

---

---

# Contents

1. OUTLINE .....	3
1.1. Palletize and Depalletize .....	3
1.2. Basic Specification.....	4
1.2.1. Duplicate handling .....	4
1.2.2. Multiple handling.....	4
1.2.3. Basic function .....	5
1.3. The operation flow of Palletizing function .....	6
1.4. Before to start teaching.....	6
1.5. Definition of wording ( Concerned palletizing function ) .....	7
2. System setting .....	10
2.1. Usage setting of the robot .....	10
2.2. User key setting .....	11
2.3. Palletizing pattern resistor setting.....	11
2.3.1. The way to operate .....	11
2.3.2. Palletize pattern resistor .....	13
3. Teach .....	27
3.1. The pattern of palletizing path .....	27
3.1.1. Step condition and path .....	27
3.1.2. Teach step .....	29
3.1.3. Editing program to insert sheet.....	30
3.1.4. Example of elaborately corrected program (Palletizing and shift function) ....	31
3.1.5. PK(Picking), PS(Palletize Shift), PU(Picking up) Function.....	33
3.1.6. The screen formation in performing the teaching of step.....	35
3.2. Command language and M code.....	36
3.2.1. Call and input of the program( TIERST, M94 ) inserting the letter-paper ....	36
3.2.2. Input of the palletize picking up shift(PALPU, M95) .....	36
3.2.3. Input of the palletize shift(PAL, M96) .....	37
3.2.4. Input of the palletize end(PALEND, M97) .....	38
3.2.5. Input of the palletize reset(PALRST, M98) .....	39
4. Replay .....	40

---

4.1. Replay of PK step .....	40
4.2. Replay of PS step .....	40
4.3. Replay of PU step .....	41
5. Service menu .....	41
5.1. Palletize monitoring.....	41
5.1.1. Display item.....	41
5.1.2. Operation method .....	42
5.2. Palletize register.....	42
5.2.1. Display item.....	42
5.2.2. Operation method .....	43
6. The creation and control of palletize pattern file.....	45
6.1. The creation of palletize pattern file(ROBOT . PAL).....	45
6.2. The re-creation of palletize pattern file(ROBOT . PAL) .....	45
7. Disorder disposal and Error .....	46

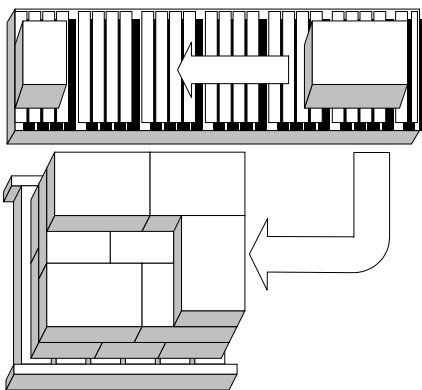
## 1. OUTLINE

“Palletize function” means make target point to Palletize or Depalletize.

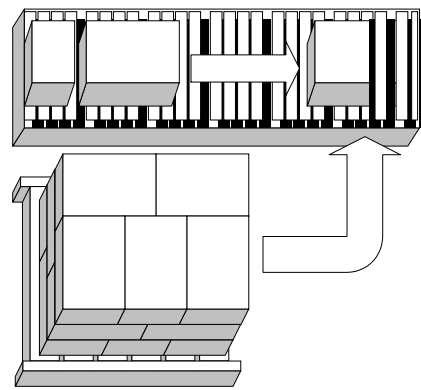
“Palletize” means pick up works at a settled position and move to specified form.

“Depalletize” means move works which are palletized in specified form to a settled position.

### 1.1. Palletize and Depalletize



**Fig 1.1 Palletize**



**Fig 1.2 Depalletize**

Fig 1.1, Fig 1.2 is an example of Palletize and Depalletize.

## 1.2. Basic Specification

### 1.2.1. Duplicate handling

- (1) In case of several palletes they can be loaded in same time.
- (2) Maximum 16 palletes can be loaded within robot's working area.
- (3) Refer to figure 2.1 & 2.3..

### 1.2.2. Multiple handling

- (1) While several palletes are loaded in same time, it is impossible to load precedently an specific pallet.
- (2) Refer to figure 2.2 & 2.4.

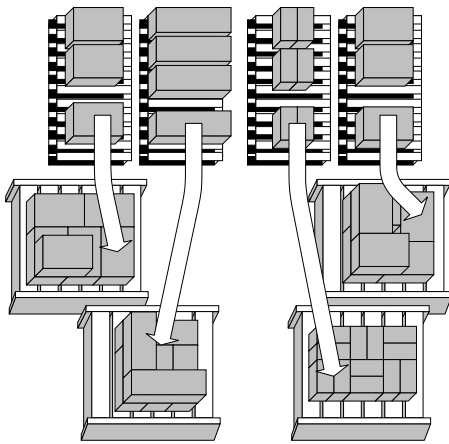


Figure 2.1 Duplicate handling function

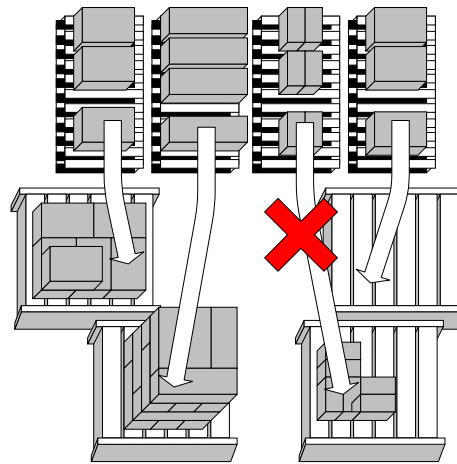


Figure 2.2 Multiple handling function

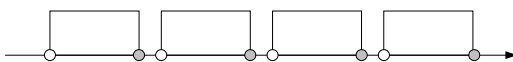


Figure 2.3 Program 1 cycle duplicate handling

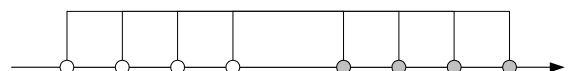


Figure 2.4 Program 1 cycle multiple handling

Palletize shift (PAL)

Palletize end (PALEND)



#### 【Reference】

- (1) Duplicate handling . Multiple handling function (Multiple handling is a part of the duplicated function)
- (2) If teaching program is formed in order (PAL, PALEND), (PAL, PALEND) . . . , palletizing is possible.

- (3) If teaching program is formed in order (PAL, PAL . . . , PALEND, PALEND . . . ), palletizing is impossible.

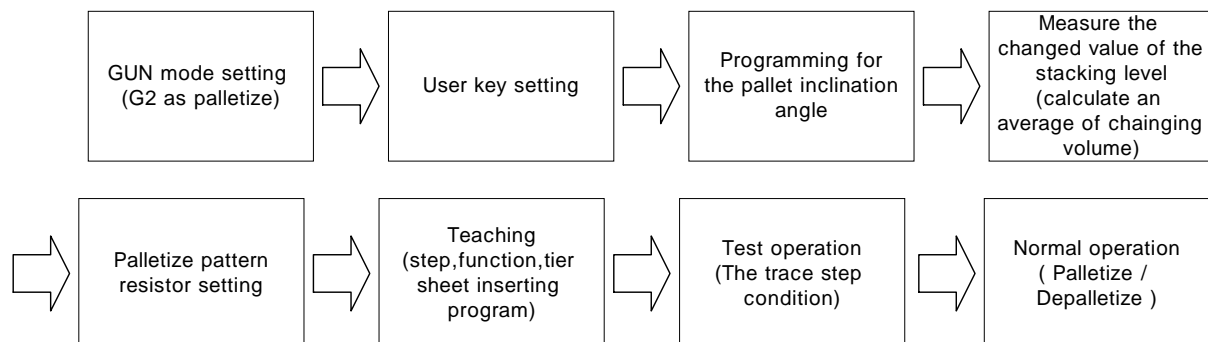
PAL means “Palletize shift”, and PALEND means “Palletize end”.

### 1.2.3. Basic function

- (1) Palletize
- (2) Depalletize
- (3) Picking position change for various (different size) works.
- (4) Picking position change comparing to stacking level
- (5) Compensation for height deviation by weight or volume.
- (6) Measurement the inclination angle of pallet.
- (7) Palletizing order change according to approach direction.
- (8) Rotative stacking on even level.
- (9) Tier sheet inserting
- (10) Work piece formation (outer or inner)
- (11) Function jump by palletizing count.

### 1.3. The operation flow of Palletizing function

The operation of palletizing function is as follows.



(1) Refer to GUN mode setting

(2) Refer to “User key setting”

(3) Refer to “Pallet inclination angle programming”

(4) Measure the changed value of the stacking level caused by work’s weight or volume and calculate the average.

(5) Refer to “palletize pattern resistor setting”

(6) Refer to “Teaching step”.

(7) Confirm taught program.

(8) Refer to “Play back”.

### 1.4. Before to start teaching

Before you start teaching, please check follows surely.

- (1) At the GUN mode setting, please confirm that you set GUN2 as palletize. If not, palletizing function can not be operated.
- (2) Check if “User key setting” is selected correctly.
- (3) Confirm taught “pallet inclination angle measurement program”
- (4) If there is a tire sheet , please check “Tire sheet inserting program” is in or not.
- (5) Please confirm palletize pattern resistor setting value is input correctly or not.

### 1.5. Definition of wording ( Concerned palletizing function )

- (1) Palletize pattern resistor  
: A resistor inputting necessary data to carry out palletizing function..
- (2) No. of workpiece/level  
: Ther number of work to be stacked on one level.
- (3) Pattern number  
: A number distinguishing the stacking shape of work.
- (4) Workpiece formation  
: Means the method of workpiece formation.
- (5) Total stacking level  
: Final level of works to be stacked.
- (6) Even level rotation  
: It means the amount of rotation (angle) to put the work on even level on the basis of odd level. The stacking order will be changed according to rotation angle.
- (7) Approach direction  
: It means the step's approach direction just before the work is put on the pallet. The stacking order is decided according to work's approach direction.
- (8) Height deviation by weight or volume  
: Compensating the height deviation in case stacking level height is changed by work's weight, volume etc.
- (9) Compensation SRT LVL  
: This means stacking level to start deviation compensating.
- (10) Sag or swell value  
: Average value of the height deviation.

$$\text{MdH} = \frac{\text{Calculated stacking height ( } H_{\text{ideal}} \text{ )} - \text{Real stacking height ( } H_{\text{real}} \text{ )}}{\text{Total level} - \text{compensation SRT LVL}}$$

MdH : Mean value Delta of the Height-deviation

Calculated stacking height (  $H_{\text{ideal}}$  ) = Height of work(H) × Total level

Real stacking height (  $H_{\text{real}}$  ) : Real height measured by tape line or other measure.

(11) K (Constant)

: A constant compensating the changed value of height deviation.

(12) Pallet inclination angle

: It means the inclination angle of a pattern constituted with robot coordinates in the center, as pallet is paralleled to pattern it is named pallet inclination angle.

(13) Picking up

: An action to pick and lift up the work from conveyor fixed jig.

(14) Picking

: An action to pick the work form conveyor or fixed jig.

(15) Tier sheet

: It is the paper, anti-heat paper, moisture-proof paper which is put between levels when the level is changed

(16) Tier sheet inserting

: An action to insert tier sheet between levels.

(17) The criterion of tier sheet inserting

: It means the criterion to decide that how often the sheet to be inserted..

(18) Whether inserting tier sheet or not.

: To decide if you insert the tier sheet at last level.

(19) Subtle compensating

: It means that user creates and compensates position data which user wants in free choice reflecting subtle shift value (dX, dY, dZ) to a position data created automatically by palletizing function.

(20) Palletize count

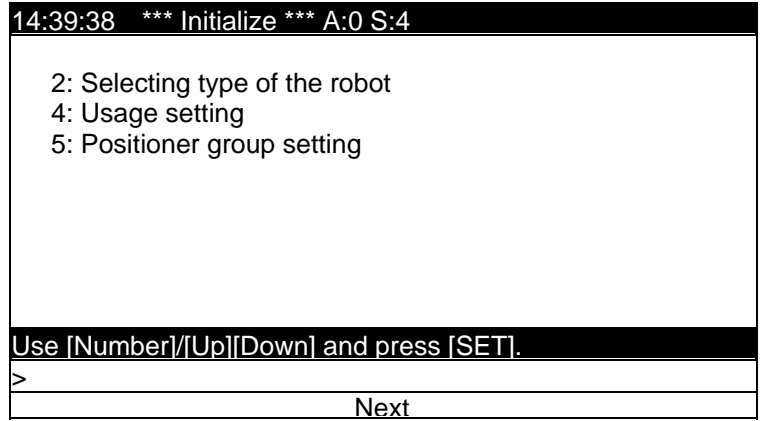
: The number of work which is being stacked.

(21) PALCNT

: It means the palletize count among a system variable.

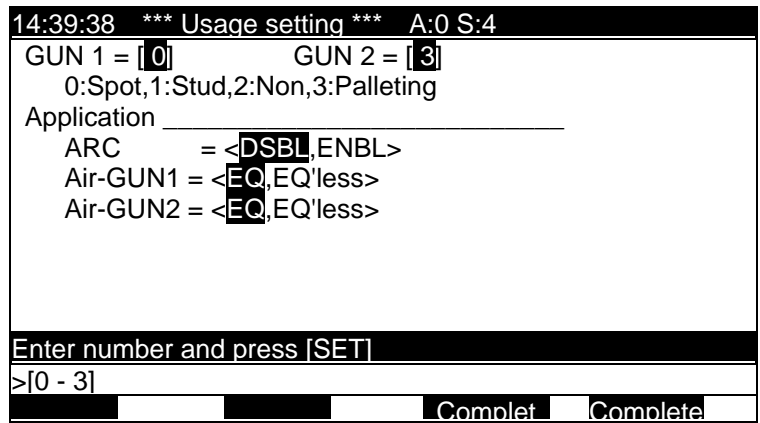
## 2. System setting

### 2.1. Usage setting of the robot



(1) Select System setting/ 5: Initialize/ 4: Usage setting.

(2) Select GUN2 =[3]. It is displayed as follows.



#### 【 Attention 】

- (1) You must select GUN2 as palletizing or you can't use palletizing function.
- (2) GUN mode could be changed after inputting engineer code.
- (3) If you push Finish [PF5] after selecting "Usage setting", you can see the message "Do you want to initialize the input/output assignment signal? [Y/N]. Please refer to input/output assignment in the controller manual.



## 2.2. User key setting

(1) Select system setting/ 2: Controller parameter/ 11: f-key setting. It will be displayed as follows.

```

14:39:38 *** f-key setting *** A:0 S:4
f1=[ 0] f2=[ 0] f3=[ 0] f4=[ 0]
501 :pickingup rise step selecting
511 :pickingup step selecting
523 :palletizing setp selectiong

Select and Enter number. Press [SET]
>[0 - 527]
Previous Next Complete

```

501 : Work picking up rise step selecting

PU ( At step recording, designate picking up step of the work )

511 : Work picking step selecting

PK ( At step recording, designate picking step of the work)

523 : Palletizing step selecting

PS ( At step recording, designate stacking step of the work)



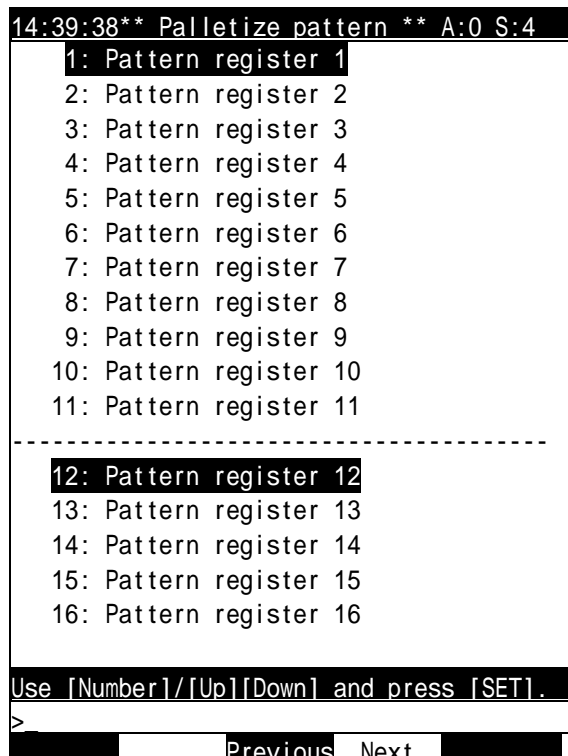
### 【Reference】

At a constant mode, you can assign PU, PK, PS to f1, f2, f3, f4 of T/P. If you push each key one time, it turns “ON” and push it one more it turns “OFF”

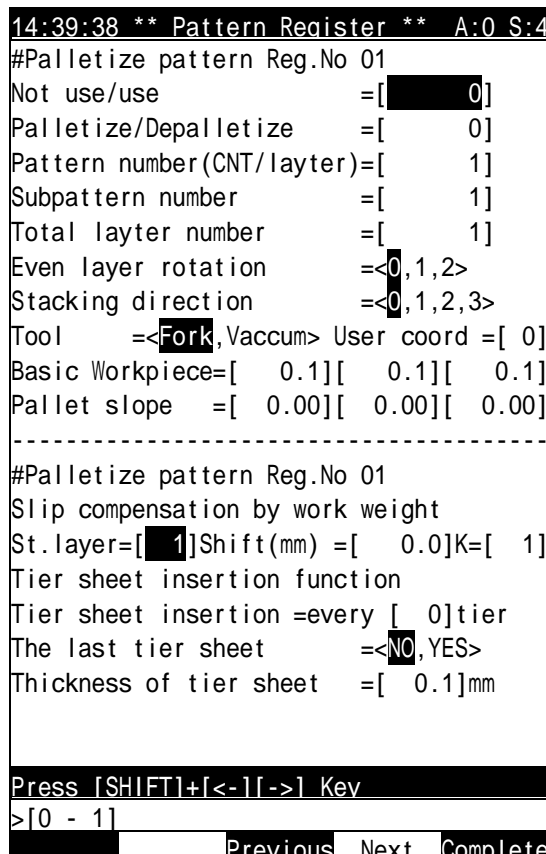
## 2.3. Palletizing pattern resistor setting

### 2.3.1. The way to operate

- (1) To input palletizing information, select the constant mode group 1-37. “Palletizing pattern resistor setting”. There are totally sixteen palletizing pattern resistor in it.



- (2) If you select any one of the sixteen pattern resistor following picture will be



displayed

### 2.3.2. Palletize pattern resistor

To input basic elements to perform palletizing function, you must do this to user palletizing function. You can store max. sixteen pattern resistor. The word of number set in ,  and  is initial data.

(1) Palletize function usage < , Use >

: To decide whether you use pattern resistor or not. If you want to user, you must select "Use".

(2) Work = < Palletizing , Depalletizing >

: To decide to do palletizing or depalletizing.

(3) No. of workpiece/level =  workpiece

: It says the number of work in one level, there will be max 25 works on it. Set the number which you want to stack. The setting range is from 1 to 250.

Refer fig 3.1, 3.2, 3.3.

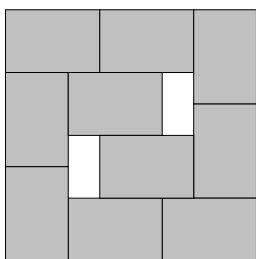


Fig 3.1 10pcs/level

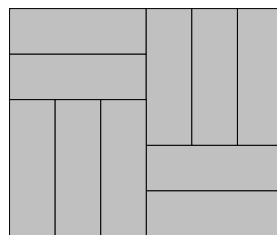


Fig 3.2 10pcs/level

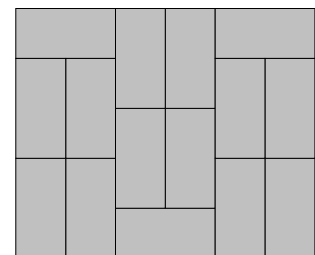


Fig3.3 15pcs/level

#### 【Attention】

Some certain number among 25 workpiece can't be stacked, but if user wants to stack with that number of workpiece supplier will reflect it.

(4) Pattern number =

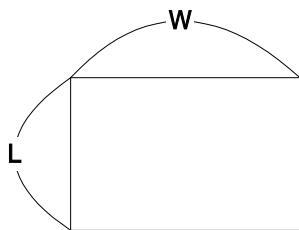
: The pattern number says stacking type and there are six types of pattern.  
 You have to select the pattern number of type which you want. The number are from 1 to 6

**【Attention】**

There is some pattern that you can't use, but if your want to use, supplier will reflect it.

(5) Work piece formation = < Outer , Inner > line

: When your arrange the workpiece on the pallet, at first, work palletizing pattern type should be decided to select the line type of workpiece formation for offset amount which is occurred according to the ratio of work's width(W) and length(L) composing the pattern. In here, offset amount means the gap between workpiece and user have to generate this offset amount in palletize function and decide the part apply to according to setting value.



For example; To compose the pattern such as fig 4.1, the work is ratio (W:L) must be 3:2. In case the ratio is not 3:2, the pattern shape could be fig 4.2, fig 4.3, fig 4.4 and fig 4.5. Also it could be different shape of pattern accordingly to user's offset amount setting.

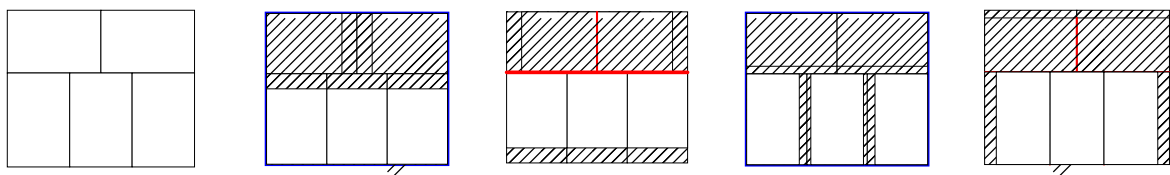


Fig 4.1 2W=3L Fig 4.2 2W<3L Fig 4.3 2W<3L Fig 4.4 2W>3L Fig 4.5 2W>3L

- In case of outer line( Blue line ): The pattern shape becomes fig 4.2, fig4.4,
- In case of inner line (Red line) :The pattern shape becomes fig 4.3, fig 4.5.

(6) Total stacking level =[ 1]

: Set the total level to stack, Max level is 100.

Setting range is 1 - 100.

## (7) Even level rotation = &lt;0,90,180&gt;deg

: This means the works are stacked after you rotate the pattern properly on even to protect the work collapsing. Even level can be turned  $0^\circ$ ,  $90^\circ$ ,  $180^\circ$  on the basis of basic pattern. Generally on even level, pattern turns 180 deg from odd level.

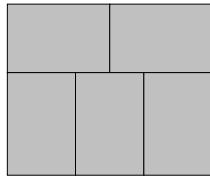


Fig 5.1 Basic pattern

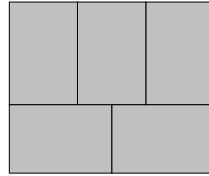


Fig 5.2 180 deg turned pattern

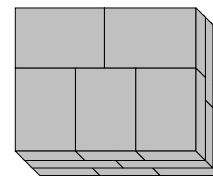


Fig 5.3 Shape of stacked work

## 【Reference】

For example when you select the pattern fig 5.1, even level can be turned  $0^\circ$ ,  $90^\circ$ ,  $180^\circ$  base on fig 5.1. Fig 5.2 shows the pattern fig 5.1 turned  $180^\circ$  and fig 5.3 shows the figure of works being stacked.

## (8) Approach direction = &lt;0,1,2,3&gt;

: When stack the work, settle the workpiece approach direction to decide the stacking order.

The reason to decide stacking order by settling workpiece approach direction is

To avoid interference between workpieces

To avoid interference between work and handling tool.

In principle, the selection of approach direction number should be opposite direction of the first stacked work.

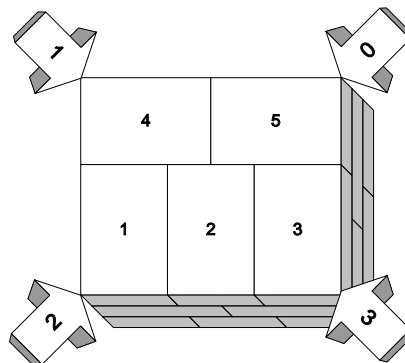


Fig6.1 The selection of approach direction

Stacking order is decided as one among four by approach direction. The number 0,,1,2,3 in fig 6.1 is a approach direction and means approach step direction before you stack the work on the pallet.

If the first work is “1”, please select arrow “0” as approach direction.

The order to stack the work will be 1 2 3 4 5

In case the first work is “3”, Select arrow “1” as approach direction.

The order to stack the work will be 3 2 1 5 4

In case the first work is “5”, please select arrow “2” as approach direction.

The order to stack the work will be 5 4 3 2 1

If the first work is “4”, select arrow “3” as approach direction.

The order to stack the work will be 4 5 1 2 3

Above is the stacking order according to work’s approach direction.  
On even level, the palletizing will be performed as the order selected.

**【 Attention 】**

1. Select the direction of stack first, before teach the palletize program. Please teach the program considering above thing surely.

2. In case the hand type is chucking or forking, you have to teach as the expression of 4 pattern manuals because the hand or work may be interfered with other work.

**【 Reference 】**

1. If all step approach directions ar on 1/4 area on the basis of the work position which is to be stacked on the pallet, select “0” as the work approach direction. ( refer to fig 6.2 )

2. If all step approach direction are on 2/4 area on the basis of work position which is to be stacked on the pallet, select “1” as the work approach direction. (refer to fig 6.3)

3. If all step approach direction are on 3/4 area on the basis of work position which is to be stacked on the pallet, select “2” as the work approach direction (refer to fig 6.4)

4. If all step approach direction are on 4/4 area on the basis of work position which is to be stacked on the pallet, select “3” as the work approach direction (refer to fig 6.5)

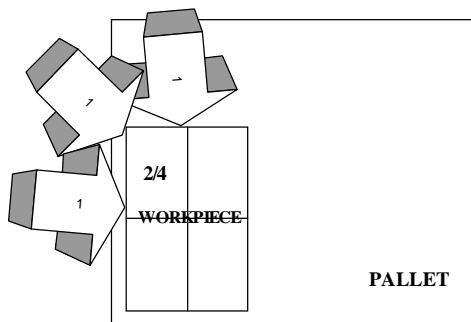


Fig 6.2 Reference 1

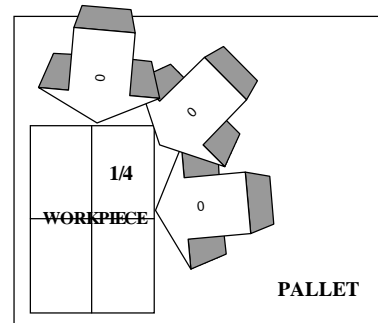


Fig 6.3 Reference 2

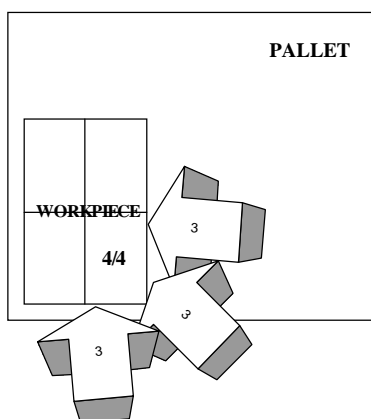


Fig 6.4 Reference 3

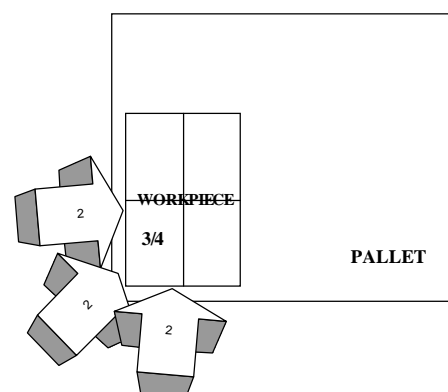


Fig 6.5 Reference 4

(9) Height deviation by weight or volume (+:be high,-:be low)

: The height of stacked work could be changed by the weight or volume of the workpiece. This irregularly changed height should be compensated with a certain value of the height on every level. The gap between total height which is calculated with workpiece's height and actual height on the pallet should be checked.

Calculated height (  $H_{ideal}$  ) = The height of workpiece(H) × The number of level

- Actual height (  $H_{real}$  ) = Measured height on pallet

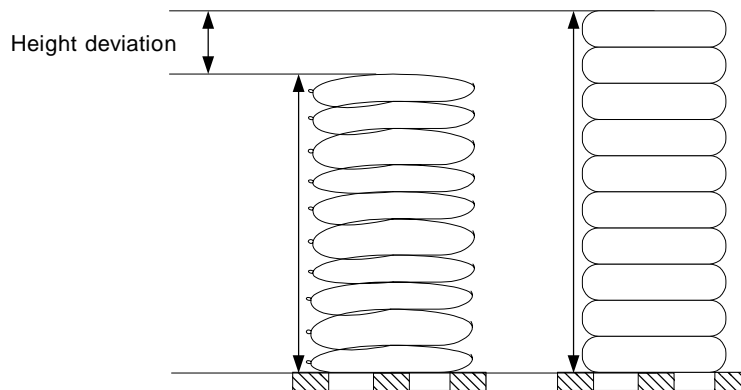


Fig 7.1 The deviation between H<sub>real</sub> and H<sub>ideal</sub>

- The compensation for height deviation = (( stacking level – compensating SRT LVL ) × Sag or swell value )<sup>K</sup>

Fig 7.1 shows the height deviation between actual height and calculated ideal height.

- Compensation SRT LVL = [ 1 ]

: Input the starting level to reflect sag or swell value for compensating the height deviation.

Range is 1 - 100.

- Sag or swell value (MdH) = [ 0.0]mm

: Mean value of the height difference between actual height and calculated height.

- MdH = Total level - compensation SRT LVL

Range is -255.0 - 255.0 .

- K(Constant) = [ 1]

: Compensate the deviation by adjusting "K" value base on the height chain g rate.

Range is 1 - 3.

#### 【Reference】

When not considering the changes of column height, set up stacking impossible column as deviation applied starting column.

In the case that the amount of column height changes rapidly, set up as 2 or 3 and in the case that the amount of column height changes linearly set up as 1.

#### 【Attention】

1. The deviation is larger as much as the staking column is higher, so then there could be problems.

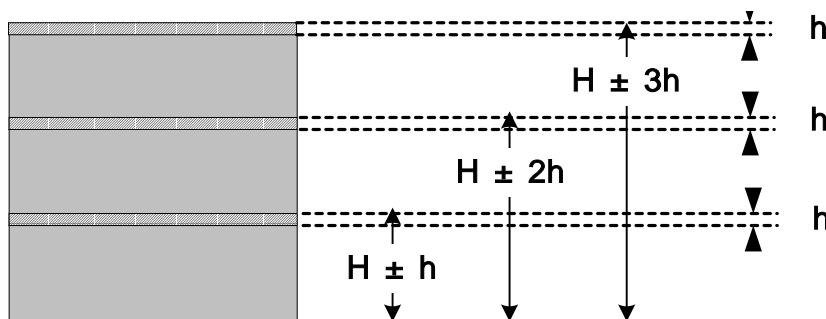


Figure 7.2 the changes of column height by the mass of workpiece

H : height of workpiece

h : the amounts of deviations by mass

2. The correction of the deviations of the height of stacking level is a function to correct the deviations for the safety of palletizing. And then it depends on user's estimations to adjust the proper value of deviations.

(10) Handling Tool = < Poking, Vaccum >

: There are two cases to set up this item.

- In the case that the position of picking up changes according to handling tools.
- In the case that the position of picking up changes according to the size of workpieces.

Robot should properly accommodate the change of picking up position.

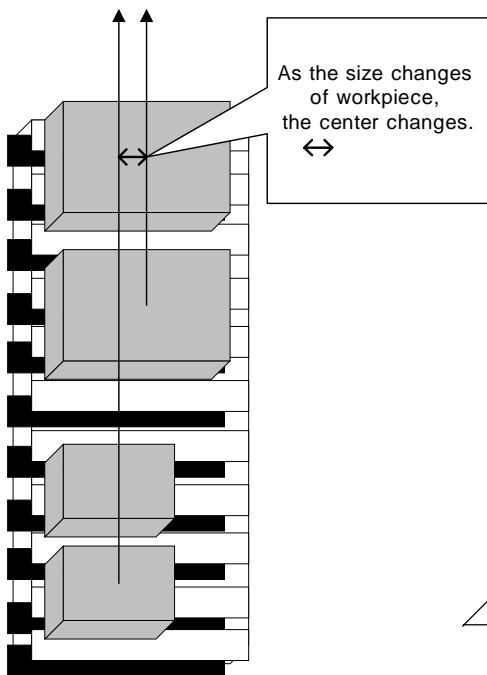


Figure 8.1 The changes of picking up position (PK)

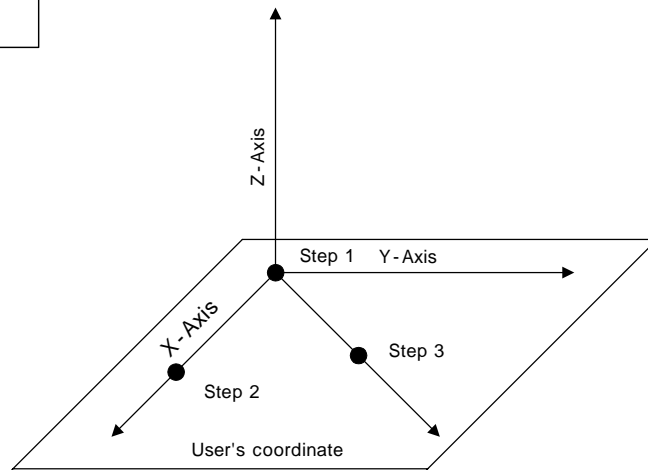


Figure 8.2 How to teach by user's coordinate

The teaching method is following in the case that picking up position (PK) changes.

- Select "VACCUM" in the handling tool.

- Teach user's coordinate.
- Select USER'S COORDINATE in the coordinate system

**【Attention】**

User's coordinate could be used for PK only in the case that vacuum is selected for handling tool.

(11) User's coordinate = [ 0]

: User's coordinate could be used for PK only in the case that vacuum is selected for handling tool and the step that user's coordinate could be applied is only the step that the condition is "PK".

The range is 1~10.

Recording user's coordinate (To teach the 3 basic steps for the definition of user's coordinate. Refer figure 8.2)

Step 1 : Define the origin point

Step 2 : Define x axis

Step 3 : This step is to define XY coordinate and Z axis.

14:39:38 \*\*\* User coordinate \*\*\* A:0 S:4

User Coord. No. = [ 0]

Program No. for registration = [ 0]

Select and Enter number. Press [SET]

>[1 - 10]\_

Execute

Select "28:Record user's coordinate" in the service function of teach mode.

Input the number of user's coordinate and program that 3 points is teached.

**【Attention】**

Teach on the basis of left hand for the definition of user's coordination.

**【Reference】**

1. Totally 10 user's coordinates could be recorded.
2. Attention when recording coordination.
  - basic 3 points must not be on same line.
  - basic 3 points must have proper distances each other.

(12) The information of workpiece

: Set up the size of basic workpiece. The why to set up the size of basic workpiece is following.

- The change of picking position could be calculated from the size as workpiece changes.
- To protect the change of palletizing pattern according to the size.
  
- Width (necessarily  $W > L$ ) = [ 0.1]mm
  - : Set up the width. The width should be the long surface of workpiece.
- Length = [0.1]mm
- Height = [0.1]mm
  - : Range 0.1 ~ 3000.0 mm.

**【 Attention 】**

Basic size is on the basis of actual workpiece of Palletiz Shift (PAL,M96). If the basic size is not input, shift amount could not be calculated for pattern. Necessarily basic must be input.

(13) The information of pallet

- the axis's angle of pallet ( x, y, z )

To correct the tilting angle when palletizing. The correction amount is applied to the shift amount.

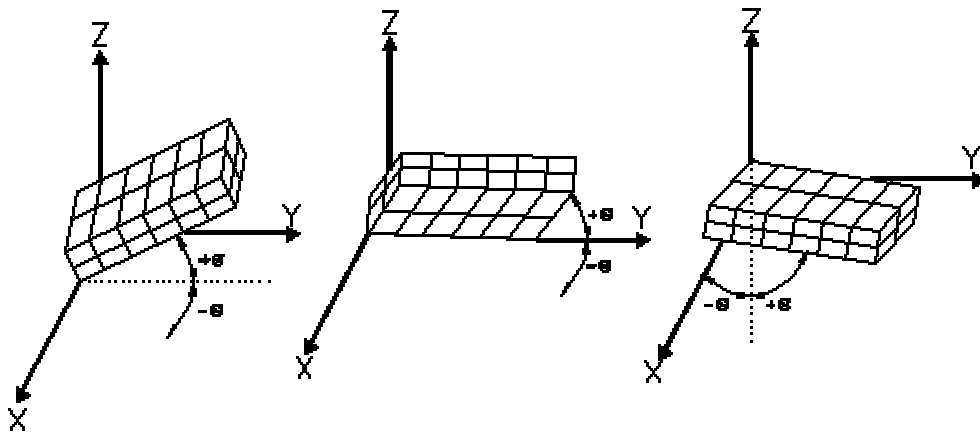


FIGURE 9.1 The changes of shift amount according to the tilting angle of pallet.

- How to measure the tilting angle

It is difficult to measure slop of conveyor and pallet. Even if measuring is done, the result is unbelievable. So there is a function to calculate automatically slop of pallet. It is easy to calculate the slop by using this function.

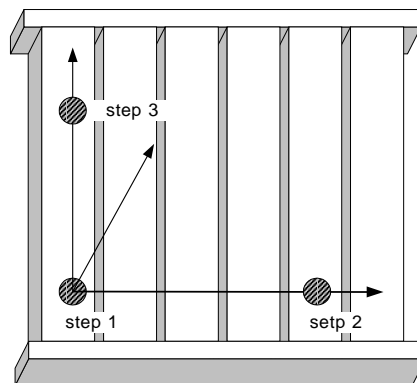
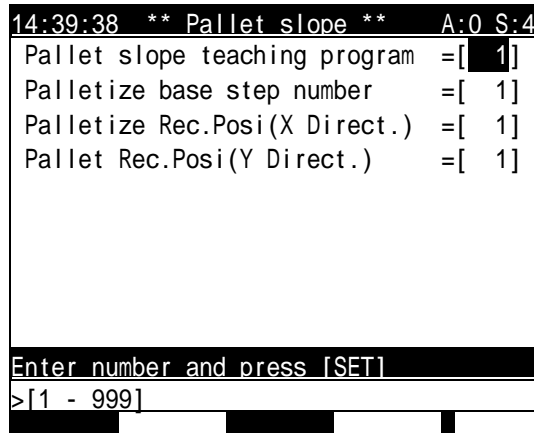


FIGURE 9.2 Teaching step of program to measure slop

- Step 1 : Record the position where the first workpiece places
- Step 2 : Record x axis of pallet (the basis of robot coordination)
- Step 3 : Record y axis of pallet (the basis of robot coordination)

- Select "13 measuring the slop of pallet" in edit mode

- After selecting “13 measuring the slop of pallet”, the next screen would be displayed as following.



- Input items

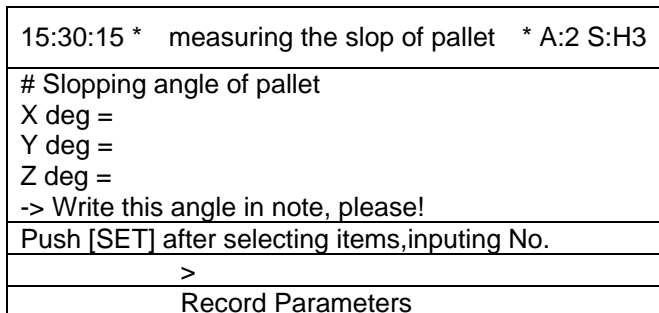
Measuring program No. : Input the program number to measure slop

Basic step No. : Input “1”

Recording Step No. of X axis : Input “2”

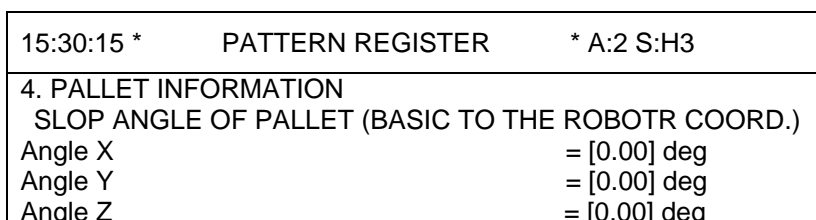
Recording Step No. of Y axis : Input “3”

- After input done, if [EXECUTE] key is pushed, the next screen would be displayed as following.



- Record X deg, Y deg, Z deg in note.

- Input the above data into “the slop angle of Pallet” in “PALLETIZE PATTERN REGISTER”



Push [SET] after selecting items, inputing No.
>
Record Parameters

- Angle X = [0.00] deg.  
: Input slop angle on the basis of robot X coordination.
  - Angle Y = [0.00] deg.  
: Input slop angle on the basis of robot Y coordination.
  - Angle Z = [0.00] deg.  
: Input slop angle on the basis of robot Z coordination.
- The range is  $-180.00^{\circ} \sim 180.00^{\circ}$ .

### 【Attention】

1. The accurate angle could be calculated only when the step is recorded in contact with the surface of pallet. If handling tool is equipped, record steps at the lowest speed. And the next move to edit mode.

2. When recording, teach on the basis of left hand.

### (14) Inserting sheet

- The basis of sheet insertion = [0] each level  
: Set up the standard to insert sheet. It defines which level to insert sheet.  
The range is 1~100.
- Insetting sheet at last level = <unavailable, available>  
: It defines to insert sheet or not on the last level.
- sheet thickness = [0.1] mm  
: Input the thickness of insertion sheet. The height of next level after inserting sheet is automatically calculated. The range is 0.1 ~ 500.0.

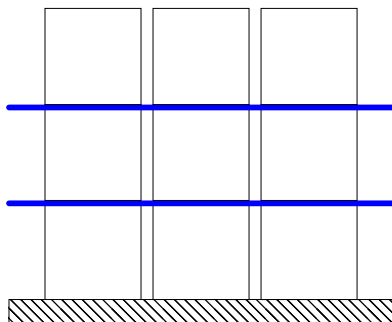


FIGURE 10.1 INSERTION SHEET OF SHEET



FIGURE 10.2 THE THICKNESS

**【Attention】**

It is impossible to insert sheet above the pallet (0 level) when palletizing and it is impossible to unload sheet of last level when depalletizing.

The data would be recorded after pushing RECORDING PARA.[PF5] key.

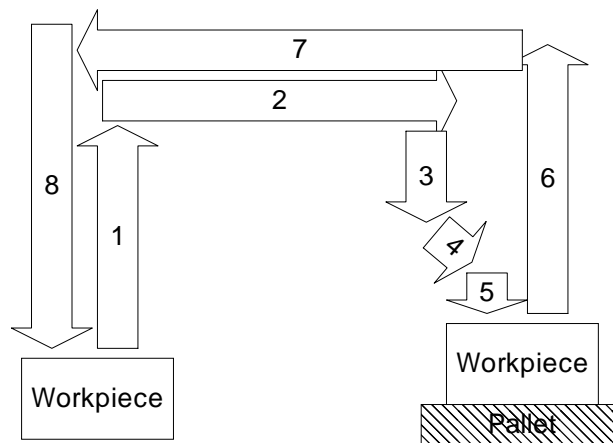
### 3. Teach

Necessarily confirm or set up the following items before teach.

- (1) Confirm wheter palletizing is set up at the Gun Set up mode or not. If not, set up.
- (2) Confirm user key definition.
- (3) Check wheter user coordination program is recorded or not.
- (4) Check wheter slop measuring program is recorded or not.
- (5) Check that the value of palletizing pattern register is correct.
- (6) When recording steps, check that the condition of step is correct.

#### 3.1. The pattern of palletizing path

The palletizing path of robot refers to followings.



**Fig 12.1 Palletizing path**

##### 3.1.1. Step condition and path

### 3. Teach

---

PATH	MEANING	THE CONDITION OF START STEP			THE CONDITION OF TAGE T STEP		
		INTER PO.	ACCRACY	FUNCTION	INTER PO.	ACCRACY	FUNCTION
1	Pick up workpiece	ON	0	PK	ON	3	PU
2	Move to the above safe point before stacking	ON	3	PU	OFF	3	PS
3	Move to approach position	OFF	3	PS	ON	3	PS
4	Start to approach	ON	3	PS	ON	3	PS
5	Move to stacking point	ON	3	PS	ON	0	PS
6	Move to the space above stacking position	ON	0	PS	ON	3	PS
7	Move to the space above next picking position	ON	3	PS	OFF	3	PU
8	Move to picking position	OFF	3	PU	ON	0	PK

### 3.1.2. Teach step

The following is sample program for palletizing.

PAL 1,1,100.0,100.0,100.0	Input basic parameter to start palletizing. Cmd.No : 362
PAL 1,1,100.0	Input shift amount for picking up.
S1 MOVE L, S=100%, A=0, H=0, PK CLOSE HAND	Picking position Picking workpiece
S2 MOVE L, S=100%, A=3, H=0, PU	Moving up after picking comparing to palletizing level.
S3 MOVE P, S=100%, A=3, H=0, PS	Rotating S axis to above stacking position
S4 MOVE P, S=100%, A=3, H=0, PS	Moving to starting position of approach.
S5 MOVE P, S=100%, A=0, H=0, PS	Starting to approach stacking position
S6 MOVE L, S=100%, A=3, H=0, PS OPEN HAND	Loading workpiece
S7 MOVE L, S=100%, A=3, H=0, PS	Moving up to the space above stacking position
<b>F001 TIERST[1,P1,1,2]</b>	Call program to insert sheet
S8 MOVE P, S=100%, A=3, H=0, PU	Move to the space above next picking position keeping height
PALEND P1, M1	Ending palletizing Cmd. No : 371
END	Ending program



#### 【Reference】

Cmd. No : Each command of robot language has own number.

PAL : Cmd. No 362, PALPU : Cmd. No 363, PALRST : Cmd. No 364,

PALEND : Cmd. No 371

### 3.1.3. Editing program to insert sheet

**F001 TIERST[1,P1,1,2]**: Add this part to insert sheet. When needing to insert sheet, robot calls inserting program.

```

S1  MOVE P, S=100%, A=0, H=0      Move to the near sheet position.
S2  MOVE L, S=100%, A=0, H=0      Picking sheet
     T. 5 (PICKING SHEET)
     M52 1, 0, R1, 3
S3  MOVE L, S=100%, A=0, H=0      Move up with picking
S4  MOVE P, S=100%, A=0, H=0      Move to the space above levels to insert.
S5  MOVE L, S=100%, A=0, H=0      Load sheet
     T. 5 (LOADING SHEET)
S6  MOVE L, S=100%, A=0, H=0      Move up to the space above the level.

M52 0, 0, R1, 0                    End the insertion program and return to main program.

END
    
```

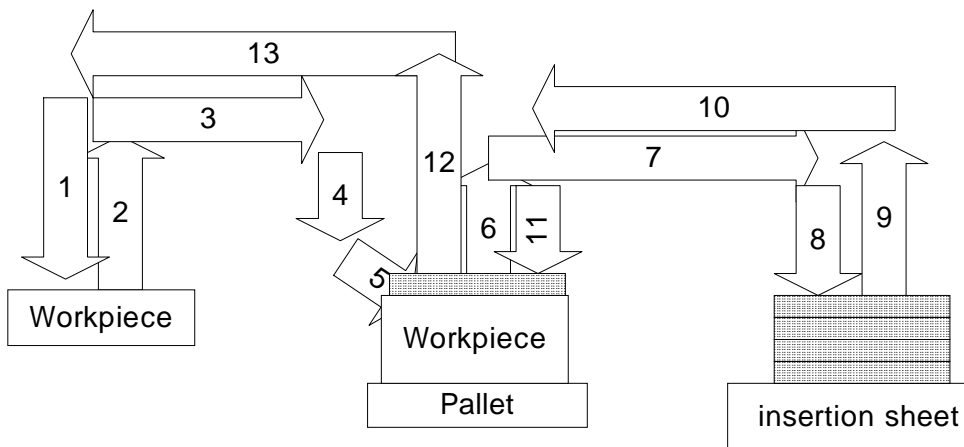


FIGURE 12.2 Palletizing path with inserting sheet



**【Reference】**

- (1) The previous program is sample program to palletiz with she INSERTION SHEET program.
- (2) The shift amount of sheet insertion program uses the value of palletizing pattern register.
- (3) TIERSH : Cmd. No 365

### 3.1.4. Example of elaborately corrected program (Palletizing and shift function)

The shift function can be used with palletizing function at the same time. The data that automatically calculated in the palletizing function can be corrected to reflect dX, dY, dZ by user.

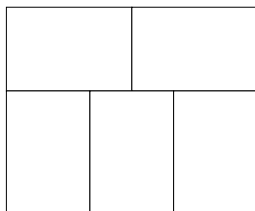


FIGURE 11.3 PATTERN

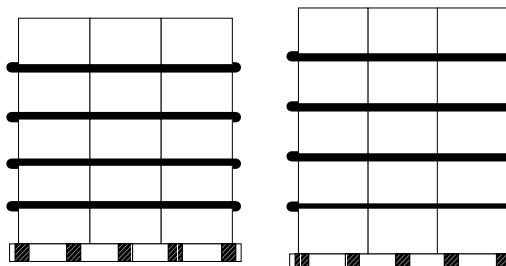


FIGURE 11.4 Case that the height of level is variable.

For example, in the case that stacking level is 5 and each level has own shift amount with palletizing pattern like figure 11.3, program is following

M93 [P1, 1, 5]

Function jump by palletizing counter

M68 [R1,0.0,0.0,-10.0,0.00,0.00,0.00]

M68 [R1,0.0,0.0,-11.0,0.00,0.00,0.00]

M68 [R1,0.0,0.0,-12.0,0.00,0.00,0.00]

M68 [R1,0.0,0.0,-13.0,0.00,0.00,0.00]

M68 [R1,0.0,0.0,-14.0,0.00,0.00,0.00]

M88

Substitution shift amount according to level  
Ending jump

PAL [P1,1,100.0,100.0,100.0]

PALUP [P1,2,100.0]

S1 MOVE P, S=100%, A=0, H=0, PK  
CLOSE HAND

S2 MOVE P, S=100%, A=0, H=0, PU  
M52 [1,0,R1,0]

Start ON-LINE SHIFT FUNCTION

S3 MOVE P, S=100%, A=0, H=0, PS

S4 MOVE P, S=100%, A=0, H=0, PS

S5 MOVE P, S=100%, A=0, H=0, PS

S6 MOVE P, S=100%, A=0, H=0, PS  
OPEN HAND

S7 MOVE P, S=100%, A=0, H=0, PS  
M52 [0,0,R1,0]

End ON-LINE SHIFT FUNCTION

TIERST[R1,P1,1,2]

Call sheet insertion program using same register with M68

```
S8 MOVE P, S=100%, A=0, H=0, PU
PALEND [P1, M1]   End palletizing
END
```

**【 Attention 】**

1. M93 (Function jump) must precede M96(PAL, palletizing shift) in program.
2. TIERST (M94, call sheet insertion program) must use the same register with of M68(Substitutue shift amount) or M69(Add shift amount).
3. M52(On line shift) must be ended before using TIERST (M94, call sheet insertion program).

**【 Reference 】**

1. M93 is function to jump by palletizing counter. It can be used in various applications.
2. For example, it can be used in the case that correcting elaborately work pieces, inserting pallet and palletizing workpieces in the shape of pyramid.

3.1.5. PK(Picking), PS(Palletize Shift), PU(Picking up) Function

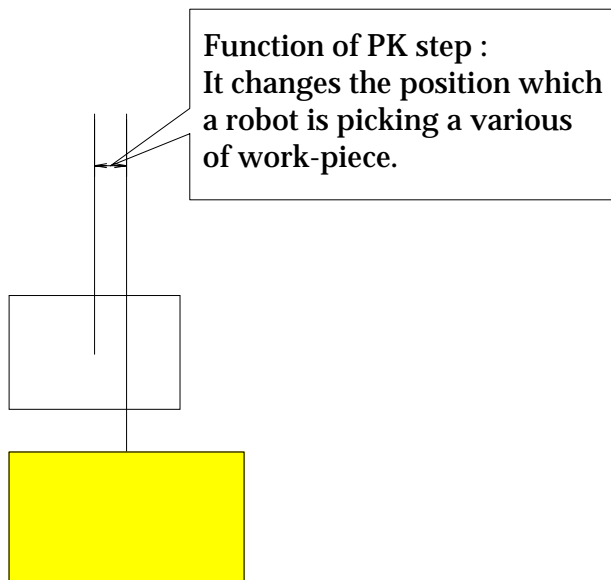


Figure 13.1 Function of picking step

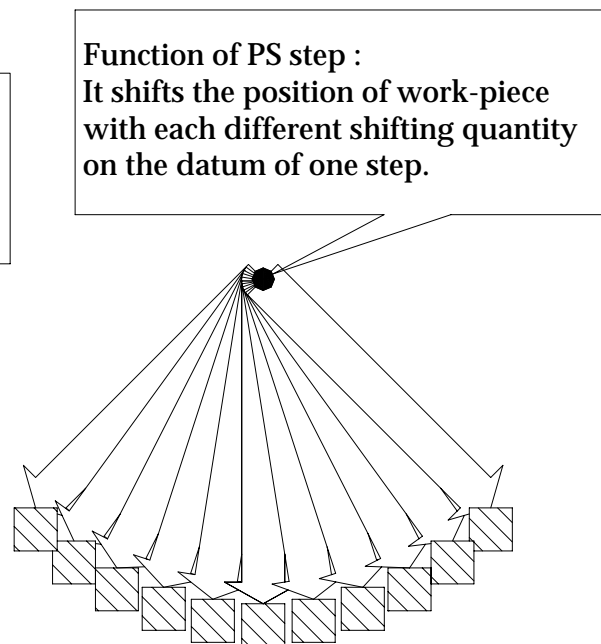


Figure 13.2 Function of palletize shift step

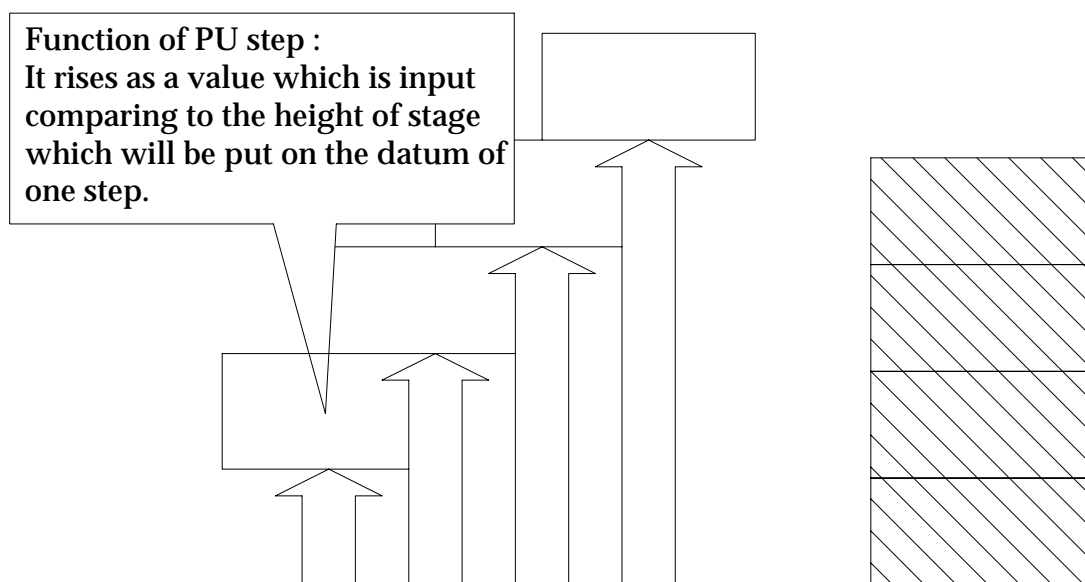


Figure 13.3 Function of picking up(PU) step



**【Reference】**

PK,PU and PS are what give a function on a step for performing the palletize Function and must use a proper step condition according to the decision of user.

There are two methods which set up the PK,PU and PS.

A method which sets it up by using the user keys(f1,f2,f3,f4).

( Please refer to the “User key setting” which is on 5page of “Operation manual”)

A method which sets it up by modifying the order after pressing the STEP key of the Teach Pendant.



**【Attention】**

When performing the teaching of a robot, the step should perform the teaching after considering sufficiently not only a step which performed the teaching for the first time but also a step position which will be shifted can be existed within the working area . Otherwise, it can be made an error such as “The angle between arms is small(or big)” or “It is a shift limit of ( )axis.” In this case, it can be solved by adjusting the step which performed the teaching.

### 3.1.6. The screen formation in performing the teaching of step and the screen in replaying

The next screen is a part screen which performs the teaching of a palletize program.

It displays the proceeding Speed of step.

It displays the accuracy setting

It sets up the step condition satisfying the upper condition and also, it can turn on/off each condition by moving the screen cursor.

```

15:30:15 *** Teaching *** A:3 S:H4
TO PK FS PU
PN:003[*]__S/F=1/5 SP:100.0

PAL 1,1,100.0,100.0,100.0
PU 1,1,1
MOVE P.S=100%,A=0,H=0,PU,PK,PS
MOVE P.S=100%,A=0,H=0,PK
MOVE P.S=100%,A=0,H=0,PU
... MOVE P.S=100%,A=0,H=0
S5 MOVE P.S=100%,A=0,H=0,PS
S6 MOVE P.S=100%,A=0,H=0,PS
S7 MOVE P.S=100%,A=0,H=0,PS
S8 MOVE P.S=100%,A=0,H=0,PS
S9 MOVE P.S=100%,A=0,H=0,PS
PALEND 1.1

>_
Service Wait Cancel Condition Setting

```

The following is a screen which is displayed in case of replaying the palletize function program.

The point(.) is displayed in replayed order or step.

```

15:30:15 *** Replay *** A:3 S:H4
TO SR:100% 1Cycle
PN:003[*]__S/F=1/5
.PAL 1,1,100.0,100.0,100.0
.PALPU 1,1,1
S1 .MOVE P.S=100%,A=0,H=0
S2 MOVE P.S=100%,A=0,H=0,PK
S3 MOVE P.S=100%,A=0,H=0,PU
S4 MOVE P.S=100%,A=0,H=0
S5 MOVE P.S=100%,A=0,H=0,PS
S6 MOVE P.S=100%,A=0,H=0,PS
S7 MOVE P.S=100%,A=0,H=0,PS
S8 MOVE P.S=100%,A=0,H=0,PS
S9 MOVE P.S=100%,A=0,H=0,PS
PALEND 1.1

>
Service Wait Cancel Condition Setting

```



**【 Attention to error occurrence 】**

When editing the step condition or program in teaching mode, the role of each step must be memorized. Otherwise, this can set up a wrong condition and cause the robot to work for a locus which it doesn't want to.

**3.2. Command language and M code**

**3.2.1. Call and input of the program( TIERST, M94 ) inserting the letter-paper**

- (1) Input M94
- (2) Input the on-line shift register. [Input the register number(1~8)]
- (3) Input the pallet number of palletize. [Input the pallet number of palletize(1~16)]
- (4) Input the pattern register number of palletize. [Input the pattern register number of palletize(1~16)]
- (5) Input the program number to call for inserting the letter-paper. [Input the program inserting the letter-paper(0~999)]

Before input

TIERST <span style="color: blue;">█</span> , _ , _ , _ , _ , _ , _ , _ , _

After input

TIERST R1 , P1 , D1 , 1

The pallet number of palletize is displayed to P#.

**3.2.2. Input of the palletize picking up shift(PALPU, M95)**

- (1) Input the M95
- (2) Input the pallet number of palletize. [Input the pallet number of palletize(1~16)]

(3) Input the start stage number. [Input the start stage number(1~100)]

(4) Input the shift quantity.

[Input the shift quantity in case of picking rising(-2000~2000)]

In the record of function which calculates the picking up quantity of workpiece, if input the M code(M95) after setting the step in teaching mode and set up each parameter value according to the guiding message, the following screen is displayed.

Before input

PALPU <span style="color: blue;">█</span> , _ , _ , _ , _ , _ , _ , _ , _

After input

PALPU P1 , 1 , 1 , 0

The pallet number of palletize is displayed to P#.

### 3.2.3. Input of the palletize shift(PAL, M96)

(1) Input the command language(PAL).

(2) Input the pallet number of palletize.

[Input the pallet number of palletize(1~16)]

(3) Input the pattern register number of palletize.

[Input the pattern register number of palletize(1~16)]

(4) Input the size of work-piece.

[Input the size(W , L , H) of work-piece(1~16)]

In the record of palletize shift function, if input PAL after setting up the step in teaching mode and set up each parameter value according to the guiding message, the following screen is displayed.

Before input

PAL 1 , 1 , 0 , 1 , 0 , 1 , 0 , 1

After input

PAL P1 , D1 , 0 , 1 , 0 , 1 , 0 , 1

The pallet number of palletize is displayed to P# . And the pattern register number is displayed to D#.

### 3.2.4. Input of the palletize end(PALEND, M97)

Input the pallet number of palletize.

[Input the pallet number of palletize(1~16)]

Input the end output signal.(O signal)

[Input the end signal(0~318)]

In the record of palletize end function, if input PALEND after setting up the step in teaching mode and set up each parameter value according to the guiding message , the following screen is displayed.

Before input

PALEND 1 , 0

After input

PALEND 1 , 0

The pallet number of palletize is displayed to P#.

### 3.2.5. Input of the palletize reset(PALRST, M98)

- (1) Input the pallet number of palletize. [Input the pallet number of palletize(1~16)]
- (2) Input the condition signal.(I signal). [Input the condition signal(0~240)]
- (3) Input the end output signal(M signal). [Input the response signal (1~318)]

The palletize compulsive reset is a function which uses in finishing the palletize work compulsively due to the occurrence of situation to stop the loading from the outside. And it goes through the process of “Input of I signal      Output of response signal      Pallet withdrawal”. In the record of palletize compulsive reset function, if input PALRST after setting up the step in teaching mode and set up each parameter value according to guiding message, the following screen is displayed.

Before input

PALRST 1 , 0 , 1

After input

PALRST 1 , 0 , 1

The pallet number of palletize is displayed to P#.



**【Attention】**

The precise pallet number of palletize should be input.

## 4. Replay

At first, after making out the palletize program and then replay it after confirming a locus of robot proceeding to the first step in teaching mode.

### 4.1. Replay of PK step

It is applied to the step which picks up the working object.

It shifts as the change quantity of position which is different according to its size when picking up the work-piece.

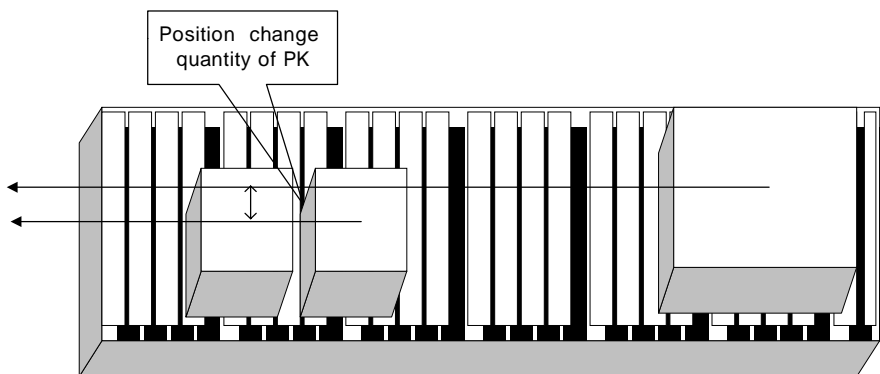


Figure14. The role of PK in case that the work-piece which the size is different enters from C/V(conveyor)

### 4.2. Replay of PS step

It is applied to the approach step , loading step and withdrawal step after loading.

In the step which PS is set up, it shifts the step with each different shift quantity according to the pattern shape.

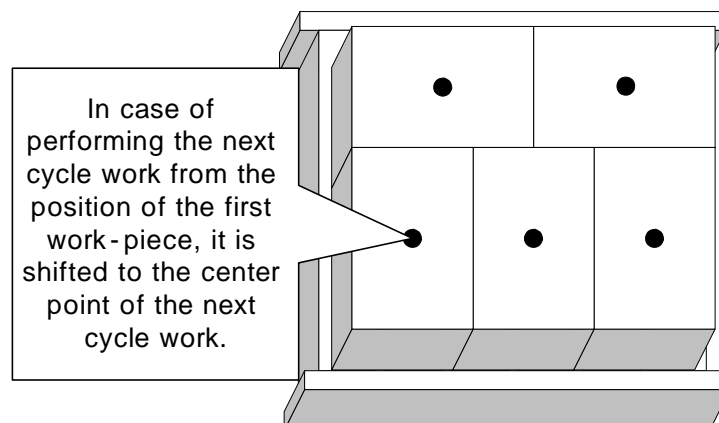


Figure 15. The role of PS which finds out the shift quantity for the direction of the center point of next work-piece from the position which the first work-piece is put.

### 4.3. Replay of PU step

It is applied to the step picking and lifting up the work-piece.

After picking the work-piece, it makes it possible that the shift quantity of withdrawal step is adjusted comparing the height of withdrawal step with that of stage. If you use the step condition of PU, the unnecessary locus of robot can be minimized.

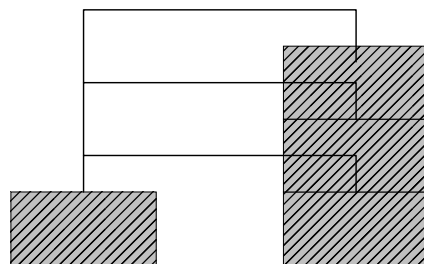


Figure16. The role of PU shifting the step which picks and lifts up the work-piece according to the height of stage



#### 【Attention】

When there is only a command language of palletize shift(PAL), the step option of PU , PS and PK is applied.

## 5. Service menu

### 5.1. Palletize monitoring

It shows an information of palletize which is in process of working at present.

#### 5.1.1. Display item

It shows the item as followings.

- (1) Work condition : It displays a condition that is in process of palletize.
- (2) Pattern register : It displays the pattern register number of palletize.
- (3) Counter : It displays the present counter quantity of palletize.
- (4) Total number of work : It displays the total number of palletize work-piece.

(5) Size of work-piece - X

: It displays the size(W) of box which is in process of operation at present.

(6) Size of work-piece - Y

: It displays the size(L) of box which is in process of operation at present.

(7) Size of work-piece - Z

: It displays the size(H) of box which is in process of operation at present.

5.1.2. Operation method

(1) Select the “ Service/ 1: Monitoring “.

(2) Make the next screen displayed selecting the “ [PF4] “key.

15:30:15	*** Monitoring function ***	A:2 S:H3
19	: Axis & Conveyer data	
20	: Servo gun axis data	
21	: Palletize data	
22	: Equalizerless gun data	
Select the [SET] key after moving the item with a numeral/direction key.		
> _		
Line number change	Previous screen	Next screen

(3) If you select the “ Service/ 1: Monitoring/ 21: Palletize data , it is displayed as following.

15:30:15	*** Teaching ***	A:2 S:L2		
TO				
PN :	003[*]_ _ S/F : 1/7 Sp : 100.0			
EN+ [< - - >]	<Pal1>	<Pal2>	<Pal3>	<Pal4>
Work condition	: ON	OFF	OFF	OFF
Pattern register	: 1	0	0	0
Counter	: 20	0	0	0
Total number of Work	: 80	0	0	0
Size of work-piece-X	: 1000.0	0	0	0
Size of work-piece-Y	: 1000.0	0	0	0
Size of work-piece-Z	: 1000.0	0	0	0
> _				
Service	System	Wait cancel	Condition setting	

5.2. Palletize register

It can voluntarily set up the contents of palletize register in the “ Service/ 2: Register/ 4: Palletize register “.

5.2.1. Display item

There are the items as followings.

(1) Palletize register : It can voluntarily set up the shift quantity for palletize.

It can actually be used in confirming the shift quality and coordinates value before performing the work than using in process of palletize.

(2) Palletize preset : It can voluntarily set up the counter value of palletize.

And it begins the work from the counter of set value.

(3) Palletize reset : It can compulsively reset the value of palletize register and counter which is in process of being in motion at present and also, finish the palletize work of pallet which is in process of being in motion.

It can reset the palletize by using R code(R55) in teaching mode.

### 5.2.2. Operation method

(1) Set up the “ Service/ 2: Register/ 5: Palletize register ”.

15:30:15	*** Register ***	A:2 S:H3
1 : Palletize register		
2 : Palletize preset		
3 : Palletize preset [R55]		
Select the [SET] key after moving the item with a numeral/direction key.		
> _		
	Previous screen	Next screen

(2) If setting up the “ 1: Palletize register ”, the screen as following is displayed.

15:30:15	*** Register ***	A:2 S:H3
# Palletize register		
1. Palletize shift data		
X= [ 0.0 ] Y= [ 0.0 ] Z= [ 0.0 ]mm		
Ax= [ 0.00] Ay= [ 0.00 ] Az= [ 0.00 ] deg		
2. Picking up shift data		
X= [ 0.0 ] Y= [ 0.0 ] Z= [ 0.0 ]mm		
Select the [SET] key after moving the item with a numeral/direction key.		
> _		
Completion		

Palletize shift data : It shows or inputs the data to shift.

Picking up shift data : It shows the shift quantity in performing the picking up.

(3) If set up the “ 2: Palletize preset ”, the screen as following is displayed.

15:30:15 *** Register *** A:2 S:H3	
# Palletize preset	
Pallet number of palletize	= [ 0 ]
Pattern register number of palletize	= [ 0 ]
Start number	= [ 0 ]
Select the [SET] key after moving the item with a numeral/direction key.	
> _	
	Setting

Pallet number of palletize : It inputs the pallet number to designate in advance.

Pattern register number of palletize : It inputs the pattern register number which is using.

Start number : It inputs the number which is going to start the work.

(4) If set up the “ 3: Palletize reset ”, the screen as following is displayed.

15:30:15 *** Register *** A:2 S:H3	
1 : Palletize register	
2 : Palletize preset	
3 : Palletize reset	[R 55]
Would you like to perform the palletize completion?	
[Y/N]	
> _	



**【 Attention to error occurrence 】**

In case of changing the register value or inputting it newly, look out for it constantly because of being connected to the shift motion of robot.

Also, it is impossible to change the register value in process of replaying the robot. but the preset is possible to use it except for only pallet which is in process of being in motion.



**【 Reference 】**

The counter reset of palletize is possible in inputting the R55 in teaching mode.

## **6. The creation and control of palletize pattern file**

In initializing the controller, it can back up and load the palletize pattern register by controlling the palletize pattern register which is essentially made out to perform the palletize function as a separate file. The formal name of this file is called as the palletize pattern register and the file name is a ROBOT . PAL.

### **6.1. The creation of palletize pattern file(ROBOT . PAL)**

- (1) The palletize pattern file is created when setting up the GUN2 to palletize in the System setting/ 5.Initialization/ 4.GUN mode
- (2) It can confirm the file creation by selecting the mark of Service/ 5.File control / 1.Interior memory file name.
- (3) Even if it is changed to the GUN mode, the existing file which is made out at former times exists until before deleting it.

### **6.2. The re-creation of palletize pattern file(ROBOT . PAL)**

- (1) In case that there is an existing file which is made out at former times and sets up the GUN mode to palletize over again, it puts a question such as “ ROBOT. PAL is existent, refresh? [Y/N]”.

If you want to make out it again, input the [YES] key and If you want to use the existing file, input the [NO] key.

If you input the [YES] key, the new pattern register file(ROBOT . PAL) is re-created.

In case of re-creating the file, the existing palletize pattern register file

**【 Caution to error occurrence 】**



【 Attention to error occurrence 】

(ROBOT . PAL) which is made out at former times is deleted automatically. In this case, the palletize pattern register which was used in existing teaching program.

## 7. Disorder disposal and Error

The followings are the errors which can be made in using the palletize function.

“E1321 The pallet number isn’t the same.”

This error is made in case of not being the same with pallet number to use in the PALEND in performing the function of PAL and PALEND. Please, use the same pallet number in the function of PAL and PALEND(M95) .

“E1322 It is a pattern register which doesn’t use”

This error is made in case that the palletize pattern register number of TIERST, PALPU and PAL isn’t used in the palletize pattern register of a constant group 1. Please, confirm whether the use of palletize pattern register is correct or not.

“E1324 Palletize work environment setting error”

This error is made in case of performing the palletize function in the condition which the GUN mode 2 isn’t selected to “palletize” in the Initialization menu of constant group 1. To perform the palletize function, please, select the GUN mode 2 of constant group 1 to “palletize”.

“E1325 Palletize picking up function use error”

This error is made in case of performing the PALPU in a condition which the PAL isn’t performed. Please, perform the PAL without fail before performing the PALPU function.

- “E1148 The palletize function is already in process of performing”  
After confirming whether you performed the teaching of PAL repeatedly or not in case of performing the multi-palletize, Please, make up the program again.
- “E1150 It can't be used in process of performing the palletize”  
In case of confirming or operating the palletize register value of service function or resetting it when the palletize is in process of being in motion, please, perform each function after stopping the palletize motions
- “E1166 The setting of palletize standard coordinate system is inaccurate”  
This error is made in case that the operating coordinate system of palletize isn't the same with that of robot. ( It doesn't have any point because it is the coordinate system of robot which has a default value.
- “E1321 Please, input the same pallet number”  
In case that the pallet number of palletize shift(PAL) is different from that of palletize end(PALEND), please, input the same pallet number in the PAL , PALPU and PALEND.
- “Please, input another pattern.[Voluntariness]”  
In case of selecting the pattern which doesn't support, please, confirm the pattern which supports.
- “Please, set up the sub-pattern after setting up the pattern.[Voluntariness]”  
In case of setting up the pattern which doesn't support by setting up the pattern number after first setting up the sub-pattern, please, input the sub-pattern number after inputting the pattern number.
- “Please, input another sub-pattern.[Voluntariness]”  
In case of selecting the sub-pattern which doesn't support, please, input it again after confirming the pattern which supports.
- “It can't be used ! It is an environment which can't set up.”  
It is displayed in case of being going to set up the palletize pattern register not setting up the GUN 2 to palletize in the constant setting mode and GUN setting of initialization.

It is displayed in case of being going to set up the palletize register of service function not setting up the GUN 2 to palletize in the constant setting mode and GUN setting of initialization.

It is displayed in case of being going to set up the monitoring function of service function not setting up the GUN 2 to palletize in the constant setting mode and GUN setting of initialization.

“ Please, use it in the palletize mode.[ Cancel]”

The input of PALPU , PAL , PALEND , PALRST is impossible in the condition which doesn't set up the GUN 2 to palletize in the constant setting mode and GUN setting of initialization.

Error) The counter number of work-piece was exceeded.[Voluntariness]

In case of setting up 0(zero) in selecting the start number in process of the palletize preset, please, get out of it by pressing the [ESC] key.

“ Reference) The selection of coordinate system is valid in vacuum. ”

In case of setting up the user coordinate system after setting up the handling tool to the forking, if you want the setting of coordinate system, please, set up the handling tool to vacuum.

“ The user coordinate system of selected number doesn't exist. ”

This message is displayed in case of setting up the coordinate system which isn't defined in setting up the user coordinate system after setting up the handling tool to vacuum.

“ The number of coordinate system doesn't exist. ”

In case of pressing the setting key ([PF5]) after setting up the handling tool to vacuum but not setting up the user coordinate System, please, input the defined user coordinate system or if you doesn't the user coordinate system, please, perform the teaching of it.

“ The standard of letter-paper insertion can't be bigger than total stage number. ”

In case that the letter-paper insertion is bigger than total stage number to pile the work-piece, the standard of letter-paper can't be bigger than total stage number. Please , set up the standard of letter-paper insertion small.

The followings are the errors which are made “ in case of using the user coordinate system.”

- “ E1010      The point performed the teaching is less than 3 points. ”  
It is displayed in case that the step recorded in the inside of teaching program for registering the coordinate system is less than 3 unit.  
Please, teach the step of 3 unit.
- “ E1011      The 3 points for the user coordinate system are close too much. ”  
It is displayed in case that the distance among the 3 points recorded in the inside of teaching program for registering the coordinate system is less than 1      mm. Please, modify the step which is taught.
- “ E1012      The 3 points for the user coordinate system are on the same straight line. ”  
It is displayed in case of not being able to decide each axis direction of user coordinate system because the 3 points recorded in the inside of teaching program for registering the coordinate system exist nearly on the same straight line. Please, confirm the teaching program.

The followings are the message which are made “ in case of measuring an angle of inclination of pallet.”

- “ The teaching step is close too much. [Cancel] ”  
It is displayed in case of having a difficulty in measuring an angle of inclination because the teaching point of the program which made out to measure an angle of inclination is in neighboring position.  
In this case, please, modify the program over again.
- “ There is no teaching program which is input. [Cancel] ”  
In case that the program number measuring an angle of inclination of Pallet is input erroneously or the step number of program which is input

is insufficient, please, confirm whether the teaching is right or not after confirming whether the file exists or not.

“ There is no step in the inside of program. [Cancel] ”

It is displayed in case that the step of program which is selected to calculate an angle of inclination doesn't exist. Please, confirm the designated program.

“ The teaching step exists on the straight line. [Cancel] ”

It is displayed in case of not being able to calculate an angle of inclination because the 3 points recorded in the inside of teaching program for measuring an angle of inclination exist nearly on the same straight line. Please, confirm the teaching program.