

# Detailed Measurement of Five One-Handed Swords from the Armoury of the Grandmaster's Palace in Valletta, Malta

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## Abstract

*In this article, five one-handed swords from the Armoury of the Grandmaster's Palace in Valletta, Malta, are described in image and text and presented together with their measurements. The weapons cover a narrow time range from the 16th to the 17th century. An authentic reconstruction of the blades is made possible with these measurements.*

## I. INTRODUCTION

**D**ETAILED MEASUREMENTS OF period weapons are the most important source of information for the manufacture of authentic reproductions. Furthermore, parameters of blade geometry and mass distribution are very illuminative for the interpretation of period fencing treatises.

In this article, five one-handed swords from the 16th and 17th century are presented with photographs, detailed measurements of blade, hilt and grip as well as cross section diagrams.

## II. TERMINOLOGY

Most measurable parameters are common to all swords and quite clear, although some need a more detailed explanation, which follows. The measurement coordinate origin in all planes is the center of the grip front end.

- *Ricasso Length* – Ricasso length is measured from the front end of the grip to the start of the edge.
- *Blade Length* – Blade length is measured from the front end of the grip to the point.
- *Point of Balance (POB)* – The point of balance is usually considered the main parameter of handling and can be easily located by balancing the sword on an edge. However, it only determines little regarding handling characteristics. It is measured from the front end of the grip.
- *Blade dorsal length* – Length of the flat area on the back of a blade.

- *Pommel Neck Length* – The length of the pommel part that is the transition to the grip, which extends the actual grip length.
- *Crossguard Diameter* – The diameter of the crossguard at its thinnest point. This value is an indicator for the stability of the hilt.

Overall length	$l_o$
Blade length	$l_b$
Ricasso length	$l_r$
Ricasso block length	$l_q$
Grip length	$l_g$
Pommel length	$l_p$
Pommel neck length	$l_{pn}$
Fuller length	$l_f$
Point of balance	$l_{pob}$
Hilt height front of crossguard	$l_{hf}$
Hilt height rear of crossguard	$l_{hr}$
Blade dorsal length	$l_s$
Blade width	$w_b$
Ricasso width at front end	$w_{rf}$
Ricasso width at rear end	$w_{rr}$
Fuller width	$w_f$
Hilt width	$w_h$
Grip width at crossguard end	$w_{gf}$
Grip width at pommel end	$w_{gr}$
Grip width at distance X	$w_{gX}$
Blade dorsal width	$w_s$
Blade thickness	$d_b$
Ricasso thickness at the front end	$d_{rf}$
Ricasso thickness at the rear end	$d_{rr}$
Fuller depth	$d_f$
Hilt depth outside	$d_{ho}$
Hilt depth inside	$d_{hi}$
Grip thickness at the crossguard end	$d_{gf}$
Grip thickness at the pommel end	$d_{gr}$
Grip thickness at distance X	$d_{gX}$
Edge thickness	$d_e$
Blade cross-section area	$A$
Overall mass	$m$

*Table 1: Edged Weapon Parameter Overview*

### III. BLADE CROSS SECTION CALCULATION

Blade cross sections can be calculated along a blade according to its shape. The formulae used are as follows:

### III.1. HEXAGON CROSS SECTION

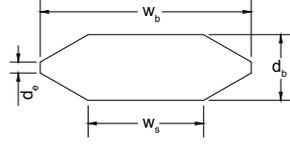


Figure 1: Hexagon Cross Section

$$A = (d_b - d_e)w_s + w_b d_e + \frac{(d_b - d_e)(w_b - w_s)}{2} \quad (1)$$

### III.2. DIAMOND CROSS SECTION

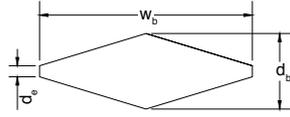


Figure 2: Diamond Cross Section

$$A = w_b d_e + \frac{(d_b - d_e)w_b}{2} \quad (2)$$

### III.3. LENTICULAR CROSS SECTION

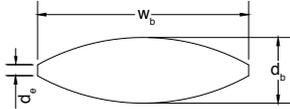


Figure 3: Lenticular Cross Section

Here, cross section is approximated by circle segments, a precise calculation is not possible.

$$A = w_b d_e + \frac{\frac{1}{2} \arctan\left(\frac{d_b - d_e}{w_b}\right) ((d_b - d_e)^2 + w_b^2) + \frac{(d_b - d_e)}{2} w_b ((d_b - d_e)^2 - w_b^2)}{2(w_b - d_e)^2} \quad (3)$$

For sharp blades we can disregard the striking edge and therefore omit parameter  $d_e$ .

### III.4. FULLER CROSS SECTION

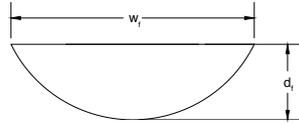


Figure 4: Fuller Cross Section

$$A = \frac{\frac{1}{2} \arctan\left(\frac{2d_f}{w_f}\right)(4d_f^2 + w_f^2)^2 + w_f b(4w_f^2 - w_f^2)}{16w_f^2} \quad (4)$$

#### IV. DESCRIPTION AND MEASUREMENT OF FIVE EDGED WEAPONS

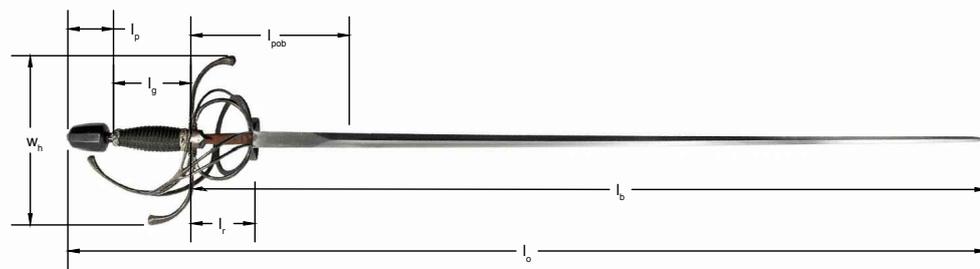


Figure 5: Sketch of a one-handed sword.

##### IV.1. OBJECT PA0303

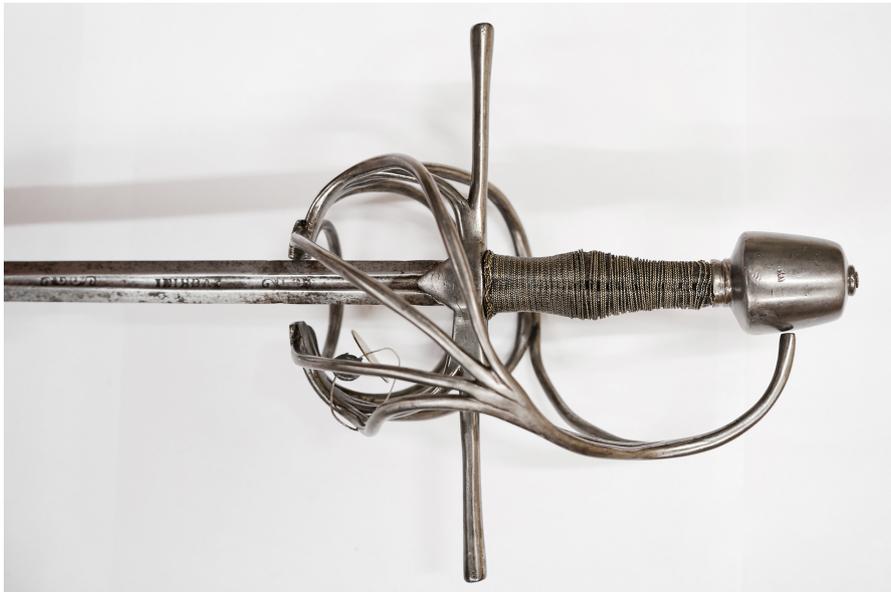
Object PA0303 is a rapier with a hexagonal/diamond shaped blade with one fuller. The blade is missing the ricasso, which indicates that it broke at the tang and was remounted shorter. The fuller inscription reads "IOHANNES" on the outside and "ZUCHINI" on the inside. The hilt is of three-ring type with a knuckle bar and straight crossguard, all bars of round cross section. The pommel has a truncated cone shape without decoration. The grip has a double-concave shape and is made of wirewrapped wood.

Classification according to [Norman, 1980]:

- *Outer Guard*: type 61
- *Inner Guard*: type 36
- *Pommel*: type 31



*Figure 6: Object PA0303 – Hilt and forte outside view*



*Figure 7: Object PA0303 – Hilt and forte inside view*



*Figure 8: Object PA0303 – Hilt rear side view*



*Figure 9: Object PA0303 – Hilt front side view*



*Figure 10: Object PA0303 – Total view*



*Figure 11: Object PA0303 – Inside oblique view*

Object PA0303				
Overall length [mm]	1173			
Blade length [mm]	1035			
Fuller length [mm]	205			
Overall mass [g]	1080			
Point of balance [mm]	68.0			
Pommel length [mm]	53			
Pommel width [mm]	38.5			
Pommel thickness [mm]	28.5			
Pommel neck length [mm]	8.0			
Grip length [mm]	82.5			
Grip material	wood, wire			
	Distance [mm]	0	37	82.5
Measurements Grip	Width [mm]	22.3	25.8	18.3
	Thickness [mm]	17.8	23.8	17.5
Quillon block length [mm]	24			
Quillon block thickness [mm]	16.2			
Quillon block width [mm]	23			
Hilt width [mm]	103			
Hilt depth outside [mm]	60			
Hilt depth inside [mm]	53.3			
Crossguard length	210			
Crossguard shape	round			
Crossguard diameter [mm]	6.1			
Blade shape	rectangle to 17.5mm, hexagon to 270mm, diamond to point			

Table 2: Overview of the measurement parameters of object PA0303

$l_b$ [mm]	$w_b$ [mm]	$d_b$ [mm]	$ws$ [mm]	$wf$ [mm]	$df$ [mm]	$A$ [mm <sup>2</sup> ]	Blade shape
15	17.4	6.3	-	5.0	1.1	102.3	Rectangle
30	16.5	6.4	8.0	5.6	1.4	67.9	Hexagon
100	16.9	6.3	7.5	4.0	1.2	70.5	Hexagon
200	16.1	6.5	6.7	-	-	74.1	Hexagon
300	14.8	4.7	-	-	-	34.8	Diamond
400	14.1	4.2	-	-	-	29.6	Diamond
500	13.6	4.1	-	-	-	27.9	Diamond
600	11.8	3.1	-	-	-	18.3	Diamond
700	12.5	3.2	-	-	-	20	Diamond
800	10.5	2.6	-	-	-	13.6	Diamond
900	9.9	2.5	-	-	-	12.4	Diamond
1000	8.8	1.0	-	-	-	4.4	Diamond

Table 3: Blade measurements of object PA0303, a one-handed sword

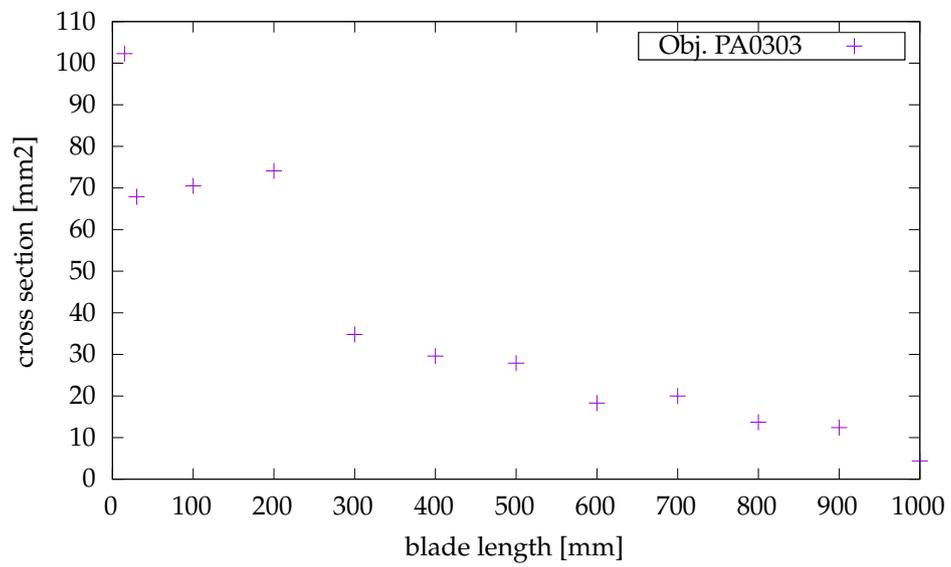


Figure 12: Cross Section of Object PA0303

#### IV.2. OBJECT PA0833

A sword with a sturdy hexagonal blade with one fuller which is decorated with punched ornaments. The hilt is symmetrical and consists of three rings and a shell on each side, curved knuckle bar and crossguard, of rounded diamond cross section. The plates are cut in one piece attached to the hilt with two screws with prominent heads. The pommel is small and spherical which results in a point of balance 180mm forward of the grip/hilt transition. The grip has a double-concave shape and is made of wirewrapped wood.

Classification according to [Norman, 1980]:

- *Outer Guard*: type 68
- *Inner Guard*: type 68
- *Pommel*: type 14

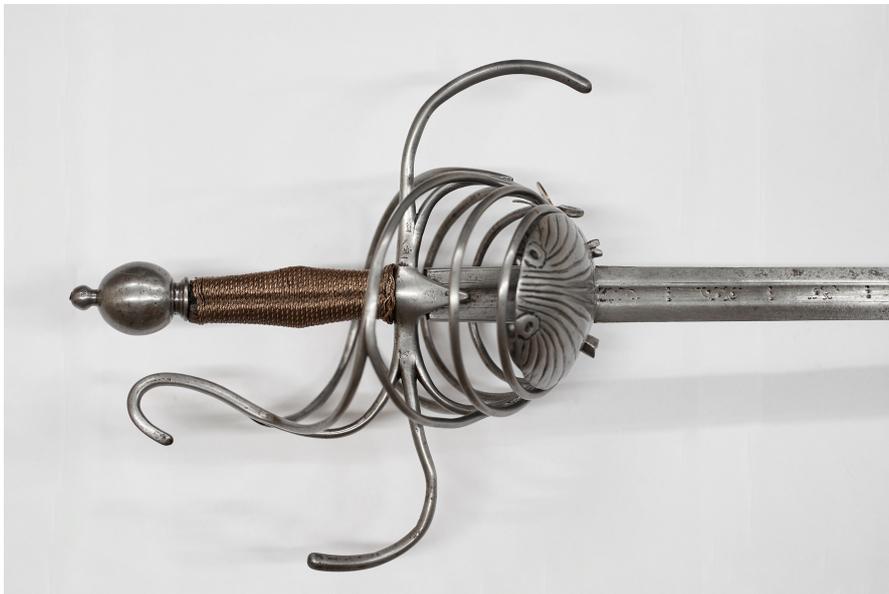
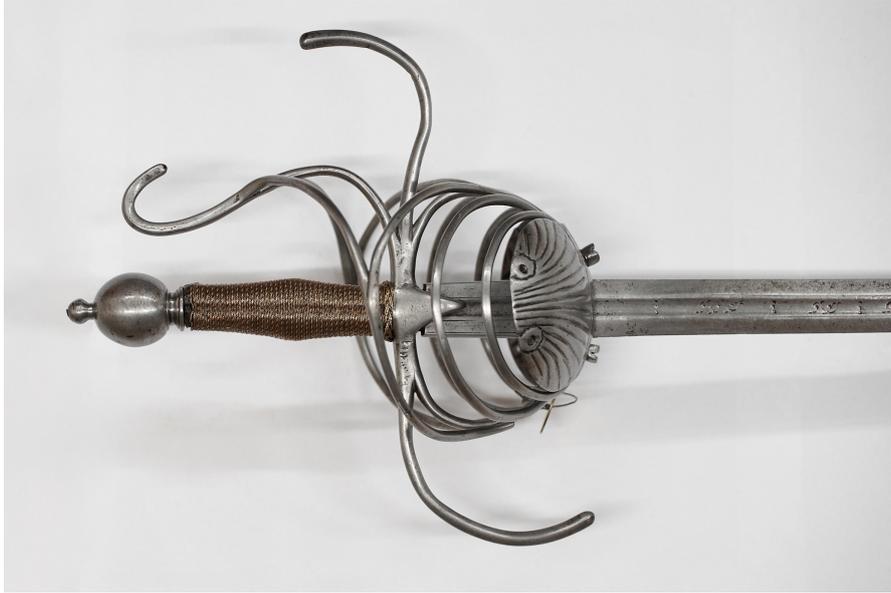


Figure 13: Object PA0833 – Hilt and forte outside view



*Figure 14: Object PA0833 – Hilt and forte inside view*



*Figure 15: Object PA0833 – Hilt rear side view*



Figure 16: Object PA0833 – Hilt front side view

Object PA0833				
Overall length [mm]	1230			
Blade length [mm]	1100			
Fuller length [mm]	265			
Overall mass [g]	1060			
Point of balance [mm]	180			
Pommel length [mm]	46.6			
Pommel width [mm]	31			
Pommel thickness [mm]	31			
Pommel neck length [mm]	7.1			
Grip length [mm]	85.5			
Grip material	wood, wire			
Measurements Grip	Distance [mm]	0	40	85.5
	Width [mm]	22	25.8	19.6
	Thickness [mm]	17.3	21.7	17
Quillon block length [mm]	19			
Quillon block thickness [mm]	11.7			
Quillon block width [mm]	24			
Hilt width [mm]	104			
Hilt depth outside [mm]	61.5			
Hilt depth inside [mm]	61.5			
Crossguard length	213			
Crossguard shape	diamond			
Crossguard diameter [mm]	5			
Blade shape	rectangle to 66mm, hexagon to point			

Table 4: Overview of the measurement parameters of object PA0833



*Figure 17: Object PA0833 – Total view*



*Figure 18: Object PA0833 – Inside oblique view*

$l_b$ [mm]	$w_b$ [mm]	$d_b$ [mm]	$w_s$ [mm]	$w_f$ [mm]	$df$ [mm]	$A$ [mm <sup>2</sup> ]	Blade shape
13	22.5	7.5	-	7.0	1.5	154.8	Rectangle
69	25.0	7.5	-	7.0	1.5	173.5	Rectangle
80	23.6	6.4	10.8	6.0	1.2	100.5	Hexagon
100	23.0	6.2	9.3	6.0	1.0	92.1	Hexagon
200	21.4	5.7	9.2	6.0	0.8	80.8	Hexagon
300	19.7	4.9	8.5	-	-	69.1	Hexagon
400	18.9	4.3	7.6	-	-	57.0	Hexagon
500	18.3	3.9	8.0	-	-	51.3	Hexagon
600	18.2	3.7	8.3	-	-	49.0	Hexagon
700	18.4	3.4	8.3	-	-	45.4	Hexagon
800	18.0	2.9	8.3	-	-	38.1	Hexagon
900	17.8	2.5	8.3	-	-	32.6	Hexagon
1000	17.8	2.1	8.3	-	-	27.4	Hexagon
1060	12.6	1.3	5.5	-	-	11.8	Hexagon

Table 5: Blade measurements of object PA0833, a one-handed sword

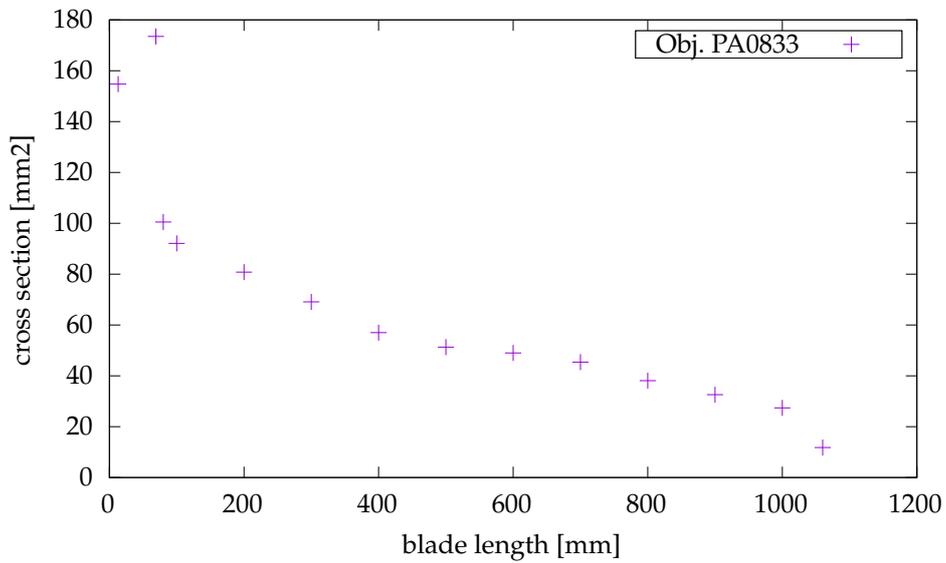


Figure 19: Cross Section of Object PA0833

#### IV.3. OBJECT PA0834

This beautiful rapier has a slender hexagonal blade with one fuller. The fuller inscription is "INTE DOMINE / SPERAVIT" which is the beginning of psalm 30:2. The ricasso is marked with the Maltese cross on both sides. The symmetrical hilt is a very rare style with two rings, joined by intertwined bars, forming a figure-eight knot in the center. The crossbar is long and straight, the knuckle bow very thin. The top ring on each side bears a rectangular hole, probably the mounting points of, now missing, plates. The pommel is a truncated cone with 12 bevels, the grip wooden and wrapped with wire, of double-conical shape.

Classification according to [Norman, 1980]:

- *Outer Guard*: close to type 58
- *Inner Guard*: close to type 58
- *Pommel*: type 31



Figure 20: Object PA0834 – Hilt and forte outside view



*Figure 21: Object PA0834 – Hilt rear side view*



*Figure 22: Object PA0834 – Hilt front side view*



*Figure 23: Object PA0834 – Total view*



*Figure 24: Object PA0834 – Inside oblique view*

Object PA0834				
Overall length [mm]	1221			
Blade length [mm]	1078			
Fuller length [mm]	210			
Overall mass [g]	1290			
Point of balance [mm]	124			
Pommel length [mm]	51.6			
Pommel width [mm]	38–28.5			
Pommel thickness [mm]	37.5–22.8			
Pommel neck length [mm]	5.3			
Grip length [mm]	88.3			
Grip material	wood, wire			
Measurements Grip	Distance [mm]	0	39	88.3
	Width [mm]	23	28	21.1
	Thickness [mm]	18.3	24.9	18.6
Quillon block length [mm]	18			
Quillon block thickness [mm]	13.5			
Quillon block width [mm]	-			
Hilt width [mm]	106/101			
Hilt depth outside [mm]	48.5			
Hilt depth inside [mm]	48.5			
Crossguard length	285			
Crossguard shape	round			
Crossguard diameter [mm]	6.2			
Blade shape	rectangle to 71.6mm, hexagon to point			

Table 6: Overview of the measurement parameters of object PA0834

$l_b$ [mm]	$w_b$ [mm]	$d_b$ [mm]	$w_s$ [mm]	$w_f$ [mm]	$d_f$ [mm]	$A$ [mm <sup>2</sup> ]	Blade shape
13	21	7.0	-	-	-	147	Rectangle
71	23.1	9.1	-	-	-	210.2	Rectangle
75	22.3	8.6	13.2	6.9	2.9	126.0	Hexagon
100	21.1	8.0	11.0	6.5	2.3	108.5	Hexagon
200	20.2	6.3	8.7	5.6	1.4	80.6	Hexagon
300	16.2	5.9	5.6	-	-	64.3	Hexagon
400	15.3	5.4	4.9	-	-	54.5	Hexagon
500	14.9	5.3	4.6	-	-	50.7	Hexagon
600	14.4	4.7	3.9	-	-	43.0	Hexagon
700	13.9	4.1	3.9	-	-	36.5	Hexagon
800	13.5	3.9	3.9	-	-	33.9	Hexagon
900	13.3	3.4	3.9	-	-	29.2	Hexagon
1000	13.1	3.1	4.0	-	-	26.5	Hexagon
1060	12.3	2.4	5.2	-	-	21.0	Hexagon

Table 7: Blade measurements of object PA0834, a one-handed sword

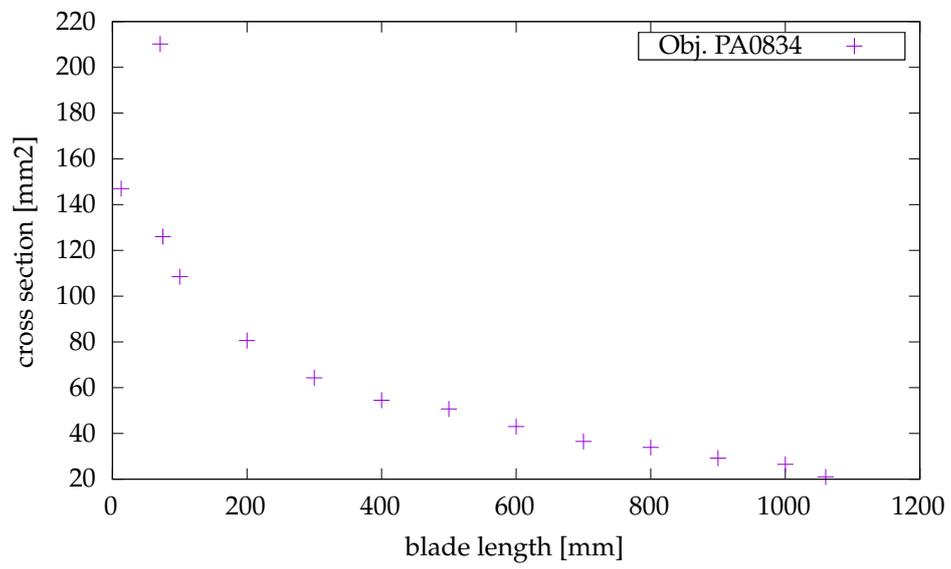


Figure 25: Cross Section of Object PA0834

#### IV.4. OBJECT PA4792

Object PA4792 is a rapier with a very long blade. The blade is of hexagonal shape, ground into lenticular form at the *debole* from resharpener. It has one fuller with an inscription: "CONFONDAR / IN ETERNA", which is a part of psalm 30:2: "non confundar in aeternum". The ricasso is marked with the Maltese cross on both sides. The hilt is a classic rapier two-ring hilt with a straight crossguard and a knuckle bow, all of round cross section. The round grip is wire-bound, the pommel a truncated cone shape with 12 bevels.

Classification according to [Norman, 1980]:

- *Outer Guard*: close to type 58
- *Inner Guard*: type 31
- *Pommel*: type 31



Figure 26: Object PA4792 – Hilt and forte outside view



*Figure 27: Object PA4792 – Hilt and forte inside view*



*Figure 28: Object PA4792 – Hilt rear side view*



Figure 29: Object PA4792 – Hilt front side view

Object PA4792		
Overall length [mm]	1282	
Blade length [mm]	1140	
Fuller length [mm]	310	
Overall mass [g]	1280	
Point of balance [mm]	148	
Pommel length [mm]	57	
Pommel width [mm]	41–32.2	
Pommel thickness [mm]	38.6–29.5	
Pommel neck length [mm]	4.6	
Grip length [mm]	84	
Grip material	wood, wire	
Measurements Grip	Distance [mm]	0    40    84
	Width [mm]	22.6    24.7    20.2
	Thickness [mm]	18.7    24.4    20
Quillon block length [mm]	24.2	
Quillon block thickness [mm]	18.4	
Quillon block width [mm]	22.8	
Hilt width [mm]	101	
Hilt depth outside [mm]	61	
Hilt depth inside [mm]	56.5	
Crossguard length	215	
Crossguard shape	round	
Crossguard diameter [mm]	6.5	
Blade shape	rectangle to 68.5mm, hexagon to 970mm, lenticular to point	

Table 8: Overview of the measurement parameters of object PA4792



*Figure 30: Object PA4792 – Total view*



*Figure 31: Object PA4792 – Inside oblique view*

$l_b$ [mm]	$w_b$ [mm]	$d_b$ [mm]	$ws$ [mm]	$wf$ [mm]	$df$ [mm]	$A$ [mm <sup>2</sup> ]	Blade shape
0	20.5	9.5	-	-	-	194.7	Rectangle
68.5	23.0	9.0	-	-	-	207.0	Rectangle
69	23.0	8.6	13.3	8.5	2.0	133.4	Hexagon
100	22.1	7.6	11.0	8.5	1.5	108.8	Hexagon
200	20.4	6.3	9.4	6.6	1.4	81.6	Hexagon
300	18.8	5.3	7.7	4.7	0.1	69.6	Hexagon
400	17.9	4.9	7.1	-	-	61.2	Hexagon
500	17.5	4.4	6.9	-	-	53.7	Hexagon
600	16.9	4.2	6.6	-	-	49.3	Hexagon
700	17.1	4.0	6.6	-	-	47.4	Hexagon
800	16.1	3.5	6.8	-	-	40.1	Hexagon
900	16.7	3.1	7.1	-	-	36.9	Hexagon
970	16.9	3.1	-	-	-	35.2	Lentil
1000	16.7	2.7	-	-	-	30.2	Lentil
1100	15.1	1.4	-	-	-	14.1	Lentil
1120	13.2	1.1	-	-	-	9.7	Lentil

Table 9: Blade measurements of object PA4792, a one-handed sword

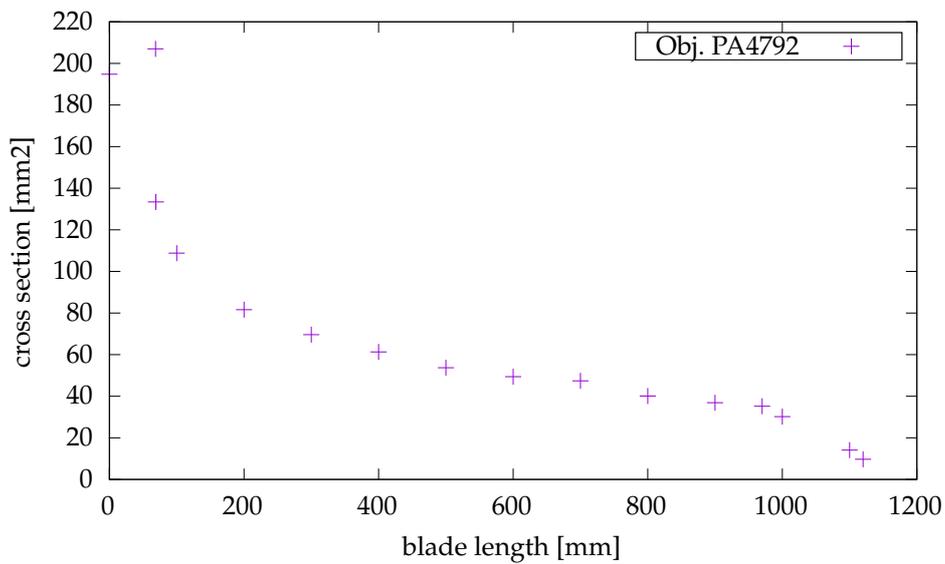


Figure 32: Cross Section of Object PA4792

#### IV.5. OBJECT PA4807

A light cup hilt rapier with an undecorated diamond cross section blade. The hilt consists of a closed cup, long straight crossguard and a knuckle bow. The handle is made of wood and the disc shaped pommel mounted on the blade by a thread on the tang, which is rare in swords of this period.

Classification according to [Norman, 1980]:

- *Cup*: type 104
- *Pommel*: type 66



*Figure 33: Object PA4807 – Hilt and forte outside view*

Object PA4807				
Overall length [mm]	1195			
Blade length [mm]	1090			
Overall mass [g]	1000			
Point of balance [mm]	158			
Pommel length [mm]	38			
Pommel width [mm]	37.5			
Pommel thickness [mm]	37.5			
Pommel neck length [mm]	9.5			
Grip length [mm]	70.8			
Grip material	wood, wire			
Measurements Grip	Distance [mm]	0	35	70.8
	Width [mm]	21.5	30	2-
	Thickness [mm]	19.0	27.7	19.0
Quillon block length [mm]	21.7			
Quillon block thickness [mm]	17.3			
Quillon block width [mm]	21			
Hilt width [mm]	140			
Hilt height front of crossguard [mm]	58.5			
Crossguard length	315			
Crossguard shape	round			
Crossguard diameter [mm]	6.3			
Blade shape	rectangle to 72mm, diamond to point			

Table 10: Overview of the measurement parameters of object PA4807

$l_b$ [mm]	$w_b$ [mm]	$d_b$ [mm]	$A$ [mm <sup>2</sup> ]	Blade shape
10	18.8	9.0	169.2	Rectangle
72	22.1	9.2	203.3	Rectangle
80	21.0	8.0	84.0	Rectangle
100	20.7	7.7	79.7	Diamond
200	18.7	6.0	56.1	Diamond
300	18.1	5.3	48.0	Diamond
400	17.8	5.0	44.5	Diamond
500	17.5	4.6	40.3	Diamond
600	17.1	4.2	35.9	Diamond
700	17.0	4.1	34.9	Diamond
800	16.5	3.6	29.7	Diamond
900	15.9	3.1	24.7	Diamond
1000	14.7	2.4	17.6	Diamond
1060	11.2	1.9	10.6	Diamond

Table 11: Blade measurements of object PA4807, a one-handed sword



*Figure 34: Object PA4807 – Total view*



*Figure 35: Object PA4807 – Oblique view*



*Figure 36: Object PA4807 – Cup inside view*



Figure 37: Object PA4807 – Tang thread view

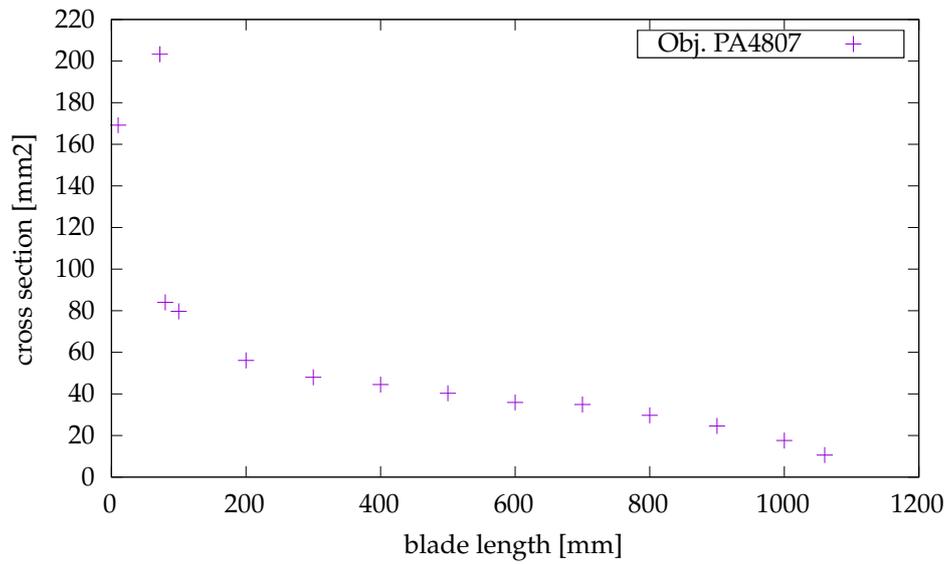


Figure 38: Cross Section of Object PA4807

## V. DIAGRAMS

Each object described above has been presented with a cross section progression diagram to get an idea of the assumable handling characteristic. Now we are going to combine those diagrams for comparison of those swords. For better visibility, measurement points are connected with lines.

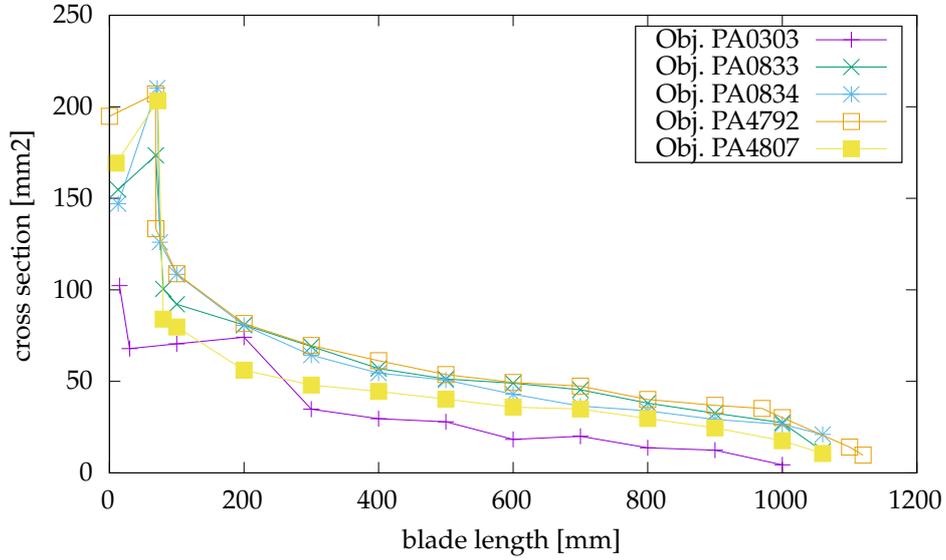


Figure 39: Cross Section Graph Comparison of Five One-handed Swords

## VI. ACKNOWLEDGEMENTS

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## REFERENCES

A.V.B. Norman. *The Rapier and Smallsword: 1460-1820*. Ayer Company Publishers, Inc., 1980.