

# RELEASE NOTES

MSC.Dytran

Version 4.7 for UNIX

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# Introduction

MSC.Dytran is a general-purpose, three-dimensional computer program for simulating the dynamic response of solids, structures, and fluids. It combines structural and fluid mechanics technology to facilitate modeling, and uses explicit time integration to provide an efficient solution. MSC.Dytran is developed, marketed, and supported by MSC.Software.

MSC.Dytran Version 4.7 is released on Digital, HP, IBM, SGI, and SUN hardware. MSC.Dytran Version 4.7 uses FLEXlm as the licensing system for nodelock and networking licensing.

Existing users of MSC.Dytran Version 4.5 do not need to acquire a new authorization code from MSC.Software.

The installation procedure, similar to MSC.Nastran and MSC.Patran, allows an easy install of MSC.Dytran and the FLEXlm licensing system from CD ROM.





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# New Features and Enhancements

Several new features, enhancements, and error fixes in MSC.Dytran Version 4.7 augment the capabilities in areas such as structural crashworthiness and occupant safety, underwater explosions and gas dynamics.

## 1. MSC.Dytran on UNIX Workstations is Year 2000 Compliant

To ensure the viability of MSC.Dytran Version 4.7 operational integrity, security, and authorization systems on UNIX workstations as they relate to Year 2000 compliance, several tests were conducted.

The test results indicated that:

- The license for MSC.Dytran is valid to operate over a supported date range that extends from before January 1, 2000 and encompasses a time period reasonably suitable for the intended use of the product. This includes the critical moment of February 29, 2000. The license authorization is applicable to both nodelock and network licensing.
- MSC.Dytran does not perform date calculations.
- MSC.Dytran only obtains a date from the computer operating system and transfers it to print and results files.
- Date stamping data, although not four characters, is correct, valid, and will not lead to ambiguity in interpretation of data.

## 2. FLEXIm Licensing

MSC.Dytran Version 4.5 introduced the FLEXIm license manager as the license system for network and nodelock licensing.

Existing licensing problems on some UNIX platforms have all been solved and with Version 4.7 campus licensing is also supported.

Please refer to the *MSC.Dytran Installation and Operations Guide*, Version 4.7 for UNIX for detailed instructions on installing MSC.Dytran Version 4.7 and the FLEXIm licensing system.

### 3. New User's Manual

MSC.Dytran Version 4.5 came with a User's Manual Update in Appendix D of the *MSC.Dytran Version 4.5 Release Notes*, that covered all the new functionality with respect to the *MSC.Dytran Version 4.0 User's Manual*.

With MSC.Dytran Version 4.7 a new updated User's Manual will be part of the release, covering all new functionalities in MSC.Dytran since Version 4.0.

You will also see the company and product name change appearing in the release documentation. You are accustomed to the names The Macneal-Schwendler Corporation and MSC/DYTRAN, you will now see the new names MSC.Software Corporation and MSC.Dytran.

### 4. Coupling to MADYMO

- The coupling to MADYMO has been upgraded to MADYMO V5.3.
- The coupling between MSC.Dytran and MADYMO in MSC.Dytran Version 4.7 uses a direct coupling instead of using the pvm message passing system. The MSC.Dytran libraries and MADYMO libraries are linked into one executable.
- Rigid planes in MADYMO can be visualized with MSC.Dytran Version 4.7. By requesting the geometry of the planes to be written out to the MSC.Dytran archive file, the MADYMO planes are covered with dummy shell elements at each requested output step and can be visualized during postprocessing.

### 5. Initial Metric Method for Airbag Analysis

The initial configuration of an airbag can be obtained from its original shape by folding or scaling (shrinking) operations in order to make it fit into the airbag compartment. However, at the start of an airbag analysis it is always assumed that this initial configuration is undeformed (no stresses), which makes the generation of the initial mesh quite complicated.

The initial metric method inside MSC.Dytran Version 4.7 allows the use of an initial airbag model, obtained from a folding or a scaling operation, in which the strains are initialized such that the original (stressless) shape is preserved. The initial metric method uses the initial airbag configuration and the original (or design) configuration to generate the initial strains. Elements can be initialized smaller than the original state, but it is also possible that they are initialized larger.

- If an element is initialized smaller compared to its size in the original configuration, no element stresses are introduced until the original state is reached.
- Elements that are initialized larger will have a positive initial metric strain. When shrinking, there will be no stresses applied until the original state is reached.

### 6. New ATB Occupant Dummy Models

The ATB occupant dummy library in MSC.Dytran has been extended with 3 new dummy models. The existing library that included the 5%, 50% and 95% HYBRID III dummy models in SI units, has been extended with a new HYBRID II dummy model in SI units as well as in English units. The existing 50% HYBRID III model is now also available in English units.



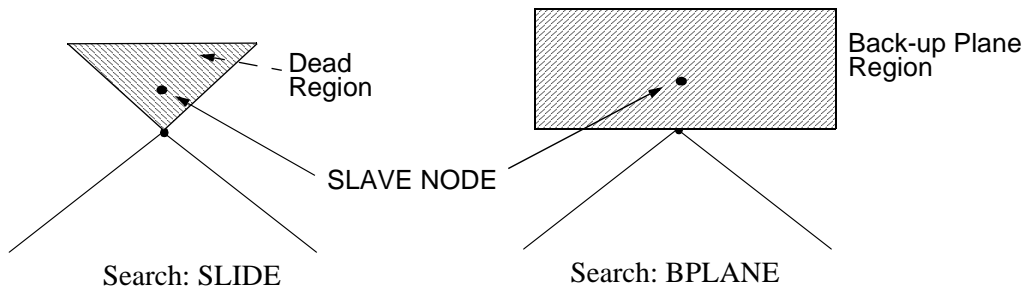
All dummy models are available as a part of the MSC.Dytran example problems, and can be found under the <install\_dir>/dytran47/Demo/EP6\_3 directory.

7. Multiple Detonation Sources for Explosives

In MSC.Dytran Version 4.5 only a single detonation point for high explosive materials could be used. In MSC.Dytran Version 4.7, the use of multiple detonation points for explosive materials has been implemented.

8. Contact Improvements

- The adaptive contact algorithm has been revised. As a result, CPU time usage for adaptive contact generation and contact analysis has been greatly reduced.
- A new search option called BPLANE has been implemented in the contact algorithm. The search option SLIDE searches for the closest master face under the assumption that a slave node will only slide from the current master face to its neighbors during one time step. This search algorithm is much faster than the FULL option. However, the FULL search option can cause problems for slave nodes that have entered the “dead-region” on the “penetrated side” between neighboring master faces, where it can not be projected on either face, and the contact is lost because of that.



The search option BPLANE alleviates the problems for slave nodes that have entered the “dead-region” by automatically creating a plane perpendicular to the folding line between two master faces. Contact for slave nodes that reside in the back-up plane area is preserved, and the nodes remain in the contact search algorithm. A force perpendicular to the BPLANE is applied to those nodes, since they are on the penetrated side of the master surface.

Because the BPLANE search algorithm is very fast, it is advisable to contact search algorithm for airbag analysis.

9. Eulerian Boundary Condition Output

In analysis involving Eulerian elements, the material state at the boundaries of the mesh can be written to an archive file for interpretation during postprocessing. Available are the mass flow, transported impulse and energy through the boundary, the velocity at the boundary and forces, and impulses acting on the Eulerian boundary.

#### 10. Eulerian Body Loading

For Eulerian materials, a body force loading has been implemented. The body force acceleration field acts on top of the gravitational acceleration field.

#### 11. Rigids

- The moments of inertia of a rigid material (MATRIG) can be defined in a local coordinate system, which is attached to the center of gravity of the MATRIG.
- A hinge connection between a rigid and a deformable Lagrangian structure (RBHINGE) has been implemented.
- An RBC3 constraint for a rigid body can be used together with a FORCE or MOMENT constraint. The FORCE or MOMENT entry can not constrain a degree of freedom that is already constrained by the RBC3 entry.

#### 12. Rigid Lagrangian Wall

Based upon the penalty method, a new rigid Lagrangian wall with friction has been implemented.

#### 13. Rigid-body Rotation Correction for the BLT Shell

For the Belytschko-Lin-Tsay shell element, a rigid-body rotation correction is now available. The rigid-body rotation correction on the hourglass forces will improve the accuracy of the analysis in problems where shell elements undergo a large rigid-body rotation.

#### 14. USA Interface

- The USA interface has been extended with a cavitation model.
- A new bubble explosion algorithm has been implemented in MSC.Dytran Version 4.7, providing more accurate results in underwater explosion analysis.

#### 15. Composites

Aside from a rectangular coordinate system, the fiber direction for a composite laminate can also be defined in a cylindrical or spherical coordinate system. The fiber direction will be in the radial direction through the center of the shell element.

# System Information

## 2.1 Software Installation

MSC.Dytran Version 4.7 easily installs from CD ROM using an installation procedure, called mscsetup. The installation procedure is described in the *MSC.Dytran Installation and Operations Guide*, Version 4.7.

MSC.Dytran Version 4.7 uses the FLEXlm license manager as the licensing system for nodelock and network licensing. To be able to run MSC.Dytran Version 4.7, you need an authorization code from MSC.Software Corporation. Existing authorization codes for MSC.Dytran Version 4.5 on UNIX workstations will continue to work with MSC.Dytran Version 4.7.

An overview of platforms supported by MSC.Dytran Version 4.7:

**Table 2-1. Supported Hardware Configurations.**

Hardware	OS	OS Level
Digital	Digital UNIX	4.0
HP	HP-UX	10.2,11.0
IBM	AIX	4.1.4
SGI	IRIX IRIX64	6.2 6.4,6.5
SUN	Solaris	2.6

For installation of the MSC.Patran-MSC.Dytran Preference, see the *MSC.Patran-MSC.Dytran Preference Guide*.

For installation of XDEXTR, the Motif V1.2-based translator program and XDYTRAN, the Motif V1.2-based user interface, see the *Installation and Operations Guide*.

## 2.2 Memory Requirements

In general, the amount of memory required by MSC.Dytran Version 4.7 depends on the size of the engineering problem. The default memory size of MSC.Dytran Version 4.7 is preset to 40 megabytes. This size is appropriately set for smaller analysis problems. However, the default MSC.Dytran executable may not be large enough to solve medium- or large-size problems. Besides the default size, MSC.Dytran Version 4.7 is delivered with two larger executables, that can be used to run medium- and large-size problems.

The executable for medium-size problems uses 90 MB of memory, and large-size problems use 160 MB. The *MSC.Dytran Installation and Operations Guide*, Version 4.7 explains how the different executable sizes can be used.

Guidelines for typical memory and disk space requirements are as follows:

**Table 2-2. Disk Space and Memory Requirements.**

	Small Models	Medium Models	Large Models
<b>Random Access Memory (RAM) per user</b>	128 MB	256 MB	512 MB
<b>Scratch Disk Space (/tmp)</b>	50 MB	100 MB	200 MB

- For all computer systems, the amount of disk space required for the installation is about 225 megabytes. Storage space is dependent upon the amount of results data that is to be saved. For extremely large problems where many variables and time steps are saved by the user, up to one gigabyte of storage space may be required. For small problems, 50 megabytes may be sufficient.
- During problem generation, MSC.Dytran uses scratch files. On IBM RS/6000 and Digital Alpha/OSF1 these temporary scratch files reside on the /tmp file system by default, which should accommodate up to 20 megabytes of scratch data. If /tmp is not large enough to hold all the scratch data, you can define another directory for the temporary scratch files. Do this by using the UNIX command:

```
setenv TMPDIR <userdir>
```

where <userdir> is a user defined directory.

## Running MSC.Dytran

The easiest way to start an MSC.Dytran analysis job interactively is to use the graphical user interface program XDYTRAN. XDYTRAN is an X11/Motif-based application for UNIX systems that can be used to launch MSC.Dytran runs, and to create customized versions of the MSC.Dytran executable. The main features of XDYTRAN are:

- Submitting MSC.Dytran jobs
- Automatic detection of RESTART statements in the input file
- Selection of ATB input files
- Killing, suspending, and forced wrap-ups of running MSC.Dytran jobs
- Customization of executables with user routines and/or modified memory allocations
- Interactive creation of the memory allocation routine `memory.f`
- Preview of output files while the program is running

For more information on how to use XDYTRAN, see Appendix A, “Using XDYTRAN,” of the *MSC.Dytran User’s Manual*.

For those machines that do not support X-Windows/Motif, or to start MSC.Dytran as a batch job, the run script `dytran` can be used. The use of this run script is described in Section 2.5 of the *MSC.Dytran User’s Manual Version 4.7*.



## MSC.Dytran Translator

The program XDEXTR translates information stored in archive and time history files produced by MSC.Dytran to MSC.XL and MSC.Patran 2.5 import-file format, as well as import-file formats for I-DEAS and FEMB.

XDEXTR is an X-Windows/Motif-based application that allows the user to translate the archive and time history files using a graphical user interface. For those machines that do not support X-Windows/Motif, or for remote machines where the graphical user interface imposes significant network overhead, XDEXTR can also be used without a graphical user interface. In that mode, XDEXTR can be driven by a translation description file (TDF) and run as a batch process. This capability provides the same functionality as the obsolete DEXTR program. See Appendix B of the *MSC.Dytran User's Manual* for more information about the use of XDEXTR.

XDEXTR allows the user to select variable, entity, and cycle results for translation. Only the entity results for the variables in the selected cycle will be translated. The translator programs allow for the definition of value-based filters for variables stored on the archive and/or time history files.

XDEXTR can be run as often as necessary as long as the MSC.Dytran archive or time history still exists. Since the import files produced by XDEXTR are in text format, they can be used to transfer data from one computer to another even if they are of different types. XDEXTR can therefore be run on one machine, and the import files can be moved to another machine for postprocessing with MSC.XL, MSC.Patran 2.5, or another third-party application package.





# MSC.Dytran and Parallel Processing

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## 5.1 Shared Memory Parallel

Since MSC.Dytran calculations can use a large amount of time and computing resources, optimization is an important part of the development of MSC.Dytran. One such optimization effort is in the area of parallel processing, which attempts to speed up a calculation by harnessing the combined power of a computer with several CPUs.

MSC.Dytran will run certain kinds of calculations in parallel, if the right kind of hardware is available, and if you request it to do so. Shared memory parallelism has been built into MSC.Dytran for shared memory parallel configurations SGI with R8000 and R10000 multiple processors.

If you are running on SGI machines that supports shared-memory parallel operations, calculation on the following element types will run in parallel on the number of CPUs requested on the PARAM,PARALLEL entry:

- Belytschko-Lin-Tsay (BLT) quad shells
- Hughes-Liu quad shells
- Key-Hoff quad shells

### The Parallel Execution Report

After completion of a job, a report may be written about the actual and potential distribution of work among the concurrent processes. This will show information such as the fraction of work executed on a particular number of processors. Note that for different runs this report may show different work distribution, caused by differences in overall load of the system.

To write out the parallel execution report, include an entry `PARAM,PARALLEL,INFPAR,ON` in your input data file. At this moment, the parallelization information option is available for the quad shells solvers only.

---

## 5.2 Distributed Memory Parallel

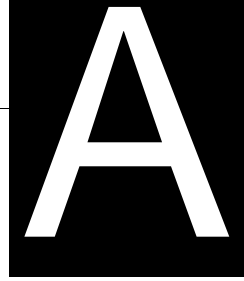
Distributed memory parallel computing is not supported by MSC.Dytran Version 4.7.

# Documentation

The following documentation is provided with MSC.Dytran Version 4.7:

- *MSC.Dytran User's Manual*, Version 4.7.
- *MSC.Dytran Installation and Operations Guide*, Version 4.7 for UNIX.
- *MSC.Dytran Release Notes*, Version 4.7 for UNIX.
- *MSC.Dytran Example Problem Manual*, Version 3.0.





## List of Fixed CSRs

### Licensing

- Existing licensing problems on some UNIX platforms have all been solved and with MSC.Dytran Version 4.7 campus licensing is also supported.

### Euler

- The multimaterial transport algorithm has been improved. An improved handling of the transport of voids provides a more robust multimaterial analysis. Asymmetric results for symmetric problems no longer occur.
- When a restart is made of an analysis that involves multimaterial Euler with shear strength, the information in the output file about the Eulerian element type is printed out as multimaterial Euler hydrodynamic. This is only a print error, and the analysis is not affected.

### Contact

- In many cases, simultaneous use of coupling and contact leads to the use of incorrect friction coefficients.
- When a contact definition with SEARCH = FULL is used in combination with a CONTINI initialization, a core dump is the result. The CONTINI logic is not suited to work in combination with the SEARCH = FULL option. A new error message is implemented to avoid the core dump.

### Composites

- The output variables Q1 and Q2 are not stored for composite shells. The values remain zero.
- When you reference a coordinate system on the CQUAD4 entry to define the fiber direction of a composite laminate, MSC.Dytran assumes that you are using a rectangular coordinate system. If a nonrectangular coordinate system is used, no error message is displayed and the analysis provides unpredictable results.

### USA

- When a (U)nderwater (S)hock (A)nalysis surface is attached to a rigid, a core dump is the result. A new error message prevents the use of dummy shell elements in a USA analysis and the core dump is prevented.

### Rigid Bodies

- A combination of more than one FORCE and MOMENT entry for a rigid body is not merged correctly.
- In case an incorrect rigid ID is given in the rigid body output definition an MSC.Dytran analysis core dump results. An new error message will warn the user and prevent the core dump.
- Only one RBC3 entry can be applied on a RIGID. This error has been fixed and the RIGID behaves now similarly to a MATRIG.

### Shell Elements

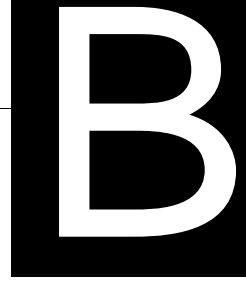
- The failure flag for QUAD shell elements is based on a time step smaller than 1. When using different unit systems, this criterion can lead to erroneous results.

### Output Requests

- The burn fraction FBURN in Eulerian analysis is not available for output.
- Output request for SURFACE gives incorrect results when a coupling surface is used in combination with QUAD or TRIA elements.

### Miscellaneous

- A breakable connection (BJOIN) or spotweld connection (SPOTWELD) can not be used in combination with a kinematic join (KJOIN).
- The initial velocity generation for grid points consistent with a rotational field (TIC2) is incorrect when beam elements are used in combination with QUAD shell elements or Lagrangian solids.
- In many cases, the use of CTETRA or CPENTA element faces for rigid body definition leads to an incorrect face area calculation.
- Improved error message in case double entities are used in MSC.Dytran.



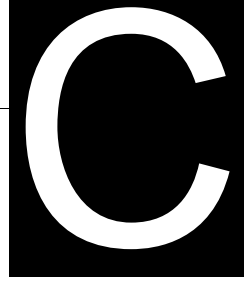
## Current Limitations

- The interface to USA is not supported on CRAY and CONVEX.
- Distributed memory parallel computing is not available in MSC.Dytran Version 4.7.
- The memory usage summary is not fully accurate. Keep safe margins in tailoring your memory.f routine.
- Shell sublayer variables can not be initialized using a TICEL or TICEEX entry. Only element variables can be initialized by a TICEL or TICEEX entry.
- It is not possible to use both multimaterial Eulerian elements and hydrodynamic Eulerian elements in the same calculation, even if the Eulerian regions are disconnected.
- For user-defined access to shell element sublayer variables, at least one element sublayer variable must be saved in an archive or time history file.
- ALE can only be used in conjunction with a hydrodynamic single material Euler formulation or with a multimaterial Euler formulation.
- The symmetric option on composite laminates is not available.
- There can be at most 15 Eulerian elements connected to a Eulerian grid point.
- There is a maximum of 127 continuation lines in the MSC.Dytran input file.
- Eulerian-Lagrangian coupling surfaces do not include friction.
- A Eulerian-Lagrangian coupling surface must not initially lie completely outside the Eulerian mesh.
- An Eulerian mesh must contain at least one nonvoid material somewhere in the mesh.
- The multimaterial Eulerian formulation can include no more than five materials in one element simultaneously.
- For multiple BJOINS, boundary conditions can only be applied to the master node.

- Miscellaneous limits:

Item	Limit
Open Files	100
Generic File Names	20
Grid Point Constraints	2047
Rigid Constants	127
Surfaces	127
Subsurfaces	1024
Surface Constraints	256
Rigid Ellipsoids	127
Join Sets	127





## Current Error List

- PROD and PCOMP definitions should have different Property Numbers (PIDs).
- When defining your own variables, each name defined should be unique (see PARAM,EXTRAS).
- It is advisable not to use the subcycling (structural) in combination with the adaptive contact. At activation of contact faces, the newly generated contact surface is penetrated and may not be detected.
- The element time step as used in certain failure models is the currently used element time step and not the individual stable time step. The failure criterion is such that the first criterion must be satisfied before the time step can cause total failure. Do NOT use the time step as a criterion on its own for total element failure in a user-defined failure model as FAILEX1.
- In cases where a high rotational velocity occurs, either through initial conditions, boundary conditions or due to local effects, the stable time step computed according to the CFL condition (based on linear problems) may be too large. It can give rise to local instabilities. Especially in problems where subcycling is used, this can show up prominently due to the spreading in the magnitude of the time steps used to continue the solution.
- The ALE interface cannot be deactivated using the ACTIVE entry.

Workaround: The Eulerian processor can be deactivated, causing the FSI to be deactivated as well.

- Gravity on rigid bodies is applied differently at time step zero compared to later time steps:

Time step zero: Gravity is applied directly to the center of gravity of the rigid body.

Later time steps: Gravity is applied to the grid points belonging to the rigid body.

- On the CBEAM entry, MSC.Nastran assumes that the value for X1/X2/X3 = 0.0 if they are not defined. MSC.Dytran requires input.

Workaround: Fill in zeros.

- For the gas bag option (GBAG), the volume and pressure inside a gas bag are not updated if the mass flow is not defined.

Workaround: Specify a mass flow equal to zero.

- The damping entry `PARAM,VDAMP,0.0` on restart gives an error message.

Workaround: Use `VISCDMP` to turn damping on and off.

- The contribution of the rotational velocities on beam grid points to the kinetic energy is not taken into account.
- If the `CONTREL` refers to a `SET1` ID that does not exist, there is no User Warning Message supplied. The `CONTREL` definition will not appear in the problem setup.
- When `TICGP` is accidentally given on rigid body nodes, a warning is normally issued from subroutine `P3036502_V3_CHECK_RIGID_PNT_AND_RBOUND`, for possible incorrect results. Sometimes this warning message is not given, which causes erroneous results. In fact, the warning should be a fatal message.
- When breakable joins (`BJOIN`) are used together with ALE-Euler:

For `BJOIN` without offset: `XDIS,YDIS,ZDIS` of grid points is not correct.

For `BJOIN` with offset: `BJOIN` does not work properly.

- Deactivated variables can be requested for editing, but will not contain any data. If you wish to use the variable (e.g., in a user subroutine), be sure that it gets activated with a `PARAM,VARACTIV` entry in the input file.
- The following error message is not correct:

```
%P3028706-P3_INITIALIZE_STANDARD_MULTYP
'A grid point has moment of inertia equal to zero'
```

In reality it is a zero mass.

It does not specify which grid point. In a large mesh this makes it difficult to find the grid point.

The error seems to be the same for normal `JOIN` through `JOIN` cards, as well as for “Multiple-Join” by means of common grid points *not* explicitly connected by `JOIN`. This makes it difficult to locate the type of input data to use as a starting point to find a modeling mistake.

- The `PARAM,GEOCHECK` entry may reverse the surface vector of a `CONTACT` surface when it makes connectivity corrections for `CHEXA` elements, and the contact surface segments are on the `HEXA` faces.
- In an analysis where coupling and contact are used together, the friction coefficients defined for different contact surfaces can become confused.

Workaround: Define `COUPLE` first and use the same friction coefficient for all surfaces.

- MSC.Dytran does not give the correct output for centroidal strains for DMAT or DMATEL materials. A very high value is given.
- A  $4 \times 4$  Gauss integration for the Hughes-Liu beam with a tube section does not work; only a  $3 \times 3$  integration works.
- Mass scaling (PARAM,SCALEMAS) does not work for membrane elements.

