packVol - User Guide

Introduction

Features

packVol is a powerful load planning software. The application has no limits on the number of containers, or on the total number of different package items, or on the total number of packages it can manage, which are limited only by the available memory. The program is extremely fast and can optimize space utilization for load plans with thousands of packages in fractions of a second on a common personal computer.

packVol can operate in two distinct modes, automatic and manual:

- In automatic mode the load plan is evaluated by the internal optimizer of the program;
- In manual mode the load plan is defined by the User, thanks to a 3D graphical environment having the most common editing functions: select, copy, paste, cut, undo, redo, zoom, pane, etc..

To simplify data entry operations **packVol** has,

- an internal database where you can store container and package data;
- filters to import from Excel file or from ODBC data sources.

packVol offers many functions for saving data, creating reports and exporting data.

Versions

The application is available in three versions: **LITE** [LTE], **STANDARD** [STD] and **DYNLOAD** [DYN]. Check out the Versions online page for a description of the main features of each edition, the most appropriate scope of use, and the analytical comparison table of available features.

System requirements

MS Windows ©: The program has been tested on Windows Vista, Windows 7, Windows 8/8.1, Windows 10/11, Windows Server 2012, Windows Server 2016, Windows Server 2022. Minimum requirements:

- 233 MHz processor or higher;
- 64 MB RAM memory;

To my wife and my daughter,
for their infinite patience

- Video card with 16 bit color depth or higher. A screen resolution of 1024x768 or higher is recommended. Resolutions lower than 1024x768 are not supported;
- 3D graphics acceleration is not required but highly recommended if you want to use the manual mode;
- 22 MB of free space on hard disk.

Installation

MS Windows ©: a setup program will install the application and configure your system. You can easily uninstall the program by invoking the "Windows Control Panel", by double-clicking on "Add/Remove Programs", and then by choosing the "packVol" item.

The non-registered evaluation version is fully functional for 30 days after the first installation.

Getting Started

For information on using the program, check out the Tutorials available online, which guide you step by step in learning how the program works, with simple but concrete examples of use.

User Interface

The working area of the application, besides the standard menu bar, tool bar, and status bar, is divided in five parts:
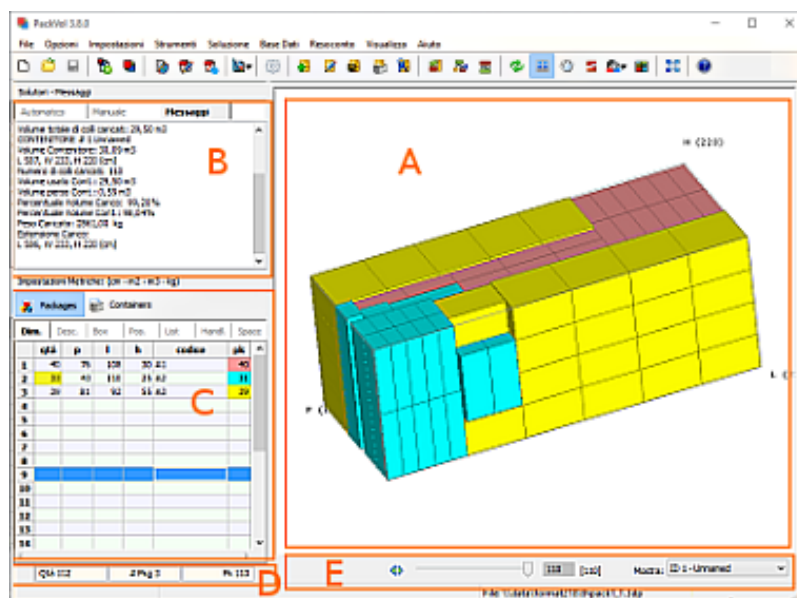
A) the Visualization Area, on the right;

B) the Solver Panel and Messages Panel, up - left;

C) the Package and Container Panels, down - left;

D) the Report Text Controls, below the former;

E) the Auxiliary Toolbar panel, down - right.

packVol works with one document at a time, as any other single document application, but you can open a different document with no need to quit the application. The program asks for closing and saving when there is a currently unsaved document.

> For saving of data the program uses files with **3dp** extension (the application icon is 🔴). During installation, the extension is added to the system registry, so that the files can be opened by double clicking or via drag & drop. The Dynload and integrable versions also support an **xml** interchange file.

Menu Bar

The various commands are organized in the menu sections File, Options, Settings, Tools, Solution, Database, Report, View, Help.

Menu File

Here you find the commands to open, save, import and print the document.

Command	Description
New [Ctrl+N]	Creates a new document by dropping all data and results. Before performing the operation, the program asks to save any modification.
Open [Ctrl+O]	Opens an existing document.
Import (Excel) →	→ Master Data [Ctrl+Shift+M] imports the full load list from an Excel file. See Import Master Data and Master Data layout. → Import code/qty [Ctrl+Shift+Q] defines the load list via code/quantity pairs, by selecting the package from the internal database. See Import by code and Code/quantity data layout. → Import stack matrix imports the stack matrix for the current run. It should always be imported after the definition of the load list. See stack matrix data layout.
Export (Excel)	Exports data on an Excel file.
Import (ODBC) [Ctrl+Shift+Q]	Imports data from an ODBC data source. See the section Import data via ODBC.
Export (ODBC) [Ctrl+Shift+S]	Exports data to an ODBC data source. See the section ODBC Export.
Import containers	Imports the list of containers to be used in optimization from an Excel file. See the section Container data layout.
Export containers	Exports the list of containers on Excel file. See the section Container data layout.
Paste from clipboard [Ctrl+V]	Pastes data from the system clipboard to the current document. See the section Copy and paste via Clipboard on how to format data.
Copy to clipboard [Ctrl+C]	Copies data of selected rows to the system clipboard, so that they can be pasted into an external application. See Copy and paste via Clipboard.
Save [Ctrl+S]	Saves on file the current document.
Save as	Saves the current document with a new name.
Save partial data	→ Save loaded packages saved the list of loaded packages and containers used in the current solution.

Command	Description
	→ Save unloaded packages saves the list of packages that are not been loaded. → Save selected rows allows you to save on file only the selected rows in data grids.
Print report [Ctrl+P]	The entry becomes active when the Report is visualized and allows to print it.
Print preview	The entry becomes active when the Report is visualized and allows to open the print preview manager.
Save report	The entry becomes active at end of the optimization run and allows saving the Report as an **html** document.
Open recent	The program keeps a list of the most recently used files, up to a maximum of nine entries. By clicking on a voice, the corresponding file is opened.
Exit [Ctrl+Q]	Quits the application.

Options Menu

Here you find the commands to change at any time the properties of the visualization area. The default values can be set in the *Options* section of the Preferences dialog.

Command	Description
Black stage [Ctrl+B]	Allows to choose the background color of the visualization area between black, if selected, or white.
Info under mouse [Ctrl+U]	Information on packages and containers are shown under the mouse pointer. The function is left as an option because it can produce slowdowns with outdated hardware and can be ineffective in manual mode.
Enable item highlight	When selected, the program highlights the row in the Package Panel grids corresponding to the item currently under the mouse pointer.
English pdf load plan	When selected, the program creates the **pdf** Load plan report in English (for non-English localization only).

Settings Menu

Here you can set the properties and behavior of the solver and open the Preferences dialog.

Command	Description
Unusable section	Opens the Unusable Section dialog window, where you can define and/or delete an unusable section for that container. The command is enabled when there is only one container visualized on the main view (use the Container drop-down menu or the contextual menu to change selection).
Preferences	Displays the Preferences Dialog. Settings are saved and then loaded at start up.
Metric Units	Displays the dialog where you set the Metric Units.
Disable loading rules	The command opens a sub-menu where you can force the program to disable some constraint even when these are defined. → Minimum Check disables the constraint on the minimum number of packages to be loaded (parameter min). → Support surface disables check of the bearing surface → Stacking disables stacking indexes stk and stack matrix elements regulating the vertical order. → Set / Batch load disables set load (parameter set) and batch load (parameter bat). → Stacking weight disables the maximum bear weight that a package can sustain (parameter mw). → Matching code disables the rule which ensures that the package must be loaded only in a specific container (parameter mc). → Maximum load disables the Maximum load assigned to a container.
Cancel read-only status	Data loaded from the database or imported from an Excel file or via ODBC can be set as *read-only* to prevent accidental modification of the input data. The option can be set in the Configure Database dialog box. The command removes the read-only status.
Improve solution	This option only applies to the automatic calculation. The program implements a statistical method when searching for the best solutions. The option restarts the calculation from the current solution. In case of complex load plans you may obtain an improvement in terms of volumetric occupancy.
Dynload version	
Two-stage settings	Opens the dialog to set configuration parameters for the two-stage loading.

Test settings are intended as options to check how the various constraints affect the solution. At end of calculation or whenever a document is modified, all options are automatically deselected. This choice has been made to avoid that, by forgetting the test settings state, one obtains results which are apparently inconsistent.

Tools Menu

Here you find the most important commands which allow to execute the calculation and to set the loading rules.

Command	Description
Start evaluation [Ctrl+R]	The command starts the calculation, automatic or manual, depending on which of the two tabs Automatic or Manual is active in the Solvers Panel.
Constraint panel [Ctrl+D]	Opens the Constraint Panel. This auxiliary window allows to define, in an intuitive mode, the allowed positions ps for a package, and to easily impose all constraints.
Set dialog	Opens the Set Load dialog window. The dialog allows you to define in visual mode which items need to enter a set group, or to delete existing groups.
Stack matrix	Opens the Stack matrix Panel, which shows in visual mode all stacking rules and allows to set any exceptions to the stacking rules.
Destination dialog [Ctrl+Alt+D]	Opens the Destination Dialog, where you can define the type of ordering for packages with assigned destination index (parameter ds).
Container optional data	Opens the container optional parameters dialog for the current container. For the Standard/Lite version it is activated only for *Rack/Flat* container type, while it is always active for the Dynload version.

Solution Menu

The menu has various commands to modify the current solution.

Command	Description
Start from solution	By checking the voice before starting a run all packages already loaded are kept in fixed position. See Modify solution.
Modify solution	Allows manual editing of the current solution. The entry shows a sub-menu with two options

Command	Description
	→ Keep fixed item qty [Ctrl+F] checks that the numbers of packages don't exceed the values in the qty cells of the *Dim.* grid. → Don't fix item qty [Ctrl+ALT+F] disables the previous check.
Redistribute load	In the case of an optimal multi-container solution, optimizes again the solution by placing the packages in the most uniform possible way among the various containers.
Container selection	The menu commands replicate those present on the Output tab. The sub-commands allow you to perform some operations on the containers selected in the *Output* tab. → Save selected saves the load plan of the containers entering the selection. → Re-optimize selected starts a new optimization of the containers entering the selection. → Remove selected removes the selected containers, updating the load list of the packages left on ground..
Merge solution	Allows you to "merge" the current solution with another, previously saved on file.
Remove unused container(s)	Removes all empty containers.
Restore solution	Undoes changes made to constraints or other parameters of the current solution.
Delete solution	Deletes the optimization solution while preserving all input data.
Dynload version	
Container selection	→ Empty selected acts like the Remove selected command but does not delete the containers from the input list.
Convert	The commands allow you to work with two-stage scheme. The controls are activated / deactivated based on the current state of the calculation → Convert to packages moves to the second stage, converting the containers of the solution into packages and loading, if defined, the working container. → Convert to containers converts a package into a container by adapting the properties to the new object, for example the weight becomes the tare weight.

Dynload version

	→ Save as pattern saves a single-reference solution in the database for use with Dynload loading criteria. → Cancel conversion allows you to move back to the first stage.
Multi stage operations	The group of commands is activated after the conversion to second stage. → Assign as first stage records the current solution as the first stage. → Manage stages opens a dialog summarizing the recorded stages.

Database Menu

Here you find the most important commands which allow to configure the internal Database, to retrieve item definitions, and to manage the ODBC connection.

Command	Description
Package manager	→ Data Retrieval displays the Package manager in retrieval mode, used to transfer the package data stored in the database onto the Package Panel. → DB maintenance displays the Package Manager in maintenance mode, which allows you to insert, modify, or delete the database records.
Save items in database	Saves the rows selected in the *Dim. grid* into the database. A row can be saved if you have defined the three dimensions of the package and the code.
Container manager	Displays the Container Manager, a dialog window listing all containers saved into the database. Once opened, the load plan view is substituted by a preview of the selected container.
Configure database	Opens the dialog window used to Configure the Database.
Manage ODBC connection	Duplicates the connection management dialog ODBC. The command is always available, even in case the database management is password protected.
Manage ODBC load List	Opens a window that displays the load lists that can be imported via ODBC. The window allows you to assign their status. See the section ODBC Import for details.
Import / Update database →	→ Data from ODBC, → Data from Excel → ... . Allows you to rebuild the entire internal Database by importing data from a data source or from Excel sheet. See Import Database.

Command	Description
Export to Excel file →	→ Package data, → Container data, → Stack matrix data. Allows you to save the content of the internal database in an Excel file.

Dynload version	
Package manager	→ Pattern maintenance opens the Pattern manager dialog.

Report Menu

Here you find the commands to create and visualize the reports. The tools for creating documents are activated only at the end of the calculation.

Command	Description
Pdf load plan	→ Manual Creation starts a work session where you can manage the visualization of the load plan corresponding to the solution. The work can be saved on file in **pdf** format. See the section *Create Load Plan*. → Export load plan [Ctrl+E] allows you create the Load plan report in **pdf** format for all containers entering the solution. The command opens the Pdf Exporter dialog box where you can set the print parameters and choose the container range.
Measurements	→ View empty spaces allows you to view and measure the unused spaces in the container. See View of Empty Spaces for details. → View weight / density allows to check visually the weight distribution of the current solution. See the section Load Distribution.
Destination list [Ctrl+Shift+D]	Opens the Destination Grid, showing the list of destinations ds. Using the grid, you can insert short notes about the numerical indexes and choose the color for each destination.
View report	Once selected, the load plan view is substituted by the *Report Window* which shows a brief report about the optimization results.

Dynload version	
Report by external volume	Calcola il volume di un contenitore tenendo conto delle misure esterne.

View Menu

Here you find the commands used to change how the load plan is shown in the

visualization area. The view can be rotated by dragging the mouse while holding down the left button.

Command	Description
Restore [F5]	The view can be altered in many ways with the commands described in the following. The command restores the initial view.
Zoom in [Up] Zoom out [Down]	The view depth can be changed by acting with the mouse wheel. The commands perform the same operations and allow to use the Up/Down arrows as acceleration keys.
Quad view	Switches from the standard axonometric view to the quad-view. In the latter case the screen area is divided in four viewports (axonometric, frontal, top, lateral view). The mouse action is limited to the axonometric view (top-left part).
Special rendering ..	The item carries a sub-menu having two options, useful in manual mode. → Wire frame visualizes the box edges only. → Transparent visualizes the box with transparency.
Hand tool	When the command is activated, the mouse gesture translates the container view.
Slider on shrink boxes [Ctrl+K]	When the command is active, the slider shrinks the dimensions of the box edges while keeping unchanged the position of the center-of-mass of the package.
View by grouped blocks	In addition to the standard view by single package, the program can display the load plan by groups of identical packages. It is recommended to use this feature if the number of boxes is large, say of the order of thousands of items, or if you don't have an accelerated 3D graphics card.
Load sequence ...	The item carries a sub-menu having three options, which control the ordering of the load sequence. → Bottom-top sequence shows the sequence of packages according to *Bottom-Top* order, starting from the bottom of the container upwards; → Rear-front sequence shows the sequence of packages according to *Rear-Front* order, starting from the rear of the container towards the front; → Container default sequence defines the sequence according to the value of the Pack: list box inside the Current tab of the Container panel.
Special colors ...	You can associate colors to some parameters.

Command	Description
	→ By FI/LO order associates the package color to the destination ds; → By set groups associates the color to the set group set, graying out those packages that do not enter a set; → By stack index associates the color to the stack index stk, graying out those packages that do not have a defined index.
Show "casting spaces"	Shows/hides the spacing around the packages (parameters sp) in case these have been set.
Hide unusable sections	Hides/shows the unusable sections in case these have been set.
Full screen [F11]	Turns on/off the program into full screen mode.
Hide Left Panels [Ctrl+H]	Hides/shows all left panels as to maximize the visualization area. The corresponding tool Expand ◁▷ is present in the Auxiliary Toolbar.
Center of mass	Activates the visualization of the center of mass, shown as crosshair.
Dynload version	
Show pallet envelop	Shows the extent of a converted package using transparency.

The menu item **Load Sequence ...** and the option **Pack:** in the *Current* Container panel are unrelated. You can choose the *Bottom-top* sequence in the Current panel and then visualize the load plan according to the *Rear-front* slider sequence, or vice versa.

Help Menu

The commands allow to access the online help and to register the product.

Command	Description
Help contents [F1]	Displays this Guide in **chm** format.
Help on constraint panel	Displays a message which reminds you that short descriptions of the fields in the Constraint grids can be obtained by clicking on the column labels.
Register packVol ...	Shows a dialog prompting for user and registration details to validate the license of your copy of the program.
About packVol	Displays a window showing information about the program: version, copyright, registration.

Command	Description
Check for updates	Opens a page at www.packvol.com via the default browser to check for the presence of program updates.

Tool Bar

The most frequently used menu entries have an equivalent command in the tool bar

New   Open

Save   Start from Current

Start evaluation   View summary report

Create load plan   Export load plan

Measurements   Preferences

Package manager - Retrieval   Package manager - Maintenance

Save record   Container manager

Configure database   Constraint panel

Set load panel   Stack matrix

Restore original view   Quad view

Hand tool   Block view

Slider on contract boxes   Special colors

Full screen   Help

Convert to packages [Dynload] Cancel conversion [Dynload]

Pattern manager [Dynload]

Status Bar

The status bar is divided in three parts: left, center, right.

Left: the pane carries information about the selected menu tool. During a manual session it reports instead the item code of the selected package, and a short message about the positioning of the box.

Center: during a manual session, the pane reports basic information about the selected package:

Box [L=92 W=81 H=55] @ [184 81 0] - pos: 04 - item ID: 1 cnt ID: 2

means, e.g., a box with ID 1 having length 92, width 81, and height 55 positioned with orientation 04 at coordinates 184, 81, 0 of the second container. A small progress bar appears when saving the pdf file of the load plan.

Right: the pane shows the complete path of the opened file.

Report Controls

The text fields show the values of the global parameters of the optimization: number, volume, weight of the packages and of the containers, in input and after the optimization.

Visualization area

The visualization area takes up most of the program window area and usually shows the load plan view. You can visualize the load plan in axonometric or orthographic (see figure) by pressing the command View → Quad view 🔲 . The program employs many auxiliary windows to perform specific tasks. When opened, these windows temporarily hide the visualization area or, in some cases, occupy the whole application area.

To maximize the visualization area, the panel window on the left can be temporarily hidden by using the command View → Hide Left Panel or by pressing the corresponding tool ◀▶ found in the Auxiliary Toolbar. The width of the left panel can be changed by dragging the black bar that appears by clicking on the edge separating the panel from the *Visualization Area*.

Whenever you modify a constraint and/or the quantity of packages, the load view is rendered with pastel colors to stress that the shown solution is no more in sync with the panel data. By changing dimensions, both for packages and containers, or by changing the type of container, the solution is erased. Input data are preserved.

Using the 3D View

- the mouse wheel enlarges/narrows the load plan view. You can also use the menu tool **View → Zoom in/out** or the keys **Arrow Up**/**Arrow Down**;
- the view can be rotated around the center of the ideal rectangle bounding the containers by moving the mouse while holding the left button down;
- The view can also be translated with the same mouse gesture after checking the command **View → Hand tool** ;
- the command **View → Restore** (key **F5**) cancels changes to the view and restores the initial settings.

Context menu

Pressing the right mouse button on the visualization area activates a popup menu. This menu shows the code of the package and the name of the container under the mouse pointer, and has the following commands:

| Command	Description
Go to definition [line n.]	Selects the row of the Data Panel corresponding to the package under the mouse pointer.
Show container #	If the solution contains more than one container, selects the container under the mouse pointer. It acts exactly as the Container List combo box.
Show all containers	Undoes the previous action and shows all containers entering the solutions.
Save load plan #	Allows you to save a **3dp** file with the data of the selected container.
Add cnt # to selection	Adds the container to the active selection of the Output tab.
Reoptimize cnt #	Starts redistribution of the load for the active container.
Delete cnt #	Removes the container and its content from the solution.
Dynload version	
Empty cnt #	Empties the container by keeping it in the solution.
Save cnt # as pattern	Save the load plan as pattern, checking that the solution is single reference.

Solver Panel
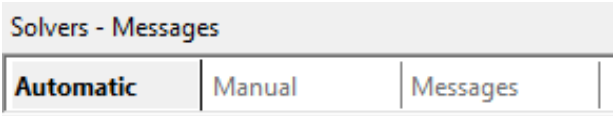
The Panel is formed by three tabs, Automatic, Manual and *Messages*. The first two allow you to select the choose the work method and the start-up parameters of the session. The *Messages* tab displays info on the performed operations.

Data Panel
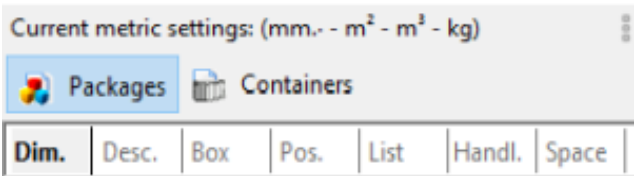
Input / output data are managed within the *Data Panel*. The two *Packages* and *Containers* tools allow you to quickly select the Package Panel, for managing package data, or the Container Panel, for managing container data. Above these buttons a label reminds the metric units currently in use.

Dynload version When passing to the second stage, the *Primary* tab is added to the Data Panel. The new tab carries the summary list of the first stage data.
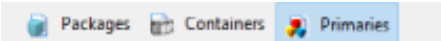
Auxiliary Toolbar

The auxiliary toolbar has various controls that can be active / inactive / hidden.
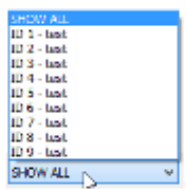

min Dim.	The text box is active when you visualize the empty spaces and allows you to set the minimum size of the displayed objects.
Expand	The tool allows you to hide/show the Panel on the left as to maximize the workspace area.
Slider	The slider allows you to change the view of the load in two different ways, *deformation mode* and *sequence mode*.

Show:	The **drop-down list** lists all containers and allows you select one of them. The same action can be obtained by opening the contextual menu of the workspace area or by using the Output Tab toolbar.

Option	Description
sequence mode	Action in the slider arrow shows/hides the sequence of loaded packages or blocks of packages. Mode is active when you select the tool View → Slider on Load Sequence (tool depressed).
deformation mode	Action in the slider arrow shrinks the dimensions of the boxes while keeping their center fixed. Mode is active when you select the tool View → Slider on shrink boxes (tool pressed).

The command View → View by grouped Blocks toggles between the view by blocks or by single package. The ordering of the sequence is set by choosing one of the items in the menu entry View → Load Sequence ...

If the solution includes multiple containers and you set the *sequence mode*, the slider is enabled only when you select a single container. Instead, it is always active in *deformation mode*.

Package Panel

The Package Panel reports in tabular form data and parameters of the packing list and is activated by clicking on the *Packages* tab.

In the User Interface of the program the properties of an item are divided into seven tabbed grids, easily accessible with mouse click. Temporarily the grids can be replaced by those of the Destinations and the Distribution.

1) Dim., reports code, input quantity, and dimensions;
2) Desc., reports color and description of the items;
3) Box, reports weight and priority rules;
4) Pos., reports all positional constraints;
5) List, reports constraints applying on the current list;
6) Hand., reports settings for handling of the packages;
7) Space, reports settings for empty spaces and columnar ordering;

Data can be entered:

- by manual input, to perform tests or modify the packing list;
- by data retrieval from the internal database;
- by importing master data from Excel file;
- by importing from Excel file with code/qty option;
- from any external database with support for the ODBC protocol;
- by entering the item code in a cell;
- by pasting from the system clipboard.

> The input values follow a specific encoding, whose knowledge is needed only if you plan to import data from external sources. Whenever you type in a cell that refers to a constraint, the program automatically displays the Constraint Panel, which offers a complete graphical environment to enforce intuitively all loading rules. After you make a change on the Panel, the numerical value in the grid cell is immediately updated. Similarly, if you input a numeric value in a cell, the Panel immediately reflects the change.

Dim. Grid (Dimensions)

Dim.	Desc.	Box	Pos.	List	Handl.	Space

	qty	l	w	h	code	pk	^
1	40	76	108	30	A1	40	
2	33	43	110	25	A2	31	

qty
number of packages   Number of packages of the item.

> Zero quantities are allowed, and the cell is colored red. At the end of calculation, a cell acquires yellow color when the item has been partially loaded.

l, w, h
dimensions   Length l, width w and height h of the item. The fields **are integer valued**.

> The unit measures are those defined in the Metric Units dialog window and are reported on top of the grid for convenience.

code
package code   The code is an alphanumeric string. In the load list the duplication of code is allowed.

> If you enter the code of a record present in the internal database, the definitions of the item are automatically retrieved (see Retrieval by code).

pk
loaded packages   After optimization reports the number of loaded packages. Cells of the fields are always read-only.

> The color of the cell is that defined in the **c** field of the *Desc.* grid. At the end of calculation, by clicking on a cell **pk** all boxes of that item are hidden from the view. By clicking a second time the group is shown again.

Dim. Grid Menu

Command	Description
Add package(s) from database	Opens the database window in retrieval mode.
Select all [Ctrl+A]	Selects all rows.
Delete selected rows Ctrl+X	Deletes selected rows from **all** panel grids.
Copy selected rows Ctrl+C	Replicates the command present in the File menu.
Paste copied rows Ctrl+V	Replicates the command present in the File menu.

Command	Description
Add rows to database	Stores selected rows into the database. For Standard / Lite version, if Enable load by objects is enabled, the type, box or plt, is that of the row.
Show all type	By clicking on a colored cell pk, all packages of that type are hidden from the view. The command allows to restore the original view.
Hide all type	The command hides all packages from the view.
Help about the constraints	The command reminds to click on the grid labels to get a description of the constraints.

Desc. Grid (Description)

code **identifier string**	Identifier string, repeated from the Dim. grid and unchangeable.
descr. **description**	Optional notes and descriptions, included in the load plan report.
other **optional description**	Optional description or numeric field.

> The field is displayed when you enable the option **Enable secondary description field** in the database configuration dialog.

c **package color**	Color of the item.

> Clicking on a cell opens the standard Color Dialog, which allows you to assign a color to the item. The value 1 indicates a User defined color. The value 2 indicates that the color has been assigned randomly.

Desc. Grid Menu

Command	Description
Select all [Ctrl+A]	Selects all rows.
Cancel User color	Cancels the color chosen by the User for all selected rows.

Command	Description
Set random color	Chooses the package color randomly for all selected rows.
Choose item color	Allows you to assign a color to the item.
Show all type	By clicking on a colored cell of the rightmost column, all packages of that type are hidden from the view. The command allows to restore the original view.
Hide all type	Hides all packages from the view.

Box Grid (Single Box Constraints)

	code	wt.	qt/b	bat.	set		∧
1	A1	24.00	1				
2	A2	11.00	1				

code **identifier string**	Identifier string, repeated from the Dim. grid and unchangeable.
wt. **package weight**	Weight of the package. Must be expressed in the same unit of measure used in Current Tab of the *Container Panel*.
qt/b **number of objects**	Number of "objects" forming the package.

Standard: the cell is visible if load by objects or field display is enabled in the Preferences dialog. Always visible for **Dynload**.

bat **batch load**	Packages are loaded in each container in multiples of the bat number.

If the input quantity **qty** is not a multiple of **bat**, a dialog window helps you correct the input. The zero or the empty value removes the constraint.

fml **family**	For Dynload version only, patter name or rule of grouping / exclusion. Table of possible values.
set **set load**	In each container, items with the same alphanumeric label must be in a defined ratio.

> In set load, the connected items form a single logical unit with quantities in a defined ratio. For example, [tables, chairs] in (1:4) ratio. The program calculates the ratio automatically from the item with minimum quantity. For example, if you define a set with elements A, B and C, with **qty** equal to 10, 20 and 40 respectively, the program loads the packages A, B, C respecting the proportions 1:2:4. If the program cannot find the ratio, the optimization is stopped.

Box Grid Menu

Command	Description
Select all [Ctrl+A]	Selects all rows.
Show all items	By clicking on a colored cell on the rightmost column, all packages of that type are hidden from the view. The command allows to restore the original view.
Hide all items	The command hides all packages from view.
Help about the constraints	The command reminds to click on the grid labels to get a description of the constraints.

Pos. (Position Constraints) Grid

Dim.	Desc.	Box	**Pos.**	List	Handl.	Space

	code	ps	fl	tp	nf	xs	mw	^
1	A1	63						
2	A2	63						

code **identifier string**	Identifier string, repeated from the Dim. grid and unchangeable.
ps **allowed positions**	Values between 1 and 63 in which a given package can be loaded. See the section Position Codes for a full description of the numeric codes and for their use in the import process.

> Easy to remind values are: 1 (the package cannot be rotated), 3 (only the positions corresponding to rotations about the vertical axis), 63 (all positions allowed).

fl **floor-only**	The numerical value, between 1 and 63 defines the positions for which the constraint must be applied. The zero or empty value removes the constraint.

tp **top-only**	The value, between 1 and 63, defines the positions for which packages of different type, or of same type but with a different orientation, cannot be placed on top of it. The zero or the empty value removes the constraint.

> When the rule is applied the whole space above the package is considered as unusable. As a reminder, the upper part of the package is rendered in yellow.

nf **not at floor**	The value, between 1 and 63, defines the positions for which the package cannot stay at floor. The zero or empty value removes the constraint.

> The field forces the package to stay above others. It is possible to stow other packages on top of an item marked as **nf**, if these have a stacking index strictly higher to **stk**.

xs **max stack** **max height**	The cell sums up the values of the parameters max stack and max height as set in the *Constraint Panel*. If edited sets max stack for all faces.

> The cell reports the numeric value of **stack max** if this is defined for all positions, while it reports the label "V" in the case of a mixed rule. The cell color is set to red if **max height** is nonzero for some position.
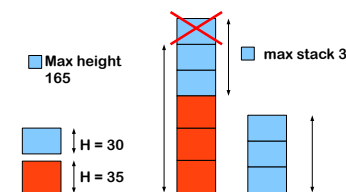
The **stack max** field, with a positive integer value, can be enforced for packages with an assigned fl, nt, or nf constraint. The stack max value can be defined with respect to each support face and indicates how many packages of the same type and with the same orientation can be stacked one on top of the other. The zero or empty value removes the constraint so that the stack is limited by the height of the container.

max height indicates the maximum height at which a package can be placed. The parameter can be set for each support face. The entry in the *Constraint Panel* is disabled if the fl constraint is active, to avoid inconsistencies with max stack.

mw **maximum weight** **supported**	Maximum weight that the package can bear. The cell reports the numeric value of max weight if this is defined for all positions, while it reports the label "V" in the case of a mixed rule. If edited sets max weight for all faces. The zero or the empty value removes the constraint.
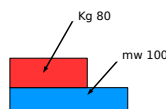
The program requires a value of weight but converts it internally in the normal stress through division for the area of the supporting surface. Hence, in a situation as depicted in figure, the object cannot be positioned above because, although its weight is lower than pm, it generates a stress higher than the maximum allowed. To avoid positioning on the face you can impose a small non-zero value, for example 0.01.

Pos. Grid Menu

Command	Description
Select all [Ctrl+A]	Selects all rows.
Allow all positions	The package can be placed in any position (ps 63).
Only horizontal positions	Only the positions corresponding to rotations about the vertical axis are allowed (ps 3).
Reference position only	Only the position corresponding to the edges as defined in the Dim. grid is allowed (ps 1).
Set allowed positions	Opens a dialog where you can impose the ps position parameter for all selected rows.
Set as floor only	The package should be placed only on floor. The constraint is applied to all allowed positions (fl = ps).
Cancel as floor only	Cancels the previous condition.
Set as top only	Forces a package to sustain only packages of same type and position. The constraint is applied to all allowed positions (tp = ps).
Cancel as top only	Cancels the previous condition.
Set as not at floor	The package cannot be positioned at floor. The constraint is applied to all allowed positions (nf = ps).
Cancel as not at floor	Cancels the previous condition.
Set common rules	Opens a dialog where you can quickly set a common value of max stack, max height and max bearing weight mw for all selected rows.
Cancel all rules	Cancels all applied rules, restoring the default values.
Show all items	By clicking on a colored cell on the rightmost column, all packages of that type are hidden from the view. The command restores the original view.
Hide all items	Hides all packages from the view.
Help about the constraints	Reminds to click on the grid labels to get a description of the constraints.

List (List Constraints) Grid

	code	ds	min	mc	stk	
1	A1					
2	A2					

code
identifier string

Identifier string, repeated from the Dim. grid and unchangeable.

ds
destinations
unloading order

Numerical identifier of longitudinal ordering along depth (length axis). The value zero or empty cell disregards the constraint.

min
minimum numbers
priority rule

The rule enforces a priority, as minimum numbers or priority index. It is applied in the case of solutions with fixed number of containers,

> The rules on how to apply the **ds** order and the meaning of the **min** parameter can be set in the Destinations Dialog.

minimum number: in case you input a positive value, the solver tries to load at least this number of packages for the given item. The constraint applies only in automatic mode. The solver reports a warning whenever it's not able to find a solution.

priority: the value is treated as a priority index. Packages with lowest index are loaded first. The program does not impose any sort of spatial ordering.

mc
container
matching code

Assignment to container in the load list or, in Dynload version, to primary container type. The zero value or the null field removes the constraint.

> **Standard**: the **mc = n** constraint forces a package to be loaded into the **n** container of the list, with container numbering as reported in the container list .
> **Dynload**: the type of primary container to be used in the calculation methods of the first stage.

stk
stacking index

The rule enforces that no package with a lower stk value can be placed on top of it. If edited sets the constraint for all faces. The zero or empty value removes the constraint.

> The cell reports the numeric value of **stack** as set in the *Constraint Panel* if this is defined for all positions, while it reports the label "V" in the case of a mixed rule.

> The **stk** and **pm** constraints impose vertical ordering and can compete. It is recommended not to use them at the same time.

List Grid Menu

| Command	Description
Select all [Ctrl+A]	Selects all rows.
Cancel destination ds	Deletes destination indexes ds for the selected rows.
Cancel match code mc	Deletes container indexes mc for the selected rows.
Cancel min number	Deletes minimum numbers min for the selected rows.
Cancel stk index	Deletes stack indexes stk for the selected rows.
Show all items	By clicking on a colored cell on the rightmost column, all packages of that type are hidden from the view. The command allows to restore the original view.
Hide all items	The command hides all packages from view.
Help about the constraints	The command reminds to click on the grid labels to get a description of the constraints.

Handl. Grid (Handling Constraints)

code **identifier string**	Identifier string, repeated from the Dim. grid and unchangeable.
tpl	Parameter for controlling the movement through forklift. The zero or empty value removes the constraint. The cell reports numerically the value of Control for forklift handling defined in the *Constraints Panel*.
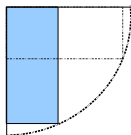
 If you set tpl=1 the program checks that, when the package is loaded with the long side aligned with the short side of the container, there is enough space for the complete rotation of the package. The constraint applies only to closed containers and is disregarded for containers with overflow or rack/flat type. In this way configurations are excluded which, although volumetrically more advantageous, lead to the impossibility of loading. The program automatically sets the columnar constraint *"face to face"*, useful when handling in blocks is foreseen. There are other possible values as described in the following table.

tpl=1	Sets the handling control via forklift in the case of "long side of package" / "short side of container" side by side. Automatically set the *"face to face"* columnar order.
tpl=2	Same as tpl=1, but leave columnar constraints unchanged.
tpl=3	Rotation check is performed with respect to both sides of the package when aligned with the short side of the container. Automatically set the *"face to face"* columnar order.
tpl=4	Same as tpl=3, but leave columnar constraints unchanged.
overh **max overhang**	Percentage value (from 0 to 49) of overhang with respect to the support base. The empty field, or the value -1, re-assigns the default value of the container.

 The program checks that the position of center of mass of each package lies within the base (physical equilibrium). The default value is taken from the text box Max box overhang (%) in the "Current" tab of the Container panel. The field overh allows you to change the default value of specific packages.

bdepth **max depth**	Maximum depth of a box with respect to packages that support it. The empty field, or the value -1, removes the constraint.

 This parameter is useful if the positioning of the upper box is performed using forklifts.

clm **column order**	The cell sums up the values of the parameters Columnar order and All orientations when at the top as set in the *Constraint Panel*. The zero or the empty value removes the constraint.

The numerical values, which can be combined, are:

clm=1 - *"columnar order"*
The package should stay within the base provided by the lower package.

clm=2 - *"face on face"*
The surfaces between lower and upper packages must coincide.

clm=4 - *"only on vertex"*
A vertex of the package must coincide with a vertex of the lower package.

clm=8 - *"free at top"*
Allows you to stow a package in any position (ps=63) when it is placed on top of a stack, regardless of the constraint currently imposed.

The rules can be combined. For example, clm=5 (1+4) enforces the two constraints clm=1 and clm=4 simultaneously.

Menu Handl. Grid

Command	Description
Select all [Ctrl+A]	Selects all rows.
Set columnar order	Adds (deletes) the value clm=1 to the current value of clm, always erasing clm=2.
Cancel columnar order	Cancels the value clm=1 from the current value of clm.
Set as only on vertex	Adds (the value clm=4 to the current value of clm, always erasing clm=2.
Cancel as only on vertex	Cancels the value clm=4 from the current value of clm.
Set as "face on face"	Sets clm=2 as current value of clm.
Cancel "face on face"	Cancels the value clm=2 from the current value of clm.
Set "all positions when at the top"	Adds the value clm=8 to the current value of clm.
Cancel "all positions when at the top"	Cancels the value clm=8 from the current value of clm.
Set parameters	Opens a dialog where you can assign the value of overh and max depth for all selected rows.
Cancel all rules	Cancels all applied rules, restoring the default values.

Command	Description
Show all items	By clicking on a colored cell on the rightmost column, all packages of that type are hidden from the view. The command restores the original view.
Hide all items	The command hides all packages from the view.
Help about the constraints	The command reminds to click on the grid labels to get a description of the constraints.

Space Grid (Spacing)

code **identifier string**	Identifier string, repeated from the Dim. grid and unchangeable.
spL, spW, spH **padding space**	Lateral empty spaces

Sometimes it is necessary to leave free space around a package (for example, due to anchor hooks).
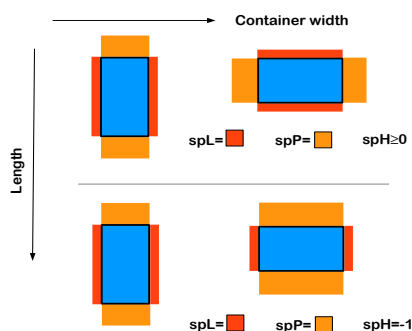
The parameters spL and spW specify the amount of free space ("padding space") in the direction of the depth and width side, respectively. The third parameter spH specifies the orientation of the free spaces.

When spH ≥ 0 (or empty) the orientation refers to the package ("relative", see figure). A non-zero value of spH is used for packages that can be fully rotated when the top is placed sideways.

If spH=-1 (or otherwise negative), the orientation instead refers to the container ("absolute", see figure), regardless of the position of the package.

Rsp, Fsp **spaces not allowed**	Prevents placement of the package in rear (for a length Rsp) or at the front (for a length Fsp) of the container.

Space Grid Menu

Command	Description
Select all [Ctrl+A]	Selects all rows.
Set empty spaces	Opens a dialog wherein you can set the spacing for all selected rows.
Cancel empty spaces	Cancels spL, spW, and spH parameters, for all selected rows.
Set as absolute spacing	Sets spH=-1, for all selected rows.
Cancel absolute spacing	Cancels spH, for all selected rows.
Cancel all rules	Cancels all applied rules, restoring the default values.
Show all items	By clicking on a colored cell on the rightmost column, all packages of that type are hidden from the view. The command restores the original view.
Hide all items	The command hides all packages from the view.
Help about the constraints	The command reminds to click on the grid labels to get a description of the constraints.

Destination Grid

The *Destinations Grid* has only descriptive fields and is used to assign a color of your choice to the destination parameters, or to enter descriptions that are included in the report, if required. The grid can be opened by pressing the menu command Report → View Destination Grid [Ctrl+Shift+D].

	ds	label	tot	pk	c
1	1	destination 1	258	258	
2	2	destination 2	238	238	

ds	numerical identifier of the destination	label	description field
tot	number of packages per destination	pk	number of loaded packages per destination
c	color, changeable by clicking on the cell		

Destination Grid Menu

Command	Description
Show all type	By clicking on a pk cell, all packages with that destination are hidden from the view. The command restores the original view.
Hide all type	Hides all packages from the view.
Cancel User color	Cancels the color chosen by the User.

Shared properties

The grids of the *Package Panel* share some common properties:

- the field **code** is repeated all over the tables;
- cells of the *Dim.* grid are always writable and are used to type in data manually. Instead, cells of the other grids are initially read-only. A row of these grids becomes writable when you input at least the box dimensions **l**, **w**, and **h** in the corresponding row of the first grid;
- each table has initially twenty-four rows. New rows are automatically added by the program when needed;
- each grid provides a contextual menu activated by right clicking on any cell, which allows to perform actions on the selected items;
- to perform the selection, you can click and/or drag the mouse over the cells. Hold the **Ctrl** key down to deselect a row from an existing selection. By pressing the **Shift** key, it is possible to select a group of contiguous rows;
- when switching from a grid to another (e.g., from Dim. to Desc), selection is preserved;
- apart for the *Desc.* grid, all cells of the rightmost column behave as visualization buttons, allowing you to hide or show items from the load plan view.

Quick constraint settings

It is possible to impose the same value of the constraints with a suitable dialog, specialized for each tab an opened with the contextual menu of the tab. Action applies to all selected rows.
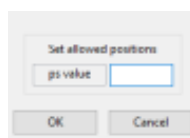
Set allowed positions
Opens a where you can impose the ps position parameter for all selected rows in the Pos. grid.
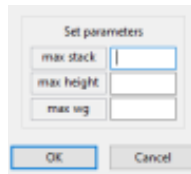
Set parameters
Allows you to assign the same value to the parameters for all
selected rows. The fields displayed depend on the selected
tab. If you want to reset to the default value, leave the field
blank and press OK.

Constraint Tips

As a help, you can obtain a synthetic description about the meaning of the con-
straints by clicking on each column's tab.
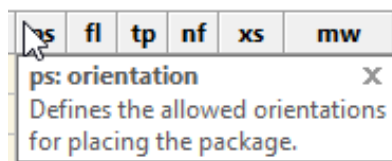
Grid Status

When the option Settings → Start from current is active, all the columns except qty,
code, description, and qt/b, are set as read-only and not-editable. Cells are shown
with green to remember that the values are referring to the packages already loaded
and that their content cannot be changed.
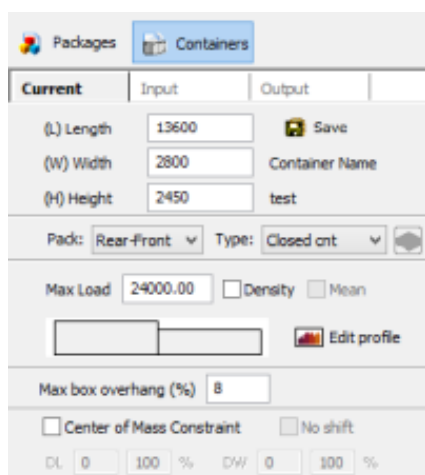
The option Protect data loaded from Database or from Excel in the Configure Datab-
ase dialog box sets as read-only the previous columns for all records loaded from the
internal database, via ODBC or imported from an Excel file. This option is useful
to prevent accidental modification of the input data. Differently from the "Start
from current" case, the read-only status can be eliminated at any time with the
command Tools → Cancel read-only status.

Containers

The Container Panel allows you to define the containers to be used and the rules for their loading. To activate the panel, click on the ▥ *Containers* icon. Data are organized in three panels accessed can be selected by clicking on the tabs.

1) Current Tab, shows data and parameters of the *"active"* container;
2) Input Tab, lists the types of containers to be used, and their number;
3) Output Tab, lists, in tabular form, information about the containers employed in the optimization.

Current Panel

The *Current Panel* allows you to define the dimensions of the container and to set parameters for the positioning of the load. If the solution has more than one container, the panel becomes active once it's shown a single container. You can select the active container via:

- the drop-down menu found in the Auxiliary toolbar;
- the contextual menu of the Visualization Area;
- clicking on the edit cell of the Input Panel.

You can input the data manually, or you can retrieve the definitions from the internal Database or from an Excel file.

Control	Description
L, W, H **Internal dimensions**	The input fields (L) Length, (W) Width, and (H) Height refer to the "internal" or to the "nominal" dimensions of the container. **Data are integer valued** and must always be set.
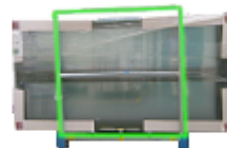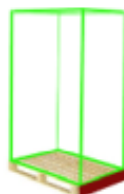
Pack:
Packing direct-ion

The combo-box choices instruct the solver on how to stow the packages.

Bottom-Top		The program places the packages starting from the bottom of the container, filling the base, and then goes upward.
Rear-Front		the program places the packages starting from the rear of the container, filling as much as possible a "slice" upward, and then continues to the front of the container.
Layer-Front		It's a combination of the previous two: the positioning follows the *Rear-Front* order, but the height of the load is kept as low as possible, by maximizing the base as in *Bottom-Top* ordering.
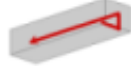
Type:
Type

The combo-box shows the possible type of containers.

Closed cnt	This is the standard container, defined as any rectangular envelop with fixed assigned sizes.
Open cnt	The optimization is performed with respect to the height of the container, which doesn't have a fixed value and is kept as small as possible. The load sequence is managed by the application and the **Pack:** combo box is disabled.
Rack/Flat	This is a special container, open on one side and with usable height greater than its actual physical size (see figure). See properties.

> For *Open cnt* the program keeps the height as small as possible but at the same time tries to load the maximum number of the packages. The type is present for backwards compatibility. It is recommended not to use it and to use the *Rack/Flat* type instead.

Max Load
max load

The text field Max Load, having **decimal values**, allows you imposing the maximum load of the container.

Density
density

When Max Load is active, the rule ensures that the load distribution stays uniform throughout the length of the container. To ensure this, the application checks that in every possible "strip" of length L, the weight W of the strip satisfies the relationship $W/L \leq$ weight/length where weight and length are the data entered in dialog Load Distribution.

Mean **mean density**	In many situations, the density should be understood as an average value to verify how much space must be occupied by heavy packages resting on the ground. If the option is active, for each package with weight w, the program evaluates the length l needed to place the package in accordance with rule w/l = weight/length. If l exceeds the base length of the package, other packages are spaced appropriately.
Max overhang **Max box** **overhang (%)**	Defines the default value of max overhang when a package is stacked on another. The allowed value is expressed as percentage of the edge dimension and varies from 0 to 49 (physical limit). For any package, the default value can be changed by acting on the cells overh of the Space grid.
Center of Mass **center of mass**	The rule forces the solution to have the center of mass of the load included in a target rectangle (see figure).
Forbid shift **no shift**	To fulfill the requirement on the center of mass, the program can shift the position of blocks of packages or even of the entire load. The check box Forbid shift, if checked, inhibits this functionality.
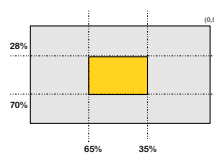
The target rectangle is defined by the four values DL (maximum and minimum) and DW (maximum and minimum), expressed as a percentage of the length and width of the container. No control is operated in the vertical direction. If the option Forbid shift is active, do not input too restrictive limits on the target rectangle, otherwise the solver may not be able to find a solution.

Tool / Description

	Save	Save the container data in the internal database. Before saving, a window allows you to enter the descriptive name of the container. Leave the field blank if you want to cancel the operation. In case of a duplicate name, a further dialog allows you to resolve the collision by choosing among the options *update the record*, *save the container with a new name* (the save window is called up), *cancel the operation*.
	Edit profile	Opens the Load Profile dialog to assign a separate maximum load for different sections of the container.
	Additional container data	Opens the Additional data dialog to assign the parameters of the rack/flat container type and, for the Dynload version only, data needed to convert the container to a package.
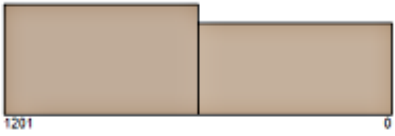
Load Profile

The program allows you to assign a maximum load for different sections of the

container, up to a maximum of five sections. Press the Edit Profile 📊 command. In the dialog box choose the number of sections, and input the size and weight assigned to each section. Whenever the data changes, the value of Max load is recalculated automatically.

Additional data

The dialog allows you to assign parameters for the rack/flat container type (all versions) and, for the Dynload version, the *"external"* dimensions of the container as well as the rules for its conversion to package.

The data of the dialog are used in the case of conversion of the container into a package when using the two-stage calculation scheme.
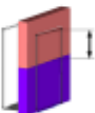
The *primary / secondary* options are used to assign a descriptive flag to simplify searching the container database.

Control	Description
Base heigh	Lower external vertical dimension, the thickness of the base for a pallet or the plinth for a crate. Rendered in dark red graphically.
Height [H]	When converting to package, the *Fixed dimensions* option leaves the nominal height unchanged (box-type), while the *Load extension* option takes as height of the package the height of the load (pallet-type)

Control	Description
	Upper external vertical dimension.
Length [L] Width [W]	Meaning of the value entered in the text box: *Add thickness* considers the value as external lateral dimension, *Max over length* assumes the value as the maximum overhang with respect to the dimensions of the base.
x 2	Value of overlength / thickness, applied symmetrically
Weight	Container weight.

Control	Description
	Min vertical overlap (%)	Applies to Rack / Flat containers and non-floor packages only. Specifies the minimum percentage of contact between the package and the physical height of the wall. Packages higher than the height of the wall are not loaded.
	Allow over length at any level "inverse stair"	In containers with overlength, placement beyond the base is allowed only for floor packages. If activated, the overhang is allowed at any height. In this case one can obtain solutions as shown in the figure.

Constraints for second stage

The grids replicate those of the Package manager and allow you to assign the constraints of the package obtained by conversion of the container.

Input Tab
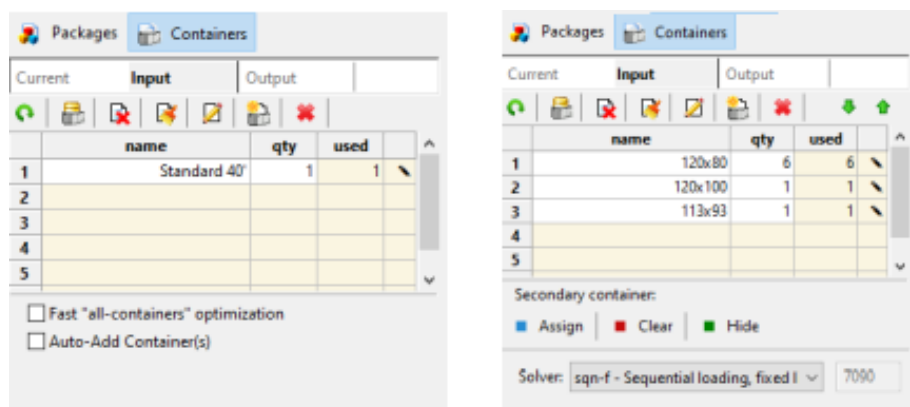
The container *Input* tab reports the list of container types to be used, their number

and the loading criterion. The tab differs between the Standard and Dynload versions and is absent in the Lite version. Except the first line, which is always defined at start-up, all rows are entered by acting on the tool ▤ (Add) in the panel toolbar or via the same tool in the *main toolbar*, by using the menu command Database → Open Container Manager or by cloning ▤ a row. The tab has various groups of controls:

Container list,   List tools,

"Secondary" tools,   Loading criterion tools.

Container list

The list reports the container types and has the following fields

Column	Description
name	container name. The field is editable and allows changing label.
qty	number of containers.
used	number of containers actually used (read-only).
(edit) ⬉	allows you to switch to the *Current* tab of the container.

In the Standard and Lite version, entering **qty=0** deletes the row, while in the Dynload version the row is preserved.

List Tools

The panel carries a specialized toolbar which includes the following commands

Icon	Command	Description
⟳	Cancel	Deselects any active line.
▤	Add	Opens the Container Manager to retrieve data.
▤	Delete	Deletes selected rows from the list.
▤	Clean	Deletes all the unused containers.
▥	Edit	Displays the *Current* panel for editing purposes.
▤	Clone	Duplicates the container row.

Icon	Command	Description
✖	Delete All	Deletes the solution without altering the input data in the *Package Grids*

Secondary tool
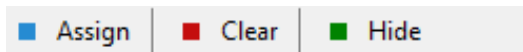
In the Dynload version the Assign tool opens the Container Manager and allows you to assign the container that will be converted into the working container after the conversion to packages (*"secondary container"*). The Undo tool deletes the association, while the Hide tool hides it from the workspace. The assignment of the secondary container, other than to speed up the conversion operations, allows to adapt the nominal dimensions of the containers of the first stage.

Loading criterion tools

The panel shows the Solver: control (Dynload version) or a pair of controls (Standard version) to define the loading criterion of the chosen containers.
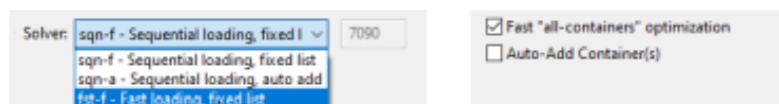
The rules are the basis of the automatic calculation, and the action of the controls is described in the Loading criteria section of the automatic calculation.

Output Tab

The *Output Tab*, not available in Lite version, shows in tabular form the percentages of load weight, used volume, and number of loaded packages, thus providing a summary about the results achieved in the optimization. Detailed information can be obtained by opening the panel Summary Report.

The panel also offers several tools that allow you to manipulate the solution without invalidating the results.

Toolbar

Icon	Command	Description
↻	Clear	Deselects all active rows.

Icon	Command	Description
	Save	Saves the load plan of the containers entering the active selection.
	Re-optimize	Starts a new optimization of the containers entering the active selection.
	Merge	Allows you to "merge" the current solution with another previously saved on file.
	Remove	Removes the selected containers, updating the load list of the packages left on ground.
	Show	Displays the selected container.

To add/remove containers in the active selection, double click on the corresponding line, or click on the box shown in the second column. You can also use the contextual menu of the work area.

Unusable Spaces

The program allows you to define irregular containers with unusable volumes. In this way, during the optimization, no package will be placed inside these regions. Such spaces must have "rectangular" shape and are divided between "unusable spaces" and "unusable sections". Unusable spaces are considered as a property of the irregular container. Unusable sections, instead, can be changed as desired in the solution and are not saved into the Database. If present, unusable volumes are shown in transparency.
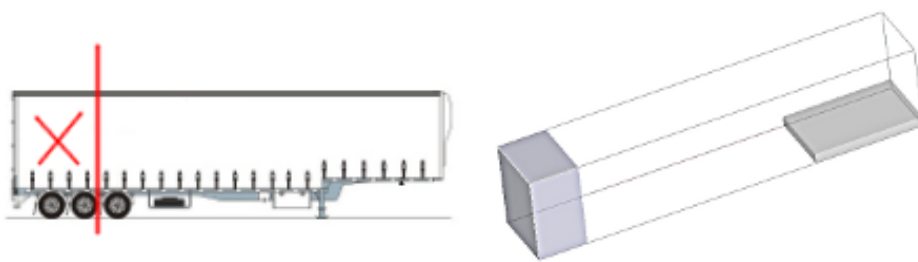
Container with unusable spaces

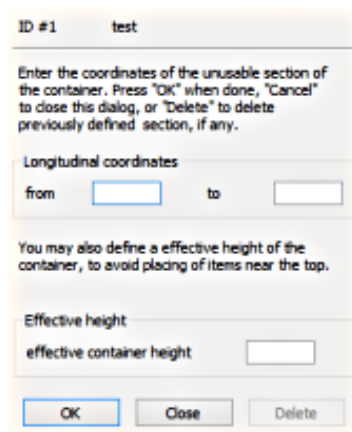You can define a container with unusable spaces in two ways:

By import

With the command File → Import container you can import an Excel file appropriately formatted (see Import containers for details). If you need to save the

definitions in the Database, select the *Current* Tab and click on the Save ⊞ command.

By manual session

You can use a special manual session that allows you to visually locate the areas to leave empty. First, enter the dimensions of the container in the Current tab of the Container Panel. Then, enter in the Dim. grid the dimensions of the "blocks" that form the unusable volumes. It is not necessary to specify their number and you can leave blank the cells qty. Choose the tab *Manual* and check the option Define a container with unusable spaces. Then, start the session as usual. A dialog message reminds that the program will work in this specific mode. With the present setting the program does not perform constraint checks, so that blocks can be placed in arbitrary positions. At the end of the session a dialog allows entering the name of the custom container which is then stored in the database. Leave the text field blank to cancel the operation and disregard save of data.

Unusable Section

You can define unusable sections for each single container. If your solution includes multiple containers, you must first select the container of interest via the container *drop down box*.

the command Settings → Unusable Section opens a dialog where you enter the extension of the unusable section with the text boxes from – to.

You can also define an effective height of the container, to prevent the placing of the packages near the "ceiling" of the container. In this way is not necessary to set the limit via the constraint maximum height.

The command OK assigns or modifies the section (the program ensures that the entered values are distinct). The command Delete eliminates the section. The command Close closes the dialog without performing any operation.

Package Constraints

packVol offers graphical environments for dealing with all loading rules in a simple and intuitive way.

Constraint Panel	allows you to impose rules for individual packages.
Destination Dialog	allows you to enforce rules related to ordering of the load plan.
Stack Panel (with variants)	allows you to view the stacking rules between pairs of packages and to apply exceptions, if required.
Set Load Dialog	allows you to define which packages must be grouped in case of set load.

Constraint Panel

The *Constraints Panel* is opened with the menu entry Tools → Open Constraint Panel ⬛ . The panel is also automatically displayed whenever you edit a cell of the Box Grid, a cell of Space grid, a cell of Handl. Grid, or the cell stk of the List Grid.
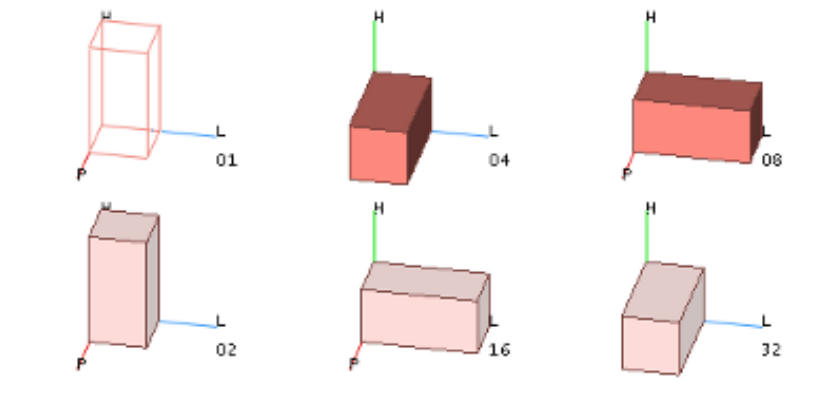
Once opened, the load view is substituted by a view of all the six possible positions of the package, shown with solid faces if the position is allowed, with wire-framed edges if the position is forbidden. The package to be dealt with is selected by clicking on the corresponding row of the Package Panel.

❙ The positions are labeled according to the *Encoding of Positions.*

The *Constraint Panel* comes in two variants, the *Panel Position*, automatically shown when you work with the *Pos.* and *List* tabs, and the *Spacing Panel*, shown when you work with the *Handl.* or *Space* tab.

In both panels, after any change is made, the numerical value in the grids is immediately updated. Similarly, if you input a numeric value in the grids, the panel immediately reflects the change.
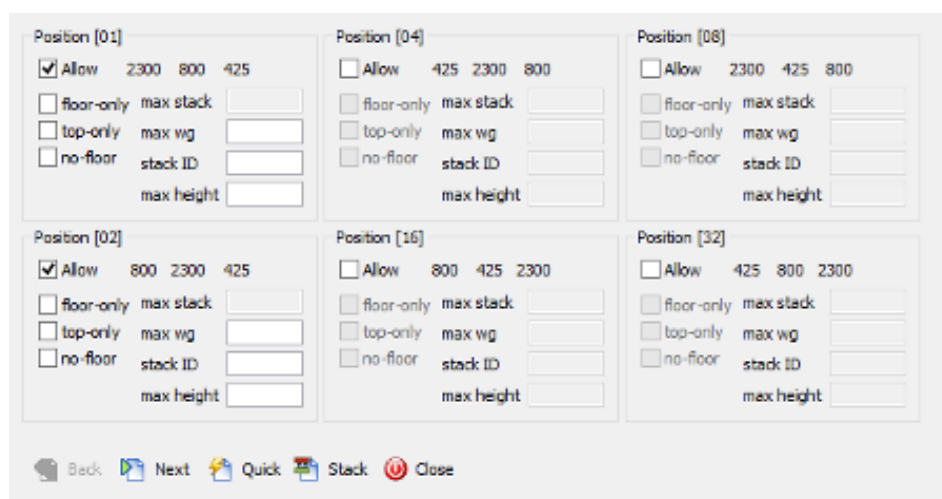
Constraint Panel Tools

The *Constraint Panel* has a toolbar at the bottom with the following commands

Command	Description
Back	Selects the previous row of the package grids.
Next	Selects the following row of the package grids.
Quick	Opens the contextual menu of the active tab and operates only on the selected package.
Stack	Opens the Stack matrix dialog, where you can define "exceptions" to stacking rules.
Close	Closes the Panel.

Position constraints

By clicking on the proper controls, divided into six groups according to face and orientation, you can impose all the constraints of the Box Grid and List Grid tabs.

Please pay attention to the fact that at least one position should be allowed. If you try to deselect all the checkboxes, the first position is automatically checked. In case of manual input or automatic import, the program can change the numerical values to preserve the consistency of the data.

The association between the controls of the panel and the cells of the grids is as follows

ps	Allow	xs	max stack, max height
fl	floor-only	mw	max weight
tp	top-only	stk	stack index
nf	no floor.		

as shown in the figure below
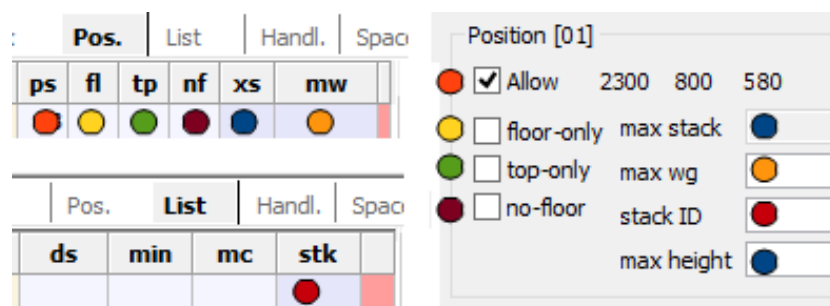
As a help to the User, the controls are disabled when their values are undefined. In particular:

- if an edge dimension of the package is not defined or the item is read-only, all groups are disabled;
- if a position is equivalent to a previous one, the whole group is disabled;
- if a position is forbidden, all controls of the group are disabled;
- the textbox for the **max stack** (xs) is enabled only if the package has been marked as **floor-only** (fl), **top-only** (tp), or **no-floor** (nf);
- the constraint **floor-only** (fl) and **no-floor** (nf) are mutually exclusive, therefore the program disables a check box if the other is checked;
- the **max height** textbox is disabled in case of **floor-only** position, to avoid conflicts with the **max stack** value.

Spacing constraints

The *Spacing Panel* is automatically shown when you select Handl. or Space tab and allows you to enter the parameters in an intuitive way.

tpl	Handling by fork-lifts	The checkbox applies the rule of handling by forklifts. The button change allows you to assign the desired value for the parameter tpl. The positions subject to check are shown with red color.
spL, spW, spH	Free space around package.	The three text boxes allow you to enter the value of the empty space around packages. The Abs choice allows you to distinguish between "absolute" or "relative" spacing.
overh, max depth	Max overhang/ Max depth	Allows you to enter the values of Max overhang and/or Max depth.
Rsp, Fsp	Unavailable Spaces	The two text boxes are used to enter the values of the unavailable spaces Rsp and Fsp.
clm	Columnar order	Applies the columnar ordering, combining the values chosen in the proper checkboxes.
clm	Special position	Applies the constraint "free at top", adding the suitable value to the parameter clm.

The following figure shows, using colors, the association among cells of the grid and controls of the panel.
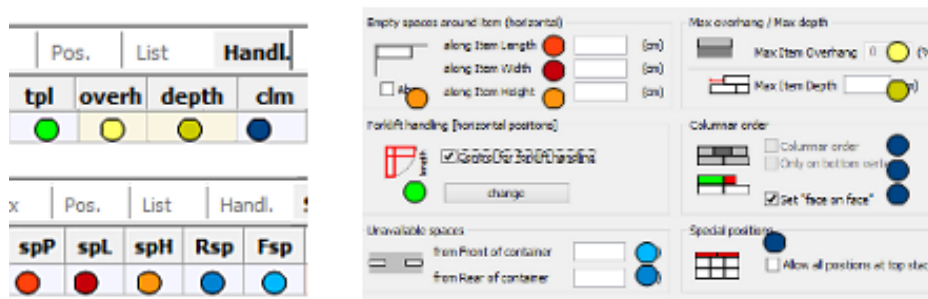
As a help to the User, the controls are disabled when their values are undefined. In particular:

- if you activate the check-box **Abs** (spacing relative to the container), the textbox for the vertical dimension is disabled;
- if you impose **Columnar order**, the textbox **Max item overhang** is set on zero and disabled;
- if you impose **Set "face on face"**, the textbox **Max item overhang** is set on zero and disabled together with the options **Columnar order** and **Only on bottom vertex**;

– when you enable the option **Forklift handling**, the option **Set "face on face"** is automatically activated, although it can be changed at later time.

Destination Dialog

The Destinations Dialog is used to enforce spatial and non-spatial ordering rules inside the containers. It consists of various groups of controls, some of which employ the ds parameter set in the List grid, others are independent of it.
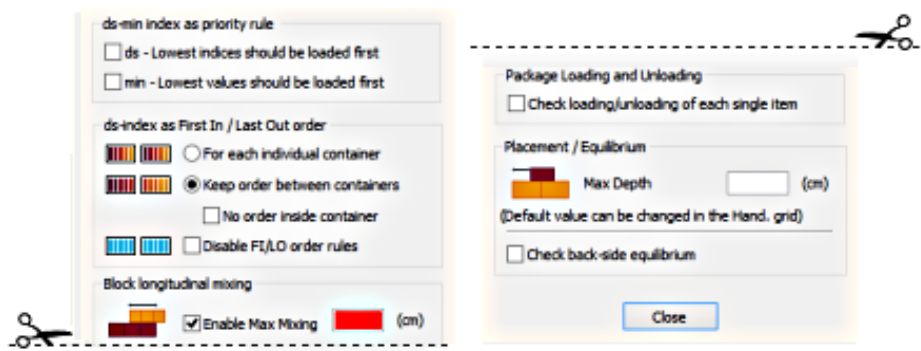
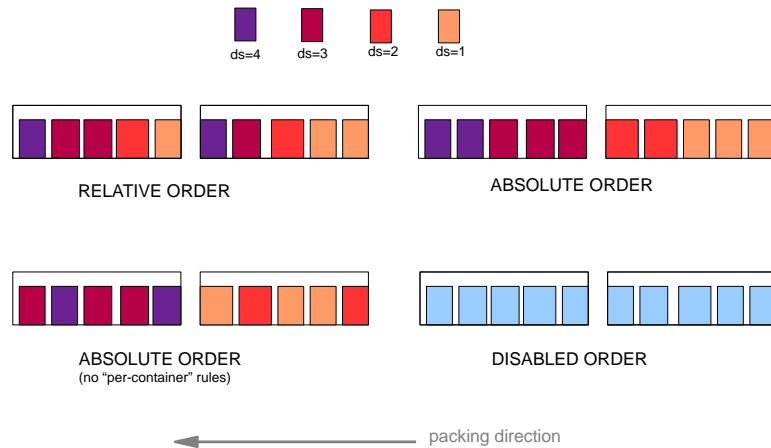| **ds-min index as priority rule**	
ds - lowest indexes should be loaded first	A package is loaded only after complete loading of all packages with lower ds value.
min - lowest indexes should be loaded first	A package is loaded only after complete loading of all packages with lower min value.

Priority indexes are applied only in load criteria that do not require the addition of containers. The **min** option allows you to reserve the index **ds** for spatial sorting, making it possible to combine logical and geometric ordering.

ds-index as First In / Last Out order	
For each individual container	The packages are ordered in each container, but no rule is set between the containers.
Keep order between containers	The packages are ordered by considering the ordering between consecutive containers.
No order inside container	The option is shown when the previous option is selected. When active, the order is maintained among different containers, but not in each single container.

ds-index as First In / Last Out order

Disable FI/LO order	Disables temporarily the ordering ds without altering the parameters. It's mainly a test option.

RELATIVE ORDER

ABSOLUTE ORDER

ABSOLUTE ORDER
(no "per-container" rules)

DISABLED ORDER

packing direction

When FI/LO is active, the program always checks that no packages with lower ds indexes are "in front of" or "above" others with higher indexes, but no check is performed in lateral direction. The blocks of the same ds can therefore be arranged side by side and this arrangement is not always acceptable. The *Longitudinal mixing* group allows you to control the mixing.

Longitudinal mixing

Enable Max mixing	The program tries, as far as possible and with the same volumetric occupancy, to reduce the interpenetration of blocks with different ds parameter.
max mixing	Allows you to limit the extension of the overlap of blocks of packages with different ds destinations within a maximum value that must be entered in the text box with the red background.

The empty field or a zero value for the **max mixing** text field result in a different behavior. The empty field allows the application to minimize the overlap, while the zero value completely prevents the mixing. In the latter case, one has a simple subdivision of the container in independent longitudinal sections. If there are specific requirements, it is recommended to keep this parameter field empty, as **max mixing** has a significant impact on the volumetric efficiency.

Loading / Unloading	
Check loading / unloading for each package	The function does not require the entering of ds values. The program internally assigns a fictitious ds index to each type, so that identical packages are always grouped together, deciding the best sequence. The function is useful in case you need to manage only one type at a time.

Position / Equilibrium	
Max depth	The text box allows setting a predefined value for the depth constraint common to all packages. In the Handl.. tab you can change the value for specific items.
Rear balance check	When applied the program checks that the back of the package is resting against the wall of the container or against another package.

> The two options are competitive (*Max depth* tends to "bring forward", while *Rear Balance* tends to "bring backwards"). If *Rear Balance* is set, do not assign an overly restrictive value to *Max depth*.

Stack Panel
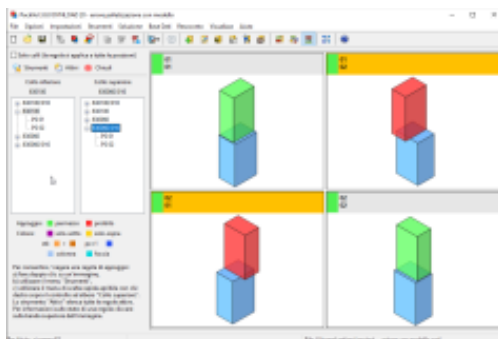
It's opened via the menu command Tools → Open Stack Matrix 🗜 , and shows the stack rules between pairs of packages resulting from the setting of constraints fl, tp, stk and xs..

Upon opening, two tree-controls allow the selection of any pair of items on the loading list (figure on the left). In area to the right, the pairs are shown, with the upper package colored *green* if the stack is allowed, or *red* if the stack is prohibited. The displayed combinations can be reduced by expanding the items of the tree control and selecting the individual positions of the packages. The gray box above each figure shows the state (green/red) and colored indicators of the applied constraints. Click on the gray frame to display information on the stacking rule.

Stack Matrix

In addition to being an analysis tool, the panel allows you to define "exceptions" to the default stacking constraints, namely, *"to exclude stacking otherwise allowed"* or *"to allow stacking otherwise excluded"*.

The list of exceptions forms the *Stack Matrix*, and it is displayed by pressing the

Active tool. Instead of the tree controls, a list appears that shows the imposed exceptions. The first time it opens, the list is usually empty.

> Exceptions can be imposed for each contact face. To exclude/accept a configuration, simply double click with the mouse over the image, or, once you have selected a configuration, use the commands of the work menu. If the command **List item only** is selected, the tree-control does not show the positions. At the same time, two tools are activated to allow / deny stacking for all positions. When an exception is activated, the upper gray band becomes orange.

At the top of the panel, there is a tool menu with the following commands:

Command	Description
Tools	Opens the contextual menu.
Active	Shows the Stack Matrix
Allow	If List item only is active, allows stacking for all positions.
Deny	If List item only is active, denies stacking for all positions.
Close	Closes the dialog.

Work menu

The menu opens by right-clicking on the work area or by clicking on the Tools command.

Command	Description
Deny this stacking	Same action as double click.
Allow this stacking	Same action as double click.
Set conjugate rule	Assigns the same rule to the configuration rotated by 90.
Deny shown stacking	Excludes stacking between the two items (all positions).
Allow shown stacking	Allows stacking between the two items (all positions).
Clear shown exceptions	Delete all exceptions for the shown packages.
Delete ALL exceptions	Delete all exceptions. The action cannot be undone.

Stack Matrix Dialog

The Stack Panel is displayed as a dialog window when called up by the command

Stack ⬜ of the Constraint Panel;

Stack 📚 of the Package Manager.

The functions are identical to those described in the Stack Panel section.

In this display mode, the tree control on the left (bottom package) only lists the selected package. The Tools menu features a filter that can be used to quickly select the upper package. In the case of opening from the Database the dialog carries two navigation buttons, and the exceptions apply to the stored records.
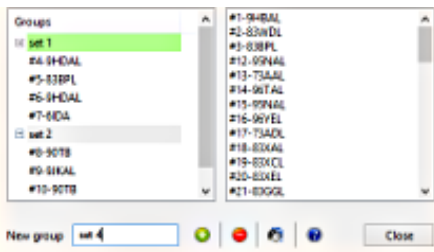
Set Load Dialog

The dialog is employed to enforce the Set Load set constraint. You can open it by using the command Tools → Open Group Dialog 🔲 , or by double-click on a cell set of the *List* grid.

To form a group:

1) input the name in the text box New group and press the button +;

2) select the items in the list to the right (hold the button Ctrl down for multiple selections);

3) drag the selection on the name that appears in panel on the left.

To delete a group, or part of a group, use the contextual menu, opened by clicking the right mouse button. The menu also holds commands to expand or collapse the tree-list on the left. A button allows to choose the color for the group.

Error on Constraints

In case of inconsistency of the input list, the program stops the execution of the optimization and displays an information window. Typical errors are:

– setting the center-of-mass control with types of package without assigned **weight**;
– **mc** index higher than the number of containers;
– starting solution inconsistent with the **set** or **bat** constraints.

In the following cases, the dialog instead allows the User to take steps to solve the problem.

Package Dimensions

The error window is activated when the dimensions of certain packages exceed the dimensions of the containers. The dialog shows four self-explanatory options

Set qty=0 for this item

Remove the item from the input list

Leave the input list unchanged

Stop the optimization run

Batch Load

The dialog is used to correct the input data whenever the input quantity `qty` is inconsistent with the batch parameter `bat`. You can select one of the following intuitive options

*Delete the packages in excess from load plan*

Treat remaining packages as new batch

Keep remaining packages as individual items

Cancel the optimization

Solvers

packVol can operate in two distinct modes, *automatic* and *manual*. In *automatic* mode the load plan is evaluated by the internal optimizer of the program, while in *manual* mode the load plan is created or modified by the User, thanks to a 3D graphical environment having the most common editing functions.
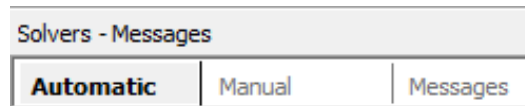
The choice is made by selecting the *Automatic* or *Manual* tab in *Panel Solver* before starting the session. If the *Message* tab is selected, the program opens a window where you can choose the desired mode.

Automatic Solver
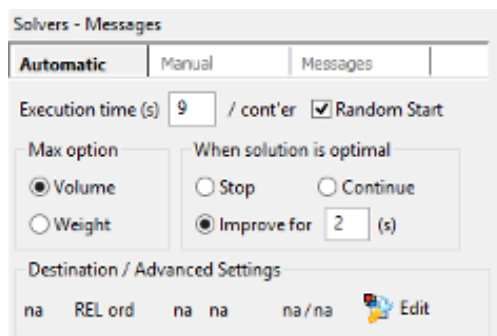
To start the automatic optimization, select the tab *Automatic* and then click on the command Tool → Start Evaluation in the menu bar 🔴 . Once started the run, a small window is displayed on top of the main window, which carries a timer, showing the elapsed time, and a button, which allows you to stop the calculation. This window also freezes any interaction with the main application window. During the evaluation, the Solver panel is set on the *Messages* tab, which displays short messages about the optimization status. The best solutions are visualized on the visualization area as soon as they are found by the program.

Loading criteria

Load optimization can take place according to two somewhat conflicting schemes:

a) maximize the volumetric occupation of the loading list in a predetermined number of containers;

b) minimize the number (or capacity) of containers needed to load the entire loading list.

packVol can apply both schemes with the controls of the Input tab of the Container Panel. Loading normally occurs *"sequentially"*, one container at a time. In the case of minimizing the number of containers, the last container in the loading list is used for completion.

The program also has a *"fast"* mode in which all containers are processed simultaneously. The function is certainly useful as a method of estimation because it allows

you to quickly obtain information on the number of containers needed. Sometimes it is superior to the sequential method. The choice of the most suitable method is left to the User tests, as the effectiveness is too dependent on the type of load plan. The table lists the possible choices

label	Standard (controls)	Dynload (menu option)
sqn-f	− Auto-Add container(s) − Fast optimization	*Sequential loading, fixed list*
sqn-a	+ Auto-Add container(s) − Fast optimization	*Sequential loading, auto add*
fst-f	− Auto-Add container(s) + Fast optimization	*Fast loading, fixed list*
fst-a	+ Auto-Add container(s) + Fast optimization	*Fast loading, auto add*

> The Lite version has only the method **sqn-f** for a single container.

Dynload criteria

The Dynload version offers additional loading criteria

label	description	menu option
mbin	estimation of the type of container	*Sized multibin method*

With the mbin criterion it is not necessary to enter a specific quantity in the Container list but only a value greater than zero to take the type into account. The application tries to estimate the best combination of types to minimize the capacity of the containers needed to load the whole loading list.

The remaining criteria are intended for palletizing and take into account the *"family"* fml parameter of the Box tab.

label	description	menu option
plt-r	single reference with reuse of formed pallets	*Mono article, reuse formed*
plt-e	single reference without reuse of formed pallets	*Mono article, without reuse*
plt-s	pallets with pairs of articles	*Threshold pairing article*

With the plt-r and plt-e criteria the application optimizes each package in the input list, "row by row" (or by groups of rows controlled by fml), looking for the best possible saturation on the container types available in input. The solutions formed in this first step have therefore defined items. The remaining packages are then optimized in mixed loading. In the case plt-r, before starting the optimization in

mixed loading, the program checks if the packages can be loaded in the nominal volume of the containers formed. This step can improve the volumetric efficiency, but it leads to mixing of the items. With the plt-e criterion the step is skipped, and the containers formed in the initial step remain with the assigned items.

The plt-s criterion performs the palletization calculation for all possible pairs of packages. It arises from a personalization and is currently considered as *"experimental"*. It is not described here.

Family fml

The fml parameter of the *Box* tab has the following values

value	description
0 or blank	With the criteria plt-r and plt-e the row is optimized individually (single-item pallet formation).
> 0	With the plt-r and plt-e criteria, the rows with the same value of the fml parameter are optimized in the same container (multi-item pallet formation)
-1	This value excludes the application of the plt-r, plt-e criteria and the item is optimized only in mixed load.
-2	This value completely excludes the item from the calculation. The function is useful in the two-stages scheme if it is necessary to mix packages to be optimized with preformed packages to be left unchanged. With this value, the lines acquire a light gray color to highlight that they are not included in the calculation.
pattern	If the field is validated with the name of a pattern the formation of single-reference containers is performed by applying the palletizing scheme. Pattern and item size must be consistent.

Run options

The automatic tab carries the following controls

Option	Description
Max execution time (s)	Maximum execution time in seconds. If the solution has more than one container, or if the setting Auto-Add container(s) is active, the execution time refers to each container. The program can alter the execution time if needed.
Random start	The optimization begins from a random choice. This allows you exploration of different possible solutions.
volume weight	The program optimizes the volumetric occupation of the container (default option), or the weight loaded in the container.

Option	Description
Stop *Continue* *Improve for*	The group of options defines the behavior in case the solver can complete the load for a single container. Since the program also tries to stow the load in the most compact way, it can be useful to leave the program running even when it finds an optimal solution.
Destinations *Advanced settings*	Shows a schematic summary of the current settings entered in the Destinations Dialog. The Edit 🔧 tool replicates the Tools → Destination dialog [Ctrl+Alt+D] menu command.

Redistribute load

One of the possible ways in which the program can be used is to calculate the number of containers needed to completely load the input list. Sometimes it may happen that the last containers have much lower volumetric efficiencies than the first containers. Using the same number of containers, it is often preferable to have a homogeneous distribution of the load among the containers. The command Tools → Redistribute Load meets this need. If called up, the program redoes the calculation starting from the solution obtained and searching for the most homogeneous distribution.

Re-optimize Solution

The Re-optimize cnt # command from the visualization area menu performs load compaction. This function can be useful when optimizing by weight. The complete saturation of the maximum weight often corresponds to low volumetric efficiency. Re-optimizing makes it possible to easily explore different load configurations, letting the User choose the most suitable one. The command Solution → Container selection → Re-optimize selected, or the 🔄 Reoptimize tool of the Output tab, performs the same function but allows you to work on the containers selected in the *Output* tab at the same time.

Manual Solver
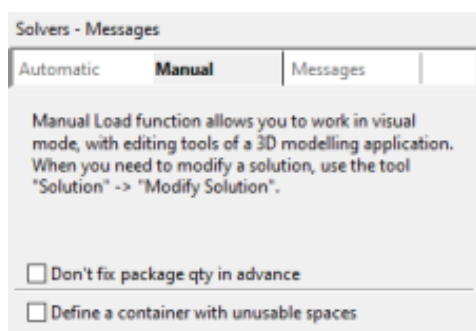
In manual mode the load sequence is defined by the User. To start the work session, select the tab *Manual* in the Solver Panel and then click on the command Tool → Start Evaluation in the menu bar 🔲 . The panel, besides a brief note on the features of the mode, has two check boxes which should be checked, if necessary, before you start.

Run options

Option	Description
Don't fix package qty in advance	Starts the session without assigning the number of packages, which can then be placed at will.
Define a container with unusable spaces	Starts a session where you can define a container with unusable spaces.

Work Environment
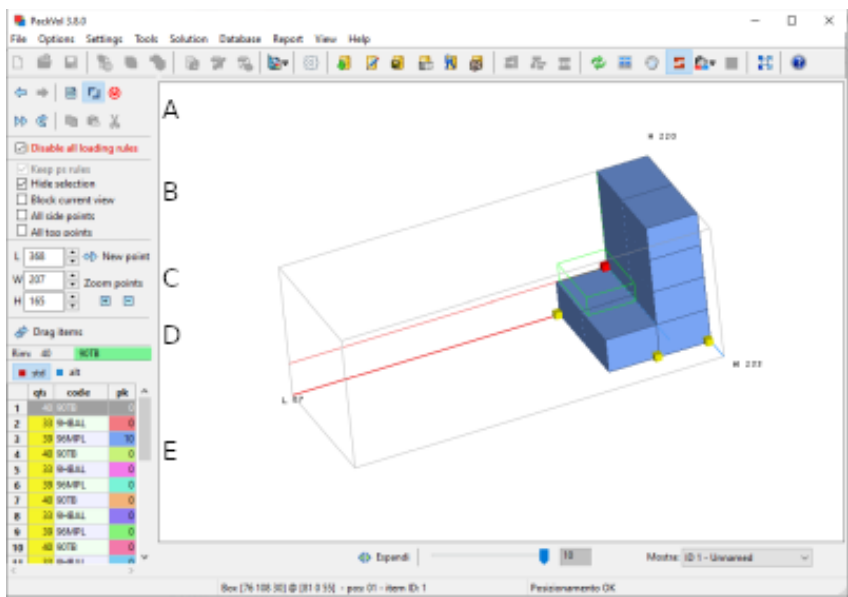
The work environment is formed by: (A) the tools panel, (B) the settings panel, (C) the control point tools, (D) the tool to switch in drag mode, (E) the package list. The visualization area acquires interactive capabilities in response to the mouse input. The toolbox has the usual editing functions of a graphics application. Tools have an associated shortcut which allows to operate directly from the keyboard.

> **packVol** is an optimization program, not a computer graphics application and the operations that you can perform may differ substantially. For example, paste of packages takes place only for those objects that satisfy all constraints and can be repeated only up to the complete loading of a selected item (unless *Don't fix package qty in advance* or *Define a container with unusable spaces* is active).

Insertion mode

The insertion mode is the default mode and allows you to insert / delete packages from the loading plan.

Positioning the package

Packages can be positioned only at points predetermined by the program, called *"control points"*, displayed as small yellow cubes and generated by the program itself. The point in which to insert the package is chosen by clicking on it with the mouse. After selection, the box is displayed with green color if the position is valid, with red color if any rule is violated.

By acting on the Settings it is possible to control the formation of the control points and the application or not of the load rules. The dimension of cubes can be changed using the Zoom in ⊞ and Zoom out ⊟ .

Choosing a package

The package to be placed is selected by clicking on the line displayed in the read-only list on the left. The code of the selected type is shown on a line at the top with a background of the same color as the item and which also shows the number of packages of this type still to be loaded. By clicking on a row, the package positioned at the current control point is shown in the visualization area with orientation the first among those allowed.

	qty	code	pk
1	40	90TB	40
2	33	9HBAL	31
3	39	96MPL	39

Rem: 2 — 9HBAL
■ std ■ alt

Displaying columns

■ std ■ alt   The package list can be displayed via the item code (*std*) or with an alternative listing (*alt*) as set in the Advanced tab of the Preferences dialog.

Rotation

The package can be rotated using the tool ♺ Rotate [R] according to the current Settings while preserving the control point.

Insertion

To load a package, press the tool ▷▷ Insert [SPACE]. After insertion, the package is drawn with solid shape. At the same time the program generates new control points. Whenever the package cannot be placed, the insertion button get disabled. A short message displayed in the right pane of the status bar and in the view of the load shows the reason that prevents the insertion.

> After insertion of a package the program automatically tries to load a package of same type of the last inserted. If these are all loaded, the program chooses the first not loaded package according to the numbering of items in the list. The program also tries, whenever possible, to place a package in a valid position, fulfilling all imposed constraints. In the *Advanced* tab of the Preferences dialog, you can choose if the new package should be placed at lowest possible level (layer packing), or on top of rear columns (wall packing), or in a position as determined by the program itself.

Selection

Selection, necessary for both editing and dragging operations, is made in two distinct ways depending on whether the ▣ Select by region tool [B] is activated or not. Selected packages acquire a light gray color.

Status	Action
Inactive	Selection is done object by object by clicking with the mouse. A second click on a selected package deselects the object.
Active	Selection is performed by "region". By clicking on two different packages, you select all objects belonging to the ideal rectangle having these two as opposite vertexes. This functionality is particularly useful because it allows selection of objects when they are not displayed, or only partially displayed.

The tool ▦ Select All [Ctrl+A]selects all packages. Press the tool *twice* to cancel a selection or hit the background of the visualization area.

Edit

The editing operations ✂ Cut [Ctrl+X], ▤ Copy [Ctrl+C], and ▥ Paste [Ctrl+V] are enabled after selecting packages, if the Hide selection setting has not been activated. The selected objects are displayed with light gray color. After a copy or cut operation, all packages entering the selection are drawn with a yellow wire frame. By clicking the tool ▥ Paste all packages are inserted, starting from the control point, if they respect all the imposed constraints.

Settings

The group settings control the checks performed by the program and some graphics settings.

Option	Action
Disable all rules	Neglects the checks of allowed positions and constraints, except collision between packages and over the boundaries of the container.
Keep ps rules	If the previous choice is active, with this option the program keeps checking of the allowed positions.
Hide selection	Suppresses the wireframe displaying the packages that are copied or cut. This functionality is useful when moving groups of packages ("cut–and–paste") because it immediately shows the position where they are placed but may be annoying if one is interested only in cut operation.

Option	Action
Block current view	Disables rotation of the load view.
All side points	Normally the program generates only one control point per usable space. The option generates side points for all individual packages.
All top points	Normally the program generates only one control point per usable space. The option generates top points for all individual packages.

Custom points

If you have need to place a package in a particular location, not provided by program, you can act in two ways:
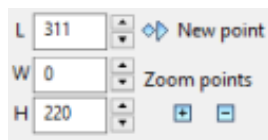
- insert the coordinates of the control point L, W and H in the spin controls and click on the tool ◇▷ New point [N];
- activate the dragging mode.

Dragging mode
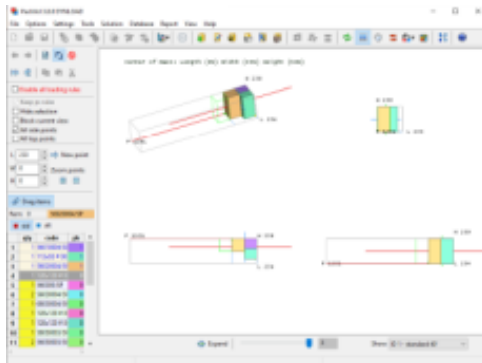
If only one container is displayed, you can activate the 🖽 Drag [D] tool. When pressed, the view is placed on quad-view because dragging is more effective on orthographic views. Selected objects can be moved by holding down the mouse and dragging the selection. In drag mode the constraints are not checked, except for the overlap between objects and over the boundaries of the container.

To restrict the working area to a single container, use the combo box in the *Auxiliary Toolbar* or the contextual menu of the visualization area.
During the manual session you can add a new container to the solution at any time. Open the Container Manager and select it among those registered in the database.

Snap function

While dragging, the selection acquires a yellow color if it can be positioned, red if there is no space to contain it. In the latter case, when the mouse is released, the

program tries to place the selection in the *"closest"* available free space (*"snap"*). This function is useful for positioning packages quickly and precisely.

Table of available tools

⬅ Undo last operation [Ctrl+Z]

➡ Redo last operation [Ctrl+Y]

▦ Select all [Ctrl+A]

◰ Select by region [B]

▷▷ Insert package [SPACE]

↻ Rotate package [R]

▦ Copy selected packages [Ctrl+C]

▤ Paste selected packages [Ctrl+V]

✂ Cut selected packages [Ctrl+X]

⏻ Close working session [Ctrl+Q]

◇▷ New point [N]

⊟⊞ Zoom in/out control points [Ctrl+(+,-)]

⇄ Drag objects [D]

Start from current

packVol allows you to combine automatic and manual modes. One can, for example,

– load some packages manually and then request the positioning of the others automatically;
– edit in manual mode a solution obtained automatically to change the positioning of some packages.

To modify a verified solution while keeping the position of the packages of the current solution unchanged, use Solution → Start from current 🗓 command.

Once the command is activated, the associated tool changes appearance to remind you that the function is active (🗓 , *"recording"*). Cells of the Package Panel become read-only, except for the qty field of the *Dim.* tab and all descriptive fields, which remain editable. The program forces to enter values for qty greater than or equal to those currently reported. You can add containers or item rows without affecting the status of the verified solution.

The starting solution is recorded and kept until the command is deselected. All optimization sessions, both automatic and manual, performed after activation will always start from the solution registered at the beginning.

When deselecting the command 🖥 , if the solution has changed, the program asks whether to accept the new solution or not.

Modify solution

Manual editing is the most common operation and for this reason the interface has the Solution → Modify solution command, which allows you to start manual editing without worrying about activating registration. The command has the two options Keep fixed item qty, which checks that the number of loaded packages does not exceed that entered in the field qty, and Don't fix item qty, which does not limit loading of packages.

Analysis Tools

In addition to tools used to create the load plan documentation, the Report menu also has tools for analyzing the solution. The commands are activated at the end of the calculation, automatic and manual.

Summary Report
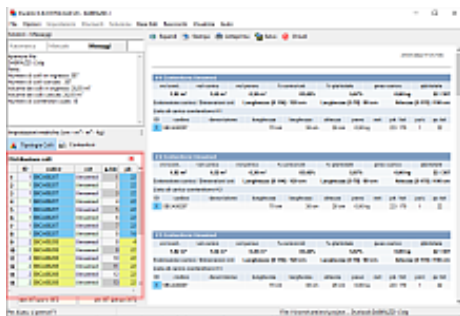
The tool Report → View report activates a window which replaces the load plan view. The new view displays a summary about essential data of the optimization session. The summary can be printed or saved in **html** format for later use and/or integration with other documents. To print or save use the standard commands in the File menu. The commands are active only when this window is open. An auxiliary toolbar allows to perform the same operations.

The report is intended primarily for use on video. For saving optimization data see section Data Export. In the Dynload version, the Package Panel is replaced by a sortable grid, listing the distribution of packages among the containers of the solution.

The panel has a toolbar with the following additional functions:

Command	Description
Expand	Expands the view of the Report to full window
Print	Prints the summary report
Preview	Starts the standard Print preview dialog
Save	Saves the summary report in **html** format
Close	Closes the panel

Measurements

packVol offers two measuring tools that are activated, in case the solution entails multiple containers, if just one container is properly displayed.

Load Distribution

To visualize the longitudinal weight distribution, select the menu command Tool → Weight / Density . The visualization area shows a lateral view of the container.

To define the section to be studied, hold the left mouse button on one of the two red triangular indicators and move the mouse. The section is given by the volume inside the two indicators. The program displays a summary on linear dimension, volume, loaded weight, and density of the section.
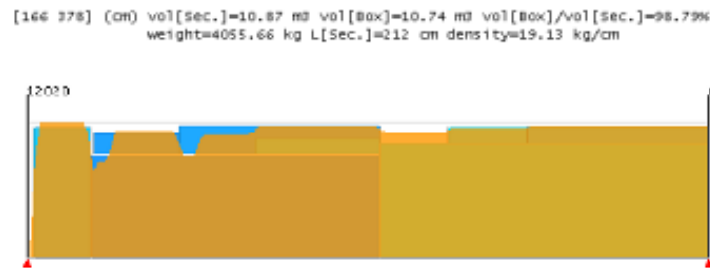
View empty spaces

The tool Report → Measurements → View empty spaces allows you to visualize the empty spaces. To display a space

- Move the mouse over the placeholders. Information is shown on top of screen.
- Double-click on a placeholder to freeze the view of an empty space.
- Double click again to restore selection mode
- Use the "min Dim." text box to control the spaces to visualize.
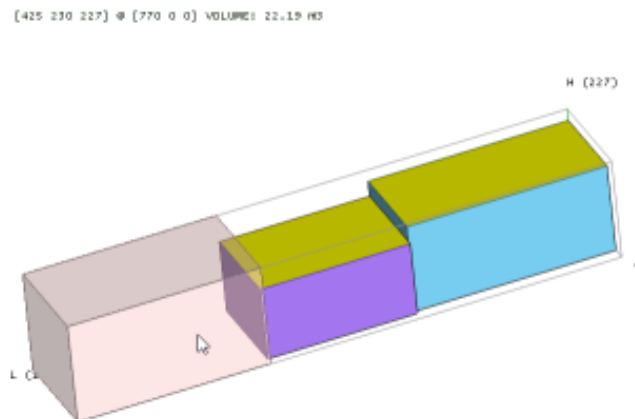
Database and Network

packVol stores data of packages and containers in an internal database and employs the definitions to simplify data entry operations in the Package Panel and Container Panel.

The application also allows the acquisition and storage of data from any external database that supports ODBC protocol. The application has been tested on many systems: Sqlite, Microsoft Access, MySql, Microsoft Sql Server, AS400/DB2, Oracle g. Please refer to the section ODBC Data Exchange for details.

> The internal Database is not needed for proper program operation, and its use is optional. The application does **not** automatically store information on packages or containers of the solution, but instead stores them in the internal Database only when requested by User. The use of the ODBC support is also optional. This last function is not included in the Lite version.

Internal Database

Data are physically stored in the file *packVol.sqlx* of the installation folder for Windows 2000/XP (usually *C:\Program Files\packVol*), or in the application data folder for Windows Vista/7/8/10/11 (usually *C:\ProgramData*). If the file is lost or damaged, a fresh copy can be found in the sub-folder *packRescue* of the installation folder (usually *C:\Program Files\packVol* for Windows 2000/XP, *C:\Program Files(x86)\packVol* for Windows Vista/7/8/10/11).

> By default, the folder *C:\ProgramData* is hidden. To display it, change the folder display settings or enter the address *C:\ProgramData\packVol* in the address bar of Windows Explorer.
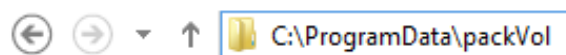
Data Insert

You can populate the **packages** Database by either "saving data" of the solution or through an "automatic import".

> The database manager does not allow duplication of the field *code* (packages) and *name* (containers). In case of manual saving, suitable dialogs help you resolve name collision. During the automatic import, duplicated records are disregarded.

Data saving

The rows selected in the Packages Data Panel can be permanently stored in the

database using the menu command Database → Save items in database 🔲 , or the equivalent Insert row(s) into database command of the *Dim.* grid contextual menu.

For the container use the tool Save 🔲 in the Input Tab of the Container panel.

Database import

Package data can be imported massively by ODBC connection or from Excel files using the Database → Import / Update Database commands.

The Excel layouts for packages and containers are identical to those used for importing master data and containers.

The ODBC tables used are pv_sku, pv_cnt and pv_obs. In case of import, all rows are processed, regardless of the value of the selection index *g_job*.

In both cases, data that refer to number of objects or destinations are not used.
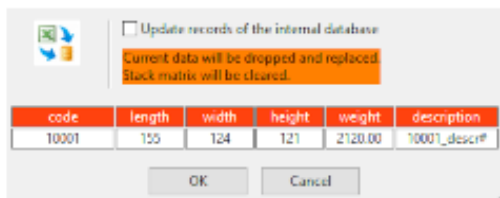
Before starting the operation, a dialog box allows you to specify whether you want to import (*"delete and write"*) or update (*"write or overwrite"*). In both cases the operation cannot be undone. During the operation, the program saves the current database in the backup file *packVol.sqlx.SAVE*. In case you need to restore the old data, delete the file *packVol.sqlx* and rename the backup file using that same name.

Retrieval
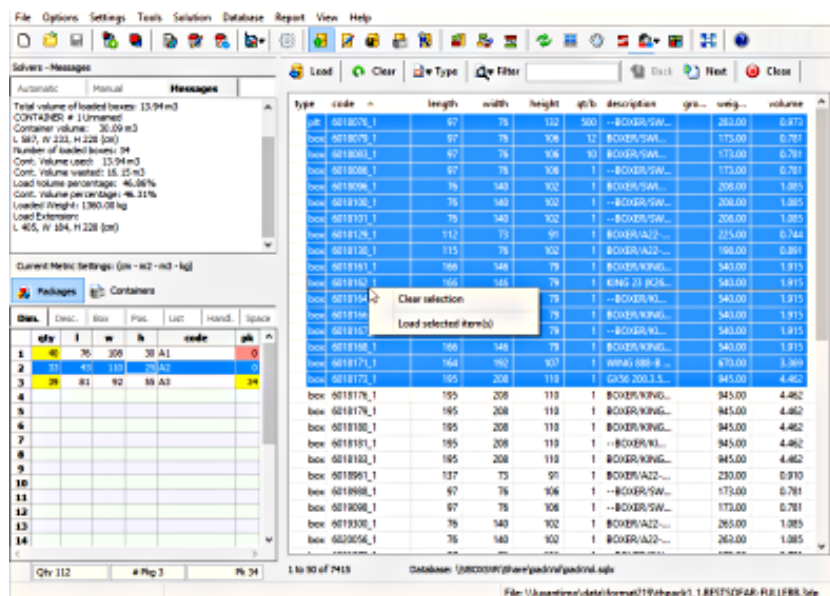
To transfer the package definitions from the database into the Package Panel grids you can use the menu command Database → Package managers → Data retrieval , or the context menu command Add package(s) from database of the *Dim.* grid.

Once opened, the Manager window takes the place of the load view and shows in tabular form all database records. The records can be sorted by clicking on the field labels, which reproduce that of the *Package* tabs. The volume field is displayed for reference and for ordering purposes. The value is automatically evaluated by the program.

To load the data, select the desired rows and click on the Load button, or use the contextual menu as shown in the figure.

The window has an additional toolbar having the following tools:

Command	Description
Load	Appends the selected records to the package grids.
Clear	Clears the current selection.
Type	Displays a menu with which you can isolate records having a stack matrix rule. If the "load by objects" is active, the menu also allows to show only packages of type box and/or type plt.
Back	Displays the previous records.
Next	Displays the next records.
Filter	Displays a menu where you can filter the records according to code or to description. The input string should follow the usual SQL syntax, with % as the wild card character.
Close	Closes the window.

Two commands Next, Back allow you to browse the records. The database can easily store thousands of records, but the manager limits the view to one hundred rows at a time.

Retrieval by code

If you enter the code of a record present in the internal database, as soon as the cursor changes position, the definitions of the item are automatically retrieved from the database and transferred to the *Package Panel*. At this point you need just to enter the number of packages. This function allows you to quickly create the load list, without the need to open the *Package Manager*.

Retrieval by pattern

For the Dynload version, if you enter the name of a registered pattern in an fml cell, the package data is automatically loaded, and the associated container is added to the container list.

Container Manager

The Container Manager allows you to transfer the definitions stored in the database to the Container Panel. The manager is opened with the command Database → Container manager ⛁ . The tool is replicated in the Input Tab of the Containers Panel.

The manager does not have maintenance tools. All records are read-only. Data should be inserted by means of the tool the 🖫 **Save Data**, found in the Current tab.

The dialog shows all registered containers and lists name, dimensions, type and whether it's irregular. You can select a container by clicking on a row of the grid list. When the dialog is active, the visualization area displays a preview of the selected container. The manager has the following tools

Command	Description
🔄 Cancel	Deselects any active line.
📤 Load	Transfers the container data into the Current tab of the Container Panel

Command	Description
Delete	Deletes permanently the selected records.
Close	Closes the dialog.

The Dynload version allows you to filter by primary and secondary containers.

Package maintenance

The maintenance interface is used to insert / modify / delete records of the database and is activated with the menu command Database → Package managers → DB maintenance .
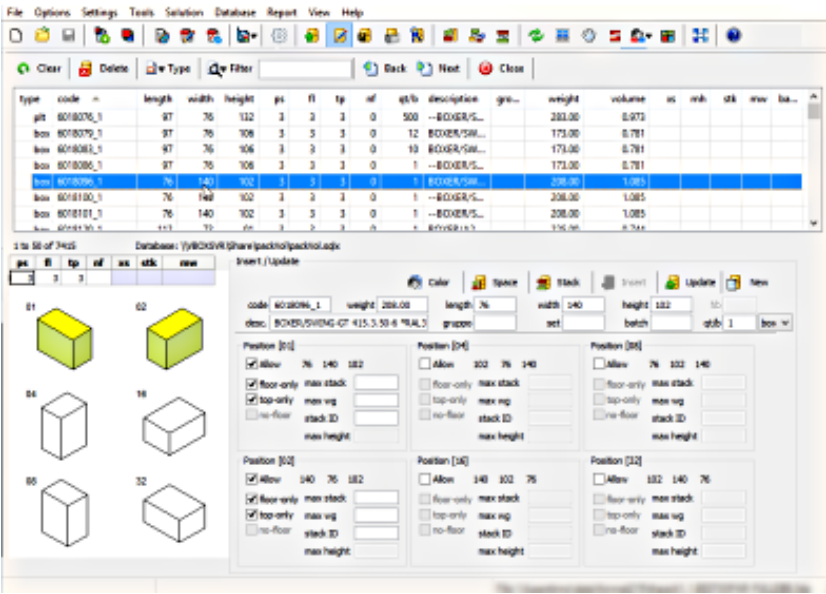
The auxiliary toolbar on top of the list of records have essentially the same tools of the Data Retrieval manager. Only difference:

the tool **Delete** takes the place of the tool **Load** and allows to delete the selected records.

Below the record list a set of suitable input boxes allow insertion of a new record or the update of an existing one. The following list shows association with the fields of the Package Panel tabs.

- code, length, width, height: fields of Dim. Tab.
- desc [, other]: fields of Desc. Tab.
- weight, batch, set, qt/b: fields of Box Tab.

Some tools depend on the version:

Tool	Version	Description
hbase	standard	pallet base, if > 0 and load by object is active, assumes a type *plt* item
plt/mc	dynload	name of the associated container, the ↩ tool opens the Container Manager for name selection.

To set the constraints of the List, Pos., Handl. and Space tabs, the Manager includes a specialized version of Constraint Panel, and a grid

ps	fl	ns	nf	xs	stk	mw
1						

tpl	spL	spP	spH	overh	clm

which reports the numerical value of the imposed constraints. Cells can be edited as a shortcut option.

Above the group of textboxes there is a second toolbar with the following functions:

Command	Description
Color	Assigns the color of the package.
Space	Shows the *Spacing constraints* Panel.
Stack	Opens the Stack Matrix dialog. The dialog, besides all functions of the standard *Stack Matrix* dialog, has two other browsing buttons for navigating through records on the database.
Insert	Inserts a new item into the database.
Update	updates data of a record. All the fields can be changed except the code.
New	Deletes all data entered in text boxes.

Configure Database

The database can be configured with a dedicated dialog, that you open using the command Tools → Configure database . The dialog is formed by four tabbed windows, Authentication, General, ODBC, Local DB.

> In the Windows Vista/7/8/10/11 operating systems, all operations marked with require administrator privileges. To start the program as administrator, right-click on the program icon and select the item *Run as administrator.*

Authentication
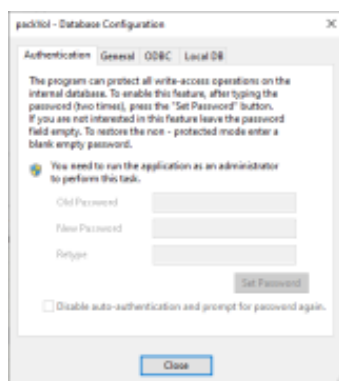
If you input and confirm a password ( ), the access to the database maintenance window and all operations involving changes to the data will become password protected. When you start the program the first time, authentication is disabled. To enable it, enter the password in the first box, confirm it in the second and press the Set Password button ( ). If you activate a password and you wish to return to the non-authenticated mode, simply enter an empty password and press confirm.

Protected operations are:

- management of the internal database, including insertion of new records via the contextual menu of *Dim.* tab;
- updating of the internal Database of data import;
- update/insertion/deletion on container data;
- modification of the ODBC connection start configuration;
- creation of ODBC exchange tables;
- configuration of the generation of automatic reports when saving data;
- change of the read-only status of input data, if this option has been enabled in the tab *General* described below.
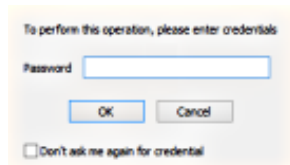
To perform each of those operations, password should be entered in the text field of a simple dialog. Checking the box Remember my credentials for this session, the password will no longer required for the current work session. In case you need to restore the password prompt, open again the tab *Authentication* and check the box Disable auto-authentication and prompt for password again.

General
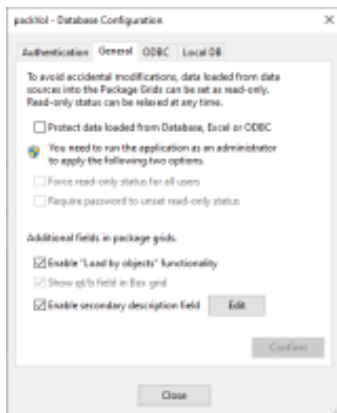
The *General* Tab is used to:
- set the protection options against changes in the imported data;
- enable additional fields in the *Package Panel*.
To make the changes operational, click on Confirm before closing the dialog or changing tab.

Protect data loaded from Database, Excel or ODBC	The data of containers and packages can be modified at any time by editing the input controls. When checked, the option prevents modification of the imported data imported from data sources. This feature is intended to prevent accidental changes.
Force read-only status for all users	The command sets the read-only status for all Users accessing the program.
Require password to unset read-only status	Read-only status can be eliminated at any time using the command Settings → Cancel read-only status. When checked, the command can be executed only if User has administrator privileges.
Enable secondary description field	Displays the optional description in the Description Grid. The values are used only to format the reports.
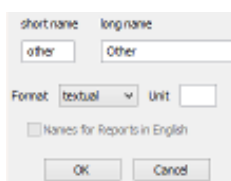
The command Edit allows you to configure the properties of the descriptive secondary field: format (textual, numeric or listings) and labels, both for the current interface language and for English reports. In the case of a numeric format the total value of the field is reported in the reports generated by the application.

For the Standard version there are two further fields

Enable "load by objects"	Enables the load by objects functionality.
Show qt/b field in Box grid	Displays the qt/b column as a purely descriptive field.

ODBC
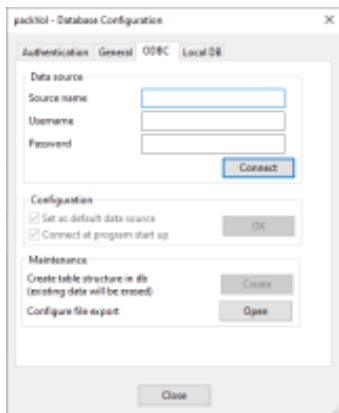
The tab allows you to configure the connection to any external database that supports the ODBC protocol. It consists of three control groups, for the connection, for the connection start options and for the creation of exchange tables and saving options. This single window can also be opened with the menu command Database → Manage ODBC Connection, which is always available, even in case password protection is enabled.

Datasource	In the text box you enter the name of the Data Source (DSN).
Username	In the text box you enter the username for connecting, if necessary.
Password	In the text box you enter the username for connecting, if necessary.
Connect	Establishes the connection to the Data Source. If the operation is successful, the button shows the label Disconnect and can be used to disconnect from the data source.
Set as default data source	Allows to register the DSN as the default and to fill the text boxes with the data required for connection at start-up.
Connect at program start up	Establishes the connection to the data source at start-up, without need for further intervention by the User.
Create	The button is used to create the exchange tables. See the section ODBC Tables for details. The operation should be done the first time only. The action leads to the deletion of the tables if they are already present.
Open	Opens the dialog where you can set up the reports creation when the ODBC data is exported. The configuration is described in the section ODBC Export.

Local DB
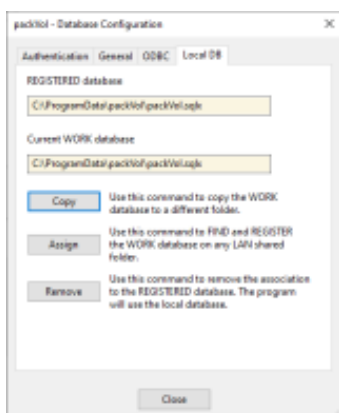
The fourth panel allows you to operate backup copies of the local database and to force the loading of a Database from a location other than the predefined one. This second operation, as described in the section Sharing the Database, allows the sharing of a local LAN network among users.

Copy DB	Allows you to copy the database currently in use, if available, in a different folder.
Assign	Allows you to assign the database to be used in the current session and all next openings of the program.
Clear	Removes the association for the recorded database and restores loading the database of the original installation.
REGISTERED Database	The text reports the registered database for loading at the start or the message *No database registered* in case of loading of the predefined database. If the registered database is not accessible, the message *[ERROR]* will appear.
WORKING Database	The text reports the address of the currently loaded database or the message *No database loaded* in case of error during the loading.

Error Management

If for any reason the database is no more accessible, the program displays a dialog allowing you correct the problem. You can undertake the following actions:

- **Connect to a different work database**, opens the Local DB tab to register a different database;
- **Use the database of the local installation**, temporarily removes the registered association;
- **Continue without database support**.

The first two options may require administrator privileges to be accepted. The last option does not require password.

Sharing the database

packVol can be installed on a local folder of a client PC but can be configured to use a network shared database. We consider the case where you have installed the program on various LAN connected PCs.

To share the database, follow these steps:

1) Run the program from any PC and open the Configure Database dialog (Database → Configure database → Local DB). Press the button Copy and copy the database on a shared folder at your choice. A standard dialog will help you find the folder or to create a new folder. The folder must have **read and write permissions**.

2) Click on the button Assign, find the previous shared folder and select the file packVol.sqlx.

3) Repeat the previous step 2) from all other installations.

ODBC Data Exchange

The program can retrieve package and container data from any external database with support for the ODBC protocol. As an example of how to set up the feature we consider the case Microsoft Access. After creating a blank database, open the ODBC Data Sources control panel (Start → Administrative Tools → Data Sources (ODBC)). Press the button Add and click MS Access Driver. Enter a name for the DSN, say *pvDATA*, and select the file you have just created.

> On Windows Vista/7/8/10 64-bit /11, to properly register the data origin, it may be necessary to open the 32-bit DSN management program.

Once **packVol** has started, open the configuration dialog using the command Tools → Configure Database , choose the Configure ODBC tab and establish the connection.

After the connection is established, click on Create to create the exchange tables. At this point you can populate the Access Database following the format of the tables. Populate the table pv_job, assigning a positive progressive value to the *ID* primary key and setting g_status equal to zero

> In the installation folder you find a MS Access database called pvDLL.mdb that can be used for testing purposes. The database contains data of a real example that can thus be taken as reference.

Jobs List

The application uses the table pv_job as a list of possible load plans (or "jobs") to be optimized. In this way, the program can be used concurrently by different users or workstations. Through the menu command Database → Manage ODBC Import, a
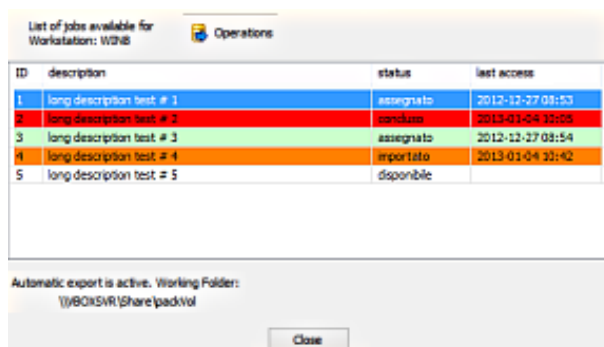
dialog window opens that displays the list of jobs registered in the external Database, with fields that faithfully reproduce those contained in the table pv_job.

The rows are colored according to the following Color key

status	color	description
assigned	green	job already imported yet to be optimized.
imported	orange	job currently imported.
completed	red	job set in the completed state (automatically set in case of export).
available	white	job never imported.

The Operations button (or the contextual menu) allows you to

1) mark a job as *completed* even without the export;
2) restore the previous state (from *completed* to *assigned* or from *assigned* to *available*);

> In case the file is saved, the information on data source of the imported job is preserved. You can mark a job as completed only if said job is currently loaded (in other words, only an "orange" row can be marked as "red"). Data can be loaded through ODBC or through the opening of a file that was previously saved. The program does **not** check whether the optimization has been performed and/or if the pdf report has been generated.

Share on LAN

Remote Desktop

The program has been tested for use by Remote Desktop and with Terminal Server services. It has also been verified to work properly in Linux and Mac OS X with WINE emulator and with CodeWarrior.

Sharing the Program

In this note we assume the program **packVol** has been installed in the folder C:\Test\packVol with computer name \\NAMESERVER.

> The default installation folders are
> C:\Programs\packVol (Windows 2000/XP/Vista/7/8/10 32-bit),
> C:\Program Files(x86)\packVol (Windows Vista/7/8/10 64-bit /11).

To share the program, follow these steps:

1) Share the installation folder C:\Test\packVol on the SERVER, say with name packVol. **Do not alter any permission**.

2) Share the data folder C:\ProgramData\packVol on the SERVER, say with name packVoData, or create a folder for sharing the database. Make sure that Users have **read and write permissions** on the shared folder, otherwise the program will generate errors on all database operations which require write privileges.

3) From the CLIENT PC, open Explorer clicking on *"My Network Places"* and find the shared folder (in the address bar should appear the address \\NAMESERVER\packVol). Open the folder, right-click on the executable packVol.exe and click *"Send to Desktop (create shortcut)"*.

4) Run **packVol** by double-clicking on the newly created shortcut. In case you get the error message Database not found, choose the option Connect to a different work database and skip to point 6).

5) Once the program is running, open the *Configure Database* dialog (Tools → Configure Database → Local DB).

6) Click on the button Assign and find the data folder packVolData on the SERVER. Select the file packVol.sqlx and press OK.

If you open the database, (Tools → Open Package Manager → Data Retrieval), the Database: label will report the path \NAMESERVER\packVolData\packVol.sqlx.

Data Import

Import Data from Excel

packVol offers a complete set of functions for importing data via Excel in native file format **xls** (Excel 97/2000/XP) or **xlsx** (Excel 2007/2010). Import commands can be found in the menu File.
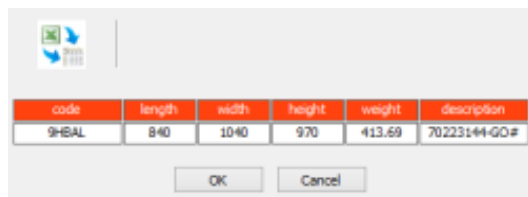
When you use import commands, prior the opening of the Excel file an auxiliary window allows you to quickly check the correctness of the data to be imported. The step can be skipped by setting the option Don't show row preview on Excel (ODBC) import in the Preferences Dialog.

Import master data

The command File → Import (Excel) → Import Master Data [Ctrl+Shift+M] imports in the data tabs the full definitions of the package types. The import layout is fixed.

> In order not to have to distinguish between input and output Excel files, the program acquires data only from the first sheet of the Excel file. Next sheets are ignored.
> The installation does not provide sample files as creating a template is a straightforward process. Open the program, Click on **File → Export (Excel)**. A file is created with complete headers that can be used to create the file to be imported.
> If the file is generated by the export of the database, the AK - BI columns have additional data. These fields are not intended for editing.

Import by code

The command File → Import (Excel) → Import by code [Ctrl+Shift+Q] allows you to create the load list with minimum effort from the data stored in the database. In Excel file you can define only two columns: the first (A) with the package code as stored in the database, the second (B) with the number of packages. Optionally,

you can also set the values that are not stored in the internal Database. See import layout for formatting file data.

While reading the file, the program selects in the Database the record with the code assigned in column **A**. If the record exists, the program retrieves the data and sets the quantity as assigned in column **B**.

Import containers

The command File → Import container allows to import the list of containers. In the Excel file format, you can define both the dimensions of the container, and of the possible unusable spaces.

Import via ODBC
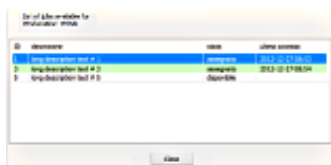
To use the function, a data origin should be registered, configured and populated as described in the section ODBC Data Exchange. To import, click on the menu command File → Import (ODBC) [Ctrl+Shift+O] and select the desired job in the Jobs list dialog window. This dialogue is the same as the one described in the Jobs List section, but with disabled management functions.

Copy and paste via Clipboard

You can "Copy to" / "Paste from" the Clipboard all row data of the Package Panel. To copy data from the program and paste it into an external application

1) in any of the *Data Panel* grids, select the lines you need to copy;
2) click on **File → Copy to clipboard [Ctrl+C]** or select the *Dim.* grid and use the contextual menu;
3) paste in the external application (usually with the key combination **[Ctrl+V]**)

To copy data from an external application and paste it into the program

1) in the external application format the file using the tab character (**Tab** key) as data separator, using the same data sequence as reported in the Excel master data or code/quantity format;

2) in the external program, copy the data (usually with the combination **[Ctrl+C]**);

3) from **packVol** click on **File** → **Paste from clipboard [Ctrl+V]** or use the contextual menu if the *Dim.* tab is active.
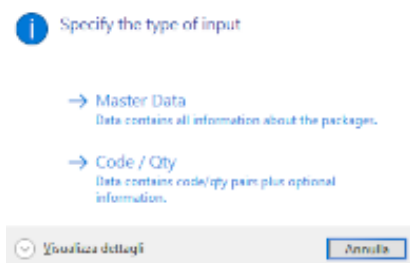
The program automatically loads the data based on the number of columns and the layout of pasted data. If the application is not able to interpret the input, a dialog is shown for choosing the type of import. Inconsistent lines are ignored.

Standard/Lite features

Load by objects

"Load by objects" is a form of implicit palletizing used by the Standard and Lite versions and is activated by checking the Enable "load by objects" checkbox in the

– *General* tab of the database configuration dialog, Standard version;
– *Data Options* section of the Preferences dialog, Lite version.

When the function is activated the Box tab shows the additional field qt/b which shows the number of objects that make up the package and, optionally, the number of objects per layer. In fact, the program provides the possibility that each package can be filled with objects, of unspecified shape, in a maximum number per package equal to the value entered for qt/b and to force the creation of the number of packages by modular division between the quantity of incoming items and the number of items per package.

> The format of the qt/b field is <number per layer|>number of objects, for example qt/b=4|12, qt/b=16. The default is qt/b=1 which disables the function.

The records with qt/b≠1 are then divided into records of type *box* (default) and *plt* and an additional parameter hbase can be associated with the latter. The distinction is applied in the creation of packages and must be imposed according to the data entry procedure.

Database

In the Package manager the type is chosen from the drop-down menu, validating the qt/b field and, if necessary, the hbase field.

Excel Import

The F (qt/b) and AD columns should be used. If the AD field is empty and the F field does not carry any layer information the type is *box*, otherwise the type is *plt* and the AD value is associated with hbase

ODBC Import

The *g_qtb* and *g_btype* fields must be used with the same rules seen for Excel import.

On import, the number of packages is deducted by division. The following example illustrates the logic applied to the incoming data

qty	code	dimensions	weight	qt/b	(type)	hbase
14	BOX	120 x 80 x 180	240.00	8	box	
18	PLT	120 x 80 x 180	240.00	4|12	plt	15

Two lines are created for the BOX package, with the same dimensions and different weight, and two lines for the PLT package, different in weight and height

qty	code	dimensions	weight	qt/b
1	BOX	120 x 80 x 180	240.00	8

qty	code	dimensions	weight	qt/b
1	BOX	120 x 80 x 180	180.00	6
1	PLT	120 x 80 x 195	240.00	4|12
1	PLT	120 x 80 x 75	80.00	4|4

> When the package definitions are transferred from the internal database, either through the Package Manager or by entering the code, the data is passed to a mask in which you enter the number of objects to be loaded, so that the program can proceed with the formation of the list of packages. After the load list has been created, the **qt/b** parameter remains purely descriptive and is no longer used.

Dynload version features

Two-stage loading
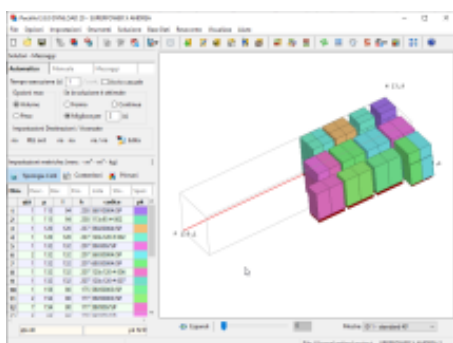
The Dynload version can convert the containers of the solution, obtained both manually and automatically, into actual packages to be optimized in additional containers. This feature responds to a commonly used scheme, which requires a *"first stage"* where the packages are loaded into containers ("primary" in the program terminology, for example boxes on pallets), and a subsequent *"second stage"* in which these are further loaded into larger containers ("secondary" in the terminology of the program, for example pallets on trucks).

The conversion is done with the Solution → Convert → Convert to package command or with the associated tool ⬛ . After the conversion, the *Primary* tab is activated, and the display of the converted packages is maintained. Packages left on the ground or excluded from the calculation are not displayed.

The two commands are changed to Solution → Convert → Cancel conversion (⬛) and allow you to return to the first stage.

> If you cancel the conversion after running the second optimization step, the solution is lost. Upon rollback, the program asks to save the solution and proposes a new name to save the data that would be otherwise lost.

Patterns

The program allows you to maintain a single reference solution as a palletization
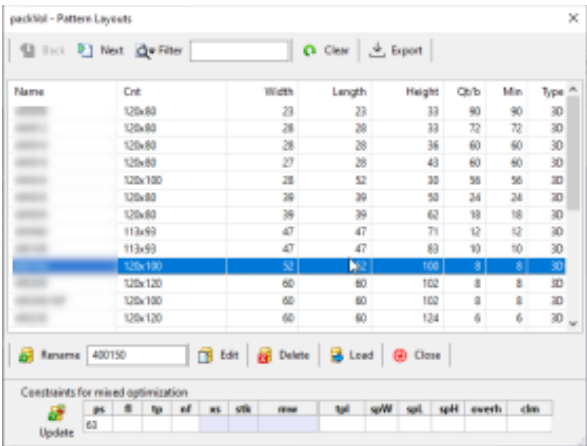
scheme ("*pattern*") and to use information about geometry and quantity during automatic optimization. Normally the pattern is built in manual session, reproducing a known scheme, for example that of an automatic palletizer.

To save a pattern, you can use the contextual menu of the visualization area by pressing the Save cnt # as pattern item or the menu command Solution → Convert → Save as pattern. In the latter case, the conversion takes place for the containers selected in the Output tab. If there is no selection, the current container is converted, if any, otherwise the conversion is performed for all single-reference containers entering the solution.

In the dialog box that appears, enter the name of the pattern and, optionally, the minimum number of objects to consider the schema valid. If the pattern name already exists, a dialog allows you to resolve the collision.

Pattern manager

The Pattern manager reports the list of registered models, indicating name, associated container, object size, number of objects in the schema, minimum number of objects to keep the schema valid, pattern type (always "3D").

To open the Pattern manager, use the command Database → Package manager → Pattern maintenance ⬚ . Once a model is selected, the view of the load is replaced by a preview of the palletizing scheme. In addition to the usual navigation and filtering tools, the manager has the following tools

Command	Description
↻ Cancel	Deselects any active line.
↓ Export	Exports selected patterns, or all patterns if no lines are selected, to **xml** file.

	Command	Description
	Rename	Allows you to change the name of the pattern, which must be entered in the sided text box.
	Edit	Imports the pattern as a solution for a possible modification.
	Delete	Deletes the pattern(s) from the database.
	Load	Transfers pattern data to the Data Panel, updating the Packages and Containers tabs accordingly.
	Close	Closes the dialog box.

The dialog optionally allows you to define the rules for loading the object of the pattern when it is not palletized. To assign them, after having edited the two constraint grids, which replicate those of the Package manager, press the tool ⏚ . The ability to assign rules is present because a pattern is independent and is not associated with any package registered in the database. In the absence of an item code, this happens for example with the command Load, the program has no way of associating rules for the constraints. On the other hand, when the pattern is associated with an existing package in the database, this happens for example during import where you can set both the item code and the pattern, the rules of the registered package take precedence over those of the pattern.

Two-stage load settings

The dialog, in addition to a self-explanatory error handling section for incorrect or missing patterns, allows, with the option ".. set the height ..", to adapt the height of the primary container to the height of the secondary container in which the object will be placed. The option can be applied if secondary container has been defined in the Current tab.

Reports and Saving data

Saving on File

The work session can be saved at any time in a file, with extension **3dp** using the File → Save 💾 and File → Save as commands. In addition to these two standard commands, the program offers the possibility to save partial with the command File → Save partial data and Solution → Container selection → Save selected. The Dynload and integrable versions also support an **xml** interchange file.

Save Summary Report

The Summary report (see section) is intended primarily for on-screen use. It can nevertheless be saved in the **html** format, using the command File → Save summary.

Load plan in PDF format

packVol generates documentation on the load plan in **pdf** format, with automatic procedures, started by the User or by the program itself, or with a manual procedure. The commands are found in the menu Report → Load plan in pdf format and are enabled for optimized solutions only.

> Some formatting options are present on the Report of the Preference dialog, as they are fixed once.
> Please note that if the file that you want to save is in use by another program, such as Adobe Reader, saving the file may fail. When creating the **pdf** file, a dialog freezes any input. The operation cannot be interrupted.

Document formatting

There are many ways to format documentation; the main formatting parameters are shown below.

List Options

Summary list	When selected, in addition to the load list for each container, the program generates a summary list with the distribution of packages between the various containers of the solution.
Unique code	The program allows the code to be duplicated in the load list. The option forces the program to group together types with identical code into a single actual type, recalculating the totals in the output list.

Layout

The Layout sets the type and number of views to be generated. The layouts are divided into dynamics, with a variable number of views, and statics, with a fixed number of views. For dynamic layouts, the number of views is controlled in the set of options Load instructions/Number of views.

single view [dynamic]
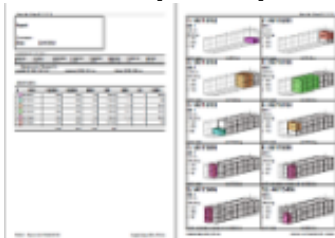
A sequence of views of the position is displayed from a single angle. The figure shows the option "Print loading instructions".

duo view [dynamic]
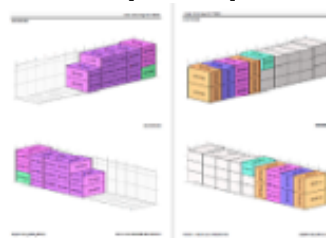
The same sequence of views of the single layout is shown from two opposite angles. The figure shows the document with the option "view by sections".

quad view [dynamic]
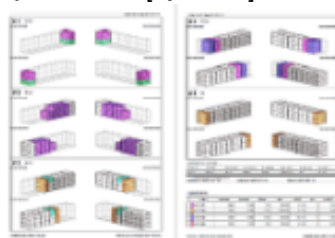
The same sequence of views of the single layout is shown from four opposite angles. The figure shows the print option without positioning instructions.

planar layout [static]
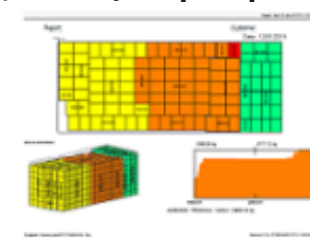
A single view from above is generated, with progressive numbering of the stacked packages. The layout shows the summary view and the load distribution.

simple layout [static]

Two summary views are generated from opposite angles. General information and load list, if possible, are concentrated on a single page.

level layout [static]

Displays a sequence of views from above formed by horizontal sections. Stacked identical packages are grouped in columns.

layer layout [static] 	Like the previous one, but each layer consists of a single package. Identical stacked items are not grouped.

The group displays also other drawing options

drawing style	
color and text	The package is rendered with color and displays item code.
text only	The package is rendered with color but does not display item code.
color only	The package displays item code but is rendered in gray.
blank style	The package is rendered in gray and does not display item code.

Single box label	For drawing clarity, the code is associated, where possible, with blocks of identical packages. This option forces displaying of the code on every package.
Plan on new page	If the option is selected, the sequence of views begins on a new page, otherwise begins immediately after the load list.

Loading Instructions / Number of Views

The group is active only for dynamic layouts and allows you to control the number of views and their presentation. The most important option is **Simple view by sections of the load**. When the option is checked, the group displays only two active controls

Simple view by sections of the load [active]	The views are drawn by splitting the load in longitudinal sections.
Nr of view sections	Here you enter the number of sections, from one (equivalent to the *simple layout*) up to a maximum number determined by the program.

When **Simple view by sections of the load** is inactive, the views are created by displaying a sequence of blocks of identical packages, to have an effective description of the load positioning sequence. In this case, the group of controls provide a greater number of options.

Nr of steps per view	Number of blocks to be included in the same view. Varies from one to four.
block size	The combo box is used to set the size of the blocks. Options are *small*, *medium* and *large*.
Print loading instructions	If selected, for each block the document reports a summary of weight and volume of the block, orientation of the package, position and extent of the block.

block size is a useful parameter only when the load plan is formed by a small number of different items but a large number of packages. In this case, it may happen that the load plan is formed by a small number of large blocks. The user can choose whether to display them in full, or whether to use the view for small blocks to respect the load positioning sequence.

Sequence order

The group is enabled only for dynamic layouts and makes it possible to choose the order of the views, regardless of the option selected during the optimization.

Sequence	description
Container default sequence	The views are shown according to the current choice of the Load combo-box.
Rear-Front sequence	The views are shown according to the rear-front sequence.
Bottom-Top sequence	The views are shown according to the bottom-top sequence.

Destinations

The group is active only when you employ the ds parameter.

option	description
Print destinations	Adds to the report the list of destinations ds. The descriptions are taken from Destination Grid.
Use ds color	The package is rendered with the color assigned to the destination.

Document Header

The various options let you customize the headings in the document.

option	description
Print manifest header	Prints the two text fields and the date of the document. The labels of the text fields can be customized in the Report tab of the Preferences dialog. If data is imported via ODBC, the strings can be imported from the fields g_desc, g_rif and g_date of pv_job table.
With image logo	Prints on the document the Company logo, which can be customized in the Report tab of the Preferences dialog.
Logo on all pages	When checked, the logo is printed on all pages, otherwise only on the first.
Show page header	Includes the header line with the date of creation.
Show page footer	Includes the footer line with application name and **3dp** filename.

Automatic Export
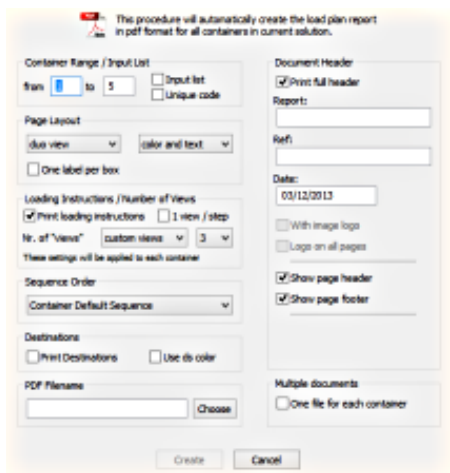
The command Report → Export Load Plan in pdf format [Ctrl+E] allows you to automate creation of the report. Beside the standard groups of controls, the dialog has tools to be used in the case of multi-container solutions.

Container Range allows to limit the range of containers to be included into the report;

One file for each container breaks the report into multiple files, one for each container. The file names are created by adding to the name chosen by User a progressive suffix.

Manual procedure

The manual procedure is started with the command Report → Load Plan in pdf format → Manual creation and allows the User to choose in real time the layout and to acquire partial views of the load as desired in case of dynamic layout. When it opens, the window takes up all the available space, with a panel on the left that contains controls used to define the Layout. The toolbar is replaced by a specialized toolbar. Under the toolbar there are fields used for headers and date formatting. In case of a solution with multiple containers, to start the creation you need to first select the container you are interested in from the drop-down menu of the Auxiliary Toolbar.

Command	Description
Auto	Automatically generates the report given the current layout settings.
Back	Removes pictures from the visualization.
Next	Adds pictures from the visualization.
Snap	Creates a partial view ("snapshot"). The partial views are added to the report.
5 ▾	The drop-down menu shows the list of partial views, which can be large in number for complex solutions. By selecting a number, all views up to said number are automatically displayed. This way, you can quickly create the relation without having to go through the Next and Back commands.
Cancel	Destroys the snapshots and restarts the procedure.
Save	saves the report in **pdf** format.
Close	Closes the panel.
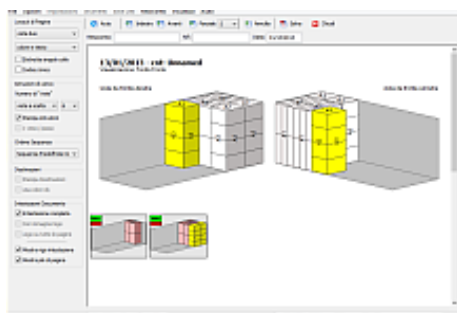
No other action is necessary for static layouts. For dynamic ones, the two Next and Back buttons are used to add / delete partial views to current view. The Snap command adds the view to the Load Plan document. The captured visuals are briefly reported under the work view as a reminder. You can save the document at any time, there is no need to complete the process.

Excel Export

Work data can be exported onto Excel files at any time, using the menu command File → Export (Excel). The available format is xls or xlsx, as desired. The generated file contains only one sheet, if non-optimized data is being exported, or multiple sheets in case of verified solutions.

First sheet

First sheet always contains the input data formatted according to master data format so that you do not have to distinguish between input and output file.

Second sheet

Second sheet contains general information on the load list

col.	header	description
A	**Cont. Nr**	Container Index, it follows the numbering of the Output Tab. For all items not loaded, the program uses a fictitious container with index 0. Cells of these items are rendered with yellow background.
B	**ID**	Item ID. The values follow the numbering of the Package Panel.
C	**Loaded**	Number of items **ID** loaded into container **Cont. Nr**.
D	**Total**	Quantity of items.
E	**Length**	Package length.
F	**Width**	Package width.
G	**Height**	Package height.
H	**Weight**	Package weight.
I	**Code**	Package code.
J	**Desc.**	Description of the package.
K	**Qt/b**	"number of objects".

Following sheets

The program creates one sheet for each optimized container that enters the solution. Each sheet contains four sections

1) summary data of volume / weight occupancy;

2) container load list with the following fields

col.	header	description
A	**Cont. Nr**	Container index, identical for all rows and equal to the number of the sheet name. The value follows the numbering of the Output Tab.
B	**ID**	Item ID. The values follow the numbering of the Package Panel.
C	**Loaded**	Number of items **ID** loaded into the container.
D	**Quantity**	Quantity of items.
E	**Length**	Package length.
F	**Width**	Package width.
G	**Height**	Package height.
H	**Weight**	Package weight.
I	**Code**	Package Code.

3) load plan summary image

4) list of geometric positioning information as per the following table

col.	header	description
A	**ID**	Item ID. The values follow the numbering of the Package Panel.

col.	header	description
B	**pos**	position of the item according to the application encoding.
C	**vert L**	length "low" coordinate.
D	**vert W**	width "low" coordinate.
E	**vert H**	height "low" coordinate.
F	**side L**	length side.
G	**side W**	width side.
H	**side H**	height side.

ODBC Export

The command File → Export (ODBC) [Ctrl+Shift+S] exports the solution data to the external data source, using the exchange tables as described in the ODBC Tables section. You can enable the automatic creation of report files during export by configuring the dialog opened by pressing the Open button of the ODBC Tab in the configuration window Database → Configure database 🔧 .

The dialog has the following groups of controls
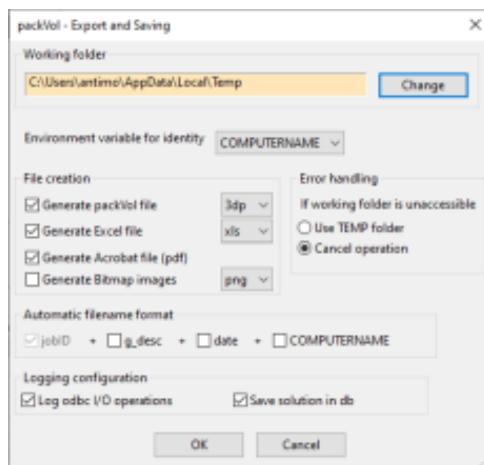
Working folder: the command Change allows you to choose a job folder where the program can create the files. The program must have write permission on this folder.

Environment variable for identity: allows you to choose the environment variable %COMPUTERNAME% or %USERNAME% when registering in pv_job.g_userID field the export operation.

File creation: the set of options carries a list of the various type of files that can be exported. Check an item to enable the creation of the corresponding file. Deselect all the options if you do not want to use the automatic export.

Automatic filename format: the file name is assigned by the program by combining the fields of the group. The box g_desc refers to the field of the table pv_job.

Error Handling: the set of options allows you to define the behavior of the program when the working folder is not accessible.

Logging configuration: the controls allow you to save the solution in the database (pv_job.g_sersol field) and to enable ODBC operation logging. If the latter is active, the ~pvODBC_import.log, ~pvODBC_export.log and ~pvODBC_tables.log files for recording import, export and table creation operations are created in the User's temporary folder.

Excel import layouts

Master Data layout

The format of the Excel file, with or without header row at your choice, is described in the following table.

col.	type	description	value	tab
A	integer	number of packages	integer ≥ 0	Dim.
B	integer	package length	integer > 0	Dim.
C	integer	package width	integer > 0	Dim.
D	integer	package height	integer > 0	Dim.
E	text	alphanumeric code (primary key in the case of import into internal database)	text	Dim.
F	integer	number of "objects" per package	integer > 0, [1,default]	Box
G	float	package weight	float ≥ 0 [0, default]	Box
H	text	description	text	Desc.
I	integer / text	destination index or name; the zero value or the empty cell excludes the constraint	[0,default]	List
J	integer	allowed positions; for empty cell, the value is taken from the default as set in the Preferences	[1-63], [3,default]	Pos.
K	integer	floor only; the zero value or the empty cell excludes the constraint	[0-63], [0,default]	Pos.
L	integer	top-only; the zero value or the empty cell excludes the constraint	[0-63], [0,default]	Pos.
M	integer	not at floor; the zero value or the empty cell excludes the constraint	[0-63], [0,default]	Pos.
N	integer	max stacking; the zero value or the empty cell excludes the constraint. The value is global and applies to all sides	integer ≥ 0, [0,default]	Pos.
O	integer	stack index; the zero value or the empty cell excludes the constraint. The value is global and applies to all sides	integer ≥ 0, [0,default]	List
P	float	max bearing weight; the zero value or the empty cell excludes the constraint. The value is global and applies to all sides	float ≥ 0, [0,default]	Pos.
Q	integer	minimum number; the zero value or the empty cell excludes the constraint	integer ≥ 0, [0,default]	List

col.	type	description	value	tab
R	integer	batch; the zero value or the empty cell excludes the constraint	integer ≥ 0, [0,default]	Box
S	text	set load alphanumeric label. Packages of a set group must have the same non-blank label	[' ',default]	Box
T	integer	matching code; the zero value or the empty cell excludes the constraint	integer ≥ 0, [0,default]	List
U	integer	forklift handling	[0-63], [0,default]	Handl.
V	integer	columnar order	[0-7], [0,default]	Handl.
W	integer	max overhang; the zero value or the empty cell excludes the constraint	[-1,default]	Handl.
X	integer	empty space, length side	[0,default]	Space
Y	integer	empty space, width side	[0,default]	Space
Z	integer	empty space, height side (spH ≥ 0) or absolute reference (spH < 0)	[0,default]	Space
AA	integer	max height; the zero value or the empty cell excludes the constraint	integer ≥ 0, [0,default]	Pos.
AB	integer	package color (black=0, white=255255255); a negative value or the empty cell assigns a random color	[-1,default]	Desc.
AC	text	optional description	text	Desc.
AD	integer	type *box* [0] or base height for type *plt* if $>$ 0	[0,default]	
AE	text	reserved		
AF	integer	max depth	[-1,default]	Handl.

Code / quantity layout

The data layout of the Excel file, which may or may not show the header row, requires only the first two fields. The others, optional, are used to validate fields that are not in the database or to replace them.

col.	type	description	value	tab
A	text	**code** as stored in the internal database.		Dim.
B	integer	number of packages	integer ≥ 0	Dim.
C	integer	destination	integer ≥ 0	List

col.	type	description	value	tab
D	integer	minimum number	integer ≥ 0	Box
E	integer	stack index. The value is global and applies to all sides	integer ≥ 0	List
F	integer	container "matching code"	integer ≥ 0	List

Dynload additional fields

col.	type	description	value	tab
J	text	family [optional]		Box.
K	integer	number of objects per package [optional]	integer > 0	Box.

Stack matrix layout

The first four fields of the Excel file layout, which may or may not contain the header row, are required. The optional E field has the same meaning as the *g_status* field of the pv_stack table to which we refer.

col.	type	description	value	tab
A	text	lower item code		
B	text	upper item code		
C	integer	position [1-63] of the lower item	integer > 0	
D	integer	position [1-63] of the upper item	integer > 0	
E	integer	control variable, optional		

Container data layout

col.	type	description	value
A	text	row identifier, container [cnt] or unusable space [rect, bbox]	[cnt, rect, bbox]
B	integer	length "low" coordinate	integer ≥ 0
C	integer	width "low" coordinate	integer ≥ 0
D	integer	height "low" coordinate	integer ≥ 0
E	integer	length [cnt,rect] or "high" length coordinate [bbox]	integer > 0
F	integer	width [cnt,rect] or "high" width coordinate [bbox]	integer > 0
G	integer	height [cnt,rect] or "high" height coordinate [bbox]	integer > 0
H	text	container name (only for [cnt] rows)	text
I	float	max load (only for [cnt] rows)	float

col.	type	description	value
J	integer	default max overhang parameter (only for [cnt] rows)	integer [0-49]
K	integer	preferred loading sequence, rear-front [0], bottom-top [1], layer-front [2] (only for [cnt] rows)	integer
L	integer	number of containers.	integer

Dynload additional fields

col.	type	description	value
M	text	container type	[box, plt]
N	integer	base height	integer ≥ 0
O	float	tare weight of the container	float

Column A must bear the row label. Possible values are:

value	description
cnt	Container row. Columns B, C, D should be set to zero. In columns E, F, G you enter the internal dimensions of the container.
rect	Unusable space row. Columns B, C, D are the "low" coordinates, E, F, G are the edges.
bbox	Unusable space row. Columns B, C, D are the "low" coordinates, E, F, G are the "high" coordinates.

Other columns are validated when exporting from the database. The Dynload version uses the *rule* label to hold information about primary containers. This data is not intended for modification and is not documented.

The rear of the container is assumed near the origin of the axes. Please take this convention into account when defining a container with unusable spaces.

Example
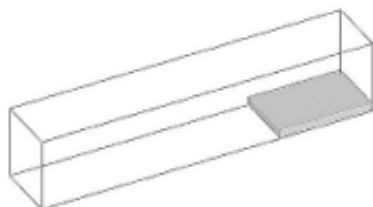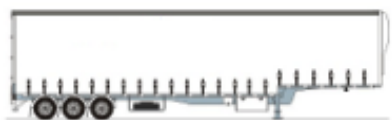
A	B	C	D	E	F	G
cnt	0	0	0	1372	249	297
rect	0	0	0	384	249	35

ODBC tables

packVol uses the following exchange tables for ODBC import/export operations. The tables can be automatically created using the **Create** command in the ODBC Configuration dialog. For a basic usage you only need to enter the few fields flagged as *not null* and shown in bold.

Table	use	description
pv_job	*In/Out*	**The table is used to define the input load list**.
pv_sku	*Input*	**Packages** This is the main table where you can define the input list of items.
pv_cnt	*Input*	**Containers** It allows you to define the types of containers to be used.
pv_obs	*Input*	**Unusable spaces** It allows you to define the possible unusable spaces of the container.
pv_stack	*Input*	**Stack matrix** It is used to define exceptions to the stacking rules between pairs of packages.
pv_exec	*Config*	**Execution parameters** The table is optional and contains the main execution parameters for the optimization of the input list.
pv_report	*Config*	**Report parameters** The table contains the parameters for formatting of the reports. **It is not used in the desktop version**.
pv_bin	*Output*	**Container list** Lists the actual containers used in the solution.
pv_geom	*Output*	**Geometry output table** Describes the geometry of the load plan.
pv_desk_sku	*Output*	**Minimal package table** Package auxiliary table, desktop version only.
pv_desk_cnt	*Output*	**Minimal container table** Container auxiliary table, desktop version only.
pv_desk_to_job	*Output*	**Correspondence table** Desktop version only.

For the two parallel tables *pv_exec* and *pv_report* the application selects the record with $g\_job = pv\_job.ID$. If the record is not found, the application selects the record with $g\_job = -1$. If not found, the application finally assigns default values. You can thus set the record with the key $g\_job = -1$ as the default record.

Table pv_job

The record defines the unique identifier of the input load list.

> The primary key is employed in all other tables to filter the records you want to import and to assign a unique code to the exported records.

field	description	type	value
ID	primary key Zero and negative values are reserved	integer not null	integer > 0
g_desc	description (optional, assigned to the first line of the header in the pdf report)	varchar(255)	text
g_rif	optional description (optional, assigned to the second line of the pdf report)	long text	text
g_date	date (optional, assigned to the date line of the pdf report). The field is textual, and formatting of the date is free.	varchar(64)	text
g_userID	user string (optional)	varchar(255)	text
g_timestamp	last access timestamp	integer	integer
g_barcode	UNUSED	varchar(24)	text
g_opt_date	UNUSED	varchar(64)	text
g_status	status: [0] not assigned, [1] assigned, [2] completed.	integer	[0, default], [1], [2]
g_sersol	serialized solution (output only)	long text	text

g_date In command line versions, the reserved word AUTO can be used to automatically format date and time in generated reports.

g_userID, g_status The desktop application checks if the record has $g\_status = 2$ (completed work), or $g\_status = 1$ (assigned work) but g_userID not empty and $g\_userID \neq$ %COMPUTERNAME% (work assigned to another seat). If these conditions are meet, the import process is stopped. Otherwise, the application sets $g\_status = 1$ and stores in g_userID the environmental variable %COMPUTERNAME%. You can configure system to use the environmental variable %USERNAME% instead of %COMPUTERNAME%. See the ODBC Export dialog.

> The command line versions don't use this filtering mechanism and only set $g\_userID =$ %COMPUTERNAME%, $g\_status = 1$ for logging purposes. You can avoid updating of g_userID and g_status by setting $g\_assign\_job = 0$ in pv_exec table.

Table pv_sku

The table is employed to enter the packages of the load list.

field	description	type	value
ID	primary key Zero and negative values are reserved	integer not null	integer > 0
g_job	unique identifier of the input list (reference to the key pv_job.ID)	integer not null	integer
g_code	alphanumeric code (the primary key in the case of import into internal database)	varchar(64)	text
g_total	number of packages, or number of objects if "*load by objects*" is enforced.	integer not null	integer ≥ 0
g_length	package length	integer not null	integer ≥ 0
g_width	package width	integer not null	integer ≥ 0
g_height	package height	integer not null	integer ≥ 0
g_ps	allowed positions	integer	[1-63], [3,default]
g_fl	floor only	integer	[0-63], [0,default]
g_nt	top only	integer	[0-63], [0,default]
g_nf	not at floor	integer	[0-63], [0,default]
g_qtb	number of "objects" per package	integer	integer > 0, [1,default]
g_btype	Desktop STANDARD version only. Type *box* [0] or base height for type *plt* if > 0	integer	[0,default]
g_dsc	description	varchar(128)	text
g_grp	optional description	varchar(64)	text
g_wgh	package weight	float	decimal ≥ 0 [0, default]
g_mbe01	max stacking position 1; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_mbe02	max stacking position 2; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_mbe04	max stacking position 4; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_mbe08	max stacking position 8; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_mbe16	max stacking position 16; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_mbe32	max stacking position 32; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_mht01	max height position 1; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_mht02	max height position 2; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_mht04	max height position 4; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]

field	description	type	value
g_mht08	max height position 8; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_mht16	max height position 16; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_mht32	max height position 32; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_stk01	stack index position 1; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_stk02	stack index position 2; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_stk04	stack index position 4; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_stk08	stack index position 8; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_stk16	stack index position 16; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_stk32	stack index position 32; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_mxp01	max bearing weight position 1; null or zero value excludes the constraint	float	decimal ≥ 0, [0,default]
g_mxp02	max bearing weight position 2; null or zero value excludes the constraint	float	decimal ≥ 0, [0,default]
g_mxp04	max bearing weight position 4; null or zero value excludes the constraint	float	decimal ≥ 0, [0,default]
g_mxp08	max bearing weight position 8; null or zero value excludes the constraint	float	decimal ≥ 0, [0,default]
g_mxp16	max bearing weight position 16; null or zero value excludes the constraint	float	decimal ≥ 0, [0,default]
g_mxp32	max bearing weight position 32; null or zero value excludes the constraint	float	decimal ≥ 0, [0,default]
g_uml	UNUSED	integer	
g_ump	UNUSED	integer	
g_lnk	group code for set-load; items forming a set must have the same label.	text	[' ',default]
g_bat	batch value; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_ds	destination index or name; null or zero value excludes the constraint	varchar(128)	[0,default]
g_fml	family name; null or blank value excludes the constraint	varchar(128)	[' ',default]
g_min	minimum number or priority; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_hexcol	package color in hexadecimal "rrggbb" format without leading # ; null or blank value assigns a random color	char(6)	[' ',default]

field	description	type	value
g_status	UNUSED	integer	
g_mc	matching code; null or zero value excludes the constraint	integer	integer ≥ 0, [0,default]
g_tsplt	forklift handling; null or zero value excludes the constraint	integer	[0-63], [0,default]
g_clm	columnar order; null or zero value excludes the constraint	integer	[0-7], [0,default]
g_bover	max box overhang; null or a negative value excludes the constraint	integer	[-1,default]
g_lsp	empty space length side	integer	[0,default]
g_wsp	empty space width side	integer	[0,default]
g_hsp	empty space height side (spH ≥ 0) or absolute reference (spH < 0)	integer	[0,default]
g_rfsp	UNUSED	integer	
g_ffsp	UNUSED	integer	
g_bdepth	max depth; null or a negative value excludes the constraint	integer	integer ≥ 0

g_length, g_width, g_height - In desktop versions, when the three values are zero and *g_code* is not empty, the program checks against the internal database for the presence of a record with primary key *g_code*. If it is found, the program takes data from the internal database and eventually replaces all not null fields of the input row when set.

Command line versions do not implement this "*code - quantity*" mechanisms and the three dimensions must be positive.

g_qtb, g_btype -The fields are employed by the STD and LTE desktop version to implement the "*load by objects*" function, if enabled. DYN version never uses this feature.

In STD command versions "*load by objects*" is applied whenever $g\_qtb \neq 1$ unless the rule is disabled in the *pv_exec.g_disable_rule* field. To use stratification, the *g_qtb* field must be modified in *varchar(128)*.

g_ds - The destination is a numerical index that can be defined directly or deduced from the textual value. In the latter case the numerical order is progressive with respect to the first occurrence in the load list. In the desktop version you can set the preferred rule in the Preferences dialog. In command line versions the rule can be set in the *pv_exec.g_named_filo* field. In case *g_named_filo* is not set the value is considered as numeric.

Table pv_cnt

The table lists the container types. The list of physical containers is created by the application by sorting the types according to the *ID* field and sequentially assigning the number of physical containers equal to *g_total*. For example, if there are two records, (*ID*=1, *g_job*=1, *g_total*=6, *g_name*='A') and (*ID*=2, *g_job*=1, *g_total*=4,

g_name='B'), the program creates a list of ten containers numbered starting from one.

A   A   A   A   A   A   B   B   B   B

1   2   3   4   5   6   7   8   9   10   ← value of pv_geom.g_binID
                                                     and of pv_bin.ID

field	description	type	value
ID	integer primary key	integer not null	integer
g_job	unique identifier of the input list (reference to the key pv_job.ID)	integer not null	integer
g_name	container name (primary key in the case of import into internal database)	varchar(64)	text
g_total	number of containers	integer	integer > 0
g_length	container internal length	integer	integer > 0
g_width	container internal width	integer	integer > 0
g_height	container internal height	integer	integer > 0
g_type	container type, closed [0], open [1], rack [3]	integer	[0, default], [1], [3]
g_bottom_top	preferred loading order, rear-front [0], bottom-top [1], layer-front [2]	integer	[0, default], [1], [2]
g_max_overhang	default max overhang percentage of a box when stacked on another	integer	[0-49], [8, default]
g_maxLoad	container max load; null or a negative value excludes the constraint	float	decimale $\geq$ 0, [0, default]
g_enforce_dens	flag to check the longitudinal weight distribution, yes [1], mean [3], no [default]	integer	[0, default], [1], [3]
g_enforce_cm	check of center of mass enabled, yes [1], forbid shift [3], no [default]	integer	[0, default], [1], [3]
g_c_of_mLowL	lower percentage limit for the center of mass along g_length axis	integer	[0-100], [0, default]
g_c_of_mHigL	upper percentage limit for the center of mass along g_length axis	integer	[0-100], [100, default]
g_c_of_mLowW	lower percentage limit for the center of mass along g_width axis	integer	[0-100], [0, default]
g_c_of_mHigW	upper percentage limit for the center of mass along g_width axis	integer	[0-100], [100, default]
g_tareWg	[dynload only]	float	
g_pdepth	[dynload only]	integer	
g_hrack	[dynload only]	integer	

field	description	type	value
g_lthick	[dynload only]	integer	
g_wthick	[dynload only]	integer	
g_length_over_length	[dynload only]	integer	
g_width_over_length	[dynload only]	integer	
g_height_as_load	[dynload only]	integer	
g_plflag	[dynload only]	integer	
g_uml	UNUSED	integer	
g_ump	UNUSED	integer	
g_status	UNUSED	integer	
g_prof_wgh1 (,2,3,4)	load of first section (to follow the second, third and fourth section of five possible)	float	decimal ≥ 0
g_prof_len1 (,2,3,4)	length of first section (to follow the 2nd, 3rd and 4th section of five possible)	integer	integer ≥ 0

> The fields **g_prof_*** are used to define the profile of a non-uniform load. The example above shows the case where the load **10000 kg** needs to be divided on a platform of length **1200 cm** in three sections. The values of the last section are calculated by subtraction.

g_maxLoad =10.000   g_length   =1.200

g_prof_wgh1=4.000   g_prof_len1 =300

g_prof_wgh2=2.000   g_prof_len2 =600
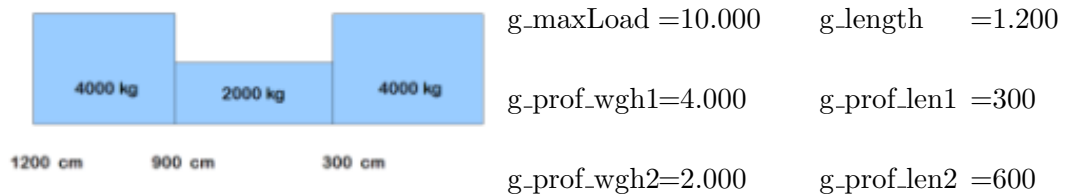
Table pv_obs

The table is used to enter the unusable volumes of a container.

field	description	type	value
ID	integer primary key	integer not null	integer
g_cntID	container index (reference to the key pv_cnt.ID)	integer not null	integer
g_job	unique identifier of the input list (reference to the key pv_job.ID)	integer not null	integer
g_vert_L	length "low" coordinate	integer	integer
g_vert_W	width "low" coordinate	integer	integer
g_vert_H	height "low" coordinate	integer	integer

field	description	type	value
g_length	length side	integer	integer
g_width	width side	integer	integer
g_height	height side	integer	integer
g_oflag	UNUSED	integer	
g_wgh	UNUSED	float	

Example
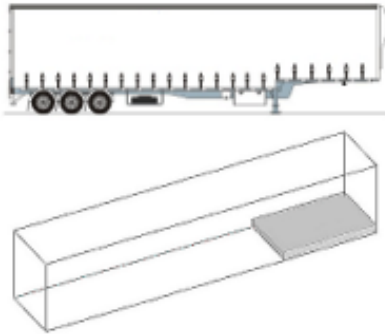
field	value
g_vert_L	0
g_vert_W	0
g_vert_H	0
g_length	384
g_width	249
g_height	35

Table pv_stack

The stack matrix sets "exceptions" to the "natural stacking rules". Each row defines a rule that allows a stacking otherwise forbidden, or forbids a stacking otherwise allowed.

field	description	type	value
g_job	unique identifier of the input list (reference to the key pv_job.ID)	integer not null	integer
g_btmID	ID of bottom package (reference to the key pv_sku.ID)	integer not null	integer ≥ 0
g_topID	ID of top package (reference to the key pv_sku.ID)	integer not null	integer ≥ 0
g_btmPs	position of bottom package	integer not null	[1-63], [63, default]
g_topPs	position of bottom package	integer not null	[1-63], [63, default]
g_status	control flag, optional	integer	integer

Example

Records of table pv_sku

ID	g_code	g_ps	g_nt	natural rule
1	AAA	3	0	no rules
2	BBB	3	0	no rules
3	CCC	63	63	nothing on top of CCC

Records of pv_stack

g_btmID	g_topID	g_btmPs	g_topPs	resulting rule
1	2	63	63	BBB **cannot** be placed on top of AAA
3	1	63	63	AAA **can** be placed on top of CCC
1	1	1	2	AAA can be placed over itself only if **turned**

g_status is an optional field to control the required rule

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g_status > 0	means that the stacking must be allowed. The program checks the natural rule and allows the stacking if it's "naturally forbidden", does nothing otherwise.
g_status < 0	means that the stacking must be forbidden. The program checks the natural rule and forbids the stacking if it's "naturally allowed", does nothing otherwise.
g_status = 0 or null	is the default choice and lets the program enforcing the applicable rule.

Table pv_exec

The table is employed to assign the execution parameters. Its use in the desktop versions is optional, as all parameters can be set from the User interface.

field	description	type	value
g_job	unique identifier of the input list (reference to the key pv_job.ID)	integer not null	integer
g_max_exec_time_ms	max execution time in milliseconds	integer	integer ≥ 0 [9000, default]
g_time_resolution	precision of the control over execution time, [0] normal, [2] accurate	integer	[0, default], [2]
g_cost_function	cost function, [0] by volume, [1] by weight.	integer	[0, default], [1]
g_on_optimality	stop execution policy, [0] stop execution, [1] improve, [2] continue.	integer	[0, default], [1], [2]
g_solv_method	solver method: *seq-f*, *seq-a*, *fst-f*, *fst-a*, [*plt-r*, *plt-e*, *plt-s*, *mbin*]	char(12)	['seq-f', default]
g_solv_smar	parameter needed by the *plt-s* solver method.	integer	[7090, default]
g_priority_list	priority constraint, [0] no, [1] **ds** as priority, [2] **min** as priority.	integer	[0, default], [1], [2]
g_named_filo	assigns the destination index **ds** based on the descriptive string of the field pv_sk.g_ds: [0] no, [1] yes.	integer	[0, default], [1]

field	description	type	value
g_filo_order	FI/LO constraint, [0] no, [1] order in each container, [2] absolute order between consecutive containers, [3] absolute order without order inside container.	integer	[1, default], [0], [2], [3]
g_with_dsmixing	max mixing constraint, [0] no, [1] yes.	integer	[0], [1, default]
g_max_dsmixing	max mixing threshold, integer ≥ 0 or -1 if not defined.	integer	integer [-1, default]
g_max_bdepth	max depth, integer ≥ 0 or -1 if not applies.	integer	integer [-1, default]
g_block_loadable	check loading / unloading, [0] no, [1] yes.	integer	[0, default], [1]
g_back_equil	rear balance check, [0] no, [1] yes.	integer	[0, default], [1]
g_assign_job	writing of g_userID e g_status in table pv_job: [0] no, [1] yes.	integer	[0], [1, default]
g_disable_rule	allows you to disable certain constraints even if they are defined.	integer	integer ≥ 0
g_plane_tolerance	UNUSED	varchar(255)	
g_crossing_par	UNUSED	varchar(255)	
g_back_face_perc	face contact percentage. The values is applied in case **g_back_equil** is active.	integer	integer ≥ 0 [30, default]
g_check_seed	Assigns the seed of the random generator.	integer	integer ≥ 0

g_solv_method defines the optimization criterion.

g_max_exec_time_ms. In command line versions, when *g_max_exec_time_ms* $= 0$ the application estimates the minimum number of containers needed to hold the load list. The result is not optimized and must be considered as an upper bound. The desktop version rounds the value to the closest non-zero time expressed in seconds, hence the minimum sensible value is *g_max_exec_time_ms* $= 1000$.

g_time_resolution is used by the command line versions only.

g_check_seed is a test option, and it is recommended that you do not set it.

g_disable_rule is a test option and normally should be set null or zero. The numeric value is the sum of the following values:

1 - disables bearing checks	2 - disables destinations
4 - disables priority rules	8 - disables stacking checks
16 - disables set / batch load	64 - disables bearing weight
128 - disables container max load	256 - disables "matching code"
512 - disables "load by object"	

Table pv_report

The table is used by the command line versions to assign the parameters of the report. The table is **not** used by the desktop versions.

field	description	type	value
g_job	unique identifier of the input list (reference to the key pv_job.ID)	integer not null	integer
g_img_layout	image layout. The value 0 or null prevents creation of the images. See section.	integer	[0, default]
g_img_style	style of the images, applies if g_img_layout $\neq$ 0. See section.	integer	[3, default]
g_img_width	image width in pixels ($\leq$ 1200)	integer	[600, default]
g_img_height	image height in pixels ($\leq$ 900)	integer	[450, default]
g_img_type	image format. Supported: bmp, png, jpg, tif, gif, svg	char(3)	[png, default]
g_xls_report	Excel file format, xls o xlsx. Blank or null field prevents the creation of the file.	char(4)	xls, xlsx [", default]
g_pdf_layout	layout of pdf file. The value 0 or null prevents the creation of the file. See section.	integer	[0, default]
g_pdf_style	style of the pdf report, applies if g_pdf_layout $\neq$ 0. See section.	integer	[0, default]
g_n_views	number of views, or steps in case of stepped layouts.	integer	[4, default]
g_block_size	size of blocks of identical packages : [0] small, [1] medium, [2] large.	integer	[0, default], [1], [2]
g_htm_layout	reports in html format. The value 0 or null prevents creation of the files. See section.	integer	[0, default]
g_um_units	metric unit for formatting of reports.	varchar(64)	[", default]

g_img_layout controls the production of images. The value is obtained by summing up the following flags, that we organize in sections and to which we give a descriptive name for clarity

view section	
1 FRONT_RIGHT - view from front-right	2 FRONT_LEFT - view from front-left
4 BACK_LEFT - view from back-left	8 BACK_RIGHT - view from back-right
16 PLANAR - planar view	

step section	
128 FORCE_RESUME - full container view	256 STEP_BLOCK - step images by blocks
512 STEP_LEVEL - step images by levels	1024 STEP_LAYER - step images by layers

resume section
4096 FULL_PLAN - full load plan view

If *g_img_layout* is zero or null the program doesn't create images. Otherwise, the program first checks for the presence of FULL_PLAN and, if the flag is found, produces an image of the complete load plan. Then the program prepares for production of images of each container entering the solution, checking for the presence of one of the flags STEP_BLOCK, STEP_LEVEL or STEP_LAYER. For each flag, the program prepares a step-by-step sequence describing the loading of the container. If the flags are not found the program creates a single summary image. The actual production of the images depends on the remaining "view" flags, that can be combined. For each "view" the program creates an image. If the "view" flags are absent, the program applies the FRONT_RIGHT flag as default. The flag FORCE_RESUME allows adding of the summary image at the end of the step sequences.

g_img_style controls the style of images. The value is obtained by summing up the following values

1 - display text	2 - display color
4 - label on single box	8 - color by destination
16 - length sign	32 - front sign
64 - no label on top face	

g_pdf_layout defines the type of pdf report. The possible values are

1 single view layout	2 duo view layout
3 quad view layout	4 planar layout
5 simple layout	6 level layout
7 layer layout	

g_pdf_style controls the production of pdf report. The value is obtained by summing up the following flags

1 - simple view by sections	2 - print loading instructions
4 - print summary list	8 - unique code
16 - one file for container	32 - load plan on new page
64 - without input quantity	128 - no package color
256 - no package label	512 - single box label
1024 - label on loaded boxes	2048 - without manifest header
4096 - without page header	8192 - without page footer
16384 - without logo image	32768 - logo image on all pages
65536 - enforce bottom-top sequence	131072 - enforce rear-front sequence
262144 - print "number of objects"	524288 - use FI/LO colors
1048576 - print FI/LO list	

g_htm_style controls the production of reports in html format. The value is obtained by summing up the following flags

1 - create the resume report	2 - create the distribution report
4 - create the webGL report	

g_um_units sets the metric units. The default is cm. Set *g_um_units*=1 if you need mm.

Table pv_bin

The table lists the actual containers used in the solution.

field	description	type	value
ID	integer primary key (assigned by the program with numbering starting from 1)	integer not null	integer
g_job	unique identifier of the input list (reference to the key pv_job.ID or assigned programmatically if pv_job.ID is not coherent)	integer not null	integer
g_cntID	container identifier(reference to the key pv_cnt.ID or to pv_desk_cnt.ID in case g_job is assigned by the application)	integer	integer
g_vol_pc	container loading percentage	float	decimal
g_sersol	UNUSED	long text	

Table pv_geom

The table gives information about the distribution of the packages among the various

containers and the positions of the items.

field	description	type	value
ID	integer primary key (assigned by the application)	integer not null	integer
g_job	unique identifier of the input list (reference to the key pv_job.ID or assigned programmatically if pv_job.ID is not coherent)	integer not null	integer
g_skuID	package identifier (reference to the key pv_sku.ID or to pv_desk_sku.ID in case g_job is assigned by the application)	integer	integer
g_posID	position of the item according to the application encoding	integer	[1, 2, 4, 8, 16, 32]
g_binID	container index (reference to the key pv_bin.ID)	integer	integer
g_vert_L	length "low" coordinate	integer	integer
g_vert_W	width "low" coordinate	integer	integer
g_vert_H	height "low" coordinate	integer	integer
g_edge_L	length side	integer	integer
g_edge_W	height side	integer	integer
g_edge_H	width side	integer	integer
g_status	UNUSED	integer	

The following picture shows how input and output tables are related
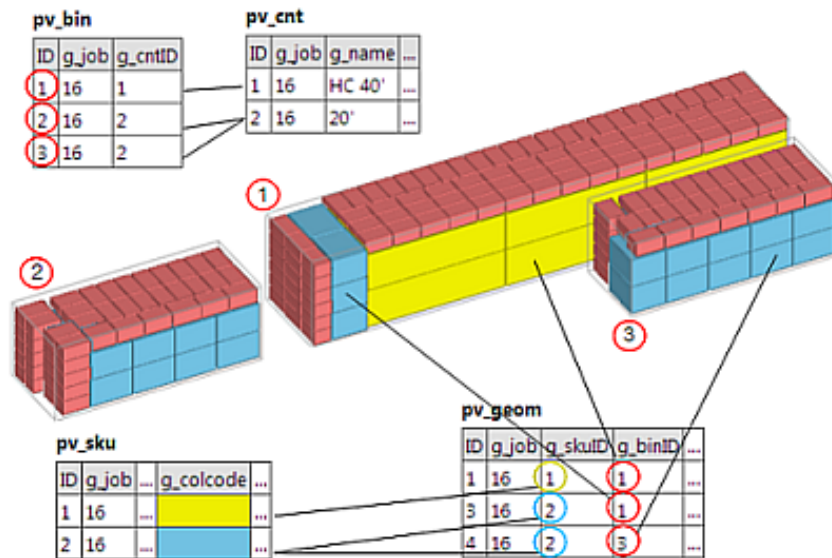
Tables pv_desk_

The special tables *pv_desk_sku*, *pv_desk_cnt* and *pv_desk_to_job* are used by the desktop version only and allow exports of data when *pv_sku* or *pv_cnt* are empty or not coherent. This situation occurs, e.g., when the list is defined by other means (Excel, using the internal database, open files, direct input, etc.), or User modifies the imported list. In such cases, on export the application generates a fictitious negative *g_job* and uses this value to populate the output tables *pv_bin* and *pv_geom*. At same time, the program populates *pv_desk_sku* and *pv_desk_cnt* tables assigning to each record a progressive negative *ID*.

In case of modification of the imported list, the table *pv_desk_to_job* keeps track of the association between the generated negative *g_job* and the original *pv_job.ID* identifier. The application uses the *pv_desk_xxx* version in case of modified input only and keeps the original *pv_xxx.ID* value for all unmodified records.

Table pv_desk_cnt

field	description	type	value
ID	integer primary key	integer not null	integer
g_job	unique identifier of the input list	integer not null	integer
g_name	container name	varchar(64)	text
g_length	container length	integer	integer
g_width	container width	integer	integer
g_height	container height	integer	integer
g_maxLoad	max load ($\leq$ 0 when not defined)	float	decimal

Table pv_desk_sku

field	description	type	value
ID	integer primary key	integer not null	integer
g_job	unique identifier of the input list	integer not null	integer
g_code	alphanumeric code	varchar(64)	text
g_length	package length	integer	integer
g_width	package width	integer	integer
g_height	package height	integer	integer
g_weight	package weight	float	decimal

Table pv_desk_to_job

field	description	type	value
g_desk	the generated fictitious g_job	integer	integer < 0
g_job	the original pv_job.ID of the imported list	integer	integer > 0

Settings and Preferences

Metric Units

The tab is part of the Preferences dialog, but can be opened directly with the menu command Setting → Metric Units. Here you may define the Metric Units used by the program and set the accuracy of your data. Possible values are

- Length: mm, cm, m, mil, in, ft;
- Surface: mm^2, cm^2, m^2, sq.in, sq.ft;
- Volume: mm^3, cm^3, m^3, cu.in, cu.ft;
- Mass: kg, lbs, t, ton.

If you don't fix a choice, the program employs the default values cm (1x), m^2, m^3, kg.

To enforce data accuracy the program requires integer-valued input without decimal digits, while it allows for a more conventional formatting of the various reports via the scale factor. An example should clarify the matter.

Suppose that the sides of a package are 12.7 cm, 14 cm and 23.2 cm. Even though the employed units are centimeters, accuracy is actually millimeters and input must be 127, 140 and 232. Output depends on settings.

User data	input	output	output	output
		mm 1x	cm 10x	m 1000x
12.7 cm	127	127 mm	12.7 cm	0.127 m
14 cm	140	140 mm	14.0 cm	0.140 m
23.4 cm	234	234 mm	23.4 cm	0.234 m

This scheme forces User to drop the decimal dot and it clearly stresses that the program never rounds the input, which is left "as is". The same scheme is employed for Imperial Units.

A change in the metric convention does not lead to conversion of the input data. The choice of units must be understood as a way to keep the printing of values, especially those of volumes, within limits of acceptable size.

Use fractional inches .. formats the data with the fractional format. The drop-down menu on the side of the control allows you to choose rounding of the fraction.

Preferences

The Preference dialog is activated with the menu command Tools → Preferences ⚙ . It is composed by seven tabs, accessible by clicking on the list placed on the left. Each tab displays various groups of parameters logically linked among themselves: Metric, Options, Solver, Container, Import, Advanced, Report.

Options

The tab allows you to manage the warnings raised by the program and to restore the state of the application.

command	
Prompt for confirmation before deleting a solution	Enables all warnings that allow you to undo an action that leads to the deletion of the solution.
Restore dialog to manage start solver / change of solution	Restores the dialog which allows you to choose the type of solver when not defined.
Restore all information message boxes	Some message box can be hidden by activating the option *"Don't show this dialog again"*. The option restores all messages.
Restore default grid size settings	Resets the size of the panels on the left, and the size of the grid cells, to their default values.

Lite version

The Lite version carries the *Data Options* subsection to configure parameters managed in the other versions with the *General* tab of the database configuration dialog.

command	
Protect data loaded from Database or from Excel.	Enable secondary description field.
Enable "Load by objects" functionality.	Show qt/b field in Box grid.

Solver

The panel displays the default that the program uses in case of opening a new document, or in case of import of data. If you select the option *show current values* the panel displays the current settings. To save the shown settings, check the option *save these as default* and press Apply.

Container

You can define a particular container as default, forcing the program to automatically load its data when opening a new document. This feature may be useful if you work most of the time with the same container. To define the default container, simply choose the container from the list and press the button Set as default. The button Reset removes the association.

Two text boxes allow you to set the default values for max box overhang (%) and for load order.

Import

The options inside the panel allow you to assign some preferences for the import procedures.

option	
Use "named" destination on import (ordered by first entry)	If active, the Excel cell, or the ODBC table field, which carries the destination is considered alphanumeric. The numerical value of the parameter ds is assigned progressively based on the first occurrence of the string. If inactive, the value is assumed numeric and assigned directly.
Don't show row preview on Excel (ODBC) import	The option allows to skip the preview dialog shown before importing data.
Assign color to dimensions / weight	If the color of an item is not defined, assigns the color based on the size and weight of the package.

Advanced

Default positions. To avoid too much typing, when entering items manually, the program automatically sets all positions as allowed, and assigns the value 63 to the corresponding cell ps of the Constraint tab. You may change the default value by selecting the proper entry in the drop-down menu. In case you choose the option other, the value must be typed manually using a numerical code.

Manual Solver options. In manual mode the program tries, whenever possible, to place a package in a valid position fulfilling all imposed constraints. The three options

- at lowest possible level (layer packing);
- on top of rear columns (wall packing);
- as decided by the program itself;

suggest to the program how the control points should be searched and tested.

Packages are listed by code or with an alternative label. The combo box Show alternate list by, having options *description*, *dimensions* and *volume/weight* allows you to choose the alternative label.

Report

The panel shows various groups of controls.

Report customization	
Modify current automatic Pdf export settings	Opens the pdf Export dialog in preference mode. All values are saved and used as default when formatting the pdf documents.

Report customization

Don't show input qty on packing lists	If selected, the input quantities are not included in the report.
Show code labels on all listed packages	Displays the code on all groups of packages.
Description label on load plan image	Allows you to choose the label to be shown on the package, with options *item code*, *description*, *[other]* and *dimensions*.
Show object quantities qt/b and qt/b total	The options allow you to choose whether to display in the list the quantities per package qt/b and the number of loaded objects.

Header captions

Header Captions	Allows you to change the caption of the two header lines and the date format.

### Logo and Company name

Logo - Name	Allow you to choose the logo image and to add a Company header to the reports.
Define names of positions	Allows you to assign a name to the position ps. The names are included in the loading instructions.
Set captions and labels for English reports	Captions and labels are assigned to the report in English (localized versions only).

Appendix

Encoding of positions

The parameter ps which describes the allowed positions is encoded with a single integer obtained by summing up the values in the following table for each allowed position. The parameters fl, tp and nf are encoded in an analogous manner.

value	description
1	reference position: length, width, and height are aligned with length, width, and height of the container.
2	rotation about the vertical axis of position **1** (swap length ↔ width).
8	the reference position **1** is "lying down" on the width side (swap width ↔ height).
4	rotation about the vertical axis of position **8** (swap width ↔ height, then width ↔ length).
32	the reference position **1** is "lying down" on the length side (swap length ↔ height).
16	rotation about the vertical axis of position **32** (swap length ↔ height, then width ↔ length).
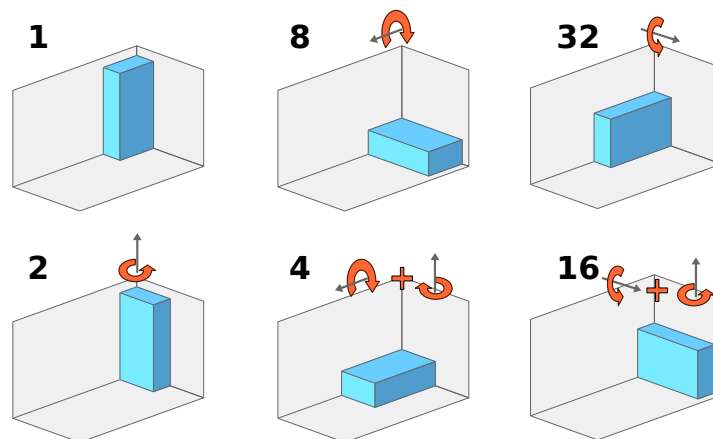
Knowledge of the position code is needed for all operations related to the automatic import of data. A special dialog of the Preferences window allows you assign a label to each position.

Some examples

When all positions are allowed you set ps = 63 (1+2+4+8+16+32).

For a pallet, which should never be lying on its sides, you need ps = 3 (1+2).

For a freezer, that you want to just lay on a given side, you must force ps = 12 (8+4) or ps = 48 (16+32), according to the definition of the edges.

Coordinates
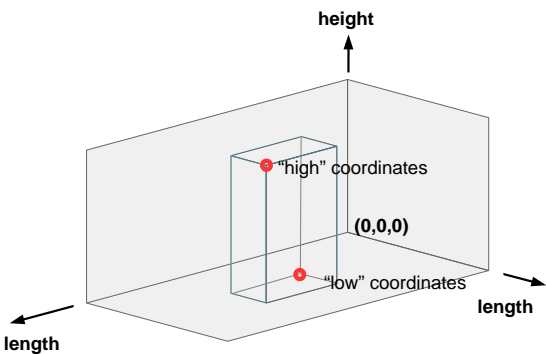
The origin of the coordinates is located at the rear of the container.

"Low" and "high" coordinates are those of the vertex closer and farther from the origin.

Dynload panels

The Dynload version has two read-only summary panels

Primary panel

List of items loaded or left on the ground in the first stage. The grid reports the code, the destination (zero if absent), the size of the package, the total quantity, the number of packages loaded, and any remaining part to be loaded in the second stage.

Package distribution

Sortable grid of the package distribution. In the headers ID is the progressive number assigned by the program, cnt is the container type, bin is the used container according to the numbering of the Output tab (or -1 if left on ground), pk is the number of loaded packages.

Rack/Flat container
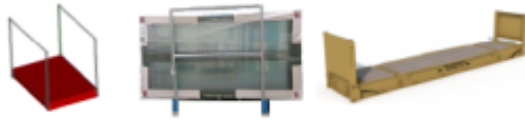
The container is open from the width side and has the height equal to the height of the front wall.

Floor packages are positioned with symmetrical overhang if they have a greater extension than the base, while they are positioned according to the value of Max box overhang (%) in case of lower extension.

Packages not on the floor at a height greater than or equal to the height of the container wall are never loaded. For intermediate heights, positioning is controlled by the parameter Min vertical overlap (%).

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