NDDB

BULK MILK COOLING UNITS
COMMISSIONING, OPERATION AND MAINTENANCE

BMC Commissioning

Before the BMC is put in actual operation the complete installation has to be checked and functions of each component have to be understood properly. The operating staffs have to get acquainted with these functionalities for trouble free and efficient operation of the system.

1. Ensure that the floor where BMC is being installed is strong enough to sustain load of BMC filled with milk.
2. The BMC should be oriented in such a way that the condenser side of refrigeration unit should face clear opening of window.
3. In case of BMC having separate skid for refrigeration unit, ensure that it is properly located facing the window. The refrigerant piping and electrical/control cables are properly laid and protected by cross over bridge.
4. There should be at least 600 mm gap between the tank and wall to allow access for cleaning.
5. There should be a 2 meter free operating area around the operating panel of the tank.
6. The total system at site is pressure tested by contractor for integrity of joints and leakages in the connections.
7. The adjustable legs of tank should be adjusted to position the tank level horizontally.
8. The drainage grate on the floor should be easily accessible.
9. The minimum clearance from the floor to the underside of the outlet pipe should be 100 mm.
10. Check all the gauges and controls for its proper functioning.
11. The entire system is evacuated below 10 mm Hg before charging of refrigerant.

12. Check that adequate refrigerant is charged in the system. Check that there are no leaks of refrigerant.
13. Check whether electrical connections are properly made and proper earthing is done for the BMC, Panels & DG set as per the local code for electrical installations. Check direction of rotation of agitator.
14. Take trial runs of BMC on water for checking operation of all the equipment, gauges & controls for proper operations, cooling time, thermostat temperature cut off & in, insulation i.e. temperature rise as per specifications. When refrigeration unit is operating, note that there should not be any sweating on outer surface of BMC tank. The checks should also be carried for dip stick calibration with measured volume of water, digital temperature indicator, meters, agitator operation and DG set, voltage stabiliser, milk pump operations.
15. Note any discrepancy observed during trial runs in any of the equipment and get the same rectified by the Supplier.

Checking D G Set - Alternator installation:

a. Before putting the set into service, an insulation check between phase and earth and between phases is carried out. The insulation resistance when machine is cold should normally be > 10 mega ohms.

b. No machine should be operated if insulation resistance is less than 1 mega ohm for stator and other windings.
c. Check direction of rotation as given in Operator Manual.
d. Check all foot and flange bolts are tightened.
e. Cooling air should freely be circulating around 86 through the machine. Exhaust system supplied is not to be disturbed/ tampered with.
f. All louvers, guards etc are correctly fitted.
g. Ensure before start up that terminal nuts are properly tightened.
h. The control panel protection equipment is correctly set.

i. There should be no short circuit due to wrong connections either/ or in between the terminals of the alternator and power switch or breaker.

j. When the alternator is operating at nominal voltage at no load the auxiliary windings has to supply a line to line voltage within 72 and 75 Volts.

k. Before cranking check the hanging foundation of engine, free movement of flywheel, any foreign material inside

the housing, oil level, battery charge, any fuel/ oil leakage, loose belting/ coupling/ fastening or mountings etc.

Diesel Engine

a. Check lubricating oil level in sump and ensure that dipstick shows it between V to 'H' mark.
b. Check fuel level. Drain sediments from fuel tank. Never allow level to go below minimum recommended level.
c. Check that inlet & outlet of cooling AIR is not obstructed. In case of water cooled engine, check water/coolant level in reservoir. Top up level if required, with coolant.
d. Check fan belt tension and adjust, if necessary
e. Clean engine and surroundings.
After running:
- Check lubricating oil pressure at operating temperature.
- Check for leakages of fuel, oil, water, air, exhaust, if any.

Important: *After the operation is over, do not shutdown engine immediately after unloading. Run the engine on no load for about 10 minutes and then stop it. Clean down the engine at the end of each shift when it is still warm. Top oil to 'H' mark if it has gone to V.*

Bulk Milk Cooler:

a) Open the tank cover/ man hole for 10 minutes before starting milk reception.

b) Ensure that the tank inside is clean from extraneous matter and residues from previous milking/cleaning.

c) Start the cooling unit with **Setting 1,** when the milk level in tank touches the agitator blade.

d) Check and ensure that the direction of air flow from the condenser is proper and the compressor is working normal. In case the compressor is working normal, the air being blown out from condenser would be relatively warm.

e) Check the voltage and current consumption from meters on the control panel.

f) The cooling unit shall shut down when the pre-set temperature (4°C) is achieved. The Mains in this case should not be switched-off. The control setting should be left in Setting **1** for automatic functions to operate as designed.

g) After the milk reception is over, the outside surface of the tank should be wiped off thoroughly with wet cloth to remove any milk residues which may have accumulated during the milk reception.

h) Do not spray or pour water on the tank surface during operation as it may enter into the tank.

i) Clean the floor and the room to maintain good hygienic conditions and to avoid foul smell in the room.

j) During second milking, when already milk is available in the tank from the previous collection, repeat the above operational procedures with an exception in the mode of operation, i.e., start the cooling unit in **Setting 2.**

k) When the milk gets cooled to the desired temperature, then switch the unit back to **Setting 1** and let it stay until the road milk tanker from dairy plant arrives for milk collection.

1) The unit should be switched-on in **Setting 3** to enable the 2 minutes agitation. This shall allow uniform distribution of fat and temperature and the milk sampler to take an authentic representative sample for the dairy plant.

m) After the tank is emptied, the unit should be switched to Position-0 and wait for the pump down operation to complete before switching-off the mains or DG set.

n) In case the system is operated on DG set, then to save on the power cost, the Mains may be switched-off and the DG set shut down.

o) After the DG set is shut down, ensure to change over to the Mains and put the switch back to **Setting 1.**

Typical Operational Sequence of Electronic Control System

An electronic control unit is normally installed with the cooling tank. When the tank and cooling unit are installed separately, the control unit will be provided separately.

The functions of the control unit are to maintain the required milk temperature by starting and stopping the cooling unit, and to ensure adequate agitation of the milk stored in the tank. The control unit has five settings for different combination of operations as briefed below:

Setting-0:

- Unit non-operational.
- Pump down system operational, if required.

Setting 1: Automatic function

- The compressor starts with a 10 minute delay operates for 2 minutes to cool its walls to prepare itself before milk pouring and is controlled by the thermostat. The rest time may be programmed to 20 minutes. The pump down when required is automatic.
- The agitator remains off as there is no milk in the tank at this point.

Setting-2: Automatic function

- The compressor starts with no delay and operates automatically till the set cooling temperature is achieved.
- Pump down if required on any cut-off is done automatically provided the power supply is not switched off.
- The agitator starts at the same time as the compressor unless the milk temperature is above 23°C, since the agitator only operates at temperatures below 20°C.
- The agitator operates continuously even after the compressor has been disconnected.
- At temperatures below 20°C the agitator operates until the set cooling temperature has been reached on the thermostat.
- Once the milk has been cooled to the required temperature the agitator operates during the pre-programmed time on the ON button, and only stops during the programmed OFF time.

Setting-3: Collection By Tanker

- Compressor non-operational.
- Pump down operational as required.
- Agitator operational for 2 minutes to facilitate sampling.

Setting-4: External contact function

- Compressor non-operational.
- Pump down operational as required.
- The contact function can be used for a separate washing unit, if required.
- Depending upon pre programmed setting of the micro-controller the agitator may or may not be operational. Normally 2 minutes run and 12 to 18 minutes rest time is set.

Setting-5: Manual cooling

- Compressor and agitator operations become independent of thermostat and other settings of micro controller and gravity switch for agitator vis-à-vis door/ lid opening.

- Refrigerant pump down has to be done by moving to setting 1 before switching off the power supply in this setting 5. Operation at this position should be avoided unless the engineer is present.

The temperature is displayed in all settings, except Setting-O. The BMC should only be started and stopped by means of the selector on the control panel.

Alarm-box

- Battery 'back-up', which reinstates and shows temperature on the display if the voltage drops or the power supply falls out.
- If the power failure or voltage drop takes place and the milk is not getting chilled, an audio-visual alarm will ask the operator to start the DG set manually and reset the alarm.
- When the milk gets chilled to the pre-set temperature (4°C), a new audio-visual alarm will ask the operator to stop the DG set and reset the alarm. This alarm is to alert operator for DG set operations.

Emptying the Cooling Tank:

- The unit should be switched-on to **Setting 3** to enable the 2 minutes agitation. This shall allow uniform distribution of fat and temperature. It facilitates the milk sampler to take an authentic representative sample for the dairy plant.
- After the tank is emptied, the unit should be switched to **Setting 1** and wait for the pump down operation to complete before switching-off the mains or DG set.

Trouble Shooting & Remedies

I. Bulk Milk Cooler:

S.No	Problem	Cause	Remedial Measure
1	Not getting desired milk temperature	a. Less operating time b. Frequent opening of BMC door c. Inadequate refrigerant	a. Allow to operate BMC for 2 .5 hrs b. Avoid frequent opening of BMC door c. Call service engineer d. Avoid mixing of high

		d. High temperature milk are mixed e. Faulty temperature control f. Immediate reading on start	temperature milk e. Correct the temperature gauge f. Take reading after 2.5 hrs
2	Fat separation	High agitator speed Continuous operation of agitator	Don't alter setting of machine
3	Foam formation	**a.** Top feeding of milk **b.** Use of high HP milk pump **c.** Agitator speed is high Continuously operating agitator	**a.** Always feed milk from bottom **b.** Use recommended HP milk pump only **c.** Don't use high speed agitator **d.** Don't operate agitator continuously
4	Foul smell from BMC	**a.** Foul smell entrapped by air Improper cleaning of tank	**a.** Open tank lid for 10 minutes before starting milk reception Ensure proper cleaning of tank
5	Compressor and ventilator not operating	a. Activate reset button on control box RO 56 - 02 c. Pressure sensitive detector KP 15 solenoid valve defective	Call the service engineer

	System cut out after reset	Fuses of refrigeration tank not functioning	Check the fuses and replace if not working
6	Agitator motor not operating	**a.** Fibre gearwheel defective Control defective	Call the service engineer
7	Agitator motor not operating according to the preset ON-OFF times	Control defective	Call the service engineer
8	System doesn't stop at desired temperature	**a.** Refrigeration circuit defective **b.** Control defective Selector set to Setting - 4	Call the service engineer
9	Display shows EEE	Sensor switch off	Call the service engineer
10	Display show ---'	Sensor short - circuited	Call the service engineer

II. Diesel Engine:

S.No	Problem	Cause	Remedial Measure
1	Air in fuel system	Sucking of air through joints	Check fuel suction joints , & prime the system
2	Fuel leakage	Loose pipe connection or crack in pipe	Check pipe connection between pump and injector
3	Obstruction in fuel system	Choking/clogging of filter	Inspect filter and clean it. Flush all fuel pipes and replace if found chocked
4	Black exhaust	a. Engine is over loaded	a. Reduce load b. Fit new spring

		b. Broken or defective valve spring c. Incorrect valve trap clearance d. Valve sticking or leaking e. Piston rings are sticking f. Piston rings worn or broken Excessive piston ring top clearance	c. Adjust to correct clearance d. Clean 86 grind valve. Re set tap clearance e. Remove piston & clean it f. Replace with new one Check bumping clearance and adjust
5	Knocking	a. Sucking of air throug h joints b. Excessive carbon on piston & or head c. Slack bearing d. Bearing worn out e. Piston slap Exhaust system choke d	a. Check fuel suction joints & prime the system b. Decarbonise c. Replace with new d. Fit new bearing e. Renew liner and or piston Clean out exhaust ports, pipes and silencer
6	Overheatin g	a. Can be result of trouble of 1 & 5 b. Unsuitable lubricant c. Obstruction of air flow due to dust & oil on the fan d. Loose belt	a. Use appropria te remedy b. Change to correct grade c. Clean fan and remove obstruction d. Tighten the belt Check condenser

		e. Obstruction in cooling system	and correct it
7	Any other trouble		Call service engineer

III. Periodic checks for DGSet:

DG Set:

Periodically remove air ducting and clean any deposits from the cylinder barrel and head. The periods between cleaning will depend upon operating conditions, but, under very dusty conditions, deposits should be removed from the fins every 300 hours of operation.

Occasionally:

- Lubricate the links and connections of all external controls
- Check grease cups or lubricators or any auxiliary equipment
- Check tension of the cooling fan belts and other auxiliary included in the installation
- Clean the air filter

Every 200 hours operation:

- Drain lubricating oil sump, clean sump strainers and filter
- Renew lubricating oil & filter element
- Refill sump with new oil and prime the lubricating oil system
- Check hose pipe and replace if found defective
- Check belt condition
- Check grease cups or lubricate any auxiliary equipment.
- Check battery. Top up distilled water if required

Every 1000 hours operation:

- Remove injectors and test spray. Replace without interference if spray is satisfactory

Every 2000 hours operation:

- Replace fuel filter elements
- If engine shows sign of loss of power. Remove cylinder head and examine valves. Grind it if any scratches, pitting, or wear is observed.

Every 3000 hours operation:

- Close attention is required at during this servicing. Remove the cylinder head and piston, de-carbonise and grind in valves, examine wear.

IV. Preventive Maintenance

Programme: *Daily:*

1. Clean and sanitize the cooling tank properly, after emptying.
2. Maintain a log book to monitor the performance of the system from time to time.

Quarterly (by trained / authorized persons):

a. Check all the electrical connections in tank panel, Mains panel, stabilizer and DG set for any abnormalities and rectify wherever necessary.
b. Check the body and neutral earth voltages and pour water on the earthing places, if necessary - especially in summer.
c. Use air blowers on the condenser fins to blow out the dust accumulated.
d. Check temperature settings and timer settings on the tank panel and re-set, if necessary. Check the current consumption of the unit.
e. The data and information entered in the log book would be useful to monitor overall performance of the unit.
f. Carryout trial run of the unit on water to ascertain that the system is trouble-free.

Half yearly (by trained / authorized persons):

1. Repeat the procedures as briefed for quarterly maintenance.
2. Check the suction and discharge pressure of the compressor. Top-up with the recommended refrigerant, if felt necessary.
3. Check the pressostats and safety devices are in working condition.
4. Check the oil level in the compressor through the oil level sight glass installed on the base of the compressor. If oil is visible in the sight glass, the system does not need any additional oil charge. If felt necessary, top-up the oil level with the approved grade of oil only.
5. View the flow of refrigerant (in ON condition) in the sight glass installed on the copper line after the filter drier and check for moisture and liner flow_

6. If bubbles are observed during normal operation, it indicates that the refrigerant volume is less and needs to be topped-up.
7. If the colour of the ceramic indicator is greenish, it indicates healthy refrigerant and filter drier.
8. If the colour is yellow, it indicates that there is moisture content in the refrigerant. In this case, the refrigerant should be evacuated and fresh refrigerant to be filled-in.
9. Always replace the filter drier before replacing the refrigerant.

Do's and Don'ts:

Do's: Strictly follow the operating instructions:

1. Always keep the tank and the surroundings clean and dry.
2. Use only the tank panel to operate the system at all the times.
3. Take care not to disturb the cabling and thin copper pipes, which serve as connection to the control and safety devices.
4. Maintain a log book on daily basis to monitor the performance of the cooling system.
5. In case the cooling unit is not working, empty the milk into clean milk cans and transport to the milk to dairy plant or nearest chilling plant to save milk from deterioration.
6. Calibration of temperature indicator has to be done using standard glass thermometer atleast once a week.

Don'ts:

Do not try to repair anything yourself. Call the service engineer.

1. Do not start / stop the unit from the Mains supply. If it is required to shut down the Mains supply for any reason, don't do the same before ensuring that the pump down operation has been completed.
2. Do not keep the junction boxes / control panels open or loosely fitted.
3. Do not clean the cooling unit especially the copper tubes with water. If excessive dust or dirt has accumulated, wipe off the same by using dry cloth.
4. In case of shut down of the system due to power failure during operation, wait for 5 to 10 minutes before restarting.
5. Do not try to start the compressor when it gets tripped due to internal heat sensing relay. Wait for the compressor to cool down by itself and then restart. It may take 30 to 180 minutes depending upon the internal heat for the compressor to restart again. If you start the compressor in tripped condition,

it may lead to further overheating and can result in compressor failure.

6. Do not alter the settings in the control panel with regard to the temperature or agitator time intervals. **Do not chill. milk below 4 deg. C.**
7. Don't by-pass any safety devices to make the system operational during failures.
8. Do not by-pass the voltage stabilizer. In case of faulty stabilizer, call the service engineer and get the same rectified before starting the system. In case the service engineer removes any safety device, get him to sign the log book for the maintenance with remarks.

Do not shut down the DG set until the pump down operation is completed, when the system is operated on DG set.

Cleaning of Milk Collection Equipment & BMC, General Hygiene & Sanitation at Centre:

A. Cleaning the milk cooling unit:

The bulk cooler acts as an intermediate storage of milk at DCS level itself. Therefore, it is utmost necessary that between successive collection cycles, all the inside surfaces of the bulk milk coolers are thoroughly cleaned with potable water, suitable detergents and sanitized / sterilized with hot water as feasible. Accumulation of deposits on any of the inner surfaces such as covers, corners, etc., should be prevented as this could do more harm to the milk quality.

1. Every time the tank is emptied, first rinse the tank from inside and outside with cold water.
2. Clean with hot alkali solution and scrub the surfaces with nylon brush.
3. Then rinse the tank thoroughly with hot water at 60 °C.
4. After cleaning, disinfect the tank inner surface using Iodophor solution and put down the tank lid.
5. After disinfection, wipe the outer surface of the tank with a dry cloth.
6. Due care should be taken during the cleaning operation: do not pour or spray water or detergent on the cooling (refrigeration) unit especially the motors, which may result in hazards or major failures.

B. Hygiene and sanitation at milk collection centre:

Unless the milk collection centre surroundings and inside is kept clean and tidy, the chances of contamination of the raw milk

increases. The following salient aspects need to be looked into for maintaining desired hygienic environment in the place:

- ✓ The floor should be regularly swept and/or washed and milk spillage if any should be immediately cleaned.
- ✓ The wall, corners and ceiling shall be free from dust, cob webs and flies.
- ✓ All working surfaces/ platforms should be regularly cleaned and washed daily.
- ✓ For cleaning purposes potable water should be used. The water storage tank should be periodically (at least every 6 months) cleaned.
- ✓ The collection centre building shall be maintained free from entry of dogs, cats and rats.
- ✓ The SS line for the milk collection and the hose pipe used for dispatch of milk from bulk coolers to road milk tanker shall be thoroughly cleaned before and after use. The capped hose pipe should preferably be kept on a hanger to prevent entry of extraneous matter, insects and rodents.

- ✓ All the milk collection accessories and detachable parts such as unions, valves, dipstick, measures coming in contact with milk etc shall be cleaned as described above in section 'A'.

C. Cleanliness of surroundings:

- The surroundings of the milk collection centre should be kept clean so as to avoid breeding of insects and flies. The waste material generated shall be immediately removed from the vicinity and placed in the covered dust bin or at a particular place for further disposal.
- There should be a proper method of collection and disposal of waste water from the collection centre either to drain line or a soak pit.
- Ponds and pools of stagnated water shall be treated appropriately to avoid breeding of flies, insects and mosquitoes.
- The windows of the building should be covered with wire mesh to prevent entry of birds, flies, insects & dust in the building.

D. Hygiene of the milk collection staffs:

- ✓ Personnel involved in milk collection operations should be clean & tidy. Clothes should be clean, washed and tidy.
- ✓ Before starting milk collection, the personnel involved should wash
their hands preferably with soap and wipe dry with clean cloth.

- Coughing, sneezing, spitting, smoking within the collection centre premises should be avoided/ discouraged.
- Consumption of tobacco, paan/ gutka, alcohol within premises by anyone should be strictly prohibited.

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Annexure: Part I A

Guide Lines for Village Site and Building Selection for Milk Collection Centre with BMC

Village Site Selection Criteria:

1. For locating site in cluster of villages, the BMC village should have potential of contributing to around 40% of the milk collection envisaged.
2. The village should have all weather (pucca) good approach roads for movement of tankers up to 14,000 lit capacity.
3. The village should have single and three-phase grid supply available preferably in the morning and evening hours.
4. Round the year drinking quality water source.
5. Find out the voltage range on low 86 high side generally available at the village to decide on operating range of other electrical equipment.

BMC Capacity:

The bulk milk cooler capacity is based on the potential marketable milk available in the area and next 5 years projection to avoid capacity inadequacy and related quality concerns.

Milk Collection Centre Building:

- It should have clean surroundings preferably away from open drains, garbage dumps, public toilets etc.
- Spacious building(min. 40/60/90 sq.m. for 1/2/5 KL BMC resp.) with big hall for accommodating milk reception, collection operation & BMC tanks and accessories.
- The plinth level should be 1.1 m high from the surrounding area to avoid water ingress during heavy rainy days.
- The building should have sufficient space in the front for movement, turning and parking of tanker up to 14,000 litre capacity.
- Outside main building adequate space should be available for installation of DG set either at rear end or on the sides. The DG set is preferably installed outside the BMC main building.
- It should have firm RCC floor for installation of BMC, DG set etc.
- The BMC room should have large window/s of height not less than 1500 mm x width 2000 mm. The windowsill should be as much near to the floor. To achieve good cross ventilation of air, window on opposite wall is essential.
- The floor should have proper slope and drains to ensure free flow of water during cleaning.

- For three-phase power supply, DP (Double Pole structure of electricity Supply Company) should be available in the vicinity. This is to avoid additional charges & time delay in laying cable & pole for bringing 3 phase supply near to the place of BMC installation.
- All weather drinking water source near to milk collection centre.

Annexure Part I B

Guide Lines on Facilities and Amenities Required at Milk Collection Centre with BMC and AMCU

I. Milk reception:

Platform 1.1 m high for unloading of milk can from reception vehicle. The existing veranda of the building can also be used for this purpose after carrying suitable modifications.

II. Operation Area:

Working platform/ s of adequate length with minimum width 600 mm and 750 mm high for carrying milk collection and testing operations. The top of the platform should be finished with Kota stone/Catalpa stone for easy cleaning.

In case an exhaust fan is installed in the room to remove hot air from condensing unit of the BMC, it should be located below the ceiling level. For effective exhaust and prevention of short-circuiting, window if any, below the exhaust fan is to be kept closed.

III. Water for cleaning equipment and its disposal:

This is specific to each location. If source of water is available nearby then water can be stored for use in storage tank located on RCC terrace.

The wash water of BMC after loading to tanker is generally pumped to the dispatch tanker. The wash water of equipment, BMC and floor cleaning should be properly disposed to the available drains of the locality. It should not be allowed to spread outside the building causing any nuisance to local population.

IV. Checklist for BMC package supplies when received at site:

- Tool box has complete set of tools
- SS filter on the unloading pipe supplied or not.
- 2 inch x 1.5 inch SS reducer supplied or not.
- Operating manuals, warranty cards for all relevant package equipment are supplied with BMC. Keep it handy but in safe custody.
- The BMC package includes set of spares for all critical equipment. Verify against Order specifications, the quantity received.
- Study warranty obligation of all the suppliers thoroughly. Unless it is specified as comprehensive warranty, the scope of supplier is limited for providing free labour.