

DUMAG® - Swirl Preheater SPH unit

A combination of

**Burner + Combustion chamber + Swirl device
with high swirl effect + Homogenizer**

for direct heating of air or flue gases



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1. Application

The DUMAG swirl preheater SPH follows an innovative system for heating gases in the combustion chamber with burner and an energy-saving swirl device as well as a homogenization section which has been developed into a compact unit.

The system is supplied as a compact unit. Although in these documents types of units are specified, each unit is individually designed and adapted to the need.

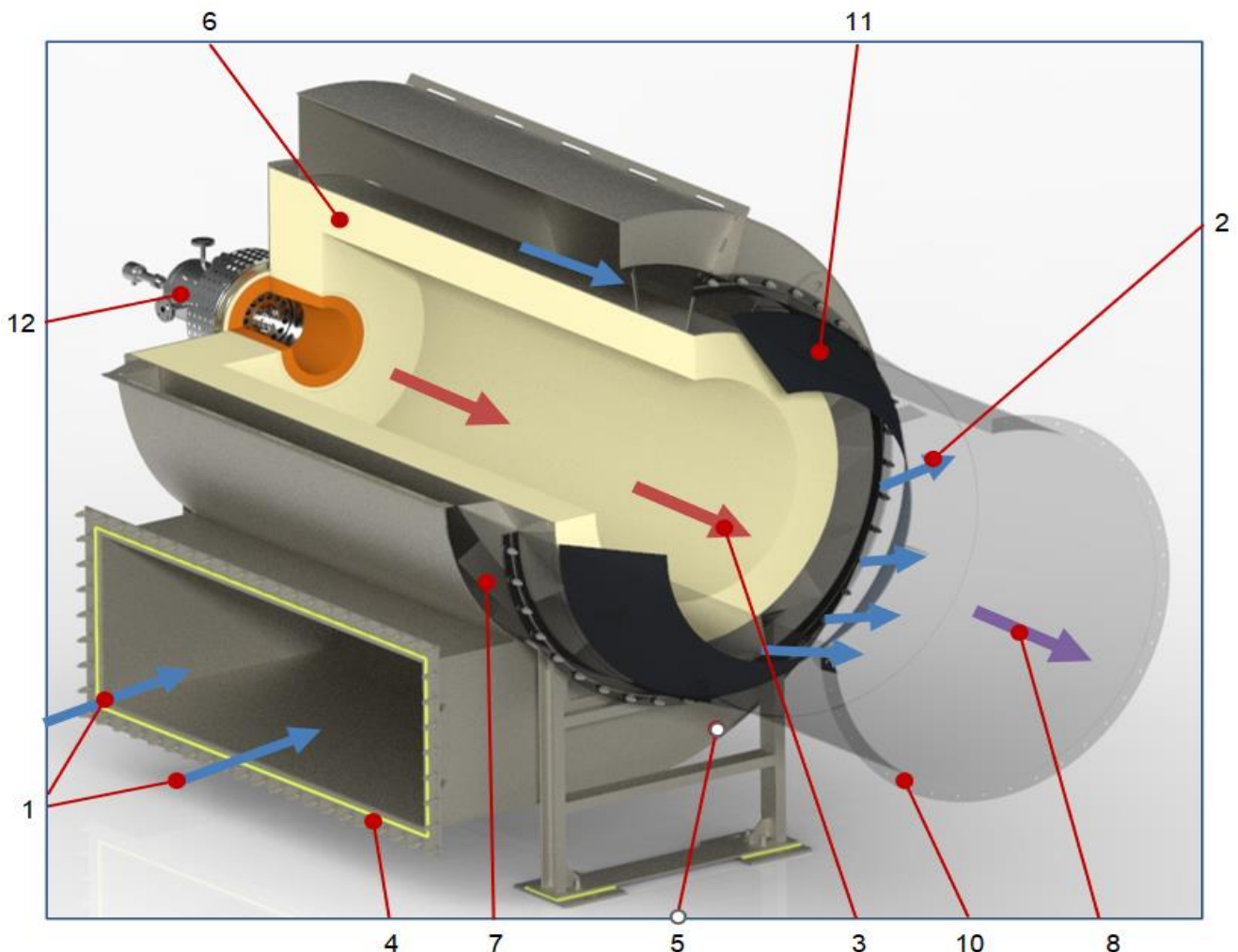
In this design, great efforts were made to realize an optimum degree of mixing, the avoidance of hot spots, a low pressure drop and a short overall length.

The use of this SPH is useful when gases have to be heated directly as in a hot gas generator.

This SPH offers a particular advantage when flue gases from an RTO or a combustion chamber for liquid or gaseous waste have to be reheated after the heat exchanger in order to supply them to the SCR at the correct temperature. In SCR's it is particularly important that the flue gas is supplied as homogeneously as possible - in terms of temperature and mixture of media - so that the denitrification produces optimum results.

This SPH is characterized by particularly low pressure drop due to its design with spiral inlet and individual calculation of each swirl preheater.

2. Description of the Swirl Preheater SPH



Legend

- | | |
|--|--|
| 1 Inlet gas to be heated | 7 Swirl channel for gas to be heated |
| 2 Exit gas to be heated | 8 Flue gas - to be heated gas mixture to the homogenization line |
| 3 Flue gas from combustion chamber | 9 Thermocouples (see picture next page) |
| 4 gas to be heated - connecting flange | 10 Connection flange homogenization line |
| 5 gas to be heated: spiral feed | 11 Mixing chamber section for mixing the flue gas with the gas to be heated. |
| 6 combustion chamber in refractory lining made of refractory concrete or ceramic fiber | 12 DUMAG burner for gas or light oil |

Subject to change without notice

vers. 11

15.01.2024

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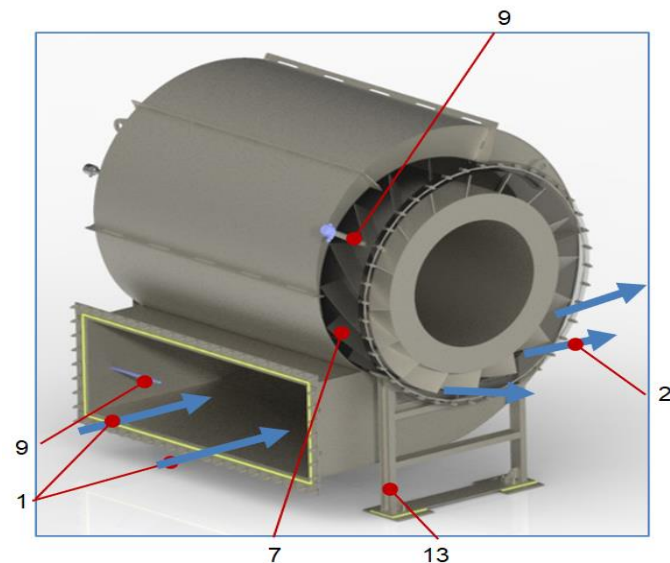
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Continued description

- 1 Inlet gas to be heated
- 2 Outlet of gas to be heated
- 7 Swirl channel for gas to be heated
- 9 Thermocouples
- 13 Support



3. Function

Path of the gas to be heated

The gas to be heated (air or flue gas from combustion plants) [1] enters the spiral gas supply to be heated [5] via the connecting flange [4].

Due to the spiral arrangement of the gas supply, firstly a uniform distribution of the gas to be heated is achieved for entry into the swirl channel. Secondly, the pressure loss of the entire system is reduced.

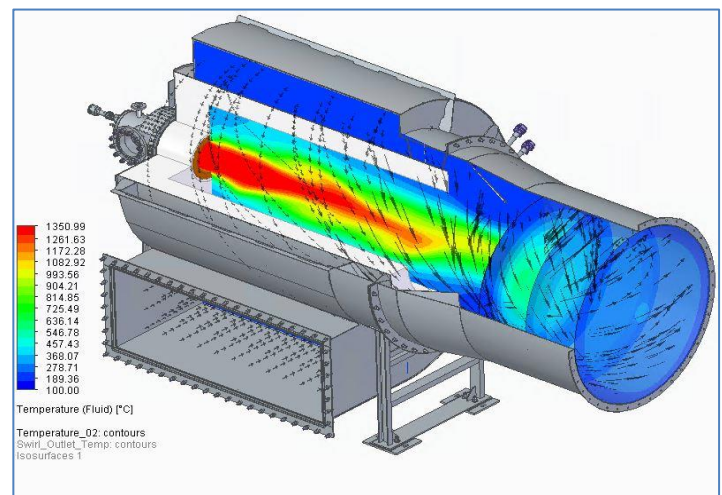
This was confirmed and optimized via extensive CFD simulations.

The gas to be heated reaches the subsequent mixing chamber [11] via the swirl channel [7].

Burner [12] and Combustion chamber [6]

The necessary flue gas is generated with a DUMAG burner [12]. The burner is operated either with fuel gas or light oil. A combined fuel gas/light oil burner can also be used. The burner can be provided as a standard or as a lowNOx burner.

The flue gas is fed into the mixing chamber [11] via the combustion chamber [6]. The combustion chamber is lined with either refractory bricks, refractory concrete or ceramic fibers. Design at least 1450°C



Mixing chamber [11]

In the mixing chamber, the gas stream [2] to be heated is mixed with the flue gas of the burner [3].

Mixing takes place due to high turbulence, which the swirl of the swirl channel [7] imparts to the gas stream [2] to be heated the appropriate mixing energy to achieve a homogeneous mixture with the flue gas of the burner.

Due to the uniform distribution of mixed gas, there are no hot spots on the flue gas pipe or on the homogenization section.

The optimization of homogenization as a function of pressure drop was determined in extensive CFD studies.

Homogenization line (following flange [10])

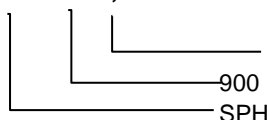
After the Swirl Preheater SPH, one or more lines of the DUMAG homogenization line can be used to increase the degree of homogenization.

Specific design of the DUMAG Swirl Preheater SPH

Each application of a swirl preheater is designed individually. The type series given in chapter 7 is only intended as an example to give an idea of the size of a device.

Example of the designation of a Swirl Preheater SPH

SPH900-0,9



ca. \varnothing Acc [m] of the inner diameter from the Combustion chamber of the Swirl Preheater

Capacity in kW from the burner for Swirl Preheater

Swirl Preheater

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4. Applied standards, regulations and rules, depending on the design of the burner

The standards are applied depending on the design of the equipment.

EN 746-1	Industrial thermo processing equipment – Common safety requirements for industrial thermo processing equipment
EN 746-2	Industrial thermo processing equipment – Safety requirements for combustion and fuel handling systems
EN 12952-8	Water-tube boilers and auxiliary installations – Part 8: Requirements for firing systems for liquid and gaseous fuels for the boiler
EN 12952-16	Water tube boilers and auxiliary installations – Part 16: Requirements for grate and fluidized bed firing systems for solid fuels for the boiler
EN 50156-1	Electrical equipment for furnaces and ancillary equipment. (VDE 0116)
TRG	Technical Rules for Pressurized Gases
TRbF	Technical Rules for flammable liquids
2014/68/EU	Pressure Equipment Directive
2006/42/EC	Machinery directive
API 535	Standard for burners for fired heaters in General Refinery Services
API 560	Standard for design and manufacture of fired heaters
API 660	Shell and Tube Heat exchangers for General Refinery Services.
ASME VIII/Div.1	American Boiler and Pressure Vessel Code. Regulation for Design and Construction
API RP 582	Recommended Practice and Supplementary Welding Guidelines for the Chemical, Oil, and Gas Industries
ASME B31.2 (NFP AZ223.1)	Regulation of Fuel Gas Piping
ASME B31.3	Regulation of Process Piping
ASME IX	Welding Qualifications
ASTM	Material Specifications

5. Certificates

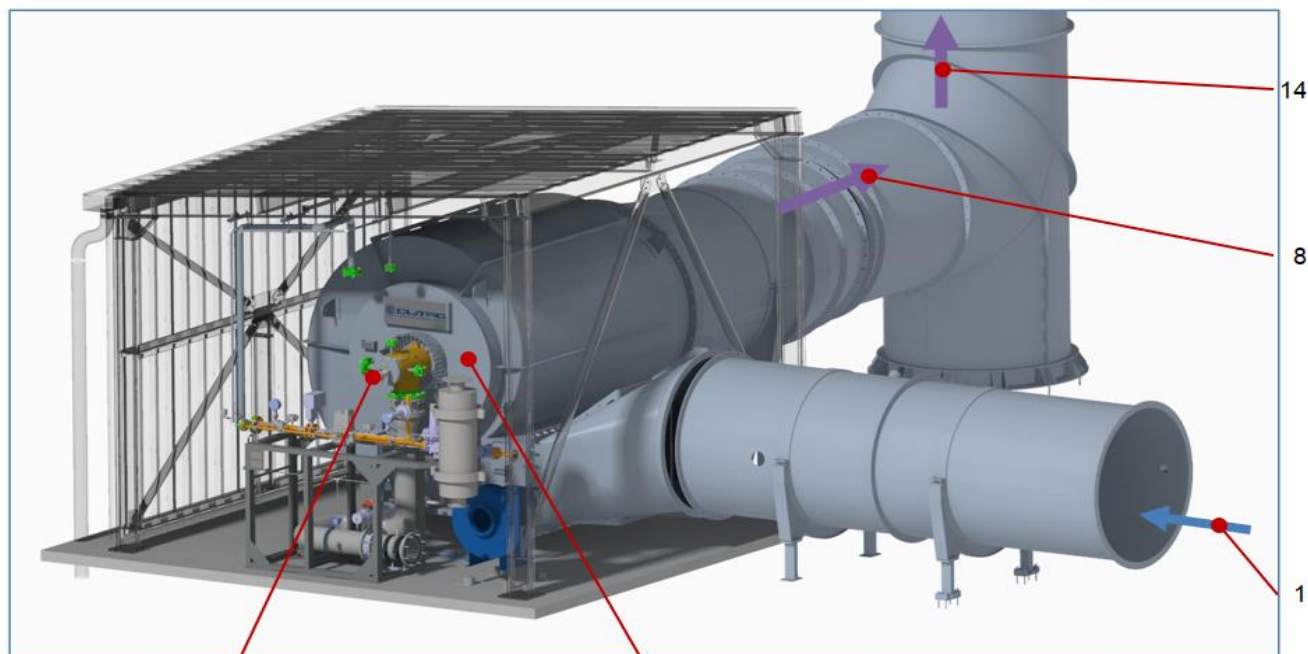
certified according to ISO9001

Produced according to European and American standards, regulations and quality certificates

6. Materials

- SPH housing: P265GH or 1.4301 (AISI304) or 1.4571 or 1.4404 (AISI316L/AISI316Ti), in special cases 1.4841 (AISI314) or other materials on request. Turned parts made of stainless steel, at least the same quality as the housing.
- Combustion chamber lining [6] made of refractory lining or refractory concrete or ceramic fiber mats.

7. Example of a DUMAG Swirl Preheater SPH for heating a flue gas before it enters the SCR



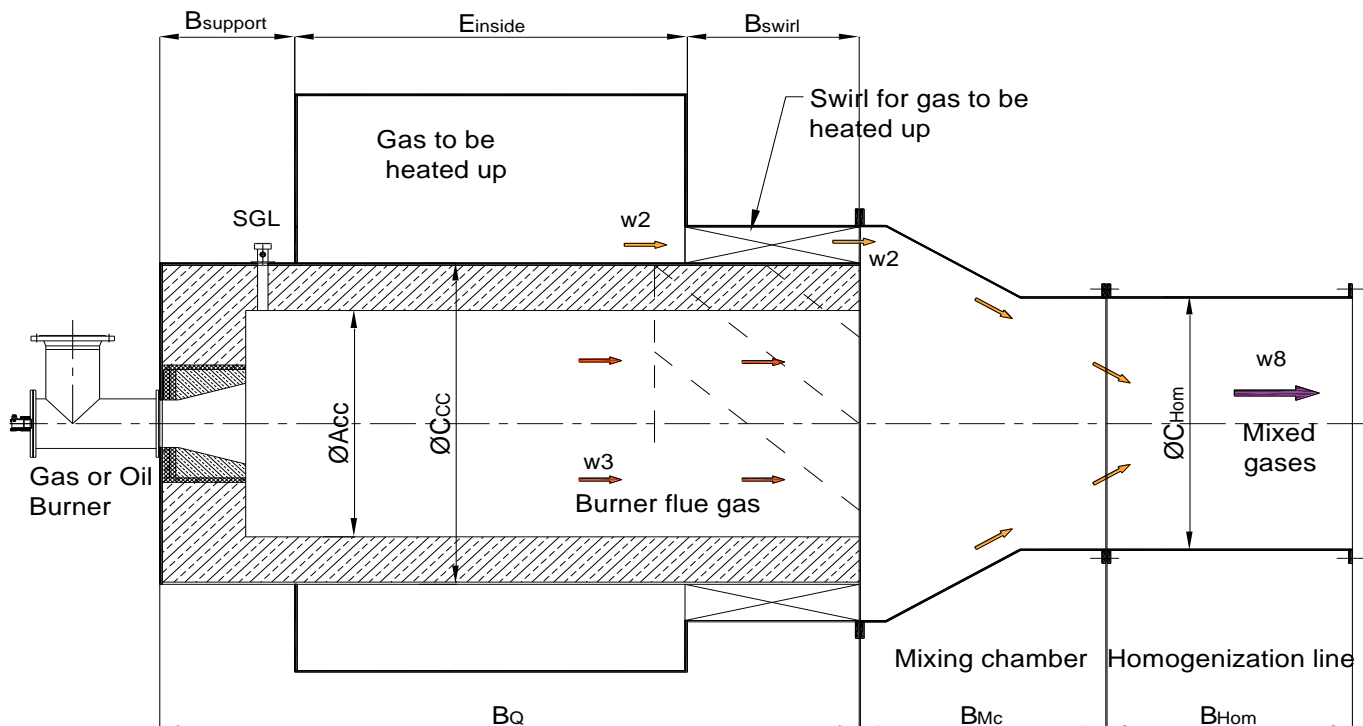
- 12 DUMAG burners for gas or LFO
14 to the SCR
- 1 Inlet gas to be heated
8 Flue gas - to be heated up Gas mixture to the homogenization line

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8. Dimensions



Swirl Preheater unit Type SPH...	Burner capacity	Flue gas flow rate	Flue gas temperature	Gas to be heated up, flow rate	Gas to be heated up, inlet temp.	Hot gas mixture, flow rate	Hot gas mixture, temperature	ØAcc	ØCcc	BQ	Bsuppo	Bswirl	BMC	BHom
	kW	Nm³/h	°C	Nm³/h	°C	Nm³/h	°C	mm	mm	mm	mm	mm	mm	mm
SPH300-0,7	300	505	1340 - 1370°C	1.650	200	2.155	500	700	1.110	1.900	750	750	1.000	1.000
SPH350-0,75	350	550		1.850	200	2.400	500	750	1.160	1.950	750	750	1.000	1.000
SPH500-0,8	500	820		2.650	200	3.470	500	800	1.210	2.350	950	750	1.000	1.000
SPH900-0,9	900	1.520		5.000	200	6.520	500	900	1.310	2.860	1.160	800	1.000	1.000
SPH1150-1	1.150	1.940		6.200	200	8.140	500	1.000	1.410	3.160	1.260	900	1.000	1.000
SPH1200-1,1	1.200	2.020		6.500	200	8.520	500	1.100	1.510	3.060	1.160	900	1.000	1.000
SPH2000-1,15	2.000	3.350		10.800	200	14.150	500	1.150	1.560	3.810	1.260	900	1.000	1.000
SPH3500-1,2	3.500	5.890		19.000	200	24.890	500	1.200	1.610	4.860	1.960	900	1.000	1.000
SPH4500-1,3	4.500	7.580		24.000	200	31.580	500	1.300	1.710	5.160	2.160	1.000	1.000	1.000
SPH5700-1,4	5.700	9.600		30.500	200	40.100	500	1.400	1.810	5.860	2.860	1.000	1.000	1.000

designed for fuel gas or LFO with excess air 1.6. exhaust gas temperature approx. 1370°C

All specifications and dimensions are approximate and non-binding, as the Swirl Preheater SPH units are designed individually for the specific application.

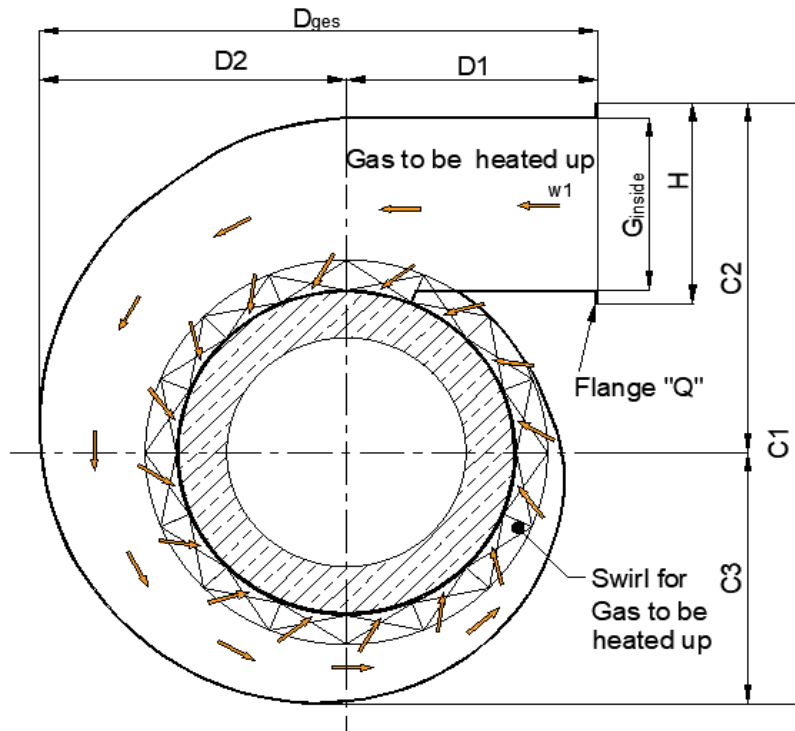
The refractory lining is designed for min. 1450°C

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8. Dimensions - continued



Swirl Preheater unit Type SPH...	Burner capacity	Burner type MFB.. MFBX.. PB.. PBX	Ø Chom	C1	C2	C3	D1	D2	Dges	E	G			Weight Steel + ceramic fiber
	kW	-	mm	mm	mm	mm	mm	mm	mm	mm	mm			ca. kg
SPH300-0,7	300	..350	710	1.616	905	711	730	786	1.516	400	300			1710
SPH350-0,75	350	..350	800	1.666	930	736	760	811	1.571	450	300			1860
SPH500-0,8	500	..700	800	1.716	955	761	780	836	1.616	650	300			2250
SPH900-0,9	900	..1200	1.000	1.891	1.055	836	850	924	1.774	900	350			2920
SPH1150-1	1.150	..1200	1.000	2.066	1.155	911	910	1.011	1.921	1.000	400			3500
SPH1200-1,1	1.200	..1200	1.120	2.166	1.205	961	960	1.061	2.021	1.000	400			3760
SPH2000-1,15	2.000	..2000	1.250	2.216	1.230	986	980	1.086	2.066	1.650	400			4760
SPH3500-1,2	3.500	..4000	1.250	2.416	1.355	1.061	1.030	1.186	2.216	2.000	500			5920
SPH4500-1,3	4.500	..5000	1.250	2.666	1.505	1.161	1.110	1.311	2.421	2.000	600			6740
SPH5700-1,4	5.700	..6000	1.400	2.916	1.655	1.261	1.180	1.436	2.616	2.000	700			8080