FANUC ROBOWELD iC series

R-30iB/ R-30iB Mate CONTROLLER

OPERATOR'S MANUAL

Original Instructions

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

- No part of this manual may be reproduced in any form.
- All specifications and designs are subject to change without notice.

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.

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Should you wish to export or re-export these products, please contact FANUC for advice.

In this manual we have tried as much as possible to describe all the various matters.

However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities.

Therefore, matters which are not especially described as possible in this manual should be regarded as "impossible".

SAFETY PRECAUTIONS

Thank you for purchasing FANUC Robot.

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 WORKING PERSON

The personnel can be classified as follows.

Operator:

- Turns robot controller power ON/OFF
- Starts robot program from operator's panel

Programmer or teaching operator:

- · Operates the robot
- · Teaches robot inside the safety fence

Maintenance engineer:

- Operates the robot
- Teaches robot inside the safety fence
- Maintenance (adjustment, replacement)
- An operator cannot work inside the safety fence.
- A 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 fence, the person must be trained on proper robot operation.

During the operation, programming, and maintenance of your robotic system, the programmer, teaching operator, and maintenance engineer should take additional care of their safety by using the following safety precautions.

- Use adequate clothing or uniforms during system operation
- Wear safety shoes
- Use 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". Read the contents of each "Warning", "Caution" and "Note" before attempting to use the robots.

⚠ WARNING

Applied when there is a danger of death or injury to the working person and the equipment being damaged, if the approved procedure is not observed.

CAUTION

Applied when there is a danger of the equipment being damaged, if the approved procedure is not observed.

NOTE

Notes are used to indicate supplementary information other than Warnings and Cautions.

• Read this manual carefully, and store it in a safe place.

3 WORKING PERSON SAFETY

Working person safety is the primary safety consideration. Because it is very dangerous to enter the operating space of the robot during automatic operation, adequate safety precautions must be observed. The following lists the general safety precautions. Careful consideration must be made to ensure working person safety.

(1) Have the robot system working persons attend the training courses held by FANUC.

FANUC provides various training courses. Contact our sales office 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 working person 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 working person can enter the work area 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 gate 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, see Fig.3 (a) and Fig.3 (b).

- (4) Provide the peripheral devices with appropriate grounding (Class A, Class B, Class C, and Class D).
- (5) Try to install the peripheral devices outside the work area.

- (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 working person enters the work area.
- (8) If necessary, install a safety lock so that no one except the working person in charge can turn on the power of 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, be sure to turn off the power of the robot.
- (10) Operators should be ungloved while manipulating the operator's panel or teach pendant. Operation with gloved fingers could 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 should be transported and installed by accurately following the procedures 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) When the robot is used, the following precautions should be taken. Otherwise, the robot and peripheral equipment can be adversely affected, or workers can be severely injured.
 - Avoid using the robot in a flammable environment.
 - Avoid using the robot in an explosive environment.
 - Avoid using the robot in an environment full of radiation.
 - Avoid using the robot under water or at high humidity.
 - Avoid using the robot to carry a person or animal.
 - Avoid using the robot as a stepladder. (Never climb up on or hang from the robot.)
- (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) When preparing trestle, please consider security for installation and maintenance work in high place according to Fig.3 (c). Please consider footstep and safety bolt mounting position.

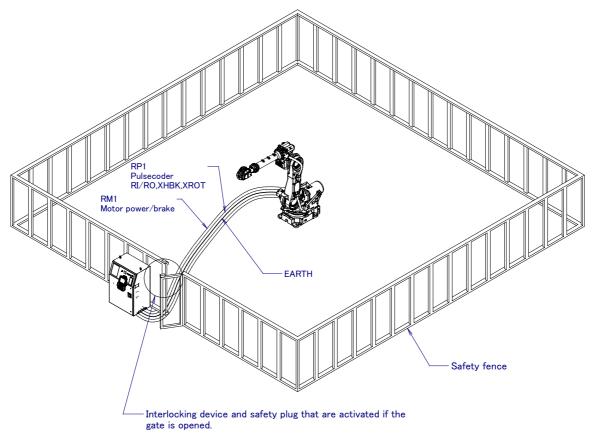


Fig. 3 (a) Safety fence and safety gate

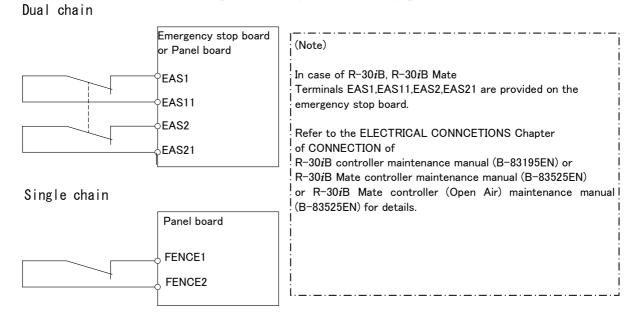


Fig. 3 (b) Limit switch circuit diagram of the safety fence

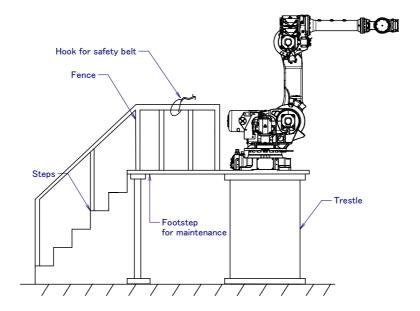


Fig.3 (c) Footstep for maintenance

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. However, this section does not apply to teach pendant operators.

- (1) If you do not have to operate the robot, turn off the power of the robot controller or press the EMERGENCY STOP button, and then proceed with necessary work.
- (2) Operate the robot system at a location outside of the safety fence
- (3) Install a safety fence with a safety gate to prevent any worker other than the operator from entering the work area unexpectedly and to prevent the worker from entering a dangerous area.
- (4) Install an EMERGENCY STOP button within the operator's reach.

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.

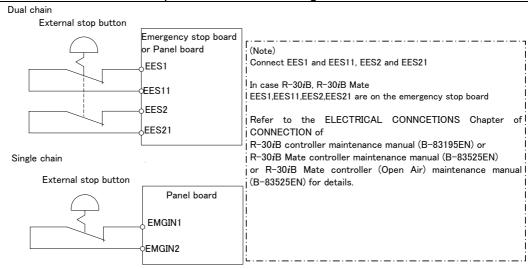


Fig.3.1 Connection diagram for external emergency stop button

3.2 SAFETY OF THE PROGRAMMER

While teaching the robot, the operator must enter the work area of the robot. The operator must ensure the safety of the teach pendant operator especially.

- (1) Unless it is specifically necessary to enter the robot work area, 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 operating condition.
- (3) If it is inevitable to enter the robot work area 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 work area.
- (5) Programming should be done outside the area of the safety fence as far as possible. If programming needs to be done in the area of the safety fence, the programmer should take the following precautions:
 - Before entering the area of the safety fence, ensure that there is no risk of dangerous situations in the area.
 - Be prepared to press the emergency stop button whenever necessary.
 - Robot motions should be made at low speeds.
 - Before starting programming, check the entire system status to ensure that no remote instruction to the peripheral equipment or motion would be dangerous to the working person.

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.

Our teach pendant is provided with a DEADMAN switch as well as an 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 differently depending on the teach pendant enable/disable switch setting status.
 - (a) Disable: The DEADMAN switch is disabled.
 - (b) Enable: Servo power is turned off when the operator releases the DEADMAN switch or when the operator presses the switch strongly.
 - 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 programmer'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 programmer 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 SW 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
	On	Local	Not allowed	Not allowed	Not allowed
AUTO	Oli	Remote	Not allowed	Not allowed	Not allowed
mode	O#	Local	Not allowed	Allowed to start	Not allowed
	Off	Remote	Not allowed	Not allowed	Allowed to start
	On	Local	Allowed to start	Not allowed	Not allowed
T1, T2	Oli	Remote	Allowed to start	Not allowed	Not allowed
mode	Off	Local	Not allowed	Not allowed	Not allowed
	Oll	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 the robot work area and that there are no abnormal conditions in the robot work area.
- (7) When a program is completed, be sure to carry out a test operation according to the procedure below.
 - (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 should leave the robot work area.

3.3 SAFETY OF THE MAINTENANCE ENGINEER

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

- (1) During operation, never enter the robot work area.
- (2) A hazardous situation may arise 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 should 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 range while the power is on, press the emergency stop button on the operator panel, or the teach pendant before entering the range. 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 worker must check the entire system in order to make sure no dangerous situations exist. 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 teaching, check that the robot and its peripheral devices are all in the normal operating condition.
- (7) Do not operate the robot in the automatic mode while anybody is in the robot work area.
- (8) When you maintain the robot alongside 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 when any moving device other than the robot is installed, such as belt conveyor, pay careful attention to its motion.
- (10) If necessary, have a worker who is familiar with the robot system stand beside the operator panel and observe the work being performed. If any danger arises, the worker should be ready to press the EMERGENCY STOP button at any time.
- (11) When replacing a part, please contact FANUC service center. If a wrong procedure is followed, an accident may occur, causing damage to the robot and injury to the worker.
- (12) When replacing or reinstalling components, take care to prevent foreign material from entering the system.
- (13) When handling each unit or printed circuit board in the controller during inspection, turn off the circuit breaker to protect against electric shock.

 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 a fire.
- (15) When restarting the robot system after completing maintenance work, make sure in advance that there is no person in the work area and that the robot and the peripheral devices are not abnormal.
- (16) When a motor or brake is removed, the robot arm should be supported with a crane or other equipment beforehand so that the arm would not fall during the removal.
- (17) Whenever grease is spilled on the floor, it should be removed as quickly as possible to prevent dangerous falls.
- (18) The following parts are heated. If a maintenance worker 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 the controller
 - Reducer
 - Gearbox
 - Wrist unit
- (19) Maintenance should be done under suitable light. Care must be taken that the light would not cause any danger.
- (20) When a motor, reducer, or other heavy load is handled, a crane or other equipment should be used to protect maintenance workers from excessive load. Otherwise, the maintenance workers would be severely injured.
- (21) The robot should not be stepped on or climbed up during maintenance. If it is attempted, the robot would be adversely affected. In addition, a misstep can cause injury to the worker.
- (22) When performing maintenance work in high place, secure a footstep and wear safety belt.
- (23) After the maintenance is completed, spilled oil or water and metal chips should be removed from the floor around the robot and within the safety fence.
- (24) When a part is replaced, all bolts and other related components should put back into their original places. A careful check must be given to ensure that no components are missing or left not mounted.
- (25) In case robot motion is required during maintenance, the following precautions should be taken:
 - Foresee 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.
 - Always pay attention to potentially dangerous situations, and be prepared to press the emergency stop button whenever necessary.
- (26) The robot should be periodically inspected. (Refer to the robot mechanical manual and controller maintenance manual.) A failure to do the periodical inspection can adversely affect the performance or service life of the robot and may cause an accident

(27) After a part is replaced, a test operation should be given for the robot according to a predetermined method. (See TESTING section of "R-30iB/R-30iB Mate Controller operator's manual (Basic Operation)".) During the test operation, the maintenance staff should work outside the safety fence.

4 SAFETY OF THE TOOLS AND PERIPHERAL DEVICES

4.1 PRECAUTIONS IN PROGRAMMING

- (1) Use a limit switch or other sensor to detect a dangerous condition 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 so that they do not 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, and operate the robot in an environment free of grease, water, and dust.
- (2) Don't use unconfirmed liquid for cutting fluid and cleaning fluid.
- (3) Employ a limit switch or mechanical stopper to limit the robot motion so that the robot or cable does not strike against its 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.
 - Don't add user cable or hose to inside of mechanical unit.
 - Please do not obstruct the movement of the mechanical unit cable 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 execute 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 executed.
 - When alteration was necessary, safety switch is operated by opening safety fence and power-off stop is executed 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 operate routinely and power-off stop is executed for the robot.

(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 MECHANISM

5.1 PRECAUTIONS IN OPERATION

- (1) When 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 you know in advance what motion the robot will perform in the jog mode.

5.2 PRECAUTIONS IN PROGRAMMING

- (1) When the work areas of robots overlap, make certain that the motions of the robots do not interfere with each other.
- (2) Be sure to specify the predetermined work origin in a motion program for the robot and program the motion so that it starts from the origin and terminates at the origin.
 Make it possible for the operator to easily distinguish at a glance that the robot motion has terminated.

5.3 PRECAUTIONS FOR MECHANISMS

(1) Keep the work 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) To control the pneumatic, hydraulic and electric actuators, carefully consider the necessary time delay after issuing each control command up to actual motion and ensure safe control.
- (2) Provide the end effector with a limit switch, and control the robot system by monitoring the state of the end effector.

7

STOP TYPE OF ROBOT

The following three robot stop types exist:

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.

The following processing is performed at Power-Off stop.

- An alarm is generated and servo power is turned off.
- The robot operation is stopped immediately. 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.

The following processing is performed at Controlled stop.

- The alarm "SRVO-199 Controlled stop" occurs along with a decelerated stop. Execution of the program is paused.
- An alarm is generated and servo power is turned off.

Hold (Category 2 following IEC 60204-1)

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

The following processing is performed at Hold.

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

⚠ WARNING

The stopping distance and stopping time of Controlled stop are longer than the stopping distance and stopping time 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
	AUTO	P-Stop	P-Stop	C-Stop	C-Stop	P-Stop
Α	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop
	AUTO	P-Stop	P-Stop	P-Stop	P-Stop	P-Stop
В	T1	P-Stop	P-Stop	-	P-Stop	P-Stop
	T2	P-Stop	P-Stop	-	P-Stop	P-Stop
	AUTO	C-Stop	C-Stop	C-Stop	C-Stop	C-Stop
С	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>i</i> B/ R-30 <i>i</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 stopping time of Controlled stop is longer than the stopping distance and stopping time 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 stopping 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 stopping time of Controlled stop are longer than the stopping distance and stopping time 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.

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1 PREFACE

Prior to the use of the arc welding robot package FANUC ROBOWELD *i*C series, 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 ROBOWELD iC 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. The models names indicated below are collectively referred to as the "ROBOWELD".

Model name
FANUC ROBOWELD 100iC/E
FANUC ROBOWELD 100iC/H
FANUC ROBOWELD 100iC/H2
FANUC ROBOWELD 100iC/H3
FANUC ROBOWELD 120iC/E
FANUC ROBOWELD 120iC/H
FANUC ROBOWELD 120iC/H2
FANUC ROBOWELD 120iC/H3

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.

! WARNING

Applied when there is a danger of the user being injured or when there is a danger of both the user being injured and the equipment being damaged if the approved procedure is not observed.

ACAUTION

Applied when there is a danger of the equipment being damaged, if the approved procedure is not observed.

NOTE

The Note is used to indicate supplementary information other than Warning and Caution.

- Read this manual carefully, and store it in a safe place.

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.

⚠ WARNING

Do not use the robot in the circumstances listed below. Otherwise, not only the robot and peripheral equipment can be affected adversely, but also there is a serious danger of the operator being injured.

- Use in an flammable environment
- Use in an explosive environment
- Use in an environment where a large amount of radiation exists
- Use under water or use in a highly humid environment
- Use for human or animal transportation purposes
- Use as a footstool (climbing up or dangling on the robot)

↑ WARNING

When operating the robot, the operator must wear the following for safety:

- Work clothes suitable for work
- Safety shoes
- Helmet

NOTE

The operator who is to perform programming and maintenance work must be trained in an appropriate FANUC's training course.

Precautions relating to operation

! WARNING

Before operating the robot, be sure to check that there is no person within the safety fence. At the same time, check for potential danger. If such a danger should be found, be sure to remove it before starting robot operation.

ACAUTION

Whenever using the operator's panel or teach pendant, take off your gloves. Operating these devices with gloves on can cause operation errors.

NOTE

Data such as programs and system variables can be saved on floppy disks (optional). It is recommended that such data be saved periodically in preparation for accidental loss of data (see the operator's manual).

Precautions relating to programming

↑ WARNING

Perform programming outside the safety fence where possible. If programming needs to be performed within the safety fence, observe the following:

- Before entering the safety fence, check the area within the safety fence to confirm that there is no danger.
- Always be ready to press the emergency stop button.
- Move the robot at low speed.
- Before starting work, check the overall system status to ensure that remote instructions and operations for peripheral equipment do not place the operator in danger.

ACAUTION

When completing programming, be sure to perform test operation according to a specified procedure (see the operator's manual). During test operation, the operator must perform operation outside the safety fence.

NOTE

The operator who is to perform programming must be trained in an appropriate FANUC's training course.

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.

↑ WARNING

Before replacing parts, be sure to read the maintenance manual to understand the procedure. Doing replacement work with an incorrect procedure can lead to accidents, resulting in a damage to the robot or injury to the operator.

! WARNING

Before entering the safety fence, check the overall system to confirm that there is no danger. If you have to enter the safety fence with danger present, grasp the system status, and enter the fence.

↑ WARNING

Whenever replacing parts, use FANUC-specified parts. Using a part not specified by FANUC can cause malfunction or damage. In particular, using a wrong fuse can cause a fire, so never use fuses other than the specified ones.

! WARNING

Before removing a motor or brake, take measures to prevent components such as the arm from falling; for example, use a crane for hoisting.

WARNING

If the robot has to be moved during maintenance work, observe the following:

- Be sure to keep your way of refuge. During maintenance work, always grasp the entire system movement to prevent the robot or peripheral equipment from blocking your way of refuge.
- Always be careful of danger, and be ready to press the emergency stop button at any time as necessary.

NWARNING

When a heavy component or unit such as a motor and decelerator is to be handled, a device such as a crane should be used to help the operator so that excessive load is not applied to the operator. Wrong handling presents a serious danger of the operator being injured, so care must be taken.

ACAUTION

Be careful not to slip on grease spilled on the floor. Grease on the floor must be wiped off immediately to prevent possible danger.

! CAUTION

Do not put your foot on part of the robot or climb up the robot during maintenance work. Otherwise, not only the robot is affected adversely, but also the operator can stumble down and be injured.

ACAUTION

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

Parts (such as bolts) removed during part replacement must be re-installed in their original places correctly. If there is a lost part or remaining part, make a check again, and perform installation correctly.

! CAUTION

Before maintaining the pneumatic system, be sure to turn off the supply pressure to decrease the line pressure to 0.

ACAUTION

After part replacement, be sure to perform test operation according to a specified method (see the controller operator's manual). During test operation, the operator must perform operation outside the safety fence.

! CAUTION

Upon completion of maintenance work, clean oil, water, and chips off the area around the robot and inside the safety fence.

ACAUTION

When replacing parts, be careful not to let dust and dirt enter the inside of the robot.

NOTE

The operator who is to perform maintenance and inspection must be trained in an appropriate FANUC's training course.

NOTE

Provide an appropriate level of lighting during maintenance work. However, be careful not to cause the lighting to generate another danger.

NOTE

Be sure to perform periodic inspections. Neglecting a periodic inspection can not only affect the robot function and service life adversely but also cause unexpected accidents.

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

ACAUTION

- 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

ACAUTION

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.

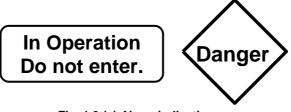


Fig. 1.3 (a) Alarm indications

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.

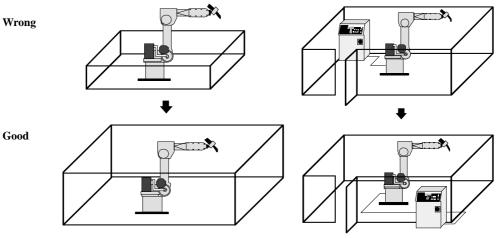


Fig. 1.3 (b) Safety fence

When this plug is pulled out, the contact becomes open.

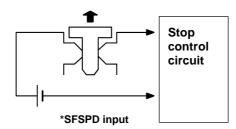


Fig. 1.3 (c)Safety plug

- 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.

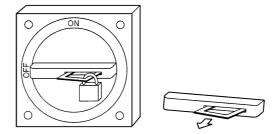


Fig. 1.3 (d) Locking the circuit breaker

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.

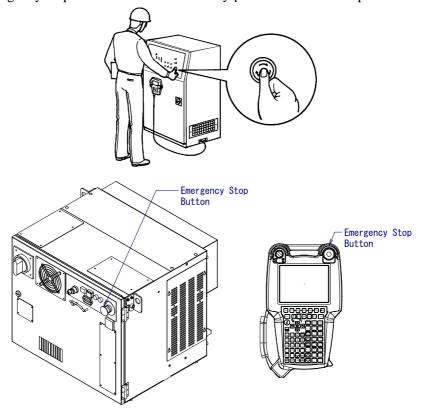


Fig. 1.3 (e) Emergency stop button

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.

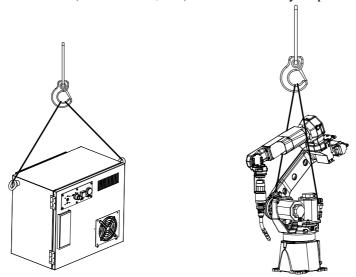


Fig. 1.3 (f) Transportation of robot

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 starting to teach a program to the robot, make sure that the robot and peripheral equipment are functioning normally and that no dangerous conditions are present.
- 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.

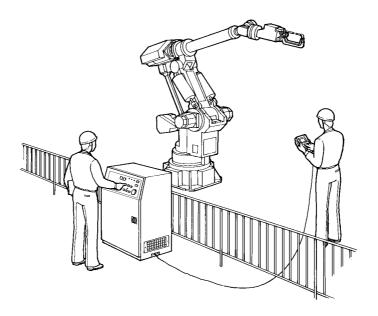


Fig. 1.3 (g) Additional worker to watch for danger

Table 1.3 Safety precautions

	rabic 1.0 darcty precaution	
Operator	Workshop	Transportation and installation
Avoid dangerous behavior.	Keep the work environment neat, tidy,	Keep the transportation path free of
Wear safety clothes.	and clean.	obstacles.
Wear safety shoes and a	Provide a safety fence and warning	When carrying the robot on a carrier such
helmet.	indications.	as a crane or forklift, ensure that the robot
	Provide ventilation.	is firmly secured to the carrier.
	Never bring flammable materials into	Allow sufficient clearance.
	the workshop.	Make connections properly.
Attend training classes.	Perform repair work using FANUC	Check and maintain the cables.
Master the operating	products only.	Check the pneumatic system.
procedures.	Before starting maintenance and	Insulate the robot from the welding gun.
Exclude unauthorized	inspection, turn off the power.	Provide a spatter shield.
persons.	Keep the controller door closed.	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.

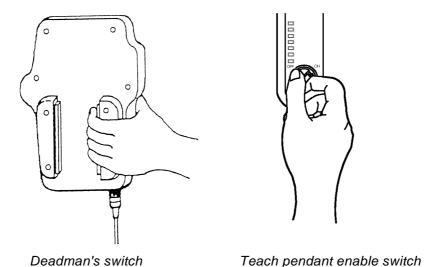


Fig. 1.3 (i) Deadman's switch and Teach pendant enable switch

- 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	Article 1	
troubles	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		Intended readers:	
All persons who use the FANUC Robot and		Operator, system designer	
system designer must read and understand		Topics:	
thoroughly this handbook		Safety items for robot system design, operation, maintenance	
R-30 <i>i</i> B /	OPERATOR'S MANUAL	Intended readers:	
R-30iB Mate	(Basic Operation)	Operator, programmer, maintenance person, system designer	
controller	B-83284EN	Topics:	
		Robot functions, operations, programming, setup, interfaces,	
	OPERATOR'S MANUAL	alarms	
	(Alarm Code List)	Use:	
	B-83284EN-1	Robot operation, teaching, system design	
	OPERATOR'S MANUAL		
	(Optional Function)		
	B-83284EN-2		
	ARC Welding Function		
	OPERATOR'S MANUAL		
	B-83284EN-3		
	MAINTENANCE MANUAL	Intended readers:	
		Maintenance engineer, system designer	
	R-30 <i>i</i> B : B-83195EN	Topics:	
	R-30 <i>i</i> B Mate :B-83525EN	Installation, connection to peripheral equipment, maintenance	
		Use:	
		Installation, start-up, connection, maintenance	
FANUC Robot	OPERATOR'S MANUAL	Intended readers:	
ARC Mate	B-82754EN	System designer, Maintenance engineer,	
100 <i>i</i> C,M-10 <i>i</i> A		Topics:	
Mechanical		Installation, connection to the controller, maintenance	
unit		Use:	
		Installation, start-up, connection, maintenance	
FANUC Robot	OPERATOR'S MANUAL	Intended readers:	
ARC Mate	B-82874EN	System designer, Maintenance engineer,	
120 <i>i</i> C,M-20 <i>i</i> A		Topics:	
Mechanical		Installation, connection to the controller, maintenance	
unit		Use:	
Torch	Installation, start-up, connection, maintenance		
	Refer to manual of BINZEL .Ltd or Tregaskiss .Ltd(*)		
Welding power	Refer to manual of LINCOLN(*)		
supply Wire feeder			
vviie leedel			

(*) If there is indispensability, please make a demand in us.

B-83374EN/02 2.OVERVIEW

2 overview

This chapter describes the basic configuration and components of the FANUC ROBOWELD *i*C series arc welding robot package.

Organization of this chapter:

- 2.1 CONFIGURATION
- 2.2 ROBOT MECHANICAL SECTION
- 2.3 WELDING POWER SUPPLY
- 2.4 CONNECTION
- 2.5 HOW TO USE THE TEACH PENDANT
- 2.6 SOFTWARE

2.1 CONFIGURATION

The FANUC ROBOWELD *i*C series consists of a robot mechanical section, controller, welding power supply, wire feeder, welding torch, wire reel stand, and so forth.

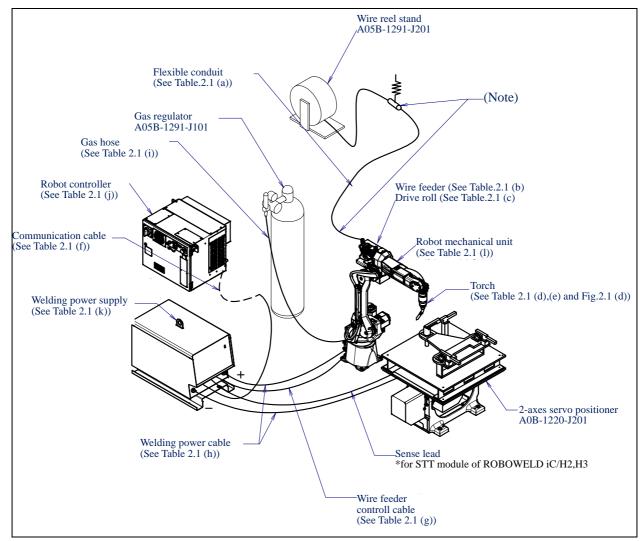


Fig.2.1 (a) Composition example of ROBOWELD iC

2.OVERVIEW B-83374EN/02

! CAUTION

Be sure to hang the flexible conduit. Refer to caution of Fig. 2.1 (c).

Table.2.1 (a) Specification of flexible conduit

	Spec	Model
ELEVIDI E CONDUIT 4 Fee	A05B-1291-H401 (*1)	
FLEXIBLE CONDUIT 4.5m	A05B-1291-H411 (*2)	
ELEVIELE COMPUIT TO	A05B-1291-H402 (*1)	All models
FLEXIBLE CONDUIT 7.6m	A05B-1291-H412 (*2)	
FLEXIBLE CONDUIT 3.0m	A05B-1291-H413 (*2)	

- (*1) This is heavy-duty conduit. (It is impossible to adjust the length.)
- (*2) This is light weight and variable-length conduit.

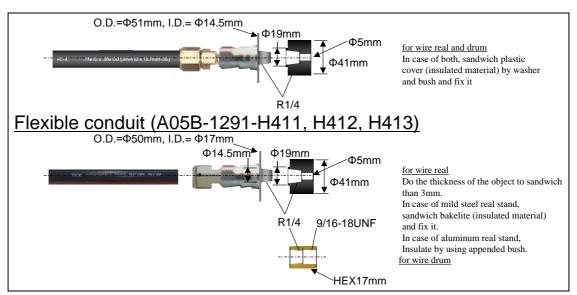


Fig.2.1 (b) External dimension of flexible conduit

! CAUTION

When using attached washers of flexible conduit (A05B-1291-H411,H412,H413), be sure to stack 2 pcs.

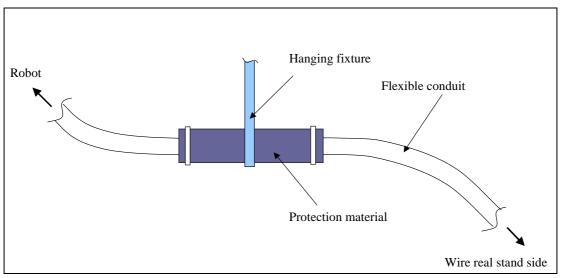


Fig.2.1 (c) Hanging method of flexible conduit

B-83374EN/02 2.OVERVIEW

↑ CAUTION

When forming cables of flexible conduit, pay attention cables does not interfere idle arm of wire feeder or peripheral devices during robot is operated.

When hanging the conduit, pay attention that stress is not concentrated in one place. (especially in case of light weight conduit)

Make bend radius of back of wire feeder or around the hanging tool more than 400mm, maximize the bend radius of other parts, and length of the arc is 90 degree or less so that you can feed wire smoothly. Be careful not to wind flexible conduit 90 degree or more.

When flexible conduit is used, be sure to hang it in the moderate position referring to Fig.2.1 (c). Cover hanging position by protection material (such as rubber), and be careful not to damage the flexible conduit.

Table 2.1 (b) Specification of wire feeder

	Spec.	Model
	A05B-1291-H201	ROBOWELD iC/H series
AutoDrive 4R100 Wire feeder		ROBOWELD iC/H2 series
Autoblive 4K 100 Wile leedel	A05B-1291-H202	ROBOWELD iC/E series
	A05B-1291-H203	ROBOWELD iC/H3 series
AutoDrive 4R220 Wire feeder	A05B-1291-H204	All models

Table 2.1 (c) Specification of drive roll

	Spec	Model	
Drive roll for 4 rolls Iron ϕ 0.9mm	A05B-1291-H251 (*)		
Drive roll for 4 rolls Iron ϕ 1.2mm	A05B-1291-H252 (*)	All models	
Drive roll for 4 rolls Iron ϕ 1.0mm	A05B-1291-H254 (*)		

^(*) Four drive rolls make a set.

Table 2.1 (d) Specification of torch (1/2)

	Spec	Model
BINZEL 350GC-30S (air cooling)	A05B-1291-H301	
BINZEL 350GC-30L (air cooling)	A05B-1291-H303	
BINZEL 350GC-30S (air cooling)	A05B-1291-H305	ROBOWELD 100 <i>i</i> C/H ROBOWELD 100 <i>i</i> C/H2
BINZEL 350GC-30L (air cooling)	A05B-1291-H307	
BINZEL ABIROB W500-35	A05B-1291-H311	ROBOWELD 100iC/H3
BINZEL ABIROB A360-35	A05B-1291-H321	ROBOWELD 100iC/H3
BINZEL 350GC-30L (Conventional dress out)	A05B-1291-H343	(Mechanical unit: ARC Mate 100iC)
BINZEL 350GC-30S (air cooling) (with wire clamp)	A05B-1291-H351	
BINZEL 350GC-30L (air cooling) (with wire clamp)	A05B-1291-H353	
BINZEL 350GC-30S (air cooling)	A05B-1291-H302	
BINZEL 350GC-30L (air cooling)	A05B-1291-H304	
BINZEL 350GC-30S (air cooling)	A05B-1291-H306	ROBOWELD 100 <i>i</i> C/H
BINZEL 350GC-30L (air cooling)	A05B-1291-H308	ROBOWELD 100iC/H2
BINZEL ABIROB W500-35	A05B-1291-H312	ROBOWELD 100iC/H3
BINZEL ABIROB A360-35	A05B-1291-H322	ROBOWELD 100iC/E
BINZEL 350GC-30L (Conventional dress out)	A05B-1291-H344	(Mechanical unit:
BINZEL 350GC-30S (air cooling) (with wire clamp)	A05B-1291-H352	ARC Mate 100iC/6L)
BINZEL 350GC-30L (air cooling) (with wire clamp)	A05B-1291-H354	

Table 2.1 (e) Specification of torch (2/2)

IUI	Table 2.1 (e) Specification of torch (2/2)				
	Spec	Model			
BINZEL 350GC-30S (air cooling)	A05B-1292-H301				
BINZEL 350GC-30L (air cooling)	A05B-1292-H303				
BINZEL 350GC-30S (air cooling)	A05B-1292-H305	ROBOWELD 120 <i>i</i> C/H			
BINZEL 350GC-30L (air cooling)	A05B-1292-H307	ROBOWELD 120iC/H2			
BINZEL ABIROB W500-35	A05B-1292-H311	ROBOWELD 120iC/H3			
BINZEL ABIROB A360-35	A05B-1292-H321	ROBOWELD 120iC/E (Mochanical unit: APC Mate 120iC)			
BINZEL 350GC-30S (air cooling) (with wire clamp)	A05B-1292-H351	(Mechanical unit: ARC Mate 120 <i>i</i> C)			
BINZEL 350GC-30L (air cooling) (with wire clamp)	A05B-1292-H353				
BINZEL 350GC-30S (air cooling)	A05B-1292-H302				
BINZEL 350GC-30L (air cooling)	A05B-1292-H304				
BINZEL 350GC-30S (air cooling)	A05B-1292-H306	ROBOWELD 120 <i>i</i> C/H			
BINZEL 350GC-30L (air cooling)	A05B-1292-H308	ROBOWELD 120iC/H ROBOWELD 120iC/H2			
BINZEL ABIROB W500-35	A05B-1291-H312	ROBOWELD 120iC/H3 ROBOWELD 120iC/E			
BINZEL ABIROB A360-35	A05B-1292-H322	(Mechanical unit: ARC Mate 120 <i>i</i> C/10L)			
BINZEL 350GC-30S (air cooling) (with wire clamp)	A05B-1292-H352	(
BINZEL 350GC-30L (air cooling) (with wire clamp)	A05B-1292-H354				

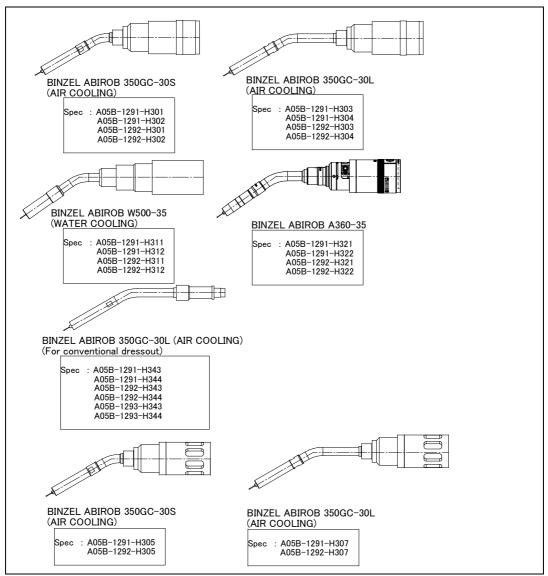


Fig.2.1 (d) Externals chart of torch

Table 2.1 (f) Specification of communication cable

rable 2.1 (1) opecification of communication cable		
	Spec	Model
Integration kit	A05B-1291-H501	
Ethernet cable 3.0m	A05B-1291-H551	
Ethernet cable 7.6m	A05B-1291-H552	ROBOWELD iC/H series
Ethernet cable 15.2m	A05B-1291-H553	
Ethernet cable 22.9m	A05B-1291-H554	
Ethernet cable 30.5m	A05B-1291-H555	
Ethernet cable 7.6m	A05B-1291-H571	ROBOWELD iC/H2 series

(*) In case of ROBOWELD iC/E series, communication cable is included in welding power supply.

Table 2.1 (g) Specification of wire feeder control cable

Table 2.1 (g) Specification of wire feeder control cable		
	Spec	Model
Wire feeder control cable 5m	A05B-1291-H621	
Wire feeder control cable 10m	A05B-1291-H622	All models
Wire feeder control cable 15m	A05B-1291-H623	All Models
Wire feeder control cable 20m	A05B-1291-H624	

Table 2.1 (h) Specification of welding power cable

	Spec	Model
Welding power cable 60SQ 5m (not for movable part)	A05B-1291-H711	
Welding power cable 60SQ 10m(not for movable part)	A05B-1291-H712	
Welding power cable 60SQ 15m(not for movable part)	A05B-1291-H713	
Welding power cable 60SQ 20m(not for movable part)	A05B-1291-H714	All models
Welding power cable 60SQ 10m (for movable part)	A05B-1291-H722	
Welding power cable 60SQ 15m (for movable part)	A05B-1291-H723	
Welding power cable 60SQ 20m (for movable part)	A05B-1291-H724	
Welding power cable 60SQ 4m (not for movable part)	A05B-129-H751	DODOWELD :C/E corios
Welding power cable 60SQ 8m (not for movable part)	A05B-129-H751	ROBOWELD iC/E series

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

Table 2.1 (i) Specification of gas hose

	(·/ - p	
	Spec	Model
Gas hose 10m	A05B-1291-J151	
Gas hose 15m	A05B-1291-J152	All madele
Gas hose 20m	A05B-1291-J153	All models
Gas hose 25m	A05B-1291-J154	

Table 2.1 (j) Specification of controller

(1) open to the contract of th	
	Model
R-30 <i>i</i> B Controller A cabinet (*1)	
R-30 <i>i</i> B Controller B cabinet All models	
R-30iB Mate Controller	

^(*1) Controller integrated welding power supply can be selected when R-30*i*B controller A cabinet and ROBOWELD *i*C/H (PowerWave *i*400) is selected.

Table 2.1 (k) Specification of welding power supply

\
Welding power supply for ROBOWELD iC/H (PowerWave i400)
Welding power supply for ROBOWELD iC/H2 (PowerWave 455M.STT) (*)
Welding power supply for ROBOWELD iC/H3 (Power Wave R350) (*)
Welding power supply for ROBOWELD iC/E (CV350-R)

We recommend to use welding power supply in the environment it does not absorb mine dust and sputter. 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.

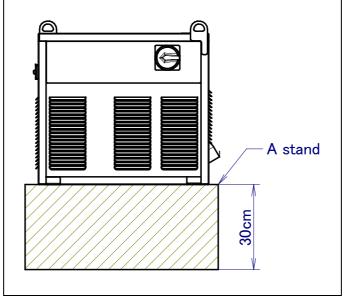


Fig.2.1 (e) Quantity advance of welding power supply.

Table 2.1 (I) Specification of welding power supply

ARC Mate 100iC	
ARC Mate 100iC/6L	
ARC Mate 120iC	
ARC Mate 120iC/10L	

↑ CAUTION

These cables cannot be used for the moving part such as the cable tracks. (Except for movable) Please contact your local FANUC representative 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 nylon band etc., and power should not concentrate on a specific part.

2.2 ROBOT MECHANICAL SECTION

The robot mechanical section consists of axes and arms driven by servo motors. A point where arms are coupled is referred to as an axis or joint. A vertical articulated robot usually consists of six axes. The first three axes (J1 to J3) are referred to as the basic axes, and the second three axes (J4 to J6) are referred to as the wrist axes.

CAUTION

For details of the mechanical parts, refer to the operator's manual of the mechanical unit.

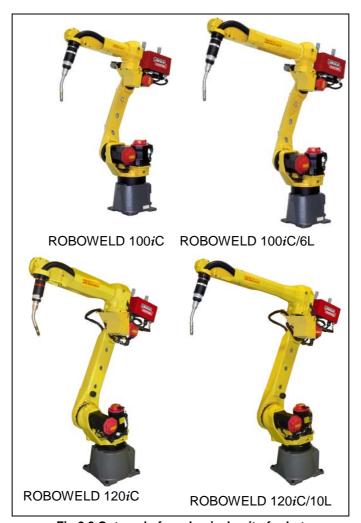


Fig.2.2 Outward of mechanical unit of robot

2.3 WELDING POWER SUPPLY AND WIRE FEEDER

2.3.1 Welding Power Supply

Fig.2.3.1 is A figure of the appearance of welding power supply.

Controller integrated welding power supply can be selected in case of ROBOWELD *i*C/H (PowerWave i400). In case of controller integrated welding power supply, the controller containing the welding power supply has a welding power supply built into the robot control board, and all control operations can be exercised from the robot.

In case of remote type, Both power supplies are turned on, and turning off is needed. Refer to Section 2.4 about forming of cables.



Fig.2.3.1 Figure of the appearance of the welding power supply

! CAUTION

NOTICE OF CONNECTING ETHENET CABLE

In case of integrated welding power supply, when the robot is shipped, it is connected. In case of remove, it is put on the controller.

In case of the R-30*i*B controller, Ethernet cable 1 is connected to Ether net port 2(CD38B), in case of the R-30*i*B Mate controller is connected to Ethernet cable (CD38A). Only the cross cable corresponds when the welding power supply is connected directly with the R-30*i*B Mate controller, and a straight cable cannot be used.

When the R-30*i*B controller is connected directly with the welding power supply, both a straight cable and the cross cable can be used. Connection through HUB is needed when there are two or more robots and devices. Please contact you local FANUC representative for details.

2.3.2 Wire Feeder

Fig.2.3.2 (a) is a figure of the appearance of wire feeder. Please refer to Section 2.4 about the forming.

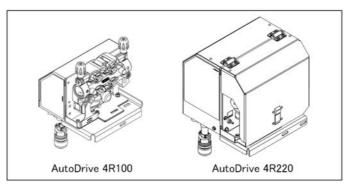


Fig. 2.3.2 (a) Figure of appearance of the wire feeder

CAUTION

(only for AutoDrive 4R220)

J2-axis and J3-axis motion angle are restricted. Total of J2-axis angle and J3-axis angle cannot exceed 85° during the operation. There is no motion restriction for AutoDrive 4R100.

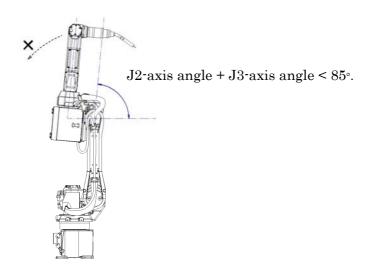


Fig. 2.3.2 (b) Motion range restriction for AutoDrive 4R220

2.4 CONNECTION

2.4.1 Connection Interface

Connection interface of welding power supply, wire feeder and robot are showed in Fig 2.4.1 (a) to (k). See mechanical unit operator's manual about piping and wiring of mechanical unit.



Fig.2.4.1 (a) Connection interface position of welding power supply



Fig.2.4.1 (b) Connection interface of Welding power supply of ROBOWELD iC/H (Power Wave i400)

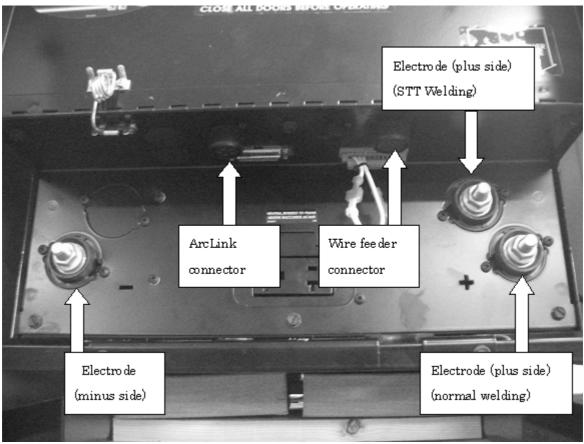


Fig.2.4.1 (c) Connection interface of Welding power supply of ROBOWELD iC/H2 (Power Wave 455M/STT)

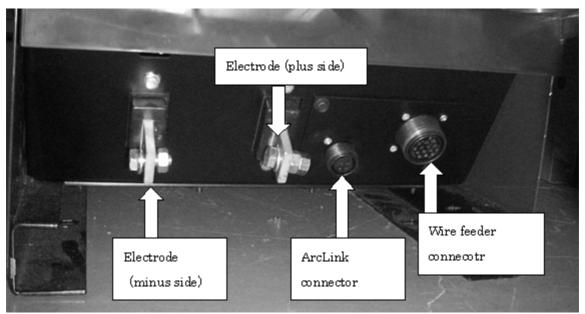


Fig.2.4.1 (d) Connection interface of welding power supply of ROBOWELD iC/E (Invertec CV350-R)

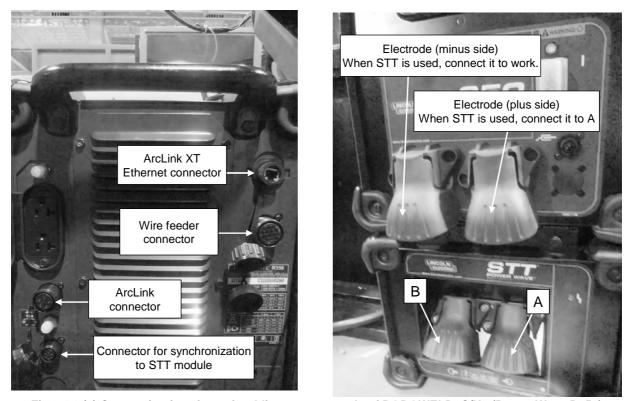


Fig.2.4.1 (e) Connection interface of welding power supply of ROBOWELD iC/H3 (Power Wave R350)

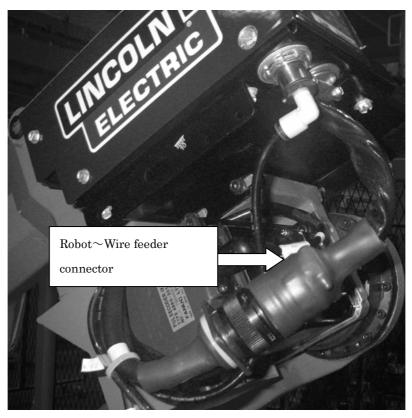


Fig.2.4.1 (f) Connection interface of Wire feeder (1/2)

⚠ CAUTION

When servo torch is specified, it must not be connected to wire feeder connector. Refer to Servo torch operator's manual (B-83074EN) about connection of servo torch.

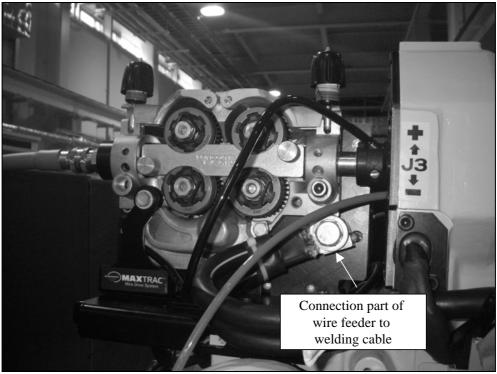


Fig.2.4.1 (g) Connection interface of Wire feeder (2/2)

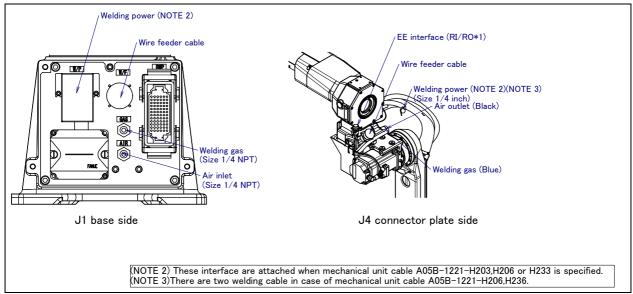


Fig.2.4.1 (h) Connection interface of ARC Mate 100iC, ARC Mate 100iC/6L

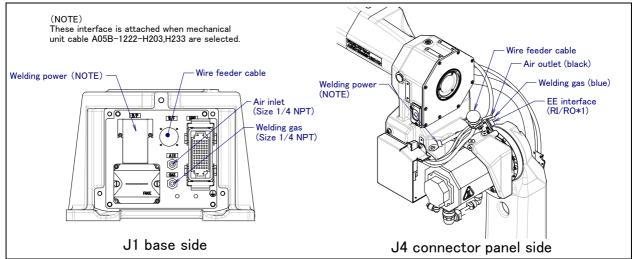


Fig.2.4.1 (i) Connection interface of ARC Mate 120iC, ARC Mate 120iC/10L

NOTE

Rated current of welding cable of A05B-1221-H203,H233 and A05B-1222-H203,H233 is 190A. (Ambient temperature: 40°C) Rated current of welding cable of A05B-1221-H206,H236 and A05B-1222-H206,H236 is 300A. (Ambient temperature: 40°C)

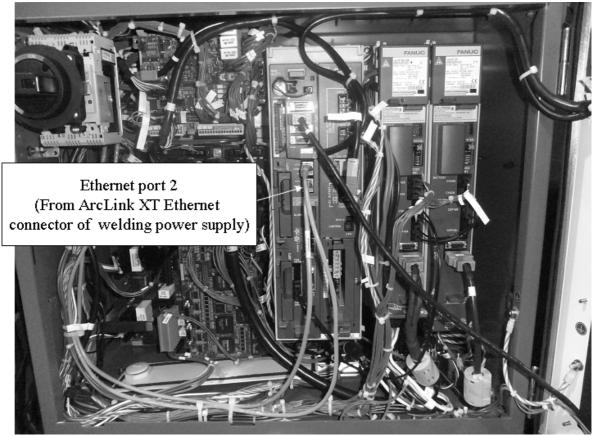


Fig.2.4.1 (j) Connection interface for R-30iB Controller of ROBOWELD iC/H (Power Wave i400)

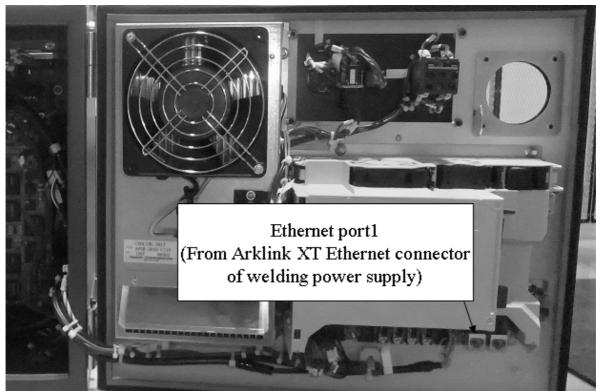


Fig.2.4.1 (k) Connection interface for R-30*i*B Mate Controller of ROBOWELD *i*C/H (Power Wave *i*400)

2.4.2 Connection

CONNECTION OF ROBOWELD *i***C/H** (Power Wave i400)

A) Connection of remote type welding power supply

1 Connect LAN cable to main board. In case of R-30*i*B controller, connect LAN cable to Port2 (CD38B). (See Fig.2.4.2 (a).) If the controller is R-30*i*B Mate, the port number for inserting Ethernet cable becomes followings corresponding to the number of ports.

Controller has only one Ethernet port: Connect the cable to Port 1

Controller has two Ethernet ports: Connect the cable to Port 2

Be sure to separate the LAN cable from 24V cable for emergency stop (red).

2 Connect LAN cable, wire feeder control cable and welding power cable (+)(-) to welding power supply referring to Fig.2.4.2 (b).

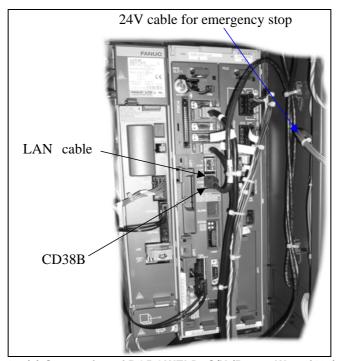


Fig.2.4.2 (a) Connection of ROBOWELD iC/H (Power Wave i400) (1/7)

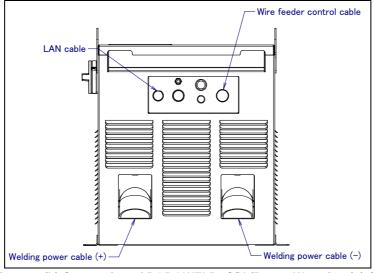


Fig.2.4.2 (b) Connection of ROBOWELD iC/H (Power Wave i400) (2/7)

B) Connection of integrated type welding power supply

- 1 Remove four M10 bolts of under surface of controller referring to Fig.2.4.2 (c).
- 2 Remove hook (2 pcs) and cover A. (See Fig.2.4.2 (d)). Fix bolt which fixed hook to original position.
- 3 Put controller on welding power supply and fix with M10 bolts which were removed in procedure 1.
- 4 Remove cover B. (See Fig.2.4.2 (d).)
- 5 Put unified kit plate which is the right of the inside the controller and pass LAN cable and power cable. (See Fig.2.4.2 (e).)
 - LAN cable can be passed only from welding power supply side.
- 6 Fix U,V and W earth of power cable to specified position. (See Fig. 2.4.2 (f).) Fix the cover B.
- 7 Connect LAN cable to main board. (See Fig.2.4.2 (e).)
- 8 Forming power cable as route of Fig.2.4.2 (e).

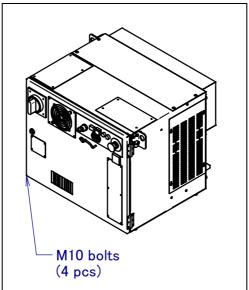


Fig.2.4.2 (c) Connection of ROBOWELD iC/H (Power Wave i400) (3/7)

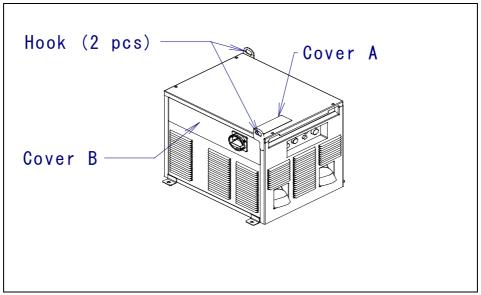


Fig.2.4.2 (d) Connection of ROBOWELD iC/H (Power Wave i400) (4/7)

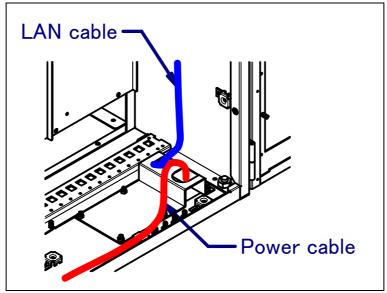


Fig.2.4.2 (e) Connection of ROBOWELD iC/H (Power Wave i400) (5/7)

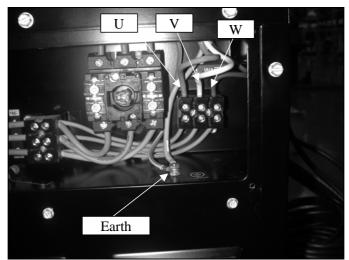


Fig.2.4.2 (f) Connection of ROBOWELD iC/H (Power Wave i400) (6/7)

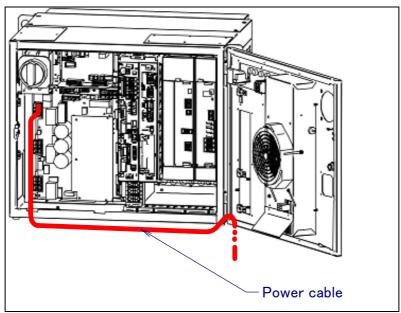


Fig.2.4.2 (g) Connection of ROBOWELD iC/H (Power Wave i400) (7/7)

CONNECTION OF ROBOWELD iC/H2 (Power Wave 455M/STT)

1 Connect welding power cable (+), (-), wire feeder control cable, communication cable and minus side sense lead to welding power supply referring to Fig.2.4.2 (h).

- 2 Put crocodile clip of minus side sense lead to energized part of fixture. (See Fig. 2.4.2 (i).)
- 3 Connect communication cable and 24V cable to Device Net connector referring to Fig.2.4.2 (j).
- 4 Connect 24V cable referring to Fig.2.4.2 (k).
- When servo torch is specified, Connect rod terminal side of plus side sense lead to J2 base part of robot referring to Fig.2.4.2 (l). (In case of normal wire feeder, plus side sense lead is included in wire feeder control cable.)

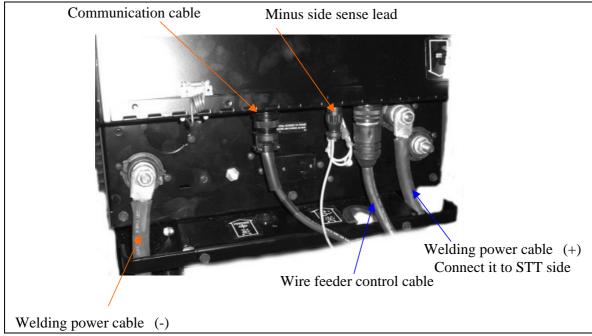


Fig.2.4.2 (h) Connection of ROBOWELD iC/H2 (PowerWave 455M/STT) (1/5)

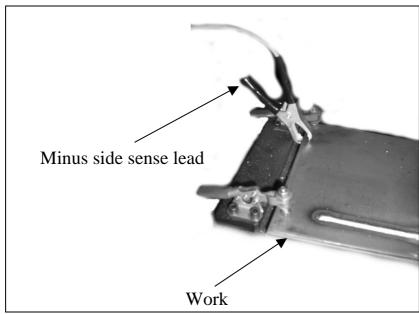


Fig.2.4.2 (i) Connection of ROBOWELD iC/H2 (PowerWave 455M/STT) (2/5)

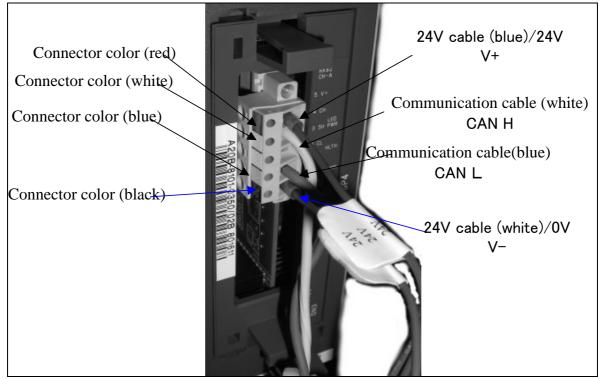


Fig.2.4.2 (j) Connection of ROBOWELD iC/H2 (PowerWave 455M/STT) (3/5)

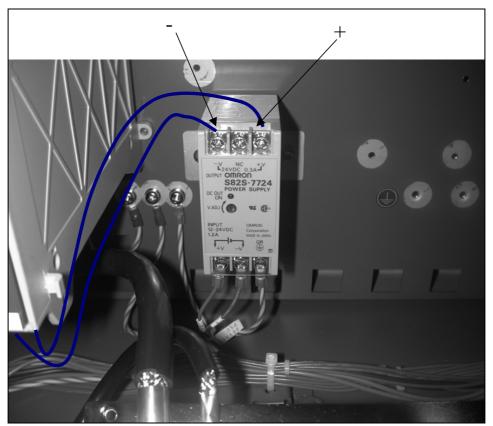


Fig.2.4.2 (k) Connection of ROBOWELD iC/H2 (PowerWave 455M/STT) (4/5)

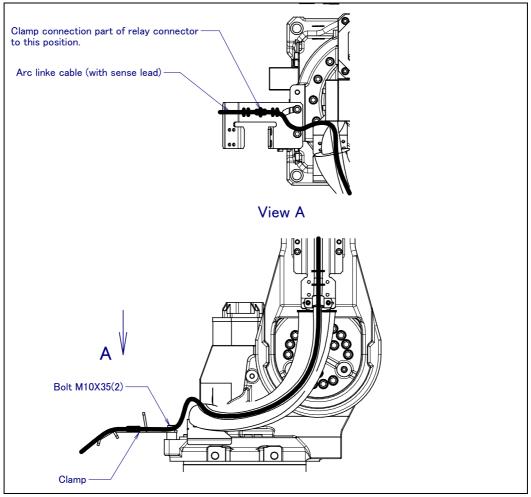


Fig.2.4.2 (I) Connection of ROBOWELD iC/H2 (PowerWave 455M/STT) (5/5)

Connection of ROBOWELD iC/E(Invertec CV350-R)

- 1 Connect welding power cable (+),(-), wire feeder control cable, communication cable to welding power supply referring to Fig .2.4.2 (m).
- 2 Connect communication cable to DeviceNet connector referring to Fig.2.4.2 (n). If wire of communication cable is out of connector, insulate it using insulating tape.

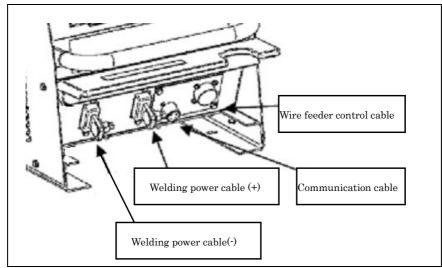


Fig.2.4.2 (m) Connection of ROBOWELD iC/E (Invertec CV350-R) (1/2)

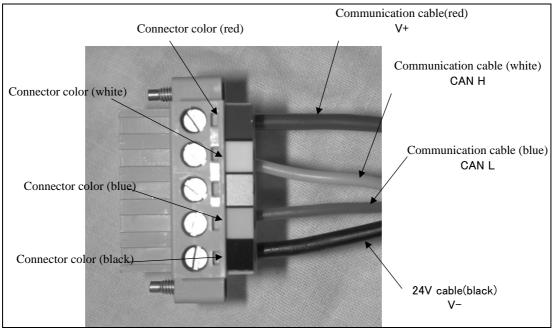


Fig.2.4.2 (n) Connection of ROBOWELD iC/E (Invertec CV350-R) (1/2)

(*) If the welding power supply was shipped before Jan., 2011, Connector and cable color may differ.

Connection of ROBOWELD iC/H3 (Power Wave R350)

1 Connect welding power cable (+), (-), wire feeder control cable and communication cable to welding power supply referring to Fig.2.4.2 (o) and (p).



Fig.2.4.2 (o) Connection of ROBOWELD iC/H3 (Power Wave R350) (1/4)

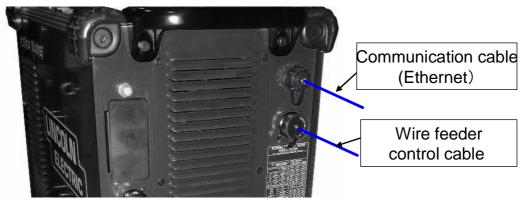


Fig.2.4.2 (p) Connection of ROBOWELD iC/H3 (Power Wave R350) (2/4)

2 Remove both upper side cover and side panel. (When STT module is specified, it is common.)

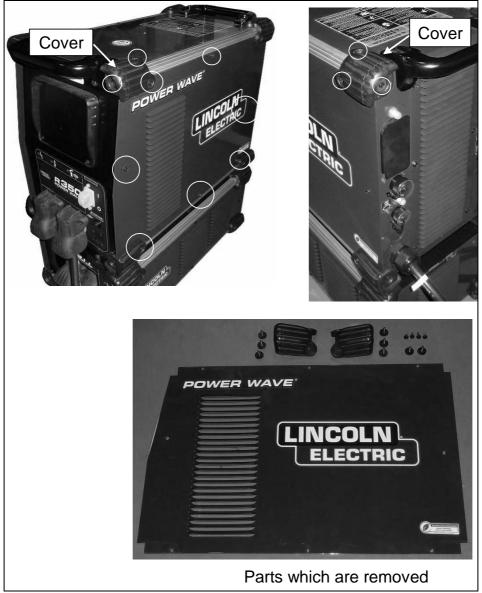


Fig.2.4.2 (q) Connection of ROBOWELD iC/H3 (Power Wave R350) (3/4)

3 Connect primary power supply cable and put side panel back. (When STT module is specified, it is common.)

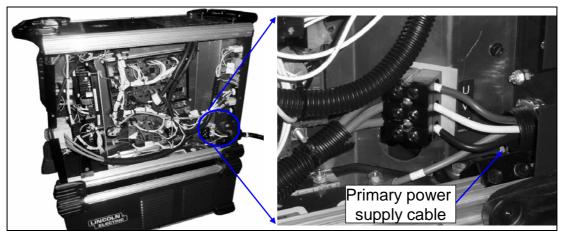


Fig.2.4.2 (r) Connection of ROBOWELD iC/H3 (Power Wave R350) (4/4)

Connection of ROBOWELD iC/H3 (Power Wave R350) with STT module

Fix welding power supply main body on STT module. Remove metal plate of STT module and set welding power supply main body referring to Fig.2.4.2 (s). Fix welding power supply main body with removed metal plate.

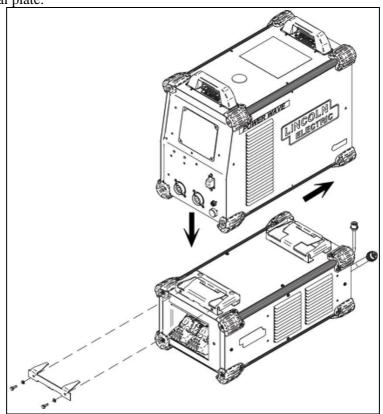


Fig.2.4.2 (s) Connection of ROBOWELD iC/H3 (Power Wave R350) and STT module (1/3)

2 Connect welding power cable (+),(-), wire feeder control cable and communication cable and sense lead to welding power supply referring to Fig.2.4.2 (t) and (u).

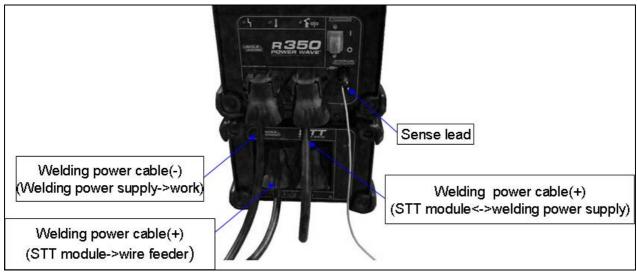


Fig.2.4.2 (t) Connection of ROBOWELD iC/H3 (Power Wave R350) and STT module (2/3)

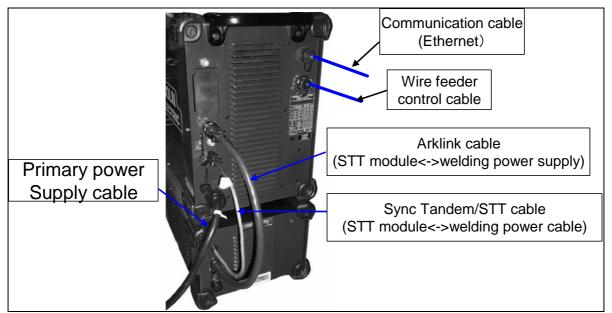


Fig.2.4.2 (u) Connection of ROBOWELD iC/H3 (Power Wave R350) and STT module (3/3)

Put crocodile clip of minus side sense lead to energized part of fixture. (See Fig. 2.4.2 (i).) When servo torch is specified, connect two line sense lead to the terminal of the front panel. Then connect the rod terminal side on the cable of the robot J2 base referring to Fig.2.4 2 (l). Fix the another crimp terminal side on the energized part of the fixture. (In case of normal wire feeder, plus side sense lead is included in wire feeder control cable.)

When forming cable of ROBOWELD iC/H, be sure to remove this cable from emergency stop cable referring to Fig.2.4.2 (v).

Emergency stop cable (red) Ethernet cable (black) 0

Fig.2.4.2 (v) Connection interface for R-30iB Controller of ROBOWELD iC/H (PowerWave i400)

(*) If robot is shipped before Jan, 2011, color of connector and cable may differ.

Ethernet cable between main and hub is not included in upper description, It is possible to order below. A660-2042-T220#L1R703

Use standard cable below between hub and welding power supply. 05B-2512-J280 - J282 or A05B-1291-H551 - H555

2.5 TEACH PENDANT

The teach pendant provides an interface between the Application tool software and the operator. The teach pendant is connected to the PC board in the controller by a cable.

The following operations can be performed using the teach pendant:

- Jog feed of the robot
- Program generation
- Test execution
- Actual work
- Status check

The teach pendant includes the following:

- 640 x 480 pixel Liquid crystal display
- 2 LEDs
- 68 keys

A CAUTION

The operator of the teach pendant should use gloves that would not cause any operation error.

The following switches are also provided:

Teach pendant enable switch	This switch enables or disables the teach pendant. When the teach pendant is disabled, a jog feed, program generation, or test execution cannot be carried out.
Deadman switch	DEADMAN SWITCH is used as an enabling device. When the teach pendant is enabled, this switch allows robot motion only while the deadman switch is gripped. If you release this switch, the robot stops immediately.
Emergency stop button	When pressed, the emergency stop button immediately stops the robot (Please refer to "STOP TYPE OF ROBOT" in SAFETY PRECAUTIONS for detail of stop type).

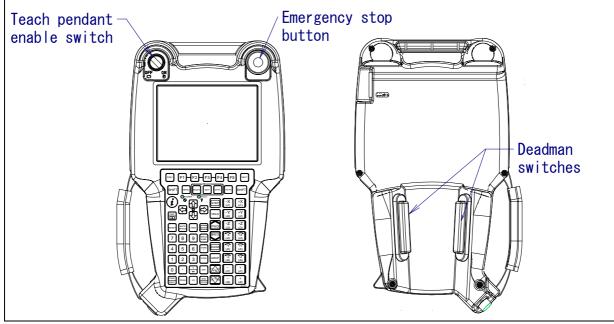


Fig. 2.5 (a) Switches on the teach pendant (iPendant)

Fig. 2.5 (b) shows the teach pendant.

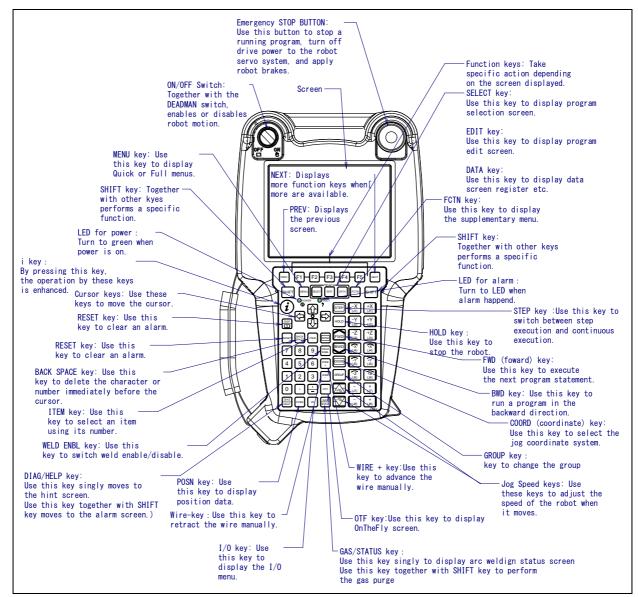


Fig. 2.5 (b) Teach Pendant (iPendant)

Keys on the teach pendant

The teach pendant has the following keys:

- Keys related to menus
- Keys related to jog feed
- Keys related to execution
- Keys related to arc welding

Table 2.5 (a) Keys related to menus

rabio zio (a) riojo rolatoa to monac		
Key	Function	
F1 F2 F3 F4 F5	The function (F) key to select a function menu at the last line of the screen.	
NEXT	The next page key to switch the function key menu on the next page.	

Key	Function
MENU FCTN	The MENUS key to display the screen menu. The FCTN key to display the function menu.
SELECT EDIT DATA	The SELECT key to display the program selection screen. The EDIT key to display the program edit screen. The DATA key to display the program data screen.
STATUS	The STATUS key displays the status screen.
OTF I/O POSN	The OTF key display the screen of On the fly function. The I/O key displays the I/O screen. The POSN key displays the current position screen.

Table 2.5 (b) Keys related to menus (only *i*Pendant)

Key	Function
DISP	Pressing this key singly changes the operation target screen. Pressing this key together with SHIFT key splits the screen (single Screen, double screens, triple screens, or status/single screen).
DIAG HELP	Pressing this key singly moves to the hint screen. Pressing this key together with the SHIFT key moves to the alarm screen.
GROUP	Pressing this key change the group

Application-dedicated keys differ depending on the application.

Table 2.5 (c) Keys related to welding

Table 2.5 (c) Reys related to welding	
Items	Descriptions
WELD ENBL	The WELD ENBL key (+ SHIFT key) enables/disables welding.
WIRE +	The WIRE+ key (+SHIFT key) feeds the wire manually.
WIRE -	The WIRE- key (+SHIFT key) rewinds the wire manually.
GAS STATUS	When pressed only it, arc welding status screen is displayed. When pressed in with SHIFT key, gas purge process performs.

Table 2.5 (d) Keys related to jog feed

Key	Function
SHIFT	The SHIFT key is used to execute a jog feed of the robot, teach the position data, and start a program. The right and left Shift keys have the same function.
$ \begin{array}{c c} -Z \\ (J3) \\ \hline \\ -Z \\ (J6) \\ \hline \end{array} \begin{array}{c c} -Y \\ (J2) \\ \hline \\ -X \\ (J4) \\ \hline \end{array} \begin{array}{c c} +Z \\ +Z \\ (J6) \\ \hline \end{array} \begin{array}{c c} +X \\ (J2) \\ \hline \\ -X \\ (J4) \\ \hline \end{array} \begin{array}{c c} +Z \\ +Z \\ (J6) \\ \hline \end{array} \begin{array}{c c} +X \\ (J2) \\ \hline \\ +X \\ (J4) \\ \hline \end{array} $	The jog keys are effective while a Shift key is held down. They are used for jog feed.
COORD	The COORD key selects a manual-feed coordinate system (jog type). Each time the COORD key is pressed, it selects the next jog type in the order: JOINT, JGFRM, World frame, TOOL, USER. When this key is pressed while a Shift key is held down, a jog menu for changing the coordinate system appears.
+%	The override key adjusts the feedrate override. Each time the override key is pressed, it selects the next override in the order: VFINE, FINE, 1%, 5%, 50%, 100%. (Changing amount 5% for 5% or less and changing amount 5% for 5% or more.)

Table 2.5 (e) Keys related to execution

- unit 210 (0) 110 yo 10 unit 10 0 x 0 0 unit 11		
Key	Function	
FWD BWD	The FWD key or BWD key (+ SHIFT key) starts a program. When the shift key is released during regeneration, the program halts.	
HOLD	The HOLD key causes a program to halt.	
STEP	The STEP key selects step or continuous test operation.	

Table 2.5 (f) Keys related to editing			
Key	Function		
PREV	The PREV key restores the most recent state. In some cases, the screen may not return to the immediately preceding status.		
ENTER	The ENTER key enters a numeral or selects a menu.		
BACK	The BACK SPACE key deletes the character or numeral immediately before the cursor.		
	The cursor key moves the cursor. The cursor is the highlighted part which can move on the teach pendant screen. This part becomes the object of operation (input or change of the value or contents) from the teach pendant key.		
ITEM	The ITEM key moves the cursor to a line whose number is specified.		

Table 2.5 (g) Other keys		
Key	Function	
(i)	 i key is used with the following keys. By pressing the following keys while the i key is held down, the operation by these keys is enhanced. MENU key FCTN key EDIT key DATA key POSN key JOG key DISP key 	

LEDs on the teach pendant

The window at the top of the *i*Pendant screen is called the status window. In this window, eight software LEDs, alarm indication, and override value are displayed. Each software LED is "on" when displayed together with an icon or "off" when displayed with no icon.

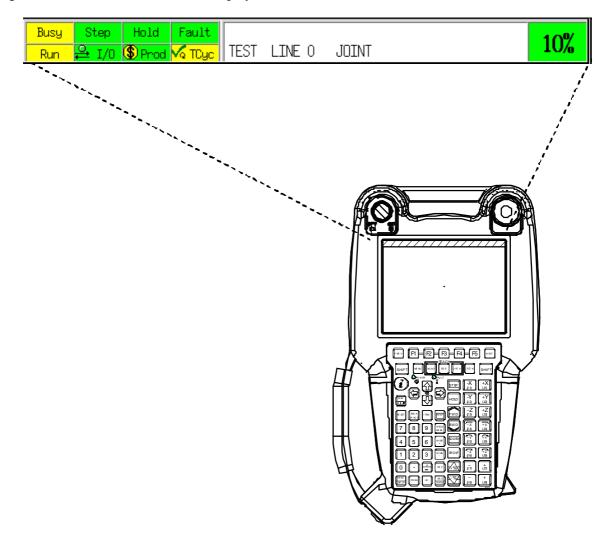


Table 2.5 (h) Description of software LEDs

ı	LEDs	Table 2.6 (II) Beschiption of Settware 22.56
(Upper: On, Lower: Off)		Description
Busy	Rusy Busy	Indicates that the robot is working. This LED is on during execution of a program. It is also on when the printer or floppy disk drive is busy.
Step	≯ Step Step	Indicates that the robot is in the step operation mode.
Hold	Mold Hold	Indicates that the HOLD button is being held or the HOLD signal is input.
Fault	OFault Fault	Indicates that an alarm occurs.
Run	Run Run	Indicates that a program is being executed.
Weld	Weld	Indicates that arc welding is enabled/disabled.
Arc	Estab	Indicates that an arc is generated or not.
Dry run	DRun	Indicates that "dry run mode" is enabled/disabled. If the mode is enabled, welding doesn't perform.

Display Screen of the Teach Pendant

The liquid crystal display screen (liquid crystal display) displays the Application tool software screen shown in Fig. 2.5 (c). To operate the robot, select a screen corresponding to a desired function. The screen is selected by the screen menus shown in Fig. 2.5 (c).

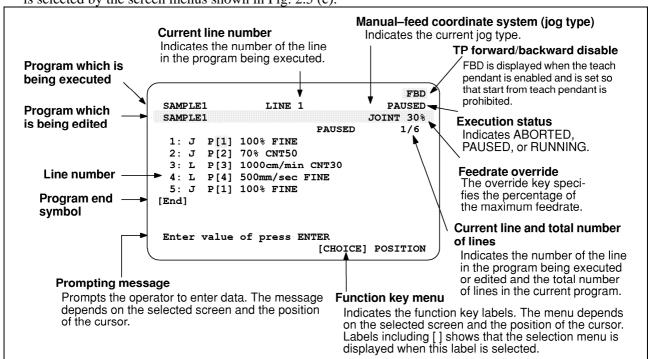


Fig. 2.5 (c) Program Edit Screen

Screen menu and function menu

Menus are used to operate the teach pendant. The screen menu is selected by the MENUS key and the function menu is selected by the FCTN key.

Fig. 2.5.(d), Fig. 2.5 (e), and Fig. 2.5 (f) show the screen menu, auxiliary menu, and quick menu respectively.

- Screen menu

The screen menu is used to select a screen. The screen menu lists the following options. (For the list of menus, see Appendix A.1 of controller operator's manual For the screen type, see Appendix A.2 of controller operator's manual.) To display the screen menu, press the MENUS key on the teach pendant.

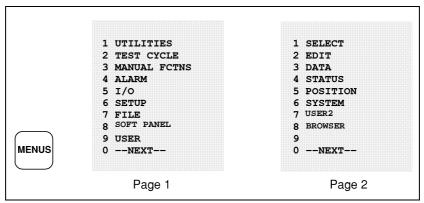


Fig. 2.5 (d) Screen menu

LED	Function
UTILITIES	The utility screen is used to display the hints'.
TEST CYCLE	The test cycle screen is used to specify the data for test operation.
MANUAL FCTNS	The manual operation screen is used to execute macro instructions.
ALARM	The alarm history screen shows the history and details of alarms.
I/O	The I/O screen is used to display and set manual output, simulated input/output, and assign of signals.
SETUP	The setting screen is used to set the system.
FILE	The file screen is used to read or store files.
SOFT PANEL	This screen is used to execute frequently used functions.
USER	The user screen shows user messages.
SELECT	The program selection screen is used to list or create the programs.
EDIT	The program edit screen is used to correct and execute a program.
DATA	The program data screen shows the values in registers, position registers, and pallet register.
STATUS	The status screen shows the system status.
POSITION	The current position screen shows the current position of the robot.
SYSTEM	The system screen is used to set system variables and mastering.
USER2	This screen displays messages output from KAREL programs.
BROWSER	This screen is used to brows Web pages on the network. (Displayed only when the <i>i</i> Pendant teach pendant is used.)

- Function menu

The function menu is used to execute a miscellaneous function. (For the list of menus, see Appendix A.1 of controller operator's manual.) To display the function menu, press the FCTN key on the teach pendant.

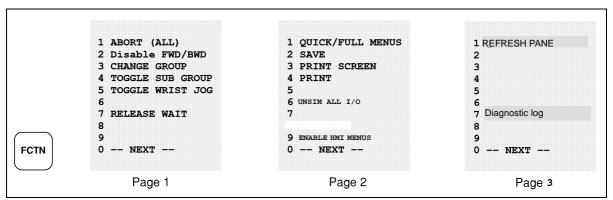


Fig. 2.5 (e) Function menu

Table 2.5 (j) Function menu

LED	Function
ABORT (ALL)	ABORT forces a program, which is being executed or temporarily halted to terminate.
Disable FWD/BWD	Disable FWD/BWD enables or disables starting a program with a teach pendant
CHANGE GROUP	Changes the operation group for jog feed. Displayed only when multiple groups are set.
TOGGLE SUB GROUP	TOGGLE SUB GROUP toggles jog between robot standard axes and extended axes.
TOGGLE WRIST JOG	TOGGLE WRIST JOG toggles jog between the attitude control feed and the wrist joint feed
	which does not maintain the wrist attitude in linear feed.
RELEASE WAIT	Skips the wait instruction currently being executed. When the wait state is released,
	execution of the program stops temporarily at the line subsequent to the wait instruction.
QUICK/FULL MENUS	QUICK/FULL MENUS toggles the menu between a usual screen menu and a quick menu.
SAVE	SAVE saves the data related to the current screen on a floppy disk or memory card.
PRINT SCREEN	PRINT SCREEN prints the data displayed on the current screen.
PRINT	PRINT prints the data on the current screen exactly.
UNSIM ALL I/O	Cancels the simulated settings of all IO signals.
CYCLE POWER	Makes a restart (power OFF/ON).
ENABLE HMI MENUS	Used to select whether to display the HMI menu when the MENUS key is pressed.

Restart

It is now possible to make a restart (power off/on) from the FCTN key.

- Condition

- The teach pendant is enabled.
- The controller is in a cold start status.

- Step

- 1 Press the [FCTN] key.
- 2 Select [CYCLE POWER].
- 3 The screen below appears.

```
This will cycle power.
Are you sure ?
[NO] YES
```

- 4 Press the [NEXT] key and select [YES].
- 5 Press the [ENTER] key.

- Quick menu

When a quick menu is selected in QUICK/FULL MENUS of FUNCTIONS, the screen that can be displayed by using the screen menu is limited to the following:

- ALARM / alarm occurrence and alarm history screen
- UTILITIES / hint screen
- TEST CYCLE screen
- DATA / register screen
- Tool 1 / Tool 2 screen
- STATUS/axis screen
- I/O/digital/group/Robot I/O screen
- POSITION screen
- SETUP / Coordinate system setup screen
- USER / USER 2 screen
- SETUP PASSWORD screen
- BROWSER screen (only when *i*Pendant is used)

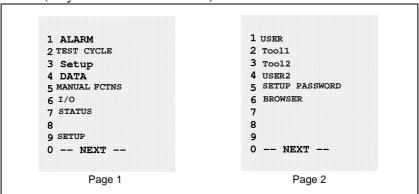


Fig. 2.5 (f) Quick menu

NOTE

- 1 The program selection screen can be displayed by the SELECT key. But the only available function is selecting a program.
- 2 The program edit screen can be displayed by the EDIT key. But the only available functions are changing position and speed values.

2.6 SOFTWARE

ROBOWELD *i*C series is arc welding robot package that mounts welding equipment PowerWave series or Invertec series (these are called "Power Wave" hereafter) of Lincoln Electric Company (refer to Fig. 2.6 (a)). PowerWave is connected with the robot controller by the ArcLink and the robot system can be constructed. ArcLink is a standard interface developed by Lincoln Electric Company. This is used to communicate between devices that compose the welding system.

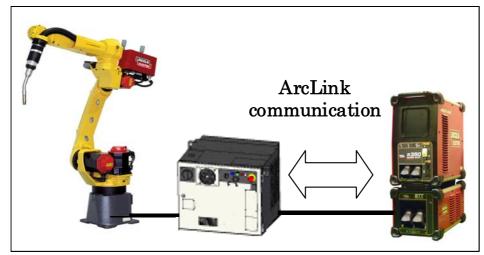


Fig. 2.6 (a) Arc welding robot package (example: ROBOWELD 100iC/H3)

Communication by ArcLink

In communication of ArcLink used by ROBOWELD *i*C series, analog I/O or digital I/O on process I/O board are not used for the connection with the weld equipment. Setting of PowerWave and welding control can be easily set from the robot controller by the ArcLink.

There are two methods of hardware connections that use the ArcLink.

- ArcLink (CAN bus): Connection by DeviceNet board
- ArcLink XT (Ethernet): Connection by Ethernet



Fig. 2.6 (b) Kind of welding equipment

ROBOWELD *i*C/H series that mounts PowerWave *i*400 mainly uses the connection method with ArcLink XT. ROBOWELD *i*C/E series that mounts Invertec CV 350-R or ROBOWELD *i*C/H2 series that mounts PowerWave 455M/STT uses the connection method with ArcLink (CAN bus) only. The model of the selected welding equipment is different depending on connected method (refer to 2.6 (b)).

⚠ CAUTION

In ROBOWELD *i*C series, please wait for 10~30 seconds after the robot controller start-up. Then, the communication is established. Please start the program after the communication establishes.

The communication establishment can be observed from the external control board by checking the "Weld EQ ready" and "Power fault" output signals. Please refer to the 5.3.6 for these signals.

Arc Weld Procedure

ROBOWELD iC series use "Weld Procedure" which includes important settings/parameters in one screen.

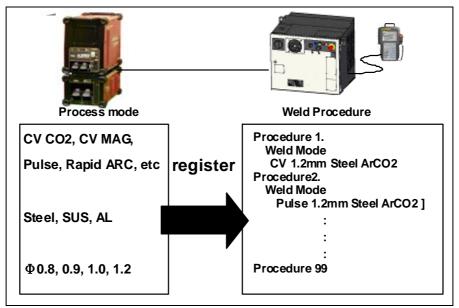


Fig. 2.6 (c) Overview of process mode and Weld Procedure

Additionally, schedules of weld process; runin, wire burnback/retract, wire stick reset, on the fly etc are specified each weld procedure. About more details, please refer to Section 4.3 "OPERATION OF WELD PROCEDURE".

Command Form of Weld Schedules

The arc welding for ROBOWELD *i*C/H, H3 series and ROBOWELD *i*C/E is achieved by controlling "Voltage" and "Current" which are used as standard weld parameters of standard weld equipment in Japan/Asia. The available output ranges are different from each selected weld mode.

Otherwise, the arc welding for ROBOWELD *i*C/H2 series is achieved by controlling mainly "Wire Feed Speed" command and "Trim" (or "Voltage") which are conventionally used in North America. Trim can be adjusted between the range of 0.5 - 1.5 and the basis is "1.0".

Additionally, "Pinch" and "UltimArc" are prepared as the special parameter for ROBOWELD iC series. The Pinch and UltimArc are used for the fine adjustment of weld current waveform. The available output range is -10 - +10.

ROBOWELD iC/H, H3, E series

Current Command

- Voltage
- Current
- Pinch or UltimArc

```
DATA Weld Procedure
                                  1/7
 1 Weld Procedure 1 [
                     GMAW-P
                                  # 221
  [Pulse
  [1.2 mm steel
                     Ar CO2
 2 Weld Schedule
 3 Current
                            0.0 Amps
                           0.00 Volts
 4 Voltage
5 UltimArc
                           0.00
                            0.0 \text{ cm/min}
 6 Travel speed
 7 Delay Time
                           0.00 sec
  Feedback Currnt
                            0.0 Volts
   Feedback Voltage
                            0.0 Amps
TYPE ] SCHEDULE AUTO [V]
```

ROBOWELD iC/H2 series

WFS Command

- WFS (Wire Feed Speed)
- Voltage or Trim
- Pinch or UltimArc

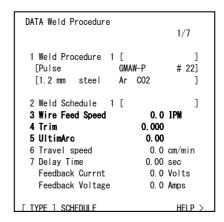


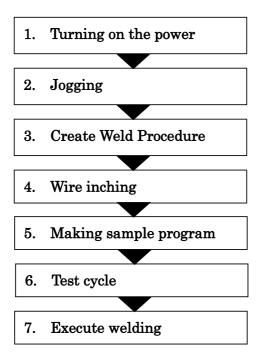
Fig. 2.6 (d) Differences of weld command process in ROBOWELD iC series

ROBOWELD *i*C/H2 and H3 series support STT (Surface Tension Transfer) welding in addition to conventional short arc welding and pulse welding. About the weld mode, please refer to Appendix D "STT Welding (Only for ROBOWELD *i*C/H2 and *i*C/H3 series)".

ROBOWELD *iC*/H, H3 and E series can change the command form from Current Command to WFS Command. Additionally, it is also possible to use Trim for Pulse mode. About more details, please refer to Appendix G.4 "CHANGING COMMAND FORM OF WELD SCHEDULES".

3 BASIC OPERATION (QUICK REFERENCE)

3.1 OVERVIEW



This chapter describes the shortest procedure from turning on the power of 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 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 3-2.

Procedure 3-2 Turning on the power

Step

- 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 operator is safe.
- 2 Turn on the robot controller.

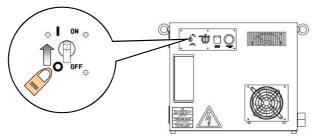


Fig.3.2 (a) Turning on the robot controller

3 Turn on the welding power supply.

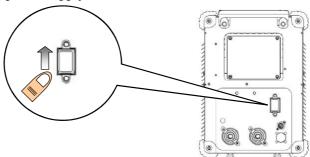


Fig.3.2 (b) Turning on the welding power supply

4 Normally, "ARC-051 Weld EQ1 ONLINE: ArcLink" is displayed on upper part of the screen of the teach pendant when approximately dozens of seconds pass after completion of turning on the welding power supply.

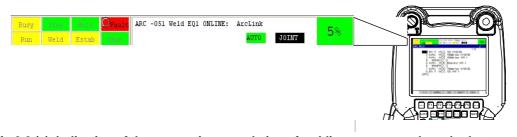


Fig.3.2 (c) Indication of the connection completion of welding power supply and robot controller

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.

3.3 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 3-3 Jogging

Step

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

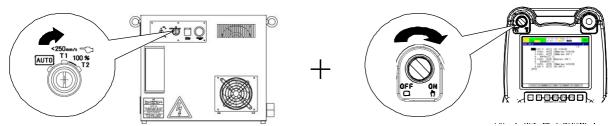


Fig.3.3 (a) Setting of 3 mode switch and teach pendant switch

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.3.3 (c).

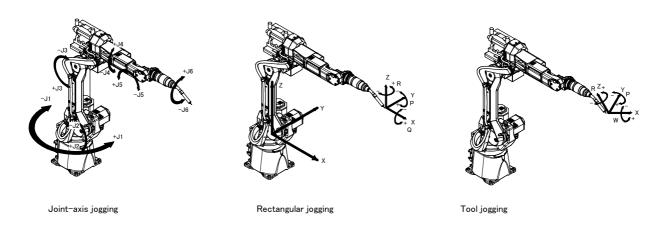


Fig.3.3 (b) The kind of jogging

Table 3.3 (a) Jog modes (manual feed coordinate system)

Jog modes	Description
Joint-axis jogging	Directs the robot axes (joint axes) by manipulating corresponding keys on the teach pendant.
Rectangular jogging	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 jogging	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.

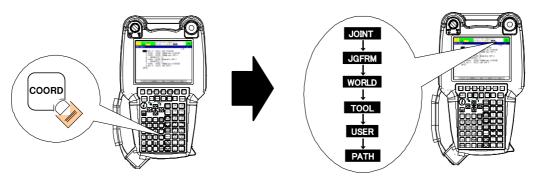


Fig.3.3 (c) Change of jogging variation by manual-feed coordinate system key

4 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 3.3 (b) for details.

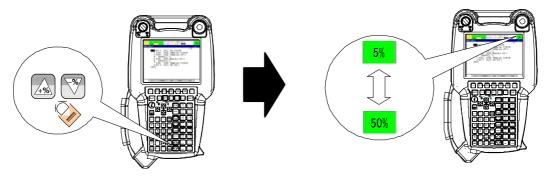


Fig.3.3 (d) Operation of override key

Table 3.3 (b) The change of the value when override key is pressed

Override key	VFINE \rightarrow FINE \rightarrow 1% $\underline{\rightarrow}$ 5% $\underline{\rightarrow}$ 100%
	Steps of 1% Steps of 5%
Shift + Override key	VFINE \rightarrow FINE \rightarrow 5% \rightarrow 25% \rightarrow 50% \rightarrow 100%

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

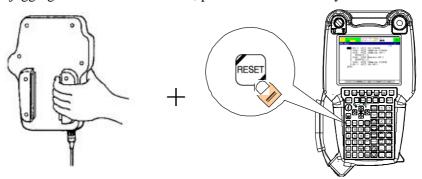


Fig.3.3 (e) Operation of deadman switch and alarm release key

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

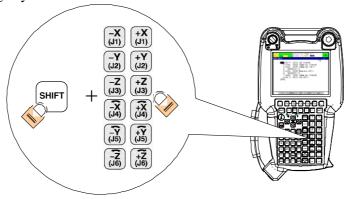


Fig.3.3 (f) Operation of jog key

⚠ 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.

3.4 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.

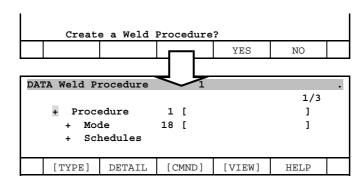
NOTE

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".

Procedure 3-4 Creating Weld Procedure

Step

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.



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, no-pulse 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, "20") by numerical keys on Teach Pendant, and press ENTER key. Specified Process Mode number is applied to Weld Procedure.

DAT	TA Weld P	rocedure	1			•
	+ Mod	edure de nedules	1 [20 [CV		2/3]]	
	[TYPE]	DETAIL	[CMND]	[VIEW]	HELP	

Table 3.4 Main Process Modes

Wire Material	Wire Diameter	Gas Type	Process Mode Number
Steel	1.2mm	CO2	20
Steel	1.2mm	MAG	21
Steel	1.0mm	CO2	10
Steel	1.0mm	MAG	11

NOTE

If there is no appropriate type on the table, perform Process Mode Search referring to Procedure 4-3-2 "Assignment of process mode number by searching", or search Process Mode number from the table on Appendix B "Process Mode" and perform Procedure 4-3-1 "Assignment of process mode number by direct input".

3.5 WIRE INCHING

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 3-5.

Procedure 3-5 Manual Wire Inching

Step

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



Fig.3.5 (a) Wire Inching

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



Fig.3.5 (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.

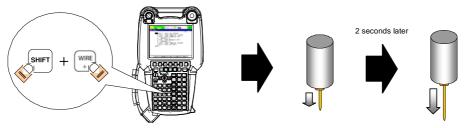


Fig.3.5 (c) High Speed Wire Inching

! CAUTION

Wire inching is not available if available Process Mode is not assigned to Weld Procedure. Please perform wire inching after assigning available Process Mode.

! CAUTION

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

3.6 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 3.3, and save 5 positions of the right figure of Fig.3.6 (a) to the motion program. Please refer to Procedure 3-6.

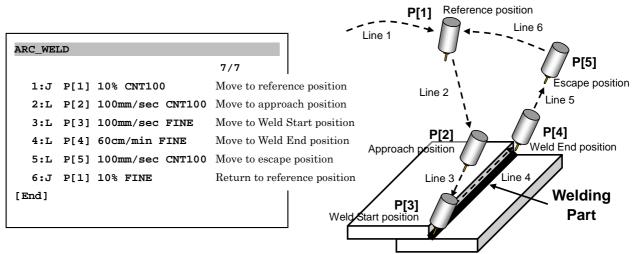


Fig.3.6 (a) Sample Program

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 "Program Edit".

Procedure 3-6 Creating Motion Program

Step

- 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.
- Adjust the wire stickout by wire inching operation. Recommended stickout is "12mm" for 1.0mm wire diameter, or "15mm" for 1.2mm wire diameter.

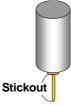
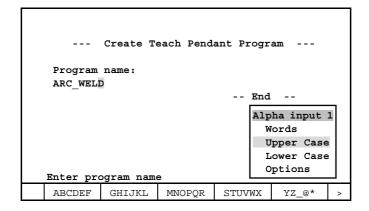


Fig.3.6 (b) Adjustment of Wire Stickout

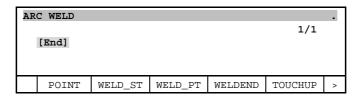
3 Press SELECT key on a teach pendant. Following Program List screen is displayed.

Sel	Lect								•
			103	9556	bytes	free	1	/9	
	No.	Pro	ogram	name	Co	mment			
	1	-BC	KEDT-		[1	
	2	GET	DATA	MI	[Get	PC Dat	:a]	
	3	REQ	MENU	MI	Requ	[Request PC Menu]			
	4	SENDDATA MR			[Send	l PC Da	ıta	1	
	5	SEN	DEVNT	MI	[Send	PC Ev	rent	1	
	[TYF	E]	CREA	TE	DELETE	MON	ITOR	[ATTR]	>

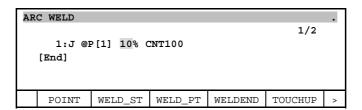
Press F2[CREATE] key. A screen for entering program name is displayed. Additionally, a list of [Alpha input 1] is displayed at the lower left. In this operation example, define the sample program name as "ARC_WELD". Move the cursor on "Upper Case" and enter the program name by using F1-F5 function keys.



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.



- 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.
- 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).

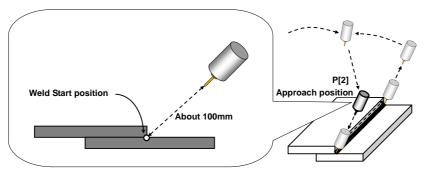


Fig.3.6 (c) Jog to Approach Position

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.

AR	C WELD					
					3/3	
	1:J I	P[1] 10% C	CNT100			
	2:L @I	P[2] 100mm	n/sec CNT1	.00		
	[End]					
	POINT	WELD_ST	WELD_PT	WELDEND	TOUCHUP	>

10 Jog the robot to Weld Start position.

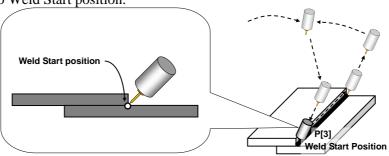
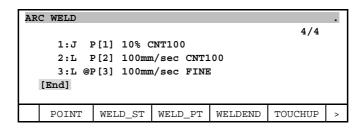


Fig.3.6 (d) Jog to Weld Start Position

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.

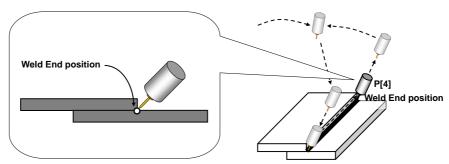
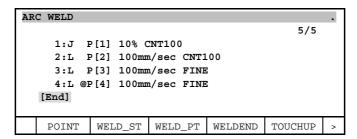


Fig.3.6 (e) Jog to Weld End Position

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 a 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 | 5/5 | 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_PT | WELDEND | TOUCHUP | >

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

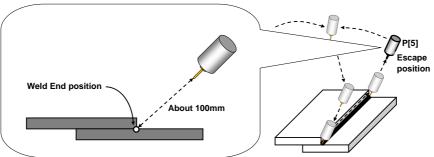


Fig.3.6 (f) Jog to Escape Position

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 >
```

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)

3.7 SPECIFY ARC WELD SCHEDULE

It is impossible to achieve arc welding by only the motion program created on Section 3.6. For achieving arc welding, it is necessary to specify an arc weld schedule by using Weld Procedure created on Section 3.4, 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.

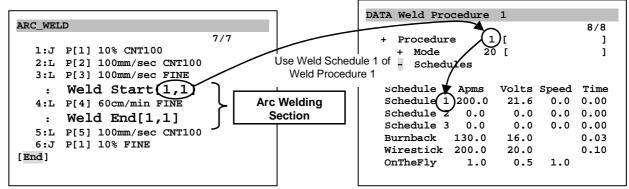


Fig.3.7 Relationship between Sample Program and Arc Weld Schedule

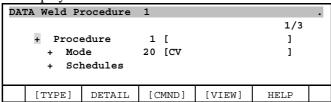
NOTE

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 4.4 "TEACHING AND EDITING OF ARC WELD INSTRUCTION".

Procedure 3-7 Specify Arc Weld Schedule

Step

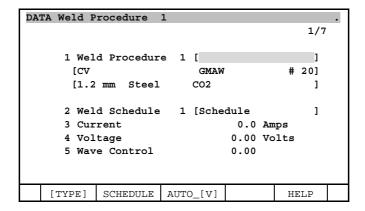
1 Press DATA key and display Weld Procedures screen.



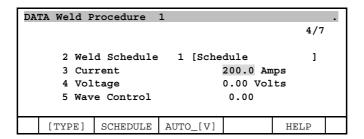
2 Move the cursor on "+" at the left of "Schedules" and press ENTER key. A list of weld schedules is displayed.

DA:	TA Weld P:	roce	dure	1						
									2/9	
	+ Proced	dure		1	[]	
	+ Mod	de	2	20	[CV]	
	+ Scl	nedu	les							
	Schedule		Amps		Volts	Speed	Т	ime		
	Schedule	1	0.0		0.0	0.0	C	.00		
	${\tt Schedule}$	2	0.0		0.0	0.0	C	.00		
	${\tt Schedule}$	3	0.0		0.0	0.0	C	.00		
	Burnback		130.0		16.0		C	0.03		
	[TYPE]	DE'	TAIL	[CMND]	[VIEW]	HE	LP	

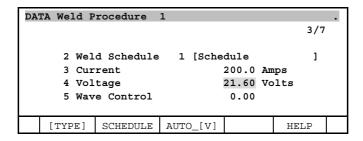
Move the cursor on unused weld schedule (in this example, Weld Schedule 1), and press F2[DETAIL]. Detail screen for the weld schedule is displayed.



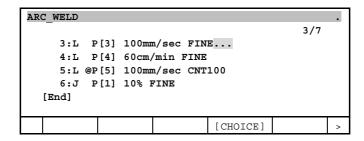
4 In this example, specify the current "200A" as the weld schedule. Move the cursor on the line of "Current" and input "200" by numerical keys, and then press ENTER key.



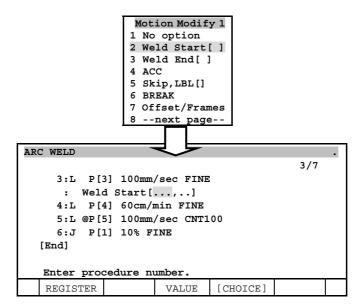
5 Next, input voltage. Move the cursor on the line of "Voltage" and press F3[AUTO_[V]]. Then, the message "Reset recommended voltage. Are you OK?" is displayed on the prompt line. When F4[YES] is pressed, recommended voltage for the preset current is automatically set. In this stage, the preparation of weld schedule was completed.



6 Display the edit screen of the motion program created on Procedure 3-6. Press EDIT key, or press SELECT key and select the sample program name which was set by Step 4 in Procedure 3-6 (in this example, ARC_WELD). Then, move the cursor on a blank part just behind "FINE" on line 3.



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



8 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.

9 Next, move the cursor on a blank part just behind "FINE" on line 4.

```
ARC_WELD 4/7

4:L P[4] 60cm/min FINE...

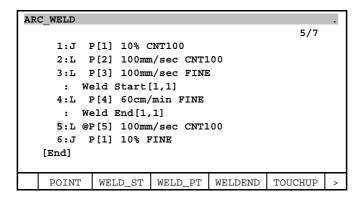
5:L @P[5] 100mm/sec CNT100

6:J P[1] 10% FINE

[End] [CHOICE] >
```

10 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.

11 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.



12 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 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.

3.8 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 3-8 (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. After 5 seconds has passed, the gas flow stops automatically.

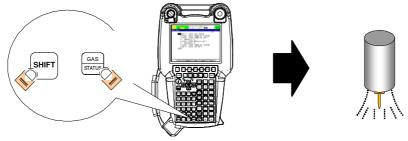


Fig.3.8 (a) Gas Check by Gas Purge Key Operation

- 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 To change time between gas is left and stop automatically from default value "5 seconds", perform below procedure. Press MENU key and select "6 SETUP". Then, press F1[TYPE] and select "Weld System". Weld System Setup screen is displayed.

		1 7			
SETUP Wel	ld System				•
				1/22	
	NAME		VALUE		
Monito	oring Functi	lons			
1 A:	rc loss:		ENABL	ED.	
2 Ga	as shortage:	:	DISAB	LED	
3 W	ire shortage	e:	DISAB	LED	
4 Wi	ire stick:		ENABL	ED	
5 Pc	ower supply	failure:	ENABL	ED	
[TYPE	[]		ENABLED	DISABLED	

4 Move the cursor down on the screen and set the cursor on "Gas purge time" item. Input desired time using a numeric key, and press ENTER key.

SETUP Weld System .						
		22/22				
18 Weld from teach penda	int: E	NABLED				
19 Remote gas purge:	D	ISABLED				
20 Remote wire inch:	D	DISABLED				
21 Gas purge key:	E	NABLED				
22 Gas purge time:	5	0 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 3-8 (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.

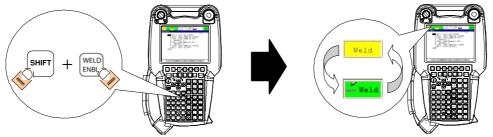


Fig.3.8 (b) Switching Operation of Weld Enabled/Disabled by WELD ENBL Key

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.

3.9 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 3-9 (a) Step Operation

Step

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



Fig.3.9 (a) Operation of Dead Man Switch and Teach Pendant Enable Switch

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

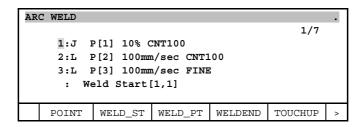


Fig.3.9 (b) Setup of Override

⚠ 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.

4 Display the edit screen of the arc welding program created by Procedure 3-6. Press EDIT key, or press SELECT key and select the sample program name which was set by Step 4 in Procedure 3-6 (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.

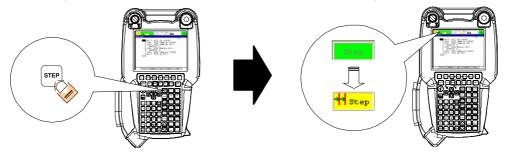


Fig.3.9 (c) Switch to Step Mode

⚠ 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.

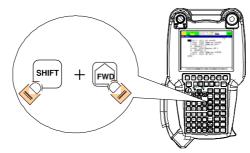


Fig.3.9 (d) Step Operation of Program

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.

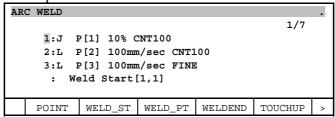
NOTE

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

Procedure 3-9 (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.

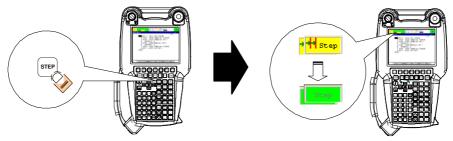


Fig.3.9 (e) Switch to Continuous Operation Mode

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

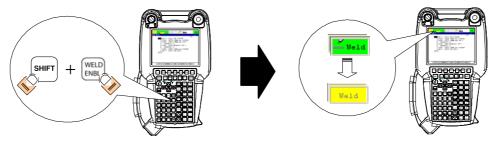


Fig.3.9 (f) Switch to Weld Disabled

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

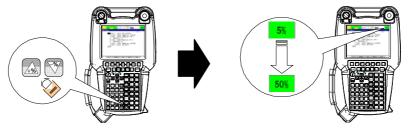


Fig.3.9 (g) Setup of Override

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.

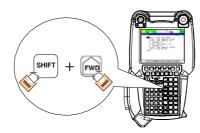


Fig.3.9 (h) Continuous Execution of Program

3.10 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 3-10.

Procedure 3-10 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.

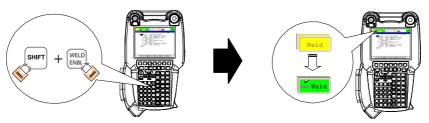


Fig.3.10 (a) Switch to Weld Enabled

2 Set 100% override by override key.



Fig.3.10 (b) Set 100% Override

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

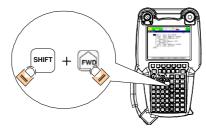


Fig.3.10 (c) Continuous Operation of Weld Program

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

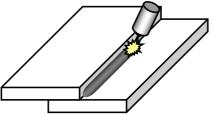


Fig.3.10 (d) Execution of Arc Welding

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 describe about ROBOWELD *i*C series basic operation except contents which are already described in Chapter 3 "QUICK REFERENCE".

4.1 SETTING OPERATION OF ArcLink I/O

Robot controller and LINCOLN welding power supply perform digital communication by special communication method called "ArcLink".

The assignment of Arclink signals must be set correctly. When the assignment is incorrect, welding can not be executed correctly. Normally, no setting is required because the Arclink I/O is automatically set at the first communication between the robot controller and the welder.

Please take care not to assign the Arclink I/O incorrectly when the Arclink I/O assignment is changed. Also, please take care it when the Arclink I/O assignment is shifted after adding other communication board (DeviceNet board, CC-Link board etc.).

This section explains the procedure to confirm the correct assignment of Arclink I/O and the procedure to change the assignment of Arclink I/O.

4.1.1 Detail of ArcLink I/O

The state of each Arclink I/O signals can be confirmed in the Weld I/O screen. And the assignment range of Arclink I/O can be confirmed / modified on the Digital I/O screen because the Digital I/O signals are used for Arclink I/O.

Normally, the assignment range of Arclink I/O is automatically set. Though the Arclink I/O is assigned in the range of [21-36] in the Fig. 4.1.1 (b), the assignment range is changed corresponding to the configuration of the I/O hardware. As the result, the assignment range is different in every case.

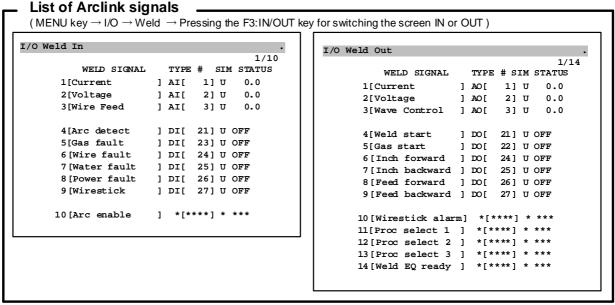


Fig. 4.1.1 (a) Weld I/O screen

Assignment range of Arclink I/O (MENU key \rightarrow I/O \rightarrow Digital \rightarrow F2:CONFIG key \rightarrow Press F3:IN/OUT key for switching the screen IN or OUT) I/O Digital Out I/O Digital In 1/3 1/3 RACK SLOT START STAT. RANGE START STAT. 2 DI[21- 361 90 21- 361 1 ACTIV ACTIV 1 OC 90 DI[37-512] 37- 5121 D0[0 UNASG

Fig. 4.1.1 (b) Digital I/O assignment screen

A 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.

NOTE

Such WI / WO signals are not used because ArcLink is digital communication. Actually, analog signals are not used. Though [AI] and [AO] are displayed in the Weld In/Out screen, those are common notation with the conventional welder.

4.1.2 Confirm the Correct Assignment Range of ArcLink I/O

At the stage of the system start-up, there are opportunities that the I/O assignment is changed or communication board is newly added. At that time, there is a risk that the assignment of Arclink I/O is deleted or the Arclink I/O is assigned incorrectly. Therefore, please confirm whether the Arclink I/O is assigned correctly. When the Arclink I/O is assigned incorrectly, it is impossible to weld.

Procedure 4-1-2 Confirm the assignment range of Arclink I/O

Step

- 1 Press the [MENU] key and select [I/O].
- 2 Press F1 [TYPE] and select [Digital].
- 3 Press the F2[CONFIG]. Assignment screen is displayed.
- 4 Please confirm the signals assigned to RACK 90 on both IN and OUT screens.
- 5 Please confirm that the signals assigned to RACK 90 are such as the following [Example of correct assignment]. That means, there are 16 points at the RANGE field (it is not necessary to start from 153), SLOT number is 1, START number is 1.
 - Please confirm that assignment is not such as the following [Example of wrong assignment 1, 2].

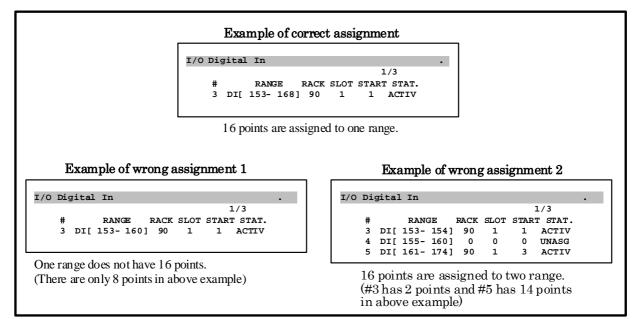


Fig. 4.1.2 Correct assignment and Wrong assignment

6 If there is not signal assigned to RACK 90 or wrong assignment is executed, please execute the [Procedure to change the assignment of Arclink I/O] in next section. After that, please execute this procedure again.

NOTE

This procedure is assumed that the system has only one weld equipment. If your system has two or more weld equipment, SLOT is 2 in the second weld equipment. RACK and START number are the same as the first weld equipment. That means, RACK is 90, START is 1. It is necessary to assign another RANGE besides the assignment of first weld equipment.

4.1.3 Procedure to Change the Assignment of ArcLink I/O

ArcLink I/O is automatically assigned to vacant range concerning to the hardware configuration at the first Cold Start timing. Therefore, for example, if DO [1] – DO [16] are not used by other hardware, ArcLink I/O is assigned to DO [1] – DO [16].

There is a case that the user would like to use DI [1] and DO [1] as the start number for other hardware (Process I/O Board, DeviceNet, CC Link, etc.). Then, if ArcLink I/O has already assigned from DI [1], please change the I/O number by the following procedure.

Procedure 4-1-3 Change the assignment of Arclink I/O

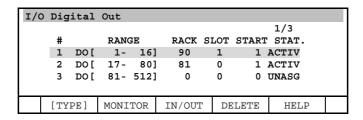
Condition

- Weld equipment power supplies are ON.
- "ARC-051 Weld EQi ONLINE: ArcLink" is displayed after Cold Start (If the message is not displayed on the top of the Teach Pendant, please confirm it by Alarm History screen).
- System variable of \$IO_AUTO_CFG is set to TRUE (This is standard setting).

Step

- 1 Press [MENU] key and select [5 I/O].
- 2 Press F1[TYPE] and select [Digital]. I/O Digital Output screen is displayed.

Press F2[ASSIGN]. The following screen is displayed. In this screen, ArcLink I/O (Rack 90) has already been assigned to DO[1] – DO[16].



- Move the cursor on the line for output signals to which rack 90 are assigned (In above example screen, it is DO [1 16]), and press F4[DELETE]. The assignment of ArcLink I/O is deleted.
- During this state, change the range, rack, and slot and start number for I/O hardware which you would like to change the assignment to desirable values. (Please perform assignment change according to each I/O hardware manuals.)
- 6 Check that the DO status of changed I/O hardware becomes [PEND]. If the status is [INVAL], range, rack or slot number etc. may have incorrect setting. Please check and correct.
- 7 Perform cycle power of the robot controller.
- 8 ArcLink I/O is automatically assigned to a vacant range of I/O.
- 9 Please perform similar settings (Step 1 7) in Digital Input screen (you can switch the display by pressing F3[IN/OUT] key when Digital Output screen is displayed.).

⚠ CAUTION

If you already set \$IO_AUTO_CFG to FALSE manually, automatic assignment of ArcLink I/O is not performed. For ArcLink I/O assignment, it is necessary to set \$IO_AUTO_CFG to TRUE.

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 that you already know.

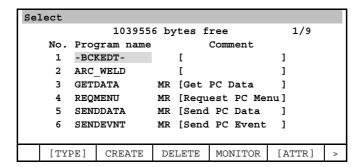
4.2.1 Selecting and Editing of Program

About the method for creating new program, procedure 3-6 "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

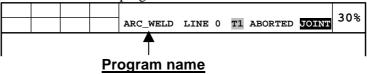
Step

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.

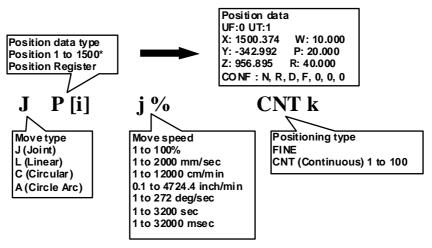


4 Press [MENU] key and select the [EDIT] from the displayed menu if you would like to display the program edit screen for currently selected. Or, press [EDIT] key.

4.2.2 Editing of Motion Instruction

About the teaching of motion instruction, procedure 3-6 "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.

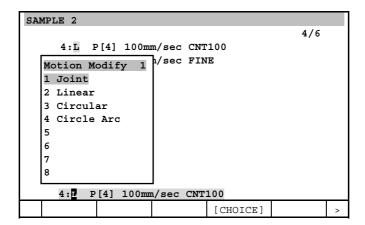
The maximum move speed differs according to robot model.

Fig. 4.2.2 Composition of motion instruction

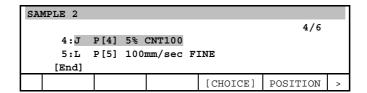
Procedure 4-2-2 Editing of motion instruction

Step

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

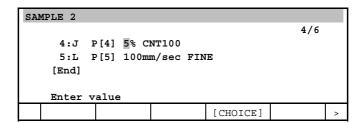


When the move type is selected from the sub menu, move type is changed. If it is changed, move speed and its unit are also changed according to the move type.

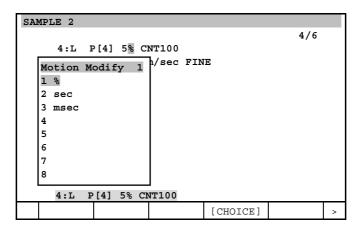


3 In case of changing position data number, move the cursor to the position data number and input new position data number.

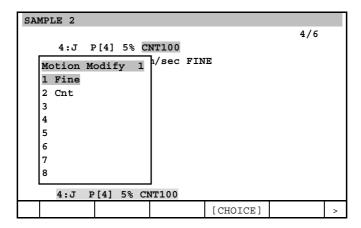
4 In case of changing move speed, move the cursor to move speed and input new value.



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.



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.



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

SAI	MPLE 2							
							4/6	
	4:J	P[4]	5% C	NT30				
	5:L	P[5]	100m	m/sec	FIN	E		
	[End]							
	Enter	value	•					
						[CHOICE]		>

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).

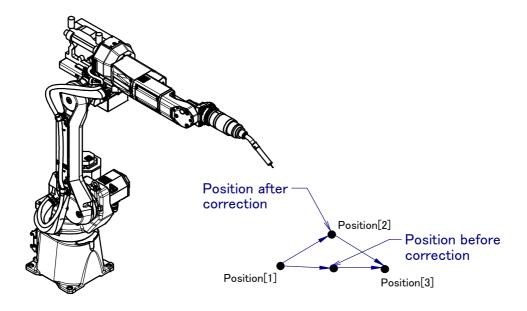
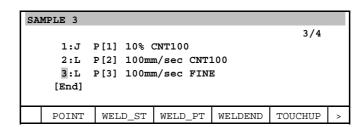


Fig. 4.2.3 Correcting a position

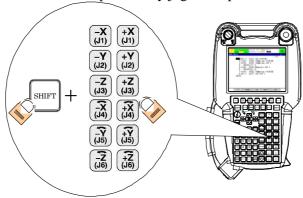
Procedure 4-2-3 (a) Correcting a position

Step

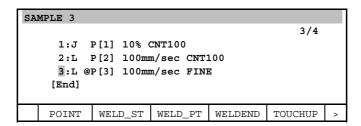
1 Move the cursor to the beginning of motion instruction line that you would like to correct.



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



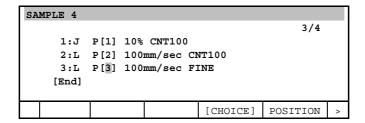
Press F5[TOUCHUP] with holding shift key. The position data in the motion instruction of current cursor position (it is P[3] in the following example screen) is modified to the current robot TCP position.



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

Step

1 Move the cursor to the position data number.

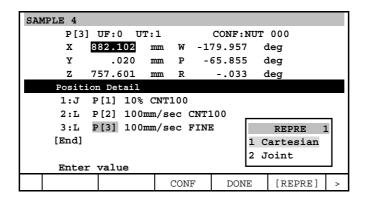


2 Press F5[POSITION] key. Sub menu for position data is displayed. In standard, the position is displayed based on the cartesian coordinate system (world coordinate system).

```
SAMPLE 4
                                CONF:NUT 000
      P[3] UF:0
          882.102
                             -179.957
                                        deg
              .020
                     mm
                         Ρ
                              -65.855
                                        deg
           757.601
                          R
                                  .033
                                        deg
     Position Detail
           P[1] 10% CNT100
           P[2] 100mm/sec CNT100
     2:L
           P[3] 100mm/sec FINE
     3:L
    [End]
     Enter value
                        CONF
                                  DONE
                                          [REPRE]
```

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).

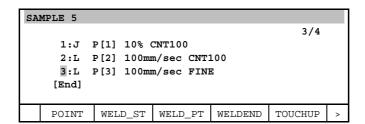
Table 4.2.4 (a) Kind of program edit instructions

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.
Сору	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.

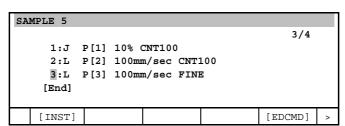
Procedure 4-2-4 (a) Insert blank lines

Step

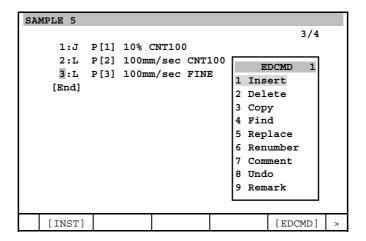
1 Move the cursor to the head of line where you would like to insert blank lines.



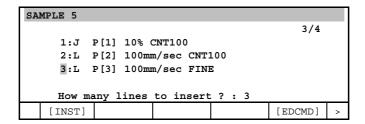
2 Press NEXT key then the next page of function key menu is displayed.



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.

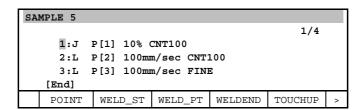


5 The number of specified blank lines are added to specified cursor position.

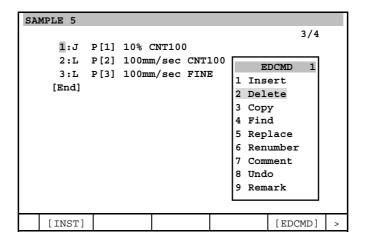
Procedure 4-2-4 (b) Delete lines

Step

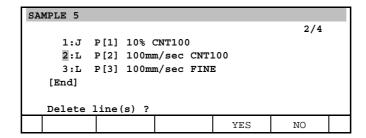
1 Move the cursor to the head of line where you would like to delete lines.



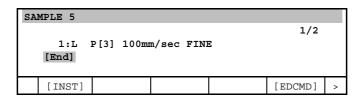
2 Perform the step 2 and 3 in procedure 4-2-4 (a) then the EDCMD menu is displayed.



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



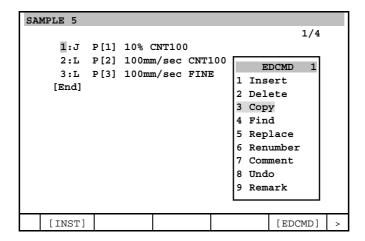
4 The specified range of lines are deleted.



Procedure 4-2-4 (c) Copy lines

Step

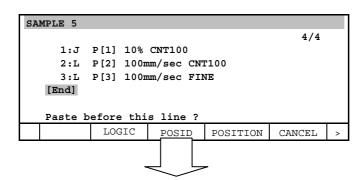
Perform the step 2 and 3 in procedure 4-2-4 (a) then the EDCMD menu is displayed. Select "Copy" from the displayed menu.



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

4 Press F5[PASTE] after moving the cursor to the position where you would like to paste.

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.



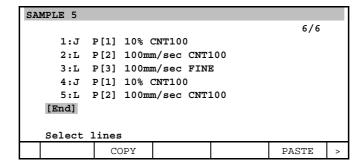


Table 4.2.4 (b) Kind of program edit instructions

	tante tier (a) tanta et program cana men accident
F2 LOGIC	The position number of pasted motion instruction becomes "" (initial state).
F2 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

In the PowerWave of welding power supply mounted to ROBOWELD *i*C series, it is possible to switch multiple "process mode". "process mode" is defined by Lincoln Electric Company. "process mode" is prepared for using different welding output characteristic according to each combination of welding methods (Short-arc, Pulse, Rapid-Arc) and wire diameter, wire material, gas. For example, process mode 22 is used in the welding configuration of [MAG welding, Steel 1.2mm, Ar-CO2 (80% - 20%) gas]. About the list of defined process mode, please refer to "APPENDIX B PROCESS MODE".

On the other hand, robot software controls the weld schedule with a unit of "Weld Procedure". One weld procedure associates to one process mode. And, one weld procedure could have multiple weld schedules.

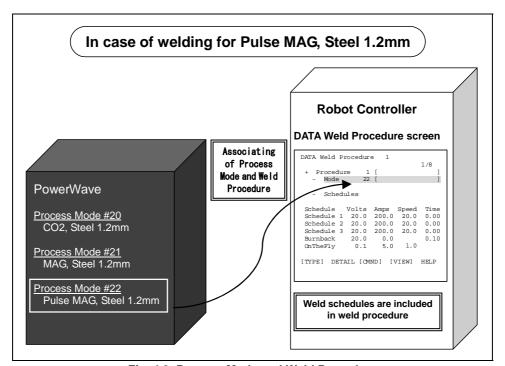


Fig. 4.3 Process Mode and Weld Procedure

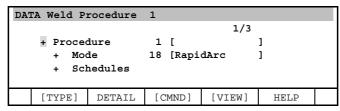
It is possible to create the weld procedure up to 20. And, one weld procedure could have weld schedules up to 32.

The new creation method of the first weld procedure is explained by Procedure 3-4. So Procedure 4-3 explains the creation method of the second or later weld procedure.

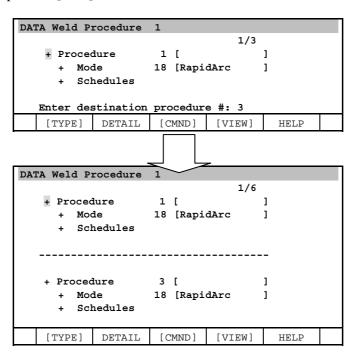
Procedure 4-3 Copy weld procedure

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.



- In case of creating another weld procedure, it is achieved by copying the existing weld procedure. Press F3[CMND] and select [Copy WP].
- The message of "Enter destination procedure #:" is displayed at prompt line. Please input the weld procedure number that you would like to create. The message of "Copy procedure i to procedure j" is displayed. Then, press F4[YES].



4.3.1 In Case of Process Mode Number is Known

When the process mode number that you would like to use is known, it is possible to input the process mode number directly in the DATA Weld Procedure screen (refer to Procedure 4-3-1). Or, it is possible to perform this method after checking the process mode number that you would like to use by referring "APPENDIX C PROCESS MODE".

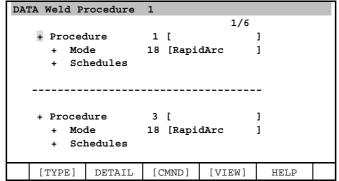
Procedure 4-3-1 Assignment of process mode number by direct input

Condition

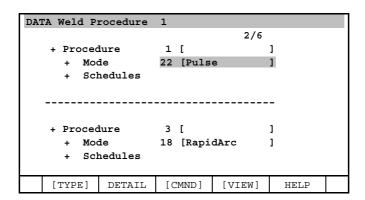
- The power supply of weld equipment is ON.
- After the power supply ON, the message of "ARC-051 Weld EQi ONLINE: ArcLink" is posted (If this message is not displayed on the top of the Teach Pendant, please confirm it by Alarm History screen.).

Step

1 Perform the step 1 - 3 in Procedure 4-3 then DATA Weld Procedure screen is displayed.



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.



4.3.2 In Case of Process Mode Number is Unknown

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.

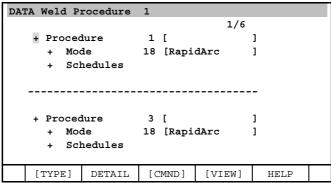
Procedure 4-3-2 Assignment of process mode number by searching

Condition

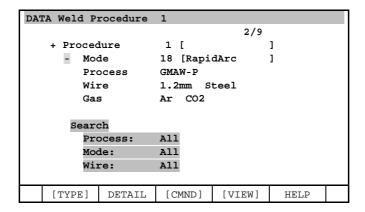
- The power supply of weld equipment is ON.
- After the power supply ON, the message of "ARC-051 Weld EQi ONLINE: ArcLink" is posted (If this message is not displayed on the top of the Teach Pendant, please confirm it by Alarm History screen.).

Step

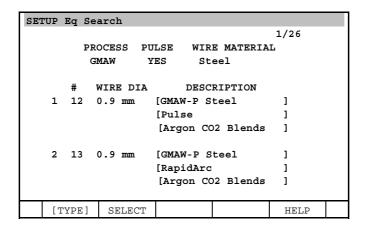
1 Perform the step 1 - 3 in Procedure 4-3 then DATA Weld Procedure screen is displayed.



2 Move the cursor to "+" in the head of "Mode" line and press ENTER key. Following "Search" setting items are displayed.



3 Set "Process", "Mode" and "Wire" items. Press F3[CMND] and select [Search] from the displayed menu. Following search result screen is displayed.



- 4 This screen is scrollable by using cursor key (up / down arrow key). When the founded process mode exists over 30, it is possible to display the search result since 30 process modes by pressing F3[MORE] 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.

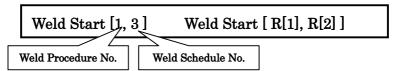
4.4 TEACHING AND EDITING OF ARC WELD INSTRUCTION

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.

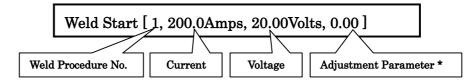
4.4.1 Arc Weld Start Instruction

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)



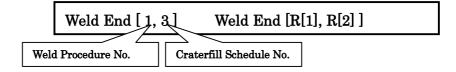
^{*} The command value such as [Wave control] enters to the adjustment parameter.

4.4.2 Arc Weld End Instruction

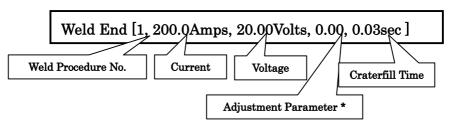
The arc welding end instruction requests to end an arc welding. When an arc welding ends, the craterfill is performed. The craterfill schedule is specified in this instruction. Craterfill is a function to avoid the crater hole generation due to a rapid voltage decrease.

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)



^{*} The command value such as [Wave control] enters to the adjustment parameter.

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.

NOTE

The number/kinds of command parameters are changed according to the specified process mode number. Therefore, you may not see the above explanation.

4.4.3 Note while Teaching Arc Weld Instruction

- Please use the FINE motion when robot moves to arc welding start position.
- Please use the linear, circular or circle arc with CNT motion when robot moves to pass point during arc welding.
- Please use the linear, circular or circle arc 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.

4.4.4 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 (Volts, Amps etc.).

Teaching procedure is shown in Procedure 4-4-4.

Procedure 4-4-4 Teaching of arc indirect instruction

Step

- Press the [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.
- 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.

DATA Weld P	roce	dure	1					
						/9		
+ Proced	+ Procedure		1 []	
+ Mod	е	2	0 [C	V]	
- Sch	edul	es						
Schedule		Volts	Am	ps	Speed	Ti	me	
Schedule	1	0.0	0	.0	0.0	0.	00	
Schedule	2	0.0	0	.0	0.0	0.	00	
Schedule	3	0.0	0	.0	0.0	0.	00	
Burnback		16.0	130	.0		0.	03	
[TYPE]	DE	TAIL	[CMI	ND]	[VIE	W]	HELP	

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

DAT	A Weld Pr	ocedure 1				
				3/7		
	1 Weld P	rocedure	1[]	
	[CV		CMAW	#20]	
	[1.2m	m Steel	CO2]	
	2 Weld S	chedule	1 [Sched	ule]	
	3 Volts:		20.00	Volts		
	4 Amps:		200.0	Amps		
	5 Wave C	ontrol:	0.0			
	6 Travel	speed:	0.0	cm/min		
	7 Delay	time:	0.00	sec		
	Feedba	ck Voltage	0.0	Volts		
	Feedback Current			Amps		
	[TYPE]	DETAIL	[CMND]	[VIEW]	HELP	

- Input commands (voltage, current, etc.). The maximum and minimum values of each parameter are different according to the selected process mode.
- 6 Input the weld schedule number to the arc indirect instruction in the TP program.

4.4.5 Teaching of Arc Direct Instruction

In arc direct instruction, you specify the weld procedure number and each command (voltage, current, etc.) directly in TP program.

Teaching procedure is shown in Procedure 4-4-5.

Procedure 4-4-5 Teaching of Arc direct instruction

Step

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.

```
TEST1 2/3

2:L P[1] 250cm/min FINE

: Weld Start [0, 0.0Amps,

: 0.00Volts, 0.00]

[End]

POINT WELD_ST WELD_PT WELDEND TOUCHUP >
```

- 2 Move the cursor to the first parameter and input the weld procedure number here.
- After inputting the weld procedure number, input commands (voltage, current, etc.). The maximum value and the minimum value of each parameter are different in each process mode.

NOTE

The input parameters are reset to 0 when you change the weld procedure number. Please input the weld procedure number first before inputting commands for each parameter.

4.5 STATUS OF ArcLink

ArcLink Status screen shows the communication status of the ArcLink. In this screen, detailed information (CAN status, firmware version of weld equipment, weld table version, ArcLink object status, etc.) is displayed. Status of Ethernet communication is also displayed when the system is ROBLWELD *i*C/H, H3 series. The method of operating the ArcLink Status screen is shown in Procedure 4-5.

STATUS 2	Arclink					
			1/3	LO		
	ink channel:	_				
1 (Comment: [***	******	*****	**]		
	CAN status:	ONL				
	Arclink status					
1	Motherboard II): -1	·			
٤	Slot ID:	0				
	CAN Xmit:	0				
(CAN Recv:	0				
(CAN Error:	0				
Arcli	ink Version					
V	Weld Controlle	er:	S28735-0	01		
7	Wire Drive:		S28626-0	02		
V	Weld Table:		Z11323	30		
Aral:	ink Object St	. .	ו ערגשם	FAUL'	r	
	ink Object Sta Weld Sequence:		255	0		
	Weld Sequencer Weld Controlle		255	0		
	Wire Drive:	ar:	255	0		
	Wile Dilve: Gas Controlle:			0		
	Sense Lead Cor	- •		-		
	Sense Lead Cor Ethernet:	mection:	0	0		
	Ethernet: Production Mor	aitor.	0	0		
, ,	PIOGUECTON MOI	iitoi:	U	U		
	rnet Port Stat					
	Port number:					
_	Robot IP:		2.168.2			
7	Weld Eq IP:	19	2.168.2	.152		
		SETTIN	G ACT	JAL		
1	Robot speed	: AUTO	100 1	Mbps		
	Robot duplex			-		
	Weld Eq speed					
	Weld Eq duples					
			[GTT 0 T ===	., [
[TYF	PE] NEXT_CH	LOCATE	[CHOICE	<u>[</u>]	HELP	

Procedure 4-5 Operation of ArcLink status screen

Step

- 1 Press the MENU]key and press 0. Then, select [4 STATUS].
- 2 Press the F1[TYPE] key and select [ArcLink]. ArcLink Status screen is displayed.
- When the display of [CAN status] is [ONLINE], the communication between the robot controller and the weld equipment is correct. When it is [OFFLINE], the communication is not established by some reasons such as no power supply of the weld equipment. When the communication error occurs, this field shows [ERROR].
- When this screen is displayed before establishing a communication, there are some items that are not displayed. In this case, please press F3[LOCATE] key after establishing a communication. The display is updated and all items are displayed.

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.

- Strike wire feed speed function
- Gas purge/ Gas pre flow function
- Runin function
- Repeat touch Retry function
- Scratch start function

This section explains overview and using method of these functions.

5.1.1 Strike Wire Feed Speed

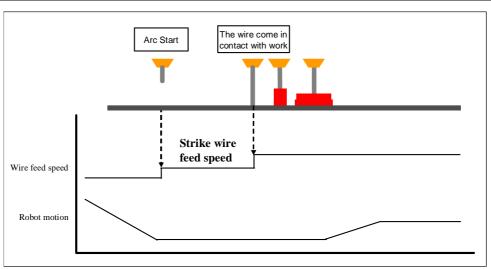


Fig. 5.1.1 Strike wire feed speed

Strike wire feed speed is the wire feed speed from the beginning of the execution of the arc start instruction to the contact of the wire to work (refer to Fig.5.1.1). Normally, it is not necessary to change strike wire feed speed from a standard value (125cm/min). ROBOWELD *i*C series can adjust the strike wire feed speed when users do not obtain arc start with enough quality.

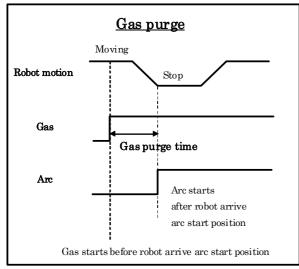
Strike wire feed speed can be defined in each weld procedure. This content is the bottom of a weld procedure screen.

DAT	TA Weld Pı	rocedure		L				•
							1/8	
	- Proced	dure		1	[]	
	Weld equipment			1				
	Manufa	acturer:		Lincoln Electric				
	Model	•		PowerWave+Enet				
	File :	name:		AWE1WP01				
	Schedules:			3				
	Runin : Burnback: Wirestick reset:			3		ENZ	ABLED ABLED ABLED	
	Gas purge: Gas preflow Gas postflow: Strike wire feed sp			ed		0.0	35 sec 00 sec 00 sec 5 cm/min	
	[TYPE]	DETAIL	[CMN	D]	[VI	EW]	HELP	

5.1.2 Gas Purge / Gas Preflow Function

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.

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.



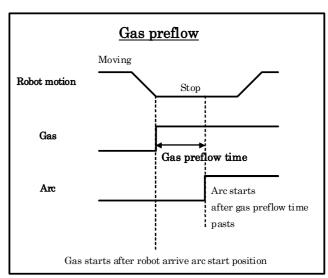


Fig 5.1.2 Timing chart of gas purge and gas preflow

Gas purge time and gas preflow time are setup in each weld procedure. When a time is zero, the corresponding function becomes disabled.

In standard 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.

Dat	ta Weld Pı	rocedure				•	
					1/8		
	- Proced	lure	1	[]		
	Weld 6	equipment	1				
	Manufa	acturer:	Li	ncoln Elec	ctric		
	Model	•	Po	PowerWave+Enet			
	File :	name:	AW.	AWE1WP01			
	Sched	ıles:	3				
	Runin	:		ENZ	ABLED		
	Burnba	ack:		ENABLED			
	Wirest	cick reset	t: 3	3 ENABLED			
	Gas pu	ırge:			35 sec		
	Gas p	reflow		0.0	00 sec		
	Gas po	ostflow:		0.0	00 sec		
	Strike wire feed sp			125	cm/min		
	[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.

5.1.3 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 voltage/current commands from welding.

The command values of the function are defined on Weld Process Setup/Weld Procedure Data screen. The command value for this function is prepared for every Process Selection/Weld Procedure.

In standard is that the function is disabled, when you would like to use it, set up the configurations with Procedure 5-1-3.

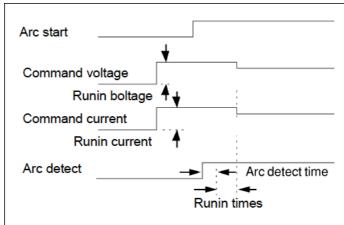


Fig. 5.1.3 Runin function

Procedure 5-1-3 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.

DAT	A Weld Pr	cocedure	1				
				1/8			
	- Procedure			[]		
	Weld 6	equipment	1	1			
	Manufacturer:			ncoln Ele	ctric		
	Model:			PowerWave+Enet			
	File name:			AWE1WP01			
	Sched	ıles:	3				
	Runin : Burnback: Wirestick reset:			ENZ	ABLED ABLED ABLED		
	[TYPE]	DETAIL	[CMND]	[VIEW]	HELP		

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

DA:	TA Weld Pı	cocedure	1			•	
				1/8			
	- Proced	lure	1	[]		
	Weld equipment			1			
	Manufacturer:			ncoln Elec	ctric		
	Model:			PowerWave+Enet			
	File n	name:	AW)	AWE1WP01			
	Sched	ıles:	3	3			
	Runin	-		ENZ	ABLED		
	Burnba	ack:		ENA	ABLED		
	Wirestick reset:			ENZ	ABLED		
	[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 Pr	cocedure	1			•
				7/12	
+ Mod	le .	22	[Pulse]	
- Sch	edules				
Schedule #	Amps	Volts	Speed	Time	
Runin	200.0	20.0		0.00	
Schedule	1 0.0	0.0	20.0	0.00	
Schedule	2 0.0	0.0	20.0	0.00	
Schedule	3 0.0	0.0	20.0	0.00	
Burnback	130.0	16.0		0.03	
Wirestick	200.0	20.0		0.10	
OnTheFly	5.0	0.1	1.0		
[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.

5.1.4 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.

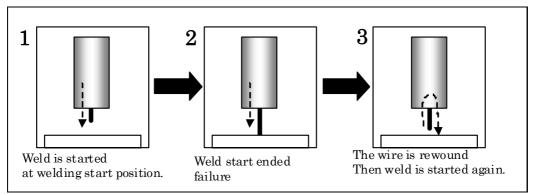


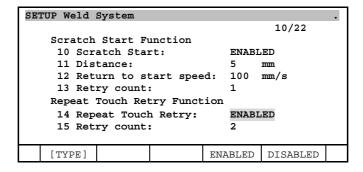
Fig.5.1.4 Repeat Touch Retry Function

In standard, Repeat Touch Retry is enabled and retry count is 2. The following procedure 5-1-4 shows the setup procedure of Repeat Touch Retry function.

Operation 5-1-4 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.



- 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.

5.1.5 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.

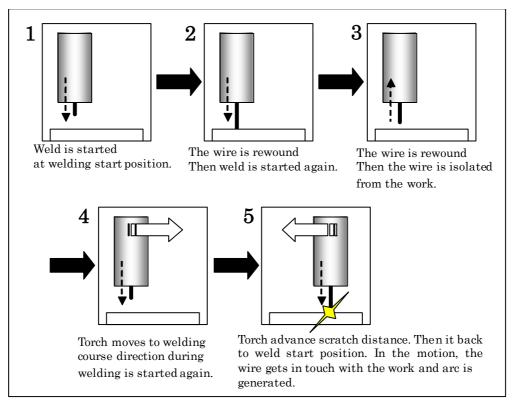


Fig. 5.1.5 Scratch start function

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 standard is that scratch start is enabled, scratch distance is 7 mm and scratch return speed is 50 mm/sec. Retry count is 1. **Those settings support various welding from thin metal welding to heavy welding.**

The following procedure 5-1-5 shows the setup procedure of scratch start function.

Procedure 5-1-5 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 Over lap 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		

- 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.

ACAUTION

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.

- Wire burnback function
- Wirestick detect/reset function
- Gas end flow / post flow function

This section explains overview and using method of these functions.

5.2.1 Wire Burnback

ROBOWELD *i*C series requires wire burnback process to adjust the head of wire at weld ending. If the process is unable to function normally, wire will be stick to a work at weld ending or t the head of wire becomes spherically and creates an adverse result to the next welding.

In the standard is that the function is enabled, so wire burn back process is executed every weld ending.

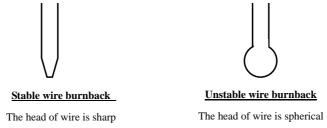


Fig. 5.2.1 Effect of wire burn back

The following values are factory default values of wire burnback for ROBOWELD *i*C series.

- Voltage:16V
- Current:130A
- Delay time: 0.03 sec

When you do not obtain the enough burnback quality by the above-mentioned standard value, please bring the command values (voltage, current, WFS and Trim) close to the weld schedule value in arc welding. When the amount of burn is too large, please shorten the delay time.

The confirmation of wire burnback is enabled or not is described in Procedure 5-2-1 (a). The adjustment of it is described in Procedure 5-2-1 (b).

Procedure 5-2-1 (a) Confirmation of wire burnback is enabled/disabled

Step

- 1 Press DATA key and press F1[TYPE] and select "Weld Procedure".
- Move cursor to "+" on the top of "Procedure" line and press ENTER key. The following screen is displayed.

Dat	a Weld Pı	cocedure	1			•	
				1/8			
	- Procedure			[]		
	Weld 6	equipment	1				
	Manufa	acturer:	Li	ncoln Ele	ctric		
Model:			Por	PowerWave+Enet			
	File name:			AWE1WP01			
	Sched	ıles:	3				
	Runin	•		ENZ	ABLED		
	Burnback:			ENZ	ABLED		
	Wires	tick rese	t: 3	ENZ	ABLED		
	[TYPE]	DETAIL	[CMND]	[VIEW]	HELP		

3 Check "Burnback" is enabled. If it is disabled, move cursor on the it and press F4 "ENABLE".

CAUTION

Normally, do not set burnback to disabled and the process time to zero. If the process isn't executed, wire may burst.

Procedure 5-2-1 (b) Adjustment of wire burnback schedule

Step

- 1 Press DATA key and press F1[TYPE] and select "Weld Procedure".
- 2 Move cursor on "Schedules" in the weld procedure and press ENTER key. The following screen is displayed.

DAT	TA Weld Pr	cocedure	1			•
					1/8	
	+ Mode	е	22	[Pulse	1	
	- Sch	edules				
Sc	chedule #	Amps	Volts	Speed	Time	
Sc	chedule 1	0.0	0.0	0.0	0.00	
Sc	chedule 2	0.0	0.0	0.0	0.00	
Sc	chedule 3	0.0	0.0	0.0	0.00	
Βι	ırnback	130.0	16.0		0.03	
W	Wirestick 200.0		20.0		0.10	
	[TYPE]	DETAIL	[CMND]	[VIEW]	HELP	

3 Change the command in "Burnback" if necessary.

5.2.2 Wire Stick Detect/Rest Function

WIRE STICK DETECT FUNCTION

Wire Stick Detect Function is the function that a weld equipment judges whether the wire is fixed or not during arc end (the timing of the execution of Arc End instruction, or pause the program during welding). When the robot is moved even if a wire have stuck, the weld torch or a fixture may be bent. To prevent it, Wire Stick Reset is executed automatically or the following alarm occurs when wire stick is detected.

ARC-011 STOP.L Wire stick, not reset

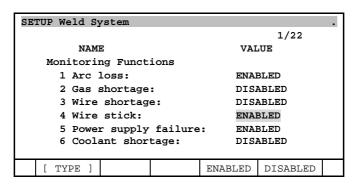
The function always enable when except ROBOWELD *i*C/E series is selected and always disable when ROBOWELD *i*C/E series is selected because ROBOWELD *i*C/E series doesn't support wirestick detect function.

Procedure 5-2-2 (a) shows how to change the enabling/disabling Wire Stick Detect Function.

Procedure 5-2-2 (a) Enabled/Disabled wire stick detect function

Step

- 1 Press [MENU] key. and select "6. Setup".
- 2 Press F1[TYPE] key and select "1,. Weld System". the following screen is displayed.



Move the cursor on "4. Wire stick", when it becomes enabled, press F4 "ENABLED", on the other hand, when it becomes disabled, press F5 "DISABLED"

Auto Wire Stick Reset Function

If a wire stick occurs at the end of welding, this function burns off the stick by applying a voltage for a fraction of a second.

You can set the total number of wire stick reset tries, commanded parameters and processing time to output. If a wire stick is detected again after wire stick reset, a wire stick reset is repeated. As a result, if wire stick is reset, the program execution is continued. After a wire stick reset is repeated a specified number of reset tries, if a wire stick is still detected, a weld alarm is posted and a robot motion is stopped.

ARC-012 STOP.L Wire stick reset(s) failed

The relation between Wire Stick Detect Function and Auto Wire Stick Reset Function are described in Fig. 5.2.2. The setup procedure for Auto Wire Stick Reset Function is described in Procedure 5-2-2 (b).

In the standard is that the function is enabled except ROBOWELD *i*C/E series. But when wirestick detect function is disabled, the function is never operated even if it is enabled.

Both of enable/disable the function and schedule are setup in each weld procedure.

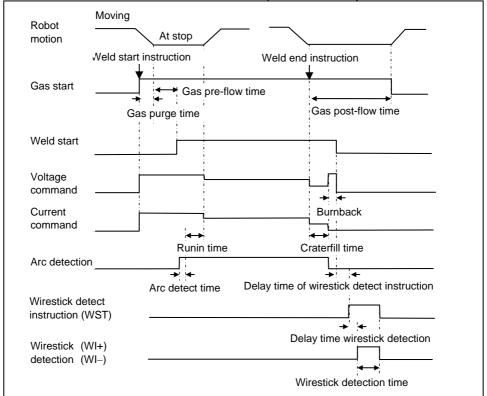


Fig 5.2.2 Wire stick detect and reset sequence

Procedure 5-2-2 (b) Setup Auto Wire Stick Reset Function

Condition

• Wire stick detect function is enabled.

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 ENTER key.
- Move the cursor on "Wire stick reset", when it becomes enabled, press F4 "ENABLED", on the other hand, when it becomes disabled, press F5 "DISABLED"

DA'	TA Weld Pı	rocedure	1			•	
				1/8			
	- Procedure			[]		
	Weld 6	equipment	1				
	Manufacturer:			ncoln Ele	ctric		
	Model:			PowerWave+Enet			
	File name:			AWE1WP01			
	Schedules:						
	Runin	•		ENZ	ABLED		
	Burnback:			ENZ	ABLED		
	Wirestick reset:			ENZ	ABLED		
	[TYPE]	DETAIL	[CMND]	[VIEW]	HELP		

The left content of enabled/disable of the function is setup the retry count of the function. it retry for up to 3 times.

5 Next, setup wirestick reset schedule. Move cursor on "Schedules" in the weld procedure and press ENTER key. The following screen is displayed.

DAT	TA Weld Pi	rocedure	1			•
					1/8	
	+ Mod	e	22	[Pulse]	
	- Sch	edules				
Sc	chedule #	Amps	Volts	Speed	Time	
Sc	chedule 1	0.0	0.0	0.0	0.00	
Sc	chedule 2	0.0	0.0	0.0	0.00	
Sc	chedule 3	0.0	0.0	0.0	0.00	
Вι	urnback	130.0	16.0		0.03	
W	Wirestick 200.0		20.0		0.10	
	[TYPE]	DETAIL	[CMND]	[VIEW]	HELP	

6 Move the cursor on Wirestick in the schedules and change the command if necessary.

Treatment of Wire Stick State

When a wire sticks, Wire Stick Reset (Weld Equipment Setup Screen) is performed. But there is a case that wire still sticks after Auto Wire Stick Reset. Then, ARC-012 is posted.

When wire has still stuck after pressed alarm reset key, the following alarm occurs. The severity of the alarm is STOP.L, so you cannot perform program execution during wire stick.

ARC-030 STOP.L Wire stick is still detected

In this case, it is necessary to cut the wire by yourself. After you cut the wire, press alarm reset key and check that ARC-030 doesn't occur.

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

Procedure 5-2-2 (c) 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 alarm 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, <u>once press alarm reset key.</u> 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 5-2-2 (d).

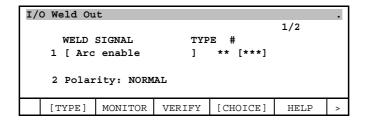
Procedure 5-2-2 (d) Assignment of wire stick alarm output signal

Step

- 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.
- When Weld Input screen is displayed, press F3 "IN/OUT".
- 3 Move cursor on "Wirestick alarm".

I/O	Weld (Out							•
							10/14		
2	[Curr	ent]]OA	2]	υ	0.0		
3	ſ₩ave	Control	1	ТΟД	31	υ	0.0		
	•		-		-				
4	[Weld	start	1	10d	11	U	OFF		
	•	start	-	10d	-	-	OFF		
	-	forward	-	-	-	-	OFF		
	-	backward	_	_	_	-	OFF		
	-		_	_	_	-			
	-	forward	_	_	_	U	OFF		
9	[Feed	backward]	DO[7]	U	OFF		
10	[Wire	stick ala	arm]	[*	***]	*	***		
['	TYPE]	HELP	IN	OUT				·	>

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.

5.2.3 Gas End Flow / Post Flow Functions

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.

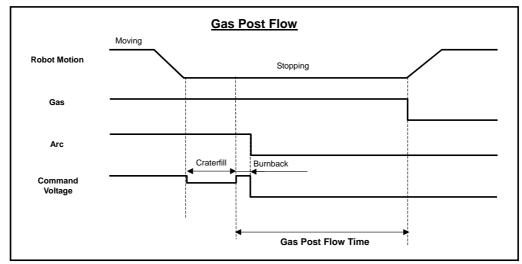


Fig 5.2.3 Timing Chart of Gas Post Flow

Robot stops until finishing gas post flow, so the setup of gas post flow time influences the cycle time. As Fig 5.2.3, 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.

Dat	ta Weld Pı	rocedure					•
						1/8	
	- Proced	iure	1	[]
	Weld e	equipment	1				
	Manufa	acturer:	L:	incoln	Elec	ctric	
	Model	•	Po	owerWa	ve+E1	net	
	File n	name:	Α	WE1WP0	1		
	Sched	ıles:	3				
	Runin	:			ENZ	ABLED	
	Burnba	ack:			ENA	ABLED	
	Wirest	cick reset	t: 3		ENZ	ABLED	
	Gas pı	ırge:			0.3	35 sec	
	Gas p	reflow			0.0	00 sec	
	Gas postflow:				0.0	00 sec	
	Strike wire feed spe				125	5 cm/mi	n
	[TYPE]	DETAIL	[CMND]	[VI	EW]	HELP	

5.3 OTHER FUNCTION RELATED TO ARC WELDING

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

- Return to Path Function
- Remote Gas Purge Function
- Remote Wire Inching Function

- Monitoring Functions
- Weld External Output Function
- Torch Guard Function
- Torch Mate Function
- Arc Abnormal Monitor Function
- Arc Welding Analogue Meter Displaying Function
- Touch Sensing Function

5.3.1 Return to Path Function

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.

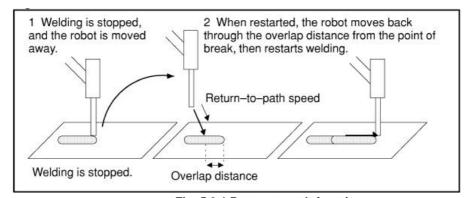


Fig. 5.3.1 Return to path function

In 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 standard 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.

ACAUTION

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

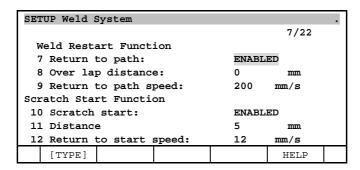
Overlap distance is used only when a program is stopped during welding motion. When robot restart with weld disabled or the program is stopped without welding, the distance is ignored.

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.



- Move the cursor to [7 Return to pass]. 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 pass speed] if necessary.

5.3.2 Remote Gas Purge Function

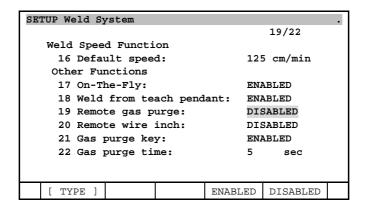
Remote gas purge function is the function to execute the gas purge by the external input signal. When you use this function, gas check can be executed without teach pendant.

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

Procedure 5-3-2 Setup Remote Gas Purge Function

Sten

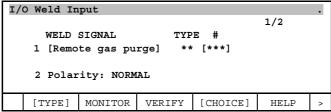
1 Press [MENU] key and select "6. Setup". and press F1[TYPE] key and select "Weld System", Weld System Setup screen is displayed. Move a cursor to the bottom and then the following screen will be displayed.



- Move cursor on "Remote gas purge", when it needs to be enabled, press F4 "ENABLED" when it needs to be disabled press F5 "DISABLED".
- 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/C) We	ld In	out							•
								11/	15	
	4	[Arc c	letect	J	DI[1]	U	OFF		
	5	[Gas f	ault]	DI[3]	U	OFF		
	6	[Wire	fault]	DI[4]	U	OFF		
	7	[Water	fault]	DI[5]	U	OFF		
	8	[Power	fault]	DI[6]	U	OFF		
	9	[Wires	stick]	DI[7]	υ	OFF		
		_			_					
	10	[Arc e	enable]	**[*	***]	*	***		
	11	[Remot	e gas pu	rge]	**[*	***]	*	***		
	[T	YPE]	HELP	IN	OUT	(N		OFF	>

- 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
- 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.
- 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 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

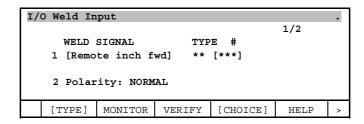
1 Press [MENU] key and select "6. Setup". and press F1[TYPE] key and select "Weld System", Weld System Setup screen is displayed. Move a cursor to the bottom and then the following screen will be displayed.

SETUP Weld System	•
	20/22
Weld Speed Function	
16 Default speed:	100 cm/min
Other Functions	
17 On-The-Fly:	ENABLED
18 Weld from teach penda	ant: ENABLED
19 Remote gas purge:	DISABLED
20 Remote wire inch:	DISABLED
21 Gas purge key:	ENABLED
22 Gas purge time:	5 sec
[TYPE]	ENABLED DISABLED

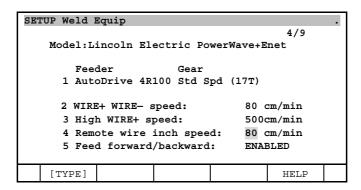
- 2 Move cursor on "Remote wire inching", when it needs to be enabled, press F4 "ENABLED".
- Next, assign the input signal. Press [MENU] key and select "5 I/O" and Press F1[TYPE] key and select "Weld". Either Weld Input screen or Weld Output screen is displayed.
- 4 When Weld Output screen is displayed, press F3[IN/OUT] and change to Weld Input screen.

```
I/O Weld Input
                                        11/16
                        ] DI[
     [Arc detect
                                11 U
                                       OFF
      [Gas fault
                        ] DI[
                                3] U
                                       OFF
      [Wire fault
                        ] DI[
                                       OFF
      [Water fault
                        ] DI[
                                5] U
                                       OFF
      [Power fault
                                6] U
                        ] DI[
                                       OFF
      [Wirestick
                        ] DI[
                                71 U
                                       OFF
   10 [Arc enable
   11 [Remote inch fwd]
      [Remote inch bwd ]
    [TYPE]
              HELP
                       IN/OUT
```

- 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.



- 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. Selected signals are allocated after cycle power.
- 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 in step 2. Input the speed of remote wire inching.
- 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 5.2.2 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 standard in that this function is enabled with ROBOWELD *i*C series. 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.

SETUP Weld System			•
		1/22	
NAME	VAI	.UE	
Monitoring Functions			
1 Arc loss:	ENZ	ABLED	
2 Gas shortage:	DISABLED		
3 Wire shortage:	DISABLED		
4 Wire stick:	ENZ	ABLED	
5 Power supply failure	: ENZ	ABLED	
6 Coolant shortage:	DIS	SABLED	
	•		
[TYPE]	ENABLED	DISABLED	

- Move cursor on "Arc Loss". When it needs to be enabled, press F4 "ENABLED" when it needs to be disabled press F5 "DISABLED".
- 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.
- Move cursor to the bottom and "Arc loss error time" will be appeared.

SET	SETUP Weld Equip .						
		6/8					
	3 Remote wire inch speed:	: 80 cm/min					
	4 Feed forward/backward:	ENABLED					
	Timing						
	5 Arc start error time:	1.40 sec					
	6 Arc detect time:	0.005 sec					
	7 Arc loss error time:	0.25 sec					
	8 Gas detect time:	0.05 s					
	[TYPE]	HELP					

- 6 In the standard is that the time is 0.25 sec, change the command if necessary.
- 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 with ROBOWELD *i*C series. Normally, please use it with enabled.

Gas, Wire, Coolant Shortage Detect

ROBOWELD *i*C series do not support these functions 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. ROBOWELD *i*C series are 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, theisdelay 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.

ACAUTION

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.

ACAUTION

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

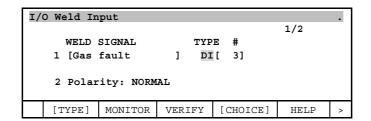
- 1 Press [MENU] key and select [6 SETUP].
- 2 Press F1 [TYPE] and select [Weld System]. The following screen is displayed.

SETUP Weld System				•
			2/22	
NAME		VAI	UE	
Monitoring Function	ons			
1 Arc loss:		ENZ	ABLED	
2 Gas shortage:		DI	SABLED	
3 Wire shortage	:	DISABLED		
4 Wire stick:		ENABLED		
5 Power supply	failure	: ENZ	ABLED	
6 Coolant short	age:	DI	SABLED	
		1	1	
[TYPE]		ENABLED	DISABLED	

- 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.

I/C	Weld In	put							•
							5/16		
	4 [Arc	detect]	DI[1]	υ	OFF		
	5 [Gas	fault]	DI[3]	U	OFF		
	6 [Wire	fault]	DI[4]	U	OFF		
	7 [Wate:	r fault]	DI[5]	υ	OFF		
	8 [Powe:	r fault]	DI[6]	U	OFF		
	9 [Wire	stick]	DI[7]	υ	OFF		
	10 [Arc	enable]	[*	***]	*	***		
	[TYPE]	HELP	IN	OUT	(N	OH	FF	>

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.

SET	SETUP Weld Equip .					
					8/8	
	3 Remo	ote wire	inch spee	d: 80 c	m/min	
	4 Fee	d forward	/backward	: ENAE	BLED	
	Timing					
	5 Arc	start er	ror time:	1.40) sec	
	6 Arc	detect t	ime:	0.00)5 sec	
	7 Arc	loss err	or time:	0.25	sec	
	8 Gas detect time:)5 ຮ	
	[TYPE]				HELP	

You can output the gas, wire and coolant shortage state to external as digital signal. Please refer to [5.3.6 External Output Function for Weld Signals] and setup.

5.3.5 Setting for Wire Clamp Function

When your system uses a welding torch with wire clamp mechanism, it is possible to control the wire clamping ON and OFF automatically by enabling this function. The outline of this function is shown below.

- Wire clamping ON/OFF is controlled by RO[1](Robot Output I/O).
- Wire clamping becomes OFF at power ON.
- When wire inching operation is started, wire clamping automatically becomes OFF. After that, inching starts.
- When wire inching operation is finished, inching stops. After that, wire clamping automatically becomes ON.
- If welding program is executed with wire clamping ON, wire clamping automatically becomes OFF when arc start instruction is executed.
- Wire clamping does not become ON when welding program ends.
- It is possible to control the wire clamping ON/OFF by manual operation. When you change the RO[1] to ON, wire clamping becomes ON. When you change the RO[1] to OFF, wire clamping becomes OFF
- Wire clamp mechanism is operated by air. Supply 015 0.49MPa air to the air inlet of the robot J1 base back side.

Procedure 5-3-5 Setting for Wire Clamp function

Step

- 1 Press the [MENU] key and press 0. Then, select [6 SYSTEM].
- 2 Press the F1 [TYPE] key and select [Variables]. SYSTEM Variables screen is displayed.
- 3 Move the cursor to \$AWECUSTOM and press ENTER key.
- 4 Move the cursor to weld equipment number that controls the wire clamp mechanism and press ENTER key.
- 5 Move the cursor to \$WIRE_CLAMP and press ENTER key.
- 6 Move the cursor to \$ENABLE and press F4 [TRUE] key. Confirm that the value is changed to TRUE.
- 7 Cycle power.

NOTE

Do not execute wire clamp when wire is not inserted. It causes damage of parts.

5.3.6 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 5.3.6 shows setup items on this screen and the explanation. Setup procedure of this function is shown in Procedure 5-3-6 (a).

I/O Weld External Output		
		1/8
SIGNAL	INPUT	OUTPUT
1 Arc enable	*****	DO[0]
2 AS failed	*****	DO[0]
3 Arc loss	*****	DO[0]
4 Power fault	*****	DO[0]
5 Gas fault	DI[27]	DO[0]
6 Wire fault	DI[28]	DO[0]
7 Water fault	DI[29]	DO[0]
8 Touch detect	DI[26]	DO[0]
[TYPE]		HELP

Table 5.3.6 weld signals and the explanation

	Table 5.3.6 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.
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. At ROBOWELD iC series, 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 5-3-6 (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		
		1/8
SIGNAL	INPUT	OUTPUT
1 Arc enable	*****	DO[0]
2 AS failed	*****	DO[0]
3 Arc loss	*****	DO[0]
4 Power fault	*****	DO[0]
5 Gas fault	DI[27]	DO[0]
6 Wire fault	DI[28]	DO[0]
7 Water fault	DI[29]	DO[0]
8 Touch detect	DI[26]	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.

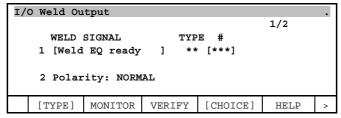
Procedure 5-3-6 (b) Assignment weld equipment ready to weld signal

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.

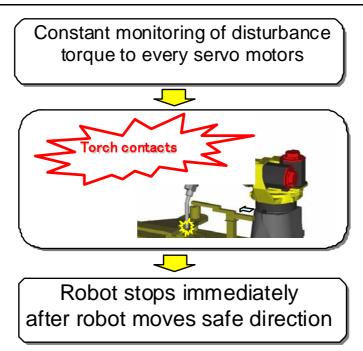
I	/(Weld O	utput								•
							11/14				
		7	[Inch	bac	kward]	DO[5]	U	OFF	
		8	[Feed	for	ward]	DO[6]	U	OFF	
		9	[Feed	bacl	kward]	DO[7		U	OFF	
		10	reed		_11_	7			*	***	
	10 [Wire stick alarm] [****] * *							* * *			
		11	[Weld	EQ :	ready]	[*	***]	*	***	
		[TYPE]	HEI	LP	IN/O	TU	0	N		OFF	>

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.

5.3.7 Touch 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 standard is that the function is enabled at ROBOWELD iC series and it isn't required some setting

5.3.8 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.

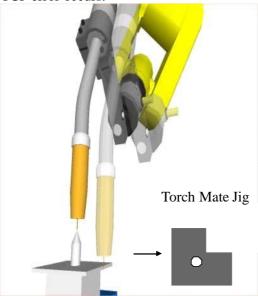


Fig. 5.3.8 Torch Mate Function

Torch Mate function requires special software and hardware. At ROBOWELD iC series, it has been installed the software, so, it isn't required an arrangement.

At hardware, torch mate jig and torch sensor circuit; detect to the wire torch the torch mate jig are required. Except ROBOWELD *i*C/E series have torch sensor circuit as standard, so it isn't required an arrangement. On the other hand, ROBOWELD *i*C/E series doesn't have torch sensor circuit, so, it requires an torch sensor circuit separately. For more details, please see "Connection and Setting for Torch Mate function in case of Invertec CV-350R" in Appendix I "I TORCH MATE SETTING OF ROBOWELD *i*C/E".

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 torch 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 5-3-8.

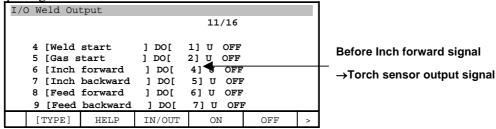
Procedure 5-3-8 Confirm port numbers of touch sensor circuit

Step

- 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.
- When Weld Output screen is displayed, press F3[IN/OUT] and change to Weld Input screen.
- 3 Torch sensor input signal is the next port of arc detect signal; The following example, DI[2] is torch sensor input signal.

I/C	4 [Arc of 5 [Gas f 6 [Wire 7 [Water 8 [Power 9 [Wires	letect ault fault fault fault] DI[] DI[] DI[5/16 1] U OFF 3] U OFF 4] U OFF 5] U OFF 6] U OFF 7] U OFF			— Next signal of arc detect signal → Torch sensor input signal
	[TYPE]	HELP	IN/OUT	ON	OFF	>	

- Press F3[IN/OUT] and change to Weld Input screen. Each analog and digital outputs are assigned correctly.
- 5 The port will be not used between gas start signal and inching forward signal. This signal will be corresponding to torch sensor output signal; In the following example, DO[3] becomes torch sensor output signal.



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

5.3.9 Arc Abnormal Monitor Function (Option)

Normally, when some bad conditions occur during arc welding, an operator needs to stand near the system, needs to check the weld conditions by an analog meter etc., and needs to chase the root cause.

Arc Abnormal Monitor Function monitors the actual current and voltage during arc welding, and it can inform the operator that some bad welding 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. 5.3.9 (b) on Teach Pendant.

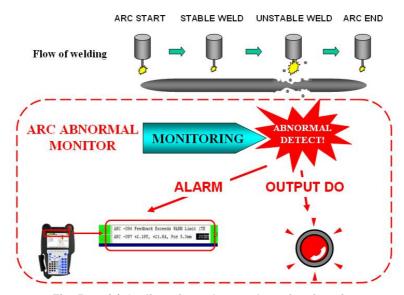


Fig. 5.3.9 (a) Outline of arc abnormal monitor function

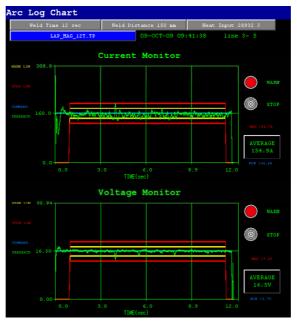


Fig. 5.3.9 (b) Arc weld log - chart function

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.

5.3.10 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.

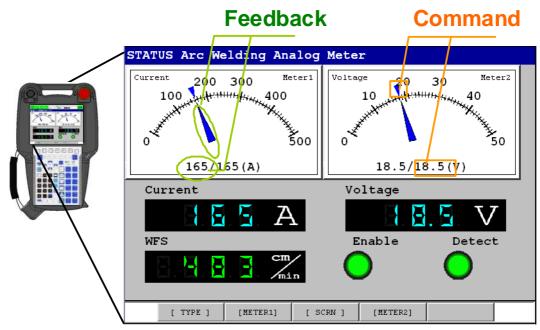


Fig. 5.3.10 Arc Welding Analogue Meter Displaying Function

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.

5.3.11 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.

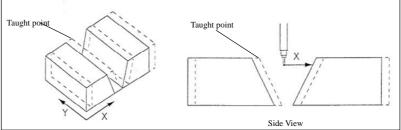


Fig.5.3.11 (a) Search motion for detecting shift of X direction

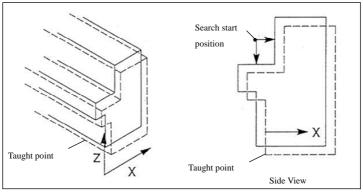


Fig.5.3.11 (b) Search motion for detecting shift of X, Z directions

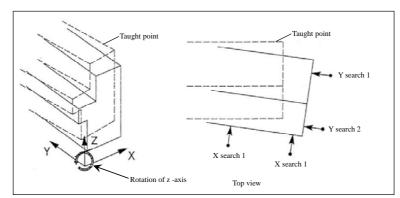


Fig.5.3.11 (c) Search motion for detecting shift of X, Y directions and Z rotation

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 ARC Welding Function OPERATOR'S MANUAL (B-83284EN-3). Please refer to it.

Assignment Torch sensor I/O

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

NOTE

I/O port numbers of torch sensor is depended on assignment range of ArcLink I/O. Be sure to confirm torch sensor port number with Procedure 5-3-8 and setup torch sensing I/O.

WELDING MACHINE INSPECTION AND MAINTENANCE

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

- For the method of inspection and maintenance of the robot mechanical section, refer to manuals below
 - ARC Mate 100iC,M-10iA, ARC Mate 100iCe,M-10iAMechanical unit operator's manual
 - : B-82754EN
 - ARC Mate 120*i*C,M-20*i*A Mechanical unit operator's manual
 - : B-82874EN
- For the robot controller, refer to manuals below.
 - R-30*i*B Controller Maintenance Manual : B-83195EN
 - R-30*i*B/Mate Controller Maintenance Manual : B-83525EN

Organization of this chapter:

- 6.1 ROUTINE INSPECTION
- 6.2 1-month (320 hours) checks
- 6.3 6-month (1920 hours) checks
- 6.4 1-year (3840 hours) checks
- 6.5 CHECKING GAS FLOW RATE
- 6.6 REPLACING CONSUMABLES
- 6.7 SIMPLE FAULT RECOVERY
- 6.8 PROGRAM BACK-UP

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	
- 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 a that cool air flows normally (from the rear to the front). (The cooling fan operates by internal temperature.)		internal inspection, additional tightening, part replacement, or other measures. Refer to the welding power supply for details	
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.	

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

1. Be sure to take enough time till discharge of capacitor completely finished. (this may take several minutes)

If voltage is present wait for capacitors to completely discharge. (this may take several minutes)

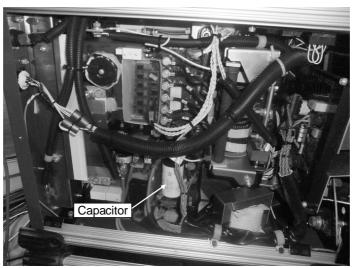
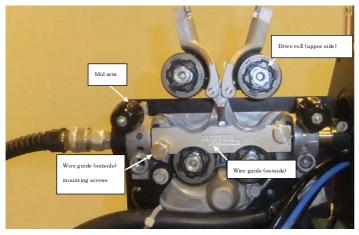
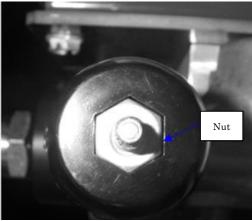


Fig.6.1.1 Capacitor discharge

6.1.2 Wire Feeder (common to Auto drive 4R100 and 4R220)

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.	





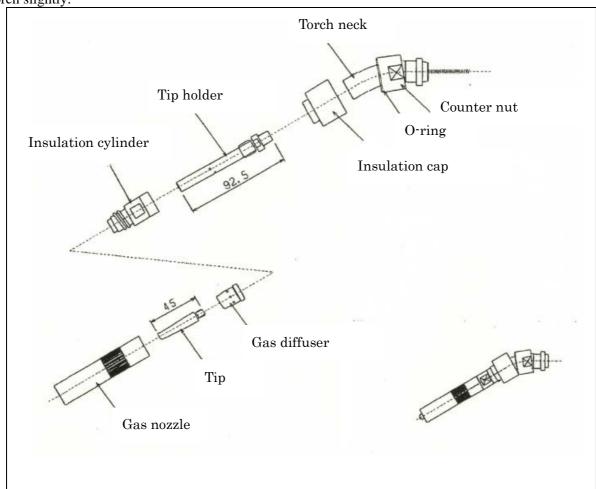
NOTE

There is a spring in the idle arm. If you remove the idle arm, remove it while putting nut of center of the idle arm.

6.1.3 Welding Torch

Figure is example of ROBOWELD iC/H 350GC -30S (air cooling). Part constitution is different by a

torch slightly.



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.)
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	Check if no gas diffuser is installed, the gas diffuser is cracked, the hole is clogged	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. O Make rough and simple checks in
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.	routine instruction. Make rough and simple checks in routine instruction. O Make detailed and through checks in periodic inspection.
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	

6.2 1-MONTH (320 HOURS) CHECKS

Item	Check items		Check points
1	Welding torch	Confirm the looseness of counter nut (In case of BINZEL torch)	In case of BINZEL torch, remove insulated cap and rubber cover referring to Subsection 9.2.5 and confirm looseness of counter nut. If it is loosen, retighten it with torque of 30Nm.

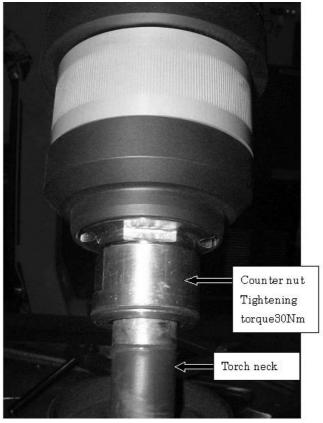


Fig.6.2 Check of counter nut

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 maintenance and check parts of LINCOLN welding power supply manual.

Item	Check items		Check points
1	Welding power	Cleaning inside the welding power supply	Perform air blow using dried air. (Note)
2	supply	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	Cleaning each parts	Perform air blow using dried air.
5	feeder (common	Check the tighten of bolts and other connection parts.	Check the looseness of torch mounting parts. and retighten the terminal of power supply parts.
6	to 4R100 and	Check the length of wire feeding	Check the length of inching is regulated degrees.
7	4R220)	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		Replace the motor brush	Replace the motor brush after 6 months operation or 250 million times of welding start (which ever comes first). If the brush is shorter than 12.7mm, replace it.
9	Welding torch	Confirm looseness of counter nut. (BINZEL torch only)	See Section 6.2.

(Note) Cleaning in the inside the welding power supply

Clean inside the welding power supply referring to maintenance section of welding power supply manual.

Remove panel of both side. In case of ROBOWELD iC/H2, then remove top plate and clean in the inside.

If there is very dirty parts, remove it using a cloth, and check whether the cable is not damaged. Internal element have a capacitor (condensers). There might be the electric shock just after turning off power. So be careful.

Minus driver (nominal 4.5x50) and box wrench (width across flats 8mm) are necessary to remove terminal of power cable.

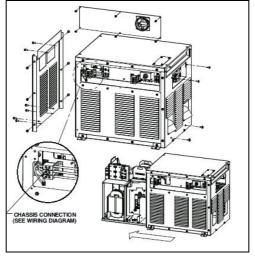


Fig.6.3 (a) Cleaning inside the welding power supply (ROBOWELD iC/H)

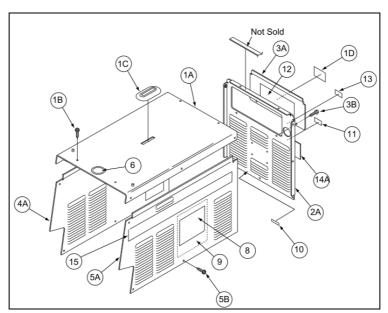


Fig.6.3 (b) Cleaning inside the welding power supply (ROBOWELD iC/H2)

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.

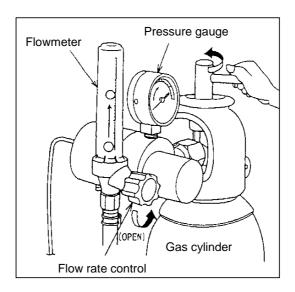
Item	Check items		Check points
1	Welding power	Cleaning inside the welding power supply	See Section 6.3.
2	supply	Confirm the damage situation of fan	See Section 6.3.
3		Check the allophone and vibration	See Section 6.3.
4	Wire	Cleaning each parts	See Section 6.3.
5	feeder	Check the tighten of bolts 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	Confirm looseness of counter nut. (BINZEL torch only)	See Section 6.3.
9		Replacing torch cable (Including conduit)	Confirm whether it is not damaged. If it is damaged, replace it to new one. (See torch cable replacement section of Chapter 9.)
10		Replacing liner	Confirm whether it is not damaged. If it is damaged, replace it to new one. (See liner replacement section of Chapter 9.)
11	Around cable	Confirm real side conduit.	Confirm whether it is not damaged. Check whether it is moderate length and bending radius is not to small.

6.5 CHECKING GAS FLOW RATE

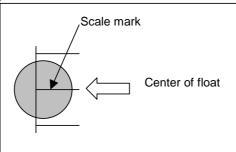
The gas flow rate is an important factor in ensuring stable arc welding. The gas flow rate can vary depending on the primary gas pressure. So, check the gas flow rate every day.

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 CO₂ gas, and 15.7 MPa for argon gas and mixed gas (CO₂ + argon).
- 2. Make a gas check from the teach pendant. Refer to [Procedure 3-8 (a) 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.



6.6 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.

6.6.1 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.

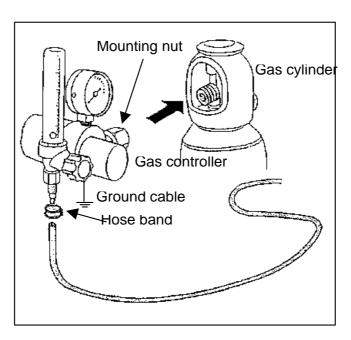
6.6.2 Gas

∱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.
- 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 Section 6.5, " CHECKING GAS FLOW RATE ".



6.6.3 Nozzle

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

- 1. Remove the nozzle.
- 2. Attach a new nozzle.

NOTE

Remember to mount a gas diffuser.

6.6.4 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.

6.6.5 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 by new one (See Subsection 9.2.3.)

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.

6.7 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.

Refer to Subsection 7.3.4 "Acquisition of All Backup" , 7.3.5 "7.3.5 Acquisition of Image Backup" or Subsection 8.4 "SAVING FILES" of R-30*i*B/R-30*i*B Mate Controller (Basic Operation) OPERATOR'S MANUAL. (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 setting of ROBOWELD iC series

ARC -022:Weld AO scaling limit used (###, i)

Cause:

The warning message is posted when the command values in weld schedules for arc instruction (or direct arc instruction) become out of range. Then, command values are clumped by upper or lower limits.

Remedy:

Set the command values within a range. The ranges for command values are different in each process mode. Therefore, if you change the assignment of process selection or process mode number, please confirm that the command values in arc instruction which uses the process mode number are not out of range. Additionally, please also confirm command values of weld processes (Burnback, Runin and Wirestick Reset) are not out of range. You can see the range for each process mode on Weld Schedule list screen.

ARC-040 EQi Missing I/O:

Cause:

When arc link I/O (welding I/O) is not allocated definitely, it occurs.

Remedy:

- 1. In the case of the "gas alarm" "wire alarm" "coolant alarm", a signal of I/O non-detection allocate these signals by manual operation in reference to Subsection 5.3.4 "Monitoring Functions". If you do not need these signals, please disable the detection function by "Procedure 5-2 Setup of Gas, Wire, Coolant Shortage Detect Function".
- 2. There is a case that only "ARC-204 Arclink ch i available" is posted but "ARC-051 Weld EQ i ONLINE: ArcLink" is not appeared with the generation of ARC-040 just after the communication establishment. In this case, \$IO_AUTO_CFG may be set to FALSE. Please set \$IO_AUTO_CFG to TRUE and perform cycle power of the robot controller. After that, ArcLink I/O will be automatically assigned and the communication will be established. If you would not like to perform auto assignment (you cannot set \$IO_AUTO_CFG to TRUE) for I/O devices (DeviceNet, Profibus etc.), please contact your local FANUC representative.
- 3. Because communication establishment with the welding power supply is never performed, there is a possibility that arc link I/O is not allocated. In reference to Appendix G.1 Weld Equipment Select", please perform communication establishment with the welding equipment.

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. This first message becomes alarm handling, but becomes the warning message after having pushed the reset.

The arc welding cannot be carried out during message indication, but the operation of the robot is possible.

Remedy:

- 1. Please confirm that the welding equipment is switched on.
- 2. Please confirm that a communications cable is connected definitely. In the case of the ROBOWELD *i*C/H, H3 series, please confirm that an Ethernet cable is connected to the following port number.
 - R-30iB/ R-30iB Mate Controller has only one Ethernet port:
 R-30iB/ R-30iB Mate Controller has two Ethernet ports:
 Port 1
- 3. When connection with the welding equipment cannot be performed in the ROBOWELD *i*C/H, H3 series suddenly and cannot be restored, carry out F3 [CHECK] with a Controlled Start screen, and please reconnect it.
- 4. There is a possibility that choice of the welding equipment is not performed definitely. Please perform "Procedure 3-1 Selection of Weld Equipment (ROBOWELD *i*C/H, H3 Series Case)" in Appendix G.1 "Weld Equipment Select" for ROBOWELD *i*C/H, H3, or please perform "Procedure G-1 (b) Selection of Weld Equipment (ROBOWELD *i*C/E, H2 Series Case)" for ROBOWELD *i*C/H2 or *i*C/E to establish communication with the welding equipment.
- 5. With an ArcLink Status screen, please confirm the state of the arc link. In addition, in the case of ROBOWELD *i*C/H, H3, please confirm the Ethernet Port Status (refer to Section 4.5 "Status of ArcLink"). The Ethernet Port Status has to seem to become Fig.7.1 (Port number for R-30*i*B is 2, and for R-30*i*B Mate is 1). When the SETTING state of speed or duplex are different from 7.1 figures, please perform the two changes.
- · Move the cursor on "10 Weld Eq speed" during communication establishment with the welding equipment, and press F4[CHOICE], and please choose "10Mbps". Just after the change, please perform cycle power of the weld equipment.
- · With a system variable screen, please input "2" into \$ENETMODE[i].\$SPEED. (i becomes the port number displayed by an ArcLink Status screen). In addition, please set \$ENETMODE[i].\$FULL_DUPLEX to "TRUE". Just after the change, please perform cycle power of the robot controller.

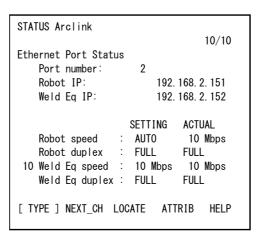


Fig.7.1 Ethernet port status

- 6. If the alarm still has been posted after performing above remedies, there is a possibility of the trouble of the control board on weld equipment. Please contact us and ask us to change the control board. After changing the control board, please perform "3.2.5 Setting When Weld Equipment Are Exchanged" (Normally the work is completed by us).
- 7. If you only would like to operate robot movement without arc welding, this message does not become the problem. Another alarm may appear when LED of "ALARM" turns on as well as this message being given when the reset is pushed. Confirm an alarm history screen and confirm the alarm, and please get rid of a cause.

ARC-046 Weld EQ communication error

Cause:

There was a communication error detected between ArcTool and the Weld Equipment.

Remedy:

- 1. Please confirm whether other alarms occur at the same time on the alarm history screen (Refer to 7.1). 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 not possible, please deal in reference to countermeasures to ARC-045.
- 3. Please confirm whether some errors of the welding power supply appears or not by referring to [7.3.2 Check of LED of Weld Equipment]. If some errors appear, please contact your local FANUC representative after checking an alarm number of the welding power supply. Additionally, please follow [7.3 REMEDY FOR TROUBLES].

ARC-47:Not allowed during a weld

Cause:

The operation that cannot be performed during a stop at one time of 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 Process i switch to j failed

Cause:

The Reshuffling of the welding process is failed. The power supply 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 Process i NOT found

Cause:

A welding mode allocated for the welding process that appointed on a welding power supply was not found.

Remedy:

Confirm whether a welding mode allocated for the welding process that appointed is a thing allocated definitely. In reference to 4-3-1 and 4-3-2 operation, allocate an appropriate welding mode number for a welding process. When it was not set a value of WP by an arc direct order, this alarm produces (when it is 0).

ARC-051 Weld EQ i ONLINE: ArcLink

Cause:

It is the message which is displayed when the communication between a robot controller and a weld equipment are established.

Remedy:

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

ARC-059 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 Weld Cmd error EQi (j, k)

Cause:

An error occurred 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 7.1). 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.
- 3. Please confirm whether some errors of the welding power supply appears or not by referring to [7.3.2 Check of LED of Weld Equipment]. If some errors appear, please contact your local FANUC representative after checking an alarm number of the welding power supply. Additionally, please follow [7.3 REMEDY FOR TROUBLES], and please report numbers in () on ARC-092 to FANUC.

ARC-093 Wire Feed Cmd error EQi (j, k)

Cause:

An error occurred sending the command to the wire feeder.

Remedy:

- 1. Please confirm whether Strike Wire Feed Speed is the very limit value against the upper or lower limits or not. For checking the upper and lower limits, please input "0" as Strike Wire Feed Speed and push Enter keys. After that, the upper and lower limits appear in () of the message like "Invalid rea. (76.000, 999.000)". If the setup value is the very limit, please adjust about +1 or -1.
- 2. Please confirm whether other alarms occur at the same time on the alarm history screen (Refer to 7.1). If other alarms occur, please execute the remedy of the alarm and after that, check that ARC-093 is also resolved.
- 3. 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.
- 4. Please confirm whether some errors of the welding power supply appears or not by referring to [7.3.2 Check of LED of Weld Equipment]. If some errors appear, please contact your local FANUC representative after checking an alarm number of the welding power supply. Additionally,

please follow [7.3 REMEDY FOR TROUBLES], and please report numbers in () on ARC-093 to FANUC.

ARC-094 Can't enter mode, EQi is OFFLINE

ARC-094 Can't SEARCH, EQi is OFFLINE

ARC-094 Can't select mode. EQi is OFFLINE

ARC-094 Can't select feeder, EQi is OFFLINE

ARC-094 Can't select gear, EQi is OFFLINE

ARC-094 Can't inch wire, EQi is OFFLINE

Cause:

Because Power Wave was in an off-line state, an alarm message was not able to perform described operation.

Remedy:

Please operate it after establishing communication with the welding power supply. When communication establishment with the welding power supply is not possible, please deal in reference to measures to ARC-045.

ARC-134 EQI E8 PM missing machine option ARC-134 EQI E9 PM missing robot option

Cause:

The message is about Lincoln Production Monitor function.

Remedy:

ROBOWELD *i*C series have not supported Lincoln Production Monitor function yet now. There is no problem when this message appears. There is no need to remedy.

ARC-200 Arclink ch i heartbeat timeout

Cause:

The Arclink bus master did not respond to a heartbeat request within the maximum time period.

Remedy:

Check the Arclink connections and the weld controller devices that are on the Arclink network.

ARC-201 WARN Arclink ch i obj #j no resp

Cause:

The message appears when the response from the weld equipment is not arrived (or late) in ArcLink communication.

Remedy:

If the message appears frequently, please perform the Remedy 4 of ARC-045. If the symptom is not recovered, please contact your local FANUC representative.

ARC-202 Arclink ch i obj #j error resp

Cause:

A device on the Arclink sent unexpected error response to a request message.

Remedy:

Check the Arclink connections and the weld controller devices that are on the Arclink network.

ARC-203 Arclink ch i reset by master

Cause:

The Arclink connection between the robot controller and the weld equipment is reset if the other PC try to connect to the weld equipment while the connection between the robot controller and the weld equipment is established. After that, the communication between the PC and the weld equipment is established.

Remedy:

You cannot operate the weld equipment from the robot controller until finishing the connection between the PC and the weld equipment. If you do not request the reset, please check the Arclink connections.

ARC-204 WARN Arclink ch i available

Cause:

When it has access to a robot controller and communication with the weld equipment, the message is displayed just before ARC-051.

Remedy:

When ARC-051 appears just after that, there is no problem. The remedy is unnecessary. When ARC-051 is not displayed after the message, please refer to Remedy 2 of ARC -040.

ARC-205 Arclink ch i h/s event lost

Cause:

The high speed event message expected during welding failed to arrive in time.

Remedy:

The Arclink network is automatically reset. If this error persists, it indicates a problem with the settings of the communications network, noise, or communication devices. Please follow the following remedies.

- 1. Perform "Remedy 5" for ARC-045. If you use ROBOWELD *i*C/H, H3, please check whether the status of Ethernet port is correct.
- 2. Check whether Ethernet cable (for ROBOWELD *i*C/H, H3) or Arclink cable (ROBOWELD *i*C/H2, E) is correctly connected to a connector. Additionally, check that Ethernet cable or Arclink cable is away from power cables. If they are touched or closed, please change the cabling and separate them.
- 3. If the communication is not solved after the above remedies, there is a possibility that one of communication devices has a trouble. If you use ROBOWELD *i*C/H, H3, change the Ethernet cable, the main board on the robot controller, and the communication board on the weld equipment sequentially. If you use ROBOWELD *i*C/H2 or E, change the Arclink cable, DN3 board, and the communication board on the weld equipment sequentially.

ARC-206 Arclink ch i too many errors

Cause:

The Arclink interface detected too many errors on the network.

Remedy:

Please perform the remedy for ARC-205.

ARC-207: Arclink ch i no bus power

Cause:

When an error in conjunction with the plural arc links occurred on a CAN bus network, this alarm is displayed. It becomes the cause that poor noise and communication is important. This alarm is also displayed when the DeviceNet board for ArcLink communication is not power supplied.

Remedy:

Confirm the connection situation of the arc link network, a communications cable.

ARC-208 Arclink ch i no nodes on bus

Cause:

The Arclink interface is not detecting any other devices on the Arclink network.

Remedy:

Check the Arclink cable connections and make sure that the welding equipment is also connected and powered on.

ARC-209 Arclink ch i bus errors

Cause:

The Arclink interface is detecting a high number of errors on the network.

Remedy:

Please perform the remedy for ARC-205.

ARC-210 Arclink ch i network flooded

Cause:

The Arclink interface is unable to send messages due to too much traffic on the network.

Remedy:

Cycle power on the robot controller and weld controller.

ARC-211 Arclink ch i comm error i

Cause:

The Arclink interface has detected a fatal error condition.

Remedy:

Check the Arclink cable connections and make sure that the welding equipment is also connected and powered on.

ARC-212 Arclink ch i CAN-Enet conflict

Cause:

On the channel which has the setting for the connection by Ethernet (ArcLink XT), the setting for the connection by DN3 board (Arclink) is also detected.

Remedy:

Change the channel for Ethernet, or change the channel for DN3 board by DIP switches, and avoid the mixed traffics on one channel.

ARC-213 XXX: Invalid Arclink I/O EQi

Cause:

The assignment of Arclink I/O is wrong.

Remedy:

Check Arclink I/O assignment on DI/DO assignment screen or AI/AO assignment screen referring to 4.1. If you only would like to jog or run programs without arc before solving this alarm, turn the weld equipment off.

7.2 TROUBLE SHOOTING AGAINST SITUATIONS

Table 7.2 Troubleshooting against some situations

_	Table 7.2 Troubleshooting against some situations			
No.	Problems	Cause	Remedy	
1	Wire inching is not made.	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. In reference to Appendix G.1 "Weld Equipment Select ", please perform communication establishment setting again.	
		A welding mode available for a welding process choosing is not assigned now (a welding mode becomes 0)	In reference to 4.3 OPERATION WELD PROCEDURE, please assign the welding mode to a welding process.	
		An idle arm does not go up	Put up an idle arm.	
	Wire feeder is not	Choice of wire feeder is not right	In reference to Appendix G.3 "SETTING OF WIRE FEEDER", please choose wire feeder.	
2	stable (Wire feeding speed is too fast or	There is a problem to idle arm or drive roll.	In reference to "6.1.2 wire feeder", please perform maintenance check of wire feeder.	
	there is allophone while wire feeding)	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.	
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. In reference to Appendix G.1 " Weld Equipment Select ", please perform communication establishment setting again.	
		The valve of the gas bomb, a gas adjustment knob do not open.	In reference to "the confirmation of 6.2 CHECKING GAS FLOW RATE ", please confirm the gas flow quantity.	

No.	Problems	Cause	Remedy
	There is much	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 4.4, select the proper weld data or weld mode number for the Arc Instruction.
4	spattering at the time of the arc start	Stick out is not reasonable.	Confirm stick out of the welding program inside, and revise it
		A ball of the wire tip that you had at the time of the welding end just before that is big	Adjust the burnback schedule referring to "5.2.1 Wire Burnback".
		Gas flow quantity is insufficient (or do not appear)	Perform a gas check in reference to 6.5 CHECKING GAS FLOW RATE, and please confirm that gas appears definitely.
5	There is much spattering at the time of the welding or an arc is unstable or is	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 4.4, select the proper weld data or weld mode number for the Arc Instruction.
	poor in welding	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".
6	At the time of the arc end, a wire explode.	Wire feeding is unstable Wire burnback/retract becomes invalid	Carry out No. 2 remedy. Please refer to "3.1.3.2 Wire Burnback" and set wire burnback function to ENABLED.
7	A ball of the wire tip to have after the arc end is big	Burnback schedule is not reasonable.	Adjust the burnback schedule referring to "5.1.2 Wire Burnback".
8	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 Arc-link I/O by automatic Arc-link assign function.	In reference to "4.1 ArcLink I/O", revise a layout of arc link I/O.
9	Welding source's LED has blinked in red.	An error occurs in the welding power supply inside	Please perform "7.3.2 Check of LED of Weld Equipment". If the problem is not recovered after cycle power of the weld equipment, please perform "7.3 REMEDY FOR TROUBLES" as possible as you can. Then, please contact your local FANUC representative.
10	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.
11	The Wire is Deposited onto the Base Metal.		Cut wire of deposited part referring to 「5.2.3. Treatment of Wire Stick State」. There is the automatic stick reset function to prevent deposit of the wire. See 「5.2.2 Auto Wire Stick Reset Function」 about this function.

No.	Problems	Cause	Remedy
12	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. Restart the robot.
13	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. Restart the robot.

7.3 REMEDY FOR TROUBLES

We gathered up the contents which would you like to go when the following troubles occurred in the ROBOWELD iC series 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
- · Welding source's LED has blinked in red

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. In condition confirmation of the LED of the welding power supply
- 3. Get ARCLINK.DG
- 4. Get all back up
- 5. Get image back up (If possible)

7.3.1 The 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 whether LECO alarm is not given. In addition, please confirm arc alarm. (The part which Arc-045, Arc-200, Arc-051 form a line, and appears is normal.)
- 6. After confirming, press F1[SCREEN] and select [alarm], return it to an original state

7.3.2 Check of LED of Weld Equipment

Please confirm a lighting state of two LED on the panel of the welding power supply. An alarm occurs in a welding power supply when it flashes on and off in red.

Please count the blinking number of times of the red LED of the welding power supply.

```
(Example 1)
Green → Red (Three times of continuation) → Some light out → red (one time)
In this case alarm number is "31".
(Example 2)
Green → Red (Three times of continuation) → Some light out → red (one time) → Green
→ Red (Three times of continuation) → Some light out → Red (Two times of continuation)
In this case alarm "31" and alarm "32" occurs at the same time.
```

7.3.3 Acquisition of ARCLINK.DG

In ROBOWELD iC series, backup data concerning the ArcLink communication can be acquired. Normally, it is not necessary to acquire ARCLINK.DG, but there is a case to acquire this data for maintaining the system.

You can save ARCLINK.DG to external devices automatically by the operation of "7.3.4 Acquisition of All Backup". The sample contents of ARCLINK.DG is the following.

```
F Number: F00000
VERSION : ArcTool
$VERSION: V7.3059
                     05/16/2007
         20-AUG-07 18:54
ArcLink Diagnostics
ArcLink Channel: 0 Bus Available: 1
Weld Sequencer Event Log
Num Cd(h) dd-mm-yy hh:mm:ss Data(h)
 1 11 20-08-07 18:23:23 0 5 11 13 = LECO- 17 Action db failed (5,17,19)
     11 20-08-07 18:21:57 0 5 11 13 = LECO- 17 Action db failed (5,17,19)
     11 20-08-07 16:47:06 0 5 11 13 = LECO- 17 Action db failed (5,17,19)
     11 20-08-07 16:45:39 0 5 11 13 = LECO- 17 Action db failed (5,17,19)
                            0 5 11 13 = LECO- 17 Action db failed (5,17,19)
     11 20-08-07
                  16:29:07
     11 20-08-07 16:24:19 0 5 11 13 = LECO- 17 Action db failed (5,17,19)
     11 20-08-07 16:10:38
                            0 5 11 13 = LECO- 17 Action db failed (5,17,19)
     11 20-08-07 16:04:46 0 5 11 13 = LECO- 17 Action db failed (5,17,19)
     11 20-08-07 16:01:20 0 5 11 13 = LECO- 17 Action db failed (5,17,19)
         20-08-07 15:59:32
                             0 5 11 13 = LECO- 17 Action db failed (5,17,19)
     11
                             0 5 11 13 = LECO- 17 Action db failed (5,17,19)
     11 20-08-07 15:58:18
 12
     11 20-08-07 15:56:37
                            0 5 11 13 = LECO- 17 Action db failed (5,17,19)
     11 20-08-07 15:27:01 0 5 11 13 = LECO- 17 Action db failed (5,17,19)
 13
     11 20-08-07 15:21:25 0 5 11 13 = LECO- 17 Action db failed (5, 17, 19)
Weld Sequencer Attributes
Num Attrib (hex) Type Name
                                                        " = "The Lincoln Electric Co."
                      "Vendor Name
              1 14
                                                        " = "i400"
 2
               2
                       "Module Model Number
                  14
                                                        " = "PowerSource Controller"
 3
                      "Module Model Name
              3
                  14
                                                        " = 0
 4
        4
              4
                  11 "Class ID
                                                         " = "Weld Sequencer"
 5
              5
                  14
                      "Class Name
```

Fig. 7.3.3 Sample of ARCLINK.DG

7.3.4 Acquisition of All Backup

Next, acquire all back up

Operation 7-3-4 is procedure of back up.

Operation 7-3-4 Acquisition of all backup

Procedure

- 1 Please place an empty memory card or USB memory in a robot controller.
- 2 Select [7 file].
- 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 backup is completed, Press F5[UTIL] and select [Set Device].then correct it at an original device.

7.3.5 Acquisition of Image Backup

If possible ,acquire image backup.

Please do not perform this during robot operation.

Operation 7-3-5 is procedure of image back up.

Operation 7-3-5 Acquisition of all Image backup

Procedure

- 1 Please place an empty memory card or USB memory in a robot controller.
- 2 Select [7 file].
- 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 You are asked "Cycle power?". Select [Yes].
- When you do OFF of a power supply and do ON ,image back up is started.(In case of R-30*i*B Mate ,turn off and on by hand.
- When backup is completed, Press F5[UTIL] and select [Set Device].then correct it at an original device
- 8 Press F5[UTIL], select [Select Device] then correct it at an original device.

SPECIFICATIONS OF WELDING POWER SUPPLY, TORCH AND PERIPHERAL DEVICES

8.1 SPECIFICATION

Table 8.1 (a) Specification of welding power supply of ROBOWELD iC/H (Power Wave i400)

ltem	Specifications
Type	CO2/MAG/MIG/Pulse MAG/Pulse MIG
Rated input voltage	AC 200 V 3 ϕ or AC 400 V 3 ϕ
Input frequency	50/60Hz
Rated input power	17.0kVA
Output current	DC 10A - 420A
Output voltage	DC 14V - 38V
Rated duty	100% at 350A (Complied with IEC60974-1)
Mass	85.5kg (200V) /95kg (400V)
Outer dimensions	W600mm × D400mm × H533mm

Table 8.1 (b) Specification of welding power supply of ROBOWELD iC/H2 (Power Wave 455M/STT)

Table 6.1 (b) openication of welding power supply of Robowello fortiz (1 ower wave 455m/611)		
Item	Specifications	
Туре	CO2/MAG/MIG/Pulse MAG/Pulse MIG	
Rated input voltage	AC208/230/460/575V, 3φ	
Input frequency	50/60Hz	
Rated input power	19.0kVA	
Output current	DC5 - 570A	
Output voltage	DC5 - 55V	
Rated duty	100% at 400A (Complied with IEC60974-1)	
Mass	133kg	
Outer dimensions	W505 x D835 x H663	

Table 8.1 (c) Specification of welding power supply of ROBOWELD *i*C/H3 (Power Wave R350)

Item	Specifications	
Туре	CO2/MAG/MIG/Pulsed	
Rated input voltage	AC 208V.230V,380-415V,460V or 575V 3φ	
Input frequency	50/60Hz	
Rated input power	17.0kVA	
Output current	DC5 - 350A	
Output voltage	DC 14V to 38V	
Rated duty	100% at 300A (Complied with IEC60974-1)	
Mass	Mass : 39kg STT module : 21kg	
Outer dimensions	Main body : W356mm × D630mm × H518mm STT module : W353mm × D645mm × H292mm	

Table 8.1 (d) Specification of welding power supply of ROBOWELD *i*C/E (Invertec CV350-R)

Item	Specifications	
Туре	CO2/MAG/Stainless MIG	
Rated input voltage	AC400V,3 φ	
Input frequency	50/60Hz	
Rated input power	13.4kVA	
Output current	DC50 - 390A	
Output voltage	DC16 - 39V	
Rated duty	60% at 350A (Complied with IEC60974-1)	
Mass	60kg	
Outer dimensions	W400 x D800 x H600	

Table 8.1 (e) Specification of wire feeder (Auto drive 4R100)

Item	Specifications
Drive roll	4 drive roll
Mass	6kg
Electrode wire	Steel or stainless ϕ 0.9,1.0,1.2

Table 8.1 (f) Specification of wire feeder (Auto drive 4R220)

Item	Specifications	
Drive roll	4 drive roll	
Mass	9.5kg	
Electrode wire	Steel or stainless ϕ 0.9 - 2.0	

Table 8.1 (g) Specification of regulator (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	Voltage	100V
device	Heating capacity	200W
performance	Power supply code	2P(2m)

8.2 EXTERNAL DIMENSIONS

External dimensions of welding power supply are showed below. Use hole for mounting bolt when transport welding power supply with palette.

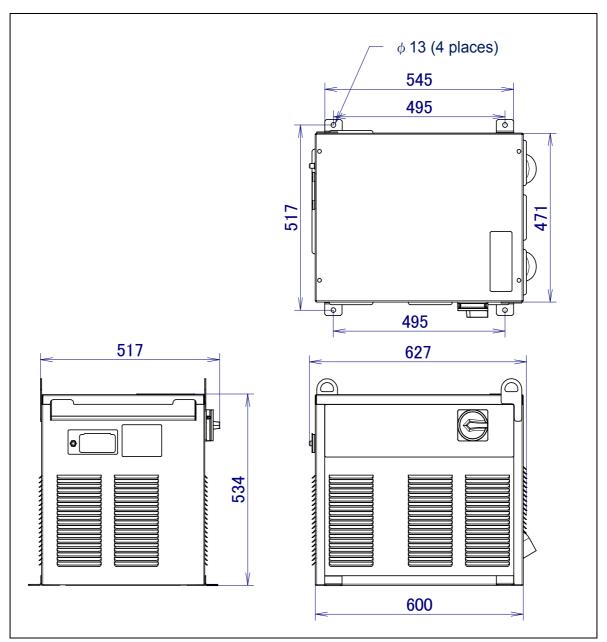


Fig. 8.2 (a) Welding power supply of ROBOWELD iC/H (Power Wave i400)

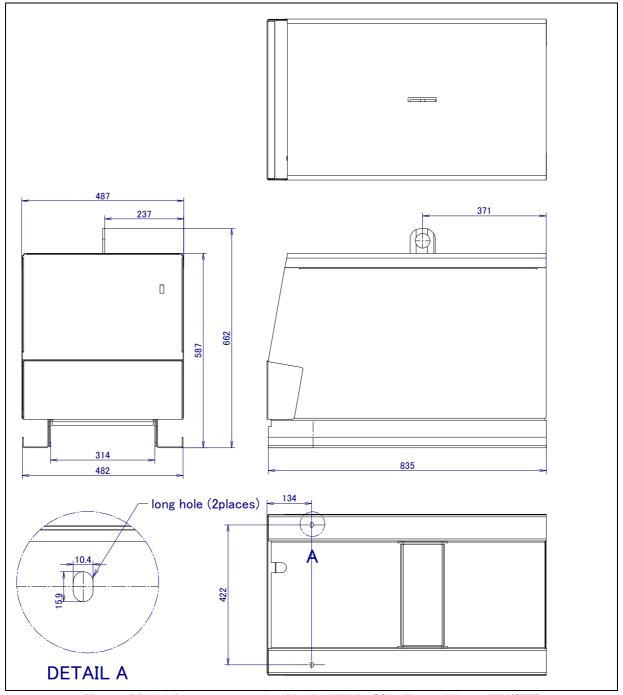


Fig. 8.2 (b) Welding power supply of ROBOWELD *i*C/H2 (Power Wave 455M/STT)

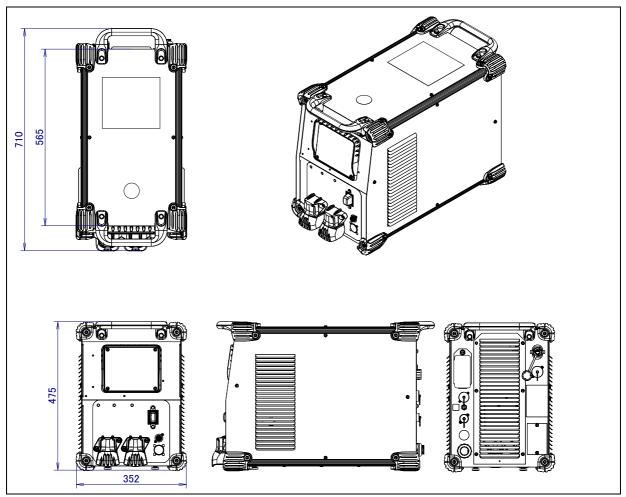


Fig.8.2 (c) Welding power supply of ROBOWELD *i*C/H3 (Power Wave R350)

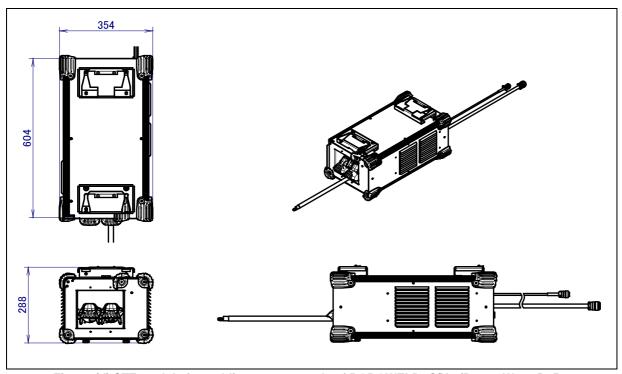


Fig.8.2 (d) STT module for welding power supply of ROBOWELD $i\mathrm{C/H3}$ (Power Wave R350)

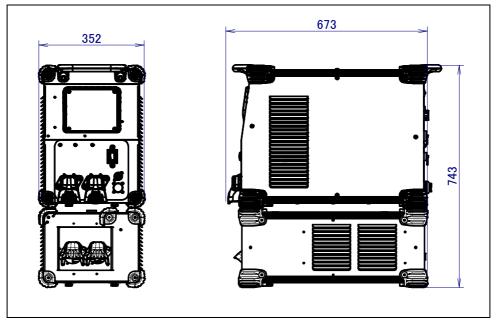


Fig.8.2 (e) Welding power supply of ROBOWELD *i*C/H3 + STT module (Power Wave R350)

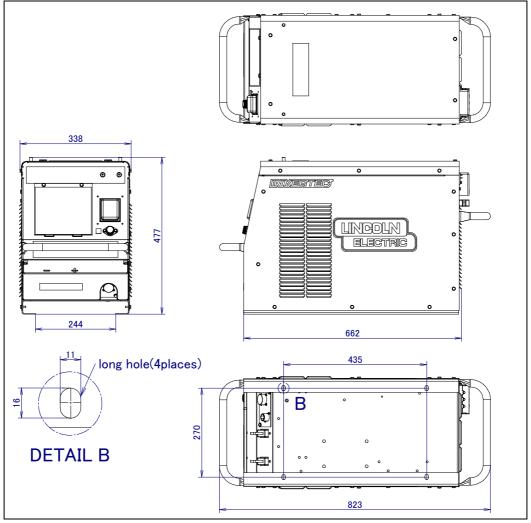


Fig. 8.2 (f) Welding power supply of ROBOWELD iC/E (Invertec CV350-R)

Fig.8.2 (g) shows external dimensions of wire feeder.

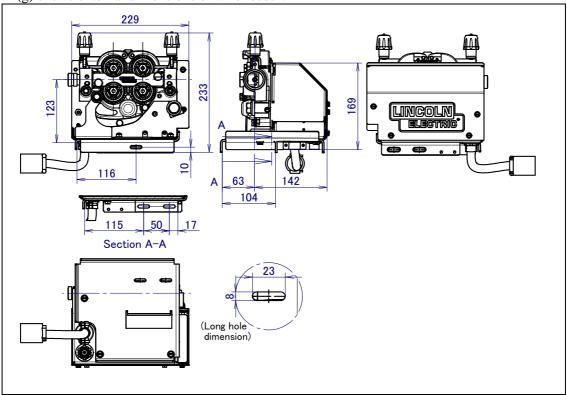


Fig.8.2 (g) Outer dimensions of wire feeder (Auto drive 4R100)

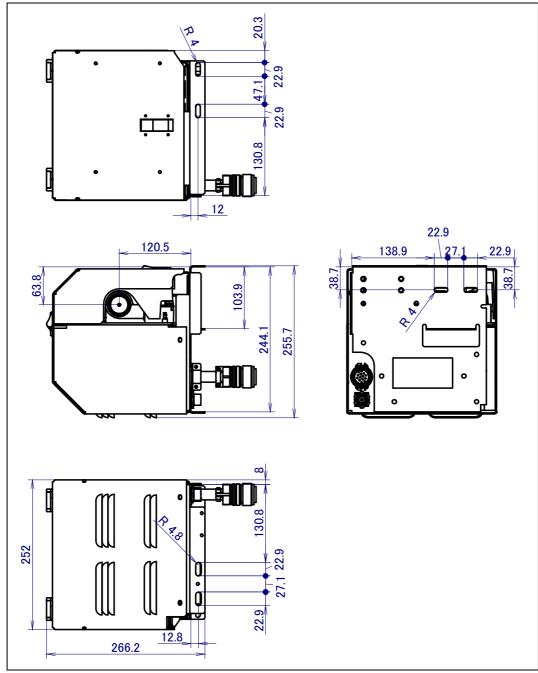


Fig.8.2 (h) Outer dimensions of wire feeder (Auto drive 4R220)

Fig.8 (i) shows dimension of wire reel stand.

There is a ϕ 11 hole for fastening stand . Pitch is 287mmx 588mm. It is necessary to remove leg of the stand to use these holes.

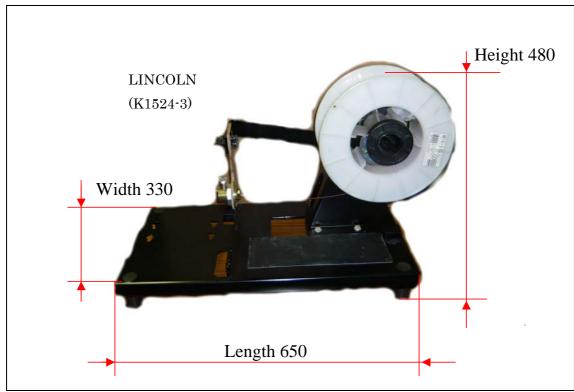


Fig.8.2 (i) Dimension of wire reel stand (A05B-1291-J201)

Fig.8.2 (j) shows dimension of regulator

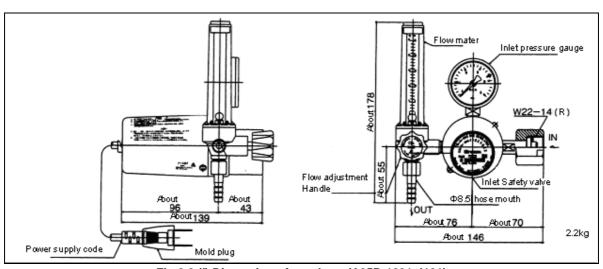


Fig.8.2 (j) Dimension of regulator (A05B-1291-J101)

Fig. 8.2 (k) shows outer dimensions of high speed torch recovery jig (A05B-1221-J056). Plate A290-7221-X822 Bolt M6X12(2) Conical washer (2) Spring washer (2) 3.5 ± 0.1 Bolt M8X25(2) (Please prepare by user.) SECTION A-A 81.5 Pin A290-7221-X821

Fig.8.2 (k) Outer dimensions of high speed torch recovery jig

8.3 TRANSPORTATION METHOD

Transportation method of controller integrated welding power supply (ROBOWELD iC/H)

When transporting controller integrated welding power supply, Install 2 slings to the plate of side of the controller and transport it by crane. In other case, refer to maintenance manual of controller.

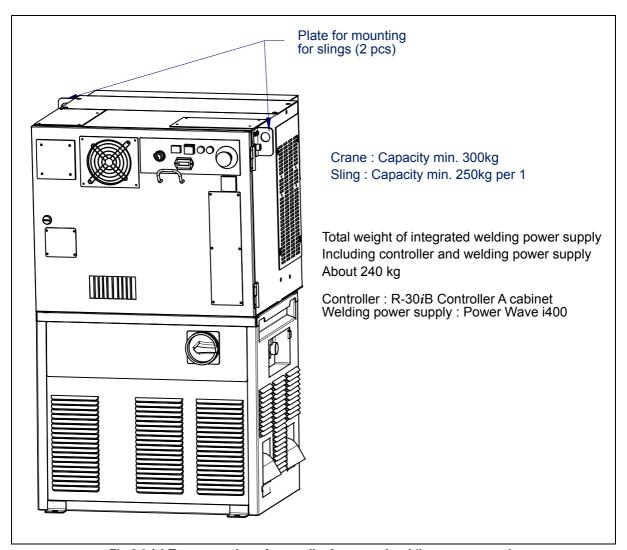


Fig.8.3 (a) Transportation of controller integrated welding power supply

Transportation method of welding power supply

When transporting welding power supply only, Use crane or hand referring to Fig.8.3 (b). When transporting Power Wave R350 or CV350-R ,be sure to transport it with two people.

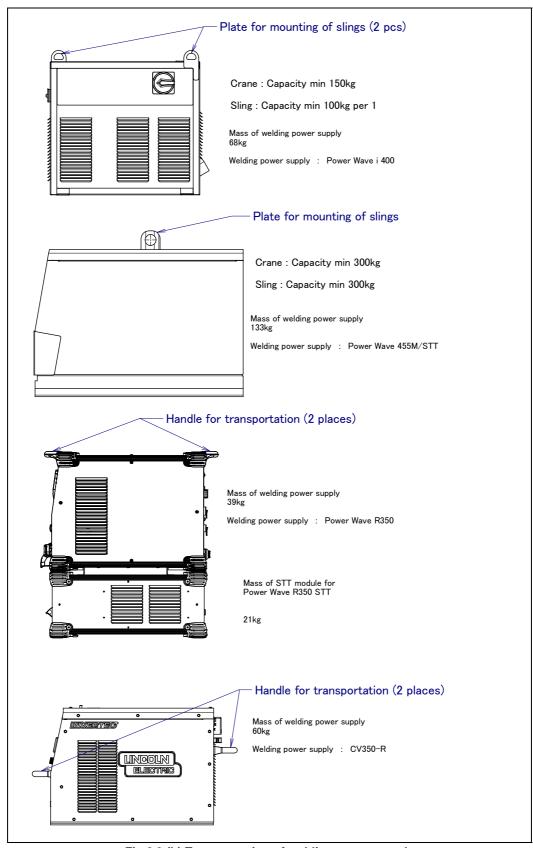


Fig.8.3 (b) Transportation of welding power supply

8.4 **TORCH CABLE**

Rated specifications of the torch cable

When a ROBOWELD is used, the service factor (duty) of the torch cable must not exceed the range indicated by shading in Fig. 8.4 (a).

The service factor (duty) of the torch cable is calculated from the following expression:

Actual welding time/total operation time per cycle (cycle time) \times 100 [%]

When a current exceeding the permissible current level flows, ignition, electric shock, or shortened torch cable life can result. So care should be taken.

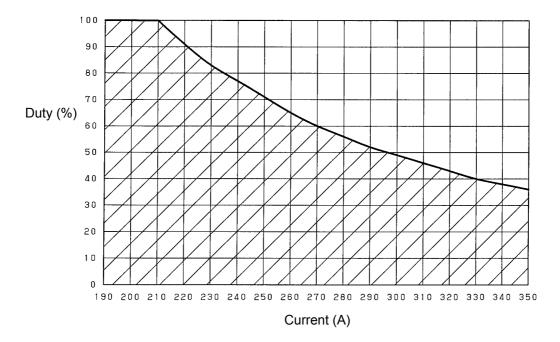


Fig. 8.4 (a) Relationship between current flowing through the torch cable and service factor (duty)

⚠ WARING

When a current exceeding the permissible current level flows, ignition or electric shock can result. So care should be taken.

When a ROBOWELD is used, the current flowing through the torch cable must not exceed the range indicated by shading in Fig. 8.4 (b).

When a current exceeding the permissible current level flows, ignition, electric shock, or shortened torch cable life can result. So care should be taken.

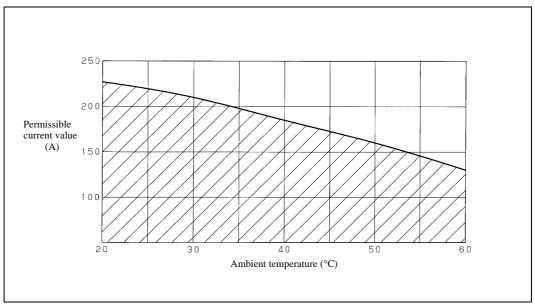


Fig. 8.4 (b) Relationship between ambient temperature and permissible current for the torch cable

Welding torch

Spec of FANUC ROBOWELD is below.

Torch name	Cooling method	Gas	Ration	Rated service factor	Applicable wire
ABIROB 350GC	- Air cooling	CO ₂		350A	
		$Ar+CO_2(*)$	100%	300A	0.9mm <i>φ</i> ,1.0mm
ABIROB A360		CO ₂		360A	
		$Ar+CO_2(*)$		290A	
ABIROB W500	Water cooling	CO ₂		550A	ϕ ,1.2mm ϕ
		$Ar+CO_2(*)$		500A	
Tough Gun	Air cooling	CO ₂		500A	
		Ar+CO _{2 (*)}		350A	

(*)Ratio of Ar and CO₂ is 82:18

This table show TCP and Load setting of each torch.

Table 8.4 (a) TCP of torch and payload setting (1/2)

	ABIROB 350GC	ABIROB 350GC	ABIROB A360	ABIROB W500	Tough Gun	
	Short neck	Long neck				
TCP X	-84.5	-84.5	-91.9	-91.4	-46.9	[mm]
TCP Y	0	0	0	0	0	[mm]
TCP Z	362	440.7	403.7	403.8	385.1	[mm]
PAYLOAD	1.94	2.04	1.82	2.32	1.46	[kg]
PAYLOAD CENTER X	-0.7	-0.7	-0.7	-0.7	-0.7	[cm]
PAYLOAD CENTER Y	-0.3	-0.3	-0.3	-0.3	-0.3	[cm]
PAYLOAD CENTER Z	16.7	16.7	16.7	16.7	16.7	[cm]
PAYLOAD INERTIA Ix	0.35	0.35	0.35	0.35	0.35	[kgf·cm·s ²]
PAYLOAD INERTIA Iy	0.35	0.35	0.35	0.35	0.35	[kgf·cm·s ²]
PAYLOAD INERTIA Iz	0.03	0.03	0.03	0.03	0.03	[kgf·cm·s ²]
ARM LOAD AXIS (AXIS 3)	7	7	7	7	7	[kg]

Table 8.4 (b) TCP of torch and payload setting (2/2)

	ABIROB 350GC for ASIA Short neck	ABIROB 350GC for ASIA Long neck	ABIROB 350GC Conventional dress out type Long neck	
TCP X	-84.5	-84.5	0	[mm]
TCP Y	0	0	0	[mm]
TCP Z	362	440.7	361	[mm]
PAYLOAD	1.61	1.71	2.00	[kg]
PAYLOAD CENTER X	-0.7	-0.7	9.8	[cm]
PAYLOAD CENTER Y	-0.3	-0.3	-0.6	[cm]
PAYLOAD CENTER Z	16.7	16.7	10.0	[cm]
PAYLOAD INERTIA IX	0.35	0.35	0.14	[kgf·cm·s ²]
PAYLOAD INERTIA Iy	0.35	0.35	0.18	[kgf·cm·s ²]
PAYLOAD INERTIA IZ	0.03	0.03	0.05	[kgf·cm·s ²]
ARM LOAD AXIS (AXIS 3)	7	7	7	[kg]

^{*}Above-mentioned TCP is the one of 15mm in the wire thrusting out length.

9

REPLACING UNITS

This chapter describes the method of replacing each unit of the welding power supply cabinet incorporating the controller.

⚠ WARNING

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 manuals:

FANUC Robot series R-30iB controller maintenance manual B-83195EN

FANUC Robot series R-30iB Mate controller maintenance manual B-83525EN

Organization of this chapter:

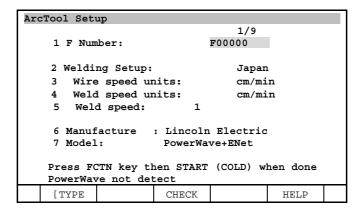
- 9.1 REPLACING WELDING POWER SUPPLY
- 9.2 REPLACING TORCH CABLE, LINER, DRIVE ROLL WIRE GUIDE , TORCH NECK AND WIRE FEEDER

9.1 REPLACING WELDING POWER SUPPLY

9.1.1 Replacing Welding Power Supply (ROBOWELD iC/H)

In the following, it explains the welding power supply integrated controller of ROBOWELD iC/H.

- Open the door of the controller.
- 2 Remove the connector of the cable, which is connected to CD38B referring to Fig.9.1 (a).
- Remove the cover of the right side of the bottom, then remove the nuts which fix the unification kit referring Fig.9.1.1 (b).
- 4 Pull out the cable to the controller side.
- 5 Remove sheet metal of upper side of welding power supply referring to Fig. 9.1 (c).
- Remove the terminal of cable of U1, V1, W1 and G in upper right of welding power supply referring to Fig.9.1 (d).
- 7 Pull out the cable which is removed procedure 6 from the outside of controller.
- Remove the bolt which is fixation of welding power supply to controller and hang the controller by crane referring to Fig. 9.1 (b), (e).
- 9 Attach new welding power supply by opposite procedure.
- 10 Do a basic setting of software referring to Subsection 3.2.5. [Setting When Weld Equipment Are Exchanged]
- 11 After controlled start, ARC TOOL setup screen as below starts up.



- Since, connection between controller and new weld equipment isn't established, the message "PowerWave not detect" is displayed. Press F3 "CHECK" key.
- 13 Configurations to connect older weld equipment are displayed and a message "Press ENTER to continue" is displayed. Press ENTER key.

```
ArcTool Setup
                                 1/9
    1 Enet port
                   : 2 is correct
    2 Bootp server : is enabled
    3 Bootp index : 1 is valid
    4 EQ MAC ID
                   : 00:04:EE:XX:XX:XX
    5 Weld EQ IP
                   : 192.168.2.152 valid
                  : 192.168.2.151 default
    6 Robot IP
    7 Subnet mask : 255.255.255.0
      Robot subnet : 192.168.2.0
      Equip subnet: 192.168.2.0 match
    8 IP Addresses: are compatible
   Press ENTER to continue
    [TYPE
                      CHECK
                                        HELP
```

Next, controller try to connect new weld equipment based on older weld equipment configuration and will fail to connect. The following message box will be appeared, press ENTER key.

The Ethernet connection is not working. Exit this menu, check the Ethernet cable, and cycle power on the robot and the Procedure

Next, the following message box is appeared. In this message box, it requires to operation to establish to connect with new PowerWave. Press PREV key to move cursor on "YES" and press ENTER key.

If a power OFF does not help or if you are connecting a different PowerWave you can redo the Ethernet setup. Redo the Ethernet setup?

Message box as below is opened. Confirm Ethernet cable connection is correct and PowerWave power supply is turned ON, then press ENTER key.

To setup PowerWave+Ehernet the Ethernet cable must be connected and the PowerWave must be ON.

[OK]

- 17 Communication establishment with replace welding power supply is performed.
- When communication becomes established, a message "PowerWave detects" will be displayed. Press FCTN key and select "START(COLD)" to perform cold start.
- 19 After cold start is complete set correct wire feeder referring to Setting of wire feeder of Appendix F.4.

↑ CAUTION

When firmware version or weld table version isn't same between older weld equipment and new weld equipment, different welding result may occur even if same weld condition is used since, firmware or weld table are incompatible. If firmware version or weld table version isn't same as older weld equipment, please let us. To confirm the versions, please see ArcLink Status screen(Section 4.5).

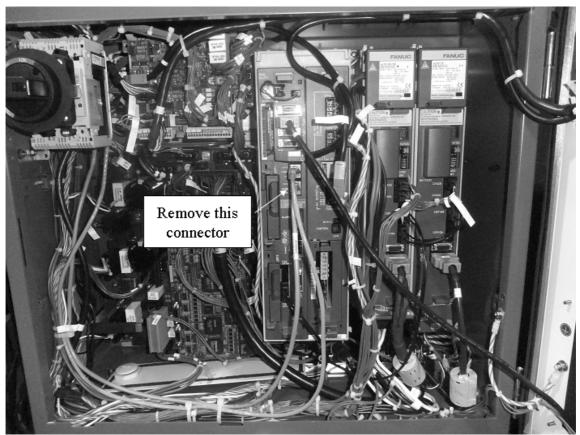


Fig.9.1.1 (a) Remove the connector of main board (R-30*i*B Controller A cabinet)

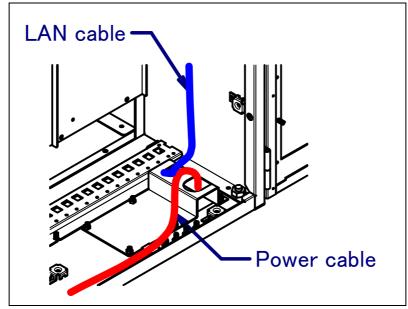


Fig.9.1.1 (b) Remove cable fixation sheet metal and welding power supply fixation bolt

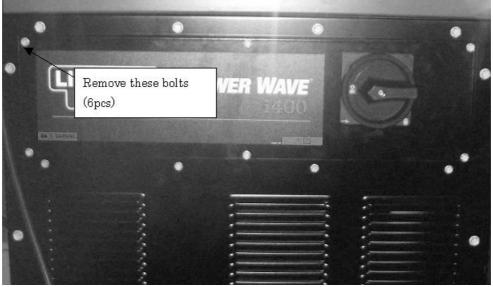


Fig.9.1.1 (c) Remove cover of welding power supply

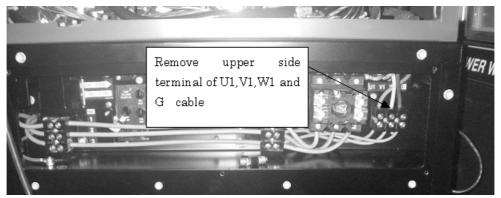


Fig.9.1.1 (d) Remove terminal of welding power supply

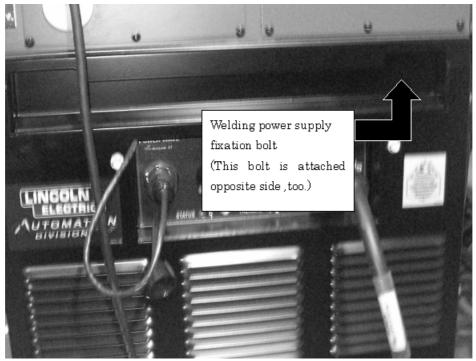


Fig.9.1.1 (e) Remove fixation bolt of welding power supply

9.1.2 Replacing the Welding Power Supply (ROBOWELD *i*C/H3)

- 1 Turn off the controller power.
- 2 Remove welding power cable (+), wire feeder control cable and communication cable from welding power supply referring to Fig.9.1.2 (a), (b).



Fig.9.1.2 (a) Connection of welding power supply Power Wave R350 (1/4)

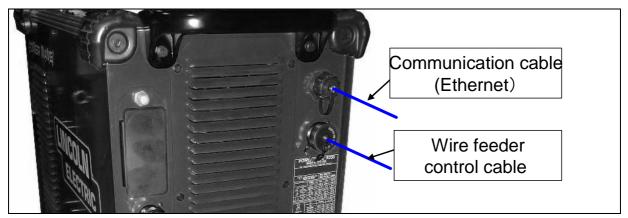


Fig.9.1.2 (b) Connection of welding power supply Power Wave R350 (2/4)

3 Remove both upper side cover and side face panel. (It is similar when STT module is specified.)

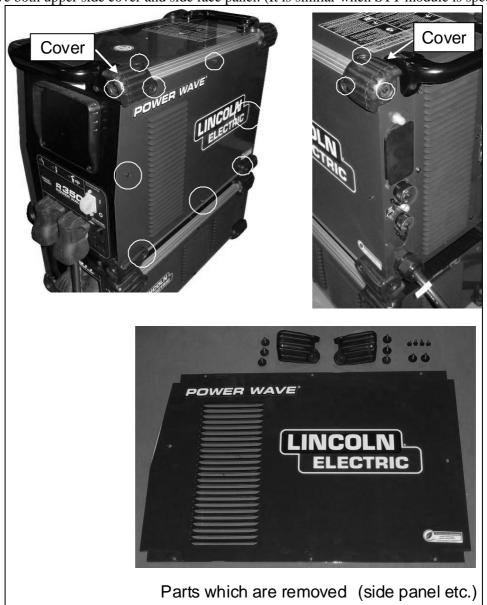


Fig.9.1.2 (c) Connection of welding power supply Power Wave R350 (3/4)

4 Remove primary power supply cable and put side face panel back. (It is similar at STT module is specified.)

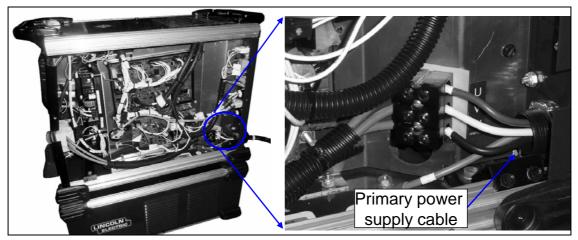
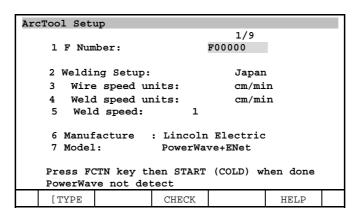


Fig.9.1.2 (d) Connection of welding power supply Power Wave R350 (4/4)

- 5 Replace old welding power supply by new one. For its assembly, please apply the steps above in reversed sequence.
- Next, perform communication establishment of replaced welding power supply and robot controller. Turn on the robot controller during pressing PREV key and NEXT key of the teach pendant. Controlled start is performed.
- 7 After controlled start, ARC TOOL setup screen as below starts up.



- 8 Since, connection between controller and new weld equipment isn't established, the message "PowerWave not detect" is displayed. Press F3 "CHECK" key.
- 9 Configurations to connect older weld equipment are displayed and a message "Press ENTER to continue" is displayed. Press ENTER key.

```
ArcTool Setup
                                  1/9
                   : 2 is correct
    1 Enet port
    2 Bootp server : is enabled
    3 Bootp index : 1 is valid
    4 EQ MAC ID
                   : 00:04:EE:XX:XX:XX
    5 Weld EQ IP
                   : 192.168.2.152 valid
                   : 192.168.2.151 default
    6 Robot IP
    7 Subnet mask
                   : 255.255.255.0
      Robot subnet : 192.168.2.0
      Equip subnet: 192.168.2.0 match
    8 IP Addresses : are compatible
   Press ENTER to continue.
    [TYPE
                      CHECK
                                         HELP
```

Next, controller try to connect new weld equipment based on older weld equipment configuration and will fail to connect. The following message box will be appeared, press ENTER key.

The Ethernet connection is not working. Exit this menu, check the Ethernet cable, and cycle power on the robot and the Procedure

[0K]

Next, the following message box is appeared. In this message box, it requires to operation to establish to connect with new PowerWave. Press PREV key to move cursor on "YES" and press ENTER key.

If a power OFF does not help or if you are connecting a different PowerWave you can redo the Ethernet setup. Redo the Ethernet setup?

YES [NO]

12 Message box as below is opened. Confirm Ethernet cable connection is correct and PowerWave power supply is turned ON, then press ENTER key.

To setup PowerWave+Ehernet the Ethernet cable must be connected and the PowerWave must be ON.

[OK]

- 13 Communication establishment with replace welding power supply is performed.
- When communication becomes established, a message "PowerWave detects" will be displayed. Press FCTN key and select "START(COLD)" to perform cold start.
- 15 After cold start is complete set correct wire feeder referring to Setting of wire feeder of Appendix F.4.

! CAUTION

When firmware version or weld table version isn't same between older weld equipment and new weld equipment, different welding result may occur even if same weld condition is used since, firmware or weld table are incompatible. If firmware version or weld table version isn't same as older weld equipment, please let us. To confirm the versions, please see Arclink Status screen(Section 4.5).

When STT module is specified

Refer to Appendix E about STT module replacing method. When using STT module, connect sense lead of Fig.9.1.2 (e). Be sure to connect this cable, too.

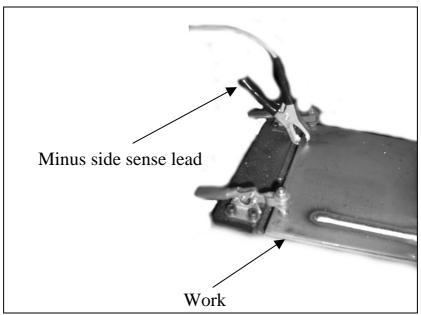


Fig.9.1.2 (e) Connection of welding power supply Power Wave R350 and STT module

9.2 REPLACING TORCH CABLE, LINER, DRIVE ROLL, TORCH NECK

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) Mating of the torch cable nut			
	(b) Liner replacement			
	(c) Wire feed capability			
	(d) Forming of gas hose and water hose			
Liner	(a) Wire feed capability			
Drive roll				
Wire guide				
Torch neck	(a) Mating of the torch cable nut			
	(b) Wire feed capability			

NOTE

Chapter below explains replacing method of ROBOWELD iC/H, H2 (except conventional dress out). Contact us about replacing method of conventional dress out torch or ROBOWELD iC/E.

9.2.1 Replacing Torch Cable (When using torch cable changing tool (Recommended))

- Move the robot posture to $J4=J5=J6=0^{\circ}$, The J1-J3 axis is not cared about by arbitrary posture.
- 2 Confirm the gas hose and the water cooling hoses arrange as Fig.9.2.1 (a). In addition, remove the torch cable from the conduit and confirm grease is applied on the hoses and does not occur interference of the hoses.

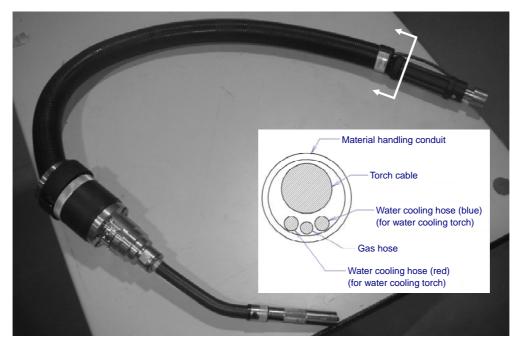


Fig.9.2.1 (a) Torch appearance (Section view is seen from the arrow direction)

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.

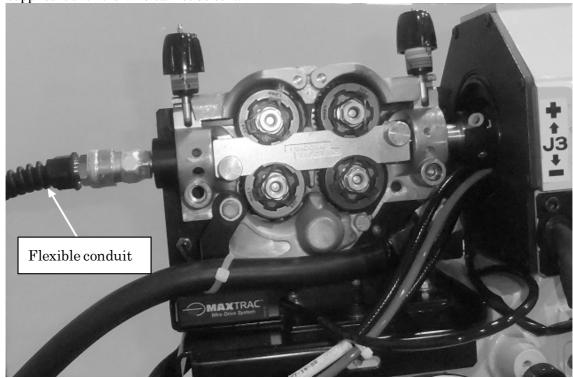


Fig.9.2.1 (b) Remove flexible conduit

- 4 Remove torch neck referring to Subsection 9.2.5.
- 5 Remove the conduit cover of J3 arm referring to Fig.9.2.1 (c).

6

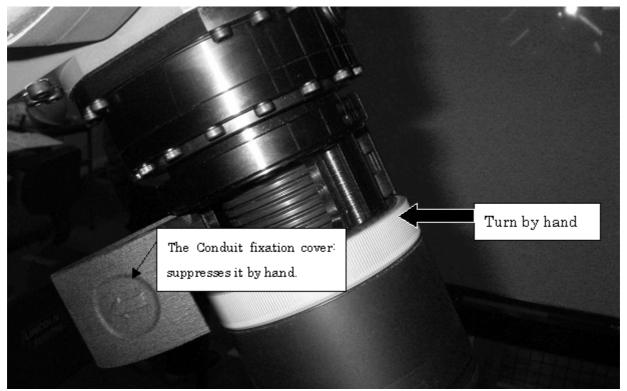


Fig.9.2.1 (c) Remove conduit

Loosen the fixation two bolt of torch side referring to Fig.9.2.1 (d).

Loosen these bolts.

Tighten this bolt by tightening torque 7.5Nm when you install it.

Fig.9.2.1 (d) Fixation bolt of torch side

Remove torch cable from torch adapter (Fig.9.2.1 (e).)

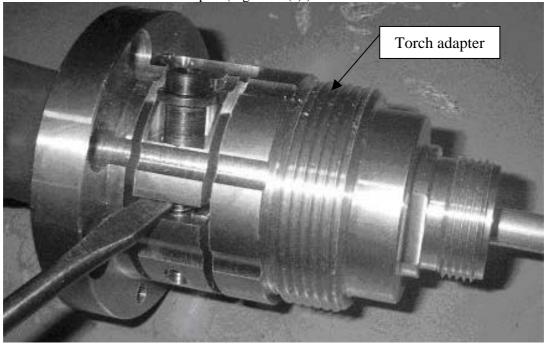


Fig.9.2.1 (e) Ditch of torch adapter

Hexagon hole bolt
Width across flat 1/4 inch (Use appended hexagon wrench)
Recommended tightening torque 10 to 15Nm

Appended hexagon
wrench

Fig.9.2.1 (f) 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.9.2.1 (g),(h).

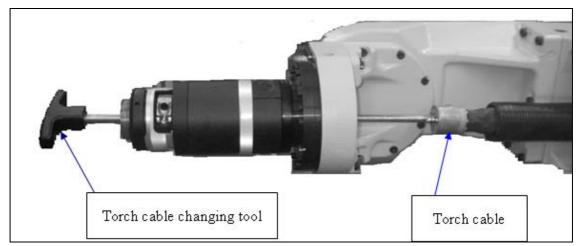


Fig.9.2.1 (g) Installing of torch cable changing tool



Fig.9.2.1 (h) 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. When the torch cable doesn't enter easily, it becomes easy if a minus driver is inserted in the ditch, and the ditch is expanded. (See Fig.9.2.1 (i))

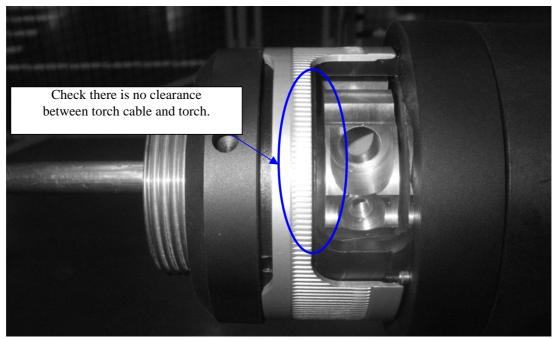


Fig.9.2.1 (i) Confirming of no clearance of torch cable

- 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 Subsection 9.2.5. Make aim of tightening torque of counter nut 30Nm.
- According to Subsection 9.2.3, insert new liner to torch cable and tighten liner suppression nut. Adjust the length of liner.
- 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.9.2.1 (f).) This part is thumb screw depending on the time of shipment. In this case, tighten it with torque of 10Nm. (See Fig.9.2.1 (j).)

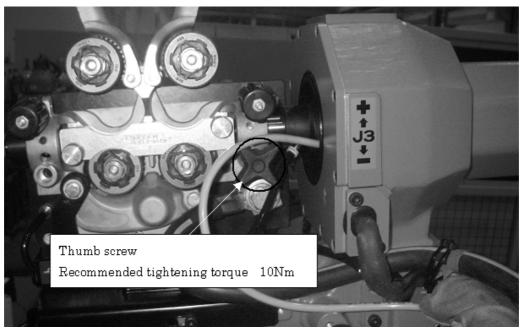


Fig.9.2.1 (j) Remove the thumbscrews of wire feeder

18 Form the gas hose and water cooling hoses referring to Fig. 9.2.1 (k) ,Fig.9.2.1 (l). At this chance, be careful to prevent the interference of the hoses. Rotate the gas hose and water cooling torch 90° around the torch cable as shown in Fig. 9.2.1 (k). Locate it in the lower side of the torch cable (In case of floor mount) , Push it 20mm into the conduit, then fix it with nylon bands referring to Fig.9.2.1 (l).

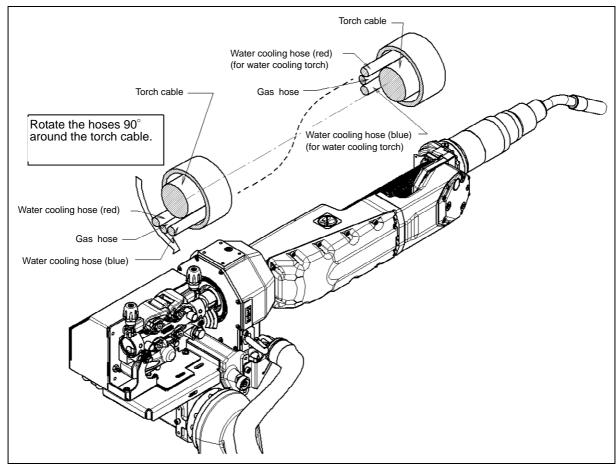


Fig. 9.2.1 (k) Arrangement of the cables and hoses

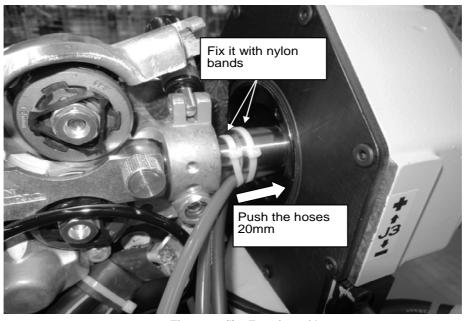


Fig. 9.2.1 (I) Forming of hoses

19 Attach fixation 2 bolts of torch side referring to Fig.9.2.1 (d). Tighten black bolt with torque of 7 5Nm

- 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. 9.2.1 (c).
- 21 Lift the roll, insert wire and restore them.
- Adjust the length of the liner referring to Subsection 9.2.3.

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.

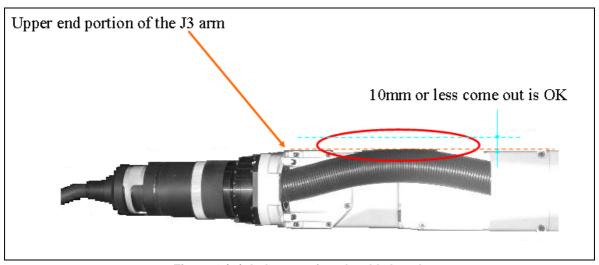


Fig.9.2.1 (m) Judgment of torch cable length

9.2.2 When not Using Torch Cable Changing tool (In case of there is no tool only.)

- Move the robot posture to $J4=J5=J6=0^{\circ}$, The J1-J3 axis is not cared about by arbitrary posture.
- 2 Confirm the gas hose and the water cooling hoses arrange as Fig.9.2.2 (a). In addition, remove the torch cable from the conduit and confirm grease is applied on the hoses and does not occur interference of the hoses.

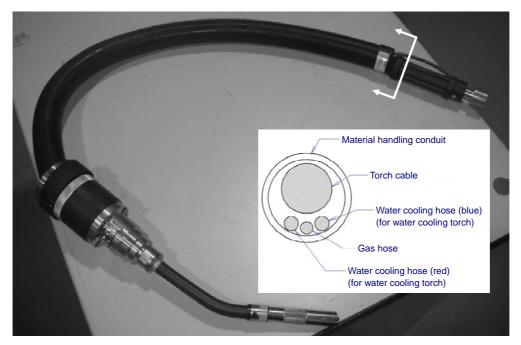


Fig.9.2.2 (a) Torch appearance (Section view is seen from the arrow direction)

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. (It is not necessary to remove torch neck.)

4 Remove the conduit cover of J3 arm referring to Fig.9.2.2 (b).

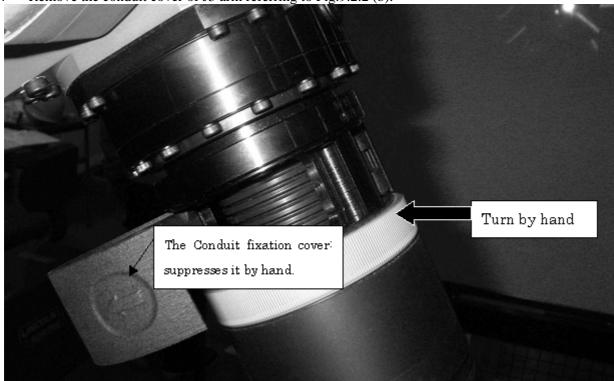


Fig.9.2.2 (b) Remove conduit

Loosen the fixation two bolt of torch side referring to Fig.9.2.2 (c).

Loosen these bolts.

Tighten this bolt by tightening torque 7.5Nm when you install it.

Fig.9.2.2 (c) Fixation bolt of torch side

6 Remove torch cable from torch adapter (Fig.9.2.2 (d).)

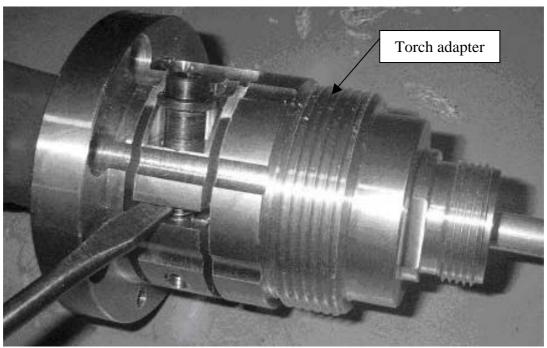


Fig.9.2.2 (d) Ditch of torch adapter

Length=About 14cm Hexagon hole bolt Width across flat 1/4 inch (Use appended hexagon wrench) Recommended tightening torque 10 to 15Nm Appended hexagon wrench

Loosen the bolt with hexagon hole of wire feeder referring to Fig. 9.2.2 (e).

Fig.9.2.2 (e) Remove the thumbscrews of wire feeder

- Pull out the torch cable from the J3 arm part with Conduit to torch side.
- Insert a new torch cable in the J3 arm part.
- Match tip of metal of torch to the keyway and insert it into torch adapter.
- 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 ditch, and the ditch is expanded. (See Fig.9.2.2 (f))

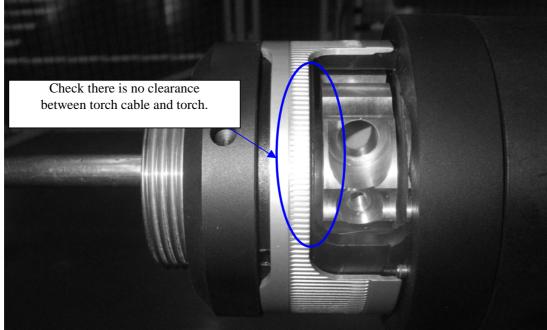


Fig.9.2.2 (f) Confirming of no clearance of torch cable

- Shut up a conduit till it do not move towards the torch neck, and lock a conduit fixation cover
- According to Subsection 9.2.3, insert new liner to torch cable and tighten liner suppression nut. 13 Adjust the length of liner.
- Loosen a fixed bolt of the wire feeder to the torch cable to become parallel to wire feeder, insert 14 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) This part is thumb screw depending on the time of shipment. In this case, tighten it with torque of 10Nm. (See

Fig.9.2.2 (g).)

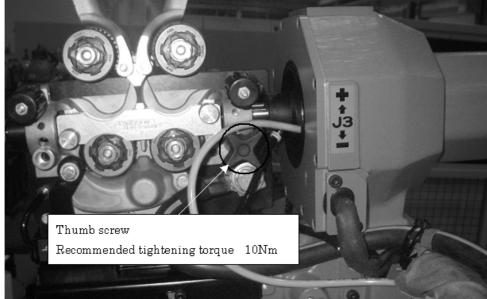


Fig.9.2.2 (g) Remove the thumbscrews of wire feeder

15 Form the gas hose and water cooling hoses referring to Fig. 9.2.2 (h) ,Fig.9.2.2 (i). At this chance, be careful to prevent the interference of the hoses. Rotate the gas hose and water cooling torch 90° around the torch cable as shown in Fig. 9.2.2 (h). Locate it in the lower side of the torch cable (In case of floor mount) , Push it 20mm into the conduit, then fix it with nylon bands referring to Fig.9.2.2 (i).

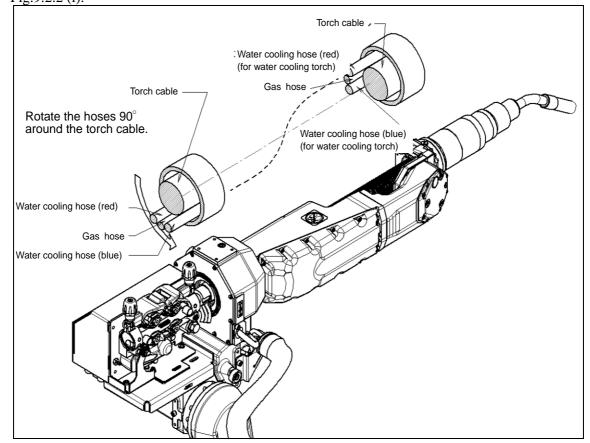


Fig. 9.2.2 (h) Arrangement of the cables and hoses

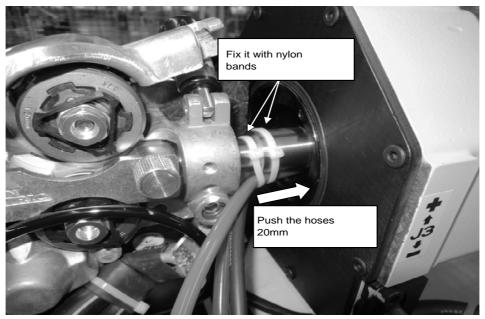


Fig. 9.2.2 (i) Forming of hoses

- Attach fixation 2 bolts of torch side referring to Fig.9.2.2 (c). Tighten black bolt with torque of 7.5Nm.
- 17 Firmly push Conduit into the interior before applying the Conduit fixation cover, and install the cover that fixes Conduit referring to Fig. 9.2.2 (b).
- 18 Lift the roll, insert wire and restore them.
- 19 Adjust the length of the liner referring to Subsection 9.2.3.

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.

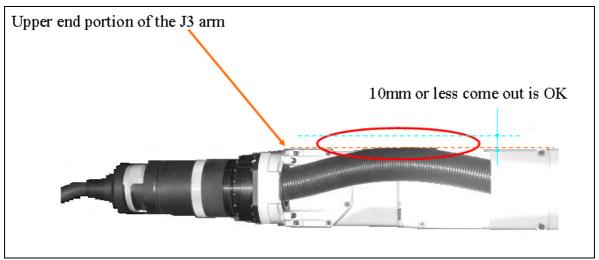


Fig.9.2.2 (j) Judgment of torch cable length

9.2.3 Replacing Liner

- Move the robot posture to J4=0°, J5=-90°, J6=0°. The J1-J3 axis is not cared about by arbitrary posture. And turn off the controller power and welding power supply.
- 2 Cut the wire around the roller of wire feeder, pull out the wire from the tip point.
- Remove nozzle, gas diffuser and welding tip. At this time, pay attention not to drop and destroy gas diffuser from nozzle. (See Subsection 6.1.3 about each part.)
- 4 Loosen the bolt with the hexagon hole of wire feeder, and pull out torch cable from wire feeder.
- 5 Pull out the torch cable from the hole of J4-axis hollow parts of J3 arm to wrist side.
- 6 Loosen the liner suppression nut by the monkey spanner and remove it. (See.Fig.9.2.3 (a))
- 7 Pull out the liner from torch cable.
- 8 Insert liner to torch cable, and temporally tighten the liner suppression nut.
- 9 Cut the liner in the tip holder point. (See Fig. 9.2.3 (b))
- 10 If torch cable is not new one, pull out the liner from the torch cable again and cut about 8-10mm from the point further.
- Peel off the liner hull (orange) from the point part to about 250mm. (See Fig.9.2.3 (c))
- 12 Remove burr, etc of cutting part. (Apply roundness.)
- 13 Insert liner to torch cable again, and tighten the liner suppression nut firmly.
- Insert torch cable to J4-axis hollow part and insert torch into the interior while pushing bolt with the hexagon hole of wire feeder and tighten it, and attach torch cable to wire feeder.
- Turn on the controller power then feed the wire to check that the wire is fed through the torch tip. Next, operate the robot slowly to check that no problem is found.

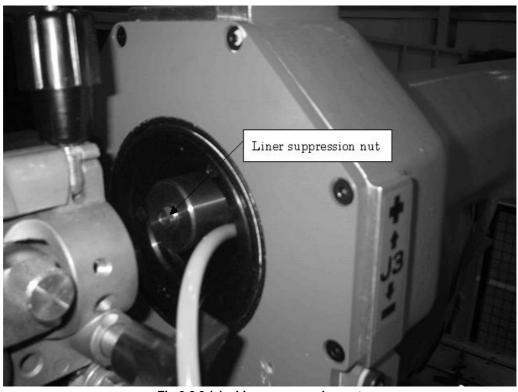


Fig.9.2.3 (a) Liner suppression nut

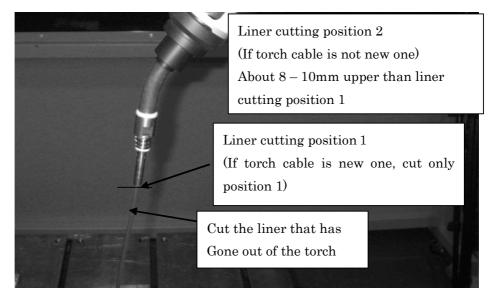


Fig.9.2.3 (b) Cutting liner

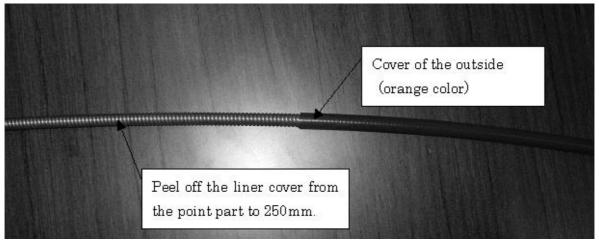


Fig.9.2.3 (c) Peeling off the line cover

9.2.4 Replacing Drive Roll and Wire Guide

This chapter indicates procedure of replacing both of drive roll and wire guide(inside).

- 1 Loosen the screw in two places of the wire guide (outside) and remove wire guide (outside)
- 2 Knock down the idle arm below, and lift the drive roll of upper side. (See. Fig. 9.2.4 (a))
- Turn a triangular ring that is attached to the drive roll by the hand and phase it as unlocked.(See Fig.9.2.4 (b))
- 4 Remove the drive roll.
- 5 Remove wire guide (inside) after removing the 4 drive rolls.
- Replace drive roll and wire guide (inside) to new one by opposite procedure. Pay attention to the direction of wire guide (inside) (See Fig.9.2.4 (c))

 Turn at the same time and install two screws when you install the wire guide(outside).

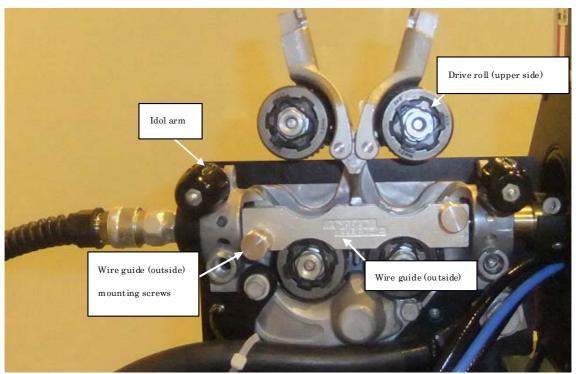


Fig.9.2.4 (a) Lift the drive roll

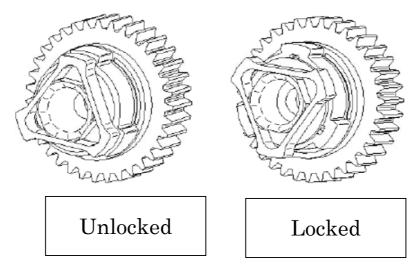


Fig.9.2.4 (b) Release lock of the drive roll

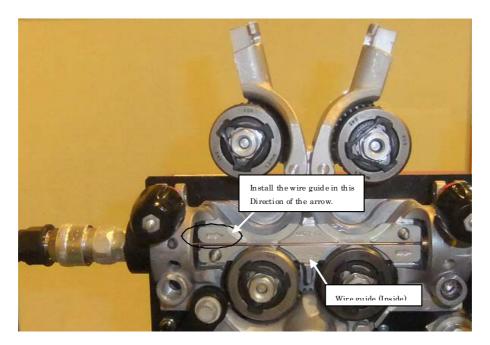


Fig.9.2.4 (c) Wire guide(Inside)

9.2.5 Replacing Torch Neck

When torch neck is broken ,replacing is needed. In this case, you may need to set TCP again by using, for example, torch recovery.

Use the procedure below for replacement.

- 1 Remove the nozzle.
- 2 Loosen screw of insulation cylinder by the monkey spanner and remove it. (See Fig.9.2.5 (a))
- 3 Loosen the screw of tip holder and remove tip holder. (See.9.2.5 (b))
- 4 Loosen insulation cap by the hand and remove it. (See.Fig.9.2.5 (c))
- 5 Remove rubber cover . (See.9.2.5 (d))
- 6 Loosen counter nut by the monkey spanner , remove torch neck and replace it to new one. (See Fig.9.2.4 (d)) Tighten counter nut by regulated torque.
- 7 Attach the tip holder. (See Fig.9.2.5 (b))
- 8 Attach rubber cover . (See.9.2.5 (d))
- 9 Attach insulation cap.(See Fig.9.2.5 (c))
- 10 Attach insulation cylinder. (See Fig. 9.2.5 (a))
- 11 Attach the nozzle.

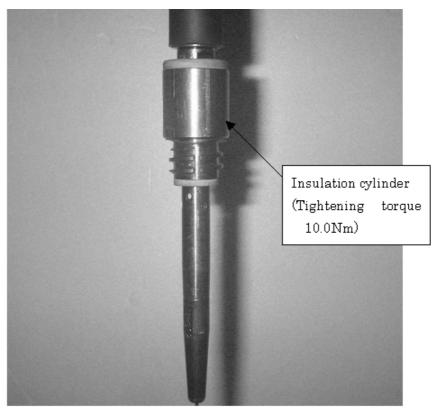


Fig.9.2.5 (a) Remove insulation cylinder

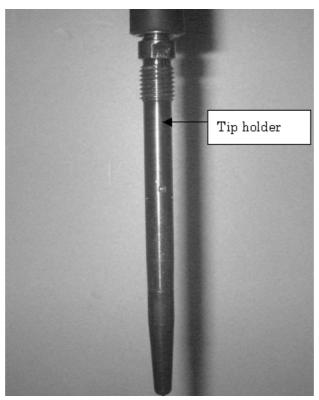


Fig.9.2.5 (b) Remove tip holder

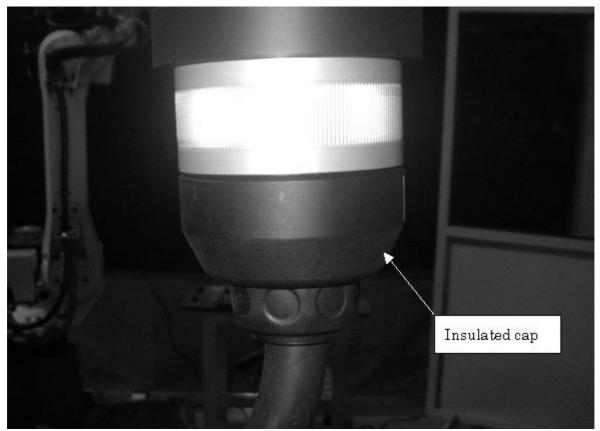


Fig.9.2.5 (c) Remove insulation cap



Fig.9.2.5 (d) Remove rubber cover

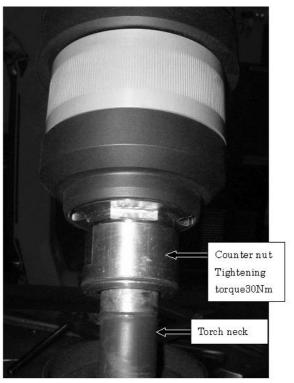


Fig.9.2.5 (e) Remove torch neck

9.2.6 Replacing the Wire Feeder (Auto drive 4R100)

- 1 When cover is attached, remove it and perform procedure below.
- 2 Loosen torch mounting hexagon bolt using a hexagon wrench which is appendix of wire feeder, then remove the torch from the wire feeder.
- 3 Remove gas hose of wire feeder side and torch side.
- 4 Remove the joint which connect flexible conduit to wire feeder.
- 5 Cut the wire, and pull out it from torch cable tip side.
- 6 Loosen welding power supply mounting nut and remove welding power cable.
- 7 Remove wire feeder mounting bolts.
- 8 Replace old wire feeder by new one. For its assembly, please apply the steps above in reversed sequence.

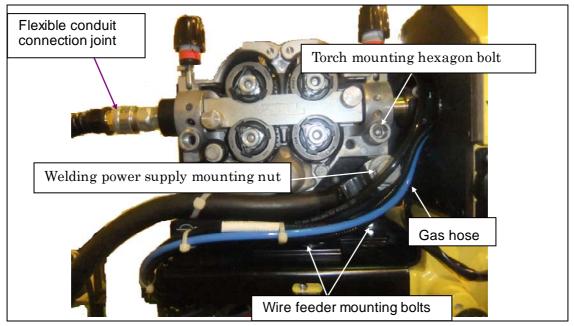


Fig.9.2.6 (a) Replacing the wire feeder Auto drive 4R100 (1/3)

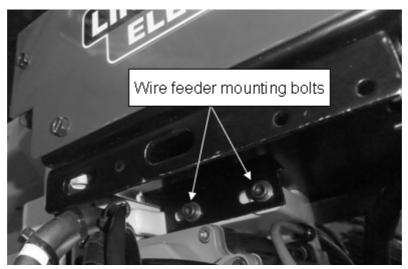


Fig.9.2.6 (b) Replacing the wire feeder Auto drive 4R100 (2/3)

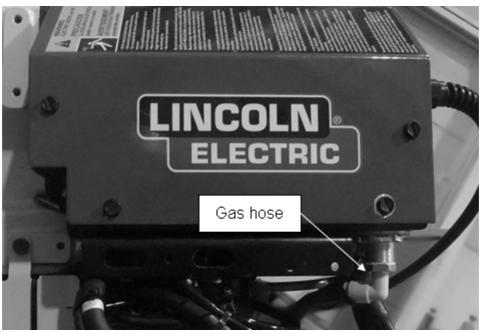


Fig.9.2.6 (c) Replacing the wire feeder Auto drive 4R100 (3/3)

9.2.7 Replacing the Wire Feeder (Auto drive 4R220)

- 1 Remove the wire feeder cover.
- 2 Loosen torch mounting hexagon bolt using a hexagon wrench which is appendix of wire feeder, then remove the torch from the wire feeder.
- 3 Remove the gas hoses of the wire feeder wide and the torch side.
- 4 Cut the joint which connect the flexible conduit to the wire feeder.
- 5 Cut the wire, and pull out it from torch cable tip side.
- 6 Loosen the welding power supply cable mounting nut, then remove the welding power supply cable.
- 7 Remove the wire feeder mounting bolts.
- 8 Replace old wire feeder by new one. For its assembly, please apply the steps above in reversed sequence.
- 9 Perform the wiring sot that it is does not installed on the robot body referring to Fig. 9.2.7 (d),(e).

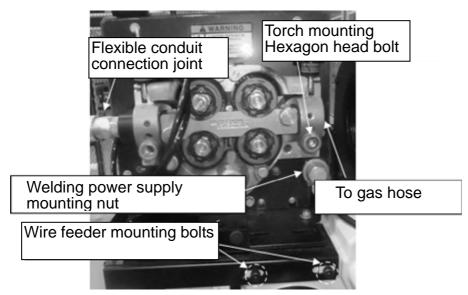


Fig. 9.2.7 (a) Replacing the wire feeder Auto drive 4R220 (1/3)

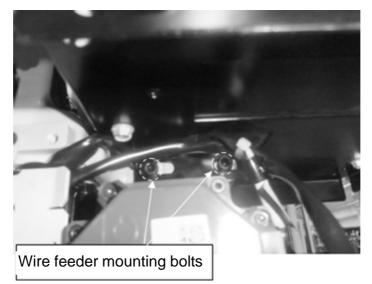


Fig. 9.2.7 (b) Replacing the wire feeder Auto drive 4R220 (2/3)



Fig. 9.2.7 (c) Replacing the wire feeder Auto drive 4R220 (3/3)

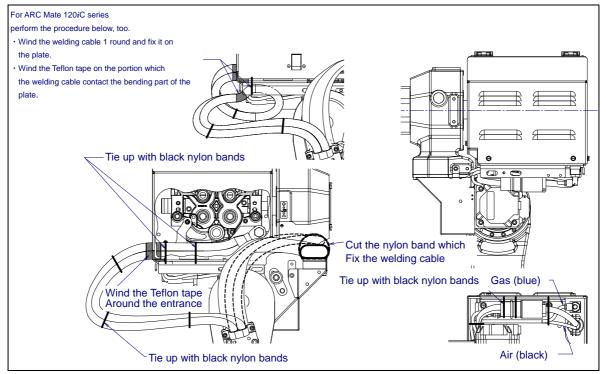


Fig. 9.2.7 (d) Wiring of the Wire Feeder Auto drive 4R220 (1/2)

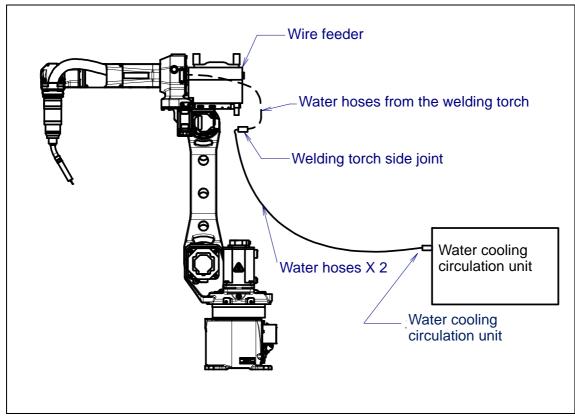
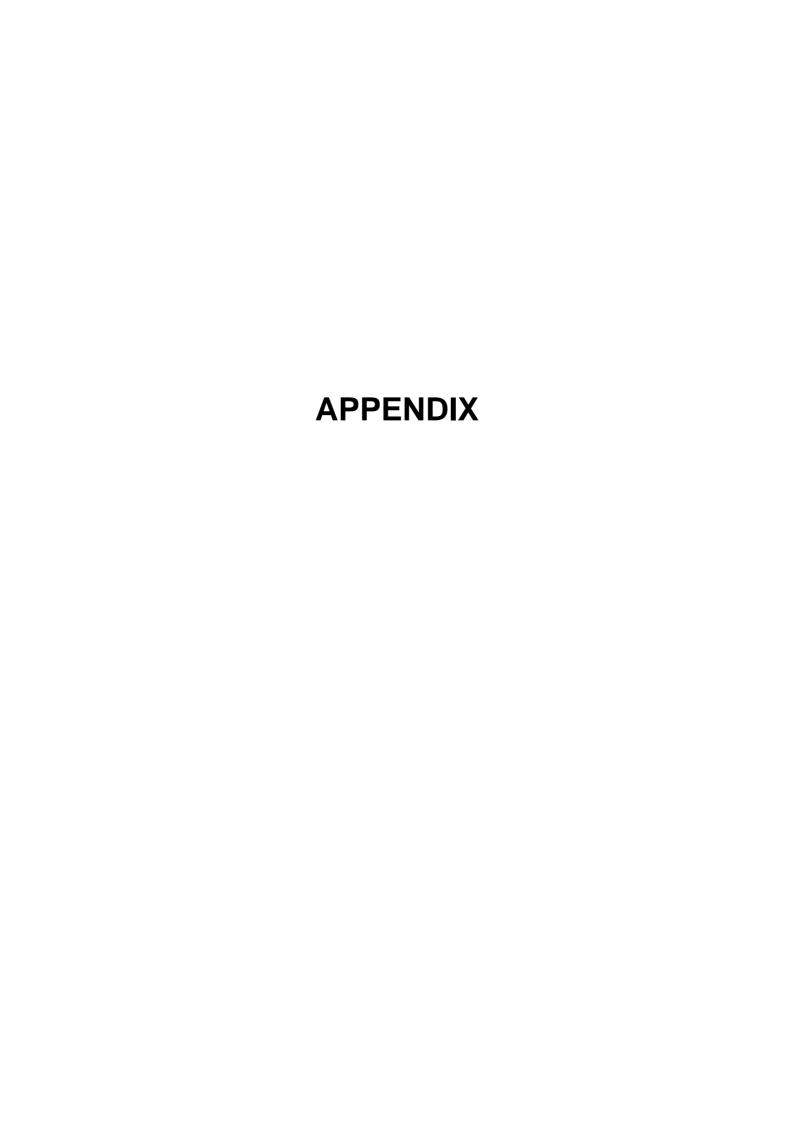


Fig. 9.2.7 (e) Wiring of the Wire Feeder Auto drive 4R220 (2/2)





SPARE PARTS LIST

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 A (a) Parts for maintenance of welding power supply Power Wave i400 (200V) (A05B-1291-H101)

Spec of parts for	Name of parts for	Unit	Remarks
maintenance	maintenance	requirement	
A14L-0166-0101	Power wave i400	1	For 200V
A14L-0166-0101#F1X03A	Switch Board	1	
A14L-0166-0101#C1X12A	Aux. Transformer	1	
A14L-0166-0101#E1X02A	40V DC Bus Board	1	
A14L-0166-0101#G1X12A	Input Rectifier Module	1	
A14L-0166-0101#D1X02F	Ethernet Receptacle	1	
A14L-0166-0101#D1X02H	Ethernet Cable - 2ft	1	
A14L-0166-0101#E1X09A	Output Rectifier Assembly	1	
A14L-0166-0101#H1X15C	Switch - On/Off	1	
A14L-0166-0101#G1X03	Fan Blade	1	
A14L-0166-0101#G1X02A	Fan Motor	1	
A14L-0166-0101#E1X06	Capacitor - 40V Supply	1	
A14L-0166-0101#F1X15	Capacitor - Main	2	
	MOV Assembly - Input		
A14L-0166-0101#G2X40	Rectifier	1	
A14L-0166-0101#C1X10A	Current Transducer	1	
A14L-0166-0101#H1X10B	Lift Hook	2	
A14L-0166-0101#E1X20A	Control Board Assembly	1	
	Feed Head Board		
A14L-0166-0101#C1X18C	Assembly	1	
A14L-0166-0101#G1X20E	Fuse	1	
A14L-0166-0101#D1X02K	Circuit Breaker - 15A	2	
A14L-0166-0101#E1X04A	Thermostat - Bus Board	1	
	Thermostat - Output		
A14L-0166-0101#E1X09G	Rectifier	1	
A14L-0166-0101#E1X03A	Diode Module	1	
	MOV Assembly - Input		
A14L-0166-0101#G2X41	Rectifier	1	
A14L-0166-0101#C1	Inverter Chassis	1	
A14L-0166-0101#C1X04A	Choke Asbly.	1	
A14L-0166-0101#D1X02G	Ethernet Cover	1	
A14L-0166-0101#J1X03C	Terminal Block Assembly	4	

Table A (b) Parts for maintenance of welding power supply Power Wave i400 (400V) (A05B-1291-H102)

Spec of parts for maintenance	Name of parts for maintenance	Unit requirement	Remarks
A14L-0166-0101#F1X03A	Switch Board	1	
A14L-0166-0101#C1X12A	Aux. Transformer	1	
A14L-0166-0101#E1X02A	40V DC Bus Board	1	
A14L-0166-0101#G1X12A	Input Rectifier Module	1	
A14L-0166-0101#D1X02F	Ethernet Receptacle	1	
A14L-0166-0101#D1X02H	Ethernet Cable - 2ft	1	
A14L-0166-0101#E1X09A	Output Rectifier Assembly	1	
A14L-0166-0101#H1X15C	Switch - On/Off	1	
A14L-0166-0101#G1X03	Fan Blade	1	

Spec of parts for maintenance	Name of parts for maintenance	Unit requirement	Remarks
A14L-0166-0101#G1X02A	Fan Motor	1	
A14L-0166-0101#E1X06	Capacitor - 40V Supply	1	
A14L-0166-0101#F1X15	Capacitor - Main	2	
	MOV Assembly - Input		
A14L-0166-0101#G2X40	Rectifier	1	
A14L-0166-0101#C1X10A	Current Transducer	1	
A14L-0166-0101#H1X10B	Lift Hook	2	
A14L-0166-0101#E1X20A	Control Board Assembly	1	
	Feed Head Board		
A14L-0166-0101#C1X18C	Assembly	1	
A14L-0166-0101#G1X20E	Fuse	1	
A14L-0166-0101#D1X02K	Circuit Breaker - 15A	2	
A14L-0166-0101#E1X04A	Thermostat - Bus Board	1	
	Thermostat - Output		
A14L-0166-0101#E1X09G	Rectifier	1	
A14L-0166-0101#E1X03A	Diode Module	1	
	MOV Assembly - Input		
A14L-0166-0101#G2X41	Rectifier	1	
A14L-0166-0101#C1	Inverter Chassis	1	
A14L-0166-0101#C1X04A	Choke Asbly.	1	
A14L-0166-0101#D1X02G	Ethernet Cover	1	
A14L-0166-0101#J1X03C	Terminal Block Assembly	4	

Table A (c) Parts for welding power supply Power Wave R350 (A05B-1291-H141)

Spec of parts for maintenance	Name of parts for maintenance	Unit requirement	Remarks
A14L-0166-0141 #E1X4A	Control Board	1	
A14L-0166-0141 #D1X13	Switch Board / Power Conversion Asbly	1	
A14L-0166-0141 #C1X16A	Input Board / PFC Control	1	
A14L-0166-0141 #E1X2A	40V DC Buss Board	1	
A14L-0166-0141 #H1X10B	Feedhead Bd.	1	
A14L-0166-0141 #H1X10H	Feedhead Bd.	1	

Table A (d) Parts for STT module (A05B-1291-H142)

Spec of parts for maintenance	Name of parts for maintenance	Unit requirement	Remarks
A14L-0166-0142 #E1X10B	Switchboard & Heatsink Assembly	1	
A14L-0166-0142 #E1X11B	Status Board Assembly.	1	

Table A (e) Parts for maintenance of Wire feeder Auto drive 4R100 (A05B-1291-H203)

Spec of parts for	Name of parts for	Unit	Remarks
maintenance	maintenance	requirement	
A14L-0166-0201#D1X04	Motor/Gearbox Asbly	1	
A14L-0166-0201#D1X09	Wire Guide Asbly	1	
A14L-0166-0201#C1X12A	Gas Solenoid	1	
A14L-0166-0201#C1X18	Cable Asbly.	1	

Table A (f) Parts for maintenance of Wire feeder Auto drive 4R220 (A05B-1291-H204)

Spec of parts for maintenance	Name of parts for maintenance	Unit requirement	Remarks
A14L-0166-0201#D1X09	Wire Guide Asbly	1	

Spec of parts for maintenance	Name of parts for maintenance	Unit requirement	Remarks
A14L-0166-0201#C1X12A	Gas Solenoid	1	
A14L-0166-0201#C1X18	Cable Asbly.	1	
A14L-0166-0201#D1X04E	Motor brush	1	

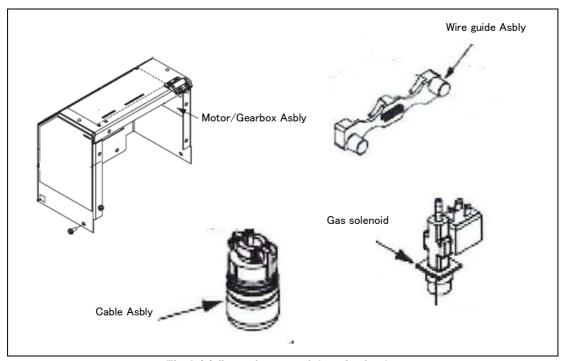


Fig.A (a) figure for part of the wire feeder

Table A (g) Parts for maintenance of torch ABIROB 350GC-30S for ARC Mate 100iC (A05B-1291-H301)

Spec of parts for	Name of parts for	Unit	Remarks
maintenance	maintenance	requirement	
A14L-0166-0301#980XF111	Torch neck Asbly. (*1)	1	With short neck and tip
			L=45mm,φ1.2
A14L-0166-0301#980XF112	Torch neck Asbly. (*2)	1	With short neck and tip
			L=40mm,φ1.2
A14L-0166-0301#980X0027	Torch neck	1	30 deg. short neck
A14L-0166-0301#142X0143	Tip holder (*1)	1	For tip L=45mm,φ1.2
A14L-0166-0301#142X0144	Tip holder (*2)	1	For tip L=40mm,φ1.2
A14L-0166-0301#980X0142	Insulator	1	
A14L-0166-0301#980X0019	Gas diffuser	1	
A14L-0166-0301#140JP005	Tip (*1)	1	L=45mm/CuCrZr/φ1.2/M6
A14L-0166-0301#140JP006	Tip (*2)	1	L=40mm/CuCrZr/φ1.2/M6
A14L-0166-0301#145X0558	Gas nozzle(*2)	1	Tapered type φ12/Cr coarting
A14L-0166-0301#145XJ054	Gas nozzle(*1)	1	Straight type φ15.6 normal
A14L-0166-0301#145X0557	Gas nozzle(*2)	1	Straight type ϕ 15.6/Cr coarting
A14L-0166-0301#145X0559	Gas nozzle(*2)	1	Bottle type φ14/Cr coarting
A14L-0166-0301#145X0573	Gas nozzle(*2)	1	Tapered type φ13/Cr coating
A14L-0166-0301#780A3230	Robot mount (*3)	1	
A14L-0166-0301#980X0013	Insulated cap (*3)	1	
A14L-0166-0301#780X0680	Insulated flange	1	
A14L-0166-0301#780X3220	Swivel	1	_
A14L-0166-0301#980X2112	Torch cable	1	For ROBOWELD 100iC
A14L-0166-0301#124X0165	Liner	1	
A14L-0166-0301#980X2030	Cable changing help tool	11	

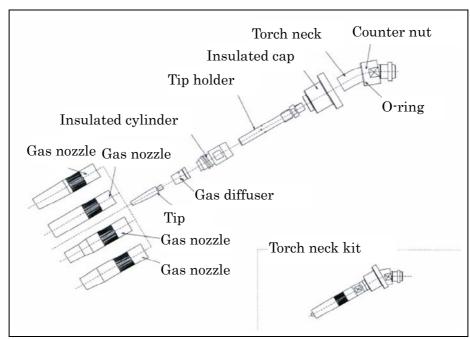


Fig.A (b) figure for part of the torch (1/2)

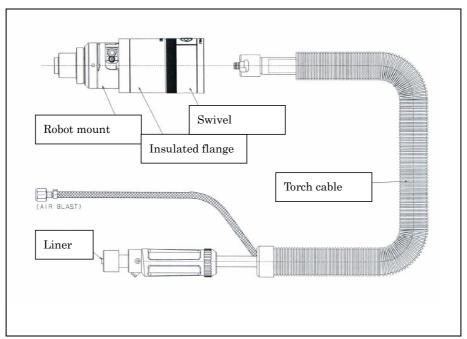


Fig.A (c) figure for part of the torch (2/2)

Table A (h) Parts for maintenance of torch ABIROB 350GC-30S for ARC Mate 100iC/6L (A05B-1291-H302)

Spec of parts for maintenance	Name of parts for maintenance	Unit requirement	Remarks
A14L-0166-0301#980XF111	Torch neck Asbly. (*1)	1	With short neck and tip L=45mm,φ1.2
A14L-0166-0301#980XF112	Torch neck Asbly. (*2)	1	With short neck and tip L=40mm,φ1.2
A14L-0166-0301#980X0027	Torch neck	1	30 deg. short neck
A14L-0166-0301#142X0143	Tip holder (*1)	1	For tip L=45mm,φ1.2
A14L-0166-0301#142X0144	Tip holder (*2)	1	For tip L=40mm,φ1.2
A14L-0166-0301#980X0142	Insulator	1	

Spec of parts for maintenance	Name of parts for maintenance	Unit requirement	Remarks
A14L-0166-0301#980X0019	Gas diffuser	1	
A14L-0166-0301#140JP005	Tip (*1)	1	L=45mm/CuCrZr/φ1.2/M6
A14L-0166-0301#140JP006	Tip (*2)	1	L=40mm/CuCrZr/φ1.2/M6
A14L-0166-0301#145X0558	Gas nozzle (*2)	1	Tapered type φ12/Cr coarting
A14L-0166-0301#145XJ054	Gas nozzle (*1)	1	Straight type φ15.6 normal
A14L-0166-0301#145X0557	Gas nozzle (*2)	1	Straight type ϕ 15.6/Cr coarting
A14L-0166-0301#145X0559	Gas nozzle (*2)	1	Bottle type φ14/Cr coarting
A14L-0166-0301#145X0573	Gas nozzle (*2)	1	Tapered type φ13/Cr coating
A14L-0166-0301#780A3230	Robot mount (*3)	1	
A14L-0166-0301#980X0013	Insulated cap (*3)	1	
A14L-0166-0301#780X0680	Insulated flange	1	
A14L-0166-0301#780X3220	Swivel	1	
A14L-0166-0301#980X2131	Torch cable	1	For ROBOWELD 100iC/6L
A14L-0166-0301#124X0165	Liner	1	
A14L-0166-0301#980X2030	Cable changing help tool	1	

Table A (i) Parts for maintenance of torch ABIROB 350GC-30L for ARC Mate 100iC (A05B-1291-H303)

Spec of parts for	Name of parts for	Unit	Remarks
maintenance	maintenance	requirement	
A14L-0166-0301#980XF113	Torch neck Asbly. (*1)	1	With long neck and tip
			L=45mm,φ1.2
A14L-0166-0301#980XF114	Torch neck Asbly. (*2)	1	With long neck and tip
			L=40mm,φ1.2
A14L-0166-0301#980X0028	Torch neck	1	30 deg. long neck
A14L-0166-0301#142X0143	Tip holder (*1)	1	For tip L=45mm,φ1.2
A14L-0166-0301#142X0144	Tip holder (*2)	1	For tip L=40mm,φ1.2
A14L-0166-0301#980X0142	Insulator	1	
A14L-0166-0301#980X0019	Gas diffuser	1	
A14L-0166-0301#140JP005	Tip	1	L=45mm/CuCrZr/φ1.2/M6
A14L-0166-0301#140JP006	Tip	1	L=40mm/CuCrZr/φ1.2/M6
A14L-0166-0301#145X0558	Gas nozzle (*2)	1	Tapered type φ12/Cr coarting
A14L-0166-0301#145XJ054	Gas nozzle (*1)	1	Straight type φ15.6 normal
A14L-0166-0301#145X0557	Gas nozzle (*2)	1	Straight type ϕ 15.6/Cr coarting
A14L-0166-0301#145X0559	Gas nozzle (*2)	1	Bottle type φ14/Cr coarting
A14L-0166-0301#145X0573	Gas nozzle (*2)	1	Tapered type φ13/Cr coating
A14L-0166-0301#780A3230	Robot mount (*3)	1	
A14L-0166-0301#980X0013	Insulated cap (*3)	1	
A14L-0166-0301#780X0680	Insulated flange	1	
A14L-0166-0301#780X3220	Swivel	1	
A14L-0166-0301#980X2112	Torch cable	1	For ROBOWELD 100iC
A14L-0166-0301#124X0165	Liner	1	
A14L-0166-0301#980X2030	Cable changing help tool	1	

Table A (j) Parts for maintenance of torch ABIROB 350GC-30L for ARC Mate 100iC/6L (A05B-1291-H304)

Spec of parts for	Name of parts for	Unit	
maintenance	maintenance	Requirement	Remarks
A14L-0166-0301#980XF113	Torch neck Asbly. (*1)	1	With long neck and tip L=45mm, ϕ 1.2
A14L-0166-0301#980XF114	Torch neck Asbly. (*2)	1	With long neck and tip L=40mm, ϕ 1.2
A14L-0166-0301#980X0028	Torch neck	1	30 deg. long neck
A14L-0166-0301#142X0143	Tip holder . (*1)	1	For tip L=45mm, <i>φ</i> 1.2
A14L-0166-0301#142X0144	Tip holder (*2)	1	For tip L=40mm, <i>φ</i> 1.2
A14L-0166-0301#980X0142	Insulator	1	
A14L-0166-0301#980X0019	Gas diffuser	1	
A14L-0166-0301#140JP005	Tip . (*1)	1	L=45mm/CuCrZr/ φ 1.2/M6
A14L-0166-0301#140JP006	Tip (*2)	1	L=40mm/CuCrZr/ ϕ 1.2/M6
A14L-0166-0301#145X0558	Gas nozzle (*2)	1	Tapered type ϕ 12/Cr coarting
A14L-0166-0301#145XJ054	Gas nozzle . (*1)	1	Straight type ϕ 15.6 normal
A14L-0166-0301#145X0557	Gas nozzle (*2)	1	Straight type ϕ 15.6/Cr coarting
A14L-0166-0301#145X0559	Gas nozzle (*2)	1	Bottle type ϕ 14/Cr coarting
A14L-0166-0301#145X0573	Gas nozzle (*2)	1	Tapered type ϕ 13/Cr coating
A14L-0166-0301#780A3230	Robot mount (*3)	1	
A14L-0166-0301#980X0013	Insulated cap (*3)	1	
A14L-0166-0301#780X0680	Insulated flange	1	
A14L-0166-0301#780X3220	Swivel	1	
A14L-0166-0301#980X2131	Torch cable	1	For ROBOWELD 100iC/6L
A14L-0166-0301#124X0165	Liner	1	
	Cable changing help		
A14L-0166-0301#980X2030	tool	1	

Table A (k) Parts for maintenance of torch ABIROB 350GC-30S for ARC Mate 120iC (A05B-1292-H301)

Spec of parts for	Name of parts for	Unit	Remarks
maintenance	maintenance	requirement	Remarks
			With short neck and tip L=45mm, ϕ
A14L-0166-0301#980XF111	Torch neck Asbly. (*1)	1	1.2
			With short neck and tip L=40mm, ϕ
A14L-0166-0301#980XF112	Torch neck Asbly. (*2)	1	1.2
A14L-0166-0301#980X0027	Torch neck	1	30 deg. short neck
A14L-0166-0301#142X0143	Tip holder . (*1)	1	For tip L=45mm, ϕ 1.2
A14L-0166-0301#142X0144	Tip holder (*2)	1	For tip L=40mm, ϕ 1.2
A14L-0166-0301#980X0142	Insulator	1	
A14L-0166-0301#980X0019	Gas diffuser	1	
A14L-0166-0301#140JP005	Tip (*1)	1	L=45mm/CuCrZr/ ϕ 1.2/M6
A14L-0166-0301#140JP006	Tip (*2)	1	L=40mm/CuCrZr/ \(\phi \) 1.2/M6
A14L-0166-0301#145X0558	Gas nozzle (*2)	1	Tapered type ϕ 12/Cr coarting
A14L-0166-0301#145XJ054	Gas nozzle . (*1)	1	Straight type ϕ 15.6 normal
A14L-0166-0301#145X0557	Gas nozzle (*2)	1	Straight type ϕ 15.6/Cr coarting
A14L-0166-0301#145X0559	Gas nozzle (*2)	1	Bottle type ϕ 14/Cr coarting
A14L-0166-0301#145X0573	Gas nozzle (*2)	1	Tapered type ϕ 13/Cr coating
A14L-0166-0301#780A3230	Robot mount (*3)	1	
A14L-0166-0301#980X0013	Insulated cap (*3)	1	
A14L-0166-0301#780X0680	Insulated flange	1	
A14L-0166-0301#780X3220	Swivel	1	
A14L-0166-0301#980X2147	Torch cable	1	For ROBOWELD 120iC
A14L-0166-0301#124X0165	Liner	1	
	Cable changing help		
A14L-0166-0301#980X2030	tool	1	

Table A (I) Parts for maintenance of torch ABIROB 350GC-30S for ARC Mate 120iC/10L (A05B-1292-H302)

Spec of parts for	Name of parts for	Unit	Remarks
maintenance	maintenance	requirement	
A14L-0166-0301#980XF111	Torch neck Asbly. (*1)	1	With short neck and tip L=45mm,
			φ1.2
A14L-0166-0301#980XF112	Torch neck Asbly. (*2)		With short neck and tip L=40mm,
		1	φ1.2
A14L-0166-0301#980X0027	Torch neck	1	30 deg. short neck
A14L-0166-0301#142X0143	Tip holder (*1)	1	For tip L=45mm, ϕ 1.2
A14L-0166-0301#142X0144	Tip holder (*2)	1	For tip L=40mm, ϕ 1.2
A14L-0166-0301#980X0142	Insulator	1	
A14L-0166-0301#980X0019	Gas diffuser	1	
A14L-0166-0301#140JP005	Tip (*1)	1	L=45mm/CuCrZr/ ϕ 1.2/M6
A14L-0166-0301#140JP006	Tip (*2)	1	L=40mm/CuCrZr/ ϕ 1.2/M6
A14L-0166-0301#145X0558	Gas nozzle (*2)	1	Tapered type ϕ 12/Cr coarting
A14L-0166-0301#145XJ054	Gas nozzle (*1)	1	Straight type ϕ 15.6 normal
A14L-0166-0301#145X0557	Gas nozzle (*2)	1	Straight type ϕ 15.6/Cr coarting
A14L-0166-0301#145X0559	Gas nozzle (*2)	1	Bottle type ϕ 14/Cr coarting
A14L-0166-0301#145X0573	Gas nozzle (*2)	1	Tapered type φ 13/Cr coating
A14L-0166-0301#780A3230	Robot mount (*3)	1	
A14L-0166-0301#980X0013	Insulated cap (*3)	1	
A14L-0166-0301#780X0680	Insulated flange	1	
A14L-0166-0301#780X3220	Swivel	1	
A14L-0166-0301#980X2148	Torch cable	1	For ROBOWELD 120 <i>i</i> C/10L
A14L-0166-0301#124X0165	Liner	1	
A14L-0166-0301#980X2030	Cable changing help tool	1	

Table A (m) Parts for maintenance of torch ABIROB 350GC-30L for ARC Mate 120iC (A05B-1292-H303)

Spec of parts for maintenance	Name of parts for maintenance	Unit requirement	Remarks
A14L-0166-0301#980XF113	Torch neck Asbly. (*1)	1	With long neck and tip L=45mm, ϕ 1.2
A14L-0166-0301#980XF114	Torch neck Asbly. (*2)	1	With long neck and tip L=40mm, <i>ϕ</i> 1.2
A14L-0166-0301#980X0028	Torch neck	1	30 deg. long neck
A14L-0166-0301#142X0143	Tip holder (*1)	1	For tip L=45mm, ϕ 1.2
A14L-0166-0301#142X0144	Tip holder (*2)	1	For tip L=40mm, ϕ 1.2
A14L-0166-0301#980X0142	Insulator	1	
A14L-0166-0301#980X0019	Gas diffuser	1	
A14L-0166-0301#140JP005	Tip (*1)	1	L=45mm/CuCrZr/ ϕ 1.2/M6
A14L-0166-0301#140JP006	Tip	1	L=40mm/CuCrZr/ ϕ 1.2/M6
A14L-0166-0301#145X0558	Gas nozzle (*2)	1	Tapered type ϕ 12/Cr coarting
A14L-0166-0301#145XJ054	Gas nozzle (*1)	1	Straight type ϕ 15.6 normal
A14L-0166-0301#145X0557	Gas nozzle (*2)	1	Straight type ϕ 15.6/Cr coarting
A14L-0166-0301#145X0559	Gas nozzle (*2)	1	Bottle type ϕ 14/Cr coarting
A14L-0166-0301#145X0573	Gas nozzle (*2)	1	Tapered type ϕ 13/Cr coating
A14L-0166-0301#780A3230	Robot mount (*3)	1	
A14L-0166-0301#980X0013	Insulated cap (*3)	1	
A14L-0166-0301#780X0680	Insulated flange	1	
A14L-0166-0301#780X3220	Swivel	1	
A14L-0166-0301#980X2147	Torch cable	1	For ROBOWELD 120iC
A14L-0166-0301#124X0165	Liner	1	
A14L-0166-0301#980X2030	Cable changing help tool	1	

Table A (n) Parts for maintenance of torch ABIROB 350GC-30L for ARC Mate 120iC/10L (A05B-1292-H304)

APPENDIX

Spec of parts for	Name of parts for	Unit	Remarks
maintenance	maintenance	requirement	
A14L-0166-0301#980XF113	Torch neck Asbly. (*1)		With long neck and tip L=45mm,
		1	φ1.2
A14L-0166-0301#980XF114	Torch neck Asbly. (*2)		With long neck and tip L=40mm,
		1	φ1.2
A14L-0166-0301#980X0028	Torch neck	1	30 deg. long neck
A14L-0166-0301#142X0143	Tip holder (*1)	1	For tip L=45mm, ϕ 1.2
A14L-0166-0301#142X0144	Tip holder (*2)	1	For tip L=40mm, ϕ 1.2
A14L-0166-0301#980X0142	Insulator	1	
A14L-0166-0301#980X0019	Gas diffuser	1	
A14L-0166-0301#140JP005	Tip (*1)	1	L=45mm/CuCrZr/ φ 1.2/M6
A14L-0166-0301#140JP006	Tip	1	L=40mm/CuCrZr/ φ 1.2/M6
A14L-0166-0301#145X0558	Gas nozzle (*2)	1	Tapered type ϕ 12/Cr coarting
A14L-0166-0301#145XJ054	Gas nozzle (*1)	1	Straight type ϕ 15.6 normal
A14L-0166-0301#145X0557	Gas nozzle (*2)	1	Straight type ϕ 15.6/Cr coarting
A14L-0166-0301#145X0559	Gas nozzle (*2)	1	Bottle type ϕ 14/Cr coarting
A14L-0166-0301#145X0573	Gas nozzle (*2)	1	Tapered type ϕ 13/Cr coating
A14L-0166-0301#780A3230	Robot mount (*3)	1	
A14L-0166-0301#980X0013	Insulated cap (*3)		
A14L-0166-0301#780X0680	Insulated flange	1	
A14L-0166-0301#780X3220	Swivel	1	
A14L-0166-0301#980X2148	Torch cable	1	For ROBOWELD 120iC/10L
A14L-0166-0301#124X0165	Liner	1	
A14L-0166-0301#980X2030	Cable changing help tool	1	

- (*1) These parts are usually incorporated.
- (*2) The change to these parts is possible by optional appointment.
- (*3) The robot mount is not installed to an old-model insulated cap. When you order robot mount in case of old-model insulated cap, be sure to order insulated cap at the same time.

Be sure to apply grease of figure to O ring of water cooling torch neck.

If grease is not applied, it may cause broken of O ring. Use cotton swab of appendix to apply grease.

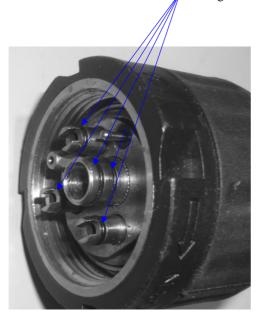




Fig.A (d) Applying grease to O ring of attached of water cooling torch

Unit: Nm

B

MOUNTING BOLT TORQUE LIST

NOTE

When applying LOCTITE to the important bolt tightening points, make sure that it is applied to the entire length portion of the engaging area of the female threads. If it is applied to the male threads, the bolts could become loose due to insufficient adhesion. Clean the bolts and threaded holes and wipe off oil on the engaging section. Make sure that there is no solvent in the threaded holes. Be sure to wipe the excess LOCTITE after tightening the bolt.

Use bolt which strengths are below.

But if it is specified in text, obey it. Hexagon socket head bolt made by steel

Pacammandad halt tightaning tarquae

Size is M22 or less: Tensile strength 1200N/mm² or more Size is M24 or more: Tensile strength 1000N/mm² or more All size of bolt of the plating: Tensile strength 1000N/mm² or more

Hexagon bolt, stainless bolt, special shape bolt (button bolt, low-head bolt, flush bolt .etc) Tensile strength 400N/mm^2 or more

If no tightening torque is specified for a bolt, tighten it according to this table.

Recomme	ended bolt tightening torques Unit: Nm Hexagon socket head							
Nominal diameter	bo	ocket head olt eel)	Hexagon socket head bolt (stainless)		button bolt gon socket head Hexagon socket head		Hexagon bolt (steel)	
	Tightenir	ng torque	Tightenii	ng torque	Tightenir	ng torque	Tightenir	ng torque
	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit
М3	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						

C PROCESS MODE

C.1 PROCESS MODE LIST

In this section, the process mode list of PowerWave R350, PowerWave i400 and Invertec CV350-R is explained. If you want to know more detailed information or process mode of another weld equipment, please refer to weld equipment manual.

NOTE

Available process modes will be changed by the installed firmware version and weld table version in the weld power supply. Please use these lists as a reference information.

C.1.1 PowerWave R350 Process Mode List

Firmware Version : S28735-01 Weld Table Version : Z113230

Mode	Pulse/CV	Material	Diameter (mm)	CTWD (mm)	Gas
10	CV	Steel	1.0	12	100%CO2
11	CV	Steel	1.0	12	80%Ar 20%CO2
12	Pulse	Steel	1.0	12	80%Ar 20%CO2
13	Rapid Arc	Steel	1.0	12	80%Ar 20%CO2
18	Rapid Arc	Steel	1.2	15	80%Ar 20%CO2
20	CV	Steel	1.2	15	100%CO2
21	CV	Steel	1.2	15	80%Ar 20%CO2
22	Pulse	Steel	1.2	15	80%Ar 20%CO2
29	CV	Stainless	0.9	12	80%Ar 20%CO2
30	Pulse	Stainless	0.8	12	98%Ar 2%O2
31	Pulse	Stainless	1.0	12	98%Ar 2%O2
33	Pulse	Stainless	1.0	12	80%Ar 18%He 2%CO2
34	Pulse	Stainless	1.0	12	80%Ar 18%He 2%CO2
36	Pulse	Stainless	1.0	12	80%Ar 20%CO2
41	CV	Stainless	1.2	15	80%Ar 20%CO2
43	CV	Stainless	1.2	15	80%Ar 18%He 2%CO2
44	Pulse	Stainless	1.2	15	80%Ar 18%He 2%CO2
46	Pulse	Stainless	1.2	15	80%Ar 20%CO2
61	CV	Stainless	0.8	12	80%Ar 20%CO2
63	CV	Stainless	0.8	12	80%Ar 18%He 2%CO2
64	CV	Stainless	0.8	12	80%Ar 18%He 2%CO2
66	CV	Stainless	0.8	12	80%Ar 20%CO2
71	CV	Alumi 4043	1.2	15	100%Ar
72	Pulse	Alumi 4043	1.2	15	100%Ar
73	CV	Alumi 4043	1.6	18	100%Ar
74	Pulse	Alumi 4043	1.6	18	100%Ar
75	CV	Alumi 5356	1.2	15	100%Ar
76	Pulse	Alumi 5356	1.2	15	100%Ar
77	CV	Alumi 5356	1.6	18	100%Ar
78	Pulse	Alumi 5356	1.6	18	100%Ar
93	CV	Steel	0.8	12	100%CO2

Mode	Pulse/CV	Material	Diameter (mm)	CTWD (mm)	Gas
94	CV	Steel	0.8	12	80%Ar 20%CO2
95	Pulse	Steel	0.8	12	80%Ar 20%CO2
151	CV	Alumi 5356	1.0	12	100%Ar
152	Pulse	Alumi 5356	1.0	12	100%Ar
280	CV	Steel	0.9	12	100%CO2
281	CV	Steel	0.9	12	80%Ar 20%CO2
282	Pulse	Steel	0.9	12	80%Ar 20%CO2
283	Rapid Arc	Steel	0.9	12	80%Ar 20%CO2

You can use process modes in the following list only when STT unit is connected to PowerWave R350.

Mode	Pulse/CV	Material	Diameter (mm)	CTWD (mm)	Gas
155	Rapid X	Steel	1.0	12	80%Ar 20%CO2
156	Rapid X	Steel	1.2	15	80%Ar 20%CO2
304	Non-synergic STT	Steel	0.9	12	100%CO2
305	Non-synergic STT	Steel	0.9	12	80%Ar 20%CO2
306	Non-synergic STT	Steel	1.0	12	100%CO2
307	Non-synergic STT	Steel	1.0	12	80%Ar 20%CO2
308	Non-synergic STT	Steel	1.2	15	100%CO2
309	Non-synergic STT	Steel	1.2	15	80%Ar 20%CO2
324	Synergic STT	Steel	0.9	12	100%CO2
325	Synergic STT	Steel	0.9	12	80%Ar 20%CO2
326	Synergic STT	Steel	1.0	12	100%CO2
327	Synergic STT	Steel	1.0	12	80%Ar 20%CO2
328	Synergic STT	Steel	1.2	15	100%CO2
329	Synergic STT	Steel	1.2	15	80%Ar 20%CO2
344	Non-synergic STT	Stainless	0.9	12	80%Ar 20%CO2
345	Non-synergic STT	Stainless	0.9	12	80%Ar 18%He 2%CO2
346	Non-synergic STT	Stainless	1.0	12	80%Ar 20%CO2
347	Non-synergic STT	Stainless	1.0	12	80%Ar 18%He 2%CO2
348	Non-synergic STT	Stainless	1.2	15	80%Ar 20%CO2
349	Non-synergic STT	Stainless	1.2	15	80%Ar 18%He 2%CO2
364	Synergic STT	Stainless	0.9	12	80%Ar 20%CO2
365	Synergic STT	Stainless	0.9	12	80%Ar 18%He 2%CO2
366	Synergic STT	Stainless	1.0	12	80%Ar 20%CO2
367	Synergic STT	Stainless	1.0	12	80%Ar 18%He 2%CO2
368	Synergic STT	Stainless	1.2	15	80%Ar 20%CO2
369	Synergic STT	Stainless	1.2	15	80%Ar 18%He 2%CO2

C.1.2 PowerWave i400 Process Mode List

Firmware Version : S27271-15 Weld Table Version : Z123258

Mode	Pulse/CV	Material	Diameter (mm)	CTWD (mm)	Gas
10	CV	Steel	1.0	12	100%CO2
11	CV	Steel	1.0	12	80%Ar 20%CO2
12	Pulse	Steel	1.0	12	80%Ar 20%CO2
13	Rapid Arc	Steel	1.0	12	80%Ar 20%CO2
18	Rapid Arc	Steel	1.2	15	80%Ar 20%CO2
20	CV	Steel	1.2	15	100%CO2
21	CV	Steel	1.2	15	80%Ar 20%CO2
22	Pulse	Steel	1.2	15	80%Ar 20%CO2
29	CV	Stainless	0.9	12	80%Ar 20%CO2
30	Pulse	Stainless	0.8	12	98%Ar 2%O2
31	CV	Stainless	1.0	12	98%Ar 2%O2
32	Pulse	Stainless	1.0	12	98%Ar 2%O2
41	CV	Stainless	1.2	15	98%Ar 2%O2
42	Pulse	Stainless	1.2	15	98%Ar 2%O2
93	CV	Steel	0.8	12	100%CO2
94	CV	Steel	0.8	12	80%Ar 20%CO2
138	CV	Steel	0.9	12	100%CO2
139	CV	Steel	0.9	12	80%Ar 20%CO2
140	Pulse	Steel	0.9	12	80%Ar 20%CO2
141	Rapid Arc	Steel	0.9	12	80%Ar 20%CO2

C.1.3 Invertec CV350-R Process Mode List

Firmware Version : S27357-11 Weld Table Version : Z103122

Mode	Pulse/CV	Material	Diameter (mm)	CTWD (mm)	Gas
10	CV	Steel	1.0	12	100%CO2
11	CV	Steel	1.0	12	80%Ar 20%CO2
12	Pulse	Steel	1.0	12	80%Ar 20%CO2
13	Rapid Arc	Steel	1.0	12	80%Ar 20%CO2
14	CV	Steel	0.9	12	100%CO2
15	CV	Steel	0.9	12	80%Ar 20%CO2
16	Pulse	Steel	0.9	12	80%Ar 20%CO2
17	Rapid Arc	Steel	0.9	12	80%Ar 20%CO2
18	Rapid Arc	Steel	1.2	15	80%Ar 20%CO2
20	CV	Steel	1.2	15	100%CO2
21	CV	Steel	1.2	15	80%Ar 20%CO2
22	Pulse	Steel	1.2	15	80%Ar 20%CO2
29	CV	Stainless	0.9	12	80%Ar 20%CO2
30	Pulse	Stainless	0.8	12	98%Ar 2%O2
31	CV	Stainless	1.0	12	98%Ar 2%O2
32	Pulse	Stainless	1.0	12	98%Ar 2%O2
41	CV	Stainless	1.2	15	98%Ar 2%O2
42	Pulse	Stainless	1.2	15	98%Ar 2%O2
93	CV	Steel	0.8	12	100%CO2
94	CV	Steel	0.8	12	80%Ar 20%CO2

C.2 RECOMMEND VOLTAGE AND RANGES BY CURRENT IN **PROCESS MODE**

Power Wave i400: Weld Mode Data Sheet

Mode Number:

Process Information:

GMAW	CV	Trim Range
1.0mm	Steel	40%
100% CO2		

		12mm		e Data for CTWD of:	I able
Maximu Weldir Voltad	Recommended Welding Voltage	Minimum Welding Voltage	Welding Current	eed Speed inches/min	Wire Fe
23.8	17.0	10.2	32	50	1.27
25.2	18.0	10.8	55	75	1.91
26.6	19.0	11.4	75	100	1.91
27.4	19.6	11.8	100	150	2.54
29.1	20.8	12.5	125	200	3.81
30.5	21.8	13.1	150	250	5.08
31.4	22.4	13.4	175	300	6.35
32.9	23.5	14.1	200	350	7.62
34.4	24.6	14.8	220	400	8.89
37.0	26.4	15.8	240	450	10.16
43.7	31.2	18.7	300	600	11.43
49.3	35.2	21.1	370	800	15.24

Power Wave i400: Weld Mode Data Sheet

Mode Number:

11

Process Information:

GMAW	CV	Trim Range
1.0mm	Steel	40%
Argon CO2		

Table Data for CTWD of: 12mm

Wire Fe	eed Speed	Welding	Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding Voltage	Welding Voltage	Welding Voltage
1.27 1.91 1.91 2.54 3.81 5.08 6.35 7.62 8.89 10.16 11.43 15.24	50 75 100 150 200 250 300 350 400 450 600 800	40.0 55.0 75.0 105.0 135.0 160.0 185.0 205.0 225.0 245.0 305.0 400.0	8.5 9.2 9.9 10.5 11.1 11.7 12.0 12.4 12.9 13.5 16.1 20.7	14.2 15.3 16.5 17.5 18.5 19.5 20.0 20.6 21.5 22.5 26.8 34.5	19.9 21.4 23.1 24.5 25.9 27.3 28.0 28.8 30.1 31.5 37.5 48.3

Mode Number: 12

Process Information:

GMAW	Pulse	Trim Range
1.0mm	Steel	25%
Argon CO2		

Table Data for CTWD of: 12mm

Wire Fe	ed Speed	Welding	Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding	Welding	Welding
			Voltage	Voltage	Voltage
1.27	50	30	13.5	18.0	22.5
1.52	60	35	13.9	18.5	23.1
1.91	75	45	15.0	20.0	25.0
2.54	100	60	15.4	20.5	25.6
3.81	150	87	16.5	22.0	27.5
5.08	200	115	17.6	23.5	29.4
6.35	250	140	18.4	24.5	30.6
7.62	300	165	19.1	25.5	31.9
8.89	350	190	19.9	26.5	33.1
10.16	400	215	20.6	27.5	34.4
11.43	450	250	21.4	28.5	35.6
12.70	500	275	22.1	29.5	36.9
15.24	600	310	23.3	31.0	38.8
17.78	700	345	24.4	32.5	40.6
20.32	800	375	25.1	33.5	41.9

Power Wave i400: Weld Mode Data Sheet

Mode Number: 13

Process Information:GMAWRapicArcTrim Range1.0mmSteel25%

1.0mm Steel 25% Argon CO2

Table Data for CTWD of: 12mm

Wire Fe	ed Speed	Welding	Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding	Welding	Welding
			Voltage	Voltage	Voltage
1.52	60	35	13.9	18.5	23.1
1.91	75	45	14.3	19.0	23.8
2.54	100	57	14.6	19.5	24.4
3.81	150	85	15.4	20.5	25.6
5.08	200	110	16.9	22.5	28.1
6.35	250	135	17.6	23.5	29.4
7.62	300	160	18.0	24.0	30.0
8.89	350	185	18.4	24.5	30.6
10.16	400	205	18.8	25.0	31.3
11.43	450	225	19.1	25.5	31.9
12.70	500	245	19.5	26.0	32.5
15.24	600	280	20.3	27.0	33.8
17.78	700	310	21.0	28.0	35.0
20.32	800	330	21.8	29.0	36.3

Mode Number: 18

Process Information:

GMAW	RapidArc	Trim Range
1.2mm	Steel	25%
Argon CO2		

Table Data for CTWD of:	15mm

Wire Fe	ed Speed inches/min	Welding	Minimum	Recommended	Maximum
111/111111	inches/min	Current	Welding Voltage	Welding Voltage	Welding Voltage
1.52	60	50	14.3	19.0	23.8
1.91	75	65	14.6	19.5	24.4
2.54	100	85	15.4	20.5	25.6
3.81	150	125	16.5	22.0	27.5
5.08	200	155	17.3	23.0	28.8
6.35	250	185	17.6	23.5	29.4
7.62	300	220	18.0	24.0	30.0
8.89	350	250	18.4	24.5	30.6
10.16	400	275	18.8	25.0	31.3
11.43	450	300	19.1	25.5	31.9
12.70	500	330	19.5	26.0	32.5
15.24	600	375	20.3	27.0	33.8

Power Wave i400: Weld Mode Data Sheet

Mode Number: 20

Process Information: GMAW

GMAW	CV	Trim Range
1.2mm	Steel	40%
100% CO2		

Tabl	le Data for CTWD of:		15mm		
Wire Fe	eed Speed	Welding	Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding Voltage	Welding Voltage	Welding Voltage
1.27 1.91 2.54 3.18 3.81 4.45 5.08 6.35 7.62 8.89 11.43 15.24	50 75 100 125 150 175 200 250 300 350 450 600	55 85 115 135 150 165 185 215 250 290 340 395	10.3 10.4 10.6 10.9 11.1 11.7 12.3 13.3 14.2 15.7 18.2 20.3	17.1 17.4 17.7 18.1 18.5 19.5 20.5 22.1 23.6 26.1 30.3 33.9	23.9 24.4 24.8 25.3 25.9 27.3 28.7 30.9 33.0 36.5 42.4 47.5

Mode Number: 21

Process Information:

GMAW	CV	Trim Range
1.2mm	Steel	40%
Argon CO2		

Table Data for CTWD of: 15mm

	eed Speed inches/min	Welding	Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding Voltage	Welding Voltage	Welding Voltage
1.27	50	65	8.4	14.0	19.6
1.91	75	90	8.7	14.5	20.3
2.54	100	115	9.0	15.0	21.0
3.18	125	140	9.3	15.5	21.7
3.81	150	160	9.5	15.9	22.3
4.45	175	175	10.0	16.7	23.4
5.08	200	200	10.3	17.2	24.1
6.35	250	235	10.8	18.0	25.2
7.62	300	255	12.0	20.0	28.0
8.89	350	280	15.0	25.0	35.0
11.43	450	350	16.8	28.0	39.2
15.24	600	430	18.6	31.0	43.4

Power Wave i400: Weld Mode Data Sheet

Mode Number: 22

Process Information:

GMAW	Pulse	Trim Range
1.2mm	Steel	25%
Argon CO2		

15mm Table Data for CTWD of: Wire Feed Speed Welding Minimum Recommended Maximum inches/min m/min Welding Current Welding Welding Voltage Voltage Voltage 1.27 50 40 13.5 18.0 22.5 1.52 60 50 14.3 19.0 23.8 75 65 15.4 20.5 25.6 1.91 2.54 100 90 16.1 21.5 26.9 3.81 150 135 17.6 23.5 29.4 5.08 200 170 18.8 25.0 31.3 6.35 250 205 19.9 26.5 33.1 7.62 300 250 21.4 28.5 35.6 8.89 350 285 21.8 29.0 36.3 10.16 400 310 22.3 29.7 37.1 450 11.43 340 22.9 30.5 38.1 12.70 500 370 23.3 31.0 38.8 15.24 600 420 24.4 32.5 40.6

Mode Number: 29

Process Information:

Table Data for CTWD of:

GMAW	CV	Trim Range
0.9mm	Stainless	35%
Argon O2		

Table Data for CTWD of:	12mm

Wire Fe	ed Speed	Welding	Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding	Welding	Welding
			Voltage	Voltage	Voltage
1.27	50	26	8.1	12.5	16.9
1.91	75	38	8.3	12.8	17.3
2.54	100	52	8.5	13.1	17.7
3.18	125	63	8.8	13.5	18.2
3.81	150	75	9.0	13.9	18.8
4.45	175	85	9.4	14.4	19.4
5.08	200	95	9.8	15.0	20.3
6.35	250	114	10.4	16.0	21.6
7.62	300	135	10.8	16.6	22.4
8.89	350	155	11.3	17.4	23.5
10.16	400	175	12.0	18.5	25.0
11.43	450	190	12.6	19.4	26.2
13.97	550	220	13.7	21.0	28.4
15.24	600	236	14.6	22.5	30.4
17.78	700	250	15.3	23.5	31.7
20.32	800	275	15.6	24.0	32.4

Power Wave i400: Weld Mode Data Sheet

Mode Number: 30

Process Information: GMAW Pulse Trim Range

0.9mm Stainless 25% Argon O2

12mm

Wire Fe	Wire Feed Speed		Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding Voltage	Welding Voltage	Welding Voltage
1.52	60	29	11.6	15.4	19.3
1.91	75	40	11.9	15.9	19.9
2.54	100	54	12.7	16.9	21.1
3.81	150	72	13.4	17.9	22.4
5.08	200	93	14.3	19.0	23.8
6.35	250	110	15.0	20.0	25.0
7.62	300	135	15.7	20.9	26.1
8.89	350	156	16.4	21.9	27.4
10.16	400	176	17.2	22.9	28.6
11.43	450	201	17.9	23.9	29.9
12.70	500	219	18.4	24.5	30.6
15.24	600	251	18.8	25.0	31.3
17.78	700	274	19.1	25.5	31.9
20.32	800	300	19.9	26.5	33.1

Mode Number: 31

Process Information:

GMAW	CV	Trim Range
1.0mm	Stainless	35%
Argon O2		

Table Data for CTWD of: 12mm

Wire Fe	ed Speed	Welding	Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding	Welding	Welding
			Voltage	Voltage	Voltage
1.27	50	34	8.0	12.3	16.6
1.91	75	52	8.4	12.9	17.4
2.54	100	69	8.6	13.2	17.8
3.18	125	84	8.7	13.4	18.1
3.81	150	100	9.0	13.8	18.6
4.45	175	113	9.4	14.4	19.4
5.08	200	128	9.7	14.9	20.1
6.35	250	149	9.9	15.3	20.7
7.62	300	166	10.5	16.1	21.7
8.89	350	191	11.0	16.9	22.8
10.16	400	205	11.5	17.7	23.9
11.43	450	223	12.1	18.6	25.1
13.97	550	250	12.8	19.7	26.6
15.24	600	263	13.2	20.3	27.4
17.78	700	288	13.7	21.1	28.5
20.32	800	317	14.3	22.0	29.7

Power Wave i400: Weld Mode Data Sheet

Mode Number: 32

Process Information: GMAW Pulse Trim Range
1.0mm Stainless 25%
Argon O2

Table Data for CTWD of: 12mm Wire Feed Speed Welding Minimum Recommended Maximum inches/min m/min Current Welding Welding Welding Voltage Voltage Voltage 1.27 50 32 12.4 16.5 20.6 12.8 60 38 17.0 21.3 1.52 1.91 75 47 13.5 18.0 22.5 2.54 100 65 14.3 19.0 23.8 3.81 150 90 15.0 20.0 25.0 5.08 200 120 16.1 21.5 26.9 6.35 250 150 22.5 28.1 16.9 7.62 300 170 17.6 23.5 29.4 8.89 350 200 18.4 24.5 30.6 400 225 19.0 25.3 10.16 31.6 11.43 450 250 19.5 26.0 32.5 12.70 500 265 20.0 26.6 33.3 550 285 20.3 27.1 33.9 13.97 15.24 600 300 20.6 27.5 34.4 17.78 700 320 20.9 27.8 34.8 20.32 800 340 28.2 35.3 21.2

Mode Number: 41

Process Information:

GMAW	CV	Trim Range
1.2mm	Stainless	50%
Argon O2		

		15mm		e Data for CTWD of:	Table
Maximui Welding	Recommended Welding	Minimum Welding	Welding Current	ed Speed inches/min	Wire Fe
Voltage	Voltage	Voltage			
19.4	12.9	6.5	61	50	1.27
19.8	13.2	6.6	86	75	1.91
20.6	13.7	6.9	108	100	2.54
21.2	14.1	7.1	123	125	3.18
21.8	14.5	7.3	137	150	3.81
22.2	14.8	7.4	152	175	4.45
22.7	15.1	7.6	170	200	5.08
23.3	15.5	7.8	203	250	6.35
25.5	17.0	8.5	222	300	7.62
27.0	18.0	9.0	251	350	8.89
28.5	19.0	9.5	273	400	10.16
30.0	20.0	10.0	288	450	11.43
33.8	22.5	11.3	320	550	13.97
35.3	23.5	11.8	350	600	15.24

Power Wave i400: Weld Mode Data Sheet

Mode Number: 42

Process Information:

GMAW	Pulse	Trim Range
1.2mm	Stainless	25%
Argon O2		

Tabl	e Data for CTWD of:		15mm		
Wire Fe m/min	eed Speed inches/min	Welding Current	Minimum Welding Voltage	Recommended Welding Voltage	Maximum Welding Voltage
1.27 1.52 1.91 2.54 3.81 5.08 6.35 7.62 8.89 10.16 11.43 12.70 13.97 15.24	50 60 75 100 150 200 250 300 350 400 450 500 550 600	45 55 72 99 135 176 211 244 275 300 330 355 385 405	14.3 14.9 15.1 15.8 16.5 17.6 18.8 19.5 20.3 20.9 21.4 21.8 22.4 22.9	19.0 19.8 20.1 21.0 22.0 23.5 25.0 26.0 27.0 27.8 28.5 29.0 29.8 30.5	23.8 24.8 25.1 26.3 27.5 29.4 31.3 32.5 33.8 34.8 35.6 36.3 37.3 38.1

Mode Number: 93

Process Information:

GMAW	CV	Trim Range
0.8mm	Steel	35%
100% CO2		

Table Data for CTWD of:	12mm

Wire Fe	ed Speed	Welding	Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding	Welding	Welding
			Voltage	Voltage	Voltage
1.27	50	20	10.7	16.5	22.3
1.91	75	30	11.1	17.0	23.0
2.54	100	40	11.7	18.0	24.3
3.18	125	50	12.0	18.5	25.0
3.81	150	60	12.3	18.9	25.5
4.45	175	67	12.7	19.5	26.3
5.08	200	75	13.0	20.0	27.0
6.35	250	90	13.7	21.0	28.4
7.62	300	110	14.3	22.0	29.7
8.89	350	125	15.0	23.0	31.1
10.16	400	140	15.6	24.0	32.4
11.43	450	160	16.9	26.0	35.1
13.97	550	185	17.6	27.0	36.5
15.24	600	205	18.2	28.0	37.8
17.78	700	225	19.5	30.0	40.5
20.32	800	240	20.8	32.0	43.2

Power Wave i400: Weld Mode Data Sheet

Mode Number: 94

Process Information:

GMAW	CV	Trim Range
0.8mm	Steel	35%
Argon CO2		

Tabl	e Data for CTWD of:		12mm		
Wire Fe	ed Speed inches/min	Welding Current	Minimum Welding	Recommended Welding	Maximum Welding
111/111111	11101100/111111	Current	Voltage	Voltage	Voltage
1.91	75	35	9.4	14.5	19.6
2.54	100	45	9.8	15.0	20.3
3.18	125	57	10.1	15.5	20.9
3.81	150	70	10.4	16.0	21.6
4.45	175	80	10.7	16.5	22.3
5.08	200	90	11.1	17.0	23.0
6.35	250	105	11.4	17.5	23.6
7.62	300	120	11.7	18.0	24.3
8.89	350	135	12.0	18.5	25.0
10.16	400	150	12.4	19.0	25.7
11.43	450	165	13.0	20.0	27.0
13.97	550	180	15.6	24.0	32.4
15.24	600	195	16.6	25.5	34.4
17.78	700	220	18.2	28.0	37.8
20.32	800	245	19.5	30.0	40.5

Mode Number: 138

Process Information:

GMAW	CV	Trim Range
0.9mm	Steel	35%
100% CO2		

Table Data for CTWD of: 12mm	

Wire Fe	ed Speed	Welding	Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding Voltage	Welding Voltage	Welding Voltage
1.27	50	22	10.7	16.5	22.3
1.91	75	37	11.1	17.0	23.0
2.54	100	52	11.7	18.0	24.3
3.18	125	68	12.0	18.5	25.0
3.81	150	80	12.4	19.0	25.7
4.45	175	90	12.7	19.5	26.3
5.08	200	100	13.0	20.0	27.0
6.35	250	120	13.7	21.0	28.4
7.62	300	150	14.3	22.0	29.7
8.89	350	170	15.0	23.0	31.1
10.16	400	185	15.6	24.0	32.4
11.43	450	205	16.9	26.0	35.1
13.97	550	235	18.2	28.0	37.8
15.24	600	265	19.5	30.0	40.5
17.78	700	295	20.8	32.0	43.2
20.32	800	325	22.1	34.0	45.9

Power Wave i400: Weld Mode Data Sheet

Mode Number: 139

Process Information:

GMAW	CV	Trim Range
0.9mm	Steel	35%
Argon CO2		

Tabl	e Data for CTWD of:		12mm		
Wire Fe m/min	ed Speed inches/min	Welding Current	Minimum Welding Voltage	Recommended Welding Voltage	Maximum Welding Voltage
1.27	50	30	9.4	14.5	19.6
1.91	75	45	9.8	15.0	20.3
2.54	100	65	10.1	15.5	20.9
3.18	125	80	10.4	16.0	21.6
3.81	150	95	10.7	16.5	22.3
4.45	175	110	11.1	17.0	23.0
5.08	200	120	11.4	17.5	23.6
6.35	250	140	11.7	18.0	24.3
7.62	300	155	12.4	19.0	25.7
8.89	350	175	13.7	21.0	28.4
10.16	400	195	15.0	23.0	31.1
11.43	450	215	16.3	25.0	33.8
13.97	550	250	17.9	27.5	37.1
15.24	600	275	18.9	29.0	39.2
17.78	700	300	19.5	30.0	40.5
20.32	800	325	20.2	31.0	41.9

Mode Number: 140

Process Information:

GMAW	Pulse	Trim Range
0.9mm	Steel	25%
Argon CO2		

Table Data for CTWD of: 12mm

Wire Fe	ed Speed	Welding	Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding Voltage	Welding Voltage	Welding Voltage
1.27 1.52 1.91 2.54 3.81 5.08 6.35 7.62 8.89 10.16 11.43	50 60 75 100 150 200 250 300 350 400 450 500	25 30 38 50 73 95 118 140 160 180 195 220	13.5 13.9 14.3 15.0 15.8 16.9 18.0 18.8 19.5 20.3 21.0 21.8	18.0 18.5 19.0 20.0 21.0 22.5 24.0 25.0 26.0 27.0 28.0 29.0	22.5 23.1 23.8 25.0 26.3 28.1 30.0 31.3 32.5 33.8 35.0 36.3
15.24 17.78 20.32	600 700 800	255 290 325	22.9 24.0 24.8	30.5 32.0 33.0	38.1 40.0 41.3

Power Wave i400: Weld Mode Data Sheet

Mode Number: 141

Process Information: GMAW RapidArc Trim Range
0.9mm Steel 25%
Argon CO2

Table Data for CTWD of: 12mm

Wire Fe	Wire Feed Speed		Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding	Welding Voltage	Welding
			Voltage		Voltage
1.52	60	28	13.5	18.0	22.5
1.91	75	35	13.9	18.5	23.1
2.54	100	50	14.3	19.0	23.8
3.81	150	70	14.6	19.5	24.4
5.08	200	90	15.8	21.0	26.3
6.35	250	110	16.5	22.0	27.5
7.62	300	130	17.3	23.0	28.8
8.89	350	150	18.0	24.0	30.0
10.16	400	165	18.4	24.5	30.6
11.43	450	180	18.8	25.0	31.3
12.70	500	200	19.1	25.5	31.9
15.24	600	230	19.9	26.5	33.1
17.78	700	255	20.6	27.5	34.4
20.32	800	275	21.4	28.5	35.6

Mode Number: 10

Process Information:

GMAW	CV	Trim Range
1.0mm	Steel	NA
100% CO2		

Table Data for CTWD of:	12mm

Wire Fe m/min	eed Speed inches/min	Welding Current	Minimum Welding Voltage	Recommended Welding Voltage	Maximum Welding Voltage
			Voltage		Voltage
1.27	50	31		18.0	
1.91	75	55		18.4	
1.91	100	75		19.3	
2.54	150	101		20.0	
3.81	200	126		20.8	
5.08	250	153		21.8	
6.35	300	174		22.4	
7.62	350	200		23.5	
8.89	400	225		24.6	
10.16	450	250		27.1	
11.43	600	300		31.2	
15.24	800	350		35.2	

Invertec CV350-R: Weld Mode Data Sheet

Mode Number: 11

Process Information: GMAW CV Trim Range
1.0mm Steel NA
Argon CO2

_	
Table Data for CTWD of:	12mm

Wire Fe	Wire Feed Speed		Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding Voltage	Welding Voltage	Welding Voltage
1.27	50	37		14.2	
1.91	75	55		15.3	
1.91	100	70		16.5	
2.54	150	100		17.5	
3.81	200	125		18.5	
5.08	250	142		19.5	
6.35	300	172		20.0	
7.62	350	190		20.6	
8.89	400	212		21.8	
10.16	450	231		22.5	
11.43	600	300		26.8	
15.24	800	400		34.5	

Mode Number: 14

Process Information:

700

800

17.78

20.32

GMAW	CV	Trim Range
0.9mm	Steel	NA
100% CO2		

32.0

34.0

Tab	le Data for CTWD of:		12mm		
	eed Speed	Welding	Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding Voltage	Welding Voltage	Welding Voltage
1.27	50	22		17.5	
1.27	75	22 37		18.0	
2.54	100	52		18.5	
3.18	125	68		19.0	
3.81	150	80		19.5	
4.45	175	90		20.0	
5.08	200	100		20.5	
6.35	250	120		21.0	
7.62	300	150		22.0	
8.89	350	170		23.0	
10.16	400	185		24.0	
11.43	450	205		26.0	
13.97	550	235		28.0	
15.24	600	265		30.0	

Invertec CV350-R: Weld Mode Data Sheet

Mode Number: 15

295

325

Process Information: GMAW CV Trim Range
0.9mm Steel NA
Argon CO2

Tab	le Data for CTWD of:			
Wire Fe	eed Speed	Welding	Minimum	Recommended
m/min	inches/min	Current	Welding	Welding Voltage

	Wire Feed Speed		Welding	Minimum	Recommended	Maximum
	m/min	inches/min	Current	Welding	Welding Voltage	Welding
L				Voltage		Voltage
	1.27	50	30		14.5	
	1.91	75	45		15.0	
	2.54	100	65		15.5	
	3.18	125	80		16.0	
	3.81	150	95		16.5	
	4.45	175	110		17.0	
	5.08	200	120		17.5	
	6.35	250	140		18.0	
	7.62	300	155		19.0	
	8.89	350	175		21.0	
	10.16	400	195		23.0	
	11.43	450	215		25.0	
	13.97	550	250		27.5	
	15.24	600	275		29.0	
	17.78	700	300		30.0	
	20.32	800	325		31.0	

Mode Number: 20

Process Information:

Table Data for CTWD of:

7.62

8.89

11.43

13.97

GMAW	CV	Trim Range
1.2mm	Steel	NA
100% CO2		

15mm

23.6

26.1

30.3

33.9

	Wire Feed Speed		Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding Voltage	Welding Voltage	Welding Voltage
1.27	50	54		17.1	
1.91	75	80		17.4	
2.54	100	104		17.7	
3.18	125	130		18.1	
3.81	150	145		18.5	
4.45	175	162		19.5	
5.08	200	177		20.5	
6.35	250	206		22.1	

235

276

333

354

Invertec CV350-R: Weld Mode Data Sheet

Mode Number: 21

Process Information:

300

350

450

550

GMAW	CV	Trim Range
1.2mm	Steel	NA
Argon CO2		

Tab	le Data for CTWD of:		15mm		
Wire Fo	eed Speed	Welding	Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding Voltage	Welding Voltage	Welding Voltage
1.27	50	57		14.0	
1.91	75	89		14.5	
2.54	100	112		15.8	
3.18	125	132		15.9	
3.81	150	149		16.4	
4.45	175	161		17.7	
5.08	200	180		18.5	
6.35	250	208		19.8	
7.62	300	239		20.6	
8.89	350	270		25.8	
11.43	450	300		28.0	
15.24	600	354		31.0	

Mode Number: 31

Process Information:

Table Data for CTWD of:

GMAW	CV	Trim Range
1.0mm	Stainless	NA
Argon O2		

12mm

Wire Fe	re Feed Speed Welding		Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding Voltage	Welding Voltage	Welding Voltage
1.27	50	34		13.5	
1.91	75	52		14.0	
2.54	100	69		14.5	
3.18	125	84		15.0	
3.81	150	100		15.4	
4.45	175	113		15.8	
5.08	200	128		16.2	
6.35	250	149		16.5	
7.62	300	166		17.0	
8.89	350	191		18.5	
10.16	400	205		19.0	
11.43	450	223		19.5	

Invertec CV350-R: Weld Mode Data Sheet

Mode Number: 41

250

263

288

317

Process Information:

550

600

700

800

13.97

15.24

17.78

20.32

GMAW	CV	Trim Range
1.2mm	Stainless	NA
Argon O2		

20.5

22.0

23.5

25.0

Wire Feed Sp	peed	Welding	Minimum	Recommended	Maximum
n/min	inches/min	Current	Welding Voltage	Welding Voltage	Welding Voltage
1.91	75	86		14.6	
2.54	100	108		15.0	
3.18	125	123		15.2	
3.81	150	137		15.4	
4.45	175	152		15.7	
5.08	200	170		16.2	
6.35	250	203		17.5	
7.62	300	222		18.5	
8.89	350	251		19.5	
10.16	400	273		20.5	
11.43	450	288		21.5	
13.97	550	320		22.5	
15.24	600	350		23.5	
	1.27 1.91 2.54 3.18 3.81 4.45 5.08 6.35 7.62 8.89 10.16 11.43 13.97	1.27 50 1.91 75 2.54 100 3.18 125 3.81 150 4.45 175 5.08 200 6.35 250 7.62 300 8.89 350 10.16 400 11.43 450 13.97 550	1.27 50 61 1.91 75 86 2.54 100 108 3.18 125 123 3.81 150 137 4.45 175 152 5.08 200 170 6.35 250 203 7.62 300 222 8.89 350 251 10.16 400 273 11.43 450 288 13.97 550 320	1.27 50 61 1.91 75 86 2.54 100 108 3.18 125 123 3.81 150 137 4.45 175 152 5.08 200 170 6.35 250 203 7.62 300 222 8.89 350 251 10.16 400 273 11.43 450 288 13.97 550 320	1.27 50 61 14.2 1.91 75 86 14.6 2.54 100 108 15.0 3.18 125 123 15.2 3.81 150 137 15.4 4.45 175 152 15.7 5.08 200 170 16.2 6.35 250 203 17.5 7.62 300 222 18.5 8.89 350 251 19.5 10.16 400 273 20.5 11.43 450 288 21.5 13.97 550 320 Welding Voltage Welding Voltage

Mode Number: 93

Process Information:

GMAW	CV	Trim Range
0.8mm	Steel	NA
100% CO2		

Table Data for CTWD of:		IZMM		
			_	
Wire Feed Speed	Welding	Minimum	Recommended	N
m/min inches/min	Current	Welding	Welding Voltage	١

Wire Fee	Wire Feed Speed		Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding	Welding Voltage	Welding
			Voltage		Voltage
1.91	75	30		17.8	
2.54	100	40		18.2	
3.18	125	50		18.5	
3.81	150	60		19.0	
4.45	175	67		19.5	
5.08	200	75		20.0	
6.35	250	90		21.0	
7.62	300	110		22.0	
8.89	350	125		23.0	
10.16	400	140		24.0	
11.43	450	160		26.0	
13.97	550	185		27.0	
15.24	600	205		28.0	
17.78	700	225		30.0	
20.32	800	240		32.0	

Invertec CV350-R: Weld Mode Data Sheet

Mode Number: 94

CV **Process Information:** GMAW

Trim Range 0.8mm Steel NA Argon CO2

Tab	le Data for CTWD of:				
Wire Fe	ed Speed	Welding	Minimum	Recommended	Maximum
m/min	inches/min	Current	Welding	Welding Voltage	_
			Voltage		Voltage
1.91	75	35		14.5	
2.54	100	45		15.0	
3.18	125	57		15.5	
3.81	150	70		16.0	
4.45	175	80		16.5	
5.08	200	90		17.0	
6.35	250	105		17.5	
7.62	300	120		18.0	
8.89	350	135		18.5	
10.16	400	150		19.0	
11.43	450	165		20.0	
13.97	550	180		24.0	
15.24	600	195		25.5	
17.78	700	220		28.0	
20.32	800	245		30.0	
				- 310	

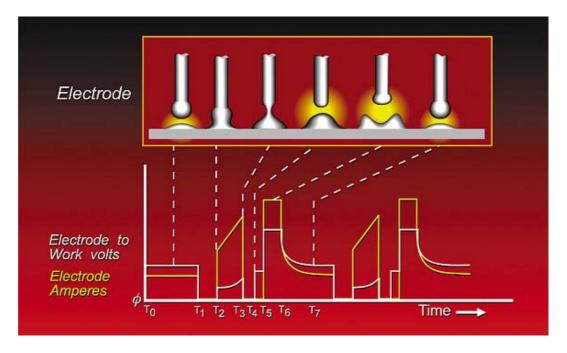
D STT WELDING (ROBOWELD iC/H2, H3)

D.1 OUTLINE OF STT WELDING

ROBOWELD *i*C/H2 and *i*C/H3 series support STT Welding (Surface Tension Transfer). STT Welding provides optimum droplet transfer made by maximal use of surface tension and minimal use of electromagnetic force with optimizing welding current and voltage waveform. As a result, you can get the following advantages.

- · Less spatter
- · Certain fusion with low heat input welds
- · Easier penetration welding
- · Less percent defective by burn through
- · Lower gas costs

The followings are the Waveform Control of STT Welding.



- (i) T0 T1: Background current is stabled
- (ii) T1 T2: After the electrode initially shorts to the weld pool, the current is quickly reduced to almost 0A to ensure a solid short.
- (iii) T2 T3: After ensuring a solid short, pinch current is then increased to squeeze molten metal down into the pool. During this section, the voltage is always monitored, the rate of change is calculated and the timing just before the short extinction is detected.
- (iv) T3 T4: When the timing just before the short extinction is detected, suddenly decrease the current and prevent the spatter by phase effect. Additionally, transfer the molten metal to the pool softly by a surface tension.
- (v) T4 T5: The short extinction occurs and arc is generated. However, the section is very short and just then transfers the next mode.
- (vi) T5-T6: After arc is generated again, suddenly increases the current (with 150-400A of peak current), accelerate the melt of wire. Arc length becomes proper and the melt into the work is maintained.

D.2 SETTING OF PROCESS MODE FOR STT WELDING

ROBOWELD iC/H2 Series

ROBOWELD iC/H2 can set and use the following two STT process modes.

STT CO2 Welding (Steel 1.2mm wire): Process Mode 117
 STT MAG Welding (Steel 1.2mm wire): Process Mode 118

ROBOWELD iC/H3 Series

About available STT process modes for ROBOWELD iC/H3, please refer to Appendix C.1.1.

D.3 ADJUSTMENT OF WELD SCHEDULE FOR STT WELDING

ROBOWELD iC/H2 Series

STT Weld Mode has the following three weld parameters.

Wire Feed Seed: Control deposition of wire (UNIT: inch/min)

Background Current: Control bead shape (DEFAULT:1.0, RANGE: 0.5 – 1.5)
 Peak Current: Control arc length (DEFAULT: 0.0, RANGE: -10 - +10)

Followings are the adjustment method of weld schedule.

1 First, set Wire Feed Speed that the deposition speed becomes ideal.

- 2 Execute welding while keeping Background Current with 1.0 and Peak Current with 0.0.
- 3 If arc explosion is large (a lot of spatter), adjust the Background Current between 1.1 1.2.

NOTE

When you use Non-Synergic STT process mode, wire feed speed command type should be selected. Please refer to Appendix G.4 "CHANGING COMMAND FORM OF WELD SCHEDULE".

E SHUNT OPTION

Shunt is highly precise resistor which resistance is small made for the current measurements of the circuit which a severe electric current flowed through.

In case of ROBOWELD iC series, you can confirm welding electric current and voltage by teach pendant. If you use ammeter which is set outside, shunt option which output current is prepared. In this chapter, connecting method and how to put out current and voltage signal are shown.

Table E shows specification of shunt. For details, such as the dimensions, refer to catalog of Yamaki Electric Corporation.

Table E Specification of shunt

Model	A rating electric current	A rating voltage descent	Maker / Dealer		
YS-3-400A60mV-C1	400A * Please set the electric current turning on electricity to become less than 80% (less than 320A).	60mV	YAMAKI Electric Corporation		

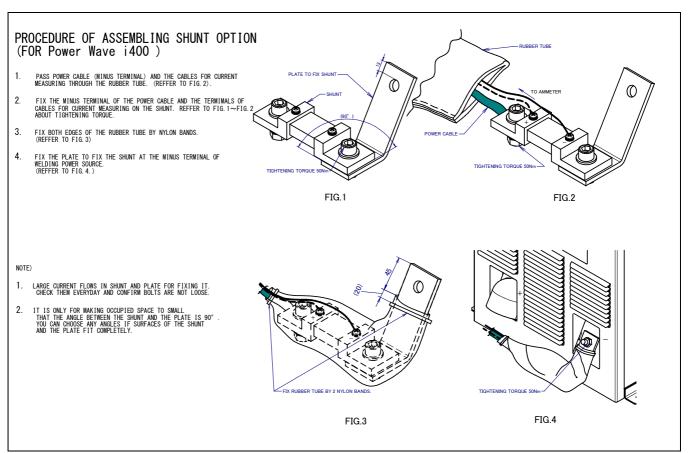


Fig.E (a) Procedure of assembling shunt option (ROBOWELD iC/H)

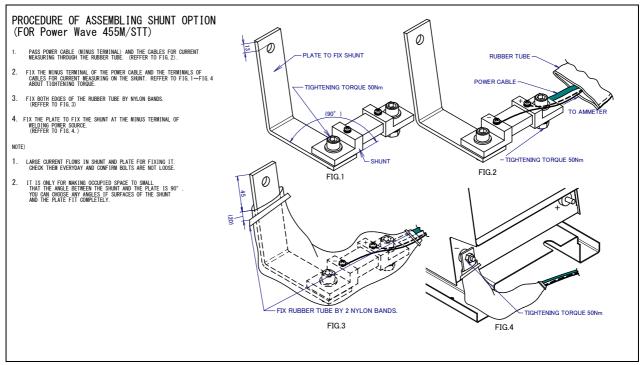


Fig.E (b) Procedure of assembling shunt option (ROBOWELD iC/H2)

Fig,E(c),(d) show connection method of voltmeter.

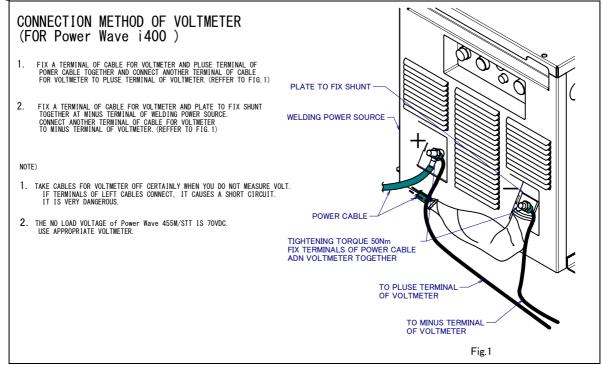


Fig.E (c) Connection method of voltmeter (ROBOWELD iC/H)

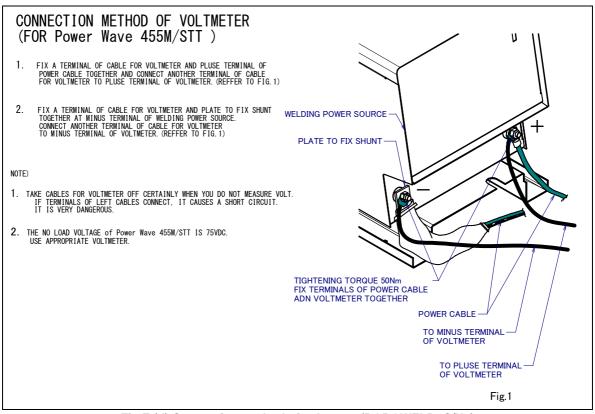


Fig.E (d) Connection method of voltmeter (ROBOWELD iC/H2)

F

PERIODIC MAINTENANCE TABLE

ROBOWELD iC

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
wer	1	Cleaning inside the welding power supply	0.5H			0		0		0		0		0	
Welding power supply	2	Confirm the damage situation of fan	0.1H			0		0		0		0		0	
Wel		Check the allophone and vibration	0.2H			0		0		0		0		0	
	4	Cleaning each parts	0.5H			0		0		0		0		0	
der	5	Check the tighten of bolts and other connection parts.	0.1H			0		0		0		0		0	
Wire feeder	6	Check the length of wire feeding	0.1H			0		0		0		0		0	
5	7	Check the gas valve	0.1H			0		0		0		0		0	
	8	Replace motor brush (*1)	0.5H			0		0		0		0		0	
Welding torch	9	Confirm looseness of counter nut. (BINZEL torch only) (*2)	0.1H	0	0	0	0	0	0	0	0	0	0	0	0
Velding	10	Replacing torch cable (Including conduit)	1.0H					•				•			
	11	Replacing liner	0.2H					•				•			
Around cable	12	Confirm the wire conduit	0.2H					0				0			

- *1 Replace the motor brush after 6 months operation or 250 million times of welding start (which ever comes first). If the brush is shorter than 12.7mm, replace it.
- *2 Perform check of confirm looseness of counter nut at every 1 month.
- *3 Refer to Chapter 6 about daily check and check items.
- *4 •: requires order of parts
 - O: doe not requires order of parts
- *5 Be sure to refer to maintenance section of welding power supply manual.
- *6 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		21120	22080	6 years 23040	24000	24960	25920	7 years 23040	27840	28800	29760	Item
0		0		0		0		0		0		0		0		0		0		1
0		0		0		0		0		0		0		0		0		0		2
0		0		0		0		0		0		0		0		0		0		3
0		0		0		0		0		0		0		0		0		0		4
0		0		0		0		0		0		0		0		0		0		5
0		0		0		0		0		0		0		0		0		0		6
0		0		0		0		0		0		0		0		0		0		7
0		0		0		0		0		0		0		0		0		0		8
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
•				•				•				•				•				10
•				•				•				•				•				11
0				0				0				0				0				12

G INITIAL SETTING

This chapter describes "Weld equipment select", "Setting of multi-process function", "Setting of wire feeder" and "Changing command form of weld schedule" as initial setting of welding power supply. These were already set when robot was shipped, so those settings are usually not required.

G.1 WELD EQUIPMENT SELECT

After you turn on the power supply of Robot controller and weld equipment, please wait a minute. This operation is required only when the message of "ARC-045 Weld EQ is OFFLINE" keeps displaying.

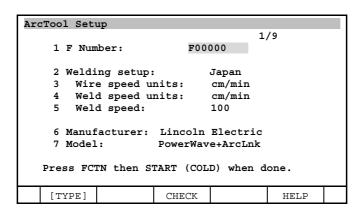
Weld equipment select is performed in ArcTool Setup Screen after controlled start. The procedure is different by kind of weld equipment. In case of ROBOWELD iC/H series or ROBOWELD iC/H3 series, please refer to Procedure G-1 (a). In case of ROBOWELD iC/E series or ROBOWELD iC/H2 series, please refer to Procedure G-1 (b).

In case of setting ROBOWELD *i*C/H series or ROBOWELD *i*C/H3 series, success/failure of the communication is displayed on the ArcTool Setup Screen. The method of the re-setting when the communication failed is also shown in Procedure G-1 (a).

Procedure G-1 (a) Weld equipment select (In case of ROBOWELD iC/H, H3 series)

Condition

- Lincoln Asia package is installed.
- LAN cable and robot controller are connected to the weld equipment correctly.
- The power supply of Robot controller and weld equipment are ON.
- · Controlled Start has been performed and the following ArcTool Setup screen is displayed.
- On ArcTool Setup screen, "Manufacturer" isn't "Lincoln Electric" or "Model" isn't "PowerWave + ENet".



ACAUTION

If the item of [Manufacturer] has already been set to "Lincoln Electric", do not change the item. Additionally, if the item of [Model] has already been set to "PowerWave + ENet", do not change the item. If those items are changed and then performed Cold Start, ArcTool recognizes that the model of the weld equipment is changed, and the part of current settings about Arc Welding (Weld Schedules, etc.) will be lost.

NOTE

[Welding setup] of the above-mentioned screen is not supported. It is not necessary to change this function from an initial value "Japan".

Step

- 1 Move the cursor to the [Manufacturer:]. Press F4 [CHOICE] and select [Lincoln Electric].
- 2 Move the cursor to the [Model]. Press F4 [CHOICE] and select the [PowerWave+ENet].
- 3 After the step 2, the following screen is displayed. Press F3 [CHECK]. Press ENTER key.

To setup PowerWave+Ethernet the Ethernet cable must be connected and the PowerWave must be ON.

[OK]

- 4 Robot controller begins obtaining MAC address and assigning the IP address of weld equipment. When the assignment completes, [PowerWave detected] is displayed at the prompt line. If this message is displayed then next procedure jumps to step 12.
- 5 When the communication failed in step 4, [Checking for PowerWave] is displayed and countdown starts. When the communication doesn't establish during countdown, [PowerWave not detected] is displayed.
- 6 If you would like to try setup again after failing setup, press F3 [CHECK]. The following screen is displayed. Press ENTER key.

Arc	Tool Setu	ıp				
				1/9		
	1 Enet	port :	1 is cor	rect		
	2 Bootp	server:	is enabl	ed		
	3 Bootr	index :	0 is INV	ALID		
	Pres	s ENTER to	o continu	e.		
	[TYPE]		CHECK		HELP	

7 The following message box is displayed. Select [YES].

The Ethernet setup is not Complete. It is best to Redo the Ethernet setup.

Redo the Ethernet setup?

[YES] [NO]

8 The following message box is displayed again. Please check the input power of weld equipment and the connection of Ethernet cable. If the power of weld equipment is not turned on, please turn it on and press ENTER key.

To setup PowerWave+Ethernet the Ethernet cable must be connected and the PowerWave must be ON.

[OK]

- 9 When IP address assignment completes, the message [PowerWave detected] is displayed. If this message is displayed then next procedure jumps to step 12.
- 10 If the connection is not established, [PowerWave not detected] is displayed and then the following message box is displayed. Please execute cycle power of both weld equipment and robot controller.

The Ethernet connection is not working. Exit this menu, check the Ethernet cable, and cycle power on the robot and the PowerWave.

[OK]

- 11 After robot controller completes the controlled start, [Setup incomplete, use CHECK] is displayed at the prompt line. Then, you can attempt to setup by pressing F3 [CHECK] key again. Please retry from Step 6.
- 12 If PowerWave is detected, press FCTN key and select [START (COLD)] and perform it.
- 13 After the 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: ArcLink

- 14 If ARC-051 is not displayed at step 13 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.
 - The setting of the welding equipment is not completed.

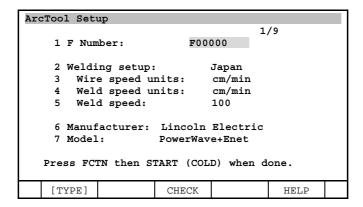
Please continue this procedure from step 6 in case of the power supply of weld equipment is turned on and this message keeps displaying. Please refer to Troubleshooting 7.1 for this message.

ARC-045 Weld EQ Device is OFFLINE

Procedure G-1 (b) Weld equipment select (In case of ROBOWELD iC/E, H2 series)

Condition

- Lincoln Asia package for standard weld equipment is installed.
- Robot controller is connected to weld equipment correctly by DeviceNet board and ArcLink cable.
- Robot controller and weld equipment power supplies are ON.
- Controlled Start has been performed and the following ArcTool Setup screen is displayed.
- On ArcTool Setup screen, "Manufacturer" isn't "Lincoln Electric" or "Model" isn't "PowerWave + ArcLnk".



ACAUTION

If the item of [Manufacturer] has already been set to "Lincoln Electric", do not change the item. Additionally, if the item of [Model] has already been set to "PowerWave + ArcLnk", do not change the item. If those items are changed and then performed Cold Start, ArcTool recognizes that the model of the weld equipment is changed, and the part of current settings about Arc Welding (Weld Schedules, etc.) will be lost.

ACAUTION

[Welding setup] of the above-mentioned screen is not supported. It is not necessary to change this function from an initial value "Japan".

Step

- Move the cursor to the [Manufacturer:]. Press F4 [CHOICE] and select [Lincoln Electric].
- Move the cursor to the [Model]. Press F4 [CHOICE] and select the [PowerWave+ArcLink]. 2
- Press FCTN key and select [START (COLD)] and perform it. 3
- 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: ArcLink

- If ARC-051 is not displayed at step 4 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.

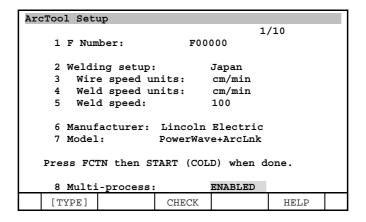
G.2 SETTING OF MULTI-PROCESS FUNCTION

In ROBOWELD *i*C series, 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 G-2 Setting of multi-process function

Condition

- · "PowerWave+ArcLnk" or "PowerWave+ENet" is selected as model of welding power supply
- ArcTool setup screen is displayed after performing Controlled Start.



Step

- Move the cursor to below and confirm multi-process is ENABLE. If multi-process is DISABLE, match the cursor to "multi-process" then press F4 「ENABLE」 key.
- 2 Press FCTN key and select [START (COLD)] then perform it.

G.3 SETTING OF WIRE FEEDER

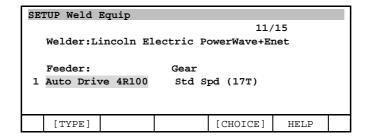
This section describes about setting of wire feeder. When except ROBOWELD *i*C/E series is connected, it is necessary to set appropriate wire feeder model correctly. If this setting is wrong, you cannot perform arc welding correctly. ROBOWELD *i*C/E series does not have setting item of wire feeder, so this setting is not required.

This setting is already set when robot is shipped, so it is usually not required.

Procedure G-3 Setting of wire feeder

Step

- 1 Press MENU key and select [6 SETUP].
- 2 Press F1 [TYPE] and select [Weld Equip]. The following weld equip set screen is displayed.



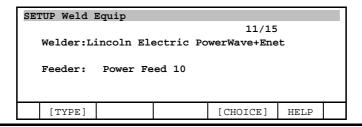
3 Confirm whether wire feeder model name of weld equip setup screen accords with wire feeder model name which is real installed to robot. If they are not equal, press F4 [CHOCE] key and select wire feeder which is installed to robot. Then "Reset Ei Arclink [NO]?" message is displayed, then press F4 [Yes].

NOTE

Setup information of wire feeder is saved by the weld equipment. Therefore, there is a possibility that the setup is different from previous one after the weld equipment unit is changed.

NOTE

If the connection with weld equipment has not been established or if the system is ROBOWELD *i*C/E series, the screen becomes the following and you cannot move the cursor on Wire Feeder item.



NOTE

If item of wire feeder and gear are not displayed after establishment of communication is done when weld equipment is connected, Select F1[TYPE] and select [Weld Equip], then display weld equip setting screen again.

G.4 CHANGING COMMAND FORM OF WELD SCHEDULE

It is possible to change the command form of weld schedule in case of except ROBOWELD *i*C/H2 series. In Japan/Asia, command form of weld schedule by current (Amps) is mainly used. On the other hand, command form by wire feed speed (WFS) is general in America.

About voltage command, Voltage (Volts) is used for CV process mode and Trim is used for Pulse process mode in America.

PowerWave supports the both command form. It is possible to use the following American specification.

DATA Weld Pro	cedure	1		•	
				1/7	
1 Weld	Procedur	e 1 [1	
[Pulse		GMAW	;	# 22]	
[1.2 m	m Steel	Ar CO	2]	
2 Weld	Schedule	1 [Sche	edule	1	
3 Wire	Feed Spe	ed	0.0 IPM	Ī	
4 Trim		1	.000		
5 Ultim	Arc	(0.00		
[TYPE]	SCHEDULE			HELP	

These changes can be achieved by the following system variables.

• \$AWECFG.\$USE_AMPS = TRUE: current command(Amps)

- \$AWECFG.\$USE_AMPS = FALSE: wire feed speed command(WFS)
- \$AWEPCR.\$TRIM_IN_VLT = TRUE: Voltage command(Volts)
- \$AWEPCR.\$TRIM_IN_VLT = FALSE: Trim command *Only Pulse mode

As shown in above, current and voltage commands are generally used in Japan/Asia, so the default value of \$AWECFG.\$USE_AMPS and \$AWEPCR.\$TRIM_IN_VLT are both TRUE. On the other hand, wire feed speed and trim commands are generally used in America, so the default value of \$AWECFG.\$USE AMPS and \$AWEPCR.\$TRIM IN VLT are both FALSE.

The user can change which of these commands to be used. For example, the change procedure from current command to wire feed speed command is shown below.

! CAUTION

ROBOWELD *i*C/H2 series does not support Voltage and Current command form. In ROBOWELD *i*C/H2, do not change \$AWECFG.\$USE_AMPS and \$AWEPCR.\$TRIM_IN_VLT from FALSE.

Procedure G-4 Changing command form

Condition

- Lincoln Asia package is installed
- Robot controller and PowerWave are correctly connected with LAN cable or DN3 board and communication has been established
- The power supply of robot controller and PowerWave are turned on.

Step

1 Perform a Controlled Start and following screen is displayed.

```
ArcTool Setup
                                      1/9
                          F00000
    1 F Number:
    2 Welding setup:
                              Japan
        Wire speed units:
                              cm/min
        Weld speed units:
                              cm/min
        Weld speed:
                              100
    6 Manufacturer: Lincoln Electric
                     PowerWave+ArcLnk
  Press FCTN then START (COLD) when done.
    [TYPE]
                       CHECK
                                          HELP
```

- 2 Press the [MENU] key and select the [4 Variables].
- Move the cursor to "AWECFG_T" of the \$AWECFG line and press [ENTER] key. On the next screen, match the cursor to "AWECFG_T" and press [ENTER] key.
- 4 Move the cursor to "TRUE" of the \$USE_AMPS line and press F5[FALSE].

SYSTEM Va	ariables				
			12/12	2	
\$AWECE	'G[1]				
3 \$P	S_PROCESS	*uninit	*		
4 \$W	FEED_DESC	'Power 1	Feed 10'		
5 \$M	ANUF FILE	'AWMLEC	o.vr'		
6 \$M	ODEL_FILE	'A*ELEEI	NJ.VR'		
7 \$N	UM_AO	3			
8 \$N	UM_AI	3			
9 \$N	UM_DO	10			
10 \$N	UM_DI	7			
11 \$A	RC_PROCESS	1			
12 \$U	SE_AMPS	TRUE			
[TYPE	E]		TRUE	FALSE	

5 Execute the cold start. Open the weld schedule screen and confirm that [Current] is changed to [WFS].

G.5 MULTI EQUIPMENT FUNCTION

The section explains Multi Equipment Function for ROBOWELD *i*C series. About entire contents of Multi Equipment Function, please refer to Chapter 25 in R-30*i*B/R-30*i*B Mate Controller Arc Welding Function Operator's Manual(B-83284EN-3).

The function permits the simultaneous control of max four Lincoln weld equipments by one robot controller. About the communication establishment method with first weld equipment, please refer to C.1. The section explains the communication establishment method with second or later weld equipments. Likewise G.1, communication method between a robot controller and two or more Lincoln weld equipments are different by the type of the weld equipment. Procedure G-5 (b) shows the method for ROBOWELD *i*C/E and H2 series, and Procedure G-5 (a) shows the method for ROBOWELD *i*C/H, H3 series.

Setting of Multi Equipment Function for ROBOWELD iC/E, H2 series

Procedure G-5 (a) Setting of two or more weld equipment (ROBOWELD iC/E, H2 series)

Condition

• Multi Equipment option (A05B-###-J617) is installed.

Step

Set the DIP switch of DeviceNet board referring to the following figure.

(Board 1 means first weld equipment, Board 2 means second weld equipment.)

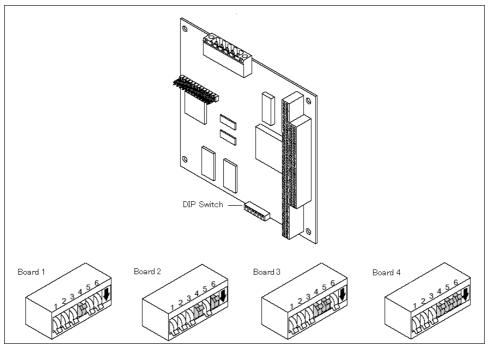
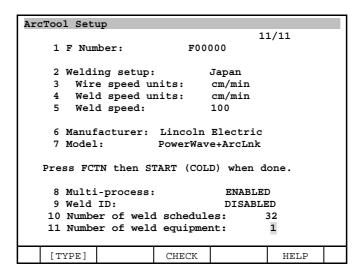
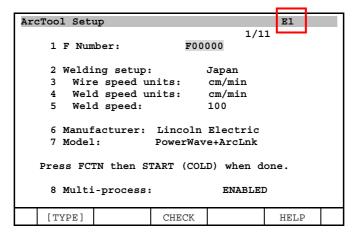


Fig. G.5 Setting of DIP switch for DeviceNet board

- Mount the board whose DIP switch setup is finished to the robot controller and connect an ArcLink cable to the weld equipment.
- 3 Perform a Controlled Start. The following screen is displayed.



- 4 Move the cursor on [Number of weld equipments] and input the number of equipments (Max 4).
- 5 Perform cycle power of the robot controller. The controller automatically performs a Controlled Start again.
- After ArcTool Setup screen is displayed, please check the equipment No. on the top of a right side of the screen (EX: E1, E2, ...). The number is the present select number.



- 7. Window menu is displayed when SHIFT key and WINDOW key are pressed simultaneously. Then, select [Display Equip] and select Equipment number which you would like to set. For example, you would like to set second weld equipment, please select [E2].
- 8. Perform a Cold Start. You can switch the equipment number for screens (Weld Equipment Setup screen, Process Select screen, Weld Schedule screen, Process Data screen, etc.) by Step 7. After selecting an equipment number which you would like to set, please perform a setup for each equipment.

Setting of Multi Equipment Function for ROBOWELD iC/H

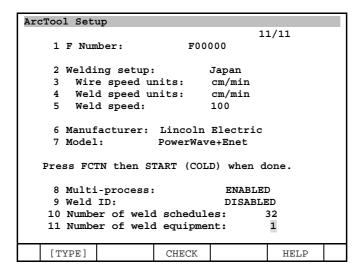
Procedure G-5 (b) Setting of two or more weld equipment (ROBOWELD iC/H and H3 series)

Condition

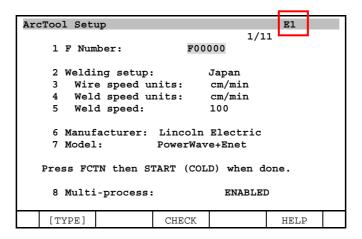
- Multi Equipment option (A05B-###-J617) is installed.
- The connection to first weld equipment has already achieved. (Refer to C.1.)
- Prepare a switching hub for Ethernet connection.
- The robot controller (R-30*i*B: Ethernet port 2, R-30*i*B Mate: Ethernet port 1) and the switching hub are connected, and switching hub and each weld equipment are connected.

Step

- 1 Turn off the robot controller and all of weld equipments.
- 2 Turn on the robot controller with Controlled Start. Next, turn on only one weld equipment which you plan to connect now. Keep the power of other equipments off.



- After ArcTool Setup screen is displayed, mover the cursor on [Number of Equipments] and input the number of equipments (Max 4).
- 4 Execute cycle power of the robot controller (the weld equipment is still ON). The controller automatically turns on with Controlled Start.
- 5 Please check the equipment number on a right side of the top of the screen (EX: E1, E2, ...). The number is a present select number.



- Window menu is displayed when SHIFT key and WINDOW key are pressed simultaneously. Then, select [Display Equip] and select Equipment number which you would like to set. For example, you would like to set second weld equipment, please select [E2].
- 7 The following box is displayed. Press ENTER key.

To setup PowerWave+Ethernet the Ethernet cable must be connected and the PowerWave must be ON.

[OK]

8 The controller starts the assignment of an IP address to the weld equipment. When the assignment is completed, "PowerWave detected" is displayed.

- 9 In Step 8, if weld equipment is detected, check the communication by pressing F3 [CHECK] key.
- 10 If PowerWave is not detected or CHECK is failed, turn both robot controller and weld equipment OFF, and execute F3 CHECK again after controller and weld equipment are turned ON. If the communication is not established, please refer to 3.1.1.1 or TROUBLE SHOOTING (7.1).
- 11 If CHECK is succeeded, execute Cold Start.
- 12 The communication establishment is completed. If there are some weld equipments that have not established the communication yet, perform Step 1-2 and 5-11 again. (Then Step 3 and 4 are not required)
- 13 After the communication establishment for any equipment is completed, turn the equipments ON.
- 14 Window menu is displayed when SHIFT key and WINDOW key are pressed simultaneously. If you select [Display Equip], you can switch the weld equipment number for each ArcTool-related screen (EX: Weld Equipment Setup screen, Process Select screen, Weld Schedule screen and Weld Process screen, etc). Please perform the setup for each weld equipment after selecting a weld equipment number.

Check method for Weld Equipment Number

If the model is ROBOWELD iC/H2 or iC/E, you can check weld equipment numbers by confirming connections in Fig G.5.

On the other hand, if the model is ROBOWELD *i*C/H or H3 series, you cannot check weld equipment numbers by connections. You can check weld equipment numbers by wire inching. Additionally, you can also check by ArcLink Status screen.

Procedure G-5 (c) Check method for Weld Equipment Number

Condition

- Multi equipment setup has already finished.
- All of weld equipments are turned ON.

Step

- Press MENU key and press "0" key. Then, select [4 STATUS].
- 2 Press F1 [TYPE] key and select [ArcLink]. ArcLink Status screen is displayed.
- Display ArcLink Status screen whose weld equipment number is that you would like to check by pressing F2[NEXT_CH].
- 4 Press F3[LOCATE]. The LED of one of the weld equipment is flashed rapidly with green (about 1 second). This weld equipment has the equipment number in ArcLink Status screen.

H WELD CONDITION ADJUSTMENT

This chapter describes general adjustment method of welding condition, welding defects and countermeasure.

H.1 INFLUENCE BY ADJUSTMENT OF WELDING CONDITION

Table H.1.(a) describes the effect of weld schedule to bead appearance and Table H.1.(b) describes the effect of weld schedule to welding.

Table H.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 H.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.

H.2 COUNTERMEASURE TO WELDING DEFECTS

Table H.2. (a) describes the problems and counter plan for bead appearance, Table H.2.(b) describes the problems and counter plan for gas and surface pores and Table H.2.(c) describes Problem and Cause and counter plan for unstable arc.

	Table H.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	1.	Set weld voltage higher				
	With of bead is narrow	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				
<u> </u>	0	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)				
<u> </u>	D	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. 5.	Adjust arc start position Change downward welding to upward welding				
8	Undercut	1.	Set weld current lower				
	Ondercut	2.	Set weld current lower				
		3.	Set welding speed slower				
		4.	Set torch angle wider				
		5.	Clean up groove face				
9	Overlap	1.	Set weld current higher				
Ĭ	o volidap	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)				
			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)				
			More heat input				
			2. More preheating and postheating				
			3. Clean up wire and work				
			4. Stable gas flow.				

Table H.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 1 st 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 H.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.	1 st 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
I		2.	Wire size is too big
		3.	Torch angle is too wide
		4.	Arc blow occurs

TORCH MATE SETTING OF ROBOWELD iC/E

ROBOWELD *i*C/E series do not have a touch sensor circuit. Therefore, following special connection and setting are needed to use Torch Mate function.

Please refer to the Fig. I (a) - I (d) and perform the connection. After that, please perform the Procedure I. A relay is derived by DO signal that is output during a recovery motion. By using the relay, the contact between a recovery fixture and a wire is detected. "#" in following four figures are the port number specified in Procedure I.

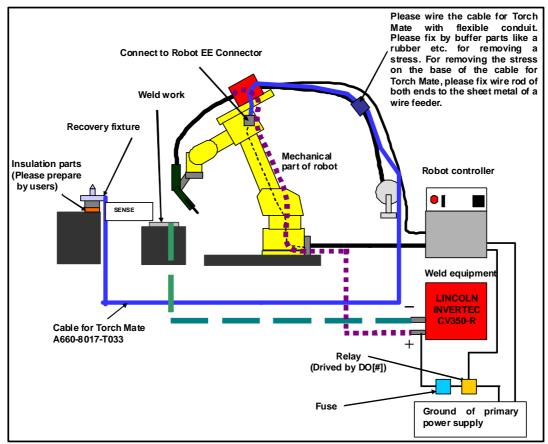


Fig. I (a) Entire connection figure

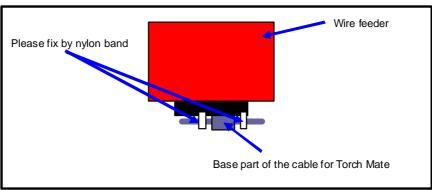


Fig. I (b) Fix method of the cable to wire feeder

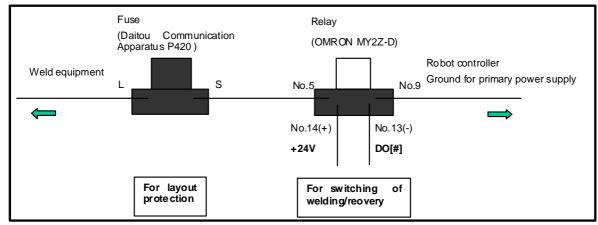


Fig. I (c) Detailed connection figure of fuse and relay (in case of sink type DO)

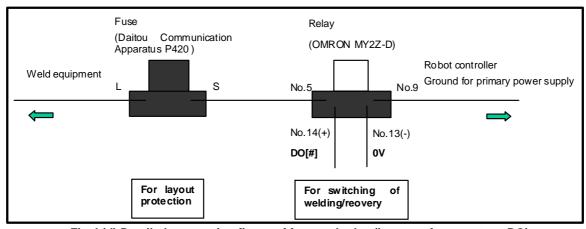


Fig. I (d) Detailed connection figure of fuse and relay (in case of source type DO)

Procedure I Setting for Torch Mate function in case of Invertec CV350-R

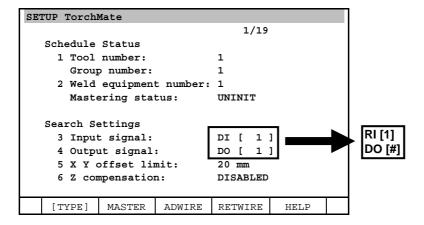
Step

- 1 Press the [MENU] key and select [5 I/O].
- 2 Press the F1[TYPE] key and select [Digital].
- 3 Press F3[IN/OUT] and display Digital Output screen.
- 4 Press F2[ASSIGN]. The following screen is displayed. (The contents are different depend on I/O hardware configuration.)

I/O	I/O Digital Out								
	1/3								
	#		RAN	ΞE	RACK	SLOT	START	STAT.	
	1	DO[1-	20]	0	1	21	ACTIV	
	2	DO[21-	36]	90	1	1	ACTIV	
	3	DO[37-	512]	0	0	0	UNASG	
	[TY	PE]	MONI	TOR	IN/OUT	DEI	LETE	HELP	

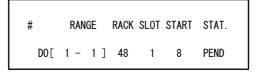
One digital output signal among the range of DO [1 - 8] should be prepared for this function. The prepared DO becomes a signal to drive the relay. Please check whether the DO (that can be used for this purpose and the status is ACTIV) exists or not. In the example of the above screen, DO [1 - 20] is ACTIV. So the free signal among the range of DO [1 - 8] can be used (In later, the port number of this free signal is assumed to #). By the way, DO assigned to rack 90 is for ArcLink I/O, so those could not be used.

- When all of DO [1 8] are used, please prepare one free signal for this function. When there is not ACTIV assignment among the range of DO [1 8], there is no problem to use the ACTIV port number other than the range of 1 8. However, in this case, it is necessary to perform the step 13 17 additionally.
- 7 Press MENU key and select [6 SETUP].
- 8 Press F1[TYPE] and select [Torch Mate]. The following screen is displayed.



- 9 Move the cursor on [3. Input signal] and select "RI" from the menu by F4[SELECT] key.
- 10 Move the cursor to the next right position from Step 9 and input "1".
- 11 Move the cursor on [4. Output signal] and select "DO" from the menu by F4[SELECT] key.
- Move the cursor to the next right position from Step 11 and input "#" number which you could get at Step 5 6. The specified DO signal becomes a signal for the relay drive. If the number of "#" is in the range of 1 8, setting procedure ends at this step.
- 13 If the number of "#" is not in the range of 1 8, please continue following steps.
- Please confirm the assignment of signal "#" referring to step 1 4. For example, when "#" is 108 (DO[108]) and the assignment is as follows, you can know DO[108] is assigned to RACK 48, SLOT 1, START 8.

Please assign the signal that is checked at step 14 to either range of 1 - 8. For example, following screen shows the assignment to DO [1].



- 16 Please cycle power of robot controller.
- 17 After the controller start up, please display the screen of SETUP Torch Mate. As a precaution, please confirm the setting of [4 Output signal] to the number that you set in Step 15 (In case of above-mentioned example, this is DO[1]).

NOTE

- 1 Please check that recovery fixture is insulated by using a tester.
- 2 Please check there is no looseness on insulation cylinder, chip, and torch body of the torch before the Torch Mate teaching.
- 3 Please check that TCP setting and Load setting are performed correctly before the Torch Mate motion.
- 4 Please check that Torch Mate works fine before production operating. (Please refer to Chapter 12 in R-30*i*B/R-30*i*B Mate Controller ARC Welding Function OPERATOR'S MANUAL (B-83284EN-3).)

J TIG WELDING SPECIFICATION

J.1 OVERVIEW

This is the specification about TIG welding using FANUC Robot ARC Mate 100*i*C, 120*i*C (R-30*i*B, R-30*i*B Mate controller).

Executing following restriction, reconstruction and countermeasure that are countermeasures for TIG noise can do stable TIG welding.

J.2 CAUTION

Restriction

- 1) Specify the 10m length teach pendant cable.
- 2) Specify 3m or 7m for welding connection cable.
- 3) Specify 7m for the robot connection cable.

TIG welding modification items

TIG welding needs a welding modification and mechanical unit cable as below.

1 Mechanical unit TIG welding modification

a) ARC Mate 100*i*C A05B-1221-J101, J102, J103

b) ARC Mate 120*i*C A05B-1222-J101

2 Applied mechanical unit cables

a) ARC Mate 100*i*C A05B-1224-H201, H215,H231,H261 b) ARC Mate 120*i*C A05B-1222-H201,1225-H231

In addition, use robot controller with insulation transformer. When the robot controller does not include insulation transformer, prepare the insulation transformer and connect the primary power to the robot controller through insulation transformer.

Countermeasure for TIG welding equipment side

1 Welding cable

Use base metal cable that is over 38mm2 in order to prevent overheating of cable and to do proper welding. Strengthen the insulation effect of cables and prevent electric discharge among cables, robot body, iron plate fixing robot body and others.

Refer to Fig.J.2 as examples.

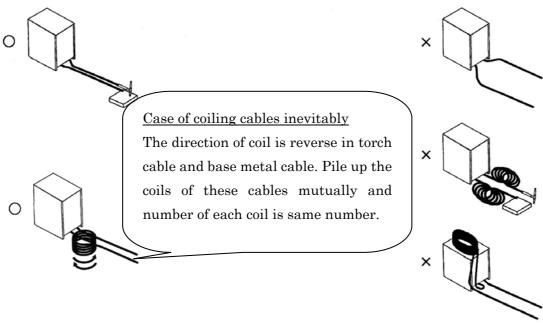


Fig. J.2 Wiring example of the welding cable

2 Weld equipment connection cable

Keep this cable away from arc generating zone, torch cable, base metal cable, base metal ground cable, input power cable, ground cable and others to prevent the troubles by inserting high frequency noise. Don't wire parallel to welding cable and robot connection cable as possible.

3 Ground cable

Connect one side of ground cable to ground terminal of welding machine and do class C or class D grounding to another side of ground cable.

Use ground cable which conductor size is more than one of input power cable (8 mm² is needed as the lowest one).

Grounding should be done by a person who has the license of electric engineering technician.

Don't connect ground cable to water pipe or steel frame of building because it is not enough ground. Don't share grounds of welding machine and base metal with grounds of robot body, common base, jig and other welding machine.

Grounding		Applied class of machine and tool
Class C	Grounding resistance should be $100~\Omega$ or less. (For low voltage electric circuit, if the purpose is constructing the equipment that cut off its circuit automatically within 0.5 seconds when ground fault generate in its circuit, grounding resistance should be $500~\Omega$ or less.)	Below 300V and low voltage
Class D	Grounding resistance should be 10 Ω or less. (For low voltage electric circuit, if the purpose is constructing the equipment that cut off its circuit automatically within 0.5 seconds when ground fault generate in its circuit, grounding resistance should be 500 Ω or less.)	Over 300V and low voltage

(extract from "the interpretation of technical standard for electric equipment" Art. 19 and Art. 29)

4 Installation distance

Refer to Installation layout of Section J.3.

Others

1 Teach pendant and teach pendant cable

Keep teach pendant and teach pendant cable over 0.5m away from the object where welding electric current flow, such as welding cable, jig, iron plate used to fix the jig. High frequency noise with welding electric current may cause trouble, if it is inducted directly to teach pendant or teach pendant cable.

2 Ground cable

Provide ground cables of robot (ground cable between mechanical unit and controller is connected in standard specification), welding machine, wire feeder and others individually, which cables are over class D. Ground securely using ground cable that is designated by welding machine between welding machine and jig. Use attached four-core power cable (7m) to connect power and ground to robot controller.

3 Interface of USB and PCMCIA

It may become impossible to use the memory card, the sensor, PC etc, which use the USB or PCMCIA interface during the TIG welding due to noise.

4 Primary input wiring

Provide switch box of primary input for robot and welding machine individually.

In case of using some welding machines, provide switch box involving input protection equipment designated by each TIG welding machine individually.

5 Water cooling unit

Don't set water cooling unit on the top panel of welding machine.

6 Others

While TIG welding, close all doors and covers of robot controller and welding machine securely.

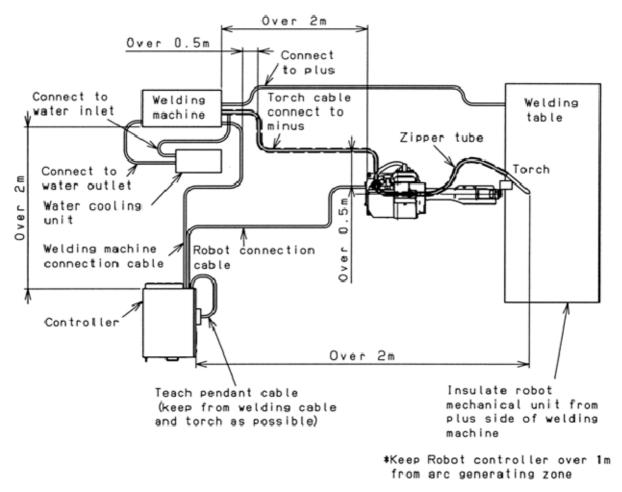
The way of connecting cables and the way of grounding affect the toughness for noise of welding machine. So, need to modify the way of connecting cables and grounding in case of generating gap of welding position or alarm.

High frequency noise of TIG welding may insert following near equipment, and cause electromagnetic trouble.

- a) input cable, output cable, telephone cable etc.
- b) radio, television etc.
- c) computer or other controller
- d) Detectors for industrial purpose or safety device
- e) pacemaker or hearing aid

In those cases, please follow the caution of the TIG welding equipment.

J.3 INSTALLATION LAYOUT



APPENDIX

Fig. J.3 (a) Installation layout

The above notice of "Over 2m between Welding machine and Controller" does not needed for Lincoln PowerWave i400 that is integral type of Welding machine and Controller.

We recommend to connect the zipper tube of the torch cable to the earth of the high frequency unit of the welding machine or advanced module.

The way of grounding

Make grounding in referring following matters.

- Use ground cable which conductor size is over 8mm² as thick as possible and fix it securely.
- Construct a ground per a robot or a welding machine and not share with other equipment.
- Insulate robot mechanical unit from welding jig, welded work (plus side of welding machine) perfectly.
- Insulate welded work from jig body, auxiliary axis and robot common base. (insulation resistance should be over $1 M\Omega$.) and insulate from robot controller. (not turn on electricity) For inserting insulated material, use different bolts for insulated material mounting bolts and jig/outer axis/robot/robot controller mounting so that insulation is performed at the mounting part absolutely. Please contact your local FANUC representative for details.
- In case of using common base, construct ground that is beyond class D with cabtyre cable that is over 8 mm² for common base and jig body. Don't share this ground with ground of robot or welding machine.

• In case of setting robot mechanical unit or controller on the common base, insulate them from common base surely.

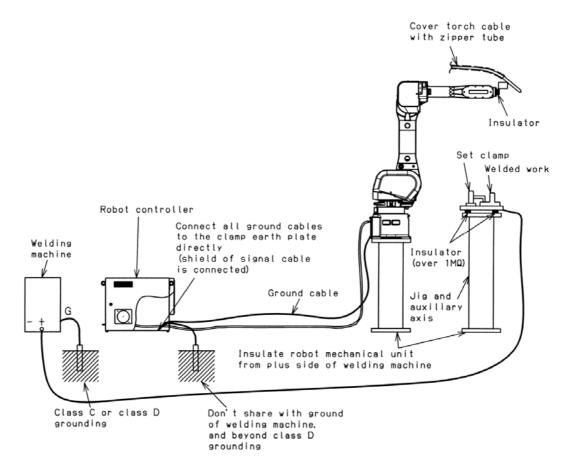


Fig. J.3 (b) Installation layout (good example)

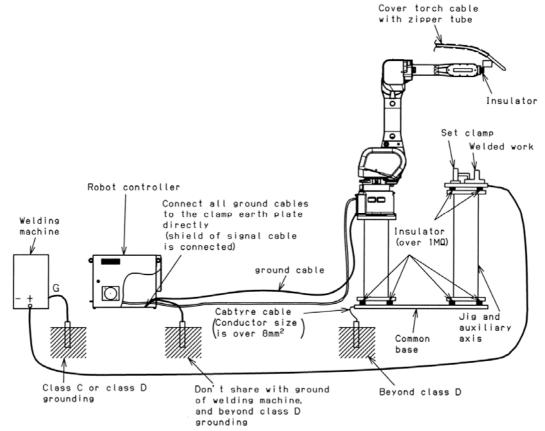


Fig. J.3 (c) Installation layout (good example (when a common base))

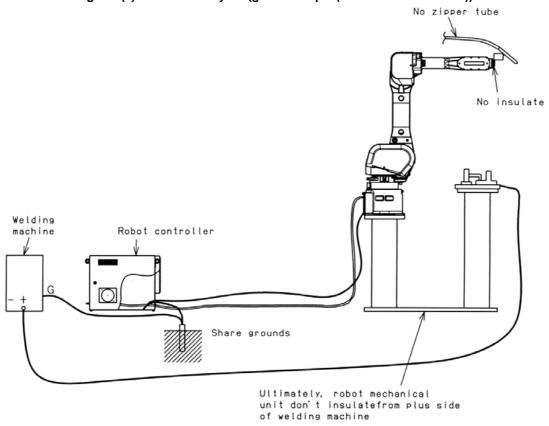


Fig. J.3 (d) Installation layout (bad example)

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REVISION RECORD

REVISION RECORD

Edition	Date	Contents
02	Sep., 2014	 Addition of wire feeder 4R220 Addition of TIG welding specification Correction of errors
01	Apr., 2013	

B-83374EN/02

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