Pharmatec GmbH
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Pure Steam for Pharmaceutical Sterilizers

Albrecht Voigt / Pharmatec GmbH
Steam for Pharmaceutical Application

**Content:**

- Classification of steam
- Characteristic of Quality / Differences of Quality Standards and Guidelines for Steam
- Typical Applications for Steam

- Package Unit Pure Steam Generator
- Different types of evaporators
- Package Unit Pure Steam Generator with Membrane Degassing System
- Package Unit Pure Steam Generator with Thermic Degassing System
- Measurement of Non-Condensable Gases according to EN 285
- Measurement of Steam Quality according to EN 285
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Classification

- Plant Steam
- Industrial Steam
- Utility Steam
- Technical Steam
- Process Steam
- Clean Steam
- Pure Steam
- Pharmaceutical Steam
Classification

- **Plant Steam:**
  Plant Steam is steam used for heating systems and **not** be in contact with sterile goods.

- **Process Steam:**
  Process Steam is steam produced from pre-treated water, which contains **no** parts from corrosion-inhibitors and anti-scaling-additives.
  Process steam is steam with small soiling, suitable for direct effect on sterilizer goods like group I according DIN 58950.

- **Pure Steam (Clean Steam):**
  Pyrogen free dry, saturated Steam that is generally produced by a Pure Steam Generator and which when condensed shall meet the requirements of WFI.
  Pure steam is steam with small soiling, suitable for direct effect on sterilizer goods like group II according DIN 58950.
## Characteristic of Quality / Differences of Quality

<table>
<thead>
<tr>
<th>Quality of Steam</th>
<th>Plant Steam</th>
<th>Process Steam</th>
<th>Pure Steam</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chemical requirements</strong></td>
<td>Only examples from important values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH-value</td>
<td>no declaration</td>
<td>6-8</td>
<td>5-7</td>
</tr>
<tr>
<td>Conductivity</td>
<td>no declaration</td>
<td>max. 10 µS/cm</td>
<td>1,1 µS/cm (20°C)</td>
</tr>
<tr>
<td>Non-condensable gases</td>
<td>no declaration</td>
<td>&lt;40 ml/ kg</td>
<td>&lt;40 ml/ kg</td>
</tr>
<tr>
<td><strong>Chemical requirements</strong></td>
<td>Only examples from important values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature, pressure</td>
<td>correlation with dry saturated steam</td>
<td>correlation with dry saturated steam</td>
<td>correlation with dry saturated steam</td>
</tr>
<tr>
<td>Moisture</td>
<td>&lt; 10%</td>
<td>&lt; 5%</td>
<td>&lt; 5%</td>
</tr>
<tr>
<td>Superheat</td>
<td>&lt; 10°C</td>
<td>&lt; 5°C</td>
<td>&lt; 5°C</td>
</tr>
<tr>
<td><strong>Biological requirements</strong></td>
<td>Only examples from important values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bacterial endotoxins</td>
<td>no test</td>
<td>no test</td>
<td>&lt;0,25 EU/ml</td>
</tr>
</tbody>
</table>
## Characteristic of Quality / Differences of Quality

According DIN 58950-7

<table>
<thead>
<tr>
<th>sterilizer goods group</th>
<th>I</th>
<th>II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples for sterilized goods</td>
<td>Clothes and textiles in general, sterile equipment and material for Labs, material not in contact with product in sterile areas, parenteral solutions in closed containers, ophthalmic</td>
<td>Clean room clothes, Primary packing material for parenteral and ophthalmic, solutions for aseptic produced pharmaceuticals in open containers, Equipment-parts, instruments, containers and material in sterile rooms</td>
</tr>
<tr>
<td>Quality of steam</td>
<td>Process steam</td>
<td>Pure steam</td>
</tr>
</tbody>
</table>
Standards and Guidelines for Steam

Where we can find important Definitions:

Part 7: Requirements on services and installation


ISPE Water Steam Guide


HTM 2010 Sterilization – Steam Sterilizers – Large Sterilizers

In European Standard EN 285 (and HTM 2010) we can read:

“The sterilizer shall be designed to operate with dry saturated steam containing not more than 3.5 \% V/V non-condensable gases ...”

What is the difference between EN 285 and HTM 2010?

HTM 2010 is a UK National Health Document. It has been created awaiting EN 285.

EN 285 is based upon HTM 2010 and is the European standard for sterilization and steam sterilizers, it describes the steam quality tests and is regarded as the definitive reference.
Pure Steam Monograph (USP 29, valid since 01.04.2006)

Pure Steam is water that has been heated above 100 degrees Celsius and vaporized in a manner that prevents source water entrainment. It is prepared from water complying with the U.S. EPA NDWWR, or with drinking water regulations of the EU, Japan or with WHO drinking water guidelines. It contains no added substance.

The level of steam saturation or dryness, and the amount of non-condensable gases are to be determined by the Pure Steam application.

[Note: Pure Steam is intended for use where the steam or its condensate comes in contact with the article or the preparation. Pure Steam quality is difficult to assess in its vapour form; therefore its condensate is used to test its quality. The process used to collect the condensate for analysis must not adversely impact these quality attributes.]

Bacterial endotoxins: (85): The condensate contains less than 0.25 EU/ml.

Total organic carbon (643): The condensate meets the requirement.

Water conductivity (645): The condensate meets the requirement.
Typical Applications

<table>
<thead>
<tr>
<th>Kind of Steam</th>
<th>Examples for application</th>
<th>Branch of Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Steam</td>
<td>Heat up from liquids, Warm Water Generation, Pure Steam Generation, WFI-Generation with WFI-stills</td>
<td>Food Industry, Pharmaceutical Industry, Biotechnology, Hospitals</td>
</tr>
<tr>
<td>Process Steam</td>
<td>SIP, air-humidifying in clean rooms, Sterilization from CIP-equipment, Sterilization from aseptic equipment, pipes, storage tanks</td>
<td>Food Industry, Pharmaceutical Industry, Biotechnology, Hospitals</td>
</tr>
<tr>
<td>Pure Steam</td>
<td>Sterilization of product, SIP from process tanks, air-humidifying in „critical clean rooms“</td>
<td>Pharmaceutical Industry, Biotechnology</td>
</tr>
</tbody>
</table>
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Package Unit Pure Steam Generator
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Package Unit Pure Steam Generator

- **WFI / Pure Steam**
  - Germs: 10 cfu / 100 ml
  - Endotoxins: < 0.25 EU / ml

- **USP 30**
  - TOC: 0.5 mg / l as total
  - Conductivity: 1.1 µS/cm at 20°C

- **Ph. Eur. Status 2000**
  - TOC: 0.5 mg / l limited for a number of substances
  - Conductivity: 1.1 µS/cm at 20 °C
Falling Film Heat Exchanger / Thin Film Heat Exchanger
Pharmatec GmbH

External Heat Exchanger
Integrated Natural Circulation Heat Exchanger

Integrated Natural Circulation Heat Exchanger

Integrated Natural Circulation Heat Exchanger
Function of the column

Industrial steam

Pure steam

Automatic water circulation

Condensate
pyrogen removal

pyrogens separated from pure steam
Package Unit Pure Steam Generator with Degassing System

→ **Non-condensable gases (inert gases):**

Mainly NH₃ (Ammonia), CO₂, N₂, O₂ and halogenated Hydrocarbons

Why we have to test non-condensable gases?

EN 285: The steam quality test, non-condensable gases, is used to demonstrate that the level of non-condensable gases contained in the steam will not prevent the attainment of sterilization conditions in any part of the sterilizer load.
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Package Unit Pure Steam Generator with Membrane Degassing System
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Package Unit Pure Steam Generator with Membrane Degassing System
Operating Modes

By changing the partial pressure of the gas we can either remove from or dissolve gas into water.

- Lower the partial pressure, the gas will be removed from the water
- Increase the partial pressure, the gas will dissolve into the water
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Membrane Degassing System

Extra-Flow Membrane Contactor

- Patented Design
- FDA Compliant
  (With Appropriate O-Rings)

www.liqui-cel.com
**Reference**

**Pure steam generator 500**

**IVAX, UK**

Performance: detail engineering, design, technology and software development, manufacturing, assembly, start-up

Project term: 6 months

FAT: at Pharmatec

Assembly on site: 1 day

Qualification: complete IQ/OQ

Manufacturer: Pharmatec/2003

Performance of the pure steam generator 1,000 kg/h at 6 bar (g) heating steam pressure; 2.5 bar (g) pure steam pressure. With integrated vacuum degassing.
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Package Unit Pure Steam Generator with Thermic Degassing System
Pharmatec GmbH

Package Unit Pure Steam Generator with Thermic Degassing System
Pharmatec GmbH

Package Unit Pure Steam Generator with Thermic Degassing System
Pharmatec GmbH

Package Unit Pure Steam Generator with Thermic Degassing System

Reference

Pure steam generator PSG 800 with thermal degassing
Sanofi-Aventis Deutschland GmbH

Units

Performance: detail engineering, design, technology and software development, manufacturing, assembly, start-up
Project term: 6 months
FAT: at Pharmatec
Assembly on site: 1 day
Qualification: complete IQ/OQ
Manufacturer: Pharmatec/2005

Performance of the pure steam generator 4,000 kg/h at 9 bar (g) heating steam pressure, 3 bar (g) pure steam pressure.
With thermal degassing (buffer vessel, pre-heater, vacuum unit) for the generation of high-purity steam in compliance with EN 285 and HTM 2010.
Different Types of Pure Steam Generators

<table>
<thead>
<tr>
<th>Type</th>
<th>pure steam pressure [barg]</th>
<th>Quantity of pure steam (kg/h) at heating steam pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>4 bar g</td>
</tr>
<tr>
<td>PSG 50 E</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>PSG 100 E</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>PSG 200 E</td>
<td>2</td>
<td>200</td>
</tr>
<tr>
<td>PSG 200</td>
<td>2</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>PSG 300</td>
<td>2</td>
<td>190</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>PSG 400</td>
<td>2</td>
<td>375</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>PSG 500</td>
<td>2</td>
<td>480</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>170</td>
</tr>
<tr>
<td>PSG 600</td>
<td>2</td>
<td>690</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>240</td>
</tr>
<tr>
<td>PSG 650</td>
<td>2</td>
<td>1130</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>400</td>
</tr>
<tr>
<td>PSG 700</td>
<td>2</td>
<td>1650</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>505</td>
</tr>
<tr>
<td>PSG 800</td>
<td>2</td>
<td>2110</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>740</td>
</tr>
<tr>
<td>PSG 1000</td>
<td>2</td>
<td>2630</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>915</td>
</tr>
</tbody>
</table>
Measurement of non-condensable gases according to EN 285
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Measurement of non-condensable gases according to EN 285
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Measurement Steam Quality according to EN 285

Measurement of Non-Condensable Gases
Measurement of Steam Dryness Value
Measurement of Superheat