The oboes of Richters: about methods of research in woodwind instruments

Part 5: Acoustical design of the instruments: lengths and tone-holes

Introduction

This is the fifth article in a series about the oboes by (or in the style of) Hendrik and Fredrik Richters and two very similar instruments with the stamp of H. Rijkstijn. These oboes are particularly famous for their luxurious appearance. They are often made from expensive materials such as ebony, with ivory mounts and silver rings and keys which are on several instruments elaborately turned and engraved. But the Richters oboes in boxwood with brass mounts and keys (where the profiles of the balusters and the shapes of the keys are not distracted from by the embellishments) - show also the great craftsmanship of their makers.

Were these oboes made (and sold) as show objects, maybe as promotional gifts between rich people? Or were they in the first place musical instruments, for experienced or even professional players? After our studies of the exterior aspects oboes such as the turned profiles and the keys, it is time to concentrate on the acoustical design: the length of the parts of the oboes, the tone-holes and (see part 5b) the bore profiles.

The previous articles in this series dealt with:

- Part 1 (Comm. 2000): Checking source material: list of instruments, biographical data of the Richters family.
- Part 2 (Comm. 2011): A close look to a boxwood oboe by Hendrik Richters, a methodical approach to this instrument.
- Part 3 (Comm. 2015): Methods for comparing instruments; the search for a proper terminology; comparing baluster profiles from drawings and photos.
- Part 4 (Comm. 2016): - Survey of characteristics of the keys of the oboes by Richters, in Richters-stijl and by Rijkstijn; making keys and axle holes.

Length, sounding length and 'visible length'

Sounding length (SL) is a term often used by woodwind makers and researchers. The SL is defined as the length of the vibrating air column of a woodwind instruments with all tone-holes closed; SL is an indication (a calculation tool) for comparing pitches of instruments. SL is also sometimes used - perhaps rather confusingly - for the separate parts of the instrument. SL is then what you see of a joint when all parts of the instrument are mounted. For instance for the middle joint of a baroque oboe: it is the length of that joint without the tenon to the bell (and leaving aside the length of the socket at the other end). Maybe that 'VL' (visual length) is a better term than SL.

In table 1 I have summarized the most important SL measurements of the oboes. The bells have no tenons, so their visual length is also the actual length. For the top joints with a finial cup I have measured the distance from the bottom of that cup.

The first conclusion is that there are no two oboes with exactly the same lengths of the separate parts; however for the total length there are several instruments with a length between 565 and 567 mm (565.2 mm = is 24 *duim* of 23.55 mm derived from the Amsterdam foot). Some other oboes have a longer total length of about 571 mm. In part 2 of this series I have given the theory that for oboe HR27 this length fits better in a golden section proportion. But I must add this golden section does not fit perhaps so nicely for other instruments with about the same length.

Table 1: Length and bore measurements of the oboes by Richters and Rijkstijn

instrument	*SL (VL) sections and total*	
	I + II + III = total L	L1-6ext (*L1-6 int*)
HR1:	209.8 + 211.4 + 146.2 = 567.4	187.5 (*189*)
HR2:	210.0 + 210.2 + 146.0 = 566.2	185.7 (*186.5*)
HR3:	209.2 + 210.2 + 142.9 = 562.3	185.8 (*187.5*)
HR4:	207.7 + 210.5 + 141.1 = 559.3	189.2 (*189.5*)
HR5:	209.5 + 211 + 146 = 566.5	186.5 (*187.5*)
HR6:	209 + 211.5 + 145.5 = 566	187 (*188.5*)
HR7:	211.1 + 212.5 + 148.1 = 571.7	188.7 (*191*)
HR8:	213.9 + 211.0 + 146.7 = 571.6	185.6 (*186*)
HR9:	211 + 210.5 + 141.8 = 563.3	189.1 (*189.5*)
HR10:	212.5 + 210.5 + 160.5* = 583.5	185.8 (*no measurements*)
HR11:	total length: 566 no further measurements	
HR12:	210.0 + 211 + 145.4 = 566.4 no further measurements	
HR13:	209.3 + 211 + 144.6 = 564.9	186.8 (*189*)
HR14:	ca. 211 + 214 + 149.1 = 574.1	189.1 (*189.5*)
HR15:	209.4 + 214.2 + 150.0 = 573.6	186.3 (*187*)
HR16:	total length: 572 no further measurements	
HR17:	210.6 + 211.0 + 146.2 = 567.8	187.0 (*187.5*)
HR18:	209 + 211 + 142.1 = 562.1	186.2 (*188*)
HR20:	212.5 + 210.2 + 146 = 568.7	187.0 (*no measurements*)
HR21:	no measurements	187.8 (*no measurements*)
HR23:	ca. 212 + 209 + 147 = ca. 568 no further measurements	
HR24:	210 + 212.5 + 158.5** = 581	188.0 (*190*)
HR25:	210 + 210 + 145.8 = 565.8	185.7 (*187.2*)
HR27:	211.5 + 212 + 146.7 = 570.2	187.3 (*189.5*)
FR1:	210.0 + 210.0 + 146.8 = 566.8	186.0 (*186.5*)
FR2:	209.9 + 209.5 + 146.5 = 565.5	185.8 (*187*)
FR3:	215.2 + 211.2 + 145.2 = 571.6	183.6 (*184*)
FR4:	211.5 + 209 + 144.7 = 565.2	186.0 (*186.5*)
RS1:	209.5 + 210.3 + 147.2 = 567.0	187.7 (*188*)
RS2:	210.5 + 208.2 + 144.0 = 562.7	183.9 (*184*)
RS3:	204.7 + 211.0 + 145.6 = 561.3	185.7 (*186*)
RS4:	ca. 212 + 211.5 + ca. 150 = ca. 573.5 no further measurements	
RS5:	ca. 217 + 211 + 148.2 = ca. 576.2	184.0 (*184.5*)
RS6:	210 + 211 + 145.5 = 566.5	185.2 (*185.5*)
Rijkstijn-1:	212.2 + 209.5 + 144.6 = 566.3	183.1 (*183.5*)
Rijkstijn-2:	204.4 + 211.5 + 144.0 = 559.9	185.0 (*185*)

HR = Hendrik Richters; FR = Fredrik Richters; RS = Richters-style*; Boxwood instruments in italics (F3 = in stained fruitwood).*

SL/VL= sounding/'visual' length (length of the joints without tenons; SL/VL of head joints is measured from the bottom of the finial cup); L1-6ext = distance from centre of hole 1 to the centre of hole 6, measured at the outside of the oboe; between brackets L1-6int: the distance between these two holes inside the bore of the oboes

**: a huge silver 'skirt' is attached to the flare of the bell, making the bell ca. 15 mm longer than it was before. **: bell made by Philip Borkens*

The SL/VL's for the top joints vary for the oboes by Hendrik and Fredrik Richters from 209.3 to 215.2 mm; the variation is SL/VL's for the centre joints is about the same: from 209.5 to 214.2. The average of both series of lengths is about 212 mm, which is 9 *duim* (211.95 mm). The total SL gives us a useful indication for the pitch of instruments as traversos and recorders, but we also need information about the bore profiles. For instance: a wider bore over the whole length of these instruments means generally a lower pitch, and the same can be said for a conical bore which narrows more strongly towards the lower end.

The sounding length and the oboe bells, with a short excursion to the traverso

Can we use the sounding length in the same way as a useful variable to characterize certain acoustical aspects of the baroque oboe? There are some complications. The SL is on wind instruments never the same as the corresponding theoretical wavelength, which of course must be divided by the factor 2, because on recorders, traversos and oboes there is for the tones of the first register only the length between the antinodes, which is half the wavelength.

On a traverso the vibrating air column protrudes when all fingerholes are closed at both ends of the instrument: at the mouthhole and at the lower end of the bore. Only at these points, just outside the instrument, can the air vibrate freely, and there are for the lowest note (the fundamental) the two antinodes of the soundwave. For calculating the length of a traverso with a specific pitch, you must know the correction factors for how far the air column protrudes at both ends (mouthhole correction and end correction).

> Example: I have made copy of a renaissance traverso in d1 (modern pitch). The wavelength (divided by 2) for the d1 is 586 mm. The mouthhole correction for a mouthhole with a diameter of 10 mm is about 40 mm, the end correction about 7 mm. That makes 47 mm, which subtracted from 586 gives a sounding length of the instrument of 539 mm. The SL on my copy is a bit shorter (535 mm), what is caused by the mouthhole which is a bit smaller (8.5 x 9 mm) which results in a slightly bigger correction. See for the formulas for these and other corrections Otto Steinkopf: *Zur Akustik von Blasinstrumenten* ('About the acoustics of wind instruments', Moeck Edition 4029, Celle 1983).

Opening successively the tone-holes shortens the soundwave and so we can play higher tones. But as with the lower end of the instrument, the antinodes of these higher tones clearly stretch further in the bore than just after the lowest open tone-hole. There is a formula for each tone-hole correction, which include factors for the size of the hole, the diameter of the bore and the thickness of the wall.

The oboe has, however, not a foot, but a flared bell with two tuning or resonance holes in the upper half. Where is the end of the vibrating air column when all tone-holes are closed? Not at the lower bell rim, but somewhere between that rim and the tuning holes.

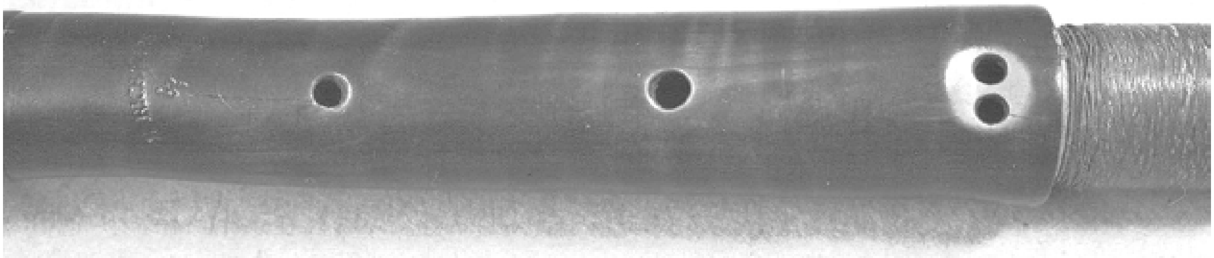
Otto Steinkopf, writes concerning these bells: '*Die Schallstück- oder Becherformen der Holzblasin- strumente sind so unterschiedlich, dass sie schwer rechnerisch zu erfassen sind'* (The shapes of the bells of woodwind instruments show so much variation, that it is difficult to find ways to carry out calculations). It is hardly possible for a baroque oboe to calculate the length of the bell, the bore profile and the place and size of the tuning holes.

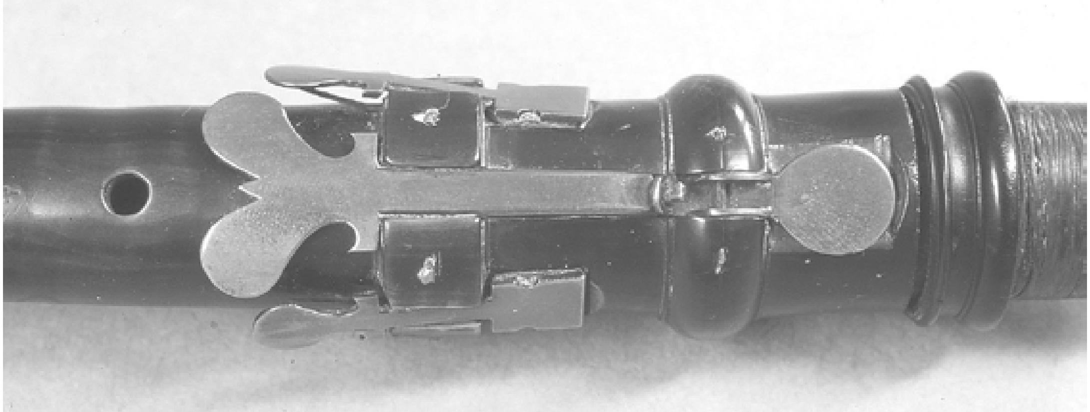
Oboe HR24 (a boxwood oboe by Hendrik Richters in the Horniman Museum in London) is interesting because its bell is by another woodwind maker from Amsterdam, Philip Borkens (born 1693, still active in 1761). This bell is probably not the result of an accidental interchange of parts. I think that Borkens added this bell to the Richters oboe because the original bell was lost or badly damaged. He lacquered not only the new bell but also the upper and middle joint in a dark brown colour, just in the style of Borken's clarinet in the Gemeentemuseum in The Hague (inv. no. Ea 306-1933).

The bell which Borkens made is interesting because it has completely different dimensions: it is over 10 mm longer than the longest original bells by Richters, but the tuning holes are just much closer to the upper end of the bell. What is the effect of this other design? The only way to find out is to make a copy of this oboe with two different bells.

Another interesting aspect: the upper end of the bell by Borkens is smooth, turned without a group of socket beads. This type of bell profile is not uncommon: see oboes by Thomas Stanesby (1668-1734), I.H. Rottenburgh (1772-1765), Charles Bizey (active from 1716 to 1752) and other woodwind makers. I suppose that the bells with a group of socket beads are the older ones, but the other type were introduced rather early in the 18th century or even already at the end of the 17th century. But why? Perhaps because at the shoulder at the lower end of the centre joint is already a group of beads; two groups of connecting beads was perhaps for some woodwind makers visually not ideal.

Photo left: the bell by Philip Borkens for the oboe HR24 by Hendrik Richters. Photos below: fingerholes 1 - 3 on the top joint of this oboe. We can just see that hole 1 is slanted slightly upwards. The wood of both upper and centre joint of this oboe has warped rather curiously: the surface has become undulating in some places (see photo below). The brass keys are beautifully made; the axle holes are not blind, but go through. But we don’t know what Borkens might have changed here.





L1-6: the distance from hole 1 to hole 6
At the other end of the oboe is another problem for the determination of the SL. The length and dimensions of the counter bore is not relevant for the sounding length, but the length and profile of the staple (and how far that is inserted in the counter bore of the oboe) is very much so, as of course are the dimensions of the reed. As there are no original staples and reeds preserved for Dutch oboes, modern players and instrument makers must make these most important parts by trial and error. Choosing a reed and staple is a very individual matter: the pitch of a baroque oboe may vary 30 cents or sometimes even more when played by different players. Instead of the sounding lengths of the joints or the total length of the oboe, I have chosen the distance between the (centres of the) first and sixth fingerhole (L1-6) as parameter which is likely to be more relevant to compare the pitch of the oboes.

> Bruce Haynes used in *The Eloquent Oboe'* another distance, from the top of the oboe to hole 6; another option is the distance from hole 1 to hole 8 (the hole of the C-key), or from the top of the instrument to hole 8.

In table 1 I have not only given this distance at the exterior of the instruments (L1-6ext), but also, as hole 1 is sometimes drilled obliquely upwards and hole 6 downwards, the distance in the bore (L1-6int).

Holes 1 to 6 on most of Hendrik Richters' instruments are drilled straight and slightly undercut (generally speaking, the most pronounced undercutting is in holes 5 and 6). Holes 1 and 4 are sometimes drilled at a slightly upward angle, with a shift of no more than 1 mm, holes 2 and 3 (and occasionally 6) sometimes at a downward angle (with a shift of 0.5 mm). It is not always clear whether the holes were drilled at an angle or merely undercut on one side (measuring these aspects is not an easy job). Hole 1 on oboe no. HR24 is drilled at a fairly pronounced ascending angle; on oboe no. HR7, by way of exception, the tone-holes 5 and 6, the key holes and the tuning holes are more undercut. The tone-holes on Frederik Richters' instruments are always straight or as good as straight, and slightly undercut.

The variation in the L1-6int (see table 1) of the instruments is surprisingly small: from 187 to 191 mm for the oboes of Hendrik Richters (remarkable: 9 *duim* is 188.4 mm); some instruments by Fredrik Richters, in the style of Richters and by Rijkstijn are somewhat shorter (to 183.5). That is a variation of 2% for the oboes of Hendrik Richters, and 4% for all oboes. These percentages correspond with variations in pitch of 35 and 70 cents respectively. That seems very much, but considering the use of a wide range of possible reeds and staples, it is also conceivable that a group of experienced players can play the oboes by Hendrik Richters at the same pitch. Bruce Haynes (*The eloquent oboe*, p. 93) writes: '*On the hautboy (unlike the recorder and clarinet), notes can quite possibly be 'bent' to accommodate pitch levels as much as 40 cents apart on the same instrument. Not only there are differences between players, but the same player can alter the pitch of a single instrument by using reeds of different dimensions'*.

The variation of L1-6 is in the selection of Dutch oboes in table 2 (see next page) slightly bigger than for the instruments of with the Richters stamps; the shortest being about 185, the longest one (Boekhout no. 18) about 195 mm. These variations correspond by and large with the variations in the pitches of the oboes, such as which were assessed by Piet Dhont in a comparative playing session for the catalogue of Dutch double reed instruments (Van Acht, Bouterse & Dhont, 1997). What does that mean? That the oboes by Richters are instruments which stand at the centre of the Dutch tradition of their time.

Richard Haka's oboe no.17 has a L1-6int of about 195 mm. The American oboe maker Mary Kirkpatrick made last year a copy of this instrument and found it perfect playable at a pitch of a1=405 Hz. I myself made copies of Van Heerde no. 13 and Wijne no. 13, which with a length of about 188 mm for L1-6int were played at a1=415 Hz. I give these examples as an indication for what we may expect of the oboes by Richters.

Table 2: Length and bore measurements of a selection of oboes by other Dutch woodwind makers

	SL sections and total I + II + III =	total L	L1-6ext (+ means: L1-6int is 2 to 4 longer, ++ means: L1-6 is up to 6 mm longer than L1-6ext)
Abraham van Aardenberg			
no. 14:	213.1 + 214.3 + 156.1 =	583.5	181.2++ (L1-6ext is ca. 187)
no. 15:	210.5 + 214 + 152.7 =	577.2	181.5++ (L1-6ext is ca. 187)
Willem Beukers			
no. 12:	210.2 + 210.5 + 150.8 =	571.5	185.3
no. 14:	212.4 + 214.6 + 150.2 =	577.2	189.6
Thomas Boekhout			
no. 18:	213.2 + 214.4 + 153.6 =	581.2	194.8+
no. 19:	211.3 + 215.5 + 143.1 =	569.9	185.0
Philip Borkens			
no. 6:	215 + 212 + 148.7 =	575.7	190.7+
Richard Haka			
no. 17:	214.6 + 216.4 + 146.4 =	577.4	192.4+
no. 21:	210.7 + 211 + 141.6 =	563.3	189.1+
Van Heerde			
no. 12:	211 + 210.5 + 147.6 =	569.1	184.8
no. 13:	210.5 + 211.5 + 152.1 =	574.1	187.8+
Coenraad Rijkel			
no. 4:	210.8 + 216 + 140.5 =	567.3	187.1(+)
no. 6:	212 + 214 + 148.0 =	574	187.2(+)
Jan Steenbergen			
no. 10:	212.1 + 213.8 + 146.6 =	572.5	193.6+
no. 11:	212.3 + 210.1 + 149.3 =	571.7	192.1+
Engelbert Terton			
no. 10:	211.9 + 215.7 + 148.5 =	576.1	191.7+
no. 12:	212 + 216.5 + 146.4 =	574.9	188.8+
Robbert Wijne			
no. 13:	212.7 + 212.5 + 149 =	574.2	188.5+

The numbering of the oboes is the same as in the lists in my dissertation (Bouterse 2005). Nota bene: oboe no. 13 of Robbert Wijne doesn't mean that there are twelve other oboes by this maker; the lower numbers (1 to 12) are in his case for recorders and traversos.

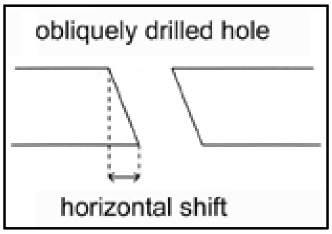
The tone-holes of the Richters oboes; how they affect pitch and sound

It is not really possible to write separately about tone-holes and the bore profiles of the oboes. Or to separate that information from playing characteristics of the instruments. On p. 92 of his book *The eloquent oboe* Bruce Haynes writes: '*Tone-hole size is not linked to bore size*'. He mentions that of the large-holed instruments he had seen, some oboes by Denner are always with a narrow bore, while another by Stanesby junior is unusually wide. Another remark by Haynes is important: in a footnote on p. 93 he says: '*In this case* [altering the pitch of an oboe by using other reeds and staples], *the internal intonation requires adjusting the size of the lowest tone-holes: as the pitch goes up, they must be enlarged'.* That means that if we see an oboe with these lower holes which are unusually wide (wider than on other instruments by the same maker), that that instrument might be altered by a player.

It is therefore that one of the questions that must be asked is whether the tone-holes of the Richters-oboes are in original condition. In table 3 the variations are listed of the size of several tone-holes of the oboes for which I have collected measurements. The exterior diameters of the wood (Ø-ext) at these holes are added too.

Nota bene: as it was not always possible or allowed to remove the keys, the size of these holes could not be assessed with the same accuracy as the other holes. Therefore the many 'circas' (c.) for the sizes of hole for the great key (hole 8).

Measuring the position and size of the tone-holes is not so easy: holes are sometimes drilled obliquely and can be undercut as well. The positions of an instrument's tone-holes are represented in the tables of this article as the distance from the middle of one hole to the lower or upper edge or edge of the shoulder of the relevant section of the instrument. In the case of obliquely drilled holes there is a difference between their position on the outside (surface) of the instrument and their harder to determine internal position, which is acoustically more relevant. Various researchers indicate the angle at which such holes were drilled; another method is to indicate the degree of horizontal shift. Both methods are however inaccurate when fingerholes are not only drilled at a slant but are moreover undercut.



Why are fingerholes drilled at a slant? That is not only to get these holes in an easier reach of the fingers or to achieve a more regular spacing of the holes in a group of three: a hole which is drilled at an angle is also longer than a straight hole and that has - together with the shape and mount of undercutting - influence of the sound and other playing characteristics of the tone. One of them is the relation between the main tone and the corresponding fork-fingered tone on that hole (for instance: hole 2 and the tones b and b-flat, fingered respectively 1 and 1 . 3). Another aspect is the 'resistance', a concept that is not easy to define. When producing a tone on an oboe, the player aims for a precise and well-balanced attack, whether he is playing legato or piano, staccato or louder. For a successful result it helps if the player encounters a certain degree of resistance from the instrument, so that the tone will not go off uncontrolled in all directions. Resistance does not depend solely on the quality of the reed, but also on the oboe's bore and the size and shape of the tone-holes. Generally speaking, a player encounters less resistance from a relatively wide bore and large tone-holes than from a narrower bore and holes. Additional factors are the effective local thickness of the oboe wall at the tone-holes and the angle at which the hole is drilled. Bruce Haynes (Haynes 2005, p. 91) writes that undercutting makes a note louder and brighter in tone colour, and makes it easier to push up or down in pitch. It makes also it sound more easily. Of a tone-hole has sharp edges where it enters the bore, it speaks less easily, thereby causing the player to blow harder than usual to overcome the initial inertia.

Cecil Adkins mentions that in the Richters oboes he assessed undercutting is not common in the top joints. Six of these eighteen oboes have the first hole drilled upward between 10 or 15 degrees. Four of the second holes slant downward and one upward. For the double third holes he observed that the two holes were joined together in the bore. According to Adkins there is much more variation in fingerhole size and placement on the middle joints, and the undercutting is minimal.

Table 3: Relation between tone-hole size and wall thickness of the oboes by Richters and Rijkstijn

instrument	*hole 2*	*hole 5*	*hole 7 (d#)*	*hole 8 (C)*	*tuning hole (bell)*
(smallest diameter / Ø-ext of hole)					
HR1:	3.5/18.6	5.2/21.1	4.5/24.2	c. 6.3	4.1/27.8
HR2:	3.6/19.4	4.8/21.4	4.3/24.6	c. 6.6	4.3/28.2
HR3:	3.5/19.1	4.4/21.0	4.1/24.1	c. 6.0x6.2	4.1/28.6
HR4:	3.4/18.9	4.8/21.5	4.5/24.8	c. 6.0	4.2/27.0
HR7:	3.4/19.0	4.4/22.5	4.6/25.4	6.4x6.8	4.7/26.6
HR8:	3.5/19.0	4.6/21.7	3.8/25.1	c. 6.0x6.4	3.9/28.0
HR9:	3.4/19.2	5.0/21.9	4.5/24.7	c. 6.6x7.0	4.2/26.2
HR13:	3.7/19.0	4.6/21.2	4.0/24.4	c. 6.7	4.0/28.6
HR15:	3.5/18.8	4.7/22.5	5.9/25.7	7.0x7.6	5.0/26.9
HR17:	3.5/19.0	4.7/21.1	4.5/24.8	5.9x6.1	4.0/28.2
HR18:	3.5/18.7	4.5/21.9	4.1/25.6	c. 6.2	nm/ 27.2
HR20:	3.4/18.9	4.9/21.5	4.8/24.3	6.0	4.1/27.6
HR21:	3.5/17.9	4.8/20.7	5.7/24.3	6.3	4.1/27.6
HR24:	3.5/19.2	4.6/22.4	4.3/25.7	c. 6.5	4.7/nm
HR25:	3.5/19.3	4.7/21.9	4.0/25.8	5.7x6.1	4.2/27.6
HR27:	3.4/16.8	4.5/21.7	c. 5 /25.0	c. 6.5	4.0/27.0
HR30 (tenor):	3.6/22.6	4.6/25.9	5.5/30.4	7.6x7.8	4.9/34.5
FR1:	3.3/19.3	4.5/21.5	3.9/25.0	6.0x6.1	4.0/29.0
FR2:	3.3/18.9	4.6/22.0	4.2/25.4	c. 6.4	3.9/28.5
FR3:	3.4/18.8	3.8/22.0	3.6/25.5	c. 6.2x6.6	3.6/29.5
FR4:	3.6/19.0	4.4/21.3	3.7/25.2	6.2x6.4	4.1/28.6
RS1:	3.2/18.9	4.4/21.4	3.8/25.8	5.9x6.1	3.9/29.6
RS2:	3.4/18.0	4.3/21.2	4.8/24.7	c. 6.2x6.7	3.8/30.1
RS3:	3.5/19.2	4.4/22.3	4.2/27.3	c. 6.2x6.5	4.1/30.1
RS5:	3.5/nm	4.7/nm	4.0/nm	c. 6.0x6.2	4.2/nm
RS6:	3.4/19.0	4.6/21.9	4.4/25.0	6.3x6.5	4.0/29.4
Rijkstijn-1:	3.2/18.9	4.5/21.7	3.5/25.6	c. 6.0	4.1/27.9
Rijkstijn-2:	3.4/18.6	ca. 5.8*/23.0	3.8/ca. 27	c. 5.5	nm/28.5

Explanation: before the slash the smallest diameter, after the slash the local outside diameter (= Ø-ext); of hole 8 (the hole for the great key): only diameter (min x max) of the hole.
HR = Hendrik Richters; FR = Fredrik Richters; RS = Richters-style; nm= not measured.

What conclusions can be drawn from the data in table 3? About possible enlargements of the holes, there is only one suspect: oboe HR15 which belonged to the oboe player Michel Piguet. Holes 7 and 8 as well as the tuning holes on the bell are larger than on all other instruments. I have not seen this oboe myself, so I don't know if there are any traces on the holes (such as sharper corners or irregular undercutting) which are indications of an enlargement by a player. Oboe HR21 has also a rather large 7th hole, but the lower holes have normal sizes.
Oboe FR3 have very small holes 5 and 7 and tuning holes on the bell. But this is a slightly odd instrument, the stamps are rather vague, but the 'F' of the name and the cloverleaf are unmistakable from the maker's marks of F. Richters. The wood of this oboe (fruit wood?) is rather dull, and so are the metal rings; further are the keys probably not original: the quality of the engraving doesn't match the design of the mounts. The tenon of the upper joint is a replacement, there are several deep cracks in the middle joint and bell. Conclusion: this instrument does not (in its present condition) match quality of the other oboes by Fredrik Richters.

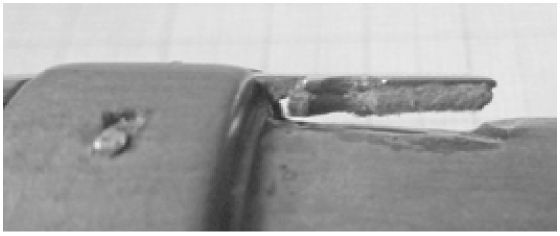
Bruce Haynes says that the Dutch oboes from the end of the 17th century and persisting until possibly as late as the 1760s belong to 'Type A3'*, which '*shows unusually sharp flares at the finial and short bell and an 'emphatic roundness' at the balusters'.* Then he continues: '*Aggre- gate tone-hole size* [which is the total of the diameters of fingerholes 1, 2, 4 and 5] *is typically on the small side, average 15.8, but the bores are relatively wide; the length is standard (AL about 328).'*

* Haynes follows in *The eloquent oboe* (p. 81) a classification of Eric Halfpenny, which was published in the article 'The English 2- and 3-keyed Hautboy' (*Galpin Society Journal* 2, 1949, p. 10-26). 'AL' is the distance from the top of the oboe to hole 6.

Comparing hole sizes of the oboes by Richters with those of other European makers exceeds the scope of this article. I must confine myself to a selection of data of the oboes by Richters only, see table 3.

About hole 2: the variation in size of this hole on the oboes is small, on most instruments it is 3.4 or 3.5 mm. Only four oboes have smaller holes (two by Fredrik Richters) and three have larger holes. And these larger holes don't mean that the corresponding lower holes are bigger as well. I cannot further see any relation between the size of the hole and the Ø-ext at the hole. Hole 5 is on average between 4.4 and 4.8 mm, only two are smaller (FR3 and RS3) and three are larger (HR1, HR9 and HR20, respectively 5.2, 5.0 and 4.9 mm), again with no relation to the size of the other holes on these instruments. Hole 5 on Rijkstijn measures 5.8 mm, but both hole 5 and 6 on this oboe are not in original condition and look now more overcut than undercut. See the photos of this oboe on the next page.

There are two complication for hole 7. At first, it is not only the size of the hole that we must take in consideration, but also the action of the key. A low key action means that the key is 'shadowing' the hole below, and on many Dutch oboes I have seen indeed a rather low key action (for instance on HR27, see photo right).



Secondly, there is the question about the relative pitch of the tone played with holes 1 to 6 closed and the small key pressed (opening hole 7). We were confronted with this point during the preparations for the catalogue of Dutch double reed instruments in the Gemeentemuseum in The Hague (1997), for which professional baroque oboe player Piet Dhont was asked to assess the acoustical properties of the instruments. On several Dutch oboes, these tone appeared to be rather flat, more a d-sharp than a e-flat. What does that mean? It is a complicated matter, involving the aspect of the temperament in which the oboes were tuned and which kind of music was played on them.

From para. 9.6.3 of my dissertation: ... *'it was apparent that a few critical forks in the first octave of some oboes were easier to play than on others. On Boekhout's no. 18, for instance, f1 played well without recourse to the small-key, at the same time - but from a technical point of view not influenced by that instrument's easier-speaking f1- the tones d-sharp/e-flat1 and d-sharp/e-flat2 sound relatively high; this is the direct consequence of the fairly large hole of the small-key. Other oboes have an f1 that speaks less easily, the small-key having to be used for this tone. On these 'd-sharp/f-sharp oboes', moreover, the tone d-sharp/e-flat is often somewhat low in both octaves (the small-key's hole is often little too), making it more practical to use them as a d-sharp than as an e-flat, based on a mean-tone temperament'.*

Table 4a: pitch and some playing characteristics of oboes by Hendrik and Fredrik Richters (table 9.10 in Bouterse 2005)

	pitch of a1	*remarks*
HR1*	412-415 Hz	f1 needs d-sharp-key, d-sharp1/d-sharp2 not very flat; sound character and quality are between those of HR6 and HR7
HR2*	410-415 Hz	f1 easy, d-sharp1/d-sharp2 a little flat, c-sharp3 and d3 slightly difficult
HR6*	415-417 Hz	f1difficult, d-sharp1/d-sharp2 rather flat; this oboe has a direct attack, is very sensitive to fluctuations in wind pressure
HR7*	410-415 Hz	f1 and b-flat1 easy, d-sharp1 a little flat, b2 slightly difficult; the sound of this oboe is somewhat modest
HR8*	408-412 Hz	f1 slightly difficult, but d-sharp1/d-sharp2 not too flat; the sound of this instrument is not so much free (somewhat stopped) as of other Richters oboes
HR9*	ca. 415 Hz	d-sharp1/d-sharp2 are flat, f1 needs d-sharp-key; beautiful sound
HR10	430-435 Hz	
HR13	ca. 415 Hz	
HR30	< 400 Hz (after Haynes) or ca. 405 Hz (after Cottet)	
FR1*	412-415 Hz	f1 easy, also without d-sharp-klep; d-sharp1/d-sharp2 not (too) flat; because of cracks, this oboe could only be played during a short time
FR2*	408- 412 Hz	f1 reasonably easy, d-sharp1/d-sharp2 rather flat; very good oboe, perhaps even a little more modest than HR7

*Explanation: *: these instruments are from the Gemeentemuseum Den Haag (The Hague). HR10 is the oboe in the Beethoven Archive, Bonn, Germany, HR13 in a private collection in London, HR30 is the tenor oboe in the Musée de la Musique in Paris.*

Table 4b: Aggregate tone-hole sizes (ATS)

HR1: 16.4	HR2: 16.6	HR6: 16.5	HR7: 15.3
HR8: 15.8	HR9: 16.5	HR27: 15.6	
FR1: 15.5	FR2: 15.8	FR4: 15.6	

The aggregate tone-hole size (ATS) is the total of the average diameters of fingerholes 1, 2, 4 and 5.

Table 4a shows the results of the playing sessions in The Hague, complemented with data from some instruments in other collections. Oboe HR10's extremely high tuning (a=430 Hz) was undoubtedly measured as such, but fails to tell us very much, partly due to the lack of reed and staple measurements. The Richters oboes at The Hague can sound as much as a semitone lower than the instrument in Bonn, in tunings varying from a=408 to 416 Hz. In view of their only slightly differing lengths, this variation is remarkable and difficult to account for. Oboe no. HR9 was one of the highest-sounding instruments, probably because it had been recently oiled. However, this cannot account for the differences between the tunings of nos. HR1 and HR6 for example, or HR8 and FR2 (none of which were oiled).

I have had in recent years discussions with players about the sound of the f1 on baroque oboes. While on recorders and traversos the second register is the intensive register (see Steinkopf, pp. 9 and 49), which among other things means that the fork-fingered notes are critical (it is only restrictedly possible to change the pitch of these by adding a finger down in the fork), the intensive register for oboes is the first register. The f2 in the second register (with 1 2 3 4 6) is never problematical, but the f1 sounds often a bit muted with this fingering. Opening hole 7 (by pressing the small key) gives on such instruments an improvement. But oboe players do not like pressing the keys when it is not strictly necessary. Piet Dhont has discovered that the f1 speaks and sound better when he puts a small ring of paper in the bore of the middle joint, just below the socket to the upper joint. This narrows the bore at that point and has not much negative consequences for other tones; Piet uses this technique often in concert. Michel Piguet (I met him only once in Basel, in the coffee room of the Musikhochschule) told me that for a good f1 the shape of the bore of the bell is important; the properties of the tuning holes on the bell may affect the f1 as well. But so much depends on the reed and staple, which I discovered when American oboe maker Mary Kirkpatrick sent me some of them which see has made herself: with her reeds I had for the first time no problems at all with the f1 on one or two of my own copies of Dutch baroque oboes.

Is there a conclusion? It is hardly possible to find a tendency or relations between the properties of the tone-holes and the pitch and other characteristics of the tones of the oboes. But larger holes mean generally a louder sound. Give the aggregate tone-hole sizes (ATS) a clue? HR7 has a 'somewhat modest sound' and an ATS of only 15.3; HR9 has a 'beautiful' (and perhaps also louder) sound with a higher ATS of 16.5. But the relation is by far not so obvious for the other instruments in tables 4a and 4b.

How to compare these numbers with those given by Bruce Haynes, in Appendix 2 of *The eloquent oboe*? I have calculated for HR14 (Bate Collection, Oxford, No. 2037): 15.9, and Haynes 15.85; for FR4 (collection Han de Vries, Amsterdam) I measured 15.6 and Haynes 15.8; but for the oboe 17 by Richard Haka (Gemeentemuseum Den Haag, Ea 6-1952) I have 16.2 and Bruce Haynes 17.15, which is considerably more and has nothing to do with a different rounding off of the measurements. My impression is that adding hole sizes is a bit dangerous technique: it means also that you are adding the inaccuracies which always occur when measuring these holes (which is not so easy at it seems).

Bruce Haynes mentioned an average ATS of 15.8 for Dutch baroque oboes. This value seems also to be the average ATS of the oboes by Hendrik and Fredrik Richters. As we saw before too, the lengths of the joints and the distance from hole 1 to hole 6 are on their oboes never extreme and there is no sign that the brothers (and other family members) were involved in experiments in making new types of oboes. The standard model of their instrument was good enough to meet the expectations of the people who were interested in buying them.

Bibliography:

Acht, Rob van, J. Bouterse & P. Dhont: *Niederländische Dopperrohrblattinstrumente des 17. und 18. Jahrhunderts - Dutch double reed instruments of the 17th and 18th centuries* (Laaber 1997).

Adkins, Cecil: 'Oboes beyond compare: the instruments of Hendrik and Fredrik Richters', *Journal of the American Musical Instrument Society* 16 (1990), p. 42-117.

Bouterse, Jan: *Dutch woodwind instruments and their makers, 166-1760* (Utrecht 2005).

Haynes, Bruce: *The eloquent oboe, a history of the hautboy from 1640 to 1760* (Oxford, 2005).