

INSTALLATION, LICENSING, AND CONFIGURATION

This chapter provides detailed instructions for installing *FLOW-3D* Cast, configuring software licensing, and setting up the remote solving features. If you have any trouble during the installation, please contact our support department at support@flow3d.com or by calling (505) 982-0088 and we will be happy to assist you.

1.1 Pre-installation

1.1.1 Supported operating systems

There are certain operating systems on which *FLOW-3D* Cast and FlowSight are tested. While it may be possible to install and run both of these programs on other operating systems, Flow Science supports and provides installation assistance for only the following **64 bit** operating systems:

- Microsoft **Windows 7** and greater
- Microsoft **Windows Server 2008** and greater
- **Red Hat Enterprise Linux 6** and greater

Note: 32 bit operating systems are not supported. **SUSE Enterprise Linux 11** is not supported for this release.

1.1.2 Hardware requirements and recommendations

- **Processor:** An x86-64 compatible CPU is required. Multiple processor cores are recommended. **Intel Core i7** and **Intel Xeon** CPUs are strongly recommended.
- **Memory:** The software requires a minimum of 2GB RAM per processor core. Note that the amount of RAM required is highly problem dependent. For simulations with large domains, or with complex geometry requiring fine resolution, significantly more RAM than the required minimum will be necessary. Memory speed has a small effect on simulation time and typically 1333 or 1600 MHz memory is adequate.
- **Graphics:** The FlowSight postprocessor works best with a workstation card. **nVidia Quadro K series** cards or **AMD FirePro W series** cards are highly recommended. nVidia's **GTX series** 660 and above have shown decent performance on desktop and notebook machines.
- **FLOW-3D** Cast for **Windows** requires at least 1GB of free disk space. On **Linux** operating systems, at least 1.2GB of free disk space is necessary. Additional space is required for simulation results, which can be upwards of 100GB depending on the simulation.
- **Settings:** Machines that run *FLOW-3D* Cast should be set to a high-performance power setting to prevent the machine from sleeping or otherwise powering-down during long-running simulations. Additionally, using automatic file compression utilities is not recommended.

1.1.3 Licensing requirements

Please ensure that you have a valid **FLOW-3D** Cast license file or the name or IP address of your **FLOW-3D** Cast license server before beginning the installation. If you do not have a license file or a license server please contact your sales associate or licenses@flow3d.com and provide the following information:

- The host name of the machine that will run the license server software
- Either the FlexID (if using a hardware dongle; the FlexID is printed on the side of the dongle) or the MAC address of the machine

If the MAC address is not known:

- On **Windows** operating systems, the host name and MAC address can be found by opening the command prompt and entering `ipconfig /all`. When multiple ethernet cards are present, multiple MAC addresses may be listed in the output. The connected ethernet device or the first in the series is preferable.
- On Linux operating systems, typing `/sbin/ifconfig` in a terminal window will provide the MAC address, under the heading `HWAddr`. The host name can be found by entering the `hostname` command in a terminal window. When multiple ethernet cards are present, multiple MAC addresses may be listed in the output. `eth0` is usually best, but if you are unsure which MAC address to use, please send a text file or attach a screen capture with the output of the command, and the License Administrator will determine the best option.

Once the host name and MAC address or FLEXID have been received, the License Administrator at Flow Science will send the license file (`flow3d.lic`) as an email attachment. It is an ASCII text file with encryption codes that allow it to be used only on the computer for which it was generated. Check the license file to be sure that it contains the host name and HOSTID that matches the license server. More information about licensing can be found in the [Licensing Information](#) section.

1.2 Installation Procedure

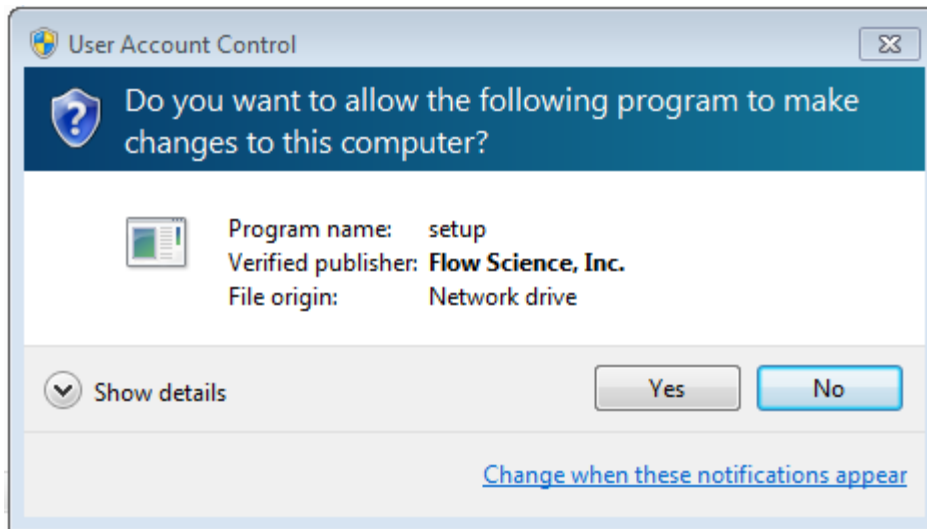
1.2.1 Windows Installation

Note:

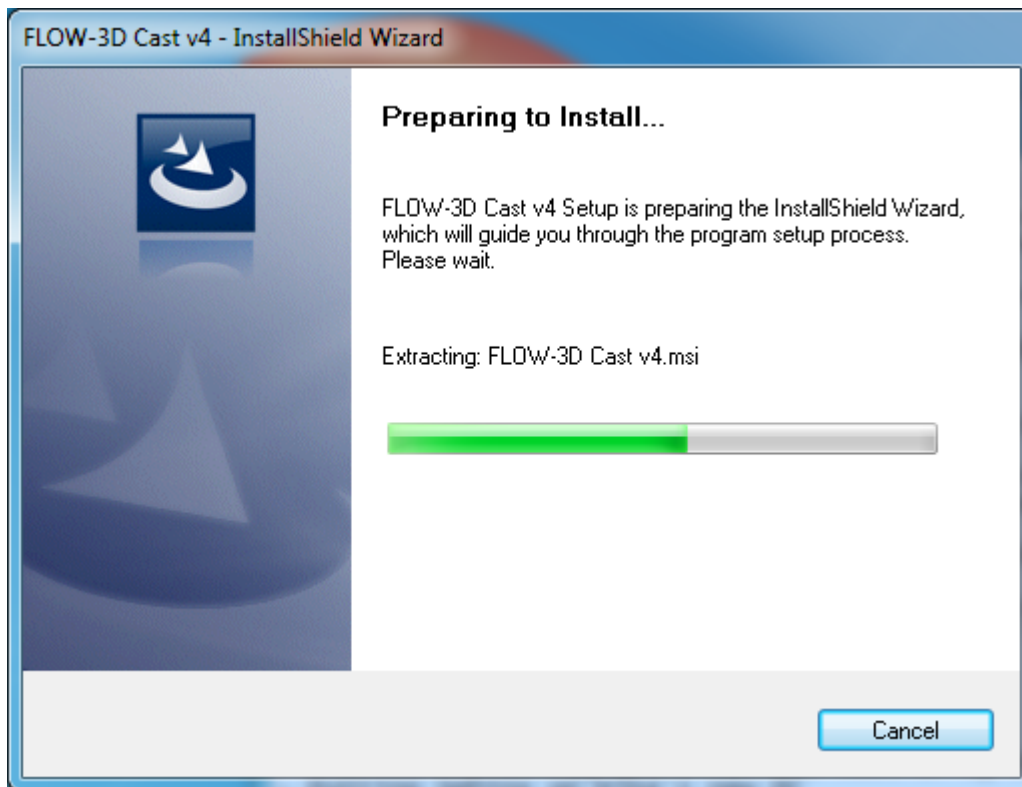
- Administrator privileges are necessary to install **FLOW-3D** Cast on **Windows**. Before installing, please close all other running programs.
 - If installing on the **Windows 8** operating system, please consult the [Special Considerations for Windows 8 and 8.1](#).
 - If installing on a machine that has **FLOW-3D** version 10.1 installed, please close any running copies of **RunnerServer.exe**. This can be done by either:
 - Right-clicking the green running person icon in the system tray and choosing *Quit*
 - Opening the **Windows Task Manager** and stopping any **RunnerServer.exe** processes shown in the *Processes* tab. It may be necessary to click the *Show Processes from All Users* button. The **RunnerServer** process may be chosen and the *End Process* button can then be clicked to close the program.
-

The installation can be started by double clicking the downloaded **flow3dcast.exe** file.

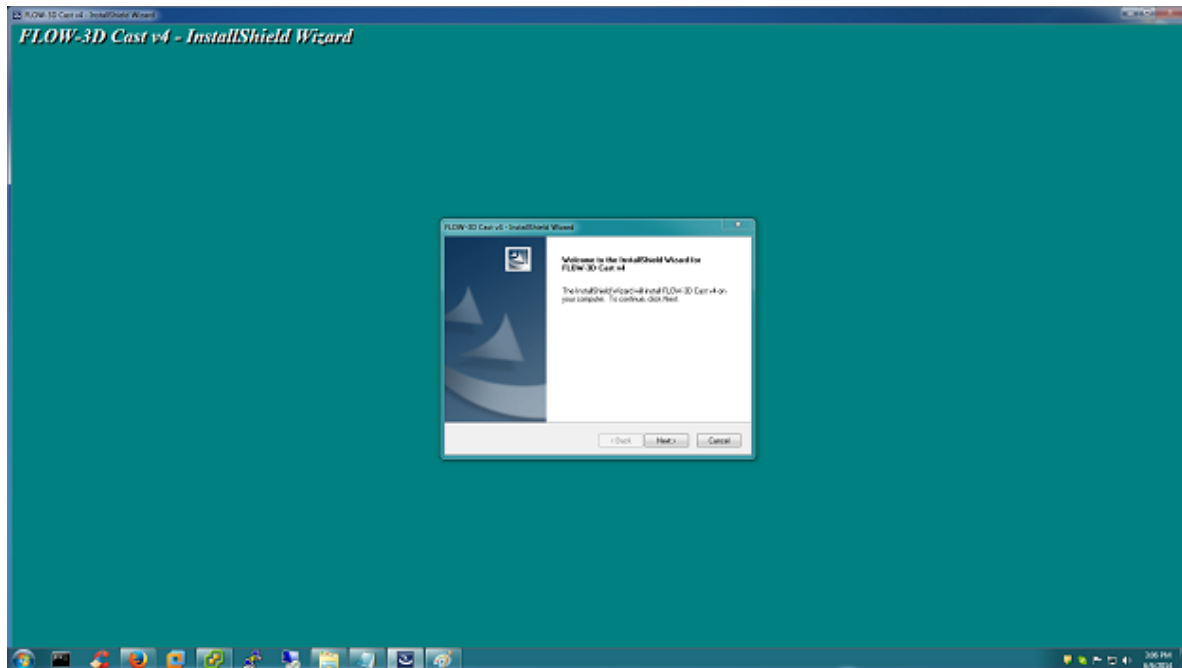
1. On **Windows** operating systems, a User Account Control dialog, similar to the one below, will appear. The “Verified publisher” entry should confirm that the executable has been digitally signed by Flow Science, Inc.



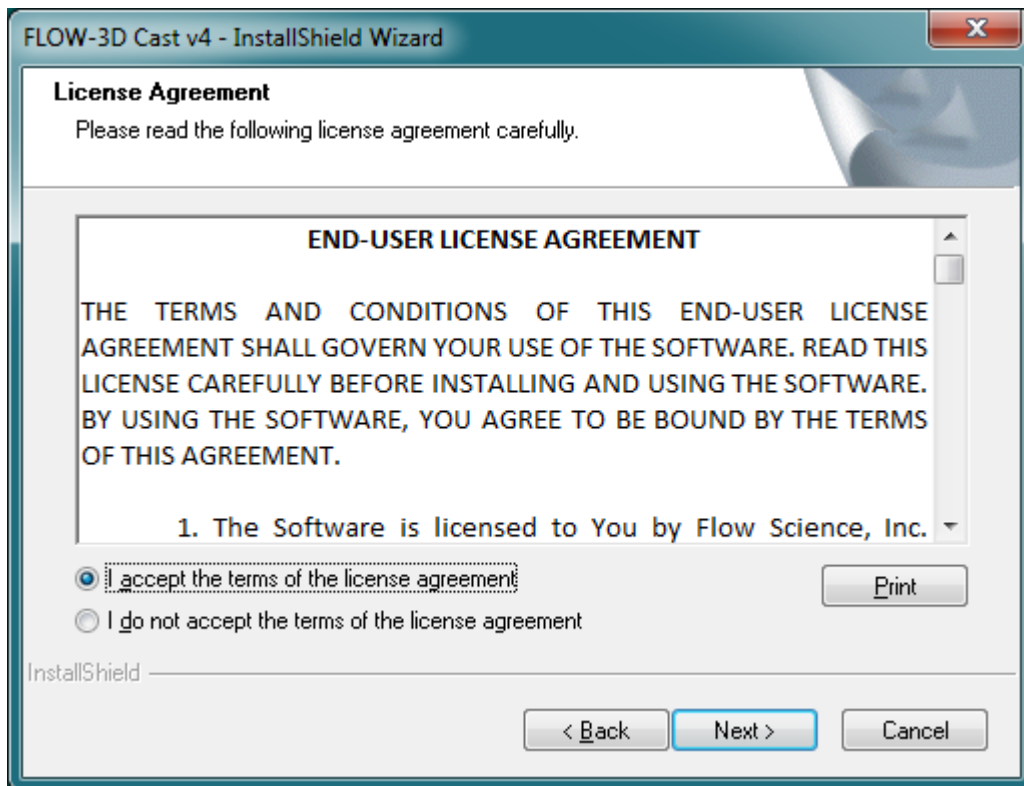
2. Next, the Preparing to Install dialog will be displayed. It requires no user input and will disappear after several seconds.



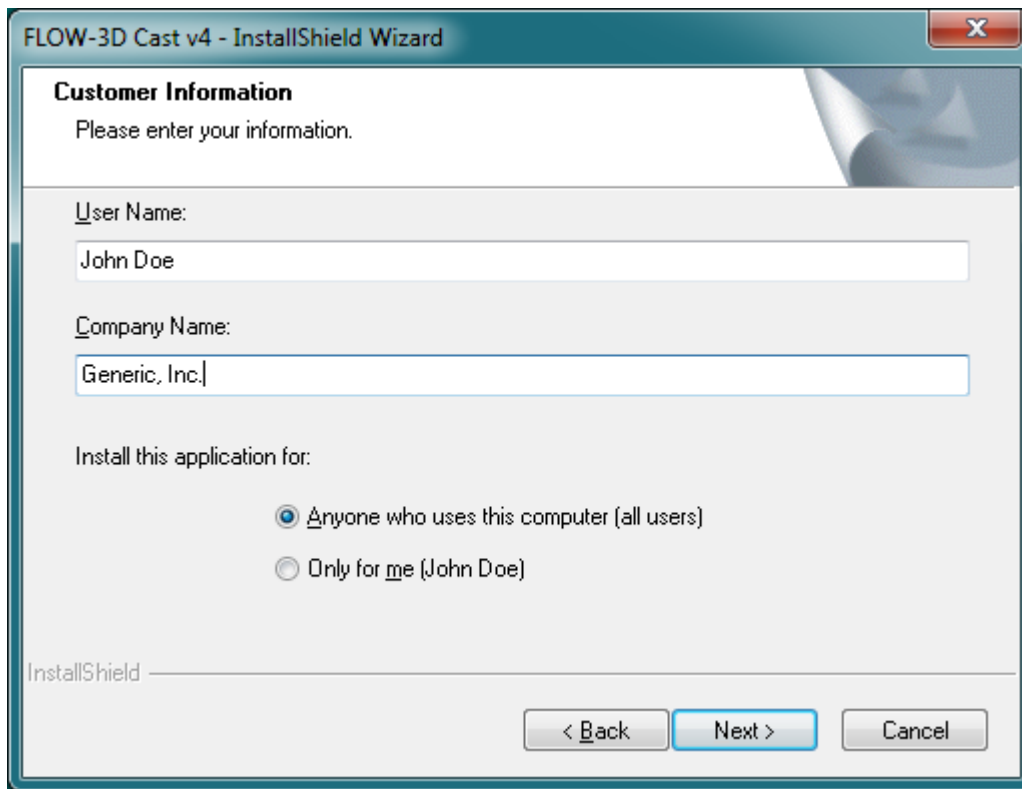
3. The next dialog to appear is the Welcome screen. Click *Next* to continue.



4. The next dialog is the **FLOW-3D** Cast end user license agreement. Please read it carefully. If all the terms are acceptable, click the *Next* button to signify agreement and move to the next dialog.



5. This dialog collects user information. Enter user and company names and click *Next* to move forward.



Customer Information
Please enter your information.

User Name:
John Doe

Company Name:
Generic, Inc.

Install this application for:

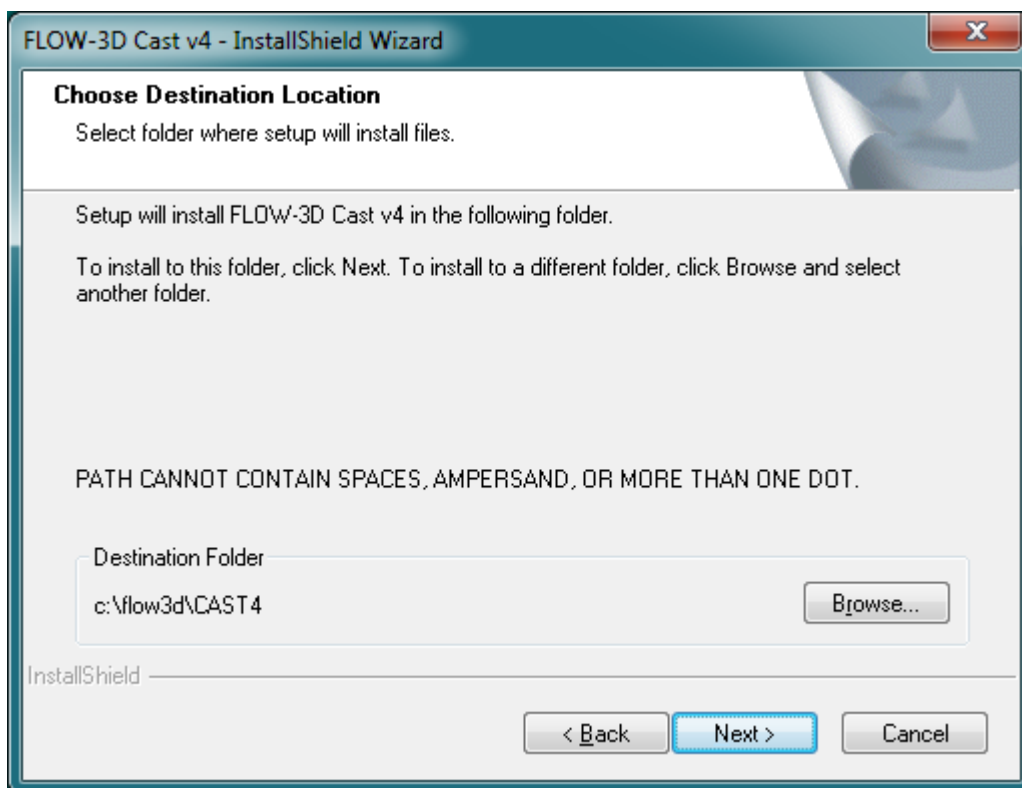
☒ Anyone who uses this computer (all users)

☐ Only for me (John Doe)

InstallShield

< Back Next > Cancel

6. Now the install location can be chosen. The default directory can be used, or *FLOW-3D* Cast can be installed to a specific directory. Once the location is chosen, click *Next*. When installing to a different location, it is important that the directory name not contain spaces, ampersand characters, or multiple dots.



Choose Destination Location
Select folder where setup will install files.

Setup will install FLOW-3D Cast v4 in the following folder.

To install to this folder, click Next. To install to a different folder, click Browse and select another folder.

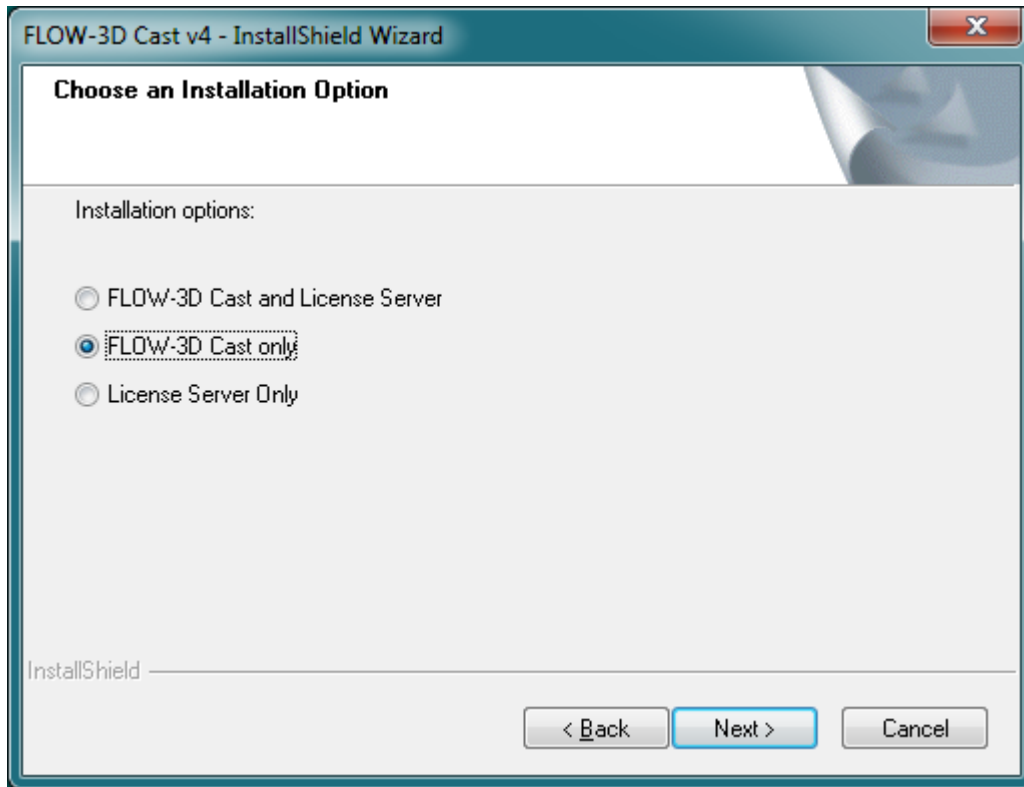
PATH CANNOT CONTAIN SPACES, AMPERSAND, OR MORE THAN ONE DOT.

Destination Folder
c:\flow3d\CAST4 Browse...

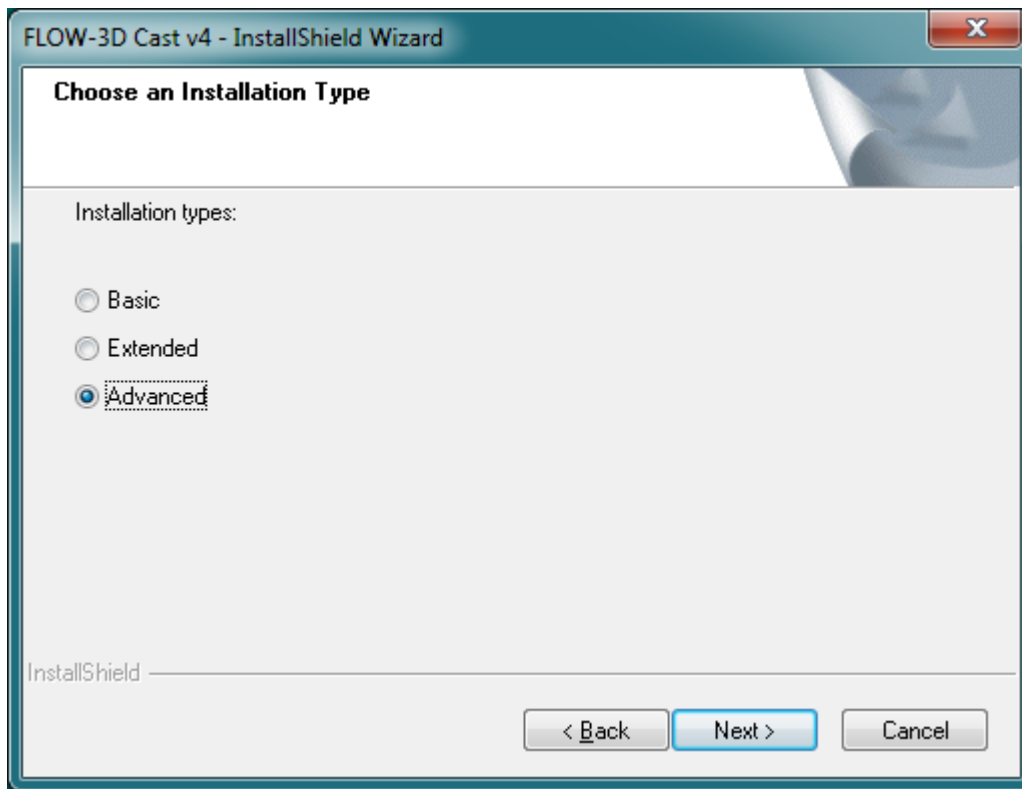
InstallShield

< Back Next > Cancel

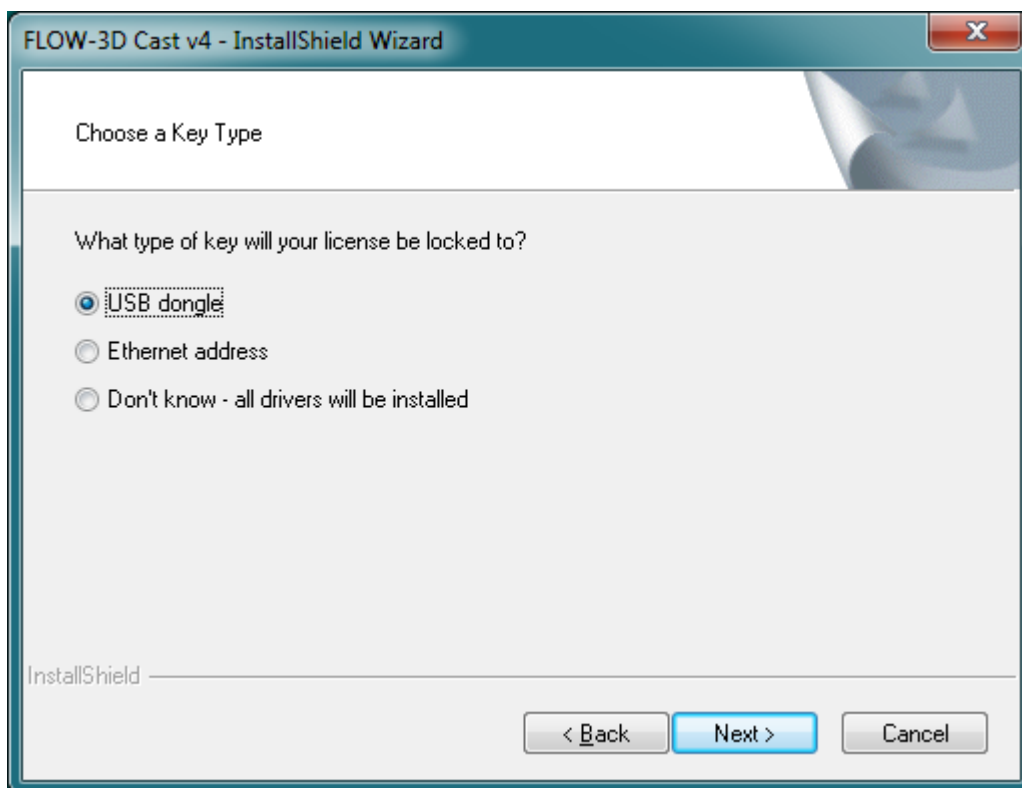
7. The installation options are shown. Choose *FLOW-3D Cast and License Server* if this computer should contain both the **FLOW-3D** Cast software and the license server software. Choose *FLOW-3D Cast only* if the license server software is running on a different computer on the network. *License server only* installs only the license server components; the GUI and Solver will not be installed. A *FLOW-3D Cast only* install would then be required for machines that will connect to this license server. If the machine is intended to act as a remote server with the new Remote Solving feature, an Installation Option that includes **FLOW-3D** Cast should be chosen.



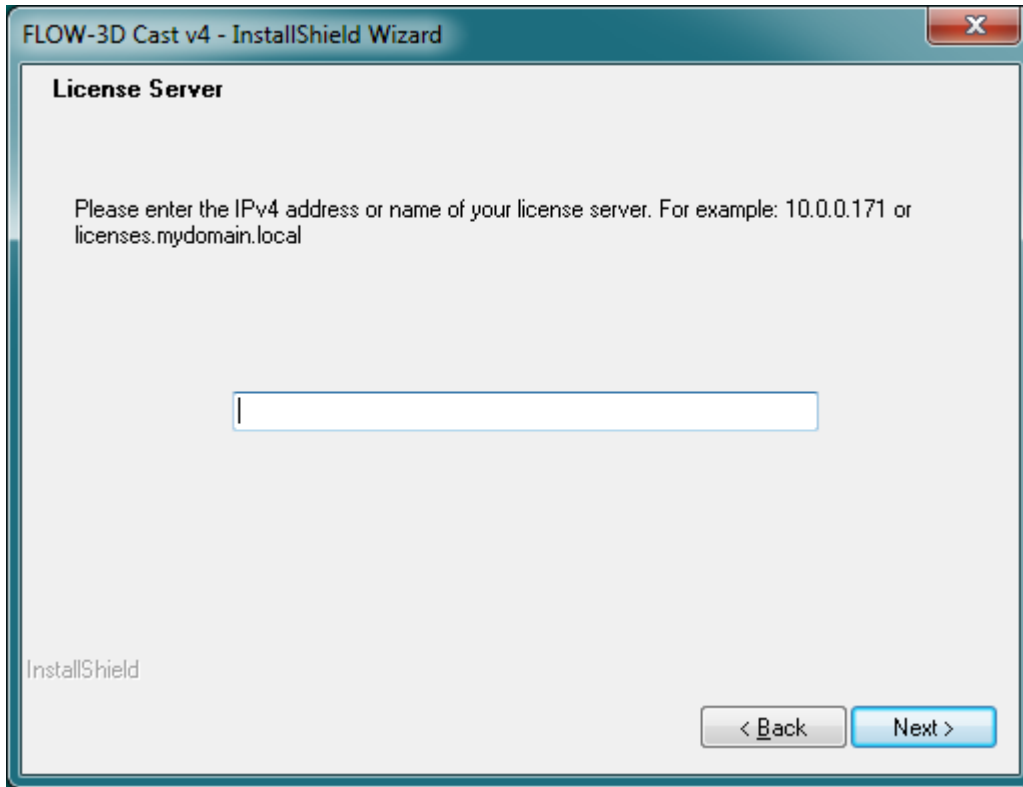
8. Now an Installation Type may be chosen. This should be based on the type of license purchased.



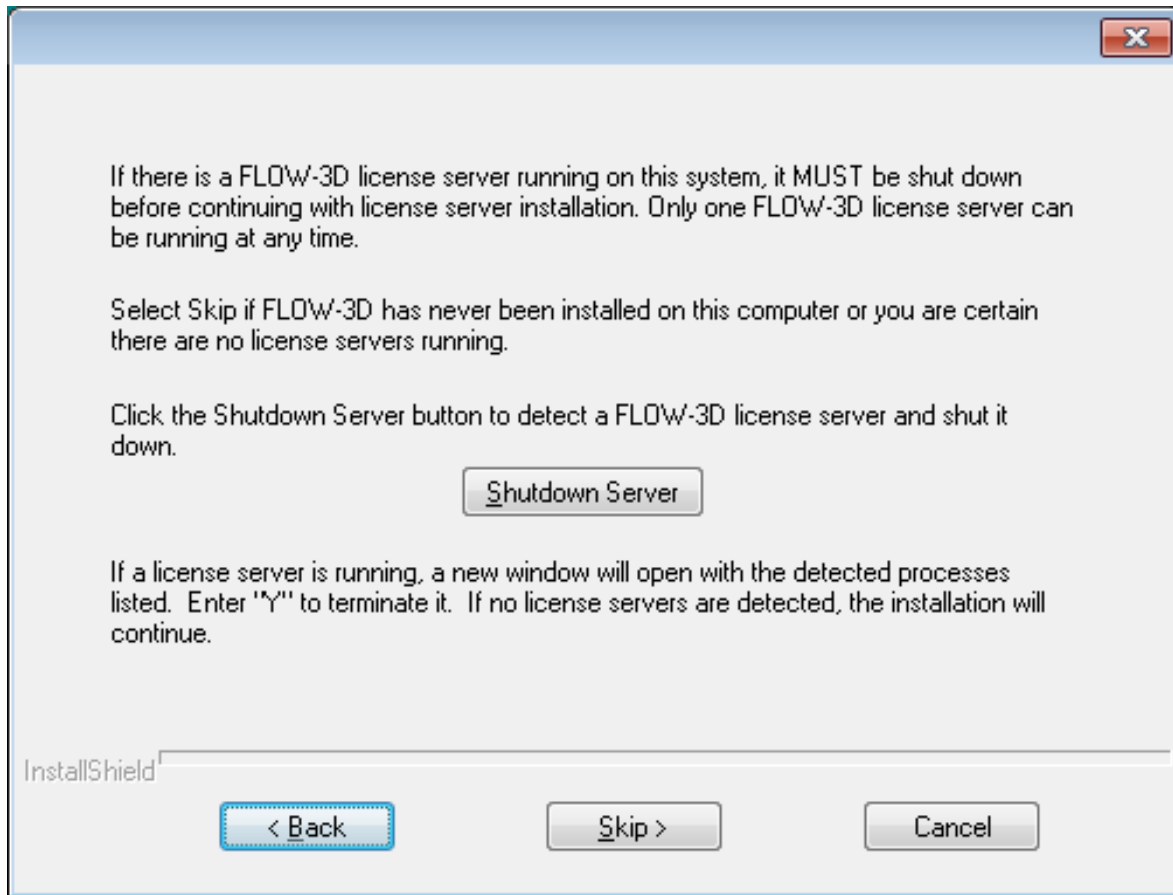
9. If the *FLOW-3D Cast and FlexLM license server* or *FlexLM license server only* installation option was chosen, this dialog will appear. This choice determines the appropriate drivers. The *USB dongle* or *Don't know* options will install special drivers for the FlexLM USB key.



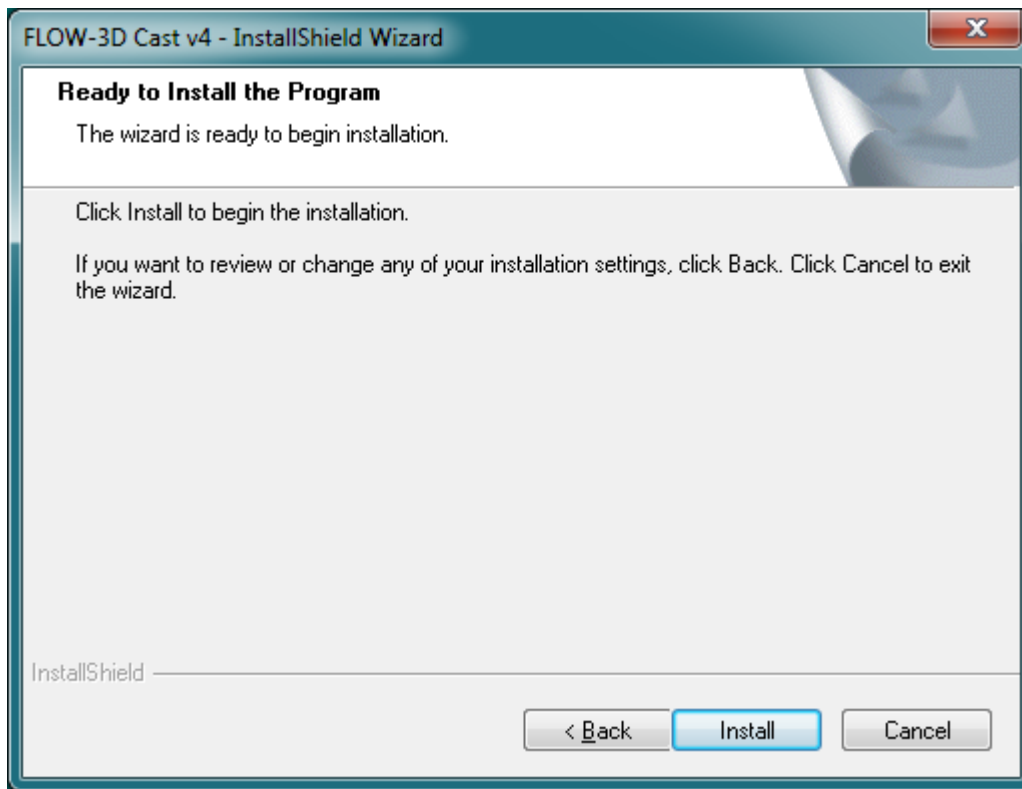
10. If the *FLOW-3D Cast only* installation option was chosen, this dialog will be shown instead. It allows an IPv4 address or a server name to be specified for the license server. If unknown, the IP address can be found by opening the command prompt and entering `ipconfig /all` on the license server machine. The name can be determined by opening a command prompt or terminal window and issuing the command `hostname`. When using a hostname, the server should respond to `ping` requests. The name required may differ based on the network. For example, a machine may respond to `ping host.company.com` but not to `ping host`. If this is the case, the full name must be used. If the hostname entered is not reachable, the client will not be able to check out a license.



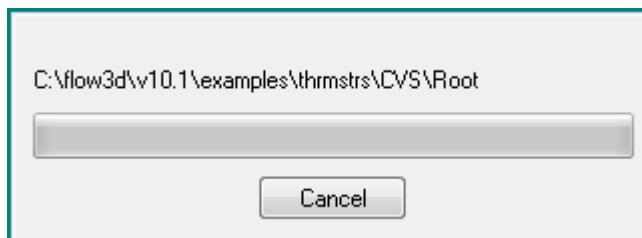
11. If a license server is being installed, *FLOW-3D Cast* will ask to temporarily shut down any existing license servers. This allows the *FLOW-3D Cast* license as well as **FlexLM** licenses from other vendors to be served. This can only be skipped safely when no other software that uses **FlexLM** licensing is installed, including older versions of *FLOW-3D Cast* or *FLOW-3D*.



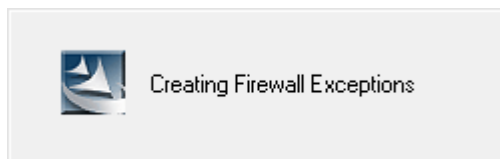
12. **FLOW-3D** Cast is now ready to install.



13. The *FLOW-3D* Cast installer will copy the necessary files.



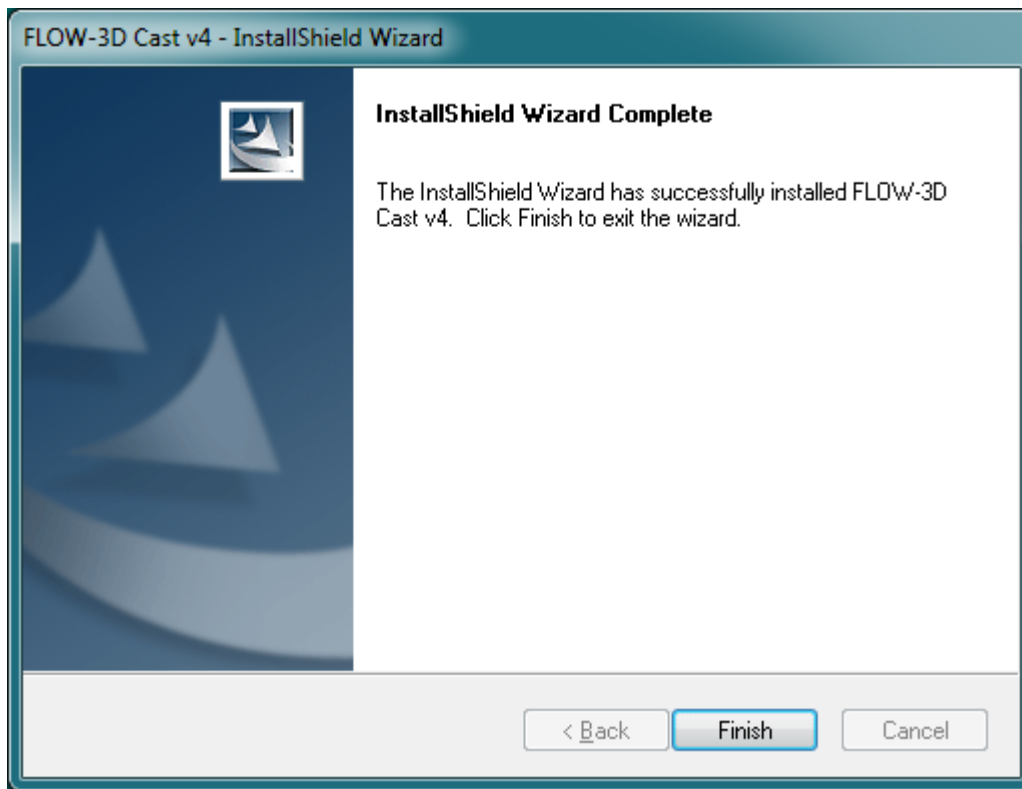
14. Next, the installer will create firewall exceptions to allow communication to remote license servers and for the new remote solving capability.



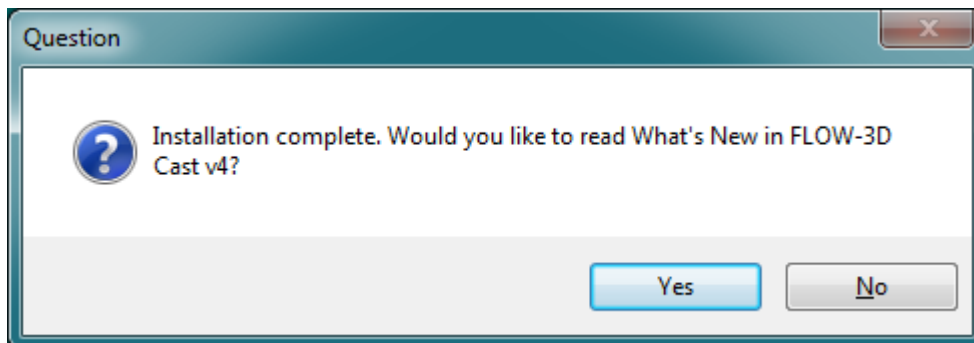
15. Finally, the Microsoft Visual C++ redistributables will be installed.



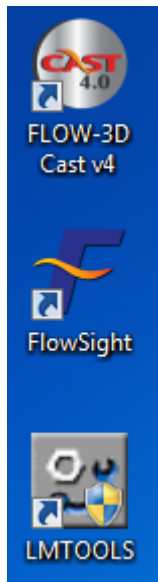
16. The installation is now complete.



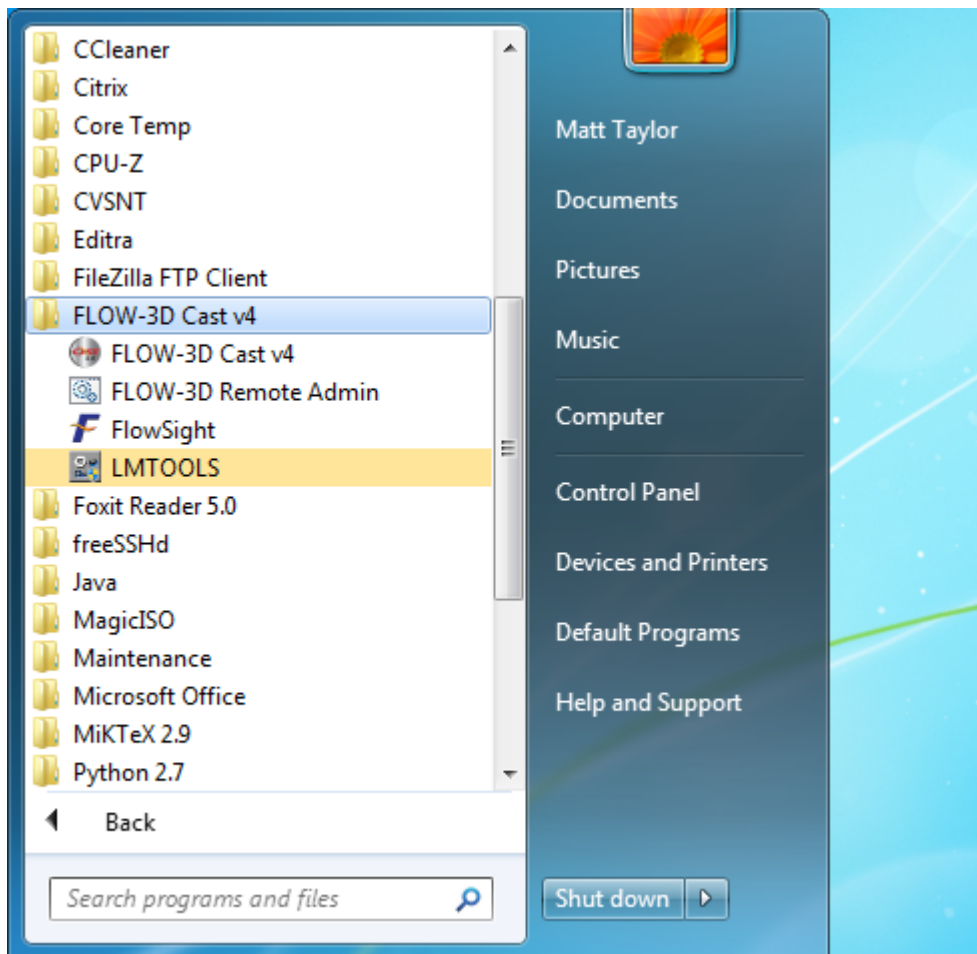
17. After installation, an opportunity is presented to learn about new features.



18. The **FLOW-3D** Cast, FlowSight, and **LMTOOLS** icons will now appear on the desktop. LMTOOLS allows for interaction and configuration of local or remote license servers.



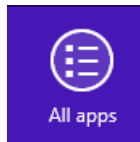
19. Also, there will be a new *Program Group* in the **Windows Start Menu**.



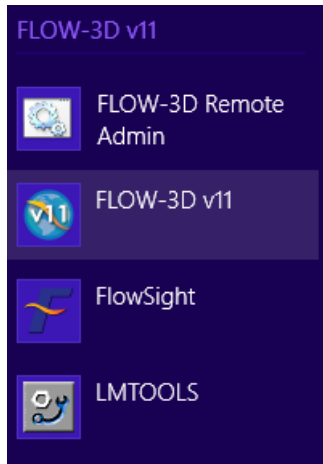
Special Considerations for Windows 8 and 8.1

Flow Science highly recommends updating **Windows 8** to **version 8.1 Update 1** (or the newest version available) before installing **FLOW-3D Cast**.

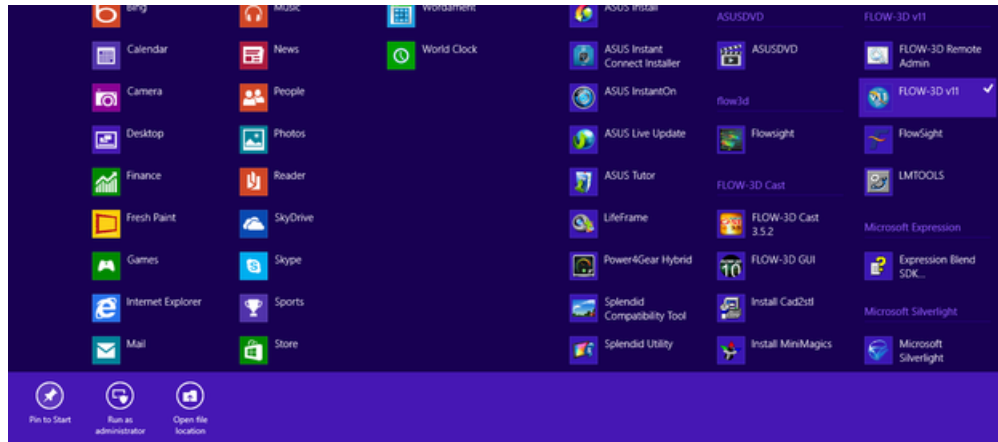
- On all versions of the **Windows 8** operating system, including those which have been updated, the following considerations apply:
 - Secure boot must be disabled for the **Sentinel HASP USB drivers** to install. Please see <http://technet.microsoft.com/en-us/library/dn481258.aspx> for the procedure.
 - The “Creating Firewall Exceptions” dialog is not shown. However, the firewall exceptions are created.
- When the **Windows 8** operating system has not been updated, the desktop icons are not created by the installer automatically.
 - One potential solution is to install a third-party Start Menu replacement, such as **Classic Shell** or **Start8**. If a Start Menu replacement is installed prior to installing **FLOW-3D Cast**, the icons will be created correctly.
 - Another option is to use the Modern interface *All Apps* view. This can be done by right-clicking the Start Screen, then clicking *All Apps* at the lower right.



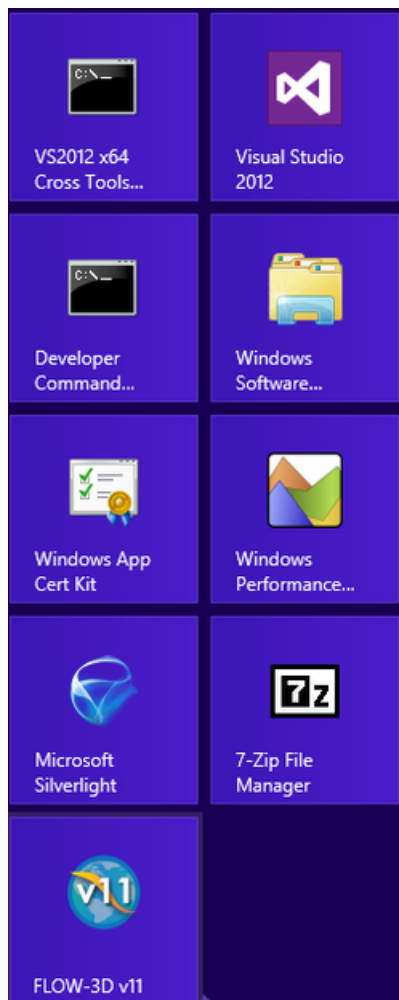
There will be a Program Group for **FLOW-3D Cast**.



Right-click one of the icons and choose *Pin to Start* at the lower left to place the icon on the main Start Screen.



The icon should now appear on the main Start Screen and can be used to launch the program.



1.2.2 Linux Installation

FLOW-3D Cast for Linux is distributed as a gzip-compressed tar archive, often called a tarball. The installation files can be extracted from `flow3dcast.tar.gz` in a terminal window, using the command `tar -xzf`

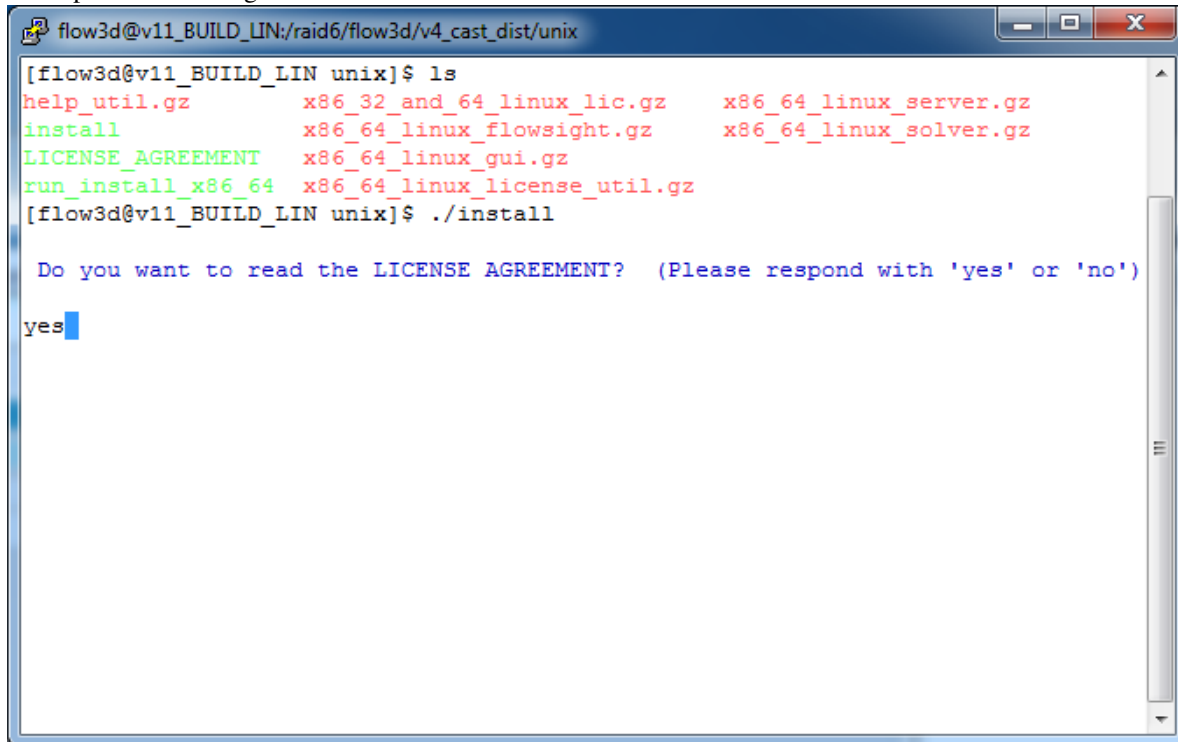
flow3dcast.tar.gz. The tarball can be unpacked into any directory on the filesystem using the -C flag. For example, to extract the tarball to /home/user, use `tar -xzvf flow3dcast.tar.gz -C /home/user`.

Navigate to the directory where the installation files exist, or to which they have been unpacked. The script `install` can now be run. A preceding dot slash may be necessary depending on whether the current directory is on the system PATH (i.e., `./install`). By default, this file is executable. **FLOW-3D** Cast is only supported on **64-bit** Red Hat Enterprise Linux 6 or newer and SUSELinux Enterprise 11 SP2 or newer. It may be possible to install on other distributions, but due to potential library and package differences, Flow Science does not provide technical assistance on these distributions.

Note:

- SUSE Linux 11 must be at Service Pack 2 or greater when available
 - For installations including the FlexLM license server, the `lsb` (RHEL) (or `lsb-base` (SUSE) when available) package is required. If it is not found, the installation script will output a reminder.
 - The FlowSight visualization software requires `libstdc++.so.5`. This can be installed as follows:
 - RHEL: `yum install compat-libstdc++-33`
 - SUSE: `zypper install libstdc++33` when available
-

1. Execute the `install` script in the directory where the tarball was unpacked. The license agreement can be read prior to installing the software.



```

flow3d@v11_BUILD_LIN:/raid6/flow3d/v4_cast_dist/unix
[flow3d@v11_BUILD_LIN unix]$ ls
help_util.gz          x86_32_and_64_linux_lic.gz    x86_64_linux_server.gz
install               x86_64_linux_flowsight.gz     x86_64_linux_solver.gz
LICENSE_AGREEMENT     x86_64_linux_gui.gz
run_install_x86_64    x86_64_linux_license_util.gz
[flow3d@v11_BUILD_LIN unix]$ ./install

Do you want to read the LICENSE AGREEMENT? (Please respond with 'yes' or 'no')
yes
  
```

2. If all the terms are acceptable, typing `y` or `yes` and pressing Enter will continue the installation.

```

flow3d@v11_BUILD_LIN:/raid6/flow3d/v4_cast_dist/unix
approval from or notice to You, to make changes in and to the Software.
e) This Agreement shall be governed by and construed in accordance with the laws
of the United States and the State of New Mexico, as applied to agreements ente
red into and to be performed entirely within New Mexico between New Mexico resid
ents without reference to conflict of laws. This Agreement and the performance
of the Parties required hereunder shall not be governed by or otherwise subject
to the United Nations Convention for the International Sale of Goods. Any civil
suit or proceeding relating to this agreement shall be brought only in U.S. Fed
eral District Court or State District Court within the State of New Mexico, and
each of the Parties consent to the personal jurisdiction and venue of such court
s. Judgment upon any award made in such proceeding may be entered and enforced
in any court of competent jurisdiction.
f) In the event of any conflict between the terms of this Agreement and the appl
icable Acquisition Agreement, the terms of the Acquisition Agreement shall preva
il. If there are any terms in either agreement which are different from, but not
inconsistent or in conflict with the other agreement, then such terms shall bin
d the parties.

YOU MUST ACCEPT THE LICENSE AGREEMENT FOR FLOW-3D TO BE INSTALLED. IF YOU DO NO
T ACCEPT, THE INSTALLATION WILL BE ABORTED.

DO YOU ACCEPT ALL OF THE TERMS OF THE PRECEDING LICENSE AGREEMENT?
(Please respond with 'yes' or 'no')
yes

```

3. **FLOW-3D** Cast can be installed to a directory of your choosing. The default is /home/(current_user)/FLOW3D/CAST4. Press Enter to use this. To change the default, enter the full path here and press Enter.

```

flow3d@v11_BUILD_LIN:/raid6/flow3d/v4_cast_dist/unix
eral District Court or State District Court within the State of New Mexico, and
each of the Parties consent to the personal jurisdiction and venue of such court
s. Judgment upon any award made in such proceeding may be entered and enforced
in any court of competent jurisdiction.
f) In the event of any conflict between the terms of this Agreement and the appl
icable Acquisition Agreement, the terms of the Acquisition Agreement shall preva
il. If there are any terms in either agreement which are different from, but not
inconsistent or in conflict with the other agreement, then such terms shall bin
d the parties.

YOU MUST ACCEPT THE LICENSE AGREEMENT FOR FLOW-3D TO BE INSTALLED. IF YOU DO NO
T ACCEPT, THE INSTALLATION WILL BE ABORTED.

DO YOU ACCEPT ALL OF THE TERMS OF THE PRECEDING LICENSE AGREEMENT?
(Please respond with 'yes' or 'no')
yes

The default path for installing Flow3D is
/home/flow3d/FLOW3D/CAST4

Press 'ENTER' to install in the Default Directory
OR
Enter the full path of the directory where FLOW-3D files will be installed:

```

4. After the directory has been determined, an installation type may be chosen. . The *FLOW-3D Cast and Flexlm License Server* option is used if this machine should contain both **FLOW-3D** Cast and the license server software. *FLOW-3D Cast only* is used if this is a client machine that will connect to a remote license server. Finally,

Flexlm License Server only is used when this machine will only run the license server software; the GUI and Solver will not be installed. A *FLOW-3D Cast Only* install would then be required for machines that will connect to this license server. If the machine is intended to act as a remote server with the new Remote Solving feature, an installation type that includes **FLOW-3D Cast** should be chosen. **Note that SUSE Linux (currently not available) machines cannot use the Remote Solving feature.**

```

flow3d@v11_BUILD_LIN:/raid6/flow3d/v4_cast_dist/unix
/home/flow3d/FLOW3D/CAST4

Press 'ENTER' to install in the Default Directory
OR
Enter the full path of the directory where FLOW-3D files will be installed:
/home/flow3d/FLOW3D/install_instruct

Directory /home/flow3d/FLOW3D/install_instruct does not exist, creating it.
Creating /home/flow3d/FLOW3D/install_instruct

FLOW - 3D CAST4 will be installed in /home/flow3d/FLOW3D/install_instruct

Choose the type of installation:

1. FLOW-3D Cast and Flexlm License Server    - Client/Server Installation
2. FLOW-3D Cast only                        - Client Installation
3. Flexlm License Server only                - Server Installation
4. None of the above -- exit

Please enter a number from 1 to 4:

```

5. The **FLOW-3D Cast** cast version may now be chosen. This would be based on the license purchased from Flow Science.

```

flow3d@v11_BUILD_LIN:/raid6/flow3d/v4_cast_dist/unix

Choose the type of installation:

    1. FLOW-3D Cast and Flexlm License Server    - Client/Server Installation
    2. FLOW-3D Cast only                        - Client Installation
    3. Flexlm License Server only                - Server Installation
    4. None of the above -- exit

Please enter a number from 1 to 4:
2

Choose FLOW-3D Cast version:

    1. Basic
    2. Extended
    3. Advanced
    4. None of the above -- exit

Please enter a number from 1 to 4:

```

6. If the *FLOW-3D Cast only* option is chosen, the script will display an installation summary, and request the name or IPv4 address of the license server. This server machine must be accessible by the client. Unless networking is configured otherwise, `ping hostname` or `ping (ip_address)` will verify whether the machine can be reached.

```

flow3d@v11_BUILD_LIN:/raid6/flow3d/v4_cast_dist/unix

    4. None of the above -- exit

Please enter a number from 1 to 4:
3

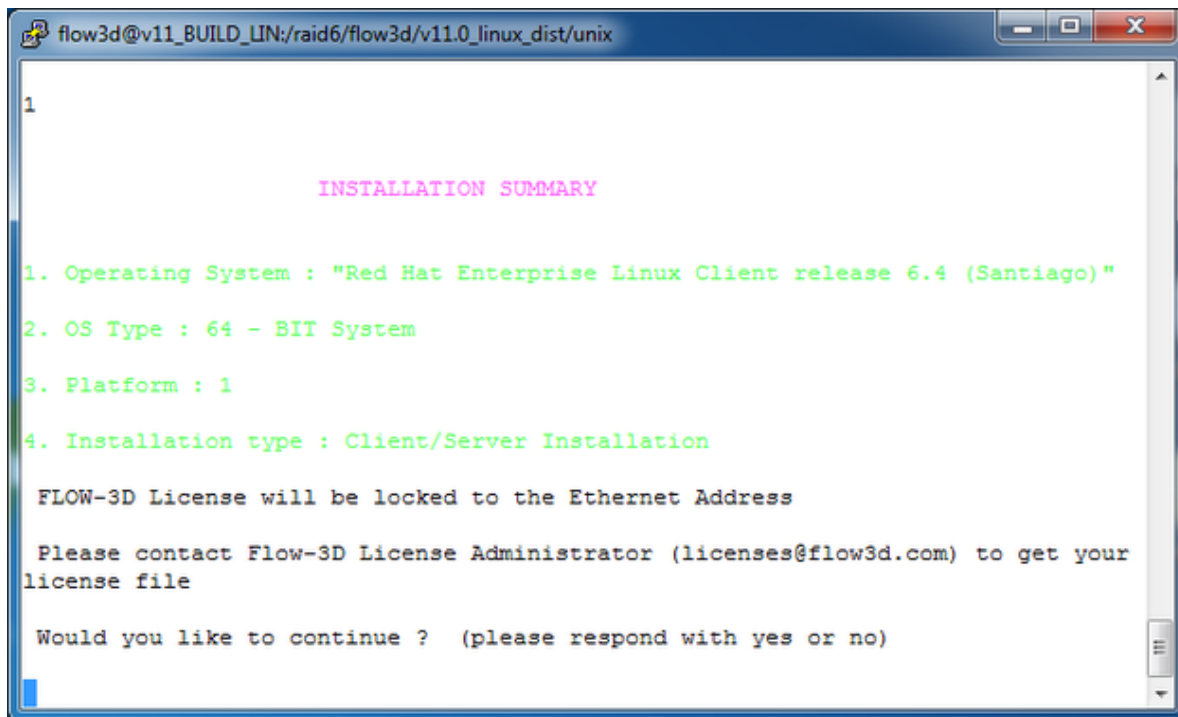
          INSTALLATION SUMMARY

1. Operating System : "Red Hat Enterprise Linux Client release 6.4 (Santiago)"
2. OS Type : 64 - BIT System
3. Platform : 1
4. Installation type : Client Installation
5. Cast version : advanced

Please specify the name or IP address of the License Server
10.0.0.28

```

7. If an Installation Type that includes FlexLM is chosen, the script will display the installation summary and advise that the license will be locked to the ethernet address. USB dongles are no longer supported on Linux.

A terminal window titled 'flow3d@v11_BUILD_LIN:/raid6/flow3d/v11.0_linux_dist/unix'. The terminal displays the 'INSTALLATION SUMMARY' in pink. It lists four items in green: 1. Operating System : "Red Hat Enterprise Linux Client release 6.4 (Santiago)", 2. OS Type : 64 - BIT System, 3. Platform : 1, and 4. Installation type : Client/Server Installation. Below this, it states 'FLOW-3D License will be locked to the Ethernet Address' and 'Please contact Flow-3D License Administrator (licenses@flow3d.com) to get your license file'. At the bottom, it asks 'Would you like to continue ? (please respond with yes or no)'.

```
flow3d@v11_BUILD_LIN:/raid6/flow3d/v11.0_linux_dist/unix
1

      INSTALLATION SUMMARY

1. Operating System : "Red Hat Enterprise Linux Client release 6.4 (Santiago)"
2. OS Type : 64 - BIT System
3. Platform : 1
4. Installation type : Client/Server Installation

FLOW-3D License will be locked to the Ethernet Address

Please contact Flow-3D License Administrator (licenses@flow3d.com) to get your
license file

Would you like to continue ? (please respond with yes or no)
```

8. The installation will now unpack the tarballs that are needed for the selected Installation Type.

```

flow3d@v11 BUILD LN/raid6/flow3d/v4 cast dist/linux
Please enter a number from 1 to 4:
3

          INSTALLATION SUMMARY

1. Operating System : "Red Hat Enterprise Linux Client, release 6.4 (Santiago)*"
2. OS Type : 64 - BIT System
3. Platform : 1
4. Installation type : Client Installation
5. Cast version : advanced

Please specify the name or IP address of the license server
10.0.0.28

Name or IP address for the license server will be set to 10.0.0.28

Installing flow3d CAST4 only
install_type 1
cast_version advanced
platform 1
f3d_home /home/flow3d/FLOW3D/install_instruct
Current operating system: linux

Installing x86_64 linux solver.gz

Installing x86_64 linux gui.gz

Installing x86_64 linux license_util.gz

Installing x86_32_and_64 linux lin.gz

Installing help util.gz

Installing x86_64 linux flowright.gz

```

9. As a final step, the install script checks the system for the libraries needed to run **FLOW-3D** Cast. Two shell scripts for launching **FLOW-3D** Cast, `flow3dvars.sh` and `flow3dvars.csh`, are written into the *local* directory of the installation path. Another pair of scripts is included in the *local* directory to launch FlowSight. These scripts set up the environment and launch the executable. They are named `FlowSight.sh` and `FlowSight.csh`. Another option is to allow the install script to create desktop icons to run **FLOW-3D** Cast and FlowSight. These icons set up the environment and run the software. They are only created for the **GNOME** desktop environment which is the default for Red Hat and SUSE Linux (not available at this time). *If other desktop environments are used, the icons will not be created.*

Necessary libraries are included with the distribution in the `$F3D_HOME/gui/lib` directory. The `LD_LIBRARY_PATH` environment variable is set in the `flow3dvars` scripts so any libraries not found on the system will be accessible. The install script also gives the `source` command that can be used on your system to set up an environment to run **FLOW-3D** Cast. The command may be added to the user's `.bashrc` or `.cshrc` file, if desired. **FLOW-3D** Cast can then be run from a terminal prompt using the command `flow3d&` or `flow3d`.

```

fow3d@v11 BUILD LN/raid6/fow3d/v4 cast dist/unix

Installer did not find either 'linefix' or 'linefix' in your path. To use FLOW3D
Help please set F3D_HELP to a browser executable.

Checking system compatibility

shared library libifcproc.so.5 not found

/home/fow3d/FLOW3D/install_instruct/gui/lib/ifeat is required in LD_LIBRARY_PATH
for libifcproc.so.5

shared library libifport.so.5 not found

/home/fow3d/FLOW3D/install_instruct/gui/lib/ifeat is required in LD_LIBRARY_PATH
for libifport.so.5

shared library libiml.so not found

/home/fow3d/FLOW3D/install_instruct/gui/lib/ifeat is required in LD_LIBRARY_PATH
for libiml.so

shared library libiml.so not found

/home/fow3d/FLOW3D/install_instruct/gui/lib/ifeat is required in LD_LIBRARY_PATH
for libiml.so

To resolve the missing libraries on your system, the LD_LIBRARY_PATH
environment variable has been appended in the flow3dvars.sh and flow3dvars.csh
files to include the libraries included with FLOW-3D. The libraries included
with FLOW-3D provide maximum compatibility but may not be the latest available
for your system. If you choose to resolve these libraries by installing the appropriate
package, comment out the corresponding setting in flow3dvars.sh and/or flow3dvars.csh
and source them to refresh the LD_LIBRARY_PATH environment variable.

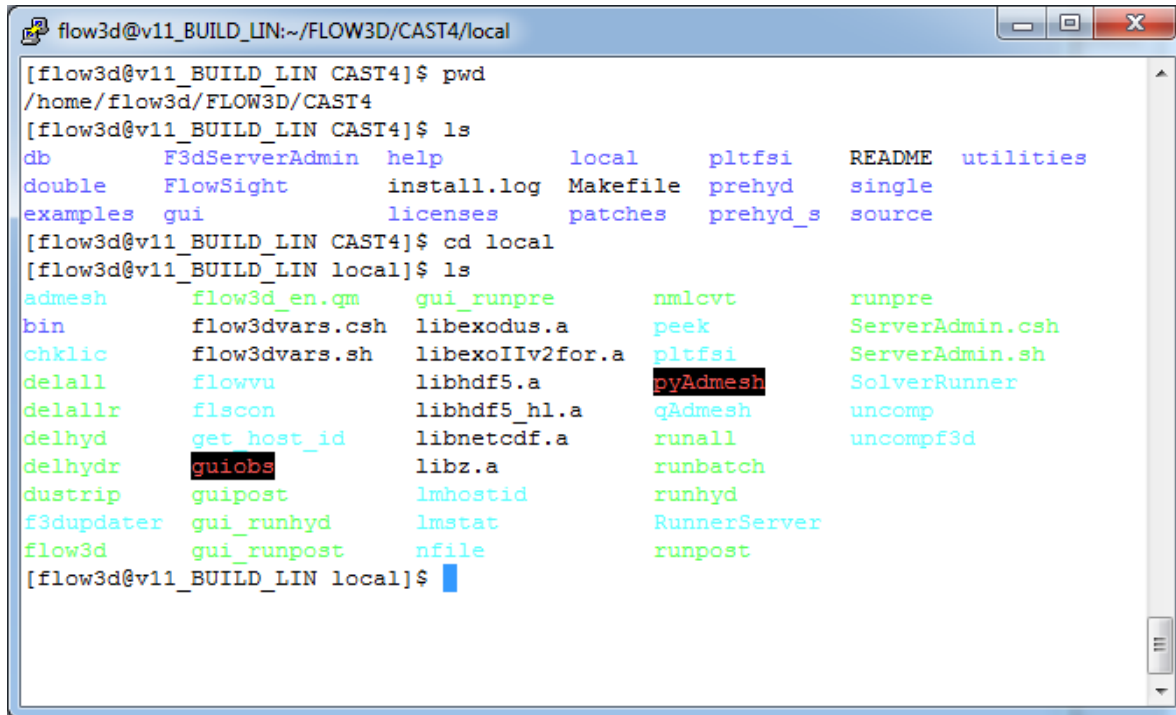
To use FLOW3D please run 'source /home/fow3d/FLOW3D/install_instruct/local/flow3dvars.sh' or
'source /home/fow3d/FLOW3D/install_instruct/local/flow3dvars.csh' in the shell you
add it to your .bashrc or .cshrc, respectively.

File /home/fow3d/FLOW3D/install_instruct/install.log contains a log of installation
log.

Do you want to install a desktop icon? (please respond with 'yes' or 'no')

```

- After installation, the installation directory will contain a directory structure similar to the one shown. A log of the installation, named `install.log` will be at the top level, and the scripts created by the installer will be in the `local` directory.

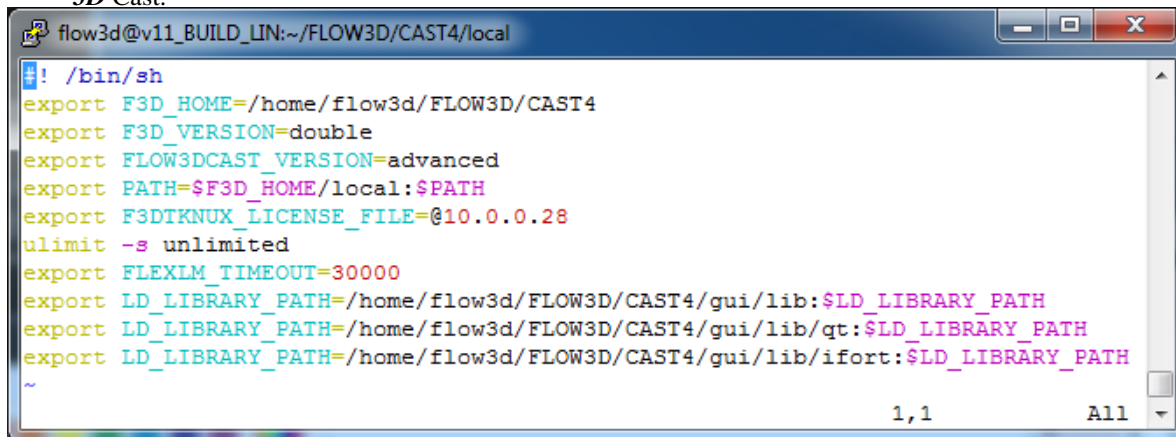


```

flow3d@v11_BUILD_LIN:~/FLOW3D/CAST4/local
[flow3d@v11_BUILD_LIN CAST4]$ pwd
/home/flow3d/FLOW3D/CAST4
[flow3d@v11_BUILD_LIN CAST4]$ ls
db          F3dServerAdmin  help          local        pltfsi        README        utilities
double      FlowSight       install.log   Makefile     prehyd        single
examples    gui             licenses     patches     prehyd_s     source
[flow3d@v11_BUILD_LIN CAST4]$ cd local
[flow3d@v11_BUILD_LIN local]$ ls
admesh      flow3d_en.qm    gui_runpre    nmlcvt       runpre
bin          flow3dvars.csh  libexodus.a   peek         ServerAdmin.csh
chklic      flow3dvars.sh   libexoIiv2for.a pltfsi       ServerAdmin.sh
delall      flowvu          libhdf5.a     pyAdmesh     SolverRunner
delallr     flscon          libhdf5_hl.a  qAdmesh      uncomp
delhyd      get_host_id     libnetcdf.a   runall       uncompf3d
delhydr     guiobs          libz.a        runbatch
duststrip   guipost         lmhostid      runhyd
f3dupdater  gui_runhyd      lmstat        RunnerServer
flow3d      gui_runpost     nfile         runpost
[flow3d@v11_BUILD_LIN local]$

```

11. The `flow3dvars.sh` file illustrates the environment variables that should be set to successfully run **FLOW-3D** Cast.



```

flow3d@v11_BUILD_LIN:~/FLOW3D/CAST4/local
#!/bin/sh
export F3D_HOME=/home/flow3d/FLOW3D/CAST4
export F3D_VERSION=double
export FLOW3DCAST_VERSION=advanced
export PATH=$F3D_HOME/local:$PATH
export F3DTKNUX_LICENSE_FILE=@10.0.0.28
ulimit -s unlimited
export FLEXLM_TIMEOUT=30000
export LD_LIBRARY_PATH=/home/flow3d/FLOW3D/CAST4/gui/lib:$LD_LIBRARY_PATH
export LD_LIBRARY_PATH=/home/flow3d/FLOW3D/CAST4/gui/lib/qt:$LD_LIBRARY_PATH
export LD_LIBRARY_PATH=/home/flow3d/FLOW3D/CAST4/gui/lib/fort:$LD_LIBRARY_PATH
~
1,1 All

```

1.3 Remote Solving Setup

A new feature in **FLOW-3D** Cast v4 is the ability to connect remote machines (called remote servers) to a primary workstation (referred to as the client) and submit simulations from the primary workstation to run on these remote computers. In addition to running remote simulations, these remote computers retain their ability to run **FLOW-3D** Cast as a client. The following sections will discuss how to set up *Remote Servers* and *Clients*.

1.3.1 Terminology and Requirements

The remote solving setup uses several programs on multiple machines, so it helps to define what each program is and the terminology that will be used beforehand. A list of the programs and terms is given below:

- **Server:** The remote machine where the simulation will be run.
- **Client:** The local machine where the setup is done. Simulations can also be run on this machine.
- **F3dServerAdmin:** This is a configuration program that is run on the server to configure **RunnerServer** for remote solving.
- **RunnerServer:** This program interfaces between the **FLOW-3D** Cast user interface and **SolverRunner**. An instance of this runs on both the client (for running local simulations) and the server (for running remote simulations).
- **SolverRunner:** This program interfaces between **RunnerServer** and the solver, **hydr3d**.

Additionally, there are two main requirements for the remote solving feature:

1. All of the clients and servers must have either a working client installation or client/server installation of **FLOW-3D** Cast before the remote setup can begin (see [Installation Procedure](#) for more information on installing **FLOW-3D** Cast).
2. **SolverRunner**, **RunnerServer**, and **FLOW-3D** Cast all communicate using sockets, so certain ports will need to be opened in the firewall.

1.3.2 Remote Servers

1. Run **F3dServerAdmin** on the server machine **F3dServerAdmin** is an executable that configures and controls the **RunnerServer** for use as a remote server. It is accessed differently depending on the OS:
 - **Windows:** Use the **FLOW-3D Remote Admin** icon in the **FLOW-3D** Cast Program Group in the Windows Start Menu. This is a shortcut to a batch file in the *local* folder of the **FLOW-3D** Cast installation directory (e.g., `c:\flow3d\CAST4\local\ServerAdmin.bat`)
 - **Linux:** Run the script `ServerAdmin.sh` (or `ServerAdmin.csh`) located in the *local* folder of the **FLOW-3D** Cast installation directory (e.g., `home/usr/FLOW3D/CAST4/local/ServerAdmin.sh`)

Note:

- **FLOW-3D Remote Admin** must be run as `root` or `Administrator`. Failure to do so will result in an error.
 - There is only one database file so **FLOW-3D Remote Admin** must be run by only one user.
 - **FLOW-3D Remote Admin** needs to update environment variables, so use `su -` to switch to the `root` user when using the tool on Linux.
-

2. *File→Server Configuration:* configure the settings for **RunnerServer**.
 - *Server Name:* The *Server Name* field provides a way for the server administrator to name the server for tracking purposes.
 - *IP address:* The IP address specified here is the IP address of the server machine. This field will automatically be populated with possible entries; select the one that is appropriate for your network.
 - *Server Port Number:* This is the port through which **FLOW-3D** Cast on the client will communicate with **RunnerServer** on the remote machine. *This port must be accessible through the firewall.*
 - *SolverRunner Minimum / Maximum Port Number:* Each time **RunnerServer** receives a job to run, it will spawn a new instance of **SolverRunner** to run the solver. Each instance of **SolverRunner** communicates simulation status information with the **FLOW-3D** Cast user interface using a different port, so these fields

specify the range of ports that may be used for communication between **FLOW-3D** Cast and each **Solver-Runner**. *This range of ports must be open for communication through the firewall.* The number of open ports is recommended to be equal to or greater than the number of solver tokens that are available.

3. *File→Solver Registration*: Configure what solvers are available. When a simulation is submitted to run on the remote server, it will automatically select the newest compatible installation to run the simulation. It should also be noted that only **FLOW-3D** v11.0.3 and newer solvers are supported.

- *Add*: Add a **FLOW-3D** Cast installation to the available solver list.
 - *Installation Directory*: The directory where **FLOW-3D** Cast is installed on the server machine.
 - *Release Number*: The version number associated with the solver in the *double* folder of the **FLOW-3D** Cast installation directory. This is automatically populated and not editable.
 - *Solver versions*: A list of the available solvers in the directory specified above. These are automatically populated and not editable.
- *Edit*: Edit the selected solver entry.
- *Delete*: Remove the selected set of solvers from the list.

4. *File→User Registration*: Configure user authentication settings.

- *Add*: Adds a new user to the authenticated user list.
 - *Full Name*: The name of the user (for the administrator's tracking purposes)
 - *User ID*: This is the username that will be used to authenticate the user when a client attempts to connect to the server.
 - *Password*: The password associated with the user ID for authentication
 - *Confirm Password*: Re-enter the password to avoid typographical errors
 - *Email Address*: The email address of the user. The administrator can send setup information to this address.
 - *Phone Number*: The phone number of the user (for the administrator's tracking purposes)
 - *Home Directory*: The directory on the server where the user's files are to be written before being transferred to the client.
- *Edit*: Edits the selected user's account settings.
- *Delete*: Deletes the selected user's account.
- *Email*: Provided for the administrator to send an email to one or more of the registered clients for disk management, maintenance issues, etc. When the administrator adds a new user during the remote server setup, the software automatically generates an email message with the user ID, password, IP address and server port number to the user. The administrator is given the chance to modify the message if desired and then send it. The same also occurs if any of those fields are modified when the Edit button is selected where the email message specifically references the change.

5. *File→Start Server*: Starts **RunnerServer**, allowing client machines to connect and submit jobs. When the server is running, this automatically changes to *Stop Server*. The server can also be activated and deactivated by toggling the icon of a running person.

Once **RunnerServer** is configured and running on the server, clients may begin submitting jobs to the server. When a job completes, the results files are compressed, encrypted, and copied back to the client machine where they are decrypted and uncompressed. The results files are not deleted from the server, so the administrator will need to do periodic cleanup of the file system to manage the available disk space. This can be done by selecting one or more simulations in the main list and clicking the *Delete Selected Jobs* button.

If necessary, the server administrator can also kill running jobs by selecting one or more simulations and choosing the *Kill Selected Job* button. If the administrator kills a running job from the server, the simulation is aborted and **the results files are not saved**. This is intended as a **last resort** option for stopping a running simulation; terminating from the client is preferred as the results will be saved and transferred to the client.

Note:

- Any changes made to the server settings in **FLOW-3D Remote Admin** do not take effect until **RunnerServer** is restarted.
 - The remote server cannot be stopped while simulations are running.
 - The client and server will only communicate if they have the same GUI and solver version.
 - Results files can take a significant amount of time to transfer from the remote server to the client machine.
 - The GUI on the client machine may slow down while a results file is being transferred from the remote server.
-

1.3.3 Clients

Once the remote server setup is complete (see *Remote Servers*), client machines can be configured to use this server for remote solving. When adding a new remote server on a client machine, the relevant setup information is entered in the *Preference→Remote Simulation Preferences→Remote Server Registration* dialog:

- *Server name*: the name of the server machine
- *IP address*: the IP address of the server machine
- *Port Number*: the port on the server machine through which **RunnerServer** communicates with external programs.
- *User ID*: the user ID (for authentication purposes)
- *Password*: the password associated with the user ID (for authentication purposes)

Existing remote servers can be edited or deleted using the respective buttons. After registration, the available remote servers will be listed in the queue and in the menu when submitting jobs to preprocess or run. As with any program running on a network, there are some potential issues that may occur:

- If a remote server disconnects it may be reconnected by right-clicking on the disconnected remote server in the queue (shown in red) and choosing *Try reconnecting to remote server*.
- If the file upload fails when submitting a job, a simulation can be removed from the queue by right-clicking on the simulation and choosing *Remove from queue*.
- If the results file fails to transmit (e.g., due to a connectivity problem) the results file must be manually retrieved from the server.

The *Preference→Remote Simulation Preferences→Automatically download results* preference controls whether the results are automatically or manually downloaded from the server when the simulation completes. If this preference is unchecked, the simulation will remain in the queue until the user clicks on the download button () or removes the simulation from the queue using the right-click menu. The results can only be downloaded after the download status icon () is shown next to the simulation in the queue.

Note:

- The client and server will only communicate if they have the same GUI and solver version.
- Results files can take a significant amount of time to transfer from the remote server to the client machine.
- The GUI on the client machine may slow down while a results file is being transferred from the remote server.

1.4 Licensing Information

1.4.1 FlexNet License Administration Tools

Flexera Software provides utilities for users or local license administrators to manage FlexNet licensing activities. The FlexNet End User Manual is available in the “utilities” subdirectory of the **FLOW-3D** Cast installation. This manual is available in both PDF and HTML formats. For Windows computers, the program **lmtools.exe** is provided with all installations. With **LMTOOLS**, users can start, stop and configure FlexNet license servers, get system information, get server information, and more. For more information, please see Chapter 12 of FlexNet End User Manual.

On **Windows** computers, the license manager daemon `lmgrd` will restart automatically whenever the computer is rebooted. On Linux computers, however, the license manager must be started each time the computer is rebooted. To have the license manager start automatically on Linux requires editing the appropriate boot script and inserting the appropriate startup commands. See Section 6.2 of the FlexNet End User Manual for more information. A summary of commonly used administration tools on Linux is included here. Full descriptions of these and other available utilities can be found in Chapter 12 of the FlexNet manual.

- **lmdiag** – diagnoses license checkout problems Useful debugging command: `lmutil lmdiag -n -c "full_license_file_path"`
- **lmdown** – gracefully shuts down all license daemons on the license server node.
- **lmgrd** – the main daemon program for FlexNet
- **lmhostid** – reports the HOSTID of a system
- **lmreread** – causes the license daemon to reread the license file and start any new vendor daemons
- **lmstat** – helps monitor the status of all network licensing activities Useful debugging command: `lmutil lmstat -a -c "full_license_file_path"`
- **lmver** – reports the FlexNet version of a library or binary file

Note: Using `kill -9` to shut down the license server on Linux computers is not recommended. Instead, use either “lmdown” or use the `kill` command without the `-9` parameter.

1.4.2 Licensing Terminology

- **Definition of Client and License Server:** Any computer running **FLOW-3D** Cast is referred to as a “client.” The computer on which the FlexNet license server is installed will be referred to as the “license server.” The client and server may be (and often are) the same machine.
- **Software Package and Software Distribution:** The terms “software package” and “software distribution” will be used to refer to the directory structure containing all of the data files and executables needed to run **FLOW-3D** Cast on a particular computer.
- **License Files and Servers:** A valid license file from Flow Science is required to use **FLOW-3D** Cast. This license file will be sent as an email attachment from Flow Science’s License Administrator at licenses@flow3d.com. This license file must be saved in the licenses directory of the **FLOW-3D** Cast installation on the machine that will act as the license server. More detail about this is given in the [Windows Installation](#) and [Linux Installation](#) sections below.

As discussed in [Floating vs. Node-Locked Licenses](#), **FLOW-3D** Cast can be used on multiple computers, but one computer must be selected to be the license server. If the computer chosen to be the license server will

not actually be used to run **FLOW-3D** Cast, then only the FlexNet license server needs to be installed on that machine. Also, if the FlexNet license server will be installed on a Windows computer, a licensing dongle that attaches to the USB port of the computer will be provided by Flow Science. This key is enclosed in the **FLOW-3D** Cast package.

Tokens

The total number of **FLOW-3D** Cast solver processes that can be run concurrently is determined by the number of “tokens” contained in the license file. The number of tokens available depends on how many were purchased. The license server checks tokens out to client computers on the network, and then checks them back in when the application has completed. In this process, tokens are counted by the license server and when all of the tokens purchased have been checked out, no more tokens can be checked out until a token which is in use has been checked in.

There are several different types of solver tokens. The most important distinction is between “serial” solver tokens and “parallel” solver tokens. Flow Science offers multi-processor versions of **FLOW-3D** Cast for both shared-memory (SMP) and distributed-memory (cluster) environments. A shared memory parallel solver token (shown in the license file as `hydr3dp`) enables **FLOW-3D** Cast simulations using more than one processor on a multiprocessor computer. For the distributed-memory version, **FLOW-3D/MP**, a `hydr3d` or `hydr3dp` instance token is required as well as `hydr3dmpi` rank tokens. For example, to run a simulation on 16 processors using **FLOW-3D/MP**, the license file must have a `hydr3d` token and 15 `hydr3dmpi` tokens.

There are tokens specific to **FLOW-3D** Cast. The Basic version uses `hydr3dcci` tokens, the Extended token uses `hydr3dcci`, and the Advanced version uses **FLOW-3D** `hydr3d` or `hydr3dp` tokens. These solver tokens can be used on computers running any supported operating system. There are essentially an unlimited number of tokens available to run **FLOW-3D** Cast’s auxiliary programs such as the preprocessor, the postprocessor, and the various visualization options.

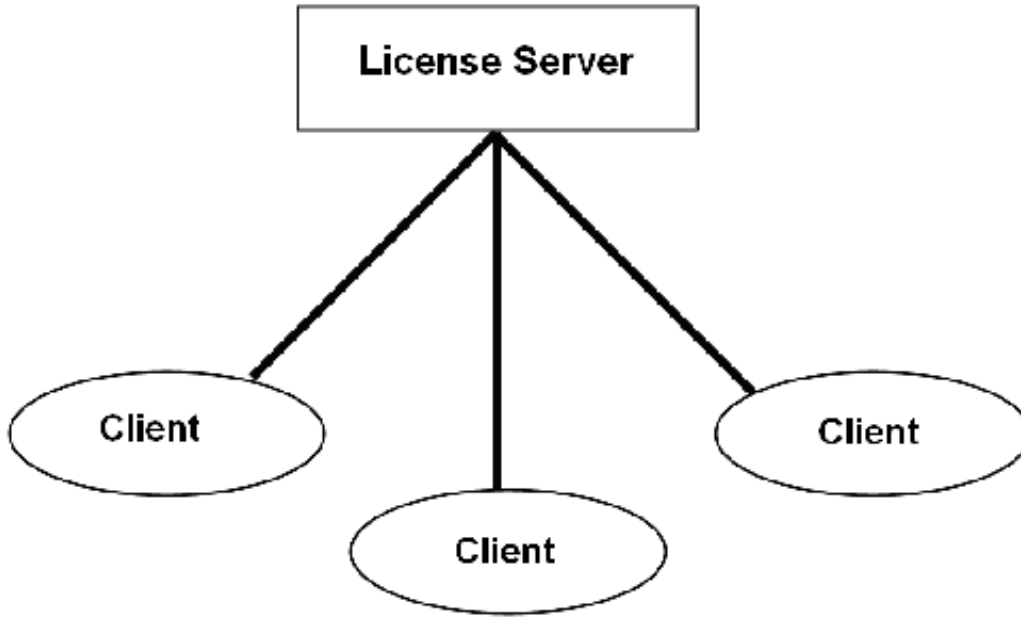
Floating vs. Node-Locked Licenses

There are two general types of licenses used to enable **FLOW-3D** Cast: “floating” and “node-locked.” A floating license is the most common type of license and is available to any computer on the network. Flow Science can also provide a node-locked license. Node-locked licenses can only be used on the designated computer.

Both floating and node-locked licensing schemes require that one computer be designated as the license server.

- **Floating Licenses:** To use floating licenses, it is important that both the network and the computer intended for use as the license server are reliable. The TCP/IP protocol must be loaded and functional, and all intended clients must be able to access the license server. Floating licenses may also be accessed through a VPN tunnel. The computer that is acting as the license server may be any computer on the network, and does not need to have **FLOW-3D** Cast installed. The license server may be a Windows or a Linux computer. Users may load **FLOW-3D** Cast on any client running a supported Linux or Windows computer on the network. A hardware key is not needed on a client computer unless it uses a node-locked license.

To employ a floating license on a single computer, **FLOW-3D** Cast should be installed with the client/server option. The license server and the clients may reside on the same local area network, over a WAN, or across VPN. **FLOW-3D** Cast must be installed locally on each client. An example of a floating license configuration is shown below.



- **Node-Locked Licenses:** Users may choose to have their solver tokens locked to a particular computer so that only that computer can run the solver.

Both floating and node-locked licensing schemes have their advantages and disadvantages. A floating license is advised if several people are sharing a license, or it may be necessary to run *FLOW-3D* Cast on a different computer if a particular computer is busy. With a floating license, a problem can be set up on one computer while using another to run the *FLOW-3D* Cast solver on a second problem. If other machines or problems are using all available tokens, the solver will not run until a token becomes available. The main advantage of a node-locked license is the ability to ensure that token(s) are always available to a specific machine and not available to others on the network.

Note: All licenses are floating licenses unless specifically requested as node-locked.

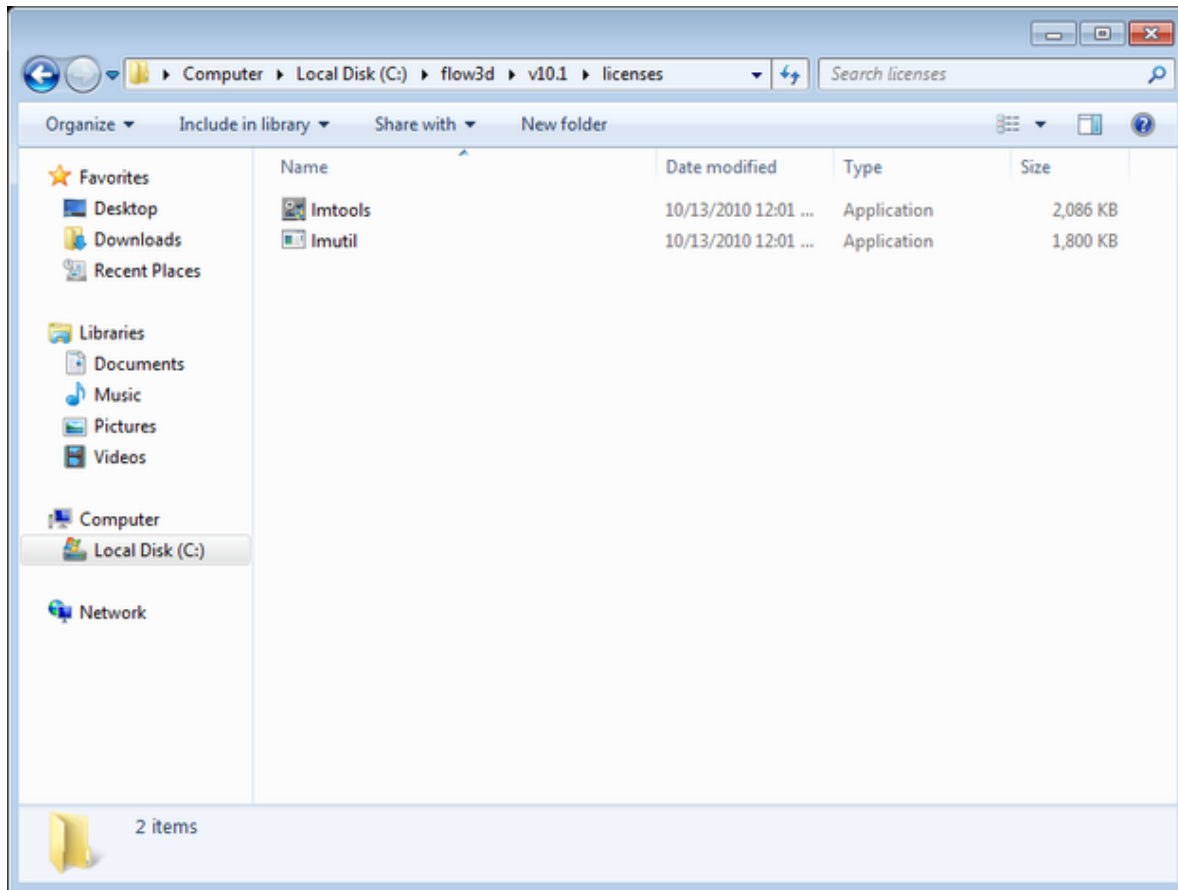
1.4.3 Moving License Servers

When a floating license is locked to a fixed host ID, such as an Ethernet address or host ID, it is recommended that users choose a server which is likely to be used for the duration of the license. Changing license servers can be done once a year without incurring a re-licensing fee. Re-licensing fees are not necessary (maximum one change per year) when users use a USB or parallel port hardware key (dongle) as their host ID. To move the dongle (and hence license server) to a different computer, the user simply has to change the first line in the license file to reflect the computer name change. For example, if the license server was previously running on a server named Celsius and will be moved to Kelvin, the first line in the license file would be changed from `SERVER Celsius FLEXID= "your ID"` to `SERVER Kelvin FLEXID= "your ID"`.

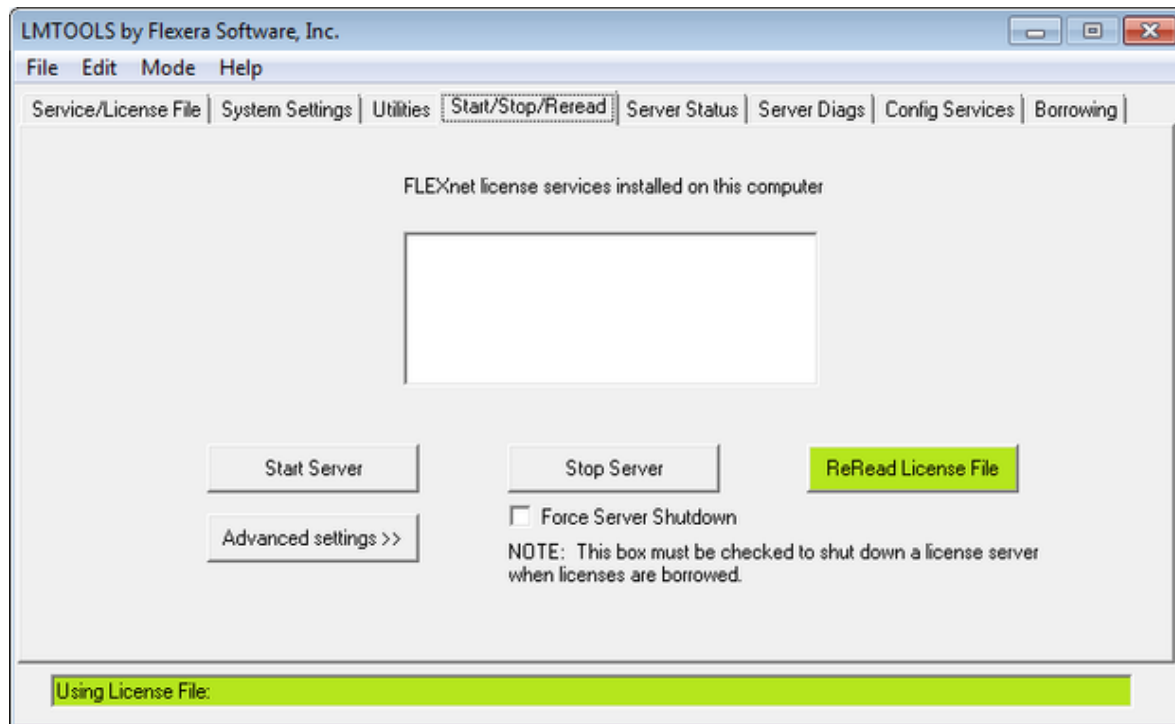
1.4.4 Installing a New/Replacement License File

Windows

1. When a new or replacement `flow3d.lic` is received from the License Administrator, place it into the `licenses` subdirectory found within the directory where *FLOW-3D* Cast was installed.

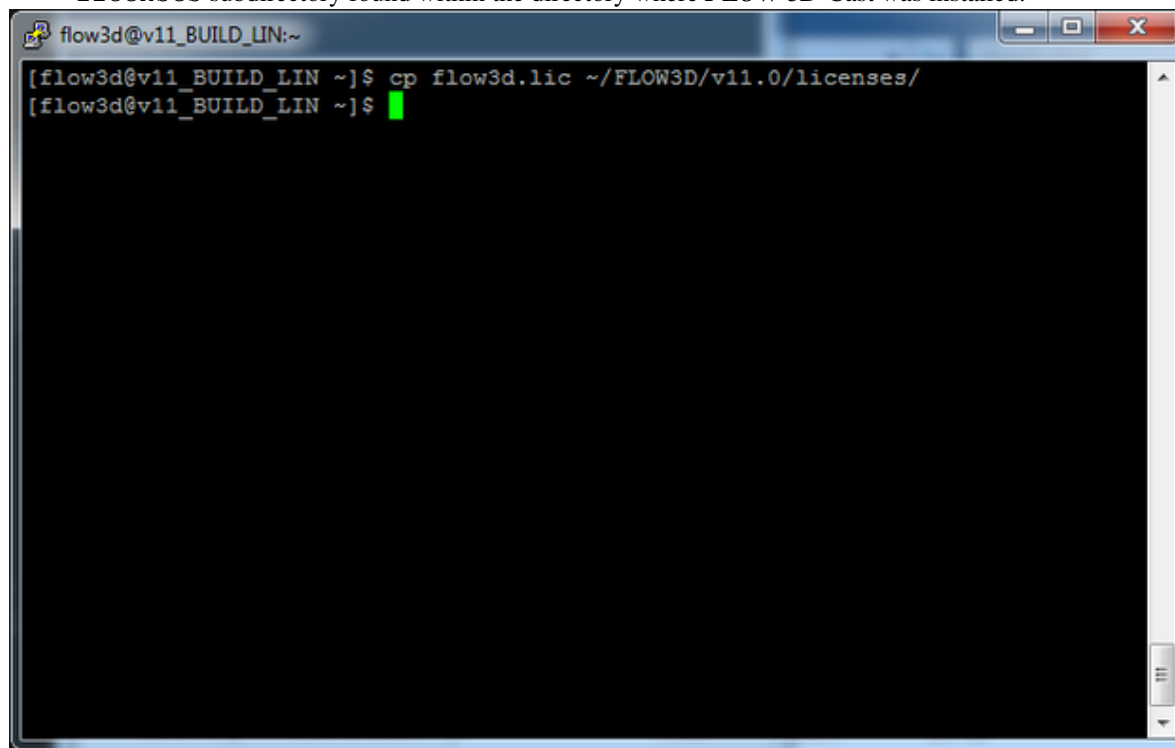


2. Start the **LMTOOLS** utility, from either this directory, the shortcut on the desktop, or the icon in the *Start Menu*. Click the *Start/Stop/Reread* tab. Verify that the license file is in the correct location by checking the directory shown (highlighted in the figure below). If correct, click the *ReRead License File* button (also highlighted).



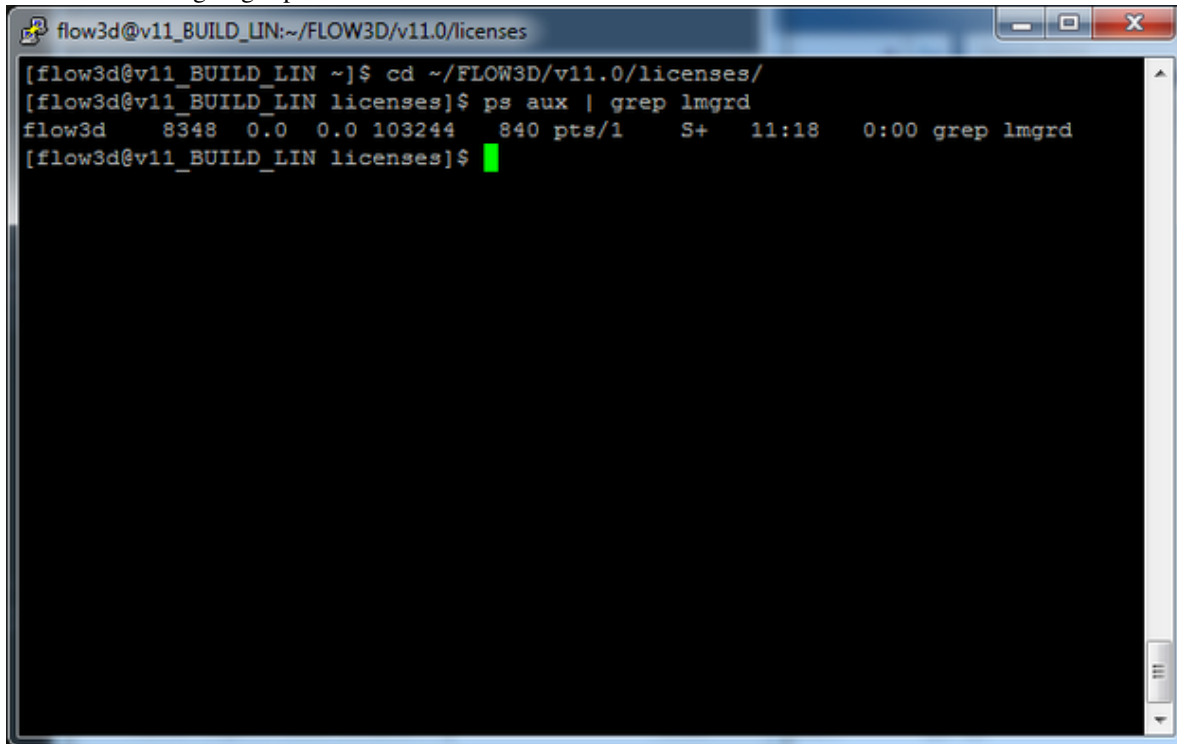
Linux

1. When a new or replacement `flow3d.lic` is received from the License Administrator, place it into the `licenses` subdirectory found within the directory where **FLOW-3D** Cast was installed.



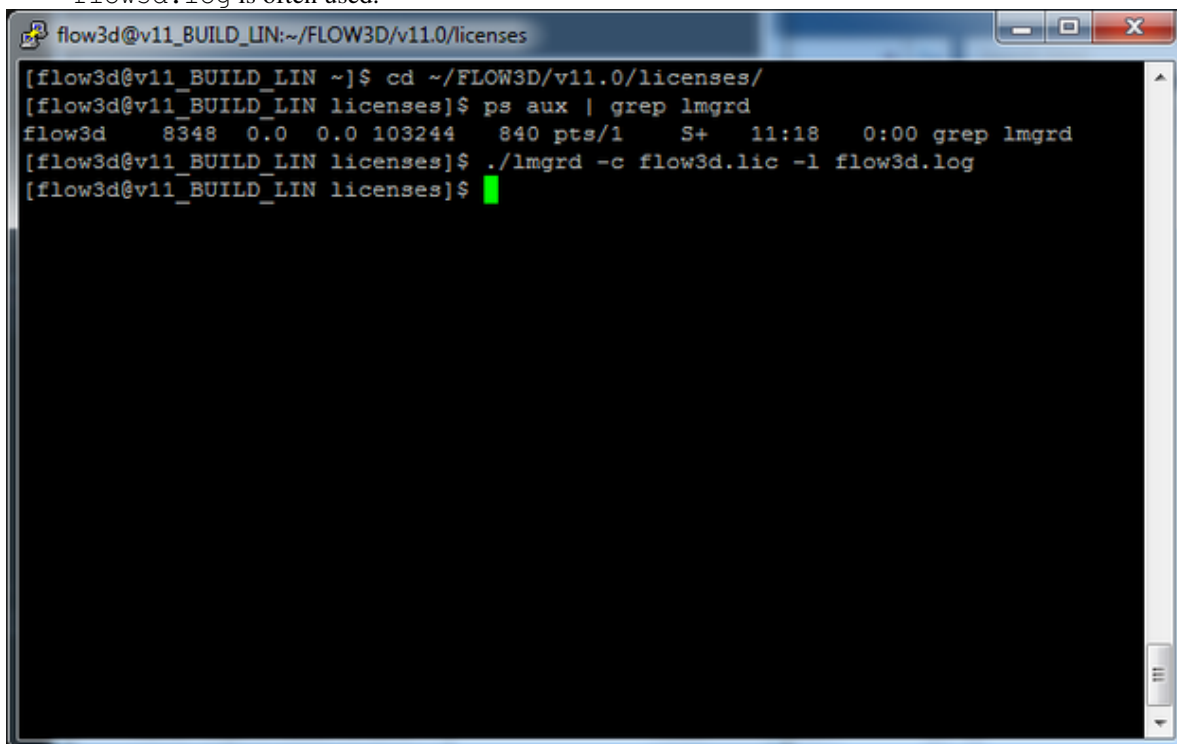
2. Check whether the license server is running using `ps aux | grep lmgrd`. This will provide the PID of

any running license servers. They can be killed using `kill (PID)`. It is not recommended to use `kill -9` on a running `lmgrd` process.



```
flow3d@v11_BUILD_LIN:~/FLOW3D/v11.0/licenses
[flow3d@v11_BUILD_LIN ~]$ cd ~/FLOW3D/v11.0/licenses/
[flow3d@v11_BUILD_LIN licenses]$ ps aux | grep lmgrd
flow3d      8348  0.0  0.0 103244   840 pts/1    S+   11:18   0:00 grep lmgrd
[flow3d@v11_BUILD_LIN licenses]$
```

3. It is recommended to run the license server as a user, not as root. The command to start the new `lmgrd` process is `lmgrd -c flow3d.lic -l logfile.log`, where the logfile name may be changed as needed. `flow3d.log` is often used.



```
flow3d@v11_BUILD_LIN:~/FLOW3D/v11.0/licenses
[flow3d@v11_BUILD_LIN ~]$ cd ~/FLOW3D/v11.0/licenses/
[flow3d@v11_BUILD_LIN licenses]$ ps aux | grep lmgrd
flow3d      8348  0.0  0.0 103244   840 pts/1    S+   11:18   0:00 grep lmgrd
[flow3d@v11_BUILD_LIN licenses]$ ./lmgrd -c flow3d.lic -l flow3d.log
[flow3d@v11_BUILD_LIN licenses]$
```

1.4.5 Troubleshooting License Problems

Windows

This guide provides a series of steps that can be used to diagnose and resolve licensing issues with **FLOW-3D** Cast. Feel free to contact our support staff at support@flow3d.com or at (505) 982-0088 if you have trouble at any point.

1. Close any open instances of **FLOW-3D** Cast and close *RunnerServer.exe* (an application running in the task tray). After closing **FLOW-3D** Cast, confirm that there are no instances of *flow3d.exe*, *hydr3d.exe*, *RunnerServer.exe*, *guiobs.exe*, or *flscon.exe* running by looking at the processes tab of the task manager. If there are, terminate the process.
2. Verify that the correct install option was chosen.
 - (a) **Client**: You intend to run **FLOW-3D** Cast on this computer but will install the license server on another computer.
 - (b) **Server / Client**: You intend to run both **FLOW-3D** Cast and the license server on this computer.
 - (c) **Server**: You are only installing the license server on this computer.

If the *Server* or *Server/Client* installation was not selected for the machine running the license server you will need to run the *Server* installation on this computer. You can check if the necessary software was installed by looking for the files *F3DTKINUX.exe* and *lmgrd.exe* in the licenses folder of the installation directory on the server machine. If they are in this folder then the server software was installed.

3. Verify that the license file (*flow3d.lic*) is in the correct location. It should be in the licenses subfolder of the installation directory on the server machine (e.g. C:\flow3d\v11.0\licenses).
4. Make sure you are using the correct license file for your server machine. You will need to open the license file (*flow3d.lic*) in a text editor on the server machine.
 - (a) Make sure the server machine computer name (or IP address) matches what is in the license file. This parameter may be edited in the license file to match the computer.
 - i. The first line of the license file will read `SERVER <name> . . .`
 - ii. The computer name, <name>, can be found from *My Computer* → *Properties*. Alternatively, the IP address can be found by opening a command prompt and typing `ipconfig -all`. The IP address looks like: `xx.x.x.xxx`.
 - (b) If you were sent a USB dongle:
 - i. Verify that the dongle is plugged into the server machine and that the red light on the dongle is lit.
 - ii. Make sure that the dongle matches the license file
 - A. Compare the flexID marked on the dongle with the one at the top of the license file (open in a text editor). The first line of the license file should look like: `SERVER <name> FLEXID=<flexID> <port>`, where <flexID> is a string of numbers and characters and cannot be modified. The dongle flexID must match what is specified in the license file.
 - B. This can also be checked by opening LMTOOLS, located in the licenses folder of the install directory, and viewing the FLEXID box on the system settings tab.
 - (c) If your license is locked to an Ethernet (MAC) address:
 - i. Make sure the server network card physical address matches what is specified in the license file. The value in the license file cannot be changed.
 - A. The first line of the license file will read `SERVER <name> <physical address> <port>`

- B. The server network card physical address, <physical address>, can be found by opening a command prompt and typing `ipconfig -all`. The server network card physical address looks like: `xx-xx-xx-xx-xx-xx`
5. Check that the necessary environment variables are set on the client machines.
 - (a) Right-click on the **FLOW-3D** Cast icon and choose *Edit*.
 - (b) Verify that the following variables have the correct values. Note that the values below are based on the default install location.
 - i. `F3D_HOME = C:\flow3d\Cast402` (the **FLOW-3D** Cast installation directory)
 - ii. `PATH = C:\flow3d\Cast402\local`
 - iii. `F3DTKNUX_LICENSE_FILE = @xx.x.x.xxx` (this should point to the server IP address preceded by the @ symbol)
 6. Verify that the firewall on the server machine has exceptions for the license daemons.
 - (a) Go to *Start* → *Control Panel* → *Windows Firewall*.
 - (b) Click *Allow a program or feature through Windows Firewall*.
 - (c) Verify that `FLOW-3D_v11_license_daemon` and `FLOW-3D_v11_vendor_daemon` are in the list and checked for the appropriate networks. If not, choose *Allow another program...* and browse to the licenses folder of the installation directory and add exceptions for `lmgrd.exe` and `F3DTKNUX.exe`.
 7. Now restart the license server and reread the license file on the server machine.
 - (a) Open a command prompt and change to the licenses folder in the install directory (e.g. `cd c:\flow3d\Cast4\licenses`)
 - (b) Type `lmutil lmdown -c flow3d.lic` to shut down any running license daemons
 - (c) Type `lmgrd -c flow3d.lic -l flow3d.log` to restart the server. You may be notified that the firewall is blocking the license daemons. If this is the case, allow exceptions for `F3DTKNUX.exe` and `lmgrd.exe`
 - (d) Perform a status check by typing `lmutil lmstat -c flow3d.lic`. This will display the server status. It should now report:


```
[Detecting lmgrd processes...]
License server status: <port>@<name>
License file(s) on <name>: @<IPaddress>
License file(s) on <name>: <licensepath>: <name>: license server UP (MASTER) v11.9
Vendor daemon status (on <name>): F3DTKNUX: UP v11.9
```

Where <port> is the port number being used by the server, <name> is the name of the computer running the server (as it appears on the network), <IPaddress> is the IP address of the server, and <licensepath> is the full directory location of the license file (`flow3d.lic`). Note that running multiple license servers on the same machine may result in conflicts in port usage. If there is a conflict, change (or add) the port number, <port>, in the license file and repeat step 6. The default port number is 27000.
 8. You should now be able to launch and run **FLOW-3D** Cast.

Linux

This guide provides a series of steps that can be used to diagnose and resolve licensing issues with **FLOW-3D** Cast. Feel free to contact our support staff at support@flow3d.com or at (505) 982-0088 if you have trouble at any point.

1. Close any open instances of **FLOW-3D** Cast and close *RunnerServer.exe*. It is worth verifying that there are no instances of *flow3d.exe*, *RunnerServer.exe*, *hydr3d.exe*, *guiobs.exe*, or *flscon.exe* running by typing `ps -A | grep flow3d`, `ps -A | grep hydr3d`, etc. If something is running it can be stopped using the kill command.
2. Verify that the correct install option was chosen.
 - (a) **Client:** You intend to run **FLOW-3D** Cast on this computer but will install the license server on another computer.
 - (b) **Server / Client:** You intend to run both **FLOW-3D** Cast and the license server on this computer.
 - (c) **Server:** You are only installing the license server on this computer.

If the *Server* or *Server/Client* installation was not run on the machine running the license server you will need to run the *Server* installation on this computer. You can check if the server software was installed by looking in the licenses folder of the installation directory on the server machine for the files *F3DTKNUX.exe* and *lmgrd.exe*. If they are in this folder then the server software was installed.

3. Verify that the license file (*flow3d.lic*) is in the correct location. It should be in the licenses subfolder of the installation directory on the server machine (e.g. `/home/flow3d/Cast402/licenses`).
4. Make sure you are using the correct license file for your server machine. You will need to open the license file (*flow3d.lic*) in a text editor (or using more) on the server machine.
 - (a) Make sure the server machine computer name (or IP address) matches what is in the license file. This parameter may be edited in the license file to match the computer.
 - i. The first line of the license file will read `SERVER <name> . . .`
 - ii. The IP address, `<name>`, can be found by entering `/sbin/ifconfig` in to a terminal. The `eth0` section will contain the information. The IP address is called `inet addr` and looks like: `xx.x.x.xxx`
 - (b) If you were sent a USB dongle (RHEL only):
 - i. Verify that the dongle is plugged into the server machine and the red light on the dongle is lit.
 - ii. Make sure that the dongle matches the license file
 - A. The first line of the license file should look like: `SERVER <name> FLEXID=<flexID> <port>`, where `<flexID>` is a string of numbers and characters.
 - B. The `flexID` is marked on the dongle and at the top of the license file (open in a text editor). The dongle `flexID` must match what is specified in the license file and the value in the license file cannot be modified.
 - C. This can also be checked by opening LMTOOLS, located in the licenses folder of the install directory, and viewing the FLEXID box on the system settings tab
 - (c) If your license is locked to an Ethernet (MAC) address:
 - i. Make sure the server network card physical address matches what is specified in the license file. The value in the license file cannot be changed.
 - A. The first line of the license file will read `SERVER <name> <physical address> <port>`.
 - B. The server network card physical address, `<physical address>`, can be found by entering `/sbin/ifconfig` into a terminal. The `eth0` section will contain the information. The server network card physical address is called `HWaddr` and looks like: `xx-xx-xx-xx-xx-xx`
5. Check that the necessary environment variables are set on the client machines. The easiest way to do this is to run one of the included shell or c-shell files.

- (a) Open a terminal and change to the local directory in the install directory (e.g. `cd /home/flow3d/Cast402/local`)
 - (b) Type `more flow3dvars.sh` (or `more flow3dvars.csh`) and verify that the environment variables are correct. The variables and example definitions are shown below. If the definitions are incorrect they can be fixed using a text editor like `vi`.
 - i. `export F3D_HOME = /home/Cast402/`: This should point to the **FLOW-3D** Cast installation directory.
 - ii. `export F3D_VERSION=double`: Sets the default solver type to double-precision.
 - iii. `export PATH=$F3D_HOME/local:$PATH`: Tells the file system where to find the **FLOW-3D** Cast executable
 - iv. `ulimit -s unlimited`: This unlimits the stack size. Not doing this is a common cause of segmentation faults.
 - v. `export F3D_HELP=/usr/bin/firefox` (default browser for help files)
 - vi. `export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:$F3D_HOME/gui/lib`
 - vii. `export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:$F3D_HOME/gui/lib/qt`
 - viii. `export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:$F3D_HOME/gui/lib/ibft`
 - ix. `export F3DTKNUX_LICENSE_FILE = @xx.xx.xx.xxx`: This variable is used on client machines and should point to the server name or IP address.
 - (c) Type `source flow3dvars.sh` (or `source flow3dvars.csh`) to set the variables defined in the shell (or c-shell). This command will need to be called every time a new terminal is opened to launch **FLOW-3D** Cast. Alternatively, this command can be added to the `.bashrc` file to make this an automatic process.
6. Now restart the license server and reread the license file on the server machine
- (a) Open a terminal and change to the licenses directory in the install directory (e.g. `cd /home/flow3d/Cast402/licenses`)
 - (b) Type `./lmdown -c flow3d.lic` to shut down the running license daemons
 - (c) Type `./lmgrd -c flow3d.lic -l flow3d.log &` to restart the server
 - i. The `&` is to run the daemons in the background
 - ii. You may need to allow firewall exceptions for *F3DTKNUX.exe* and *lmgrd.exe*
 - (d) Type `./lmreread -c flow3d.lic` to reread the license file
 - (e) Perform a status check by typing `./lmstat -c flow3d.lic`. This will display the server status. It should now report:


```
[Detecting lmgrd processes...]
License server status: <port>@<name>
License file(s) on <name>: @<IPaddress>
License file(s) on <name>: <licensepath>: <name>: license server UP (MASTER) v11.9
Vendor daemon status (on <name>): F3DTKNUX: UP v11.9
```

Where `<port>` is the port number being used by the server, `<name>` is the name of the computer running the server (as it appears on the network), `<IPaddress>` is the IP address of the server, and `<licensepath>` is the full directory location of the license file (*flow3d.lic*).
 - (f) Note that running multiple license servers on the same machine may result in conflicts in port usage. If there is a conflict, change (or add) the port number, `<port>`, in the license file and repeat step 6. The default port number is 27000.

7. You should now be able to launch and run *FLOW-3D* Cast.

1.5 License Agreement and Copyright

1.5.1 *FLOW-3D* End User License Agreement

THE TERMS AND CONDITIONS OF THIS END-USER LICENSE AGREEMENT SHALL GOVERN YOUR USE OF THE SOFTWARE. READ THIS LICENSE CAREFULLY BEFORE INSTALLING AND USING THE SOFTWARE. BY USING THE SOFTWARE, YOU AGREE TO BE BOUND BY THE TERMS OF THIS AGREEMENT.

1. The Software is licensed to You by Flow Science, Inc. (**Licensor**) on a nonexclusive and nontransferable basis, subject to the commercial terms specified in the Acquisition Agreement and subject to the terms and conditions set forth herein.

IF YOU ARE AN ACADEMIC USER, YOU UNDERSTAND THAT YOU ARE OBLIGATED TO RESTRICT YOUR USE OF THE SOFTWARE TO TEACHING, ACADEMIC AND/OR UNSPONSORED RESEARCH, OR SPONSORED RESEARCH THAT CAN AND WILL BE FREELY PUBLISHED WITH NO PROPRIETARY RESTRICTIONS.

2. Definitions: **Acquisition Agreement** means a separate executed agreement between You (or the entity under whose authorization You are using the Software) and Licensor or one of its authorized distributors. Such agreement governs, among other things, the specific *FLOW-3D* Cast Product that is licensed to you, the number of allowed concurrent instances, price, license duration, and rights to technical support and upgrades.

Agreement means this End-User License Agreement

Documentation means manuals, release or installation notes related to *FLOW-3D* Cast Products and/or FlowSight, including electronic versions thereof.

FLOW-3D Cast **Product** means those computational fluid dynamics software programs, sold and distributed individually as *FLOW-3D* Cast, *FLOW-3D*/MP, *FLOW-3D* Cast Cast or *FLOW-3D* Cast ThermoSET, and any other similar product which is now available or may become available from Licensor under the same family name.

FlowSight means the post-processing and visualization tool packaged with the *FLOW-3D* Cast Product. FlowSight is a custom version of EnSight, limited to use in conjunction with *FLOW-3D* Cast Products only, which is distributed by Licensor under license from Computational Engineering International, Inc. (CEI).

Software means such computer program from among the *FLOW-3D* Cast Products that is licensed to You hereunder, FlowSight, the Documentation, and any backups or other copies.

3. License Management. In connection with the License granted herein, Licensor will issue one or more electronic license files which shall be tied to either a **FLEXIm** hardware dongle or to the Ethernet address of a designated server. Such license file(s) will enable the running of the Software's preprocessor and postprocessor and control the number of concurrent instances of the Software's solver module and FlowSight in use. You agree not to take any steps to avoid or defeat the purpose of such licensing measures. Use of the Software without a license file, or in excess of the number of authorized concurrent instances is expressly prohibited. Upon request, You agree to submit log files to Licensor for verification. Use of the Software on a network is restricted to a fifty-mile radius around one geographic location, unless otherwise authorized by Licensor.
4. Maintenance. If arrangements for technical support have been made, only the person designated by You as the **Registered User**, or persons who have attended a *FLOW-3D* Cast Training Class, will be entitled to contact Licensor or its authorized distributor to seek technical support. Technical support will be provided via telephone, e-mail, web-based meetings, fax, and/or mail during normal business hours.

In order to enable Licensor to provide timely and beneficial technical support for the Software, You agree to install updates, fixes, circumventions, and corrective code to the Software in a reasonable time after receipt

thereof and to be responsible for the installation and administration of the Software on platforms officially supported by Licensor). Licensor shall not be obligated to provide technical support unless You are using the current version of the **FLOW-3D** Cast Product You are licensed to use or the previous major release thereof.

If You are an academic user and have purchased maintenance service, such service is limited to the following: (a) Licensor will provide User with software upgrades when they become available; (b) Licensor will assist in installation of the code and will answer questions about how to use the input variables to implement the various models in **FLOW-3D** Cast; (c) at its option, Licensor will analyze results that appear obviously incorrect because they don't seem to reproduce simple analytical results or expected conservation laws; (d) Licensor will also provide access to a number of subroutines to allow users to implement small changes to **FLOW-3D** Cast, including boundary conditions and material properties; (e) Licensor will not assist in the making of revisions or customizations to the Software.

5. Use and Limitations. The Software is the property of Licensor, or with respect to FlowSight, of CEI. You recognize that the Software is copyrighted under the laws of the United States of America and international treaty provisions. Notwithstanding the copyrights, the Software contains trade secrets and proprietary information of Licensor and CEI, and You agree not to act in contravention of any of Licensor's or CEI's intellectual property rights. You acknowledge that Licensor and CEI own the aforementioned rights and have the following exclusive rights with regard to the applicable portions of the Software: to reproduce it; to adapt, transform or rearrange it; to prepare derivative works from it; and to control its distribution.

The Software is licensed, not sold. No title to or ownership of the Software or any part thereof is hereby transferred to You, and all rights not specifically granted to You shall remain with Licensor and CEI, as appropriate. You acknowledge that, by virtue of this Agreement, You acquire only the right to use the Software pursuant to the terms of this Agreement.

You agree to take all necessary action to protect the confidential and proprietary information in the Software to avoid the disclosure of the contents of the Software to any other person, firm, or corporation, and to treat the Software with the same degree of care that You provide Your own confidential information. You agree to credit Licensor and the Software in any written or verbal presentation where results obtained using the Software are discussed.

You may use the Software only as expressly permitted in this Agreement. You may not: (i) rent, loan, transfer, sublicense, distribute, or otherwise assign the Software or any or all of Your rights hereunder without prior written consent of Licensor, and any attempt at the same shall be wholly void and ineffective for all purposes; (ii) copy the Software (except to make archival copies for backup purposes); (iii) decompile, disassemble, or otherwise reverse engineer the Software; (iv) publish the Software for others to copy; or (v) use the Software in any way that is against the law or contrary to the terms of this Agreement. You may use the Documentation only in support of Your use of the Software and You may print or duplicate the Documentation, but only for internal use and provided that each copy includes all of the copyright or related notices of the original.

The License and the rights granted hereunder are subject to Your compliance with all laws, regulations, orders, or other regulations relative to export or redistribution of the Software that may now or in the future be imposed by the government of the United States or any agency thereof or of any other country into which the Software may be transported. Any act of noncompliance shall immediately terminate this License.

If You are the USA Department of Defense ("DOD"), the Software is subject to "Restricted Rights," as that term is defined in the DOD Supplement to the Federal Acquisition Regulations section 252.227-7013(c). If You are any unit or agency of the U.S. Government other than the DOD, Your rights in the Software will be defined in paragraph 52.227-19(c)(2) of the Federal Acquisition Regulations. Any use, duplication, reproduction, or disclosure by the U.S. Government is subject to such restrictions. Contractor/Manufacturer is: Flow Science, Inc., 683 Harkle Road, Santa Fe, NM 87505.

6. Termination. This Agreement shall terminate upon occurrence of any of the following events: (a) any breach of Sections 3, 4 or 5 hereof (effective immediately); (b) Your failure to observe or perform any other material covenants, terms, and conditions of this Agreement where such nonperformance is not fully remedied by You within thirty (30) days after written notice from Licensor; or (c) the filing of a petition for Your bankruptcy, whether voluntary or involuntary, or an assignment of Your assets made for the benefit of creditors, or the

appointment of a trustee or receiver to take charge of Your business for any reason, or Your becoming insolvent or voluntarily or involuntarily being dissolved.

Upon termination of the Agreement, Licensor shall have the right, without notice, to repossess the Software. In addition, Licensor shall have all other remedies and damages available to it in law or equity. Licensor is entitled to reimbursement from You for any expenses, legal fees, and/or court costs incurred in the enforcement of its rights hereunder or in the collection of damages.

7. **Warranties.** The Licensor warrants that it has the right to grant to You a license and warrants that the Software does not infringe third party intellectual property rights. Licensor shall indemnify and hold You harmless from and against any claim of infringement of a United States patent or copyright based upon the Software, provided You gives Licensor prompt notice of and the opportunity to defend any such claim. Licensor shall have the right to settle such claim or, at Licensor's option, provide You: (i) a paid-up license; (ii) substitute functionally equivalent software; or (iii) a refund of a pro rata portion of the license fee paid for the Software.

The warranty and the obligation and liability of Licensor expressed in the preceding paragraph are in lieu of, and YOU HEREBY WAIVE, ALL OTHER GUARANTEES AND WARRANTIES OR OBLIGATIONS AND LIABILITIES OF LICENSOR HEREUNDER, EXPRESSED OR IMPLIED, ARISING BY LAW OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY AND ALL OBLIGATIONS AND LIABILITIES WITH RESPECT TO USE OF THE SOFTWARE OR USE OF RESULTS AND DATA DERIVED FROM SUCH USE, LOSS OF USE, DATA, REVENUE, OR PROFIT, OR INDIRECT, SPECIAL, PUNITIVE, OR CONSEQUENTIAL DAMAGES. You agree that the obligations of Licensor as set forth herein shall constitute the sole remedy for a claim relating in any way to the Software provided under this Agreement. The liability of Licensor shall in all cases be limited to the purchase price of the Software.

8. Licensor takes certain steps to attempt to minimize unauthorized use and piracy of the Software. In this context, the Software may include a security mechanism that can detect the installation or use of illegal copies of the Software, and collect and transmit data about those illegal copies. Data collected will not include any customer data created with the Software. By using the Software, You consent to such detection and collection of data, as well as its transmission and use if an illegal copy is detected.
9. **Audit.** Licensor shall have the right, upon reasonable notice to You, to audit Your use of the Software no more than once each calendar year to assure compliance with the terms of the agreement between Flow Science and You. If an audit reveals that You have underpaid license fees to Licensor by overuse of solver tokens, You shall agree to compensate Licensor based upon Licensor's price list in effect at the time the audit is completed. If the underpaid fees exceed 5% of the license fees previously paid by You, then You shall also pay Licensor's reasonable cost of conducting the audit.

10. **General:**

- (a) The parties' exercise of, or failure to exercise, any right, remedy, or privilege under this Agreement will not constitute a waiver of any rights of that party under this Agreement.
- (b) A judicial determination that any provision of this Agreement is invalid, illegal, or unenforceable shall not affect the enforceability of any other provision.
- (c) You acknowledge and agree that You (and any third party acting on Your behalf) may provide, and Licensor (and third parties acting on behalf of Licensor) may obtain, certain information and data with respect to You (including, without limitation, personal information) and Your business in connection with this Agreement, including, without limitation, information and data provided to or obtained by Licensor (or third parties acting on behalf of Licensor) through a Customer Information Form and otherwise, in connection with ordering, registration, activation, updating, validating entitlement to, auditing, monitoring installation of and access to the Software. You hereby consent to Licensor maintaining, using and storing such information and data (including, without limitation, personal information, if any) for such purposes. Without limitation of the generality of the foregoing, You acknowledge and agree that:
 - i. Licensor may from time to time provide information and data, including, without limitation, information and data about Licensee's use of the Software, to Licensor's affiliated and unaffiliated distributors;

and

- ii. Licensor may make cross-border transfers of such information and data, including to jurisdictions with privacy or data protection laws that are less protective of You than the jurisdiction in which You are domiciled. You acknowledge and agree that such policies may be changed from time to time by Licensor.
- (d) Licensor reserves the right, without limitation, and without obtaining prior approval from or notice to You, to make changes in and to the Software.
- (e) This Agreement shall be governed by and construed in accordance with the laws of the United States and the State of New Mexico, as applied to agreements entered into and to be performed entirely within New Mexico between New Mexico residents without reference to conflict of laws. This Agreement and the performance of the Parties required hereunder shall not be governed by or otherwise subject to the United Nations Convention for the International Sale of Goods. Any civil suit or proceeding relating to this agreement shall be brought only in U.S. Federal District Court or State District Court within the State of New Mexico, and each of the Parties consent to the personal jurisdiction and venue of such courts. Judgment upon any award made in such proceeding may be entered and enforced in any court of competent jurisdiction.
- (f) In the event of any conflict between the terms of this Agreement and the applicable Acquisition Agreement, the terms of the Acquisition Agreement shall prevail. If there are any terms in either agreement which are different from, but not inconsistent or in conflict with the other agreement, then such terms shall bind the parties.

1.5.2 Supplemental License Agreements

EXODUS II Library

Copyright (c) 2005 Sandia Corporation. Under the terms of Contract DE- AC04-94AL85000 with Sandia Corporation, the U.S. Government retains certain rights in this software.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- Neither the name of Sandia Corporation nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

NETCDF Library

Copyright 1993-2013 University Corporation for Atmospheric Research/Unidata

Portions of this software were developed by the Unidata Program at the University Corporation for Atmospheric Research.

Access and use of this software shall impose the following obligations and understandings on the user. The user is granted the right, without any fee or cost, to use, copy, modify, alter, enhance and distribute this software, and any derivative works thereof, and its supporting documentation for any purpose whatsoever, provided that this entire notice appears in all copies of the software, derivative works and supporting documentation. Further, UCAR requests that the user credit UCAR/Unidata in any publications that result from the use of this software or in any product that includes this software, although this is not an obligation. The names UCAR and/or Unidata, however, may not be used in any advertising or publicity to endorse or promote any products or commercial entity unless specific written permission is obtained from UCAR/Unidata. The user also understands that UCAR/Unidata is not obligated to provide the user with any support, consulting, training or assistance of any kind with regard to the use, operation and performance of this software nor to provide the user with any updates, revisions, new versions or “bug fixes.”

THIS SOFTWARE IS PROVIDED BY UCAR/UNIDATA “AS IS” AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL UCAR/UNIDATA BE LIABLE FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE ACCESS, USE OR PERFORMANCE OF THIS SOFTWARE.

HDF5 Library

Copyright Notice and License Terms for HDF5 (Hierarchical Data Format 5) Software Library and Utilities

HDF5 (Hierarchical Data Format 5) Software Library and Utilities Copyright 2006-2013 by The HDF Group.

NCSA HDF5 (Hierarchical Data Format 5) Software Library and Utilities Copyright 1998-2006 by the Board of Trustees of the University of Illinois.

All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted for any purpose (including commercial purposes) provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions, and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions, and the following disclaimer in the documentation and/or materials provided with the distribution.
3. In addition, redistributions of modified forms of the source or binary code must carry prominent notices stating that the original code was changed and the date of the change.
4. All publications or advertising materials mentioning features or use of this software are asked, but not required, to acknowledge that it was developed by The HDF Group and by the National Center for Supercomputing Applications at the University of Illinois at Urbana-Champaign and credit the contributors.
5. Neither the name of The HDF Group, the name of the University, nor the name of any Contributor may be used to endorse or promote products derived from this software without specific prior written permission from The HDF Group, the University, or the Contributor, respectively.

DISCLAIMER: THIS SOFTWARE IS PROVIDED BY THE HDF GROUP AND THE CONTRIBUTORS “AS IS” WITH NO WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED. In no event shall The HDF Group

or the Contributors be liable for any damages suffered by the users arising out of the use of this software, even if advised of the possibility of such damage.

Contributors: National Center for Supercomputing Applications (NCSA) at the University of Illinois, Fortner Software, Unidata Program Center (netCDF), The Independent JPEG Group (JPEG), Jean-loup Gailly and Mark Adler (gzip), and Digital Equipment Corporation (DEC).

Portions of HDF5 were developed with support from the Lawrence Berkeley National Laboratory (LBNL) and the United States Department of Energy under Prime Contract No. DE-AC02-05CH11231.

Portions of HDF5 were developed with support from the University of California, Lawrence Livermore National Laboratory (UC LLNL). The following statement applies to those portions of the product and must be retained in any redistribution of source code, binaries, documentation, and/or accompanying materials:

This work was partially produced at the University of California, Lawrence Livermore National Laboratory (UC LLNL) under contract no. W-7405-ENG-48 (Contract 48) between the U.S. Department of Energy (DOE) and The Regents of the University of California (University) for the operation of UC LLNL.

DISCLAIMER: This work was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor the University of California nor any of their employees, makes any warranty, express or implied, or assumes any liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately-owned rights. Reference herein to any specific commercial products, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or the University of California, and shall not be used for advertising or product endorsement purposes.

cURL Library

COPYRIGHT AND PERMISSION NOTICE

Copyright (c) 1996 - 2014, Daniel Stenberg, daniel@haxx.se.

All rights reserved.

Permission to use, copy, modify, and distribute this software for any purpose with or without fee is hereby granted, provided that the above copyright notice and this permission notice appear in all copies.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT OF THIRD PARTY RIGHTS. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

Except as contained in this notice, the name of a copyright holder shall not be used in advertising or otherwise to promote the sale, use or other dealings in this Software without prior written authorization of the copyright holder.

Material Properties by Ken Mills

The data marked with 'Ken Mills' in the database is provided by [Mil02]:

Recommended values of Thermophysical Properties for Selected Commercial Alloys

Edited by: Ken Mills

Published by: Woodhead Publishing Ltd

© Queen's Printer and Controller of HMSO.

http://www.asminternational.org/search/-/journal_content/56/10192/06947G/PUBLICATION

FLOW-3D and **TruVOF** are registered trademarks in the USA and other countries.

UTILITIES

2.1 Tools for file conversion and checking STL quality

FLOW-3D Cast only supports the neutral .STL file format and, while most CAD packages also support the .STL format, there may be reasons why the geometry cannot be created in the .STL format. Because of this, several file conversion utilities are available for **FLOW-3D** Cast users. Additionally, several utilities that can be used to verify the quality of an .STL file are also available. These utilities, listed below, are described in detail in the subsequent sections.

- *Cad2Stl*: Used to convert files from various CAD formats to .STL files
- *Netfabb Basic*: Used to check .STL files for errors
- *qAdmesh*: Used to check .STL files for errors and fix minor issues

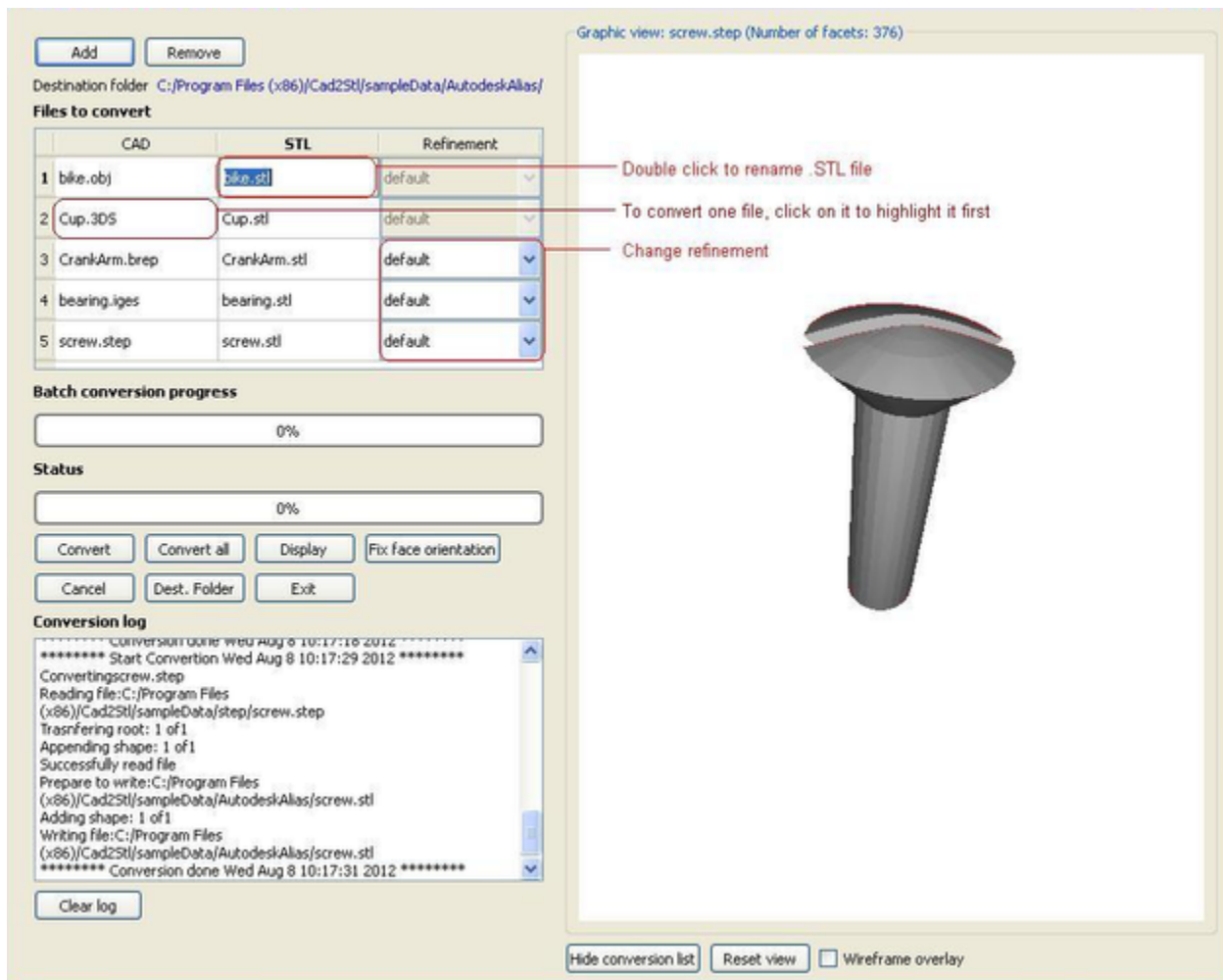
2.1.1 Cad2Stl

Cad2Stl is a file conversion tool for converting different CAD file types to the .STL file format used in **FLOW-3D** Cast. **Cad2Stl** converts the following file types to an .STL format:

- **Autodesk 3D Max**: .3ds
- **Autodesk Alias**: .obj
- **IGES**: .igs, .iges
- **BREP**: .brep
- **STEP**: .stp, .step
- **ABAQUS 6.2+**: .inp
- **NASTRAN**: .blk
- **Marc Mentat**: Fixed format and comma separated .dat

Cad2Stl also has the ability to correct reversed normal vectors in the file. This utility is available for free for all **FLOW-3D** Cast customers with an active maintenance contract and can be downloaded from the Utilities page on the [FLOW-3D Cast Users Site](#). **Cad2Stl** was developed for **FLOW-3D** Cast users by Flow Science's subsidiary in Japan, [Flow Science Japan](#).

Instructions:



1. Add the files to convert to the conversion list
 - *Add* – adds files to the conversion list.
 - *Remove* – removes files from the conversion list. To remove, highlight the file in the conversion list and select remove.
 - The STL file names by default match the name of the imported CAD file. This can be changed by double clicking the STL file name and renaming.
2. Choose the quality of the STL file using the *Refinement* option. There are four levels of accuracy that can be selected and viewed. Each time a file is converted, the STL file created is displayed so that the user can determine if it is satisfactory or needs a higher level of refinement. With the improvement in accuracy, the file size increases, but processing time does not increase much. Different file types can be loaded and converted all at once. Also, a dialog opens when the conversion process is completed to load and display the file. This only applies to the file types; BREP, IGES and STEP.
3. Choose the desired operation. Different file types can be loaded and converted all at once. Also, a dialog opens when the conversion process is completed to load and display the file.
 - *Convert* – converts the file. To convert one file, highlight that file in the list of loaded files to convert
 - *Convert all* – converts all files

- *Display* – displays whichever converted file is highlighted
 - *Fix face orientation* – normal repair routine
 - *Hide conversion list* – increases the viewing screen for better display of the part
 - *Wireframe overlay* – Overlays the facet edges for each STL facet; this is a check box at the bottom right
 - *Clear log* – clears all data output to the *Conversion Log* text box
4. *Exit* – closes the program

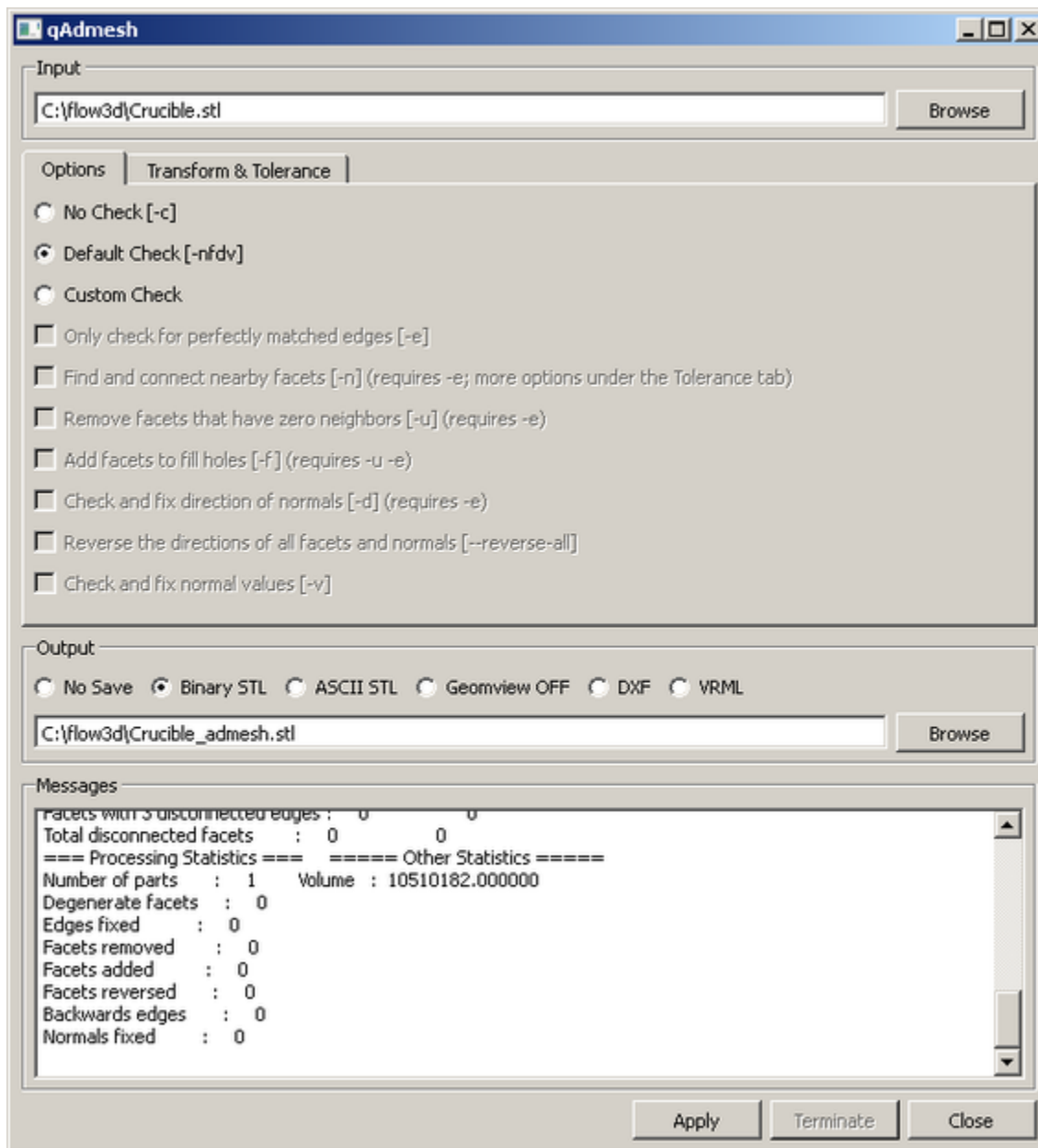
2.1.2 qAdmesh

qAdmesh is a tool that checks .STL files for errors and can be used to fix minor issues like disconnected facets, reversed normals, disconnected edges, and missing facets. To launch **qAdmesh**:

- From the GUI: Go to *Tools* → *qAdmesh* on the *Model Setup* → *Meshing & Geometry* tab.
- On Windows: click the desktop icon
- On Linux: run `$F3D_HOME/utilities/qAdmesh`.

Instructions:

Open **qAdmesh** and load the geometry file using the *Browse* button. To fix problems and generate a new geometry file with the fixes, simply leave the default options and choose an *Output* type and specify the path to the new geometry file. *Binary STL* is recommended because it will produce smaller files than the *ASCII STL* option (note that only the binary and ASCII formats are recognized by **FLOW-3D** Cast). Then, click *Apply* to check and fix the file.



The output from **qAdmesh** is shown in the *Messages* section of the interface. The output shows any errors that were detected and what actions would be taken to fix these problems if an Output option were selected.

The *Custom Check* options are also available to give more control about what the program will do when fixing a file. Additionally, there are options on the *Transform & Tolerance* tab that give the ability to rotate, mirror, scale, translate, and merge .STL files.

It should be kept in mind that **qAdmesh** is a free utility and is not supported by Flow Science. The ability of **qAdmesh** to fix problems depends on their severity. As the number of problems increase, the likelihood that **qAdmesh** can fix them decreases. If the problems can't be fixed, it is recommended that the .STL file be regenerated using a CAD package.

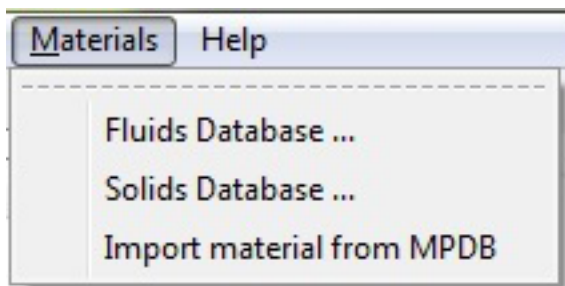
2.1.3 Netfabb Basic

Netfabb Basic is a free STL file visualization and repair utility. While not included with **FLOW-3D** Cast, it is a useful tool for STL file analysis and repair that provides an alternative to *qAdmesh*.

2.2 Material Properties Database (MPDB) Expansion

The Material Properties Database (MPDB) is a third party database that can be purchased from Flow Science, Inc. separately from **FLOW-3D** Cast. It contains a rich collection of temperature-dependent solid material properties from the literature. **MPDB for FLOW-3D** Cast is an exclusive version of **MPDB** that allows the user to export file formats that are compatible with **FLOW-3D** Cast's native databases and therefore, the data can conveniently be imported into **FLOW-3D** Cast. The material properties in **MPDB** are mostly for the solid phase. Therefore, any model in **FLOW-3D** Cast that requires solid properties can take advantage of the data, in particular, the fluid-structure interaction, solidification and thermal stress evolution models.

MPDB can be used as a stand-alone database that can export data in a wide variety of formats. For general instructions on **MPDB** visit [JAHM Software, Inc.](#). The instructions here are on how to use **MPDB** in conjunction with **FLOW-3D** Cast. To properly integrate with **FLOW-3D** Cast the executable for **MPDB** must reside in %F3D_HOME%\Utilities in Windows and \$F3D_HOME/Utilities in Linux. The executable is called MPDB_for_FLOW-3D. This executable is detected by the **FLOW-3D** Cast GUI and the menu item *Import material from MPDB* under the *Materials* menu becomes active. If any of these conditions are not met, **MPDB** cannot be accessed through the **FLOW-3D** Cast GUI.



Click on *Import material from MPDB* and the user interface for **MPDB** opens in a separate window. Materials have been categorized by their main elements. On the *Elements* tab, by right-clicking on an element from the table, the user can see a list of materials that contain that element.

MPDB for FLOW-3D v7.33

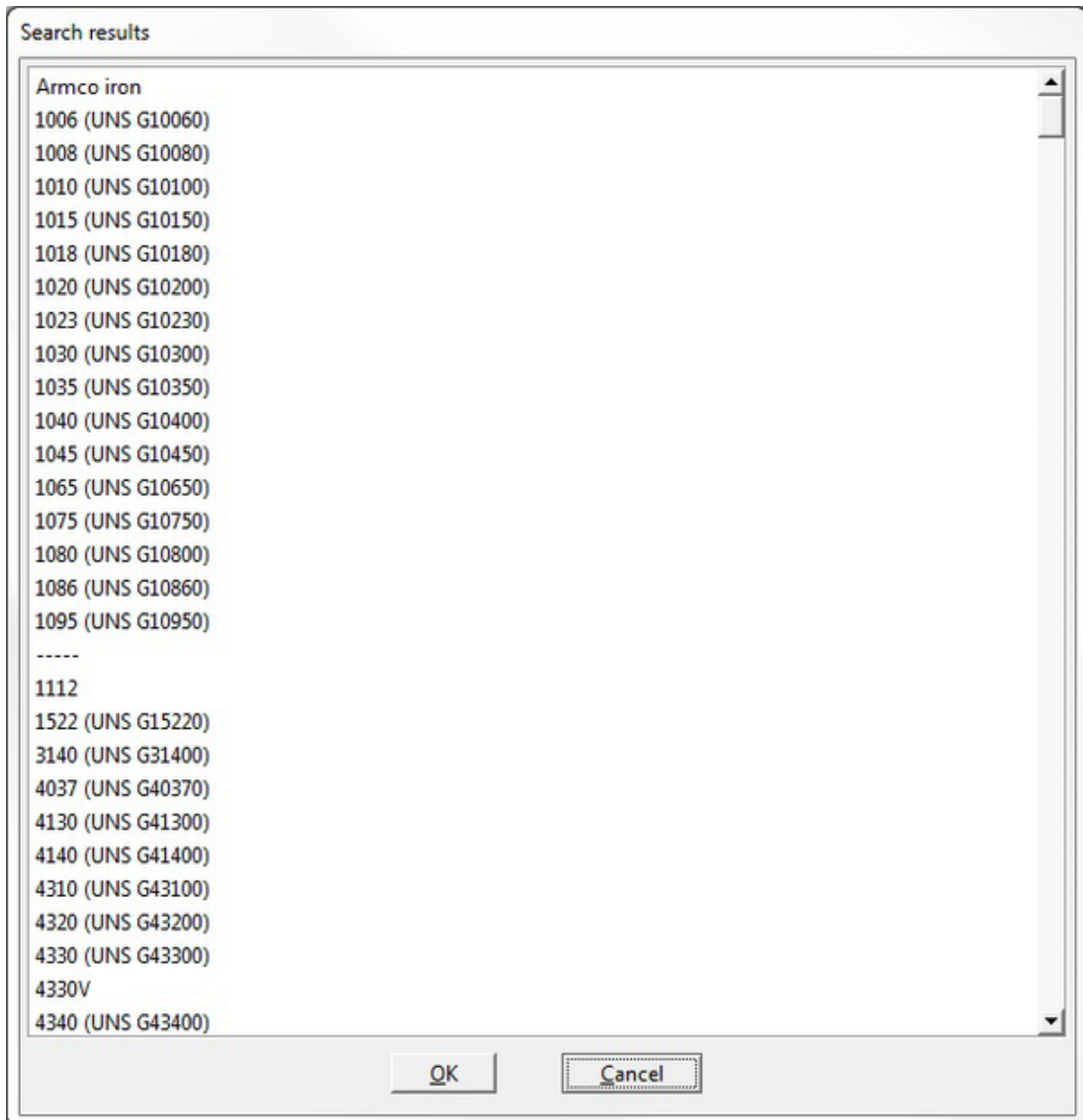
FileMaterialsOptionsUser materialsFLOW-3D/SolidWorks/ANSYSHelp



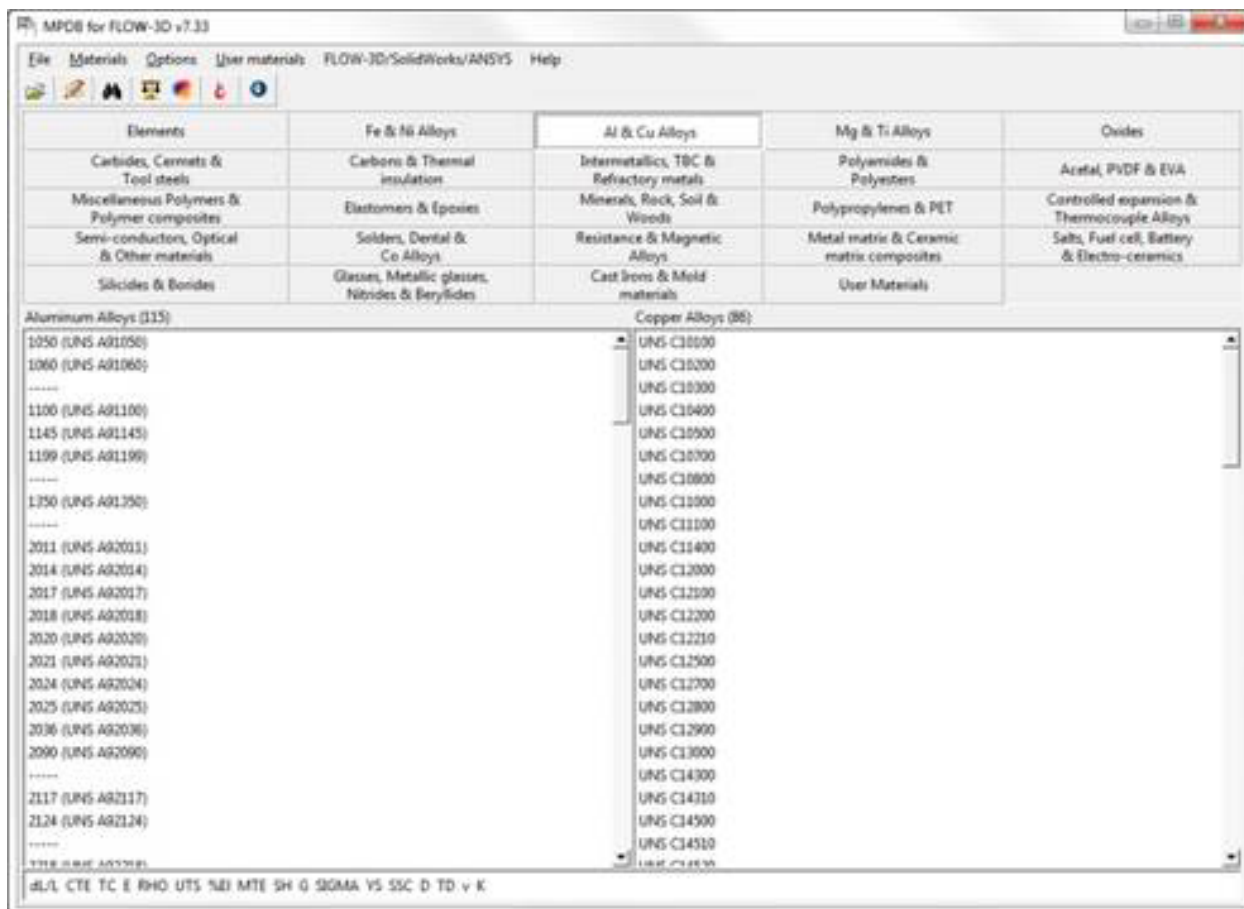
Elements	Fe & Ni Alloys	Al & Cu Alloys	Mg & Ti Alloys	Oxides
Carbides, Cermets & Tool steels	Carbons & Thermal insulation	Intermetallics, TBC & Refractory metals	Polyamides & Polyesters	Acetal, PVDF & EVA
Miscellaneous Polymers & Polymer composites	Elastomers & Epoxies	Minerals, Rock, Soil & Woods	Polypropylenes & PET	Controlled expansion & Thermocouple Alloys
Semi-conductors, Optical & Other materials	Solders, Dental & Co Alloys	Resistance & Magnetic Alloys	Metal matrix & Ceramic matrix composites	Salts, Fuel cell, Battery & Electro-ceramics
Silicides & Borides	Glasses, Metallic glasses, Nitrides & Beryllides	Cast Irons & Mold materials	User Materials	

I																		VIII									
H 1	BA																III B 5	IVB C 6	VB N 7	VIB O 8	VII F 9	VIII Ne 10					
Li 3	Be 4	solid liquid gas																Al 13	Si 14	P 15	S 16	Cl 17	Ar 18				
Na 11	Mg 12	IIIA Sc 21	IVA Ti 22	VA V 23	VIA Cr 24	VIIA Mn 25	Fe 26	Co 27	Ni 28	Cu 29	Zn 30	Ge 32	As 33	Se 34	Br 35	Kr 36											
Rb 37	Sr 38	Y 39	Zr 40	Nb 41	Mo 42	Tc 43	Ru 44	Rh 45	Pd 46	Ag 47	Cd 48	In 49	Sn 50	Sb 51	Te 52	I 53	Xe 54										
Cs 55	Ba 56	La 57	Hf 72	Ta 73	W 74	Re 75	Os 76	Ir 77	Pt 78	Au 79	Hg 80	Tl 81	Pb 82	Bi 83	Po 84	At 85	Pn 86										
Fr 87		Ra 88	Ac 89	Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	Ho 67	Er 68	Tm 69	Yb 70	Lu 71										
			Th 90	Pa 91	U 92	Np 93	Pu 94	Am 95	Cm 96	Bk 97	Cf 98	Es 99	Fm 100	Md 101	No 102	Lr 103											

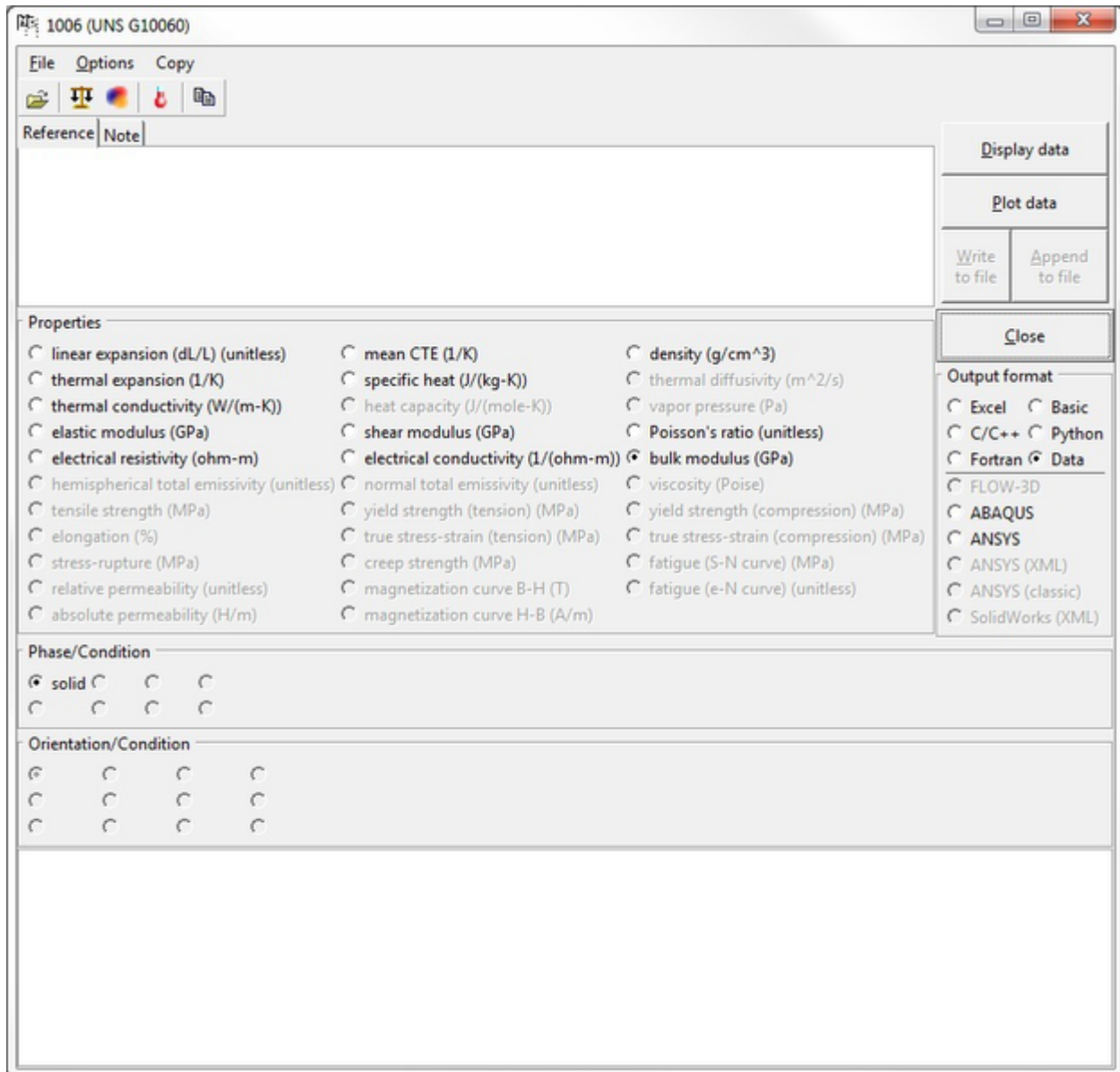
For example, the following figure shows a list of materials in the database that contain iron (Fe).



The user also can switch to other tabs that categorize different alloys, ceramics, glass, or other unclassified material. The next figure shows the list for Al & Cu alloys.



Once a material is identified, double-click on it and a separate window with a list of properties that are available for that material appears. For example, from the Fe & Ni Alloys, open 1006 (UNS G10060). Not all of these properties are used in *FLOW-3D* Cast.



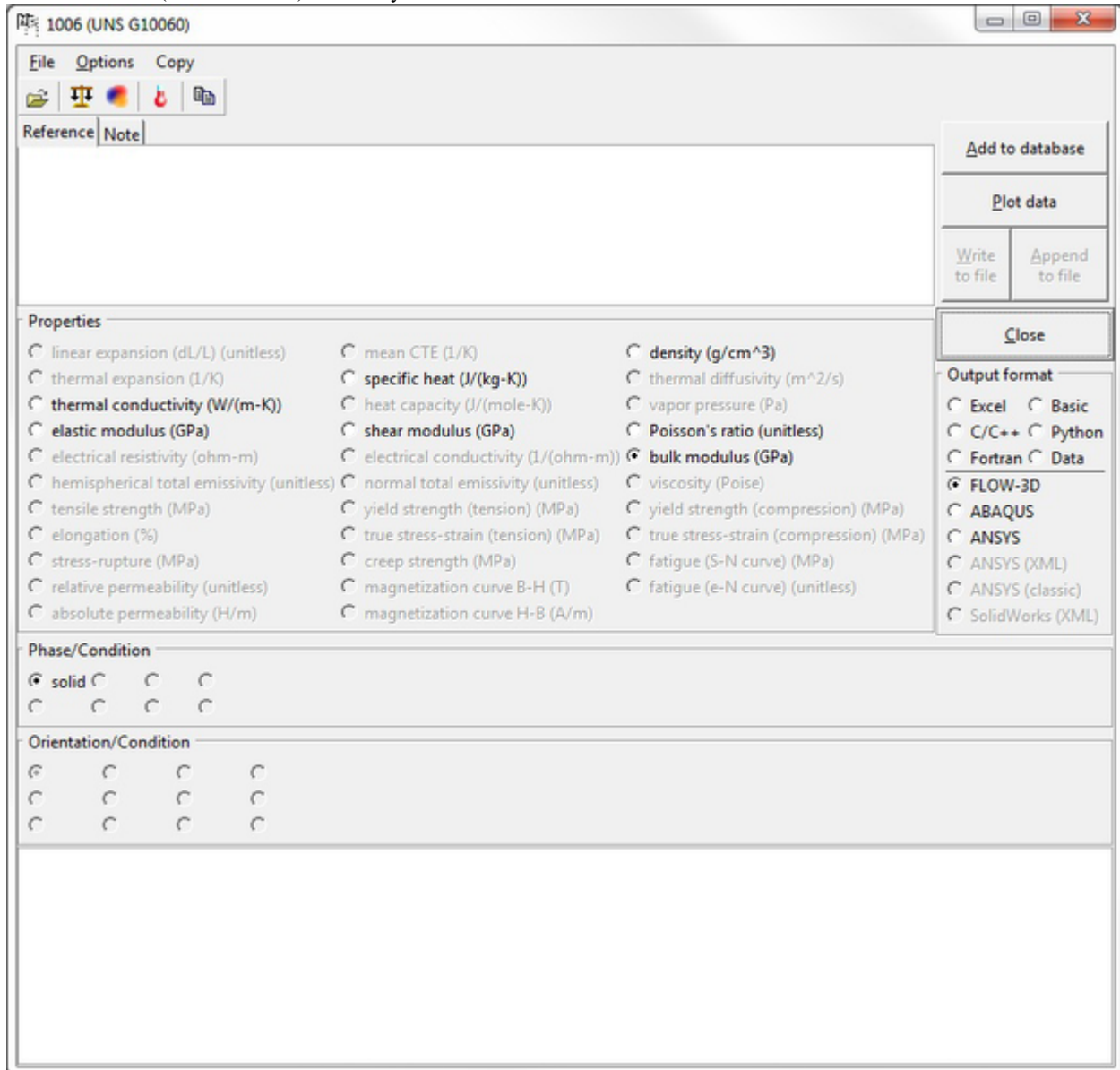
Each property can be displayed, plotted or saved to a file in different formats that can be selected on the right side of this window. However, not all of these properties are recognized in **FLOW-3D** Cast. In order to generate file formats that are compatible with **FLOW-3D** Cast, close the material window and start from **FLOW-3D/SolidWorks/ANSYS** menu. There are three file formats with which the properties for a material can be imported into **FLOW-3D** Cast, *Fluids database format* which has `.f3d_dbf` extension, *Solids database format* which has `.f3d_dbs` extension, and general comma separated value CSV format. From the **FLOW-3D/SolidWorks/ANSYS** menu, select the **FLOW-3D** Cast compatible format suitable to the simulation at hand. Even though the materials in **MPDB** are mostly solid, if the user wants to import properties for the solidified fluid, the *Fluids database format* should be chosen because in **FLOW-3D** Cast the solidified fluid properties are part of fluid properties. The solids and fluids database file formats as well as the CSV files will be saved in the current user's documents folder and inside `<My Documents>\FLOW-3D\gui\MaterialsDatabase` in Windows and `/home/<user>/FLOW-3D/gui/MaterialsDatabase` in Linux.

These locations are where the databases in **FLOW-3D** Cast look for user-defined materials. Any material that is exported by **MPDB** into these locations gets picked up by the native databases in **FLOW-3D** Cast.

From the **FLOW-3D/SolidWorks/ANSYS** menu select one of the **FLOW-3D** formats, for example, *FLOW-3D solids*

database format (.f3d_dbs). Click on *Create a new database...* and choose a units system, for example, SI. The *FLOW-3D/SolidWorks/ANSYS* menu turns green which indicates a database file is open.

Select the 1006 (UNS G10060) iron alloy.



Some of the properties that were available previously are disabled because they are not relevant in *FLOW-3D* Cast. As soon as each property is processed, meaning plotted or its data is displayed, the *Reference* and *Note* sections become active. The *Reference* tab indicates where the property was taken from and the *Note* section usually contains notes regarding composition and accuracy of the data. Each property can be plotted to help understand the behaviour of the property with temperature. Additionally, there may be warnings about the validity of the data. For example, plotting the thermal conductivity first gives a *Low temperature warning* before showing the plot as a function of temperature.

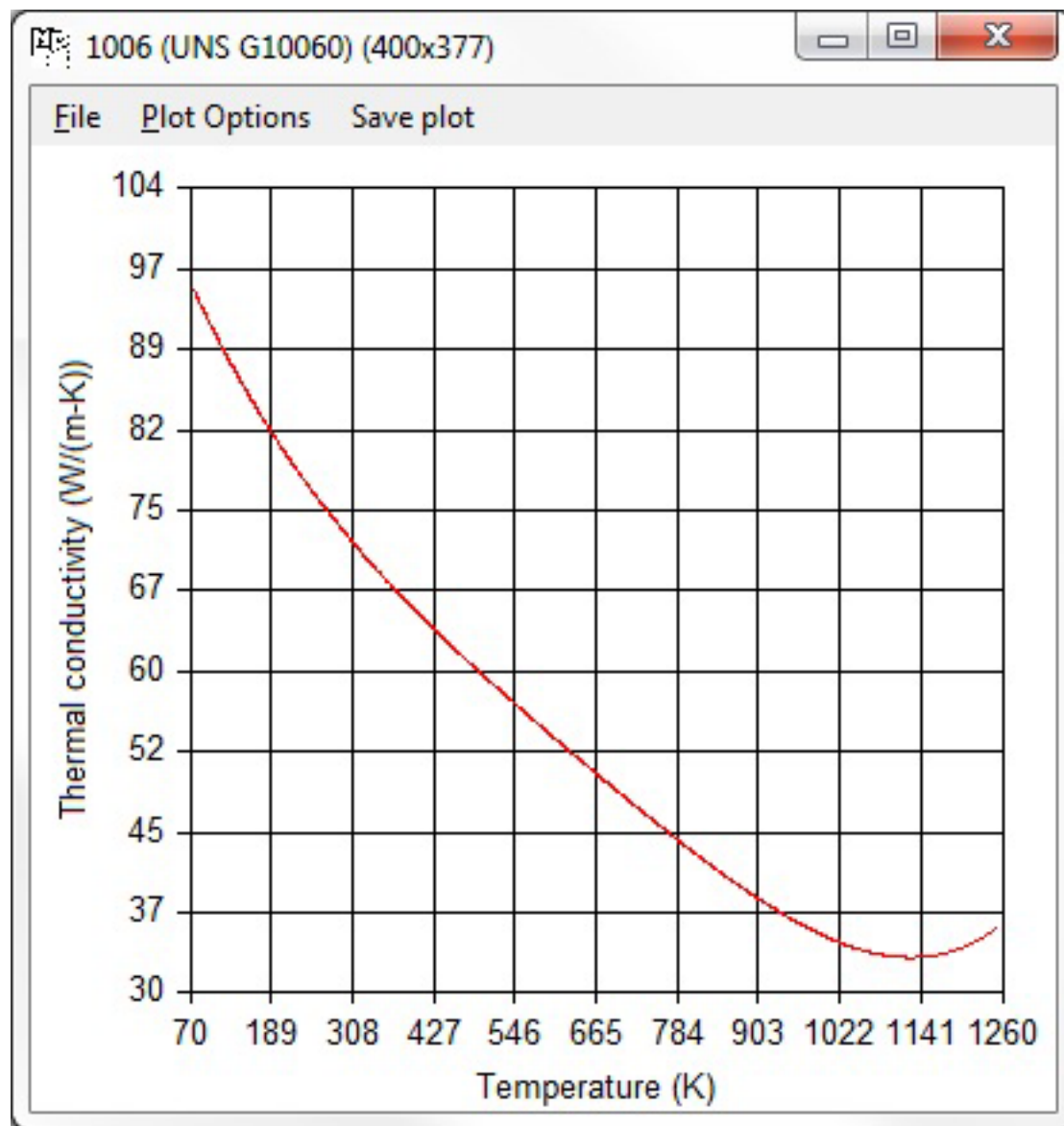
Low temperature warning

Transport properties (thermal conductivity, diffusivity and electrical resistivity) are strongly dependent on impurity levels especially at temperatures below room temperature. Therefore, this data may not be accurate for your particular material below room temperature.

☐ Do not show this warning again

If you disable this now you can reset this option in the Options->Output menu item

Close



In order to write the `.f3d_dbs` file, click on the *Add to database* button and select the properties to be written to file on the next window. Properties can be selected for available phases. Once the properties are selected, click *Write data* and *Close*. Close the material window. Close database from the *FLOW-3D/SolidWorks/ANSYS* menu.

In some cases a material is missing a property that the user needs. In those situations after adding available properties to database, the missing property can be obtained from an alloy that has similar properties (at the user's own risk). As long the database is open, properties can be mixed and matched for the one material that is going to be used in *FLOW-3D Cast*.

Select properties to write to file

linear expansion (dL/L) ☐ include	mean CTE ☐ include	density ☒ include solid
thermal expansion ☐ include	specific heat ☒ include solid	thermal diffusivity ☐ include
thermal conductivity ☒ include solid	heat capacity ☐ include	vapor pressure ☐ include
elastic modulus ☒ include solid	shear modulus ☒ include solid	Poisson's ratio ☒ include solid
☒ Use program Poisson's ☐ Use constant Poisson's		
electrical resistivity ☐ include	electrical conductivity ☐ include	bulk modulus ☒ include solid
hemispherical total emissivity ☐ include	normal total emissivity ☐ include	viscosity ☐ include
tensile strength ☐ include	yield strength (tension) ☐ include	yield strength (compression) ☐ include
elongation ☐ include	true stress-strain (tension) ☐ include	true stress-strain (compression) ☐ include
stress-rupture ☐ include	creep strength ☐ include	fatigue (S-N curve) ☐ include
relative permeability ☐ include	magnetization curve B-H ☐ include	fatigue (e-N curve) ☐ include
absolute permeability ☐ include	magnetization curve H-B ☐ include	
<u>C</u> lose	Write data	Select all
De-select all		

After closing the database the user will be prompted for a filename, the default is what **MPDB** assigns to the material. The location and the extension of the file are preset so that **FLOW-3D** Cast recognizes the material as a user-defined material.

Fluids Database

	Material Name	Units System	Temperature Unit
1	1006 (UNS G10060)	SI	Kelvin
2	Air at 288 K	CGS	Kelvin
3	Aluminum Alloy 4.5% Cu	CGS	Kelvin
4	Aluminum Alloy 85% Al, 15% Cu	SI	Kelvin
5	Aluminum Alloy 86% Al, 14% Mg	SI	Kelvin
6	Aluminum Alloy A357	SI	Celsius
7	Aluminum Alloy A360 ADC3	SI	Celsius
8	Aluminum Alloy A380 (LM24, ADC10/AC4B)	SI	Celsius
9	Aluminum Alloy A383	SI	Celsius
10	Aluminum Alloy A384 (LM2, ADC12)	SI	Kelvin

The same process applies if a CSV file is selected. Once the data is written to file it can be retrieved from the *Import Values* button on each tabular property window.

The first column is always temperature.

Please select the independent data column that you want to import.

	temperature	density	thermal conductivity
1	92.0	7.898294e+000	9.292785e+001
2	97.0	7.897410e+000	9.228380e+001
3	102.0	7.896549e+000	9.164896e+001
4	107.0	7.895706e+000	9.102316e+001
5	112.0	7.894876e+000	9.040625e+001
6	117.0	7.894055e+000	8.979806e+001
7	122.0	7.893238e+000	8.919845e+001
8	127.0	7.892422e+000	8.860727e+001

FLOW-3D and *TruVOF* are registered trademarks in the USA and other countries.

USER FEEDBACK

Please use the following link to report any typos, suggestions for content, or feedback of any kind so that we can continue improving our documentation:

[User guide feedback form](#)

Thank you!

The Flow Science team

FLOW-3D and **TruVOF** are registered trademarks in the USA and other countries.