

Lab 2 TOOL Frame Set Up

Assignment: The student will:

Locate the present TOOL Frame value.

Set/Teach a TOOL Frame using 3 point method.

Jog in TOOL and verify the correct operation of the robot.

Set/Teach a TOOL Frame using 6 point method.

Jog in TOOL and verify the correct operation of the robot.

Completed:

Instructor: _____

NOTES:

Three Point Method

Use the three point method to define the **location** of the tool frame when the values cannot be measured and directly entered. The three approach points must be taught with the tool touching a common point from three different approach directions.

Six Point Method

Use the six point method to define the **location** and **orientation** of the tool frame when the values cannot be measured and directly entered. The six point method requires three points that define the direction vector for the tool, and three points that define

the location of the tool center point.

Setting Up Tool Frame Using the Three Point Method



WARNING

If you set up a new frame, make sure that all frame data is zero or uninitialized before you record any positions.

Press **F4**, CLEAR, to clear frame data.

If you modify an existing frame, make sure that all frame data is set the way you want before you change it.

Otherwise, you could injure personnel or damage equipment.

- Step 1 Press **MENU**.
- 2 Select SETUP.
- 3 Press **F1**, [TYPE].
- 4 Select Frames.
- 5 **To choose the motion group for the frame you are setting up in systems with multiple motion groups**, press **F3**, [OTHER], and select the group you want. The default motion group is Group 1.
- 6 **If tool frames are not displayed**, press **F3**, [OTHER], and select Tool Frame. If **F3**, [OTHER], is not displayed, press PREV.
- 7 **To display the settings for all frames**, press **PREV** repeatedly until you see a screen similar to the following.

```

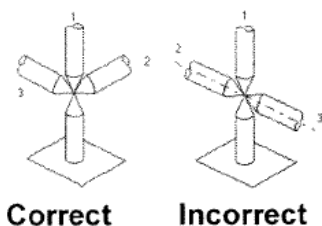
SETUP Frames
Tool Frame Setup / Three Point
X      Y      Z      Comment
1:    0.0    0.0    0.0    *****
2:    0.0    0.0    0.0    *****
3:    0.0    0.0    0.0    *****
4:    0.0    0.0    0.0    *****
5:    0.0    0.0    0.0    *****
6:    0.0    0.0    0.0    *****
7:    0.0    0.0    0.0    *****
8:    0.0    0.0    0.0    *****
9:    0.0    0.0    0.0    *****
Active TOOL $MNUTOOLNUM[1]=1

```

NOTE: The maximum number of tool frames is set in the system variable \$SCR.\$MAXNUMUTOOL.

- 8 To set the numerical values to zero, move the cursor to the frame number, press **F4**, CLEAR, and then press **F4**, YES, to confirm.
- 9 Press **F2**, DETAIL.
 - a To select a frame,
 - b Press **F3**, FRAME.
 - c Type the desired frame number.
 - d Press **ENTER**.
 - e Press **F2**, [METHOD].

f Select Three Point. You will see a screen similar to the following.



```

SETUP Frames
Tool Frame Setup / Three Point
Frame Number: 1
X: 0.0      Y: 0.0      Z: 0.0
W: 0.0      P: 0.0      R: 0.0
Comment: *****

Approach point 1:      UNINIT
Approach point 2:      UNINIT
Approach point 3:      UNINIT

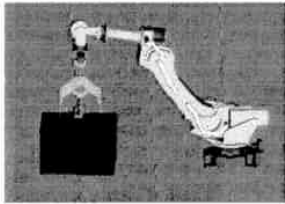
Active TOOL $MNUTOOLNUM[1]=1

```

10 To add a comment:

- a Move the cursor to the comment line and press **ENTER**.
- b Select a method of naming the comment.
- c Press the appropriate function keys to enter the comment.
- d When you are finished, press **ENTER**.

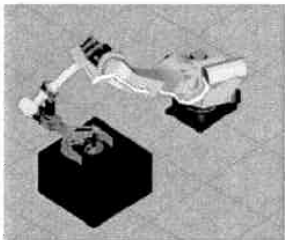
NOTE: Record the three approach points with the tool tip touching the same point from three different approach directions.




- 11 Record the first approach point:
- Move the cursor to Approach point 1.
 - Jog the robot so that the tool tip touches a reference point.
 - Press and hold the **SHIFT** key and press **F5**, RECORD.



- 12 Record the second approach point:
- Move the cursor to Approach point 2.
 - Rotate the faceplate about the z axis of the tool coordinates.
Large rotations, near 90°, give the best results. However, smaller rotations can be used if motion is restricted by cabling or other attachments.
 - Jog the robot so that the tool tip touches the reference point.
 - Press and hold the **SHIFT** key and press **F5**, RECORD.



- 13 Record the third approach point:
- Move the cursor to Approach point 3.
 - Rotate the tool about the X, Y, & Z axis of the tool coordinates. The three approach point angles must converge on the same point in space, the reference point. The angles must not be 180° apart or in the same plane.
 - Jog the robot so that the tool tip touches the reference point.
 - Press and hold the **SHIFT** key and press **F5**, RECORD.
You have finished the tool frame.

 **NOTE:** To use the Tool Frame data taught, you must select it, continue to step 17

- 14 To select the tool frame to use, press **F5**, SETIND, type the number of the tool frame you want, and press **ENTER**. If **F5**, SETIND, is not displayed, press **PREV**.

-OR-

Use the Jog Menu. Press and hold **SHIFT** and press **COORD**, move the cursor to Tool, and type the number of the frame you want to use. Jog the robot in the frame you just taught.

- If the TCP is correct, it will remain stationary during rotational moves. Go to Step 15.

⚠ CAUTION

When you are finished setting the frame configuration, save the information to the default device so that you can reload the configuration data if necessary. Otherwise, if the configuration is altered, you will have no record of it.

- If the TCP is not correct, it will not remain stationary during rotational moves. You need to review your recorded positions. If they are not correct, re-record them correctly. Go to Step 11.

⚠ WARNING

When you use **F4**, MOVE_TO, to move the robot, unexpected motion can occur. This could injure personnel or damage equipment.

- 15 To move to a recorded position, move the cursor to the desired position, press and hold the **SHIFT** key and press **F4**, MOVE_TO.
- 16 To save the frames and related system variables to a file on the default device,
 - a Press **MENU**.
 - b Select FILE.
 - c Press **F1**, [TYPE].
 - d Select File.
 - e Press **F5**, [UTIL].
 - f Select Set Device.
 - g Move the cursor to the device you want and press **ENTER**.

- h Display the tool frame screen.
- i Press **FCTN**.
- j Select SAVE. This will save the frame positions and comments for all frames to the file, FRAMEVAR.SV, on the default device.

Display the SYSTEM Variables menu,

- k Press **MENU**.
 - l Select SYSTEM.
 - m Press **F1**, [TYPE].
 - n Select Variables.
 - o Press **FCTN**.
- p Select SAVE. The tool frame positions and system variables are saved in the SYSVAR.SV file, on the default device.

Setting Up Tool Frame Using the Six Point Method


⚠ WARNING
If you set up a new frame, make sure that all frame data is zero or uninitialized before you record any positions. Press **F4**, CLEAR, to clear frame data.
If you modify an existing frame, make sure that all frame data is set the way you want before you change it. Otherwise, you could injure personnel or damage equipment.

- Step 1** Press **MENU**.
- 2** Select SETUP.
- 3** Press **F1**, [TYPE].
- 4** Select Frames.
- 5** To choose the motion group for the frame you are setting up in systems with multiple motion groups, press **F3**, [OTHER], and select the group you want. The default motion group is Group 1.

6 If tool frames are not displayed, press **F3**, [OTHER], and select Tool Frame. If **F3**, [OTHER], is not displayed, press **PREV**.

7 To display the settings for all the frames, press **PREV** repeatedly until you see a screen similar to the following.

```
SETUP Frames
  Tool Frame Setup / Six Point
      X      Y      Z      Comment
1:    0.0    0.0    0.0    *****
2:    0.0    0.0    0.0    *****
3:    0.0    0.0    0.0    *****
4:    0.0    0.0    0.0    *****
5:    0.0    0.0    0.0    *****
6:    0.0    0.0    0.0    *****
7:    0.0    0.0    0.0    *****
8:    0.0    0.0    0.0    *****
9:    0.0    0.0    0.0    *****
Active TOOL $MNUTOOLNUM[1]=1
```

 **NOTE:** The maximum number of tool frames is set in the system variable \$SCR.\$MAXNUMUTOOL.

8 To set the numerical values to zero, move the cursor to the frame number, press **F4**, CLEAR, and then press **F4**, YES, to confirm.

9 Press **F2**, DETAIL.


10 To select a frame,

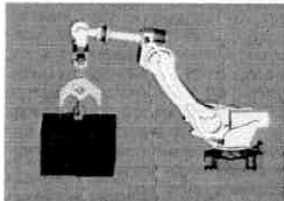
- a Press **F3**, FRAME.
- b Type the desired frame number.
- c Press **ENTER**.
- d Press **F2**, [METHOD].
- e Select Six Point. You will see a screen similar to the following.

```
SETUP Frames
Tool Frame Setup/ Six Point
Frame Number: 1
  X:  0.0      Y:  0.0      Z:  0.0
  W:  0.0      P:  0.0      R:  0.0
Comment: *****
Approach point 1: UNINIT
Approach point 2: UNINIT
Approach point 3: UNINIT
Orient Origin Point: UNINIT
X Direction Point: UNINIT
Z Direction Point: UNINIT
Active TOOL $MNUTOOLNUM[1]=1
```

11 To add a comment:

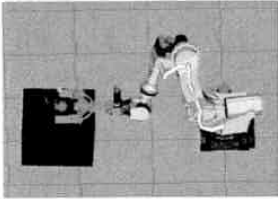
- a Move the cursor to the comment line and press **ENTER**.
- b Select a method of naming the comment.
- c Press the appropriate function keys to enter the comment.
- d When you are finished, press **ENTER**.

 **NOTE:** Record the three approach points with the tool tip touching the same point from three different approach directions. The Tool frame will be inaccurate if the approach points face each other.



12 Record the first approach point:

- a Move the cursor to Approach point 1.
- b Jog the robot so that the tool tip touches a reference point.
- c Press and hold the **SHIFT** key and press **F5**, RECORD.

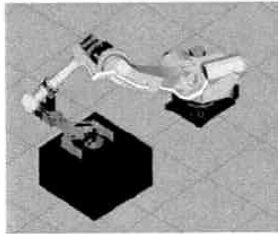


13 Record the second approach point:

- a Move the cursor to Approach point 2.
- b Rotate the faceplate about the z axis of the tool coordinates.

Large rotations, near 90°, give the best results. However, smaller rotations can be used if motion is restricted by cabling or other attachments.

- c Jog the robot so that the tool tip touches the reference point.
- d Press and hold the **SHIFT** key and press **F5**, RECORD.



14 Record the third approach point:

- a Move the cursor to Approach point 3.
- b Rotate the tool about the X, Y, & Z axis of the tool coordinates. The three approach point angles must converge on the same point in space, the reference point. The angles must not be 180° apart or in the same plane.

Large rotations, near 90°, give the best results. However, smaller rotations can be used if motion is restricted by cabling or other attachments.

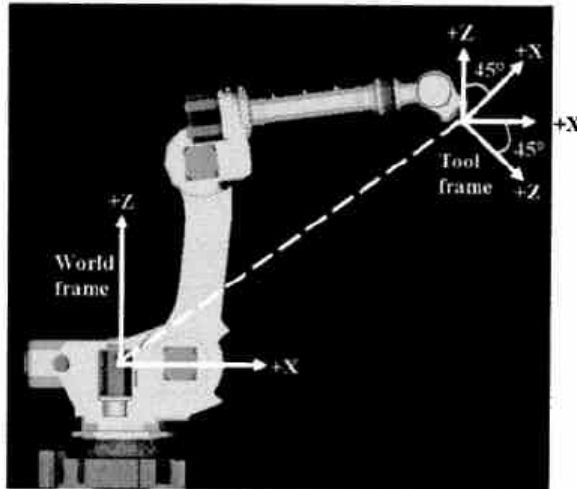
- c Jog the robot so that the tool tip touches the reference point.
- d Press and hold the **SHIFT** key and press **F5**, RECORD.

15 Define the orientation of the origin (Orient Origin Point):

NOTE: To simplify teaching points 4, 5, and 6 in the Six Point Method, align the desired X, Y, and Z directions of the tool with the X, Y, and Z of the World frame in any order that avoids singularity. In this example it is convenient to align the tool frame Z with the World frame Z and the Tool frame X with the World frame X. This alignment is based on the shape of the tool and the need to avoid singularity.


- a Move the cursor to Orient Origin Point.
- b Jog the robot so that the tool is aligned with the robot's World Frame. Any orientation of the tool will work as long as the tool is square to the World frame and the robot is not in singularity. See Figure 6-2 Defining the Orientation of the Origin.
- c Press and hold the **SHIFT** key and press **F5**, RECORD.

Tool Frame



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16 Define the X direction point:

- a Move the cursor to X Direction Point.
- b Change the jog coordinate system to WORLD.
- c Jog the robot so that the tool moves in its X direction. In this example, the x axis of the tool is aligned with the world z axis, so jog in the world Z direction.
 -  **NOTE:** +x move the tool at least 250mm or more.
- d Press and hold the **SHIFT** key and press **F5**, RECORD.

17 Define the Z direction point:

- a Move the cursor to Orient Origin Point.
- b Press and hold the **SHIFT** key and press **F4**, MOVE_TO, to move the robot to the Orient Origin Point.
- c Move the cursor to Z Direction Point.
- d Jog the robot in the Z direction (of the world frame).
- e Press and hold the **SHIFT** key and press **F5**, RECORD.

18 To select the tool frame to use, press **F5**, SETIND, type the number of the tool frame you want, and press **ENTER**. If **F5**, SETIND, is not displayed, press **PREV**.

-OR-

You can also select the frame using the Jog Menu. Press and hold **SHIFT** and press **COORD**, move the cursor to Tool, and type the number of the frame you want to select.

19 Jog the robot in the frame you just taught, to verify it is correct,

- If the TCP is correct, it will remain stationary during rotational moves. Go to Step 20.



CAUTION

When you are finished setting the frame configuration, save the information to the default device so that you can reload the configuration data if necessary. Otherwise, if the configuration is altered, you will have no record of it. You may also wish to record the values now shown on the direct entry screen.

- If the TCP is not correct, it will not remain stationary during rotational moves. You need to review your recorded positions. If they are not correct, re-record them correctly. Go to Step 12.



WARNING

When you use F4, MOVE_TO, to move the robot, unanticipated joint motion can occur. This could injure personnel or damage equipment. Remember, this is a JOIN move.

20 To move to a recorded position, press and hold the **SHIFT** key and press **F4**, MOVE_TO.

- 20 To move to a recorded position, press and hold the **SHIFT** key and press **F4**, MOVE_TO.
- 21 To save the frames and related system variables to a file on the default device,
- a Press **MENU**.
 - b Select FILE.
 - c Press **F1**, [TYPE].
 - d Select File.
 - e Press **F5**, [UTIL].
 - f Select Set Device.
- g Move the cursor to the device you want and press **ENTER**.
- h Display the tool frame screen.
- i Press **FCTN**.
- j Select SAVE. This will save the frame positions and comments for all frames to the file, FRAMEVAR.SV, on the default device.

Display the SYSTEM Variables menu,

- k Press **MENU**.
- l Select SYSTEM.
- m Press **F1**, [TYPE].
- n Select Variables.
- o Press **FCTN**.
- p Select SAVE. The tool frame positions and system variables are saved in the SYSVAR.SV file, on the default device.