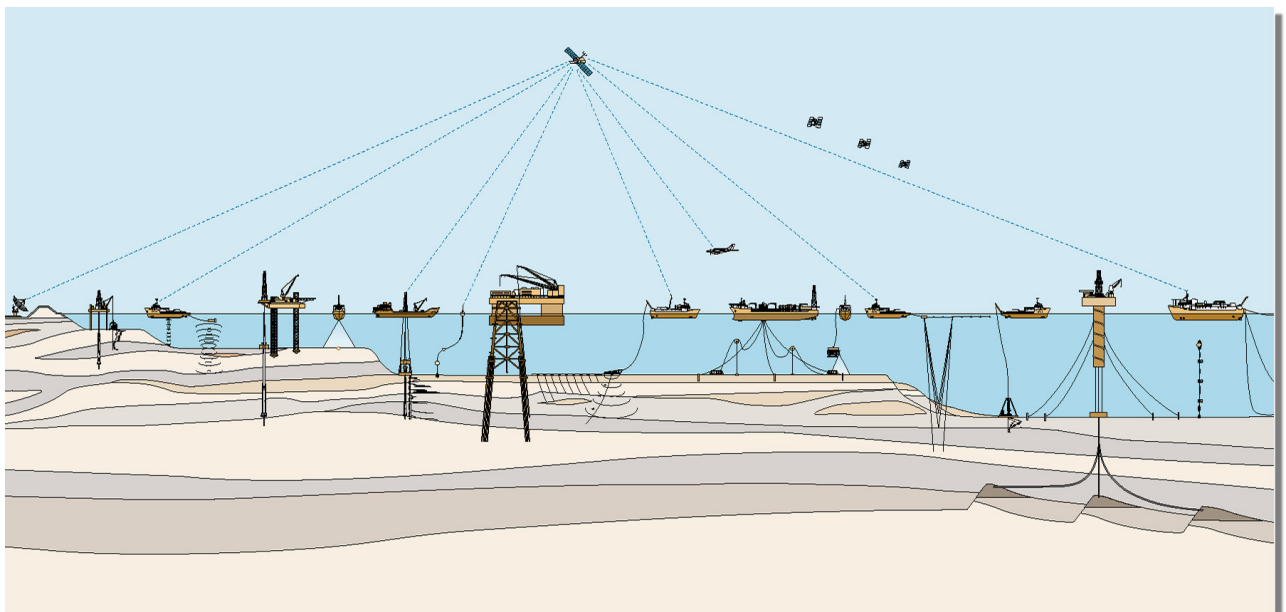


Rock Physics Module for PowerLog

Getting Started Guide

RPM for PowerLog version 2.7

August 25, 2006



Fugro-Jason

Please see our web site www.fugro-jason.com for a list of our offices, addresses, and contact numbers.

For general information please send an email with your request to info@fugro-jason.com.

Technical Support

When you need assistance with your work in *Rock Physics Module for PowerLog*, contact these resources in the Fugro-Jason RPM Technical Support Group:

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Fax +1 214 368 5281

E-mail support.RPM@fugro-jason.com

Hours 8:00 AM - 6:00 PM (CST), Monday through Friday

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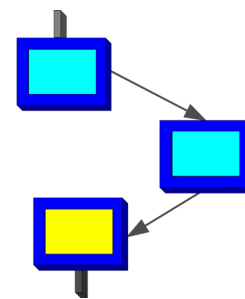


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Best Practices

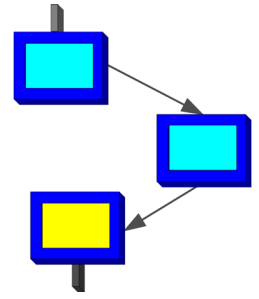
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USING THIS DOCUMENT

This section describes the initial tasks and information you want to know prior to first installing the Rock Physics Module (RPM) for PowerLog software. It includes:

- [Introduction](#)
- [Where to find information](#)
- [Document conventions](#)
- [Using the Acrobat online guides](#)
- [Document revisions](#)
- [Technical support](#)

Introduction

Audience

This document is for petrophysicists, geophysicists, geologists, and reservoir engineers who want to develop standard and customized workflows for determining rock physics and pore fluid properties in well curves.

Where to find information

RPM for PowerLog — Getting Started Guide:

- Section 1, “*Using this Document*”, describes (a) locating information in the RPM for PowerLog documents, (b) documentation font conventions used, (c) effective procedures for using Adobe Acrobat documentation, and (d) Technical Support contact information.
- Section 2, “*Installation*”, describes the procedures needed to install the RPM for PowerLog software and a brief introduction to rock physics workflows.
- Section 3, “*Frequently Asked Questions*”, describes answers to common questions and work-around procedures for specific software issues.
- Section 4, “*Best Practices*”, provides some advice about handling specific situations in RPM for PowerLog, based on some initial software testing by the Fugro-Jason Professional Services group.
- Section 5, “*Release Notes*”, provides last-minute information about (a) issues resolved in this release, (b) known issues the development team is correcting, and (c) new features added from the previous RPM for PowerLog software release.
- *Glossary*, explains terminology used in this document.
- *Index*, provides a quick method to locate information throughout this document.

RPM for PowerLog — User Guide:

- Section 1, “*Using this Document*”, describes (a) locating information in the RPM for PowerLog documents, (b) documentation font conventions used, (c) effective

procedures for using Adobe Acrobat documentation, and (d) Technical Support contact information.

- Section 2, “*RPM Concepts*”, shows you the components that make up the elemental calculation nodes and how these nodes assemble as a workflow.
- Section 3, “*Planning Workflows*”, describes how to manage and plan your workflow. This involves defining input PowerLog curves, creating named constants, preparing mix defaults, and organizing rock physics properties.
- Section 4, “*Building Rock Physics Workflows*”, illustrates the step-by-step procedures used to create a complete workflow.
- Section 5, “*Performing Advanced Workflow Tasks*”, describes how to better organize the workflow, setup user preferences, troubleshoot calculations, import another RPM project parameters, and do curve fitting.
- Section 6, “*Tutorial Workflows*”, uses several workflows to illustrate general principles for developing a workflow, while providing individual users the freedom to create customized workflows with their unique methodologies. Topics covered include:
 - Setting up input curves and rock parameters
 - Organizing computations into groups
 - Comparing calculated values against measured logs
 - Selecting different error evaluation criteria
 - Reducing the number of nodes for a mature workflow by using the **SimpleExpression** function
 - Using conditional logic within the workflows
- Section 7, “*RPM User Interface*”, describes the organization of the Windows menus, mouse button three (right-click) functionality, tool bars, and significant dialog windows you use in developing the RPM workflow.
- *Glossary*, explains terminology used in this document.
- *Index*, provides a quick method to locate information throughout this document.

RPM for PowerLog — Function Reference Guide:

- Section 1, “*Using this Document*”, describes (a) locating information in the RPM for PowerLog documents, (b) documentation font conventions used, (c) effective procedures for using Adobe Acrobat documentation, and (d) Technical Support contact information.
- Section 2, “*Rock Physics Introduction*”, provides information common to the rock physics and basic functions. Topics include:
 - Relevant publications
 - Common Greek symbols used for rock properties
 - Parameter types and how mineral default values are selected
 - Rock and Fluid properties
 - Algorithms for mix velocity ρ , V_p , and V_s
- Section 3, “*Function Overview*”, provides a one line summary of each basic (math, trigonometry, conditional logic, statistics, and random numbers) and rock physics function provided by RPM. RPM organizes the functions into these groups:
 - Anisotropy
 - Anisotropy Inversion Support Arithmetic
 - Arithmetic
 - Discrimination and Conditional Logic
 - Empirical Velocity
 - Fluid/Rock Physics Functions for Brine, Gas, and Oil
 - Gardner’s

- Gassmann’s Functions for Fluid Substitution
 - Greenberg-Castagna
 - Media-Bounds Functions (Two-phase Media)
 - Media-Bounds Functions (Three-phase Media)
 - Miscellaneous Supporting Functions
 - Random Numbers
 - Simple Modulus-related Functions
 - Statistical
 - Trigonometric
 - Velocities for Bounds
 - Velocity-Synthesis Functions
- Section 4, “*Rock Physics Functions*”, uses a terse, standard presentation format to describe how to use each rock physics function.
 - Section 5, “*Basic Functions*”, uses the same standard presentation format to describe the use of basic mathematical, trigonometric, conditional logic, statistical, and random number functions.
 - *Glossary*, explains terminology used in this document.
 - *Index*, provides a quick method to locate information within the document.

Document conventions

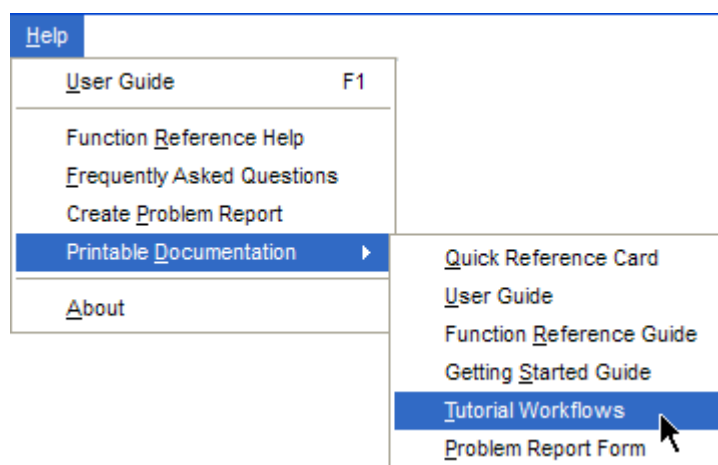
This guide uses concise menu notation, typeface changes, and reader alerts to define information in a structured way that makes it easy for the user to read.

Menu selection notation

Throughout the RPM for PowerLog documentation set, a shorthand notation is used to indicate the exact manner to invoke a specific menu command. The notation uses the format **Menu > Command (or cascading menu name) > Command** and displays the text in a bold font.

Example If the documentation shows how to select the command needed to display the *RPM for PowerLog Getting Started Guide*, you would see **Help > Printable Documentation > Getting Started Guide** in the text.

Figure 1. Help menu for RPM for PowerLog



Typeface notation

Table 1. Typeface conventions and symbols

| Typeface convention | Purpose |
|---------------------|--|
| <i>italics</i> | <ul style="list-style-type: none"> Document or software titles Introduction of a new term Words that require emphasis |
| Bold | Denotes graphical user interface objects and RPM functions. For example, RPM function names, menus, button labels, window names, option buttons, text fields, drop-down selection lists, and so forth. |
| [Alt+F] | Keyboard keys are enclosed in square brackets and bold font. If the keys must be pressed simultaneously, a plus sign is used in the text. |
| { } | Text surrounded by braces (or curly brackets) indicates more than one option. |
| [] | Text surrounded by plain square brackets indicate optional elements |
| ... | Horizontal ellipsis indicates you can supply more than one value or parameter for the preceding item(s) |

Reader alerts

These reader alerts provide valuable information throughout the *Rock Physics Module for PowerLog* documentation set.

Note Note text that alerts you to additional information to help with the work procedure. The note does not contain information necessary for you to complete the procedure. The note may extend the circumstances (If you want to save your project to a network drive) of a procedure.

Hint Hint text provides you with shortcuts or insight that help you gain the more experience and efficiency with the RPM software.

Caution! The cautions text alert you to situations when you can possibly lose information or work that was just performed. For example, cautions are used for situations where project files can potentially get corrupted or you could accidentally delete critical files.

Example This is an in-line example used to quickly clarify a point just made in the document.

Step 1 The tutorial step 1 begins a series of tutorial steps that stand-out from the text to call attention to this procedure for the user.

Step 2 Second step

Step 3 Step number three

Step 4 Second to the last step

Step 5 Final step of the tutorial procedure.

Using the Acrobat online guides

The online Fugro-Jason documentation can be read using the Adobe Acrobat™ Reader. (If you do not have this software, you can download a free version of the Acrobat Reader software from Adobe's Internet site - <http://www.adobe.com/>) The Adobe Portable Document File (PDF) displays the Fugro-Jason guides in full color and acts similar to an online help system. With the online guides you can:

- Control the size of the displayed document
- Print all or a portion of an RPM for PowerLog guide
- Find a specific topic using full-text search procedure
- Use bookmarks and hyperlinks to swiftly navigate among the pages

Note Throughout the Fugro-Jason documentation you will see text that is colored as **Blue**. This text is a hyperlink (active link) that takes you to another portion of the document or to an external Internet site.

Displaying the online user guides

Step 1 Select the **Help > Printable Documentation** command and choose from the documents found on the cascading menu.

or

Outside the RPM application, use Microsoft Explorer to find the Acrobat PDF document in the X:\Pwrlog32\RPM installation directory and double-click on one of these guides:

- *RPM_PowerLog_User_Guide.pdf*
- *RPM_PowerLog_Function_QuickRef_Guide.pdf*
- *RPM_Freq_Asked_Questions.pdf*
- *RPM_PowerLog_Getting_Started_Guide.pdf*

Step 2 Click in the left pane to display the table of contents **Bookmarks** and access specific document pages.

Setting the navigation menu for the online user guides

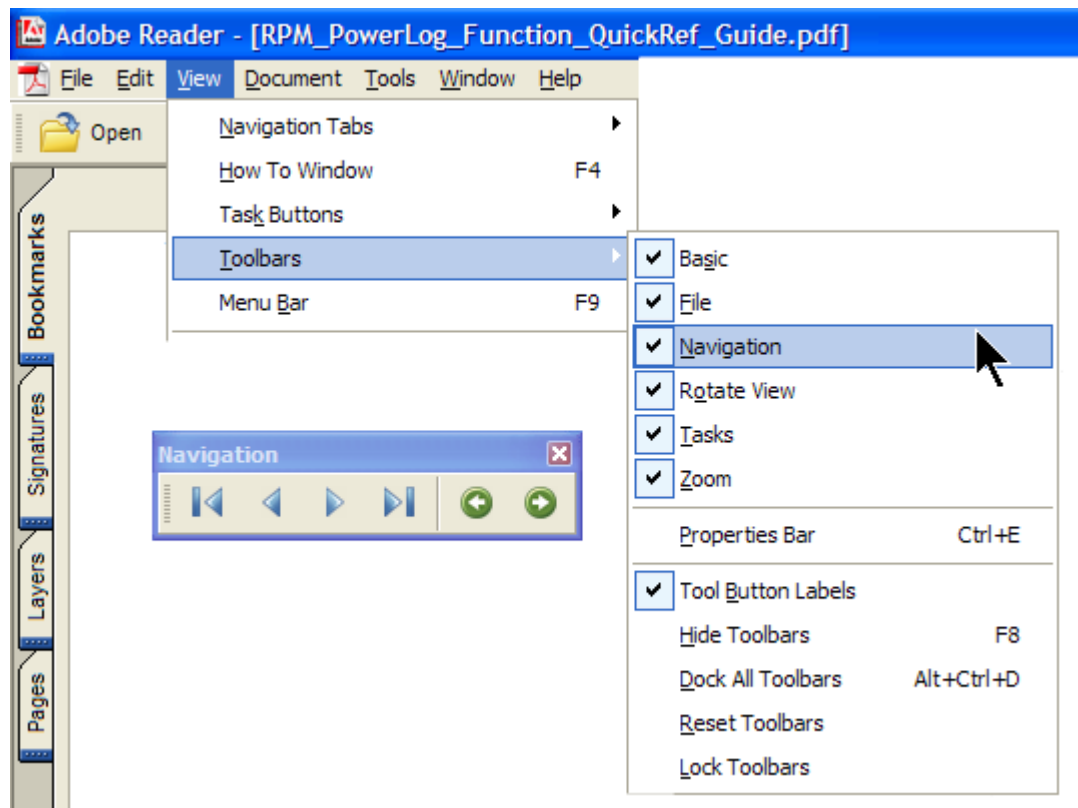
The RPM for PowerLog documentation files can be navigated similar to HTML pages on the Internet, using a Forward and a Back button to display pages. To display the Acrobat Navigation toolbar for this functionality, do this:

Step 1 Choose the **View > Toolbars** command.

Step 2 Ensure that the check box beside the **Navigation** toolbar is selected. Your screen should look like **Figure: 2, 'Display the Acrobat Navigation toolbar', on page 11**, for version 6 of Acrobat Reader.

Step 3 [Optional] To dock the **Navigation** toolbar with other Acrobat toolbars, press [Alt+Ctrl+D] keys.

Figure 2. Display the Acrobat Navigation toolbar



Changing the display size of online user guide text

Step 1 Press [Ctrl+M] keys to access the **Zoom To** dialog box.

Step 2 Type a value for the **Magnification** and click **OK**. The user guide page displays at the specified magnification.

Viewing an online user guide with bookmarks

Step 1 Click the **Bookmarks** tab on along the left side of the Acrobat Reader window. The bookmarks display as an interactive table of contents.

Step 2 Click the Bookmark for the user guide section you want to view. The **Bookmark's** page and location display in the Acrobat window.

Jump to a specific page in an online guide

Step 1 Press [Ctrl+Shift+N] keys to display the **Go To Page** dialog.

Step 2 Type a value for the **Page** and click **OK**. The specified user guide page displays.

Printing part or all of an online user guide

-
- Step 1** Choose the **File > Print** command or press [Ctrl+P] keys to access the **Print** dialog.
- Step 2** Select the printer and specify the number of copies to print.
- Step 3** Type the page numbers (starting and ending) in the **From** and **To** text fields.
- Step 4** Click **Print** button.
-

Note To print an online user guide, you must have Adobe Acrobat Reader or the full Acrobat Exchange product installed on your computer.

Searching an online user guide

-
- Step 1** Choose the **Edit > Find** command or press [Ctrl+F] keys to display the **Search PDF** pane.
- Step 2** Type your search in the **What word or phrase would you like to search for?** area. It can be a word, words, or part of a word.
- Step 3** Search only in the current PDF document ([Figure: 3, 'Acrobat search text', on page 13](#)). Select any of the applicable check boxes below the **All PDF Documents** in drop down-selection list:
- **Whole words only**—finds only occurrences of the complete word typed.
 - **Case-Sensitive**—finds only occurrences of words in the exact combination of lower- and upper-case you typed in the search area.
 - **Search in Bookmarks**—searches the text in the Bookmarks pane as well as the document text.
 - **Search in Comments**—searches the comment annotations and the document text. Any Comment instances found have an icon beside the search word and a word or two of the context.
- Step 4** Click **Search** button.
- Step 5** When the search results display ([Figure: 4, 'Acrobat search results displayed', on page 13](#)), click the underlined search words (hyperlinked) to go to this page in the online user guide.
- Step 6** If you want to do another search or refine your current search to yield a more specific result, click the **New Search** button.
-

Figure 3. Acrobat search text

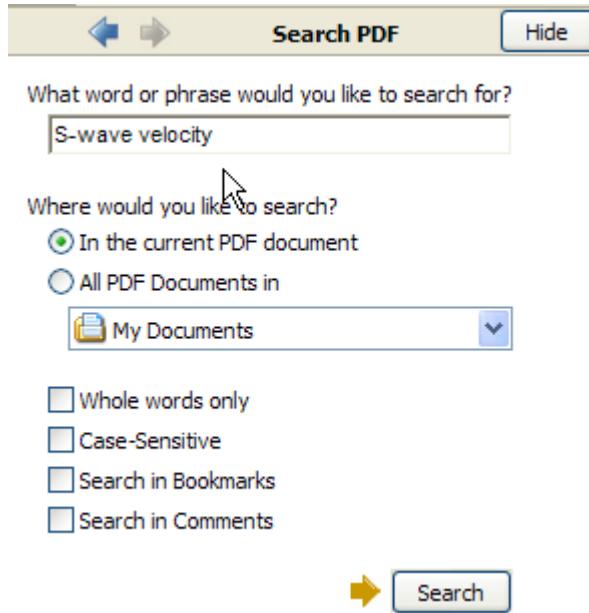
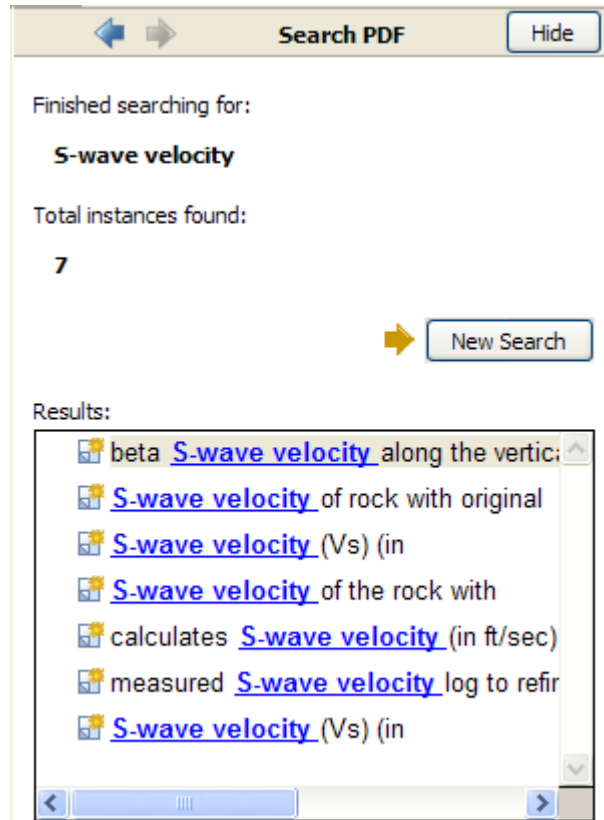


Figure 4. Acrobat search results displayed



Document revisions

Revisions and corrections to the Rock Physics Module for PowerLog documentation set are recorded in the next table.

Table 2. Document revisions

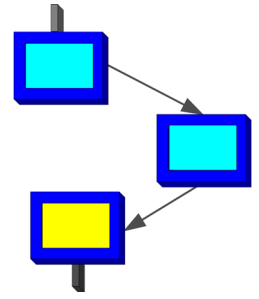
| Date | Author | Changes made |
|------------|-------------|---|
| 05/01/2006 | Lance Smith | Revised Document into three distinct RPM for PowerLog Guides. |
| 05/09/2006 | Lance Smith | Added menu selection convention and metric well conversion procedures. Inserted remaining FAQ and best practice items |
| 05/13/2006 | Lance Smith | Updated complete list of enhancements, known issues |
| 05/31/2006 | Lance Smith | Reviewed Beta Version completed. |
| 06/11/2006 | Lance Smith | Add uninstall procedure |
| | | |

Technical support

Fugro-Jason provides detailed documentation to help you efficiently install, configure, and use your purchased software investments. Fugro-Jason documentation is designed to help you find descriptions of product functionality and step-by-step procedures to accomplish your exploration goals. For answers to your technical support questions or to suggest ways to improve this Fugro-Jason product, please contact us.

When you need assistance with your work in *Rock Physic Module for PowerLog*, contact these resources in the Fugro-Jason RPM Technical Support Group:

| | |
|-----------------|--|
| Phone | +1 214 368 2191 |
| Fax | +1 214 368 5281 |
| E-mail | support.RPM@fugro-jason.com |
| Hours | 8:00 AM - 6:00 PM (CST), Monday through Friday |
| Address | PETCOM, Inc. 1600 North Collins, Suite 1700 Richardson, TX 75080 |
| Internet | www.fugro-jason.com |



RPM FOR POWERLOG 2.7 INSTALLATION

This section describes the initial tasks and information you want to know prior to first starting the Rock Physics Module (RPM) for PowerLog software. It includes:

- [RPM for PowerLog functionality](#)
- [Software and hardware requirements](#)
- [Obtaining an RPM for PowerLog v2.7 software license](#)
- [Downloading software from Fugro-Jason](#)
- [Tools for downloading PowerLog and RPM software](#)
- [Performing the RPM installation](#)
- [Uninstalling RPM for PowerLog](#)
- [Starting a new RPM project](#)
- [Workflows](#)
- [Rock and Fluid Properties](#)
- [Publications](#)
- [Symbols used in Rock Physics](#)
- [Parameter conventions used in RPM](#)

Algorithms from a Jason Geosciences Workbench product were used to create the RPM (Rock Physics Module) product that runs on the Windows platform and is integrated with Petcom, Inc. PowerLog[®] software. Using RPM with PowerLog helps users with the project management, presentation results, and provides some calculation functions previously done with the older product.

RPM for PowerLog functionality

Capabilities

The Rock Physics Module for PowerLog:

- Implements the Jason Geosciences Workbench product spreadsheet capabilities using a Windows interface that helps a user to design, correct, and standardize calculation workflows.
- Performs all the Rock Physics functions and integrates PowerLog's project, well, and curve management/display features.
- Improves workflow management by demonstrating calculation dependencies and order.

Temporary limitations

To achieve these enhanced capabilities for our users and automate the entire workflow, RPM currently has minor and temporary limitations¹:

- If a workbench function exists in PowerLog, it is not duplicated in the RPM software. You may need to interrupt your workflow to create the curve using an existing PowerLog function and use the output as an input to a workflow function.
- Only one well can be selected at a time in PowerLog for the workflow operations. RPM can be extended to allow multiple well selections at a later date.
- Because PowerLog works with US units, only US units are used in the calculations (exceptions are ρ -density, K -bulk modulus, and μ -shear modulus). The specified units for each parameter are shown in the node display. Unitless values are shown as `none` or blank.

Installing the RPM software

Important notes

Note [Windows 2000 Users Only] If you are installing RPM for PowerLog on the Windows 2000 operating system, you must be an **Administrator** to install and run the software.

Caution! If a previous RPM for PowerLog software version exists on your machine, perform **“Uninstalling RPM for PowerLog” on page 20** before you install the latest RPM for PowerLog software.

Introduction

The RPM for PowerLog installation software integrates RPM into the PowerLog menu. PowerLog must already be installed for you to begin using RPM. You should have a PowerLog project directory defined where the well data for your PowerLog project is stored. This is where the RPM for PowerLog project file, drawing file and default parameters should be stored; however you can store the RPM project data in whatever local or network directory you want.

The installation software installs a sample RPM project, example workflows, and the default file `ProjDefaults.rpm`, which includes preliminary rock properties and other project defaults, in the `C:\Pwrlog32\RPM` directory. Once you create a new RPM project, it contains its own project defaults and RPM-defined properties that you can modify.

The example workflows must be modified to use the curve names for your well.

To use the curve fitting and anisotropy functions you must install the Numerical Algorithms Group (NAG) license file. This is a temporary license that expires on September 1, 2006. Additional information can be found in the **“Installing the NAG licence” on page 20** section and in the `cldl1074z1_license_readme.txt` file.

1. Fugro-Jason’s current short-term plans are to enhance the RPM functionality. However, no statement in this document should be interpreted as a commitment to this development effort.

Software and hardware requirements

Software

- Windows 2000 or Windows XP
- **[Ideal]** A PowerLog version 2.7 (with RPM enabled) license must be installed in the two directories [C:\Pwrlog32\Working and C:\Flexlm\Powerlog]. See [Figure 5, 'Example RPM for PowerLog license file'](#).
- A project directory defined for storing the well data and RPM project files

Hardware

- Pentium 4 with 2.0 GHz processor speed or higher
- 256 MB RAM or more
- 300 MB or more of hard disk space
- **[Ideal]** Dual-monitor video card (Windows XP) - display PowerLog curves and RPM workflows at the same time

Obtaining an RPM for PowerLog v2.7 software license

To obtain an RPM for PowerLog v2.7 license from Fugro-Jason

- 1 Contact **Joe Jacquot** - *Strategic Marketing Manager for Fugro-Jason*
Office Telephone: +1 713-369-6938
Mobile Telephone: +1 832-474-7191
Email your request to: jjacquot@fugro-jason.com
or support@petcominc.com

Figure 5. Example RPM for PowerLog license file

```
SERVER MYRPMBOX COMPOSITE=DCF8A15XXXXX
VENDOR Fugro-Jason
FEATURE NPowerLogRPMS petcom 99.000 14-aug-2006 1 SIGN=2EB46B5885D0

# License Request Parameters:
#
# type = Petcom
# statmin/rpm = 1
# recipient = HYPERLINK "mailto:yourname@yourcompany.com"yourname@yourcompany.com
# company = Fugro-Jason
# timeout = 14-aug-2007
# server = MYRPMBOX
# key = DCF8A15XXXXX
# status = On
```

Downloading software from Fugro-Jason

To access the Fugro-Jason FTP Internet server:

- 1 Copy and paste the Internet link into your browser (Internet Explorer, FireFox, Opera, etc.) address line:
`ftp://petcomcust:RPM@ftp.fugro-jason.com`
- 2 Download these RPM for PowerLog installation files:
PowerLog_27.zip (unzip with password "petcom" and run setup.exe)
RPMforPowerLog2.7Setup.exe

RPM_for_PowerLog_27_Installation_Instructions.pdf
 NAG_License_App_and_Serial_Number.zip (if needed)

Note If the Internet browser fails to access the Fugro-Jason FTP site, use one of the free software tools ([Table 3 on page 18](#)) and log in to the FTP with these credentials:

- **FTP Site:** ftp.fugro-jason.com
- **UserID:** <Provided with software license>
- **Password:** <Provided with software license>

Tools for downloading PowerLog and RPM software

There are several free tools to download the PowerLog and RPM software installation packages from the Fugro-Jason Internet server:

Table 3. Where to obtain free tools to download software

| Software | Internet address |
|-----------------|---|
| Core FTP LE 1.3 | http://www.coreftp.com/download.html |
| FileZilla | http://sourceforge.net/project/showfiles.php?group_id=21558 |
| FTP Commander | http://www.internet-soft.com/ftpcomm.htm |
| FTP Surfer | http://www.whispertech.com/surfer/ |
| i.FTP | http://www.memecode.com/iftip.php |
| Star Downloader | http://www.stardownloader.com/ |
| WinGet | http://www.indentix.com/winget.html |
| Net Transport | http://www.xi-soft.com/ |

Performing the RPM installation

RPM runs as an integrated part of PowerLog. A licensed PowerLog 2.7 software version must previously have been installed to run RPM. A project directory must be defined for storing the well data and RPM project files (drawing file and default parameters).

Once RPM for PowerLog is installed, you can use the PowerLog command **Interp > Rock Physics Module** to start RPM.

Once a new project has been created, it has its own copy of this data and it can be modified to suit your project needs.

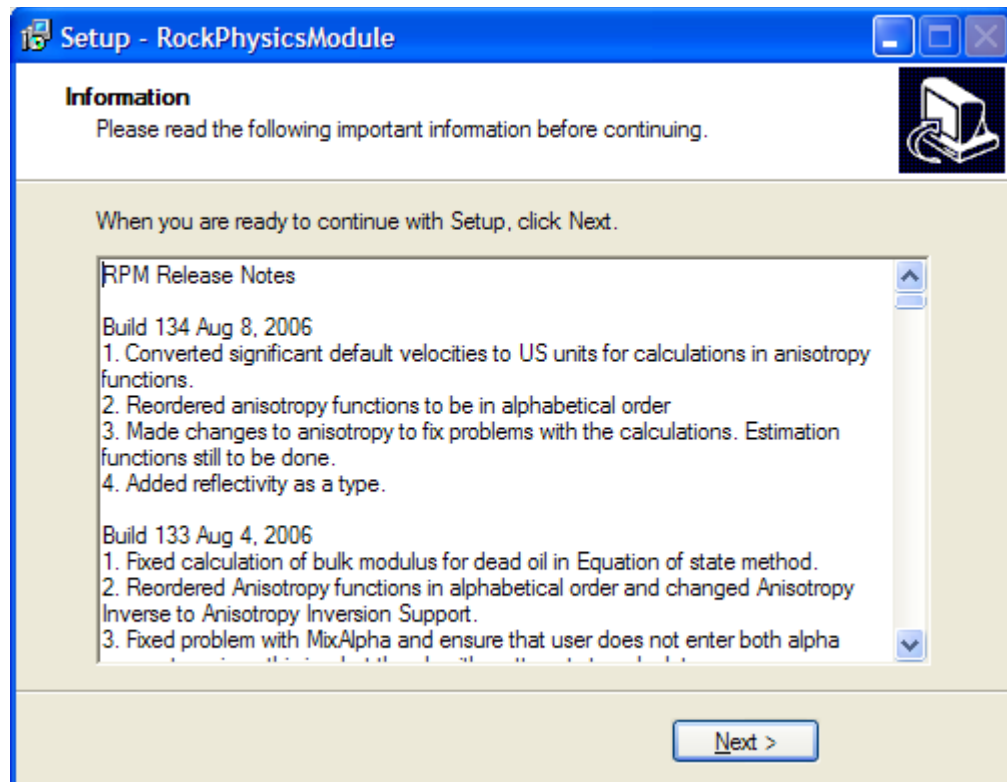
To install the Rock Physics Module software

- 1 Close other Windows applications.
- 2 Download the RPM for PowerLog v2.7 software from the Fugro-Jason website using this URL:
<http://www.fugro-jason.com/Downloads/RPMSetup.exe>
- 3 Once the installation package (14 Mb) completes its download from the website, place it in a temporary installation directory on the PC where you want to run PowerLog and RPM.

- 4 Double-click the RPM for PowerLog v2.7 installation file:
RPMSetup.exe.
- 5 When the **Welcome to the RockPhysicsModule Setup Wizard** displays, click **Next**.
- 6 Supply the password necessary to install the software and click **Next**.
- 7 If all your selections are correct, click **Install** after the **Ready to Install** screen displays. The Install screen displays the progress of copying RPM files to your local drive.
- 8 When the **Information** screen displays, note carefully the most recent changes (Release Notes) to the RPM for PowerLog software and its project files.

Caution! This screen often has information and instructions you want to follow to ensure correct results.

Figure 6. Release Notes



- 9 When the **Completing the RockPhysicsModule Setup Wizard** displays, click **Finish**.

Caution! RPM for PowerLog v2.7 primarily uses Imperial units (with a few exceptions). Wells sampled at metric intervals can be converted to feet using the procedure found in [“How can I work with well curves sampled in meters?”](#) on page 38.

Installing the NAG licence

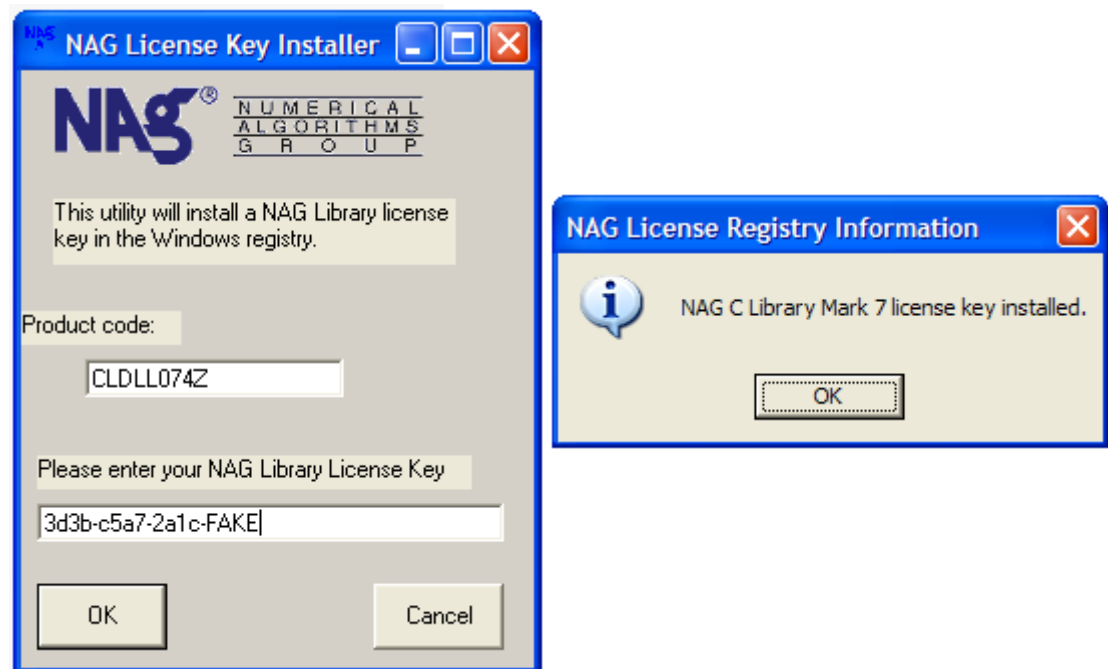
Note You only need to install the Numerical Algorithm Group (NAG) license if you want to use the Curve Fitting or Anisotropy functionality in RPM for PowerLog.

To install the NAG license file

- 1 Unzip the `RPMNagBeta.zip` into a temporary directory.
- 2 Open the text file `cldll074z_license_readme.txt`.
- 3 Copy the license number having the format `xxxx-yyy-zzzz-aaaa` to the Windows clipboard.
- 4 Double-click to run the file: `cldll074z1_key_inst.exe`
- 5 Paste the NAG license number into the NAG License Key Installer window (see [Figure 7, 'Inserting NAG license number'](#)) and click **OK**.

The license installer should provide this message, indicating a successful installation.

Figure 7. Inserting NAG license number



Uninstalling RPM for PowerLog

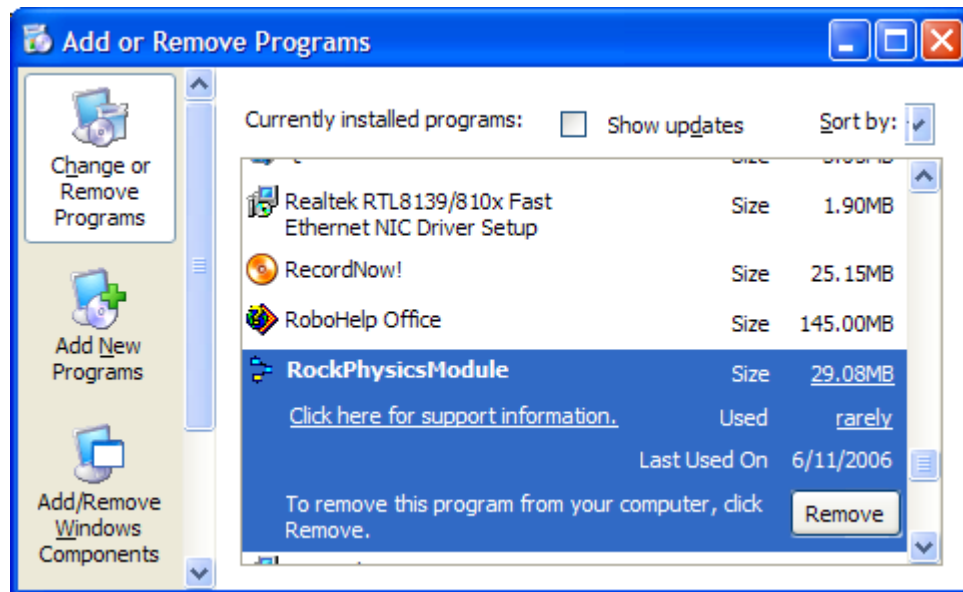
Prior to installing a new version of RPM for PowerLog, you should completely uninstall the previous software version. Using the Uninstalling RPM for PowerLog I procedure ensures that all previous RPM software is removed, except for your RPM projects and PowerLog files.

To remove RPM for PowerLog from your machine

- 1 Click the windows start icon and navigate to the **Control Panel** using (Windows XP) **start > Control Panel**
or
(Windows 2000) **Start > Settings > Control Panel**

- 2 When the **Control Panel** window displays, select the **Add or Remove Programs** icon/item.
- 3 The **Add or Remove Program** window displays and builds a list of applications installed on your machine. Select **RockPhysicsModule** and click **Remove**.

Figure 8. Add or Remove Programs window



- 4 A confirmation window displays. Click **Yes** if the window title is **RockPhysicsModule Uninstall**.
- 5 Once the installation successfully finishes, an information window displays a confirmation message. Click **OK**.
- 6 Close the **Add and Remove Programs** window.
- 7 Close the **Control Panel** window.

You can now install a new version of the RPM for PowerLog software on your machine.

Starting a new RPM project

Note [Windows 2000 Users Only] If you are running RPM for PowerLog on the Windows 2000 operating system, you must be a user with **Administrator** authority level.

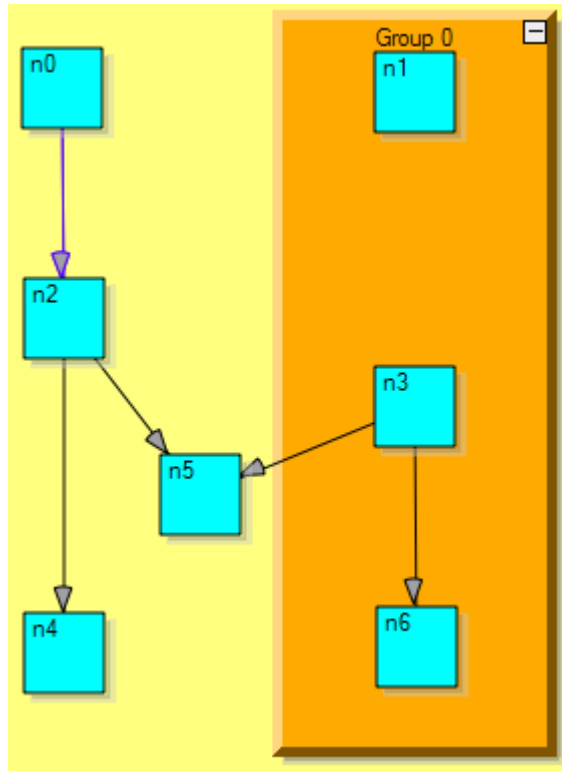
Your first RPM project

- Step 1** Start the PowerLog application using the Windows Start menu or the PowerLog desktop icon.



- Step 2** Select a PowerLog project using the **File > Project > Open** command.

-
- Step 3** Display each well you need to use by repeatedly using the **File > Well > Open** command. The well name, depth range, and sample interval display in a list.
- Step 4** Select a single well from the project well list (see [Figure: 13, 'PowerLog window title and <project name> Well List'](#), on page 38).
- Caution!** If you attempt to start the RPM for PowerLog application before selecting a project and a well, the warning in [Figure: 12, 'No PowerLog well selected'](#), on page 36 displays when RPM for PowerLog begins. Additionally, the Status bar displays no well name.
- Step 5** Start the RPM application using the PowerLog **Interp** menu. The **Rock Physics Module** command displays as the last menu item of the **Interp** menu.
- Step 6** Create a new project using the **File > New Project** command. Fugro-Jason recommends you select the project directory where the well data is stored.
- Hint** Keeping the well data and the rock physics projects associated with these wells together helps your data management.
- Step 7** Define nodes for the workflow by using the **Edit > Add Node** command.
- Step 8** Define the function for each node by double-clicking on the node to bring up the **Function Selection** dialog. (For more options and choices, see the **Function Selection** dialog described in the *RPM for PowerLog User Guide*.)
- Step 9** Select parameter values, right-click (third mouse button) in the **Value/Name** column and a context menu displays. Select node, curve, curve alias, constant, rock property or user value, and choose its appropriate value. There are parameters which are necessary for the computation (*mandatory parameters*) and some that trigger the function to perform additional, more complex calculations (*optional parameters*). The mandatory parameters are denoted by **dark blue** text in the parameter window. The units expected for each value are shown (if defined). A value with matching units must be entered. The optional parameters are shown in **green**. (See **Input Parameter Types** in the *RPM for PowerLog User Guide* for more information about RPM parameter types.)
- Close the window when all of the values have been selected. A value can be entered in a cell using the menus. The menus help the user to choose a rock property, for example, Quartz.rho, and have that value always match the value in the rock **Rock and Fluid Properties**. The shortcut menus are context-sensitive, so only parameters with units matching the current cell display for this cell.
- Step 10** Save the data by clicking **OK**.
- Step 11** If you select a node as input to a cell, RPM automatically draws the connection from the appropriate node. The connections represent the inputs and outputs to a particular function at each node.
- Step 12** Save the project with the **Save Project** icon on the tool bar. If you hover over the icon you see a status line message that says, *Save Project*.
- Step 13** Calculate a function for a node by hovering over a particular node, right-clicking to bring up the shortcut menu and selecting the **Calculate** command. The resulting curve or value generates in RPM or error messages are displayed. You may also calculate nodes in a group, path, or the entire workflow. (See the **Calculate** menu in [RPM for PowerLog — User Guide](#), for additional workflow calculation options.)
-

Figure 9. Generic RPM workflow

Key files used by RPM

- **Project file**—has a filename of `<projectname>.proj`. The project file contains the project name, the graphic workflow file name, the rock and fluid properties list, the constants list, and the defined end members for the mixing functions. The default values supplied with each new project are stored in the read-only `ProjDefaults.proj` file. Once the workflow is defined, the project can be saved under the current project name or be renamed. The project has its own set of rock/mineral/fluid properties that you can modify using the RPM user interface.

Note See the File menu in the *RPM for PowerLog User Guide* to rename a project or to create a backup copy to preserve your work.

- **Node definitions file**—is defined by the filename `<projectname>Node.txt`. It contains the function details for individual nodes, that is, the input parameters, the output, and the function name.
- **Graphic Workflow file**—has the filename of `<projectname>.dot`. The `.dot` file contains the instructions for drawing the workflow.

Note All the RPM project files are text files, which can be displayed in a text editor.

Workflows

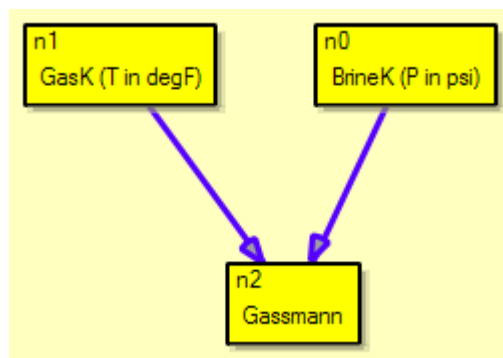
Nodes can be linked together in workflows by using the output value or output curve of one node as an input for another node.

In this example you can calculate a new bulk modulus (K) for a sandstone when the original fluid (100% gas) is replaced by 100% water.

Consider this three node workflow that looks like [Figure 10, 'Simple three node workflow'](#), one node for each rock physics function:

- **GasK**—calculates the original fluid bulk modulus.
- **BrineK**—calculates the bulk modulus for the water for specific physical conditions in the reservoir.
- **Gassmann**—requires a bulk modulus for a replacement fluid (κ_{F_new}) and an original fluid (κ_{F_old}) for two of its input parameters.

Figure 10. Simple three node workflow



The input for **GasK** is $P=2900$ psi, $T=176$ degrees F, and $spec_grav=0.6$. The result is a value for the node (node **n1**) of $4.0502e7$ N/m².

Similarly, the input for **BrineK** is $P=2900$ psi, $T=176$ degrees F, and $salin=35000$ ppm, but a value for the node (node **n0**) of $2.64747e9$ N/m².

Once **n0** and **n1** are calculated, the **Gassmann** function node **n2** inputs become:

```

Kbulk = 12.29e9 N/m2
Kmineral = 36.0e9 N/m2
Porosity = 0.20
K_F_new = node n0 (BrineK - bulk modulus of brine node)
K_F_old = node n1 (GasK - bulk modulus of gas node)
  
```

The connecting arrows in [Figure 10, 'Simple three node workflow'](#) display when the **n2** node is saved, because node **n2** is an output descendent of nodes **n0** and **n1**.

When the **Gassmann** function node calculates, the result is a node **n2** with the constant value $K_{sandstone} = 1.7148e10$ N/m², which is the sandstone bulk modulus with the replacement fluid (water) and verified by manual computation with Gassmann's equation.

This workflow can be modified to use curves (also curve alias names) instead of `UserValues` for pressure and temperature in **BrineK** and **GasK**, thus actual

measured pressure and temperature variations in the well are used for the computation. Curves for pressure and temperature in PowerLog can be used. The resulting bulk density curve will vary in value, but still be approximately $1.7 \times 10^3 \text{ N/m}^2$.

Rock and Fluid Properties

The **Rock and Fluid Properties** contains parameters for minerals, fluids, and rocks. Parameters for minerals and fluids are available from the defaults for input as parameters in functions. Parameters for rocks, minerals, and fluids are available for input parameters in functions using the shortcut menus in the **Function-Selection** dialog for specific functions.

As initially provided with RPM, the **Rock and Fluid Properties** includes only those parameters suitable for minerals on rows with named minerals, only those parameters suitable for rocks on rows with named rocks, and only those parameters suitable for fluids on rows with named fluids.

Caution! You can modify the **Rock and Fluid Properties**. However, any new rock, mineral, fluid, or property names *must not* contain spaces.

Importing rock, mineral, and fluid properties from another RPM project

RPM for PowerLog v2.0 will provide a feature to import and export rock and fluid properties from existing projects. For those who want to import properties today, you can manually import rock and fluid properties from one RPM project to another, using a standard text editor.

Note RPM for PowerLog comes with a *default* set of rock, mineral, and fluid properties. You only need to import properties if you want your own custom values for these properties.

To import rock and fluid properties manually

- 1 Ensure that neither project (`*.proj`) file is in use by the RPM for PowerLog software.
- 2 Using a text editor application such as NotePad[®], TextPad[®], or UltraEdit[®], open your *source* RPM project (project containing the rock, mineral, and fluid properties you want to copy).
- 3 Open the *destination* RPM project (project for which you want to include these specific existing rock, mineral, and fluid properties).
- 4 In the *source* project find the ROCK, MINERAL, or FLUIDORGAS property you want to copy.
- 5 Select the entire section of the property, include a blank line, so that what you copy is similar to [Figure: 11, 'Property imported into an RPM project'](#), on page 26.

Note Each RPM property begins with a dollar sign (\$) and ends with a blank line, line feed, or return character.

Caution! All properties must be inserted into any RPM project file above the **Constants** section, which begins with the text (`$$Constants`).

- 6 Copy and paste the text to the *destination* RPM project. Each new property should look similar to the portion of the RPM project file displayed.

- 7 Repeat steps four through six for each property you want to import into the *destination* RPM project.
- 8 Save and close the *destination* RPM project using the text editor.

Figure 11. Property imported into an RPM project

```

$MyHardRock, MINERAL
Rho, 4.93, g/cc
K, 1.4708e+11, N/m^2
Mu, 1.3228e+11, N/m^2
Alpha, -999, none
DAlpha, -999, none
OriginalPorosity, -999, none
API, -999, none
SpecificGravity, -999, none
Salinity, -999, ppm
CriticalPorosity, -999, none
Rs, -999, m^3/m^3
GreencastA0, -999, grca0
GreencastA1, -999, grca1
GreencastA2, -999, grca2
GardenerA, -999, grda
GardenerB, -999, grdb
Vpm, 26575, ft/s
Vsm, 16995, ft/s
Dtm, 37.6296, none
Dtsm, 58.8417, us/ft
VpmVsm, 1.56371, none

$$Constants
KGG_A0, 3.7, 3.7, 5
KGG_A1, 0.0, 0.0, 6
MUDROCK_A0_QUARTZ, -1172.0, -1172.0, 35

```

A property

Publications

Table 4. Selected RPM Publications

| Document title | |
|----------------|--|
| [1] | Alkhalifah, T. and Tsvanklin, I. (1995) Velocity analysis for transversely isotropic media. <i>Geophysics</i> , volume 60, pages 1550-1566. |
| [2] | Alkhalifah, T. et. al. (1996) Velocity analysis and imaging in transversely isotropic media: Methodology and a case study. <i>The Leading Edge</i> , 15, #5, pages 371-378. |
| [3] | Avseth, P., Mukerji, T. and Mavko, G. (2005) <i>Quantitative Seismic Interpretation: Applying Rock Physics Tools to Reduce Interpretation Risk</i> , Cambridge University Press, ISBN 0521816017, 376_pages. |
| [4] | Baldwin, J. (2006) Petrophysics/Rock Physics Integration: PowerLog and RPM Log Modeling. RPM Rollout-July, <i>Fugro-Jason Internal Communication</i> , PowerPoint Presentation. |
| [5] | Batzle, M.N. and Wang, Z. (1992) <i>Seismic properties of pore fluids</i> : <i>Geophysics</i> , 57 , pages 1396-1408. |

Table 4. Selected RPM Publications (Continued)

| Document title | |
|----------------|--|
| [6] | Berryman, J. G. (1992) <i>Journal of Acoustic Society of America</i> 68 (1980) pages 1809-1831 [reprinted in <i>Seismic and Acoustic Velocities in Reservoir Rocks</i> , volume 2, Z. Wang and A. Nur (editors), Society of Exploration Geophysics (SEG), Geophysics reprint series, No. 10.] |
| [7] | Berryman, J. and Milton, G. (1991) Exact results for generalized Gassmann's equations in composite porous media with two constituents. <i>Geophysics</i> , Volume 56, Issue 12, pages 1950-1960. |
| [8] | Brie, A., et al. (1995) Shear sonic interpretation in gas-bearing sands, <i>SPE</i> 30595, pages 701-710. |
| [9] | Carcione, J.M. and Helle, H.B. (2002) Rock Physics of Geopressure and Prediction of Abnormal Pore Fluid Pressures Using Seismic Data. <i>CSG Recorder</i> , September 2002, pages 9-32. |
| [10] | Castagna, J.P., Batzle, M.L., and Eastwood, R.L. (1985) Relationships between compressional-wave and shear-wave velocities in clastic silicate rocks. <i>Geophysics</i> , Volume 50, Issue 4, pages 571-581. |
| [11] | Chen, Q. and Nur, A. (1994) Critical concentration models for porous material. Corapcioglu, M.Y. (Editor), <i>Advances in Porous Media</i> (Vol. 2), Elsevier, pages 169-308. |
| [12] | Chopra, S. et al. (2004) Integrated Reservoir Characterisation - a successful interdisciplinary working model. <i>CSEG National Convention</i> paper. |
| [13] | Dvorkin, J., Moos, D., Packwood, J.L., and Nur, A. (1999) Identifying patchy saturation from well logs, <i>Geophysics</i> , volume 64, number 6, pages 1756-1759. |
| [14] | Dvorkin, J. and Nur, A. (1996) Elasticity of high-porosity sandstones: Theory of two North Sea data sets: <i>Geophysics</i> 61, pages 1363-1370. |
| [15] | Furre, A. K., and Bevik, I. (1998) Characterization of angle dependency in sonic logs. <i>68th Annual International Meeting, SEG, Expanded Abstracts</i> , BG2.1. |
| [16] | Goldberg, I. and Gurevich, B. (1998) A semi-empirical velocity-porosity-clay model for petrophysical interpretation of P- and S-velocity. <i>Geophysical Prospecting</i> 46, pages 271-285. |
| [17] | Goodway W., Chen, T. and Downton, J. (1997) Improved AVO fluid detection and lithology determination using Lamé parameters, $\lambda\rho$, $\mu\rho$, and λ/μ fluid stack from P and S inversions, <i>CSEG National Convention Expanded Abstracts</i> , pages 148-151. |
| [18] | Goodway, W. (2001) AVO and Lamé constants for rock parameterization and fluid detection. <i>CSEG Recorder</i> , June 2001, pages 39-60. |
| [19] | Greenberg, M.L. and Castagna, J.P. (2000) <i>Geophysical Prospecting</i> 40 (1992) pages 195-209. [reprinted in <i>Seismic and Acoustic Velocities in Reservoir Rocks</i> , volume 3, Z. Wang and A. Nur (editors), Society of Exploration Geophysics (SEG), Geophysics reprint series, No. 19 (2000) pages 402-416] |
| [20] | Hornsby, B.E., Howie, J.M. and Ince, D.W. (1999) Anisotropy correction for deviated well sonic logs: Application to seismic well tie. <i>69th Annual International Meeting, SEG, Expanded Abstracts</i> , BH/RP4.7, pages 112-115. |
| [21] | Keys and Xu, S. (2000) <i>SEG 2000 Proceedings</i> , paper RPB 6.2, page 1830. |

Table 4. Selected RPM Publications (Continued)

| Document title | |
|----------------|---|
| [22] | Kumar, Dhananjay. (2006) A Tutorial on Gassmann Fluid Substitution: Formulation, Algorithm, and Matlab Code. <i>Geohorizons</i> , January 2006. pages 4-12. |
| [23] | Kuster, G.T. and Toksöz, M.N. (1992) <i>Geophysics</i> 39 (1974) pages 587-618 [reprinted in <i>Seismic and Acoustic Velocities in Reservoir Rocks</i> , volume 2, Z. Wang and A. Nur (editors), Society of Exploration Geophysics (SEG), Geophysics reprint series, No. 10] |
| [24] | Marion, D. and Nur, A. (1992) Pore-filling material and its effect on velocity in rocks. <i>Geophysics</i> , Vol 56 , #2, pages 225-230. |
| [25] | Mavko, G. Chan, C. and Mukerji, T. (1995) Fluid substitution: Estimating changes in V_p without knowing V_s : <i>Geophysics</i> 60 , pages 1750-1755. |
| [26] | Mavko, G., Katahara, K., and Smith, T. (2005) Expert Answers, <i>CSG Recorder</i> , May 2005, pages 8-12. |
| [27] | Mavko, G., Mukerji, T. and Dvorkin, J. (2003) <i>The Rock Physics Handbook: Tools for Seismic Analysis of Porous Media</i> , Cambridge University Press, Second Edition, ISBN 0521543444, 339 pages. |
| [28] | Mavko, G., Mukerji, T., and Dvorkin, J. (1998) <i>The Rock Physics Handbook</i> : Cambridge University Press, section 7.8. |
| [29] | Mavko, G. and Mukerji, T. (1995) Seismic pore compressibility and Gassmann's relation. <i>Society for Exploration Geophysicists</i> , Volume 60, No. 6, pages 1743-1749. |
| [30] | Mavko, G. and Mukerji, T. (1995) Fluid substitution: Estimating changes in V_p without knowing V_s . <i>Society for Exploration Geophysicists</i> , Volume 60, No. 6, pages 1750-1755. |
| [31] | Mukerji, T. and Mavko, G. (2006) Recent Advances in Rock Physics and Fluid Substitution. <i>CSEG Recorder</i> , 2006 Special Edition, pages 123-127. |
| [32] | Nur, A., Mavko, G., and Dvorkin, J. (1998) Critical Porosity, <i>The Leading Edge</i> , vol.17, no.3, pages 357-362. |
| [33] | Rowbotham, Peter et. al. (2003) The implications of anisotropy for seismic impedance inversion. <i>First Break</i> , Volume 21, May. Pages 23-28. |
| [34] | Russell, B.H., Hedlin, K., Hilterman, F. and Lines, L.R. (2001) Fluid-property discrimination with AVO: A Biot-Gassmann perspective. <i>CREWES Research Report</i> , Volume 13, pages 403-419. |
| [35] | Sams, M. (2006) Reservoir Engineering vs. Seismic Inversion. RPM Rollout-July, <i>Fugro-Jason Internal Communication</i> , PowerPoint Presentation. |
| [36] | Sams, M. and Andrea, M. (2001) <i>Geophysical Prospecting</i> 49, pages 128-150. |
| [37] | <i>Schlumberger Educational Services</i> . (1989) Log Interpretation Principles/Applications. |
| [38] | Schmidt, D. and Barnett, M. (2005) PowerLog 2.61 Online User's Guide - Project, well, curve management, and presentation displays. <i>Petcom, Inc.</i> , version 2.61. |
| [39] | Smith, G.C. and Gidlow, M. A comparison of the fluid factor with λ and μ in AVO analysis. (2000) ann. Int. Mtg., <i>SEG. Expanded Abstracts</i> , pages 122-125. |
| [40] | Thomsen, L. (1986) Weak elastic anisotropy: <i>Geophysics</i> , 51, 1986, pages 1954-1966. |

Table 4. Selected RPM Publications (Continued)

| Document title | |
|----------------|---|
| [41] | Vernik, L. (2001) Elastic Seismic Inversion. <i>EAGE/SEG Research Workshop on Reservoir Rocks, Pau.</i> |
| [42] | Walls, J. D., Dvorkin, J. and Smith, B.A. (1998) Modeling Seismic Velocity in the Ekofisk Chalk, <i>Society for Exploration Geophysics, 68th Annual International Meeting</i> , pages 1016-1019. |
| [43] | White, R. and Xu, S. (2000) <i>Geophysical Prospecting</i> 43 (1995) page 91. and erratum in <i>Geophysical Prospecting</i> 48, page 629. |
| [44] | Xu, S. and White, R.E. (1995) A new velocity model for clay-sand mixtures: <i>Geophysical Prospecting</i> 43, pages 91-118. White, R.E., Simm, R. and Xu, S. (1998) <i>Geophysical Prospecting</i> 46, page 323. Xu, S., Doorenbos, J., Raikes, S. and White, R. (1997) <i>Developments in Petrophysics</i> , edited by M.A. Lovell and P.K. Harvey, Geological Society London, Special publication 122, page 87. |

Symbols used in Rock Physics

Table 5. Commonly used symbols in rock physics

| Symbol | Name | Purpose |
|-----------|-----------------------|--|
| λ | lambda | Lamé's constant ($K - 2\mu/3$) |
| K | -- | bulk modulus |
| E | Epsilon | Young's modulus |
| μ | mu | shear modulus (G also used in literature) |
| ρ | rho | (1) density or (2) correlation coefficient |
| ϕ | phi | porosity |
| σ | sigma | standard deviation (variance is σ^2) |
| ν | nu | Poisson's ratio |
| ω | omega | angular frequency |
| α | alpha (V_{p0}) | (1) crack (pore) aspect ratio, (2) P-wave velocity along the vertical symmetry axis of a transversely isotropic media, (3) mean deviation. |
| β | beta (V_{s0}) | S-wave velocity along the vertical symmetry axis of a transversely isotropic media |
| Δ | Delta | Acoustic and shear sonic travel times (measured in $\mu\text{sec}/\text{ft.}$) |
| M | -- | P wave modulus ($M = \rho V_p^2$) |

Table 5. Commonly used symbols in rock physics (Continued)

| Symbol | Name | Purpose |
|--|---------|--|
| θ | theta | (1) well bore or (2) formation dip angle <i>deviation from true vertical</i> ^{1 2} |
| φ | phi | (1) well bore or (2) formation azimuth (AZ) <i>clockwise deviation from true magnetic north</i> ^{1 2} |
| Thomsen's anisotropy parameters - relates P-wave and S-wave velocities along the vertical symmetry axis to three phase velocities propagating in the direction of a deviated well. | | |
| γ | gamma | The fractional difference in V_{sh} between the horizontal and vertical directions, and the normalized difference between V_{sh} and V_{sv} in the horizontal propagating S-waves (Mavko et al, [27]). |
| δ | delta | Thomsen anisotropy parameter that relates P-wave and S-wave velocities along the vertical symmetry axis to the three phase velocities propagating in the direction of a deviated well (Mavko et al, [27]). |
| ϵ | epsilon | Thomsen anisotropy parameter for <i>P-wave anisotropy</i> or the fractional difference in P-wave velocity between the horizontal and vertical directions (Mavko et al, [27]). |

1. Well bore angle input parameters in RPM begin with a `track_` suffix.
2. Formation angle input parameters in RPM begin with an `aniso_` suffix.

Parameter conventions used in RPM

[between 0 and 1] - denotes a porosity or fraction that has a value between 0.0 and 1.0.

(MANDATORY-NO DEFAULT) - you *must* specify a value for this parameter type.

(MANDATORY-defaulting) - you can specify a value. Nonetheless a value is required for the calculation and defaults are chosen according to [Table 6, “RPM Function input parameter types,” on page 30](#).

(OPTIONAL-NO DEFAULT) - you *must* specify a value for this parameter type for the optional calculation.

(OPTIONAL-defaulting) - you can specify a value. Nonetheless a value is required for the optional calculation and defaults are chosen according to [Table 6, “RPM Function input parameter types,” on page 30](#).

Input parameter types

Table 6. RPM Function input parameter types

| Type | Display | Parameter type description |
|----------------------|---------|--|
| mandatory-no default | MN | You <i>must</i> explicitly specify a value in the Function Selection dialog input parameter |

Table 6. RPM Function input parameter types (Continued)

| Type | Display | Parameter type description |
|-----------------------------|---------|---|
| mandatory-defaulting | MD | You <i>may</i> specify a value. A value is required for the calculation. If no value is specified explicitly by the user, the value defaults to: <ul style="list-style-type: none"> a value from the Rock and Fluid Properties corresponding to the mineral member or fluid specified in the Function Selection dialog shortcut menu, where the input value is specified. a value from the Rock and Fluid Properties corresponding to the default mineral member or fluid. |
| optional-no default | ON | You <i>must</i> explicitly specify OPTIONAL-NO DEFAULT parameters. Optional parameters require a function to perform additional or different calculations. Using optional parameters is often (but not always) triggered by a value of a mandatory parameter (such as a clay fraction $\nu_{o1_2}>0$). |
| optional-defaulting | OD | You <i>may</i> specify a value. Optional parameters require a function to perform additional or different calculations. Using optional parameters is often triggered by a value of a mandatory parameter (such as a clay fraction $\nu_{o1_2}>0$). OPTIONAL-defaulting parameters default to: <ul style="list-style-type: none"> a value from the Rock and Fluid Properties corresponding to the mineral member or fluid specified in the Function Selection dialog shortcut menu, where the input value is specified. a value from the Rock and Fluid Properties corresponding to the mix default mineral. |

The parameter type for all function inputs is shown on the **Function Selection** dialog when you edit a node.

Input parameter type examples

mandatory-no default

Each of the RPM function input parameter lists begin with the (**MANDATORY-NO DEFAULT**) parameters displayed in **bold blue text**. These parameters require a value or curve input for the calculation to succeed.

mandatory-defaulting

The input parameters **rho_1**, **rho_2**, and **rho_F** for **MixVelocityRho** are an example of (MANDATORY-defaulting) parameters. The parameters must be specified explicitly. Alternatively, a shortcut menu helps you select a value from the **Rock and Fluid Properties**, such as quartz.density for **rho_1**. If neither options are used, these parameters default from the **Rock and Fluid Properties** according to the default settings and the default values displayed on the status bar. For example, **rho_1** defaults to the density for the first mineral member.

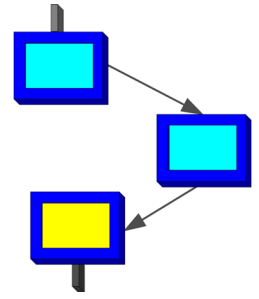
optional-no default

Consider the Bubble point pressure at in-situ temperature (**P_bubble**) in the **LiveOilRho** function as an example of an (OPTIONAL-NO DEFAULT) parameter. When this optional parameter is used, it overrides any input value for R_s the calculation, but there is no default value.

optional-defaulting

The input parameters for **GreenCastVptoVs** are an example of (OPTIONAL-defaulting) parameters. When this function is simply used to determine V_s from V_p in brine-

saturated rocks, there are four mandatory parameters. But when a fluid substitution is required to calculate V_s from V_p for rocks saturated with fluids other than brine, using the ten optional parameters (both defaulting and no default) requires that an optional calculation happens.



FREQUENTLY ASKED QUESTIONS

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RPM for PowerLog is not starting, is something wrong?

No, RPM for PowerLog has two requirements for the software to begin building or using workflows:

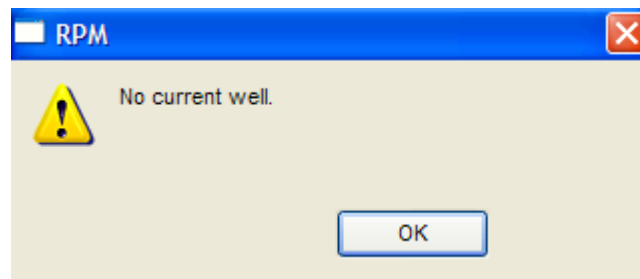
- RPM for PowerLog version 2.7 software (see [“Downloading software from Fugro-Jason” on page 17](#))
- Version 2.7 RPM for PowerLog license (see [“Obtaining an RPM for PowerLog v2.7 software license” on page 17](#))

To determine the PowerLog software version

- 1 Start the PowerLog software.
- 2 Select the **Help > About** command. The **About** dialog should display the text “Powerlog Version 2.7”.

Caution! PowerLog version 2.61a and earlier versions *do not* support the RPM for PowerLog license.

If you have not selected a PowerLog well when the RPM for PowerLog application starts, you receive the large warning displayed in [Figure: 12, ‘No PowerLog well selected’](#).”

Figure 12. No PowerLog well selected

If a well name does not display in the RPM for PowerLog Status bar ([Figure: 14, ‘RPM for PowerLog status bar information’, on page 38](#)), use PowerLog to select a project and a well.

To select a PowerLog project and well

- 1 Select a PowerLog project using the **File > Project > Open** PowerLog command.
- 2 Display each well you need to use by repeatedly using the **File > Well > Open** PowerLog command. The well name, depth range, and sample interval display in a list similar to [Figure: 13, ‘PowerLog window title and <project name> Well List’, on page 38](#).
- 3 Select a single well from the project well list.
- 4 Select the **Interp > Rock Physics Module** PowerLog command.
- 5 When RPM for PowerLog starts, the well name displays in the status bar. An example well would look like [Figure: 14, ‘RPM for PowerLog status bar information’, on page 38](#).

Why does the RPM curve alias list not display?

If the curve alias list has not been created by PowerLog, then the RPM for PowerLog software cannot display the list.

Create the initial Curve Alias Table by using the **Tools > Curve Alias Table** command in PowerLog.

Why does an error happen when I try to start a new project?

If you get an error message, that states, “Cannot open defaults file for new project - ProjDefaults.rpm”, exit the RPM for PowerLog software, exit PowerLog, and perform the next procedure. You must start both PowerLog and RPM for PowerLog software before you begin switching PowerLog projects.

Starting PowerLog, RPM, and switching PowerLog projects

- 1 Start PowerLog v2.7 (or more recent) software.
- 2 Use the PowerLog **Interp > Rock Physics Module** command to start the RPM for PowerLog software.
- 3 Begin with the PowerLog **File > Project > Open** command to locate your PowerLog project.
- 4 Use the PowerLog **File > Well > Open** command to open one or more wells.
- 5 In the RPM for PowerLog software, use the **File > New Project** command to create a new project.

Why does the RPM online help not display?

The RPM online help for the mathematical and rock physics functions:

- Displays in an HTML browser window
 - Requires that Javascript option for the browser is enabled.
- 1 Check to see that the browser displays HTML files on your local drive.
 - 2 Verify the Javascript is enabled. For Internet Explorer, use the **Tools > Internet Options** command. Enable active content on your local machine.
 - 3 Verify that the RPM online help is in this directory:
C:\Pwrlog32\RPM\Help\Quick Ref

Where did the Greek symbols go in the online help?

If you have a Mozilla Internet browser (Netscape or FireFox) defined as your default browser, the Greek symbols are rendered incorrectly. Also some of the fonts display abnormally large due to Mozilla's rendering of cascading styles.

For optimum viewing, Fugro-Jason *recommends* you use Internet Explorer as your Internet browser for the RPM for PowerLog online help.

To correct FireFox and Netscape browsers to display the Greek symbols:

- 1 Find the Internet Browser `fontEncoding.properties` file on your PC.

For the Netscape browser, it is located in the folder:

```
Program Files\mozilla.org\Mozilla\res\fonts\fontEncoding.properties
```

For the FireFox browser, it is located in the folder:

```
Program Files\Mozilla Firefox\res\fonts\fontEncoding.properties
```

- 2 Make a backup copy of the `fontEncoding.properties` file.
- 3 Change the line in the `fontEncoding.properties` file

From this,

```
encoding.symbol.ttf = Adobe-Symbol-Encoding  
to this,
```

```
encoding.symbol.ttf = windows-1252
```

- 4 Save the `fontEncoding.properties` file.
- 5 Restart your Internet browser program.

Can I display my curves in RPM for PowerLog?

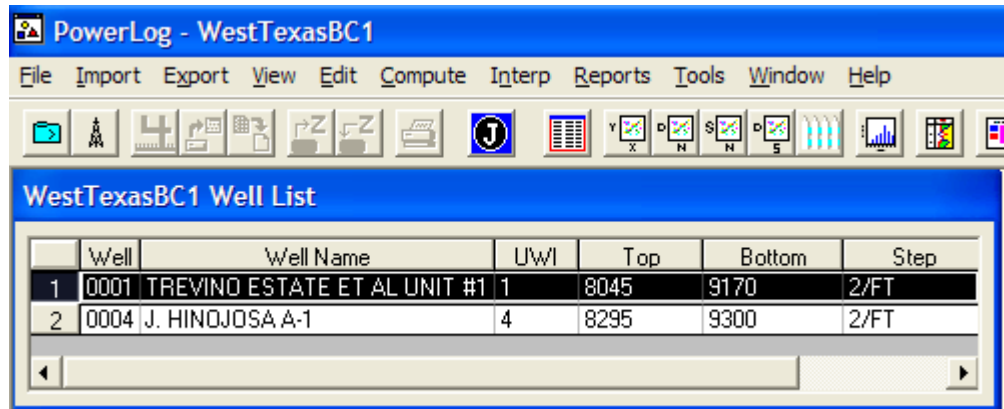
RPM for PowerLog is a calculation engine for implementing rock physics computations. To display your curves for the best possible presentation, use PowerLog. PowerLog contains many graphic views [log plots-with tops, histograms, cross plots, and cross-section collages] that automatically update whenever your curves (recorded or synthetic) are updated with RPM and PowerLog calculations.

What project and well is this RPM workflow using?

The PowerLog and RPM for PowerLog applications provide a detailed description of how the current workflow is being used. As shown in [Figure: 13, 'PowerLog window](#)

title and <project name> Well List”, on page 38, the PowerLog application window title and the project Well list describe the current PowerLog project and well name used by the workflow. Additionally, the top and bottom well depths are displayed, along with the step (sampling interval). In this example, the project name is **WestTexasBC1** and the currently selected well name is **TREVINO ESTATE ET AL #1**.

Figure 13. PowerLog window title and <project name> Well List



The RPM for PowerLog window title provides project and calculation elements (defaults):

- RPM Workflow Project name
- End member #1 (**Quartz**, a mineral)
- End member #2 (**Clay**, a mineral)
- Pore Fluid (**Water**)
- Algorithm used to determine the bulk modulus (**none**)

Figure 14. RPM for PowerLog status bar information

Well: TREVINO ESTATE ET AL UNIT #1 OVR 1600 X 1200

The RPM for PowerLog status bar provides this information:

- PowerLog well name in use
- Indication that PowerLog curve overwriting is in effect (OVR)
- Current size of the workspace in pixels

How can I work with well curves sampled in meters?

The first release of RPM for PowerLog, with few exceptions, works only with Imperial units. Later RPM and PowerLog software versions will permit you to use whatever units you want. To use a well sampled at metric intervals, you need to convert the well depth values to feet. We recommend you use 1/2 foot sample spacing.

To convert a PowerLog well from metric sampling to feet:

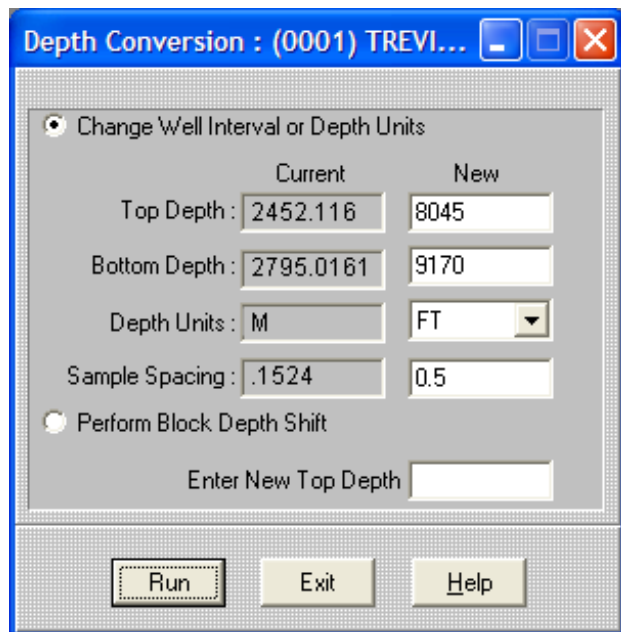
- 1 Shutdown RPM for PowerLog software and any other PowerLog plug-ins running.
- 2 Select a well in a project to convert using the **File > Well > Open** command.

- 3 Select the **File > Well > Depth Conversion** command.
- 4 When the **Depth Conversion** window displays, click the **Change Well Interval or Depth Units** option button.
- 5 Under the **New** column, select **FT** for **Depth Units** in the drop-down selection list.

Caution! Start curve on *integer* number (not fraction) of feet and use **.5 FT** sample spacing.

- 6 Click **Run** and a confirmation alert asks, **Do you want to pack the well?**
- 7 Click **Yes** and the well curves are now sampled in feet.

Figure 15. PowerLog Depth Conversion window



How do I make sense of all the parameters in the MixVelocity functions?

Many of the parameters for the **MixVelocityRho**, **MixVelocityVp**, and **MixVelocityVs** rock physics functions are specific to the chosen mixing function algorithm (Xu-White Approximation, Layered Clay, Critical Porosity, and so forth).

Mixing function algorithm groups

The mixing function algorithms (20) can be classified into six groups:

- **Group 1**—Grain supported, Layered clay, Matrix supported, Self consistent, Xu-White (iterative), Xu-White approximation, and Woods
- **Group 2**—Dispersive clay and Dispersive and layered clay
- **Group 3**—Cemented spheres scheme 1 and Cemented spheres scheme 2
- **Group 4**—Critical porosity
- **Group 5**—Backus, Hashin-Shtrikman Lower Bound, Hashin-Shtrikman Upper Bound, Reuss, Voigt, Voigt-Reuss-Hill, and Wyllie
- **Group 6**—mixing algorithm Krief-Gurevich-Goldberg

Mixing algorithm specific parameter usage

Table 7. MixVelocityVp Parameter Usage Matrix by Mixing Function Algorithm Group

| Mixing Function Algorithm Group | 1 | 2 | 3 | 4 | 5 | 6 |
|--|----|----|----|----|----|----|
| Input Parameter for MixVelocityVp | | | | | | |
| alpha_1 Crack (pore) aspect ratio 1st mineral | MD | MD | | | | |
| alpha_2 Crack (pore) aspect ratio 2nd mineral | MD | MD | | | | |
| Dalpha_1 Change in aspect ratio with change in porosity for 1st mineral | OD | OD | | | | |
| Dalpha_2 Change in aspect ratio with change in porosity for 2nd mineral | OD | OD | | | | |
| orig_Poro1 Original porosity first rock | | MD | MD | | | |
| Crit_por_1 Critical porosity 1st mineral | | | | MD | | |
| Crit_por_2 Critical porosity 2nd mineral | | | | MD | | |
| KGG_A0 Krief-Gurevich-Goldberg coefficient 0 | | | | | | MD |
| KGG_A1 Krief-Gurevich-Goldberg coefficient 1 | | | | | | MD |
| method algorithm - insert appropriate mixing function algorithm | MD | MD | MD | MD | MD | MD |

Consult the online help topic named *Mixing Function Algorithm Examples - MixVelocityVp* and a similar discussion in the [RPM for PowerLog — Function Quick Reference Guide](#).

These topics provide:

- A table showing what input parameters are needed for each mixing function algorithm (**MixVelocityVp method** parameter)
- Two sets of **MixVelocityVp** function example inputs
- A results summary obtained from using different mixing function algorithms. (**method**) with the two examples.

How is information in the RPM documentation organized?

Each RPM document begins with a *Using this Document* section and contains in the *Where to find information* area, a description of what information each Adobe Acrobat document contains.

What determines if a node generates a curve or a single value?

If the function contains *at least one* input curve (curve alias name), a *curve* is the function output. To state it conversely, if all inputs are single values, the function output is a *value*.

Exceptions to the statements apply to functions that specifically create *only a single value* for output. See the [RPM for PowerLog Function Quick Reference Guide](#) for functions marked: **Output Single Value Only**.

How do I make suggestions to improve RPM for PowerLog?

As customers begin using RPM for PowerLog to enhance their rock physics modeling and exploration decision-making, we want to hear your ideas for making this software more efficient, easier to use, and oriented to helping you develop new methodologies.

You can send, and we will respond to enhancement requests at:

- **Email**— support.RPM@fugro-jason.com
- **Telephone**— +1 214 368 2191

See “[Scheduled Enhancements](#)” on [page 63](#), for the current enhancement items planned for RPM for PowerLog in 2006.

What example workflows can I use to get started?

RPM for PowerLog comes with four, ready-to-use tutorial workflows. These workflow files can be accessed from the C:\Pwrlog32\RPM\Workflow Templates directory.

Documentation that describes the key goals and strategies for these workflows can be found in the *Tutorial Workflows* section of the [RPM for PowerLog — User Guide](#). The documentation describes the (1) input curves, (2) resulting PowerLog curves, (3) named constants, and (4) key equations used.

How do I know if a calculation failed or succeeded?

To determine the success of a calculation at a specific node:

- Examine the **Output Log** dialog and look for errors.
- If a curve is output, place the cursor over the node and examine the status bar. You should see the mean value of the curve, number of samples, node number, and curve name. See [Figure: 21, ‘Displaying node curve mean value’, on page 55](#) as an example.
- When you place cursor over a node, node n: Output curve is <curve name> or node n: <Output type> is <value> displays, the calculation succeeded.

When a node calculation fails, the message displaying in the status line says, “node n: output is undefined and calculation failed.”.

What’s the procedure to report a software problem?

You can quickly report any software problems to the RPM for PowerLog team by:

- 1 Select the **Help > Create Problem Report** menu command. Fill-out the Microsoft® Word document and save it to a file. Attach this Problem Report to an email, along with any PowerLog and RPM project data files.
- 2 Select the **Help > Printable Documentation > Problem Report Form** menu command. Print this Problem Report and fill-out the form. Fax or send this problem report to our offices at:
 - **Email**— support.RPM@fugro-jason.com
 - **Fax number**— +1 214 368 5281
 - **Address**—1600 North Collins, Suite 1700, Richardson, Texas 75080 USA

To help us resolve the software difficulty fast and efficiently

- 1 Include your contact information. We may need to ask more questions.
- 2 Provide your three RPM workflow files. We can examine the files and help spot any difficulties.
 - RPM Project file: <projectname>.proj
 - RPM Node Definition file: <projectname> + Node.txt

- RPM Workflow graphic file: `<projectname>.dot`
- 3 Is the problem related to a specific rock physics or basic function? Please list the input parameters and types of curves so we can run tests to duplicate the issue.
- 4 Is the problem data-dependent? Does the error happen on a specific well or using a specific curve? Depending upon the well's confidentiality, we can discuss how to resolve the problem, while constantly protecting your commercial and intellectual property.

What makes an effective problem report?

Problem reports that get effective results, concisely provide three key pieces of information:

- **Inputs**—PowerLog project name, well name used with workflow, plus curves and constants used as inputs in the workflow.
- **Customer RPM settings**—functions used, function input parameters, and rock physics properties. Most of this information is in the three RPM workflow files.
- **Reproduction**—the steps you remember taking before the problem in RPM happened.
- **Final output**—curves saved to PowerLog and modeling constants estimated.

Reproducing your situation in our test environment, is the key for the RPM software development team to diagnose, fix, and document any software problem.

We (Fugro-Jason) cannot say enough about recalling and writing down the sequence of steps that brought the RPM software problem to your attention. Some tips for writing steps to re-enact a software problem include:

- **Goal**—state in the problem description what you were attempting to do.
- **Unexpected result**—what first happened (visually or in a message) that indicated things were not correct.
- **Concise steps**—write brief descriptions of each step (you don't need to say why you did the step) so we can duplicate your actions.

Fugro-Jason is your partner in successfully developing your rock physics modeling projects with the RPM for PowerLog software.

Does RPM handle rocks and minerals differently?

RPM for PowerLog handles minerals and rocks differently. How the defaulting mechanism differs for minerals and rocks, requires more explanation.

RPM makes a distinction between minerals (such as quartz and calcite) and rocks (sandstone and limestone). Properties unsuitable for minerals (such as original porosity `OriginalPorosity`) have values that are initially set as undefined (`UNDEF`). Properties unsuitable for rocks (such as the density, `Rho`, which would imply dependencies on other Properties table parameters such as porosity) have values which are also initially undefined. From **Set Mix Defaults** dialog, only *mineral* property values (not rocks) can be used as an *automatic* default in an RPM function parameter.

Example If the bulk modulus of a mineral phase is required as an input parameter `κ_1` in **MixVelocityVp** (Xu-White Approximation method) function and the user does not specify a value, the quantity found in the **Rock and Fluid Properties** for `minera11.κ` is used. This is indicated by the tool tip displayed when the cursor hovers over the input field. If `minera11` is quartz, then the default value is `quartz.κ`.

Caution! This automatic default value mechanism *does not* apply to *rocks*. There is no specification of a default rock or rocks, and rock values are not automatically used from the **Rock and Fluid Properties**, if the user leaves the input parameter blank.

Example In **MixVelocityVp** (Xu-White Approximation method), if the `Orig_Poro1` parameter is blank, it cannot default to `OriginalPorosity` for a rock (such as sandstone). The reason is there is no default rock, and the function cannot default to `OriginalPorosity` for the default mineral. The user may change the `UNDEF` values for a rock or mineral in the **Rock and Fluid Properties** to specific values, but these property values associated with a rock or mineral are still not used as a default if the user leaves an input field (with a rock blank, as opposed to a mineral) in a function. Input fields associated with rocks that are left blank default to undefined (`UNDEF`) values. The documentation and the tool tips indicate which input parameters default to undefined values for this reason.

The limitations on automatic defaulting described do not inhibit your ability to explicitly select a rock or mineral value from the **Rock and Fluid Properties**. You can still enter a numerical value as a rock input for an RPM function.

For complete details, see the [RPM for PowerLog User Guide](#).

How can I systematically remove my errors from a workflow?

There are many techniques and user interface elements you can use to find and remove workflow errors. One systematic approach might look like this:

- 1 Use the **Calculate > Output Log** menu command to determine what nodes are generating errors. Look for the initial node where the calculation fails.
- 1 Check to see that all input curves exist for the well you selected Use the **Curve List** and **Curve Alias List** dialogs to determine possible well curve names.
- 2 Check to see that all input node calculations (those with input curves) succeeded. If not, check the constants and the input curve names used.
- 3 Isolate a node calculation that failed. Use the **Show Ancestors** command to identify all nodes that contribute inputs to the failed node's calculation.
- 4 Determine a path where most calculations are failing. Beginning with the initial failing node (examine the Output Log to identify this node), calculate each node one at a time.
- 5 Check each node's result by hovering the cursor over the node. Each node displays the calculated value (mean value for curves) or an undefined message in the status bar.

Where do I find details about basic and rock physics functions?

The documentation about the rock physics and basic (math, trigonometric, statistics, random numbers, and conditional logic) functions can be accessed several ways:

- In the **Function Selection** dialog (when you edit a node), click the **Help** button to display details about the results, input parameters, and procedures.
- Use the **Help > Function Quick Reference** command to display summaries of all the rock physics and basic functions. Use this online help to print function reference sheets.
- Read the [RPM for PowerLog — Function Reference Guide](#) to see examples, references, and explanations about each Rock Physics function.

How can I minimize workflow calculation messages, yet still fix any problems?

To minimize the number of message alerts you receive when you calculate the workflow, do this:

- Turn-off the PowerLog curve overwrite warnings by using the **Calculate > Block Curve Overwrite Warnings** command.

Caution! This setting permits RPM for PowerLog to overwrite PowerLog curves that are not write-protected.

- Remove the check mark beside the **Calculate > Show Node Process Order** command to eliminate this quality control display.
- Send any node warning and error messages to your output log file by displaying the **Output Log** dialog *before* you calculate the entire workflow. Do this with the **Calculate > Output Log** command, then calculate the workflow by pressing [F8].

Note The PowerLog curve overwrite warnings are blocked from one RPM work session to another, until you remove the check mark from the **Calculate** menu by selecting the **Calculate > Block Curve Overwrite Warnings** command once again.

Note PowerLog curves that are “write-protected”, are not overwritten with new data. You only need to protect the input curves from changing. RPM for PowerLog creates and writes all other calculation curves to PowerLog.

Can I use an expression for inputs to the ConditionalExpression function?

(Conditional Logic category) The `if_true` and `if_false` input fields *cannot* have an expression. If you need to make a calculation such as converting an acoustic log to a velocity function ($1000000/n4$), create another node that implements this operation and put *the conversion* node number in the `if_true` field within the **Function Selection** dialog.

What can I do if all my connections don't redraw on a complex workflow?

Select the **Edit > Reconnect** command or press the [F6] function key. RPM for PowerLog redraws and saves all the connections when the workflow gets complex.

How can I copy project properties from one RPM project to another?

In RPM for PowerLog version 2.0, the software will contain functions to import and export rock, fluid, and mineral properties among RPM projects. For now, you must use a text editor and manually copy the desired rock, fluid, and mineral properties using this procedure in the *RPM for PowerLog Getting Started Guide*.

To import rock and fluid properties manually

- 1 Ensure that neither project (*.proj) file is in use by RPM for PowerLog.
- 2 Using a text editor such as NotePad, TextPad, or UltraEdit, open your *source* RPM project (project containing the rock, mineral, and fluid properties you want to copy).
- 3 Open the *destination* RPM project.

- 4 In the *source* project find the ROCK, MINERAL, or FLUIDORGAS property you want to copy.
- 5 Select the entire section of the property, include a blank line.

Caution! Each RPM property begins with a dollar sign (\$) and ends with a blank line, line feed, or return character. All properties must be inserted into any RPM project file above the **Constants** section, which begins with the text (\$\$Constants).

- 6 Copy and paste the text to the *destination* RPM project.
- 7 Repeat steps four to six for each property you want in the *destination* RPM project.
- 8 Save and close the *destination* RPM project

What keyboard shortcuts can I use for frequent RPM commands?

RPM for PowerLog menus contain shortcut keys to help you quickly choose RPM commands instead of clicking on main or context-sensitive menus.

Note If you are running on Windows XP and the shortcut keys are not displaying, use the procedure found in the *RPM GUI Reference* section of the [RPM for PowerLog User Guide](#) to display the menu shortcuts.

Table 8. Common RPM for PowerLog shortcut commands

| Shortcut keys | RPM command |
|-------------------|--|
| Ctrl + Keypad "+" | Add node to workflow |
| Ctrl + R | Ancestor display for selected workflow node |
| Ctrl + Keypad "-" | Block Curve Overwriting Messages |
| F8 | Calculate the entire workflow |
| Ctrl + L | Curve list for selected well displays |
| Ctrl + D | Descendents display for selected workflow node |
| Ctrl + F | Find a node in the workflow |
| Alt + h + r | Function quick reference documentation displays |
| Ctrl + O | Open RPM project file (can browse through directories) |
| Ctrl + / | Output Log displayed to show calculation messages |
| F5 | Refresh the workflow display |
| Ctrl + S | Save the current RPM project |
| Ctrl + Z | Undo the last workflow operation |
| F1 | User Guide documentation displays |

How do I use conditional logic to select calculations for specific situations?

Three functions can implement conditional logic within workflows:

- **IsUndefined**—detects undefined parameters or curves within your workflow.
- **ConditionalExpression**—helps you compare two values and create your output from one input if the relationship evaluates `True`, and takes output from another input if `False`.
- **SimpleExpression**—helps you develop a more complex mathematical and logic expression, using up to 20 input parameters to build the custom function.

See the [RPM for PowerLog Function Quick Reference Guide](#) for details and examples.

What tools can I use to successfully create a robust workflow?

RPM for PowerLog provides a number of integrated tools to help you successfully build a rock physics model consistent with your available logs. Consult the [RPM for PowerLog User Guide](#) to get additional details about each of these tools.

The RPM for PowerLog tools you can use include:

- **Documentation**—you can access all of the RPM for PowerLog documentation using the Adobe Acrobat Reader (version 6 recommended) to quickly find information. Each document has an extensive index and you can employ a full-text search to find significant keywords.
- **RPM User Interface**—you can quickly define input nodes (that incorporate available well logs), define your calculations using the **Function Selection** dialog, and create output curves to display in PowerLog.
- **Function Help buttons**—each basic or rock physics function has a **Help** button, which displays function documentation in an Internet browser window.
- **Shortcut menus**—nodes, connections, groups, and the workflow workspace itself contain context-sensitive menus that permit you do operations quickly.
- **Right-click selection lists**—within many of the dialogs you can right-click (MB3) to display a selection list that provides appropriate choices for this parameter, parameter type, and so forth.
- **Status bar and node tool tips**—as you build the workflow, you can use the cursor to “hover” over a node to get node function and calculation result information.

How can I simplify the workflow once all calculations are working?

Fugro-Jason is currently developing techniques to enhance the workflow calculation and to optimize the calculation procedure. One of the first steps toward this optimization is creating the **SimpleExpression** function. This function helps you construct a useful arithmetic expression within a single node, which can also include conditional logic.

See the [RPM for PowerLog Function Reference Guide](#) for exact details and examples for using the **SimpleExpression** function.

What basic functions are most useful for RPM workflows?

Some of the more useful basic functions include:

- **Add**—add samples for two curves or just two values together.
- **Conditional**—Have the output be one of two results, based on a conditional relationship test.
- **DivideBy**—divide one value by another
- **GetCurve**—define a curve or a parameter as an input node.
- **Mean**—mean value of a curve's samples (undefined samples ignored)
- **Power**—raise `parm1` to a power specified by `parm2` (single values or curves)
- **Product**—multiply samples for two curves or just two values together.
- **Rms**—Root-mean-squared power of a curve.
- **SimpleExpression**—create a simple expression from up to 20 inputs. Use to reduce the number of nodes after calculations are validated and known to provide predictable results.
- **Subtract**—take the difference of two values

How do I determine which nodes or curves are correct for a function?

The output from any RPM node can be assigned a type. RPM function input parameters take a specific type, such as bulk modulus or shear velocity. You can define your output as a specific type. Later, when you need that node as an input to another function (that requires this input) type, the right-click selection list only displays nodes with the appropriate types.

If you perform an arithmetic calculation such as addition, the default output type is **any**. For some functions, if you know the output type, you can choose it from the **Type** drop-down selection list on the **Function Selection** dialog.


For a complete list of output types defined by RPM, see the *Outputs and types* area of the *RPM Concepts* section within the [RPM for PowerLog User Guide](#).

How do I find an individual node in a complex workflow?

RPM for PowerLog uses its **Find Node** function to help you locate any node within the workflow.

To find a node in the workflow

- 1 Use one of these methods to invoke the Find Node command:
 - Select the **View > Find Node** menu command.
 - Right-click in an empty workspace area and select **Find Node** from the Workspace shortcut menu.

- Click the  toolbar icon.

- 2 When the **Node Locator** dialog displays, select the desired node and click **OK**.

The specified node flashes with a yellow background twice. If the node location is outside the screen display area, the screen scrolls left or right to display the node. If the specified node is hidden within a minimized group, the group opens to reveal the node.

Is there an RPM reference of all software commands and functions?

Currently you can find a list of all:

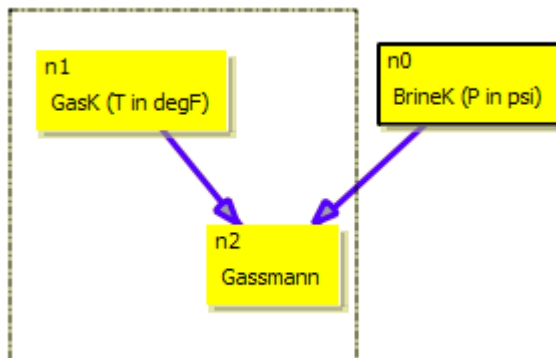
- All functions and user interface commands—*RPM at a Glance* quick reference PDF.
- Software commands—the *RPM User Interface* section within the [RPM for PowerLog User Guide](#).
- Rock physics and basic functions—the *Functions Overview* section of the [RPM for PowerLog Function Reference Guide](#).

How do I delete multiple workflow nodes?

To delete several nodes at once

- 1 Move the nodes you want to delete by clicking and dragging each node to an unused portion of the workflow.
- 2 Click and hold the mouse down at a point in the workspace representing the top left-hand corner of your node deletion area.
- 3 Drag the cursor to the bottom right-hand corner of the area containing all the nodes you want to delete. Release the mouse button. Your workflow would look similar to [Figure: 16, 'Deleting multiple nodes within a workflow area'](#).
- 4 Press the [Delete] key. This deletes the enclosed nodes.

Figure 16. Deleting multiple nodes within a workflow area



Hint If you included a node you did not want to delete, use the **Edit > Undo** command to restore all the deleted notes to your workflow.

Can I avoid retyping the same function input values?

RPM for PowerLog has two features that help you define rock model constants:

- **Rock and Fluid Properties**—helps you define constant properties for rocks, minerals, fluids, and gases.
- **Constants**—helps you define named constants for a (a) literature value, (b) equation coefficient obtained from empirical measurements, or (c) any number you want to use consistently as a function input parameter.

Use the **Data > Rock Fluid Properties** command to supply different values to rocks, minerals, gas, and fluids defined by the software. Alternatively you can add other

rocks, minerals, gases, and fluids to the list. Once you add a new **Rock, Fluids, and Minerals** list item, you can define values and units for one or more properties that are associated with your new list item.

Use the **Data > Constants** command to define any named constant that you want to use in the node function input parameters. When editing any node using the **Function Selection** dialog, right-click on a space under the **Value/Name** column and select **Constant**. Select the constant you want to use as a function input parameter.

Hint At any time, you can add, change, or delete your **Rock, Fluids, and Minerals** list items and properties. Also you can do the same with the **Constants**. However, the default list of **Rock and Fluid** properties defined by RPM for PowerLog can be changed, but *never* deleted.

Caution! You need to take care *whenever you rename* an existing RockProperty (for example, quartz.K) or a named constant. RPM for PowerLog currently *does not* automatically fix all the Constant and RockProperty names in existing nodes. See [“How do I fix nodes when a RockProperty and Constant is renamed?” on page 57](#).

How does curve fitting work with workflow nodes?

RPM for PowerLog performs curve fitting within its workflow node structure by using three workflow components:

- **Function**—node containing a rock physics or basic function with one or more parameters. This is the function for which you vary the input parameters.
- **Curve**—node whose output is the curve you want to *approximate* with the Function Node.

Note RPM for PowerLog minimizes error between the fitted curve and Curve Node output using Mean Least-squares or Average Difference error criteria.

Example Curve fitting in an RPM for PowerLog workflow generally follows the procedure in this example, However a user can experiment by varying multiple combinations of function input parameters.

- 1 Identify the *Function* Node. This is the workflow node that has the approximating function you want to fit to the *Curve* node. This example uses the **GardnerVtoRho** function with several empirical coefficients (**GardA** and **GardB**) that the curve fitting algorithm can vary. The output curve is named **RHOCalc**.
- 2 Identify the *Curve* Node. This is the curve that the *Function* Node attempts to approximate by varying its input parameters. The output curve is named **RhoMeas**.
- 3 Select the **Calculate > Curve Fitting** command. The **Curve Fit** dialog displays.
- 4 Right-click in the *Function (Calculated Node to Fit)* text box. Select **Node** and choose **n2** from the node list. Immediately the **GardnerVtoRho** function parameters found in the *Function* Node **n2** display in the **Curve Fit** dialog.
- 5 Right-click in the *Curve (Observed Data Node)* text box. Select **Node** and choose **n1** from the node list. This is your *Curve* Node.
- 6 Select the **Optimization Method** used to calculate the error between the approximating function (**Calculated Node to Fit**) and the curve (**Observed Data**):
 - **Mean Least Squares**, default setting
 - **Averaged Difference**, used for large sample values
- 7 In the **User Param** column select the check box beside parameter **GardA**. For the **Lower Bound** cell, type 250. For the **Upper Bound** cell, type 270. The software varies the **GardA** parameter within this range and attempts to minimize the error.
- 8 Leave the **Log output to file** box unchecked (minimizes the calculation time) and use the default value for **Fit Precision** of **1.0e-15**.
- 9 Click **Compute**. The **Curve Fit** dialog displays the parameters that found the minimum error (**GardA** = 253.059) between the output from the *Function* Node (**n2**) and the Curve Node output (**n1**). The curve **FITCURVE** is stored in the PowerLog well and can be plotted with the *Curve (RhoMeas)*.
- 10 Click **Apply**. The **GardA** input parameter value that produced the minimum error (**GardA** = 253.059) is copied to the *Function* node **n2**.

Figure 17. Curve Fitting example

The image shows two dialog boxes from a software application. The top dialog, 'Function Selection', is used to configure a function node. It shows 'Node #' as 2, 'Node name' as n2, and 'Label' as 'Rho - Calculated'. The 'Function Type' is 'Gardner' and the 'Function' is 'GardnerVtoRho'. A table lists parameters: Velocity (n0, ft/s), GardA (263.384, grda), and GardB (.261, grdb). The output is 'RHOCalc' with type 'density' and units 'g/cc'. The bottom dialog, 'Curve Fit', is used to fit a curve. It shows 'Calculated Node to Fit' as n2 and 'Observed Data Node' as n1. The optimization method is 'Mean Least Squares'. A table shows parameter values: Velocity (n0), GardA (253.059, 250-270), and GardB (.261). A mouse cursor is over the GardB value. Blue arrows connect the nodes in the workflow diagram to the corresponding fields in the dialog boxes.

Function Selection Dialog:

- Node #: 2
- Node name: n2
- Label: Rho - Calculated
- Function Type: Gardner
- Function: GardnerVtoRho

| Specify Parameters: | Parameter | Value/Name | Units |
|---------------------|-----------|------------|-------|
| 1 | Velocity | n0 | ft/s |
| 2 | GardA | 263.384 | grda |
| 3 | GardB | .261 | grdb |

Output: RHOCalc Type: density Units: g/cc

Curve Fit Dialog:

Fitting Parameters

- Calculated Node to Fit: n2
- Observed Data Node: n1
- Max Iterations: 100
- Weighting: 1.0

Optimization Method

- Mean Least Squares
- Average Difference

Custom Parameters

- Log output to file
- Fit Precision: 1e-15

| | Use Param | Current Value | Lower Bound | Upper Bound |
|---|---|---------------|-------------|-------------|
| 1 | <input type="checkbox"/> Velocity | n0 | | |
| 2 | <input checked="" type="checkbox"/> GardA | 253.059 | 250 | 270 |
| 3 | <input type="checkbox"/> GardB | .261 | | |

Workflow Diagram:

- n0 Velocity - Measured (yellow box)
- n2 Rho - Calculated (yellow box, labeled 'Function Node')
- n1 Rho - Measured (yellow box, labeled 'Curve Node')

Where can I display details about the curve fitting computations?

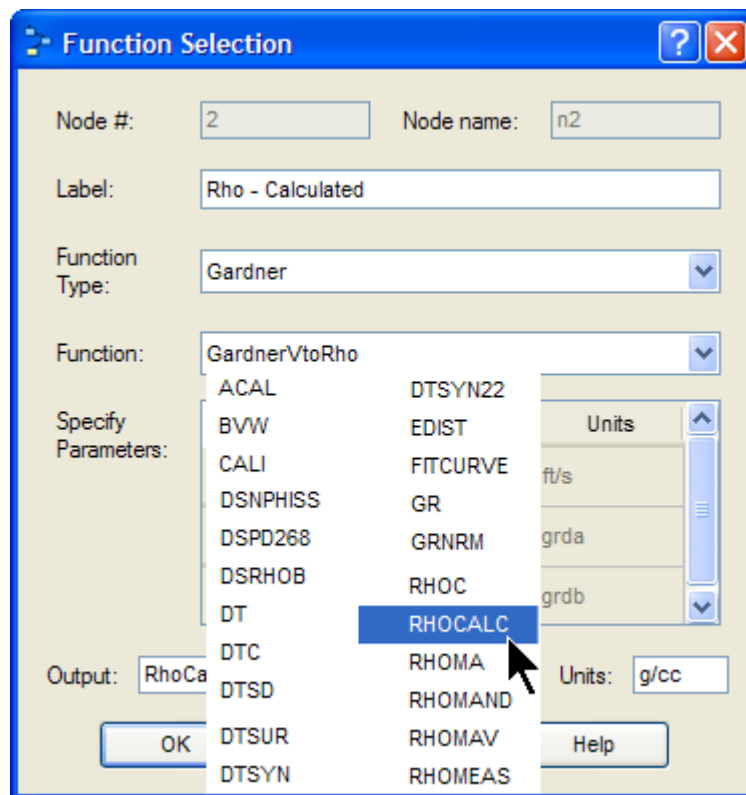
To see the computation details about the curve fitting

- 1 Perform the desired curve fitting and select the **Log output to file** check box under the **Custom Parameters** area of the **Curve Fit** dialog. (See [Figure: 17, 'Curve Fitting example'](#), on page 51.)
- 2 Once the curve fitting completes, select the **Calculate > View Curve Fitting Log File** menu command to display the computation details.
- 3 [Optional] You can plot the curve you wanted to approximate on top of or alongside the **FITCURVE** curve in PowerLog to compare your results.

Can I select a curve name for a node output?

Yes. You can right-click (MB3) the **Output** field when editing any node with the **Function Selection** dialog. RPM for PowerLog displays the current list of PowerLog well curve names ([Figure: 18, 'Selecting a curve name for output'](#)). Click on the desired curve name to place it in the **Output** field.

Figure 18. Selecting a curve name for output



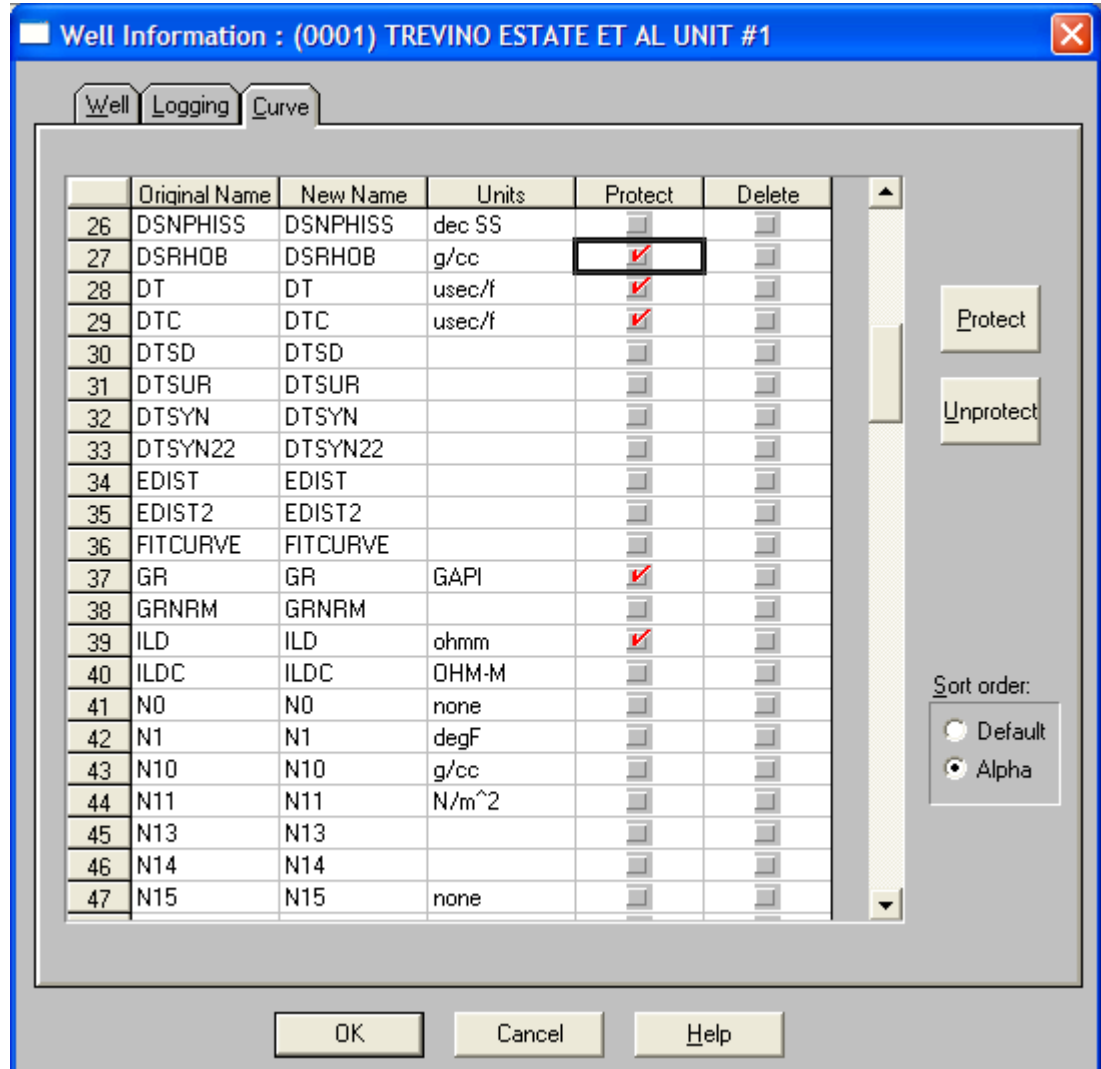
Caution! Prior to selecting curves that you can overwrite in your PowerLog well, you may want to protect your input curves to avoid accidental well data loss.

To protect PowerLog curves from accidental overwriting

- 1 In PowerLog, select the **File > Well > Information** command.
- 2 Click the **Curves** tab.

- 3 Select the check box found under the **Protect** column, beside each curve name you wish to protect (**Figure: 19, 'Protecting curves in PowerLog'**).
- 4 Click **OK**.

Figure 19. Protecting curves in PowerLog

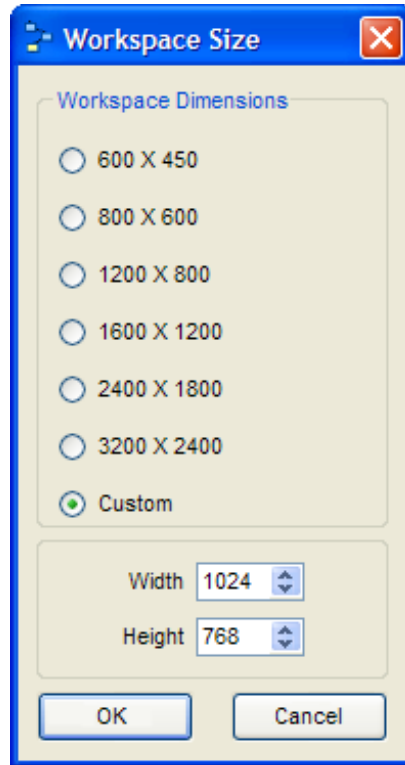


Can I get a hardcopy of my workflow?

Yes, use this procedure to print your workflow.

To print an RPM for PowerLog workflow

- 1 Using the **Edit > Set Workspace Size** menu command to customize your workspace size to contain your workflow, without excess surrounding space. **Figure: 20, 'Customize the workspace size'**, on page 54 shows how you can customize the workspace size to fit your workflow complexity.

Figure 20. Customize the workspace size

Hint Because the hardcopy output of a single page is scaled to the RPM workspace size, setting the workspace too large reduces it to a smaller size on the printed copy or plotter. Set the workspace too small and parts of the workflow may not print.

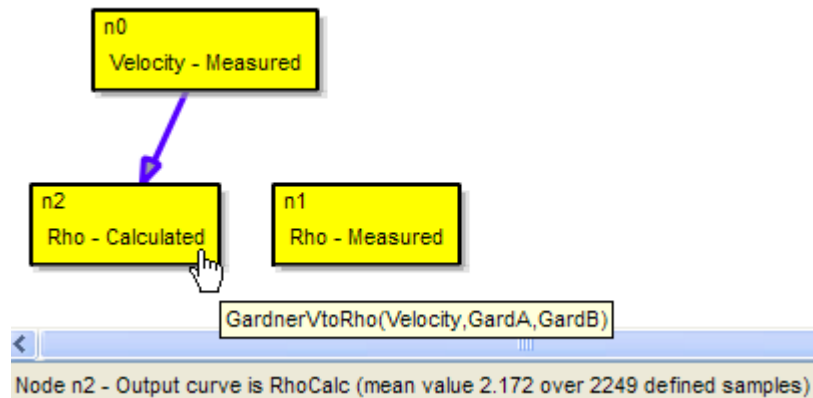
- 2 Use the **Edit > Preferences** menu command to set your workspace color so it is:
 - A light background that does not obscure the printed workflow contents
 - Compatible with your node, connection, and group colors chosen
 - Easy to view on the screen

Note See the example found in [“Background workspace color” on page 61](#).

- 3 Select the **File > Print Workflow** menu command.
- 4 When the **Print** window displays, select one of your local printers in the **Select Printer** area.
- 5 Change the **Number of Copies** if necessary and click **Print**.

Is there a quick way to see if a node curve calculation is correct?

Yes, after running a calculation at one or more nodes (or the entire workflow), place your cursor over the desired node. The tool tip displays the function name and parameters. The status bar displays the *mean value*, the number of samples, node number, and curve name. See [Figure: 21, ‘Displaying node curve mean value’](#).

Figure 21. Displaying node curve mean value

Will workflows accommodate comments or titles?

Not at the moment. If you want to add titles or comments to your workflow, use the node or group procedure shown.

To add a comment using a node

- 1 In any blank area of the workspace, right-click (MB3) and select the **Add Node** shortcut command.
- 2 Click in the workspace to add the node.
- 3 Double-click the node and display the **Function Selection** dialog.
- 4 Use the default **Add Function**. Type 1 for the values of **val1** and **val2**.
- 5 Type the node number in the **Output** field.
- 6 In the **Label** field add your title or comment. The function dialog should look similar to [Figure: 22, 'Adding a node title or comment', on page 56](#).

Hint The title displays as a single line so you should not try to insert multiple sentences. You can make several comments or titles throughout the workflow.

Figure 22. Adding a node title or comment

Function Selection

Node #: 1 Node name: n1

Label: Title Comment Added to my Workflow

Function Type: Arithmetic

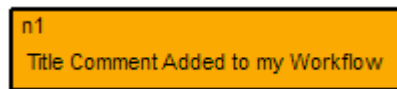
Function: Add

| Specify Parameters: | Parameter | Value/Name | Units |
|---------------------|-----------|------------|-------|
| 1 | val1 | 1 | |
| 2 | val2 | 1 | |

Output: n1 Type: any Units:

OK Cancel Help

- 7 Right-click (MB3) on the node and select the **Change Color** shortcut command.
- 8 Select a basic color or add a custom color in the **Select Color** dialog. Click **OK**.
- 9 The node displays the contents of the **Label** field on the workflow.



Creating a multi-line comment using a group

To add a comment using a group rectangle

- 1 In any blank area of the workspace, right-click (MB3) and select the **Define Group** shortcut command.
- 2 Left-click (MB1) in the workspace. Hold the MB1 down and drag the mouse to define an area for the group. Release the mouse button (MB1).
- 3 Double-click in the group.
- 4 When the **Group Name** dialog displays, type your comment in the **Type Group Name** text field.

Hint The **Type Group Name** field is small, yet it accommodates a very long multi-line comment.

- 5 When you finish typing the comment in the **Group Name** dialog, click **OK**. The comment displays as the group name.
- 6 Place the cursor on the top, left, right, or bottom group border. When the cursor changes to a resizing cursor (two arrows), click and resize the group rectangle smaller or larger.

- 7 Repeat step 6 to adjust the comment in the group rectangle.
- 8 Click in the group center. Hold the mouse button (MB1) down and drag the group to the desired location in your workspace.

What is the best way to define constants for a workflow?

If the constants are not linked to rock, mineral, gas, or fluid properties, two approaches exist to define constants:

- **Individual nodes**—create a node with a `UserValue` or perform a needed basic mathematics function. Repeat this for each constant you require. The node **Label** documents the constant and the node **Output** can be used as an input parameter throughout the workflow. For examples and procedures, see the *Setting up typical input curve and constant nodes* area of the *Planning Workflows* section in the [RPM for PowerLog — User Guide](#).
- **Named constants**—define several named constants and document with a group box. This approach minimizes the number of additional nodes added to the workflow. For procedures, see the *Creating named constants* area of the *Planning Workflows* section in the [RPM for PowerLog — User Guide](#).

To document named constants for a workflow

- 1 Create all the named constants using procedures found in the [RPM for PowerLog — User Guide](#).
- 2 Create a new group for a multiple line comment using the procedure: “[Creating a multi-line comment using a group](#)” on page 56.
- 3 Adjust the spacing between the constants so they display as a vertical list of names in the format: `ConstantName = value (units)`. This has to be done by trial and error.

How do I fix nodes when a RockProperty and Constant is renamed?

To fix nodes with a renamed RockProperty or Constant

- 1 Double-click the desired node or right-click (MB3) desired node and select the **Edit Node** shortcut menu command.
- 2 Right-click (MB3) on the `RockProperty` or `Constant` input parameter.
- 3 When the input parameter type list displays, select the type.
- 4 When the `RockProperty` selection list displays, select a rock, mineral, fluid, or gas, then choose the desired property.
or
When the `Constants` selection list displays, select the desired named constant.
- 5 Repeat steps two through four for each input parameter to fix.
- 6 Click **OK** to save the node changes.
- 7 Repeat steps one through six for all affected workflow nodes.

How rules does RPM use to name properties, constants, and curves?

RPM for PowerLog uses these business rules to name your data items:

- **Named constants**—constants defined by the user are *case-insensitive* and can not have blank characters in their names. The two named constants `Shale_Velocity` and `Shale_velocity` are considered the same constant.

- **RockFluidProperty**—the RPM-defined and user-added rock, mineral, fluid, and gas, plus their property names, are *case-insensitive* and can not have blank characters in their names. The user-added items `Halite`, `HALITE`, and `halite` are considered the same item by RPM.
- **PowerLog curve names**—the curve names are *case-insensitive*, can not have blank characters, and are limited to a maximum of eight characters. PowerLog curve names display in capitals letters (GR, DT, RHOB, and so forth) in the RPM for PowerLog dialogs, regardless of whether lower-case letters or capitals were used in the curve names.

What is an example of an effective workflow color scheme?







RPM for PowerLog provides you the ability to set the colors of each workflow:

- Node
- Group
- Connection
- Workspace background

While using individual colors can make your workflow take on a kaleidoscopic appearance, you may want to use a color scheme that helps you easily recognize workflow elements, displays well on the screen, and provides a good printed workflow.

Note This color scheme is used in the *RPM User Guide* to document the Tutorial Workflows.

Table 9. Example workflow color scheme

| Workflow Element | Color | Color Specification Red: xxx, Green: yyy, Blue: zzz |
|---------------------------------|---|--|
| Workspace (background) |  | Red: 255, Green: 255, Blue: 192 |
| PowerLog input curves (nodes) |  | Red: 255, Green: 85, Blue: 0 |
| Computation nodes |  | Red: 255, Green: 255, Blue: 127 |
| Groups (background) |  | Red: 255, Green: 170, Blue: 0 |
| Output results (nodes) |  | Red: 173, Green: 216, Blue: 230 |
| Labels - workflow and constants |  | Red: 85, Green: 170, Blue: 255 |
| Connections | Black | Red: 0, Green: 0, Blue: 0 |

What are the assumptions for using Gassmann's fluid substitution?

Before using Gassmann's fluid substitution functions, you should ensure that the underlying assumptions for this model are satisfied and that your input parameters take into account these assumptions (Mavko et al, 2005 [27]):

- **Rock solid phase is elastic and homogeneous**
 - In practice, estimate average bulk modulus of mineral mix and substitute this average.
 - Works for quartz, feldspar, calcite, and dolomite. Large clay volumes induce errors and clay pore-filling and structural clay impact mixing differently
- **All saturations are pure and 100%, without mixtures**
 - Estimate average density and compressibility of pore fluid mixture
 - Determine whether the fluid mix is fine or the saturation is “patchy”
- **Isotropic rocks** - in practice, ignored
- **Perfect fluid communication in pore space**
 - Good for low viscosity pore fluids and high porosity rocks
 - Poor for heavy oil, high shale content, and low permeability

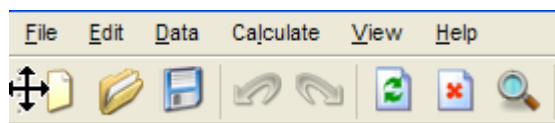
Can I position the RPM tool bar icons anywhere?

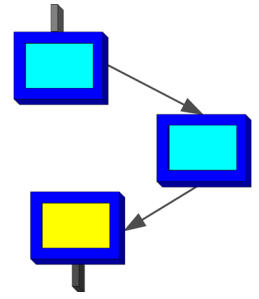
You can move the RPM for PowerLog tool bar icons to the left, right, bottom, or top of the workspace area.

To undock and dock the tool bar icons:

- 1 Place the mouse on the extreme left top portion of the tool bar until the cursor looks like [Figure: 23, 'Drag dockable tool bar to new location'](#).
- 2 Click (MB1) and drag the tool bar to the left, right, bottom, or top side of the RPM workspace.
- 3 Release the mouse button (MB1).

Figure 23. Drag dockable tool bar to new location





BEST PRACTICES

This section describes some of the best practices developed at Fugro-Jason for using the RPM for PowerLog software:

- **Minimizing the number of temporary curve names**
- **Using workflow color preferences**
- **Using input nodes effectively in a workflow**
- **Using node numbers and curve names wisely**
- **Determining inputs to a problem calculation**

Minimizing the number of temporary curve names

You can use the same name for multiple curves (for example, TEMPCALC) provided the curves are not used as input to other calculations. This helps eliminate the situation where you have a large number of extra curve names that are not used in other parts of the workflow. However, this does not permit you to review the intermediate results produced.

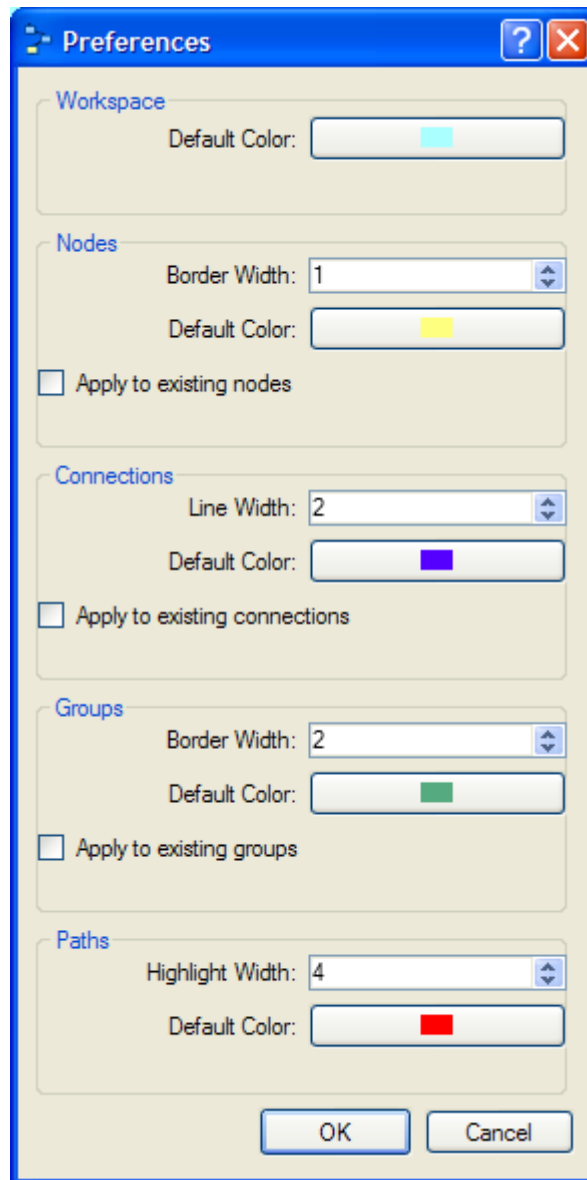
Using workflow color preferences

At any time during the construction of an RPM workflow, you can change the colors of:

- background workspace
- nodes
- connections
- groups
- selected path

Using the **Edit > Preferences** command, you can display the **Preferences** dialog where you can select specific colors (see [“Background workspace color” on page 61](#)) for each of the items and apply the colors to existing workflow elements.

Figure 24. Preferences dialog



Hint You want your selected colors to be high-contrast and not very dark, so the workflow image can be displayed on a black and white printer.

Caution! For your workspace, you want to avoid a dark gray (R-128, G-128, B-128) or a light gray (R-192, G-192, B-192) color.

Background workspace color

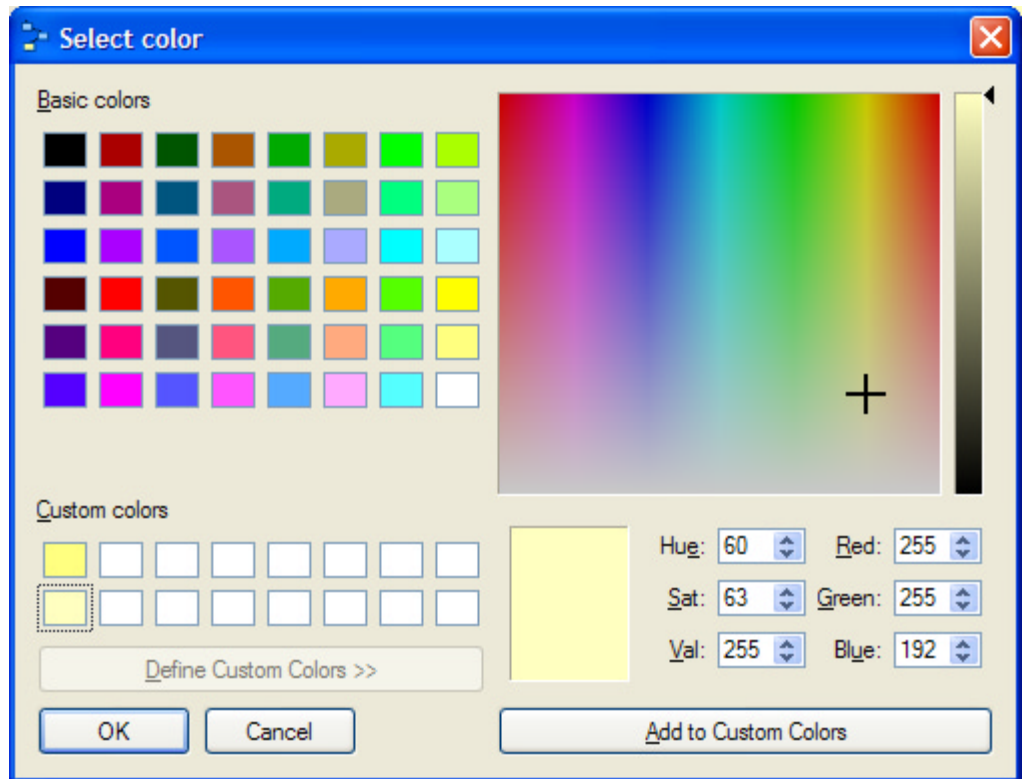
To create a background workspace color that decreases eye strain and displays well on a black and white printer, follow this procedure.

Setting the workspace color:

- 1 Select the **Edit > Preferences** command to display the **Preferences** dialog.
- 2 Click the **Default Color** for the **Workspace** area.

- 3 When the **Select Color** dialog displays, type these numbers:
Red: 255, Green: 255, Blue: 192.
- 4 Click **Add to Custom Colors** to define this light-maize background.
- 5 Select this new maize color that displays under **Custom colors** and click **OK**.
- 6 On the **Preferences** dialog, click **OK**.

Figure 25. Select color dialog



Using input nodes effectively in a workflow

Several nodes within your workflow are classified as *input nodes*, that is, nodes that use PowerLog curve names (or curve aliases), defined RPM constants, or numbers to define an output that can be connected to multiple nodes throughout the workflow.

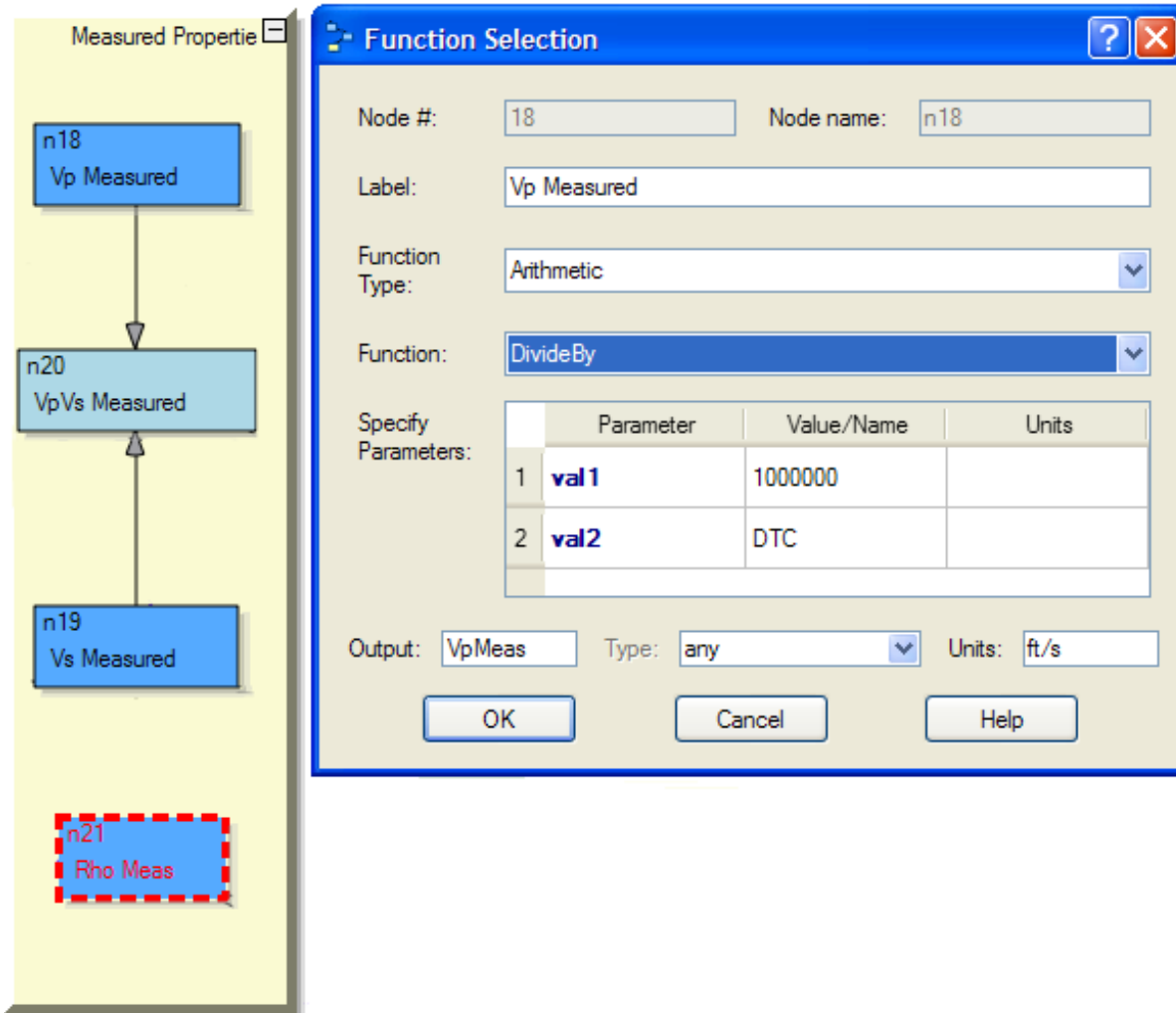
Most input nodes are usually defined as:

- A user value
- A pre-defined constant from the **Constants** dialog or a property from the **Rock Fluid Properties** dialog
- A single curve read from the PowerLog well (use the `GetCurve` function to specify the curve as a node output)
- A simple computation using a PowerLog curve and a constant (such as converting an acoustic log to velocity, as done in [Figure 26, 'Input nodes example', on page 63](#)).

Hint To help you effectively use input nodes in a workflow that is applied to multiple wells, you may want to provide a unique color code (such as red or blue) to all your input

nodes. See the *RPM for PowerLog User Guide* for the procedure to apply a color to a single node.

Figure 26. Input nodes example



Using node numbers and curve names wisely

Workflow calculation nodes can specify a node number or a curve name as the output (written to the PowerLog project well). Curves are created as the results of RPM node calculations and written to the PowerLog well project. On the positive side, populating PowerLog with a number of intermediate curve results can be helpful in reviewing your calculations as you develop the workflow. The downside, you may need to delete curves later or the curve selection list contains too many entries.


The RPM calculation nodes can be classified into three categories:

- **Input nodes**—Use PowerLog *curve names* or constants, along with the **GetCurve** function for these nodes.
(See [Using input nodes effectively in a workflow](#).)
- **Connection nodes**—These nodes create outputs that are used as input parameters in other nodes. You should always use the *node name* for the input parameter, even if the curve has a different name. This creates the visual connections between nodes in the workflow.
- **Output nodes**—These nodes produce results that you want to store in the PowerLog project well. Specify a curve name [**maximum eight characters**, no blank spaces] for the result you want stored.

Determining inputs to a problem calculation

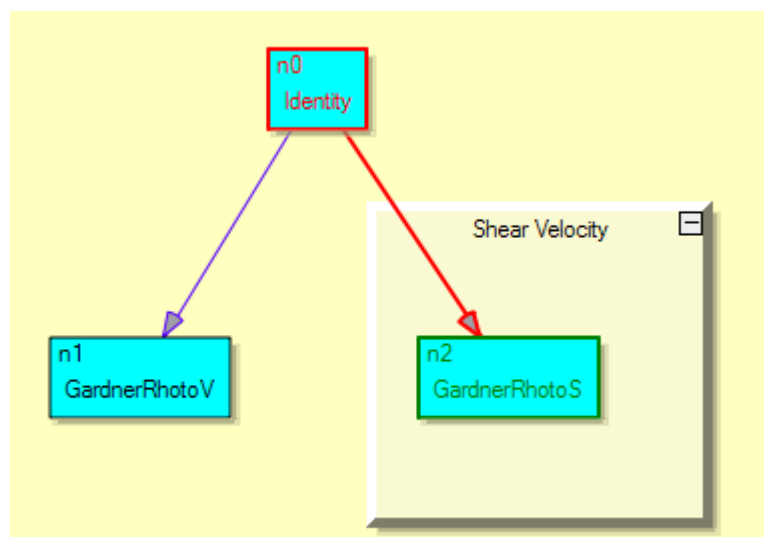
When a calculation at a node fails, one of the initial steps you can perform to resolve the problem is to determine all the inputs that affect this node.

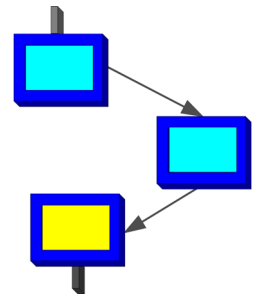
To determine the nodes inputs

- 1 Select the **View > Show Ancestors** command or click the  toolbar icon.
- 2 Click the node where your calculation had difficulty. The nodes inputs are highlighted, according to your preferences.
- 3 [Optional] If the highlighted nodes are not distinctive enough, use the **Edit > Preferences** command to change your workflow element color preferences.

Hint Alternatively, you can determine the problem node if you select the **Calculate > Output Log** command. The log messages show the calculation sequence and the first error message indicates often where the calculation failed.

Figure 27. Show Ancestors example





RELEASE NOTES

This section provides some of the most current documentation about last-minute changes made to the RPM for PowerLog software. These include:

- **Resolved Issues**—Issues and problems that were fixed in this software release.
- **Known issues**—These are problem areas in which the RPM for PowerLog software may required the user (temporarily) to perform a more lengthy procedure or other work around.
- **New Features**—Functionality or features recently added to the software, but are not yet documented in the *RPM for PowerLog User Guide*. Sections “**Frequently Asked Questions**” on page 33 or the “**Best Practices**” on page 60 may provide brief descriptions of how to use these new features.

Resolved Issues

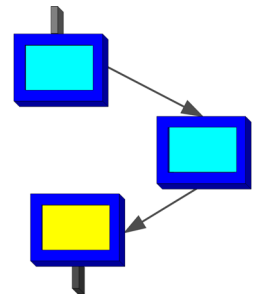
This is the initial release of the RPM for PowerLog software.

Known issues

- 1 Lassoing nodes that include a group box and then moving them does not move the group box, only the nodes inside the group.
 - 2 Displayed connections can get out of synchronization with the RPM project. If this happens, the displayed connections can be restored by pressing the [F6] key or by selecting the **Edit > Reconnect** command.
 - 3 Adding a new rock/mineral/fluid/gas and three new properties and then deleting one property results in two properties removed from the interface. Only the interface is incorrect. If you click **Save** and request the **Rock and Fluid Properties** dialog again, the missing property displays.
 - 4 The **GeometricMean** function cannot handle undefined values. It gives an error if any of the values are `UNDEF_POWERLOG`. The function needs to check for undefined values on input.
 - 5 **RanVector** and **RanVectorGauss** function do not create output PowerLog curves filled with random numbers.
- **Tan** and **Atan** functions not processing all input values correctly.

New Features

All features are new for this release of the RPM for PowerLog software.



GLOSSARY

| | |
|------------------------------|---|
| ancestors | The collection of workflow nodes that affect the <i>input</i> connections to a selected node. |
| anisotropy | Predictable variation of a property of a material with the direction in which it is measured, which can occur at all scales. For a crystal of a mineral, variation in physical properties observed in different directions is anisotropic. In rocks, variation in seismic velocity measured parallel or perpendicular to bedding surfaces is a form of anisotropy. See isotropy . |
| AVO | A mplitude V ariation with O ffset. Variation in seismic reflection amplitude with change in distance between shotpoint and receiver that indicates differences in lithology and fluid content in rocks above and below the reflector. AVO analysis is a technique by which geophysicists attempt to determine thickness, porosity, density, velocity, lithology and fluid content of rocks. Successful AVO analysis requires special processing of seismic data and seismic modeling to determine rock properties with a known fluid content. |
| azimuth | The compass direction of a directional survey or of the wellbore as planned or measured by a directional survey. The azimuth is usually specified in degrees with respect to the geographic or magnetic north pole. |
| bubble point pressure | Pressure below which (for constant temperature) gas in solution in oil is released. Also called saturation pressure. |
| connection | Input from one node of a workflow to another node which defines the ancestor and descendent relationships within the workflow. |
| crack aspect ratio | Also called pore aspect ratio . The ratio [$\alpha = a/b$] of the minor (a) and major (b) ellipsoidal axes that characterize the spheroidal pore shape of the representative reservoir rock. |
| critical porosity | Porosity <i>below</i> which compressive load is transmitted through mineral grain physical contact, and <i>above</i> which compressional load is transmitted through the pore fluid, and the rock becomes a slurry. |
| crossplot porosity | Porosity obtained by plotting two porosity logs against each other, normally a density and neutron porosity. The computation assumes a particular fluid, usually fresh water, and particular response equations. The result is largely independent of lithology and is often a more reliable porosity estimate than one porosity log. |

| | |
|---------------------------|--|
| dead oil | Oil that contains no gas in solution. |
| DEM | D ifferential E ffective M edium. This method is derived by assuming the composite is formed by successively mixing very small (infinitesimal) fractions of one inclusion material in another host material. |
| descendents | The collection of workflow nodes affected by the <i>output</i> connections <i>from</i> a selected node. |
| deviation | The angle at which a wellbore diverges from vertical. Wells can deviate from vertical because of the dips in the beds being drilled through. |
| directed graph | Another name for a workflow containing nodes (where calculation functions happen) and connections (with arrows) that determine the calculation dependencies. |
| effective porosity | Porosity due to movable plus hydrostatically bound fluids. The interconnected pore volume or void space in a rock that contributes to fluid flow or permeability in a reservoir. Effective porosity excludes isolated pores and pore volume occupied by water adsorbed on clay minerals or other grains. Usually less than total porosity . |
| function | A calculation or a boolean operation applied to one or more connection inputs and yielding an output (value or curve). |
| gas-oil ratio | The volume of liberated gas at one atmospheric pressure (and 15.6° C) produced per unit of oil produced. Given as Rs as a dimensionless volume ratio and as GOR in Scf/BBl. |
| group | A collection of nodes that can be named and manipulated together, so that the workflow complexity can be managed. These node collections help a user associate a workflow subsection with a computation goal. |
| isotropy | A quality of directional uniformity in material such that physical properties do not vary in different directions. In rocks, changes in physical properties in different directions, such as the alignment of mineral grains or the seismic velocity measured parallel or perpendicular to bedding surfaces, are forms of anisotropy. See anisotropy . |
| inclination | The deviation from vertical, irrespective of compass direction, expressed in degrees. For most vertical wellbores, inclination is the only measurement of the path of the wellbore. |
| inversion | A mathematical process by which data are used to generate a model that is consistent with the data, the process of solving the inverse problem. In seismology, surface seismic data, vertical seismic profiles and well log data can be used to perform inversion, the result of which is a model of Earth layers and their thickness (seismic trace), density and P- and S-wave velocities. Successful seismic inversion usually requires a high signal-to-noise ratio and a large bandwidth. |

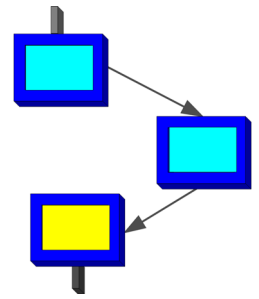
| | |
|----------------------------|--|
| live oil | Oil that contains some gas in solution. |
| node | A point in the workflow where you can define a function, using one or more connection inputs (values or curves), and generate an output (value or curve). A node's output can be delivered to one or more other nodes. |
| MRU | M ost R ecently U sed list. List of the last five RPM projects accessed with the RPM software on this computer. |
| path | A set of RPM nodes defined by a selected beginning node, a selected final node, and all connection nodes between the two selections. RPM for PowerLog permits you to perform all the calculations along a chosen workflow path. |
| RPM | R ock P hysics M odule for PowerLog. A porting of the rock physics portion of the Jason Geoscience Workbench product that uses a Windows graphical user interface and takes advantage of the project and well management capabilities of PowerLog. PowerLog provides presentation displays and also performs some of the computations found in the previous product. |
| saturation equation | <p>An equation for calculating the water saturation from resistivity and other logs. There are many saturation equations. Practical equations are all extensions of the Archie equation, which is valid for a rock with very little clay, or very high salinity water, and with a regular pore structure. The majority deal with the problem of shaly sands, and can be divided into two main groups; (1) those that treat the shale as a volume of conductive material (V_{sh} models), and (2) those that analyze the effect of clay counter-ions.</p> <p>V_{sh} models take many forms. Typical examples are the Simandoux, laminated sand, and Indonesian equations. The clay counter ion group includes the Waxman-Smits, Dual Water and SGS equations. Most nonshaly sand equations deal with the problem of mixed pore types, for example combinations of fractures, isolated pores, and intergranular pores.</p> |
| specific gravity | The ratio of a material's density to the density of water; often used for gas. |
| survey | A completed measurement of the inclination and azimuth of a location in a well (typically the total depth at the time of measurement). In both directional and straight holes, the position of the well must be known with reasonable accuracy to ensure the correct wellbore path and to know its position in the event a relief well must be drilled. The measurements themselves include inclination from vertical, and the azimuth (or compass heading) of the wellbore if the direction of the path is critical. |
| total porosity | Total porosity = effective porosity + clay (electrostatically) bound porosity. The total pore volume per unit volume of rock. It is measured in volume/volume, percent or porosity units. Total porosity is the total void space and as such includes isolated pores and the space occupied by clay-bound water. |

workflow

A set of nodes that define the order and calculation dependencies for a set of rock physics calculations. Nodes can be linked together by using the output value or output curve of one node as an input for another node. A workflow is developed in an iterative manner and refined as you develop your methodology.

workspace

A rectangular screen size chosen to construct and display the workflow. The compass direction of a directional survey or of the wellbore as planned or measured by a directional survey. The azimuth is usually specified in degrees with respect to the geographic or magnetic north pole.



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