Case study

on the restoration

of the

1735 Richard Bridge Organ

at

Christ Church Spitalfields

Metal and Wooden Pipework

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Metal and Wooden Pipework

General Description of Metal Pipework.

Pipe metal

The metal of the bodies and feet is scraped on the outside.

With pipes smaller than 1'c the metal shows scrape marks across the length of the bodies and feet.

Larger pipe bodies show scrape marks along the length. The feet still across.

With the Front Principal the change happens somewhat above 1'c.

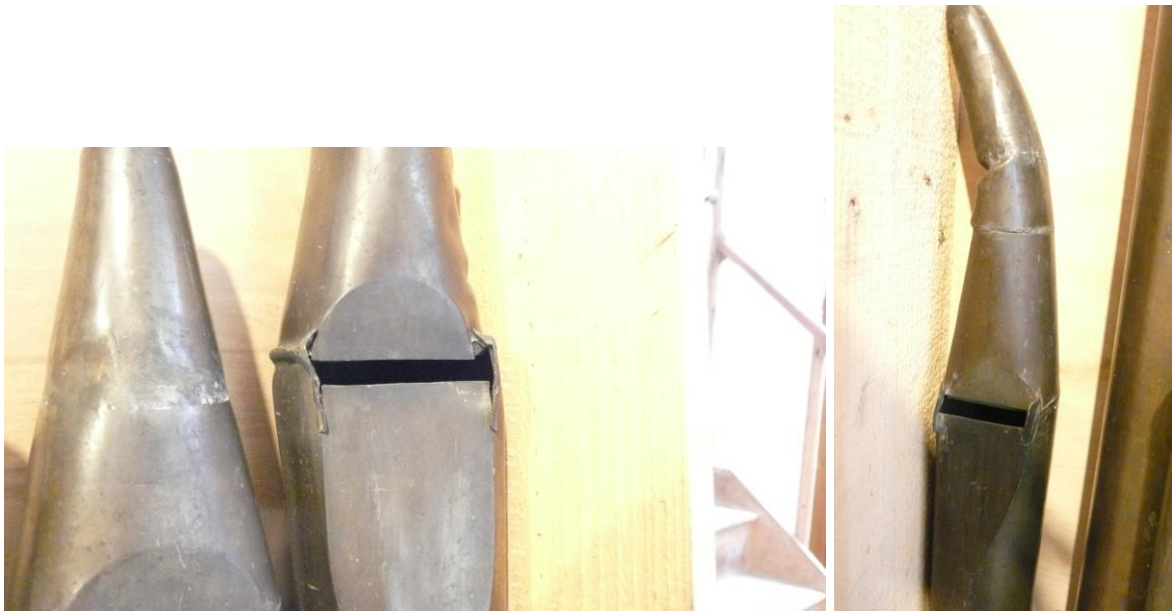
The metal thicknesses show a distinct tendency of the use of tapered sheets for the pipe bodies below 1' speaking length.

With all the Stop[t] Diapason pipes the original size from soldering on the lids survives. This is quite a course size (lumpy). Although the appearance seems reddish, in contact with moisture it would turn white.

This size is also evident on the reed resonators where hooks have been originally soldered.

Condition of metal pipes

The majority of the pipes was found in a still cone-tuned condition. The middle and upper ranges had suffered some, but relatively little collapse due to tuning. The larger pipes though were in a much worse state. Through insufficient support (broken rackboards etc.) the pipes had suffered collapse at the feet and mouth area.



Examples of damage through collapse

Distorted feet with tips sometimes considerably shortened and reformed

New pipes amongst restored old pipes

Cleaning method

The pipes were cleaned using a dry method for the inside. The inside of pipe feet was tackled with tiny brushes and bottle cleaners, in order to get right under the languid to clean the nicking from below. During the brushing a vacuum cleaner was also used. The pipe bodies were cleaned with bottle cleaners and flue brushes of varying sizes. After all this the outside of the pipes was wet-wiped taking special care not to remove the old solder size.

The largest pedal pipes could quite easily be cleaned from the inside

Analysis Pipe metal 4 foot pipe

DATE-S/N	REFERENCE	ELEMENT	RESULT		METHOD
25/02/2013 0080	S1	Silver	0.006%	mean	ICP-OES
			%	low	
			%	high	
25/02/2013 0080	S1	Aluminium	<0.005%	mean	ICP-OES
			%	low	
			%	high	
25/02/2013 0080	S1	Arsenic	0.014%	mean	ICP-OES
			%	low	
			%	high	
25/02/2013 0080	S1	Bismuth	<0.005%	mean	ICP-OES
			%	low	
			%	high	
25/02/2013 0080	S1	Cadmium	<0.0005%	mean	ICP-OES
			%	low	
			%	high	
25/02/2013 0080	S1	Copper	0.071%	mean	ICP-OES
			%	low	
			%	high	
25/02/2013 0080	S1	Iron	<0.002%	mean	ICP-OES
			%	low	
			%	high	
25/02/2013 0080	S1	Lead	75.5%	mean	ICP-OES
			%	low	
			%	high	
25/02/2013 0080	S1	Antimony	0.059%	mean	ICP-OES
			%	low	
			%	high	
25/02/2013 0080	S1	Tin	24.4%	mean	ICP-OES
			%	low	
			%	high	
25/02/2013 0080	S1	Zinc	<0.0005%	mean	ICP-OES
			%	low	
			%	high	

Analysis Pipe metal 12th pipe

DATE-S/N	REFERENCE	ELEMENT	RESULT		METHOD
25/02/2013 0081	S2	Silver	0.007% % %	mean low high	ICP-OES
25/02/2013 0081	S2	Aluminium	<0.005% % %	mean low high	ICP-OES
25/02/2013 0081	S2	Arsenic	0.016% % %	mean low high	ICP-OES
25/02/2013 0081	S2	Bismuth	<0.005% % %	mean low high	ICP-OES
25/02/2013 0081	S2	Cadmium	<0.0005% % %	mean low high	ICP-OES
25/02/2013 0081	S2	Copper	0.070% % %	mean low high	ICP-OES
25/02/2013 0081	S2	Iron	<0.002% % %	mean low high	ICP-OES
25/02/2013 0081	S2	Lead	75.1% % %	mean low high	ICP-OES
25/02/2013 0081	S2	Antimony	0.056% % %	mean low high	ICP-OES
25/02/2013 0081	S2	Tin	24.7% % %	mean low high	ICP-OES
25/02/2013 0081	S2	Zinc	<0.0005% % %	mean low high	ICP-OES

Scale Analysis

Front Open Diapason

Scale close to 3 : 5

Mouth width $^{1}/_{4.3 – 4.2 \text{ (top d)}}$

Back Open Diapason

Mouth width large pipes $^{1}/_{4.28}$, small pipes slightly under $^{1}/_{4}$

Front Principal

The scale progression varies from 8^{ve} to 8^{ve} but it does not to the extent of halving in the 8^{ve} with an additions constant. 2 semitones smaller than the Front Open.

Back Principal

Scale 3:5 widening below CC.

Mouth width $^{1}/_{4}$

Twelfth

Scale varies throughout the 8^{ves}

From g^{o} to d' there is a more rapid decline causing the scale to increase to the treble.

Mouth width $^{1}/_{4}$

Fifteenth

Scale same as Twelfth, pipe for pipe.

(The existing 5 bass notes and the surviving rack board holes point to this)

Mouth width $^{1}/_{4}$

Tierce

Scale same as Twelfth, pipe for pipe.

(One half surviving rack board hole in the middle range suggested this.)

Sesquialtra & Furniture

Scale same as Front Principal

Mouth width $^{1}/_{4.1}$

Great Stop Diapason

Scale g^{o} - $\#^{o}$ 5 : 8

c' – c'' halving on 8^{ve} with additions constant 11.7

c'' – d''' halving on 8^{ve} with additions constant 8

Mouth width $^{1}/_{4}$

Choir Stop Diapason

Scale is halving on the 8^{ve} with an additions constant of 7.3

Mouth width $^{1}/_{4.3}$

Choir Principal

Scale similar to back Principal.

Mouth width GG - ## $^{1}/_{4.23}$

Mouth width FF $^{1}/_{4.3}$

Swell Stop Diapason

Scale a' – $c^{\#}$'' 0.5.84

$c^{\#''}$ – d''' 0.68

Mouth width $^{1}/_{4}$

Using evidence from within the organ to reconstruct stops

Back Open Diapason

There were a number of stops partly or completely missing.

From the Back Open Diapason the majority of the stopped bass and helpers and three large full-length pipes of the continuation had survived. Besides these, also five smaller treble pipes had survived. Reconstructing the scale was therefore not a problem. Finding out the correct foot lengths in order that the original holes in the rackboards wouldn't need altering was more involved. This was done by fitting in old pipes of the appropriate scale and allowing for adjustments.

Testing out appropriate foot lengths with random pipes with the right scale (note the 5 smallest original pipes)

Fifteenth, Tierce and Larigot

Of the Fifteenth only five bass pipes and the upperboard and rackboard holes survived. Trails of fitting old pipes into the rackboard showed that the pipes from the Twelfth fitted convincingly note for note. This was also the case for the lowest 5 rackboard holes of the Tierce and one half surviving hole in the middle range (all the other holes had been enlarged for a stop change). The interesting pattern that showed itself was that the Twelfth, Fifteenth and the Tierce were originally of the same scale. As for the Larigot, there was no evidence to be found. A decision was made to reconstruct also this stop to the same scale.

The Tierce rackboard with the lucky half-hole survival

Later enlarged holes being filled in

The choosing of pitch and temperament

The pitch of the Bridge organ was originally somewhere around modern pitch (a 440 Hz at 20^{o}C).

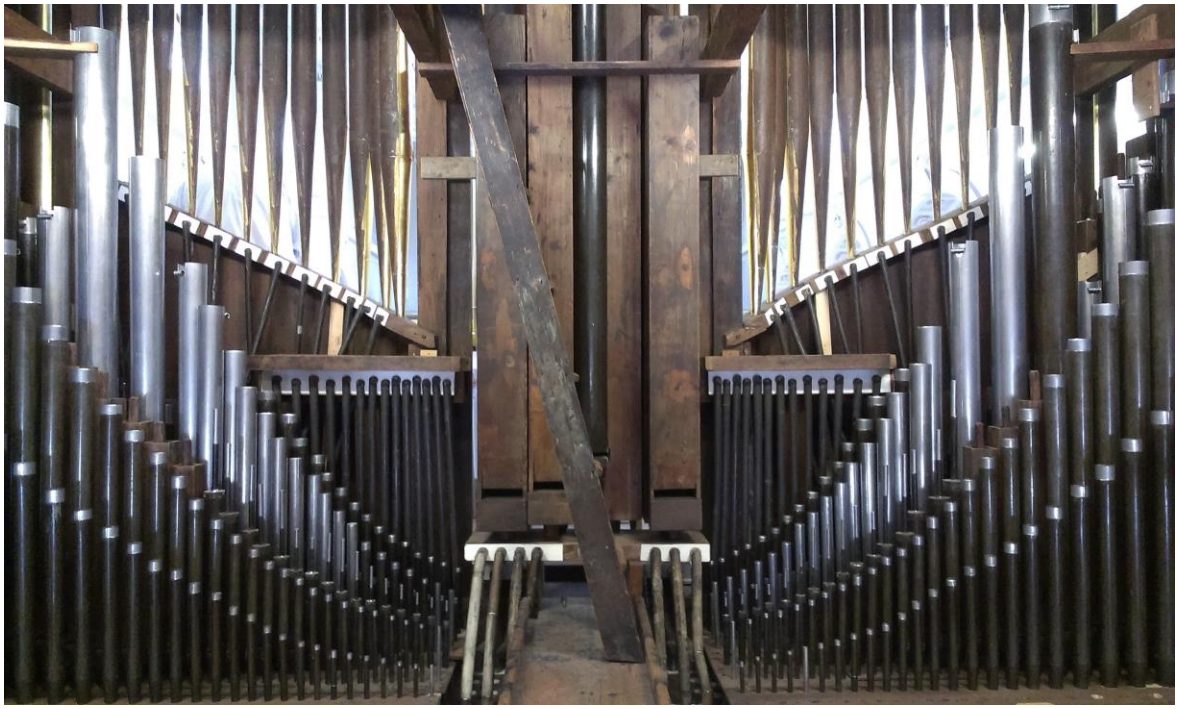
During the restoration of the tuning areas of the front pipes it was discovered that DD$^{\#}$ of the Front Principal and D$^{\#}$ of the Front Open Diapason had not been substantially altered in pitch. Even though the organ had undergone a significant rise in pitch (to above a 450Hz), these two pipes have escaped being cut out further unlike the other front pipes. The conclusion one could draw from this, is that these notes were already sharp in the original temperament and did not need altering for an alteration to equal temperament at a new sharper pitch. G$^{\#\,o}$ of the Front Open Diapason proved to be quite flat in pitch after restoring its tuning area and showed that its pitch could not have been significantly sharper due to the position of the tuning window in the back of the pipe.

Restored tuning areas of the front pipes (and the reconstructed Swell building frame support using large screws instead of nails)

The pattern that emerged here is one that could be interpreted as suggesting the original use of a meantone type temperament with a wolf between D$^{\#}$ and G$^{\#}$. Using the fifth (syntonic) comma meantone temperament the tuning areas of the front pipes could be reinstated whilst not removing any original pipe metal. The

chimney lengths of the Stop Diapason trebles have turned out to be somewhat irregular (mostly in the Great). Any conclusion as to temperament could not be drawn from this as the inaccuracies in chimney length are contradictory from octave to octave and stop to stop.

The main core of original Great pipework up to the 12th re-installed in the organ (note 5 old treble pipes in the Back Open)



Voicing Method in the Workshop

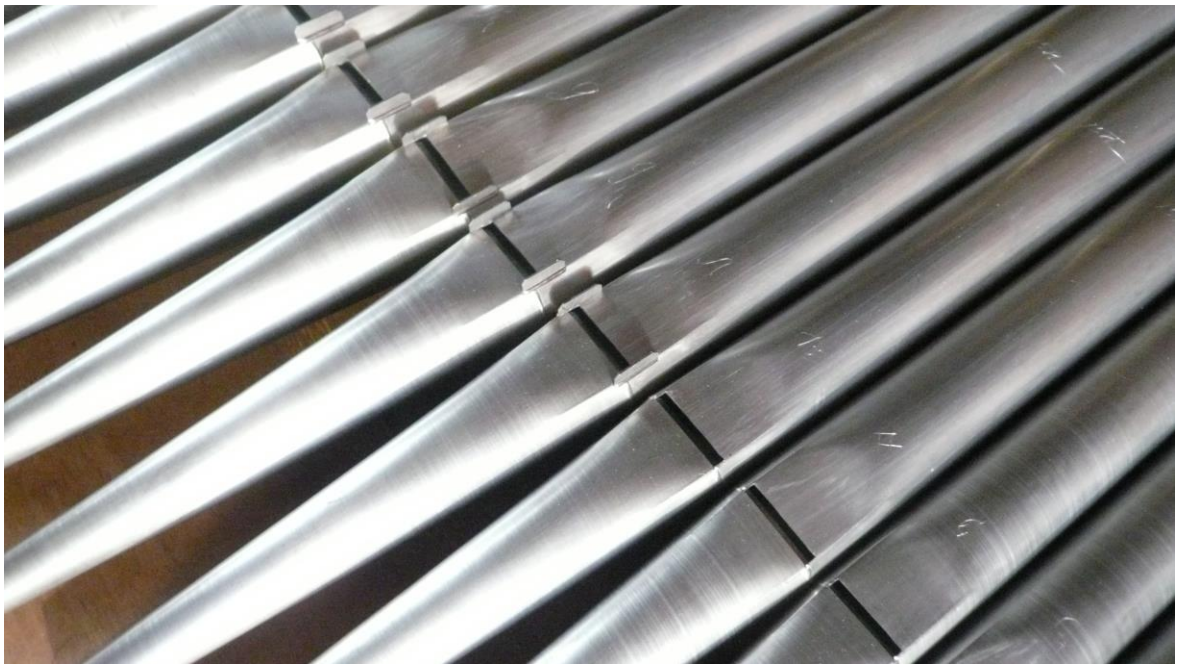
I started by completing the existing stops on the voicing machine and regulating the old pipework. For the new pipes all original voicing details were copied to fit in with the old pipes first. The nicking was especially important to get right. Not too deep (one can always deepen the nicking), not too shallow and especially, applied at the right angle. The nicking of the old pipes shows a change of angle towards the left corner of the mouth. It starts on the right side in the very corner at quite an oblique angle to the face of the languid, and ends up somewhat more square on the languid in the left corner. The nicking doesn't reach as far into the left corner

as it does into the right. Could it be that the angle of the knife used for nicking did not allow this? Thus there is strong evidence that the pipes were nicked by the voicer and not during the manufacture of the pipes.

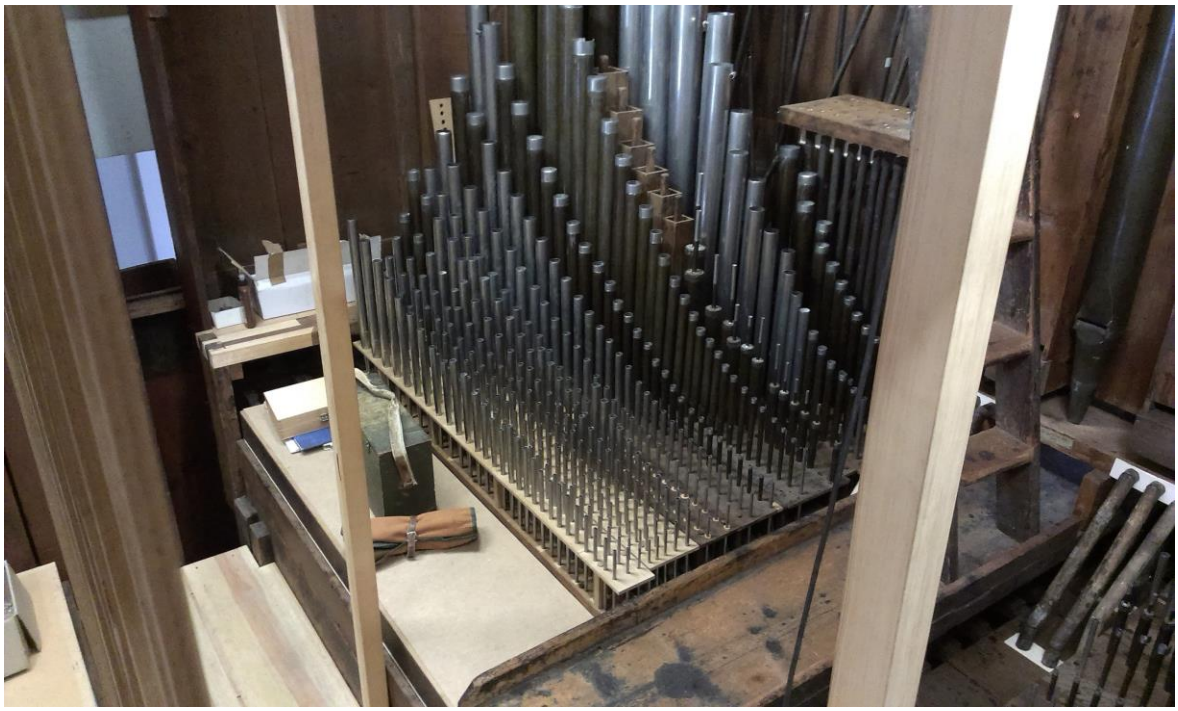
The old remaining Sesquialtra pipes are more sparingly nicked than the Front Principal and other foundation stops. There is no evidence that the frequency of nicking has been increased by subsequent re-voicing of the Front Principal. GG of the 19th ($1^{1}/_{3rd}$) rank for example has 12 nicks, compared with 18 in the equivalent pipe in the Front principal. A of the 24th ($^{4}/_{5th}$) rank has 6 nicks compared with 8 in the equivalent pipe in the Front Principal.

Details like the appropriate size of the flue for the new pipes were determined by the pipe maker's meticulous attempt to successfully copy the old pipes. Details were not copied because they are necessarily believed to be good pipe making practise. It was decided to faithfully copy the old style of manufacture to ensure a good tonal blend between the old and the new pipe work.
I discovered that if the details were applied appropriately and in the right style, the tonal finishing didn't present too much of a problem and the sound of the new pipes matched the old.

New (unvoiced) pipes from the fifteenth faithfully copied from the original Twelfth



Treble Great soundboard with reconstructed flue chorus



Voicing on site

The voicing on site is a process where an assistant at the keyboard listens to every detail of the character of the pipes within a stop. He gives instructions to the voicer inside the organ as to their loudness, technical speech and balance within the stop and context within the organ. This is a time consuming exercise which takes every bit of your attention and energy. At this stage the final length of the pipes is determined. Once this stage has been reached one is very restricted in being able to correct the loudness. If a pipe has to be made louder when it has been cut to pitch it is likely to end up too short.

The first stops voiced were the front pipes and the inside continuations of the two stops present in the front, the Front Open Diapason and the Front Principal. (so called as they are the stops placed most to the front on the soundboard)

Getting to grips with the front pipes first was a good discipline, as this showed us the boundaries of the possibilities and limitations of the old pipework. The reasonably untouched voicing of the front pipes pointed the way how to go about regulating and voicing the remainder of the inside stops.

Small Mixture

The Twelfth, Fifteenth, Tierce and Larigot are scaled and voiced alike. The Fifteenth has been given the most drive. This group of stops forms a combination which is sometimes called a “small mixture” which forms though, through its relatively wide scaling compared to the principals, a somewhat cornet like ensemble.

Mixtures

The 1735 voicing method allows the pipes to speak with an audible but gentle attack. In the mixtures there is a considerably more character in the speech which might be attributable to the sparse nicking compared to the foundation stops.

The Mixtures are because of this lighter in tone than the foundation stops but not necessarily any less loud. Listening to the organ from outside the case, these extraneous noises can hardly be heard anymore as unmusical and the full chorus sound is truly colourful and vibrant.

Recorded Flue Scales and details

These details are the actual hand written spread-sheets produced during the initial research. This shows the inscriptions of the individual pipes as they appear on each pipe. This is mostly just above or on the upper lip and the front of the foot.

The Principal of the Choir has its inscriptions on the side of the pipe next to the upper lip and underneath on the side of the foot. Also note that the style of inscriptions of the Choir Stop Diapason is showing a different hand from all the other stops in the organ. All in all, there seem to be three different hands present in the manufacture of the metal pipes.

The voicing details though, are very similar throughout the instrument with perhaps one exception. The Back Principal on the Great has chamfered upper-lips as standard, while with the other stops, this was only done when really needed (originally or later?).

Cut-ups of the Chimney flute trebles are arched and not chamfered. The cut-ups of the open pipes vary from dead-straight (or even slightly low in the middle) in the Choir Principal, and straight to moderately arched in the large pipes to slightly

more arched in the small treble pipes in the remainder of the stops. All flue-pipes have been cut up to an angle with the upper-lip which is less than 90^{o}. Large pipes more square to the upper-lip (80–85^{o}), smaller pipes under a somewhat sharper angle (75-80^{o}). It could be that this method of cutting pipes up was just a practical method to prevent the waste metal from ending up in the delicate flue area, rather than a deliberately thought out voicing method.

It has not been possible to measure exactly the languid thicknesses, as numerous languids are slightly below the top of the lower lip. A mention of thickness is given tough when it was found possible to make an accurate guess of the measurement.

Languids quite often chamfered.

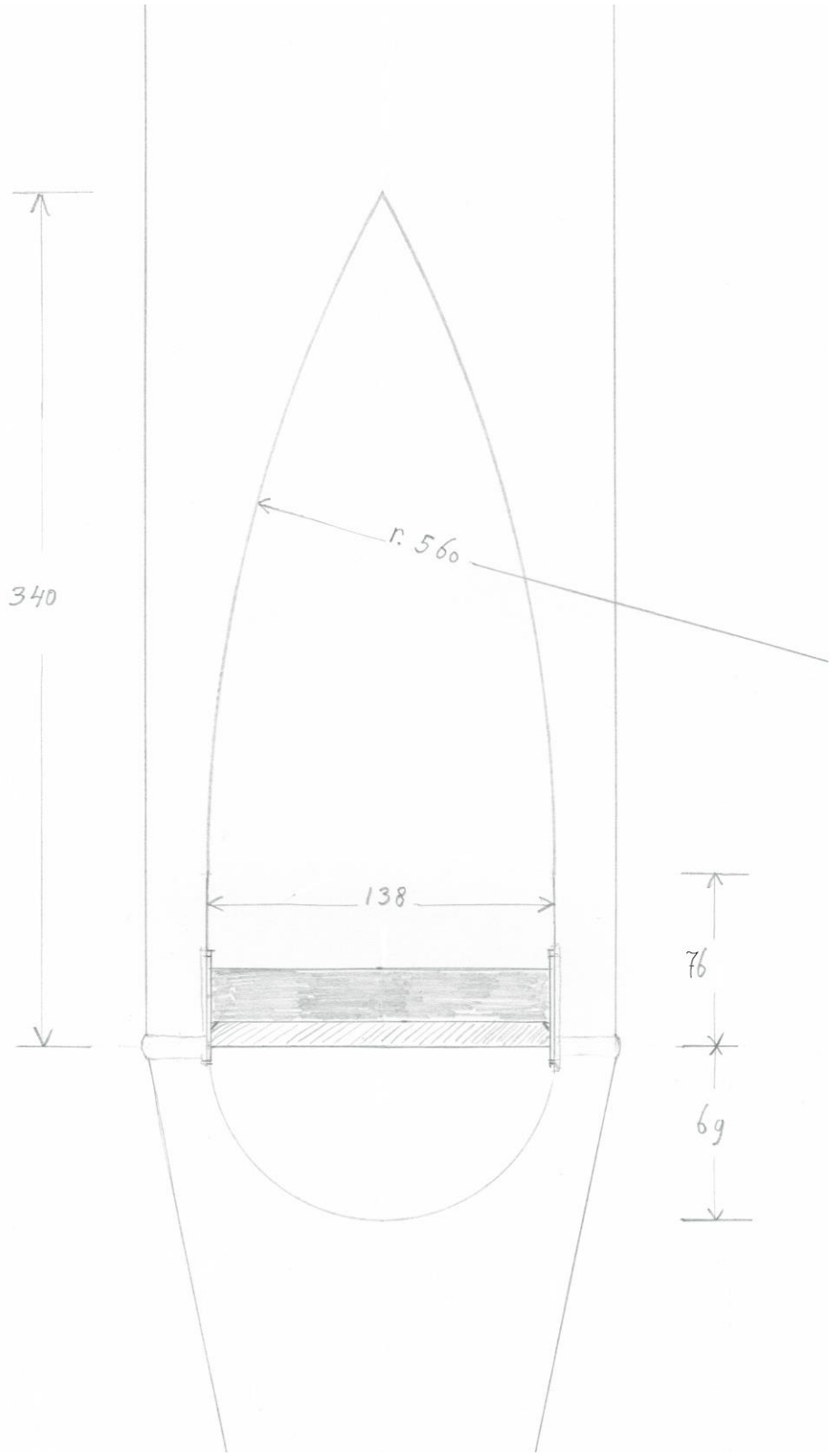
Languid th — Front pipes average

	Ø	MV	ears	CV	
GG	188	138	46(orig)	30.5	
aa	170	123.5	46 × 8.2	28.38 (31.5)	
BB	1635	121.4	44.5 × 7.7	28.3	
44	154	112	41.6 × 6.4	(30.2) 27.7	
CC	149.7	111	big	28.5 (25.7)	< 19th century pipe (remodelled)
CC*	139.2	101	38.75 × 6.4	24.35	Languid th 9.85
DD	133.7	98	38.73 × 6.4	23.75	
DD*	126.2	91.6	40.9 × 6.3	24	
EE	121	?	N.A.	23	This languid ?? orig 19.33 ? C.U.
FF	115.8	?	N.A.	19.8	
FF*	112.3	82.6	37.4 × 6.3	19.5	
G	106.6	77.8	34.5 × 5.9	19.8	
G*	101.3	73.5		19.7	
a	100	72.9	33.8 × 4.8	17.45	
B	97.2	70.72	33.35 × 4.9	17	
4	93	68.5	32.4 × 4	15.6	
C	89	64.5	31.5 × 3.2	16.1	
C*	86	62	30.7 × 3.8	14.9	
D	82.3	59.9	30.1 × 4.2	14.4	
D*	78	56.7	29.3 × 3.9	14.18	
E 5?	75.3 (71)	54.18 (51.3)	29.1 × 3.7	13.5	
F 5?			25.8 × 3.6	12.85	
F*	68.2	49.4	25.2 × 3.4	12.15	
g	65	46.2	24 × 3.6	11.9	
g* 4?	62.2	45.6	24.5 × 3.1	11.6	

average

	Ø	MW	ears	CU
GG	106.6	77.6		18.3
GG*	101.5	73.5		17.8
aa	97	69.15		17.5
BB	93.5	68	32 × 4.8	17.15
44	89.5	65	31.6 × 3.85	15.9
CC	86.5	62.5	32 × 3.8	15.9
CC*	82.2	59.5	30.4 × 4.5	14.7
DD	78.8	57.5	29.3 × 3.7	14.25
DD*	75	54.6	26 × 3.8	13.5
EE	72	51.75	26.4 × 4.3	12.8
FF	68	49.4	24.9 × 3.1	11.95
FF*	66	47.4	25 × 3.9	12.3
G	62	44.8	23.4 × 3.7	11.4
G*	60.5	43.6	23.3 × 3.1	10.7

Mouth of GG Front Open Diapason



orig. inscr. body, foot	Pipe body length	foot length	outside ∅	foot tip ∅ Fu	mouth width	thickness body	thickness foot	th languid	cut up	nr nicks
			Lt front Open							
A	654	173	58.8	7.5	42.34	0.71	1.3		10.51	
B	614	167 (S)	55.5		40.95	0.7	1.2		9.6	
✕	580	175	53.3		38.8	0.6	1.4		9.2	19
C	543	173	51.2	7.2	37.73	0.54	1.3			21
Cs	513	174	49.2		36.22	0.72	0.8		9.2	
D	483	173	47.3		34.5	0.86	0.8/09			
Ds	452	173	45.4		33.5	0.84	"			
e	431	169 (S)	42.9		31.44	0.83				
f	408	174	41.2	5.7	29.8	0.8	0.9?			16
fs	387	175	39.5		29.12	0.65	0.9?		7.1	
g	363	169 (S)	37.9		27.85		0.8			
gs	344	174	36.5		26.75	0.85	0.9			
a	324	172	35.2		25.55	0.9				
B	303	172	34		24.55					
✕	285	167 (S)	32.5		23.09	0.73	0.8			
c	269	173	31.6		22.56	0.83			5.65	
cs	255	165 (S)	30.2		21.46	0.82				
d	237	170	28.8	4.5	19.92	0.75				11
ds	220	152 (S)	27.4		19.9				4.8	
e	210	162 (S)	26.2		18.27		0.7?			
f	200	174	25.15		17.98	0.78				
fs	190	174	24.85		17.18	0.65	0.7?		4.6	
g	176	173	22.8		16.78					
gs	170	164 (S)	21.8	3.5	15	0.07			3.7	10
a	149 (S)	175	20.3	⇅ ?	14.3	0.65		wide foot narrow body?		
B	158	NA	20.9		14.6					
✕	140	175	19.5		13.66	0.66				
c	133	NA	18.6		12.71	0.68			3.44	
cs	124	NA	17.6		12.06					
d	116	176	17.25	3.2	11.7	0.54			3.35	6

Front Open Diapason. Note the narrow mouths

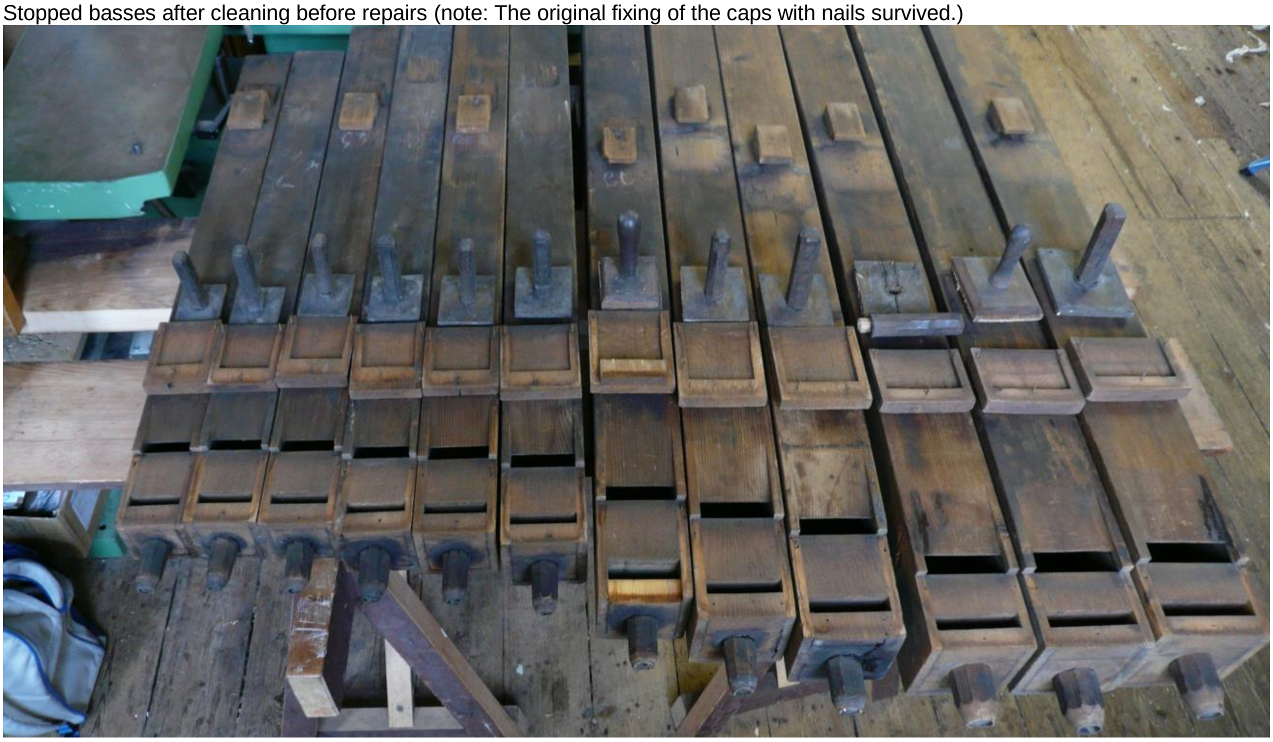
orig. inscr. body/foot	Pipe body length	foot length	outside ø	foot tip ø	mouth width	thickness body	thickness foot	th languid	cut up	nr. nicks
			GT	15	th					
GG	750	200?	59.5		45.87	0.74	1.1/1?			
G_1G_1	705	193?	57.5		44.49	0.65	1?			24
AA	660	191?	55.4		42.74	0.7	1?			
BB	618	190	53.6		41.3	0.6	1/0.9?			
☆⚹	582	187	51.3		39.71	0.62				23
Helpers			GT	~~front~~	back open		(with tayleaf			mouth)
GG	1509	291	98.3		77.45	0.78	1.1			
GG*	is old	second hand	pipe		very heavy		! marked	A		
AA	1416	243	96.4		67.3	1.67	± 2			
cAcA	1345	268	90.7		70.25	0.77	1.1?			
BB	1261	257	87.1		67.37	0.67	1.1?			
⚹⚹	1203	238	83.8		65.34	0.69				
CC	1109	239	80.3		63.14	0.81	0.9?			
C_1C_1	1068	NA	76.8		NA	0.86	NA	NA		
DD	missing									
D_1D_1	919	213	70		57.74	0.65	0.9? ~~[illegible]~~	4.9?	(scored mouth)	
EE	881	213	67		52.93	0.62	1.2?			
FF	818	201	64.1		49	0.68	0.9?			
F_1F_1	774	211	61.5		47.5	0.62	0.9?	(last helper)		
GG!	1502	244	106.3		77.7?	0.99	1.1/1.2	(scored mouth)		
AA	1336	225?	97.2		70.64	0.93	1	7.76		
B	1249	219?	93.1		67.64	0.64	1			36
D	242	150?	25.9		20.07	0.53	0.8?	2.3		
e	216	150	24		18.06	0.48	0.7?			
f_1	192	151	21.85		16.16	0.59	0.7?			
g_1	168	154	20.3		15	0.51	0.7?			
B	152	152	18.5		13.75	0.47	0.7?			

(37)

Stop Back Open [illegible]

Note	T. L.	OW	OD	IW	ID	Block			Foot oct				Cap				Cut-up	
						T. L.	upper	cut-out	tip	bottom	top	bore	length	thick	flue	cut-out	fr cap	step
GG	1622	130	147	108	121	91	46	20	28	35	43	22	89	23	1,6	8,5	26	2,6
GG#	1590	125	140	100	116	91	48	20	28	42	45	22	89	23	1,6	8,5	26	2.5
AA	1480	117	132	96	110	92	50	18	26	33	43	21	88	23	1,6	9	23	2,4
BB	1412	112	128	90	102	129	80	19	24	34	37	18	124	19	1,4	6	21	1,9
HH	1370	110	122	87	100	129	80	18	22	32	36	18	126	19	1,4	6	21	1,9
CC	1293	105	118	81	95	128	79	18	20	31	35	16	126	19	1,0	6	19	1,8
CC#	1195	98	112	77	90	106	65	15	18	29	32	14	110	18	1,1	5,5	18	1,5
DD	1140	95	110	73	87	104	63	14	20	28	30	14	100	17	1,3	5,5	17	2,4
DD#	1055	89	105	69	83	104	63	14	20	31	33	16	113	17	1,1	5,7	16	2,2
EE	1016	87	100	67	79	104	62	14	18	26	29	13	108	17	1,2	6,1	15	1,8
FF	936	84	95	63	76	103	62	14	18	24	29	14	100	17	1,4	6,-	14	1,5
FF#	930	79	92	59	72	104	62	14	17	25	28	14	107	20	0,9	5,5	13	1,8
G																		

Stopped basses after cleaning before repairs (note: The original fixing of the caps with nails survived.)



Back Open Diapason racked-in on the bench. Note that the large pipes have scored mouths

orig. inscr. body/foot	Pipe body length	foot length	outside ø	foot tip ø		mouth width	thickness body	thickness foot	th languid	cut up	nr nicks
g c	— to g	G	front	Principal			(transposed)			, cut up)	
g	in front Gis			out	in		measured at top				
A	659	200	54	10.3	7.7	41.9	0.69/+	1.1 ?	4.03	11.27/12.18/11.62	20
B	595	198	51.9	11.3	6.94	40	0.6/+	1. ?	NA	10.3/10.59/10.6	22
H	564	193	49.8	10	7.7	38.5	0.52/+	0.93?	3.9 ?	11.24/11.17/11.6	22
c	531	195	47.7	10.21	6.86	36.85	0.5/+	?	3.62?		
cis	502	186	46.7	NA	NA	35.7	0.53/+	0.9 ?	NA		18
d	472	185	43.5	9.5	NA	33.55	0.61	0.75	NA		
dis	443	184	42	9	NA	32.7	0.61	0.75	2.95?		
e	416	172	40	NA	NA	30.9	0.55	0.9 ?	NA		
f	vrrellvaut	175	38.5			29.28	0.64	NA	2.96		⌒
fis		175	36.6			28.05	0.5	NA	NA		16
g		175	35.3			27.1	0.6	0.84?	NA		
gis		174.	34			25.5	0.5	NA	NA		
a		173.5	32.7			24.9	0.64	NA	NA		
B		175.5	31.1			24.3	0.57	NA	NA		
H		176	30.2	8.8	5.8	23.22	0.58	NA	NA		
c		174.5	29.			22.09	0.54	NA	NA		13
cis		176	28	8.8	5.22	21.2	0.56	NA	NA		
d		174	26.8			20.6	0.54	NA	NA		
dis		173	25.5	8.7	4.7	19.37	0.51	NA	NA		⌒
e		175	24.4	8.3		18.46	0.51	NA	NA		
f		176	23.4	8.23		17.4	0.51	NA	2.11?	↑	
fis		176	22.3	7.8		10.8	0.5	NA	1.98?		12
g		170	21.2			15.9	0.45	NA	NA	ears	
gis		176.5	20.2			15.05	0.43	NA	NA	no ears?	
a		176	19.45			14.55	NA	NA	2 ?		↓
B		177	18.5			13.7	0.4	NA	1.8 ?		
H		176	17.7			13.04	0.45		1.75?		
c		176	17.2	7.7	4.75	12.84	0.45	NA	NA		8
cis		174	16.6			NA		NA	NA		
d		177	15.1			12.07	0.43				
dis	missing										

Front Principal

orig. inner body/foot	Pipe body length	foot length	outside ϕ	footing ϕ out	footing ϕ in	mouth width	thickness body	thickness foot	Th tongue	cut up	rivets
e		176	14.7	7.42	3.84	11.08	0.42	~~0.48~~	1.48		
f		176.5	14.3			10.7			1.47		
fr		176	13.5			10.4	0.43		1.48		5
g		174	13.05	7.15	4.22	NA	0.47?				
gr		174	12.55			9.16	0.43				
a		174	12.2			9.01	0.43				
B		174	11.8	7.1		8.31	0.35				
X		172.5	11.57	6.77		8.4	0.41		1.3?		
C		175	11.25			8.5	0.42				
D		174	10.7	6.7	3.3	8	0.?				4
Dr	missing V										

orig. impr. ~~body~~/foot	Pipe body length	foot length	outside ∅	foot ∅	mouth width	thickness body	thickness foot	th. languet	cut up	nr. nicks
			Back principal							
on foot						upper lip				
GG	1502	?	106.4		81.9	1.3/2		?	18.66	
G☆G☆	1427	285?	103.3		80.3	0.92/1.73		?		
aa	1351	?	~~99.7~~ 94		72.3	1.06/1.72		?	17.33	
BB	1261	281	91.5		70.66	0.93/?				
☆☆	1207	?	83.2		63.7	1.1				
CC	1131	257	81		62 65	0.88				
C☆C☆	1070	260	76.3		59.6	1			1	
DD	1005	258	72.8		54.2	1				
D☆D☆	940	259	71.9		55.16	0.96			12.5	
CC	903	243	66.8		51.5	0.94			12.39	
HH	841	242?	64.6		50.6	0.88				
H☆H☆	796	235	61.5		47.6	0.82				
GG	750	235	58.9		45.5	0.7			11.1	
G☆G☆	709	234	54.9		42.2	0.89			10.65	
aa	668	235	53		41.3	0.83				
BB	627	225	50.8		38.8	0.77				
B☆B☆	596	224	49.2		38	0.83		3.44		
CC	558	215	47.8		37.9	0.9			9.2	
C☆C☆	523	212	46.3		35.78	0.65				
DD	495	213	43.5		33.55	0.58		3.15	8.41	
D☆D☆	466	211	41.6		32.46	0.58				
EE	438	212	40.1		29.9	0.67				
FF	408	212	38.7		30.1	0.74		2.66		
F☆F☆	388	204	37.1	10.5/6.22	28.99	0.74			6.65	
GG	364	204	35.9	9.9	27.3	0.78		2.62		
G☆G☆	346	193	34.1		26.24	0.6		-		
aa	325	193	33.15		24.78	0.72		2.51?		
BB	302	190	31.7		23.23	?		2.4?	5.74	
AA	286	192.5	30		23.14	0.56				
CC	270	187	29		21.9	0.51		2.6	5.42	

orig. inscr. body/foot	Pipe body length	foot length	outside ø	foot lip ø	mouth width	thickness body	thickness foot	thickness tongue	cut up	nr nicks
			Back principal.							
C✕	254	187	27.9	9.5	20.68	0.58				
D	244	185	26.8		20.62	0.5				
D□	225	186.5	25.9		19.18	?			4.88	
E	215	186	24.3	9	18.53	0.43				
F	203	188	23.4	8.35/4.76	18.37	0.5				
F□	192	187	22.9	8.3/4.51	17.72	?			4.34	
G	181	187	22.2		17.34	0.58				
G◇	172	185	20.74	7.5	16.1	0.57			4.5	
A		186	19.83		15.47	0.53				
B	150	185.5	19.23		15.19	0.53				
K	145	187	18.25	7.1/4.13	14.2	0.53		1.454	? 4.06	
C		187	17.7		13.91					
C✕	127	186.5	16.9		12.99					
D	119	186	16.34		12.50				3.35	
D□	110	185	15.4	6.5/3.9	11.54	0.63		1.47?		
E	106	186	14.65		11.25	0.52				
F	101	186	13.67		10.69			1.59	2.99	
F□	95	186	13.2		10.02	0.61			2.85/2.96	
G	86	184	12.45	7.3	9.4	0.63				
G□	84	183	12.1		9.0					
A	78	184	11.36		8.4	0.77			2.3/2.39	
B	73	183	11.1		8.3					
K	69	?	10.8		8.5V	0.65			1.84/2.37	
C	655	184	10.68		7.57				2.17/2.45	
C✕	missing		10.5	missing		▽				
D	missing		10.2	missing		▽				

Back Principal racked in on the bench. Note the long feet in comparison with the other flue pipework.

orig. inscr. body/foot	Pipe body length	foot length	outside ⌀	foot tip ⌀	mouth width	thickness body	thickness foot	th languid	cut up	nr sides
			G		12 th					
						at top			10.8	
AA	845	211	67.7		52.16	0.71	1.2?	foreign old pipe		
HH	789	209	62.25		48.89	0.67	1?		11.6	27
CC	739	210	59.8		46.7	0.67	0.8?		11.8	
Cis Cis	696	193?	57.45		44.5	0.7	0.8?	foreign old pipe	9.3	
DD	660	201	55.5		42.8	0.56	0.9?		11.25	
Dis Dis	610	189	53.6		41.04	0.7	0.9/1?	4.2?	10.77	
EE	584	185	51.5		39.87	0.62	0.8		10.3	26
F	548	182?	49.7	<	38.42	0.6	0.9/1		9.6	22
Fis	519	181	47.7		36.63	0.53	0.8		9.45	
G	490	181	46		35.4	0.61	0.8		9.38	
Gis	464	177	43.8		33.24	0.68	1.1		N.O.	
A	436	178	42.2		32.99	0.65	1		8	
B	406	176	40.6		31.7	0.65	1.1		8.1	
H	389	166?	~~37.2~~	39	29.95	0.57	0.8		7.36	16
C	366	174	~~37.6~~	37.5	28.97	0.58	0.8	2.7?	N.O.	
Cis	343	176	36.3		27.74	0.61	r	4	7.37	
D	321	175	34.8		26.65	0.58	+		6.2/6.8	
Dis	304	174?	33.3		25.07	0.61	0.8?		6.6	
E	288	172?	32.4		24.3	0.65	0.8/0.9?		6.2	15
F	269	172?	31.4		23.75	?	?		5.85	
Fis	255	?	29.4		22.67	0.61	0.8?		5.3	
G	238	173?	28.6		21				5.6	
Gis	227	177	27.1		20.45	0.44			5.35	
a	215	175	25.9		19.6	0.5	0.8		5	
b	201	176	24.7		18.5				5.23	
h	192	173	23.4		17.8				4.95	11/12?
c	180	175	22.6		17.14	0.54	0.8?	1.77?	4.4	
cis	170	170	21.7		16.42				4.65/4.5	

orig. inner body/foot	Pipe body length	foot length	outside ϕ	foot ϕ	mouth width	thickness body	thickness foot	thickness flange/rim	cut up	rivets
			G 12th			at top				
b	159	166	20.7		15.77	0.46	0.7/0.8		4.45	
b	151	167	20		15.4			1.75?	4.35	
c	141	166	19.45		14.61				4.15	10
f	133	158?	18.5		13.95	0.52			3.75	
f	123	153	18.15		13.28	0.51		1.57?	3.97	
g	114	152	17.3		13.13	0.35	0.7?		3.48	
g	112	153	16.68		12.34	0.32			3.59	
a	104	152	16.12		12.06	0.4	0.7?		3.50	
B	96	152	15.35		11.24	0.5			3.23	
A	92	152	15.1		11.15			1.41?	3.5	7
C	84	152.5	14.55		10.81				2.91	
C	79	152	13.8		10.8				3.1	
E	72	151	13.5		9.88	0.46			lower cut up ??	
D	71.5	151.5	13.1		9.39	0.41		1.15?	2.49	
c	66	152	12.55		9.3				2.6	7
f	missing									
f	56	152	11.65		8.43				2.4	
g	54	152	11.35		8.1				2.25	
g	52	152	11.1		8.23				2.3	
a	48	152	10.9		7.91				2.3	
b	44	152.5	10.5		7.7				2.2	
A	41	152	10.35		7.22				2	4
C	38.5	152	9.9		7.10				1.74	0
C	35	150	9.75		7.03				N.A.	0
b	missing									0

The pipes of the 12th racked-in on the bench

orig. inner body, foot	Pipe body length	foot length	outside ø	foot ø	mouth width	thickness body	thickness foot	th. lanyard	cut up	no. nicks
			Gt Sesqui.							
GG 1	494	176	43.6		32.9	0.63	1?			12
GGn AA	462	174	41.7		31.64	0.55	1			11
↓↓	436	177	40.1		30.07	0.55	0.8?	19th		11
BB	410	172	38.2		28.7	0.6	0.7			12
XX	389	176	36.8		27.36	0.53	0.7			10
GG 2	368	173?	35.3		26.44	0.64	0.7			11
GGn	344	166	34		25.3	0.62	0.8			10
AA	324	172	32.6		24.16	0.56	0.8	22nd.		10
BB	303	166.5	31.3		23.17	0.66	0.9/1?			9
XX	292	170	30.2		22.9	0.67	0.7/0.8			9
GG 4	243	160	26.1		19.4	0.61	0.7	26th		8
bb	161	153	19.3		14.13	0.47	0.5/0.6			7
bb	47 (S) (short)	NA (lengthen to bottom O of 29th.)	15.9		11.7			29th		6
A	42 (S) (short)	152	16.7		12.5			17th or	24th	6
X	106.5 (short)	152	15.25		11	0.39				6

inner	body length	foot length	outside ⌀	chimney out ⌀	thickn. chimney	mouth width	thickness foot	nr of nicks	cut up L	M	R
			5?? G	Stopt.							
g	374	191	60	15	0.41	46.6	1.3				
g#	360	198	57.2	14.5	0.49	43.95	1.2				
a	357	193	55.4	14	0.5	42.[illegible]	1.3				
B	313	197.5	53.1	13.3	0.56	40.94	1.2				
✕	295	194	51.3	12.7	0.49	38.8	1.2				
c	275	188	49.3	12.4	0.55	37.3	1/0.9	16 v. slanted	9.1	11.8	9.4
c#	260	187	47.	12.28	0.49	35.83	1				
d	248	187	45	11.95	0.5	34.4	1.1/1.2				
d#	224	184	43.3	11.65	NA	33.11	0.9 ?				
e	215.5	182.5	41.4	11.21	0.51	31.7	1.2				
f	204.5	184	39.8	10.63	0.51	29.95	0.9 ?				
f#	194	181	38.	10.22	0.49	28.85	0.[illegible]	15 V. slanted	7.92	9.53	7.52
g	180	180	36.5	9.97	0.44	27.4	1 ?				
g#	174	181	35.1	9.73	0.46	26.16					
a	158	181	33.8	9.47	0.35	25.57	1 ?				
B	148	180	32.7	9.03	0.41	24.22					
✕	138.5	178	31.9	9	0.34	24.06	0.9 ?				
c	129.5	178.5	30.5	8.7	0.42	23.0[illegible]	0.9	15, sl. less slanted	5.98	7.73	6.26
c#	121	177	29.4	8.25	NA	21.9					
d	114.5	177	28.5	8.2	0.39	20.92					
d#	107.5	176.5	27.06	8.1	NA	20.49					
e	104.5	176.5	25.67	7.6	0.4	19.06	0.9				
f	97.	175.5	24.84	7.68	0.4	18.76					
f#	93.5	176	23.8	7.42	0.43	17.74	0.8 ?	11 less slanted	4.96	5.45	4.75
g	88.0	176	22.98	7.4	0.41	17.71					
g#	82.5	176	21.72	7.08	0.41	16.25	measured on	score lines			
a	76	176.5	21.27	6.89	0.53	15.6					
B	70.5	177	20.65	6.95	0.45	15.21	0.8				
✕	69.5	177	19.85	6.8	0.43	14.6					
c	63.75	176	19.2	6.73	0.39	13.75		9 ditto	3.84	4.52	3.82
c#	59.5	176	18.5	6.54	0.40	13.85					
d	53	177	17.95	6.35	0.5	13.25					

Stop Great Stopl oliaparson Spitalfielol

Note	T. L.	OW	OD	IW	ID	Block			Foot oct(12)				Cap				Cut-up	
						T. L.	upper	cut-out	tip	bottom	top	bore	length	thick	flue	cut-out	fr cap	step
GG	1595	160	172	134	151	89	50	17	30	44	48	25	85	27	2,-	10-	30,-	2,3
GG#	1585	155	158	130	137	90	51	18	29	46	50	25	85	27	1,9	10-	29,-	2,3
AA	1430	140	152	120	130	87	50	14	31	41	43	25	84	28	1,9	11,-	25,5	2,-
BB	1425	140	150	117	129	88	52	16	31	44	44	25	86	27	1,9	9-	27	1,9
H	1305	141	145	117	121	86	49	18	31	40	40	25	87	25	1,8	8,3	27	1,5
CC	1230	135	142	110	119	86	49	17	28	38	40	23	86	27	1,7	8,5	25	1,4
CC#	1230	125	132	103	111	76	41	15	27	36	38	22	76	23	1,4	9-	21	2,5
DD	1076	118	131	99	111	75	44	13	27	35	36	22	76	20	1,5	8,-	15	2,5
DD#	1094	113	126	93	106	76	43	14	25	35	37	20	76	22	1,5	7,-	20	2,2
EE	1025	110	119	90	110	76	44	13	26	33	36	21	76	21	1,5	7,-	19	2,2
FF	962	105	116	85	95	70	40	13	27	32	34	21	70	20	1,3	9,-	20	1,5
FF#	915	102	112	81	92	69	40	13	22	30	32	18	69	20	1,4	7,5	19	1,7
G	840	99	110	78	88	78	46	10	18	26	37	15	78	17	1,5	10-	16	1,7
G#	810	94	107	74	86	78	45	11	17	25	34	14	78	17	1,4	9-	15,5	1,6
A	764	90	103	71	82	77	45	10	17	24	34	14	77	17	1,2	9-	15	1,6
B	719	85	97	66	77	77	46	11	19	23	34	14	77	16	1,2	6,5	15	1,6
H	676	82	92	64	74	72	41	11	18	24	34	14	72	17	1,4	9-	14,5	1,6
c	637	76	89	59	72	71	41	10	17	24	34	14	71	14,5	1,-	9-	13,5	1,5
c#	612	72	84	56	67	71	41	10	18	23	33	14	72	14,5	1,-	9-	13,-	1,9
d	580	70	80	54	64	71	41	10	18	23	31	13	71	13,5	1,2	9-	12,-	1,9
d#	550	68	75	52	59	71	41	11	16	20	30	12	70	13	1,2	9,-	11,-	1,9
e	530	65	74	50	59	70	40	10	16	21	31	12	70	13	1,-	8,5	10,-	2,-
f	497	62	71	46	56	71	41	10	16	20	30	12	72	13	1,-	9,-	10,-	1,9
f#	474	60	69	44	53	71	41	10	16	20	29	12	71	13	1,1	8,5	12,-	1,6
g																		
g#																		
a																		
b																		
h																		

inner	body length	foot length	outside Ø	chimney out Ø	thickn. chimney	mouth width	thickness foot	thickness languid	nicking
c	273	202	47.4	12.38	0.77	33.65	1.1/1.2	3.4?	16
cs	261	202	44.8	11.55	0.6	31.7	1.2		14
d	247	196	42.6	11.2	0.57	30.07	1		18
ds	230	201	40.2	10.58	0.68	28.8	1.1?		18
e	217	202	39.	10	0.58	27.46	1.2?		15
f	200	201	37	9.62	0.65	26.5	0.9		14
fs	100	201	35.8	9.48	0.59	24.74	1.1		15
g	176	201	33.8.	9.04	0.57	25.1	1		15
gs	172	200	32.4	8.65	0.56	23.45	8.8		13
a	missing		31						~~13~~
b	148	200	29.4	7.9	NA	20.94	0.8		12
h	141	196	29.	7.66	0.47	20.4	1		13
c	130	201	27.5	7.30	0.47	19.51	0.8		12
cs	125	201	26.2	7.1	0.57	19.27	0.9		12
d	117	200	25	7.1	0.38	?			11
ds	109	201	23.5	6.6	0.46	17.05	0.7?		9
e	102	202	23.3	6.3	0.42	16.84	0.8		10
f	96	200	22.1	6.15	0.42	15.7	0.7		9
fs	91	201	21.6	5.75	0.45	15.18	0.7		12
g	83	200	20.6	5.7	0.62	15.1			9
gs	79	201	19.8	5.0	NA	14.75			8
a	74	201	19.1	5.7	NA	14.01	0.6?		9
b	68.5	201	18.65	5.28	NA	13.5			9
h	64.5	202	18.22	6.72?	NA	12.75	0.7/0.8?		9
c'''	missing		17.3						
cs	59	201.5	16.67	7.34	0.61	11.05			7
d'''	missing		16.2						

Choir Stopped
length of body is including thickness of top disc.

Stop Stopt Diapason Spitzflöl

Chor

Note	T. L.	OW	OD	IW	ID	Block			Foot oct				Cap				Cut-up	
						T. L.	upper	cut-out	tip	bottom	top	bore	length	thick	flue	cut-out	fr cap	step
GG	1556	160	173	137	148	88	50	16	31	41	47	24	87	23	1,5	9,5	28,5	2
GG#	1474	150	161	125	138	85	50	14	30	41	44	22	87	26,5	1,5	10,5	27,-	2
AA	1420	142	155	120	134	82	49	13	29	38	40	22	80	26,5	1,5	8,5	27,5	2
BB	1294	135	151	117	128	80	48	13	29	39	41	21	80	26,5	1,5	8,5	26,5	1,8
H	1294	138	150	112	124	95	48	20	25	35	38	18	92	23,-	1,5	9,5	24,5	2
CC	1200	131	142	112	122	79	45	14	27	34	37	21	79	24,-	1,2	9,-	17,-	2
CC#	1129	123	137	104	117	74	43	12	25	34	35	20	74	24,-	1,5	7,5	21,3	2
DD	1076	118	130	98	111	74	44	12	27	33	35	21	76	20	1,4	8,5	15,5	2,5
DD#	989	115	125	96	106	74	43	13	24	33	35	19	74	19,5	1,2	8,-	16,-	2,-
EE	938	107	117	90	102	75	46	12	20	26	26	17	74	18,5	1,7	7,5	18,-	2,-
FF	884	101	114	84	96	67	39	11	19	25	28	16	67	19	1,3	7,-	19,-	1,9
FF#	848	97	107	80	92	67	42	10	19	23	27	17	68	18,5	1,1	7,5	18,-	1,9
G	809	92	102	77	86	69	43	09	19	25	29	15,5	67	18,5	1,1	7	17,-	1,6
G#	817	89	99	73	83	68	43	10	26,5	23	34	18	67	21,5	1,5	6,5	16,5	1,9
A	771	86	93	69	77	66	39	11	26	22	35	18	64	18,-	1,5	7	15,5	1,9
B	694	80	90	64	75	65	39	11	20	16	27	12	63	16,-	1,4	5,5	14,5	1,9
H	660	76	86	62	71	65	39	11	21	17	26	12	65	16,5	1,1	7	14,5	1,9
c	660	73	83	59	70	62	37	11	21	18	27	12	64	16,-	1,1	5,7	13,5	1,9
c#	630	69	79	57	66	64	38	10	19	17	25	12	64	14,5	1,1	6	12,5	1,9
d	590	68	77	54	64	60	37	9	20	17	26	10	60	14,5	1,1	5,7	11	1,4
d#	523	64	72	51	60	60	36	9	19	17	25	10	60	14,5	1,1	5,4	10,3	1,4
e	484	63	72	48	58	59	36	9	18	16	25	9	60	14	1,1	5,5	10,3	1,4
f	470	60	70	45	55	58	36	8,5	18	15	22	9	58,5	14,5	1,1	5,5	8,5	1,4
f#	452	57	65	43	52	58	35	9	18	15	22	9	58	13,5	1,1	5,5	8,5	1,4
g	419	55	64	41	50	59	38	8	ϕ 16	ϕ 12	ϕ 18	10	58	13	1,-	5,5	8,5	1,5
g#	408	52	61	39	48	58	37	8	18	15	22	9	57	11,5	1,1	5,-	8,5	1,4
a	387	51	59	38	45	58	36	8	17	14	20	7	58	11,-	1,-	5,-	8,-	1,5
b	354	49	58	35	46	58	37	7,5	16	14	20	7,5	58	10,5	1,-	4,5	7,5	1,5
H	342	46	55	33	42	58	37	7,5	16	14	19	6,5	57	10	1,-	4,-	6,5	1,5
c'																		

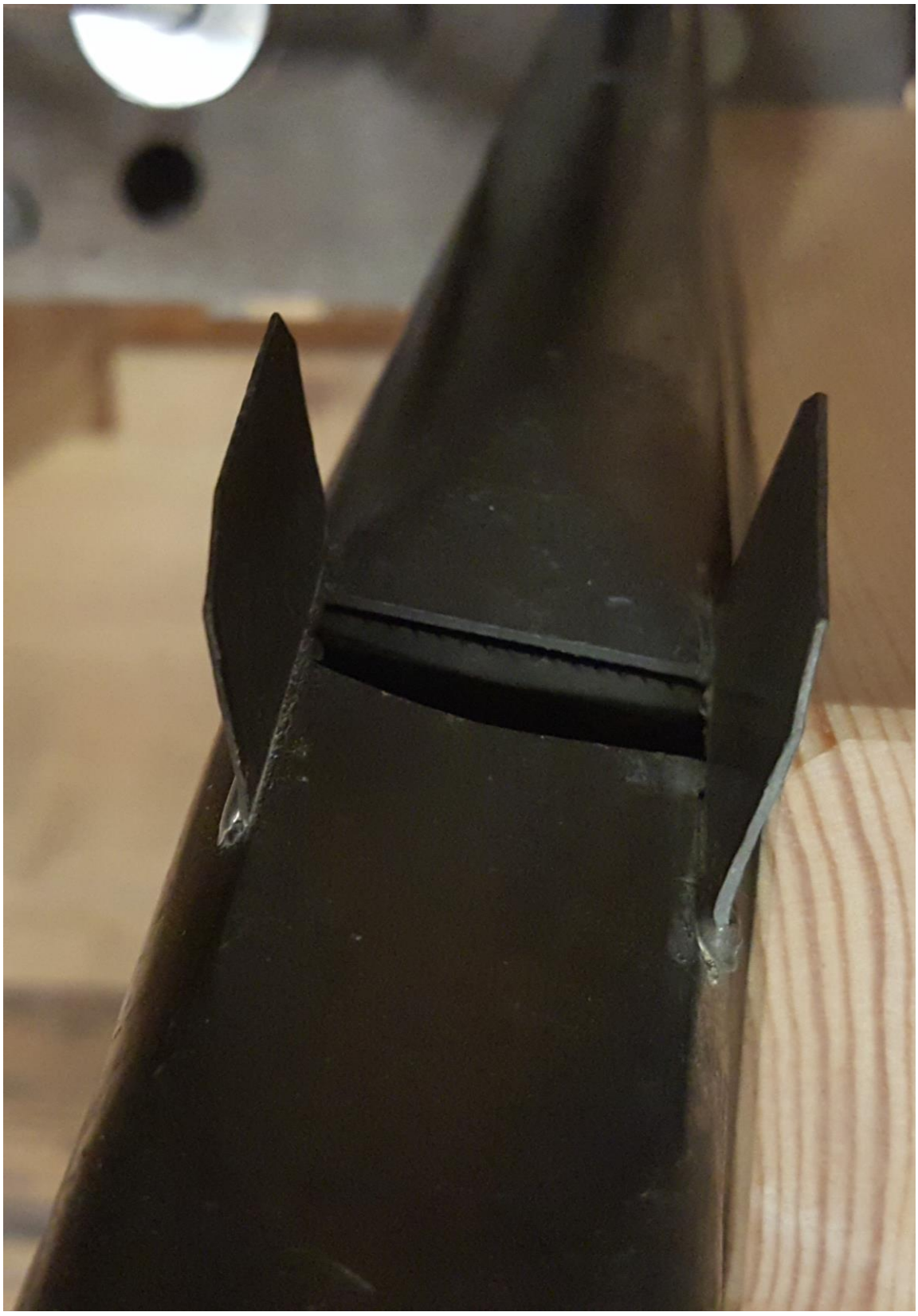
Stopped basses after restoration (The caps were re-fixed using original nails where possible.)

Voicing detail of the inside of the caps

Original cut-ups and bevels on the blocks

Mouth shape of f$^{\#'}$ of the Choir Stop Diapason. Note: the ears are positioned very close to the scoring

Voicing details. Note the relatively generous flue (for a stopped pipe)



Stop flute ch spital

Note	T. L.	OW	OD	IW	ID	Block			Foot ϕ				Cap				Cut-up	
						T. L.	upper	cut-out	tip	bottom	top	bore	length	thick	flue	cut-out	fr cap	step
GG	848	73	81	57	66	66,5	40	8	19	15	24,5	11,5	67	15,5	1,5	7,-	12,5	1,4
GG#	779	70	78	54	62	67	41,5	8,5	17	15	24	11,-	67,5	16	1,3	7,-	11,5	1,3
AA	757	66	72	51	60	67	40,5	8,5	18	14	24	11,-	66,5	16	1,3	7,5	11,-	1,8
BB	716	64	70	50	56	66,5	40,5	8,5	17	15	24	11,-	67	16,5	1,4	7,-	10,5	1,6
HH	683	62	69	47	55	66,5	40,-	8	17	15	23,5	10,-	66,5	16,5	1,3	7,5	10,-	1,6
CC	649	60	68	46	54	66	39	8	16,5	14	23	10,-	66	15	1,3	6,-	10,-	1,4
CC#	612	60	67	45	53	60	33	9	16,5	13	22	9,-	61	15	1,4	6,-	9,5	1,4
DD	581	56	63	43	51	60	34	8	16	13	21,5	9,-	60	15	1,1	6,5	9,5	1,3
DD#	548	55	62	42	48	60	34	8,5	16	14	21,5	9,5	61	14,5	1,-	5,5	9,2	1,3
EE	530	53	60	40	47	59	34	8	15	13	21	8,-	59	14,5	1,1	5,5	9,2	1,3
FF	489	52	57	39	45	56	33	8,5	15	12	21	9,-	57	14	0,9	5,9	8,5	1,3
FF#	468	51,5	57	38	43	56	32,5	8,5	15	13	20,5	9,-	57	14	1,2	5,8	8,2	1,3
G	448	50	56	37	43	56	34,5	7,-	14	12	19	8,-	57	11,5	1,-	5,5	8,2	1,-
G#	425	49	54	36	42	56	35	7,-	14	12	19	7,5	56	13	1,1	5,5	8.8 ~~7,4~~	1,9
A	470	~~47,5~~	~~53,5~~	34,5	40.5	55	34	7	14	12	19	7,5	55	12	1	5,5	7,3	1,6 NEW
B	380	46	51	33	39	55	33	7,-	13,5	11,5	18,-	7,5	55	12	0,8	5,5	8.2 ~~7,2~~	1,6
H	360	44	48	32	36	55	33	7,-	13,5	10,5	18,-	7,5	55	11,5	0,8	5,4	8 ~~7,-~~	1,6
c																		

orig. inner body/foot	Pipe body length	foot length (S) = short	outside ϕ	foot tip ϕ	mouth width	thickness body	thickness foot	Th language	cut up	nr nicks
			Chor		Principal					
GG	1530	2	102	1.2	74.53	2	1.2/1.3			
GG	1425	2035	98.8	1.2	72.48	0.82	1.8	foreign pipe		bit old
AA	1345	2005	94.2	1.0	69.7	1.02	1.2			
BB	1252	191 (S)	90	1.0	65.25	0.97	1.5			
HH	1192	195	87	1.2	64.3	0.83	1.3			25
FF	832	193	65.2	1.2	46.96	0.78	1.2			25

inner	body length	foot length	outside Q	channel out Q	channel thickness	mouth width	thickness foot	thickness lanyard	cut up	no of nicks
				SW Stop						
g°	missing									
g	missing									
a	160?	170	31.1	10.5	0.54	?	0.8?	1.9?		14
b	missing									
f	missing									
c	missing									
C_L	124	178	26	8.95	NA	19.9	0.9		5.5/6.5	13
D	116	179	25.1	8.57	0.63	18.6	0.9		5/6	12
D_L	108	176	24.3	8.55	0.48	18.48			4.95/5.9	13
E	104	177	23.6	8.11	NA	17.84?	0.8?		4.45/6.1	11
F	98	175	22.6	8.17	NA	17.3			4.45/6	12
F_L	93	178	22.15	7.87	NA	16.2	0.8		4.2/6	11
G	89.5	178	21.28	7.7	NA	?			4.05/5.43	12
G_L	~~89~~ 80	178	20.5	7.57	0.55	14.85?	?		3.84/4.35	11
A	76	178	19.95	7.45	NA	14.86	0.7?		3.47/5.0	11
B	69	178.5	19.42	7.15	NA	13.7	0.7?		3.38/4.8	9
X	66.5	177.5	18.65	7.25?	0.61	14	?		3.37/4.55	10
C	62	177.5	17.95	7.05?	NA	13.4			3.35/4.55	9
C_L	58	178.5	17.6	6.8	NA	13.04	0.8		3.13/3.8	9
D	55	178.5	17.1	6.78	0.58	13			3.25/4.25	8
		length of body including top disc thickness								
				SW flute 4' c** and d'					3	
C_L	60	176.5	16.05	6	?	12.3?			3.2/4.07	8
D	56	178	15.4	5.77	0.57		0.7?		2.95/4	9

Reed research, scales + details

The reed pipes have been through a rough time over the years. Pipes from Trumpet and Clarion stops from both Great and Swell have been interchanged, re-scaled, etc. and used just about anywhere in the organ where felt appropriate.

The original Bridge pipes were contained in the following stops:

On the Great	Contra Fagotto 16' (from G)
	Clarion 4'
On the Swell	Contra Fagotto 16' (from c^{o})
	Clarion 4'
On the Choir	Bassoon/Hautboy 8'
	GG - ## 3 Vochumane pipes and 2 Cremona pipes

After lengthy analyses this pipework was found to belong to the following original stops:

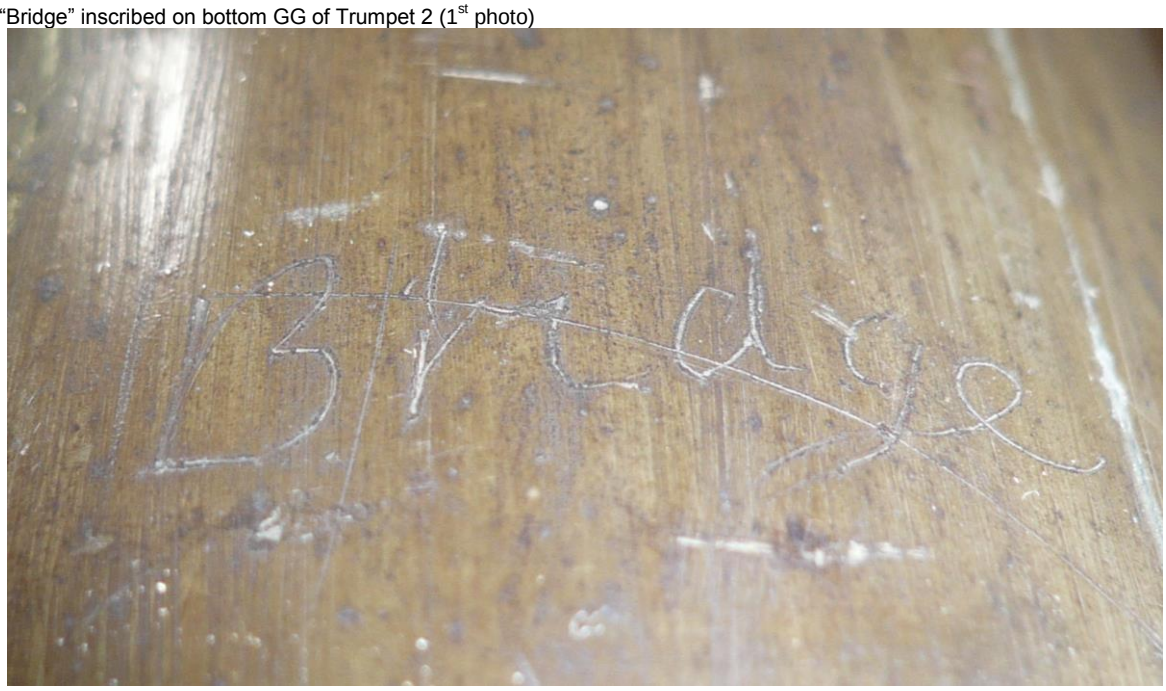
Great	Trumpet I	(43 pipes)
	Trumpet II	(33 pipes)
	Bassoon	(11 pipes)
	Clarion	(39 pipes)
Choir	Cremona	(2 pipes)
	Vochumane	(3 pipes)
Swell	Trumpet	(22 pipes)
	Hautboy	(27 pipes)
	Clarion	(14 pipes)

The nearly complete original Hautboy prior to restoration (note broken tips and later added lids)

Bridge inscription

During the sorting out of the reed pipes into their appropriate stops it was discovered that the bottom CC of the second Trumpet had an interesting inscription. This is the only place in the organ where Bridge's name is evident.

"Bridge" inscribed on bottom GG of Trumpet 2 (1st photo)

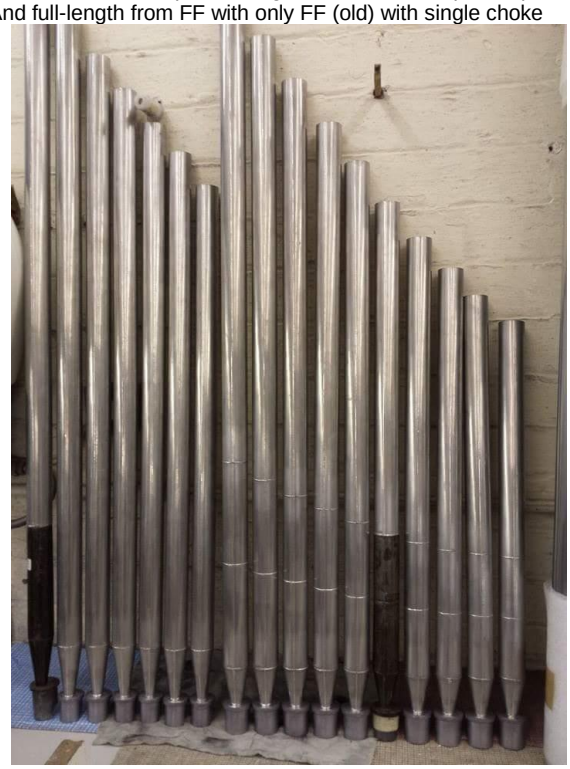


Bridge inscription (2nd photo)

Inscription of note on CC of second Trumpet

The Vochumane old and new

Cremona GG-EE quarter-length double chokes (CC old)
And full-length from FF with only FF (old) with single choke



The Trumpet nr 1 with its partly original stay

In some cases small differences in scale and partly obliterated inscriptions were the only pointers as to what stop a pipe might belong to.
The Great Clarion was the easiest stop to sort out as all the pipes belonging to this stop are inscribed with a sizable letter C. Whilst restoring the Clarion upperboard, it became likely that the top octave was originally repeated at 8 foot pitch. The original large reed toe holes had been covered with mahogany veneers in order to take flue pipes instead of reed pipes. These were removed and a new top octave was made.
The next breakthrough happened after ignoring all misleading “later” inscriptions I found that an almost complete set of Trumpet pipes were inscribed with a small number 2.
If this was indeed the second Trumpet then there must be a Trumpet number 1.
The left over pipework turned out to be of three different scales.
The largest of these was another almost complete Trumpet slightly larger scale in the treble than Trumpet number 2. One pipe, middle c, carries the inscription Trumpet nr 1.
The next scale down is very similar to the Trumpet nr 2. I believe this to be the Swell Trumpet. The pipes left over are smaller than the Swell Trumpet but larger than the Great Clarion. I believe this to be the Swell Clarion.

Repair

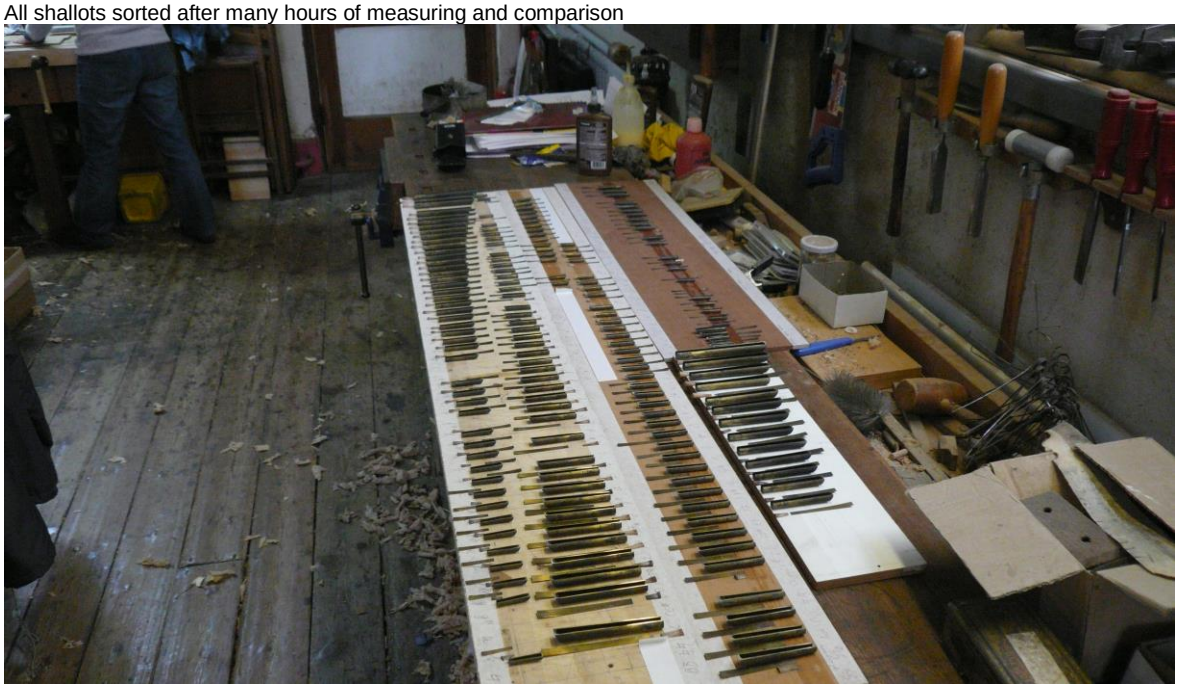
Earlier lengthening has been removed because inappropriate metal thicknesses and taper were used in previous alterations.
Many tips were buckled and bulging slightly just above the block. Also special attention was given to tips showing metal fatigue.
Some resonators were lengthened at the tip in order to restore the original tip diameter.

The restored Swell reed chorus being voiced by Michael Blighton (note the top 8^{ve}repeat in the clarion

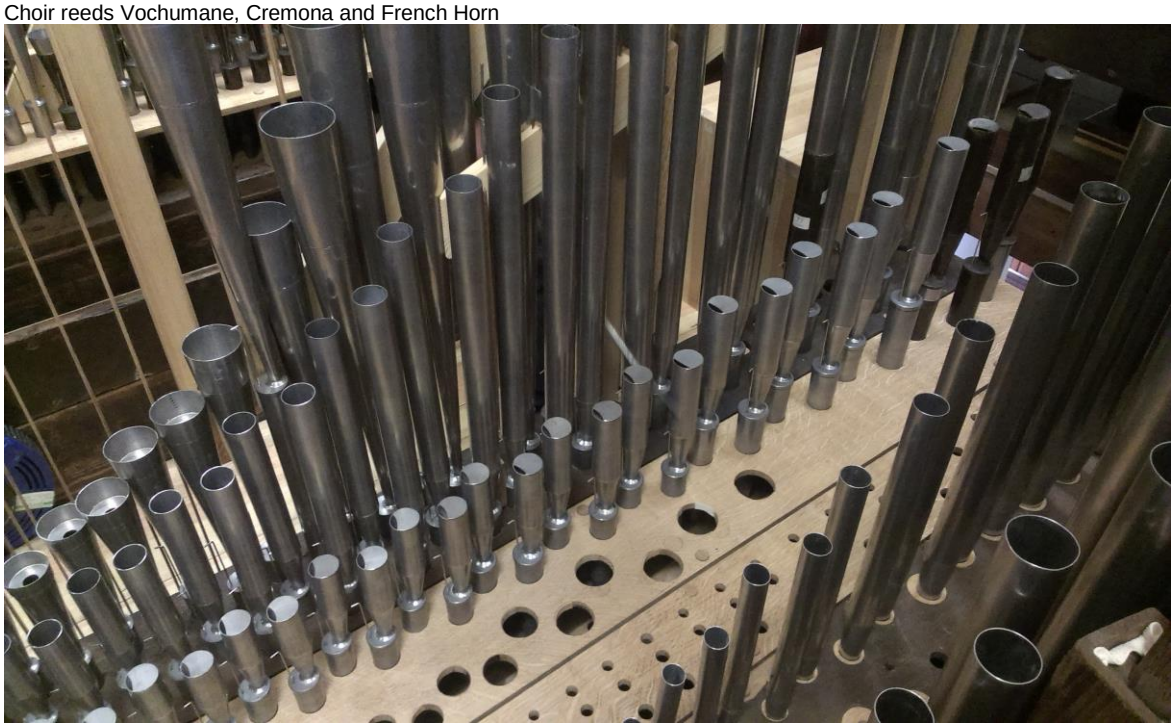
Shallots

The shallots seemed to have ended mixed up just anywhere in any reed stop in the organ. They have been sorted out in length, scale, slot size and inscription, and we are now as confident as we can that they are dedicated to the right stops.

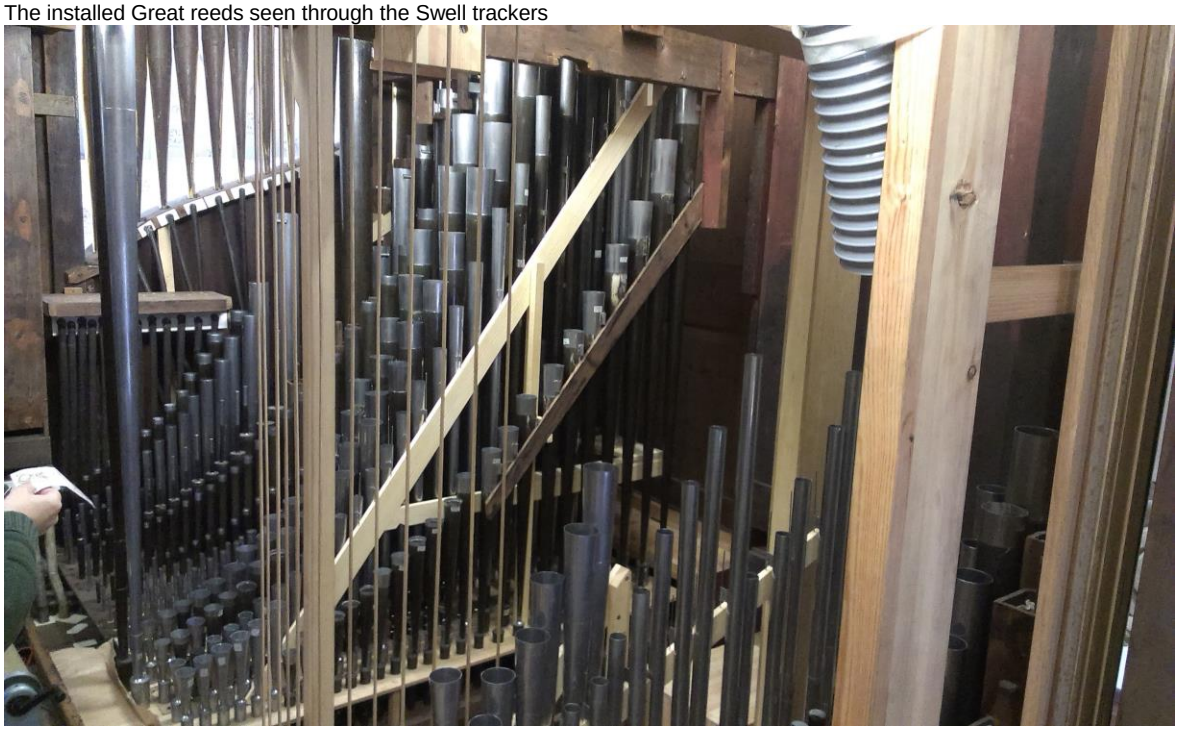
All shallots sorted after many hours of measuring and comparison



Choir reeds Vochumane, Cremona and French Horn



The installed Great reeds seen through the Swell trackers



n = new

Chorus reed - scale sheet

Church Christ Church Spitalfields

Stop Great Trumpet I & Pressure 2½" Pitch A: 440 Temp.

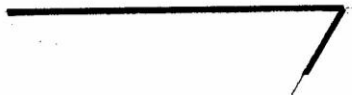
General	C alt	F# alt	c°	f#°	c 1 n	f# 1	c 2	f# 2	c 3	f# 3	16' C 4
	98.8	77.3	o	o	Resonator n	n	n	n	New		New
Top scale internal	~~Aog.3~~	~~87.8~~	69.8	58.8	54.3	49.8	44.4	39.4	35		127.5
Tip scale external	~~15.1~~	13.55	12.3	11.8	11.4	11.2	10.8	9.8	10.2		18.3
Metal thickness	0.8	0.~~78~~	0.75	0.75	0.74	0.73	0.~~58~~	0.55	0.55		0.9
Resonator length	~~2306~~	1654	1087	760	526	361	240~~4~~	161	94		2978
Slot dist. fr. top	2226										
Slot width											
Lgth of slot open											
Block diameter	36.6	31.8	29.2	29.3	25	24.6	24.6	24.2	24.4		
Block depth	29	24.7	21.5	21.6	17.6	17.4	17.2	20.9	19.8		
Shoulder D.	50	41.4	35.9	36.9	25.9	26	25.2	28.9	25.4		
Tongue											
Height of curve											
Tuned length											
Complete length											
Width at tip											
Width at back											
Thickness: metric											
Imperial	15	14									20
Loading											
Desc. of loading											
Shallot											
Proj.length fr.block											
Complete length	94	73.8	61	50.9	41.5	37.3	34.2	30	26.9		118.7
Metal thickness	.7	.7	.76	.6	.5	.6	.4	.6	.6		.9
Outside dia.top	10.4	9.5	8.4	7.6	7.3	6	6.2	6.2	5.6		12.6
Inside dia. top											
Outside dia.tip	12.4	11	9.7	8.5	8.2	7.2	7	6.7	6.2		14.3
Inside dia. tip											
Face width tip	9.7	8.3	7.4	6.9	6.4	5.8	5.6	5.2	4.8		10.8
Face width top	8	6.9	5.8	5.5	5.45	4.9	4.4	4.7	4.2		8.6
Opening length											
Op. width tip	7.3	5.8	5.23	4.5	4.6	4	4	3.65	3.4		7.8
Op. width top	6.35	4.5	3.9	3.5	3.5	2.9	2.5	2.7	2.55		6.1
O/A length res.						+		+			+
top to shall. tip											
Tip hole											
Socket length											
Bleed hole											

n = new

Chorus reed - scale sheet

Church Christ Church Spitalfields

Stop Great Trumpet no. 2			Pressure 2½"			Pitch 86,		Temp. 16'			
General	C$_0$	F#	c^0	f#^{0}	c^1	f#^{1}	c^2	f#^{2}	c^3	G^3	c^4
	99.5	0	0	0	Resonator	0	0	0	n		
Top scale internal	~~F0 44.3~~	80.1	70.2	60	52.4	49.3	47.9	41.2	41.6	109.6 ~~cut~~	
Tip scale external	15.1	13	10.4	11.6	9.8	10	9.8	10	10.3	1735	
Metal thickness	0.84	0.68	1/4"	cut	0.7	0.6	0.62	0.6	0.64	0.93	
Resonator length	~~2238.2~~	1673	1097	762	513	363	248	166	107	3335	
Slot dist. fr. top	2243										
Slot width											
Lgth of slot open											
Block diameter	36	31.8	31.9	29.2	24.4						
Block depth	30	24.4	24.6	21.7	19.5						
					Nail. →						
Tongue											
Height of curve											
Tuned length											
Complete length											
Width at tip											
Width at back											
Thickness: metric	.44	.37	.36	.28	.22	.22	11	11	11		
Imperial	17.5	14.5	14	11	9	9	4.5	4.5	4.5	17.5	
Loading											
Desc. of loading											
Shallot											
Proj.length fr.block	83	64	54	43	33.3	31	28	23.2	20	106	
Complete length	94	76	62	51	42.6	37.2	34	30.5	26	118	
Metal thickness	.9	.8	.7	.7	.6	.6	.44	.43	.6	.7	
Outside dia.top	10.9	9.3	8.3	7.5	7	6.7	6	6	5.8	12.2	
Inside dia. top											
Outside dia.tip	12.3	10.6	9.2	8.2	7.9	7.5	7.3	7	6.2	13.9	
Inside dia. tip											
Face width tip	9.5	7.8	6.7	6.1	6.5	6.2	5.3	5.3	5.2	9.9	
Face width top	8	6.3	6.1	5.3	5.3	5.6	4.3	4.2	4.5	8.7	
Opening length											
Op. width tip	6.6	5.3	4.1	4	4	4.1	3.6	3.6	2.9	7.4	
Op. width top	5.4	3.8	3.1	3	3	3.1	2.7	2.7	2.6	6.2	
O/A length res. top to shall. tip											
Tip hole	7.5 →										
Socket length											
Bleed hole											



Chorus reed - scale sheet

Church Christ Church Spitalfields

Stop Great: Clarion 4 Pressure 2½" Pitch A = 440 Temp. GG

General	C	F#	c°	f#°	c¹	f#¹	c²	f#²	c³	f#³	G⁴
Resonator											
Top scale internal	65.7	55.4	50.2	46.4	43.2	39.3	36.9	repeat			74.2
Tip scale external	12.9	11.5	11.2	10.1	10.2	10.2	11	new ranges			13.44
Metal thickness	0.73	0.76	0.72	0.65	0.6	0.6	0.6	d#''' – d'''			0.75
Resonator length	1077	753	517	360	243	116	1077				1463
Slot dist. fr. top											
Slot width											
Lgth of slot open											
Block diameter	29.2	29.3	24.5	25.5	24.5	24.6	24.6				31.8
Block depth	22	22	17.9	17.6	19.4	17.4	17.8				24.5
Shoulder D	35.9	36.2	25.6	25.7	25.2	26	25.6				41.5
Tongue											
Height of curve											
Tuned length											
Complete length											
Width at tip											
Width at back											
Thickness: metric											
Imperial											
Loading											
Desc. of loading											
Shallot											
Proj.length fr.block											
Complete length	63	50.8	42.8	38.4	31	30	27.2				72.4
Metal thickness	.8	.6	.6	.6	.6	.6	.6				.8
Outside dia.top	8.5	7.4	7	6.6	6.2	6	5.9				8.7
Inside dia. top											
Outside dia.tip	10.15	8.9	8.1	7.4	6.7	6.8	6.4				10.8
Inside dia. tip											
Face width tip	7.5	6.66	5.7	5.4	5.3	5	5				7.2
Face width top	6.2	5.7	5.1	5	4.4	4.4	4.4				6
Opening length											
Op. width tip	5.5	4	3.7	3.35	3.4	2.8	2.9				5
Op. width top	3.5	2.9	2.8	2.84	2.2	2.25	2.4				4
O/A length res.	+				+						+
top to shall. tip											
Tip hole											
Socket length											
Bleed hole											

8' pitch from Treble d#

Chorus reed - scale sheet

a#"/4" orig length ?

Church Ch Ch Spirit

Stop Gt Bassoon			Pressure 2½"			Pitch 8'		Temp. 16'			
General	**C**	**F#**	**c°**	**f#°**	**c¹**	**f#¹**	**c²**	**f#²**	**c³**	**G³** (~~f#³~~)	**c⁴**
	40.3		new		**Resonator**			a#"	4"	43.75	
Top scale internal	~~40.75~~	37.9	35.6		32		29	31.7	30.4	42	
Tip scale external	12.55	10.65	10.8		9.6		9.1	8.25	8.6?	13.6	
Metal thickness	0.9	0.75	0.8		0.7			0.5	0.5	1	
Resonator length			~~[illegible]~~		489		~~[illegible]~~	118.4	109.2	2364	
Slot dist. fr. top			1002				224				
Slot width											
Lgth of slot open											
Block diameter											
Block depth											
					Tongue						
Height of curve											
Tuned length											
Complete length											
Width at tip											
Width at back											
Thickness: metric											
Imperial	15	14	12	9.5	8.5	7	7	3.5	2	1.7	
Loading											
Desc. of loading											
					Shallot						
Proj.length fr.block											
Complete length											
Metal thickness											
Outside dia.top											
Inside dia. top											
Outside dia.tip											
Inside dia. tip											
Face width tip											
Face width top											
Opening length											
Op. width tip											
Op. width top											
O/A length res. top to shall. tip											
Tip hole											
Socket length											
Bleed hole											

Cremona - Corno - di - Bassetto - Clarinet scale sheet

Church Christ Church Spitalfields

Stop Choir Voc Humana 8' Pressure 2½" Pitch 86, Temp. 16'

General	C	F#	c°	f#°	c¹	f#¹	c²	f#²	c³	G#³	c⁴
Resonator											
Body scale/ exct	36	35	33	31	28·8	27·3	26·5	26·1	25·6	38	
Tip scale/external	16·6	15	13·9	13·3	12·3	11·9	12	11·5	11·4	15·6	
Metal thickness											
Body length	142	122	100	83·4	72	59·7	49	41	34·3	155	
Cone length	77	68	59	55	53	49·2	45	45·2	45·2	86·3	
Total length	220	190	160	140	124	107·9	93·7	85·6	78·5	240	
Capped-~~open top~~											
Slot dis.from top											
Slot -width											
Length slot/open											
Slide/tongue/tuned											
Tongue											
Height of curve											
Tuned length											
Complete length											
Width at tip											
Width at back											
Thickness: metric											
Imperial	17		12		8		5		3		
Loading	—										
Desc. of loading											
Shallot											
Proj.length fr.block	84	61·3	50	38·4	31·7	28·2	23·8	22·5	19·2	126	
Complete length	95	76	63	50	42·3	37·1	32·3	29·3	25·6	106	
Metal thickness	·64	·8	·7	·7	·7	·6	·6	·6	·6	·83	
Outside dia.top	10·7	9·6	8·4	7·77	7	6·5	6	5·8	5·4	12·1	
Inside dia. top											
Outside dia.tip	12·5	10·9	9·3	8·5	7·9	7·2	6·57	6·2	5·7	14·9	
Inside dia.tip											
Face width tip	9	7·3	7·1	6·5	6	5·1	4·9	4·2	4·3	10	
Face width top	7	6	6	5·4	5·2	4·5	4·6	3·9	4·1	7·7	
Opening length											
Op. width tip	6·3	4·7	4·15	3·8	3·5	2·85	2·56	2·5	2·4	7·8	
Op. width top	4·5	3·7	3·5	3·3	2·8	2·6	2·46	2·3	2·3	5·1	
O/A length res. top to shall. tip											
Tip hole	7		5·9		4·6		4·6				
Socket length											
Bleed hole											

body length ff 9 4 8

Cremona - Corno - di - Bassetto - Clarinet scale sheet

Church Christ Church, Spitalfields

Stop Ch. Cremona Pressure 2½" Pitch 8ft, Temp.

General	old C	F#	c°	f#°	c¹	f#¹	c²	f#²	c³	[redacted]	c⁴
					Resonator					16'G	
Body scale/interal		34·5	32	29	28	26	25	24·7	24·6	34	
Tip scale/external		16·6	15·1	13·9	13	12·2	11·7	11·45	11·1	18·8	
Metal thickness										0.93	
Body length	649	89.6	605	416	276	188	121	69.5	29.1	927	
Cone length		76	74	72	67·4	58·7	52·6	52	49·6	56	
Total length											
Capped-open top								Chalks from block		340	
Slot dis.from top										196	
Slot -width											
Length slot/open											
Slide/tongue/tuned											
					Tongue						
Height of curve											
Tuned length											
Complete length											
Width at tip											
Width at back											
Thickness: metric										17/14	
Imperial	17/13	15·5/11	12/8·5	11/7·5	10/7	8/6	6/5	5/4	3		
Loading											
Desc. of loading											
					Shallot						
Proj.length fr.block		63·7	50	44	37·6	33	29	24·6	21·7	106	
Complete length		78·5	65	55	47·8	42·3	36·7	32	27·8	127	
Metal thickness		1	·8	·8	·7	·7	·6	·6	·6	·9	
Outside dia.top		10·2	9·4	8·7	8	7·4	6·8	6·1	5·9	12·5	
Inside dia. top											
Outside dia.tip		11·6	10·6	9·7	9	8·25	7·6	6·8	6·5	14·4	
Inside dia.tip											
Face width tip		7·2	6·9	6·6	6	5·8	5·1	4·9	4·7	9·2	
Face width top		5·5	5·8	5·6	4·7	4·7	4·6	3·8	4·2	7·2	
Opening length											
Op. width tip		4·3	4·8	4·25	3·8	3·6	3·4	3·2	2·7	5·7	
Op. width top		2·8	3.2	3	2·7	2·8	2·8	1·95	2·4	4	
O/A length res. top to shall. tip											
Tip hole											
Socket length											
Bleed hole											

Chorus reed - scale sheet

Church Christ Church Spitalfields

Stop French Horn			Pressure 2½"			Pitch 8ft.		Temp. 70°F.			
General	C	F#	D°	f#°	c¹	f#¹	c²	f#²	c³	f#³	c⁴
Resonator											
Top scale internal			65	63	55	50	42	39	32		
Tip scale external				11.2	10.7	10.4	10	10	1.0		
Metal thickness											
Resonator length			940	740	490	318	190	130	69		
Slot dist. fr. top	Chute fr. Uvch		745	570	385	250	164	109	62		
Slot width											
Lgth of slot open											
Block diameter											
Block depth											
Tongue											
Height of curve											
Tuned length			41								
Complete length											
Width at tip											
Width at back											
Thickness: metric			.32	.32	.23	.17	.13	.11	.08		
Imperial			12.5	12.5	9	6.5	5	4.5	3		
Loading											
Desc. of loading											
Shallot											
Proj.length fr.block			48	42.3	37.9	28.5	22.5	25.7	16.6		
Complete length			57.8	52.3	44.4	39	34.4	31			
Metal thickness			.8	.8	.8	.7	.7				
Outside dia.top			8.7	8	7.4	6.8	6.5	6			
Inside dia. top											
Outside dia.tip			9.5	8.65	8.2	7.55	7	6.7	6.2		
Inside dia. tip											
Face width tip			5.5	5.4	5.3	5.5	4.9	4.4	4.7		
Face width top			4.7	4.9	4.6	4.7	4.6	4			
Opening length											
Op. width tip			3	3	3.2	2.9	2.76	2.7	2.8		
Op. width top			2.5	2.6	2.45	2.1	2.3	2.2			
O/A length res. top to shall. tip											
Tip hole			6.7	6.7	5.3	5	4.6	4.2	4.3		
Socket length			155								
Bleed hole			1.9	1.9	1.7	1.7	1.6	1.3	1.3		

Chorus reed - scale sheet

Church Christ Church Spitalfields

Stop Sw Trumpet 8 Pressure 2½" Pitch A = 440 Temp.

General	C	F#	c°	f#°	c¹	f#¹	c²	f#²	c³	f#³	c⁴
Resonator											
Top scale internal				56.3	56.3	47	45.5	44.4	37.6		
Tip scale external				11.3	10.6	10.3	11.4	9.4	10.5		
Metal thickness									+		
Resonator length				710	533	361	242	167.5	107.7		
Slot dist. fr. top											
Slot width											
Lgth of slot open											
Block diameter				28.8	24.3	24.6	24.3	24.5	24.6		
Block depth				24.3	17.5	17.8	17.7	17.4	17.7		
					25.7	25.9	26	25.6	25.4		
Tongue											
Height of curve											
Tuned length											
Complete length											
Width at tip											
Width at back											
Thickness: metric											
Imperial											
Loading											
Desc. of loading											
Shallot											
Proj.length fr.block											
Complete length				48.4	44.8	36.5	32.8	30.7	27.1		
Metal thickness				4874	4468	.5	.6	.5	.6		
Outside dia.top				7.6	7	6.6	6.2	6	5.7		
Inside dia. top											
Outside dia.tip				8.1	7.8	7.3	7	7	6.6		
Inside dia. tip											
Face width tip				6.2	6.8	5.8	5.6	5.3	5.2		
Face width top				5.2	4.9	5.2	4.7	4.5	4.3		
Opening length											
Op. width tip				4.3	4.25	3.6	3.7	3.5	3.4		
Op. width top				3.35	3.3	3	3	2.7	2.4		
O/A length res.					+				+		
top to shall. tip											
Tip hole											
Socket length											
Bleed hole											

Oboe - Hautboy Scale Sheet

Church Christ Church Spitalfields — top 6 trumpet pipes

Stop 8W Hautboy B — Pressure 2½" — Pitch A=440 — Temp.

General	C	F#	c°	f#	c¹	f#¹	c²	f#²	c³	f#³	c⁴
				G Resonator					38.6		
Bell top sc. int.				60.35	51.6	48.9	50.7	48.6	Tpt		
Bell bot. sc. ext.				30	27	24.5	22.5	20			
Tip sc. ext.				11.5	10.8	9.1	8.6	8.6	10		
Metal thickness											
Bell length				212	136	95.4	75.5	57.5			
Tube length				500	380	264	181	116	115.1		
Total tube length											
Capped/open											
Shoulder D				27.2	29.5	29.3	22	22			
Block diameter				26.3	24.3	24.5	23.1	23.2			
Block depth				22.2	21.1	21	14.8	14.9			
				Tongue							
Height of curve											
Tunnel length											
Complete length											
Width at tip											
Width at back											
Thickness: metric											
Imperial											
Loading											
Desc. of loading											
				Shallot							
Proj.length fr.block											
Complete length				55	45	38.4	33.6	31.6	27.5		
Metal thickness				.6	.5	.5	.5	.6	.6		
Outside dia.top				7.4	6.8	6.3	5.6	5.6	5.7		
Inside dia. top											
Outside dia.tip				8.5	8	7.36	6.5	6.3	6.3		
Inside dia.tip											
Face width tip				6.1	5.6	5	4.5	5	4.5		
Face width top				5.3	4.7	3.9	3.9	3.8	4.4		
Opening length											
Op. width tip				4	3.7	3.4	2.9	3.2	2.8		
Op. width top				3.1	3.3	2.3	2.2	1.9	2.3		
O/A length res.				+				+	+		
top to shall. tip											
Tip hole											
Socket length											
Bleed hole											

Chorus reed - scale sheet

Church Christ Church Spitalfields

Stop Sco. Clarion 4 Pressure 2½" Pitch A = 440 Temp.

General	C	F#	c°	f#°	c¹	f#¹	c²	f#²	c³	f#³	c⁴
G Resonator											
Top scale internal				57.7	43.6	42.1	39.2	41.5	39.6		
Tip scale external				11.3	11.2	10.0	10.5	10.3	10.6		
Metal thickness									New		
Resonator length				331.5	246.5	172	109.7	166	pipe ← 107.3		
Slot dist. fr. top											
Slot width											
Lgth of slot open											
Block diameter				24.3	24.6	24.6	24.6	24.6	24.5		
Block depth				21	17.6	17.6	17.6	19.77	19.3		
				28.3	25.1	25.8	26.2	25.6	25.3		
Tongue											
Height of curve											
Tuned length											
Complete length											
Width at tip											
Width at back											
Thickness: metric											
Imperial											
Loading											
Desc. of loading											
Shallot											
Proj.length fr.block									only		
Complete length				34.7	33.1	30	27.6	30	28.3		
Metal thickness				.55	.7	.7	.5	.6	.7		
Outside dia.top				7	6.5	6	5.4	6	5.8		
Inside dia. top											
Outside dia.tip				7.8	7.1	6.6	6.4	6.8	6.3		
Inside dia. tip											
Face width tip				5.3	5.2	5.2	4.8	5.2	5		
Face width top				5	4.6	4.33	4.3	4.2	4.2		
Opening length											
Op. width tip				3.33	3.2	3.1	2.8	2.9	3		
Op. width top				2.7	2.5	2	2.7	2.35	2.3		
O/A length res. top to shall. tip											
Tip hole											
Socket length											
Bleed hole											

8' pitch from Grebe's C#

Chorus reed - scale sheet

Church Christ Church Spitalfields

Stop Pedal Trumpet Pressure 2½" Pitch 8ft. Temp.

General	C	~~F#~~	c	f#	c	f#	c	~~f#~~	c	f#	c
		16' G				Resonator		8 3 C			
Top scale internal		167	158	129	111.1	91.3	Ext → 723				
Tip scale external		11·7int	13·2	11·7	8·8	9·2	11·5	10·5			
Metal thickness		0·96		0·78	0·74		0·7				
Resonator length		3062	2285	1600	1131	786	537	422			
Slot dist. fr. top											
Slot width											
Lgth of slot open											
Block diameter											
Block depth											
					Tongue						
Height of curve											
Tuned length											
Complete length											
Width at tip											
Width at back											
Thickness: metric		·52	·42	·37	·3	·29	·24	·2			
Imperial		20·5	16·5	14·5	12	11·5	10	8			
Loading											
Desc. of loading											
					Shallot						
Proj.length fr.block											
Complete length		130	103·5	82·3	68	55·9	47	43			
Metal thickness		1·40	1·14	1·3	1·2	·9	·7	·7			
Outside dia.top		15	13·1	11·6	10·7	9·2	8·35	7·8			
Inside dia. top											
Outside dia.tip		18·2	14·5	12·7	10·1	9·3	9	8·6			
Inside dia. tip											
Face width tip		13·4	8·4	7·3	7	6·4	5·9	5·7			
Face width top		10·7	7·4	6·2	6	5·7	5·3	5·1			
Opening length											
Op. width tip		10	5·9	5·4	4·8	4·7	3·8	3·5			
Op. width top		6·9	5·2	3·3	4	3·9	3·3	3·15			
O/A length res. top to shall. tip											
Tip hole											
Socket length											
Bleed hole											