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Hyundai Robot

Hi4aEQ071001FMEN3

Hi4a Controller Function Manual

Equalizer

HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

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: Equalizing function by robot

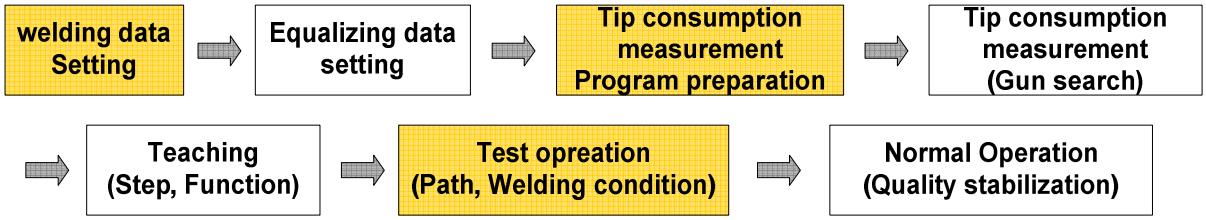
(4) Supply Specifications of Air-gun

Type	Components		Supply Specification
	GUN 1	GUN 2	
Single Gun	Equalizer Robot Gun		Adequate
	Equalizerless Robot Gun		Adequate
	Equalizerless Stationary Gun		Adequate
Multi-Gun	Equalizer Robot Gun	Equalizer Robot Gun	Adequate
		Equalizerless Robot Gun	Adequate
		Equalizerless stationary Gun	Adequate
	Equalizerless Robot Gun	Equalizerless Robot Gun	Adequate
		Equalizer Robot Gun	Adequate
		Equalizerless stationary Gun	Adequate
	Equalizerless stationary Gun	Equalizerless stationary Gun	Adequate
		Equalizerless Robot Gun	Adequate
		Equalizer Robot Gun	Adequate
Servo Gun	-	-	Inadequate
Gun Change	-	-	Inadequate

However, if the number of GUN change is only 1, it would be available to use GUN2.

1.2. Flowchart of Robot Equalizer Function

The operating method of equalizerless Air-gun is as follows.



(1) Refer to GUN mode Setting and spot & stud welding parameter Setting.

(2) Refer to equalizing data Setting.

(3) Refer to teaching of fix tip consumption searching function(M107).

(4) Refer to playback of Fix tip consumption searching function(M107) and 5.1 records of standard searching position of Fix tip consumption.

(5) Refer to teaching of step.

(6) Confirm the teaching program.

(7) Refer to playback.

1.3. Before Teaching

Be sure to follow the instructions below before teaching.

(1) Check if a constant parameter Setting is completed for equalizerless Air-gun. It is unavailable to use it in combination with servo gun.

(2) If recording a reference searching position by using the searching function of Fix tip consumption, attach an new(unworn) tip to platform in fixed part before perfoming.

(3) In case of step teaching, check in advance if the volume of wear is correctly set up.

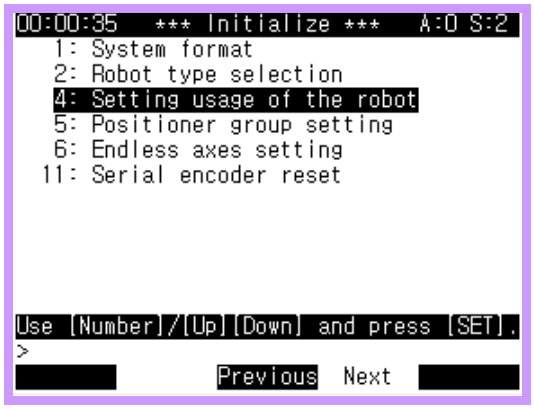
(4) In case of spot welding step teaching, be sure to press [MOVE] key with GUN LED of teach pendant ON. The position will be recorded reflecting the volume of fix tip consumption only for this case.

(5) It is unavailable to operate a simultaneous and multiple GUN working in a step when using an equalizerless Gun(robot Gun, stationary gun).

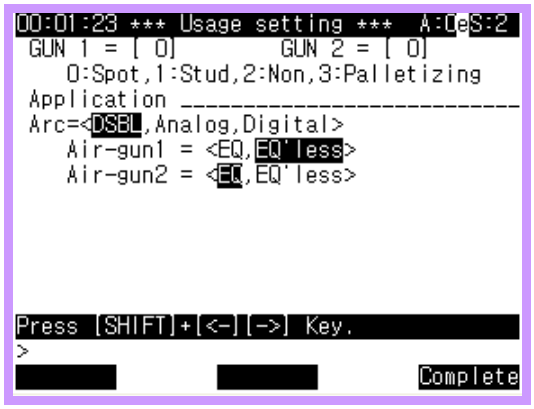
2 Constant Setting

2.1. GUN Mode Setting

(1) Select 『[PF2]: System』 → 『5: Initialize』 → 『4: Setting usage of the robot』.



(2) Select『4: Setting usage of the robot』, and the following screen will be displayed.



(3) Set up as GUN1 = 0(Spot), and then select 『EQ'less』for Air-gun. (In the above screen, GUN1 or GUN2 is used as Spot . GUN1 is an equalizerless Gun, and GUN2 is equalizer Air-gun.)

(4) Press 『[PF5]: Complete』key to finish an input.

◆【Caution】◆

- When using an equalizerless Air-gun, be sure to set 0(Spot) for GUN(GUN1 or GUN2) you intend to use in 『4: Setting usage of the robot』, and select EQ'less for a Air-gun.
- If using equalizer and equalizerless Air-guns together, the Air-gun should be classified into EQ and EQ'less.

This is an example of equalizerless Air-gun Setting.

GUN	Application	Mode/Air-gun
GUN 1	Equalizerless Air-gun	Spot(0)/EQ'lsee
GUN 2	Equalizer Air-gun or unused	Spot(0)/EQ
	Palletizing	Palletizing(2)/EQ

2.2. Assignment of Input/Output Signal

Select Assignment of Input/Output Signal in 『[PF2]: System』 → 『2: Controller Parameter』 → 『1: Setting input & output signal』.

2.2.1. Input Signal

Select an input number to assign in 『[PF2]: System』 → 『2: Controller Parameter』 → 『1: Setting input & output signal』 → 『7: Input signal assigning』.

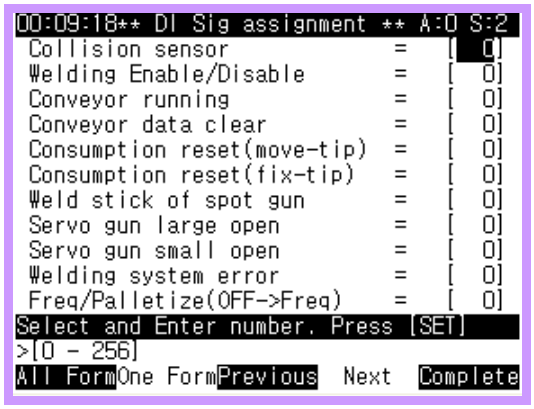
- **Consumption reset(fix-tip)**
  It is used to reset the wear of fix tip by external input signal. (In an equalizerless Air-gun, only the fix tip consumption may be reset from the outside.)

2.2.2. How To Operate Input Signal

(1) Select 『[PF2]: System』 → 『2: Controller Parameter』 → 『1: Setting input & output signal』.

(2) Select 『7: Input signal assigning』.

(3) Press 『[PF4]: Next 』 key to display the following screen.



(4) Input a numerical value, and press [SET] key.

(5) Press 『[PF5]: Complete』 key to finish the Setting.

※ When a “Consumption reset(fix-tip)” input signal is activated, the volume of fix tip consumption is reset if the currently selected Gun is an equalizerless Gun. It is also possible to reset with a free set function for “R220 : Equalizing tip consump. Preset”.

2.2.3. Output Signal

Select an output number to assign in 『[PF2]: System』 → 『2: Controller Parameter』 → 『1: Setting input & output signal』 → 『6: Output signal assigning』.

It is an output signal used when equalizerless Air-gun is applied.

(1) GUN(Welding) Signal
It is an output signal to send a welding instruction to welder controller(TC).

(2) Consump.(Eq) searching
It is a signal that is ON with searching operation by fix tip consumption searching function(EGUNSEA), and OFF after the completion of searching(wear detection).

(3) Tip consumption alarm
It is ON when the volume of wear detected by fix tip consumption searching is larger than the one of tip exchange wear. To turn this OFF, follow the below instructions.

- Set the volume of wear to be smaller than the fix tip exchange wear with a “R220 : Equalizing tip consump. Preset”.
- Clear the fix tip consumption by external signal input of “Consumption reset(fix-tip)”.

2.2.4. How To Operate Output Signal

(1) Select 『[PF2]: System』 → 『2: Controller Parameter』 → 『1: Setting input & output signal』.

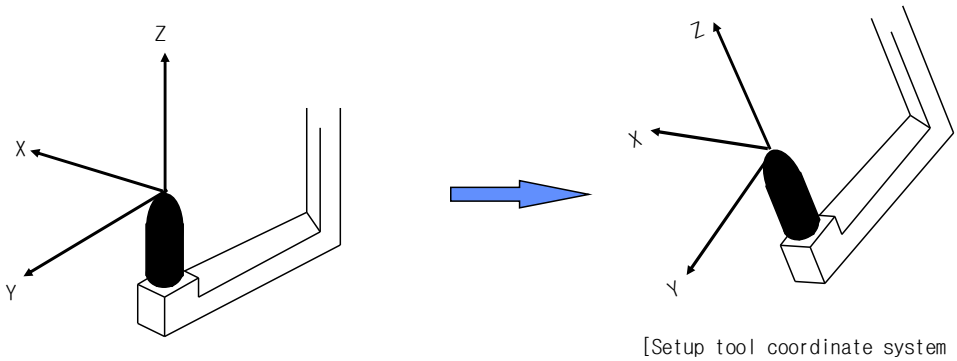
(2) Select 『6: Output signal assigning』.

(3) Press 『[PF4]: Next 』 key to display the following screen.

(4) Enter a number and press [SET]key.

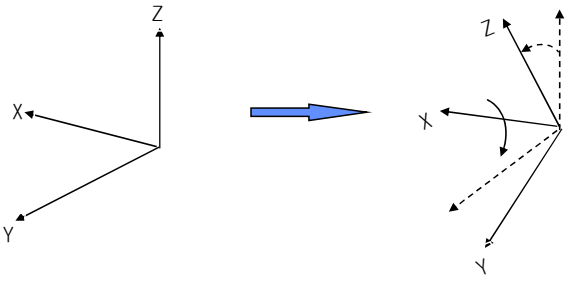
(5) Press 『[PF5]: Complete』 key to finish the Setting.

2.3. Tool Length and Angle Setting



[Standard Tool coordinate system)

[Setup tool coordinate system according to a tool shape]



Be sure to match the Z direction of coordinate system with the traveling direction of electrode in a fixed axis.

2.3.1. Tool Length

Tool length is the distance from the center of flange in robot axis R1 to the tool nose(top of fix tip) with a new(unworn) tip attached. As the above figure, the measured value of X,Y, Z , based on standard Tool coordinate system , is the tool distance.

2.3.2. Tool Angle

For the tool angle Setting, input the changed volume according to an attached tool shape in the standard Tool coordinate system in 3 directions of rotating angle($\Theta_x, \Theta_y \Theta_z$).

In case of Tool coordinate Setting, make sure that a jog key [Up]key matches with Z+ direction(squeeze direction of fix tip) when it is pressed after [Coordinate System] LED of teach pendant is ON at『Tool』.

In the above example, the way to determine the angle of 3 angles in Tool is described, assuming that a Tool shape which is set by users is the one in the right side.

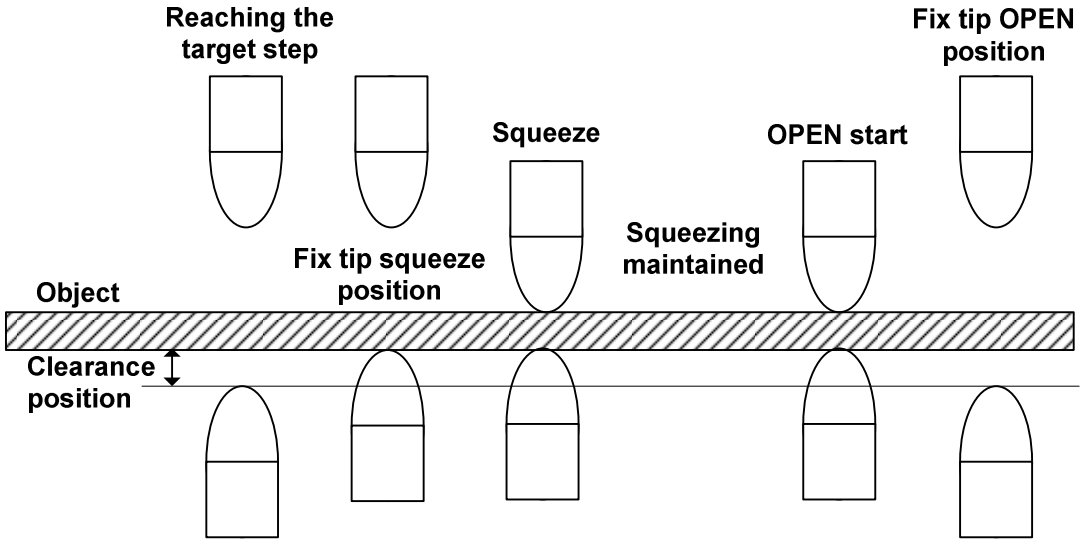
Input Tool angle of (-Θ, 0.0, 0.0) because it is a posture rotated by – on the axis X in standard Tool coordinate system.

2.4. Setting of Robot Equalizing Paramter

It is a parameter set up for spot welding with equalizerless Air-gun. When writing a mechanical constant file, an intial value is set, and if necessary, change it according to Gun or welding method.

2.4.1. Parameter

(1) Fix tip Clearance
When moving the step executing GUN squeeze instruction, it is operated as follows. Refer to Robot equalizer playback.



- Reaching the Target Step
  The target position of step recorded with squeeze(GUN) instruction in a playback is as far as fix tip clearance distance in which the consumption reflected from the recorded position.

- Fix tip Squeeze Position: Recording position of Step + Consumption

- Pressure : Move tip starts a squeeze by air control of welder timer.

- Maintain Squeeze
  It is a standby status for welding complete(WI) signal input from welder timer.

- Opening Position of Fix tip : It is a distance that a fix tip is moved as far as clearance distance after welding. Here, move tip is open first with the WI completion by airity.

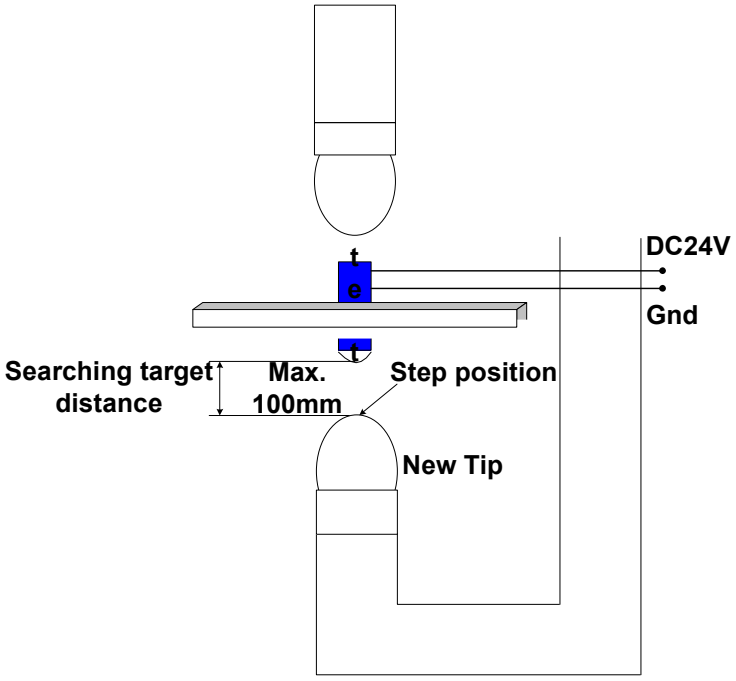
- Move to the next step from the opening position of fix tip.

※ In case of existing welding Gun, there could be a problem in working quality when setting an accuracy level to be above 0 in the target step. But in the use of equalizerless welding Gun, it is possible to set an accuracy to be above 1 unless fix tip has an interference in moving to squeeze position(object position). However, set a proper value considering an interference matter.

(2) Max fix tip consumption
If the detected wear of fix tip by Gun searching is in excess of this value, error message 『E0156 Fix-tip consumption exceeded max.』 is output and finally it stops.

(3) Fix tip Change consumption
If the detected wear of fix tip by Gun searching is in excess of this value, warning message 『W0107 Fixed-tip consumption exceeded LMT』 is output with warning signal output for tip wear to inform the exchange of tip. Here, playback is not stopped.

(4) Consumption Search length of fix tip
It is a parametr to determine the maximum range of robot movement in roder to measure the wear of fix tip. The standard coordinate system of this Gun searching is Tool coordinate system, and the target position is input by measuring the amount of movement toward Axis Z.
If playing back an excessive distance for wear searching of fix tip, 『E1320 Sensor doesn't search operation』 is output, and it stops after returning to search starting point.

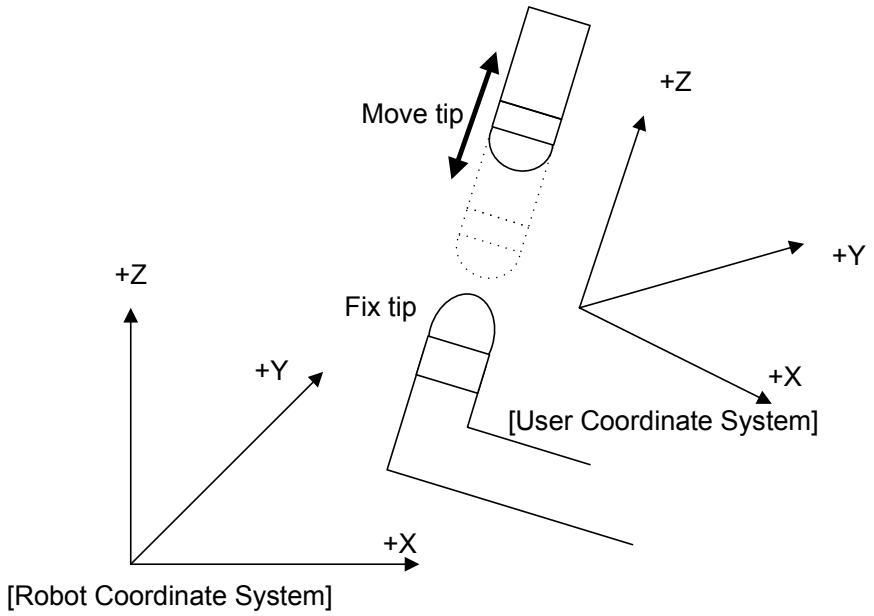


◆【Caution】◆

- For the searching distance setting, make sure that the searching target position, from the step position as its starting point, is not in excess of sensor's position. It is to avoid a collision in case of sensor error. Use "ㄷ" type of sensor as you can as possible.
- In case of searching distance input, make sure that the installed sensor is vertical to the fix tip, and manually operate the robot with Tool coordinate system (up/down key) for measurement.

(5) Robot Equalizing Speed
It is a speed for fix tip equalizing operation. The approaching speed of fix tip to object position varies depending on values assigned to it. In case of fix tip opening after welding, maximum speed of robot will be applied.

(6) Gun Type
It defines an equalizerless Air-gun for robot Gun or stationary Gun. In the use of stationary Air-gun, set a stationary Gun coordinate system for user's coordinate system, and make the direction of fix tip toward Z direction. Input the set user's coordinate system number as a stationary Gun coordinate system number. If coordinate system number is set to be 0, it becomes a robot coordinate system.



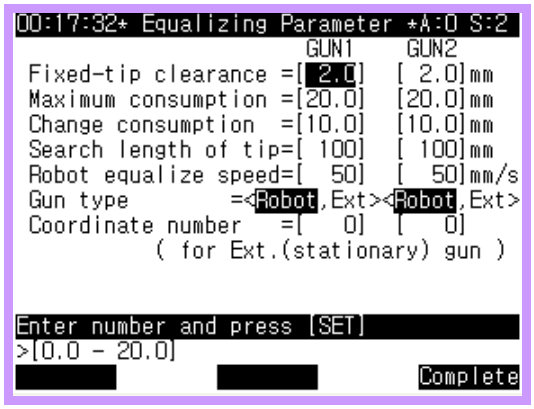
◆ 【Caution】 ◆

- If stationary Gun is selected, in a playback of spot welding step, play back the detected wear by wear searching for fix tip after the calibration of tip's target position based on user's coordinate system.

2.4.2. How To Operate Equalizing Paramter

(1) Select 『[PF2]: System』 → 『4: Application Parameter』 → 『1: Spot & Stud』 → 『4: Air-gun equalizing parameter』.

(2) The following screen will be displayed.



(3) Enter a number, press [SET]key , and press [PF5]key to complete data Setting.

◆ 【Caution】 ◆

- In case of multi-Gun, Gun change, be sure to set a parameter for GUN2.
- Stationary Gun coordinate system number is valid only for the use of stationary equalizerless Gun.
  When selecting Robot for Gun type, coordinate system number of stationary Gun is automatically changed to 0.

2.5. Parameter Setting for Spot Welding

In case of spot welding, information is set to process an internal welding sequence of controller. (It is the same way for spot welding by using an existing equalizer Air-gun.)

2.5.1. Parameter

(1) GUN Waiting Time(sec)
Set a standby time for robot until it stops completely after arriving to welding step.

(2) Robot Waiting Time(sec)
Set a standby time until GUN is completely opened after welding complete signal is input.

(3) Sticking detect(sec)
This function is not operated in application of equlaizerless Air-gun.

(4) Rewelding count
When a welding complete signal is not input within a re-welding standby time after welding signal is output, the welding signal is output again. Specify the repeating times of these process.

(5) Reweld wait time(sec)
Specify a standby time until welding complete signal is input after a welding signal is output. This parameter is invalid when the parameter of re-welding frequency is 0.

(6) Pulse Width
Determine to output welding signal either by level or by pulse. Set 0 in case of level, and it will be OFF after the input of welding complete (WI) signal.
Set a value above 0 in case of pulse, and it will remain ON as long as the set time and then automatically OFF.

(7) Earlier gun time(sec) : Push-up time of welding signal is not operated.

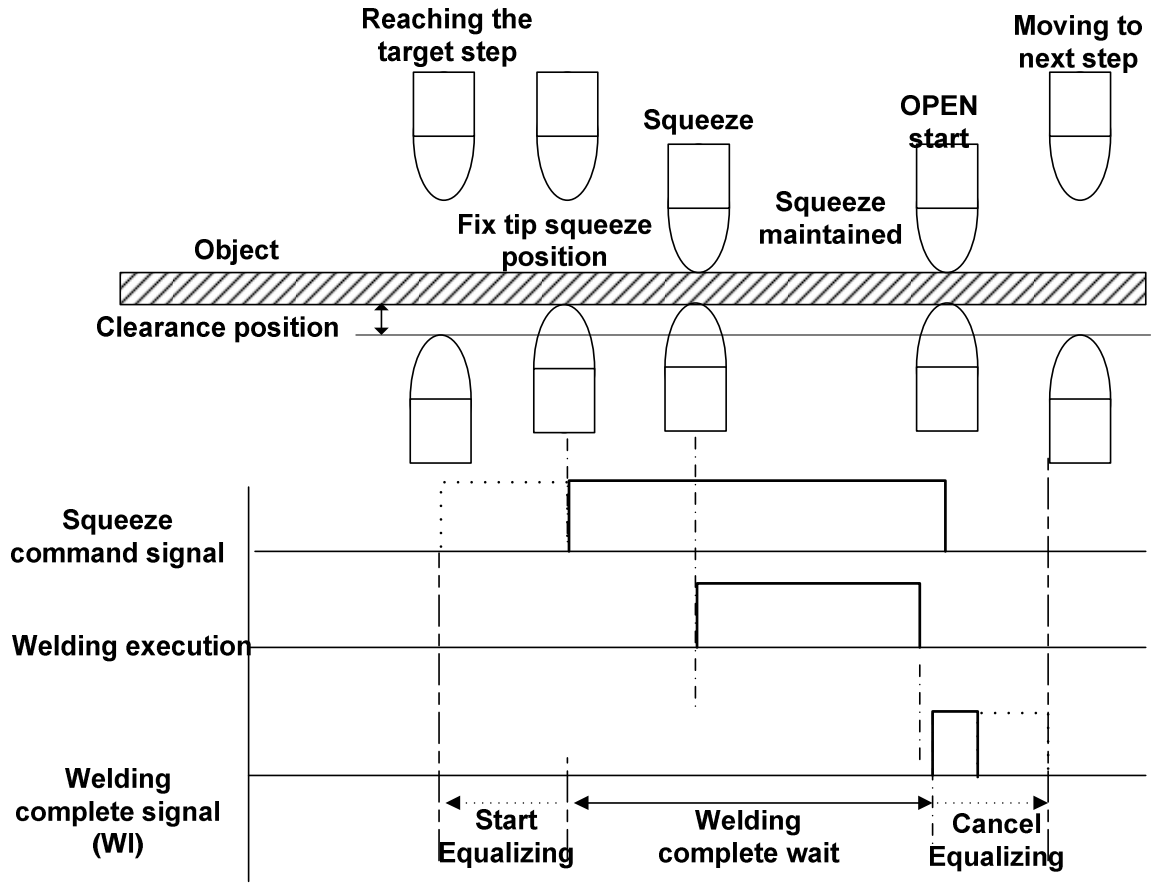
(8) Weld Cond Synchro
Determine whether to output a welding condition signal by synchronization with welding signal . If this function is ON, welding condition output function(M33) is not output even in its execution , and it is applied in welding signal output.

(9) Output Type of Welding Conditions
Determine the type of welding condition signal among discrete type/binary type.

(10) Earlier Cond time
It is a useful function only for synchronization output of welding conditions. Welding condition signal is output as early as the previously specified time before welding signal output.

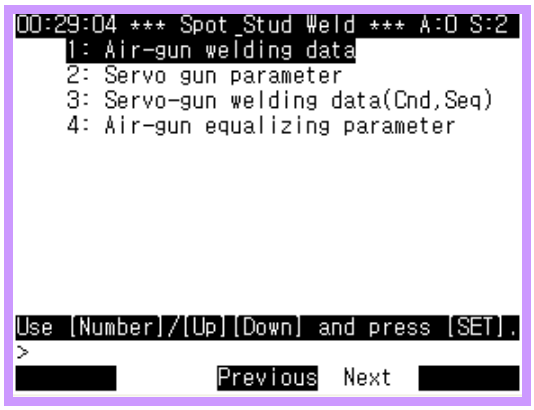
(11) WI common use
Usually, each WI signal is set for welding signal of GUN1 and GUN2, but this parameter is set to be [Enable] if one WI signal is used for both GUN1 and GUN2. In this case, the assigned input signal to WI in 『[PS2]: System』 → 『2: Controller Parameter』 → 『1: Setting input & output signal』 → 『7: Input signal assigning』 becomes a WI signal for GUN1, GUN2.

※ Relations Between Robot Movement And Spot Welding Sequence

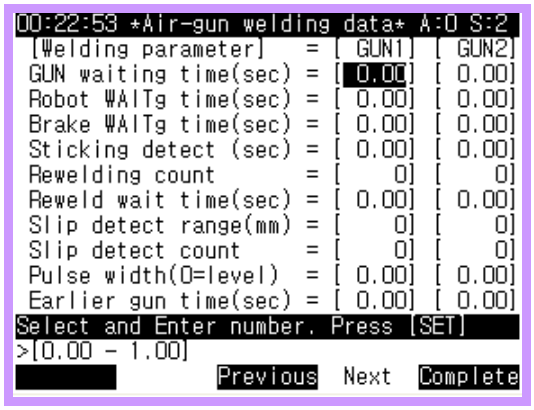


2.5.2. How To Operate Spot Welding Paramter

(1) Select 『[PF2]: System』 → 『4: Application Parameter』 → 『1: Spot & Stud』 → 『1: Air-gun welding data』.



(2) Select『[PF4]: Next』 key, and the following screen is displayed.



(3) Press [Shift] key and place a reverse bar in the preferred item with[←],[→] key, or press [SET]key after the enter a number.

(4) Press 『[PF5]: Complete』 key to finish the Setting.

2.6. Completion

After the completion of parameters Setting for equalizerless Air-gun, copy the constant file (ROBOT.C00, ROBOT.C01) in auxiliary memory unit(HRView, PC card) in the 『[PF1]: Service』 → 『5: File Manager』 → 『5: Copy』.

3
Teaching

Make sure to follow the instructions before teaching.

(1) Check if a constant setting is completed for robot equalizing and welding control.

(2) Write a searching program for fix tip consumption(step, function-EGUNSEA) to record a reference position for measuring a wear. When recording a reference position for fix tip consumption, be sure to use a new(unworn) tip. In addition, be sure to perform when a search recording condition for fix tip consumption is ON in a condtion Setting.

(3) To measure the fix tip consumption, record a reference position of fix tip consumption, and select the reference recording condition of fix tip consumption to be OFF. And then execute a searching program for fix tip consumption for 1 time in 1 Cycle in an auto mode.

(4) When recording a step, be sure to check in advance if the volume of wear is correctly set up.

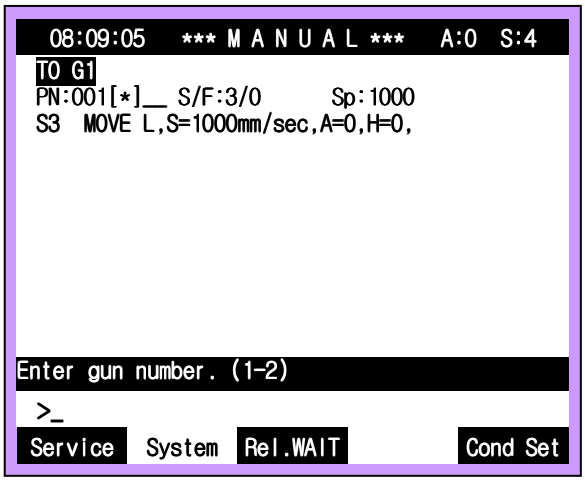
(5) When recording a welding step, be sure to press [MOVE] key with a GUN condition LED of teach pendant ON. Calibrate and record a fix tip consumption only when the GUN condition is ON.

(6) When changing a multi-Gun or Gun, check if the tool numbers for Guns are correctely selected.
Unlike a servo Gun system, the tool numbers are not automatically changed according to Gun numbers.

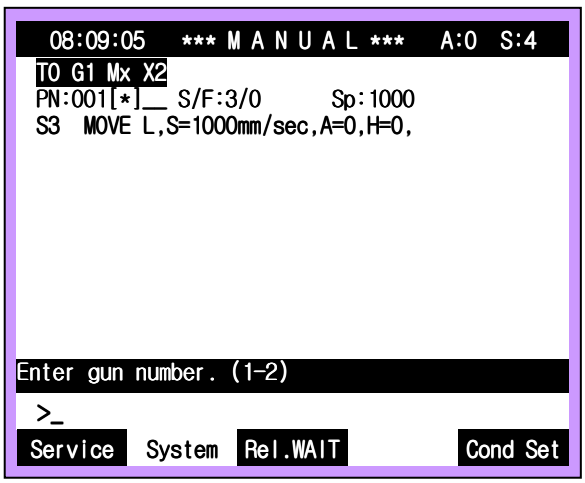
3.1. Selection of Gun, Two Steps Gun(two layers GUN)

When using a multi-Air-gun, perform R219 to select a GUN for multi-Air-gun. Select two layers GUN(Mx) by registrating with user key(f key).

(1) Input the Gun number you intend to select by operating R219 on a teach pendant in a manual mode. Once an equalizerless Gun is set up, 『T0 G1』 is displayed as shown in the second line of below screen.



(2) If pressing f key of X2, MX registered in a user key, 『T0 G1 Mx X2』 indicating its status is displayed as shown in the second line.



◆ 【Caution】 ◆

- When using an equalizerless multi-Gun, G1, G2 cannot be specified together in a step regardless of Air-gun specification. However, it is possible to two layers GUN stroke (Mx, X2).

3.2. Manual GUN Squeeze

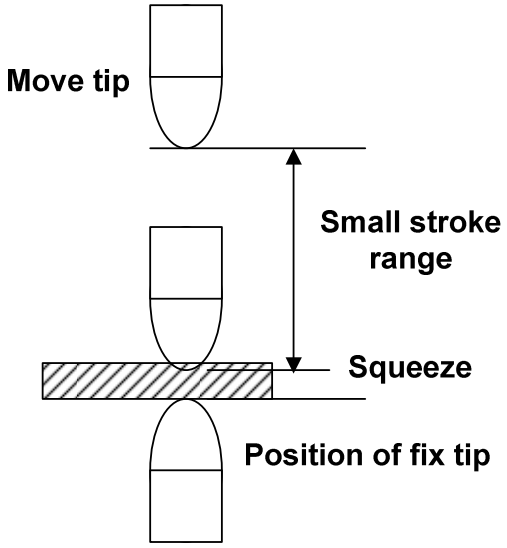
Bring a fix tip into contact with object in a manual mode, and execute a GUN squeeze.
In case you record a spot welding step, be sure to use a manual Gun squeeze with a fix tip contacting with object.

3.2.1. How To Operate

For the manual Gun squeeze, select a Gun you intend to operate and display is in the upper part of screen, and then press GUN key of teaching pendant to turn GUN LED on.

(1) Select a manual mode, and input MOTOR ON.
(2) Move a robot to bring a fix tip into contact with object.
(3) Press [Shift] and GUN keys in a teach pendant simultaneously.

※ Manual Squeeze & Opening of Equalizerless Air-gun



◆ 【Caution】 ◆

- Be sure to bring the fix tip into contact with object.
- To record a position of spot welding(GUN) step, select a Gun number and then execute it when GUN LED is ON. It is because the position compensated for a Max fix tip consumption should be recorded.

3.3. Step Teaching

Recording a spot welding step of equalizerless Air-gun is to record the position after the calibration of fix tip consumption by [MOVE] key of teach pendant.

3.3.1. Recording a Spot Welding Step

Bring a position of fix tip into contact with object and execute it by pressing [MOVE] key with GUN LED of teach pendant ON. And G1 or G2, as a condition of step, will be recorded together. Here, the record position of step means the position where a fix tip consumption is calibrated.

◆ 【Caution】 ◆

- Be sure to use [MOVE] key to specify a position by MOVE instruction and pose constant, variable in PF MENU because it does not calibrate a wear.
- In the use of equalizerless multi-Air-gun, make sure to select correctly because there is no special error check in tool numbers for Guns.
- When changing a GUN option of step, be sure to change GUN option first and then execute a position adjustment with position adjusting key. It is because a fix tip consumption should be calibrated.
- In the use of multi-Gun, do not specify G1, G2 together in a step regardless of Air-gun specification.

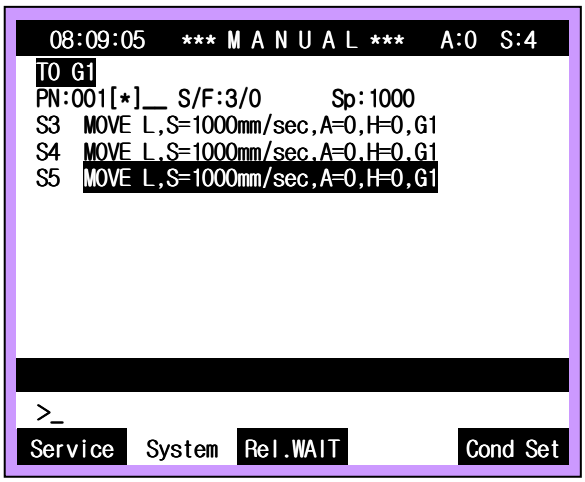
3.3.2. How To Operate

(1) Select a manual mode.

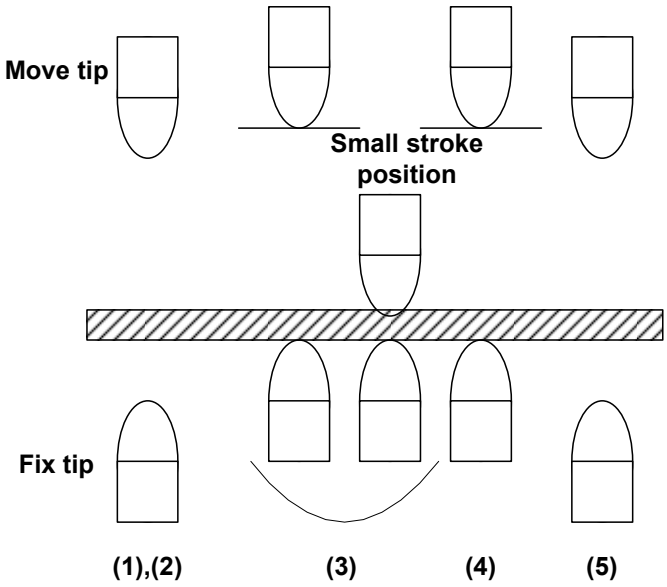
(2) Press [GUN] key to check if GUN LED is ON in a teach pendant.

(3) Bring a fix tip into contact with object by jog operation, and check the position you intend to weld with a manual Gun squeeze.

(4) Press [MOVE] key to record a step, and the following screen will be displayed.



(5) Move a robot to the next step of recording position.



◆ 【Caution】 ◆

- When recording a spot welding position of equalizerless Air-gun, the position where a fix tip consumptionis calibrated, so be sure to record after GUN LED is ON. Otherwise, errors are likely to occur during welding because the calibrated position for the fix tip consumption is not recorded.

- If recording/changing a welding point, be sure to bring a fix tip into contact with object first, and check a transformation of object with manual Gun squeeze, and then record the position. Bending moment of squeeze and welding Gun is not taken into consideration.

3.4. Wear Search(EGUNSEA) Teaching of Fix tip

Searching function for fix tip consumption is to grind an tip with tip dressing or to detect a wear of fix tip worn by welding. In a playback of spot welding step, automatically shift a squeeze position in the fixed part of object as much as detected wear by searching function for fix tip consumption to improve welding quality.

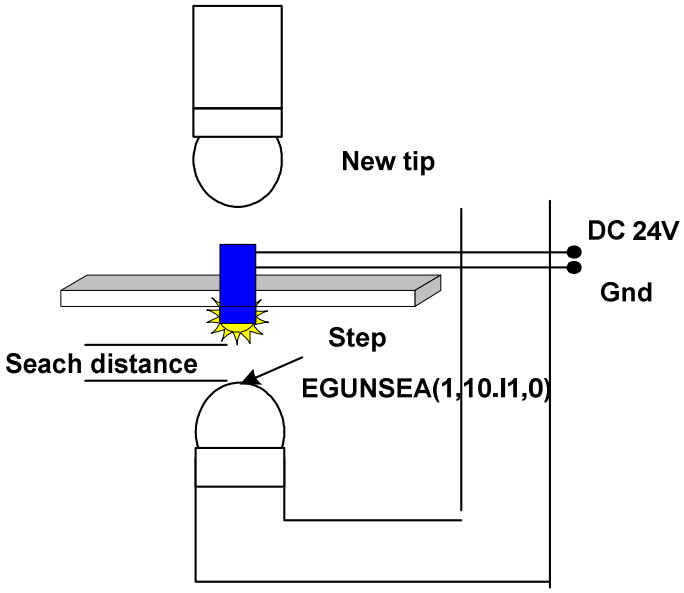
For the fix tip consumption searching, determine the difference of detected volume(value) between the previously measured standard value(new tip) and the newly measure one as the volume of wear(worn volume). The previous standard value has been measured when a fixed part of Gun, in a jig with a non-contact proximity sensor, is moved to robot and enters a certain distance(range) of fixed tip. Refer to 『**4.3. Playback of Fix tip consumption searching function**』 to get a knowledge on how to exeute a wear seach function of fix tip.

3.4.1. Parameters of Fix tip consumption Searching EGUNSEA(M107)

For the fix tip consumption searching, 4 parameters should be set up as follows.

EGUNSEA (GUN No., Searching Speed, I Signal, On/Off)

Item	Range	Details
1. GUN No.	1~2	Specify GUN No. for wear measument.
2. Searching Speed	1~100mm/s	Gun axis specifies searching speed in searching. Searching speed by input signal is based on a safety speed, and the recommended speed is 10mm/s.
3. I Signal	1~256	Specify a number for input signal.(sensing result input)
4. On/Off	1/0	Specify the conditions of sensor(signal detecting level). In case of 0 = Low, detect(Normal High) – B contact point In case of 1 = High, detect(Normal Low) – A contact point



Wear seach teaching of fix tip

◆【Caution】◆

- EGUNSEA function should be recorded only as the first function of step, and do not record it No. 0 in a step.
- In case of I signal On/Off Setting, check 『[PF2]: System』 → 『2: Controller parameter』 → 『1: Setting input & output signal』 →『1: Input signal logic』.
- It is convenient to set 'positive' for the assigned input signal logic before sensor logic Setting.
- Take note that a output signal 'High' in a sensor is detected as Low in a controller when input signal logic is set to be 'negative'.

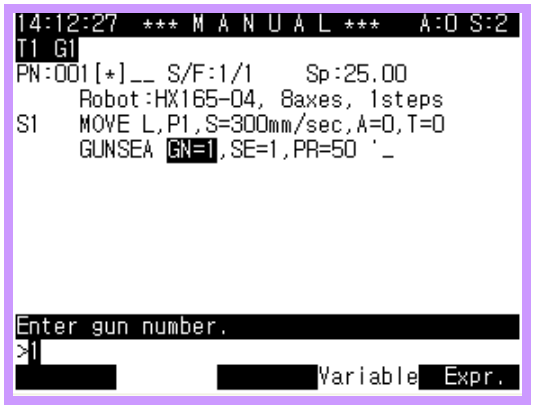
Input Signal Logic of Assigned I Signal	M107 I Signal On/Off	Sensor Output in Signal Detection
Positive	On(1)	In case of High, detect(Normal Low)
	Off(0)	In case of Low, detect (Normal High)
Negative	On(1)	In case of Low, detect (Normal High)
	Off(0)	In case of High, detect (Normal Low)

3.4.2. How To Operate the Wear Search Function of Fix tip

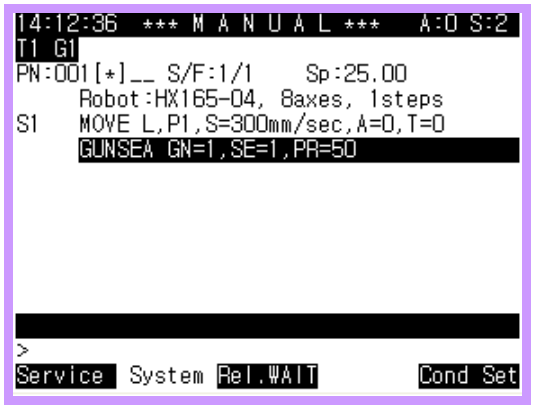
(1) Replace a new fix tip to input a wear search function of fix tip.

(2) Move a robot(fix tip) to the position to start searching. For a fixed electrode, record a step at a certain distance where the Z-axis is identical with the vertical direction of sensor.

(3) Press EGUNSEA instruction with up/down direction key in 『[Cmd]』→『[PF3]: Etc』, and press SET[Yes] key. The following screen will be displayed.



(4) Input GUN No., seaching spedd, I signal, and On/Off with numer key, and press SET key. The following screen will be displayed.



(5) Move the robot to the position to avoidance after searching and opening, and record a step again.

◆ 【Caution】 ◆

- For the tool posture in Step 2, make it vertical to a sensor in the Z direction of tool doordinate system, and then record a step.

4
Playback

4.1. Playback of Step

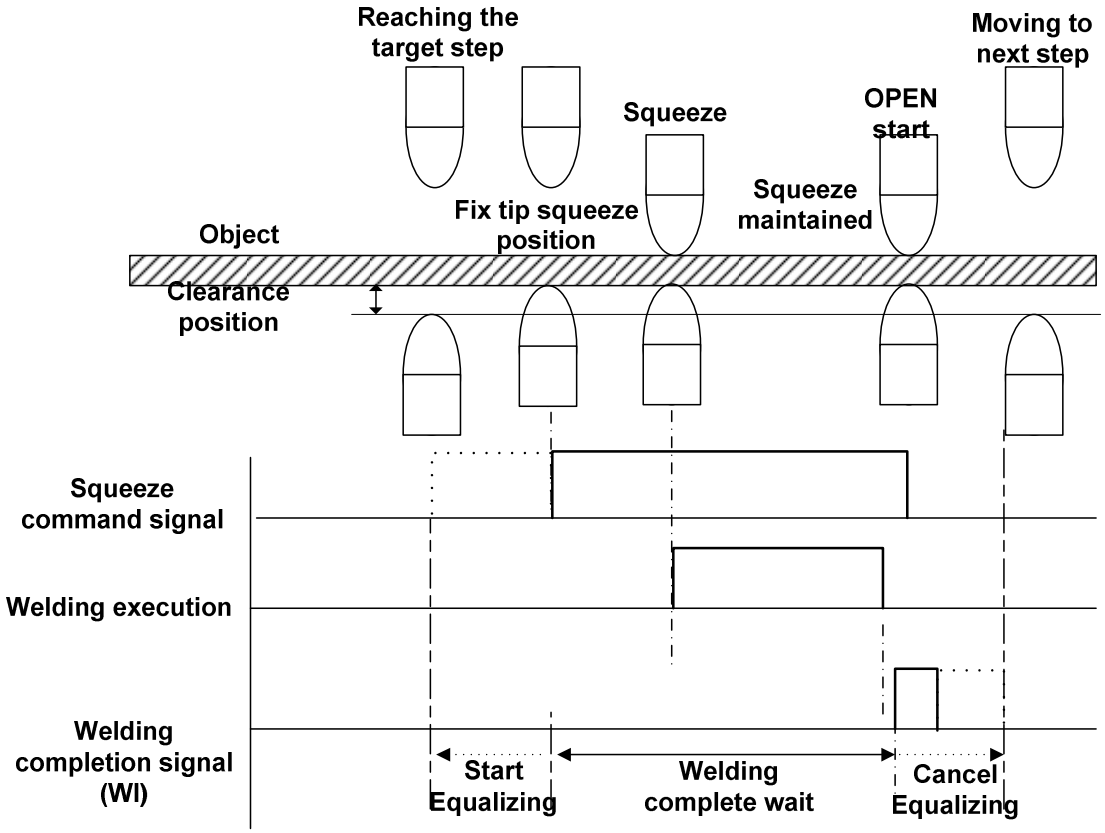
In a step playback of spot welding robot system mounted with equalizerless air-gun, operating characteristics are different each other between welding step and non-welding step.

Welding step moves to a clearance position first, considering an interference of object, and then moves to lower part of object with robot, instead of moving directly to the recorded position. However, non-welding step moves directly to the recorded position.

In addition, welding step moves to the recorded position and performs a Gun squeeze identical with the existing air system, and open it(moving part: air valve, fixed part: robot) simultaneously with the completion of welding. Here, the opening position in a fixed part is a clearance position, and the step number before welding is maintained.

4.2. Playback of Spot Welding Step

Playback of spot welding step is as follows.



(1) In the playback of spot welding step, move a fix tip to a position as far as fix tip clearance from the recording position of target step. Here, the position of fix tip determines the shifted position of fix tip consumption in Z direction of tool coordinate system as its target position.

(2) Move the robot to the recording position(lower part of object) of step from fix tip clearance position. This is the function of robot equalizer.

(3) Pressurize with force set by air system.

(4) Welding complete(WI) is input from welder controller(TC) the moment move tip opens, and open the fix tip to the position of clearance.

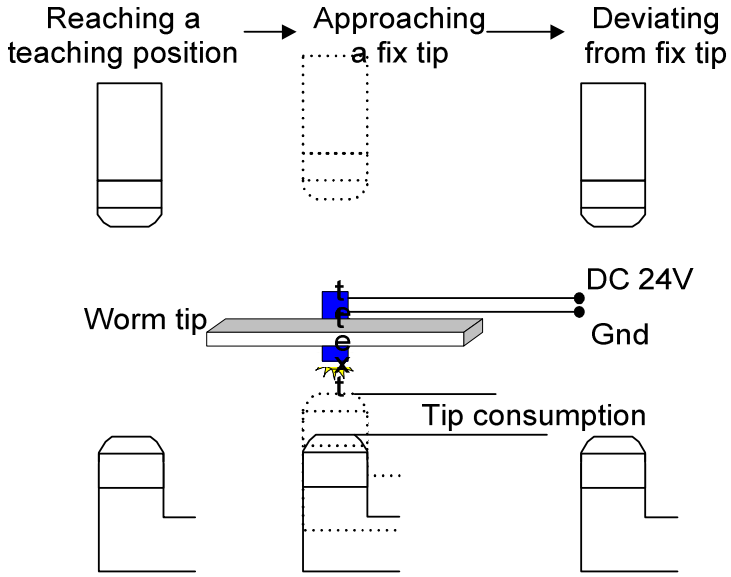
(5) Move to the next step.

◆【Caution】◆

- In case of playback with a reference position of fix tip consumption search unrecorded, an error message 『E1306 Base position data is not recorded』 is displayed and it stops.
- The fix tip consumption is detected only when the wear searching function of fix tip is operated.
- If there are two Guns, playback of tool numbers corresponding to G1, G2 is subject to Tool numbers recorded in step conditions. So, be sure to check the Tool number corresponding to GUN.
- If robot comes to a pause and error stop while approaching a object position, it moves to a clearance position and stops. Here, MOTOR OFF, Deadman, EmStop, and Power Failure stop at the position. If robot is resumed, it is moved to the clearance position and approaches the object position to execute a re-welding.
- If a pause is input during a welding complete standby, robot continues to wait until the welding complete is input and then opens at a clearance position to stop. Besides, in case of error stop, MOTOR OFF, Deadman, EmStop, and Power Failure, the robot stops at the position. If it re-starts after normalization, it waits a welding complete. Here, if the welding complete is input, robot opens at the clearance position again and approaches the object position for re-welding. This is a welding re-try function.
- In a Air-gun, Sticking of weld detecting function is not operated.

4.3. Playback of Wear Searching Function in Fix tip

To execute a wear searching function of fix tip, record a reference position in 1 Cycle of playback with『[PF5]: Cond Set』 → 『[PF1]: AppliCnd 』 → 『5: Gun search Ref.point record』ON, and then execute the wear searching program in 1 Cycle of playback with them OFF to detect the tip wear.



Wear Searching Playback of Fix tip

(1) It reaches the recording position of step(teaching position).

(2) It clears the fix tip consumption while executing and starting EGUNSEA.

(3) Searching is operated to move the fix tip to a sensor position with robot.
Searching Distance = consumption Search length of Fix tip (Z–axis distance based on Tool coordinate system)

(4) With the sensor ON, robot stops moving and starts opening the fix tip to the previous position of EGUNSEAR function.

(5) It moves to the next step.

◆ 【Caution】 ◆

- If the direction of Gun searching is not vertical to a sensor, wear error could occur. Be sure to check the Tool posture.
- Be sure to record a reference position of fix tip search before searching.
- In case of playback with step go/back in a manual mode, the wear seaching function of fix tip is not executed regardless of execution of 『[PF5]: Cond Set』 → 『3: Func in step GO/BACK』.
- It is possible to detect the tip wear in 1 Step or continuous playback. However, be sure to follow the playback cycle condition applied in the reference recording of Gun search.
- If the wear detecting is executed without recording a standard searching position of fix tip consumption, an error message『E1306 Base position data is not recorded』 is displayed and it stops.
- Retry of Fix tip consumption Search
  In case of restarting after a stop because of emergency stop or power failure without completing the wear searching of fix tip, it(fix tip consumption seaching) continues at the position. However, if in excess of **『[PF2]: System』 → 『4: Application Parameter』 → 『1: Spot & Stud』 → 『4: Air-gun equalizing parameter』** → 『Max. fix tip consumption』 or in excess of searching distance after detecting the wear, an error is displayed and the robot is moved to an opening position to stop. The wear seaching program of fix tip should be re-executed after the replacement of fix tip or repair of sensor.
- If replacing with a longer tip than the attached fix tip in recording a reference positionis, take note that the detected wear could be a negative(-) value.
- If a robot stop and error stop is input during Gun search, robot moves to the starting position of Gun search and stops. This is called Gun Opening During Searching. However, in case of MOTOR OFF, Deadman SW, EMStop, and Power Failure, it stops at the position and moves robot to the starting position of Gun search when it is resumed.
- Refer to 『**5.1. Reference recording of Fix tip consumption Search**』 for the reference recording of fix tip consumption search.

5 Condition Setting

5.1. Reference position Recording of Fix tip consumption

Change the reference position recording of fix tip consumption search to be ON, and play the fix tip consumption searching program in 1 Cycle to record the standard postion of fix tip consumption search.

After the completion of recording, make this function to be OFF, and re-play the program in 1Cycle to detect the wear. The result of wear detection is displayed in a monitor function.

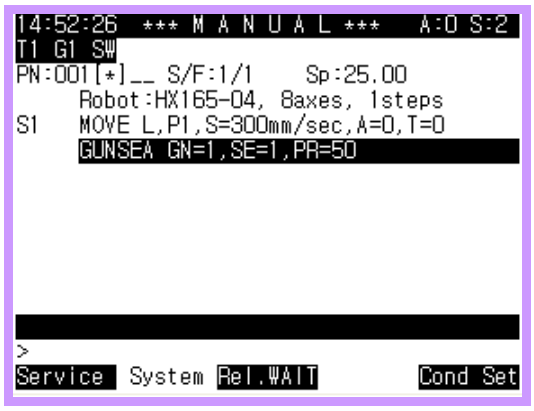
5.1.1. How To Operate

(1) Select an auto mode.

(2) Select『[PF5]: Cond Set』 → 『[PF1]: AppliCnd』.

(3) Set the『5: Gun search Ref.point record』 ON, and select 『[PF5]: Cond Set』 → 『[PF5]: Complete』or [ESC]key. Condition Setting and application condition are the items saved immediately after changing.
This item is commonly used in a reference position recording of servo gun search.

(4) The following screen will be displayed.



(5) Select the program recorded with fix tip consumption searching function , and play it in 1 Cycle.

(6) Set the『5: Gun search Ref.point record』to be OFF.

◆【Caution】◆

- After writing a mechanical constant file, be sure to record a reference position of fix tip consumption search before writing a working program.
- Make sure to attach a new and unworn tip before recording a reference position of fix tip consumption search.
- If playing a spot welding step or executing a fix tip consumption detection without recording a reference position of fix tip, an error 『E1306 Base position data is not recorded』 is displayed and robot is stopped.

6

R Code and Monitoring Function

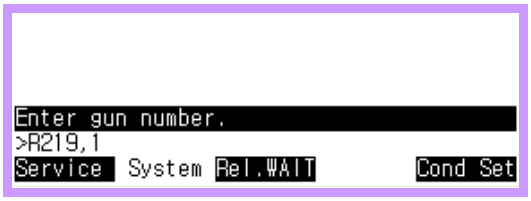
6.1. Equalizerless gun No. selection (R219)

Set the Gun No. to use in an application of eqaulizerless Air-gun.

6.1.1. How To Operate Eqaulizerless Gun No. Selection

(1) Select a manual mode or auto mode.

(2) Input R219 [SET].



(3) Select a number ,and press [SET]key.

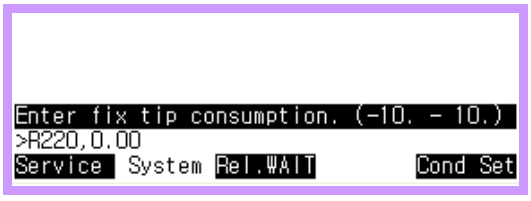
6.2. Equalizing tip consump. preset (R220)

Set a random value for the fix tip consumption of equalizerless Gun.

6.2.1. How To Operate Eqaulizerless Gun No. Selection

(1) Select a manual mode or auto mode.

(2) Input R220 [SET].



(3) Input the wear, and press [SET]key.

6.3. Monitoring Function of Equalizerless GUN

6.3.1. Display Items

(1) Real time welding condition, squeeze signal, Two step stroke output, welding complete signal, and fix tip consumption are displayed.
Welding condition No.(M33) : Current welding condition is displayed in decimal.
However, welding condition No. is valid only when using a M33 function, so it is recommended to use M33 for welding condition output.

(2) Squeeze output : It displays the ON/OFF status of current squeeze signal.

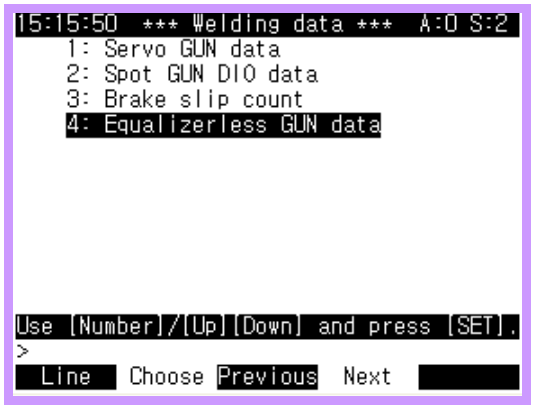
(3) Two step stroke output : It displays the ON/OFF status of current 2-step stroke output signal.

(4) Welding complete input
It displays the ON/OFF status of current welding complete(WI) input.

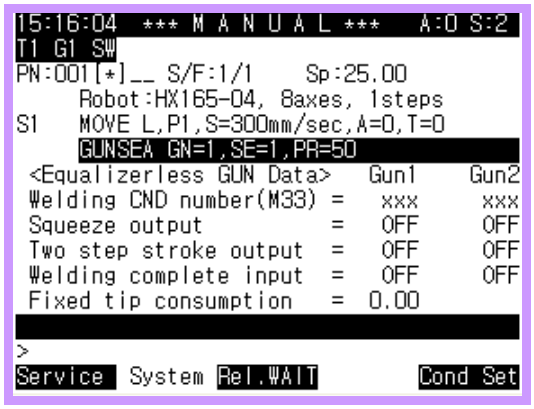
(5) Fix tip consumption
It displays the tip wear(mm) detected by a searching function for fix tip consumption .

6.3.2. How To Operate

(1) Select 『[PF1]: Service』 → 『1: Monitoring 』 → 『3: Spot/Stud welding data』.



(2) Select『4: Equalizerless GUN data』.



7
Error

7.1. Error Messages

These are errors occurred when using a robot equalizer function.

Code	E0156 Fix-tip consumption exceeded max.
Cause	Fixed tip consumption detected by gun search is in excess of the masimum shift tip consumption set in the servo gun parameter.
Action	- Check the maxi fixed tip consumption of servo gun parameter. - Repalce the tip.

Code	E1038 Can't record tip consump. position
Cause	When calibrating the tip consumption and recording the position, robot is postured not to calibrate the tip consumption.
Action	Make sure that the robot posture for calibrating as much as the detected tip consumption should not be out of working envelope.

Code	E1306 Base position data is not recorded
Cause	This error occurs when playing a gun search function or spot welding function without an execution of standard position recording for gun search after making a machine constant file.
Action	Attach a new tip , and execute the standard position recording for gun search.

Code	E1307 Gun search program is abnormal.
Cause	This error occurs when executing gun search 2 without an execution of gun search 1, or when playing spot welding function without a normal termination of gun search.
Action	Execute gun search 1,2 to detect tip wear before starting work.

Code	E0171 Gun open time is over.
Cause	In a spot welding step, fix tip is not opened in 5 sec. after squeeze.
Action	It happens when system constant data has an error. Thus, initialize it before usint. If errors still remain after initialization, make contact with our company.

Code	E1320 Sensor doesn't search operation.
Cause	This error occurs when sensor does not work even after the robot moved to the target position during wear detecting work with a sensor in a servo gun searching function or robot equalizer function for fixed tip consumption searching.
Action	1) Check if a sensor is working when tip approaches the sensor. 2) Check the connection and connector. 3) Check if the sensor contacting point is correctly specified.

Code	E1323 Equalizerless environment is wrong
Cause	This error occurs when robot equalizer function is not set in an available environment.
Action	Set the uses as spot in the system/initialization/uses setting, and select EQ'less for air-gun1, and air-gun2.

7.2. Error Messages

These are warnings occurred when using a robot equalizer function.

Code	W0107 Fixed-tip consumption exceeded LMT
Cause	It occurs when fixed tip consumption detected with gun search is in excess of unfixed tip exchange wear set in servo gun parameter.
Action	Inspect the fixed tip, and replace the tip.

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