

HONEYWELL AIR DETECTIVE

The system allows HVAC and environmental test professionals to take a snapshot of indoor air and connects them to an extensive allergen database to yield near real-time air quality analysis. The results help professionals to better inform their customers “on-the-spot” of present airborne particles and the products and services that may be useful in their homes.

The Honeywell Air Detective is intended for use by HVAC and environmental test professionals to analyze residential air quality for selected allergens including spores, specific pollen types, as well as other organic particles.

The Honeywell Air Detective system consists of three elements:

1. The **device and its associated hardware** which collects the air samples and provides the particle holographic imagery to the cloud database for analysis.
2. The **cloud-based, machine-learning software** which analyzes the detected particles and provides a particle report in near real-time.
3. The **user-supplied iPad tablet** which controls the device application and the interface to the cloud, and also displays the particle report.

The device uses a fan to in-take and capture an air sample through the impaction sampler built into a single-use, disposable cassette. After sampling the air for three minutes, the device records holographic images of the particles detected in the air sample. These images are then sent to the cloud for on-the-spot, near real-time particle classification and display. See Table 2 for detailed performance characteristics of the device.



The Honeywell Air Detective device is only one part of the Honeywell Air Detective system. For a complete list of hardware, see Table 1.

The results are returned to the iPad, providing a particle analysis report to share with the homeowner in person and via e-mail. This data is intended to help HVAC professionals and homeowners make informed decisions about the types of air handling, cleaning equipment, and services that may be beneficial to the homeowner.

FEATURES AND BENEFITS



On-the-spot particle analysis and display on the user's iPad provide both the professional and homeowner with preliminary data that can enable more informed decisions – without waiting for lengthy and expensive third-party analysis.



The portable, battery-powered device, single-use, disposable air analysis cassettes, straightforward iPad app cloud interface, and report all contribute to a system that is easy to use.



Visual display and identification of common allergens, including spores, specific pollen types, as well as other organic allergen particles, provides results in a clear, easy-to-understand format which can also be sent to the customer directly from the app via e-mail.



The application's artificial intelligence algorithms are updated periodically and deployed automatically, eliminating the need for manual intervention to enable device or system upgrades.



Allows HVAC and environmental test professionals to differentiate themselves from the competition through access to this innovative and unique offering.

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DIFFERENTIATION

- Unlike particle sensors that only provide the volume of particles present and do not provide a picture and classification, or samplers that require analysis of air sampling cassettes in a remote lab, the Honeywell Air Detective provides on-the-spot airborne particle analysis including visualization and classification
- The portable Honeywell Air Detective, with cloud connectivity, enables the user to take advantage of imaging technology and algorithms that leverage artificial intelligence

POTENTIAL APPLICATIONS






- Periodic service visits
- HVAC system diagnosis and consultation
- Collection of airborne allergen information to support marketing and sales

VALUE TO HVAC AND ENVIRONMENTAL TEST PROFESSIONALS

The Honeywell Air Detective is an innovative new tool for the test professional's toolbox. The system enables the professional to provide preliminary insights into the customer's indoor air, which will allow the customer to make more informed decisions about his/her HVAC system. This, in turn, may drive:

- Additional filters and upgraded air cleaning system sales during service visits
- Increased sign-up and renewal rate of HVAC service contracts
- Increased high-value web traffic to dealer home page with regularly updated pollen counts
- Where appropriate, additional testing of the homeowner's indoor air

TABLE 1. HONEYWELL AIR DETECTIVE HARDWARE

ITEM		QUANTITY
	<ul style="list-style-type: none"> • Honeywell Air Detective device • AC adapter power supply for external power • Power cord for external power 	<p>1 each <i>(included in case)</i></p>
	<p>Honeywell Air Detective single-use cassette</p>	<p>18 Packaged in two clear plastic tubes containing nine cassettes each <i>(included in case)</i></p>
	<p>Battery pack</p>	<p>Two sets of two <i>(one set included in case, the other set provided separately)</i></p>
	<ul style="list-style-type: none"> • Battery charging dock • AC adapter power supply • Power cord 	<p>1 each <i>(not included in case, provided separately)</i></p>
	<p>Foam-lined, hardshell case which contains the components noted above</p>	<p>1</p>

HONEYWELL AIR DETECTIVE REPORT

The detailed Honeywell Air Detective Report provides particle concentrations, images, and categories, as well as size data. It also provides important information and helpful links to aid in interpreting the results. Figure 1 shows excerpts taken from a particle report that sampled the air in an indoor location, in this case, an office. See also Tables 2 and 3 for more information.

FIGURE 1. HONEYWELL AIR DETECTIVE REPORT EXCERPTS

HONEYWELL AIR DETECTIVE REPORT

READING ID : 557

✔ Data Analysis Successful

Job ID	Tested By	Technician	Test Location	Date	Time
20201201101340	Other Individuals	Demo Demo	Living room (Indoor)	December 01 (America/New_York)	10:18 AM

PARTICLE CONCENTRATIONS#

Total Count	Spores	Other Particles	Total Pollen	Tree Pollen	15 particles/m ³
34924 particles/m ³	1086 particles/m ³	33823 particles/m ³	15 particles/m ³	Weed Pollen	0 particles/m ³
				Grass Pollen	0 particles/m ³
				Other Pollen	0 particles/m ³

IMAGE OF PARTICLES

PARTICLE CATEGORY

* Percentages based on estimated concentrations

Please see the final pages of this report for "Important Information About Interpreting Test Results and Disclaimers" which outlines the limitations of the Honeywell Air Detective's performance and your use of this report.

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HONEYWELL AIR DETECTIVE REPORT

Living room (Indoor)

The Honeywell Air Detective samples approximately 64.5 liters of air in 3 mins by collecting airborne particles on a special cassette which is then imaged using lens-less holographic microscopy.

The image of the collected particles in the cassette is shown above. The image is processed and analyzed using advanced machine-learning algorithms (MLA) running remotely on Honeywell's FORGE cloud computing platform. The MLA predict various classes of particles identified from the image of the collected particles from the cassette. Based on the image of the particles collected on the cassette, the MLA counts and estimates the sizes of the particles as shown in this report.

Please note that the MLA may not detect all particles present due to, among other reasons, the opacity and/or size of a particle or overcrowding of particles within the image. In addition, the MLA may fail to correctly classify a particle due to, among other reasons, similarities in the appearance of different classes of particle and/or the fact that the MLA may not have been trained on the particle type at issue.

The Air Detective Report is not a substitute for additional testing of longer duration and more in-depth laboratory analysis.

PARTICLE SIZE DATA

Based on the image of the particles collected on the cassette the MLA identified the sizes and the counts of particles as plotted above.

HONEYWELL AIR DETECTIVE REPORT

Living room (Indoor)

IMPORTANT INFORMATION ABOUT INTERPRETING TEST RESULTS AND DISCLAIMERS

To provide insight into the content of air to enable more informed understanding and data-based decisions, these results are based on the Air Profile™ guidelines published by Environmental Analysis Associates, Inc.

and on guidelines published by American Academy of Allergy, Asthma & Immunology (aiaa.org/reading-the-chart).

Sampling collection efficiencies and the number of particles identified in the hologram. For example, a single 2.5 m cassette to 5 per 64.5 liters of air (or 78m³).

type of airborne particle or potential allergen, and the presence of various allergens does not necessarily indicate that a health impact. In addition to allergen information, the results also help indicate the general air quality with respect to this can be found at [airquality.com/basics](#).

is recommended to improve air quality cannot be guaranteed due to the unique aspects of each indoor environment. If any of these results cause concern about health or safety, a thorough inspection by a qualified environmental assessor.

air Detective are to be considered preliminary in nature, and a complete analysis of air quality or contaminants would require a more detailed analysis. Honeywell Air Detective should never be used as a basis to diagnose disease or for any other healthcare or medical use, warranty, or guarantee as to the accuracy of any detection, failure to detect, identification, or classification of Honeywell Air Detective. Any recommendations or decisions with respect to products or services based on the data should be made with caution given the preliminary nature of the results.

designed to improve over time through advancement of its machine-learning algorithms and the availability and accuracy of the data. It may be subject to inaccuracies, misidentifications, false positives, or false negatives that impact the overall results.

clusive method of detecting, analyzing, or identifying pollens, spores, or other particles, and the data that is analyzed is not the exclusive source of data relative to particles that may be present. Honeywell Air Detective in the same location may have significant variation in the types, classes, and numbers of particles detected. The Honeywell Air Detective has been present in the past or will be present in the future. used as the sole basis for a comprehensive indoor air quality assessment or remediation.

has cautioned that air sampling of spores alone cannot (1) be used to assess potential health risks. Air sampling should be used in conjunction with other methods of air quality assessment. (2) Without a detailed evaluation of the origin, identity, location, and/or extent of mold, the suitability of any product or service it may offer or remediation services. Where such laws apply, assessment or remediation services.

air Detective for use in its application, (2) to operate the device by Honeywell (including, without limitation, disposal of the device), or to communicate the contents of the report to you, and tools, the suitability of any product or service it may offer or Honeywell Air Detective, and interpretation and use of the particle data.

air Detective – through Honeywell's literature, the Honeywell web site, or other means. In no event shall Honeywell be liable for any damages, including, without limitation, any special, incidental, or consequential damages, arising out of or in connection with the use of the device for a particular purpose. In no event shall Honeywell be liable for any damages, including, without limitation, any special, incidental, or consequential damages, arising out of or in connection with the use of the device for a particular purpose.

HONEYWELL AIR DETECTIVE REPORT

Living room (Indoor)

ALLERGEN DETAILS (3/3)

Spores [More Info](#)

Concentration	Typical Size	Category Severity
1086 particles/m ³	3-4 microns	Atypical - 4

The Asp/Pen category of spores includes numerous species of both Aspergillus and Penicillium. These are commonly found in indoor environments. Asp/Pen spores can contain mycotoxins, cause allergic reactions, and/or be opportunistic pathogens.

Pine [More Info](#)

Concentration	Typical Size	Category Severity
15 particles/m ³	40-85 microns	Elevated - 5

Pine trees (genus Pinus) do produce large amounts of pollen. However, Pine pollen is not generally considered to be allergenic.

Other Particles [More Info](#)

Concentration	Typical Size	Category Severity
33823 particles/m ³	2-144 microns	Atypical - 4

Other Particles is a broad category of both organic and inorganic particles that are not otherwise identified as allergens. This category is generally composed of dust, mineral particles, soot, other opaque particles, and fibers. It may also contain unidentified allergens such as skin cell fragments, insect parts, and other types of spores and pollen.

For indoor measurements, categories are based on total Tree, Grass, and Weed Pollen.

HONEYWELL AIR DETECTIVE REPORT

Living room (Indoor)

TEST INFORMATION

Sensor Model Number	Sensor Serial Number	Sensor Firmware Version	Image Processing Version	Particle Classification Version
HLHM100120SWUI00	APA-DV1-00001009	1.0.0	2.61	2.2.2

Cassette Serial Number

Kdjb846257583758

CONTACT INFORMATION

Company

Other Individuals

TABLE 2. PERFORMANCE

CHARACTERISTIC	PARAMETER
Collected airborne particle image	8 mega pixel reconstructed holographic image, gray scale
Collected particle minimum diameter ¹	2 µm typical
Field of view	3.7 mm x 2.8 mm or 10.1 mm ²
Typical particle collection efficiency ^{2,3} :	
>10 µm diameter	>90%
5 µm diameter	approximately 50%
2.5 µm diameter	approximately 20%
Precision % ⁴ :	
Detailed pollen classes as shown in Table 3 ⁵	91% typical
Spore class as shown in Table 3 ⁵	73% typical
% recall for spore class as shown in Table 3 ⁶	74% typical
Air sampling time per reading	3 min typical
Time to analyze one air sample reading in cloud ⁷	3 min to 5 min typical

¹The minimum diameter of detectable particles may actually be larger or smaller than 2 µm due to the refractive index and the opacity of the particle at the Honeywell Air Detective's light source wavelength (i.e., 850 nm). In some cases, particles smaller than 2 µm may be detected due to high opacity; in other cases, larger translucent particles may not be detected.

²The collection efficiencies indicated are approximations that are derived not from empirical lab characterization, but rather from fluid dynamics models assuming 2.1 liter-per-minute sampling flow and certain other simplifications, including perfectly spherical particles. The collection efficiencies also assume the use of new cassettes that have been sealed and stored properly at room temperature.

³The collection efficiencies are utilized in the calculation to translate the number of imaged particles to the average airborne particle concentration in #/m³ (i.e., the estimated average number of particles in a cubic meter of air). For example, a single 15 µm (with 100% collection efficiency) would translate to an approximate airborne particle concentration of 1 per 63 liters of air (or 16/m³); likewise, a single 2.5 µm particle (20% collection efficiency) would translate to 5 per 63 liters of air (or 79/m³).

⁴The precision % values for detailed pollen classes and the spore class reflect the average percentage of correctly detected and correctly identified particles within each of the particle classes on which the machine-learning has been trained, based on a comparison between (1) Honeywell laboratory personnel's analysis of certain particle images derived from lab-generated samples, and (2) the Honeywell Air Detective software's analysis of those same images. In addition to providing information on these particle classes, the Particle Report also provides insight into (1) the total pollen particles detected (which includes pollen types other than the detailed pollen classes), and (2) the total non-pollen particles detected. Because the Honeywell Air Detective's machine-learning has not been trained on every type of pollen, spore, or other non-pollen/non-spore particle, and because of the high variability in appearance of particles in the non-pollen/non-spore particle category, the precision % value is lower for total particles than it is for the detailed pollen class and spore class. The precision % values do not reflect or account for the existence of false negatives (i.e., where there has been a failure to detect a particle in the field of view). For the spore class, the % recall value described in more detail in Note 6 below is a measure of the probability of the Honeywell Air Detective machine-learning algorithms' detection of particles present within the field of view. Note that the precision % values may not reflect performance of the Honeywell Air Detective in the field, in particular where a sample taken in the field includes types of particles on which the Honeywell Air Detective's machine-learning has not been trained. Accordingly, the Honeywell Air Detective's performance in the field may deviate, even significantly, from the precision % values indicated herein.

⁵For comparison, an interpretation of the performance of the next best alternative (i.e., impaction sampling and off-line laboratory analysis by a trained technician) suggests that typical coefficient of variation (CV) (calculated as a ratio of the standard deviation to the mean particle concentration) ranges between 10% and 50%. See the following two references for further details on the CV of traditional methods:

1. J. Environ. Monit., 2007, 9, 855-861.
2. American Industrial Hygiene Association (AIHA) "FAQs About Spore Trap Air Sampling for Mold for Direct Microscopical Examination - Mold Analysis Document", 2020.

⁶% recall is a standard machine-learning metric used to describe the probability that the Honeywell Air Detective's algorithms will detect a spore present within the field of view (i.e., avoid a false negative). Recall is calculated using the following formula: $(TP / (TP + FN)) * 100\%$, where TP = True Positive, and FN = False Negative. The % recall indicated was determined based only on the Honeywell Air Detective's performance with respect to Aspergillus and Penicillium spores and is not indicative of its performance with respect to other spore types. To constitute a "true positive," the machine-learning algorithm's prediction must match both the location and identification of the sample analysis conducted by Honeywell laboratory personnel.

⁷Highly dependent on cellular connection of HVAC professional's iPad (standard 3G or 4G service will result in typical analysis times). It is recommended that 2G cellular service be avoided due to much longer upload and download times.

TABLE 3. HONEYWELL AIR DETECTIVE REPORT

CHARACTERISTIC	PARAMETER
Indoor sample particle concentration summary	Separate summaries for: <ul style="list-style-type: none"> • total pollen • total spores • non-pollen/non-spore particles
Outdoor sample particle concentration summary	Separate summaries for: <ul style="list-style-type: none"> • tree pollen • grass pollen • weed pollen • other (unspecified) pollen • spores • non-pollen/non-spore particles
Detailed pollen classes detected (indoor and outdoor)	Eight classes from 11 pollen genera: <ul style="list-style-type: none"> • vernal + timothy grass (combined) • corn grass • rye grass + oak tree (combined) • pecan tree • pine tree • ragweed weed • plantain weed • pellitory + nettle weed (combined)
Spore class detected (indoor and outdoor)	• Aspergillus + Penicillium

GENERAL SPECIFICATIONS

TABLE 4. GENERAL

CHARACTERISTIC	PARAMETER
Operating temperature range	0°C to 50°C [32°F to 122°F]
Operating humidity	95% non-condensing, at 50°C [122°F], steady state
Mains supply voltage fluctuations	not applicable
Pollution degree of the intended environment	Degree 2
Device dimensions	303 mm x 130 mm x 130 mm [11.9 in x 5.1 in x 5.1 in]
Approvals (provided by UL)	IEC/EN 60825-1, IEC/UL 61010-1
Laser class	1

**CLASS 1
LASER PRODUCT**

IEC 60825-1:2014

TABLE 5. POWER SUPPLIES¹

COMPONENT	MANUFACTURER	DESCRIPTION
Device DC voltage power supply	Cincon Electronics Co. LTD P/N: TR70MB120-01E02 VI	12 V, 5.8 A adapter AC input is 80 VAC to 264 VAC
Device power cord	Cincon Electronics Co. LTD P/N: 223020-01	—
Honeywell Rechargeable lithium-ion battery pack ¹	Honeywell Model: CK65-BTSC P/N: 318-063-001	nominal output: 3.6 V capacity: 7000 mAh, 25.2 Wh
Temperature ranges: operating (up to 30 days) storage (up to 30 days) charging	—	-20°C to 60°C [-4°F to 140°F] -20°C to 45°C [-4°F to 113°F] -20°C to 20°C [-4°F to 168°F]
CK3 Series Quad Battery Charger dock	Honeywell Model: AC20 P/N: 871-230-101	charges four CK3 Honeywell Rechargeable lithium-ion battery packs
Battery charger power supply	Phihong 851-810-002	—
Battery charger power cord	—	—

¹See documentation included with packaging for complete specifications, charging, and recommended use information.

DISCLAIMERS

- Results obtained from the Honeywell Air Detective (HAD) are to be considered preliminary in nature, and a complete analysis of air quality or contaminants would require secondary laboratory analyses. The HAD should never be used as a basis to diagnose disease or for any other healthcare or medical application. Honeywell makes no representation, warranty, or guarantee as to the accuracy of any detection, failure to detect, identification, or classification of any pollen, spore, or other particle by the HAD. Any recommendations or decisions with respect to products or services based on the HAD or its results should be made with caution given the preliminary nature of the results.
- The HAD system is designed to improve over time through advancement of its machine-learning algorithms and the availability and utilization of additional data sets. The product may be subject to inaccuracies, misidentifications, false positives, or false negatives that impact the overall results provided in this report.
- The HAD is not the exclusive method of detecting, analyzing, or identifying pollens, spores, or other particles, and the data that is analyzed – a one-time “snapshot” of the immediately surrounding air in a given location – are not the exclusive source of data relative to particles that may be present. Distinct samples taken and analyzed by the HAD in the same location may have significant

FOR MORE INFORMATION

Advanced Sensing Technologies serves its customers through a worldwide network of sales offices and distributors. For application assistance, current specifications, pricing or the nearest Authorized Distributor, visit [our website](#) or contact:

techsupport-honeywellairdetective@honeywell.com

Honeywell Sensing and Internet of Things

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sps.honeywell.com/ast

variation in the types, classes, and numbers of particles detected. In addition, the particle report does not constitute a determination as to either the source or viability of any particles detected. The HAD cannot determine why a particle has been detected or predict whether such particle has been present in the past or will be present in the future. Given the HAD's performance characteristics, the HAD and the report should not be used as the sole basis for a comprehensive indoor air quality assessment. Long-term, professional testing with laboratory analysis should be considered to obtain the most accurate assessment of indoor air quality and/or the causes of specific air quality concerns.

- **Specific Comments Regarding Spores:** The American Industrial Hygiene Association (AIHA) has cautioned that air sampling of spores alone cannot (1) support any definitive conclusions regarding the presence of mold in an indoor environment or (2) be used to assess potential health risks. Air sampling should be considered only as a tool used in support of an informed inspection. See <https://aiha-assets.sfo2.digitaloceanspaces.com/AIHA/resources/FAQs-About-Spore-Trap-Air-Sampling-for-Mold-for-Direct-Examination-Guidance-Document.pdf>. A more detailed evaluation of the origin, identity, location, and/or extent of any spores identified by the HAD can be provided by a professional experienced in mold assessment and remediation. State law may require training, certifications, and/or licenses in order to conduct mold assessment or remediation services. Where such laws apply, assessment or remediation should be carried out only by duly licensed and qualified professionals.
- It is buyer's sole responsibility (1) to determine the suitability of the HAD for use in its application, (2) to operate the HAD in accordance with the user manual and any other

WARNING MISUSE OF DOCUMENTATION

- The information presented in this data sheet is for reference only. Do not use this document as a product guide.
- Complete operation, and maintenance information is provided in the instructions supplied with the product.

Failure to comply with these instructions could result in death or serious injury.

- instructions provided by Honeywell (including, without limitation, disposal of the single-use cassette after each use), (3) to carefully review the particle report and accurately and completely communicate the contents of the report, and provide a full copy thereof, to the homeowner, and (4) to determine, based on buyer's experience, expertise, and other available tools, the suitability of any product or service it may offer or recommend to the homeowner.
- Any recommendations or assistance provided by Honeywell regarding the use or operation of the HAD – through our literature, the Honeywell web site, or otherwise – shall not be construed as representations or warranties of any kind, express or implied, and such information is accepted at buyer's own risk and without any obligation or liability to Honeywell.
- The information we supply in this data sheet is believed to be accurate and reliable as of this writing. However, specifications may change without notice, and Honeywell assumes no responsibility for its use.
- Honeywell disclaims all implied warranties, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, incidental, or indirect damages, or lost profits or lost revenues.

THE
FUTURE
IS
WHAT
WE
MAKE IT

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