

CNC Lathe Programming and Machining of Thin-walled Parts Macro Program

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Abstract-In this paper, thin-walled parts macro programming design and examples of realization, find its CNC lathe, the shape of the processing rules, compiled macro program implementation. Compared with the ordinary procedure by macro program, analysis of the necessity of its existence. Macro program has proved irreplaceable role in CNC machining, so engaged in CNC machining staff recognize the importance of the macro process.

Keywords-CNC Machining ; Thin-walled Parts ; Macro ; Programming and Processing

I. INTRODUCTION

I have been engaged in CNC professional practice teaching and theoretical teaching, guiding students to participate in the national competition numerical skills competition, but also deep into the enterprise jobs CNC machining work. In the teaching process, students claim NC obtain professional skills certificate, in which students apply advanced numerical control requirements must master the macro programming skills, vocational school skills competition is more of a macro program put forward higher requirements. In business, there are few programmers will use the macro programming. Most companies use computer automatic programming, few companies use manual G-code programming, the role of the macro program that cannot be reflected, many employees macro program by learning, improve their own level CNC programming to solve the previously programmed by computer automatically and manually G code programming can not solve the processing problems, greatly improving production efficiency and product quality. In the mold processing enterprises, many mold shape parts of similar size is inconsistent, macro here there is a very wide range of applications of space, can be consistent with the shape of a part programmed with a macro program, just modify the relevant parameters to the actual application size. Circle Mold Co., Ltd. Hebei Science and Technology Plan undertaken subject "car cover mold CNC machining mode and process optimization." The project is the study of the fine mold surface machining principle, the use of hierarchical contour programming methods to achieve a small amount of cutting, fast feed efficient processing, improved macro parameter library. After the implementation of the project to improve the mold quality, high efficiency, energy saving effect is obvious, the economic and social benefits significantly [2]. In the usual process of teaching, I deeply felt the need to learn a macro program, so this

macro program macro programming research at CNC lathe thin-walled parts. Through this study, so in CNC machining staff recognize the importance of the macro process of necessity and should be familiar with the use of a macro program.^[1]

II. THE MACRO DEFINITIONS AND CHARACTERISTICS

NC during manual programming, Certain values with variable assignment method to express, Read the numerical CNC system is variable and variable values are assigned a regular change , When programming may be added math and logic operations, prepared by hand out of the program in this way is called a macro.

CNC programming using macro advantages:

Using variables compiled NC program, it will make a regular shape of the parts programming easier. Program when writing more readable, easy to modify the program to read the program. When reading program CNC machine tools also liked to read such a program, because the macro will read faster CNC machine tools, processing machines faster response speed.

CNC machined parts in some shapes using computer programming software development process cannot be achieved, such as an elliptical shape thread, variable pitch thread, in the sphere processing thread, these complex shapes only use a macro program is the best solution.

The use of macros compiled programs usually are less than 70 lines, it would CNC machine storage capacity greatly enhanced. Can improve the machining efficiency, but also improve the ability of the preparation of programming staff.

III. ORDINARY MANUAL PROGRAMMING AND MACRO PROGRAMMING CONTRAST

The role of ordinary manual programming instruction processing code is fixed, entirely developed by NC programming system manufacturer, during programming, the programmer can use the programming instructions specified machining programs. Since the general instruction in the use of hand-woven single usage, unable to adapt to the programming of complex parts, a lot of numerical control system manufacturers based on the common programming instructions on the increase in macro programming function.

Manual programming can only be used when ordinary numerical programming, because it is a fixed value, it cannot be mathematical programming, CNC machine tools when reading the program does not jump to another block, can only be read line by line from top to bottom,

use when the macro compiled NC program, using variable assignment methods, can perform mathematical operations and logic operations between macro variables, when reading program CNC machine tools are available upon request to jump to the desired block, the program flexible.

TABLE I MACRO PROGRAMMING BRIEF COMPARISON WITH ORDINARY MANUAL PROGRAMMING

Ordinary manual programming	Macro Programming
Use only constants	Use variables and assign values to variables
Not operations between constants	Operations between variables can
Program can only order, can not jump	Program run can jump
Ordinary manual programming	Macro Programming

IV. CNC LATHE PROGRAMMING AND MACHINING OF THIN-WALLED PARTS MACRO PROGRAM

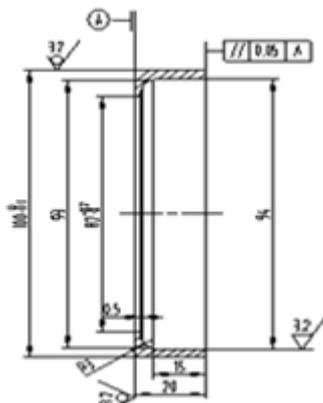


Figure 1. Thin-walled Parts Drawing

A. Analyze Parts Diagram, Determine the Installation Reference

Parts shown in Fig, and an end face of the cylindrical part machining has not displayed according to the technical requirements of the drawings illustrate the two faces of the parts does not require precision machining of relatively high. Taking into account the structure and shape of parts, as well as the actual process used by the machining characteristics, select the part of the plane for the positioning surface clamping fixture using standard anti-lathe clamping jaws. [2]

B. Select the Processing Method

Parts of the inner contour of roughness $R_a = 3.2$, so when turning, you can call were first roughing, then finishing the program. Taking into account the selected parts of the blank is 45 # steel, its good machinability and surface without crust, so the use of tip arc is $R = 0.4$ when the turning tool cutting processing, which can improve the processing of parts the surface roughness and tool wear can be reduced. When the internal bore and the inner contour, taking into account the accuracy of the machining of precision and positioning, can be used within 93

degrees hole tools, carry out roughing and finishing process, will be able to meet the requirements of precision parts. [3]

C. Select the processing line

In determining the processing line, it should follow the principle of “first base, the first hole behind after the first crude refined.”

According to the characteristics of the blank, in the process, select the bottom face as a positioning reference plane, the first in chronological order, first drilled and then the inner surface of the rough parts of $d20$ hole, and then were roughing, finishing inside part contour, taking into parts Isolation is required to make a soft jaws to ensure positioning accuracy of the work piece. [4]

D. Select the cutting parameters

Because parts of the blank choice is 45 # steel, so the processing performance of its cutting, the use of machining used machines are CNC lathes, taking into account the actual use of CNC lathes of performance and processing characteristics of its knife back to eat the amount of maximum the value of 1mm, and because the surface roughness of the machined parts is higher, so the need for rough machining, finishing, so when roughing, cutting back the amount of food choice MID is 0.2mm, finishing Select finishing allowance of 0.1mm. Also, because the machine feed rate is 0.1mm / r, so in order to improve the efficiency of processing, roughing, contour selected direction feed amount (ie FFP1) of 0.2mm / r. [5]

Since the processing of parts and materials for the 45 # steel, its good cutting performance, and the selected feed rate and the back of cut are relatively small, so by the look-up table reference, the cutting speed can get bigger, so choose cutting speed of 160m / min. So when machining end mill for turning parts, its spindle speed:

$$n = \frac{1000 \times v}{\pi \times d} = 650r / \text{min}$$

After calculation available, choose its roughing spindle speed 650r / min, finishing spindle speed 1000r / min. Selection cutting three elements are shown in Table 2[6]

TABLE II CUTTING THREE ELEMENTS

	Spindle speed (r / min)	Feed rate (mm / r)		The back of cut (mm)
		FAL	FALD	
Roughing	650	0.2	0.2	1.0
Finishing	1000	0.1	0.1	0.1

Select the tool

Turning on all surfaces of parts, using drill through the center O processing, in order to improve the surface finish of precision parts, to avoid marks at the junction of the tool, so that the diameter should try a large selection of tools more, so turning parts of the surface, through the center of the selected U drill diameter 20mm. The cemented carbide tool material, good stiffness, rigidity to meet processing requirements. [7]

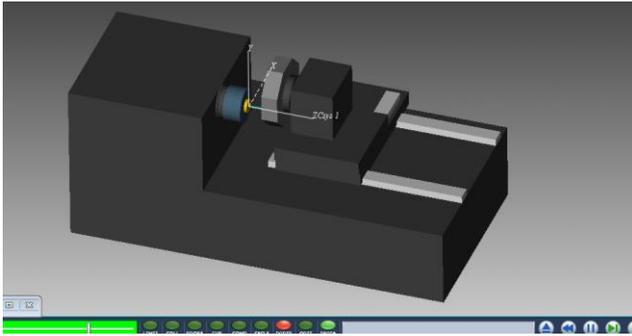


Figure 2. Work Piece Tool Installation Effect Map

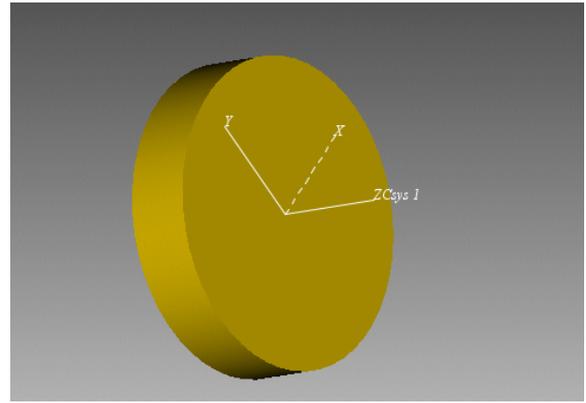


Figure 3. Setting the Work Piece Coordinate System

A. The work Piece Coordinate System

Select the center of the upper surface of the work piece as the origin of the work piece coordinate system. As shown in diagram 3:

NC machining processes and tool card
 According to the structural characteristics of the parts, press parts chucking positioning division process, due to the different structure and shape of each part, the technical requirements of each of the machined surface are different, their positioning will vary. Bottom and side of the work piece to be positioned, by stepping up fixture. In a process step, after all the processing surface by roughing finishing first step to divide. [8]

TABLE III PARTS CNC MACHINING PROCESS CARD

Worker number	Step Content	Tool number	Tool Specifications	Spindle speed (r/min)	Feed rate (mm/r)	The back of cut (mm)	Remark
1	Drill hole D20	T1	D20U 钻	650	0.2	20	Automatic
2	Roughing D82 through hole	T1	D20U 钻	650	0.2	1	Automatic
3	Rough outline of the vehicle	T1	D20U 钻	650	0.2	1	Automatic
4	Refined interior contours	T1	D20U 钻	1000	0.1	0.1	Automatic

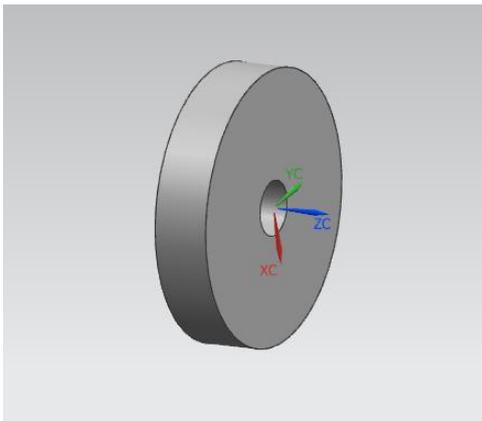


Figure 4. Workers No. 1 Machining Renderings

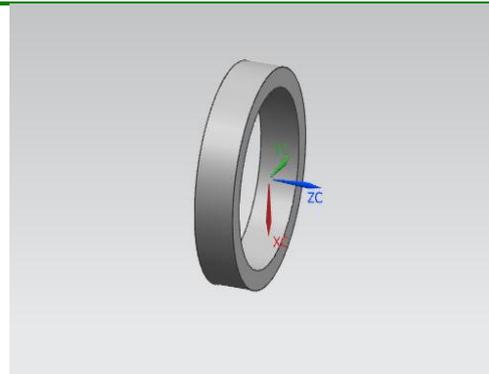


Figure 5. Workers No. 2 Machining Renderings



Figure 6. Workers No. 3 Machining Renderings

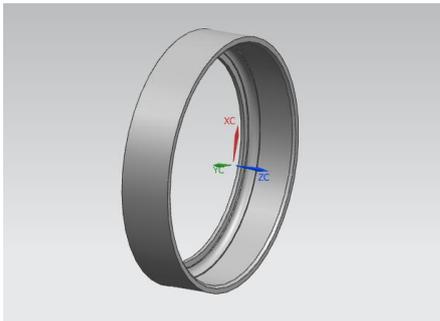


Figure 7. Workers No. 3 Machining Renderings

B. Processing procedures are as follows[9]

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O1212
T0101;
M3S650;
G0X20Z2;
#1=0;
#2=20;
WHILE[#1LE#2]DO1;
G0Z3;
G0Z[-#1+1];
G1Z-[#1]F0.2;
#1=#1+1;
END1;
G0Z0;
G1X102F0.2;
G0Z1;
X11;
#3=20;
#4=80;
WHILE[#3LE#4]DO2;
G0X[#3];
G1Z-21F0.2;
G0X[#3-0.2];
Z0;

```

```

#3=#3+2;
END2;
G0X80Z2;
G71U1R0.2;
G71P1Q2U0.2W0.2F0.2;
N1G0X95;
G1Z0;
G1X94Z-1;
Z-15;
X93;
G3X87Z-18R3;
G1Z-18.5;
X82;
Z-21;
N2X80;
M3S1500;
G70P1Q2F0.1;
G0Z100;
M30;

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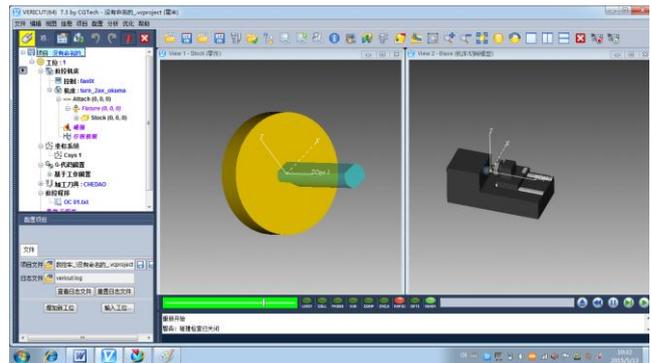


Figure 8. VERICUT Simulation Renderings

V. CONCLUSION

By programming the study of thin-walled parts CNC lathe macro program, find the preparation of complex parts on law macro CNC machine tools. CNC lathe designed for thin-walled parts programmed to NC programming personnel, in actual machining macro programs to be compiled according to the specific circumstances of the parts, in the processing of the application macro, so that simplify programming, programming of versatility. In NC programming, play a very important role. [10]

NC programmers will help improve the process, so as to solve the problems encountered in the business of CNC machining; Help enterprises processing components save time and improve efficiency; Conducive to the promotion of a macro program, so that more practitioners recognize the importance of the NC macro program, which independent macro program to stimulate interest in learning.

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