

# DuneFront PackPro

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## Release Notes



**DuneFront**

Simulate - Evaluate - Optimize



**DuneFront**  
— PackPro —

A complete solution for gravel pack  
simulation, evaluation and optimization

## PackPro 5.0

PackPro 5.0 is a general release which updates PackPro 4.2 with the following changes and improvements:

### 1. General

- a. Support for design and evaluation of cased hole treatments above fracture pressure (High Rate Water Packs).
- b. Support for thermal modeling to dynamically calculate the temperature along the entire flow path in the well (both down and up flow directions).
- c. Support for multiple gravels in a single pumping operation.
- d. Addition of a scenario manager which facilitates reordering, creating, copying, renaming, deleting and running scenario(s) on the click of a button. In addition, it also allows data from one or more screens in a selected scenario to be copied to any number of other scenarios.
- e. **A fill down option is now available on all grids which allows the value in the first selected cell to be copied to all other selected cells below it.**
- f. The screen or tab view is maintained when switching between scenarios to make it easier to navigate the file.
- g. Miscellaneous bug fixes and minor improvements.

### 2. Calculators

- a. The MASP calculator now supports calculations based on definition of either absolute pressure or differential pressure.
- b. A Leakoff Coefficient Calculator has been added which facilitates the initial estimation of the leakoff coefficient required for modeling HRWP treatments.

### 3. Well

- a. Treatment type can now be defined as either Gravel Pack (below fracture pressure) or HRWP (above fracture pressure).
- b. Three options have been added for thermal modeling:
  - i. Fixed – A temperature profile is generated based on the defined surface and BHCT and assumed constant throughout the treatment.
  - ii. Simple Calc – The initial temperature profile is generated based on the defined surface and BHCT with the new thermal model being used to determine subsequent temperature changes during the treatment.
  - iii. Detailed Calc – This works in the same way as the “Simple Calc” option above but allows the initial temperature profile along the well to be specified in more detail through two new columns in the survey grid (Down Path Temp and Up Path Temp).
- c. Additional inputs introduced in Zone Properties when using Calculate Losses which are required for HRWP calculations.

### 4. Completions

- a. The shunt nozzle leakoff model has been significantly improved for improved accuracy and stability.

5. Fluids
  - a. Thermal Conductivity and Specific Heat Capacity inputs added to support thermal modeling calculations.
  - b. Copy Fluids button added to easily create a copy of an existing fluid, which can then be modified.
6. Gravel
  - a. Oroskar & Turian Coefficient has been moved from Advanced Options to the gravel screen to make it specific to each gravel.
  - b. Thermal Conductivity and Specific Heat Capacity inputs added to support thermal modeling calculations.
  - c. Forchheimer Beta coefficient **used in Forchheimer' s equation** displayed for reference.
  - d. Copy Gravel button added to easily create a copy of an existing gravel, which can then be modified.
7. Pumping – Simulate
  - a. Stage Gravel Rate added to the schedule for reference
  - b. Added options to automatically reduce rate for pump pop-off.
  - c. Added feature to automatically locate pressure attenuators which can be used to determine the number and location of pressure attenuators required to place the treatment.
8. Pumping – Evaluate
  - a. Gravel and fluid are now specified in the **same table under “Pumped Fluid and Gravel”** on the schedule tab.
  - b. Gauge Data Chart has an added “Pressure Only” button to easily plot pressures on this chart for time-shifting.
  - c. A multiplier is added in the gauge data tab that can be used to proportionally increase or decrease the data in any column.
9. Advanced Options
  - a. Roping can now be defined by either volume or percentage.
  - b. Oroskar & Turian coefficient has been moved to the gravel screen.
  - c. Redistribute Losses (Specify Losses only) has been introduced to determine how losses in bypassed zones are managed.
  - d. Shunt nozzle leakoff options added to calibrate the performance and accuracy of modeling.
  - e. Thermal options have been added to calibrate the performance and accuracy of thermal modeling.
10. Results and Reporting
  - a. A perforation packing animation has been added in the result screen which is displayed once perforation packing starts.
  - b. Fracturing parameters added to summary tab including for HRWP treatments.
  - c. Temperature and fracture data has been added to the results for more detailed analysis.

## PackPro 4.2

PackPro 4.2 is a limited release which updates PackPro 4.1 with the following changes and improvements:

1. Advanced Options
  - a. Viscous Fluid Degradation Factor is applied in return path to viscous fluids in laminar flow regime to account for fluid degradation

## PackPro 4.1

PackPro 4.1 is a general release which updates PackPro 4.0 with the following changes and improvements:

1. PSD Analysis
  - a. Added support for additional US mesh sizes
  - b. Added sand production prediction calculation for standalone screen applications
2. Calculators
  - a. Friction calculator allows plotting against velocity (as well as rate)
  - b. Oroskar and Turian coefficient added to settling calculator
3. Well
  - a. Survey now plotted against TVD by default (previously it was MD)
  - b. Added the following inputs to the perforation properties:
    - i. Phasing
    - ii. Open Perf %
  - c. Added the following inputs to the reservoir zone data:
    - i. Vertical/Horizontal permeability ratio
    - ii. Reservoir fluid viscosity
  - d. Caliper averaging algorithm updated to better approximate diameter changes
  - e. Moved caliper tolerance from advanced options screen to caliper data tab
4. Completions
  - a. **“Generic ICD” option now supports multiple port diameters**
  - b. **Support for BHGE’s ICD/AICDs has been added**
  - c. Shunt tube nozzle dimensions added and leakoff is now calculated at each nozzle as slurry displaces along the tubes
  - d. **“Copy Schematic” button in the toolbar facilitates copy/paste into reports**
  - e. **“Volumes” tab added which provides the following functionality:**
    - i. Calculator to determine the displacement volume and amount of gravel required to pack between any two points in the flow path

- ii. Automatic calculation of the volumes and gravel mass between gauges defined in the flow path

## 5. Fluids

- a. Formate brines added to built-in fluids database
- b. Last selected fluid is now remembered
- c. Copy/paste functionality enabled for rheology grid
- d. Copy chart and copy data functions enabled for rheometer chart
- e. Shunt reference curve added to rheometer chart
- f. Added option to define rheometer test data by shear rate and viscosity

## 6. Gravel

- a. Last selected gravel is now remembered

## 7. Pumping – Simulate

- a. Added a pumping schedule generator to help define a starting schedule
- b. Added option to automatically reduce rate for fracturing
- c. Added option to automatically reduce rate for alpha/alpha
- d. Option added to dynamically vary the choke position and match return rates throughout the treatment

## 8. Pumping – Evaluate

- a. Added ability to sample data points when importing surface and downhole gauge data to reduce file size
- b. Ranges are automatically re-ordered in the list by timeline of events
- c. Option added to dynamically vary the choke position and match return rates throughout the treatment
- d. Schedule shows additional calculated data (consistent with simulate module)
- e. **“Copy to Simulate” button now copies initial data and well fluids inputs along with the schedule**
- f. Trend analysis shows all pressure data by default to ensure hydrostatic correction is always applied to all of them

## 9. Advanced Options

- a. Non-default values are now highlighted to easily identify them
- b. Added option to define depth for reporting bottomhole gravel concentration and mass (defaulted to packer depth)
- c. Added option to switch between internal (washpipe/screen) and external (screen/wellbore) annuli for washpipe gauge measurements
- d. Added option to define the net pressure at which bridging will occur in the wellbore if frac pressure is exceeded
- e. Moved caliper tolerance from advanced options screen to caliper data tab
- f. Added global options to manage file size and opening/closing performance

## 10. Results and Reporting

- a. Pumping reference parameters added to report
- b. The following data has been added to the results

- i. Annular pack percentage
- ii. Perforation packing volume
- iii. Surface cumulative gravel mass pumped
- iv. Bottomhole gravel concentration
- v. Bottomhole cumulative gravel mass pumped

#### 11. General

- a. A bridge now occurs when fracture pressure is exceeded in gravel pack simulations to visually identify the issue
- b. Cased hole leakoff calculations revised to incorporate perforation skin
- c. Improved performance when files are located on an external drive
- d. Miscellaneous bug fixes and minor improvements.

### PackPro 4.0

PackPro 4.0 is a general release which updates PackPro 3.1 with the following changes and improvements:

#### 1. PSD Analysis

- a. A PSD analysis module has been added to facilitate screen and gravel selection for both standalone screen and gravel pack applications:
  - i. Ability to input PSD data from sieve analysis test results.
  - ii. Ability to compare multiple PSDs and select those that should be included in the analysis.
  - iii. Automatic calculation of key PSD parameters such as d10, d50, uniformity coefficient and sorting coefficient.
  - iv. Automatic analysis of PSD data using industry recognized criteria for screen and gravel sizing in standalone screen and gravel pack.

#### 2. Calculators

- a. Several new calculators have been added as standalone tools for quick calculation of various parameters:
  - i. Friction calculator for determining friction in various geometries.
  - ii. Gravel settling calculator for determining stokes settling velocity and bed height in various geometries and flow conditions.
  - iii. Re-suspension calculator for determining minimum velocity required to pick up and transport particles.
  - iv. Injection test calculator for determining estimated reservoir pressure as well as frac extension rate and pressure from downhole data.
  - v. Maximum allowable surface pressure calculator for determining the surface screenout pressure based on downhole equipment limits.

#### 3. Cased Hole Gravel Pack Improvements (Below Frac Pressure)

- a. Improved modelling of non-Newtonian fluid leakoff and injection.
- b. Improved modeling of gravel diversion into perforations as a function of gravel concentration.

- c. Improved modelling of fluid distribution and perforation packing in multi-zone applications.
  - d. Support for highly deviated cased hole applications **and perforation “auto-packing”** with gravel settling.
4. Well
- a. **“Slurry/Water Pack”** treatment type option has been removed and replaced with fluid specific settling options (see Fluids section) to facilitate modelling of settling with viscous fluids, including during shunt tube treatments.
  - b. Reservoir zone depth can now be defined by MD or TVD
  - c. Reservoir zone pore and fracture pressures can now be defined in three ways:
    - i. Pressure gradient (as per previous versions of PackPro)
    - ii. Absolute pressure
    - iii. Equivalent mud weight
5. Completions
- a. Gravel pack extension and bull nose added to lower completion components.
6. Fluids
- a. Gravel settling option added to enable/disable settling for specific fluids, **replacing the “Slurry/Water Pack” option (See Well section) and facilitating** modelling of settling with viscous fluids, including during shunt tube treatments.
  - b. Viscosity can now be defined directly for Newtonian fluids.
  - c. Minimum and maximum viscosity plateaus can now be defined for specific fluids, replacing the global **“Limit Viscosity” option (see Advanced Options screen)**.
  - d. Density of fluid is displayed as equivalent pressure gradient for reference.
7. Gravel
- a. Various gravels added to the predefined database, including those provided by Carbo.
8. Pumping
- a. **“Pump pop-off” option added, replacing the “Max Surface Pressure” option** (see Advanced Options screen).
  - b. In detailed fluid definition, fluids can now be added to the bottom of the flow **path using the new “Add” button**.
  - c. Various reference parameters have been added to the schedule including cumulative volume, stage gravel mass, stage time and cumulative time.
  - d. **“Set Full Returns” button added to quickly match return rates to pump rates**.
  - e. 20 bpm max rate restrictions has been removed to enable modelling of higher rate treatments.
  - f. Ability to smooth noise and correct offsets in imported data added in the evaluate module.
9. Advanced Options

- a. “Max Surface Pressure” removed and replaced by “Pump Pop-off” (see Pumping screen).
- b. “Roping Percentage” option added to enable modelling of fluid roping in the workstring.
- c. “Limit Viscosity” removed and replaced with fluid specific min/max viscosity options (see Fluids screen).
- d. Perforation auto pack and bridging options added for improved modelling of perforation packing, including in high deviation wells.

#### 10. Results and Reporting

- a. Animation layout can now be set directly as vertical or horizontal based on user preference.
- b. Washpipe gauge positions now shown in the displacement animation.
- c. Amount of gravel placed below packer during the simulation now shown on the summary screen (blank, screen and perforation).
- d. Line thickness can now be changed by double clicking any line on a chart.
- e. Leakoff rate added to results and can be plotted to see where losses are occurring.
- f. Legend labels have been shortened to minimize space occupied on charts.

#### 11. General

- a. An evaluation guide is now accessible from the “Help” toolbar, providing an overview of the evaluation and calibration process.
- b. Press F4 on any input to view unit conversions.
- c. Press F9 on any depth input to convert MD to TVD and vice-versa.
- d. Warning messages when deleting results and enabling/disabling optimize now appear only the first time the features is used.
- e. Bug which caused a crash when using the “Model Screen Handling Length” option with shunts has been fixed.
- f. Bug which allowed service tool to be deleted has been fixed.
- g. Miscellaneous bug fixes and minor improvements.

### PackPro 3.1

PackPro 3.1 is a general release which updates PackPro 3.0 with the following changes and improvements:

#### 1. Well

- a. Well survey is now shown graphically
- b. User can now specify the water temperature profile, which supports both shallow and deepwater environments

#### 2. Completions

- a. Washpipe eccentricity input has been moved from the advanced options screen to the running string tab to make it more accessible



- b. Shunt packing factor input has been moved from the advanced options screen to the shunt tubes tab to make it more accessible
- 3. Pumping
  - a. Detailed well fluid reference parameter now shows flow path volumes and MDs based on the user selection
  - b. User can now define the amount of blank packing assumed in the calculation of gravel required on the schedule screen (note that this is for reference only and has no impact on the simulation or results).
  - c. Resolution of gauge data and trend analysis charts now improves with zoom to provide both performance and accuracy (on zooming, the data is resampled at a higher resolution).
- 4. Advanced Options
  - a. Washpipe eccentricity and shunt packing factor inputs have been moved to the completions screen (see previous note)
  - b. Added option to limit the gravel friction multiplier to specific deviations (this **has applications in simulating the potential impact of gravel “sag”** due to inadequate suspension in high deviations)
  - c. Re-organized layout of some inputs for clarity
- 5. Results and Reporting
  - a. Re-enabled the crosshair on the simulate displacement and packing animation chart so users can see the values of pack height ration and MD
  - b. Loading time of reporting screen has been significantly improved with optimizations in chart generation
  - c. Simulate module charts (including chart configuration, title, description, annotations and markers) are now copied with the scenario so users do not need to recreate them
  - d. Resolution of reporting charts now improves with zoom to provide both performance and accuracy (on zooming, the data is resampled at a higher resolution).
  - e. Fixed a bug which caused an error when using optimize with charts containing multiple data types on a single axis
- 6. General
  - a. Fixed a memory management issue which may cause the file to crash with an **“out of memory” error** after several executions (particularly when using the evaluate module with a significant amount of data)
  - b. Improved performance when files are located on a network/server
  - c. Fixed a bug which caused some text to disappear in specific configurations
  - d. Miscellaneous bug fixes and minor improvements

## PackPro 3.0

PackPro 3.0 is a general release which updates PackPro 2.2 with the following changes and improvements:

1. Well
  - a. Added support for risers in offshore applications
  - b. Added caliper multiplier for improved calibration of open hole diameter
2. Completions
  - a. Added support for isolation valves in the lower completion
  - b. Added support for ICD/AICD screens, **including Halliburton's EquiFlow®** range of products, which facilitates the modeling of gravel pack treatments with this technology
  - c. Updated schematic workstring volume calculation to account for tool joints
3. Fluids
  - a. Added Halliburton's AquaLinear® and Aqualinear® HT fluids to the built-in database
4. Pumping
  - a. Added support for coiled tubing reels with dedicated friction calculations to better simulate thru-tubing and retro-fit treatments
  - b. Added the ability to define fluids and/or gravel anywhere in the wellbore as part of the initial condition for better simulation of treatments requiring spotting or complex fluid trains.
  - c. Removed restriction on pumping gravel in reverse position to enable modeling of spotting operations
  - d. Wellbore and perforations gravel volumes are now reported separately on the schedule screen
5. Advanced Options
  - a. Separate roughness inputs are now available for treating and choke lines as well as screen basepipe/filter annulus to facilitate matching where required
  - b. Global chart colors can now be set under chart options for pump pressure, pump rate, return rate and gravel concentration which are applied throughout the software for consistency (all other lines can be customized individually as **detailed under "Results and Reporting" below**)
6. Results and Reporting
  - a. **Added "animation above packer" tab to display fluid displacement and gravel settling in the workstring and annulus above the packer (simulate module only)**
  - b. Enabled custom naming of user generated chart tabs by double-clicking on the tab
  - c. Chart line colors can now be individually customized by double-clicking the line (changes for a given line are applied throughout the software to ensure it is always shown using the same color for consistency)

## 7. Workflow

- a. Added “Lock Inputs” toolbar button which allows users to lock a file and prevent accidental editing (all results and reporting features are still accessible)
- b. Multiple pump rates and pressures can now be imported for a single range when performing evaluation (user will have the option to select which one should be used for calculations)
- c. Added ability to copy evaluate schedule (as generated from actual data) directly to simulate module for easier and more accurate matching

## 8. General

- a. License configuration is now maintained when updating to a newer version of the software so the user does not need to redefine it
- b. Added support for consecutive delimiters and single character custom delimiters in the data import wizard
- c. All diameter inputs are now shown to 3 decimal places
- d. Added several pressure gradient units for completeness
- e. Significant performance improvements
- f. Miscellaneous bug fixes and minor improvements

## PackPro 2.2

PackPro 2.2 is a general release which updates PackPro 2.1 with the following changes and improvements:

### 2. Fluids

- a. Added a fluid rheology calculator which enables the user to input and process raw data directly from fluid rheology testing

### 3. Results and Reporting

- a. Updated screen packing efficiency calculation to account for screen handling sections when present
- b. Updated pressure calculation to better support reservoir sections that are isolated using isolation packers and blanks

### 4. General

- a. Fixed validation bug for pressure attenuator placement
- b. Fixed bug when packing blanks between screens in slurry pack mode
- c. Fixed bug which resulted in incorrect reservoir zone definition when updating old files with perforated casings and multiple scenarios
- d. Added a release notes button to the help toolbar which provides the user with information on changes in each software update
- e. Miscellaneous bug fixes and minor improvements

## PackPro 2.1

PackPro 2.1 is a limited release which updates PackPro 2.0 with the following changes and improvements:

### 1. General

- a. Added support for files located on a server which allows users to work directly on the server without having to copy the file locally
- b. Fixed bug which prevented database files located on a server from being correctly loaded

## PackPro 2.0

PackPro 2.0 is a general release which updates PackPro 1.6 with the following changes and improvements:

### 1. Well

- a. Adds the capability to define multiple zones and calculate losses based on reservoir properties (permeability, porosity and skin). Along with the new closed choke option (see pumping section), **this enhances PackPro's ability to model cased hole treatments in particular, including the injection of fluid into the formation.**
- b. **New "Caliper Data" tab allows the user to paste caliper data, if available, enabling the software to automatically match variations in open hole diameter.**

### 2. Completion

- a. **Ability to select the "Measurement Type" for concentric and eccentric gauge carriers to specify whether the gauge reading is internal, external or both.**
- b. Added functionality for defining and modeling the packing of screen handling lengths during gravel pack treatments.

### 3. Fluids and Gravel

- a. Expanded fluid database which now includes rheology data for Xanthan and HEC fluids with varying polymer concentrations and base brine.
- b. Gravel no longer needs to be defined when simulating or evaluating operations that do not require gravel to be pumped (e.g. displacement operations).

### 4. Pumping

- a. Adds support for taking returns through the riser or up to 2 lines (choke, kill, or both) when modelling subsea BOP configurations.
- b. Support for modeling of closed choke injection treatments with the option to open the choke at a specified volume during the treatment. Along with the **new calculate losses option (see well section), this enhances PackPro's ability to model cased hole treatments in particular, including the injection of fluid into the formation.**

### 5. Results and Reporting

- a. Improved animation with completion schematic overlay to aid the user in the visualization and understanding of downhole events.
  - b. Added support for depth based (MD/TVD) user defined charts in addition to time based (time/volume) charts.
  - c. Improved simulation/evaluation reports which now include relevant well and user information as well as user defined charts with their respective titles and notes.
  - d. The following parameters are now reported in the results and available for plotting on user defined charts:
    - i. Hydrostatic pressure at gauge locations
    - ii. Fluid velocity at gauge locations
    - iii. Cumulative volume pumped
    - iv. Pack location
6. Evaluation
- a. Added support for importing data files with multiple date/time columns, which are now automatically interpreted by the software
  - b. **New “Trend Analysis” functionality to facilitate quick evaluation of downhole/surface data without the need to provide all the file inputs.** Through this feature, the user can shift the pressure data vertically to correct for any differences in hydrostatic before running the analysis. The ability to automatically shift the data is also available for even faster analysis.
7. Workflow
- a. Streamlined toolbars to improve efficiency and user experience while working with the software
  - b. Streamlined workflow for charting with all user defined and predefined charts now under the reporting tab, enabling easier management
8. General
- a. Fixed bug which led to incorrect number being displayed under some circumstances when changing data on the schedule screen
  - b. Improvements in performance with faster simulation and evaluation run times
  - c. Windows 10 support
  - d. Miscellaneous bug fixes and minor improvements