Milking equipment function & parlor management
Milking is a complex interaction

AND not likely related to ONE factor alone
Difficult balance to maintain
Goal of milking time...

Harvest as much milk as possible and efficiently as possible while avoiding teat end and teat skin damage.
Signs of poorly functioning equipment

- Liner squawks
- Cow behavior in the parlor
- Teat end condition
- Teat skin condition

Conversely…
Properly functioning equipment

- Udder health
- Bulk tank SCC
- PI count
- In turn…. ↑ $$$
Focal points of interest...
Focal points of interest...
Learn facts before change...
Principles of milk removal

- Vacuum is needed for efficiency
  - Keep unit on
- Inflation + pulsation & vacuum creates pressure difference
- If pulsation fails, milk flow ceases
- But….vacuum is stressful to tissue
Understanding the principles

- All systems MUST have vacuum set properly
- Accounting for inflation in use
- All other settings set to optimize machine-on-time
Role of proper milking procedures

- Milk clean, dry, properly prepped teats
- Every milking, by every milker, every day
- Milking procedures can have profound effect on milk quality
- Shorter machine-on time
- ↑ milk yield
- Healthier cows
Proper milking procedures

- Try blocks of 4-6 cows depending on parlor and milkers
- Always begin back on cow #1
  - Never weave back through in reverse order
- Use a stop watch
- Check timing on every milking and monitor
Proper milking procedures

Milk clean, dry, properly prepped teats

- Gloves (clean gloves!)
- Pre-dip – 30 s contact time (remove debris)
- Strip cup – examine for signs of mastitis
- Wipe – Single use towels (cloth or paper)
Proper milking procedures

Milk clean, dry, properly prepped teats

- Attach unit – 60-120 s of stripping
- Prevent squawks
- Avoid overmilking
- Post-dip
Proper milking procedures
30 s kill-time
Proper milking procedures

90 s delay time
Proper milking procedures

Oxytocin takes At least 60” to Reach a useful concentration in the udder
Proper milking procedures

- Equipment to examine milk flow curves
  - Unit on time
  - Time to peak milk
    - 60-90 seconds
  - Time required to harvest 50% of milk
    - 2-2.5 minutes
  - Liner squawks
  - ATOs set at 0.5-0.9 lb/min for 2-3 up to 7 seconds
    - More aggressive for 3x
Proper milking procedures
Interactive software

iPrep for Android and iPhone users
What happens if procedures are bad?

- If dip contact time < 30 seconds
  - ↑ environmental mastitis risk
- If prep-delay < 60 seconds
  - Dry milking
  - Teat end damage from vacuum with little milk
- If prep-delay > 120 seconds
  - Lost full effect of oxytocin and ↑ teat end damage
How to assess teat end damage?

- Teat end scoring used to assess the effects of:
  - Milking management
  - Milking equipment
  - Environment

- Indicator of the risk for new IMI
<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Score 1 (N)</strong></td>
<td><strong>No Ring.</strong> The teat-end is smooth with a small, even orifice. This is a typical status for many teats soon after the start of lactation.</td>
<td><img src="image1" alt="Illustration" /> <img src="image2" alt="Illustration" /></td>
</tr>
<tr>
<td><strong>Score 2 (S)</strong></td>
<td><strong>Smooth or Slightly Rough Ring.</strong> A raised ring encircles the teat orifice. The surface of the ring is smooth or it may feel slightly rough but no fragments of old keratin are evident.</td>
<td><img src="image3" alt="Illustration" /> <img src="image4" alt="Illustration" /></td>
</tr>
<tr>
<td><strong>Score 3 (R)</strong></td>
<td><strong>Rough Ring.</strong> A raised, roughened ring with isolated fragments of old keratin extending a short distance from the teat orifice.</td>
<td><img src="image5" alt="Illustration" /> <img src="image6" alt="Illustration" /></td>
</tr>
<tr>
<td><strong>Score 4 (VR)</strong></td>
<td><strong>Very Rough Ring.</strong> A raised ring with rough fragments of old keratin extending out from the teat orifice. The rim of the ring is rough and may be cracked, often giving the test-end a “flowered” appearance.</td>
<td><img src="image7" alt="Illustration" /> <img src="image8" alt="Illustration" /></td>
</tr>
<tr>
<td><strong>Score 5</strong></td>
<td><strong>Open Lesions or Scabs.</strong></td>
<td>Not pictured.</td>
</tr>
</tbody>
</table>
Interactive app for scoring
Factors affecting condition

- Short term – single milking effects
- Medium term – few days to few weeks
- Long term – 2-8 weeks
- Very long term – few to many months
Short term

- Changes in color
- Swelling/firmness at teat end and barrel
- Rings at base of teat
- Degree of openness at teat orifice (> 2mm concern)
Causes of short term effects

- Dry milking and/or overmilking
- Unusually heavy cluster weight
- High milking vacuum
- Faulty pulsation
Medium term

- Hardening or thickening of teat skin from cold, wet, windy weather
- Chemical irritation
- Petechial hemorrhages
Causes of medium term effects

- Weather related conditions
- Use of improper solution for disinfectant
- High vacuum/overmilking
- Pulsation failure (constant vacuum)
Longer-term effects

- Changes in teat end health
  - Hyperkeratosis
- Changes in skin condition due to extremely harsh weather
  - Frostbite
  - Severe cracking
Causes of longer-term effects

- Hyperkeratosis
  - Udder prep
  - Teat end shape/size
  - Production level
  - Overmilking
    - Check ATO’s
    - Machine on time
    - Amount of unit-on time when flow is < 1 kg/min
- Genetic predisposition
- Slow milking and high producing cows
- High vacuum
How to score teats

- Score all 4 teats
- Assess skin condition before milking
- Make all other assessments after milking
- Dry teat end with paper towel
- Observe side of teat and teat end, turning teat towards you
- Herds up to 80 cows – score all teats
- 80-400 – randomly select at least 80 cows
- Herds > 400 – score 20% of cows
Guidelines for concern

- Color: > 20% are red or blue
- Swelling: > 20%
- Openness of teat: > 20%
- Vascular damage: > 20%
- Teat skin condition: > 5% open lesions
- Teat end hyperkeratosis: > 20% rough and very rough or > 10% very rough
If there is concern...

- Start to examine
  - Milking procedures
  - Milking equipment function
    - Vacuum
    - Pulsation
  - Cluster alignment
Parts of the milking system

**Header pipe** –
- Dist. tank to trap, supplies vacuum to receiver/units

**Distribution tank** –
- PVC
- Usually high
- Pipes hook in

**Regulator** –
- Controls vacuum
- Lets air in
- Conventional

**Vacuum pump** –
- VSD with sensor
- Conventional with regulator
- Hooks to distribution tank

**Sanitary trap** –
- Protects dist. tank from fluid

**Milk line**

**Receiver jar** –
- Fills with milk
- Always milk in

**Transfer pump** –
- Milk to tank
- When milk touches contacts

**Units**

**Pulsator/pulsator line**
Terminology

- **Vacuum fluctuation**
  - Change in vacuum experienced during milking
  - 2” Hg drop in parlor is acceptable

- **Residual massage**
  - Total vacuum – liner touch point = residual massage

- **Effective reserve**
  - Air flow capacity leftover to milk cows

- **Manual reserve**
  - Measured without the regulator, amount of pump capacity if everything is working right
  - Only measured in systems with conventional regulators
Terminology

- **CFM**
  - Cubic feet per minute
  - Measure of air flow

- **Regulator efficiency (%)**
  - How well the regulator is working
  - \( = \frac{ER}{MR} \times 100 \)

- **Required pump capacity to milk cows**
  - \( = 1 \text{ CFM/unit} + 35 \text{ CFM} \)

- **Idle effective reserve**
  - \( = ER + \frac{1}{2} \text{ CFM per unit (pulsators active)} \)
  - \( = ER + 1 \text{ CFM per unit (pulsators not active)} \)
Role of pulsator function

- Cyclically opening and closing the liner to create pressure difference
- Easily become dirty and air inlets plug
- Wear of components affect movement
  - Can result in suboptimal massage
- Reduced teat end health
- Poor milk out & performance
- **Common ratio is 60:40**
  - Range from 55:45 to 70:30
Pulsation data

- Collected in short air tube
- Conditions in pulsation chamber
Phases of pulsation

A  Liner Opening  (Milk Phase)
B  Liner Open
C  Liner Closing  (Massage Phase)
D  Liner Closed

Pulsator Ratio is expressed in percent or ms
Milk phase : Massage Phase  Example: 60:40
What happens with bad pulsators?

- **Milk phase too long**
  - Teat end damage
  - Increased risk for IMI

- **Milk phase too short**
  - Increased machine on time
  - Reduced milk yield

- **Long transitions (A and C phase)**
  - Reduced massage and milk out
Role of vacuum

- Milk removal
- Teat end vacuum ≠ pump vacuum
- Difference depends on restrictions from
  - Milk line sizes
  - Milk tube sizes
  - Milk flow sensors
  - Milk flow volume
- Vacuum level at teat end is what counts
Too low vacuum level

- Longer milk-out time
  - Hyperkeratosis
- Reduced harvest
- Poor parlor efficiency
- Potential for damaged teat
  - Due to machine-on time
Too high vacuum level

- Cause edema & hyperkeratosis
  - Cows with ‘cauliflower’ teat ends are more likely to get an IMI
    - More antibiotics, less milk production, etc…
- Poor milk out
- Increase in BTSCC
- Reduced udder health & milk quality
Testing pulsators

- Check all 4 phases of pulsation cycle
- Make sure D phase is at least 20% during milking
- All pulsators should be within 2% of each other
- If split ratios, make sure front to rear are correct and not reversed
Common pulsator problems

- Air leak in short pulsator tube
  - Short B phase, long D phase, lower max vacuum
- Air port dirty or plugged
  - Long B phase, short D phase
- Poor electrical connection
  - Pulsator ratio is narrower than set
    • 57:37 instead of 60:40
Testing vacuum within system

- Attach Digimet to test ports
  - Vacuum header pipe above trap
  - Within 3 ft of vacuum controller
  - Close to sensor of variable speed drive
  - Within 3 ft of vacuum pump
  - Far end of pulsation line

- Static vacuum level should not vary > 0.2” Hg anywhere
Vacuum pumps

- Constant speed drives
  - Need a conventional regulator to maintain vacuum
  - More responsive, in general

- Variable speed drive (VSD/VFD)
  - Need sensor to control vacuum by controlling speed of pump
  - Sensor senses drop in vacuum, sends signal to controller to increase speed of pump
  - Sensor senses increase in vacuum, sends signal to controller to decrease speed of pump
VSD

- Reduction in energy costs up to 50%
- Noise level in parlor reduced compared to conventional regulators
- To test efficiency of VSD system, conduct same tests
Conventional regulator function

- Force of the spring in the regulator
- Force of the vacuum from milking system

- When the spring force overrides vacuum, regulator is closed and the vacuum will increase.
- When force of vacuum overrides spring, regulator opens and vacuum stabilizes.
- When two forces are equal, then no change.
Regulator or sensor location

- Old thinking – off the distribution tank
- New thinking – near the sanitary trap
  - As close to potential air leak as possible
  - To sense changes on both sides
  - Only reason not to have in the parlor is noise
Do we have enough pump capacity to milk cows?

Pump capacity
- system leaks
- pulsators
- milking units
- regulator usage
- auxiliary components

= Pump capacity left over for milking
a.k.a. True Effective Reserve
Quick and dirty way:

Quick way to test efficiency of system:

- Single unit drop off test ($\leq$ 32 units) or two unit drop off test ($> 32$ units OR two milkers)
  - If drop nears $0.6"$ Hg, then investigate air flow further
  - If drop $> 0.6"$ Hg, then system is inadequate for milking
  - If drop is $< 0.5"$ Hg, then system is ok
Single unit drop off test

- Install test port at vacuum header above trap
- Attach Digimet to port
- Turn vacuum on with all units in off position
- Turn one unit on (1 per 30 units), allow max air in
- Vacuum should not drop > 0.5” Hg
- If the system fails, investigate further
Idle effective reserve

- ER is sometimes difficult to calculate because you need teat plugs for all units
- IER is calculated instead

How to:
- System running
- Place air flow meter on each receiver
- Note whether pulsators are activated
- Turn air flow meter to allow air in until 0.6” Hg drop
- That air flow is the idle effective reserve
Convert IER to effective reserve

- If pulsators activated:
  - IER – ½ CFM per unit = effective reserve
- If pulsators not activated:
  - IER – 1 CFM per unit = effective reserve
- Requirements = 35 CFM + 1.5 CFM per milking unit
Is there enough pump capacity?

Example 1:
- IER in double 10 parlor, pulsators active: 110 CFM
- ER = 110 CFM – 20 units*0.5 CFM/unit = 100 CFM
- Need: 35 + 1.5(20) = 65 CFM

Example 2:
- IER, double 10 parlor, pulsators not active: 75 CFM
- ER = 75 CFM – 20 units*1 CFM/unit = 55 CFM
- Need: 35 + 1.5(20) = 65 CFM
If a system fails on ER:

- Causes:
  - Air leaks
  - Pump size too small
  - Pump possibly in need of maintenance
  - Regulator not working well if conventional system

- To check pump size: 1 HP = 10 CFM
  - If we determine we need 65 CFM to milk cows and it is a 5 HP pump…problem solved.

- If not the pump…then start looking for leaks
  - Regulator, elbows, joints, pulsators, etc…
Regulator efficiency

- In conventional systems (no VSD)
- Calculate ER
- Then calculate Manual Reserve (MR)
- Disengage the regulator and re-test the ER
- This value is now the MR

Regulator efficiency (%) = ER/MR * 100
  - Needs to be > 90%
System evaluation

- Full parlor evaluation done twice/yr
- ALL pulsators
- Teat end vacuum at peak flow
- Drop off test - ability to maintain vacuum
- Air flow capacity

MUST BE DURING MILKING

- Static testing (no milk flow) is not good indicator of problems
Rubber components

- Necessary to replace ALL rubber components
  - Conventional rubber ~ 1200 cow milkings
  - Silicone parts last longer
  - Unless wearing/cracks/holes seen sooner

- Shape of liner affects milk out
  - Personal preference is square
    - Improved massage over round barreled liner
Completeness of milking

- Incomplete milking = unacceptable amount of milk left in udder
- Residual milk = ‘normal’ milk left in alveoli

Causes of incomplete milking:
- Poor type or condition of liner
- Clusters poorly aligned under cow
- High vacuum levels
Monitor completeness of milking

- Average yield of stripping post-milking < 0.25 kg/cow
- If problem exists then > 0.5 kg of milk per cow can be stripped out after milking
  – Guideline: 20% quarters have > 100 ml
- Should be estimated by hand-stripping 20 cows or 80 quarters
Points to remember

- Good and consistent milking procedures critical for teat end and udder health
- Teat scoring is a great way to get an overview of how well procedures and equipment are working
- Teat end vacuum and fluxuation are important components of teat end health
- Pulsator function will affect amount of massage, MOT, total MY, and teat end health
- ATO’s can directly impact teat end health
Points to remember

- Make certain the regulator is clean and functioning well
- Choose the proper location for the regulator or transducer
- Ensure proper pump capacity for milking

...All of this directly affects cow health and farm profitability