



## **REPORT**

*Cabin Air Filtration System Nanoparticle Testing  
J020273*

*Prepared for  
Freudenberg Filtration Technologies (Aust) Pty Ltd*

<b>Rev.</b>	<b>Description</b>	<b>By</b>	<b>Checked</b>	<b>Approved</b>	<b>Date</b>
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## 1. Introduction

### Test Date: 1 Feb 2020

- Rapallo were engaged by Freudenberg Filtration Technologies (Freudenberg) to independently observe testing of their Freudenberg S.A.F.E.air cabin protection system (Filtration + Pressurisation).
- The system was installed on a Toyota Landcruiser vehicle (roof mounted).
- Rapallo were present in an observing capacity with system operation controlled by Freudenberg and their partners (Work Airtech).



Figure 1: Toyota Landcruiser with Freudenberg S.A.F.E air cabin protection system

### 1.1 Personnel:

Organisation	Person	Function
Rapallo	Zachary Dawson	Testing observation
Freudenberg Technologies	Filtration Stephen Gledhill	Emissions Analysis
Work Airtech	Greg Knowles	S.A.F.E.air system operation

### 1.2 Test Equipment:

- Testo Dismini diesel nanoparticle counter.

### 1.3 Test setup / method:

- The system was tested inside a workshop environment where there were multiple diesel vehicles running including a small tray truck, a forklift (and the Landcruiser being tested itself).
- Diesel nanoparticles were measured with the Testo Dismini device in the workshop environment and inside the vehicle cabin (with the Freudenberg S.A.F.E.air system operating).
- Primary focus was to show how nanoparticles decayed from cabin when the Freudenberg S.A.F.E.air system was turned on.

- To achieve this, the Discmini (Figure 2-right) was setup in the vehicle cabin adjacent to digital readout showing cabin air pressure (Figure 2-left).
- Nanoparticle numbers were monitored with all vehicle doors open and S.A.F.E.air system off giving an indication of what levels of diesel particulate are in workshop environment.



Figure 2: Discmini reading 310K particles per cubic centimetre and pressure reading  $-2$  Pa (doors open)

- Nanoparticle numbers were monitored after shutting all vehicle doors simultaneously and S.A.F.E.air system being turned on.



Figure 3: Discmini reading 420 particles per cubic centimetre and pressure reading  $+196$  Pa (doors closed)

## 2. Results:

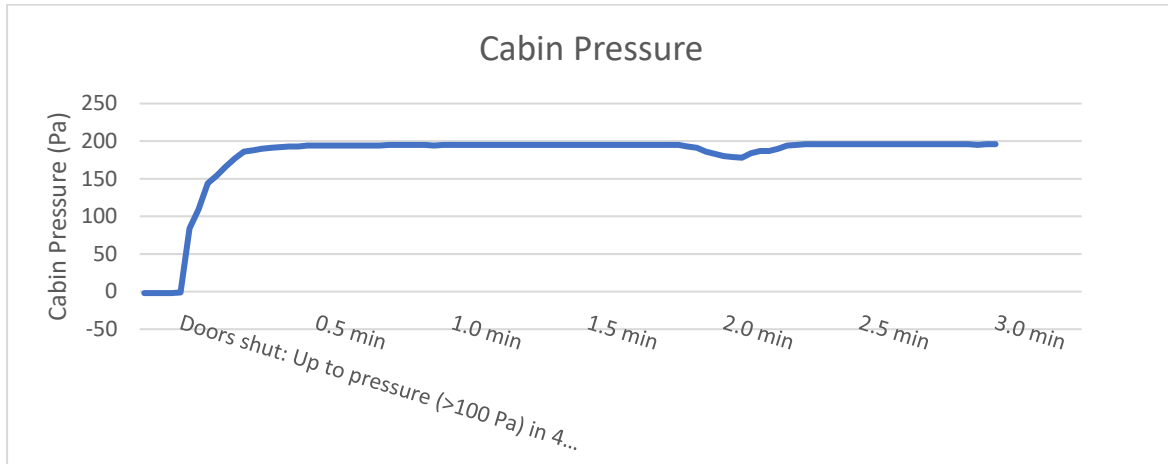


Figure 4: Cabin Pressure

- Cabin pressure increased from 0 Pa with doors open up to > 100 Pa within 4 seconds and approached 200 Pa within 10 seconds, remaining there for duration of test (note that ISO 23875:2019 calls for a minimum of 50 Pa).

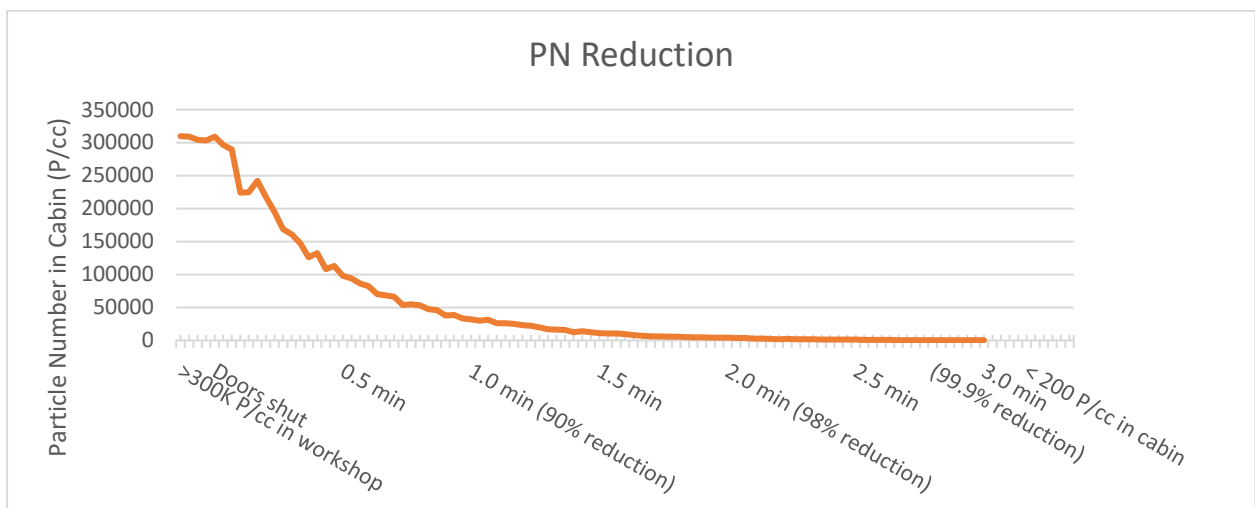



Figure 5: Number of diesel nanoparticles in cabin pre / post doors being shut / Freudenberg S.A.F.E. air system being turned on

- Particle numbers in cabin were around 300K per cubic centimetre with doors open.
- Particle numbers dropped to around 30K per cubic centimetre (90%) within 1 minute.
- Particle numbers dropped to around 3K per cubic centimetre (98%) within 2 minutes.
- Particle numbers dropped to around 700 per cubic centimetre (99%) within 2.5 minutes.
- Beyond 3 minutes particle numbers were below limit of detection of machine (apprx 200 P/cc).

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### 3. Summary:

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The Freudenberg S.A.F.E.air cabin protection system was extremely effective at eliminating diesel nanoparticles from the cabin of the test vehicle. System operation was fully automatic and integrated into the vehicles' A/C system.

Rapallo certify the above results to be true and correct as observed at the time of inspection.

Signed:



Rapallo