Tech Sheet #102
Heat Exchange Institute
1300 Sumner Avenue • Cleveland, Ohio 44115-2851 • 216-241-7333 • Fax: 216-241-0105 • www.heatexchange.org

HEI Steam Jet Vacuum Systems Troubleshooting Guide

Steam Jet Vacuum Systems are fundamentally reliable vacuum producers as they have no moving parts. If the steam supply is dry, the cooling water clean and the materials of construction matched properly to the corrosive nature of the process fluids, Steam Jet Vacuum Systems can and do last indefinitely. However, the reality of some operating environments creates problem conditions (both short term as well as long term) listed here from the most common.

Issue	Possible Causes	Possible Solutions
Plugged (completely or partially) steam nozzles	Foreign material in the steam supply (particularly from pipe fabrication at installation)	Disassemble, inspect and clean
Wear of internal working surfaces of nozzles and diffuser	Wet steam	Install a separator and trap at ejector system. Insulate lines, trap low spots, set line sizes for 150ft/sec. Superheat steam (50 F° max)
Insufficient energy supply	Lower steam pressure than the design minimum pressure	Raise steam pressure (at the ejector) above the design minimum (or ask manufacturer to redesign)
Suction flow overload and increased suction pressure	Excessive air leaks and unexpected process loads	Find and correct leaks and overloads
Insufficient condensing and cooling. High condensing pressure	Higher cooling water temperature than the design maximum Lower cooling water flow than the design value	Correct supply temperature Increase water flow

Issue	Causes	Solutions
Too much friction in ejectors and/or too little heat transfer rate in condensers and/or blockage of the condensate drain	Fouling of internal working surfaces (process fluids or cooling water)	Clean parts
Too much compression required given the design energy provided	Higher system discharge pressure then the design maximum	Decrease discharge pressure drop or redesign z stage
Too much pressure drop between vacuum user and vacuum producer	Suction pipe conditions: -smaller size than connection -partially closed block valves -fouling -liquid traps -undersized in-line equipment	Correct suction pipe condition
Flooding of condensers	Insufficient condensate removal provisions	Clean tail pipe, check for air leaks. Assure operation of installed mechanical equipment
Too much or too little steam flow	Excessive steam pressure and/or temperature	Limit overpressure to approx. 125%. Limit superheat to approximately 50° F

The primary difficulties in troubleshooting a Steam Jet System (i.e., finding and fixing the cause of a problem) result from the following:

1. Not understanding how ejector systems work.
2. Not being able to easily observe the operation (fluids flowing inside).
3. Becoming confused by the interaction of components.

There are three corresponding methods to use in simplifying the troubleshooting process:

1. Study the appropriate parts of the HEI *Standard for Steam Jet Vacuum Systems* and any available manufacturer's literature on how systems work and how ejectors behave.

2. Use the appropriate pressure and temperature gauges to determine fluid conditions and flow meters to determine their rates.

3. Isolate and check the system and its components.

This last method is the essence of the main troubleshooting procedure as follows:

1. Check the operational history of the overall system (vacuum user and vacuum producer). Check for feed rate changes, trends or abnormalities in the suction pressure being produced, operation of valves, gages, and meters.

2. Isolate the vacuum producer (steam jet vacuum system) from the vacuum user by closing off the suction valve or installing a blind flange on the jet system suction connection (assure that no liquid is trapped in the isolated section). If the no load suction pressure (for a system designed to be stable at no load) is approximately per the table below the steam jet system is most likely working.

Number of Operating Stages	No Load Suction Pressure
1	35-50 mm Hg Abs
2	5 mm Hg Abs
3	1 mm Hg Abs
4	50-100 microns Hg Abs
5	5-10 microns Hg Abs

3. If the typical no load suction pressure is not obtained keep the system isolated and install a blank on the last stage (z) ejector and turn on its steam only (leave the water on to all condensers). Check the z stage no load suction pressure per the above table (one stage operating). If it works, put the blank on the next stage up (y) and turn steam on to the z stage first (to check for interstage leaks) and then to y and z stages. Check two stage no load suction pressure per the above table. Continue on until unsatisfactory results occur.

4. As you discover unsatisfactory operation realize that an ejector requires that only four basic mechanical conditions are satisfied.

    A. No plugs (stoppage or fouling) in the nozzle or diffuser.

    B. No leaks from the atmosphere or steam at the steam nozzle connection (inside the suctions head).

    C. The internal working surfaces of the nozzle and diffuser are reasonable smooth.

    D. The correct parts are in place.

    Similarly inter- and after-shell and tube condensers require these four mechanical conditions be satisfied:

    A. Reasonable clean tube surfaces (inside and out).

    B. No blockage to fluid flow.

    C. No leaks from the atmosphere (including condensate drains) or from the water side to the condensing side.

    D. No flooding (of the condensing side).

5. Call the manufacturer with the information you've obtained from (all or part of) the above procedure. They will be able to lead you to the problem cause most effectively. 99% of all troubleshooting issues can be handled over the phone.