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developed by Rob Costello, Dairy Technical/Business Support Manager
Using This Handbook

The Automatic Calf Feeding Handbook provides an overview of the key management components of raising calves using automatic calf feeding systems. It is intended for nutrition and farm management professionals desiring to improve their understanding and familiarity with these automated systems. It is not intended as a troubleshooting guide or as a tool to compare and contrast the different systems currently available. So whether you raise calves individually and are interested in adopting automatic feeders, have a farm support role, or you currently have automatic feeders and just want to learn another viewpoint, this publication may be right for you.

Introduction

The pre-weaned calf requires a tremendous investment of labor. Traditionally calves on milk have been managed by housing individually and feeding two quarts twice daily. This has been done primarily as a matter of convenience for the labor force. As an industry, we recognize that feeding 2 quarts twice daily does not meet the demands for growth and does not achieve desired growth rates. The goal of minimizing labor and increasing efficiencies has caused more producers to turn toward automatic calf feeding systems.

Automatic calf feeders may offer advantages in raising calves on milk including increased growth rates, more consistent product delivery, and a more favorable public perception. Increased growth rates can be attained because the calf can be offered smaller more frequent meals which increases its overall intake of calories. The auto feeders tend to offer a more consistent product at delivery due to the reduction of human error. Public perception seems to be shifting to a more favorable view of group housing systems. It is believed calves can be more social in a group setting vs individual housed systems.

Automatic calf feeders do bring to the table a number of challenges to management. Group housing can be a recipe for disaster when it comes to the spread of disease. To control the transmission of disease among calves in group-housed settings many factors need to be considered: good maternity pen management, (dipped navel, good quality colostrum delivered at the correct time and in the correct quantity), facility design, (drainage, ventilation, bedding), skilled labor (employees who specialize in detecting sick animals and managing feeder software). There is a misconception that auto feeders will save the producer money on labor. It seems that labor costs are shifted to more skilled labor managing calves vs mixing of milk, delivering milk and cleaning.
1. General Information

**Water Evaluation.** A good quality water source is important for calves fed with automatic feeders. Water should be available for the calf at all times. This is especially important with calves fed on a higher plane of nutrition, like a typical feeding program on an automatic calf feeder. It takes more water to properly digest the amount of solids that the calf is being fed on an automatic feeder.

This access to free-choice water is also important to ensure increasing amounts of starter and the subsequent rumen development. There is also an increased need for water during times of stress such as periods of hot or cold weather, low humidity, high fever, and scours. This is why water quality is also important to calf health.

Prior to installation of an automatic feeder a basic water evaluation for livestock, specifically a calf suitability water evaluation, should be conducted. The calf suitability water evaluation will have adjusted tolerance levels for some of the minerals that calves are more sensitive to. It is recommended to recheck water quality annually or during any times of poor performance. The water that is sampled should be sampled at the automatic feeder and at the water source for the free-choice water in the pens. This will be the most accurate sample of the water that each calf is ingesting.

Specific items to look at on the water evaluation form are the E. coli or Coliform counts and the sodium levels of the sample. Elevated E. coli or Coliform counts will directly affect the immune system of each calf, which can become very busy and preoccupied with fighting these bacteria and may not be able to effectively combat other bacteria or viruses. If these counts are elevated, a proper treatment system should be installed. This should be done by a reputable company that installs water treatment systems.

Elevated levels of sodium, also known as salt or sodium toxicity, can be very harmful to individual calves. The sodium levels are usually elevated because of a water softener system that uses sodium chloride. The sodium ion is exchanged for the calcium ion that makes the water hard. This will allow for sodium to be sent to the automatic feeder to be mixed with the milk replacer and to the free-choice water in the pens.

Sodium should be less than 100 ppm. If the levels are above 100 ppm, calves may show signs of sodium toxicity. These signs may include mild scours, abnormal gait, stiffness, muscle twitching, seizures, convulsions, and death. It is recommended to not use water that passes through a sodium chloride water softener.

Water quality is extremely important for pre-weaned calves. Do not hesitate to submit a water sample for evaluation during times that the calves may not be performing as well as they had been.

Remember to clean the automatic waterer or the water tank that holds the free-choice water. These should be cleaned daily to ensure that clean water is offered to calves from a clean container.
Cleaning, Sanitation & Maintenance. While automated feeder technology has been streamlined to make the equipment near self-maintaining, there are still routine measures producers need to take. An automatic feeder that is not maintained may not function properly and could lead to multiple challenges, including exposing the calf to high bacteria counts.

Automatic calf feeders have lots of moving parts, from the powder hopper, hoses, nipples, to calibration cleaning and sanitization mechanisms. Maintain all these pieces on a regular basis. They are equipped with clean-in-place (CIP) systems, similar to that of a milking system, that can be run two or more times per day. Most of these circuit-cleaning systems are a mix of automatic and manual processes that cleans all hoses and valves – essentially everything that comes in contact with milk.

Automatic feeders can be set with automatic calibration, so that powder, water and milk are calibrated once a day. This automatic calibration is only to check the accuracy of the scale. However, it's important that manual calibration be done at least monthly to make sure that the amount of powder and water are accurate.

Tips For Cleaning Your Automatic Calf Feeder

- Use the proper detergent. A concentrated alkaline detergent is your best bet when it comes to internal cleaning of an automatic feeder. The machine should be rinsed with clean water, temperature dependent upon the maximum temperature setting of your feeder. The detergent should be a lower temperature detergent because the water temperature for cleaning is close to 100°F. The detergent should be effective to a temperature as low as 85°F.

- The amount of detergent needed is usually related to your water quality. For external cleaning, a high-quality manual cleaning agent should be used. Solution dilution will be dependent on water hardness and soil level. Sponge cleaning of the heat exchanger should be performed daily if the automatic feeder is not equipped with the fully automatic HE-cleaning.

- Check the powder outlet of the hopper. Look for any signs of caking that would restrict the flow of powder. In most situations, a tool is attached near the mixer to clean the outlet. A finger should never be used to clear this area.

- Regularly check and replace the suction hoses and nipples. Hoses and nipples are perfect environment for bacteria to grow. In addition to the hard-to-clean areas of hoses and nipples where bacteria can thrive, the actual rubber itself can crack, allowing bacteria to build up.

Hoses should be cleaned when they appear dirty and replaced when showing signs of wear and cracking. Nipples, like the hoses, should be replaced between each group of calves or before if there are signs of wear and cracking. Both should be monitored during cold-weather periods to ensure that nothing has frozen. Monitor year-round to evaluate milk flow rate.
• Rotate and clean nipples daily. Nipples should be removed from the feeding station daily and cleaned with sanitizer solution. Even if your feeder has a nipple rinse cycle running, nipples should be cleaned manually to avoid any film or mold from developing. Film or mold can develop in a relatively short period of time, even less than 24 hours, so it is best to clean nipples daily. Additionally, nipples should be rotated a quarter-turn each day to help extend the longevity of the nipple. Mark the nipple with permanent marker to know that the nipple is rotated a quarter-turn. It is best to have two nipples per feeding station. One nipple can be sanitized and allowed to dry for a 24-hour period, while the other nipple is in use at the feeding station.

• Monitor the mixer cleaning cycle and manually clean when necessary. Automatic feeders can be adjusted to clean up to four times per day. The setting for how many times a day will depend on water quality used for cleaning. While the automatic cleaning cycle is usually very effective, it is best to operate by this rule: “If it looks dirty, it probably is dirty.” Manually clean the machine when necessary in addition to running the closed-circuit cleaning daily. If parts of the machine need regular manual cleaning, it might be time to consult your equipment dealer to see if there is a bigger problem with the automatic cleaning cycle.

Make time to regularly check over and evaluate your machine to make sure it is performing at an optimal level. The last thing you want is for your calves to be suffering from the effects of a poorly performing machine. If you are having regular issues with a machine not cleaning or calibrating properly, be sure to contact your equipment dealer.
Cleaning & Sanitizing Protocols. Disinfection is crucial in preventing the spread of disease because feeding equipment comes in direct contact with the calf’s mouth. Careful attention to cleaning protocols will decrease the pathogenic load on bottles, nipples, buckets, and other feeding equipment resulting in healthier calves.

**Cleaning Protocol**

- Rinse all equipment/utensils with warm water (110° F) removing organic material before washing.
- Soak the equipment/utensils in hot water (140° F) with a 1% chlorinated alkaline detergent (CIP) (pH of 10-11) for approximately 20-30 minutes.
- Wash vigorously with a brush for 1-2 minutes. Bottles and buckets can be washed in an industrial dishwasher. Nipples should be manually scrubbed and washed.
- Rinse with a 50 ppm chlorine dioxide solution in warm water (110° F) for about 5 minutes. Then rinse the equipment with acid (pH of 3-4) to control milk stone once or twice weekly. After rinsing the nipples, keep them in a covered container filled with a 50 ppm solution of chlorine dioxide until they are used. *Note: prolonged submersion in water can decrease nipple life.*
- Allow the equipment to drain and dry before using again. Avoid stacking upside down on a concrete floor or on any solid surface, as this can inhibit proper drying and drainage.
- Spray the inside and outside of the equipment with a 50 ppm solution of chlorine dioxide less than 2 hours before use. Allow a minimum of 60 seconds of contact with the equipment before using.

**Environmental Cleaning**

- Clean first (cannot disinfect filth)  
  Brush, sweep, scrape to remove all organic material
- Soak with hot water (140° F) and a chlorinated alkaline detergent to break down some of the biofilm
- Wash using hand scrubbing, low pressure garden hose or a hand held foamer  
  Never use a high-pressure washer when animals are present
  Rinse
  Dry
  Disinfect with chlorine dioxide
  Repopulate with calves
Calf Environment Applications of Chlorine Dioxide

• Misting (livestock present) using 100 ppm chlorine dioxide
  At least 30 seconds contact time
  Use in maternity pens, calf pens, bedding packs, feeding stations, calf’s feet, legs, brisket and belly

• Environmental disinfecting (no livestock present) using 250 ppm chlorine dioxide
  5-10 minutes contact time
  Rinse
  Use in maternity pens, calf pens, calf barns, calf transporters, automated feeders, livestock trailers

*Note: Since chlorine dioxide concentrations vary quite a bit between different manufacturers, it is necessary that the working concentration of chlorine dioxide be verified each time prior to use. When using chlorine dioxide at concentrations > 200 ppm, operators should wear protective eye wear and a R95 approved particulate respirator mask that is carbon lined (gray color).*

**Chlorine Dioxide vs Household Bleach.** The best sanitizing rinse agent for farm use is chlorine dioxide. Chlorine dioxide activity is not affected by pH like household bleach is. The pH of household bleach (sodium hypochlorite) is 13-14. When bleach is added to water it forms both hypochlorous acid and the hypochlorite ion. Hypochlorous acid is a very good disinfectant having approximately 80 times more killing power than the hypochlorite ion. The relative amounts of each are affected by the pH of the solution.

The following graph shows that at a pH of 8.5 about 10% of the bleach exists as hypochlorous acid. At a pH of 6.5 roughly 90% of the bleach exists as hypochlorous acid. A ten percent household bleach solution has a pH of 10-11 depending on the pH of the water. When the pH is greater than or equal to 10, there is virtually no hypochlorous acid present in the solution, and consequently very little biocidal activity.

![Household Bleach Effect of pH Chlorine Species & Biocidal Activity](adapted from Bowman and Mealy (2007))

Caution: the pH of the solution should never be less than 5.5. When the pH of the solution drops below 5.0, toxic chlorine gas is created. Producers should routinely check the pH of the solution prior to use.
Cryptosporidium Control. The following table shows the concentration and contact time needed for different types or classes of disinfectants to kill > 99% of Cryptosporidium parvum oocysts at room temperature. We want to ensure the sanitizing solution is strong enough to kill Cryptosporidium parvum oocysts since they have a high resistance to chemical germicides. Chlorine dioxide has the greatest biocidal activity compared to other disinfectants, is not affected by changes in pH as are other disinfectants and is recommended for use on farm as a sanitizing rinse agent.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Concentration (ppm)</th>
<th>Contact Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine Dioxide</td>
<td>100</td>
<td>1 minute</td>
</tr>
<tr>
<td>Hydrogen Peroxide (6%)</td>
<td>60,000</td>
<td>4 minutes</td>
</tr>
<tr>
<td>Peracetic Acid</td>
<td>3,500</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Ammonia (5%)</td>
<td>50,000</td>
<td>18 hours</td>
</tr>
<tr>
<td>Formalin (10%)</td>
<td>100,00</td>
<td>18 hours</td>
</tr>
<tr>
<td>Benzalkonium Chloride (1%)</td>
<td>10,000</td>
<td>Not Effective</td>
</tr>
<tr>
<td>Chlorhexidine (2%)</td>
<td>20,000</td>
<td>Not Effective</td>
</tr>
<tr>
<td>Cresylic Acid (5%)</td>
<td>50,000</td>
<td>Not Effective</td>
</tr>
<tr>
<td>Isopropanol (70%)</td>
<td>700,000</td>
<td>Not Effective</td>
</tr>
<tr>
<td>Sodium Hydroxide</td>
<td>200</td>
<td>Not Effective</td>
</tr>
<tr>
<td>Sodium Hypochlorite (6%) Bleach</td>
<td>60,000</td>
<td>Not Effective</td>
</tr>
</tbody>
</table>

Adapted from Crockett (2012)

Implementing these sanitation protocols will reduce the load of pathogens calves are exposed to every day. An effective sanitation protocol gives the immune system the advantage it needs to keep calves healthy, saving you time and money by reducing treatments. It is important to note that while these products and procedures are very efficacious, they only work if protocols are carried out correctly, consistently and measured for effectiveness.

Calf Transition To the Automatic Feeder. Successful transition of calves into group housing with automatic feeders requires vigorous calves with a strong suckling reflex. To limit spread of disease, new calves should be housed and fed individually for 1 to 2 weeks before they transition to group housing. The timing of the transition will depend on a given farm’s colostrum management program, the health of each calf and the age range of the group into which new calves are being introduced. Calves should be drinking milk well and appear healthy before moving them into group housing.

After calves are moved into a group, a combination of direct observation of calves and the data on number of visits to the feeder is important to detect sick calves early and remove them to individual housing for treatment or treated individually in the group housing.
Training Management

- Do not move hungry calves
- Give calves time to get used to their new environment
- Separate moving and the first training; move calves in the evening and train the next morning
- On the first day of training on the automatic feeder, assisting the calf to the feeder should be done in the morning, and the second time assisting the calf to the feeder should be done in the afternoon or evening
- On the second day of training, assist the calf only in the morning, if there has been no feed intake
- Train calves carefully on the feeder. Use the training pump with care, and do not hurry
- Do not over train the calves; allow them to feed themselves

Feeding Programs. After transitioning to the auto-feeder, a proper feeding plan will promote optimum health and performance. There are any number of feeding plans to choose from. The best feeding plan for your operation is based on the goals for the health and performance of the calves and the stressors that the calves may encounter.

There are two main feeding plans: unrestricted and restricted. One of the most popular unrestricted feeding plans is the 40FIT plan from Förster Technik. This plan is a controlled ad lib feeding system. The calf can drink as much as it wants over a 24-hour period; however, the amount per visit is limited. For example, a calf can consume up to 2.5 L every 2 hours. If the calf drinks the maximum every 2 hours, it may consume 30 L per day. On a restricted plan, there is a maximum the calf can consume over a 24-hour period. The success of each program depends on the calf’s environment and management of the calf rearing program.

Weaning. The proper weaning process has a huge impact on the success of an automatic feeding program. There are several different methods of weaning calves with an automatic feeder. The most popular method of weaning is to slowly reduce (over a 2-week period) the amount allowed at each meal and for each 24-hour period.

Another approach is to lower the concentration of the milk replacer. This reduces the total amount of solids available to the calf each meal. Another possible weaning method is to reduce the allocated amount of milk replacer quickly over a few days. This will “force” the calves to consume more starter rather quickly. The preferred weaning method is to begin by lowering the amount of milk replacer allowed during a 24-hour period by 2-3 L over a 2-day period. Then gradually lower the amount of milk replacer allowed over each 24-hour period over the next 10 to 14 days.

<table>
<thead>
<tr>
<th>Feed</th>
<th>Quantity per Visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days</td>
<td>Min.</td>
</tr>
<tr>
<td>Period</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>56</td>
</tr>
</tbody>
</table>
2. Calf Growth Requirements

**Nutrients.** Once the calf has received 4L of high quality colostrum within 4 hours of birth, it is on its way to a healthy start. Now it’s time to think about the nutrient requirement of the calf. The goal of many calf rearing programs is to have maximum retention of nutrients and high growth rates at the lowest cost possible.

Meeting this goal can become difficult because during the first 2-3 weeks of life the calf’s digestive tract is rapidly developing in regard to digestive enzyme secretions as well as undergoing physiological and metabolic changes. Additionally, the amount of nutrients provided by liquid and solid feed are in constant flux, the physical capacity of the digestive system is increasing as well as the fermentative capacity, all leading to changes in digestibility of solid feeds.

There are three phases of development related to digestive function in the young calf:

1. **Liquid feeding phase:** nutrient requirements are essentially met by colostrum and milk replacer
2. **Transition phase:** liquid diet and starter feed both contribute to meeting the calf’s nutrient requirements
3. **Ruminant phase:** the calf derives all its nutrients from solid feeds

This section focuses primarily on nutrient requirements during the first two phases of digestive tract development.

**Energy** in the diet is first used for basal metabolism, thermogenesis, immune function, and lastly growth. The first two functions are grouped into what is called the maintenance requirement. If there is insufficient dietary energy to meet the maintenance requirement, growth will be stunted. The net energy for maintenance (NE\textsubscript{M}) in calves and heifers increases with age, body weight and the desired amount of gain. Feeding above the amount of energy and protein needed for maintenance allows for growth.

Young calves lack certain digestive enzymes and are therefore unable to completely digest starch, some sugars (e.g., sucrose or table sugar), and some types of fat. While calves can digest saturated fats, including milk fat, coconut fat, lard, and tallow, they have limited ability to digest unsaturated fats such as corn and soybean oils. The major sources of energy for the newborn should be derived primarily from lactose (milk sugar) and highly digestible fat. It is very important to provide adequate energy, since the calf’s metabolic rate, or rate at which energy is used, is greatest during the first two weeks of life. Cold weather and other environmental stresses increase the calf’s energy requirements.

The rate of rumen development and microbial growth determines how soon the calf can digest complex starchy carbohydrates, since microbes convert these energy sources into microbial protein. Within two weeks of age, the calf can digest starch. Shortly thereafter, it can digest complex carbohydrates. This allows the calf to increase intakes of the Starter.

**Proteins** in milk replacer are broken down by digestive enzymes into peptides and amino acids. The amino acids are then absorbed by the small intestine and used as the building blocks for synthesis of proteins within the calf. A newborn calf has few digestive enzymes, and it cannot utilize most vegetable proteins as well as it utilizes milk proteins.

Milk protein is digested and broken down at a greater efficiency; therefore, a milk replacer derived from milk proteins is often broken down at a greater efficiency than milk replacer that contains non-milk proteins. Once the calf begins to eat starter and the rumen begins to develop, some of the protein requirement is met by microbial protein.

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**Factors Affecting Protein Requirements**

- **Rate of gain:** the genetics of the animal, facilities and management can either encourage or hinder rate of gain
- **Imbalance Protein:** Energy Ratios: excess protein and limited energy will lead to decreased rate of gain because of an insufficient amount of energy
- **Size of animal:** more protein is required to support lean growth in larger animals

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**Vitamins.** Calves require many of the same vitamins as monogastrics, including vitamin K and the water-soluble B vitamins: thiamine, riboflavin, niacin, choline, biotin, pyridoxine, folic acid, B12, and pantothenic acid. Vitamin K and water-soluble B vitamins are found in colostrum, whole milk and good quality milk replacers. Rumen microorganisms can produce these vitamins once the calf’s rumen begins to function. The young calf also requires the fat-soluble vitamins A, D and E, which are in short supply at birth, but are present in colostrum. Whole milk or milk replacers and grain mixtures normally supply all these vitamins. Vitamin C is synthesized in the calf’s tissue and is provided in milk and milk by-products at such a level that supplementation of vitamin C is generally not required.

**Minerals.** Dairy calves require the same minerals for growth as other animals. Milk and milk replacer generally supply adequate amounts of many minerals needed during the first few weeks of life. The mineral content of colostrum and milk may be low or deficient, especially in mineral-deficient dams. Calf starters usually contain adequate levels of the major and trace minerals required by the young calf.

**Ideal Milk Replacer To Reach These Goals.** Milk replacer considerations can influence how they interact with automatic calf feeders. These interactions not only affect how the milk replacer behaves in the feeder but may also affect calf performance. The mixability of a milk replacer is not as important with automatic feeders because they are equipped with mechanical mixers that rapidly and completely mix milk replacer powders. The ingredients used in the formulation is likely more important than the manufacturing process.

The key is to find a milk replacer that:
- Is consistent from bag-to-bag and batch-to-batch
- Feeds through the machine without bridging in the hopper or causing build-up residue in the mixing bowl or lines leading to the feeding stations
- Has a mixing temperature appropriate for the automatic feeder. In most automatic feeders, milk replacer mixing temperature is the same as feeding temperature, or around 105-110°F. Therefore, milk replacers that recommend hot mixing temperatures (~150°F) should NOT be used. Instead, use milk replacers that are directed to be mixed at ~110°F.
The growth performance of each milk replacer is determined by the allowable gain (protein or energy) that is lowest. This is also known as the limiting factor for growth. For example, the 28:20 formula, fed at 2.5 pounds per day, provides the highest growth rate of milk replacers listed in the table. The maximum potential gain is 2.49 pounds per day, not 2.58. The protein balance (-10g) indicates the calf is receiving more energy than protein and another 10 grams of protein is needed to match the energy provided by the milk replacer. The objective here is not to achieve a protein balance of 0. Providing a bit more energy than protein is often desirable, especially in cold weather.

The amount of fat in the milk replacer may limit growth performance. This is because total fat consumed is typically greater due to the higher feed rates that are possible with automatic feeders. Growth rates may be lower due to the satiety effects that higher energy levels have on the brain. Even so, growth rate goals may be reached. With higher fat consumption, achieving weight gain goals may be due to fat deposition and not lean muscle and bone growth. For efficient growth, the recommendation for milk replacers used in automatic feeders would be a protein level of 26-30% and a fat level of 15-20%.

**Feeding Calf Starter.** The pre-weaned calf requires both liquid and dry feeds and should be offered a dry grain mix by three days of age. The purpose of feeding calf starter is to transition the calf from milk-feeding to the dry feeding period. During the first week of life, calves eat very little grain. By the second week, however, they should be eating noticeable amounts.

Adequate, early intake of dry feed is important because dry grain stimulates rumen development. Dry feed increases the number and variety of rumen bacteria and protozoa. These microorganisms grow rapidly on grain carbohydrates and produce the volatile fatty acids butyrate and propionate. These acids provide nutrients for the calf and stimulate rumen development.

The physical form of the calf starter is especially crucial for rumen development and to encourage rumination in calves. Research generally supports feeding texturized or pelleted versions of calf starters. Regardless of which you choose, it is important to offer your calves a starter with minimal fines. An increase in fines can lead to a decrease in intake.

<table>
<thead>
<tr>
<th>Milk Replacer (CP%: Fat%)</th>
<th>Feed Rate (lb/day)</th>
<th>Energy Allowable Gain (Mcal/lb)</th>
<th>Protein Allowable Gain (Mcal/lb)</th>
<th>Protein Balance (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25:15</td>
<td>1.50</td>
<td>1.14</td>
<td>1.22</td>
<td>9.0</td>
</tr>
<tr>
<td>28:20</td>
<td>2.5</td>
<td>2.58</td>
<td>2.49</td>
<td>-10.0</td>
</tr>
<tr>
<td>28:20</td>
<td>1.5</td>
<td>1.26</td>
<td>1.24</td>
<td>15.0</td>
</tr>
<tr>
<td>25:20</td>
<td>1.5</td>
<td>1.24</td>
<td>1.22</td>
<td>-3.0</td>
</tr>
<tr>
<td>20:20</td>
<td>1.5</td>
<td>1.21</td>
<td>0.92</td>
<td>-33.0</td>
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**Key Attributes That Calf Starters Should Possess**

- Coarse particles and few fine particles.
- Maximize the grain content (> 50% grain).
- Avoid high fiber feeds, such as wheat midds, soy hulls, cottonseed hulls, and hay, because they are poorly digested.
- Keep the molasses content of the starter low (< 9%).
- Starters should contain at least 18% crude protein (20-22% is better).
- Keep the concentration of fat low (< 4%).
- Starters should be based on soybean meal and corn.
- Consider including a coccidiostat.
- Certain fatty acids, such as linolenic acid, that are naturally low in feedstuffs may be worth considering adding and are cost-effective.

**Winter Feeding.** The nutritional needs of young calves continue to increase as the temperature decreases. Calves require energy to maintain their bodies, to promote healthy growth and development, to stay warm, and to recover from illness. If a calf does not receive the necessary energy to do all these things, there will be a decrease in performance and weight loss.

The thermal neutral zone for newborn calves is 50-78°F, while one-month old calves’ thermal neutral zone is 32-78°F. Once the temperature drops below the lower critical temperature of 32°F for one-month old calves or 50°F for newborn calves, the energy they consume is now used for maintenance, making less available for growth and immune function. Calves need 1.0-1.3% more energy for each degree the environmental temperature drops below the lower critical temperature.

Failure to minimize the effects of cold stress can result in depressed immune function, increased risk of sickness, poor response to treatment, decreased growth performance and possible death. The following are some feeding strategies to minimize the effects of cold stress:

- Feed more fat. Adding 0.25 lbs of a 60% supplemental fat can either maintain or increase growth rate during times of cold stress.
- Feed more milk replacer.
  - Add a feeding. Feeding an additional meal will increase the total amount of solids consumed within a 24-hour period.
  - Increase volume. Increasing the feeding volume by 1/3 is the same as adding an additional feeding. Do not change the % solids level of each feeding; add more milk replacer and water to keep the % solids the same.

The feeding programs with automatic feeders can be changed during times of cold stress. This can allow the calf to have additional feedings or a higher amount per meal. These feeders can also have a 60% fat product added via the add pack attachment.

No matter what type of feeding program is used, keep these general principles in mind to keep calves healthy and performing well. The goal, during times of cold stress, is to either maintain or increase performance and growth rates.
3. Housing Guidelines

A large factor in being successful raising calves in an auto feeder system is housing. The essential factors in housing are stocking density, ventilation, bedding and drainage. Calves perform best when managed in an “all-in, all-out” style of management. However, this is not always practical on all farms. Calves thrive in a clean, dry, draft free environment.

**Number of Calves/Pen Size.** The University of Minnesota conducted a study on resting space per calf and health incidences. The number of health incidences declined as the square footage per calf increased. The minimum recommendation is 35 sq. ft. per calf, 40-45 sq. ft. is recommended for large framed breeds. The maximum number of calves per nipple is 25-30 calves. The number of calves per nipple is based on system capacity. The actual number of calves per pen may be less. Researchers found that the average pen size with automatic feeders in Minnesota, Wisconsin and Iowa in 2017 was about 17 calves per pen. The fewer calves per nipple the less likely to see health issues. However, reducing the number of calves per nipple increases the cost per calf to raise.

**Ventilation** effects air quality and bed pack moisture. It is recommended to achieve 4 air exchanges per hour during cold weather. To achieve this, it is common to use positive pressure ventilation systems. When designing ventilation for a facility consulting with a graduate of University of Wisconsin’s Air Quality School is beneficial.
**Bedding** a group housed barn is different from managing bedding in an individual housed systems. If ventilation is not adequate or if drafts are present calves tend to group up or “huddle”. When this occurs, the problem should be corrected as keeping those areas dry becomes a challenge. In the warmer seasons, a bedding score of 1 is adequate.

Producers may choose to use a variety of bedding material such as, sand, sawdust, wood chips and straw. The bedding material should be absorbent and not too dusty. When temperatures are below 50°F a bedding score of 3 is more appropriate. This provides an opportunity for the calf to nest and maintain body temperature. To achieve a bedding score of 3, straw is the best choice since it is the most absorbent and provides the greatest thermal value. Sand, on the other hand, provides a bedding score of 1.

![Wood Chips](image1)

In all seasons, bedding should be maintained so the environment is dry. A simple knee test will tell you if the bedding is adequate. If a person drops to their knees for 30 seconds and then stands and has dry knees it is adequate. However, if after 30 seconds the person’s knees are damp or wet bedding is not adequate.

Maintaining the environment of the calf will help to gain the desired results.

![Straw](image2)
4. General Health Concerns

Every heifer calf born on a dairy farm represents an opportunity to maintain or increase herd size, to improve the herd genetically, or to improve economic returns to the farm. The objectives of raising the newborn calf to weaning age are optimizing growth and minimizing health problems.

One very important fundamental of raising healthy calves is “cleanliness.” Calf raisers must be proactive when it comes to cleanliness. Remember, “dirty calves become sick calves.” And, sick calves should not be an acceptable standard on the dairy farm. Keeping calves clean is a lot of work. It takes time. It takes someone being responsible on the farm to get it done. There needs to be a consistent, efficient, cost-effective approach to managing for calf cleanliness, every day.

**Scours.** Even though the causative agents differ, the resulting scours or enteritis is remarkably consistent in terms of the presenting clinical signs. Calves with scours consistently have some degree of dehydration. The dehydration can be life threatening, particularly in young calves. For this reason, treatment of calves with scours is primarily supportive. The most important aspects are early recognition and aggressive fluid therapy.

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**Conditions That Cause Calf Scours**

- The disease that causes the greatest mortality in young calves is scours. This can be caused by bacteria, viruses, protozoa, stress, improper nutrition or any combination of these problems. E. coli is the most common cause of calf scours, especially within the first 48 hours of life. E. coli is a common inhabitant of the GI tract. The bacteria enter the body when calves ingest manure from infected animals.

- Coccidiosis is caused by single-celled parasites that invade the intestinal tract of animals. This disease has been observed in calves three weeks of age and older. It usually follows stress, poor sanitation, overcrowding or sudden changes of feed. Coccidiosis can be controlled by feeding a coccidiostat in the milk replacer and the calf starter.

- Salmonella is a common inhabitant of the GI tract of cattle and is present in manure. Calves usually become infected shortly after birth, when manure from infected or carrier animals is ingested. Salmonella affects calves that are greater than two weeks of age; however, it can be seen in calves as young as two days old.

- Cryptosporidium is caused by a single-celled parasite similar to the parasite that causes coccidiosis. With cryptosporidium, the parasite can lay dormant in manure and soil for up to one year. Calves typically pick up the cryptosporidium organism by ingesting manure from infected animals.

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**Respiratory Disease.** The other main disease that calves can have, especially in group-housed calves, is pneumonia. Pre-weaned calves that develop pneumonia frequently share the same risk factors as those that develop scours – failure or incomplete transfer of immunity from colostrum, prolonged exposure to adult cattle, and/or the ventilation limitations of warm housing.

As with scours, frequently more than one agent is identified in an outbreak. Antibiotic therapy is necessary but frequently yields disappointing results. Because of the significant impact that dairy calf pneumonia has on growth and future productivity, early identification and treatment is important, but resolution of significant risk factors is imperative.
Early vaccination is only effective in lessening the severity of the disease and not a means of prevention. Infectious agents involved in causing pneumonia include Mannheimia haemolytica, Haemophilus somnus, Infectious Bovine Rhinotracheitis (IBR), Bovine Respiratory Syncytial Virus (BRSV) and Parainfluenza Virus type III (PI3), along with many other bacteria and mycoplasma species and viruses.

It can be difficult to control pneumonia when calves are group-housed. Improved husbandry, ventilation and good nursing care can all reduce risks of pneumonia, as well as understanding that these diseases can be spread through unsanitary conditions underlines the importance of keeping calves clean to reduce their exposure to disease causing organisms.

### Sanitation Management Practices

- **Maternity pens** – Keep them clean, sanitized and freshly bedded. Remove all manure, soiled bedding, or other debris from previous calvings. Each cow entering the maternity pen contributes bacteria and other infectious agents.
- **Clean teats on cows before collecting colostrum.** Do not allow the calf to nurse or even attempt to nurse. Remove the calf from the mother and maternity pen immediately after it is born.
- **Keep newborn calves clean, dry and warm.**
- **Calf pens should be kept clean and well bedded at all times to reduce exposure to infected manure.**
- **Clean feed and water is important.** Prevent manure contamination of the feed and feed area. Colostrum, milk replacer, dry feed, and water sources should always be clean.
- **Clean, wash, disinfect and dry out pens between calves.**
- **Wear clean clothes and boots when working with calves.**
- **Replace bedding in pens between groups of calves.**
- **Constantly check the bedding for dryness.** Increased moisture in the bedding can increase the risk of pneumonia.

It is important to work with the herd’s veterinarian to develop specific treatment and prevention protocols based on the organisms common in the herd. But, prevention of disease is the key. Maintaining a clean and healthy calf environment will help assure they come into the milking herd as soon as possible and become healthy, high producing cows for the future profitability of the herd.