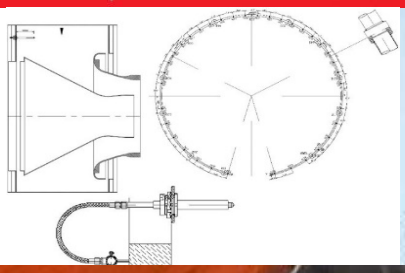
For a good reason...

CHEMTRON

Compressor Cleaning Systems for Gas Turbines



Chemtron GmbH

Industriestr.69

28876 Oyten

Germany

Phone: +49 4207-7099-0

Fax: +49 4207-7099-70

E-Mail: info@chemtron.de

www.chemtron.de

- Industrial pollutants
- Traffic pollutants
- Airborne dust
- Pollen
- Oil
- Sea salts

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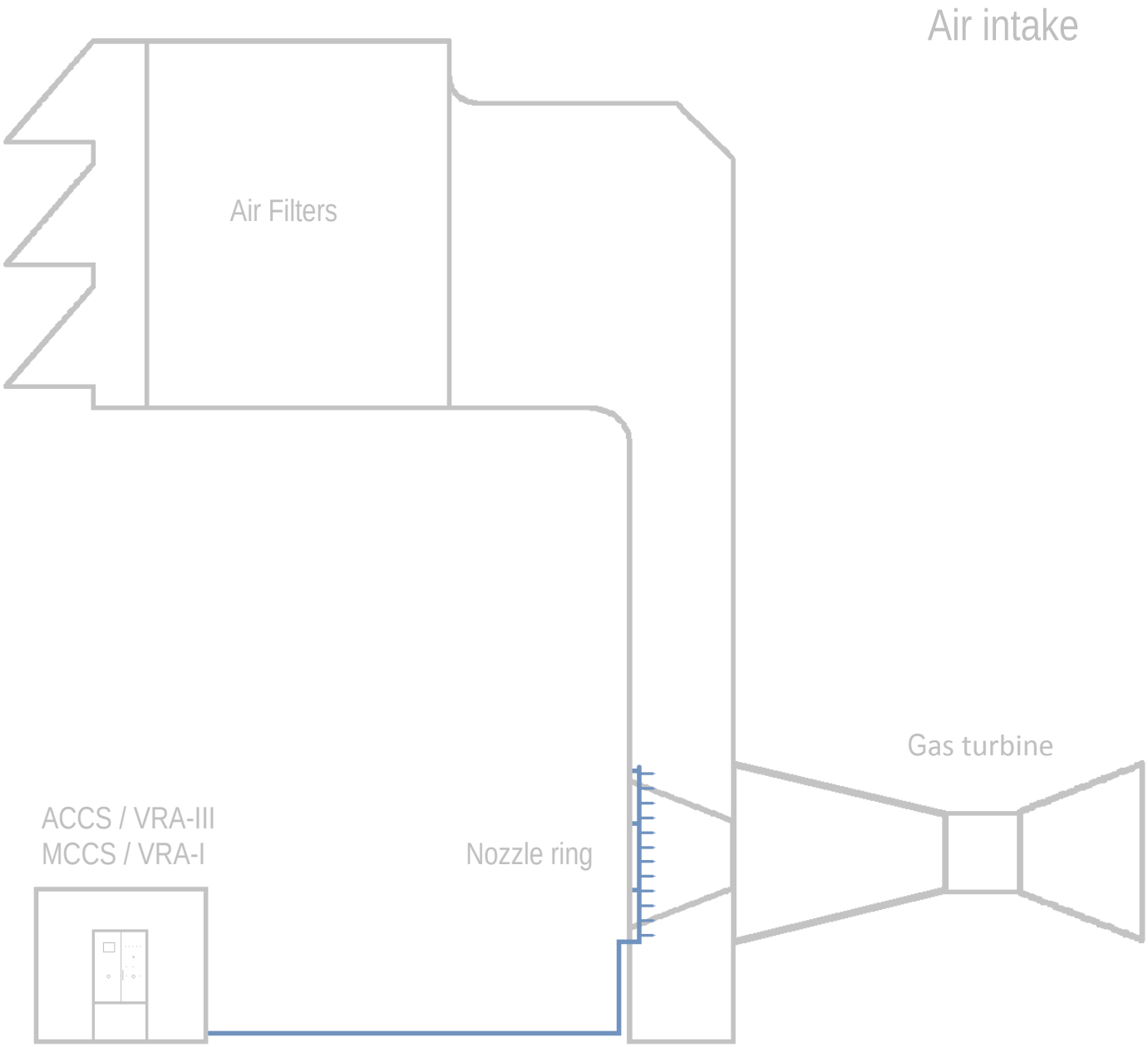

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Introduction

History

The founder of Chemtron GmbH gathered quantities of experience in Energy Sector. Since 1976 as an engineer, he was engaged in the development and manufacture of plant constructions for combustion processes and development of chemicals for the improvement of combustion processes.
At the very beginning, these were only for coal-, brown coal-, and waste incineration plants. In the same years as the era of gas turbine generation came, it appeared also the problem of gas turbine compressor cleaning.

Chemtron was founded in 1988. It started with the demand from the operators of Power Plants for a high-performance compressor cleaning system. This should consist of a nozzle system and a full automatic supply system, which should be usable from the control room. Together with the hardware, we have been asked to supply also a high efficiency cleaning solution.
The development and manufacturing of the compressor cleaning system VRA-III also known under the Siemens name as ACCS – Advantage Compressor Cleaning System in its last stage of development arises on a long-term experience with different manual systems, cleaning solutions and on the basic of a pool of experience of the engineers.
Now, the VRA-III / ACCS is the most effective compressor cleaning system in the whole world and installed in more than 100 Power Plants.

Performance profile

The function of the compressor cleaning system is to clean the compressor of the turbine in OFF-LINE use and to hold the maximum compressor power in ON-LINE use.
Due to pollution for example through pollen, subtle particles and aerosol on the blades, the flow cross-section is going to change.
The covering on the blades are acid and following elements are contained in the covering: Si, Ti, Ca, Mg, Al, Iron and Sulphur.
Because of these pollutions, there is a decrease of power.
This is the point where we start with our compressor cleaning system and our detergents.

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Our product and service program

Development and manufacture of compressor cleaning systems for gas turbines:

- Automatic - VR-III / ACCS
- Mobile - VRA-I / MCCS Units
- Nozzle systems for different gas turbine air intakes

As well as our cleaning agents:

- Chem Turbo OL / Siwash S (solvent based)
- Chem Turbo OL – W / Siwash W (water based)
- Chem Antifreeze / Si – Antifreeze (anti - icing fluid)

Waste incineration plants, steamer and furnaces cleaning:

Bulk Products	–	ChemRon 2000, ChemRon MG
Liquids	–	ChemLon W 700, ChemKat CM 150, ChemMag MF

Industrial cleaning products:

Tanks cleaner	–	ChemClean T, ChemClean TM
Cold cleaner	–	ChemClean K 15, ChemClean K 20, ChemClean NC
Safety acid	–	ChemClean SP
Alkaline Cleaner	–	ChemClean AK, ChemClean 100 A
Flow improver	–	ChemFlow

Bulk solids and liquids for the combustion process improvement and reduction of NOx, CO2.

In addition, we also carry out chemical-technical cleaning and pickling in power stations, refineries and industrial plants. Here we use our additives and industrial cleaning products.

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Compressor cleaning agents

ChemTurbo OL / Siwash S

is a solvent-based detergent that grants a maximum cleaning effect for ON-LINE and OFF-LINE cleaning. Siwash S removes all the contamination on the turbine blades. The compressor cleaning products are very successful and highly appreciated by all customers.

Chem-Antifreeze / Si-Antifreeze

prevents the icing of the compressor inlet. It is mixable with water in any Ratio. No bonding or contamination of the turbine blade surfaces. The range of use is from +8° C down to -35°C air intake temperature.

ChemTurbo OL-W / Siwash W

is a water-based detergent. The wet fluid contacts the fouled surface; the solution then penetrates the porous matrix and dissolves it.

Siemens Erlangen has approved all products. We are a certified partner of them. Siemens also invented their own Branch name for our products, beginning with "Si".

The results obtained with Siwash S and Siwash W is well inside those required in the specifications of all other manufacturers so that approval can be obtained immediately without any problem.

Advantages:

- Very low reduction in output
- High fuel utilization
- No requirement to shut the compressor down for cleaning at regular intervals
- Very high availability of the gas turbines
- Fully automatic cleaning sequence
- No pulsing of the washing solution
- Excellent distribution of the washing solution in the bell mouth
- Maximum possible cleaning effect
- Injecting in under full load (depending on the project possible)
- No damage to material and coatings

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Description of the VRA-I / MCCS-Skid for ON- and OFF- Line Use

- Can be used at several Gas Turbines
- Tank capacity 200 - 700 Liters
- 50 or 60 Hz operation
- Hose connection to the Gas Turbine
- Connection with Cam Locking Couplings

Compressor Cleaning Fluid

- Demin Water
- 20% ChemTurbo-OL / Siwash S
  or
- 20% ChemTurbo OL-W / Siwash W

Mobile Compressor Cleaning Skid (MCCS)

The compressor-cleaning package is required to supply the cleaning fluid used for compressor washing to the cleaning nozzles. It essentially comprises a pressure boost station and associated components.

The package is mounted on a frame constructed of steel sections and designed as a transport cart so that it can be used for several gas turbines. The most important components of the compressor-cleaning package are centrifugal pump MBA18 AP001 and tank MBA18 BB002. To enable the mixing of demineralized water (deionized water) with a cleaning agent to a homogeneous cleaning fluid, circulation of the cleaning solution shall be provided.

Therefore, a branch piping with isolation valve has to be included, starting after the pump and leading back into the tank. Demineralized water is filled into the tank from an existing demineralized water line; the cleaning agent is dosed to the cleaning package tank from a storage tank using a hand drum pump (MBA18 AP002). During the cleaning operation the centrifugal pump forwards the cleaning fluid at a pressure of at least 6 bar (g) through a flexible hose line to the respective nozzle system.

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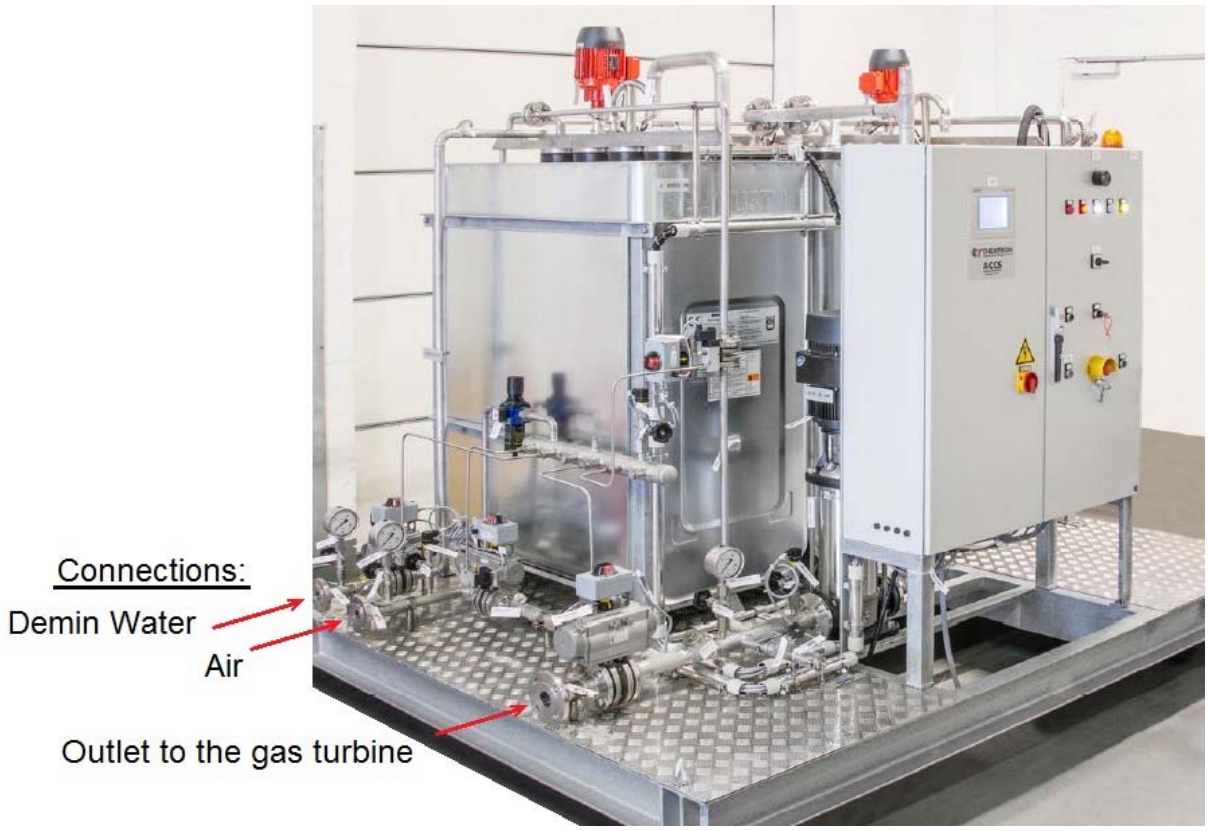
Description of the VRA-III / ACCS-Skid Standard for ON- and Off-Line Use

- Can be used at several Gas Turbines
- 3 tanks with the capacity per 1000 Liters
- 50 or 60 Hz operation
- Winter Module optional; fine dosage of antifreeze from +8°C to -15°C

The Construction Module will be connected with three pipelines with the Power Plant:

- VE-Water-Supply
- Pressure Gas
- Turbine Connection



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Compressor Cleaning Fluid

- Demin Water
- 20% ChemTurbo-OL / Siwash S
- ChemAntifreeze / Si-Antifreeze

Electrical Connection:

- TN-S Net, 415 V, 50 Hz, 9,5 kW or specific for the Country
- Signal exchange with the control room – the construction module will be remote controlled from there.
- Option: The Construction Module can be controlled from every other room through an additional control panel.

Advanced Compressor Cleaning Skid

The ACCS is a system that has been developed to improve the compressor cleaning and to simplify it at the same time. The compressor cleaning package is required to supply the nozzles in the air intake with the cleaning liquid.

The plant includes two storage tanks and a process tank with 1000 liters each, pumps, measuring technology and a control system (Programmable Logic Controller - PLC). This allows the ACCS to mix the appropriate cleaning solution consisting of demineralized water, detergent and, if necessary, antifreeze depending on the type of gas turbine and the temperature in the air intake.

Only two commands are required by the user to operate the system: 1. “Preparation of the cleaning liquid”, 2. “Start of spraying”.

The cleaning programs are deposited in the PLC. The admix of the Chem-Antifreeze / Si-Antifreeze starts as soon as the temperature of the intake air drops under +8°C.

Optionally the system can be designed for the supply of up to three gas turbines.

If desired, the operating display can be programmed out in a country language.

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The Compressor Cleaning with the VRA-III / ACCS

We recommend a compressor ON-LINE cleaning daily. Every third day with the addition of our cleaning agent ChemTurbo-OL / Siwash S or ChemTurbo-OL-W / Siwash-W.

The use of cleaning agents ensures improved cleaning efficiency.
The fouling of the compressor can vary according to the plant location.
Therefore, the operator can adjust the cleaning cycle to the local site condition

Recommended cleaning cycles		n.-Day	n+1.-Day	n+2.-Day
ON-Line	1 (demin. water with cleaning agent added)	---	---	✓
	2 (demin. water)	✓	✓	---
OFF-Line Double volume as ON-Line		Once a 3 month, or at a suitable opportunity		

The operation of the VRA-III is possible from two places.

- HMI-Touch Panel (Remote - Control)
- HMI-Touch Panel for VRA-III
- (Compressor Cleaning Unit)

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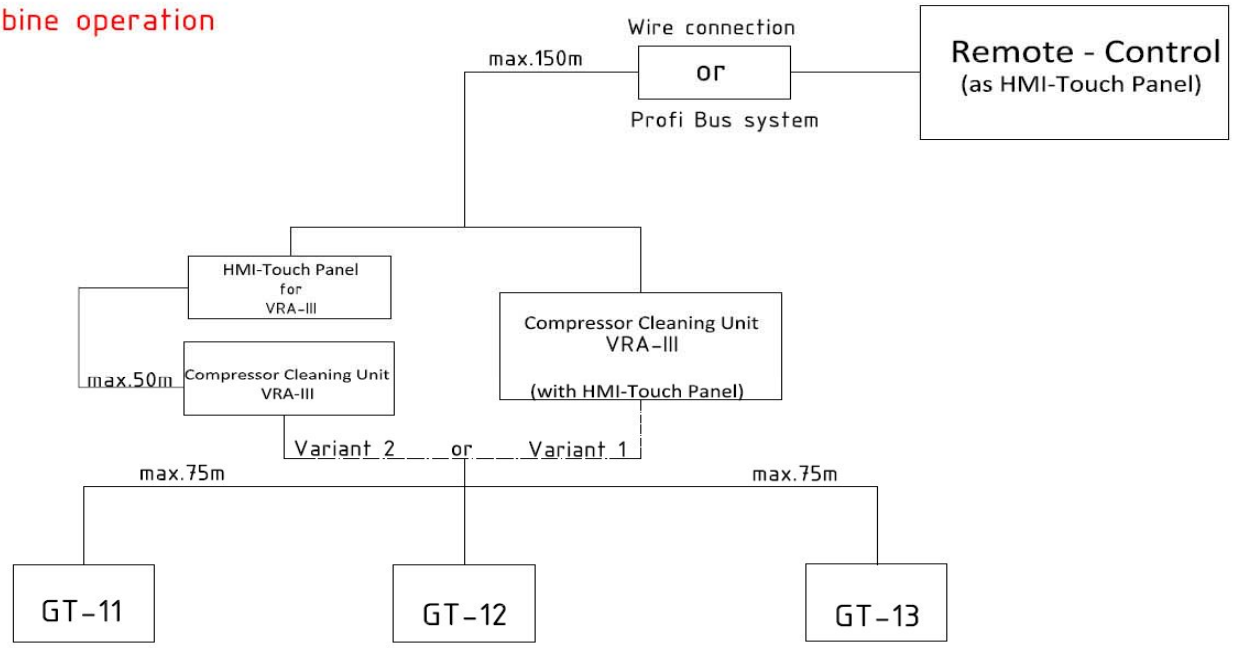
Connection for Installation

- Air Pressure: 6-10 bar
- Power Supply: Country specific
- Fluid: Demin Water

Gas Turbine operation



alternating operation

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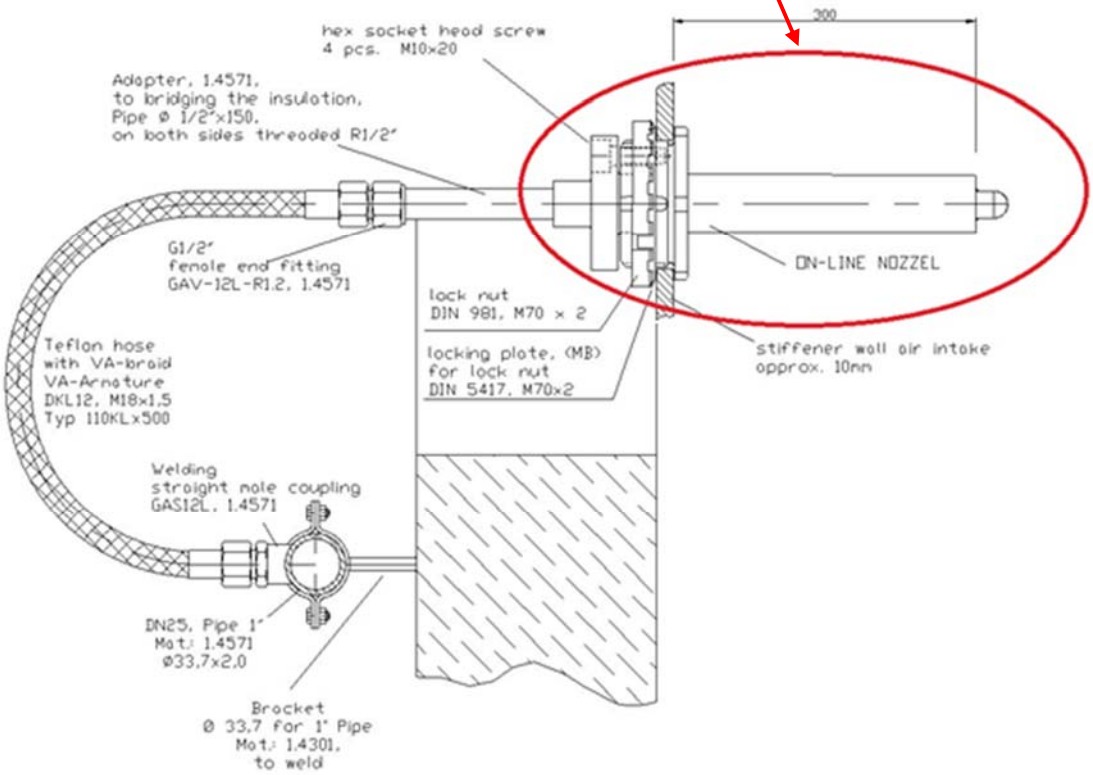
Typical Nozzle installation - Type: Mounting from outside



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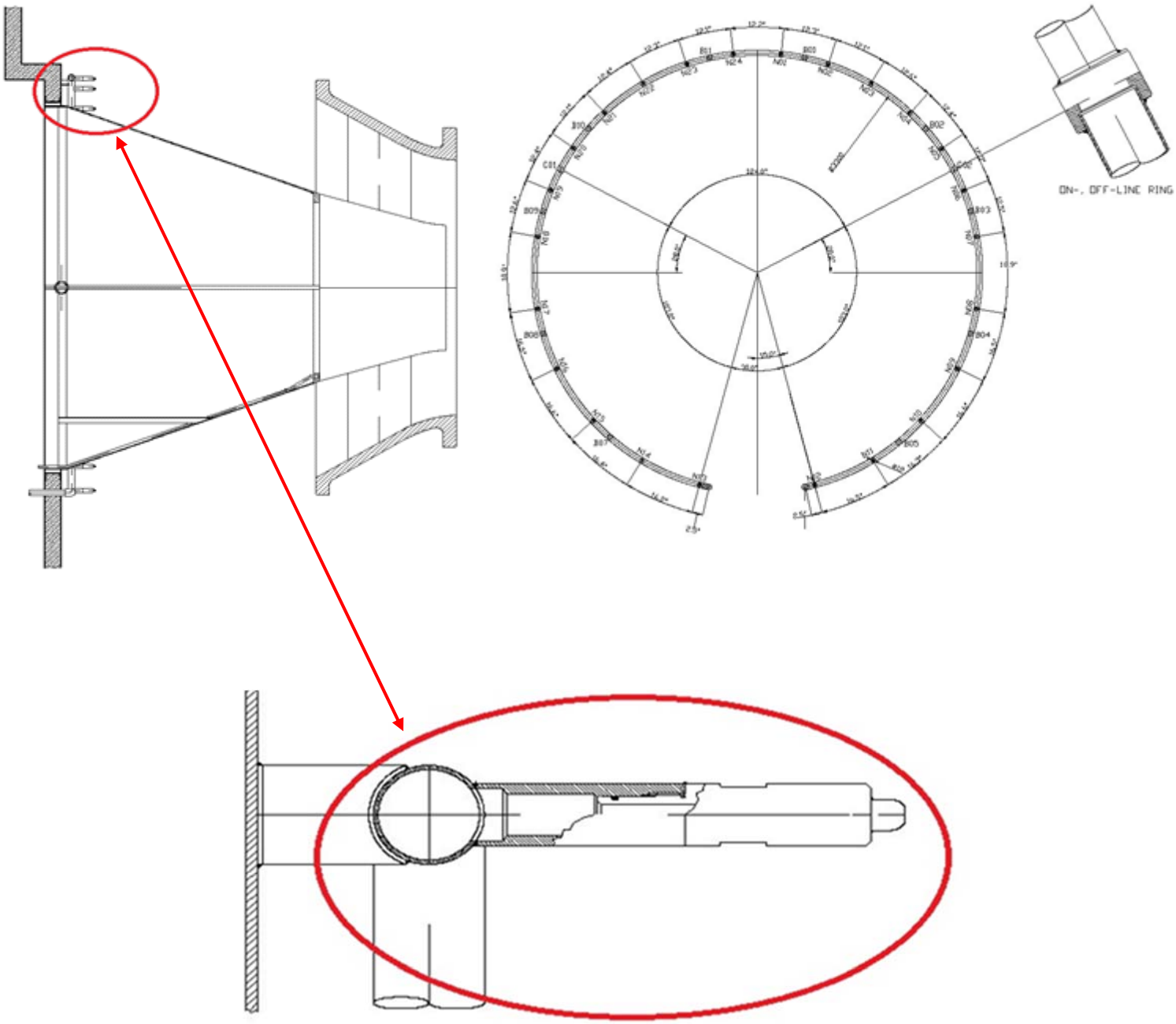
Typical Nozzle installation - Type: Mounting from inside

The installation of the nozzles are possible as construction on a ring or as a mesh construction

To be more accurate, we need the drawing of the Air Intake Plenum of the above-mentioned Gas Turbine.



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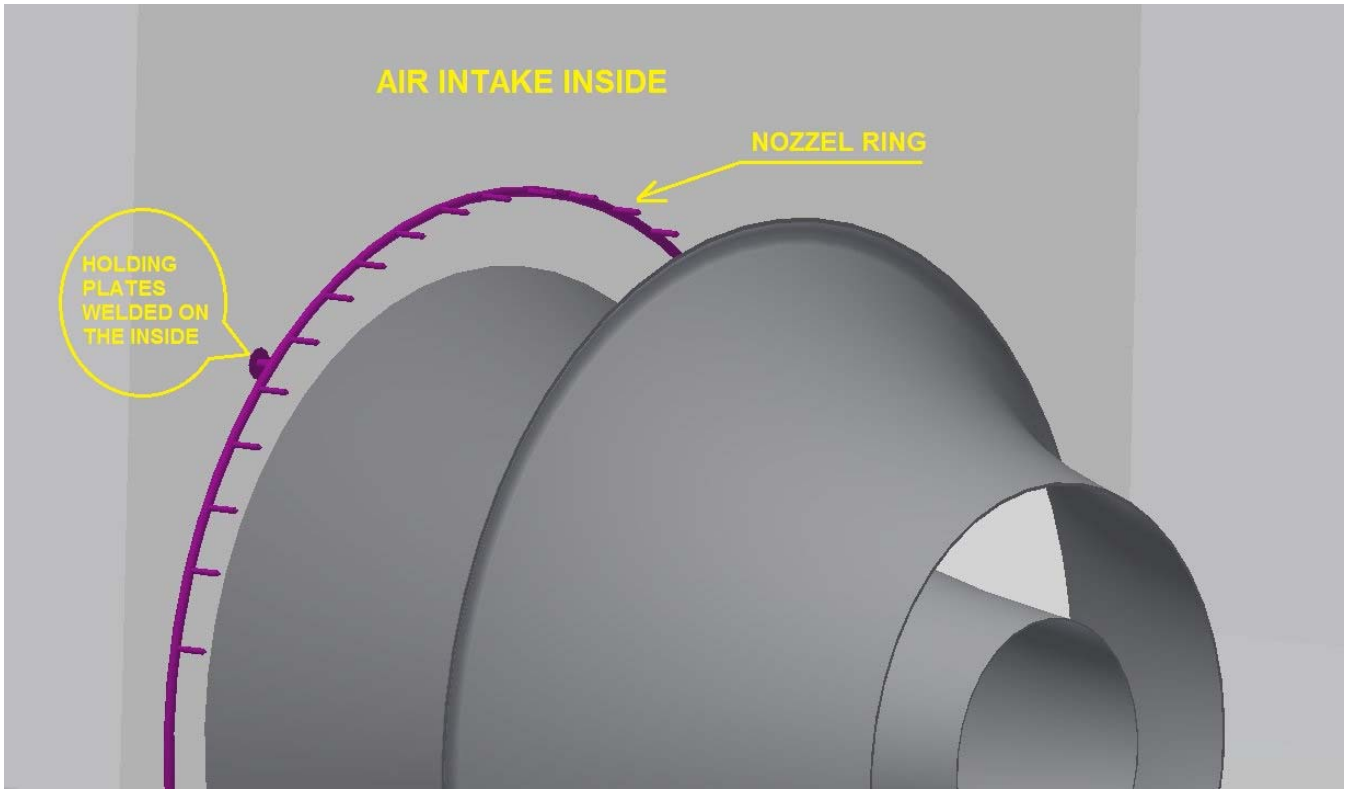

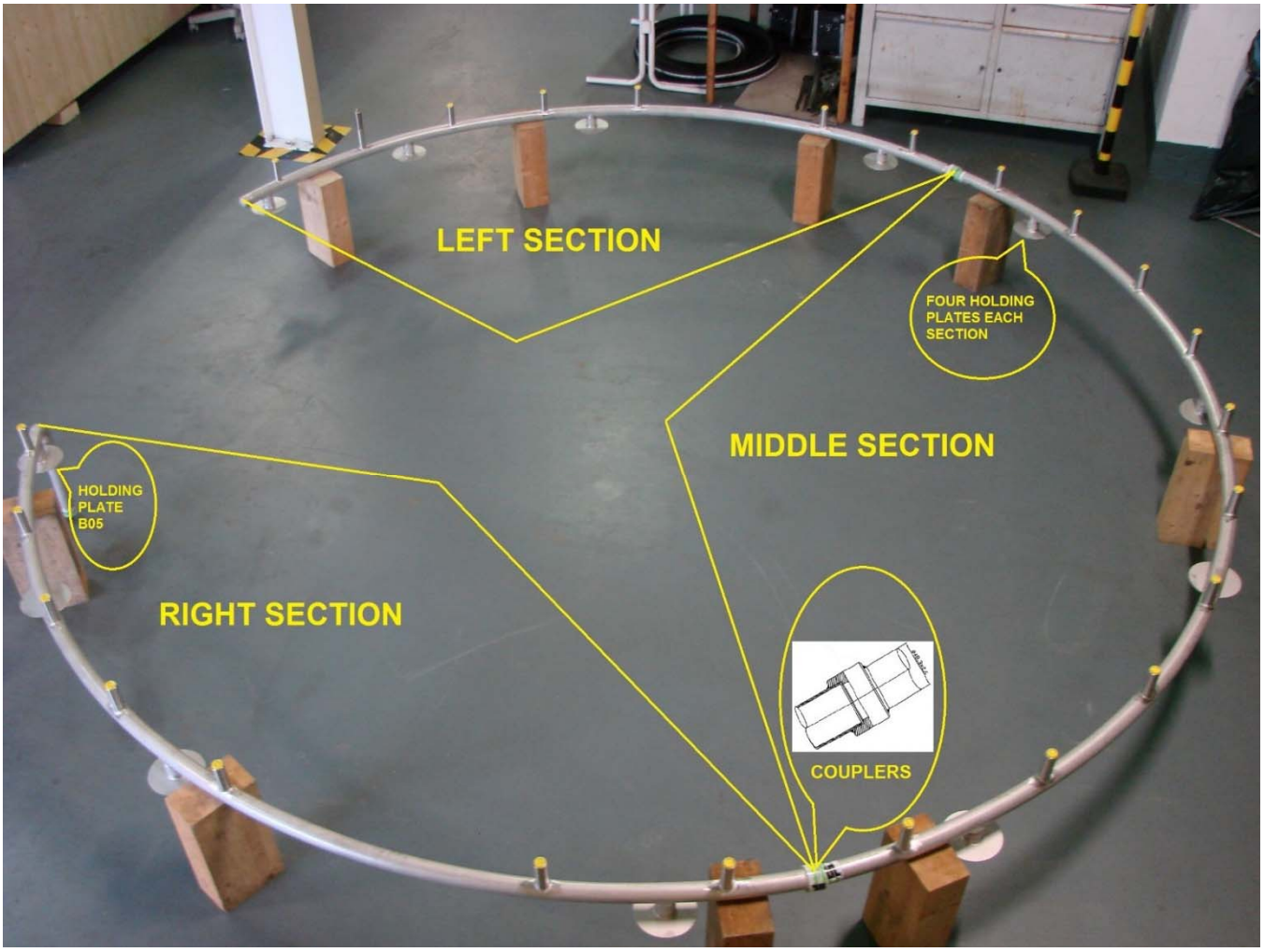

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ANNEX

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2. Product descriptions
3. References

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1. Typical Values

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Typical Values

1. Cleaning concentrate

Parameter and Elements	ChemTurbo OL / SIWASH S solvent base (100% concentrate)	ChemTurbo OL-W / SIWASH W water base
pH	n.m.	7,0 – 7,6
Flash point	> 60°C	non
Freezing point	< -20°C	> -1°C / < 1°C
Specific gravity	0,93-0,95	1,02
Total alkali metals	1,10 ppm	0,8 ppm
Magnesium + Calcium	0,05 ppm	0,4 ppm
Vanadium	non	0,05 ppm
Lead	non	0,03 ppm
Tin + copper	0,05 ppm	non
Sulphur	10,8 ppm	6,7 ppm
Chloride	12,0 ppm	0,8 ppm
Chlorine	non	non
Total ash content:	< 40,0 ppm	10,5 ppm

2. Cleaning solution 1 + 4 with demi- water typical

	ChemTurbo OL / SIWASH S	ChemTurbo OL-W / SIWASH W
pH	7,5 – 9,5	7,0 – 7,6
Total ash content:	4,8 ppm	2,1 ppm

02.06.2017

CHEMTRON
Chemie und Anlagentechnik

Typical Values

1. Chem-Antifreeze / Si-Antifreeze

Parameter	
pH	n. d.
Total alkali metals	non
Sulphur	5,0 ppm
Iron	0,2 ppm
Boiling point	197°C
Flash point	111°C
Density at 20°C	1,11 g/cm^3
Melting point	70% w/w – 67°C
Chloride	0,2 ppm
Chlorine	non
Total ash content:	5,4 ppm

05.03.2015

2. Product descriptions

ChemTurbo OL / SIWASH S

Description

CHEMTURBO OL / SIWASH S is a cleaning product developped according to latest tendencies and is based on hydrocarbon containing emulsifying agents, solution agents and inhibitors.

Specification

Appearance	:	clear liquid
Density 20 °C	:	0,93-0,95
Viscosity 20 °C	:	17 cST
Flash point	:	> 60 °C
Boiling point	:	180 °C
Freezing point	:	< - 20 °C
Ash	:	< 0,004 %

Solution 1 part CHEMTURBO OL / SIWASH S and 4 parts demineralized water

Appearance	:	clear, yellow liquid
ph-Value	:	7,5 - 9,5
Flash point	:	none

Application

CHEMTURBO OL / SIWASH S is an ON-LINE and OFF-LINE compressor-cleaning product for gasturbines. CHEMTURBO OL / SIWASH S is suitable for the general industry-, air- and marine-gasturbines of all powers and types.

Effects

Due to the special components of CHEMTURBO OL / SIWASH S an effective and reliable cleaning of the compressor is achieved while the gasturbine is operating under full load or with crank speed by OFF-LINE cleaning. CHEMTURBO OL / SIWASH S removes and prevents contamination of the compressor blades, if the agent is applied periodically, thus preventing reduction of the capacity and performance. The components of CHEMTURBO OL / SIWASH S are causing no contamination of the hot blade of the gasturbine. CHEMTURBO OL / SIWASH S cleans highly effective atmospheric comtamintions such as dust, grease, oil, soot, tyre-abraison, salt and blossom-dust. CHEMTURBO OL / SIWASH S has no influence on the following materials and and linings: Nickel, Nickel-Cadmium, stainless-steel, Aluminium, Magnesium, Titan and steel as well as coatings or Sermetal etc.

All data meet actual standards. Guarantees and liabilities as to data are excluded. Since handling of these agents is out of our control, the user himself has to observe legal direction.

ChemTurbo OL / SIWASH S

Procedure

ON-LINE compressor cleaning:

CHEMTURBO OL / SIWASH S is sprayed as a solution via the ChemTurbo ON-LINE Spray-diffuser into the compressor intake duct. CHEMTURBO OL / SIWASH S is transported via the suction flow into the gasturbine and is burned with no residuals.

OFF-LINE compressor cleaning:

CHEMTURBO OL / SIWASH S is sprayed as a solution via the ChemTurbo OFF-LINE Spray-diffuser into the compressor intake duct with crank speed. After rinse with demineralized water.

Dosing

ON-LINE compressor cleaning:

CHEMTURBO OL / SIWASH S is dosed as a solution. The solution is a stable emulsion consisting of one part CHEMTURBO OL / SIWASH S and four parts of demineralized water. This solution has to be applied every 48 h. up to 120 h. Duration of the injection time is 1 - 10 minutes. After rinse with demineralized water, see dosage table.

OFF-LINE compressor cleaning:

CHEMTURBO OL / SIWASH S is dosed as a solution. The solution is a stable emulsion consisting of one part CHEMTURBO OL / SIWASH S and four parts of demineralized water. The soaking time is 20 - 30 minutes. After this time start and rinse with demineralized water, check drained rinsing water until the water is clean.

Observe the cleaning instructions of the gas turbine manufacturer.

All data meet actual standards. Guarantees and liabilities as to data are excluded. Since handling of these agents is out of our control, the user himself has to observe legal direction.

ChemTurbo OL / SIWASH S

ON-LINE dosage table:

The dosing-quantity of the solution amounts:

GT-power	CHEMTURBO OL / SIWASH S	demi-water	solution-quantity	demi-water
		1st injection		2nd injection
0,5 - 1,0 MW	2 l	8 l	10 l	10 l
1,0 - 5,0 "	5 l	20 l	25 l	25 l
5,0 - 10,0 "	9 l	36 l	45 l	45 l
10,0 - 25,0 "	12 l	48 l	60 l	60 l
25,0 - 35,0 "	18 l	72 l	90 l	90 l
35,0 - 45,0 "	21 l	84 l	105 l	105 l
45,0 - 65,0 "	28 l	112 l	140 l	140 l
65,0 - 75,0 "	32 l	128 l	160 l	160 l
75,0 - 85,0 "	40 l	160 l	200 l	200 l
85,0 - 95,0 "	44 l	176 l	220 l	220 l
95,0 - 105,0 "	48 l	192 l	240 l	240 l
105,0 - 115,0 "	52 l	208 l	260 l	260 l
115,0 - 125,0 "	56 l	224 l	280 l	280 l
125,0 - 150,0 "	62 l	248 l	310 l	310 l
150,0 - 175,0 "	68 l	272 l	340 l	340 l
175,0 - 200,0 "	74 l	296 l	370 l	370 l
200,0 - 225,0 "	80 l	320 l	400 l	400 l
> 225,0 "	86 l	344 l	430 l	430 l

Please note:
During the ON-LINE compressor cleaning procedure, ice-forming is possible if the air-temperature is below 5 °C. In this case, CHEMTURBO OL / SIWASH S solution has to be mixed with Chem-Antifreeze / Si-Antifreeze, please look at the following mixing-table. It is not necessary that the CHEMTURBO OL / SIWASH S solution has to be mixed with Chem-Antifreeze / Si-Antifreeze if the air temperature is over 0 °C.

All data meet actual standards. Guarantees and liabilities as to data are excluded. Since handling of these agents is out of our control, the user himself has to observe legal direction.

ChemTurbo OL / SIWASH S

Mixing-table for CHEMTURBO OL / SIWASH S

During the ON-LINE compressor cleaning procedure, ice-forming is possible
if the air-temperature is under 0 °C.

In this case CHEMTURBO OL / SIWASH S solution has to be mixed with Chem-Antifreeze / Si-Antifreeze.

Mixing table for Chem-Antifreeze / Si-Antifreeze to - 10 °C outside air temperature

Volume %

CHEMTURBO OL / SIWASH S	demi-water	Chem-Antifreeze / Si-Antifreeze	Antifreeze to
1 part	3 parts	1 part	- 10,0 °C

Please do not carry out a 2nd injection if the temperature is under 3 - 5 °C, because ice-forming is possible.

Generally we do not recommend to carry out a 2nd injection under 0 °C.

Handling and storage

CHEMTURBO OL / SIWASH S is an industrial cleaner, use gloves and eye-protection. The storage has always to be dry and at normal temperature.

Precaution

Handling this agent, rubber gloves and safety goggles are to be worn. In case of skin or eye contact amply clean with water and immediately consult eye-doctor. Observe material safety data-sheet.

All data meet actual standards. Guarantees and liabilities as to data are excluded. Since handling of these agents is out of our control, the user himself has to observe legal direction.

CHEMTRON
Chemie und Anlagentechnik

Chem-Antifreeze / Si-Antifreeze

Description

Chem-Antifreeze / Si-Antifreeze is a colourless, slightly viscous and highly hygroscopic liquid. The product can be mixed with water in any mixing ratio.

Specification

Density at 20C°:	1.113 g/ml
Flash point:	116 ° C
Boiling point:	197 ° C
Ash:	< 0,002 %

Use

Chem-Antifreeze / Si-Antifreeze is mainly used for ON-LINE cleaning of compressors in order to avoid icing at the compressor inlet. The product is a distillate and filtered. It does not contain any additives (e.g. phosphates, potassium, etc.) and does not pollute the compressor blades.

Mixing table for Chem-Antifreeze / Si-Antifreeze with water:

Compressor inlet temperature:	Antifreeze
+ 7 ° C	4,5 %
+ 5 ° C	11 %
± 0 ° C	21 %
- 5 ° C	27,1 %
- 10 ° C	32,6 %
- 15 ° C	37,8 %
- 20 ° C	42,5 %

Our compressor cleaning agents ChemTurbo OL / SIWASH S can be mixed with Chem-Antifreeze / Si-Antifreeze in the percentages and can be used without any problems.
Please ask us for a specific application description for your location.

Precautions

When handling the material, wear rubber gloves, safety goggles and a dust mask. Change soiled clothes immediately. If material comes into contact with the skin or eyes, rinse with plenty of water and consult an eye specialist, if necessary. Comply with safety data sheet.

All specifications reflect the current state of our knowledge. However, we do not provide any warranty nor assume any liabilty for the information provided. Since the use of the products is beyond our control, the user shall be responsible for complying with the relevant legal regulations.

ChemTurbo OL-W / SIWASH W

Description

ChemTurbo OL-W / SIWASH W is a cleaning product developed according to latest tendencies and is based on water with a special combination of nonionic emulsifiers, inhibitors and solution agent.

Specification

Appearance	:	clear, yellow liquid
Density 20°C	:	1,02
Flash point	:	none
Boiling point	:	100 °C
Freezing point	:	0 °C
Ash	:	< 0,002 %

Solution 1 part ChemTurbo OL-W / SIWASH W and 4 parts demineralized water

Appearance	:	clear, yellow liquid
ph-Value	:	7,0 - 7,5
Flash point	:	none

Application

ChemTurbo OL-W / SIWASH W is an ON-LINE and OFF-LINE compressor-cleaning product for gasturbines. ChemTurbo OL-W / SIWASH W is suitable for the general industry air- and marine-gasturbines of all powers and types.

Effects

Due to the special components of ChemTuro OL-W an effective and reliable Cleaning of the compressor is archieved while the gasturbine is operating under full load. ChemTurbo OL-W / SIWASH W removes and prevents contamination of the of the compressor blades, if the agent is applied periodically, thus preventing reduction of the capacity and performance.The components of ChemTurbo OL-W / SIWASH W are causing no contamination of the hot blade of the gasturbine. ChemTurbo OL-W / SIWASH W cleans highly effective atmospheric comtamintions such as dust, grease, oil, soot, tyre-abraison, salt and blossom-dust. ChemTurbo OL-W / SIWASH W has no influence on the following materials and and linings: Nickel, Nickel-Cadmium,stainless-steel, Aluminium, Magnesium, Titan and steel as well as coatings or Sermetal etc.

Procedure

ChemTurbo OL-W / SIWASH W is sprayed as a solution via the ChemTurbo Spray-diffuser into the compressor intake cut. ChemTurbo OL-W / SIWASH W is transported via the suction flow into the gasturbine and is burned with no sesiduals.

All data meet actual standards. Guarantees and liabilities as to data are excluded. Since handling of these agents is out of our control, the user himself has to observe legal direction.

ChemTurbo OL-W / SIWASH W

Dosing

ON-LINE compressor cleaning:

ChemTurbo OL-W / SIWASH W is dosed as a solution. The solution is a stable solution consisting of one part ChemTurbo OL-W / SIWASH W and four parts of demineralised water. This solution has to be applied every 48 h. up to 120 h. Duration of the injection time is 1 - 10 minutes. After rinse with demineralised water.

OFF-LINE compressor cleaning:

ChemTurbo OL-W / SIWASH W is dosed as a solution. The solution is a stable consisting of one part ChemTurbo OL-W / SIWASH W and four parts of demineralised water. Afterwards rinse with demineralised water until the outflow is clear. At strong contamination repeat it eventually. Please pay attention to the details by the gas turbine manufacturer.

Please note:

During the ON-LINE compressor cleaning procedure, ice-forming is possible if the air-temperature is below 8 °C. ChemTurbo OL-W / SIWASH W cannot be used in combination with Chem-Antifreeze / Si-Antifreeze.

Handling and storage

ChemTurbo OL-W / SIWASH W is an industrial cleaner, use gloves and eye-protection. The storage always above freezing temperature.

Precaution

Handling this agent, rubber gloves and safety goggles are to be worn. In case of skin or eye contact amply clean with water and immediately consult eye-doctor. Observe material safety data-sheet.

All data meet actual standards. Guarantees and liabilities as to data are excluded. Since handling of these agents is out of our control, the user himself has to observe legal direction.

3. References

ACCS	Advanced Compressor Cleaning Skid with winter module
MCCS	Mobile Compressor Cleaning Skid
SCCS	Static Compressor Cleaning Skid
Injektor skid	Special system without mixing tank. The liquids are being mixed during pumping through an injection system. (without winter module)
WPS	Water Pump Set (**next generation** system - MCCS)
ACCS-MT	Advanced Compressor Cleaning Skid with tanks of stainless steel (without winter module). On individual customer with request.

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Type	Country / City	Year	Project	Gas Turbine	Units
ACCS	-	-	-	-	-
ACCS	Argentina	2014	Guillermo Brown	SGT5-4000F	2
ACCS	Austria	2010	GDK Mellach	SGT5-4000F	1
ACCS	Austria	2007	Timelkam	SGT5-4000F	1
ACCS	Austria	2007	Simmering	SGT5-4000F	1
ACCS	Belgium	2010	T-Power	SGT5-4000F	1
ACCS	Czech Republic	2012	Pocerady	SGT5-4000F	1
ACCS	Egypt	2006	Kureimat	SGT5-4000F	1
ACCS	Egypt	2005	New Talkha	SGT5-4000F	1
ACCS	Germany	2012	Knapsack II	SGT5-4000F	1
ACCS	Germany	2008	Irsching 5	SGT5-4000F	1
ACCS	Germany	2007	Irsching 4	SGT5-8000H	1
ACCS	Germany	2006	Herdecke	SGT5-4000F	1
ACCS	Germany	2006	Knapsack, Hürth	SGT5-4000F	1
ACCS	Germany	2005	Weisweiler	SGT5-3000T	1
ACCS	Germany	2000	HKW DREWAG	V64.3	1
ACCS	Germany	2000	Siemens Berlin		1
ACCS	Germany / Brandenburg	2000	EON Kirchmöser	V64.3A	1
ACCS	Germany / Obernb.M.	1999	Acordis Ind.Fibers	V64.3A	1
ACCS	Hungary	2009	Gönyü	SGT5-4000F	1
ACCS	Italy	2011	Turbigo 3	SGT5-4000F	2
ACCS	Italy	2008	Livorno	SGT5-4000F	1
ACCS	Italy	2006	Turbigo 3	GT V94.3A	1
ACCS	Korea	2013	Andong	SGT6-8000H	1
ACCS	Korea	2013	Posco	SGT6-8000H	3
ACCS	Korea	2013	Deagu City	SGT6-8000H	1
ACCS	Korea	2012	Bugok 3	SGT6-8000H	1
ACCS	Netherlands	2011	Diemen	SGT5-4000F	1
ACCS	Netherlands	2011	Hemweg 9	SGT5-4000F	1
ACCS	Netherlands	2010	Enecogen	SGT5-4000F	2
ACCS	Netherlands	2008	Sloe Centrale Unit 10	SGT5-5000	1
ACCS	Netherlands	2008	Sloe Centrale Unit 20	SGT5-4000F	1
ACCS	Poland	2016	Plock	SGT5-8000H	1
ACCS	Russia	2014	Verkhnetagilskaya	SGT5-4000F	1
ACCS	Russia	2013	Yuzhnouralskaya	SGT5-4000F	1
ACCS	Russia	2013	Perm	SGT5-4000F	2
ACCS	Russia	2012	Lukomiskaya	SGT5-4000F	1
ACCS	Russia	2012	Mosenergo TEZ 16	SGT5-4000F	1
ACCS	Russia	2012	Berezovskaya	SGT5-4000F	1
ACCS	Russia	2012	Novosavalatskaya	SGT5-4000F	1
ACCS	Russia	2012	Cherepovetskaya	SGT5-4000F	1
ACCS	Russia	2012	Serovskaya	SGT5-4000F	2
ACCS	Russia	2011	Nyaganskaya	SGT5-4000F	2
ACCS	Russia	2011	Yuzhnouralskaya	SGT5-4000F	1
ACCS	Russia	2010	Yajva	SGT5-4000F	1
ACCS	Russia	2010	Nyaganskaya	SGT5-4000F	1
ACCS	Russia	2009	Nevinnomyssk	SGT5-4000F	1
ACCS	Russia	2009	Kirishi	SGT5-4000F	1
ACCS	Russia	2002	Tjumen	V64.3A	1
ACCS	Slovakia	2010	Malzenice	SGT5-4000F	1
ACCS	Syria	2007	Deir Ali	SGT5-4000F	1
ACCS	Thailand	2012	Chana II	SGT5-4000F	2
ACCS	Turkey	2016	Hamitabat	SGT5-8000H	2
ACCS	Turkey	2016	Kazan	SGT5-4000F	1

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Type	Country / City	Year	Project	Gas Turbine	Units
ACCS	Turkey	2014	Bandirma II	SGT5-8000H	1
ACCS	United Kingdom	2009	Didcot B	SGT5-4000F	1
ACCS	United Kingdom	2001	Seabank	V94.3A	1
ACCS	Uruguay	2014	Punta del Tigre	SGT5-2000E	2
ACCS	USA	2002	Westingh. Chatou	V94.3	1
Injektor skid	-	-	-	-	-
Injektor skid	United Arab Emirates	2016	Jebel Ali M	SGT5-4000F	2
Injektor skid	United Arab Emirates / Dubai	2008	Jebel Ali M	SGT5-4000F	6
Injektor skid	United Arab Emirates / Dubai	2008	Al Aweer	SGT5-4000F	4
Injektor skid	United Arab Emirates / Dubai	2006	Jebel Ali	SGT5-4000F	2
MCCS	-	-	-	-	-
MCCS	Algeria	2014	Biskra	SGT5-4000F	2
MCCS	Argentina	2016	Timbues	SGT5-4000F	1
MCCS	Argentina	2009	Pilar	SGT5-2000E	1
MCCS	Argentina	2008	Genelba	SGT5-2000E	1
MCCS	Argentina	2008	Brigadier Lopez	SGT5-4000F	1
MCCS	Argentina	2008	Ensenada	SGT5-4000F	1
MCCS	Bangladesh	2016	Ghorasal	SGT5-4000F	1
MCCS	Bangladesh	2016	Sirajganj Phase II	SGT5-2000E	1
MCCS	Bangladesh	2015	Sikalbaha Phase II	SGT5-2000E	1
MCCS	Bangladesh	2014	Ashuganj North	SGT5-4000F	1
MCCS	Bangladesh	2014	Ashuganj South	SGT5-4000F	1
MCCS	Bangladesh	2013	Ashuganj	SGT5-2000E	1
MCCS	Bangladesh	2011	Sirajganj	SGT5-2000E	1
MCCS	Bangladesh	2009	Shikalbaha	SGT5-2000E	1
MCCS	China	2016	Shijiazhuang	SGT5-4000F	2
MCCS	Egypt	2016	Beni Suef	SGT5-8000H	4
MCCS	Egypt	2016	Burullus	SGT5-8000H	4
MCCS	Egypt	2016	New Capital	SGT5-8000H	4
MCCS	Egypt	2015	Attaqa	SGT5-2000E	4
MCCS	France	2011	Toul	SGT5-4000F	1
MCCS	France	2008	Emil Huchet	SGT5-4000F	2
MCCS	India	2012	Dgen	SGT5-4000F	3
MCCS	India	2012	Dhuvaran	SGT5-4000F	1
MCCS	India	2011	Unosugen	SGT5-4000F	1
MCCS	Iraq	2015	Khormala Phase III	SGT5-2000E	1
MCCS	Iraq	2013	Khormala	SGT5-2000E	2
MCCS	Iraq	2012	Sadder Baghdad	SGT5-4000F	2
MCCS	Iraq	2011	Dibis Kirkuk	SGT5-2000E	1
MCCS	Iraq	2011	Rumaila Basra	SGT5-4000F	1
MCCS	Iraq	2011	Taza Kirkuk	SGT5-4000F	1
MCCS	Iraq	2011	Baiji	SGT5-2000E	1
MCCS	Israel	2013	Dead Sea Works	SGT5-2000E	1
MCCS	Italy	2010	Enel	SGT5-4000F	1
MCCS	Jordan	2010	Al Qatrana	SGT5-2000E	1
MCCS	Libya	2009	Sarir	SGT5-4000F	2
MCCS	Libya	2008	Zwitina	SGT5-4000F	1
MCCS	Libya	2008	Benghazi	SGT5-4000F	1
MCCS	Libya	2008	Misurata	SGT5-4000F	1
MCCS	Malaysia	2016	Pengerang	SGT5-8000H	2
MCCS	Malaysia	2014	Prai	SGT5-8000H	2
MCCS	Malaysia	2014	Connaught Bridge	SGT5-4000F	1

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Type	Country / City	Year	Project	Gas Turbine	Units
MCCS	Netherlands	2009	Rijmond 2	SGT5-4000F	1
MCCS	Nigeria	2011	Geregu	SGT5-2000E	2
MCCS	Obari	2011	Libya	SGT5-2000E	2
MCCS	Oman	2012	Sur	SGT5-4000F	3
MCCS	Oman	2011	Barka 3	SGT5-4000F	1
MCCS	Oman	2011	Sohar 2	SGT5-4000F	1
MCCS	Portugal	2009	Pego	SGT5-4000F	2
MCCS	Qatar	2016	Umm Al Houl	SGT5-4000F	2
MCCS	Saudi Arabia	2012	Hail 2	SGT6-2000E	4
MCCS	Saudi Arabia	2012	Shoaiba 2	SGT6-2000E	10
MCCS	Saudi Arabia	2011	Hail 2	SGT6-2000E	2
MCCS	Saudi Arabia	2011	Rafha	SGT6-2000E	2
MCCS	Singapore	2013	Tuaspring	SGT5-4000F	1
MCCS	Singapore	2012	GMR Energy	SGT5-4000F	2
MCCS	Singapore	2009	Seraya	SGT5-4000F	2
MCCS	Singapore	2008	Seraya	SGT5-4000F	2
MCCS	Thailand	2012	Wang Noi 4	SGT5-4000F	1
MCCS	Thailand	2010	Glow	SGT5-4000F	1
MCCS	Turkey	2010	Ambarli Repowering	SGT5-4000F	1
MCCS	United Arab Emirates / Abu Dhabi	2012	Shuweihat	SGT5-4000F	2
MCCS	Vietnam	2010	Nhon Trach 2	SGT5-4000F	1
MCCS	Yemen	2013	Marib II	SGT5-2000E	2
SCCS	-	-	-	-	-
SCCS	Algeria	2014	Ain Arnat	SGT5-4000F	3
SCCS	Algeria	2014	Ras Djinet	SGT5-4000F	2
SCCS	Kuwait	2016	Sabiya II	SGT5-4000F	1
SCCS	Kuwait	2014	Sabiya	SGT5-4000F	1
SCCS	Kuwait	2014	Az Zour South	SGT5-4000F	1
WPS	-	-	-	-	-
WPS	Algeria	2006	Berouaghia	SGT5-4000F	1
WPS	Argentina	2007	Jose de San Martin	SGT5-4000F	1
WPS	Argentina	2007	Manuel Belgrano	SGT5-4000F	1
WPS	Australia	2008	Braemer	SGT5-2000E	1
WPS	Australia	2008	Neerabup	SGT5-2000E	1
WPS	Australia	2007	Urnquinty	SGT5-2000E	1
WPS	Australia	2005	Laverton	V94.2	2
WPS	Australia	2005	Kemerton	V94.2	1
WPS	Azerbaijan	2006	Sumgait	SGT5-2000E	1
WPS	Bahrain	2005	Alezzel	V94.2	1
WPS	Belgien	2004	BASF Antwerpen	V94.3A	1
WPS	Chile	2008	Tirra Amarilla	SGT5-2000E	1
WPS	Dominican Republic	2000	San Pedro	SGT-1000F	1
WPS	Dominican Republic	2000	Porto Marghera		1
WPS	Epypt	2004	Nubaria	V94.3A	2
WPS	Epypt	2004	Fast Track	V94.2	1
WPS	France	2008	Pont sur Samre	SGT5-4000F	1
WPS	Germany	2006	Ham-Uentrop	SGT5-4000F	2
WPS	Germany	2006	Knapsack	SGT5-4000F	1
WPS	Germany	2004	BASF Ludwigshaven	V94.2A	2
WPS	Germany	2003	HKW Köln-Niehl 2	V94.3A	1
WPS	Germany	2002	Siemens Berlin		7
WPS	Germany	2001	Siemens Berlin		13
WPS	Germany	2000	Donau Stadt	GE MS 3002	1
WPS	Great Britain	2008	Machwood	SGT5-4000F	1

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Type	Country / City	Year	Project	Gas Turbine	Units
WPS	India	2007	Sugen	SGT5-4000F	2
WPS	India	2006	Sugen	SGT5-4000F	2
WPS	India	2005	Konaseema	V94.2	1
WPS	Indonesia	2003	Muara Tawar	V94.2	2
WPS	Indonesien	2008	Senkang	SGT-1000F	1
WPS	Irak	2004	Kirkuk Unit 1	V64.3A	1
WPS	Irak	2004	Kirkuk Unit 2	V94.3A	1
WPS	Irak	2004	Kirkuk Unit 3	V94.2	1
WPS	Iran	2005	Rudeshur	V94.3A	1
WPS	Israel	2005	Haifa	V94.3(A)	2
WPS	Israel	2003	Gezer	V94.3A	2
WPS	Israel	2003	Hagit	V94.3A	1
WPS	Italy	2006	Livorno	SGT5-4000F	1
WPS	Italy	2004	Piacenza	V94.3A	2
WPS	Italy	2003	Moncalieri	V94.3 A	1
WPS	Italy	2000	La Casella		1
WPS	Japan	2004	Yokosuka	V94.2	1
WPS	Jemen	2006	Marib	SGT5-2000E	1
WPS	Kuwait	2003	Az Zour	V94.2	2
WPS	Marokko	2004	Tahaddart	V94.3A	1
WPS	Netherlands	2003	Rijumond	V94.3A	1
WPS	Nigeria	2005	Geregu	V94.2	2
WPS	Norway	2006	Karstoe	SGT5-4000F	1
WPS	Oman	2005	Sohar	V94.2	1
WPS	Pakistan	2006	Karachi	V64.3	1
WPS	Portugal	2005	Ribatejo Unit 30	V94.3A	1
WPS	Portugal	2003	Ribatejo Unit 2	V94.3A	1
WPS	Quatar	2005	Ras Laffan	V94.3A	1
WPS	Saudi Arabien	2004	Asir / Bisha	V84.2	2
WPS	South Afrika	2007	Eskom Atlantis Gas1	SGT5-2000E	1
WPS	South Afrika	2007	Eskom Mosel Bay G.1	SGT5-2000E	1
WPS	South Afrika	2006	Eskom Peking Atlant.	SGT5-2000E	1
WPS	South Afrika	2006	Eskom Mossel Bay	SGT5-2000E	1
WPS	South Korea	2007	Bugok	SGT5-4000F	2
WPS	Spain	2006	Palos	SGT5-4000F	1
WPS	Spain	2006	Sagunto	SGT5-4000F	1
WPS	Spain	2004	Palos de la Frontera	V94.3	1
WPS	Spain	2003	Arubal	V94.3A	1
WPS	Spain	2003	Campo de Gibraltar	V94.3A	1
WPS	Spain	2003	Palos de la Fontera	V94.3	1
WPS	Spain / Valencia	2008	Sagunto	SGT5-4000F	2
WPS	Thailand	2007	Bang Pakong	SGT5-4000F	1
WPS	Thailand	2006	Songkhla	SGT5-4000F	2
WPS	Thailand	2004	Chol Buri II	V94.3A	1
WPS	Turkey	2008	Antalya	SGT5-4000F	1
WPS	United Arab Emirates	2006	New Taweelah	SGT5-4000F	1
WPS	United Arab Emirates	2002	Shuweihat	V94.3A	1
WPS	Vietnam	2007	Can Man 2	SGT5-4000F	1
WPS	Vietnam	2006	Can Man	SGT5-4000F	1

Type	*Country / City*	*Year*	*Project*	*Gas Turbine*	*Units*
Special projects	-	-	-	-	-
ACCS-MT	United Arab Emirates / Dubai	2005	Al Aweer	V94.2	3
MCCS with heating	Japan	2012	Yoshinoura	SGT6-4000F	1
VRA-I	Austria	2010	Steyrermühl		1