

12 PROGRAM CONFIGURATION

12.1 PROGRAM COMPONENTS OTHER THAN
PROGRAM SECTIONS

12.2 PROGRAM SECTION CONFIGURATION

12.3 SUBPROGRAM



General

· Main program and subprogram

There are two program types, main program and subprogram. Normally, the CNC operates according to the main program. However, when a command calling a subprogram is encountered in the main program, control is passed to the subprogram. When a command specifying a return to the main program is encountered in a subprogram, control is returned to the main program.

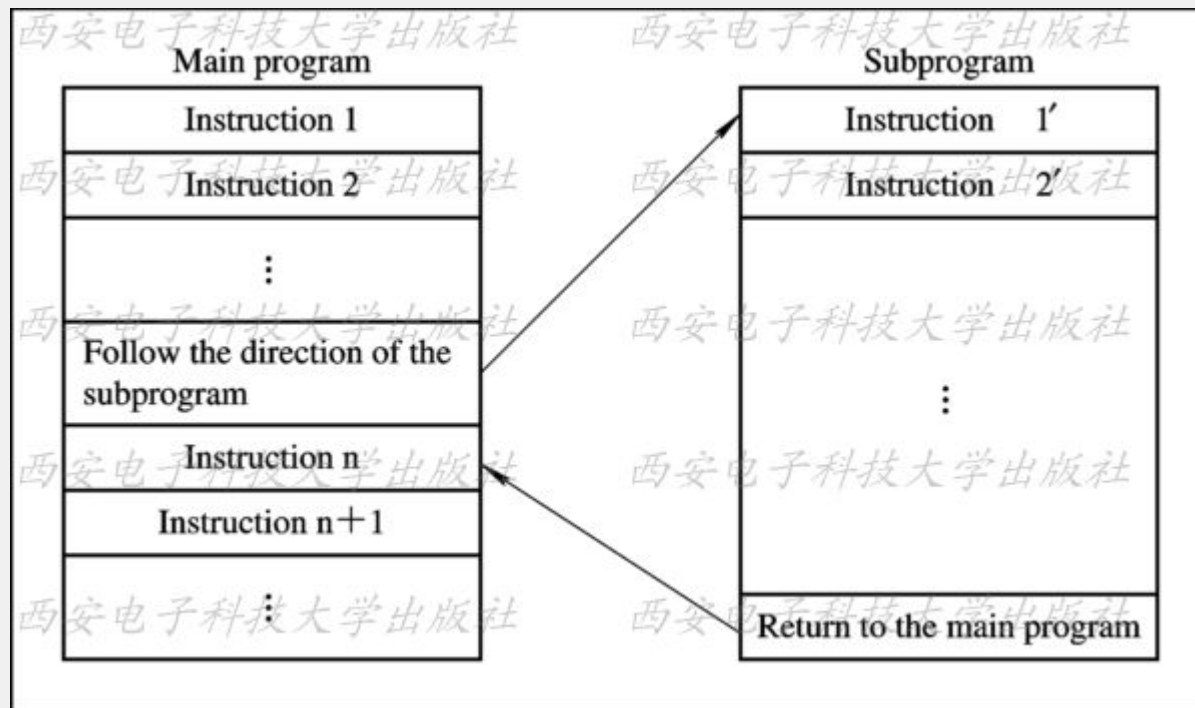


Fig.12.0(a) Main program and Subprogram

The CNC memory can hold up to 400 main programs and subprograms (63 as standard). A main program can be selected from the stored main programs to operate the machine. See section 9.3 or section 10 for the methods of registering and selecting programs.

- **Program components**

A program consists of the following components.

Table 12.0 Program components

Components	Descriptions
Tape start	Symbol indicating the start of a program file
Leader section	Used for the title of a program file, etc.
Program start	Symbol indicating the start of a program
Program section	Commands for machining
Comment section	Comments or directions for the operator
Tape end	Symbol indicating the end of a program file

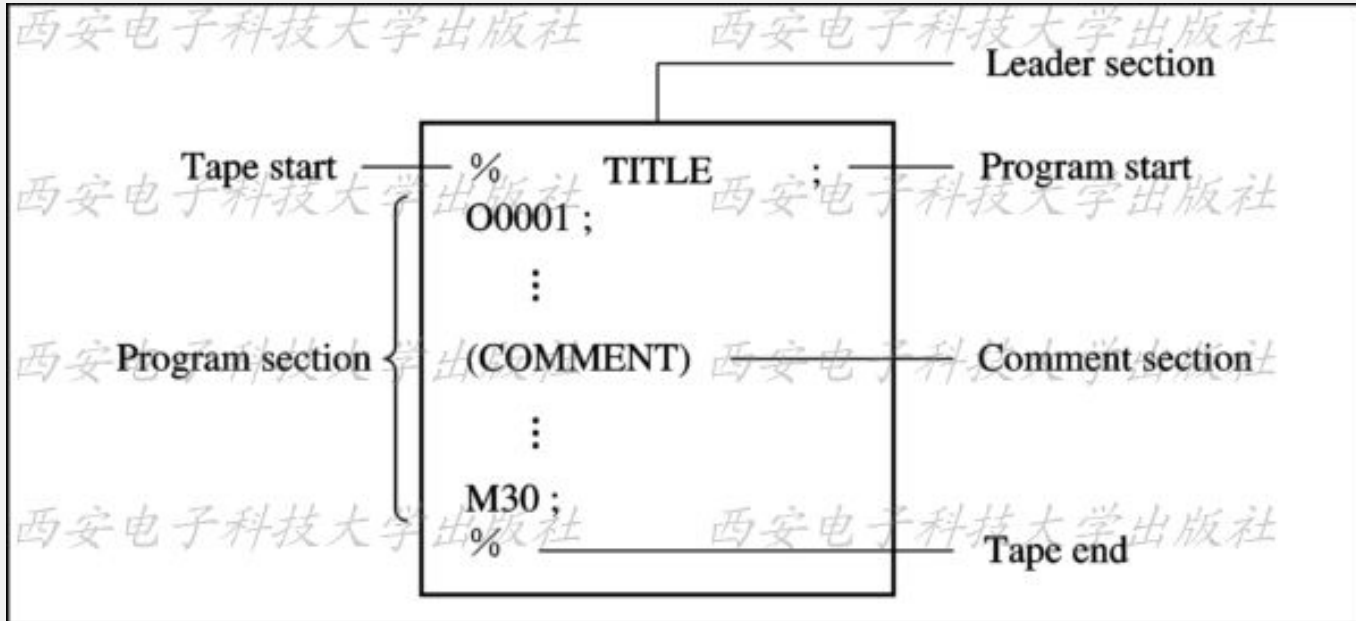


Fig.12.0(b) Program configuration

- **Program section configuration**

A program section consists of several blocks. A program section starts with a program number and ends with a program end code.

Program section configuration	Program section
Program number	O0001;
Block 1	N1 G91 G00 X120.0 Y80.0;
Block 2	N2 G43 Z-32.0 H01;
⋮	⋮
Block n	Nn Z0;
Program end	M30;

A block contains information necessary for machining, such as a move command or coolant on/off command. Specifying a slash (/) at the start of a block disables the execution of some blocks.



12.1 PROGRAM COMPONENTS OTHER THAN PROGRAM SECTIONS

This section describes program components other than program sections. See section 12.2 for a program section.

Explanations

- **Tape start**

The tape start indicates the start of a file that contains NC programs.

The mark is not required when programs are entered using SYSTEM P or ordinary personal computers. The mark is not displayed on the CRT display screen.

However, if the file is output, the mark is automatically output at the start of the file.

Table 12.1 Code of a tape start

Name	ISO code	EIA code	Notation in this book
Tape start	%	ER	%

- **Leader section**

Data entered before the programs in a file constitutes a leader section.

When machining is started, the label skip state is usually set by turning on the power or resetting the system. In the label skip state, all information is ignored until the first end of block code is read. When a file is read into the CNC unit from an I/O device, leader sections are skipped by the label skip function.

A leader section generally contains information such as a file header.

When a leader section is skipped, even a TV parity check is not made. So a leader section can contain any codes except the EOB code.

- **Program start**

The program start code is to be entered immediately after a leader section, that is, immediately before a program section.

This code indicates the start of a program, and is always required to disable the label skip function.

With SYSTEM P or ordinary personal computers, this code can be entered by pressing the return key.

Table 12.2 Code of a program start

Name	ISO code	EIA code	Notation in this book
Program start	LF	CR	;

NOTE

If one file contains multiple programs, the EOB code for label skip operation must not appear before a second or subsequent program number.

- **Comment section**

Any information enclosed by the control *out* and control *in* codes is regarded as a comment.

The user can enter a header, comments, directions to the operator, etc. in a comment section using the EOB code or any other code.

Table 12.3 Codes of a control-in and a control-out

Name	ISO code	EIA code	Notation in this book	Meaning
Control-out	(2 - 4 - 5	(Start of comment section
Control-in)	2 - 4 - 7)	End of comment section

When a program is read into memory for memory operation, comment sections, if any, are not ignored but are also read into memory. Note, however, that codes other than those listed in the code table in Appendix A are ignored, and thus are not read into memory.

When data in memory is output on external I/O device, the comment sections are also output.

When a program is displayed on the screen, its comment sections are also displayed. However, those codes that were ignored when read into memory are not output or displayed.




During memory operation or DNC operation, all comment sections are ignored.

The TV check function can be used for a comment section by setting parameter CTV (bit 1 of No.0100).

CAUTION

If a long comment section appears in the middle of a program section, a move along an axis may be suspended for a long time because of such a comment section. So a comment section should be placed where movement suspension may occur or no movement is involved.

NOTE

If only a control  in code is read with no matching control  out code, the read control  in code is ignored.

• **Tape end**

A tape end is to be placed at the end of a file containing NC programs.

If programs are entered using the automatic programming system, the mark need not be entered.

The mark is not displayed on the CRT display screen. However, when a file is output, the mark is automatically output at the end of the file.

If an attempt is made to execute % when M02 or M03 is not placed at the end of the program, the P/S alarm (No.5010) is occurred.

Table 12.4 Code of a tape end

Name	ISO code	EIA code	Notation in this manual
Tape end	%	ER	%



12.2 PROGRAM SECTION CONFIGURATION

This section describes elements of a program section.

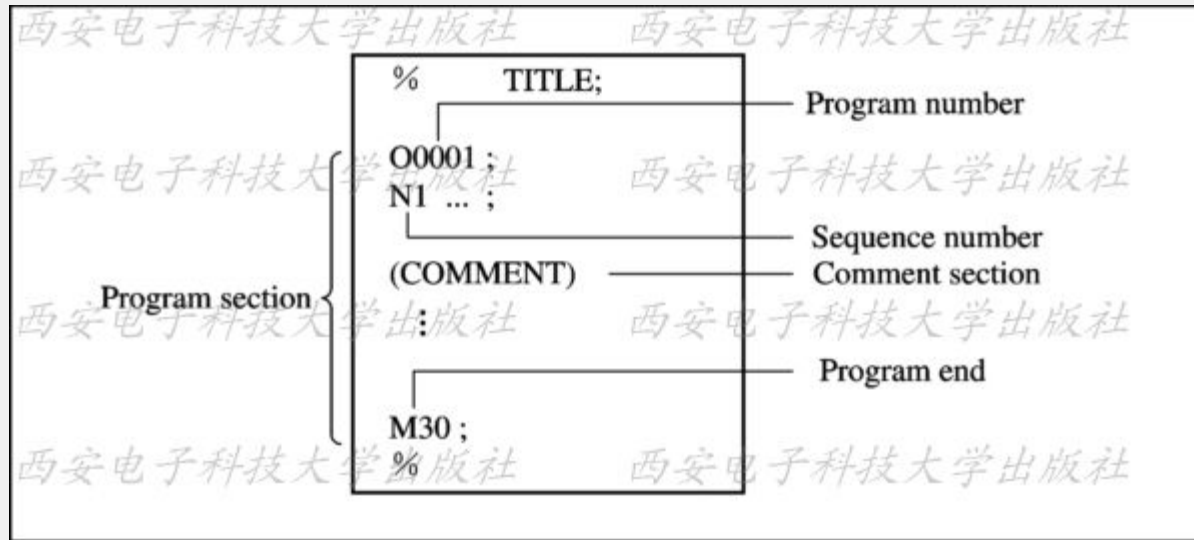


Fig.12.2(a) Program configuration

• **Program number**

A program number consisting of address O followed by a four-digit number is assigned to each program at the beginning registered in memory to identify the program.

In ISO code, the colon (:) can be used instead of O.

When no program number is specified at the start of a program, the sequence number at the start of the program is regarded as its program number. If a five-digit sequence number is used, the lower four digits are registered as a program number. If the lower four digits are all 0, the program number registered immediately before added to 1 is registered as a program number. Note, however, that N0 cannot be used for a program number.

If there is no program number or sequence number at the start of a program, a program number must be specified using the CRT/MDI panel when the program is stored in memory.

NOTE

Program numbers 8000 to 9999 may be used by machine tool builders, and the user may not be able to use these numbers.

· Sequence number and block

A program consists of several commands. One command unit is called a block. One block is separated from another with an EOB of end of block code.

Table 12.5 EOB code

Name	ISO code	EIA code	Notation in this book
End of block(EOB)	LF	CR	;

At the head of a block, a sequence number consisting of address N followed by a number not longer than five digits (1 to 99999) can be placed. Sequence numbers can be specified in a random order, and any numbers can be skipped. Sequence numbers may be specified for all blocks or only for desired blocks of the program. In general, however, it is convenient to assign sequence numbers in ascending order in phase with the machining steps. (For example, when a new tool is used by tool replacement, and machining proceeds to a new surface with table indexing.)

Sequence number and block (example):

N300 X200.0 Z300.0; A sequence number is underlined

NOTE

N0 must not be used for the reason of file compatibility with other CNC systems.

Program number 0 cannot be used. So 0 must not be used for a sequence number regarded as a program number.

- **TV check (Vertical parity check along tape)**

A parity check is made for a block on input tape vertically. If the number of characters in one block (starting with the code immediately after an EOB and ending with the next EOB) is odd, an P/S alarm (No.002) is output. No TV check is made only for those parts that are skipped by the label skip function. Bit 1 (CTV) of parameter No.0100 is used to specify whether comments enclosed in parentheses are counted as characters during TV check. The TV check function can be enabled or disabled by setting on the MDI unit.

- **Block configuration (Word and address)**

A block consists of one or more words. A word consists of an address followed by a number some digits long. (The plus sign (+) or minus sign (-) may be prefixed to a number.)

Word = Address + number (Example : X-1000)

For an address, one of the letters (A to Z) is used ; an address defines the meaning of a number that follows the address. Table 12.6 indicates the usable addresses and their meanings.

Table 12.6 Major functions and addresses

Function	Address	Meaning
Program number	O	Program number
Sequence number	N	Sequence number
Preparatory function	G	Specifies a motion mode (linear, arc, etc.)
Dimension word	X, Y, Z, U, V, W, A, B, C	Coordinate axis move command
	I, J, K	Coordinate of the arc center
	R	Arc radius
Feed function	F	Rate of feed per minute, rate of feed per revolution
Spindle speed function	S	Spindle speed
Tool function	T	Tool number
Auxiliary function	M	On/off control on the machine tool
	B	Table indexing, etc.
Offset number	D, H	Offset number
Dwell	P, X	Dwell time
Program number designation	P	Subprogram number
Number of repetitions	P	Number of subprogram repetitions
Parameter	P, Q	Canned cycle parameter

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