

Triton ULTRA Vape Detection Accuracy Validation Report

Evidence summary for the reported 98.9% accuracy claim

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Validation corpus	8,400 logged test events
Test coverage	2,900 genuine vape events + 5,500 non-vape events; 30 distinct sources
Observed aggregate accuracy	98.988% (8,315 / 8,400)
Published accuracy figure	98.9%, reported conservatively by rounding down to one decimal place
Firmware Version	Triton ULTRA May 25th 2026 Update

Executive Summary

This report summarizes the validation evidence underlying Triton ULTRA's published accuracy figure. The testing program evaluated genuine vape events and a range of non-vape sources that can produce aerosol, vapor, or fume signatures that may be relevant to sensor classification.

The study log contains 8,400 individual test events: 2,900 genuine vape events and 5,500 non-vape events. Across the complete logged dataset, Triton ULTRA produced 2,861 true positives, 5,454 true negatives, 46 false positives, and 39 false negatives. This resulted in 8,315 correct classifications and an observed aggregate accuracy of 98.988%.

Among genuine vape events, the observed sensitivity was 98.655%. Against the non-vape sources included in the study, the observed specificity was 99.164%. Testing included 23 non-vape sources and 7 vape-event sources representing different products and test conditions.



One of the testing setups in a commercial setting, tape was put on the floor to make it easy to record distance from the sensor.

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1. How the 98.9% Reported Accuracy Figure Was Calculated

Outcome	Events	Meaning
True positive	2,861	Genuine vape event correctly detected
True negative	5,454	Non-vape event correctly rejected
False positive	46	Non-vape event incorrectly classified as vape
False negative	39	Genuine vape event not classified as vape
Total	8,400	All logged events

Accuracy = (True Positives + True Negatives) / Total Events

Accuracy = (2,861 + 5,454) / 8,400 = 98.988% observed.

Published accuracy = 98.9%, reported conservatively by rounding the observed figure down to one decimal place.

The 98.9% published figure is an aggregate classification accuracy for the test corpus. It incorporates both sides of the classification problem: detecting genuine vape events and correctly rejecting the non-vape aerosols, vapors, fumes, and other sources included in the test set.

2. Study Design and Test Coverage

The testing program was designed as a repeated-event validation exercise using a range of products, conditions, and locations. The supplied study log contains 8,400 individual testing events, each identified by a unique Testing ID and associated with a defined source, expected result, sensor output, test distance, and amount used. This event-level structure allows the aggregate accuracy figure to be traced back to individual observations.

The broader testing program was conducted over several months and incorporated different products and test locations.

3. Test Dataset

Dataset component	Events	Share
Genuine vape events	2,900	34.52%
Non-vape events	5,500	65.48%
Total	8,400	100.00%

The full testing log is available in Appendix B at the bottom of this report. The test log includes 30 distinct source IDs (P01-P30): 23 non-vape sources and 7 vape-event sources. The non-vape set includes aerosol body sprays, antiperspirants, hairsprays, dry shampoo, disinfectant sprays, fabric/air refreshers, surface cleaners, thermal styling (curling irons, etc.), water vapor, and soldering fumes. The vape set includes disposable and refillable nicotine devices, high-VG and high-PG e-liquids, zero-nicotine e-liquid, a Delta-8 cartridge device, and filtered/exhalation-into-clothing conditions.

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Some of the products used to test for false vaping detection alerts include spray deodorants and hair spray.

4. Test Methodology

4.1 Event-Level Testing

Each trial was recorded as an individual event. The log identifies the source and source category, the expected binary result, the sensor output, the resulting binary assessment, the distance from the sensor, and the amount of material used. This structure makes each result independently countable and permits the aggregate result to be traced to the underlying records.

4.2 Detection Window and Ventilation Between Trials

Each trial used a two-minute observation window beginning with the first puff, spray, or other introduction of the test source. For genuine vape trials, a vape detection registered within this window was counted as a true positive; a trial without a vape detection within the window was counted as a false negative. For non-vape trials, a vape detection within the same window was counted as a false positive, while no vape detection was counted as a true negative.

Between trials, the room was ventilated to allow residual aerosols, vapors, or fumes to dissipate and environmental conditions to return to a sufficiently clean-air baseline (PM_{2.5} below 10 µg/m³ and TVOC below 400 ppb) before the next test began. This procedure was intended to minimize carryover between trials.

The two-minute window defined the criterion for classification scoring. It should not be interpreted as the typical detection time or as a measurement of notification delivery speed.

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4.3 Range of Test Conditions

Across all 8,400 events, testing distances ranged from 0 to 6 feet, with a median distance of 3 feet. The amount-used field ranged from 1 to 60 units, depending on the source and its measurement unit. The log contains 4,200 spray-based events (mostly for aerosols), 2,900 puff-based vape events, 800 events measured in seconds (for exposure to humidity, fumes, etc), and 500 events measured in squirts (mostly for spray propelled cleaning products).

The test conditions varied by product, quantity, measurement type, and distance. This was intended to evaluate the detector across multiple aerosol and vapor signatures and across a range of source-to-sensor distances rather than under a single test condition.



During testing, multiple sensors were sometimes used to confirm consistency between sensors and to understand the impact of room placement on accuracy and response.

5. Results

5.1 Overall Classification Performance

Metric	Result	Calculation	Interpretation
Overall accuracy	98.988%	8,315 / 8,400	98.9% reported conservatively
Vape-event sensitivity	98.655%	2,861 / 2,900	Share of genuine vape events detected
Non-vape specificity	99.164%	5,454 / 5,500	Share of non-vape events correctly rejected

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Metric	Result	Calculation	Interpretation
False-positive rate	0.836%	46 / 5,500	Non-vape events incorrectly alerted
False-negative rate	1.345%	39 / 2,900	Genuine vape events missed

5.2 Results by Source Category

Type	Source category	Events	Correct	Errors	Accuracy
Non-vape	Aerosol antiperspirant	2,000	1,980	20	99.00%
Non-vape	Aerosol body spray	1,600	1,591	9	99.44%
Non-vape	Combustion / fume	300	291	9	97.00%
Non-vape	Disinfectant spray	100	100	0	100.00%
Non-vape	Dry shampoo	100	96	4	96.00%
Non-vape	Fabric / air refresher	200	200	0	100.00%
Non-vape	Hairspray	300	298	2	99.33%
Non-vape	Surface cleaner	400	400	0	100.00%
Non-vape	Thermal styling	400	398	2	99.50%
Non-vape	Water vapor	100	100	0	100.00%
Vape	Filtered vape	400	393	7	98.25%
Vape	Nicotine vape	1,800	1,780	20	98.89%
Vape	Nicotine-free vape	200	197	3	98.50%
Vape	THC vape	500	491	9	98.20%

5.3 Results by Individual Product / Source

ID	Type	Category	Product / source	Events	Errors	Accuracy
P01	Non-vape	Aerosol body spray	Dove pomegranate spray	400	2	99.50%
P02	Non-vape	Aerosol body spray	AXE Collision body spray	400	0	100.00%
P03	Non-vape	Aerosol body spray	Dove Men+Care whole-body spray	400	4	99.00%
P04	Non-vape	Aerosol body spray	Dove coconut/vanilla whole-body spray	400	3	99.25%
P05	Non-vape	Aerosol antiperspirant	Degree Ultraclear Fresh	400	4	99.00%
P06	Non-vape	Aerosol antiperspirant	Degree rose/waterlily deodorant	400	7	98.25%
P07	Non-vape	Aerosol antiperspirant	Dove Cool Essentials	400	6	98.50%
P08	Non-vape	Aerosol antiperspirant	Dove Rose Petals	400	3	99.25%
P09	Non-vape	Aerosol antiperspirant	Native sea salt/cedar deodorant	400	0	100.00%
P10	Non-vape	Hairspray	TRESemme Silk Smooth hairspray	100	2	98.00%
P11	Non-vape	Hairspray	Pantene strong-hold hairspray	100	0	100.00%
P12	Non-vape	Hairspray	Kendra Volume hairspray	100	0	100.00%
P13	Non-vape	Dry shampoo	Batiste dry shampoo	100	4	96.00%

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ID	Type	Category	Product / source	Events	Errors	Accuracy
P14	Non-vape	Disinfectant spray	Lysol Disinfectant Spray	100	0	100.00%
P15	Non-vape	Fabric / air refresher	Febreze Fabric Refresher	100	0	100.00%
P16	Non-vape	Fabric / air refresher	Febreze Air Effects	100	0	100.00%
P17	Non-vape	Surface cleaner	Multi-surface cleaner, trigger spray	100	0	100.00%
P18	Non-vape	Surface cleaner	Glass / whiteboard cleaner	100	0	100.00%
P19	Non-vape	Surface cleaner	Bleach-based cleaner	200	0	100.00%
P20	Non-vape	Thermal styling	Curling iron, dry hair (using a wig)	200	2	99.00%
P21	Non-vape	Thermal styling	Hair dryer	200	0	100.00%
P22	Non-vape	Water vapor	Shower steam (using clothing steamer)	100	0	100.00%
P23	Non-vape	Combustion / fume	Soldering fume (used to simulate welding from shop class)	300	9	97.00%
P24	Vape	Nicotine vape	Disposable device	800	9	98.88%
P25	Vape	Nicotine vape	Refillable pod device	200	4	98.00%
P26	Vape	Nicotine vape	High-VG e-liquid	400	1	99.75%
P27	Vape	Nicotine vape	High-PG e-liquid	400	6	98.50%
P28	Vape	Nicotine-free vape	Zero-nicotine e-liquid	200	3	98.50%
P29	Vape	THC vape	Delta-8 cartridge device	500	9	98.20%
P30	Vape	Filtered vape	Vape exhaled into clothing	400	7	98.25%

5.4 Results by Test Distance

Source type	Distance	Events	Correct	Errors	Accuracy
Non-vape	0–1 ft	1,271	1,262	9	99.29%
Non-vape	1–2 ft	869	861	8	99.08%
Non-vape	2–3 ft	874	864	10	98.86%
Non-vape	3–4 ft	850	840	10	98.82%
Non-vape	4–5 ft	809	805	4	99.51%
Non-vape	5–6 ft	827	822	5	99.40%
Vape	0–1 ft	662	654	8	98.79%
Vape	1–2 ft	443	431	12	97.29%
Vape	2–3 ft	461	456	5	98.92%
Vape	3–4 ft	462	455	7	98.48%
Vape	4–5 ft	433	429	4	99.08%
Vape	5–6 ft	439	436	3	99.32%

5.5 Results by Measurement Type

Source type	Measurement	Events	Correct	Errors	Accuracy
Non-vape	seconds	800	789	11	98.62%
Non-vape	sprays	4,200	4,165	35	99.17%
Non-vape	squirts	500	500	0	100.00%

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Source type	Measurement	Events	Correct	Errors	Accuracy
Vape	puffs	2,900	2,861	39	98.66%

6. Error Analysis

The complete dataset contains 46 false positives and 39 false negatives, for 85 total classification errors.

False positives occurred only among non-vape sources. The largest contributors were aerosol antiperspirants (20), combustion/soldering fume (9), aerosol body sprays (9), dry shampoo (4), thermal styling (2), and hairspray (2). The remaining non-vape categories in the supplied log recorded no false positives.

False negatives occurred only among genuine vape events. They totaled 39, 20 from nicotine-vape events, 9 from the THC/Delta-8 category, 7 under the filtered/exhalation-into-clothing condition, and 3 among nicotine-free vape events.

7. What Does the 98.9% Accuracy Figure Mean?

The 98.9% figure is the published, conservative representation of the 98.988% observed aggregate accuracy for the specific test corpus represented in the study log. It should not be interpreted as a universal performance rate for every vape product, building, or environmental condition. Performance can vary with source characteristics, distance, airflow, room geometry, installation, and other conditions.

Based on the supplied data, the direct evidence statement is: across 8,400 logged events covering 30 distinct products/sources and several testing locations, Triton ULTRA correctly classified 8,315 events, corresponding to 98.988% observed aggregate accuracy. Triton reports this conservatively as 98.9%.

8. Related Field Interpretation: Response Time, Aerosol Travel, and Coverage

The classification results in Sections 5 and 6 describe whether an event was correctly identified. This separate section addresses related operational questions, including alert timing, aerosol travel, coverage, and field interpretation. The material below is not part of the 8,400-event accuracy calculation; it draws on Triton's internal timing tests and aggregated customer feedback.

8.1 What Determines Alert Timing

The interval between a vape event and an alert has two distinct components. The first is physical, i.e. aerosol must travel from the point of exhalation to the sensor intake. The second is computational, i.e. the algorithm must process the signature once sufficient aerosol is present at the device. Only the second component is governed by the device.

Physical travel time can vary with the volume of aerosol produced, the distance between the user and the sensor, whether exhalation is directed toward or away from the device, and the room's airflow and HVAC behavior. A larger plume exhaled toward a nearby sensor may reach the intake quickly. A small puff exhaled downward, into clothing, or at the far edge of a room may take longer to reach the intake and, in some cases, may not reach a detectable concentration. The false negatives documented in Section 6 include events under these attenuated conditions.

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Once sufficient aerosol reaches the device, the detection algorithm evaluates the signature and generates an alert. Observed response time therefore includes both aerosol travel time and device processing time.

8.2 Confidence in a Positive Alert

The observed false-positive rate was 0.836%: 46 of the 5,500 non-vape trials produced a vape detection. This measures the proportion of non-vape trials incorrectly classified as vaping; it is not the proportion of all positive alerts that were false.

Within this test corpus, 2,861 of 2,907 positive classifications were true positives, giving an observed positive predictive value (precision) of 98.418%. The remaining 46 positive classifications, or 1.582%, were false positives. These proportions reflect the test corpus, in which 34.52% of events were genuine vape events, and should not be assumed to apply unchanged to deployed schools. The proportion of alerts that are correct depends on the frequency of genuine vaping and the mix of background sources and operating conditions.

Customer feedback describing confirmed vaping alerts provides supporting context but is not part of the 8,400-event calculation and does not establish a measured field precision.

8.3 Interpreting an Alert When No One Is Present on Arrival

Staff responding to an alert may arrive to find the restroom or space empty. This can occur because aerosol travel time and the subsequent response interval can extend beyond the time the person remains in the location. When a vape event occurs at a distance from the sensor, aerosol must reach the intake before the device can begin its evaluation; additional time then elapses while staff are notified and travel to the location. A person may therefore have left before staff arrive. Triton ULTRA can integrate with camera and video management systems to provide footage associated with an event, depending on the deployment.

An empty room on arrival should not, by itself, be read as a false positive. Where staff want to close that gap, the practical levers are response protocol (who is nearest and how quickly they are dispatched) and sensor placement relative to the likely emission point, both of which shorten the total elapsed interval.

8.4 Coverage Area and Multiple-Puff Behavior

Triton's recommended coverage area for a single ULTRA is approximately 160 square feet with ceiling heights up to 8.5 ft. Within that envelope, internal testing found that multiple-puff vape events produced sufficient aerosol at the device for detection at each distance tested. Conditions that may lengthen response time or contribute to a missed event include spaces larger than the recommended coverage area for the number of sensors installed, higher ceilings, strong local exhaust, or single small puffs filtered through clothing.

The 160-square-foot recommendation is installation guidance, not a measured guarantee of uniform 98.9% accuracy throughout that area. The accuracy dataset covers source-to-sensor distances of 0–6 feet and does not establish performance beyond that tested range.

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Where a space exceeds the recommended coverage area, additional sensors rather than extended range are the appropriate remedy.

8.5 Environment-Specific Optimization

Because detection performance and response time can be affected by placement and airflow, Triton works with customers to configure deployments for their buildings. This may include sensor placement relative to stalls, doorways, vents, and exhaust fans; unit count relative to room dimensions and ceiling height; sensitivity configuration; and response-protocol guidance. Sites that report slower-than-expected response times or unexpected alert patterns can be reviewed for placement or configuration changes.

9. Traceability and Reproducibility

The underlying workbook is the primary evidence record for this report. Every event has a unique Testing ID and is linked to a Source ID. The Source ID connects the event to the product/source and source category in the Summary sheet. This allows a reviewer to trace the aggregate result to the underlying source-level records.

Testing was completed at various intervals from May to July 2026 in multiple locations including in actual school restrooms, a commercial environment, and a residential environment. Testing was conducted with the default sensitivity settings on Triton ULTRA using the firmware released on May 25, 2026 .

10. Limitations

Testing was conducted in multiple locations and across a range of products and test conditions. As with sensor-based detection systems generally, actual performance can vary depending on the installation environment. Factors such as room layout, airflow, HVAC configuration, sensor placement, distance from the likely emission point, background aerosol levels, and other environmental conditions can affect detection performance. Where an environment presents unusual conditions, additional testing, placement changes, or configuration adjustments may be appropriate.

- The workbook records test distance from 0 to 6 feet. It does not establish performance beyond 6 feet. The supplied data therefore should not be used to infer a measured accuracy rate at distances beyond the tested range.
- The non-vape interference set is broad but not exhaustive of every airborne substance or activity that may occur in a deployed environment.
- The THC category contains one listed source, a Delta-8 cartridge device (P29). Its 491 correct detections in 500 trials establish observed vape-event detection for that tested source under the recorded conditions. This binary vape/non-vape study does not establish performance across all THC products or demonstrate differentiation of THC from nicotine.
- The 98.9% result is an aggregate metric reported conservatively from an observed 98.988% accuracy. Individual products, source categories, distances, and conditions can perform above or below the aggregate figure.

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- The supplied event log does not provide enough information to independently assess alert latency, room airflow, temperature, humidity, or sensor placement relative to HVAC equipment. The response-time and coverage material in Section 8 is drawn from Triton's internal timing tests and aggregated customer feedback, not from the 8,400-event accuracy dataset. This distinction should be preserved when citing the report.

11. Evidence Basis and Publication Guidance

Triton ULTRA correctly classified 8,315 of 8,400 logged test events, for an observed aggregate accuracy of 98.988%. Triton reports the result conservatively as 98.9%. In the same validation corpus, observed vape-event sensitivity was 98.655% and observed non-vape specificity was 99.164%.

This publication language distinguishes observed test performance from a universal performance guarantee. Results can vary with source characteristics, distance, airflow, room geometry, installation, and other environmental conditions. The study evaluates Triton ULTRA and does not establish a competitor accuracy rate or a claim of superiority over other sensors.

The primary evidence for this claim is the 8,400-event testing corpus and the source-level records referenced in Appendix B. For public-facing use, the report can be presented as a permanent research or validation resource on Triton's website, with an HTML version of the key findings and a downloadable copy of this report. If the underlying workbook is published, the dataset landing page should explain the fields, testing period, source categories, and relationship between the dataset and this report.

Appendix A - Calculation

Total events: 8,400

True positives: 2,861

True negatives: 5,454

False positives: 46

False negatives: 39

Correct classifications: 8,315

Observed aggregate accuracy: 98.988095%

Published accuracy (one decimal place): 98.9%, reported conservatively by rounding down

Appendix B - [Testing Logs/Summary](#)

A full log of all 8,400 events is available in the link above. The study includes 23 non-vape source IDs (P01-P23) and 7 vape source IDs (P24-P30). The source-level table in Section 5.3 provides the product/source list and associated results.