



# Online Condenser Cleaning System



## Operation Manual

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**INTRODUCTION:**

Shell and tube condensers and heat exchangers are core to a wide range of processes including power generation, oil refining, industrial processing, and HVAC comfort cooling. Unfortunately, this means that “fouling” of these heat exchangers (the accumulation of efficiency-killing deposits) is also pervasive at extremely high economic and social costs.

The expenses associated with fouled heat exchangers and condensers are significant, and include increased power consumption, increased fossil fuel consumption, reduced production, and frequent condenser cleaning costs.

In HVAC applications, fouling of the chiller condenser tubes has substantial impact on the power consumption of the compressor. Even with good water treatment programs, it’s not uncommon to find chillers that appear to be in good working order operating at a fouling factor of 0.0025 hr-ft<sup>2</sup> -F/Btu or higher — causing compressor power consumption to increase by 25% or more.

Fouling occurs because cooling water contains minerals, such as calcium and magnesium that precipitate to form deposits on heat transfer surfaces. Cooling water systems are also commonly plagued by biological growth that forms slime or algae on heat transfer areas. Additional foulants include mud, silt, corrosion products, petroleum products, etc. All of these foulants reduce the heat transfer efficiency of even the best-designed heat exchangers, induce localized corrosion leading to early equipment failure and force shut downs of the power generation, refining or cooling process.

Several methodologies are commonly used to mitigate or reduce fouling in various plants and industries.

Typically these include off-line mechanical or chemical cleaning or on-line mechanical cleaning systems.

Off-line cleaning methods require periodic shutdown of the process for heat exchanger cleaning via hydro blasting, scrapers, nylon or metallic brushes, or chemical cleaning. Major drawbacks and disadvantages of an off-line cleaning approach are that the process unit has to be removed from service for cleaning, and that the process efficiency immediately degrades after being placed back into service.

On-line heat exchanger cleaning methods typically involve mechanical cleaning that fall into a category commonly referred to as Automatic Tube Cleaning Systems. Of these systems, the most commonly applied are sponge-ball type tube cleaning systems

**TECHNICAL ASPECTS:**

THEWHIRLER™ is a closed recirculating loop in which sponge cleaning balls are injected into the condenser cooling water from the BALL STORAGE TANK. The balls carried along with water flow, pass through the tubes and clean the inner tube surface. The cleaning balls are then collected by BALL ARRESTOR that is located on the condenser water outlet line of the condenser. Then the balls again passed from Ball Arrestor to Ball storage tank.

The cycle will repeat every hour (can be adjusted.) to keep the condenser clean all the time.

The Sponge balls used are made up of Natural Rubber. It has a tremendous flexibility. The balls are slightly bigger than the condenser tube diameters. When passes through the tubes, wipe off all the particles settled on the tube surface.

**Silent features of THE WHIRLER™.**

- Easy to install. Modification in the existing system is installation of Ball Arrestor on condenser outlet pipe & 2 tapings on condenser inlet line.
- THEWHIRLER™ unit can be designed for 3 condensers.
- Use Sponge Ball made of natural rubber which does not harm copper tubes while cleaning.
- Use PLC based control system for automation.

**The advantages of THE WHIRLER™ are:**

- Eliminates condenser de-scaling completely.
- Maintains condenser approach.
- Improves plant efficiency.
- Reduces plant power consumption by minimum 10-25 %.
- Increases life of tubes due to reduction in the de-scaling frequency.

**OPERATING PRINCIPLE:**

The operation of sponge-ball type automatic tube cleaning systems is based on the passage of sponge rubber balls through the heat exchanger tubes. The balls are slightly larger than the tube diameter and prevent the deposition of scale, biofilm, silt, or other foulants. The sponge balls are periodically injected into the cooling water inlet line and are circulated through the condenser tubes by the cooling water flow. The balls are designed and injected in a method that enables a uniform distribution of balls across the tube sheet. Since the diameter of a ball is slightly larger than the inner diameter of the tube, accumulation of deposits in the condenser tube is prevented by shear forces between the ball and tube wall and the wiping action of the cleaning balls. The balls are constructed of material that is much softer than the tubes preventing tube erosion.

**THE WHIRLER™ - Condenser Cleaning Ball**

THE WHIRLER™ - Condenser Cleaning Balls are produced using specific formula and a quality controlled, top of the line manufacturing process. Our Balls are designed using our improved hybrid pore technology that gives its scrubbing capabilities of an open pored ball, and the durability of a closed pored ball. Specific designs enable us to produce balls to match every need of our customers while maintaining abrasive resistance and durability of our balls.

We offer Condenser Cleaning balls in the sizes of 14mm in diameter to 32mm in diameter in different grades of hardness, and temperature. We produce Condenser Cleaning Balls customized to our Customers' needs, where we can produce balls in any combination of soft, medium soft, medium, and hard; high or low temperature resistance; and for fresh and salt water systems. Condenser Cleaning Balls can be used for both soft and hard crystalline residue deposits using specialized granule coated condenser cleaning balls.

Ball lifetime:

Ball lifetime can vary enormously (from days to months) according to

Working parameters such as:

Inner tube surface condition: roughness, corrosion, scaling...

Cooling water characteristics: mud or sand in suspension, type of fouling generated...

Type of duty: Continuous duty required when using scaling water: each tube must be cleaned every 5 minutes on average to prevent scaling. Intermittent duty allowed when water fouling (such as mud or organic deposit) can be wiped out easily: ball circulation would be set for operation only a few times a day for a preset period of time.

Diameter:

Standard range of products includes balls in diameters from 14 to 32 mm. Increment 1 mm. Other sizes can be supplied on request.

Temperature:

1: standard balls up to 80° C

2: heat resistant balls up to 140° C

## THE WHIRLER™ BALL ARRESTER



- The ball arrester is located at the outlet line of the cooling water.
- The balls which are injected through the ball storage tank with the help of differential water pressure are passed through the condenser tubes and get trapped in the ball arrester.

The ball arrester separates the ball from the cooling water and guides them to the extraction point.

- The arrester is made up of M.S. and S.S. components and its size vary with respect to the pipe size of outlet.
- It has SS strainer for separation of balls and its size varies as per design and capacity of system.

**BALL STORAGE TANK**

It is used to store the sponge balls and inject into the condenser inlet line.

There are two tapping at the condenser inlet line in such a way that it can create a pressure difference by virtue of which the balls are injected into the condenser inlet line.

Ball storage tank is used for addition of new balls and replacing old worn out balls from the system.

Ball storage tank made up of M.S. material and it consists of transparent toughened glass to visually inspect the sponge balls in the system.



**AUTO-CONTROL VALVES**

Auto-Control valves are used to direct the sponge balls for the batch type operation of THE WHIRLER system & are operated through control panel.

The Auto-control valves are used for:

1. Water inlet & Injection line: Auto Valves are installed on the Water inlet & injection line. Its operation helps to inject the balls in the condenser inlet line.
2. Return water line from Ball arrestor to Ball storage tank: Auto Valve installed on the return line helps to carry the balls from the Ball Arrestor to the Ball storage tank.
3. Drain line: Auto valve installed on the Drain line helps to travel balls from Ball Arrestor to Ball storage tank.

**CONTROL PANEL**

The actuation of the valves and ball collection can be performed manually or by automatic mode.

The control of tube cleaning system can be atomized to any extent by programmable logic control system. PLC is fed with the program as per the application of the system. Actual time, hold/delay time is programmed in the hard disk of the panel.

Panel also consist of selector switch, which is mounted on the front frame of the panel box. Selector switch can be used to stop running cycle/program as well as the switch is compatible with the servicing mode by which the systems flow and release the balls which are stuckin the lines just to insure smoother operation of the system while in running mode.

**TROUBLESHOOT**

- AUTO SERVICING
  - Put the selector switch on 7<sup>nd</sup> position for servicing mode. It will open all passages of pipe line and free up the lines for ball movement.
- MANUAL SERVICING
  - Close all actuator and manual valve initially except drain suction valve.
  - Open only main drain, return valve and manual valves which provide to the ball arrester.
  - Switch off the all system (chiller & condenser pump) and restart it after 5 minutes.
- Other precautions to be taken for smoother operations
  - Clean the Ball storage tanks quarterly basis. Frequency depends upon the water quality & site conditions.
  - Clean Ball arrester on quarterly basis. Frequency depends upon the water quality & site conditions.

**PREVENTIVE MEASURES**

- Balls have to be change after completing of three months in the system else ball can be trapped inside the ball arrester. (if warned out badly)
- Lines must be free from waste particles such as plastic material, corroded particles and other particle of cooling tower mud and small pebble.
- If descaling is done then strainer or ball arrester ought to be cleaned on mandatory basis.
- Even though the whole piping is of M.S. material, while having any other operation or task performed by any of the person of company as well as other vendor, the piping are not to be climbed by any person.

**SUMMARY**

Sponge-ball type tube cleaning system technology has been a widely-adopted best practice for optimizing condenser performance in the power generation industry for decades. Advances in tube cleaning system technology have resulted in more effective and reliable systems with enhanced scalability. Case studies from across the globe demonstrate realized energy efficiency gains up to 15% or more in HVAC applications. Coupled with increasing energy costs and intensifying focus on energy conservation, sponge-ball type THE WHIRLER technology represents a good opportunity for facility managers to save energy, reduce maintenance costs, and lengthen chiller life expectancy.