

TEST OF 10 DIFFERENT FARROWING PENS FOR LOOSE-HOUSED SOWS

REPORT NO.1803

None of the ten pens tested scored 'good' or 'very good' in all parameters, and results confirm that further development and testing is necessary to produce a robust farrowing pen for loose-housed sows.

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PUBLISHED: 1 MARCH 2018

Abstract

Ten different farrowing pens for loose-housed sows were tested under identical conditions in a commercial herd. The results show that there are still many challenges to be solved before the requirements of sow, the litter and staff can be fulfilled in one pen. The pens were evaluated according to a range of parameters, which in combination with pig performance will help pig producers decide which farrowing pen to invest in.

None of the pens scored "good" or "very good" in all parameters, which shows that further development of pens for loose-housed lactating sows is necessary before a satisfactory solution is available to Danish pig producers. In addition, to determine whether these pens may be a competitive alternative to conventional farrowing crates, the pig producers need also to include productivity and investment volume required.

Pig producers who consider investing in farrowing pens for loose-housed sows must decide on and prioritize their requirements to the pen: management routine and staff preferences vary from farm to farm, and hence the requirements to the pens will vary. This test provided an impression of the pros and cons of the pens tested. However, before making an investment, pig producers are advised to also visit farms where the pens in questions are used in a large-scale production.

Background

Some pig producers are considering converting their farrowing units and increasingly more pig producers are already investing in farrowing pens for loose-housed sows, and consequently information on and experience with farrowing pens for loose-housed sows is in demand from many parties. Furthermore, according to the 'Declaration of Intent' made at the Animal Welfare Summit in 2014 [1] and the target set by the pig industry, 10% of all sows must be loose-housed during lactation by 2020/2021.

Years ago, the FreeFarrowing (FF) pen, a farrowing pen for loose-housed sows, was developed by SEGES Danish Pig Research Centre in cooperation with Aarhus University, the Danish Animal Welfare Society and commercial manufacturers of farrowing pens. SEGES Danish Pig Research Centre subsequently modified this pen in cooperation with the University of Copenhagen to facilitate restricting the sow's movements, for instance during farrowing. This new, modified pen was called the SWAP pen (SWAP = Sow Welfare And Piglet protection) [2] [3].

The development of the FF pen and the SWAP pen generated a list of criteria deemed necessary by SEGES Danish Pig Research Centre to ensure operational and reliable pens. The requirements of sow, piglets and staff differ, just as some work routines are performed frequently and in many pens, and some are only performed once for each sow. Therefore, there will not be one pen that meets all criteria, and compromises are inevitable when developing and designing a farrowing pen for loose-housed sows.

However, as both sow and piglets must be able to exploit natural behaviour and perform optimum in the farrowing pen, it is possible to list several criteria that should form the cornerstones in the development of these pens [4] [5]. The sow, for instance, needs to be able to perform nest building behaviour in the hours leading up to farrowing, and sow as well as piglets need room to move in the pen. These conditions and many more will automatically generate certain requirements to the size and design of the pen.

Some of the pens for loose-housed lactating sows available today do offer options for restricting the sow's movement around farrowing, but none of these pens are yet fully developed. No country has voluntarily enrolled loose housing of lactating sows, but in countries such as Holland, Austria and the

United Kingdom, various pens for loose-housed lactating sows are already available and may inspire further development of pens for Danish production conditions.

An evaluation of farrowing pens for loose-housed lactating sows available in Denmark and internationally will provide a sound decision-making basis for producers planning to undertake a new building project. The decision may be a difficult one to make as the various types/models differ in so many ways. Being able to witness a variety of pens in operation under identical genetics, management and housing conditions may make this decision easier.

This test focused on parameters deemed essential to sow, piglets and staff in regard to daily use of the pens, and the test did not include analysis of piglet mortality for the pens.

The aim was to evaluate and compare different farrowing pens for loose-housed sows under identical management and housing conditions, and hereby support the decision-making process for pig producers who are about to invest in farrowing pens for loose-housed sows.

Materials and method

The test was conducted on a commercial farm with approx. 1,000 year sows. Three new farrowing sections were built as part of an expansion of the farm: two of these sections were equipped with Vissing Agro Opti-Farrow, and the test facilities were located in the third section.

The test section was divided into five smaller rooms to meet the climate requirements of each design (figure 1). The temperature was generally higher in the section with heat mats (orange) and lower in the section with partly solid floor (green). In the section with the Vereijken Hooijer pen, an alternative ventilation principle was installed (blue, to the right). In the remaining sections, the pens were designed with fully slatted floors and covered creep area.

The test comprised ten types of farrowing pens (producer and name of pen):

1. Big Dutchman (Free Move)
2. Bopil (BeFree)
3. ACO Funki (Welsafe)
4. Vissing Agro (Opti Farrow)
5. Vereijken Hooijer (Pro Dromi 1,5) (Holland)
6. Søren Juul Jensen/Abildballe Innovation (Well-Fair-Pen)
7. STEWA (WING) (Austria)
8. Midland Pig (360) (UK)
9. VSP/KU (SWAP version 2)*
10. Jyden (JLF14-sidevendt)

*Joint venture between the then Danish Pig Research Centre and the University of Copenhagen.

All Danish manufacturers of farrowing pens for loose-housed sows were invited to participate in the test. In addition, three foreign manufacturers were selected according to certain technical criteria, such as new elements, interesting details and space requirement.

Each manufacturer was responsible for installing the farrowing pens per their own recommendations. They also outlined management routines, such as daily cleaning of the sow's lying area and supply of bedding and nest building material.



Figure 1. Outline of the test facilities illustrating the location of each design of farrowing pen.

Each type of pen was tested in six test pens. Where possible, the test pens were placed in the centre of the row of pens from that manufacturer. Images and detailed information of each type are available in the results section and the Appendix.

All sows were transferred to the test section on the same day. The test comprised ten farrowing batches (replicates) corresponding to approx. 60 farrowings per design.

Selection of sows for the trial

The sows for the test were selected one week before transfer to the farrowing unit according to the below criteria:

- Sows with visible/severe leg and hoof problems were excluded from the test

- Identical percentage in terms of age (parity) in each type of pen

Nest building material (straw, jute sack) was supplied daily from transfer until farrowing. In pens with an option to confine, the sows were confined approx. three days before expected farrowing and released approx. five days after farrowing.



Figure 2. In the Vereijken pen, a jute sack was used as nest building material.

Piglets were confined in the creep during the first two feedings of the sow post-farrowing. Litters were crossfostered within 24 hours after farrowing, and the sows had 14 piglets each. Where nursing sows proved necessary, the piglets stayed in the pen and the sow was moved to another section.

Recordings:

- Use of creep area/heat mat: The staff rated the pigs' use of the creep/heat mat twice daily during a resting period (approx. 30 min after the sows were fed, at 7:30 and 14:00) in the first week post-farrowing. Four codes were used to describe the observations: 1=no piglets in the creep; 2=fewer than 50% in the creep; 3=more than 50% in the creep; 4=all piglets nurse.
- Fouling in pens: A technician from SEGES Danish Pig Research Centre recorded fouling in the pens weekly. The pens were divided into five zones (figure 3): 1=creep/heat mat; 2=floor by trough; 3=lying area: solid/drained floor in the pen; 4=dunging area: fully slatted floor; 5=15 cm edge around dunging area. In each zone, fouling was rated: less than 25% was fouled; more than 25% was fouled; more than 50% was fouled; more than 75% was fouled.

- Fouling in trough: Fouling in trough(s) was recorded weekly: 1=clean; 2=cleaning required before next feeding.

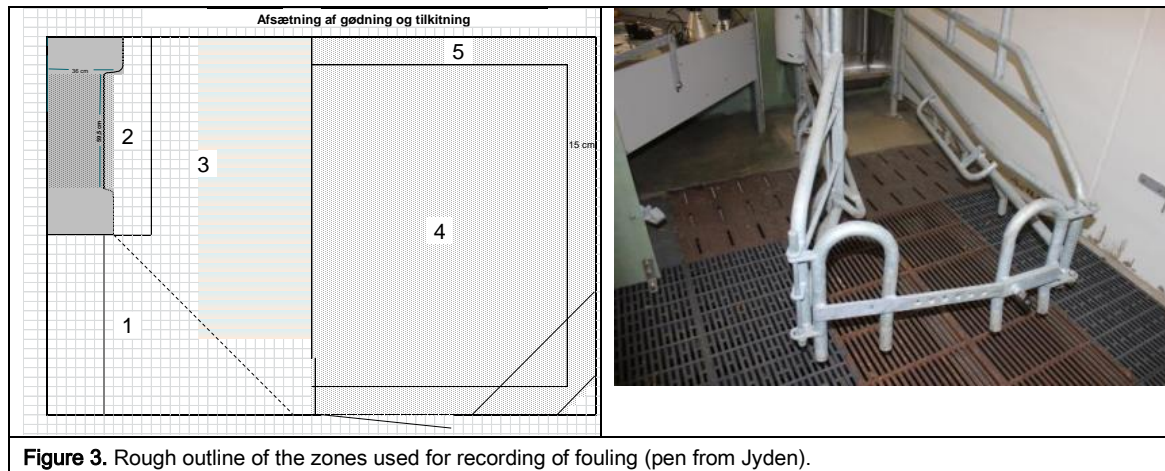


Figure 3. Rough outline of the zones used for recording of fouling (pen from Jyden).

Visual evaluation of the farrowing pens

Using a detailed trial protocol, a technician from SEGES Danish Pig Research Centre visually rated the pens minimum twice during the test period. The full trial protocol can be obtained by contacting the author of this report.

The following parameters were rated:

- Working conditions during transfer of sows to the pens and gate function
- Sow's room for manoeuvre when confined and when loose, including assistance during farrowing
- Sows and piglets with knee injuries
- Dispersal of feed for sow and pigs, including hygiene in the trough
- Design of creep area and supervision of pigs in the creep
- Piglets' use of the creep area
- Working conditions during weaning of sow and piglets
- Working conditions in general and staff safety
- Cleanliness/Hygiene in the pen

In addition to a thorough inspection of the pens, 1-2 of the above parameters were given extra attention in each batch of sows. Conditions were rated before, during and once after farrowing, and each parameter was as a minimum rated twice during the test period to allow the staff to gain experience with the pens. Ratings of each parameter typically included assessment of several sub-parameters, and the overall score is therefore a subjective outcome of several conditions.

Each parameter was rated ****=very good; ***=good; **=below average; *=poor. The description of each pen includes the overall score shown as asterisk after the name of the pen. To be awarded three

asterisks, a given parameter must meet all requirements that could be expected with the technology and know-how available at the time in question.

Statistical analyses

Data were not subject to statistical analyses.

Results and discussion

The test comprised 583 sows, as shown in table 1, and approx. 60 sows per brand. All litters, regardless of pen type, were crossfostered to averagely 14.7 pigs. Sows housed in pens with an option to confine were confined 3.8 days before farrowing and released averagely 4.8 days after farrowing. The data set was not sufficiently comprehensive to allow for further analyses of litter data.

Table 1. Number of sows included in the test and average parity of the sows.

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren Juul	STEWA	Midland	VSP/KU	Jyden	Total
Sows in the test	60	59	60	59	59	59	59	53	58	57	583
Av. parity	3.0	3.0	3.0	2.9	2.9	2.9	3.0	2.9	3.0	2.9	2.9

Working conditions during transfer of sows and gate function

It must be easy for the staff to prepare pen for transfer of sows. The entry conditions must encourage the sow to move forward and the gate must help lead the sow into the pen. Two staff members helped each other transfer sows to the pens. Table 2 shows the overall score for *transfer of sows and gate function*.

In the pen from Big Dutchman* it was rather difficult to operate the equipment used to confine the sows during transfer of sows. If, when the previous sow was weaned, the one side of the equipment had been moved and attached to the trough, the staff had to move it back to the creep area after transfer of a new sow.

In the pen from Vereijken** where two pens shared one entrance, the staff had to push the sides of the equipment used to confine the sows back and forth to make sufficient room for the sow.



Figure 4. Transfer of sows to the Vissing pen. The gate blocks most of the entry and the gate has bars allowing the sow to see what is in front of it.



Figure 5. This handle can be operated with one hand and the gate 'shuts tight' (Jyden).

The staff reported no problems in getting the sow through the gate/entry. However, the entry conditions in the pens from Bopil^{***}, Vereijken^{**}, STEWA^{***} and Midland^{****} were slightly narrow, and the sow had to make a sharp turn to enter the pen. In the pens from Bopil^{***} and STEWA^{***} the sow had to move far into the pen before the staff was able to move the fence of the crate into position and ensure that the sow did not leave the pen.

The gates were all designed and positioned differently. It was difficult to determine whether one type of gates worked better than others as transfer strategies vary between herds. Nevertheless, it should be possible for the gate to stay open, partly to block off part of the passageway, and to be able to operate the gate with one hand. Many of the pens (Big Dutchman^{**}, Bopil^{**}, Vereijken^{**} and STEWA^{****}) had a low gate (approx. 50 cm), and the staff could easily step into the pen. However, if a large group of sows were transferred at the same time, the sows were able to jump over the low gates.

The gates in the pens from Bopil^{**} faced the opposite way as how the sow entered the section and as a result the gates could not be used to block the passageway nor was it possible to operate the gate with one hand. *The gate was subsequently modified, but was not tested.*

The gate from Big Dutchman** easily disconnected when the staff operated it and it was not possible to operate the gate with one hand. The gate from Vereijken** could not block a standard passageway (approx. 1 m wide) and could not be operated with one hand. The gate from Midland** could not remain open or block the passageway, and the shutting device was difficult to operate as it consisted of a pole that had to be inserted through four holes.

In the pen from VSP/KU*** the trough was attached to the gate. This, in combination with the way the feed pipe was fitted (liquid feed), made the gate unable to remain open in several of the pens. *A more appropriate fitting of the feed pipe is possible, but was not modified for this test.*

Table 2. Overall evaluation of working conditions during transfer of sows to the pens and gate function.

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/KU	Jyden
Transfer	*	***	****	****	**	****	***	****	****	****
Gate	**	**	****	****	**	****	****	**	***	****

Sow's room for manoeuvre when confined/loose, including assistance during farrowing

The design of the equipment used to confine the sow must allow the sow to get up and lie down unhindered; there must be room for the staff to provide obstetric aid and there must be plenty of room by the udder the first days post-farrowing. When the sow is loose-housed, it must be able to 'turn around itself' and to lie down freely. Table 4 shows the overall score of the *sow's room for manoeuvre when confined/loose, including assistance during farrowing.*

Recommended inside dimensions of farrowing crates are 65 cm by the post and 90 cm to the back and an inside length of 2.1 m, not including the trough [6]. None of the confinements fully complied with the recommended crate dimensions. In particular the crate from Midland* was very short, and when lying stretched out, the sow lay with its head under the elevated trough. In addition, old sows had difficulty turning around in the pen when housed loose. In the pens from Big Dutchman**, Søren Juul** and STEWA* large sows had difficulty turning around unhindered when housed loose.

In the pen from STEWA* the front part of the confinement could not be widened, and towards the end of the lactation period this became a problem when the pigs tried to access the udder and the sow laid down between the wings.

In the pens from Big Dutchman**, Bopil**, VSP/KU*** and Jyden*** the confinement was placed along one side of the pen. As a result, there was limited room at the front part of the udder in the pens from Big Dutchman** and Bopil**. Furthermore, in the pen from Big Dutchman** the container holding rooting and enrichment material was placed by the trough, which further reduced available space. The pen from Bopil** measured 88 cm from the pen side to the opposite side of the confinement (50 cm

measured from the back of the trough). The other pens with similar location of the confinement measured approx. 100 cm from the side of the pen to the opposite side of the confinement.

Table 3. Design of crate and pen. All measurements are inside dimensions.

* Width by the trough and maximum width. ** Length excl. trough

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/ KU	Jyden
Pen dimensions b x l, m	2.7 x 2.4	2.3 x 2.7	2.4 x 2.4	2.4 x 2.4	2.1 x 3.3	1.8 x 3.3	2.1 x 2.7	2.1 x 2.4	2.1 x 3.0	2.0 x 3.0
Net area pen m ²	6.5	6.2	5.8	5.8	6.9	5.9	5.7	5,0	6.3	6.0
Width of confinement, front/back * cm	68/86	52/86	64/72	55/76	56-69	-	60/71	73/73	64/74	60/67
Length of confinement, mid ** cm	184	200- 240	189- 199	213	174-191	-	210	177	180- 204	190



Figure 6. The pen from FUNKI had plenty of room for sow and piglets when the sow was confined.



Figure 7. Obstetric aid was easily performed in the pen from Midland.

The design of the confinement must allow room for the staff to perform obstetric aid; there must be plenty of room behind the confinement and it must be possible to open the rear gate without the sides of the confinement moving (thereby easier to close the rear gate).

In the pens from Big Dutchman**, Bopil** and VSP/KU** the staff found it difficult to provide obstetric aid when the sow lay on one side (crate placed close to fence of the pen). *Bopil subsequently increased the distance between crate and fence of pen, but this was not tested.* In the pen from Søren Juul** the farrowing rail was in the way if the sow faced the entry gate. It was possible, but difficult, to move the farrowing ring.

In the pens from Big Dutchman**, FUNKI*** and VSP/KU** there was no device holding the pen together when the rear gate opened, which consequently led to extra work as the pen had to be 'reassembled'. In the pen from Vereijken* it was very difficult to provide obstetric aid as the confinement was short and consequently the sow took up all the room within it. This problem was intensified further as the pen was placed up against a wall.

Table 4. Overall evaluation of space in confinement and pen, and assistance during farrowing

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/KU	Jyden
Dimensions	**	**	***	***	***	**	*	*	***	***
Obstetric aid	**	**	***	****	*	**	****	****	**	****

Sows and piglets with knee injuries

It is a requirement that sows and piglets do not sustain injuries of any kind in the farrowing pen. The sows were inspected three times in the farrowing pen: at transfer; when the confinement was opened; and at weaning. The pen from Søren Juul did not include an option to confine, but the sows housed in this pen were inspected at the same time as the others.

There was a large percentage of thin sows in this herd, which is known to increase the risk of shoulder sores. Analyses revealed that there were no differences throughout the test period in the percentage of thin/fat sows between the different types of pens.

It should be noted that the rating of knee injuries comprised only a small number of sows. Results indicate that the percentage of shoulder sores varied between pens with a higher proportion in the pens from Vereijken* and Midland*, and Big Dutchman**, FUNKI**, Vissing* and Jyden** than the others. The percentage of sows with shoulder sores was generally lower in the pens with solid floor. Very few sows were observed with shoulder sores in the pen from Søren Juul***. The development of shoulder sores is also seasonal: thus significantly more shoulder sores were observed in the summer months (batches 9 + 10, farrowing May-August).

The term 'knee injuries' covers multiple leg problems such as pastern lesions on hind legs and injuries on front legs. Research has previously reported of pastern lesions in Danish sows [7], whereas injuries on the front legs are not as frequent. Results reveal a large percentage of sows with injuries on their front legs in pens from Big Dutchman**, FUNKI**, Vissing* and Midland*, which may be attributed to the flooring in these pens. There were no indications that season affected the development of injuries.

Injuries were observed on sows in many of the pens, but none required treatment. The method used to record injuries could not be used to fully determine the triggering factor. However, there were indications that some of the cases observed in the pens from Big Dutchman** and Jyden** were attributed to the pen equipment. Injuries observed on sows in the pen from FUNKI** were attributed to a bar above the trough; injuries observed in the pen from Vereijken* were attributed to a small device holding the jute sack (nest building material); and injuries observed on the backs of sows in the pen from Søren Juul*** were attributed to the pendulum in the pen. *Vereijken subsequently modified the jute sack dispenser, but this was not tested.*

Piglets' knees were examined on d 2-5 and again d 14-18. The variation in age was the result of fitting the examinations into the staff's schedule. Knee injuries were recorded if the skin was torn on either knee. Thus data provide no indication of the severity of the injury or of the number of affected knees.

The percentage of knee injuries tended to drop in this test as floors were exposed to wear. A previous study [8] of knee injuries on piglets revealed that 65% of 3-5-day old piglets had knee injuries. In this study, the pens were equipped with concrete or rubber mats.

Data revealed a lower frequency of knee injuries in the pens from FUNKI**, Vissing**, Vereijken**, STEWA** and Midland** compared with the other pens. Piglets in pens with solid floor in part of the lying area (Bopil*, Søren Juul*, VSP/KU* and Jyden*) had a higher occurrence of knee injuries, but also the floor in the pen from Big Dutchman* lead to knee injuries.

The overall evaluation of this feature is rather conservative as sows and pigs in all pens, regardless of type, had knee injuries.

Table 5. Overall evaluation of knee injuries.

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/KU	Jyden
Injury sow	**	***	**	*	*	***	***	*	***	**
Injury piglet	*	*	**	**	**	*	**	**	*	*

Dispersal of feed to sow and piglets and hygiene in the trough

Sows and pigs must have easy to access fresh feed just as it must be easy for the staff to check the trough. The sow's trough was placed either by the passageway or in the middle or the back of the pen (see appendix). When the trough is placed by the passageway it is easy for the staff to check whether

sow is eating, but access to the sow (in the crate) may be difficult when providing obstetric aid, and vice versa when the trough is placed in the middle or at the back of the pen. The sows were fed liquid feed and the feed dose could be adjusted from the passageway. If sows were fed dry feed, adjustment of the feed dose would be trickier. Table 7 shows the overall evaluation of dispersal of feed for sow and pigs and hygiene in the trough.

The majority of the troughs worked satisfactorily. In the pen from Big Dutchman*** the trough was elevated and as a result small sows often placed their front legs in the trough to reach the feed. Big Dutchman modified the trough, but this did not eliminate the problem.

In many of the pens from Søren Juul*** and VSP/KU*** faeces was observed in the troughs, probably because the trough was placed between the lying area and the dunging area. In addition, fouling was observed in the trough fitted on the gate in the pen from VSP/KU*** when the sow was loose-housed and did not use the trough (sows' only access to water was the trough used for feeding). The trough was cleaned before transfer of the next farrowing batch.

In the pen from STEWA*** feed clotting was regularly seen in the trough.

Table 6. % observations of a clean trough. Data for the VSP/KU pen includes both troughs: trough 1/trough 2 (on the gate).

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/KU	Jyden
Trough	98	97	98	96	95	89	97	96	87/86	98



Figure 8. The trough from STEWA was easy to empty.



Figure 9. Feed for the piglets can be provided without the sow gaining access to the feed (Big Dutchman).

It is quite a challenge to feed piglets without the sow gaining access to the feed. However, feed for the piglets should not be dispersed in the creep as that often leads to unrest and fouling.

In the pen from Jyden^{***} piglets were fed in a separate part of the pen, but unfortunately this area was often fouled by faeces (from the sow). In the pens from Big Dutchman^{****}, Bopil^{****}, FUNKI^{****}, Vissing^{****} and Vereijken^{****} feed was placed by the gate and protected by the side of the confinement. In the pens from Søren Juul^{***}, STEWA^{***}, Midland^{***} and VSP/KU^{***} feed was provided in the creep/on the heat mat.

In the pen from Vereijken^{****} feed was dispersed from a feeder placed in the intersection between two pens. This was overall a fine solution, but if one pen was empty, observations revealed a very poor level of hygiene and a large amount of feed wastage.

Table 7. Overall evaluation of dispersal of feed and hygiene in the trough.

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/KU	Jyden
Feed sow	***	****	****	****	****	***	***	****	***	****
Feed piglet	****	****	****	****	****	***	***	***	***	***

Design of creep area and supervision of pigs in creep area

The creep area is an excellent opportunity for increasing the temperature in the pigs' microclimate. The creep can also be used to confine the piglets during feeding of the sow in the first 24 hours post-farrowing. On the other hand, a heat mat makes it easier for the staff to inspect the pigs, but requires more energy for heating.

To create an optimum microclimate for the piglets, the creep must be large enough to fit all pigs at the same time as a minimum for the first couple of weeks. Research shows that ten 4-week-old pigs take up approx. 1 m² when they lie in partial lateral position and recommended minimum size of the creep is therefore 0.8 m² [9]. In this herd, litters were crossfostered to approx. 15 pigs per litter, and data shows that in the first few weeks post-farrowing all piglets fitted in the creep/heat mats. The creep from VSP/KU had a net area of approx. 1 m², while the other pens, with the exception of the pens from Søren Juul and Midland, had a creep/heat mat of slightly less than 1 m² (table 8).

Danish legislation requires that all pigs must be able to lie down on solid floor at the same time in the farrowing pen and this must of course be met. The appendix provides an outline of the percentage of solid floor in each pen.

Table 8. Net area in creep/heat mat

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/KU	Jyden
M ²	0.8	0.8	0.8	0.9	0.9	0.6	0.8	0.7	1.0	0.8

Table 9 shows the overall evaluation of creep design and inspection of pigs in creep/pen.

It must be easy for the staff to reach all pigs in the creep area from the passageway. In the pens equipped with a creep area it was possible to see all pigs by opening the roof of the creep. The exception is the pen from FUNKI** where the opening to the creep was small (two-piece cover), the creep was deep and the handle operating the cover board was slightly in the way. In the pens from Vissing**, Søren Juul** and VSP/KU** the creep was deep and it was difficult to reach all pigs from the passageway.

When the staff works in the pen and the sow is loose, it must be easy to confine the piglets in the creep. In the pen from Big Dutchman** there was quite a distance between the sow's area and the creep. In the pens from Søren Juul** and Vereijken** the fence by the creep was very high.

In all pens with a creep, it was possible to use a board to cover the front of the creep area: in most of the pens this board was attached to the creep, but in the pen from Vissing** the boards were stacked outside the pen in the passageway (*cover could be attached, but this feature was not tested*). In the

pen from Vereijken** it was possible to shut the openings to the creep and divide the creep into zones using small boards stacked outside the pen.

In the pens from Big Dutchman**, VSP/KU** and Jyden***, the board was heavy and difficult to handle in the daily work. In the pen from Big Dutchman** the board sometimes got stuck which made handling it even more difficult. In the pen from Bopil*** the staff was unable to see if piglets were crushed when the board was lowered. In a few cases, the sow unintentionally made the board drop thereby keeping the pigs inside/outside the creep.

The pens from STEWA** and Midland** were not equipped with such a board, and that at times made it difficult to feed the sow the first 24 hours post-weaning.

In the pens from Big Dutchman** and Søren Juul** the boards clashed when the creeps in two adjoining pens were opened at the same time, which was rather inappropriate.



Figure 10. The creep in the VSP/KU pen was spacious and had plenty of room for all piglets.



Figure 11. The creep in the pen from Søren Juul was located close to the sow's lying area, which encouraged the piglets to use the creep soon after farrowing.

Table 9. Overall evaluation of creep area and supervision of piglets in the creep/pen.

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/ KU	Jyden
Creep space	***	***	***	***	***	**	***	**	****	***
Supervision	**	***	**	**	**	**	**	**	**	***

Piglet use of the creep area

When piglets use the creep area, the risk of crushing drops and it is easier to create an optimum environment for the pigs. The piglets' use of the creep was observed during a period of rest the first six days post-farrowing: noon and afternoon (figure 12). It was not determined whether the immediate environment was optimum as the pigs' lying position was not recorded.

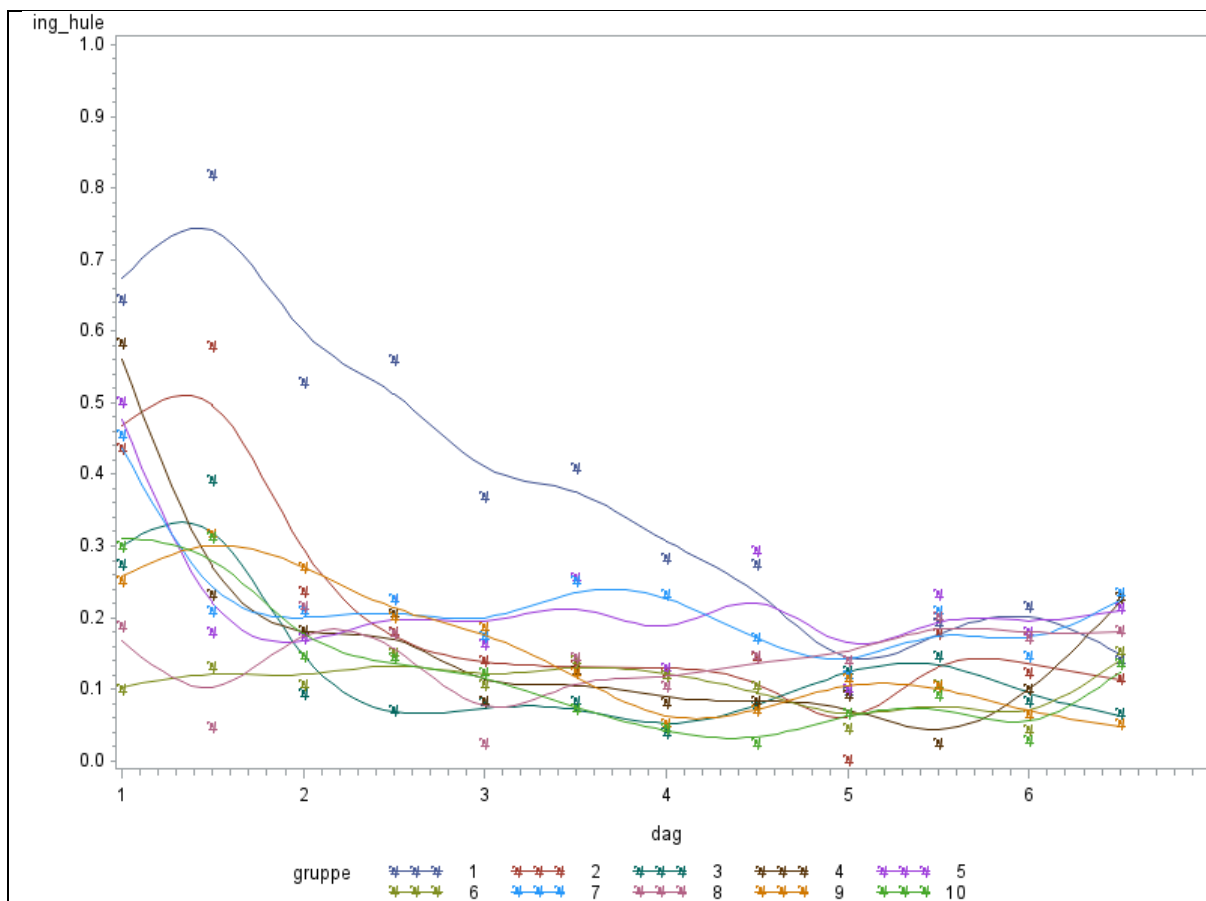


Figure 12. % observations of no piglets in the creep d 1-6 (d=0 when piglets were born is excluded due to few recordings). 1-10 represents the individual companies in the test.

Table 11 shows the overall evaluation of the pigs' use of the creep.

In particular the piglets in the pen from Big Dutchman* took longer time to start using the creep area, most likely due to a long distance between sow/udder and creep (table 10). In the pens from Bopil***, Vissing***, Vereijken*** and STEWA*** around half of the pigs used the creep on day 1 and the majority of the pigs used the creep the following days. In the pens from Søren Juul**** and Midland**** most pigs used the creep/heat mat soon after farrowing. Note that because the pen from Midland was very narrow, the heat mat was very close to the sow/crate.

Table 10. Shortest distance from sow lying in the crate (mid-udder) to creep entry and distance from udder (front legs) to creep entry (cm) when the sow was lying with the udder towards the creep.

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/KU	Jyden
Sow – creep	130	75	45	50	100	60	30	40	70	70
Udder by front legs - creep	150	40	45	50	60	40	30	40	45	80

Table 11. Overall evaluation of piglet use of the creep/heat mat

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/KU	Jyden
Use of creep	*	***	***	***	***	****	***	****	***	***

Working conditions during weaning of sow and piglets

Staff needs easy access to the pen when they wean the sows just as it must be easy to lead the sow out of the pen. It should also be possible to collect the pigs and lead them out of the pen without having to lift them. Table 12 shows the overall evaluation of weaning of sow and pigs.

The staff reported that in the pen from Big Dutchman** and partly the pen from Vereijken*** additional work was required during weaning of the sow as they had to move the equipment used to confine the sows to avoid blocking the exit.

In the pen from Bopil*** the sow risked getting its head 'caught' by the equipment used for confinement when leaving the pen. In the pens from STEWA***, Midland*** and Jyden*** it was also difficult to turn the sow around and make it move in the right direction. This was primarily due to the fact that the pens were narrow and that the sow moved towards the trough (Midland*** and Jyden***), and that it was difficult to completely remove equipment used for confinement (STEWA***). In the pen from VSP/KU**** it was difficult to keep the gate to the pen open, as reported also when sows were transferred to the pens.

In all the pens, it was possible for one person to wean the sows.

When pig producers wean an entire litter of pigs, they often block the access to the creep with a board. This was not an option in the pens from STEWA*** and Midland**. In the pen from Vissing*** the board was not permanently fitted, but was placed in the passageway. In the remaining pens, it was possible to block the access to the creep.

In the pen from Vereijken*** 'Easy Catch' was installed on one of the entries to the creep area (automatic one-way gate), which made it possible to gather pigs automatically over time in the creep, though not all pigs in that age group used the creep. Furthermore, the creep did not fit all pigs at weaning. Some pigs managed to open the Easy Catch from inside the creep, and therefore this option was not used.

When designing pens for loose-housed farrowing sows, manufacturers should make sure that there are no obstacles when staff collects and moves pigs from the pen. In some of the pens, there were areas where the pigs could hide and/or where it was difficult to use, for instance, a board. This in particular applied to the pens from Big Dutchman*** (between wall and fence of the crate), Bopil*** (by the swing fence of the crate), Vereijken*** (crate equipment), STEWA*** (crate equipment) and Jyden** (between creep and gate in the corner with feed for the pigs).

In the pens from Midland** and Jyden** the exit was located in the centre of the pen side, which made weaning more difficult. However, in the pen from Midland** some parts of the pen facing the passageway (besides the gate) could be removed, but that did not eliminate all problems related to weaning.

Table 12. Overall evaluation of weaning of sow and piglets.

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/KU	Jyden
Wean sow	**	***	****	****	***	****	***	***	****	***
Wean piglet	***	***	****	***	***	****	***	**	****	**

Working conditions in general and staff safety

Working conditions and staff safety include a wide range of issues. In this test, observations focused on entry conditions to the pen during the daily tasks (eg supervision) and staff safety during confrontations with aggressive sows. Working conditions were also evaluated in connection with certain other parameters (obstetric aid and management of the creep). Table 13 shows the overall evaluation of safety when the sow is loose/confined.

The sow is confined

In the pens from Big Dutchman***, Bopil*** and STEWA*** most of the pen side facing the passageway was low enough for staff to step into the pen without opening the roof of the creep and having to lift their legs up high. The pens from FUNKI**** and Vissing**** were equipped partly with a high gate and partly with a low, narrow entry by the creep. The pen from Jyden*** had a high gate leading into the pen.

In the pen from Vereijken*** it was easy to step over the pen side from one side and into the pen, while it was difficult to access then pen from the opposite side. In the pen from Midland** it was possible to remove part of the front of the pen and thereby gaining access to one side of the sow. Access to the opposite side of the sow was only possible through the adjoining pen.

In the pen from VSP/KU** staff was instructed not to use the gate when the sow was confined. Access to the pen took place via the creep (open the roof, lower the board, step into creep), which was not an optimum solution.

In the pens from Big Dutchman***, Bopil***, Vereijken***, VSP/KU** and Jyden*** there was not enough room for the pigs on one side of the sow when confined as the equipment to confine the sow was placed too far to one side of the pen.

The sow is loose-housed

In the pen from Søren Juul* the sow was permanently loose-housed and it was therefore difficult for the staff to protect themselves from aggressive sows. Staff risked getting caught at the back of the pen if the sow blocked one part of the pen and the pendulum the other.

In the pens from Bopil**** and Vissing**** loose-housed sows could be confined in part of the pen by swinging parts of the confinement around the sow. In the pens from FUNKI**, Vereijken**, STEWA***, VSP/KU** and Jyden** the sows could also be confined. However, in the pens from FUNKI** and Jyden** the confinement could not be locked around the sow as in the other pens.

In the pen from Big Dutchman** it was not possible for the staff to confine the sow in a small part of the pen, which made it difficult to catch the piglets. In the pens from Vereijken** and VSP/KU** it was challenging and physically demanding (heavy equipment) to confine the sow. In the pen from Midland** the staff had to access the adjoining pen to confine the sow. In the pen from STEWA*** the staff had to operate two parts to confine the sow.

Table 13. Overall evaluation of safety (sow loose / confined).

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/KU	Jyden
Safety										
Sow confin.	***	***	****	****	***	-	***	**	**	***
Sow loose	*	****	**	****	**	*	***	**	**	**

Hygiene in the pen

Ideally, the creep area/heat mat and lying area (sow) should be clean, ie no fouling, and defecations in the dunging area be pushed through the slats. The staff cleaned the pens when needed, and the extent of fouling was routinely evaluated during the test period. The pens were divided into zones depending on function/flooring. Table 15 shows the overall evaluation of hygiene in the pens.

Table 14. % 'clean' observations (less than 25% of the pen was fouled (dung)).

* Last pen by the outer wall excluded from data set (heat bridge by outer wall).

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/ KU	Jyden*
Creep	100	91	99	97	84	96	98	98	85	79
Floor by trough	70	82	98	93	72	97	91	94	55	53
Solid / drained floor	90	75	93	91	94	91	96	-	83	68
Fully slatted floor	100	96	99	99	98	98	98	100	99	99
Edge	91	65	92	86	84	63	62	98	82	88

In the pen from Jyden* a large amount of fouling was observed in the creep, which originated from several sources, such as defecation in the area between entry and creep that spread into the creep. Fouling observed in the creep in the pen from VSP/KU* was likely due to fouling (dung) by the sow's trough placed in the middle of the pen. Furthermore, fouling was observed by the trough in the creep.

In the pen from Vereijken** fouling was observed around the Easy Catch, but also by the opening in the middle of the pen. This was most likely due to draught from the passageway/pen. During transport to the farm, the insulation of the creep area had shifted slightly, which also contributed to fouling. Consequently, the creep areas were replaced halfway through the test.

In the pens from Big Dutchman***, Bopil**, Vereijken**, VSP/KU* and Jyden* large amounts of fouling were also observed on the floor by the trough. The recordings made in this test do not clarify the cause of this, but indicate that both the design of the trough and defecation in the area had something to do with it. Halfway through the test, Jyden decided add a concrete casting construction below the trough, but this did not completely eliminate fouling.

The pens from Bopil**, VSP/KU* and Jyden* all had solid/drained floor in the lying area, and in all three pens a large amount of fouling was observed in this area. However, the pen from Søren Juul**** also had solid floor in the lying area, but this did not negatively affect the degree of fouling. In this pen, a little fouling was observed along the pen side opposite the creep, but this constituted only a small percentage of the overall lying area.

In all pens, the fully slatted floor in the dunging area was clean. There were, however, variations in the extent of dung that was pushed through the slats around the edges of the dunging.

Table 15. Overall evaluation of hygiene

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/KU	Jyden
Hygiene	***	**	****	****	**	****	****	****	*	*

Cleanliness of the pen

The staff evaluated the following points during wash of the pens:

- Was it easy to prepare the pen for wash?
- Were any parts/creep/trough in the way during cleaning?
- Was it easy to use the high-pressure cleaning lance during cleaning?

Table 16 shows the overall evaluation of cleanability

All pens, except the VSP/KU** pen, were easy to prepare for wash and the lance was easy to move around during cleaning. In the pens from STEWA*** and VSP/KU** staff reported that some elements were in the way during cleaning. In the pen from STEWA*** the cover of the heat mat was in the way, and in the pen from VSP/KU** the backside of the lying walls was difficult to clean. In addition, the gate could not remain open, but kept closing.

Table 16. Overall evaluation of cleanliness.

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/KU	Jyden
Cleanliness	***	***	****	****	***	****	***	***	**	***

Overall evaluation of the pens

Table 17 shows the overall evaluation of the pens. Farrowing pens for loose-housed sows are still being developed, and this test is one of the first of its kind where several types of pens are assessed under identical, practical conditions. The parameters evaluated in this test were selected on the basis of experiences from other research and development activities concerning farrowing pens for loose-housed sows, but as experience with loose-housed lactating sows under Danish production conditions is still scarce, each parameter must be considered individually. It is not possible to present one overall index per pen as parameters and pig producers/staff priorities differ.

Table 17. Overall evaluation of the pens ¹⁾

	Big D	Bopil	FUNKI	Vissing	Vereijken	Søren	STEWA	Midland	VSP/ KU	Jyden
Transfer	*	***	****	****	**	****	***	****	****	****
Gate	**	**	****	****	**	****	****	**	***	****
Dimension	**	**	***	***	***	**	*	*	***	***
Obstetric aid	**	**	***	****	*	**	****	****	**	****
Injury sow	**	***	**	*	*	***	***	*	***	**
Injury pig	*	*	**	**	**	*	**	**	*	*
Feed sow	***	****	****	****	****	***	***	****	***	****
Feed pig	****	****	****	****	****	***	***	***	***	***
Space creep	***	***	***	***	***	**	***	**	****	***
Supervision	**	***	**	**	**	**	**	**	**	***
Use of creep	*	***	***	***	***	****	***	****	***	***
Wean sow	**	***	****	****	***	****	***	***	****	***
Wean pig	***	***	****	***	***	****	***	**	****	**
Safety										
Sow confin.	***	***	****	****	***	-	***	**	**	***
So loose	*	****	**	****	**	*	***	**	**	**
Hygiene	***	**	****	****	**	****	****	****	*	*
Cleanliness	***	***	****	****	***	****	***	***	**	***

1) ****=very good; ***=good; **=average; and *=poor

To be awarded three asterisks, a parameter must meet all requirements that can rightfully be expected with the technology and know-how available at the time.

Conclusion

The results of this test showed that there were still many challenges to be solved before the requirements of sow, the litter and staff can be fulfilled in one pen.

Pig producers who consider investing in farrowing pens for loose-housed sows must decide on their requirements to the pen: management routine and staff preferences vary from farm to farm, and hence the requirements to the pens will vary. This test provides an impression of the pros and cons of the pens tested. However, before making an investment, pig producers are advised to also visits farms where the pens in questions are used in a large-scale production.

None of the brands were rated “good” or “very good” in all parameters, but several of them achieved satisfactory results in several parameters.

The pens were evaluated according to a range of functional features, but the trial design did not allow a full assessment of whether each pen fulfilled the pigs' behavioural needs and succeed in generating a high performance among the sows nor did the test include the cost of investment for the different designs.

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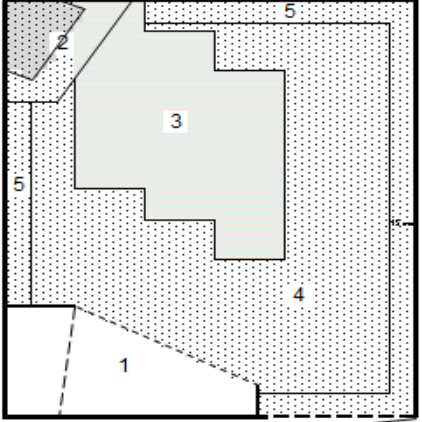
Statistical assistance: Jens Vinther

Trial no. 1348


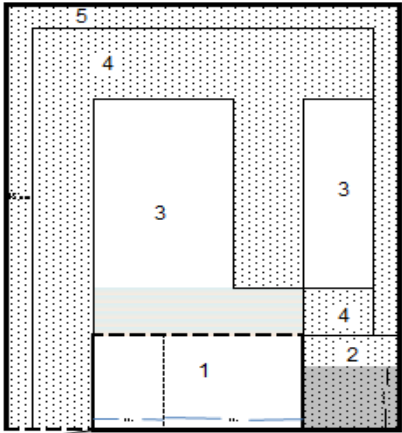
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Appendix


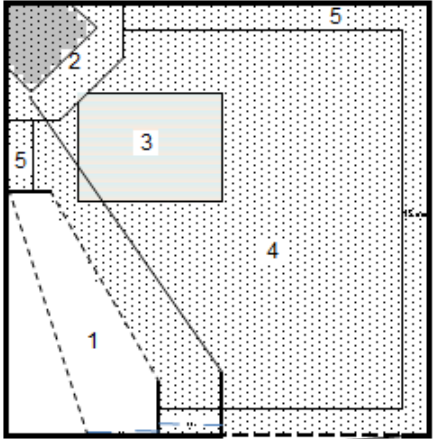
Big Dutchman

	
<p>Flooring</p>	<p>Drained floor (cast iron) in the sow's lying area, slatted floor in the remaining part of the pen (plastic). Solid rubber mat in creep.</p>
<p>m² in creep area/heat mat</p>	<p>0.8 m²</p>
<p>m² solid floor (incl. creep)</p>	<p>0.8 m²</p>
<p>Creep or heat mat</p>	<p>Creep.</p>
<p>Is the roof of the creep split in two, curtain</p>	<p>Yes, creep board forms a curtain, but there is an opening between roof and curtain.</p>
<p>Description of creep board + operation</p>	<p>The creep board is fixed, operated by a cord. The creep board has six holes in the top.</p>
<p>Heat source in creep + controls (on/off, steps, stepless)</p>	<p>Rubber mat on floor and "Animal Care" radiant heat in roof. Heat is controlled by an electronic curve.</p>
<p>Feed for piglets</p>	<p>By creep entry (protected by crate fence).</p>
<p>Rooting & enrichment material</p>	<p>Wooden stick, on crate fence by the trough against the back wall.</p>
<p>Nest building material</p>	<p>Unchopped straw on floor.</p>


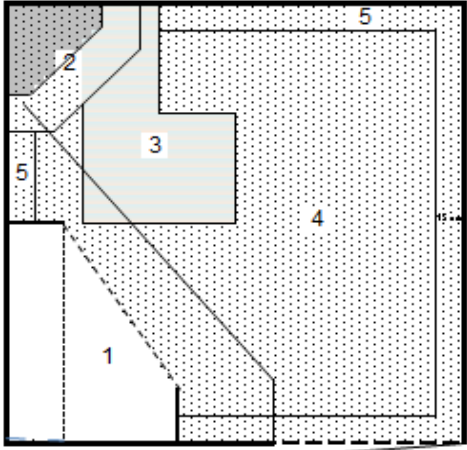
Bopil

	
<p>Flooring</p>	<p>Slatted floor (plastic and cast iron) and solid floor (concrete). Solid floor with plastic elements in creep area.</p>
<p>m² in creep area/heat mat m² solid floor (incl. creep) Creep or heat mat Is the roof of the creep split in two, curtain Description of creep board + operation Heat source in creep + controls (on/off, steps, stepless) Feed for piglets Rooting & enrichment material Nest building material</p>	<p>0.8 m² 2.2 m² Creep Yes, bent edge made of metal. Board is fixed, operated by a cord. Water-borne floor heat and "Aniheater" radiant hear in roof (3 steps: off, half heat, full heat). By creep entry (protected by crate fence). Unchopped straw on floor. Unchopped straw on floor.</p>

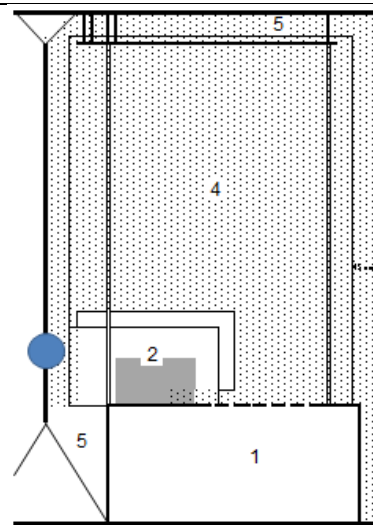
FUNKI

	
<p>Flooring</p>	<p>Slatted floor (plastic and cast iron) and drained floor (cast iron). Slatted floor (plastic) and solid floor (concrete and plastic) in creep.</p>
<p>m² in creep area/heat mat m² solid floor (incl. creep) Creep or heat mat Is the roof of the creep split in two, curtain Description of creep board + operation Heat source in creep + controls (on/off, steps, stepless) Feed for piglets Rooting & enrichment material Nest building material</p>	<p>0.8 m² 0.8 m² Creep Yes, bent edge made of metal. Board is fixed, operated by metal handle that can be adjusted in three heights Water-borne floor heat and heat lamp in roof (on/off). By creep entry (protected by crate fence). Wooden stick by farrowing rail close to the trough Unchopped straw on floor.</p>


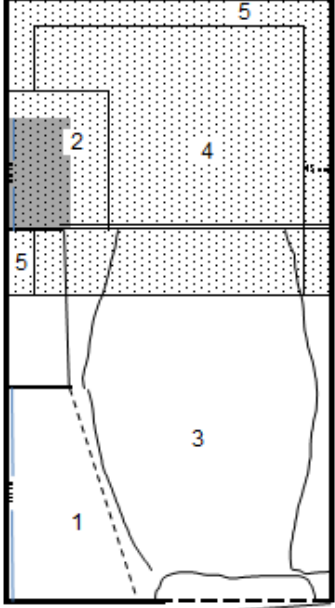
Vissing

	
<p>Flooring</p>	<p>Slatted floor (plastic and cast iron) and drained floor (cast iron). Solid rubber mat in creep.</p>
<p>m² in creep area/heat mat m² solid floor (incl. creep) Creep or heat mat Is the roof of the creep split in two, curtain Description of creep board + operation Heat source in creep + controls (on/off, steps, stepless) Feed for piglets Rooting & enrichment material Nest building material</p>	<p>0.9 m² 0.9 m² Creep Yes, bent edge made of metal Board placed in container in passageway. Floor mat and "Aniheater" radiat heat in roof (3 steps: off, half heat, full heat) By creep entry (protected by crate fence). Wooden stick by farrowing rail close to the trough Unchopped straw on floor.</p>


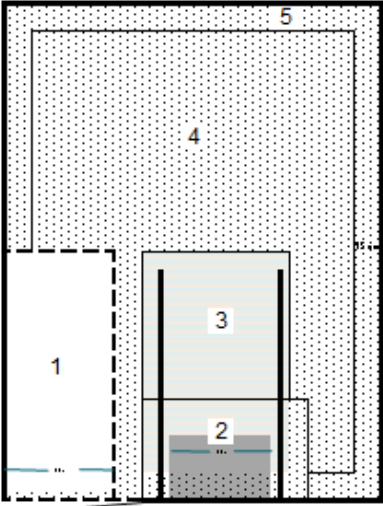
Vereijken




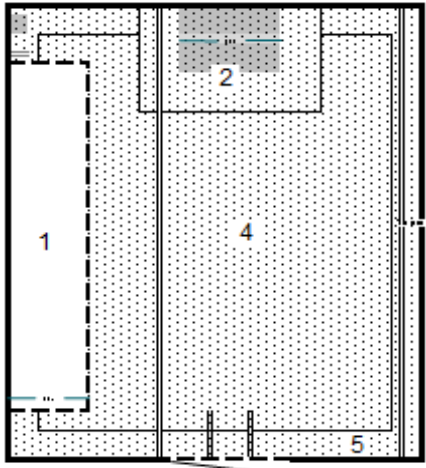
Flooring	Slatted floor (plastic) and solid floor (plastiv). Solid floor of plastic in creep.
m ² in creep area/heat mat	0.9 m ²
m ² solid floor (incl. creep)	1.4/1.7 m ²
Creep or heat mat	Creep
Is the roof of the creep split in two, curtain	No, roof does not shut completely tight
Description of creep board + operation	Three detachable boards (one is used for dividing creep into smaller zones)
Heat source in creep + controls (on/off, steps, stepless)	Water-borne floor heat.
Feed for piglets	By creep entry (protected by crate fence).
Rooting & enrichment material	Wooden stick by farrowing rail close to the trough
Nest building material	Jute sack, by farrowing rail close to the trough.


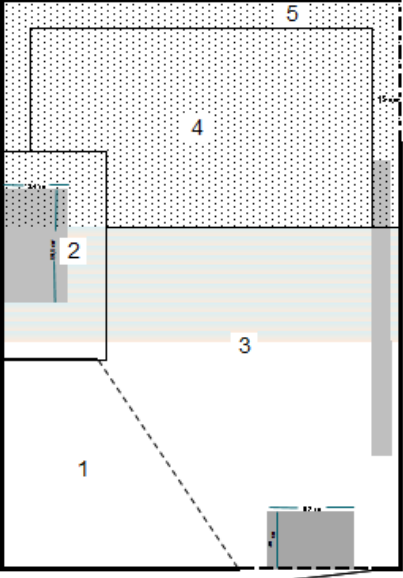
	
<p>Flooring</p>	<p>Slatted floor (cast iron) and solid floor (concrete). Solid concrete floor in creep.</p>
<p>m² in creep area/heat mat m² solid floor (incl. creep) Creep or heat mat Is the roof of the creep split in two, curtain Description of creep board + operation Heat source in creep + controls (on/off, steps, stepless) Feed for piglets Rooting & enrichment material Nest building material</p>	<p>0.6 m² 2.9 m² Creep Yes, board forms a bent edge sealed with rubber moulding Board is fixed, operated by metal handle. Water-borne floor heat and heat lamp in roof of creep (2 steps: Off, half heat, full heat) In creep. Easy-strø + unchopped straw on floor. Easy-strø, on floor.</p>

STEWA


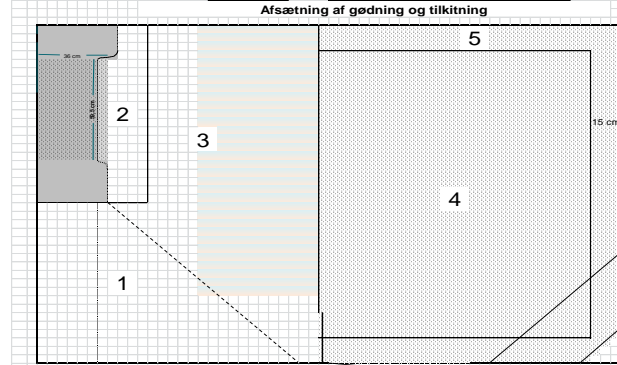
	
<p>Flooring</p>	<p>Slatted floor (plastic and cast iron) and drained floor (concrete and plastic). Solid concrete floor in creep.</p>
<p>m² in creep area/heat mat m² solid floor (incl. creep) Creep or heat mat Is the roof of the creep split in two, curtain Description of creep board + operation Heat source in creep + controls (on/off, steps, stepless) Feed for piglets Rooting & enrichment material Nest building material</p>	<p>0.8 m² 0.8 m² Heat mat, simple cover No, plastic edge on cover No board Water-borne floor heat. On heat mat. Unchopped straw in rack on farrowing rail Unchopped straw in rack on farrowing rail</p>

MIDLAND

	
<p>Flooring</p>	<p>Slatted floor in pen (plastic). Solid plastic floor on heat mat.</p>
<p>m² in creep area/heat mat</p>	<p>0.7 m²</p>
<p>m² solid floor (incl. creep)</p>	<p>0.7 m²</p>
<p>Creep or heat mat</p>	<p>Heat mat</p>
<p>Is the roof of the creep split in two, curtain</p>	<p>No roof</p>
<p>Description of creep board + operation</p>	<p>No board</p>
<p>Heat source in creep + controls (on/off, steps, stepless)</p>	<p>Water-borne floor heat</p>
<p>Feed for piglets</p>	<p>On heat mat</p>
<p>Rooting & enrichment material</p>	<p>Unchopped straw on floor</p>
<p>Nest building material</p>	<p>Unchopped straw on floor</p>

	
<p>Flooring</p>	<p>Slatted floor (cast iron), drained floor (cast iron) and solid floor (concrete). Solid concrete floor in creep.</p>
<p>m² in creep area/heat mat m² solid floor (incl. creep) Creep or heat mat Is the roof of the creep split in two, curtain Description of creep board + operation Heat source in creep + controls (on/off, steps, stepless) Feed for piglets Rooting & enrichment material Nest building material</p>	<p>1 m² 2.6 m² Creep Yes, board forms a bent edge sealed with rubber moulding Board is fixed, operated by metal handle that can be adjusted in three heights Floor heat and "Aniheater" radiant heat in roof (3 steps: off, half heat, full heat) In creep. Unchopped straw in rack on fence by gate/floor Unchopped straw in rack on fence by gate/floor</p>

Jyden

	
<p>Flooring</p>	<p>Solid floor (concrete and plastic), drained floor (cast iron) and slatted floor of plastic and cast iron</p>
<p>m² in creep area/heat mat m² solid floor (incl. creep) Creep or heat mat Is the roof of the creep split in two, curtain Description of creep board + operation Heat source in creep + controls (on/off, steps, stepless) Feed for piglets Rooting & enrichment material Nest building material</p>	<p>0.8 m² 1.9 m² Creep Yes, board forms a bent edge sealed with rubber moulding Board is fixed, operated by metal handle that can be adjusted in three heights Floor heat and heat lamp (on/off). In separate part of the pen. Unchopped straw in rack on farrowing rail Unchopped straw in rack on farrowing rail</p>



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