December 15, 2021

Todd Coleman
Existing Chemicals Risk Management Division
Office of Pollution Prevention & Toxics
Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC. 20460-0001

Re: Ramboll US Consulting's Attached Report on "Airborne Particle Size Characterization of C.I. Pigment Violet 29 (PV29)" and its Relevance to EPA's Risk Management Rulemaking on PV29; EPA-HQ-OPPT-2021-0277

Dear Mr. Coleman:

The Color Pigments Manufacturers Association (CPMA) is pleased to present the attached report by Ramboll US Consulting (Ramboll) regarding the "Airborne Particle Size Characterization of C.I. Pigment Violet 29 (PV29)." We appreciate the input we received from you and your colleagues earlier on Ramboll's slide presentation summarizing this work. I am writing now to provide CPMA's views regarding this report and its relevance to the Agency's ongoing risk management rulemaking on PV29.

CPMA is the national trade association representing the color pigments industry. CPMA represents companies in the value chain that are engaged in the production or selling of color pigments in North America. Color pigments are important components in a wide range of applications, including printing inks, paints and coatings, plastics, building materials, cosmetics, personal care products, pharmaceuticals and agricultural products. Formed in 1925, CPMA provides programs to enhance regulatory compliance and support the manufacture and use of color pigments.

As we have discussed, CPMA is not seeking to re-open the risk evaluation of PV29. While it would have been preferable to have had the attached information during the preparation of the risk evaluation, that was not the case. We also recognize EPA's desire to meet its productivity obligations under Sections 6(b) and (c) of TSCA. We do, however, believe that this report has important implications for the PV29 risk management rulemaking.

In its study, Ramboll measured airborne concentrations of particulates at DCL Corporation's Bushy Park facility, the sole U.S. facility manufacturing PV29. The study focused on the PV29 grind and blend pack-out process, which is the final stage in the batch production of this material and the one most likely to generate the highest concentrations, and smallest particle size, of PV29. The study also conducted the same measurements at an adjoining room where sealed bags of pigment were loaded into boxes.

At each location, Ramboll employed three measurement devices. The first counted "ultrafine" particles (UFP); i.e., those with size ranges from 0.02 to 1 µm. This range encompassed the particle size

characteristic of primary particles of PV29 (0.043 µm) – the particle size that the risk evaluation found to present an unreasonable risk of harm to workers and occupational non-users (ONUs), based on consideration of carbon black as an analogue.[1] The other two devices measured larger particles across various size ranges or "bins." One device counted particles within each of six bins (0.3 to 0.5 µm, 0.5 to 1.0 µm, 1.0 to 3.0 µm, 3.0 to 5.0 µm, 5.0 to 10.0 µm, and greater than 10 µm); the other measured the mass of particles cumulatively across five ranges (<1.0 µm (PM1), <2.5 µm (PM2.5), <4.0 µm (respirable), <10.0 µm (PM10), and total PM). These devices operated from before the PV29 packout process began until after it concluded, in order to capture background concentrations as well as fluctuations in concentrations.

For purposes of the risk management rule, the most important finding of the study was that "airborne UFP were not generated as part of the PV29 grind and blend pack-out process." The study observed that "[a]irborne ultrafine particle concentrations decreased throughout the monitoring period with a mean concentration [that] was less than the mean background concentration [that] was measured prior to handling PV29." Also, the concentrations of UFP did not increase during activities and events involving handling of PV29. By contrast, measurements of larger particle sizes demonstrated lower background concentrations and clear increases that corresponded closely with tasks performed during bag filling, including overfilling bags, wiping down surfaces and the "shake down" task that occurred at the end of the bag filling process. This correlation was particularly pronounced in the 1.0-3.0 µm size range, the bin that encompasses the most likely average particle size observed during the study (estimated to be approximately 2.5 µm, or more than 50 times larger than the size found to give rise to unreasonable risk). As Ramboll concluded, "[t]hese results demonstrate that airborne PV29 particulate was not generated at the size used by USEPA in their risk evaluation." Rather, under "real-world manufacturing conditions," primary "particulates . . . form larger agglomerates."

TSCA Section 6(a) requires that, where a risk evaluation finds unreasonable risk under a condition of use, EPA issue a risk management rule "to the extent necessary so that the chemical substance . . . no longer presents such unreasonable risk."[2] The Ramboll study shows definitively that workers and ONUs at the Bushy Park facility are not exposed to PV29 particles in the ultrafine range that EPA found to present health hazards. In the final PV29 risk evaluation, EPA noted that it "may make a determination of no unreasonable risk for conditions of use where the substance's hazard *and exposure potential,* or where the risk-related factors described previously, lead the Agency to determine that the risks are not unreasonable."[3] Such a circumstance exists here. Based on the information now available to EPA regarding exposures to PV29 at particle sizes of concern, EPA can (indeed, must) conclude that PV29 "no longer presents [an] unreasonable risk" at the Bushy Park facility. Accordingly, no additional risk management requirements are required (or authorized) for the manufacturing condition of use.

CPMA believes that similar circumstances would exist at other conditions of use involving PV29 (e.g., incorporation into paints, coatings, inks and plastic and rubber products), given our understanding of the processes they use to transfer PV29 particles from bags into process equipment. We believe it would be appropriate for EPA to conclude that no unreasonable risk exists at any such downstream use of PV29 unless such uses involve agitation and dispersion of PV29 particles in a way absent at the Bushy

[1] *See* EPA, Risk Evaluation for C.I. Pigment Violet 29 (Jan. 2021) at 56, 66-72, 86-87.
[2] 15 U.S.C. § 2605(a).
[3] Risk Evaluation at 87 (emphasis added).

Park facility. Alternatively, EPA could encourage representatives of these downstream industries to conduct similar UFP monitoring at representative workplaces and provide the Agency with the results.

At an absolute minimum, the proposed risk management rule should provide facilities with the option of conducting initial monitoring at appropriate locations, comparable to that conducted by Ramboll, to determine whether ultrafine particles are observed to fluctuate in ways that correspond to activities involving PV29. Where no such correlation is observed, facilities would have no further obligations under the rule. Retesting could be required where processes are changed in significant ways that could reasonably be expected to create exposures to ultrafine particles of PV29.[4]

We very much appreciate the opportunity to submit the attached report. If you have any questions regarding the matters discussed here, please do not hesitate to contact me at 571-348-5106 or davidwawer@cpma.com.

Sincerely,

David Wawer
Executive Director

[4] It would not make sense to require such monitoring to be personal breathing zone monitoring, for two reasons. First, such devices would measure all particulates of the size range for which the device is designed to measure, not just particles of PV29. Potentially complex analysis involving electron microscopy would be required to identify the portion, if any, composed of PV29. Second, and more fundamental, if no ultrafine particles of PV29 are being generated at a process, it would be impossible for any to be drawn into a personal breathing zone sampler.

Prepared by:
Ramboll US Consulting, Inc.
Chicago, Illinois

Date
December 2021

Project Number
1690023419

AIRBORNE PARTICLE SIZE CHARACTERIZATION OF C.I. PIGMENT VIOLET 29 (PV29)

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Airborne Particle Size Characterization of PV29

CONTENTS

APPENDICES

ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
%	percent
counts/cc	particle counts per cubic centimeter of air
CPMA	Color Pigments Manufacturers Association
DCL	DCL Corporation
EHS	environmental health and safety
EI	EI Environmental Health and Safety Solutions
EPA	Environmental Protection Agency
the Facility	1506 Bushy Park Road, Goose Creek, South Carolina formerly owned by Sun Chemical
LEV	local exhaust ventilation
µm	micrometers
mg/m^3	milligrams per cubic meter
mm	millimeter
$particles/ft^3$	particle counts per cubic meter of air
PM	particulate matter
pt/cc	particles per cubic centimeter
PV29	Pigment Violet
PVC	polyvinyl chloride
Ramboll	Ramboll US Consulting, Inc.
RH	relative humidity
SEG	similar exposure group
TWA	time weighted average
UFP	ultrafine particles

Airborne Particle Size Characterization of PV29

SUMMARY

The United States Environmental Protection Agency (EPA) completed a Risk Evaluation of C.I. Pigment Violet (PV29) (EPA Document #740-R-18-015). This evaluation included the assumption that airborne PV29 particulate in workplace air has an average diameter of 43 nanometers (0.043 micrometers or µm). EPA's conclusion of unreasonable risk to workers relied on this assumption. The particle size used in EPA's Risk Evaluation was based on data from laboratory analysis of primary PV29 particles, and not real-world manufacturing conditions where particulates this small form larger agglomerates. The purpose of this assessment was to better understand the particle size distribution of PV29 that a worker would be exposed to in real-world conditions. The EPA risk evaluation also assumed worker exposure to PV29 to be 1.2 milligrams per cubic meter of air (mg/m^3) over a 10.5 hour duration occurring 190 times per year. This assumption was based on a "total dust" sample collected in a 2014 industrial hygiene assessment at the same facility. The report that includes this sample result does not indicate what tasks the worker was doing, or if they were even working with PV29 when the sample was collected.

A study was conducted on September 27, 2021 at the DCL Corporation (DCL) facility (the facility) located at 1506 Bushy Park Road, Goose Creek, South Carolina, formerly owned by Sun Chemical. This facility is the only known domestic manufacturer of PV29. The assessment included performing direct particle measurements during the grind and blend pack-out process (pack-out). This task involves filling bags with finished PV29 product. At this stage in the process the PV29 is finely ground, in the form it would be sent to customers, and it was reported by the process operator that the bag filling task generates the highest levels of airborne PV29 when compared to other steps in the production process. A previous industrial hygiene study performed by EI Environmental Health and Safety Solutions (EI) pursuant to a test order issued by EPA and dated June 23, 2020 identified this process as similar exposure group (SEG) #5 in the batch production of PV29. Personal respirable dust samples collected by EI from this SEG were the only samples in their report with concentrations above the limit of detection. EI's results for employees performing the pack-out had respirable dust time weighted average (TWA) exposure concentrations of 0.26 and 0.42 mg/m^3. The samples were analyzed using a gravimetric method, which cannot differentiate between PV29 and any other particulate matter captured in the sample.

The airborne particle size assessment discussed in this report involved deploying 3 instruments at each of two monitoring stations. The instruments consisted of a condensate particle counter (P-Trak™) and two light scattering particle counters: an AeroTrak™ and DustTrak™ DRX. The P-Trak was used to measure ultrafine particles (UFP) with size range from 0.02 to 1 µm and results were reported in particle counts per cubic centimeter of air (counts/cc). This size range encompasses the 0.043 µm particle size used by EPA in its risk evaluation. The AeroTrak measures particles with size range from 0.3 to 25 µm with results provided in number of particles per volume ($particles/ft^3$). The DustTrak DRX measures particle concentrations of PM1, PM2.5, Respirable (PM4), PM10 and Total PM size fractions in mass per volume, reported as mg/m^3. Both the AeroTrak and DustTrak results included segregation of particles based on size.

Monitoring stations were positioned 1) approximately 3 feet from the bag filler and 2) on the main floor of the building, approximately 20 feet outside of the pack-out room where bags were being filled. Instruments were started approximately two hours and twenty minutes before the first bag was filled to evaluate background particle concentrations and continued running for approximately 35 minutes after the last bag was filled, when the workers left the area.

There were two workers in the area. The operator was responsible for filling the bags and was the only person in the room when bags were being filled. An assistant was present on the main floor and his tasks include folding, taping, and stacking boxes and moving pallets. The assistant was in the area less than 50 percent (%) of the time and was not observed entering the room where bags were being filled.

Findings are summarized as follows; more detailed discussion is provided in the report.

Airborne Particle Size Characterization of PV29

- Airborne ultrafine particle concentrations decreased throughout the monitoring period with a mean concentration of 2,863 particles per cubic centimeter (pt/cc) measured while bags were being filled with PV29. This was less than the mean background concentration of 5,060 pt/cc which was measured prior to handling PV29. The decrease throughout the monitoring period was likely due to a decrease in ambient background concentrations. Additionally, measured increases, observed for larger particle sizes that corresponded to tasks performed during bag filling, were not observed in the ultrafine particle size range. These results demonstrate that airborne PV29 particulate was not generated at the size used by EPA in their risk evaluation.
- The mean airborne particle size near the pack-out process was evaluated by subtracting the mean background concentration from the mean concentration during the bag filling process. Analysis of the data indicated that the average particle size was within the 1 to 3 µm bin. Since the instrument does not provide a size distribution within each bin the exact average size could not be determined; however, the distribution of data indicates that the average size was closer to 3 µm than 1 µm.
- The objective of the study was to evaluate particle size, not worker exposure. In order to accurately measure worker exposure a method would be needed that includes samples collected from the breathing zone that could differentiate PV29 particles from other airborne particulate matter. However, the DustTrak positioned near the pack-out process adjacent to the where bags were being filled with PV29 can provide an estimate of potential worker exposure. After subtracting the average background concentration and adjusting for particle density, the average mass concentration of respirable particulate matter (PM 4) measured by the DustTrak DRX was 0.42 mg/m^3. The exposure duration from when filling of the first bag began until all bags were sealed and the worker left the area was 326 minutes. The same concentration, 0.42 mg/m^3, was reported as a time weighted average concentration from the personal respirable dust sample collected by EI for this same process. The total duration of time the worker spent performing the pack-out task in the EI study was 387 minutes. The reproducibility of this data is evidence that actual worker exposure is less than the 1.2 mg/m^3 of total dust for 10.5 hour (630 minute) duration used by EPA for the risk evaluation.
- Results from the monitoring station on the main floor found concentrations for both ultrafine and larger particulate higher in the morning before handling PV29 (background) than during the PV29 pack-out process. This indicated that the PV29 bagging process in the pack-out room did not increase airborne particulate levels outside of this area, and that exposure to PV29 to workers on the main floor was negligible.

1. INTRODUCTION

Ramboll US Consulting, Inc. (Ramboll) performed an assessment to evaluate the distribution of airborne particle sizes associated with the manufacturing of PV29. The study was performed on September 27, 2021 at the DCL facility located at 1506 Bushy Park Road, Goose Creek, South Carolina, formerly owned by Sun Chemical. This facility is the only known domestic manufacturer of PV29. Study design, project management and on-site field work was provided by Robert Rottersman, MS, CIH Principal with Ramboll with assistance from Mr. Jason Lang, CIH, CSP, Senior Consultant with Ramboll. Data analysis was performed by Ms. Cynthia Van Landingham, Senior Managing Consultant with Ramboll. Onsite assistance was provided by DCL management, workers and environmental health and safety (EHS) staff. The study was commissioned by the Color Pigments Manufacturers Association (CPMA).

Field notes are provided in Appendix A. The laboratory report that contains the integrated DustTrak DRX sample result, used to adjust mass concentration based on particle density, is found in Appendix B. Certificates of calibration for the instruments used in this study (Appendix C) and instrument specification sheets are found in Appendix D.

1.1 Facility and Operations

At the time of testing outdoor temperatures ranged from the upper 70°F to low 80°F (degrees Fahrenheit) with relative humidity in the low 60s (% rh). It was cloudy and calm, with no perceptible wind at the facility.

Airborne Particle Size Characterization of PV29

The production of PV29 is a batch process that occurs in stages. It was reported by the manufacturer that batches are produced a few times per year based on customer demand. Ramboll interviewed DCL employees familiar with production and determined that the grind & blend pack-out stage would be expected to result in employee exposure to the finest dust particles and the highest concentrations. This is due to the product being manufactured to a finely ground powder and the use of an air delivery system from an overhead hopper to fill 44 pound bags with the PV29. This was also the only stage of production that resulted in respirable dust concentrations exceeding the limit of detection in EI's 2020 industrial hygiene study. The bags of PV29 from the pack-out process contain the product sent to users.

The pack-out process was performed in room 706-E14-1B, also labeled as 326 (the room). The room contained two bag filling operations, one for PV29 and another filler that was being used for another product at the time of the assessment. This other bag filling station was larger than the PV29 operation and had supersacks sealed directly to the hopper. There was no visual particulate emanating from this process; however, it was running prior to the PV29 process beginning and continued until after the PV29 process was complete, so any particulate generated by this other process would be included in the background measurements. The room was open to the outdoors to the south and to the main production floor of the building to the north. The manufacturer reported that overhead doors to the outdoors and the main floor are kept open as part of normal operations. The open doors were also referenced in EI's 2020 industrial hygiene report.

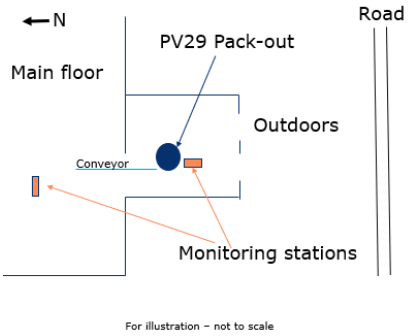

Figure 1
General Layout (not to scale)

The ground PV29 bulk product is located in a hopper above the bag filling area. The operator inserts a bag over a filling port and PV29 is blown into the bag until it is full, ~44 lbs. The operator then seals the bag and places it in a box on the conveyor that takes it to the main floor. On the main floor, the boxes are stacked on a pallet. Full pallets are wrapped in plastic and removed from the building with a lift truck. At the end of the process, the last bag is filled through a "shake down" process when the hopper is vibrated to remove residual PV29.

Instruments were turned on and began data logging between 08:20 and 08:23 on the morning of the assessment. At this time, samples of PV29 had been taken to a laboratory for quality analysis, which was required prior to the pack-out process beginning. There was minimal activity and workers were not present in the area until just before the pack-out process began and first bag was filled at 10:43. Bag filling continued intermittently until the last bag was filled at 15:34 and workers left the area at 16:09. 326 minutes elapsed from when the PV29 was first handled to when the process was completed and workers left the area. There were times during the process when workers left the area for breaks and lunch and to perform other tasks. The process dispensed 3,207 pounds of PV29 into 77 bags, each weighing approximately 44 pounds. Activities are documented in a time log which is included in Appendix A.

Airborne dust was generally not visibly apparent for most of the process, although a small amount of particulate can be seen escaping when the bag is removed from the filling port. There were times when the operator overfilled the bag. During these instances, PV29 spilled from the bag and small amounts of airborne particulates were observed when the operator used a towel to wipe up the spilled material. The

process of filling the last bag, during shake down, took approximately 20 minutes and appeared to be the most visibly dusty task.

Local exhaust ventilation (LEV) is provided through a duct connected to a bag house that was attached to a flanged opening just below where the bag to receive product was inserted onto the filler. This duct is a branch connected to a main exhaust duct located above the process. Other duct branches extended from the main duct, one of which was attached to the other filling process and another was open to the air space in the room. A qualitative assessment of the LEV system found minimal capture velocity at the PV29 bag filler, as pressure from the exhaust system was reduced by the time it reached this capture point. General ventilation in the room was provided from the door that was open to the outdoors. On the day of the assessment, winds were calm and there was no noticeable air movement between the room and outdoors. Ventilation on the main floor was provided by supply and return/exhaust vents. Moderate air movement was observed on the main floor in an east to west direction, parallel to the room with no discernable air movement between the room and main floor.

2. METHODOLOGY

Three different direct-read particle counters were used, with each type of instrument placed at two monitoring stations. One monitoring station was positioned in the room approximately 3 feet from where the bags attached to the filling port. This location was selected because it was a position where airborne dust from the filling process would be present during bag filling.

Photo 1 – Bag being filled.

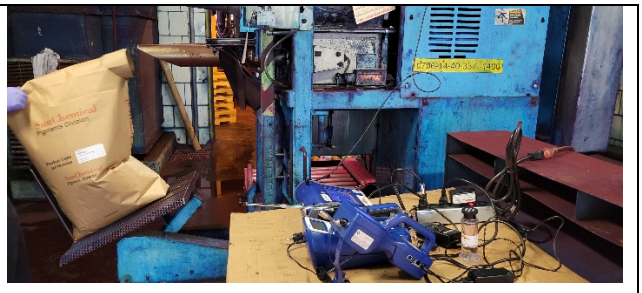

Photo 2 – Bag filling process, removing bag from fill port.

The second location was positioned on the main floor approximately 20 feet from the room where bags were filled. This location was selected as the area where the assistant performed tasks such as folding and stacking boxes and moving pallets.

Photo 3 – Position of instrument on main floor.

Photo 4 – Operations on main floor. Sealed boxes exit room on a conveyor and are stacked on pallets.

The instruments used in the study were a condensate particle counter (P-Trak™) and two light scattering particle counters: an AeroTrak™ and a DustTrak™ DRX.

Airborne Particle Size Characterization of PV29

2.1 Ultrafine Particulate (P-Trak™)

Ultrafine particles (UFP) were measured using a TSI P-Trak, which is a condensate particle counter that measures particles with size ranges from 0.02 to 1 µm. The P-Trak reports particulate in count based units (pt/cc) and cannot further differentiate between particle sizes within the instrument's range. The instruments had been calibrated per the manufacturers specification and were zero calibrated on the morning of the study. The instrument was programmed to log UFP concentrations every minute. Condensate particle counters require use of a wick to deliver isopropyl alcohol to a chamber within the instrument. The instruments were monitored for indication of low alcohol, and when this occurred the instruments were stopped, the wick was removed and regenerated and then reinserted in the instrument. This process lasted approximately 5 minutes and was done twice during the monitoring period.

2.2 Size Segregated Particulate – Count Based (AeroTrak™)

TSI AeroTrak model 9306-V2 was used to measure particles with size ranges from 0.3 to 25 µm. The instrument measures particle count and was programed to report particle concentrations within each of six size ranges (or "bins") as number of particles/ft^3. The size ranges were 0.3 to 0.5 µm, 0.5 to 1.0 µm, 1.0 to 3.0 µm, 3.0 to 5.0 µm, 5.0 to 10.0 µm and greater than 10 µm. The instrument was programed to measure in differential mode, which reports the total number of particles measured within each bin. The instruments had been calibrated per the manufacturer's specification and were zero calibrated on the morning of the study. The logging interval was set so data was recorded once every minute throughout the monitoring period.

2.3 Size Segregated Particulate – Mass Based (DustTrak™)

TSI DustTrak DRX model 8533 was used to measure particles with sizes ranging from 0.3 to 25 µm. The instrument is mass based and was programed to report particle concentrations in number of particles for each of five size ranges (bins) as mg/m^3. The instrument measured the mass of particles in size ranges of <1.0 µm (PM1), <2.5 µm (PM2.5), <4.0 µm (respirable), <10.0 µm (PM10) and total PM. The instrument measures in cumulative mode, which reports the mass of particles measured for each PM size and smaller. The instruments had been calibrated per the manufacturer's specification and were zero calibrated on the morning of the study. Data was recorded once every minute throughout the monitoring period.

The DustTrak assumes particle mass based on the density of the calibration particulate for the instrument (Arizona Road Dust). Since PV29 would not be expected to have the same density, a calibration factor is needed. The instrument has the ability to simultaneously collect a gravimetric sample, and this capability was used to develop a calibration factor for PV29, as follows: A pre-weighed 37-millimeter (mm) polyvinyl chloride (PVC) filter cassette (cassette holder SKC part #225-308) was inserted into the instruments at the beginning of the monitoring period. The DustTrak was programed to draw air at 1 liter per minute with two thirds of air passing through the filter and one third through the sheath for direct read particle counting. Air volume for the gravimetric samples was calculated by multiplying the total run time by 0.667. The sample was sent to Galson Laboratories for total dust analysis, and laboratory reports are included in Appendix B. The calibration factor was calculated by dividing the reference concentration from the laboratory sample by the average total dust concentration recorded by the instrument during the monitoring period. The sample from the instrument in the main floor had levels less than the limit of quantification for the laboratory method. This was the same method, gravimetric analysis, that was used for sample analysis in the 2020 EI study, in which most results were also below the detection limit. The concentration reported by the lab from the sample collected near bag-filling was 0.80 mg/m^3 and the concentration from the instrument was 0.3679 mg/m^3. This indicates the airborne particulate in the pack-out room was denser than the particulate used to calibrate the instrument. The corresponding calibration factor was 2.1745. All mass-based results recorded by the instrument were multiplied by this value, so mass based concentrations used on for data analysis and interpretation are 2.1745 times higher than the levels measured by the instrument.

3. RESULTS

3.1 Ultrafine Particulate (UFP)

Airborne ultrafine particle concentrations decreased throughout the day at the monitoring station adjacent to the bag filling operation. There was no discernable increase in UFP when PV29 was being handled. The pack-out room had an average concentration while bags were being filled with PV29 of 2,863 pt/cc. This was less than the average background concentration of 5,060 pt/cc, which was measured in this room prior handling PV29.

For the monitoring station on the main floor there was a general trend of decreasing UFP concentrations until work activity began in that area. Increases in UFP were observed at times when employees were handling boxes near the instrument. Handling included folding and taping boxes and using electric lift trucks to move pallets. The smaller spikes in the pack-out area, illustrated by the orange line on Figure 2, appeared to correlate with activities occurring on the main floor and not with the use of PV29. For example, the peak that occurred between at 13:01 was after workers had returned from lunch and were preparing boxes and performing other tasks, prior to restarting the PV29 bag filling operation.

UFP Results are summarized on Figure 2.

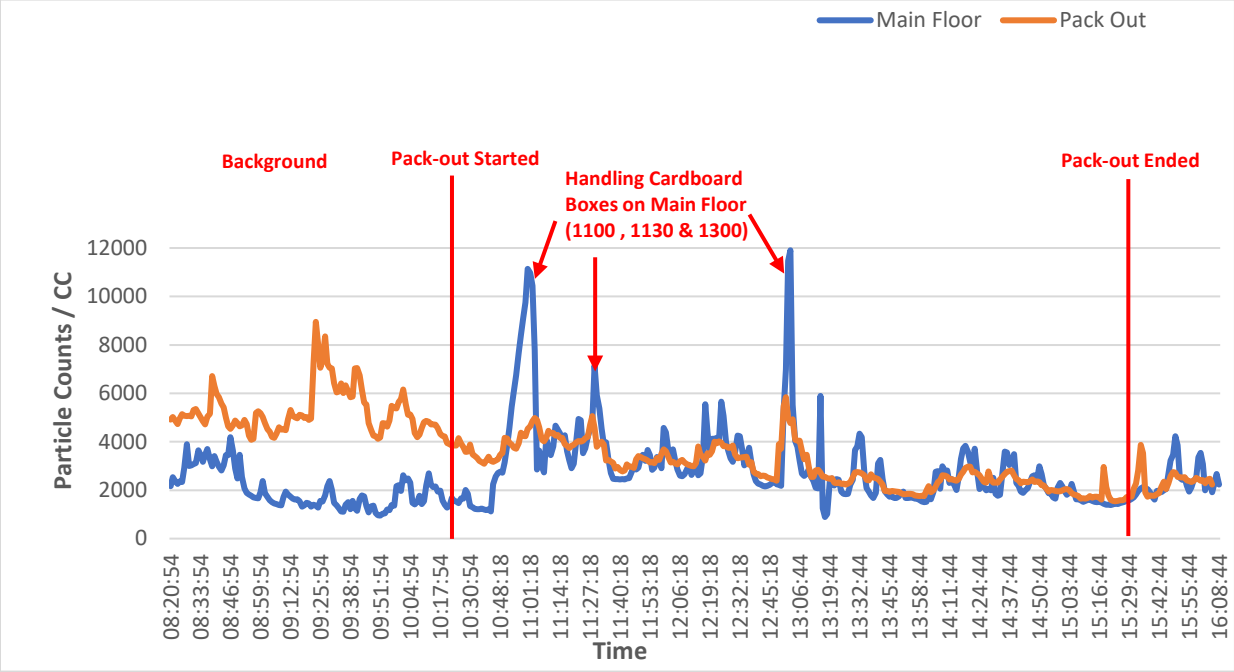

Figure 2
Ultrafine Particulate (Counts / CC)

UFP exist as background levels in ambient air from a variety of sources with by-products from combustion including vehicle emissions and industry being major sources of UFP in outdoor air. The decreasing UFP concentrations in the room was likely due to decreasing outdoor background levels. It is unclear why ambient background conditions were higher in the morning and decreased throughout the day, this may have been associated with morning rush hour, or higher vehicle traffic, in the area during that time.

3.2 Size Segregated – Count Based

Similar to the UFP concentrations, airborne particulate concentrations in the 0.3 to 0.5 µm size range, measured in the room near the bag filling station, decreased over the course of the monitoring period. The exception was toward the end of the process, with increases in airborne particulate that appeared to correspond with the shake-down task when vibration was used to remove remaining product from the

hopper. The highest concentrations measured during this process were still less than background concentrations measured before handling of PV29 began.

For figures 3 through 8 the vertical red line is the time when pack-out began, when PV29 was first handled during the monitoring period. The horizontal red line is the average concentration. Results on the Y axis are in numbers of particles per cubic foot of air and time is on the X axis.

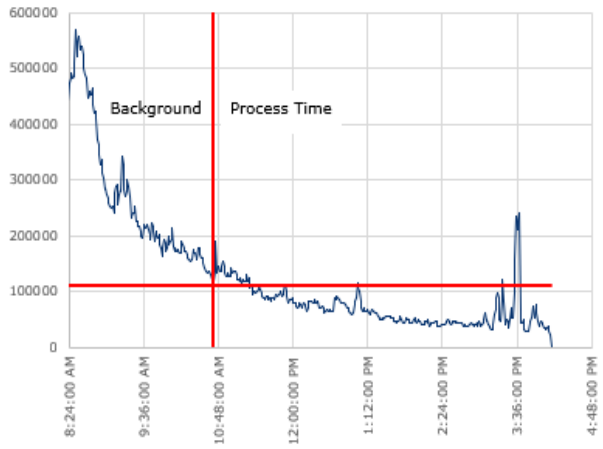

Figure 3
Airborne Concentrations of Particles 0.3 to 0.5 µm
Measured near bag filling

As particle sizes increased, background concentrations were lower and increases associate with discrete tasks from the PV29 pack-out process became apparent. These included peaks in data that correlated with overfilling bags, wiping down surfaces and the shake down task that occurred at the end of the bag filling process. This is illustrated on figures 4 through 8.

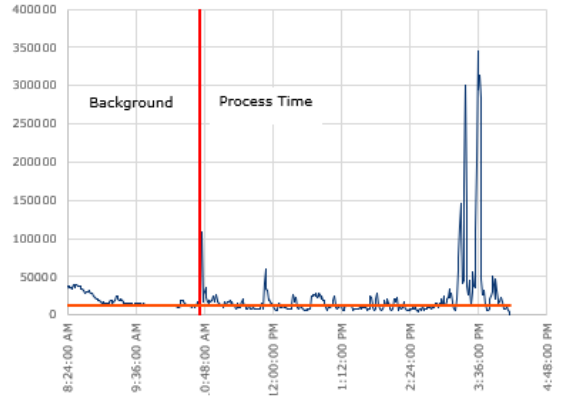

Figure 4
Airborne concentration of Particles 0.5 to 1.0 µm
Measured near bag filling

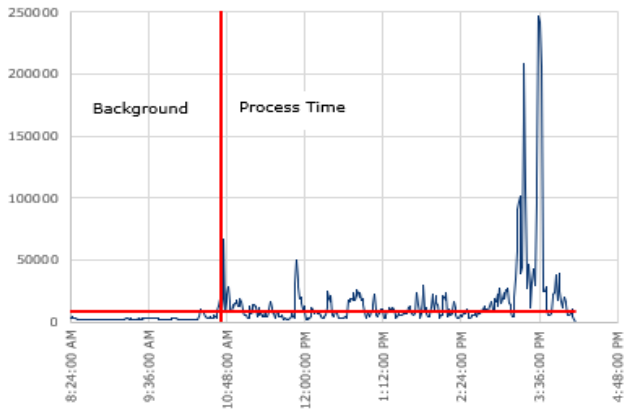

Figure 5
Airborne concentration of Particles 1.0 to 3.0 µm
Measured near bag filling

Airborne Particle Size Characterization of PV29

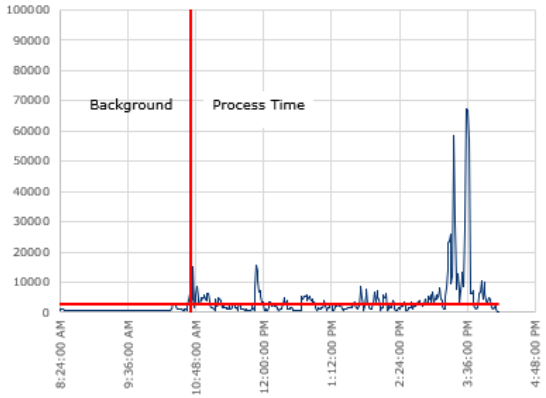

Figure 6
Airborne concentration of Particles 3.0 to 5.0 µm
Measured near bag filling

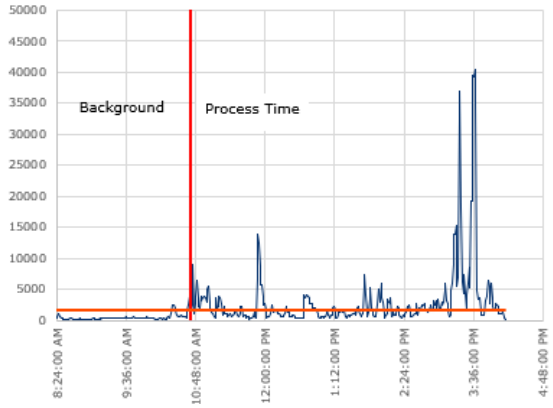

Figure 7
Airborne concentration of Particles 5.0 to 10.0 µm
Measured near bag filling

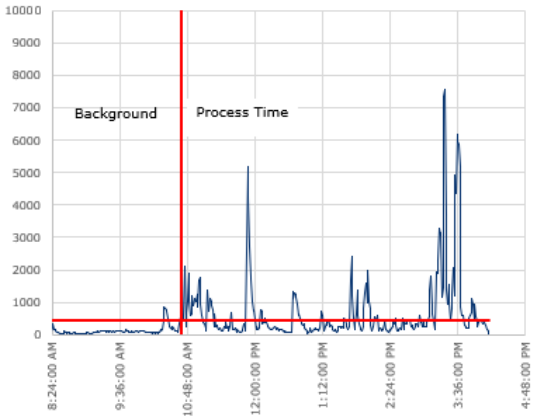

Figure 8
Airborne concentration of Particles greater than 10.0 µm
Measured near bag filling

Data was analyzed to estimate the average airborne particle size associated with the PV29 process. This was done by subtracting the average background concentration for each size range from the concentrations measured during the pack-out process for each size range. This analysis demonstrated that the average particle size of PV29 was most likely in the bin that included particles from 1.0 to 3.0 µm. The AeroTrak instrument does not measure particle size within each bin, so the exact particle size of workplace PV29 particulate cannot be determined more precisely. It can be estimated, however. The average particle size in the 1.0 to 3.0 µm bin was calculated to provide an estimate of average particle size and demonstrated that the average particle in this bin was closer to 3 µm than 1 µm, or approximately 2.5 µm. See Figure 9.

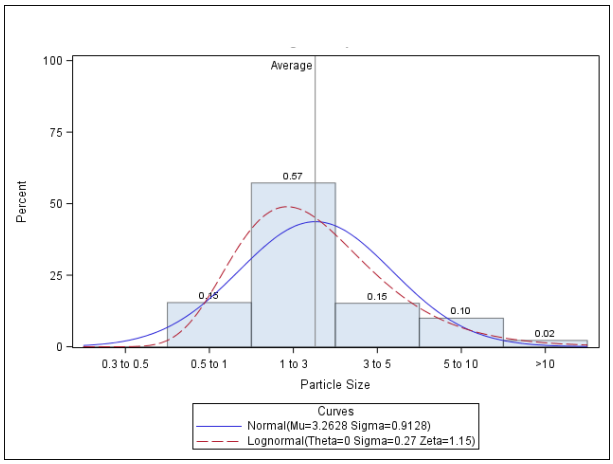

Figure 9
Aero Trak PV29 Pack – Average of Particle Size Counts (after Subtracting Background Using Means)

3.3 Size Segregated – Mass Based

Mass based data from the DustTrak instruments were multiplied by a particle calibration factor of 2.1745 based on the results of the integrated gravimetric sample collected in the instrument deployed in the pack-out area. Results for the instrument deployed on the main floor were also multiplied by the calibration factor of 2.1745. This value was used because the inline cassette on the main floor did not capture sufficient dust mass to derive a calibration factor from this instrument. For both instruments, the average concentration of the background period was subtracted from the average concentration measured during the pack-out process to provide an estimate of PV29 particulate mass attributable to the process.

After adjusting for particle density and subtracting background airborne particle concentrations the average concentration of respirable dust (PM 4) near the bagging process was 0.42 mg/m^3 and the total dust concentration was 0.92 mg/m^3.

Particle mass concentration on the main floor decreased throughout the monitoring period, with average background concentration exceeding the average concentration during the PV29 pack-out process. Subtracting the background from concentrations during the process resulted in a negative number, indicating mass based airborne dust levels were higher in the morning, before workers began handling PV 29 than during the bagging operation. These results indicate that PV29 operations did not influence airborne particulate levels on the main floor.

Results are summarized in Table 1.

Table 1
Summary of Mass Based Particulate Concentrations
Average Concentrations after Adjusting for Density and Subtracting Background

Particle Size	Pack-Out (mg/m^3)	Main Floor (mg/m^3)
PM 1	0.30	(0.05)*
PM 2.5	0.34	(0.05)*
PM 4	0.42	(0.05)*
PM 10	0.77	(0.05)*
Total	0.92	(0.04)*

* - negative number, results were less than zero

4. CONCLUSIONS

Results of this study found that airborne UFP were not generated as part of the PV29 grind and blend pack-out process, which is the final stage in the batch production of this material and the one most likely to generate the highest concentration and smallest particle size of PV29. UFP includes the primary particle size of 0.043 µm, which is the size EPA assumed and relied upon during its risk evaluation. Most of the particles generated during the PV29 pack-out process were within the 1 to 3 µm size range with the average concentration in this range closer to 3 or approximately 2.5 µm, more than 50 times larger than the size used in EPA's evaluation.

The average concentration of respirable particulate (PM 4) measured during the pack-out process and adjacent to the bag filler was 0.42 mg/m^3. Respirable particulate concentration is less than the 1.2 mg/m^3 concentration used in the EPA's risk assessment. While the use of stationary direct read instruments is not typical for measuring actual worker exposure, this study found the same concentration of respirable dust measured for the pack-out bag filling operator as the 2020 industrial hygiene assessment performed by EI that utilized personal sampling and gravimetric analysis for respirable dust. This finding demonstrated reproducible results for the workplace location, involving the same tasks, using two different sampling methodologies.

Both IE's 2020 study and this study found the total time required for the pack-out procedure to be similar, between 323 and 386 minutes and that this batch process is only run occasionally with the pack-out process likely occurring a few times per year. Whereas EPA assumed 10.5 hours (630 minutes) for 190 days in a year.

Results of this assessment demonstrated that the pack-out process did not affect concentrations of airborne particulate in the area immediately outside the room where PV29 bagging occurred. Worker exposure to PV29 outside of this room would be negligible.

APPENDIX A
FIELD NOTES/LOG

September 17, 2021
Background Notes:

- Pack Out Room 706-E14-1B (326): Instruments Start 08:23
  - DustTrak SN: 8533153204
    - Internal Cassette Sample ID# 21-0248655
  - P-Trak SN: 8525-06-190003
  - AeroTrak SN: 93061342008
- Main Floor Production: Instruments Start 08:20
  - DustTrak SN: 8533163801
    - Internal Cassette Sample ID# 21-0248657
  - P-Trak SN: 8525-08-08130011
  - AeroTrak SN: 93062030012
- Background in Pack Out room – higher UFP than main floor
- Two overhead doors open and near forklift and road traffic in the back of the bag filling bay. Two overhead doors open between the Main Floor Production area and the Pack Out Room. Most forklifts battery powered.
- Filling supersacks W370E in same room ~ 15 feet from sampling instruments operating during background readings and planned to run throughout the day.
- PV 29 production run = 3,207 lbs into 44 lb bags (approximately 73 bags)

Time in Motion:

- 10:39 – Changed alcohol wicks in P-Trak's
- 10:43 – Start filling first bag
- 10:44 – Visible dust at filling port into bag
- 10:45 – Remove first bag from filling port (44 lb bag)
- 10:46 – Excess dust observed spilling from back when removing from filling port
- 10:47 – Operator reported test valve settings need to be adjusted to maintain proper feed rate of filler panel to adjust valve
- 10:48 – Valve adjusted on filler and turned back on
- 10:50 – Restated filling bags
- 10:53 – Wiped down filling area with towel. Some visible dust noted. Wiping down is done periodically between filling bags when spillage occurs
- 11:00 – Dust falls on air sampling instruments from above. Instruments wiped down with towel causes a notable increase in particle readings. In the main floor area, cardboard boxes were being built, folded, and taped.
- 11:11 – Small spill and wipe down in filling area
- 11:21 – Filling paused to stack pallets near air sampling instruments in the main floor production area
- 11:27 – Restart filling
- 11:31 - In the main floor area, cardboard boxes were being built, folded, and taped. Pallets have 10 boxes. 1 bag per box. Pallets stacked on top of each other for a total of 20 boxes/bags
- Supersack bags from other process (not PV29) being run in the room
- 11:53 – Compressed air used to blow down bag filling area
- 12:03 – Filling Operator leaves filling area to move pallets. Filling paused
- 12:10 – Lunch Break
- 12:50 – Remove wick in P-Trak in Main Floor Production area, put in alcohol to regenerate
- 12:51 - Remove wick in P-Trak in Pack Out Room, put in alcohol to regenerate

- 12:57 – Replace wick in P-Trak in Main Floor Production area and restart data logging
- 12:58 - Replace wick in P-Trak in Pack Out Room and restart data logging. Filling Operator returns to work area from lunch break. Begins labeling cardboard boxes.
- 13:03 – Worker folds and stacks boxes on work bench near bag filling station
- 13:05 – Worker labels bags at work bench near bag filling station
- 13:10 - Worker dispenses PV29 into sample bag, then transfers contents into plastic jar container away from the bag filling station, a product quality sample. 1st PV29 task after returning from lunch.
- 13:11 - Worker dispenses PV29 into another sample bag, and again transfers contents into plastic jar container away from the bag filling station
- 13:12 – Worker begins filling PV29 bags, first post-lunch bag filled.
- 13:18 – Bag filling paused. Worker leaves filling area and goes to office area
- 13:30 – Worker restarts bag filling
- 13:37 – Cardboard boxes being handled and forklift operating near Main Floor sampling instruments
- 13:43 – Bag overflows. Worker uses towel to wipe down filling area
- 13:45 – Worker vibrates overhead hopper that feeds the filling port
- 13:50 – Bag filling paused to move pallets
- 13:54 – Bag filling restarted
- 13:59 – Small spill and wipe down with towel
- 14:07 – Bag filling paused to transfer overfilled backs back into charger. Worker leaves bag filling area
- 15:01 – Bag filling restarted
- 15:14 – Vibrator turned on to feed more product from hopper into filling port
- 15:20 – Worker filling last bag. Worker mentioned that filling last bag is dustier due to air in the system. Visible dust is apparent at the bag filling area
- 15:22 – System "shake down" to move last amount of product into bag. Visible dust apparent
- 15:32 – Worker turns on bag filler and continues to shake down product into last bag. Visible dust apparent
- 15:34 – Last bag filled and removed from the bag filler. Process complete. Visible dust apparent when last bag is removed, process is complete.
- 15:40 – Nearby supersack filling in the back bay (not PV29) producing visibly apparent dust in the room
- 16:09 – Workers left the area. Air sampling instruments stopped in Main Floor Production and Pack Out areas

APPENDIX B
LABORATORY REPORTS

SGS GALSON

Mr. Robert Rottersman
Ramboll Environ US Corporation
333 West Wacker
Suite 2700
Chicago, IL 60606

September 28, 2021

Account# 11676

Login# L547146

Dear Robert Rottersman:

Enclosed are the analytical results for the samples received by our laboratory on September 21, 2021. All samples on the chain of custody were received in good condition unless otherwise noted. Any additional observations will be noted on the chain of custody.

Please contact client services at (888) 432-5227 if you would like any additional information regarding this report. Thank you for using SGS Galson.

Sincerely,

SGS Galson

Lisa Swab
Laboratory Director

Enclosure(s)

Terms and Conditions & General Disclaimers

- This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/en/Terms-and-Conditions.aspx. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.
- Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

Analytical Disclaimers

- Unless otherwise noted within the report, all quality control results associated with the samples were within established control limits or did not impact reported results.
- Note: The findings recorded within this report were drawn from analysis of the sample(s) provided to the laboratory by the Client (or a third party acting at the Client's direction). The laboratory does not have control over the sampling process, including but not limited to the use of field equipment and collection media, as well as the sampling duration, collection volume or any other collection parameter used by the Client. The findings herein constitute no warranty of the sample's representativeness of any sampled environment, and strictly relate to the samples as they were presented to the laboratory. For recommended sampling collection parameters, please refer to the Sampling and Analysis Guide at www.sgsgalson.com.
- Unrounded results are carried through the calculations that yield the final result and the final result is rounded to the number of significant figures appropriate to the accuracy of the analytical method. Please note that results appearing in the columns preceding the final result column may have been rounded and therefore, if carried through the calculations, may not yield an identical final result to the one reported.
- The stated LOQs for each analyte represent the demonstrated LOQ concentrations prior to correction for desorption efficiency (if applicable).
- Unless otherwise noted within the report, results have not been blank corrected for any field blank or method blank data.

Accreditations SGS Galson holds a variety of accreditations and recognitions. Our quality management system conforms with the requirements of ISO/IEC 17025. Where applicable, samples may also be analyzed in accordance with the requirements of ELAP, NELAC, or LELAP under one of the state accrediting bodies listed below. Current Scopes of Accreditation can be viewed at http://www.sgsgalson.com in the accreditations section of the "About" page. To determine if the analyte tested falls under our scope of accreditation, please visit our website or call Client Services at (888) 432-5227.

National/International	Accreditation/Recognition	Lab ID#	Program/Sector
AIHA-LAP, LLC - IHLAP, ELLAP, EMLAP	ISO/IEC 17025 and USEPA NLLAP	Lab ID 100324	Industrial Hygiene, Environmental Lead, Environmental Microbiology

State	Accreditation/Recognition	Lab ID#	Program/Sector
New York (NYSDOH)	ELAP and NELAC (TNI)	Lab ID: 11626	Air Analysis, Solid and Hazardous Waste
New Jersey (NJDEP)	NELAC (TNI)	Lab ID: NY024	Air Analysis
Louisiana (LDEQ)	LELAP	Lab ID: 04083	Air Analysis, Solid Chemical Materials
Texas	Texas Dept. of Licensing and Regulation	Lab ID: 1042	Mold Analysis Laboratory license

Legend

< - Less than	mg - Milligrams	MDL - Method Detection Limit	ppb - Parts per Billion
> - Greater than	ug - Micrograms	NA - Not Applicable	ppm - Parts per Million
l - Liters	m3 - Cubic Meters	NS - Not Specified	ppbv - ppb Volume
LOQ - Limit of Quantitation	kg - Kilograms	ND - Not Detected	ppmv - ppm Volume
ft2 - Square Feet	cm2 - Square Centimeters	in2 - Square Inches	ng - Nanograms

SGS GALSON

6601 Kirkville Road
East Syracuse, NY 13057
(315) 432-5227
FAX: (315) 437-0571
www.sgsgalson.com

LABORATORY ANALYSIS REPORT

Client : Ramboll
Site : NS
Project No. : CPMA-PV29
Date Sampled : 17-SEP-21
Date Received : 21-SEP-21

Account No.: 11676
Login No. : L547146

Date Analyzed : 27-SEP-21
Report ID : 1266795

Total Dust

Sample ID	Lab ID	Air Vol liter	Total mg	Conc mg/m3
21-0248655	L547146-1	311	0.25	0.80
21-0248657	L547146-2	313	<0.050	<0.16
21-0248662	L547146-3	NA	<0.050	NA

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Level of Quantitation: 0.050 mg
Analytical Method : mod. NIOSH 0500; Gravimetric
Collection Media : PVC PW 37mm

Submitted by: EAP
Date : 28-SEP-21
Supervisor : KEG

Approved by: CMP

SGS GALSON

6601 Kirkville Road
East Syracuse, NY 13057
(315) 432-5227
FAX: (315) 437-0571
www.sgsgalson.com

LABORATORY FOOTNOTE REPORT

Client Name : Ramboll
Site :
Project No. : CPMA-PV29

Date Sampled : 17-SEP-21
Date Received: 21-SEP-21
Date Analyzed: 27-SEP-21

Account No.: 11676
Login No. : L547146

L547146 (Report ID: 1266795):
SOPs: GRAV-SOP-5(31), GRAV-SOP-6(25)

L547146 (Report ID: 1266795):
Accuracy and mean recovery data presented below is based on a 95% confidence interval (k=2). The estimated accuracy applies to the media, technology, and SOP referenced in this report and does not account for the uncertainty associated with the sampling process. The accuracy is based solely on spike recovery data from internal quality control samples. Where N/A appears below, insufficient data is available to provide statistical accuracy and mean recovery values for the associated analyte.

Parameter	Accuracy	Mean Recovery
Total Dust	+/-7.4%	103%

1ZHTK9121307905036
Date:09/21/21
Shipper:UPS
Initials:MAK

Prep:UNKNOWN

L547146

39

GALSON CHAIN OF CUSTODY

Turn Around Time (TAT):	(surcharge)
☒ Standard	0%
☐ 4 Business Days	35%
☐ 3 Business Days	50%
☐ 2 Business Days	75%
☐ Next Day by 6pm	100%
☐ Next Day by Noon	150%
☐ Same Day	200%

☐ Samples submitted using the FreePumpLoan™ Program

☐ Samples submitted using the FreeSamplingBadges™ Program

You may edit and complete this COC electronically by logging in to your Client Portal account at https://portal.galsonlabs.com/

Client Acct No.: 11676

Original Prep No.: PSY626765

CS Rep: EOLDRIDGE

Online COC No.: 233868

Report To :	Mr. Robert Rottersman
Company Name :	Ramboll Environ US Corporation
Address 1 :	333 West Wacker
Address 2 :	Suite 2700
City, State Zip :	Chicago, IL 60606
Phone No. :	312 - 288 - 3857
Cell No. :	312 - 622 - 0255
Email reports to :	rrottersman@ramboll.com
Email EDD to :	rrottersman@ramboll.com
Comments :	

Invoice To :	Accounts Payable
Company Name :	Ramboll
Address 1 :	333 W. Wacker Drive
Address 2 :	Suite 2700
City, State Zip :	Chicago, IL 60606
Phone No. :	312 - 288 - 3881
Email Address :	US169_vendor@ramboll.com
Comments :	
P.O. No. :	1690023419
Payment info. :	☐ I will call SGS Galson to provide credit card info ☐ Card on File (enter the last five digits on the line below)

Comments :

State Sampled :

Please indicate which OEL(s) this data will be used for :
☐ OSHA PEL ☐ ACGIH TLV ☐ MSHA ☐ Cal OSHA
☐ IAQ : _____ (Specify Limit(s)) ☐ Other : _____ (Specify Other)

Site Name :

Project : CPMA-PV29

Sampled By : R. Rottersman

List description of industry or Process/interferences present in sampling area :

Sample ID * (Maximum of 20 Characters)	Date Sampled *	Collection Medium	Sample Volume / Sample Time / Sample Area *	Liters / Minutes / in², cm², ft² *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
21-0248655	9/17/21	PW PVC in 225-308 cassette	~~313~~ 311	L	Total Dust	N0500	
21-0248657	9/17/21	PW PVC in 225-308 cassette	313	L	Total Dust	N0500	

☐ ^ If the method(s) indicated on the COC are not our routine/preferred method(s), we will substitute our routine/preferred methods. If this is not acceptable, check here to have us contact you.

Chain of Custody	Print Name / Signature		Date	Time		Print Name / Signature		Date	Time
Relinquished By :					Received By :				
Relinquished By :					Received By :	Michelle Krause	Michelle Krause	9/21/21	11 18

*** You must fill in these columns for any samples which you are submitting.**

Samples received after 3pm will be considered as next day's business.

Online COC No. : 233868
Prep No. : PSY626765
Account No. : 11676
Draft : 9/15/2021-4:06:14 PM

All services are rendered in accordance with the applicable SGS General Conditions of Service accessible via: http://www.sgs.com/en/Terms-and-Conditions.aspx

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SGS GALSON CHAIN OF CUSTODY

Comments :

Sample ID * (Maximum of 20 Characters)	Date Sampled *	Collection Medium	Sample Volume Sample Time Sample Area *	Liters Minutes in², cm², ft² *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
21-0248662		PW PVC in 225-308 cassette	Blank		Total Dust	N0500	
		PW PVC in 225-308 cassette			Total Dust	N0500	
		PW PVC in 225-308 cassette			Total Dust	N0500	
		PW PVC in 225-308 cassette			Total Dust	N0500	
		PW PVC in 225-308 cassette			Total Dust	N0500	
		PW PVC in 225-308 cassette			Total Dust	N0500	
		PW PVC in 225-308 cassette			Total Dust	N0500	
		PW PVC in 225-308 cassette			Total Dust	N0500	

☐ ^ If the method(s) indicated on the COC are not our routine/preferred method(s), we will substitute our routine/preferred methods. If this is not acceptable, check here to have us contact you.

Chain of Custody	Print Name / Signature		Date	Time		Print Name / Signature		Date	Time
Relinquished By :					Received By :				
Relinquished By :					Received By :	Michelle Krause	Michelle Krause	9/21/21	1118

*** You must fill in these columns for any samples which you are submitting.**

Samples received after 3pm will be considered as next day's business.

Online COC No. : 233868
Prep No. : PSY626765
Account No. : 11676
Draft : 9/15/2021 4:06:14 PM

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APPENDIX C
CERTIFICATES OF CALIBRATION

CERTIFICATE OF CALIBRATION

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

Environment Condition		
Temperature	73.8 (23.2)	°F (°C)
Relative Humidity	32	%RH
Barometric Pressure	29.03 (983.1)	inHg (hPa)

Model	**9306-V2**
Serial Number	**93061342008**
Customer Inst ID	

☒ As Left ☐ As Found

☒ In Tolerance ☐ Out of Tolerance

AeroTrak Calibration Kit			
Measurement Variable	**System ID**	**Date Last Calibrated**	**Calibration Due Date**
Flow Meter	E005519	07/02/2020	01/31/2021
7201-02F	E005520	04/22/2020	10/31/2020
Flow Meter	E005546	07/02/2020	01/31/2021

Particle Standards				
Particle Size	**Standard Uncertainty**	**Standard Deviation**	**Lot No.**	**Expiration Date**
0.303 µm	0.003 µm	0.0047 µm	219211	11/30/2022
0.510 µm	0.0035 µm	0.0092 µm	218477	10/31/2022
0.994 µm	0.0075 µm	0.010 µm	217315	10/31/2022
2.92 µm	0.015 µm	0.03 µm	213336	6/30/2022
5.020 µm	0.02 µm	0.07 µm	220284	12/31/2022
9.990 µm	0.04 µm	0.17 µm	221642	2/28/2023

TSI does hereby certify that the calibration performed on the above described instrument meets the requirements of ISO 21501-4. TSI does hereby certify that the above described instrument conforms to the original manufacturer's specification (not applicable to As Found data) and has been calibrated using standards whose accuracies are traceable to the United States National Institute of Standards and Technology (NIST) or has been verified with respect to instrumentation whose accuracy is traceable to NIST, or is derived from accepted values of physical constants. TSI is registered to ISO-9001:2008.

Sophoma Chap
Calibrated

October 20, 2020
Date

TSI P/N 2300157

CERTIFICATE OF CALIBRATION

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

Size Calibration and Verification of Size Setting			
Nominal Particle Size	Gain Stage	Digital Cutpoint	Expanded Uncertainty
0.3 µm	A	29	4.1%
0.5 µm	A	350	3.8%
1 µm	B	8	3.9%
3 µm	B	65	3.7%
5 µm	B	188	3.6%
10 µm	B	645	3.6%

Counting Efficiency			
Particle Size	Actual	Allowable Range	Pass/Fail
0.3 µm	50%	50% ± 20%	Pass
0.5 µm	98%	100% ± 10%	Pass

Size Resolution			
Particle Size	Measured	Allowable Range	Pass/Fail
0.5 µm	6.8%	≤15%	Pass

False Count Rate						
Sample Time (min)	Sampled (L)	Measured Counts (#)	Concentration (#/M^3)	95% UCL (#/M^3)	Allowable Range (#/M^3)	Pass/Fail
30	85	0	0.00	35.3	≤70.7	Pass

Sampling Flow Rate (L/min)				
Nominal	Actual	Error	Allowable Range	Pass/Fail
2.83	2.83	0.0 %	± 5%	Pass

Sampling Time †		
Measured	Allowable Range	Pass/Fail
< ± 0.1%	± 1%	Pass

Response Rate †		
Measured	Allowable Range	Pass/Fail
0.08%	≤ 0.5%	Pass

Maximum Particle Concentration †
210000000 #/m^3 @10% Coincidence Loss

† Tested and verified during product development

Calibration Interval	
Calibration Date	Expiration Date
October 20, 2020	October 20, 2021

TSI P/N 2300157

CERTIFICATE OF CALIBRATION

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

Environment Condition		
Temperature	74.6 (23.7)	°F (°C)
Relative Humidity	49	%RH
Barometric Pressure	29.08 (984.8)	inHg (hPa)

Model	9306-V2
Serial Number	93062030012
Customer Inst ID	

☒ As Left ☐ As Found

☒ In Tolerance ☐ Out of Tolerance

AeroTrak Calibration Kit			
Measurement Variable	System ID	Date Last Calibrated	Calibration Due Date
Flow Meter	E003739	02/01/2021	08/31/2021
7201-02F	E005520	03/05/2021	09/30/2021
Flow Meter	E005633	02/02/2021	08/31/2021

Particle Standards				
Particle Size	Standard Uncertainty	Standard Deviation	Lot No.	Expiration Date
0.303 µm	0.003 µm	0.0047 µm	238629	03/31/2024
0.510 µm	0.0035 µm	0.0092 µm	236574	02/29/2024
0.994 µm	0.0075 µm	0.010 µm	234756	12/31/2023
2.92 µm	0.015 µm	0.03 µm	213336	6/30/2022
5.020 µm	0.02 µm	0.07 µm	228192	07/31/2023
9.990 µm	0.04 µm	0.17 µm	221642	2/28/2023

TSI does hereby certify that the calibration performed on the above described instrument meets the requirements of ISO 21501-4. TSI does hereby certify that the above described instrument conforms to the original manufacturer's specification (not applicable to As Found data) and has been calibrated using standards whose accuracies are traceable to the United States National Institute of Standards and Technology (NIST) or has been verified with respect to instrumentation whose accuracy is traceable to NIST, or is derived from accepted values of physical constants. TSI is registered to ISO-9001:2015.

Calibrated

July 29, 2021
Date

TSI P/N 2300157

CERTIFICATE OF CALIBRATION

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

Size Calibration and Verification of Size Setting			
Nominal Particle Size	Gain Stage	Digital Cutpoint	Expanded Uncertainty
0.3 µm	A	36	4.1%
0.5 µm	A	340	3.8%
1 µm	B	7	3.9%
3 µm	B	60	3.7%
5 µm	B	162	3.6%
10 µm	B	560	3.6%

Counting Efficiency			
Particle Size	Actual	Allowable Range	Pass/Fail
0.3 µm	51%	50% ± 20%	Pass
0.5 µm	99%	100% ± 10%	Pass

Size Resolution			
Particle Size	Measured	Allowable Range	Pass/Fail
0.5 µm	5.5%	≤15%	Pass

False Count Rate						
Sample Time (min)	Sampled (L)	Measured Counts (#)	Concentration (#/M^3)	95% UCL (#/M^3)	Allowable Range (#/M^3)	Pass/Fail
30	85	0	0.00	35.3	≤70.7	Pass

Sampling Flow Rate (L/min)				
Nominal	Actual	Error	Allowable Range	Pass/Fail
2.83	2.83	0.0 %	± 5%	Pass

Sampling Time †		
Measured	Allowable Range	Pass/Fail
< ± 0.1%	± 1%	Pass

Response Rate †		
Measured	Allowable Range	Pass/Fail
0.08%	≤ 0.5%	Pass

Maximum Particle Concentration †
210000000 #/m^3 @10% Coincidence Loss

† Tested and verified during product development

Calibration Interval	
Calibration Date	Expiration Date
July 29, 2021	July 29, 2022

TSI P/N 2300157

NISTLab/SAI
Wilner-Greene Engineering Services

Certificate of Calibration
ISO 9001 Certified

Order Number: 20212324
Certificate Number: 120437

Issued To: RAECO RENTS
135 BERNICE DR
BENSENVILLE, IL 60106

Date Received: 2/11/2021
Date Issued: 3/2/2021
Valid Until: Mar 2022

Equipment:
Manufacturer: TSI
Model Number: 8533
SerialNumber: 8533153204
Control #:

Test Conditions :

Temperature:	21.8	C
Humidity:	42.9	%
Barometric Pressure:	1004.2	mBar

As Found:
FULLY FUNCTIONAL AND IN TOLERANCE.

As Returned:
FULLY FUNCTIONAL AND WITHIN TOLERANCE.

Special Conditions:
NONE

Work Performed.
ALIGNED AND CALIBRATED PER CALIBRATION PROCEDURE DM-001.

CALIBRATED TO: MANUFACTURERS SPECIFICATIONS

MeasurementUncertainties: DC VOLTAGE 0.1%, BAROMETRIC +/- 0.15 HPA, RH +/- 1%, TEMP +/- 0.05C, PARTICLE CONCENTRATION +/- 2% AS REFERENCED TO ARIZONA DUST A2 FINE, AIR FLOW RATE +/- 0.3%

Device, Description, Report Number, Date Due
Reference Standards:

1042, PHOTOMETER, REAL TIME 90 DEGREE LIGHT SCATTERING PHOTOMETER, 300268715-171712, 5/13/2021

9102, C-29, MICROBALANCE, 551220084047935, 1/30/2023

9105, ML-800-44, PRIMARY VOLUMETRIC STANDARD, 18556, 7/30/2021

Reviewed by: 3/2/2021

Authorized Signature: Brian Stanhope

This report certifies that all calibration equipment used in the test is traceable to the National Institue of Standards (NIST) , and applies only to the unit identified under "Equipment" above. This report must not be reproduced except in it's entirety without express written approval.

Order-Certificate # 20212324-120437 Page 2

Model: TSI 8533 **Date:** 3/2/2021
Serial # 8533153204

Test Results As Received

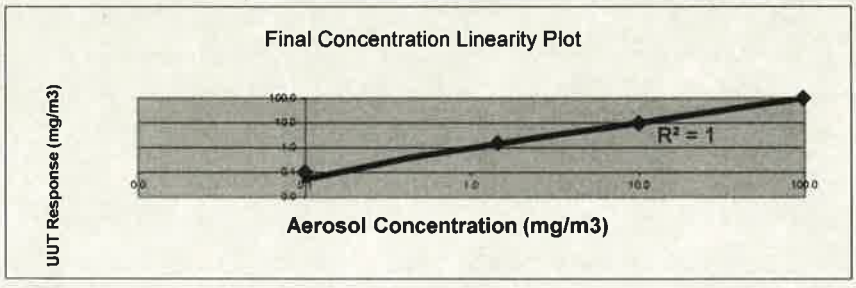
Calibration Standard		Instrument Output		delta	Diff %	Result
98.39	mg/m3	99.3	mg/m3	0.913	0.93%	PASS
10.17	mg/m3	10.56	mg/m3	0.393	3.86%	PASS
1.47	mg/m3	1.52	mg/m3	0.054	3.70%	PASS
0.096	mg/m3	0.101	mg/m3	0.005	5.05%	PASS
3000.0	cc	2993.0	cc	-7.0		

Tolerance Limits
Conc: calibrated to respirable fraction of standard ISO 12103-1, A1 test dust
Sample Volume Rate: +/- 100ccm

Test Results As Returned

Calibration Standard		Instrument Output		delta	Diff %	Result
98.44	mg/m3	98.1	mg/m3	-0.303	-0.31%	PASS
9.98	mg/m3	9.78	mg/m3	-0.205	-2.05%	PASS
1.46	mg/m3	1.48	mg/m3	0.022	1.49%	PASS
0.099	mg/m3	0.097	mg/m3	-0.002	-2.07%	PASS
3000.0	cc	2993.0	cc	-7.0	-0.23%	

Tolerance Limits
Conc: calibrated to respirable fraction of standard ISO 12103-1, A1 test dust
Sample Volume Rate: +/- 5%



Zero Stability

0.000	mg/m3	0.000	mg/m3	0.001	mg/m3	4:00 hrs
AVG		**Min:**		**Max:**		**Time:**

This report is valid only as an attachment to the Calibration Certificate number indicated above.

Certificate of Calibration
ISO 9001 Certified

NISTLab/SAI
Wilner-Greene Engineering Services

Order Number: 20212665
Certificate Number: 121947

Issued To: RAECO RENTS
135 BERNICE DR
BENSENVILLE, IL 60106

Date Received: 4/6/2021
Date Issued: 4/21/2021
Valid Until: Apr 2022

Equipment:
Manufacturer: TSI
Model Number: 8533
SerialNumber: 8533163801
Control #:

Test Conditions :
Temperature: 22.6 C
Humidity: 42.3 %
Barometric Pressure: 981.6 mBar

As Found:
FULLY FUNCTIONAL AND IN TOLERANCE.

As Returned:
FULLY FUNCTIONAL AND WITHIN TOLERANCE.

Special Conditions:
NONE

Work Performed:
REPLACED DAMAGED POWER CONNECTOR. CLEANED AND ALIGNED CONTAMINATED OPTICS AND LASER TRAP. ALIGNED AND CALIBRATED PER CALIBRATION PROCEDURE DM-001.

CALIBRATED TO: MANUFACTURERS SPECIFICATIONS

MeasurementUncertainties: DC VOLTAGE 0.1%, BAROMETRIC +/- 0.15 HPA, RH +/- 1%, TEMP +/- 0.05C, PARTICLE CONCENTRATION +/- 2% AS REFERENCED TO ARIZONA DUST A2 FINE, AIR FLOW RATE +/- 0.3%

Device, Description, Report Number, Date Due
Reference Standards:
1042, PHOTOMETER, REAL TIME 90 DEGREE LIGHT SCATTERING PHOTOMETER, 300268715-171712, 5/13/2021
9102, C-29, MICROBALANCE, 551220084047935, 1/30/2023
9105, ML-800-44, PRIMARY VOLUMETRIC STANDARD, 18556, 7/30/2021

Reviewed by: 4/21/2021

Authorized Signature: Brian Stanhope

111 Smith Hines Road, Suite K
Greenville, SC 29607

www.nistlab.com
800-238-7550

NISTLab/SAI
Wilner-Greene Engineering Services

Order-Certificate # 20212665-121947

Model: 8533 **Date:** 4/21/2021

Serial # 8533163801

Test Results As Received

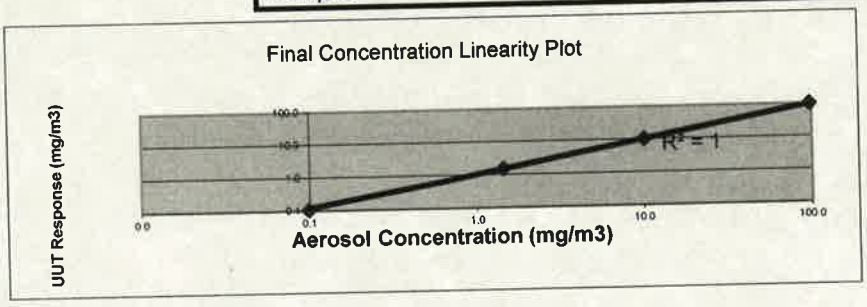
Calibration Standard		Instrument Output		delta	Diff %	Result
98.42	mg/m3	99.1	mg/m3	0.676	0.69%	PASS
10.01	mg/m3	9.81	mg/m3	-0.203	-2.03%	PASS
1.48	mg/m3	1.46	mg/m3	-0.028	-1.88%	PASS
0.102	mg/m3	0.106	mg/m3	0.003	3.37%	PASS
3000.0	cc	2887.0	cc	-113.0		

Tolerance Limits
Conc: calibrated to respirable fraction of standard ISO 12103-1, A1 test dust
Sample Volume Rate: +/- 100ccm

Test Results As Returned

Calibration Standard		Instrument Output		delta	Diff %	Result
97.86	mg/m3	97.6	mg/m3	-0.259	-0.26%	PASS
10.07	mg/m3	10.06	mg/m3	-0.012	-0.12%	PASS
1.45	mg/m3	1.48	mg/m3	0.029	1.96%	PASS
0.099	mg/m3	0.102	mg/m3	0.003	3.22%	PASS
3000.0	cc	3006.0	cc	6.0	0.20%	

Tolerance Limits
Conc: calibrated to respirable fraction of standard ISO 12103-1, A1 test dust
Sample Volume Rate: +/- 5%



Zero Stability

0.000	mg/m3	0.000	mg/m3	0.001	mg/m3	4:00 hrs
AVG		**Min:**		**Max:**		**Time:**

This report is valid only as an attachment to the Calibration Certificate number indicated above.

Calibration Certificate

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
TEL:1-800-874-2811 1-651-490-2811 FAX: 1-651-490-3824 www.tsi.com

CALIBRATION STANDARDS USED
PortaCount Bench 2

MODEL	P-TRAK® Ultrafine Particle Counter 8525
SERIAL NO.	8525-08130011

VERIFICATION DATA (PARTICLE CONCENTRATION)

TESTING NUMBER	MEASURED CONCENTRATION IN *Particles/cm²* *Tolerance: 95% to 105% of standard*		
	TESTING STANDARD	INSTRUMENT OUTPUT	PERCENT OF STANDARD
1	254.6	252.9	99.36
2	556.9	547.2	98.27
3	1262.4	1241.2	98.32
4	3911.7	3875.0	99.06
5	11233.6	11120.0	98.99

* *Indicates out of tolerance condition*

TSI Incorporated does hereby certify that the above described instrument conforms to the original manufacturer's specifications (not applicable to As Found data) and has been tested using some (but not all) standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of NIST's calibration services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. TSI is registered to ISO-9001:2015, Quality Assurance Requirements. This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the calibration organization issuing this report.

Measurement Variable	System ID Number	Date Last Calibrated	Calibration Due Date
DC Voltage	E002456	08-16-19	02-28-21
DC Voltage	E002794	08-16-19	02-28-21
Particle Concentration	E010043	05-21-20	05-31-21
Particle Concentration	E010042	05-21-20	05-31-21
Particle Diameter	E005270	09-22-20	09-30-21

Calibration procedure used: 10000005005 Overall Rating: PASS

Calibrated By

Feb. 1, 2021
Calibration Date

TSI P/N 2300157

Calibration Certificate

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
TEL:1-800-874-2811 1-651-490-2811 FAX: 1-651-490-3824 www.tsi.com

CALIBRATION STANDARDS USED
PortaCount Bench 2

MODEL	P-TRAK® Ultrafine Particle Counter 8525
SERIAL NO.	8525-06190003

VERIFICATION DATA (PARTICLE CONCENTRATION)

TESTING NUMBER	MEASURED CONCENTRATION IN *Particles/cm³* *Tolerance: 95% to 105% of standard*		
	TESTING STANDARD	INSTRUMENT OUTPUT	PERCENT OF STANDARD
1	219.9	216.8	98.57
2	477.8	466.8	97.70
3	1087.4	1067.7	98.19
4	3389.9	3337.8	98.46
5	9694.2	9561.2	98.63

* *Indicates out of tolerance condition*

TSI Incorporated does hereby certify that the above described instrument conforms to the original manufacturer's specifications (not applicable to As Found data) and has been tested using some (but not all) standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of NIST's calibration services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. TSI is registered to ISO-9001:2015, Quality Assurance Requirements. This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the calibration organization issuing this report.

Measurement Variable	System ID Number	Date Last Calibrated	Calibration Due Date
DC Voltage	E002456	08-16-19	02-28-21
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Particle Concentration	E010043	05-21-20	05-31-21
Particle Concentration	E010042	05-21-20	05-31-21
Particle Diameter	E005270	09-22-20	09-30-21

Calibration procedure used: 18000005005 Overall Rating: PASS

Calibrated By

Nov. 30, 2020
Calibration Date

TSI P/N 2300157

APPENDIX D
INSTRUMENT SPECIFICATIONS

P-TRAK® ULTRAFINE PARTICLE COUNTER MODEL 8525

The TSI's P-Trak® Ultrafine Particle Counter (UPC) 8525 is an ideal instrument for measuring workplace ultrafine particulate levels, as well as helping eliminate indoor air quality (IAQ) problems. This portable instrument detects and counts ultrafine particles (smaller than one micrometer) that often accompany or signal the presence of a pollutant that is the root cause of complaints.

Ultrafine particles are defined as having a diameter less than 0.1 µm (or 100 nm). Engineered nanoparticles (nanomaterials) are a subset of ultrafine particles with dimensions from 1 to 100 nm. Nanomaterials are produced and used for industrial and high-tech applications, while ultrafine particles are the byproducts of combustion and other chemical reactions. Unfortunately, the occupational health risks associated with manufacturing and using nanomaterials are not clearly understood. As a result, a need has arisen to assess workplace conditions. Using TSI's proven technology, the P-Trak gives direct, real-time measurement of workplace ultrafine particulate levels.

The P-Trak UPC also locates obvious pollutant sources such as boilers, furnaces, and vehicles, and it also detects the not-so-obvious sources such as photocopy machines and printers. Use this instrument to detect the migration of toxic exhaust gases, malfunctioning office equipment, pinhole gasket leaks in boilers and a wide variety of other problems.

Applications

+ Check office equipment
+ Clean room containment checks
+ Filter checks
+ Check fume hoods
+ Check safety cabinets
+ Vehicle emission migration
+ Combustion leaks
+ Control smoking areas

Features and Benefits

+ Real-time ultrafine particle counter
+ Solves tough IAQ problems
+ Easy to use
+ Data log information

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SPECIFICATIONS

P-TRAK ULTRAFINE PARTICLE COUNTER
MODELS 8525

Concentration Range
0 to 5 x 10^5 particles/cm^3

Particle Size Range
0.02 to 1 micrometer

Temperature Range

Operation	32 to 100°F (0 to 38°C)
Storage	-40 to 160°F (-40 to 70°C)

Flow Rate

Sample	100 cm^3/min
Total	700 cm^3/min (nominal)

Power Requirement

Battery type	6 AA alkaline
Battery life	6 hrs at 70°F (21°C)

Alcohol Requirement

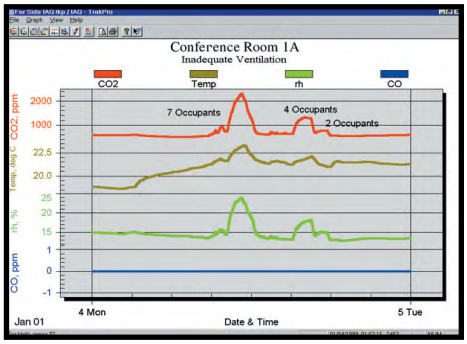
Type	100% reagent grade isopropyl
Hours per charge	8 hours at 70°F (21°C)

RS232 Output
Baud rate 9600

Memory

Single points	470
Data logging	1,000 hours at one-minute intervals. A maximum of 141 separate tests.[1]

Size (H x W x D)
10.75 in. x 5.5 in. x 5.5 in. (27 cm x 14 cm x 14 cm)



Easy-to-use TrakPro™ Data Analysis Software stores, organizes and reports test results.

Weight

Instrument with batteries	3.8 lbs (1.7 kg)
Factory Recalibration Interval	One year

Warranty
Two years on parts and labor[2]

Computer Requirements
PC with Microsoft Windows® 2000 or XP; Windows-compatible printer; 5 MB hard disk space; and available RS232 serial port (for downloading)

P-Trak Ultrafine Particle Counter and accessories includes: Telescoping Sample Probe, Shoulder Strap, Inlet Screen, Spare Wicks (2), Alkaline Batteries, Alcohol Fill Capsule with Storage Cap, Reagent Grade Isopropyl Alcohol, Zero Filters (2), Carrying Case, TrakPro™ Software, Computer Cable, Operation and Service Manual, Calibration Certificate, and Two-year Warranty.

1 The P-Trak will operate with an AC adapter for long periods but the alcohol wick must be resaturated every 8 hours when operating over an extended time.

2 Warranty repairs returned via overnight carrier at TSI expense.

Specifications are subject to change without notice.

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TSI Incorporated - Visit our website **www.tsi.com** for more information.

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UK	**Tel:** +44 149 4 459200	**China**	**Tel:** +86 10 8251 6588
France	**Tel:** +33 4 91 11 87 64	**Singapore**	**Tel:** +65 6595 6388
Germany	**Tel:** +49 241 523030		

P/N 2980197 Rev D Printed in U.S.A.

AEROTRAK® HANDHELD PARTICLE COUNTER MODEL 9306

The TSI AeroTrak® 9306 Handheld Particle Counter offers the most features and flexibility for customers interested in versatile handheld particle contamination monitoring. The Model 9306 features an ergonomic handle with thumb controls, for easy one-hand operation. The 3.5-inch (8.9-cm) color touch screen interface makes it easy to configure and operate. The Model 9306 can generate Pass/Fail reports for ISO 14644-1, EU GMP Annex 1, and FS209E. Particle count data can be conveniently viewed on screen, downloaded using TrakPro™ Lite Secure Software, or printed directly to an optional external printer.

Multiple AeroTrak 9306 particle counter configurations can be conveniently stored and uploaded as needed using the TrakPro Lite Secure data download and reporting software supplied as standard.

The Model 9306 complies with all the stringent requirements set forth in ISO 21501-4. These particle counters are calibrated with NIST traceable PSL spheres using TSI's world-class Classifier and Condensation Particle Counters, the recognized standard for particle measurements. Backed with a standard two-year warranty and TSI's long-standing reputation for high quality, there are no other handheld particle counters like it on the market today.

Features and Benefits

+ Complies with all requirements of ISO 21501-4
+ 0.3 to 25 µm size range
+ 0.1 CFM (2.83 L/min) flow rate
+ Measures up to six channels of simultaneous data
+ Model 9306-V2 provides unique variable binning option
+ Mass Concentration option (density parameter is user-configurable)
+ Integrated handle for one hand operation
+ Removable, rechargeable Li-ion battery
+ Long life laser diode
+ Compatible with TrakPro™ Lite Secure and FMS 5 software packages
+ USB Cable, USB Storage Device and Ethernet data transfer
+ Data storage: 250 zones, 999 locations, and 10,000 samples
+ Provides Pass/Fail reporting on ISO 14644-1, EU GMP, and FS209E
+ External reporting of ISO 14644-1, EU GMP, and FS209E via TrakPro™ Lite Secure
+ Optional Temperature/RH sensor available

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SPECIFICATIONS

AEROTRAK HANDHELD PARTICLE COUNTER MODEL 9306

9306	
Size Range	0.3 to 25 µm
Particle Channel Sizes	9306-03: 0.3, 0.5, 0.7, 1.0, 2.0, 5.0 µm 9306-04: 0.3, 0.5, 1.0, 3.0, 5.0, 10.0 µm 9306-V2: 0.3 to 10 µm, user-selectable; factory-calibrated at 0.3, 0.5, 1.0, 3.0, 5.0, 10.0 µm
Size Resolution	<15% @ 0.5 µm (per ISO 21501-4 requirements)
Counting Efficiency	50% at 0.3 µm; 100% for particles >0.45 µm (per ISO 21501-4 and JIS)
Concentration Limit	5,950,000 particles/ft^3 (210,000,000/m^3) @ 10% coincidence loss
Light Source	Long life laser diode
Zero Count	<1 count per 5 minutes (per ISO 21501-4 and JIS B9921)
Flow Rate	0.1 CFM (2.83 L/min) with ±5% accuracy (meets ISO 21501-4 and JIS requirements)
Flow Rate Control	Electronic, automatic closed loop (patented* flow control technology)
Calibration	NIST Traceable with TSI calibration system
Calibration Frequency	Recommended minimum once per year
Sampling Modes	Manual, automatic, beep; cumulative/differential; count or concentration
Sampling Time	1 second to 99 hours
Sampling Frequency	1 to 9999 cycles or continuous
Exhaust	Internally HEPA filtered
Communication Mode	Modbus® TCP over Ethernet or USB
Alarm Status	Audible alarm on counts
Status Indicators	Low battery, flow, laser
Environmental Sensors	Optional Temp/RH probe
Display	QVGA 3.5-inch (8.9-cm) touch screen
Reports	Provides Pass/Fail on ISO 14644-1, EU GMP, and FS209E reports
Unit ID	Configurable IP address

Security	2-level password protection to lock out usage and configuration
Data Storage	250 Zones
	999 Locations
	10,000 sample records including: date, time, six total particle size channels, flow status, and instrument status
Data Transfer	Via USB storage device, connection to TrakPro™ Lite Secure software through Ethernet or USB cable, or optional TSI FMS software
Languages	English, Japanese, German, French, Spanish, and Chinese (simplified), Italian
Software	Compatible with TrakPro™ Lite, TrakPro™ Lite Secure and FMS 5 Software
External Surface	High Impact injection molded plastic
Dimension (H x W x D)	9.4 in. x 4.6 in. x 4.9 in. (23.9 cm x 11.7 cm x 12.4 cm) (without isokinetic inlet, includes handle)
Weight	2.2 lb (1.0 kg) with battery
Power	110 to 240 VAC, 50 to 60 Hz universal in-line power supply
Battery	Removeable/rechargeable Li-Ion
Battery Life	>6 hours of continuous use
Recharge Time	<2 hours
Standards	ISO 21501-4, CE, JIS B9921
Warranty	Two years, extended warranties available
Operating Range	41˚to 95˚F (5˚ to 35˚C), 20% to 95% noncondensing
Storage Range	32˚ to 122˚F (0˚ to 50˚C), up to 98% RH noncondensing
Included Accessories	Operating manual on CD, power supply, battery, isokinetic inlet, purge filter, stylus, USB cable and TrakPro™ Lite Secure
Optional Accessories	Spare Battery, external battery charger, isokinetic probe, sample tubing, Temp/RH probe, printer, printer paper and carrying case

*Patent Number 6,167,107

Specifications are subject to change without notice.

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TSI Incorporated - Visit our website **www.tsi.com** for more information.

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Germany **Tel:** +49 241 523030
India **Tel:** +91 80 67877200
China **Tel:** +86 10 8219 7688
Singapore **Tel:** +65 6595 6388

P/N 5001210 Rev L Printed in U.S.A.

DUSTTRAK™ DRX AEROSOL MONITORS MODELS 8533, 8533EP AND 8534

REAL-TIME DUST AND AEROSOL MONITORING FOR ANY ENVIRONMENT, ANY APPLICATION

Only DustTrak™ DRX Aerosol Monitors can simultaneously measure both mass and size fraction–no other monitor can do both. DustTrak DRX monitors are battery-operated, data-logging, light-scattering laser photometers that give you real-time aerosol mass readings. They use a sheath air system that isolates the aerosol in the optics chamber to keep the optics clean for improved reliability and low maintenance. From desktop with external pump models to a handheld model, the DustTrak DRX offers a suitable solution for harsh industrial workplaces, construction and environmental sites and other outdoor applications, as well as clean office settings. DustTrak DRX monitors measure aerosol contaminants such as dust, smoke, fumes and mists.

Features and Benefits

All Models

+ Real-time mass concentration and size fraction readings, as well as data-logging allow for data analysis during and after sampling.
+ Simultaneously measure size-segregated mass fraction concentrations corresponding to PM1, PM2.5, Respirable, PM10, and Total PM size fractions
+ Easy-to-use graphical user interface with color touch-screen for effortless operation

Handheld Model (8534)

+ Long life internal pump for continuous sampling
+ Single-point data collection for walk through surveys
+ Lightweight design with ergonomic handle for portable applications

Desktop Models (8533 and 8533EP)

+ Energy-efficient, long lasting external pump for continuous, unattended, 24/7, outdoor monitoring applications (Model 8533EP only)
+ Long life internal pump for shorter work-shift or IAQ sampling applications (Model 8533)
+ Gravimetric reference sampling capability for custom reference calibrations
+ Automatic zeroing (with optional zero module) to minimize the effect of zero drift
+ STEL alarm setpoint for tracking 15-minute average mass concentrations
+ Standard and advanced calibration capabilities for consistent accuracy
+ Environmental protected and tamper-proof secure (with an optional environmental enclosure)
+ Inlet sample conditioning (with optional heated inlet sample conditioner) to reduce the effect of humidity on photometric mass measurements (for use with an environmental enclosure)
+ Cloud Data Management System hosted by Netronix™

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Unsurpassed Technology and Performance

DustTrak DRX monitors are laser photometers that simultaneously measure five size segregated mass fraction concentrations at once–something no other monitor can do. The desktop, desktop with external pump and handheld monitors are continuous, real-time, 90°, light-scattering laser photometers that simultaneously measure size-segregated mass fraction concentrations corresponding to PM1, PM2.5, Respirable, PM10, and Total PM fractions. They combine both particle cloud (total area of scattered light) and single particle detection to achieve mass fraction measurements.

This size-segregated mass fraction measurement technique is superior to either a basic photometer or optical particle counter (OPC). It delivers the mass concentration of a photometer and the size resolution of an OPC. Typically, photometers can be used at high mass concentration, but they do not give any size information (unless used with size selective inlet conditioners) and significantly underestimate large particle mass concentrations. OPC's provide size and count information; however, they do not provide any mass concentration information and cannot be used in high mass concentration environments. The DustTrak DRX can do both.

Handheld Models: Perfect for Walk-Through Surveys and Single-Point Data Collection Applications

The DustTrak DRX handheld Model 8534 is lightweight and portable. It is perfect for industrial hygiene surveys, point source location monitoring, indoor air quality investigations, engineering control evaluations/validation, and for baseline trending and screening. Like the desktop models, it has manual and programmable data logging functions. In addition, the handheld model also has a single-point data logging capability for walk-through industrial hygiene surveys and indoor air quality investigations.

Desktop Models: Ideal for Long-Term Surveys and Remote Monitoring Applications

The DustTrak DRX is also offered as a standard desktop (Model 8533), as well as a desktop with external pump (Model 8533EP.) Both models have manual and programmable data logging functions, making them ideal for unattended applications. The standard desktop model is most suitable for indoor, continuous monitoring, while the desktop with external pump is designed for 24/7 unattended, remote monitoring outdoors.

The DustTrak DRX desktop models come with USB (device and host), Ethernet, and analog and alarm outputs allowing remote access to data. User adjustable alarm setpoints for instantaneous or 15-minute short-term excursion limit (STEL) are also available on desktop models. The alarm output with user-defined setpoint alerts you when upset or changing conditions occur.

The DustTrak DRX Desktop Monitors have several unique features:

+ External pump (Model 8533EP) with low power consumption for continuous, unattended monitoring in remote outdoor locations.
+ Gravimetric sampling capability using a 37-mm filter cassette which can be inserted in-line with the aerosol stream allowing you to perform an integral gravimetric analysis for custom reference calibrations.
+ Zeros automatically using the external zeroing module. This optional accessory is used when sampling over extended periods of time. By zeroing the monitor during sampling, the effect of zero drift is minimized.
+ STEL alarm feature for tracking 15-minute average mass concentrations when alarm setpoint has been reached for applications like monitoring fugitive emissions at hazardous waste sites.
+ Provide for environmental protection and tamper-proof security using an environmental enclosure. This optional accessory encloses the instrument within a waterproof, lockable, custom-designed case.
+ Condition the sample air stream before entering the instrument optics using a heated inlet sample conditioner (designed for use with the environmental enclosure.) This optional accessory is used in humid environments. By conditioning the sample, the humidity and water vapor are minimized.
+ Standard and advanced calibration capabilities. The DustTrak DRX Aerosol Monitor has two calibration factors: a photometric calibration factor (PCF) and a size calibration factor (SCF). The PCF accounts for the photometric response difference between A1 Test Dust and the aerosol under measurement, while the SCF accounts for the aerodynamic size difference.
  - The primary goal of the standard calibration is to obtain the SCF for the aerosol of interest. The standard calibration process is very easy and does not require comparison to gravimetric samples. Measure with and without a PM2.5 impactor, and the instrument takes the ratio of these two size distributions and compares this reading to the PM2.5 impactor transmission efficiency curve to calculate the SCF. However, the absolute mass concentration may not be as accurate as the advanced calibration.
  - The advanced calibration method yields high size segregated mass concentration accuracy. It involves two separate gravimetric measurements to obtain PCF and SCF in sequence. The advanced calibration will accurately measure size segregated mass concentrations.

Applications	Desktop	Handheld
Aerosol research studies	+	+
Baseline trending and screening	+	+
Engineering control evaluations		+
Engineering studies		+
Epidemiology studies	+	+
Indoor air quality investigations	+	+
Industrial/occupational hygiene surveys	+	+
Point source monitoring		+
Outdoor environmental monitoring	+	
Process monitoring	+	+
Remote monitoring	+	

DustTrak DRX Aerosol Monitor Features

All Models

+ Li-Ion rechargeable batteries
+ Internal and external battery charging capabilities
+ Outlet port for isokinetic sampling applications
+ User serviceable sheath flow and pump filters
+ Logged test pause and restart feature
+ Logged test programming
  - Color touch screen–either manual mode or program mode
  - TRAKPRO™ Data Analysis Software via a PC
+ User adjustable custom calibration settings
+ Instantaneous alarm settings with visual and audible warnings
+ Real-time graph display
+ View statistical information during and after sampling
+ On-screen instrument status indicators: FLOW, LASER and FILTER
+ Filter service indicator for user preventative maintenance

Desktop Models (8533 and 8533EP)

+ Long life external pump (8533EP)
+ Internal pump (8533)
+ Hot swappable batteries
+ Gravimetric reference sample capability
+ STEL alarm setpoint

Optional Accessories

+ Auto zeroing module
+Protective environmental enclosure (8535 and 8537)
+ Heated inlet sample conditioner (for use with an environmental enclosure)
+ Cloud Data Management System as hosted by Netronix™

Handheld Model (8534)

+ Long life internal pump
+ Single-point data collection for walk through surveys

Easy to Program and Operate

The graphical user interface with color touch-screen puts everything at your fingertips. The easy-to-read display shows real-time mass concentration and graphical data, as well as other statistical information along with instrument pump, laser and flow status, and much more. Perform quick walk-through surveys or program the instrument's advanced logging modes for long-term sampling investigations. Program start times, total sampling times, logging intervals, alarm setpoints and many other parameters. You can even set up the instrument for continuous unattended operation.

TRAKPRO™ Software Makes Monitoring Easier than Ever

TrakPro™ Data Analysis Software allows you to set up and program directly from a PC. It even features the ability for remote programming and data acquisition from your PC via wireless communication options or over an Ethernet network. As always, you can print graphs, raw data tables, and statistical and comprehensive reports for recordkeeping purposes.

Battery Performance		
Models 8533 and 8533EP (Typical) 6600 mAH Li-Ion Battery Pack (P/N 801680)	1 Battery	2 Batteries
Battery runtime (hours)	Up to 6	Up to 12
Charge time* (hours) in DustTrak	4	8
Charge time* (hours) in external battery charger (P/N 801685)	4	8

Model 8534 (Typical) 3600 mAH Li-Ion Battery Pack (P/N 801681)	Battery
Battery runtime (hours)	Up to 6
Charge time* (hours) in DustTrak	4
Charge time* (hours) in external battery charger (P/N 801686)	4

* Of a fully depleted battery

SPECIFICATIONS

DUSTTRAK™ DRX AEROSOL MONITORS MODELS 8533, 8533EP AND 8534

Sensor Type
90° light scattering

Particle Size Range
0.1 to 15 µm

Aerosol Concentration Range

8533 Desktop	0.001 to 150 mg/m^3
8533EP Desktop with External Pump	0.001 to 150 mg/m^3
8534 Handheld	0.001 to 150 mg/m^3

Display
Size Segregated Mass Fractions for PM1, PM2.5, Respirable, PM10 and Total. All displayed

Resolution
±0.1% of reading or 0.001 mg/m^3, whichever is greater

Zero Stability
±0.002 mg/m^3 per 24 hours at 10 sec time constant

Flow Rate
3.0 L/min

Flow Accuracy
±5% of factory set point, internal flow controlled

Temperature Coefficient
+0.001 mg/m^3 per °C

Operational Temp
32 to 120°F (0 to 50°C)

Storage Temp
-4 to 140°F (-20 to 60°C)

Operational Humidity
0 to 95% RH, non-condensing

Time Constant
User adjustable, 1 to 60 seconds

Data Logging
5 MB of on-board memory (>60,000 data points)
45 days at 1 minute logging interval

Log Interval
User adjustable, 1 second to 1 hour

Physical Size (H x W x D)

Handheld	4.9 x 4.8 x 12.5 in. (12.5 x 12.1 x 31.6 cm)
Desktop	5.3 x 8.5 x 8.8 in. (13.5 x 21.6 x 22.4 cm)
External Pump	4.0 x 7.0 x 3.5 in. (10.0 x 18.0 x 9.0 cm)

Weight

Handheld	2.9 lb (1.3 kg), 3.3 lb (1.5 kg) with battery
Desktop	3.5 lb (1.6 kg), 4.5 lb (2.0 kg) - 1 battery, 5.5 lb (2.5 kg) - 2 batteries
External Pump	3.0 lb (1.4 kg)

Communications

8533	USB (host and device) and Ethernet. Stored data accessible using flash memory drive
8533EP	USB (host and device) and Ethernet. Stored data accessible using flash memory drive plus, cable assembly for external pump
8534	USB (host and device). Stored data accessible using flash memory drive

Power-AC
Switching AC power adapter with universal line cord included, 115-240 VAC

Analog Out

8533/8533EP	User selectable output, 0 to 5 V or 4 to 20 mA. User selectable scaling range

Alarm Out

8533/8533EP	Relay or audible buzzer Relay Non-latching MOSFET switch + User selectable set point + -5% deadband + Connector 4-pin, Mini-DIN connectors
8534	Audible buzzer

Screen

8533/8533EP	5.7 in. VGA color touchscreen
8534	3.5 in. VGA color touchscreen

Gravimetric Sampling

8533/8533EP	Removable 37 mm cartridge (user supplied)

CE Rating

Immunity	EN61236-1:2006
Emissions	EN61236-1:2006

Specifications are subject to change without notice.

UNDERSTANDING, ACCELERATED

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