KNOWLEDGE CENTRE FOR AGRICULTURE
Cattle

Guide to designing milk room with adjoining service room

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Guide to designing milk room with adjoining service room

Editor	Helge Kromann
Review	Vibeke Fladkjær Nielsen
Layout	Inger Camilla Fabricius
Graphics	Kirsten Thorvig Kjeldsen, BYG LandboMidtØst
Fotos	Helge Kromann
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Preface

This guide was prepared to be used for design of new service sections or renovation of existing designs related to milk handling and storage at the farm.

The guide targets consultants, equipment suppliers, contractors and farmers working with planning, design and operation of dairy cow facilities.

The guide was prepared to provide an overall presentation of applicable legislation and general practice for milk storage and handling.

This guide was prepared in cooperation with:

- Eskil Nilsson, Arla Foods
- Jesper Bo Petersen, Arla Foods
- Mats Gyllenswärd, Svedish Dairy Association
- Per Justesen a.o., The project team Teknik på gården (Farm technology), VFL, Kvæg
- Ole Ugelvig, Rasmus Nielsen, Poul Kirkegaard, DLBR Kvægstalde
- Gunnar Schmidt, Technical consultant, Byggeri og Teknik I/S
- Vibeke Fladkær Nielsen, Team Production Systems, VFL, Kvæg
- Kurt Mortensen, Energy consultant, Energi Midt
- Suppliers of milking equipment and milk cooling tanks.

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Introduction

The milk room is a room in which food is stored. Keen attention must therefore be paid to hygiene and optimum conditions for milk handling, cooling and storage. Large volumes of milk are now being handled on the individual farm. So the same high standard is expected as in a dairy.

The milk room should not be used as entrance to the cowshed. Only milking staff, drivers and service staff for milking and cooling systems should use the room.

The milk room should further constitute a good and safe working place for the staff and be accessible and convenient for the driver and other service staff. Since strong chemicals and cleaning agents are used to clean the milking system and the milk cooling tank, heavy demands are placed on fixtures and equipment and building materials. These guidelines contain the key aspects of function and design of milk rooms and related facilities. The intention is that the guidelines can help ensuring that both new building and renovation including new design of existing milk rooms are made professionally and environmentally responsibly with focus on food safety, milk quality, the environment and health and safety.

Prior to launching renovation and new building of milk rooms, the dairy should be contacted with a view to clarifying requirements to storage and collection.

Definitions

Milk room

Room holding the entire or parts of the milk cooling tank and from which milk is collected for the dairy or rooms connected with outdoor tanks to which the connecting branch and all other piping are conducted and from which milk is collected.

Mini collection room

Detached rooms connected to outdoor milk cooling tank from where milk can be collected. The room may be an integrated element of the tank.

Utility room and other rooms

Room holding technical equipment related to milking and cooling systems

Employee Areas

Room in which staff has changing room, toilets, lunch room and entrance to the cowshed

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Milk room ...

Design of milk room and equipment room depends highly on milking system, tank type and cooling system.

The milk room is a room in which food is stored. It must be in excellent hygienic condition and must be kept clean and tidy.

Generally, a milk room must meet the following requirements:

- Insulation making the room frost-proof, if necessary supplemented with under-floor heating
- Ventilation constantly ensuring fresh air, preferably mechanical ventilation
- Closed off to dogs, cats, flies and all types of vermin
- Surfaces that are easy to clean and resistant to the cleaning agents used
- Milk cooling tank and other equipment may advantageously be placed on a platform
- Entrance door (preferably inward opening door offering easy access for drivers and protecting the door in case of powerful gusts of wind). Alternatively a sliding door.
- Roof gutter above door, if the door is placed below an overhang
- Light in the milk room which is turned on at the entrance door
- The milk room should only be used by drivers, milking staff and service staff.

Access to milk room with inward-opening door and direct access to the collection branch.

In addition to the milk cooling tank including various valve equipment, only the following should be found in the room:

- Collection branch
- Where distance from entrance door to tank branch is max. 160 cm.
- Where distance between wall and tank branch is max. 120 cm.
- Drain
- Cleaning unit with control board and tank alarm
- Control board for milking system/AMS
- Washbasin (driver must be able to wash hands)
- Drain tap with hose
- Info board (supplied by dairy)
- Ventilating tube from cooling tank ends in the milking room (in connection with filling and emptying, air must only be exchanged via a non-polluted room).

Additionally, the following may be placed in the room:

- Cleaning unit for milk cooling tank and milking system
- Milk filter (may be placed in milking parlour and the AMS room)
- Plate/tube cooler
- Buffer tank (can be placed in AMS room) and extra tank
- Milk separator/milk pump (separator pit)
- Washing machine for cloths
- Steel table with wash basin and steel shelf (hot and cold water)
- CIP system.

Five different milk rooms ...
– examples of different designs

The following describes five different milk room designs. The first three models apply to horizontal tanks and the two following to vertical tanks (silo tanks).

Model 1

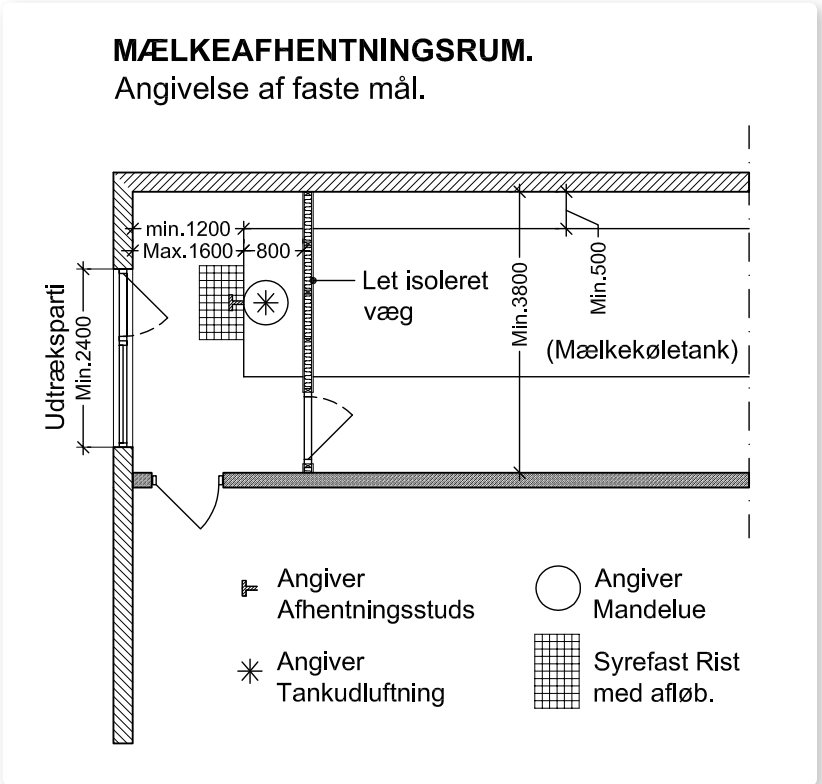
Milk room with indoor horizontal milk cooling tank, but where only the front of the cooling tank with tank branch and man hole cover is inside the room, while the rest of the cooling tank is placed in the equipment room.

Note that, in connection with the cooling tank, the following must be observed:

- Min. 50 cm. distance between tank and wall
- Min. 60 cm. distance between tank and ceiling
- The manhole cover must be able to open completely and allow easy inspection of the tank. So the distance at the man hole must be at least 60 cm. (and more, if possible).

Advantages

- Small area that is easy to clean and keep tidy
- Good ventilation can be ensured by installing an ordinary bathroom extractor fan, which may/can run constantly without consuming much energy.



Five different milk rooms ...

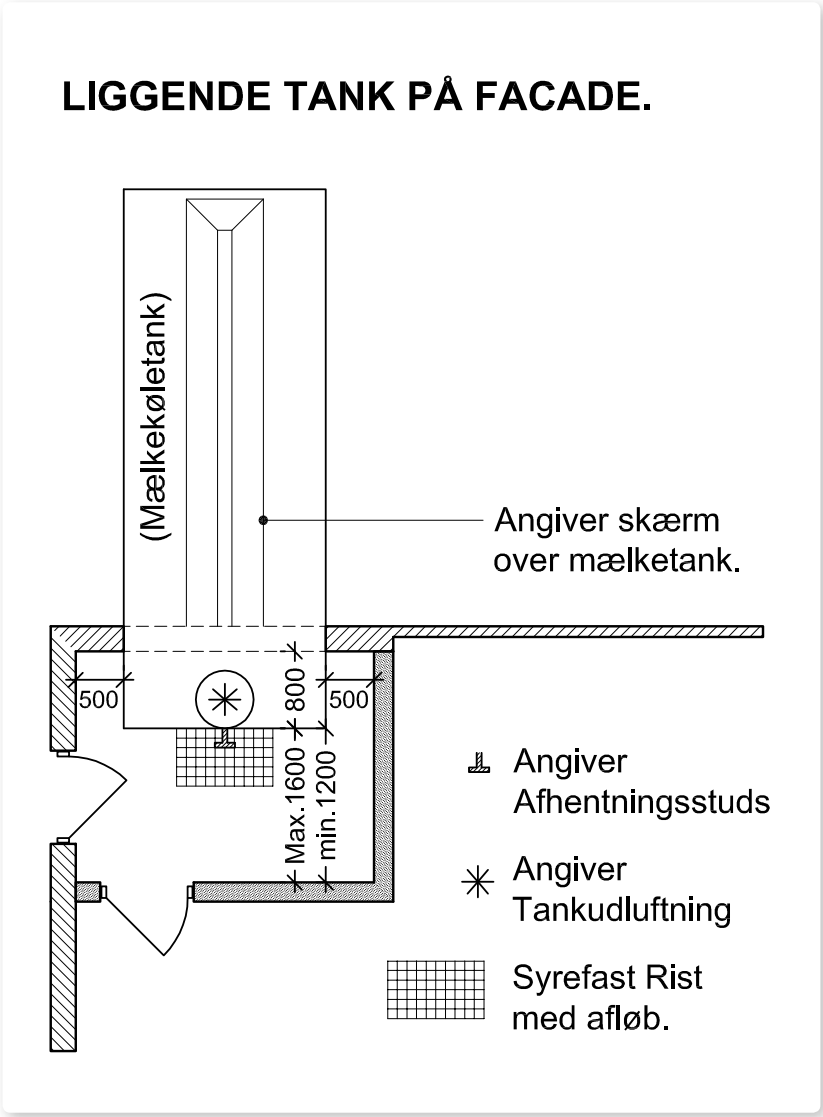
Model 2

Milk room with outdoor horizontal milk cooling tanks, where only the front of the cooling tank with tank branch and man hole cover is inside the room, while the rest of the cooling tank is placed in open air.

Advantages and comments as for model 1.

Disadvantages:

- Tank exposed to direct sun



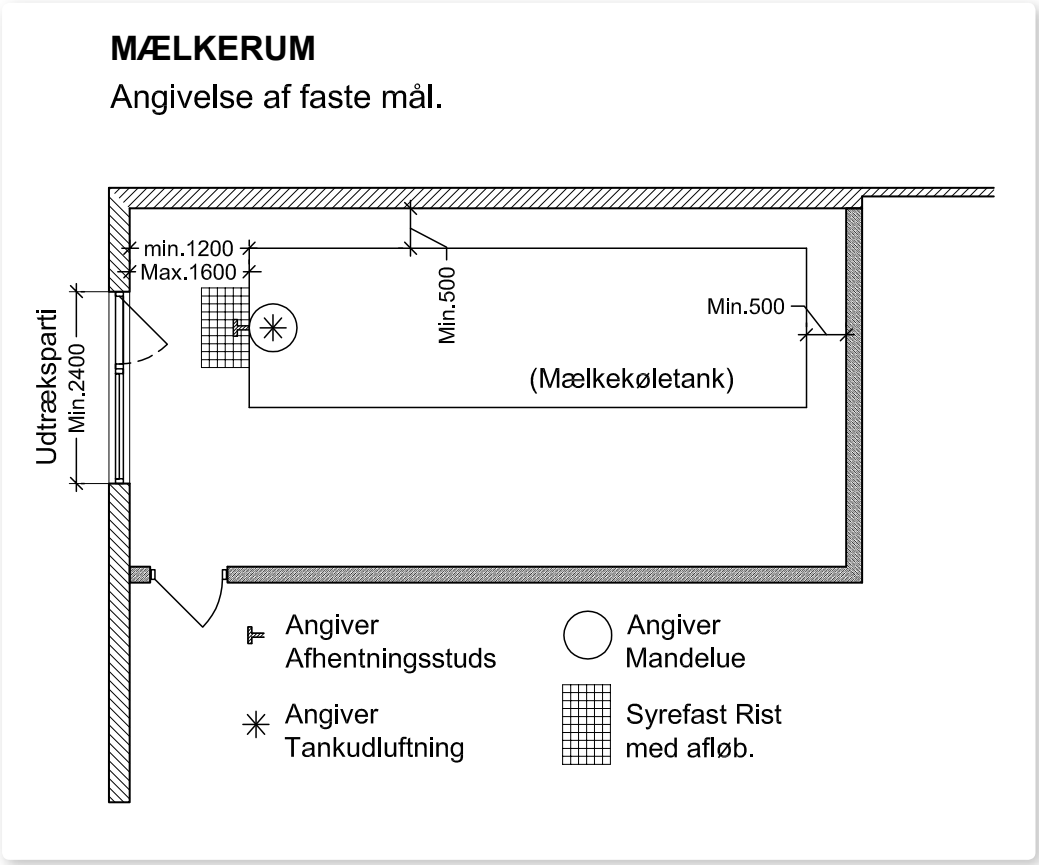
Model 3

Milk room with indoor horizontal tanks where the entire tank is placed in the room.

Advantages and comments as for model 1.

Disadvantages:

- The entire room serves as milk room requiring a higher level of cleanliness, so polluting equipment such as vacuum pumps must be placed in another room.



Five different milk rooms ...

Model 4

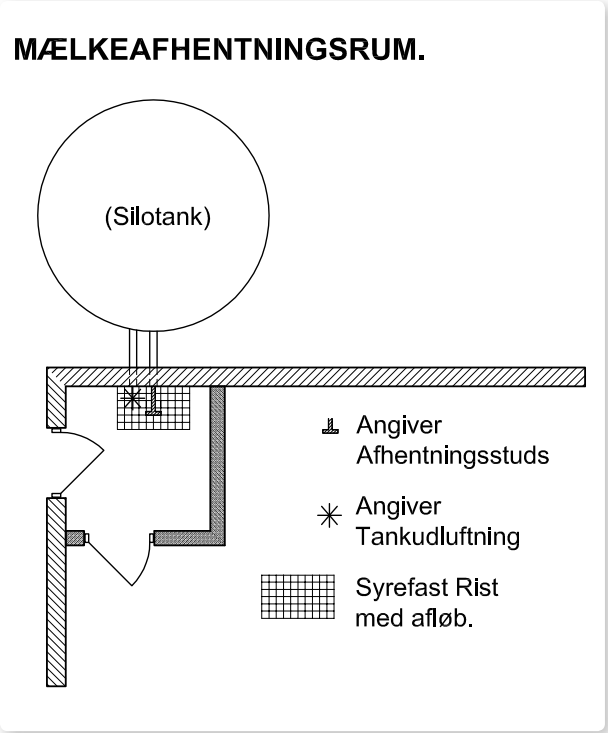
Milk room placed in the Milking Center connected to outdoor vertical tank (silo tank)

Advantages

- Small area that is easy to clean and keep tidy
- Good ventilation can be ensured by installing an ordinary bathroom extractor fan, which may/can run constantly without consuming much energy

Disadvantages

- Tank exposed to direct sun



Milk room containing

- Tank branch
- Cleaning unit
- Plate/tube pre-cooler
- Milk filter
- Wash basin.

Model 5

Milk room placed in separate building / integrated with outdoor vertical tank (silo tank).

Advantages

- Small area that is easy to clean and keep tidy
- The tank may be placed separately from the other service rooms
- Makes it possible to drive directly to the tank for collection
- Good alternative if existing tank needs replacing
- Good ventilation can be ensured by installing an ordinary bathroom extractor fan, which may/can run constantly without consuming much energy

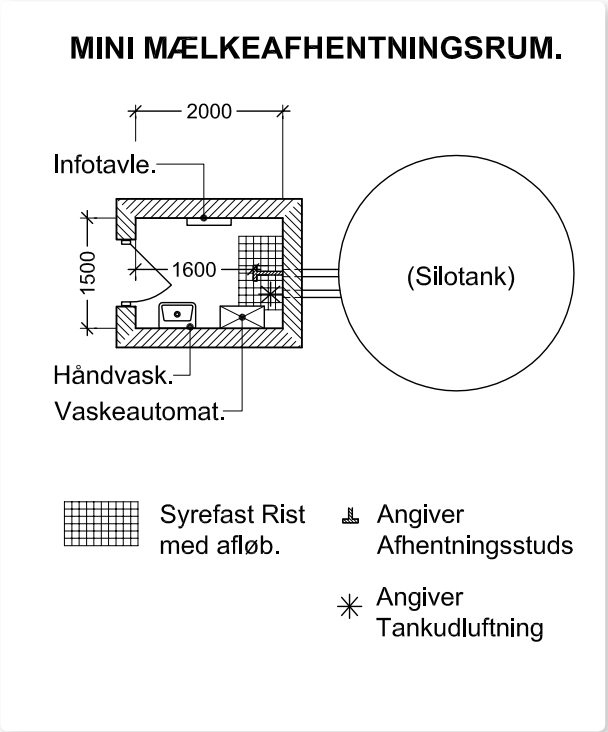
Disadvantages

- Tank exposed to direct sun

Distance requirements

- Between tank and wall 60 cm recommended.
- Distance between tank and ceiling must be at least 60 cm. (The manhole cover must be able to open completely and allow easy inspection of the tank)
- Distance from door to connection branch max. 160 cm.
- Between wall and connection branch min. 120 cm.
- (If the tank outlet faces the wall)
- Doors between entrance, corridor, milk room and cowshed must be at least 90 cm wide.

See also 'Tekniske krav til mælkekøletanke' (Technical requirements for milk cooling tanks), May 2010.



Silo tank with integrated collection room.

Location of milk room ...

General recommendations to milk room placing

- The connection branch must be reachable from a tank truck with a 6-metre hose
- When milk is collected, the tank truck side or tail-gate will be parked about 1.5 m. from the milk room door.
- Collection should preferably be possible from the left side of the tank truck.
- The tank truck must be able to drive to the milk room without reversing.

If the milk room is placed at a building corner, the milk room door can be installed to face the tank truck collection point, and the outdoor tank can be placed on the other side so that the tank truck can drive directly up to the milk room door without reversing.

If the outdoor tank is placed along the same facade/ end wall as the milk room door, the milk room must be constructed with a dock or similar entrance area for the outlet branch. The tank truck hose cannot reach the branch, if the truck is meant to drive directly up to the door without reversing.

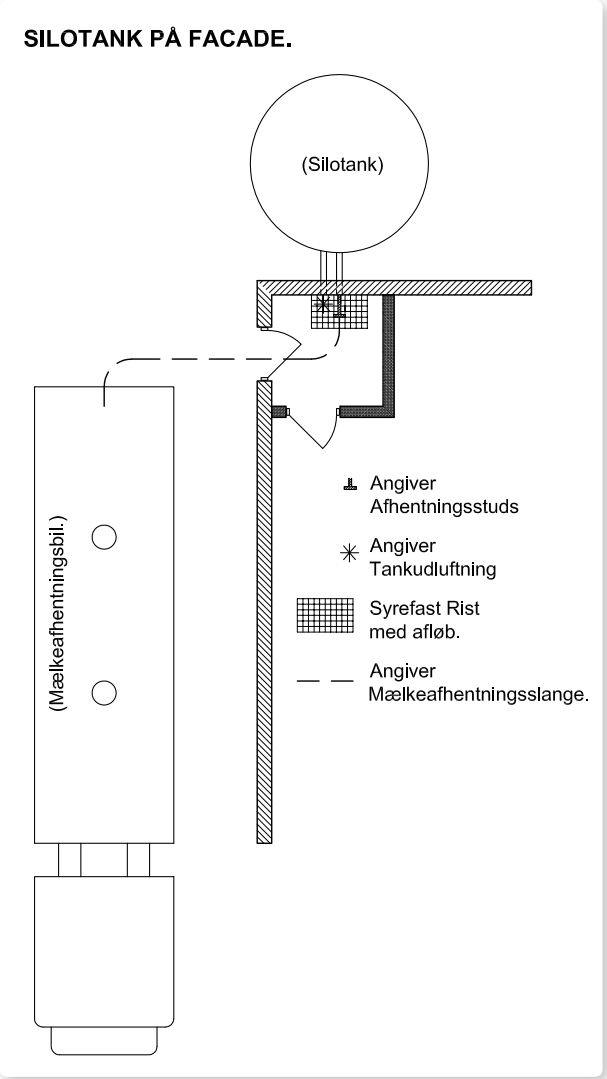


Diagram of outdoor tank placed at a corner of a building.

Silo tank placed at end wall of cowshed. Milk room in the form of dock, ensuring that the tank truck can drive directly up to the tank

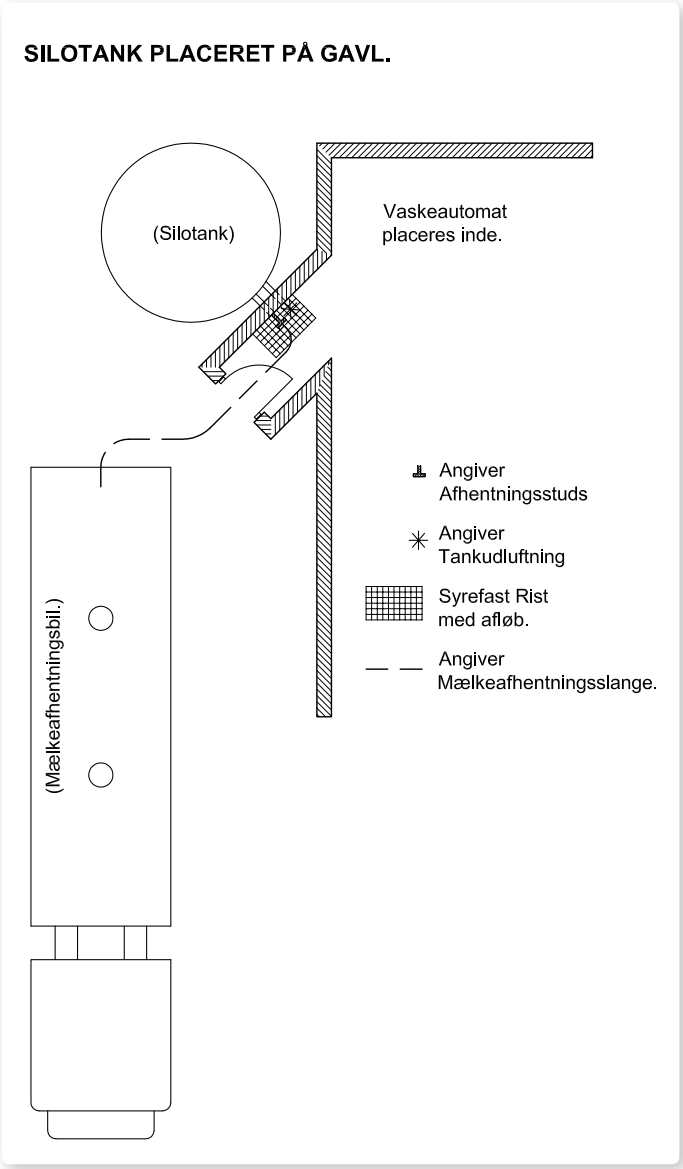


Diagram of outdoor tank placed in front of a building.

Outdoor tanks must be lifted off the ground, e.g. by being placed on a cast concrete platform.

No vegetation, trees or bushes within five (5) metres from the tank.

It must be possible to replace the milk cooling tank and other equipment without having to break a hole in the wall. This is why access should consist of a door unit with removable side unit, a double door, sliding door or hinged gate. If the tank is partially placed in the equipment room, it may be replaced via the equipment room.

General hygiene conditions ...

The milk room must not be used as entrance to the cowshed. Only milking staff, milk truck drivers and service staff for milking system and cooling tank should be allowed to access the milk room.

Access to the toilet may not be through the milk room.

Boot wash should not be effected in the milk room, but be placed in the entrance area/lock at the cowshed entrance.

The milk room should contain a tap for cleaning the room and for the driver's use as well as a wash basin with hot and cold water.

Openable windows should be equipped with insect net.

For hygienic causes, the collection point and the traffic area at the truck dismount space and milk room door must be clean and made from solid material or drained washed gravel. A surfaced area or similar measuring 200 x 200 cm should be established outside the milk room door.

Finally, the location should be considered in relation to manure heap, slurry tank, silage silos, etc. The milk room should for hygienic causes not be placed close to such facilities. Nor should access roads to the milk room run adjacent to cow passageways nor cross the passageways to ensure external contamination protection.

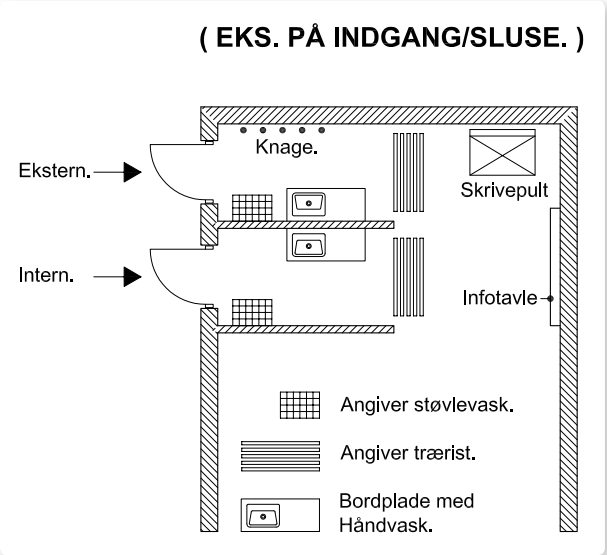
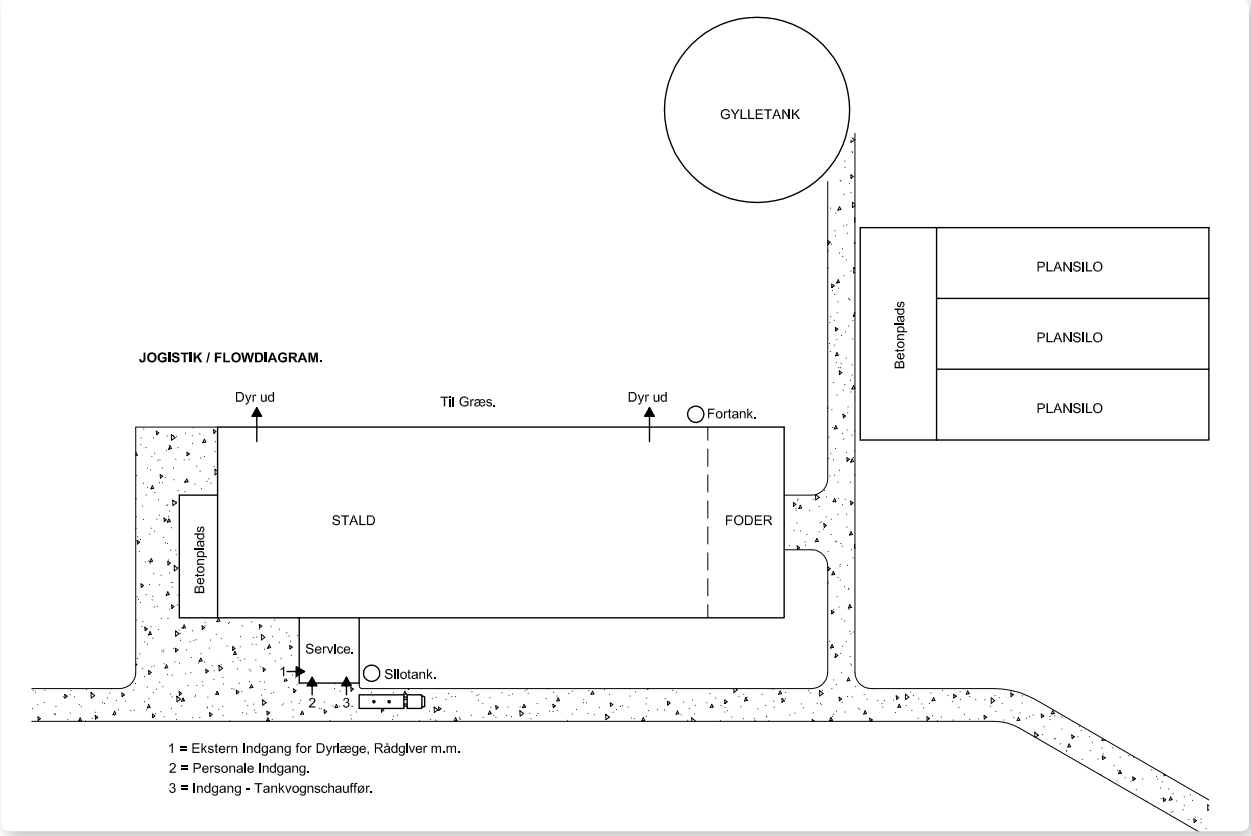


Diagram of entrance area/lock.



Flow diagram of logistics of milk production.

Disease prevention ...

Visits to the herd constitute risks of introducing contamination. It would be practical if visitors only enter and leave at one spot, where their footwear can be cleaned. A clean, surfaced base outside the cowshed entrance is a precondition for leaving the place again with clean footwear.

External staff (inseminators, veterinaries, control assistants and hoof trimmers) are in direct contact with animals in other herds and therefore constitute potentially greater risks of transmitting contamination than other visitors.

The possibility also exists of transmitting contamination via equipment (e.g. hoof trimming van). It is therefore important that equipment is only taken into the herd, if it has previously been cleaned and disinfected, if necessary. Footwear must be cleaned and disinfected both before and after the visit. The necessary facilities must be placed, so that it seems natural to pass them in connection with visits to the herd.

The service staff coming into contact with the animals must change into a clean protective suit or protective coat between each visit. If the individual herd owner wants addition measures such as wash or change of clothing or footwear, the necessary facilities must be available. Special entrances (locks) for the service staff should be continued.

Other guests or visitors from agricultural colleges, schools, nursery schools, etc. do not pose the same risk, as they have limited contact with cattle. If the farm has visitors from abroad or the herd owner wants increased safety in relation to visits, visitors may be equipped with protective suit or shoes.

It must be possible to wash and disinfect hands and boots after visits to the cowshed.

Combating vermin and rodents is also important for the external contamination. Not least rats are a known source of infection transmission between herds. Contaminant transmission from rodents is presumably only relevant at short distances (a few kilometres).

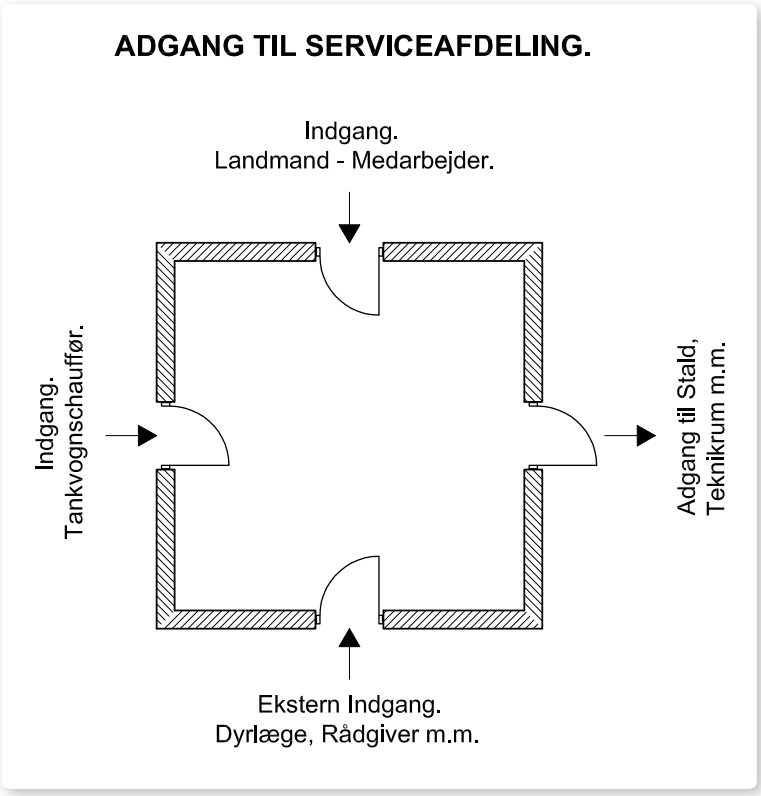


Diagram of principle sketch of the four entrances to the service section.

Access conditions – outdoor areas ...

To ensure optimum access conditions, a firm, well-drained road and turning space must be established for the tank truck. The road must be able to carry a fully-loaded tank truck all year without risks, inconvenience or extra wear.

Road and turning space must be dimensioned according to the following recommended measures:

Tank trucks	Turning radius, m
Normal for car	7.0
Semitractor with trailer	10.5
Tank truck with trailer	13.0
The tank truck with trailer must be able to turn without disconnecting the trailer.	

The milk room should not be placed adjacent to a traditional farmyard or farmhouse. To many farmers, the farmyard has become a more private area, often the playground of children. Big trucks do not belong here.

In connection with new building or conversion, the milk room should be placed so that the truck can drive directly to the door of the collection room without having to reverse.

For passage at trees, it is necessary for unobstructed traffic that height and width clearance is at least 400 cm.

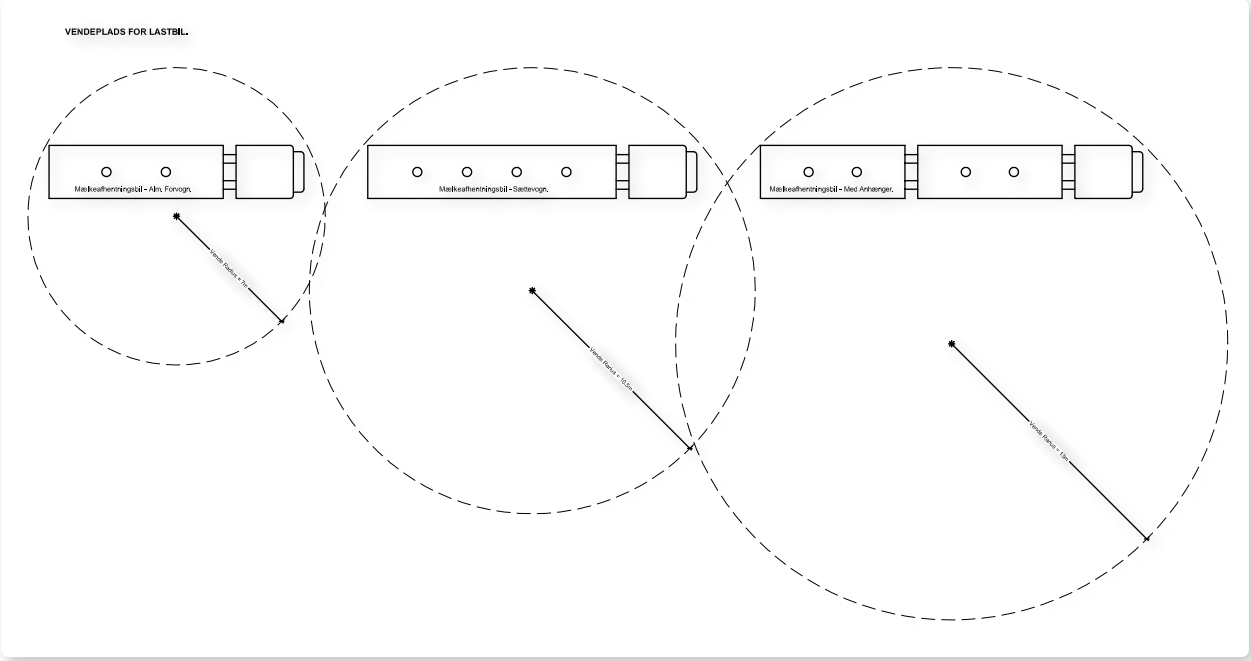


Diagram with turning radiuses for four-axle truck, tank truck with trailer and semi-tractors with trailer.

Size of milk room ...

As food is being stored in the milk room, the room must be designed and fitted out in such a way that high hygiene can be maintained. For this reason, the milk room must be easy to clean in terms of materials and surfaces.

The tank size depends on herd size and collection schedule. It must be ensured that there is room for a later extension or changed collection schedule. (e.g. three-day collection)

Minimum dimensions of milk room in metres for indoor horizontal milk cooling tanks.

Tank sizes, litres	Min. length, m	Min. width, m	Ceiling height, m*)
3,500 - 4,500	5.5	4.3	3.0
6,000 - 7,000	6.0	4.3	3.2
8,000 - 10,000	6.5	4.8	3.4
12,000 - 15,000	7.5	4.8	3.6
20,000	9.5	5.0	3.6
25.000	11.0	5.0	3.6
30,000	12.5	5.0	3.6

*) The manhole cover must be able to open completely and allow easy access of the tank.

Typical sizes of silo tanks.

Tank sizes, litres	Diameter, m	Height, m
12,000	2.80	3.50
15,000	2.80	4.25
18,000	3.20	3.75
20,000	3.20	4.30
25,000	3.20	4.95
30,000	3.20	5.70

Cooling tank types

Definition of tank concepts

Indoor tank
Milk cooling tank to be placed inside the milk room. Part of the tank may be placed in the equipment room with connection branch, manhole cover and tank air vent in the milk room. The tank may be horizontal or vertical (silo tanks).

Outdoor tanks
A milk cooling tank placed outside milk room and other piping incl. outlet pipes conducted to milk room. The tank may be horizontal or vertical (silo tanks).

Buffer tank
A tank that allows milk collection independently of milking schedule. Placed between the milking system and the milk-cooling tank.

Major herds producing more than 11,000 kg milk daily may have milk collected every day at no extra costs. In such cases, it may be possible to install two equally big tanks, where milking is conducted to the two tanks alternating.

Reference is also made to 'Tekniske krav til mælke-køletanke' (Technical requirements for milk cooling tanks) available on www.maelkekvalitet.dk.

Buffer tank placed in the milk room. The tank is mounted on legs for direct emptying.

Utility room

The utility room is usually a dry room as milking systems and cleaning units are not normally placed in this room. To facilitate cleaning of the room, all technical equipment should be placed on a concrete platform (10 cm high and sloping from the wall).

In small facilities, the equipment room will simply be a room holding all technical equipment. In larger facilities, it is more suitable to have several rooms, e.g own Power supply room, room for chemicals and cleaning agents, etc.

It would be relevant to make space available for the following equipment in the equipment room:

- Vacuum pumps (may be integrated in AME)
- Air Compressor (should be placed in a separate room, possibly with the electrical panel and emergency power generator)
- Cooling machine/heat exchanger
- Ice water tank
- Uninterruptible power supply
- CIP system
- Water supply pipe (non-return valve, main water meter)
- Waterworks/water treatment
- System for recycling washing water/water from tube cooler/tank with cleaning pump
- Freeze protection of water to the cowshed (drinking water, boot wash, hose reels)
- High-pressure cooling system
- Fixed high-pressure cleaner/warm water cleaner
- Heat for milking pit/aisle
- Water heater tanks (heat recovery, electric water heaters)
- Power supply cabinet (possibly in office or separate room)
- Uninterruptible power supply/connection to uninterruptible power supply
- Oil burner (water/calorifiers).

Fixed warm water cleaners with oil burner must be fitted with a chimney with ventilation to open air. Flue gas from the burner may harm the remaining equipment in the room.

Compressor room:

- Air compressor
- Any emergency power generator
- Any electrical panel.

The air driers of the compressors are sensitive to ammonia, and the room must therefore have external air supply, e.g. in the form of an intake valve to open air. The same applies to the exhaust from vacuum pumps and any exhaust gas from warm water cleaners which should not be placed in the same room as the air compressor.

Equipment basement below milking centres with vacuum pumps and air compressor for the milking facility.

Utility room ...

Emergency power generator with stationary diesel engine.

As the most common air driers have dew points of +3° C, the room must also be frost-proof. See also "Vejledning til kvalitet af trykluft anvendt i anlæg med automatisk malkning (AMS)" (Guidelines for the quality of compressed air used in automatic milking systems (AMS)) at www.maelkekvalitet.dk.

Storage Room

- Work bench (shed workshop)
- Shelves for consumables, spare parts, etc.

Chemicals room

- Cleaning agents (cleaning, disinfection) for cleaning milking system and milk cooling tank.
- Teat disinfectants, Teat cleaning (soap)
- Teat spray
- Hoof care products
- Various dosing pumps
- Other agricultural chemicals

Cooling machine

Location of compressor and condensing unit. If the tank and cooling machine are not integrated, the cooling machine may be placed in the equipment room separately from the tank.

The condensing unit should only be placed outdoors subject to the supplier's instructions. The condensing unit should generally be placed in a frost-free location.

Employee areas ...

The size of the service rooms depends on the size of the facility and the number of employees. Requirements include practical matters and matters of a legislative nature. As an example, facilities must be provided for both men and women if the number of employees is more than five.

- Entrance / lock
- Changing rooms
- Shower
- Toilet
- Lunch room/meeting room
- Office.

Entrance / lock
- Boot wash (here + at the shed entrance)
- Boot bench with boots for external visitors
- Rack with protective clothing for external visitors
- Wash basin with hot and cold water
- Desk with cowshed documents for the veterinary, inseminator
- Magnetic board – whiteboard
- Possibly a telephone.

In large facilities, it would be appropriate to have several separate entrances to the service section. One for own staff and one for external visitors, e.g. veterinary and inseminator. This way, effective external contamination protection can be maintained with respect to external visitors.

A separate entrance should also be provided for service staff (service technicians for the milking system, cooling tank, etc.) who only need to access the equipment room. Finally, there should be goods reception entrance for cleaning agents, consumables, etc.

Hanging rooms / shower
- Facilities for men and women (depending on the number of employees)
- Lockers
- Possibly washing machine and tumble dryer.

Toilet
- Toilet in the cowshed
- Toilet in connection with shower and changing rooms.

Lunch room/meeting room
- Dining table and chairs
- Kitchenette with table, cupboards, refrigerator and freezer
- Hotplate, coffee machine, microwave oven, dishwasher
- Notice board
- Music system, TV, PC.

Office
- Desk
- PCs in the cowshed with internet access, printer, etc.
- Telephone
- Fax
- Cupboards, shelves
- Possibly a conference table
- Notice board.

Detached service building containing milk room, equipment room and staff facilities.

Safety and staff conditions ...

Anterooms or milk rooms should have a desk or shelf hanging on the wall for personal hygiene products and protection, e.g. apron, safety goggles, gloves, dressing materials and eye wash. A folder with product and safety data sheets (workplace assessments) must also be available.

In respect of hazardous substances and materials, workplace instructions must be available for each product. Such workplace instructions must include the supplier's instructions for use (safety data sheets) and farm-specific (own) information.

The farm's own information should include a description of the following points of measures in the event of accidents:

- Scope of application (Person responsible at the farm in case of doubt as to the use).
- Use restrictions (If the farm has its own restrictions for use).
- Special training requirements (In accordance with supplier instructions and own initiatives).
- Precautions for equipment handling (Where personal protective equipment is stored).
- First aid (What first aid equipment does the farm have and where is it kept).
- Procedures in the event of fire (Where and what fire extinguishing equipment is available on the farm).
- Procedures in the event of spillage and other accidents involving chemicals on the farm (Specification of internal disposal procedure, where and how the chemicals are to be stored and disposed of).

The entrance should have room for a notice board (Info board – white board)

Furthermore, health and safety in the milk room is subject to a number of acts and regulations under the Danish Working Environment Act.

A workplace assessment (APV) must be available on the farm. An APV must be in writing and be revised when material changes are made; however at least every three years.

Pay attention to the location and handling of cleaning agents for milking systems and cooling tank. Cleaning agents and other chemicals should not be placed in the milk room but in the equipment room and preferably in a separate chemicals room.

Make sure that equipment/chemicals room can readily be accessed to ensure that pallets and drums can easily be brought to and from the room. Only choose closed containers with self-priming pumps.

Maintain proper routines for the handling of cleaning agents in connection with replacing and refilling storage cans. Always use the recommended protective equipment.

Always use the original packaging to avoid the risk of mixing up the different agents. Examples have been seen of mistaking a cleaning agent for a teat spray, resulting in the cows having to be emergency slaughtered because of severe suffering and caustic burns on the udder.

All chemicals must be kept out of reach of children.

Surfaces and material choices ...

Floor and wall covering in milk rooms

Since strong chemicals containing both acid and base are used to clean the milking system and the cooling tank, floors and walls may be subjected to corrosion. For this reason, all surfaces should be protected against corrosion and be made of acid-resistant materials. Furthermore, all surfaces should be washable.

Floorings should meet the following requirements:

- Water-tight
- Hard-wearing (acid-resistant, protected against corrosion)
- Heat-resistant
- Non-slip
- Be able to resist temperature fluctuations (frost-proof).

For this purpose the following groups of materials are available:

- Ceramic products (floor tiles, wall tiles)
- Synthetic products (Epoxy, polyurethane, acrylics, etc.).

Floor tiles

Joints should meet the same acid resistance requirement as the tiles. This particularly applies to the various synthetic products, see the synthetic products section.

Wall tiles

Wall tiles or thin floor tiles may be used for wall covering. In unheated rooms, the tiles must, however, be frost-proof.

A recognised joint filler must be used between the tiles.

Synthetic products

The synthetic products most commonly used today are Epoxy-based, as one- or two component products.

Flooring

Epoxy must be laid on a level concrete floor. Any laitance must be removed from the finished surface before Epoxy is laid. It is very important that the concrete is completely dry before Epoxy is laid as any vapour pressure from the concrete will make the Epoxy loosen from the floor and be destroyed.

Wall covering

Walls may also be sealed up using a synthetic product to be painted on a clean and dry surface. As most washable synthetic products are diffusion-tight, it is important to ensure that the walls are completely dry to prevent vapour migration as a result of different vapour pressure through brickwork and plaster to the back of the wall covering.

Walls must be treated at a height of about two metres. Washable wall paint or cement-stabilised paint/whitewash must be used as surface finish.

Walls should be treated before any fixtures and equipment are fitted in the room.

When choosing materials for walls in milk rooms and equipment rooms, you need to be aware that part of the equipment for e.g. milking systems, such as end unit and milk pump, are generally mounted in wall brackets. For this reason, wall materials must be suited for mounting fixtures and equipment, e.g. by using plugs/expansion bolts. Otherwise it must be specified that fixtures and equipment should be mounted using through bolts.

Ceiling lining

The following materials may be used as ceiling lining:

- Concrete
- Cement-stabilised plates (Eternit slabs, cement-stabilised chip boards)
- Plastisol-treated steel plates
- Wood concrete (e.g. fine, light Troldtekt)

The supplier's installation instructions must be followed carefully. All joints must be tight and prevent access for various insects and rodents.

Drain ...

Appropriate drain must be established from the milk room. All materials must be acid-resistant and be able to resist corrosion from the milk and the cleaning agents used.

As an alternative to the traditional floor drain, the drain may be constructed as an open drain channel with fall, e.g. made of polyester concrete. The drain body under the pipe branch of the cooling tank may also be a standard kitchen sink made of stainless steel embedded in the floor.

All drain pipes must be made of PVC.

As a minimum, grated drains should be established at the pipe branch of the cooling tank and at the water draining point. Both grate and drain body must be acid-resistant. Systems with their own drain may advantageously be taken directly to the sewer. E.g. drain from cleaning unit, washing machine for cloths, etc. The washing machine for cloths must be without pump and lint filter and with direct bottom outlet for which a separate drain should be established.

All floor drains must have a water seal.

Drains from milk rooms and equipment rooms must be taken to the slurry tank. Drains from service and staff rooms must be taken to percolation or to public sewers. Permission from local authorities must always be obtained to discharge wastewater from service and staff rooms.

Acid-resistant floor drain with a stainless steel grate.

Ventilation ...

Adequate ventilation of the milk room and the adjoining equipment and service rooms must be ensured. This is to ensure that the rooms are kept dry and have proper fresh air.

Natural ventilation may be used in the milk room. A shutter should be fitted in the milk room door (e.g. 50 x 50 – 65 x 65 cm) or an actual wall vent combined with ventilation through the ceiling and to open air. The supply of fresh air is ensured when a mechanical ventilator is installed.

All ventilation openings must prevent birds, rodents or other vermin from entering.

Mechanical ventilation may be necessary in large milk rooms and equipment rooms. This may be in the form of a ventilating chimney taken through the ceiling and to open air or a wall vent. The ventilator should be should be temperature and humidity controlled.

Housing the vacuum pump, cooling system condensing unit and air compressor, the equipment room develops much heat and must always be ventilated in the interest of the useful life of the equipment and the cooling costs.

Under-floor heating is recommended in the milk collection room. This ensures that the room is always kept free from frost and can be ventilated in the winter, thus ensuring fresh air in the room throughout the year.

Aftræksskorsten med ventilation ført op gennem loftet.

Lighting

The milk room must appear bright and hygienic. The milk room door should always have windows or a glass panel to allow daylight into the room.

The milk room and adjoining service room must have artificial lighting in the form of fluorescent light fixtures or similar.

See table for recommended luminous intensity.

Room	Lux
Milk room	200
Equipment room and other service rooms	50
General rooms	100

(DS 700)

LThe lighting in the milk room must be placed to enable the driver to check the milk (appearance, smell and taste) before it is pumped into the tank truck.

Furthermore, external light must be installed above the entrance door to the milk room, preferably with a sensor which turns on the light when the tank truck enters the site.

The switch to the light in the milk room must be located to make it easy for the driver to turn on the light when he enters the room (not behind the door).

Electrical installations/power supply ...

Electrical installations include both 230 volt and three-phase 400 volt with ground connection. The power need depends on the size of the facility and the choice of milking and cooling system.

Recommended power need for milk rooms (conventional milking)

Cooling tank	• **0,25 kW per 100 l.** - if collection every day • **0.15 kW per 100 l.** - if collection every second day • **0.75 kW** for cleaning unit (pump) and agitation
Vacuum pump	3.00 - 5.00 kW
Electric water heater	3.00 - 5.00 kW
Lighting	2 x 100 W 1 x 100 W above the milk room door 1 x 230 volt plug socket

Electricity consumption during milking

Type	Consumption during each milking session	Consumption for each tonne of milk
Single box milking robot *)	0.215 - 0.295 kWh	19.5 - 22 kWh
Milking parlour 2x12 herringbones **)	0.26 kWh	19 kWh
26 points inward carousel **)	0.24 kWh	21 kWh
40 points outward carousel **)	0.40 kWh	38 kWh

*) FarmTest - Cattle no. 61, 2009. **) FarmTest - Cattle no. 17, 2004.

The electrical installation must contain the necessary switches for light, turning on milking system, cooling tank and plug sockets for 230 and 400 volt.

Electrical cabinet in office.

To this should be added data cables and internet connection.
If the driver is to start the cleaning process, the cleaning unit control panel must be located in the milk room. Furthermore, a quick reference guide must be provided, specifying how the cleaning unit is started (and how milking robots are stopped).

The farmer is responsible for ensuring that the cooling tank cleaning unit is ready for use and that cleaning agents and disinfectants have been added.

Equipotential

All technical equipment must be equipotentially bonded in accordance with the Danish Heavy Current Executive Order. This work must be performed by an authorised electrician.

Particularly milking robots should have their own power supplies for their own group.

Heating, water supply and plumbing ...

A properly dimensioned water supply must be able to provide the required amount and quality of water with adequate pressure and rate of flow to ensure that the individual consumption sites receive an optimum supply.

Water is needed both in the cowshed and adjoining milking centre, regardless of whether it is a conventional milking parlour or milking robots. The water supply must at all times be able to provide water to all these sites in the required amount at the required pressure. This requires pipes to be adequately dimensioned to avoid major pressure losses and reduction in water flow. The greatest demand is defined as peak load and is also the maximum simultaneous consumption.

This means that the main must be able to supply the required volume and quality also during peak loads. Finally, the waterworks or own water well must be able to supply the necessary water volume. If the supply system cannot handle all peak loads, it may be relevant to establish a buffer tank (temporary water reservoir/stocks).

In major cowsheds (+ 500 cows), consumption during peak loads may be more than 20 m^3 per hour or 330 l per minute. This places great demands on both supply system and pipe dimension.

Inlet

In connection with the construction of most new cowsheds, an entirely new water supply inlet will have to be established. **Instead of the conventional non-return valve, the inlet must be made with a** BA valve which meets the EU environmental requirements. The valve consists of a two-valve set, meaning that there is an extra chamber if water flows back into the system.

The new BA valve prevents water which has been in contact with technical equipment in the system and thus might contain traces of oil, milk, etc. from flowing back into the water distribution networks and seep into the groundwater.

The BA valve may be placed before the individual components, e.g. milking robot, high-pressure cleaners, etc. A tap or draining point may not be placed between the valve and the equipment.

To protect the valves in the drinking-water supply, pump, etc. in the technical equipment, the inlet should also have a mesh and a filter to remove impurities and foreign bodies in the raw water.

Piping system

Typically, three types of water pipes are used:

- Galvanised steel pipes
- Stainless steel pipes
- Plastic pipes (PEX, PEL or PEM).

Galvanised steel pipes and stainless steel pipes are mainly used as internal visible pipes and can normally withstand the contact with animals. Plastic pipes normally do not withstand direct contact with animals without additional protection and are therefore primarily used in water supply systems in the ground and under the building. PEL and PEM are typically used as main and for cold water (max. temperature 20° C. at 6.3 bar). PEX pipes are used for hot water (max. temperature 95° C).

Water pipe dimensioning

The current pipe dimension is calculated in connection with the preparation of plumbing tender invitations or in cooperation with a plumber based on the actual need.

Water volumes

Working routines impact greatly on total water consumption and the extent of the peak loads. The largest consumption will normally occur when the milking system and cooling tank are cleaned and the cows, immediately after milking, drink large volumes of water.

Cleaning the milk cooling tank

The water volume required to clean the milk cooling tank will normally account for
4 – 5% of the tank cubic content.

- 0.5 – 0.75% of the tank cubic content to pre-rinse, intermediate rinse and post-rinse
- 1% of the tank cubic content for main cleaning and disinfection.

- < 10,000 l. tanks 1% of the cubic content for each process
- > 10,000 l. tanks 0.8 % of the cubic content for each process.

For a 20,000 l. tank, this corresponds to 1,000 l. every second day and with a cleaning time of 45 min., an hourly output of 1,333 l.

Plumbing with main inlet of water, water treatment and domestic waterworks.

The volume of hot water in the main cleaning process also depends on the tank inner surface, how much steel is to be heated and of the size of the cooling jacket and the amount of cooling medium to be heated.

Silo tanks sold in Denmark have between 13 l and 42 l of ice water in the cooling jacket. In respect of the tanks with a large cooling jacket, at least 1% of the tank cubic content is used for main cleaning regardless of the tank size.

In many cleaning units, the water volume may be set manually for each process.

Plumbing in a cowshed with AMS Main water inlet, container for heat recovery, hot water tanks and ice water tanks. Unit for frost-proofing drinking-water in the cowshed.

Cleaning of conventional milking systems

At a farm test, measurements have been made for three conventional milking systems

Type of milking parlour	No. of cleaning processes/day	Daily consumption l.
Herring bone - 2x12 fast exit	2	876
Carousel - 26 points inward	2	1,727
Carousel - 40 points outward	2	1,883

FarmTest no. 17, 2004 Electricity and water consumption during milking.

There is no major difference between the two milking carousels despite the difference in the number of milking clusters because the milking pipes in the inward carousel (herring bone) are longer than in the outward (side-by-side) as the milking platform has a larger diameter.

Furthermore, in the milking parlour, water will be required to clean the milking parlour, the milking points and collection point and to wash any cloths.

For milking parlours of the above type, 2,500 l./day (1,500 l. for a 30 min. wash).

Cleaning the AMS

The average daily consumption per AMS is 755 l. With three main cleaning processes per day, the hourly consumption will be 250 l. per robot (measured for single box models). Farmtest no. 61, 2009 Electricity and water consumption during milking with AMS.

There will be continuous water consumption for teat cleaning, intermediate rinse, any floor washing and hoof cleaning and for general cleaning of the AMS room.

Floor washer installed in connection with the robots will have a daily consumption of 250 - 300 l. per robot.

Other consumption is estimated at 450 l. per AMS/day.

The water volume must at all times follow the suppliers' installation instructions for both hot and cold water.

Cleaning udders

Normally one cloth for each cow is used to clean the udder in milking parlours. The cloths should be washed in an industrial washing machine (milking cloth machine without pump but with direct drain from the machine). Depending on the number of cloths and the capacity of the washing machine (up to 700 cloths), between 100 and 300 l. are used for each milking for washing cloths.

Many milking parlours also have water hoses with a shower head so that udders can be cleaned using lukewarm water, if they are very filthy. The hoses are also used to clean the milking cluster during milking.

Udder and teat cleaning in AMS differs somewhat depending on the make. Cleaning is either done by using a set of automatic brushes and lukewarm water in some nozzles or otherwise a jetter cup is used where cleaning of the individual teat is done using a combination of lukewarm water and compressed air in some nozzles in the jetter cup. Typical water consumption is 100 - 200 l./day.

Cleaning of milking parlour and collection point

Cleaning the areas in which the cows are primarily requires large volumes of water with a relatively low pressure. High-pressure cleaners are normally not recommended for cleaning milking parlours as the high pressure creates aerosols of water and manure deposited on walls, fixtures and equipment instead of being removed.

Typically a low pressure water pump with a large diameter hose and spray gun/shower head is used. The output of that type of system will typically be 50 l. per minute.

Alternatively a small 230 volt hobby high-pressure cleaner may be used. It works with a smaller volume of water and a lower pressure than a professional high-pressure cleaner and does not have the same disadvantages of aerosols and water mist.

Cleaning AMS room and milking points

Apart from the daily cleaning of the AMS room, it will generally be necessary to clean the milking points more frequently. Either in the form of a manual wash or with automatic wash of the box floor.

The typical daily water consumption is about 200 l per AMS.

Example		
Washing of platform/milking parlour	10 min. of 50 l. per min.	500 l.
Washing of collection point	20 min. of 50 l. per/min.	1,000 l.
Consumption for cleaning for each milking session		1,500 l.
However, water consumption may be reduced significantly if the areas are scraped before they are washed.		

A FarmTest shows that automatic floor wash in the milking box has a daily water consumption of 250 – 300 l. per box.

Pre-cooling milk

AMS

When a plate or tube cooler is used to pre-cool the milk, well water or ice water is used, often a combination of both. However, it is recommended to use tube coolers rather than plate coolers, as they are easier to clean and may also be used in connection with compressed air, which is used to empty the system.

If the water volume will be controlled by the milk flow, the ratio of milk to cooling water will be 1:2. If it is assumed that milking sessions are more or less evenly distributed throughout the day, peak loads will usually not be a problem for the water supply system.

Tube coolers on AMS systems cooled with ice water.

Example
1 robot milks 2,000 l. of milk per day – 4,000 l. of water will be used for pre-cooling. Milk is pumped to the tank every 5 minutes for about 1 minute, corresponding to 7 l. of milk per minute. The supply system must be able to supply 14 l. of water per min.

Conventional milking
In conventional milking, the demand for water will be significantly higher, as the milking period is much shorter and the milk comes in large volumes per unit of time.

Example
A milking carousel with 36 milking clusters can milk 2400 l/hour and with a frequency-controlled milk pump, the milk is continuously pumped to the tank. In this case, the hourly consumption will be 4800 litres of cooling water corresponding to a peak load of 80 l/min. while the daily output will be the same as for an AMS herd.

As no cleaning takes place during milking and peak loads do not exceed the total peak load for the cowshed (consumption for drinking water and cleaning), the pre-cooling only affects the daily consumption and not the dimensioning specifications for peak loads.

If the cooling water is also recycled as drinking water and for washing systems, the daily consumption will not be affected either.

Water consumption in service rooms and staff facilities
The consumption of water for toilets, changing rooms and showers and any lunch room obviously depends on the number of employees and whether the facilities are being used.

The standard figures for a normal household is 170 m^3 per year (2 adults and 2 children) corresponding to a consumption of 400 – 500 l per day. The consumption will probably not be higher with up to 10 employees.

However, staff facilities should have their own water supply and hot water tank.

Hot water
According to the industry code for cleaning milking systems and cooling tanks, the wash water should maintain a temperature of at least 60°C. for 5 min. and a minimum end temperature of 42°C. Furthermore, five-step cleaning is recommended rather than a three step cleaning.

Milk system and cooling tank cleaning consumes large volumes of hot water, and in many cases, cleaning units do not have suitable heating elements but depend on the temperature of the water from the hot water tank being sufficiently high.

With a consumption of about 250 l. for each main cleaning process for one robot and a regular consumption of pre-heated water for teat cleaning and intermediate rinse, a 300 litre hot water tank will in many cases have to be installed for each robot.

This also applies to cleaning of the cooling tank, particularly tanks with a large volume of water in the cooling jacket. When cleaning the cooling tank, it will often be necessary with an extra pre-rinse using hot water to heat the ice water in the cooling jacket in order to reach the recommended cleaning temperatures. However, some systems are constructed so that the cooling jacket is emptied of water before the tank commences.

This also applies to systems with tube coolers to pre-cool the milk. These tube coolers contain large volumes of ice water, which should also be let out before the system is cleaned.

Finally, it is important to ensure that there is no circulation of ice water or well water in tube and plate coolers when the system is cleaning.

Measurements on silo tanks have showed that even though the recommended temperature of the wash water of at least 42°C, the temperature during the cleaning process never reached the required 60°C.

The substantial volumes of water put great demands on the primary supply and not least the hot water supply.

We therefore recommend that a separate supply system be established to the individual sections of the cowshed and to the various functions of the milking centre. This includes separate hot water supply to milking system, cooling tanks and other consumption.

The hot water tanks should be dimensioned separately to fit the individual system.

- 1 water heater tank for washing and cleaning the milk cooling tank
- 1 hot water tank supplying the milking parlour
- If AMS, then 1 hot water tank for every 2 milking robots
- 1 hot water tank for other consumption.

Recycling cooling water

Often water used to pre-cool the milk in plate/tube coolers is collected and recycled. The water is collected in a reservoir, which could e.g. be used cooling tanks, fibreglass tanks or any other suitable container (2000 – 4000 l). The equipment room must have room for the tank. The tank may advantageously be a ground tank placed on the ceiling or outdoors so that it does not take op space in the equipment room. The water is included in the general supply of drinking water and wash water, etc. Most commonly, the tank is fitted with a domestic water works supplying the pressure and the water for the water troughs in the cowshed.

The tank is then fitted with a float and external water supply which supplements the recycled water. This is because the water volume used for pre-cooling only covers a small amount of the daily consumption of drinking water.

However, it is important to pay attention to the cleanliness of such reservoir as over time, impurities will occur in the water resulting in deteriorating water quality. Emptying and cleaning the reservoir once a year should therefore be a routine on the farm.

Recycling wash water

Normally, it is not recommended to recycle wash water from cleaning units and CIP systems. Milk residues and cleaning agents will always be left in the water and if the water is then used to clean e.g. a milking parlour, it will always leave a yellow deposit on walls, fixtures and equipment.

In some systems recycled water from the cleaning systems are used to wash/flush the collection point. In this case the water is collected in a container on legs or on top of the service rooms and can, by means of a gate and a large pipe be emptied into the collection point and wash it in a few seconds.

Heat recovery

Milk cooling generates substantial quantities of surplus heat which may in most cases be reused without problems. This applies to systems with directs and indirect evaporation. The cooling machine is replaced by a heat pump, and the surplus heat may be used for e.g. heating service rooms, the farm house, etc.

Technical insulation

So far, milk and water pipe insulation has not been a fixed part of the tender documents in connection with farm buildings. This is contrary to industrial buildings where technical insulation is always included as an independent contract.

However, much money can be saved if pipes are also insulated in cattle sheds. If milk pump pipes and hot water pipes are insulated, the energy consumption relating to system cleaning may be reduced by 12 – 15%.

It will also improve milk quality as the heat loss will also be reduced in connection with cleaning of milking systems and cooling tanks, thus providing more certainty that the required temperatures are achieved during cleaning.

For further reference, see the website www.maelke-kvalitet.dk which includes an **excel** spreadsheet for calculating water consumption in dairy cows facilities.

Example of water supply system dimensioning, conventional milking.

Cowsheds with 300 cows and young stock. Conventional milking.			
Drinking water			
300 cows	130 l. /day	39.00 m^3	
165 heifers, 1-2 years old	30 l./day	4.95 m^3	
165 calves < 1 year old	15 l./day	2.48 m^3	
Daily consumption		**46.425 m^3**	
The calculation of peak load is based on 10% of the cows drinking at the same time and an even consumption among heifers and calves.			
Peak load, drinking water		**4.210 m^3**	**Corresponding to 70 l./min.**
Process water			
2 x cleaning of milking system		1,050 l.	Per cleaning
Cleaning of tank	20,000 l.	1.000 l.	Every second day
Other consumption		2,500 l.	Per day - peak load 50 l./min. for washing
Daily consumptions		**5.10 m^3**	
Peak load		**5.38 m^3**	**Per hour, corresponding to 90 l./min.**
Total consumption for cowshed and systems			
Daily consumption		**51.525 m^3**	
Peak load		**9.59 m^3**	**Per hour, corresponding to 160 l./min.**

Example of water supply system dimensioning, automatic milking.

Cowsheds with 300 cows and young stock. Automatic milking.			
Drinking water			
300 cows	130 l./day	39.00 m^3	
165 heifers 1-2 years old	30 l./day	4.95 m^3	
165 calves < 1 years old	15 l./day	2.48 m^3	
Daily consumption		**46.425 m^3**	
The calculation of peak load is based on 10% of the cows drinking at the same time and an even consumption among heifers and calves.			
Peak load, drinking water		4.21 m^3	Per hour, corresponding to 70 l./min.
Process water			
4 AMS		755 l.	Per day
Cleaning of tank	20,000 l.	1,000 l.	Every second day
Other consumption		450 l.	Per day
Daily consumption		5.32 m^3	
Peak load		1.91 m^3	Per hour, corresponding to 32 l./min.
VedWhere two robots and tank are cleaned at the same time. Other sonsumption is evenly distributed throughout the day.			
Total consumption for cowshed and systems			
Daily consumption		**51.75 m^3**	
Peak load		**6.12 m^3**	**Per hour, corresponding to 102 l./min.**

Appendix ...

Laws and orders

- Danish Working Environment Act no 784 of 11 October 1999
- Executive Order on the design of permanent workplaces no. 96 of 13 February 2001
- Executive Order substances and materials no. 292 of 16 April 2001 and notice 3.02.2
- (September 1999)
- Danish Building Regulations, 2010
- The Danish Heavy Current Executive Order of 1 July 2001, section 6 on electrical installations (equipotential bonding)
- Executive Order no. 418 of 23 June 1993 of the Ministry of Food, Agriculture and Fisheries on milk production and transport
- Executive Order on food hygiene for milk, eggs and derived products, 2002
- The EU Hygiene Regulation, 2004
- Various ISO standards for milking and cooling (no. 5707, no. 5708)
- EN standard for milk cooling tanks (no. 13732)
- Veterinary legislation.

Literature

- Guide to designing milk rooms, 3nd edition, January 2011
- Arlagården quality programme, 4.2d edition, July 2014
- Gården quality programme
- Technical requirements to milk cooling tanks, February 2010
- Guide to using compressed air in milking parlours
- Industry code for self-monitoring
- DS no. 700 lighting in farm buildings, 1997
- Water supply in cattle sheds, 2001
- Farmtest – Cattle no. 17, 2004 Electricity and water consumption during milking
- Farmtest – Cattle no. 61, 2009 Electricity and water consumption during milking using AMS
- Designing cattle sheds – Danish recommendations 5th edition 2010.

KNOWLEDGE CENTRE FOR AGRICULTURE
Dairy & Cattle Farming
Agro Food Park 15
8200 Aarhus N
Denmark
+45 8740 5000
vfl@vfl.dk
vfl.dk

DLBR