

# \*LSO

These cards provide a general data output mechanism, causing the creation of a sequence of LSDA files. This facility is intended to allow several different time sequences of data to be output in the same simulation. In addition, any number of domains (and any number of variables on those domains) may be specified within each time sequence. The keyword cards in this section are defined in alphabetical order:

\*LSO\_DOMAIN

\*LSO\_ID\_SET (*not available in the single-precision version of LS-DYNA*)

\*LSO\_POINT\_SET

\*LSO\_TIME\_SEQUENCE

\*LSO\_VARIABLE\_GROUP

Note that only the mechanics solver is available in the single-precision version of LS-DYNA, and therefore, only LSO mechanics variables are available for output from single precision LS-DYNA. These mechanics variables are listed by domain type in a separate document. This document (LSO\_VARIABLES.TXT) is created by running the command: LS-DYNA print\_lso\_doc. Contrary to LSO\_VARIABLES.TXT, element quantities such as stress are not available for output from the mechanics solver to the "lso" database.

An additional option "\_TITLE" may be appended to all \*LSO keywords. If this option is used, then an 80 character string is read as a title from the first card of that keyword's input. At present, LS-DYNA does not make use of the title. Inclusion of titles gives greater clarity to input decks.

**\*LSO****\*LSO\_DOMAIN****\*LSO\_DOMAIN**

Purpose: This command provides a way to specify variables on a subset of the domain for a given solver. This domain can be a subset of the mesh used by that solver, a set of output points created with \*LSO\_POINT\_SET, or a set of objects created with \*LSO\_ID\_SET. The frequency and duration of the output for any given domain is determined by each \*LSO\_TIME\_SEQUENCE card that references this \*LSO\_DOMAIN card. Note that for the single-precision version of LS-DYNA, the only allowed value of SOLVER\_NAME = MECH.

Card 1	1	2	3	4	5	6	7	8
Variable	DOMAIN_TYPE							
Type	A							

Card 2	1	2	3	4	5	6	7	8
Variable	SOLVER_NAME							
Type	A							

**Special Domains Card.** Card 3 when DOMAIN\_TYPE is one of ROGO, CIRCUIT, THIST\_POINT or TRACER\_POINT.

Card 3	1	2	3	4	5	6	7	8
Variable	OUTID	REFID		REDUCT				
Type	I	I		I				
Default	none	none		none				

**Miscellaneous Domain Card.** Card 3 when DOMAIN\_TYPE is one of NODE, PART, SEGMENT, SURFACE\_NODE, SURFACE\_ELEMENT, VOLUME\_ELEMENT, SURFACE\_PART, VOLUME\_PART.

Card 3	1	2	3	4	5	6	7	8
Variable	OUTID	REFID	OVERRIDE	REDUCT				
Type	I	I	I	I				
Default	none	0	0	none				

**Variable Name Card.** Provide as many cards as necessary. This input ends at the next keyword ("\*") card

Card 4	1	2	3	4	5	6	7	8
Variable				VARIABLE_NAME				
Type				A				

VARIABLE	DESCRIPTION
DOMAIN_TYPE	The type of domain for which LSO output may be generated.
SOLVER_NAME	Selects the solver from which data is output on this domain. Accepted entries so far are "MECH", "EM", "CESE", and "ICFD".
OUTID	LSO domain ID associated with this domain, and used by *LSO_TIME_SEQUENCE cards.
REFID	Support set ID. This can be a set defined by a *SET card, a *LSO_ID_SET card, or a *LSO_POINT_SET card. Unless OVERRIDE is specified, this set must be of the same type as DOMAIN_TYPE.
OVERRIDE	If non-zero, then REFID is interpreted as: EQ.1: a PART set for SOLVER_NAME EQ.2: a PART set of volume parts created with a *LSO_ID_SET card (volume parts are defined with *MESH_VOLUME cards).

**VARIABLE****DESCRIPTION**

EQ.3: a PART set of surface parts created with a \*LSO\_ID\_SET card (surface parts are defined with \*MESH\_SURFACE\_ELEMENT cards).

EQ.4: a set of segment sets created with a \*LSO\_ID\_SET card.

<b>VECTORS</b>	<b>EN</b>	A function that operates on the entire domain and returns a single value for scalar variables, three values for vector variables, or 6 values for symmetric tensor variables. For REDUCT="range", the number of returned values doubles. The following are the supported functions:	
	magneticFie	EQ.BLANK: no reduction (default)	
	electricFie	EQ."none": Same as above	
	vecpotFie	EQ."avg": the average by component	
	currentDens	ScalarPoten	EQ."average": Same as above
		EQ."min": the minimum by component	
		EQ."minimum": Same as above	
		EQ."max": the maximum by component	
		EQ."maximum": Same as above	
	REDUCT	EQ."sum": the sum by component	
		EQ."range": the minimum by component followed by the maximum by component	
<b>SCALARS</b>	<b>VARIABLE_NAME</b>	Either the name of a single output variable or a variable group. See remarks.	

**Remarks:**

1. Supported choices for VARIABLE\_NAME are listed by DOMAIN\_TYPE for each SOLVER\_NAME in a separate document. This document (LSO\_VARIABLES.TXT) is created by running the command: LS-DYNA print\_lso\_doc. The following table shows a sample of the point output variables available when DOMAIN\_TYPE = THIST\_POINT:

**\*LSO\_ID\_SET**

Purpose: Provides a way to create a set of existing sets (segment sets), or to define a set that is not available with other set-related keyword cards. These are then used in other \*LSO cards to specify LSO output. This card is not available in the single precision version of LS-DYNA.

Card 1	1	2	3	4	5	6	7	8
Variable	SETID	TYPE	SOLVER					
Type	I	A	A					
Default	none	none	MECH					

**Referenced IDs.** Provide as many cards as necessary. This input ends at the next keyword ("\*") card

Card	1	2	3	4	5	6	7	8
Variable	ID1	ID2	ID3	ID4	ID5	ID6	ID7	ID8
Type	I	I	I	I	I	I	I	I
Default	none							

**VARIABLE****DESCRIPTION**

SETID

Identifier for this ID set.

**\*LSO****\*LSO\_ID\_SET**

<b>VARIABLE</b>	<b>DESCRIPTION</b>
TYPE	The kind of IDs in this set:  EQ.'SEG_SETS': Each ID is a segment set connected with SOLVER.  EQ.'CIRCUIT': Each ID is a circuit ID (from *EM cards)  EQ.'SURF_PARTS': Each ID is a surface part number (See *MESH_SURFACE_ELEMENT)  EQ.'VOL_PARTS': Each ID is a volume part number (See *MESH_VOLUME)  EQ.'SURF_ELES': Each ID is a surface element number (See *MESH_SURFACE_ELEMENT)
SOLVER	Name of the solver (MECH, ICFD, CESE, EM, ...)
ID1, ...	IDs of the TYPE kind.

**\*LSO\_POINT\_SET**

Purpose: Define a list of points used to sample variables in time. Of the different sampling methods, the most common one is to specify points for time history output.

Card 1	1	2	3	4	5	6	7	8
Variable	SETID	USE						
Type	I	I						
Default	none	1						
Remarks		1						

**Point Cards.** Provide as many cards as necessary. This input ends at the next keyword ("\*") card

Card 2	1	2	3	4	5	6	7	8
Variable	X	Y	Z					
Type	F	F	F					
Default	none	none	none					

VARIABLE	DESCRIPTION
SETID	Identifier for this point set which is used by *LSO_DOMAIN
USE	Points in this set are used as: EQ.1: fixed time history points (default) EQ.2: positions of tracer particles
X, Y, Z	Coordinates of a point. As many points as desired can be specified.

**Remarks:**

1. **USE.** For USE = 1, with the ICFD and CESE solvers, the fixed points must remain inside the fluid mesh or a zero result is returned, while for the EM solver, the points can be defined inside the conductors or in the air. In the latter case, the fields will be computed using a Biot-Savart type integration. For USE = 2, a massless tracer particle is tracked for the ICFD and CESE solvers using their local velocity field to integrate the position of each particle in time.

**\*LSO\_TIME\_SEQUENCE**

Purpose: This command provides users with maximum flexibility in specifying exactly what they want to have appear in the output LSO binary database. Each instance of the \*LSO\_TIME\_SEQUENCE command creates a new time sequence with an independent output frequency and duration. Furthermore, while the default domain for each output variable will be the entire mesh on which that variable is defined, at all selected snapshot times, the \*LSO\_DOMAIN keyword commands can be used to specify that output will only occur on a portion of SOLVER\_NAME's mesh, and for a limited time interval, or that it will occur at a set of points (see \*LSO\_POINT\_SET), or over a set of object IDs (see \*LSO\_ID\_SET). Note that for the single-precision version of LS-DYNA, the only allowed value of SOLVER\_NAME = MECH.

Card 1	1	2	3	4	5	6	7	8
Variable				SOLVER_NAME				
Type				A				

Card 2	1	2	3	4	5	6	7	8
Variable	DT	LCDT	LCOPT	NPLTC	TBEG	TEND		
Type	F	I	I	I	F	F		
Default	0.0	0	1	0	0.0	0.0		
Remarks	1	1	1	1				

**\*LSO****\*LSO\_TIME\_SEQUENCE**

**Domain IDs.** Provide as many cards as necessary. This input ends at the next keyword ("\*") card, or when a global variable name card appears

Card 3	1	2	3	4	5	6	7	8
Variable	DOMID1	DOMID2	DOMID3	DOMID4	DOMID5	DOMID6	DOMID7	DOMID8
Type	I	I	I	I	I	I	I	I
Default	none							

**Global variable names.** Provide as many cards as necessary. This input ends at the next keyword ("\*") card

Card 4	1	2	3	4	5	6	7	8
Variable	GLOBAL_VAR							
Type	A							

VARIABLE	DESCRIPTION
SOLVER_NAM E	Selects the solver from which data is output in this time sequence. Accepted entries so far are 'MECH', 'EM', 'CESE' and 'ICFD'
DT	Time interval between outputs.
LCDT	Optional load curve ID specifying the time interval between dumps.
LCOPT	Flag to govern behavior of plot frequency load curve:  EQ.1: At the time each plot is generated, the load curve value is added to the current time to determine the next plot time (this is the default behavior).  EQ.2: At the time each plot is generated, the next plot time T is computed so that T = the current time plus the load curve value at the time T.  EQ.3: A plot is generated for each ordinate point in the load curve definition. The actual value of the load curve is ignored.

<b>VARIABLE</b>	<b>DESCRIPTION</b>
NPLTC	DT = ENDTIM/NPLTC overrides DT specified in the first field.
TBEG	The problem time at which to begin writing output to this time sequence
TEND	The problem time at which to terminate writing output to this time sequence
DOMID1, ...	Output set ID defining the domain over which variable output is to be performed in this time sequence. Each DOMID refers to the domain identifier in an *LSO_DOMAIN keyword card.
GLOBAL_VAR	The name of a global output variable computed by SOLVER_NAME. This variable must have a single value (scalar, vector, or tensor), and therefore does not depend upon any DOMID. Any number of such variables may be specified with a given time sequence. These variables are listed as having "global" domain for SOLVER_NAME in a separate document. This document (LSO_VARIABLES.TXT) is created by running the command: LS-DYNA print_lso_doc.

**Remarks:**

1. If LCDT is nonzero, then it is used and DT and NPLTC are ignored. If LCDT is zero and NPLTC is non-zero, then NPLTC determines the snapshot time increment. If LCDT and NPLTC are both zero, then the minimum non-zero time increment specified by DT is used to determine the snapshot times.

**\*LSO****\*LSO\_VARIABLE\_GROUP****\*LSO\_VARIABLE\_GROUP**

Purpose: To provide a means of defining a shorthand name for a group of variables. That is, wherever the given group name is used, it is replaced by the list of variables given in this command. Note that for the single-precision version of LS-DYNA, the only allowed value of SOLVER\_NAME = MECH.

Card 1	1	2	3	4	5	6	7	8
Variable	SOLVER_NAME							
Type	A							

Card 2	1	2	3	4	5	6	7	8
Variable	DOMAIN_TYPE							
Type	A							

Card 3	1	2	3	4	5	6	7	8
Variable	GROUP_NAME							
Type	A							

**List Of Variables In Group.** Provide as many cards as necessary. This input ends at the next keyword ("\*") card

Card 4	1	2	3	4	5	6	7	8
Variable	VAR_NAME							
Type	A							

**VARIABLE****DESCRIPTION**

SOLVER\_NAME

Selects the solver for which data is output in a time sequence.

<b>VARIABLE</b>	<b>DESCRIPTION</b>
DOMAIN_TYPE	Name of the type of domain on which each VAR_NAME is defined.
GROUP_NAME	Name of (or alias for) the group of names given by the listed VAR_NAMES
VAR_NAME	The name of an output variable computed by SOLVER_NAME

**Remarks:**

1. Valid VAR\_NAMES depend both upon the SOLVER\_NAME and the DOMAIN\_TYPE. These variables are listed by DOMAIN\_TYPE for each SOLVER\_NAME in a separate document. This document (LSO\_VARIABLES.TXT) is created by running the command: LS-DYNA print\_lso\_doc.

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**\*LSO\_VARIABLE\_GROUP**

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