MSC.Dytran® 2005

Release Guide
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MSC.Dytran 2005 Release Guide

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MSC.Dytran® 2005 is the most significant and comprehensive version of MSC.Dytran released by MSC.Software. 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.

Many major enhancements have been incorporated into this release:

- Additional structural capabilities are available in MSC.Dytran LS-DYNA, which can be used to run simulations in Distributed Memory Parallel (DMP) on a cluster. This capability is now available on Windows, Unix, and Linux. The job-submission and monitoring on Windows have been significantly improved to
provide ease-of-use and enhance capabilities and robustness. Among other features, it now supports complete user-name and password control within the Explorer GUI.

See Chapter 2: MSC.Dytran LS-DYNA for complete details.

• The unique “Adaptive Multiple Eulerian Domains” technology has been extended to support the multi-material Eulerian solvers. The materials can be either hydrodynamic or have shear strength. In addition, the Multi-Material Eulerian solvers have been dramatically improved for robustness and accuracy.

MSC.Dytran 2005 advanced Eulerian technology provides unprecedented capabilities for complex fluid-structure interaction applications such as bird strike with multiple impacts, blast resistance and survivability, fuel tank filling, fuel tank sloshing, fuel tank crush with ruptures and spill out, UNDEX, ship explosion events involving severe damage and water penetration inside the compartment and many others. In addition, the Ignition & Growth explosive material model is now fully supported in the Adaptive Multi-Material Eulerian solver.

Four new Fluid Structure Interaction (FSI) examples have been added to the MSC. Dytran Example Problem Manual (see Contents to find a specific example), demonstrating the latest modeling techniques:

• 4.9 – Multiple Bird-Strike on a Box Structure
• 4.10 – Shaped Charge, using IG Explosive Model, Penetrating two thick plates
• 4.11 – Fuel Tank Filling
• 4.12 – Water Pouring into a Glass

See Chapter 3: Airbags (OOP) and General FSI for more details and images of the examples.

Many minor enhancements and bug-fixes were completed in MSC.Dytran 2005 to improve the quality and robustness of the solution. Please see Chapter 4: Robustness, Speed, Ease of Use, and Accuracy for a detailed list of these enhancements.

Chapter 5: System Information includes the supported platforms and operating systems for MSC.Dytran 2005, and Chapter 6: Using MSC.Dytran provides the basic information for job submittal and results post-processing.

We have added many new articles related to MSC.Dytran and MSC.Dytran LS-DYNA. Please visit our searchable Knowledge Base at: http://support.mscsoftware.com/kb. For example, the following article provides in depth information about potential MPI issues on Windows:

With the release of MSC.Dytran 2005, the MSC.Dytran LS-DYNA module is now supported on all major UNIX, Linux and Windows platforms. MSC.Dytran LS-DYNA offers structural solutions on a single or on multiple processors in a Distributed Memory Parallel (DMP) mode based on the LS-DYNA solver.

The new licensing will not require MSC.Dytran as a pre-requisite to MSC.Dytran LS-DYNA module, either on single or multiple processors. In other words, MSC.Dytran LS-DYNA module can now be utilized as a separate and “standalone” solution from MSC.Dytran.

On Windows, the MSC.Dytran Explorer tool has been enhanced to provide more control over the MPI based job-submission of MSC.Dytran LS-DYNA simulations. It now provides job status monitoring, user account and password passing options, queuing of MSC.Dytran LS-DYNA jobs, and logging of events for cluster/MPI debug purposes. Complete details are provided in Chapter 6: Using MSC.Dytran.

To obtain additional time history data in ASCII format, a utility called dumpbdb.exe is required. The utility can be found in the MSC.Dytran installation directory:

```
<Installation_Directory>\ bin\exe\dumpbdb.exe
```

The instructions to use the utility can be found in Chapter 8: Output Requests of the MSC.Dytran LS-DYNA User’s Guide.
MSC.Dytran LS-DYNA has been extensively improved to support many new elements and constraints including spot welds, thick shells, rigid joints and more than 36 additional material models:

- **Thick Shells** for modeling thin solid structures. The input options are:
  - **CTQUAD** Connectivity of a quadrilateral thick shell element
  - **CTTRIA** Connectivity of a triangular thick shell element
  - **PTSHELL** Property definition for thick shell elements

- **DMATOR** – added to support tire impact modeling

- **FFCONTR** – modeling a fluid filled container using an average pressure technique. Important for top-load analysis of bottles.

- Additional method for contact definition, consistent with MSC.Nastran SOL 700:
  - **BCONTACT** case control option to activate contact definitions in BULK DATA
  - **BCBODY** contact body
  - **BCBOX** contact region defined by a box
  - **BCHANGE** change definition of a contact body
  - **BCMATL** contact body defined by material IDs
  - **BCPROP** contact body defined by property IDs
  - **BCTABLE** contact table to specify which bodies are in contact
  - **BSURF** contact body defined by element IDs

- Additional spot weld definitions, consistent with MSC.Nastran SOL 700:
  - **CSPOT** Spot Weld with failure
  - **CFILLET** Filled Weld with failure
  - **CBUTT** Butt Weld with failure
  - **CCRSFIL** Cross-Fillet Weld with failure
  - **COMBWLD** Combined (multiple type) Weld with failure

- Additional dynamic relaxation entry, consistent with MSC.Nastran SOL 700:
  - **DAMPGBL**

- Additional rigid body joints & motors, consistent with MSC.Nastran SOL 700:
  - **RBJSTIFF**
  - **RBJJOINT**

- Additional materials, consistent with MSC.Nastran SOL 700:
  - **MATD001** isotropic elastic
  - **MATD2OR** orthotropic elastic
  - **MATD2AN** anisotropic elastic
  - **MATD003** plastic kinematic
  - **MATD005** soil and foam
  - **MATD006** viscoelastic
  - **MATD007** Blatz-Ko rubber
• MATD012 isotropic elastic plastic
• MATD013 isotropic elastic with failure
• MATD014 soil and foam with failure
• MATD015 Johnson-Cook
• MATD018 power law plasticity
• MATD019 strain rate dependent plasticity
• MATD020 rigid
• MATD20M merging of rigid materials MATD020
• MATD022 composite with damage
• MATD024 piecewise linear plasticity
• MATD026 honeycomb
• MATD027 Mooney-Rivlin rubber
• MATD028 resultant plasticity
• MATD030 shape memory
• MATD031 frazer nash rubber
• MATD054 enhanced composite damage
• MATD055 enhanced composite damage
• MATD057 low density foam
• MATD059 composite failure
• MATD062 viscous foam
• MATD063 crushable foam
• MATD064 rate sensitive powerlaw plasticity
• MATD077 hyperelastic or Ogden rubber
• MATD080 Ramberg-Osgood
• MATD081 plasticity with damage
• MATD082 plasticity with damage
• MATD100 spotweld with failure
• MATD127 arruda boyce rubber
• MATD181 simplified rubber

• Additional constraints, consistent with MSC.Nastran SOL 700:
  • MPC Multipoint Constraint
  • RBE3, RBE3D Interpolation Constraint Element
Chapter 2: MSC.Dytran LS-DYNA

- **New Parameters to control the solution**
  - **DYLDKND** Interpreting stress-strain curves
  - **DYCOWPRD** Interpreting D in Cowper Symonds strain rate equation
  - **DYCOWPRP** Interpreting P in Cowper Symonds strain rate equation
  - **DYBULKL** Linear coefficient in bulk viscosity equation
  - **DYINISTEP** Alternative for specifying initial timestep
  - **DYCONSLSFAC** Scale factor for contact forces
  - **DYCONRWPNAL** Scale factor for penalties for rigid bodies penetrating a rigid wall
  - **DYCONPENOPT** Penalty stiffness value options
  - **DYCONTHKCHG** Shell thickness change in contact option
  - **DYCONENMASS** Treatment of mass of eroded grids in adaptive contact
  - **DYCONECODT** Time step size override for eroding contact
  - **DYCONIGNORE** Treatment of first penetrations during contact
  - **DYCONSKIPRWG** Display options for stationary rigid wall
  - **DYHRGIHQ** Hourglass viscosity type
  - **DYHRGQH** Hourglass viscosity coefficient QH
  - **DYENERGYHGEN** Hourglass energy calculation option
  - **DYTERMNENDMASS** Wrap up condition for mass scaled simulations
  - **DYTSTEPERODE** Behavior when minimum time step is reached (stop or erode)
  - **DYTSTEPDT2MS** Time step for mass scaled solutions
  - **DYMAXSTEP** Maximum time step
  - **DYMINSTEP** Minimum time step
  - **DYSHHELLFORM** Default shell formulation
  - **DYSHTHICK** Thickness change due to membrane straining
  - **DYSHNIP** Default number of integration points thru thickness for shells
  - **DYSTEPFCTL** Alternative method to define time step safety factor
  - **DYBEAMIP** Number of beam integration points for output
  - **DYMAXINT** Number of shell integration points written to the binary database
  - **DYNEIPS** Number of additional integration point history variables written to the binary database for both shell and thick shell elements for each integration point
  - **DYNINTSL** Number of solid element integration points written to the database
  - **DYNEIPH** Number of additional integration point history variables written to the binary database for solid elements
  - **DYSTRFLG** Set to 1 to dump strain tensors for solid, shell and thick shell
  - **DYSIGFLG** Flag for including shell stress tensor in the database
  - **DYEPSFLG** Flag for including shell effective plastic strain in the database
  - **DYRLTFLG** Flag for including shell stress resultants in the database
• **DYENGFLG**  Flag for including shell internal energy and thickness in the database

• **DYCMPFLG**  Orthotropic and anisotropic material stress and strain output in local material coordinate system for solids, shells and thick shells

• **DYIEVERP**  Every plot state for d3plot database is written to a separate file

• **DYDCOMP**  Data compression to eliminate rigid body data

• **DYSHGE**  Output shell hourglass energy

• **DYSTSSZ**  Output shell element time step, mass, or added mass

• **DYN3THDT**  Material energy written option for D3THDT database

**Figure 2-1**  Calculation of WTC impact performed with MSC.Dytran LS-DYNA
Many new powerful features have been introduced in this release, resulting in higher degrees of robustness, performance and ease-of-use. A major emphasis in MSC.Dytran 2005 release has been enhanced capabilities and robustness of the Multi-Material Eulerian Solver which will offer a unique and unprecedented technology to solve complex FSI applications such as the examples shown below. With MSC.Dytran 2005, simulating these new and complex FSI applications become a reality while existing applications can be predicted with much more fidelity.
Multiple Adaptive Eulerian Domains for Multi-Material Eulerian Solver

Multiple Eulerian domains are automatically generated around a coupling surface, and each Eulerian domain automatically adapts itself when the coupling surface moves and deforms. The coupling surface can represent any structure, from a simple plate to a complicated jet engine modeled with hundreds of thousands of elements.

This capability has been extended for the multi-material Eulerian solver to include HYDRO, MMHYDRO, and MMSTREN. The Eulerian material(s) can be either hydrodynamic or have shear strength.

Material in- and out-flow can be defined, as well as flow between the Eulerian domains, across porous or open areas in the coupling surfaces.

When the structure fails, the Eulerian material will start to flow through the holes, failed surfaces and ruptured areas.

Robustness of the Multi-Material Eulerian Solver

A study was performed to investigate the robustness of the Multi-Material Eulerian Solver by using large customer models that were provided to the MSC.Dytran development team as well as a smaller set of test models that were developed specifically for this purpose. The models included:

![Airplane Water Landing](image)

Courtesy: Image by CEVEnsight

**Figure 3-1a** Simulation Using Multi-Material Eulerian Solver of MSC.Dytran 2005
Chapter 3: Eulerian & Fluid-Structure Interaction (FSI)

**Water Impact with Failing Bottom Structure**

**Figure 3-1b**  Simulation Using Multi-Material Eulerian Solver of MSC.Dytran 2005

**Bird Impact and Penetration through a Sequence of Shell Structures, such as a Wing Box**

**Figure 3-1c**  Simulation Using Multi-Material Eulerian Solver of MSC.Dytran 2005
Shaped Change Formation and Penetration through Thick Places Using IG Explosive Model (see MSC.Dytran Example Problem Manual)

**Figure 3-1d** Simulation Using Multi-Material Eulerian Solver of MSC.Dytran 2005

Fuel Tank Filling (see MSC.Dytran Example Problem Manual)

**Figure 3-1e** Simulation Using Multi-Material Eulerian Solver of MSC.Dytran 2005
Fuel Tank Crush

Figure 3-1f  Simulation Using Multi-Material Eulerian Solver of MSC.Dytran 2005

Pouring of Fluid from a Bottle into a Container or Cup
(see MSC.Dytran Example Problem Manual)

Figure 3-1g  Simulation Using Multi-Material Eulerian Solver of MSC.Dytran 2005
Hydrodynamic RAM and Underwater Explosion (UNDEX)

Figure 3-1h  Simulation Using Multi-Material Eulerian Solver of MSC.Dytran 2005

Bird Strike on a Sequence of Thin Blades

Figure 3-1i  Simulation Using Multi-Material Eulerian Solver of MSC.Dytran 2005

All the above models now run successfully until completion with identical cross-platform results.
**Ignition Growth (IG) Equation of State for Multi-Material Eulerian Solver**

The Ignition Growth equation of state has been fully implemented in the multi-material Eulerian Solver. The limitation that only one material can be used has been removed, and it works in combination with the multiple adaptive Eulerian domains.

The IG material model can work in combination with COUPLE and void. The advantage of the IG model over the conventional JWL equation of state is given by the fact that details of the onset and growth of an explosive detonation wave can be accurately calculated. For example, the IG Model can predict if a compression wave will build up to a detonation wave and whether or not such a detonation wave can extinguish at a later point in time. In conventional JWL modeling, assumptions have to be made about the detonation to actually occur and then proceed with a constant detonation speed.

IG calculations are significant in modeling and understanding the detailed material behavior for blast applications. Furthermore, the uncertainty on detonation build-up is important in calculations of ‘sympathetic’ detonations, i.e. safety issues where unintended impact loads on potentially explosive materials may actually develop detonation characteristics.

Apart from the QA models developed during the implementation into the previous release, the IG material model has been verified on several customer models in addition to the Shaped Charge simulation example as described in the *MSC.Dytran Example Problem Manual*.

**EXFLOW for Roe Solver**

The EXFLOW user subroutine has been activated for the 2nd Order Roe Solver.
In this chapter, some details are given on the QA metrics of MSC.Dytran 2005, and how the enhancements affect the overall robustness, speed, ease of use, and accuracy.

**Quality and Robustness**

The robustness of this release is quantified by a cross-platform quality metric. The QA for MSC.Dytran 2005 contains a set of 531 input decks. The binary result files (ARC and THS) are compared to a reference result, which is identical for each platform. By using the same reference result for each platform, a consistent cross-platform behavior is ensured. The quality metric for this release was reached at:

98+ % success rate for every QA model (531) on every release machine (See Table 1)
The few models that did not pass the QA comparison ran properly till the end-time, but there were insignificant differences in results. These differences were within bounds and acceptable “hardware-noise” levels due to numerical round-offs when running the models cross-platform.

**Performance**

**Single CPU (MSC.Dytran)**

MSC.Dytran 2005 performance on single processor was evaluated on all the supported platforms and is comparable to the previous release, MSC.Dytran 2004. Please refer to the table below.

| Table 4-1 | Performance of MSC.Dytran 2004 and 2005 on Single Processor |

For the multi-material Euler simulations, we have added new capabilities that can dramatically improve the CPU time with respect to previous releases. The adaptive multiple Euler domains allows optimization of element size and minimizes required number of elements.

Furthermore, due to increased stability of the Multi-Material Eulerian solver, it will not be uncommon to see a job runs much faster than previous releases due to a larger time-step. Certain examples have shown a speedup of 5x.

**SMP (MSC.Dytran)**

Regular MSC.Dytran supports Shared Memory Parallel (SMP) on multi-cpu hardware. The percentage of functionality that runs in SMP mode has been increased with respect to the previous release (see Tables 4-2 and 4-3). Most notable is the addition of the C0-TRIA elements, whose data structure was re-written to support SMP and to be able to share material routines with the quad shell elements.
Table 4-2 Performance of MSC.Dytran 2005 on Single and Dual Processors

Table 4-3 Performance Comparison Between MSC.Dytran 2004 and 2005 on Dual Processors

DMP (MSC.Dytran LS-DYNA)

With this release the Distributed Memory Parallel (DMP) option becomes available on the Unix and Linux platforms as well as Windows. It is applicable to structural models only. A typical simulation that can be performed with the DMP option is Bottle Top-Load of a partially filled bottle, where the fluid is modeled using the FFCONTR entry. Typical speedup performance is given in Figure 4-1.

MSC.Dytran 2004 - 1 CPU: 5.85h CPU time
MSC.Dytran LS-DYNA 2005 - 2 CPUs: 1.24h CPU time

Speedup = 4.72x

Figure 4-1 Typical Bottle Top-load Analysis Speedup Using MSC.Dytran LS-DYNA 2005
Ease of Use

The MSC.Dytran preference of MSC.Patran 2005 supports all the new functionality released with MSC.Dytran 2005, except for new features mentioned in Chapter 2: MSC.Dytran LS-DYNA that are specific to MSC.Dytran LS-DYNA.

The modeling effort of multi-material Eulerian problems can be decreased significantly by using the multiple adaptive Euler domains. The multiple adaptive Eulerian domains are generated automatically and eliminate the manual creation of Multi-Material Eulerian meshes. In addition, this technology will ensure that moving structures or deformed coupling surfaces are always residing within the boundary of the generated Eulerian domains. This will help to accurately predict the minute details of the physics which will occur as the model goes through severe deformation. In the areas where Eulerian elements are no longer needed, they’ll be removed to substantially reduce the memory requirements.

By using multiple Eulerian domains one can also model thin structures as coupling surfaces, thus eliminating the need to artificially thickening the structure to match the underlying Eulerian element size. Good examples are bird-strike on blades modeled with shell elements, and the fill & vent tubes of a fuel tank. See the examples in Chapter 3: Airbags (OOP) and General FSI.

Accuracy

Several enhancements were made that dramatically increase the accuracy of the solution.

1. Polpack based porosity for multi-material Euler
2. Ignition Growth Equation of State for multi-material Euler
3. Re-write and algorithmic changes to the multi-material Euler solver

Enhancements for Quality, Robustness, Speed, Ease of Use, and Accuracy

The enhancements listed are implemented to make several customer applications run with higher degrees of robustness, fidelity, automation and performance. Whenever appropriate, the Quality # is mentioned. This Quality # can be used for future reference and for searching in the web-based Knowledge Base: http://support.mscsoftware.com/kb

In total, 43 qualities have been closed by means of enhancements to MSC.Dytran 2005. At the print time for this document, there were 10 error reports and 31 enhancement requests outstanding.

• /3GB Boot Option for Windows XP

MSC.Dytran 2005 supports the /3GB boot option for Windows XP. This means that the MSC.Dytran solver is able to allocate a total of 3GB of memory. To be able to use this kind of memory you will have to choose a “Customized” executable. The 3GB executables can be found in the MSC.Dytran Installation directory.

- For a single CPU run, please use the executable dytran.3GB.exe in the dytranexe directory.
- For a multi CPU run (shared memory parallel), please run the executable dytran.3GB.exe in the DY-mp directory.
- This option is not yet available for the MSC.Dytran LS-DYNA executable(s).
For more information about enabling the 3GB option on Windows XP, please refer to:

http://www.microsoft.com/whdc/system/platform/server/PAE/PAEmem.mspx

Basically, you need to add /3GB to the boot.ini file and then reboot. The boot.ini file is typically found in c:/

For example, the boot.ini line can look like:

```
multi(0)disk(0)rdisk(0)partition(2)\WINDOWS="Microsoft Windows XP Professional" /fastdetect /3GB
```

**Note:** If you do not see the file, you have to go to your directory browser:

Tools -> Folder Options... => View -> Files and Folders ->
deselect the option:

“Hide protected operating system files”

**• 64 bit Linux Version**

The 64 bit Linux version is not limited to 2 GB of maximum memory.

MSC.Dytran 2005 comes in two Linux flavors (See Table 4-1. Supported Hardware):

- 32 bit, released on RedHat 7.3
- 64 bit: release on “RedHat advanced server 2.1”

The Linux versions will run on any hardware that uses these OS levels.

**• Ths2Txt: Utility for Translating THS to ASCII Format**

With MSC.Dytran 2004, the XDEXTR program was discontinued. One of the most used features was the ability to translate a binary timehistory file (THS) into ASCII format. This functionality is now available again within a new utility, called Ths2Txt.

It works as follows:

- Type the command:  
  `% Ths2Txt.exe <filename>.THS`
- This will result in one file per variable, with names: ascii_<varname>.txt
- These ASCII files have two columns: problem time and var value

As with all other utilities, the program can be found in the Installation Directory:

  `<Installation_Directory>\ bin\exe\Ths2Txt.exe`

**• Name Change for ALL Common Blocks – Important Notice for User Subroutines**

All common block names in MSC.Dytran 2005 have been modified to include a prefix: **MSCD_**

This update was required to avoid conflicts between the MSC.Dytran and LS-DYNA source code.

    For example: COMMON /XYZ/
    Now reads: COMMON /MSCD_XYZ/

User subroutines with common blocks from MSC.Dytran need to be updated.
• **Remove Limit on Number of TIC Options**  
  Quality 1-16208506  
  The limitation on the number of TIC options (500) has been removed.  
  There is no limit anymore in MSC.Dytran 2005.

• **Rigid Element seems to Determine the Time Step.**  
  Quality 1-16327901  
  When solid elements are referring to both non-rigid and rigid material and the minimum time step is determined by one of these solid elements, then the element ID in the `.OUT` file may refer to the wrong element. It might result in a situation that the `.OUT` file shows that a rigid element is determining the time step.  
  This is only a problem with the `.OUT` file. The minimum time step is correctly calculated, and the result of the simulation is correct.  
  This problem is fixed in MSC.Dytran 2005.

• **PSPR1 must start at (0.,0.)**  
  Quality 1-16208503  
  In MSC.Dytran 2004, it was not possible to define the table in `PSPR1` starting with any values but (0.,0.) This was a limitation that was introduced during the implementation of the hysteresis logic, and has been fixed in MSC.Dytran 2005.

• **WALL not on Restart File**  
  Quality 1-15943601  
  The `WALL` entries were not written to the restart file.  
  This problem is fixed in MSC.Dytran 2005.

• **Grounded Spring Requires Specification of G2,C2 = 0,0**  
  Quality 1-15786101  
  A flaw in Dytran input reader required the specification of 0,0 for G2,C2 when defining a grounded spring.  
  
  This worked: `CELAS1 ,6992,6,1,1,0,0`  
  This did not work: `CELAS1 ,6992,6,1,1`  
  This problem is fixed in MSC.Dytran 2005.

• **RFORCE was not available for Linear Tetrahedron Element (Element Type 14)**  
  Quality 1-15032801  
  The `RFORCE` option was not active for the new tetrahedron element introduced with MSC.Dytran 2004.  
  This problem is fixed in MSC.Dytran 2005.
• **TICEUL Initialization of Euler Material Using a BOX**  
  Quality 1-16468001  
  
  The **TICEUL** option can reference primitive shapes to initialize material inside an Euler mesh. Apart from the existing CYLINDER and SPHERE, a third option has been added: a BOX.

  This enhancement is available in MSC.Dytran 2005

• **VID Parameter of a SURF Entry in TICEUL Option does not work**  
  Quality 1-16468004  
  
  Problem Description: The **VID** parameter of a **SURF** entry in a **TICEUL** option does not fulfill its role. One can use a different **VID** on the **MATINI** option, and it still works.

  Resolution: This was identified as a bug in the code. In the upcoming release, this has been fixed. It is now required to refer from **TICEUL** to **MATINI** and from **MATINI** to **SURFACE**. In the previous MSC.Dytran 2002 version, the reference was made directly from **TICEUL** to **SURF**. In the current version, if the **SURF** entry is directly referenced, it will cause an error message:

  %E-P1006101-NAS_GET_LINK_FROM_LIST,,,  
  INPUT DECK: ticeul2.dat  
  LINE #25685: SURF,1,1,3,2,,,  
  MESSAGE : Failure to locate link number  
    Type = MATINI  
    Id number = 1  

  This problem is fixed in MSC.Dytran 2005

• **MSC.Dytran Explorer's Online Help Closes When You Close Notepad or WordPad**  
  Quality 1-8062803  
  
  The online help from MSC.Dytran Explorer gets closed when a session of Notepad or Wordpad is closed.

  This problem is fixed in MSC.Dytran 2005

• **Improve Error Messages & Warnings**  
  
  Several unclear error messages and warnings are re-written.
Software Installation

On the Windows platforms, MSC.Dytran 2005 can easily be installed from CD-ROM as it uses the standard Windows 2000 Installation Wizard. On Unix and Linux platforms, the MSC.Software standard installation script can be used to install the software on your system. MSC.Dytran 2005 is the successor of MSC.Dytran 2004.
Licensing

MSC.Dytran uses the FLEXlm license manager as the licensing system for nodelock and network licensing. To run MSC.Dytran, you need an authorization code from MSC.Software Corporation. If you already have a license for MSC.Dytran 2004, you will not need to obtain a new license for MSC.Dytran 2005.

On Windows and Linux computers, MSC.Dytran requires an Ethernet card on your computer, even if your computer is not connected to a network. The FLEXlm licensing mechanism uses the Ethernet card to create the unique system identification encrypted in the license information file.

Release Platforms

MSC.Dytran 2005 was built and tested on the following hardware with the listed software installed as given in Table 5-1.
## Table 5-1  Supported Hardware Configuration

<table>
<thead>
<tr>
<th>Platform</th>
<th>Operating System</th>
<th>Compiler Version</th>
<th>OpenMP Parallel Support</th>
<th>LS-DYNA and LS-DYNA-DMP</th>
<th>USA</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel Pentium III</td>
<td>Windows NT 4.0-SP6A</td>
<td>Compaq Fortran 6.6B SMP: Intel 7.1(*)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Ethernet Card</td>
</tr>
<tr>
<td>Intel Pentium III</td>
<td>Windows 2000-SP4</td>
<td>Compaq Fortran 6.6B SMP: Intel 7.1(*)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Ethernet Card</td>
</tr>
<tr>
<td>Intel Pentium III</td>
<td>Windows XP-SP1</td>
<td>Compaq Fortran 6.6B SMP: Intel 7.1(*)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Ethernet Card</td>
</tr>
<tr>
<td>SGI (**) R10K/R12K</td>
<td>IRIX64 6.5.7m</td>
<td>MIPSpro 7.3.1.3m</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>N.A.</td>
</tr>
<tr>
<td>HP-UX – PA RISC 2.0 (**)</td>
<td>HPUX 11.0</td>
<td>HP F90 V2.7</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>N.A.</td>
</tr>
<tr>
<td>HP-UX Itanium2</td>
<td>HPUX B.11.22</td>
<td>HP F90 V2.7</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>N.A.</td>
</tr>
<tr>
<td>Compaq Alpha</td>
<td>Tru64 Unix v5.1/1885</td>
<td>DF 90 V5.5-2602</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>N.A.</td>
</tr>
<tr>
<td>Sun Sparc Solaris (**)</td>
<td>Solaris 8, 64-bit ( = SunOS 5.8 )</td>
<td>Sun Work Shop 8 (FORTRAN 95 7.1)</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>N.A.</td>
</tr>
<tr>
<td>IBM RS/6000</td>
<td>AIX 4.3.3.0</td>
<td>XL Fortran 8.1</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>N.A.</td>
</tr>
<tr>
<td>Linux Itanium2 IA64 (**)</td>
<td>RedHat Advanced Server 2.1</td>
<td>Intel 7.1</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Ethernet Card</td>
</tr>
<tr>
<td>Intel Linux (**)</td>
<td>Red Hat Linux release 7.3</td>
<td>Intel 7.1</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Ethernet Card</td>
</tr>
</tbody>
</table>

(*)  For correct operation of the Intel Fortran compiler, MS DevStudio 6.6 or Compaq Visual Fortran 6.6B must be installed prior to installing the Intel compiler.

(**) With Dytran 2005, the following configurations are no longer supported:

- SGI: R4k and R5k; HP: HP-UX 10.20; SUN: Solaris 7; Linux: Redhat 7.2

With Dytran 2005, the following configurations are supported by above builds:

- Windows: Intel Pentium IV (NT,W2k,XP) (tested)
- SGI: R8k (not tested)
- SUN: Solaris 9.0 (=SunOS 5.9) (tested)
- IBM: power3, Power4 (tested)
- Intel Linux: Red Hat Linux Advanced Server release 2.1AS (tested)
- Red Hat Enterprise Linux AS release 3 (tested)

Linux Itanium2 IA64:
- RedHat Enterprise 3.0 (=RedHat 10.0) (tested)

In most cases MSC.Dytran 2005 will run on higher OS levels. It has been found that MSC.Dytran 2005 will not run on following configurations:

- Intel Linux: Redhat 9.0, SuSE, Mandrake

➤ A Redhat 9.0 version, supporting these 3 Linux systems, is available for download at:

http://www.mscsoftware.com/support/prod_support/dytran/
MPI for MSC.Dytran LS-DYNA

MSC.Dytran LS-DYNA requires MPI to be installed on every machine used. This is true even for single processor machines.

MSC.Dytran LS-DYNA expects hardware-specific native MPI to have been installed at default locations. When MPI is not properly installed on your Unix/Linux machine or is not installed at the expected default location, a job submission will exit with an error message to this effect. See Table 5-2 for details.

### Table 5-2  MPI Version and Expected Location

<table>
<thead>
<tr>
<th>Platform</th>
<th>Operating System</th>
<th>MPI Version</th>
<th>MPI Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel Pentium III</td>
<td>Windows NT 4.0-SP6A</td>
<td>MPich V.1.2.5</td>
<td>/usr/bin, /usr/lib</td>
</tr>
<tr>
<td>Intel Pentium III</td>
<td>Windows 2000-SP4</td>
<td>MPich V.1.2.5</td>
<td>/usr/bin, /usr/lib</td>
</tr>
<tr>
<td>Intel Pentium III</td>
<td>Windows XP-SP1</td>
<td>MPich V.1.2.5</td>
<td>/usr/bin, /usr/lib</td>
</tr>
<tr>
<td>SGI R10K/R12K</td>
<td>IRIX64 6.5.7m</td>
<td>SGI MPT 1.3</td>
<td>/usr/bin, /usr/lib</td>
</tr>
<tr>
<td>HP-UX – PA RISC 2.0</td>
<td>HPUX 11.0</td>
<td>HP MPI 1.08</td>
<td>/opt/mpi</td>
</tr>
<tr>
<td>HP-UX Itanium2</td>
<td>HPUX B.11.22</td>
<td>HP MPI 1.08</td>
<td>/opt/mpi</td>
</tr>
<tr>
<td>Compaq Alpha</td>
<td>Tru64 Unix v5.1/1885</td>
<td>Compaq dmpirun 1.9.6</td>
<td>/usr/opt/MPI196</td>
</tr>
<tr>
<td>Sun Sparc Solaris</td>
<td>Solaris 9, 64-bit ( = SunOS 5.9 )</td>
<td>SUN HPC mprun 5.0</td>
<td>/opt/SUNWhpc/HPC5.0</td>
</tr>
<tr>
<td>IBM RS/6000</td>
<td>AIX 4.3.3.0</td>
<td>POE 3.2</td>
<td>/usr/lpp/ppe.poe</td>
</tr>
<tr>
<td>Linux Itanium2 IA64</td>
<td>RedHat Advanced Server 2.1</td>
<td>DMP not supported</td>
<td>DMP not supported</td>
</tr>
<tr>
<td>Intel Linux</td>
<td>Red Hat 7.3</td>
<td>LAM V 7.0.4</td>
<td>/usr/local/..</td>
</tr>
</tbody>
</table>

1 Exact location not important as long as it is installed. Install location will be picked up from the registry.
2 Install in not on a separate location but inserted at default.
3 Proper install will provide soft links to /usr/bin, /usr/lib.

### Memory Requirements

In general, the size of the memory required by MSC.Dytran depends on the size of the engineering problem you wish to solve. The default memory size is set to approximately 30MB. This default size is appropriate for smaller problems.

You can change the preset default in the MSC.Dytran Explorer so that it fits your personal needs. In addition, you can define the minimum and maximum memory size and use the slider in the front panel to select the desired memory size. On Unix and Linux platforms you can use the command-line option (size=small/medium/large) or you can enter the MEMORY-SIZE definition in the input file.
MSC.Dytran traces the usage of memory and prints a summary at the end of the output file of each analysis. The memory size listed in the summary is exact. It reflects the memory required for storing the model in core memory after one integration step. Additional memory required during the analysis is automatically allocated and de-allocated.

When you change the memory setting for an analysis through the MSC.Dytran Explorer, the settings will be stored to be used the next time that you run the analysis.

Under certain conditions, MSC.Dytran may stop and issue a message that it cannot allocate the required memory. Since the memory allocation in MSC.Dytran is dynamic, the system may require additional memory during an analysis. If the memory is available, it will be allocated and de-allocated when it is no longer needed. When your computer runs out of memory, the MSC.Dytran analysis may stop when it needs more memory to continue. You may solve this problem by closing applications on your computer that you do not need, or you can decrease the size of the core memory that MSC.Dytran allocates for the analysis if you are using substantially more than the analysis requires. You can find the information on the memory size requirements of the analysis in the memory summary at the end of the analysis. We recommend to use MSC.Dytran on a computer that has at least 256 MB of RAM.
Running MSC.Dytran on Windows

On Windows, submit an MSC.Dytran analysis by double-clicking the MSC.Dytran icon. The icon should be available on your desktop. Alternatively, you can use the Start Menu to locate MSC.Dytran under the Programs Folder. Once you picked either the icon or the menu entry, the MSC.Dytran user environment appears on your screen.

The MSC.Dytran Explorer provides an on-line help system that contains information about the functionality of the MSC.Dytran Explorer. The MSC.Dytran Explorer provides some basic post-processing and animation tools.
With MSC.Dytran 2005, the following enhancements are made to the Dytran Explorer tool:

- **Job monitoring of MSC.Dytran LS-DYNA jobs**
  The command shell has disappeared and now the progress bar can be used to monitor your jobs similar to regular MSC.Dytran jobs.

- **Account and password saving**
  One new feature in job submission is to save and change your account name and password that is used when submitting your jobs through MPIch (for your MSC.Dytran LS-DYNA runs).

- **Ths2Txt batch utility**
  Another added feature is that you can not only use the VisualTHS utility to view your THS files, but also export your results to txt format in batch mode.
• **Multiple file select for the Binary Conversion tool**
  The Binary conversion tool now also accepts multiple THS files, multiple ARC files or a combination of multiple THS and ARC files.

• **Improved and more robust MSC.Dytran LS-DYNA job submission**
  The job submission for MSC.Dytran LS-DYNA jobs has been made more robust and all information (errors included) is stored directly in the corresponding output files. The head node, no longer has to be the local machine, even when you are running without shares.

Deleting old (result) files is now more robust.

**MSC_LICENSE_FILE can be overruled**

For both MSC.Dytran and MSC.Dytran LS-DYNA jobs the user can overrule the system settings of the MSC_LICENSE_FILE.

• **Scan on user-subroutines for correct COMMON definition.**
Running MSC.Dytran on Unix and Linux

On Unix and Linux platform you would use the command line interface like:

• `dytran jid=xxx` to submit MSC.Dytran
• `dytrandmp jid=xxx` to submit MSC.Dytran LS-DYNA

Note that the `dytrandmp` job submission script expects MPI to be properly installed. See Chapter 5: System Information - for more details.

Before running a dytrandmp job, it is required to insert the following line as the first line in the input deck:

```
*dytran
```

Postprocessing MSC.Dytran Results

MSC.Dytran results can be postprocessed with MSC.Patran. With MSC.Patran 2005, the Direct Result Access (DRA) method is available for both regular MSC.Dytran output files (ARC,THS) as well as for the d3plot file which is generated by the LS-DYNA option.

In addition, on Windows, you can use the VisualVrml postprocessing, animation and Visual Time History tool. The tool is built-in inside the MSC.Dytran Explorer and offers web-based postprocessing capabilities. When using the LS-DYNA option, a conversion tool of the `d3plot` file to regular MSC.Dytran ARC files is available by right-clicking on the file inside MSC.Dytran-Explorer.

Postprocessing MSC.Dytran Results of Windows on UNIX

If you wish, you can postprocess the analysis results obtained from a Windows platform, on a UNIX computer. In this case, you need to convert the binary result files (.ARC and/or .THS) files to a UNIX format. You can perform this conversion by using the right-mouse button menu in the MSC.Dytran Explorer. Point your mouse at the file that you wish to convert, click the right mouse button and select the Convert to binary... menu item. The converted files will have the `sb_` prefix. For Compaq Alpha workstations, the native Windows result files can be used directly without conversion.

Alternatively, when running on windows, you can select the option to output result files in UNIX format by default. To set this option, select the Preferences from the Options menu. Choose Formats and select Convert output files automatically to UNIX-format. If you select this option, the regular Windows result files and the converted UNIX-format files are written at the end of the analysis. You can recognize the UNIX-format files by the `ux` prefix.