

A composer's guide to the Fokker organ

by Ere Lievonen

version 4.9.2013

This guide contains useful information for composers who want to compose for the microtonal 31-tone "Fokker" organ, situated in the small hall of the Muziekgebouw aan 't IJ in Amsterdam. Most of the information herein is based on questions from composers, and my answers to them. However, there remain more issues to be discussed, so this guide is still a work in progress – and you may always ask me further questions.

Of course, not all the information in this guide is relevant to every composer and every situation. Nevertheless, I would kindly ask you to also read the last section "Some general requests about notation and layout".

Other resources that you should be aware of:

1. My website at <http://www.erelievonen.eu/documents/>

Here you will find, among other things:

- **Fokker organ emulator**: the software with which you can have a virtual Fokker organ on your own computer.
- **Ere's Fokker organ console**: the software used for mapping 12-tone MIDI keyboards to play 31-tone pitches, and for many other Fokker organ related tasks. The user manual of "Ere's Fokker organ console" contains a lot of information that complements this guide.
- Tables of all 31-tone intervals, and of all the pitches of the Fokker organ.
- A chart of the 31-tone Fokker keyboard.
- Instructions on how to write microtones in Finale.

2. The website of the Huygens-Fokker Foundation, at <http://www.huygens-fokker.org/>

Especially this in-depth article on the 31-tone system, by Paul Rapoport:
<http://www.huygens-fokker.org/docs/rap31.html>

Specifications of the Fokker organ

Built originally in 1950 by B. Pels & Zoon, at the Teyler's Museum in Haarlem, according to plans by A.D. Fokker.

Restored in 2009 by Pels & Van Leeuwen, and rebuilt at the Muziekgebouw aan 't IJ in Amsterdam.

Keyboards:

Manual II (upper manual): keyboard range C-g³ (4 1/2 octaves, 143 tones)

Manual I (lower manual): keyboard range C-g³ (4 1/2 octaves, 143 tones)

Pedal: keyboard range C-f (1 1/2 octaves, 45 tones)

Registers:

Manual II:

- Salicionaal 8' (143 pipes)

- Roerfluit 4' (143 pipes)

Manual I:

- Quintadena 8' (143 pipes)

- Prestant 4' (143 pipes)

- Coupler I + II

Pedal:

- Subbas 16' (45 pipes)

- Gedekt 8' (14 lowest pipes borrowed from Subbas + 31 own pipes)

- Coupler P + I

- Coupler P + II

Total 648 pipes

Tuning:

31-tone equal temperament, at a₁ = 443 Hz

Fully MIDI controllable, with MIDI in and MIDI out connections.

Pictures of the Fokker organ keyboards:

<http://www.huysens-fokker.org/instrumenten/fokkerorgel.html>

A chart showing the full keyboard layout of one manual can be found on my website:

<http://www.erlievonen.eu/documents/>

The two manuals have identical layouts.

The size of the manual keys in real life is 12 x 40 mm (inclusive the space between keys).

All the pipework is situated on the ledge over the glass wall of the hall. The playing console is movable and can be situated anywhere on the hall floor. Most usually it is placed in the middle under the organ pipes, the keyboards facing the audience.

About registers, keyboard ranges, and notation

Registers and registration:

The organ has 6 registers:

Manual II: Salicionaal 8', Roerfluit 4'

Manual I: Quintadena 8', Prestant 4'

Pedal: Subbas 16', Gedekt 8'

Manual I can be coupled to manual II (i.e., when you play on manual I, any stops on manual II that are on will sound as well).

Pedal can be coupled to Manual I and/or Manual II.

The two pedal registers are similar in tone: flute-like and rather soft, especially in the 16' range. But the Subbas 16' is able provide the necessary feeling of depth, even with the full organ.

The manual I Quintadena 8' and Manual II Roerfluit 4' are flute-like stops.

The Quintadena 8' is the softest stop on the organ.

Roerfluit 4' is somewhat louder (even if played one octave lower).

Salicionaal 8' on manual II is a string-like stop with a singing tone. It is louder than the manual I Quintadena, and can also be used as a solo stop (and accompanied by the Quintadena).

The manual I Prestant 4' is a principal-style stop, and it is the loudest single stop on the organ. On this organ, adding the Prestant 4' to the other stops adds brilliance and creates the effect of "full organ".

The Fokker organ is, after all, a relatively small organ with only 6 stops; but the full sound of the organ is quite loud enough, relatively speaking, for the small hall.

You could specify precise registrations in your score, but I recommend doing this *only* if you are sure of what you are doing, or if you have a special effect in mind. In most cases, it is more practical to leave the choice of registration to the performer. Especially in ensemble situations, it is quite difficult to judge the necessary volume and balance beforehand, thus registrations may need to be adjusted during the rehearsals anyway.

Of course, you can (and should) write dynamic marks in the score. That gives me a good starting point for choosing the registrations. If you don't put in any dynamics, then I will have to guess and/or make an interpretation of my own.

The Fokker organ has *no swell box*, so you might better not write crescendo/decrescendo hairpins.

You don't need to worry about leaving the player time to make registration changes, because by using "Ere's Fokker organ console" software, all registration changes can be entirely automatized and done by the computer.

Keyboard ranges:

The range of both manuals is C to g³ (four octaves and a fifth).

The pedal range (written) is C to f (ONE octave and a fourth).

Do not write any notes outside these ranges.

The apparent sounding range of the organ could of course be extended one octave upwards, if playing on a 4' stop alone. In this case you would have to write the notes one octave lower, and

specify 4' as the registration. But because of differences in sound color and limitations in volume, this doesn't work in all circumstances, so be careful, or you might get disappointed.

The pedal 16' could also similarly be played alone; but this rarely works on this organ because the Subbas 16' is so soft, and lacks definition when not reinforced by another stop.

Traditionally in organ music, the pedal is most often registered with 16' and 8' together (with or without manual couplers), but there's nothing against using 8' only (with or without manual couplers).

In every case, *in organ music one always writes the key that's to be played, not the sounding pitch.*

With MIDI programming (i.e. "Ere's Fokker organ console" software), I have created the additional possibility of using more (artificial) couplers (in fact, almost all the imaginable combinations), so there is some more flexibility in registration than in the original Fokker organ disposition. For example, using octave couplers, the apparent maximum volume can actually be more than six simultaneously sounding stops. But you may leave the choice of using (or not using) these to me.

Organ notation:

The traditional notational setup of organ music is two staves for the two hands, and a third staff for the pedal. When your texture does not include an (obligatory) pedal part, the pedal staff can be omitted.

There is no obligation in organ music to write notes for both manuals and pedals all the time. It is also fine to use no pedal at all.

About 31-tone notation

31-tone music is best notated using the usual modern quarter-tone accidentals (even though Fokker did have his own slightly different set of accidentals).

In the 31-tone system, the "quarter-sharps" and "quarter-flats" will actually stand for 1/5-tone sharps and 1/5-tone flats.

All the 31 pitches of the 31-tone scale can be notated just by using naturals, semi-sharps, sharps, semi-flats and flats, as follows:



Because of enharmonic equivalence:

- E semi-sharp and B semi-sharp could also be written as F flat and C flat.
- F semi-flat and C semi-flat could also be written as E sharp and B sharp.

The 31-tone system also allows further enharmonic usage of accidentals (e.g. a sharp equals a 3/5-flat, a double sharp equals a 1/5-flat etc.), and these may be used whenever there is a good (tonal) reason to do so. However, experience has shown that 31-tone music is usually the easiest to read when it is notated using only naturals, sharps, flats, semi-sharps and semi-flats.

Of course, this may depend on the tonal context: if you want to write a D sharp major triad, it does make more sense to write it with a F double sharp than with a G semi-flat. But probably in every case it would be better to write a C semi-sharp major chord rather than a D double-flat major chord!

On my website, you can find a table of all the existing intervals in the 31-tone system.

31-tone notation in Finale and Sibelius:

- If you're using Finale, please find and follow the easy instructions for writing 31-tone accidentals (and other microtones) on my website: <http://www.erlievonen.eu/documents/>
- Sibelius is able to display the standard quarter-tone accidentals "out of the box" (although it won't know they're 31-tone accidentals, and thus won't be able to treat enharmonics correctly).

Pitch of the Fokker organ

The pitch of the Fokker organ is (about) $a_1 = 443$ Hz. Like with any pipe organ, the exact pitch of the organ varies slightly with the temperature in the hall. There are also small variations in the tuning of the individual pipes, like on any acoustic organ. So one cannot expect the same level of pitch accuracy as on an electronic instrument. But for practical music-making this is rarely a problem.

The pitch 443 Hz is a practical average of the pitch of the organ, as observed and measured by myself on several occasions over the past few years. In any case, the overall pitch usually stays within the range 442–444 Hz.

On my website, you can find a complete table of all the pitches of the Fokker organ, with their frequencies (calculated on the basis of $a_1 = 443$ Hz).

About playing the Fokker organ with 31-tone or 12-tone keyboards

The Fokker organ can be played, in the first place, using its own playing console with the special 31-tone keyboards (2 manuals and pedal).

But it can also be controlled using regular 12-tone MIDI keyboards; in this case, "Ere's Fokker organ console" software can be used to map the keys of the 12-tone keyboards to any 31-tone pitches. (See the instructions of "Ere's Fokker organ console" for more details.)

It is of course much more challenging to study music on the 31-tone keyboards than on a regular 12-tone keyboard. With this in mind, it is wise to not make Fokker organ parts unreasonably complicated, if you wish them to be played on the 31-tone keyboard. Otherwise it might take too much time to learn them, and (at present) no-one could be studying the Fokker organ full-time, unfortunately.

If you write a piece that turns out to be too difficult to learn on the 31-tone keyboard, within the available time, I reserve the right to transcribe the music to be played on regular 12-tone MIDI keyboards (meaning, sounding the same pitches but with the help of a computer). Doing this might involve a lot of work as well, but would render difficult pieces more easily playable.

If it suits your compositional ideas, you could also decide at the outset to write for 12-tone keyboards. This does not mean you have to restrict yourself to using 12 pitches only. For instance, the keymapping can be changed automatically while playing. If you take a look at "Ere's Fokker organ console" software on my website, you can see that the possibilities are almost unlimited also on 12-tone keyboards.

Indeed it is in many cases easier to play on a 12-tone keyboard with keymapping, as compared to playing the same notes on a 31-tone keyboard; at least, it usually requires much less practice time to do so. But if the organ texture is simple, it is sometimes less trouble to just play on the 31-tone keyboard, rather than to start creating the keymaps required. That depends very much on the situation, though. A single melodic line (not too fast), or slower two-voiced lines, or long chords, or anything which is not microtonal, should be quite unproblematic to play on the 31-tone keyboard. But anything more complex is often easier on 12-tone keyboard.

On the other hand, playing the Fokker organ on its "native" 31-tone keyboard has some additional value in itself (and it looks cool, too). So it may be worth the extra trouble to learn some more difficult parts – or to compose in such a way that the level of difficulty does not become too high!

It will be good to discuss these options together, in view of what you wish to achieve as a composer. But ultimately, after seeing a score, I do reserve the right to decide myself if a part is better playable on a 31-tone or 12-tone keyboard.

At present, though, the Fokker organ has no 12-tone pedal keyboard, so *pedal parts will always be played on the 31-tone pedalboard.*

About writing for the 31-tone manuals and pedal

The manual keys of the Fokker keyboard are slightly narrower than normal keyboards, and one hand can easily reach the span of an octave, or even a tenth (myself, I have big hands and can do even an eleventh).

On the manuals, any kinds of single- or two-voiced passages should be of no problem, when the speed is not very high.

Manual passages in more than two voices will be no problem only if there are no more than 10 different pitches within a phrase; in this case I could just put my fingers on those keys and play on without changing finger positions.

Changing finger positions within a phrase is not too difficult to do either, if only the hand position does not change (i.e. when all the notes are inside the range of a fifth or so, per hand).

In contrast, passages with more than two voices, if they also require hand position changes, are much more demanding to learn. This is partly because the keys are so small.

The Fokker organ's pedal is quite another issue. The distances on the pedalboard are much larger than on a normal organ pedal. With one foot, it is hardly possible to play any intervals larger than a minor second legato.

A pedal part that has no more than two different pitches is (of course) very easy to play with two feet. When there are more notes in a phrase, they would normally be played, as far as possible, with alternating feet.

But when a pedal line has more than two consecutive notes moving in the same direction, you must cross one foot over the other. On this organ, doing this often necessitates looking at your feet, and is also rather difficult over larger intervals. You can hardly cross over any interval larger than a fourth, and often not even that.

If there is a long enough note, you can of course make a silent foot change, and thus avoid crossing your feet.

But whenever you have to look at your feet, you cannot look at your hands or read your music, so moving pedal parts will make things much more difficult. In fact, three voices on the manuals could be less difficult than two voices on the manuals plus one on the pedal, if the pedal line is a moving one.

About chords larger than 3 or 4 voices: often such chords that contain only naturals, sharps or flats (i.e. white and black keys) are easier to find quickly, than chords that include more microtones (the blue keys). But when preceded by a longer silence, no chord should be a problem.

However, it may be very difficult or even impossible to play larger chords legato, because of the topography of the Fokker keyboard.

A good rule of thumb for all organ writing is: if the manual parts are moving, the pedal part should be kept more simple, and if the pedal part is moving, the manual parts should be kept more simple. Otherwise, the level of difficulty will rise exponentially, and will require virtuosity and a lot of (maybe too much) time to study...

Clusters

31-tone clusters sound much more intense than 12-tone clusters, and are also quite easy to play on the 31-tone keyboards, even as glissandos.

Unfortunately it is not possible to play all the pipes of the Fokker organ together as a cluster. The organ's blower is not calculated for that, and cannot pump enough air to keep all pipes sounding. When you try to do this, all pipes will be underblown, and the result is only a soft, whispering cluster. For a fortissimo cluster with all stops on, the blower's capacity is enough for hardly more than half of the pipes, and that is if you play the upper half of the range. The lower you go, the more air the pipes will consume, and fewer pipes will be able to sound together.

Reducing stops is usually a better solution. In practice, a large cluster with Quintadena 8' + Prestant 4' sounds just as effective (if not more so) than a cluster with all stops on (although, even with just two stops, the wind pressure is still not quite enough to play all the keys).

Using two 12-tone keyboards as one "24-tone keyboard"

With "Ere's Fokker organ console", it is possible to design a keymap for two 12-tone keyboards where *different* sets of 12 tones are assigned to each keyboard, thus creating a "24-tone keyboard".

Normally, the two 12-tone keyboards correspond to manual I and manual II, and thus play on different registers. To make both keyboards play on the same registers, keep virtual couplers 17 and 27 (in "Ere's Fokker organ console") always on.

If you make a keymap where the two keyboards are tuned in a similar scale, but 1/5 tone apart, it probably makes more sense to have the upper manual "tuned higher" – although, it's not a huge problem if there's some reason to have it the other way around. Other, more irregular distributions are also possible, of course.

Because in organ terminology, the lower manual is always called the first manual, and the upper is the second manual, your score layout should preferably be such that manual I is placed lower.

A score of four staves (two for each manual) would be theoretically clear, but in practice, if the musical lines are constantly jumping from staff to staff, a score of four staves becomes quite difficult to read. It is much better to try to reduce the manual parts to two (or maybe three) staves.

If you choose to use two 12-tone keyboards as a "24-tone keyboard", instead of using the 31-tone keyboards, many technical problems regarding the 31-tone keyboards will be avoided. There is one potential new problem, though, and that is the jumping between the two keyboards. The 12-tone keyboards that we have, when placed on top of each other, are vertically about 10 cm apart, so moving from one keyboard to the other one cannot be done in an instant. This is not a big problem in longer note values, but quick changes of keyboard will be problematic.

There are maybe two exceptions: 1. If the long fingers of one hand are playing white keys of the upper keyboard, it is possible (but not necessarily easy) to play one key on the lower keyboard with the thumb, without moving the whole hand down. 2. If you're playing on the lower manual, it is possible (but not necessarily easy) to pick one white key of the upper manual in between with one finger (not the thumb), without moving the whole hand up. Aside from these exceptions, it is not really feasible for one hand to play on two keyboards at the same time.

The easiest situation is such where one hand can play all the notes that are to be played on the upper manual, and the other hand plays all the notes of the lower manual. In this case, neither of the hands needs to jump between the manuals, so the playing position remains easy. Eventual temporary crossing of the hands is no problem.

When it is not possible to retain this situation, and the hands must move between the keyboards, there will (almost) always be a little gap at the moment you move up or down. If there are many manual changes like that in a row, the musical line will inevitably become very chopped. And it will be difficult to play, too.

On the other hand: it is not necessary to keep the distribution of the 24 tones over the two keyboards the same throughout a piece. Some passages could be easier to play (i.e. with less jumping between the manuals) if temporarily the tones were differently distributed over the two keyboards.

Controlling the Fokker organ via MIDI

The most often used Fokker organ MIDI specification ("Method 3") uses 3 channels per keyboard, thus 9 channels in total. You will find a table of these MIDI specifications in the appendix of the Fokker Emulator instructions.

If you wish to compose a piece for the Fokker organ to be played by a computer via MIDI, you could compose and edit your music using a MIDI sequencer program. But it is also possible to send MIDI data to the (virtual) Fokker organ directly from a notation program (like Finale or Sibelius), without using any MIDI sequencer.

However, if you played a regular notation file that uses only one MIDI channel, you would only hear 12 tones (those of the traditional meantone temperament). To hear all 31 tones, the score must be set up so that it has separate staves for every MIDI channel.

Unfortunately, so far no plug-in for Finale or Sibelius exists which would automatically translate regular 31-tone notation into a Fokker organ compatible score. I'm looking into possibilities of creating such a plug-in in the future, but at the moment, the only way to accomplish this is to manually separate the notes onto the 9 channels of the Fokker organ. A few composers have indeed done so, and with successful results.

To do this, you need to set up your score with a separate staff (or a pair of staves) for each MIDI channel, and divide the notes correctly among those staves. Refer to the table of MIDI channels and note numbers at the end of the Fokker Emulator instructions. It could be enough to use just channels 1–3, unless you need to be able hear all the registrations and manual changes.

Important: The note you have to write in the score is always the note on the *leftmost* column of the table – thus also for channels 2 and 3!

On the other hand: you could always use "Ere's Fokker organ console" software and its keymapping function to play any 12-tone subsets of the 31 tones. (In this case, you wouldn't need to divide the notes onto separate channels.) To do this, you will need to send the MIDI data through "Ere's Fokker organ console", instead of sending it directly to the (virtual) Fokker organ.

Keep the following in mind when creating MIDI files to be played on the Fokker organ:

1. *Notes that are too short will not sound at all.* This is because the pipes on the real organ need some time before the air in the pipe starts to vibrate. The length of the shortest possible note varies somewhat according to the register and pitch. Large pipes need more time to sound than small pipes. The minimum time needed for a (super short) staccato note to sound with any kind of recognizable pitch is about 35–40 ms. A well sounding staccato note has to be about 50–60 ms long. Notes that are too short will create no pitch, only the noise of the mechanism (which can, of course, be a usable effect as well).

2. *If there is not enough silence between two repeated notes, they will sound like tied notes.* This is because the pipes on the real organ need some time to stop sounding before they can articulate a new attack. To create any audible new attack, the minimum time of silence between two notes is about 20 ms. A better sounding repeated note has at least 30 ms of silence before it.

(To easily solve this problem in a notation program, you could create and use an articulation sign that shortens the duration of the preceding note by a suitable amount.)

Some general requests about notation and layout

These may be my personal preferences only, but since I'm likely to be the performer of any new composition for the Fokker organ, I wish you will take note of the following points.

If some of these appear self-evident to you, I apologize. However, all of the remarks below are borne out of my actual experiences with different composers.

Moreover – reading microtonal music is difficult enough as it is, so anything that can be done to make the reading and the performer's work easier will also benefit the composer and the music.

Computer notation vs. hand-written scores:

To write your score using computer notation software is no easier to do well than writing a score by hand. I would much rather be reading a clearly hand-written score, than a badly made computer-notated score. The very minimum requirement for a computer-notated score is: *make sure that the score is spaced so that no notes, signs or other markings are colliding with each other.*

Page size:

The most practical page size is A4.

If you really need to use a larger page size, use B4.

Please do *not* use A3, because it is too big to be usable on a normal music stand.

(Also do not use US page sizes (Letter etc.), as they are completely irrelevant everywhere in the world outside North America.)

Page turns:

I do not want to use a page turner – so the score should be laid out so that page turns are possible.

If you don't want to do that yourself, you can let me do that on your Finale or Sibelius file (supposing you are using Finale or Sibelius). I wouldn't mind that – because for me, doing page layout is the most fun part of computer notation!

Page orientation:

Whenever page turns pose no problems, the pages could equally well be laid out in portrait or landscape orientation. In other cases, however, I prefer portrait (upright) page orientation, for the following two reasons:

1. If quick page turns are needed, page turns can be done quicker in portrait orientation than in landscape orientation, because the turning radius is shorter!
2. In case that no page turn can be arranged within an opening of 2 pages, it is no big problem to have 3 portrait pages standing next to each other, or even 4 (at an organ or piano). However, in landscape orientation, even 3 pages don't fit on a normal music stand (and even if they did, the 3 pages would be very troublesome at the next page turn).

Staff size:

Please don't make the staves of your score too large. If the staves are too large, less music fits on one page, and this creates more page turns. (The default settings in all notation programs are too large, because they're intended for lead sheets.)

The height of one staff, when printed, should be *no more than 6 mm*. I find this large enough for all keyboard music.

If you're using Finale: use the Resize Tool (%), click at the top left corner of your score, and resize all pages to no more than 82 %. 80 or 75 % may be even better. (This is supposing that you leave Staff Size and System Size at 100 %.)

Margins and instrument names:

The default score layout in many notation programs has a wide left margin and instrument names shown to the left of every system throughout the score. *In a score for just one or two instruments, this is a waste of space.* Please make the left margin same as the right margin, and remove the instrument names from the margin. This way more music will fit on the page.

Accidentals:

"Courtesy accidentals" are very useful, yes, please use them where appropriate. Even better: repeat *all* non-natural accidentals on all notes, unless the note is repeated immediately.

But please DO NOT USE parentheses around accidentals. Parentheses around courtesy accidentals are totally unnecessary. An accidental either exists or does not exist – there is no "maybe", is there? With or without parentheses, the pitch would be the same. The parentheses only take up extra space, and make reading *more* difficult!
