

ET 805.50

Determination of the vapour content



Learning objectives/experiments

- determining the vapour content using
 - ▶ a separating calorimeter with cyclone water separator
 - ▶ a throttling calorimeter with vapour depressurisation
- using an h-s diagram

Description

■ two different ways to determine the vapour content

The vapour content x is a dimensionless ratio between 0 and 1. It is defined by the ratio of mass of vapour and total mass. The total mass is calculated from the sum of fluid mass and vapour mass. If the vapour content is $x=0$, the evaporation medium is completely liquid, $x=1$ means dry saturated vapour, a value in between means wet steam with a variable liquid content. Separating and throttling calorimeters are used to determine the vapour content. In practice, devices to determine the vapour content are used in steam power plants, downstream of steam turbines or at steam boilers upstream of the superheater.

The ET 805.50 trainer uses a two-stage method to determine the vapour content. A separating calorimeter with cyclone water separator is used to determine vapour contents with a high liquid content ($0,5 < x < 0,95$). The liquid part is separated, cooled and collected in a measuring cup.

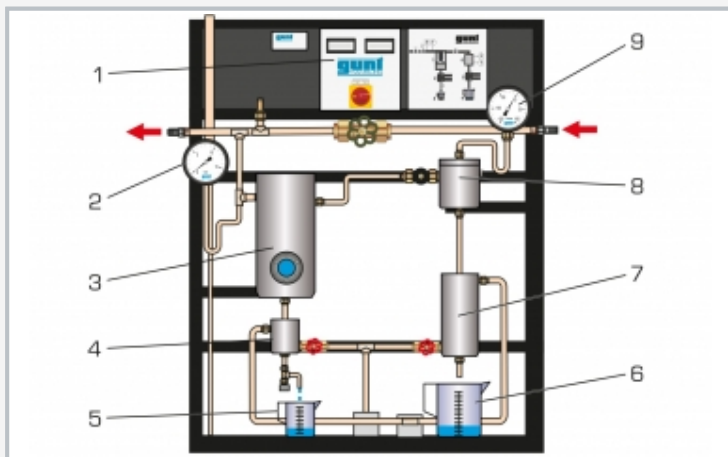
A downstream throttling calorimeter is used to determine vapour contents between $x=0,95$ and $x=1$. The wet steam is depressurised in this process. The remaining vapour part is depressurised and then liquefied in a water-cooled condenser and also collected in a measuring cup. The two quantities can be used to determine vapour mass and total mass to calculate the vapour content.

Sensors measure the pressure and temperature before and after depressurisation. The measuring results can be used to determine the vapour content with the h-s diagram.

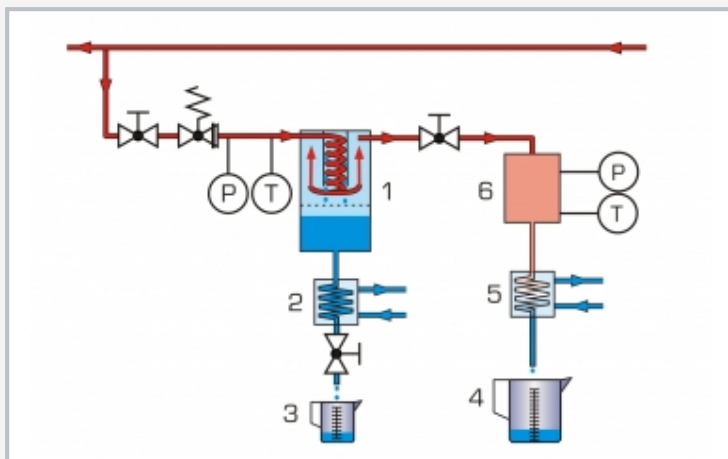
The water vapour has to be generated externally, e.g. with the electrical steam generator WL 315.02. To determine the vapour content of the steam power plants ET 805, ET 830, ET 850 or ET 833, ET 805.50 is recommended.

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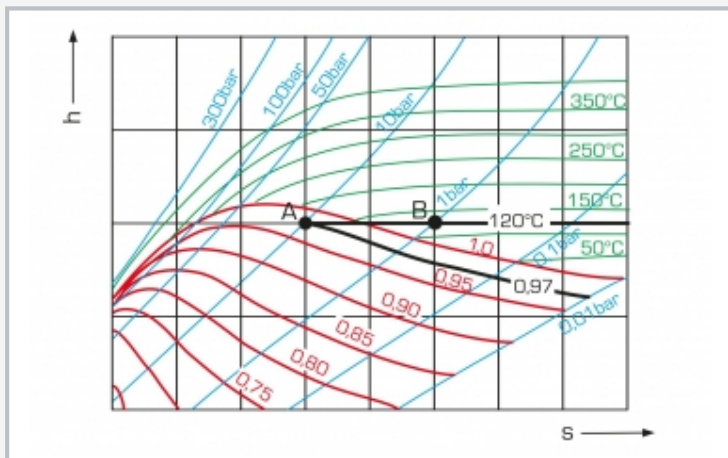
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1 displays for temperature, 2 vapour inlet manometer, 3 cyclone water separator, 4 cooler for separated water, 5 measuring cup for separated water, 6 measuring cup for liquefied vapour, 7 condenser, 8 tank for depressurising the vapour, 9 manometer for depressurisation process; red: vapour inlet and outlet



1 water separator with cyclone, 2 cooler, 3 measuring cup for separated water, 4 measuring beaker for liquefied vapour, 5 condenser, 6 tank for depressurising the vapour; red: wet steam, orange: depressurised steam, blue: water; P pressure, T temperature



h-s diagram; h enthalpy, s entropy; red: vapour content, green: temperature, blue: pressure; black: example of measuring result: A steam at 10bar, B steam after adiabatic depressurisation at 1bar, vapour content 0,97

Specification

- [1] two different ways to determine the vapour content
- [2] separating calorimeter for vapour content $0,5 < x < 0,95$, with water-cooled aftercooler
- [3] throttling calorimeter for vapour content $x > 0,95$, with water-cooled condenser
- [4] safety valve for safe operation
- [5] water vapour has to be supplied by an external steam generator, e.g. electrical steam generator WL 315.02
- [6] accessory for steam power plants ET 805, ET 830, ET 850 or ET 833

Technical data

Supplied steam

- max. temperature: 240°C
- max. pressure: 10bar

Safety valve: 10bar

Measuring ranges

- temperature: 0...400°C
- pressure (inlet): 0...16bar
- pressure (outlet): -150...100mbar

230V, 50Hz, 1 phase
 230V, 60Hz, 1 phase
 120V, 60Hz, 1 phase
 UL/CSA optional
 LxWxH: 890x800x1890mm
 Weight: approx. 90kg

Required for operation

steam: max. 10bar, 240°C
 water connection, drain

Scope of delivery

- 1 trainer
- 2 measuring cups
- 1 set of weights
- 1 set of instructional material

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Required accessories

060.31502 WL 315.02 Electrical steam generator 12kW