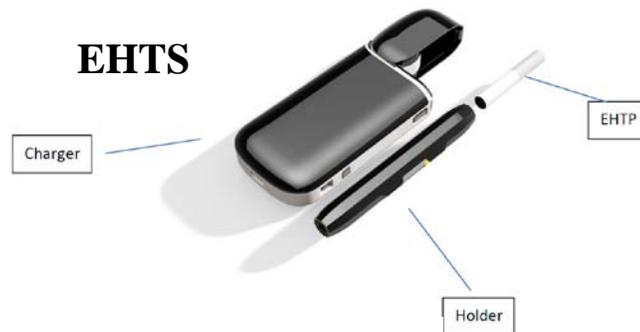


Philip Morris International (PMI) has developed a patented Electrically Heated Tobacco System (EHTS) that heats a specifically designed tobacco product (Electrically Heated Tobacco Product or EHTP). The EHTP contains tobacco¹ material in the form of a plug that undergoes a controlled heating process to produce a vapor (aerosol). The tobacco is only heated and is not burnt as happens in a lit cigarette.



PMI retained scientific experts at Advanced Fuel Research (AFR), Inc., USA to review and analyze scientific data concerning combustion and smoke generating processes.

AFR is a privately owned business, founded in 1980, that supplies contract research, product development and analytical services to corporate research centers, research institutes, and government laboratories. The company provides expertise in combustion, pyrolysis, and torrefaction of biomass (materials obtained from plants) including combustion monitoring and clean energy.

Scientific experts at AFR performed a literature search of scientific definitions for combustion and smoke. They then reviewed the operation of the EHTS, analyzed experimental data on the EHTS provided by PMI (that included data generated by an independent analytical laboratory), and assessed whether any combustion processes occur in the EHTP and if the aerosol formed is smoke.

Based on the above, AFR issued an expert opinion that includes:

1. Scientific definitions of combustion and smoke.
2. Analyses as to whether any combustion processes occur when the Holder heats the tobacco material in the EHTP.
3. Analyses as to whether the aerosol formed from heating the tobacco material in the EHTP is smoke.

¹ The EHTP does not contain tobacco cut-filler (tobacco leaf cut in small pieces found in cigarettes) or pipe tobacco. All of the tobacco in the EHTP is reconstituted (cast-leaf) tobacco made from tobacco powder, water, glycerin, guar gum and cellulose fibers.

Expert Opinion on Combustion

From their literature review, the authors conclude that the key attributes of tobacco combustion are: (1) a rapid oxidative process; (2) that occurs at elevated temperatures (typically above 600 °C); (3) is associated with the release of energy in the form of heat and/or light; and (4) is associated with the evolution of certain species that can be considered combustion markers.

The expert opinions of the authors conclude that no combustion processes occur in the tobacco material when the Holder heats the EHTP to produce an aerosol and are based on the following findings from their assessment:

- The heating process is not rapid nor self-sustaining; in fact, it is self-extinguishing if the power to the heating device is turned off.
- Heating of the tobacco material in the Holder occurs at temperatures typical for drying/vaporization i.e. at temperatures significantly lower than those required for combustion to occur

Expert Opinion on Smoke

The experts opine that one of the main distinguishing features of smoke is that it is always associated with combustion and/or pyrolysis processes associated with combustion, as in a burning cigarette.

In the authors' opinion the EHTP does not produce smoke when heated as intended in the Holder.

Their expert opinion that the EHTS operation does not produce smoke is based on the following findings from their assessment:

- As the use of the EHTS does not involve combustion (nor pyrolysis), then the aerosol formed is not smoke. The tobacco in the EHTP is heated to temperatures typical of torrefaction reactions i.e. < 300 °C.
- Another distinguishing feature of smoke versus aerosol is its composition. In the case of the EHTS under an ISO puffing regime, water and glycerin constitute 91% of the aerosol, whereas the corresponding percentage for a regular cigarette is much lower (19%). Consequently, the use of conventional cigarettes is associated with *smoke* formation, whereas the corresponding product of the EHTS is an *aerosol*.
- In addition, the aerosol produced by the EHTS device can be distinguished from combustion derived tobacco smoke by the very small amount of hydrocarbon component (produced from torrefaction) and the lack of complexity in the EHTP aerosol when compared to cigarette smoke.
- The smoke formed during the combustion of a traditional cigarette contains solid particles, whereas the EHTP, when used as intended and heated in the holder, does not produce any solid particles as part of the aerosol.

As a result of the above findings, AFR determined that the aerosol produced by the heating of the EHTP in the Holder is not smoke.