Technical Performance Report

Ranger | Dust vs TSI DustTrak DRX

aeroqual

Ranger | Dust vs DustTrax DRX Report

Aeroqual Ranger | Dust is a new real-time handheld dust monitor, providing simultaneous measurement of multiple PM size fractions (including PM_1, $PM_{2.5}$, PM_4, PM_{10} and TSP).

So, how does it perform compared with alternative products on the market?

We selected the TSI Dust Trak DRX 8533 to go head-to-head against Ranger | Dust. Using ISO 12103 A1 ultrafine test dust we measured the accuracy of each monitor, tracking the linearity of response when compared with a reference instrument (in this case an EN16450-certified Palas Fidas 200).

Experiment Setup

The test instruments were placed in a glass chamber, measuring 750 mm x 750 mm x 600 mm. The chamber was fitted with four x 90 mm fans for air circulation, with an air exhaust positioned at the top. The Ranger | Dust used in this experiment was a newly manufactured instrument, factory calibrated using Aeroqual's standard calibration procedure. The TSI DustTrak DRX 8533 was supplied by a local rental agency and had been calibrated by the local TSI certified agent.

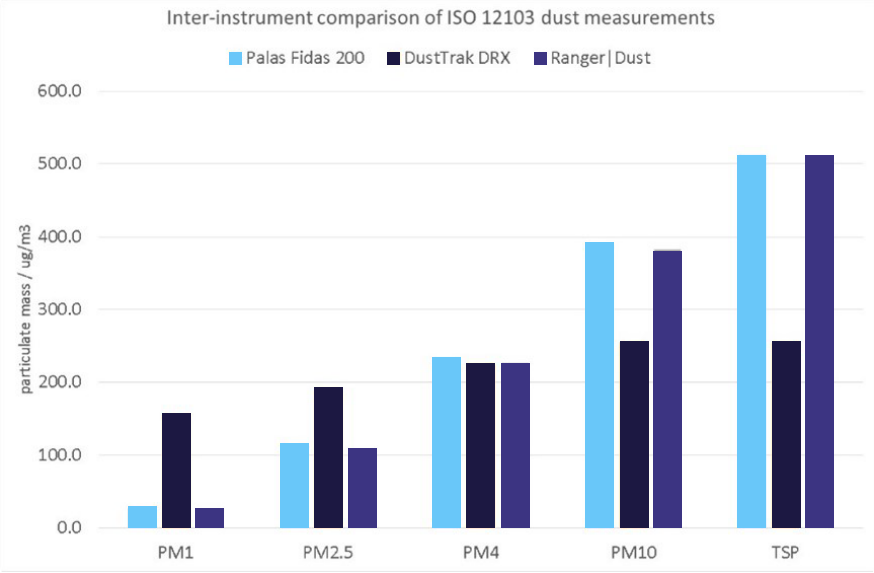
The reference instrument (a Palas Fidas 200) was operated in ambient mode and mounted below the chamber. The Palas Fidas 200 sampled the chamber via a 12mm ID tubing of length 500 mm. ISO 12103 A1 test dust, suspended in distilled water, was nebulised into the chamber using a Palas AGK2000 nebulizer operating at 20-30 LPM fed with dry compressed air. Different test dust concentrations were generated by changing the dust suspension concentration.

The Results

The particle mass measurements from each instrument for a constant level of test dust is shown in Figure 1. The measurement error for each size fraction was calculated using the equation:

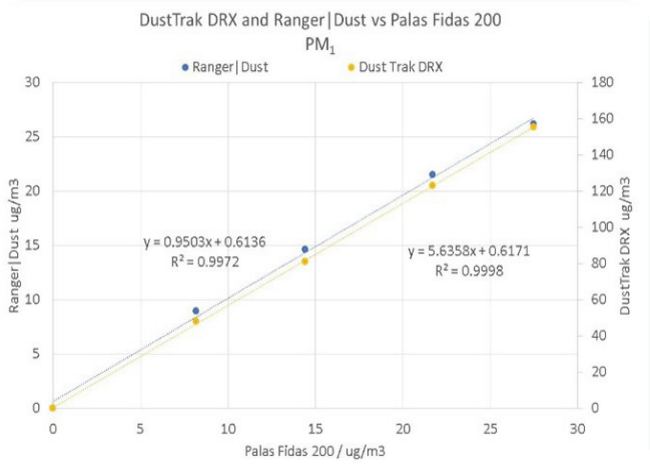
$$\% \text{ error} = 100 \times \frac{|[PM]_{test} - [PM]_{Palas}|}{|[PM]_{Palas}|}$$

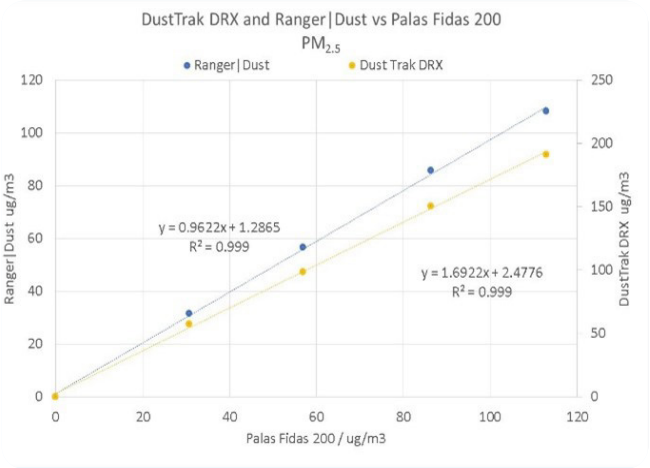
Ranger | Dust closely matched the Palas reference instrument, with a measurement error below 5% for all particle mass fractions. However, the TSI DustTrak exhibited large errors at all PM sizes except for PM_4. Channels PM_1 and $PM_{2.5}$ over-read significantly while PM_{10} and TSP were notably under-read. These measurement error results can be found in the below table, to the right of Figure 1.

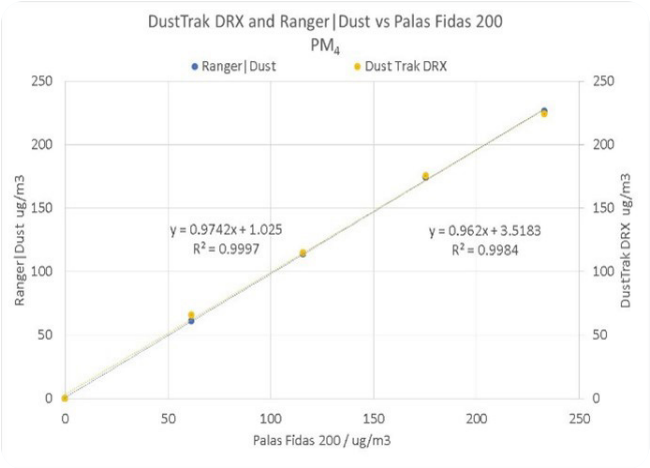


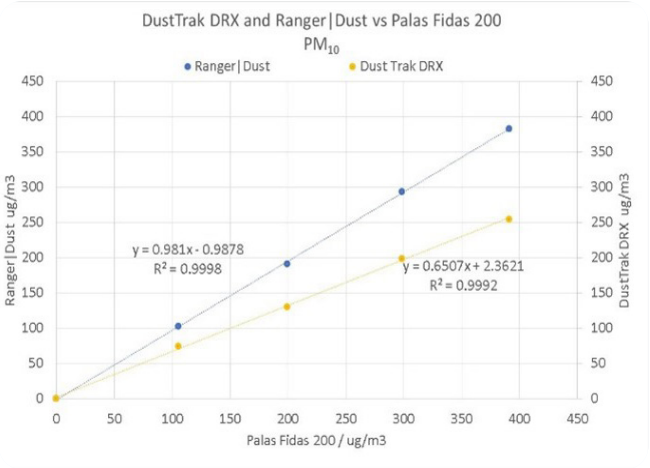
	% error	
	TSI	Ranger
PM_1	465.4	4.7
$PM_{2.5}$	69.5	4.1
PM_4	3.8	3.0
PM_{10}	34.8	2.1
TSP	50.0	2.1

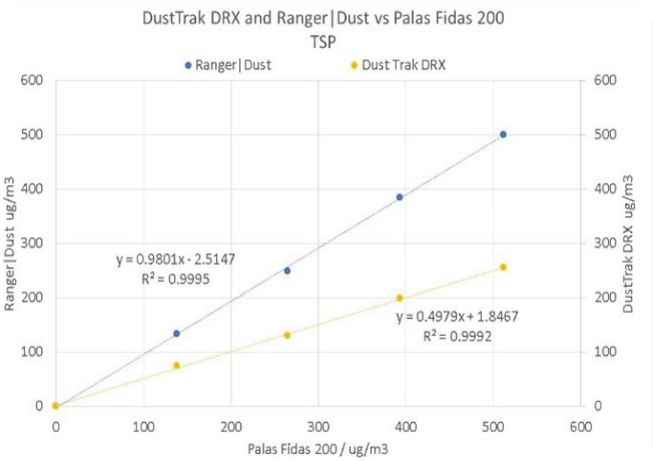
The linearity of response for each instrument was determined by measurement at five dust concentrations, with the coefficient of determination (R^2) calculated for each device versus the Palas reference instrument. The results are shown in the figures on the following page for each particle mass fraction.











The Results

	R^2 vs Palas Reference	
	DustTrak DRX	Ranger | Dust
PM_1	0.9998	0.9972
$PM_{2.5}$	0.9990	0.9990
PM_4	0.9984	0.9997
PM_{10}	0.9992	0.9998
TSP	0.9992	0.9995

This table lists the R^2 coefficient for Ranger | Dust and the TSI DustTrak DRX for each particle size fraction. Both instruments exhibit a high degree of linearity, with R^2 values very close to 1. These results show that both Ranger | Dust and the TSI DustTrak DRX demonstrate high-performing optics and flow systems.

Discussion

Ranger | Dust exhibited strikingly similar performance when compared to the certified Palas Fidas 200 reference instrument with ISO1 2103 A1 Arizona Road Dust. It showcased excellent linearity, with R^2 values greater than 0.99. Measurement error was consistently low, tracking below a 5% threshold for all size fractions (ranging from PM_1 to TSP).

The TSI DustTrak also demonstrated excellent linearity with the reference instrument, with R^2 values greater than 0.99. However, recorded measurement accuracy was highly inconsistent, with percent errors ranging from 4% (PM_4) to over 400% (PM_1). Inconsistencies of this magnitude suggest the instrument's calibration was incorrect, despite the instrument having been calibrated by a TSI certified agent.

A traceable and transferable laboratory calibration is a vital step in providing users with a reliable particle mass measurement. It is possible that TSI's laboratory calibration method is inadequate for consistent accuracy across the different PM size fractions. Since there is no internationally recognized standard method for laboratory calibration of direct reading particle mass instruments, manufacturers employ in-house procedures, which may account for different results between instruments.

Conclusion

Ranger | Dust demonstrated high linearity and accuracy versus an EN16450 certified Palas Fidas ambient reference instrument in a controlled laboratory test with ISO 12103 A1 test dust.

However, the TSI DustTrak, tested under the same conditions, exhibited large measurement errors versus the Palas reference instrument. This discrepancy in accuracy can reasonably be interpreted to be due to poor instrument calibration, highlighting how crucial a role correct calibration plays in determining measurement accuracy.

Demonstrating near equivalent performance to a certified reference instrument, Ranger | Dust has proven itself as an accurate, trusted alternative for simultaneous measurement of PM size fractions.