

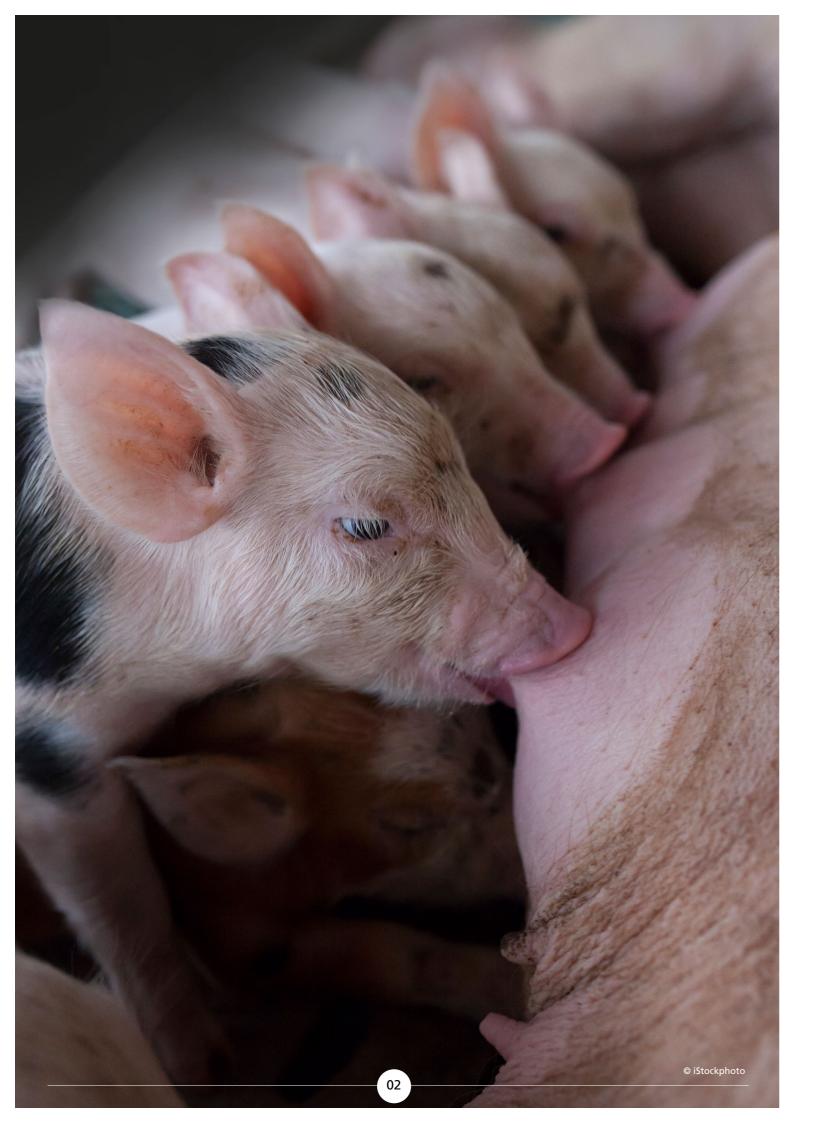


## COMPASSION Food Business

## **INDOOR FARROWING SYSTEMS FOR SOWS**

Practical alternatives to the farrowing crate





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© CIWF, Farrowing crate

## **INTRODUCTION: THE FARROWING CRATE**

Most indoor female breeding pigs (sows) farrow in crates, which are used to restrain sows from approximately 5-7 days before they are due to give birth (pre-farrowing) until their piglets are weaned at approximately 21-28 days of age (post-farrowing, lactation period).

Farrowing crates were introduced to:

- Reduce the risk of sows crushing their piglets by limiting sow movement, particularly as they lie down
- Provide safe working conditions to enter the pen and handle piglets without interference from the sow
- Reduce space requirements during farrowing and lactation, as crates typically measure 3.5-4.5m² per sow and litter
- Improve worker efficiency as crates are usually built on fully or partially slatted floors with no bedding, thus resulting in minimal cleaning.

However, farrowing crates limit the most basic of behaviours in the sow; they are unable to turn around, walk, nest build or form a good maternal bond with their young. In addition, there is an increased risk of piglets being born dead or savaged by their mothers (especially for first time mothers), and piglet behaviour is severely restricted due to the barren environment and lack of space.

Farrowing crates are considered outdated and obsolete. Scientific evidence demonstrates the negative effects of farrowing crates on the welfare of sows and piglets and the latest Eurobarometer<sup>i</sup> report shows that nine in ten (90%) European citizens want a ban on individual cages for farmed animals. There is a growing body of evidence and best-case examples of commercial adoption highlighting key design features of alternative systems to meet the needs of the sow, her piglets and the stock person.

### ALTERNATIVES TO THE FARROWING CRATE

The success of alternative farrowing systems depends on multiple factors but choosing the best pen design is a critical first step. There is a wide range of alternative systems available, but without clear recommendations on pen size and design, there is continued uncertainty in which systems to invest for producers.

There is increasing adoption of alternative systems in countries that have banned farrowing crates, such as Switzerland, Sweden, Norway, Germany and Austria.

A comprehensive overview of indoor alternative farrowing pens can be found at www.freefarrowing.org.uk produced by Scotland's Rural College (SRUC) and Newcastle University. This booklet summarises some of the information provided on the website, particularly in relation to the key features of the farrowing accommodation which contribute to meeting the needs of the sow, piglets and stockperson, and evaluates a number of individual systems. This booklet also includes additional learnings from Compassion in World Farming's visits to farms which operate alternative systems.

There are different types of indoor alternative systems to the farrowing crate, which can be categorised as follows:

- **Temporary crates**: Where sows are routinely confined around farrowing (usually 3-7 days) but freed a few days after. These systems fall below Compassion's recommendations on space and are less likely to be successfully operated in the open position at all times;
- Individual pens with the option to temporarily crate: Are typically larger, welldesigned pens that can be successfully operated in the open position at all times;
- Individual free farrowing pens: Are typically larger, well-designed pens that do not have the option to routinely crate the sows;
- **Group systems:** Allow group housing of sows and their litters during lactation.



© CIWF, PigSAFE visit at SRUC

<sup>&</sup>lt;sup>1</sup> Eurobarometer. Attitudes of Europeans towards Animal Welfare Project title Special Eurobarometer 533 on Animal Welfare-Report [Internet]. 2023. Available from: https://www.europa.eu/eurobarometer

In this booklet, we focus only on indoor alternative systems with the potential to operate successfully under zero confinement: including individual free farrowing pens and pens with the option to temporarily crate, and we briefly introduce indoor group systems.

#### **Definitions**

**Farrowing crates:** Conventional, indoor farrowing systems where the sow is confined in a farrowing crate several days prior to farrowing until she is weaned (a period lasting ~ 4–5 weeks).

**Temporary crates:** Indoor farrowing pens which allow for the routine temporary confinement of the sow, particularly around farrowing (usually 3–7 days) and fall below Compassion's space recommendations for the sow ( $\geq 5.9$ m<sup>2</sup>).

**Pens with the option to temporarily crate:** Indoor farrowing pens which allow for the temporary confinement of the sow, particularly around farrowing (usually 3–7 days) and fall within Compassion's minimum space recommendations for the sow (≥5.9m²) and are more likely to be successfully operated as zero-confinement pens.

Free farrowing pens: Indoor farrowing pens which allow for freedom of movement at all times and fall within Compassion's best practice space recommendations for the sow (≥6.6m²). Free farrowing pens do not have the option to confine the sow, except for stockperson safety and management purposes (less than 1–2 hours).

**Alternative farrowing pens:** Generic reference to pens with the option to temporarily crate and free farrowing pens listed above, without differentiating design or management practices around temporary confinement.

**Outdoor systems:** Generic reference to outdoor systems that farrow sows, in individual or group paddocks with a straw bedded arc for shelter. Well-designed outdoor systems allow for the successful cage-free management of breeding sows.



© Aco Funki, FT30 Free Farrowing Pen

Free farrowing pens marketed by equipment manufacturers include:

- WelCon Bio
- PigSAFE
- SowComfort
- FAT2 System
- ATX® Suisse Structure Bay
- ET2(

Pens with the option to temporarily crate marketed by equipment manufacturers include:

- Evoteck
- Aco Funki® WELSAFE

An evaluation of those systems is presented in this booklet. In addition, some producers have developed their own alternative farrowing pens; examples of those are also featured in this booklet.

# BARRIERS TO ADOPTING ALTERNATIVE FARROWING

Higher capital costs may be offset by higher weaning weight, improved sow condition and lower rates of mortality through good management. Despite offering the opportunity to improve sow welfare during farrowing and lactation, barriers preventing scaled uptake of alternative farrowing systems centre on:

- Concerns around piglet mortality
- Concerns around ease of management, labour and hygiene
- Concerns around the cost of investment and increased cost of production
- Knowledge gaps such as which system to invest in and how to manage alternative systems
- The need for skilled stock people to manage loose sows and the need for a mindset change.

There is evidence that similar levels of piglet mortality can be achieved in alternative farrowing systems compared to farrowing crates but to be successful, multiple factors need to be considered including key design features, good management practices, as well as stockperson and sow experience of these new systems.

A number of projects in several countries have addressed the design of alternative farrowing pens using basic behavioural needs as the starting point of the design process. As these are tested and modified for individual farms, several practical alternatives are becoming commercially viable. Farmers operating these systems emphasise the importance of a positive stockperson-animal relationship for safe management and good performance.

Before considering key features that make alternative farrowing a success, it is important to first understand the needs of the sow, piglets and stockperson(s).



# THE NEEDS OF THE SOW, PIGLETS AND STOCKPERSON

All farrowing systems should be designed to satisfy the **triangle of needs** between the sow, her piglets and the stockperson.

#### SOW

Satisfy behavioural and physical needs (e.g. nest building)

FARROWING SYSTEMS

**STOCKPERSON** 

Good piglet survival,

cost effective,

efficient and safe

#### **PIGLETS**

Satisfy behavioural and physical needs, survive and thrive





© M. Farish, SRUC, Sow nest building

#### **Needs of the sow**

These change throughout the different phases of farrowing:

## Nest building prepares the sow for farrowing. In this phase she needs:

- Space for increased activity, to seek and create a nest site and to turn around
- Private nest site to farrow and rest without disturbance from neighbouring sows
- Manipulable materials to satisfy her motivation to nest build and improve comfort
- Provision of bedding for thermal and physical comfort.

## During farrowing and early lactation, she needs:

- Undisturbed nest site
- Thermal comfort
- Udder comfort.

#### **During late lactation, she needs:**

- Opportunity for sow-neighbour interaction
- Space to gradually reduce contact with her piglets.

Sows must be given time to habituate, or get used to, a new system. Gilts may habituate to alternative farrowing more easily as they have no prior experience of crates. However, research and commercial experience has shown that sows who farrow consistently in the same system have lower piglet mortality compared to sows who farrow in different systems. Training of the sow and continued experience of alternative farrowing pens are vital for a successful transition.

A **sow** is an adult female pig that has previously been bred.

A **gilt** is a young female pig that has not yet been bred and has never given birth.



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### **Needs of the piglets**

Essentially piglets need to survive and thrive. Much of their fate is reliant on good maternal behaviour and systems should be designed in a way that encourage the sow to exhibit this. Sow genetics can influence maternal behaviour and litter size, both of which have a large effect on piglet survival. Incorporating maternal behaviour and reduced litter size into breeding strategies is important for piglet survivability and the commercial success of alternative farrowing systems.

#### **During farrowing and early lactation,** piglets need:

- Thermal comfort
- Colostrum and milk, so easy and almost constant udder access
- Protection, especially from crushing.

#### **During late lactation the piglets need:**

- Thermal comfort
- Good milk provision, so easy udder access
- Protection
- Enrichment (nutritional and environmental)
- Social integration.

#### Important factors to reduce piglet mortality:

#### **Piglet mortality increases:**

- With litter size and lower birth weights associated with hyper prolific breeds
- At low body temperature and extended farrowing periods
- With smaller sow space allowance.

#### Piglet survival can be influenced by selecting sows for:

- Good mobility and care when lying down
- Good maternal behaviour so they require less intervention from the stockperson
- Good temperament so they are calm in the postfarrowing period and are relaxed towards the stockperson.

#### **Good stockmanship is** essential as:

- Mortality may increase when a new system is first installed but good training and a positive attitude will reduce mortality
- Development of a positive human-animal relationship will help the sow to stay relaxed towards the stockperson.





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#### **Needs of the stockperson**

**Stock workers need a safe working environment** which must be considered in the design of the pen. A system will be successful, welfare-friendly, hygienic, safe and profitable if the staff running it can:

- Observe sows and piglets effectively
- Access all areas easily and safely
- Easily exit/escape the pen when necessary
- Clean easily throughout the pen
- Temporarily separate the sow for management purposes (no longer than 2 hours)
- Separate the sow and her piglets for management tasks.

#### Stock workers need appropriate training in

the operation and management of any new farrowing system. They are required to have a positive attitude for change and to adapt their working practices to suit the new system. Transitioning to alternative farrowing requires stock workers to have an open mind:

- Alternative systems can be very different to conventional crates and trying to manage them as crates may slow progress.
- Sows will behave differently when unrestrained. Having a good human-animal relationship with the sow (including in the dry sow house) will benefit working routines, as well as piglet and sow welfare. Gentling the sow pre-farrowing will also allow safer interactions post-farrowing.
- Stockperson training is fundamental to the success of a new system so that stock workers can set up a routine and confidently and calmly manage loose sows.

Stock workers need to take ownership of a new system, but also need management support to resolve any issues arising. At all times, stock workers need:

- Good piglet survival
- Efficient working environment
- Safe working environment
- Cost effective working environment.

By understanding the needs of the sows, piglets and stockpersons, key design features can be identified for an alternative farrowing system to be successful.

### **KEY FEATURES OF FARROWING SYSTEMS**

Pen design is a crucial determinant in delivering good sow and piglet welfare. Key pen design features include:

- Sufficient space
- Separate functional areas
- Anti-crushing features
- Attractive and safe creep area
- Nesting material and bedding
- Comfortable flooring and waste management
- Appropriate thermal environment

In 2022, The European Food Safety Authority (EFSA) published a Scientific Opinion on the welfare of pigs on farm<sup>ii</sup> which identifies welfare issues that pigs and piglets are exposed to when kept in farrowing crates and recommends measures to prevent or mitigate these issues using alternative farrowing systems.

" EFSA (2022) Welfare of pigs on farm.



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## EFSA Scientific Opinion on the Welfare of Pigs: Pen Design Recommendations

Pen size: minimum 7.8m<sup>2</sup>

Space allowance per sow: minimum

6.6m<sup>2</sup>

**Pen design**: separation of functional areas (lying/nesting, feeding and dunging areas); designed to maximise nestbuilding and maternal behaviour.

**Well-designed nest site**: with anticrushing features such as sloped walls and farrowing rails.

#### Attractive and safe creep area:

inaccessible to the sow, heated, spacious (i.e. at least 1-1.2m<sup>2</sup> based on an average litter size of 14 piglets) with bedding.

**Flooring**: non-slip and comfortable for the sow to rest. Includes an area of solid flooring in the nest area, large enough to allow nest building and allows for hygiene maintenance (e.g. through a slatted dunging area, sloped flooring, perforated floors). Waste management should be designed with the flooring and bedding system in mind.

**Substrate to promote nest building behaviour**: sufficient prior to farrowing (i.e. above a depth of 5cm) and made of material with longer structure (e.g. long cut straw).

**Bedding**: straw available at all times for physical and thermal comfort.

**Design ensuring workers' safety**: e.g. easy observation and safe access to the sow and the piglets.







#### Sufficient space

Providing sufficient space is crucial when designing an alternative farrowing pen to allow freedom of movement for the sow and to minimise piglet crushing.

It is important to consider:

- Space allowance for the sow
- Size of the creep area
- Total pen size.

Some pens have large total pen sizes but, if poorly designed, the sow may only have access to a small area making it difficult for her to turn around, lie down and keep the space clean.

#### For the sow

Sufficient space is required for the sow be able to turn around unhindered, rest comfortably in a lateral position and dung in a dedicated area to maintain hygiene.

#### **Space recommendations are based on:**

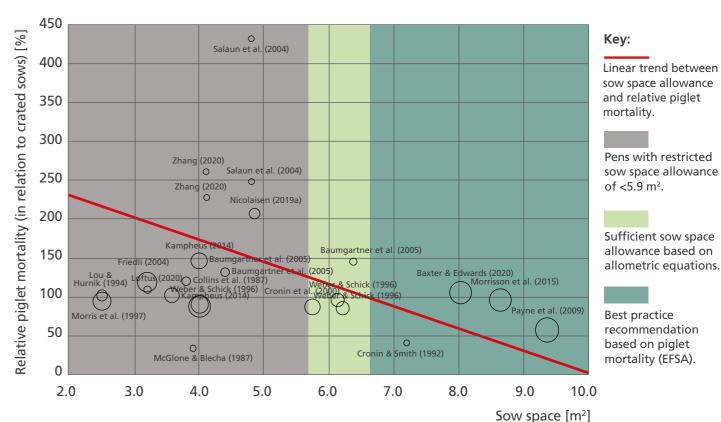
- The size of the sow data collated from commercial farms in Denmark showed a modern day, large sowii can weigh up to 352kg and measure 2m in lengthiii
- Allometric equations<sup>iv, v</sup> (used to estimate the space that an animal needs as a consequence of its weight) for a 350kg sow to stand up, sit and lie on her stomach =  $0.019 \times 350^{2/3} = 0.94 \text{m}^2$
- The turning diameter for a 2m-long sow is  $2 \times 2 = 4m^2$
- The **movement and behaviour** sows can perform in a given space
- Piglet mortality estimations related to space.

Based on the allometric equations alone, the minimum space for feeding<sup>vi</sup> + dunging<sup>vi</sup> + space to turn freely<sup>vii</sup> =  $0.94\text{m}^2 + 0.94\text{m}^2 + 4.00\text{m}^2 = 5.9\text{m}^2$ .

Higher piglet mortality is associated with small sow space allowance. To achieve similar piglet mortality to a crated system, EFSA estimated that a minimum space allowance of 6.6m<sup>2</sup> for the sow would be required (see Figure 1).

#### FIGURE 1

Amended graph from EFSAviii showing the effect of sow space allowance on the piglet mortality in pens expressed relative to the mortality in farrowing crates (= 100%). The area of the circles represents the sample size.



The area of the circles represent the sample size.

#### For the piglets

A creep is a thermoregulated area that only piglets have access to and provides piglets with a comfortable, safe space to rest together without risk of crushing from the sow. A litter of 14 piglets requires a creep area of approximately 1-1.2m<sup>2</sup> at 4 weeks of age (based on a body length of 0.56m), if all piglets lie in the creep at the same time.

#### **BEST PRACTICE RECOMMENDATIONS**

A total pen size of 7.8m<sup>2</sup> (sow space allowance: 6.6m<sup>2</sup>; creep: 1.2m<sup>2</sup>) will provide space for a partitioned pen with a lying area, separate dunging/feeding area, space for growing piglets and a creep.

#### **MINIMUM RECOMMENDED SPACE**

Key:

Pens with restricted

Sufficient sow space

allowance based on

allometric equations.

of  $<5.9 \text{ m}^2$ .

Best practice

recommendation

based on piglet

mortality (EFSA).

sow space allowance

A total pen size of 6.9m<sup>2</sup> pen (sow space allowance: 5.9m<sup>2</sup>; creep: 1m<sup>2</sup>) provides sufficient space for a modern-day large sow to move freely and for the pen to have separate functional areas without partitions.

Pen size is only one feature, and in some cases, a well-designed, smaller pen can achieve good welfare provided the size and behaviour of the sow is taken into account.

<sup>&</sup>quot;Moustsen, V. A., Poulsen, H. D., & Nielsen, M. B. F. (2004). Krydsningssøer dimensioner. Landsudvalget Fur Svin, Danske Slagterier, Faglig Publikation

iv Petherick, J. C., & Baxter, S. H. (1981). Modelling the static spatial requirements of livestock. Modelling, design and evaluation of agricultural buildings, 75

<sup>&</sup>lt;sup>v</sup> Petherick, J. C. (1983). A biological basis for the design of space in livestock housing vi Allometric equation for 350kg sow to stand up, sit and lie on stomach = 0.019 × 3502/3

vii 2m length sow has a 2 x 2m turning diameter so needs 4m<sup>2</sup> to turnaround

viii EFSA (2022) Welfare of pigs on farm.



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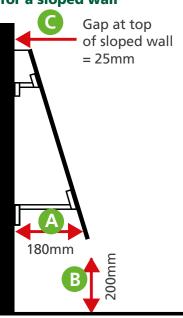
#### **Separate functional areas**

Given the choice, sows use separate spaces for resting, feeding and dunging. The provision of separate functional areas will provide the sow with a quiet and private nesting area to farrow and rest in, as well as specific areas for feeding and dunging, all of which will help the sow to keep the pen clean thus benefitting sow and piglet hygiene.

## Anti-crushing features: sloped walls

Vertical walls can cause a high risk of piglets being trapped and crushed, whereas sloped walls support sow descent whilst also allowing piglets to escape and prevent trapping. Sloped walls also provide additional protective space to the creep.

## Recommended dimensions for a sloped wall



- Nesting area: Sows have a behavioural need to nest build and prefer enclosed areas in which to farrow. It is important that the nest area:
  - o Has 3 solid walls (minimum 1m height) to provide an attractive and private nesting space
  - o Has solid flooring to allow provision of nesting substrate and bedding
  - o Has anti-crushing features to protect piglets when the sow changes posture e.g. farrowing rails or sloped walls
  - Sloping walls are considered best practice as they support the sow as she lies down smoothly, and allow piglets to escape from being trapped, perform teat seeking behaviour safely, and even improve udder access.
  - European legislation (EU Council Directive 2008/120/EC) states that farrowing pens, where sows are kept loose, must have some form of piglet protection.
  - o Is located next to the creep to help piglets find it after farrowing.
- Dunging area: Having a distinct and separate dunging area facilitates hygiene maintenance and helps to keep the animals and the pen clean. A separate dunging area should have:
  - o Slatted flooring to minimise cleaning, improve worker efficiency and improve hygiene
  - o Part-barred walls to make this area unattractive for farrowing, provide a cooler environment, and allow sow social contact with their neighbours.

- **Feeding area:** Sows will typically feed and immediately turnaround to defecate away from their feeding area. This can influence hygiene, particularly in systems with limited space. Solutions include:
  - o Ensuring the dunging area is large enough and clearly separated from the feeder
  - o Designing the pen so that when finished eating, the sow turns, walks away from the feeder and defecates in the dunging area
  - o If wet feed is provided, feeders should be placed over slatted flooring to prevent build-up of wet feed on the floor.
- Attractive and safe creep area: Piglets require a warm environment, particularly when newly born and young. A spacious and attractive creep is key to reducing the risk of piglet crushing and should provide:
  - o A safe area that is inaccessible to the sow, where piglets can lie without risk of crushing
- o A supplementary heat source to make it attractive and encourage piglets inside
- o Sawdust or shavings for a comfortable lying area; if using such substrates in conjunction with a heat lamp, make sure the substrate is not too close (>30cm) to the heat lamp to reduce the risk of fire
- Ability to lock-in piglets for management observation when needed, and ability to provide supplementary solid feed and/or supplementary milk if necessary.

Corner or side creeps are recommended, as they are closer to the udder when the sow lies down, and all creeps should be accessible from the passageway for ease of use.

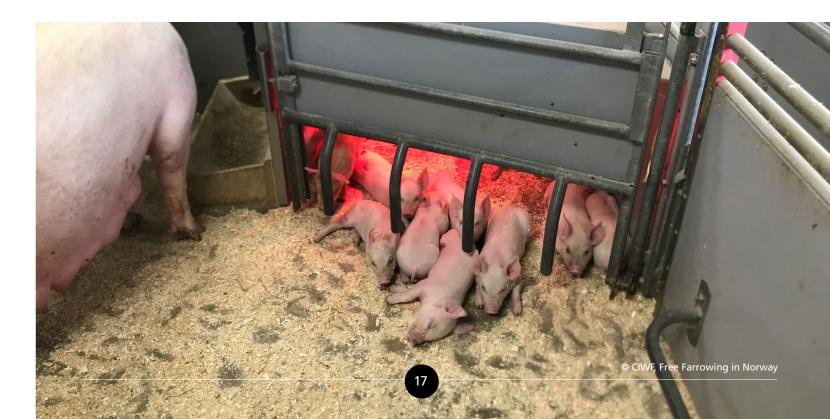
Partitions to separate functional areas:
Pen partitions can be used to define the dunging and nesting areas but, partition design can impact maternal behaviour, how sows and piglets react to stock people, and stockperson safety. Lockable feeding stalls, gates or partitions between different pen areas can help separate stock people from the sow when they need to treat piglets or clean

## Partitions should be around 1m in height so that they are:

the pen but these need to be easy to use.

- o High enough that sows cannot climb/jump over the top of them
- o Not too high that stock people have difficulty inspecting the pigs from outside the pen or have difficulty exiting the pen once inside.

Although partitions are important to create a sense of enclosure in the nest area, by separating the nesting and dunging area, the partitions can disrupt airflow and may negatively affect thermal comfort and ammonia emissions. Moveable partitions could help overcome this by partly enclosing the nest site during farrowing and opening up the space after the first week or so of lactation.





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To enable nesting behaviour pre-farrowing, and to achieve physical and thermal comfort post-farrowing, a minimum of 2kg of fresh straw should be added to the pen each day.

#### **Nesting material and bedding**

Sows are instinctively motivated to begin nest building approximately 16-24 hours before they give birth. This involves arranging, carrying and biting the nesting material. To enable these behaviours, material with longer structures (e.g. long-stemmed or long-cut straw, hay or haylage) are required and although straw is widely considered as the gold-standard material for its manipulable as well as thermal properties, paper sheets or long shreds are also acceptable.

#### For the sow

- At least 48 hours before the expected farrowing date, provide a minimum of 2kg of long-stemmed straw and a minimum depth of 5cm for the sow to adequately perform nest building
- From 24 hours post-partum, nesting material can be reduced to small quantities of chopped straw or sawdust
- Clean bedding sufficient for physical and thermal comfort post-farrowing should be provided daily.

#### For the piglets

- During and shortly after birth, straw in the nesting area should provide a depth of over 5cm to absorb fluids from farrowing and encourage piglets to dry off and warm up
- Provide foraging material such as chopped straw, wood shavings or peat for enrichment, which may also help to discourage behaviours such as belly-nosing.

Solid flooring with drainage holes in the nest area and slatted flooring in the dunging area allow for hygiene maintenance and thus help to reduce stock person workload.

#### **Comfortable flooring and waste management**

Flooring should be non-slip, non-abrasive, hygienic, and comfortable for the sow and the piglets to rest.

Lying areas for the sow and piglets should provide thermal and physical comfort, while dunging areas should be separate and easily cleaned to reduce the risk of disease and contamination of the lying areas.

■ **Nest area: Solid flooring** should be provided in the nest area as nesting substrate can fall down slats and block the slurry system.

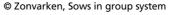
To allow for the maintenance of good hygienic conditions and to improve drainage on solid floors:

- o Solid flooring can have a 2% slope away from the nest/creep area
- o Solid flooring can be perforated (drainage holes), helping liquid to drain away
- o Additional bedding can be provided (especially during farrowing) to help soak up placental fluids and prevent splaying.
- **Dunging area: Slatted flooring** should be provided in the dunging area for ease of cleaning and improved hygiene maintenance.
- Waste management: Where possible, slurry systems that can deal with both substrate and dung should be installed to prevent blockages. Some examples include:
  - o Under-slat scrapers
  - o Flushing systems
  - o Waste disposal grinders.

#### Remember to:

- o Adhere to regulations for slat widths and voids (so safe for piglets)
- o Have strong support structures under any raised floors
- o Have good drainage, and
- o Have an appropriate slurry system if straw is used with slats.







© iStockphoto

For piglets, access to a heated creep prevents chilling after birth but the farrowing room temperature should be maintained for sow comfort as sows are prone to heat stress.

#### Thermal environment

Sows and their litters have very differing thermal requirements.

#### For the sow

- Temperature in farrowing houses should not exceed 18-23°C, as heat stress in the sow can lead to reduced feed intake, lower milk output and increased piglet mortality as the sow lies down less carefully
- Providing bedding allows sows to create a warmer micro-climate for her piglets
- As lactation continues, consideration should be given to cooling the sow in order to maintain feed intake and milk output. Floor cooling systems can increase nursing time, feed intake and piglet weight gain, and evaporative cooling is recommended in hot climates.

#### For the piglets

Newly born piglets are wet, cannot thermoregulate and have no active immunity. They need to dry off, warm up and ingest colostrum as soon as possible.

- Newborn piglets require temperatures of 34-35°C, but by 3-4 weeks of age they can thermoregulate more effectively
- Access to long straw in the nest at birth, and access to a heated creep until weaning, should ensure that piglets do not become chilled
- If piglets are observed huddling, then the creep is too cold; if they are lying outside the creep, then it is too hot.

Overall, a successful transition to alternative farrowing is dependent on a variety of factors, including:

- Optimal pen design
- A shift in the breeding goals for sows, including reduced litter size and selecting for good maternal behaviour
- A shift in management practices and appropriate staff training.

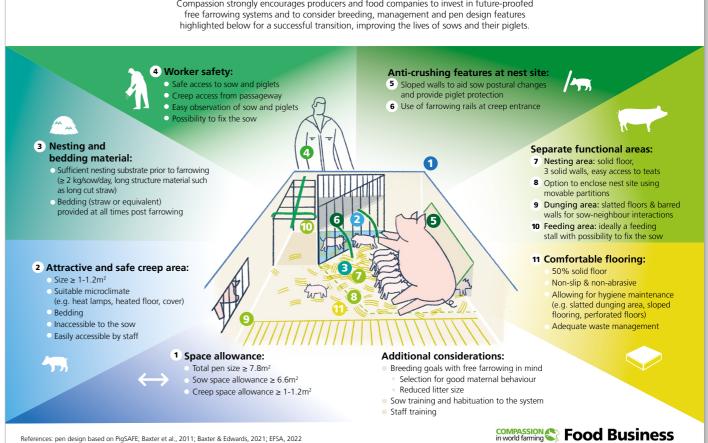
See our Free Farrowing Pen: Key Features for Success Infographic below for a visual summary.



© CIWF, Free Farrowing in Norway

#### Free Farrowing Pen: Key Features for Success

Compassion strongly encourages producers and food companies to invest in future-proofed free farrowing systems and to consider breeding, management and pen design features



# PRACTICAL ALTERNATIVES TO THE FARROWING CRATE

Equipment manufacturers have alternative farrowing pen prototypes, but these can often be customised, such as adapting the pen size and flooring.

Other features, such as the provision of bedding and nesting substrate, are subject to appropriate slurry systems and management on farm. Systems were evaluated according to how well the design features meet the needs of the sow, the piglets and stock people.

Evaluations were based on manufacturer specifications online and/or by visiting systems in situ on farm.

There are a variety of designs available but not all systems are considered acceptable based on their space allowance and ability to operate with zero-confinement (Table 1). Currently there are more systems commercially available that meet a total pen size of  $\geq 6.9 \text{m}^2$  (sow space allowance of  $\geq 5.9 \text{m}^2$ ) compared to  $\geq 7.8 \text{m}^2$  (sow space allowance of  $\geq 6.6 \text{m}^2$ ).



## TABLE 1: ALTERNATIVE FARROWING PENS: TOTAL PEN SIZE, SOW SPACE ALLOWANCE AND ACCEPTABILITY

- Pens meet a pen size of  $\geq$ 7.8m<sup>2</sup> and a sow space allowance of  $\geq$ 6.6m<sup>2</sup>. These are best practice space recommendations.
- Pens meet a pen size of  $\geq$ 6.9m² and a sow space allowance of  $\geq$ 5.9m². These are minimum space recommendations to allow space to move and use separate functional areas.
- Pens meet a pen size of  $\geq$ 6.9m<sup>2</sup> but do not meet a sow space allowance of  $\geq$ 5.9m<sup>2</sup>.
- Pens do not meet a minimum pen size of  $\geq 6.9 \text{m}^2$  or a space allowance of  $\geq 5.9 \text{m}^2$ .

Design	Total pen size (m²)	Sow space allowance
	Free farrowing pens	
Manufacturer pen designs*		
WelCon Bio	13.75	10.65
PigSAFE	8.9	7.9
Sow Comfort	7.68	7.68
FAT2 (Swiss)	7.0	6.14
WelCon	6.55	5.42
Danish Farrower	6.0	5.0
On-farm pen designs**		
Swiss Farm	12.0	10.35
FT30	8.0	6.8
ATX® Structure Bay	8.0	6.35
Pens w	ith the option to temporarily cra	te
Manufacturer pen designs*		
Evotek	7.3	6.0
On-farm pen designs**		
Aco Funki® WELSAFE	7.5	5.8
Fumagalli	7.2	6.2
	Temporary Crates	
Pro Dromi® Liberté	7.5	4.07
BeFree	6.0	5.28
SWAP	6.0	5.0
MultiFarrow®	6.0	Unknown
Combi-Flex	5.76	4.92
Vissing-Agro Opti-farrow	5.76	Unknown
360 Freedom Farrower	5.48	3.9
ProDromi® Swing	5.5	3.44

<sup>\*</sup>Manufacturer pen designs: pen designs evaluated based on manufacturer prototype information online.

Based on a minimum pen size of 6.9m², the alternative farrowing designs highlighted as green for space allowance in Table 1 are evaluated below, either from manufacturer pen prototype information available online or from pen designs seen during on-farm visits.

<sup>\*\*</sup>On-farm pen designs: pen designs evaluated based on a farm visit where some manufacturer names are unknown.

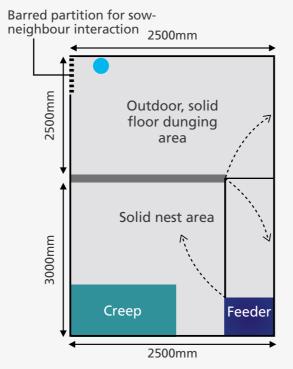
#### **FREE FARROWING PENS**

#### **WelCon Bio**

The WelCon (Welfare for animals and Convenience for farmers) Bio farrowing pen was designed by researchers at the Institute of Organic Farming and Farm Animal Biodiversity, Agricultural Research and Education Centre Raumberg-Gumpenstein in Wels, Austria. It is manufactured by Schauer Agrotronics. The pen operates a one-way system where the sow moves from one area to another via a passageway. This design aims to encourage the sow to keep pens clean by following the one-way system and dunging in the outdoor run. The evaluation is based on the manufacturer's prototype.



© Nature-Line.com

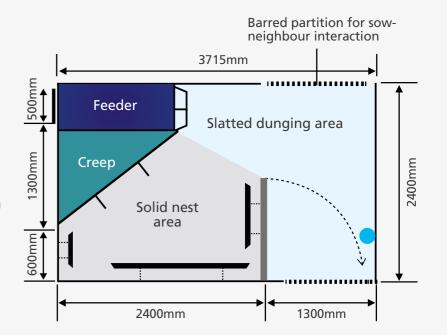


#### **PigSAFE**

PigSAFE was designed by researchers at SRUC and Newcastle University, with input from industry and NGOs. The most important concept of PigSAFE is that it is designed to stimulate good maternal behaviour, giving the sow optimal, functional areas whilst still providing for stockperson safety and piglet protection. A report on PigSAFE research and trials can be found here and further information can be found here. The evaluation is based on the manufacturer's prototype.



© M. Farish, SRUC



© freefarrowing.org, PigSAFE floorplan

#### **EVALUATION MATRIX BASED ON MANUFACTURER PROTOTYPE:**

Key design feature	Sow	Piglet	Extra information
Total pen size	+++	+++	13.75m² (sow space: 10.65m²; creep area: 1.2m²)
Freedom of movement	+++		Freedom of movement at all times
Nest site design	++	++	Private nest area with farrowing rail. Straw rack provided.
Creep environment		+++	1.2m² creep at front of nest. Large covered heated area with additional space for piglet feeders
Social contact	+++		Barred walls in dunging area for sow-sow contact. Partition doesn't allow piglets to contact neighbouring sows and piglets
Flooring and bedding	+++	+++	Solid flooring and bedding throughout
Thermal environment	+++	+++	Bedded nest, heated creep. Cooler outdoor dunging area for sow
Safety, hygiene and ease of management	+++	+++	Safe, easy access to pen and creep. Ability to separate piglets from sow using creep. Easy provision of straw. Option to segregate sow in separate areas for management purposes. No slatted flooring but instead have a one-way system with clear, separate functional areas to encourage cleanliness.

Key: (not provided), + (adequate), ++ (improved), +++ (best practice)

#### **EVALUATION MATRIX BASED ON MANUFACTURER PROTOTYPE:**

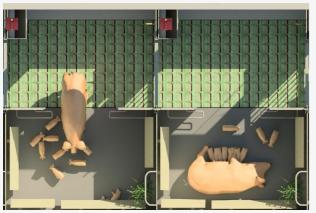
Key design feature	Sow	Piglet	Extra information
Total pen size	+++	++	With separate feeder: 8.9m² (sow space: 7.9m²; creep area: 1m²)
	++	++	Without separate feeder: 7m² (sow space: 6m²; creep area: 1m²)
Freedom of movement	+++		Freedom of movement at all times
Nest site design	+++	+++	Private nest area with sloped walls. Adjustable wall to open up nest area
Creep environment		++	1m² corner creep. Covered heated area and additional space for piglet feeders.
Social contact	+++		Barred walls in dunging area for sow-sow contact. Partition doesn't allow piglets to contact neighbouring sows and piglets
Flooring and bedding	+++	+++	Solid flooring and bedding in nest area. Separate dunging area with slatted flooring
Thermal environment	+++	+++	Bedded nest, heated creep
Safety, hygiene and ease of management	+++	+++	Safe, easy access from multiple points. Ability to separate sow from piglets using creep. Option to separate sow in feeder for management purposes. Easy provision of straw. Slatted dunging area.

Key: (not provided), + (adequate), ++ (improved), +++ (best practice)

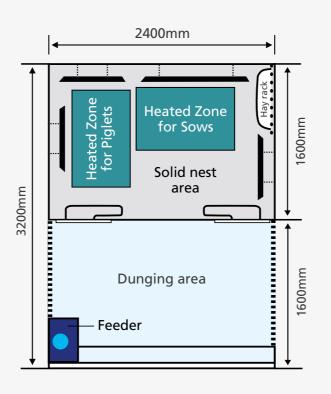
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#### **SowComfort**

The Sow Comfort farrowing pen was designed in Norway by researchers at the Norwegian University of Life Sciences, together with manufacturer company Fjøssystemer and cooperating producers. The concept is part-based on the Werribee Farrowing Pen developed in Australia in the 1980s and 90s. This design offers a dunging area with slatted flooring and nest site with solid flooring but there is no separate creep area for the piglets. Instead, the pen has under-floor heating for the piglets and sow. The evaluation is based on the manufacturer's prototype.



© freefarrowing.org, SowComfort floorplan

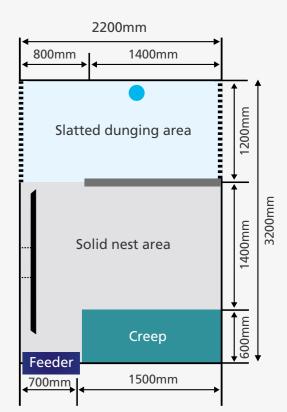


#### **FAT2 System**

The FAT2 system was developed in Switzerland by the Agroscope Research Station. In Switzerland, farrowing crates have been banned since 1997. Over the years, there have been different versions of the FAT2 pen but largely with similar key design features such as separate functional areas, solid flooring in the nest area, slatted flooring in the dunging area and a heated creep area for the piglets. The design in the photo has no partition between the nesting and dunging area but other versions include a partition. The evaluation is based on the manufacturer's prototype.



© AgroVet-Strickhof, Switzerland



#### **EVALUATION MATRIX BASED ON MANUFACTURER PROTOTYPE:**

Key design feature	Sow	Piglet	Extra information
Total pen size	+++		7.68m² (no separate creep area so sow has access to total pen)
Freedom of movement	+++		Freedom of movement at all times
Nest site design	+++	+++	Private nest with sloped walls. Straw rack provided.
Creep environment			No separate creep. Under-floor heated area in nest with rubber mattress
Social contact	+++	+++	Barred walls in dunging area for sow-sow contact. Allows piglets to contact neighbouring sows and piglets.
Flooring and bedding	+++	++	Solid, part-heated floor and bedding in nest area. Separate dunging area with slatted flooring
Thermal environment	+++	+	No separate creep, warm area in nest
Safety, hygiene and ease of management	++	+	Safe, easy access to pen. No separate creep to separate sow from piglets using creep. Easy provision of straw

Key: (not provided), + (adequate), ++ (improved), +++ (best practice)

#### **EVALUATION MATRIX BASED ON MANUFACTURER PROTOTYPE:**

Key design feature	Sow	Piglet	Extra information
Total pen size	++	+	7m² (sow space: 6.1m²; creep area: 0.9m²)
Freedom of movement	+++		Freedom of movement at all times
Nest site design	+++	+++	Private nest area. Anti-crushing features are optional
Creep environment		+	0.9m² creep at front of pen includes covered area with heat lamp and an uncovered area
Social contact	+++	+++	Barred walls in dunging area for sow-sow contact. Allows piglets to contact neighbouring sows and piglets
Flooring and bedding	+++	+++	Solid flooring and bedding in nest area. Separate dunging area with slatted flooring
Thermal environment	+++	+++	Bedded nest, heated creep
Safety, hygiene and ease of management	++	+++	Safe, easy access to pen. Ability to separate sow from piglets using creep. Easy provision of straw. Slatted dunging area.

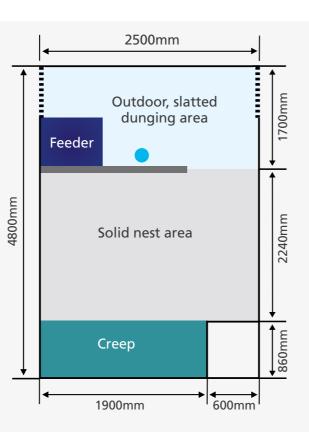
Key: (not provided), + (adequate), ++ (improved), +++ (best practice)

#### **Swiss Kennel and Run**

A Swiss farm visited uses free farrowing pens with an indoor nesting area, a covered outdoor dunging area for the sow and the ATXR Thermonest for the piglets. This design provides a generous sow space allowance, creep size and total pen size, but does not include anti-crushing features, as the producer found the sows rarely used the walls to lie down, and good sow mobility was considered an important factor to reduce incidences of piglet crushing. However, it is important to note that EU regulations state that free farrowing pens must have 'some means of protecting piglets, such as farrowing rails'. The evaluation is based on a farm visit.



© CIWF, Free Farrowing Switzerland



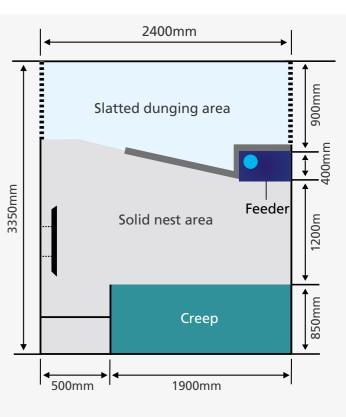
\* pen dimensions are estimations only

## ATX® Suisse: Structure Bay and 3 Zone Bay

ATX® Suisse is a Swiss manufacturing company with two similar free farrowing pens: ATX Structure Bay and 3 Zone Bay. The main difference between the two designs is that the 3 Zone Bay is suitable for outdoor climate barns and the sow nest area has an automated cover to thermoregulate the sow's nest site independently from the open-air ventilation. The location of the feeder and drinker also differ between designs and are either located in the dunging area (ATX® Structure Bay) or the nesting area (ATX® 3 Zone Bay). Footage of the ATX Structure Bay in use can be found here. The evaluation is based on a farm visit of the 3 Zone Bay pen.



© CIWF, 3 Zone Bay, Switzerland



\* pen dimensions are estimations only

#### **EVALUATION MATRIX BASED ON MANUFACTURER PROTOTYPE:**

Key design feature	Sow	Piglet	Extra information
Total pen size	+++	+++	12m² (sow space: 10.35m²; creep area: 1.65m²)
Freedom of movement	+++		Freedom of movement at all times
Nest site design	+++	++	Private nest area. No anti-crushing features
Creep environment		+++	1.65m² creep at front of nest. Large covered heated area with additional space for piglet feeders.
Social contact	+++	+++	Barred walls in dunging area for sow-sow contact. Allows piglets to contact neighbouring sows and piglets
Flooring and bedding	+++	+++	Solid flooring and bedding in nest area. Slatted, scrape through dunging area
Thermal environment	+++	+++	Bedded nest, heated creep. Cooler outdoor dunging area for sow
Safety, hygiene and ease of management	+++	+++	Safe, easy access to pen and creep. Ability to separate piglets from sow using creep. Easy provision of straw. Easy monitoring of room and creep temperature. Slatted dunging area.

Key: (not provided), + (adequate), ++ (improved), +++ (best practice)

#### **EVALUATION MATRIX BASED ON MANUFACTURER PROTOTYPE:**

Key design feature	Sow	Piglet	Extra information
Total pen size	++	+++	8m² (sow space: 6.35m²; creep area: 1.65m²)
Freedom of movement	+++		Freedom of movement at all times
Nest site design	+++	+++	Private nest area with sloped walls
Creep environment		+++	1.65m² creep at front of nest. Large covered heated area with additional space for piglet feeders
Social contact	+++	+++	Barred walls in dunging area for sow-sow contact. Allows piglets to contact neighbouring sows and piglets
Flooring and bedding	+++	+++	Solid flooring and bedding in nest area. Separate dunging area with slatted flooring
Thermal environment	+++	+++	Bedded nest, heated creep. When nest cover is used the dunging area is cooler
Safety, hygiene and ease of management	+++	+++	Safe, easy access to pen and creep. Ability to separate piglets from sow using creep. Easy provision of straw. Easy monitoring of room and creep temperature. Slatted dunging area.

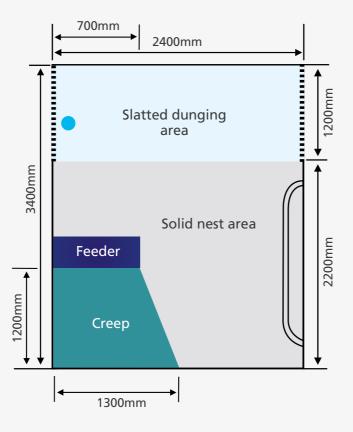
Key: (not provided), + (adequate), ++ (improved), +++ (best practice)

#### **FT30**

FT30 free farrowing pens are a Norwegian design by manufacturing company Fjøssystemer. The FT30 design has a creep area of 1.2m<sup>2</sup> and when visiting farms in Norway the pen sizes ranged from 7.6m<sup>2</sup> to 8.5m<sup>2</sup>. The FT30 is designed for piglets to stay in the pens after weaning, up to 30kg. The larger pen size is recommended to provide more space to the piglets postweaning. The evaluation is based on a farm visit.



© CIWF, 8m2 FT30 pen in Norway



#### **EVALUATION MATRIX BASED ON MANUFACTURER PROTOTYPE:**

Key design feature	Sow	Piglet	Extra information
Total pen size	+++	+++	8m² (sow space: 6.8m²; creep area: 1.2m²)
Freedom of movement	+++		Freedom of movement at all times
Nest site design	+++	+++	Nest area beside creep and with farrowing rails
Creep environment		+++	1.2m² corner creep. Covered heated area
Social contact	+++	+++	Barred walls in dunging area for sow-sow contact. Allows piglets to contact neighbouring sows and piglets
Flooring and bedding	+++	+++	Solid flooring and bedding in nest area. Separate dunging area with slatted flooring
Thermal environment	+++	+++	Bedded nest, heated creep
Safety, hygiene and ease of management	+++	+++	Safe, easy access to pen and creep. Ability to separate sow from piglets using creep. Easy provision of straw. Slatted dunging area.

Key: (not provided), + (adequate), ++ (improved), +++ (best practice)

#### INDIVIDUAL PENS WITH THE OPTION TO TEMPORARY CRATE

Systems with the option to temporary crate are able to confine the sow when piglets are most vulnerable and allow the sow to be loose during lactation. A moveable gate or partition is locked into position in the pen to create a temporary crate.

Generally, confinement is conducted between 2-5 days before the sow is due to farrow and until 3-7 days after farrowing. However, the length of confinement is subject to voluntary management practices or regulations, and well-designed systems can be operated in the open position by experienced stock people. There are many different designs of temporary confinement systems, but not all provide sufficient space to be operated successfully with zero-confinement. It is crucial that sows have enough space to use separate functional areas when the pen is operated in the open position, in particular by ensuring an optimal positioning of the gate so that sow space allowance within the pen is maximised.

#### **Compassion's recommendations on temporary crating practices**

- Temporary confinement may be used during an initial learning phase:
  - o For a maximum of one year after installation, and
  - o Limited to a maximum of 3 days around farrowing
- Following the learning phase, temporary crates must be operated in the open position throughout farrowing and lactation
- In exceptional circumstances, such as for veterinary treatment or for agitated sows, a temporary crate may be used (max 3 days around farrowing)
- Sows may be confined for management purposes e.g. veterinary treatment, for a maximum of 2 hours or less at a time
- A monitoring system must be in place to ensure the crate is operated in the open position.





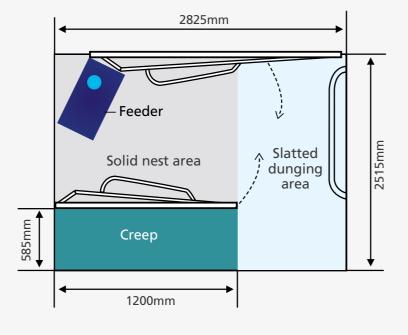


© CIWF, piglets

#### **Evoteck**

Evoteck call this system the 'flexi pen model' which can range from 6m<sup>2</sup> and above. The gates that form the temporary crate are designed in a way that takes up minimal space when open, thus optimising sow space allowance. The evaluation is based on the manufacturer's prototype with a total pen footprint of 7.3m<sup>2</sup>.





© Evoteck.it, Flexi pen mode

#### **EVALUATION MATRIX BASED ON MANUFACTURER PROTOTYPE:**

Key design feature	Sow	Piglet	Extra information
Total pen size	++	+++	7.3m² (sow space: 6m²; creep area: 1.3m²)
Freedom of movement	++		When the gates that form the temporary crate are closed sow movement is restricted but when open the sow is free to move around
Nest site design	+++	+++	Private nest area when sow is lying down with farrowing rail
Creep environment		+++	1.3m² creep at front of nest. Large covered heated area
Social contact	++		Low partitions between pens with bars above for sow-sow interaction when standing. Partition doesn't allow piglets to contact neighbouring sows and piglets
Flooring and bedding	+++	+++	Solid flooring in nest area with bedding. Dunging area with slatted flooring
Thermal environment	+++	+++	Bedded nest, heated creep
Safety, hygiene and ease of management	++	+++	Safe, easy access to pen and creep. Ability to separate sow from piglets using creep. Option to routinely crate sow. Easy provision of straw. Slatted area for dunging.

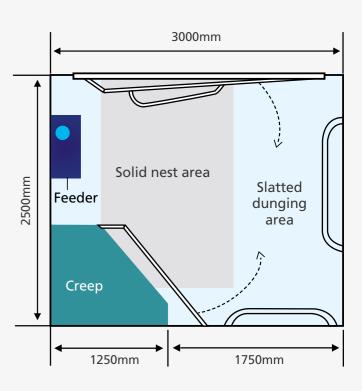
Key: (not provided), + (adequate), ++ (improved), +++ (best practice)

#### **Aco Funki® WELSAFE**

A farm visited in Finland customised the Aco Funki® WELSAFE pen. The WELSAFE prototype is 5.76m² with fully slatted flooring, which is not recommended. However, the farm visited had installed a 7.5m² version with customised flooring (with areas of cast-iron slatted and solid flooring, plastic coated slatted flooring and plastic-coated solid flooring with perforations). The evaluation is based on a farm visit.



© HKFoods Oyj, Customised WELSAFE pen in Finland



#### **EVALUATION MATRIX BASED ON MANUFACTURER PROTOTYPE:**

Key design feature	Sow	Piglet	Extra information
Total pen size	++	+	7.5m² (sow space: 5.8m²; creep area: 0.9m²; additional piglet space: 0.8m²)
Freedom of movement	++		When the gates that form the temporary crate are closed sow movement is restricted but when open the sow is free to move around. When open, the gates take up some of the sow's space allowance
Nest site design	+++	+++	Private nest area when sow is lying down with farrowing rails.
Creep environment		+	0.9m² corner creep. Covered heated area with 0.8m² additional space due to gate that forms temporary crate. Total piglet space of 1.7m² allows room to provide piglet drinker and creep feed
Social contact	++		Solid 52cm partitions between pens with bars above for sow- sow interaction when standing. Partition doesn't allow piglets to contact neighbouring sows and piglets
Flooring and bedding	++	+++	Part-solid flooring with perforations. 50% of total pen floor is solid. Risk of bedding blocking slurry system
Thermal environment	+	+++	Heated creep
Safety, hygiene and ease of management	++	+++	Safe, easy access to pen and creep. Ability to separate sow from piglets using creep. Option to routinely confine sow. Easy provision of straw. Slatted area for dunging. Covered hole to scrape dung into for ease of cleaning.

Key: (not provided), + (adequate), ++ (improved), +++ (best practice)

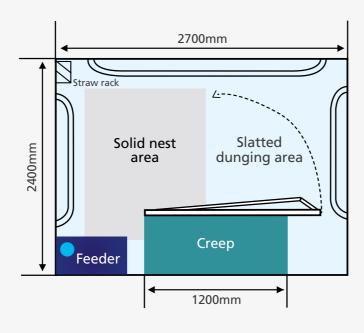
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#### **Fumagalli**

Italian producer Fumagalli began their conversion to alternative farrowing systems in 2015. Fumagalli have temporary crate designs but operate them successfully under zero-confinement practices, so the sow is not confined during farrowing and lactation. On average, pens measure 7.2m² ranging from 6.6 to 7.5m² depending on the building size they were converting. The evaluation is based on a farm visit.









© Zonvarken, Sows in group system

#### **Evaluation matrix based on manufacturer prototype:**

Key design feature	Sow	Piglet	Extra information
Total pen size	++	+	7.2m² (sow space: 6.2m²; creep area: 0.72m²; 0.28m² allows access to pen which piglets can access)
Freedom of movement	++		When the gates that form the temporary crate are closed, sow movement is restricted, but when open the sow is free to move around. Fumagalli operate with the gates open at all times
Nest site design	+++	+++	Private nest area when sow is lying down. Farrowing rails on three pen sides. Straw rack provided
Creep environment		+	Creep at front of nest, with heat lamp. Total enclosed area 0.72m² and extra 0.28m² for pen access can be used to provide piglet feed
Social contact	++		Low partitions between pens with bars above for sow-sow interaction when standing. Partition doesn't allow piglets to contact neighbouring sows and piglets
Flooring and bedding	++	+++	Solid flooring in nest area. Dunging area with slatted flooring
Thermal environment	+	+++	Heated creep
Safety, hygiene and ease of management	++	++	Access to front creep, easy provision of feed, slatted dunging area

Key: (not provided), + (adequate), ++ (improved), +++ (best practice)

#### **Group systems**

In natural conditions, sows farrow away from the herd and re-join approximately 7-14 days after farrowing, integrating piglets with other litters before weaning. Similar to natural conditions, group systems allow sows and litters to mix before weaning.

## There are two main types of group systems:

- **Group lactation** systems keep sows within their stable, gestation groups and give sows free access to individual pens with a heated creep box as well as a communal area. In some systems, the individual nest boxes are removed 7-10 days post-farrowing to provide increased space for group suckling;
- Two-stage group lactation systems keep sows in crates (not-recommended) or individual alternative farrowing pens until between 10-21 days post-farrowing when sows and their litters are re-integrated into groups in larger multi-suckling pens.

Although group systems are generally less common than individual systems, they are used on some farms. Australian producer Rivalea use the PigSAFE free farrowing pen to house sows individually for farrowing before re-integrating the group post-farrowing, whereas other farms use temporary crates such as pig farmer Vernooij, Netherlands.

For group systems to be successful, careful consideration to management, group size and group dynamics is required. Piglet mortality can also be a concern in these systems, as well as missed sucklings due to cross-suckling issues. However, group housing systems also offer the sow and piglets more space to exhibit a wider range of natural behaviours.



© courtesy of Y Li, University of Minnesota, Multi-suckling system

## Group systems using individual free-farrowing pens should provide the sow with:

- Well-designed individual pens
- Freedom of movement at all times
- Opportunity to nest-build
- Private nest-site
- Separate functional areas for dunging, feeding and resting
- Physical contact with other sows
- Opportunity to withdraw from piglets and for gradual weaning
- Enrichment materials for nesting and exploratory behaviours.

## Group systems should provide piglets with:

- Creep area for thermal comfort
- Socialisation with litters pre-weaning as well as with different sows
- Opportunity to be weaned at a later age
- Separate functional areas for dunging, feeding and resting
- Enrichment materials for exploratory behaviour.

#### The staff should have:

- Access to piglet creep area from passageway
- The ability to easily provide feed from the passageway
- Easy access to the farrowing pens
- Option to separate the sow(s) and piglets by using fences or individual farrowing pens

## Recommendations for a successful group housing system include:

- Manageable groups of 6-10 sows and litters
- Groups of familiar sows (e.g. keep gestation groups together)
- Space for separate functional areas (e.g. enough feeder, drinking, and lying space)
- Space for sow-sow social interactions but also space to rest away from others
- Private areas for suckling (e.g. space for litters to suckle with their sow to limit crosssuckling)
- Suitable flooring
- Sufficient bedding for resting
- Minimum space allowance of 10m<sup>2</sup> per sow and litter (Group systems freefarrowing.org).

For group systems to be successful, careful consideration to management, group size and group dynamics is required. Piglet mortality can also be a concern in these systems, as well as missed-sucklings due to cross-suckling issues. However, group housing systems also offer the sow and piglets more space to exhibit a wider range of natural behaviours.

### **CONCLUSION**

When designing or choosing an alternative farrowing system, it is important to consider the needs of the sow, piglet and stockperson.

#### **Key considerations include:**

- Pen size
- Space allowance per sow
- Separate functional areas
- Well-designed nest site with solid flooring
- Attractive and safe creep area

- A specific dunging area with slatted flooring
- Anti-crushing features
- Substrate to promote nest building behaviour
- Bedding provision
- Design ensuring workers' safety.

Temporary crates are often considered a compromise between farrowing crates and free farrowing pens as they offer a level of freedom for the sow during lactation but allow for easier management when piglets are more vulnerable. However, they are often designed with the use of routine temporary crating in mind and can lack the space and key design features to operate successfully under zero-confinement practices. Even with a good total footprint, gates that form the temporary crate often take up additional space, leaving the sow with less space than in a free farrowing pen with the same total footprint. It is important that any system is designed with zero-confinement in mind.

Investing in well-designed, spacious systems is considered a future-proofed investment compared to investing in smaller, less-well-designed pens which may receive later scrutiny on space allowance and consumer-perception of cage-free systems.

#### Alternative farrowing can:

- ✓ Improve pig welfare
- ✓ Give acceptable performance
- ✓ Be practical to use
- ✔ Have better consumer perception

#### **Critical success factors are:**

- ✓ Good pen design
- ✓ Selecting the right sows
- ✓ Good management
- ✔ Cross-sector financial support







Compassion in World Farming is recognised as the leading international farm animal welfare charity. It was founded in 1967 by Peter Roberts, a British dairy farmer who became concerned about the development of modern, intensive factory farming.

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