FANUC Robot series

R-30*i*B/ R-30*i*B Mate CONTROLLER

ARC Welding Power Supply Option (DAIHEN DIGITAL Welding Power Supply)

OPERATOR'S MANUAL

B-83614EN-2/01

- **Original Instructions**

Thank you very much for purchasing FANUC Robot.

Before using the Robot, be sure to read the "FANUC Robot SAFETY HANDBOOK (B-80687EN)" and understand the content.

The products in this manual are controlled based on Japan's “Foreign Exchange and Foreign Trade Law". The export from Japan may be subject to an export license by the government of Japan. Further, re-export to another country may be subject to the license of the government of the country from where the product is re-exported. Furthermore, the product may also be controlled by re-export regulations of the United States government. Should you wish to export or re-export these products, please contact FANUC for advice.

In this manual, we endeavor to include all pertinent matters. There are, however, a very large number of operations that must not or cannot be performed, and if the manual contained them all, it would be enormous in volume. It is, therefore, requested to assume that any operations that are not explicitly described as being possible are "not possible".

SAFETY PRECAUTIONS

This chapter describes the precautions which must be observed to ensure the safe use of the robot. Before attempting to use the robot, be sure to read this chapter thoroughly.

Before using the functions related to robot operation, read the relevant operator's manual to become familiar with those functions.

For the safety of the operator and the system, follow all safety precautions when operating a robot and its peripheral devices installed in a work cell.
In addition, refer to the "FANUC Robot SAFETY HANDBOOK (**B-80687EN**)".

1 DEFINITON OF USER

The user can be classified as follows.

Operator:
- Turns the robot controller power ON/OFF
- Starts the robot program with operator's panel

Programmer:
- Operates the robot
- Teaches the robot inside the safety fence

Maintenance engineer:
- Operates the robot
- Teaches the robot inside the safety fence
- Maintenance (repair, adjustment, replacement)

- "An operator" ***cannot*** work inside the safety fence
- "Programmer", "Teaching operator", and "Maintenance engineer" ***can*** work inside the safety fence. The working activities inside the safety fence include lifting, setting, teaching, adjusting, maintenance, etc.
- To work inside the safety fence, the person must be trained on proper robot operation.

During the operation, programming, and maintenance of your robotic system, programmer, teaching operator and maintenance engineer must operate with circumspection by using following safety precautions.

- Adequate clothes for the operation
- Safety shoes
- A helmet

2 DEFINITION OF WARNING, CAUTION AND NOTE

To ensure the safety of working persons and prevent damage to the machine, this manual indicates each precaution on safety with "**WARNING**" or "**CAUTION**" according to its severity. Supplementary information is indicated by "**NOTE**". Please read each "**WARNING**", "**CAUTION**" and "**NOTE**" before attempting to use the robots.

Symbol	Definitions
WARNING	Used if hazard resulting in the death or serious injury of the user will be expected to occur if he or she fails to follow the approved procedure.
CAUTION	Used if a hazard resulting in the minor or moderate injury of the user, or equipment damage may be expected to occur if he or she fails to follow the approved procedure.
NOTE	Used if a supplementary explanation not related to any of WARNING and CAUTION is to be indicated.

- Check this manual thoroughly, and keep it handy for the future reference.

3 USER SAFETY

User safety is the primary safety consideration. As it is very dangerous to enter the operating-area of the robot during its automatic operation, adequate safety precautions must be observed.

The following lists the general safety precautions. Careful consideration must be made to ensure user safety.

(1) We obligate the User to take a FANUC training courses.

FANUC provides various training courses. Contact your local FANUC representative for details.

(2) Even when the robot is stationary, it is possible that the robot is still in a ready to move state, and is waiting for a signal. In this state, the robot is regarded as still in motion. To ensure user safety, provide the system with an alarm to indicate visually or aurally that the robot is in motion.
(3) Install a safety fence with a gate so that no user can enter the safety fence inside without passing through the gate. Install an interlocking device, a safety plug, and so forth in the safety gate so that the robot is stopped as the safety gate is opened.

The controller is designed to receive this interlocking signal of the door switch. When the safety fence is opened and this signal received, the controller stops the robot (Please refer to **"STOP TYPE OF ROBOT" in SAFETY PRECAUTIONS** for detail of stop type). For connection, refer to below **Fig.3 (b).**

(4) Provide the peripheral devices with appropriate grounding (Class A, Class B, Class C, and Class D).
(5) Recommend to install the peripheral device outside of the motion range.
(6) Draw an outline on the floor, clearly indicating the range of the robot motion, including the tools such as a hand.
(7) Install a mat switch or photoelectric switch on the floor with an interlock to a visual or aural alarm that stops the robot when a user enters the motion range.

(8) If necessary, install a safety lock so that no one except the user in charge can turn the power on the robot.

The circuit breaker installed in the controller is designed to disable anyone from turning it on when it is locked with a padlock.

(9) When adjusting each peripheral device independently, make sure to turn the power off the robot.
(10) Operators must take the gloves off while manipulating the operator's panel or teach pendant. Operation with gloved fingers may cause an operation error.
(11) Programs, system variables, and other information can be saved on memory card or USB memories. Be sure to save the data periodically in case the data is lost in an accident.
(12) The robot must be transported and installed by accurate procedure recommended by FANUC. Wrong transportation or installation may cause the robot to fall, resulting in severe injury to workers.
(13) In the first operation of the robot after installation, the operation should be restricted to low speeds. Then, the speed should be gradually increased to check the operation of the robot.
(14) Before the robot is started, it should be checked that no one is in the area of the safety fence. At the same time, a check must be made to ensure that there is no risk of hazardous situations. If detected, such a situation should be eliminated before the operation.
(15) Do not operate the robot under the following conditions. Otherwise, the robot and peripheral equipment can be adversely affected, or workers can be severely injured.
- Flammable
- Explosive
- Massive dose of Radiation
- Under water, high (heavy) Humidity
- Transport human or animals
- Stepladder (climb or hang down)
- Outdoor

(16) When connecting the peripheral devices related to stop(safety fence etc.) and each signal (external emergency , fence etc.) of robot, be sure to confirm the stop movement and do not take the wrong connection.
(17) In preparing the trestle, please secure the maintenance engineer safety at high place in reference to Fig. 3 (c). Design with the Scaffolding and Safety-belt with circumspection.

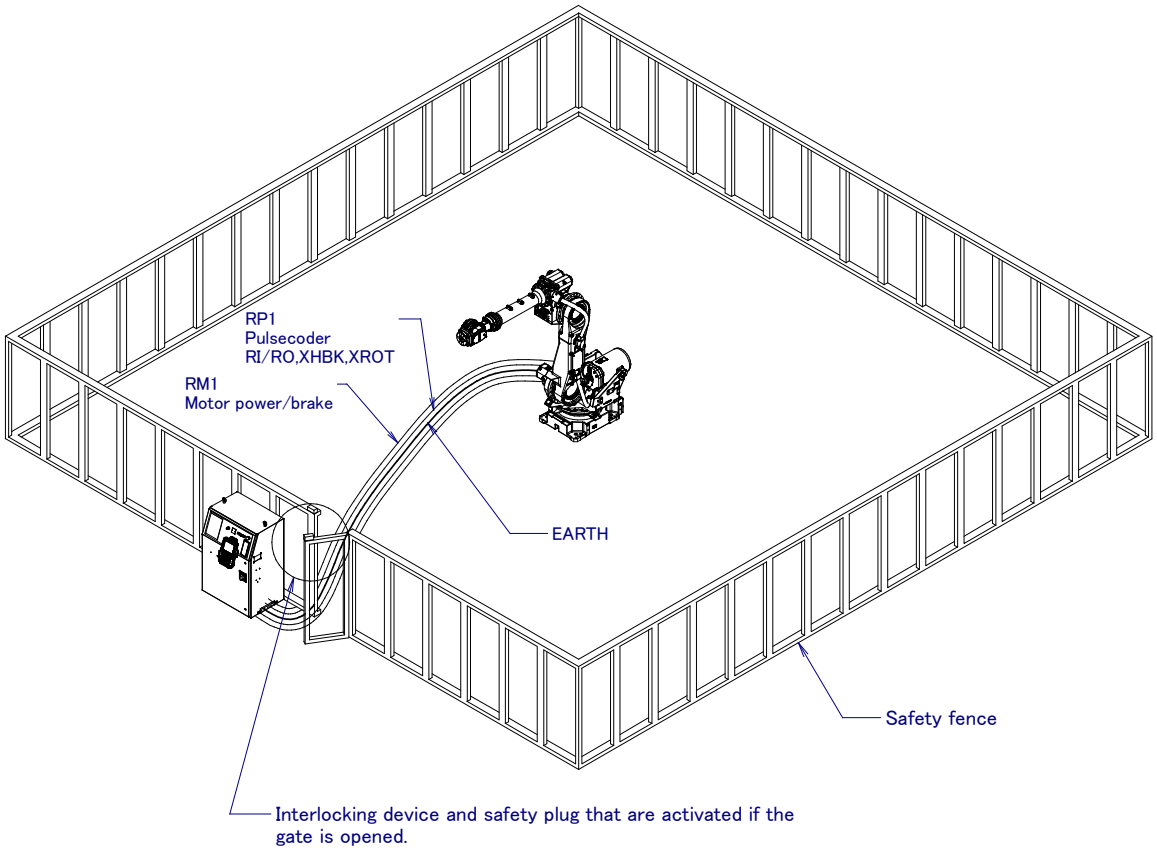


Fig. 3 (a) Safety fence and safety gate

> **⚠WARNING**
> When you close a fence, please confirm that there is not a person from all directions of the robot.

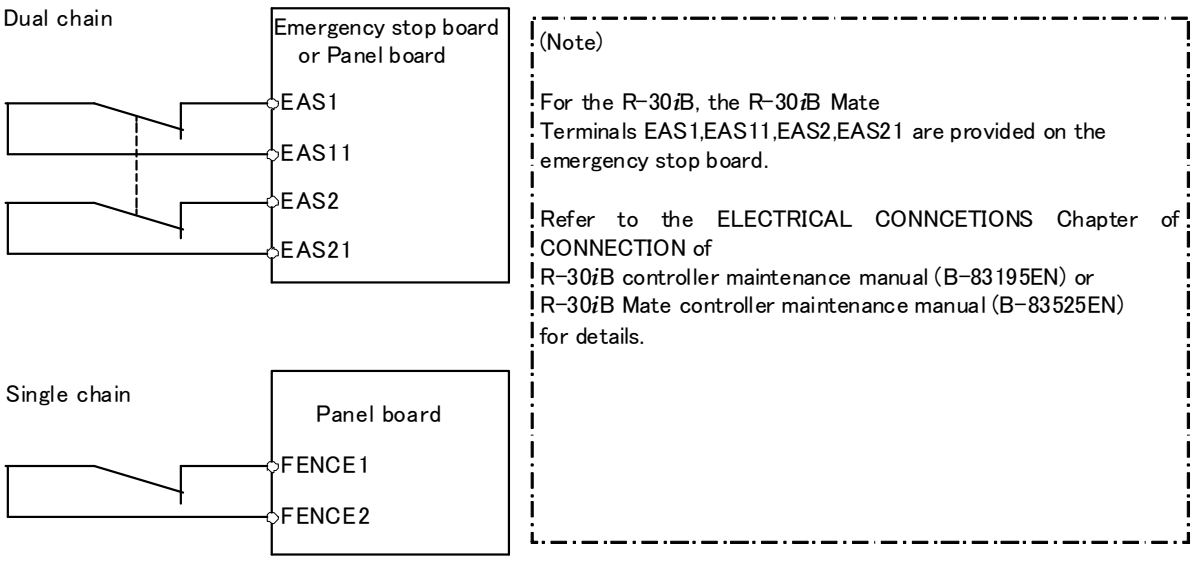


Fig. 3 (b) Connection diagram for the signal of safety fence

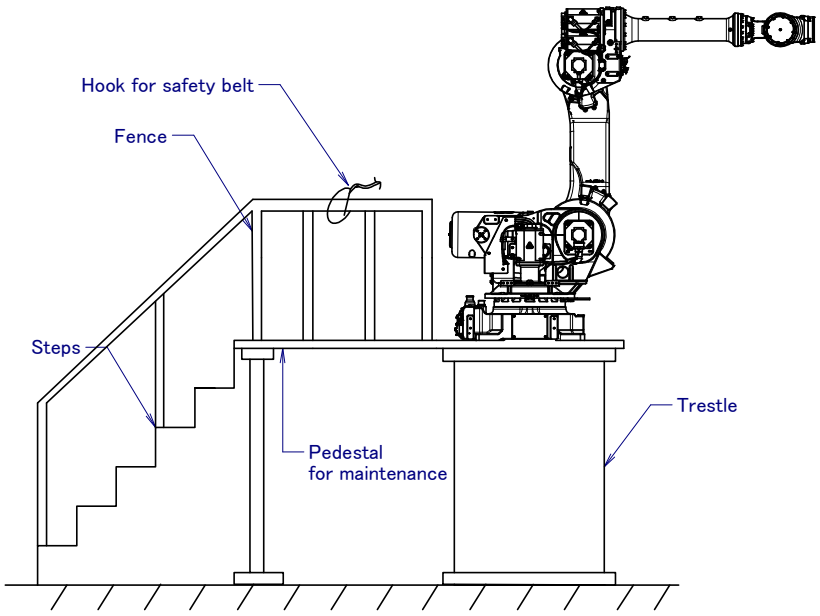


Fig. 3 (c) Pedestal for maintenance

3.1 OPERATOR SAFETY

The operator is a person who operates the robot system. In this sense, a worker who operates the teach pendant is also an operator. Operator cannot work inside the safety fence.

(1) If you don't need to operate the robot, turn the power off the robot controller, or press the "EMERGENCY STOP" button, and then proceed your work.
(2) Operate the robot system outside of the robot motion range.
(3) Install a safety fence with a safety gate to prevent any worker other than the operator from entering the dangerous area unexpectedly and the worker from entering a hazardous area.
(4) Install one or more necessary quantity of EMERGENCY STOP button(s) within the operator's reach in appropriate location(s) based on the system layout.

The robot controller is designed to be connected to an external EMERGENCY STOP button. With this connection, the controller stops the robot operation (Please refer to "STOP TYPE OF ROBOT" in SAFETY PRECAUTIONS for detail of stop type), when the external EMERGENCY STOP button is pressed. See the diagram below for connection.

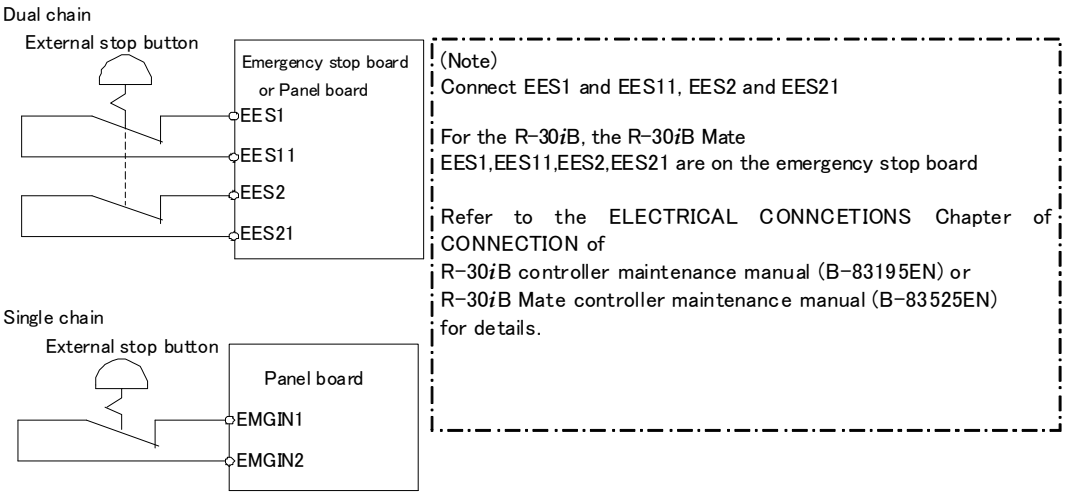


Fig. 3.1 Connection diagram for external emergency stop button

3.2 SAFETY OF THE PROGRAMMER

While teaching the robot, the operator must enter the motion range of the robot. Please ensure the safety of programmer.

(1) Unless it is specifically necessary to enter the robot motion range, carry out all tasks outside the area.
(2) Before teaching the robot, check that the robot and its peripheral devices are all in the normal condition.
(3) If it is inevitable to enter the robot motion range to teach the robot, check the locations, settings, and other conditions of the safety devices (such as the EMERGENCY STOP button, the DEADMAN switch on the teach pendant) before entering the area.
(4) The programmer must be extremely careful not to let anyone else enter the robot motion range.
(5) Programming must be done outside of the safety fence as far as possible. If programming needs to be done in the area of the safety fence, the programmer must take the following precautions:
   - Before entering the safety fence area, ensure that there is no risk of hazardous situation in the area.
   - Be ready to press the emergency stop button whenever it is necessary.
   - Operate the Robot at low speed.
   - Before starting programming, check the entire system status to ensure that no remote instruction to the peripheral equipment or motion would harm user .

Our operator panel is provided with an emergency stop button and a key switch (mode switch) for selecting the automatic operation mode (AUTO) and the teach modes (T1 and T2). Before entering the inside of the safety fence for the purpose of teaching, set the switch to a teach mode, remove the key from the mode switch to prevent other people from changing the operation mode carelessly, then open the safety gate. If the safety gate is opened with the automatic operation mode set, the robot stops (Please refer to "**STOP TYPE OF ROBOT**" in SAFETY PRECAUTIONS for detail of stop type). After the switch is set to a teach mode, the safety gate is disabled. The programmer should understand that the safety gate is disabled and is responsible for keeping other people from entering the inside of the safety fence.

Teach pendant is provided with a switch to enable/disable robot operation from teach pendant and DEADMAN switch as well as emergency stop button. These button and switch function as follows:
(1) Emergency stop button: Causes the stop of the robot (Please refer to "STOP TYPE OF ROBOT" in SAFETY PRECAUTIONS for detail of stop type) when pressed.
(2) DEADMAN switch: Functions are different depending on the teach pendant enable/disable switch setting status.
   (a) Enable: Servo power is turned off and robot stops when the operator releases the DEADMAN switch or when the operator presses the switch strongly.
   (b) Disable: The DEADMAN switch is disabled.
   (Note) The DEADMAN switch is provided to stop the robot when the operator releases the teach pendant or presses the pendant strongly in case of emergency. The R-30*i*B/R-30*i*B Mate employs a 3-position DEADMAN switch, which allows the robot to operate when the 3-position DEADMAN switch is pressed to its intermediate point. When the operator releases the DEADMAN switch or presses the switch strongly, the robot stops immediately.

The operator's intention of starting teaching is determined by the controller through the dual operation of setting the teach pendant enable/disable switch to the enable position and pressing the DEADMAN switch. The operator should make sure that the robot could operate in such conditions and be responsible in carrying out tasks safely.

Based on the risk assessment by FANUC, number of operation of DEADMAN switch should not exceed about 10000 times per year.

The teach pendant, operator panel, and peripheral device interface send each robot start signal. However the validity of each signal changes as follows depending on the mode switch and the DEADMAN switch of the operator panel, the teach pendant enable switch and the remote condition on the software.

Mode	Teach pendant enable switch	Software remote condition	Teach pendant	Operator panel	Peripheral device
AUTO mode	On	Local	Not allowed	Not allowed	Not allowed
		Remote	Not allowed	Not allowed	Not allowed
	Off	Local	Not allowed	Allowed to start	Not allowed
		Remote	Not allowed	Not allowed	Allowed to start
T1, T2 mode	On	Local	Allowed to start	Not allowed	Not allowed
		Remote	Allowed to start	Not allowed	Not allowed
	Off	Local	Not allowed	Not allowed	Not allowed
		Remote	Not allowed	Not allowed	Not allowed

T1,T2 mode: DEADMAN switch is effective.

(6) To start the system using the operator's panel, make certain that nobody is in the robot motion range and that there are no abnormal conditions in the robot motion range.
(7) When a program is completed, be sure to carry out the test operation according to the following procedure.
  (a) Run the program for at least one operation cycle in the single step mode at low speed.
  (b) Run the program for at least one operation cycle in the continuous operation mode at low speed.
  (c) Run the program for one operation cycle in the continuous operation mode at the intermediate speed and check that no abnormalities occur due to a delay in timing.
  (d) Run the program for one operation cycle in the continuous operation mode at the normal operating speed, and check that the system operates automatically without trouble.
  (e) After checking the completeness of the program through the test operation above, execute it in the automatic operation mode.
(8) While operating the system in the automatic operation mode, the teach pendant operator must leave the safety fence.

3.3 SAFETY OF THE MAINTENANCE ENGINEER

For the safety of maintenance engineer personnel, pay utmost attention to the following.

(1) Must never be in the area during its operation.
(2) A hazardous situation may occur when the robot or the system, are kept with their power-on during maintenance operations. Therefore, for any maintenance operation, the robot and the system must be put into the power-off state. If necessary, a lock should be in place in order to prevent any other person from turning on the robot and/or the system. In case maintenance needs to be executed in the power-on state, the emergency stop button must be pressed.
(3) If it becomes necessary to enter the robot operation area while the power is on, press the emergency stop button on the operator panel, or the teach pendant before entering the area. The maintenance personnel must indicate that maintenance work is in progress and be careful not to allow other people to operate the robot carelessly.
(4) When entering the area enclosed by the safety fence, the maintenance engineer must check the entire system in order to make sure that there is no dangerous situation around. In case the worker needs to enter the safety area whilst a dangerous situation exists, extreme care must be taken, and entire system status must be carefully monitored.
(5) Before the maintenance of the pneumatic system is started, the supply pressure should be shut off and the pressure in the piping should be reduced to zero.
(6) Before the start of maintenance, check the robot and its peripheral devices are all in the normal condition.
(7) Do not operate the robot in the automatic mode while anybody is in the robot motion range.

(8) In maintaining the robot parallel to a wall or instrument, or when multiple workers are working nearby, make certain that their escape path is not obstructed.
(9) When a tool is mounted on the robot, or any moving device other than the robot is installed, such as belt conveyor, careful attention required for those motion.
(10) Assign an expert near the operator panel who can press the EMERGENCY STOP button whenever he sees the potential danger.
(11) In case of replacing a part, please contact your local FANUC representative. Wrong procedure may cause the serious damage to the robot and the worker.
(12) Make sure that no impurity into the system in while (in) replacing or reinstalling components.
(13) Turn off the circuit breaker to protect again electric shock in handling each unit or printed circuit board in the controller during inspection. If there are two cabinets, turn off the both circuit breaker.
(14) A part should be replaced with a part recommended by FANUC. If other parts are used, malfunction or damage would occur. Especially, a fuse that is not recommended by FANUC should not be used. Such a fuse may cause not only a damage to the internal parts of the controller but also a fire.
(15) When restarting the robot system after completing maintenance work, make sure in advance that there is no person in the motion range and that the robot and the peripheral devices are not abnormal.
(16) In case of remove the motor or brake, suspend the arm by crane or other equipment beforehand to avoid falling.
(17) Whenever grease is spilled on the floor, remove them as soon as possible to prevent from falling.
(18) The following parts are heated. If a maintenance engineer needs to touch such a part in the heated state, the worker should wear heat-resistant gloves or use other protective tools.
- Servo motor
- Inside of the controller
- Reducer
- Gearbox
- Wrist unit

(19) Maintenance must be done with appropriate lightning. Be careful that those lightning will not cause any further danger.
(20) When a motor, reducer, or other heavy load is handled, a crane or other equipment should be used to protect maintenance engineers from excessive load. Otherwise, the maintenance engineers would be severely injured.
(21) Must never climb or step on the robot even in the maintenance. If it is attempted, the robot would be adversely affected. In addition, a misstep can cause injury to the worker.
(22) Secure a pedestal and wear the safety belt in performing the maintenance work in high place.
(23) Remove all the spilled oil or water and metal chips around the robot in the safety fence after completing the maintenance.
(24) All the related bolts and components must return to the original place in replacing the parts. If some parts are missing or left (remained), repeat the replacement work until complete the installation.
(25) In case robot motion is required during maintenance, the following precautions should be taken :
- Secure an escape route. And during the maintenance motion itself, monitor continuously the whole system so that your escape route will not become blocked by the robot, or by peripheral equipment.
- Keep vigilant attention for the potential danger. and to press the emergency stop button whenever it is necessary.

(26) Periodic inspection required. (Refer to the robot mechanical manual and controller maintenance manual.) A failure to do the periodical inspection can may adversely affect the performance or service life of the robot and may cause an accident
(27) After replacing some parts, a test run required by the predetermined method. (See TESTING section of "Controller operator's manual". During the test run, the maintenance staff must work outside the safety fence.

4 SAFETY OF THE TOOLS AND PERIPHERAL DEVICES

4.1 PRECAUTIONS IN PROGRAMMING

(1) Adopt a limit switch or other sensor to detect a dangerous state and, if necessary, design the program to stop the robot when the sensor signal is received.
(2) Design the program to stop the robot when an abnormal condition occurs in any other robots or peripheral devices, even though the robot itself is normal.
(3) For a system in which the robot and its peripheral devices are in synchronous motion, particular care must be taken in programming in order not to interfere with each other.
(4) Provide a suitable interface between the robot and its peripheral devices so that the robot can detect the states of all devices in the system, and can be stopped according to the states.

4.2 PRECAUTIONS FOR MECHANISM

(1) Keep the component cells of the robot system clean, operate the robot where insulated from the influence of grease, water, and dust.
(2) Don’t use unconfirmed liquid for cutting fluid and cleaning fluid.
(3) Adopt limit switches or mechanical stoppers to limit the robot motion, and avoid the robot from collisions against peripheral devices or tools.
(4) Observe the following precautions about the mechanical unit cables. Failure to follow precautions may cause mechanical troubles.
- Use mechanical unit cable that have required user interface.
- Do not add user cable or hose to inside of mechanical unit.
- Please do not obstruct the movement of the mechanical unit when cables are added to outside of mechanical unit.
- In the case of the model that a cable is exposed, please do not perform remodeling (Adding a protective cover and fix an outside cable more) obstructing the behavior of the outcrop of the cable.
- When installing user peripheral equipment on the robot mechanical unit, please pay attention that equipment does not interfere with the robot itself.

(5) The frequent power-off stop for the robot during operation causes the trouble of the robot. Please avoid the system construction that power-off stop would be operated routinely. (Refer to bad case example.) Please perform power-off stop after reducing the speed of the robot and stopping it by hold stop or cycle stop when it is not urgent. (Please refer to "STOP TYPE OF ROBOT" in SAFETY PRECAUTIONS for detail of stop type.)
(Bad case example)
- Whenever poor product is generated, a line stops by emergency stop and power-off of the robot is incurred.
- When alteration is necessary, safety switch is operated by opening safety fence and power-off stop is incurred for the robot during operation.
- An operator pushes the emergency stop button frequently, and a line stops.
- An area sensor or a mat switch connected to safety signal operates routinely and power-off stop is incurred for the robot.
- Power-off stop is regularly incurred due to an inappropriate setting for Dual Check Safety (DCS).

(6) Power-off stop of Robot is executed when collision detection alarm (SRVO-050) etc. occurs. Please try to avoid unnecessary power-off stops. It may cause the trouble of the robot, too. So remove the causes of the alarm.

5 SAFETY OF THE ROBOT MECHANICAL UNIT

5.1 PRECAUTIONS IN OPERATION

(1) Operating the robot in the jog mode, set it at an appropriate speed so that the operator can manage the robot in any eventuality.
(2) Before pressing the jog key, be sure to comprehend the robot movement by the key in advance.

5.2 PRECAUTIONS IN PROGRAMMING

(1) Design to arrange avoiding mutual interfere when various robot's operation area crossover significantly.
(2) Be sure to specify the predetermined work origin in a motion program so that the robot starts from the origin and terminates at the origin. Make it possible for the operator to distinguish easily that the robot motion has terminated at a glance.

5.3 PRECAUTIONS FOR MECHANISMS

Keep the motion range areas of the robot clean, and operate the robot in an environment free of grease, water, and dust.

5.4 PROCEDURE TO MOVE ARM WITHOUT DRIVE POWER IN EMERGENCY OR ABNORMAL SITUATIONS

For emergency or abnormal situations (e.g. persons trapped in or pinched by the robot), brake release unit can be used to move the robot axes without drive power.
Please refer to controller maintenance manual and mechanical unit operator's manual for using method of brake release unit and method of supporting robot.

6 SAFETY OF THE END EFFECTOR

6.1 PRECAUTIONS IN PROGRAMMING

(1) Circumspect program with sufficient delay required for the program after executing some control command in adopting actuators (pneumatic, hydraulic, and electric)
(2) Adopt limit switches for the end effector, and control the robot system by monitoring the state.

7 STOP TYPE OF ROBOT

There are following three types of Stopping Robot.

Power-Off Stop (Category 0 following IEC 60204-1)

Servo power is turned off, and the robot stops immediately. Servo power is turned off when the robot is moving, and the motion path of the deceleration is uncontrolled.

"**Power-Off stop**" performs following processing.

- An alarm is generated, and then the servo power turns off. Instantly the robot stops.
- Execution of the program is paused.

Frequent Power-Off stop of the robot during operation can cause mechanical problems of the robot.
Avoid system designs that require routine or frequent Power-Off stop conditions.

Controlled stop (Category 1 following IEC 60204-1)

The robot is decelerated until it stops, and servo power is turned off.

"**Controlled stop**" performs following processing.

- The alarm "**SRVO-199 Controlled stop**" occurs along with a decelerated stop. The program execution is paused.
- An alarm is generated, and then the servo power turns off.

Hold (Category 2 following IEC 60204-1)

The robot is decelerated until it stops, and servo power remains on.

"**Hold**" performs following processing.

- The robot operation is decelerated until it stops. Execution of the program is paused.

> ⚠ **WARNING**
> The stopping distance and time of Controlled stop are longer than those of Power-Off stop. A risk assessment for the whole robot system which takes into consideration the increased stopping distance and stopping time, is necessary when Controlled stop is used.

When the emergency stop button is pressed or the FENCE is open, the stop type of robot is Power-Off stop or Controlled stop. The configuration of stop type for each situation is called *stop pattern*. The stop pattern is different according to the controller type or option configuration.

There are the following 3 Stop patterns.

Stop pattern	Mode	Emergency stop button	External Emergency stop	FENCE open	SVOFF input	Servo disconnect
A	AUTO	P-Stop	P-Stop	C-Stop	C-Stop	P-Stop
	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop
B	AUTO	P-Stop	P-Stop	P-Stop	P-Stop	P-Stop
	T1	P-Stop	P-Stop	-	P-Stop	P-Stop
	T2	P-Stop	P-Stop	-	P-Stop	P-Stop
C	AUTO	C-Stop	C-Stop	C-Stop	C-Stop	C-Stop
	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop

P-Stop: Power-Off stop
C-Stop: Controlled stop
-: Disable

The following table indicates the Stop pattern according to the controller type or option configuration.

Option	R-30*i*B/ R-30*i*B Mate
Standard	A (*)
Controlled stop by E-Stop (A05B-2600-J570)	C (*)

(*) R-30*i*B / R-30*i*B Mate does not have servo disconnect. R-30*i*B Mate does not have SVOFF input.

The stop pattern of the controller is displayed in "Stop pattern" line in software version screen. Please refer to "Software version" in operator's manual of controller for the detail of software version screen.

"Controlled stop by E-Stop" option

When "**Controlled stop by E-Stop**" (A05B-2600-J570) option is specified, the stop type of the following alarms becomes Controlled stop but only in AUTO mode. In T1 or T2 mode, the stop type is Power-Off stop which is the normal operation of the system.

Alarm	Condition
SRVO-001 Operator panel E-stop	Operator panel emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open.
SRVO-408 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[3] is OFF.
SRVO-409 DCS SSO Servo Disconnect	In DCS Safe I/O connect function, SSO[4] is OFF.

Controlled stop is different from **Power-Off stop** as follows:

- In Controlled stop, the robot is stopped on the program path. This function is effective for a system where the robot can interfere with other devices if it deviates from the program path.
- In Controlled stop, physical impact is less than Power-Off stop. This function is effective for systems where the physical impact to the mechanical unit or EOAT (End Of Arm Tool) should be minimized.
- The stopping distance and time of Controlled stop is longer than the those of Power-Off stop, depending on the robot model and axis. Please refer to the operator's manual of a particular robot model for the data of stopping distance and time.

When this option is loaded, this function cannot be disabled.

The stop type of DCS Position and Speed Check functions is not affected by the loading of this option.

> ⚠ **WARNING**
> The stopping distance and time of Controlled stop are longer than those of Power-Off stop. A risk assessment for the whole robot system which takes into consideration the increased stopping distance and stopping time, is necessary when this option is loaded.

150809

TABLE OF CONTENTS

1 PREFACE

Prior to the use of the arc welding robot package FANUC Robot welding power supply option, this chapter provides an introduction to this manual and describes safety precautions.
Before using the robot, be sure to read and understand this documentation.

Organization of this chapter:
- 1.1 MANUALS
- 1.2 SAFETY PRECAUTIONS
- 1.3 SAFETY MEASURES
- 1.4 RELATED MANUAL

1.1 MANUALS

About this manual

The arc welding package " FANUC R-30*i*B/R-30*i*B Mate Controller arc welding power supply option Operator's Manual" describes how to operate a welding machine incorporating a robot and controller.
This manual provides descriptions of the models indicated in the table below, and uses the abbreviations of the model names below in the text.

Model name	Abbreviation
FANUC Robot ARC Mate 100*i*C/12	ARC Mate 100*i*C series
FANUC Robot ARC Mate 100*i*C/7L	
FANUC Robot ARC Mate 120*i*C	ARC Mate 120*i*C series
FANUC Robot ARC Mate 120*i*C/10L	
FANUC Robot ARC Mate 120*i*C/12L	

Definition of WARNING, CAUTION, and NOTE

This manual includes safety precautions for protecting the user and preventing damage to the machine. Precautions are classified into Warning and Caution according to their bearing on safety.
Also, supplementary information is described as a Note. Read the Warning, Caution, and Note thoroughly before attempting to use the machine.

Serious injuries mentioned below are those injuries that have after-effects and those that require hospitalization or reception of long-term hospital treatment as outpatients, such as loss of eyesight, wounds, burns (high-temperature and low-temperature burns), electric shocks, fractures, and poisoning. Medium troubles and minor injuries are those wounds, burns, electric shocks, and so forth that do not require hospitalization or reception of long-term hospital treatment as outpatients. Equipment damages refer to property damages and extended damages related to device damages.

Symbol	Definitions
⚠**WARNING**	Used if hazard resulting in the death or serious injury of the user will be expected to occur if he or she fails to follow the approved procedure.
⚠**CAUTION**	Used if a hazard resulting in the minor or moderate injury of the user, or equipment damage may be expected to occur if he or she fails to follow the approved procedure.
NOTE	Used if a supplementary explanation not related to any of WARNING and CAUTION is to be indicated.

- Check this manual thoroughly, and keep it handy for the future reference.

1.2 SAFETY PRECAUTIONS

Introduction

⚠WARNING

- Before using this machine, read this operator's manual thoroughly to use the machine correctly.
- The precautions in this manual are presented so that you can use the equipment safely and that injuries and damages to you and other people can be prevented.
- This equipment is designed and manufactured with sufficient consideration given to safety. When using the equipment, observe the precautions described in this operator's manual. Disregarding these precautions can cause serious accidents resulting in a human injury or death.

General precautions

⚠WARNING

- Observe the laws and your company's standards when performing power supply construction on the input side, selection of an installation place, handling and storing of high-pressure gas, piping, storing of welded products, waste disposal, and so forth.
- A person who uses a heart pace maker must keep away from the operating welding machine unless he or she gets permission from the doctor. When powered, the welding machine generates a magnetic field which affects pace maker operation adversely.
- For safety, installation, inspection, and repair of this equipment must be done by qualified persons or those who are familiar with the welding machine.
- For safety, operation of this equipment must be performed by those who are familiar with this operator's manual and have knowledge and skill to operate this equipment safely.
- Do not use this equipment for purposes other than welding.

Precautions relating to maintenance

⚠WARNING

When performing maintenance work, turn off the power to the robot and system where possible. If the power is on, some maintenance operations present a danger of electric shock. As necessary, provide a lock not to prevent other persons from turning on the power. If you have to perform maintenance work with the power on, press the emergency stop button where possible.

⚠CAUTION

The following parts will heat, so care must be taken. If you have to touch such a part when it is hot, prepare protectors such as heat-resistant gloves.

- Servo motor
- Inside of the controller
- Welding torch

⚠ CAUTION

When replacing parts, be careful to the dust intrusion into the robot.

Electric shock

⚠WARNING

- Do not touch any charged part.
- Grounding the case of the welding power supply, a base metal, and a jig electrically connected to the base metal, and so forth must be performed according to the law (the electric facility engineering standard) by a person qualified as an electrician.
- Before starting maintenance and inspection, be sure to turn off the switch of the power panel (the power supply of the factory). The capacitor may be charged even after the input power supply is turned off, so wait at least five minutes.
- Do not use cables with insufficient capacities, damaged cables, and cables of which conductors are exposed.
- Cable connection parts must be tightened securely then insulated.
- Do not use the machine with the case or cover of the welding power supply left removed.
- Do not use broken or wet gloves.
- Maintenance and inspection must be performed periodically, and any damaged parts must be repaired before the use of the machine.

Weld fumes and gases

⚠WARNING

- In places defined by the laws (the labor safety and health regulation and the regulation for preventing anoxia and so forth), provide sufficient ventilation or use a device such as an air respirator to prevent gas poisoning and suffocation.
- To prevent dust troubles and poisoning due to fumes and so forth, use a local exhaust system defined by the laws (the labor safety and health regulation and the regulation for preventing dust troubles) or a respiratory protector.
- Carbon dioxide gas and other gases that are heavier than air stay in a bottom part. Therefore, when performing robot welding operation in the bottom part or a narrow place, provide sufficient ventilation, or use an air respirator.
- Do not perform robot welding near the places where degreasing, cleaning, and spraying are performed. Otherwise, toxic gas may be generated in such environments.
- When welding coated steel, be sure to provide sufficient ventilation or use a respiratory protector. Welding coated steel generates toxic gas or fumes.

Prevention of fires and explosions

⚠WARNING

- A base metal immediately after spattering or cutting is heated and can cause a fire.
- A portion where a cable is connected incompletely or an incomplete contact in the current path on the base metal side such as a steel frame can be heated when the power is on, which can cause a fire.
- Generating arc in a container of a combustible substance such as gasoline can cause explosion.
- Get rid of any combustible substance so that a spatter does not splash over the substance. If a combustible substance cannot be removed, cover the substance with a non-combustible cover.
- Do not perform welding near the presence of a combustible gas.
- Cable connection parts must be tightened securely and insulated.
- The cable should be connected on the base metal side as close as possible to the portion to be welded.
- Install a fire extinguisher near the welding place in preparation for emergency.

Arc light, spatter, and noise

⚠CAUTION

- The arc light can cause eye inflammation or skin burning.
- Splashing a spatter and slag can cause eye injury or burning.
- Noise can cause abnormality in hearing.
- When supervising welding work, wear safety glasses that provide sufficient glare protection or wear a safety mask for welding.
- Wear safety glasses to protect the eyes from spatter and slag.
- Wear protectors such as leather gloves for welding, long-sleeved clothes, foot covers, and a leather apron.
- Install a safety curtain around the welding place to prevent the arc light from reaching the eyes of other persons.
- If the noise level is high, use a noise protector.

Gas cylinder and gas regulator

⚠CAUTION

- If the gas cylinder falls, an accident can be caused, resulting in a human injury or death.
- High-pressure gas is encapsulated in the gas cylinder. Therefore, incorrect handling of the gas cylinder can cause high-pressure gas to blow out, which can lead to an accident resulting in a human injury or death.
- When handling the gas cylinder, observe the law and the in-house standard.
- Use the gas flow rate controller supplied by FANUC or recommended by FANUC.
- Before using the gas flow rate controller, read the relevant operator's manual and observe the precautions described in the manual.
- Secure the gas cylinder on a dedicated gas cylinder stand.
- Do not subject the gas cylinder to a high-temperature environment.
- When opening the valve of the gas cylinder, keep your face away from the outlet.
- Whenever the gas cylinder is not in use, be sure to mount the protection cap on the cylinder.

Welding wire

⚠CAUTION

The wire can protrude suddenly from the tip of the welding torch, which can result in an eye, face, or body injury.

- Do not perform inching with your eyes or face close to the tip of the welding torch. Should the wire protrude unexpectedly, the wire can injure the eyes, face, or body.

1.3 SAFETY MEASURES

Safety precautions

Unlike ordinary automatic machines, robots have arms and wrists which can be moved. This means that robots can adopt any posture quite easily, but it also means that they are quite dangerous. Usually, a robot and peripheral equipment make up an automatic system.

Therefore, the user of the robot must take safety precautions for the entire system. The safety precautions are described below.

Safety precautions for installation and layout

- Use signals such as warning lamps to indicate that the robot is in operation.

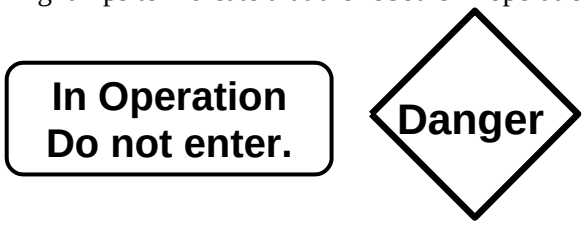


Fig. 1.3 (a) Alarm indications

- Install a safety fence with a safety door so that a worker can enter the inside of the fence only by opening the door, and opening the door causes the robot to stop.

NOTE

The controller brings the robot to a deceleration stop when the safe speed (XSFSPD) input signal is turned off.

- Install the safety fence so that it encloses the robot operation area completely. Install the controller outside the safety fence.

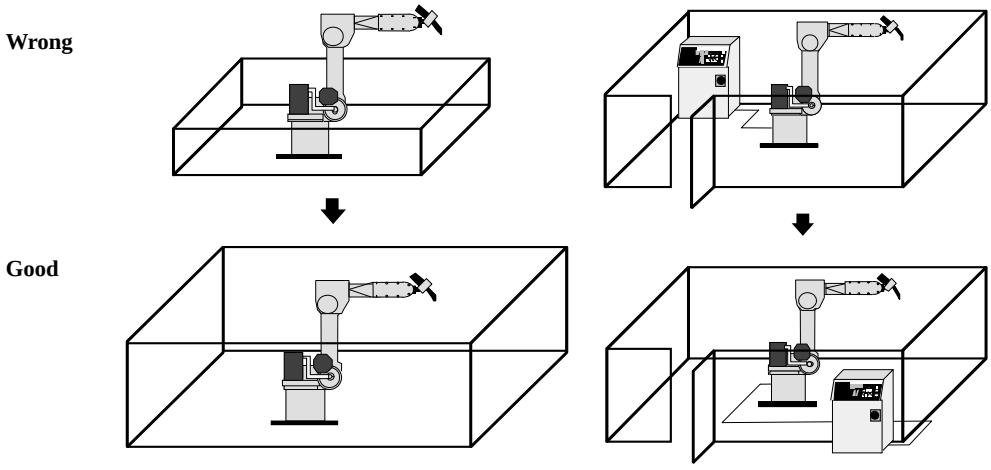


Fig. 1.3 (b) Safety fence

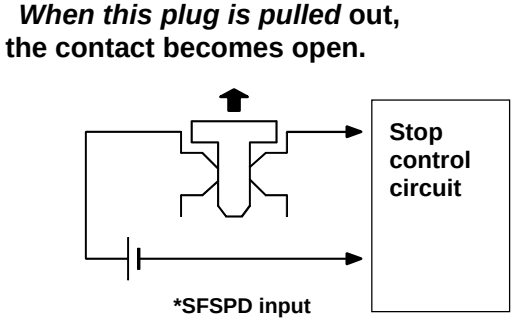


Fig. 1.3 (c)Safety plug

- Install an emergency stop button in a place that allows the operator to press it immediately.

NOTE
Upon receiving the emergency stop signal, the controller brings the robot to an emergency stop.

Safety precautions for system design

- Install a safety joint between the robot's joints forming a tool so that if an abnormal external force is applied to the robot the safety joint breaks and the robot stops.

NOTE
When the hand break (XHBK) input signal is turned off, the controller brings the robot to an emergency stop.

- Ground all peripheral units properly.
- When an available operating area is smaller than the maximum operating area of the robot, the operating area can be specified by parameters.
- The robot can receive several types of external interlock signals.
  By sending the operating status of a peripheral unit to the robot, robot operation can be suspended or stopped.
- Install a lock as required so that only authorized workers can turn on the power.

NOTE
A padlock can be installed on the circuit breaker of the controller door to prevent the power from being turned on by an unauthorized person.

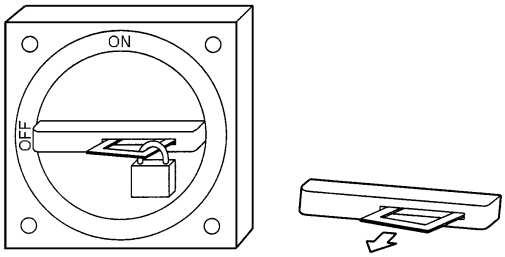


Fig. 1.3 (d) Locking the circuit breaker

Safety precautions for inspection and maintenance

- Before starting inspection and maintenance, turn off the power to the controller whenever possible. Lock the circuit breaker or place a guard to prevent an unauthorized person from turning on the power.
- Before disconnecting the pneumatic system, release the supply pressure.

- Before making an electrical check that requires no robot operation, press the emergency stop button.
- When making an inspection that requires robot operation, carefully observe the motion of the robot so that the emergency stop button can be immediately pressed whenever required.

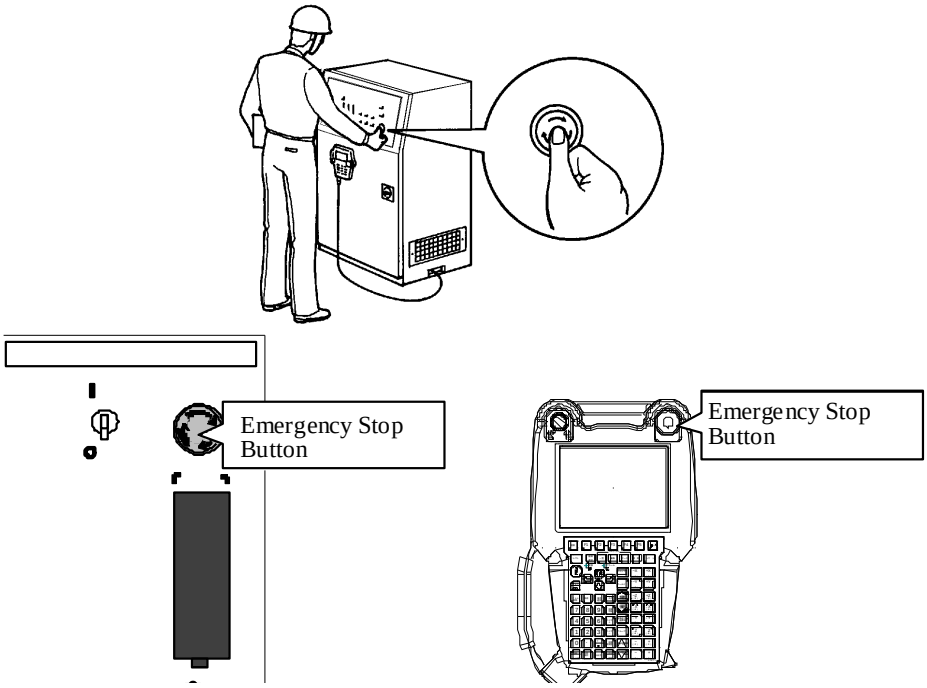


Fig. 1.3 (e) Emergency stop button

Safety precautions for transportation

- Before lifting the robot with a crane or carrying the robot with a forklift, firmly secure the robot to the crane or forklift.
- Carefully inspect the carrier (crane forklift, etc.) and also carefully inspect the grips of the product.

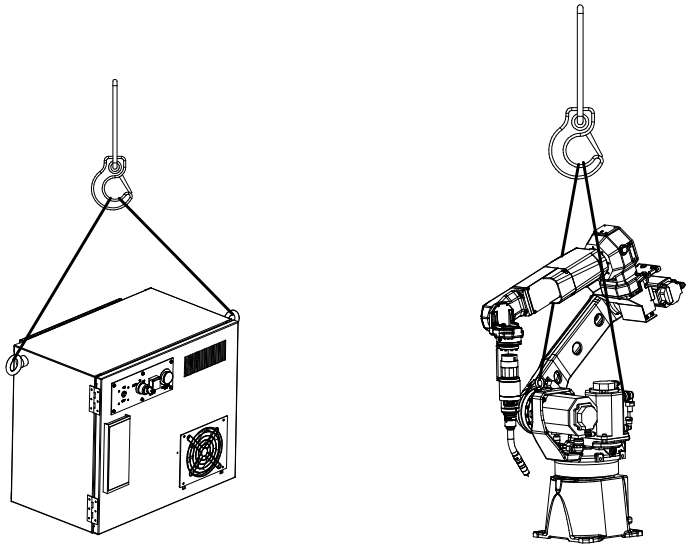


Fig. 1.3 (f) Transportation of robot

Safety precautions for operation

- All robot system users are requested to attend FANUC training courses to acquire sufficient knowledge about the safety precautions and robot functions.
- Before working within the operating area of the robot -even when the robot is not running-, turn off the power to the robot or the press the emergency stop button. In addition, place a guard, warning sign, or

other provision to prevent an unauthorized person from entering the operating area of the robot or activating the robot using the operator's panel or some other device.

- While working in the operating area of the robot, for example, to teach the robot a program, place a guard so that the robot can be immediately stopped in an emergency.

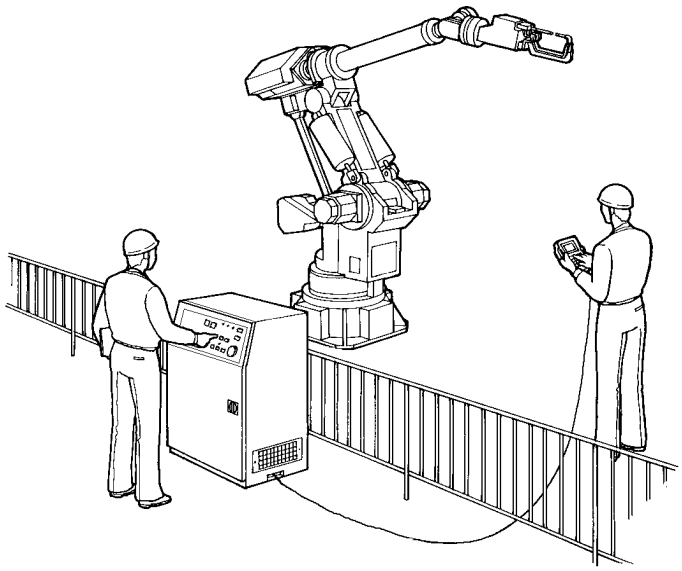


Fig. 1.3 (g) Additional worker to watch for danger

Table 1.3 Safety precautions

Operator	Workshop	Transportation and installation
Avoid dangerous behavior. Wear safety clothes. Wear safety shoes and a helmet.	Keep the work environment neat, tidy, and clean. Provide a safety fence and warning indications. Provide ventilation. Never bring flammable materials into the workshop.	Keep the transportation path free of obstacles. When carrying the robot on a carrier such as a crane or forklift, ensure that the robot is firmly secured to the carrier. Allow sufficient clearance. Make connections properly.
Operation	**Maintenance・Check**	**Welding power supply・Torch**
Attend training classes. Master the operating procedures. Exclude unauthorized persons.	Perform repair work using FANUC products only. Before starting maintenance and inspection, turn off the power. Keep the controller door closed.	Check and maintain the cables. Check the pneumatic system. Insulate the robot from the welding gun. Provide a spatter shield. Check for cooling water leakage.

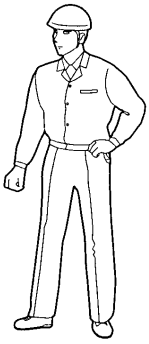
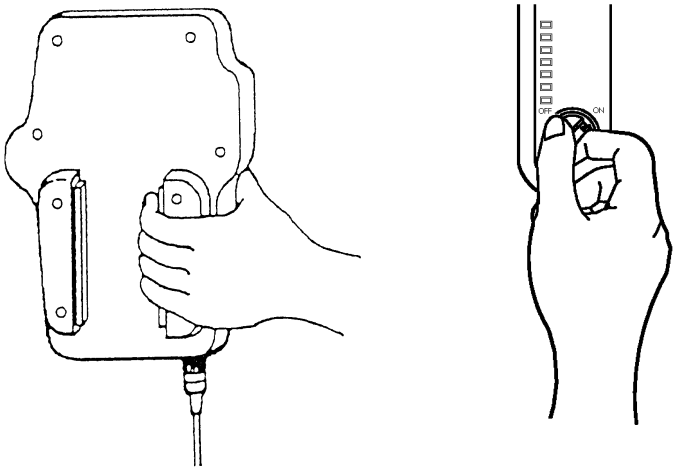


Fig. 1.3 (h) Safety Clothes and Safety Helmet

- Before approaching the robot to teach a program to it, hold the teach pendant, press the deadman's switch, then turn on the teach pendant enable switch.

NOTE
The deadman's switch, if released when the teach pendant enable switch is on, brings the robot to an emergency stop.



Deadman's switch *Teach pendant enable switch*

Fig. 1.3 (i) Deadman's switch and Teach pendant enable switch

- Before starting to jog the robot, carefully observe the operation of the jog keys and the robot.
- During jogging, use a sufficiently low robot override speed.

Reference

Laws and qualifications related to installation, operation, maintenance and inspection, and repair

Installation

Person qualified as an electrician		
Electric facility engineering standard	Article 19	Grounding class, class D grounding (the former class 3 grounding), class C grounding (the former class 3 grounding)
	Article 40	Installation of ground-fault interrupter and so forth
Labor safety and health regulation	Article 325	Division and protection of arc light
	Article 333	Electric leakage breaker
	Article 593	Protectors
Regulation for preventing anoxia and so forth	Article 21	Measures relating to welding
Regulation for preventing dust troubles	Article 1	
	Article 2	
Grounding	Person qualified as an electrician	

Operation

Labor safety and health regulation Paragraph 3, Article 36
Labor safety and health special education (Article 4 in the regulation for safety and health special education) JIS/WES qualified person
Persons who receive education based on the labor safety and health regulation

Maintenance and inspection, and repair

Persons who received in-house education or education made by the welding machine supplier and are familiar with welding machines

Standards related to protectors

JIS Z 3950	Method for measuring weld fume density
JIS Z 8731	Method for measuring noise level
JIS Z 8735	Method for measuring vibration level
JIS Z 8812	Method for measuring harmful ultraviolet rays
JIS Z 8813	General rules for measuring floating dust density
JIS T 8113	Leather safety gloves for welding
JIS T 8141	Light protectors
JIS T 8142	Safety mask for welding
JIS T 8147	Safety glasses
JIS T 8151	Dust protection mask
JIS T 8160	Dust protection mask for fine particles
JIS T 8161	Sound protectors

NOTICE

The warning indications attached to the product and the contents of this operator's manual are created based on the product-related legislation, standards, requirements, regulations, and so forth (referred to as the related laws). The related laws are subject to amendment. If restrictions on the use of the product which are defined on the user side based on the related laws need to be modified because of amendment of the related laws, the modification should be made on the user's responsibility.

1.4 RELATED MANUALS

Safety handbook **B-80687EN** All persons who use the FANUC Robot and system designer must read and understand thoroughly this handbook		Intended readers: Operator , system designer Topics: Safety items for robot system design, Operation, Maintenance
R-30*i*B, **R-30*i*B Mate controller**	OPERATOR'S MANUAL (Basic Operation) **B-83284EN** OPERATOR'S MANUAL (Alarm Code List) **B-83284EN-1** OPERATOR'S MANUAL (Optional Function) **B-83284EN-2** ARC WELDING FUNCTION OPERATOR'S MANUAL **B-83284EN-3**	Intended readers : Operator, programmer, Teaching operator, Maintenance engineer, System designer Topics : Robot functions, Operations, Programming, Setup, Interfaces, Alarms Use : Robot operation, Teaching, System design
	MAINTENANCE MANUAL **R-30*i*B : B-83195EN** **R-30*i*B Mate: B-83525EN**	Intended readers : Maintenance engineer, System designer Topics : Installation, Connection to the controller, Maintenance Use : Installation, Start-up, Connection, Maintenance
FANUC Robot **FANUC Robot ARC Mate 100*i*C/12/7L/12S,M-10*i*A/12/7L/12S** **Mechanical unit**	OPERATOR'S MANUAL **B-83654EN**	Intended readers: System designer, Maintenance engineer Topics: Installation, Connection to controller, Maintenance Use: Installation, Start-up, Connection, Maintenance
FANUC Robot **ARC Mate 120*i*C,M-20*i*A** **Mechanical unit**	OPERATOR'S MANUAL **B-82874EN**	Intended readers: System designer, Maintenance engineer Topics: Installation, Connection to controller, Maintenance Use: Installation, Start-up, Connection, Maintenance
Torch	Refer to manual of BINZEL .Ltd (*)	
Welding power supply **Wire feeder**	Refer to manual of DAIHEN(*)	

(*) If there is indispensability, please make a demand in your local FANUC representative.

2 OVERVIEW

This chapter describe the basic configuration and component of the robot with arc welding power supply option.

Organization of this chapter

- 2.1 Standard configuration
- 2.2 Option configuration

2.1 STANDARD CONFIGURATION

Robot with welding power supply consists of a robot mechanical section, controller, welding power supply, controller , wire feeder, welding torch, wire reel stand , and so forth.

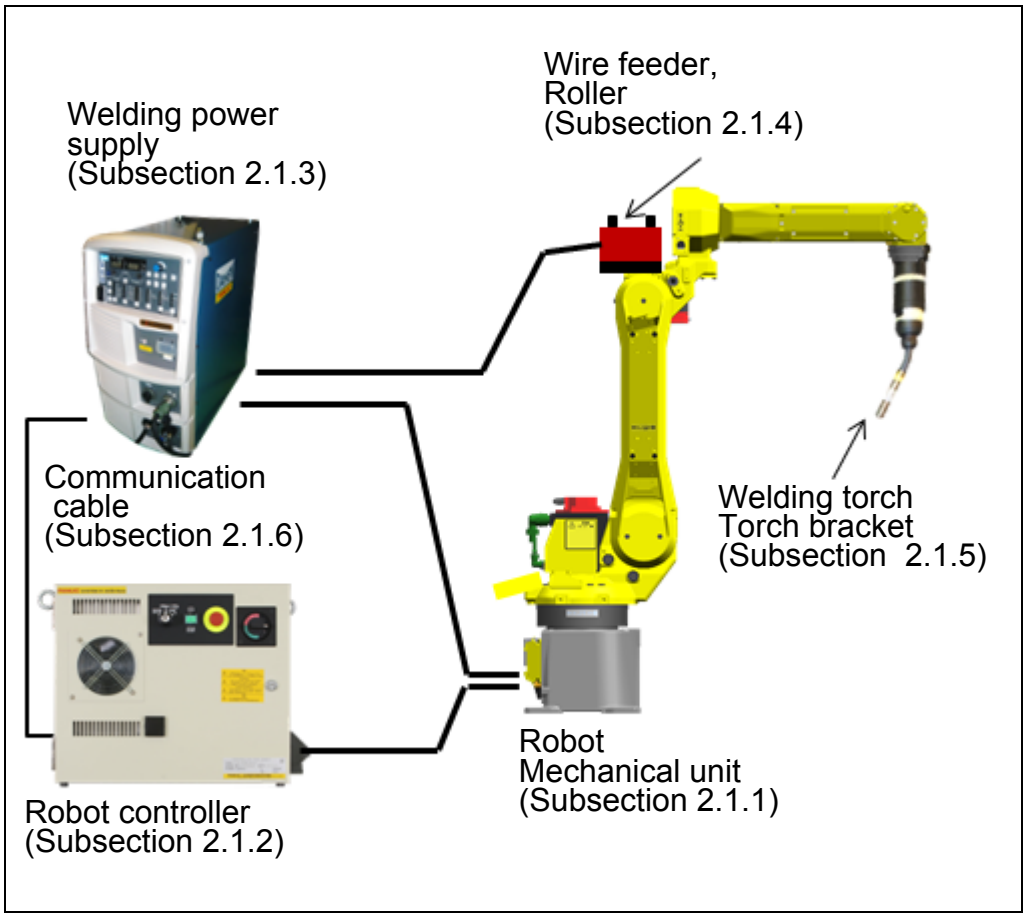


Fig. 2.1 (a) Configuration of robot with welding power supply option

2.1.1 Mechanical Unit Specification

Table 2.1.1 (a) Specifications

Item		Specification		
Model		ARC Mate 100*i*C/12		
Type		Articulated type		
Controlled axes		6 axes(J1, J2, J3, J4, J5, J6)		
Installation		Floor, Upside-down, Wall & Angle mount (Note 1)		
Load setting		3 kg (Standard welding torch mode)		12 kg (Standard inertia mode)
Motion range	J1-axis	Upper limit /Lower limit	170° (2.97rad)/-170° (-2.97rad) 180° (3.14rad)/-180° (-3.14rad) (option)	
	J2-axis	Upper limit /Lower limit	160° (2.79rad)/-90° (-1.57rad)	
	J3-axis	Upper limit /Lower limit	267°(4.66rad)/-180°(-3.14rad)	
	J4-axis	Upper limit /Lower limit	190° (3.31rad)/-190° (-3.31rad)	
	J5-axis	Upper limit /Lower limit	Cable integrated J3 arm	140° (2.44rad)/-140° (-2.44rad)
			Conventional dress-out	190° (3.31rad)/-190° (-3.31rad)
	J6-axis	Upper limit /Lower limit	Cable integrated J3 arm	270° (4.71rad)/-270° (-4.71rad)
			Conventional dress-out	360° (6.28rad)/-360° (-6.28rad)
Maximum speed (Note 2)	J1-axis	230°/s(4.01rad/s)		
	J2-axis	225°/s(3.93rad/s)		
	J3-axis	230°/s(4.01rad/s)		
	J4-axis	430°/s(7.50rad/s)		
	J5-axis	430°/s(7.50rad/s)		
	J6-axis	630°/s(11.0rad/s)		
Maximum load	At wrist	3 kg (Note 3)		12 kg (Note 3)
	On J3 arm (Note 4)	12 kg		
Allowable load moment at wrist	J4-axis	7.7 N·m		22.0 N·m
	J5-axis	7.7 N·m		22.0 N·m
	J6-axis	0.2 N·m		9.8 N·m
Allowable load inertia at wrist	J4-axis	0.24 kg·m^2		0.65 kg·m^2
	J5-axis	0.24 kg·m^2		0.65 kg·m^2
	J6-axis	0.0027 kg·m^2		0.17 kg·m^2
Repeatability		±0.08 mm		
Mass		130 kg		
Acoustic noise level		Less than 70dB (Note 5)		
Installation environment		Ambient temperature: 0 to 45℃ (Note 6) Ambient humidity: Normally 75%RH or less (No dew or frost allowed) Short time 95%Rh or less (Within 1 month) Permissible altitude: Above the sea 1000m or less Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases (Note 7)		

NOTE

1 There is not the limit in the motion range in all installation.
2 In case of short distance motion, the axis speed may not reach the maximum value stated.
3 When arc tool is specified, robot is shipped with 3kg payload setting.
4 Maximum load on J3 arm is influenced by load of wrist. See Section 4.2 of MECHANICAL UNIT OPERATOR'S MANUAL (B-83654EN) in detail.
5 This value is equivalent continuous A-weighted sound pressure level, which applied with ISO11201 (EN31201). This value is measured with the following conditions.
- Maximum load and speed
- Operating mode is AUTO
6 When robot is used in low temperature environment that is near to 0ºC,or robot is not operated for a long time in the environment that is less than 0ºC in a holiday or the night, because viscous resistance of the drive train is so big that may cause occurrence of collision detect alarm (SRVO –050) etc. In this case, we recommend performing the warm up operation for several minutes.
7 Contact the service representative, if the robot is to be used in an environment or a place subjected to hot/cold temperatures, severe vibrations, heavy dust, cutting oil splash and or other foreign substances.

Table 2.1.1 (b) Specifications

Item		Specification		
Model		ARC Mate 100*i* C/7L		
Type		Articulated type		
Controlled axes		6 axes(J1, J2, J3, J4, J5, J6)		
Installation		Floor, Upside-down, Wall & Angle mount (Note 1)		
Load setting		3 kg (Standard welding torch mode)		7 kg (Standard inertia mode)
Motion range	J1-axis	Upper limit /Lower limit	170° (2.97rad)/-170° (-2.97rad) 180° (3.14rad)/-180° (-3.14rad) (option)	
	J2-axis	Upper limit /Lower limit	160° (2.79rad)/-90° (-1.57rad)	
	J3-axis	Upper limit /Lower limit	267°(4.66rad)/-180°(-3.14rad)	
	J4-axis	Upper limit /Lower limit	190° (3.31rad)/-190° (-3.31rad)	
	J5-axis	Upper limit /Lower limit	Cable integrated J3 arm	140° (2.44rad)/-140° (-2.44rad)
			Conventional dress-out	190° (3.31rad)/-190° (-3.31rad)
	J6-axis	Upper limit /Lower limit	Cable integrated J3 arm	270° (4.71rad)/-270° (-4.71rad)
			Conventional dress-out	360° (6.28rad)/-360° (-6.28rad)
Maximum speed (Note 2)	J1-axis	230°/s(4.01rad/s)		
	J2-axis	225°/s(3.93rad/s)		
	J3-axis	230°/s(4.01rad/s)		
	J4-axis	430°/s(7.50rad/s)		
	J5-axis	430°/s(7.50rad/s)		
	J6-axis	630°/s(11.0rad/s)		
Maximum load	At wrist	3 kg (Note 3)		7 kg (Note 3)
	On J3 arm (Note 4)	12 kg		
Allowable load moment at wrist	J4-axis	7.7 N·m		15.7 N·m
	J5-axis	7.7 N·m		10.1 N·m
	J6-axis	0.2 N·m		5.9 N·m
Allowable load inertia at wrist	J4-axis	0.24 kg·m^2		0.63 kg·m^2
	J5-axis	0.24 kg·m^2		0.38 kg·m^2
	J6-axis	0.0027 kg·m^2		0.061 kg·m^2
Repeatability		±0.08 mm		
Mass		135 kg		
Acoustic noise level		Less than 70dB (Note 5)		
Installation environment		Ambient temperature: 0 to 45℃ (Note 6) Ambient humidity: Normally 75%RH or less (No dew or frost allowed) Short time 95%Rh or less (Within 1 month) Permissible altitude: Above the sea 1000m or less Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases (Note 7)		

NOTE
1 There is not the limit in the motion range in all installation.
2 In case of short distance motion, the axis speed may not reach the maximum value stated.
3 When arc tool is specified, robot is shipped with 3kg payload setting.
4 Maximum load on J3 arm is influenced by load of wrist. See Section 4.2 of MECHANICAL UNIT OPERATOR'S MANUAL (B-83654EN) in detail.
5 This value is equivalent continuous A-weighted sound pressure level, which applied with ISO11201 (EN31201). This value is measured with the following conditions.
- Maximum load and speed
- Operating mode is AUTO
6 When robot is used in low temperature environment that is near to 0ºC,or robot is not operated for a long time in the environment that is less than 0ºC in a holiday or the night, because viscous resistance of the drive train is so big that may cause occurrence of collision detect alarm (SRVO –050) etc. In this case, we recommend performing the warm up operation for several minutes.
7 Contact the service representative, if the robot is to be used in an environment or a place subjected to hot/cold temperatures, severe vibrations, heavy dust, cutting oil splash and or other foreign substances.

Table 2.1.1 (c) Specifications

Item			Specification	
Model			ARC Mate 120*i*C	
Type			Articulated type	
Controlled axes			6axes(J1, J2, J3, J4, J5, J6)	
Installation			Floor, (Upside-down, Wall & Angle mount) (Note 1)	
Load setting			3 kg mode (Standard welding torch mode)	20 kg mode (High inertia mode)
Motion range Upper limit /Lower limit	J1-axis		185° (3.23rad)	/ -185° (-3.23rad)
	J2-axis		160° (2.79rad)	/ -100° (-1.75rad)
	J3-axis		273° (4.77rad)	/ -185° (-3.23rad)
	J4-axis		200° (3.49rad)	/ -200° (-3.49rad)
	J5-axis	(Note 2)	140° (2.44rad)	/ -140° (-2.44rad)
		(Note 3)	180° (3.14rad)	/ -180° (-3.14rad)
	J6-axis	(Note 2)	270° (4.71rad)	/ -270° (-4.71rad)
		(Note 3)	450° (7.85rad)	/ -450° (-7.85rad)
Maximum speed (Note 4)	J1-axis		195° /s(3.40rad/s)	
	J2-axis		175° /s(3.05rad/s)	
	J3-axis		180° /s(3.14rad/s)	
	J4-axis		360° /s(6.28rad/s)	
	J5-axis		360° /s(6.28rad/s)	
	J6-axis		550° /s(9.60rad/s)	
Maximum load	At wrist		3kg	20kg
	On J3 arm (Note 5)		12kg	
Allowable load moment at wrist	J4-axis		7.7N·m	44N·m
	J5-axis		7.7N·m	44N·m
	J6-axis		0.22N·m	22N·m
Allowable load inertia at wrist	J4-axis		0.24kg·m^2	1.04kg·m^2
	J5-axis		0.24kg·m^2	1.04kg·m^2
	J6-axis		0.0027kg·m^2	0.28kg·m^2
Repeatability			±0.08 mm	
Robot mass			250kg	
Acoustic noise level			Less than 70dB (Note 6)	
Installation environment			Ambient temperature: 0 to 45℃ (Note 7) Ambient humidity: Normally 75%RH or less (No dew or frost allowed) Short time 95%Rh or less (Within 1 month) Permissible altitude: Above the sea 1000m or less Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases (Note 8)	

NOTE

1 Under the installation condition within ( ), motion range will be limited only when high inertia mode. See Section 3.6 of MECHANICAL UNIT OPERATOR'S MANUAL (B-82874EN) in detail..
2 The specification of "Cable integrated J3 Arm".
3 The specification of "Conventional dress-out".
4 In case of short distance motion, the axis speed may not reach the maximum value stated.
5 Maximum load on J3 arm depends on load of wrist. See Section 4.2 in detail.
6 This value is equivalent continuous A-weighted sound pressure level, which applied with ISO11201 (EN31201). This value is measured with the following conditions.
-Maximum load and speed
-Operating mode is AUTO
7 When robot is used in low temperature environment that is near to 0ºC, or robot is not operated for a long time in the environment that is less than 0ºC in a holiday or the night, because viscous resistance of the drive train is so big that may cause occurrence of collision detect alarm (SRVO –050) etc. In this case, we recommend performing the warm up operation for several minutes.
8 Contact the service representative, if the robot is to be used in an environment or a place subjected to hot/cold temperatures, severe vibrations, heavy dust, cutting oil splash and or other foreign substances.

Table 2.1.1 (d) Specifications

Item			Specification	
Model			ARC Mate 120*i*C/12L	
Type			Articulated type	
Controlled axes			6axes(J1, J2, J3, J4, J5, J6)	
Installation			Floor, (Upside-down, Wall & Angle mount) (Note 1)	
Load setting			3 kg mode (Standard welding torch mode)	12 kg mode (High inertia mode)
Motion range Upper limit /Lower limit	J1-axis		185° (3.23rad)	/ -185° (-3.23rad)
	J2-axis		160° (2.79rad)	/ -100° (-1.75rad)
	J3-axis		275.6° (4.81rad)	/ -185° (-3.23rad)
	J4-axis		200° (3.49rad)	/ -200° (-3.49rad)
	J5-axis	(NOTE 2)	140° (2.44rad)	/ -140° (-2.44rad)
		(NOTE 3)	180° (3.14rad)	/ -180° (-3.14rad)
	J6-axis	(NOTE 2)	270° (4.71rad)	/ -270° (-4.71rad)
		(NOTE 3)	450° (7.85rad)	/ -450° (-7.85rad)
Maximum speed (Note 4)	J1-axis		200°/s (3.49rad/sec)	
	J2-axis		175°/s (3.05rad/sec)	
	J3-axis		190°/s (3.32rad/sec)	
	J4-axis		430°/sec (7.50rad/sec)	
	J5-axis		430°/sec (7.50rad/sec)	
	J6-axis		630°/sec (11.00rad/sec)	
Maximum load	At wrist (Note 5)		3kg	12kg
	On J3 arm (Note 6)		12kg	
Allowable load moment at wrist	J4-axis		7.7N·m	22N·m
	J5-axis		7.7N·m	22N·m
	J6-axis		0.22N·m	9.8N·m
Allowable load inertia at wrist	J4-axis		0.24kg·m^2	0.65kg·m^2
	J5-axis		0.24kg·m^2	0.65kg·m^2
	J6-axis		0.0027kg·m^2	0.17kg·m^2
Repeatability			±0.08 mm	
Robot mass			250kg	
Acoustic noise level			Less than 70dB (Note 5)	
Installation environment			Ambient temperature: 0 to 45℃ (Note 7) Ambient humidity: Normally 75%RH or less (No dew or frost allowed) Short time 95%Rh or less (Within 1 month) Permissible altitude: Above the sea 1000m or less Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases (Note 8)	

NOTE

1 Under the installation condition within ( ), motion range will be limited only when high inertia mode. See Section 3.6.
2 The specification of “Cable integrated J3 Arm”.
3 The specification of "Conventional dress-out".
4 In case of short distance motion, the axis speed may not reach the maximum value stated.
5 Maximum load on J3 arm depends on load of wrist. See Section 4.2 of MECHANICAL UNIT OPERATOR’S MANUAL (B-82874EN) in detail.
6 This value is equivalent continuous A-weighted sound pressure level, which applied with ISO11201 (EN31201). This value is measured with the following conditions.
-Maximum load and speed
-Operating mode is AUTO
7 When robot is used in low temperature environment that is near to 0ºC,
or robot is not operated for a long time in the environment that is less than 0ºC in a holiday or the night, because viscous resistance of the drive train is so big that may cause occurrence of collision detect alarm (SRVO –050) etc. In this case, we recommend performing the warm up operation for several minutes.
8 Contact the service representative, if the robot is to be used in an environment or a place subjected to hot/cold temperatures, severe vibrations, heavy dust, cutting oil splash and or other foreign substances.

2.1.2 Robot Controller

Table 2.1.2 (a) Controller specification (R-30*i*B Controller)

Item	Model	Specification/condition
Rated Voltage	All models	Trans. Type E:380-415, 440-500, 500-575VAC(*1) Trans. Type D: 380-400,200-230VAC 50/60Hz 3phases (*1) In case of NRTL controller with UL/CSA breaker (600V Rating), 500-575VAC tap can be used.
Tolerant fluctuation	All models	Tolerant voltage fluctuation: +10% -15% Tolerant frequency fluctuation: ±1Hz
Input power source capacity	ARC Mate 120*i*C	3kVA
	ARC Mate 100*i*C	2kVA
Average power consumption	All models	1kW
Permissible ambient temperature	All models	Operating 0°C to 45°C Storage, Transport -20°C to 60°C Temperature change 0.3°C/minute or less
Permissible ambient humidity	All models	Normal: 75%RH or less, no condensation Short period(less than 1 month): 95%RH or less, no condensation
Surrounding gas	All models	An additional protective provision is necessary if the machine is installed in an environment in which there are relatively large amounts of contaminants (dust, dielectric fluid, organic solvent, acid, corrosive gas, and/of salt).
Installation category	All models	Installation categoryⅢ, Pollution degree 3, IEC60664-1 and IEC61010-1
Vibration acceleration	All models	4.9m/s^2 (0.5G) or less. When using the robot in a location subject to serious vibration, consult with your FANUC sales representative.
Altitude	All models	Operating:Up to 1,000m above sea level Non-operating:Up to 12,000m above sea level
Ionized and non-ionized radiation	Common to all models	A shielding provision is necessary if the machine is installed in an environment in which it is exposed to radiation (microwave, ultraviolet rays, laser beams, and/or X-rays).
Mass of controller	A-cabinet	120kg
	B-cabinet	180kg
Degree of protection	A-cabinet	IP54
	B-cabinet	
	Teach pendant	

NOTE

The power rating indicated above is sufficient as the continuous rating. However, when the robot is rapidly accelerating, the instantaneous requirement may increase to several times the continuous rating.

If the acceleration/deceleration override (ACC) greater than 100% is set in the robot program, the extreme current may flow to the robot controller instantaneously and the input voltage of robot controller will drop.

In this case, if the supply voltage is decreased 10% or more per rated voltage, Power supply alarm, Move error excess alarm, DCLV alarm of servo amplifier may occur.

NOTE

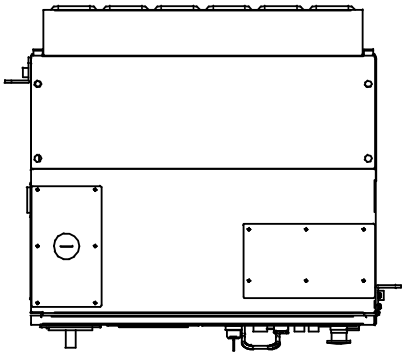
In case of CE controller

R-30*i*B controller is a group 1, class A product according to IEC55011.
This means that this product does not generate and/or use intentionally radio-frequency energy, in the form of electromagnetic radiation, inductive and/or capacitive coupling, for the treatment of material or inspection / analysis purpose and that it is suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.
There may be potential difficulties in ensuring electromagnetic compatibility in environments other than industrial, due to conducted as well as radiated disturbances.
This product must not be used in residual areas.
This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

Table 2.1.2 (b) Controller specification (R-30*i*B Mate Controller)

Item	Specification/condition
Rated Voltage	200-230VAC 50/60Hz Single Phase
	200-230VAC 50/60Hz 3 phase
Tolerant fluctuation	Tolerant voltage fluctuation: +10% -15% Tolerant frequency fluctuation: ±1Hz
Input power supply capacity	2.0KVA
Average power consumption	1.0KW
Permissible ambient temperature	Operating 0℃ to 45°C Storage, Transport -20°C to 60°C Temperature change 0.3°C/minute or less
Permissible ambient humidity	Normal: 75%RH or less, no condensation Short period (less than 1 month): 95%RH or less, no condensation
Surrounding gas	An additional protective provision is necessary if the machine is installed in an environment in which there are relatively large amounts of contaminants (dust, dielectric fluid, organic solvent, acid, corrosive gas, salt, etc.).
Installation Category	Installation Category Ⅱ, Pollution Degree 3, IEC60664-1 and IEC61010-1 (NOTE2)
Vibration	Vibration acceleration : 4.9m/s^2 (0.5G) or less When using the robot in a location subject to serious vibration, consult with your FANUC sales representative.
Altitude	Operating: Up to 1000m Non-operating: Up to 12000m
Ionized and non-ionized radiation	A shielding provision is necessary if the machine is installed in an environment in which it is exposed to radiation (microwave, ultraviolet rays, laser beams, and/or X-rays).
Mass of controller	40kg
Degree of protection	IP54

NOTE
1 The power rating indicated above is sufficient as the continuous rating. However, when the robot is rapidly accelerating, the instantaneous requirement may increase to several times the continuous rating.
If the acceleration/deceleration override (ACC) greater than 100% is set in the robot program, the extreme current may flow to the robot controller instantaneously and the input voltage of robot controller will drop.
In this case, if the supply voltage is decreased 10% or more per rated voltage, Power supply alarm, Move error excess alarm, DCLV alarm of servo amplifier may occur.
2 In case of connected with Input power supply of Installation category Ⅲ, set up isolated transformer between Input power supply and controller.



	Munsell	Color
Body	5GY3.5/0.5	Gray
Door	3.0GY8.2/0.9	White
Op. panel	N1.5	Black

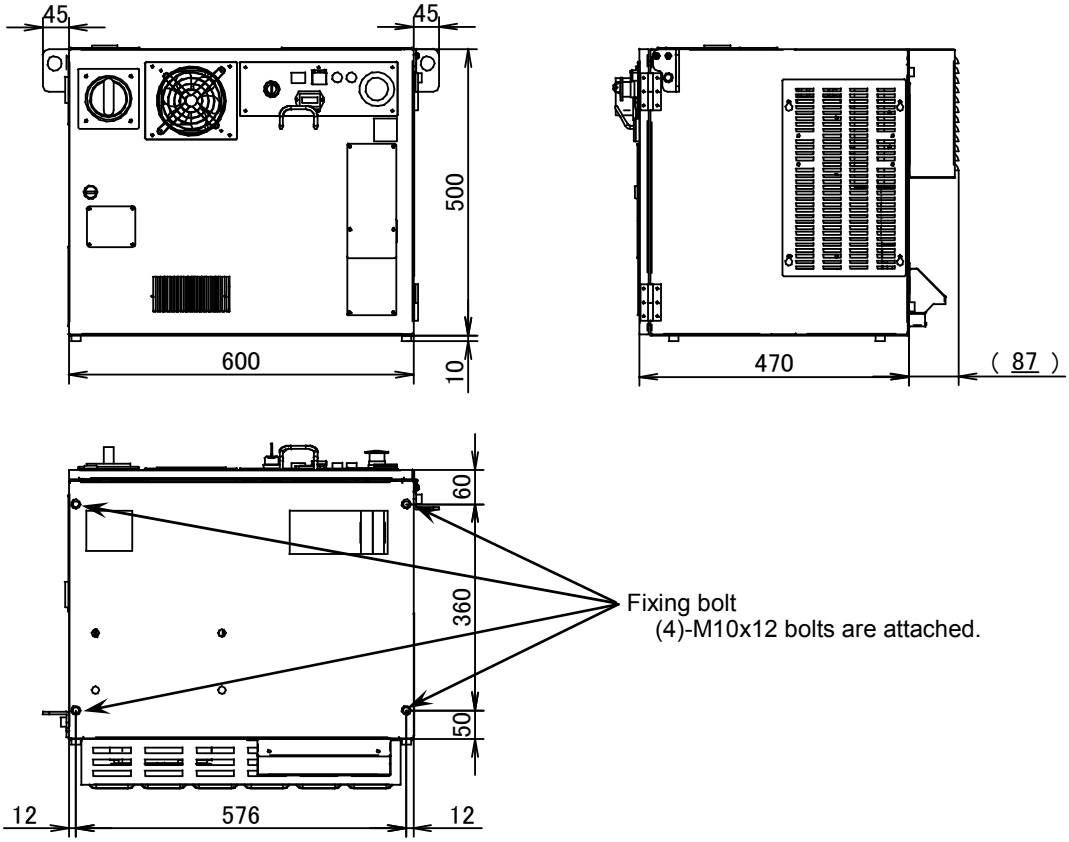
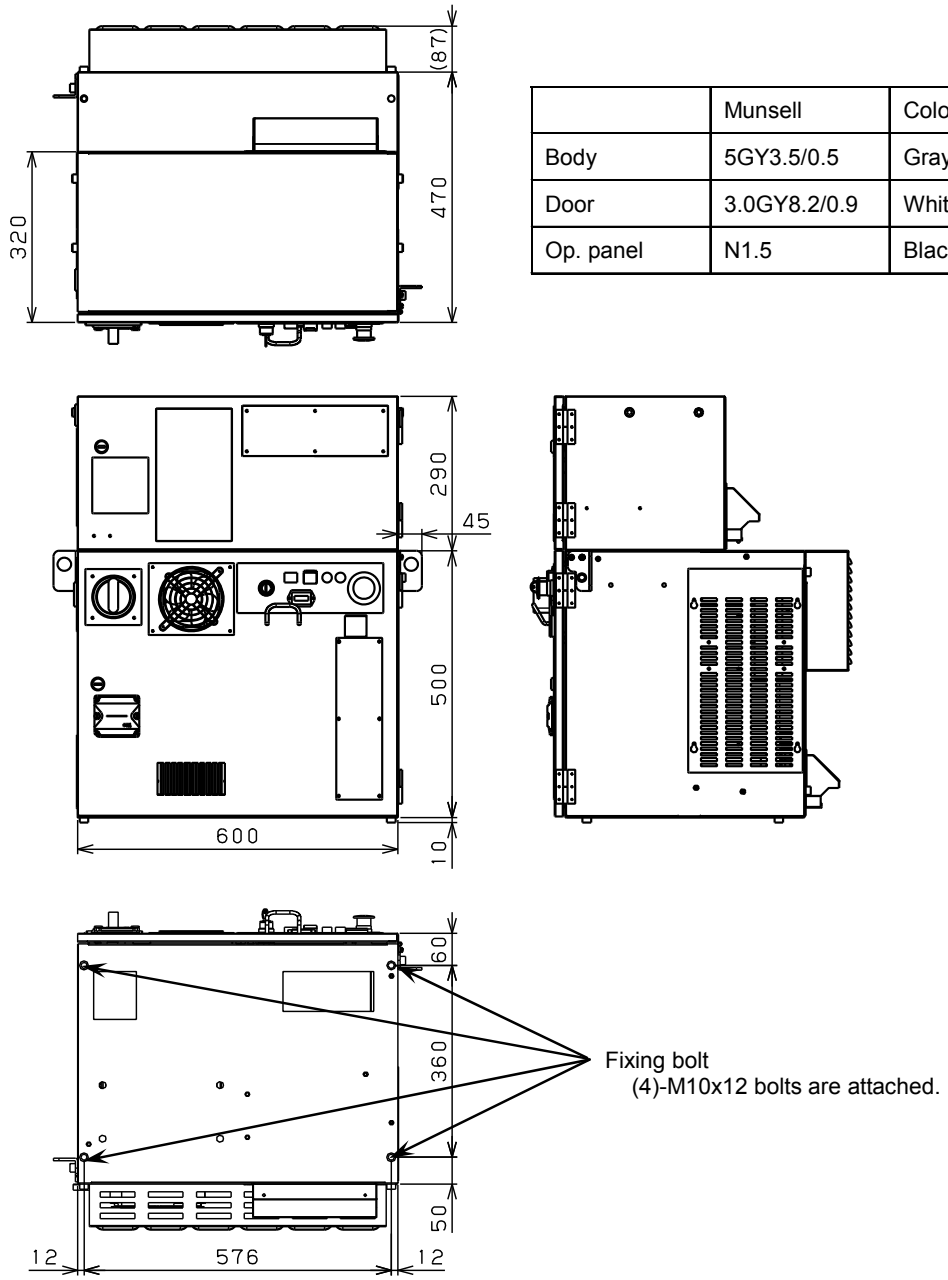
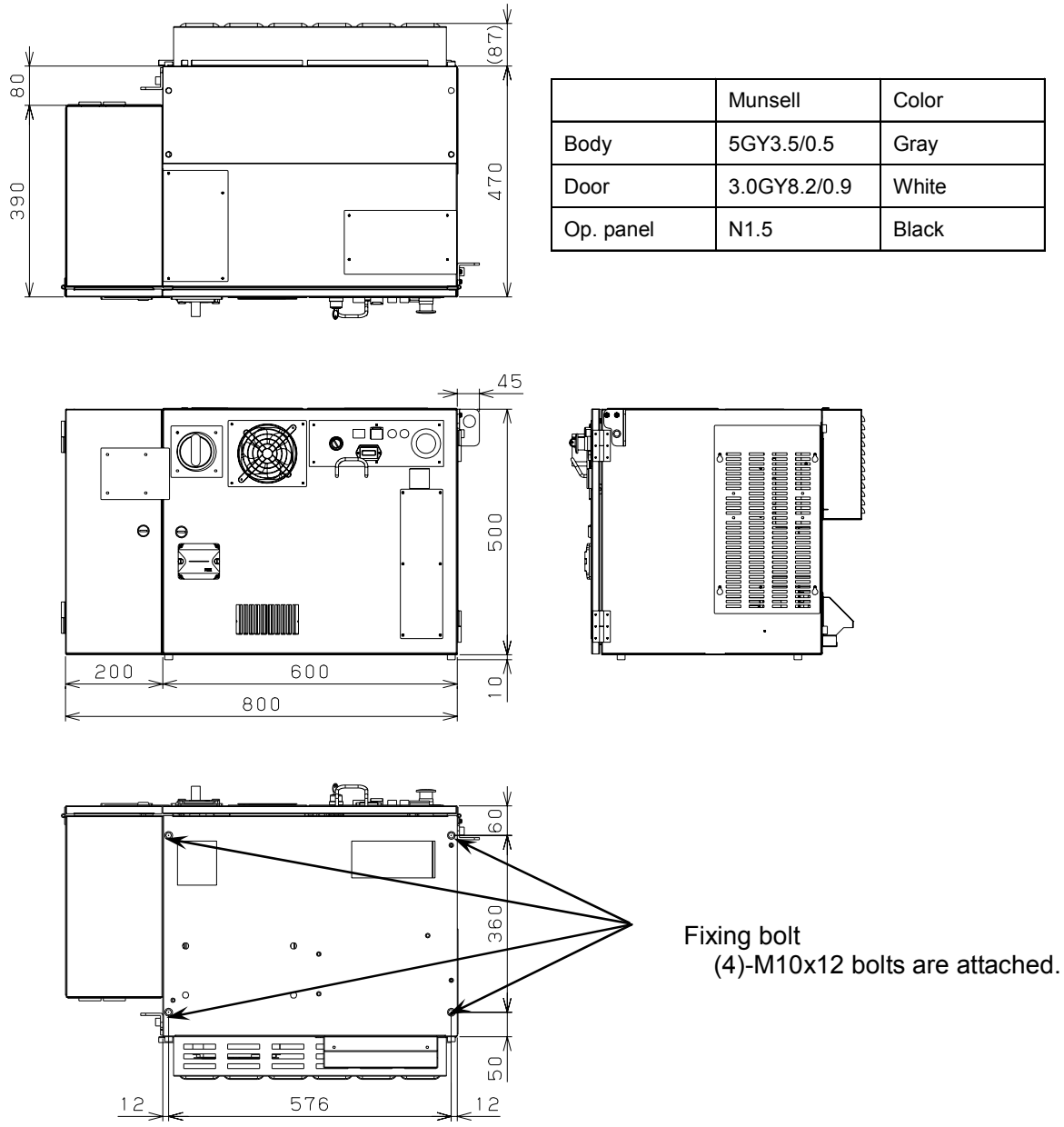


Fig. 2.1.2 (a) External dimensions (A-cabinet) (R-30*i*B Controller)



	Munsell	Color
Body	5GY3.5/0.5	Gray
Door	3.0GY8.2/0.9	White
Op. panel	N1.5	Black

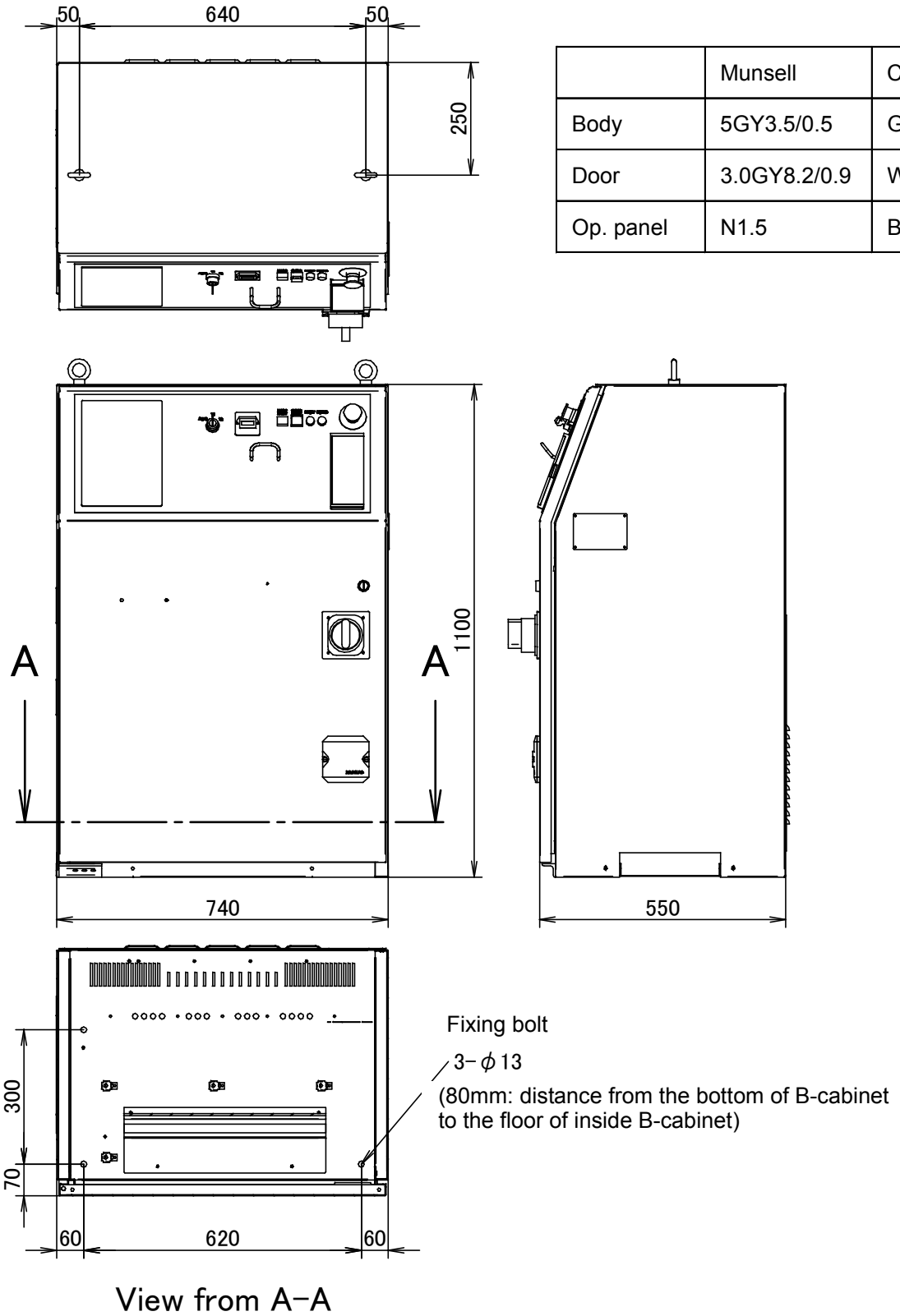
Fig. 2.1.2 (b) External dimensions (A-cabinet with Top box) (R-30*i*B Controller)



	Munsell	Color
Body	5GY3.5/0.5	Gray
Door	3.0GY8.2/0.9	White
Op. panel	N1.5	Black

Fixing bolt
(4)-M10x12 bolts are attached.

Fig. 2.1.2 (c) External dimensions (A-cabinet with Side box) (R-30*i*B Controller)



	Munsell	Color
Body	5GY3.5/0.5	Gray
Door	3.0GY8.2/0.9	White
Op. panel	N1.5	Black

Fig. 2.1.2 (d) External dimensions (B-cabinet) (R-30*i*B Controller)

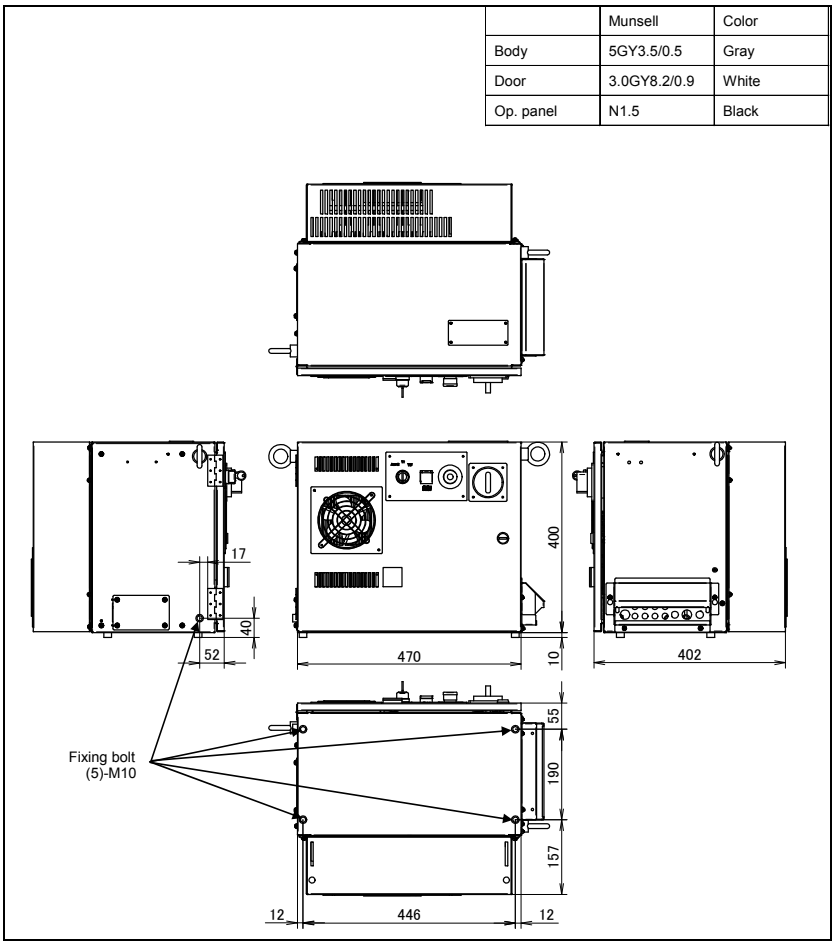


Fig. 2.1.2 (e) Controller external dimensions (R-30*i*B Mate Controller)

2.1.3 Welding Power Supply

Table 2.1.3 (a) Specification of welding power supply (WB-P500L)

Item	Specifications
Welding power supply spec.	A05B-1293-H111
Welding type	CO2 / MAG / MIG Low Spatter CO2 / Low Spatter MAG / Low Spatter MIG Pulse MAG / Pulse MIG Wave Pulse MAG / Wave Pulse MIG
Rated input voltage	200/220V ±10%, 3 Phase
Input frequency	50/60Hz
Rated input power	27.9kVA
Output current	DC 30A to 500A
Output voltage	DC 12V to 45V
Rated duty	60% at 500A direct current, 80% at 500A pulse current.
Mass	74kg
Maker type	WB-P500L

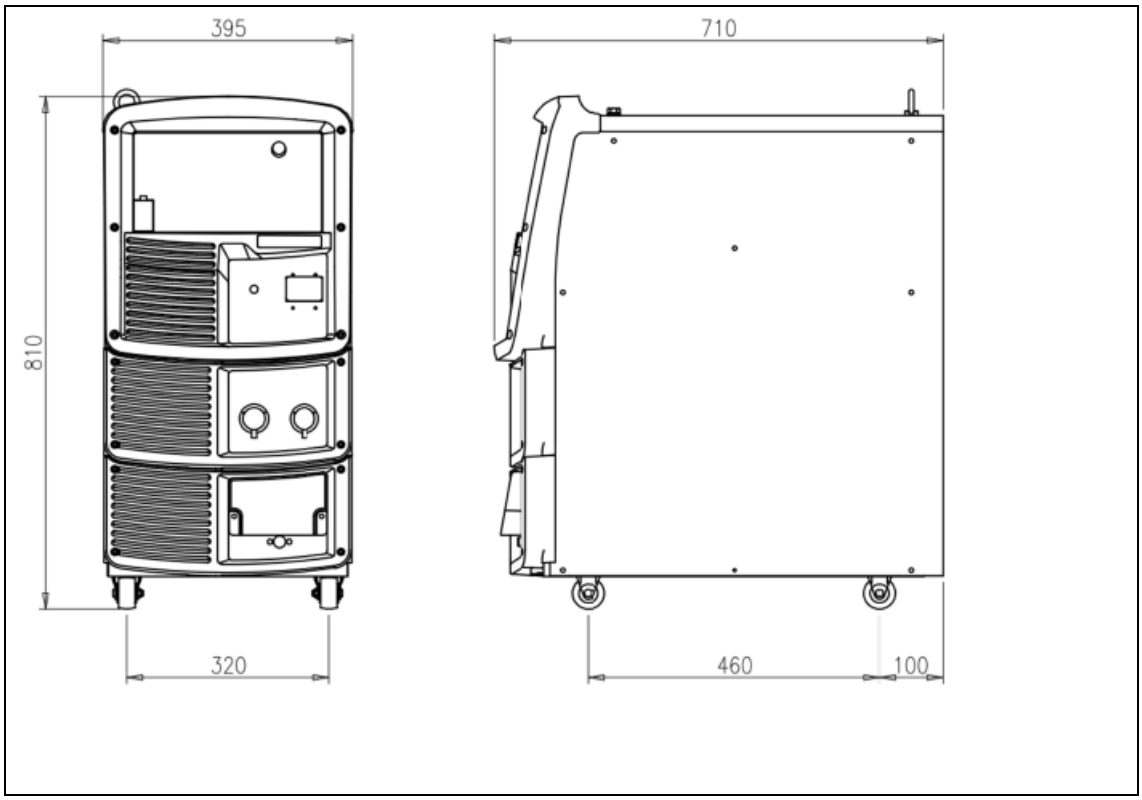


Fig. 2.1.3 (a) External dimensions of WB-P500L

Table 2.1.3 (b) Specification of welding power supply (WB-P350)

Item	Specifications
Welding power supply spec.	A05B-1293-H112
Welding type	CO2 / MAG / MIG Pulse MAG / Pulse MIG Wave Pulse MAG / Wave Pulse MIG
Rated input voltage	200/220V ±10%, 3 phase
Input frequency	50/60Hz
Rated input power	18.6kVA
Output current	DC 30A to 500A
Output voltage	DC 12V to 45V
Rated duty	60% at 350A
Mass	54kg
Maker type	WB-P350

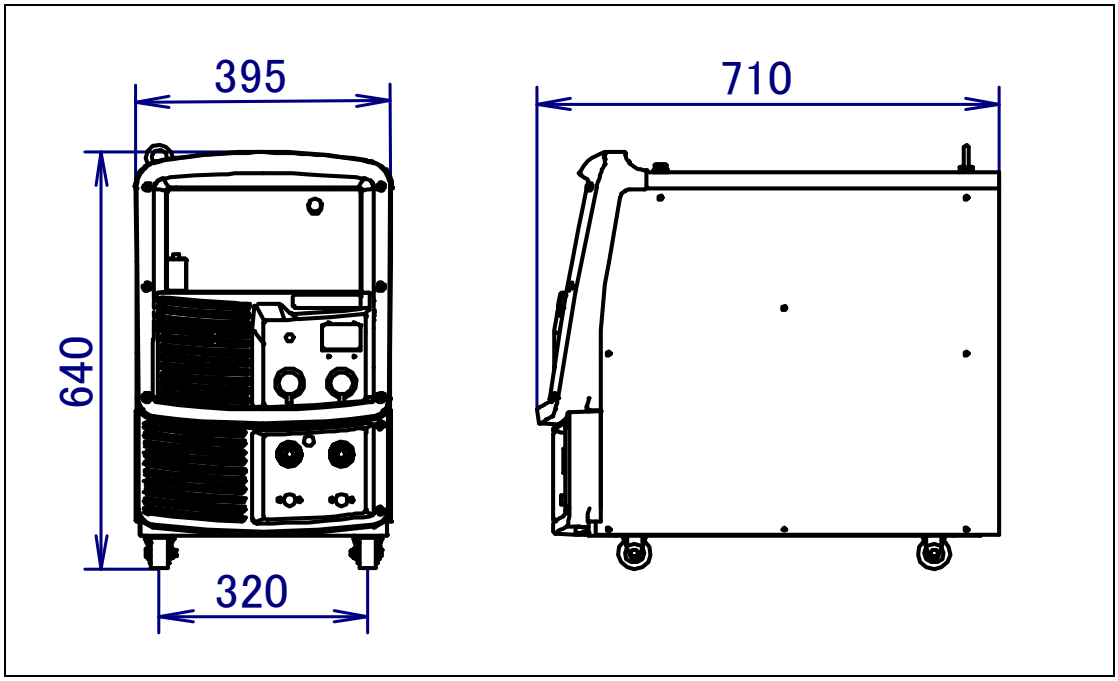


Fig. 2.1.3 (b) External dimensions of WB-P350

Table 2.1.3 (c) Specification of welding power supply (WB-M350L)

Item	Specifications
Welding power supply spec.	A05B-1293-H113
Welding type	CO2/MAG/MIG(Only fluxcore mode) Low Spatter CO2/ Low Spatter MAG/Low Spatter MIG
Rated input voltage	200/220V, 3 phase
Input frequency	50/60Hz
Rated input power	16.4kVA
Output current	DC 30A to 350A
Output voltage	DC 12V to 36V
Rated duty	60% at 350A. (complied with IEC60974-1)
Mass	56kg
Maker type	WB-M350L

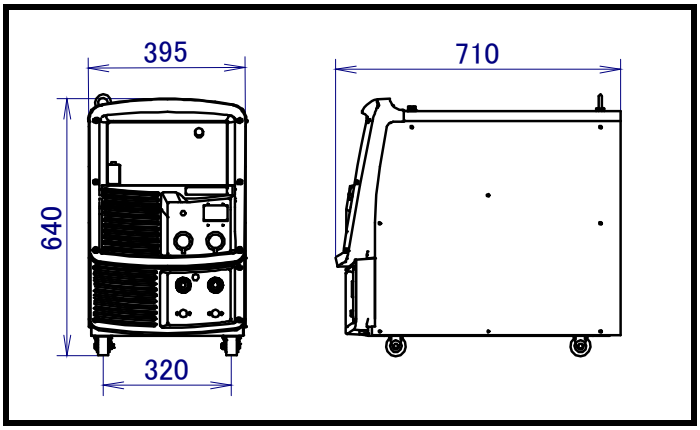


Fig. 2.1.3 (c) External dimensions of WB-M350L

Table 2.1.3 (d) Specification of welding power supply (WB-M500)

Item	Specifications
Welding power supply spec.	A05B-1293-H114
Welding type	CO2/MAG/MIG
Rated input voltage	200/220V, 3 phase
Input frequency	50/60 Hz
Rated input power	27.9kVA
Output current	DC 30A to 500 A
Output voltage	DC 12V to 45 V
Rated duty	100% at 350A
Mass	73kg
Maker type	WB-M500

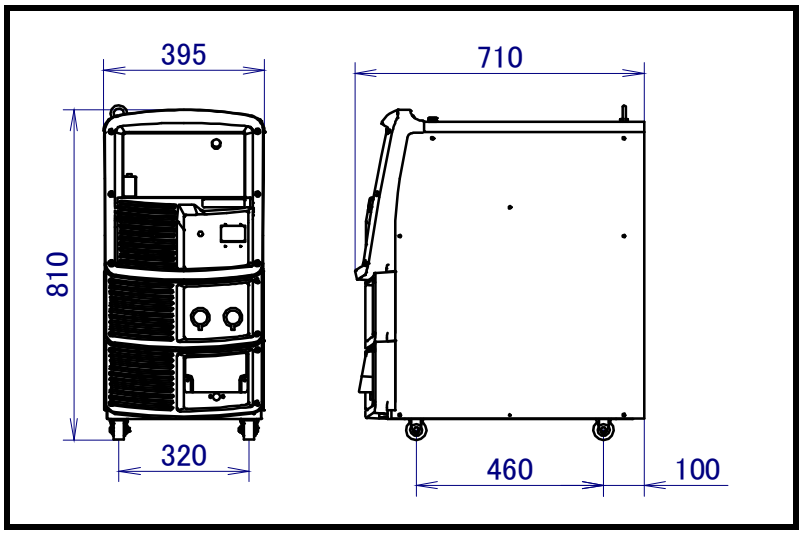


Fig. 2.1.3 (d) External dimensions of WB-M500

Table 2.1.3 (e) Specification of welding power supply (WB-M350)

Item	Specifications
Welding power supply spec.	A05B-1293-H115
Welding type	CO2/MAG/MIG
Rated input voltage	200/220V, (3 相)
Input frequency	50/60Hz
Rated input power	16.3kVA
Output current	DC 30A to 350A
Output voltage	DC 12V to 36V
Rated duty	60% at 350A (complied with IEC60974-1)
Mass	55kg
Maker type	WB-M350

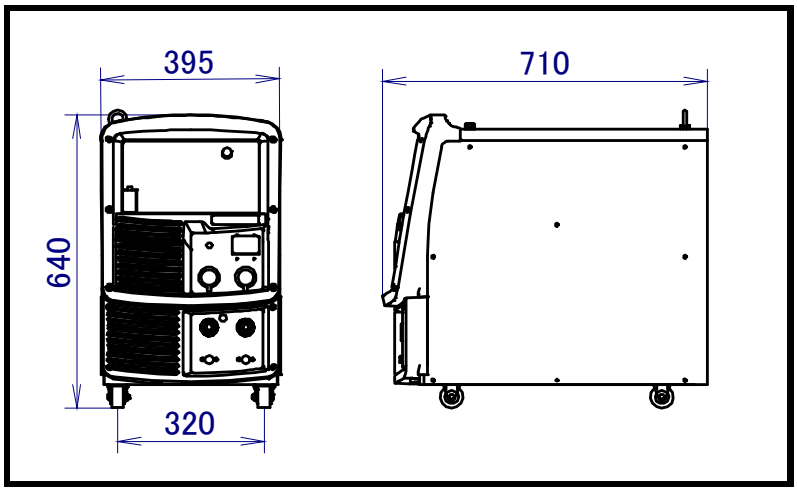


Fig. 2.1.3 (e) External dimensions of WB-M350

If there is a risk of the mine dust and sputtering are scattered, set welding power supply on a stand of around 30cm to prevent absorb them.
Please refer to Setup section of welding power supply manual.

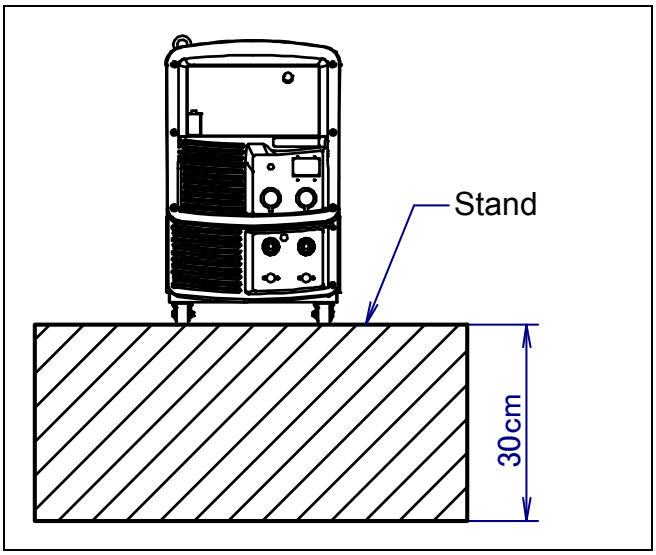


Fig. 2.1.3 (f) Quantity advance of welding power supply.

Transportation method of welding power supply

When transporting welding power supply only, use hand referring to Fig. 2.1.3 (g).

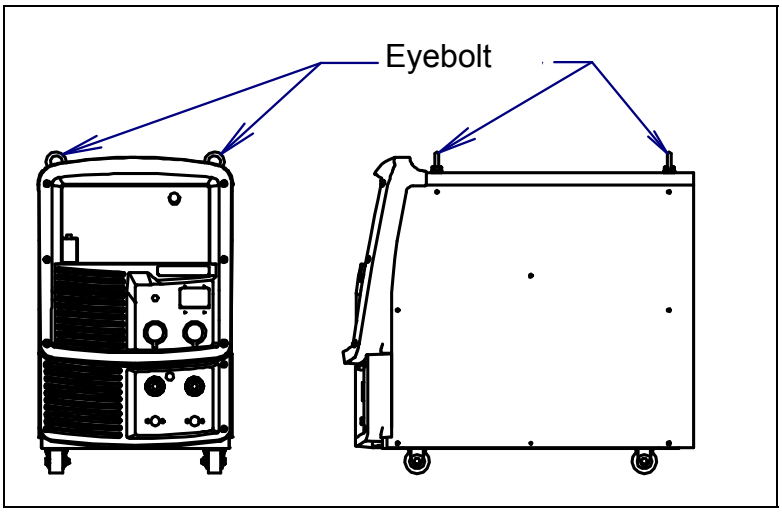


Fig. 2.1.3 (g) Transportation of welding power supply

2.1.4 Wire Feeder

Table 2.1.4 (a) Wire feeder (CMRE-742)

Specification	A05B-1293-H211
Drive system	2 driving and 2 driven rolls
Roller type	(0.6),(0.8),0.9,1.0,1.2,(1.4),(1.6) mmφ
Motor voltage / current	DC42V
Wire speed	1.5 to 22 m/min
Operating temperature limit	-10 to 40℃
Operating humidity limit	20 to 80% (non condensing)
Keeping temperature limit	-10 to 60℃
Keeping humidity limit	20 to 80% (non condensing)
Mass	7kg

0.9-1.0/1.2mm ϕ feeding roller is installed when the wire feeder is shipped.

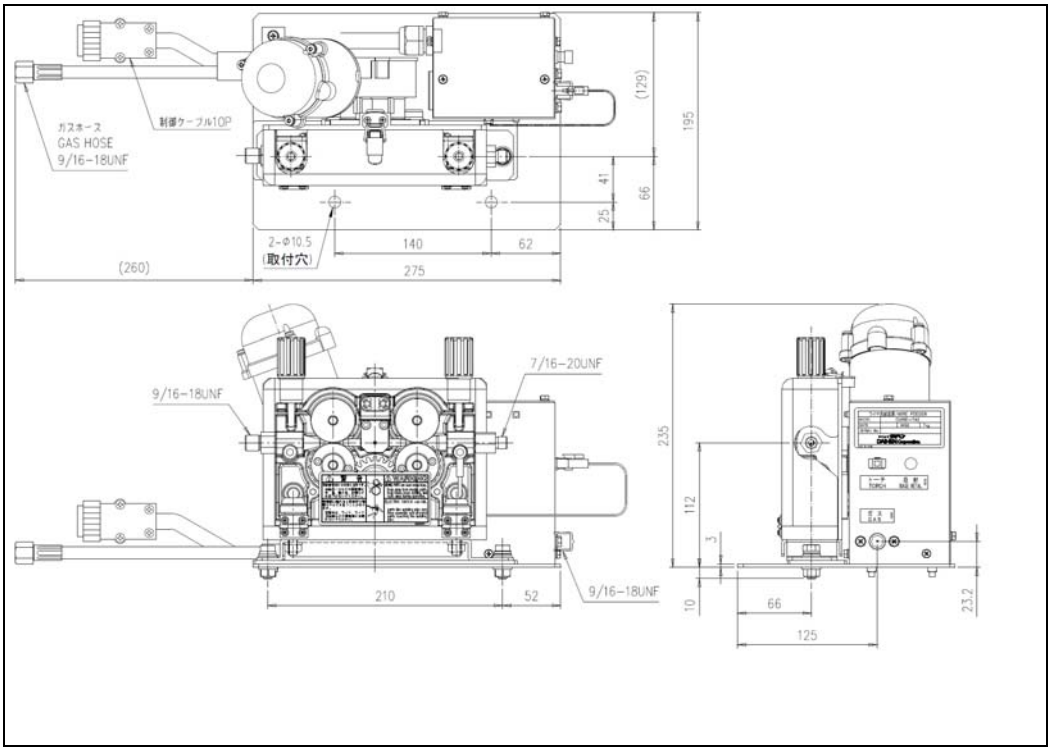


Fig. 2.1.4 Wire feeder external dimensions

Specification of feeding rollers are below.

Table 2.1.4 (b) Feeding roller

	Specifications
Feeding roller 1.4mm/1.6mm for mild steel 2 pcs/per 1 machine	A14L-0193-0211#K5439B01
Feeding roller 1.2mm/1.4mm for mild steel 2 pcs/per 1 machine	A14L-0193-0211#K5439B04
Feeding roller 1.2mm/1.2mm for mild steel 2 pcs/per 1 machine	A14L-0193-0211#K5439B05
Feeding roller 1.4mm/1.4mm for mild steel 2 pcs/per 1 machine	A14L-0193-0211#K5439B06
Feeding roller 1.6mm/1.6mm for mild steel 2 pcs/per 1 machine	A14L-0193-0211#K5439B07
Feeding roller 0.6mm/0.8mm for mild steel 2 pcs/per 1 machine	A14L-0193-0211#K5439B09
Feeding roller 1.2mm/1.6mm for mild steel 2 pcs/per 1 machine	A14L-0193-0211#K5439B11
Feeding roller 0.9-1.0mm/1.2mm for mild steel 2 pcs/per 1 machine	A14L-0193-0211#K5439B12
Feeding roller 0.8mm/0.9-1.0mm for mild steel 2 pcs/per 1 machine	A14L-0193-0211#K5439B13
Jamming roller	A14L-0193-0211#K5439C00

2.1.5 Welding Torch

Table 2.1.5 (a) Specification of torch

	Specification	Model
BINZEL 350GC-30S (air cooling)	A05B-1293-H301	ARC Mate 100*i*C/12
BINZEL 350GC-30L (air cooling)	A05B-1293-H303	
BINZEL 350GC-30S (air cooling)	A05B-1293-H302	ARC Mate 100*i*C/7L
BINZEL 350GC-30L (air cooling)	A05B-1293-H304	
BINZEL 350GC-30S (air cooling)	A05B-1294-H301	ARC Mate 120*i*C
BINZEL 350GC-30L (air cooling)	A05B-1294-H303	
BINZEL 350GC-30S (air cooling)	A05B-1294-H302	ARC Mate 120*i*C/12L
BINZEL 350GC-30L (air cooling)	A05B-1294-H304	

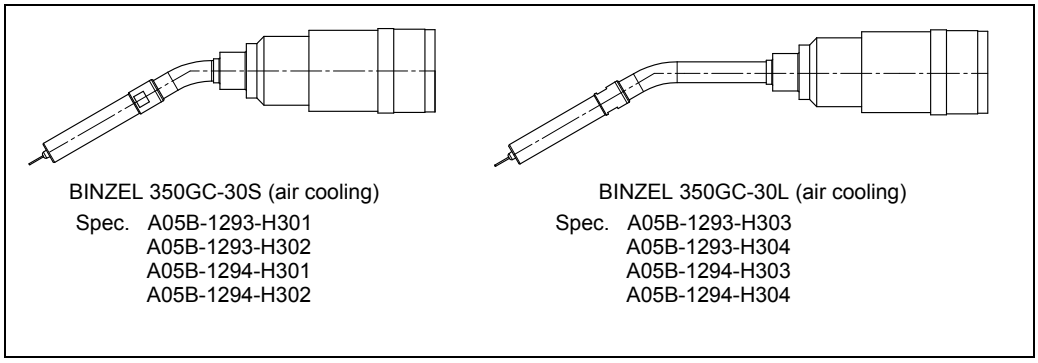


Fig. 2.1.5 Externals chart of torch

TCP and payload setting of torch is below.

Table 2.1.5 (b) TCP and payload setting of torch (ARC Mate *i*C series))

	ABIROB 350GC Short neck	ABIROB 350GC Long neck	
TCP X	-84.5	-84.5	[mm]
TCP Y	0	0	[mm]
TCP Z	362	440.7	[mm]
PAYLOAD	1.94	2.04	[kg]
PAYLOAD CENTER X	-0.7	-0.7	[cm]
PAYLOAD CENTER Y	-0.3	-0.3	[cm]
PAYLOAD CENTER Z	16.7	16.7	[cm]
PAYLOAD INERTIA Ix	0.35	0.35	[kgf·cm·s^2]
PAYLOAD INERTIA Iy	0.35	0.35	[kgf·cm·s^2]
PAYLOAD INERTIA Iz	0.026	0.026	[kgf·cm·s^2]
ARM LOAD AXIS (AXIS 3)	7	7	[kg]

∗Above-mentioned TCP is the one of 15mm in the wire thrusting out length.

2.1.6 Communication Cable Specifications

Table 2.1.6 Communication cables

	Specification	Remarks
Eternet cable 3.0m	A05B-2512-J280	
Eternet cable 7.6m	A05B-2512-J281	
Eternet cable14.0m	A05B-2512-J282	

2.2 OPTION CONSTITUTION

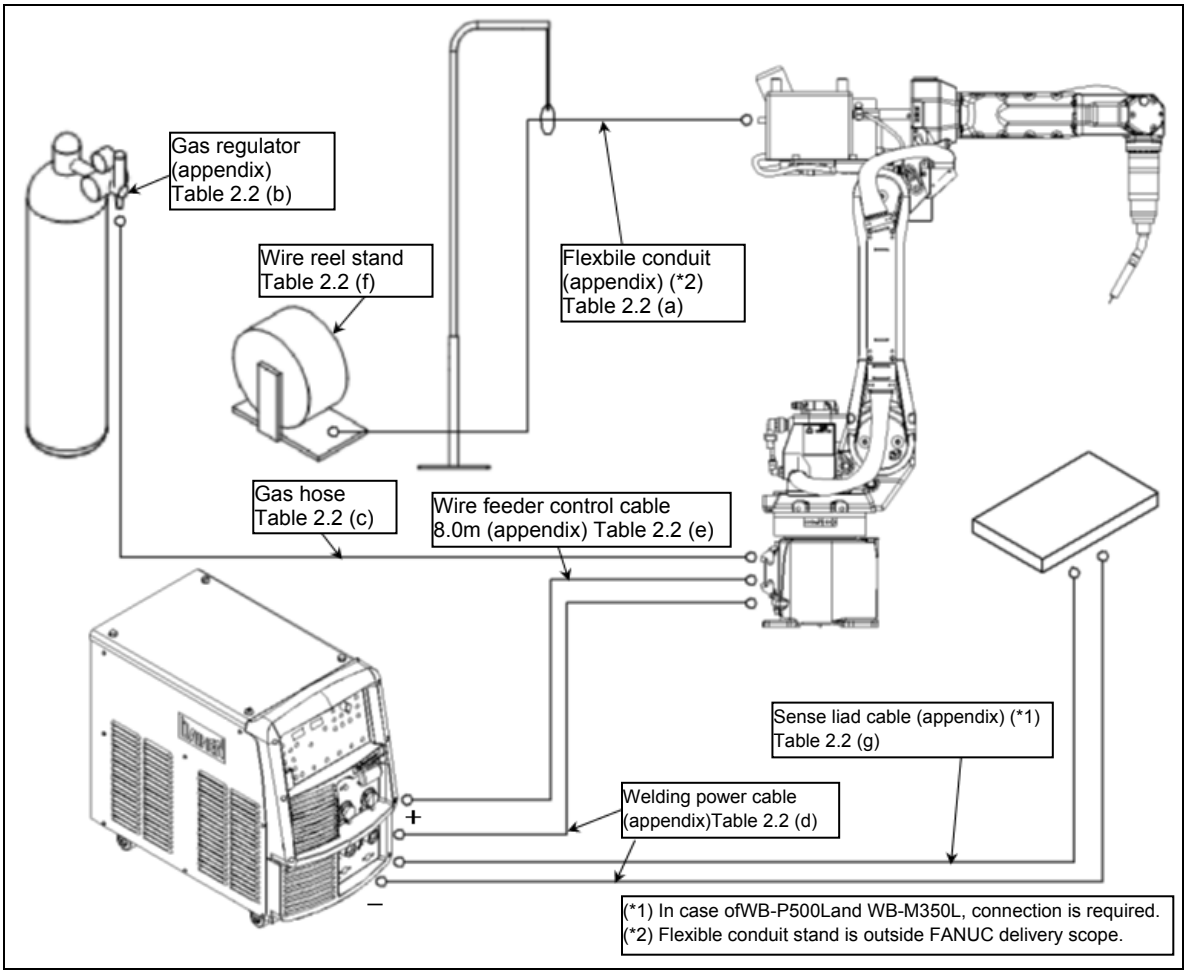


Fig. 2.2 (a) Option constitution

Table 2.2 (a) Flexible conduit specifications

	Specifications
Flexible conduit 4.6m	A05B-1291-H411
Flexible conduit 7.6m	A05B-1291-H412
Flexible conduit 3.0m	A05B-1291-H413

Table 2.2 (b) Specification of regulator

Specifications		A05B-1291-J101
Maker		Yutaka.LTD
Decompression method		Two step decompression method
Basic performance	Inlet pressure gauge	0 to 25Mpa
	Inlet pressure	Ar, MAG: 0 to 14.8MPa CO2: 0 to 12MPa
	Measurement flow quantity range	1 to 25L/min
	Safety valve	20Mpa or more
	Regulated pressure	0.25MPa
Coupling	Inlet	W22-14 (R)
	Outlet	Φ8.5 hose mouth
Heating device performance	Voltage	100V
	Heating capacity	200W
	Power supply code	2P(2m)

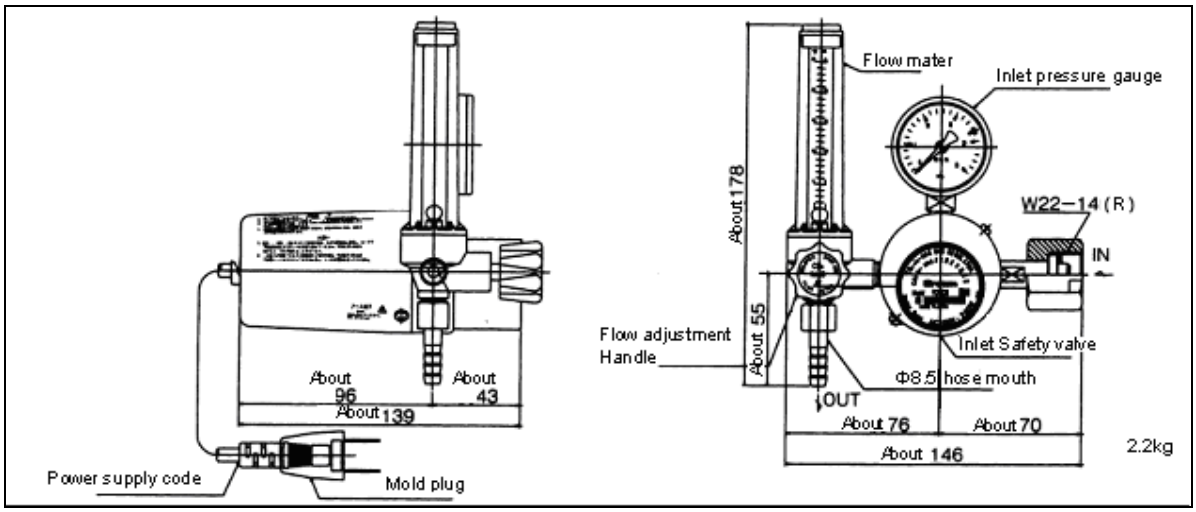


Fig. 2.2 (b) Regulator external dimensions (A05B-1291-J101)

Table 2.2 (c) Gas hose specifications

	Specifications
Gas hose 10m	A05B-1291-J151
Gas hose 15m	A05B-1291-J152
Gas hose 20m	A05B-1291-J153
Gas hose 25m	A05B-1291-J154

Table 2.2 (d) Welding power cables specifications

	Specifications
Welding power cable(not for movable part) 38SQ 6m	A05B-1223-K701
Welding power cable(not for movable part) 38SQ 10m	A05B-1223-K702
Welding power cable(not for movable part) 38SQ 15m	A05B-1223-K703
Welding power cable(not for movable part) 38SQ 20m	A05B-1223-K704
Welding power cable(not for movable part) 60SQ 5m	A05B-1291-H711
Welding power cable(not for movable part) 60SQ 10m	A05B-1291-H712
Welding power cable(not for movable part) 60SQ 15m	A05B-1291-H713
Welding power cable(not for movable part) 60SQ 20m	A05B-1291-H714

(*) When 2 welding power supplies are used in system, be sure to separate each power cable when forming them.

⚠ CAUTION
These cables cannot be used for the moving part such as the cable tracks. (Except for movable) Please contact FANUC beforehand when the application such as the cable tracks to the moving part is necessary.
Please insulate the seam of the sheath and the terminal of the welding power cable firmly. There is danger of breaking the robot when the seam touches the robot.

⚠ CAUTION
Please consider covering the cable with the rubber mule for protection etc. when hanging it with the balance device etc. that set up the cable in the surrounding for the welding outside so that it plans, the limited part is bound in the cable tie etc., and power should not concentrate on a specific part.

Table 2.2 (e) Wire feeder control cable

	Specifications
Wire feeder control cable 5m	A05B-1293-H601
Wire feeder control cable 10m	A05B-1293-H602
Wire feeder control cable 15m	A05B-1293-H603
Wire feeder control cable 20m	A05B-1293-H604

Table 2.2 (f) Wire reel stand

	Specifications
Wire reel stand (stationary)	A05B-1291-J203

Table 2.2 (g) Sense lead cable

	Specifications
Sense lead cable (*)	A05B-1293-H581

(*) In case ofWB-P500Land WB-M350L, connection is required

Additional axis option

If additional axis cabinet (option) is added to R-30*i*B Mate controller, it supports additional axis positioner.

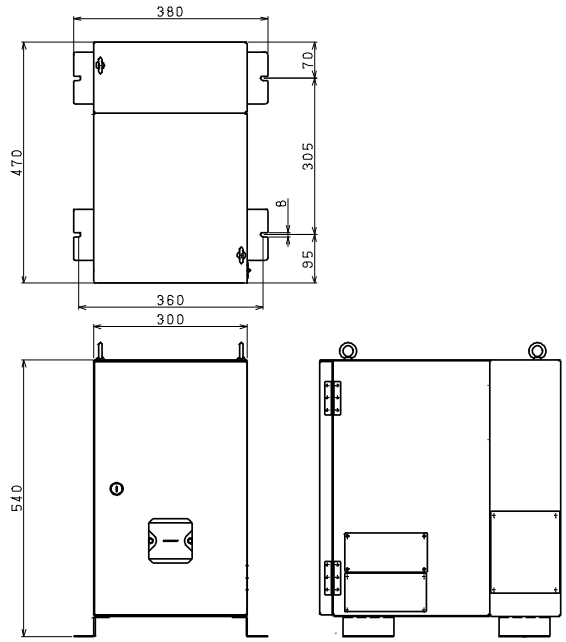
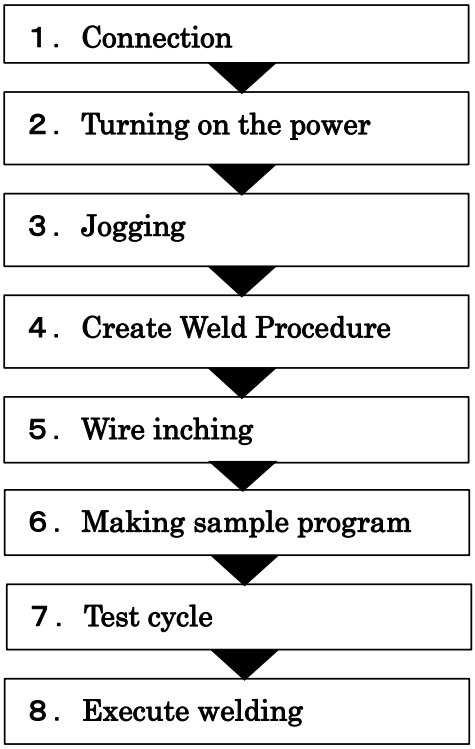


Fig. 2.2 (c) Additional axis cabinet external dimensions

3 BASIC OPERATION (QUICK REFERENCE)

3.1 FLOW FOR WELDING



This chapter describes the shortest procedure for installing robot to carry out arc welding.
This chapter is intended for beginners of FANUC Robot.
You may skip this chapter if you are familiar with the subject.
Please refer to Chapter 4 or later and R-30*i*B/R-30*i*B Mate CONTROLLER Arc Welding Function OPERATOR'S MANUAL (B-83284EN-3) for more details of arc welding robot operation method.

3.2 CONNECTION

Fig.3.2 (a), (b) show connection contents of a robot, a controller and welding power supply.
Refer to Subsection 3.2.1 to 3.2.5 for details.

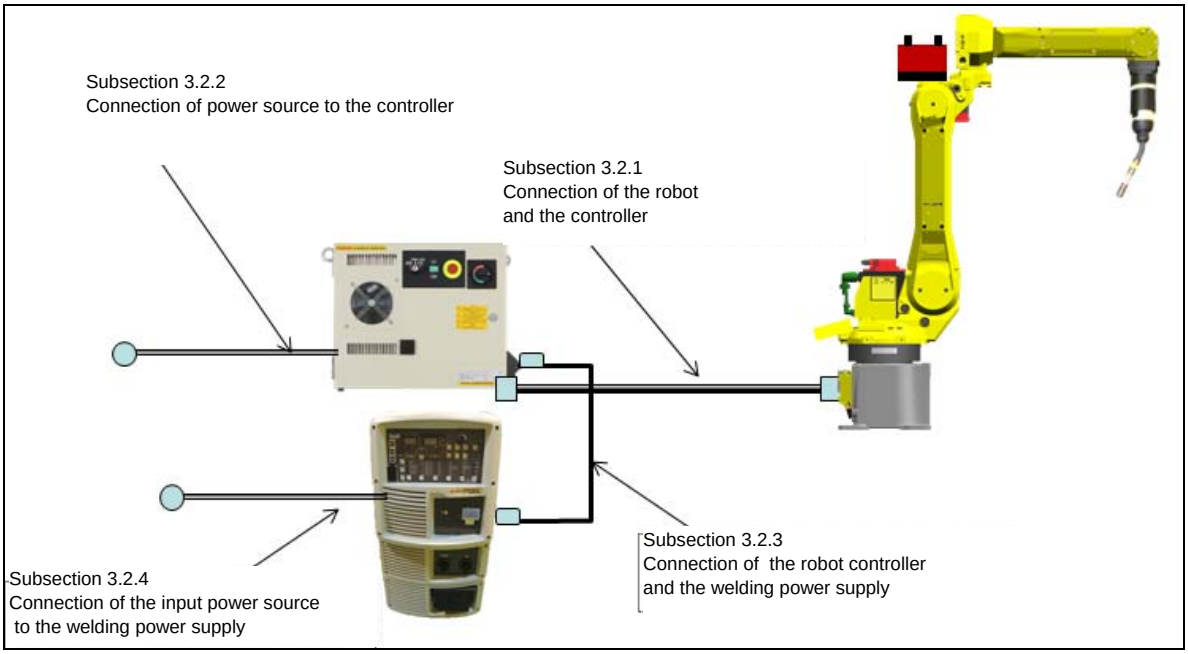


Fig. 3.2 (a) Connection contents (1/2)

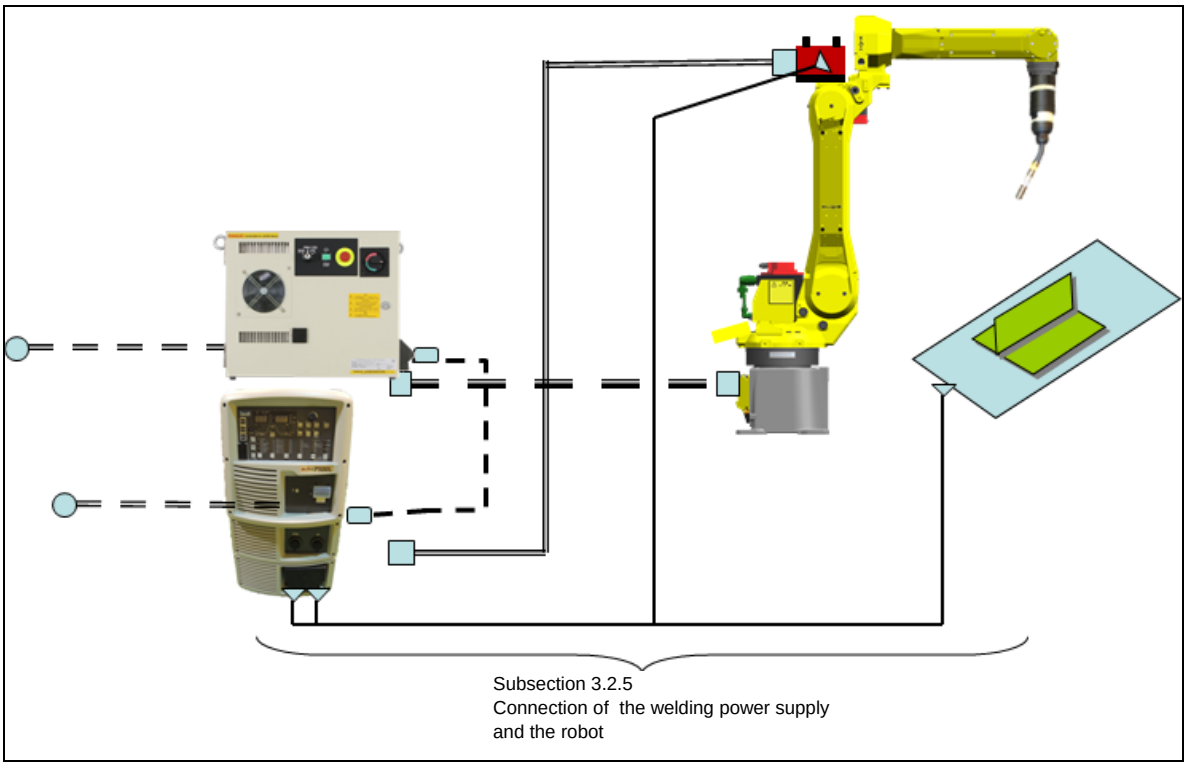


Fig. 3.2 (b) Connection contents (2/2)

3.2.1 Connection of Robot and Controller

The robot is connected with the controller (NC) via the power and signal cable and earth cable. Connect these cables to the connectors on the back of the base.

> ⚠ **CAUTION**
> 1 Before connecting the cables, be sure to turn off the controller power.
> 2 Don't use 10m or longer coiled cable without untying. The long coiled cable will heat and damage itself.

> ⚠ **WARNING**
> Before turning on controller power, be sure to connect robot and controller with the earth line. Otherwise, there is the risk of electrical shock.

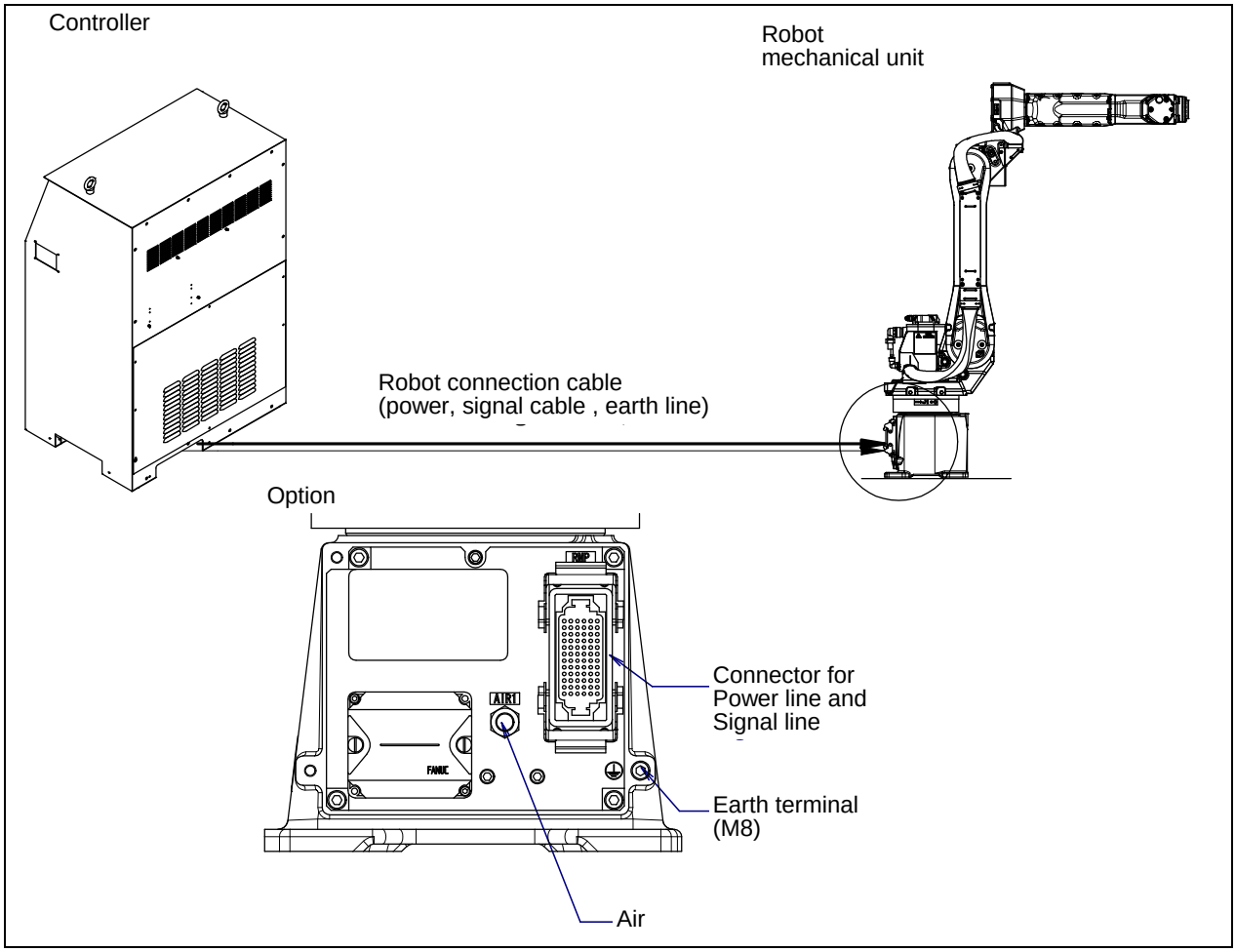
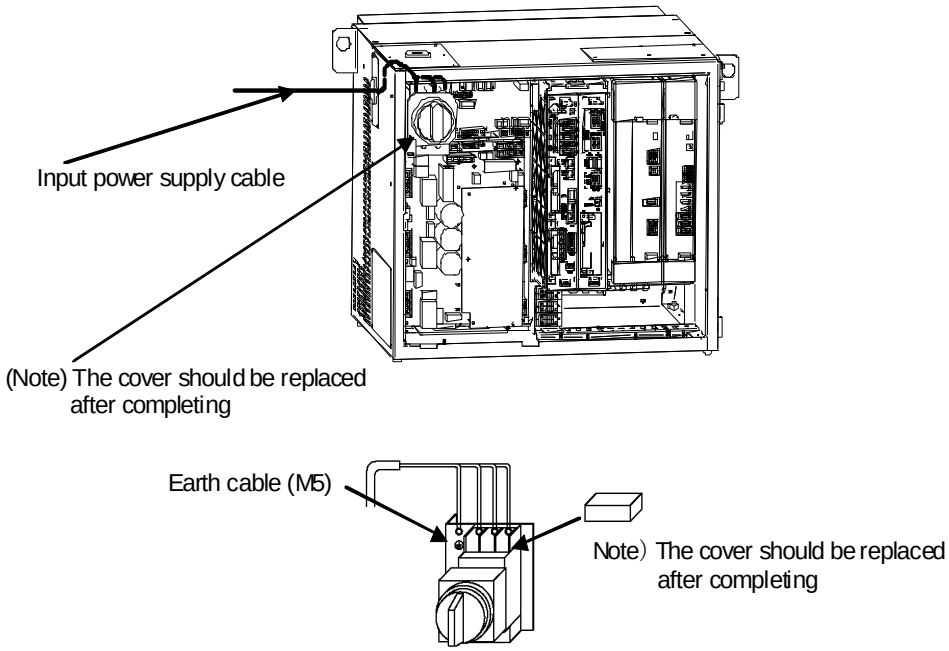


Fig. 3.2.1 Cable connection figure

3.2.2 Connection of Input Power Supply to Controller



(A-cabinet)

Fig. 3.2.2 (a) Connecting the input power cable (R-30*i*B Controller, A-cabinet)

> ⚠ **WARNING**
> The cover for primly terminal of main breaker should be replaced after completing.

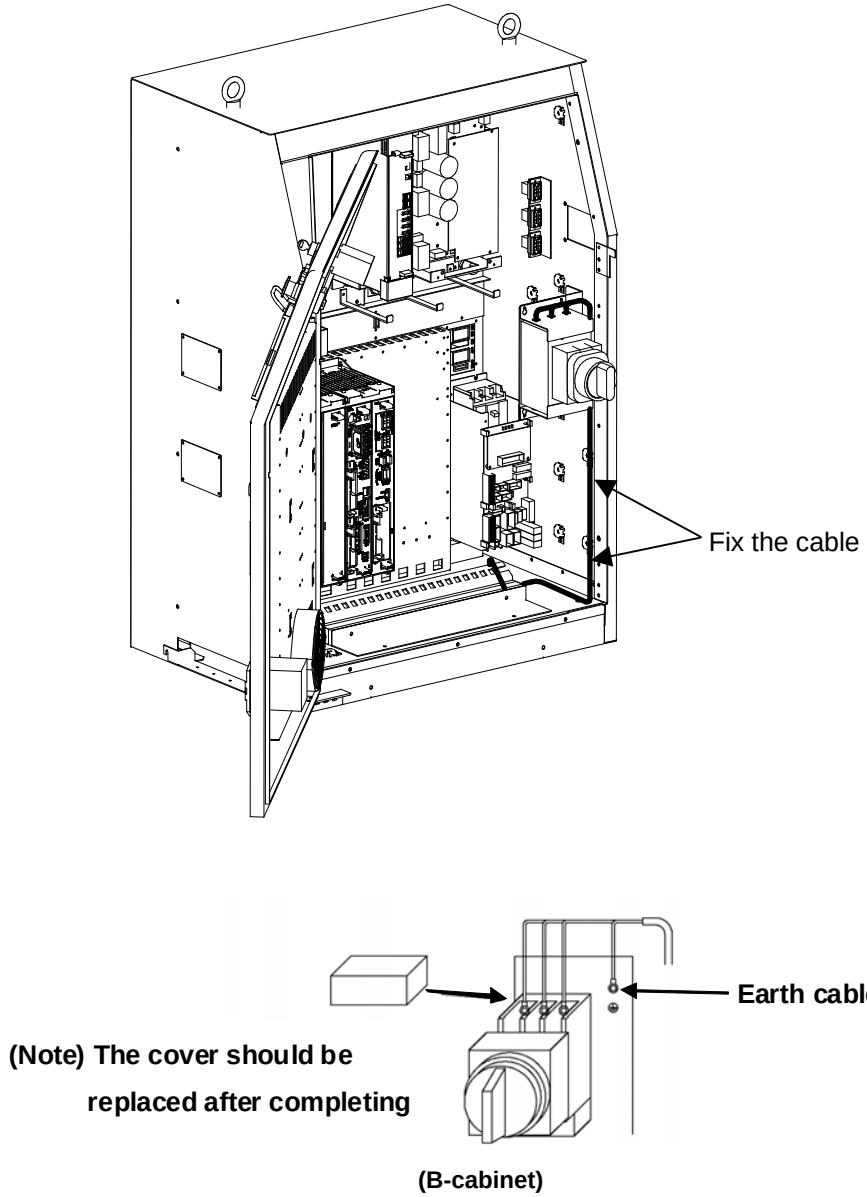


Fig. 3.2.2 (b) Connecting the input power cable (R-30*i*B Controller, B-cabinet)

> ⚠ **WARNING**
> The cover for primly terminal of main breaker should be replaced after completing.

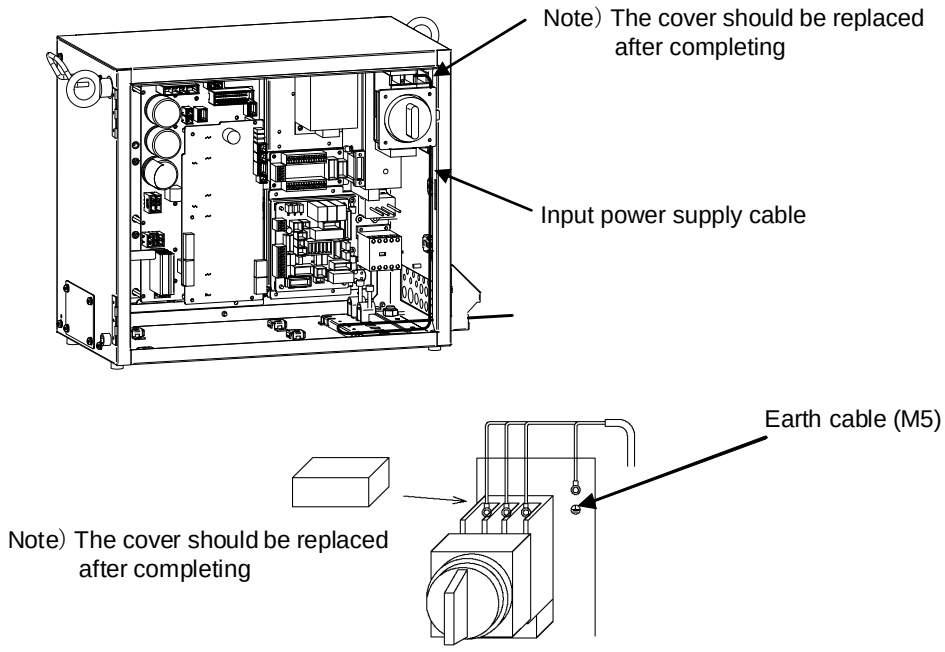


Fig. 3.2.2 (c) Connecting the input power cable (R-30*i*B Mate Controller)

NOTE1
Use the wire which size is from AWG14 (2mm^2) to AWG10 (5.5mm^2) for input power supply cable and earth cable.

3.2.3 Connection of Controller and Welding Power Supply

For this type of controller, the cable is drawn out only from the front of the controller. See the outline drawing of each type of board for the location of the connector.

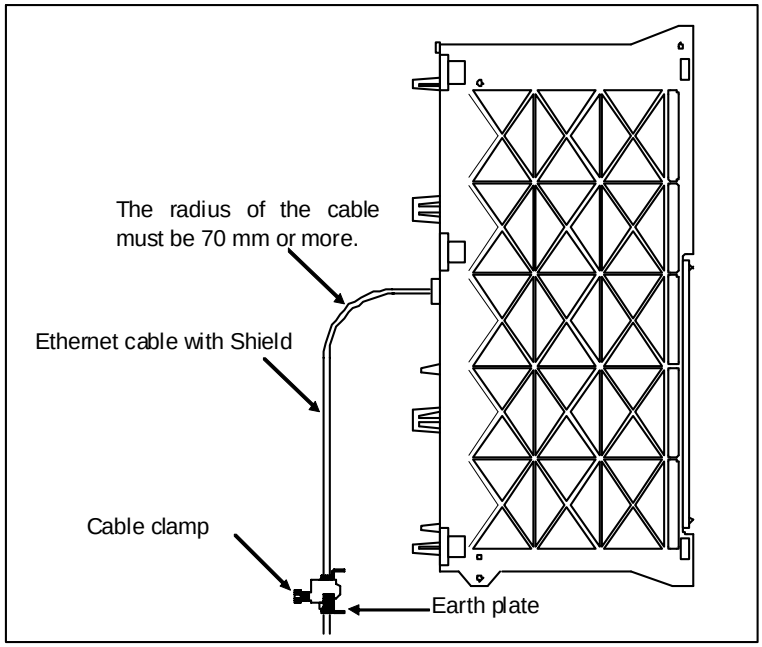


Fig. 3.2.3 (a) Connection of Eternet cable (R-30*i*B controller)

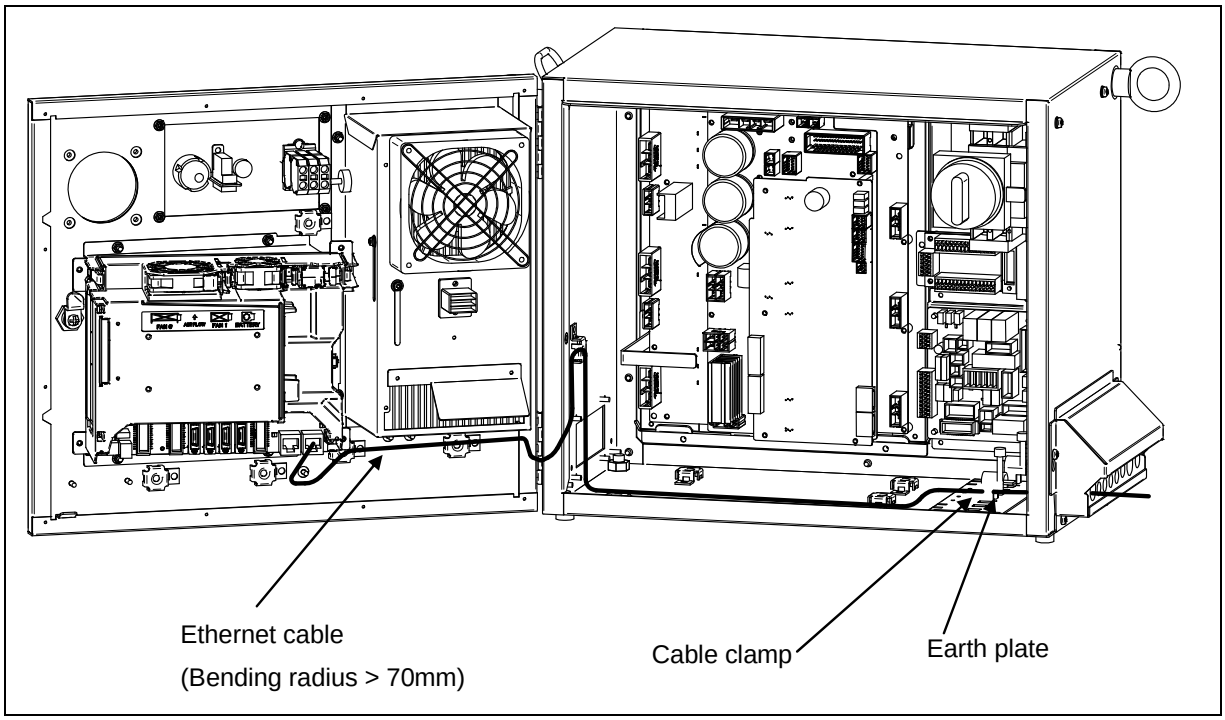


Fig. 3.2.3 (b) Connection of Eternet cable (R-30*i*B Mate controller)

If one robot controller is used to control multiple welding power supply, a hub is required.
In case of R-30*i*B controller, connect the CD38B port of the controller and the hub, then connect the hub and each welding power supply.

In case of R-30*i*B Mate Controller

- Robot controller has only CD38A port: Connect the cable to CD38A, then connect the hub and the each welding power supply
- Robot controller has CD38A and CD38B ports: Connect the cable to CD38B, then connect the hub and each welding power supply.

The Ethernet cable must be fastened by a cable clamp to prevent tension being applied to the modular connector (RJ-45) that connects the cable to the controller even if the Ethernet cable is pulled directly. Connect this cable to the welding power supply back side.

Fig. 3.2.3 (c) Connection of Ethernet cable

3.2.4 Connection of Input Power Supply to Welding Power Supply

1. Connect the primary cable, then attach the input terminal cover and cable fixation part.

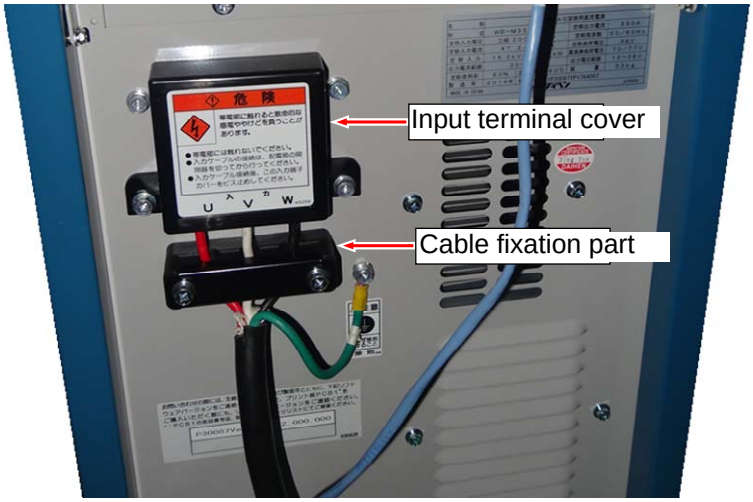


Fig. 3.2.4 Connection of welding power supply

3.2.5 Connection of Welding Power Supply and Robot

1 Connect welding power cable (+),(-) and the wire feeder control cable to the welding power supply referring to Fig .3.2.5 (a) and (b). Remove the cover before connecting them.

2 In case of WB-P500L,WB-M350L, connect the minus side sense lead to the energized part of the fixture.

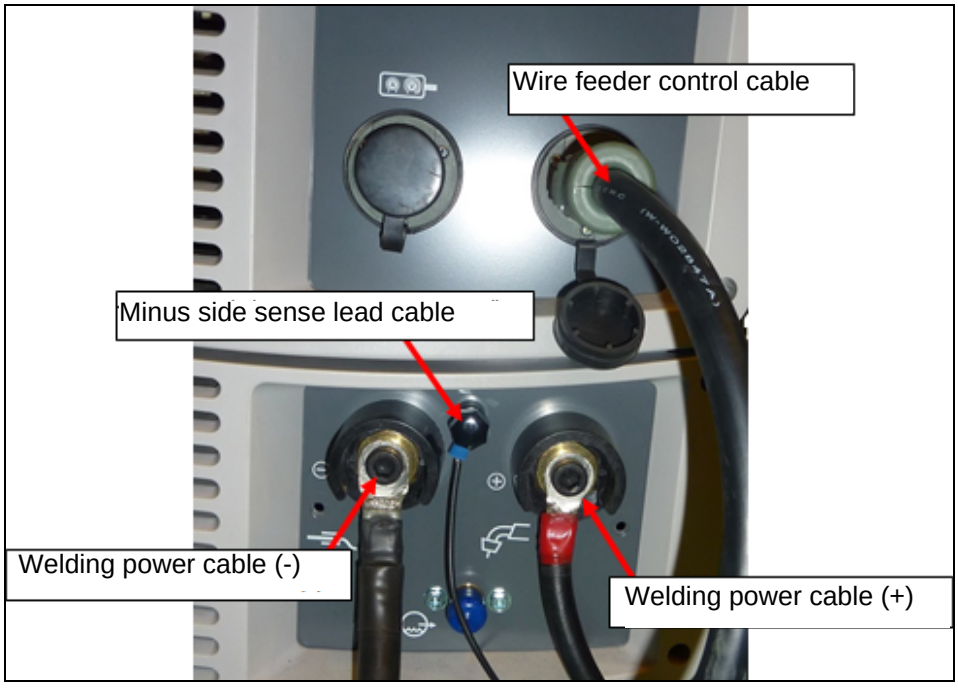


Fig. 3.2.5 (a) Connection of DAIHEN digital welding power supply

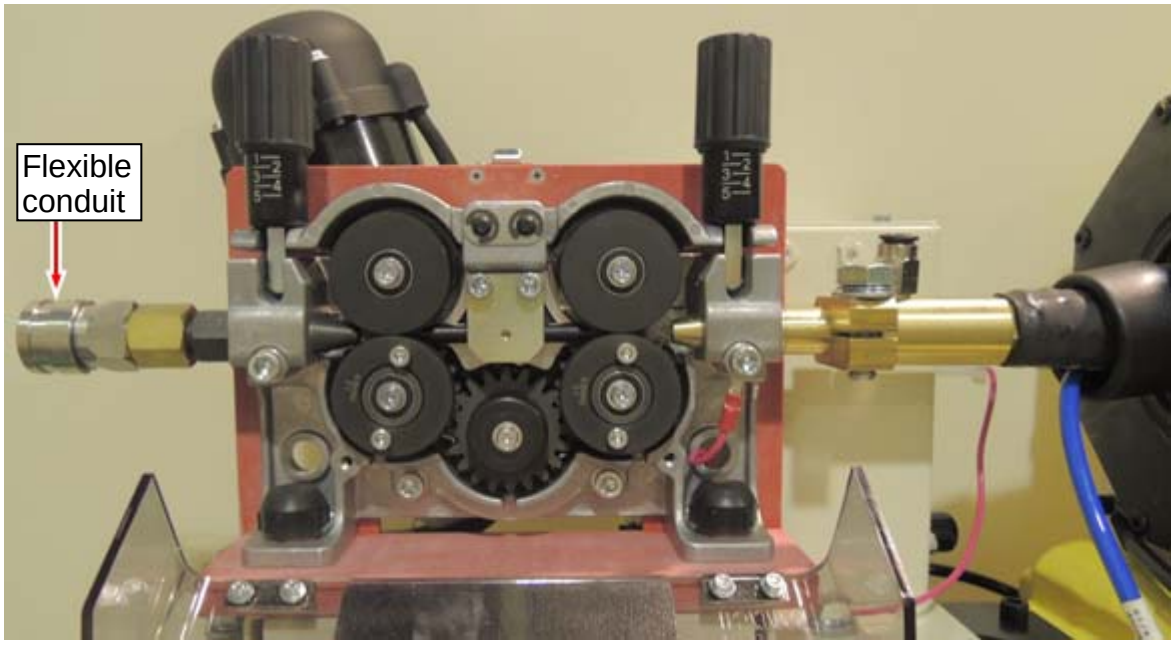


Fig. 3.2.5 (b) Connection to wire feeder

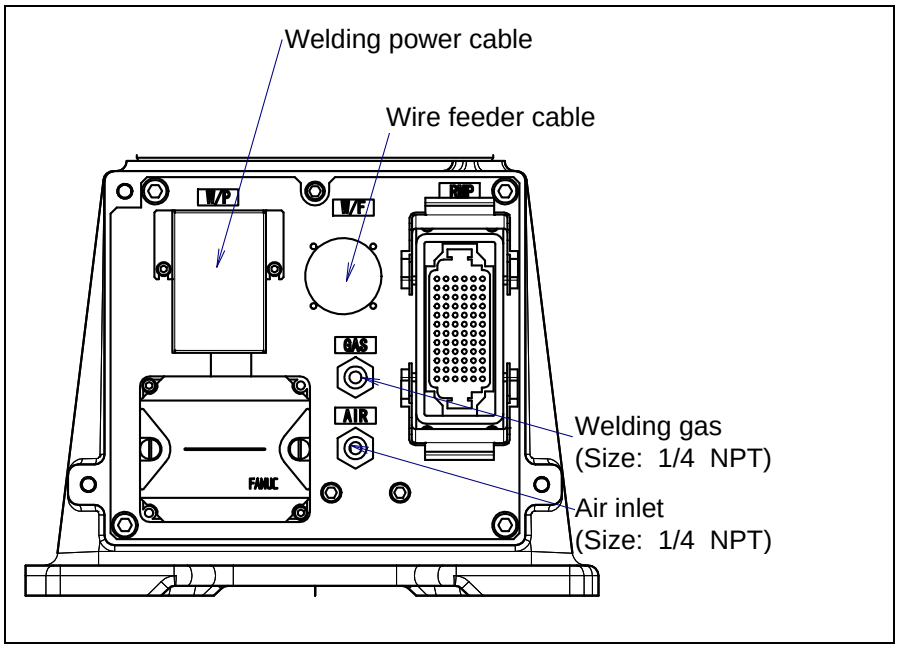


Fig. 3.2.5 (c) Connection to robot

Connection of Flexible conduit

At the joint part as shown in Fig. 3.2.5 (b) connect the flexible conduit to the wire feeder.

Connection of welding power cable

Tighten the bolt as shown in Fig. 3.2.5 (c) , fix the welding power cable.

Connection of welding power cable

Connect the gas hose to the gas hose connection part as shown in Fig. 3.2.5 (c).

3.3 TURNING ON THE POWER

When connection is completed, turn on the robot controller and welding power supply. Dozens of seconds later, communication connection between robot controller and welding power supply is completed, and it becomes possible to perform the operation of welding power supply from robot controller. Turn them on according to Procedure 3-3.

Procedure 3-3 Turning on the power

Step

1 Before turning on the power, Check working area such as robot , controller and processing cells. Confirm that the all safety devices work correctly, and working area for worker is safe.

2 Turn on the robot controller.

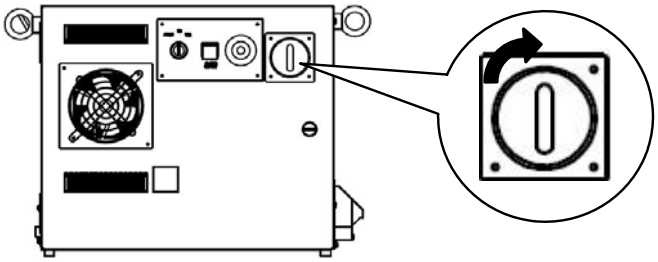


Fig. 3.3 (a) Turning on the robot controller

3 Turn on the welding power supply.

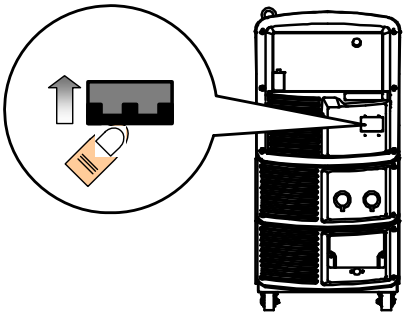


Fig. 3.3 (b) Turning on the welding power supply

4 Normally, “ARC-051 Weld EQ1 ONLINE: EthernetIP“ is displayed on upper part of the screen of the teach pendant when approximately dozens of seconds has passed since completion of turning on the welding power supply.

Fig. 3.3 (c) Indication of the connection completion of welding power supply and robot controller

5 If “ARC-051“ is not displayed on upper part of the screen of the teach pendant, and “ARC-045 Weld EQ Device is OFFLINE” is displayed, confirm whether connection does not have problems referring to Chapter 7 “TROUBLESHOOTING”.

⚠ WARING
Please cancel turning on power when you found some kind of abnormality or potential danger element. It might cause a serious accident when turning on the power by insufficient check.

3.4 MOVING THE ROBOT MANUALLY (JOGGING)

Jogging is an operation to move the robot to an arbitrary position by manipulating keys on the teach pendant. During program teaching, the positions of the robot are recorded by actually moving the robot.

NOTE
This chapter explains minimum jogging operation to move a robot.
Please refer to Subsection 5.2.3 of R-30*i*B/R-30*i*B Mate Controller OPERATOR'S MANUAL (Basic Operation) (B-83284EN) for more details of jogging operation.

Procedure 3-4 Jogging

Step

1 If robot controller has 3 mode switch, insert key and change switch to T1 mode.
Turn on the teach pendant switch.

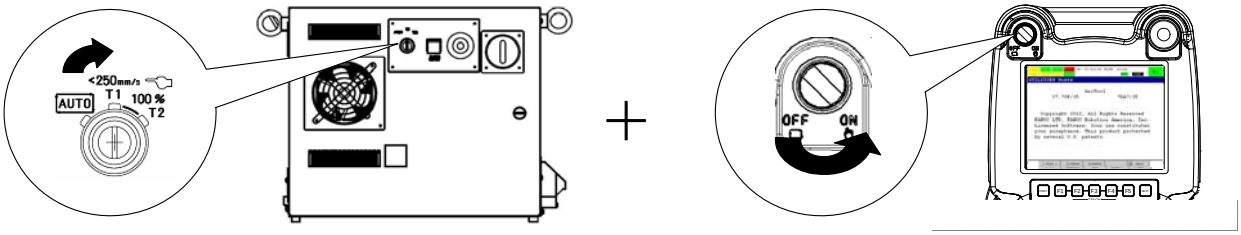
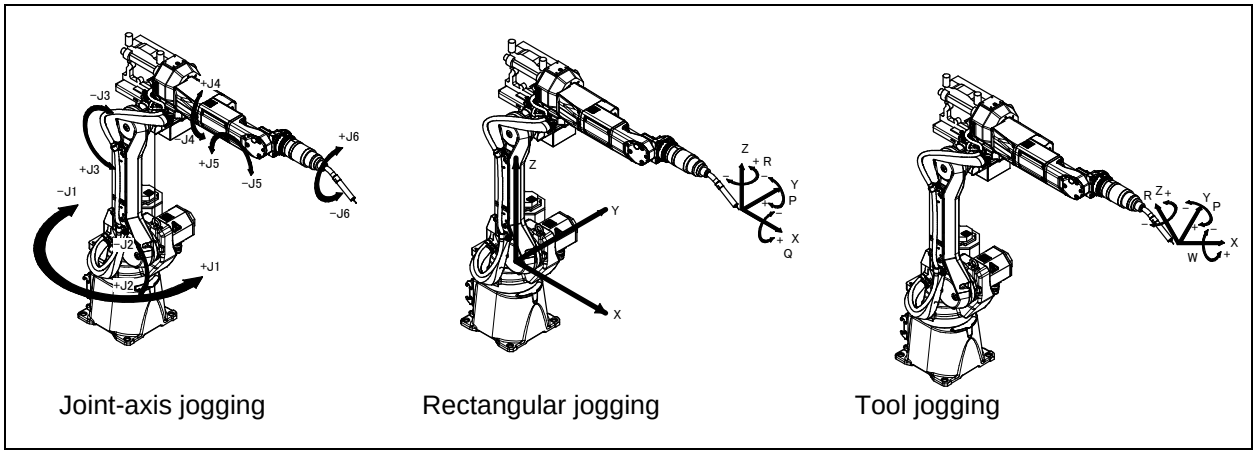


Fig. 3.4 (a) Setting of 3 mode switch and teach pendant switch

2 Decide the kind of the jogging. Kind of jobs are shown in Fig.3.4 (b). Change jogging variation by pressing manual-feed coordinate system key on teach pendant. You can confirm the present jogging by screen of Fig.3.4 (c).



Joint-axis jogging Rectangular jogging Tool jogging

Fig. 3.4 (b) The kind of jogging

Table 3.4(a) Jog modes

Jog modes	Description
Joint jog	Directs the robot axes (joint axes) by manipulating corresponding keys on the teach pendant.
Cartesian jog	Moves the robot rectilinearly along the axes of a Cartesian coordinate system (jogging coordinate system or user coordinate system). Rotation can also be performed to change the tool posture. **The jogging coordinate system** is a Cartesian coordinate system set specifically for jogging. **The user coordinate system** is a Cartesian coordinate system set in the work space.
Tool jog	Moves the robot rectilinearly along the axes of the current tool coordinate system. Rotation can also be performed to change the tool posture. The tool coordinate system is a Cartesian coordinate system set to match the orientation of the tool.

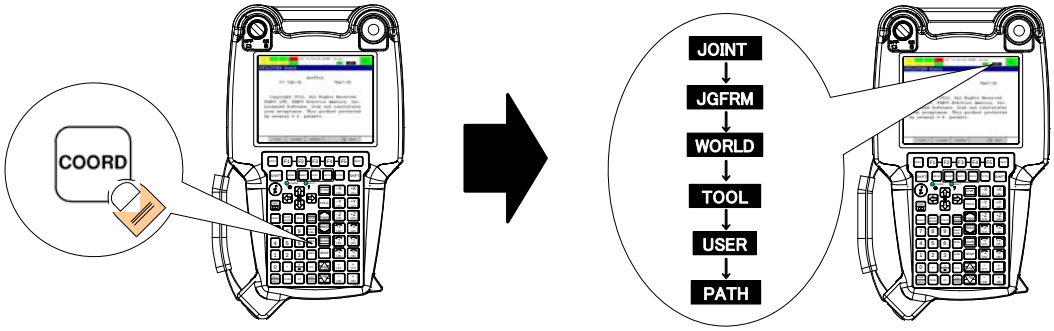


Fig. 3.4 (c) Change of jogging variation by manual-feed coordinate system key

3 Press override key on teach pendant, and decide robot motion speed.
The amount of change of the value becomes large by pressing shift key and override key together.
Please refer to Table 3.4 (b) for details.

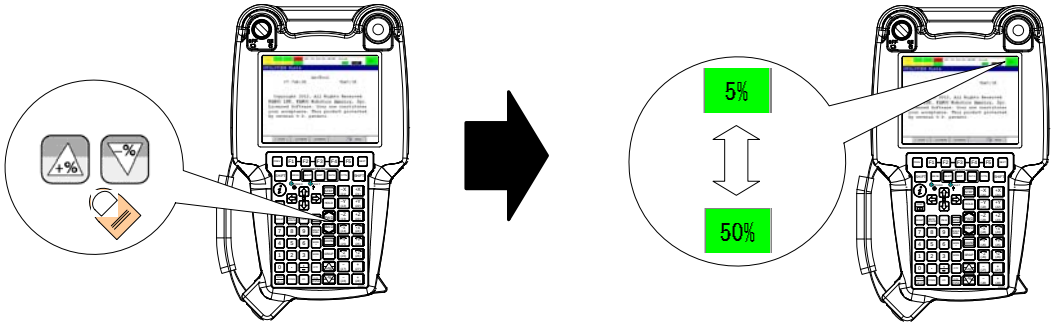


Fig. 3.4 (d) Operation of override key

Table 3.4 (b) The change of the value when override key is pressed

Override key	VFINE → FINE → 1% → 5% → 100% Steps of 1% Steps of 5%
Shift + Override key	VFINE → FINE → 5% → 25% → 50% → 100%

4 Grasp the teach pendant and press deadman switch. Afterward, keep the deadman switch on while performing a jogging. When an alarm occurs, press [RESET] key and release the alarm.

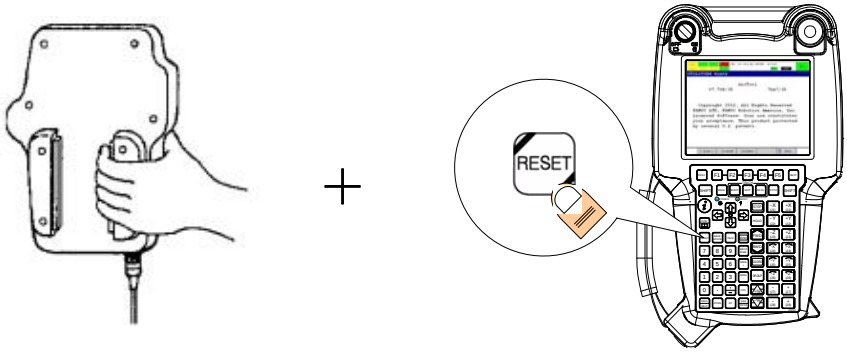


Fig. 3.4 (e) Operation of deadman switch and alarm release key

5 Execute a jogging. When shift key and jog key are pressed, the robot moves to the direction decided by jog mode and jog key.

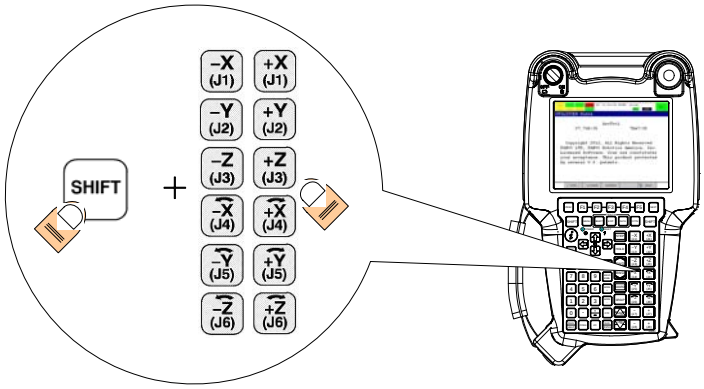


Fig. 3.4 (f) Operation of jog key

> ⚠ **WARING**
> At the beginning of operation, please set the value of the override in low speed (10% around). If the robot speed is fast, you cannot deal with an emergency. In addition, please confirm that no person is in the work area when you start to move a robot.

3.5 CREATING WELD PROCEDURES

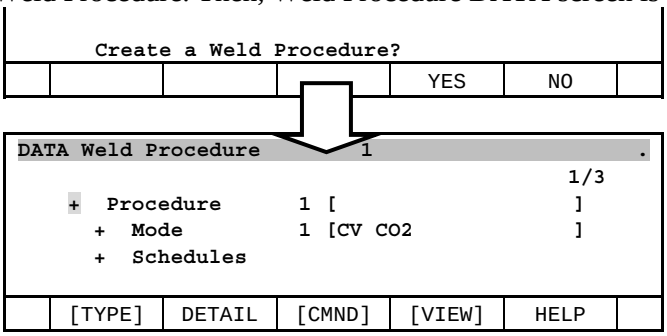
Arc welding robot manages weld setups (weld schedules, etc.) by the data units called “Weld Procedures”. On the other hand, multiple of appropriate weld control methods for the combination of wire material, wire diameter, Gas type and pulse weld are registered as “Process Mode”, and users can perform the welding with appropriate weld control method each time by selecting “Process Mode” number.
At least one Weld Procedure is necessary for performing wire inching and for specifying arc weld schedule explained later. This section explains the creating process of Weld Procedure and the allocation process between Process Mode and Weld Procedure easily.

NOTE
This section only explains the basic operation (creating new Weld Procedure) for performing arc welding. About details of Weld Procedures (the method for preparing multiple Weld Procedures, the general method for assigning Process Mode, etc.), please refer to Section 4.3, “OPERATION OF WELD PROCEDURE AND PROCESS MODE”.

Procedure 3-5 Creating Weld Procedure

Step

1 Press [DATA] key and display DATA Weld Procedure screen. When there is no Weld Procedure, the message “Create a Weld Procedure?” is displayed on the lower position of the screen. Press F4 [YES] and create a new Weld Procedure. Then, Weld Procedure DATA screen is displayed.



2 Next, move the cursor on the line of Mode number, and specify a Process Mode number. A process for welding is decided by this Process Mode number. In this example, CO2 welding is performed. Search the Process Mode number from Table 3.5 according to the used wire material, wire diameter and gas type. Then, input the number (in this example, “1”) by numerical keys on Teach Pendant, and press [ENTER] key. Specified Process Mode number is applied to Weld Procedure.

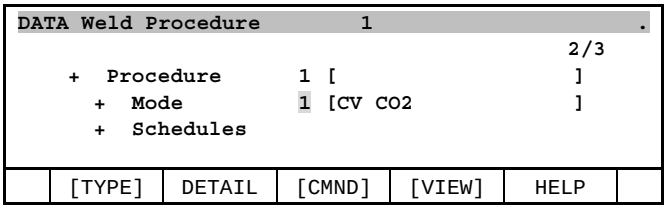


Table 3.5 Main Process Modes

Wire Material	Wire Diameter	Gas Type	Process Mode Number
Steel	1.2mm	CO2	1
Steel	1.2mm	MAG	5
Steel	1.0mm	CO2	11
Steel	1.0mm	MAG	15

NOTE
If there is no appropriate type on the table, perform Process Mode Search referring to Procedure 4-3-4 “Assignment of process mode number by searching“, or search Process Mode number from the table on Chapter 10. “Process Mode” and perform Procedure 4-3-3 “Assignment of process mode number by direct input”.

3.6 WIRE INCHING / RETRACT

It is possible to perform wire inching/retract by key operations on Teach Pendant. By this operation, you can pass a wire through a conduit or can adjust wire stickout. Please refer to the following Procedure 3-6.

Procedure 3-6 Manual Wire Inching

Step

1 Press “WIRE+” key on Teach Pendant. Wire is fed while pressing the key.

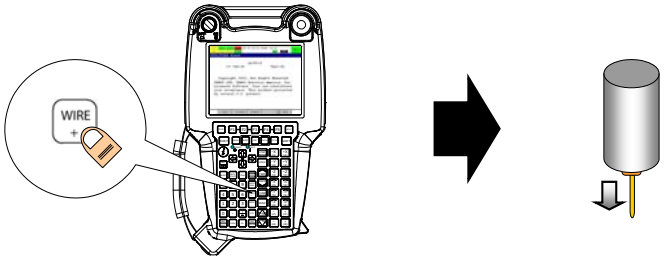


Fig. 3.6 (a) Wire Inching

2 Press “WIRE-” key on Teach Pendant. Wire is retracted while pressing the key.

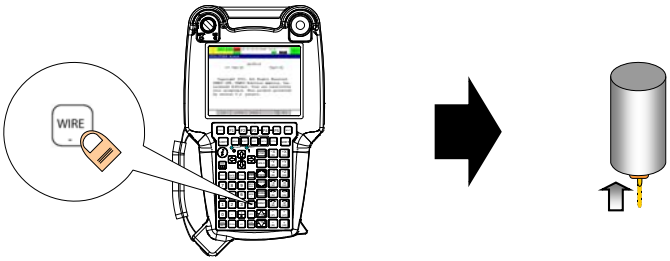


Fig. 3.6 (b) Wire Retract

3 Press “WIRE+” key while pressing SHIFT key on Teach Pendant. Wire is fed with low speed for 2 seconds since pressing “WIRE+” key. After 2 seconds since pressing “WIRE+” key, wire feed speed becomes high.

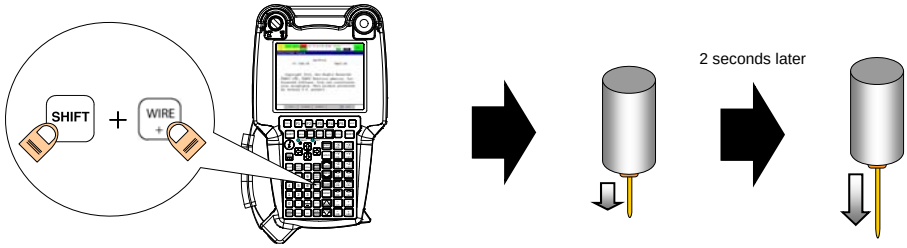


Fig. 3.6 (c) High Speed Wire Inching

⚠ CAUTION
Do not perform wire inching when wire is stuck to the tip, or when wire is clogged up.

3.7 CREATING MOTION PROGRAM

Next, create a program for arc welding. As an easier arc welding program, the creating procedure of a sample program of arc welding for a lap joint like the following is explained. In this section, the creation of robot motion part of the program is explained. Move the robot manually referring Section 3.4, and save 5 positions of the right figure of Fig.3.7 (a) to the motion program. Please refer to Procedure 3-7.

```
ARC_WELD                                          7/7
   1:J  P[1] 10% CNT100          Move to reference position
   2:L  P[2] 100mm/sec CNT100    Move to approach position
   3:L  P[3] 100mm/sec FINE      Move to Weld Start position
   4:L  P[4] 60cm/min FINE       Move to Weld End position
   5:L  P[5] 100mm/sec CNT100    Move to escape position
   6:J  P[1] 10% FINE            Return to reference position
[End]
```

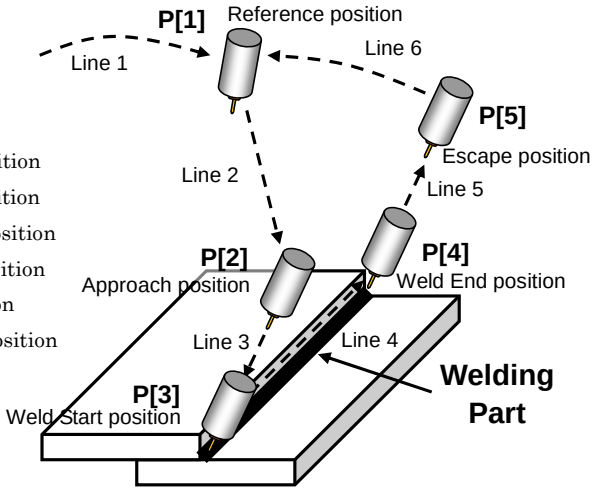


Fig. 3.7 (a) Sample Program

> **NOTE**
> This section explains the basic operation for creating sample program. If you would like to know more details about program edit, please refer to Section 4.2 “EDITING OPERATION OF PROGRAM”.

Procedure 3-7 Creating Motion Program

Step

1 Set a workpiece for arc welding on the place electrified to the weld power cable (-). In this timing, Please fix the workpiece tightly to prevent a gap during the program creation.

2 Adjust the wire stickout by wire inching operation. Recommended stickout is “12mm” for 1.0mm wire diameter, or “15mm” for 1.2mm wire diameter.

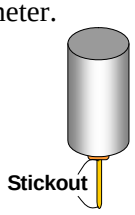
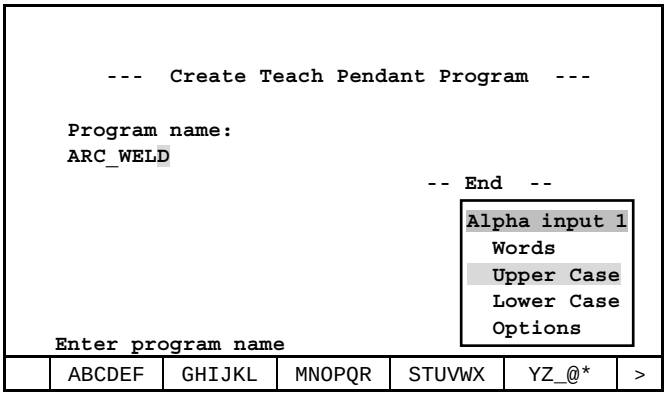


Fig. 3.7 (b) Adjustment of Wire Stickout

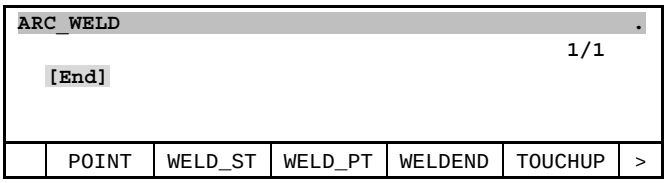
3 Press [MENU] key on a teach pendant. Following Program List screen is displayed.

```
Select                                                .
                1039556 bytes free      1/9
    No.  Program name      Comment
      1  -BCKEDT-          [                  ]
      2  GETDATA     MR    [Get PC Data       ]
      3  REQMENU     MR    [Request PC Menu   ]
      4  SENDDATA    MR    [Send PC Data      ]
      5  SENDEVNT    MR    [Send PC Event     ]

 | [TYPE] | CREATE | DELETE | MONITOR | [ATTR] | > |
```

4 Press F2[CREATE] key. A screen for entering program name is displayed. Additionally, a list of [Alpha input 1] is displayed at the lower left. In this operation example, define the sample program name as “ARC_WELD”. Move the cursor on “Upper Case” and enter the program name by using F1-F5 function keys.

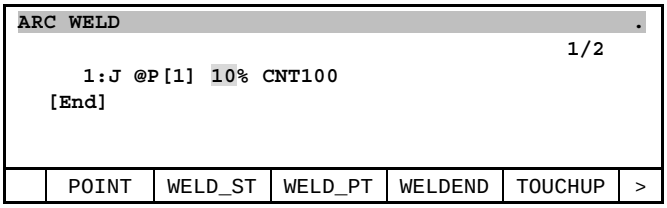


5 After finishing the input of program name, press ENTER key. After that, press F3[EDIT] and complete the input of program name. The screen is automatically moved to Program Edit screen.



6 Move the robot on the reference position by jogging. Any places are allowed if there is no obstacle between this position and Weld Start position.

7 Teach a motion instruction for moving to the reference position. Press F1[POINT] when the cursor is placed on [End]. Select “2 J P[] 100% CNT100” from a displayed list. Next, move the cursor on a value “100” in 100%, and then enter “10” by numerical keys, and press ENTER key.



8 Jog the robot to an appropriate posture for welding, and then jog the robot to the position that is diagonally upper 100mm away from Weld Start position (approach position).

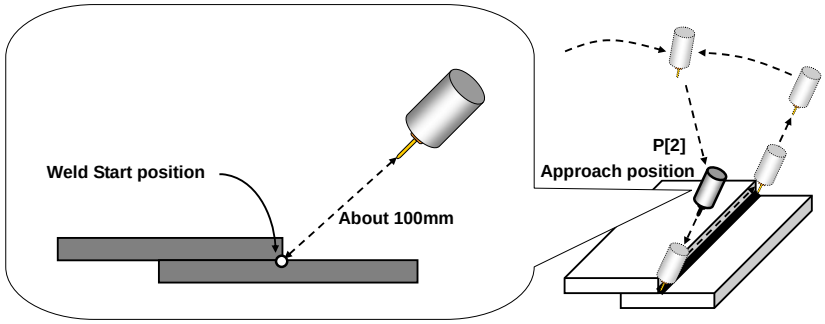
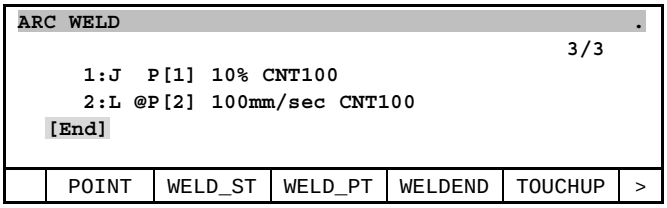


Fig. 3.7 (c) Jog to Approach Position

9 Teach a motion instruction for moving to the approach position. Press F1[POINT] when the cursor is placed on [End]. Select “4 L P[] 100mm/sec CNT100” from a displayed list.



10 Jog the robot to Weld Start position.

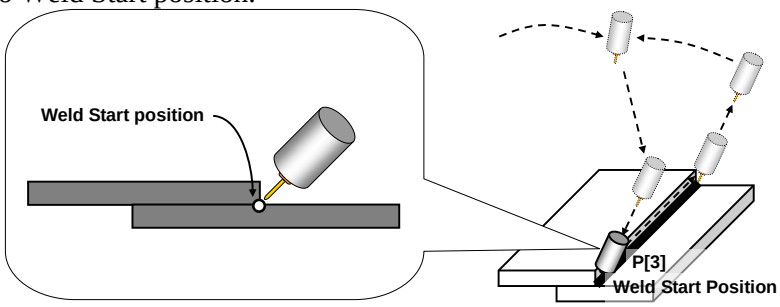
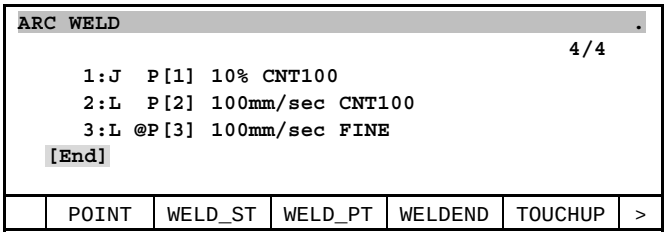


Fig. 3.7 (d) Jog to Weld Start Position

11 Teach a motion instruction for moving to Weld Start position. Press F1[POINT] when the cursor is placed on [End]. Select “3 L P[] 100mm/sec FINE” from a displayed list.



12 Jog the robot to Weld End position.

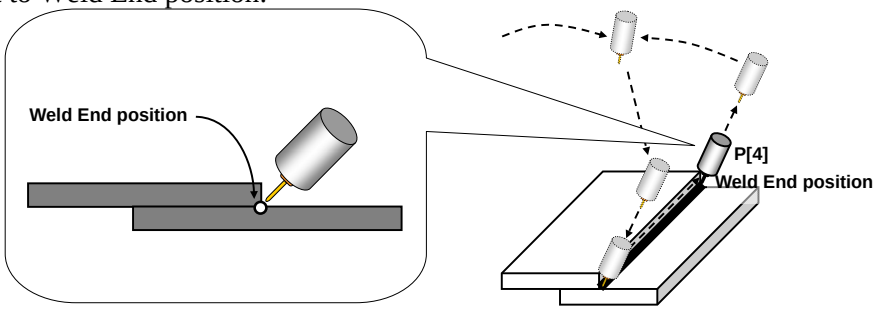
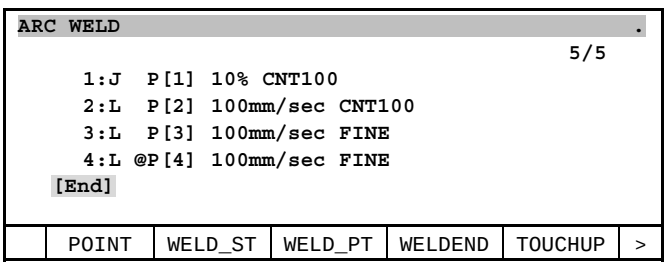


Fig. 3.7 (e) Jog to Weld End Position

13 Teach a motion instruction for moving to Weld End position. Press F1[POINT] when the cursor is placed on [End]. Select “3 L P[] 100mm/sec FINE” from a displayed list.



14 Next, input weld speed. The motion speed on the motion instruction for moving from Weld Start position to Weld End position becomes weld speed. Move the cursor on “100” value and press F4[CHOICE] key. Select “cm/min” from the displayed list. Then, enter “60” by numerical keys.

```
ARC WELD                                                .
                                                      5/5
     1:J  P[1] 10% CNT100
     2:L  P[2] 100mm/sec CNT100
     3:L  P[3] 100mm/sec FINE
     4:L @P[4] 60cm/min FINE
  [End]
 | POINT | WELD_ST | WELD_PT | WELDEND | TOUCHUP | > |
```

15 Jog the robot to the position that is diagonally upper 100mm away from Weld End position (escape position).

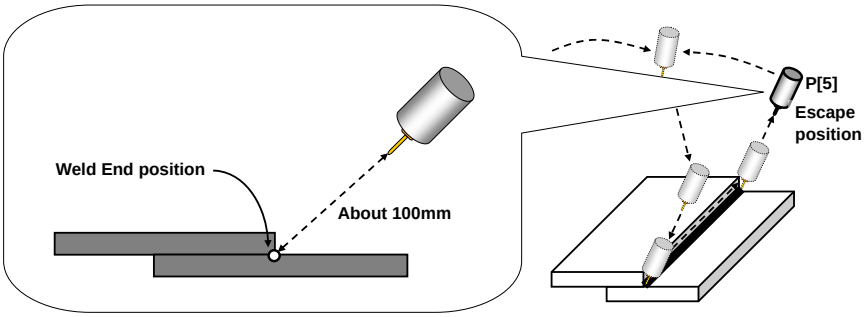


Fig. 3.7 (f) Jog to Escape Position

16 Teach a motion instruction for moving to the escape position. Press F1[POINT] when the cursor is placed on [End]. Select “4 L P[] 100mm/sec CNT100” from a displayed list.

```
ARC_WELD                                                .
                                                      6/6
     1:J  P[1] 10% CNT100
     2:J  P[2] 100mm/sec CNT100
     3:L  P[3] 100mm/sec FINE
     4:L  P[4] 60cm/min FINE
     5:L @P[5] 100mm/sec CNT100
  [End]
 | POINT | WELD_ST | WELD_PT | WELDEND | TOUCHUP | > |
```

17 Teach a motion instruction for returning to the reference position. Press F1[POINT] when the cursor is placed on [End]. Select “1 J P[] 100% FINE” from a displayed list. Next, move the cursor on a value “6” in P[6] and input “1” by numerical key, and press ENTER key. Move the cursor on a value “100” in 100% and input “10” by numerical keys, and then press ENTER key.

```
ARC WELD                                                .
                                                      6/7
     1:J  P[1] 10% CNT100
     2:L  P[2] 100mm/sec CNT100
     3:L  P[3] 100mm/sec FINE
     4:L  P[4] 60cm/min FINE
     5:L @P[5] 100mm/sec CNT100
     6:J  P[1] 10% FINE
  [End]

 | POINT | WELD_ST | WELD_PT | WELDEND | TOUCHUP | > |
```

NOTE
This section explains one operation example for creating easy sample program. However, you can create a sample program even if you do not follow the operation in this section. About details of program edit, please refer to Section 5.4 in R-30*i*B/ R-30*i*B Mate CONTROLLER OPERATOR'S MANUAL (Basic Operation) (B-83284EN).

3.8 SPECIFY ARC WELD SCHEDULE

It is impossible to achieve arc welding by only the motion program created on Section 3.7. For achieving arc welding, it is necessary to specify an arc weld schedule by using Weld Procedure created on Section 3.5, and also necessary to specify this schedule on Weld Start and Weld End instructions.
Arc welding robot performs arc welding on the section between Weld Start and Weld End instructions.

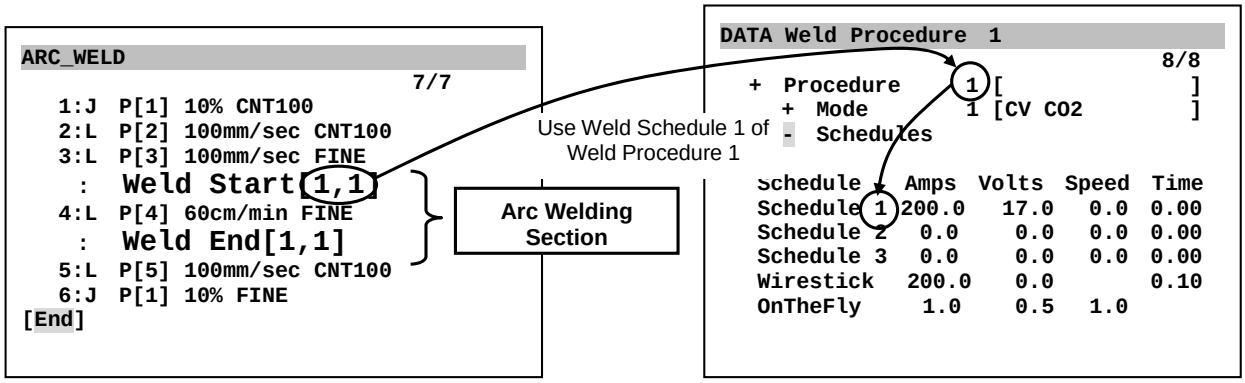


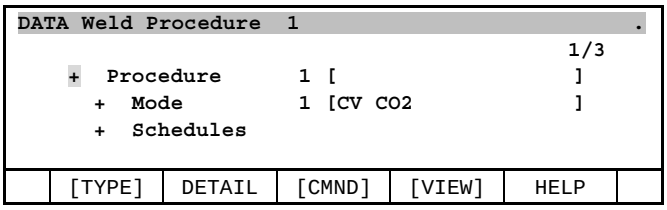
Fig. 3.8 Relationship between Sample Program and Arc Weld Schedule

NOTE
This section explains the basic operation for operating arc weld instructions. If you would like to know more details about arc weld instructions, please refer to Section 4.5 "TEACHING AND EDITING OF ARC WELD INSTRUCTION".

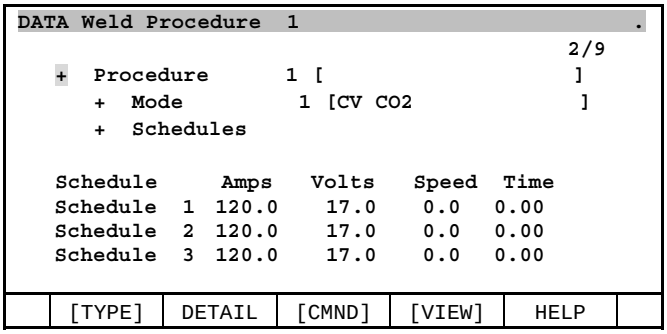
Procedure 3-8 Specify Arc Weld Schedule

Step

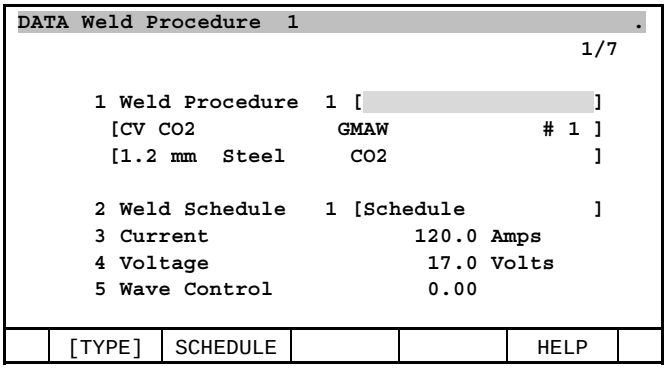
1 Press DATA key and display Weld Procedures screen.



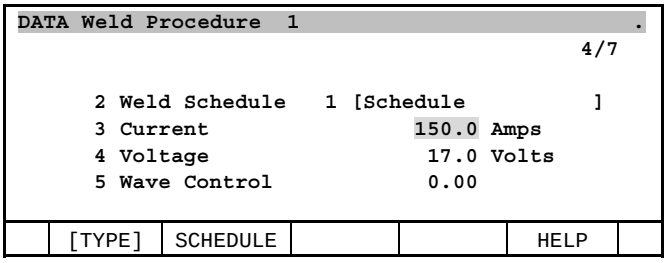
2 Move the cursor on "+" at the left of "Schedules" and press ENTER key. A list of weld schedules is displayed.



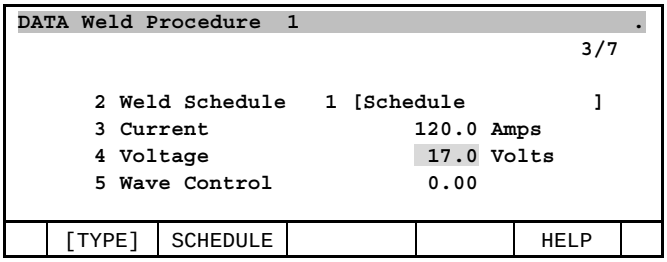
3 Move the cursor on unused weld schedule (in this example, Weld Schedule 1), and press F2[DETAIL]. Detail screen for the weld schedule is displayed.



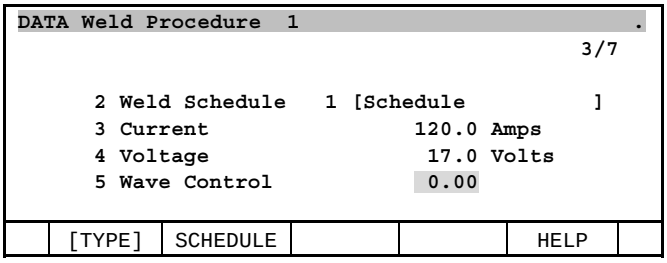
4 In this example, specify the current "150A" as the weld schedule. Move the cursor on the line of "Current" and input "150" by numerical keys, and then press ENTER key.



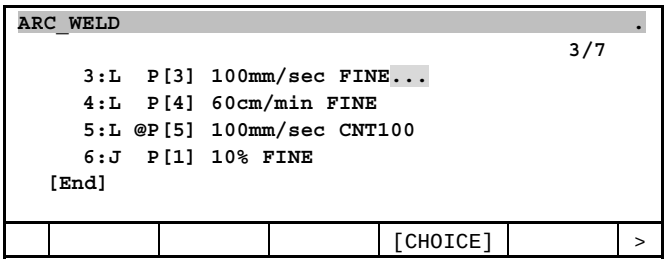
5 Next, input Trim. Move the cursor on the line of "Voltage" and input any value.



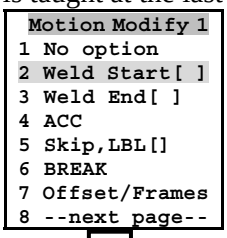
6 Next, input Wave Control. Move the cursor on the line of “Wave Control” and input “0.00”. If it has already become 0.00, no operation is required.

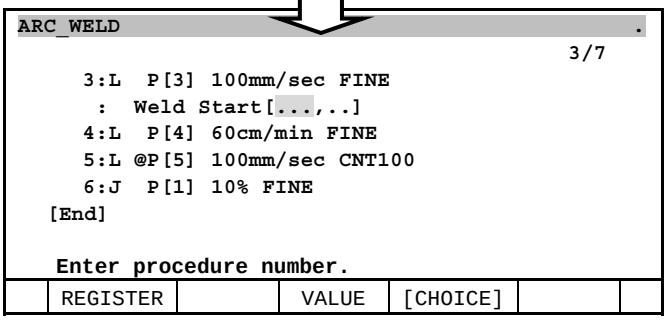


7 Display the edit screen of the motion program created on Procedure 3-7. Press EDIT key, or press SELECT key and select the sample program name which was set by Step 4 in Procedure 3-7 (in this example, ARC_WELD). Then, move the cursor on a blank part just behind “FINE” on line 3.

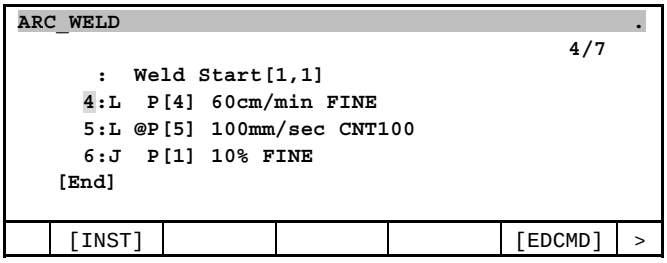


8 Press F4[CHOICE]. The list of additional motion instructions are displayed. Select “Weld Start[]” from the list. Weld Start instruction is taught at the last of line 3.

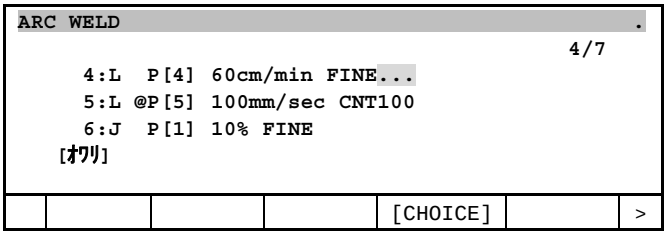




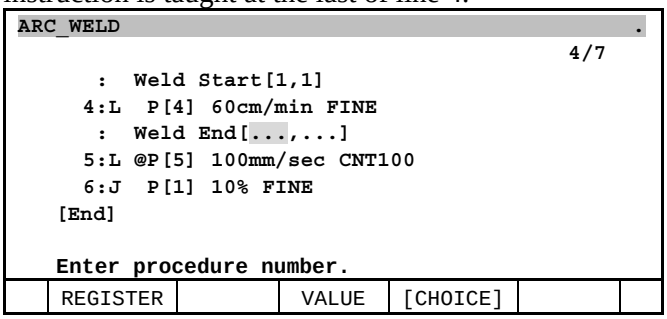
9 Input the Weld Procedure number (in this example, 1) to the first argument of Weld Start instruction. Next, input the weld schedule number that is specified in Step 4 (in this example, 1) to the second argument.



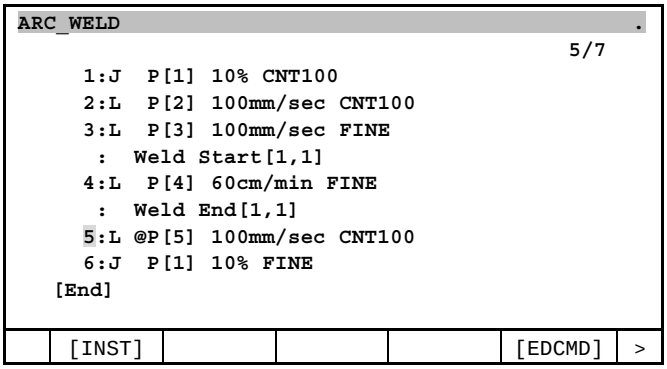
10 Next, move the cursor on a blank part just behind “FINE” on line 4.



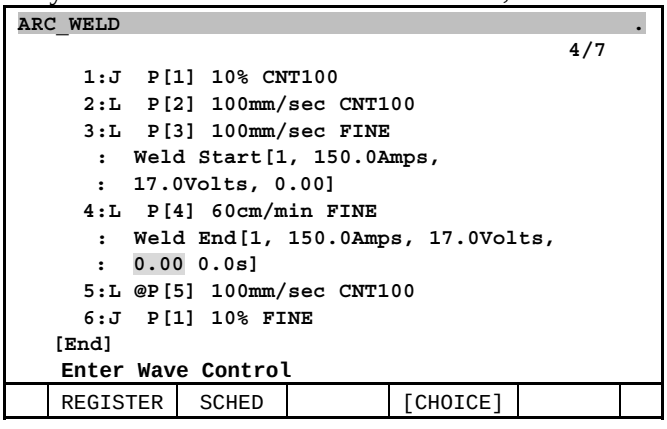
11 Press F4[CHOICE]. The list of additional motion instructions is displayed. Select “Weld End[]” from the list. Weld End instruction is taught at the last of line 4.



12 Input the Weld Procedure number (in this example, 1) to the first argument of Weld Start instruction. Next, input the weld schedule number that is specified in Step 4 (in this example, 1) to the second argument. In this stage, sample program for arc welding was completed.



13 You can directly specify command voltage and current parameters for arc weld schedule in Weld Start/Weld End instructions on Program Edit screen. Move the cursor on the argument part in Weld Start instruction and press F3[DIRECT]. It becomes possible to input parameters like voltage and current to Weld Start instruction directly. In this example, same values with Step 4, 5 and 6 are specified. Then, specify same values to Weld End instruction, too.



NOTE
The operation procedure in this section assumes the status just after factory shipment. If Weld Procedures or weld schedules have already been set, please perform the copy of Weld Procedure (refer to Section 4.3) or use unused weld schedule for preventing the change of existing setup.

3.9 MANUAL OPERATION FOR WELDING

As preparations for arc welding, following weld-related manual operations are required.

- Gas Check
- Switching Weld Enabled/Disabled

Gas Check

Open the valve for shield gas and check a gas pressure and a gas flow before performing arc welding.

Procedure 3-9 (a) Manual gas check

Step

1 Press GAS/STATUS key once while pressing SHIFT key on Teach Pendant. Gas is left out from the top of the torch. When 5 seconds have passed, the gas flow stops automatically.

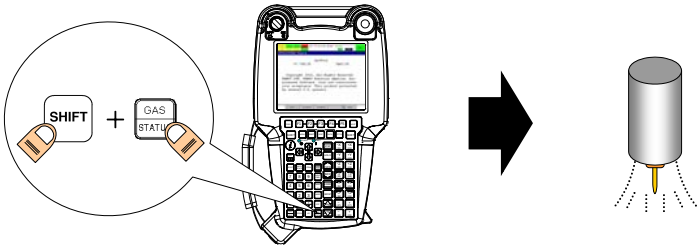


Fig. 3.9 (a) Gas Check by Gas Purge Key Operation

2 During the gas flow, you can also stop the gas flow manually by pressing [GAS/STATUS] and [SHIFT] key simultaneously again before passing Gas Purge Time.

3 If you would like to change the gas purge time from 5 seconds, please perform the following steps. Press [MENU] key and select “6 SETUP”. Then, press F1[TYPE] and select “Weld System”. Weld System Setup screen is displayed.

```
SETUP Weld System                                          .
                                                      1/19
        NAME                              VALUE
  Monitoring Functions
    1 Arc loss:                           ENABLED
    2 Gas shortage:                       DISABLED
    3 Wire shortage:                      DISABLED
    4 Wire stick:                         ENABLED
    5 Power supply failure:               ENABLED

 |  | [TYPE] |  |  | ENABLED | DISABLED |  |
```

4 Move the cursor below on the screen, and move the cursor on “Gas Purge Time”. Then, input appropriate time by numerical keys and press ENTER key.

```
SETUP Weld System                                        .
                                                    19/19
    15 Weld from teach pendant: ENABLED
    16 Remote gas purge:        DISABLED
    17 Remote wire inch:        DISABLED
    18 Gas purge key:           ENABLED.
    19 Gas purge time:          20   sec

 |  | [TYPE] |  |  | ENABLED | DISABLED |  |
```

Switching Weld Enabled/Disabled

Arc welding can be performed with Weld Enabled status when arc weld instruction is executed. On the other hand, arc welding is never performed with Weld Disabled status even when arc weld instruction is executed. Switching operation of Weld Enabled/Disabled is achieved by the following procedure.

Procedure 3-9 (b) Switching Weld Enabled/Disabled

Step

1 Press [WELD ENBL] key while pressing [SHIFT] key on Teach Pendant. “Weld” software LED on Teach Pendant is switched to yellow and green alternately.

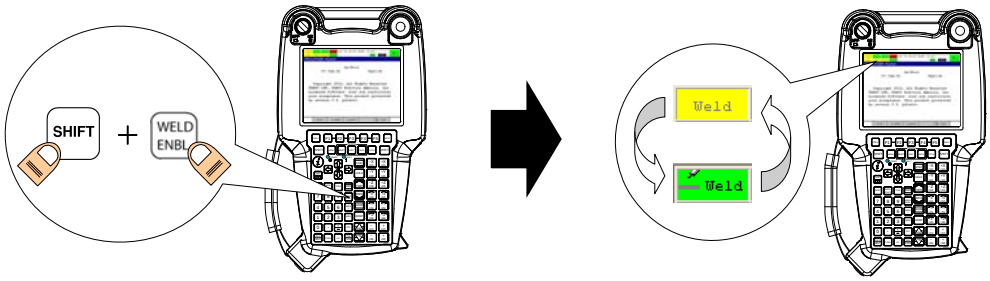


Fig. 3.9 (b) Switching Operation of Weld Enabled/Disabled by WELD ENBL Key

2 When “Weld” software LED is yellow, arc welding is not performed even if arc weld instruction is executed. When “Weld” software LED is green, arc welding is performed if arc weld instruction is executed.

3.10 TEST OPERATION

Before performing arc welding, test operation is required for the motion check of created program. Test operation has step operation and continuous operation. Normally, step operation is performed first, and then continuous operation is performed next.

Procedure 3-10 (a) Step Operation

Step

1 Grasp Teach Pendant, press dead man switch and turn the Enable switch on Teach Pendant ON.

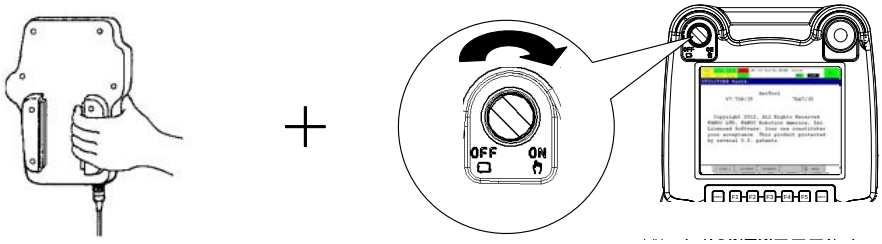


Fig. 3.10 (a) Operation of Dead Man Switch and Teach Pendant Enable Switch

2 Set the robot speed during program execution by override keys.

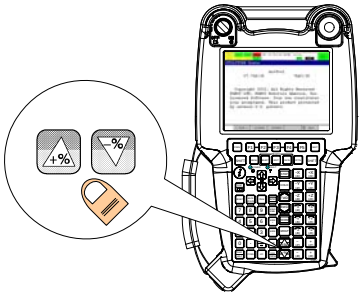
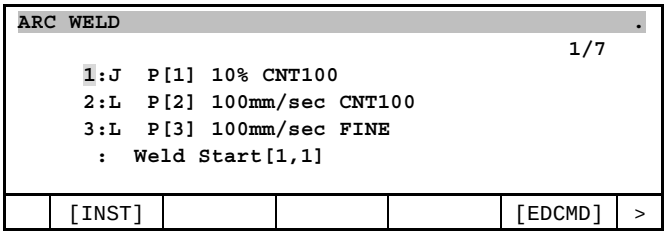


Fig. 3.10 (b) Setup of Override

> ⚠ **WARNING**
> Please set the value of the override in low speed (10% around). If the speed of the robot is fast, you cannot deal with an emergency.

3 Display the edit screen of the arc welding program created by Procedure 3-7. Press EDIT key, or press SELECT key and select the sample program name which was set by Step 4 in Procedure 3-7 (in this example, ARC_WELD). Then, move the cursor on the top of line 1.



4 Press STEP key and set “Step” software LED on Teach Pendant to yellow status.

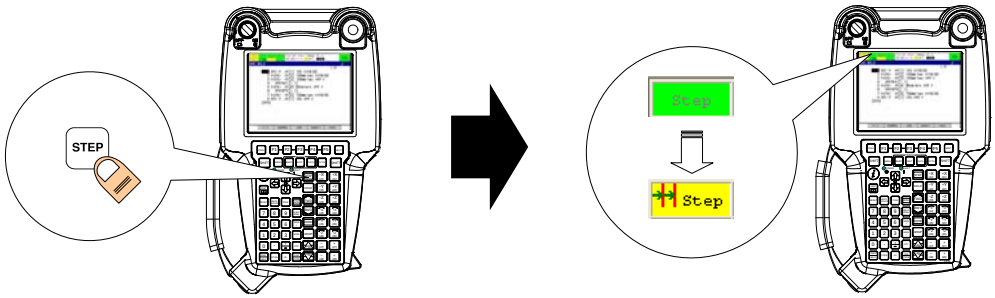


Fig. 3.10 (c) Switch to Step Mode

> ⚠ **WARNING**
> Program instructions will be executed and the robot will move by the next step. The robot may perform unexpected motion by program contents. Please check that there is no person in the working area and please check there is no needless equipment sufficiently. Additionally, during next or later steps, if you would like to pause the program before the program execution completes, please release SHIFT key or dead man switch, or please press [HOLD] key or Emergency Stop button.

5 Start the program execution. Press FWD key while pressing SHIFT key. After the robot starts to move, release only FWD key, but keep SHIFT key pressed. The robot stops after the robot arrives at the taught position of line 1. The cursor on Teach Pendant moves on the line 2 of the program.

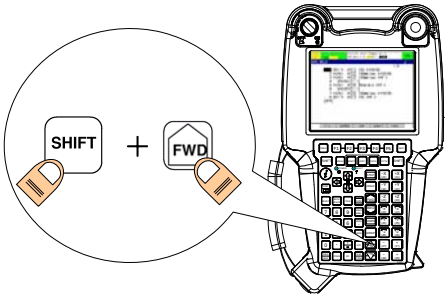


Fig. 3.10 (d) Step Operation of Program

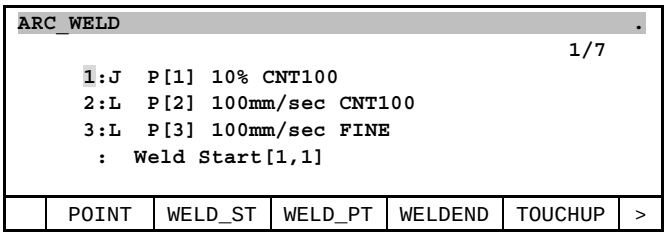
6 When FWD key is pressed while pressing SHIFT key again, the execution of line 2 on the program is started. Please check the motion path of the robot by repeating the operation.

NOTE
Arc weld instructions are never executed during Step Operation. Therefore, arc welding is not performed even with Weld Enabled status.

Procedure 3-10 (b) Continuous Operation

Step

1 Move the cursor on the top of line 1.



2 Set continuous operation mode. Press STEP key and set “Step” software LED on Teach Pendant to green status.

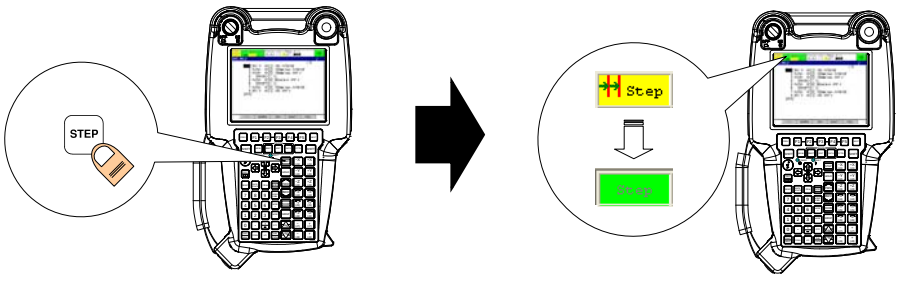


Fig. 3.10 (e) Switch to Continuous Operation Mode

3 Set Weld Disabled status. Press WELD ENBL key and set “Weld” software LED on Teach Pendant to yellow status.

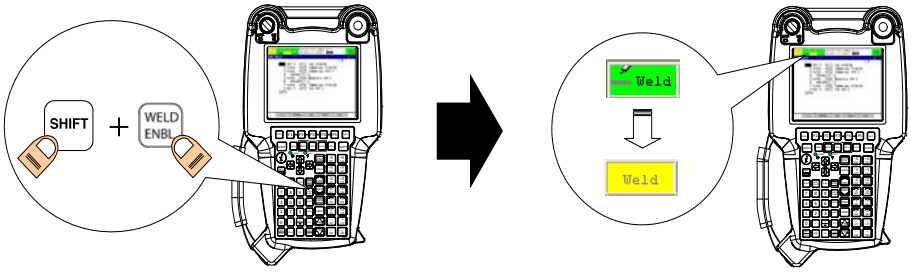


Fig. 3.10 (f) Switch to Weld Disabled

4 Set the robot speed during program execution by override keys.

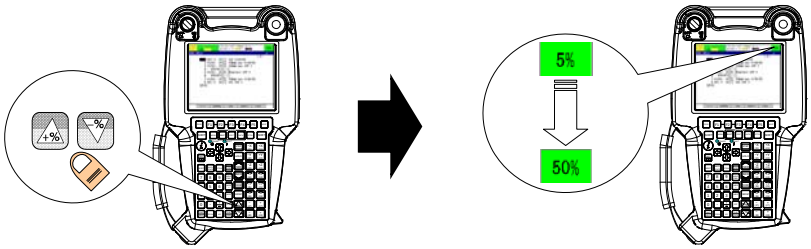


Fig. 3.10 (g) Setup of Override

5 Start the program execution. Press FWD key while pressing SHIFT key. After the robot starts to move, release only FWD key, but keep SHIFT key pressed. The program is continuously executed to the last line without stop. This is the different point between continuous operation and step operation.

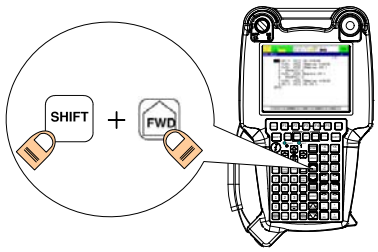


Fig. 3.10 (h) Continuous Execution of Program

3.11 EXECUTION OF WELD PROGRAM

For executing arc welding, the program must be executed with Weld Enabled status, 100% override and continuous operation. Please refer to the following Procedure 3-11.

Procedure 3-11 Execution of Weld Program

Step

1 Set Weld Enabled status. Press [WELD ENBL] key and set “Weld” software LED on Teach Pendant to green status.

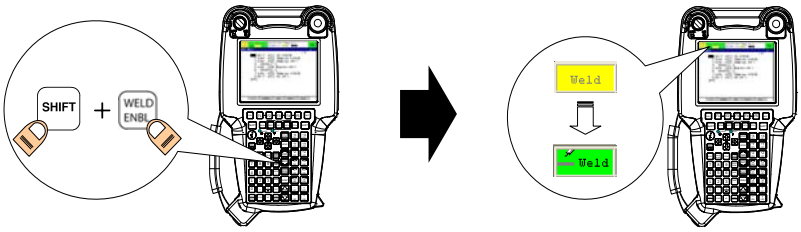


Fig. 3.11 (a) Switch to Weld Enabled

2 Set 100% override by override key.

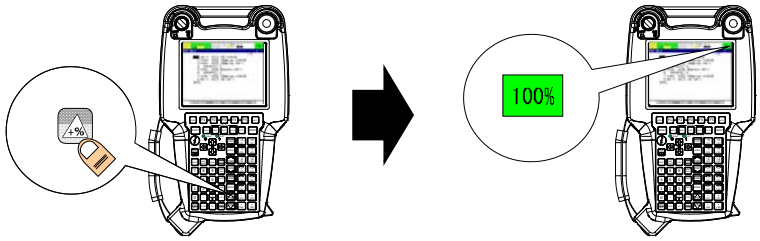


Fig. 3.11 (b) Set 100% Override

3 Move the cursor on the top of line 1 and then perform the program execution.

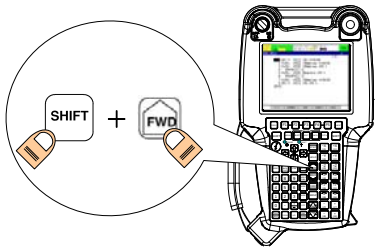


Fig. 3.11 (c) Continuous Operation of Weld Program

4 Arc welding is performed when the motion instruction that is put between Weld Start and Weld End instructions is executed.

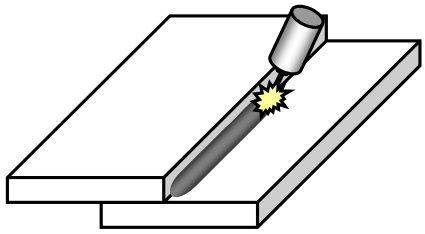


Fig. 3.11 (d) Execution of Arc Welding

NOTE
If Weld Start instruction is executed without 100% override, “ARC-033 Override must be 100% to weld” alarm is posted and the program pauses. In this case, please change override to 100% and then perform program execution again.

NOTE
If arc is not generated at Weld Start position, “ARC-013 Arc Start failed” alarm is posted and the program pauses. Then, please investigate the cause of arc failure referring to Chapter 7 “TROUBLE SHOOTING”.

4 BASIC OPERATION

This Chapter describes about robot basic operation except contents which are already described in Chapter 3 “QUICK REFERENCE”.

4.1 SETTING OF I/O FOR DAIHEN DIGITAL WELDING POWER SUPPLY

Robot Controller and DAIHEN digital welding power supply “Welbee” perform digital communication by EtherNet I/O.

Normally, communication with DAIHEN digital welding power supply requires no setting because the communication I/O is automatically set at the first communication between the robot controller and the welding power supply.
Please refer to this section if I/O assignment change is required by the addition of other communication board (DeviceNet board, CC-link board etc.) or the re-arrangement of I/O port numbers.

> ⚠ **WARNING**
> When wrong I/O assignment is done, Welbee cannot be controlled properly. Additionally, welding cannot be executed correctly and the system might do unexpected behaviors by erroneous motions.

4.1.1 Default Setting of Communication I/O for DAIHEN Digital Welding Power Supply

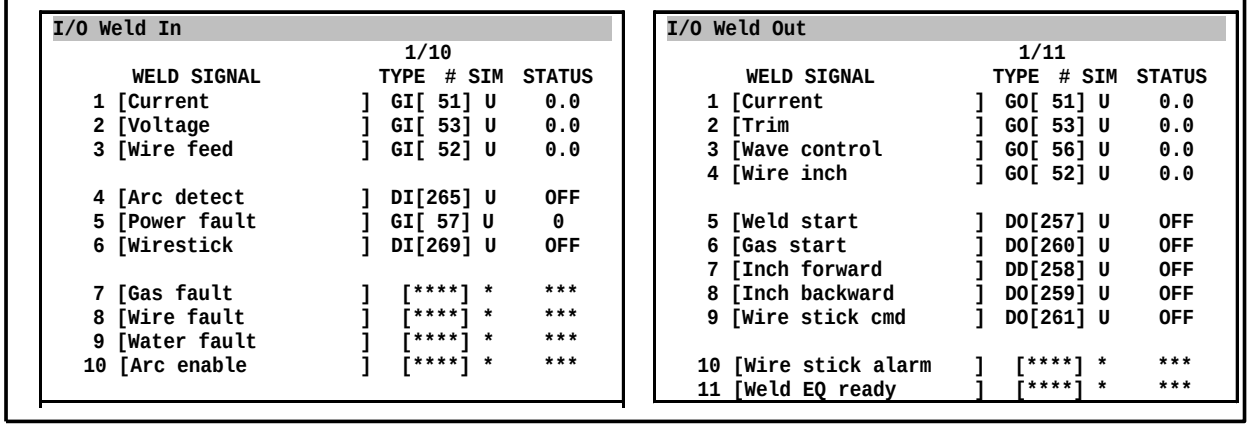
Following I/O signals are reserved for communication with DAIHEN digital welding power supply as default.

- Digital Output(DO): 257 – 512 (Total 256 points)
- Digital Input(DI): 257 – 512 (Total 256 points)
- Group Output(GO): 51 – 59 (Total 9 points)
- Group Input(GI): 51 – 59 (Total 9 points)

The reserved I/O signals as above for DAIHEN digital welding power supply are called “Weld I/O”. These have some functions. The state of each Weld I/O signal can be confirmed in the Weld I/O screen. In default setting, the state of them is following.

List of I/O signals

(MENU key → I/O → Weld → Switch IN/OUT screens by F3:IN/OUT key)



I/O Weld In — 1/10

	WELD SIGNAL	TYPE	#	SIM	STATUS
1	[Current]	GI[	51]	U	0.0
2	[Voltage]	GI[	53]	U	0.0
3	[Wire feed]	GI[	52]	U	0.0
4	[Arc detect]	DI[	265]	U	OFF
5	[Power fault]	GI[	57]	U	0
6	[Wirestick]	DI[	269]	U	OFF
7	[Gas fault]	[	****]	*	***
8	[Wire fault]	[	****]	*	***
9	[Water fault]	[	****]	*	***
10	[Arc enable]	[	****]	*	***

I/O Weld Out — 1/11

	WELD SIGNAL	TYPE	#	SIM	STATUS
1	[Current]	GO[	51]	U	0.0
2	[Trim]	GO[	53]	U	0.0
3	[Wave control]	GO[	56]	U	0.0
4	[Wire inch]	GO[	52]	U	0.0
5	[Weld start]	DO[	257]	U	OFF
6	[Gas start]	DO[	260]	U	OFF
7	[Inch forward]	DD[	258]	U	OFF
8	[Inch backward]	DO[	259]	U	OFF
9	[Wire stick cmd]	DO[	261]	U	OFF
10	[Wire stick alarm]	[	****]	*	***
11	[Weld EQ ready]	[	****]	*	***

Fig. 4.1.1 Weld I/O screen for DAIHEN Digital Welding Power Supply

> **⚠ CAUTION**
> Do not change weld I/O signal to SIM mode. If arc welding is executed with SIM mode of weld I/O signal, there is a case that the welding is not performed correctly.

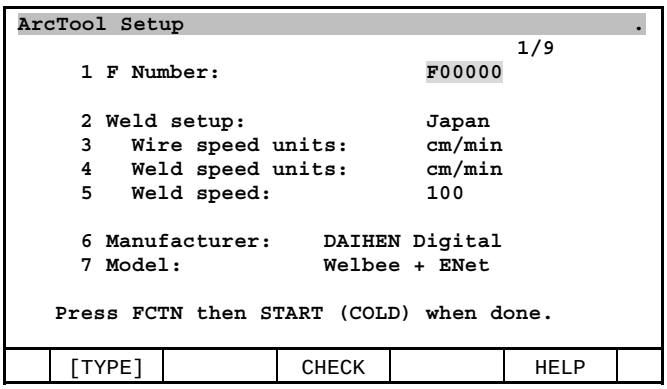
4.1.2 Change Communication DI/O Numbers for DAIHEN Digital Welding Power Supply

Please follow Procedure 4-1-2 whenever the assignment of DI/O to communicate with DAIHEN digital welding power supply is changed. Do not set on digital I/O screen directly.

Procedure 4-1-2 Change communication DI/O numbers for DAIHEN digital welding power supply

Condition

- Controlled Start has been performed and the following ArcTool Setup screen is displayed.
- "DAIHEN Digital" is set to Manufacturer and "Welbee + ENet" is set to Model.



ArcTool Setup — 1/9

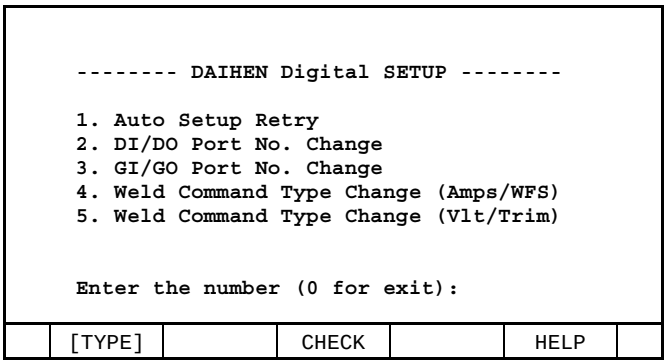
1	F Number:	F00000
2	Weld setup:	Japan
3	Wire speed units:	cm/min
4	Weld speed units:	cm/min
5	Weld speed:	100
6	Manufacturer:	DAIHEN Digital
7	Model:	Welbee + ENet

Press FCTN then START (COLD) when done.

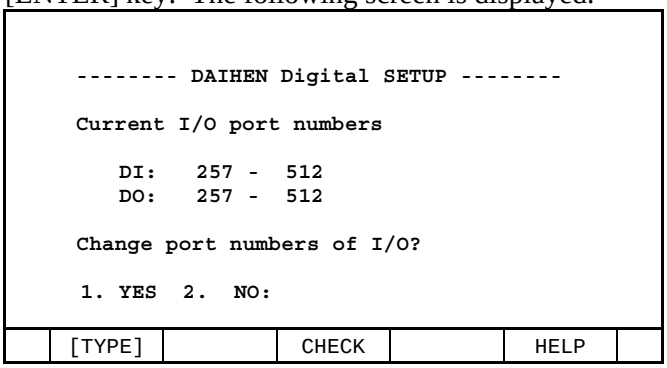
[TYPE] | CHECK | HELP

Step

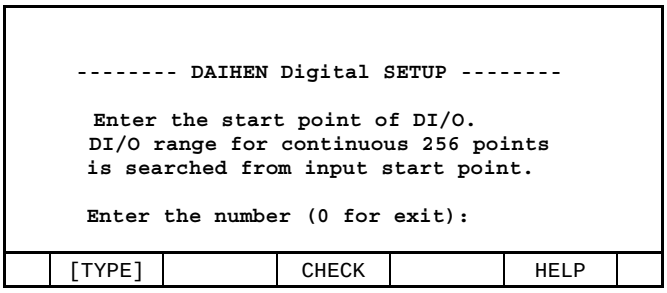
1. Press F3 [CHECK]. The following screen is displayed.



2. Input 2, and press [ENTER] key. The following screen is displayed.

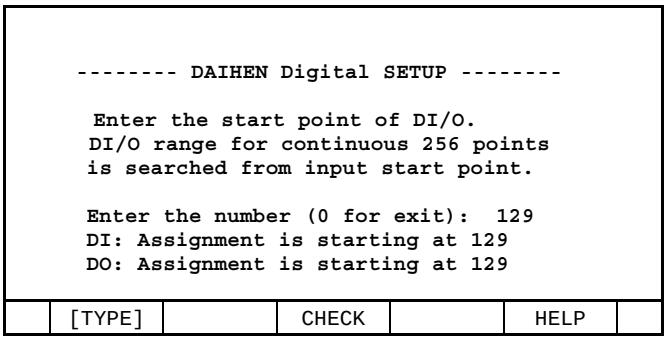


3. Input 1, and press [ENTER] key. The following screen is displayed.



4. Input the start point of DI/O assignment, and press [ENTER] key. If changing port number for communication with Welbee to 129 – 384 is required, input “129” that is first number of region of assignment.

5. A number that has 256 free ports is searched from this or after this, and then assignment is done. Searched start point is displayed in the lower line.



6. After “CHECK is complete.” is displayed, return to ArcTool setup screen automatically.

7. After COLD START, execute wire inching while weld I/O screen is displayed. Confirm that a signal of “Inch forward” is ON and wire inching is done. About the wire inching, please refer to “3.6 WIRE INCHING”.

8. As a result of searching, a following prompt box is displayed if there is no region that is not able to assign. In this case, please change start point or increase max number of digital I/O signals ([MENU] – PROGRAM SETUP – Num. Dig. Ports). And then retry this procedure.

```
Sufficient digital IO ports
for weld EQ cannot be found.
Change the start point or
increase the maximum number
of digital IO ports and then
try to CHECK.
          [OK]
```

⚠ CAUTION
When step 8 comes, retry this procedure. If not retry, the control of welding power supply is wrong.

4.1.3 Change Communication GI/O Numbers for DAIHEN Digital Welding Power Supply

Please follow Procedure 4-1-3 whenever the assignment of GI/O to communicate with DAIHEN digital welding power supply is changed. Do not set on group I/O screen directly.

procedure 4-1-3 Change communication GI/O numbers for DAIHEN digital welding power supply

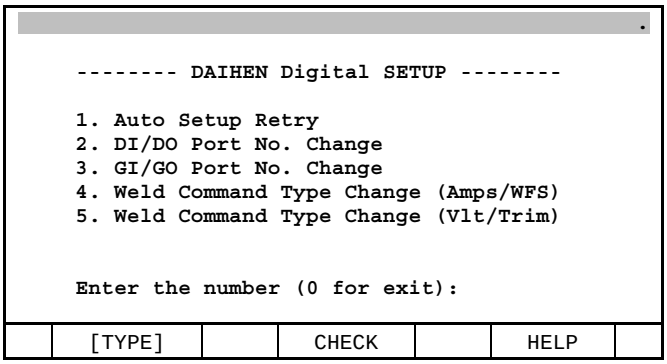
Condition

- Controlled Start has been performed and the following ArcTool Setup screen is displayed.
- “DAIHEN” is set to Manufacturer and “Welbee + ENet” is set to Model.

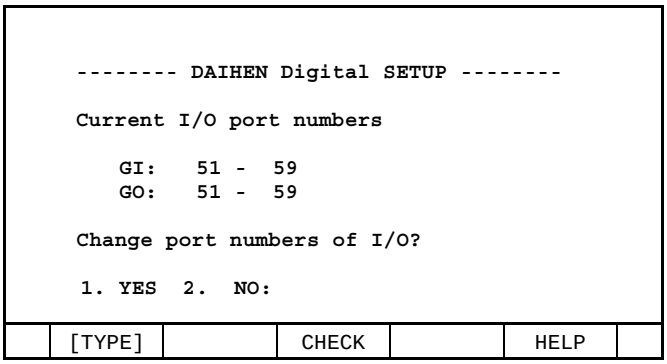
```
ArcTool Setup                                        .
                                                  1/9
     1 F Number:                  F00000

     2 Weld setup:                Japan
     3   Wire speed units:        cm/min
     4   Weld speed units:        cm/min
     5   Weld speed:              100

     6 Manufacturer:    DAIHEN Digital
     7 Model:           Welbee + ENet

   Press FCTN then START (COLD) when done.

 |  [TYPE]  |  |  CHECK  |  |  HELP  |
```

Step

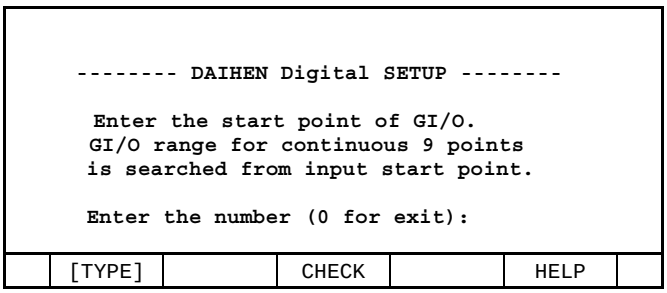
1 Press F3 [CHECK]. The following screen is displayed.



2 Input 3, and press [ENTER] key. The following screen is displayed.

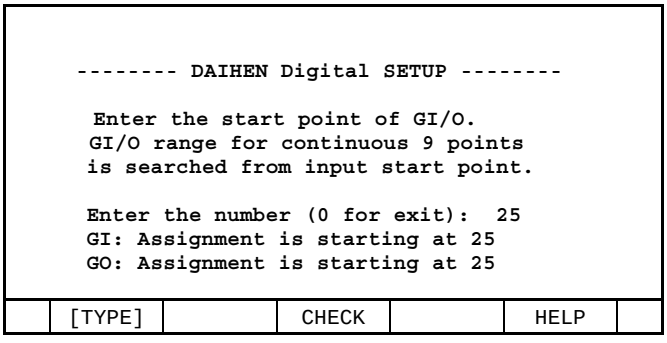


3 Input 1, and press [ENTER] key. The following screen is displayed.



4 Input the start point of GI/O assignment, and press [ENTER] key. If changing port number for communication to 25 – 33 is required, input “25” that is first number of region of assignment.

5 A number that has 9 free ports is searched from this or after this, and then assignment is done. Searched start point is displayed in the lower line.



6 After “CHECK is complete.” is displayed, return to ArcTool setup screen.

7 As a result of searching, a following prompt box is displayed if there is no region that is not able to assign. In this case, please clear unnecessary ports or change start point. And then retry this procedure.

```
Sufficient group IO ports
for weld EQ cannot be found.
Change the start point or
delete unused group IO ports
and then try to CHECK.
          [OK]
```

4.1.4 In Case of Assignment of Communication I/O is Incorrect

DAIHEN digital welding power supply cannot be controlled correctly if the relationship between DI/O(GI/O) and Weld I/O is disrupted by following operations.

- Assignment region for communication I/O is deleted on the configuration screen I/O Digital In or Out.
- Assignment region for communication I/O is deleted on the configuration screen I/O Group In or Out.
- Assignment region for communication I/O is deleted when "UOP auto assignment" is done on System/Config screen.

In these cases, the assignment of I/O for DAIHEN digital welding power supply can be recovered by executing Procedure 6-3-4 for setup of DAIHEN digital welding power supply.

> ⚠ **CAUTION**
> By this operation, some settings (Arc Start/End Adjust setup values, assignment of communication I/O and weld command form) return to default.
> Please take a note about above settings and restore these settings manually after recovery operations, if necessary.

Procedure 4-1-4 Recover the assignment of communication I/O

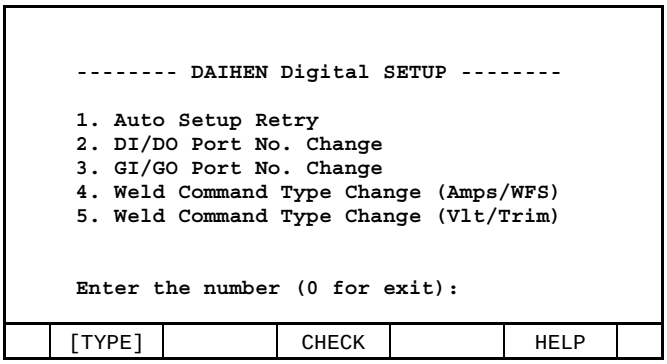
Condition

- Controlled Start has been performed and the following ArcTool Setup screen is displayed.
- "DAIHEN Digital" is set to Manufacturer and "Welbee + ENet" is set to Model.

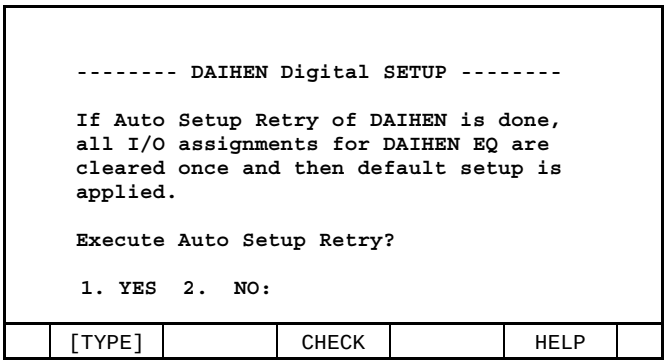
```
ArcTool Setup                                        .
                                                  1/9
     1 F Number:                  F00000

     2 Weld setup:                Japan
     3   Wire speed units:        cm/min
     4   Weld speed units:        cm/min
     5   Weld speed:              100

     6 Manufacturer:    DAIHEN Digital
     7 Model:           Welbee + ENet

   Press FCTN then START (COLD) when done.

|  | [TYPE] |  | CHECK |  | HELP |  |
```

Step

1 Press F3 [CHECK]. The following screen is displayed.



2 Input 1, and press [ENTER] key. The following screen is displayed.



3 Input 1, and press [ENTER] key. Auto setup retry is executed. After “CHECK is complete.” is displayed, return to ArcTool setup screen automatically.

4.2 EDITING OPERATION OF PROGRAM

This section explains the basic editing operation of program. This explanation overlaps with the explanation of Chapter 3. So there is no problem to ship reading the explanation if it is known.

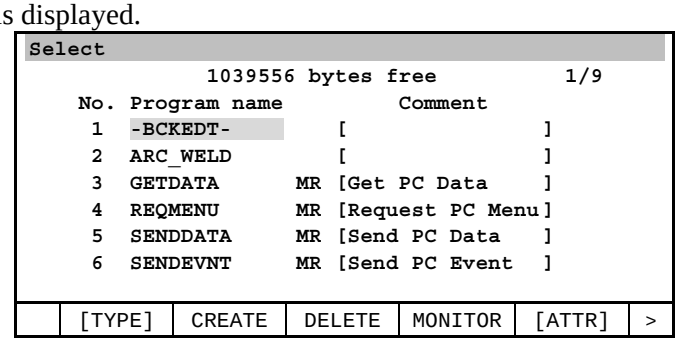
4.2.1 Selecting and Editing of Program

About the method for creating new program, procedure 3-7 “Creating Motion Program” explains. This Subsection explains the procedure for selecting and editing the program that already exists.

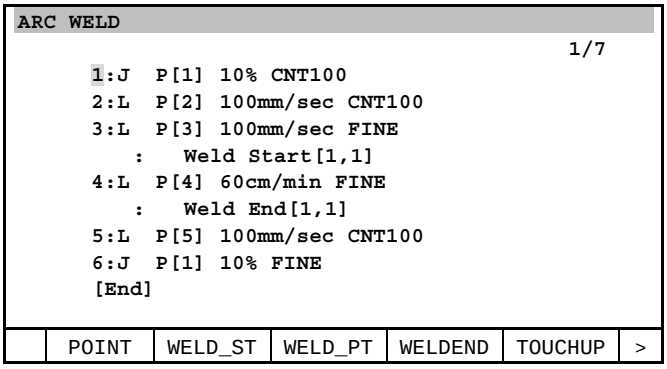
Procedure 4-2-1 Selecting and editing of program

Step

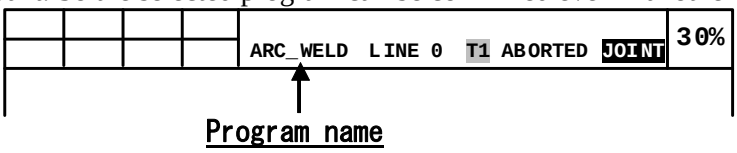
1 Select a program on the program selection screen.
Press [MENU] key and select [SELECT] from the displayed menu. Or, press [SELECT] key. Program selection screen is displayed.



2 Move the cursor on the program that you would like to select and press [ENTER] key. The program is selected and the edit screen for this program is displayed.



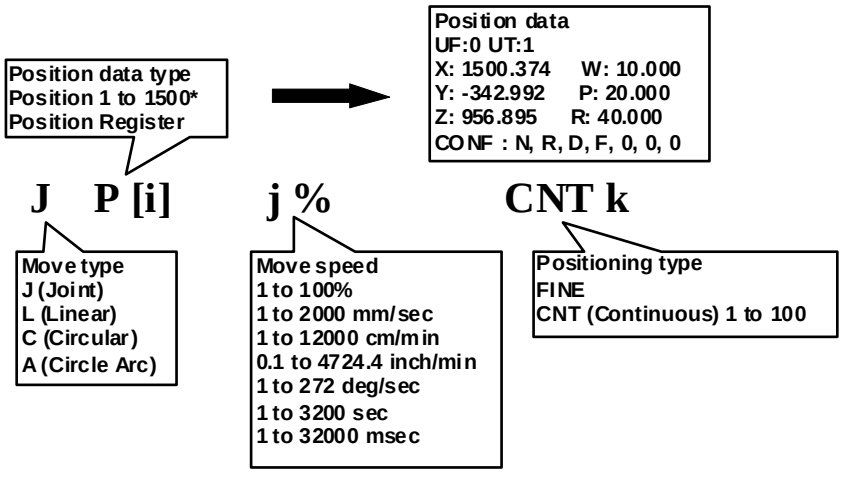
3 The program name of currently selected can be confirmed at status line that is in the window at the top of the teach pendant. So the selected program can be confirmed even if another screen is displayed.



4 Press [MENU] key and select the [EDIT] from the displayed menu if displaying the program edit screen for currently selected is required. Or, press [EDIT] key.

4.2.2 Editing of Motion Instruction

About the teaching of motion instruction, procedure 3-7 “Creating Motion Program” explains. This Subsection explains the procedure for editing the motion instruction that is already taught.
Motion instruction is composed of move type and position data type, move speed, positioning type (Refer to Fig. 4.2.2). Procedure 4-2-2 explains about the editing method of those four compositions.



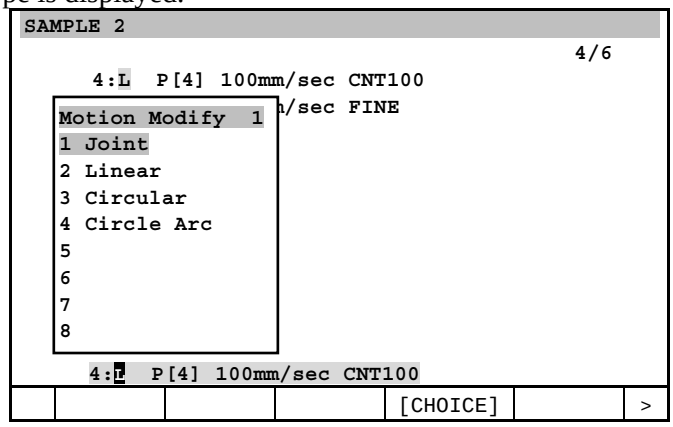
*** A position number can be as large as memory allows.**
The maximum move speed differs according to robot model.

Fig. 4.2.2 Composition of motion instruction

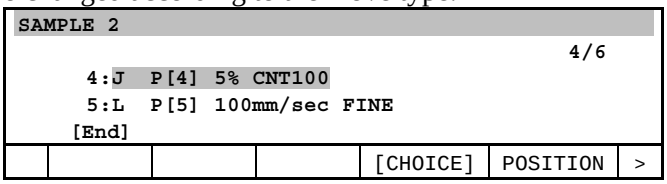
Procedure 4-2-2 Editing of motion instruction

Step

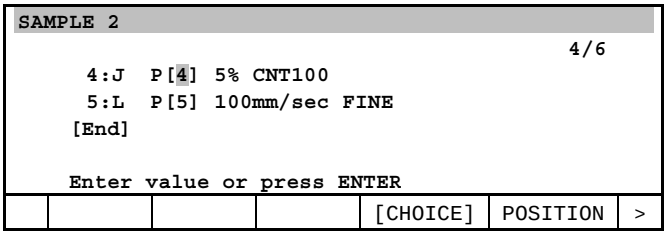
1 In case of changing move type, move the cursor to move type and press F4[CHOICE]. Sub menu for selecting move type is displayed.



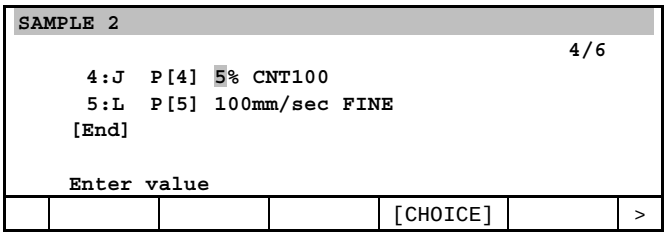
2 When the move type is selected from the sub menu, move type is changed. If it is changed, move speed and its unit are also changed according to the move type.



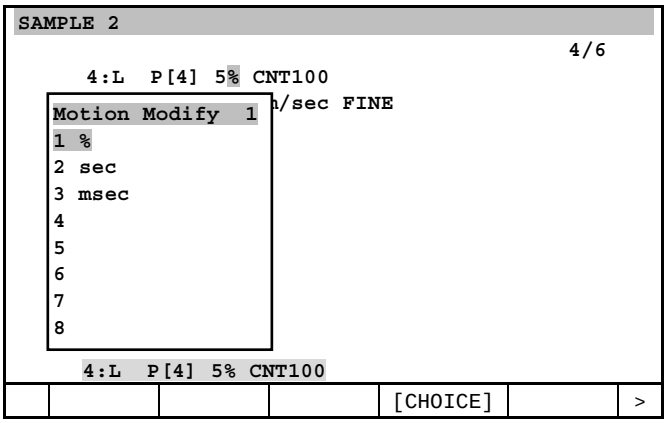
3 In case of changing position data number, move the cursor to the position data number and input new position data number.



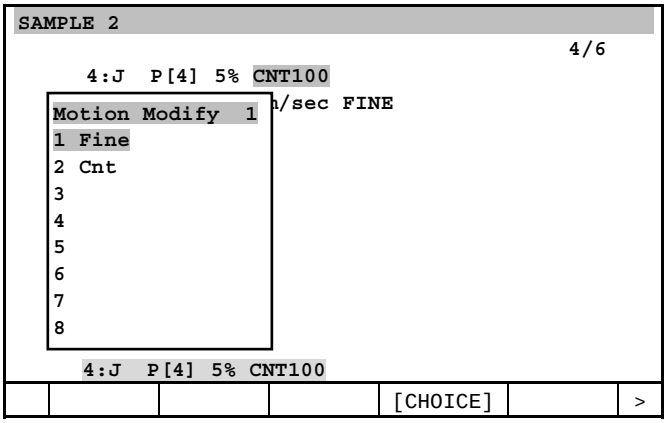
4 In case of changing move speed, move the cursor to move speed and input new value.



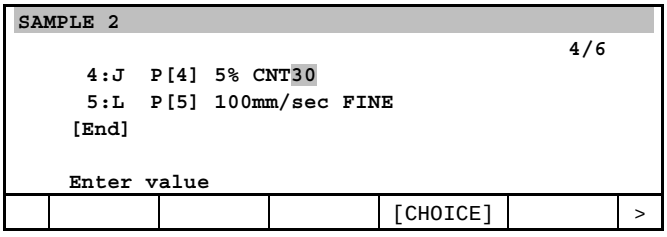
5 In case of changing the unit of move speed, move the cursor to move speed and press F4 [CHOICE]. Sub menu for selecting the unit is displayed. Select new unit from the sub menu. If it is changed, the value of move speed is automatically converted to new unit.



6 In case of changing the positioning type, move the cursor to positioning type and press F4 [CHOICE]. Sub menu for selecting positioning type is displayed. Select new positioning type from the sub menu.



7 If “Cnt” is selected as the positioning type, move the cursor to the value field of positioning type and input new value.



4.2.3 Correcting a Position

If the robot does not track the ideal path, it is necessary to modify the position that is taught by motion instruction. Operator can touch-up the position data in motion instruction after moving the robot to the position that should be corrected by jog feed. Please refer to procedure 4-2-3 (a).
Operator can confirm the taught position data in motion instruction. Operator can also modify the taught position data by changing the position number in motion instruction. Please refer to procedure 4-2-3 (b).

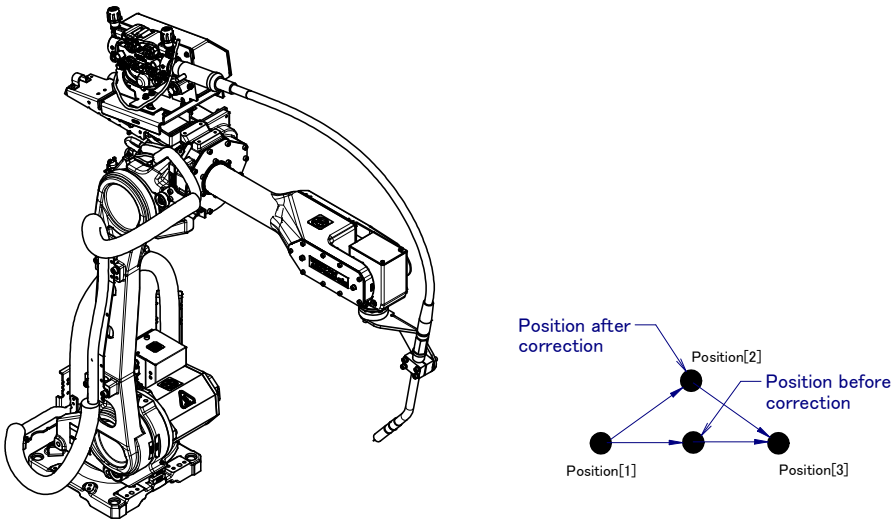
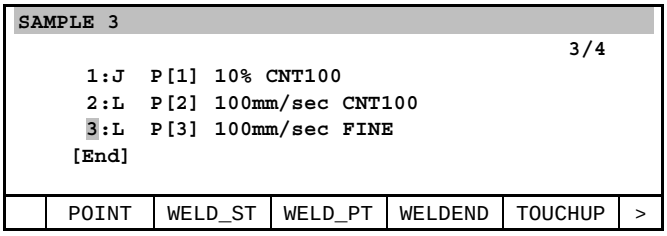


Fig. 4.2.3 Correcting a position

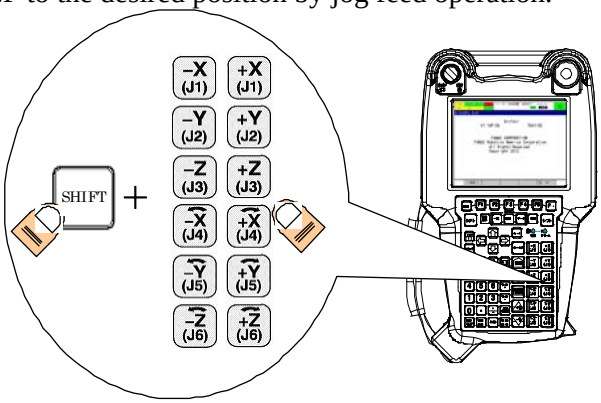
Procedure 4-2-3 (a) Correcting a position

Step

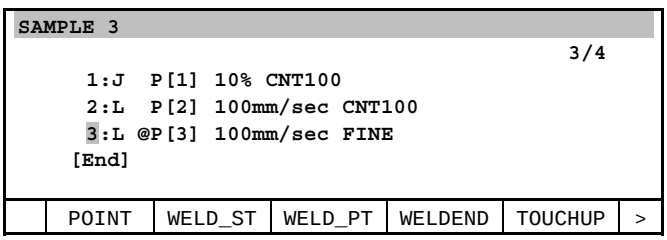
1 Move the cursor to the beginning of motion instruction line that correction is required.



2 Move the robot TCP to the desired position by jog feed operation.



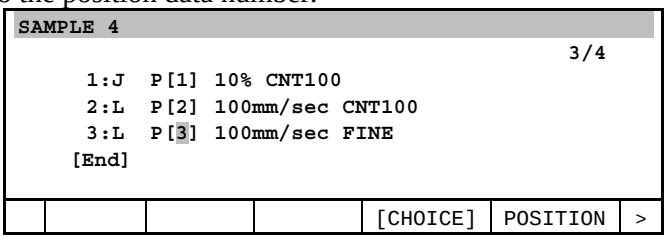
3 Press F5[TOUCHUP] with holding [SHIFT] key. The position data in the motion instruction of current cursor position (it is P[3] in the following example screen) is modified to the current robot TCP position.



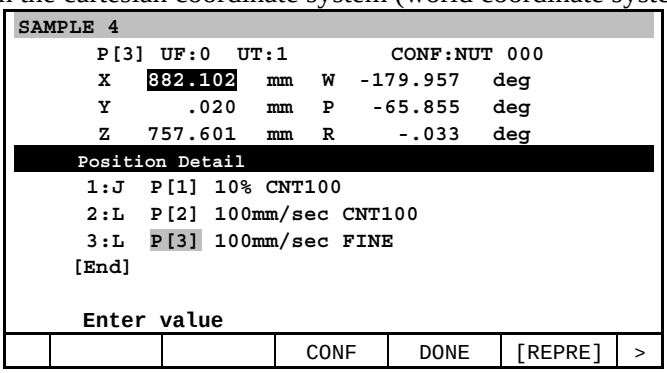
Procedure 4-2-3 (b) Confirm position data and Change position data number

Step

1 Move the cursor to the position data number.

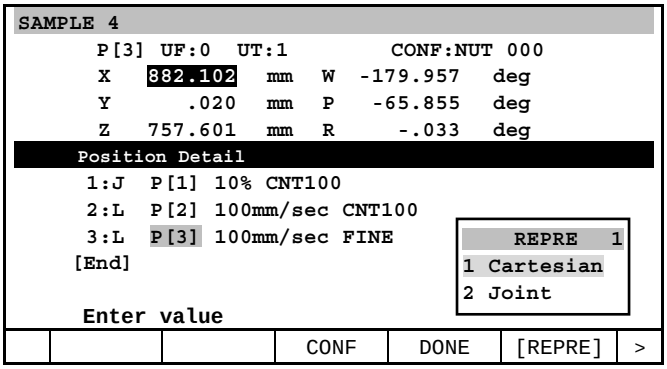


2 Press F5[POSITION] key. Sub menu for position data is displayed. In standard, the position is displayed based on the cartesian coordinate system (world coordinate system).



3 Move the cursor to desired coordinate position data and input the desired value with numeric key. After that, press [ENTER] key.

4 It is possible to change the format of position data. Press F5[REPRE] and select the desired format. For example, display changes as follows when the format of position data is changed from “Cartesian” to “Joint”.



5 When the confirmation / changing position data ends, press F4[DONE]. Display is returned to program edit screen.

4.2.4 Edit by Using Program Edit Instructions

It is possible to modify / edit the program efficiently by using the program edit instructions. Kind of those are shown in following Table 4-2-4 (a). In those instructions, “Insert” and “Delete”, “Copy” are often used. So those are explained in procedure 4-2-4 (a) – (c).

Table 4.2.4 (a) Kind of program edit instructions

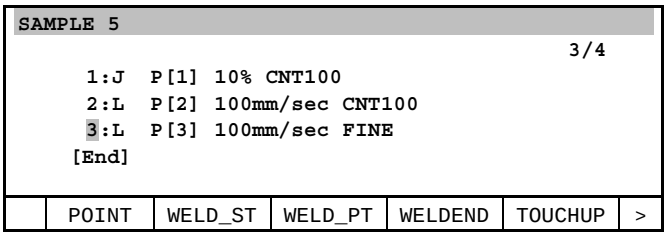
Insert	Inserts blank lines, the number of which is specified, between the existing lines of a program.
Delete	Deletes a series of instructions from a program.

Insert	Inserts blank lines, the number of which is specified, between the existing lines of a program.
Copy	Copies a series of instructions and inserts the instruction range into another location in the program.
Find	A specified element of a program instruction is found.
Replace	Replaces an item of the specified program instruction with another item.
Renumber	Renumbers the position number in ascending order.

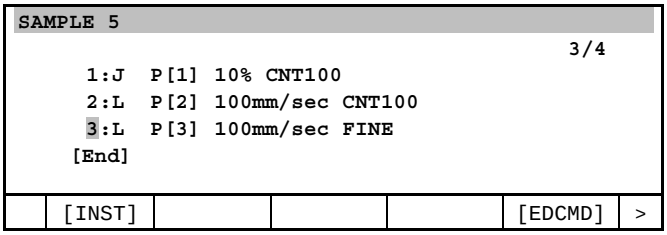
Procedure 4-2-4 (a) Insert blank lines

Step

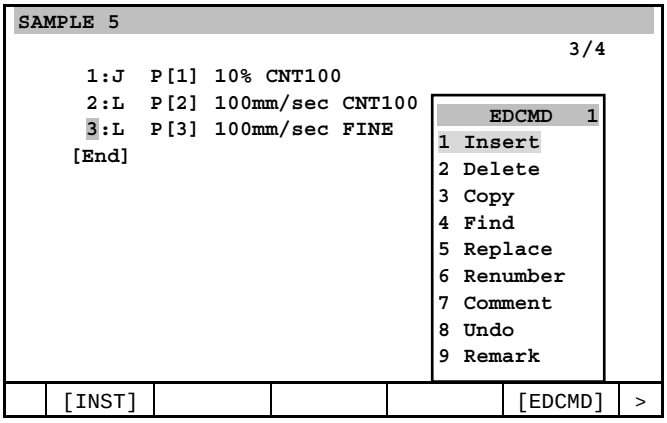
1 Move the cursor to the head of line where blank lines are inserted.



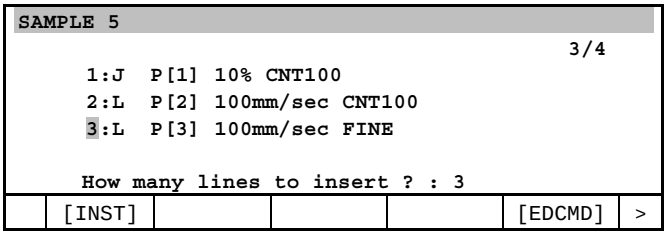
2 Press [NEXT] key then the next page of function key menu is displayed.



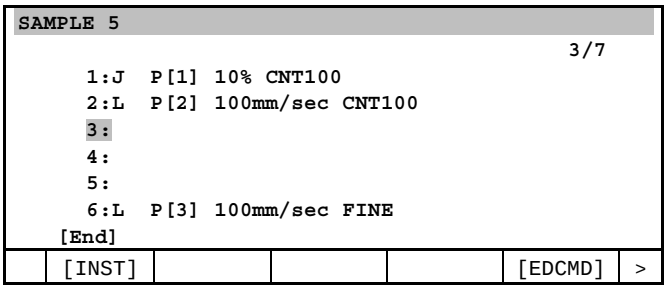
3 Press F5[EDCMD] then the EDCMD menu is displayed.



4 Select “Insert” from the displayed menu. Input the number of lines to insert by numeric key and press [ENTER] key.



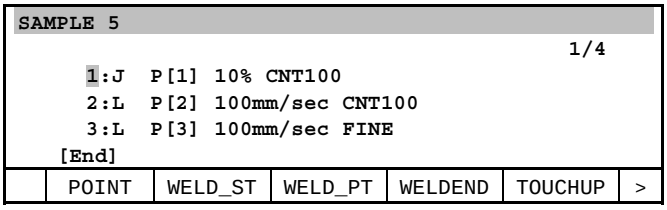
5 The number of specified blank lines are added to specified cursor position.



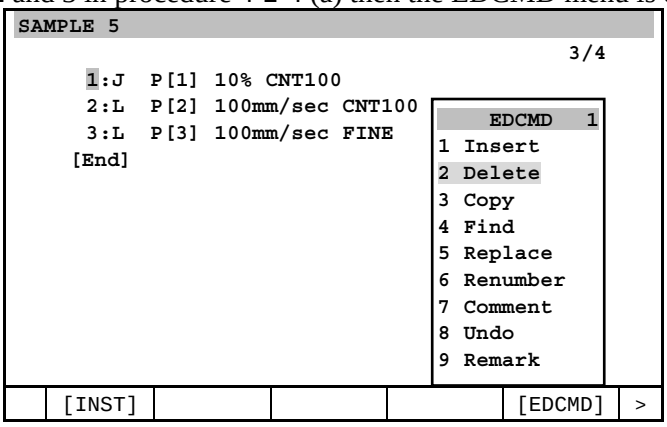
Procedure 4-2-4 (b) Delete lines

Step

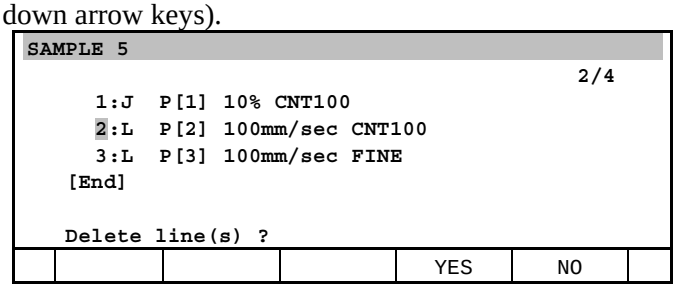
1 Move the cursor to the head of line where the line is deleted.



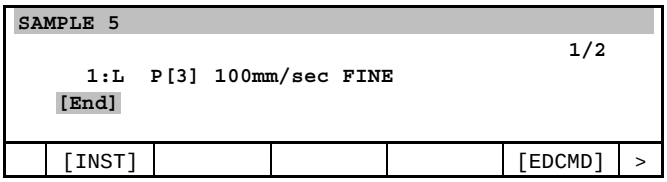
2 Perform the step 2 and 3 in procedure 4-2-4 (a) then the EDCMD menu is displayed.



3 Select “Delete” from the displayed menu. Press the F4[YES] after specifying the delete range by using cursor keys (up / down arrow keys).



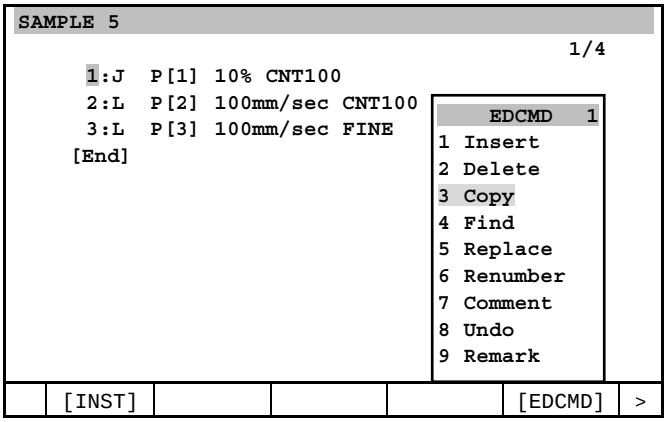
4 The specified range of lines are deleted.



Procedure 4-2-4 (c) Copy lines

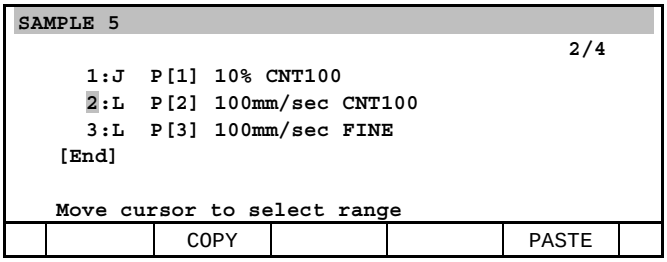
Step

1 Perform the step 2 and 3 in procedure 4-2-4 (a) then the EDCMD menu is displayed. Select “Copy” from the displayed menu.

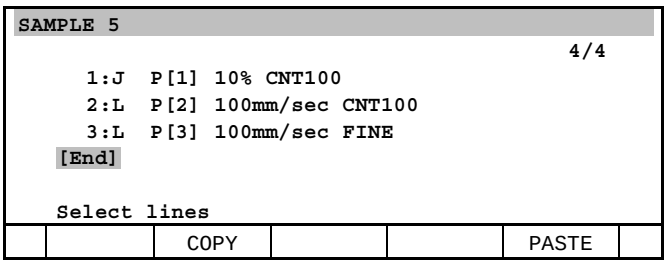


2 The message of “Select lines” is displayed at prompt lines. Press F2[COPY] after moving the cursor to beginning of copy range.

3 The message of “Move cursor to select range” is displayed at prompt lines. Press F2[COPY] after moving the cursor to ending of copy range. The specified range of program lines is stored to the internal memory.



5 Press F5[PASTE] after moving the cursor to the position where that is pasted.



5 The message of “Pate before this line?” is displayed at prompt line. Select the copy mode by pressing F2 or F3 or F4 key. Program lines stored by step 3 and 4 are inserted. About the copy mode, please refer to the following table.

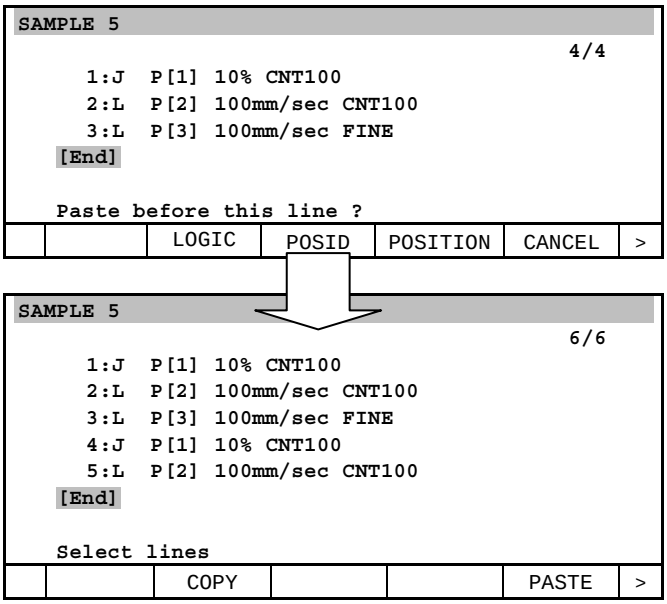


Table 4.2.4 (b) Kind of program edit instructions

F2 LOGIC	The position number of pasted motion instruction becomes “...”(initial state).
F3 POSID	The position number of pasted motion instruction succeeds the position number of copied motion instruction.
F4 POSITION	The position number of pasted motion instruction becomes unused position number.

4.3 OPERATION OF WELD PROCEDURE AND PROCESS MODE

4.3.1 About Weld Procedure and Process Mode

Arc welding power supply can use different output characteristics to wire diameter, wire material, gas type and weld method, and it has the database of the most suitable output characteristic for each combination. The database of output characteristic can be changed for each weld point. Therefore, the most suitable characteristic for each point can be selected and then execute welding.
For switching the database of output characteristics for arc welding power supply during welding, it is necessary for arc welding robot to specify “This combination is used for this weld point”.
Between arc welding robot – welding power supply, the relevance of each combination is done by specifying the number called “Process Mode”.
Process Mode number cannot be specified on arc weld instruction directly. Therefore, one “Process Mode” is assigned to one “Weld Procedure”. Then Weld Procedure which is assigned the desired Process Mode is specified on arc weld instruction, and it is possible to achieve the switching of output characteristic from arc welding robot to arc welding power supply.

NOTE
It is necessary to select Process Mode number whose wire diameter, wire material and gas type are suitable for using ones.

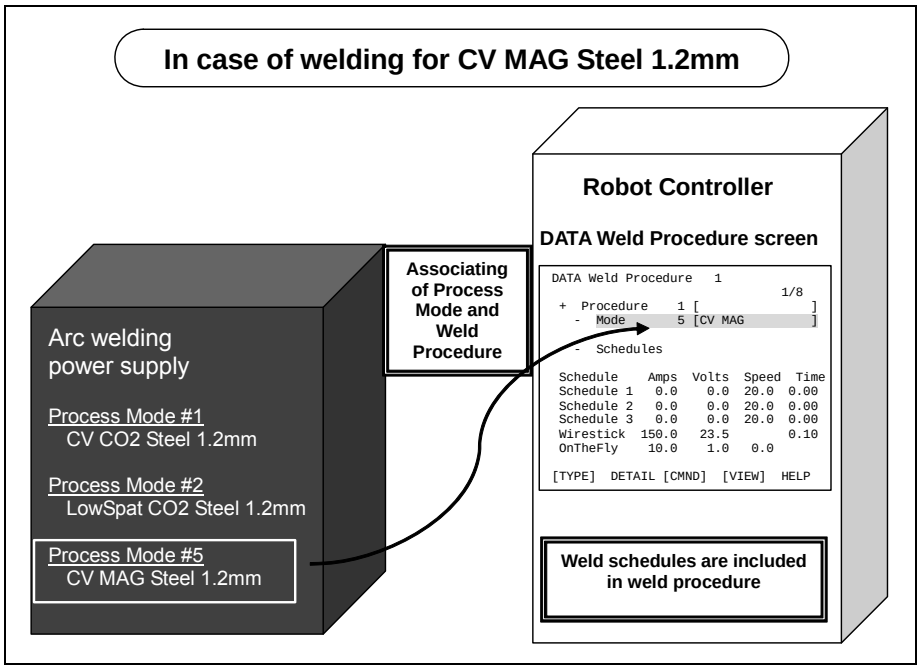


Fig. 4.3.1 Process Mode and Weld Procedure

4.3.2 Operation of Weld Procedure

"Weld Procedure" has "Weld Schedule", and also setups which decide welding sequence. When this weld procedure number is specified on arc weld instruction, weld process on the point where the instruction is taught is decided.

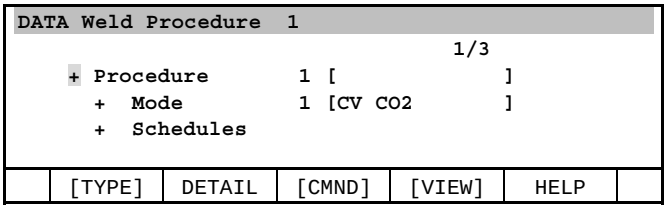
One weld procedure has multiple weld schedules. It is possible to create weld procedure up to 20. Additionally, one weld procedure can have weld schedules up to 32.

The new creation method of the first weld procedure is explained by Procedure 3-5. So Procedure 4-3-2 explains the creation method of the second or later weld procedures. Please refer to Section 3.5 of R-30*i*B/R-30*i*B Mate CONTROLLER Arc Welding Function OPERATOR'S MANUAL (B-83284EN-3) for other operations for weld procedures.

Procedure 4-3-2 Copy weld procedure

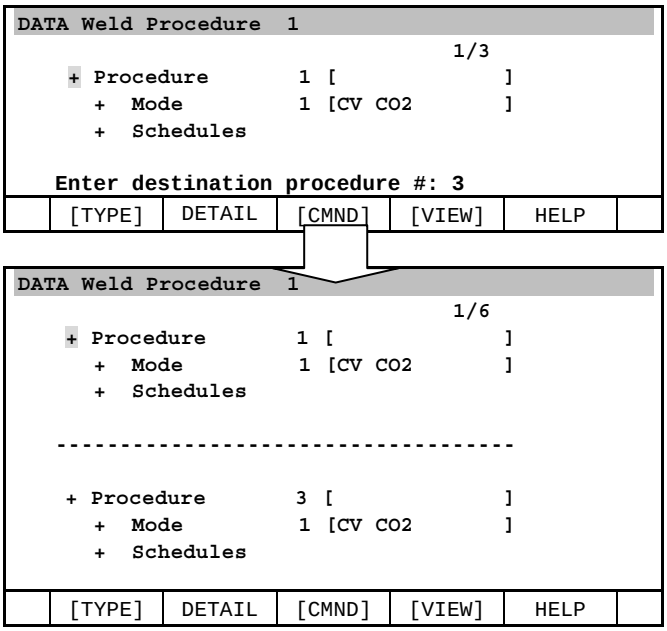
Step

1 Press [MENU] key and select [0 -- NEXT--].
2 Select [3. DATA].
3 Press F1[TYPE] key and select [Weld Procedure]. Following screen is displayed.



4 In case of creating another weld procedure, it is achieved by copying the existing weld procedure. Press F3[CMND] and select [Copy WP].

5 The message of “Enter destination procedure #:” is displayed at prompt line. Please input the weld procedure number that is required. The message of “Copy procedure i to procedure j” is displayed. Then, press F4[YES].



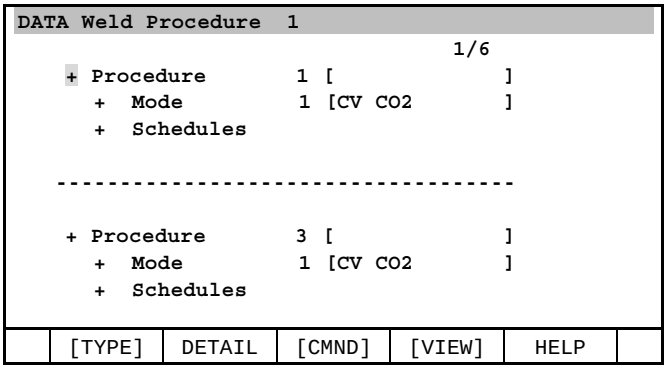
4.3.3 In case of Process Mode Number is Known

When the process mode number that is needed is known, it is possible to input the process mode number directly in the DATA Weld Procedure screen (refer to Procedure 4-3-3). Or, it is possible to perform this method after checking the process mode number that you would like to use by referring “Chapter 10 PROCESS MODE”.

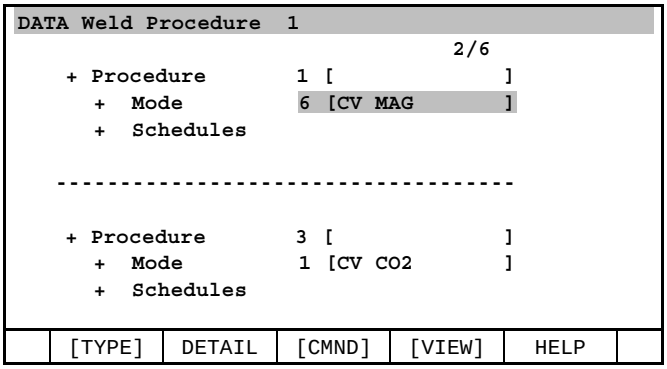
Procedure 4-3-3 Assignment of process mode number by direct input

Step

1 Perform the step 1 - 3 in Procedure 4-3-2. Then, DATA Weld Procedure screen is displayed.



2 Move the cursor to “Mode” line in the desired weld procedure and input the process mode number that you would like to use. The comment of specified “Mode” line is updated to the content that corresponds to the inputted process mode number. Please confirm the content whether it is correct or not. If it does not exist in the weld equipment, the value of “Mode” is returned to the original value.



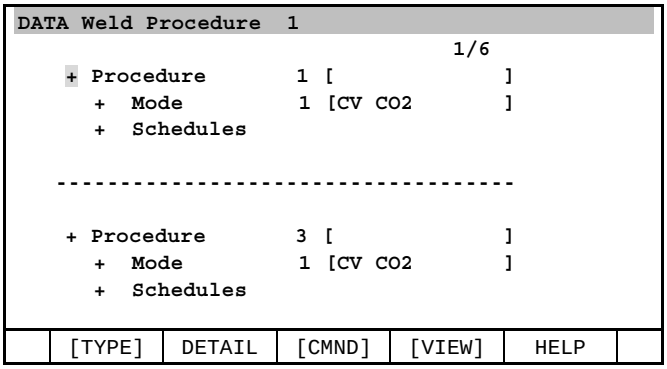
4.3.4 Search Process Mode

When the process mode number that you would like to use is unknown, it is necessary to find the process mode number by using the information of welding methods and wire diameter, etc. Process mode number is founded by accessing to the process mode data base in weld equipment.

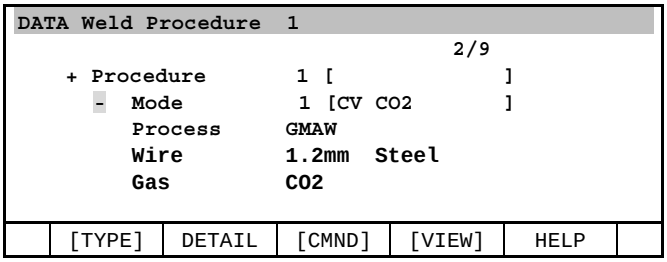
Procedure 4-3-4 Assignment of process mode number by searching

Step

1 Perform the step 1 - 3 in Procedure 4-3-2. Then, DATA Weld Procedure screen is displayed.



2 Move the cursor to “+” in the head of “Mode” line and press [ENTER] key. “Mode”, “Wire” and “Gas” by current process mode are displayed.



3 Press F3[CMND] and select [Search] from the displayed menu. Following search result screen is displayed.

```
SETUP Eq Search
                                        1/15

      #   WIRE DIA      DESCRIPTION
1     1   1.2 mm    [GMAW Steel          ]
                    [CV CO2              ]

2     2   1.2 mm    [GMAW Steel          ]
                    [LowSpat CO2         ]

3     5   1.2 mm    [GMAW Steel          ]
                    [CV MAG              ]

 | [TYPE] | SELECT |  |  | HELP |
```

4 This screen is scrollable by using cursor key (up / down arrow key). Move the cursor to desired process mode number and press F2[SELECT]. When you would like to exit from this screen without selecting process mode, please press [PREV] key.

4.4 PARAMETER OF WELD SCHEDULE

This section explains about weld parameters in weld schedule in detail. Weld parameters are changed by setting of Weld command type of Amps/WFS and Volts/Trim. Each of them is explained at 4-4(a)&(b).

Table 4.4 Weld parameters

Weld Parameter	Detail
Current	Set weld current. Unit is amperes (A). This is displayed if Current command form is selected.
Wire feed	Set wire feed speed. Unit is cm/min as default. This is displayed if Wire Feed Speed command form is selected.
Voltage	Set weld voltage. Unit is volts (V). This is displayed if Voltage command form is selected.
Trim	When 0.0 is set, standard voltage is output in welding. This can be adjusted from -100.0 to 100.0 based on standard voltage. This is displayed if Trim command form is selected.
Wave Control	Arc is set to soft or hard. 0.0 is standard. If this is increased, arc becomes hard. If this is decreased, arc becomes soft. The range is different for each of model. -10 to +10 : WB-P500L, WB-P350 -99 to +99 : WB-M500, WB-M350L, WB-M350 This is always displayed.
Frequency	Set Wave Frequency of Wave Pulse welding. Unit is Hz. This can be adjusted from 0.5 to 32.0Hz. This is displayed if DC Wave Pulse is selected.

```
DATA Weld Procedure      1                    .
                                        1/7

     1 Procedure      1 [                    ]
       [CV CO2           GMAW           #  1]
       [1.2 mm  Steel     CO2                ]

     2 Weld Schedule       1 [Schedule     ]
     3 Current                 120.0  Amps
     4 Voltage                 17.00  Volts
     5 Wave Control             0.00

 | [TYPE] | SCHEDULE |  |  | HELP |
```

Fig. 4.4(a) Weld Parameters using Amps & Volts

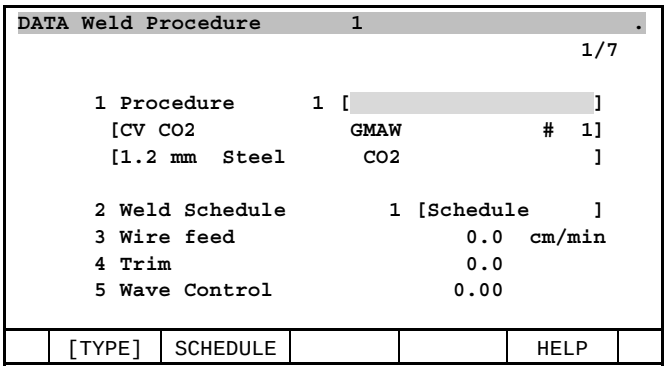


Fig. 4.4(b) Weld Parameters using WFS & Trim

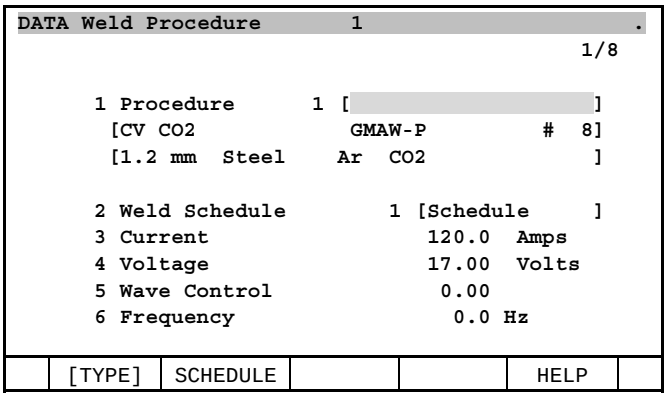
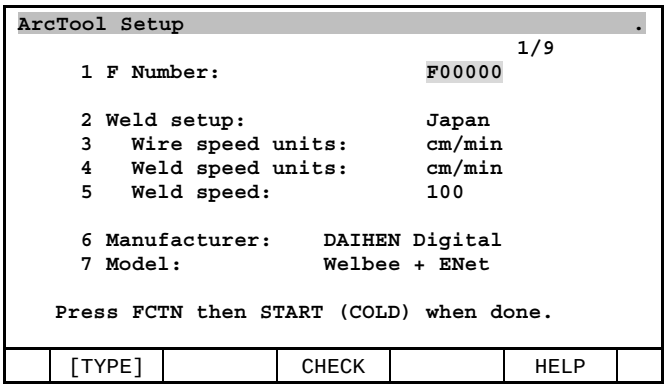


Fig. 4.4(c) Weld Parameters using Wave Pulse Welding

Procedure 4-4(a) Change Weld command form “Amps/WFS”

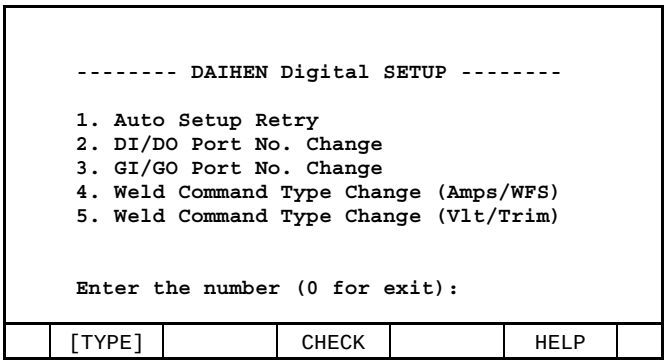
Condition

- Controlled Start has been performed and the following ArcTool Setup screen is displayed.
- “DAIHEN Digital” is set to Manufacturer and “Welbee + ENet” is set to Model.

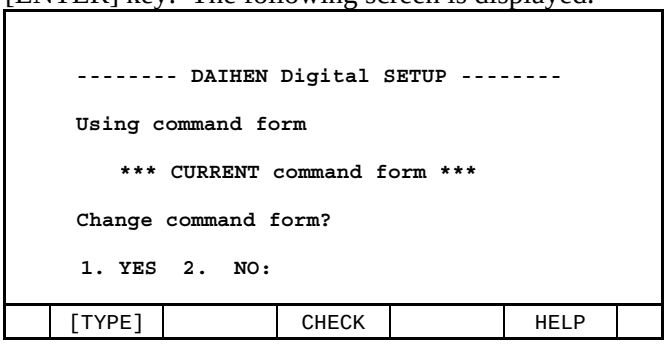


Step

1. Press F3 [CHECK]. The following screen is displayed.

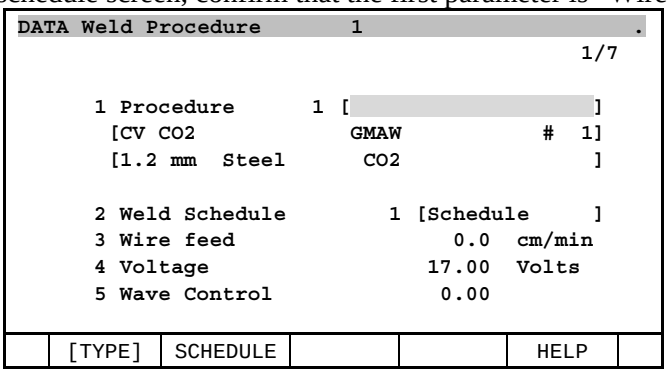


2. Input 4, and press [ENTER] key. The following screen is displayed.



3. Input 1, and press [ENTER] key. After "CHECK is complete." is displayed, return to ArcTool setup screen automatically.

4. In Detail of weld schedule screen, confirm that the first parameter is "Wire feed".



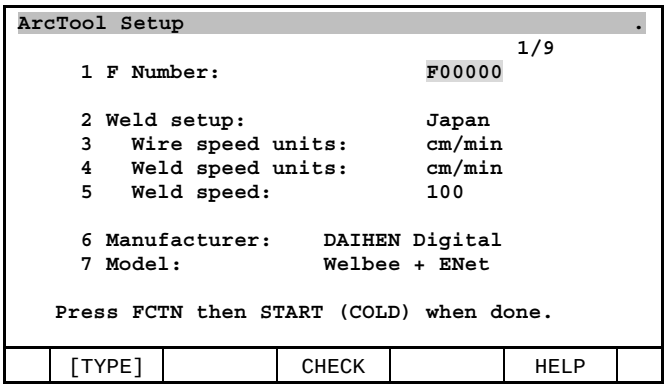
If you need to reset to Current form, please change by the same procedure.

> ⚠ **CAUTION**
> If you change the command form between current and wire feed speed, values of weld schedule and arc direct instruction are not changed. They are same as before change.
> Please make sure to reset all parameters if you change the command form. If you do welding before reset, unexpected and abnormal schedule is used.

Procedure 4-4(b) Change Weld command form "Volts/Trim"

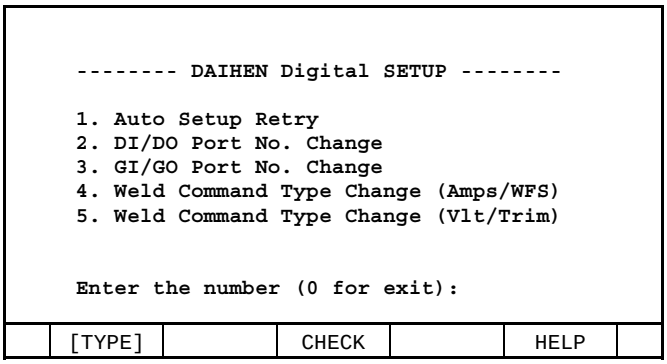
Condition

- Controlled Start has been performed and the following ArcTool Setup screen is displayed.
- "DAIHEN Digital" is set to Manufacturer and "Welbee + ENet" is set to Model.

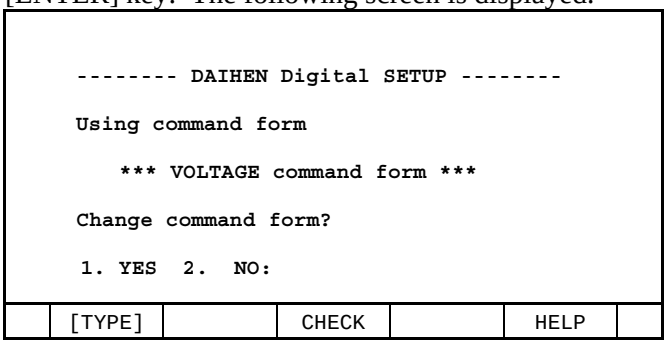


Step

1. Press F3 [CHECK]. The following screen is displayed.

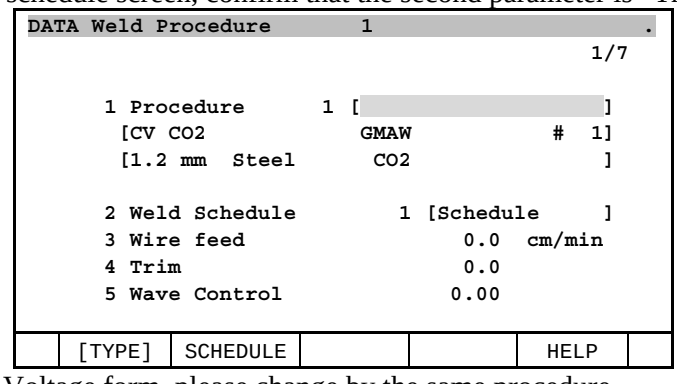


2. Input 5, and press [ENTER] key. The following screen is displayed.



3. Input 1, and press [ENTER] key. After “CHECK is complete.” is displayed, return to ArcTool setup screen automatically.

4. In Detail of weld schedule screen, confirm that the second parameter is “Trim”.



If you need to reset to Voltage form, please change by the same procedure.

> ⚠ **CAUTION**
> If you change the command form between voltage and trim, values of weld schedule and weld instruction of value format are not changed. They are same as before change.
> Please make sure to reset all parameters if you change the command form. If you do welding before reset, unexpected and abnormal schedule is used.

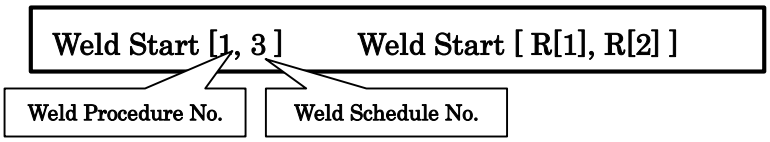
4.5 TEACHING AND EDITING OF ARC WELD INSTRUCTION

Arc weld instruction performs the arc welding start / end. Though the Procedure 3-8 explains briefly about teaching of arc weld instruction, this section explains it in detail.

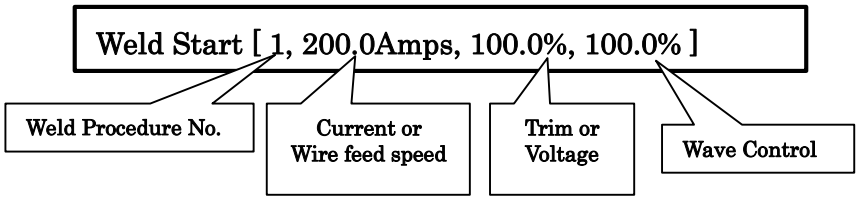
4.5.1 Arc Weld Start Instruction

The arc weld start instruction requests to start an arc welding. Once arc welding has started, welding pass becomes the robot movement path. The welding is continued until requesting the arc weld end instruction. There are two methods in arc weld start instruction. One is arc indirect instruction, two is arc direct instruction.
Following shows the example of those two instructions.

Schedule number specified (Arc indirect instruction)



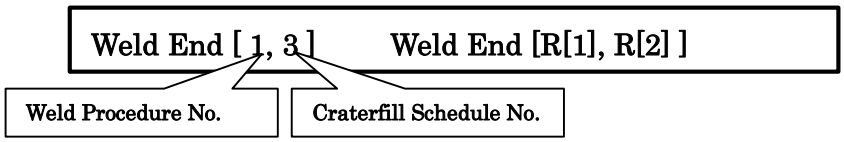
Schedule directly specified (Arc direct instruction)



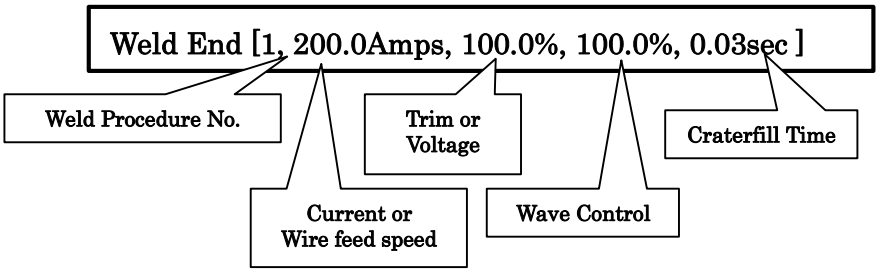
4.5.2 Arc Weld End Instruction

The arc welding end instruction requests to end an arc welding. When an arc welding ends, the craterfill is performed. The craterfill schedule is specified in this instruction. Craterfill is a function to avoid the crater hole generation due to a rapid voltage decrease.
In the craterfill schedule, it is necessary to specify craterfill time in addition to various command values. If you do not perform the craterfill, set the craterfill time to 0sec. There are two methods in arc weld end instruction well as arc weld start instruction.

Schedule number specified (Arc indirect instruction)



Schedule directly specified (Arc direct instruction)



NOTE

In case of schedule directly specified, all commands are cleared to 0 when the weld procedure number is changed (This is measures to prevent original commands from becoming outside the range that is for the weld procedure after changed). Please always set each commands after setting the weld procedure number.

4.5.3 Note while Teaching Arc Weld Instruction

- Please use the FINE motion when robot moves to arc welding start position.
- Please use the linear or circular, C-circular with CNT motion when robot moves to pass point during arc welding.
- Please use the linear or circular, C-circular with FINE motion when robot moves to arc welding end position.
- Please set torch to appropriate angle against welding object.
- Please use the appropriate welding schedule.
- Do not execute arc weld start instruction on condition that welding wire touches to the welding object. It may cause the welding trouble. Welding wire should not touch to the welding object at arc start point. In case of those touching, please confirm stick out length at last arc end point, etc.

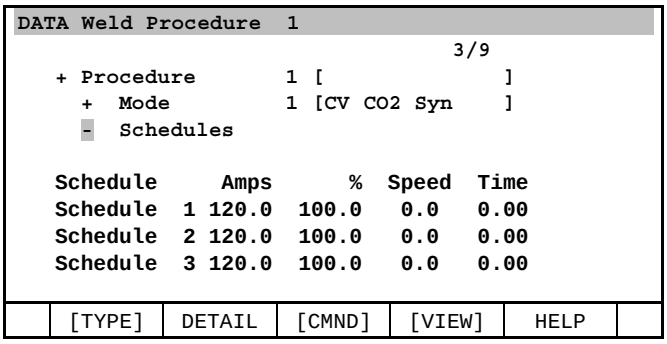
4.5.4 Teaching of Arc Indirect Instruction

Arc indirect instruction performs the welding according to the specified weld schedule that is set in weld procedure. The weld schedule must be set beforehand at weld procedure screen. It is necessary to specify the weld procedure number and schedule number in the use of arc indirect instruction.
In the weld procedure screen, please set the process mode number at first. Next, please set each weld command values (Amps, Volts, etc.).
Teaching procedure is shown in Procedure 4-5-4.

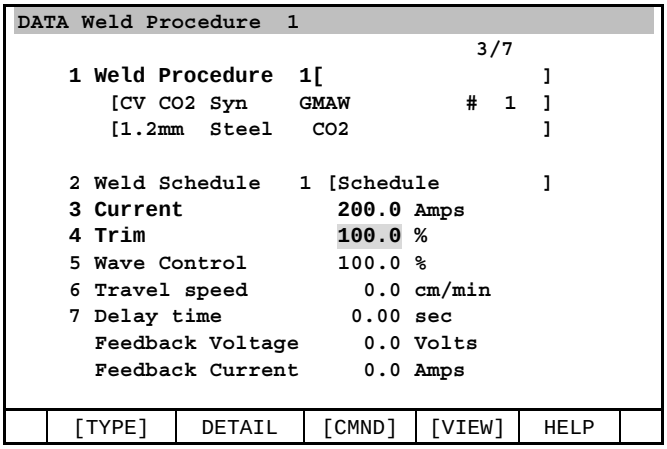
Procedure 4-5-4 Teaching of arc indirect instruction

Step

1 Press [MENU] key and select [0 -- NEXT --]. Select [3 DATA].
2 Press the F1 [TYPE] key and select [Weld Procedure]. Then, Weld Procedure screen is displayed.
3 Move the cursor to “Schedules” included in weld procedure used by arc indirect instruction. Press F2 [DETAIL] or ENTER key. Weld schedule list is displayed as the followings.



4 Move the cursor to schedule that you would like to use and press F2 [DETAIL]. The following screen is displayed.



5 Input commands (current, voltage, etc.).
6 Input the weld schedule number to the arc indirect instruction in the TP program.

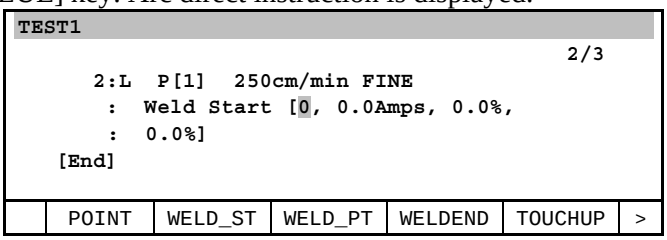
4.5.5 Teaching of Arc Direct Instruction

In arc direct instruction, you specify the weld procedure number and each command (current, voltage, etc.) directly in TP program.
Teaching procedure is shown in Procedure 4-5-5.

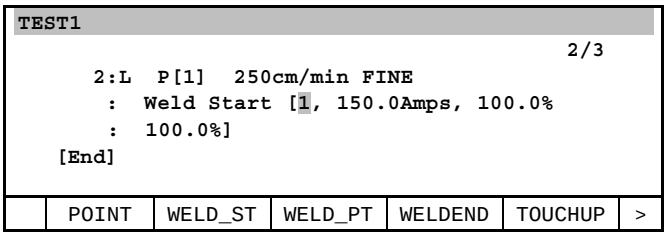
Procedure 4-5-5 Teaching of Arc direct instruction

Step

1 Teach the arc weld instruction in TP program. Move the cursor to inside "[]" of the arc weld instruction and press F3 [VALUE] key. Arc direct instruction is displayed.



2 Move the cursor to the first parameter and input the weld procedure number here.
3 After inputting the weld procedure number, input current, trim (or voltage) or Wave Control values.



NOTE

The input parameters (EX: current, voltage, etc.) are reset to 0 when you change the weld procedure number. Please input the weld procedure number first before inputting commands for each parameter.

5 ARC WELDING FUNCTIONS

This chapter describes about setting operation of functions related to arc welding depending on using situation (when starting arc welding, when finishing arc welding and others.)

5.1 FUNCTION OF ARC WELDING START TIMING

Functions related to arc welding start timing are follow.

- Gas control just before weld start (Gas purge/ Gas pre flow function)
- Adjustment of weld schedule at weld start position (Runin function)
- Retry after weld start failed (Repeat touch retry function, Scratch start function)

This section explains overview and using method of these functions.

5.1.1 Gas Control Just before Weld Start

There are two functions for executing gas control just before weld start: Gas Purge function and Gas Preflow function.

Gas Purge

Gas purge function improves arc start quality without increasing cycle times by starting gas flowing before robot arrives arc start position and still be moving. Only the additional motion instruction type weld instructions support the function.

Gas Preflow Function

On the other hand, gas preflow function also improves quality by starting gas flowing during assigned time after robot arrived. The additional motion instruction type and single type weld instructions support the function but the cycle time increases preflow time.

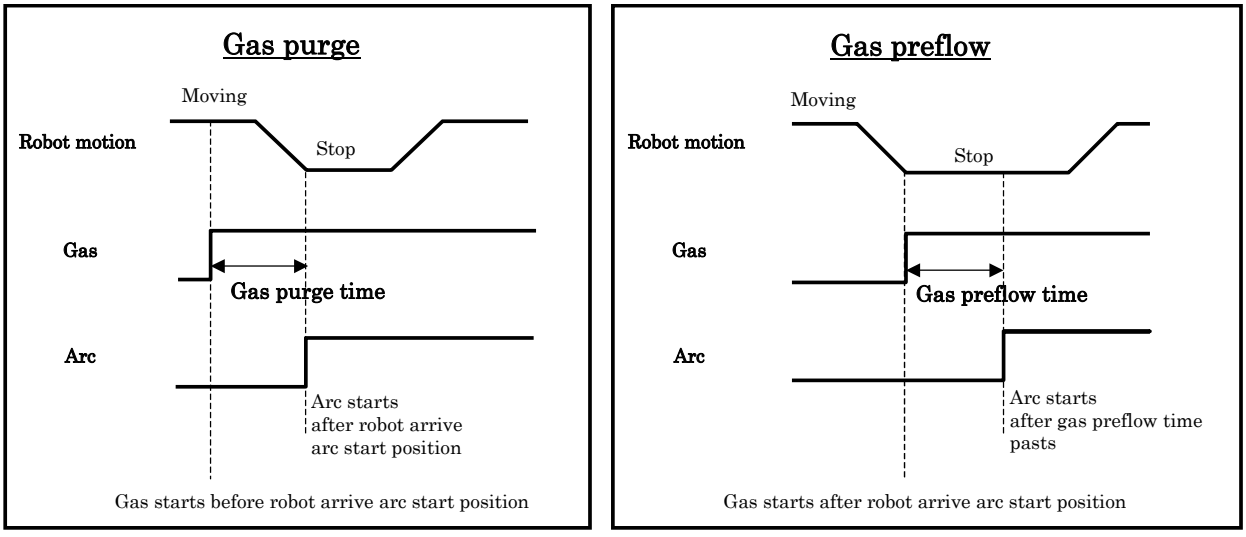


Fig. 5.1.1 Timing chart of gas purge and gas preflow

Gas purge time and gas preflow time are setup in each weld procedure. When a time is zero, the corresponding function becomes disabled.
Default setting is that gas purge time is 0.35 sec and gas preflow time is 0 sec, so gas purge function is executed every additional motion instruction type weld instruction and gas preflow function is never executed without setup the time manually.

```
DATA Weld Procedure      1                              .
                                                  1/8
  -  Procedure             1 [                      ]
     Weld equipment        1
     Manufacturer:         DAIHEN Digital
     Model:                Welbee + Enet
     File name:            AWE1WP01
     Schedules:            3

     Runin :                          ENABLED
     Burnback:                        ENABLED
     Wirestick reset:      3          DISABLED

     Gas purge:                  0.35  sec
     Gas preflow                 0.00  sec
     Gas postflow:               0.00  sec

 | [TYPE] | DETAIL | [CMND] | [VIEW] | HELP |
```

CAUTION
When gas purge time is longer than the moving time of the weld start added motion instruction, gas purge is executed during the moving time.

CAUTION
Both of gas purge time and gas preflow time setup in a weld procedure, both of the function are executed when the weld procedure is selected.

5.1.2 Adjustment of Weld Schedule at Weld Start Position

Runin Function

Runin function requests specified welding commands with the torch stops at the arc start position. This function is used for arc start executes smoothly by requested different current/voltage commands from welding.
Command values and delay time for runin can be specified on each weld procedure.

Default setting is that the function is disabled. If you would like to use it, set up the configurations with Procedure 5-1-2.

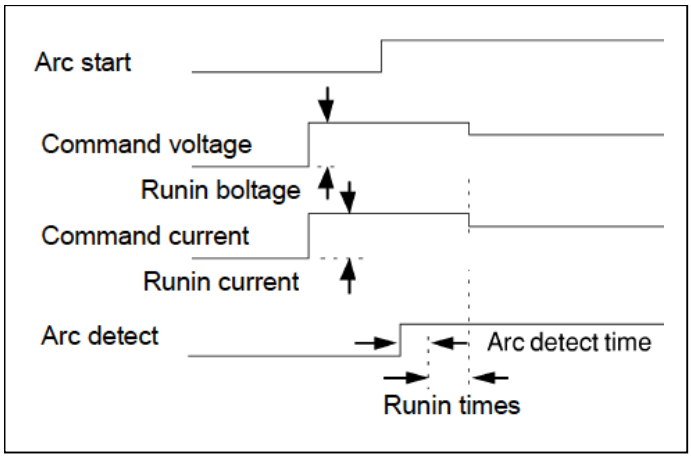


Fig. 5.1.2 Runin function

Procedure 5-1-2 Setup of Runin Function

Step

1 Press [DATA] key and press F1[TYPE] and select “Weld Procedure”. Weld Procedure data screen is displayed.

2 Move cursor to “Procedure” you would like to use and press F2 [DETAIL]. The following screen is displayed.

```
Data Weld Procedure                                    .
                                                  1/8
   -  Procedure              1 [                    ]
      Weld equipment         1
      Manufacturer:          DAIHEN Digital
      Model:                 Welbee + Enet
      File name:             AWE1WP01
      Schedules:             3

      Runin :                           DISABLED
      Burnback:                         DISABLED
      Wirestick reset:       3          DISABLED

 | [TYPE] | DETAIL | [CMND] | [VIEW] | HELP |
```

3 Move the cursor to [Runin]. If it needs to be enabled, press F4 [ENABLED]. If it needs to be disabled it, press F5 [DISABLED].

```
Data Weld Procedure                                    .
                                                  1/8
   -  Procedure              1 [                    ]
      Weld equipment         1
      Manufacturer:          DAIHEN Digital
      Model:                 Welbee + Enet
      File name:             AWE1WP01
      Schedules:             3

      Runin :                           ENABLED
      Burnback:                         DISABLED
      Wirestick reset:       3          DISABLED

 | [TYPE] | DETAIL | [CMND] | [VIEW] | HELP |
```

4 Next, setup Runin schedule. Move cursor on “Schedules” in the weld procedure and press F2 [DETAIL]. The following screen is displayed.

```
DATA Weld Procedure          1                         .
                                                  7/12
   +  Mode          1 [CV CO2 Syn          ]
   -  Schedule
   Schedule#  Amps       % SPEED  TIME
   Runin      200.0  100.0         0.00
   Schedule 1   0.0  100.0   0.0   0.00
   Schedule 2   0.0  100.0   0.0   0.00
   Schedule 3   0.0  100.0   0.0   0.00
   Burnback   200.0  100.0          0.1

 | [TYPE] | DETAIL | [CMND] | [VIEW] | HELP |
```

5 Move cursor to the schedule of Runin and change the command value if necessary.

⚠CAUTION
Even if the runin is enable, runin is not executed when “Delay Time” is 0sec.

⚠CAUTION
When you set the Runin enable and Delay Time, it is applied to all the welding parts where the corresponding process selection number is used. When both the Runin applying part and the Runin not applying part exists for one process mode, please assign the process mode number to two process selection number. One side set the Delay Time and the other side does not set the Delay Time.

5.1.3 Retry after Weld Start Failed

There are two functions to retry weld start after weld start failed: Repeat Touch Retry Function and Scratch Start Function.

Repeat Touch Retry Function

When arc is not generated at arc start instruction, Repeat Touch Retry Function retry start of welding at the same position (arc start position) by the motion of the Figure below. If arc is not generated after this motion, Scratch Start function of next Section works.

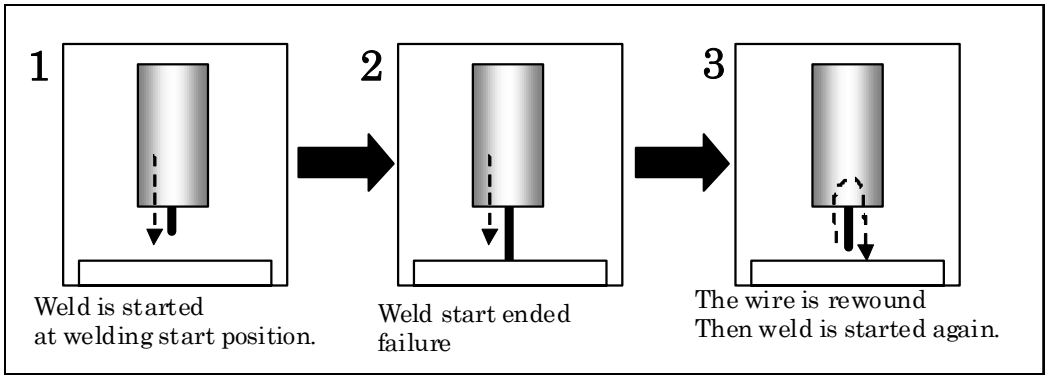


Fig. 5.1.3 (a) Repeat Touch Retry Function

In default setting, Repeat Touch Retry is enabled and retry count is 2. The following procedure 5-1-3 (a) shows the setup procedure of Repeat Touch Retry function.

Operation 5-1-3 (a) Setup of Repeat Touch Retry Function

Step

1 Press [MENU] key and select [6 SETUP].
2 Press F1 [TYPE] key and select [Weld System]. SETUP Weld System screen is displayed. Move the cursor to below and the following screen is displayed.

```
SETUP Weld System                                    .
                                              10/22
    Scratch Start Function
     10 Scratch Start:           ENABLED
     11 Distance:                5     mm
     12 Return to start speed:   100   mm/s
     13 Retry count:             1
    Repeat Touch Retry Function
     14 Repeat Touch Retry:      ENABLED
     15 Retry count:             2

 |  [TYPE]  |  |  | ENABLED | DISABLED |  |
```

3 Move the cursor to [14 Repeat Touch Retry]. When you set this function ENABLE, press F4 [ENABLED]. When you set this function DISABLE, press F5 [DISABLED].
4 Change the value of [Retry count] if necessary.

Scratch Start Function

When arc is not generated at arc start instruction, scratch start function is performed. The top of the wire moves from arc start position to next target position by specified distance. When arc generates during this process, the top of the wire returns to welding starting position at once and the welding program is continued.

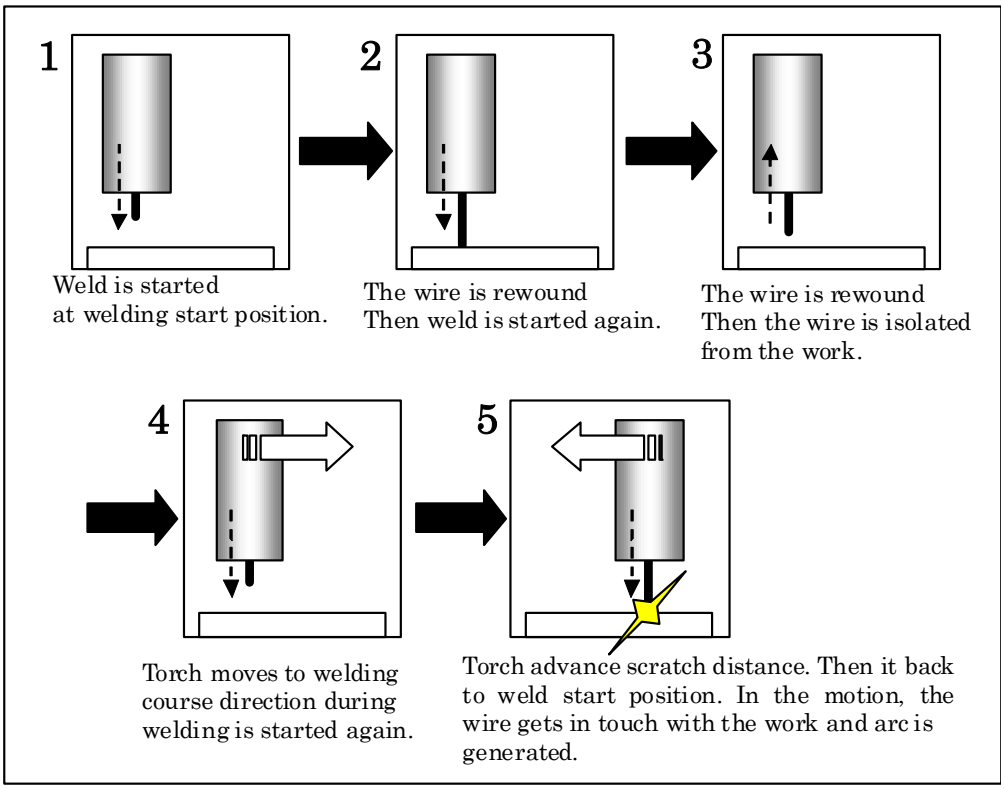


Fig. 5.1.3 (b) Scratch start function

Scratch start has the following three setting items.

Scratch return speed

This is the returning speed from the arc generating position during scratch motion. When this value is too low, some holes are generated at work since heat gain increases by the arc output during returning motion. So please set this value to high as much as possible.
When robot approach change rapidly in the motion like a circular motion, robot cannot reach the speed; for example, when robot approach changes rapidly, the scratch return speed may become 30 mm/sec even if the command is 100 mm/sec.

Scratch distance

This is the maximum distance that robot moves during scratch motion. When the arc does not generate even if the top of the wire moves by this distance, alarm is generated. When this value is too long, the area of heat insertion becomes large. So please set this value to short as much as possible.

Retry count

Specify the number of times of Scratch Return.

In the default setting is that scratch start is enabled, scratch distance is 5 mm and scratch return speed is 100 mm/sec. Retry count is 1. Those settings support various welding from thin metal welding to heavy welding.
The following procedure 5-1-3 (b) shows the setup procedure of scratch start function.

Procedure 5-1-3(b) Setup of Scratch Start Function

Step

1 Press [MENU] key and select [6 SETUP].
2 Press F1 [TYPE] key and select [Weld System]. SETUP Weld System screen is displayed. Move the cursor to below and the following screen is displayed.

```
SETUP Weld System                                    .
                                                10/22
Weld Restart Function
  7 Return to path:              ENABLED
  8 Overlap distance:            0    mm
  9 Return to path speed:        200  mm/s
Scratch Start Function
 10 Scratch start:               ENABLED
 11 Distance                     5    mm
 12 Return to start speed:       100  mm/s
 13 Retry count:                 1
[TYPE]                                        HELP
```

3 Move the cursor to [10 Scratch start]. When you set this function ENABLE, press F4 [ENABLED]. When you set this function DISABLE, press F5 [DISABLED].
4 Change the value of [Distance] , [Return to start speed] and [Retry count] if necessary.

> **⚠CAUTION**
> When the scratch start is executed in circular or circle arc motion, scratch return motion becomes linear motion. Please set [distance] to short because there is a possibility that the torch interferes with work in circular motion.

5.2 FUNCTION OF ARC WELDING END TIMING

Functions related to arc welding end timing are follows.

- Check and reset of wire stick (Wire stick detect/reset function)
- Gas control at weld end timing (Gas end flow / post flow functions)

This section explains overview and using method of these functions.

5.2.1 Check and Reset of Wire Stick

In DAIHEN Digital welding power supply, wire stick detect/reset function by the robot controller is not needed. Because Welbee has a built-in function to reset wire stick. This function is always executed at weld end sequence.

Since the robot position is too difficult for cutting the wire, please jog the robot to refer to the following procedure.

Procedure 5-2-1 (a) Wire Cutting after Jogging a Robot

Step

1 Change 3 Mode Switch to T1 or T2.
2 Change a Teach Pendant Switch to ON.
3 **Press [RESET] key while pressing [SHIFT] key.** The severity of ARC-030 alarm changes from STOP.L to WARN. As a result, you can jog a robot.
4 Set a low speed override and carefully jog a robot. Then, cut the wire.
5 After cutting the wire, **once press [RESET] key.** At the timing, wire stick detect is performed again and alarm is reset.

NOTE
You can jog a robot during wire stick state, but you cannot execute/resume a program. If you resume a program when the severity of ARC-030 is WARN, "INTP-106 Continue request failed" is posted.

External Output of Wire Stick Alarm

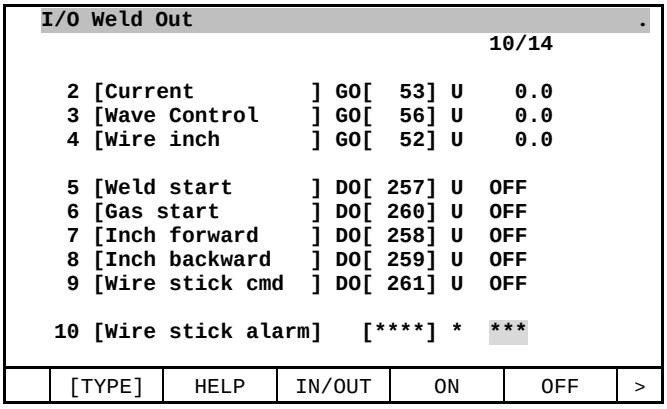
It is possible to output the wire stick state by Wire Stick Alarm Output Signal.
Wire Stick Alarm Output Signal is continued to output while the wire sticks (Wire Stick Detect Input Signal is ON) with Wire Stick Detect Function ENABLED (Weld System Setup Screen). If Auto Wire Stick Reset Function is ENABLED (Weld Equipment Setup Screen), the signal is output after wire stick reset and wire stick is still detected.

About the assignment of Wire Stick Alarm Output Signal, refer to Procedure 5-2-1 (b).

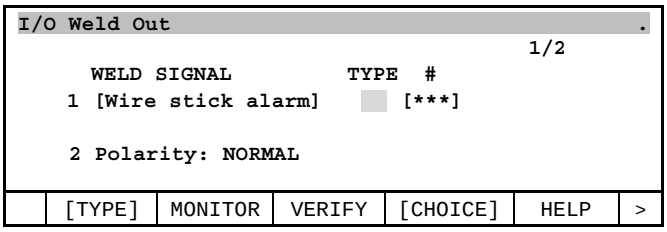
Procedure 5-2-1 (b) Assignment of wire stick alarm output signal

Step

1 Press [MENU] key and select "5 I/O". and Press F1[TYPE] key and select "Weld". Either Weld Input screen or Output screen is displayed.
2 When Weld Input screen is displayed, press F3 "IN/OUT".
3 Move cursor on "Wire stick alarm".



4 Press [NEXT] key and F3 "Config", the following screen is displayed.



5 Select signal type and number.
6 Press F3 "VERIFY" after press F2 "MONITOR" to check selected signal whether exists or not.
7 Cycle power the controller. After reboot it, selected signal is assigned as wire stick alarm output signal.

5.2.2 Gas Control at Weld End Timing

At the weld end timing, gas flow continues automatically until all the weld end processes (burnback, wire stick detect, reset, etc.) are finished. This is called "Gas End Flow". The time of gas end flow becomes the time of both burnback and wire stick detect/reset processes, but the time for wire stick detect process is changed by the wire stick status. Therefore, gas end flow time never becomes constant.

After craterfill process, if you always would like to perform gas flow with the constant time over gas end flow time on the weld end point, you can use gas post flow function. Gas post flow function can be used by setting gas post flow time.

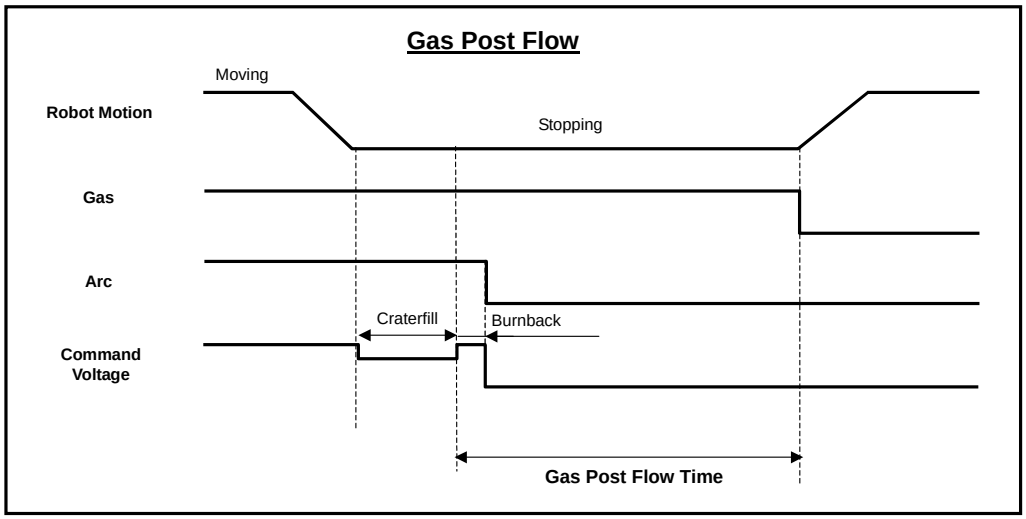


Fig. 5.2.2 Timing Chart of Gas Post Flow

Robot stops until finishing gas post flow, so the setup of gas post flow time influences the cycle time. As Fig 5.2.2, the count of gas post flow time starts just after craterfill process is completed, so burnback time and wire stick detect/reset time (gas end flow time) are included in gas post flow time. As a result, gas flow stops and robot moves to the next motion after finishing the longer process between gas end flow and gas post flow.

Gas post flow function is applied when the weld procedure which sets the gas post flow time is specified on Weld End instruction. When 0 sec is specified as gas post flow time, this function becomes disabled. 0 sec is specified as default, so normally gas end flow is applied.
Gas post flow can be used with both additional-motion instruction or single instruction of Weld Start instruction.

```
Data Weld Procedure                                    .
                                                 1/8
  -  Procedure              1 [                  ]
     Weld equipment         1
     Manufacturer:          DAIHEN Digital
     Model:                 Welbee + Enet
     File name:             AWE1WP01
     Schedules:             3

     Runin :                    ENABLED
     Burnback:                  DISABLED
     Wirestick reset:       3   DISABLED

     Gas purge:                  0.35  sec
     Gas preflow                 0.00  sec
     Gas postflow:               0.00  sec

   | [TYPE] | DETAIL | [CMND] | [VIEW] | HELP |
```

5.3 OTHER FUNCTION RELATED TO ARC WELDING

This section describes several useful functions supporting arc welding with robots.

- Auto recovery to pause position (Return to Path Function)
- Gas control by external devices (Remote Gas Purge Function)
- Wire feed control by external devices (Remote Wire Inching Function)
- Monitoring Functions
- Weld External Output Function
- Torch Guard Function
- Auto recovery of TCP gap (Torch Mate Function)
- Arc Abnormal Monitor Function
- Arc Welding Analogue Meter Displaying Function
- Touch Sensing Function

5.3.1 Auto Recovery to Pause Position

Return to Path Function (Original Path Resume Function) enables the weld from a breakpoint if the weld motion is interrupted by HOLD or Alarm and then the robot is move away. First, a robot moves to a breakpoint without welding and then restarts welding from the point by resuming a program. For resuming a welding from a breakpoint, you need to set a weld to ENABLED.

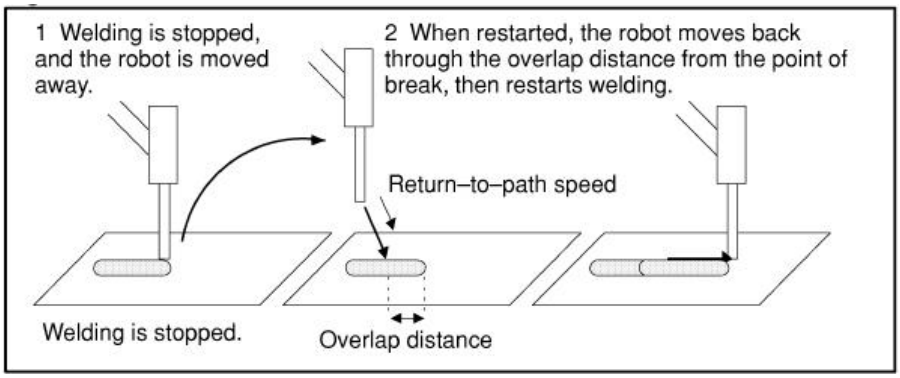


Fig. 5.3.1 Return to path function

Additionally, when a program is stopped without welding and robot moves to away, robot moves to break point at first and restart the program.

The following two setting items are prepared for Return to Path Function.

Overlap Distance

When directed to restart, the robot moves back from the breakpoint through the overlap distance, then restarts welding. This is intended to prevent the sequence of beads from being out. If the specified overlap distance extends beyond the previous teaching point, the actual overlap distance is limited to within that teaching point.

Return to Path Speed

Specifies the return-to-path speed at which the robot moves to the breakpoint when restarted.

In the default setting is that return to path function is enabled, Overlap distance is 0 mm and Return to path speed 200 mm/sec. Normally, please use it with enabled.

⚠CAUTION
In the case of this function DISABLE, welding is restarted from current position when JOG operation is executed during welding. The welding pass becomes from current position to the next target position. So please set this function enable normally.

⚠CAUTION
When operator restarts the program after robot is moved by JOG at HOLD for avoiding interference with work, welding restarting position is the position that HOLD is executed. So robot returns the HOLD position. To avoid this problem, please do the backward execution momentarily at the JOG position.

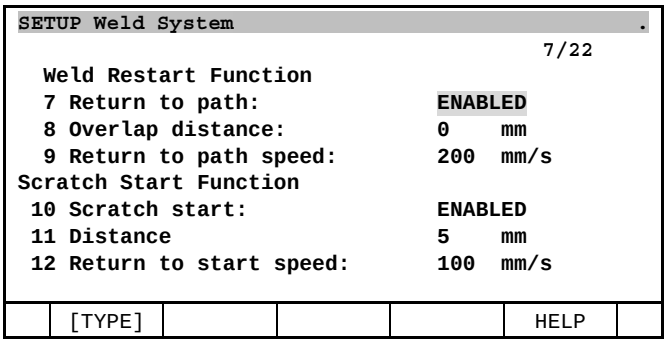
NOTE
Overlap distance is used only when a program is stopped during welding motion. When robot restart with weld disabled or the program is stopped without welding, the distance is ignored.

Following procedure 5-3-1 shows the setup procedure for return to pass function.

Procedure 5-3-1 Setup of Return to Pass Function

Step

1 Press [MENU] key and select [6 SETUP].
2 Press F1 [TYPE] key and select [Weld System]. SETUP Weld System screen is displayed. Move the cursor to below. The following screen is displayed.



3 Move the cursor to [7 Return to path]. When you set this function ENABLE, press F4 [ENABLED]. When you set this function DISABLE, press F5 [DISABLED].
4 Please change the value of [Overlap distance] and [Return to path speed] if necessary.

5.3.2 Gas Control by External Devices

Remote Gas Purge Function

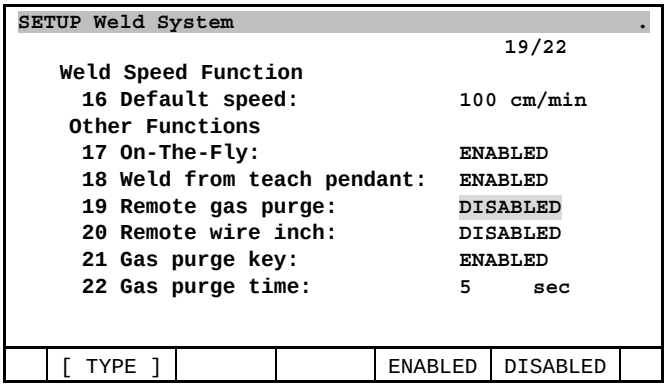
Remote gas purge function is the function to execute the gas purge by the external input signal. When you use this function, gas check can be executed without teach pendant.

If you would like to use this function, please execute the following setting procedure.

Procedure 5-3-2 Setup Remote Gas Purge Function

Step

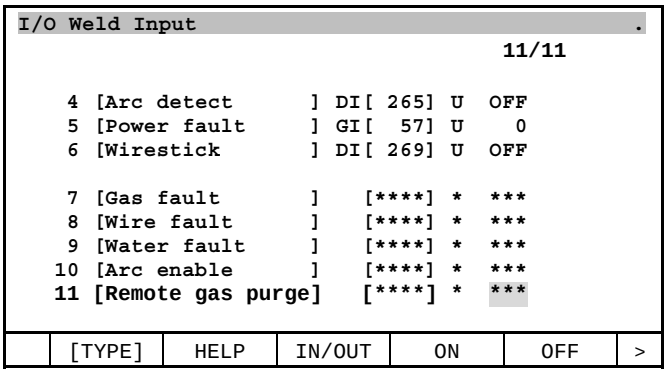
1 Press [MENU] key and select “6. Setup”. and press F1[TYPE] key and select “Weld System”, Weld System Setup screen is displayed. Move a cursor to the bottom and then the following screen will be displayed.



2 Move cursor on “Remote gas purge”, when it needs to be enabled, press F4 “ENABLED” when it needs to be disabled press F5 “DISABLED”.

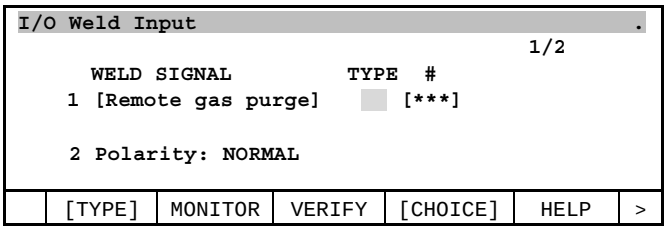
3 Next, assign the input signal. Press [MENU] key and select “5 I/O” and Press F1[TYPE] key and select “Weld”. Either Weld Input screen or Weld Output screen is displayed.

4 When Weld Output screen is displayed, press F3[IN/OUT] and change to Weld Input screen.



5 “Remote gas purge” signal will be appeared at the bottom of Weld Input screen only when remote gas purge function is enabled at step 2 in the procedure

6 Move cursor on “Remote gas purge” and press NEXT key and F3 “Config”, the following screen is displayed.



7 Select signal type and number.

8 Press F3 “VERIFY” after press F2 “MONITOR” to check selected signal whether exists or not.

9 Cycle power the controller. After reboot it, selected signal is assigned as remote gas purge output signal.

10 When a signal is input through the signal assigned as remote gas purge signal (remote gas purge input signal becomes ON), robot request gas output signal and gas purge will be operated.

5.3.3 Wire Feed Control by External Devices

Remote Wire Inching Function

Remote wire inching function is the function to execute the wire inching (forward / backward) by the external input signal. When you use this function, wire inching can be executed without teach pendant.

Remote wire inching speed and manual wire inching (using teach pendant) speed can be independently set.
If you would like to use this function, please execute the following setting procedure.

Procedure 5-3-3 Setup Remote Wire Inching Function

Step

1 Press [MENU] key and select “6. Setup”. and press F1[TYPE] key and select “Weld System”, Weld System Setup screen is displayed. Move a cursor to the bottom and then the following screen will be displayed.

```
SETUP Weld System                                    .
                                                20/22
   Weld Speed Function
     16 Default speed:                 125 cm/min
    Other Functions
     17 On-The-Fly:                    ENABLED
     18 Weld from teach pendant:       ENABLED
     19 Remote gas purge:              DISABLED
     20 Remote wire inch:              DISABLED
     21 Gas purge key:                 DISABLED
     22 Gas purge time:                5     sec

 |  | [ TYPE ] |  |  | ENABLED | DISABLED |  |
```

2 Move cursor on “Remote wire inching”, when it needs to be enabled, press F4 “ENABLED” when it needs to be disabled press F5 “DISABLED”.

3 Next, assign the input signal. Press [MENU] key and select “5 I/O” and Press F1[TYPE] key and select “Weld”. Either Weld Input screen or Weld Output screen is displayed.

4 When Weld Output screen is displayed, press F3[IN/OUT] and change to Weld Input screen.

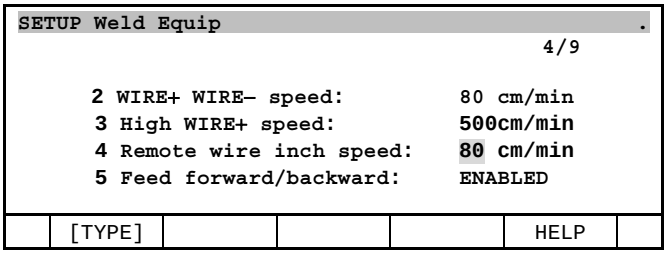
```
I/O Weld Input                                       .
                                                11/11

    4 [Arc detect      ] DI[ 265] U  OFF
    5 [Power fault     ] GI[  57] U    0
    6 [Wirestick       ] DI[ 269] U  OFF

    7 [Gas fault       ]   [****] *  ***
    8 [Wire fault      ]   [****] *  ***
    9 [Water fault     ]   [****] *  ***
   10 [Arc enable      ]   [****] *  ***
   11 [Remote inch fwd ]   [****] *  ***
   12 [Remote inch bwd ]   [****] *  ***

 |  | [TYPE] | HELP | IN/OUT | ON | OFF | > |
```

5 “Remote inch fwd” and “Remote inch bwd” signals will be appeared at the bottom of Weld Input screen only when remote gas purge function is enabled at step 2 in the procedure.

6 Move cursor on “Remote inch fwd” and press [NEXT] key and F3 “Config”, the following screen is displayed.

```
I/O Weld Input                                       .
                                                 1/2
      WELD SIGNAL          TYPE  #
    1 [Remote inch fwd]      [***]

    2 Polarity: NORMAL

 |  | [TYPE] | MONITOR | VERIFY | [CHOICE] | HELP | > |
```

7 Select signal type and number.
8 Press F3 “VERIFY” after press F2 “MONITOR” to check selected signal whether exists or not.
9 Assign “Remote inc bwd” with same steps (Refer to step.6 to 8)
10 Cycle power the controller. After cycle power, selected signal is newly assigned.
11 At last, setup remote wire feed speed. Press [MENU] key and select “6. Setup” and press F1[TYPE] key and select “Weld Equip”. Weld Equipment Setup screen is displayed.



12 “Remote wire inch speed” will be appeared below on “High Wire+ speed” only when remote wire inching function is enabled. Input the speed of remote wire inching.
13 When “Remote inch fwd” signal becomes ON, wire feeding to forward, on the other hand, “Remote inch bwd” signal becomes ON, wire feeding to backward.

5.3.4 Monitoring Functions

These functions are for monitoring abnormal state during arc welding. Monitoring functions have following six functions.

- Arc Loss Detect
- Gas Shortage Detect
- Wire Shortage Detect
- Wire Stick Detect
- Power Supply Failure Detect
- Coolant Shortage Detect

Subsection 5.2.1 describes wire stick detect function more detailed, please see the subsection about it.

Arc Loss Detect

The function posts an alarm and stops the welding and robot motion if the arc is lost during the fixed time of the welding.

Enabled/Disabled this function is set by Weld System Setup Screen. Allowance time of arc loss is defined on Weld Equipment Setup screen. If the arc detect signal is not returned over the time, the following alarm occurs and the welding and robot motion are stopped.

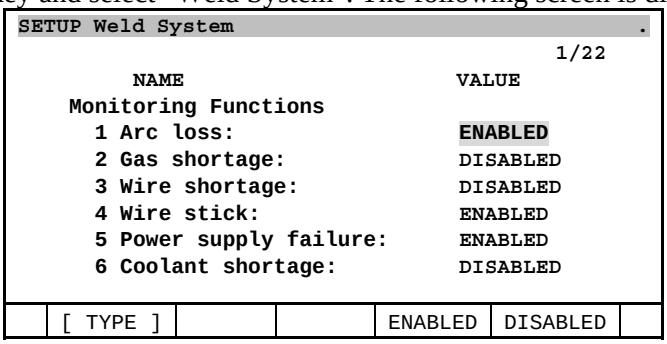
“ARC-018 Lost arc detect”

In the default setting in that this function is enabled. Normally, please use it with enabled.

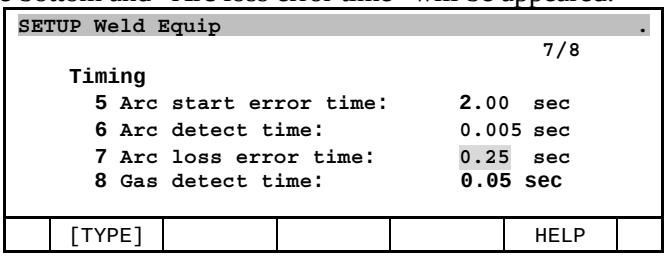
Procedure 5-3-4 (a) Setup Arc Loss Detect

Step

1 Press [MENU] key and select “6. SETUP”.
2 Press F1[TYPE] key and select “Weld System”. The following screen is displayed.



3 Move cursor on “Arc Loss”. When it needs to be enabled, press F4 “ENABLED” when it needs to be disabled press F5 “DISABLED”.
4 When the function becomes enabled in step 3, setup arc error detect time.
Press F1[TYPE] key and select “Weld Equip”. Weld Equipment Setup screen is displayed.
5 Move cursor to the bottom and “Arc loss error time” will be appeared.



6 In the standard is that the time is 0.25 sec, change the command if necessary.
7 The status of arc loss can output other devices through digital output, for more details , please see Subsection 5.3.5 Weld external output function.

Power Supply Failure Detect

Power Supply Failure Detect signal will become ON if internal of weld equipment is abnormal. If the welding is requested when the input signal is ON, or if the signal becomes ON during welding, the following alarm occurs and the welding and robot motion are stopped.

“ARC-008 Power supply fault”

If the input signal is ON, please specify the cause by using “7.3 REMEDY FOR TROUBLES”.
In the standard in that this function is enabled. Normally, please use it with enabled.

Gas, Wire, Coolant Shortage Detect

These functions are not supported as default. Therefore, they are DISABLED as factory default. If you use these functions, please prepare and mount the sensors yourself and operate Procedure 5-3-4 (b). (FANUC does not prepare these sensors.)

When gas/wire/coolant supply become abnormal, sensors detect it and send some signals to the robot controller. The robot controller is monitoring them and when it receives the signals, the following alarms occurs, and the welding and robot motion are stopped.

- **Gas Shortage Detect --- “ARC-005 Gas fault”**
- **Wire Shortage Detect --- “ARC-006 Wire fault”**
- **Coolant Shortage Detect --- “ARC-007 Water fault”**

Enabled/disabled the functions are set on Weld System Setup screen. Next, the assignment of input signals from sensors to the robot controller is required.

Gas shortage detect function has the setup item “Gas Shortage Detect Time”. Normally, this delay time exists since robot controller outputs gas signal and gas valve opens until gas arrives to the sensor for gas shortage detect. “Gas Shortage Detect Time” allows the delay time. If the alarm signal is input after the delay time passed, a weld alarm occurs. You should set appropriate value to Gas Shortage Detect Time according to your gas system structure.

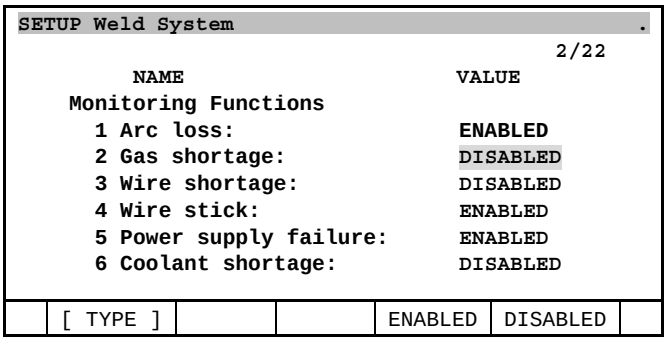
⚠CAUTION
If Gas Shortage Detect Function becomes ENABLED, the delay time for Gas Shortage Detect Time is generated at arc start timing. Therefore, the cycle time is also increased. Do not set Gas Detect Function to ENABLED if you do not use the sensor for gas shortage detect.

⚠CAUTION
If Gas Shortage Detect Time is too short, “ARC-005 Gas fault” might occur at every arc start timing. If so, set it longer time.

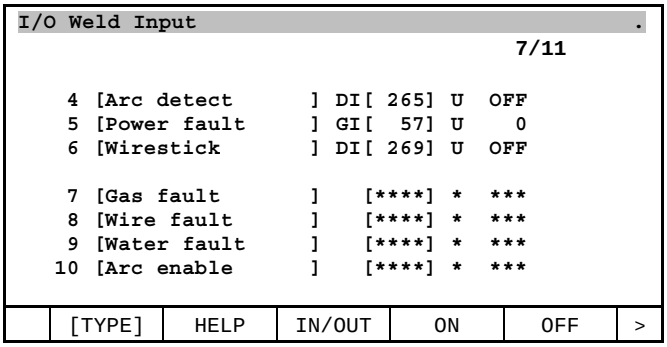
Procedure 5-3-4 (b) Setup of Gas, Wire, Coolant Shortage Detect Function

Step

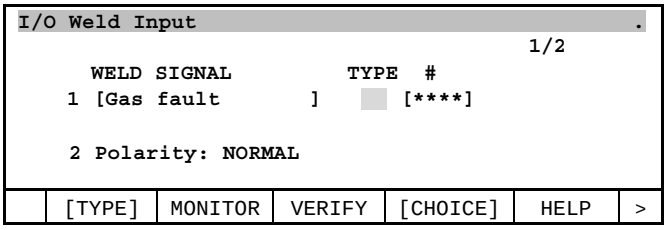
1 Press [MENU] key and select [6 SETUP].
2 Press F1 [TYPE] and select [Weld System]. The following screen is displayed.



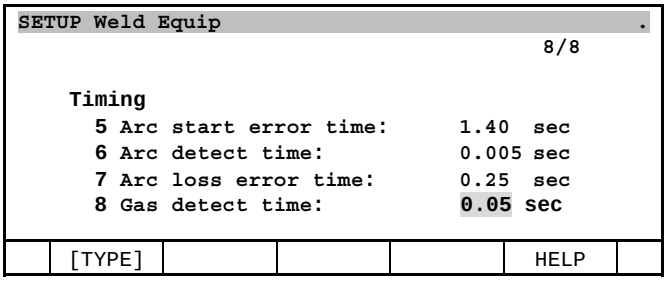
3 Move the cursor on the item, which you would like to set. If you set the function to ENABLED, press F4 “ENABLED”. If you set the function to DISABLED, press F5 [DISABLED].
4 Next, assign the input signals. Press [MENU] key and select “5 I/O” and press F1[TYPE] key and select “Weld”. Either Weld Input screen or Weld Output screen is displayed.
5 When Weld Output screen is displayed, press F3[IN/OUT] and change to Weld Input screen.



6 Move the cursor on Gas Alarm, Wire Alarm or Coolant Alarm. Then, Press F-> key and press F3[CONFIG]. The following screen is displayed. (Following screen is the example of Gas Alarm.)



7 Select the port type and port number for the input signal from the sensor.
8 Check the existence of the selected signal by F3 [VERIFY], and press F2 [MONITOR].
9 Cycle power the controller. After reboot it, the selected signal is newly assigned.
10 If Gas Shortage Detected Function is set, you must also set Gas Shortage Detect Function. Please also carry out Step 11 or later
11 Press [MENU] key and select [6 SETUP]. Press F1 [TYPE] and Select [Weld Equip].
12 Move the cursor to below. [Gas detect time] is displayed. Input the desired value to this item.



13 You can output the gas, wire and coolant shortage state to external as digital signal. Please refer to [5.8 External Output Function for Weld Signals] and setup.

5.3.5 Weld External Output Function

Weld external output function is a function to output various signals that relate to the welding to an outside device such as PLC. The screen to set this function is shown below. Table 5.3.5 shows setup items on this screen and the explanation. Setup procedure of this function is shown in Procedure 5-3-5 (a).

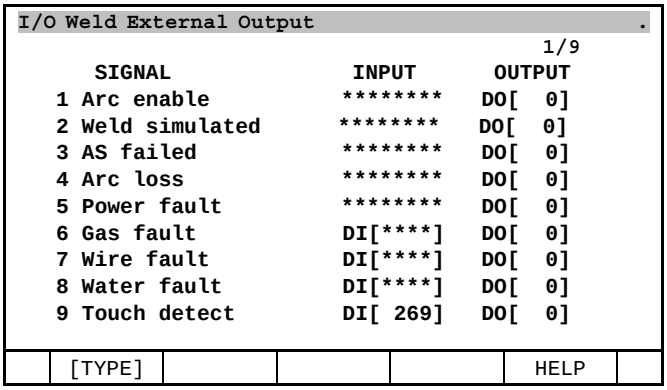


Table 5.3.5 weld signals and the explanation

Signal	Explanation
Arc enable	This signal is output when weld enable. This signal is turned ON/OFF according to the state (weld enable/disable of each equipment). The state of weld enable/disable is displayed on the TEST CYCLE Arc screen.
Weld Simulated	This signal is output when weld simulated mode is enabled. Regarding to the details of weld simulated mode, please refer to Section 5.7 of R-30*i*B/R-30*i*B Mate CONTROLLER Arc Welding Function OPERATOR'S MANUAL (B-83284EN-3).
AS failed	This signal is output when Arc Start fails. When this signal is ON, an alarm of **[ARC-013 Arc Start failed]** generates at the same time. When this alarm is reset, this signal is OFF.
Arc loss	This signal is output when the Arc loss generates. When this signal is ON, an alarm of **[ARC-018 Lost arc detect]** generates at the same time. When this alarm is reset, this signal is OFF.
Power fault	This signal is output when it is impossible to communicate with the weld equipment. Moreover, this signal is also output when ArcTool software detects the abnormal state in the weld equipment. This signal is output until [ARC-051 Weld EQi ONLINE: ArcLink] is displayed after turning on the power supply.
Gas fault	An external sensor is necessary to use this signal. This signal is output according to the state of the input signal allocated to the item of **[Gas fault]** of weld I/O input screen. This signal is invalid when the input signal is not assigned. This signal doesn't depend on a setting item of [Gas shortage] on the SETUP weld system screen.(If the signal is valid and becomes ON, ARC-003 or ARC-005 alarm occurs as conventionally.)
Wire fault	An external sensor is necessary to use this signal. This signal is output according to the state of the input signal allocated to the item of **[Wire fault]** of weld I/O input screen. This signal is invalid when the input signal is not assigned. This signal doesn't depend on a setting item of [Wire shortage] on the SETUP weld system screen. (If the signal is valid and becomes ON, ARC-006 alarm occurs as conventionally.)
Water fault	An external sensor is necessary to use this signal. This signal is output according to the state of the input signal allocated to the item of **[Water fault]** of weld I/O input screen. This signal is invalid when the input signal is not assigned. This signal doesn't depend on a setting item of [Coolant shortage] on the SETUP weld system screen. (If the signal is valid and becomes ON, ARC-007 alarm occurs as conventionally.)
Touch detect	Touch detect signal is output when the wire contact with a work. This signal is output according to the state of the Touch sensing input signal. The signal is used for touch sensing function and torch mate function. **Reference:** The Touch sensing input signal turns ON in the state of Touch sensing output signal is ON when the wire contact with a work.

Procedure 5-3-5 (a) Setup of Weld external output function

Step

1 Press [MENU] key then screen menu is appeared.
2 Select the "5 I/O".
3 Press the F1 [TYPE] and select "Weld Ext DO". Following screen is displayed.

```
I/O Weld External Output                                .
                                                    1/9
     SIGNAL                  INPUT       OUTPUT
  1 Arc enable               ********    DO[  0]
  2 Weld simulated           ********    DO[  0]
  3 AS failed                ********    DO[  0]
  4 Arc loss                 ********    DO[  0]
  5 Power fault              ********    DO[  0]
  6 Gas fault                DI[****]    DO[  0]
  7 Wire fault               DI[****]    DO[  0]
  8 Water fault              DI[****]    DO[  0]
  9 Touch detect             DI[ 269]    DO[  0]

 [TYPE]                                          HELP
```

4 Set the external output signal corresponding to each usage. When you set OUTPUT to 0, the output signal is invalid. When the specified value has already been used as weld input, [This NO. is already used as Weld Output] is displayed, back to before editing. When the specified value does not exist, [Port assignment is invalid] is displayed, back to before editing.

> **⚠CAUTION**
> In Step 4, the setting of the specified output signal is reflected at once. Therefore, there is a possibility that the signal is immediately turned on after this setting. Please confirm the number well before setting up it.

5 Concerning to [Gas fault], [Wire fault] and [Water fault], it requests to assign the signal of external sensor to weld I/O input. Please refer to Procedure 5-3-4 (b) about the method to assign.

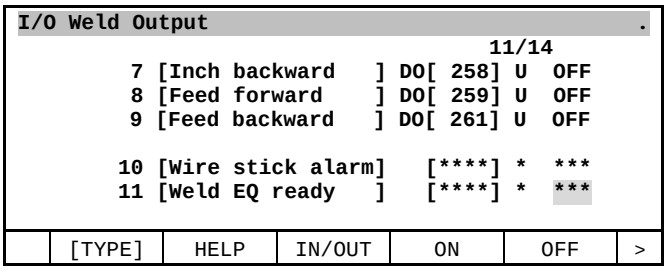
Output weld equipment ready to weld signal

In addition to preceding signals, the output signal announcing that the weld equipment ready to weld to external device is provided.
At start up the controller and weld equipment 30 to 40 sec is required to establish connecting to weld equipment. This signal becomes ON after the establishment of communication. Since external devices checks robot can weld or not through the signal, users can check right and wrong of operations related to weld equipment and starting welding program on external devices.
This signal is displayed on Weld Output screen not Weld External Output screen. Procedure 5-3-5(b) describes the assignment of the signal.

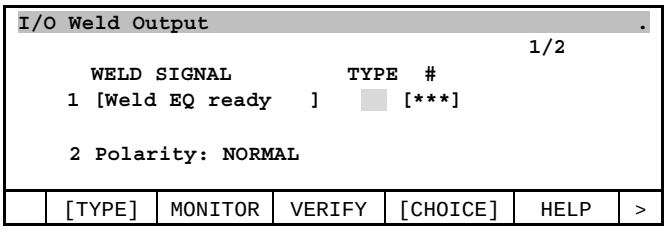
Procedure 5-3-5 (b) Assignment weld equipment ready to weld signal

Step

1 Press [MENU] key then screen menu is appeared.
2 Select “5 I/O”.
3 Press F1[TYPE] key and select “Weld”. Weld Input screen or Weld Output screen is displayed.
4 When Weld Input screen is displayed, press F3[IN/OUT] and change to Weld Output screen.

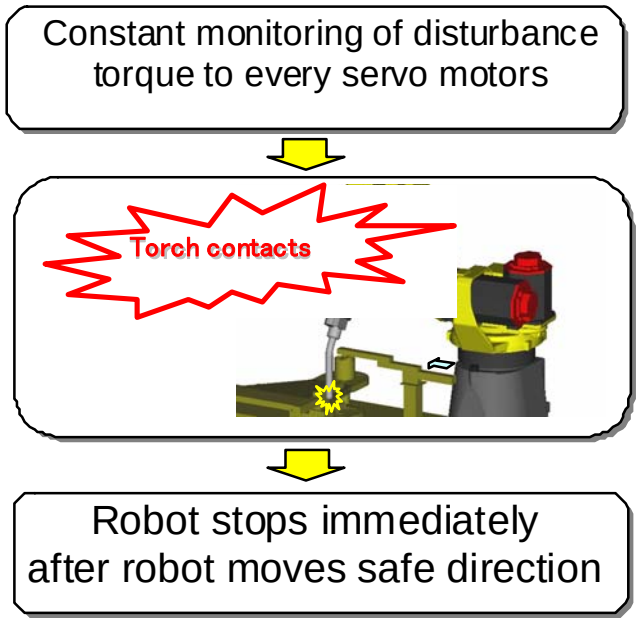


5 Move the cursor on “Weld EQ ready”, press NEXT key and press F3”CONFIG”. The following screen is displayed.



6 Select the port type and port number for the input signal from the sensor.
7 Check the existence of the selected signal by F3 [VERIFY], and press F2 [MONITOR].
8 Cycle power the controller. After reboot it, the selected signal is newly assigned.

5.3.6 Torch Guard Function



Torch guard function avoid TCP(Tool Center Point) error with reducing damage to robot at torch interference by stopping robot motion immediately. Since TCP error doesn't occur, even if an unexpected robot contact is occurs, the function provides to avoid time-consuming operation; re-setup TCP and re-teach weld program etc.
Since the contact is detected through constant monitoring of disturbance torques for every servo motors, the function detect contacts without additional sensor; shock sensor etc. and the robot stops after it moves to minimize disturbance torques, the damage to torch will be minimized.
This function can detect the contact between jig etc. and not torch but mechanical section of robot.

In the default seeting is that the function is enabled and it isn't required some setting

5.3.7 Auto Recovery of TCP Gap

Torch Mate Function

Torch mate function detects and recoveries TCP(Tool Center Point) error with executing macro program for a few seconds. This function minimizes restoration time from abnormal status, since the function avoid re-teach weld program even if TCP error occurs.

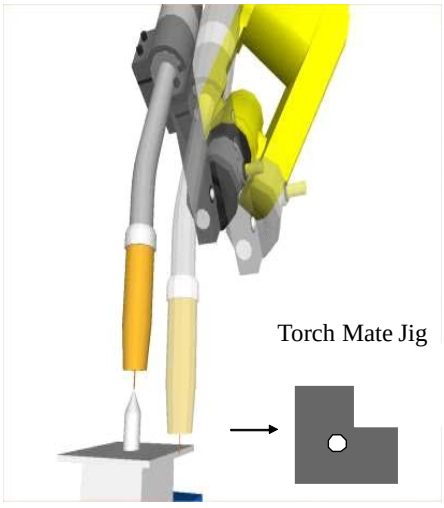


Fig. 5.3.7 Torch Mate Function

Torch Mate function requires special software and hardware. The software has been installed, so it isn't required an arrangement.
At hardware, torch mate jig and touch sensor circuit; detect to the wire touch the torch mate jig are required.

DAIHEN digital welding power supply has wire stick detection circuit as default and it can be used for touch sensing, so it isn't required an arrangement.

About details of approach in the use of torch mate function, refer to Chapter 12 in R-30*i*B/ R-30*i*B Mate CONTROLLER Arc Welding Function OPERATOR'S MANUAL (B-83284EN-3).

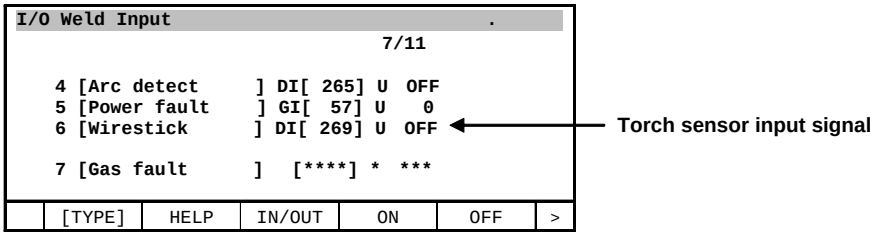
Assignment of I/O for Torch Mate Function

To use touch sensor circuit on welding power supply for Torch Mate function, specify the port number of I/O of Torch Mate function on Torch Mate setup screen after confirming them on Weld I/O screen with Procedure 5-3-7.

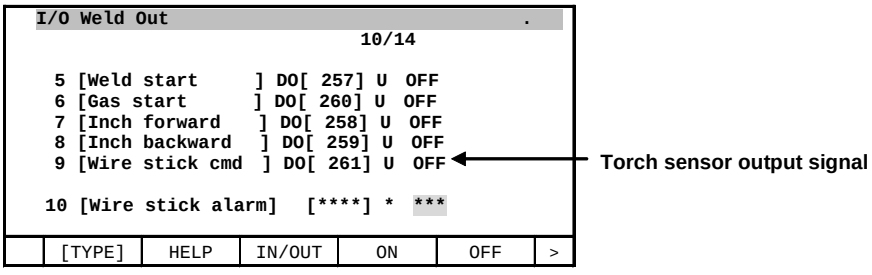
Procedure 5-3-7 Confirm port numbers of touch sensor circuit

Step

1 Press [MENU] key and select "5. I/O", and press F1[TYPE] key and select "Weld". Weld Input screen or Weld Output screen is displayed.
2 When Weld Output screen is displayed, press F3[IN/OUT] and change to Weld Input screen.
3 Port number of touch sensor input signal is equal to the one of "Wirestick". (The following example, DI[269] is touch sensor input signal.)



4 Press F3[IN/OUT] and change to Weld Input screen.
5 Port number of touch sensor output signal is equal to the one of "Wire stick cmd". (The following example, DO[261] is touch sensor input signal.)



6 To use torch mate function, setup port number of the I/O in torch mate setup screen.
To use touch sensor function, setup port number on touch sensor I/O screen.

5.3.8 Arc Abnormal Monitor Function (Option)

Arc Abnormal Monitor Function monitors the actual current and voltage during arc welding, and it can inform the operator that some bad weldings occurred quickly by some alarms and output signals when these values exceed the thresholds (it is possible to stop the running program by alarms). This function makes the root cause analysis of the bad welding easier.
Additionally, Arc Weld Log function is included in Arc Abnormal Monitor Function. The function can save the actual current and voltage in output device for each weld bead, and it can also display graphs such as Fig. 5.3.8 (b) on Teach Pendant.

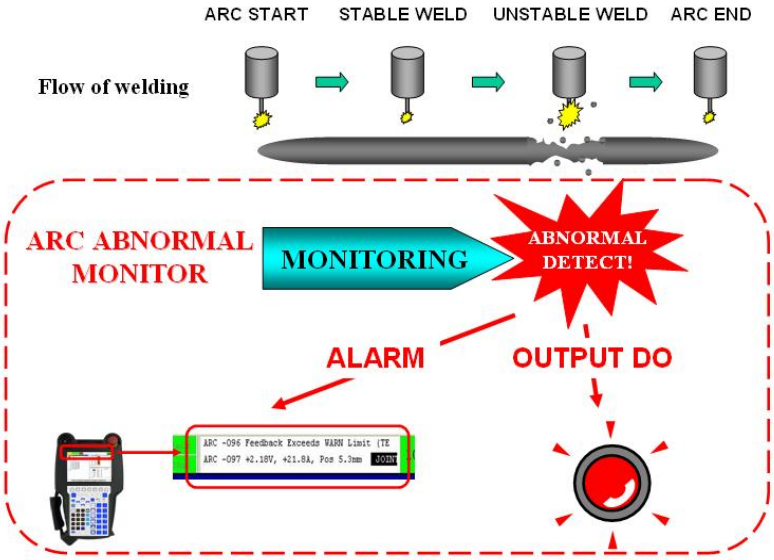


Fig. 5.3.8 (a) Outline of arc abnormal monitor function

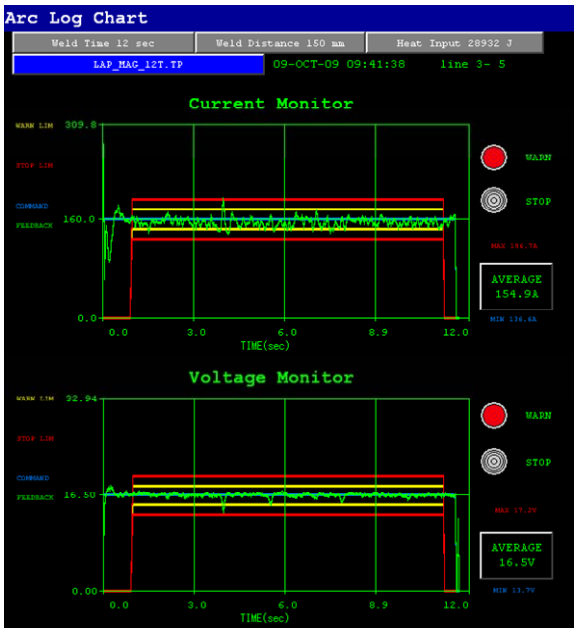


Fig. 5.3.8 (b) Arc weld log – chart function

Arc abnormal monitor function is an optional function. Detail of this function is written in Chapter 19 of R-30*i*B/ R-30*i*B Mate CONTROLLER Arc Welding Function OPERATOR'S MANUAL (B-83284EN-3). Please refer to it.

5.3.9 Arc Welding Analogue Meter Displaying Function (Option)

Arc welding analogue meter function is the graphical user interface of displaying welding command/feedback voltage and current.

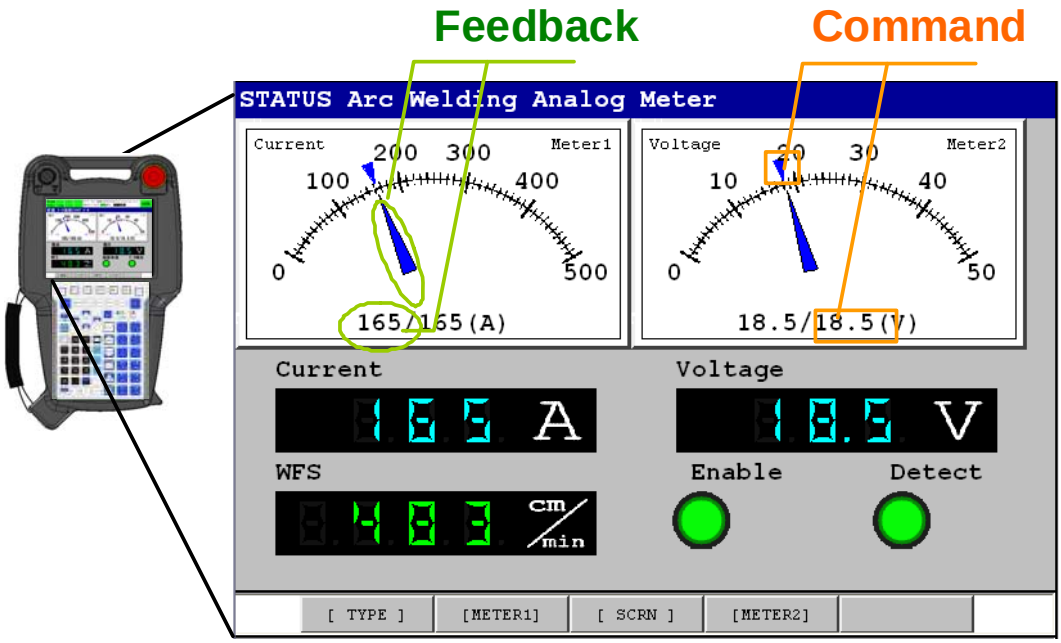


Fig. 5.3.9 Arc Welding Analogue Meter Displaying Function

The UIF displays not only the contents on arc welding status screen but also the following contents.

- Show Current/Voltage/Wire feed speed as analog meter format.
- Average of welding voltage, current and wire feed speed per a welding
- The name of currently-running TP program
- The line number of the latest arc start instruction in currently-running TP program
- Currently using weld mode
- Weld distance and welding speed
- Arc on time per a welding

Arc welding analogue meter displaying function is an optional function. Detail of this function is written in Chapter 18 of R-30*i*B/ R-30*i*B Mate CONTROLLER Arc Welding Function OPERATOR'S MANUAL (B-83284EN-3).Please refer to it.

5.3.10 Touch Sensing (Option)

Touch sensing allows the robot to change a path automatically to compensate for object displacement.
Touch sensing consists of two phases: Search Motion phase and Touch Offset phase.

Search Motion

Search Motion can detect the current position of workpiece.

- Move touch sensor part (on arc welding robot, the top of wire = TCP) toward the workpiece using pre-defined robot motion, speed, and direction.
- Use an input signal to indicate that the robot has come into the contact with the object.
- Store the found location of the workpiece, or position offset information, in position registers.

The example of search motion is shown below.

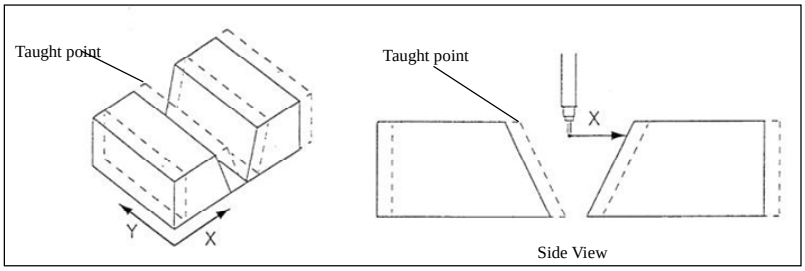


Fig. 5.3.10 (a) Search motion for detecting shift of X direction

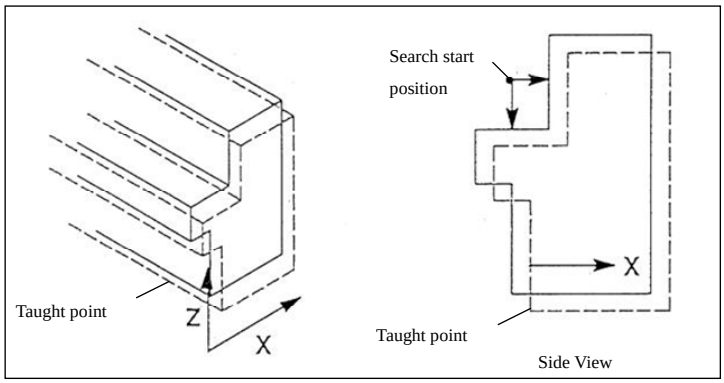


Fig. 5.3.10 (b) Search motion for detecting shift of X, Z directions

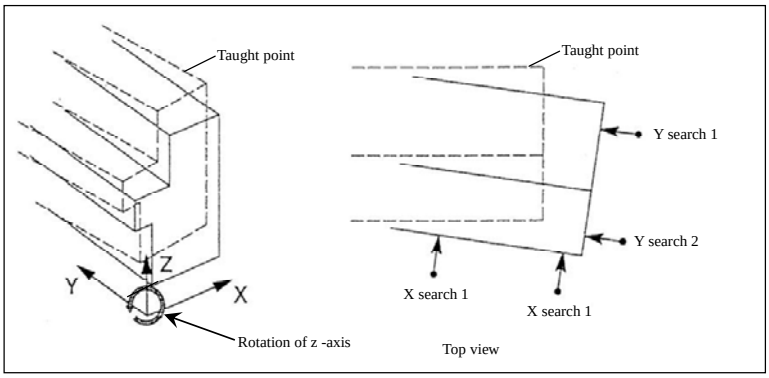


Fig. 5.3.10 (c) Search motion for detecting shift of X, Y directions and Z rotation

Touch Offset

Shift one or more teaching positions in your welding program by using the stored position the stored position offset information.

Touch sensing is an optional function. Detail of this function is written in Chapter 39 of R-30*i*B/ R-30*i*B Mate CONTROLLER Optional Function OPERATOR'S MANUAL (B-83284EN-2) Please refer to it.

Assignment Torch sensor I/O

To use touch sensor circuit on welding power supply for torch sensing function, specify touch sensor I/O port numbers on touch sensing I/O setup screen after confirming them on Weld I/O screen with Procedure 5-3-7.

NOTE

I/O port numbers of touch sensor is depended on assignment range of I/O. Be sure to confirm touch sensor port number with Procedure 5-3-7 and setup touch sensing I/O.

6 WELDING MACHINE INSPECTION AND MAINTENANCE

This chapter describes the method of routine and periodic inspection and maintenance of the welding power supply section of welding power supply option.

- For the method of inspection and maintenance of the robot mechanical section, refer to “ARC Mate 100*i*C/12/7L/12S, M-10*i*A/12/7L/12S operator’s manual”. (B-83654EN)
- For the method of inspection and maintenance of the robot mechanical section, refer to “ARC Mate 120*i*C/M-20*i*A operator’s manual”. (B-82874EN)
- For the robot controller, refer to "R-30*i*B controller Maintenance Manual". (B-83195EN)
- For the robot controller, refer to "R-30*i*B Mate controller Maintenance Manual". (B-83525EN)

Organization of this chapter

6.1 ROUTINE INSPECTION

> **⚠ WARNING**
> Before inspection, adjustment, and replacement, be sure to turn off the switch of the switch box and confirm safety at all times except when an inspection is required while the power is on.
> Otherwise, a serious accident resulting in an electrical shock or burn can occur.

To make full use of the welding machine and ensure safe operation in daily work, routine inspection is indispensable.
In routine inspection, check the components listed below, centering on the checking of the welding torch and wire feeder for worn, deformed, and clogged consumable parts. Replace or clean components as required.
For component replacement, be sure to use a component specified by FANUC in order to maintain the performance and functions.

6.1.1 Welding Power Supply

Component	Point of inspection	Remarks
Front	- Check that equipment is securely mounted. - Check that equipment (such as a switch) is not broken	If there is a problem, perform an internal inspection, additional tightening, part replacement, or other measures. Refer to the welding power supply for details.
Side	- Check that the "Input Voltage" switch is correctly set. - Check that equipment and terminal covers are securely mounted. - Check that the rotation sound of the cooling fan is normal and that cool air flows normally (from the rear to the front). (The cooling fan operates by internal temperature.)	

Component	Point of inspection	Remarks
Peripheral	- Check that cases are securely mounted on the top board or other sections.	If it is loosened, perform additional tightening.
General	- Check that there is no visual sign of overheating such as discoloration. - Check the looseness of connector - Confirm the tightening of cable terminal connection part of secondary side - During power-on, Check that there is no abnormal vibrations or whines. Check that there is no abnormal smell.	If there is an abnormality, make an internal inspection.

Caution when abnormal is founded

Capacitor discharge procedure (Refer to welding power supply manual for details.)

Before inspection and maintenance, be sure to take enough time till discharge of capacitor completely finished. (this may take several minutes)

6.1.2 Wire Feeder

Component	Point of inspection	Remarks
Idle arm	Check if the nut is tightened in the degree that does not slip. (In particular, wires of 1.2 mm ϕ and up must not be tightened excessively.)	Unstable wire feed and unstable arc operation can occur.
Drive roll(4pcs)	Check the matching between the welding wire diameter and the nominal diameter of the feed roller. Check if the feed roller groove is clogged and if the cut groove is worn.	Wire chips can be generated, resulting in a clogged conduit tube and unstable arc operation. If any of these problems is found, replace them with a new articles.
General	Clean each parts. Check the looseness of bolts and other connection parts.	

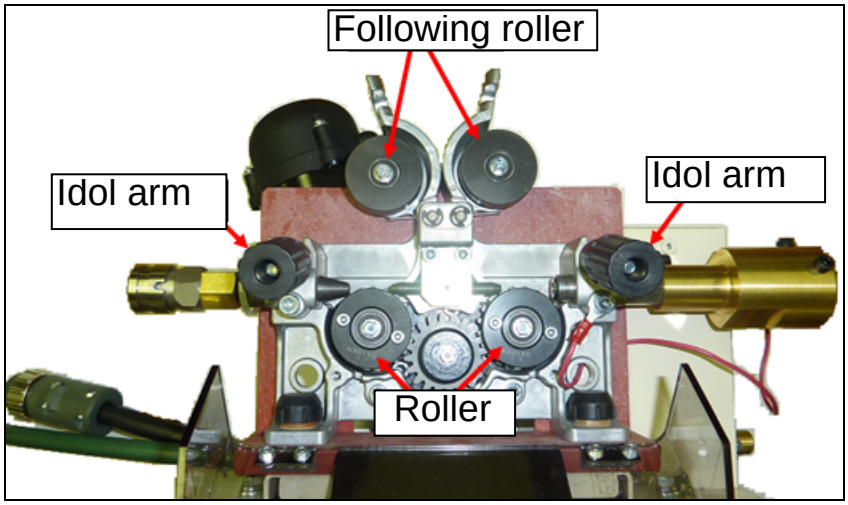


Fig. 6.1.2 Wire feeder

6.1.3 Welding Torch

(Part constitution is different by a torch slightly.)

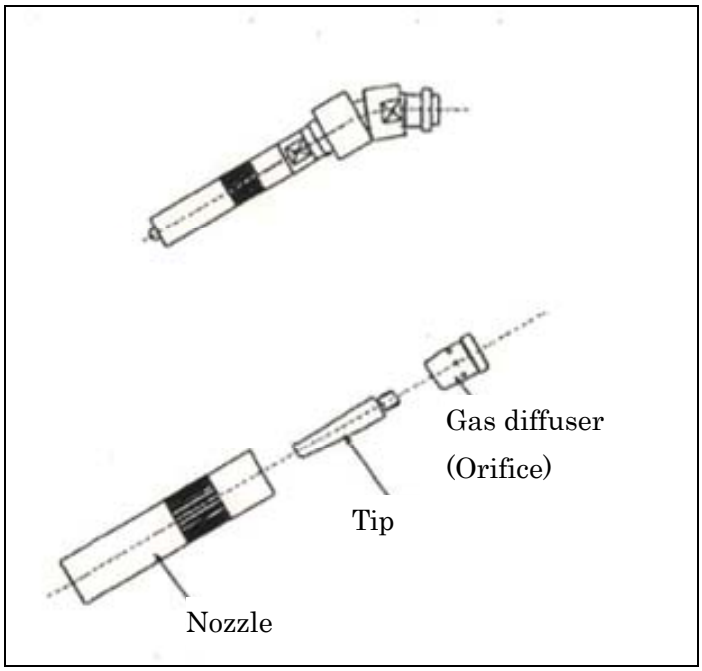


Fig. 6.1.3 Welding torch

Component	Point of inspection	Remarks
Nozzle	Loose attachment and tip deformation	A blow hole can result.
	Sputter attachment	The torch can burn, or a blown hole can result. (The use of a sputter attachment protection agent is useful.) Clean frequently to prevent accumulation of spatter.
Tip	Loose attachment	The screws of the main torch body can be damaged.
	Tip damage, and hole wear and clogging	Unstable arc operation and intermittent stop of operation can occur.
Gas diffuser (Orifice)	Check if no gas diffuser is installed, the gas diffuser is cracked, the hole is clogged, or a gas diffuser of another supplier is installed.	A welding defect (such as a blow hole) can occur due to a gas shielding failure or the main torch body can burn (spark in the main body). Take necessary action.
General	- Check the looseness of bolts and other connection parts. - Perform air blow using dried air.	

6.1.4 Cable

Component	Point of inspection	Remarks
Torch cable	Check if the torch cable is not attached firmly to the mounting fixture. Check if the torch cable is bent excessively.	Wire feed can fail. The arc can flicker due to irregular wire feed, or unstable arc operation can occur. Ensure that the torch is extended straightly where possible.
Output side cable	Check if the cable insulator is worn or broken. Check if the cable joint is exposed (insulator is broken) or if the cable connection is loose (at the base metal connection point of the welding power supply terminal or between cables).	To ensure human safety and stable arc operation, conduct an inspection suitable for the status of the factory floor. ○ Make rough and simple checks in routine instruction. Make rough and simple checks in routine instruction. ○ Make detailed and through checks in periodic inspection.
Input side cable	Check if the cables on the input/output terminal on the input protective device of the switch box are loosely connected. Check if the fuse mounting section is not securely fastened. Check if the connections on the input terminal of the welding power supply are not securely fastened. Check if the cable insulator is worn, broken, or exposed in the input-side cabling.	
Ground wire	Check if the ground wire for welding power supply grounding is disconnected or loosely connected. Check if the ground wire for base metal grounding is disconnected or loosely connected.	To ensure safety against an unexpected leakage accident, be sure to perform routine inspection.
Confirm connection part of hose	Stop the main cylinder valve and confirm pressure go down.	
Confirm the installation place	Check there is combustibles or water and remove them.	

6.1.5 Welding Wire

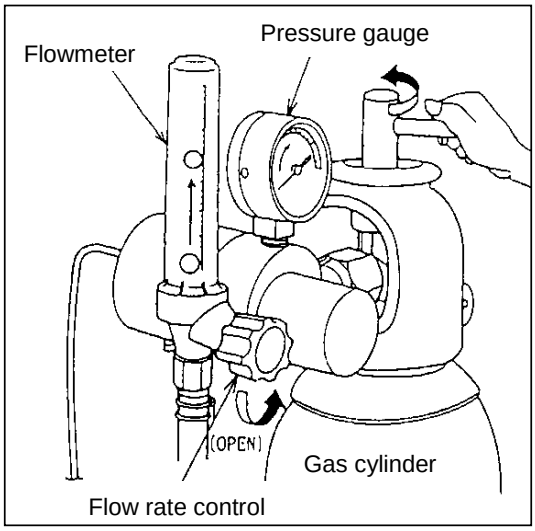
Point of inspection	Remarks
Confirm there is rust or oil, and remove them	

6.1.6 Checking Gas Flow Rate

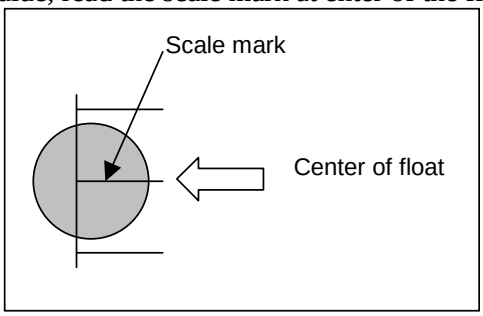
The gas flow rate is an important factor in ensuring stable arc welding. The gas flow rate can vary depending on the primary gas pressure. So, check the gas flow rate every day.

Use the procedure below when checking the gas flow rate.

1 When gas is not output, check that the specified gas pressure is observed.
   * The maximum input pressure of the gas controller is 11.8 MPa for CO_2 gas, and 15.7 MPa for argon gas and mixed gas (CO_2 + argon).
2 Make a gas check from the teach pendant. Refer to [Procedure 4-7 manual gas check] about this operation.
3 Meanwhile, read the value of the gas flow meter.
4 Check that the read value satisfies the specification. If the specification is not satisfied, adjust the flow rate control to set the specified flow rate.



* When reading a flow rate value, read the scale mark at enter of the float as shown below.



6.2 1-MONTH (320 HOURS) CHECKS

Item	Check items		Check points
1	Welding torch	Confirm the looseness of union nut (In case of BINZEL torch 350GC)	In case of BINZEL torch, remove insulated cap and rubber cover referring to Section 8.7 to 8.10 and confirm looseness of union nut. If it is loosen, retighten it with torque of 30Nm.

Fig. 6.2 Check of the union nut

6.3 6-MONTH (1920 HOURS) CHECKS

Check the following items in the cycle that is shorter between every 3 months and every 1920 hours.
Refer to DAIHEN welding power supply manual.

Item	Check items		Check points
1	Welding power supply	Cleaning inside the welding power supply	Perform air blow using dried air. (Note)
2		Confirm the damage situation of fan	Confirm whether a fan is not damaged.
3		Check the allophone and vibration	Check there is allophone and vibration.
4	Wire feeder	Cleaning each parts	Perform air blow using dried air.
5		Check the tighten of bolts and other connection parts.	Check the looseness of torch mounting parts. and retighten the terminal of power source parts.
6		Check the length of wire feeding	Check the length of inching is regulated degrees.
7		Check the gas valve	Check opening and shutting is normal And check whether there are not forwarding irregularities when opening and shutting is normal.
8	Welding torch	Confirm looseness of union nut. (BINZEL torch only)	See Section 6.2.

6.4 1-YEAR (3840 HOURS) CHECKS

Check the following items in the cycle that is shorter between every 1 year and every 3840 hours.
Refer to maintenance and check parts of welding power supply manual.

Item	Check items		Check points
1	Welding power supply	Cleaning inside the welding power supply	See Section 6.3.
2		Confirm the damage situation of fan	See Section 6.3.
3		Check the allophone and vibration	See Section 6.3.
4	Wire feeder	Cleaning each parts	See Section 6.3.
5		Check the tighten of bolts and other connection parts.	See Section 6.3.
6		Check the length of wire feeding	See Section 6.3.
7		Check the gas valve	See Section 6.3.
8	Welding torch	Replacing torch cable (Including conduit)	Confirm whether it is not damaged. If it is damaged, replace it by new one. (See Chapter 8.)
9		Replacing liner	Confirm whether it is not damaged. If it is damaged, replace it to new one. (See Chapter 8.)
10	Around cable	Confirm reel side conduit.	Confirm whether it is not damaged. Check whether it is moderate length and bending radius is not to small.

6.5 REPLACING CONSUMABLES

⚠WARNING
Before inspection, adjustment, and replacement, be sure to turn off the switch of the switch box and confirm safety at all times except when an inspection is required while the power is on.
Otherwise, a serious accident resulting in an electrical shock or burn can occur.

This section describes how to replace consumables.
Use consumables supplied by FANUC at all times except wire and gas. Use special care when selecting a wire and gas.

6.5.1 Wire

1 When wire remains in the conduit, pull out the wire.
2 Detach the empty wire reel from the wire reel stand.
3 Attach a new wire reel.
4 Run the wire.

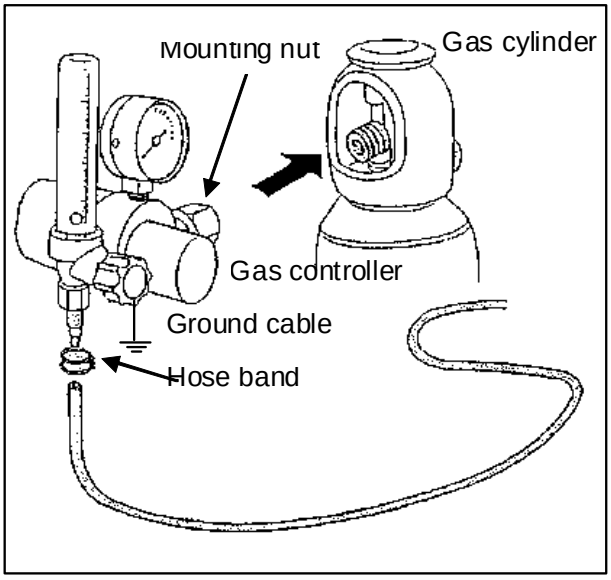
6.5.2 Gas

⚠WARNING
When handling a gas cylinder, observe the high-pressure gas regulation, and manage the gas cylinder according to the standard defined in your company. A gas cylinder contains high-pressure gas. If a gas cylinder is handled incorrectly, high-pressure gas can blow out, and can cause an accident resulting in a human injury or death. Be sure to observe the following items:

- When a gas cylinder falls, an accident resulting in a human injury or death can occur.
- Secure a gas cylinder to a dedicated cylinder stand. Be sure to secure a gas cylinder vertically. When using a gas cylinder, do not lay it.
- The internal pressure of a gas cylinder varies with temperature. If a gas cylinder is exposed to direct sunlight or placed close to a heat source, the internal pressure increases, and the safety valve of the gas cylinder can be actuated.
- Before mounting a gas controller onto the gas cylinder, check that a cylinder packing is inserted in the cylinder mounting nut of the gas controller. If no cylinder packing is inserted, be sure to insert a cylinder packing.
  When opening the valve of the gas cylinder, open the valve step by step until the valve is fully open.

1 Close the valve of the gas cylinder.
2 Detach the gas controller.
3 Replace the gas cylinder.
4 Mount the gas controller.
  Mount the gas controller onto the gas cylinder with a mounting nut. Tighten the nut sufficiently with a monkey wrench.
5 Open the valve of the gas cylinder.
6 Check the gas pressure and gas flow rate.

For gas check operation, see Subsection 6.1.6, " CHECKING GAS FLOW RATE ".



6.5.3 Nozzle

Before starting operation, make a check every day. Replace the nozzle if distorted.

1 Remove the nozzle.
2 Attach a new nozzle.

> **⚠CAUTION**
> Remember to mount a gas diffuser.

6.5.4 Tip

Before starting operation, make a check every day. Replace the tip if its hole is enlarged.

1 Remove the nozzle.
2 Remove the tip.
3 Mount a new tip.

> **NOTE**
> Mount a tip that matches the diameter of wire used.

4 Mount a nozzle.

> **NOTE**
> Remember to mount a gas diffuser.

6.5.5 Liner

Clean the liner with an air blow at least once a week.
Replace the liner if it has lost elasticity or is broken.

1 Remove the welding torch from the wire feeder.
2 Replace liner to new one (See Section 8.4.)

> **NOTE**
> Mount a liner spring that matches the diameter of wire used.

3 Paying attention to the following, mount the welding torch onto the wire feeder:

- When mounting the welding torch onto the wire feeder, push the welding torch sufficiently up to the base. Otherwise, trouble such as gas leakage, wire distortion in the torch due to a caught wire, and feed failure can occur.

6.6 PROGRAM BACK-UP

Usually, programs are stored in the memory internal to the robot controller. Even when the power is turned off, this memory is powered by a battery so that information stored in the memory is not lost. However, it is recommended to back up programs stored in the memory, considering an accidental damage to the memory or battery life expiration. Moreover, when a modification is to be made to a taught program, it is recommended that the program be backed up before and after the modification. By backing up programs in this way, a program or position data lost by an incorrect operation can be restored.

You can use “Flash ATA memory Card”.

About backup, please refer to Subsection 7.3.4 Acquisition of All Backup, 7.3.5 Acquisition of Image Backup and Section 8.4 SAVING FILES in R-30*i*B/ R-30*i*B Mate CONTROLLER OPERATOR’S MANUAL (Basic Operation) (B-83284EN).

⚠CAUTION
Flash ATA memory card.
In order to protect against accidental loss of data from a flash ATA memory card, it is recommended to back up the files of the flash ATA memory card to another medium such as a memory card.

7 TROUBLE SHOOTING

7.1 TROUBLE SHOOTING ABOUT ALARM

This section describes about main cause of a displayed alarm / message and the measures related to welding power supply.

NOTE
The following symbols are used in alarm codes
%d : Decimal number
%f : Floating number
%x : Hexadecimal
%s : String
Number may be inserted after "%". It means display width.

ARC-008 STOP.L Weld power supply fault (%s, %d)
Cause: A problem generates in the welding power supply.
Remedy: Please check the content of ARC-124 alarm which is posted simultaneously. Then please contact your local FANUC representative.

ARC-022 WARN Weld AO scaling limit used (%s, %d)
Cause: The warning message is posted when command values in weld schedules for arc instruction (or command values in direct arc instruction) become out of range. Then, command values are clamped by upper or lower limits.
Remedy: Set the command values within a range. The range for command values is different in each process mode. Therefore, if you change the assignment of Weld Procedure or process mode number, please confirm that the command values in arc instruction that uses the process mode number are not out of range. Additionally, please also confirm command values of weld processes (Runin and Wirestick Reset) are not out of range. You can see the range for each process mode on Weld Procedure screen.

ARC-040 STOP.L EQ%d Missing I/O: %s
Cause: When Weld I/O is not allocated definitely, it occurs.
Remedy: If the missing I/O name is "gas alarm", "wire alarm" or "coolant alarm", assign these signals by manual operation in reference to Subsection “5.3.4 Gas, Wire, Coolant Shortage Detect”. If you do not use these signals, please disable the detection function by “Procedure 5-3-4 (b) Setup of Gas, Wire, Coolant Shortage Detect Function”.

ARC-045 WARN Weld EQ is OFFLINE
Cause: A robot controller tried communication with the welding power supply, but this alarm is displayed when communication cannot be established. A status of EtherNet/IP communicated with the welding power supply must be set <RUNNING>.
The first message becomes alarm handling, but becomes the warning message after having pushed the reset.
Remedy: Please try following procedures and confirm the status changes to <RUNNING>.
1. Please confirm that the power of weld equipment is ON.
2. Please confirm that a communication of EtherNet is connected referring Chapter 9 in EtherNet/IP manual (B-82854EN). Please confirm EtherNet cable and connector when the connection is not OK.
3. Please confirm the alarm of EtherNet/IP by following procedures when the status doesn’t change to <RUNNING>.

1. Turn FALSE a connection for the welding power supply.
2. Turn FALSE Reconnect referring section 4.2.4 in EtherNet/IP manual (B-82854EN).
3. Turn TRUE a connection for the welding power supply.
4. Confirm alarms of EtherNet/IP and implement the remedy.
5. After confirm the connection, turn TRUE Reconnect by above procedures.

4. If this alarm is continuously posted, The assignment of I/O may be wrong. Please confirm assignment of I/O referring Section 4.1.4 and recover the assignment of communication I/O.

ARC-046 WARN Weld EQ communication error

Cause: There was a communication error detected between Arc Tool and the welding power supply.

Remedy: 1 Please confirm whether other alarms occur at the same time on the alarm history screen (Refer to Subsection 7.3.1). If other alarms occur, please execute the remedy of the alarm and after that, check that ARC-046 is also resolved.

2 Please operate the weld after establishing communication with the welding power supply. When the communication establishment with the welding power supply is impossible, please deal in reference to countermeasures to ARC-045.

ARC-047 WARN Not allowed during a weld

Cause: The operation that cannot be performed during a stop at one time during welding or the welding was going to be performed.

Remedy: Operate it after a program is finished or forces it, and having been finished

ARC-049 WARN Process %d switch to %d failed

Cause: The Reshuffling of the welding process is failed. The power of the welding power supply becomes OFF, or communication is not established.

Remedy: Confirm that the welding power supply is switched on, and establish communication.

ARC-050 WARN Process %d NOT found

Cause: A process mode allocated for Weld Procedure that appointed on a welding power supply was not found.

Remedy: Confirm whether a process mode allocated for Weld Procedure that appointed is a thing allocated definitely. In reference to 4-4-3 and 4-4-4 operation, allocate an appropriate process mode number for Weld Procedure. Even when Weld Procedure number is not set on arc direct type instruction, this alarm produces (when it is 0).

ARC-051 WARN Weld EQ %d ONLINE：EthernetIP

Cause: It is the message which is displayed when the communication between a robot controller and a welding power supply are established.

Remedy: Because it is not an alarm, the remedy is unnecessary. A message disappears when reset is done.

ARC-059 STOP.L Gas purge stopped

Cause: By the gas purge operation(pressing both SHIFT key and STATUS key), the following operations are executed in the state of gas ON. To prevent the gas being left ON, gas is automatically stopped when this alarm is generated.

- Start the program
- Teach Pendant disabled or switched to AUTO mode
- Changed the setting item of [Gas purge key] to DISABLED in the Weld System screen.

Remedy: Please do not execute the above operation while gas is ON by the gas purge operation. Please stop the gas flow before executing the above operation.

ARC-092 STOP.L Weld Cmd error EQ%d (%d,%d)

Cause: An error occurred when sending the welding command to the power supply.

Remedy: 1 Please confirm whether other alarms occur at the same time on the alarm history screen (Refer to Subsection 7.3.1). If other alarms occur, please execute the remedy of the alarm and after that, check that ARC-092 is also resolved.
2 Please operate the weld after establishing communication with the welding power supply. When the communication establishment with the welding power supply is not possible, please deal in reference to countermeasures to ARC-045.

ARC-093 STOP.L Wire Feed Cmd error EQ%d (%d,%d)
Cause: An error occurred sending the command to the wire feeder.
Remedy: 1 Please confirm whether other alarms occur at the same time on the alarm history screen (Refer to 7.3.1). If other alarms occur, please execute the remedy of the alarm and after that, check that ARC-093 is also resolved.
2 Please operate the weld after establishing communication with the welding power supply. When the communication establishment with the welding power supply is impossible, please deal in reference to countermeasures to ARC-045.

ARC-124 WARN EQ %d E: %d DAIHEN Digital
Cause: An error occurred in DAIHEN digital welding power supply.
Remedy: Please confirm DAIHEN Digital is displayed and the number after “E:”. Then, please contact your local FANUC representative.

ARC-253 STOP.L I/O polarity is inverted:E %d
Cause: Some I/O polarities are set to Inverse.
Remedy: Please power OFF/ON. This alarm continues to be posted until performing power OFF/ON.

ARC-254 WARN Please power OFF/ON.
Cause: This is a cause code for ARC-253.
Remedy: Please power OFF/ON.

7.2 TROUBLE SHOOTING AGAINST SITUATIONS

Table 7.2 Trouble shooting against some situations

No.	Problems	Cause	Remedy
1	Wire inching is not performed.	A robot controller and the communication establishment of the welding power supply are not done	Please confirm whether the welding power supply is switched on. Please confirm whether a robot controller is connected to a welding power supply definitely. If ARC-045 alarm is posted, please perform the remedy of ARC-045 in Section 7.1. In reference to " WELDING POWER SUPPLY SELECT" of Section 11.1, please perform communication establishment setting again.
		An idle arm does not go up	Put up an idle arm.
2	Wire feed is not stable (Wire feeding speed is too fast or there is allophone while wire feeding)	There is a problem to idle arm or drive roll.	In reference to "wire feeder" of Subsection 6.1.2, please perform maintenance check of wire feeder.
		There is the slack in the joint of the blowtorch cable	Please confirm whether the slack does not occur in a joint with the blowtorch cable installation metal fittings.

No.	Problems	Cause	Remedy
3	A gas purge (a gas check) is not possible by manual operation	A robot controller and the communication establishment of the welding power supply are not done	Please confirm whether the welding power supply is switched on. Please confirm whether a robot controller is connected to a welding power supply definitely. If ARC-045 alarm is posted, please perform the remedy of ARC-045 in Section 7.1. In reference to " WELDING POWER SUPPLY SELECT" of Section 11.1, please perform communication establishment setting again.
		The valve of the gas cylinder, a gas adjustment knob do not open.	In reference to “Checking Gas Flow Rate" of Subsection 6.1.6, please confirm the gas flow quantity.
4	There is much sputtering at the time of the arc start	A welding process choosing, a welding mode are wrong	In reference to “OPERATION OF WELD PROCEDURE AND PROCESS MODE” of Section 4.3 or “TEACHING AND EDITING OF ARC WELD INSTRUCTION” of Section 4.5, select the proper weld data or weld mode number for the Arc Instruction.
		Stick out is not reasonable.	Confirm stick out of the welding program inside, and revise it
5	There is much spattering at the time of the welding or an arc is unstable or is poor in welding	Gas flow quantity is insufficient (or do not appear)	Perform a gas check in reference to “Checking Gas Flow Rate of Subsection 6.1.6, and please confirm that gas appears definitely.
		A welding process choosing, a welding mode are wrong	In reference to “OPERATION OF WELD PROCEDURE” of Section 4.3 or “TEACHING AND EDITING OF ARC WELD INSTRUCTION” of Section 4.5, select the proper weld data or weld mode number for the Arc Instruction.
		Stick out is not reasonable.	Confirm stick out of the welding program inside, and revise it
		There is a problem to welding torch	Please perform maintenance check of the welding torch in reference to "6.1.3 welding torch".
		Wire feeding is unstable	Carry out No. 2 remedy.
		Others	Refer to 4 of Appendix A.2.
6	DI that you would like to use, a number of the DO are used for weld I/O (ArcLink I/O).	I/O number you would like to use is assigned to I/O by automatic I/O assignment function.	In reference to "4.1 SETTING OF I/O FOR DAIHEN DIGITAL WELDING POWER SUPPLY", revise a layout of communication I/O.
7	The Power Lamp is not Turned on.	Power is not supplied correctly.	Check if power is fed correctly. If the power lamp is not turned on when power is fed correctly, contact your local FANUC representative.
8	The Robot Collided with a Fixture		Recover it according to the procedure below/. 1. Stop the motion of the robot by pressing the emergency stop button, then enter within the safety fence. 2. Correct the cause of collision. 3. Exit from within the safety fence. 4. Reset the emergency stop button. 5. Reset the system error. 6. Cycle power of the controller.
9	The Emergency Stop Button was Pressed during Operation.		Recover it according to the procedure below/. 1. Reset the emergency stop button. 2. Reset the system error. 3. Cycle power of the controller.

7.3 REMEDY FOR TROUBLES

We gathered up the contents which would like you to do when the following troubles occurred in a procedure.

・A robot and a welding power supply do not communicate
・Welding is not possible (it stops by alarm etc.)
・Wire inching, a gas check are not possible

In this case, please operate the following because the identification of the cause is difficult only for the symptom mentioned above.

Confirming procedure
1 The confirmation of the alarm history
2 Get all back up
3 Get image back up (If possible)

7.3.1 Confirmation of the Alarm History

Open alarm history screen, Confirm whether arc alarm, LECO alarm are given.
Please contact us when alarm is given what kind of turn alarm is given with.
Please take the confirmation method of the alarm history in the following procedures.

1 Press [MENU] key, select 4 alarm」
2 Active alarm screen is displayed. Press F3[history] key.
3 Alarm history screen is displayed.
4 Press F1[TYPE] and select [application]. Only an arc-related alarm history is displayed.
5 Please confirm ARC alarms.
6 After the confirmation, press F1[SCREEN] and select [alarm] , return it to an original state

7.3.2 Acquisition of All Backup

Next, acquire all back up

Operation 7-3-2 is procedure of back up.

Procedure 7-3-2 Acquisition of all backup

Step

1 Please insert an empty memory card or USB memory in a robot controller.
2 Select「7 FILE」.
3 Press F5[UTIL] and select [Set Device] .In case of memory card, select [MC],In case of USB memory ,select [UDI].
4 Select F4[BACKUP] and select [All of above]. When the message “Delete XXXX before backup files?” is displayed, please select “YES”.
5 When backup is completed, press F5[UTIL] and select [Set Device]. then correct it at an original.

7.3.3 Acquisition of Image Backup

If possible ,acquire image backup.
Please do not perform this during robot operation.

Operation 7-3-3 is procedure of image back up.

Procedure 7-3-3 Acquisition of all Image backup

Step

1 Please insert an empty memory card or USB memory in a robot controller.
2 Select [7 FILE].
3 Press F5[UTIL] and select [Set Device] .In case of memory card, select [MC],In case of USB memory ,select [UDI].
4 Select F4[BACKUP] and select [Image].
5 The message “Please cycle power.” is displayed. Please cycle power of the robot controller.
6 When you turn the robot controller ON, image back up is started.
7 When backup is completed, If the massage “Image backup completed successfully.” is displayed, the image backup was successfully obtained.
8 Press F5[UTIL] , select [Select Device] then correct it at an original device.

8 REPLACING UNITS

This chapter describes the method of replacing each unit.

> ⚠ **WARING**
> Before replacing a unit, be sure to turn off the main power and pull the cable plug out the socket. When replacing a unit, ensure a safe state where peripheral equipment is not operating.

*For the robot mechanical unit, contact your local FANUC representative about replacing

*For the robot controller, refer to the following maintenance manual.
FANUC Robot series R-30*i*B controller maintenance manual B-83195EN
FANUC Robot series R-30*i*B Mate controller maintenance manual B-83525EN

Organization of this chapter:
- 8.1 Welding power supply
- 8.2,8.3 Torch cable
- 8.4 Liner
- 8.5 Roller
- 8.6, 8.7 Torch neck
- 8.8 Wire feeder

After replacing a part, be sure to check the corresponding item(s).
The table below indicates replacement parts and the corresponding check items. Make checks according to the table below.

Replacement part	Check item
Torch cable	(a) Liner replacement (b) Wire feed capability
Liner Roller	(a) Wire feed capability

8.1 REPLACING THE WELDING POWER SUPPLY

1 Turn off the controller power.
2 Remove welding power cable (+),(-), wire feeder control cable, minus side sense lead cable and Ethernet cable from welding power supply referring to Fig. 8.1 (a), (b).

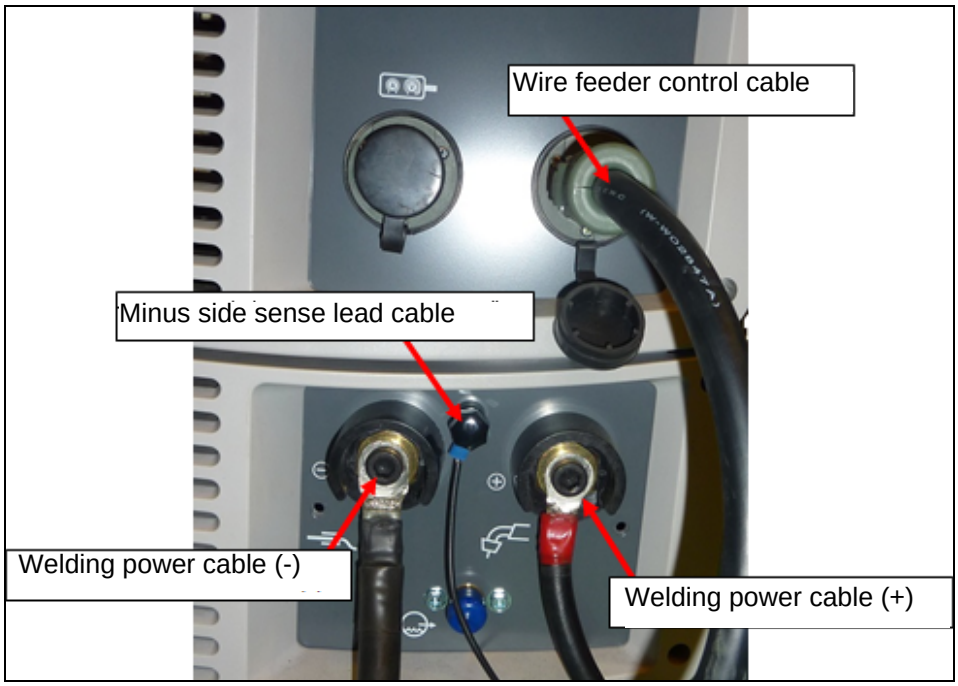


Fig. 8.1 (a) Replacing the welding power supply (1/3)

Fig. 8.1 (b) Connection of welding power supply (2/3)

3 Remove the input terminal cover and cable fixation part, then remove the primary power cable referring to Fig. 8.1(c).

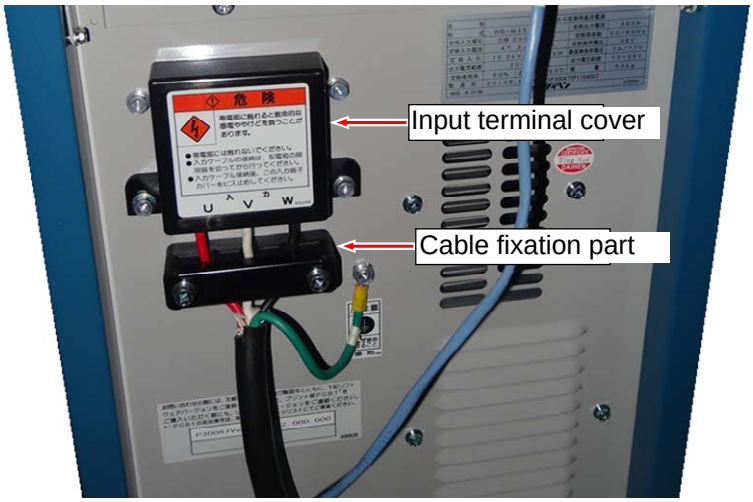


Fig. 8.1 (c) Connection of welding power supply (3/3)

4 Replace old welding power supply by new one. For its assembly, please apply the steps above in reversed sequence.

8.2 REPLACING TORCH CABLE (WHEN USING TORCH CABLE CHANGING TOOL (RECOMMENDED))

1 Move the robot posture to J4=J5=J6=0^{o}, The J1-J3 axis is not cared about by arbitrary posture.
2 Confirm that grease is applied on the hoses of the new torch cable , each hose does not intersect each other.
3 Remove the flexible conduit of wire feeder, cut the wire. Pull out the wire from the tip point after it supplies it until the wire cannot be sent.

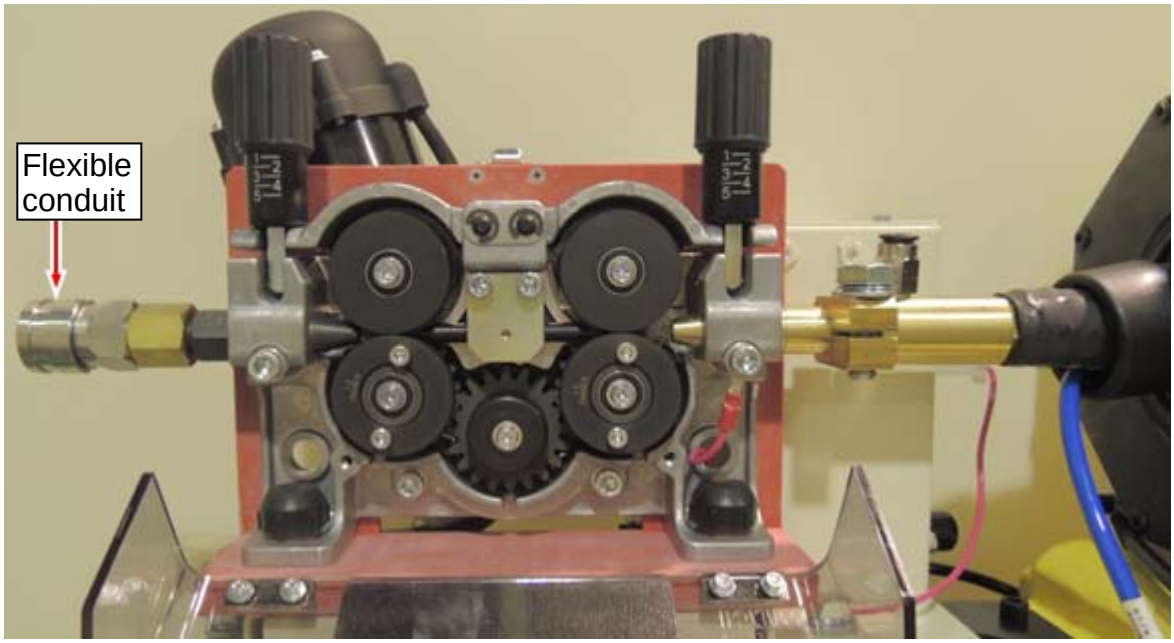


Fig. 8.2 (a) Removing the flexible conduit

4 Remove torch neck referring to Section 8.6 and 8.7.

5 Remove the conduit cover of J3 arm referring to Fig. 8.2 (b).

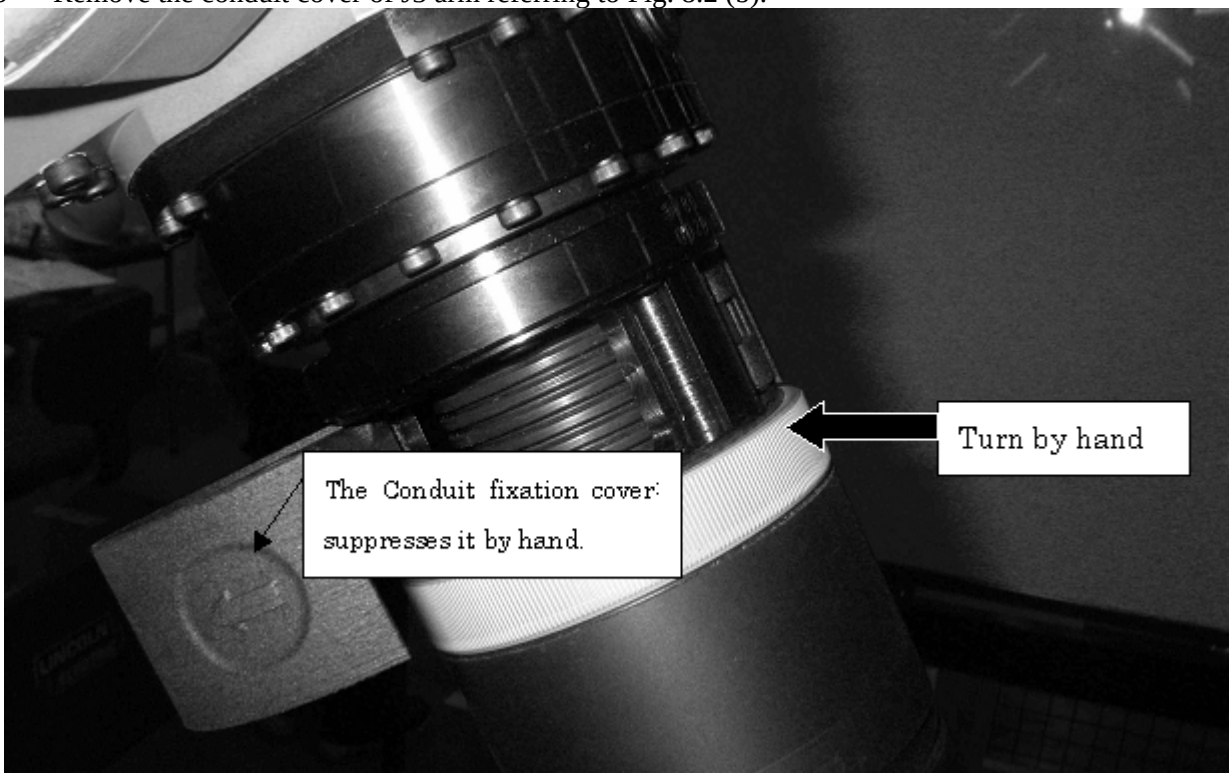


Fig. 8.2 (b) Remove conduit

6 Loosen the fixation two bolt of torch side referring to Fig. 8.2 (c).

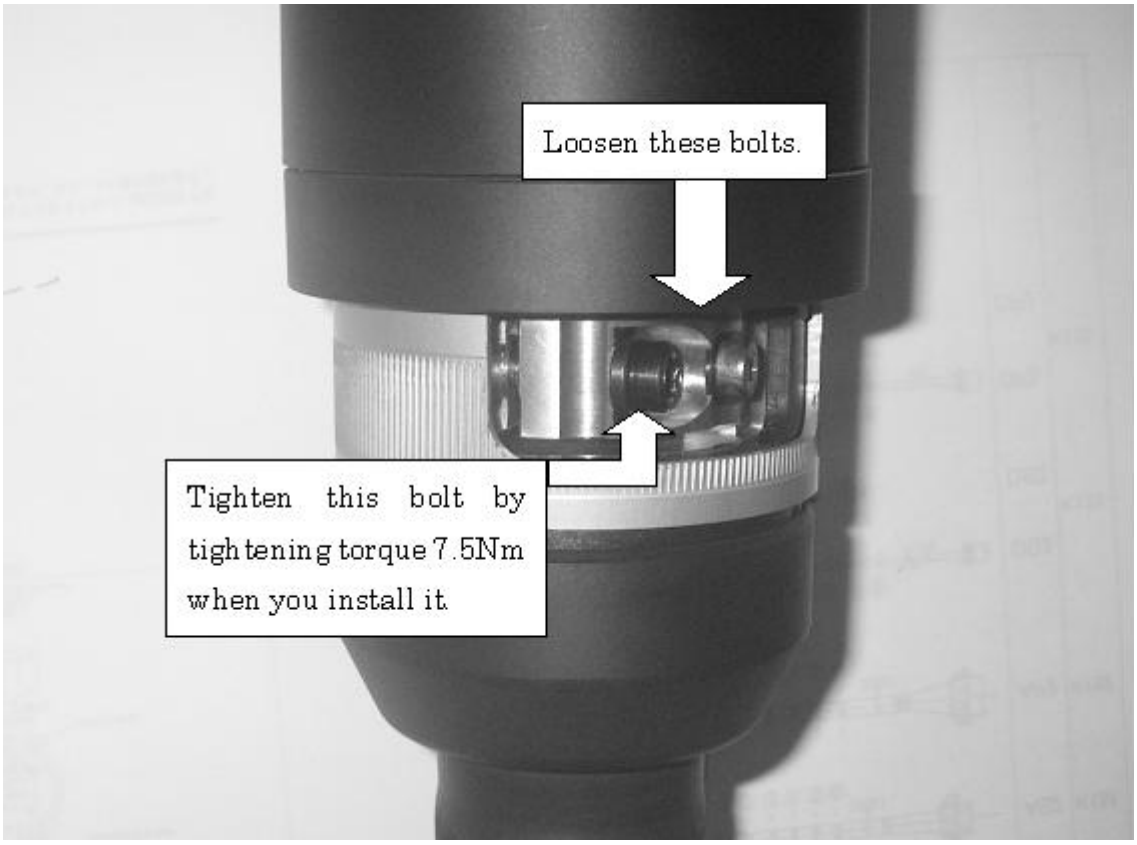


Fig. 8.2 (c) Fixation bolt of torch side

7 Remove torch cable from torch adapter (Fig. 8.2 (d).)

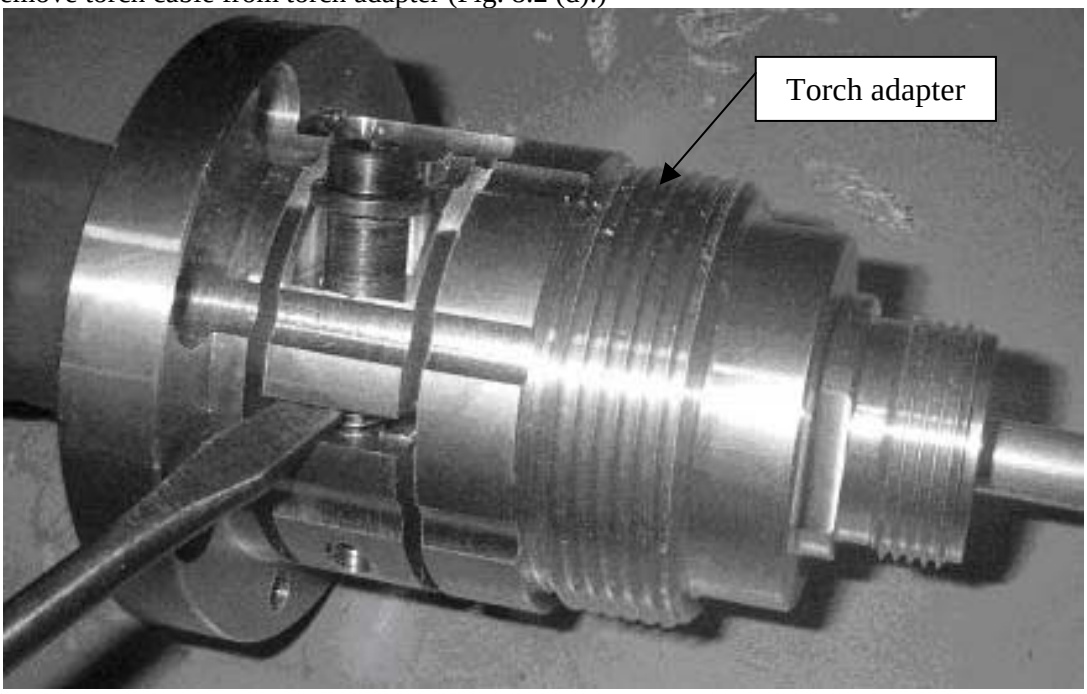


Fig. 8.2 (d) Groove of torch adapter

8 Remove the hexagon bolt (M10), hexagon hole bolt(M6) and the joint for gas hose, then pull out the outlet guide of the torch cable end from the wire feeder referring to Fig. 8.2 (e).

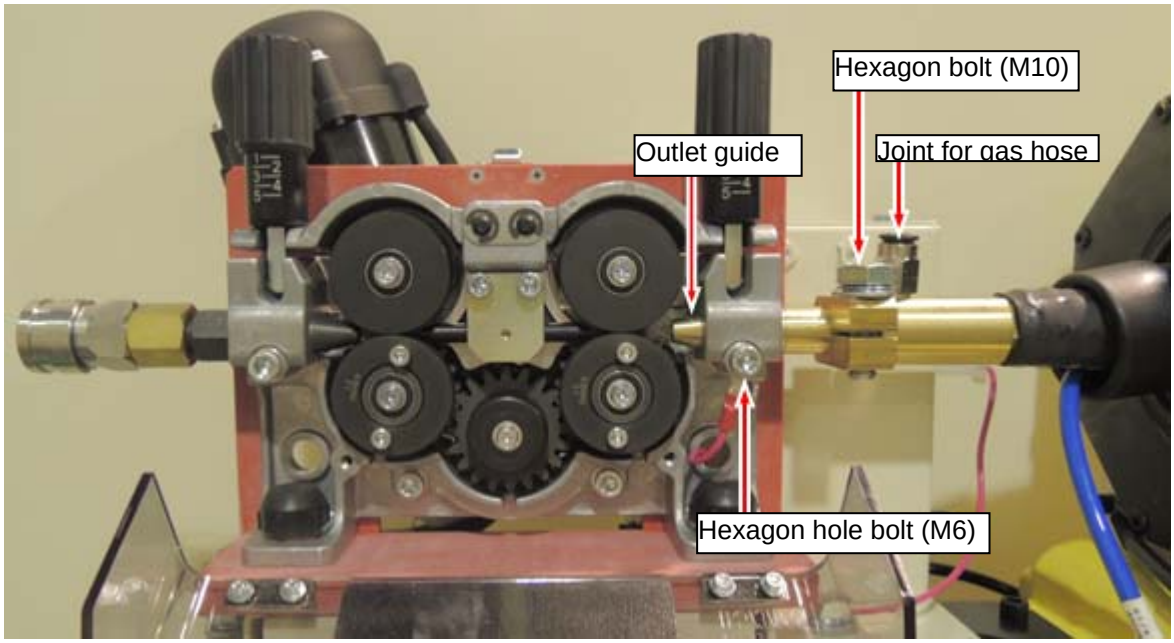


Fig. 8.2 (e) Remove the thumbscrews of wire feeder

9 Pull out the torch cable from the J3 arm part with Conduit to torch side.
10 Insert a new torch cable in the J3 arm part.
11 Insert torch cable changing tool referring to Fig. 8.2 (f) and (g).

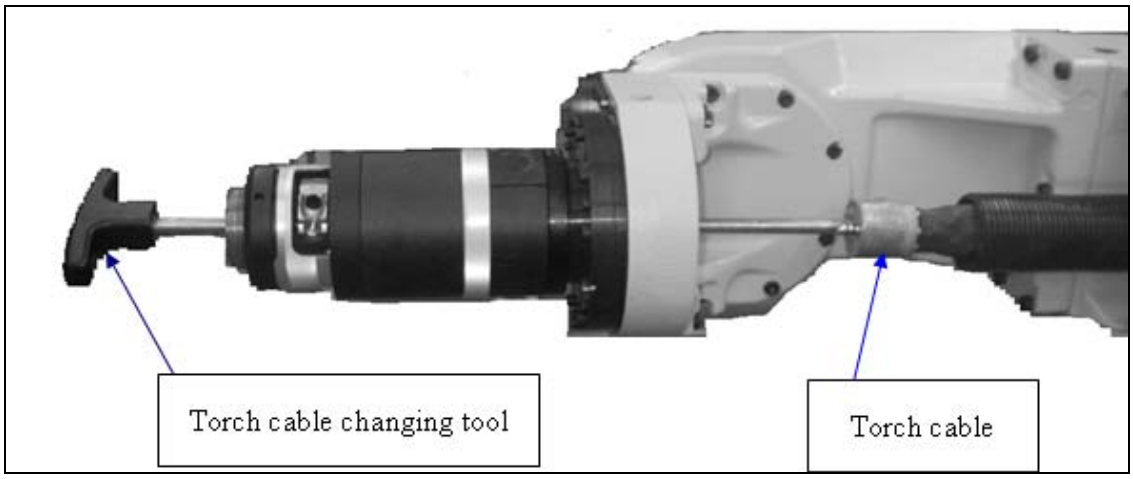


Fig. 8.2 (f) Installing of torch cable changing tool

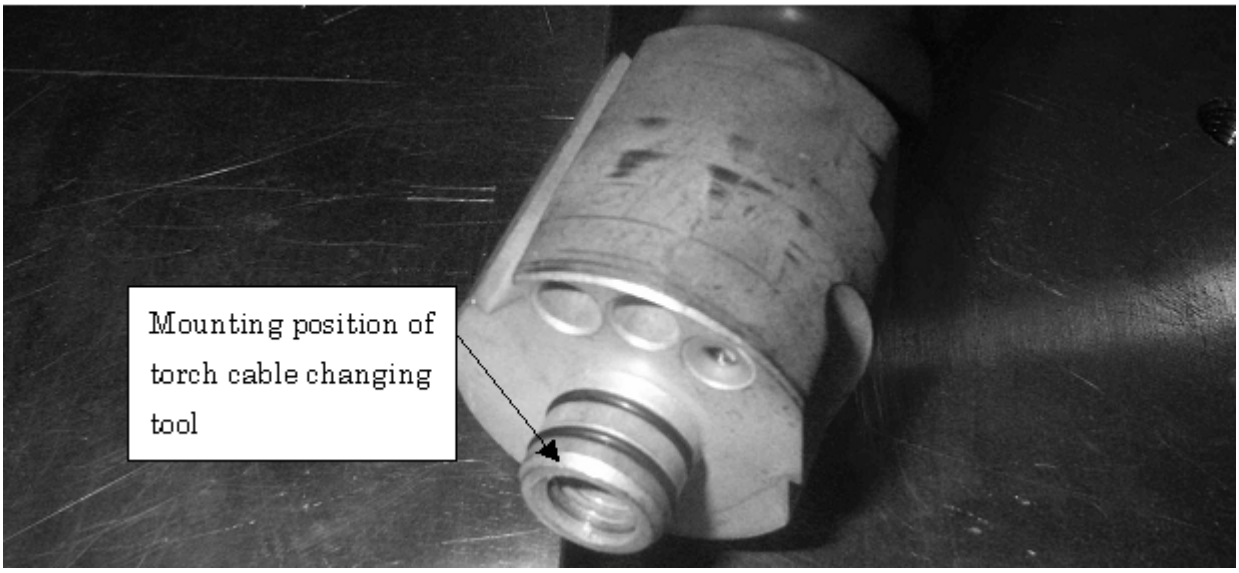


Fig. 8.2 (g) Mounting position of torch cable changing tool

12 Match tip of metal of torch to the keyway and insert it into torch adapter.
13 Confirm the bottom of tip of metal of torch cable has stuck to the face of torch adapter. (See Fig. 8.2 (h))When the torch cable doesn't enter easily, it becomes easy if a minus driver is inserted in the groove, and the groove is expanded. (See Fig. 8.2 (d))

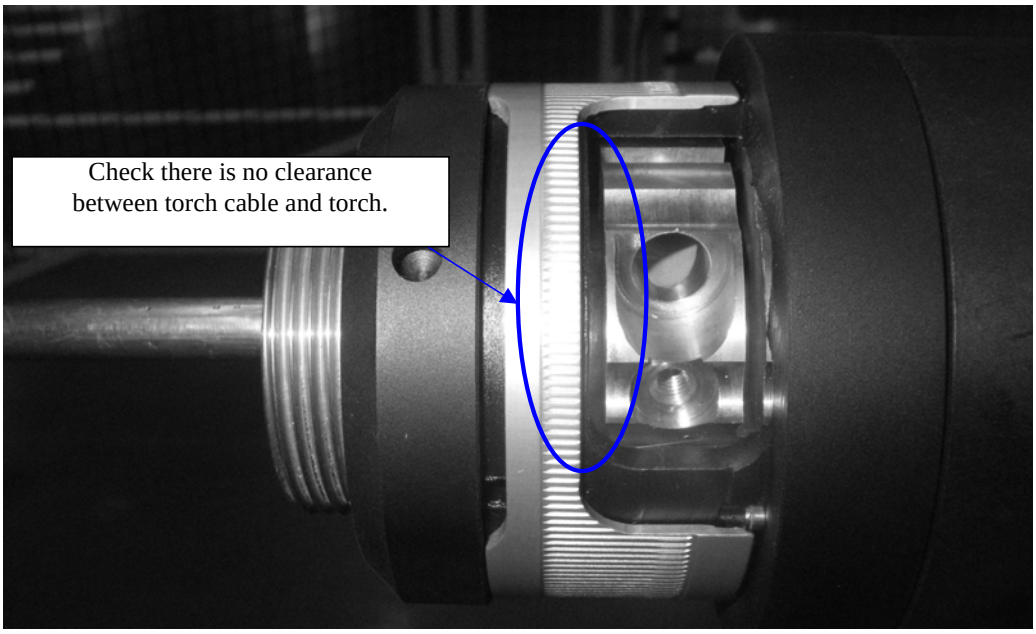


Fig. 8.2 (h) Confirming of no clearance of torch cable

14 Shut up a conduit till it do not move towards the torch neck, and lock a conduit fixation cover
15 Install torch neck referring to Section 8.8 to 8.10. Make aim of tightening torque of union nut 30Nm.
16 According to Subsection 8.5, insert new liner to torch cable and tighten liner suppression nut. Adjust the length of liner.
17 Loosen a fixed bolt of the wire feeder to the torch cable to become parallel to wire feeder, insert torch cable all the way and tighten the bolt which is inside the wire feeder with wrench (1/4in) which is appended to wire feeder . (Recommended tightening torque 10 to 15 Nm) (See Fig. 8.3 (f).) This part is thumb screw depending on the time of shipment. In this case, tighten it with torque of 10Nm. (See Fig.8.3 (j).)
18 Attach fixation 2 bolts of torch side referring to Fig. 8.2 (c).Tighten black bolt with torque of 7.5Nm.
19 Firmly push Conduit all the way into the interior before applying the Conduit fixation cover, and install the cover that fixes Conduit referring to Fig. 8.2 (b).
20 Lift the roll, insert wire and restore them.

Judgment of torch cable length

Confirm torch cable come out is less or equal to 10mm.
If it exceeds 10mm, pull out wire feeder to a direction apart from the robot and adjust it.

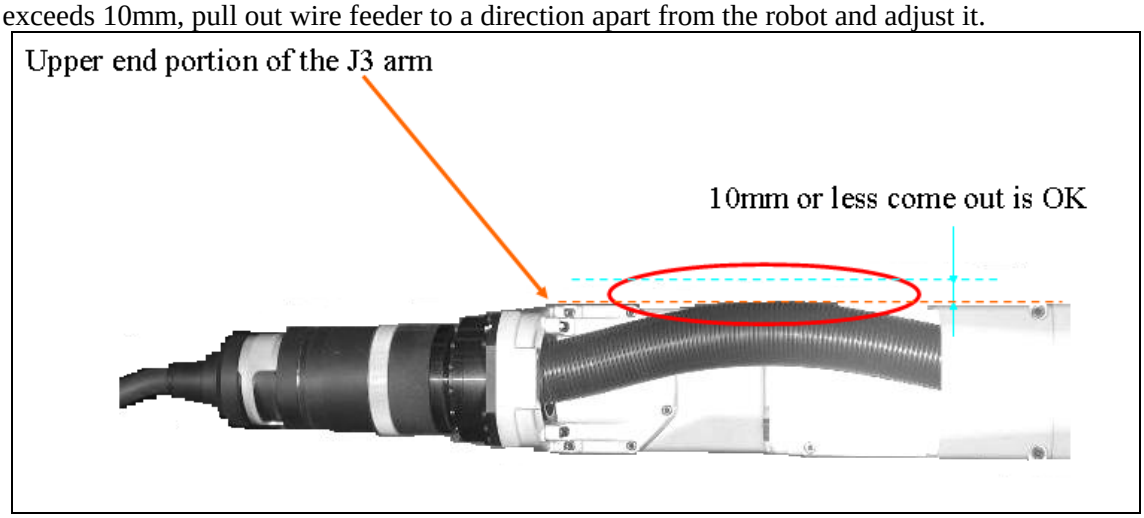


Fig. 8.2 (i) Judgment of torch cable length

8.3 REPLACING TORCH CABLE (WHEN NOT USING TORCH CABLE CHANGING TOOL)

1 Move the robot posture to J4=J5=J6=0^{O}, The J1-J3 axis is not cared about by arbitrary posture.
2 Confirm that grease is applied on the hoses of the new torch cable , each hose does not intersect each other.
3 Remove the flexible conduit of wire feeder, cut the wire. Pull out the wire from the tip point after it supplies it until the wire cannot be sent.

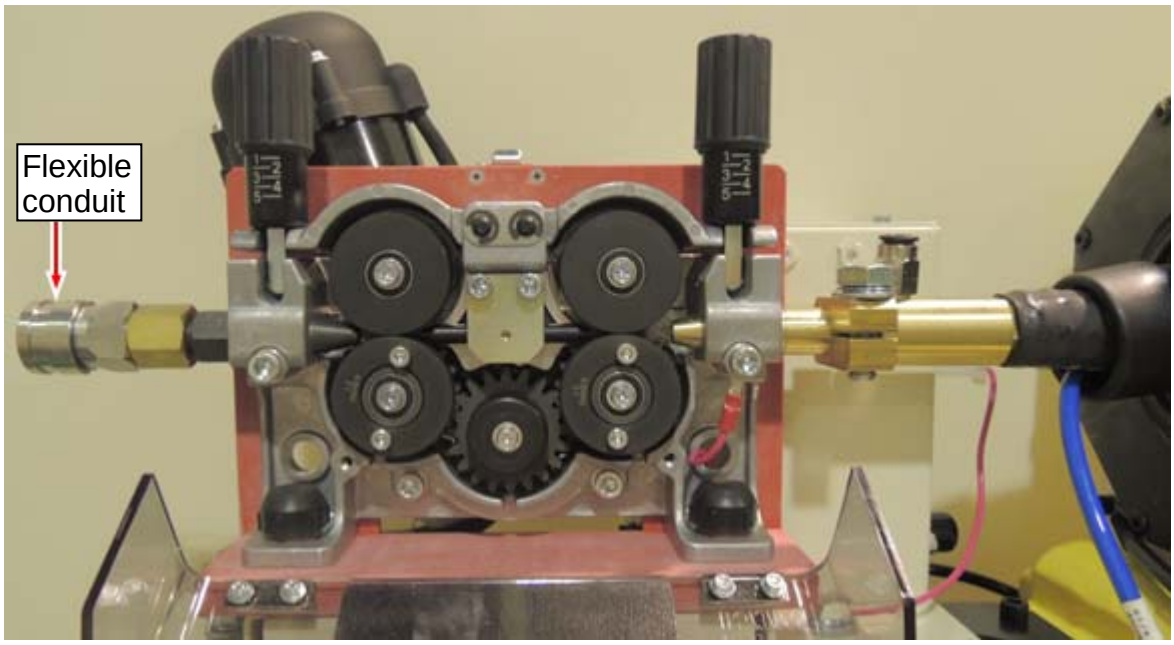


Fig. 8.3 (a) Removing the flexible conduit

5 Remove the conduit cover of J3 arm referring to Fig. 8.3 (b).

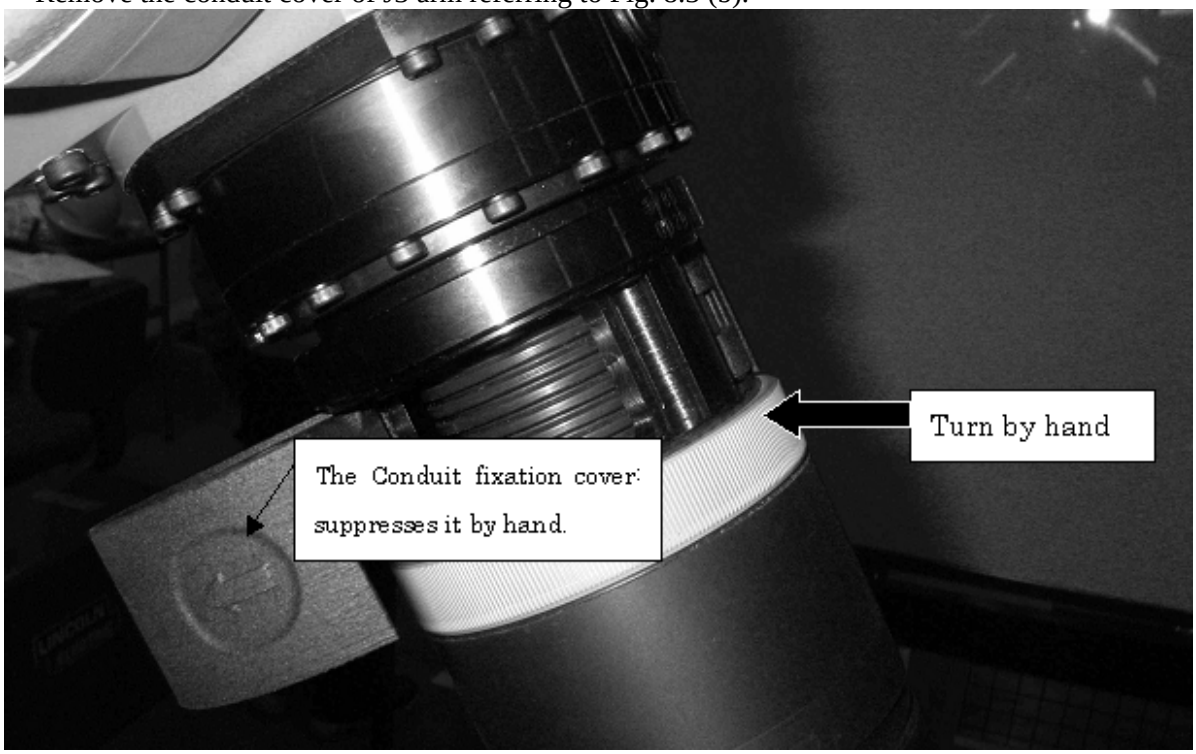


Fig. 8.3 (b) Remove conduit

5 Loosen the fixation two bolt of torch side referring to Fig. 8.3 (c).

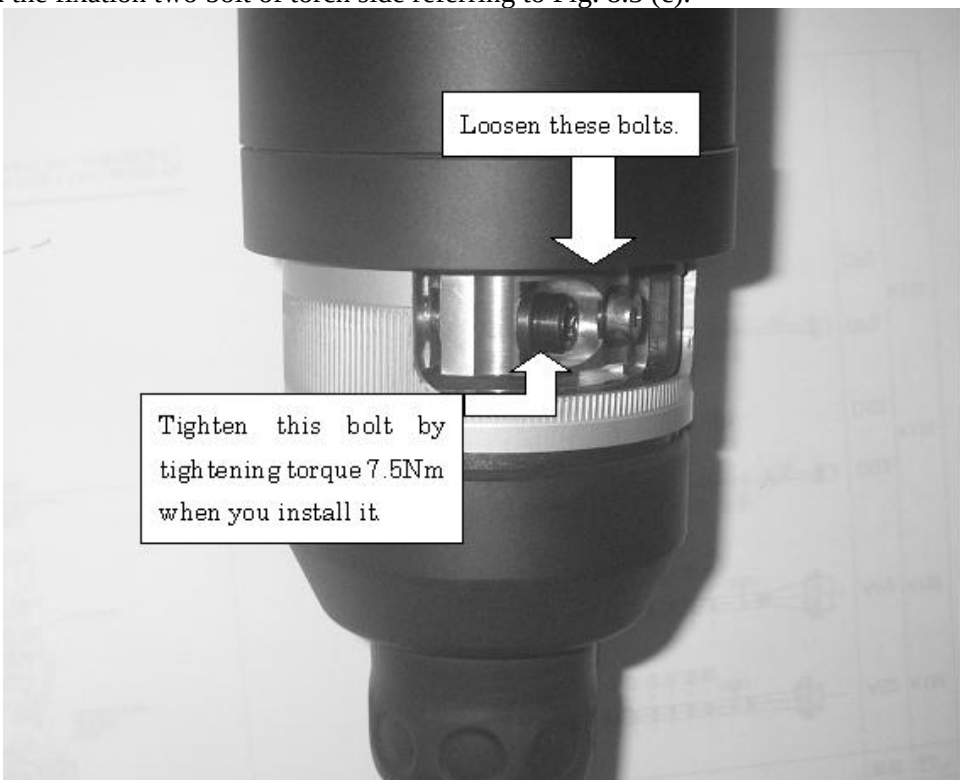


Fig. 8.3 (c) Fixation bolt of torch side

6 Remove torch cable from torch adapter (Fig. 8.3 (d).)

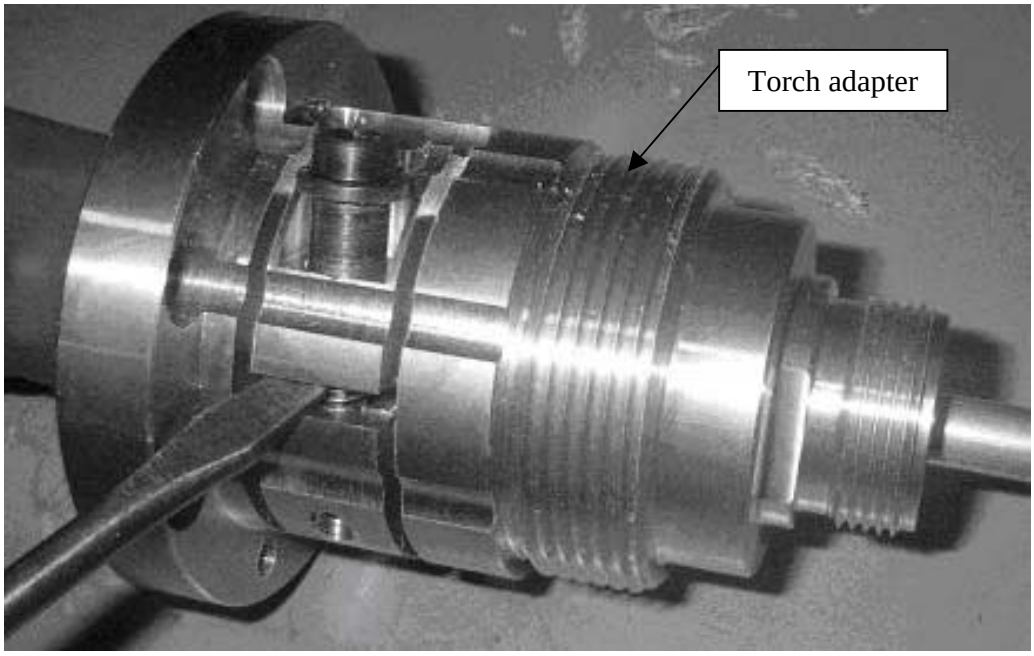


Fig. 8.3 (d) Groove of torch adapter

7 Remove the hexagon bolt (M10), hexagon hole bolt(M6) and the joint for gas hose, then pull out the outlet guide of the torch cable end from the wire feeder referring to Fig. 8.3 (e).

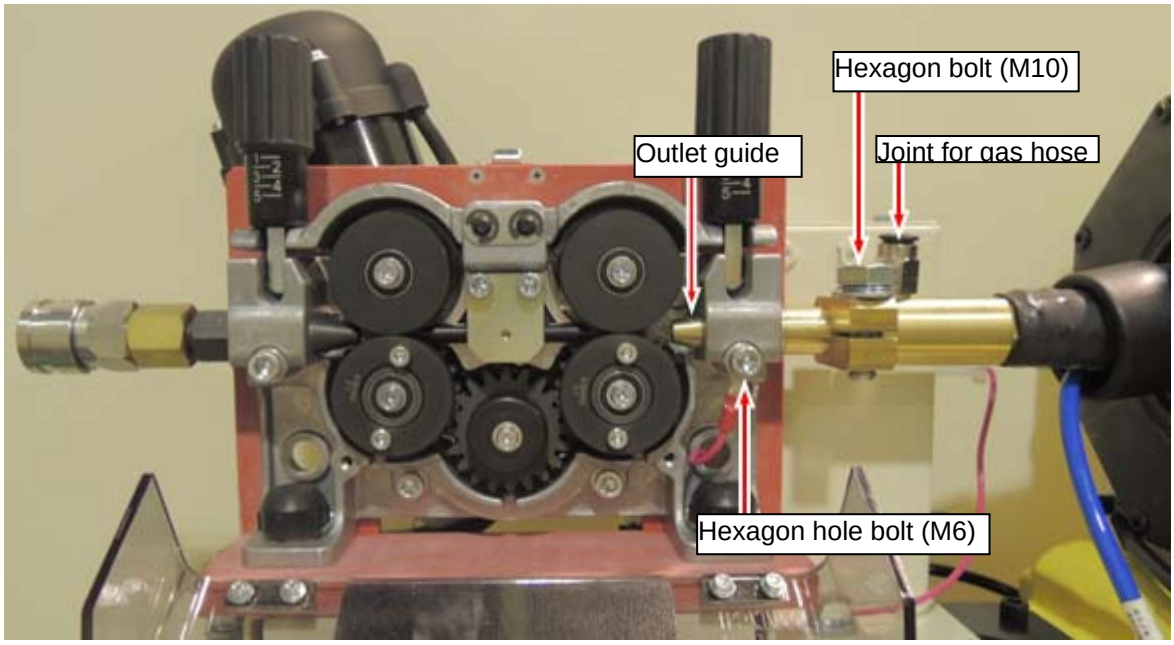


Fig. 8.3 (e) Remove the thumbscrews of wire feeder

8 Pull out the torch cable from the J3 arm part with Conduit to torch side.
9 Insert a new torch cable in the J3 arm part.
10 Match tip of metal of torch to the keyway and insert it into torch adapter.
11 Confirm the bottom of tip of metal of torch cable has stuck to the face of torch adapter. When the torch cable doesn't enter easily, it becomes easy if a minus driver is inserted in the groove, and the groove is expanded. (See Fig. 8.3 (d))

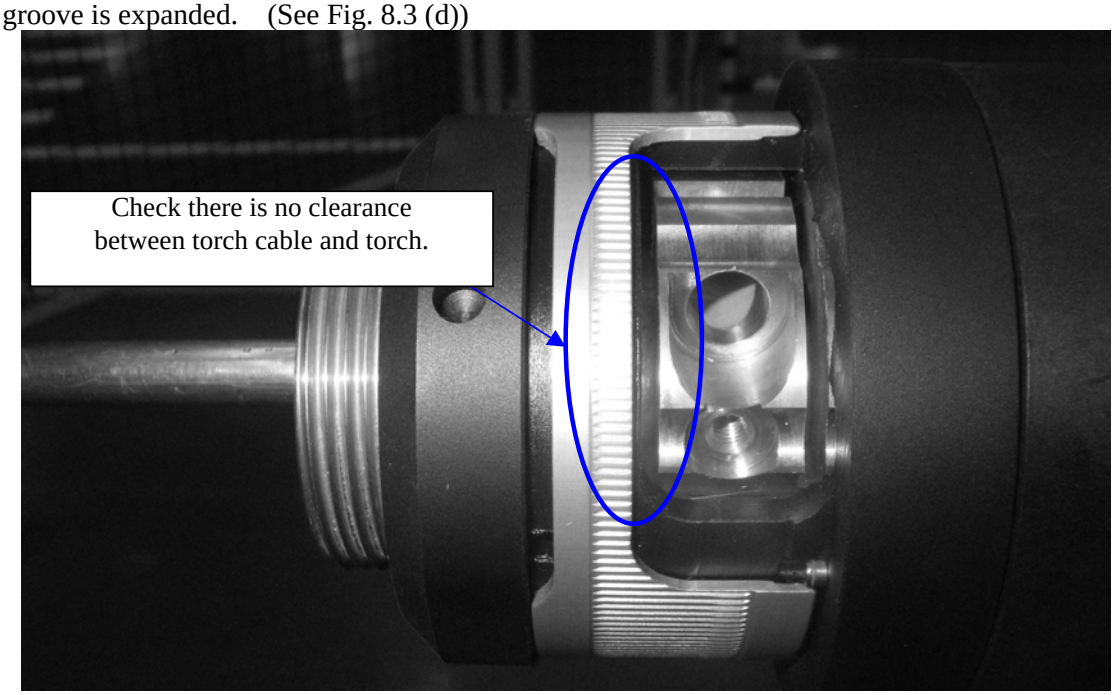


Fig. 8.3 (f) Confirming of no clearance of torch cable

12 Shut up a conduit till it do not move towards the torch neck, and lock a conduit fixation cover
13 According to Section 8.4, insert new liner to torch cable and tighten liner suppression nut. Adjust the length of liner.
14 Loosen a fixed bolt of the wire feeder to the torch cable to become parallel to wire feeder, insert torch cable to a deep corner and tighten the bolt which is inside the wire feeder with wrench (1/4in) which is appended to wire feeder . (Recommended tightening torque 10 to 15 Nm)(refer to Fig. 8.4

(e)) This part is thumb screw depending on the time of shipment. In this case, tighten it with torque of 10Nm. (See Fig. 8.4 (g).)

15 Attach fixation 2 bolts of torch side referring to Fig. 8.3 (c). Tighten black bolt with torque of 7.5Nm.

16 Firmly push Conduit into the interior before applying the Conduit fixation cover, and install the cover that fixes Conduit referring to Fig. 8.3 (b).

17 Lift the roll, insert wire and restore them.

Judgment of torch cable length

Confirm torch cable come out is less or equal to 10mm.
If it exceeds 10mm, pull out wire feeder to a direction apart from the robot and adjust it.

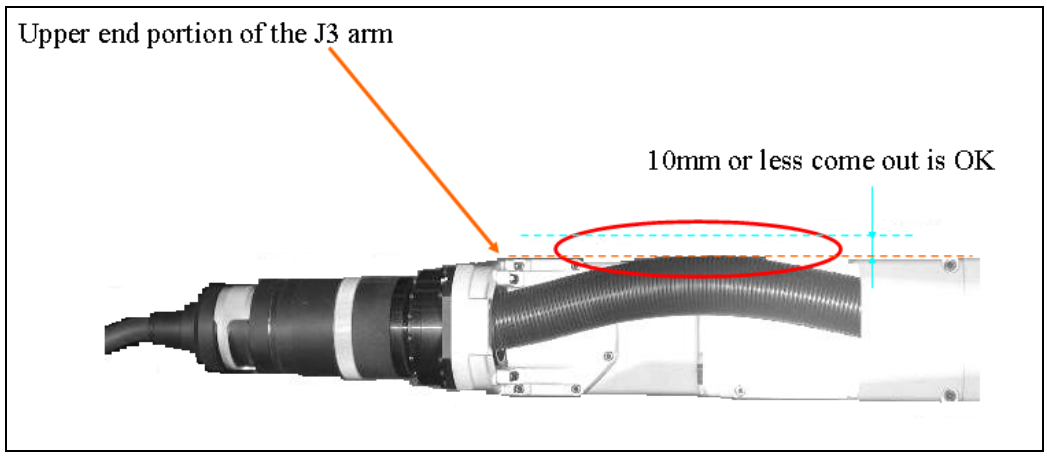


Fig. 8.3 (g) Judgment of torch cable length

8.4 REPLACING THE LINER

1 Move the robot posture to J4=J6=0º and J5=-90º, The J1-J3 axis is not cared about by arbitrary posture. Then turn off the controller power.
2 Cut the wire at the wire feeder roller part, then pull out the wire with bead from the tip end.
3 Remove the nozzle, gas diffuser and welding tip. At this time, be careful not to drop the gas diffuser from the nozzle. (See Subsection 6.1.3 for each part.)
4 Remove the hexagon bolt (M10), the hexagon hole bolt (M6) and joint for gas hose, then pull out the outlet guide of the torch cable end from the wire feeder referring to Fig. 8.2 (e).
5 Remove the outlet guide and pull out the liner referring to Fig. 8.4.
6 Insert new liner into the torch cable.
7 Assemble the torch cable on the wire feeder in the reversed sequence, then attach the nozzle, the gas diffuser and the welding tip on the torch neck.
8 Turn on the controller power, feed the wire and confirm the wire comes out from the torch end. Then operate the robot slowly and confirm there is no problem.

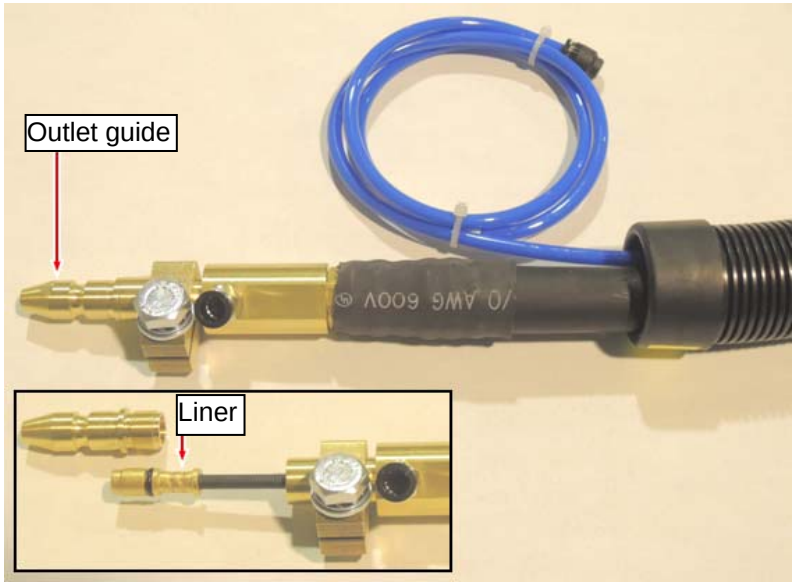


Fig. 8.4 Replacing the liner

8.5 REPLACING THE ROLLERS

Below shows the procedure for replacing the rollers.

1 Lift down the idol arms. (Refer to Fig. 8.5.)
2 Lift up the following rollers.
3 Remove the roller mounting screws with a minus driver etc.
4 Replace old rollers by new one. For its assembly, please apply the steps above in reversed sequence.

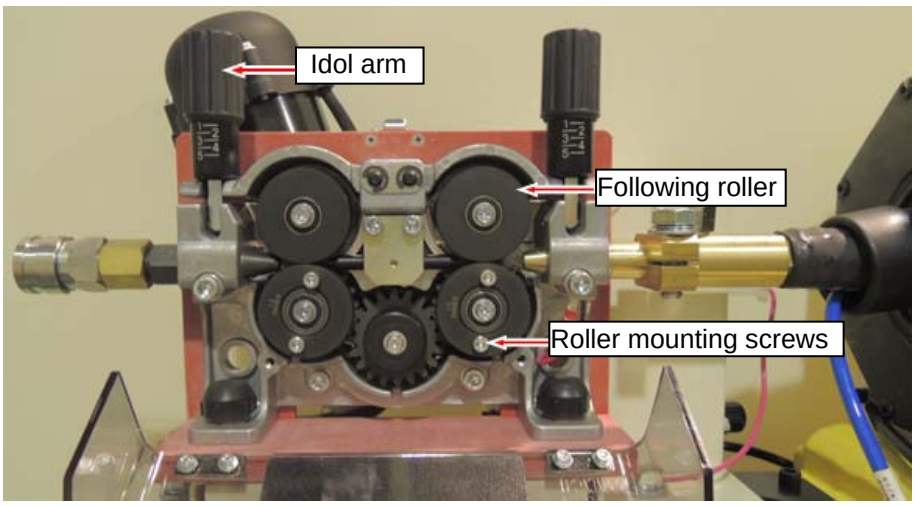


Fig. 8.5 Replacing the rollers

8.6 REPLACING THE TORCH NECK (BINZEL AIR COOLING TORCH 350GC ARC Mate *i*C series)

When torch neck is broken, it is necessary to replace it.
In this case, there is a possibility that TCP must be set again using torch recovery etc. Replace parts according to the following procedure.

1 Remove the nozzle. (Refer to Fig. 8.6 (a))

2 Loosen the screws of the insulation cylinder with a pliers and remove it. (Refer to Fig. 8.6 (b))
3 Loosen the screw of the tip holder with a spanner and remove it. (Refer to Fig. 8.6 (b))
4 Remove the protection cap. (Refer to Fig. 8.6 (c))
5 Loosen the union nut with a spanner, remove the torch neck, then replace by new one. (Refer to Fig. 8.8 (d)) Tighten the union nut with the regulated torque.
6 Attach the protection cap. (Refer to Fig. 8.6 (c))
7 Attach the tip holder. (Refer to Fig. 8.6 (b))
8 Attach the insulated cap. (Refer to Fig. 8.6 (b))
9 Attach the nozzle. (Refer to Fig. 8.6 (a))

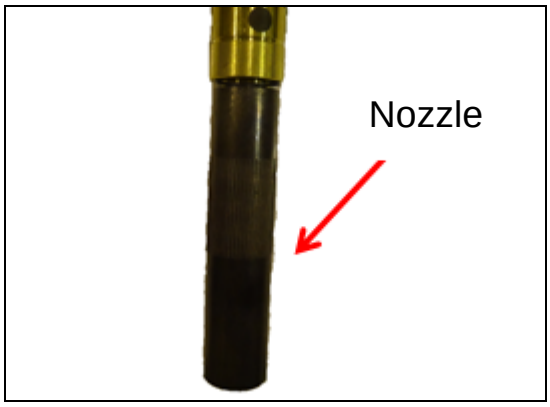


Fig. 8.6 (a) Removing the nozzle

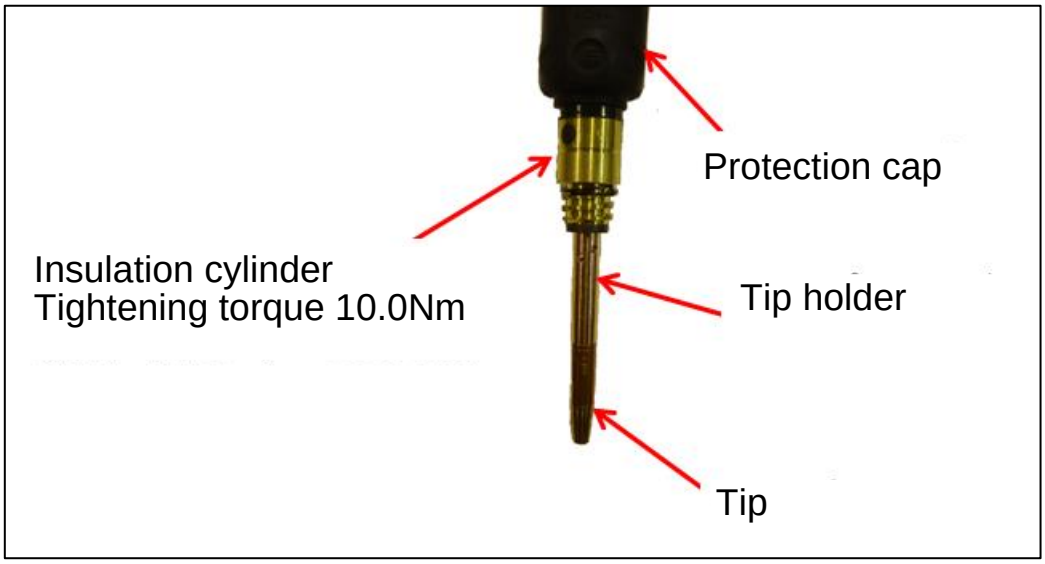


Fig. 8.6 (b) Removing the insulated cap and the tip holder

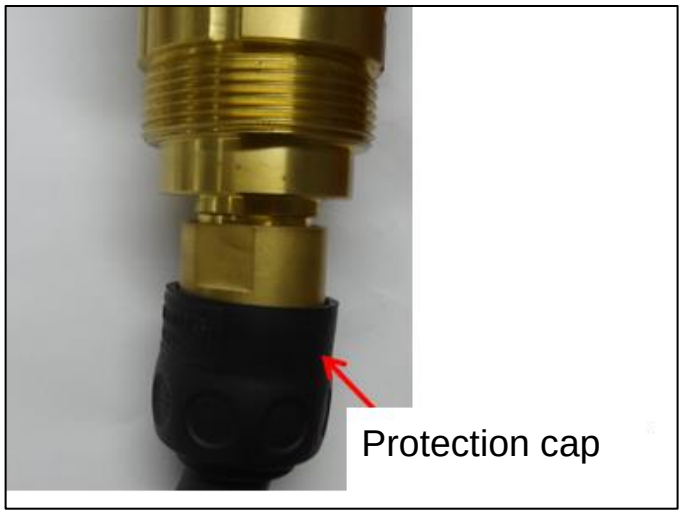


Fig. 8.6 (c) Removing the protection cap

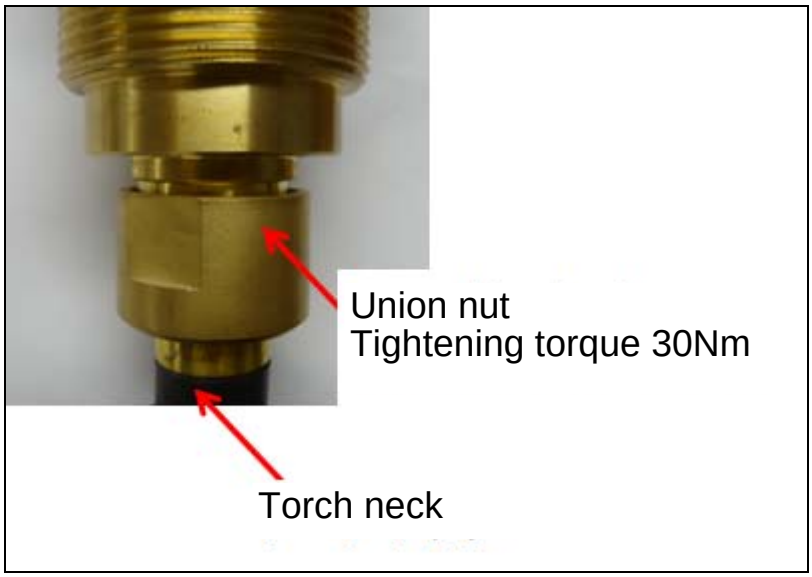


Fig. 8.6 (d) Removing the torch neck

8.7 REPLACING THE TORCH NECK (BINZEL TORCH W500 for ARC Mate *i*C series)

When torch neck is broken, it is necessary to replace it. In this case, there is a possibility that TCP must be set again using torch recovery etc. Replace parts according to the following procedure.

1 Remove the nozzle. (Refer to Fig. 8.7 (a))
2 Loosen the screw of the tip holder with a spanner and remove it. (Refer to Fig. 8.7 (b))
4 Rotate the union nut to the arrow direction with hands and remove it. (Refer to Fig. 8.7 (c))
5 Remove the torch neck, then replace it with new one. Install the torch neck and wrist with no gap referring to the Fig. 8.7 (d). Tighten the union nut.
7 Attach the tip holder. (Refer to Fig. 8.7 (b))
8 Attach the nozzle. (Refer to Fig. 8.7 (a))

Fig. 8.7 (a) Removing the nozzle

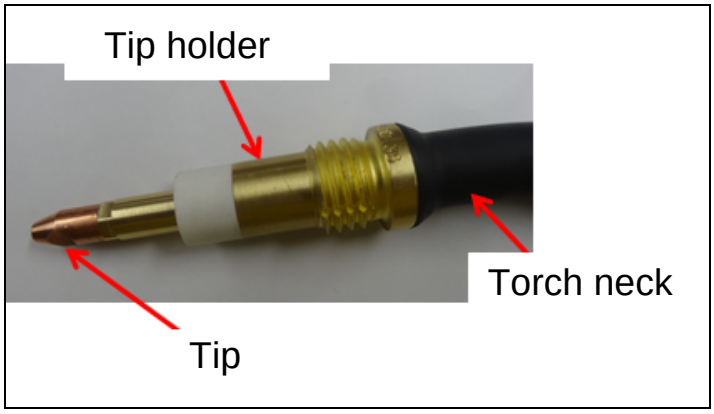


Fig. 8.7 (b) Removing the tip holder

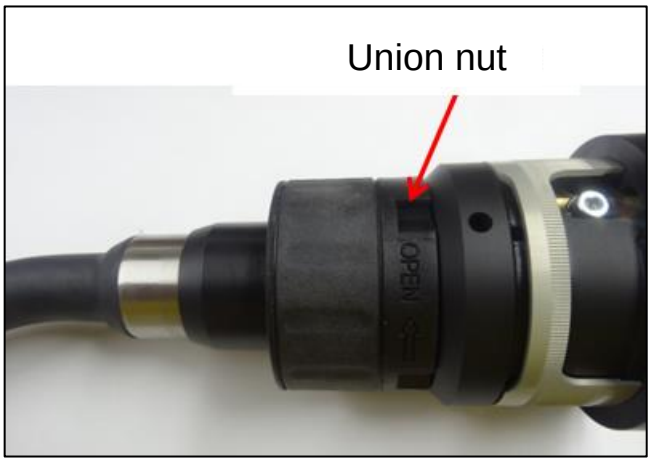


Fig. 8.7 (c) Removing the torch neck

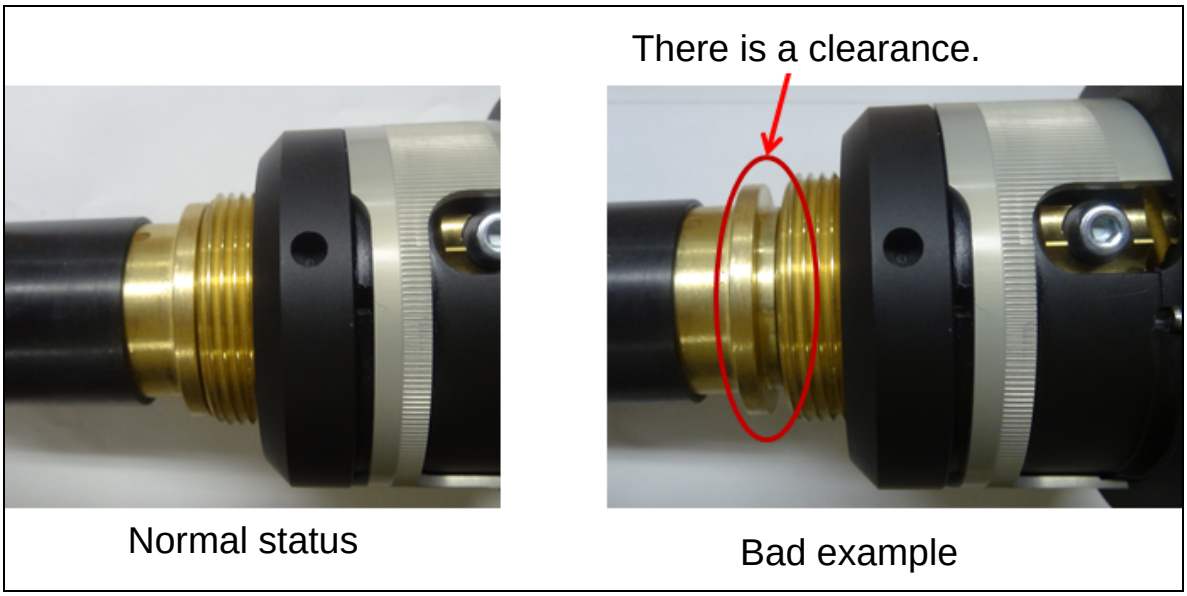


Fig. 8.7 (d) Check no gap of the torch neck

8.8 REPLACING THE WIRE FEEDER

1 Remove the flexible conduit of the wire feeder referring to Fig. 8.8, cut the wire, feed the wire until it does not come from the roller part, then pull out the wire from the tip end.
2 Remove the hexagon bolt (M10), hexagon hole bolt (M6) joint for gas hose of torch side.
3 Remove the flexible conduit side gas hose and wire feeder control cable.
4 Remove the wire feeder mounting bolts.
5 Replace old wire feeder by new one. For its assembly, please apply the steps above in reversed sequence.

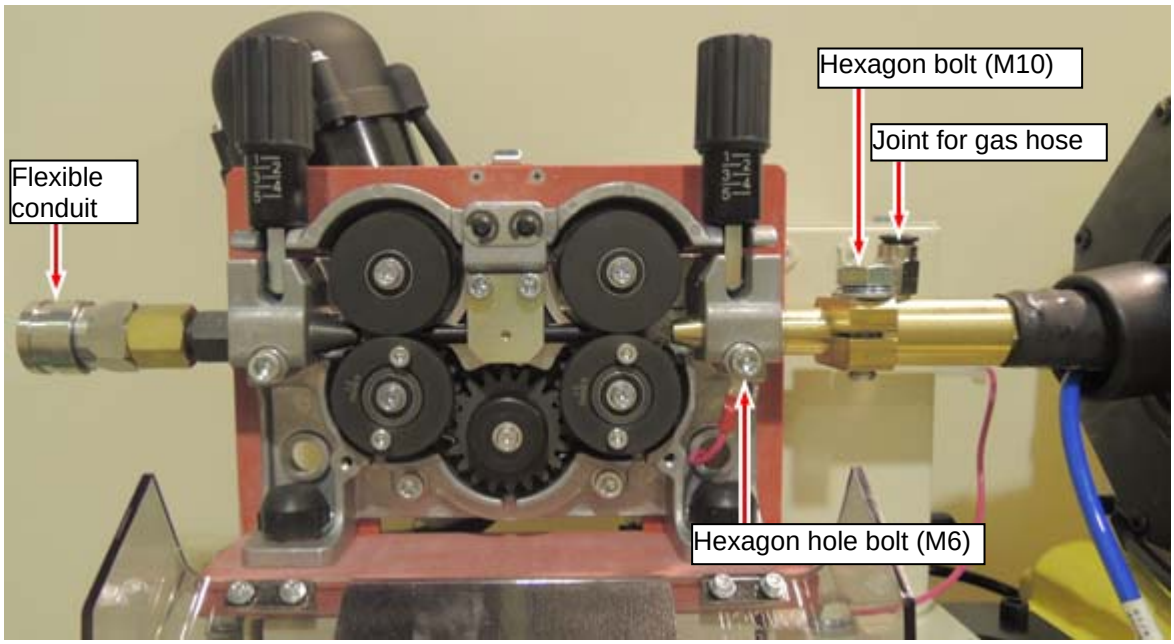


Fig. 8.8 Replacing the wire feeder

9 MAINTENANCE PARTS

When part unit is needed about welding power supply and welding torch, refer to this section.
Please inquire of our company about parts that not are described in this section.

Table 9 (a) Maintenance parts of welding power supply WB-P500L (A05B-1293-H111)

Part No.	Parts name	Sign	Q'ty	Remarks
A14L-0193-0111#100X0234	Carbon resistance	R5 to 10	6	
A14L-0193-0111#100X1429	Fan	FM1 to 3	3	
A14L-0193-0111#100X1750	IGBT module	TR1 to 4	4	
A14L-0193-0111#100X1822	Circuit protector	NF	1	
A14L-0193-0111#100X1823	Diode module	DR1	1	
A14L-0193-0111#100X1825	Fan	FM4	1	
A14L-0193-0111#100X1889	USB memory		1	For program installation
A14L-0193-0111#100X2033	IGBT module	TR5 to 7	3	
A14L-0193-0111#4255X016	Pressure switch	PS1	1	
A14L-0193-0111#4341X206	Relay		1	PCB1 is installed
A14L-0193-0111#4508X317	Carbon resistance	R20 to 22	3	
A14L-0193-0111#4531X119	Diode module	DR2 to 5, 8 to 11	8	
A14L-0193-0111#K5791B00	Constant voltage power supply	DCV1	1	
A14L-0193-0111#K5791C00	Constant voltage power supply	DCV2	1	
A14L-0193-0111#30086Q00	printed circuit board	PCB3	1	
A14L-0193-0111#30086R00	printed circuit board	PCB2	1	
A14L-0193-0111#30086S00	printed circuit board	PCB10	1	
A14L-0193-0111#30086V00	printed circuit board	PCB5	1	
A14L-0193-0111#30087Q00	printed circuit board	PCB4	1	
A14L-0193-0111#30087V00	printed circuit board	PCB6	1	
A14L-0193-0111#30088V00	printed circuit board	PCB11	1	
A14L-0193-0111#30099P00	printed circuit board	PCB1	1	
A14L-0193-0111#30125M00	printed circuit board	PCB7	1	

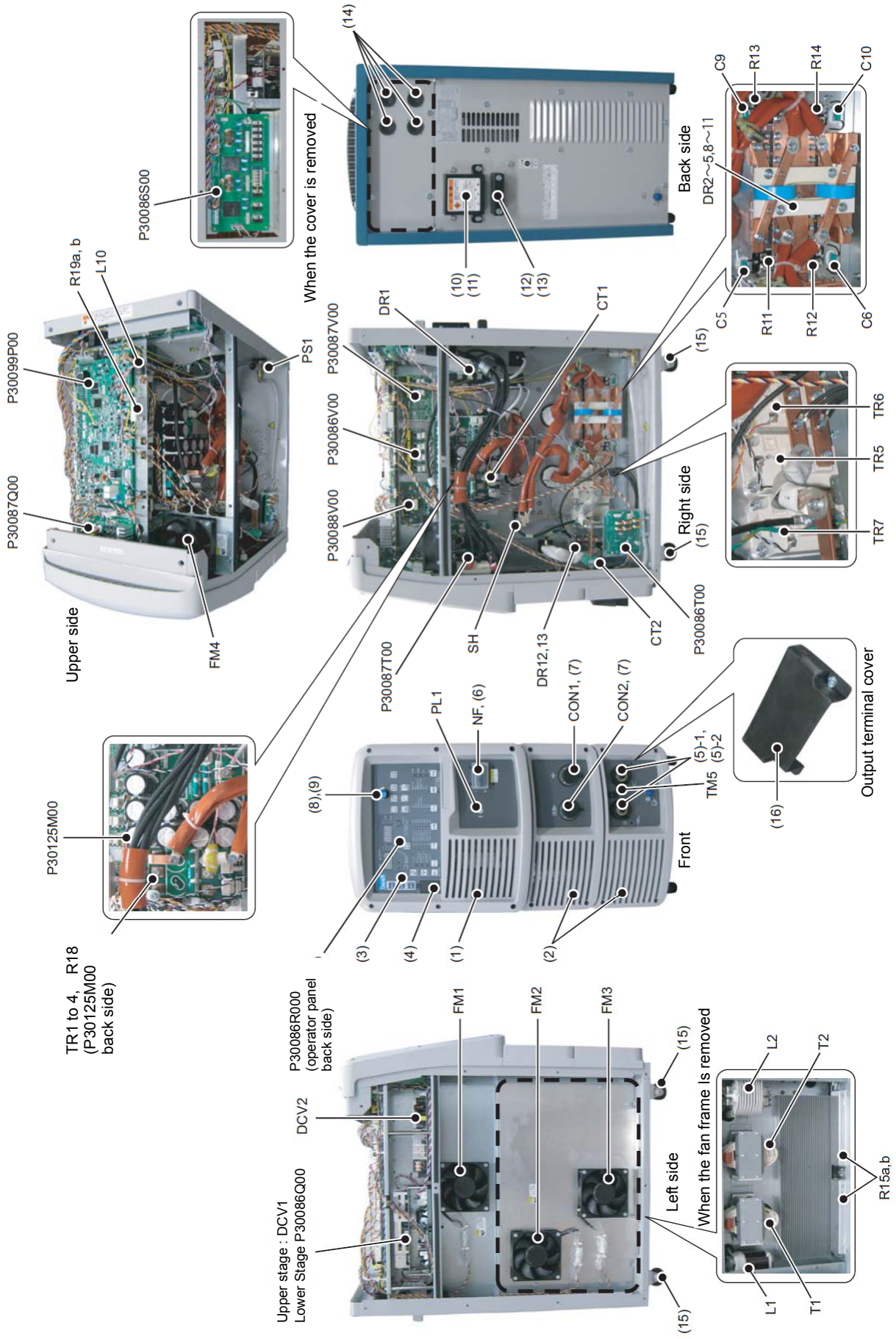


Fig. 9 (a) Welding power supply WB-P500L

Table 9 (b) Maintenance parts of welding power supply WB-P350 (A05B-1293-H112)

Part No.	Parts name	Sign	Q'ty	Remarks
A14L-0193-0111#100X0234	Carbon resistance	R5 to 10	6	
A14L-0193-0112#100X1492	Fan	FM1,2	2	
A14L-0193-0111#100X1823	Diode module	DR1	1	
A14L-0193-0111#100X1825	Fan	FM4	1	
A14L-0193-0111#100X1889	USB memory		1	For program installation
A14L-0193-0112#100X1998	Circuit protector	NF	1	
A14L-0193-0112#100X1999	IGBT module	TR1 to 4	4	
A14L-0193-0111#4255X016	Pressure switch	PS1	1	
A14L-0193-0111#4341X206	Relay		1	PCB1 is installed
A14L-0193-0111#4531X119	Diode module	DR6	1	
A14L-0193-0111#4531X119	Diode module	DR2 to 5,8	5	
A14L-0193-0112#4734X007	Machine socket	⑤	2	
A14L-0193-0111#K5791B00	Constant voltage power supply	DCV1	1	
A14L-0193-0111#K5791C00	Constant voltage power supply	DCV2	1	
A14L-0193-0111#30086Q00	printed circuit board	PCB3	1	
A14L-0193-0111#30086R00	printed circuit board	PCB2	1	
A14L-0193-0111#30086S00	printed circuit board	PCB10	1	
A14L-0193-0111#30086V00	printed circuit board	PCB5	1	
A14L-0193-0111#30087Q00	printed circuit board	PCB4	1	
A14L-0193-0111#30087V00	printed circuit board	PCB6	1	
A14L-0193-0111#30099P00	printed circuit board	PCB1	1	
A14L-0193-0111#30124M00	printed circuit board	PCB7	1	
A14L-0193-0112#WXW00032	Pressure switch	23-10	1	

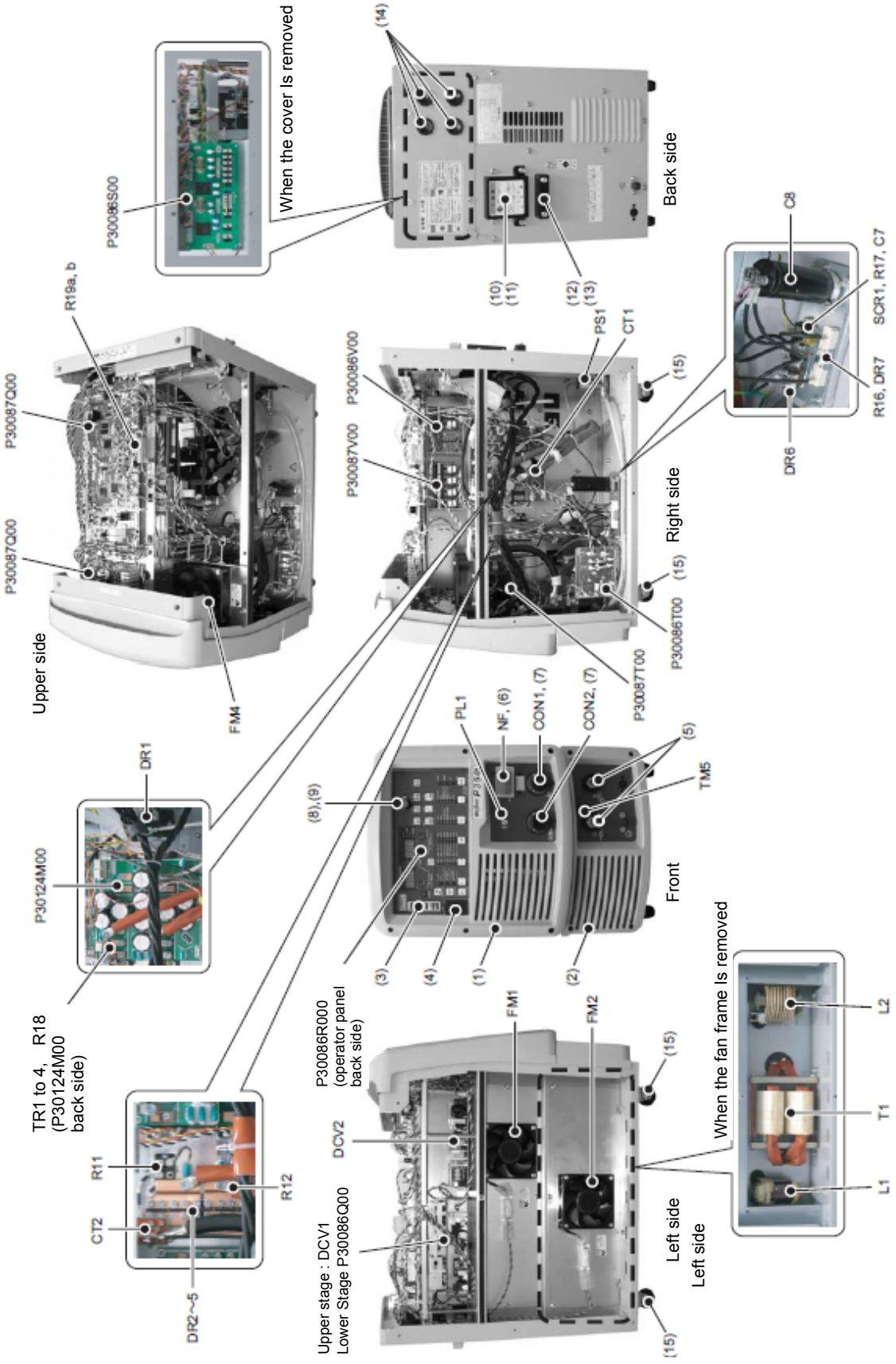


Fig. 9 (b) Welding power supply WB-P350

Table 9 (c) Maintenance parts of welding power supply WB-M350L (A05B-1293-H113)

Part No.	Parts name	Sign	Q'ty	Remarks
A14L-0193-0111#100X0234	Carbon resistance	R5 to 10	6	
A14L-0193-0113#100X1426	Circuit protector	NF	1	
A14L-0193-0113#100X1427	Diode module	DR1	1	
A14L-0193-0113#100X1428	IGBT module	TR5,6	2	
A14L-0193-0113#100X1492	Fan	FM1,2	2	
A14L-0193-0111#100X1889	USB memory		1	For program installation
A14L-0193-0112#100X1999	IGBT module	TR1 to 4	4	
A14L-0193-0111#4341X206	Relay		1	PCB1 is installed
A14L-0193-0111#4508X317	Carbon resistance	R13,14	2	
A14L-0193-0111#4531X119	Diode module	DR2 to 5	4	
A14L-0193-0112#4734X007	Machine socket	⑤	2	
A14L-0193-0111#K5791B00	Constant voltage power supply	DCV1	1	
A14L-0193-0111#K5791C00	Constant voltage power supply	DCV2	1	
A14L-0193-0113#K5791K00	Fan	FM4	1	
A14L-0193-0113#30086M00	printed circuit board	PCB7	1	
A14L-0193-0111#30086Q00	printed circuit board	PCB3	1	
A14L-0193-0111#30086R00	printed circuit board	PCB2	1	
A14L-0193-0111#30086S00	printed circuit board	PCB10	1	
A14L-0193-0111#30086V00	printed circuit board	PCB5	1	
A14L-0193-0111#30087Q00	printed circuit board	PCB4	1	
A14L-0193-0111#30087V00	printed circuit board	PCB6	1	
A14L-0193-0111#30088V00	printed circuit board	PCB11	1	
A14L-0193-0111#30099P00	printed circuit board	PCB1	1	

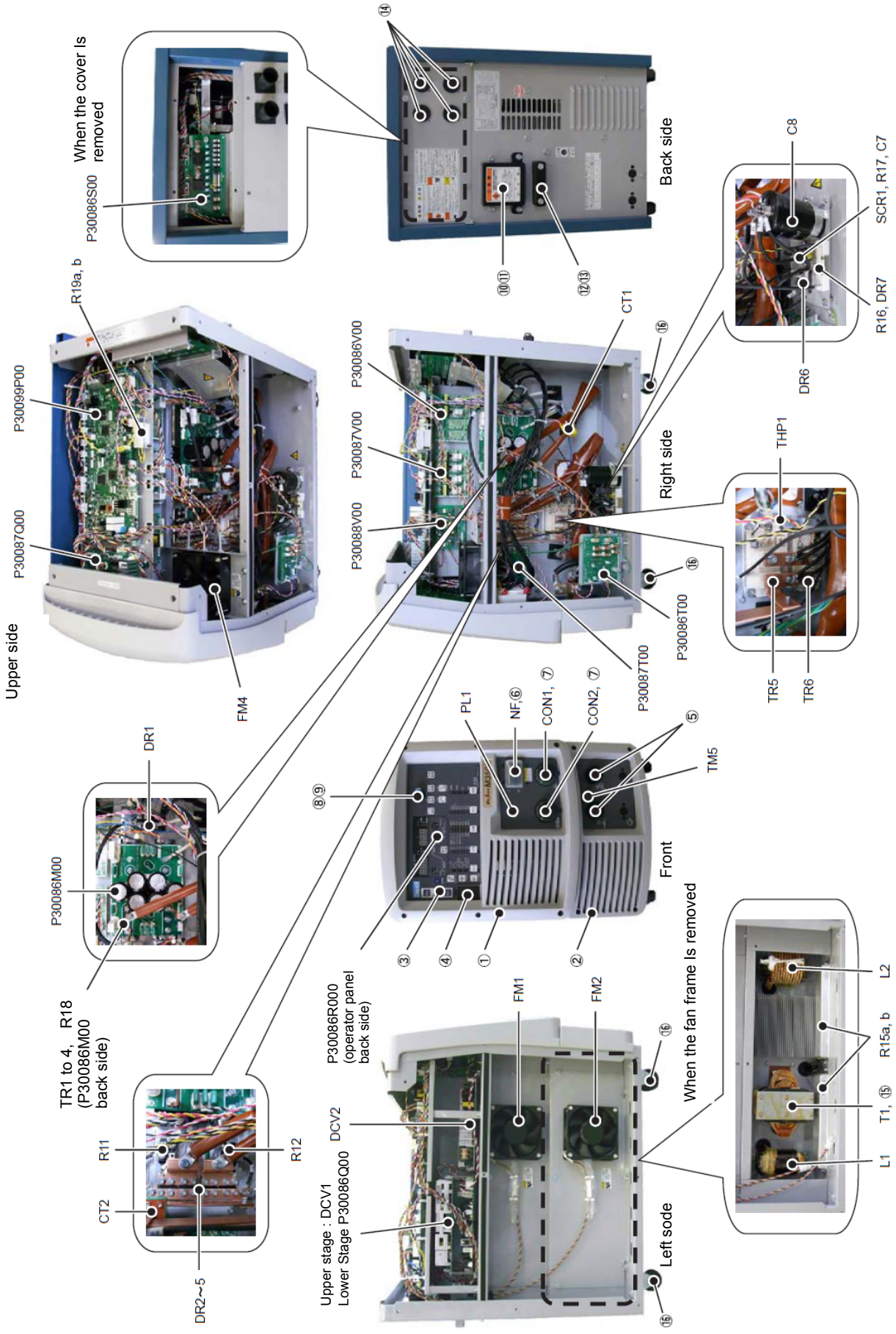


Fig. 9 (c) Welding power supply WB-P350L

Table 9 (d) Maintenance parts of welding power supply WB-M500 (A05B-1293-H114)

Par No.	Parts name	Sign	Q'ty	Remarks
A14L-0193-0111#100X0234	Carbon resistance	R5 to 10	6	
A14L-0193-0111#100X1429	Fan	FM1 to 3	3	
A14L-0193-0111#100X1750	IGBT module	TR1 to 4	4	
A14L-0193-0111#100X1822	Circuit protector	NF	1	
A14L-0193-0111#100X1823	Diode module	DR1	1	
A14L-0193-0111#100X1825	Fan	FM4	1	
A14L-0193-0111#100X1889	USB memory		1	For program installation
A14L-0193-0111#4341X206	Relay		1	PCB1 is installed
A14L-0193-0111#4531X119	Diode module	DR6	1	
A14L-0193-0111#4531X119	Diode module	DR2 to 5, 8 to 11	8	
A14L-0193-0111#K5791B00	Constant voltage power supply	DCV1	1	
A14L-0193-0111#K5791C00	Constant voltage power supply	DCV2	1	
A14L-0193-0111#30086Q00	printed circuit board	PCB3	1	
A14L-0193-0111#30086R00	printed circuit board	PCB2	1	
A14L-0193-0111#30086S00	printed circuit board	PCB10	1	
A14L-0193-0111#30086V00	printed circuit board	PCB5	1	
A14L-0193-0111#30087Q00	printed circuit board	PCB4	1	
A14L-0193-0111#30087V00	printed circuit board	PCB6	1	
A14L-0193-0114#30089M00	printed circuit board	PCB7	1	
A14L-0193-0111#30099P00	printed circuit board	PCB1	1	

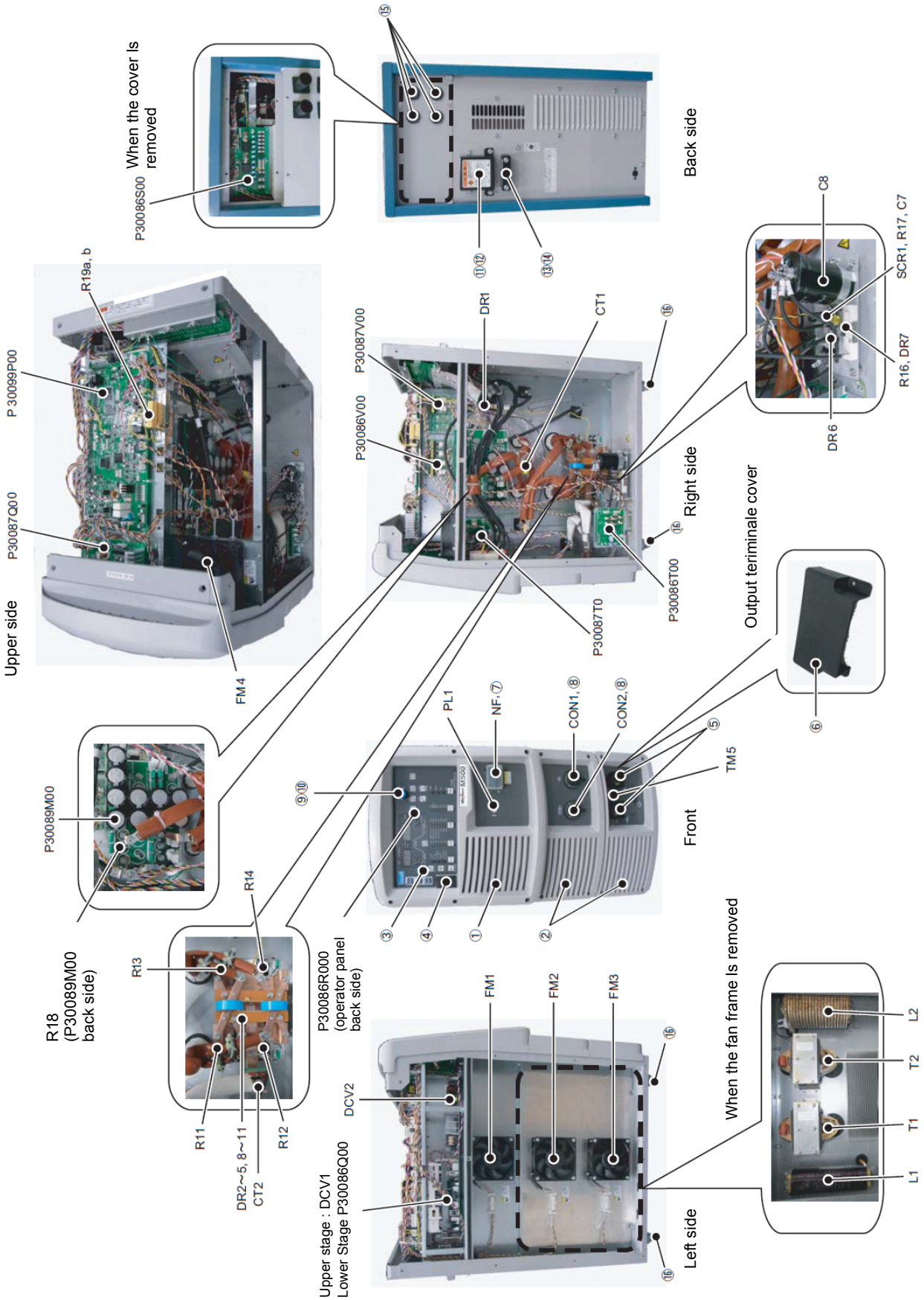


Fig. 9 (d) Welding power supply WB-M500

Table 9 (e) Maintenance parts of welding power supply WB-M350 (A05B-1293-H115)

Part No.	Parts name	Sign	Q'ty	Remarks
A14L-0193-0111#100X0234	Carbon resistance	R5 to 10	6	
A14L-0193-0113#100X1426	Circuit protector	NF	1	
A14L-0193-0113#100X1427	Diode module	DR1	1	
A14L-0193-0113#100X1492	Fan	FM1,2	2	
A14L-0193-0111#100X1889	USB memory		1	For program installation
A14L-0193-0112#100X1999	IGBT module	TR1 to 4	4	
A14L-0193-0111#4341X206	Relay		1	PCB1 is installed
A14L-0193-0111#4531X119	Diode module	DR2 to 5	4	
A14L-0193-0111#4531X119	Diode module	DR6	1	
A14L-0193-0112#4734X007	Machine socket	⑤	2	
A14L-0193-0111#K5791B00	Constant voltage power supply	DCV1	1	
A14L-0193-0111#K5791C00	Constant voltage power supply	DCV2	1	
A14L-0193-0113#K5791K00	Fan	FM4	1	
A14L-0193-0113#30086M00	printed circuit board	PCB7	1	
A14L-0193-0111#30086Q00	printed circuit board	PCB3	1	
A14L-0193-0111#30086R00	printed circuit board	PCB2	1	
A14L-0193-0111#30086S00	printed circuit board	PCB10	1	
A14L-0193-0111#30086V00	printed circuit board	PCB5	1	
A14L-0193-0111#30087Q00	printed circuit board	PCB4	1	
A14L-0193-0111#30087V00	printed circuit board	PCB6	1	
A14L-0193-0111#30099P00	printed circuit board	PCB1	1	

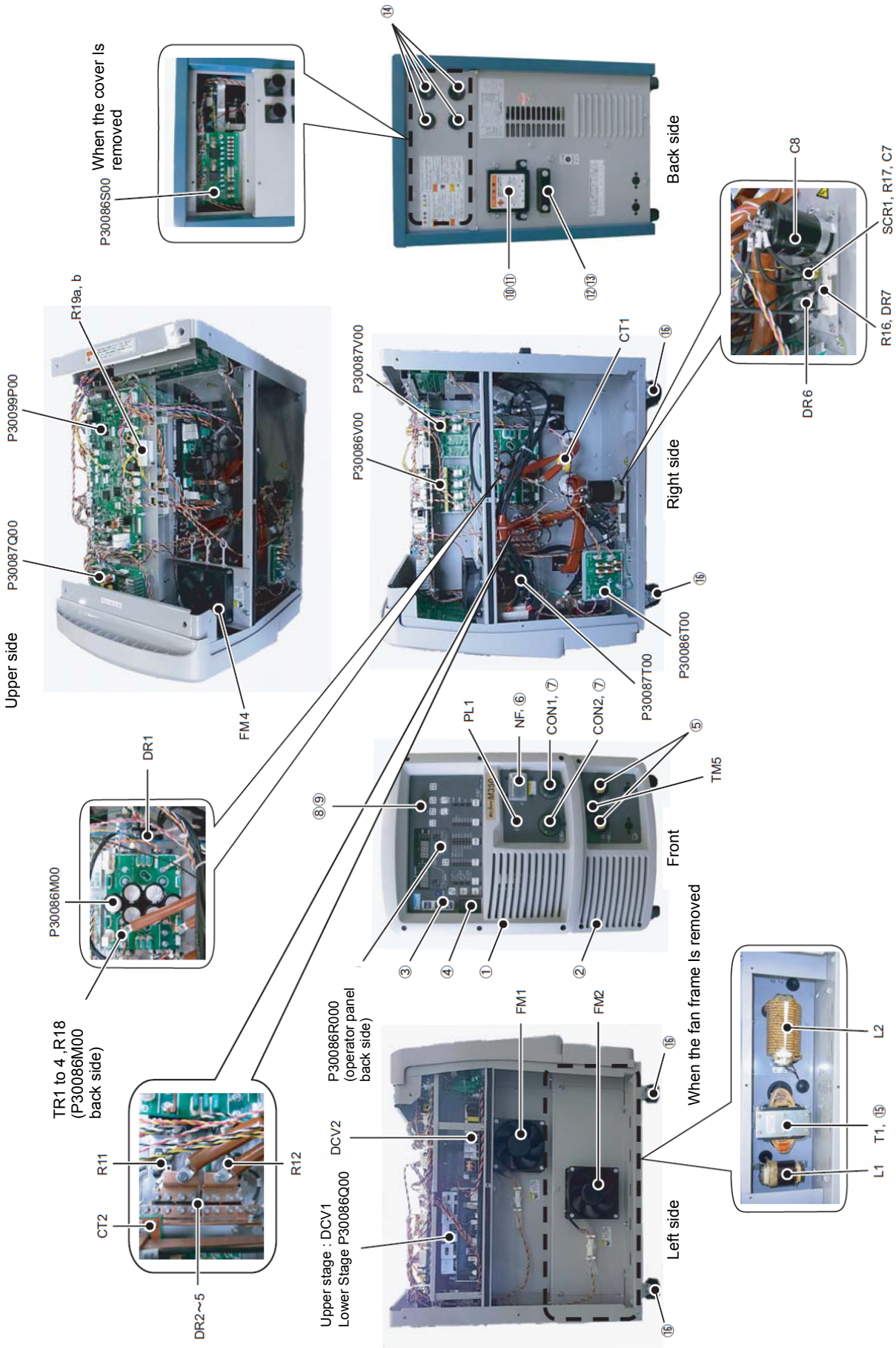


Fig. 9 (e) Welding power supply WB-M350

Table 9 (f) Maintenance parts of wire feeder CMRE-742 (A05B-1293-H211)

Par No.	Parts name	Sign	Q'ty	Remarks
A14L-0193-0211#30024E00	Control cable	Fig. 9(f). 11	1	
A14L-0193-0211#U5206G00	Gas piping	Fig. 9(f). 12	1	
A14L-0193-0211#U5293S00	Common mode coil	Fig. 9(f). 13	1	
A14L-0193-0211#K5879E00	Adapter cable (1)	Fig. 9(f). 14	1	
A14L-0193-0211#10595B03	Drive roll axis	Fig. 9(g) 3	2	
A14L-0193-0211#WXW03729	Feed motor	Fig. 9(h). 2	1	Fig 9(h). 2-1 is not include
A14L-0193-0211#K5439C00	Jamming roll	Fig. 9(i). 3	2	Fig. 9(j). 3-1 is not include
A14L-0193-0211#10595P00	Middle gear	Fig. 9(j). 5	2	Fig. 9(j) 5-1 is not include
A14L-0193-0211#K5439B12	Feed roll (0.9-1.0/1.2)	Fig. 9(j). 6	2	For mild steel , Fig. 9(j). 6-1 is not include
A14L-0193-0211#10595Q00	Drive gear	Fig. 9(j). 10	1	Fig. 9(j). 10-1 is not include

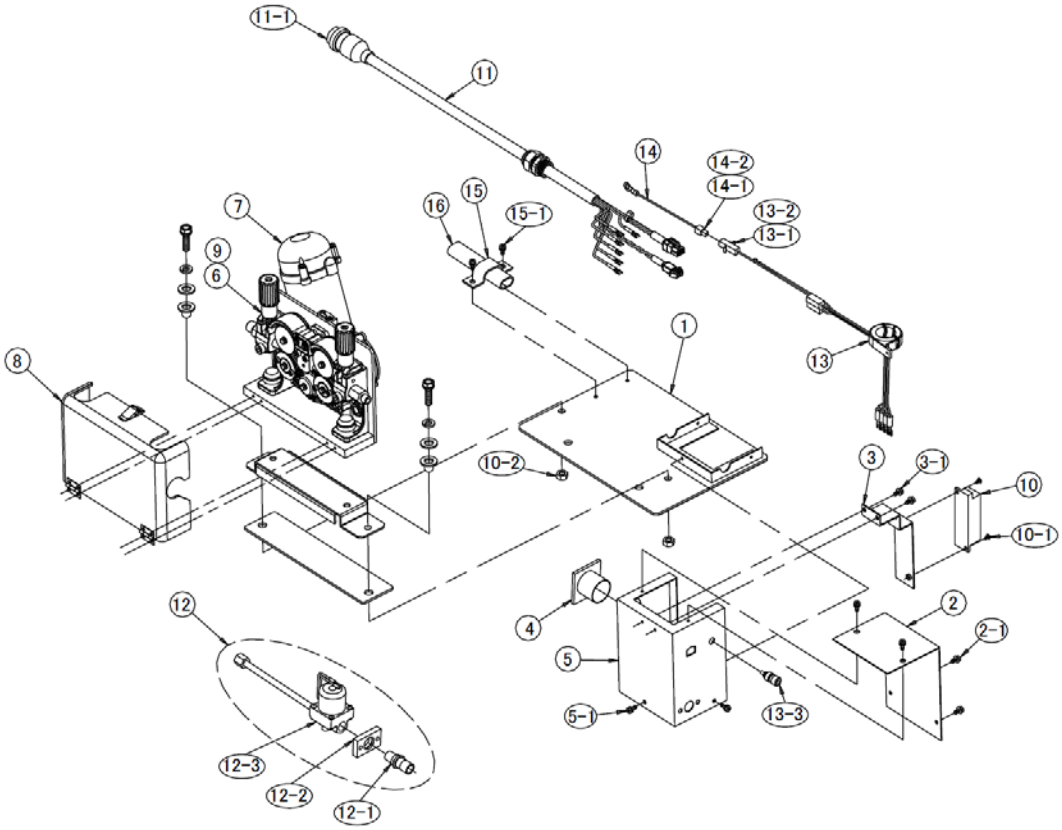


Fig. 9 (f) Wire feeder (main body, disassembling figure related to piping)

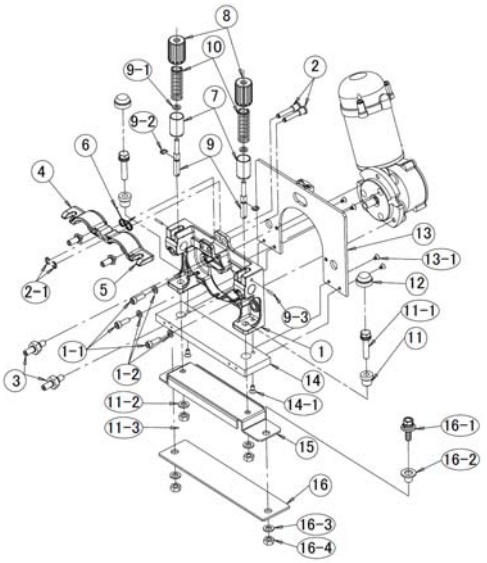


Fig. 9 (g) Disassembling figure of wire feeder

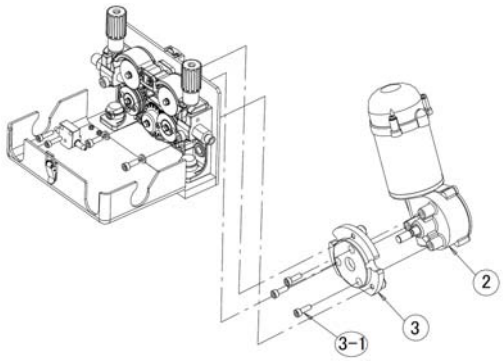


Fig. 9 (h) Disassembling figure of feed motor

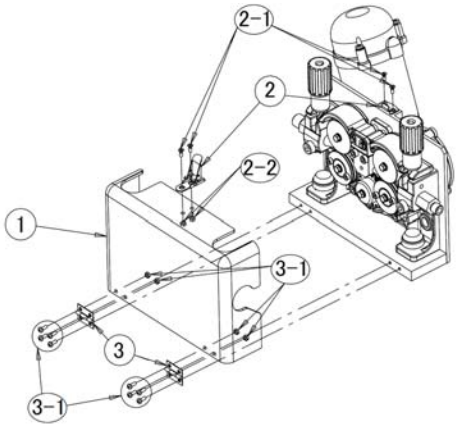


Fig. 9 (i) Disassembling figure of feed cover

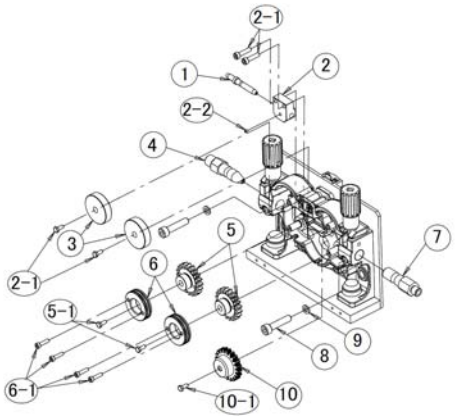


Fig. 9 (j) Disassembling figure of installed parts

Table 9 (g) Maintenance parts of torch

Spec of parts for maintenance	Name of parts for maintenance	Sign	Unit requirement	Remarks
A14L-0193-0301	Welding torch	-	1	ABIROB 350GC-30S For ARC Mate 100iC/12 (A05B-1293-H301)
A14L-0193-0302	Welding torch	-	1	ABIROB 350GC-30S For ARC Mate 100iC/7L (A05B-1293-H302)
A14L-0193-0303	Welding torch	-	1	ABIROB 350GC-30L For ARC Mate 100iC/12 (A05B-1293-H303)
A14L-0193-0304	Welding torch	-	1	ABIROB 350GC-30L For ARC Mate 100iC/7L (A05B-1293-H304)
A14L-0194-0301	Welding torch	-	1	ABIROB 350GC-30S For ARC Mate 120iC (A05B-1294-H301)
A14L-0194-0302	Welding torch	-	1	ABIROB 350GC-30S For ARC Mate 120iC/12L (A05B-1294-H302)
A14L-0194-0303	Welding torch	-	1	ABIROB 350GC-30L For ARC Mate 120iC (A05B-1294-H303)
A14L-0194-0304	Welding torch	-	1	ABIROB 350GC-30L For ARC Mate 120iC/12L (A05B-1294-H304)
A14L-0166-0301#124XJ005	Liner	1	1	φ1.0 to φ1.2
A14L-0166-0301#140X1357	Tip	2	1	L=45mm/CuCrZr/φ1.2/M6
A14L-0166-0301#142X0143	Tip holder	3	1	
A14L-0166-0301#145X0558	Gas nozzle (*2)	4	1	Tapered type/φ12/Cr coating
A14L-0166-0301#145XJ054	Gas nozzle (*1)	5	1	Straight type/φ15.6/Normal
A14L-0166-0301#145X0557	Gas nozzle (*2)	6	1	Straight type/φ15.6/Cr coating
A14L-0166-0301#145X0559	Gas nozzle (*2)	7	1	Bottle type/φ14/Cr coating
A14L-0166-0301#145X0573	Gas nozzle (*2)	8	1	Tapered type/φ13/Cr coating
A14L-0166-0301#980X0013	Insulated cap (*3)	9	1	
A14L-0166-0301#980X0014	Counter nut	10	1	
A14L-0166-0301#980X0019	Gas diffuser	11	1	
A14L-0166-0301#980X0142	Insulated tube	12	1	
A14L-0166-0301#980X0027	Torch neck	13	1	For ABIROB 350GC-30S
A14L-0166-0301#980X0028	Torch neck	14	1	For ABIROB 350GC-30L
A14L-0166-0301#780A3230	Robot mount (*3)	15	1	
A14L-0166-0301#780X0680	Insulated flange	16	1	
A14L-0166-0301#780X3220	Swivel	17	1	
A14L-0193-0301#980XD301	Torch cable	18	1	For ARC Mate 100iC/12
A14L-0193-0301#980XD302	Torch cable	19	1	For ARC Mate 100iC/7L
A14L-0194-0301#980XD303	Torch cable	20	1	For ARC Mate 120iC
A14L-0194-0301#980XD304	Torch cable	21	1	For ARC Mate 120iC/12L
A14L-0166-0301#980XF111	Torch neck Asbly.	22	1	For ABIROB 350GC-30S Tip L=45mm/φ1.2
A14L-0166-0301#980XF113	Torch neck Asbly.	23	1	For ABIROB 350GC-30L Tip L=45mm/φ1.2

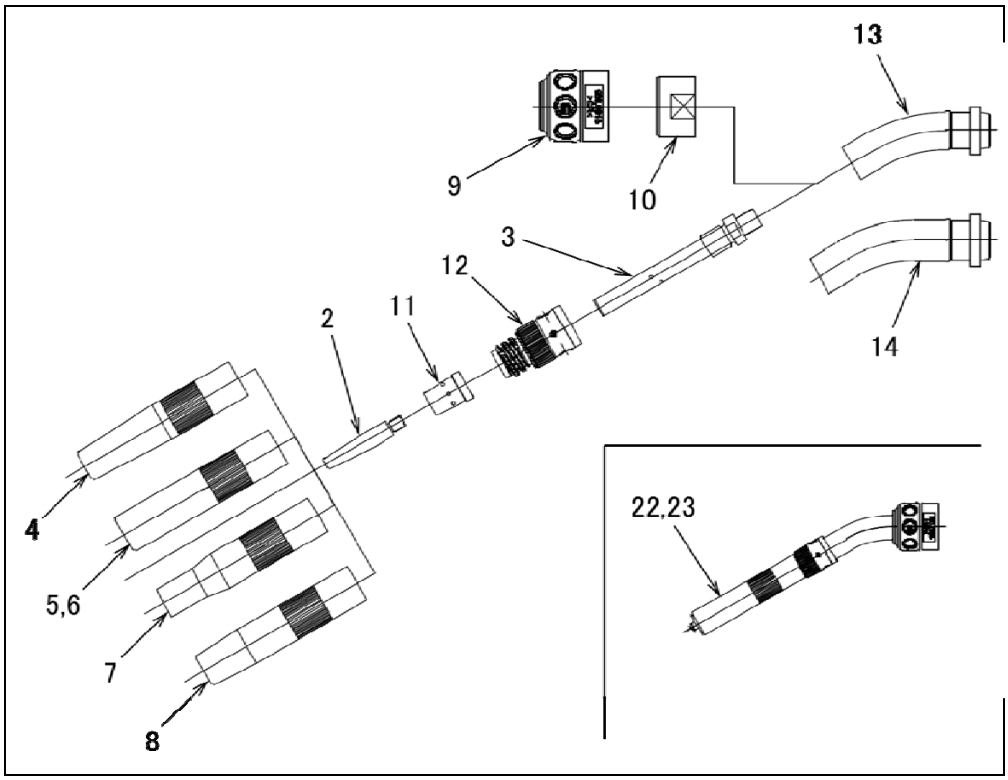


Fig. 9 (k) figure for part of the torch (1/2)

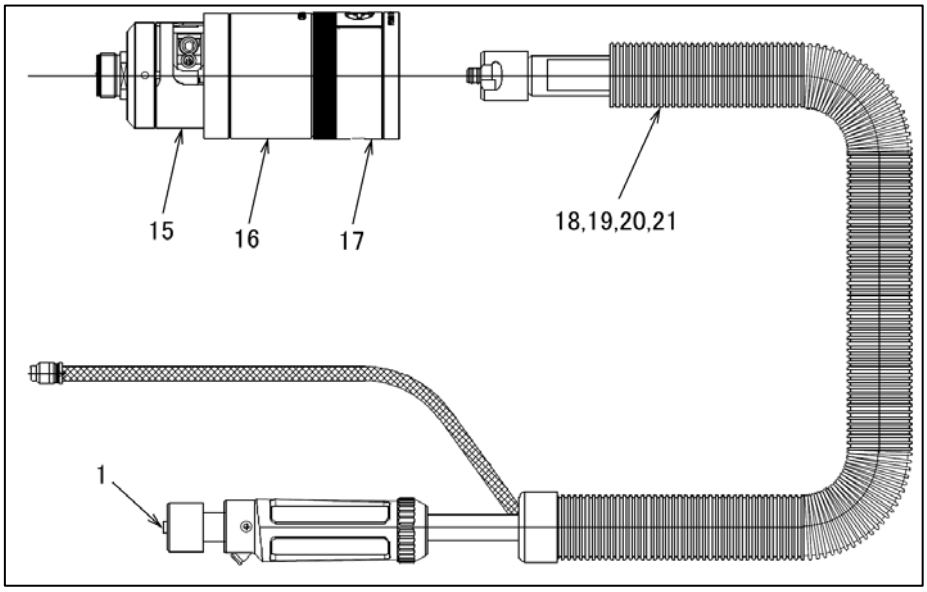


Fig. 9 (l) figure for part of the torch (2/2)

(*1) These parts are installed normally.
(*2) Change to these parts is possible by specifying options.
(*3) Robot mount cannot be installed to the old type insulated cap. When ordering the robot mount, order insulated cap at the same when insulated cap is old type.

10 PROCESS MODE

This chapter describes about available process modes of DAIHEN digital welding power supply Welbee series. About details of Process mode, please refer to Section 4.3 “OPERATION OF WELD PROCEDURE AND PROCESS MODE”.

NOTE
Available process modes will be changed by the installed firmware version and weld table version in the welding power supply. Please use these lists as reference information.

10.1 PROCESS MODE LIST FOR WELBEE SERIES

Mode	Welding method	Material	Diam-eter (mm)	CTWD (mm)	Gas	Available model				
						P500 L	M500	P350	M350 L	M350
1	DC	Steel	1.2	15	100%CO2	OK	OK	OK		OK
2	DC low spatter	Steel	1.2	15	100%CO2	OK			OK	
5	DC	Steel	1.2	15	80%Ar 20%CO2	OK	OK	OK		OK
6	DC low spatter	Steel	1.2	15	80%Ar 20%CO2	OK			OK	
7	DC Pulse	Steel	1.2	15	80%Ar 20%CO2	OK		OK		
8	DC Wave Pulse	Steel	1.2	15	80%Ar 20%CO2	OK		OK		
11	DC	Steel	1.0	12	100%CO2	OK		OK		OK
12	DC low spatter	Steel	1.0	12	100%CO2	OK			OK	
15	DC	Steel	1.0	12	80%Ar 20%CO2	OK		OK		OK
16	DC low spatter	Steel	1.0	12	80%Ar 20%CO2	OK			OK	
17	DC Pulse	Steel	1.0	12	80%Ar 20%CO2	OK		OK		
18	DC Wave Pulse	Steel	1.0	12	80%Ar 20%CO2	OK		OK		
21	DC	Steel	0.9	12	100%CO2	OK		OK		OK
22	DC low spatter	Steel	0.9	12	100%CO2	OK			OK	
25	DC	Steel	0.9	12	80%Ar 20%CO2	OK		OK		OK
26	DC low spatter	Steel	0.9	12	80%Ar 20%CO2	OK			OK	
27	DC Pulse	Steel	0.9	12	80%Ar 20%CO2	OK		OK		
28	DC Wave Pulse	Steel	0.9	12	80%Ar 20%CO2	OK		OK		
31	DC	Steel	0.8	12	100%CO2	OK		OK		OK
32	DC low spatter	Steel	0.8	12	100%CO2	OK			OK	
35	DC	Steel	0.8	12	80%Ar 20%CO2	OK		OK		OK
36	DC low spatter	Steel	0.8	12	80%Ar 20%CO2	OK			OK	

Mode	Welding method	Material	Diam-eter (mm)	CTWD (mm)	Gas	Available model				
						P500L	M500	P350	M350L	M350
37	DC Pulse	Steel	0.8	12	80%Ar 20%CO2	OK				
38	DC Wave Pulse	Steel	0.8	12	80%Ar 20%CO2	OK				
41	DC	Steel	1.4	15	100%CO2	OK	OK			
45	DC	Steel	1.4	15	80%Ar 20%CO2	OK	OK			
47	DC Pulse	Steel	1.4	15	80%Ar 20%CO2	OK				
48	DC Wave Pulse	Steel	1.4	15	80%Ar 20%CO2	OK				
51	DC	Steel	1.6	18	100%CO2	OK	OK			
55	DC	Steel	1.6	18	80%Ar 20%CO2	OK	OK			
57	DC Pulse	Steel	1.6	18	80%Ar 20%CO2	OK				
58	DC Wave Pulse	Steel	1.6	18	80%Ar 20%CO2	OK				
101	DC	Stainless Steel	1.2	15	98%Ar 2%O2	OK	OK	OK		OK
102	DC low spatter	Stainless Steel	1.2	15	98%Ar 2%O2	OK			OK	
103	DC Pulse	Stainless Steel	1.2	15	98%Ar 2%O2	OK		OK		
104	DC Wave Pulse	Stainless Steel	1.2	15	98%Ar 2%O2	OK		OK		
111	DC	Stainless Steel	1.0	12	98%Ar 2%O2	OK		OK		OK
112	DC low spatter	Stainless Steel	1.0	12	98%Ar 2%O2	OK			OK	
113	DC Pulse	Stainless Steel	1.0	12	98%Ar 2%O2	OK		OK		
114	DC Wave Pulse	Stainless Steel	1.0	12	98%Ar 2%O2	OK		OK		
121	DC	Stainless Steel	0.9	12	98%Ar 2%O2	OK		OK		OK
122	DC low spatter	Stainless Steel	0.9	12	98%Ar 2%O2	OK			OK	
123	DC Pulse	Stainless Steel	0.9	12	98%Ar 2%O2	OK		OK		
124	DC Wave Pulse	Stainless Steel	0.9	12	98%Ar 2%O2	OK		OK		
131	DC	Stainless Steel	0.8	12	98%Ar 2%O2	OK		OK		OK
132	DC low spatter	Stainless Steel	0.8	12	98%Ar 2%O2	OK			OK	
133	DC Pulse	Stainless Steel	0.8	12	98%Ar 2%O2	OK				
134	DC Wave Pulse	Stainless Steel	0.8	12	98%Ar 2%O2	OK				
151	DC	Stainless Steel	1.6	18	98%Ar 2%O2	OK	OK			

Mode	Welding method	Material	Diam -eter (mm)	CTWD (mm)	Gas	Available model				
						P500 L	M500	P350	M350 L	M350
153	DC Pulse	Stainless Steel	1.6	18	98%Ar 2%O2	OK				
154	DC Wave Pulse	Stainless Steel	1.6	18	98%Ar 2%O2	OK				
201	DC	Stainless Ferrite	1.2	15	98%Ar 2%O2	OK				
202	DC low spatter	Stainless Ferrite	1.2	15	98%Ar 2%O2	OK				
203	DC Pulse	Stainless Ferrite	1.2	15	98%Ar 2%O2	OK				
204	DC Wave Pulse	Stainless Ferrite	1.2	15	98%Ar 2%O2	OK				
211	DC	Stainless Ferrite	1.0	12	98%Ar 2%O2	OK				
212	DC low spatter	Stainless Ferrite	1.0	12	98%Ar 2%O2	OK				
213	DC Pulse	Stainless Ferrite	1.0	12	98%Ar 2%O2	OK				
214	DC Wave Pulse	Stainless Ferrite	1.0	12	98%Ar 2%O2	OK				
221	DC	Stainless Ferrite	0.9	12	98%Ar 2%O2	OK				
222	DC low spatter	Stainless Ferrite	0.9	12	98%Ar 2%O2	OK				
223	DC Pulse	Stainless Ferrite	0.9	12	98%Ar 2%O2	OK				
224	DC Wave Pulse	Stainless Ferrite	0.9	12	98%Ar 2%O2	OK				
231	DC	Stainless Ferrite	0.8	12	98%Ar 2%O2	OK				
232	DC low spatter	Stainless Ferrite	0.8	12	98%Ar 2%O2	OK				
233	DC Pulse	Stainless Ferrite	0.8	12	98%Ar 2%O2	OK				
234	DC Wave Pulse	Stainless Ferrite	0.8	12	98%Ar 2%O2	OK				

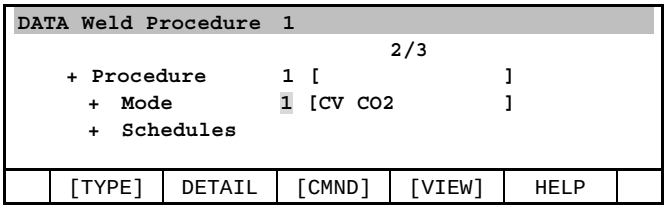
10.2 TEST MODE

DAIHEN digital welding power supply has a wide variety of process modes outside the list in Section 10.1. In this section, the method to set arbitrary process mode to the robot controller is explained.
See Procedure 10-2.

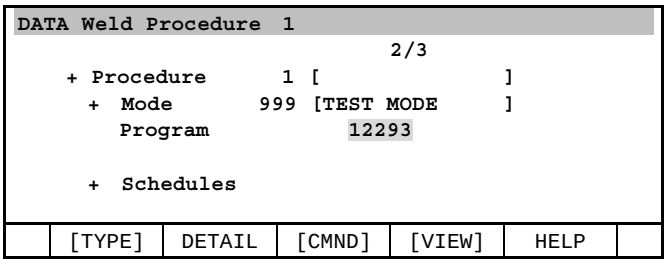
Procedure 10-2 Set process mode by Test mode

Step

1. Press [DATA]. The following screen is displayed.
2. Select the weld equipment number and move the cursor to “Mode” line in the desired weld procedure. Press F3 [CMND] and select [Select WP].



3. Move the cursor to “Mode” number, and input “999”.



4. Move the cursor to “Program” number, input a program number.
5. Setting is done. Confirm the control panel of Welbee whether desired weld methods are set.

NOTE
If the weld procedure is not selected in step 2 at confirming, the program number set by other weld procedure is send to Welbee.
The adaptive program number differs depending on type of welding power supply. If the non-adaptive one is send, the LED sign of Welbee are not changed.

Calculation the program number

This explanation is about a way to calculate the program number in procedure 10-2. The program number is a combination of diameter, material, gas and welding method. They are set by binary number. The process number is them converted to decimal number.

Process number (DN) = AAABBBBCCCDDD01 (BN)

Line up following numbers

AAA : Diameter (3-digit)
BBBB : Material (4-digit)
CCC : Gas (3-digit)
DDD : Welding method (3-digit)
Last 2-digits are always "01".

Table 10.2 Setting Number for Program Number

	A Diameter(mm)	B Material	C Gas	D Welding Method
0	0.8	Steel	100%CO2	DC Pulse
1	0.9	Steel Cored	80%Ar 20%CO2	DC
10	1.0	Stainless Steel	98%Ar 2%O2	DC Low Spatter
11	1.2	Stainless Ferrite	100%Ar	DC Wave Pulse
100	1.4	Stainless Cored	-	-
101	1.6	Al/Mg	-	-
110	-	Al/Pure	-	-

Example

Calculate the program number of following conditions. First, set binary numbers from the conditions.

- Diameter = 1.6mm = 101
- Material = Al/Pure = 110
- Gas = 100%Ar = 11
- Welding Method = DC Pulse = 0

Set above binary numbers to the digits as follow, and convert to decimal number.

101 0110 011 000 01 (BN) = 22113 (DN)

Welding Method (3-digit)
Gas (3-digit)
Material (4-digit)
Diameter (3-digit)

11 INITIAL SETTING

This chapter describes “Weld equipment select” and “Setting of multi-process function” as initial setting of welding power supply. **These were already set when robot was shipped, so those settings are usually not required.**

11.1 WELDING POWER SUPPLY SELECT

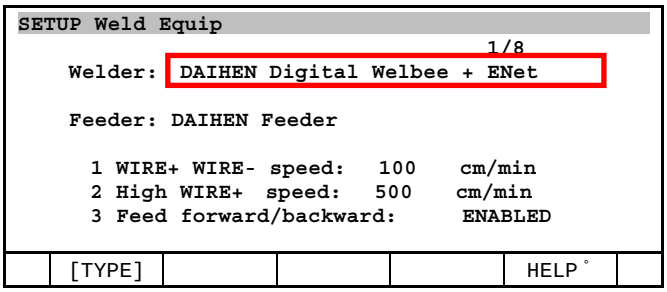
If appropriate welding equipment (welding power supply) is not selected, not only communication between arc welding robot and welding equipment cannot be performed, but also weld equipment cannot be controlled.
After you turn on the power supply of Robot controller and weld equipment, please wait a minute. **when the message of “ARC-045 Weld EQ is OFFLINE” keeps displaying,** Please refer to Procedure 11-1 (a) to confirm weld equipment select.

If wrong weld equipment is selected, selecting appropriate weld equipment is required. To select weld equipment, perform a Controlled start , then display arc tool setup screen. Perform the procedure 11-1 (b).

Procedure 11-1 (a) Confirm welding power supply select

Procedure

1 Press [MENU] key and select[6 SETUP]
2 Press F1[TYPE] and select [Weld Equip]. The following weld equip set screen will be displayed.



3 Please Confirm “Welder” is set up as “DAIHEN Digital Welbee + ENet”
4 If different name is written, please execute Procedure 11-1 (b).

Procedure 11-1 (b) Welding power supply select

Condition

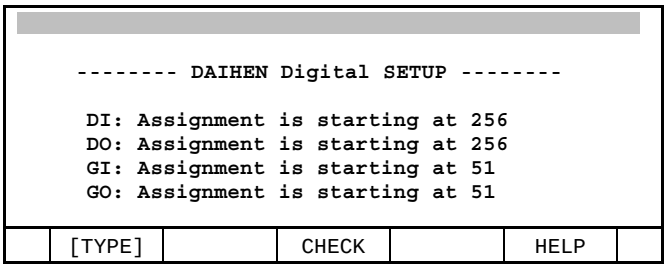
- DAIHEN Digital Weld Equipment library is installed.
- Robot controller and weld machine are connected via EtherNet cable.
- ”Manufacture” is except “DAIHEN Digital” or “Model” is except “Welbee + ENet” in ArcTool Setup Menu.

⚠ CAUTION
If robot manufacture is already “DAIHEN Digital”, please do not change weld manufacture. If weld manufacture is changed and cold start, controller recognizes weld machine model is changed and some settings of current ArcTool are lost.

NOTE
“Welding Setup” in the screen above is not supported. So it is not necessary to change from initial setting ”Japan”.

Procedure

1 Please set cursor to “Manufacture” and press F4 ”Choice”, choose “DAIHEN Digital”.
2 Please set cursor to “Model” and press F4 ”Choice”, choose “Welbee + ENet”.
3 After model is changed to “Welbee + ENet”, following messages are displayed and ArcTool setup menu is displayed automatically.



4 Press FCTN key and select [START (COLD)] and perform it.

5 After Cold Start, ArcTool automatically tries to communicate with the weld equipment. After the Cold Start finishes and 10sec - 1min passes, the communication succeed if the following message is displayed on the upper side of the screen. After this message is displayed, it is possible to set and control the weld equipment by Teach Pendant. (“i” in the message is Weld Equipment Number.)

ARC-051 Weld EQ i ONLINE: Ethernet/IP

6 If ARC-051 is not displayed at step5 and ARC-045 keeps displaying, the communication fails. Major cause of communication failing is shown below.
- The power supply of weld equipment is turned off.
- The communication cable is not correctly connected.

In case of the power supply of weld equipment is turned on and this message keeps displaying. Please refer to Troubleshooting of Section 9.1for this message.

ARC-045 Weld EQ Device is OFFLINE

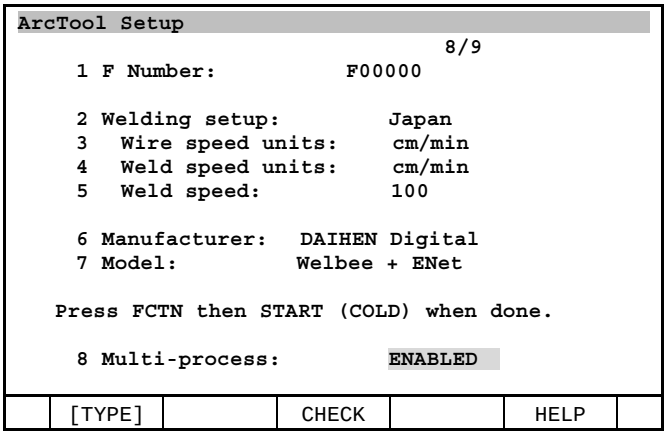
11.2 SETTING OF MULTI-PROCESS FUNCTION

When DAIHEN Digital welding power supply is connected, it is necessary to set multi-process function to enable. Setting of multi-process function is performed in ArcTool setup screen after Controlled Start. **This is already set when robot is shipped, so it is usually not required.**

Procedure 11-2 Setting of multi-process function

Condition

- ArcTool setup screen is displayed after performing Controlled Start.



Step

1 Move the cursor to below and confirm multi-process is ENABLED. If multi-process is DISABLED, match the cursor to “multi-process” then press F4「ENABLED」key.
2 Press [FCTN] key and select [START (COLD)] then perform it.

APPENDIX

A WELD CONDITION ADJUSTMENT

This chapter describes general adjustment method of welding condition, welding defects and countermeasure.

A.1 INFLUENCE BY ADJUSTMENT OF WELDING CONDITION

Table A.1.(a) describes the effect of weld schedule to bead appearance and Table A.1.(b) describes the effect of weld schedule to welding.

Table A.1 (a) Effect to appearance of each weld condition

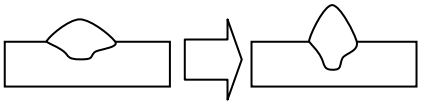
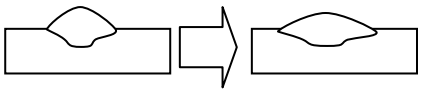
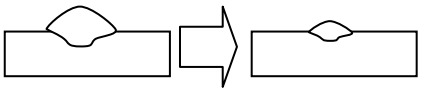
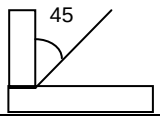
#	Factor	Change	Effect to bead	Notes
1	Weld current	Higher	Penetration becomes deeper Width of bead becomes wider Toe angle becomes smaller Less spatter	
2	Weld Voltage	Higher	Arc length becomes longer Penetration becomes shallower Width of bead becomes wider Convexity height becomes bigger spatter size becomes bigger	
3	Welding speed	Faster	Penetration becomes shallower Width of bead becomes narrower Toe angle becomes bigger Undercut may more occur	

Table A.1 (b) Effect to weld of each weld condition.

#	Factor	Change	Effect to weld	Notes
1	Wire size	Wider	More spatter Arc generation becomes unstable Penetration becomes shallower	Robots support 0.9, 1.0 1.2 mm
2	Contact tip distance	Longer	Less current Arc length becomes longer Penetration becomes shallower Arc generation becomes unstable	Suggested distance ϕ1.2 mm : 15 mm ϕ0.9, 1.0mm: 12 mm
3	Torch angle	Wider	Penetration becomes deeper Width of bead becomes narrower Toe angle becomes smaller	Common 45 degree 
4	Travel angle	Push/Pull	Pull angles are Penetration becomes deeper Width of bead becomes narrower Toe angle becomes smaller than push angle.	Push angle: Common attitude Pull angle Attitude for higher power
5	Gas	CO2/mixed	Mixed gas are Less spatter Arc generation becomes more stable bead becomes better in appearance Penetration becomes shallower than CO2 gas	CO2 gas: Cheaper and popular. Mixed gas More expensive Use for appearance and thin metal.

A.2 COUNTERMEASURE TO WELDING DEFECTS

Table A.2. (a) describes the problems and counter plan for bead appearance, Table A.2.(b) describes the problems and counter plan for gas and surface pores and Table A.2.(c) describes Problem and Cause and counter plan for unstable arc.

Table A.2 (a) Problems in appearance and counter plan

#	Problem in appearance	Counter plan
1	Unstable appearance	1. Correct a twist of conduit cable(Correct a twist of wire) 2. Change tip 3. Set contact tube distance shorter 4. Clean up groove face 5. Measure arc blow(Stable arc generation)
2	Convex bead or With of bead is narrow	1. Set weld voltage higher 2. Set wire size wider 3. Use weaving function(Set the width of bead wider) 4. Set welding speed slower
3	Short leg length	1. Set weld current higher 2. Set welding speed slower 3. Use weaving function(Set the width of bead wider) 4. Increase weld path
4	Different leg lengths	1. Move arc start position to vertical work side 2. Set torch angle wider 3. Set welding speed slower 4. Use weaving function(Set the width of bead wider) 5. Increase weld path 6. Set travel angle to push
5	Crater inferiority	1. Adjust crater-fill process schedule.
6	Burn-through	1. Set weld current lower. 2. Set welding speed slower 3. Use weaving function(Set the width of bead wider) 4. Set gaps of joint shorter
7	Penetration shortage	1. Set weld current higher 2. Set welding speed slower 3. Set travel angle to pull 4. Adjust arc start position 5. Change downward welding to upward welding
8	Undercut	1. Set weld current lower 2. Set weld voltage lower 3. Set welding speed slower 4. Set torch angle wider 5. Clean up groove face
9	Overlap	1. Set weld current higher 2. Set weld voltage higher 3. Set welding speed faster 4. Set contact tube distance shorter 5. Clean up groove face
10	Bead crack	a. Hot crack (Vertical crack and lateral crack on the bead surface) 1. Set weld current lower 2. Set weld speed slower 3. Less heat input b. Cold crack (crack inside the bead and crack of heat-affected zone) 1. More heat input 2. More preheating and postheating 3. Clean up wire and work 4. Stable gas flow.

Table A.2 (b) Cause and counter plan for gas pore and surface pore

#	Cause	Counter plan
1	Dirt of work	Clean up oil, stain, paint, water and oxide scale on groove face completely
2	Dirt of wire	Use internal wire, since most outer wire will rust out
3	Dirt of nozzle	Remove spatter cohesion nozzle
4	Effect of wind	If welding part is exposed to wind, it may cause the disturbance of the shield gas, therefore air is involved to the arc and fusion zone. Increase gas flow Equip screen
5	Gas flow	Change gas cylinder when 1st pressure is less than 10 kg/cm2 Confirm heat equipped gas flow controller Confirm leak of gas hose and connection
6	Gas quality	Confirm whether the purpose of the gas is welding. Confirm mixture device
7	Contact tube distance	Adjust the distance
8	Weld schedule	Set weld current higher Set welding speed slower

Table A.2 (c) Problem and Cause and counter plan for unstable arc

#	Problem	Cause
1	Unstable wire feed	1. Wrong bore size of contact tip or attrition 2. Twist conduit cable. 3. Wire sniggles in the reel 4. Size of wire feed role is wrong Wire feed role is attrition Pressure to wire feed role is wrong. 5. Liner spring is clogging up
2	Unstable weld voltage	1. 1st input of weld equipment is unstable 2. Connection of power cable is loose-knit 3. Contact tube distance is too long 4. Unstable wire feed. 5. Wire size is wrong for weld schedule.
3	Arc blow occurs	1. Earth connection is wrong. 2. Use tab board 3. Set the gap of joint narrower
4	Increase spatter	1. Wrong weld current and voltage 2. Wire size is too big 3. Torch angle is too wide 4. Arc blow occurs

B PERIODIC MAINTENANCE TABLE

Arc welding power supply option Periodic maintenance table

			Check times	First check 320	3 months 960	6 months 1920	9 months 2880	1 year 3840	4800	5760	6720	2 year 7680	8640	9600	10560
Welding power supply	1	Cleaning inside the welding power supply	1.0H			○		○		○		○		○	
	2	Confirm the damage situation of fan	0.1H			○		○		○		○		○	
	3	Check the allophone and vibration	0.2H			○		○		○		○		○	
Wire feeder	4	Cleaning each parts	0.5H			○		○		○		○		○	
	5	Check the tighten of bolts and other connection parts.	0.1H			○		○		○		○		○	
	6	Check the length of wire feeding	0.1H			○		○		○		○		○	
	7	Check the gas valve	0.1H			○		○		○		○		○	
Welding torch	8	Confirm looseness of union nut. (BINZEL torch only) (*2)	0.1H	○	○	○	○	○	○	○	○	○	○	○	○
	9	Replacing torch cable (Including conduit)	0.5H					●				●			
	10	Replacing liner	0.2H					●				●			
Around cable	11	Confirm the wire conduit	0.2H					○				○			

*1 Perform check of confirm looseness of union nut at every 1 month.
*2 Refer to Chapter 6 about daily check and check items.
*3 ●: requires order of parts
○: doe not requires order of parts
*4 Be sure to refer to maintenance section of welding power supply manual.
*5 Be sure to refer to operator's manual about mechanical unit of robot.

3 years 11520	12480	13440	14400	4 years 15360	16320	17280	18240	5 years 19200	20160	21120	22080	6 years 23040	24000	24960	25920	7 years 23040	27840	28800	29760	Item
○		○		○		○		○		○		○		○		○		○		1
○		○		○		○		○		○		○		○		○		○		2
○		○		○		○		○		○		○		○		○		○		3
○		○		○		○		○		○		○		○		○		○		4
○		○		○		○		○		○		○		○		○		○		5
○		○		○		○		○		○		○		○		○		○		6
○		○		○		○		○		○		○		○		○		○		7
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	8
●				●				●				●				●				9
●				●				●				●				●				10
○				○				○				○				○				11

C STRENGTH OF BOLT AND BOLT TORQUE LIST

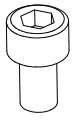
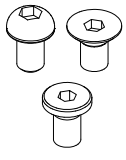
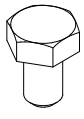
NOTE
In apply the LOCTITE to designate part, spread to the entire length area of the engaging part of female thread. If applied to the male threads, poor adhesion provoke loose bolt. Clean the bolts and the threaded holes and wipe off the oil on the engaging section. Make sure that there is no solvent left in the threaded holes. In this case remove all the excess LOCTITE finished screwing.

Adopt following strength bolts.
Comply with the instruction prescribed in a manual if the bolt specified.
Hexagon socket head bolt made by steel
Size M22 or less: Tensile strength 1200N/mm^2 or more
Size M24 or more: Tensile strength 1000N/mm^2 or more
All size plating bolt: Tensile strength 1000N/mm^2 or more

Hexagon bolt, stainless bolt, special shape bolt (button bolt, low-head bolt, flush bolt .etc.)
Tensile strength 400N/mm^2 or more

Refer to the following tables if the bolts tightening torque are not specified.

Recommended bolt tightening torques **Unit: Nm**

Nominal diameter	Hexagon socket head bolt (Steel)		Hexagon socket head bolt (stainless)		Hexagon socket head button bolt Hexagon socket head flush bolt Low-head bolt (steel)		Hexagon bolt (steel)	
	Tightening torque		Tightening torque		Tightening torque		Tightening torque	
	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit
M3	1.8	1.3	0.76	0.53	———	———	———	———
M4	4.0	2.8	1.8	1.3	1.8	1.3	1.7	1.2
M5	7.9	5.6	3.4	2.5	4.0	2.8	3.2	2.3
M6	14	9.6	5.8	4.1	7.9	5.6	5.5	3.8
M8	32	23	14	9.8	14	9.6	13	9.3
M10	66	46	27	19	32	23	26	19
M12	110	78	48	33	———	———	45	31
(M14)	180	130	76	53	———	———	73	51
M16	270	190	120	82	———	———	98	69
(M18)	380	260	160	110	———	———	140	96
M20	530	370	230	160	———	———	190	130
(M22)	730	510	———	———	———	———	———	———
M24	930	650	———	———	———	———	———	———
(M27)	1400	960	———	———	———	———	———	———
M30	1800	1300	———	———	———	———	———	———
M36	3200	2300	———	———	———	———	———	———
								

D CABLE FORMING ROUT FOR USING MULTI WELDING POWER SUPPLY

Bad example

In the following Fig. D (a) 1, 2, the welding power cables are installed parallel to the Voltage detection line, and then the noise breakout.

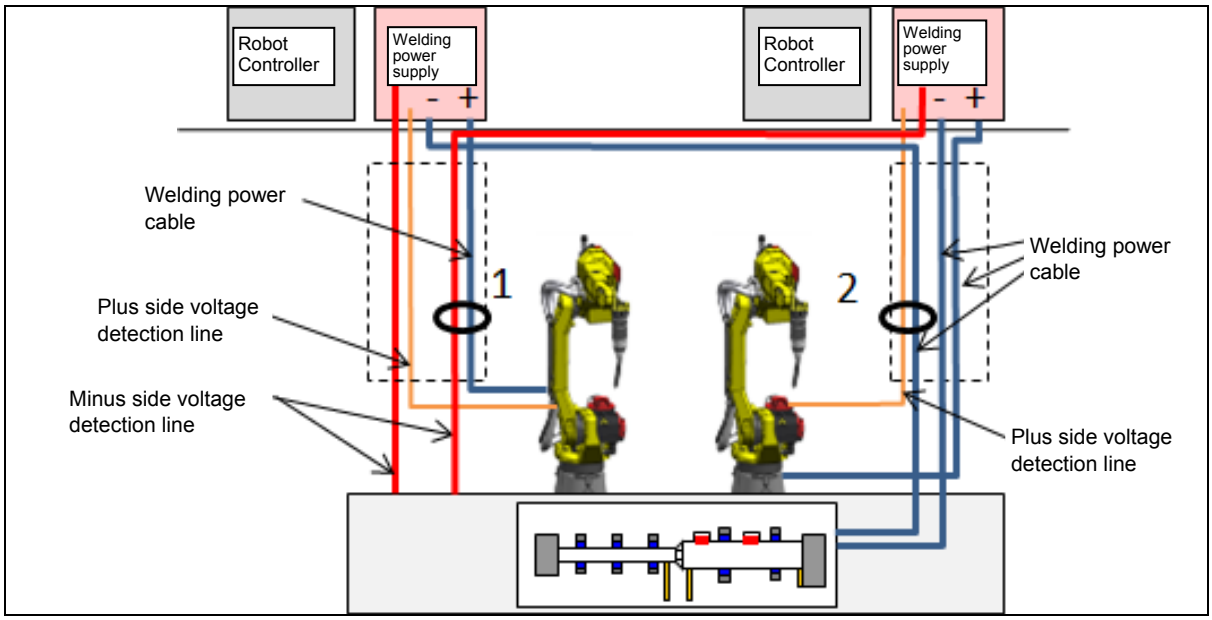


Fig. D (a) Bad wiring example

Good example

Wire each Welding power cable and Voltage detection line separately.
Locate the Welding power cable well away from the Voltage detection line, and the Welding power supply + and – abut.

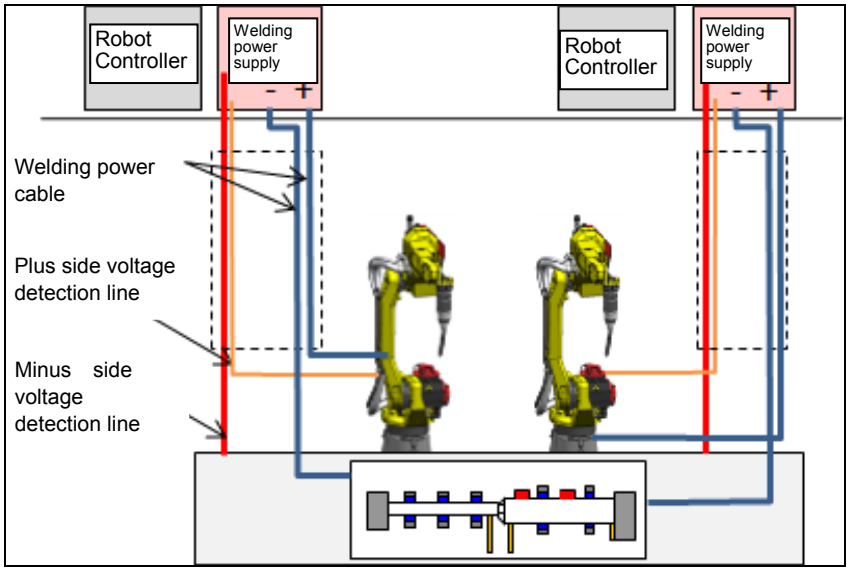


Fig. D (b) Good wiring example

INDEX

<S>

<T>

<W>

REVISION RECORD

Edition	Date	Contents
01	Sep., 2015	

B-83614EN-2/01