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BOSCH

Expert's Congress 13.-14.09.2007

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

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

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

Characteristic of Quality / Differences of Quality

According DIN 58950-7

sterilizer goods group	I	II
Examples for sterilized goods	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	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
Quality of steam	Process steam	Pure steam

Standards and Guidelines for Steam

→ Where we can find important Definitions:

DIN 58950 (2003) Sterilization – Steam sterilizers for pharmaceutical products
Part 7: Requirements on services and installation

DIN EN 13824 (2005) Sterilization of medical devices – Aseptic processing of
liquid medical devices – Requirements

ISPE Water Steam Guide

DIN EN 285 (2006) Sterilization – Steam Sterilizers – Large Sterilizers

HTM 2010 Sterilization – Steam Sterilizers – Large Sterilizers

USP 29-NF24 Supplement No.1 (2006)

Standards and Guidelines for Steam

→ 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.

Standards and Guidelines for Steam

→ 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 NDWR, 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

Kind of Steam	Examples for application	Branch of Industry
Plant Steam	Heat up from liquids, Warm Water Generation, Pure Steam Generation, WFI-Generation with WFI-stills	Food Industry, Pharmaceutical Industry, Biotechnology, Hospitals
Process Steam	SIP, air-humidifying in clean rooms, Sterilization from CIP-equipment, Sterilization from aseptic equipment, pipes, storage tanks	Food Industry, Pharmaceutical Industry, Biotechnology, Hospitals
Pure Steam	Sterilization of product, SIP from process tanks, air-humidifying in „critical clean rooms“	Pharmaceutical Industry, Biotechnology



Package Unit Pure Steam Generator

→ WFI / Pure Steam

Germes:	10 cfu / 100 ml
Endotoxins:	< 0.25 EU / ml

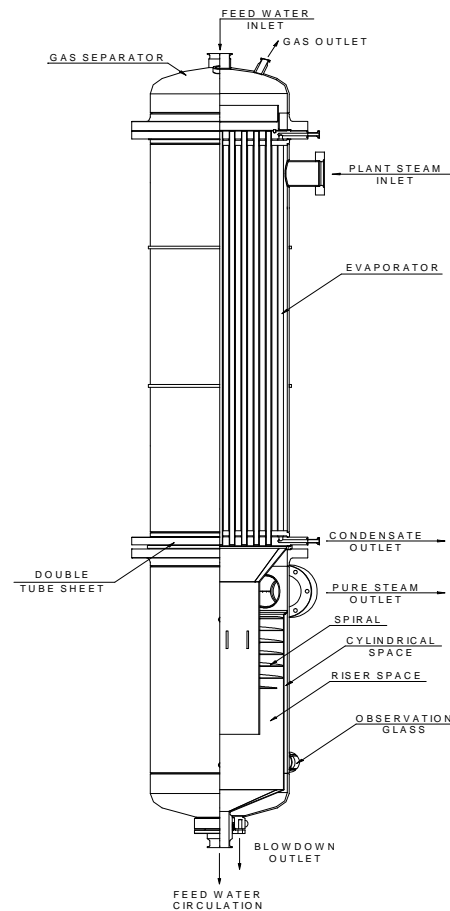
→ USP 30

TOC	0.5 mg / l as total
Conductivity	1.1 µS/cm at 20°C

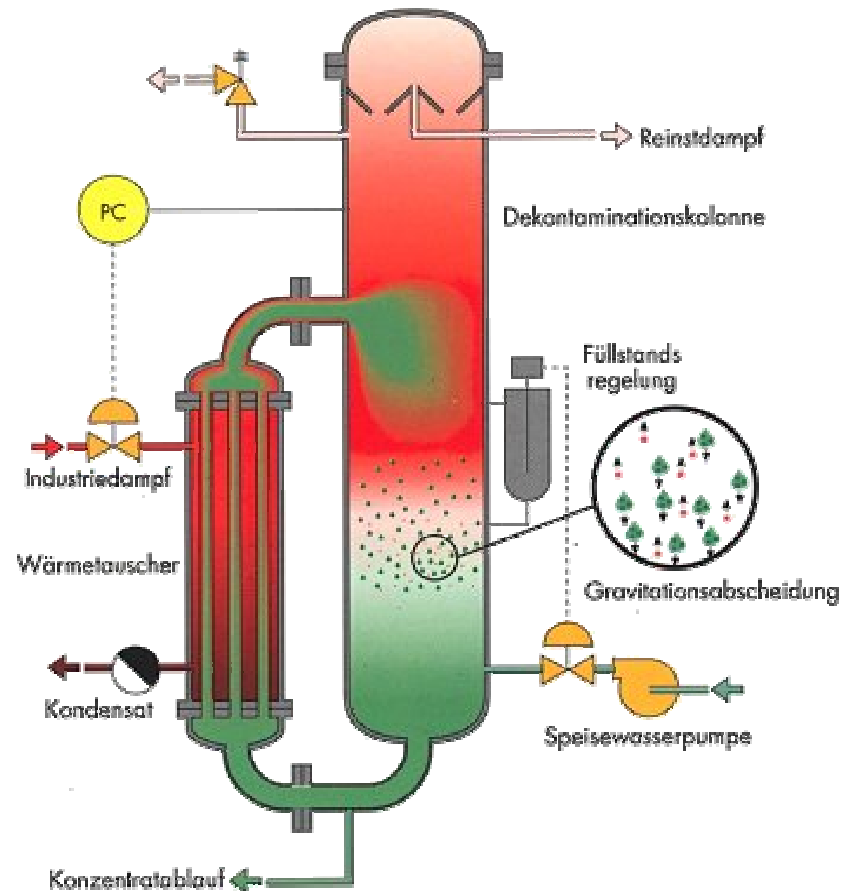
→ Ph. Eur. Status 2000

TOC	0.5 mg / l limited for a number of substances
Conductivity	1.1 µS/cm at 20 ° C

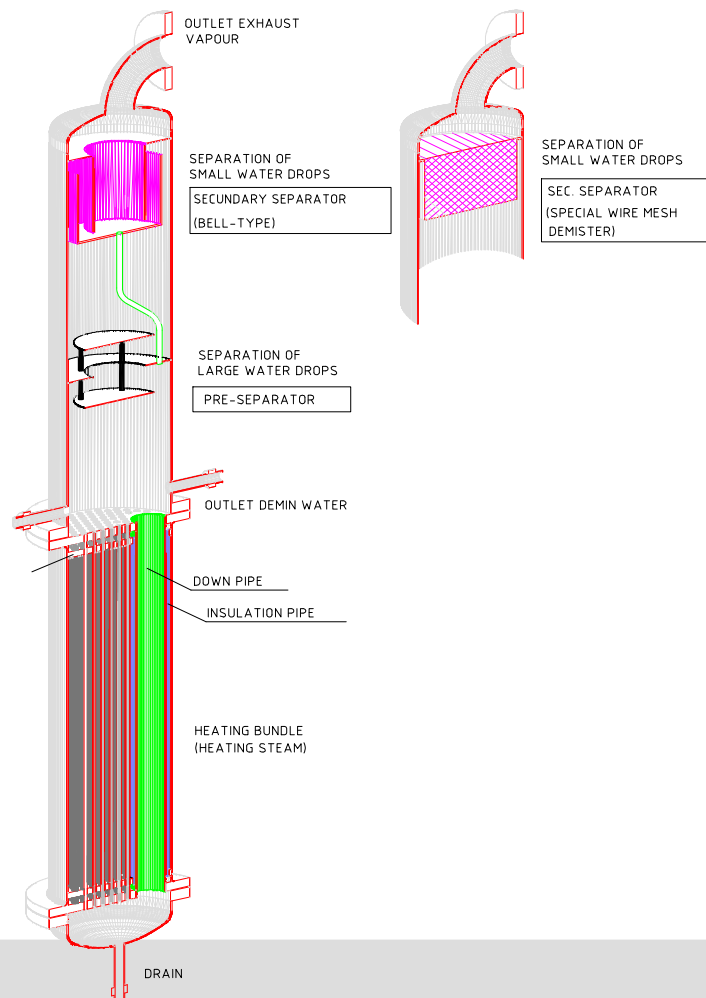
→ Falling Film Heat Exchanger / Thin Film Heat Exchanger



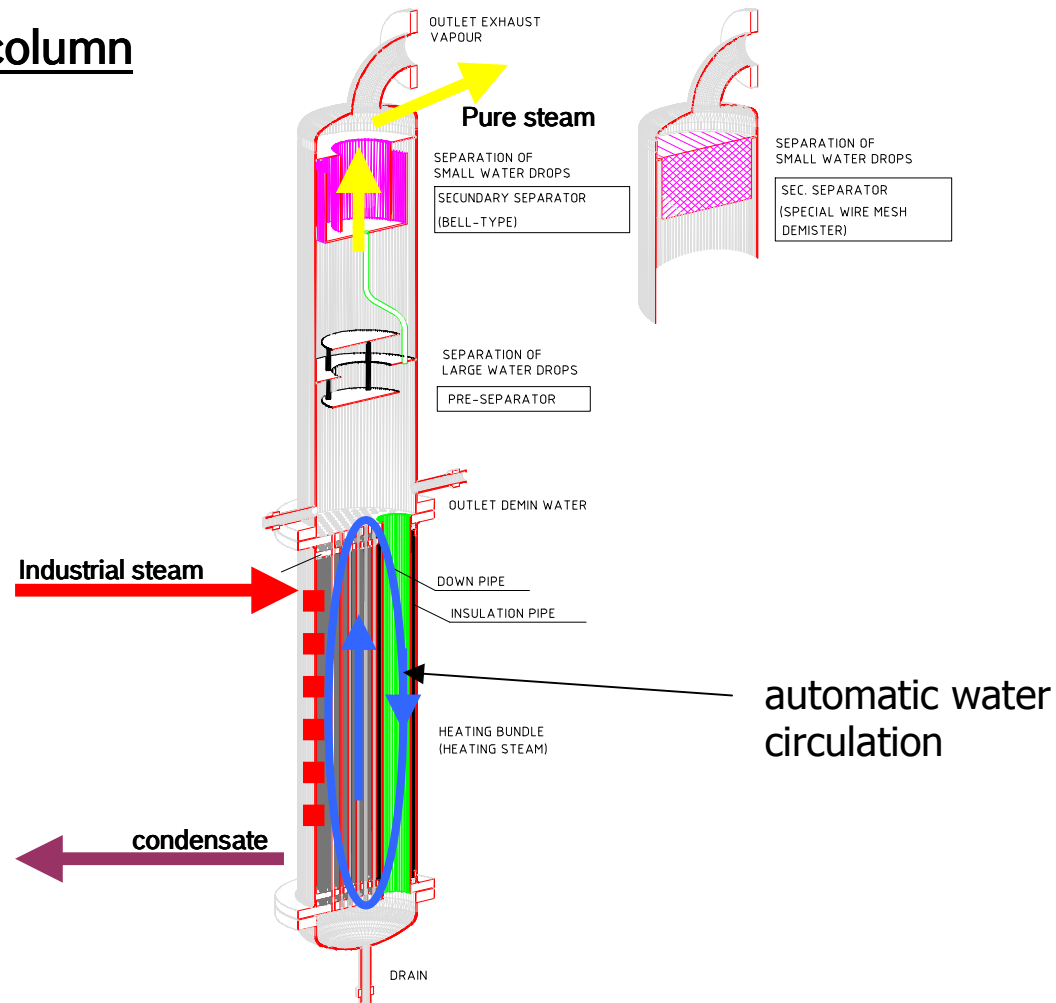
→ External Heat Exchanger

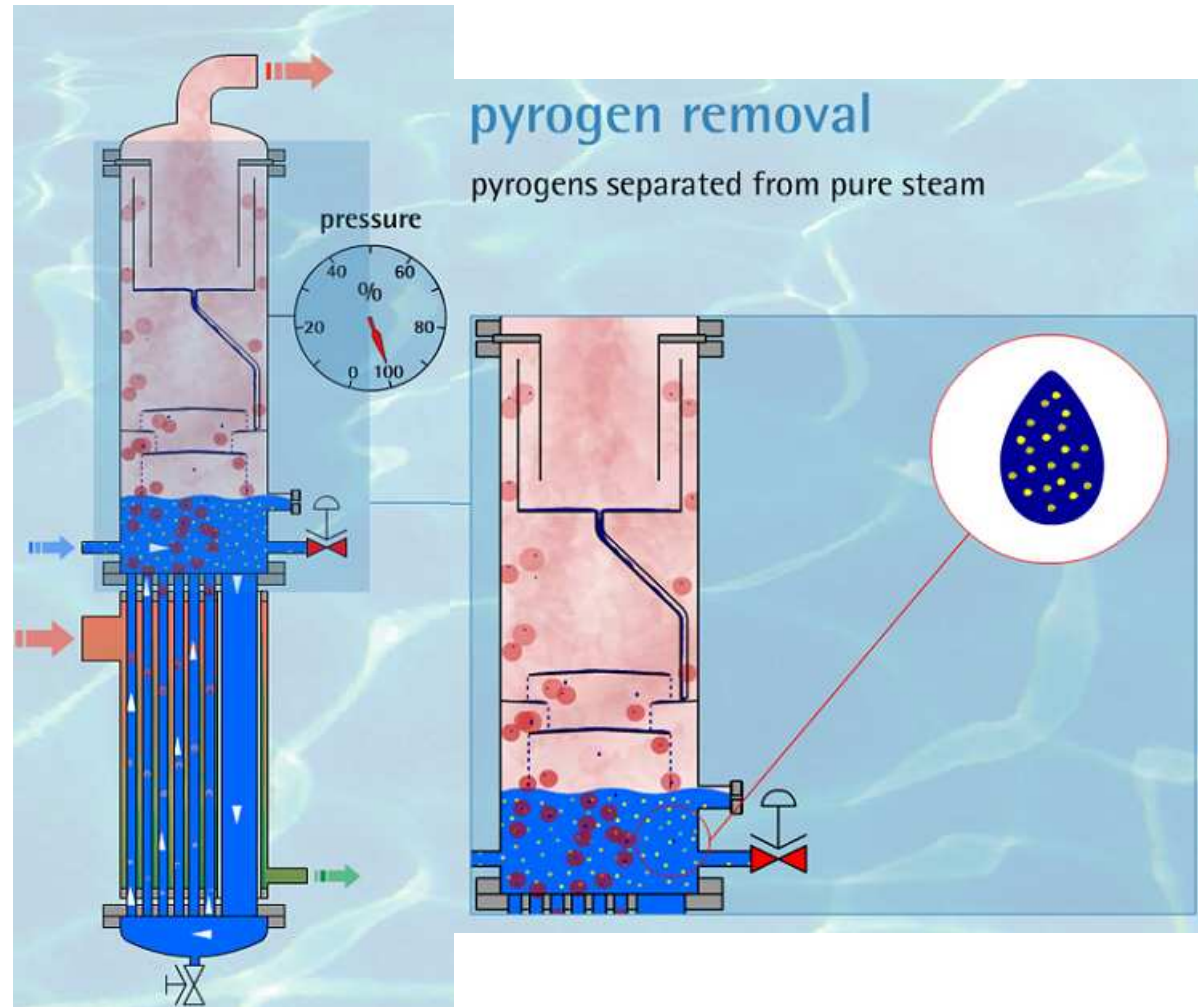


→ Integrated Natural Circulation Heat Exchanger



→ Function of the column





Package Unit Pure Steam Generator with Degassing System

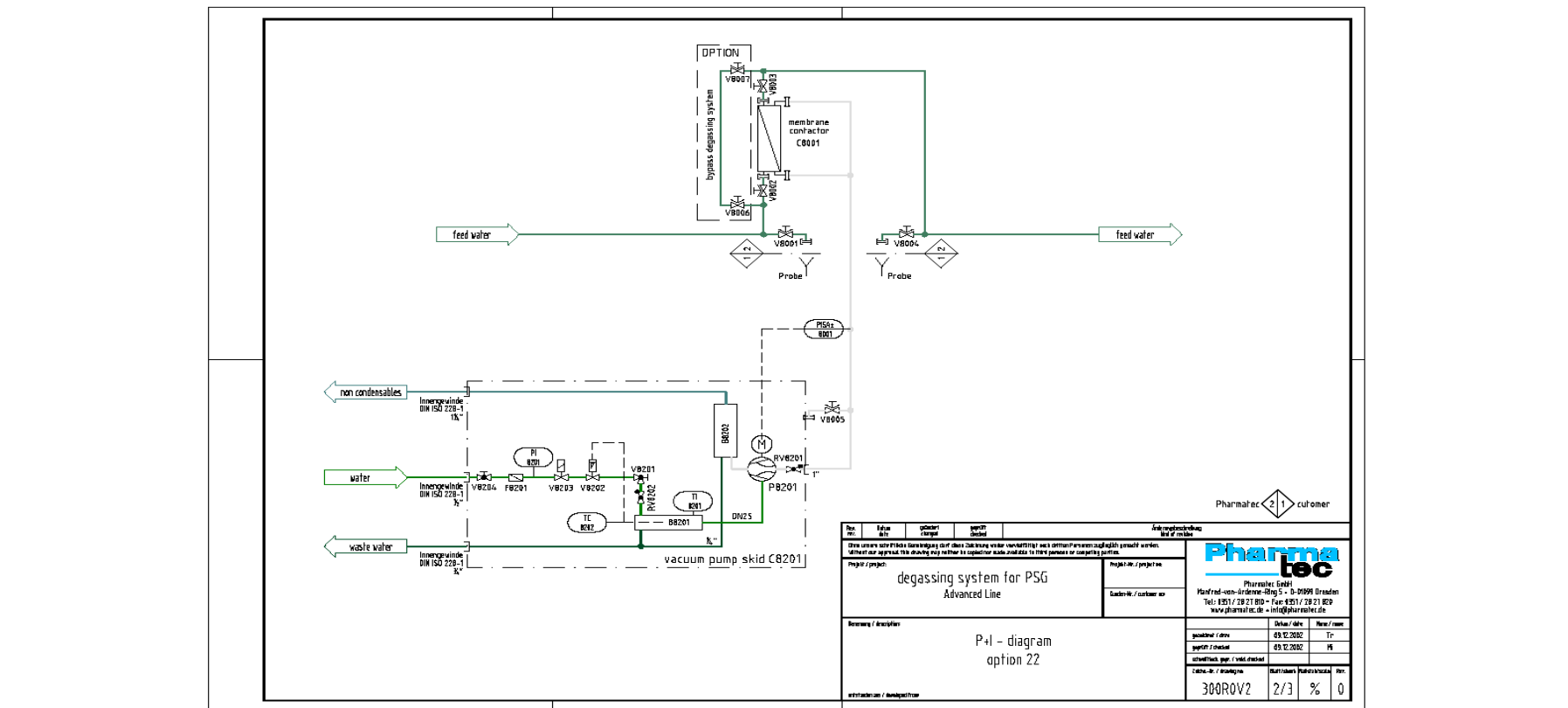
→ Non-condensable gases (inert gases):

Mainly NH_3 (Ammonia), CO_2 , N_2 , O_2 and halogenated Hydrocarbons

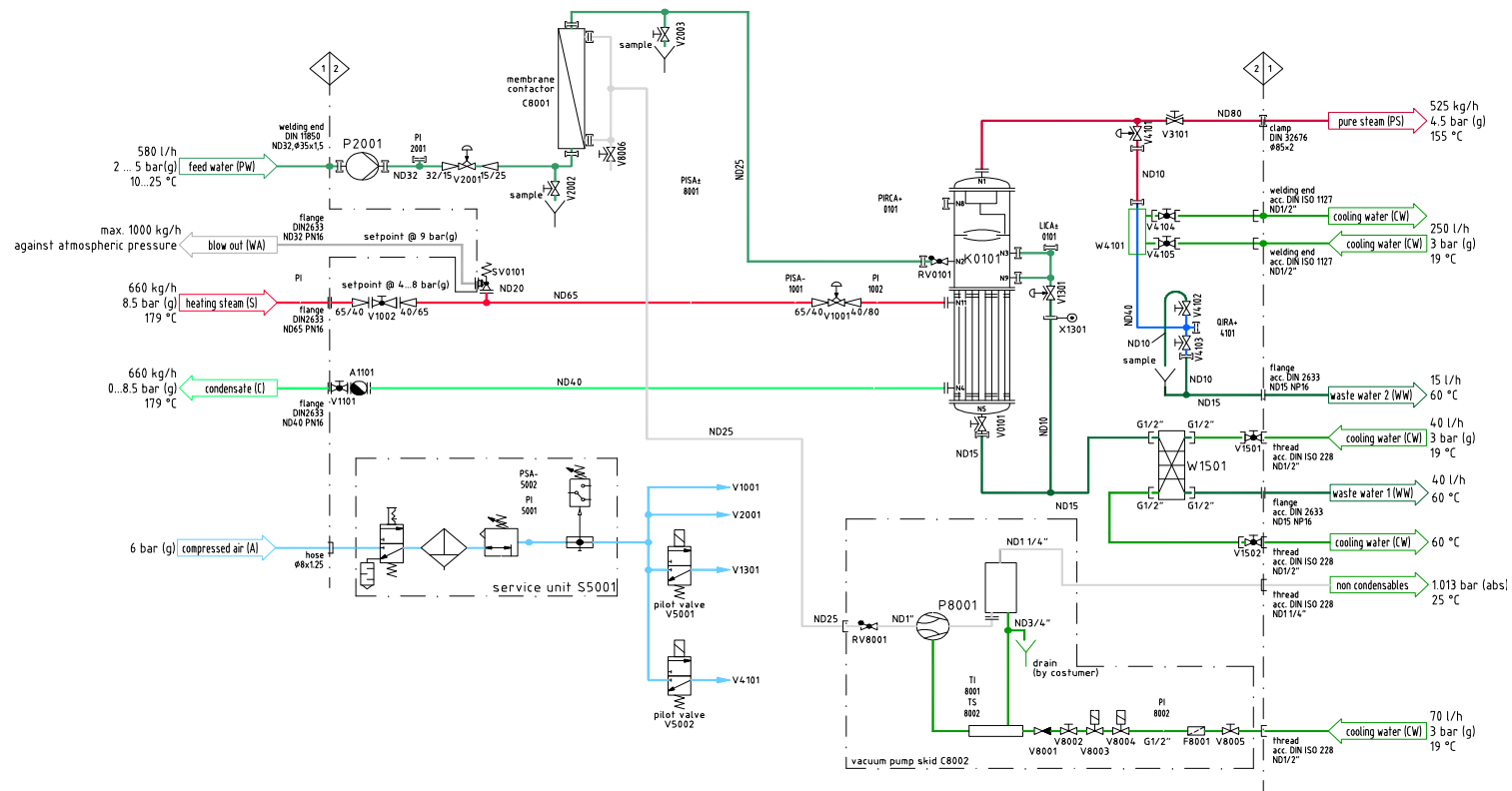
Why we have to test non-condensable gases?

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.

Package Unit Pure Steam Generator with Membrane Degassing System



Package Unit Pure Steam Generator with Membrane Degassing System



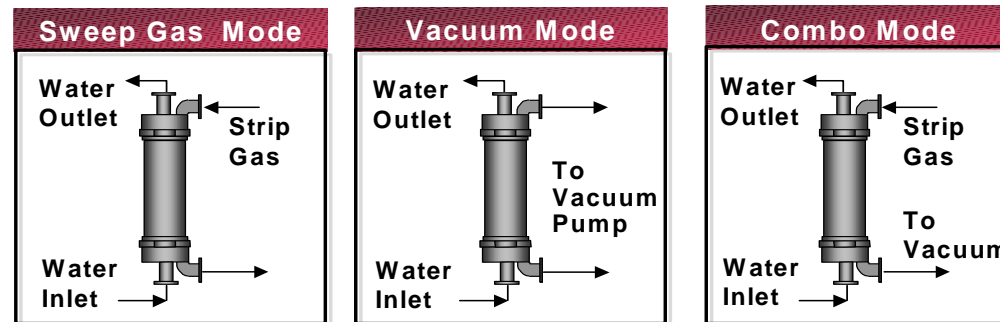
Membrane Degassing System

MEMBRANA
Underlining Performance

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



Liqui-Cel®
Membrane Contactors

www.liqui-cel.com

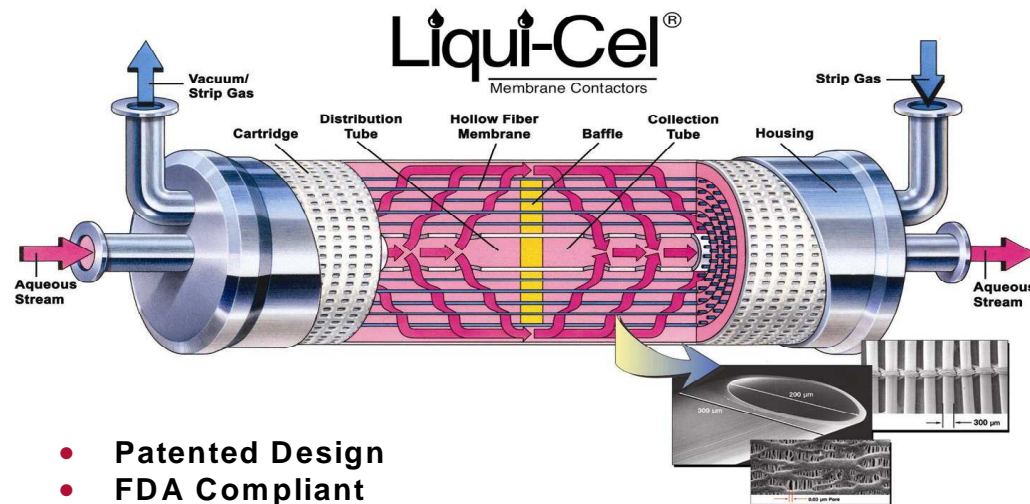
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P56 UPW2002.Rev-3 (8-02)

Membrane Degassing System

MEMBRANA
Underlining Performance

Extra-Flow Membrane Contactor



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

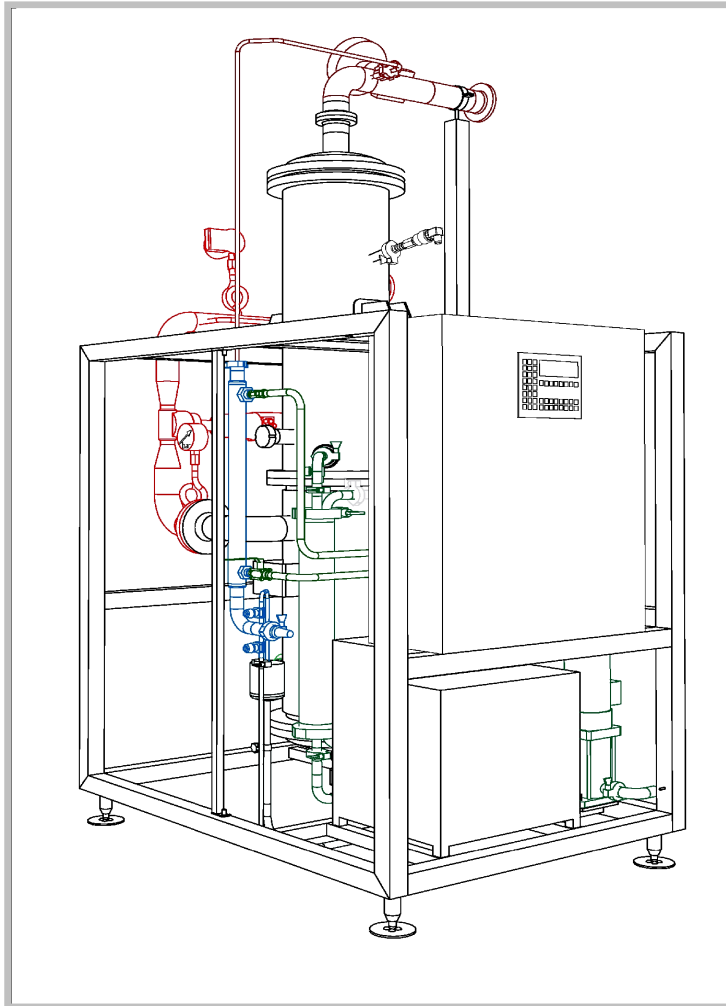
Liqui-Cel®
Membrane Contactors

www.liqui-cel.com

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P56 UPW2002.Rev-3 (8-02)

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Reference

Pure steam generator 500
IVAX, UK

Units



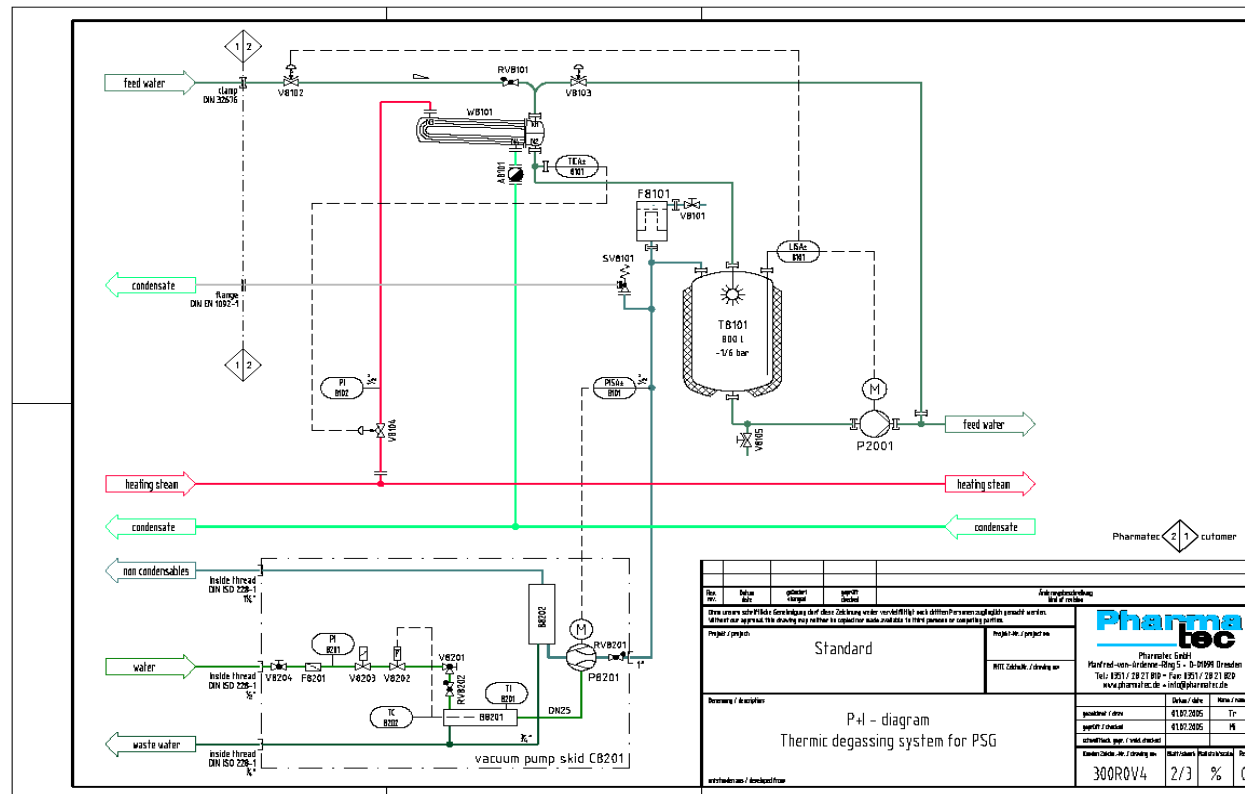
Performance	: detail engineering, design, technology and software development, manufacturing, assembly, start-up
Project term	: 6 months
FAT	: at Pharmatec
Assembly on site	: 1 day
Qualification	: complete IQ/OQ
Manufacturer	: Pharmatec/2003

Performance of the pure steam generator 1.000 kg/h at 8 bar (g) heating steam pressure; 2,5 bar (g) pure steam pressure.
With integrated vacuum degassing.

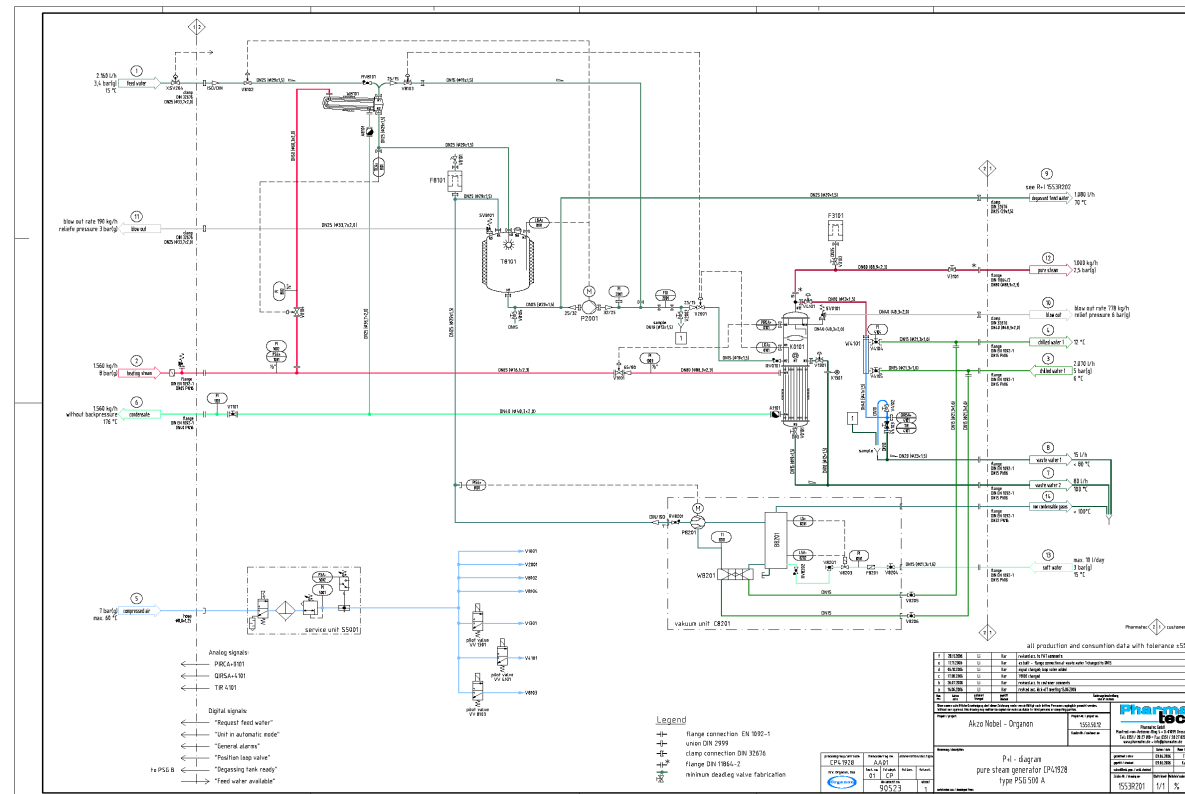
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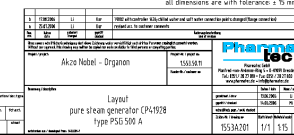
Stand: 04/2003

Package Unit Pure Steam Generator with Thermic Degassing System



Package Unit Pure Steam Generator with Thermic Degassing System





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.

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Different Types of Pure Steam Generators

Type	pure steam pressure [barg]	Quantity of pure steam (kg/h) at heating steam pressure		
		4 bar g	6 bar g	8 bar g
PSG 50 E	2	50		
PSG 100 E	2	100		
PSG 200 E	2	200		
PSG 200	2	45	80	105
	3	-	50	80
PSG 300	2	190	325	410
	3	-	220	330
PSG 400	2	375	650	730
	3	-	440	660
PSG 500	2	480	855	1120
	3	170	600	890
PSG 600	2	690	1230	1605
	3	240	860	1280
PSG 650	2	1130	2000	2905
	3	400	1405	2085
PSG 700	2	1650	2650	3800
	3	505	2000	3250
PSG 800	2	2110	3770	4940
	3	740	2630	3930
PSG 1000	2	2630	4735	
	3	915	3290	4950

Measurement of non-condensable gases according to EN 285



Measurement of non-condensable gases according to EN 285



Measurement Steam Quality according to EN 285

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

