*NODE

The keywords defined in this section include:

NODE_*{OPTION}

*NODE_MERGE_SET

*NODE_MERGE_TOLERANCE

*NODE_REFERENCE

*NODE_RIGID_SURFACE

NODE_SCALAR_*{OPTION}

*NODE_THICKNESS

*NODE_TO_TARGET_VECTOR

*NODE_TRANSFORM

***NODE**_*{OPTION}*

Available options include:

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MERGE

Purpose: Define a node and its coordinates in the global coordinate system. Also, the boundary conditions in global directions can be specified. Generally, nodes are assigned to elements; however, exceptions are possible (see Remark 2 below). The nodal point ID must be unique relative to other nodes defined in the *NODE section.

The MERGE option is usually applied to boundary nodes on disjoint parts and only applies to nodes defined when the merge option is invoked. With this option, nodes with identical coordinates are replaced during the input phase by the first node encountered that shares the coordinate. During the merging process a tolerance is used to determine whether a node should be merged. This tolerance can be defined using the keyword *NODE_MERGE_TOLERANCE keyword, which is recommended over the default value. See the *NODE_MERGE_TOLERANCE input description in the next section.

Node Cards. Include as many cards in the following format as desired. This input ends at the next keyword ("*") card.

Card 1	1	2	3	4	5	6	7	8	9	10
Variable	NID	X		Y		Z		TC	RC	
Type	I	F		F		F		I	I	
Default	none	0.		0.		0.		0	0	
Remarks								1	1	

VARIABLE	DESCRIPTION
NID	Node number
X	*x* coordinate
Y	*y* coordinate
Z	*z* coordinate

VARIABLE	DESCRIPTION
TC	Translational Constraint: EQ.0: no constraints, EQ.1: constrained x displacement, EQ.2: constrained y displacement, EQ.3: constrained z displacement, EQ.4: constrained x and y displacements, EQ.5: constrained y and z displacements, EQ.6: constrained z and x displacements, EQ.7: constrained x, y, and z displacements.
RC	Rotational constraint: EQ.0: no constraints, EQ.1: constrained x rotation, EQ.2: constrained y rotation, EQ.3: constrained z rotation, EQ.4: constrained x and y rotations, EQ.5: constrained y and z rotations, EQ.6: constrained z and x rotations, EQ.7: constrained x, y, and z rotations.

Remarks:

1. **Boundary Conditions.** Boundary conditions can also be defined on nodal points in a local (or global) system by using the keyword *BOUNDARY_SPC. For other possibilities also see the *CONSTRAINED keyword section of the manual. No attempt should be made to apply boundary conditions to nodes belonging to rigid bodies (see *MAT_RIGID for application of rigid body constraints).

2. **Massless Nodes.** A node without an element or a mass attached to it will be assigned a very small amount of mass and rotary inertia. Generally, massless nodes should not cause any problems but in rare cases may create stability problems if these massless nodes interact with the structure. Warning messages are printed when massless nodes are found. Also, massless nodes are used with rigid bodies to place joints, see *CONSTRAINED_EXTRA_NODES_*OPTION* and *CONSTRAINED_NODAL_RIGID_BODY.

*NODE_MERGE_SET

Purpose: The MERGE_SET option is applied to a set of boundary nodes on disjoint part. With this option, nodes with identical coordinates that are members of any node set ID defined by this keyword are replaced during the input phase by one node within the set or sets. Of the nodes sharing the same coordinates, the node chosen is the one with the smallest ID. During the merging process a tolerance is used to determine whether a node should be merged. This tolerance can be defined using the keyword *NODE_MERGE_-TOLERANCE keyword, which is recommended over the default value. See the *NODE_-MERGE_TOLERANCE input description in the next section. Only nodes contained within the specified sets will be merged. Nodes contained within the set are defined by the *NODE keyword. With this option, the keyword *NODE_MERGE is not needed.

Node Set Cards. Include as many cards as desired. This input ends at the next keyword ("*") card.

Card 1	1	2	3	4	5	6	7	8
Variable	NSID							
Type	I							
Default	none							

VARIABLE	DESCRIPTION
NSID	Node set ID containing list of nodes to be considered for merging.

*NODE_MERGE_TOLERANCE

Purpose: Define a tolerance that determines whether a node listed in *NODE_MERGE should be merged.

Card 1	1	2	3	4	5	6	7	8
Variable	TOLR							
Type	F							
Default	Rem 1							

VARIABLE	DESCRIPTION
TOLR	Physical distance used to determine whether to merge a nodal pair of nearby nodes.

Remarks:

1. **Default Tolerance.** If the tolerance, TOLR, is undefined or if it is defaulted to zero, a value is computed as:

$$\text{TOLR} = 10^{-5} \cdot \frac{\text{XMAX} + \text{YMAX} + \text{ZMAX} - \text{XMIN} - \text{YMIN} - \text{ZMIN}}{3 \times \sqrt[3]{\text{NUMNP}}},$$

where XMIN, XMAX, YMIN, YMAX, ZMIN, and ZMAX represent the minimum and maximum values of the (x, y, z) nodal point coordinates in the global coordinate system, and NUMNP is the number of nodal points.

*NODE_REFERENCE

Purpose: Define a nodal coordinate in the reference configuration of a solid element. Only *ELEMENT_SOLID_REFERENCE refers to this node.

Node Card. Include as many cards in the following format as desired. This input ends at the next keyword ("*") card.

Card 1	1	2	3	4	5	6	7	8	9	10
Variable	NID	X1		X2		X3				
Type	I	F		F		F				
Default	none	0.0		0.0		0.0				

VARIABLE	DESCRIPTION
NID	Node ID for the reference configuration node. Only *ELEMENT_SOLID_REFERENCE can refer to this node.
X1, X2, X3	Coordinates in the reference configuration

*NODE_RIGID_SURFACE

Purpose: Define a rigid node and its coordinates in the global coordinate system. These nodes are used to define rigid road surfaces, and they have no degrees of freedom. The nodal points are used in the definition of the segments that define the rigid surface. See *CONTACT_RIGID_SURFACE. The nodal point ID must be unique relative to other nodes defined in the *NODE section.

Node Cards. Include as many cards in the following format as desired. This input ends at the next keyword ("*") card.

Card 1	1	2	3	4	5	6	7	8	9	10
Variable	NID	X		Y		Z				
Type	I	F		F		F				
Default	none	0.		0.		0.				

VARIABLE	DESCRIPTION
NID	Node number
X	*x* coordinate
Y	*y* coordinate
Z	*z* coordinate

***NODE_SCALAR**_*{OPTION}*

Available options include:

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VALUE

Purpose: Define a scalar nodal point which has a specified number of degrees-of-freedom. The scalar point ID must be unique relative to other nodes defined in the *NODE section.

Node Card. Card 1 for no keyword option (option set to <BLANK>). Include as many cards in the following format as desired. This input ends at the next keyword ("*") card.

Card 1a	1	2	3	4	5	6	7	8	9	10
Variable	NID	NDOF								
Type	I	I								
Default	none	0								

Node Card. Card 1 for the VALUE keyword option. Include as many cards in the following format as desired. This input ends at the next keyword ("*") card.

Card 1b	1	2	3	4	5	6	7	8	9	10
Variable	NID	X1		X2		X3		NDOF		
Type	I	F		F		F		I		
Default	none	0.0		0.0		0.0		0		

VARIABLE	DESCRIPTION
NID	Scalar node ID
NDOF	Number of degrees-of-freedom: EQ.0: Fully constrained EQ.1: One degree-of-freedom

VARIABLE	DESCRIPTION
	EQ.2: Two degrees-of-freedom
	EQ.3: Three degrees-of-freedom
X*i*	Initial value of i^{th} degree of freedom

***NODE_THICKNESS**_*{OPTION1}_{OPTION2}*

For OPTION1 the available options include:

<BLANK>

SET

For OPTION2 the available options include:

<BLANK>

GENERATE

Purpose: Define nodal thickness that overrides nodal thickness otherwise determined via *SECTION_SHELL, *PART_COMPOSITE, or *ELEMENT_SHELL_THICKNESS. The option GENERATE generates a linear thickness distribution between a starting node (or node set) and a ending node (or node set).

Card 1	1	2	3	4	5	6	7	8
Variable	ID1	THK	ID2	INC				
Type	I	F	I	I				
Default	none	none	none	none				

VARIABLE	DESCRIPTION
ID1	Node ID, or node set ID if SET option is active. If GENERATE option is active, ID1 serves as the starting node (or node set).
THK	Thickness at node ID1, or node set ID1 if SET option is active (ignored if GENERATE option is active).
ID2	Ending node (or node set) if GENERATE option is active.
INC	Increment in node numbers if GENERATE option is active.

Remarks:

When the GENERATE option is active, both the starting and ending nodes (or node sets) must have a nodal thickness as defined by *NODE_THICKNESS or NODE_THICK-

NESS_SET. The sample commands shown below create a linear thickness distribution between node set 100 and node set 200.

```
*SET_NODE_LIST
100
1, 15, 39
*SET_NODE_LIST
200
7, 21, 45
*NODE_THICKNESS_SET
$ assign thickness of 2.0 to node 1, 15 and 39
100, 2.0
*NODE_THICKNESS_SET
$ assign thickness of 5.0 to node 7, 21 and 45
200, 5.0
*NODE_THICKNESS_SET_GENERATE
$ assign thickness of 3. (= 2.+1.) to node 3 (=1+2), 17 (=15+2) and 41 (=39+2)
$ assign thickness of 4. (= 2.+2.) to node 5 (=1+4), 19 (=15+4) and 43 (=39+4)
100,, 200, 2
```

*NODE_TO_TARGET_VECTOR

Purpose: When the input contains a *CONTROL_FORMING_BESTFIT_VECTOR card, LS-DYNA writes as output a keyword file named bestfit.out. Unlike most keyword cards, which are read by LS-DYNA to define a model, LS-DYNA's keyword reader ignores this card. This card and its associated data cards are a kind of output for the user's benefit (or for post-processing).

Recall that the *CONTROL_FORMING_BESTFIT_VECTOR keyword (mentioned above) rigidly moves a part to best fit a target, such as a scanned part. For each node of the best fit part LS-DYNA writes a data card (Card 1, below) consisting of the components of the vector that is the shortest distance from the node to the target.

Node Cards. As many cards as needed are output in the following format. This output ends at the next keyword ("*") card.

Card 1	1	2	3	4	5	6	7	8	9	10
Variable	NID	XDELTA		YDELTA		ZDELTA				
Type	I	F		F		F				
Default	none	0.		0.		0.				

VARIABLE	DESCRIPTION
NID	Node ID on a part best fitted to the target.
XDELTA	x-component of the shortest vector from the node to the target
YDELTA	y-component of the shortest vector from the node to the target.
ZDELTA	z-component of the shortest vector from the node to the target.

Revision Information:

The keyword is available starting from revision 112655.

*NODE_TRANSFORM

Purpose: Perform a transformation on a node set based on a transformation defined by the keyword *DEFINE_TRANSFORMATION.

Transformation Cards. Include as many cards in the following format as desired. This input ends at the next keyword ("*") card.

Card 1	1	2	3	4	5	6	7	8
Variable	TRSID	NSID	IMMED					
Type	I	I	I					
Default	none	none	0					

VARIABLE	DESCRIPTION
TRSID	The ID of the transformation defined under *DEFINE_TRANSFORMATION.
NSID	Node set ID of the set of nodes to be subject to the transformation.
IMMED	Optional flag for transformation processing: EQ.0: Node transformation is performed after all input cards are read through. It is more efficient, and the definition sequence of *NODE_TRANSFORM and its NSID is irrelevant, meaning the referred NSID doesn't have to be defined prior to *NODE_TRANSFORM. However, if nodes in NSID are used in, for instance, POS6N of *DEFINE_TRANSFORMATION, the original coordinates, not the transformed coordinates, will be used to define the transformation matrix. EQ.1: Node transformation is performed immediately after *NODE_TRANSFORM is read. The referred NSID and its nodes must be defined prior to *NODE_TRANSFORM.