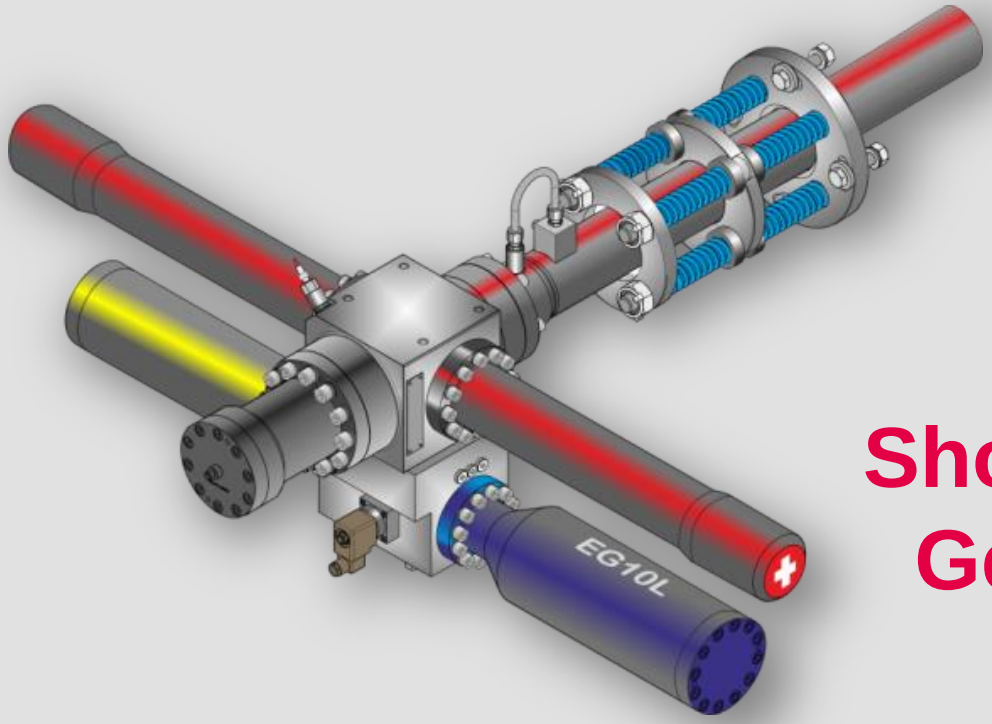
EXPLOSION POWER



Shock Pulse Generators

the leading online boiler cleaning system

EXPLOSION POWER

is a company in Switzerland,
which develops, manufactures, sells and services worldwide

Shock Pulse Generator Systems

for continuous, automated online-boiler cleaning processes
in power plants.

Installed Shock Pulse Generators

New built Energy-from-Waste plant
Perlen (Lucerne) /Switzerland
2015

Distribution Partners of Explosion Power

For certain regions and customer groups, Explosion Power co-operates with partner companies which manage distribution, installation and maintenance:

- Delete for Scandinavia
- KRR ProStream for UK and Ireland
- Clyde Bergemann Power Group, non-exclusive worldwide, except for Scandinavia, UK, IE, China
- Vibrant Solution for Thailand
- EPE (Shanghai) Investment Co., Ltd. for China
- Martin GmbH
- Hitachi Zosen Inova
- CNIM
- Babcock & Wilcox Vølund

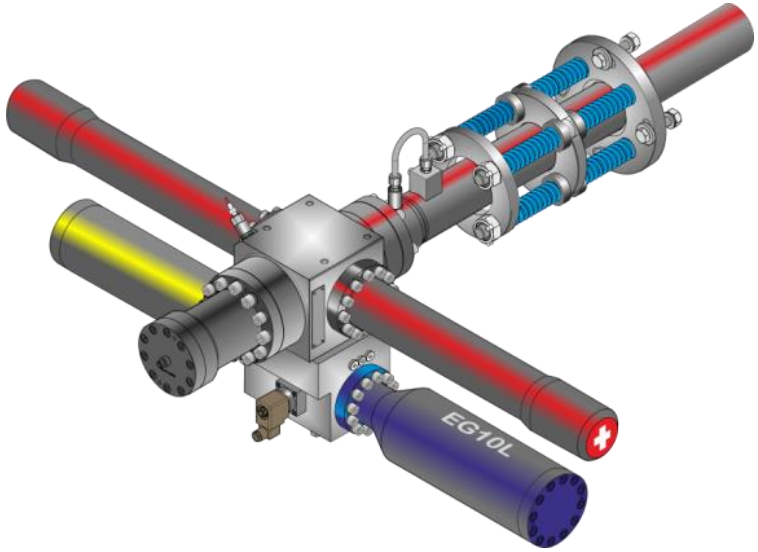
The technology is available for all OEMs.

Shock Pulse Generator (SPG) Characteristics

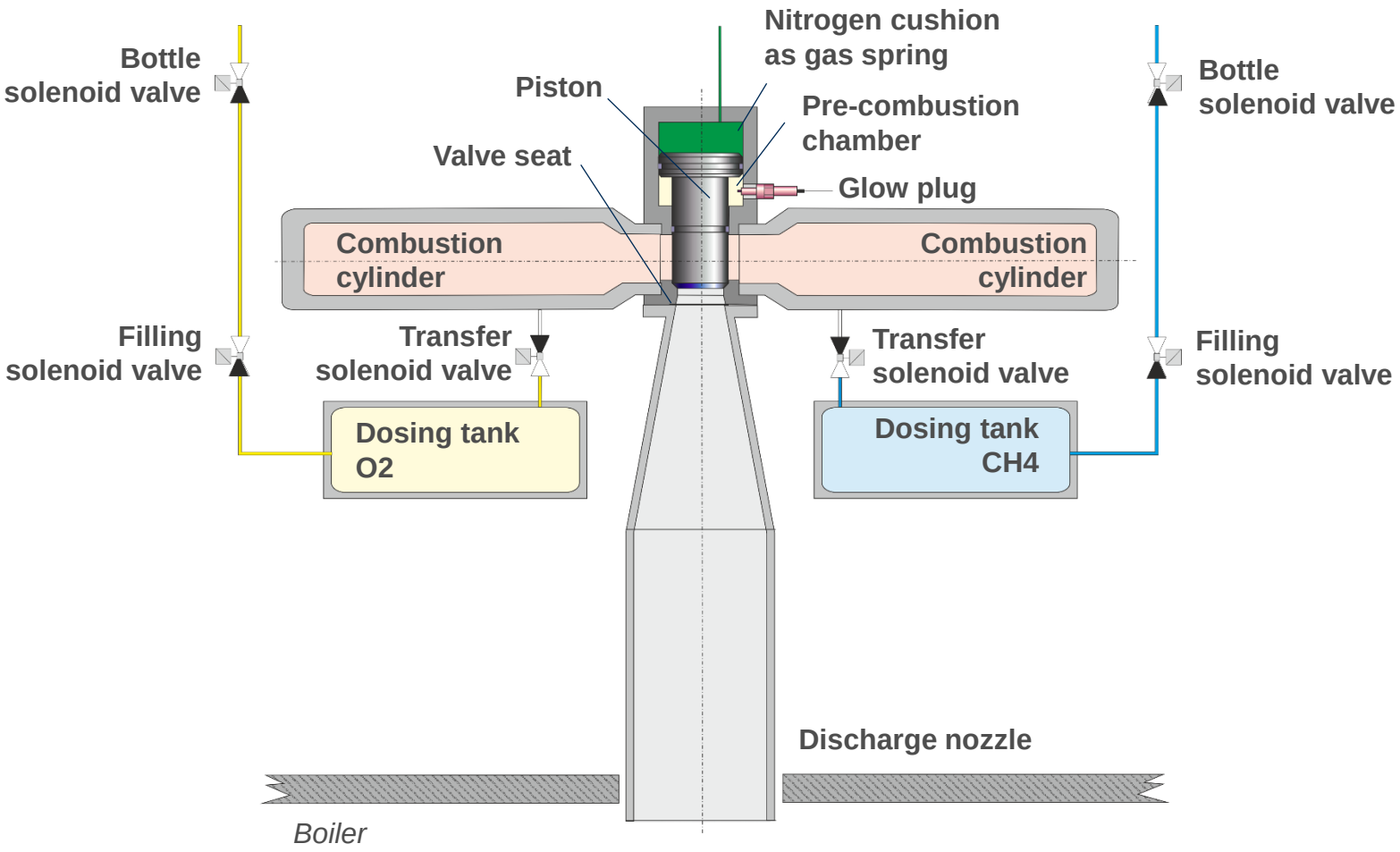
- Most efficient online boiler cleaning system with automated shock pulses
- Pressure wave injection at supersonic speed results in outstanding cleaning efficiency

- Standardized and modular type series
- Compact robust design for simple installation at the boiler
- Installation with or without spring package

- Higher boiler efficiency
- Reduced standstill periods
- 300 reference installations in 20 countries

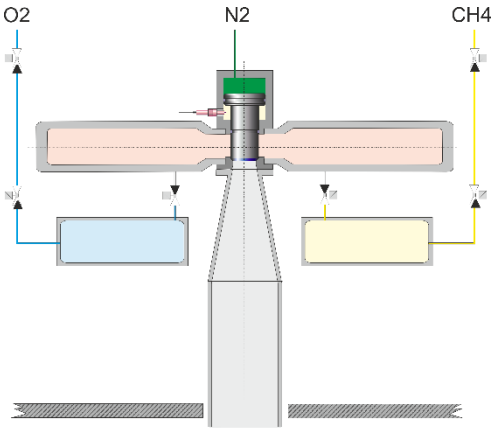


Scheme of «EG» Series

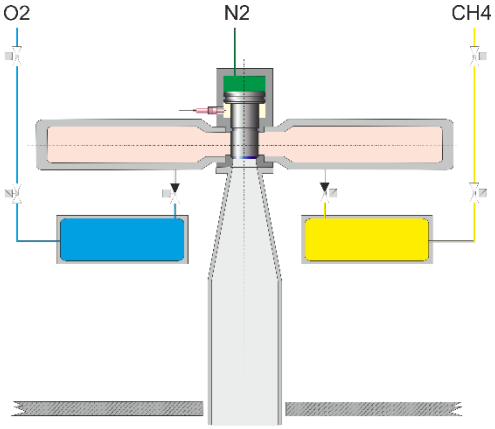


Operation Sequence of «EG» Series

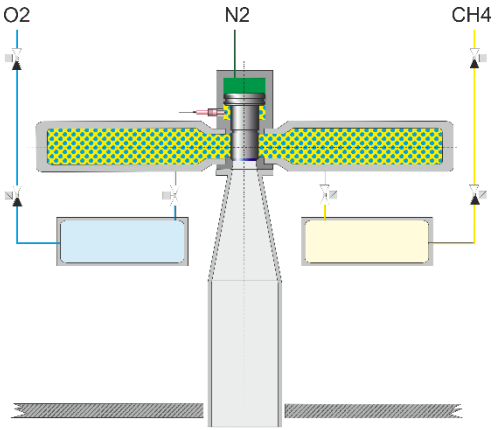
0 Start of sequence



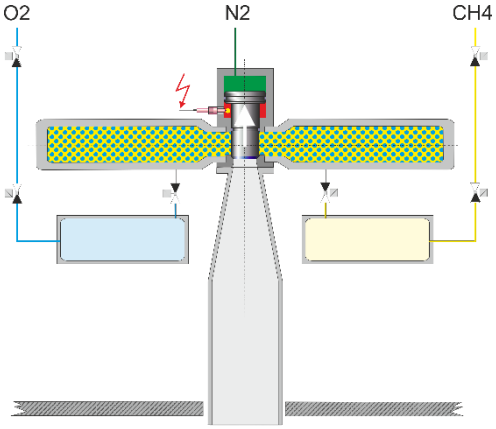
1 Filling Dosing Tanks



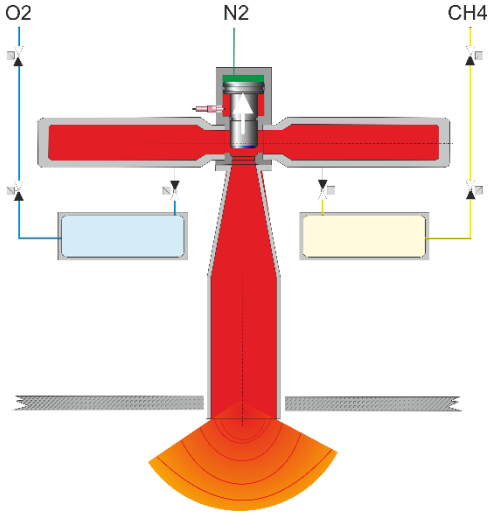
2 Transfer and Mixing



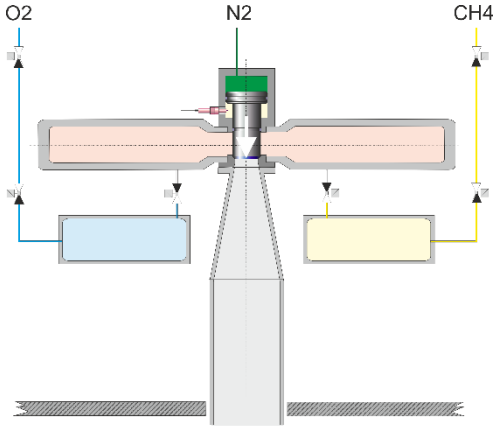
3 Ignition and Pre-Combustion



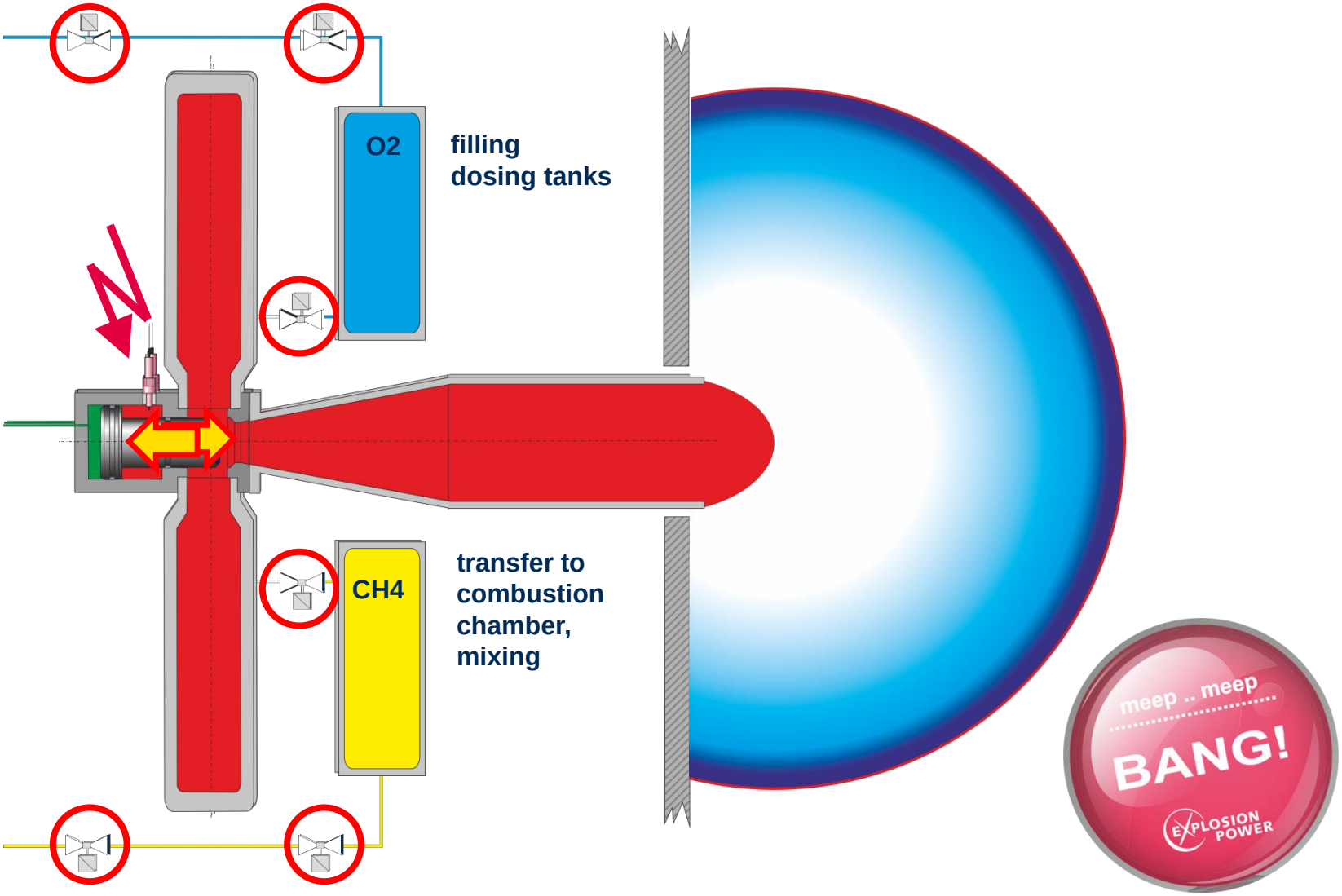
4 Combustion, Pressure wave



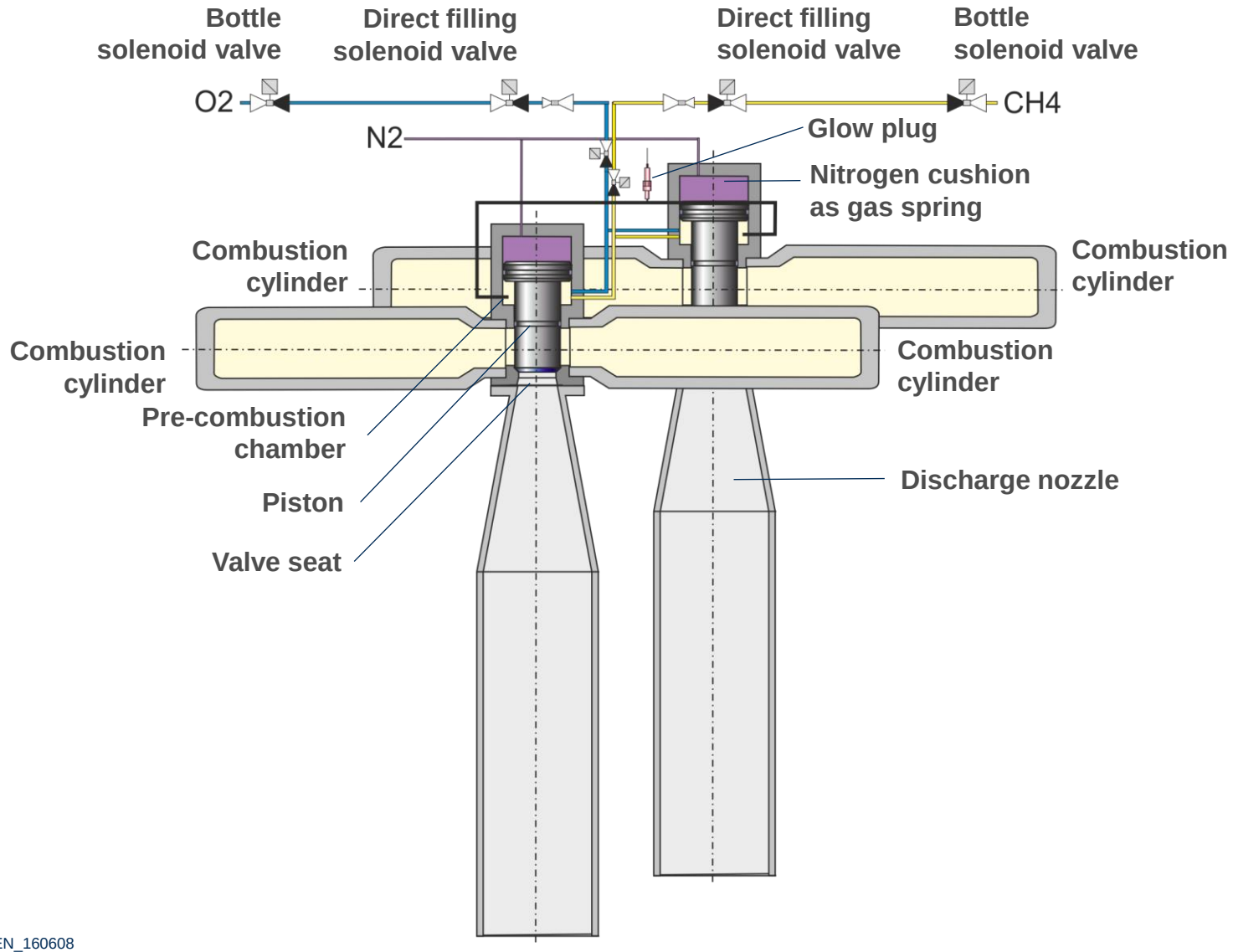
5 Closing of Piston



Operation Sequence of «EG» Series

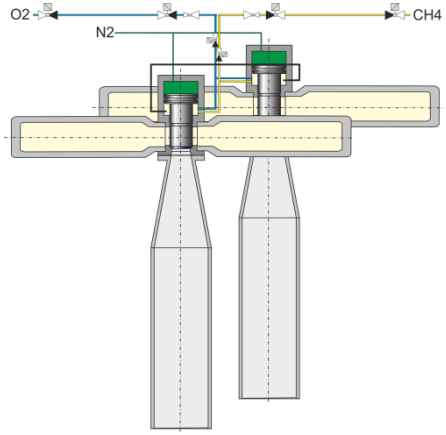


Scheme of «Twin» Series

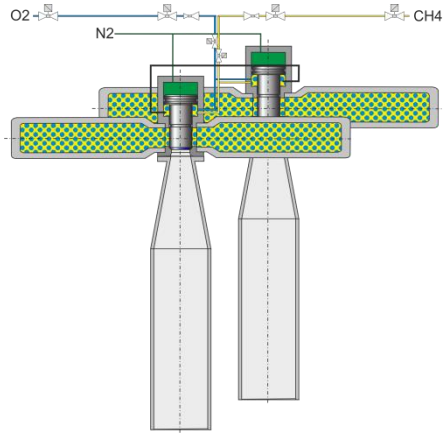


Operation Sequence of «Twin» Series

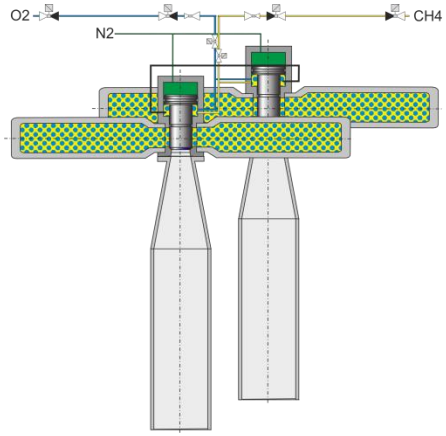
0 Start of sequence



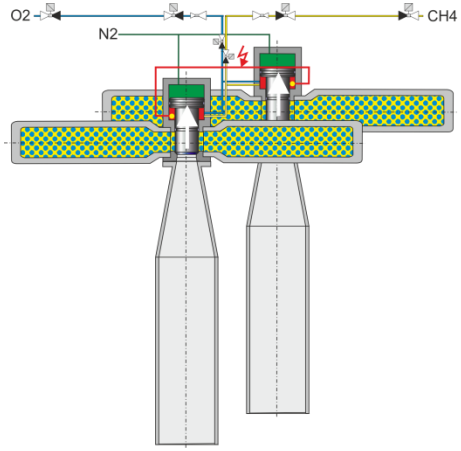
1 Start direct filling



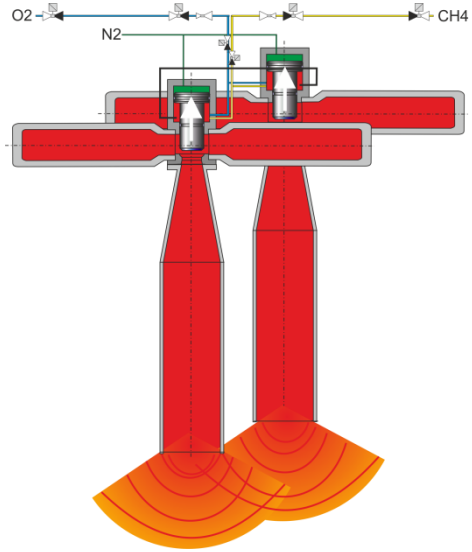
2 End direct filling



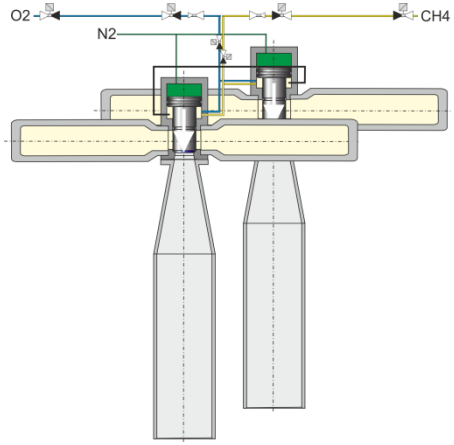
3 Ignition and Pre-Combustion



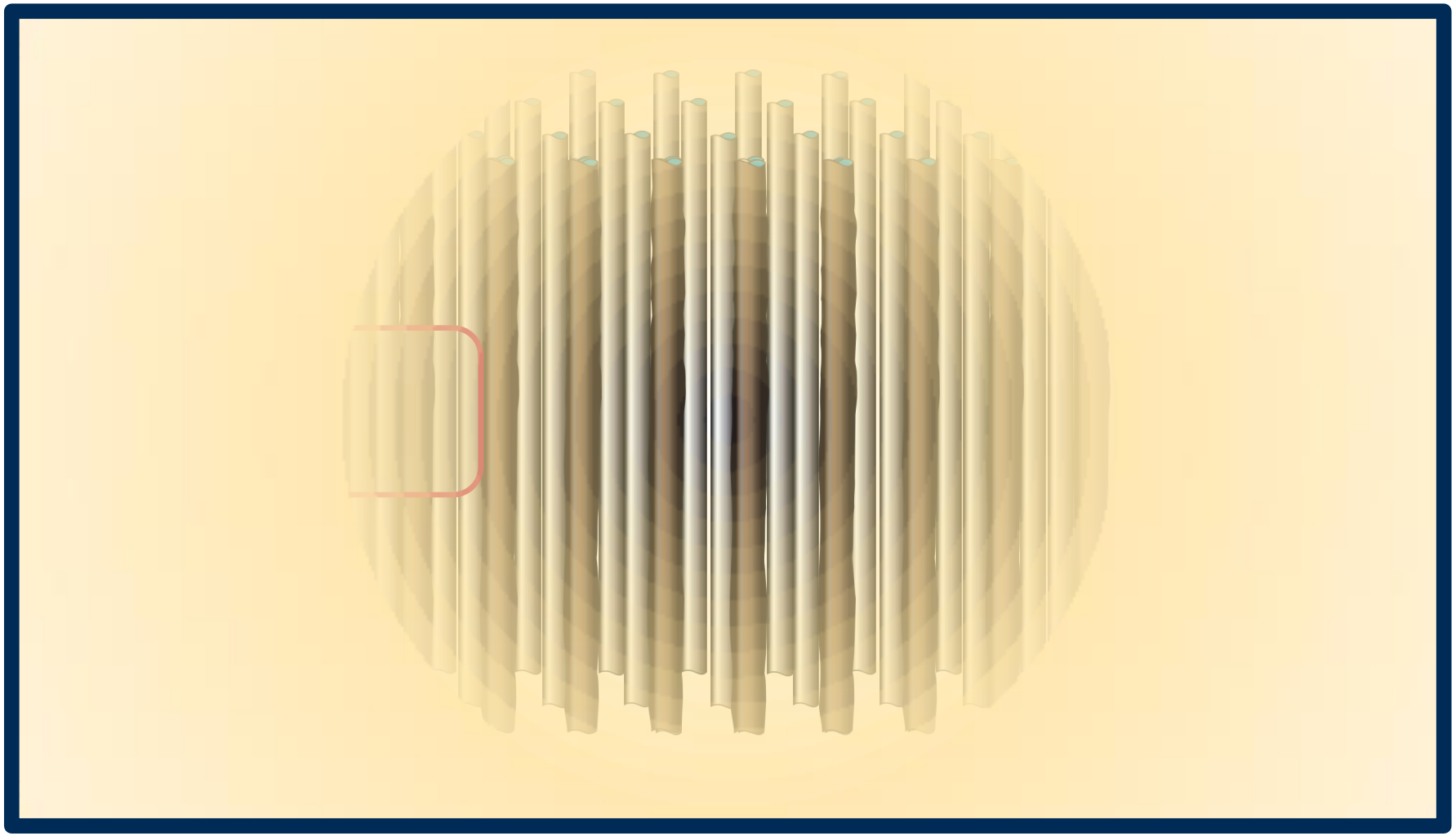
4 Combustion, Pressure wave



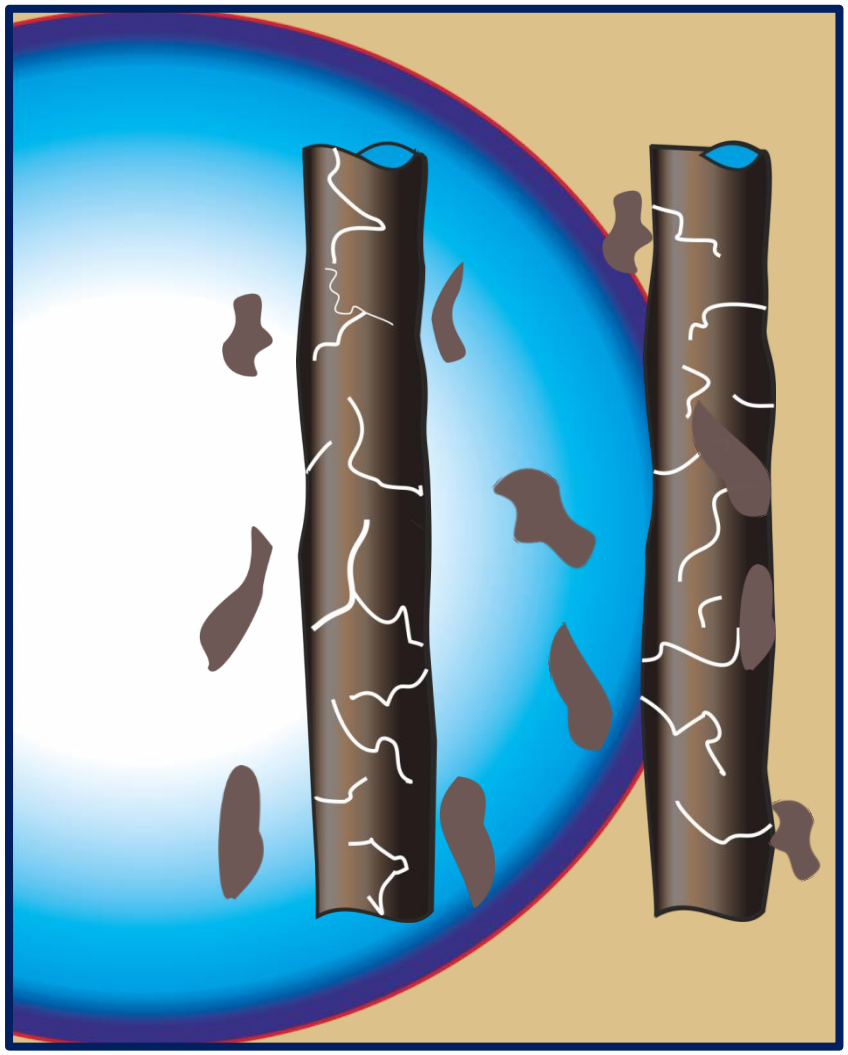
5 Closing of Pistons



Main Cleaning Mechanisms of the Shock Pulse



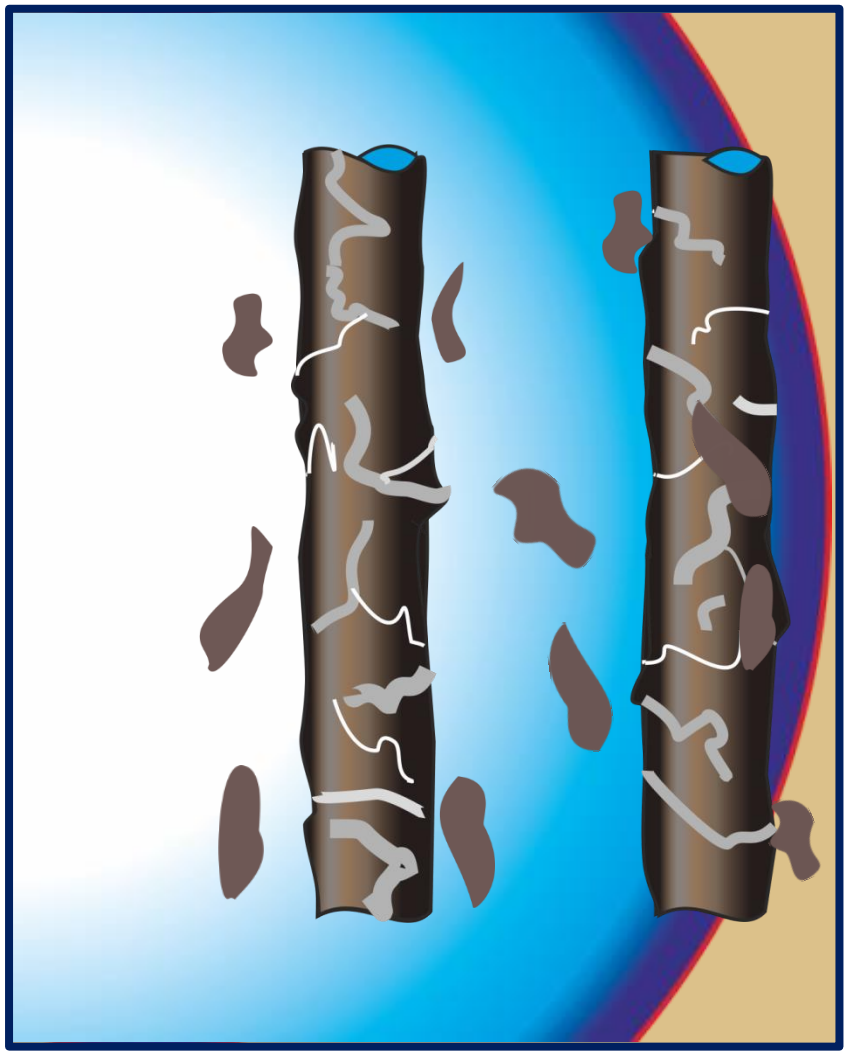
Main Cleaning Mechanisms of the Shock Pulse



1. Impact-sound vibration

- Induction of an impacted-sound vibration within the fouling
- Generation of tension and compressive stress
- Initiation of cracks inside the fouling
- Removal of the fouling

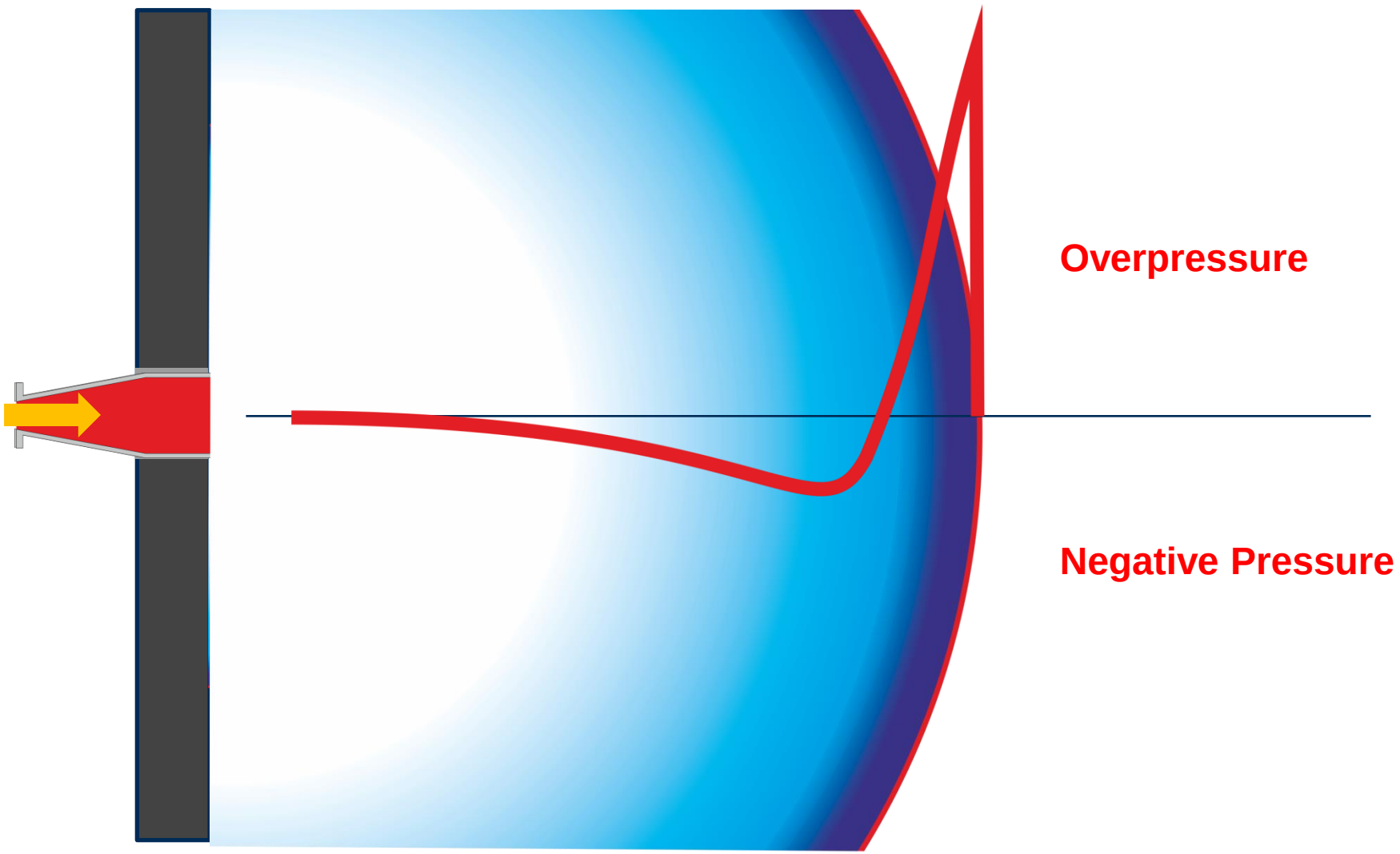
Main Cleaning Mechanisms of the Shock Pulse



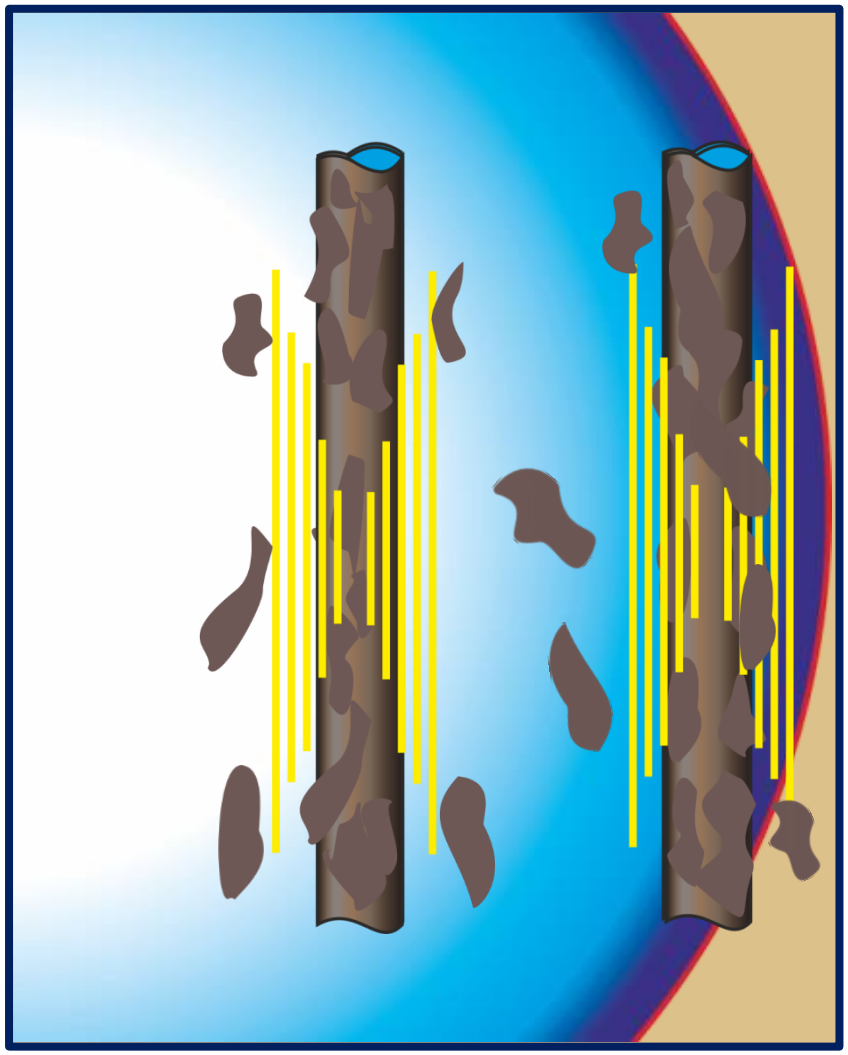
2. Pulling and suction effect of shock wave

- According to the Friedlander wave form the shock peak is followed by a zone with negative pressure
- This pulling and suction effect promotes the removal of the fouling

The Friedlander Wave of the Shock Pulse



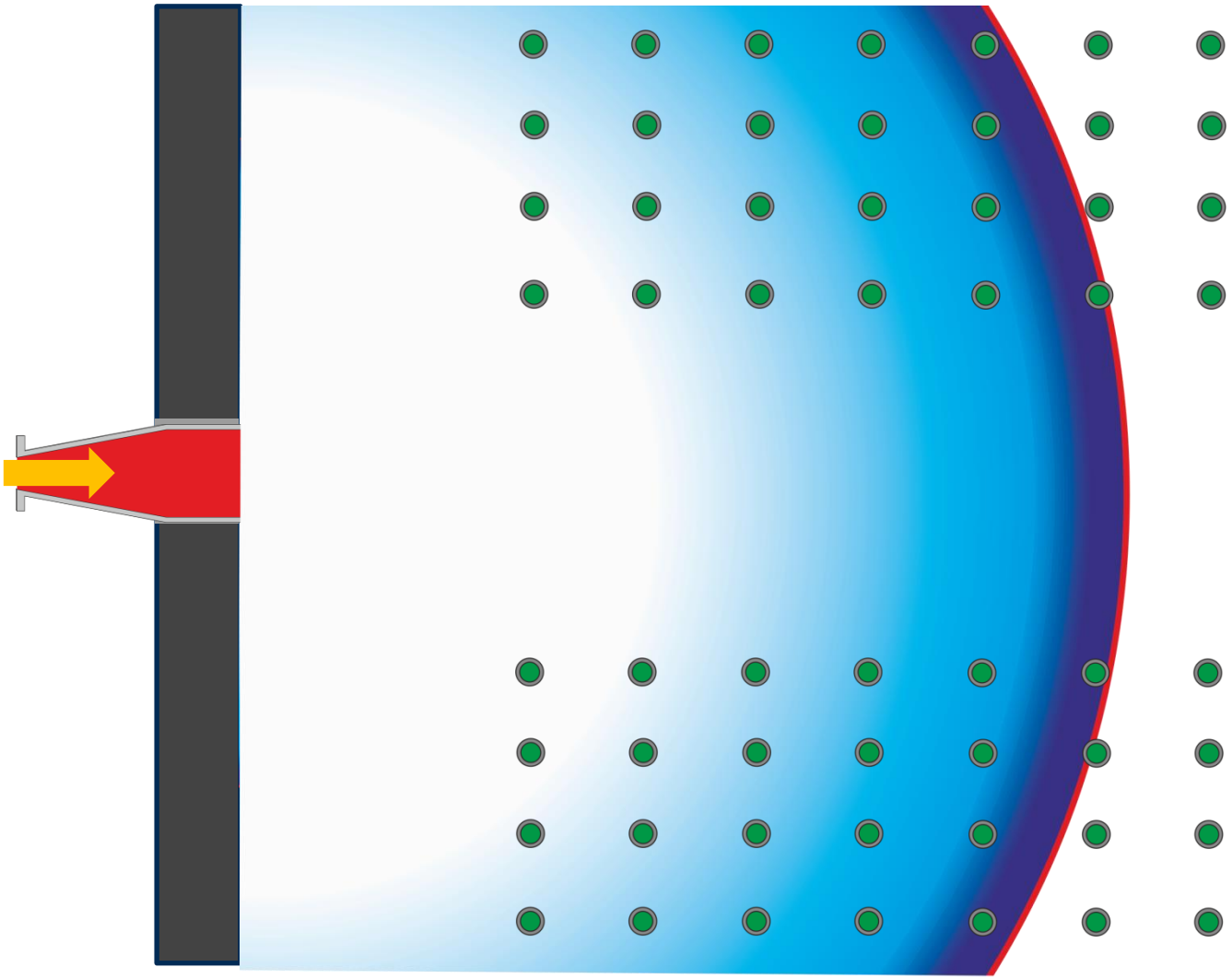
Main cleaning mechanism of the Shock Pulse



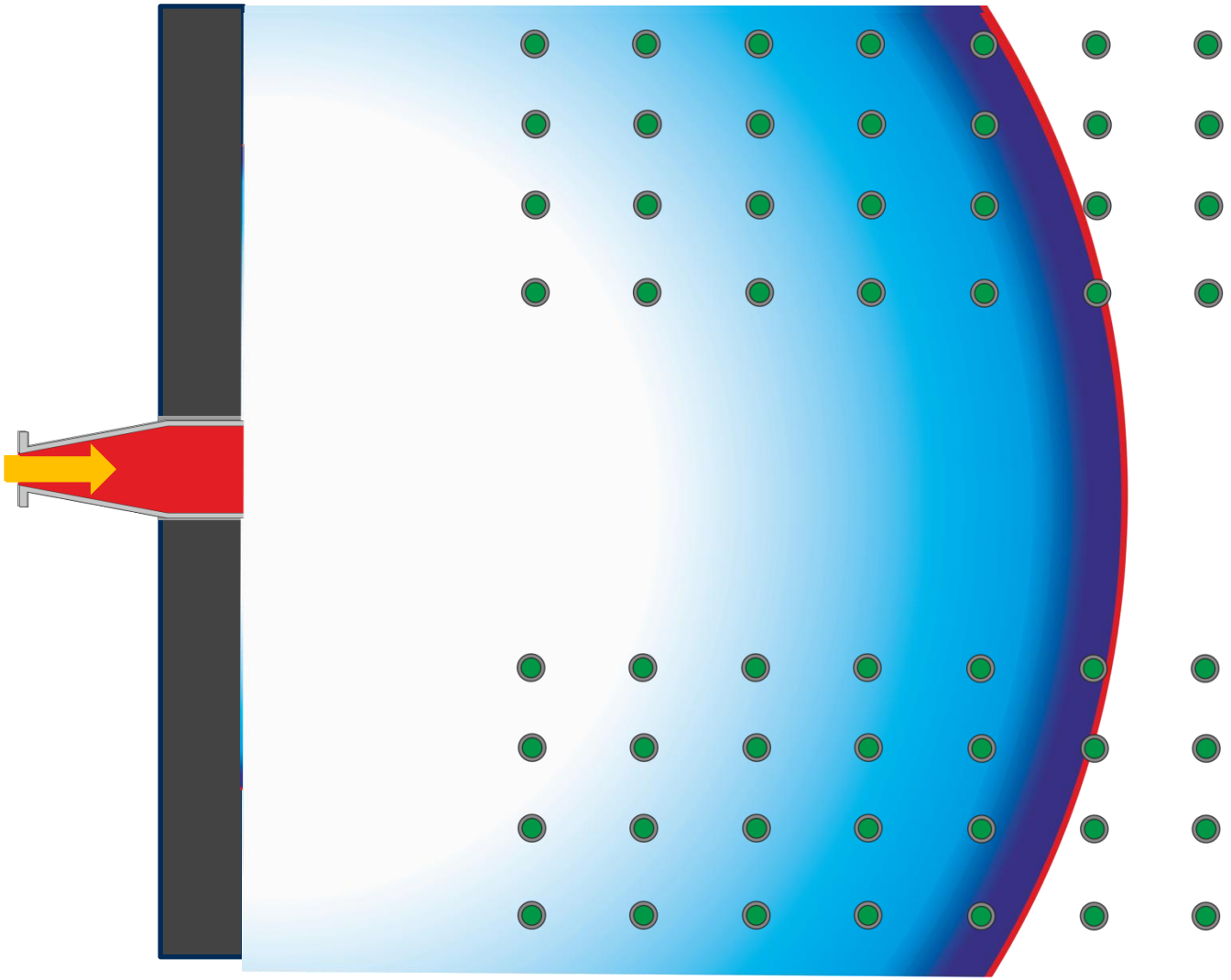
3. Short-term vibration

- A short-term vibration of the tube-bundle is initiated by the shock wave
- This supports removal and cleaning effect

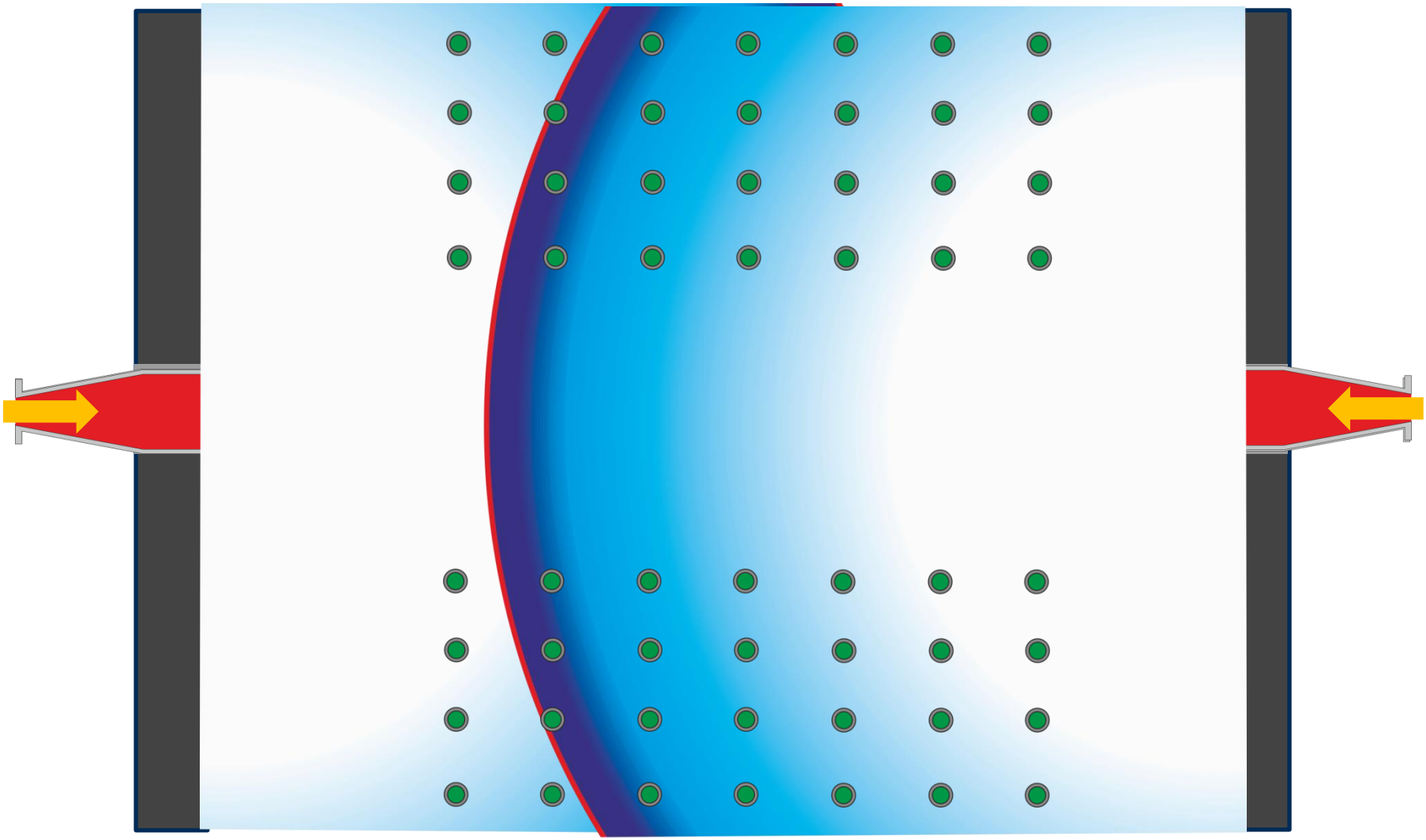
Operation Modes of the SPG, optmised for each task: SINGLE SHOT



Operation Modes of the SPG, optmised for each task: PULSE MODE



Operation Modes of the SPG, optmised for each task: SIMULTANEOUS SHOT



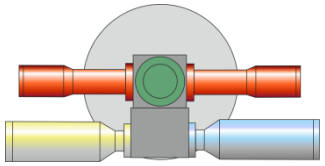
Application Range

- Energy from waste plants
- Industrial boilers (biomass / various fuels)
- Sludge incineration plants
- Hazardous waste incineration plants
- Coal fired power plants
- Black liquor boilers
- Filters and spray absorbers
- Cement kilns
- Metallurgic factories

4 Levels of Shock Pulse Power depending on different Combustion Volume Sizes

EG10

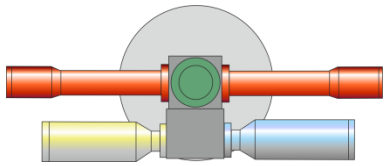
2.5 l



1.1 m

EG10L

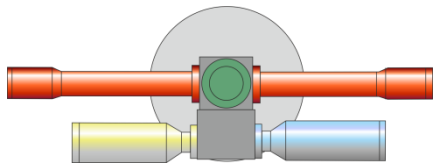
3.5 l



1.4 m

EG10XL

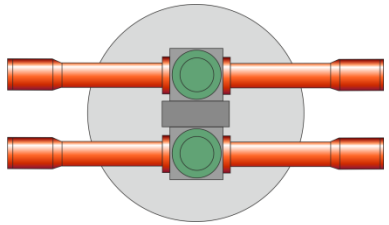
4.4 l



1.6 m

TwinL

2 x 3.5 l

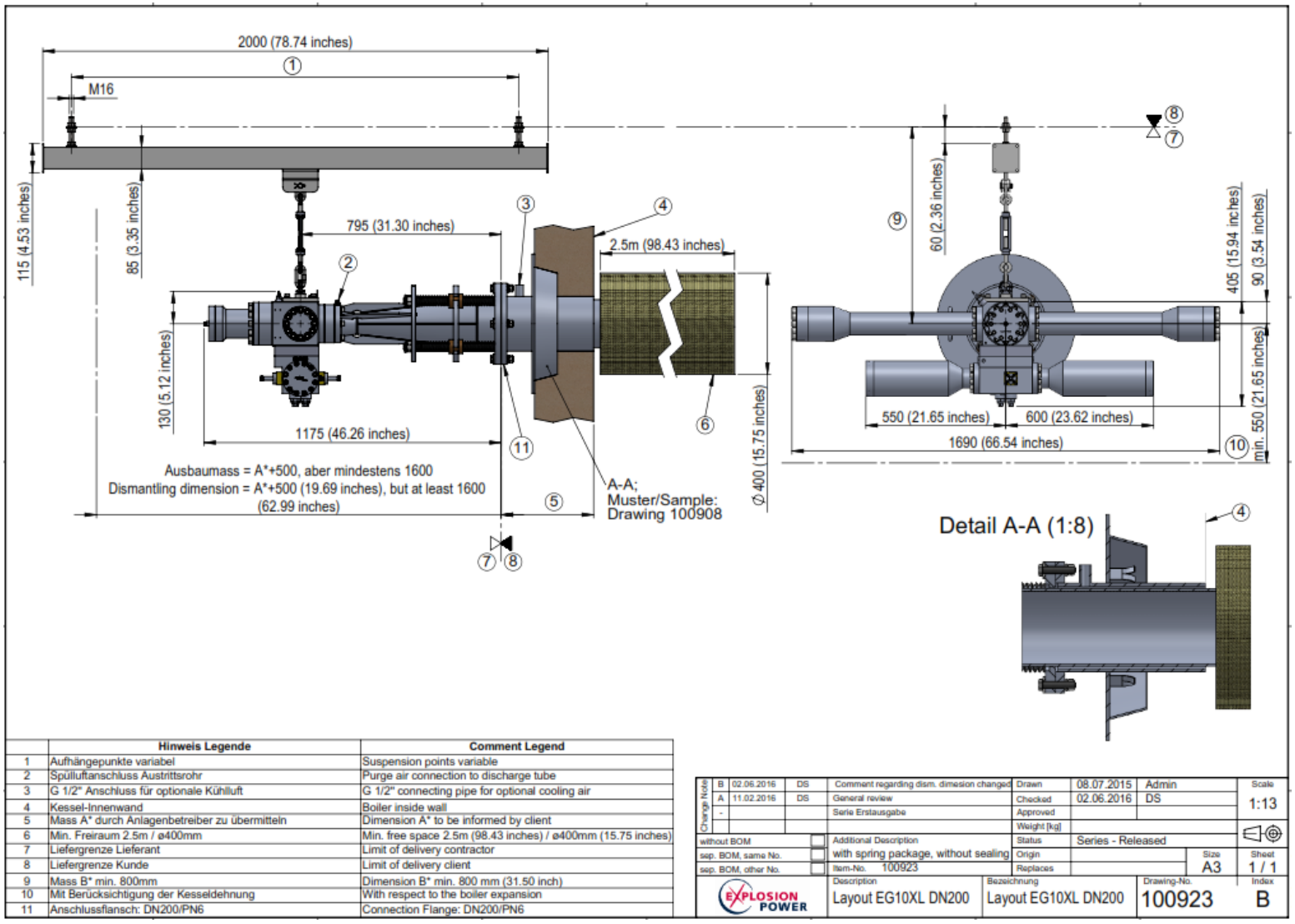


1.4 m

Technical Data

	EG10	EG10L	EG10XL	TwinL
Volume combustion chamber [l]	2.5	3.5	4.4	2 x 3.5 = 7.0
Dosing system	Predosing	Predosing	Predosing	Direct Injection
Dosing cylinders filling pressure [bar]	ca. 29	ca. 32	ca. 35	-
Combustion chamber filling pressure [bar]	20	20	20	20
Gas consumption per shock pulse [g, ca.], CH4 or natural gas / O2 / N2	16 / 34 / 1	22 / 48 / 1	28 / 61 / 1	44 / 96 / 2
Compressed air consumption (6 bar) [Nm³/h] for 1 Shock Pulse (SP)/h and per additional SP/h	3 (+0.2/SP)	3 (+0.2/SP)	7 (+0.2/SP)	6 (+0.4/SP)
Sealing/cooling air consumption (>20 mbar) [Nm³/h] (if flue gas temperature > 700 °C and/or if the boiler is operated at positive pressure)	10	10	10	20
Sound level, average 8h / peak [dBA]	< 80 / 120	< 80 / 120	< 80 / 120	< 80 / 120
Installation flange [DN]	125	125	200	2x125
Weight [kg]	265	275	300	410

Installation Requirements (EG10XL, nozzle DN200)

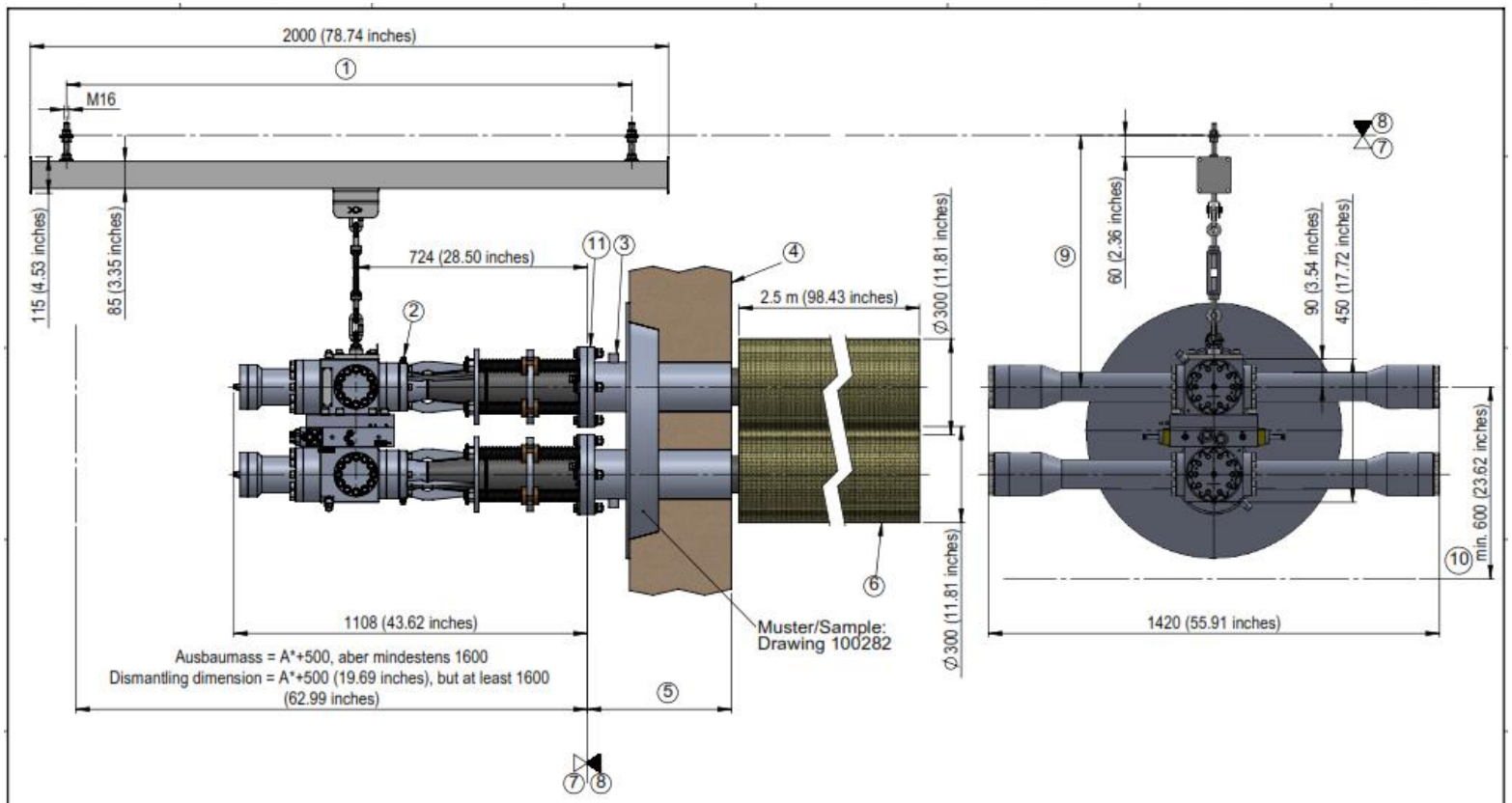


	Hinweis Legende	Comment Legend
1	Aufhängepunkte variabel	Suspension points variable
2	Spülluftanschluss Austrittsrohr	Purge air connection to discharge tube
3	G 1/2" Anschluss für optionale Kühlluft	G 1/2" connecting pipe for optional cooling air
4	Kessel-Innenwand	Boiler inside wall
5	Mass A* durch Anlagenbetreiber zu übermitteln	Dimension A* to be informed by client
6	Min. Freiraum 2.5m / ø400mm	Min. free space 2.5m (98.43 inches) / ø400mm (15.75 inches)
7	Liefergrenze Lieferant	Limit of delivery contractor
8	Liefergrenze Kunde	Limit of delivery client
9	Mass B* min. 800mm	Dimension B* min. 800 mm (31.50 inch)
10	Mit Berücksichtigung der Kesseldehnung	With respect to the boiler expansion
11	Anschlussflansch: DN200/PN6	Connection Flange: DN200/PN6

Change Note	B	02.06.2016	DS	Comment regarding dism. dimesion changed	Drawn	08.07.2015	Admin
	A	11.02.2016	DS	General review	Checked	02.06.2016	DS
	-			Serie Erstausgabe	Approved		
					Weight [kg]		
without BOM				Additional Description	Status	Series - Released	
sep. BOM, same No.				with spring package, without sealing	Origin		
sep. BOM, other No.				Item-No. 100923	Replaces		
EXPLOSION POWER				Description: Layout EG10XL DN200	Bezeichnung: Layout EG10XL DN200	Drawing-No.: 100923	

Scale: 1:13 | Size: A3 | Sheet: 1 / 1 | Index: B

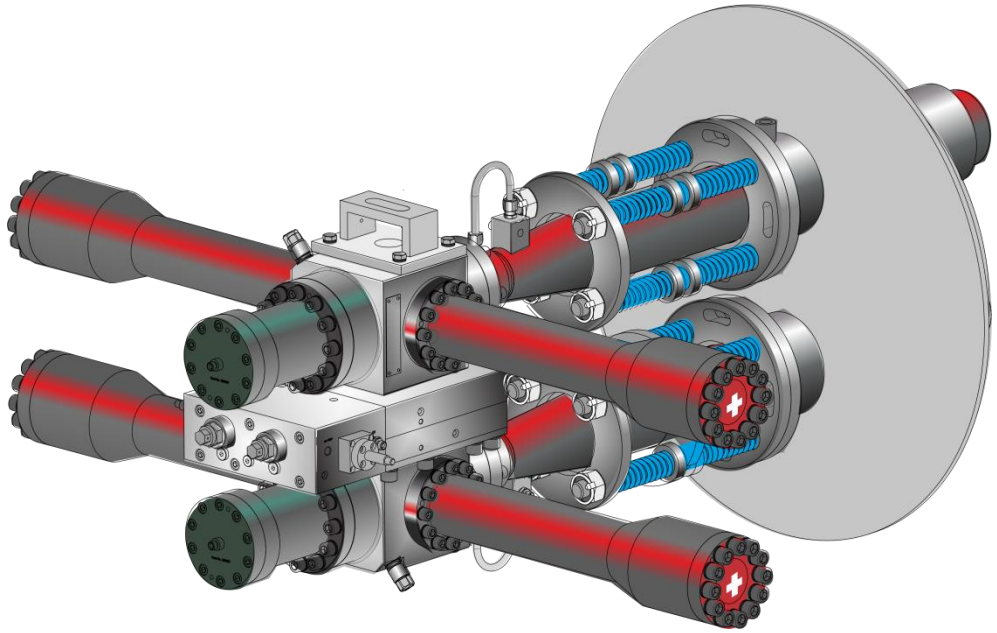
Installation requirements (TwinL, 2x nozzle DN125)



	Hinweis Legende	Comment Legend
1	Aufhängepunkte variabel	Suspension points variable
2	Spülluftanschluss Austrittsrohr	Purge air connection to discharge tube
3	G 1/2" Anschluss für optionale Kühlluft	G 1/2" connecting pipe for optional cooling air
4	Kessel-Innenwand	Boiler inside wall
5	Mass A* durch Anlagenbetreiber zu übermitteln	Dimension A* to be informed by client
6	Min. Freiraum 2.5m / 2 x ø300mm	Min. free space 2.5m (98.43 inches) / 2 x ø300mm (11.81 inches)
7	Liefergrenze Lieferant	Limit of delivery contractor
8	Liefergrenze Kunde	Limit of delivery client
9	Mass B* min. 800mm	Dimension B* min. 800 mm (31.50 inch)
10	Mit Berücksichtigung der Kesseldehnung	With respect to the boiler expansion
11	Anschlussflansch: 2x DN125/PN16	Connection Flange: 2x DN125/PN16

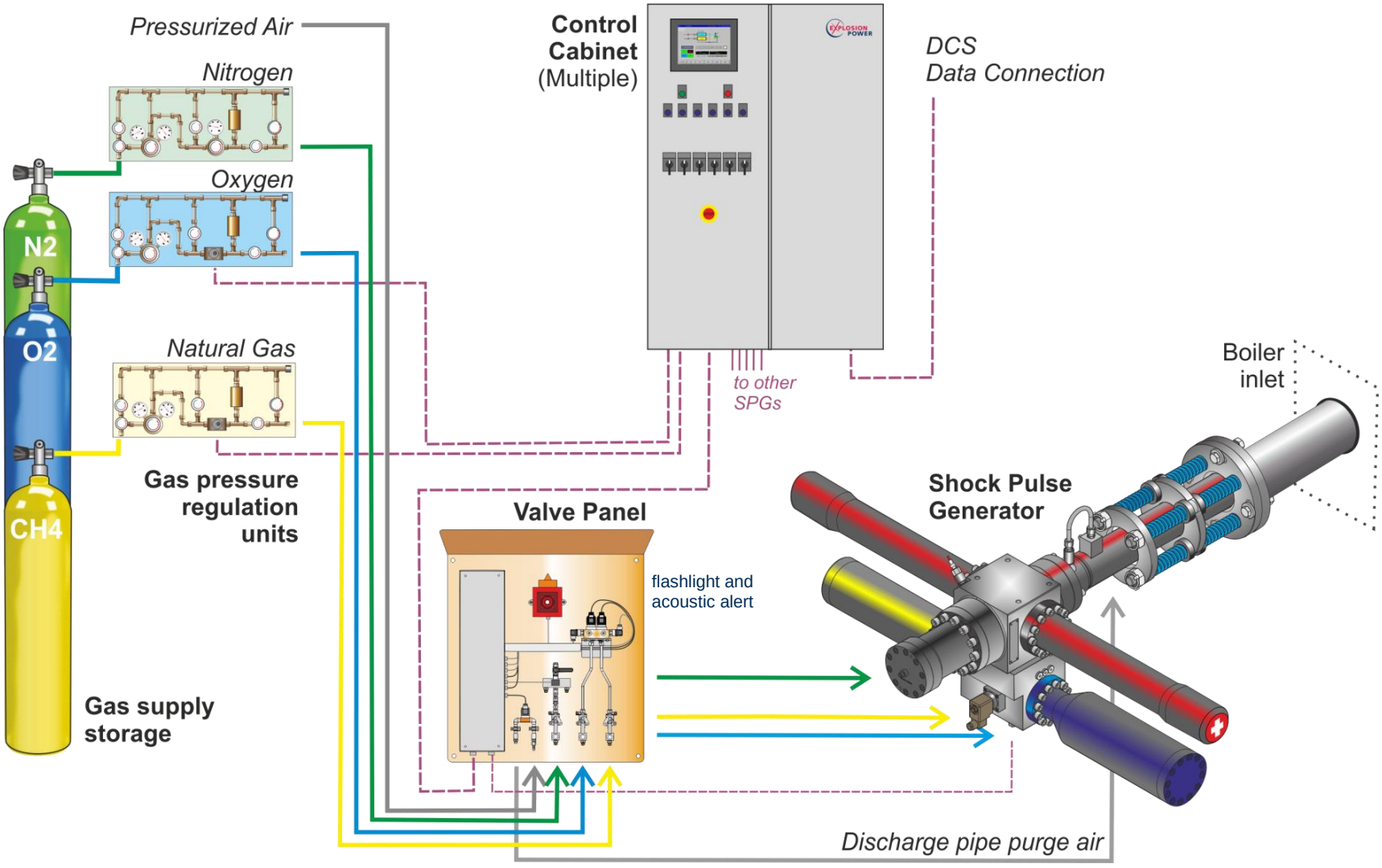
Change Note								
	B	01.06.2016	DS	Comment regarding dim. dimension changed	Drawn	17.08.2015	Admin	Scale
	A	01.03.2016	DS	General review	Checked	01.06.2016	DS	1:12
	-			Serie Erstausgabe	Approved	02.06.2016	DS	
					Weight [kg]			
without BOM				Additional Description	Status	Series - Released		
sep. BOM, same No.				with spring package	Origin	-	Size	Sheet
sep. BOM, other No.				Item-No. 101116	Replaces	-	A3	1 / 1
EXPLOSION POWER				Description Layout TwinL	Bezeichnung Layout TwinL		Drawing-No. 101116	Index B

The new TwinL Generator

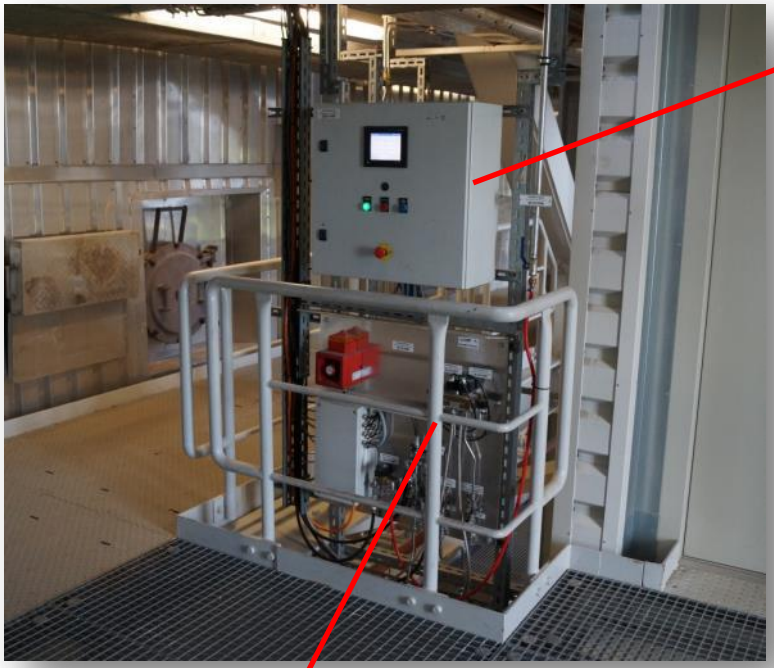


- Significantly increased pulse strenght by combining 2 EG10L devices
- Direct filling of Natural Gas/Methane and Oxygen without special dosing tanks
- Installation Volume ca. 1.5m³ due to new case concept

System Components



Installation Example



Single Control Cabinet

Valve Panel

Crane Railway

Shock Pulse Generator EG10XL

Gas Consumption and Maintenance

- Number of shock pulses from one 50 l, 200 bar gas cylinder:

	CH4 (Nat. gas)	O2	N2
EG10	350	320	>3‘000
EG10L	240	220	>3‘000
EG10XL	190	170	>3‘000
TwinL	120	110	>1‘500

- Maintenance by Explosion Power, nominated partners or end user:

  - Every 4500 hours / every 3000 shock pulses
  - 2-3 hours work per Shock Pulse Generator for base service
  - Maintenance contract with EP or nominated partners
  - Plant operating staff can carry out maintenance after training and certification

Certified Safety

- SPG-technology is designed according to highest safety requirements
- All SPG-System components incl. PLC certified
- Gases are only mixed in the pressure resistant generator
- Boiler remains closed, no opening of doors, manholes etc. during operation
- High sophisticated SPG-PLC system monitoring

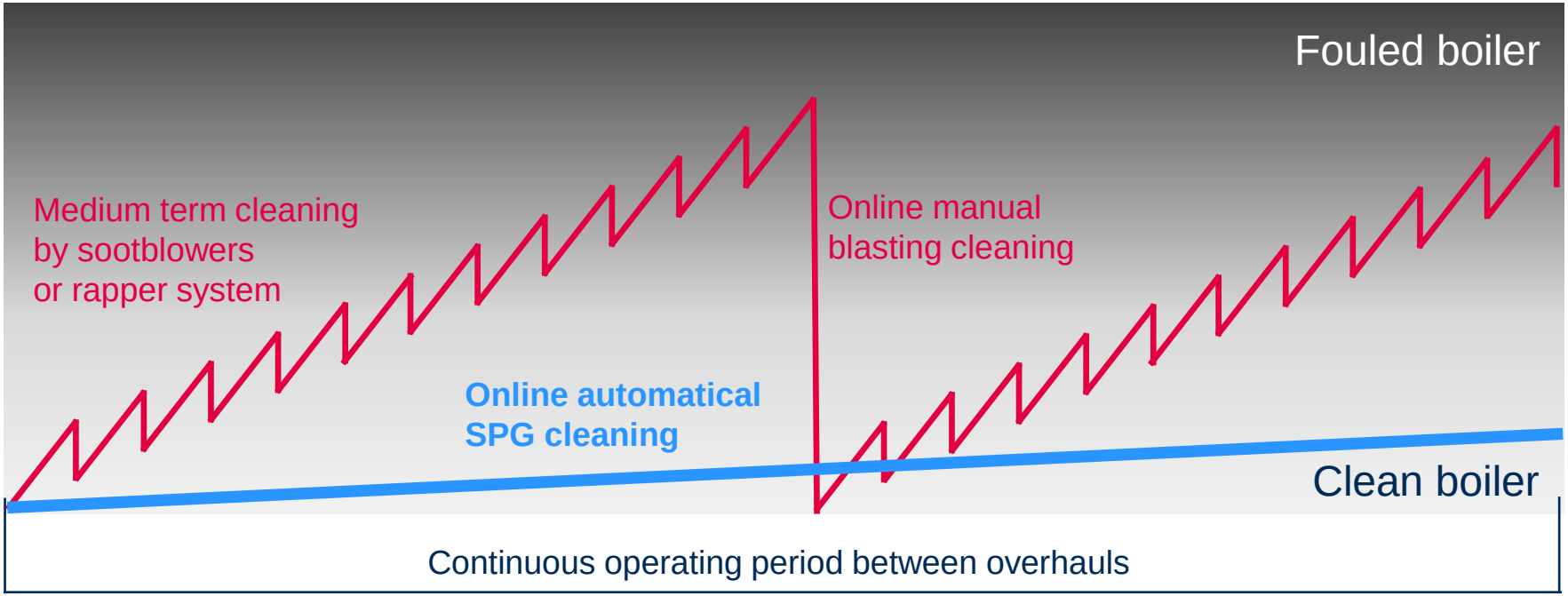
- CE-certification and EU-Conformity declaration according pressure equipment directive PED, Category II /III
- No ASME code requirements
- No ATEX requirements except for gas storage and gas regulation unit
- Installation of gas distribution according to local regulation

Operation Cost Benefits

- Improved cleaning efficiency compared to conventional cleaning technologies
- Higher boiler efficiency due to lower exhaust temperature
- Higher plant availability by longer boiler traveling period
- No thermal abrasion or damaging of boiler pipes
- Reduced operating cost and no steam consumption
- Reduced maintenance costs / less cleaning needs during maintenance stops
- Improved CO2 plant performance

Avoiding «saw-tooth» operation by continuous boiler cleaning

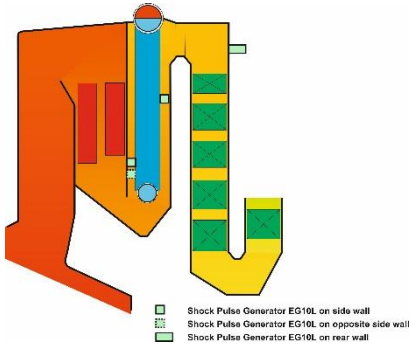
increase of flue gas pressure difference and temperatures

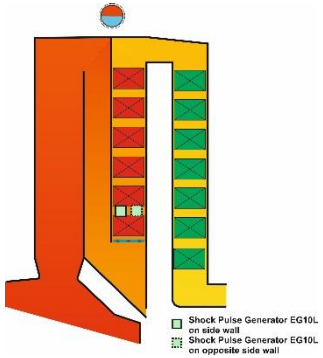


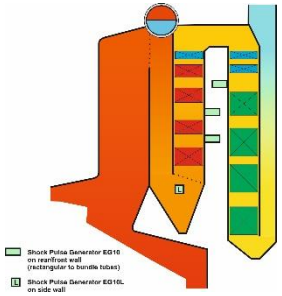
Invest Cost Benefits

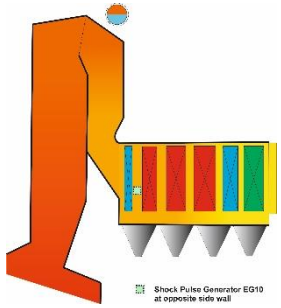
- Reduction of heat transfer surface area for same steam capacity
- Saving of boiler volume by reduced space requirement and no steam piping
- No piping for steam required
- Investment cost saving by reduced number of cleaning devices

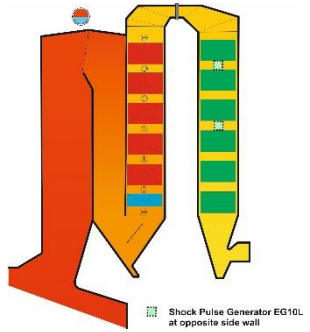
300 Shock Pulse Generator References in Various Plants (fuel, boiler design, etc.)

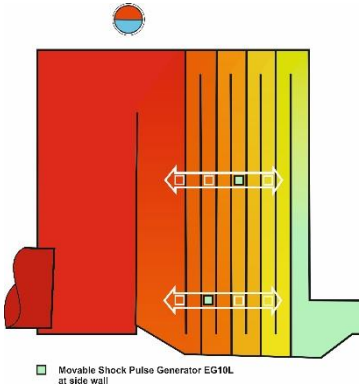


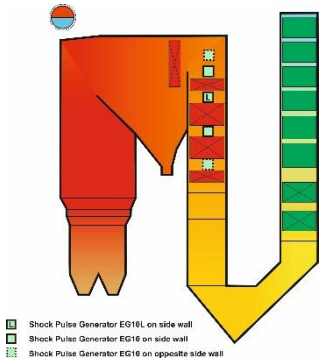


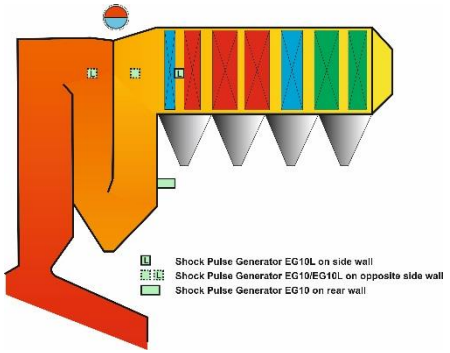


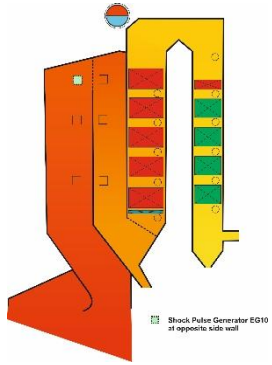


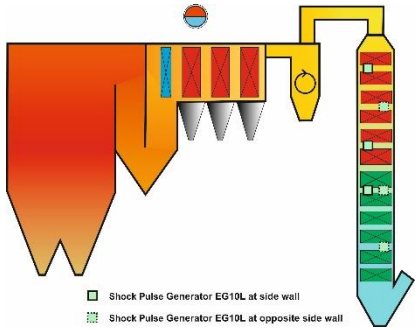


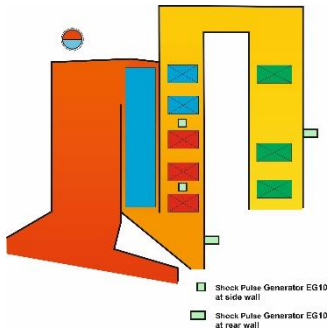


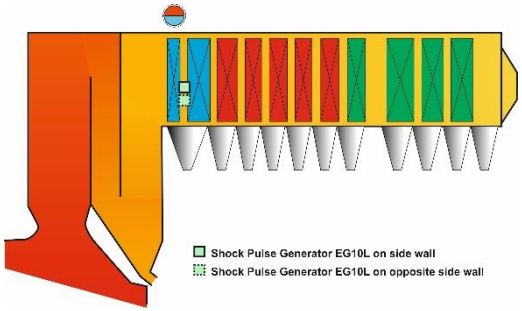


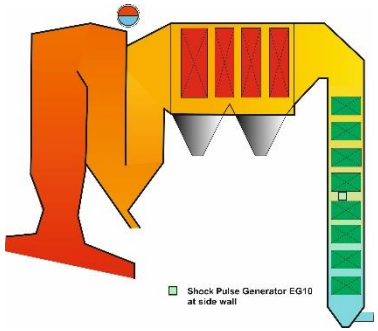




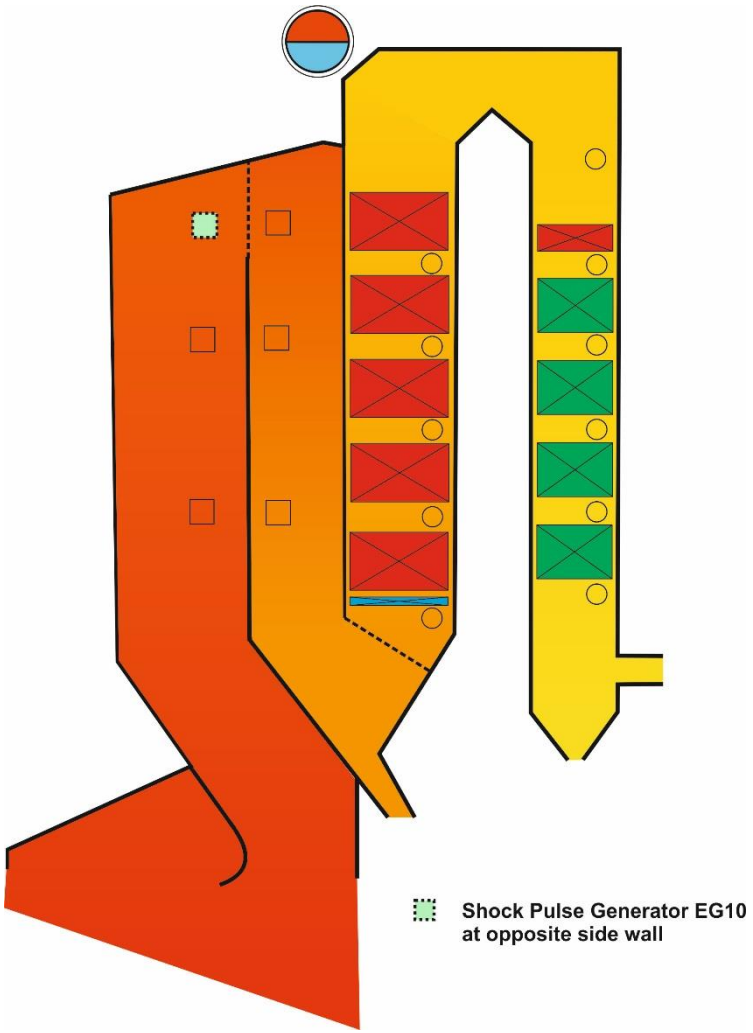






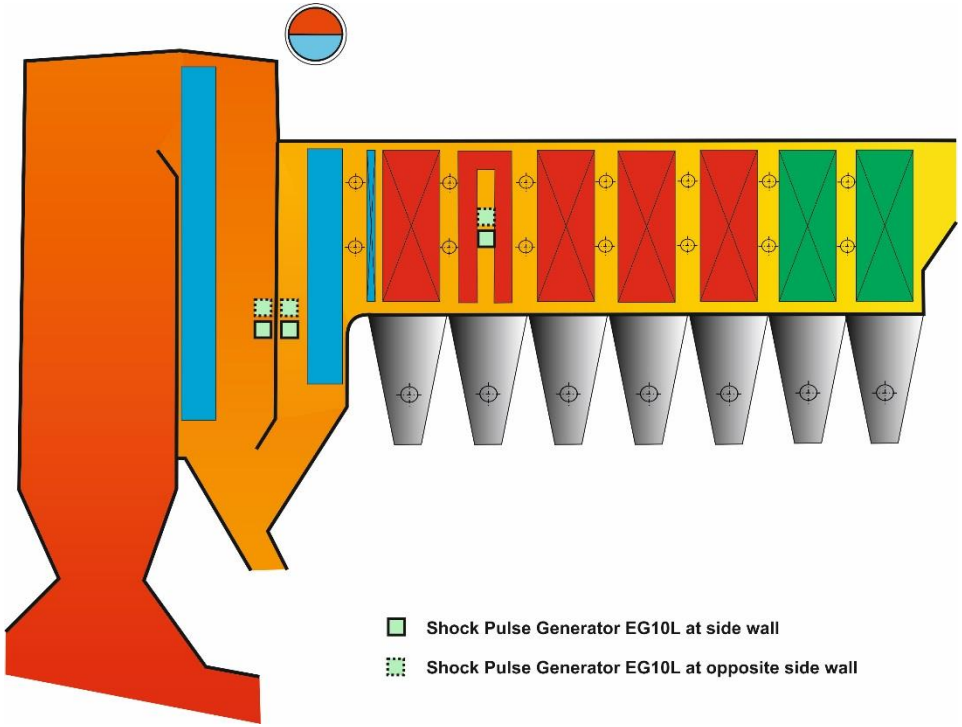


Example for Furnace Pass (Radiation Pass): WtE Asdonkshof / Germany



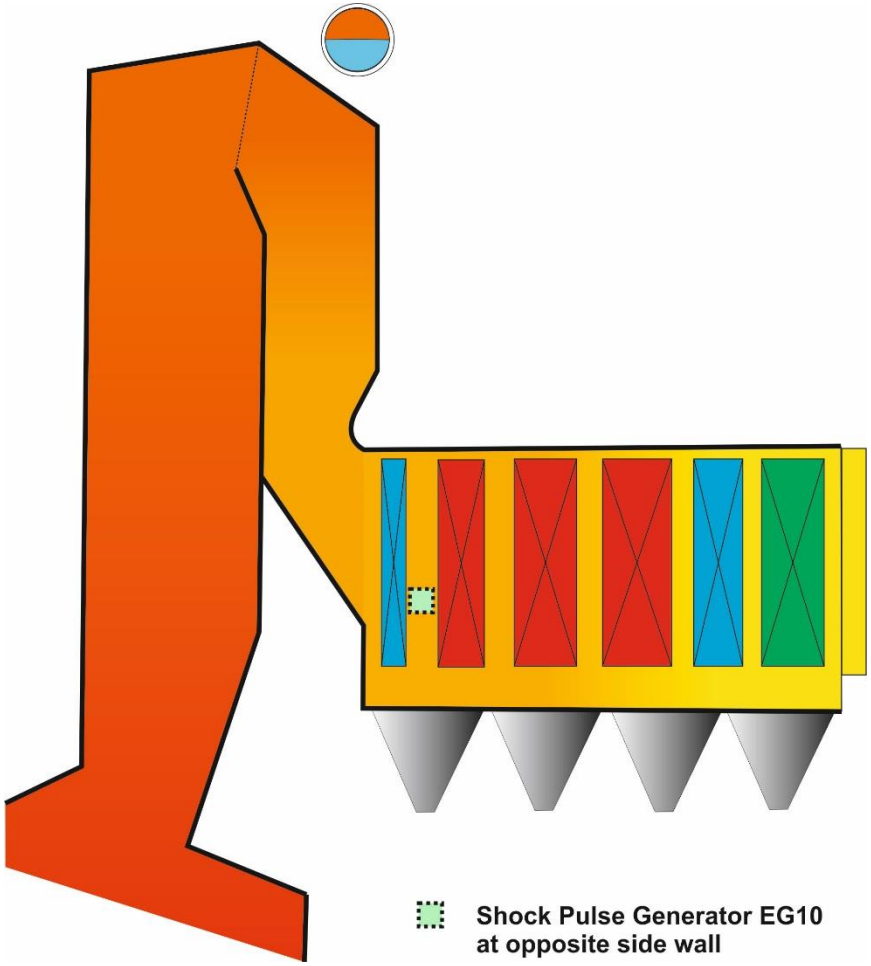
- 2 boilers with 55 t/h steam capacity each
- Boiler width: 4.8 m
- Refurbishment of 2 x EG10, commissioned 01/2012 (1 per boiler, at 1st pass)
- Good cleaning effect at grid tubes between 1st and 2nd pass; Cleaning effect also clearly visible at walls of 1st pass by reduced outlet temperatures at 1st pass
- Load was increased in 2008 by 15%, therefore increased flue gas temperature, velocity and fouling.
- Number of manual B&C cleanings within one traveling period was reduced to approx. 1/3 by installation of EG10
- Plant supplier: Babcock
- Plant operator: Kreis Weseler Abfallgesellschaft mbH & Co. KG (KWA)

Example for Radiation Passes: WtE Grossräschen / Germany



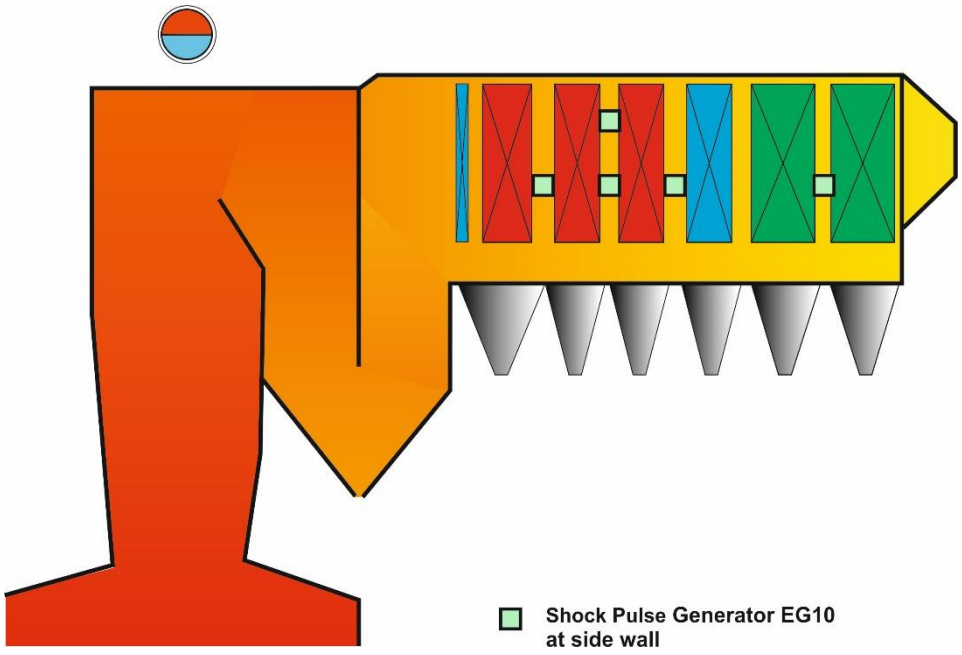
- 100 t/h steam capacity
- 2nd pass: W 9 x L 3.5m, flag shape evaporators,
  2 EG10L, 03/2012, simultaneous shock pulses; instead shower cleaning
- 3rd pass: W 9 x L 3.5m, flag shape evaporators,
  2 EG10L, 03/2012, simultaneous shock pulses; additional to shower cleaning
- 4th pass: W 7m
  2 EG10L, 08/2011
  additional to rapping
- Cleaning effect good, travel period of boiler was increased by 100%
- Before: intermediate manual explosion cleanings on a weekly basis
- Plant supplier: Alstom DE
- Plant operator: EEW Energy from Waste

Example for Horizontal Pass: WtE Breisgau / Germany



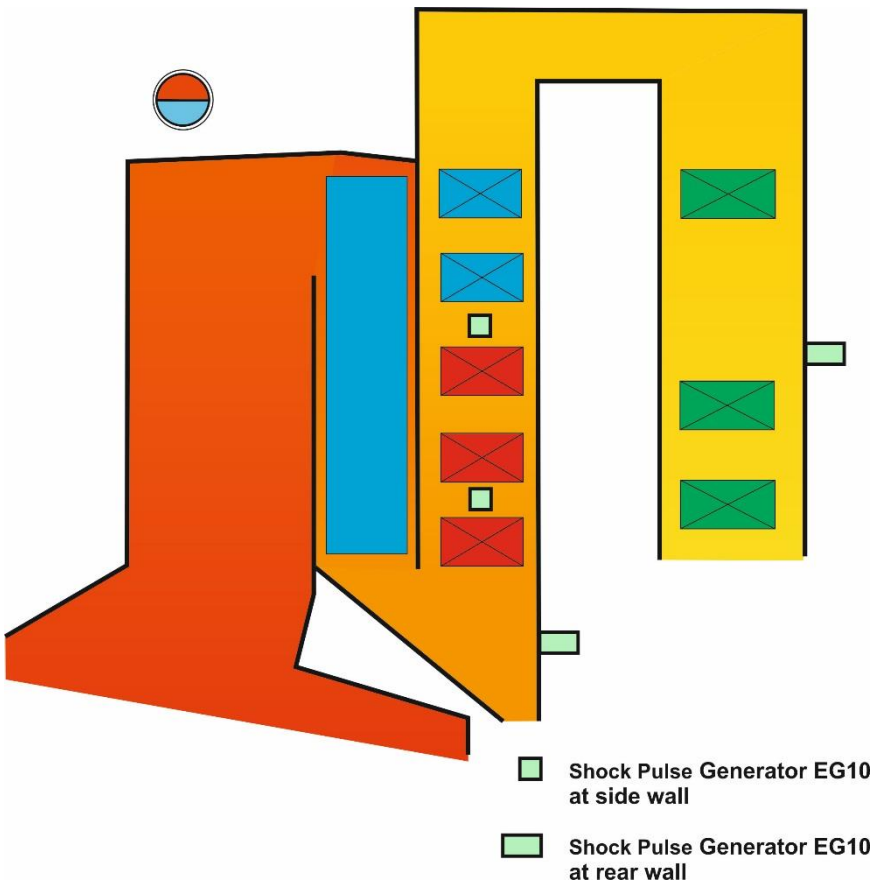
- 3-pass horizontal boiler
- 71 t/h steam capacity
- 2nd pass: W 7.5 x L 4.0 x H 19 m
- 3rd pass: W 5.8 x L 15 x H 7.5 m
- 1 x EG10, since 04/2010 behind EVAP1
- No shower cleaning necessary since then
- No more blockages at boiler hopper
- Reduced flue gas temperatures (in average 30°C lower)
- Additional tests at Eco 04/2010 (1EG10) and again 11/2012 – 01/2013 (2 EG10L): heat transfer can be increased by SPG.
- Plant supplier: Hitachi Zosen Inova
- Plant operator: E.ON Energy from Waste

Example for Horizontal Pass: WtE Tyseley (B1, B2) / UK



- 2 units of 4-pass horizontal boiler,
- steam capacity 65 t/h
- Boiler width: 5 m
- 04/2010 : 2 x EG10 for testing,
- Since 03/2011, per boiler: 4 EG10
- Since 05/2014 and 10/2014, per boiler: 5 EG10
- Rapping system completely stopped
- Cleaning efficiency good
- Considerable improvements:
  - availability increased
  - Water consumption decreased
  - Electricity production increased
  - Intermediate cleanings reduced
- Plant supplier: Steinmueller Babcock Engineering (Steinmueller)
- Plant operator: Veolia Environmental Services

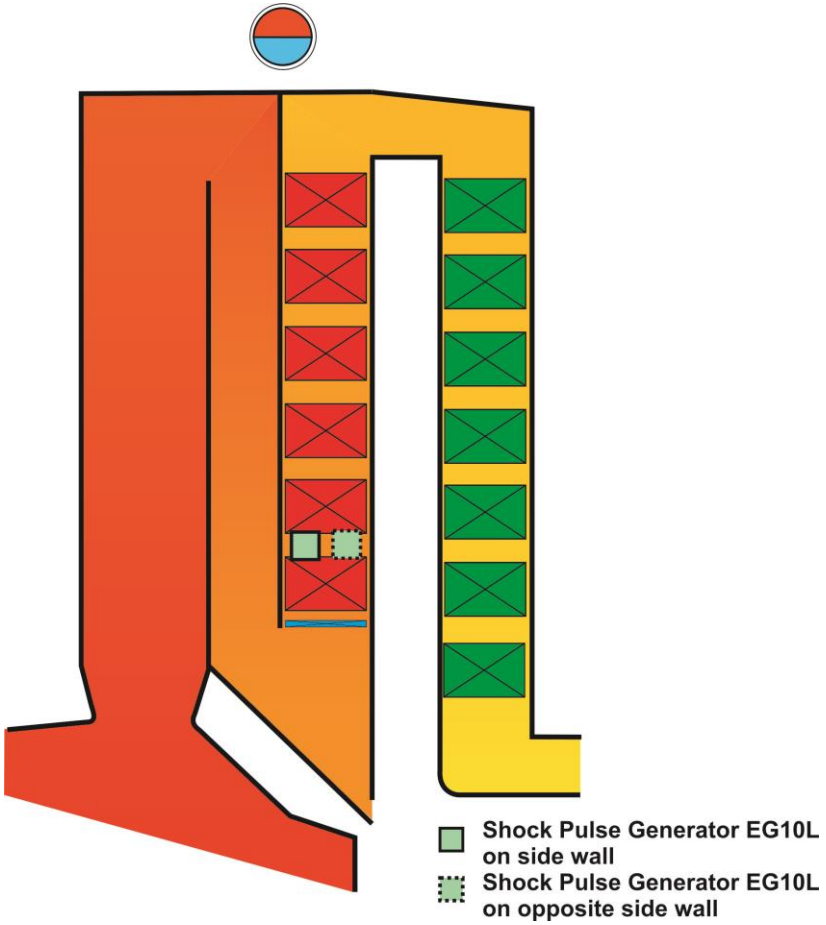
Example for Vertical Pass:
WtE Lucerne, B3 / Switzerland



- 17 t/h steam capacity
- 2nd pass: W 3.1 x L 1.6 m
  + 4 panel evaporators, pitch 600mm;
  cleaned by 1 EG in 3rd pass since 11/2009,
  instead of manual explosion cleanings every 2-4 months
- 3rd pass: W 3.1 x L 2.1 m
  bundles: Pitch H/V/tube Dia; bundle height
  EVAP1: 125/80/31.8mm; 1.0m
  EVAP2: 125/80/31.8mm; 1.0m
  PSH1: 125/80/31.8mm; 1.0m
  PSH2: 125/80/31.8mm; 1.0m
  FSH: 150/80/31.8mm; 1.0m,
  2 SPG since 06/2009, instead of 8 sootblowers
- 4th pass: W 3.1 x L 1.9 m
  pitch H/V: 80/80; tube: 31.8mm,
  bundle heights 1.3/1.5/1.6m
  1 SPG since 02/2010, instead of shot ball system
- Cleaning effect very good
- Improvements in boiler operating & maintenance cost
- Plant supplier: Von Roll (HZI)
- Plant operator: Real Luzern

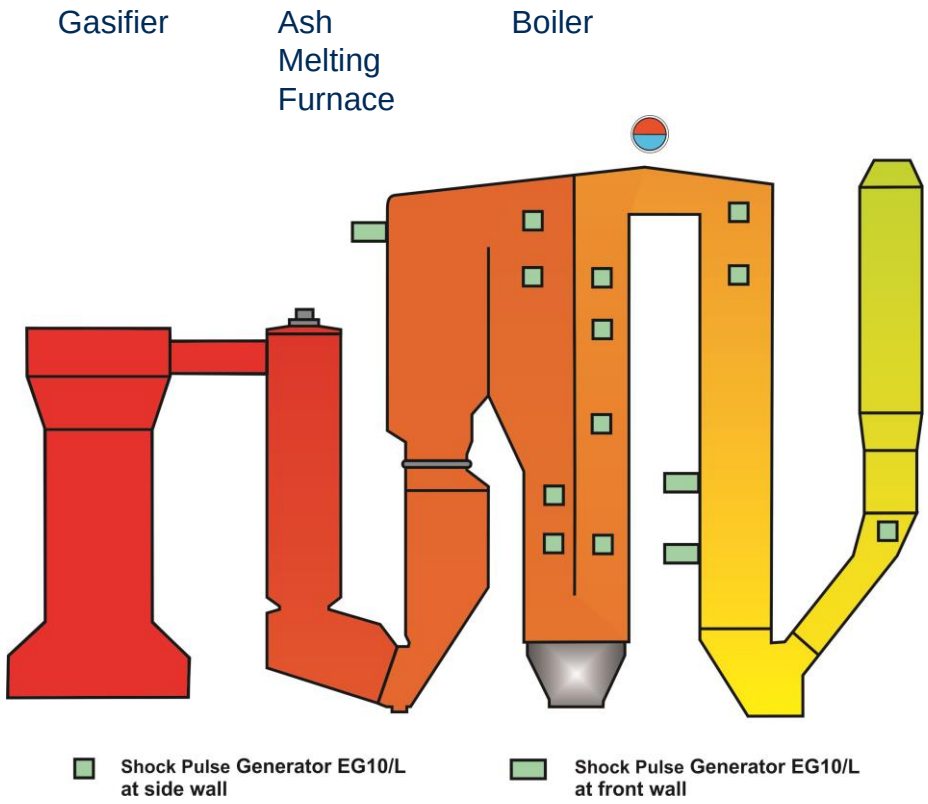
Lucern all 3 boilers:
SPG's were the only boiler cleaning equipment for 5 years performing a total sum of > 500'000 Shock Pulses (more than required; EP test plant)

Example for Vertical Pass:
WtE Hamburg - Rugenberger Damm / Germany



- 72 t/h steam capacity
- 3rd pass: W 6.5 x L 3.5 m x H 20m
- bundles: Pitch H/V/tube Diameter; bundle height
  SH1.1-1.4: 150 / 130 / 48.3 mm; 2.2 m
  SH2: 150 / 130 / 51.0 mm; 2.2 m
  SH3: 150 / 130 / 51.0 mm; 2.2 m
- Boiler 2: Refurbishment of 2 EG10L, between SH3 and SH2, commissioning 11/2012
- 1 sootblower was shut off; the cleaning effect of the 2 SPG's is comparable
- Significantly reduced erosion and corrosion at the bundle
- Based on the positive results on boiler 2, MVR decided to refurbish 2 EG10L on boiler 1 in 05/2014
- Plant supplier: Steinmueller
- Plant operator: MVR Rugenberger Damm GmbH & Co. KG

Example for All Boiler Sections: WtE Aomori / Japan



- Energy from Waste Plant, incinerating 120’000 t/y shredding residues and sewage sludge
- Shredding residues originate from recycling of cars, trains, household appliances, etc
- 2 boilers, each 40 t/h steam capacity
- 30 Shock Pulse Generators EG10/ EG10L in operation since 11/2013 (Line B) and 12/2013 (Line A)
- Shredding residues are known to create stronger boiler fouling than municipal solid waste
- Beneficial cleaning effect of the SPG’s:
  - lower flue gas temperatures
  - higher average steam production
  - strongly reduced number of manual explosion cleaning interventions
- Plant owner and operator: Aomori RER (SEINAN Corporation)


meep .. meep
BANG!
EXPLOSION POWER