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Machine tools automatic production line for automobile gears

汽车齿轮机床加工自动生产线

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1 Scope

This Standard specifies requirements for design, manufacture, inspection and acceptance of machine tool automatic production line for automobile gears.

This Standard is applicable to machine tool automatic production line for automobile gears of which the maximum workpiece diameter is 260mm, that mainly completes the processes of turning, tooth making, chamfering and deburring (hereinafter referred to as “automatic line”).

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.

GB/T 4208-2017, *Degrees of protection provided by enclosure (IP code)*

GB/T 5226.1-2019, *Electrical safety of machinery - Electrical equipment of machines - Part 1: General requirements*

GB/T 6576-2002, *Machine tools - Lubrication systems*

GB/T 7932-2017, *Pneumatic fluid power - General rules and safety requirements for systems and their components*

GB/T 9061-2006, *General Specifications for Metal - Cutting Machines Tools*

GB 15760-2004, *Metal-cutting machine tools - General safeguarding specification*

GB/T 17421.5-2015, *Test code for machine tools - Part 5: Determination of the noise emission*

GB/T 23570-2009, *Welding parts for metal cutting machines - General specifications*

GB/T 23572-2009, *Hydraulic system general specifications for metal-cutting*

etc.;

b) the logistics unit includes truss manipulator or robot, feed bin, exchange channel (equipped when needed), etc.;

c) the control unit includes computer, control system, sensor, etc.

4 Technical requirements

4.1 Requirements for production line entry

The truss manipulator (or robot) in the CNC equipment and the logistics unit in the automatic line, before entry to the production line, shall be respectively inspected accepted according to corresponding product standards and technical agreements.

4.2 Parameters

The parameters of the automatic line shall comply with the provisions of the design documents.

4.3 Layout and appearance

4.3.1 The automatic line shall be reasonably arranged, beautiful in appearance and harmonious in color.

4.3.2 The operation desk shall be easy to operate. The operating buttons are clearly marked for easy identification, in accordance with the ergonomic principles.

4.3.3 The protective cover and protective guard shall be flat and well-proportioned. They shall not warp or dent.

4.3.4 The color and gloss of the coating shall be uniform. The coating shall be flat. There shall be no defects such as blistering and falling-off on the surface of the coating.

4.3.5 The marks and signs of all kinds of information shall be flat and fixed in obvious position, clear and durable, not skewed.

4.3.6 Others shall meet the requirements of 3.15 and design documents in GB/T 9061-2006.

4.4 Performances and functions

4.4.1 The mechanical docking interface between the CNC equipment and the logistics unit of the automatic line shall be adapted to each other.

d) If necessary, the logistics unit of manual loading shall have measures to prevent incorrect placement of the workpiece.

4.5 Electrical system

The electrical system in the automatic line shall comply with the provisions of GB/T 5226.1-2019.

4.6 CNC system

The CNC system in the automatic line shall comply with the provisions of GB/T 26220-2010.

4.7 Hydraulic, pneumatic and lubrication systems

4.7.1 The hydraulic system of the automatic line shall comply with the provisions of GB/T 23572-2009.

4.7.2 The pneumatic system of the automatic line shall comply with the provisions of GB/T 7932-2017.

4.7.3 The lubrication system of the automatic line shall comply with the provisions of GB/T 6576-2002.

4.7.4 There shall be no leakage in any part of the hydraulic, lubrication and pneumatic system of the automatic line.

4.8 Hygiene and safety

4.8.1 The safety protection of automatic lines shall comply with the provisions of GB 15760-2004 and GB/T 5226.1-2019.

4.8.2 The working area of the automatic line shall be equipped with protective devices, which is convenient for the operator to observe.

4.8.3 The manual operating area shall be spatially isolated from the truss manipulator (or robot) motion area. It shall set logical control in the coincident area. There shall be a hardware protection mechanism.

4.8.4 The hydraulic system and the pneumatic system shall provide stable normal working pressure. When it exceeds the set limit, it shall issue a warning signal or make the automatic line motion stop.

4.8.5 After the emergency stop, release the alarm after the emergency stop button is released. The automatic line shall not start automatically.

4.8.6 The alarm device of the processing equipment shall be located in an easy-to-view position.

c) Verify the truss manipulator (or robot) jaws to pick up and place the workpiece 10 times each time. The action shall be reliable. The workpiece shall have no damage;

d) Simulate the working state to manipulate the entire line's "emergency stop" button (or switch) for 10 consecutive times, which shall be accurate and trouble free;

e) Use a numerical control program to operate. At a moderate speed, respectively perform positive and negative start, stop (or brake), work feeding, rapid feeding to each coordinate axis for 10 times. The action shall be flexible, accurate and reliable;

f) According to the design requirements, respectively test the functions such as positioning of each coordinate axis, feeding coordinate overtravel protection, coordinate position display, reference point return, manual data input, programming, serial number indication and retrieval, program pause, program elimination. The functions shall be reliable. The actions shall be flexible and accurate;

g) Test the safety protective device. The function shall be reliable. The action shall be accurate.

4.10.2 Requirements for continuous idle operation

The automatic line simulates the working state to perform the continuous idle operation test of the entire line according to the designed beat (non-cutting state with material). Its continuous operation time is not less than 48h. During the idle operation process, each part shall work normally. The operation shall be stable. All functions and performances shall be reliable and no faults occur. Otherwise, it shall re-perform the continuous idle operation.

4.11 Working accuracy requirements

There are two assessment methods for automatic line's working accuracy: "direct assessment" and "process capability index assessment". The assessment method, assessment items and requirements of working accuracy shall be determined by the manufacturer and the user through negotiation:

a) Working accuracy when using "direct assessment": After the automatic line completes the continuous machining of the specified number of parts to be processed (not less than 50 pieces), inspect the confirmed assessment items, which shall be meet the requirements;

b) Working accuracy when using "process capability index assessment": After the automatic line completes the continuous machining of the specified number of parts to be processed (not less than 50 pieces),

that is fastened with anchor bolts shall not be re-adjusted during the inspection process. Otherwise, it shall re-inspect the affected items after adjustment.

5.2.4 The inspection principle is to perform on the finished products. In special cases, some parts can be disassembled according to the manufacturer's instructions.

5.2.5 Since the automatic line is structurally limited or does not have the specified test tool, it can be replaced by a method equivalent to the standard one.

5.3 Entry inspection

Inspect whether the exit-factory documents (instruction manual, certificate of conformity, packing list) of truss manipulator (or robot) in the CNC equipment and the logistics unit in the automatic line meet the requirements of 4.1.

5.4 Parameter inspection (random inspection)

According to the parameters specified in the product instruction manual or technical agreement, verify whether the parameters of the automatic line meet the requirements of 4.2.

5.5 Layout and appearance inspection

Use visual inspection and pattern inspection methods to inspect whether the layout and appearance of the automatic line meet the requirements of 4.3.1~4.3.6.

5.6 Performance and performance inspection

5.6.1 According to the process requirements, perform the interactive inspection of the machined parts between the CNC equipment and the logistics unit to see whether the results meet the requirements of 4.4.1.

5.6.2 According to the designed beats, carry out inspection of processing equipment for each procedure of continuous idle operation of automatic line to see whether the results meet the requirements of 4.4.2.

5.6.3 According to the control execution mode of automatic line control unit, inspect the CNC equipment and the logistics unit to see whether the results meet the requirements of 4.4.3.

5.6.4 During the continuous idle operation of automatic line, inspect the CNC equipment and the logistics unit of the automatic line to see whether the results meet the requirements of 4.4.4 and 4.4.5.

5.7 Inspection of electrical system

line's chip evacuation and recovery of waste gas oil, waste oil and wastewater generated during operation to see whether the results meet the requirements of 4.8.10.

5.11 Processing and assembly quality inspection

5.11.1 Use visual inspection and/or pattern check mode to inspect the assembly of automatic line, machined parts and welded parts of the logistics unit to see whether the results meet the requirements of 4.9.1.

5.11.2 Use visual inspection and/or actual inspection mode to inspect parts of the logistics unit such as gear, rack, guide bar, jaw to see whether the results meet the requirements of 4.9.2.

5.11.3 Use visual inspection and/or pattern check mode to inspect the joint surface of the logistics unit such as linear guide to see whether the results meet the requirements of 4.9.3.

5.11.4 According to the visual inspection method and hand-feeling method specified in GB/T 25374-2010, inspect the cleanness of automatic line to see whether the results meet the requirements of 4.9.4.

5.12 Idle operation inspection

5.12.1 Action inspection

When the entire automatic line continuously operates, inspect the action of automatic line to see whether the results meet the requirements of 4.10.1.

5.12.2 Continuous idle operation inspection

The automatic line simulates the working state according to the designed beats, perform continuous idle operation inspection not less than 48h (non-cutting state with material) to see whether the results meet the requirements of 4.10.2.

5.13 Working accuracy inspection

According to the cutting specification that complies with the process drawings and beat requirements of the machined parts and tools, perform continuous cutting to the machined parts. The continuous processing is not less than 50 pieces (if it stops due to a fault, it needs to be re-started after troubleshooting). Inspect the working accuracy of automatic line to see whether the results meet the requirements of 4.11.

6 Packaging

6.1 Before packaging of automatic line, it shall conduct anti-rust treatment.

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