

**\*CONTROL\_FORMING\_AUTOPOSITION\_PARAMETER\_{OPTION}**

Available options include:

**<BLANK>**

**SET**

Purpose: The keyword is developed to calculate the minimum required separation distances among forming tools for initial tool and blank positioning in metal forming simulation.

**Cards 1,2,3,4, ... (the next “\*” card terminates the input)**

Card 1            1            2            3            4            5            6            7            8

Variable	PID	CID	DIR	MPID	POSITION	PREMOVE	THICK	PARORDER
Type	I	I	I	I	I	F	F	I/A
Default	none	0	none	none	0	0.0	0.0	None

<u>VARIABLE</u>	<u>DESCRIPTION</u>
PID	Part ID. This part will be moved based on the following controlling parameters. When option <u>_SET</u> is activated, PID becomes part set ID, defined by <u>*SET_PART_LIST</u> . It is useful in defining tailor-welded blanks, where two pieces of the blanks must move simultaneously.
CID	Coordinate ID (Default is global coordinate system).
DIR	Direction in which the part will be moved: EQ. 1: x direction, EQ. 2: y direction, EQ. 3: z direction.
MPID	Master part ID, whose position is to be referenced by PID for positioning. When option <u>_SET</u> is activated, MPID becomes part set ID, defined by <u>*SET_PART_LIST</u> .

<u>VARIABLE</u>	<u>DESCRIPTION</u>
POSITION	Definition of relative position between PID and MPID: EQ.1: PID is above MPID; EQ.-1: PID is below MPID. Definition of 'above' is determined by the defined coordinate system. IF PID is above MPID, it means PID has a larger z-coordinate. This definition is helpful in line die simulation where local coordinate system may be used.
PREMOVE	PID is moved with a value of PREMOVE before it is positioned.
THICK	Thickness of the PID.
PARORDER	The name of the variable without the ampersand &, as defined in *PARAMETER, or the position or order of the parameter defined in the *PARAMETER list.

**Remarks:**

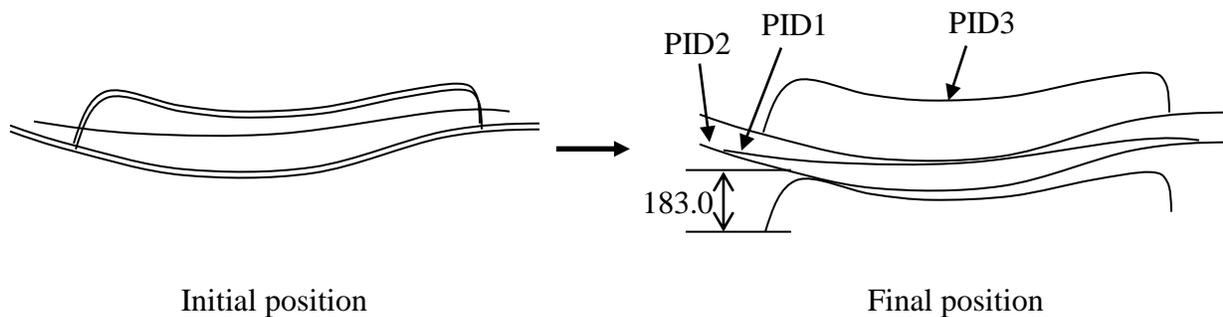
1. In line-die (multi-stage) simulation, initial positioning of tools and blank is one of the major issues preventing several die processes to be run automatically with one job submission. A previous method to run line die simulation is to use a preprocessor between each process to re-position the tools and blank and re-generate the required input decks. In the new approach, all the tools are placed in home position, with desired final gaps. The keyword \*PARAMETER is used to define and initialize the moving distance of each tool as a variable, which later is defined in this keyword for auto positioning. The required distance between each contact pair is calculated and stored in the variable, and in conjunction with \*PART\_MOVE, all tools can be positioned properly. In addition \*PARAMETER\_EXPRESSION can be used to calculate all time related inputs for the tools from the moving distances and user defined tool moving speeds.
2. All tools must be in their home positions. In addition, inputs pertaining to this keyword is order sensitive. The following order should be followed:  
All model information – include all elements and nodes first;  
Part set definition with \*SET\_PART\_LIST;  
\*PARAMETER;  
This keyword;  
\*PARAMETER\_EXPRESSION;  
\*PART\_MOVE.
3. This keyword can also be used to just position the tools and blank, without forming simulation, and output dynain file which contains the blank and tools. In this case, keywords \*PARAMETER\_EXPRESSION, \*CONTROL\_TERMINATION, and tool kinematic definitions do not need to be defined.

- To calculate the kinematics of the tools, it is suggested to use the ABSOLUTE value of the auto positioned distance by using the ABS function with the \*PARAMETER\_EXPRESSION. This is especially useful when working on flanging simulation with local coordinates and vectors, which could generate negative distances depending on the local coordinate system defined. Flanging steel moving in any direction can be defined by creating a local coordinate system and a vector, with keywords \*DEFINE\_COORDINATE\_SYSTEM. The local coordinate system can be created easily with *Coord* and *Vector* menus in page 5 of the LS-PrePost. For the local system, select *SYSTEM* under *Create*, and use *EPoint* and *alongZ* to define the system based on one straight line.
- Draw beads can be modeled with beam elements, positioned and attached to a tool at home position. Draw beads with beam elements can be moved in the keyword \*PART\_MOVE, and automatically positioned just like any other types of elements.
- REMOVE can be used to position the lower punch a specific distance away from the blank. For example, in an air draw process in the example below, a blank PID 1 is positioned relative to the binder PID 2 first, then an upper die cavity PID 3 is positioned relative to the blank PID 1. Finally a binder PID 2 is positioned with respect to the blank PID 1 and with a pre-determined REMOVE distance of 183.0 mm. The following keywords illustrate the details.

```

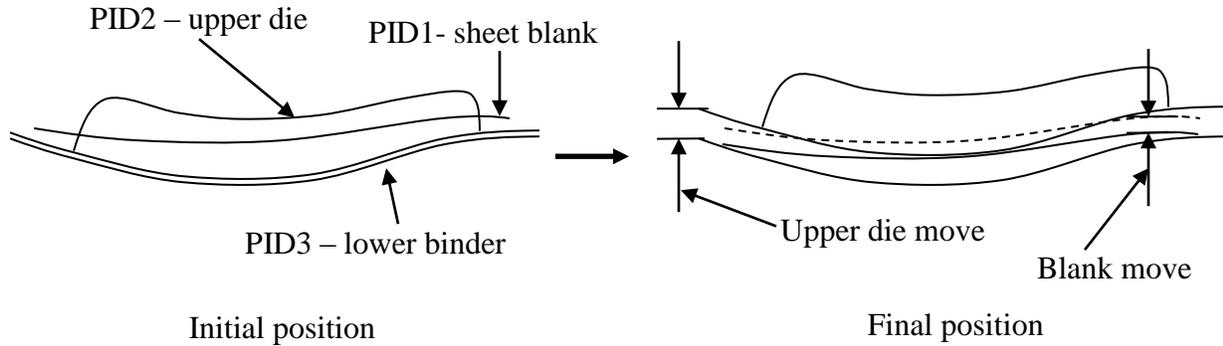
$---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---8
*CONTROL_FORMING_AUTOPOSITION_PARAMETER
$---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---8
$      PID      CID      DIR      MPID  POSITION  PREMOVE  THICK  PARORDER
$ blankmv
      1          3          2          1          &bthick  blankmv
$ updiemv
      3          3          1          1          updiemv
$ remove of binder up 183.0 so post won't support blank at all. The distance
$ have to be pre-measured by users. It's a part of the process input.
$ bindmv
      2          3          1          -1  183.0          bindmv
$---+---1---+---2---+---3---+---4---+---5---+---6---+---7---+---8

```



- Extra punch support or extra gap between punch and blank can also be achieved by adding (or subtracting) a user defined value to (or, from) the auto positioned distance, using \*PARAMETER\_EXPRESSION and \*PART\_MOVE.

8. A partial input deck and a drawing are shown below to illustrate an example of a binder closing simulation in an air draw in global Z-direction:



```
*INCLUDE
$blank from previous case
case5.dynain
*INCLUDE
closing_tool.k
*INCLUDE
beads_home.k
*SET_PART_LIST
$ blank
1
1
*SET_PART_LIST
$ upper die
2
2
*SET_PART_LIST
$ lower binder
3
3
$---+----1---+----2---+----3---+----4---+----5---+----6---+----7---+----8
*parameter
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$ Tool move variables
R blankmv      0.0
R updiemv      0.0
R bindmv       0.0
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$ Tool speed and ramp up definition
R tclsup       0.001
R vcls         1000.0
$---+----1---+----2---+----3---+----4---+----5---+----6---+----7---+----8
*CONTROL_FORMING_AUTOPOSITION_PARAMETER_SET
$ PID CID DIR MPID POSITION PREMOVE THICK PARORDER
$ positioning blank on top of lower binder
1 3 3 1 0.7 blankmv
$ positioning upper die on top of blank
2 3 1 1 0.7 updiemv
$---+----1---+----2---+----3---+----4---+----5---+----6---+----7---+----8
*PARAMETER_EXPRESSION
$ PRMR1 EXPRESSION
R clstime      (abs(updiemv)-vcls*tclsup)/vcls+2.0*tclsup
R endtime      &clstime
$---+----1---+----2---+----3---+----4---+----5---+----6---+----7---+----8
```

```
*PART_MOVE
$  PID          XMOV          YMOV          ZMOV          CID
   1           0.0           0.0           &blankmv
   2           0.0           0.0           &updiemv
$-----1-----2-----3-----4-----5-----6-----7-----8
*CONTROL_TERMINATION
&endtime
```

8. This feature is implemented in LS-PrePost4.0 eZSetup for metal forming in both explicit and implicit application:

**\*CONTROL**

**\*CONTROL\_FORMING\_AUTOPOSITION\_PARAMETER**

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