

# TURBOfog System for Gas Turbine Air Inlets



**TURBOFOG system built into container  
with sound attenuation**

## **Munters Experience in the Power Business**

Evaporative Air Inlet Cooling for Combustion Turbines has been a working field for Munters for many years. Munters have now evaporative cooling units in more than 300 gas turbine air inlets installed worldwide and we add a few thousand of units per year to this fleet. We either sell preassembled units being manufactured in ISO 9001 factories ex-works by trained workers or turn-key installed systems including commissioning. A team of application engineers takes care of design and installation of any possible on-site installation.

Munters computer programs are available to analyse the power enhancement of your turbine at a specific location based on the weather data of this location.

## Customer Benefits

Approach 100 % Saturation and more with Minimal Pressure Drop

Decrease Heat Rate

Reduce NOx emissions

Easy to Retrofit in Existing Structures

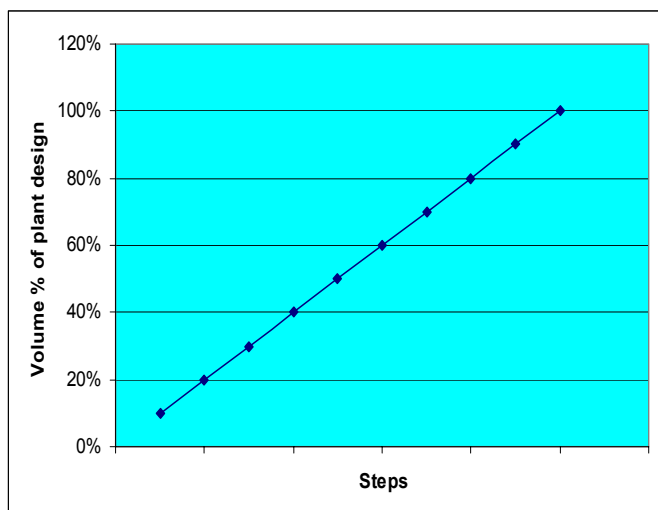
Rapid Return on Investment

Helps to meet Peak Demand

Turn-key packages ex-works or turn-key installed



**Installed fogging arrays in air intake**



### Seamless water injection

Due to the 5 nozzle arrays installed we achieve a highly unique droplet distribution over the air intake during all operation modes. We have carefully tested all the selected nozzles on our own droplet test benches.

We do deliver the systems either boxed or unboxed or on request of the client as a „built into container“ solution - ready to be connected and started up.

## System-Design

Munters have introduced the infinitely variable water injection of our fogging systems which requires for most of the applications only one frequency controlled pump. We have put emphasis in smart controls in order to monitor any deviation of the system from the designed operation and to act immediately in case of serious damage (pipe break, nozzle failure etc.). Thus we have reduced the number of parts to a minimum by simultaneously providing a maximum of output and flexibility. Please see also the attached P&ID.

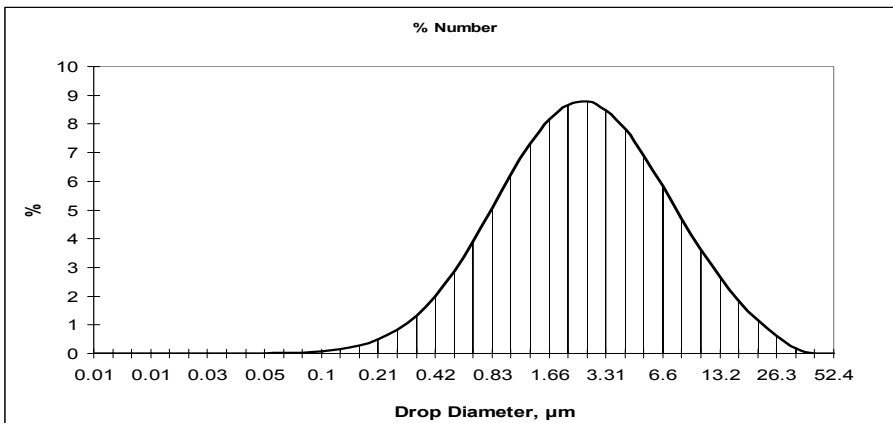


**Water distributor (5 stage)**

MUNTERS KOOLGAS(sm) BETA V.2.3										
LOCATION: PALERMO, ITALY					Date: 25.06.2001 Project: V94.3A					
Month	Cooling Hours	Ave. Temp Drop °C	Degree Hours-°F	High Temp °C	Max Temp drop °C	Output Cooler		Water		Lost Power Recovered MMHr
						Off MW	On MW	Evaporated Cubic Meters	Evaporated bic Meters/Hour	
JAN	682	3.9	2654	25	9.8	247.62	263.60	2.471	9.077	4.352
FEB	623	3.9	2452	31	16.3	238.51	265.15	2.282	15.128	4.020
MAR	703	4.0	2838	31	17.3	238.51	266.79	2.642	16.059	4.653
APR	701	4.1	2858	34	16.8	233.95	261.42	2.661	15.593	4.687
MAY	744	3.6	2668	36	13.8	229.40	251.94	2.483	12.800	4.374
JUN	720	4.2	2991	34	9.8	233.95	249.94	2.784	9.542	4.904
JUL	744	4.6	3389	39	16.8	224.84	252.31	3.155	15.593	5.557
AUG	744	4.8	3534	39	15.3	224.84	249.85	3.290	14.197	5.795
SEP	720	4.6	3302	39	12.8	224.84	245.75	3.074	11.869	5.414
OCT	731	4.6	3395	31	11.3	238.51	256.95	3.161	10.473	5.567
NOV	707	4.1	2929	28	11.8	243.06	262.33	2.727	10.938	4.803
DEC	718	4.1	2919	25	10.3	247.62	264.42	2.717	9.542	4.786
TOT	8,537	4.2	35,928	17.3	28			33,447		58,911

Unit of Currency for your Country: \$  
Inch-Pound or Metric S-I  
Temperature when cooler will be shut off: 10 °C  
Inlet air flow of gas turbine: 520 SCubic M/S This value is only used to calculate water consumption  
Evaporative cooling effectiveness: 90 %  
Media Pressure Drop: 100 Pascals  
Rated output of gas turbine: 265 MW of turbine at ISO conditions of 15°C inlet air  
Heat Rate: 9350 MJ per MW at ISO conditions of 15°C inlet air  
Power increase per degree cooled: 0.62 % per °C  
Heat Rate decrease per degree cooled: 0.18 % per °C  
First hour of gas turbine operation: 1 These values are reset to full day operation  
Last hour of gas turbine operation: 24 if the climatic data has no hourly information

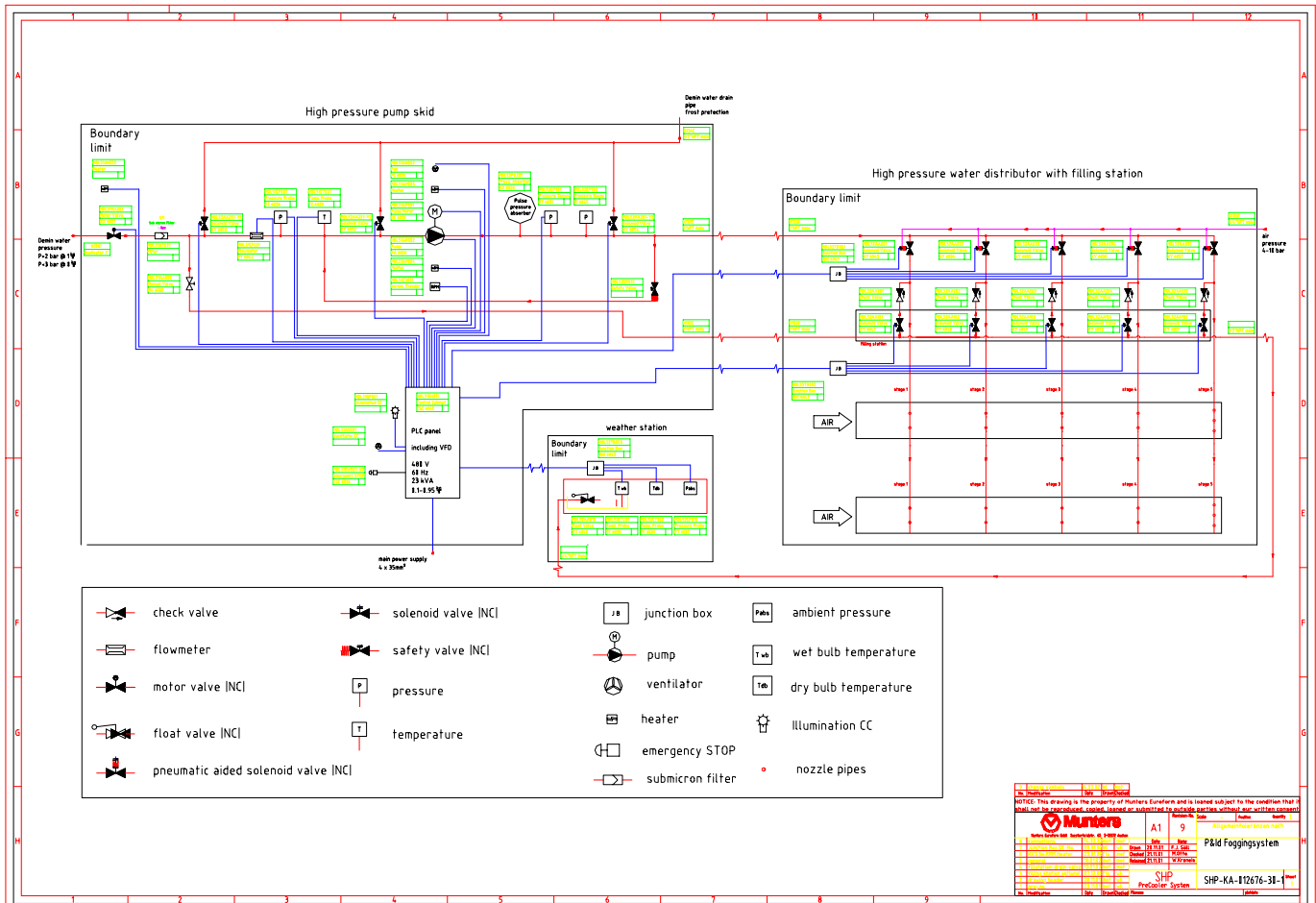
### Calculation of Power Enhancement



### Droplet size distribution curve

(6/1000" nozzle, 0.172 l/min,  $D_{32}=14.33$  mm,  $D_{v0.5}=18.74$ mm,  $D_{v0.9}=29.21$ mm)

### P&ID Munters Advanced TURBOfog™ (5 stages)



## Engineering Features

- Pumpskid with switchboard + frequency converter(s)
- Stainless steel water pipes with stainless steel high pressure nozzles
- Operating pressure 1500-2100 psi for seamless injection of water
- Submicron filtration of incoming demin water
- Safety valve
- Incoming water pressure control
- Outgoing water pressure control
- Motor temperature control
- Optional: two pumps (2x50%)
- Nozzle failure detection
- Supply water failure detection
- High pressure failure detection
- Filter failure detection
- 1 (2) x 100% water filter + alarm
- Thermocouple failure detection
- highly precise weather station including amb.pressure sensor
- Very compact skid footprint (up to 3.3 l/s): ~2.0 m x 1.1 m

Munters have, due to their droplet elimination business, a long experience in measuring droplet contents in air flows. Munters have extensively tested various nozzle types of the relevant nozzle suppliers in the market in their own laboratories with regards to droplet spectrum, droplet size and droplet distribution, depending on residence time and ambient air condition. This knowledge gives us the basis to select the appropriate nozzles for each project.



**Gearbox type after workshop assembly prior to FAT (1.5 kg/s)**



**Field installation of Turbofog system for GE LM 6000 gas turbine (1.0 kg/s)**



**For further information pls do not hesitate to contact us**

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