4 INSTRUCTIONS

This chapter shows arc instructions and weld speed instructions dedicated to Arc Tool Software.

4.1 ARC WELD INSTRUCTIONS

Arc weld instructions demonstrate how, where and when to execute arc welding. The domain between arc weld start instruction and arc weld end instruction becomes welding domain.

- Arc weld start instruction: Demonstrating start position/timing/procedure of arc welding.
- Arc weld end instruction: Demonstrating end position/timing/procedure of arc welding.

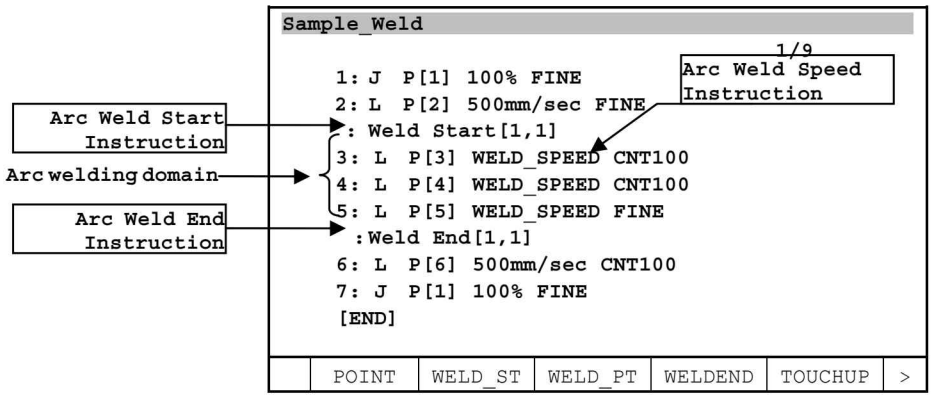


Fig. 4.1 Execute arc welding with arc weld start/end instruction

4.1.1 Arc Weld Start Instruction

Arc weld start instructions request to start arc welding or change the welding condition. ArcTool software has two formats of instructions.

- Weld Start [WP, i] : Use arc weld schedule defined at arc weld procedure.
- Weld Start [WP, V, A,…] : Use several conditions specified in TP program directly.

Weld Start [WP, i]

Weld Start [WP, i] instruction executes welding based on an arc weld schedule defined at an arc weld procedure.

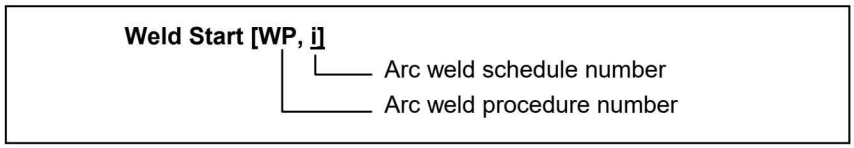
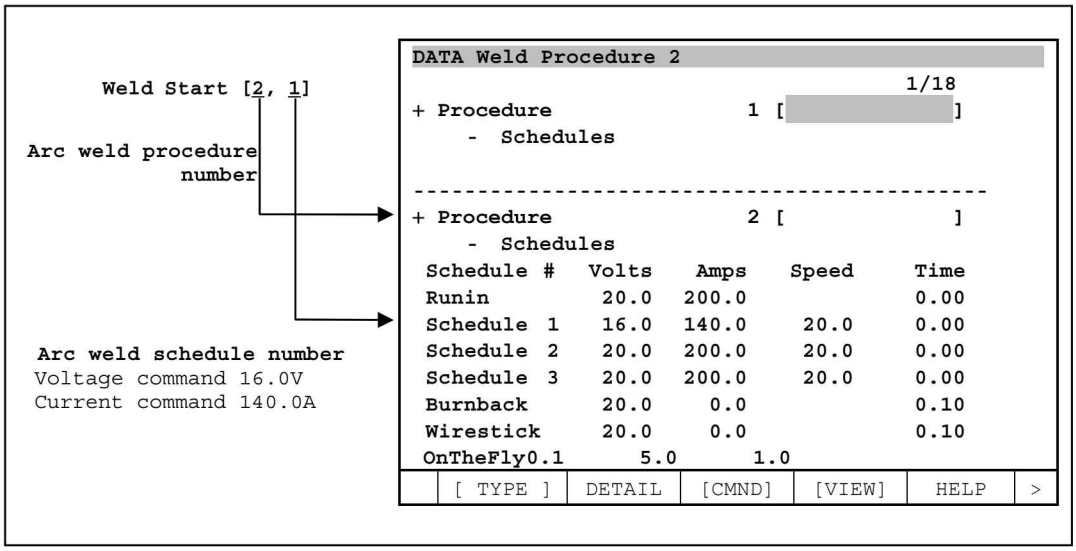


Fig. 4.1.1 (a) Arc weld start instruction at arc weld schedule format



⚠CAUTION
Delay time is invalid at arc weld start instruction normally. However, it effects to welding condition when ArcTool ramping function or arc wait start function is enabled. Please set the time to 0.0 when it is not necessary.

Weld Start [WP, V, A,…]

Weld Start [WP, V, A,…] instruction executes welding based on the specified welding condition; voltage, current and/or wire feed speed et.al. directly.
The type and number of the conditions depends installed option, connecting weld equipment and the configurations of weld I/O.

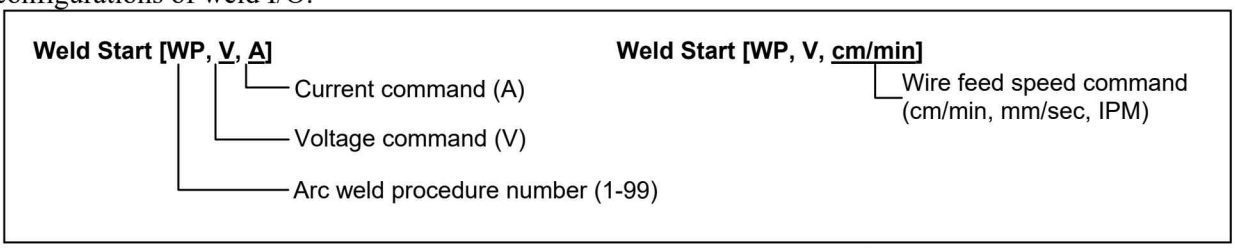


Fig. 4.1.1 (b) Arc weld start instruction at direct format

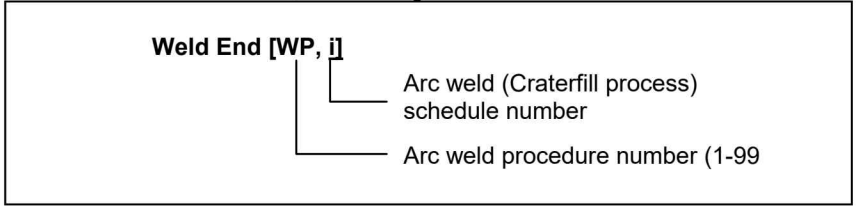
4.1.2 Arc Weld End Instruction

Arc weld end instructions request to finish arc welding.

- Weld End [WP, i] : Use arc weld schedule defined at arc weld procedure.
- Weld End [WP, V, A,…] : Use several conditions specified in TP program directly.

Weld End [WP, i]

Weld End [WP, i] instruction requests to execute craterfill process based on the specified arc weld schedule defined at the arc weld procedure and finish arc welding.
Craterfill process keeps off crater hole at weld ending by decreasing welding voltage and current. If the delay time of the arc weld schedule is 0.0, craterfill process is invalid.



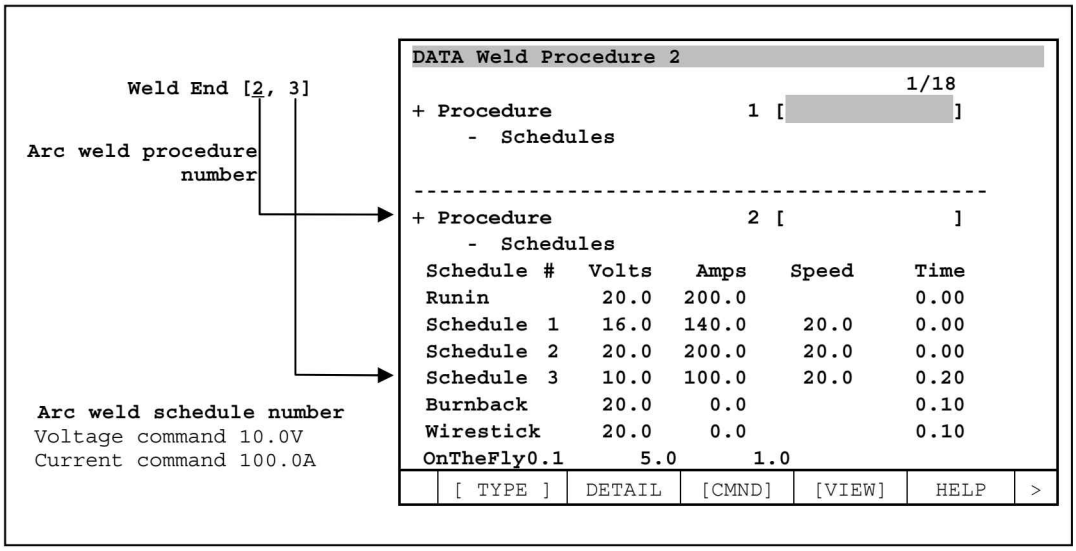


Fig. 4.1.2 (a) Arc weld end instruction at arc weld schedule format

Weld End [WP, V, A, sec]

Weld End [WP, V, A, sec] instruction requests to execute craterfill process based on the specified conditions on the TP program directly and finish arc welding.

The type and number of the conditions depends installed option, connecting weld equipment and the configurations of weld I/O.

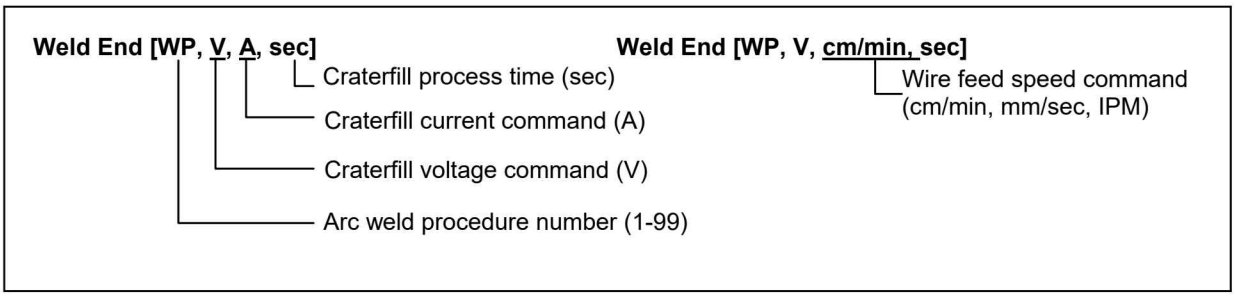


Fig. 4.1.2(b) Arc weld end instruction at direct format

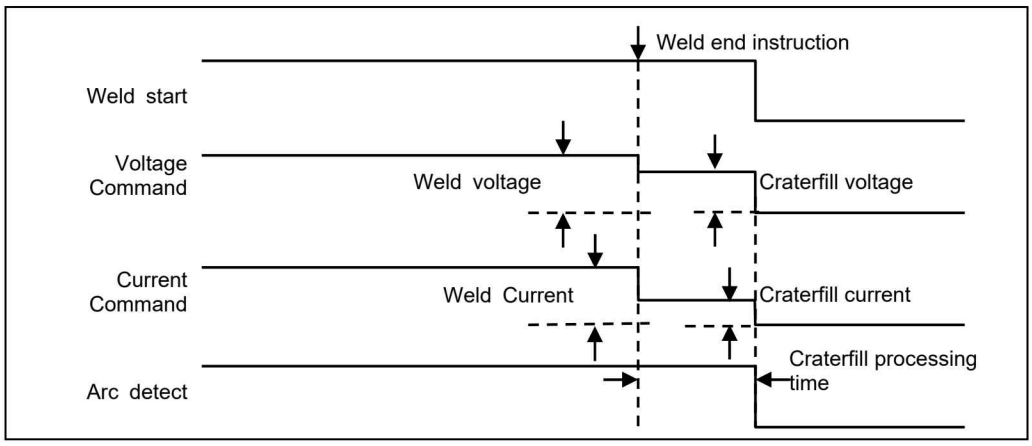


Fig. 4.1.2 (c) Sequence of craterfill process

4.1.3 Teaching Arc Instructions

Arc instructions have two type teaching ways as followings. Arc welding sequence depends on the type. Please refer to Subsection 3.1.2

- Additional motion instruction type
- Single instruction type

Additional Motion Instruction Type

This type is taught by using standard arc instruction (F2"WELD_ST"key and F4"WELDEND" key) (Refer to Step 1-4 in Procedure 4-1.)

- F2"WELD_ST": Show additional motion instruction type standard arc instructions that include arc start instruction as following.

```
                        Weld Start def menu 1
1 J P[] 40% FINE Weld Start[1,1]
2 J P[] 100% FINE Weld Start[1,1]
3 L P[] 250cm/min FINE Weld Start[1,1]
4 L P[] 100.0inch/min FINE Weld Start[1,1]
```

Fig. 4.1.3 (a) Menu of default weld start instruction

- F4"WELDEND": Show additional motion instruction type standard arc instructions that include arc end instruction as following.

```
                          Weld End def menu 1
1 L P[] WELD_SPEED FINE Weld End[1,1]
2 L P[] 50cm/min FINE Weld End[1,1]
3 L P[] 20.0inch/min FINE Weld End[1,1]
4 L P[] 8mm/sec FINE Weld End[1,1]
```

Fig. 4.1.3 (b) Menu of default weld end instruction

Moreover, teach as additional motion instruction to an existing motion instruction. (Refer to Step 6-7 in Procedure 4-1.)

> **⚠ CAUTION**
> When an arc weld instruction is taught with offset instruction, tool compensation and/or coordinated motion instruction, the arc weld instruction must be after them.
> Correct: L P[1] 250cm/min FINE Offset Weld Start[1,1]
> Failure : L P[1] 250cm/min FINE Weld Start[1,1] Offset

Single Instruction Type

Teach as single instruction. Please refer to Procedure 4-2.

Please satisfy the followings when you teach arc weld instruction.

- Use FINE as terminal type for the approach motion to weld start position.
- Don't use joint motion for welding motion and approach motion to weld end position.
- Use CNT as terminal type for welding motion to welding relay point.
- Use FINE as terminal type for the approach motion to weld end position.
- Use suitable torch angle for the welding.
- Use suitable weld condition.

Procedure 4-1 Teach as Additional motion instruction type

Condition

- Program edit screen has been displayed
- Teach pendant is enabled

Step (In the case of arc weld start instruction)

1 Press F2“WELD_ST” key. The following list appears.

```
                        Weld Start def menu 1
1 J P[] 40% FINE Weld Start[1,1]
2 J P[] 100% FINE Weld Start[1,1]
3 L P[] 250cm/min FINE Weld Start[1,1]
4 L P[] 100.0inch/min FINE Weld Start[1,1]
```

2 Select the most similar motion instruction you would like to teach in 1-4. The instruction is added to the program.

```
Sample1                                          1/2
      1: L P[] 250cm/min FINE
        :  Weld Start[1,1]
    [END]

|  | POINT | WELD_ST | WELD | WELDEND | TOUCHUP | > |
```

3 Change the robot speed, the arc weld procedure and the arc weld schedule number.

4 If you would like to use register as the arc weld procedure number and/or arc weld schedule number, Move cursor on the condition and press F1“REGISTER”, the condition changed to register format and enter the register number you would like to use.

5 If you would like to specify each condition on TP program directly, move cursor on the weld procedure number or weld schedule and press F3”VALUE”, the arc weld start instruction changes to direct format.

```
Sample1                                          1/2
      1: L P[] 250cm/min FINE
        :  Weld Start[1,1]
    [END]

|  | REGISTER |  | VALUE | [CHOICE] |  |  |
```

6 If you would like to use normal arc weld schedule format(initial format) from register format or direct format, move cursor on the condition and press F2”SCHED”, the instruction change to the format.

```
Sample1                                          1/2
      1: L P[] 250cm/min FINE
        :  Weld Start[0, 0.00Volts,0.0Amps]
    [END]

|  | REGISTER | SCHED |  | [CHOICE] |  |  |
```

7 When additional motion instruction is taught without standard arc instruction, move cursor the end of motion instruction you would like to append and press F4 [CHOICE], the following menu will appear and select “Weld Start []”

```
  Motion modify 1
1 No option
2 Weld Start[]
3 Weld End[]
4 ACC
5 Skip, LBLB
6 BREAK
7 Offset/Frames
8 --Next page--
```

Fig. 4.1.3 (c) Menu of motion appending instructions

8 Select welding condition with steps 3, 4, 5, and 6.
9 Arc weld end instruction also can be appended as the same procedure of arc weld start instruction.

Procedure 4-2 Teach as single type arc instruction

Condition

- Program edit screen has been displayed
- Teach pendant is enabled

Step (In the case of arc weld start instruction)

1 Move the cursor on the "[END]" or line number of the program and press NEXT key and F1 [INST] key. The following menu will appear.

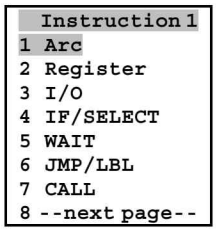
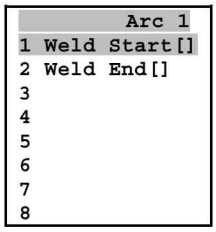


Fig. 4.1.3 (d) Menu of single instructions

2 Select "Arc" the following menu appears.



3 Select "Weld Start []". Specify the welding condition. Please refer to Step 3-6 of Procedure 4-2
4 Arc weld end instruction also can be taught as the same procedure of arc weld start instruction.

Change the welding condition while welding

Arc weld start instruction provides to change welding condition while welding by taught the instruction arc welding domain (between arc weld start instructions – arc weld end instruction).

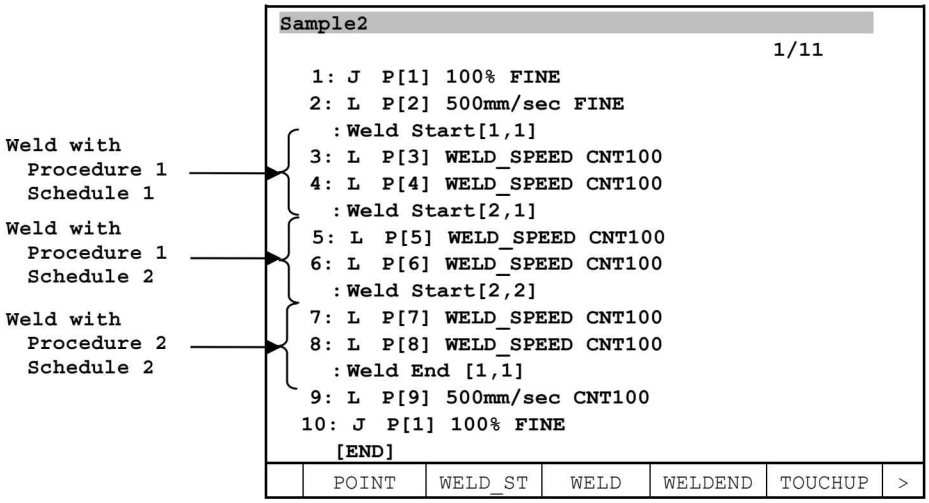
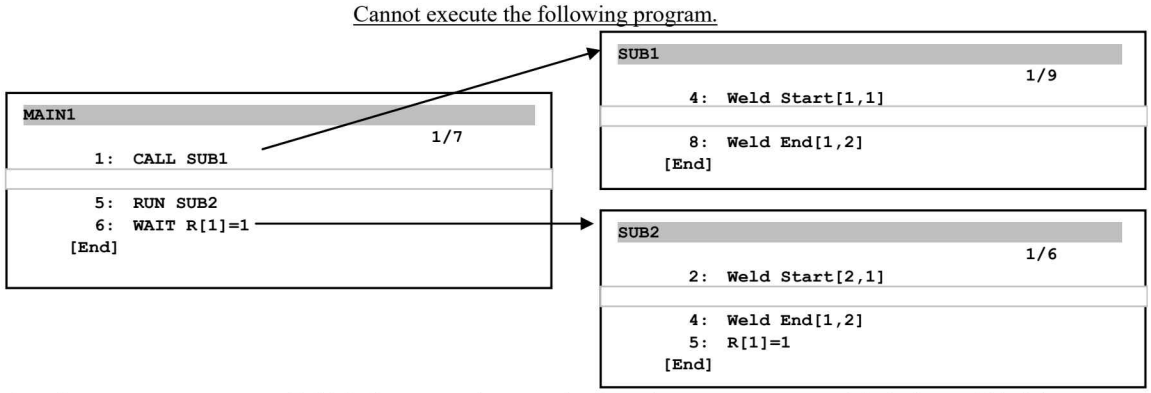


Fig. 4.1.3 (e) The arc schedule applied ranges

⚠CAUTION

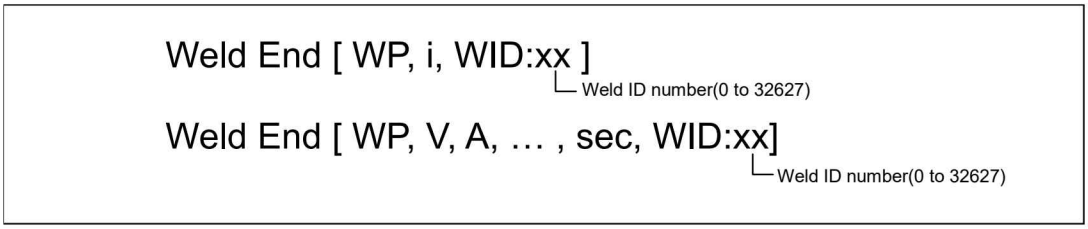
As the following figure, if a program executes a sub program that includes arc instructions by RUN instruction (refer to Section 4.15 or Section 9.13 in OPERATOR'S MANUAL (Basic Operation) (B-83284EN)) after executing the other sub program that includes arc instructions by CALL instruction (refer to Subsection 4.7.3 in OPERATOR'S MANUAL (Basic Operation) (B-83284EN)), the program which has Weld Start/End instructions cannot be executed by multi task. In this case, the sub program stops and ARC-034 alarm occurs.



At above case, use CALL instruction only for the program which has Weld Start/End instructions, or use RUN instruction for multi task execution.

4.1.4 Teaching Weld ID

When Weld ID is Enabled, Weld ID is added to the last index of Weld End instruction with "WID:" string. It is possible to input arbitrary Weld ID number on "WID" index.
Followings are examples of Weld End instruction which includes Weld ID.



Example
```
1:Weld End [1, 3, WID:10]
2:Weld End [1, 195.0A, 20.00V, 0.50sec, WID:1211]
```

NOTE

It is not allowed to use same Weld ID number in one program. When the same ID number is input in Weld End Instruction, "ARC-139 Weld ID i is already used" message is posted and the ID number is returned to original value automatically.

4.1.5 Related View for Weld Procedure

When indirect arc weld instructions (those specifies the weld procedure number and weld schedule number) are taught, user can confirm the weld procedure and weld schedule information those are specified by arc weld instructions at the current cursor position in the program edit screen by displaying the related view screen.

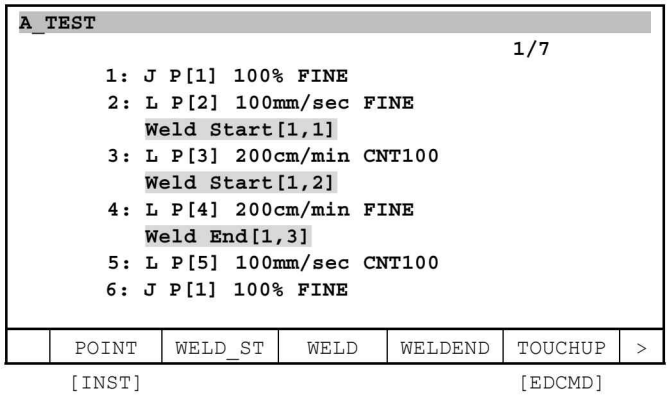
Procedure 4-3 Display the related view screen for weld procedure

Condition

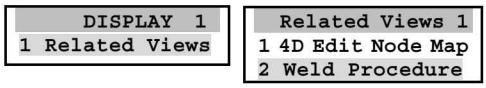
- Program edit screen has been displayed.
- Teach pendant is enabled.

Step

1 For example, the program named A_TEST is displayed as shown in following screen.

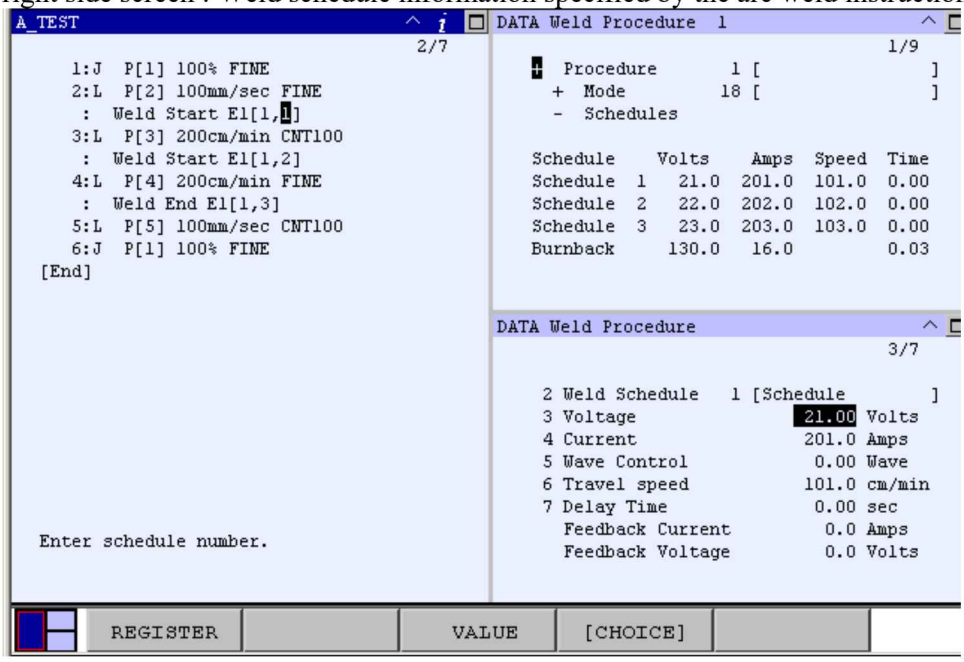


2 Please press the FCTN key with holding the ***i*** key. Following menu is displayed. Please select the [Weld Procedure] from the Related Views menu.



3 As shown following screen, three screens are displayed. When the cursor position is in arc weld instructions in the left side screen (program edit screen), the weld procedure and the weld schedule information those are specified by arc weld instructions at the current cursor position are displayed at right side screens.

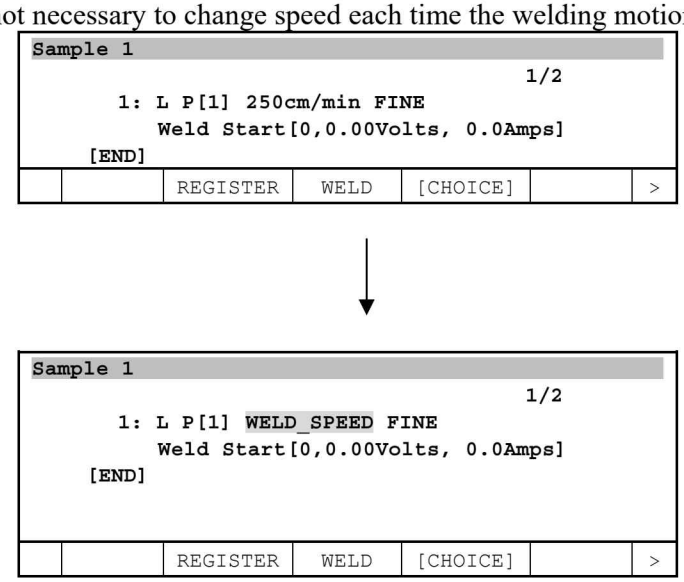
Upper right side screen : Weld procedure information specified by the arc weld instructions
Lower right side screen : Weld schedule information specified by the arc weld instructions



> **⚠ CAUTION**
> When the displaying is switched to the another screen as much as one in three screens during displaying the related view screen, the weld procedure and the weld schedule information those are specified by arc weld instructions at the current cursor position are not updated at right side screens. In such case, please execute the above-mentioned procedure again.

4.2 WELD SPEED INSTRUCTION

Weld speed instruction can be set a weld speed (refer to Subsection 3.5.3) on arc weld schedule. Therefore, weld schedule can manage voltage command, current command and robot speed command collectively and it is not necessary to change speed each time the welding motion has been taught.



When "WELD_SPEED" instruction is taught, the robot moves the speed defined at arc weld schedule. Additionally, the unit of weld speed instruction can be set on ArcTool Setup screen (refer to Section 3.2). Under the following conditions, robot moves with the speed set on ArcTool Setup screen or Weld System Setup screen, not with the speed on arc weld schedule.

- Single step mode
- When motion instruction that has weld speed instruction is executed without the execution of Weld Start instruction
- Backward motion

Program sample:

```
12: L P[10] 500mm/sec FINE Weld Start[1,1]
13: L P[11] WELD_SPEED CNT100
14: L P[12] WELD_SPEED CNT100
15: L P[13] WELD_SPEED FINE Weld End[1,1]
```

The robot speed at line 13, 14 and 15 becomes Weld speed defined at schedule 1 of procedure 1.

Even if the robot speed has been changed by On The Fly function (refer to chapter 17) at line 2 on the following program, the robot speed at line 3 becomes old value before adjustment.

```
1: L P[1] 500mm/sec FINE Weld Start[1,1]
2: L P[2] WELD_SPEED CNT100
3: L P[3] WELD_SPEED CNT100
```

⚠WARNING
When weld speed instruction is used, operator cannot confirm the actual robot speed command as register format speed. Therefore, a robot may move as unexpected speed if a wrong value is set. Please check that the defined weld speed at weld schedule is appropriate before starting the program.

⚠WARNING
At the following situations, the speed defined at arc weld system setup or ArcTool setup is used as robot speed. Please take care to run the program.
- Single step mode
- When motion instruction that has weld speed instruction is executed without the execution of Weld Start instruction
- Backward motion

⚠WARNING
When you change the weld speed on Weld System Setup screen, Please execute cycle power. Otherwise, a robot may move as unexpected speed.

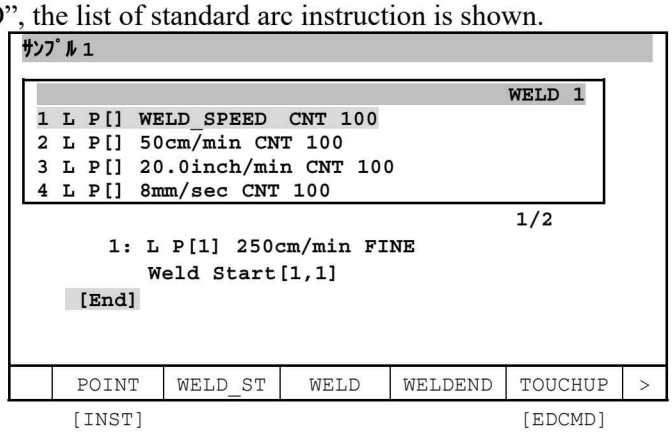
4.2.1 Teach WELD SPEED Instruction

WELD SPEED instruction can be taught by F3 “WELD” and a existing speed of motion can be changed to WELD SPEED instruction.

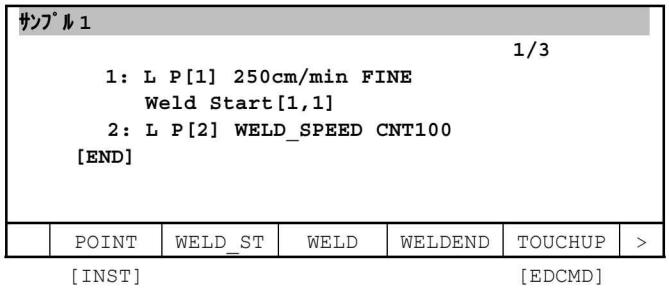
Procedure 4-4 Teach weld speed instruction

Condition
- Program edit screen has been displayed.
- Teach pendant is enabled.

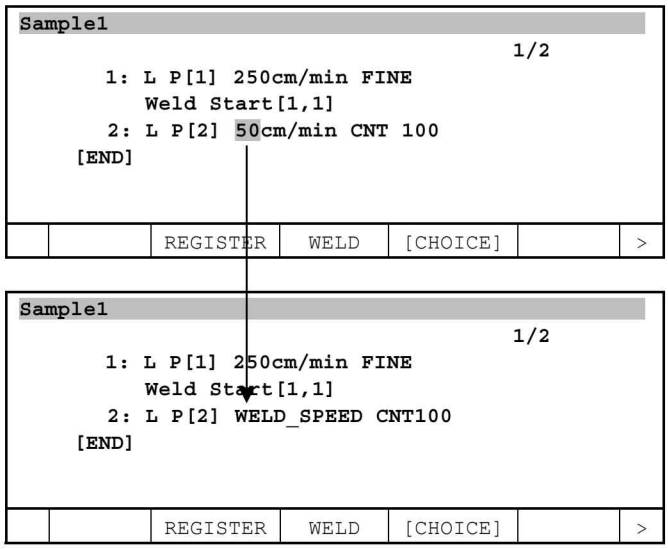
Step
1 Press F3”WELD”, the list of standard arc instruction is shown.



2 Select a motion instruction which includes WELD_SPEED instruction. The instruction is added to the TP program.



3 To change exiting motion instruction to WELD_SPEED instruction, Move cursor speed command of motion you would like to change it to weld speed command and press F3 “WELD” key or speed command of motion you would like to change it to weld speed command.



Users can customize the standard arc instruction.

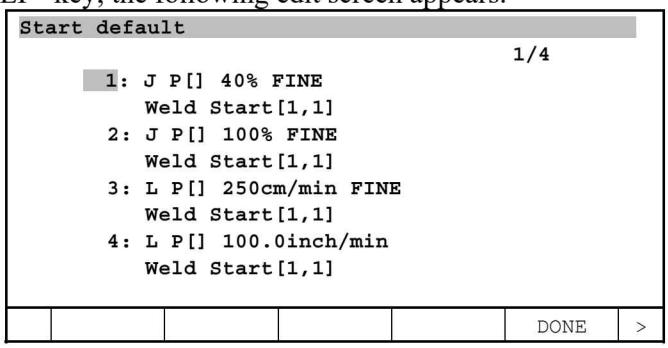
Procedure 4-5 Customize the standard instruction

Condition

- Program edit screen has been displayed
- Teach pendant is enabled

Step (In the case of arc weld start instruction)

1 Press F2 “WELD_ST”key.
2 Press F2 “ED_DEF” key, the following edit screen appears.



3 Edit each instruction (motion type, robot speed, terminal type and additional instructions et.al.).
4 If the edit has been finished, press F5 “DONE” key.