The Veriturner User Guide for Apple iOS Devices

iPhone • iPad • iPod touch

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by
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* RPT is the Piano Technicians Guild's designation of a Registered Piano Technician member.

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Preface

Know Your Apple Device

This user guide describes the features and operation of the Verituner App for Apple iOS devices—iPhone, iPad, and iPod touch—running Apple's iOS operating system. The App runs identically on the iPhone and iPod touch and runs on the iPad in (2x) zoomed view. Each of these Apple devices will run the Verituner very well. Verituner files are very small and use only a small amount of the device's storage space. If and when you plan to use or purchase one of these devices, some things you might want to consider are:

- Will the device be used as primarily a dedicated Verituner, or also as a phone and/or for use with other apps?
- If an older device, can it run the current operation system (iOS)? As the Verituner app continues to develop, a new update might require a version of the iOS that cannot be installed on the device. It's a consideration of "future-proofing" the device to some extent.
- Screen size, portability, readability, battery runtime, and cost are other obvious considerations.
- Through the Verituner Forum you can ask questions and learn from the experience of other Verituner users.
- If you are deciding on a new device, the MacRumors Buyer's Guide is a helpful resource for timing your purchase.

buyersguide.macrumors.com

In using the Verituner App, Veritune Inc. assumes you are a piano technician and/or you have at least basic piano tuning skills and that you are familiar piano tuning terminology. It is also assumed that you are familiar with the operation of your Apple device. For device-specific issues—hardware and operating system—contact Apple or your dealer. Documentation can be downloaded from Apple's website:

iPhone	support.apple.com/manuals/iphone
iPad	support.apple.com/manuals/ipad
iPod touch	support.apple.com/manuals/ipodtouch

A Note to Aural Tuners

A special note to those who have little or no experience using an Electronic Tuning Device (ETD): Be patient! Working with any ETD, including the Verituner, requires the use of hand-to-*eye* coordination while tuning, which is quite different from the hand-to-*ear* coordination that you are accustomed to. In addition, with an ETD you will be sounding the strings of only one note at a time instead of two notes, and during tuning the frequent aural checks you rely on in aural tuning are best done infrequently with the Verituner. This will most certainly require an adjustment period. Most first-time ETD users report that they actually tune slower—at first. After an adjustment period, we expect you'll be saving time *and* getting excellent results with greater ease.

Chapter 1
Getting Started

Purchasing and Installation

An iTunes account is needed. Purchasing, installing, and updating the Verituner App are done through the App Store app that is installed on Apple iOS devices.

System Requirements: For the latest information on hardware and operating system requirements go to

www.veritune.com

Battery

Become aware of your device's battery runtime. For extended periods of use, have an AC charger to use while tuning and/or a car charger while driving. An external battery pack is an especially handy option. Apple offers tips on optimizing battery performance:

www.apple.com/batteries/maximizing-performance/

Push the Home button to exit the app when you have finished using it or won't be using it for more than a short while. It will reduce battery drain and memory usage. For shorter breaks, press the On/Off Sleep/Wake button to lock the app and keep it running; upon waking the app you will be where you left off. With the iPhone, answering a call will exit the app.

Tuning Preliminaries

The information in this chapter will be clearer as you perform the tuning procedures that follow in Chapter 2. First, familiarize yourself with this overview of the Verituner's tuning interface and functions, and then refer back to it as needed.

Entering Numeric Values

Some screens call for entering values in *fields*[1] without the virtual keyboard. Entering or changing a value in a field is done with the Verituner's *numeric controls* + 1 –

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[1] A *field* is a small rectangular area that is empty or contains information— text or a value — which can be filled in or manipulated, e.g., entering a file name changing the current value.

Tap the *increment number* (the number between + –) to cycle through the available increments: 1 .1 .01 . Tap + or – to change the value in the field by the increment amount with each tap. This is the method for entering values in the Calibration procedure (described below), in the Standard Tuning Setup when setting a non-standard pitch., in creating custom temperaments, etc.

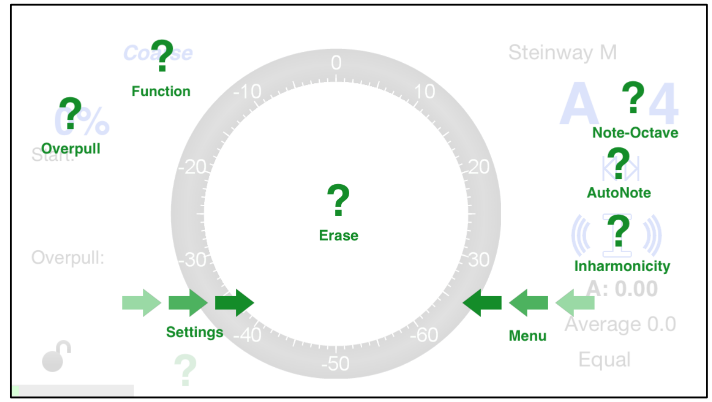
Startup

The Startup screen appears when the Veritumer App is opened. It offers three options for starting a tuning: (1) **Start** a new tuning (for which a new tuning file will be created), (2) **Load** a saved tuning file of a previously tuned piano, and (3) **Resume** tuning with the last tuning file that was open.

The Swipe

A *swipe* is a short brush of your fingertip across the device's screen. This simple gesture is widely used in iOS device apps to turn pages in e-books, magazines and the like, to scroll a webpage or list, etc. In the Veritumer app the swipe is used to scroll, to reveal the hidden menus, and to change a note name or octave on the tuning screens. If the swipe is new to you, here's a tip: make a light, short sweep on the center area of the screen, ending by lifting your finger off the screen. A little practice and it will be second nature.

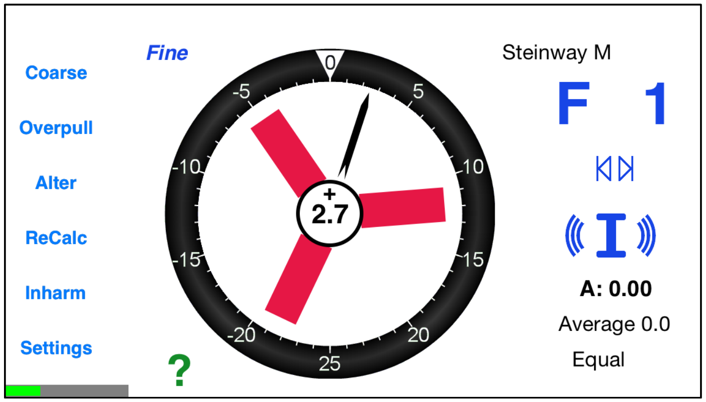
NOTE: if you are seeing the green swipe left/right instructions, swiping has no effect until you tap to dismiss the instructions.



Revealing Hidden Menus

There are two menus that are hidden from view but readily accessible. The Menu is on the right, and Settings is on the left. A horizontal swipe with your fingertip across the center area of the screen (e.g. in the spinner circle in the tuning screen) brings them into view. Only the Menu (on the right) is available at the Startup screen. To see it, swipe your finger across the screen *from right to left* as if you were dragging it from hiding into view on the screen.

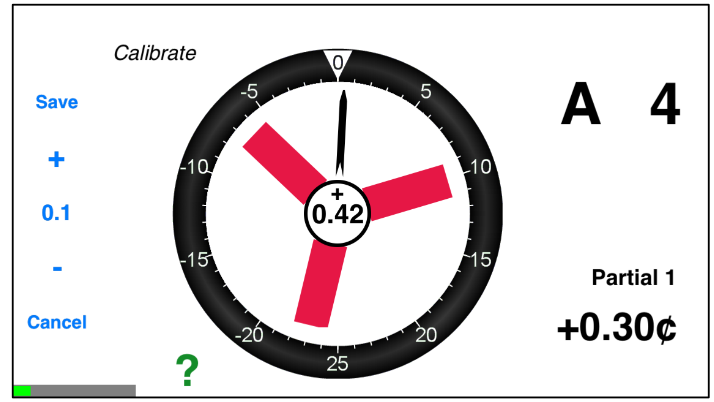
When available, a swipe *from left to right* to brings Settings into view on the left. To hide a menu, tap on the screen. Only one menu can be open at a time.



Calibration

When you first install the Verituner App, the accuracy of your iOS device's A440 pitch will typically be well within 1.0 cent, which is suitable for most piano tuning. To increase the accuracy even more precisely, a calibration can be done using a laboratory-grade frequency source.[2] Swipe out the right menu; tap **Verituner**; and then tap Show Calibration Function.

[2] For more on calibration, see Robert Scott's informative article, "Calibration of Pitch References" in the August 2001 *Piano Technicians Journal.*



1. In the Calibrate screen, use a laboratory-grade frequency source to sound A440 while you use the numeric controls **– 1 +** to stop or slow the spinner as much as possible. Calibration can be set to a precision of hundredths of a cent.
2. Tap **Save**. You might also want to write down and save the value for future reference in case recalibration is necessary.

NOTE: the *signal activity indicator* at the lower left corner gives a relative measure of the strength of the audio signal.

Tuning Options

Initially, the default tuning settings for a new standard tuning are A4=0.00¢ (440 Hz), a stretch style designed for "average" pianos, and equal temperament. Each of these tuning options—pitch, tuning style, and temperament—can be changed for a tuning in the Standard Tuning Settings screen, which is accessed on the left menu. (In general, use the "Clean" style for spinets and very small grands, and use the "Average" style for most other pianos.) These settings are displayed on the tuning screen at the lower right.

The Spinner

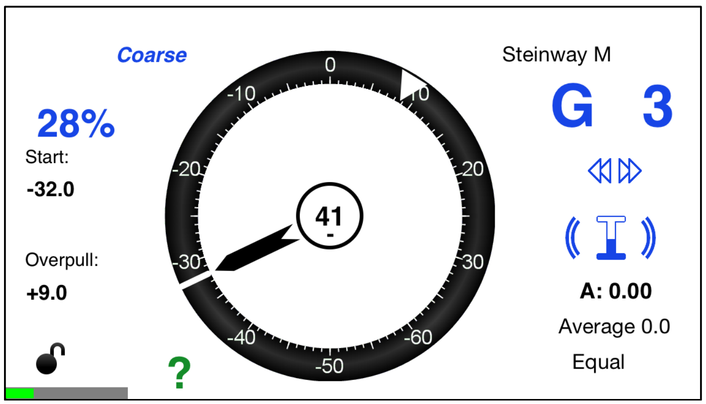
The tuning screens indicate pitch deviation (sharpness and flatness) by

- the rotation of the **spinner blades (**and by a large flat or sharp symbol that appears in the ring when the blades rotate too fast to be read distinctly);
- the position of speedometer-like **needle** on the ring marked in cents

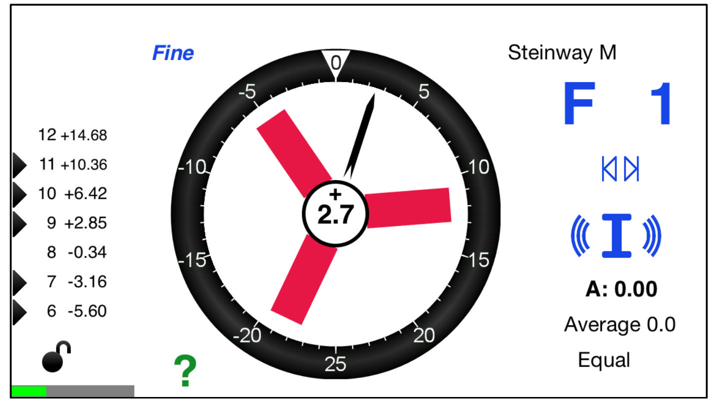
- the number in the spinner **hub** is the number in cents from the current pitch (marked on the ring by the straight white line) to the target pitch (marked by the triangle marker ∇).
- In Fine Tuning, a large ♭ or ♯ appears in the ring when pitch deviation is beyond the range of the spinner to indicate the deviation accurately.

In Fine Tuning, the goal is to stop or slow the spinner *as much as possible, and/or get the needle and the number in the hub as close to zero as possible.* When using overpull, the slash marks the initial measurement of the pitch, and the triangular marker on the ring is the target with which to align the needle. If there are pronounced variations in the pitch, from attack through decay, tune the string so the spinner blades are slowest, or the zero target is closest, *just following the attack.*

Spinner Preferences can be edited. See Chapter 7, page 47, for details.



The Coarse Tuning Screen



The Fine Tuning Screen

Pitch Correction and Overpull

The Verituner's Standard Tuning function consists of two modes: Coarse tuning and Fine tuning. Go from one to the other by tapping ***Coarse*** or ***Fine*** on the tuning screen or on the left menu. Coarse tuning is used for correcting pitch—raising or lowering—in preparation for fine tuning. **Overpull** targets can be calculated with the pre-defined or user-specified overpull percentages. The percentage currently in use is displayed on the left side of the screen in Coarse tuning and can be shown in Fine tuning by showing the menu on the left and tapping Overpull. The initial percent is **0%** (for no overpull). Tap on the percentage number to cycle through the percentages for wound, plainwire, and the treble strings, which begins around F5.

The default percentages are merely suggestions, perhaps a starting point. Use the defaults if they work well for you or experiment to determine the values—and where they are used—that give you the best results. If you want to switch to another set of percentages while tuning, touch & hold the percentage number on the tuning screen to open the Overpull Preferences screen. Tap the name of the desired set, and tap Select on the popup. Tap Cancel to return to the tuning screen. Overpull percentages can be changed at any time in. See Edit Overpull Preferences in Chapter 7, page 45, for details.

Overpull Markers When an overpull percentage is being used, two white markers appear on the ring. The straight line indicates the starting pitch, and the triangular marker ∇ marks the overpulled tuning target. Occasionally, the *start marker* is obviously set incorrectly. When this happens, **erase** the markers for the current note by tapping on the spinner hub. To erase markers for all notes, touch & hold the hub.

Zoom

In Coarse Tuning, tapping **Zoom** on the left menu changes the scale (the range) of the cents gauge. Successive taps of **Zoom** cycles between the Medium (–65¢ to +35¢), Wide (–130¢ to +70¢), and Narrow (–32.5¢ to +17.5¢) scales.

AutoNote

TheVerituner's AutoNote feature identifies the pitch it hears and displays the note and octave (at the upper right) within the limits of the current response setting. You choose how you want AutoNote to respond. The choices differ in their combination of *direction* (up, down), *distance* (random or step), and/or *sensitivity* (medium, high, low.) Tap the AutoNote icon (located under note/octave) to cycle between Random/Medium, up/down by half or whole step, and AutoNote Off. Touch & hold the AutoNote icon to open the list of all seven AutoNote response choices.

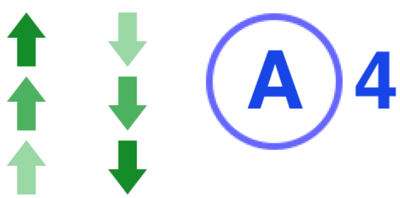
Use movement by up or down by step for the most consistently accurate response while tuning. NOTE: If AutoNote does not respond well for the notes at the extreme ends of the keyboard, turn AutoNote off and switch notes manually.

Random movement, medium sensitivity

Movement up or down by step

Changing the Note and Octave Manually

In addition to AutoNote, note and octave changes can be made manually:



Tap the note name or the octave number you want to change, which encircles it to show it is selected; then, swipe the screen up or down. Tap the circled note or octave to remove the circle. When moving from B to C, and vice versa, the octave also changes.

Inharmonicity

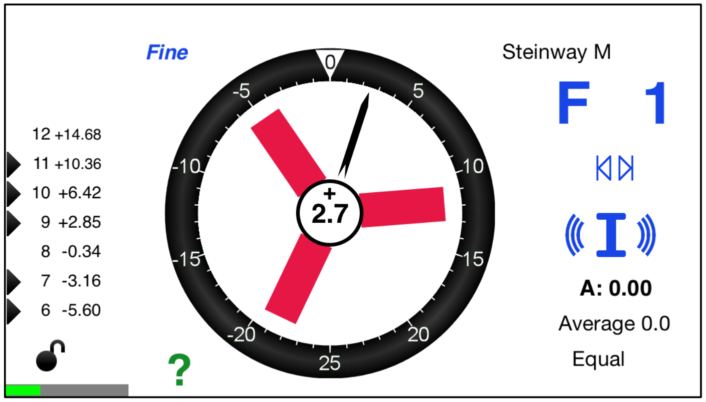
All measuring for inharmonicity is done automatically in the background as you tune. It is important to follow the recommended tuning sequence the first time you tune a piano with the Verituner so the gathered data to can be used to optimal advantage in calculating tuning targets.

The inharmonicity icon serves three functions:

- The animated "sound waves" indicate that inharmonicity is being measured. If there are no waves, inharmonicity reading is turned off.
- The amount the icon is filled indicates the amount of inharmonicity information that has been collected for the note.
- Touch & hold the icon and a list of options that pertain to inharmonicity appears:
  - **Inharm On/Off** turns inharmonicity measuring off or on. So does tapping **Inharm** on the left menu, and simply tapping toggles inharmonicity off/on.
  - **Remeasure** clears inharmonicity data for the current note. Upon remeasuring the note's inharmonicity the Verituner recalculates its tuning targets. (TIP: if you encounter a note that is apparently not being measured sufficiently, try moving your device's position; try another string, move to another note and then return to the stubborn note, and/or Remeasure again.)
  - **Recalculate** all tuning targets using the current inharmonicity data and the selected style. (**ReCalc** on the left menu in Fine tuning does the same thing.) NOTE: Recalculation of a tuning file cannot take place if the file for the selected Style is missing in the directory.
  - **Clear All Inharm** clears inharmonicity data for all notes
  - **Cancel** closes the list with no changes.

The lock icon at the lower left indicates whether the tuning targets for the current note are locked or open to additional calculations. Recalculation of targets is continuous in Coarse tuning; targets are therefore not locked and are subject to revision as new inharmonicity data is gathered. After initially being unlocked, targets in Fine tuning are locked so the targets for notes you have already tuned do not move. The brief appearance of the calculator icon next to the lock indicates that calculation of targets is taking place. ReCalc on the left menu recalculates all targets in Fine tuning.

In Fine Tuning, the targets for the measured partials are listed in a column on the left side of the display. The digits on the left are the partial numbers, and the values on the right are the calculated targets expressed in cents. Which partials are being read varies in different sections of the piano.



The small right-pointing triangles ► at the left indicate the presence or absence of each partial in the sound. A dark arrow indicates a strong partial, a gray arrow indicates a weaker partial, and the absence of an arrow indicates little or no presence of that partial. These arrows flicker on and off as you sound the note, typically showing a strong presence of all the partials when you first sound the note and the higher partials dropping off as the sound decays.

See Appendix C, page 59, for a more detailed discussion of inharmonicity.

Files & Folders

Tuning files are saved automatically and continuously as you tune. Tuning, temperament, and style files are stored and managed in directories, organized in folders. When starting a new tuning file, you select a folder in the directory where you want the file to be saved. The default location is the Temporary folder. If you anticipate using the saved file in the future, select another folder in which to save it.

Renaming Files & Folders There are 15 folders in the Standard tuning directory and six in the Measured tuning directory that can be renamed to suit your preferences for organization. *To rename a folder,* swipe to open the menu on the right and tap the desired directory (Standard or Measured) to open it; tap a folder name and then tap Rename.

NOTE: Folders can only be renamed when the directory has been accessed via the right menu.

To rename a file, swipe right and tap the name of the directory containing the file, or tap the magnifying glass icon to search for the file. Tap the file name and tap Save As. Tap the File field and change the name. If you want, select a different folder for the file. Tap Done. This file is a copy. You are given a choice to keep or delete the original file.

Searching for Files To search for a file, tap the magnifying glass at the upper right corner of a directory. Enter what you're searching for in the Search field. All folders in the directory will be searched, and all files containing your search text (alphanumeric characters, symbols, and spaces) will be listed. When you see the file you want on the list, tap the file name for the options to Select or Load the file, Save As (to save a copy of the file and/or select a different folder to save it in), or Cancel.

For more on files and file management—importing, exporting, and backing up files—see Appendix B, page 50.

Directories

The Verituner has four file directories:

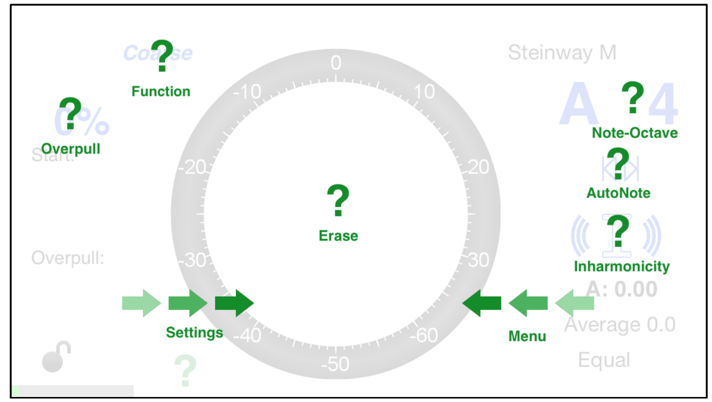
- **Standard** – Most, if not all, of your tunings will be Standard Tunings and are saved in this directory.
- **Style** – The built-in tuning styles and custom style files are saved here.
- **Temperament** – The pre-installed temperaments and custom unequal temperaments are stored in this directory. (See Chapter 4, Temperament Files, page 35.)
- **Measured** – Files generated by measuring a tuning (such as in the PTG tuning exam) are stored in the Measured directory.

To access the file directories, swipe (from right to left) to show the menu on the right. Tap the desired directory. Tap ⓘ at the right to open a folder. Tap + to start a new tuning. Tap a file and a list of options appears:

- **Delete** – Confirm by again tapping Delete or Cancel
- **Save As** – Follow the on-screen prompts to select a destination folder and name the file. Upon tapping Done, you are given the option to delete the original file.
- **Load** opens the selected file. You are asked: (1) If the file was saved with a non-standard pitch setting, do you want to use that pitch? If you tap **No**, A440 is used. (2) Do you want the tuning targets recalculated? If **No**, the file opens with Inharm turned off. If **Yes**, Inharm is turned on. (3) If the targets of any notes have been altered, Keep Alterations? (Alter is covered in Appendix C, p. 66.)
- **Cancel**

? Help Tips

When available, tap the green question mark **?** to access how-to tips on using various functions and commands, e.g. how to change the overpull percentage or preferences, or change the AutoNote setting. For example, tap **?** and a translucent overlay of additional questions marks appears superimposed on graphic elements on the tuning screen. Tap the overpull question mark and the blue overpull percent is encircled, and you're told how to cycle through the preset percentage values and how to change the preset percentage values in the overpull preferences. Tap on the screen to hide the overlay. The functions are then available by tapping or touching & holding the blue percent value.



Chapter 2

Standard Tuning Procedures

This chapter presents step-by-step procedures for tuning with a new tuning file and tuning a piano with a saved tuning file.

Aural Checks

The Verituner is designed to listen to a single note at a time. It filters out and ignores other notes while measuring inharmonicity. During tuning, playing one note at a time is recommended.

Aural checks are important—please do listen to your tuning! But because of how the Verituner works, playing an interval when first tuning a note can potentially cause some problems. Therefore, it is recommended that aural checks be delayed until a note has been tuned or, better yet, a substantial section or the entire piano has been tuned.

Tuning Unisons

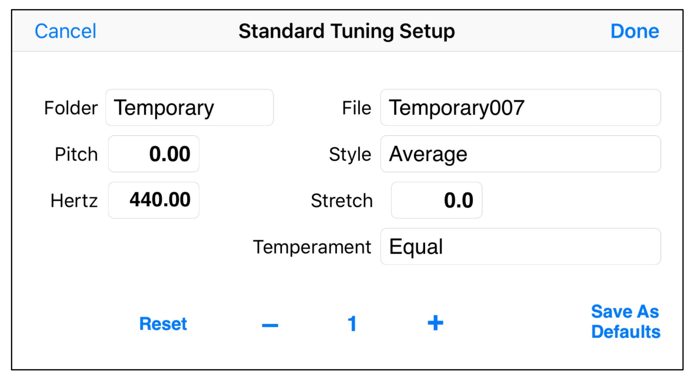
Tuning unisons as you go is recommended. Although you can tune each string of a note individually to the Verituner, if you have the skill, tune unisons aurally for greater speed. However, tuning strings individually to the Verituner may be advantageous in tuning a note with a challenging false beat. You might also find single string tuning helpful in the top octave, but let your ear be the final judge.

Tuning with a New Standard Tuning File

This procedure is used to tune a piano when you do not already have a previously saved tuning file for it; i.e. you will create a new custom tuning file for tuning the piano.

1. Turn on your device and tap the Verituner icon to start the app.
2. At the startup screen, tap **Start**.

3. In the Standard Tuning Settings/Setup screen, set the tuning options you want for this tuning.



a. Folder Unless you select a different folder for the file, it will be saved in the Temporary folder, where only the 15 most recent temporary files are stored. To select another folder, tap the folder field; tap the name of the folder, and then tap Select.

b. File To change the temporary file name, tap the File field; delete the temporary name; enter a new name, and tap the return key on the keyboard.

c. Pitch To change the pitch from the standard A440 (0.00¢), tap either the Pitch field to enter a deviation in cents, or tap the **Hertz** field to change the frequency. Use the numeric controls at the bottom of the screen to enter the desired value. A change in the cents field is automatically updated in the Hertz field and vice versa.

d. Style To change the tuning style, tap the Style field; tap ⓘ at the right of the folder name to open it; tap on the name of the style, and then tap Select.

Regarding the three Built-in styles, the **Average** style has a moderate degree of stretch and is probably the best choice for most tunings. The conservative **Clean** style has the least stretch and may be best for spinets and very small grands. The **Expanded** style gives the greatest amount of stretch. Use it on concert grands when wider octaves are desired.

Because all notes are affected when a style is changed, it is best to choose a tuning Style and/or Stretch Adjust (see the next paragraph)—*before* you begin tuning. If you do make a change after a tuning is underway, the notes you have already tuned (i.e., *locked* notes in Fine Tuning) will not be affected, *but* the notes that have not yet been tuned will use the new style's parameters calculated against what you have already tuned. Alternatively, you can Recalculate the entire tuning, *but* this would require retuning, because *all* notes will be affected.

Stretch If you want to adjust a built-in style's stretch — to expand or contract the overall amount of stretch — enter a stretch "value" (from –2.0 to +2.0). Use the numeric controls at the bottom of the screen to set the desired value. *This function has no effect for custom styles.*

e. Temperament To select another temperament, tap the Temperament field; tap the InfoCircle ⓘ by the folder name to open a folder; tap the file name and tap Select. (NOTE: tapping the InfoCircle ⓘ by a file name shows the

offsets for that temperament.)

When you change the temperament, *all tuning targets are recalculated immediately* for the current tuning file. Be aware that if you change the temperament *after* a fine tuning is underway, many of the notes you have already tuned may be invalid unless you retune them.

Setting Defaults for New Standard Tunings The Farituner's default settings for Pitch, Style, and Temperament can be changed if you prefer. Open a tuning file, and then open the Settings screen from the left menu. Choose the Pitch, Style, and Temperament settings you want as defaults, and then tap on **Save As Defaults** at the lower right. Tap Yes to confirm the change. Your default settings will now be in effect for every new tuning.

4. When you have finished with the Tuning Setup, tap Done, which takes you to the Coarse tuning screen, or tap Cancel to cancel the new tuning. (To make changes to these settings from the tuning screen, open **Settings** on the left menu.)

5. **Check the pitch level of the piano** to determine whether pitch raising or lowering is needed. Follow this procedure:

a. Play A4. Mute the left and center strings of A4 and play the note's right string while you check its pitch. If the string is off by 50¢ or more, tune it close to 0¢ and continue to play it until the ((I)) is as full as possible.[3]

b. Play A3 and check its pitch. Then, play several additional notes in various sections of the piano and check their pitch. If needed, tap **Zoom** on the left menu to change the gauge of the spinner ring.
NOTE: If the pitch is off by more than 50¢ and AutoNote is not consistently displaying the notes you are actually playing, turn AutoNote off and change notes manually.

6. **Decide how you want to proceed.** Choose the best procedure for the situation:

- Two passes—coarse tuning followed by fine tuning. If the piano requires a coarse tuning to raise or lower pitch, go to step 7.

[3] Why the right string? It is assumed it is the last string you would normally tune for this note. When the note is tuned in a later step, overpull will be correctly calculated since it will be based on the deviation of the center or left string, which was not moved.

- One pass, fine tuning. If the pitch is close enough for fine tuning, tap ***Fine*** and skip to step 8.
- One pass, fine tuning with a small pitch raise or lower. If the pitch is close enough for a single pass but you want overpull to compensate for anticipated settling, switch to ***Fine*** tuning and skip to step 9.

Coarse Tuning

7. Raise or lower the pitch in one or more passes.

As you tune, monitor the note name and octave. Be alert to any discrepancies between the note you are playing and the note the Verituner indicates it is hearing.

a. **Erase All Markers** by touching & holding the hub.

b. **Set AutoNote.** Set the Verituner to the lowest note in the tenor section. Then, for the best response, set AutoNote to move by step.

c. **Set the** overpull percentage for the lowest tenor note by tapping the number **0%**. As you tune, change overpull percentage at the recommended points. (If you are doing a large raise pitch with more than one coarse tuning, consider little or no overpull for the first pass.)

d. **Coarse Tuning Sequence**[2]

The Verituner must have inharmonicity information from A4 and A3 before beginning this sequence. (See step 5.)

1. Tune each string of the lowest tenor note.
2. From there, tune upward by half steps, tuning unisons as you go, until you have tuned C8. (Inharmonicity is measured as you tune.)
3. Tune from the top of the bass section down to A0, tuning unisons as you go.

[2] Other tuning sequences can be used. The sequences for new tunings are designed to work with the Verituner's three built-in styles—Average, Clean, and Expanded. They may or may not work well with custom styles.

e. Switch to ***Fine*** tuning by ***Coarse*** at the upper left or by selecting ***Fine*** on the left menu.

f. Proceed to step 8.

Fine Tuning

8. Fine tune the piano. (Inharmonicity is measured as you tune.)

a. **Set AutoNote** Set the Verituner to A4. Then, for the best response, set AutoNote to move up or down by step.

b. **Fine Tuning Sequence**

1. Tune each string of A4.
2. Manually set the tuner to A3, and tune each string of A3.
3. Tune A#3 and continue tuning upward by half steps, tuning unisons as you go, until you have tuned C8.
4. Set the pitch to G#3 and tune each of its strings.
5. Tune downward by half steps, tuning unisons as you go, until you have tuned A0.
6. Set AutoNote to random movement.
7. Check the completed tuning and touch it up if needed. If desired, use the Remeasure to unlock an individual note, erase and re-measure its inharmonicity, and recalculate its targets.

NOTE: If and when you want to alter the Verituner's calculated target for a note, the Alter function enables you to tune the note aurally and store the altered target in the tuning file. Alter is covered in Appendix C, page 66.

Fine Tuning with Overpull

9. Fine tune all or a portion of the piano with a small pitch correction.

a. Set AutoNote Set the Verituner to the lowest note in the tenor section. Then, for the best response, set AutoNote to move up or down by step .

b. Set the Overpull Percentage On the left menu, tap **Overpull**. Tap the overpull **0%** number to select the percentage for the lowest tenor note. If for some portion(s) of the piano overpull is not needed, hide it by tapping **Partials** on the left menu.

c. Fine Tuning Sequence with Overpull

The Verituner must have inharmonicity information for A4 and A3 before beginning this sequence. (See step 5.)

1. Begin with the lowest tenor note and tune upward by half steps to C8, tuning unisons as you go. (Inharmonicity is measured as you tune.) Change the overpull percentage at the recommended points as you tune.
2. Tune from the top of the bass section down to A0, tuning unisons as you go.
3. If it is not already hidden, hide overpull by tapping **Partials** on the left menu.
4. Set AutoNote to random movement .
5. Check the completed tuning and touch it up if needed. If desired, use the **Remeasure** to unlock an individual note, erase and remeasure its inharmonicity, and recalculate its targets.

Tuning with a Saved Standard Tuning File

This procedure is used to tune a piano using a previously created tuning file.

1. At the startup screen, tap Load.

2. Tap the InfoCircle ⓘ next to the folder you want to open; tap the filename; and tap Load.

a. If a deviation from standard pitch was in effect when the file was last used, you'll be asked **Use Saved Pitch?**. If you tap No, A=440 will be reset (displayed as A:0.00).

b. When asked **Recalculate Tuning?**, tap Yes if you are going to retune the piano. Tap No if you are only checking or touching up a recent tuning. By default, Inharm measuring will be on if you tap Yes; off if you tap No.

3. Check the tuning Settings. Change the current settings for Pitch, Style, and/or Temperament, if you want.

4. Check the pitch level of the piano. Check the pitch of selected notes to determine whether pitch raising or lowering is needed. If the pitch is off by more than 50¢ and AutoNote is not consistently displaying the notes you are actually playing, turn AutoNote off and change notes manually.

5. Decide how you want to proceed. Choose the best procedure for the situation:

- Two passes, coarse tuning followed by fine tuning. If the piano requires a coarse tuning to correct pitch, go to step 6.
- One pass, fine tuning. If the pitch is close enough, switch to ***Fine*** tuning and skip to step 7.
- One pass, fine tuning with a small pitch raise or lower. If the pitch is close enough for a single pass but you want overpull to compensate for anticipated settling, switch to ***Fine*** tuning and skip to step 8.

Coarse Tuning

6. Raise or lower the pitch in one or more coarse passes.

As you tune, monitor the note name and pitch deviation. Be alert to any discrepancies between the note you are playing and the note the Verituner indicates it is hearing.

a. **Erase All Markers** by touching & holding the hub.

b. **Set AutoNote.** Set the Verituner to the lowest note in the tenor section. Then, for the best response, set AutoNote to move by step .

c. **Set the overpull** percentage for the lowest tenor note. As you tune, change overpull percentage at the recommended points. (If you need to raise pitch with more than one coarse tuning, consider little or no overpull for the first pass.)

d. **Coarse Tuning Sequence**[2]

1. Begin with the lowest tenor note and tune upward by half steps to C8, tuning unisons as you go.
2. Tune from the top of the bass section down to A0, tuning unisons as you go.

e. Switch to ***Fine*** tuning and proceed to step 7.

Fine Tuning

7. Fine tune the piano.

a. **Set AutoNote** Set the Verituner to A4. Then, for the best response, set AutoNote to move up or down by step .

b. **Fine Tuning Sequence**

1. Begin with the lowest tenor note and tune upward by half steps to C8, tuning unisons as you go.
2. Tune from the top of the bass section down to A0, tuning unisons as you go.
3. Set AutoNote to random movement .
4. Check the completed tuning and touch it up if needed. If desired, use the **Remeasure** command to unlock an individual note, erase and remeasure its inharmonicity, and recalculate its targets.

NOTE: If and when you want to alter the Verituner's calculated target for a note, the Alter function enables you to tune the note aurally and store the altered target in the tuning file. Alter is covered in Appendix C, page 66.

Fine Tuning with Overpull

8. Fine tune all or a portion of the piano with a small pitch correction.

a. Set AutoNote Set Verituner to the lowest note in the tenor section. Then, for the best response, set AutoNote to move up or down by step .

b. Set the Overpull Percentage On the left menu, tap **Overpull**. Tap the overpull **0%** number to select the percentage for the lowest tenor note. If for some portion(s) of the piano overpull is not needed, either set the percentage to **0%**, or hide overpull by tapping **Partials** on the left menu.

c. Fine Tuning Sequence with Overpull

1. Begin with the lowest tenor note and tune upward by half steps to C8, tuning unisons as you go. Change the overpull percentage at the recommended points as you tune.
2. Tune from the top of the bass section down to A0, tuning unisons as you go.
3. If it is not already hidden, hide overpull by tapping **Partials** on the left menu.
4. Set AutoNote to random movement .
5. Check the completed tuning and touch it up if needed. If desired, use the **Remeasure** to unlock an individual note, erase and remeasure its inharmonicity, and recalculate its targets.

Chapter 3
Custom Styles

The Verituner's Custom Styles feature gives you precise control of how a tuning is calculated. Styles determine the details of a tuning's stretch by setting the partials and beat rates used in the tuning calculations. Selecting an installed style for a tuning file is done in the Settings screen of a tuning file (swipe from the left), not in the Style Directory. The selected style will be loaded and saved as a setting for the tuning file, and it will be in effect the next time you load the file. If a previously selected custom style file is no longer in the Custom style folder, you will be alerted upon opening the tuning file.

When you create a custom style, you specify the type and degree of interval stretch throughout the range of the piano. This is done by setting the stretch points, intervals, the desired beat rates, and weighting.

Getting Started

One approach is to enter the parameters of a style created by someone else. Another approach to create a style is to copy and modify an installed style file. To do this, tap Style on the right menu, tap the InfoCircle ⓘ to open the folder (Built-in or Custom), and tap the style's name. Tap Save As; rename the file, and tap Done to save it in the Custom folder. In the Custom folder, tap to load the style you want to modify. See the section Designing and Editing a Style below for details.

Alternatively, to start with a generic template file, open the Style Directory, tap ⓘ to open the Custom folder, and on the next screen tap +. A new file is saved in the Custom folder, and a screen opens showing a list of the default notes and their parameters:

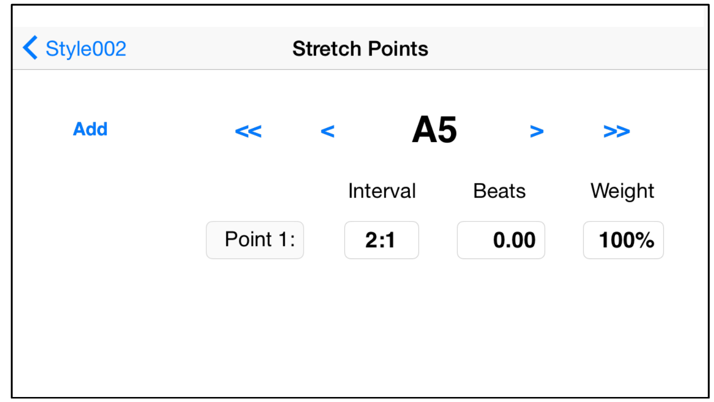
Note the following:

- All custom files are automatically saved in the Custom folder.
- To save a file with a different name or delete it, tap its name in the Custom folder.

Designing and Editing a Style

A style consists of a set of *stretch points* that specify the desired stretch at various points in the scale. If you started a new template style, the file will have only the three *required* starting stretch points—A0, A3-A4, & C8—to which you will add others. These default stretch points cannot be deleted, but you are free to change their parameters. A style is customized by adding and specifying stretch points, by customizing parameters, and/or by deleting stretch points other than the required ones.

To add a new stretch point, tap the existing stretch point (i.e. the note/octave name) that will be just below the one you want to add (C8 excepted) and tap New Note. A new note—not necessarily the one you want—with default parameters is added to the list above the stretch point (note/octave) you tapped. Tap the InfoCircle (i) at the right to go to the edit stretch points screen where you can change the note, interval, beats, and weight.



Change the stretch point's parameters as follows:

- **Note** defines the position of the stretch point in the scale. Tap the controls beside the note name << < > >> to change the note by half-steps or octaves.
- **Interval** defines what type of interval is being tuned, listed by its size and coincident partials:

Single Octave	(2:1, 4:2, 6:3, 8:4, 10:5, 12:6)
Double Octave	(4:1, 8:2)
Triple Octave	(8:1)
Twelfth	(3:1, 6:2, 9:3)

  To change the interval, tap to select the desired interval, and then tap the **Change** key. Successive taps cycle through the available intervals. (Not all intervals are available in all parts of the scale.)

- **Beats** is the number of beats per second present in the interval. Positive numbers indicate intervals that are wider than pure, and negative values indicate narrower than pure. Tap + 1 – to change this parameter. Tap the number to change the increment: 1 .1 .01
- **Weight** is a weighting percentage used to set up a compromise between multiple stretch points on the same note. (If there is only one stretch point on a note, this value is ignored.) Use + 1 – to change this parameter.

Multiple Stretch Points

A single stretch point (represented by the note/octave name) can have up to three sets of stretch parameters that specify how stretch is calculated for that note. To add a second or third set of stretch parameters to the note, tap **Add**. NOTE: When the Point 1, Point 2, or Point 3 field is selected, either **Add** *or* **Delete** will show at the left. Successive taps on a Point field toggles between which shows— **Add** to add a new Point or **Delete** to delete the selected Point. Multiple stretch parameters would be used to strike a compromise between two intervals—for example, a single octave and a double octave, or a 4:2 and a 2:1 single octave.

Practice Tutorial

See Appendix F, page 120, for a hands-on practice entering a custom Style file.

Design Considerations

The Verituner will blend your stretch point parameters into all the notes between stretch points. You can place stretch points on up to 15 notes. You must have a stretch point assigned to the first and last notes in the scale (A0 & C8) because these define the end-points. A stretch point is also required on the note pair A3 & A4, because this pair is used to set the stretch of the Verituner's temperament octave, A3 to A4.

In most cases you will also want to create at least one additional stretch point in the middle of the bass (between A0 and A3) and in the middle of the treble (between A4 and C8) in order to better control the octave stretch in these sections. You can define up to 15 stretch points.

Interval Availability

The chart on the next page summarizes the availability of various interval types across the range of notes in the scale. A green square indicates that the interval is available in the indicated range. DOWN and UP refer to the tuning direction. DOWN indicates that the note is tuned downwards from the center of the piano, i.e. the tuning for that note is calculated from a note referenced above towards the center. UP indicates the opposite – notes are tuned upwards referenced from notes below closer to the center. The interval size defines the particular note referenced. For example, setting an interval type of 6:2 (12th) on note F1, would tune F1 with reference to the note a 12th above, C3.

			A0-C#1	D1-G#1	A1-C#2	D2-G#2	A2-D3	D#3-G#3	A3-A4	A#4-D#5	E5-A5	A#5-C7	C#7-C8
DOWN	Triple Octave	8:1	■	■	■	■							
	Double Octave	8:2	■	■	■	■	■						
		4:1			■	■	■						
	12th	9:3	■	■	■	■							
		6:2		■	■	■	■	■	■				
		3:1				■	■	■	■				
	Single Octave	12:6	■	■									
		10:5	■	■	■	■							
		8:4	■	■	■	■	■	■	■				
		6:3	■	■	■	■	■	■	■				
		4:2			■	■	■	■	■				
		2:1					■	■	■				
UP	Single Octave	2:1							■	■	■	■	■
		4:2							■	■	■	■	
	12th	3:1							■	■	■	■	■
	Double Octave	4:1									■	■	■
	Triple Octave	8:1										■	■

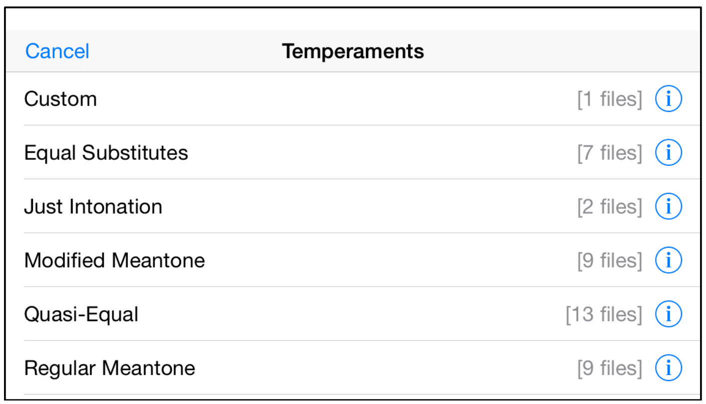
Chapter 4

Temperament Files

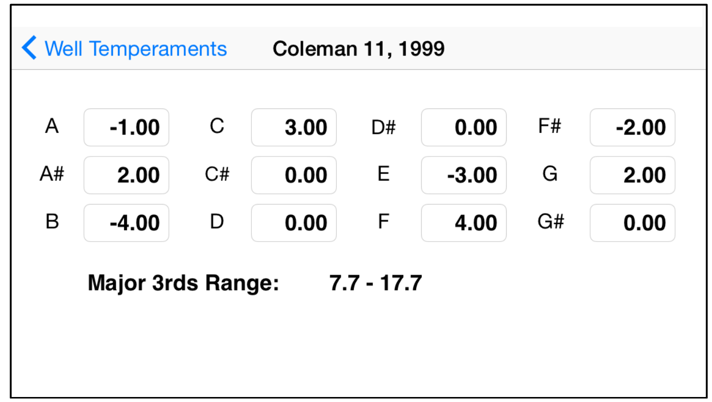
Specifying a temperament for a tuning file is done in the Settings screen of a tuning file (tap **Settings** on the left menu), not by going to the Temperament directory via the right menu. If you select an unequal temperament for a tuning file, it will be loaded and saved as a setting in the tuning file, and it will be in effect the next time you load the file.

The Verituner's default temperament is Equal. You can also tune with any of the over 90 unequal temperaments, historical and modern, that are stored in the Temperament directory. The Verituner enables you to design, store, and tune with custom unequal temperaments, which can be added to the temperament directory. See Appendix D Unequal Temperaments (page 69) for guidance on selecting unequal temperaments.

Tap **Temperament** on the right Menu to open the directory. The pre-installed temperaments are categorized in seven folders. There is also a Custom folder for temperaments you add.



To see the offsets (from equal temperament) of an unequal temperament, open a folder by tapping the InfoCircle (i) next to the folder name, and then tap (i) next to the temperament name.



In equal temperament, all Major 3rds are 13.7 cents wide (precisely 13.6863¢). The offsets screen shows the range of the widths of the Major 3rds in the temperament, which gives an idea of how mild or strong the temperament is compared to equal temperament. (This is covered in detail in Appendix D, page 96.)

Creating a Custom Temperament

To create a new temperament file from scratch, open the Custom folder and tap +. Use the + 1 – to enter the offsets with a precision of up to a hundredth of a cent. When you are finished, tap Done.

Note the following:

- All temperaments you add are stored in the Custom folder.
- To save a file with a different name or to delete it, tap its name in the Custom folder.

If you'd like to practice entering a custom temperament, here is a useful, very mild well temperament you can add to the Custom temperament folder.

Coleman 10 (2001)

A	–0.50
A#	1.00
B	–2.00
C	1.50
C#	0.00
D	0.00
D#	0.00
E	–1.50
F	2.00
F#	–1.00
G	1.00
G#	0.00

Another way to create a custom temperament is to copy an installed temperament file and change its offsets. This approach would be efficient if you want to use an already-installed temperament as a point of departure. To do this, tap Temperament on the right Menu, tap ⓘ to open the folder, and tap the temperament's name. On the popup, tap Save As, rename the file if you want, and tap Done to save it in the Custom folder.

Chapter 5
Measured Tuning

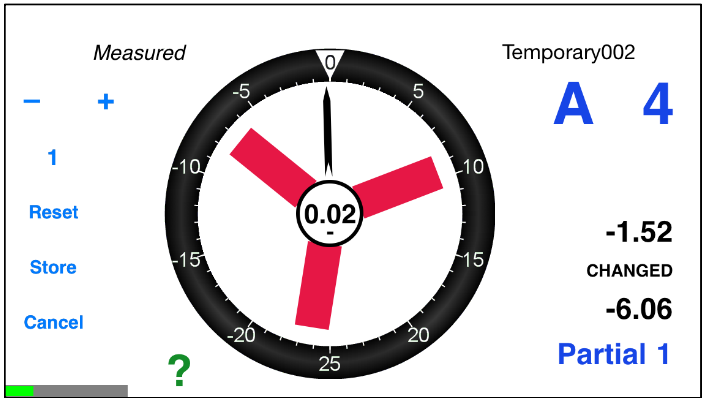
The Verituner's Measured Tuning function is used to measure the pitches of an already-tuned piano or other keyboard instrument and store the measurements. Typically the tuning would have been done either aurally or, perhaps, with an ETD. An aural tuning could, for example, be measured and stored, and the Measured tuning file could then be used to replicate the tuning at a future time. Measured Tuning is also used to score the Piano Technicians Guild tuning examination. (See Appendix E, page 112, for the procedure for Scoring the PTG Tuning Exam with the Verituner.)

Unlike the Coarse and Fine Tuning functions, Measured Tuning does not measure inharmonicity and calculate tuning targets. Its primary function is measuring pitches and storing their measurements. Since there is no calculated stretch or use of a tuning style, Measured Tuning is not intended for tuning a piano *until* it has been tuned and all notes have been measured and stored. Once the measurements have been stored, it can be retuned by loading its Measured Tuning file from the Measured Tuning directory. Theoretically, an **organ** has no inharmonicity and, therefore, no stretch. Thus, Measured Tuning could be used to tune an organ with all offsets at 0.00. Since **harpsichords** typically do have inharmonicity, albeit low, they should be tuned in Fine Tuning.

Unlike Standard tunings, in which the target of each note is based on multiple partials, each note in a measured tuning is based on the measurement of a single partial. Each of the 88 notes is preset to a default partial and zero offset. The default partials are:

A0 – B3	Partial 4
C4 – B4	Partial 2
C5 – C8	Partial 1

The current partial and cents offset are displayed at the lower right corner of the screen, e.g., 0.00. Tap **Partial** to cycle through the available partials to select the desired partial. Successive taps cycle through the available partials for the note. For example, you might want to change it if the default partial is weak or unstable.



All notes in a new Measured tuning are set at 0.00. When a note has been measured and its offset stored, the display will indicate this with **STORED**. If either the partial or the offset is changed from the stored setting, the screen will display CHANGED and the partial and/or offset number will blink.

NOTE: In Measured Tuning, AutoNote is off by default. Change the note & octave manually, or if you prefer, turn on AutoNote.

Procedure for Measuring and Storing a Tuning

1. Swipe out the right menu and tap **Measured** to open the Measured Directory.
2. Tap the InfoCircle ⓘ to open the folder you want the file saved in.
3. At the upper right corner tap + to start a new tuning file.
4. In the Measured Tuning Setup screen, name the file and change the pitch if you want. (If later you want to change the file name, go to the file in the directory and tap its name.)
5. Tap Done.
6. Before beginning measuring and storing, **minimize ambient noise** as best you can.
7. Strip **mute the piano**, or if you prefer, mute each individual note as you measure.

8. **Check the tuning** and make any necessary final adjustments.
9. **Measure and Store**:
   a. On the Measured tuning screen, set the note you want to measure.
   b. Change the partial, if you want. Tap **Partial** at the lower right corner until the partial number changes to what you want. When the partial is changed, **Partial** blinks, indicating it has been changed.
   c. If necessary, pause until there has been a second or two of musical silence before beginning the next step.
   d. Tap **Measure** and immediately …
   e. …play the note at a moderately soft volume. In about a second, the offset that was measured will be displayed— as the *cents offset* number—above the partial number. It blinks to indicate that it has not yet been stored.
   f. If necessary, adjust the measurement manually. When the measurement (expressed by the cents offset number) matches the pitch, the spinner will have stopped or slowed as much as possible, and the needle and number in the hub will be as close as possible to 0. If there are pronounced variations in the pitch, from attack through decay, adjust the offset so the spinner is slowest, and the zero target is closest just following the attack.

      To adjust the measurement, play the note (with a consistent, moderately soft volume) as you use the + 1 – to tweak the offset for the slowest spinner motion you can get. When the offset is changed, it will blink in the display.

      If you are re-measuring a previously stored note, the difference between the stored offset and the new reading is displayed above the blinking offset:

      –1.52

      CHANGED

   g. Tap the Store to store the offset and partial. After storing, **STORED** appears and the offset and partial stop blinking. To exit with no change to the stored measurement, tap **Cancel**.
10. Repeat step 9 until all notes are measured.
11. Confirm the measured tuning by playing each note in succession while checking that the spinner is virtually stopped for each.

Notes

- When playing a note, the difference between the target (the partial and offset) and the pitch being played is displayed in the spinner hub.
- In the Measure mode, a blinking offset number and/or partial indicates a change in the Verituner's offset measurement—a temporary setting until it is stored (by tapping Store). If you move to another note before storing, the offset will be lost. The spinner, needle, and the number in the hub all indicate how close the pitch is *to the offset*—whether temporary or stored. Below the cents offset number, | **STORED** or **CHANGED** indicates the current status.
- **Reset** sets the offset to 0.00
- **To re-measure** or tweak a note that already has a stored offset, repeat step 9.
- If you have a single-partial tuning measured by another tuning device, it can be transferred to the Verituner by keying in the partial number and offset for each note. Use these steps in the above procedure:

  Step 1

  Step 4 – a, b, d, f, g

  Step 5

Measuring an Interval

To measure the width of an interval in cents, follow this procedure. (An example using a Major 3rd is given in brackets.)

1. Turn AutoNote off, if it is not already off.
2. Set the Verituner to the lower note. [F3]
3. Tap **Partial** to set the lower coincident partial. [5]
4. Measure and Store (steps 9 d-g in the Procedure for Measuring and Storing a Tuning).
5. Without changing the note setting or the partial number, play the upper note. [A3]
6. Read the width in the spinner hub. (A positive number indicates an expanded interval; a negative number indicates a contracted interval.)

Coincident Partials

Single Octaves	12:6, 10:5, 8:4, 6:3, 4:2, 2:1
Double Octave	4:1, 8.2
Fifths	6:4, 3:2
Twelfth	3:1, 6:2, 9:3
Fourth	4:3
Major Third	5:4
Minor Third	6:5

Measuring a Tuning Fork

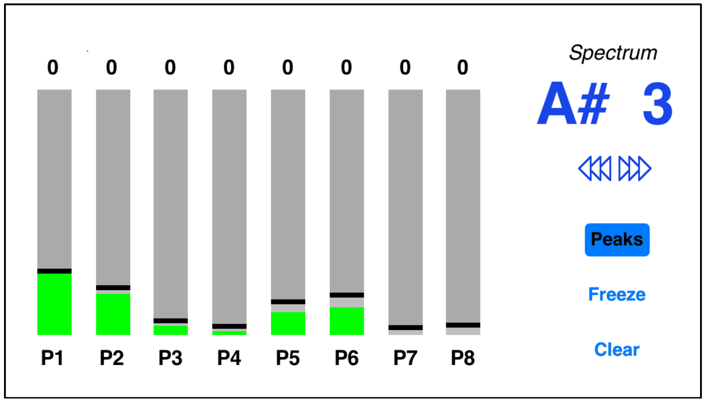
With Measured Tuning, the Verituner can be used as a reference to check the accuracy of a tuning fork. (The Verituner's accuracy is ≤ .01¢.)

1. On the right menu, tap **Measured** and start a new tuning file.
2. Set note & octave to the pitch of the fork (e.g., A4).
3. Tap **Partial** to select Partial 1, and be sure that the offset reads 0.00.
4. Sound the fork, and hold it close to your device's microphone. Hold the fork still.
5. Read the Verituner's measurement of the pitch deviation in the spinner hub.

Chapter 6

Spectrum Display

The Verituner's Spectrum Display shows the harmonic content of a note rather than its pitch. It displays in real time, i.e. what you are hearing is graphically represented instantaneously. The graphic representation consists of a set of vertical bars, one for each partial: P1, P2, P3, etc. Spectrum Display displays the same partials that are measured and used to calculate tuning targets.



These bars represent the relative strength of each partial—the longer the bar, the stronger the partial. Because they are displayed in real time, they dance across the screen as the note sounds and the tone fluctuates. By watching the sustain and decay of the notes, you can see how quickly certain partials decay in comparison to others. The Spectrum display is useful for voicing, or for otherwise correlating what you hear in a note against its partial content.

NOTE: Ambient noise in the same range as the partials being measured will be included in the display. This should be disregarded since it is not part of the piano tone.

Note & Octave can be manually selected or set by AutoNote as in Fine and Coarse tuning. Tap the note or octave and swipe to change. Tap the AutoNote icon to choose random, stepwise, or off; or tap & hold the AutoNote icon for more options. **Peaks** is used to toggle Peak Mode on and off. When on, the *peak amplitude* (volume) of each partial is remembered and displayed (with a black line across each bar) along with its

real-time value in the column at the top of each bar. (See the illustration above.) When the Peaks mode is active, **Peaks** has a blue background, as in the above graphic. The memorized peaks can be reset by tapping **Clear**. This arms the peaks memory for another note strike.

Freeze is used to freeze the spectrum display. Tap **Freeze** while a note is sounding (it turns blue), and the display stops responding, and the peak bars remain frozen at exactly that point. This allows for a close examination of the readings. The display will remain frozen until **Freeze** is tapped again.

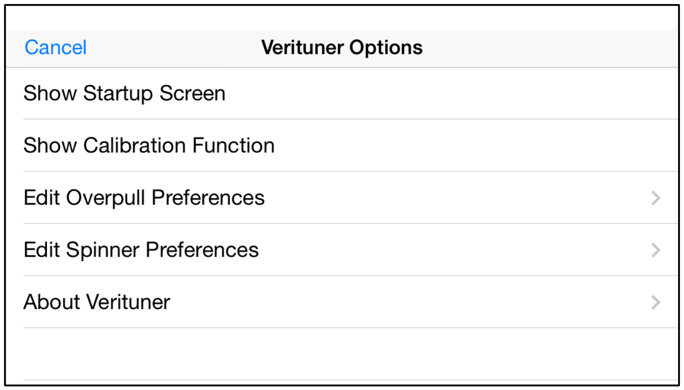
When **Freeze** is on, **Clear** is momentarily disabled.

To exit Spectrum Display, swipe to open the right menu and make another selection.

Chapter 7

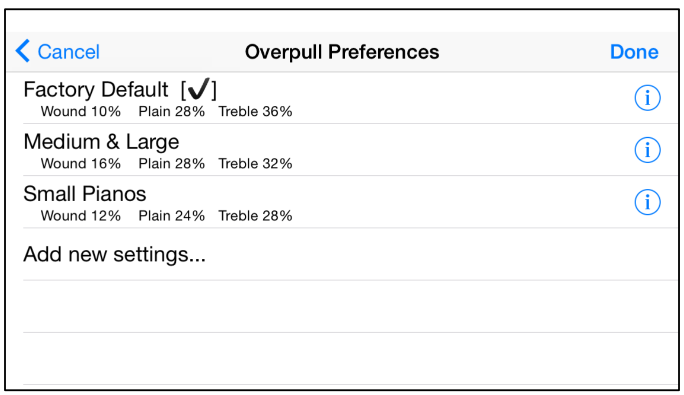
Veritimer Options

The Veritimer menu is the location of a miscellany of items. On the right menu, tap **Veritimer** to access the startup screen, the calibration screen, and to see a statement of legal matters and the version number of the installed Veritimer app. There options for setting user preferences for Overpull and the Spinner.



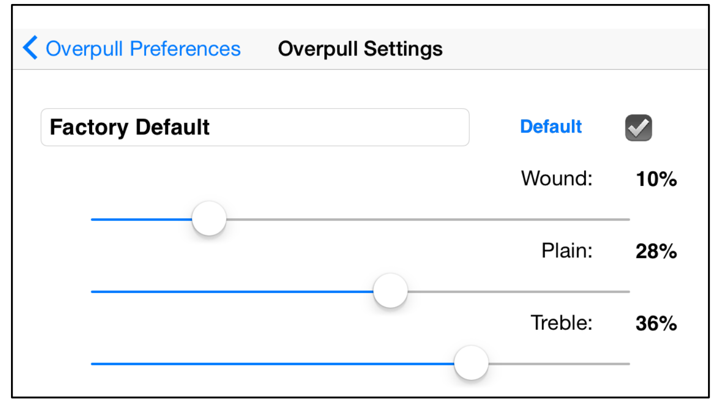
Edit Overpull Preferences

Tap Edit Overpull Preferences to open the Overpull Preferences screen.



There are four pre-installed overpull settings, each of which can be customized by changing the overpull percentages, renaming the setting, and designating a setting as the default. On the list, tap the name of an overpull setting to delete the setting or make it the default. Tap the InfoCircle ⓘ next to the setting you want to change. In the Overpull Settings screen you can change the percentages, rename the configuration, and make it the default (indicated by the checkmark).

Tap to open the Overpull Settings screen.



- Tap on the name field to edit the name.
- Use the sliders to change the overpull percentages.
- Tap the **Default** to make this the default setting.

After making changes, tap Overpull Preferences to return to the list of settings. Any changes you make to a setting are automatically saved.

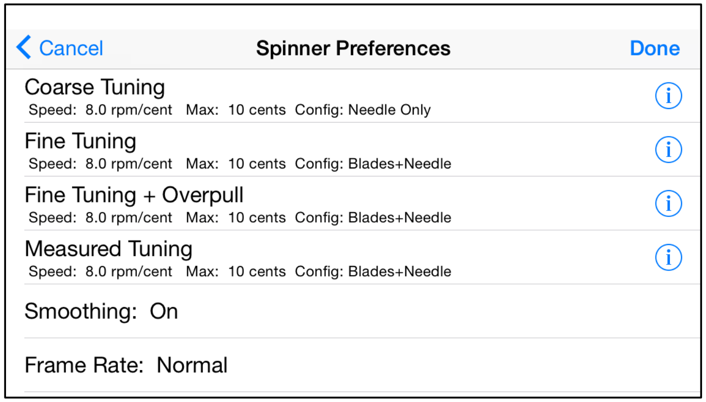
On the Overpull Preferences screen, you have the option to **Add new settings…** (up to a total of five settings.) Exit Overpull Preferences by tapping Done.

To switch to another setting of percentages while tuning, touch & hold the percentage number on the tuning screen to open the Overpull Preferences screen. Tap the name of the setting, and then tap Select.

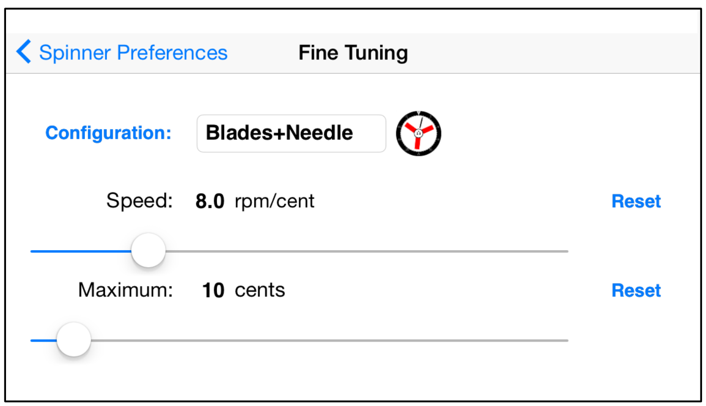
It is recommended that you use one or more of the pre-configured settings while observing how well they are working with a number of pianos. On that basis, tweak the settings until you get the best overall results you can.

Edit Spinner Preferences

Tap > to open the Spinner Preferences screen.



There are four pre-set spinner configurations. Each can be edited but not deleted. Tap the InfoCircle ⓘ next to the configuration you want to edit.



These options are available:

- Tap **Configuration** to cycle through the available configurations of blades and needle. The image on the right illustrates each configuration.
- Use the slider to adjust the **Speed** the blades rotate (rpm=revolutions per minute) for each cent of deviation; e.g., set at 8 rpm, if the pitch is 3 cents from target, the spinner will revolve at the rate of 24 rpm.
- Use the slider to set the **Maximum** pitch deviation, beyond which a large sharp or flat symbol appears inside the spinner ring; e.g., set at 10¢, the large ♭ or ♯ appears (replacing the blades & needle) when the pitch deviation is >10¢ from target.

Guidelines for Setting Speed and Maximum When the note you are tuning is sharp or flat, the spinner blades rotate at speeds in proportion to the amount the pitch is off from the target. The proportion can be changed, which has the effect of changing the sensitivity of their response to the deviation. A higher speed setting, for example, will result in higher sensitivity, i.e., its rotation will be relatively fast for small pitch deviations. However, its useful range will be narrower because it will more quickly pick up speed at greater deviations, to the point that it is unclear which direction it is rotating. The point at which the blades become too indistinct to be helpful—the point of "maximum" deviation—would be the logical place to set the ♭or ♯ to appear. A lower spinner setting results in a lower sensitivity of response, i.e., slower rotation at small pitch deviations, but a wider range in which the clear enough to be useful.

Smoothing On gives the spinner some inertia by averaging short-term changes in pitch, such as caused by false beats. The resulting smoothing of the spinner is usually the preferred setting. **Smoothing Off** increases the short-term accuracy and responsiveness of the spinner, but it also increases jumpiness.

Frame Rate Normal takes full advantage of the graphical performance capabilities of iOS devices and is therefore recommended. If it appears that background apps are interfering with the performance of the Verituner, try closing them. If the problem persists, try the Slower frame rate setting. Apps running in the background is not recommended.

Appendix A
Veritune Support

Contacting Veritune

Email support@veritune.com

Voice 888.VERITUN (888.837.4886)
outside US: +1.773.793.6530

User Community

http://www.veritune.com/community.html

To register, tap (or click) the Register link.

The Verituner Version

The version number of the installed Verituner App is shown on the startup screen.

The Latest Version of This User Guide

The latest version of the Verituner User Guide is available at the Veritune website:

http://www.veritune.com

Click the Downloads link, and on the Downloads page, click the link for the guide you want. It is in PDF format and opens in Adobe Reader or, on a Macintosh, in Preview.

Adobe Reader, can be download at

get.adobe.com/reader/

Appendix B
Importing and Exporting Verituner Files

The Verituner App automatically saves tuning files and custom style and temperament files. The capability of importing and exporting files between Verituner devices—iOS, Netbook, Pocket PC, and a computer—enables you to

- Copy saved files to other devices
- Back up your files to a computer, and from there you can back up to external storage devices, such as a flash drive, hard disk, and/or an online backup service.
- Share Verituner files with other Verituner users.

Folder Names

As a matter of organization, it will be helpful to have a set of folders on the computer that match the names of folders in the tuning directory in your Verituner device(s). For example, if you have a folder of tuning files for Schools in the Verituner, have a corresponding Schools folder on the computer.

Move Files from a Netbook or Pocket PC to a Computer

The files you want to import into the Verituner App have to be stored on the computer that will be used for importing.

- **Verituner for Netbooks** In importing and exporting files in Verituner for Netbooks, files are stored in these locations:

  Standard Tuning Files: C drive > Verituner > **vot** > [multiple subfolders]
  Measured Tuning Files: C drive > Verituner > **vmt** > [multiple subfolders]
  Temperament Files: C drive > Verituner > vuo > **Custom**
  Custom Style Files: C drive > Verituner > vus > **Custom**

- **Verituner Pocket** If you are exporting files from a Pocket PC, add a new folder in the desired location on the computer (or an external storage device attached to the computer) and name it, e.g. Verituner Files 9-7-17. This will be the destination folder for the files you are exporting from the Pocket PC. From there (on the computer), they can be imported into the Verituner App. On the Pocket PC, use File Explorer (on the Start menu) to find the desired files. [Tap just below the File Explorer header, at the top left to open the dropdown menu.]

Standard Tuning Files: My Device > Program Files > Verituner > **vot** > [multiple subfolders]
Measured Tuning Files: My Device > Program Files > Verituner > **vmt** > [multiple subfolders]
Temperament Files: My Device > Program Files > Verituner > vuo > **Custom**
Custom Style Files: My Device > Program Files > Verituner > vus > **Custom**

Copy either the Verituner folder, or in that folder copy the vot folder, the Custom folders of the of styles and temperaments. (Tap-hold the stylus or your finger nail on the folder name; release when the pop-up menu appears. Tap **Copy**. *Caution: be careful that you do not inadvertently tap* Cut *or* Delete!

With an SD card inserted in the Pocket PC, navigate in File Explorer to select the SD Card. Tap-hold with the stylus or your nail in an open area of the screen (below the last listed file or folder name) and then tap **Paste** to copy the Verituner folder onto the SD Card. NOTE: The xbin folder, which is in the Verituner folder cannot be exported into the Verituner App.

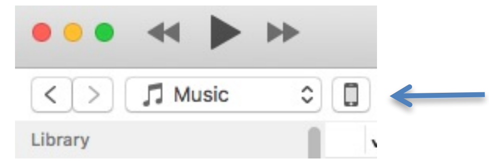
Remove the SD card and, depending on your computer, insert it in the SD card slot of the computer or a card reader connected to a USB port. Copy/drag & drop the copied folder(s) from the SD card into the destination folder on your computer.

The following are step-by-step procedures for importing and exporting files to and from an Apple iOS device with the Verituner app installed and a Mac or PC with iTunes version 12 or later installed. iTunes is pre-installed on Macintosh computers. iTunes for Windows computers can be downloaded here: www.apple.com/itunes/download

Import Files into the Verituner App on an iOS Device

Once the files are on your computer (or an external storage device attached to the computer), they can be imported into the Verituner App.

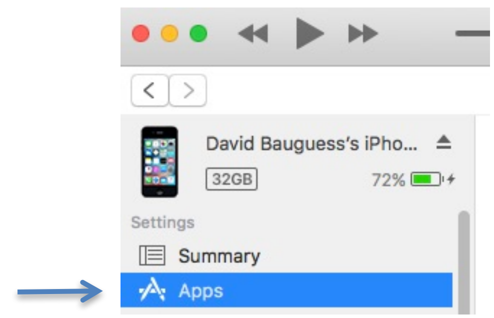
1. Open iTunes on the computer and position its window so that you can also see the files you are going to import.
2. Connect your Verituner device to the computer, and swipe from the right to open the desired directory—Standard, Style, Temperament, or Measured.
3. At the upper left of the iTunes window (above the sidebar), tap the small icon, which represents your iOS device.



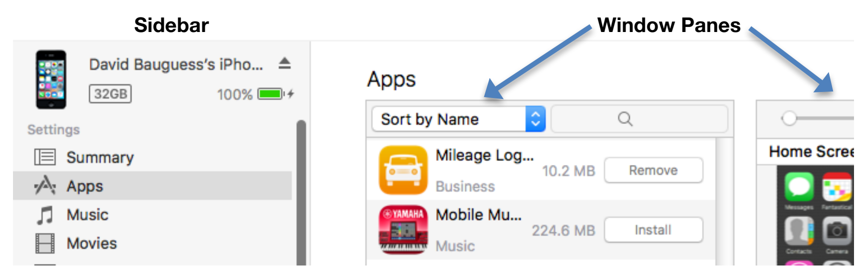
At the top of the sidebar a larger icon of your device appears next to its name. Under it there is a Settings list. (See the graphic in the next step.)

[NOTE: If your version of iTunes is earlier than version 12, select your iOS device in the sidebar under DEVICES.]

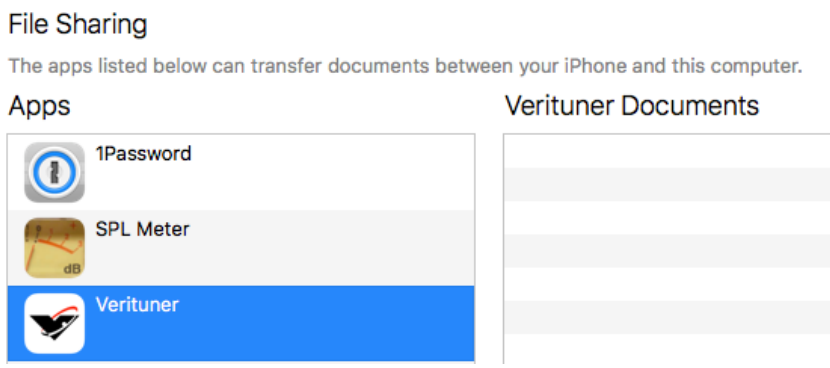
4. In the Settings list in the sidebar, click on Apps or File Sharing—whichever one is on the list:



[If you are using iTunes version 11 or earlier, click Apps near the top, center of the iTunes window.]

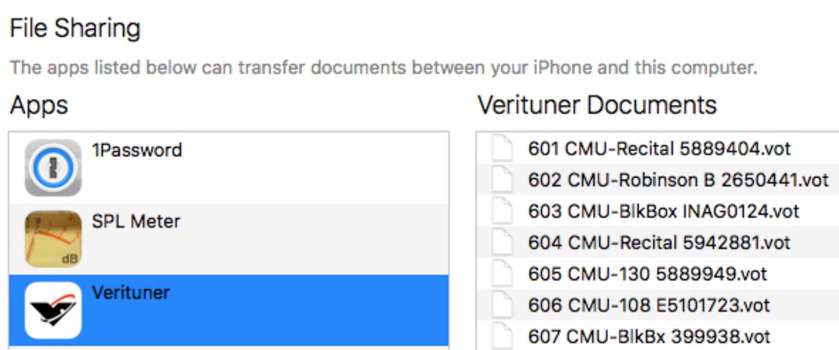


At the right of the sidebar, there is a window with two sections or "window panes". The pane on the left contains a list of **Apps** that are installed on the device or which can be installed or removed. Beneath this list is the **File Sharing Apps** list, where the Verituner app is. If you don't see it, scroll down with the scroll bar on the far right side of the iTunes window until it is in view.



5. Select the Verituner app. When you do, the pane on the right is labeled Verituner Documents. It is empty. (If not, delete any items listed there.)

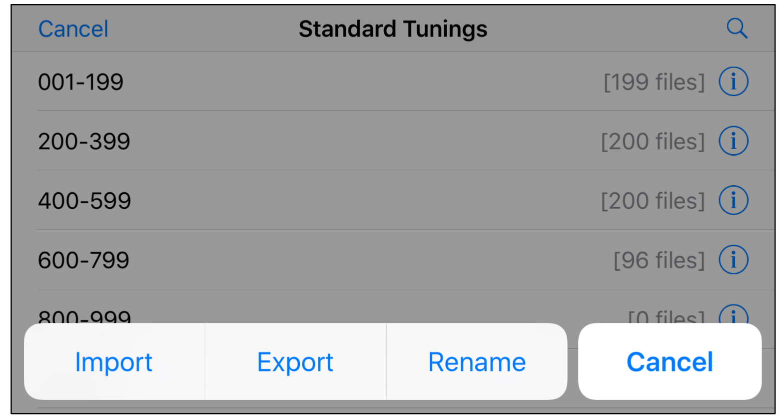
6. Now, from the computer (or external storage device), drag & drop the files you want to import into the Verituner Documents pane in iTunes.



NOTE: When you import the files from the Verituner Documents pane, they will all go into a *single* folder that you will select in the Verituner app's directory (step 7). All the files you import as a group must all be of the file type that is recog-

nized by the destination folder, e.g. only .vot files can go into a folder in a Tuning directory; a .vus Style file cannot be imported into a Temperament directory folder, which only accepts .vuo files. *You cannot import a mix of file types as a group into one folder.*

7. In the Verituner app, tap on the *name* of the folder (not the InfoCircle ⓘ) into which you want the imported files placed.



Next, tap Import. If any of the files you are importing are already in the destination folder, you will be prompted to approve overwriting them or not (Yes or No). If you tap Yes, the files are then copied from iTunes into the Verituner folder you selected. If you tap No, only files that are not in the folder will be imported.

Tap Continue, if a confirmation of the import appears. The iTunes Verituner Documents pane is then automatically emptied. (If not, delete the files from the pane.) You might want to confirm that the import was successful.

8. Repeat steps 6 and 7 until all files have been imported.

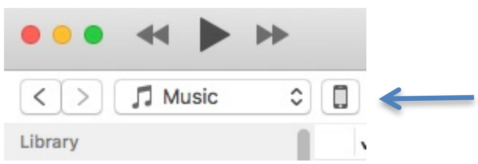
With the Import complete, you may wish to back up your device in iTunes. To do so, select Summary under Settings in the iTunes sidebar and click Back Up Now.

Export Veritunér App Files to Other Devices

As files in the Veritunér iOS App are added, deleted, or modified you can export all or selected files from your Veritunér device to your computer. From there they can be imported by another iOS device or copied into other Veritunér platforms. In addition to the backup of the files on your computer, you may also want to back them up to other storage devices, such as an external hard disk, flash drive and/or an offsite backup service such as Dropbox.

Follow this procedure for exporting Veritunér files from the app to your computer:

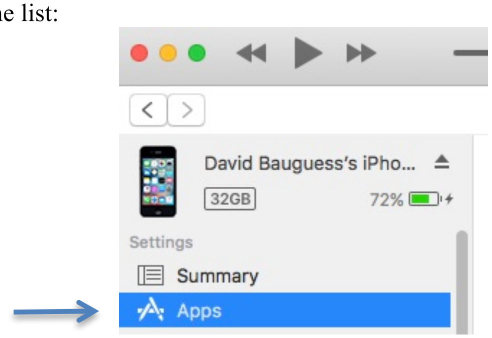
1. Open iTunes on the computer and position its window so that you can also see the folder(s) where you are going store the files you export from the Veritunér.
2. Connect your Veritunér device to the computer.
3. At the upper left of the iTunes window (above the sidebar), tap the small icon, which represents your iOS device.



At the top of the sidebar a larger icon of your device appears next to its name. Under it there is a Settings list. (See the graphic in the next step.)

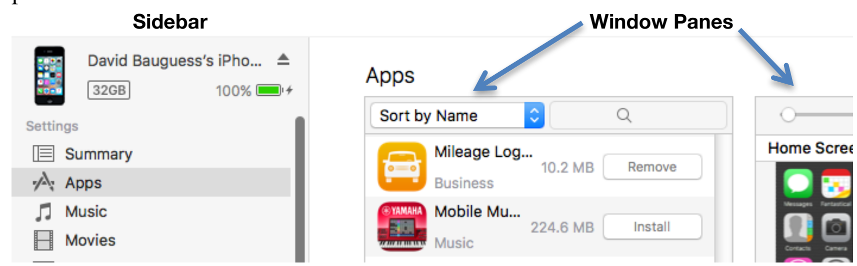
[NOTE: If your version of iTunes is earlier than version 12, select your iOS device in the sidebar under DEVICES.]

4. In the Settings list in the sidebar, click on Apps or File Sharing—whichever one is on the list:

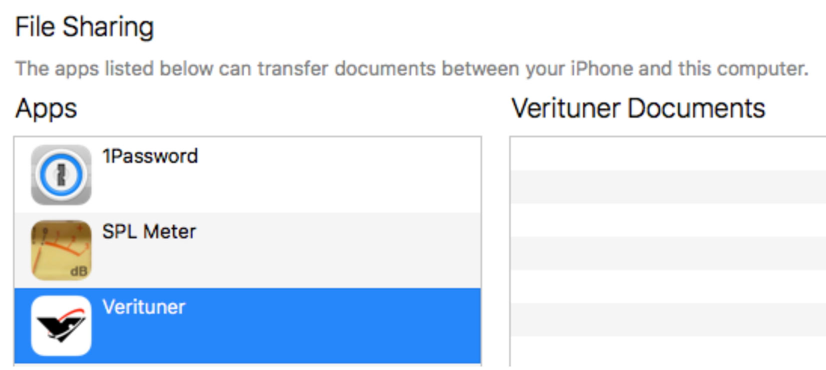


[If you are using iTunes version 11 or earlier, click Apps near the top, center of the iTunes window.]

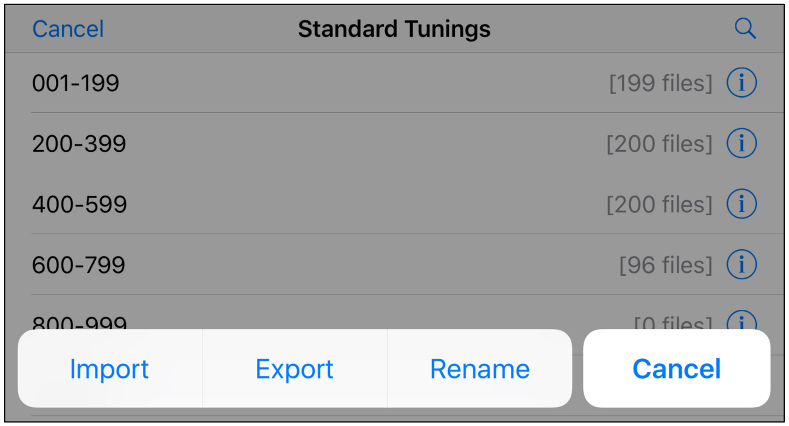
At the right of the sidebar, there is a window with two sections or "window panes".



The pane on the left contains a list of **Apps** that are installed on the device or which can be installed or removed. Beneath this list is the **File Sharing Apps** list, where the Veritunér app is. If you don't see it, scroll down with the scroll bar on the far right side of the iTunes window until it is in view.

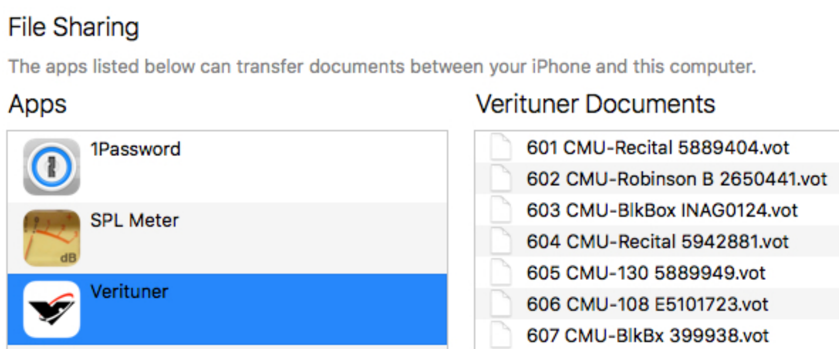


5. Select the Veritunér app. When you do, the pane on the right is labeled Veritunér Documents. It is empty. (If not, delete any items listed there.)
6. In the Veritunér App on your device, swipe to reveal the right menu. Tap the desired directory—Standard, Style, Temperament, or Measured—and then tap on the *name* of the folder (not the InfoCircle ⓘ) containing the files you want to export to your computer.



Tap Export. *All files in the folder you selected will be exported.* At the notice of the number of files exported, tap Continue.

7. In the iTunes Verituner Documents pane, select all the files or individual files, and drag & drop them into the desired folder on the computer.



8. Now, having copied the files to your computer, select the files listed in the Verituner Documents pane in iTunes and delete them all to empty the pane.

NOTE: You will be warned: "Are you sure you want to delete the selected documents from your [iOS device]?" Clicking Delete only removes the files from the Verituner Documents pane. It does not delete them from the computer or the iOS device.

9. With the iTunes Verituner Documents pane empty, repeat steps 6-8 until all the desired files have been exported.

Appendix C
Inharmonicity and Tuning Targets

The tuning procedures presented in Chapter 2 emphasize what to do. In this chapter we'll broaden the context to explain more about how the Verituner works and *why* things are done the way they are. There are insights and specific recommendations that will help you get the best results from the Verituner, especially when doing New tunings.

The following Verituner features are covered in this chapter:

- Inharmonicity Measuring
- Target List
- Recalculate / ReCalc
- Remeasure

Measuring Inharmonicity

One of the unique and powerful features of the Verituner is its ability to measure a piano's inharmonicity[1], automatically and in the background, *while you are tuning.* By the time you finish tuning the piano, the Verituner will have measured the partials of 76 notes—469 partials in all—to determine its inharmonicity. This wealth of data—all of which is automatically stored in the tuner—is used to determine how much stretch is required to "fit" the tuning to the piano's inharmonicity. Tuning targets are calculated for all 88 notes, using well-established principles used by aural tuners. The Verituner can help you obtain superior tunings with greater ease and less fatigue.

Measuring partials to determine a piano's inharmonicity is done in the Verituner's Coarse and Fine Tuning functions. Both screens display the inharmonicity icon , which has animated "sound waves" when it is measuring successfully. The icon is "empty" at first, but as you play the note several times, it begins to fill in from the bottom to the top , indicating the amount of information it is getting. Inharmonicity readings are not taken on C#7–C8, though their first partials are measured . These notes are not read for inharmonicity because no notes higher than their first partials are tuned, so their inharmonicity has no affect on the tuning. When tuning these notes, the icon does not appear in the display.

[1] **Inharmonicity** is the discrepancy between the theoretical frequencies of partials and their actual frequencies. With the exception of the first partial (the fundamental), the partials of piano tone are sharper than their theoretical frequencies, which would be exact multiples of the fundamental. This necessitates tuning octaves wider than theoretical in order to obtain an acceptable compromise of these discrepancies. The first partial of A4 is tuned to 0 cents deviation, but all notes above it are tuned increasingly sharper, and all notes below it are tuned increasingly flatter than what they would be theoretically. The result is the piano's *stretch.*

When inharmonicity reading is turned on, "sound waves" are visible and animated. If the waves are not visible, inharmonicity reading is off.

A4 First!

When you first tune a piano with the Verituner (a "New" tuning), it is *essential* that the Verituner hears and measures A4 first. In the New tuning procedures outlined in Chapter 2, this is done in Coarse Tuning (step 6). Obtaining as good a reading as possible is more important with A4 than with other pitches because this is the Verituner's first inharmonicity information, and it is the basis for the initial calculation of the piano's stretch. To measure, simply mute two of the strings and play A4 several times as you watch for the inharmonicity icon to fill.

Ideally, when the Verituner measures A4, the icon should fill completely and do so reasonably quickly. When this happens, it indicates that the note has a full set of strong, clear partials and that a set of accurate and consistent readings was taken. If it does not fill quickly, check that the non-speaking strings are properly muted, and then strike the key a few more times to see if a better reading can be achieved. For strings with weak partials or a false beat, the icon may fill up more slowly or may never fill completely. If this is the case, try another string of A4.

At least some weak partials are normal in piano tone, and since readings are taken on many notes, less inharmonicity information with some notes is quite acceptable. After A4, the icon does not need to be so closely monitored to fill it for every note. A very good tuning can be obtained with less than complete inharmonicity data, although some users may find that obtaining maximum data could result in an even more refined tuning.

Tuning Targets and Recalculation

Tuning targets are the cents offsets from theoretical pitch that are the "ideal" frequencies of each note of an individual piano. The Verituner uses the inharmonicity information it gathers, and the style and temperament parameters, to calculate tuning targets for all 88 notes. They are compared with the note you are sounding to produce the motion of the spinner and the needle's position.

Whenever the filling of the inharmonicity icon jumps substantially—indicating that additional information has been obtained—the tuning targets for all untuned notes are calculated using all of the information the Verituner currently has. In other words, as the Verituner learns more about the piano's inharmonicity, it updates and refines the stretch. This recalculation, which takes only a second or two, is indicated by the brief appearance  of the calculator icon at the lower left corner of the screen. As with measuring, it is done automatically while you tune.

In Fine Tuning, the targets for the measured partials are listed in a column on the left side of the display. The digits on the left are the partial numbers, and the values next to them are the calculated targets expressed in cents.

1 -1.70
2 -1.38
3 -0.94
4 -0.01
5 +0.86
6 +2.39
7 +3.25
8 +5.73

Which partials are being read varies in different sections of the piano. For example:

Note Played	Partials Measured
A4 & A3	**1, 2, 3, 4, 5, 6, 7, 8**
A5	**1, 2, 3, 4**
A6	**1, 2**
A7	**1 (no inharmonicity is measured)**
A2	**2, 3, 4, 5, 6, 7, 8**
A1	**3, 4, 5, 6, 7, 8, 9, 10**
A0	**6, 7, 8, 9, 10, 11, 12**

Theoretical pitch is what the frequency of a partial would be if there were no inharmonicity, i.e. the frequency of a partial would be an exact multiple of the fundamental—with 0 cents offset. A4 is the only note that is tuned to exact theoretical pitch; i.e., partial 1 of A4 is always set to 0.00 cents. The targets for all other notes are offset to fit the piano.

The *offset*, then, is the discrepancy or difference in pitch between the theoretical and the tuning target for the partial *as calculated by the Verituner*. It is not the actual measurement of the partial. Targets are calculated based on the measured inharmonicity, stretch choices (Style), temperament, and on the targets of other, previously calculated targets.

The Verituner does not set a single partial and offset. The spinner reacts dynamically to the *combined* targets of multiple partials of the note you are tuning. The relative strength and weakness of the partials also influence the motion of the spinner.[2] These and other variables are used by the Verituner's proprietary algorithm to determine the 0 point at which the spinner stops.

While a note is sounding, you will see small right-pointing triangles ▶ appear at the left of the partial numbers: These arrows indicate the presence or absence of each partial in the sound. A dark arrow indicates a strong partial, a gray arrow indicates a weaker partial, and a missing arrow indicates little or no presence of a partial. These arrows flicker on and off as you sound the note, typically showing a strong presence of all the partials when you first sound the note and the higher partials dropping off as the sound decays.

Tuning Sequences

The recommended tuning sequences, given in Chapter 2, are designed to accomplish two goals: (1) help the Verituner optimize its calculated stretch during a New tuning, and (2) support a close-to-target outcome when raising or lowering pitch.

Because the Verituner accumulates inharmonicity information *as you tune*, a carefully chosen tuning sequence can provide the Verituner with new information *when* it will be most useful. Tuning order also has a determining effect of the outcome of pitch raising and lowering due to the effects of tension changes in the piano. The best order for each goal is not the same, so in some situations a compromise must be made.

The Verituner's recommended sequences are based on these three principles:

- *For optimizing stretch in a New tuning,* the Verituner should first gather inharmonicity information from its temperament in this order: A4, then A3, and then all of the notes in between, in stepwise order. The remaining notes should be tuned and measured in a sequence outwards from the temperament.
- *For supporting the outcome of pitch raising and lowering,* begin tuning at one end of a bridge, moving in half steps to the other end.
- *For tuning stability,* tune unisons as you go.

[2] If you would like to *see* the relative strength of the partials on the targets list, tap Spectrum on the right menu. As you play a note, the Verituner displays the relative strength of each partial in a bar graph in real time. See Chapter 6 (page 40) for more information on the Spectrum Display.

From these principles, the recommended sequences may be summarized as follows:

- **For a New, one-pass fine tuning in which the present pitch is very close**, follow this sequence:

  1. Tune each string of A4.
  2. Tune each string of A3.
  3. Tune A#3 and tune upward by half steps, tuning unisons as you go, until you have tuned C8.
  4. Tune G#3 and tune downward by half steps, tuning unisons as you go, until you have tuned A0.

  NOTE: Since the pitch is very close, this sequence gives priority to optimizing the stretch by tuning the entire temperament octave first.

  VARIATIONS: Steps **3** and **4** can be reversed with one modification: tune G#4 down to A0; then tune A#4 up to C8.

- **For a New tuning in which pitch is raised or lowered,** use this sequence for the *first* pass of a Coarse tuning and for a one-pass fine tuning with overpull:

  1. Play A4 until the inharmonicity icon is as full as possible.
  2. Play A3 to at least partially fill the icon.
  3. Tune each string of the lowest tenor note, i.e. the first note on the treble bridge, regardless of whether it is wound or plainwire.
  4. From there, tune upward by half steps, tuning unisons as you go, until you have tuned C8.
  5. Tune from the top of the bass section down to A0, tuning unisons as you go.

  NOTE: The Verituner initially gets inharmonicity information from only the outside notes of its temperament (A4 & A3). By first playing A4 and A3, rather than tuning them, overpull calculations will be correct when these notes are tuned later in the sequence.

- **For all Saved tunings—coarse and fine—and for the final pass of a two-pass New tuning,** this sequence is recommended:

  1. Begin with the lowest tenor note and tune upward by half steps to C8, tuning unisons as you go.
  2. Tune from the top of the bass section down to A0, tuning unisons as you go.

  NOTE: Since, in the course of an earlier tuning or pitch raise, the inharmonicity of the entire piano has already been read, this sequence favors supporting the outcome of pitch changes. For fine tuning where the pitch is very close, any sequence can be used.

  VARIATIONS: Steps **1** & **2** can be reversed. Another sequence is to tune A0 to C8.

IMPORTANT: These tuning sequences, with their goal of optimizing the stretch of New tunings, work with the Verituner's built-in styles: Average, Clean, & Expanded. *They may or may not be best for custom styles.*

Locked Targets

Automatic recalculations are done continuously as new inharmonicity information is gathered. In Coarse Tuning, *all* targets are potentially recalculated, but in Fine Tuning, only the targets of *untuned* notes are recalculated. This is so that if you want to check or retune a previously tuned note, its target will not have moved. Targets that are changed after a recalculation are updated on the target list.

As you tune a note in Fine Tuning, the Verituner measures the inharmonicity, recalculates (assuming it got sufficient new data), sets the targets for the partials of the note, and then *locks* the targets. The lock symbols indicate the status of each note—unlocked or locked. This process takes place in just a few seconds.

In some cases notes may not lock due to false beats, especially notes in the extreme bass and treble. This is normal and will not affect the tuning calculations. You do not need to wait for a note to lock before moving to the next note.

Remeasure

Occasionally, you may want to try to improve an individual note's tuning. After more of the inharmonicity of the piano has been discovered, the Verituner may be able to make a slight adjustment to a note, resulting in a better fit with the rest, just as in aural tuning. The **Remeasure** command unlocks an individual note (if it is locked) and clears and remeasures its inharmonicity data, and then recalculates its targets. Remeasure inharmonicity if you suspect you have inaccurate inharmonicity information—from ambient noise while measuring, for example—and targets for the note are not right.

To retune a note, press **Remeasure**. The lock symbol changes to unlocked; the ((I)) is emptied and then refilled as you play the note; and, the calculator appears briefly to indicate that recalculation of the targets is taking place. The note can then be retuned to the new targets. Only the current note is affected by Remeasure. If you are still not satisfied with the note's tuning, tune it by ear and use Alter to save the altered targets (page 66).

ReCalc

In some cases, it is desirable to recalculate *all* of the tuning targets:

- You are retuning a piano using a Saved tuning file
- You are fine tuning the piano in more than one pass
- You are not satisfied with a section, or more, of the piano
- You want to retune the entire piano with a different Style or +/- Stretch

The **ReCalc** command tells the Verituner to recalculate the tuning targets of all notes, using all of the inharmonicity information that it has collected. In some cases a recalculation may result in an even smoother, more refined tuning. Recalculation is continually functioning in Coarse tuning, hence it cannot be chosen manually. In Fine tuning ReCalc is an option that is available on the left menu.

When you load a Saved tuning, you are asked, "Recalculate Tuning?". Depending on your response to the prompt, here's what happens, in both Coarse and Fine Tuning:

Yes results in a recalculation of the tuning. When the file opens, inharmonicity is on, and all tuning targets are unlocked.

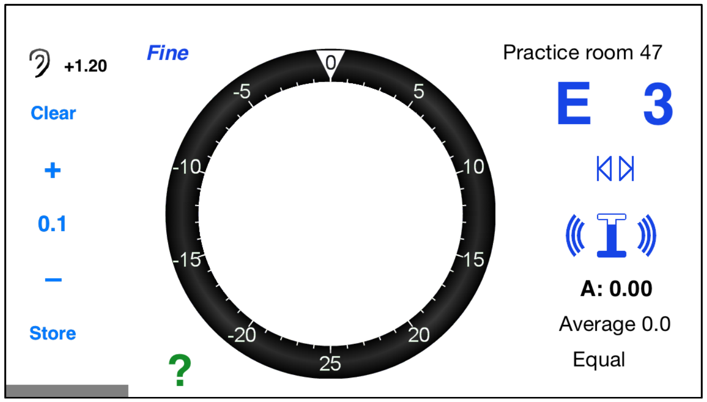
No keeps the previous tuning targets and opens the file with inharmonicity turned off and all tuning targets locked.

Select No in a situation in which you do not want any change to the current targets, i.e., you want to tune the piano to exactly the same pitches as before. If you load a Saved tuning to check a very recent tuning or touch it up, you would probably not want the targets you used to tune the piano to be changed. If you want to tune two or more pianos exactly alike, you would not ReCalc the first tuning before tuning the other piano(s).

In this situation, you would also want inharmonicity reading off while tuning the other piano(s), so no automatic recalculations and revisions to targets are made. You can, of course, ReCalc or turn on Inharm at any time.

Altering Calculated Targets

Alter, which is available in Fine Tuning, enables you to override the Verituner's calculated tuning targets for a note. You simply adjust the pitch to your ear's preference and then store the note's recalculated, altered targets. For example, if you want the temperament octave (A3-A4) somewhat wider, you could use +/–Stretch, experimenting until you got the result you wanted, or alternatively, you could aurally tune A3 downward until your ear is satisfied with the width and then use Alter to store your modified tuning target.

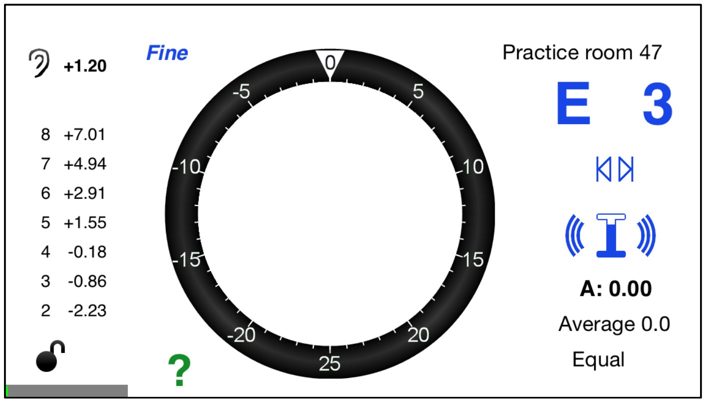


The procedure for using the **Alter** command is:

1. Tune the note aurally to the pitch you want.
2. In Fine Tuning, tap Alter on the left menu. Clear, *numeric controls* + 1 –, and **Store** appear on the left side of the screen.
3. Play the note while pressing + and – to stop or slow the spinner as much as possible.
4. Press Store. An alteration is stored as an *adjustment* of the Verituner's calculated targets for the note. (The change in the note's targets is in parallel, i.e., all of them are altered in the same direction, the same distance.) An altered note is signified

at the top left of the screen by an ear symbol and the adjusted value expressed in cents.

5. At this point, you may want to aurally check that the desired pitch held during the procedure.



To exit the alteration procedure with no change, tap **Clear** at any time before storing (step 4). To erase a stored alteration, thus restoring the Verituner's calculated targets, select the note to be changed; select Alter on the menu, and then tap **Clear**. Only the targets of the note are changed by this procedure. If you Remeasure an altered note, the alteration is cleared along with the note's inharmonicity data. As you play the note to remeasure inharmonicity, new targets are calculated without alteration.

During a tuning, the targets of any altered notes are used by the Verituner for all automatic recalculations that determine the targets for the yet untuned notes. The rule regarding locked notes in recalculations is the same for both unaltered and altered notes: The already locked notes are unaffected, but the yet untuned notes could be.

If there are any altered notes in the tuning, when you load a Saved file you will be prompted to answer two questions: **Recalculate Tuning?** If you respond No, the alterations are left untouched. If you answer Yes, you will be asked: **Keep Alterations?** If you respond Yes, the recalculation will use the altered targets, and the newly calculated targets for the altered note(s) will be adjusted by the stored amount. If you respond No, the alterations will be permanently erased.

Summary of Recalculation

In Coarse Tuning, no targets are locked, and as new inharmonicity information is obtained, recalculation of *all* targets is automatic. In Fine Tuning, if Inharm is on, the targets of tuned notes are locked, and automatic recalculation is done only on untuned notes. The targets of altered notes are used in all recalculations. Inharm turns inharmonicity measuring on or off. When Inharm is off, no automatic recalculations are done. Remeasure clears inharmonicity measurements for the current note; it unlocks and recalculates the current note with newly measured data. In Fine tuning, choosing ReCalc unlocks and recalculates *all* targets using the currently collected inharmonicity data.

More about Measuring

When the Verituner measures for inharmonicity it measures *ratios* of partial frequencies. It is, therefore, not necessary that a string be at pitch for an accurate measurement to be obtained, although some users prefer to have it close before measuring. During a pitch raise, the Verituner can still get a valid reading even though the pitch is changing as it is being measured. Furthermore, the Verituner is constantly evaluating the quality of the signal from each partial, and it only measures inharmonicity at those moments when the partials are clear and consistent. During unison tuning when there are fast beats, readings are not being taken.

As long as the Verituner's inharmonicity reading function (Inharm) is on, it will continue to take inharmonicity measurements even after a target is locked *and* during subsequent tunings (if you chose to ReCalc when loading the file). If it gets a better reading, the Verituner updates its information accordingly. If you opt to ReCalc when loading a Saved tuning, the most recently gathered data will be used in the recalculation.

Without the need for any measuring step on your part, the Verituner gathers sufficient information about the inharmonicity of the piano to extrapolate tuning targets and stretch for a very good tuning the first time you tune the piano (a New tuning). In the process of tuning A0 through C7, all of the collected inharmonicity information for the piano is saved and can be used in future tunings of that piano. Armed with a much more complete picture of the piano's inharmonicity, in some cases the Verituner can calculate an even more refined tuning. This is why doing a ReCalc before using a Saved tuning file is normally recommended.

Appendix D
Unequal Temperaments

The mechanics of working with temperament files —opening, managing, and creating— are covered in Chapter 4, Temperament Files (page 35). This chapter provides a complete listing of theVerituner's over 90 built-in unequal temperaments, and it offers resources and suggestions for getting started using alternative temperaments for tuning pianos, fortepianos, harpsichords, and clavichords.

Why We Temper

Just intervals (also called *pure*) are completely in tune and do not produce beating. Ideally, keyboard tuning would result in all *just* intervals. Unfortunately, given the division of the octave into 12 notes for keyboards, this is not possible. *No stack of any type of just intervals will add up to a just octave.* Here are two examples: Stack three contiguous just Major 3rds (C-E, E-G#, G#/A♭-C); the C-C octave is 41 cents short of being just! (This is why all Major 3rds in equal temperament are widened by 13.7 cents.) Stack seven just octaves and stack twelve just fifths, both beginning on the same note. The top note of the last fifth is almost 23.5 cents higher than that of the octaves' top note.

Because just intervals in a 12-note octave do not fit evenly within the octave, compromises in tuning are necessary to reconcile unacceptable mismatches. Some or all of the intervals (except the octave) must necessarily be altered from just, either by widening or narrowing them. This process is called *tempering,* and the result is a *temperament.* One might say that to temper is to purposely "mistune" intervals. Beating, which is so important in aural tuning, is produced by tempered intervals.

Various schemes for tempering have evolved over many centuries according to various aesthetic goals and priorities, such as

- Obtain just fifths, at the expense of the Major 3rds (Pythagorean Intonation temperaments)
- Obtain a large number of just and/or very consonant Major 3rds at the expense of a few keys which are sacrificed as unusable (Meantone temperaments)

- Create a temperament in which all keys can be used and in which there are contrasts in harmonic "color" resulting from tempering the Major 3rds to varying degrees of consonance and dissonance (Well temperaments)
- Temper all intervals equally from just, resulting in a uniformity of harmony that lacks the harmonic and key contrasts of unequal temperaments (Equal temperament)

A Growing Interest in Unequal Temperaments

For most piano tuners, equal temperament has been the only temperament they have ever tuned or thought they would tune. Early music performers, however, have routinely used historical temperaments for tuning harpsichords and other early keyboard instruments. In recent years interest in the viability of using unequal temperaments as an alternative to equal has been growing among piano tuners. Several factors have brought this about, including:

- INFORMATION – increased knowledge, largely through the research and writings of Owen Jorgensen, RPT.
- AUTHENTICITY – a growing interest in historically-authentic "period" performances in recent decades.
- ETDs – Electronic Tuning Devices enable tuners to tune any unequal temperament as easily as equal temperament.
- PROPONENTS – enthusiastic piano tuners who cite a number of advantages for alternative temperaments.

This chapter is organized in four main sections:

- A list of the Verituner's built-in temperaments (page 71)
- Selecting temperaments for historical authenticity (page 75)
- Getting started using unequal temperaments as an alternative to equal temperament (page 94)
- Temperament resources (page 104)
- Offsets for entering into electronic tuning devices, enabling them to calculate unequally tempered tunings. (page 105.)

Unequal Temperaments List[6]

Select Historical Temperaments (selected by Claudio Di Veroli)[7]

Pythagorean Intonation, circa 900–1500
One-quarter syntonic comma meantone, wolf G#–E♭ (Standard or Pietro Aron, 1523), circa 1500–1670
One-quarter syntonic comma meantone, wolf C#–A♭ (wolf shifted counterclockwise), circa 1500–1670
One-quarter syntonic comma meantone, wolf D#–B♭ (wolf shifted clockwise), circa 1500–1670
Early French temperament, circa 1650–1710
Standard French: D'Alembert-Rousseau, 3 pure Major thirds, circa 1700–1810
Shifted Vallotti-Young (same as Vallotti-Young in the Well folder), c. 1700–1810

Equal Substitutes

14th-century Pythagorean (Boulliau, 1373)
Augustus De Morgan unequal temperament of 1843
Anton Bemetzrieder Pythagorean temperament #2, 1808
Charles E. Moscow equal-beating temperament of 1895
H Grammateus Pythagorean of 1518 (Bemetzrieder #1)
Johann G. Neidhardt fifth temperament #3 of 1732
Neidhardt-Marpurg-De Morgan temperament of 1858

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[6] The offsets for sixty temperaments in the Veriutner are from *Tuning* by **Owen Jorgensen** (Michigan State University Press, 1991. Out of print). They are gratefully used with permission of the author. Temperaments bearing their names are used with permission of designers Paul N. Bailey RPT, Bill Bremmer RPT, Jim Coleman, Sr. RPT, Claudio Di Veroli, Ron Koval, George Secor, and Robert Wendell. NOTE: Most temperament names in the Temperament Directory are modified to fit in the display.

[7] **Claudio Di Verol**i lives in Bray, Rep. Ireland, where he teaches harpsichord and interpretation of early music in his Bray Baroque center http://www.braybaroque.ie. He is the author of the treatise *Unequal Temperaments* (in a revised 3rd edition, 2013), available on the author's temperament website http://temper.braybaroque.ie. The new edition includes "a full list of useful temperaments for historically-informed performances of all Western music written from the Middle Ages to the present." Dr. Di Veroli designates the seven temperaments in this folder as "really necessary in practice." Dates are for their approximate period of intensive historical use. His offsets are gratefully used with permission.

Modified Meantone Temperaments

Modified equal-beating one-fifth syntonic comma meantone temperament of 1797 (fifths ratio=1.49627972) (Encyclopedia Britannica, 1797 edition)
17th-century irregular equal-beating meantone, corrected
17th-century irregular equal-beating meantone
Alexander Metcalf Fisher modified meantone of 1818
Jean-Le Rond D'Alembert modified meantone of 1752
Standard French: Rameau version, 1726
Standard French: D'Alembert-Rousseau, 2 pure Major thirds, circa 1700–1810
Wendell Synchronous Modified Meantone/Well, 2003
William Hawkes modified meantone temperament of 1798
William Hawkes improved modified meantone of 1807

Just Intonations

Pythagorean-Just Intonation, c. 1450–1500
Standard Just Intonation, c. 1450–1500

Quasi-Equal Temperaments

A. Merrick, 1811
Alexander John Ellis in 1875 (Imitation Equal)
Alexander John Ellis in 1885 (New Equal Beating)
Ellis tuner number 5 (a Broadwood tuner)
Factory tuners of 1840
Howard Willet Pyle equal-beating, 1906
Jean Jousse quasi-equal temperament of 1832 (bearing plan #2)
Johann Christian Gottlieb Graupner equal-beating, 1819
Johann Nepomuk Hummel equal-beating, 1829, (second bearing plan)
Mark Wicks equal-beating, 1887
Tuner's Guide, Becket and Company bearing plan, 1840
Tuner's Guide, John Marsh's bearing plan, 1840
Viennese temperament (Hummel's first bearing plan tuned according to the rules of Viennese tuners in 1829)

Regular Meantone

Christiaan Huygens (31 tones), 1661
Gioseffo Zarlino equal-beating (2⁄7 syntonic), 1558
Gottfried Keller (1⁄5 ditonic), 1707
John Marsh (4⁄25 syntonic), 1809
One-fifth syntonic comma meantone, wolf G#-Eb (Homogeneous), Abraham Verheijen, c. 1600, c.1500–1670 [Listed by Jorgensen as John Holden 1⁄5 syntonic, 1770; 5ths=1.49627787]
One-quarter comma meantone (Pietro Aaron [Aron], 1523)
One-sixth comma meantone (G. Silbermann, Ramarin-Beer), 1714
Robert Smith (50 tones) "Equal Harmony" temperament, 1749
William Hawkes (1⁄6 mercator comma meantone), 1808

Well Temperaments

Almost Equal (Claudio Di Veroli, 1978)
Aron-Neidhardt[9] (Neidhardt's temperament #2 of 1732)
Bailey Equal Beating Well Temperament, 2003
Barnes-Bach (John Barnes, 1979)
Bremmer Equal Beating Victorian Temperament (EBVT III), 1992
Broadwood Best (Ellis tuner number 4), 1885
Broadwood Usual (Ellis tuner number 2), 1885
Coleman 11, 1999
Coleman 16, 2001
Jean-Le Rond D'Alembert (English equal-beating well using D'Alembert's rules of 1752)
Early 18th-century well (equal-beating Vallotti)
George Frederick Handel (published in 1780)
Jorgensen's Idealized Prinz[8] (Kirnberger III, Aron-Neidhardt) A=0
Jorgensen's Idealized Prinz[3] A= –3.42
Jean Jousse well temperament of 1832 (bearing plan #1)
Herbert Anton Kellner's Wohltemperirt-Bach, 1978

[8] In 2002 Owen Jorgensen proposed a modified version of theoretically correct Prinz (1808) as "an idealized temperament" that would authentically represent Prinz, Kirnberger III, Aron-Neidhardt, and others of that type, thus completely restoring the perfect harmonic balance for tonality (as in the Thomas Young and Francesco Vallotti temperaments) that was originally intended for this type. Since A at 0¢ deviation from equal results in the whole piano becoming rather sharp, Jorgensen also calculated a second set of offsets that maintains the overall tension on the bridges and soundboard, hence the two versions. [Personal correspondence July 22, 2002]

Kirnberger equal-beating (½ syntonic comma), 1771
Kirnberger III[9], circa 1779 (published in 1808), based on Klop
Koval 1.3
Koval 1.7
Koval 2.1
Koval 2.9
Lehman-Bach, A= –2.93, 2005
Moore (Representative Victorian temperament), 1885
Peter Prelleur, 1731
John Preston equal-beating well temperament of 1785
John Preston theoretically correct temperament of 1785
Prinz equal-beating well temperament of 1808
Prinz theoretically correct[9], 1808 (representative of Kirnberger III, Aron-Neidhardt)
Jean-Jacques Rousseau equal-beating, 1768
Jean-Jacques Rousseau theoretically correct, 1768
Secor #2 Well Temperament, 1975
Charles Earl Stanhope equal-beating (improved Kirnberger) 1806
C. E. Stanhope theoretically correct (improved Kirnberger), 1806
Tuner's Guide well temperament number 1, 1840
Tuner's Guide well temperament number 2, 1840
Tuner's Guide well temperament number 3, 1840
Vallotti (Francesco Antonio Vallotti's theoretically correct temperament of 1781; DiVeroli gives its heyday as c. 1680–1810
Vallotti-Young, (transposed Vallotti tuned according to Young's rules of 1799)
Wendell Bold Synchronous Well, 2002
Wendell Natural Synchronous Well, 2002
Wendell Synchronous ET Equivalent, 2002
Wendell Very Mild Synchronous Well, 2003
Wendell Well 2002
Werckmeister III (Correct No. 1), 1691
William Tans'ur, 1746
Th. Young's representative 18th-century well temperament #1 of 1799, c. 1700–1810

[9] Prof. Jorgensen: "The Prinz, Kirnberger III, and Aron-Neidhardt temperaments are theoretically distinct from each other, but they are so similar in musical effects that they have been classed together as a single temperament for practical purposes. For historical accuracy, this is excellent to use because the Prinz was documented in 1808, and it is a culmination of all the previous examples of this type of temperament." [Personal correspondence July 22, 2002]

Selecting Temperaments for Historic Authenticity

Unequal temperaments were used in tuning keyboard instruments for centuries. With the exception of early music performers striving for authentic performance practice, the use of unequal temperaments was largely abandoned by piano tuners in the twentieth century—perhaps much earlier.

There are two quite different views as to when equal temperament came into widespread use as an explicit goal, if not precise in outcome:

- EARLIER With the universal acceptance of the piano after 1770 came universal acceptance of equal temperament. After 1800 (and c. 1850 in England), equal temperament was by far the most widely used tuning. From 1800 to the present, most music was composed and intended for performance in equal temperament. Most musicologists and early music specialists hold this view.

- LATER Equal temperament was not fully developed and in common practice and could not have been in common use until 1917. Furthermore, composition in the 19th century was influenced by considerations of the effects of various unequal temperaments. "Equal temperament" was commonly used in the 19th century to describe what were actually "well" temperaments. "Only the 20th-century style of piano music sounds most effective when it is performed in equal temperament. All other music sounds best in the appropriate authentic temperaments that were in use when the music was composed." [10]

The discrepancy in these views—a difference of over a century, encompassing the entire Romantic period—has significant implications for tuning authentically for nineteenth-century piano music. If authenticity is the objective, a position must be taken that will guide the selection of temperament(s)—equal or unequal—during this era. The following two sections present guidelines and specific recommendations for selecting temperaments for historically-informed tunings.

[10] Owen Jorgensen, "The Historical Temperaments: An Introduction," *Piano Technicians Journal,* November 1994, pp. 35-38.

Guidelines and Recommendations of Owen Jorgensen

From point of view that equal temperament was not predominant until the early twentieth century, Owen Jorgensen (d. 2009) offers this guiding principle for making temperament choices:

> Only the 20th-century style of piano music sounds most effective when it is performed in equal temperament. All other music sounds best in the appropriate authentic temperaments that were in use when the music was composed.[11]

He gives the following time periods during which specific types of temperaments were predominant. These dates are extremely general and somewhat arbitrary because there was much overlapping between the categories. They should be considered only as a "rough guide."

15th-c. – 1690	Meantone & variants
1691 – 1721	Modified Meantone
1722 – 1818	Well Temperaments
1819 – 1901	Victorian Well Temperaments
1902 – 1916	Quasi-Equal Temperaments
1917 – present	Equal Temperament

The names of many of the temperaments on the Unequal Temperaments List (page 71) include a date, which may be helpful in selecting "temperaments that were in use when the music was composed." *This guideline should not, however, preclude using temperaments that do not meet this criterion.* There are other considerations as well. Although not historically authentic, a modern temperament might well serve music written over 100 years ago, particularly when its "finished tuning results and color effects adhere…closely to the known nineteenth-century principles and rules..."[12]

To narrow the selection of a temperament for the 1722–1916 period, Prof. Jorgensen suggests this procedure: Tune the piano with the chosen temperament and then play it sufficiently to become accustomed to the new sounds. Play the music for which the temperament was chosen and concentrate on comparing the qualities of the major thirds, tenths, and seventeenths in the context of the vertical harmonies. These intervals will contrast in width and "color." One's personal taste and knowledge of the music can help

[11] Ibid., p. 35.
[12] Personal correspondence, June 13, 2003

determine whether less or greater color contrast is desired. If so, another temperament can be tried. (Well temperaments and their characteristics are discussed more fully beginning on page 94)

THE 19TH CENTURY   Selecting historically-authentic temperaments for nineteenth century piano music poses a special difficulty. Prof. Jorgensen explains: "In the nineteenth century…any temperament in which one could freely modulate through all the keys was commonly called equal temperament no matter how unequal it might be."[13] This creates a great semantic problem with the result that, with regards to temperament, "we know less about the performance practice of the nineteenth century than we do of the centuries previous to it."

"During the nineteenth century, all of the various temperament forms were used except our modern exact equal temperament. The only thing that is certain about the nineteenth century is that the meantone temperament forms were in the minority of usage in common practice, but they nevertheless still existed in practice. The nineteenth century was a transitional century leading to the equal temperament of the twentieth century."[14]

On the next page, Owen Jorgensen offers a selected list of thirteen "historical landmark temperaments." Each temperament is in the temperament directory folder that corresponds to the temperament form in the list. Here again, for convenience, are the very *approximate* time periods for the listed forms.

15th-c. – 1690	Meantone & variants
1691 – 1721	Modified Meantone
1722 – 1818	Well Temperaments
1819 – 1901	Victorian Well Temperaments

[13] Owen Jorgensen, "Understanding Keyboard Temperament," *Piano Today,* Summer 2003.
[14] Owen Jorgensen, personal correspondence, May 20, 2003.

LANDMARK HISTORICAL TEMPERAMENTS

Selected by Owen Jorgensen[15]

Meantone Temperaments

One-quarter comma meantone (Pietro Aaron, 1523)

Gottfried Keller (⅕ ditonic), 1707

One-sixth comma meantone (G. Silbermann, Ramarin-Beer), 1714

Modified Meantone Temperaments

Jean-Le Rond D'Alembert modified meantone of 1752

Modified equal-beating one-fifth syntonic comma meantone,1797

William Hawkes improved modified meantone of 1807

Well Temperaments

Prinz, 1808 (Kirnberger III, Aaron-Neidhardt)

Werckmeister III (Correct No. 1), 1691

Francesco Antonio Vallotti theoretically correct, c. 1781

Th. Young's temperament No. 1 of 1799

Victorian Temperaments

Broadwood Best (Ellis tuner number 4), 1885

Broadwood Usual (Ellis tuner number 2), 1885

Moore (Representative Victorian temperament), 1885

[15] Personal correspondence, June 13, 2003. Also, see Prof. Jorgensen's series of articles in the *Piano Technicians Journal,* August 2003 – January 2004

A Concise Guide by Claudio Di Veroli

Claudio Di Veroli—harpsichordist, early music specialist, and author of the treatise *Unequal Temperaments*—has compiled a Concise Guide to selecting temperaments, which in his judgment are the most useful for historically-informed performances of all Western music written from the Middle Ages to the present.[16] His recommendations will be particularly useful for early music performances—from earlier than 900 to the early nineteenth century. He holds the view that equal temperament was predominant from the late eighteenth century onward.

Dr. Di Veroli designates seven temperaments as "really necessary in practice." They are in the Select Historical Temperaments folder in theVerituner's Temperament Directory. He describes an additional five temperaments as "interesting variants." These are located in other directory folders according to their type. (In the Concise Guide table, the folder location for each temperament is in the last row.)

[16] "A Concise Guide to the Most Useful 12-Note Unequal Temperaments" is copyrighted by Claudio Di Veroli and distributed exclusively by Veritune, Inc. and may not be reproduced without permission.

A Concise Guide to the Most Useful 12-Note Unequal Temperaments

Preferred name	**Pythagorean Intonation**	**Pythagorean-Just Intonation**
Alternative name		Ramos Just Intonation
Technical name	Pure-fifths tuning	Pythagorean-Just Intonation
1st described Author[1]	Ancient Greeks, St. Odo	Bartolomé Ramos
1st described Place	Cluny (France)	Spain (published in Italy)
1st described Year	c. 935	1482
Heyday	before 900 – c. 1500	c.1450 – c. 1500
Place of main use	All Europe	Possibly Spain and Italy
Typical styles/ Ideal use	Medieval Music	[Late Gothic and Early Renaissance]
Typical composers—those ideally served by the temperament	de la Halle, Machaut, Landini	Josquin des Prez [?]
Basic description. Circle of Fifths	11 pure fifths, leaving a small wolf to close the circle	Pythagorean shifted: the wolf is now a diatonic 5th, retuned to a Syntonic comma rather than Pythagorean
Circle of Major Thirds	Most M3rds are very wide; much more so than in Equal Temperament	Few diatonic pure major thirds. All the others are very wide.

Continued on the next page

[1] Earliest written account; sometimes earlier but often later than historical heyday

	Pythagorean Intonation	Pythagorean-Just Intonation
Main Features	Beautiful pure fifths. The very wide thirds are not a problem in Medieval music: they are used as dissonant intervals in Medieval counterpoint.	Transitional system. For Renaissance harmony — good thirds— the modulation scope is very restricted indeed. There are reasons to believe this system was rarely if ever used in musical practice.
Variants	Wolf shifts	Wolf shifts etc. Our preferred version follows Agricola, Wittenberg (Germany) 1539.
Comments	This tuning method, i.e. tuning by consecutive pure fifths, was known by many cultures (e.g. the Chinese) in very ancient times.	This and the "just" intonations, with their many pure intervals, deserved a totally out of proportion attention by theoreticians. But musicians knew that too many useful intervals were also thrown hopelessly out of tune.
orituner folder	Select Historical	Just Intonations

A Concise Guide to the Most Useful 12-Note Unequal Temperaments

Preferred name	**Standard Meantone, wolf G#-E♭**	**Standard Meantone, wolf shifted counterclockwise**
Alternative name	Aron's Meantone, wolf G#-Eb	Aron's Meantone, wolf C#-Ab
Technical name	1/4 Syntonic comma meantone, wolf G#-Eb	1/4 Syntonic comma meantone, wolf C#-Ab
1st described Author[1]	Pietro Aron	Pietro Aron
1st described Place	Florence (Italy)	Florence (Italy)
1st described Year	1523	1523
Heyday	c. 1500 – c. 1670	c. 1500 – c. 1670
Place of main use	All Europe	All Europe
Typical styles/ Ideal use	Renaissance and Early Baroque	Renaissance and Early Baroque
Typical composers— those ideally served by the temperament	Attaingnant, de Victoria, Lassus, Monteverdi, English Virginalists	Attaingnant, de Victoria, Lassus, Monteverdi, English Virginalists
Basic description. Circle of Fifths	11 fifths are equally-tempered by an amount such that the intervening major thirds are exactly pure.	11 fifths are equally-tempered by an amount such that the intervening major thirds are exactly pure.
Circle of Major Thirds	8 pure major thirds, 4 wolf major thirds	8 pure major thirds, 4 wolf major thirds

Continued on the next page

[1] Earliest written account; sometimes earlier but often later than historical heyday

	Standard Meantone, wolf G#-E♭	Standard Meantone, wolf shifted counterclockwise
Main Features	A most beautiful sounding system, but limited to 8 excellent major triads and 8 minor ones, the remaining wolf-ridden ones severely precluding modulation.	A most beautiful sounding system, but limited to 8 excellent major triads and 8 minor ones, the remaining wolf-ridden ones severely precluding modulation.
Variants	Other sizes of fifth (typically 1/5, 1/6 S.c. and many others), but 1/4 S.c. was almost always the preferred one.	Other sizes of fifth (typically 1/5, 1/6 S.c. and many others), but 1/4 S.c. was almost always the preferred one.
Comments	Modulation range was increased by split-sharp keyboards and string and wind players differentiating sharps from flats. Standard meantone remained in use in England until Classical times and sometimes later also.	Though there is evidence that the wolf fifth would sometimes be shifted as convenient, it is however a fact that the vast majority of the music was written for the standard wolf at G#-Eb.
Orgtuner folder	Select Historical	Select Historical

A Concise Guide to the Most Useful 12-Note Unequal Temperaments

Preferred name	**Standard Meantone, wolf shifted clockwise**	**Homogeneous Meantone, wolf G#-E♭**
Alternative name	Aron's Meantone, wolf D#-B♭	Verheijen Meantone, wolf G#-E♭
Technical name	1/4 Syntonic comma meantone, wolf D#-B♭	1/5 Syntonic comma meantone, wolf G#-E♭
1st described Author[1]	Pietro Aron	Abraham Verheijen
1st described Place	Florence (Italy)	Amsterdam (Holland)
1st described Year	1523	c. 1600
Heyday	c. 1500 – c. 1670	c.1550 – c.1730
Place of main use	All Europe	All Europe
Typical styles/ Ideal use	Renaissance and Early Baroque	Late Renaissance and Early Baroque
Typical composers—those ideally served by the temperament	Attaingnant, de Victoria, Lassus, Monteverdi, English Virginalists	Monteverdi, English Virginalists, Praetorius
Basic description. Circle of Fifths	11 fifths are equally-tempered by an amount such that the intervening major thirds are exactly pure.	11 fifths are equally-tempered so that the intervening major thirds are as good as the fifths.
Circle of Major Thirds	8 pure major thirds, 4 wolf major thirds	8 major thirds as good as the fifths, 4 wolf major thirds

Continued on the next page

[1] Earliest written account; sometimes earlier but often later than historical heyday

	Standard Meantone, wolf shifted clockwise	**Homogeneous Meantone, wolf G#-E♭**
Main Features	A most beautiful sounding system, but limited to 8 excellent major triads and 8 minor ones, the remaining wolf-ridden ones severely precluding modulation.	Not so beautiful sounding as 1/4 S.c., and still limited to 8 good major triads and 8 minor ones, the remaining wolf-ridden ones severely precluding modulation.
Variants	Other sizes of fifth (typically 1/5, 1/6 S.c. and many others), but 1/4 S.c. was almost always the preferred one	Wolf shifts. Also other sizes of fifth, but 1/4 S.c. was almost always the preferred one
Comments	Though there is evidence that the wolf fifth would sometimes be shifted as convenient, it is however a fact that the vast majority of the music was written for the standard wolf at G#-Eb.	Modulation range was increased by split-sharp keyboards and string and wind players differentiating sharps from flats. Wolf shifts away from G#-Eb were comparatively rare.
Verituner folder	Select Historical	Regular meantone

A Concise Guide to the Most Useful 12-Note Unequal Temperaments

Preferred name	**Early French**	**Standard French**
Alternative name	Modified Meantone with 3 large fifths	Tempérament Ordinaire
Technical name	Modified Meantone with 3 large fifths	D'Alembert-Rousseau with 3 pure thirds
1st described Author[1]	(modern)	d'Alembert
1st described Place		Paris (France)
1st described Year		1752
Heyday	c. 1650 – c. 1710	c. 1700? – c. 1810
Place of main use	France and England	France and Italy
Typical styles/ Ideal use	Early Baroque French music	Late Baroque French music
Typical composers— those ideally served by the temperament	L. Couperin, D'Anglebert, Purcell, young F. Couperin	F. Couperin, Rameau, D. Scarlatti, A. Soler
Basic description. Circle of Fifths	9 standard meantone fifths, the 3 remaining ones wide, "sharing the wolf"	The six fifths from C to F# are standard meantone, the others less tempered, three actually wide.
Circle of Major Thirds	6 pure, 2 acceptable, 2 Pythagorean, 2 wolves	3 pure (C-E,G-B,D-F#), 6 good, 3 very bad (but not wolves)

Continued on the next page

[1] Earliest written account; sometimes earlier but often later than historical heyday

	Early French	Standard French
Main Features	A meantone modification achieving greatly-expanded, but not unlimited, modulation scope and enharmonic capability.	A meantone modification achieving unlimited modulation and enharmony, but some tonalities (e.g. F#, C# and G#/A♭ major) sound really bad.
Variants	Few	Many. All the historical descriptions are approximative.
Comments	Never described in Baroque times, this temperament has been shown to be the ideal fit for F. Couperin's Organ Masses [Di Veroli and Leidemann, 1985]	New asymmetrical reconstruction with 3 pure thirds by C. Di Veroli 2002. Standard French has been proved best for Domenico Scarlatti [J. Sankey 1997]. Inadequate for many works by J. S. Bach.
Krituner folder	Select Historical	Select Historical

A Concise Guide to the Most Useful 12-Note Unequal Temperaments

Preferred name	**Vallotti**	**Vallotti-Young**
Alternative name	Francesco Antonio Vallotti	Shifted Vallotti
Technical name	Contiguous 1/6 P.c. good temperament	Shifted Vallotti
1st described Author[1]	Tartini	Young
1st described Place	Padova (Italy)	England
1st described Year	1754	1799
Heyday	c. 1680 – c. 1810	c. 1680 – c. 1810
Place of main use	Germany and Italy	Germany and Italy
Typical styles/ Ideal use	Late Baroque German music	Good average for Late Baroque
Typical composers— those ideally served by the temperament	Pachelbel, J. S. Bach, Handel	Pachelbel, J. S. Bach, Vivaldi
Basic description. Circle of Fifths	Diatonic 5ths (F-B) tempered by 1/6 P.c. each. The six other 5ths are tuned pure.	Vallotti shifted clockwise: the tempered fifths are now from C to F#.
Circle of Major Thirds	Oscillate from quite good to quite bad	Oscillate from quite good to quite bad

Continued on the next page

[1] Earliest written account; sometimes earlier but often later than historical heyday

	Vallotti	Vallotti-Young
Main Features	Thirds vary smoothly, from distinctively better than Equal Temperament to quite bad in tonalities with many accidentals.	Thirds vary smoothly, from distinctively better than Equal Temperament to quite bad in tonalities with many accidentals.
Variants	Barnes-Bach, Kellner-Bach	Vallotti, Barnes-Bach
Comments	The ideal universal temperament for non-French Baroque music. Easier to tune aurally—and to check—than any other Baroque temperament.	A better variant for tonalities with sharps, and also for French Baroque. This is the ideal average temperament for Baroque music from different countries.
Verituner folder	Well	Select Historical

A Concise Guide to the Most Useful 12-Note Unequal Temperaments	

Preferred name	**Barnes-Bach**	
Alternative name	Barnes	
Technical name	Barnes	
1st described Author	Proposed by John Barnes	
1st described Place	Edinburgh, Scotland	
1st described Year	1979	
Heyday	c. 1690 – c. 1750	
Place of main use	Germany	
Typical styles/ Ideal use	J. S. Bach	
Typical composers—those ideally served by the temperament	J. S. Bach	
Basic description. Circle of Fifths	Similar to Vallotti; only B changes: E-B is pure and B-F# is tempered.	
Circle of Major Thirds	Oscillate from quite good to quite bad	

Continued on the next page

[1] Earliest written account; sometimes earlier but often later than historical heyday

	Barnes-Bach	
Main Features	An intermediate between the two Vallotti variants, slightly favouring the sharps. Almost undistinguishable from Vallotti in practice.	
Variants	Vallotti, Kellner-Bach (proposed by H. A. Kellner in 1978)	
Comments	Statistically a better fit than Vallotti for Bach's keyboard works. Not proven so for other composers. There are no historical sources for it, so for general non-French Baroque music, Vallotti is preferable.	
Verituner folder	Well	

A Concise Guide to the Most Useful 12-Note Unequal Temperaments

Preferred name	**Almost Equal**	**Equal Temperament**
Alternative name	Almost Equal	Equal Temperament
Technical name	Almost Equal	Equal Temperament
1st described Author[1]	(modern)	Salinas[3]
1st described Place		Spain
1st described Year		1577
Heyday	c.1750 – c.1880	Lutes & viols: c. 1550–1650. General: c.1780–present
Place of main use		Lutes & viols: mainly Italy. General: all Europe (England late)
Typical styles/ Ideal use	Classic & Romantic music[2]	Late Renaissance lutes and viols. Classic, Romantic & Modern music[2]
Typical composers—those ideally served by the temperament	Haydn, Mozart, Beethoven, Chopin, Schumann, Liszt, Brahms	Late Renaissance viol consorts; Mozart, Haydn, Beethoven, Chopin, Schumann, Liszt, Brahms, Debussy, Stravinsky, Bartók, Britten, Schönberg
Basic description. Circle of Fifths	8 fifths slightly narrower than Equal Temperament, 4 fifths slightly wider	All the 12 fifths equally tempered 2 cents narrow
Circle of Major Thirds	5 major thirds slightly wider than ET, 5 slightly narrower, and 2 very slightly narrower	All 12 thirds equally tempered 13.7 cents wide

Continued on the next page

[1] Earliest written account; sometimes earlier but often later than historical heyday

	Almost Equal	Equal Temperament
Main Features	Thirds vary smoothly and quite imperceptibly, from slightly better than Equal Temperament to slightly worse in tonalities with many accidentals.	Fifths uniformly good; major thirds uniformly "average" (actually quite bad).
Variants	Koval 2.1	Approximative ancient methods like the "18"-rule and temperaments alternating pure and tempered fifths, described in Baroque times by both Marpurg and Neidhardt.
Comments	Historically very vaguely described, and variants were surely in widespread use. First precise description in 1978 by Claudio Di Veroli. Almost Equal cannot be considered a variant of ET; even less so the very-slightly more unequal Koval 2.1	Even before its widespread use from the Classical period on (1750–), ET had many important but isolated advocates, like Frescobaldi and the mature Rameau.
Verituner folder	Well	[Select Equal on the Temperament submenu]

[2] Although not supported historically, there are some circumstances in which a well temperament might be used advantageously for performances of Classic era music, i.e. for the performance of predominantly diatonic music in keys that are favored by the temperament.

[3] Earlier sources (e.g. Lanfranco, 1533) give descriptions that, quoting Barbour, "might be interpreted" as ET.

Well Temperaments as an Alternative to Equal Temperament[17]

The issue of authenticity aside, a growing number of piano tuners are exploring and using both historic and modern unequal temperaments and are sharing their knowledge and enthusiasm with others. They have found that well temperaments are an attractive alternative for many of their customers.

Advantages of Well Temperaments

Proponents of using alternative temperaments cite several advantages:

- Unequal temperaments are based on aesthetic considerations, versus the mathematical origin of equal temperament. Many find unequal temperaments musically and emotionally more satisfying.
- The expressive qualities of the music are enhanced by the variety of dissimilar interval widths and harmonic variation.
- In the more remote keys, wider intervals enhance the "singing" quality in melodies and emotional feeling in harmonies with greater intensity. Greater richness and warmth may be apparent in the lower register—greater sparkle and brilliance in the upper register.
- Key "color" and contrast— sacrificed in equal temperament—restore musical qualities composers may have intended by their key choices.
- For pianists who mostly play in keys with few or no sharps or flats, an unequal temperament can increase their piano's overall consonance.
- Pianists whose pianos are tuned in an unequal temperament often sense an increased resonance in their instruments.
- If equal temperament was not predominant until the 20th century, the use of appropriate unequal temperaments will more accurately reflect composers' intentions.
- In offering alternative temperaments, you distinguish your tuning services and give yourself a competitive edge. In the words of a leading proponent, Ed Foote, RPT: "It is an opportunity to deliver epiphanies to

[17] Paul Bailey RPT, Ed Foote RPT, Ron Koval, and Bob Wendell contributed to this section.

pianists. It is an opportunity to increase the emotional value of the music and to increase the attraction in the piano itself."

- Exploring and using alternative temperaments can breathe new life into a tuner's work.

Well Temperaments Defined

The use of *well* as a label for a class of temperaments is relatively recent. Owen Jorgensen says the well temperament was "the leading harpsichord and pianoforte temperament of the eighteenth and nineteenth centuries." He defines it as an "unrestrictive temperament in which one can modulate freely through all the keys…. Unlike equal temperament (another unrestrictive temperament), well temperament contains key-coloring that supports the 'character of the keys', harmonic balance, and a pleasing and orderly variety while modulating."[18]

As an alternative to equal, proponents of unequal temperaments usually suggest well temperaments for their harmonic, sensual, and emotional qualities and for their suitability for playing in all keys. Furthermore, they are effective for a wide variety of musical styles, although in some cases equal temperament may be preferred.

Characteristics of Well Temperaments

CONSONANCE and DISSONANCE In equal temperament, all intervals of the same type are tempered equally (adjusted wide or narrow from pure), resulting in uniform widths. In unequal temperament, the interval widths are varied. In equal temperament, all major thirds are 13.7 cents wider than pure. Considering pure as perfect consonance, one might regard these thirds as equally out of tune and dissonant. In well temperaments, the major thirds can range from pure to as wide as a Pythagorean third—21.5 cents wide and regarded as the threshold for modern ears—resulting in a mixture of intervals that includes both more consonant and more dissonant intervals than in equal temperament. The most frequently used major chords (C, G, F) are the most consonant, and the most dissonant chords (G♭/F#, D♭/C#, C♭/B) are those that are least used. Keys with the fewest sharps and flats are the most consonant, and the remote keys with the most sharps and flats are the most dissonant.

[18] Owen Jorgensen, *Tuning,* Michigan State University Press, East Lansing, 1991, p. 779.

KEY COLOR AND CHARACTER The major third is the interval that contributes most to the perceived character of a temperament. Because the major thirds in a well temperament include ones that are both more consonant and more dissonant than equal, harmonic variety—tempered out of equal—results in the key character and color that is so valued by proponents. Consonance and dissonance are, of course, relative terms. The thirds that are wider than in equal might not be considered harsh as much as they are valued for their "spiciness"—the intensity they add to the harmonic and expressive palettes. Just as filters can enhance a photograph's color and contrast, unequal temperaments can enrich chord and key colors compared to their monochromatic sameness in equal temperament.

HARMONIC BALANCE Another aspect of this broadened tonal spectrum is the orderly progression of consonance to dissonance in key signatures with few sharps or flats to those with the most, i.e., typically the major keys of C, G, and F are the most consonant, while F# or D♭ has the greatest overall dissonance. Following the circle of fifths, the general pattern is this: the narrowest major third is on C (at the top of the circle), and the widest is on F# (at the bottom) or D♭; the major thirds become increasingly wider progressing from C to F# or D♭ and increasingly narrower in the progression from the bottom of the circle back to C. A temperament that follows such a scheme is said to have good "harmonic balance." (A graphic representation of harmonic balance can readily be seen in Jason Kanter's temperament charts, which are available at his website, listed in the resources section at the end of this chapter.)

Relative Strength

There are many varieties of well temperaments, sufficient to suit a wide range of needs and tastes. They are distinguished by several qualities—some subtle, others more obvious. Among them are harmonic balance, equal beating, tempering of the fifths, synchronicity, and strength.[19] The most apparent difference in these temperaments is their relative "strength," which may be defined as the degree of contrast between consonance and dissonance in their major thirds. The greater the difference, the "stronger" the temperament.

[19] Owen Jorgensen defines an *equal beating temperament* as "any temperament that contains two or more intervals that beat exactly the same speed." *Synchrony* is the result of tempering in such as way as to synchronize the beats within a chord with each other.

Strength refers to the *perceived* consonance and dissonance of a temperament and is, therefore, relative. As a means for describing and comparing strength, a quantitative expression or basis of comparison can be helpful. The table on page 98 presents three somewhat different views for gauging the strength of well temperaments:

- View strength as the range of the narrowest (most consonant) and the widest (most dissonant) major thirds in the temperament [**Range of Major 3rds**]. This gives a simple thumbnail idea of a temperament's strength. The further these intervals deviate from the ET major 3rd, the greater the contrast of the temperament.
- View strength as the total cents by which the major 3rds that are narrower than in ET deviate from the ET major third.[20] [**¢ Dev.**] This gauge was used to order the temperaments in the table from the least to the greatest degree of contrast. The larger the number, the greater the overall contrast.
- View strength as the difference [**Diff**] between the average of deviation of the major 3rds that are narrower than in ET [**Avg <**] and the average of deviation of the major 3rds that are larger [**Avg >**].

Once again, in a well temperament the greatest contrast in the major thirds is typically in C-E and F# -A# (or D♭-F). The information in this table does not, of course, represent a complete picture of a temperament's sound and effect, but it does give an indication of its mildness or strength—in terms of overall consonance and dissonance—compared to equal temperament and to other well temperaments. For a more complete picture of temperament qualities, in graphic format, see Jason Kanter's charts (Resources, page 104).

The Erituner gives the range of major thirds for all installed temperaments. To see the offsets (from equal temperament), open a folder by tapping the InfoCircle ⓘ by the folder name and then tap ⓘ by the temperament name. The range of the narrowest to the widest Major 3rds is also shown.

[20] (The actual value for the width of the major 3rds in ET, which was used in the calculations for the table, was 13.6863.) To illustrate how the "¢ Dev."number is derived, Moore is good example. Moore has four major 3rds that are narrower than the ET major 3rd. Two of them are 2¢ narrower, and two are 4¢ narrower—a total of 12¢, which is the number in the cents deviation column. The number is the same for both the narrower and the wider major 3rds, so it can be derived from either.

Well Temperaments Listed by Strength

	Range Major 3rds			¢ Dev.	Avg <	Avg >	Diff.
Almost Equal	12.6	to	15.9	6.0	12.8	14.9	2.1
Wendell Synchro ET Equiv	12.9	to	15.3	6.2	12.9	15.3	2.3
Koval 1.3	11.9	to	15.2	6.3	12.6	14.7	2.1
Tuner's Guide # 2 well	11.9	to	15.9	6.3	12.8	14.9	2.2
Tuner's Guide # 3 well	11.9	to	16.2	7.6	12.7	15.6	2.9
Koval 1.7	11.3	to	15.6	8.2	12.3	15.1	2.7
Koval 2.1	10.7	to	16.1	10.1	12.0	15.4	3.4
Coleman 10, 2001	10.7	to	15.7	10.5	11.6	15.2	3.6
Moore - Rep. Victorian	9.7	to	15.7	12.0	10.7	15.7	5.0
Bremmer EBVT III, 1992	9.5	to	16.8	13.6	11.4	16.0	4.5
Koval 2.9	9.6	to	17.0	14.0	11.3	16.0	4.7
Wendell Very Mild Synchr	7.8	to	17.2	16.2	11.0	16.4	5.4
Wendell Natural Synchro	7.4	to	17.6	16.5	10.9	16.4	5.5
Rousseau th correct 1768	9.5	to	19.0	17.4	10.8	16.6	5.8
George F Handel, 1780	9.3	to	19.6	18.4	11.1	17.4	6.3
Rousseau eq-beating 1768	9.1	to	18.9	18.5	10.6	16.8	6.2
Wendell Well 2002	7.8	to	17.6	19.5	9.8	16.5	6.7
Tuner's Guide # 1 well	8.4	to	19.4	19.6	10.9	17.6	6.7
Peter Prelleur, 1731	8.4	to	19.5	20.5	10.8	17.8	7.0
Coleman 11, 1999	7.7	to	17.7	21.0	9.5	16.7	7.2
Lehman-Bach, A= –2.93	5.9	to	19.5	21.5	8.3	17.3	9.0
Wendell Bold Synchr Well	4.3	to	19.5	21.9	10.0	17.3	7.3
Broadwood Best-Ellis #4	6.7	to	17.7	22.0	9.3	16.8	7.5
Jean Jousse well, 1832	8.4	to	21.5	22.6	10.5	18.2	7.7
Preston eq-beating 1785	9.3	to	20.5	23.8	10.7	19.6	8.9
Broadwood Usual-Ellis #2	5.7	to	17.7	24.0	8.9	17.1	8.2

Continued on the next page

Well Temperaments, continued							
	Range Major 3rds			¢ Dev.	Avg <	Avg >	Diff.
D'Alembert e-b well 1752	4.8	to	18.7	24.0	8.9	17.1	8.2
Coleman 16, 2001	5.7	to	19.7	26.0	8.5	18.0	9.5
Preston th. correct 1785	10.3	to	20.5	27.2	10.3	20.5	10.2
Barnes-Bach, 1979	5.9	to	21.5	27.4	8.2	19.2	11.0
Young Rep 18th-cent 1799	5.4	to	21.5	28.3	8.0	17.7	9.7
Early 18th-century well	5.4	to	20.9	30.2	8.7	18.7	10.1
Werckmeister III, 1691	3.9	to	21.5	31.3	7.4	18.2	10.7
Vallotti, 1781	5.9	to	21.5	31.3	7.4	19.9	12.5
Vallotti-Young, 1799	5.9	to	21.5	31.3	7.4	19.9	12.5
William Tans'ur, 1746	4.5	to	20.9	32.2	7.2	18.3	11.0
Kellner Wohltemp.-Bach	2.7	to	21.5	32.8	8.2	19.2	10.9
Bailey Equal Beat, 2003	3.4	to	21.5	35.7	7.7	19.6	11.9
Kirnberger III, 1779	0.0	to	21.5	36.1	6.5	18.9	12.4
Idealized Prinz etc -3.4	0.0	to	20.5	37.6	6.2	19.1	12.9
Idealized Prinz etc 0.0	0.0	to	20.5	37.6	6.2	19.1	12.9
Prinz th. correct, etc.	0.0	to	21.5	38.1	6.1	19.1	13.1
Prinz equal-beating 1808	0.0	to	21.5	38.4	7.3	20.1	12.8
Secor #2 Well, 1975	1.7	to	21.5	39.6	7.1	20.3	13.2
Aron-Neidhardt, 1732	0.0	to	21.5	40.0	5.7	19.4	13.7
Stanhope eq-beating 1806	0.0	to	22.9	40.9	5.5	19.5	14.0
Stanhope th correct 1806	0.0	to	20.5	41.7	5.3	19.6	14.3
Kirnberger equal-beating	0.0	to	21.5	48.8	3.9	20.7	16.8

Owen Jorgensen describes a variety of well temperament called **Victorian Temperament** that was most commonly practiced during the lifetime of Queen Victoria (1819–1901) "by those tuners who thought that they were tuning equal temperament."[21] Because they are relatively mild in their deviation from equal, this type temperament could be classified as a quasi-equal temperament. However, Jorgensen explains, there is an important difference: the Victorian form of temperament follows the rules of tonality that result in harmonic balance and produce the 'character of keys' that is characteristic of well temperaments in general; quasi-equal temperaments do not. Victorian temperaments, and modern designs of this type and mildness, are particularly well suited as "starter" alternatives to equal temperament. Very mild ones are subtle enough in their effects that many listeners will notice only a vague difference in the tuning, if that. Here are a few examples of Victorian and modern well temperaments in this category. These range from very mild to moderate in strength.

Temperament	Range of Major 3rds
Almost Equal	12.6 to 15.9
Koval 1.3	11.9 to 15.2
Koval 1.7	11.3 to 15.6
Moore (Representative Victorian)	9.7 to 15.7
Coleman 11	7.7 to 17.7
Broadwood Best (Ellis Tuner #4)	6.7 to 17.7

Perception and Preference

For modern listeners, accustomed to equal temperament because of its prevalence, an unequal temperament can be an ear opener. Some effects of unequal temperaments will be perceived objectively, others subjectively. Where one listener might hear greater intensity of expression, another might hear harshness. For some, the appeal will be immediate; for others, an acquired taste and appreciation will develop over time; and for still others, equal will be preferred. A number of variables determine one's perception, but in general it is perhaps sufficient to say that with temperaments, beauty is in the ear of the beholder, and one's preferences will emerge through exposure and familiarity. For the proponents, alternative temperaments have added a wonderful dimension to their piano tuning work. The Verituner gives you and your clients many options for exploring the world of alternative temperaments.

[21] Owen Jorgensen, "The Historical Temperaments: An Introduction," *PTG Journal,* November 1994, p. 36.

Getting Started Using Alternative Temperaments

We conclude this section with some practical considerations for getting started using alternative temperaments.

Q *Where do I begin?*

A Genuine enthusiasm for alternative temperaments and conviction for their value can only come from a first-hand *musical* experience. If possible, tune a mild well temperament on a piano which you can play (or hear played) and allow ample time to become familiar with it. Do what your customers will do: *play music—not aural checks!* Play music in a variety of styles and keys. Focus on the qualities of color and key. Be sensitive to the varied degrees of consonance and dissonance. Above all, listen to the overall musical effect as compared to equal temperament. Has it been enhanced by the qualities of the well temperament?

When you are ready, move on to a somewhat stronger temperament and take the time necessary to familiarize yourself with its qualities. If possible, compare the effects of the well temperament with equal temperament. As time allows, continue to explore additional mild and moderate strength temperaments.

From this experience you will form your opinions about well temperaments and whether you want to offer them to your customers. If you are "sold," you will be able to confidently recommend temperaments that you are personally familiar with.

Q *Which of my customers might benefit from an alternative temperament?*

A In a typical clientele, a large percentage might come to prefer a well temperament to equal. The most important consideration is the type of music being played on the piano. If the preponderance is pre-twentieth century music, a recommendation for an alternative temperament would be appropriate.

Q *Are there circumstances in which equal temperament would be preferred to a well temperament?*

A Opinions on this vary among tuners, as do the preferences of individual pianists. Eventually your experience will be the best guide, but until then, a conservative approach would be prudent. Equal (or very mild well temperaments) may be preferred for popular and classical styles of twentieth-century music. Vocal music, which is often freely transposed to accommodate different voice ranges, may be unfavorably affected by arbitrary changes in key color and character, especially with moderate and strong temperaments. In performance situations, consider seeking the approval of the musician(s).

Q *How might I propose an alternative tuning to my customers?*

A [The response to this question is by Ed Foote.]

First, find out what kind of music is being played on the piano. If it is predominantly 20th-century American show tunes, or modern pop standards, etc., I don't even suggest changing it out of ET on first call.
If there is a lot of pre-1900 music, I usually tell the customer that I think a slight change of temperament would be an improvement. They rarely question my judgment and I leave a mild WT like the Moore and Co. on the piano. If there are questions, I let them know that there is more than one way to tune a piano and the clinically accurate ET is just one of them. Then I tell them that the vast majority of my customers, professional and non-professional, have come to prefer a more organic "equal" that is not really exactly equal but biased to favor the keys most often used. This is enough.

After the tuning, the music will do the heavy lifting and sell the concept for you. If they are really enthused, I tell them that there is an entire family of well temperaments that we can investigate in subsequent tunings. It gives them something to look forward to while they become acquainted with key color.

Since the differences between equal and well temperament are sensual differences, I find that verbal, intellectual descriptions are a poor substitute for the actual artifact and can lead to confusion. This is a new subject to most musicians today, and it begins to sound very complicated, very quickly.[22] Many musicians are so set in their ways that suggesting a major change is viewed as a challenge, so you want to avoid that direction if

[22] For an introduction to the technical aspects of temperaments, consider referring interested customers to the website with Ed Foote's CD liner notes, listed in the resources section (page 120).

possible. It is often helpful to describe temperaments, such as the Broadwood tunings, as the version of "equal temperament" used by master tuners of the 1800s. Customers respond to words like "organic," or "increased resonance." They often like to think they can appreciate "historical" anything. Comparing ET and WT is often most easily done by analogy, such as:

Equal temperament is like an architect's drawing, very accurate, etc.; well temperament is more like an artist's painting. Equal temperament has only one "color" or "in-tuneness" for all like intervals; well temperaments offer a palette of harmonic "shades." Historically, the palette ranged from perfectly in tune to almost too far out of tune.

Q *How can I encourage a customer who is hesitant?*

A This is a matter of risk. If the customer is hesitant and you are optimistic about the potential gain for them, consider guaranteeing their satisfaction by offering to retune the piano after, say, two or three weeks if they are not satisfied. This shifts the risk from them to you, but if you have chosen the temperament wisely, the experience of other tuners suggests you are not likely to have to retune because of dissatisfaction with the temperament. Your confidence in presenting the suggestion of an alternative can make the difference in their acceptance. Testimonials of the satisfaction of your other customers can also reduce a feeling of risk.

Q *How do I choose a temperament "wisely"?*

A The important thing is to not shock the customer with an extreme change. Ed Foote advises: "Err on the side of caution as they progress. It is easy to go further later, but almost impossible to reclaim the pianist who is offended by a change." Begin with a mild well temperament of approximately the strength of Moore. Over time, the pianist(s) may come to prefer a stronger temperament, but too much too soon can spoil their potential appreciation and acceptance.

If the piano is used for music of a particular composer or period of music history, consider the guidelines, presented earlier in this chapter, for selecting temperaments that are appropriate for historically-informed performance.

Temperament Resources

An Introduction by Ed Foote

http://www.piano-tuners.org/edfoote/index.html

Ed Foote, RPT, has produced two CDs of piano music using several unequal temperaments. This Web site, featuring his liner notes for *Beethoven In the Temperaments—Historical Tunings on the Modern Concert Grand* (Gasparo Records GSCD-332), is an excellent introduction to temperaments, addressing both technical and aesthetic considerations.

Jason Kanter's Temperament Charts

http://www.rollingball.com/TemperamentsFrames.htm

Jason Kanter's "graphic view of historical temperaments" is an informative visual presentation of the statistics and characteristics of a large number of temperaments, most of which are in the Verituner.

Claudio Di Veroli's Temperament Page

http://temper.braybaroque.ie

Claudio Di Veroli lives in Bray, Rep. Ireland, where he teaches harpsichord and the interpretation of early music. His temperaments website includes a full update (2013) of his book, *Unequal Temperaments*.

Pianotech Archives

http://moypiano.com/ptg/pianotech.php/index.html

http://moypiano.com/ptg/caut.php/index.html

The Piano Technicians Guild maintains a list for piano technicians covering a wide range of topics, including temperaments.

Verituner User Forum

http://www.veritune.com/ [click the Community link]

Veritune's user forum is for Verituner users to post questions and to share knowledge, advice, and experiences. Previous posts can be searched.

Offsets for Electronic Tuning Devices

The table in this section gives the offsets that can be entered into some electronic tuning devices, enabling them to calculate unequally tempered tunings. (Offsets are the deviations from equal temperament that are used to program an ETD.) The offsets are expressed in *cents*—one cent equaling 1⁄100 of an equally tempered half step. The precision of the values in the table is hundredths of a cent. If necessary, round off the values for your device.

The temperament names in this table are abbreviations of the names in the list that begins on page 71. The order of the names is the same in both lists.

Professor Owen Jorgensen and Dr. Claudio Di Veroli provided most of the offsets. Some have been given by their designers, and the remainder have been obtained from various other sources. Be aware that with some temperaments there are discrepancies in the offsets that may be found from different sources. Two examples are Kirnberger III and Rameau's version of the Standard French temperament. Claudio Di Veroli calculated the offsets for Kirnberger III given here based on the aural instructions of G. C. Klop. The offsets for Rameau's 1776 account of the Standard French temperament are Di Veroli's "correct interpretation" of Rameau's description.

Select Historical Temperaments												
	A	**A#**	**B**	**C**	**C#**	**D**	**D#**	**E**	**F**	**F#**	**G**	**G#**
Pythagorean Intonation	0.00	-9.78	3.91	-5.87	7.82	-1.96	-11.73	1.96	-7.82	5.87	-3.91	9.78
Qtr s c meantone, G#-Eb	0.00	17.11	-6.84	10.26	-13.69	3.42	20.53	-3.42	13.69	-10.26	6.84	-17.11
Qtr s c meantone, C#-Ab	0.00	17.11	-6.84	10.26	-13.69	3.42	20.53	-3.42	13.69	-10.26	6.84	23.95
Qtr s c meantone, D#-Bb	0.00	17.11	-6.84	10.26	-13.69	3.42	-20.53	-3.42	13.69	-10.26	6.84	-17.11
Early French, 1650-1710	0.00	17.11	-6.84	10.26	-13.69	3.42	7.35	-3.42	13.69	-10.26	6.84	-6.43
Std French Rousseau 3 M3	0.00	4.59	-6.84	10.26	-8.31	3.42	-0.88	-3.42	8.31	-10.26	6.84	-6.35
Shifted Vallotti-Young	0.00	1.96	-3.91	5.87	-3.91	1.96	0.00	-1.96	3.91	-5.87	3.91	-1.96
Equal Substitutes												
	A	**A#**	**B**	**C**	**C#**	**D**	**D#**	**E**	**F**	**F#**	**G**	**G#**
14th-c. Pythagorean 1373	0.00	-9.78	-10.82	-5.87	-6.91	-1.96	-3.00	1.96	-7.82	-8.87	-3.91	-4.96
A De Morgan unequal 1843	0.00	-4.40	-0.49	-2.93	-2.93	-0.49	-4.40	0.00	-3.91	-1.47	-1.47	-3.91
Bemetzrieder #2, 1808	0.00	-5.87	3.91	-5.87	0.00	-1.96	-3.91	1.96	-7.82	1.96	-3.91	-1.96
C E Moscow equal-beating	0.00	2.10	0.34	-1.86	0.01	-1.96	0.14	-1.62	0.69	2.29	0.10	1.96
H Grammateus Pythag 1518	0.00	1.96	3.91	-5.87	-3.91	-1.96	0.00	1.96	-7.82	-5.87	-3.91	-1.96
Neidhardt fifth temp. #3	0.00	-1.96	0.00	-1.96	0.00	-1.96	0.00	-1.96	0.00	-1.96	0.00	-1.96
Neidhardt-Marpug-Morgan	0.00	1.96	1.96	0.00	1.96	1.96	0.00	1.96	1.96	0.00	1.96	1.96

Modified Meantone Temperaments												
	A	A#	B	C	C#	D	D#	E	F	F#	G	G#
1797 meantone 1.49627972	0.00	11.72	-4.69	7.03	-9.38	2.34	14.06	-2.34	9.38	-7.03	4.69	0.98
17th-c meantone, correct	0.00	14.17	-4.73	9.99	-8.54	3.58	14.80	-1.74	12.66	-6.08	5.76	-9.53
17th-century meantone	0.00	14.17	-4.73	9.99	-8.54	3.58	17.39	-1.74	12.66	-6.08	5.76	-12.48
Alexander M Fisher, 1818	0.00	15.12	-6.84	10.26	-13.69	3.42	7.74	-3.42	12.69	-10.26	6.84	-9.67
D'Alembert mod mean 1752	0.00	-2.02	-6.14	10.26	-11.59	3.42	-8.16	-3.42	4.12	-8.86	6.84	-14.31
Std French Rameau 1726	0.00	11.73	-6.84	10.26	-1.47	3.42	8.31	-3.42	13.69	-4.89	6.84	3.42
Std French Rousseau 2 M3	0.00	4.15	-6.84	10.26	-8.31	3.42	-2.20	-3.42	8.31	-8.47	6.84	-6.35
Wendell Synchro Mod Mean	0.00	3.07	-1.44	3.91	-2.80	1.67	1.12	-1.67	5.02	-1.40	2.95	-0.84
William Hawkes, 1798	0.00	11.73	-4.69	7.04	-9.39	2.35	9.78	-2.35	9.39	-7.04	4.69	-7.43
Wm Hawkes Improved, 1807	0.00	11.73	-4.69	7.04	-9.39	2.35	2.15	-2.35	9.39	-7.04	4.69	-7.43
Just Intonations												
	A	A#	B	C	C#	D	D#	E	F	F#	G	G#
Pythagorean-Just Inton.	0.00	-9.78	3.91	-5.87	-13.69	-1.96	-9.78	1.96	-7.82	-15.64	-3.91	-11.73
Standard Just Intonation	0.00	11.73	3.91	15.64	-13.69	-1.96	31.28	1.96	13.69	-15.64	17.60	-11.73
Quasi-Equal Temperaments												
	A	A#	B	C	C#	D	D#	E	F	F#	G	G#
A Merrick, 1811	0.00	10.96	3.18	4.06	13.02	13.61	14.17	5.59	4.42	11.68	12.95	9.46
Alexander J Ellis, 1875	0.00	-0.16	0.19	0.52	0.00	0.01	-0.26	-0.01	-0.06	0.39	0.27	-0.13
Alexander J Ellis, 1885	0.00	0.54	0.58	0.08	0.28	0.01	0.44	0.38	0.02	0.20	-0.18	0.16
Ellis tuner # 5	0.00	0.00	1.00	1.00	2.00	0.00	0.00	0.00	1.00	1.50	0.50	1.00
Factory tuners of 1840	0.00	0.41	0.25	0.87	0.91	0.39	0.67	-0.48	0.89	0.81	0.19	0.38

Quasi-Equal, continued												
	A	A#	B	C	C#	D	D#	E	F	F#	G	G#
Howard Willet Pyle, 1906	0.00	0.39	0.55	0.14	0.20	0.03	0.31	0.36	0.20	0.14	-0.13	0.04
Jean Jousse, 1832	0.00	0.50	0.42	-0.19	-0.01	-0.39	0.02	-0.14	0.48	0.52	0.00	0.28
Johann C G Graupner 1819	0.00	-0.28	0.22	0.14	-0.48	-0.30	-0.67	-0.26	-0.42	0.20	0.23	-0.28
Johann N Hummel, 1829	0.00	0.62	0.65	0.14	0.42	0.14	0.64	0.56	-0.06	0.12	-0.25	0.16
Mark Wicks, 1887	0.00	-2.90	-0.47	1.26	-2.03	0.01	-2.99	-0.67	-3.43	-0.86	1.00	-2.16
Tuner's Guide Becket	0.00	0.50	0.42	-0.19	-0.01	-0.39	0.02	-0.14	0.48	0.52	0.00	0.28
Tuner's Guide Marsh	0.00	0.62	0.65	0.14	0.42	0.14	0.64	0.56	-0.06	0.12	-0.25	0.16
Viennese (Hummel), 1829	0.00	0.28	0.00	0.50	0.42	-0.20	-0.02	-0.39	0.02	-0.14	0.48	0.52
Regular Meantone												
	A	A#	B	C	C#	D	D#	E	F	F#	G	G#
Chr. Huygens - 31 tones	0.00	16.13	-6.45	9.68	-12.90	3.23	19.36	-3.23	12.90	-9.68	6.45	-16.13
Gioseffo Zarlino, 1558	0.00	20.95	-8.38	12.57	-16.76	4.19	25.14	-4.19	16.76	-12.57	8.38	-20.95
Gottfried Keller, 1707	0.00	13.61	-5.44	8.16	-10.89	2.72	16.33	-2.72	10.89	-8.16	5.44	-13.61
John Marsh, 1809	0.00	7.50	-3.00	4.50	-6.00	1.50	9.00	-1.50	6.00	-4.50	3.00	-7.50
One-fifth s c Homo. Mean	0.00	11.73	-4.69	7.04	-9.39	2.35	14.08	-2.35	9.39	-7.04	4.69	-11.73
One-quarter comma, Aaron	0.00	17.11	-6.84	10.27	-13.69	3.42	20.53	-3.42	13.69	-10.27	6.84	-17.11
One-sixth comma meantone	0.00	8.15	-3.26	4.89	-6.52	1.63	9.78	-1.63	6.52	-4.89	3.26	-8.15
Robert Smith - 50 tones	0.00	20.11	-8.04	12.07	-16.09	4.02	24.13	-4.02	16.09	-12.07	8.04	-20.11
Wm Hawkes, Mercator 1808	0.00	9.09	-3.64	5.46	-7.27	1.82	10.91	-1.82	7.27	-5.46	3.64	-9.09

Well Temperaments	A	A#	B	C	C#	D	D#	E	F	F#	G	G#
Almost Equal	0.00	0.55	-0.55	0.82	-1.09	0.27	0.00	-0.27	1.09	-0.82	0.55	-0.55
Aron-Neidhardt, 1732	0.00	6.35	-3.42	10.26	0.49	3.42	4.40	-3.42	8.31	-1.47	6.84	2.44
Bailey Equal Beat, 2003	0.00	4.24	-5.53	8.15	-1.62	1.07	2.29	-2.09	6.20	-3.58	4.34	0.33
Barnes-Bach, 1979	0.00	5.87	0.00	5.87	0.00	1.96	3.91	-1.96	7.82	-1.96	3.91	1.96
Bremmer EBVT III, 1992	0.00	2.86	-0.03	3.80	-1.29	0.86	1.59	-0.41	1.84	-0.28	3.11	0.67
Broadwood Best-Ellis #4	0.00	4.00	-1.00	5.00	1.00	3.00	3.00	-2.00	5.00	0.00	5.00	2.00
Broadwood Usual-Ellis #2	0.00	4.00	-1.00	6.00	1.00	3.00	3.00	-2.00	5.00	0.00	6.00	2.00
Coleman 10, 2001	-0.50	1.00	-2.00	1.50	0.00	0.00	0.00	-1.50	2.00	-1.00	1.00	0.00
Coleman 11, 1999	-1.00	2.00	-4.00	3.00	0.00	0.00	0.00	-3.00	4.00	-2.00	2.00	0.00
Coleman 16, 2001	-1.00	3.00	-3.00	5.00	-1.00	1.00	1.00	-3.00	5.00	-3.00	3.00	0.00
D'Alembert e-b well 1752	0.00	4.96	-0.31	7.72	1.95	2.78	3.75	-1.21	6.42	0.94	4.37	2.66
Early 18th-century well	0.00	6.31	-2.86	6.58	1.05	2.38	4.35	-0.94	8.26	-0.91	3.68	3.00
George F Handel, 1780	0.00	2.42	-0.78	4.46	-2.50	-0.08	1.41	0.08	3.44	-2.58	1.72	-0.55
Idealized Prinz etc -3.4	-3.42	3.42	-5.13	6.84	-1.71	0.00	1.71	-6.84	5.13	-3.42	3.42	0.00
Idealized Prinz etc 0.0	0.00	6.84	-1.71	10.26	1.71	3.42	5.13	-3.42	8.55	0.00	6.84	3.42
Jean Jousse well, 1832	0.00	5.32	-1.97	3.69	1.94	0.69	5.85	-1.57	3.95	-0.02	2.69	3.89
Kellner Wohltemp.-Bach	0.00	4.30	-0.78	8.21	-1.56	2.74	2.35	-2.74	6.26	-3.52	5.47	0.39
Kirnberger equal-beating	0.00	0.94	-6.88	4.85	-4.92	8.76	-1.01	-8.83	2.90	-4.92	6.81	-2.97
Kirnberger III, 1779	0.00	6.35	-1.47	10.26	0.49	3.42	4.40	-3.42	8.31	0.49	6.84	2.44
Koval Variable Well 1.3	0.00	1.13	-0.65	1.30	-0.17	0.52	0.78	-0.52	1.30	-0.35	0.87	0.35
Koval Variable Well 1.7	0.00	1.48	-0.85	1.70	-0.22	0.68	1.02	-0.68	1.70	-0.46	1.14	0.46
Koval Variable Well 2.1	0.00	1.82	-1.05	2.10	-0.28	0.84	1.26	-0.84	2.10	-0.56	1.40	0.56
Koval Variable Well 2.9	0.00	2.52	-1.45	2.90	-0.38	1.16	1.74	-1.16	2.90	-0.78	1.94	0.78
Lehman-Bach, A= –2.93	-2.93	0.98	-2.93	2.94	0.98	-0.97	0.98	-4.88	4.90	-0.97	0.98	0.98
Moore - Rep. Victorian	0.00	1.50	-1.00	2.50	0.00	1.50	1.00	-1.50	2.00	-0.50	3.00	0.50

Well Temperaments, continued	A	A#	B	C	C#	D	D#	E	F	F#	G	G#
Peter Prelleur, 1731	0.00	4.37	-1.62	4.31	-0.45	1.59	3.15	-0.41	5.33	-0.84	2.29	1.20
Preston eq-beating 1785	0.00	2.18	-2.23	2.04	-3.79	0.80	2.83	-1.73	2.40	-3.56	0.91	-4.77
Preston th. correct 1785	0.00	4.26	-1.70	2.55	-3.41	0.85	5.11	-0.85	3.41	-2.55	1.70	-4.26
Prinz equal-beating 1808	0.00	9.07	1.25	12.98	3.20	2.03	7.11	-0.71	11.02	1.25	6.03	5.16
Prinz th. correct, etc.	0.00	6.35	-1.47	10.26	0.49	3.42	4.40	-3.42	8.31	-1.47	6.84	2.44
Rousseau eq-beating 1768	0.00	4.06	-1.50	4.09	1.26	1.51	3.74	-0.36	4.56	-0.23	2.16	2.60
Rousseau th correct 1768	0.00	3.70	-2.08	3.12	0.83	1.04	3.24	-1.04	3.66	-0.62	2.08	2.29
Secor #2 Well, 1975	0.00	4.64	-5.13	8.55	-1.22	3.42	2.69	-3.42	6.60	-3.18	6.84	0.73
Stanhope eq-beating 1806	0.00	7.18	-0.64	11.09	4.69	4.85	8.60	-2.59	9.14	2.74	13.05	6.65
Stanhope th correct 1806	0.00	4.56	-3.26	8.47	-0.33	5.21	3.58	-5.21	6.52	-2.28	10.43	1.63
Tuner's Guide # 1 well	0.00	5.31	-0.79	3.69	-0.55	0.69	3.36	-1.57	3.95	-0.41	2.68	1.40
Tuner's Guide # 2 well	0.00	1.57	0.06	0.40	-0.83	-0.23	1.25	-0.35	1.35	-0.04	0.41	-0.71
Tuner's Guide # 3 well	0.00	0.99	-0.91	0.35	-1.30	0.21	1.08	-0.94	0.22	-1.53	-0.12	0.66
Vallotti, 1781	0.00	5.87	-3.91	5.87	0.00	1.96	3.91	-1.96	7.82	-1.96	3.91	1.96
Vallotti-Young, 1799	0.00	1.96	-3.91	5.87	-3.91	1.96	0.00	-1.96	3.91	-5.87	3.91	-1.96
Wendell Bold Synchr Well	0.00	3.12	-0.39	7.03	-0.78	2.35	3.13	-2.35	5.08	1.56	4.69	1.17
Wendell Natural Synchro	0.00	4.28	-0.12	4.24	-1.59	2.41	2.32	-2.08	2.29	1.83	3.74	0.37
Wendell Synchro ET Equiv	0.00	3.13	-0.39	2.74	-0.78	2.35	1.17	1.96	0.78	1.56	0.39	1.17
Wendell Very Mild Synchr	0.00	5.04	0.31	4.24	-0.83	3.04	3.08	-1.65	2.69	2.26	4.30	1.13
Wendell Well 2002	0.00	3.91	-0.98	4.89	0.98	1.96	2.93	-0.98	4.89	0.00	3.91	1.96
Werckmeister III, 1691	0.00	7.82	3.91	11.73	1.96	3.91	5.87	1.96	9.78	0.00	7.82	3.91
William Tans'ur, 1746	0.00	2.05	-4.09	5.96	-3.24	3.17	0.10	-1.47	4.01	-5.20	5.05	-1.29
Young Rep 18th-cent 1799	0.00	5.99	-1.96	6.23	0.12	2.08	4.03	-2.08	6.11	-1.83	4.15	2.08

Postscript

There are many myths and prejudices when it comes to matters of tuning. In fact, the issues of temperament can create controversies of an almost religious nature. One expert will tell you that equal temperament is the terminus of evolutionary perfection, and that it is perfect for all things. Another will howl with indignation if anything less than the exact, historically correct temperament is not carefully researched and chosen for each piece of music. The agnostic shrugs his shoulders and asks, “What does it matter? Few can tell the difference between temperaments, and even fewer can tune them.”

In these days of technology, powerful tuning devices make it possible to try any temperament. True, the differences are often subtle, but they are there, and our ears are starting to hear new colors. Increasingly we are discovering that there is more to life than equal temperament. In particular, it is fascinating to see a new generation of adventuresome piano tuners who have come to appreciate these spices of the old masters, tuning both to the tried-and-true, or formulating their own—often with fabulous success. The performer and listener can’t explain what they are hearing, only that the piano sounds better, and the music sounds more alive.

This guide will present you an overwhelming assortment of temperaments, ancient and modern, for you to choose from. More importantly, it will help you understand how to select them, whether based on the period of the music to be played, or on your own taste. Equal temperament is healthy pabulum, but there is a world of tuning curries out there. You may find some that you particularly like, providing the perfect complement to an instrument, a performer and a composition. Try them!

Kemer Thomson
Clavichordist

Piano technicians, and their clients, can benefit in a number of ways by integrating various temperaments into normal practice. Offering well temperaments, which provide increased consonance in the most-used keys, can be a marketing asset for the technician. The temperaments of the piano’s early history often create an epiphany for the serious pianist, causing a new level of respect for the technician's knowledge and service. And, perhaps most importantly, since our work tunes us, as well as the instruments upon which we labor, tuning more than one temperament offers new perspectives on our harmonic and tonal awareness. This creates an avenue for change, and change is a necessity for growth.

Ed Foote, RPT
Producer of Temperament CDs

Appendix E
Scoring the PTG Tuning Exam

The Verituner App for Apple iOS devices can greatly facilitate scoring the Piano Technicians Guild (PTG) Registered Piano Technician (RPT) tuning exam. The Verituner is used to measure and store the tunings and score the results. Measured Tuning has been customized to provide this functionality. Each of these tasks—measuring, storing, and scoring—is presented in this chapter in a step-by-step procedure that is tailored to the exam. For a general coverage of the Verituner’s Measured Tuning function, see Chapter 5 (page 38.)

The Master Tuning

Start a New Measured Tuning File for Measuring and Storing the Initial Master Tuning

1. Swipe out the right menu and tap **Measured** to access the Measured Tunings folder list.
2. Tap the InfoCircle ⓘ at the right of the Master folder. (If you do not see the Master folder, Rename one of the folders Master with capital M.) At the upper right corner tap + to create a new Master tuning file. This file will contain the single-partial tuning according to PTG exam specifications.
3. Type a filename that identifies the piano, and leave the other settings as they are and tap Done.

Measure A4 to Determine the Master Tuning Pitch Offset

Before beginning measuring and storing, minimize ambient noise as best you can.

4. Check the tuning and make any necessary final adjustments.
5. Set the Verit.uner to A4.
6. Tap **Partial** at the lower right corner until the partial number changes to **1**. (Ignore the blinking.)

7. If necessary, pause until there has been a second or so of musical silence.

8. Tap Measure and immediately…

9. …play A4 at a moderately soft volume. In about a second, a deviation from 440 Hz—if there is one—will be displayed in cents above the partial number, e.g. +1.2 or –.6

   If necessary, *adjust the measurement manually,* use **– 1 +** while you continue to sound the note. When the measurement matches the pitch, the spinner will have stopped or slowed as much as possible, and the needle and number in the spinner hub will be as close as possible to 0. When you have finished the measurement, read the deviation of A4 — the number displayed above the Partial number. This value is the *pitch offset,* i.e. the amount of deviation from A440 expressed in cents. Write down the pitch offset number, then tap Cancel. (Do not Store it.)

10. Swipe out the left menu and tap Settings. Use **– 1 +** to enter the pitch offset value measured in the previous step. Then click **Done**.

Measure and Store Each Note of the Master Tuning

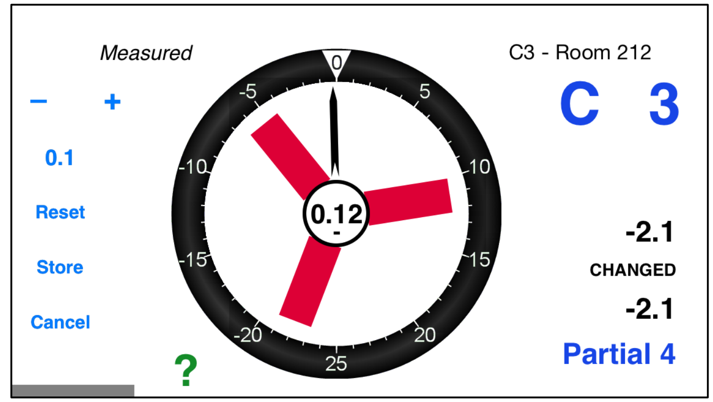
11. Set the Verituner to the note you want to measure.

    NOTE: Since this tuning is being measured for scoring the PTG exam, *do not change the partial of any note* from the default setting. The partials are pre-set to PTG requirements.

12. If necessary, pause until there has been a second or so of musical silence before beginning the next step.

13. Tap Measure and immediately…

14. …play the note at a moderately soft volume. In a second or so, the offset that was measured will be displayed— as *the cents offset number*—above the partial number. It blinks to indicate that it has not yet been stored. (Values are displayed with one decimal, the precision used in the exam record.)



15. If necessary, *adjust the measurement manually,* use **– 1 +** while you continue to sound the note. When the measurement matches the pitch, the spinner will have stopped or slowed as much as possible, and the needle and number in the spinner hub will be as close as possible to 0.0.

16. Tap **Store** to store the offset and partial. (After storing, **STORED** appears below the offset, and the offset and partial stop blinking.) If you want to exit with no change, tap **Cancel**.

17. Repeat steps 11–16 until all notes have been measured.

18. Confirm the measurements by playing each note in succession while checking that the spinner is virtually stopped for each. (After you set the first note, you may want to set AutoNote for stepwise movement.)

Detuning the Piano

1. Load the Master Tuning.

2. To “detune” the piano prior to the examinee tuning, select, swipe out the left menu and tap Detune.

   The Master tuning is now offset by the PTG-specified amount for each note. (The amount of the offset is displayed at the right side of the spinner.) Tune (detune!)

the piano to stop the spinner for each note. The Detune offsets are temporary and *are not saved* in the tuning file!

3. Set the Verituner aside while the Examinee tunes A4.

   NOTE: With iTunes file sharing (covered in 50 in the Verituner User Guide for iOS devices), the Master tuning file can be exported and installed on another Verituner, which can be used to score a future examination with this piano.

The Examinee Tuning

Three measured tuning files will be used for the examinee. Two will only be used temporarily—one for measuring A4 and the other for the stability and unison tests. The third and the most important file will be the Examinee tuning file which will be used to measure and store the examinee's tuning of C1–B7. This file will be scored against the master tuning.

Before beginning these procedures, minimize ambient noise as best you can.

Measure the Examinee's Tuning of A4

1. Swipe out the right menu and tap Measured to access the Measured Tunings folder list.
2. Tap the InfoCircle ⓘ at the right of the Temporary folder. At the upper right corner tap + to create a new tuning file.
3. Since this file will be used only once, there is no need to rename it, nor should any settings be changed. Tap Done.
4. Set the Verituner to A4.
5. Tap Partial at the lower right corner until the partial number changes to **1**. (Ignore the blinking.)
6. If necessary, pause until there has been a second or so of musical silence.
7. Tap Measure and immediately…
8. …play A4 at a moderately soft volume. In about a second, a deviation from 440 Hz—if there is one—will be displayed in cents under the Partial number, e.g. +1.17 or –.54

9. If necessary, *adjust the measurement manually,* using **– 1 +** while you continue to sound the note. When the measurement matches the pitch, the spinner will have stopped or slowed as much as possible, and the needle and number in the spinner hub will be as close as possible to 0.0.
10. When you have finished the measurement, read the deviation of A4 — the number displayed above the Partial number. This value is the *pitch offset*, i.e. the amount of deviation from A440 expressed in cents
11. Do not store the measurement in the Verituner, but do record the number on the examination form.
12. Set the Verituner aside while the Examinee tunes the midrange.

Open a New Measured Tuning for the Examinee Tuning

13. Swipe out the right menu and tap Measured to access the Measured Tunings folder list.
14. Tap the InfoCircle ⓘ at the right of the Examinee folder. (If you do not see the Examinee folder, Rename one of the folders Examinee with a capital E.) At the upper right corner tap + to create a new Examinee tuning file. This file is set up for single-partial tuning according to PTG exam specifications.
15. In the measured Tuning Setup screen, name the file, e.g., Baime, Al.
16. With no further changes, tap **Done**. The file is saved automatically.

Measure and Store the Examinee's Tuning of C3–B4

17. Set the Verituner to the note you want to measure.

    NOTE: Since this tuning is being measured for scoring the PTG exam, *do not change the partial of any note* from the default setting. The partials are pre-set to PTG requirements.

18. If necessary, pause until there has been a second or so of musical silence before beginning the next step.
19. Tap Measure and immediately…

20. …play the note at a moderately soft volume. In a second or so, the offset that was measured will be displayed— as *the cents offset number*—above the partial number. It blinks to indicate that it has not yet been stored. (Values are displayed with one decimal, the precision used in the exam record.)

21. If necessary, *adjust the measurement manually,* using **– 1 +** while you continue to sound the note. When the measurement matches the pitch, the spinner will have stopped or slowed as much as possible, and the needle and number in the spinner hub will be as close as possible to 0.

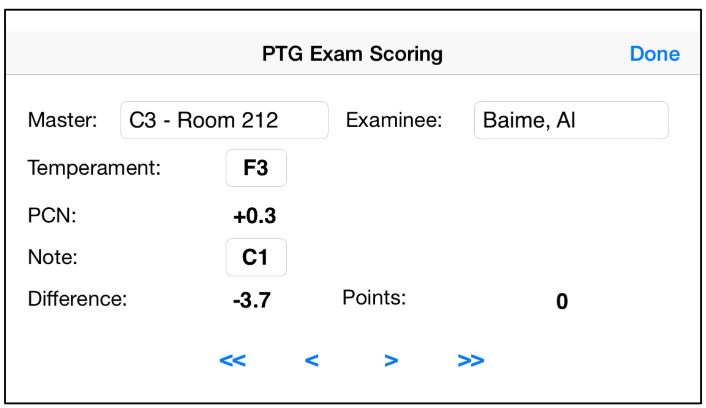
22. Tap Store to store the offset and partial. (After storing, **STORED** appears below the offset, and the offset and partial stop blinking.) If you want to exit with no change, tap Cancel.

23. Repeat step 17–22 until all notes have been measured.

24. Confirm the measurements by playing each note in succession while checking that the spinner is virtually stopped for each. (After you set the first note, you may want to set AutoNote for stepwise movement.)

Score the Examinee’s Tuning of C3–B4

25. With the Examinee tuning still open, swipe out the left menu and tap Score.



26. In the PTG Exam Scoring screen, confirm that both the Master and Examinee tuning files are correct. If not, tap on the field next to Master and select the correct file.

27. Tap on the **Temperament** field and use **< >** to select the examinee’s temperament octave.

NOTE: the **PCN** (Pitch Correction Number) is automatically calculated and displayed.

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28. Tap on the **Note** field and use **< >** to move through all notes by step. Use **<< >>** to quickly jump to only the notes for which points have been lost. As you move to each note, the Difference and Points are calculated for that note. The **Difference** (in cents) is how far the Examinee tuning is off from the Master for the selected note. **Points** is the number of points deducted, if any.

29. Set aside the Verituner while the examinee tunes the remainder of the piano.

Measure and Store the Examinee’s Tuning of C1–B7

30. To measure and store C1-B7, follow the same procedure used in steps 17–22. Be sure to measure and store the temperament octave again so the PCN will be correct.

Score the Examinee Tuning of C1–B2 and C5–B7

31. Follow the same procedure given in steps 25–28.

Open a New Measured Tuning for Checking Unisons & Stability

32. Swipe out the right menu and tap Measured to access the Measured Tunings folder list.

33. Tap the InfoCircle ⓘ at the right of the Temporary folder. At the upper right corner tap + to create a new tuning file.

34. Since this file will be used only once, there is no need to name it, nor should any settings be changed. Tap **Done**.

Score Tuning Stability

35. Before the test blows, measure and store the test note, following steps 17–22. (When the spinner is "stopped" the value in the spinner hub is 0.)

36. After the test blows, measure the note again, but do not store it. Use – 1 + to stop the spinner. If the pitch has changed, the amount of the change is displayed above CHANGED.

Score the Unisons

37. Measure and store the *center string* of the suspect unison, following steps 17–22. (When the spinner "stops," the value in the spinner hub is 0.)

38. Tap Measure and then play the *left string* and, if necessary, use – 1 + to stop the spinner (step 21). The number above CHANGED is the amount of the difference between the left and center strings.

39. Tap Cancel.

40. Tap Measure and then play the *right string*, and, if necessary, use – 1 + to stop the spinner (step 21). The number under CHANGED is the difference between the right and center strings.

41. Press Cancel.

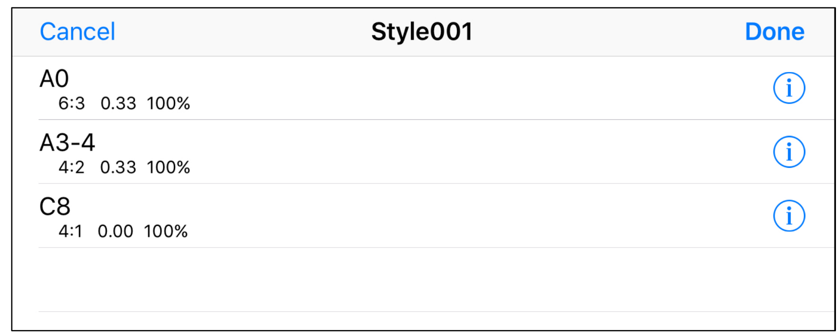
Appendix F
Custom Styles Tutorial

Custom styles are covered in Chapter 3, page 30. In this tutoial you will enter a set of style parameters which will be saved in the Custom folder in the Style Directory. CAVEAT: *This "style" is only for practice entering style parameters in this tutorial, not to use in tuning a piano!*

1. At the startup screen, swipe to open the right menu and tap Style.

2. Tap the InfoCircle ⓘ at the right of the Custom name.

3. Tap + at the upper right to start a new style. A0, A3-4, and C8 are the three required *stretch points.* (Stretch points are indicated by the Note.) Each stretch point has at least three parameters. So, for example, the default parameters for A0 are 6:3 (Interval), 0.33 (Beats), and 100% (Weight).



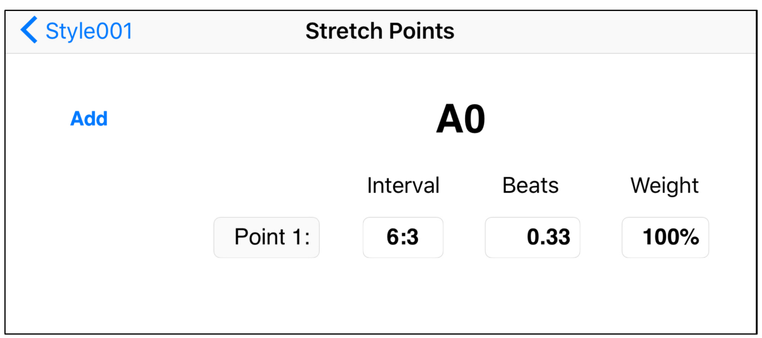
These three stretch points (the notes) cannot be changed, but you can change their Interval, Beats, and Weight. As you will see further into the tutorial, one stretch point can have up to three sets of interval/beat/weight parameters, labeled Point 1, Point 2, and Point 3. When a stretch point has two or three sets of parameters the weight is distributed between them and totals 100%.

4. These are the stretch points and parameters for this custom file:

Note	Interval	Beats	Weight
A0	6:3	0.00	65%
	12:6	0.00	35%
G2	4:2	0.20	20%
	6:3	0.33	50%
	3:1	0.40	30%
A3-4	4:2	0.00	50%
	3:1	0.00	50%
E6	4:2	1.22	30%
	4:1	0.85	30%
	3:1	0.24	40%
G7	8:1	0.00	50%
	4:1	0.00	20%
	3:1	0.00	30%
C8	4:1	1.75	40%
	8:1	2.86	60%

5. Enter and Modify Parameters The following steps apply in general to setting parameters for all of the stretch points in this tutorial, but the specific parameters are for A0.

a. Tap ⓘ at the right of the stretch point you want to edit (A0) in the screen that lists stretch points and parameters (see graphic in step 3). This opens the Stretch Points screen. Point 1 is the label for a set of parameters for A0.



b. Keep the 6:3 interval but change the Beats and Weight. Tap on the field below the Beats heading. (0.33 turns blue, indicating it is selected.) Now, use **+ 1 –** at the left to set the beat rate at 0.00. (Tap the number to change the increment as needed: **1 .1 .01**).

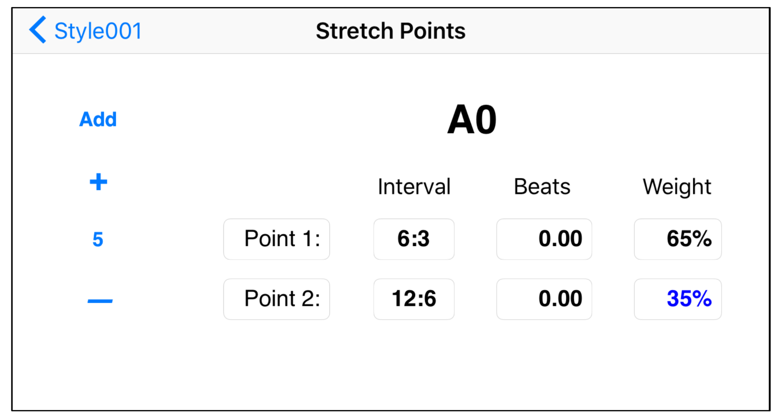
c. Tap the Weight field and use the numeric controls to change the 100% to 65%. (The numeric increments for Weight are **10 5 1**).

d. As specified in the chart in step 4, add a second set of parameters to the A0 stretch point by tapping **Add** at the upper left. (Successive taps on a Point field toggles between showing **Add** to add a new Point or **Delete** to delete the selected Point.)

e. In the Point 2 row, tap the interval field to highlight 6:3. Tap **Change** at the left to cycle through the available intervals until 12:6 appears.

f. Beats is already at 0.00, so tap the Weight field and change it to 35%, which makes the total weight for this stretch point 100%.

g. Carefully check the parameters to be sure they are correct.

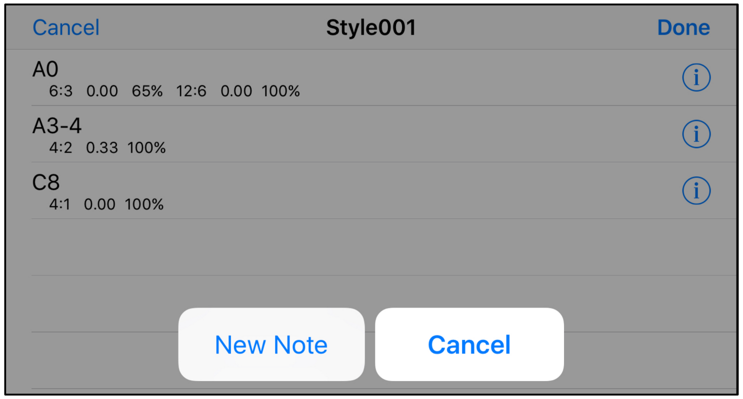


h. Tap the style's name (Style001) at the upper left to return to the list of stretch points and parameters. At the upper right corner, tap Done, which saves your changes and takes you back to the Custom files folder.

i. In the Custom styles folder tap ⓘ next to the style name (Style001). Notice that the recently changed parameters now show on this screen.

6. Add a New Stretch Point Referring to the parameters chart (in step 4), add a new stretch point at note G2 following these steps:

a. To add a new stretch point, tap on the stretch point note of the note that will be *directly below* the new stretch point. In this tutorial step, the note directly below the new G2 stretch point is A0. So, tap on A0, and tap New Note:



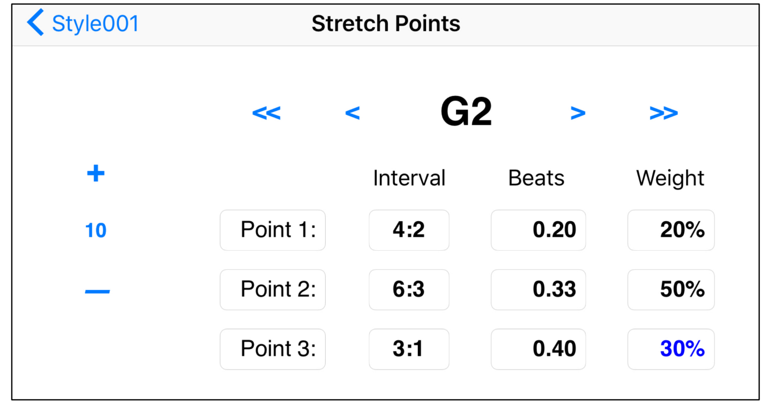
b. Since the Verituner doesn't know what note you want for the stretch point, it simply gives you a note and leaves it to you to change it to what you want. In this tutorial step we were given A1. Tap (i) at the right of A1.

c. In the Stretch Points screen, tap << < > >> to change the note by half-steps or octaves. (If these controls aren't showing, tap on the note.) For this tutorial, tap >> to raise A1 an octave; tap < twice to lower A2 to G2. NOTE: A stretch point cannot be changed to move it higher than the note above it or lower than the note below it.

d. Change the parameters of Point 1 according to the chart.

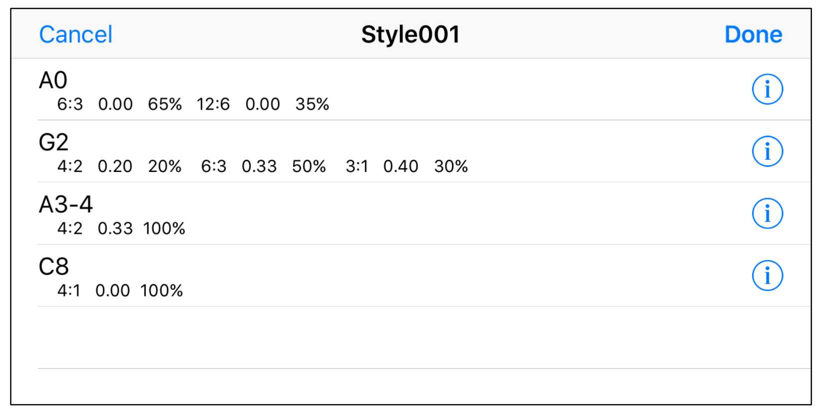
e. Tap **Add** to add Point 2 and change its parameters according to the chart. Repeat this step to add Point 3 and change its parameters.

f. Carefully check the accuracy of your entries.



g. Tap the style's name (Style001) to return to list of stretch points and parameters. At the upper right corner, tap Done to save the changes.

7. In the Custom styles folder tap (i) next to the style name (Style001) return to the screen that lists the style's stretch points and parameters.



8. Using steps 5 - 7 as your guide, continue to enter the new stretch points and parameters specified in the chart in step 4.

9. When you are done, check the accuracy of your entries against these:

Cancel	Style001	Done
A0 6:3 0.00 65% 12:6 0.00 35%		ⓘ
G2 4:2 0.20 20% 6:3 0.33 50% 3:1 0.40 30%		ⓘ
A3-4 4:2 0.00 50% 3:1 0.00 50%		ⓘ
E6 4:2 1.22 30% 4:1 0.85 30% 3:1 0.24 40%		ⓘ
G7 8:1 0.00 50% 4:1 0.00 20% 3:1 0.00 30%		ⓘ
C8 4:1 1.75 40% 8:1 2.86 60%		ⓘ

If necessary, correct any errors.

10. Tap Done. In the Custom folder list press & hold the style name (Style001). Rename it Practice Style. Delete it if you wish since it is not intended for tuning.

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