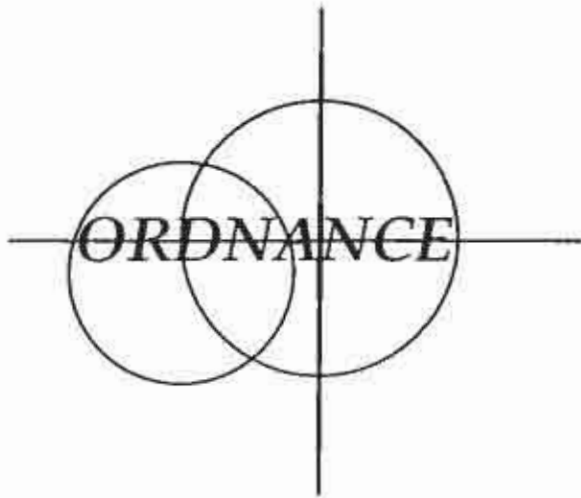


NICOLAES WITSEN

*Shipbuilding  
and  
Management*  
(1690)



Edited and Translated by Marit van Huyssee

Report - Department of Maritime Archaeology  
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# *Shipbuilding and Management*

An edited translation from the original 17th century Dutch

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of

*ARCHITECTURA NAVALIS ET REGIMEN NAUTICUM*  
OFTE

*Aeloude en Hedendaegsche Scheeps-bouw en Bestier*

by Nicolaes Witsen  
Amsterdam, Anno 1690

Edited by Marit van Huystee

[pp 500 - 504]

**Follows a detailed study of the *Boschieterij*, and the Sea-gunners function**

A good gunner must be skilful in every aspect that is related to ordnance: he has to know about the materials used at the fabrication of ordnance, and he has to know about the power/force of it; about the distance it covers; about the size and the weight of the ball; about the power of the gunpowder; and about how much is needed for a 'proof' storm and 'daily' shot.

About the material used for the ordnance: iron often was used at sea, however the best ordnance is made of bronze.

Lately there is found a way to make wooden pieces, which are able to fire 6 *pont* iron. They are easy to manage and are made of four parts fitted precisely together and tied with strong ropes. In the inside a copper tube. Yet I have no experience with them so I can not say anything useful about them.

Formerly they put several iron bars together to make an iron piece, which were girt with iron hoops, the way barrels are girt, but this is not without danger. A way is now to found them using iron or copper. The iron pieces go bad slightly, and the copper ones are not strong enough, if not mixed with tin. The alloying of these metals is the following: take nine parts yellow copper and three times as much red copper, and four parts of tin. Others put to 100 *pont* copper 10 *pont* tin, and 8 *pont* lead; others to 60 *pont* copper 10 *pont* tin and 8 *pont* *latoen* or yellow copper; some put to 100 *pont* copper, 5 *pont* tin; and finally there are people who put 200 *pont* *latoen* to 1000 *pont* copper and some tin.

A metal piece, which fires 48 *pont* iron weights 7000 *pont*; a 24 'pounder' weights 4050 *pont*.

You can see by the colour, the sound and the hardness, if the material is all right. Is the colour yellow than there is to much *latoen* in, and it is therefor to weak for the gunpowder. If the material is white than there is to much tin in, which makes it brittle and which can be recognised by the sound as well: the sound is clear and silvery. If the material is soft, there is used to much lead or to less tin. The colour of the best pieces is between yellow and white, and they feel hard; the sound is a bit dull, yet the trial shot will give you the best assurance.

Experience did not show yet exactly how far a piece of particular length and width can fires when it is loaded with a certain weight of gun-powder. The only thing one knows for sure is that a piece of average length shoots further than one that is shorter or longer; the reason for this is supposed to be the fact that when the barrel is shorter the ball has not yet got the power of the gunpowder before it leaves the piece; at a longer one the ball loses its speed/ power before it has left the barrel. Secondly a piece shoots further if lifted up slightly than when kept horizontal, and a piece of ordnance lifted a 45 degrees shoots the farthest. Thirdly experience shows that one shoots further over land than over sea: the reason for this appears to be that the damp of the water decreases the speed of the ball.

They say that a piece which recoil is obstructed, shoots further than one that is free to go backwards, due to lack of transmission of movement.

Here about, because not useless, the weight of the balls, depending of their centre-lines can be found. To get to know that, one should: Take a ball which is really round, whether made of iron, or of lead, or stone, or another material, from which you want to know the weight; divide its diameter in 100 similar parts. A ball with a diameter of 126 parts for example weights 2 *pont*; a ball which diameter contains 144 parts will weight 3 *pont*, and so on, see the following table for more details.

<i>Ponden</i>	<i>Radius</i>	<i>Ponden</i>	<i>Radius</i>	<i>Ponden</i>	<i>Radius</i>
$1\frac{1}{2}$	79	$14\frac{1}{2}$	244	37	333
1	100	15	$246\frac{1}{2}$	38	336
$1\frac{1}{2}$	$114\frac{1}{2}$	$15\frac{1}{2}$	$249\frac{1}{2}$	39	339
2	126	16	252	40	342
$2\frac{1}{2}$	136	$16\frac{1}{2}$	$254\frac{1}{2}$	41	345
3	144	17	257	42	$347\frac{2}{3}$
$3\frac{1}{2}$	152	$17\frac{1}{2}$	$259\frac{1}{2}$	43	$350\frac{1}{2}$
4	159	18	262	44	353
$4\frac{1}{2}$	165	$18\frac{1}{2}$	$264\frac{1}{3}$	45	$355\frac{1}{2}$
5	171	19	$266\frac{3}{4}$	46	348
$5\frac{1}{2}$	$176\frac{1}{2}$	$19\frac{1}{2}$	$269\frac{1}{3}$	47	$360\frac{1}{2}$
6	182	20	271	48	363
$6\frac{1}{2}$	$186\frac{1}{2}$	21	276	49	$365\frac{1}{2}$
7	191	22	280	50	368
$7\frac{1}{2}$	196	23	284	51	$370\frac{1}{2}$
8	200	24	288	52	373
$8\frac{1}{2}$	204	25	292	53	$375\frac{1}{3}$
9	208	26	296	54	$377\frac{2}{3}$
$9\frac{1}{2}$	212	27	300	55	380
10	$215\frac{1}{3}$	28	$303\frac{1}{2}$	56	$382\frac{1}{3}$
$10\frac{1}{2}$	219	29	307	57	385
11	222	30	$310\frac{1}{2}$	58	$387\frac{1}{4}$
$11\frac{1}{2}$	$225\frac{1}{2}$	31	314	59	$389\frac{1}{2}$
12	229	32	$317\frac{1}{3}$	60	$391\frac{1}{3}$
$12\frac{1}{2}$	232	33	$320\frac{2}{3}$	61	$393\frac{2}{3}$
13	235	34	324	62	396
$13\frac{1}{2}$	238	35	327	63	398
14	241	36	330	64	400

Table 1

In such a way the *Tal-stok* is made up, in which you can find the weight of balls.

The gunpowder was tested in the following way: put a little of it on a piece of paper, and light it, if all of it burns up rather quickly, without much smoke, with a *blazing* and a clear flame without leaving marks, and without damaging the paper, then the gunpowder is of a very good quality and is strong, when all these things do not appear, there must be some defect. The greyish gunpowder, which is a ting reddish is supposed to be the best.

To make gunpowder, you take 6 *pont* 8 *loot*<sup>1</sup> purified saltpetre, 29 *loot* sulphur, and 1 *pont* 8 *loot*, or 1 *pont* *vuil-bomen kolen* [ALDER BUCKTHORN COAL]. Others take 6 *pont* 4 *loot* rough saltpetre, 29 *loot* melted sulphur, and 1 *pont* 5 *loot* coals, moistened *wijnedik* [VINEGAR]. Others take 6 *pont* 4 *loot* purified or broken saltpetre, 28 *pont* sulphur, and  $1\frac{1}{2}$  *pont* alder buckthorn coal, moistened with vinegar, and let it work 24 hours. Some take 6 *pont*

<sup>1</sup> *Loot* or *lood* is a weight in former days a half *ons*, which was a twelfth of a *pond* (500 gram); at present  $\frac{1}{10}$  of an *ons* (100 gram).

8 *loot* purified rough saltpetre, 28 *pont* pure sulphur, 1 *pont* and  $\frac{1}{2}$  *loot* coals, and let it work the same time as mentioned before. Take notice of the state of the corns, are they solid, coarse or fine. Of old one made gunpowder without corn, as is still the case in China.

All bronze or iron straight running pieces, which have their proper *evenmaat* [SEIZE], and fires from 8 till 16 *pont* with  $\frac{3}{4}$  of the weight of the balls; the ones which fires from 16 till 48 *pont* with  $\frac{2}{3}$  of the same weight. The daily shots are from 1 till 8 *pont* iron,  $\frac{3}{4}$  of the weight of the balls on the gunpowder, and so on till 18 *pont* to advenant; yet from 18 till 48 *pont*, the balls half of the weight. Concerning the reduced shots, gunpowder is taken on advice of the gunner. I will give some measurements of the filling of the cartridge: Give to the pieces that fires 2 *pont* iron  $1\frac{1}{2}$  *pont* gunpowder, and these are not decreased by their daily shots; and from 2 till 12 *pont* give a  $\frac{1}{2}$  *pont* more for every *pont* iron that the balls weight more than 2 *pont*: furthermore from 12 till 48 *pont* give  $13\frac{1}{3}$  *loot* gunpowder at each *pont* iron that the piece shoots, as in the following table:

Iron balls	Proof shot in gun-powder	Daily shot	Reduced shot
1	1	$\frac{3}{4}$	$\frac{3}{4}$
2	2	$1\frac{1}{2}$	$1\frac{1}{2}$
4	4	3	$2\frac{1}{2}$
6	6	$4\frac{1}{2}$	$3\frac{1}{2}$
8	8	6	$4\frac{1}{2}$
12	9	7	6
16	11	8	7
18	12	9	$7\frac{1}{2}$
24	16	12	9

Table 2

Aloy of spijs	Ponts of gun-powder	Aloy of spijs	Ponts of gun-powder
300	$\frac{3}{4}$	5200	$11\frac{1}{2}$
400	1	5600	12
800	$1\frac{3}{4}$	6000	13
1200	$2\frac{3}{4}$	6400	14
1600	$3\frac{3}{4}$	6800	$14\frac{1}{2}$
2000	$4\frac{1}{2}$	7200	15
2400	$5\frac{1}{2}$	7600	$15\frac{1}{2}$
2800	$6\frac{1}{2}$	8000	16
3200	$7\frac{1}{2}$	8400	$16\frac{1}{2}$
3600	8	8800	$17\frac{1}{4}$
4000	$8\frac{1}{2}$	9400	$17\frac{3}{4}$
4400	$9\frac{1}{2}$	9600	18
4800	$10\frac{1}{2}$	10000	$18\frac{1}{2}$

Table 3

Some reckon the weight of the gunpowder to the weight of the pieces, giving for each 300 *pont spijs* [CAST] 1 *pont* gunpowder for a proof shot, understandingly metal pieces: for a daily shot, each 400 *pont* metal, 1 *pont* gunpowder: and for the reduced shots with metal pieces, as in table 3

When using iron ordnance you should take for a proof shot for each 400 *pont* of the weight of the piece 1 *pont* gunpowder; for a daily shot you should take for each 500 *pont spijs* 1 *pont* gunpowder; for a reduced shot you should act as indicated by the previous table 3, taking instead of 400 *pont* metal, 1000 *pont* iron, and so on.

If the seize of the muzzle is known, you can find in the following table how many *pont* of either iron, lead or stone can be fired with a piece of ordnance.

<i>Duimen</i> in the muzzle	Iron balls	Lead balls	Stone balls
1 <sup>1/2</sup>	3/4	1	
2	1	2	
2 <sup>1/4</sup>	1 <sup>1/2</sup>	3	
2 <sup>1/2</sup>	2	4	
2 <sup>3/4</sup>	2 <sup>1/2</sup>	5	
3	3 <sup>1/2</sup>	6	3/4
3 <sup>1/4</sup>	4	7	1
3 <sup>1/2</sup>	5	8 <sup>1/2</sup>	
3 <sup>3/4</sup>	5 <sup>1/2</sup>	13	2
4	8	15	
4 <sup>1/4</sup>	10	18	2 <sup>1/2</sup>
4 <sup>3/4</sup>	15	26	4
5	17	30	4 <sup>1/2</sup>
5 <sup>1/4</sup>	20	36	5
5 <sup>1/2</sup>	22	40	6
5 <sup>3/4</sup>	24	44	6 <sup>1/2</sup>
6	26	47	7 <sup>1/2</sup>
6 <sup>1/4</sup>	31	55	8 <sup>1/2</sup>
6 <sup>1/2</sup>	36	65	10
6 <sup>3/4</sup>	40	72	11
7	44	80	12 <sup>1/2</sup>
7 <sup>1/4</sup>	50	90	14
7 <sup>1/2</sup>	55	100	16
7 <sup>3/4</sup>	60	120	17
8	65	140	18
8 <sup>1/4</sup>	71	160	20
8 <sup>1/2</sup>	78		22 <sup>1/2</sup>
8 <sup>3/4</sup>	85		24
9	92		26
9 <sup>1/4</sup>	100		27 <sup>1/2</sup>
9 <sup>1/2</sup>	115		30

Table 4

To find the play of the ball related to the different pieces of ordnance, you should act in the following way: Take the circumference of the muzzle of the piece of ordnance *a b c d*, which diameter is *b d*; take with a pair of compasses half of the diameter as in *e d*, and put it from *d* to *c* and *a*; then take with the pair of compasses the width *a c*, and put one leg of the compasses in *d*, the other one should be placed then on the diameter *b d*, at *f*. Divide *f b* in three similar parts, one of these parts gives you *e to h*, and draw from *h* as a middle point a circle through *d* and this circle is the size of the ball; and the two third parts *b i* the desirable play, if the ball is not more than 10 *point* iron.



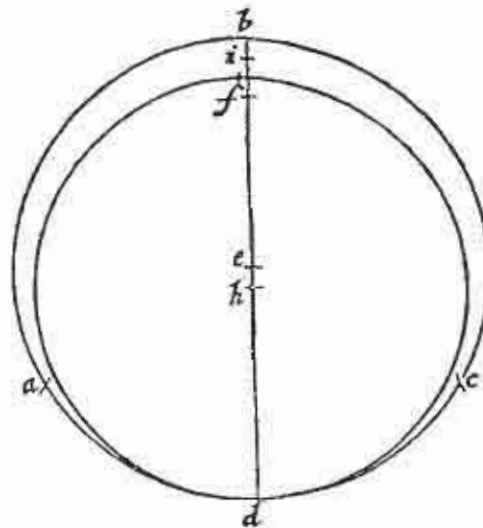


Figure 1

If the ball has more weight the play would be too big; therefore take on the *tal-stok* the interval from 12 till 15 *pont*, and keep this as a general wintage for all pieces firing more than 12 *pont* iron. If a piece shoots 18 *pont* iron, it should be drilled for 22 *pont*; 24 *pont* iron for 28 *pont*; 48 *pont* iron for 54 *pont*, and so on.

There are however several bronze pieces used on board of the ships, which have less space for the play of the ball, namely: one gives them  $\frac{1}{4}$  *duim*, and this to all pieces, no matter what they are; a piece drilled on 14 *pont*, fires 12 *pont* iron; 21 *pont* fires 24 *pont* iron; and so on. With this kept in mind a gunner can make his moulds, in order to fit the proper balls with great care to various pieces of ordnance.

In case a piece showed up, which is rusted heavily and which has no use any more, you should load it with a spoonful of gunpowder if the piece load should be 2 spoons, take a bean seize of saltpetre or camphor, and load it into the vent, put thereupon the 'loading-gunpowder' and fire it with a running fire. In this way the rust will be blown off. Load it then again with a proof shot and when fired it should be clean and ready to use.

A spiked gun can be cleaned in the following way: Load the piece with half of the gunpowder it needs for its daily shot, and press it firmly with a *aanzetter*, subsequently take a round piece of timber that fits precisely in the piece and closes it well, and make a groove in it. Drive the timber (which should be a cubit long) firm into the piece, the groove below, sprinkle gunpowder along the piece, into the groove and light it fore in the muzzle, but watch for the wad and the spike.

You can do the same by this way: make a aqua fortis by: take a half *mutts* [CAP] strong vinegar, 4 *ons* saltpetre, 1 *ons* salt, 4 *ons* verdigris, and a half *mutts* linseed oil, mix it together in another pot and cook it 3 or 4 hours without boiling over, then leave it in a bottle placed in the sun. Besmear with this aqua fortis your spike through the vent and it will eat and digest it, and be right of use again.

The first thing a careful gunner should do when he arrives on board of a new ship is to classify all the pieces, and check their numbers and the state they are in

He has to clean the pieces with a spoon and a sponge in order there isn't left any old gunpowder, sand, pieces of old iron, or any other material that can be harmful if left there.

He has to check the pieces inside as well, and see if they clockwise has no banks or pits.

He should also check the distance each piece fires with how much *pont* iron, putting the weight of the ball above each gun-port, in order that the same number can be written on the cartridges.

When the pieces are clean and approved of, he should fire them with half a spoon gunpowder, and again sponge well before loading; don't load the pieces unless with a cartridge, which should be fitted at the back carefully, putting on the cartridge a solid wad, and then again a wad on the ball to prevent losing the balls when the ship rolls. He should not put the pieces away before he has closed the muzzles with wooden stops, and has besmeared them with soot, this



for watering in; the same should be done with the vent of the pieces before putting the lit on them.

When the pieces are loaded and put away, one should make for each piece at least 24 cartridges, of which twelve unfilled, the latter ones can be filled easily when in a hurry.

He should as well take care when working with gunpowder that all the fires on board are off. And he should arrange his cartridges, boxes and barrels efficiently, in order to make them easy to use if needed.

The different seized balls should be arranged as well, a different box for each weight, the weight written on the box.

And the shot-bag for the *boven-geschut* [UPPER-ORDNANCE] should be ready in time. The best ones are those made of *pomp-leder* [thick brown leather] with a light wooden bottom pinned on them, and they should be filled with musket bullets, because experience shows that they cause great damage to the enemy's side.

When it happens that some new gun-ports are needed, take care that they are made above the *balk*, or about or if possible on the same level as the other gun-ports, and that there is enough space for play, in order when loosing a piece from the mounting a new one can be placed without much trouble.

The mountings on their wheels should be placed in a way that the upper side of it reaches straight to the half of the gun-port, in this case one is able to manage them as one likes.

The gunner should take care that the powder-barrels are covered with leather skins; that the wheels of the mountings are greased with soap; that the ropes and sponges are easy accessible. And there should be taken great care of the fuses, the candles and the fires in order to prevent fire in the gun-room.

He should keep notes off all the tools for the ordnance, like powder, balls, and so on, what is used and what left, so that he can give a good account of everything.

A *bosschieter* should when handling a enemy place a barrel of water between each two pieces, and after 7 or 8 shots the sponge should be dipped in the water and shaken, this keeps the pieces clean and cool when wiping them with the sponges.

He should as well take care that the enemy is got hitten as often as possible, in order to see to it that they don't get advantage by to many of our misses.

A young and future gunner should give notice to the following if he wants to learn how to fire a proper shot: In order that the target ships are in the level of the balls flight, put your thumbs at the back of the *broekstuk* [BREECHE] of the piece straight across the vent, forming in this way a loop-hole the seize of a *erret*. You should see through this loop-hole from behind the breech across the vent till across the middle of the muzzle, and further till about a estimated 3 or 4, yes even 6 or 8 voet, in front of the enemy's ship into the water, in this way the muzzle of the piece points often level to the hart of the ship. After firing you should fall immediately in front of the piece out of the gun-port and watch exactly where the ball falls, and what the difference is between the flight of the ball and your previous sight, so that you can improve your next shots. But when the enemy's ship is outside the level of the balls, take them again on the bilges or right in the hart, when you are in doubt about if you should fire or not, place your fist behind the bench of the piece and see right over the top of your thumb till across the middle of the muzzle into the sails of the enemy, this happens with 'upper-ordnance', when fired, immediately step on the mounting of the piece and watch the ball's flight, as told before to adapt the next shot.

At the Italian *Bosschieterij* it is held for very impressious, that all the balls hit the ship of the enemy at the same spot, for this reason they wait often very long till they are straight in front of the enemy before they fire. If this is done right, the enemy will be lost in only one firing. To do this point all pieces in the same direction, see picture:

[left out a bit because picture explains everything clearly and Dutch text is vague, pp 504]

On board no melted materials of fire work are allowed to be made only ashore, because this is extremely dangerous.

Fire works are not allowed on deck, in the cabin, or below the poop, but must be kept until needed in the gun-room, caboose or store-room, otherwise there can be expected to be great mischief.

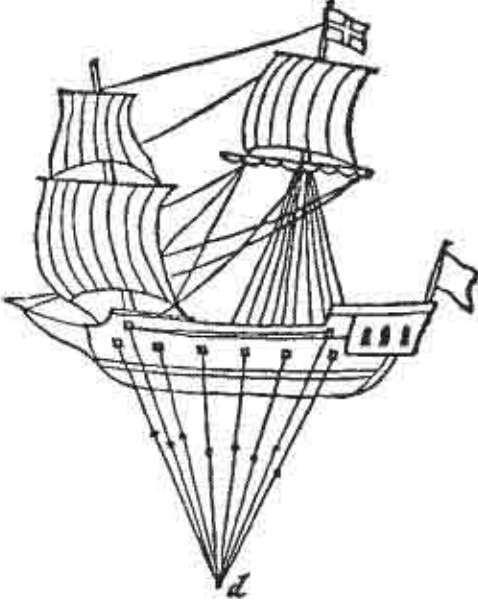


Figure 2