

A COMPRESSOR CLEANER WITH A DIFFERENCE

(SOLVENT-BASED PERFORMANCE WITHOUT THE SOLVENT)



SYNOPSIS

- Generally, compressor contamination is an oily matrix that has to be penetrated by the cleaner
- Hydrocarbon-(solvent) based cleaners were formulated due to the oil solubilizing properties of the hydrocarbon solvent. These have become uncommon due to adverse Health and Safety and Environmental hazards
- Water-based cleaners have shown inferior performance compared to solvent-based cleaners

A CLEANER WITH A DIFFERENCE – BIPHASE AND SOLVENT-FREE

Solvent-based cleaners	Water-based cleaners	
	Conventional	TURBOTECT 2020
Contains hydrocarbons	No hydrocarbons	No hydrocarbons
Biphase (two distinct phases)	Monophase (one phase)	Biphase
Solubilise oily residues	Disperse oily residues	Solubilises oily residues
Unsafe for people and the environment	Safe for people and the environment	Safe for people and the environment
Good performance	Inferior performance	Good performance

Meeting OEM specification / approval – should be minimum requirement

MONOPHASE – BIPHASE PERFORMANCE COMPARISONS

1. LABORATORY TESTING

2. ON-SITE TESTING

LABORATORY TESTING

- (1) Cleaning efficiency test according to US MIL-PRF-85704C** – to evaluate the efficiency of compressor cleaners to remove a standardized contaminant (soil).
- (2) METRATEST®** – compare compressor cleaners in their ability to clean oily surfaces.
- (3) METRATEST® 2.0** – to demonstrate the difference in mechanisms for removal of contamination.

LABORATORY TESTING

Cleaning efficiency test according to US MIL-PRF-85704C

Foulant:

Turbine oil (MIL-PRF-23699)

Carbon black

Heated (240°C) and air purged (120hrs)

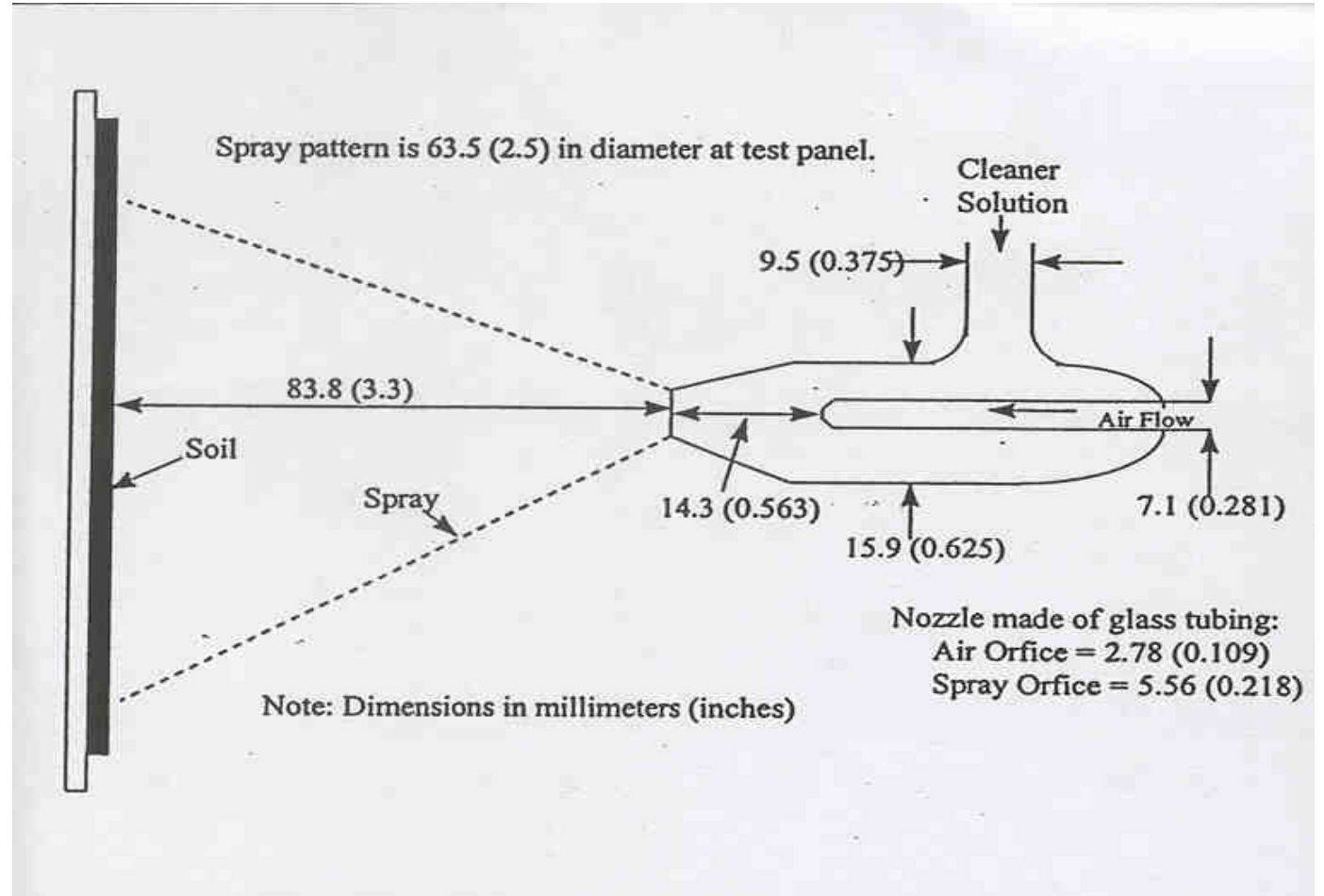
Baked coating weight 150mg

Air sprayed detergent

Disk diameter: 150 mm

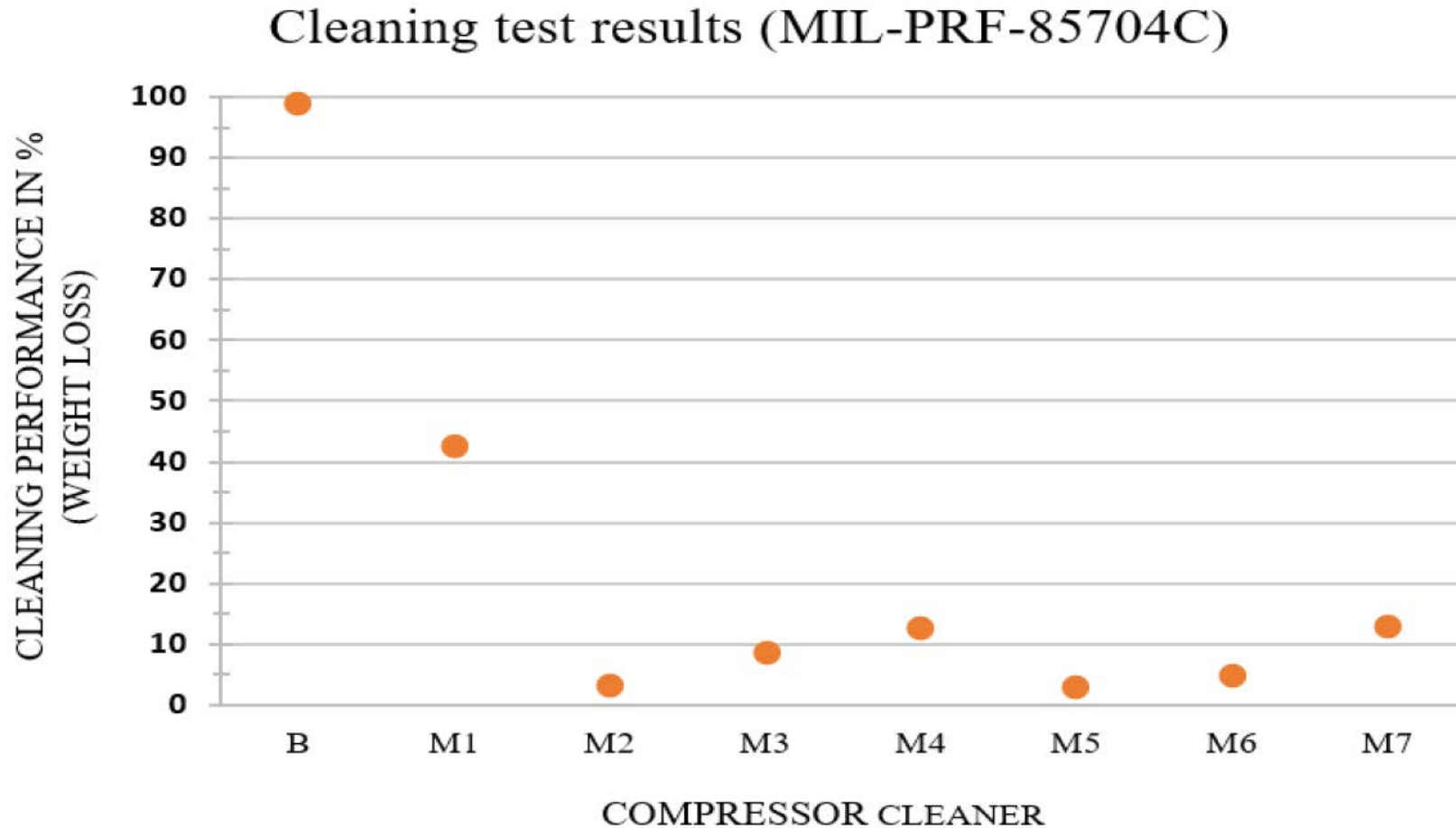
Rotation speed: 220 rpm

Cleaning efficiency calculated
from weight loss



LABORATORY TESTING

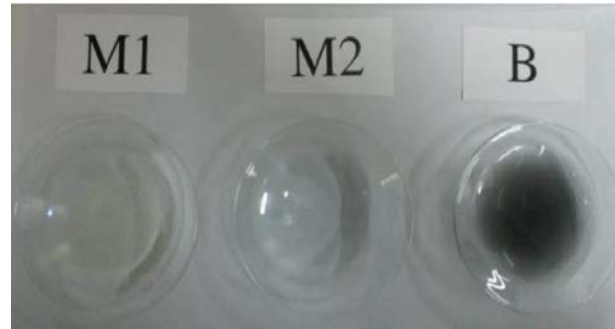
Cleaning efficiency test according to US MIL-PRF-85704C (All cleaners approved by OEMs)



LABORATORY TESTING

METRATEST®

Contaminated aluminium
chips (1 mm x 0.3 mm)



METRATEST®2

Oil-based ink



ON-SITE TESTING

Power Plant Comparison, England, UK



Two blocks, each with two Siemens SGT5-4000F gas turbines in a 2x1 configuration with a net plant capacity of 1'144 MW

ON-SITE TESTING

Situation Summer 2017 for Module 5: GT-1 & GT-2

- Contamination from the air intake and problems with a bearing oil-leak
- On- and off-line washing with Siemens OEM combined nozzle system
- Monophase water-based compressor cleaner, M1 was used
- On-line washing with the cleaner - weekly
- Off-line washing with the cleaner - approximately every 1'000 h
- **Despite this thorough wash procedure, wash results were not satisfactory.**

ON-SITE TESTING

Comparative study: M1 (GT-1) v B (GT-2)

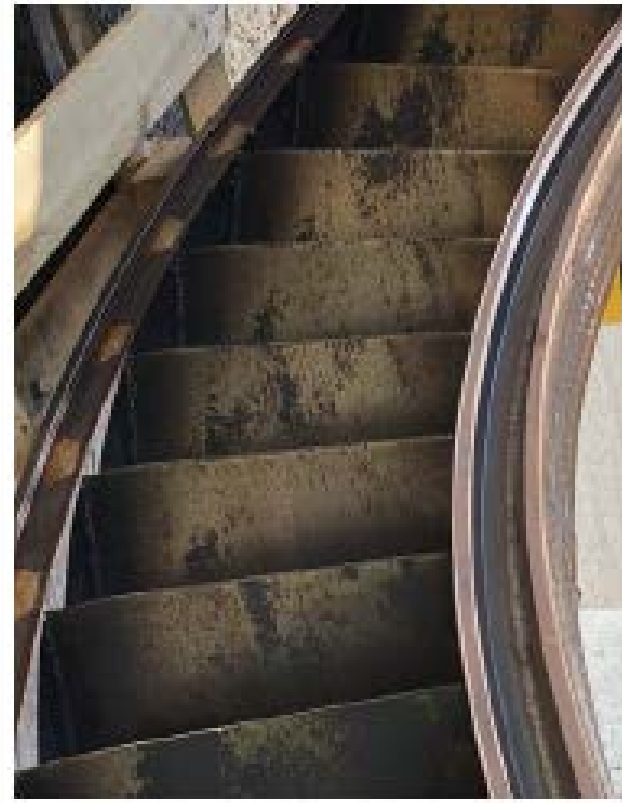
- It was confirmed by the site engineers that both GT's had similar starting conditions and were exposed to a comparable amount of new contamination over the course of the test.
- From the end of 2017 until the major overhaul in June 2018, 3 off-line washes performed on each GT:
 - GT-1 on-line washed weekly with M1, off-line washed with M1
 - GT-2 on-line washed weekly with M1, off-line washed with B

ON-SITE TESTING

Summer 2018 – 4th Stages Vanes



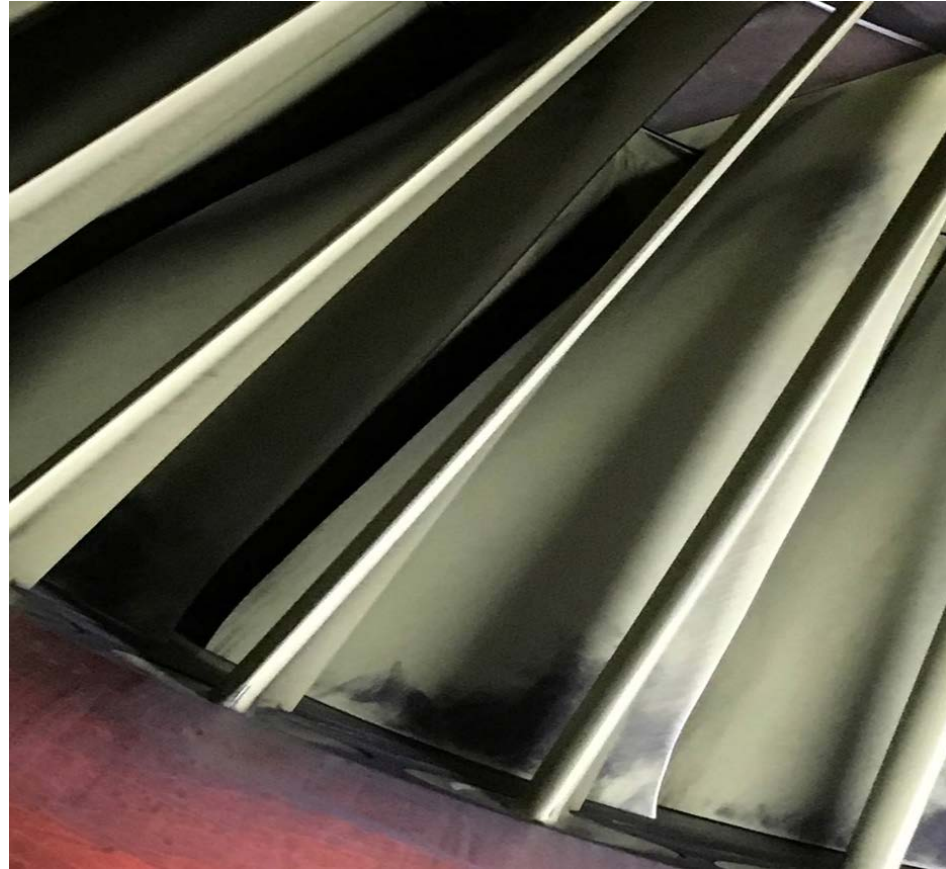
GT-1 – Monophase (M1)



GT-2 – Biphase (B)

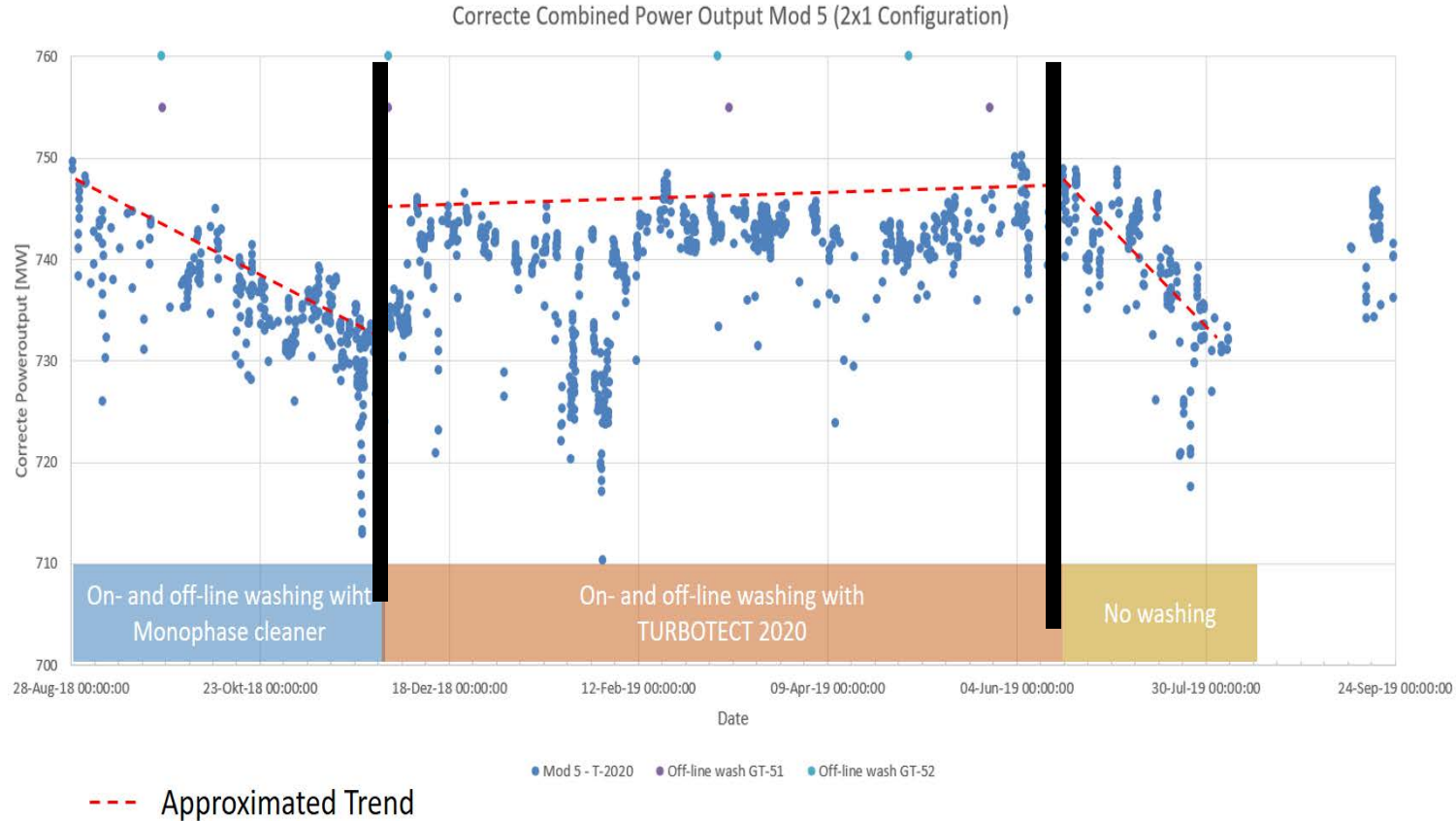
ON-SITE TESTING

Summer 2019 – 1st Stage Vane



GT-2: one year on- and off-line washing with biphasic compressor cleaner

ON-SITE TESTING



- Despite on- and off-line cleaning with cleaner M1 clear downward trend with approx. 2% power output loss over two months.
- On- and off-line washing with cleaner B recovers the losses from the first two months and maintains high power output and over time.
- No on-line and off-line washing results in steep decline in power output.
- Power output recovery due to minor outage – reason currently unknown.

LABORATORY TESTING - CONCLUSIONS

- US MIL-PRF-85704C test results show clear superiority of the biphase water-based compressor cleaner (B) over monophase water-based compressor cleaners (M1 – M7).
- METRATEST® and METRATEST® 2.0 demonstrate that:
 - more than one mechanism can be involved in the removal of contamination;
 - differences exist in performance capabilities of commercial water-based cleaners;
 - solubilisation is more effective than detachment by desorption.

ON-SITE TESTING - CONCLUSIONS

- On-site testing confirmed the laboratory test results
- The biphasic cleaner (B) clearly outperformed the monophasic cleaner (M1)
- The biphasic compressor cleaner is capable of maintaining cleanliness of the blades long-term and sustaining power output and gas turbine efficiency

A BIPHASE WATER-BASED CLEANER WITH PROVEN PERFORMANCE

Water-based cleaners	
Conventional	TURBOTECT 2020
No hydrocarbons	No hydrocarbons
Monophase (one phase)	Biphase
Disperse oily residues	Solubilises oily residues
Safe for people and the environment	Safe for people and the environment
Inferior performance	Good performance