M!

Scaling at the computer
– System Rensch –

User manual

v3.0 Mac

M! *mensura (lat.)*   *scale, size, length*
metior (lat.)   *to scale*

http://www.pleasantsoftware.com

Inhaltsverzeichnis

Preface

Welcome to M!

The purpose of this manual is to present you with a tutorial for M!

In each chapter allied functions are explained with practical examples.

It is highly recommended that the manual be worked through step by step at the computer. At the end of the manual you'll find an index with which questions or problems you might run into can be quickly solved.

Installation of M! · Entering license data · Launching M!

First launch

In order to use M!, please follow these installation instructions:

Installation of M!

1. Download the most recent version of M! here:
   http://www.pleasantsoftware.com/mensuren
2. If not mounted automatically, double click the downloaded disk image file (.dmg).
3. Follow the displayed instructions to copy M! to your applications directory.
4. Eject the disk image in Finder and launch M! from the applications directory.

If you want to add M! to the Dock, drag the program icon from the applications directory (not the disk image) to the dock. M! should appear in your Launchpad automatically, shortly after copying M! to the applications directory.

The downloadable demo version of M! matches exactly the full version of the program. The only difference is, that without entering a valid license code, the full functionality is time limited.

Entering license data

Here's how to enter your license data:

After launching M!, open the preferences window by choosing the *Preferences* command from the *M!* menu. Switch to the License tab and enter your license data exactly as received in your license information.

Please note, that M! checks both, the license name and the license code. Thus, it's recommended to enter the data via copy & paste whenever possible.

Launching M!

Launch M! by double-clicking on the application's icon in the Finder.

After launching, M! automatically shows a new document window:
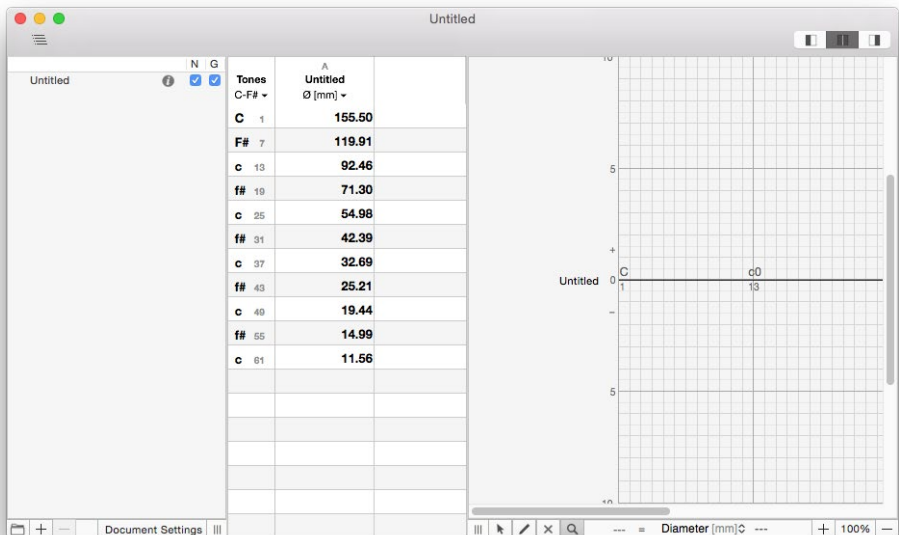
Chapter 1

The main window · Renaming stops · Using the spreadsheet · Saving a document

After M! has completed launching, a new scaling document named *Untitled* is opened.

The main window has three sections:

On the left side, the **Stop list** is displayed. This view lists the names of all stops (and groups) in the document.

In the middle, the **Spreadsheet** is displayed. When adding a stop to the document, M! automatically adds a column to this spreadsheet view, displaying the diameters of the new stop. It's easy to add additional columns for each stop (displaying other scale types) or even so called »free« columns you can use to enter comments and simple formulas.

On the right side, the **Graphic view** is displayed. The scales of all stops are displayed graphically in this view, as deviation from of the documents *Normal Scale* (NM).

All three views are continuously connected to each other. For instance, changing values in the spreadsheet will instantly update the graphic view representation of the respective stop. And if you move a line or anchor point in the graphic view, the values in the spreadsheet will change with it.

You can move the dividing lines between the three views to re-arrange the window. Click-

The main window

≡

ing on the List icon in tool bar in the upper left will toggle the visibility of the stop list off and on.

The visibility of the number and graphic views can be controlled with the segmented switch in the upper right: When the left segment is switched on, only the spreadsheet is visible. When switched to the right segment, only the graphic view is visible. To display both views side-by-side, switch to the middle segment (which is the default).

When moving divider lines between views, they will hit a limit eventually, when one of the affected views reaches its minimal width. If you continue to move the divider line after reaching this limit, the respective view will collapse. To make a collapsed view visible again, use the respective button/switch in the tool bar or the respective menu command in the View *menu.*

Toggling the visibility of the stop list as well switching the visibility of the number and graphics view is also possible by choosing one of the menu commands in the View menu. These menu commands are also associated with key board shortcuts (⌘⌥0, ⌘⌥1, ⌘⌥2 and ⌘⌥3).

If you want to maximize the size of a window without switching to full screen mode, hold down the ⌥*–key while clicking on the green maximize button in the window's title bar.*

Please note, that document windows in M! support Mac OS X's full screen mode. Click on the green maximize button in a window's title bar to switch the window to full screen mode. Move the mouse pointer to the upper edge of the screen to show the menu bar and the window's title bar. Click on the green button again to leave the full screen mode.

Rename stops

To change the name of a stop, select the stop in the stop list by clicking on its name. Then click on the selected name again to edit. After editing the name, hit the return key (↵) or select another stop in the stop list.

The new document contains a default stop *Untitled*. Rename this stop to *Principal 8'*.

The »Normal Scale« NM

Until now, the scale *Principal 8'* is only a straight horizontal line laying exactly at Normal Scale (NM). M! normally uses the *Töpfer Normal Scale* NM (octave ratio Ø = 1:$\sqrt[4]{8}$ or halving at the 17th) as a basis. All scales are shown a deviations from NM in ± n HT. For this reason, *Principal 8'* shows exactly this NM.

The Document Preferences dialog allows you to set other progressions as NM basis (see »Document preferences« at page 81).

The numerical values of this (or any other) scale are displayed in the spreadsheet, next to the stop list. For the moment, there is only one column showing the diameter in mm of each note. The name of the scale appears in the title bar of the spreadsheet along with the type of values shown. In this case *Principal 8'* and *Ø [mm]*. The data in the brackets designates the measuring unit presently in use.

A
Principal 8'
Ø [mm] ▾
155,50
119,91
92,46
71,30

Changing the type of values in a column

In order to change the data parameter(s) of a column, move the pointer onto the designation (*Ø [mm]*) of the column. When the pointer changes to a menu icon, you can open a menu by pressing the mouse button. At the top of the menu you can choose the desired parameter.

This menu will be referenced as »Column menu« in the future.

Choose *Circumference [mm]* from the column menu. The displayed values in the spreadsheet change and show now the circumference values of the scale.

Duplicating columns

Because you'll probably want to show more values than just the diameter, you should have at least two more columns to show these desired values. There are multiple ways to add these columns:

When you open the column menu for a column (see above), you'll find the menu command *Duplicate this column* at the end of the menu.

A Principal 8' Ratio (1:n) ▾	B Principal 8' C [mm] ▾
4.00	488.52
4.00	376.70
4.00	290.47
4.00	223.99
4.00	172.72
4.00	133.18

Open the column menu and choose *Duplicate this column*. You should now see two identical columns side by side in the spreadsheet. Use the column menu of the first column to change the designation of this column to *Ratio [1:n]*.

To speed things up, it's possible to execute this procedure, duplicating a column and changing the designation, in one step:

A Principal 8' Ratio (1:n) ▾	B Principal 8' C [mm] ▾	C Principal 8' Dev. [HT] ▾
4.00	488.52	0.00
4.00	376.70	0.00
4.00	290.47	0.00
4.00	223.99	0.00
4.00	172.72	0.00
4.00	133.18	0.00

Open a column menu for the second column and then hold down the ⌥ key. This changes the commands in the upper part of the column menu to *Add … Column* variants of the normal commands. Choose the first command: *Add Deviation Column*. This will add a new column with the designation *Deviation [HT]* as third column in the spreadsheet.

Another way to add columns for a stop is to drag and drop the stop's name from the stop list to the spreadsheet.

Click on the name *Principal 8'* in the stop list, then drag the name (while holding the mouse button down) into the spreadsheet. A bold, vertical separator line indicates where the new column will be inserted. For instance, drag the name between the Tones and the *Ratio [1:n]* columns. After releasing the mouse button a new column with the default

designation Ø *[mm]* is inserted as first column in the spreadsheet.

You can change the order of the columns as you see fit by clicking onto the name of a column (the pointer changes to a closed hand icon) and, while holding the button pressed, moving the column to the desired place.

Moving columns

C icipal 8' mm] ▾	B Principal 8' Ratio (🖑) ▾	D Principal 8' Dev. [HT] ▾
488.52	4.00	0.00
376.70	4.00	0.00
290.47	4.00	0.00
223.99	4.00	0.00
172.72	4.00	0.00
133.18	4.00	0.00
102.70	4.00	0.00

Move the second column (*Ratio [1:n]*) to the end of the table.

One last way to duplicate columns is to hold down the ⌥ key when moving a column. When doing so, the moved column will be duplicated at the new position.

The width of each column in the spreadsheet is adjustable. Move the mouse pointer onto the vertical separator line between two columns in the column header. The mouse pointer changes to a move icon. Then click and drag the separator line to the desired position.

Change a column's width

✛

With the submenu *Decimal places* in the column menu you can designate how many decimal places will be shown.

Decimal places

Change the decimal places preferences of the column Ø *[mm]* to 0. The diameter values are now shown as integer values.

Since most of the time only the C and F# values are of interest, the spreadsheet is filtered in that way by default. Of course, you can changed this filter to show all available half

Filter displayed half tones

tones. To do so, open the column menu of the *Tones* column by clicking on the designator *C-F#.* You can then choose between *All Half Tones*, *Only C-F#* and *Only marked*. The latter option shows only half tones which were previously selected by clicking on the tone names in the *Tones* column.

Saving a document

Save your previous work so that you can use it again later on. Use the *Save* command from the *File* menu. As this document has not been saved yet, the standard save dialog box will be opened in which you set the storage path and name of the document. Choose a path and name the document, e.g. *Practice*.

Mac OS X also auto-saves documents.

After saving, the document's window title will adapt the new document name.

Renaming a document

After a document has been saved, the dialog box will no longer appear, the data and changes therein will be stored under the same name. To save a document under a different name (i.e. change its name), choose *Rename…* from the *File* menu.

Duplicating a document

You can also base a new document on the contents of an existing on. After opening the base document, choose *Duplicate* from the *File* menu. This will create a copy of the base document. When saving this copy for the first time, you can choose a new path and name for the duplicated document.

Opening Documents · Moving scales · Positioning · Grid · Adding, changing and deleting anchor points

Chapter 2

If not already open, open the document file *Practice,* you've created and saved in the last chapter, by choosing the command *Open…* from the *File* menu.

The next exercise will be moving the present scale *Principal 8'* parallel to a new position. In order to be able to see how the values change, make sure both views, the graphics view and the spreadsheet are visible. If necessary, switch the segmented control in the upper right of the window to the middle position or use the command *Show Number & Graphics View* from the *View* menu. If needed, resize the window and move the separator line between the views to have a good overview on both views.

Select the scale *Principal 8'*. You can tell if it is activated when the name is framed and the anchor points are shown (in our present case, the beginning and end are marked with a small black square). To activate the curve, click either on the line or on the name.

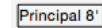To deselect a scale, click anywhere in a free region on the graphics view.

When the scale is activated, it can be moved by clicking on it and holding the mouse but-

Opening documents

In addition to dragging the separator lines directly, you can also resize the views by dragging one of the handles at the bottom of the window.

The scale is also activated if you click on the name in the stop list.

Moving a scale

ton while dragging the curve up or down. The values in the spreadsheet will be corrected to the new position immediately.

Position panel

`a 22  =  Circumference [mm]⇕  143.3`

While moving the scale you can observe the position panel in the tool bar below the graphics view of the mouse pointer at any time. You can change the parameter so that the panel shows diameter instead of horizontal and vertical deviation from NM.

Click on the type designator in the position panel to open a context menu to change the displayed type of scale.

This way, it's easy to move a given scale to a given diameter.

Grid

It is possible to establish a grid for drawing and moving operations so that undesired values are omitted. With the grid it is easier to move e.g. a scale exactly »3HT« up or down.

Actually, there are two grid positions: a horizontal or half tone and a vertical or deviation position. For the moment we are looking at the deviation position, *Snap to Vertical Grid*. Choose this command from the *Tools* menu. Now the scale can be moved only in increments of a half tone. To deactivate the grid, choose the *Snap to Vertical Grid* from the *Tools* menu again.

For short term usage, simply press the shift key (⇧) while moving the scale. The shift key is the general shortcut key for the entire

application: as long as it is held, drawing and moving operations snap to grid.

Modifying scale curves

Normally a straight line scale parallel to NM will not be desired. Of course scales can be modified by different means.

M! has two basic drawing modes:

1. Spline mode (Bézier curves)
2. free-hand mode

Bézier curves

The default setting is spline mode. You can tell the spline mode is turned on, when the scale has anchor points (the small black squares). As well, the current drawing mode of a stop is displayed in the stop's settings window.

Bézier functions are polynomials, of all orders, also called Bézier polynomials. Currently in vogue as smoothing curves in computer graphics, e.g. for shaping scalable fonts. In these applications they might be also called Bézier splines. A spline is a flexible ruler used for drawing curves. Bézier, who worked for Renault, found and applied Bernstein polynomials (by which they might be known in earlier reference books) and promptly renamed them, by which Bézier name they are now known.

You might be familiar with spline mode from other illustrator or CAD applications. At first, it will rake some practice, after a short time, you'll find it much easier and more flexible to work with this tool when using the mouse than in free-hand mode. Don't be discouraged if at first the curve doesn't want to »behave«.

Imagine a spline as a magnetic rubber band pulled into position by several sources. The simplest is, of course, a straight line between two anchor points or coordinates. One such line is our *Principal 8'* . Now, you can change such a line simply by »grabbing« one of the anchor points with the mouse and dragging it while holding the mouse button down. The spline stays drawn between the anchor points.
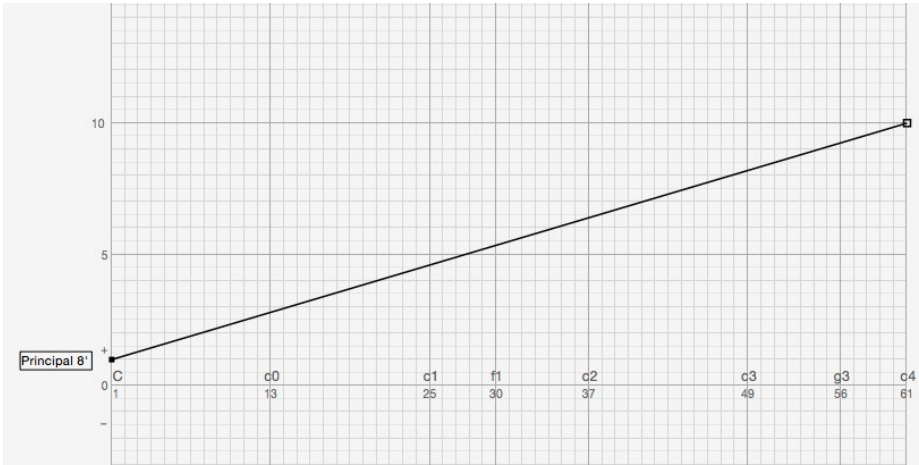
It might be helpful to set the position panel below the graphics view to Deviation [HT].

Move the left anchor point to +1HT (if needed, switch on the HT and Deviation grid or hold down the shift key) and the right anchor point to +10HT.

To further modify the scale, insert a third anchor point. Change the tool from pointer to pen in the *Tools* menu (or by clicking on the respective icon in the tool bar below the graphics view).

Click at half tone *c13* and the deviation *+4HT,* following the visible grid or the values in the position panel in the tool bar. Click at half tone *c13* on the curve.

The new anchor point will be inserted at the designated position and the scale will now conform to all three points. Should the new coordinate not be at exactly the right place, you can easily move it as we have learned.

You can move anchor points with the pen but be careful not to accidentally insert further anchor points while doing so by click next to the one you wish to move.

Splines are of course curves and so it is natural that you can use this function to draw curves as well. Do this by modifying »hard« corner points to »soft« curve points. Such curve points have, as opposed to corner points, handles. While the »rubber band« remains taught between the anchor points, the handles influence it like strong magnets. You will grasp this most readily by changing the middle anchor point to a curve point.

To insure that you do not accidentally insert anchor points in the following steps, it is better to change the tool back to Pointer.

Click with the right mouse button on the anchor point in the middle. This opens a context menu. Choose *Curve Point* from this context menu.

If there's no right mouse button, you can alternatively hold down the Ctrl key and click on the anchor point.

The curve point has two handles (×), that are not necessarily equidistant from the point, but are always connected by a straight line through the curve point. Try moving a handle. Notice how the »rubber band« follows the movements.

Curve points always have two handles, except when they are endpoints of the spline. These naturally have only one handle towards the curve.
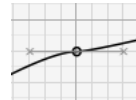
Besides the curve point, the context menu offers the option *Connection Point*. This differs from the curve point in that the handles need not necessarily be on a straight line with the anchor point itself. Thus, it is possible to smooth »hard« corners into curves.
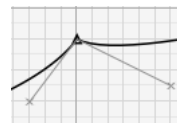
Please note that M! does not allow handles that would make loops in the scale!

With a little practice you will be able to work quickly and intuitively.

Here are a few tricks with which you can accelerate working with splines:

- If you hold down the shift key (⇧) while moving a handle, the movements of the handles snap to the grid.
- Holding down the ⌥ key make the handle opposite the one being moved assume an equidistant position.

This temporary changing of tools works for the other tools as well.

- Holding down the command key (⌘) causes the pen to change to the pointer.
- Holding the mouse button pressed when inserting a new anchor point changes this to a curve point which can immediately be »handled« with the mouse.

Naturally, you can delete individual coordinate points. Delete for example the middle anchor point of *Principal 8'*.

Inactive anchor point

Active anchor point
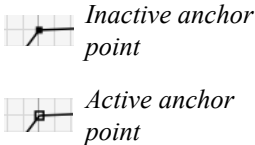
Activate that anchor point by clicking on it (the black square will change to a hollow frame) and pressing the backspace key (←).

Another possibility is choosing the *Eraser* from the *Tools* menu and clicking on the anchor point with it.

To end this section, here is another little exercise:

This exercise is easier when both snap to grid options are turned on.

Delete all of the anchor points except the two end points of *Principal 8'*. If you have moved the ends since our last exercise, replace them at +1HT (left) and +10HT (right). Now insert at c13, c25, c37 and c49 new anchor points with +4HT, +6HT, +8HT and +10HT deviation. Since our stop is to have a compass to a58, move the right endpoint to this half tone.

Now try to smooth this new scale modifying the anchor points to curve points and moving the handles.

The second method for drawing curves is the free-hand mode. It is use mostly for drawing with a graphic pad and stylus, but the mouse can be used in this mode as well.

Free-hand mode

You can tell that free-hand is turned on when the scale displays no anchor points but is drawn as a simple bold line. As well, the current drawing mode of a stop is displayed in the stop's settings window.

To change a spline into a free-hand curve, click in the stop list on the »i« button next to the stop's name. This will show the stop's settings window. In the section *Name, Graphic & Compass* you'll find the option Line type. Set this option to Bézier for spline mode or to free form for free-hand mode. Please read the margin notes to this topic as well!

Please note that a spline that is calculated on the basis of a free-hand curve is always made up of corner points, not curve points, and this can cause problems with curves. Besides, the complex calculations lead to rounding off errors that will show up in the spreadsheet at the second decimal place. Modifying a »jagged« free-hand scale normally does not cause any problems.

The function of free-hand should be self-explanatory.

Change the scale *Principal 8'* to a free-hand scale and modify it with the *Pen* from the *Tools* menu. You can shorten or delete all or part of a free-hand scale with the *Eraser* tool from the *Tools* menu.

Return to the previous version of *Principal 8'* by using the *Revert to* command from the *File* menu.

Alternatively, you could revert the changes by repeatedly undoing your changes with Edit > Undo.

Column types in the spreadsheet · Free columns

Lets have a look at the other value parameters of the spreadsheet.

Open the column menu of on of the *Principal 8'* columns.

Chapter 3

Columns and value parameters in the spreadsheet
The brackets show the unit of measure.

The categories *Deviation [HT]*, *Diameter [mm]*, *Circumference [mm]* (normally referred to as *plate width PW*) and *Half Plate Width [mm]* should be self-explanatory.

The category *Mouth Width [mm]* show the same-named scale of the stop, normally derived from the ratio stipulated in the Stop preferences (see »Stop preferences« at page 33). The default setting is 1:4, i.e. the MW is 1/4th of the circumference PW of the note.

In a later chapter (»Free-variable mouth scales« at page 47), we will see how to work with variable MW scales and progressions.

Ratio [1:n] shows the fractional division of PW for MW: 1:n. In our present case, every note displays the same default value, 4. The real usefulness of the is column will later become apparent when we get into variable MW scales (see »Free-variable mouth scales« at page 47).

The category *Pipe Depth [mm]* gives the depth of rectangular pipes; the pipe width is considered to be the same as the MW.

The *Theoretical Length [mm]*, abbr. *lth*, of a pipe is determined from its air column wave length for a given pitch (default a=440cps.) and ambient temperature (default 15°C=59°F)

Pipe length is, among other things, dependent on

a) Ø

b) MW

c) pipe body form

d) cut-up

e) wind pressure (loudness)

f) method of tuning

a) and b) are quite simple to ascertain and to compensate. The other parameters are so subjective that calculated lengths must necessarily remain approximations.

As opposed to the Scaling slide rule, M! does not make an addition to the »corrected pipe« length (lth-EC) for tuning slots.

and temperament (default equal temperament - ET or better 12tet)

M! can approximate end compensation EC for three different types of pipes:

*   *Open pipes*: parameters of the calculation are cutup area (cutup averaged as NM PW/16 - 1/4th of MW 1:4) as well as the pipe body measurements. Tapered and reverse tapered form are considered.

*   *Covered pipes*: The body length (not the tuned length with hat of metal pipes) of covered pipes is arrived at by subtracting twice the Ø from 1/2 lth: body length = lth/2 - 2 × Ø.

*   *Chimney flute (Rohrflute)*   (for tube Ø = 1/4 pipe Ø and tube length = 1/4 pipe length): body length is calculated as above but with lth +2 half tones: body length = (lth + 2 HT)/2 - 2 × Ø

The calculated approximations are all slightly smaller so that the listed values for pipe length are larger than the actual tuned pipe will have. The variation for open pipes lays between a few millimeters and several centimeters, depending on pitch and scale.

The category *lth-EC [mm]* displays the approximated pipe body lengths. Please remember that the values are larger than the tuned pipe will have.

If you have values for certain real pipes (as in a restoration), you can calculate the missing lengths **for 12tet** by entering these values into

the column category calculated length for the known pipes.

To begin, all notes will show only »---« because at least two values are necessary to calculate.

Enter the known values by double-clicking the note in this column, enter a value and hit the return key (↵). The entered values are marked with an arrow (→). The unknown between these entered values are immediately calculated **for ET** and listed in the column. Entering a new known value between the previous causes those affected to be recalculated. To remove an entered value, double-click on it, delete with the backspace (←) key and press the enter key to finish the operation.

Besides using the mouse, you can of course use the cursor to select and the enter key to enter a change.

Cut-Up

Has nothing been entered into this column yet, M! indicates mean values (C/16). These mean values are recognizable by the parenthesis. If single values are entered they are marked with a arrow (→). When at least two values are given, M! automatically interpolates all intermediate values automatically (geometric series).

The values of the Cut Up column are part of the calculation of the end compensation.

Example:

C1	(30,5)	*mean Value*
Fs7	→20,0	*entered Value*
c13	16,1	*interpolated Value*
fs19	→13,0	*entered Value*
c25	(10,8)	*mean Value*

Thickness of Material   In columns of the mode *Thickness [mm]* the thickness of pipes can be recorded. If values have been entered here (and only then!) columns of the category Ø, C, HP and D can be chosen to show resp. enter external measurements apart from the common inside dimensions. To have one of the above mentioned kind indicated as external measurement, you select the *Out* option in the column menu, the column title is thus extended by *-Out*.

Below the categories in the column menu you will find different preference commands for the columns:

Top Scale (End): When this is turned on (checked), the upper Ø of non-cylindrical pipes is shown in the categories *Ø, Circumference, Half Plate Width,* and *Pipe Depth*.

Factor…: As already noted, you can enter a factor here with which to multiply all values of the given column.

Decimal places: In this submenu you set the number of decimal places desired.

Lock: When this is turn on (checked), no values of the affected column can be changed, none entered or deleted. Thus, you protect against accidental changes. More about entering numerical values in the next chapter. Locked columns are designated by a lock icon.

Free Columns   Free columns are suitable for any kind of text as well as for values and formulas.

You create a free column by selecting the Free category from the column menu. A window appears into which you can enter a column title. After confirming with OK, an empty column with the title chosen is indicated in the spreadsheet. Now you can make any entry you wish.

You can alter the title of free columns later by again choosing the indication type Free from the column context menu. The contents of the column are thus not affected.

Entering Formulas

You may apply formulas in the free columns. To define an entry as a formula the first given symbol has to be a sign of equality (=).

If you, for instance, enter »2+4«, the term is not being calculated and is shown unaltered. If, however, you enter »=2+4« this term is treated as a formula and calculated; M! indicates the value *6*.

Links in Formulas

Apart from basic arithmetic and numerical values you can also apply links to other columns in the formulas. Links to other columns consist of letters and numerical values. The letters refer to the column (the according letters are indicated at the head of the spreadsheet: A, B, etc.) whereas the numerical part refers to the line resp. the half tone (1 to 61). The link *C52*, for example, refers to the half-tone d#52 in column C. The columns resp. half tones which are referred to can also be hidden (e.g. half tones by setting only C-F# or columns by hiding the corresponding stop in the graphic view). When you are in the input mode of a free column you can set links by simply clicking the corresponding part in the spreadsheet.

The numeration of the columns includes the letters A to Z. If there are more than 26 columns in the spreadsheet, the numeration is continued »two-placed« (AA, AB, AC,...BA, BB etc.).

Capitalization is of no importance for links.

Please make sure not to take a link for a tone!

Fill Up/Down

You can apply the *Fill Down* resp. *Fill Up* commands from the *Edit* menu for multiplying constant values, texts or formulas. To do so, you mark the section which is to be filled in, whereas the value marked last has to be the one that is to be copied. Then select either the *Fill Down* or *Fill Up* command.

A peculiarity is effective for formulas: Links in formulas are adjusted to the new position when filling in. Thus you can set a formula for a tone and then apply it accordingly for all other half tones.

Fixing Links

If you wish to stop this adjustment (for instance to always refer to a base tone in a filled in section) enter »$« after the link.

Example: In the formula *=2*A$1+B2* the link *B2* is adjusted with the *Fill Down* command the fixed command A$1, however, is not!

When columns are moved or erased the afflicted links automatically adjust to the new situation.

Example: Cut list

With free columns you can also create complex tables, such as cut lists for wooden stops, directly in M!:

This step is explained later in more detail. See »Creating a new stop« at page 33.

Create a new stop *8' covered*. Open the column menu of the *Tones* column and choose the option *All Half Tones*.

Then copy the Ø column of the spread- sheet an change into the indication mode of both columns *Pipe Depth* and *Mouth Width*.

Open the column menu of the first column, hold down the ⌥ key and choose *Add Mouth Width Column*. Open the column menu of the first column again and choose the category *Pipe Depth* (without holding down the ⌥ key).

The columns now already show the measurements of the pipes. Now copy a column of the stop and set the column type *Thickness*.

Open the column menu of the last column, hold down the ⌥ key and choose *Add Thickness Column*.

Enter the thickness of material into this column.

In the column *Thickness*, enter the value *0.6* at half tone *C1*. Then select all cells in this column by clicking onto the stop name *8' covered* in the column header. Then choose the command *Fill Down* from the *Edit* menu.

In a real world application, the thickness value wouldn't be constant throughout all half tones. It's only to simplify this example.

Now you can mark the *Out* option from the context menu of the Pipe Depth column.

Open the column menu of the column *Pipe Depth* and choose the option *Out*.

Thus the cut width is indicated in this column.

Create yet another column and set it for the indication type *lth-EC*.

Since extras have to be added to the indicated lengths (e.g. for stoppers etc.) you create another two columns which you declare Free with the corresponding column context menus.

Open the column menu of the last column and choose *Duplicate this Column*. Open the column menu of the duplicated column, choose the category *Free…* and enter *Extra Length* as column title. Repeat the whole procedure one more time, but name the column *Cut Length* this time.

In the following exemplary formulas it is assumed, that the lth-EC *column bears the column letter* D*, the* Extra Length *column the letter* E *and the* Cut Length *column the letter* F. *If your spreadsheet bears other letters, modify the formulas accordingly.*

Now you can directly set absolute values for the Extra Length column. In this example, however, an extra length of 10% of the corrected length is to be added for each pipe.

Enter the following formula into the Extra Length column at the halftone *C1*: *=D1/10*

After leaving the field M! immediately calculates the given 10% of the corrected length (from column D).

To carry out this calculation for all half tones, mark the entire column and select the *Fill Down* command from the *Edit* menu.

Thus the formula is copied into all lines. The link to the corresponding halftone in column *D* is adjusted automatically..

For calculating the final cut length you now enter the following formula into the *Cut Length* column at the halftone *C1*: *=D1+E1*

Fill in the formula for all halftones in this column with the *Fill Down* command.

.

Creating stops · Stop preferences ·
Constant progressions · Broken scales
· Free-variable scales (addition con-
stants) · Standard scale

Chapter 4

Next to the scale *Principal 8'* we shall make some new scales to demonstrate the different possibilities.

Choose *New Stop* from the *Scaling* menu.

Creating a new stop
Alternatively, just click on the + button below the stop list.

A new stop with the name *Untitled* is added to the stop list. This stop is initialized with the default stop preferences (8', cylindrical, open).

Click on the »i« button next to the new stop's name.

Stop preferences

The stop preferences window contains several sections. The title bar of each section contains a triangular button. By clicking on one of these buttons, you can toggle the visibility of the respective section. M! remembers the visibility settings of each section, so the hidden sections stay hidden the next time you open a stop preferences window.

This opens a popover window, which contains the stop's preferences. The popover window automatically closes if you click outside its bounds, somewhere in the main window.

To keep the stop preferences window open for a longer time or maybe open stop settings of multiple stops at the same time, it's possible to tear a popover window off. The stop preferences window will change to a »normal« window which can be moved around and stays open until closed manually.

To tear off a popover window, click into an empty region inside the popover window and drag the mouse.
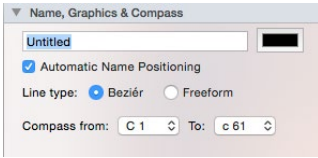
Name, Graphics & Compass

This section contains an edit field to change the stop's name. Next to the edit field, you'll find a color well. Click on this to change the color of the stop in the graphic view.

The option *Automatic Name Positioning* controls if the stop's name is positioned automatically in the graphic view (left of the grid at height of the first anchor point). See »Free placement of names« at page 64 for information on how to manually position a scale's name in the graphic view.

The option *Line type* can be used to set the drawing mode of a scale in the graphic view to either Bézier (Spline) mode or free-hand mode. See »Modifying scale curves« at page 19 for more information.

Enter the *Compass* of the stop with help of the pop up menus for the first and last half tone of the stop. This limits the scale to the entered values.

Please note, that subsequent changes of the compass temporarily change the scale to freehand mode. If a scale's line contains curve points, these will be changed into corner points.

First, enter a name for the new stop: *Tierce 1 3/5'*.

Obviously a 1 3/5' stop, you set the proper foot tone level in the next section.

Foot tone level
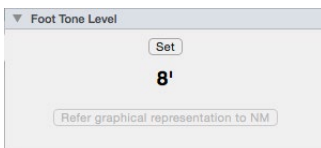
Enter the foot tone level of the stop in this section. To choose a foot tone level, click on the *Set* button. Note that the different mutations are ordered as to overtone interval:

Select option *8/5=1 3/5* in the *Thirds* section. Close the foot tone level window by clicking outside of its bounds.

If you select *Covered* in the pop up menu in the section *Type & Body*, M! calculates the end compensation according to the formula MK=2×Ø.

If you select *Chimney Flute* (Rohrflute), the end compensation is also calculated as above, but with *lth + 2 half tones* (Chimney-Ø = 1/4, Chimney length = 1/4 body length).

In either case, the theoretical length is the same as with an open pipe..

Non cylindrical pipes are explained in a later chapter (see »Non-cylindrical pipes with free-variable ratio« at page 61).

Covered Stops

Mouth Scales

This stop should have a constant ratio of 1:4.5. A constant ratio for the mouth width can be entered in the Mouth Width section of the stop settings window.

Enter *4.5* into the edit field next to the *Constant* option in the *Mouth Width* section.

We don't change any other setting for now. Other options, like variable mouth width or conical pipe bodies are handled later.

Close the popover window with the stop's settings by clicking outside of its bounds (in case you've »teared off« the popover window, click on the red close button in the settings window's title bar).

The new stop appears automatically in the spreadsheet as well as in the graphic view.

2', c13 = 25mm Ø, following NM

The next stop will be one that does not begin with the Ø value of NM: a 2' with a c13 value of 25mm.

Choose again *New Stop* from the *Scaling* menu. Then open the settings window for the new stop by clicking on the »i« button next to the new stop's name in the stop list. Change the name of the new stop to *narrow 2'*.

Now change the foot tone level of the new stop:

In the section *Foot Tone Level*, click on the *Set* button and choose the option *2'* from the *Octaves* section.

Initially, this will show the first note of the stop length in NM (8' - C1 = 155.5mm, other partials to pure intervals, i.e. 2' - C1 = 54.98mm).

Select the option *Free Ø* and enter the new value *25* into the edit field below.

Since this is not the diameter of C1 but of c13, you want to change the *Base tone* setting accordingly:

Choose *c13* from the *Base tone* pop up menu.

The entries in the Foot Tone Level window should now look like in the screen shot on the right.

Close the window Foot Tone Level by clicking into the stop settings window behind it.

The changed settings are also displayed in the section Foot Tone Level in the settings window:
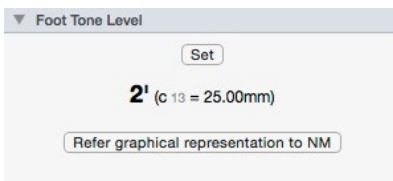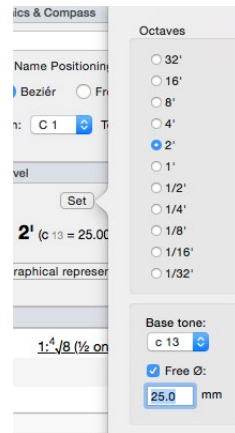
On the spreadsheet, you can see that M! has calculated the values for this stop so that c13 intersects Ø 25mm. Apart from that, the scale is parallel to NM (halved at the 17th).

Please note that the graphical representation of this scale is identical with NM.

The generated scale is superimposed on NM because NM is still stipulated as progression (halving at the 17th), only the given initial diameter is different. Graphically, this is only a horizontal replacement of the scale curve.

If you wish to compare this to a »normal« 2' stop graphically, you must go about this as follows (see also the notes in the side bar):

Add a new stop. Open the stop's settings window and rename it to *2' manually*. Set the foot tone level simply to *2'* but do not change any other settings.

Set the position panel below the graphic view to Diameter [mm] (click on the position panel to open a context menu, see »Position panel« at page 18). For easier access, its best to hide the other scale (*narrow 2'*) by deselecting the check box in the *G* column next to this stop in the stop list (see also »Stop visibility« at page 41).

Move the scale in the graph view by clicking at c13 and dragging it down until the position panel displays 25mm.

The values will be identical to *narrow 2'*. Which method you choose will depend on your intention.

Refer Graphical Representation to NM

The above manual dragging of the stop's scale line can also be done automatically by M!

Unhide the scale *narrow 2'* in the graphic view by checking the check box in the *G* column next to the stop's name in the stop list again.

For those familiar with the Scaling slide rule:

The first method is the same as setting the slide so that »25« on scale »④ Du« is under »c13« of the NM scale on the body. The remaining diameters can be read directly for NM for each note.

The second method is done as follows: set »2'« on scale »⑤ Al« to HT C0 on the body. Set the hairline edge to this position, too. Lay the slide rule on a sheet of scale paper so that the marking edge lays on ±0 NM. When you set the hairline edge to »25« on scale »④ Du« you can mark on the paper at c13 for this scale and read off the deviation. If you wish only to read, use the hairline itself (though it makes no difference). Transferring the necessary values for the scale will give you the necessary point on the paper to draw the scale. Then you can read off any note.

Open the stop settings window of *narrow 2'*. The display in section *Foot Tone Level* should still look like this:
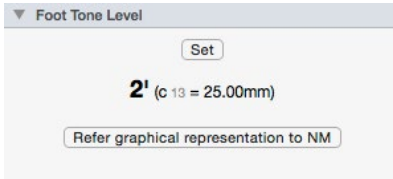
By clicking the button *Refer graphical representation to NM*, M! shifts the scale in a way that the graphical representation can be read without a shifting of the origin.

Click on *Refer graphical representation to NM.*

The scale of *narrow 2'* should now have been moved vertically down, so it's now at the same height as *2' manually*. The section *Foot Tone Level* should now display simply *2'* (without any diameter additions) since the displacement is now represented by a graphical displacement of the scale and not calculated internally as before. The numerical values of the scale are thus not altered!

The following example will explain how you can generate curves with progressions other than NM. M!'s default setting is the so-called *Töpfer normal scale* (NM), 1:$\sqrt[4]{8}$ octave ratio or halving at the 17th.

Now, we want to make a scale with a different progression: 1:1,664 (3:5).

Other constant progressions

The default progression can be defined in the document preferences (see »Document preferences« at page 81).

Create a new stop and open its setting window. Rename the stop to *8' Prop: 3:5*.

The correct 8' foot level is set by default. Now set the new progression in the section *Progression*. The table in this section currently shows the default settings of the document:

The entry *1:⁴√8 (½ on 17th)* is the *Töpfer normal scale* (NM) and it's valid for all calculated half tones (*C1* to *c61*).

Double-click on this table row in order to open a edit window for this entry. Besides some standard options for the new progression, there's also an option to enter a free progression.

Select the option next to the edit field and enter *1.664* into that edit field. Then click on the *Change* button.

The table in the section *Progression* now displays the new progression:

On the graph you see the new scale as diagonal straight line, beginning at NM (± 0HT), the starting diameter set in the stop preferences by default and not changed by us. Because the progression is stronger, the line rises to the right, giving an increasingly wider scale.

On the spreadsheet you can see that the correct progression has been used: The diameter $c13=93.45$ does correlate to $C1=155.50/1.664$.

If find the spreadsheet to be cluttered, you can delete columns of possibly uninteresting data by choosing Remove this column from the column's menu. This deletes only the chosen column, the other data and the scale itself on the graph remain untouched.

Deleting columns in the spreadsheet

Another option to organize visibility of stops in the spreadsheet (and graphic view) are the show/hide check boxes in the stop list view. To the right of the stop names are two additional columns: S and G. The check boxes in the »S« column control the visibility of the stops or groups in the spreadsheet. Links to hidden columns in formulas aren't affected by the visibility settings.

The check boxes in the »G« column control the visibility of scales in the graphic view.

Stop visibility

Broken scales

Changing from one constant progression to another in one scale give a so-called *broken scale*.

Create a new stop and open its setting window. Rename the stop to *8' broken*.

To add additional rows to the *Progression* table, use the »+« button below the table. If a row is selected, you can remove this row by clicking in the »–« button below the table.

Click on the + button below the *Progression* table.

This opens a window in which you can enter the progression of the new section.

Use the pop up menus at the top to set the range for this progression: *C1* to *c13*. Click on the option button for entering a free progression and enter the desired progression, in this case *1.6,* into the edit field. Now click onto the *Add* button to add the new section to the progression table.

The progression table contains now two rows. In the graphic view, you can see the scale rising from C1 to c13 (since the progression for this range was set to a »wider« value as the base progression ($1:\sqrt[4]{8} = 1:1.6818)$ of the document). From there on, the scale runs parallel to NM.

There is an unlimited possible number of segments in the progression list.

Add another row to the progression table. This time, set the range from *c37* to *g56* and enter the progression ratio of *1:1,714*.

In the progression list you will now see how the broke scale is divided up.

Now set the foot tone level at 8' and the start Ø at C1=130mm in the foot tone level window.

Click on the *Set* button in the section *Foot Tone Level*. Select the option *Free Ø* and enter *130* into the edit field below this option. Close the foot tone level window by clicking outside its bounds.
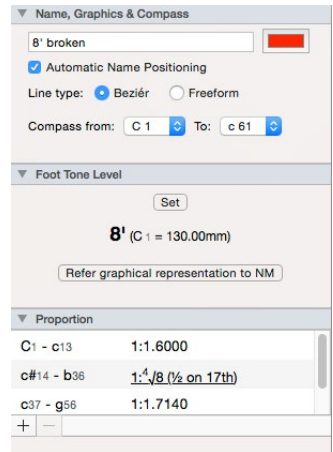
The settings window of the stop should now look like the screen shot on the right.

On the graph, you can shorten the scale to *g56*, your projected last note:

Select the last anchor point of the scale (HT c61) in the graphic view and hit the backspace key (←) to delete it.

On the spreadsheet you can now check the values in the column *8' broken (Ø [mm])*:

Tones C-F# ▾		8' broken Ø [mm] ▾
C	1	130.00
F#	7	102.77
c	13	81.25
f#	19	62.65
c	25	48.31
f#	31	37.25
c	37	28.68
f#	43	21.91
c	49	16.73
f#	55	12.78

▾ Name, Graphics & Compass

8' broken

☑ Automatic Name Positioning

Line type: ● Beziér   ○ Freeform

Compass from: C 1   To: c 61

▾ Foot Tone Level

Set

8' (C 1 = 130.00mm)

Refer graphical representation to NM

▾ Proportion

C1 - c13	1:1.6000
c#14 - b36	1:^{4}/8 (½ on 17th)
c37 - g56	1:1.7140
+ −	

Optionally, you can set the compass also in the Section Name, Graphic & Compass *in the stop's setting window.*

Fixed-variable scales

Fixed-variable scales are such that use a constant geometric progression but modify this by adding or subtracting a numerical constant - a mm value - (*addition constant*) to generate

a new curve. Compared to NM, these curves are similar to exponential curves.

This is done in M! in the window which appears when you add a progression.

Create a new stop and open its setting window. Rename the stop to *8' fixed-variable*. Double-click the only entry in the progression table in section *Progression*.

A window to edit the double-clicked row opens.

Select the option *Addition constant* and enter *5* into the edit field next to it. Finally, click on the *Change* button.

The table in the section *Progression* now shows the progression with its addition constant:

The graph now shows a ascending curve.

Thus, in the section *Progression* you can set any combination of different addition constants and even broken scales for different parts of the range of the stop.

Standard scale

In moving splines, scales are temporarily transposed to freehand, so curve points

By standard scale one means a single scale, extended at both ends, is used as a basis for several stops. In M! you can move scales horizontally as well with the mouse.

Before move, duplicate the scale in question each time:

are lost and are finally simulated by corner points.

Select a stop in the stop list. Then choose the menu command *Duplicate* from the *Edit* menu.

Mouth scales · Constant ratios · Free (variable) scales · Entering numerical values · Entering comments · Grouping scales · Macros

Chapter 5

Constant mouth scales are obviously solely dependent on diameter. The method for setting the ratio of these has already been explained in chapter 4: simply enter it in the section Mouth Width in the stop's settings window (see »Mouth Scales« at page 36).

Constant ratios

If the mouth scale is to be independent of the diameter, you must generate a separate scale curve for it. This scale should use the same parameters (foot tone level, progression) as the Ø scale in question. In order to make this process as easy as possible, M! provides an automatic function for this.

Free-variable mouth scales

Create a new stop and open its setting window. Rename the stop to *8' free mouth*. In the *Mouth Width* section, select the option *Variable*.

M! automatically creates an additional scale for the free-variable mouth scale and renames it accordingly (*MW 8' free mouth* in this case, *MW* stands for *Mouth Width*). Internally, this new scale is automatically linked with the original scale *8' free mouth*. You see this link when you open the settings window of *8' free mouth*: In the section *Mouth Width* the option *Variable* now displays *MW 8' free mouth* as the linked scale. To organize the liked scales,
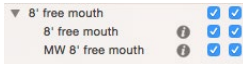
M! also creates a new group *8' free mouth*, containing the original stop and the automatically created mouth width scale.

Another method is to create the mouth width scale manually by copying and pasting the scale's curve:

Open a new document with *New* from the *File* menu.

A new document window is opened. This document contains a default stop *Untitled*.

Open the settings window of this stop and rename it to *2' free mouth*. Click on the *Set* button in the section *Foot Tone Level* and choose the option *2'* from the section *Octaves*. Leave all other settings unchanged and close the settings window.

Now generate the scale in the graphic view. Insert a further anchor point at HT c37:

To make positioning the points easier, you want to switch the position panel (below the graphic view) to Deviation [HT].

Select the scale in the graphic view by clicking onto the name of the stop. Switch to the *Pen* tool and insert a new anchor point by clicking at *HT c37* and deviation *+2 HT*. Hold the mouse button down when clicking and drag the mouse to the left.

This changes the newly created anchor point from a corner point to a curve point.

Furthermore you might want to hold down the shift key (⇧) when adding or moving anchor points. This will temporarily switch on the vertical and horizontal grid. Optionally, you can activate the grid also in the Tools *menu.*

Drag the handle to the left until the mouse pointer reaches approximately HT c25.

The scale should arch upward.

Change back to the Pointer tool. Move the left anchor point vertically to a deviation of +6,5 HT. Move the right anchor point vertically to a deviation of +7,5 HT. With the right mouse button, click on the

left anchor point and choose *Curve Point* from the context menu.

Since the left anchor point has been changed to a curve point, it now also displays a handle.

Drag this handle horizontally to the right to *HT A#11*.

The scale should resemble this:
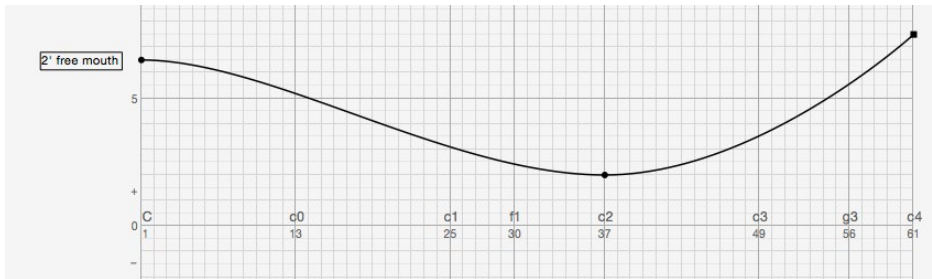
Now, copy this scale with *Copy* from the *Edit* menu.

Duplicating scales

Be sure that the scale is activated before doing this (if necessary, click on the line).

Choose *Paste* from the *Edit* menu to duplicate the scale.

Because it is superimposed on the original, it is not visible on the graph. In the stop list, however, you will find the second scale as well as in the spreadsheet..

Open the settings window of the copy and change its name to *mouth 2'*. Change the color for the scale as well by clicking on the color well next to the name edit field. For instance, choose a red color.

The curve of *mouth 2'* should still be selected in the graphic view.

If not, select *mouth 2'* by clicking on its name in the stop list.

Since mouth 2' is selected, you should now see the curve's anchor points in the graphic view.

Drag the left anchor point vertically to deviation +3,5HT, the right anchor point to deviation +4HT and the middle anchor point to deviation +6,5HT.

The graph should now look like this:
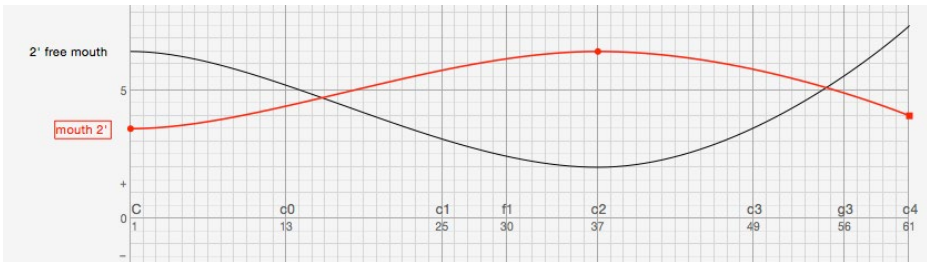
In order for the spreadsheet to be able to correctly calculate the mouth widths (for instance for EC) the mouth scale must be linked with the diameter scale.

Linking mouth scales to Ø scales

In the graphic view, click on the name of the mouth scale (*mouth 2'*). Drag the name onto the name of the diameter scale (*2' free mouth*), until the mouse pointer changes to an anchor icon. Then release the mouse button.
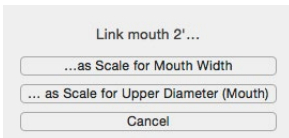
A dialog window *Link mouth 2'...* appears.

Click on the option *...as Scale for Mouth Width.*

Add an additional column for the stop 2' free mouth to the spreadsheet to display the mouth scale:

In the spreadsheet, click on *Ø [mm]* of column *2' free mouth* and hold down the ⌥ key.

By holding down the ⌥ key, the category options of the column menu change to *Add … column* options. I.e. by choosing one of these options, a new column is created with the chosen category.

Choose *Add Mouth Width Column* from the column menu.

Next to the column *2' free mouth Ø [mm]* a new column *2' free mouth MW (from mouth 2')* is inserted.

As you can see, the values for MW of the stop are identical (if necessary, change the display of *mouth 2'* to *Mouth Width [mm]*). Since the column *mouth 2'* has outlived its usefulness, you can delete it.

Open the column menu of the column *mouth 2'* and choose *Remove this Column*.

You can display the ratio for every note on the spreadsheet. Add another column to the spreadsheet:

Open the column menu for column *2' free mouth Ø [mm]* and hold down the ⌥ key. Then choose the option Add Ratio Column.

Your spreadsheet should more or less look like this:

You can tell that the mouth widths are extracted from a separate mouth scale by following column header

2' free mouth
MW (from mouth 2') [mm]

If the column is too narrow to show the entire heading, you can widen it with the mouse by dragging the separator line to the right (see »Change a column's width« at page 15).

Tones C-F# ▾	A 2' free mouth Ø [mm] ▾	B 2' free mouth Ratio (1:n) ▾	C 2' free mouth MW (from mouth 2') [mm] ▾
c 1	72.86	4.56	50.25
F# 7	55.18	4.42	39.21
c 13	40.92	4.14	31.04
f# 19	30.13	3.83	24.68
c 25	22.23	3.56	19.60
f# 31	16.57	3.37	15.46
c 37	12.60	3.29	12.03
f# 43	9.90	3.38	9.20
c 49	8.01	3.62	6.94
f# 55	6.65	4.03	5.18
c 61	5.65	4.65	3.82

Minor differences in the values are possible, since you've constructed the curves manually.

Automatic scale for mouth width for numeric documentation

If a value is entered in the spreadsheet into a column which indicates the mouth width of a register with constant ratio, that makes a free mouth width necessary, M! automatically creates the necessary scale for the free variable mouth width and links it to the diameter scale according to your wishes.

Delete *mouth 2'* by selecting this scale in the stop list and then clicking on the »–« button below the stop list.

You can see in the spreadsheet, that M! changed the mouth width of *2' free mouth* back to »constant«. The column *Ratio [1:n]* now displays the default ratio of *4.00* and the title of the mouth width column displays *MW (1:4.00) [mm]* as category.

To set the variable mouth width of *2' free mouth* numerically, you can simply change the values in the column *Ratio [1:n]*.

The same way, you can also enter MW (from …) [mm] values.

Double-click on the value at *C1* in column *Ratio [1:n]* and enter 5. Then press the Return key (↵) to commit the changes.

This change will trigger M! to do the following:

Due to the change of the ratio at half tone C1, the mouth width of the stop changes back to »free-variable«, i.e. M! creates an additional scale for the mouth width, links it with the original stop and puts both scales in an automatically created group, named 2' free mouth.
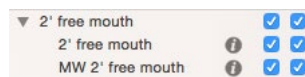
In the graphic view, the anchor point of the mouth scale at *C1* is moved to a deviation where the mouth width ratio equals 5. The curve of the mouth scale interpolates all half tones up to the next anchor point. You can see that in the spreadsheet: the ratio of the half tones between C1 and c37 (the half tone with the next anchor point) rises continuously from 1:5 to 1:4.

If you enter a value for a half tone which doesn't have an anchor point yet, a new anchor point is created.

Enter a ratio of 3.5 at half tone c25.

This creates a new half tone at c25. Please note, that automatically created anchor points

are always corner points. If you like to create smooth curves, you want to change the anchor points to curve points (or connection points) and adjust the handles manually.

Delete the anchor point at c25 by selecting it and then hitting backspace (←).

Comments in the graphic view

It is advisable to denote the basis of the free mouth scale on the graph.

Double-click in a free area of the grid.

A text cursor will show: you can enter your comment.

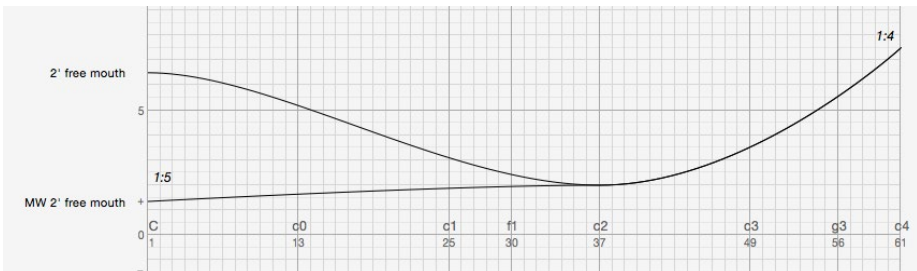Enter the text *1:4 and hit the return key* (↵).

To change the text of an existing comment, double-click on the comment to edit.

To delete a comment, either drag it into the margin area left of the grid or edit the comment and delete the text.

The comment will show in *italics*. You can drag the comments around with the mouse. Best, of course, to put them next to their respective scales.

Drag the comment to the right end of the scale. Create a second comment by double-clicking into a free area in the grid again. Enter the text *1:5*. Move this comment to the start of the scale on the left side.

The graphic view should now look like this:

To link a comment with a scale, i.e. the comment has the same color as the scale and is hidden with it, drag the comment onto the scale name until the anchor appears. After releasing the mouse button, the comment will still be where you put it first time, but it will have the color of the scale, etc.

Linking comments

For better visualization of the linked comment, first give the scale *2' free mouth* a new color:

Open the settings window for the scale *2' free mouth* and click on the color well in the section Name, Graphic & Compass. Choose, for instance, a blue color.

Now, link the two comments with the scale *2' free mouth*.

Drag the comment *1:5* onto the name 2' free mouth. When the mouse pointer changes to an anchor icon, release the mouse button.

The comment falls back on its original position after releasing the mouse. You can tell the successful link with the scale immediately, since the text color of the comment changed to the scale's color.

Repeat the procedure for the second comment: *1:4*.

Now hide the scale *2' free mouth* in the graphic view to see that the comments also hide:

In the stop list, uncheck the check box in column *G*, next to the group *2' free mouth*.

Grouping scales

▼ Untitled

Stops can be grouped together. Groups in the stop list are indicated by the triangular button left to the group's name. Click on this button to fold or unfold the group's contents.

Create a group by clicking on the folder button below the stop list. This adds a new, empty group with the default name *Untitled*.

Renaming a group works the same way as with stops.

It's also possible to select multiple stops by holding down the cmd key (⌘) or the shift key (⇧, for continuous selections) when selecting a stop.

Select the group by clicking on its name once. Then click on the name a second time to edit the group's name. Rename the group to *Great Organ*.

Stops (and other groups) can be added to a group by drag & drop.

Drag the group *2' free mouth* onto the group *Great Organ*.

With help of the menu command *New Group from Selection*, it's possible to group items without creating an empty group first.

The command New Group from Selection *is also accessible through a context menu in the stop list. Right-click on a selection in the stop list to open the context menu (or ctrl-click on laptops).*

Create two new stops: *Subbas 16'* and *Octavbass 8'*. Then select both stops (by holding down the cmd key (⌘) while selecting the stops) and choose the command *New Group from Selection* from the *Scale* menu. This groups the selected stops in anew group. Rename this group to *Pedal*.
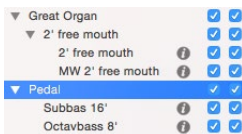
Apart from the logical and visible aspects, grouping has definite advantages:

- you can hide and show all scales of a group at once by clicking on the check boxes in the S and G columns of the stop

list. The check box in column S controls the visibility in the spreadsheet, column G the visibility in the graphic view.

- you can fold and unfold groups in the stop list to gain room or clarity. Once folded, only the group name is shown. To unfold or fold, click on the triangular button to the left of the group name.

▼ Untitled

- you can move groups as single units (Drag & Drop).

You can use fundamental arithmetic operations (+, -, *, /) while entering numerical values. After depressing the Enter key, M! calculates the statement in arithmetical order.

Macros for recurring operations like this can be made, too.

Here an example:

You have taken the scales of a historic organ; this is generally done by taking the circumference with a paper strip. Of course, the inside circumference is the important measurement, so M! must deduct the metal thickness

Using these measurements:

Using arithmetic operations and macros

HT	Outside cir.	Thickness
C	250mm	0.6mm
C#	245mm	0.6mm
D	236mm	0.6mm
D#	226mm	0.6mm
E	215mm	0.5mm
F	205mm	0.5mm
…	…	…

In a new document, create a stop *Principal 4'* (or rename the untitled default stop in the new document). Set the foot tone level to *4'*. Change the category of the stop's column in the spreadsheet to *Circumference [mm]*. Set the half tone filter of the spreadsheet to *All Half Tones*, by clicking on *C-F#* in the *Tones* column and choosing *All Half Tones* from the column menu.

Of course, the outer scale could also be entered using M!'s built-in support for thickness columns and calculating outer scales. In that case, you would select the option Out *in the column menu of column* Circumference [mm] *and add a second column with the category* Thickness [mm]. *You could enter the measured thickness values into the* Thickness [mm] *column and the outer circumferences directly into the* Circumference-Out [mm] *column. Although this might be probably the way to go, we would loose a fine example for macros here.*

The material thickness can be directly subtracted from the circumference, for example:

At half tone C, enter the formula: *250-2*3.14*0.6*

When hitting the return key (↵), M! calculates this as 246.23, the inside circumference of the pipe.

Material thickness is normally the same for several pipes, so using a macro to define thickness can accelerate the process:

C value: *250#-2*3.14*0.6#*

After entering this statement, the same value as above is calculated, but additionally the expression between the two »#« has been stored as a macro. You can reduce the next statement to the value alone:

C# value: *245#*

Instead of duplicating #, M! substitutes the macro for # and calculates:

245-2*3.14*0.6 = 241.23.

Redefining the macro is first necessary when the thickness changes, in our example at E:

E value: *215#-2*3,14*0,5#*

After entering the changed data, the macro is changed, too, and can be used until it must be changed again.

The macro subroutine of the program works like this: The value in question is first scanned for the macro sign »#«, if there is only one »#« the stored macro is displayed instead of the value, if no macro has been defined, the »#« is ignored.

If two »#«s detected, the entire statement between those »#«s is interpreted as a macro and stored.

Here is another (advanced) example of a macro:

1. statement:

250-#2*3.14*0.#6

defined macro:

2*3.14*0.

2. statement.

245-#6

interpreted:

245-*2*3.14*0.*6

3. statement:

215-#5

interpreted:

215-*2*3.14*0.5*

Non-cylindrical pipes: constant and free- variable · Free placement of names on the graph

Chapter 6

In generating scales for non-cylindrical pipes, you can choose between a constant ratio of the upper and lower Øs and a free-variable ratio.

Tapered pipes with a constant ratio can be defined directly in the stop settings window.

Non-cylindrical pipes with constant ratio

In section *Type & Body* you can enter a factor for the upper Ø. Select the option *Body: Conical (fix)*, then enter the factor into the edit field. If the upper Ø is smaller than the lower, the value must be <1. If the upper Ø is larger, the value must be >1.

To display the upper Ø on the spreadsheet, set one column to *Ø [mm]* and then select *Top scale (End)* from the column menu. This column will now show the upper Ø and the heading is augmented by »-Top«.

Displaying end Øs in the spreadsheet

The option Top scale is available for the categories *Ø [mm], Circumference [mm], Half plate width [mm]* and *Pipe depth [mm]*.

You can also make a separate scale for the upper diameter, exactly as you have done for the free-variable mouth scales, and link this to the Ø scale.

Non-cylindrical pipes with free-variable ratio

Open a new document. Change the name of the untitled default stop to *Tapered Stop*.

Create a new stop for the upper scale:

When creating a scale for the upper Ø, be sure that the starting Ø or the optional free Ø and the foot tone level are commensurate. Make, if necessary, changes to the scale of the linked stop.

Click on the + button below the stop list and rename the new stop to *Upper Scale*.

Change the curve for the upper scale:

Select the Upper Scale by clicking on its name in the stop list. Drag the left anchor point in the graphic view vertically down to a deviation of -5HT. Change the right anchor point to a curve point (right-click on the anchor point to open a context menu). Then drag the handle of the right anchor point horizontally to c25.

The scale arches upward and should look about like this:
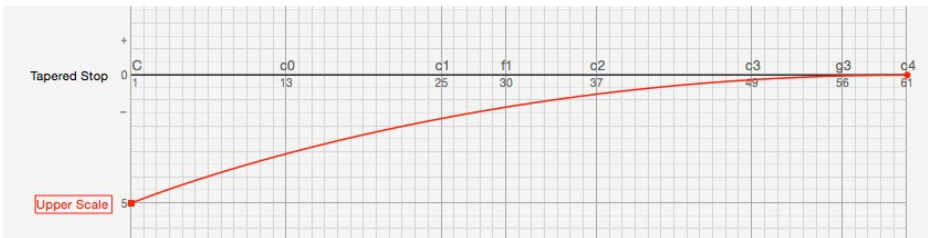
Now drag the name *Upper Scale* onto *Tapered Stop*.

After releasing the mouse, a window *Link Upper Scale...* opens.
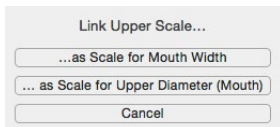
Click on *... as Scale for Upper Diameter (Mouth)* in the link window.

The two scales are linked now.

Delete the redundant column *Upper Scale Ø [mm]* in the spreadsheet:

Choose *Remove this Column* in the column menu of column *Upper Scale Ø [mm].*

Duplicate the remaining column *Tapered Stop* in order to display both, the lower and the upper diameters.

Choose *Duplicate this Column* in the column menu of the column *Tapered Stop Ø [mm]*. Then select the option *Top Scale (Mouth)* in the column menu of the duplicated column.

The two column now display the upper and lower Øs of the stop. It is obviously a tapered stop approaching cylindrical in the treble.

It is recommended, as with free-variable Ø scales, to group these related scales together in the stop list.

If you let M! create the upper scale for you, the grouping is handled automatically:

Create a new stop by clicking on th + button below the stop list. Open the new stop's setting window and rename it to *8' conical*.

The following step triggers M! to create the second scale for the upper diameter automatically:

In the settings window in section *Type & Body*, select the option *Conical (var.)*.

M! creates a new scale and renames is *Top 8' conical*. The new scale is linked to the main

scale and both are grouped in a new group *8' conical*.

Free placement of names

The more names you have on the graph, the higher the possibility that they may overlap since these are automatically placed by next to the end of the scale by the program. You can override this command by dragging the name to a different position on the graph, either vertically in the margin or anywhere on the grid.

To revert to automatic positioning, simply check the option *Automatic name position* in the stop's settings window (section *Name, Graphic & Compass*).

Analysis of given pipes · Fading out of unwanted half tones

Chapter 7

With M! you can also analyze given pipes. First, open the stop as usual, then enter the available data directly into the spreadsheet. The graph will show the resulting curve.

Open a new document. Rename the stop *Untitled* to *Superoctave 2'*.

Set a foot tone length of 2':

In the stop's settings window, click in section *Foot Tone Level* on the *Set* button and select *2'* from the *Octaves* section.

Entering a Ø scale in the spreadsheet

Since only the »Cs« were measured, only these notes will be needed for the bottom 5 octaves. The others can be faded out for easier reading.

Click on the notes *C1, c13, c25, c37*, and *c49* in the *Tones* column to mark these tones.

Possible mistakes can be corrected by clicking again.

Select *Only marked* from the column menu of the *Tones* column.

All unmarked tones will be faded out.

For the purpose here, one decimal place is sufficient, so choose *1* from the *Decimal places* submenu in the column menu of *Superoctave 2'*.

Hiding half tones

The spreadsheet should resemble this:

					Tones Marked ▾	A Superoctave 2' Ø [mm] ▾
Superoctave 2'		ⓘ	✓	✓	C 1	55.0
					c 13	32.7
					c 25	19.4
					c 37	11.6
					c 49	6.9

Now double-click on the value 55.0 to be able to edit it. Enter 62.4 and hit the return key (↵).

c13 = 37.2 mm
c25 = 28.0 mm
c37 = 18.1 mm
c49 = 12.0 mm

Do the same for the remaining half tones (values see left).

In the graphic view, activate the unnecessary coordinate at c61 and delete it with backspace (←).
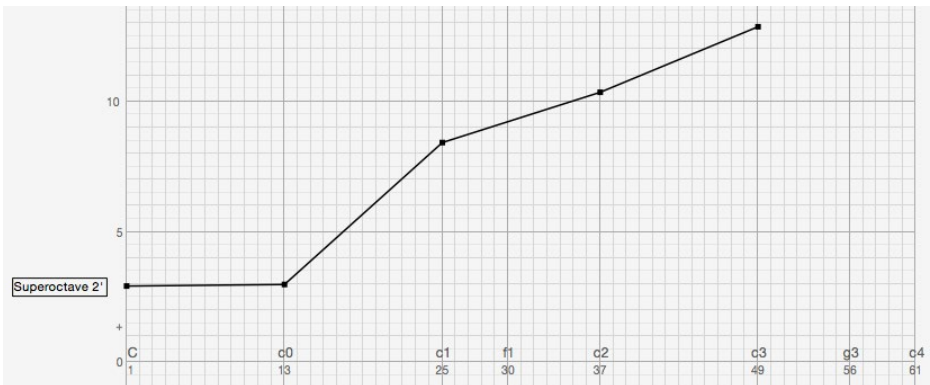
Create an additional column for the stop *Superoctave 2'* in the spreadsheet:

Hold down the ⌥ key and choose Add Circumference Column from the column menu of the available column.

Tones Marked ▾	Superoctave 2' Ø [mm] ▾	Superoctave 2' C [mm] ▾
C 1	62.4	196.0
c 13	37.2	116.9
c 25	28.0	88.0
c 37	18.1	56.9
c 49	12.0	37.7

Because the mouth scale of the measured stop were not a constant 1:4, we should generate a free-variable scale commensurate with these values.

Entering numerical values for mouth scale

Open the settings window for *Superoctave 2'* and select the option *Variable* in section *Mouth Width*.

M! automatically creates a new scale for the mouth width: *MW Superoctave 2'*, links it with the main scale and groups both in a new group *Superoctave 2'*. In the spreadsheet a new column *Superoctave 2' MW (from MW Superoctave 2' [mm]* is automatically added.

Now you can enter the available data into the spreadsheet:

Double-click on the first row of column *Superoctave 2' MW (from MW Superoctave 2') [mm]*. Enter the measured values (see on the right).

C1   =   38.5 mm
c13   =   24.0 mm
c25   =   18.0 mm
c37   =   11.2 mm
c49   =   7.1 mm

The graph should now look like this:
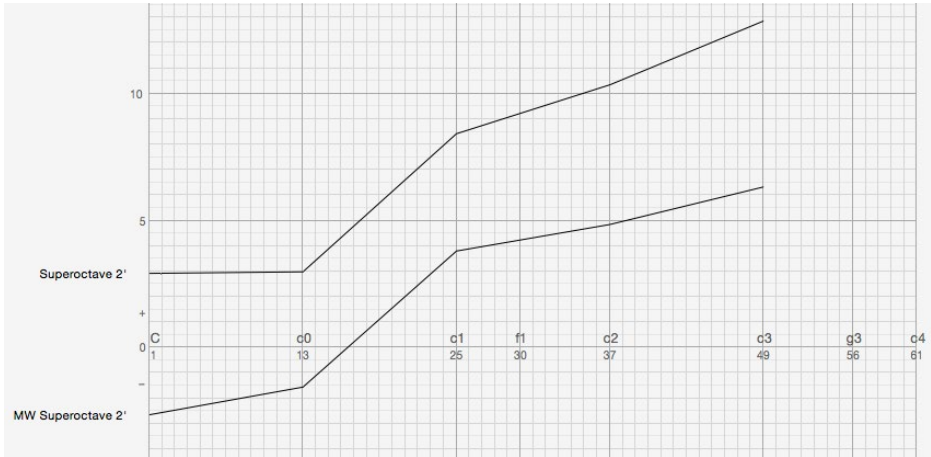
Create now a new column to analyze the mouth width ratio of this stop:

Hold down the ⌥ key and choose *Add Ratio Column* from the column menu of the last column in the spreadsheet.

Tones Marked ▾	A Superoctave 2' Ø [mm] ▾	B Superoctave 2' C [mm] ▾	C Superoctave 2' MW (fro...2') [mm] ▾	D Superoctave 2' Ratio (1:n) ▾
C 1	62.4	196.0	38.5	5.1
c 13	37.2	116.9	24.0	4.9
c 25	28.0	88.0	18.0	4.9
c 37	18.1	56.9	11.2	5.1
c 49	12.0	37.7	7.1	5.3

Entering numerical values for upper Ø

As a last step, we will generate a free- variable upper scale for this stop, since it is conical.

Open the settings window for the stop *Superoctave 2'* and select the option *Conical (var.)* in section *Type & Body*.

As before, when you added the free-variable mouth width, M! automatically creates a new scale for the variable upper scale (*Top Superctave 2'*), links it to the base scale and groups both in a new group. In the spreadsheet, a new column for the top scale is added (*Superoktave 2' Ø [mm]-Top*).

Since the top scale was measured as circumference values (and not diameter), change the category to Circumference [mm]:

Choose *Circumference [mm]* from the column menu of the last column.

The option *Top scale (End)* is retained, thus the title of the column should be now *Superoctave 2' C [mm] - Top*.

Enter the measured values in this column:

C1	=	95.8 mm
c13	=	67.9 mm
c25	=	59.1 mm
c37	=	42.1 mm
c49	=	33.0 mm

This concludes the data entry for *Superoctave 2'*.

The document window should now look like this:

Since there already existed a group for Superoctave 2'*, M! created a nested group when automatically grouping the new upper scale with the base scale. To clean things up, you might want to group all three scales (base, mouth width and upper scale) together into only one group:*

Drag *Superoctave 2'* onto the name of the outer group (also *Superoctave 2'*). This moves the stop from the nested, inner group to the outer group. Repeat this process for *Top Superoctave 2'*.

The outer group now contains all three scales as well as the empty, inner group.

Select the empty, inner group (*Superoktav 2'*) and click on the – button below the stop list.

This gets rid of the empty group.

Finally, drag the base scale *Superoctave 2'* to the top of the group's contents.
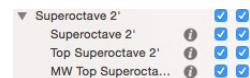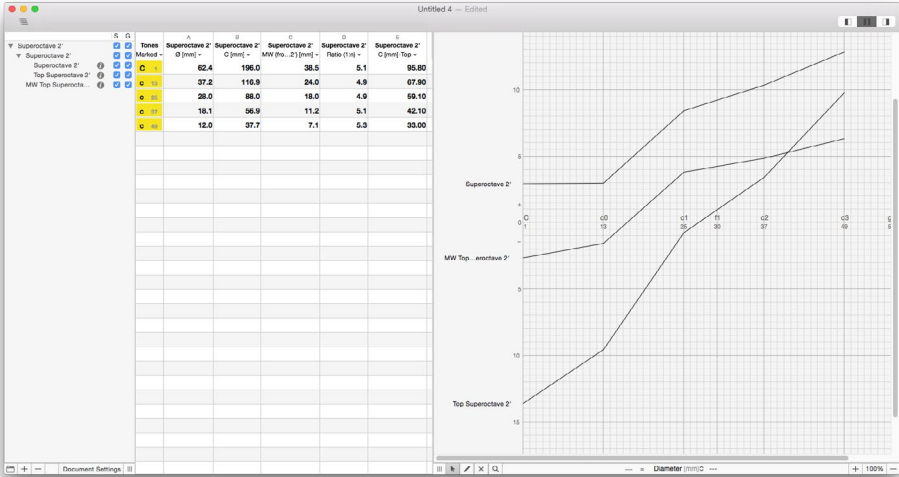
Registering Wooden Stops

For registering wooden stops one usually takes the pipe width (=mouth width) and the pipe depth.

If the inside dimensions have been taken, the values can be directly entered into the corresponding indication type. To do so you set a stop of the corresponding foot tone level.

Open a new document. Rename the *Untitled* stop to *Wooden*.

Add two columns for pipe depth and mouth with to the spreadsheet.

Hold down the ⌥ key and choose *Add Pipe Depth Column* from the column menu of the first column. Then repeat the procedure and choose *Add Mouth Width Column*.

The mouth width column initially displays a 1:4 ratio (the default value for new stops) in the column header. As soon as you enter a

first value into this column, M! automatical-
ly switches the stop to a free-variable mouth
width and creates and links the necessary ex-
tra scale.

Enter *125* as the value at *C1* in the column *Pipe
Depth*.

You can the enter the rest of the measured val-
ues. The values for the width of the pipe (i.e.
the mouth width) can be entered in the *Mouth
Width* column.

If the pipe depth was taken from the outside,
enter the thickness of the material into yet an-
other column of the stop which you have set
to *Thickness* beforehand.

Hold down the ⌥ key and choose *Add Thickness
Column* from the column menu of the last column. .

Enter the measured thickness of the material
into this column.

Select the option Out in the column menu of the
column *Pipe Depth*.

You may now enter the measured outer depth
values directly into this column.

When you attempt to enter a value or state-   Error / Bad value
ment that M! cannot manage, i.e. a deviation

of more than ±20 HT or mathematical contra-
diction, e.g. division by zero, you contract an
error.

Locking columns   If you want to lock columns, so the settings
and values cannot be changed by accident,
choose the option *Lock* from the column menu
of the respective column.

Printing · Clipboard · Export & Import · Data compatibility with other operating systems

Chapter 8

Both the graph and the spreadsheet of a document can be printed at any time.

Printing

To start printing, choose the *Print* command from the *File* menu.

A dialog appears, where you can choose to either print the spreadsheet or the graphic view.
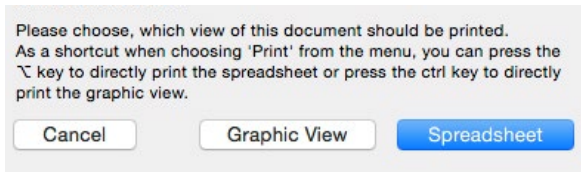
After choosing a view to print, the standard print dialog from Mac OS X appears.

If the spreadsheet is printed, the standard print dialog contains a section M! in which you can control if you want to print all or only selected columns (i.e. columns with at least one selected value). You can also change the font size, line spacing and the left margin in this section. To return to the default settings, click on the button *Reset to Defaults*.

You can skip this dialog by holding down the ⌥ *key or the* ctrl *key while choosing* Print *from the* File *menu.*

When holding the ⌥ *key, the spreadsheet is printed. Holding the ctrl key results in printing the graphic view. The standard print dialog from Mac OS X will be displayed anyway.*

When you copy values or columns from the spreadsheet with *Copy* (*Edit* menu), these are formatted onto the clipboard. You can paste the copied data in a different place on the spreadsheet or, into a different program (such

Clipboard

Excel, Numbers, Pages or Word). M! copies not only the data itself but also the column headers and note names.

Export orientation

You can specify whether the copy is to be horizontal or vertical. You'll find a setting for this in the application's preferences in the tab *Print & Export* (see »Application preferences« at page 79).

In *horizontal* mode, the columns are printed as lines:

```
                    C1      c13     c25     c37     c49
Octav 4' Ø [mm]   92.46   54.98   32.69   19.44   11.56
```

In *vertical* mode, the columns as such remain unchanged:

```
                  Octav 4'
                  Ø [mm]
         C1       92.46
         c13      54.98
         c25      32.69
         c37      19.44
         c49      11.56
```

Tabs are inserted between the individual columns by default. The separator character can be configured (see »Application preferences« at page 79).

Export as CSV

The menu command *Export* (*File* menu) works on the same principle as above, except that the data is not copied to the clipboard but to a file. The generated file can be read by any application that can read CSV files.

After choosing *Export*, a standard file dialog appears. Choose a destination and file name and select the option *Export Data as CSV File*. Optionally, you might want to select *Export only selected values*. If this option is selected, M! exports only values which are selected in the spreadsheet.

The settings for export orientation and separator character work the same way as with copying data to the clipboard (see above).

Export as DXF

M! supports export of diameter data in 2D DXF files. The diameters are exported as circles (incl. center points) and thus can be imported in many CAD applications.

The DXF data is written in R27 (2013) format.

When exporting, choose Export Diameters as DXF file in the standard file dialog. As before, you might want to also select the option *Export only selected values*, which limits the export to either the selected stops in the stop list or selected values in the spreadsheet (whichever results in fewer circles). **Please note, that only spreadsheet selections in diameter columns are considered***!*

When exporting multiple stops, the exported data is written in a folder on disk. The name of this folder is what you enter in the file dialog. The diameter data of the exported stops is written into separate files into that folder (one file per stop, the files are named after the stops). If only one stop is exported, the name of the exported DXF file is entered in the file dialog. No folder is created in this case.

By default, the exported diameters are inner diameters, i.e. without thickness of the material. In case the thickness values are available in the spreadsheet, it's also possible to export outer diameters by selecting the values in a column with the category *Ø [mm]* and the option *Out* selected (i.e. a column displaying outer diameters). Select all values in a column by clicking on the header of the column and then select the option *Export only selected values* in the export file dialog.

Import To import (*Import* in *File* menu) data, the data must have a particular format:

Columns must be separated by tabs (AS-CII:9), lines by »carriage returns« (CR, AS-CII:13). Besides the actual values, the names of the stops can be inserted

First, open the desired stops in M! and be sure that the foot tone levels are correct. Arrange the spreadsheet so that the columns are in the same order as in the import file. It is possible to define fewer columns than in the file, but the trans- fer will be stopped at that point. Be sure that the categories in the columns are set correctly according to the import data. After choosing *Import* from the *File* menu and selecting the import file, you can select multiple options:

When you select the option *Read Stop Names from First Line*, M! interprets the values of the first line in the import file as stop names.

The value at *Value start at column* controls from which column the import will be started.

If a cell is selected in the spreadsheet, you might want to select *Start Importing at Selected Cell.* If selected, the imported data is written to the spreadsheet, starting at the selected cell.

Stops can be copied between documents by drag & drop. Just drag the name of a stop or group from the stop list of one document to the stop list of another document. The dragged items are copied to the second document.

Drag & Drop

All files, saved from M! (not only exported data) can be exchanged between different operating systems: Macintosh, iOS and Windows.

The file name of document files for M! should contain the file extension *.mensur* in order to get recognized and assigned correctly with M!.

Data exchange with other operating systems

It's also possible to exchange tuning files (for calculating pipe lengths). The correct file extension for these files is .msti.

*Preferences in M! · Program prefer-
ences · Document preferences*

Chapter 9

There are two different types of preferences in M!.

The application preferences contain settings valid for the application in general, like printing preferences, as well as settings which are used when creating new documents (e.g. compass).

Documents have their own preference window to control settings only valid for the respective document (e.g. compass and tuning).

Open the application's preferences by choosing the *Preferences* command from the *M!* menu.

Application preferences
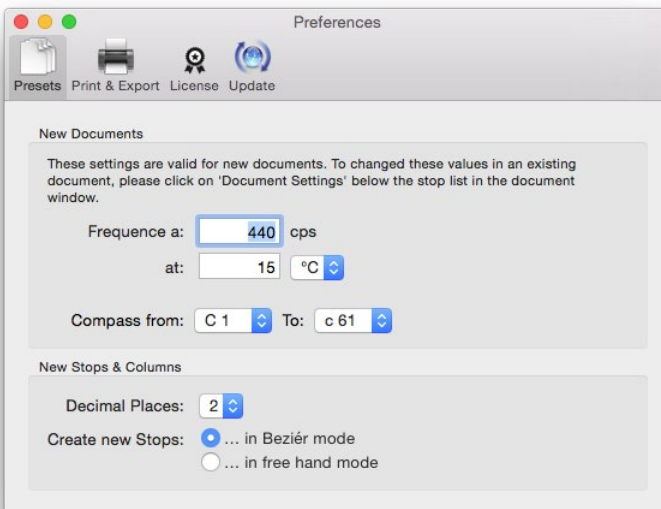
The preferences window is divided in 4 tabs: *Presets*, *Print & Export*, *License* and *Update*.

The tab Presets contains settings for new documents, stops and columns. In the section *New Documents* you can set the desired pitch and temperature. This is the default pitch and will be used for calculating pipe lengths. You can also set a default compass for new documents there. If you need to change these settings for an existing document, you want to make these changes in the document's settings (see »Document preferences« at page 81).

The preferences in section *New Stops & Columns* set the default number of decimal places in new columns and if new stops should be created with the graph in Bézier mode or freehand mode (see »Modifying scale curves« at page 19).

The tab *Print & Export* contains the section *Printing* in which you can set the default font size and line spacing for printing spreadsheets. These default values can always be overwritten in the standard print dialog (see »Printing« at page 73). The section *Export* let you control the Export Orientation and Field Separator. These settings are valid for both, Copy & Paste and Export to disk (see »Export orientation« at page 74).

The tab *License* is used for displaying and entering your application license information.

If you already own a license code for M! you can enter the licensed name and the license code here. Click on the *Check License* button after entering your credentials to unlock M! (also see »Entering license data« at page 10).

If you're using the demo version of M! and not yet own a license code, you can click on the *Buy license* button to purchase a license online.

M! supports automatic checking for updates. This feature requires an active Internet connection. M! asks during the second launch if it should automatically check for updates in the future. You can change that setting anytime in the tab *Update* and also refine some settings, like the time interval M! checks for updates.

Click on the *Check Now* button to check for updates manually. There's also a menu command *Check for Updates…* in the M! menu.

If you want to change preferences only for an existing document, open the document's preferences window by clicking on the *Document Settings* button below the stop list.

Document preferences
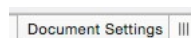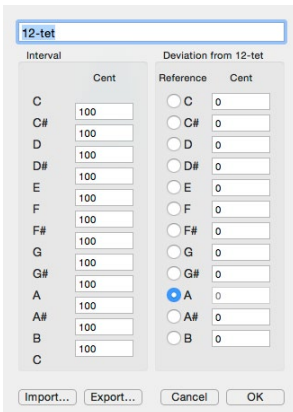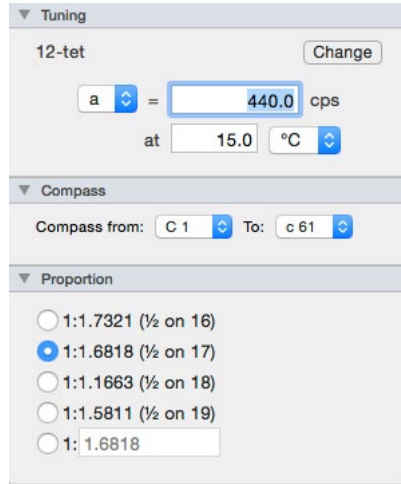
In the section *Temperament*, you can set the pitch desired for 12tet to calculate pipe lengths. If you wish a different temperament, click *Change* to open another window into which you can enter cent deviation for each halftone of the scale by activating the individual edit fields. Its possible to export and import specific temperaments. The exported temperament files can be exchanged between different computers and operating systems. The default file extension for temperament files is *.msti*.

The section *Compass* allows you to set the compass for all stops in the document.

In the *Progression* section you can define the normal scale based on which are all calculations and displays. Default setting is the so-called *Töpfer Normal Scale* (halving on the 17th).

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