Main shaft Bearing

A.1 Measurement of main shaft bearing temperature and room temperature

A.1.1 The main shaft of the machine tool runs at the maximum speed; and the main shaft bearing temperature and the room temperature are measured at a certain time interval. After the operation of a certain time, when the bearing temperature rise is not exceeding 5°C per hour, it is deemed that the machine tool's main shaft reaches the steady temperature.

A.1.2 Take the time (T) as lateral abscissa and the temperature (t) as ordinate; draw the curve of bearing temperature and room temperature measured at a certain time interval; make the gradient line of temperature rise 5°C per hour tangent to the bearing temperature change curve. The tangent point is set as the temperature (t_1) when the main shaft bearing reaches steady temperature; this value, deducted by the room temperature value (t_0) measured at same time, is the temperature rise value (t_2) when the main shaft bearing reaches steady temperature. Figure A.1.1 shows a sample of bearing temperature and room temperature change curve.

Appendix B (Informative)

Test for Maximum Torsion Moment of Machine Tool Main Drive

System and Approximate Calculation Method

In the test for maximum torsion moment of machine tool's main drive system, the motor input power and the machine tool main shaft speed may be respectively measured with power meter and tachometer. The machine tool's torsion moment shall be approximately calculated according to the following formula. Such torsion moment shall be equal to the maximum torsion moment of the machine tool. Generally, select a proper rotational speed in the rotational speed range that is less than or equal to the calculated rotational speed; change the feed amount and the cutting depth step-by-step to make the machine tool to reach the required torsion moment.

$$T \approx 9550(P - P_0)/n \quad (\text{B.1})$$

Where,

T — Torsion moment (N·m);

P — Motor input power in cutting (power of the motor supplied by the power grid) (kW);

P_0 — Idle-running power when the machine tool is loaded with work-piece (power of the motor supplied by the power grid) (kW);

n — Speed of machine tool main shaft (r/min).

The test method for 25% exceeding the maximum torsion moment of machine tool's main driving system is same to the above statement; the feed amount and the cutting depth may be changed continuously to make the cutting torsion moment to reach 125 % of the rated value.

This formula is only an approximate calculation method; if necessary, other formulas with more accuracy may be adopted.

Appendix C (Informative)

Test for Maximum Cutting Resistance of Machine Tool and Approximate Calculation Method

In the test for maximum cutting resistance of machine tool, the motor input power and the machine tool main shaft speed may be respectively measured with power meter and tachometer. The main cutting force of the machine cutting resistance shall be approximately calculated according to the following formula; the cutting resistance may be determined according to the main cutting force and the cutting tool angle. Such resistance shall be equal to the maximum cutting resistance of the machine tool. In the test, select a cutting tool that is commonly used in heavy cut and a proper rotational speed in the rotational speed range less than or equal to the calculated rotational speed; change the feed amount and the cutting depth step-by-step to make the machine tool to reach the specified cutting resistance.

$$F \approx \frac{9550(P - P_0)}{r \cdot n} \quad (\text{C.1})$$

Where,

F — Main cutting force of cutting resistance (N);

P — Motor input power in cutting (power of the motor supplied by the power grid) (kW);

P_0 — Idle-running power when the machine tool is loaded with work-piece (power of the motor supplied by the power grid) (kW);

r — Cutting radius of work-piece or cutting tool (m);

n — Speed of machine tool main shaft (r/min).

The test method for 25% exceeding the maximum cutting resistance of machine tool's main driving system is same to the above statement; the feed amount and the cutting depth may be changed continuously to make the cutting resistance to reach 125% of the rated value.

This formula is only an approximate calculation method; if necessary, other formulas with more accuracy may be adopted. For the machine tools that this formula is not

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