

## Features and enhancements included in 971 R3.2 that were not available in R3.1:

### New Material Models:

- \*MAT\_255 (piecewise linear plastic thermal)

### Enhanced Material Models:

support of user defined failure for:

- \*MAT\_123 (VP=1)
- \*MAT\_103
- \*MAT\_024 (VP=1)

\*MAT\_191 now supports end release for beams

\*MAT\_187 updates

\*MAT\_126 add corotational local coordinate system for formulation-1

Add V option for aopt=3,4

- \*MAT\_026
- \*MAT\_126

\*MAT\_036 added a cap to out-of-plane shear stress, when M is integer

\*MAT\_172 added hourglass properties for shells

\*MAT\_236 added interior strain point calculation

\*MAT\_ADD\_THERMAL\_EXPANSION now supports \*LOAD\_THERMAL\_VARIABLE\_SHELL

\*MAT\_SEATBELT added error termination if the maximum slope in the loading curve exceeds that of the unloading curve.

Added warning if modulus in a load curve table exceeds Young's modulus for several material models.

Print Warning if prca and prcb are blank in

- \*MAT\_002
- \*MAT\_022
- \*MAT\_054
- \*MAT\_055

Added warning message or error termination if user inputs improper stress-strain curve for fitting for:

- \*MAT\_027
- \*MAT\_077
- \*MAT\_177
- \*MAT\_178

Added the negative NUMINT option to material 123

It is the percentage of integration points/layers which must fail before element fails. For fully integrated shells, a methodology is used where a layer fails if one integration point fails and then the given percentage of layers must fail before the element fails.

Added history output for viscoplastic strain rate when failure is active to:

- \*MAT\_024 (VP=1)
- \*MAT\_123 (VP=1)

### Implicit:

Added synchronization of implicit time step after an adaptive remeshing

Added arclength method node control in MPP

### Boundary Conditions:

Added implicit treatment of boundary prescribed orientation

### Airbag:

\*AIRBAG\_PARTICLE

added flag on AIRBAG\_HYBRID\_CHEMKIN to turn on/off digitized load curves

### Output:

messag

- Add list of untied nodes to MESSAG file for automatic tiebreak contact option

d3plot

- enable particle database in d3plot
- added all integration points to d3plot database, activated by setting MAXINT<0

intforc

- add MPP support for recent IOOPT option for intfor file.
- Added IOOPT=3 for \*DATABASE\_BINARY\_INTFOR

Contact:

- Update for new weld option (Honda)
- Add a new feature to \*TERMINATION\_CONTACT allow the job to terminate when the maximum contact force is reached.
- Add guided cable contact to MPP
- Add flag to turn on shell element offsets in contact (\*control\_shell, third card, third field =1).

General:

- Added optional thickness scaling for \*INCLUDE\_STAMPED\_PART
- Added damage type DG\_TYP=4 to DEFINE\_CONNECTION\_PROPERTIES
- Added MPP support for IFLAG=1 in CONSTRAINED\_EXTRA\_NODES
- Added new keyword \*COMMENT
- Added "date" option for \*VENDOR keyword added to R3
- Added a new command line option: ncheck=n  
where n is the of number of times to check the existence of input file.
- Support for constrained\_extra\_nodes option in selective mass scaling scheme
- Add warning about not supporting prescribed motion during modal superposition.
- Added user-specified spin speed for PRESCRIBED\_ORIENTATION\_VECTOR

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The remainder of this file describes (sometimes quite cryptically) many other enhancements, additions, and bug fixes made since the release of LS-DYNA version 971 R3.1. These items are listed chronologically with the most recent items listed first:

Bug fix for \*MAT\_120\_... where the strain rate was not properly initialized.

Fixed possible division by zero in material 120.

Fix related to material type 120 related to FPE on selected platforms.

Fix for \*TERMINATION\_DELETED\_SHELLS

Bug fix for selective mass scaling in conjunction with 10-noded tets

Fix for \*INITIAL\_AXIAL\_FORCE\_BEAM: resultant force was too high.

Several minor bug fixes in sensors

Fix \*sensor\_define\_node when n2>0

Improvements to global search for 2d\_thermal contact

Fixed a segment based contact bug that caused the optional thickness on \*PART\_CONTACT to be ignored if shell thickness updates were active and no parts used the thickness scale factor on \*PART\_CONTACT.

Fix for \*CONTACT\_AUTOMATIC\_...\_TIEBREAK with OPTION=3 fixed in SMP - MPP was ok

Fix problem in automatic tiebreak options 8/10/11 where the mass of the slave node was being used, but was not being passed, resulting in NANs.

Bug fix for automatic tiebreak contact option 10/11 with VDC damping and negative ncpu

Fix for frictional energy calculation for auto tiebreak contact

Fix for smooth contact problem related to undefined node set.

Fix vc problem in automatic contact.

Fix for interior contact option 2

Fix for surface force transducers for segment based contact. This memory bug could have happened when not all processors have 2 surface force transducers.

Added penalty formulation for treating contact between rigid bodies and the rigid road surface.

Fix related to inconsistencies between Madymo and Is-dyna force calculations for rigid to rigid contact using a force deflection curve. Energy is now conserved.

Fix restart bug related to SPH and full deck restart.

Fix for rigid to deformable switching involving solid type 4 tetrahedron.

Fixed bug in ansys output.

Fixed bug for \*AIRBAG\_WANG\_NEFSKE/HYBRID: Negative parameter A23 with Part-ID > 9999999 was not working in single precision.

Fix. Parameters from ELEMENT\_BEAM\_SECTION were not transformed and stored correctly. Manual has to be updated, too.

Bug fix in springback compensations

Fix for \*DEFINE\_CURVE\_FUNCTION option RCF (now RCFORC)

Fix for \*PARAMETER. Allowed a -minus sign before any parameter definition, for example, -&VAR1.

Fix 2 minor include transform bugs

Fix for case including both shell and 3D EFG.

Fix for coordinate ID's related to orthotropic materials to transform to internal IDs in the keyword reader. This fix is to ensure that the dyna.str file works as intended.

Fixes related to triangular shell element coordinate system to account for invariant numbering.

Fixed MAT\_236 for shells

Fix for INCLUDE\_TRANSFORM related to material 181.

Fix for \*MAT\_ADD\_THERMAL and solid element constitutive models, e.g., type 3

Minor fix for MAT\_073 reading.

Fix for fitting of Ogden foam model due to out-of-range numbers

Fix for material 36 with hardening rule 7 (3 load curves).

Fix truncation error for \*MAT\_123

Fixed a bug in MAT\_SPOTWELD\_DAIMLERCHRYSLER when used with damage types 1 and 2. The density of the material changed to a wrong value after damage initialization.

Fix for \*MAT\_MUSCLE related to small stepsize

Bug fix for M136

Bug fix for material 187.

Fix possible bug in mat 173 principal stress direction calculation

Add option for alternative version of Mat 85 (does not affect existing models)

Fix for energy calculation in material model 122.

Minor fix for MAT\_100\_DA with DG\_TYP=3: Default for GFAD now 1.e-15 (was 0.0 before, leading to no failure at all).

Fix for mat type 172 with shell type 16

Fix for material type 61 which goes unstable for tet types 10 and 13.

Fixes for laminated shell theory (materials 22, 54, 55, 76, 114)

All materials used 2x the correct weight on the top and bottom integration points for Lobatto quadrature. For materials 76 and 114 with user defined integration, the unsorted material properties were used for calculating shear strain terms, fxi, fyi and zi1. Since the sort routine orders them top to bottom, this likely caused all the material properties to be flipped if the user input the points in the order from bottom to top. This would cause incorrect results if different properties were used in each layer unless Lobatto quadrature was used. For materials 22 and 54, and 55, the unsorted material angles were used for calculating the shear strain terms, hi1 and hi2. For orthotropic material properties, the calculated hi1 and hi2 terms were therefore incorrect unless Lobatto quadrature was used.

Fixes for thermal option related to \*LOAD\_THERMAL\_ELEMENT\_...

Fix for load\_thermal\_element option for erroneous error check leading to termination.

Fix format to tell users to check D3HSP for printed curve IDs. The curves may be internally generated in the keyword reader.

Fix related to METALF when NDOF=3.

Fix related to type 4 triangular shell and buckling.

Fix for GCEOUT file

Bug fix for AIRBAG\_SHELL\_REFERENCE\_GEOMETRY

Bug fix calculating enclosure radiation view factors for axisymmetric geometries.

Fix for spotweld option to convert subset of beam elements.

Bug fix for \*control\_forming\_template

Fix for load curve reading problem related to seatbelt shell elements.

Update for handling 1000000 load curves efficiently.

Fixed a bug in \*LOAD\_DENSITY\_DEPTH if number of parts if more than 8

Fix for \*DAMPING\_PART\_MASS related to velocity boundary conditions being affected by damping applied to deformable nodes with prescribed motion.

Fix for \*DAMPING\_GLOBAL related to nodal points that have prescribed motion. This damping changes the applied displacements from the specified values. This fix corrects this problem for the nodes of deformable bodies.

Use local rigid body accelerations for airbag pop option. Previously the global accelerations were used which is in conflict with the users manual's instructions.

Fix storage allocation for constrained\_linear with 2000+ nodes.

Bug fixed for 2D axisymmetric EFG in centering the stress point.

Fix for jumps in sliding interface energy when adaptive steps occurred.

Enabling r-adaptive load\_thermal by initializing temperature after rezoning

Fix for adaptive remeshing for ESORT=2

Fixed output of two-pass adaptivity

Fix for thick shell type 26 to properly handle offset from midsurface.  
Warping stiffness must be active.

Fix for PRESCRIBED\_ORIENTATION

Fix flexible rigid body for initialization, rigid and flexible switching.

Fix for eigenvalue problems with only solid elements and no rigid bodies.

Fix for MAT\_ARUP\_ADHESIVE in \*INCLUDE\_TRANSFORM

Fix for \*ELEMENT\_MASS\_NODE\_SET

Fixed for \*AIRBAG\_HYBRID\_CHEMKIN

Fix: Internal energy is now computed for shell type 18.

Fix bug at corners when multiple boundary conditions are used with SPH elements

Fix for file SSSTAT in restart. Also we have separated the output interval of  
\*DATABASE\_SSSTAT\_MASS\_PROPERTIES and \*DATABASE\_GLSTAT

Bug fix for ALE interface force binary plot fsifor.

A bug fix for mapping with symmetric condition

Fix for \*DEFINE\_CURVE\_FUNCTION: did not work for translational and rotational motors.

Fix to damping when IGNORE is set to 1

Fix for Brode loading and shell sets is now fixed.

Fix for format problem in DYNA.INC file related to \*LOAD\_PRESSURE\_SHELL.

Fixed type 9 beam spot weld failure. The moment term in the failure calculation may have used the wrong beam length since the wrong beam element ID was used. The 3-sheet calculation was OK. Therefore for models using 3-sheet welds, the bug may have not caused much trouble since the 3-sheet calc is used for an entire block of beam elements if any one of the beam participates in a 3-sheet weld.

Fix related to deformable to rigid switching, when the Inertia properties are specified for the merged body.

Fixed related to table lookups in CONSTRAINED\_JOINT\_GENERALIZED\_STIFFNESS.

Fix for \*CONSTRAINED\_JOINT\_TRANSLATIONAL\_MOTOR not working correctly in MPP

Fix for joints in the presence of implicit-explicit switching.

Fix for possible memory clobbering when \*RIGIDWALL\_PLANAR and \*PART\_COMPOSITE are used together

Fix in material 133 when using C-S strain rate effects with implicit

Correct Implicit handling of tied nodes with failure constraints.

Fix for rigid body coordinates for implicit to explicit switch

Fix for material 57 to correct the calculation of internal energy density which was inaccurate for the large time step sizes of the implicit solver.

Fix memory clobber for implicit solid spotwelds

Fix for Boundary Prescribed Orientation for Implicit.

Fix related to implicit nonconvergence of materials 77, 177, and 178.

Fix handling of sense switches (sw1,sw2,...) for implicit.

Fix related to implicit consistency flag (ncpu<0)

Fix for \*ELEMENT\_MASS\_PART and shells: corrected mass calculation

Fix for RBE3 with DOF's release. Problem occurred when consistency option is active.

Fixed contact for Genoa material.

Fix for non working thinning for thick shell elements and material types 2, 22, 55, and 58.

Fix for \*SET\_BEAM\_GENERAL with the ALL option to exclude phony beams for springs and dampers if BEAM is set to unity on the DATABASE\_BINARY\_D3PLOT database.

Fix I2a problem related to output of optional joint energies

Fixed problem with INCLUDE\_TRANSFORM for material model 176.

Fix for bug related to nonphysical stresses that develop soon after the calculation begins. Keyword CONSTRAINED\_SHELL\_TO\_SOLID.

Fix for MPP handling of tied thickness when specified on the contact card.

Fix for MPP "groupable" override flag in pfile, for tied interfaces

Fix for MPP output of peak pressures in intfor file: last state had all 0 for these.

Fixed MPP brick weld initialization so that it will not hang.

Fix: update orientation option for SMOOTH forming contact (MPP only)

MPP fix/change for better handling of adaptive constraints if they occur at decomposition boundaries AND they are involved in a tied interface.

Fix for RBE3 constraints for MPP Explicit.

Fix for rotations in MPP output of drdisp.sif file

Fix for MPP rigid-body compression in d3plot when used with pre-decomposition

Several MPP rigid-rigid contact:  
friction handling, force summation and surface reorientation.

Fix uninitialized variable in MPP rigid-rigid contact

MPP modifications to bucketsort for AUTO\_TIEBREAK contacts, to better handle very thick materials

Fixed a problem with solid welds. Weld failure types 7 and 8 use tied contact info to identify properties of the shells to which the welds are tied. It is possible for the tied contact to be on a different processor than the weld in which case the info cannot be found, so message passing was added to weld initialization.

Fix use of wrong variable in MPP d3part initialization.

Fix problem of MPP reopening intfor file during adaptive problems.

MPP fix for reorientation of surfaces with inconsistent normals

Fix MPP tied contact for implicit-explicit switching

Fix MPP explicit initialization for implicit joints