FoMRHI Comm. 2107 **Jan Bouterse**

Making woodwind instruments

11.12 An exercise in interpretation: an alto recorder by Van Heerde

Introduction

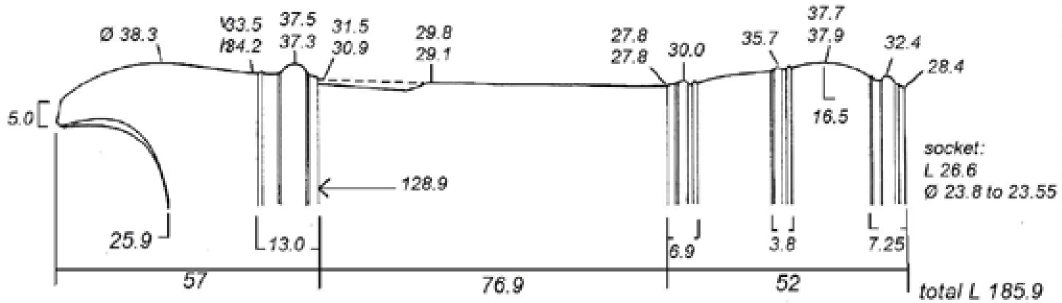
This article is an introduction in how to interpret the available information on an historical recorder, a baroque alto by Van Heerde from the Boers collection in the Rijksmuseum in Amsterdam. A full set of measurements with drawings at a scale of 1:1 is published in '*Niederländische Blockflöten des 18. Jahrhunderts - Dutch recorders of the 18th century'* by Rob van Acht, Vincent van den Ende and Hans Schimmel (published by Moeck Verlag, Celle 1991). This album deals with Dutch recorders in the collection of the Gemeentemuseum in Den Haag (The Hague), including instruments which since 1952 have been on loan from the Rijksmuseum in Amsterdam. But there is a problem: the Van Heerde alto was for many years combined with a foot with the stamp of Boekhout, another woodwind maker from Amsterdam.The original foot by Van Heerde was found in a cupboard in the Rijksmuseum, ten years after publication of the album and rejoined with the other parts! A difficulty with the album is that it takes considerable insight to understand the measuring data, how they were obtained, and to translate them into a working plan for making a copy. In this article I give some elucidation as to how the instruments were measured by Hans Schimmel. The Van Heerde alto is chosen because I can present data on the original foot. I have not yet made a copy of the recorder (I did that with another alto by Van Heerde), and that's why I am writing this article (not an easy excercise for me!) with some reluctance.

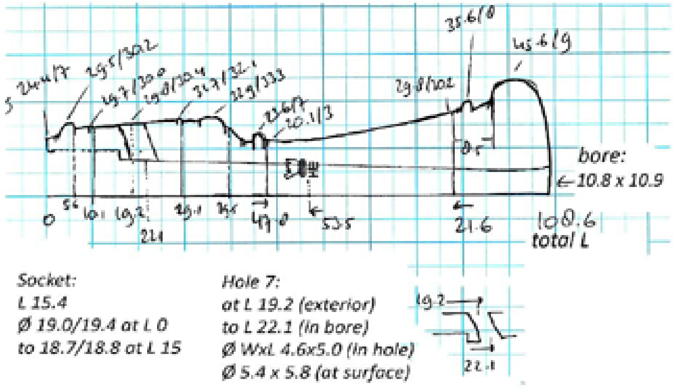
About Van Heerde

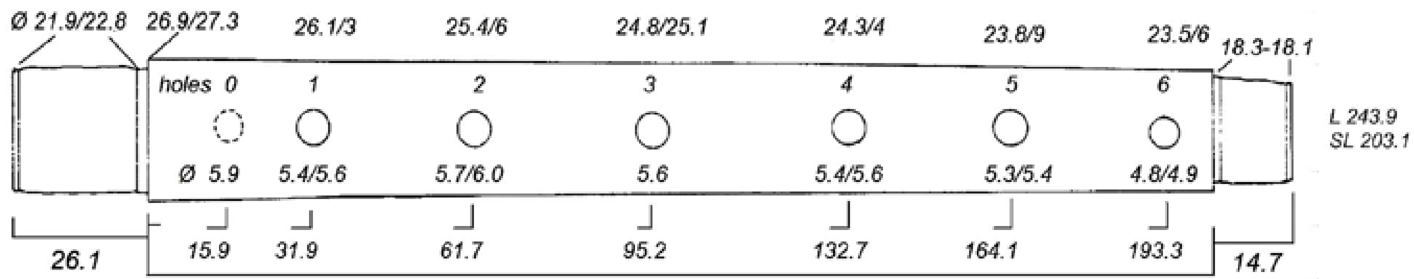
Three generations with the surname Van Heerde lived and worked in Amsterdam: Jan Jurriaensz (1638-1691), Albert(us) (1674-ca. 1720) and Jan van Heerde (1704-ca. 1750). Several recorders (all of them altos), traversos, oboes and some parts of one or two schalmeien survived. The Van Heerdes stamped their instruments VAN HEERDE in a more or less pronounced curve (and not in a scroll), but without their initials. On some instruments a crown is stamped, on others a rampant lion. There is some variation in the curve of the name and in details of the marks. The absence of initials makes it hard to tell by which member of the family the instruments are made. Two recorders in early baroque style have been discovered stamped IVH. It is possible that they are made by a member of the family, probably by the first generation, Jan Jurriaensz van Heerde. That could mean that the other woodwinds with the Van Heerde stamp are made by the later generations. See more about that question in my dissertation: Dutch wind instruments and their makers (2005).

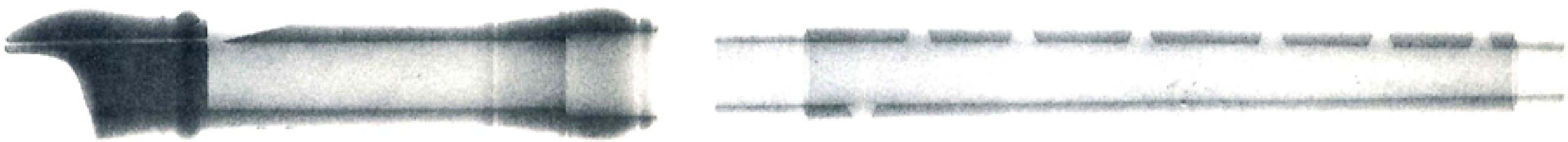
About the alto recorder

The alto recorder by Van Heerde described here comes from the collection of Johan Coenradus Boers (1812-1896), a musician and musicologist who during his lifetime collected an important set of historical instruments. There is no information where and when Boers had discovered his instruments. After his death, the collection was acquired (in 1899) by the Rijksmuseum in Amsterdam. The alto recorder by Van Heerde received the object number BK-NM-11430-95. When it was on loan to the Haags Gemeentemuseum it had another number: Ea 33-x-1952 (later changed in Ea 1952x0033). See also the information on the website www.rijksmuseum.nl.



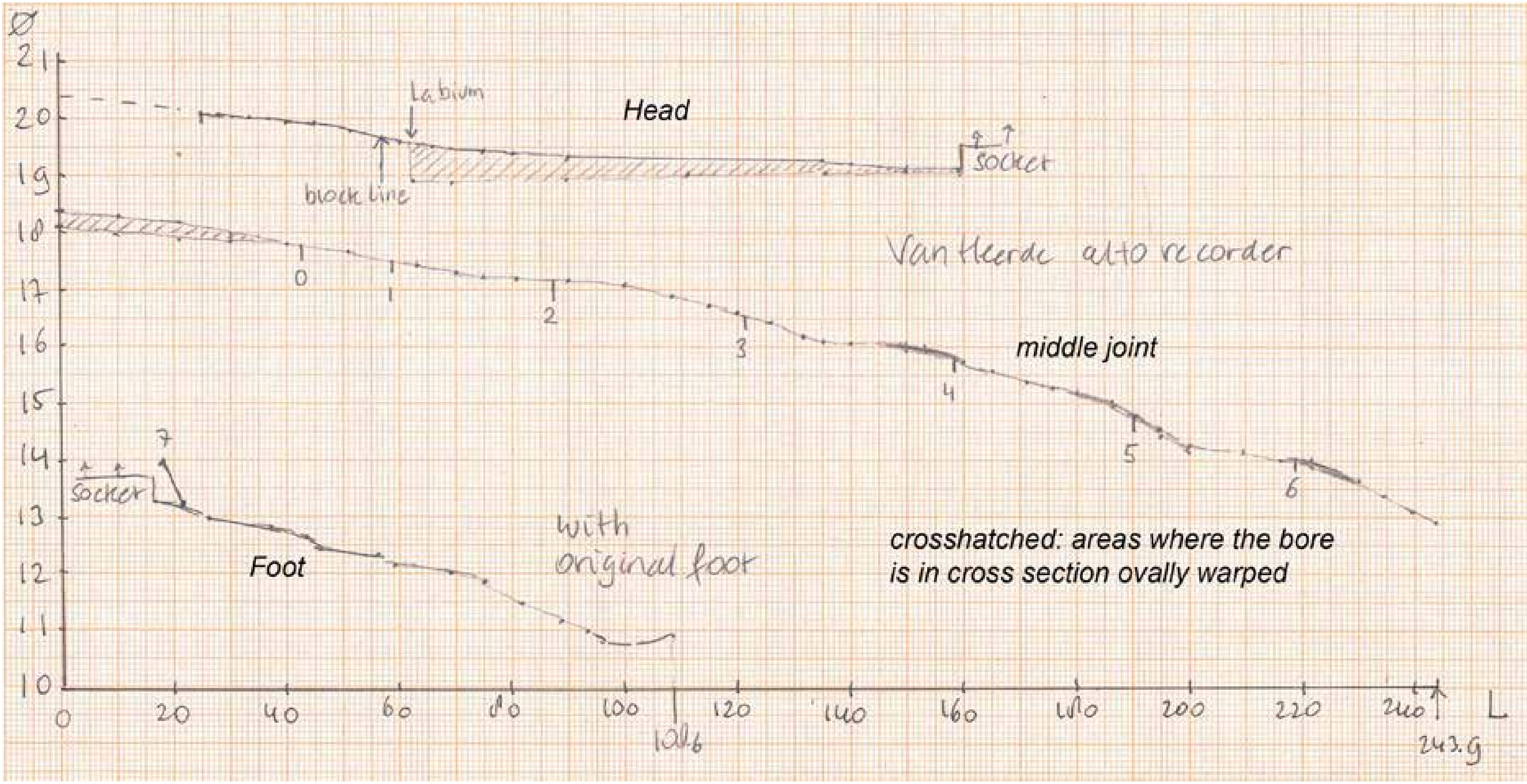






Van Heerde - alto recorder - Boers collection - Rijksmuseum, Amsterdam - Netherlands Obj. No. BK-NM-11430-95

Measurements: after Hans Schimmel and Jan Bouterse. For the fingerholes the smallest size (in two directions) inside the holes is given.


Head
Labium
block line
socket
Van Heerde alto recorder
middle joint
Foot
socket
with original foot
crosshatched: areas where the bore
is in cross section ovally warped
L
243.9

The alto is made of boxwood, stained brown. Head and middle joint have once been cleaned and polished, which also happened to the foot with the Boekhout stamp. In one of my own photos (left) the polished shine of the wood is better visible than in the photo (right), which comes from the website of the Rijks-museum. In the museum a photographing technique is used where light reflections are strongly suppressed.

It is not so strange that the feet have been swapped in the past: the foot by Boekhout (upper one in the photo below) fitted quite nicely to the parts made by Van Heerde, not only because of the colour, but also for the style of the turnery, with nicely round curves. The original foot looks not so clean and gives also a problem, because it had two deep cracks at both sides of the socket, resulting in much reduced playability of the instrument.

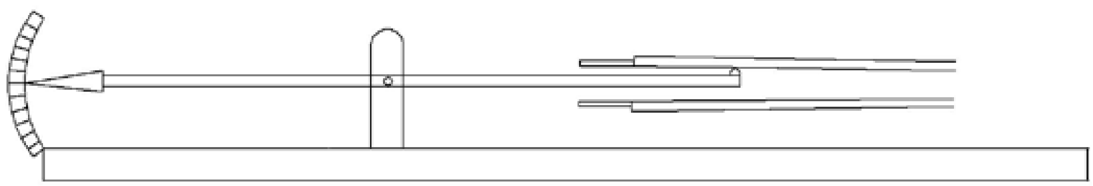
All (original) parts are stamped with the name VAN HEERDE with a crown above the name. The stamp on the foot is visible at the front when the hole on the foot is turned to the right, so for playing with the right hand under. The block (cedar type of wood) of the recorder fits well and is very probably original. All parts, and the block, have the radial face of the wood at the front. The thumb hole (hole 0) has a nail groove, but at a quick glance on the instrument doesn't show many traces of intensive use. It is generally preserved well. The middle joint is slightly curved (the west side is a bit shorter), the difference in length between the west and east side is not recorded.

The measurements by Hans Schimmel

Full attention was given by Hans Schimmel to the maximum and minimum values of the diameters of the bores of the instrument parts. Thanks to that we know that the head is rather strongly but also irregularly warped in cross section, especially around window and labium. That results in a difference in diameter of 0.8 mm between the smaller vertical and the horizontal measurement. Such differences can be caused by an irregular reaming operations, but in this case there is a similar difference in diameter at the exterior of the head: at the lower side of the labium I measured a difference of about 0.7 between the maximum and minimum value. Surprisingly, Hans Schimmel didn't give any attention to the maximum and minimum diameters for the exterior of the head. There is on the drawing for each position only one measurement. It is hard to tell whether that is the maximum or minimum value (or the horizontal or vertical value): I have made some extra measurements (horizontal and vertical) and found that the values of Hans Schimmel are sometimes close to my maxima, but not at all positions. It is all in all a bit confusing.

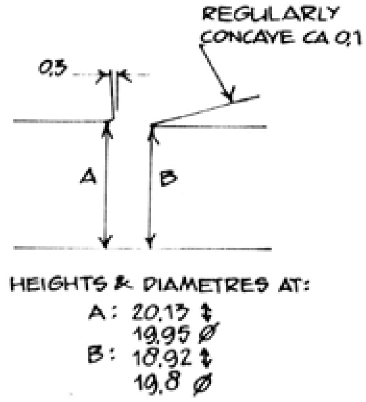
The differences between maximum and minimum diameters mean that quite a lot of irregular shrinking of the wood must have taken place. That happened (just as we read in the handbooks) more strongly in tangential (along the growth rings) than in radial direction. The effect of the warping gradually diminishes towards the lower end of the head, where there is only a difference of 0.1 to 0.2 mm between the values, in the bore as well at the outside. There is again some internal and external warpage, In the upper 40 mm of the middle joint (tenon and a bit further), of max. 0.4 mm. I have seen that on many woodwinds and is caused by the thin wall of the tenon.

Another point of discussion is the accuracy of the measurements of Hans Schimmel: he gives bore values with a precision of 0.01 mm. But the question is how he obtained these measurements. The information in 'Dutch recorders' about that is very limited, there is only mention that the apparatus to measure the windways was developed by the Kamerlingh Onnes Laboratory of the University of Leiden, that for the bore was made by the firm of Oscar Schwenk of Fellbach (Germany). But there is no elucidation how these apparatus were actually functioning. I have seen the bore measurement equipment only out of use; what I can remember is that a bar with a tracer was put into the bore of an instrument, and that at the other end an outcome - in the form of an angle measurement - was read off. Turning around over 180^0 gave a second outcome, and combined with the first the diameter of the bore at the position of the tracer was calculated.

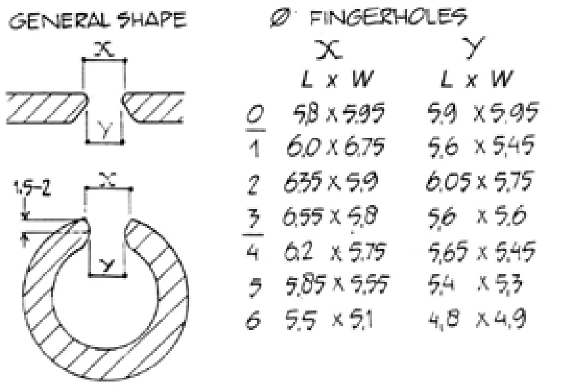


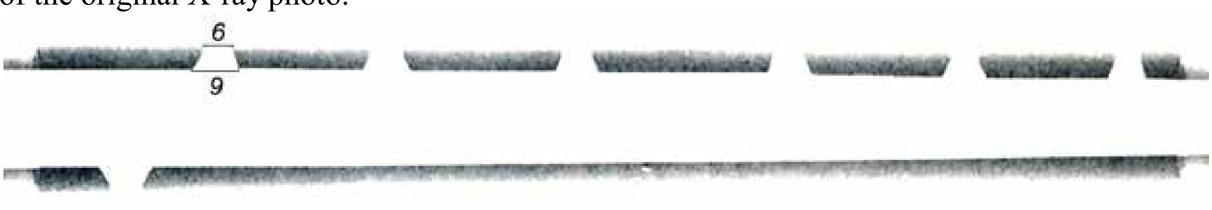
The drawing above is a (very) simplified depiction of a measuring set such as was used for the recorders in the Gemeentemuseum. Omitted on the drawing: the rather complex construction for holding and turning the instrument parts. A complication with this measuring system: how to deal with instruments with crooked parts, such as the middle joint of the Van Heerde recorder. The advantage of this way of measuring is that the tracer is only slightly touching the bore end leaves no traces, it is very safe for the instruments. The disadvantage is that measuring is a quite complex procedure, involving several steps where margins of error accumulate and the (suggested) precision of 0.01 depends on the way the calculations were carried out. My idea is that rounding off all values to 0.05 mm is more realistic and comes closer to the accuracy that modern woodwind makers can achieve.

There is a bigger problem when we compare the outcomes of the bore measurements with those of the block. The diameter of the block at L 24 is 20.35 and at its lower end (at L 57.35) 19.9 mm. Both diameters measured in the old-fashioned way with a caliper, without the need of calculations. But the horizontal diameter of the bore of the head, measured with the angle measurements, is at both points considerably lower: 20.1 and 19.65 mm (see the table on the next page). My suggestion: always check bore diameters taken with those modern sophisticated apparatus with one or more direct measurements. Hans Schimmel apparently did so: in one of diagrams (see picture right) he gives quite different values: and here the block fits perfectly in the bore of the head. I just discovered these differences when I wrote this article, and I don't know why Hans Schimmel didn't see them, or was not bothered about it. An interesting detail in the drawing: the north face of the window is slightly leaning back, 0.3 mm at the top.



Another decision of Hans Schimmel and Rob van Acht was the choice of data they gave for the fingerholes. They measured the smallest size (Y) in two directions, and the dimensions, also in two directions at the surface of the wood. But they didn't give data for the undercutting of the holes. As they explained: these measurements are not accurate enough. Instead X-ray photos were made and added to the drawings. They are not of the highest quality, but give just enough information to get an idea of the internal shape and design of the fingerholes. The undercutting is for most holes moderately strong and quite regular in all directions, the undercutting angles seem to be rather the same for all holes. The holes are as a result about 50% wider where they meet the wall of the bore. For instance hole 1 goes from 6.0 to c. 9 mm (in length). See the picture below in which I have increased the contrast of the original X-ray photo.





The bore profile of the windway

The inclination of (the roof of) the windway can be established from the bore measurements of the head: subtracting half of the horizontal values (Ø-hor) from the vertical values (Ø-ver or H-ver) gives the distance from the roof to the axis of the head (H-axis). But that is not possible where the beak is cut out and vertical measurements are missing. It is possible to give values for Ø-hor between L0 and L24, by extrapolating the graph of the bore.

Table of dimensions of bore, windway and block
E means: value calculated by extrapolating bore graphic. Outcomes for Ø-hor and Ø-ver rounded off to 0.05 mm. Values for H-axis calculated from original measurements.

L	Ø-hor	Ø-H-ver	H-axis	H-block	H windway opening
0	20.3 (E)	-			
15	20.2 (E)	-			
24	20.1	-		18.75	1.2 to 1.25
27	20.1	20.05	10.03		
30	20.1	20.1	10.055		
36	20.0	20.05	10.06		
42	19.9	20.0	10.065		
48	19.8	20.0	10.07		
54	19.7	19.9	10.07		
57	19.65 (_19.95*_)	19.9 (_20.13*_)	10.075	19.25	0.65
	step: 1.1 (_1.18*_)		(*: _values from the data in the drawings_)		
61.5	19.6 (19.8)	18.8 (18.92)			
66	19.55	18.75			
72	19.5	18.9			
78	19.4	18.85			
102	19.3	18.9			
114	19.3	19.0			
120	19.35	19.1			
135	19.3	19.1			
159	19.15	19.05			

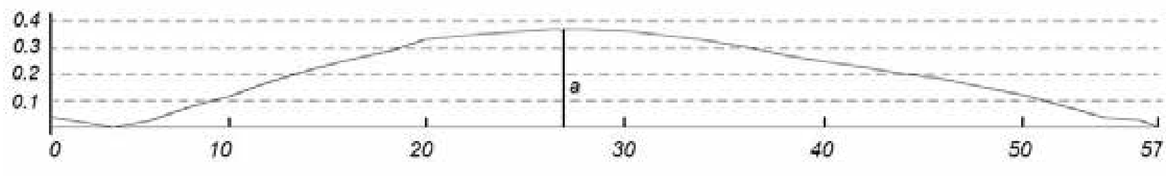

View into the windway; the labium edge or lip is (just) not visible.


Chamfers and north face of the window.

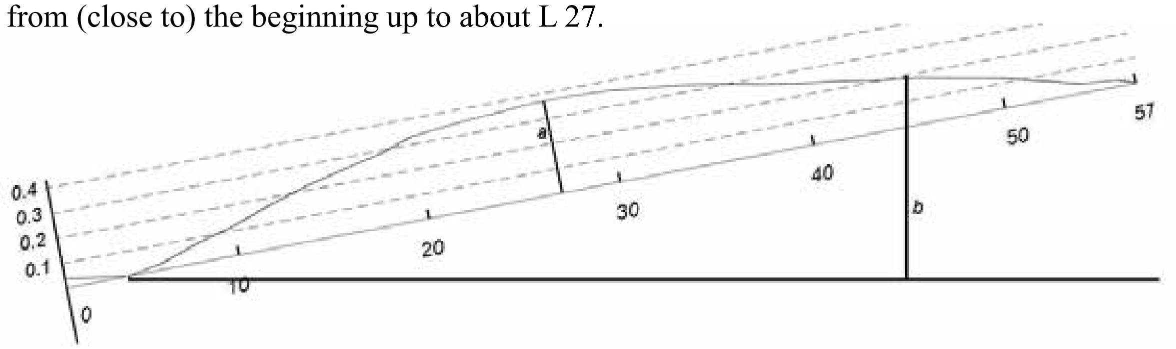

Windway, player's end. All curves of the windway are nicely parallel, there are no signs of problems, such as damage, dirt or warping of the wood of the block or of the recorder itself. The radius of the E-W curve of the windway opening is stronger (R between 25 and 30 mm) than at the other end (R 50 to 60 mm).

The height of the block at the window is 19.25 mm, the height under the labium edge 18.9 (according to the drawings of the details) or even less:18.8 (according to the table). Both values suggest that the block is so high that looking through the windway you can't see the labium edge, and that is indeed the case (see photo). The step (effective height of the windway) is now 1.1 mm, which is rather big. More likely would be a value of about 0.8 mm.

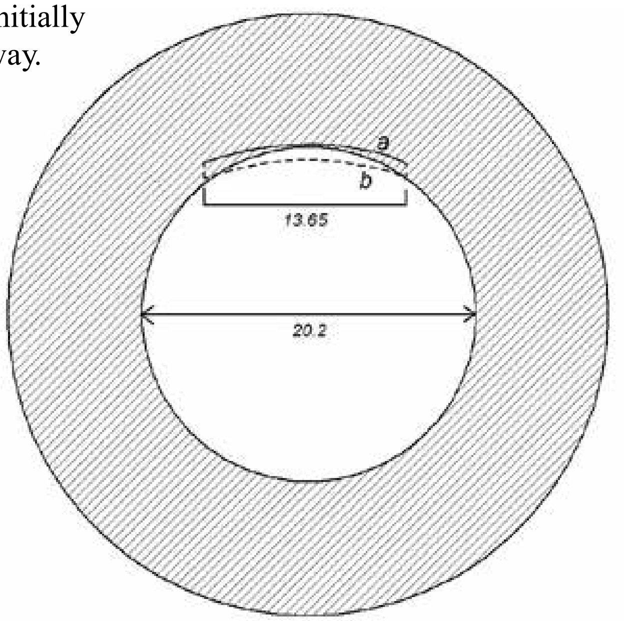
The Ø-hor values show that the bore of the head is slightly conically tapering from North to South, most clearly between L48 and L78. The windway is only very slightly rising from L 30 onwards. But is it possible to tell about the windway profile of the first 27 mm? Schimmel gives in the book a table with the height of the curve of the windway roof, measured with the specially developed apparatus to a line between the lowest points (close) at both ends. I put these heights in a graph, see below.



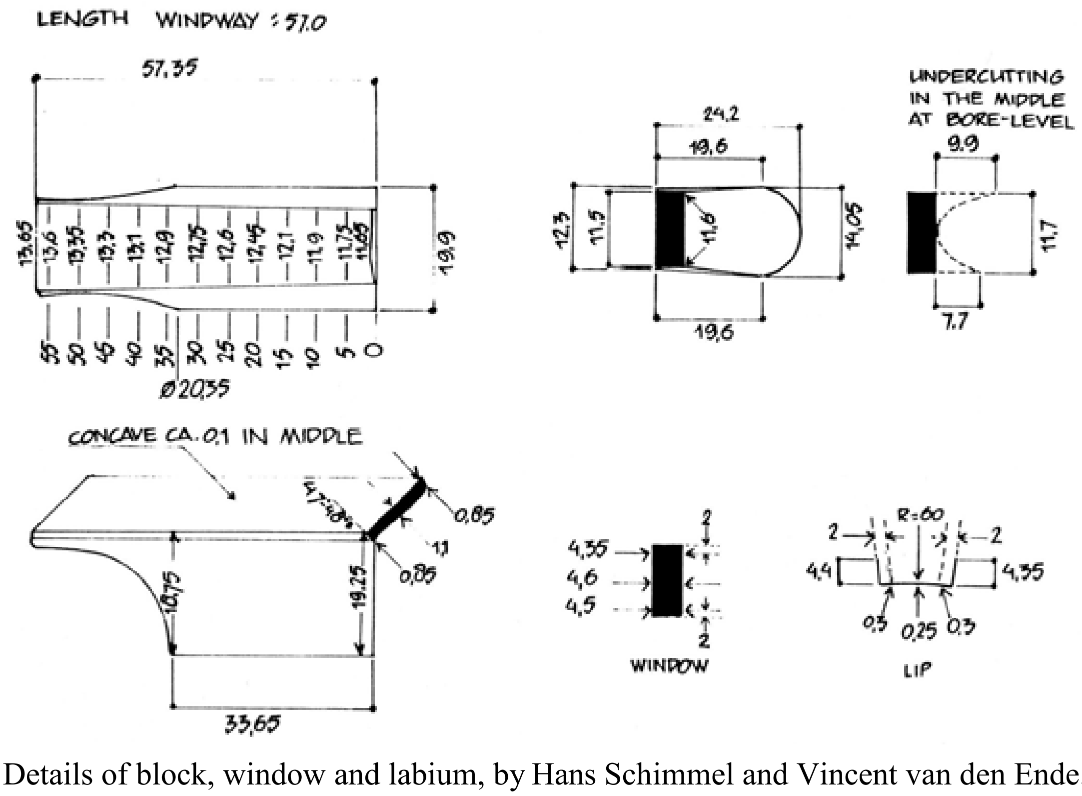
It happens that the highest point of the graph is just at L 27 (a), with a value of 0.37 mm. But as we have seen that from L 27 onwards the windway roof is parallel to the axis of the head, in the diagram below I have tilted the graph until the line after L 27 almost running horizontally to the right. And now it becomes clear that the windway roof is sharply rising from (close to) the beginning up to about L 27.



We can now calculate the distance of the windway at L 0, at the opening at the N-end. It is just comparing the lengths of line a- with line b-. As a = 0.34 mm, b will be about 0.8 mm. Which means that at L0 the distance from axis to windway roof is (about) 9.2 mm.
But is that possible? By extrapolating the graph of the bore of the head, the horizontal value at point L 0 is about 20.2 mm. And that must also have been the vertical value when the head bore was initially reamed before Van Heerde made the windway. The minimum height to the axis for the windway is consequently 10.1 mm. That is almost 1 mm more than the height calculated from the graph. Which means that according to the calculations the windway roof (dotted line b in the diagram, right) begins in mid air, not in the wood (hatched area). That is of course impossible: line a is the lowest position of the windway roof. The incongruity can only be explained by the irregular shrinking of the wood and the problems with the correctness of the bore measurements.



About shrinkage of wood
European boxwood (*Buxus sempervirens*) shrinks rather much from wet (freshly cut) to absolutely dry: 11% in radial and 15% in tangential direction. I have this information from ‘Houtvademecum, deel 1: Houtsoorten, a handbook published by the Houtvoorlichtings-instituut (wood information institute) in Amsterdam (no ISBN, no year of publication). That shrinking percentage is much more than other woods used in instrument making. For instance: the percentages for maple and most fruit woods are 4% and 9%.
I have also observed in some instruments that there is sometimes a difference in shrinkage between the wood that is close to the heart, and the wood that is closer to the bark (box-wood has no or hardly visible sapwood). This causes crooking of instrument parts; knots in the wood and wood from trees which had grown under special conditions may give additional problems during the drying process. Boxwood need carefully (slowly) drying and the old woodwind makers surely knew that. But we don’t know how dry the wood was when Van Heerde made his alto recorder. And what was his working order: making the windway after (or even some years after) he had turned the wood, or directly after drilling, reaming and doing the first stage of the turning? Was the wood perhaps already oval before Van Heerde made the windway?
Another, and rather important question: does the wood always shrink in all directions, or is it possible that - for instance - a bore which was originally perfectly round (e.g. Ø 19.6 mm) becomes distorted as well: becoming oval from those circular 19.6 to an oval cross section of 19.8 x 19.0 mm as maximum and minimum? To which of those values we must return when making a reconstruction of the original dimensions: to the probably highest, a bit lower, or average diameters? This is a point to consider, especially when an instrument has now fine playing qualities, despite having a bore profile with the problems discussed above.
Whatever it may be: the difference between the horizontal and vertical bore measurements close to window and labium are on this alto recorder by Van Heerde exceptionally high, I have seen, also in the window area, comparable differences only on some bass recorders.



Details of block, window and labium, by Hans Schimmel and Vincent van den Ende.

Sound and pitch

For a better understanding of the dimensions (especially the bore profile) of the recorder it is necessary to look at its playing qualities. As for the sound, Saskia Coolen played the alto (with the foot by Van Heerde, the cracks provisionally closed with tape or plasticine) on the CD '*Recorders recorded, Dutch repertoire for recorder played on 18th century recorders from the collection of the Gemeentemuseum The Hague*'. She does that very convincingly, in Sonata IX in G minor by Pierre Antonio Fiocco. The sound is mellow, but she avoided the highest tones of the third register. The harpsichord was tuned at a-426 Hz, which is about 40 cents above a-415 Hz. That is a rather high pitch for an alto of this length, but it corresponds with my own experiences. I have played the alto for only a short time (combined with the Boekhout foot), and measured 'cold' + 30 cents in relation to a-415 Hz for c2 and c3. The a1 and a2 were considerably lower, an indication of the mean tone character of the instrument. The f3 did speak reluctantly, most likely caused by the high position of the block in relation to the labium edge. Hans Schimmel and Rob van Acht measured a pitch of + 15 cents (to a-415) Hz for c2 and c3 and slightly lower ones (about a-415 Hz) for a1 and a2. Pitches in the top of the first register, for f2 and g2 (+ 20 and 30 cents) were just too high in relation to other notes, but that is a common phenomenon when there is shrinkage of the bore in the upper tenon or in the head bore. The octave intervals a1-a2, c2-c3 and d2-d3 were surprisingly correct. A general remark: I know that Schimmel played with a rather low wind pressure, one of the reasons of his general low pitches.

How to explain the relative high pitch of this alto recorder? For instance: the alto recorder of Engelbert Terton in the same collection (Inv. No. BK-NM-11430-94; formerly in the Gemeentemuseum Den Haag, No. Ea 31-x-1952) has a 3 mm shorter sounding length, but a lower pitch: Saskia Coolen played it at a-417 Hz (Hans Schimmel considerably lower). The total 'sounding length' of a recorder is, however, not the most suitable reference point, as the Van Heerde alto has a so-called 'long foot' (108.6 mm), the foot of the Terton is much shorter (103.1 mm). More relevant is that both head and middle joint of the Van Heerde alto are a bit shorter than those of Terton: sounding lengths 128.9 against 130 mm for the head and 203.1 against 204.3 mm for the middle joint.
Quite important for the differences in pitch between the two altos are the dimensions of the window (rather long window, max. 4.6, average 4.5 mm for Van Heerde and max. 4.3 for Terton) and especially the thickness of the wall at the window: smaller than 32 mm for Van Heerde, and 34.7 mm for Terton. Interesting detail: the bore profiles of the middle joints of both instruments are so similar that they could have been made with the same reamers.

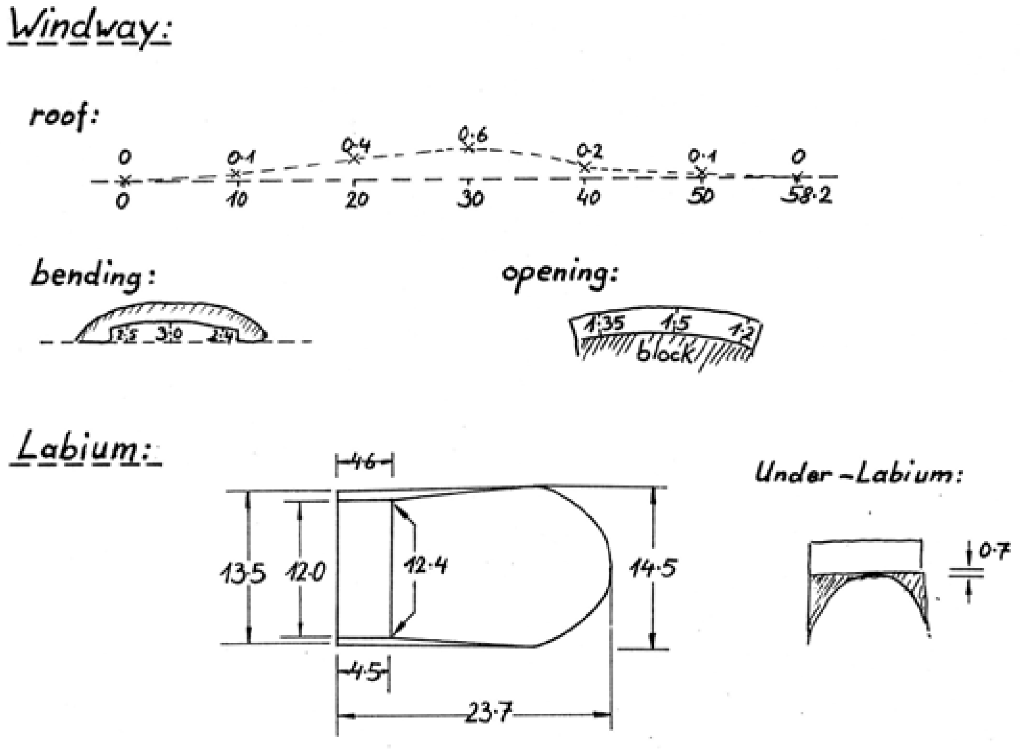
The alto recorder in Edinburgh

There is an alto recorder by Van Heerde in the Musical Instrument Collection of the University of Edinburgh (see www.ed.ac.uk/information-services/library-museum-gallery/crc/collections/musical-instrument-collection for more information) which is remarkably similar to the instrument of the Boers Collection in Amsterdam: same stamps, lengths of the parts, length of the window and thickness of the window wall, a slightly reclining north face of the window, and a similar bore profile. German woodwind maker Martin Wenner made a drawing of the recorder (in 1985), but measured only horizontal bore diameters. He gives no information about warping of the wood (oval cross sections), but mentions that the step is 0.8 mm. He also states that the top notes speak very easily. But that is not my own experience; I saw and was allowed to play the instrument for a short time in 1994 and found the third register 'a bit difficult', and rather flat. The sound a bit thin, a strong 'wolf' on the low

g. There is a short mp3 record with an impression of the sound of the recorder on internet (00322325.mp3; look at the museum website under 'demonstrations'). The sound on that record is certainly not thin, and has a plesant chiff.
Martin Wenner measured an average pitch of a-422 Hz, but some tones are - in relation to equal temperament - rather far out of tune: g1 very flat in relation to f1 and a1, d2 too sharp to c2, top of the first register also too sharp and the third register too flat. Conclusion: not an easy instrument to play in tune, or - in other words - to find fingerings (and music) on which it plays satisfactorily.

Horizontal bore measurements of the head (by Martin Wenner):
L-Ø-hor: 27 - 19.9; 38 - 19.65; 48 - 19.5; 58 - 19.4; 63 - 19.25; 68 - 19.15; 108 - 19.0; 128 - 18.9; 148 - 18.8; end: 18.8

The windway roof is clearly vaulted with a maximum of 0.6 mm. See diagram, drawing by Martin Wenner, but he doesn't mention how he measured that. The windway height at the opening is 1.5 mm. On another part of the drawing Wenner mentions for the step 0.8 mm. These numbers allow us to make not only a profile of the windway, but also a working plan for making a copy of the instrument. The horizontal diameter of the bore of the head is narrowing from 19.4 at the block line to 18.8 close to the socket, that is over the whole length 0.3 to 0.4 mm smaller than the bore of the Boers alto.



Measurements by Martin Wenner, 1985.

Canadian woodwind researcher Jean-François Beaudin also played the alto, made a few measurements, and came to the conclusion that the instrument is out of tune because some parts of the bore have become narrower. But which parts? Beaudin doesn't tell that; it might be the bore of the head. The bore of the middle joint is so regular and very much identical to that of the alto in the Boers collection, that I can hardly think that the problems are there;

the same applies to the bore of the foot. The fingerholes are on the Edinburgh alto slightly larger and are 1 to 2 mm lower on the middle joint. All in all, it is not so easy to explain what causes the impurity of some tones. Remarkable: on both altos is the g1 very flat in relation to f1 and even a1.

Despite, these uncertainties, I think that it is possible to tune a copy in a satisfactory way only with slight chances in the size and undercutting of the fingerholes; of course you have to use historical fingerings. It might be even possible to tune the alto in, or close to, a-415 Hz by reducing the length of the window (for instance to 4.1 or 4.2 mm) and making the wall at the window thicker (to about 34 mm): some other alto recorders by Van Heerde are made that way.

There is, however, another problem with this recorder and that is about understanding the relation between the height of the block, the step and the bore diameters. Martin Wenner measured 18.5 mm for the height of the block at its south end. The height under the labium edge is - when the bore is round - 19.4 mm. Adding up 0.8 (for the step) to that height gives 20.2 mm. That should mean that there is a distance of 1.7 mm (20.2 minus 18.5) between the block and windway roof at the south end of the windway. That is way too much to be true. The only explanation I can think of is that the bore at the labium edge must have warped rather much, maybe as much as 0.8 mm, just as on the recorder from the Boers collection. I have to go to Edinburgh to check that.

Conclusions

It is sometimes easier when you have only a limited amount information about an instrument you want to copy. The first recorder I ever made was after a tenor fourth flute by Stanesby and I didn't know its exact pitch and fingerings. But with some common knowledge about recorders and with the idea in which direction I wanted to go, it happened to be not a bad instrument at all. In the same way it is, or must be, possible to make a reconstruction of the Van Heerde alto from the Boers collection. Some of the measurements are a bit confusing and should be sorted out. That is now a bit difficult, because of the much stricter regulations in the museum. It is good to look behind all the available data, and to handle them not too strictly. It can be helpful to look after similar instruments of the same maker. But that is for the altos of Van Heerde also a bit confusing, because of the seven altos there is only one (in Edinburgh) that comes close, the other instruments have different dimensions.