This project has received funding from the European Union's H2020 Coordination Support Action under Grant Agreement No. 894356.

<table>
<tr><td>Best Practice</td><td>INSPECT AND REPAIR STEAM TRAPS; IMPLEMENT AN EFFECTIVE STEAM-TRAP MAINTENANCE PROGRAM</td><td>STEA-06</td></tr>
<tr><td>Application</td><td colspan="2">Steam systems</td></tr>
<tr><td>SME sector</td><td colspan="2">Processing and manufacturing industries</td></tr>
<tr><td>SME Sub-sector</td><td colspan="2">Food processing, paper, and cardboard manufacturing sectors, pharmaceutical, chemicals, distilleries, etc.</td></tr>
<tr><td>Technical description</td><td colspan="2">If steam traps work correctly, they remove unwanted condensate from the system without significant losses of steam. However, steam trap failure is often the cause of significant steam system heat losses. They can generally fail in two ways: failed open and failed closed. A failed open steam trap constantly releases steam from the system, resulting in an increased boiler load and energy costs. Failed closed steam traps do not remove the condensate from the system, leading to multiple problems: Water collected at heat exchangers will lower the heat transfer, water droplets entrained in the steam can damage the equipment, and a failed closed trap serving a steam distribution header can result in a water hammer that can cause extreme damage to the system.

It is common that in steam systems, which have not been maintained for several years, that 15% to 30% of the installed steam traps are defective.

Leaks and failed steam traps can imply costs of multiple thousand euros per year and steam trap.</td></tr>
<tr><td>Recommendation for optimisation</td><td colspan="2">There are three different types of steam traps that are suitable for different applications, as shown in Table. However, consulting an expert on the most suitable steam trap choice for the certain application is recommended.

Types and applications of steam traps

<table>
<tr><th>Type of steam trap</th><th>Application areas</th></tr>
<tr><td>Mechanical steam traps</td><td>• Heat exchanger, regulated air heater, process water heater
• Boilers, drying chambers, heating coils, drying cylinders
• Air heater, pasteurising plants, and heating of CIP units in food industry
• Air humidification, regulated storage tanks</td></tr>
<tr><td>Thermostatic steam traps</td><td>• Steam pipes, steam radiators, unregulated air heaters, sterilization, disinfection, sterile steam pipes, steam filters and washing systems in pharmaceutical plants
• Hot plates in kitchens, industrial dishwashers
• Filling systems in food industry</td></tr>
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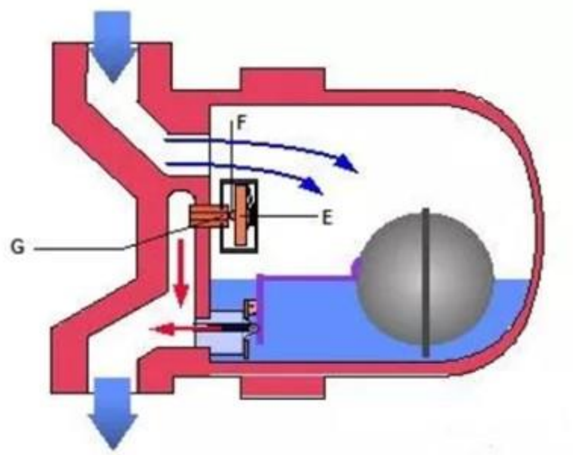
	• Tire presses in rubber industry • Trace heating (chemical plants, refineries), unregulated heating coils, unregulated storage tanks
Thermodynamic steam traps	• Hot steam pipes, unregulated heating coils and air heaters, uncontrolled storage tanks, ironing presses in industrial laundries

To avoid large energy losses, a steam trap management program should be put in place that:

- trains site staff or uses the services of a specialist provider
- inspects every steam trap on a regular basis (frequency depending on the pressure level: above 10 bar monthly, up to 10 bar quarterly and up to 2 bars yearly)
- assesses its operating condition
- maintains a database of all steam traps, both operational and faulty
- identifies the suitability of traps and ancillaries
- determines the cost of energy loss from failed traps
- acts on the assessment findings

In systems with a regularly scheduled maintenance program, leaking traps should account for less than 5% of the trap population.
To calculate the energy loss from faulty steam traps can be difficult. Losses from steam traps can be estimated based on the condition of each trap tested and the calculated steam flow that may result if it has failed, as determined from trap orifice size and steam pressure.

Schemes and diagrams



Scheme of a steam trap

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<table>
<tr><td>Economics</td><td colspan="2">Approx. 300 EUR for steam traps</td></tr>
<tr><td>Energy savings</td><td colspan="2">Up to 10% energy savings</td></tr>
<tr><td>Economic savings</td><td colspan="2">Steam trap leaks and failures can result in costs of thousands of EUR/years</td></tr>
<tr><td>Average Payback Time</td><td colspan="2">Less than 3 years
The payback time of the application of an effective steam trap maintenance program is about a year.</td></tr>
<tr><td>Emissions</td><td colspan="2">70mg NO_x/Nm^3
Exhaust-related emissions from steam generation systems</td></tr>
<tr><td>Environmental benefits</td><td colspan="2">Reduction of CO_2 and NO_x for lower energy needs for steam production</td></tr>
<tr><td>Main NEBs
(Multiple benefits)</td><td>☒ Environmental benefits
☐ Increased productivity
☒ Work environment/Health/Safety
☐ Increased competitiveness
☐ Maintenance</td><td>Faulty steam traps can leak steam which could present a safety hazard.</td></tr>
<tr><td>Replicability</td><td colspan="2">High</td></tr>
<tr><td>Related measures</td><td colspan="2">• STEA-01: Reduction of energy demand</td></tr>
<tr><td>Case study</td><td colspan="2">Steam trap management program, Sandoz GmbH (Austria, 2016)
• Initial Situation: Sandoz is one of the world's leading generic drug companies, encompassing a wide range of high-quality and affordable medicines. The Schaftenau plant is home to one of the most modern cell culture plants in Europe. The main energy-consuming units within the production processes are a) ventilation systems that are necessary to maintain optimal conditions within the premises and b) pure water and steam generators. These units are fundamental in the production of biopharmaceutical substances of the highest quality. Prior to the successful implementation of the initiatives, the total energy needs of cell culture in 2008 amounted to 20.77 GWh/year (heat: 15.01 GWh – electricity: 5.76 GWh).
• Description of the optimisation: a steam trap management program has been installed, involving a periodic review of all steam traps through ultrasonic</td></tr>
</table>

	measuring equipment. During the initial review in 2009, 9% of faulty traps were identified. This measure has led to energy savings of 500 MWh/year. • Implementation costs: not available • Payback Time: 1 year
References	Blessl and Kessler, 2017, Energieeffizienz in der Industrie, Springer Vieweg, DOI: 10.1007/978-3-662-55999-4 US Department of Energy. Energy Efficiency and Renewable Energy. Advanced Manufacturing Office: Energy Tips: Steam. Steam-tip Sheet #1, "Inspect and Repair Steam Traps" CRES, ISNOVA: STEAM UP WP4: TRAINING MATERIAL PREPARED BY CRES Steam Up, WP 3: The Steam Audit Methodology, 2016 Kulterer, K.: klimaaktiv Leitfaden für Energieaudits in Dampfsystemen, Österreichische Energieagentur im Rahmen des Programms des Lebensministeriums, Wien 2017 Kulterer, K.: klimaaktiv Messleitfaden I, Österreichische Energieagentur im Rahmen des Programms des Lebensministeriums, Wien 2015 Steam Up: D 7.5 Factsheet Steam Up Measures. https://steam-up.eu/sites/steam-up.eu/files/documents/d_7.5_factsheet_steam_up_measures_0.pdf Statistik Austria, 2019, Nutzenergieanalyse für 2017 DI Michael Schirmer, Spirax Sarco, personal communication (24.6.2011)

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