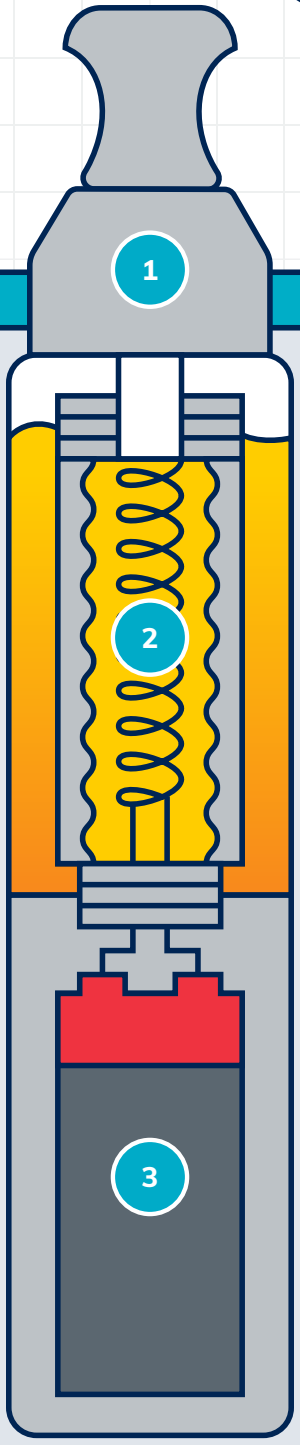
WHAT'S IN A VAPE?

Contrary to popular belief, the clouds produced by vapes are not just harmless water vapour...

Trace Metals in Vapes

All About E-Liquid



Structure of a Vape

The basic structure of the vape includes:

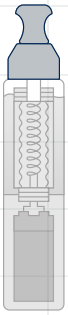
1. **the mouthpiece,**
2. **the atomizer, and**
3. **the battery.**

The battery is connected to the atomizer via copper wiring. The atomizer contains the cartridge for the liquid, a wick to deliver liquid to the heating element, and the heating element itself. The atomizer is held together with brass clamps and soldered joints.

Trace metals are abundant in vape aerosol. When the heating coil is activated, high temperatures cause leaching of metals from the vape into the inhaled aerosol[1].

STOMP
Students Together Moving to Prevent Tobacco Use

PHE Canada



MOUTHPIECE

The mouthpiece delivers vapour to the user. It is typically composed of silicon, iron, and tin[1].

CONTAINS:

Tin

ATOMIZER

The atomizer is designed to house smaller structures of the vape that aerosolize e-liquid by applying high temperatures.

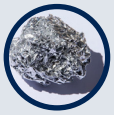
Cartridge
The cartridge holds the e-liquid prior to being delivered to the heating coil.The cartridge may contain tin or copper[1].

CONTAINS:

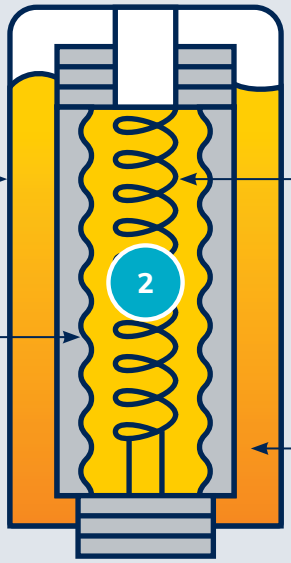
Tin Copper

Wick
The wick distributes e-liquid from the tank to the heating unit to produce vapour. The wick and its sheath are typically made from a combination of cotton and silica. The wick often contains silicone, calcium, magnesium, aluminium, and boron[1].

CONTAINS:



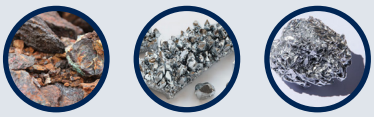
Aluminium



Heating Filament/Coil
The filament is the heating unit of the atomizer. It is also referred to as the coil.

The filament can be composed of nichrome, an alloy with nickel and chromium, or Kanthal, an alloy of iron, chromium, and aluminum[1].

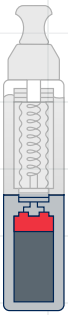
CONTAINS:



Nickel Chromium Aluminium

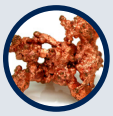
E-Liquid
E-liquid is housed in the cartridge of the atomizer prior to being pulled to the heating filament by the wick. When exposed to high temperatures, e-liquid becomes aerosolized along with the materials it is in contact with[1].

COPPER WIRES, BRASS CLAMP & SOLDERING JOINTS

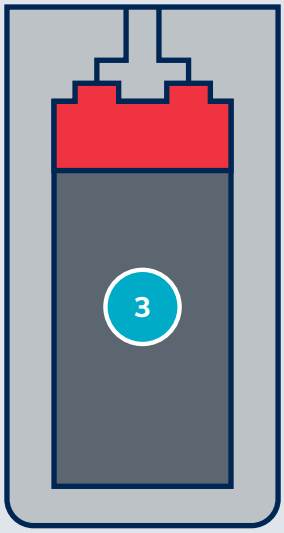


Copper Wires
The copper wires attach the battery to the atomizer and supply power. They are typically composed of an alloy with copper and silver[1].

CONTAINS:

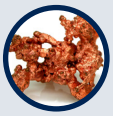


Copper



Brass Clamp
The brass clamp holds the copper wire in place with the filament and heating coil. It is composed of copper and zinc[1].

CONTAINS:



Copper

Zinc

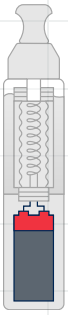
Soldering Joints
Soldered joints hold in the various parts of the atomizer. Soldered joints are typically composed of tin and lead[1].

CONTAINS:

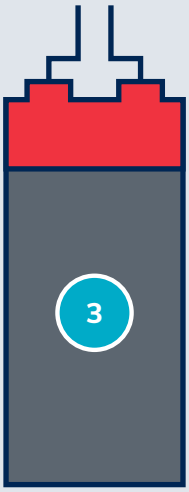
Tin

Lead

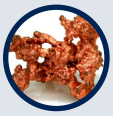
BATTERY



The battery provides power to the atomizer when activated. Batteries may be nickel-cadmium, nickel metal-hydride, lithium ion, lithium polymer, or lithium manganese. Batteries will contain any of these combinations of metals in addition to copper[1].



CONTAINS:



Copper

Nickel

Cadmium

Magnese

Metals in Vapes

NICKEL

The inhalation of nickel causes long term swelling in the lungs and irreversible scarring in the alveoli. Nickel is damaging to the liver and kidneys. Nickel is also a causative factor of lung and sinus cancer[1].

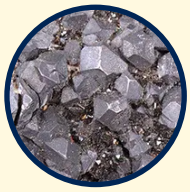
Battery | Heating Filament/Coil

CHROMIUM

Chromium is a potent cancer causing metal. Chromium breaks down the inner lining of the lung leading to permanent respiratory diseases. Chromium causes damage to the alveoli resulting in a difficulty in breathing[1].

Heating Filament/Coil

LEAD



Lead is toxic to the brain and kidneys. Exposure to lead can decrease cognitive ability, decreasing performance in school or work[1].

Soldered Joints

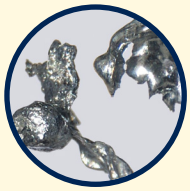
Metals in Vapes

ALUMINIUM

Aluminium particles collect in the kidney, brain, and liver. Excessive aluminium in the body causes bone degradation, decreasing growth in children and increasing likeliness of bone fractures. Aluminium causes mental diseases such as Alzheimers and Parkinsons[1].

Wick

CADMIUM



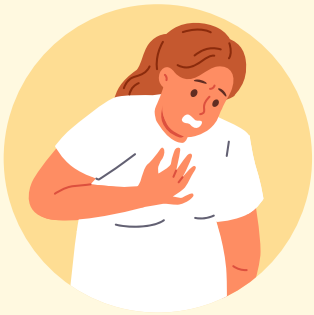
Cadmium induces irritation to the lungs, which can lead to coughing and shortness of breath. Furthermore, cadmium contributes to cancer formation in the lungs. Cadmium damages the liver, weakens bones, and weakens the immune system[1].

Battery

TIN

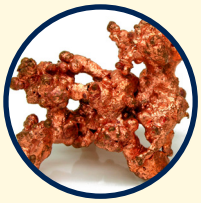
Tin particles become embedded in the lungs, impeding the ability of the lungs to function properly. Prolonged tin exposure has been associated with the development of anemia[1]. Anemia is a condition that affects the amount of healthy red blood cells and their ability to carry oxygen to tissues in the body. Anemia causes fatigue, weakness, and shortness of breath.

Mouth Piece Soldered Joints Cartridge



Metals in Vapes

COPPER



Copper exposure causes swelling in the lungs leading to shortness of breath. Additionally, copper triggers immune responses that result in permanent scarring of the lungs. Long term copper exposure leads to liver and kidney disease, as well as anemia[1,2].

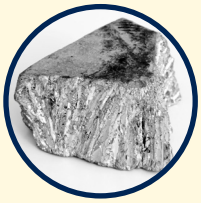
Battery | Brass Clamp | Copper Wire | Cartridge

MANGANESE

Manganese causes inflammation that can worsen conditions like asthma and other respiratory diseases. Manganese increases the likelihood of developing pneumonia and chronic cough. Furthermore, Manganese causes neurological problems like confusion or brain fog. Manganese intensifies the toxicity of other metals by enhancing absorption into the body[1].

Battery

ZINC



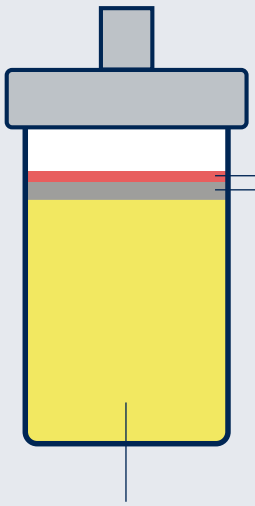
Overexposure to zinc is toxic to human cells, causing widespread damage throughout the body. Zinc can cause cancer, scarring of the lungs, and plaque buildup on blood vessels[1],[2],[3].

Brass Clamp

WHAT'S IN E-LIQUID?

Of the 825 vaping liquids examined in Canada, over 1500 unique chemicals were identified. Remarkably, 50% of these chemicals appeared in only one product. This wide variety of vaping products makes it difficult for scientists to fully understand all of the risks associated with vaping[4].

The main components of e-cigarette liquid fall into three categories. The carrier solution, which comprises 90% of the liquid, nicotine, which can be between 0-6% depending on potency, and the flavouring agents, which comprises the remainder of the blend[4].



Nicotine

Nicotine is the addictive chemical found in tobacco products and ecigarettes. Nicotine decreases blood flow throughout the body, causing damage to every organ system. Nicotine has many neurological effects, including impaired cognitive capacity, memory, and attention span. Nicotine can also contribute to several variations of cancer once metabolised in the body[5].

Flavouring Agents

Approximately 40% of the chemicals in e-liquids are flavouring agents. Each flavour of e-liquid requires a different composition of flavouring chemicals. Each flavouring chemical has their own unique health risks[4].

Learn more about flavouring agents

Carrier Solution

The carrier solution is designed to produce vapour and decrease the harsh taste of nicotine. Carrier solutions are typically a mix of propylene glycol and vegetable glycerine. These chemicals have slightly different properties and their concentrations can be modified based on manufacturer preferences.

What's in It?

Inhalation of vegetable glycerin causes inflammation in the lungs. Vegetable glycerin contributes to permanent scarring in the lung tissue. Vegetable glycerin increases susceptibility to pneumonia, alveolar damage, and acute lung injuries[6].

Propylene glycol slows down healing and growth of new cells. This can lead to the degradation of lung tissue over time. Propylene glycol damages DNA resulting in less functional lung cells, faster cell death, and increased lung scarring[7].

Have You Heard of Organic Aldehydes?

Organic aldehydes are formed when carrier solutions and flavouring agents are exposed to high temperatures[4]. Organic aldehydes have been identified as the primary contributor to **heart disease and lung disease** in cigarette smokers[4].

Newer generation vapes produce more aldehydes than prior generations due to the higher temperature of the heating coil. This means that **new generation vapes are also more dangerous[9]**.

Did you know that when **vegetable glycerin** or flavouring agents are heated, they produce glycidol and acrolein, which are both cancer causing chemicals[4,8]?

A CLOSER LOOK AT FLAVOURING AGENTS

Mint

Mint flavoured e-fluid typically uses a chemical called Monoterpene Pulegone. This chemical is known to cause cancer in people who are exposed to it long term[4].

Spice

Savoury dessert and tea flavoured e-liquids typically contain chemicals called cinnamaldehyde and benzaldehyde. These chemicals can increase the toxicity of nicotine, as well as cause immune system suppression contributing to increased risk of illness[8,10].

Cotton Candy

Sweet flavoured e-liquids such as candy, fruit, or pop drinks contain ethyl maltol. Ethyl maltol is the most common flavouring agent in e-liquids. Ethyl maltol causes permanent scarring of the lungs, induces cell death, decreases healing capacity, causes inflammation, and causes cancer[4,11].

Fruit

Fruit flavoured e-liquids often contain methylnaphthalene. This chemical causes damage to the spleen and the lungs. In the lungs, methylnaphthalene damages the alveoli and cause acute respiratory distress[4].

Milk/Creamy

Milky, creamy or buttery flavoured e-liquids may contain a chemical called diacetyl. Diacetyl causes a lung disease called bronchiolitis obliterans, also known as popcorn lung. Inhalation of diacetyl causes decreased lung function and can lead to acute respiratory distress[4].

Sweet

Sweet flavoured e-liquids such as candy, tropical, or fruit often contain vanillin. Vanillin is the second most common flavouring agent in e-liquids. Vanillin disturbs the natural healing process in the lung. Vanillin causes damage to the lung tissue and can lead to chronic diseases such as asthma or permanent lung scarring[12].

If you re thinking of quitting or reducing your vape use, please visit our STOMP hub to view more resources and supports.

References

1. Gaur, S., & Agnihotri, R. (2018). Health effects of trace metals in electronic cigarette aerosols—a systematic review. Biological Trace Element Research, 188(2), 295–315. https://doi.org/10.1007/s12011-018-1423-x
2. Gray, N., Halstead, M., Gonzalez-Jimenez, N., Valentin-Blasini, L., Watson, C., & Pappas, R. S. (2019). Analysis of toxic metals in liquid from electronic cigarettes. International Journal of Environmental Research and Public Health, 16(22), 4450. https://doi.org/10.3390/ijerph16224450
3. Sakamaki-Ching, S., Williams, M., Hua, M., Li, J., Bates, S. M., Robinson, A. N., Lyons, T. W., Goniewicz, M. L., & Talbot, P. (2020). Correlation between biomarkers of exposure, effect and potential harm in the urine of electronic cigarette users. BMJ Open Respiratory Research, 7(1). https://doi.org/10.1136/bmjresp-2019-000452
4. Kosarac, I., Kubwabo, C., Fan, X., Siddique, S., Petraccone, D., He, W., Man, J., Gagne, M., Thickett, K. R., & Mischki, T. K. (2021). Open characterization of vaping liquids in Canada: Chemical Profiles and trends. Frontiers in Chemistry, 9. https://doi.org/10.3389/fchem.2021.756716
5. Bracken-Clarke, D., Kapoor, D., Baird, A. M., Buchanan, P. J., Gately, K., Cuffe, S., & Finn, S. P. (2021). Vaping and lung cancer – a review of current data and recommendations. Lung Cancer, 153, 11–20. https://doi.org/10.1016/j.lungcan.2020.12.030
6. Su, V. Y.-F., Chen, W.-C., Yu, W.-K., Wu, H.-H., Chen, H., & Yang, K.-Y. (2023). The main e-cigarette component vegetable glycerin enhances neutrophil migration and fibrosis in endotoxin-induced lung injury via p38 MAPK activation. Respiratory Research, 24(1). https://doi.org/10.1186/s12931-022-02307-z
7. Komura, M., Sato, T., Yoshikawa, H., Nitta, N. A., Suzuki, Y., Koike, K., Kodama, Y., Seyama, K., & Takahashi, K. (2022). Propylene glycol, a component of electronic cigarette liquid, damages epithelial cells in human small airways. Respiratory Research, 23(1). https://doi.org/10.1186/s12931-022-02142-2
8. Winters, B. R., Kochar, T. K., Clapp, P. W., Jaspers, I., & Madden, M. C. (2020). Impact of e-cigarette liquid flavoring agents on activity of microsomal recombinant CYP2A6, the primary nicotine-metabolizing enzyme. Chemical Research in Toxicology, 33(7), 1689–1697. https://doi.org/10.1021/acs.chemrestox.9b00514
9. Ogunwale, M. A., Li, M., Ramakrishnam Raju, M. V., Chen, Y., Nantz, M. H., Conklin, D. J., & Fu, X.-A. (2017). Aldehyde detection in electronic cigarette aerosols. ACS Omega, 2(3), 1207–1214. https://doi.org/10.1021/acsomega.6b00489
10. Clapp, P. W., Pawlak, E. A., Lackey, J. T., Keating, J. E., Reeber, S. L., Glish, G. L., & Jaspers, I. (2017). Flavored e-cigarette liquids and cinnamaldehyde impair respiratory innate immune cell function. American Journal of Physiology-Lung Cellular and Molecular Physiology, 313(2). https://doi.org/10.1152/ajplung.00452.2016
11. Durrani, K., El Din, S.-M. A., Sun, Y., Rule, A. M., & Bressler, J. (2021). Ethyl maltol enhances copper mediated cytotoxicity in lung epithelial cells. Toxicology and Applied Pharmacology, 410, 115354. https://doi.org/10.1016/j.taap.2020.115354
12. Smith, M. R., Jarrell, Z. R., Orr, M., Liu, K. H., Go, Y.-M., & Jones, D. P. (2021). Metabolome-wide association study of flavorant vanillin exposure in bronchial epithelial cells reveals disease-related perturbations in metabolism. Environment International, 147, 106323. https://doi.org/10.1016/j.envint.2020.106323

Based on the original work of Dr. Laura Struik