

Energy Tips



Steam



Motors



Compressed Air

Distilled Water Recovery

A useful rule of thumb is that every 500 lbs/hr of recovered flash steam provides 1 gallon per minute (gpm) of distilled water.

Materials Considerations

Depending on the specific application, the vent condenser materials can be either all stainless or mild steel shell with copper tubes. For deaerator vent condensing, a stainless steel heat exchanger is recommended to avoid corrosion due to the high concentrations of gases. Mild steel can be used for receiver tank vent condensing.

Use a Vent Condenser to Recover Flash Steam Energy

When the pressure of saturated condensate is reduced, a portion of the liquid “flashes” to low-pressure steam. Depending on the pressures involved, the flash steam contains approximately 10 to 40 percent of the energy content of the original condensate. In most cases, including condensate receivers and deaerators, the flashing steam is vented and its energy content lost. However, a heat exchanger can be placed in the vent to recover this energy. The following table indicates the energy content of flash steam at atmospheric pressure.

Energy Recovery Potential of a Vent Condenser

Pipe Diameter (inches)	Energy Content, MMBtu/year*				
	Steam Velocity, feet/min				
	200	300	400	500	600
2	90	140	185	230	280
4	370	555	740	925	1,110
6	835	1,250	1,665	2,085	2,500
10	2,315	3,470	4,630	5,875	6,945

* Assumes continuous operation, 70°F make-up water, and condensed steam at 100°F.

Example

Consider a vent pipe with the following conditions:

Velocity of flash steam:	300 feet per minute
Diameter of vent pipe:	4 inches
Hours of operation:	8,000 hours per year
Boiler efficiency:	82 percent
Cost of fuel:	\$4.50 per million Btu (MMBtu)

A vent condenser could condense the flashed steam, transfer its thermal energy to incoming make-up water, and then return it to the boiler. Energy is recovered in two forms: hotter make-up water and clean, distilled condensate ready for productive use in your operation.

Referring to the table above, the potential energy recovered from the flashed steam is 555 MMBtu, based on 8,760 hours of annual operation. Correct this value for actual operating hours and boiler efficiency:

$$\begin{aligned}\text{Annual Energy Recovered} &= 555 \text{ MMBtu/year} \times 8,000 \text{ hrs/yr} / 8,760 \text{ hrs/yr} \times 1 / 0.82 \\ &= 618 \text{ MMBtu}\end{aligned}$$

$$\begin{aligned}\text{Annual Potential Fuel Cost Savings} &= 618 \text{ MMBtu/yr} \times \$4.50/\text{MMBtu} \\ &= \$2,781^{**}\end{aligned}$$

** Note that the annual fuel savings are per vent. Often, there are several such vents in a steam facility, and the total savings can be a significantly larger number. The additional heat exchanger cost still needs to be considered, but available literature shows a quick payback for the measure.

Adapted from an Energy TIPS fact sheet that was originally published by the Industrial Energy Extension Service of Georgia Tech. For additional information on steam system efficiency measures, contact the OIT Clearinghouse at (800) 862-2086.



Suggested Actions

- Inspect vent pipes of receiver tanks and deaerators for excessive flash steam plumes.
- Re-examine deaerator steam requirements.
- Eliminate remaining flash steam energy loss with a vent condenser.
- Consult manufacturers for materials specifications, as well as size and cost recommendations for the vent condenser.



BestPractices is part of the Office of Industrial Technologies' (OIT's) Industries of the Future strategy, which helps the country's most energy-intensive industries improve their competitiveness. BestPractices brings together the best-available and emerging technologies and practices to help companies begin improving energy efficiency, environmental performance, and productivity right now.

BestPractices focuses on plant systems, where significant efficiency improvements and savings can be achieved. Industry gains easy access to near-term and long-term solutions for improving the performance of motor, steam, compressed air, and process heating systems. In addition, the Industrial Assessment Centers provide comprehensive industrial energy evaluations to small and medium-size manufacturers.

FOR ADDITIONAL INFORMATION, PLEASE CONTACT:

Theo Johnson
Office of Industrial Technologies
Phone: (202) 586-6937
Fax: (202) 586-6507
Theodore.Johnson@hq.doe.gov
www.oit.doe.gov/bestpractices

OIT Clearinghouse
Phone: (800) 862-2086
Fax: (360) 586-8303
clearinghouse@ee.doe.gov

Please send any comments, questions, or suggestions to webmaster.oit@ee.doe.gov

Visit our home page at www.oit.doe.gov

Office of Industrial Technologies
Energy Efficiency
and Renewable Energy
U.S. Department of Energy
Washington, DC 20585-0121



DOE/GO-102001-1276
May 2001
Steam Tip Sheet #13

About DOE's Office of Industrial Technologies

The Office of Industrial Technologies (OIT), through partnerships with industry, government, and non-governmental organizations, develops and delivers advanced energy efficiency, renewable energy, and pollution prevention technologies for industrial applications. OIT is part of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy.

OIT encourages industry-wide efforts to boost resource productivity through a strategy called Industries of the Future (IOF). IOF focuses on the following nine energy- and resource-intensive industries:

- | | | |
|---------------|-------------------|-------------|
| • Agriculture | • Forest Products | • Mining |
| • Aluminum | • Glass | • Petroleum |
| • Chemicals | • Metal Casting | • Steel |

OIT and its BestPractices program offer a wide variety of resources to industrial partners that cover motor, steam, compressed air, and process heating systems. For example, BestPractices software can help you decide whether to replace or rewind motors (MotorMaster+), assess the efficiency of pumping systems (PSAT), or determine optimal insulation thickness for pipes and pressure vessels (3E Plus). Training is available to help you or your staff learn how to use these software programs and learn more about industrial systems. Workshops are held around the country on topics such as "Capturing the Value of Steam Efficiency," "Fundamentals and Advanced Management of Compressed Air Systems," and "Motor System Management." Available technical publications range from case studies and tip sheets to sourcebooks and market assessments. The *Energy Matters* newsletter, for example, provides timely articles and information on comprehensive energy systems for industry. You can access these resources and more by visiting the BestPractices Web site at www.oit.doe.gov/bestpractices or by contacting the OIT Clearinghouse at 800-862-2086 or via email at clearinghouse@ee.doe.gov.