

# LS-DYNA Software

## Revision 9.3.0

Release Notes



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# 1 LS-DYNA Release R9.3.0

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## 1.1 Introduction to R9.3.0

This file describes what's been added or fixed in version 9.3.0 since the release of version 9.3.0. The changes are primarily bug fixes.

## 1.2 License

The string "REVISION 9" must appear in the license file in order to run version R9.3.0.

## 1.3 Release notes for R9.3.0

The items are arranged by category. Understand that in many cases, a particular item could fall under more than one category, but in the interest of brevity, each item is listed only once, under a single category.

Excluding the "Miscellaneous" category, the categories are arranged alphabetically.

The categories are:

- \*AIRBAG
- ALE
- \*BOUNDARY
- CESE (Compressible Fluid Solver)
- CONTACT
- \*CONSTRAINED
- \*CONTROL
- EFG (Element Free Galerkin)
- \*ELEMENT
- Forming Analysis
- \*FREQUENCY\_DOMAIN
- ICFD (Incompressible Fluid Solver)
- Implicit (Mechanical) Solver
- \*INITIAL
- \*LOAD
- \*MAT and \*EOS
- MPP
- Output
- Restarts
- \*SENSOR
- Thermal Solver
- Miscellaneous

### 1.3.1 \*AIRBAG

\*AIRBAG\_PARTICLE:

- Fix bug to get consistent results for a restart run as compared to a continuous, nonstop run.  
The bug came from the airbag volume evaluation where the reference point of the geometry

was not stored in the dump file.  
- Add support of leakage parameters described in  
\*MAT\_ADD\_AIRBAG\_POROSITY\_LEAKAGE.

Made \*DEFINE\_CURVE\_FUNCTION work for \*AIRBAG\_LOAD\_CURVE and  
\*AIRBAG\_SIMPLE\_PRESSURE\_VOLUME.

Fixed hang up issue when using \*AIRBAG\_REFERENCE\_GEOMETRY with  
\*INCLUDE\_TRANSFORM.

Fixed reading of \*AIRBAG\_REFERENCE\_GEOMETRY\_ID input that contained parameters.

Fixed bug affecting \*AIRBAG\_PARTICLE whereby TEND was applied to TSTOP.  
These variables are now independent as they should be.

### 1.3.2 ALE

Fixed bug in Structured ALE for cases with ESORT=1 in \*CONTROL\_SOLID.  
Element ID mismatch would cause ALE element volume fraction to be assigned wrong value.

Fixed bug affecting dbfsi output (\*DATABASE\_DBFSI) in runs that include dynamic  
relaxation. Before the fix, dbfsi data earlier than the dynamic relaxation end  
time were not output.

Fixed bug in \*CONSTRAINED\_LAGRANGE\_IN\_SOLID, CTYPE=5 (MPP only). This  
memory-related  
bug could have caused incorrect coupling behavior.

### 1.3.3 \*BOUNDARY

Updates to the \*INTERFACE\_LINKING\_NODE<\_SET>\_LOCAL option  
so that the coordinate system transformation behavior makes  
more sense.

Fix some memory allocation and initialization related to  
\*INTERFACE\_LINKING.

Fix initialization problem that could arise if  
more than one \*INTERFACE\_LINKING instance references  
the same \*INTERFACE\_COMPONENT.

Fixed \*BOUNDARY\_PRESCRIBED\_MOTION\_SET\_BOX which was not working after full  
deck restart.

Fixed \*BOUNDARY\_PRESCRIBED\_ORIENTATION\_RIGID\_DIRCOS which did not orient  
the  
rigid body when angles are close to PI when using double precision.

Fixed restart input error when using \*CHANGE\_BOUNDARY\_CONDITION for MPP with ncpu>1.

Fixed bug affecting \*BOUNDARY\_TEMPERATURE\_OPTION:  
Some nodes might not get the correct values in case of THSHEL=1 in \*CONTROL\_SHELL and unattached nodes in the model.

### 1.3.4 CESE (Compressible Fluid Solver)

For nearly one-dimensional meshes in the three-dimensional immersed boundary FSI solver, fixed a memory bug.

Fixed a minor bug in the time step calculation for the immersed boundary FSI solvers.

Corrected geometry deduction errors in the 2D rotation case of CESE cyclic boundary conditions.

Improved some messages related to CESE solver input choices.

Corrected problems in CESE conjugate heat transfer:

- a) For wedge elements, fixed some internal geometry calculations for the 3D immersed boundary conjugate heat transfer solver.
- b) Internal sorted element indexing is now taken into account for the structural elements involved in the CESE conjugate heat transfer solvers.

For the \*CESE\_DATABASE cards, corrected these issues:

- a) Any used segments that are not in the CESE mesh are reported.
- b) Element sets look up is now guaranteed to work.
- c) Drag calculation output that is attempted for the incorrect FSI method, is now reported. Here are the illegal cases:
  - i) \*CESE\_DATABASE\_FSIDRAG is only available with the CESE immersed boundary FSI solvers.
  - ii) \*CESE\_DATABASE\_SSETDRAG is not available with the CESE immersed boundary FSI solvers. In other words, it only works with the non-FSI solvers and moving mesh FSI solvers.
- d) Failure to find an internal node number in \*CESE\_DATABASE commands is now reported.
- e) Output was not being performed for the initial conditions. Instead, it is now done after the first time step.

Changed behavior for the \*CESE\_DATABASE cards including:

- a) Output times are now selected in a manner similar to CESE d3plot output, meaning when the CESE simulation time has reached at least the requested output times. Also, output never occurs more than once per CESE time step.
- b) Cycle number was reported in some outputs as the 'time step'. The actual solver time step is now used instead.

\*CESE\_CONTROL\_SOLVER, ICESE=200:

Fixed bug for shortest distance calculations in 2D Immersed Boundary FSI.

### 1.3.5 CONTACT

Fix initialization error related to \*CONTACT\_GENERAL\_INTERIOR that resulted in every subsequent \*CONTACT\_GENERAL also being treated as INTERIOR.

Fix spot welds improperly deleted due to rigid body conflict when an IPBACK contact interface is in effect. The failure of the constraint-based contact to tie should not cause the weld to be deleted if the penalty side ties. (MPP only)

Fix forces and energies that are output for \*CONTACT\_TIED\_SHELL\_EDGE\_TO\_SOLID

Fixed zero frictional energy output to glstat and sleout when using \*CONTACT\_AUTOMATIC\_SURFACE\_TO\_SURFACE\_ORTHO\_FRICTION.

Fixed input error for duplicate part id multiple \*RIGIDWALL\_GEOMETRIC\_...\_DISPLAY are used: some with specified part id and some without.

Fixed zero sliding energy output to glstat when using \*CONTACT\_TIED\_SHELL\_EDGE\_TO\_SOLID.

Applied consistency mode for \*CONTACT\_AUTOMATIC\_SURFACE\_TO\_SURFACE\_COMPOSITE when ncpu<0. Applies to SMP only.

Fixed a possible memory error during initialization when using DEPTH=5, 15, 25, or 35 or SBOPT=4 or 5 on \*CONTACT when SOFT=2.

Fixed a possible segmentation fault during initialization when using MPP segment based contact that uses SBOXID to eliminate slave segments.

Fixed a possible error in \*CONTACT\_2D\_AUTOMATIC when there is more than one tied contact in the model. An array was being used past its allocated length.

Fixed ISLIDE option of \*CONTACT\_2D\_AUTOMATIC in MPP version. Some data was incorrectly accessed leading to possible termination or bad results.

Reduced the number of spurious penetration warnings that are printed when segment based contact is used with solid parts and IGNORE=2 on \*CONTROL\_CONTACT.

This fix affects explicit dynamic runs only.

Fixed exponential damage equation in SPR3  
(\*CONSTRAINED\_INTERPOLATION\_SPOTWELD) model.

Fix GM filter, IACCOP=2 in \*CONTROL\_OUTPUT field 4, which produced badly filtered accelerations for single precision.

Error terminate with message, KEY+1203, if IDRFLG=2  
\*CONTROL\_DYNAMIC\_RELAXATION  
and VECID is not defined on Card 2b.1 for polar coordinate initialization.

### 1.3.6 \*CONSTRAINED

Add additional error checking on coincident nodes for revolute and screw joints.

Implement a more robust solution to the storage of birth and death times for prescribed motion constraints for the LaGrange Multiplier Formulation of joints for explicit.

Fixed bug that occurred when there were multiple \*CONSTRAINED\_BEAM\_IN\_SOLID cards.

The bug caused incorrect results when sliding is permitted between beams and solids.

\*DEFINE\_BEAM\_SOLID\_COUPLING:

Added keyword for coupling of beams (or shells) to non-ALE solids, e.g., for application to simulating rebar in concrete.

This is a far more efficient alternative to \*CONSTRAINED\_LAGRANGE\_IN\_SOLID, CTYPE=2.

It's yet unclear the pros/cons of \*DEFINE\_BEAM\_SOLID\_COUPLING as compared to \*CONSTRAINED\_BEAM\_IN\_SOLID (or \*CONSTRAINED\_SHELL\_IN\_SOLID), as these features were developed independently and almost simultaneously.

Increased the distance that joint nodes can be separated before error terminating with STR+65.

The old criteria was  $\text{dist} < \max(0.001, 0.0001 * L)$  where L is the length of the joint, which is defined as the distance between nodes 1 and 3, or else 2 and 4.

The new criteria is  $\text{dist} < \max(0.001, 0.001 * L)$ .

Add new features for \*CONSTRAINED\_INTERPOLATION\_SPOTWELD (SPR3): torsion, non-linear damage, individual mode stiffnesses, output, etc.

Remove \*CONSTRAINED\_SPR2/SPR3 visualization beams from automatic contact. Sometimes they caused instability problems.

Add option to define a part id for visualization beams used with \*CONSTRAINED\_SPR2 (by default, these id's are set internally as highest numbers).

Fix for \*CONSTRAINED\_SPR2 with more than two sheets (XPIDi>0 on Card 4)

to avoid Error 30086 (INI+86), "Beam # ... N3 node on beam x-axis".

Bug fix for keyword read of \*CONSTRAINED\_LOCAL, variable TOL.  
Free format (commas) or parameter (&...) input was not working.

Fixed bug in processing \*CONSTRAINED\_NODAL\_RIGID\_BODY and \*PART\_INERTIA  
to prevent spurious error message,

\*\*\* Error 10144 (KEY+144)

node set for nodal rigid body # 1 is not found.

The set number is 0

\*CONSTRAINED\_COORDINATE:

Fix a machine-dependent bug in projection in a case where the defined coordinates  
were far away from the part.

### 1.3.7 \*CONTROL

Added global option NCDCF on \*CONTROL\_SOLUTION to only evaluate  
\*DEFINE\_CURVE\_FUNCTION  
every nth cycle. This greatly improves computational times for Active Human Body Models.

Selective mass scaling (IMSCL on \*CONTROL\_TIMESTEP):

- Neglect null beams attached to rigid bodies in the selective mass scaling scheme as they don't possess a characteristic time step.
- Fix bug in glstat related to added mass and velocity calculations for selective mass scaling.
- Fix bug in selective mass scaling when beam release conditions are used in MPP. Bug was a matter of local vs global variables mismatch.

Add flag on 4th card of \*CONTROL\_OUTPUT to output node sets and element sets  
used in computing secforc data to d3hsp. This is helpful when the \*DATABASE\_CROSS\_  
SECTION\_PLANE is used to define the cross section and the user wants to  
know what nodes and elements were automatically selected.

The sets can be appended to the keyword input file and then displayed using  
LS-PrePost.

### 1.3.8 EFG (Element Free Galerkin)

Fix memory error when using EFG shell element formulation 41 in MPP. The error  
could occur when some cores were devoid of any EFG shell elements.



### 1.3.9 \*ELEMENT

Fixed bug affecting \*PART\_COMPOSITE. If the first part in the model had very low density, or was a part for Discrete Elements that have no density, large rotational inertias could be added to the nodes of the PART\_COMPOSITE. These could act as restraints, preventing or resisting the correct motion of the elements. In this context, "first part in the model" means the first part encountered by the keyword reader, not the part with the lowest PID. For this reason the bug might be observed or not according to the order in which \*INCLUDE files were defined. For the effect of the bug to be noticeable, the "very low density" would have to be several orders of magnitude less than the density of the PART\_COMPOSITE itself.

Enhance the nodal constraint handling for superelements (\*ELEMENT\_DIRECT\_MATRIX\_INPUT) in explicit to properly handle the implicit/explicit switching case. Also extended the code to recognize \*BOUNDARY\_SPC in addition to the constraints specified on the \*NODE cards.

Fix storage allocation for \*ELEMENT\_DIRECT\_MATRIX\_INPUT when the matrices have different orders.

Fix an MPP bug for type 9 \*ELEMENT\_SEATBELT\_PRETENSIONER that could occur when a model had more than one such pretensioner.

Enable shell form 23 to output stress and strain at 3x3 integration points to eloutdet.

Fixed failure in the C0 triangle (shell form 4) when ESORT=1 on \*CONTROL\_SHELL, and the section uses element form 16 or any other element form with multiple integration points in a layer. More specifically, the fix is for failure of the type where we check for failure on the last integration point such as \*MAT\_054.

Fixed the use of both tet solid type 17 and tshells in the same model when INTOUT is set to STRAIN on \*DATABASE\_EXTECNT\_BINARY. Memory was conflicting causing bad connectivity of the tet element data.

\*mat

Fixed conflict between RTCL damage in \*MAT\_123 and heat affected zones (HAZ). The TRIAX parameter was being overwritten causing possibly excessive damage.

Corrected the thinning of shell form 24. It was thinning about 33% more than it should under large tensile strain.

Improved the accuracy of tet form 13. During rigid body translation, some pressure could develop. Now it can translate pressure free, and therefore stress free.

Ensure that cohesive elements have a big enough buffer to support SMP and hybrid parallel consistency.

Fixed tshell form 3 when used with hyperelastic materials. The L matrix was in the global coordinate system instead of the local system. The result was an incorrect strain measure.

Fix \*ELEMENT\_BEAM\_PID with offsets (\*INCLUDE\_TRANSFORM) for PID1 and PID2.

Fix a bug in cohesive elements when used with hybrid executables (consistency option was malfunctioning).

Fixed bug in reading \*ELEMENT\_SHELL\_OFFSET\_COMPOSITE.

Fixed bug affecting adaptivity with \*ELEMENT\_DISCRETE.

Fix error in reading of user-defined shell elements. LS-DYNA was trying to use the same syntax as user-defined solid elements.

Fix error when using 3D tet adaptivity in a model with non-adaptive parts consisting of hexahedral solid elements with ELFORM=0 in \*SECTION\_SOLID. This error occurred during the adaptive restart; all hex ELFORM=0 elements were incorrectly redefined as tetrahedral ELFORM=13 solid elements.

Fix incorrect rigid body velocity and kinetic energy in matsum file when \*ELEMENT\_MASS\_PART is used.

Fix hourglass energy output for Cosserat Point Element (CPE), i.e., hourglass type 10.

\*CONTROL\_TIMESTEP:

Change tolerances in selective mass scaling to avoid hang for small loads in single precision.

### 1.3.10 Forming Analysis

Fix a bug in forming contact (single precision only).

Fix a bug in drawbead defined from IGS curve in an adaptive simulation.

Fix a platform-dependent bug affecting springback compensation.

Fix platform-dependent bugs for \*CONTROL\_IMPLICIT\_FORMING and \*INCLUDE\_AUTO\_OFFSET, both bugs stemming from uninitialized variables.

Fix bug affecting solid 3D trimming.

\*DEFINE\_CURVE\_TRIM\_2D:

Fix a bug in which trimming was in wrong direction.

**\*DEFINE\_FORMING\_CLAMP:**

Fix two bugs:

1. Fix incorrect error message: "vector: xx was not defined" when in fact \*DEFINE\_VECTOR is defined.
2. Check constraints for the rigid clampers and free the constraints from the moving clampers.

**\*INCLUDE\_TRIM:**

Fix end-of-file reading error, when \*INCLUDE\_TRIM is used, and the included file does not contain stress information.

**\*bou**

**\*BOUNDARY\_SPC\_SYMMETRY\_PLANE:**

Fix bug when two symmetry planes are defined but are not aligned with global axes. The constraints were not applied correctly.

### **1.3.11 \*FREQUENCY\_DOMAIN**

**\*FREQUENCY\_DOMAIN\_FRF:**

- Added rotational dof input (torque and base angular motion) for FRF (VAD1=8,9,10,11).
- Added rotational dof output (DOF2=5,6,7,8 in R9.3.0 but changed to DOF2=4,5,6,8 in R10 and later).

**\*FREQUENCY\_DOMAIN\_ACOUSTIC\_BEM:**

Fixed bug in reading boundary elements when they are defined by a part set (SSTYPE=0).

### **1.3.12 ICFD (Incompressible Fluid Solver)**

Tentative bug fix of multiphase issue. Case that involves two phases (air and water for example) may now work in certain configurations.

### **1.3.13 Implicit (Mechanical) Solver**

Enhance dumping of matrices in the presence of implicit rotational dynamics.

Enhance Implicit Lanczos Eigensolver shift logic to avoid divide by zero.

Correct the issue where use of \*LOAD\_BODY is applied to a model with rigid bodies. If the vector of nodes having the load applied belong to a rigid body then the vector of elemental stiffness matrices is null. So logic was added to skip the

the implicit matrix assembly for such null matrices rather than trapping them as an error.

Correct control-c processing for SMP Implicit.

Apply a correction that prevents a memory clobber for implicit in single precision. Double precision is still recommended for implicit.

Add an error test for improper DRTERM when using implicit for dynamic relaxation. Enhanced implicit key point logic during dynamic relaxation phase as implicit was using the incorrect end time which led to a zero time step.

For MPP Implicit, correct the marking of the end of each d3eigv to match SMP.

Enhance the processing of dampers for implicit mechanics. Avoids turning on matrix dumping unless requested by the user.

Enhance the handling of rotational inertias for implicit, especially discrete elements and rigid body inertias.

Add \*INTERFACE\_SPRINGBACK to the cases where implicit collects and processes damping terms instead of suppressing them as is the case for implicit statics.

Correct typing of displacement array in implicit modal dynamics. It was not typed so it was real\*4 instead of real\*8 in single precision. This led to incorrect output to nodout file.

Extend the logic for implicit constraint handling to tied contact with \_CONSTRAINED\_OFFSET to skip any SPCs on the rotational dofs of the slave nodes. We already have such logic to skip the SPCs on the translational dofs for the slave nodes for all tied contact.

### 1.3.14 \*INITIAL

Fixed bug affecting large format dynain files

The \*INITIAL\_STRAIN\_SHELL data was written incorrectly under these conditions:

- "Large" dynain file format is used (as is the case in Staged Construction)
- MPP on multiple processors (the bug does not affect SMP)
- The model contains shell elements with a mix of numbers of in-plane integration points, for example ELFORM=2 (1 in-plane point) and ELFORM=16 (4 in-plane points).

If the dynain file was then used as input to a second analysis, LS-DYNA could not read it. The work-around was to delete the \*INITIAL\_STRAIN\_SHELL data from the dynain file.

Fixed ineffective \*INITIAL\_VELOCITY\_GENERATION for part defined with \*PART\_INERTIA when ID=0, STYPE=0 and IRIGID=1.

Fixed dynain writing and reading of \*INITIAL\_STRESS\_SHELL for the fully integrated C0 shell (shell form 20).

Enabled multiple \*INITIAL\_VELOCITY\_GENERATION keywords to be used with \*ELEMENT\_SHELL\_COMPOSITE or \*ELEMENT\_TSHELL\_COMPOSITE. Only one velocity generation keyword was supported previously.

Fix for \*INITIAL\_AXIAL\_FORCE\_BEAM with KBEND=1. Wrong internal index could have led to unintended memory overwrite, thus arbitrary problems.

### 1.3.15 \*LOAD

Fixed \*LOAD\_THERMAL\_VARIABLE\_ELEMENT\_TSHELL and \*LOAD\_THERMAL\_LOAD\_CURVE when used with tshells.

Fixed bug in reading \*LOAD\_SEGMENT\_FILE when jobid is specified by user.

Fix indexing bug that prevented accessing ground motion ID (\*DEFINE\_GROUND\_MOTION) from \*LOAD\_SEISMIC\_SSI.

### 1.3.16 \*MAT and \*EOS

\*MAT\_BOLT\_BEAM (\*MAT\_208): Added capability for erosion and failure due to axial compression (input variable DCFAIL on Card 3).

Backport fix that avoids division by zero in \*MAT\_100\_DA in implicit.

Fixed a divergence problem with \*MAT\_242/\*MAT\_KINEMATIC\_HARDENING\_BARLAT2000.

Fixed \*MAT\_COMPOSITE\_DAMAGE/MAT\_022 for implicit analysis which was giving the wrong eigenvalues.

Implemented pressure cutoff, PCUTT & PCUTC, for \*MAT\_PLASTICITY\_COMPRESSION\_TENSION/\*MAT\_124 with solid type 13.

Fixed seg fault when using \*MAT\_157/\*MAT\_ANISOTROPIC\_ELASTIC\_PLASTIC

for 2D analysis.

Fixed \*MAT\_023/\*MAT\_TEMPERATURE\_DEPENDENT\_ORTHOTROPIC when extremely large coefficient of expansion is used resulting in very large thermal strains. Convert the thermal strain to true strains before removing it from the total strains. \*MAT\_023 will now give the same thermal strains as \*MAT\_021 when extremely large coefficient of expansions are used.

Fixed the material direction calculation of shell \*MAT\_091. The error lead to wrong stress and strain.

Added support for CMPFLG=1 on \*DATABASE\_EXTENT\_BINARY for \*MAT\_091 and \*MAT\_092.

Fixed an error in brick spot weld assemblies when used with strain rate sensitive failure functions. For assemblies, the strain rate is a volume weighted average strain rate of the elements in the assembly. However, the volume was pulled from unallocated memory for most elements resulting in a strain rate that may be too small. This error affected failure options OPT=1 and 7 on \*MAT\_100, and also weld failure for \*MAT\_100\_DA.

Added a new option for \*MAT\_SPOTWELD called FMODE. The FMODE option is available for DMGOPT=10, 11, and 12. When the failure function is reached, and when  $FMODE > 0.0$  and  $< 1.0$ , the value of FMODE will determine if a weld will fail immediately, or will have damage initiated. The failure function may include axial, shear, bending and torsion terms. If the sum of the squares of the shear and torsion terms divided by the sum of the square of all terms is greater than FMODE, then the weld will fail immediately. Otherwise, damage will be initiated.

Fixed \*MAT\_024 plastic strain failure for beam element forms 4 and 5. The elements were not failing.

Fixed thermal strains in \*MAT\_021 when used by tshells. The material directions were not processed correctly causing incorrect thermal strains.

Fixed shell and solid \*MAT\_244 when LCY1, LCY2, LCY3, LCY4, or LCY5 was left equal to zero on card 2 of the data. In this case, we attempted to use nonexistent data. This caused the Windows executable to error terminate with a "Program Exception - access violation" message.

Addressed various issues to make \*MAT\_172 more robust, including error checking of input, and allowing FC=0 when the fraction of reinforcement = 1.0

Add default strength limits of  $1.e+16$  (XC, XT, ...) if they are not defined for \*MAT\_261/\*MAT\_262.

Enable GISSMO (\*MAT\_ADD\_EROSION) to be used with beam element type 1.

Add plane stress option (`_2D`) for `*MAT_024` and shell elements. This invokes actual plane stress treatment, i.e, transverse shear stresses are not part of the yield condition but updated elastically.

Fix rarely occurring NaN issue with `LOG_INTERPOLATION` option of `*MAT_024`, `*MAT_083`, and `*MAT_181`.

Fix for `*MAT_034` (FABRIC) with `FORM = 14, 24, or -14`. Number of history variables could have been too low for the case that tables are used for parameters `LCA`, `LCB`, `LCAA`, or `LCBB`. And that could have led to noisy stress response (in versions R8.0 to R9.2).

Fix for NaN problem with `*MAT_089` and shell elements.

Add optional interpretation of `EPSTHIN` in `*MAT_123`. The sign of the input value governs the type of strain that is used:  
- `EPSTHIN>0`: thinning total strain (as in `ISTUPD=1`)  
- `EPSTHIN<0`: thinning plastic strain (as in `ISTUPD=4`)

Some CPU cost improvements for `*MAT_123` (R9.2.0 was slower than R7.1.3).

Add option to use logarithmic strain rates in `*MAT_224`'s failure strain curve LCG.

Bug fix for `*MAT_224` and 2D contact with erosion.

Fix for failure treatment in `*MAT_224_GYS`. Update of failure function `F` could have been wrong, because the plastic strain increment was not always zero for elastic integration points.

DIEM damage model (`IDAM<0` on `*MAT_ADD_EROSION`): Allow log strain rates in DIEM damage model when tables are used. Same convention as `*MAT_024` (first argument negative) is used to deduce whether strain rate or log of strain rate is input.

Fixed the `*MAT_022` `ATRACK` option which causes the a-direction to rotate with deformation as well as element rotation.

A first-order, low-pass filter is implemented to smooth the effective strain rate for `*MAT_ADD_EROSION`; see variable `DTEFLT`. High frequency response above the cutoff frequency is filtered out.

Fix bug affect convergence in `*MAT_260B/*MAT_MOHR_NON_ASSOCIATED_FLOW` for shells.

When `EPSR` and `EPSF` are defined in `*MAT_054`, made a correction to the computation of transverse shear strains for solids and shells.

Added a criterion to avoid possible snapback behavior in `*MAT_262` by only allowing certain "softening" modulus with respect to the elastic stiffness.

This might be important when using rate-dependent strength limits and the values for the fracture toughnesses are not properly set.

Fix bug for \*MAT\_082 introduced in rev 111671.

Fix for the combination of \*MAT\_ADD\_EROSION and thick shell type 2 (\*SECTION\_TSHELL, ELFORM=2). Strain-based criteria (e.g. MXEPS) did not work correctly before.

### 1.3.17 MPP

Add new pfile option "transform\_keyword" to the "decomp" section. Including this new flag will cause the global decomposition transformations to apply to all the decomposition regions created by these keywords:

- \*PARTS\_DISTRIBUTE
- \*PARTSET\_DISTRIBUTE
- \*ARRANGE\_PARTS
- \*CONTACT\_DISTRIBUTE

Before r86885, and after that was reverted in r102224, these regions were decomposed without any coordinate transformation at all.

Between those versions, the global transformation applied to all these regions. I think this behavior makes sense, but someone complained that r86885 changed behavior, so it was removed in r102224. Then someone ELSE complained that r10224 changed the behavior that THEY wanted, so this option is now added.

Do case insensitive comparisons when processing REGION data in the pfile.

Update shell and solid cost parameters for "newcost" decomposition option.

Improve handling of some MPP decomposition temporary files to handle various combinations of local directory, job id, and keyword->structured processing.

Fix bug in MPP where the adaptive death time for fusion (CDEATH in \*CONTROL\_ADAPTIVE) was not internally set to 10E20.

Regarding MPP and Hybrid executables for X86-64 CPUs with AVX2 or AVX512 instruction sets:

In previous releases, separate AVX2 and AVX512 executables were provided only for Intel Xeon CPUs.

(1) In R9.3.0, AVX2 "common" executables are provided which will run on all AVX2-enabled x86-64 CPUs.



(2) In addition, in R9.3.0, separate AVX2 and AVX512 executables are provided that are specifically built to run only on AVX2- and AVX512-enabled Intel Xeon CPUs, and which have the same compiler flags as in previous releases.

It has been found that the common X86-64 executables in (1), when run on Xeon CPUs, may not provide the same results as these Xeon-specific executables.

In future releases, LSTC's plan is to provide only "common" executables for AVX2 and for AVX512, and eliminate the Xeon-specific executables.

**\*CONTROL\_MPP\_DECOMPOSITION\_ARRANGE\_PARTS:**

Added option to distribute a part or a partset among a specified group of processors to get better load balance.

**\*PART\_AVERAGE** is enhanced for better MPP scalability without special MPP decomposition.

Implemented a new decomposition option "together"

(\*CONTROL\_MPP\_DECOMPOSITION\_ARRANGE\_PARTS with TYPE = 20 or 21).

This qualifier works like "lumped" to keep elements in the region on a single processor but it also assigns them on the same processor with their neighboring elements with load balancing intact. In general, "together" is recommended over "lumped".

Fix missing initialization that broke d3plot files when MPP predecomposition was used with models having \*DEFINE\_CURVE\_FUNCTIONS that used the PIDCTL function.

**\*DEFINE\_SPOTWELD\_MULTISCALE, \*INCLUDE\_MULTISCALE\_SPOTWELD:**

Fix for multi-scale spotwelds in double precision.

There was a block of code executed during \*PART\_MODES initialization that only should have executed on processor 0. A fix was made accordingly.

Adjust decomposition cost factor of \*MAT\_083. This leads to a more balanced CPU load distribution in MPP calculations with this material model involved.

Adjust decomposition cost factor of solids with ELFORM=13 (nodal pressure tetrahedron). This leads to a more balanced CPU load distribution in MPP calculations with this element type involved.

### 1.3.18 Output

Fix MPP error in selecting which seatbelt elements will be output to sbtout.

Fix for improper idtrans handling of set ID in nodfor file in some

cases, which could have resulted in strange LEGEND sections in the nodfor output file.

Fixed bugs in the d3plot filter option (see second card of \*DATABASE\_BINARY\_D3PLOT) for MPP and SMP to make the filter option compatible with other d3plot options.

Added new option, NDFLAG, for \*INTERFACE\_SPRINGBACK to dump all nodes into dynain file.

Modified the writing of dynain files so that fabric elements output node and connectivity data, but omit the stress and strain data because it is not useful for initializing the stress of fabric. A warning message is written within the ascii dynain file to inform the user.

Enabled cross section force output (secforc) for higher order shell forms 23 and 24.

Efficiency improvements and fixes for \*DATABASE\_FATXML.

Fixed part id output for discrete element in d3hsp.

Fixed bug in reading heading card for \*DATABASE\_HISTORY\_NODE\_ID\_HEADING.

Fixed bug in \*DATABASE\_BINARY\_D3PLOT when variable PSETID is used and part set PSETID had duplicate parts.

Fixed bug affecting \*DATABASE\_HISTORY\_DISCRETE if BEAM=1 in \*DATABASE\_BINARY\_D3PLOT.

Fix bug that could possibly have led to incorrect output of some beam data in elout.

Fixed bug where dynain file was missing some thermal history variables when using \*INTERFACE\_SPRINGBACK\_LSDYNA\_THICKNESS with NTTHSV>0.

Fixed an error termination that could occur if swforc is not requested (no \*DATABASE\_SWFORC) and there are solid spot weld assemblies that fail.

Fixed legend output in nodout file if long format is used.

Fixed a bug affecting the labels of history nodes (i.e. \*DATABASE\_HISTORY\_NODE\_LOCAL\_ID), when long format is involved.

Fixed bug for d3plot if both DECOMP=5 or 6 in \*DATABASE\_EXTENT\_BINARY and PSETID is used in \*DATABASE\_BINARY\_D3PLOT to exclude parts.

The binout data for \*PART\_AVERAGED is revised and nodal values can be displayed in LS-PrePost.

### 1.3.19 Restarts

Fix to recompute rotational node mass increment for BEAM\_OFFSET tied contact after full deck restart.

Fixed an issue with restarting a job from cycle 1 when there are tied contacts in the model and they move nodes in cycle 1, and those nodes are also involved in segment based contact. The error was causing possible energy growth around the tied contacts.

Fixed neighbor spot weld thinning when an MPP job is terminated after 1 cycle and then restarted from the d3dump file.

Fix bug in full deck restart of tied contact where old contacts were flagged as new ones, so the initialization after restart was done with the updated coordinates, leading to force discontinuities.

### 1.3.20 \*SENSOR

Fix issue of \*SENSOR not properly turning off prescribed motion.

Fixed ineffective \*SENSOR\_CONTROL with type='PRESC-MOT' to switch off \*BOUNDARY\_PRESCRIBED\_MOTION.

### 1.3.21 Thermal Solver

\*DEFINE\_CURVE\_FUNCTION should now be working for curves used by the thermal solver.

### 1.3.22 Miscellaneous

Fix excessive memory growth for all types of adaptivity, and reduce memory requirements overall

Fix incorrect handling of symmetric load curves (\*DEFINE\_CURVE) when checking discretization errors, which resulted in misleading error messages.

Fixed \*DEFINE\_CURVE\_FUNCTION usage of the BEAM() function, which was returning information for the wrong beam.

Add failure function terms (normal, bending, shear) as arguments

of functions in \*DEFINE\_CONNECTION\_PROPERTIES with PRUL >= 2.

Add new option DGTYP=5 to \*DEFINE\_CONNECTION\_PROPERTIES.

Option to remove boundary kinks that sometimes occur in 2D r-adaptive remeshing.  
For this purpose, set CNLA = -110 in \*CONTROL\_ADAPTIVE with ADPOPT=8.

Fixed bugs in reading long format for many keywords.

Fixed bugs in writing of long format (newformat=long) for a few keywords.

Fixed bug in reading multiple \*SECTION \_SHELL\_EFG.

Added error message if bad input value for variable DIR in \*DEFINE\_COORDINATE\_NODES.

Fixed error in reading \*PART\_SENSOR; broken since r102468.

Fixed bug in writing of dynain data associated with STAGED\_CONSTRUCTION.

Fixed bug for creation of drawbead display beams in case of adaptivity.

Fixed bug causing 2d axisymmetric adaptivity to fail in some cases.

Fixed bug in which encrypted input for \*MAT\_075 was echoed to d3hsp.

The User's Manual says that non-numeric (alpha) IDs are permitted for the variables PID, SID, MID, and HGID in keywords \*PART, \*SECTION, \*MAT, and \*HOURGLASS. R9.3.0 now allows the command line option "plabel=no" which serves to disable checking for non-numeric (alpha) IDs while reading keyword input. This option may only be used if all IDs in the input deck are integers. The advantage of the option is that processing of input is faster, although the effect would not be noticed in models that initialize quickly.

Support a function name up to 80 characters in \*DEFINE\_FUNCTION\_TABULATED.  
Backported all \*DEFINE\_PRESSURE\_TUBE changes up to dev/r127782.

Fixed bug in reading long format if \*KEYWORD long=yes is used in \*INCLUDE file.

Fixed bug in newformat option for \*NODE\_SCALAR  
For newformat=i10 option, "%" sign only added to the modified keyword.

Fixed a segmentation fault that occurred when PSETID was used in \*DATABASE\_BINARY\_D3PLOT and there were eroding contact(s).

Fixed bug in reading long format input for \*INCLUDE\_STAMPED\_PART if optional cards 4 or 5 card don't exist.

Bug fix for Windows when reading an input file which is larger than 2 GB.

===== END of Release Notes for R9.3.0 =====