



# Fullwood M<sup>2</sup>erlin

## Operating Instructions for Safe Use

User Manual 294130  
Revision C

**ORIGINAL MANUAL**

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## Revision Control

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A	03/12/2014	73	G Williams	
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## Icons

Icons are used in this manual to draw the reader's attention to specific information. These icons have the following meaning:

	Failure to follow the instructions can result in severe injury to engineers, users, bystanders or livestock
	Indicates special precautions that must be taken to avoid damage to equipment.
	Gives important information to prevent potential problems
	Gives advice or suggestions to make procedures easier or clearer

### Important information - read this first

## 1. Health and Safety Statement

Fullwood Limited specialises in the design, procurement, manufacture, installation and commissioning of dairy and associated equipment comprising of pneumatic, electro-pneumatic and electrical industrial control equipment. The nature of the company's business activity places emphasis on experience, capability, performance of design, manufacture and reliability. Whilst Fullwood equipment will comply with all relevant directives, customers are reminded that all equipment into which Fullwood equipment is to be incorporated must comply with all applicable European directives.

The attention of the purchaser is drawn to the provision of Section 6 of the Health and Safety at Work Act 1974. Section 6 of the Act provides that manufacturers, designers, importers or suppliers of equipment for use at work have a duty to ensure, so far as reasonably practical, that the equipment will be safe and without risk to health when properly used. The equipment is not regarded as being 'properly used' if it is used without regard to any relevant information or advice relating to its use made available by the manufacturer, designer, importer or supplier. It is the responsibility of the purchaser to take such steps as are necessary to ensure that appropriate information relevant to the equipment is made available to their employees and any person to whom the purchaser supplies them.

It is important that the equipment be installed, commissioned, maintained and used by competent trained/skilled persons in accordance with good engineering practice. International

and national Wiring Regulations, Codes of Practice and all current relevant legislation requirements and accepted rules or art for the industry concerned.

All installations and maintenance should be carried out within the provisions of 'The Electricity at Work Regulations, 1989' and by persons so qualified as defined in that act.

Fullwood Limited supplies document packs with all equipment. These documents are supplied for information and should be disseminated to the relevant persons.

## 1.1 Risk Assessment

Risk Assessments are a legal obligation and an important step in protecting your personnel, visitors as well as your business. It helps you focus on the risks that really matter in your workplace, the ones with the potential to cause real harm. In many instances, straightforward measures can readily reduce risks. These measures should be reviewed annually or when the process changes, whichever comes first. The law does not expect you to eliminate all risk but measures must be taken to reduce the risk as far as 'reasonably practicable'.

For most, that means simple, cheap and effective measures to ensure your most valuable asset – your workforce – is protected.

## 1.2 General

M<sup>2</sup>erlin is manufactured to the latest engineering standards and acknowledged safety regulations. Nevertheless, dangers can arise through its operation;

- Danger to life and limb of the operator or third parties.
- Damages to the machine and other material assets.

Following instructions within this manual will prevent / minimise risk

## 2. Safety and Responsibility Instructions

### 2.1 Basic Instructions



- Before installing or operating the M<sup>2</sup>erlin, this manual and the appropriate operating instructions must be read and understood.
- Only use the M<sup>2</sup>erlin if it is in a technically perfect condition and only for the purpose it is intended; observe all safety measures and instructions.
- Immediately rectify / report any faults maintaining an efficient and safe machine.
- Wear the correct protective clothing and equipment.

### 2.2 Intended Use



- M<sup>2</sup>erlin is ONLY for use in dairy farming to facilitate the milking of cows; any other use is considered incorrect. (e.g. Medical treatment of cows, milking of any other animals).
- Operate the M<sup>2</sup>erlin only within its performance limits and under the conditions specified in this manual.

### 2.3 Improper Use



- Never use the M<sup>2</sup>erlin for any other use (e.g. medical treatment of cows).
- Improper use can cause damage to property, severe injuries or even death.
  - The manufacturer is not liable for any damages that may result from incorrect use. The user alone is liable for any risks incurred.

### 2.4 General Safety



- All covers and guards shall be in place before operating M<sup>2</sup>erlin.
- Keep hands, feet, hair and clothing away from all moving parts.
- Keep unauthorized or untrained persons, including **children** away from the hazardous area of the milking robot at all times.
- Do not enter the animal / milking area of the machine during operation.
- Do not block/obstruct the moving parts of the machine.
- Do not look directly into the laser light of the teat detection system.
- Do not weld on M<sup>2</sup>erlin unless instructed to do so by Fullwood Limited, follow instructions e.g. remove all connections to PCB's.
- If welding in an area within 5m of M<sup>2</sup>erlin, turn M<sup>2</sup>erlin off and remove the main Harting connection.
- Keep the working area as clean and as dry as possible.
- Ensure first aid kits and firefighting equipment are available, are clearly visible and easily accessible.
- Never use the equipment if you are not adequately trained or authorised to do so.
- Never attempt to service the equipment if you are not adequately trained or authorised to do so.
- Wear PPE (Personal Protective Equipment)
  - e.g.:-
    - Safety overalls
    - Protective gloves
    - Safety boots
    - Eye protection
    - Ear protection



## 2.5 Safety dealing with sources of danger

### 2.5.1 Electrical Safety



- SWITCH OFF the machine and isolate the electrical power supply, release pneumatic pressure and wait for all moving parts to stop before you perform any maintenance on the machine.
- Contact with electrical components can result in electric shocks, burns or death.
- Only a qualified and authorized electrician or trained personnel under the supervision of a qualified and authorised electrician shall install the electrical power supply to the machine according to local electrical regulations.
- All power supplies shall be fitted with lockable isolating devices.
- Ensure all electrical switches are in the OFF position before the electrical power supply is switched on.
- Replace any damaged electrical lines, conduits, switches and components immediately.
- Only use protective devices corresponding to the machine power.
- Isolate the electrical power supply at the wall mounted isolator and lock it off before you open the electrical panel to work on the electrical system.

### 2.5.2 Operating fluids/materials



The used operating fluids and material can cause adverse health effects. Suitable measures must be taken in order to prevent injuries.

- Only Fullwood recommended chemicals shall be used, any other product may result in damage.
- Material Safety Data Sheets (MSDS) shall be reviewed prior to use together with a risk assessment performed in accordance with COSHH regulations.
- Read safety instructions on the containers.
- Always wear protective gloves and safety goggles when handling chemicals, or when working on parts of the robot where you may come into contact with chemicals.
- Strictly forbid fire, open flame and smoking.
- Avoid contact with skin and eyes.
- Do not inhale oil mist or vapour.
- Do not eat or drink when handling chemicals.
- Suitable fire extinguishing materials must be to hand.

### 2.5.3 Unsuitable spare parts



- Unsuitable spare parts compromise the safety of the machine and could invalidate the manufacturer's warranty:
- Use only spare parts approved by the manufacturer for use in this machine.

### 2.5.4 Conversion or modification of the machine



Modifications, additions to and conversions of the machine or the controller can result in unpredictable dangers.

- Obtain written approval by the manufacturer prior to any technical modification or expansion of the machine, the controller, or the control programs.

## 2.6 Users Responsibility



- Check suitability of animals (e.g. low udders, misplaced teats, temperament)
- Check services are adequate (Power, Vacuum, Compressed Air, Water)
- Check calibration of Milk Meters and feed dispensers
- Check for hazards such as sharp objects that could cause injury to the animals.
- Check the performance of the animals during milking
- Follow manufacturers guidelines for cleaning and maintenance
- Servicing of M<sup>2</sup>erlin shall be carried out by approved dealers
- Never allow persons under the influence of drugs or alcohol operate M<sup>2</sup>erlin
- Following these instructions along with others within this and other supporting manuals will help maintain an efficient operating milking machine.
- The manufacturers guarantee does not cover direct or consequential damage caused by incorrect installation, incorrect usage, improper treatment, inadequate cleaning or servicing, or incorrect software parameter inputs or hardware settings.

## 2.7 Assembly

- Do not climb onto the machine to gain access to upper areas.
- When working at height assess the risk and use appropriate equipment.
- Only use electrical cables that are suitable and approved for the surroundings and electrical loads applied.
- Never dismantle compressed air pipes until they are fully vented.
- Only use pressure lines that are suitable and approved for the maximum working pressure and intended medium.
- Do not allow connection pipes to be placed under mechanical stress.
- Do not induce any forces into the machine via the connections, so that the compressive forces must be balanced by bracing.

## 2.8 Positioning

A suitable installation location for the machine prevents malfunction and accidents.

- Install the machine in accordance with Fullwood plans.
- Ensure sufficient lighting such that the display can be read and work can be carried out comfortably and safely.
- Ensure accessibility so that all work can be carried out without danger.

## 2.9 Commissioning, operation and maintenance

During commission, operation and maintenance you may be exposed to dangers resulting from; electricity, pressure and temperature. Careless actions can cause accidents with severe adverse effects for your health.

- Allow maintenance work to be carried out only by authorised personnel.
- Switch off and lock out the power supply isolating device and verify the absence of voltage.
- Close shut-off valves or otherwise isolate the machine from the compressed air network to ensure that no compressed air can flow back into the machine.
- Do not open the electrical cabinet while the machine is turned on.
- Carry out regular inspections;
  - for visible damages.
  - of safety installations, guards etc.

- of the EMERGENCY STOP command device.
  - of any components requiring monitoring.
- 
- Pay attention to cleanliness during all maintenance and repair work.
  - Do not leave any loose components, tools or cleaning rags on or in the machine.
  - Components removed from the machine can still be dangerous. Do not attempt to open or destroy any components taken from the machine.

## 2.10 De-commissioning, storage and disposal

- Your machine contains a great amount of recyclable material and should be disposed of according to national and local legislation.
- Improper handling of old operating fluids and components represent a danger for the environment. Drain off fluids/materials and dispose of them according to environmental regulations. These include oils and chemicals and their filters.
- Waste Electrical and Electronic Equipment shall be removed and disposed of in accordance with national and local legislation.
- Dispose of machine in accordance with local environmental regulations or hand over to an authorised disposal expert.

## 2.11 Danger Areas



- During handling and operation of this machine, everyone in the local area should be aware of the following danger areas:

Activity	Danger area	Authorised personnel
<b>Transport</b>	Within 3 m radius of the machine/machine parts	Trained installation personnel for transport preparation. No personnel during transport.
	Beneath the lifted machine/machine parts	No personnel
<b>Installation</b>	With the machine. Within 1 m radius of the machine and its supply cables	Trained installation personnel
<b>Operation</b>	Operator side - Within 1 m of machine Cow side – Within 1 m and inside the crate (cow area).	Trained and authorised operating personnel
<b>Maintenance</b>	Within the machine Within 1 m of the machine	Trained and authorised maintenance personnel
<b>Decommissioning/ disposal</b>	With the machine. Within 1 m radius of the machine and its supply cables	Trained and authorised decommissioning/disposal personnel

Note: The table above relate to the machine danger areas only and do not take into account any local risks. Please refer to the site risk assessments for site specific danger areas.

## 2.12 Safety devices



- Various safety devices ensure safe working with the machine.
- Emergency Stop buttons on the front of the process cabinet and on the Human Machine Interface (HMI).
- The robot arm has force sensing technology that has been factory set to minimise the risk of injury to operators and animals.
- The speed of the robot arm in manual operation does not exceed 250mm/s.
- Do not change, bypass or disable safety devices.
- Regularly check safety devices for their correct function.
- Replace safety decals that are missing or are illegible.

## 2.13 Power Cut

In the event of a power cut the following will occur:

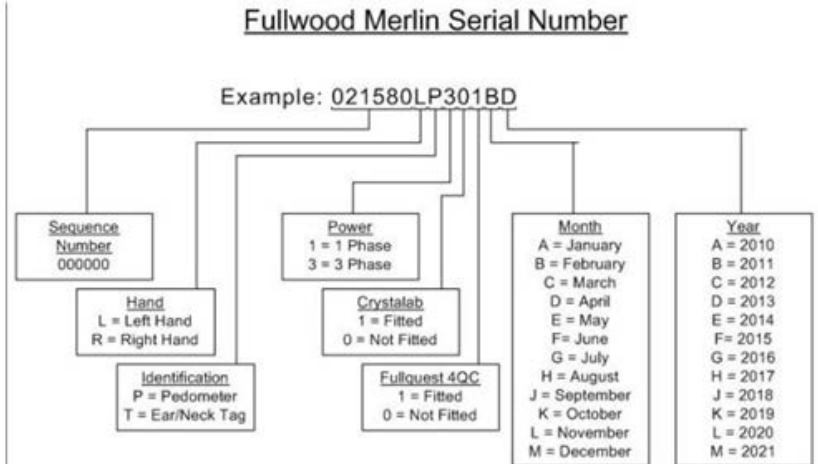
- The machine will stop and all energy will disperse. (electricity, compressed air, vacuum, etc.)
- The cups will drop from the teats.
- The exit gate(s) will become free to be pushed/pulled open so that the cow can leave the crate.
- M<sup>2</sup>erlin arm will be free to move in both the horizontal and rotational axis allowing the cow to move it as she leaves the crate.
- The vertical axis will remain at the height when the power was interrupted by the brake incorporated in the vertical motor. This brake prevents the arm from dropping in the event of power failure. The brake will hold a force of up to 400kg but must be avoided as damage to the arm may occur.
- Once power has resumed, the procedure referred to in section 10.2.3 be followed.
- It is the responsibility of the farmer to provide a suitable alternative means of power in the event of a power cut.

Note: Fullwood will not cover any damage caused by generator, substandard power supplies or third party equipment.

## 2.14 Technical Specifications

- The identification plate is located inside the electrical cabinet and provides the model and important technical information. The identification plate must not be removed.

**Merlin**  
Fullwood  
 Construction Date 22 June 2016  
 Serial Number 120542LP111FG  
  
 Part Number 294102  
  
 Hand Left Hand  
 Build revision 1.6  
 Electrical revision 1.3  
 Project Number PGE 002498  
  
 Tested By: .....  
 Final Inspection By: .....  
Manufactured and tested by:  
 Fullwood Ltd  
 Grange Road, Eblewre, Shropshire, UK, SY129DF



## 2.15 Size of Machine

Length (mm)	3693
Width (mm)	3285
Height (mm)	2438

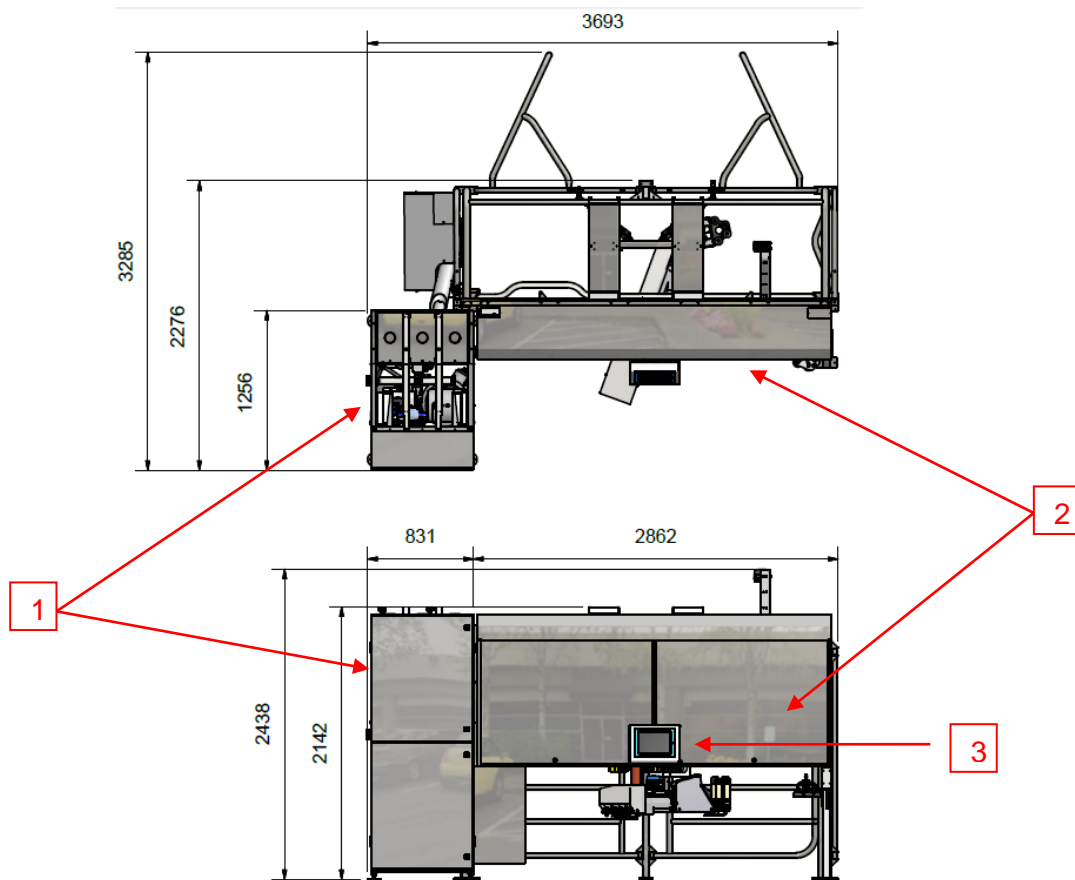
## 2.16 Transport size

Part	LxBxH (mm)
Crate (mm)	2286 x 1520 x 2142
Electrical and Process cabinet (mm)	1256 x 831 x 2142

## 2.17 Weight

Crate (kg)	750
Electrical and Process Cabinet (kg)	350

## 2.18 Spatial Requirements / Size of machine



No.	Description	Contents
1	Process Cabinet	Main control cabinet containing mains and low voltage electrical control equipment, compressed air control equipment. Milk metering, receiving and milk pumping equipment. Feed dispensing
2	Crate and Arm	Positioning device carrying teat preparation rollers, laser, teat cups, and teat spray
3	HMI	Human Machine Interface

- There must be sufficient room on the cow side to allow the entry/exit gates to open and close without hindrance.
- Allow sufficient space for the electrical doors to open to 90°.
- Refer to Fullwood installation plans/drawings for further details.

## 2.19 Power Supply Specifications

- Fullwood Ltd does not carry out any mains wiring. It is the responsibility of the customer to arrange for all mains wiring to be carried out by a competent contractor qualified in accordance with national and/or local legislation. This also applies to any mains electrical connections from switches or isolators to electrical equipment supplied by Fullwood Ltd.
- The power requirements will vary significantly, depending on the ancillary equipment specified.

Supply	Supply Voltage Volts	Max Current Amps	Power factor $\cos \varphi$	Earth Leakage mA RCD
1ph	216-253	25	>0.8	100
3ph	376-440	16	>0.8	100

- Power consumption for all other pieces of equipment e.g.: Air Compressor, Vacuum pump, Boiler Etc. will need to be calculated and specified per site.
- Earthing; It is the responsibility of the customer to ensure that all metal parts of the installation are bonded to earth in accordance with local and national legislation.
- M<sup>2</sup>erlin must be earthed according to local legislation.
- Starting up M<sup>2</sup>erlin without proper earthing will render the warranty null and void.

## 2.20 Ambient Temperature

Min	2°C
Max	45°C

## 2.21 Compressed Air Requirements

Number of M <sup>2</sup> erlins	CFM (m <sup>3</sup> /hr)	Stored Air
1	2 (3.4)	150L
2	4 (6.8)	150L
3	5 (8.5)	200L
4	6 (10.2)	200L
5	7 (11.9)	250L
6	8 (13.6)	250L



Note: Contact Fullwood for installations of over six M<sup>2</sup>erlins

<b>Minimum supply pressure</b>	7 bar
<b>Maximum supply pressure</b>	11 bar

Note: Specifications above are the requirements of the machine not of the compressor. Most rotary compressors are 100% duty cycle so calculations are required. Most piston compressors are 50% duty cycle so the compressor output needs to be double the requirement detailed above.

## 2.22 Air Drying

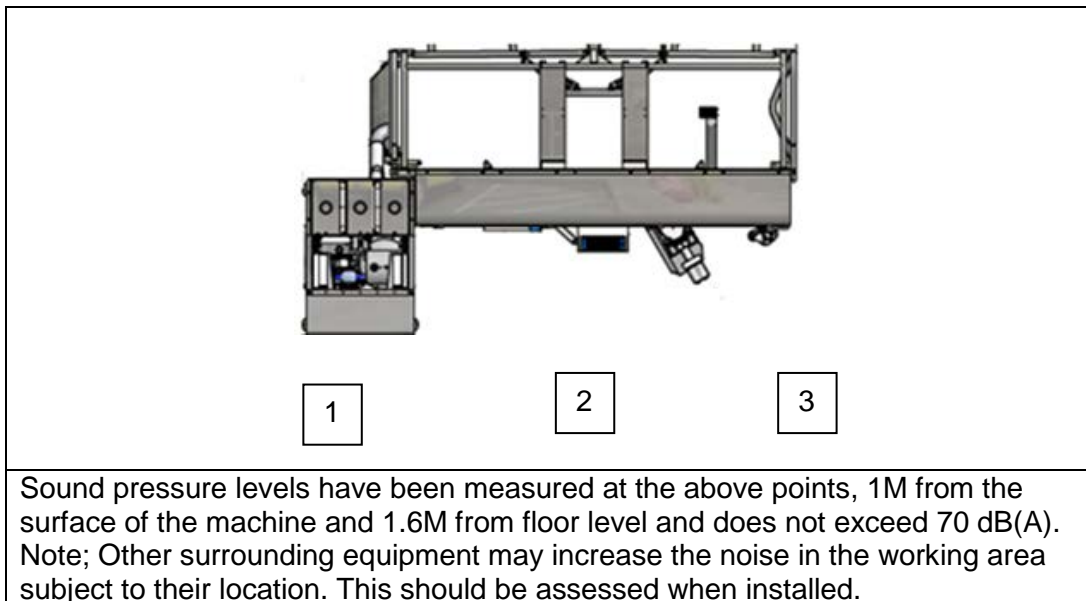
- The dryer must be rated to operate efficiently at the lowest typical temperature for the country/area.

- The filters should be located as close as possible to the compressor but after the air dryer.
- If the compressor has no filtration a 0.1 micron filter must be fitted before the drier and the remaining filters after the drier

### 2.23 Air Filtration

First stage filter	maximum 0.1 micron to reduce larger particles
Second stage filter	maximum 0.01 micron to reduce smaller particles
Carbon filter	to reduce odour and impurities

### 2.24 Noise



### 2.25 Vacuum

- The vacuum pump shall have adequate airflow capacity to meet the requirements for milking and cleaning. At a nominal 50kPa the following minimum airflow is required.

Number of M <sup>2</sup> erlin Robots	Airflow in litres / minute
One machine	450L/min
Two machines	650L/min
Each additional machine up to 6	+100L/min
> 6 machines	Contact Fullwood Ltd

These figures are based on installations at sea level (<300m) and will change depending on altitude

### 2.26 Water

	Pressure	Temperature	Volume
Cold Water	Regulated to 1.5 Bar	Ambient	Mains Supply
Hot Water	2m Head minimum* 1.5 Bar Max	92 to 96°C in the boiler	85L**



\* Equivalent pressure pumped

\*\* Subject to number of cows, site washing conditions and length of delivery line  
(Contact your Fullwood dealer for further details).

### 2.26.1 Cold Water

- Cold water should be potable, i.e. fit for human consumption, according to relevant legislation.
- If separation / air gap is required for local regulations, a header tank and pressure pump shall be used.
- Pipes shall be lagged where necessary to prevent freezing.

### 2.26.2 Hot Water

- Hot water should be potable, i.e. fit for human consumption, according to relevant legislation.
- Pipes shall be lagged where necessary to prevent freezing and heat loss.

### 2.26.3 Drainage

- Provisions shall be made for foul drainage, either by connection to a properly constructed septic tank or cesspool, constructed in accordance with current Dairy Hygiene Regulations.
- Drainage shall be through trapped gullies with water seals and rodent proof grid covers.
- Water from roofs and open yards, not subject to fouling, shall be drained to existing storm drains through gully traps.
- Drainage shall be provided from the plant room and connected to the soiled water system.

## 2.27 Luminance

At the M <sup>2</sup> erlin	350-500 luminous flux measured at the floor level
Position of lighting	Lighting should be positioned directly above the M <sup>2</sup> erlin to prevent shadows which can disturb the cows

## 2.28 Consumption Figures

Values are based upon 180 milkings, 3 hot washes and 10 M<sup>2</sup>erlin rinses per day.

### 2.28.1 Services

	Air m <sup>3</sup>	Electricity (kWh)	Hot Water (ltrs)	Cold Water (ltrs)
Per Day	38.33	3.6	192	1'180
Per Year	13'991	1'314	70'080	430'700

### 2.28.2 Chemicals

	Acid (ltrs)	Alkali (ltrs)	Teat Dip (ltrs)	Teat Rollers* (ltrs)	Acid Injection (ltrs)
Per Day	1.95 Total		3.6	3.6	0.84
Per Year	711.75 Total		1314	1314	306.6

Note: These values may vary according to factors such as length of delivery line, hardness of water and installation of system.

\* Figure based on Iodine. If the robot has been converted to use peracetic use the consumption figures for acid injection.

## 2.29 Herd Management System

Fullwood Crystal is practical and easy to use Herd Management Software.

Crystal controls and automates processes on the dairy farm, such as:













- Automatic Identification
- Feed allocation to optimize milk production at most profitable feed costs.
- Milk yield, conductivity to improve udder health and milk quality
- Activity of animals using leg mounted step counters to monitor fertility cycle, animal health and to reduce calving intervals.
- Calendar events displayed in a clear graphic display to monitor fertility and health performance.

A PC is required to run Crystal

Details and PC specifications can be obtained from your Fullwood dealer.

### 3. Safety Signs and Location

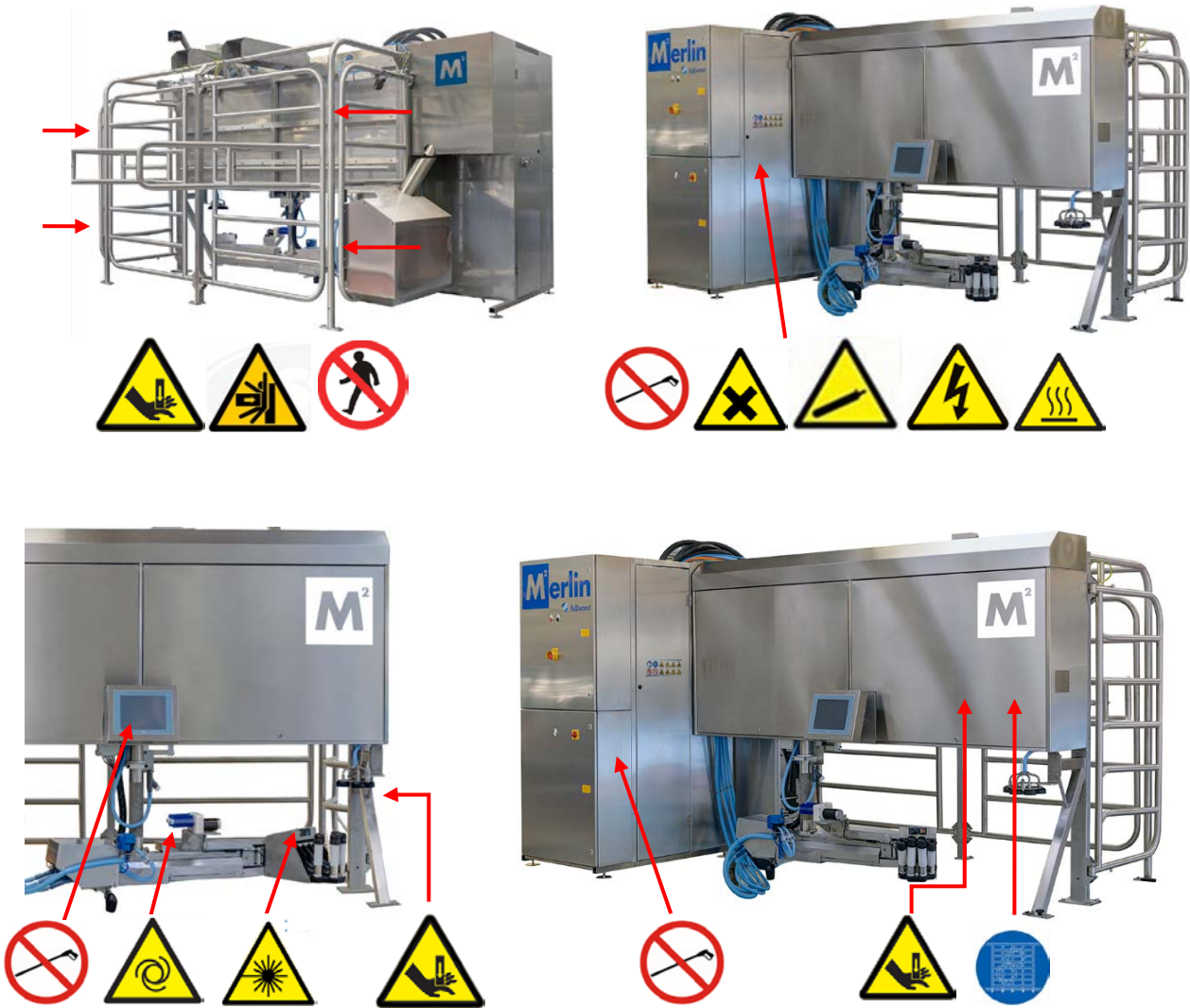
#### 3.1 Understanding safety signs

					
Read user manuals	Stop machine before removing guards	Finger / hand trapping point	Electrical Hazard	Compressed Air	Harmful chemicals
					
No access	Do not pressure wash	Body trapping point	Laser Hazard	Automatic machinery may start without warning	Hot Surfaces

#### 3.2 Position of safety sign



### 3.3 Hazard Areas



## 4. Site Positioning, Fixing Levelling and Assembly



- Site positioning, fixing, levelling and assembly shall only be carried out by personnel who have received the appropriate training.
- Attempting to perform any of the above will result in endangering persons, animals and possible damage to the machine.

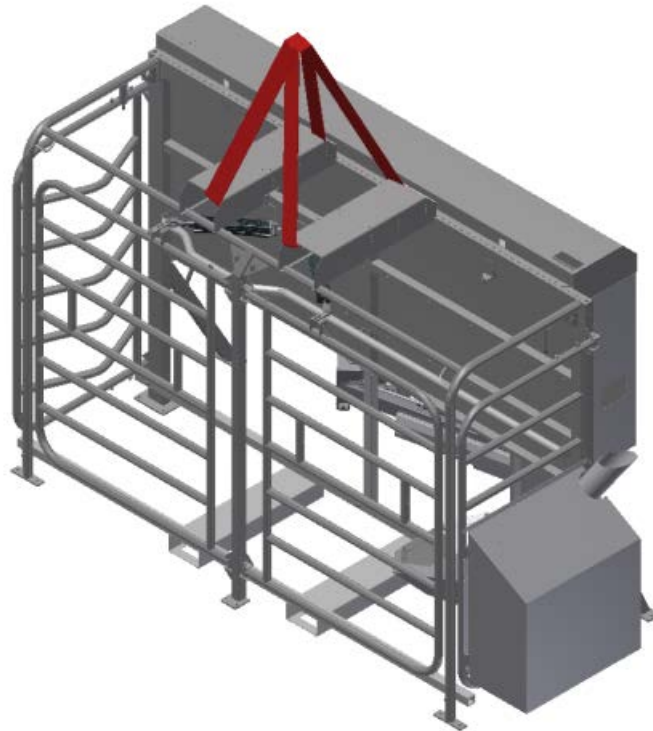
## 5. Handling and Transporting

### 5.1 The Crate



Care must be taken when lifting or transporting to prevent damage and/or injury:

Ensure adequately rated lifting equipment is used and the load is well secured at all times. Ensure ground surfaces are firm and level to avoid the unit toppling or dropping or swinging. Carry at the recommended lift points only (shown below).

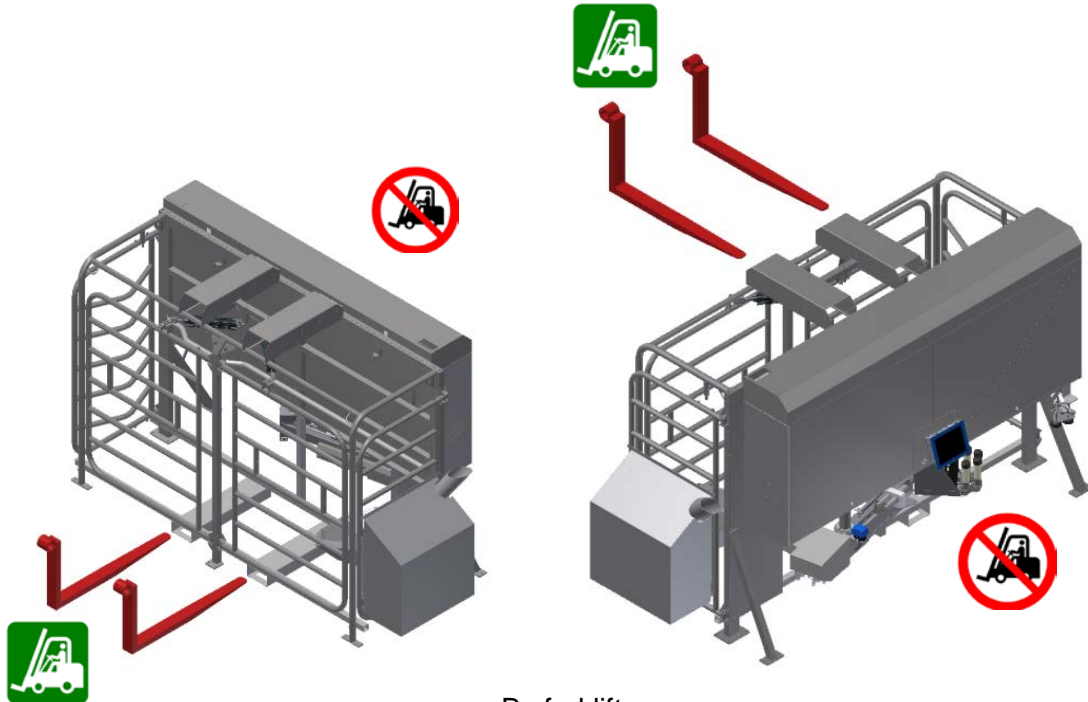


By sling

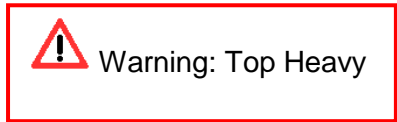
Lift from this side



Do Not Lift from this side



By forklift



**Do not lift from the Arm side of the machine**

The crate must be lifted from the cow gate side using either the fork tubes at the top of the crate or the transport frame at the bottom of the crate.

The transport frame ensures each leg is held in the correct position.

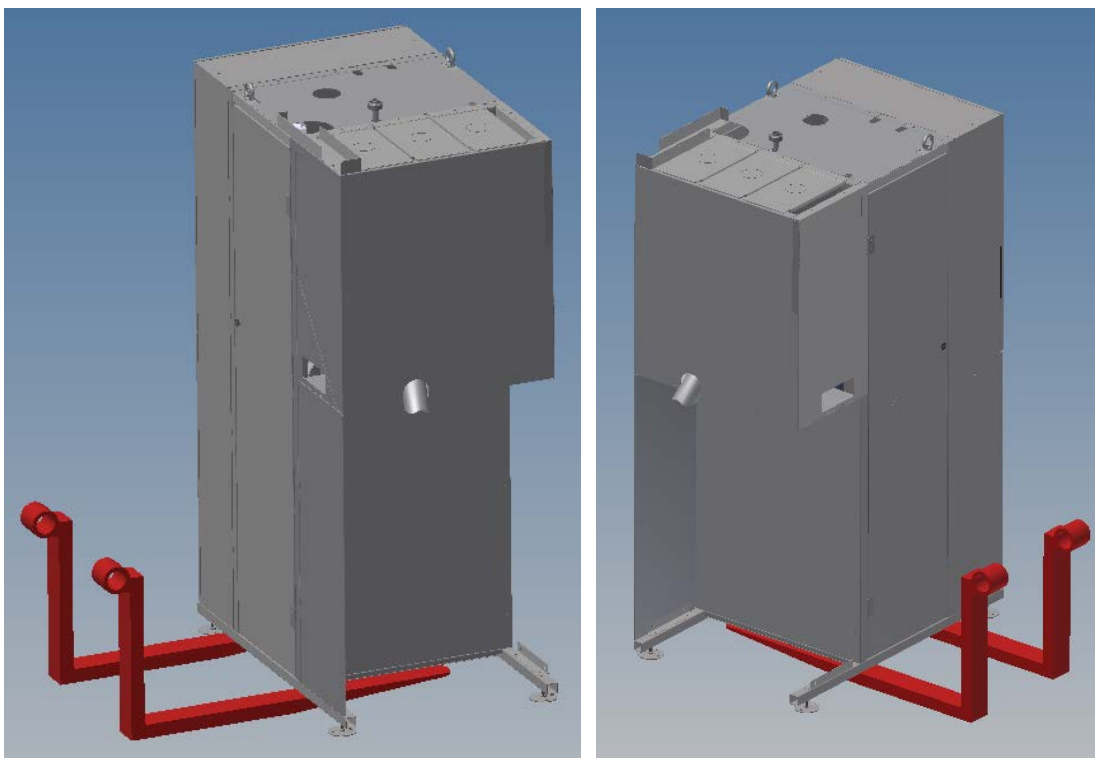
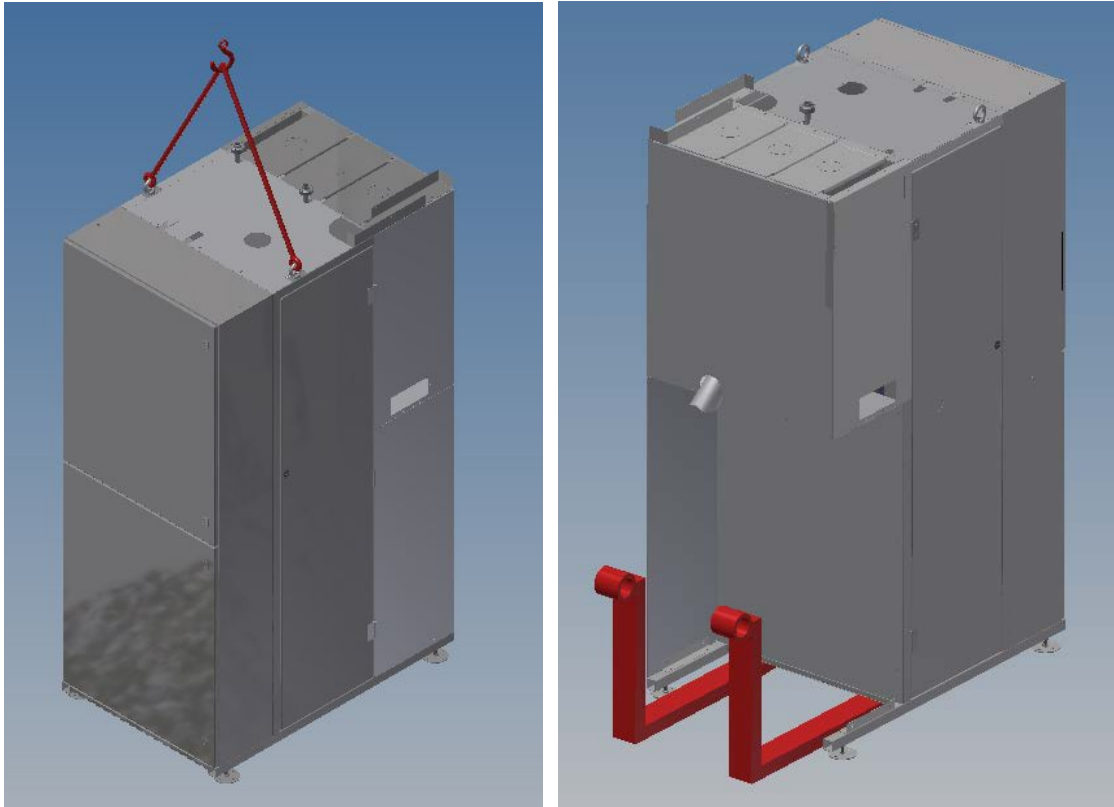
**The transport frame must not be removed from the crate until all feet are bolted down.**



**Failure to follow these instructions may result in a serious accident and/or damage.**

## 5.2 Process Cabinet

The process cabinet can be lifted from the front or the side using forks. It can also be craned using both lifting eyes at the top of the cabinet.



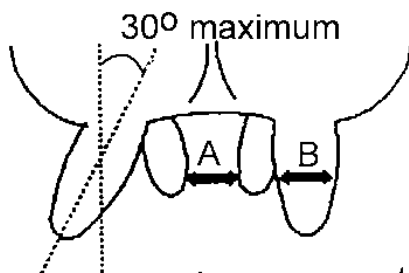
## 6. Cow Compatibility with Robotic Milking

- The size of the cow, and the condition and shape of her udder should be assessed for suitability prior to introduction.

### 6.1 Udder Shape Requirements

**THIS SECTION IS A GUIDE AND BY NO MEANS DEFINITIVE.**

- Udder Shape Requirements
  - The udders and teats should be free from dirt and excess hair. Udders and belly hair should be clipped and/or flamed using appropriate equipment and techniques, at least once every three months. Tails should be trimmed and the hair kept as short as possible.
  - The udder should be free from extra teats, bumps and swellings



#### Teat separation distance (A).

The inner dimension between the teats must be:

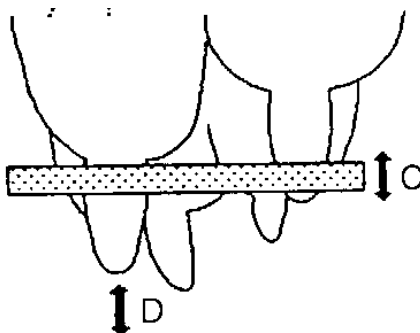
- front teats – minimum 12.5cm, maximum 30cm
- rear teats – minimum 3cm

#### Teat thickness (B):

minimum 1.5cm, maximum 3.5cm,

#### Teat vertical alignment:

maximum 30° off the vertical

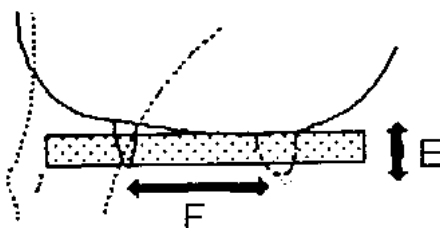


#### Teat Visibility (C):

Each pair of teats (front and rear) should be visible, without interruption, across a 3cm minimum width horizontal band.

#### Teat height (D):

The end of any teat must be a minimum of 35cm above floor level.



#### Rear teat visibility (E):

Rear teat ends must be more than 3cm below the level of the lowest part of the udder.

#### Teat spacing – front to rear (F):

Front teats should be at least 7cm before the rear teats



## 6.2 High and Low Reach

Liner Type	FL	SL
	mm	mm
Low position	268	280
High position	792	804

## 7. Starting the machine for the first time

### 7.1 Preparation

- Only appropriately trained persons shall operate the machine.
- Precondition



- No personnel are working on the machine
- No personnel on cow side of machine
- All access doors are closed
- All removable panels and guards in place and secured
- Ensure the process cabinet door nearest the robot arm is closed before operating.

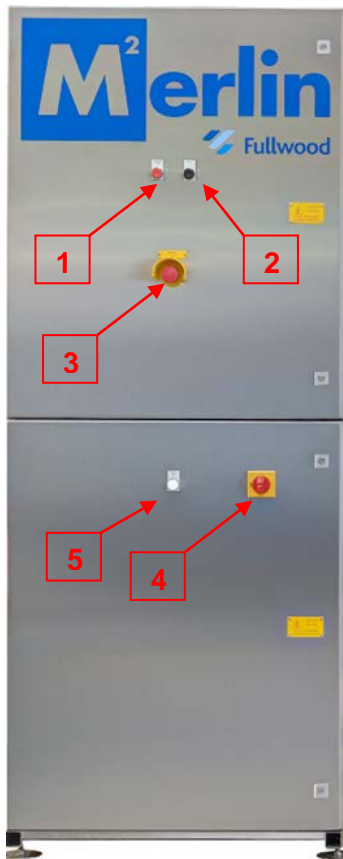
- Turn on the services to the robot; this includes:-



- Compressor
- Hot and cold water pumps
- Boiler (set to 92-96°C)
- Vacuum pump
- Feed augers.

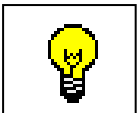
- **Turn on the robot**

- turn on the isolator on the wall
- verify the E-stop button (3) is not enabled on the robot
- turn on the machine isolator (4) positioned on the electrical cabinet
- press the **RESET** (2) button positioned on the electrical cabinet



1. Machine Stop (Black)
2. Reset (Blue)
3. Emergency Stop
4. Machine Isolator
5. Power on indication light

(Note: the machine is designed to be left on at all times; the above is for first time start up).



- Wet the floor and test brushes of the machine to allow for easy cleaning afterwards.

## 7.2 Switching off in an emergency and switching on again

- The EMERGENCY STOP push button is located on the electrical cabinet
  - **Switching off**
  - Press the **EMERGENCY STOP** push button
  - **Result**
  - The **EMERGENCY STOP** button remains latched after actuation
  - All energy sources are disabled to the machine and the machine is prevented from automatically re-starting.
  - **Switching on**
  - Precondition – the fault has been rectified and safe to continue
  - Turn the **EMERGENCY STOP** device to unlatch it
  - Turn off machine isolator on the electrical cabinet
  - Wait 5 minutes to allow all energy to dissipate from drives
  - Turn off **RCBO** and **CB1** in the electrical cabinet
  - Turn on **RCBO** and **CB1** in the electrical cabinet
  - Turn on **ISOLATOR** on the electrical cabinet
  - **Result**
  - The machine can now be started again by pressing the **RESET** button



### 7.3 Pre-Milking Start Up

Before cows are milked through the M<sup>2</sup>erlin, the following must be set up or calibrated to ensure the machine is safe to operate and accurate:

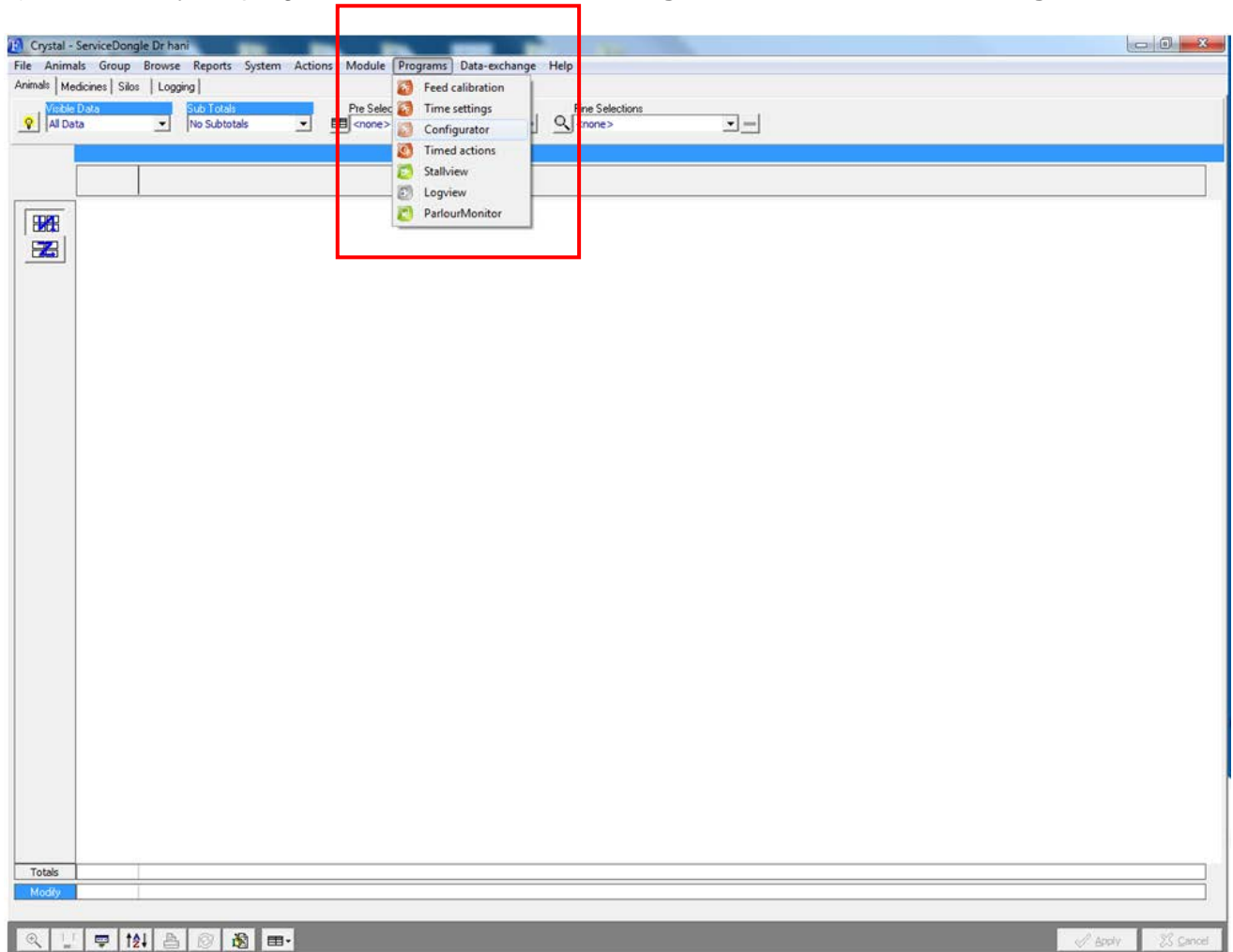
- Check M<sup>2</sup>erlin is sited and bolted down with all services connected as described in previous sections
- Check level of crate
- Ensure a Full Plant Test has been carried out and certificate issued
- Verify the compressed air system has been commissioned
- Carry out a hot wash ensuring the water temperature in the boiler has reached its full temperature
- Ensure water temperature is minimum 72°C at the drain for 2 minutes

### 7.4 Wash times and chemical usage.

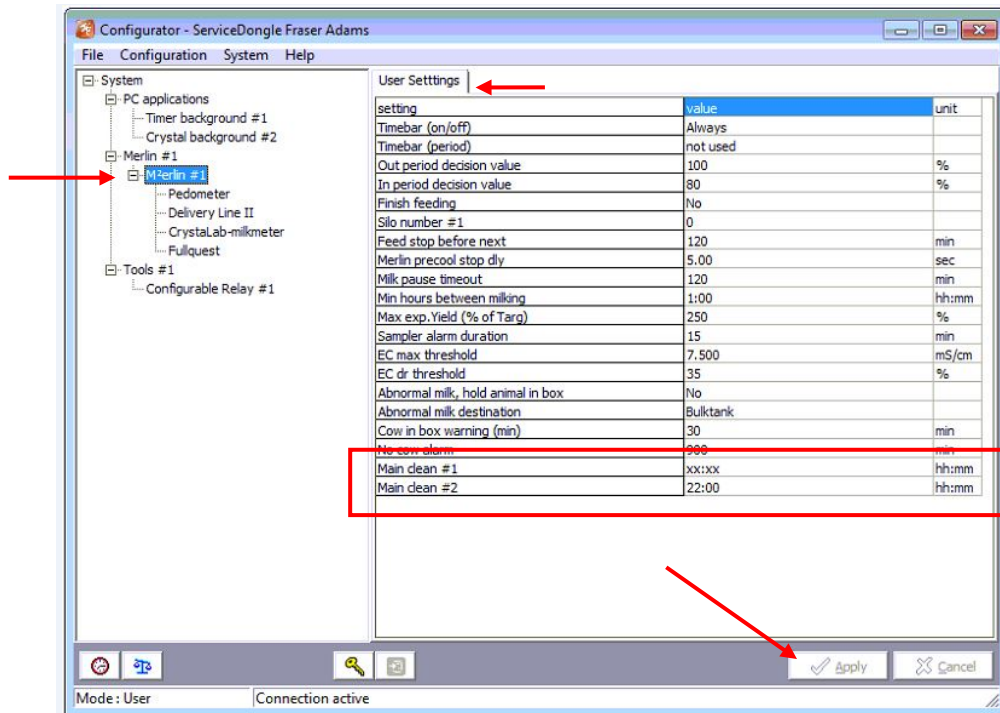
#### 7.4.1 Setting Hot Wash Cleaning Times

A Hot Wash should be set to take place 3 times a day, spaced at even intervals. It is recommended that a softener system is installed in hard water areas.

1) Start the Crystal program on the PC and select **Programs** menu and select **Configurator**



2. In the left window select **M<sup>2</sup>erlin#1** and select **User Settings**



3. At the bottom of the list are the time value settings, click and change the time value, then click apply. The number of washes can be increased by the engineer.

4. Repeat the steps for the remaining washes.

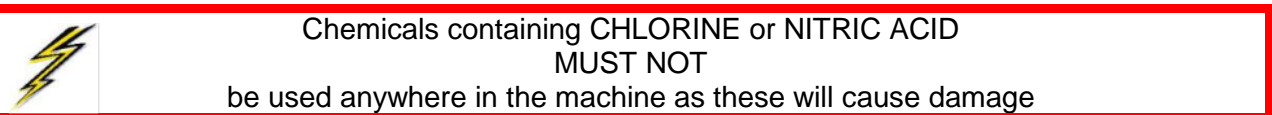
#### 7.4.2 Backflush

By default a backflush is initiated after every milking, to reduce the risk of cross contamination from cow to cow. After a cow has been milked, the backflush system sends a jet of water with compressed air down the liners and to waste via the foremilk rejection chambers.

#### 7.4.3 Cleaning Chemicals

Chemical **MUST NOT** be stored near M<sup>2</sup>erlin, as this will cause premature corrosion of the components.

- Chemicals should be stored a min. 2m and max. 20m away from the M<sup>2</sup>erlin.
- Flexible Chemical tubes should be routed through a solid pipe where ever persons may be walking underneath. This reduces the risk of harm in the event of a leak.



**Only use Fullwood Ltd approved chemicals.**

In addition - use **017439** - Laser Cleaning Solvent for removing lime scale from the laser lens

Teat spray is sprayed automatically after the cow has finished milking via a dosing pump.

#### 7.4.4 Chemicals used on M<sup>2</sup>erlin (Technical Data)

Recommended Product	Process	Pt No	Hazardous ingredients	Supplied Concentration %
Nightwash	Acid Wash	113003	Orthophosphoric Acid 100%	10-30%
AMS Cleaner	Alkali Wash	113009	Sodium Hydroxide	30-50%
Pre Post Iodine	Teat Disinfectant	113014	Alcohols, C9-11, Ethoxylated	1-10%
			Iodine	<1%
			L - (+) Lactic Acid	<1%
Iodine Extra	Teat Roll Disinfectant	113017	Alcohols, C9-11, Ethoxylated	1-10%
			Iodine	<1%
			L - (+) Lactic Acid	<1%
Cluster Sanitiser	Backflush Injection	113011	Hydrogen Peroxide Solution	10-30%
			Acetic Acid	1-10%
			Peracetic Acid	1-10%
Laser Cleaning Solution	Laser Cleaning	017439	Sulphamic acid	5-10%
			Fattyalcohol ethoxylates	1-3%
			Ethanol	1-5%

**All chemicals are ready to use as supplied  
(No dilution is necessary)**



**Ensure all chemicals are clearly identified for safety.  
Store chemical containers as per manufacturer's instructions.  
Use all above chemicals in line with manufacturer's instructions.  
Store all chemicals in their original containers, ensuring they are not misidentified and used for the wrong application.**



**Up to date data sheets for chemicals should be kept on site at all times, these can be obtained from your Fullwood dealer or by visiting [www.fullwood.com](http://www.fullwood.com)**

#### 7.4.5 Chemical

All the wash settings are set in the configurator.

At alternate cleaning events, acid or alkaline chemicals are used.

The chemical pumps must be calibrated. This is because the chemicals used have different viscosities and the quantity delivered varies considerably.

The safest method to calibrate a chemical pumps is to use the machine in wash mode to draw up chemical from a predetermined amount of chemical.

E.g.:- Using a vessel holding 1litre of the appropriate chemical with pick-up pipe for the chemical secured in the vessel, run a hot wash through the system, when the wash is complete measure the amount of chemical used from the vessel, If you then note the run time of the chemical pump from Configurator this will allow you to calculate the flow rate of the pump.

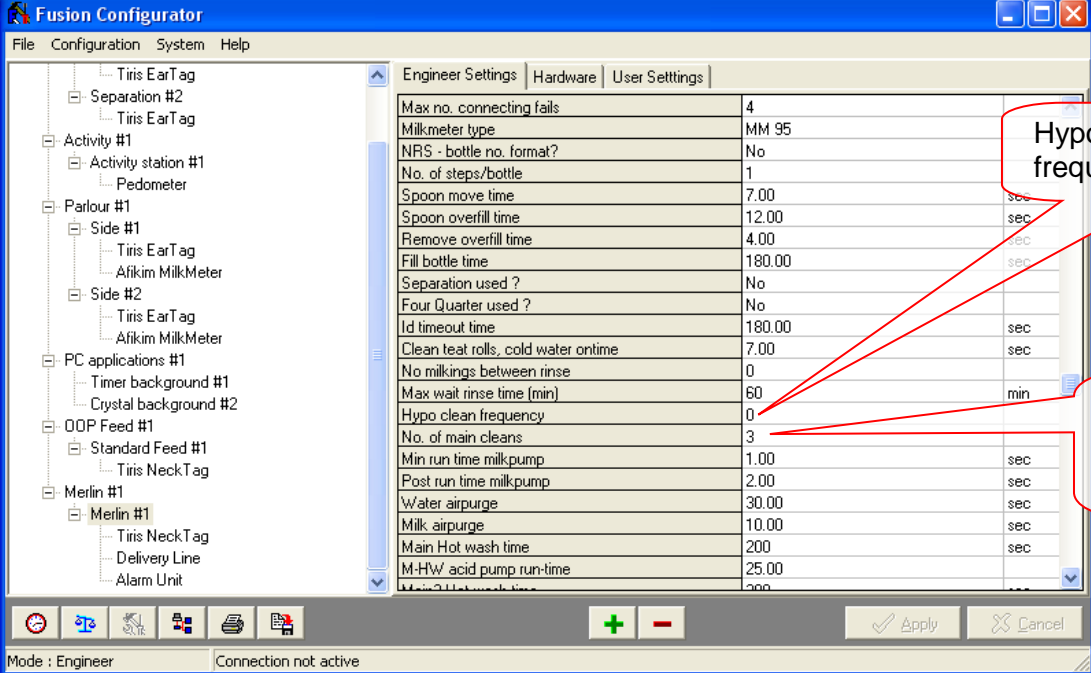
$$\text{Chemical used ml} / \text{Pump run time sec} = \text{Flow rate ml per second}$$

### 7.4.6 Changing Chemicals

Put into **Off line** before working on chemical system.

Precautions must be taken (e.g. chemical resistant mask, gloves, boots & overalls /suit) when handling chemicals. Comply with the manufacturer's recommendations on the labels.

The alkali clean frequency determines the frequency of the alkali wash. If it is set to 0 only acid washes will be done. If it is set to 1, every other wash will be an alkali wash. If it is set to 2, two acid washes will be done to one alkali etc. etc.



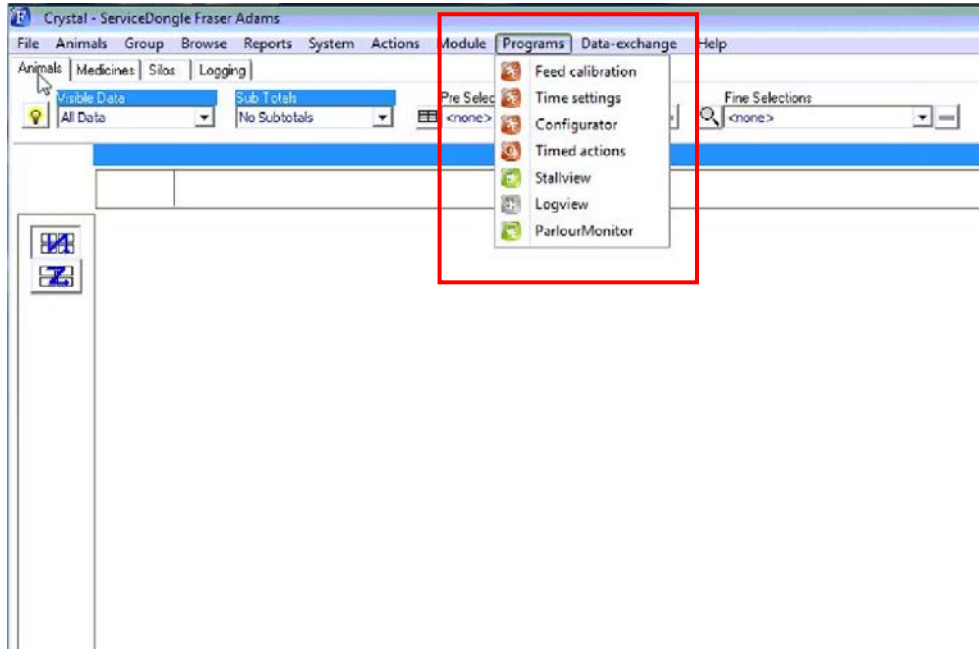
Parameter	Value	Unit
Max no. connecting fails	4	
Milkmeter type	MM 95	
NRS - bottle no. format?	No	
No. of steps/bottle	1	
Spoon move time	7.00	sec
Spoon overflow time	12.00	sec
Remove overflow time	4.00	sec
Fill bottle time	180.00	sec
Separation used ?	No	
Four Quarter used ?	No	
Id timeout time	180.00	sec
Clean teat rolls, cold water ontime	7.00	sec
No milkings between rinse	0	
Max wait rinse time (min)	60	min
Hypo clean frequency	0	
No. of main cleans	3	
Min run time milkpump	1.00	sec
Post run time milkpump	2.00	sec
Water airpurge	30.00	sec
Milk airpurge	10.00	sec
Main Hot wash time	200	sec
M-HW acid pump run-time	25.00	sec
Main 2 Hot wash time	200	sec

The chemical dosage pumps dispense at a rate of approximately 20 ml per second. The times that the pumps run for are set in the Configurator (the run time is dependent on the chemicals used and distance from the robot). The chemical dosage pump for the teat disinfectant dispenses at a rate of approximately 6 ml per second.

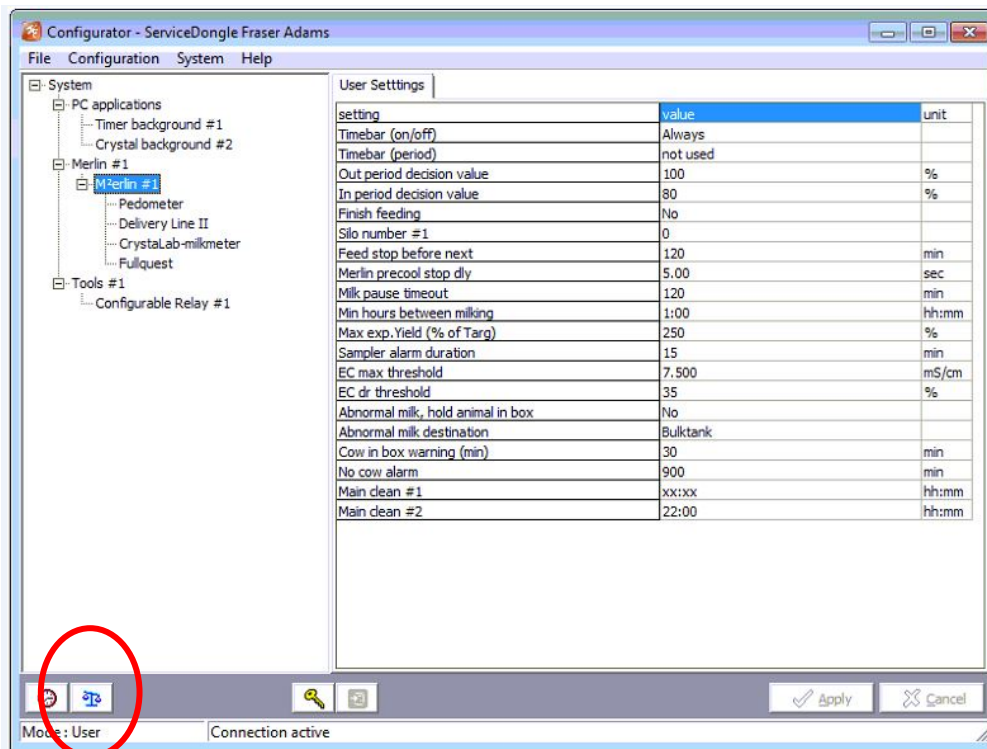
## 7.5 Calibrate Feeders

Ensure feed hopper is full prior to calibration and all robots on the system are off line;

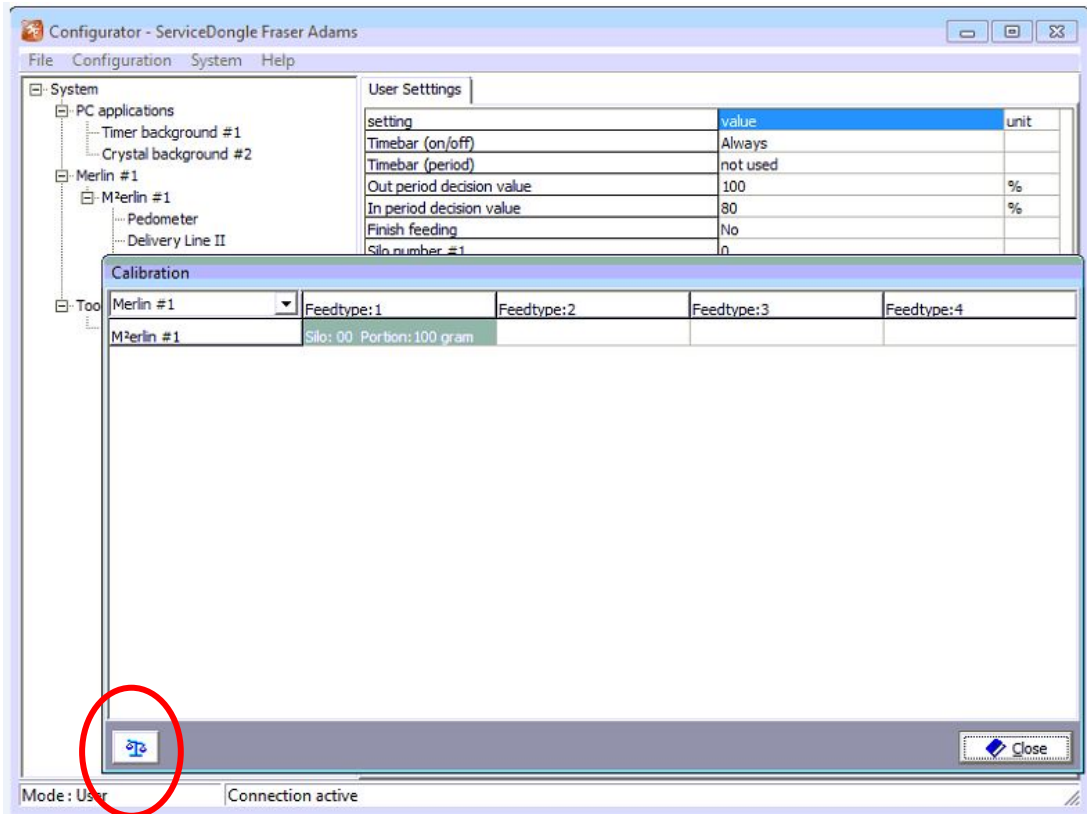
1) Start the Crystal program on the PC and select Programs menu and select Configurator



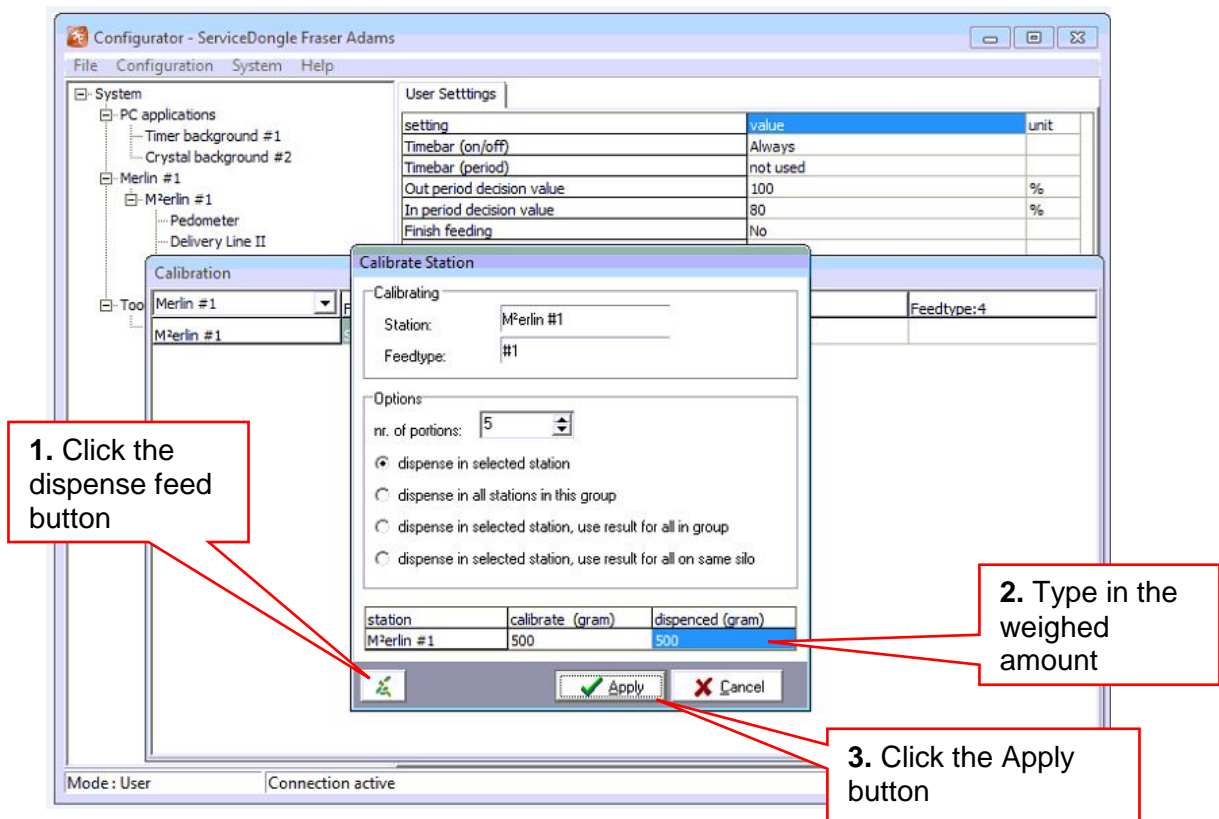
2. The following screen will appear; left click on the weigh scales:



3. The calibration screen will appear; left click on the weigh scales again:



4. The calibrate station screen will appear; click on the feed dispense button, type the weighed amount and click the Apply button.





## 8. Animal Identification

- Ensure operators are properly trained and competent in the application of ear tags.
- Follow best practice attaching animal identification methods and read the Health & Safety Executive advice on the handling and housing of cattle.
- Fullwood have various options available for automatic identification;

Examples:-

- Ear transponder
- Pedometers
- Neck Tags

### 8.1 Ear Transponder

#### 8.1.1 Best Cattle Tagging Practice

- Ensure that the correct applicator for the model of tag is used and always follow the manufacturer’s instructions.
- Fit in cool weather (where possible) to minimise infection.
- Secure the cows head to prevent jerking while tagging.
- Apply tags under hygienic conditions. The operator’s hands, the ear, the tag and the applicator should be clean. Disinfect as necessary using appropriate solution.
- When fitting plastic tags, ensure that the tags line up correctly on the applicator and will lock together when correctly fitted.
- Ensure both parts of the plastic tag have the same number. If Fullwood tags are used, the number is only required on the female part.
- The female part of the tag should always be on the inside of the ear, this will reduce the chance of the tag catching on objects. The male part of the tag should always enter from the back of the ear.
- Check the ear after about 10 days for signs of damage or infection; consult your veterinary surgeon as necessary.
- Store unused tags in a clean & dry container.
- After attachment, check that the ear tag rotates freely.

All animals in the herd must carry the transponder in the same ear. Check with the installation engineer to see which ear is preferred.

Record every transponder number against cow numbers (last 4 or 8 digits) - to enter onto the PC later.

**Example;**

EAR TAG TRANSPONDER NUMBER	COW HERD NUMBER	Herd Life Number - Ear Tag
1887 5339	77	UK FO 0140 01515



Correct location for the ear transponder. It should be inserted in between the two main blood veins of the ear, also half way into the ear from the outer edge.

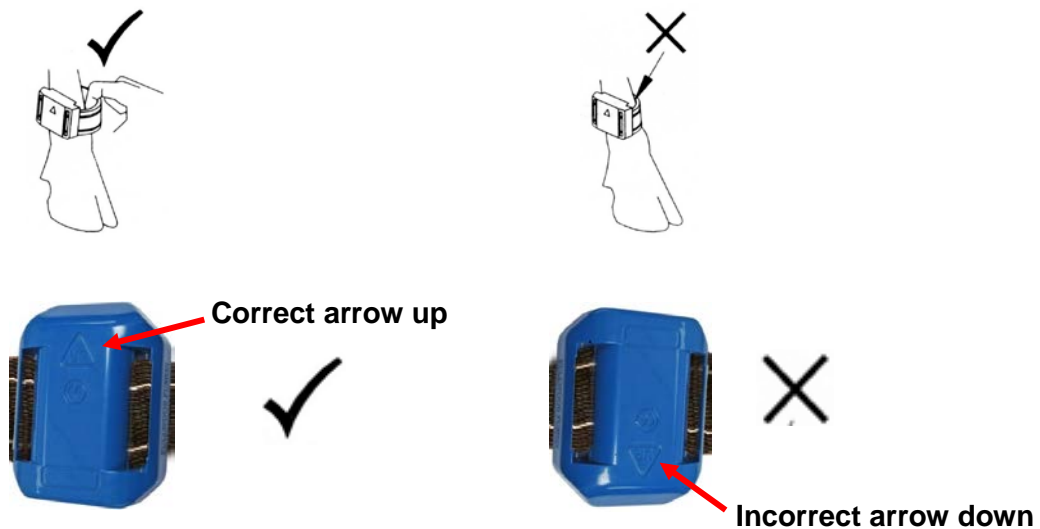
## 8.2 Pedometers

Attach a pedometer to the front leg of every cow in the herd; all animals must carry the pedometer on the same leg, check with the installation engineer which leg is preferred.

Record every transponder number against the cow numbers (last 4 digits) - to enter onto the PC later.

The pedometer must rest on the ankle of the leg and 'rotate' freely.

The strap should be fitted loosely. As a guide, an object the size of a finger should fit in-between the strap and the leg, as depicted below.



### 8.2.1 Removal of the Pedometer

Fullwood Ltd recommends that the strap is cut and a new one used. Once fitted, it is difficult to remove straps by prizing out the plastic wedge while attached to the cow.

Allow for growth of heifers. It is recommended to remove the pedometer as a matter of routine when drying off. Re-attach with a new strap.

### 8.2.2 Storage of Pedometers

Incorrect storage of pedometers results in a reduced battery life, never store;

- On their side
- Upside down
- Within 3 metres of an active antenna
- Within 3 metres of a frequency controller device, e.g. a PC monitor
- Within 3 meters of a source of heat, e.g. radiator.

Never blast pedometers with warm or hot water or soak; this will have a negative effect on their function. (Please refer to pedometer instruction leaflet.006733)



### 8.3 Neck tags

Neck tags are to be attached around the cow's neck with an appropriate strap.

The strap is to be sufficiently tightened to prevent slipping over the cows head and prevent catching on parts protruding into the barn or parlour. It must not be over tight restricting the cow's movements in any way.



## 9. Introducing Animals to the New Milking System

Moving to a new milking facility, whether conventional or robotic can be stressful and disruptive to the performance of any herd. Steps must be taken to accustom cows to the new facility and train personnel to use it correctly.

Where the change is from a conventional parlour to an automated system, the challenge is even greater. In addition to the potentially stressful period of training, for both cows and personnel, milking no longer occurs at predetermined times and regular intervals. Milking frequency depends on management strategies relating to housing and feeding together with their effects on the willingness of cows to visit the milking station.

### 9.1 Preparation















- Ensure all building work has been completed prior to introducing cow to the M<sup>2</sup>erlin
- Ensure all contractors and non-authorized personnel are off site.
- Users of automatic milking systems must not assume that they can just "leave everything to the robot".
- The herd should be inspected to identify cows with udder and/or teats that may be unsuitable for the automatic system.
- The User/operator should receive introductory training on the use of the Crystal Management System.
- Up-to-date information for every cow in the herd must be entered into Crystal prior to introduction to the system.
- Ideally, all cows should be walked into and through the milking station. Entry and Exit gates should be left open and the cows free to move around. This should be carried out for 2 – 3 days
- For the next 3-4 days M<sup>2</sup>erlin should be used as an out of parlour feed station, Feed should be used as an inducement to the cows.
- If it is not possible to familiarise the cows with M<sup>2</sup>erlin before the first milking, i.e. if the cows are moving to completely new premises and it is impractical to return to the old facility, it is more important than ever to proceed very gently and slowly on the first day of milking































## 9.2 Introduction






















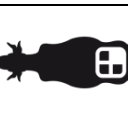








- At the first milking, teats should be cleaned and foremilked by hand to stimulate a sound oxytocin based let-down response. The automatic attachment system should be initiated under operator control, moving the arm into position under the cow prior to teatcup attachment.
- It may be necessary to encourage cows to enter the M<sup>2</sup>erlin stall for the second and third milkings. After the third milking, the robot should be left to allow cows to attend voluntarily. By this time, it is usual for cows to visit the milking station, attracted to the possibility of feed being dispensed.
- The remainder of the group should be introduced over the following days.
- Following the initial introductory period, it is essential that the farm personnel ensure that cows attend the automatic milking station at regular intervals. This should be based on examination of reports indicating which cows are overdue for milking.
- In addition to the use of information and reports generated in Crystal, M<sup>2</sup>erlin operators should also examine reports from milk buyers, herd recording organisation and other sources, e.g. milk quality reports, individual cow somatic cell counts.
- It is essential that, in the event of any adverse report, the causes are investigated immediately and appropriate action taken.







## 10. The Human Machine Interface (HMI)

### 10.1 HMI – Overview of Icons

	Home		Statistics
	Control		Milking
	Cleaning		Alarm
	Machine		Wait for cow
	Cow ID number		Milk (yield)
	Time in current status		Time
	Offline		Pause



	Online		Clear/reset alarm
	Keep cow in box		Manually dispense feed
	Separate Animal		Send milk to bucket
	Send milk to drain		Bucket
	Cancel		Stop release cow
	Change screen/refresh		Teat not (yet) attached/detach teat when attached
	Teat attached		Do not milk teat
	75% of expected milking time reached		Milking finished
	Manually identify cow		OK/Confirm/Accept
	Accept teat position		Decline teat position
	Teat not yet accepted/declined		Clear all found teat positions
	Start pulsation		Stop pulsation
	Pump/Pumping		Bulk tank (milk direction)
	Delivery line blocked		Purge milk to tank
	Purge water to drain		System rinse

	M <sup>2</sup> erlin rinse		Arm
	Acid main clean		Alkaline main clean
	Clean cups		Cold wash
	Luke warm wash (Lubricate wash)		Hot wash
	First drain (pumping)		Second drain (dry)
	Forwards		Backwards
	Down		Left
	Move arm upwards		Move arm downwards
	Move arm fast		Move arm slow
	Start automatic attachment		Start manual attachment
	Disable ACR (for 2 minutes)		Quarter
	Arm service position		Robot Statistics
	Clear List		Calibration
	Engineer settings		Touchscreen
	Sampling		Load



	I/O test menu		Save
	System information/details (Version)		Conductivity
	Wait for assistance		Change language/country

Note; Not all the icons are visible by the user, some are for engineers use only.

## 10.2 Milking the Cows

- **Read in conjunction with the following HMI screen shots**
- Put the robot in online mode (Play icon )
- Entry gate will open (if cow is hesitating to enter, use feed to lure in the cow). 
- When the cow walks in, make sure she is recognised; her ID No. will appear on the HMI screen. If not enter the cow number manually.
- If cow has milking permission arm will turn in and milking sequence will begin.


## 10.3 Introducing new cows:

Press  then  to display the screen for manually positioning the robotic head under the cow udder when first introducing cows to the machine, once this operation has been performed for the first time the coordinates are saved and will be used for future milkings.

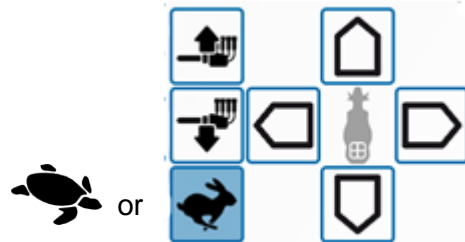
The screenshot shows the Merlin HMI interface with several callouts:

- Accept**: Icon of a hand with a checkmark.
- Decline individual teats**: Icon of a hand with an 'X'.
- Teat not yet accepted/declined**: Icon of a hand with a question mark.
- Automatic attachment: when teats to milk are in sight**: Callout pointing to the top of the central display area.
- Clear all teats found**: Callout pointing to a button on the right side of the interface.
- Arm controls**: Callout pointing to a button on the left side, describing a fast/slow toggle and a hare/turtle toggle.
- Service Button**: Callout pointing to a button on the left side, describing its function to move the arm down and forward, and retract cups.
- Manual attachment**: Callout pointing to a button on the left side, describing a 5-second manual attachment process.
- Detected teats (pink) Historic teats (grey)**: Callout pointing to the central display area, which shows four teats (two pink, two grey).




When a cow enters the crate for the first time the screen will be displayed, by pressing the tick  the arm will drop from the jettors and will move to a central position under the cow. The arm will move in relation to the cow position by means of the cow follower camera.

Grey dots on the screen show a generic teat position, by using the arrow buttons, left, right, forwards, backwards, up and down, position the head under the udder. Fast and slow mode is also available.




Position the head under the udder so the laser can see the teats, pink and yellow dots will appear on the screen. Yellow dots are showing possible teats and pink dots identified as teats. Using the position buttons move the head closer to the teats, when satisfied the pink dots are in


the same visual pattern as the udder press the tick button.  If not satisfied with the


pattern of detected teats using the directional buttons move the head to various positions under the udder to achieve better vision.

If still unable to achieve a representative pattern with one or more teats, press the buttons of the teats that have not been identified and move the head to achieve better vision.


When satisfied press the tick button. 


The arm will move and perform a second scan then proceed to clean each teat with the brushes. The arm will then attempt to attach to the cups.

If after a period of time the cups do not attach press the 'clear all teats found'  icon and repeat the process.

If still having attachment problems press the 'manual attachment icon'  to allow the cups to be attached by hand. Each cup will be released in turn, the first after 5 seconds, the second after the first has recognised vacuum etc.

Note: This process of attachment will not store the co-ordinates so the attachment process will need to be repeated at the next visit.

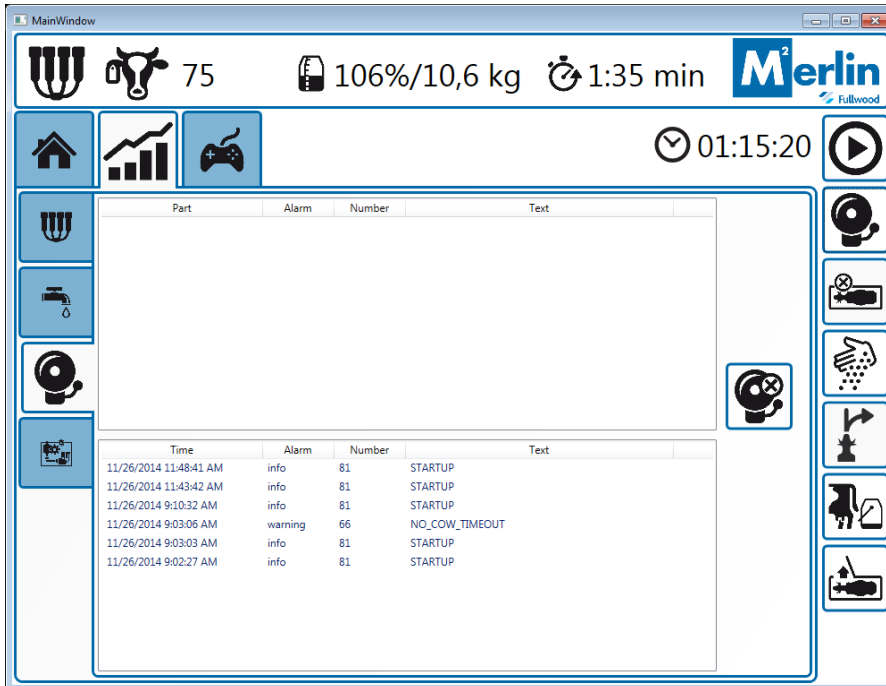
If the arm is in the jettors, pressing the service button  once moves the arm down and forward and releases the ACR ropes, pressing the service button a second time retracts the cups and returns the arm to the jettors.

If the arm is in the crate, pressing the service button  will release the ACR ropes, a second press retracts the cups and returns the arm to the jettors.

## 10.4 Using the HMI

When turning on the machine for the first time the program will boot up and the HMI will display the home screen.

Alarm Screen then



If the alarm icon is red there are alarms requiring attention. An orange alarm icon indicates a warning which does not require immediate attention.

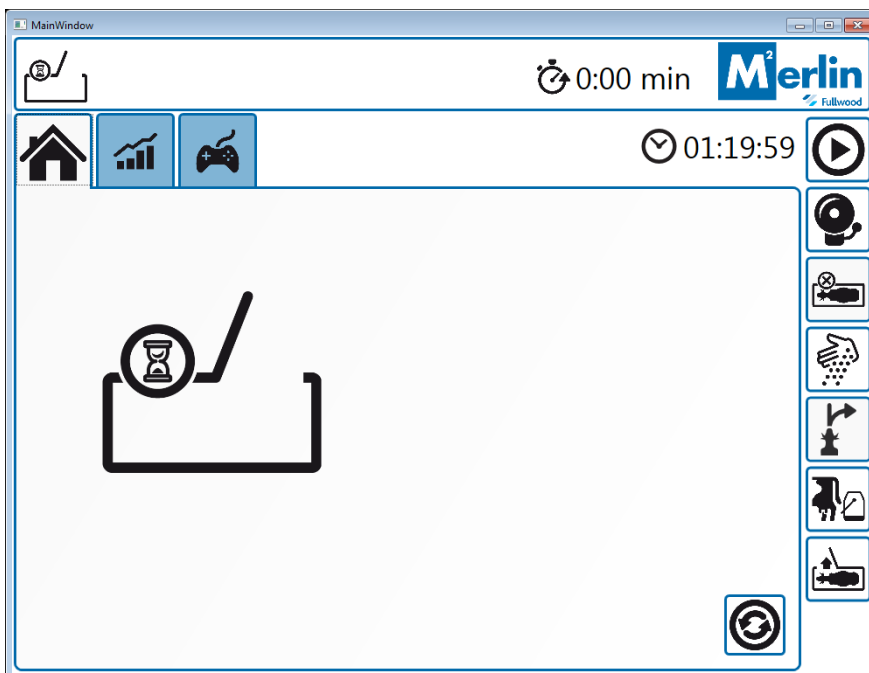
Press icon to display the alarm screen;

OR

Press the icon followed by to display the alarms.

Press to clear the alarms.

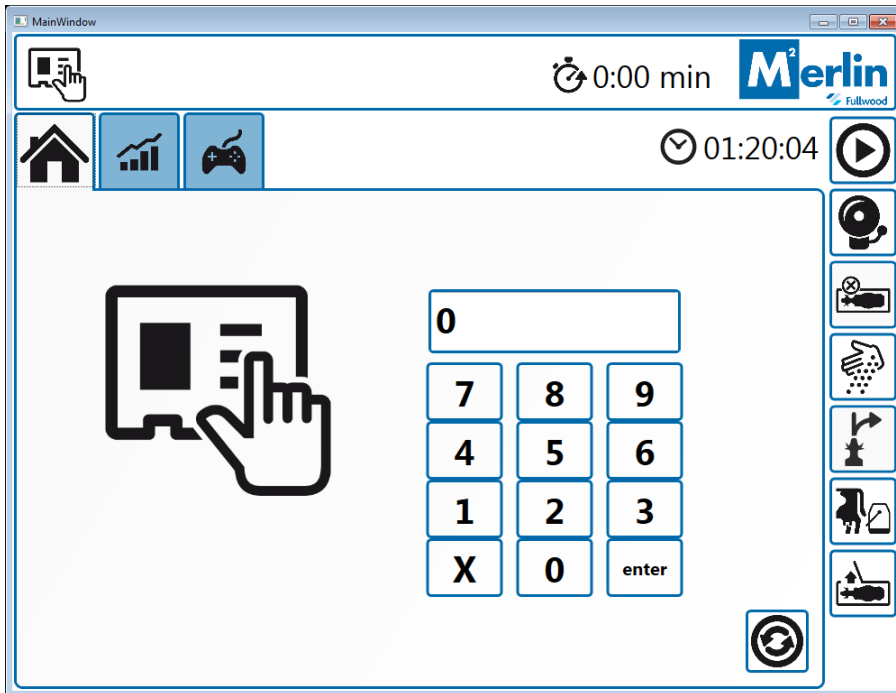
Waiting for Cow



Icons in the right bar do the following:

- Keep cow in box
- Supplies feed (feed manger drops into position on pressing button once and feed dispenses on second press. Motor runs as long as button is pressed.)
- Separate cow (default destination)
- Separate milk; shows dialog, with drain, bucket and cancel options (do not change destination)
- Stop and release (stops milking and releases cow)

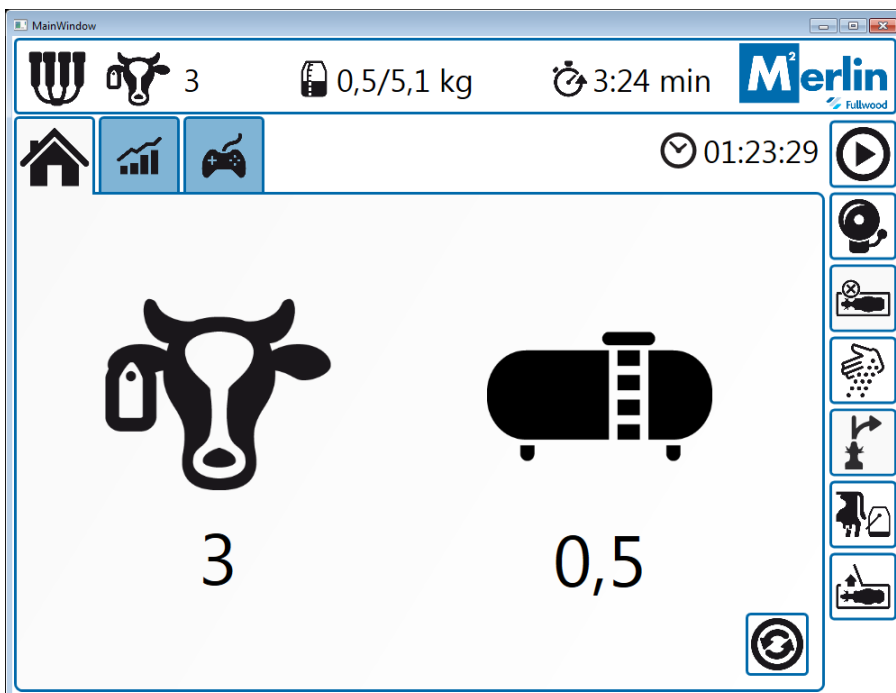
### Manually identifying a cow



#### Manually identifying a cow

In case a cow has no tag or a broken tag, the following screen appears when she enters the M<sup>2</sup>erlin. Manually enter the cow number and press enter to confirm.

### Main Screen, appears when a cow enters the crate



#### Main milking screen

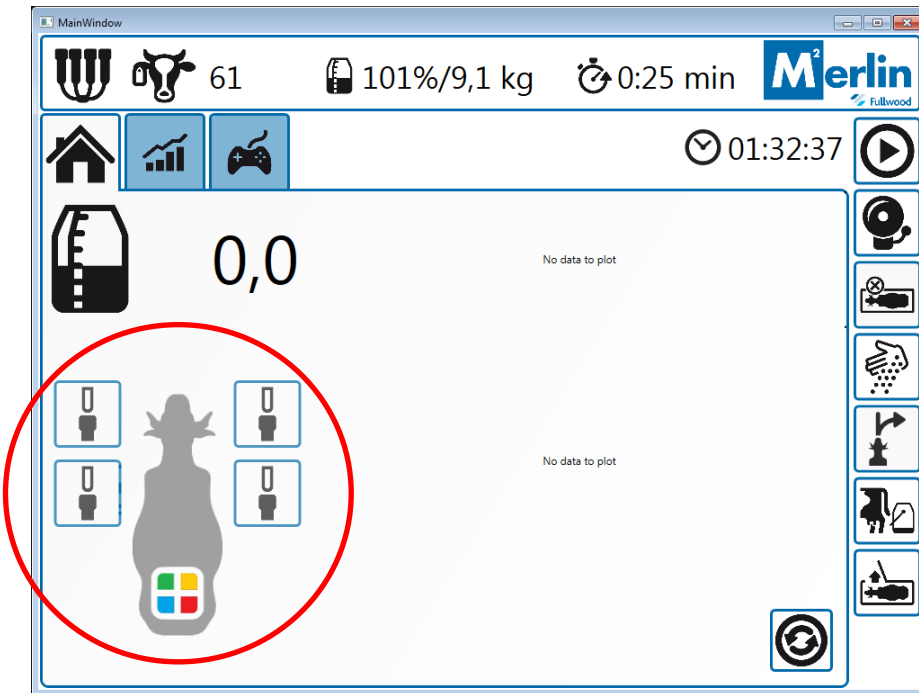
Upper bar indicates from left to right:

- Milking
- Cow 3
- 0.5/5.1kg act/expected yield
- 3:24min since start milking
- Robot in online (run) mode
- No alarms
- Current time


Toggle icon  in lower right corner is used to toggle between main milk screen and details screen

After the first milkmeter dump, the destination of the milk is shown (tank, bucket, drain)

### Milking Details (Teats not attached)

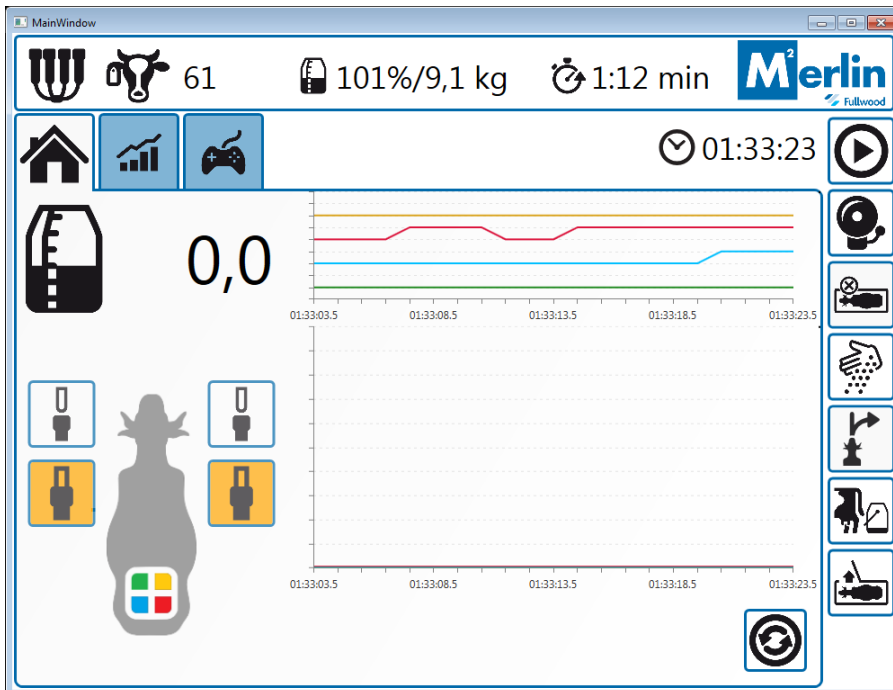


The circle details the teat attachment and will progress through the next six screens showing milking progress.




Teat not (yet) attached

### Milking Details

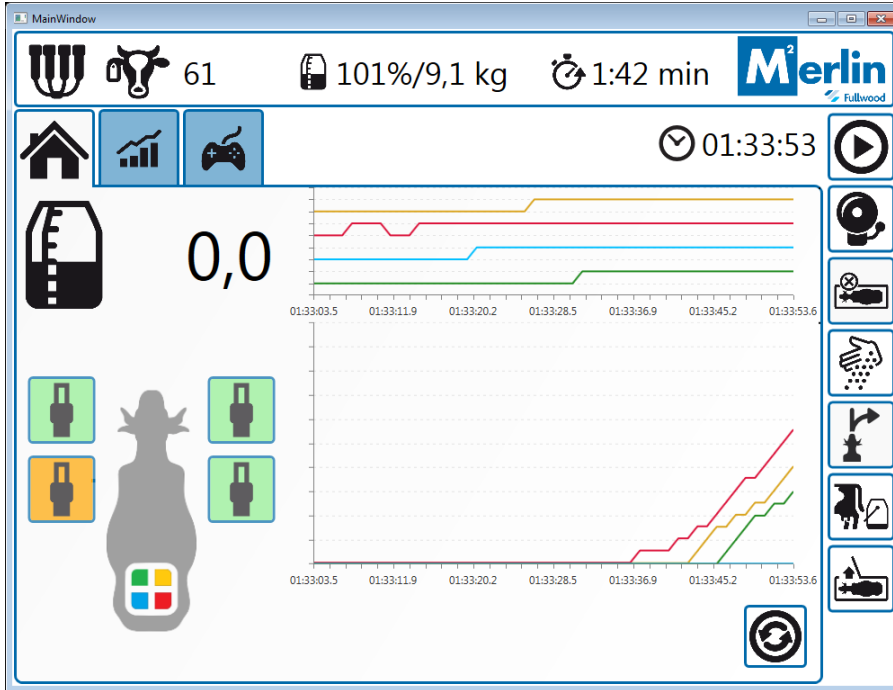


**Milking Details**  
2 teats attached, no flow detected.



Teat attached

### Milking Details



#### Milking Details

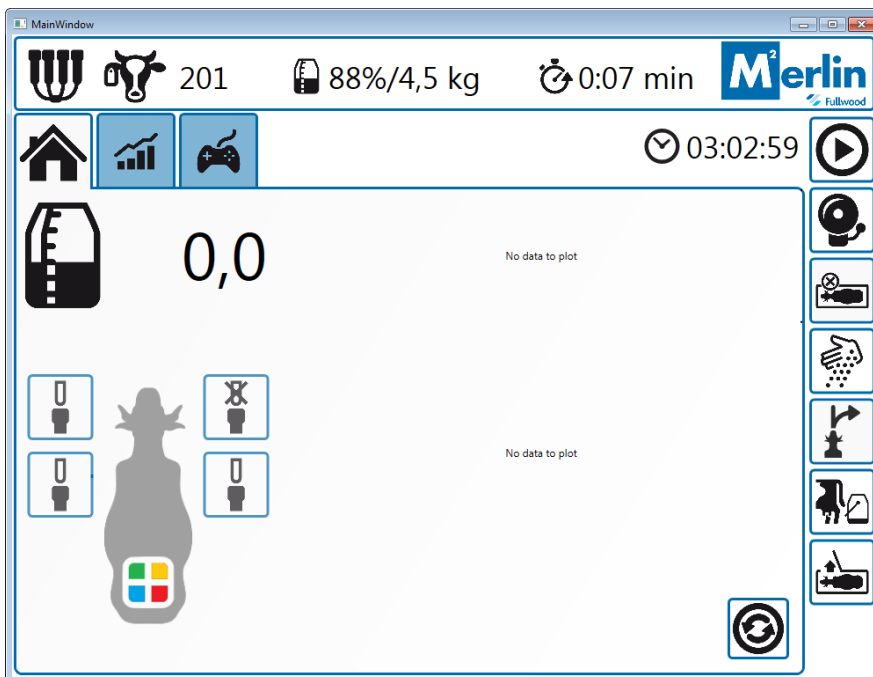
All teats attached, flow detected (above threshold) on right rear and front teats (green background),



No flow detected yet on LR (orange background)



### 3 teat cow (do not milk RF teat)



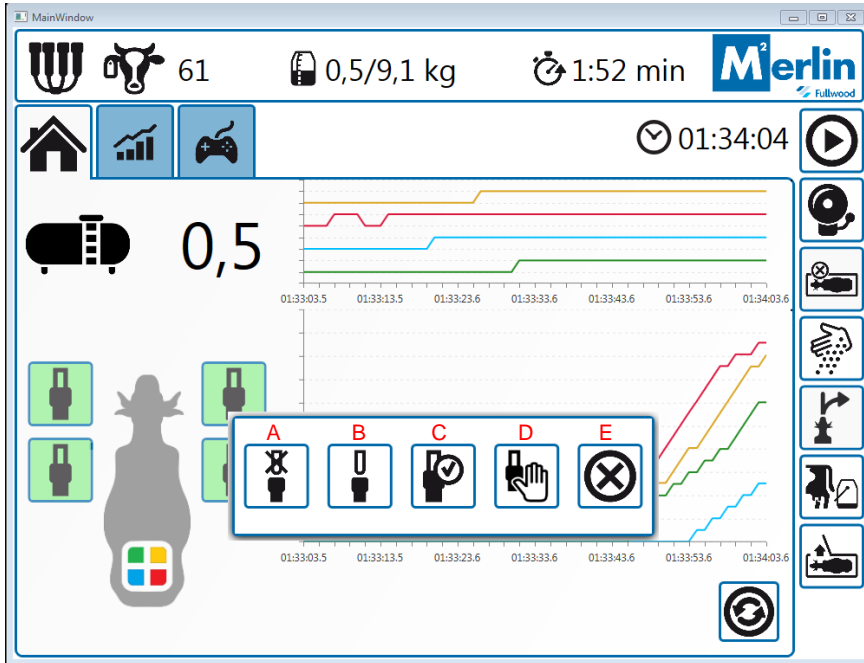
#### Milking Details

The screen shows cow 201 that has only three teats that are to be milked.

RF teat is not to be milked



**Do not milk / detach / Simulate milk flow / Cancelled ACR dialogue**

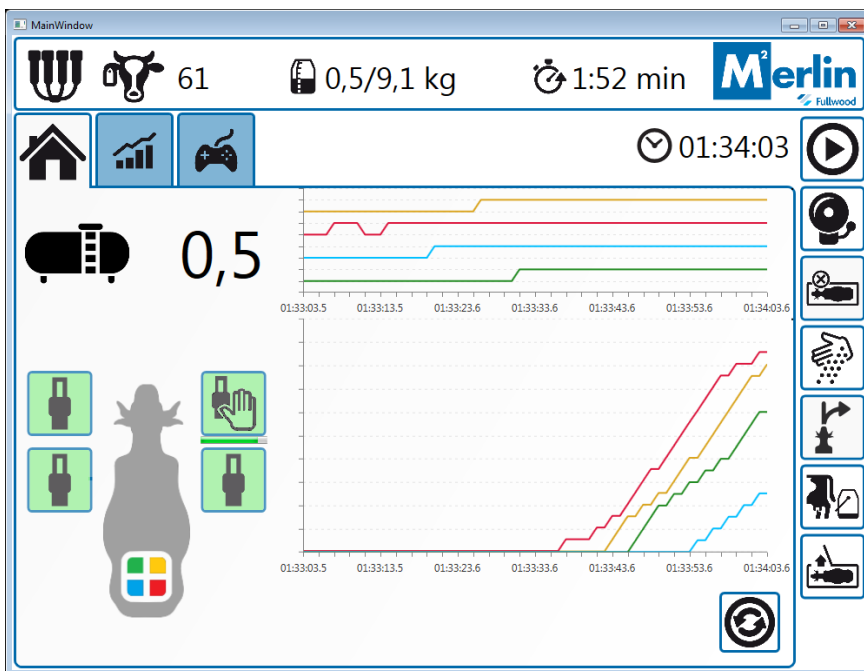


On the milking details screen, by pressing one of the teats, the user can select if a teat:

- A. Should not be milked
- B. Should be detached (will be reattached if exp. milk time has not been reached)
- C. has milk flow simulated
- D. Cancel ACR\* (2 minutes)
- E. Or cancel the dialog.

\* (ACR = Automatic Cluster release)

**Milking Details**

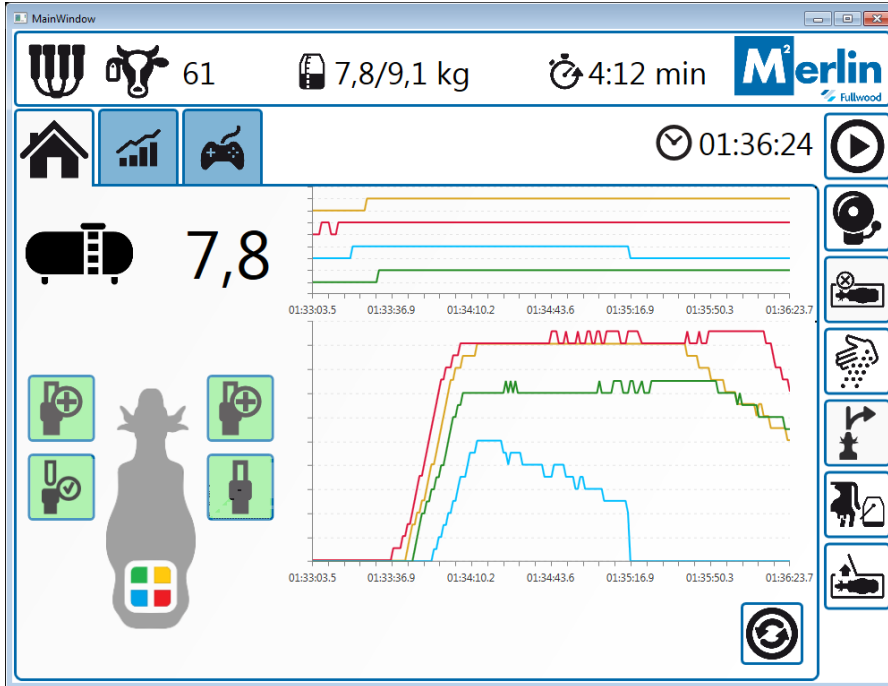


**Milking Details**

RR ACR cancelled for two minutes, ACR is cancelled Flow detected on all teats

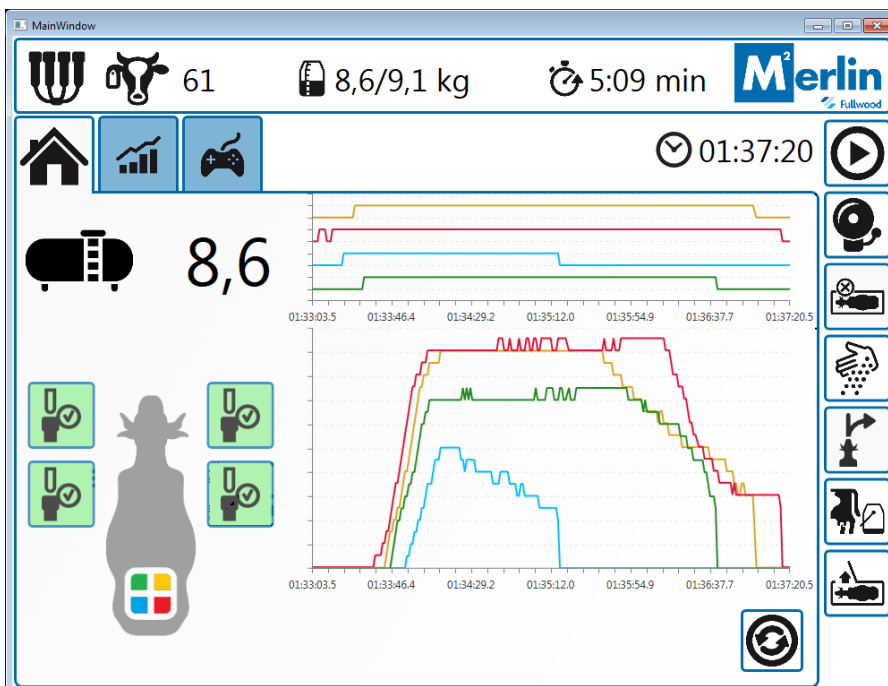


### Milking Details



#### Milking Details

75% of expected milk time reached on front teats.



#### Milking Details

All teats detached, expected yield reached.



## 10.5 Milk Separation

### 10.5.1 Withheld and Undesirable Milk

Where milk from a cow is known to have a withhold period (e.g. containing antibiotic or other pharmaceutical product) or is undesirable (e.g. colostrum or high somatic cell count), the operator must programme the M<sup>2</sup>erlin via Crystal to divert milk from that cow to drain or to milk separation facilities.

Animals that need to be milked separately must be clearly identified. Animals under antibiotic treatment must be marked with two red bands attached to the tail before the first treatment. All livestock under treatment must be clearly identified throughout the whole withdrawal period. In computerized milking systems, treated cows must be registered before the treatment begins.

### 10.5.2 Abnormal Milk

Where fitted, CrystaLab and FullQuest provide the basis for Action Planner decisions to divert milk likely to be abnormal (e.g. contains blood, low lactose level and/or high electrical conductivity). The operator via Crystal should define the conditions in which milk likely to be abnormal can be rejected to drain or separate collection.

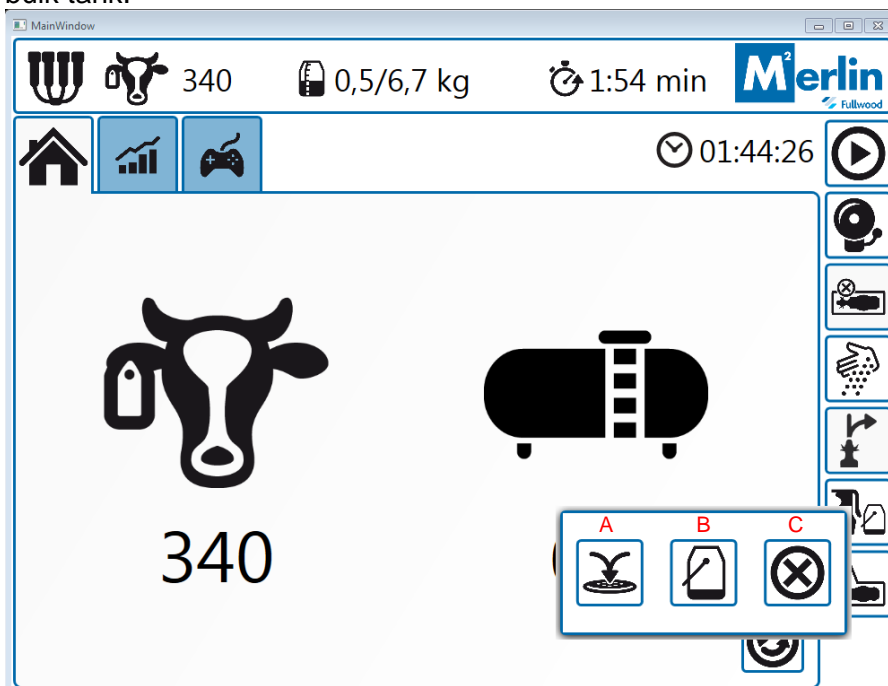
If in Crystal the milk is programmed to go to tank but for some reason the milk needs to be rejected the operator can divert the milk by pressing the milk separation button and selecting drain (A) or bucket (B).

## 10.6 Milk Cooling and storage

A refrigerated bulk tank shall have the provision to inform the automatic milking machine if milk can be received or not and where appropriate comply with EN 13732.

If milk is intended to be stored in a temporary tank (buffer tank) longer than 1hr, such as during milk collection and cleaning of the bulk tank, the cooling time specified by local, regional or national requirements applies.

The use of buffer tanks must allow the inspection of the milk before this is pumped into the main bulk tank.



When a cow is being milked and milk should not be sent to the bulk tank although this is set this way in Crystal, a one-time milk separation to the drain or bucket can be performed by pressing the milk separation button.

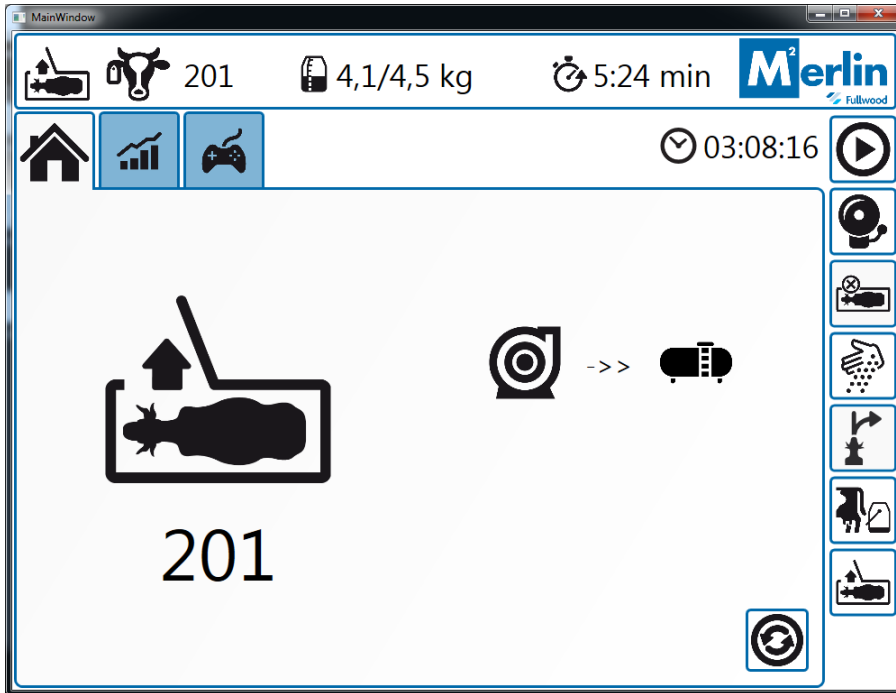







The dialog that pops-up shows the following options:



- A. Milk to drain
- B. Milk to bucket
- C. Cancel dialog

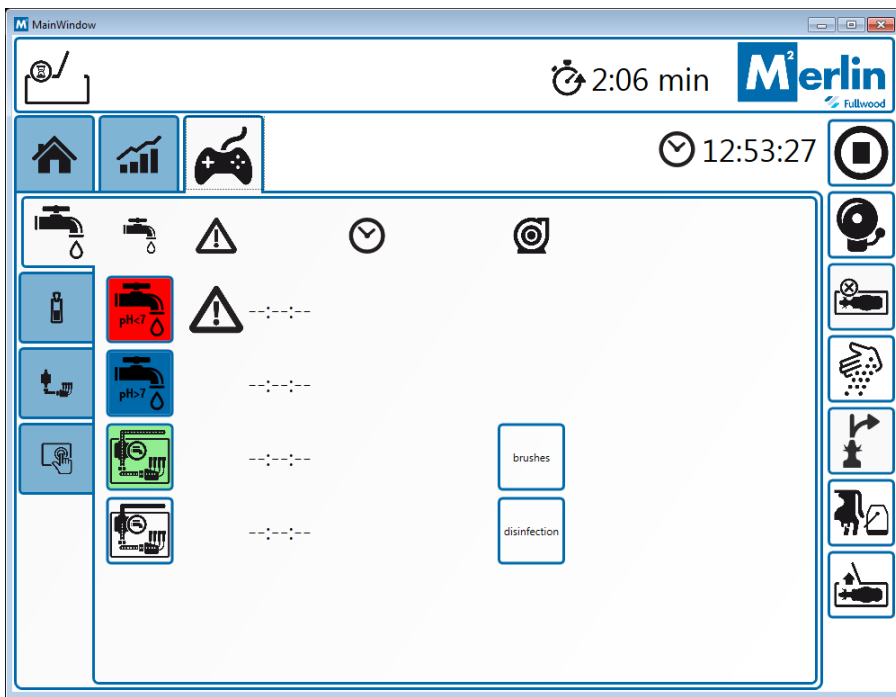


**Releasing cow and pumping milk to bulk tank**




Releasing cow and pumping milk to bulk tank. As well as the pumping icon,  and Bulk tank (milk direction) icon  a delivery line not available icon  or a pumping to drain  or finished icon  can be shown.

Select Cleaning  then  then  then 



Select cleaning:

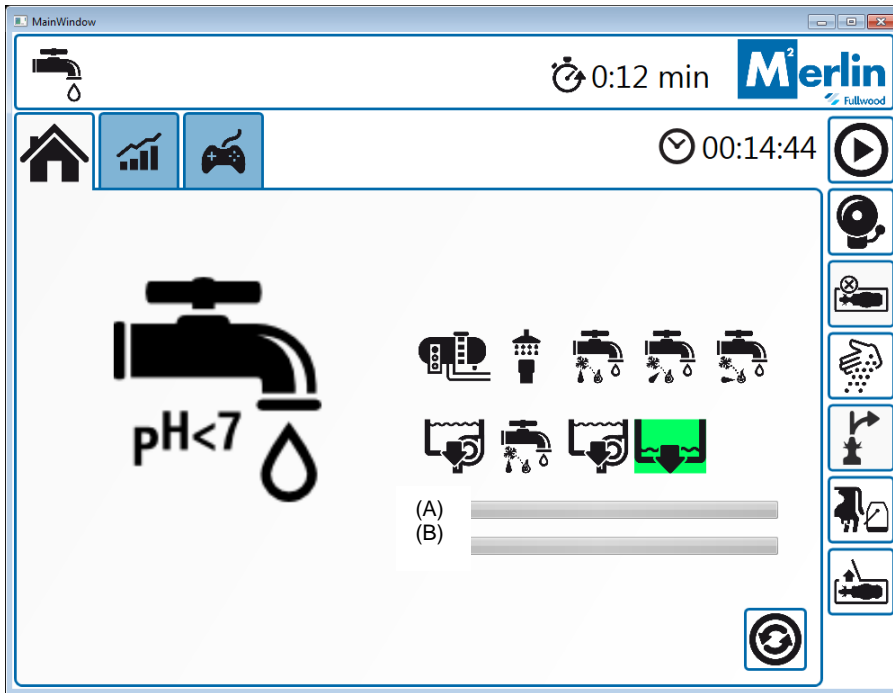
- > Red (acid) wash
- > Blue (alkaline) wash
- > Green System rinse
- > M<sup>2</sup>erlin rinse

The column with the exclamation mark icon  indicates if a cleaning should be performed according to the embedded system

The column with the clock icon shows the time the last cleaning of a certain type has been performed.

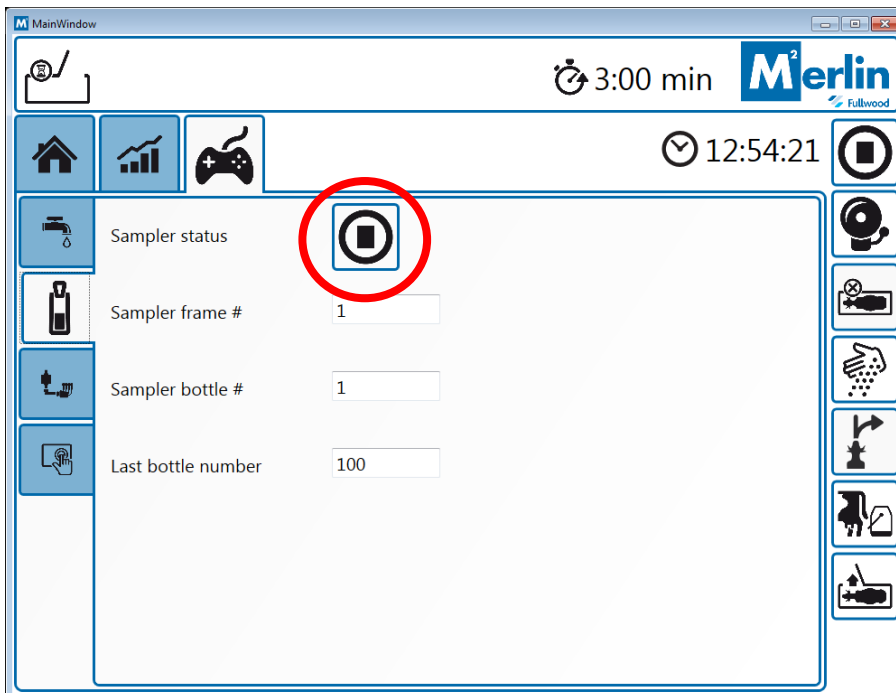
The column with the pump icon contains buttons for priming the various pumps.

### Cleaning Progress



Shows progress of the cleaning cycle  
The upper progress bar (A) shows the progress of the indicated step, the lower progress bar (B) shows the progress of the cleaning.

### Milk sampling



Stop milk sampling  
Start milk sampling  
Pause (open tube clamp)

### Milking statistics

Start	Cow	Actual/Exp. Yield	Time	Destination	Result
11/17/2014 12:09:12 AM	13	5,6 / 3,4	05:13	milk tank	ok
11/17/2014 12:09:12 AM	13	5,6 / 3,4	05:13	milk tank	ok
11/17/2014 1:42:32 AM	340	6,8 / 6,7	07:09	milk tank	ok
11/17/2014 1:32:11 AM	61	8,9 / 9,1	05:52	milk tank	ok
11/17/2014 1:31:43 AM	72	55 %	00:15		
11/17/2014 1:20:05 AM	3	6,0 / 5,1	07:09	milk tank	ok
11/17/2014 1:13:45 AM	75	10,9 / 10,6	06:09	milk tank	ok
11/25/2014 6:24:39 PM	9954	9,3 / 4,6	08:35	milk tank	ok
11/25/2014 9:06:27 PM	3882	2,0 / 15,0	00:00	milk tank	busy
11/25/2014 9:06:27 PM	3882	0,0 / 15,0	00:00		busy

Overview of visits and milkings

Screen details the following milking statistics;

- Date of milking
- Time of milking
- Cow ID
- Actual and Expected yield
- Time in crate
- Destination of milk
- Result of milking (ok/not ok)

### Cleaning statistics

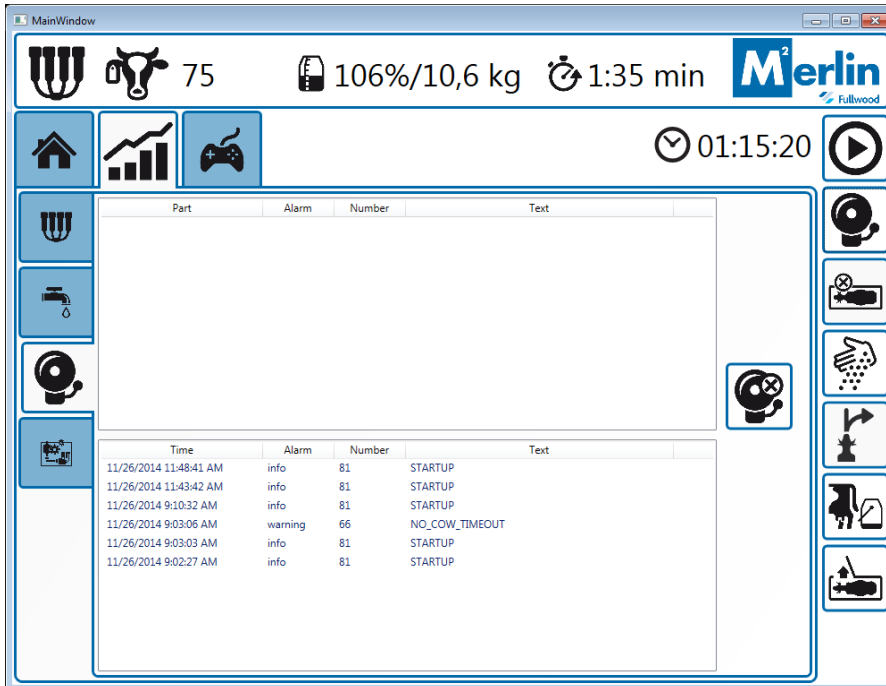
Start	Cleaning	Time	Result
11/17/2014 12:14:32 AM	acid	09:16	ok
11/17/2014 1:38:09 AM	merlinRinse	04:11	ok
11/17/2014 1:27:19 AM	merlinRinse	04:11	ok

Overview of cleaning

Screen details the following cleaning statistics;

- Date of cleaning
- Time of cleaning
- Type of cleaning (acid or alkali)
- Duration of wash cycle
- Result of cleaning (ok/not ok)

### Alarms Screen



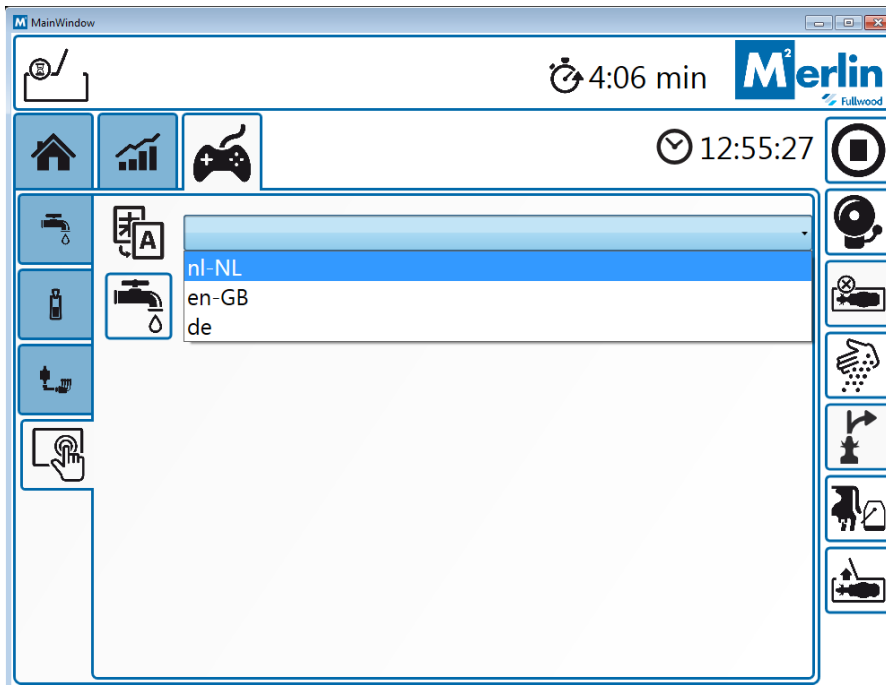
Overview of Alarms

Screen details the following Alarm statistics;

- Date of Alarm
- Time of Alarm
- Type of Alarm (info / warning / fatal / error)
- Alarm No.
- Alarm Description

Details of alarms can be found in the Fault Recognition and Rectification section.

### Touchscreen settings



The language icon can be used to change the language and country settings

When the tap icon is used, all buttons are ignored for 20seconds. This allows for cleaning the screen without accidentally pushing buttons

## 11. Routine Daily Maintenance

Within the milking system there are a number of routine activities that should take place to ensure the efficient and effective operation of the machine and are as follows;

VACUUM SYSTEM	
Check vacuum level	r
Check oil level in vacuum pump	r
CLEANING BRUSHES	
Check brushes are working correctly	r
Visual check cleaning of brushes & chemical injection	r
ROBOT ARM	
Check teat spray system & chemical level	r
Wash arm & milking equipment with low pressure water	r
Check and clean laser lens	r
Check arm has correct park position	r
Check air bleeds on shells	r
Check the Cartesian belts and rails for damage	r
Check the Z axis rollers are clean and free from dirt	r
MILKING EQUIPMENT	
Check teat cups and shells, change if damaged	r
Check condition of ACR ropes	r
Change milk filter minimum twice per day and flush housing with clean water ( <i>Pause the machine if necessary</i> )	r
Check on number of milkings that the liners have done	r
WASHING	
Check wash chemical levels	r
Check water temperature during a main clean	r
Check chemical pumps	r
CRATE	
Check operation of gates	r
COMPRESSED AIR	
Check compressed air pressure	r
Drain receiving vessel	r
Check oil level in pump	r
Check air filters	r
MILKMETER	
Check cleanliness of milkmeter body	r
OTHER	
Visually check complete system	r
Check any other equipment controlled by the robot	r

## 11.1 Changing the Liners

The teat cup liner is the only component within the robot that comes into contact with the cow's udder; therefore they, along with the shells should be checked for cracks and other damage daily and replaced when recommended in order to achieve maximum performance and minimise udder damage.

Fullwood recommend that liners are replaced every 2500 cow milkings or every six months (whichever comes first). Liners should always be replaced in sets of four.

Select the correct liner to go with the shell, vacuum chamber and liner gauge.

Put the robot into PAUSE, and turn off the compressed air supply



1. Rotate shell anti clockwise and remove



2. Shell and liner



3. Remove used liner from shell and discard



4. Fit new liner and pull into shell as far as shown (middle groove).



5. Use the correct liner gauge and cut



6. Screw the shell back into the milk vacuum chamber; ensure that the liner is not twisted.

Repeat the above process until all liners have been changed, turn the air supply back on and press PLAY on the HMI, the robot is ready to milk again.

## 12. Cleaning the machine



### PUT MACHINE INTO PAUSE BEFORE CARRYING OUT MANUAL CLEANING

- Manual Cleaning of machine
- It is recommended to have a written procedure in place, describing how the cleaning of the milking facilities shall be carried out.
- All milking equipment, lines, and surfaces that come into contact with milk, dirt or manure must be thoroughly cleaned and/or disinfected.
- In addition to the boiling water wash cycle for internal surfaces, manual cleaning of the machine is also required.
- No electrical equipment should be volume/pressure washed, for most applications a bucket of soapy warm water will remove all surface dirt.
- HMI Control Panel
  - Using a damp soft cloth gently rub the surfaces, no detergents. Never use a volume/pressure washer.
- Holding Crate & Robotic Arm
  - Using a hose pipe (low pressure) or a bucket of soapy water and a brush, remove all debris from interior and exterior of crate and arm.
- External Milking Equipment
  - Use a bucket of soapy water and a brush to remove all dirt from external milking equipment; this includes all stainless steel on show, i.e. interceptor, etc.
- Laser
  - Apply a small amount of solvent (017439) to a clean dry cloth
  - Wipe lens clean, ensuring not to leave the glass smeared
- Parlour Floor
  - The floor area surrounding the machine needs to be cleaned to keep it free from any accumulation of manure, or dirt. Floors must be constructed to slope to an appropriate point of drainage.
- Teat Rollers
  - If required, clean the teat roller brushes by removing and washing in a bucket of soapy water.
- Cartesian
  - Remove the front covers to reveal the Cartesian, clean rails and rollers with a soft cloth removing any dirt. Beware of finger traps.
- 3D camera
  - Wipe lens of camera with soft damp cloth. This may need to be performed more frequently in dusty / dirty environments.



### 13. Service Schedule

The robot requires four services per year to be carried out by suitably trained Technicians. An additional service is to take place at the end of every 2 year period. Only the fields marked X are part of the corresponding service. Fields marked with X\* are not to be carried out in the first year of service.

M <sup>2</sup> erlin Service Schedule							
Key							
x	Action Required	x*	Action /Action Required that requires parts but not in the first year				
x	Action Required and requires parts	Options					
Service Kit Pt No.		294012	94016	294017	294018	294019	294013
Service No.		1	1	2	3	4	2 Yr
<b>Milking Equipment</b>							
	Check teat cups, change if damaged	x	x	x	x	x	
	Calibrate 4QC	x	x	x	x	x	
	Check air bleeds in milk & vacuum chambers	x	x	x	x	x	
	Check vacuum sensor calibration	x	x	x	x	x	
	Check/adjust ACR ropes	x	x		x		
	Change ACR Ropes			x		x	
	Change diaphragm on milk flow sensor					x	
	Change O Rings on rope end cover and shell	x	x	x	x	x	
	Change Rope end covers					x	
	Check milk and pulsation lines for leaks and splits	x	x	x	x	x	
	Service milk pump	x	x	x	x	x	
	Change diaphragms on drain and purge valves					x	
	Change long milk tubes	x*	x*				
	Change head milk tubes	x*	x*				
	Inspect jetter cups	x	x	x	x		
	Change jetter cups					x	
	Check/clean spray ball in receiver vessel	x	x	x	x	x	
	Check operation of milk meter	x	x	x	x	x	
	Milk meter service				x		
	Change Milk meter valve service kit	x	x	x		x	
	Replace milk meter air filter				x		
	Change flexible collection manifold					x	
	Check foremilk manifold gaskets	x					
	Change foremilk manifold gaskets					x	
	Change Foremilk 11mm Polypropylene Balls					x	
	Check CrystaLab Rubber connections	x					
	Change CrystaLab Rubber connections				x		
	Change Crystalab to receiver milk tube				x		
<b>M<sup>2</sup>erlin Arm</b>							
	Check teat spray system	x	x	x	x	x	
	Check for air leaks on compressed air	x	x	x	x	x	



Check laser screen is clean and calibrate	x	x	x	x	x	
Check arm movement on all axis to limits	x	x	x	x	x	
Check force sensing on all axis	x	x	x	x	x	
Check centre box position	x	x	x	x	x	
Check under jettors position	x	x	x	x	x	
Check in jettors position	x	x	x	x	x	
Check brushes move over the cups correctly	x	x	x	x	x	
Check all wheel bearings	x	x	x	x	x	
Check Cartesian drive belts and rails for damage	x	x	x	x	x	
Check Cartesian belt tension	x	x	x	x	x	
<b>Teat roll wash line change</b>					x	
<b>Cleaning Brushes</b>						
Check brushes working correctly	x	x	x	x	x	
Check cleaning of brush & chemical injection	x	x	x	x	x	
Change teat brush chemical pump tube	x	x	x	x	x	
<b>Washing</b>						
Check for lime scale build up	x	x	x	x	x	
Check operation of all cabinet valves	x	x	x	x	x	
Check for water leaks	x	x	x	x	x	
Change large peristaltic pump tubes			x		x	
Check water temperature during a main clean	x	x	x	x	x	
Check Chemical usage	x	x	x	x	x	
Check sanitary trap	x	x	x	x	x	
Change acid injection periceltic pump tube if fitted	x	x	x	x	x	
<b>Feeding System</b>						
Check all feed types dispense correctly and calibrate	x	x	x	x	x	
Check feed pan operation	x	x	x	x	x	
Replace Feed Relays						x
<b>Vacuum System</b>						
Check vacuum pump oil system	x	x	x	x	x	
Check vacuum level/regulate	x	x	x	x	x	
Check vacuum gauge accuracy	x	x	x	x	x	
Check oil separator in exhaust (if fitted)	x	x	x	x	x	
Clean Servac & service.			x		x	
Replace Vacuum Sensor Seal					x	
<b>Pulsation System</b>						
Measure and record pulsation characteristics	x	x	x	x	x	
Change head pulsation tubes	x*	x*				
Clean pulsator air filter	x	x	x	x		
Replace pulsator air filter					x	
Replace pulsator silencer			x		x	
Service Legato Life			x		x	
<b>Compressed Air</b>						
Check M <sup>2</sup> erlin regulator settings	x	x	x	x	x	
Check air pressure switch operation	x	x	x	x	x	
Check compressed air filters	x	x	x	x	x	
Check compressor service has been completed					x	
Check operation of auto drain	x	x	x	x	x	
Check oil level in pump	x	x	x	x	x	
Check start & stop pressures	x	x	x	x	x	
Replace Air Purge Non Return Valves	x	x	x	x	x	
Replace main cabinet exhaust air silencer	x*	x*				

<b>Crate</b>						
Check operation of gates	x	x	x	x	x	
Change gate linkage bushes (Pre Rev 1.5)	x*	x*				
Change gate linkage bushes (Rev 1.5)	x*	x*				
Check and clean cow follower camera	x	x	x	x	x	
<b>Miscellaneous</b>						
Check E-stop functionality	x	x	x	x	x	
Check Machine Stop	x	x	x	x	x	
Check RCBO	x	x	x	x	x	
Visually check earth connections	x	x	x	x	x	
Check all covers are fitted correctly	x	x	x	x	x	
Check any other equipment controlled by M <sup>2</sup> erlin (Bulk tank, Buffer Tanks and Gates)	x	x	x	x	x	
Visually check complete system watch milking	x	x	x	x	x	
Fill in service record	x	x	x	x	x	
Replace Tank Sampler Seal					x	
Replace Sampler Tube						x
<b>Cartesian</b>						
Change All Belts						x
Change all Rollers						x

Check revision of machine for correct 'End Gate Linkage Bushes' to be fitted during service one in year 2, 3, 4 .....

Change end gate linkage bushes (Pre Rev 1.5)	1 x 291421 Pre Rev 1.5 Tri Link Service Kit (one gate)
Change end gate linkage bushes (Rev 1.5)	1 x 291420 Rev 1.5 Tri Link Service Kit (one gate)

Subject to options fitted, chose the following to be fitted during service one in year 2, 3, 4 .....

Change acid injection periceltic pump tube	1 x 079462 Acid inject pump tube
Change CrystaLab Rubber connections	1 off 133721 Crystalab Rubber Connector
Change Crystalab to receiver milk tube	1 x 033471, Milk Mtr/Milk Ln Connecting Tube
Teat roll wash line change	10m 030312 - Sil Tube 12nb/20mt/21od (old) - or - 10m 293661 PUN-H_12x2-NT Tubing (new)

#### Parts recommended to be changed periodically:

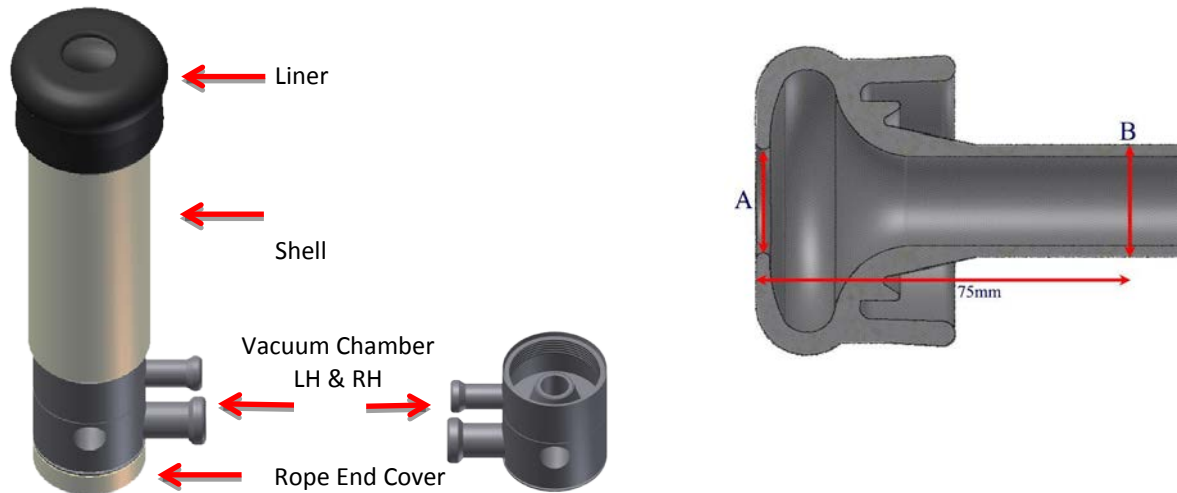
- Vacuum pump oil to be changed 4 times a year, more often in case of continuous use **(Busch pump only)**
- Ensure oil vane pump is topped up with oil - **092671** 5ltr Vac Pump Gear Box Oil  
Liners are to be changed after 2500 cow milkings

## 14. Consumables / Spares

### 14.1 Liners, Shells, Vacuum Chambers, Rope End Covers, Liner Gauge and 'O' Rings (Compatibility Chart)

Part numbers and dimensions

Liner Part No	020146	020167	020138	020227	020215
Liner Name	FL7S	FL7W	SL2CTF WT	SL1CTS	SL1CTW
Shells Part No	092677		092675		
Hood aperture 'A' (mm)	20.75	22.5		25.0	
Barrel ID 'B' (mm)	22.0		23.5	24.5	



### Vacuum level, Ratios and Rates

Liner Part No	020146	020167	020138	020227	020215
Liner Name	FL7S	FL7W	SL2CTF WT	SL1CTS	SL1CTW
Vacuum level (kPa)	47-50		46-48		
Ratio (%)	65:35			60:40	60:40* 65:35
Rate (ppm)	60				

\* Preferred Setting

### Matching Liners to Breeds

Liner Part No	020146	020167	020138	020227	020215
Liner Name	FL7S	FL7W	SL2CTF WT	SL1CTS	SL1CTW
Jersey	✓		✓		
Holstein	✓	✓	✓		
Holstein/Friesian		✓	✓	✓	
Fleckvieh/Rotvieh				✓	✓

For guidance only. Cow teats will vary in shape and size within the breed which ultimately affects the choice of liner.

#### Additional Information

Liner Part No	020146	020167	020138	020227	020215
Liner Name	FL7S	FL7W	SL2CTF WT	SL1CTS	SL1CTW
Vacuum Chambers	LH 194190 & RH 194191				
"O" Ring 37.82mm x 1.7mm	007663				
"O" Ring 10.00mm x 2.00mm	007670				
Rope End Cover	092259				
Liner Cutting Gauge	091369				
As M <sup>2</sup> erlin does not use the short milk tube section of the liner the following liners can be substituted.	020169 (FL7S WT)	020169 (FL7S WT)	020137 (SL2 CTF)		
	020198 (FL10S)	020154 (FL10W)			

## 14.2 Chemicals

Part Number	Description	Quantity
113003	Alkali Wash Chemical (Nightwash)	25L
113009	Acid Wash Chemical (AMS Cleaner)	25L
113026	Brush Sanitiser (Brush Sanitiser)	200L
113043	Iodine Extra (Teat Spray)	25L
113011	Cluster Sanitiser (Optional Backflush Acid)	25L

Other sizes are available upon request

## 14.3 Other

092264	4mm ACR Rope (2m long)	1 off
--------	------------------------	-------

## 15. Fault Recognition and Rectification

### 15.1 General

Fault	Possible Cause	Remedy
No power to machine	Isolator not on	Turn on isolator
	E-stop has been activated	Check and reset E-stops
	Breakers have tripped	Check and reset breakers
M <sup>2</sup> erlin will not reset after power up or machine stop	Low air pressure	Check air pressure to machine
	Alarm message	Check alarm list
Cow standing the wrong way in crate	Forced entry	By pressing the Machine Stop Button allows the arm to be moved and the gates to be opened manually
A cow enters M <sup>2</sup> erlin and rejected after identification	<ul style="list-style-type: none"> <li>Cow is not in the database</li> <li>Transponder/Pedometer has failed</li> <li>Cow isn't ready for milking</li> </ul>	<ul style="list-style-type: none"> <li>Enter cow details onto the database</li> <li>Replace the Transponder /Pedometer</li> <li>If the cow number is displayed the cow isn't ready for milking, check the yield expected on the display</li> </ul>

### 15.2 Alarm Messages

Fatal	This message indicates an error that cannot be solved by the M <sup>2</sup> erlin itself. This message asks for immediate action of the user.
Error	This message indicates an error where the M <sup>2</sup> erlin will try to let the current cow out of the crate and wait for action from the user.
Warning	This message indicates an error where the M <sup>2</sup> erlin will attempt to fix the problem
Info	This message indicates an error that has low priority and no immediate action is required.

### 15.3 Alarm Message Codes

No.	Classification	Alarm Code	General Description	Effect	Cause (Trigger Parameters)	Required Actions
-	info	NO_ALARM	N/A	N/A	N/A	N/A
1	warning/ error	COWINBOX	<p>Generated by Merlin when a cow traffic.</p> <p>Warning sent after drive-out attempts have failed. Then promoted to Error after the COWINBOX warning time has expired.</p> <p>Also used in separation with Texas Gate Open when animal doesn't pass the gate sensor.</p>	<p>Merlin will stop waiting for the alarm to clear.</p> <p>After a given time (Set in the configurator) an alarm is generated to the farmer.</p>	<p>1) Cow stands in box after milking has finished.</p> <ul style="list-style-type: none"> <li>- a) The exit gate does not open.</li> <li>- b) The exit race is blocked.</li> <li>- c) The cow does not move.</li> </ul> <p>2) Sensor stops sensing cow.</p>	<p>1) Remove the cow from the box.</p> <ul style="list-style-type: none"> <li>- a) Check the gate control operation.</li> <li>- b) Remove the obstruction.</li> <li>- c) Manually remove the cow.</li> </ul> <p>2) The indicate light on the sensor does not detect the cow.</p>
2	error	FEEDMOTOR	<p>Generated when "Return Switch" isn't detected in time with a portion motor.</p> <p>Note - Only affect robots with portion motors installed.</p>	No Data	<p>1) Motor is trying to turn, but no feed is being dispensed to the cow.</p> <p>2) Motor is not trying to turn and feed is not being dispensed.</p>	<p>1) Clean out feed unit.</p> <p>2) Replace damage motor.</p>
3	info	FEEDSUPPLY	<p>One of the sensors in the feeder hoppers monitoring if feed is available signals the feed hopper is empty.</p> <p>Note - This option is not installed as standard.</p>	No Data	Not used for Merlin systems	No Data
4	info	VACUUM_GEN	N/A	N/A	N/A	N/A

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5	info	VACUUMOIL	N/A	N/A	N/A	N/A
6	info	VACUUM PUMP	N/A	N/A	N/A	N/A
7	info	VACUUM SENS	N/A	N/A	N/A	N/A
8	fatal/error	ARM_GENERAL	General failure of arm (Not a specified known error).  Note - "Fatal" class alarm when arm is turned in, otherwise "Error" class alarm is generated.	Error will be generated.  Cow will be released, system will stop all action.	General failure of arm (not one of the specified errors).  Fatal when arm is turned in, otherwise Error class.	System needs to be checked and alarm needs to be reset.
9	fatal/error	ARM_NO_COMM	No communication to Merlin Arm.  Note - "Fatal" class alarm when arm is turned in, otherwise "Error" class alarm is generated.	Error will be generated. Cow will be released, system will stop all action.	No communication to Merlin Arm.  Fatal when arm is turned in, otherwise Error class.	System needs to be checked and alarm needs to be reset.
10	fatal/error	ARM_WRONG_COMMAND	Merlin arm has received wrong command.  Note - "Fatal" class alarm when arm is turned in, otherwise "Error" class alarm is generated.	Error will be generated.  Cow will be released, system will stop all action.	Merlin arm has received wrong command.  Fatal when arm is turned in, otherwise Error class.	System needs to be checked and alarm needs to be reset.  Full reset of Merlin is required.
11	fatal/error	ARM_CLEANING	Merlin arm cannot reach cleaning position.  Fatal when arm is turned in, otherwise Error class.	No Data	N/A	No Data
12	fatal/error	ARM_CLEAN_CUPS	Merlin arm cannot reach clean cups position.  Fatal when arm is turned in, otherwise Error class.	No Data	N/A	No Data

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13	fatal/error	ARM_FREE_VACUUM	Merlin arm cannot reach free vacuum position.  Fatal when arm is turned in, otherwise Error class.	No Data	N/A	No Data
14	fatal/error	ARM_DRAIN_TUBES	Merlin arm cannot reach drain hoses position.  Fatal when arm is turned in, otherwise Error class.	No Data	N/A	No Data
15	fatal/error	ARM_STAND_BY_POS	Fatal when arm is turned in, otherwise Error class.	No Data	N/A	No Data
16	warning	ARM_ASSIST_REQUEST	Merlin arm needs assistance to attach an animal without coordinates.	User will get a warning from the system.  System waits until the user arrives or until the timeout is passed.  After timeout an error will be generated, the cow will be released and the system will continue milking other cows.	Animals need to be taught for the first time milking or user has marked the animal needs the presence of the farmer when being milked.	User needs to go to the Merlin and assist the system attaching the cow.
17	fatal/error	ARM_TURNIN	Merlin arm cannot turn in. Fatal when arm is turned in, otherwise Error class.	Error 17 will be generated and system will stop all actions until alarm has been reset by the user.	Expected position is not reached within a set time when turning in.	Check the system. Reset alarm.
18	fatal/error	ARM_TURNOUT	Merlin arm cannot turn out. Fatal when arm is turned in, otherwise Error class.	Error 18 will be generated and system will stop all actions until alarm	Expected position is not reached within a set time when turning out.	Check the system. Reset alarm.



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				has been reset by the user.		
19	fatal/error	ARM_VACUUM	Fatal when arm is turned in, otherwise Error class.	No Data	Not used by M2.	No Data
20	fatal/error	ARM_WAGON_POS	Fatal when arm is turned in, otherwise Error class.	No Data	Not used by M2.	No Data
21	fatal/error	ARM_TEAT_CUP_POS	Fatal when arm is turned in, otherwise Error class.  Error generated when arm is having problems turning in.	No Data	Not used by M2.	No Data
22	fatal/error	ARM_NOTEATS	No teats are marked for milking in data send to Merlin.  Fatal when arm is turned in, otherwise Error class.	Milking which is started will be aborted.	Will happen when main control software would start milking a cow with no teats marked for milking.  However main control will not start milking this cow.	Check laser glass / clean laser glass / exchange laser.
23	info	MM_GEN	Not used	Not used	Not used by M2.	Not used
24	info	MM_COMMUNICATION	Problems in communication to a milk meter.	In case of a single message is missed an info message will be generated in case > 5 messages in a row are missed an alarm will be generated.	In case milk meter communication is failing.	Check milk meter communication and reset alarm.

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25	info	MM_SENSOR	Milk meter is not seeing Milk (0.8kg) in Merlin within the milk meter alarm interval (default 60 sec), while sufficient milk flow is present.  Since Merlin Facelift By using value 0 for the interval this check can be disabled.	As soon as the alarm is triggered, the milking will be terminated and the Merlin will go into error mode.	Milk meter is not seeing Milk (0.8kg) in Merlin within the milk meter alarm interval (default 60 sec), while sufficient milk flow is present.  - Since Merlin Facelift -  By using value 0 for the interval this check can be disabled.	Check milk meter and reset alarm.
26	info	CLEAN_LOW_TEMP	Not used	Not used	Not used by M2.	Not used
27	info	CHEMICALS	No Data	No Data	Not used by M2.	No Data
28	fatal	MILKPUMP	Merlin cannot finish the milking. Problems with emptying the milk reservoir or resetting the milk meter.	An error will be generated Merlin will stop all actions.	Milk vessel is not emptied within the set time (default 5 minutes) after the milk pump has been started.	Check milk pump and level sensors and reset alarm.
29	error/info	MILKING_ABORTED	Milking aborted by arm control Box when none of the Failed Milking End Results are valid.  Milking End Result is first send as Info, after a number of failures in a row the alarm is promoted to Error.	After 3 aborted milkings in a row an error will be generated and the Merlin will be put in pause (Cleanings will be executed).	Milking is aborted by the 'old' arm (Possibly triggered by the user).	Check system and reset alarm.
30	info	CONNECTION_FAILURE		No Data	No Data	No Data
31	info	POWER_FAILURE	Generated when the Emergency Stop input is activated	Someone pushed one or both of the emergency stop buttons and/or problem with wiring.	Emergency stop buttons input detected.	Unlock emergency stop button and/or verify wiring emergency stop buttons.
32	info	MILKING_PAUSE	In case the system is set in pause by the delivery line longer	Error will be generated.	Pause is taking longer as the set value (Default	Check system and reset alarm.

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			than the milking pause timeout		120 minutes).	
33	info	SAMPLER_FRAME_FULL	Last bottle of the sampler has been filled.	User will get a warning from the system.  System waits until the user arrives or until the timeout is passed, the system will continue milking other cows.	Last bottle of the sampler has been filled.	Replace sampler frame and reset alarm.
34	info	RETRACTABLE_TEAT	The Retractable teat doesn't function correctly.	No Data	Not used by M2.	No Data
35	info	CALF_FEEDER	Calf feeder mixer is not filled in time (by monitoring Mixer Full signal).	No Data	Not used by M2.	No Data
36	info	D-LINE TIMEOUT	Delivery line is not available for longer than the set time (45 minutes by default).	Cleaning of milk tank takes longer than set time in configurator and/or milk tank has jumped in error after cleaning.	When the delivery-line to the milk tank is not available for a longer time (Than set in the Configurator).	Check milk tank.
37	info	MILKING_TIMEOUT	When the milking time of a cow is longer than two times mean milk time plus two times mean dead time, the system will abort the milking.	Milking will be terminated; system will continue milking other cows.	When the milking time of a cow is longer than two times mean milk time plus two times mean dead time, the system will abort the milking.	No Data
38	info	CLEANING_TIMEOUT	Error will generated if cleaning time exceeds maximum	Error will be generated and Merlin will be set off-line.	Error will generated if cleaning time exceeds maximum (Default value is 30 minutes advanced engineer setting).	Check the system and reset alarm.
39	info	SPARE2	No Data	No Data	Not used by M2.	No Data
40	info	MANGER_SENSOR	The manger pan is not emptied in time (The value to be entered	No Data	Not used by M2.	No Data

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			is the number of emptying attempts after eating time has elapsed).			
41	info	LIQUID_FILLING	The filling of the liquid doesn't finish in time. Problems with liquid supply or a problem with the weighing platform.	No Data	Not used by M2.	No Data
42	info	ARM_MILKING_TIMEOUT	Timeout during milking on arm control box.	No Data	No Data	No Data
43	info	ARM_ASSIST_TIMEOUT	Timeout on arm control box waiting for assistance.	Cow will be released, info message will be generated and system will continue milking cows.	Timeout manual assistance has passed.	No Data
44	info	ARM_FINDUDDER_ERR	Error on arm control box udder cannot be found.	Cow will be released, info message will be generated and system will continue milking cows.  After 3 fails in a row, system will generate an error and will stop milking cows.	No teats can be found.  After certain number of retries finding teats system decides to stop.  This alarm/warning is also raised when a cow is set to feeding only in Crystal.	1) Check laser glass / clean laser glass / exchange laser.  2) Check cow follower/arm positioning.
45	info	ARM_FINDTEATS_ERR	Error on arm control teats cannot be found, (arm control box has seen front teats).	Cow will be released, info message will be generated and system will continue milking cows.  After 3 fails in a row, system will generate an error and will stop milking cows.	Not all teats can be found.  After certain number of retries finding teats system decides to stop.  This alarm/warning is also raised when a cow is set to feeding only in Crystal.	1) Check laser glass / clean laser glass / exchange laser.  2) Check cow follower/arm positioning.

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46	info	ARM_NOFLOW_LR	Error on arm control box, no milk flow on Left Rear teat.	<p>Cow will be release info message will be generated and system will continue milking cows.</p> <p>After 3 fails in a row, system will generate an error and will stop milking cows.</p>	A certain level of flow is not detected when expected.	Check system and reset alarm.
47	info	ARM_NOFLOW_RR	Error on arm control box, no milk flow on Right Rear teat.	<p>Cow will be released, info message will be generated and system will continue milking cows.</p> <p>After 3 fails in a row, system will generate an error and will stop milking cows.</p>	A certain level of flow is not detected when expected.	Check system and reset alarm.
48	info	ARM_NOFLOW_RF	Error on arm control box, no milk flow on Right Front teat.	<p>Cow will be release info message will be generated and system will continue milking cows.</p> <p>After 3 fails in a row, system will generate an error and will stop milking cows.</p>	A certain level of flow is not detected when expected.	Check system and reset alarm.
49	info	ARM_NOFLOW_LF	Error on arm control box, no milk flow on Left Front teat.	<p>Cow will be release info message will be generated and system will continue milking cows.</p> <p>After 3 fails in a row,</p>	A certain level of flow is not detected when expected.	Check system and reset alarm.

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				system will generate an error and will stop milking cows.		
50	info	ARM_USER_ABORT	Break off milking on arm control box, user abort on display arm control box.	<p>Cow will be release info message will be generated and system will continue milking cows.</p> <p>After 3 fails in a row, system will generate an error and will stop milking cows.</p>	Milking is aborted by the user on the HMI (Merlin M2) or with the arm control box UI.	Check system and reset alarm.
51	info	ARM_COMM_ABORT	Break off milking on arm control box, milking aborted by command from Merlin.	<p>Cow will be release info message will be generated and system will continue milking cows.</p> <p>After 3 fails in a row, system will generate an error and will stop milking cows.</p>	<p>Milking is aborted by the main control, will be generated when milking is stopped from main control due to another error.</p> <p>Usually seen next to another error not generated by the arm control.</p>	Check system and reset alarm.
52	info	ARM_SEARCH_TIMEOUT	Error on arm control box, search for udder takes too long.	No Data	Not used on M2.	No Data
53	info	CATCHING	No Data	No Data	N/A	N/A
54	info	RELEASING	No Data	No Data	N/A	N/A

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55	info	EAT SENSOR	Alarm raised when eating sensor is activated at start of a visit, probably by roughage for the eating sensor.  Calculations of the roughage station will probably fail.	No Data	N/A	N/A
56	info	NO COLD WATER ROLLS	No Data	No Data	N/A	N/A
57	info	END OF MILKING	No Data	No Data	N/A	N/A
58	warning/error	BLD SENSOR	Error generated if blood sensor sees 3 animals in a row with blood in the milk.  Warning when old type blood sensor doesn't communicate anymore.	An error will be generated and Merlin will go into pause mode.  No cows will be milked but cleanings will be executed.	Error generated if blood sensor sees 3 animals in a row with blood in the milk, warning when old type blood sensor doesn't communicate anymore.	Check the blood sensor. Sensor needs to be cleaned or replaced.
59	warning	ABNORMAL MILK	Only send when animal should be kept in box when detecting abnormal milk.	User will get a warning from the system.  System waits until the user arrives or until the timeout is passed.  After timeout an error will be generated, the cow will be released and the system will continue milking other cows.	Animal is held in box because of abnormal milk (blood or conductivity).	Check and release animal.
60	warning	BUCKET FULL	All buckets of the bucket system are filled.	All buckets filled.	HMI reports all buckets filled.	Empty buckets and acknowledge in HMI.

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61	error	BUCKET ERROR	Bucket system has problems reaching Bucket or Park position.	No Data	No Data	No Data
62	error	IDENTIFICATION ERROR	Multiple cows in crate not identified in time.	Broken antenna / broken ID circuit board / wrong configuration.	The system has been unable to identify X animals in a row.	Verify/exchange antenna (wiring) / verify / exchange ID circuit board / verify power supply to ID circuit board.
63	error	DATABASE ERROR	Cow separation, maximum no. of animals with unknown tags reached.	No Data	No Data	No Data
64	error	AIR PRESSURE	Air pressure switch is disabled.	An error will be generated, all activities will be stopped and Merlin will go into off-line mode.	The input activated by the air pressure monitoring unit is deactivated.	Check air pressure and reset alarm.
65	error	LIGHTNING PROTECTION	Lightning protection input is disabled.	An error will be generated, all activities will be stopped and Merlin will go into off-line mode.	The input activated by the air pressure monitoring unit is deactivated.	Check lightning protection and reset alarm.
66	error	NO COW TIMEOUT	No cow being milked for longer than 1 hour without Merlin being off-line or in pause (Adjustable in Crystal 2.7).	An error will be generated and Merlin will go into pause mode.	No cow alarm setting has expired.	Check the system and reset alarm.
67	warning	CRYSTALAB_ERROR	The crystalab has produced errors which aren't expected every milking, if this continues every milking Crystalab is probably broken.	Info messages are generated, System will continue milking.	The crystalab has produced errors which aren't expected every milking, if this continues every milking Crystalab is probably broken.	Check CrystaLab.
68	error	MILKPUMP_INVERTER	The milk pump inverter is in error and not working.	An error will be generated, all activities will be stopped and Merlin	The input activated by the milk pump inverter is deactivated.	Check milk pump inverter and reset alarm.



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				will go into off-line mode.		
69	fatal	REJECTION VALVE	The rejection valve isn't positioned correctly for milk pumping/purging.	A fatal error will be generated and system will be set in off-line mode.	The valve feedback is inverted to the wanted status of the valve.	Check reject valve and feedback, reset alarm.
70	error	TANK_VALVE	The tank valve isn't positioned correctly for milk pumping/purging.	An error will be generated and system will be set in pause mode.	The valve feedback is inverted to the wanted status of the valve.	Check tank valve and feedback, reset alarm.
71	error	DLINE_VALVE	The Delivery Line valve isn't positioned correctly for milk pumping/purging.	An error will be generated and system will be set in pause mode.	The valve feedback is inverted to the wanted status of the valve.	Check D-line valve and feedback, reset alarm.
72	error	Flow/Vacuum sensors	One/More of the flow/vacuum sensors aren't working.	Broken pulsator/problem wiring/pulsator not programmed and/or not configured.	System cannot communicate with flow/vacuum sensors and/or flow/vacuum sensors not present in FarmCAN network and/or one of flow/vacuum sensors broken.	Verify/correct wiring /verify/program correct software version/ verify/redo configuration in HMI /exchange corresponding flow/vacuum sensor.
73	error	PULSATOR	The FarmCan pulsator isn't working.	Broken flow/vacuum sensor/problem wiring, flow, vacuum sensors not programmed and/or not configured.	System cannot communicate with pulsator and/or pulsator not present in FarmCAN network or pulsator broken.	Verify/correct wiring /verify/program correct software version/ verify/redo configuration in HMI /exchange pulsator.
74	error	COW_FOLLOWER_NOT_CONNECTED	The cow follower isn't communicating.	Wrong or problematic connection, wrong IP address, no power supply present.	System cannot communicate with cow follower.	Verify IP address/assign new IP address/check power supply/check connections/check wiring.

75	error	COW_FOLLOWER_ERROR	The cow follower application has reported an error.	Error will be generated, milking will be terminated and system will be set to pause mode.	The cow follower application has reported an error.	Check cow follower and reset alarm.
76	error	COW_FOLLOWER_NO_COW	The cow follower isn't seeing a cow anymore. Disabled/not used while cow can be out of sight at the front or the back.	N/A	The cow follower isn't seeing a cow anymore. Disabled/not used while cow can be out of sight at the front or the back.	N/A
77	error	ARM_PLC_COMMUNICATION	No communication between the Festo PLC and the UCC.	Fatal alarm will be generated in case arm is in the box.  An error will be generated in case arm is outside the box.	No communication between the Festo PLC and the UCC.	Check system and reset alarm.
78	warning	NO_SYSTEM_COMMUNICATION	No communication/timeout between the HMI and the main UCC.	Warning will be generated.	No communication/timeout between the HMI and the main UCC.	Check system.
79	warning	ARM_NO_CONFIGURATION	The ArmUCC is not configured.	When having installed a new ARM UCC.  When battery jumper not present and power fail occurred.	The arm UCC is missing the following 3 positions. - Centre box - In jettors - Under jettors.	Recalibrate the arm positions.
80	error	UNDER/OVERVOLTAGE	Safety device in electro cabinet giving alarm when excess voltage is detected.	An error will be generated, all activities will be stopped and Merlin will go into off-line modus.	The input activated by under/over voltage monitoring unit is deactivated.	Check mains and reset alarm.
81	info	STARTUP	Indicate restart of HMI, to notify in the alarm history list.	Info message will be generated, milking of	HMI restarted.	No Data

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				cows will continue as normal.		
82	info	FLASH ERROR	Merlin M2 HMI cannot write to flash or cannot access flash.	Info message will be generated, milking of cows will continue as normal.	Flash card not accessible or broken.	Verify (CHKDSK/F) or exchange flashcard.
83	info	ARM_MILK_SENSOR_LR	Milk sensor gives incorrect value on LR. - Air bleed not open? -	Milking will be terminated; system will continue milking other cows.	no increase in milk yield detected by the milk meter for 120 seconds ,teat milking for a minimum of 120 seconds after last attachment, the total milk time on that teat is higher than 140% of the average milk time on that teat.	Check arm milk flow sensor and air bleeds and reset alarm.
84	info	ARM_MILK_SENSOR_RR	Milk sensor gives incorrect value on RR. - Air bleed not open? -	Milking will be terminated; system will continue milking other cows.	no increase in milk yield detected by the milk meter for 120 seconds ,teat milking for a minimum of 120 seconds after last attachment, the total milk time on that teat is higher than 140% of the average milk time on that teat.	Check arm milk flow sensor and air bleeds and reset alarm.
85	info	ARM_MILK_SENSOR_RF	Milk sensor gives incorrect value on RF. - Air bleed not open? -	Milking will be terminated; system will continue milking other cows.	no increase in milk yield detected by the milk meter for 120 seconds ,teat milking for a minimum of 120 seconds after last attachment, the total milk time on that teat is higher than 140% of the	Check arm milk flow sensor and air bleeds and reset alarm.

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					average milk time on that teat.	
86	info	ARM_MILK_SENSOR_LF	Milk sensor gives incorrect value on LF. - Air bleed not open? -	Milking will be terminated; system will continue milking other cows.	no increase in milk yield detected by the milk meter for 120 seconds ,teat milking for a minimum of 120 seconds after last attachment, the total milk time on that teat is higher than 140% of the average milk time on that teat.	Check arm milk flow sensor and air bleeds and reset alarm.

## 16. Milk Sampling

### 16.1 Setting Cows for Sampling in Crystal

Open Crystal, and then go **Animals > Milk**

Crystal - ServiceDongle Fraser Adams

File Animals Group Browse Reports System Actions Module Programs Data-exchange Help

Animal no. Animal name Lact. no. Curr.lact. days Last event Group 24H prod. Avg. 24H prod.

411 - 1 3 Calved 7- Merlin - -

Base Agenda Concentrate Milk Quarter Samples Activity Traffic Short term Lactation All lactations

Milking enabled Regime Irregular Last milked at 20/11/2014 08:49:50

Current performance

	Deviation (%)	Current	Average	
Production	-	-	-	Kg
Conductivity	-	-	-	mS/cm
Temperature	-	-	-	°C
Flowrate	-	-	-	Kg/min

Warnings

Max cond. dev.	10 %
Milk Ok %	80 %
Milk fail %	20 %

Milk settings

FCP Curve 0

Merlin

Use manual prod. rate Avg. prod. rate - Kg/h Manual prod. rate 1.00 Kg/h

Target yield 6.00 Kg

Target milkings 4.0

Send milk to Bulk

Samples to take 0

Parlour codes

Lactation

Total production	- Kg	Fat	- Kg
100 day production	- Kg	Protein	- Kg
305 day production	- Kg	Lactose	- Kg
Days in milk	- days		

1. Click the binoculars, search for specific cow.

2. Select the number of samples to be taken from that cow

3. Click Apply

As long as the cow is able to be milked in the robot, the next time she is milked a sample will be taken.

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File Animals Group Browse Reports System Actions Module Programs Data-exchange Help

Animals Medicines Silos Logging

Variable Data Sub Totals Pre Selections Fine Selections

All Data No Subtotals <none> 3b05. Milk settings

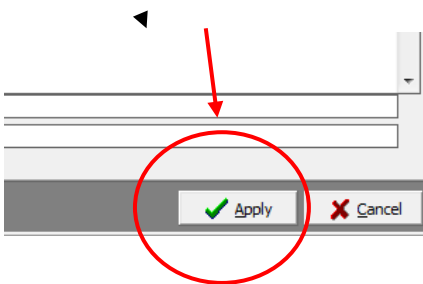
Animal no.	Milking enabled	Milking regime	Milk ok%	Milk fail%	Avg. 24H prod.	Manual prod. rate	Manual prod. rate	Avg. 24H prod. rate	Target yield	Target milkings	Samples take
3	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	10.00	-	0.00	-	0
203	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	0.80	-	5.00	3.8	0
224	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	1.00	-	6.00	4.0	0
229	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	1.00	-	6.00	4.0	0
339	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	0.86	-	5.00	4.1	0
346	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	1.00	-	6.00	4.0	0
364	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	0.80	-	5.00	3.8	0
376	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	1.00	-	6.00	4.0	0
384	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	1.05	-	6.00	-	0
390	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	1.00	-	6.00	4.0	0
411	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	1.00	-	6.00	4.0	0
415	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	1.00	-	6.00	4.0	0
420	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	1.00	-	6.00	4.0	0
422	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	1.00	-	6.00	4.0	0
440	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	1.00	-	6.00	4.0	0
450	<input checked="" type="checkbox"/>	Irregular	80	20	-	<input checked="" type="checkbox"/>	1.00	-	6.00	4.0	0

Or, select report 3b05

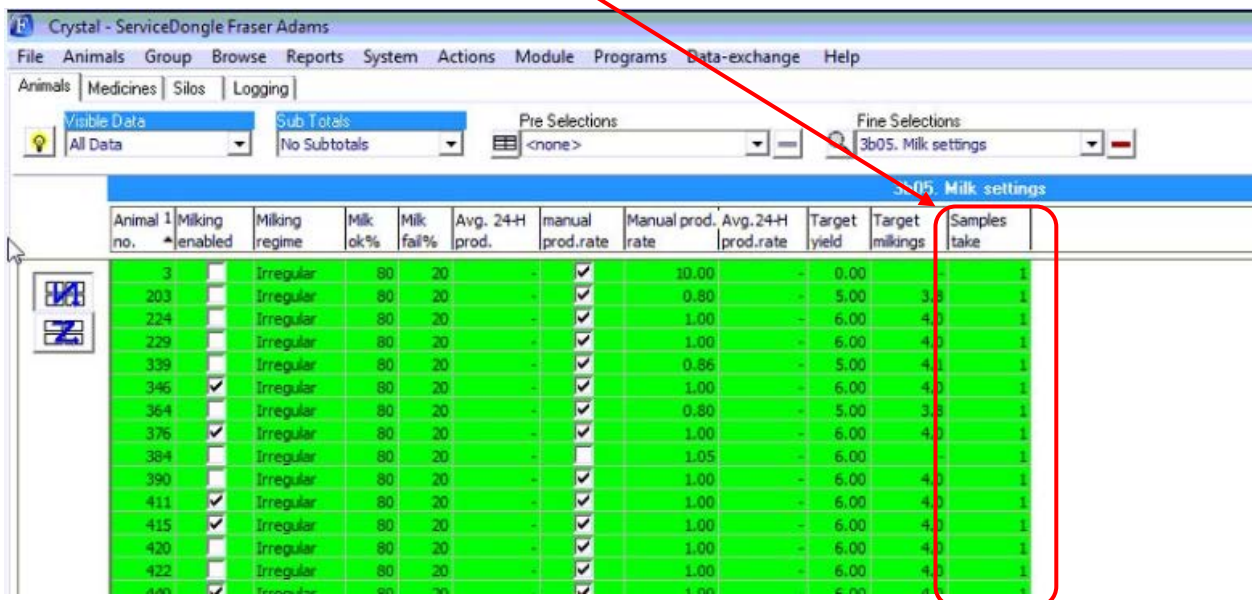
In the 'Samples take' column modify the value to '1' to set all cows to have 1 sample.



Click 'Apply' to accept the changes.



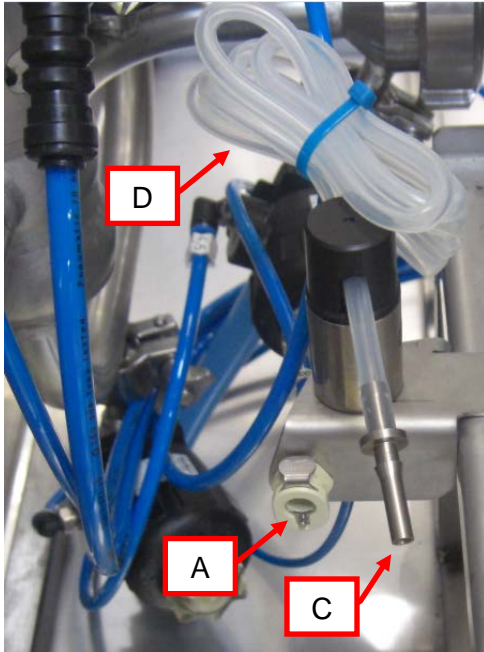
All the animals will be set to take 1 sample.



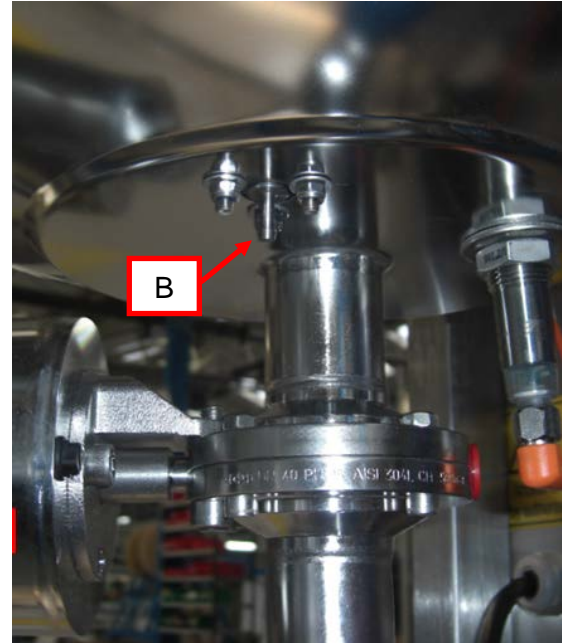
Note: The fields within the table turn green to indicate changes have taken effect, any fields that turn red indicate changes haven't been accepted.

## 16.2 Connecting the Multi Sampler

- Pause M<sup>2</sup>erlin ready for connection



Connect the red flexible airline from the Sampler to the quick connect port 'A' on M<sup>2</sup>erlin



Remove the plug 'B' from the underside of the milk receiver and replace with connector 'C'

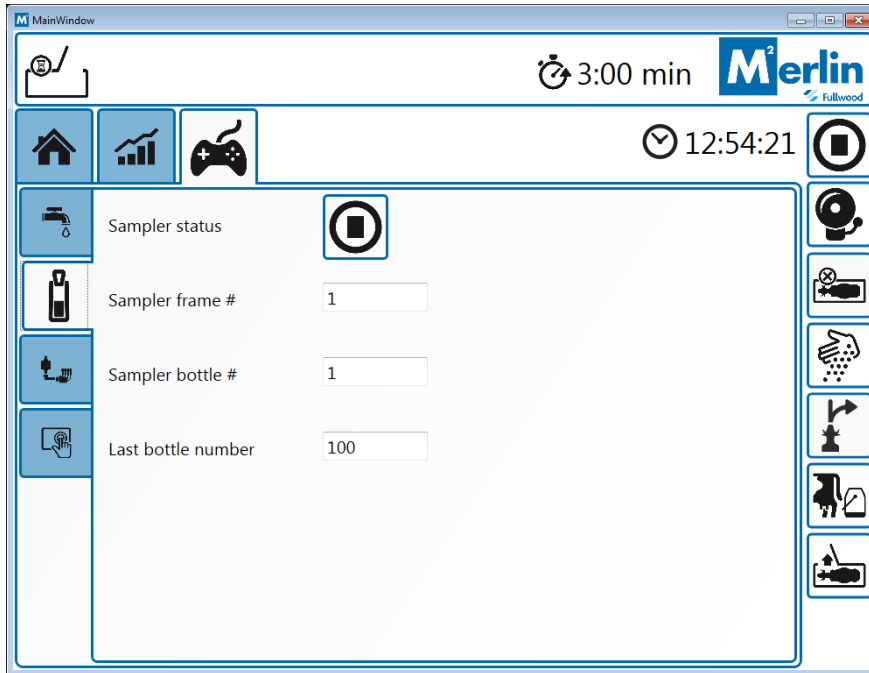


Connect the other end of the sampler 'D' tube to the spoon on the sampler



Place the spoon into position 1 of the toothed section. Ensure that the silicone tube is routed so that it cannot catch on an obstruction.

Set M<sup>2</sup>erlin HMI to display menu

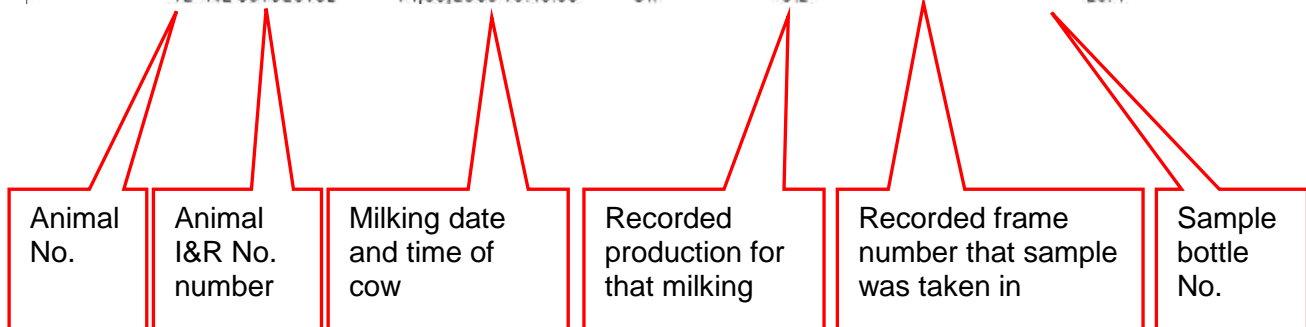


For further operating instruction refer to the user manual for the sampler used

Example of report

3604. Milk control report for screen/printer Page 3, 06/03/2004 14:49:31

Animal no.	I&R no.	Rec.timestamp milk	Rec. EOM	Rec. prod.	Rec. frame	Rec. bottle	24-H prod.
12	NL 901529182	13/09/2000 22:25:00	Ok	7.2	-	-	26.4
12	NL 901529182	14/09/2000 07:08:00	Ok	10.6	-	-	26.4
12	NL 901529182	14/09/2000 15:48:00	Ok	9.2	-	-	26.4





## 17. Disclaimers

### Foreseen Use of Machine:

Your machine has been designed and manufactured for its intended use only as detailed in this manual and should not be used for any other purpose.

If you have any doubts and/or questions regarding the specification, servicing, or features of your machine, contact your local Fullwood dealer.

Fullwood Limited reserves the right to change the specification and/or operating features regarding this machine without notice or documentation.

### Warranty:

The warranty on your **Fullwood Machine** will be invalidated if any additional ancillary equipment is fitted, or any modification or adjustments made to the controlling devices without prior notification and/or agreement from Fullwood Limited.

Fullwood Limited will not accept responsibility for loss or damage caused by a force majeure e.g. lightning strikes and purchasers are advised to take out suitable insurance to cover their equipment.

Fullwood Limited will not accept responsibility for milk contaminated by antibiotics and/or water.

### Maintenance:

All work must be carried out by personnel suitably qualified for each maintenance task to avoid damage to both the machine systems and the maintenance personnel.

Fullwood Limited cannot accept responsibility for any damage and/or loss that may occur through incorrect maintenance of your machine. Routine maintenance schedules can be found within this manual and should be adhered to.

### Electrics:

Electrics can be extremely dangerous. All mains electrical work should be performed by a suitably qualified electrician in accordance with the applicable national and/or local regulations along with other relevant regulations and/or local bylaws.

### Compressed Air:

Compressed air can be extremely dangerous. Installers and Users of compressed air equipment should be familiar with relevant safety regulations. (i.e.; **BS EN 1012-1:1997 - Compressors and vacuum pump.**) Standards and recommendations are available from BSI or HMSO.

### Water:

All owners or occupiers of premises are responsible for the water systems within the premises. Owners and/or occupiers of premises where this machinery is used are responsible for provision of an adequate water supply, where required, and for compliance with relevant national and local legislation relating thereto.

An appropriate guide for agricultural premises (**Water Supply Systems: Prevention of Contamination and Waste of Drinking Water Supplies. Agricultural Premises**) is available from the Water Regulation Advisory Scheme [www.wras.co.uk](http://www.wras.co.uk) (Tel. 01495 207 9030 UK only)

### Cleaning Chemicals:

Only recommended cleaning chemicals are to be used, details of which can be found within this manual or contact Fullwood Limited Customer Services.

### Contents of Manual:

Fullwood Limited takes pride in the accuracy of information given in this manual, but due to nature of hardware and software developments, be aware that specifications and features of this product can change without notice. The information contained in this manual is correct at the date of publication only. No liability can be accepted by Fullwood Limited, including liability to any person by reason of negligence, for loss, damage or injury caused by errors in, or omissions from, the information supplied in this manual.

Any screenshots are used for explanation purposes only. Any numbers, wording, window or button positions may be different for the configuration of the machine control software being used to control your machine.

### Language:

The original of this manual is written using British English. Translations to other languages have been done in good faith and no liability can be accepted by Fullwood Limited for loss, damage or injury caused by errors, or omissions.

**Contact:** If you have any suggestions for improvements or amendments or have found errors in this publication, please notify Fullwood Limited Customer Services, E-mail address: [customerservices@fullwood.com](mailto:customerservices@fullwood.com)