FranRica®
FR Mfg. Corporation
2807 S. Highway 99, Stockton, CA 95205
Phone: (209) 948-2811 Fax: (209) 948-5198

"DIMPLE" Tubular Heat Exchanger

Cooler Application

Operational Manual

SERIAL NUMBER: OES01-CX-01

CUSTOMER: Orion Enterprises, Inc.

LOCATION: Sioux City, South Dakota

DATE: July 1995

EQUIPMENT AND UTILITY RATINGS

Cool:	Lasagna Sauce (16 gpm, 8,628#/hr) From 200°F to 70°F
Cooling Media:	90 gpm water at 60°F, return at 85°F

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D-22599 Final Assembly DIMPLED Tube-in-Tube Heat Exchanger

I. DESCRIPTION OF DIMPLE TUBULAR HEAT EXCHANGER

Refer to drawing D-22599, Final Assembly Dimple Tubular Heat Exchanger

This DIMPLE tubular heat exchanger is designed to cool 16 gpm lasagna sauce product (8,628 product #/hr) from 200°F to 70°F using 90 gpm 60°F cooling water (returned at 85°F).

The patented DIMPLE pattern is used to enhance heat exchange while minimizing pressure drop through the system. This heat exchanger uses a tube in tube to accomplish heating the product. Product is pumped through the center DIMPLED product line. Cooling media circulates through the outer product line.

Cold water (90 gpm at 60° F) is used as the cooling media. Product flows through the center product tube, with the cooling media circulating counter flow on the exterior product tube of the DIMPLE tubular heat exchanger. The cold water enters the heat exchanger at the product discharge point.

Typically, product temperature is monitored and controlled using a controller/ recorder. The desired final temperature is used a the control setpoint. The input is the RTD signal from the discharging product. The controller's output controls the modulating flow control valve on the circulating media. If the final product temperature begins to increase, the flow control valve will open slightly until the product temperature stabilizes at the desired setpoint.

Final Product Temperature Controller/Recorder, if provided:

1. Function: Controls and records the temperature of product leaving the DIMPLE tubular heat exchanger. The control setpoint is used to control the desired final product temperature.

2. Product temperature controller/recorder. Final product temperature is automatically monitored, recorded and controlled. An RTD senses the final product temperature. The media flow control valve responds to this final product temperature. An automatic electronic output on the final product temperature controller gives an indication of the flow control valve's position (0% = fully open, 100% = fully closed).

3. The final product temperature is recorded.

4. Controls:

    a. Auto mode - control setpoint for the desired final product temperature.

    b. Manual mode - 0% (on the manual output) the flow control valve is open. 50% (on the manual output) the flow control valve is half open. 100% (on the manual output) the flow control valve is fully closed.

II. SAFETY

WARNING

IF THE SAFETY PROCEDURES AS OUTLINED IN THIS SECTION AND AS INDICATED IN OTHER SECTIONS THROUGHOUT THIS MANUAL ARE COMPROMISED OR IGNORED, SEVERE PERSONAL INJURY OR DEATH CAN OCCUR. BASIC SAFETY AND SAFETY PROCEDURES ACCEPTED BY THE INDUSTRY, AS WELL AS THOSE DICTATED BY THE RESPONSIBLE REGULATORY AGENCIES MUST BE FOLLOWED.

A. Do not attempt to start or operate this equipment without first reading this entire manual.

B. Personnel handling, transporting, and installing the machine must use proper clothing, tools, and methods of handling to avoid serious personal injury and damage to the equipment.

C. All equipment used to move or support the equipment must be of adequate design to handle the weight of the equipment to avoid damage to the equipment, serious personal injury or death.

D. Only qualified and thoroughly trained personnel should be allowed to perform installation, piping and maintenance of the steam system. Pressures and temperatures involved are dangerous and potentially fatal.

E. Only qualified electricians should perform electrical work. Electrical components operate at dangerous voltages which can cause serious shock or electrocution.

F. It is the user's responsibility to check and adequately maintain the operation of all safety devices.

G. Before any guards or covers are removed for service or cleaning, the appropriate electrical switches must be locked out with a padlock for safety. Utility isolation valves must be closed, locked out and tagged. H. Always open steam valves slowly to heat up the system. Rapid opening of valves may cause condensate to flash with a resulting hammering. Water hammer may break or otherwise shorten the life of the equipment and may cause severe personal injury or death.

III. RECEIVING AND HANDLING

WARNING

ALL EQUIPMENT USED TO MOVE OR SUPPORT THE EQUIPMENT MUST BE OF ADEQUATE DESIGN TO HANDLE THE WEIGHT OF THE EQUIPMENT TO AVOID DAMAGE TO EQUIPMENT, SERIOUS PERSONAL INJURY, OR DEATH. THE APPROXIMATE WEIGHT OF THE DIMPLE TUBULAR HEAT EXCHANGER: DIMPLE TUBULAR HEAT EXCHANGER: 3300 LB.

WARNING

PERSONNEL HANDLING, TRANSPORTING, AND INSTALLING THE MACHINE MUST USE PROPER CLOTHING, TOOLS, AND METHODS OF HANDLING TO AVOID SERIOUS INJURY OR DEATH.

A. Inspect the equipment for damage immediately upon receipt and record any damage on delivery document *BEFORE* signing. In case of damage, it is the receiver's responsibility to file a claim immediately with the carrier.

B. Unpack the equipment as soon as possible to inspect for concealed damage. Re-pack and store loose components carefully.

C. Cover and store the equipment in a clean, dry place if installation preparation prohibits immediate installing.

D. Move equipment on the shipping skid. Avoid dropping, jarring, or any movement which will bind or be abusive to the equipment. Protect all surfaces, mechanical parts, and instruments when moving.

IV. GENERAL INSTALLATION CAUTIONS

A. Give consideration to filtration and pressure reduction where piping is not provided by FranRica. Use pipe joining compounds which will not enter lines and plug small orifices.

B. Piping should be installed in a safe, organized manner by practiced, responsible personnel and adhering to local code regulations.

C. Give consideration to expansion and contraction, as well as vibration when bracing utility or product piping.

D. Piping should be supported independently. Never use equipment for support.

E. NEVER create unnecessary restrictions in piping. Minimize valves, elbows, tees, etc., to provide better flow and economize installation costs.

F. Do not use conduit or cabinets as grounds (safety ground) as they tend to be noisy, which can cause malfunctioning electronics.

G. Good earth grounds are required for filtering devices in components to operate satisfactorily with no false readings or down time.

H. If applicable: When installing steam piping, ALWAYS tap the steam header from the top. This top tapping will minimize the amount of condensate in the steam supply to the individual piece of equipment. Provide an isolation valve and some method to remove the condensate before the piece of equipment. A pressure reducing regulator is required if the user's steam pressure is capable of exceeding pressure stated on cover page.

If top tapping is not available, or the steam supply is at the end of the line, provide an adequately sized condensate separator and trap.

V. INSTALLATION OF DIMPLE TUBULAR HEAT EXCHANGER

WARNING

PERSONNEL HANDLING, TRANSPORTING, AND INSTALLING THE MACHINE MUST USE PROPER CLOTHING, TOOLS, AND METHODS OF HANDLING TO AVOID SERIOUS INJURY OR DEATH.

CAUTION

EXCESSIVE HEAT OR FREEZING CONDITIONS, AS WELL AS EXCESSIVE DUST OR CORROSIVE MATERIALS CONTACTING THE UNIT COULD BE HARMFUL TO THE EQUIPMENT CAUSING PREMATURE WEAR AND FAILURE.

A. Location:

1. Give consideration to the optimum arrangement of the DIMPLE tubular heat exchanger in relation to other equipment in the same processing line, as well as other equipment in the immediate area.

2. Use elevation and layout drawings to position the heat exchanger. Refer to the general assembly drawing provided in the appendix.

3. Give consideration to the environment in which the DIMPLE tubular heat exchanger is located. A clean area, protected from weather and having a good drainage is recommended.

4. Floor space allocated must include sufficient clearance around and above the equipment for access and maintenance work.

5. Provide sufficient area lighting.

6. An excessive media pressure drop will effect the flowrate of the cooling media. Consider the ambient temperature the location provides.

B. Clearances:

1. Provide adequate space for maintenance, clean-up and operation. Consideration should be made for removal of product passes for maintenance or repair. The DIMPLE tubular heat exchanger is designed for easy addition of product passes if more production capacity is needed.

2. Make provisions for free access to the control panel, if equipped.

E. Product Piping:

1. All welding of product line should be purge welded.

2. Connect product supply piping to tubular heat exchanger inlet. The inlet is at the lowermost entry of the unit. Refer to final assembly drawing.

3. Connect product discharge piping to tubular heat exchanger. Include the provided RTD in the product line. We suggest the RTD is positioned so the probe is facing the product flow. Placing the RTD in an elbow is a location. Position the RTD within 3 feet from the unit discharge. Using a thermal well will dampen the product temperature.

4. We suggest a return line at the discharge of the heat exchanger to allow for a smooth initial cooling of product. This allows high temperature product to be recirculated if needed.

F. Connect media circulation lines to the DIMPLE tubular heat exchanger. The media flow is counter current.

1. DIMPLE TUBULAR MEDIA DISCHARGE is located at the product entry (4" tri-clamp connection - lowermost connection).

2. DIMPLE TUBULAR MEDIA SUPPLY is located at the product discharge (4" tri-clamp connection).

G. Connect utilities and instrumentation. Refer to next section.

VI. COMPONENT TESTING

A. DIMPLE tubular heat exchanger:

1. Verify media supply and discharge lines are connected, with fail open flow control valve in place.

2. Verify product supply and discharge lines are connected with discharge RTD in place.

3. Verify automation wiring and pneumatic control lines are connected for final product temperature control loop (RTD, controller, I/P, flow control valve).

B. Verify the final product temperature RTD. A water hot temperature calibration unit is recommended for testing the RTD against a calibrated thermometer. Test at processing temperatures - product 70°F, water 60/90°F.

C. If applicable: Verify the action of the media flow control valve. With no signal to it, it should be in the open position. Turn the product discharge temperature controller to MANUAL. Adjust output to 50%. Verify the media flow control valve is half open. Adjust the controller's output to 100%. Verify the media flow control valve is closed. Adjust the controller's output back to 0%, the valve should be fully open.

VII. INITIAL WATER TESTING

CAUTION

THE HEAT EXCHANGER AND RECENTLY WELDED PRODUCT AND MEDIA LINES MUST BE RINSED TO REMOVE WELDING SLAG. WELDING SLAG CAN DAMAGE PUMPS AND OTHER COMPONENTS.

A. Rinse product line and heat exchanger to remove welding slag and construction debris. Direct water to the gutter. Avoid directing this dirty water thorough valves or pumps.

B. If applicable: Install recording pen and check pen operation in discharge product temperature recording controller.

C. If applicable: Verify air is supplied to control regulator, with 40 psig supplied to media flow control valve's I/P and positioner.

D. Turn product temperature controller to MANUAL, adjust manual output to -10% (media flow control valve open).

E. Fill media line with water.

1. Verify all manual media isolation valves are open.
2. Verify the flow control valve is open (fails open).
3. Charge system with water.
4. When initially starting circulation pump - jog pump off and on to remove all air in lines so not to cavitate pump. Verify circulation pump rotation.

F. Circulate water on the media side of the DIMPLE tubular heat exchanger. Start circulation pump. During this time, verify there are no water leaks on the media system.

G. Pump water through the product lines of the DIMPLE tubular heat exchanger. Verify there are no leaks in the product piping.

VIII. REGULAR PRODUCTION

A. Turn final product temperature controller to MANUAL, adjust output to 0% (media flow control valve open).

B. Begin circulating cold water media.

C. Begin pumping product through the heat exchanger.

D. Turn final product temperature controller to AUTO. Slowly decrease final product temperature controller setpoint to the desired process temperature.

E. Watch the final product temperature controller's output. When the system has stabilized, the controller's output should be 10% to 40%.

It is important that the media flow control valve has a range to work in. It should be able to effectively open if the final product temperature is high. The valve should also be able to effectively close to increase the final product temperature.

If is completely open (controller output = 0%), the system can provide no more cooling without decreasing the temperature of the cold water media.

If the media flow control valve is closed to much (controller output = 70-80+%), less cooling is required so the cold water media temperature should be increased.

IX. INCREASING THE DIMPLE TUBULAR HEAT EXCHANGER'S THROUGHPUT

CAUTION

TO AVOID UNCONTROLLED COOLING, SLOWLY INCREASE THE FEED PUMP'S SPEED, ALLOWING THE COOLER TO STABILIZE BETWEEN SPEED INCREASES.

A. Slowly increase the feed pump speed.

B. As the feed pump increases, more cold water media will be needed to maintain the desired final product temperature. The final product temperature controller should automatically compensate for the additional cooling requirement.

C. Look at the final product temperature controller's output. If the final product temperature controller output decreases to 0% output, additional cooling is required. To provide additional cooling, decrease the cold water temperature. When the system has stabilized, the controller's output should be 10% to 40%.

It is important that the media flow control valve has a range to work in. It should be able to effectively close if the final product temperature is low. The valve should also be able to effectively open to decrease the final product temperature.

If is completely open (controller output = 0%), the system can provide no more cooling without decreasing the temperature of the cold water media. To provide additional cooling, decrease the cold water temperature.

D. Repeat steps A, B, and C if needed to increase to a new desired throughput.

X. DECREASING THE HEATER'S THROUGHPUT

CAUTION

TO AVOID UNCONTROLLED COOLING, SLOWLY INCREASE THE FEED PUMP'S SPEED, ALLOWING THE COOLER TO STABILIZE BETWEEN SPEED DECREASES.

A. Slowly decrease feed pump speed.

B. As the feed pump decreases, less cooling will be needed to maintain the desired final product temperature. The final product temperature controller should automatically compensate for the decrease in cooling requirement.

C. Look at the final product temperature controller's output. If the final product temperature controller output increases to 80 + % output, less cooling is required. The media flow control valve is closing down to a point the media's temperature needs to be increased to allow the media flow control valve to open more. When the system has stabilized, the controller's output should be 10% to 40%.

It is important that the media flow control valve has a range to work in. It should be able to effectively close if the final product temperature is low. The valve should also be able to effectively open to decrease the final product temperature.

If is completely open (controller output = 0%), the system can provide no more cooling without decreasing the temperature of the cold water media. To provide additional cooling, decrease the cold water temperature.

D. Allow the cooled final product temperature to stabilize.

E. Repeat steps A, B, and C if needed to decrease the system's throughput further.

XI. SHUT DOWN AND CLEAN UP GUIDELINES

A. General cleaning information:

1. Cleaning is an integral part of good sanitation. A dirty system can not be sanitized. A pocket of product (due to its insulative properties) can contaminate the entire system. As a result of the need to remove **ALL** product from the system, the following steps are essential:

   a. Hot water rinse to remove product from the system.

   b. Hand cleaning of vessels.

   c. Caustic wash.

   d. Hot water rinse and disassembly with inspection of components of the system.

   Each step is important in order to achieve the end result of a clean system.

B. Safety must be held in first priority throughout the product shut down and clean-up procedures. Carefully read all warnings in this section. Caustic and hot water can cause serious injury. Do not take any short cuts or reckless actions during these steps. Always think several steps ahead to be sure there is a safe "home" for the solution being pumped through the system. Pumps must be locked out prior to any work performed on them.

C. Good cleaning is accomplished with velocity as well as chemicals. When transferring rinse water or caustic solution form point to point, try to accomplish transfer at the highest speed possible to aid in removal of product through scrubbing action.

D. For tanks and vessels: Levels of rinse waters and caustic solution must progressively be increased at each step to insure product and caustic are removed from the system.

E. Time is an important factor in cleaning the system. Product is most easily removed while still moist. If there is a mechanical breakdown, keep the system full of water and closed to decrease the drying of the product. Rinses must have sufficient time to remove all product and caustic residue. Caustic wash must be of sufficient time to chemically clean the system. Refer to your chemical supplier's recommendations for the time, temperature and concentration of the caustic wash.

WARNING

PUMPING OF CAUSTIC SOLUTIONS MUST NOT BE STARTED UNTIL A SAFE DISCHARGE IS PROVIDED. RESPONSIBLE PERSONNEL MUST BE PRESENT THROUGHOUT THE ENTIRE CAUSTIC WASH AND CLEAR WATER RINSE. FAILURE TO ALERT PERSONNEL AND CHECK DISCHARGE POINTS, EQUIPMENT, ETC, CAN RESULT IN CHEMICAL BURNS, SERIOUS PERSONAL INJURY AND/OR DEATH.

I. The DIMPLE tubular heat exchanger (if a heater) can be used to heat up the initial rinse water, caustic solution and final clear water rinse.

J. Hand clean the divert valve (if equipped) to verify cleanliness. Inspect for wear of the valve seats, stem and o-rings while the valve is disassembled.

K. DIMPLE tubular heat exchanger: Disassemble elbows on the product line to verify cleanliness of the system. If history proves your cleaning is effective, this disassembly should be done randomly to verify cleaning process.

L. The system is ready for maintenance.

XII. MAINTENANCE

A. Hourly

1. Check temperature indicators on the system. Verify they correspond with the instruments on the control panel.

2. Verify the low/high product temperature setpoint is in the correct position, if used.

3. Verify the control of the media flow control valve. Adjust cold water set temperature controller setpoint as needed to keep final product temperature controller's output in optimum working range - 10-40% output.

B. Prior to each start-up:

1. Verify the product line is intact.

2. Verify the media line is intact.

3. Verify the cold water media line is charged with water.

4. Verify the media flow control valve is open.

C. Quarterly maintenance:

1. Replace all o-rings, gaskets, elastomers, these may need to be changed more frequently than every 3 months.

2. Check and repair valves, regulators, controls and filters as needed.

3. Calibrate temperature indicators, controllers, and recorders at processing ranges (if equipped).

4. Check pneumatic system for operation and leaks. Repair as needed.

D. Off season storage and maintenance checkpoints:

1. Remove all drain plugs and drain **ALL** lines after shutting off steam, air and water supplies.

2. Leave **ALL** manual ball, globe diaphragm and gate valves in an "open" position (50%).

XIII. TROUBLE SHOOTING

A. Insufficient heat exchange - final product temperature too high

1. Verify temperature and available gpm of cold water media.

2. Is there entrained air being pumped with the cold water media?

3. Check final product temperature controller's output signal to the media flow control valve to verify proper opening. Is the output low enough to indicate the valve should be open when actually the valve stem indicates it is almost closed? If the media flow control valve is not fully open when the controller's output is 0%, and the final product temperature is above the control setpoint the controller is not functioning correctly. Is the controller on AUTO?

4. Is there fouling on the interior of the product tubes in the DIMPLE tubular heat exchanger? If there is fouling on the heat exchange surface, the heating capacity will be reduced. Clean the system, and remove the product residue on the product line.

5. Is there fouling on the exterior of the product tubes in the DIMPLE tubular heat exchanger? If there is fouling on the media side of the heat exchange surface, the heating capacity will also be reduced. This is an unusual occurrence, but it can happen. Clean the system, and remove the residue.

6. Has the production rate exceeded design capacity (refer to cover page)? Is the product inlet temperature higher than design specifications? Either of these conditions will require more cooling capacity. An increase in your product's density (specific gravity, ° Brix) will also require more cooling capacity.

7. Is the media flowrate sufficient? Has the media gpm dropped? Are all media manual isolation valves fully open? Minimize the pressure drop in the cold water circuit.

B. Cold water leaking at the DIMPLE tubular heat exchanger's ends - where the product line leaves/enters the double tube area. The o-rings at the media line have failed and need to be replace.

C. Is product getting into your water media? There must be a crack in the product line in the DIMPLE heat exchanger. Take all the product line elbows off the heat exchanger. Circulate water through the media side. Locate the fault in the product line and replace the tube.