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Supplementary Materials

Targeted Characterization of the Chemical Composition of JUUL Systems Aerosol and Comparison with 3R4F Reference Cigarettes and IQOS Heat Sticks

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Table S1. Supplementary Methods.

Compounds Classification	Compounds	Method of Capture	Analysis Method	Instrument	Testing Lab	Method Reference Code	ISO17025 Status
Nicotine, Water, Composition, Menthol	diethylene glycol, ethylene glycol, glycerol, menthol, NFDPM, nicotine, propylene glycol, Water, ACM, DML, Carbon monoxide	Pad/impinger	Pads were extracted with IPA	GC-TCD/FID, NDIR	Labstat	TMS-00115a Appendix E	Accredited
Benzoic acid	Benzoic acid	Pad	Pads were extracted with H3PO4	HPLC-UV	Labstat	TMS-00115a Appendix F	Accredited
Volatile Compounds	Benzene, Toluene, Acrylonitrile, Propylene Oxide	Pad	Sample were puffed thourgh pad into a cryogenic trap containing methanol.	GC-MS（SIM）	Labstat	TMS-00124 Appendix G	Accredited
	1,3-Butadiene, Isoprene	Pad/Impinger	Pads were extracted with IPA	GC-MS	Enthalpy	ENT208 Rev. 7.0	Accredited
Tobacco Specific Nitrosamines	N-nitrosonornicotine, 4-(N-nitrosomethylamino)-1- (3-pyridyl)-1-butanone	Pad	Pads were spiked with internal standard solution containing 4 TSNA analogues and TSNanalogues were extraction	LC-MS/MS (ESI)	Labstat	TMS-00135 AppendixI	Accredited

			into ammonium acetate solution.				
Nicotine Degradation Products	Nicotine-N-Oxide, Cotinine, B-nicotyrine	Pad	Pads were extracted with ammonium acetate solution	LC-MS/MS	Labstat	TMS-00153	Accredited
	Anatabine, Anabasine, Myosmine, Nornicotine	Pad	Pads are extracted with methanol/water	LC-MS/MS (ESI)	Enthalpy	AM-238 v3.1	Accredited
Carbonyls	Formaldehyde, Acetaldehyde , Acrolein, Isobutyraldehyde , Butyraldehyde, Crotonaldehyde , Diacetyl, Acetyl Propionyl,Ethyl Acetoacetate	Pad/Impinger	Sample were puffed thourgh pad into a cryogenic trap containing acetonitrile, extracted with the impinger solution, and derivatized with PFBHA, followed by extractionin toluene.	GC-MS (SIM)	Labstat	TMS-00155 and TMS-00155 Appendix G	Accredited
Heavy Metal	Cadmium, Lead,Chromium, Nickel, Copper, Gold	Pad	Quartz Pad was extracted with 10% (v/v) ultra-high purity nitric acid.	ICP-MS	Labstat	TMS-00160	Accredited
Aromatic Flavourants	Methyl Acetate , Ethyl Acetate , 1-Butanol, Isobutyl Acetate, Furfural, Isoamyl Acetate, Benzyl Acetate	Pad/Impinger	Pads were extracted with the impinger solution containing acetonitrile	GC-MS	Labstat	TMS-00175	Accredited
Aromatic Amines	1-aminonaphthalene, 2-aminonaphthalene, 4-aminobiphenyl	Pad	Pad was extracted with dichloromethane	GC-MS (NCI)	Enthalpy	SOP AM-221 v4.0	Accredited
Propionic Acid	Propionic Acid	Pad/Impinger	Sample were puffed thourgh pad into a cryogenic trap containing acetonitrile	GC-MS(SIM)	Labstat	TMS-00177	Accredited
Glycidol	Glycidol	Impinger	Aerosol was collected in impingers containing	GC-MS	Enthalpy	ENT203 Rev. 1.0	Accredited

			trapping solution of internal standard, hydrochloric acid, and p-toluenesulfonyl chloride, followed by hexane addition.				
Water	Water	Pad	Pad was analyzed for water by gas chromatography with thermal conductivity detection (GC-TCD) using a porous polymer packed column.	GC-TCD	Labstat	TMS-00115a Appendix E	Accredited
Ammonia	Ammonia	Pad/impinger	Vapor was passed through a filter pad and impinger containing 40 mN H2SO4	Ion exchange chromatography	Enthalpy	ENT307 Rev 2.0	Accredited
Benzo(a)pyrene	Benzo(a)pyrene	Pad	Pad were extracted for benzo[a]pyrene	GC-MS	Enthalpy	ENT217 Rev 1.0	Accredited

Table S2. Method LOD and LOQ for Me3 analysis.

Parameter/Constituent	Units	LOD	LOQ
1,3-Butadiene	µg	0.03	0.32
1-Butanol	µg	0.06	0.20
2-Aminonaphthalene	ng	6.75×10^{-04}	2.02×10^{-03}
4-Aminobiphenyl	ng	3.32×10^{-04}	9.97×10^{-04}
β-Nicotyrine	µg	3.81×10^{-03}	0.01
Acetaldehyde	µg	0.01	0.03
Acetyl Propionyl	µg	3.51×10^{-03}	0.01
Acrolein	µg	0.01	0.03
Acrylonitrile	µg	0.01	0.02
Ammonia	µg	0.01	0.12
Anabasine	µg	1.29×10^{-03}	0.01
Anatabine	µg	6.02×10^{-04}	5.99×10^{-03}
Benzene	µg	3.41×10^{-03}	0.01
Benzo(a)pyrene	ng	1.86×10^{-03}	0.01
Benzoic Acid	mg	9.59×10^{-05}	3.20×10^{-04}
Benzyl Acetate	µg	0.06	0.20
Cadmium	ng	0.01	0.04
Carbon Monoxide	mg	NA	NA
Chromium	ng	0.11	0.35
Copper	ng	0.13	0.44
Cotinine	µg	1.87×10^{-03}	0.01
Crotonaldehyde	µg	0.01	0.02

Diacetyl	µg	1.74×10^{-03}	0.01
Diethylene Glycol	mg	2.40×10^{-04}	8.00×10^{-04}
Ethyl Acetate	µg	0.06	0.20
Ethyl Acetoacetate	µg	4.80×10^{-03}	0.02
Ethylene Glycol	mg	5.05×10^{-05}	1.68×10^{-04}
Formaldehyde	µg	0.01	0.02
Furfural	µg	0.08	0.28
Glycerol	mg	1.44×10^{-03}	4.80×10^{-03}
Glycidol	µg	NA	NA
Gold	ng	NA	NA
Isoamyl Acetate	µg	0.10	0.32
Isobutyl Acetate	µg	0.06	0.20
Isobutyraldehyde	µg	1.65×10^{-03}	0.01
Isoprene	µg	0.32	3.21
Lead	ng	0.02	0.07
Menthol	mg	2.44×10^{-04}	8.14×10^{-04}
Methyl Acetate	µg	0.07	0.24
Myosmine	µg	5.95×10^{-04}	0.01
n-Butyraldehyde	µg	3.51×10^{-03}	0.01
Nickel	ng	0.21	0.70
Nicotine	mg	1.35×10^{-04}	4.49×10^{-04}
Nicotine-N-Oxide	µg	0.02	0.06
NNK	ng	0.02	0.05
NNN	ng	0.01	0.03
Nornicotine	µg	9.45×10^{-04}	5.88×10^{-03}
pH	Unitless	NA	NA
Propionic Acid	µg	0.04	0.12
Propylene Glycol	mg	2.40×10^{-04}	8.01×10^{-04}
Propylene Oxide	ng	3.12	10.40
Toluene	µg	0.01	0.04
Water	mg	3.83×10^{-03}	0.01

Table S3. Method LOD and LOQ for VT5, VT3 and Me5 analysis.

Parameter/Constituent	Units	LOD	LOQ
1-Aminonaphthalene	ng	1.64×10^{-03}	0.01
1,3-Butadiene	µg	5.70×10^{-03}	1.90×10^{-02}
1-Butanol	µg	0.06	0.20
2-Aminonaphthalene	ng	7.12×10^{-04}	2.37×10^{-03}
4-Aminobiphenyl	ng	2.86×10^{-04}	9.53×10^{-04}
β-Nicotyrine	µg	3.81×10^{-03}	0.01
Acetaldehyde	µg	0.01	0.03
Acetyl Propionyl	µg	3.51×10^{-03}	0.01
Acrolein	µg	0.01	0.03
Acrylonitrile	µg	0.01	0.02
Ammonia	µg	0.02	0.06
Anabasine	µg	0.01	0.02
Anatabine	µg	4.76×10^{-03}	0.02
Benzene	µg	3.41×10^{-03}	0.01
Benzo(a)pyrene	ng	1.06×10^{-02}	0.04
Benzoic Acid	mg	9.59×10^{-05}	3.20×10^{-04}
Benzyl Acetate	µg	0.06	0.20
Cadmium	ng	0.01	0.04
Carbon Monoxide	mg	0.01	0.03
Chromium	ng	0.11	0.35

Copper	ng	0.13	0.44
Cotinine	µg	1.87×10^{-03}	0.01
Crotonaldehyde	µg	0.01	0.02
Diacetyl	µg	1.74×10^{-03}	0.01
Diethylene Glycol	mg	2.40×10^{-04}	8.00×10^{-04}
Ethyl Acetate	µg	0.06	0.20
Ethyl Acetoacetate	µg	4.80×10^{-03}	0.02
Ethylene Glycol	mg	5.05×10^{-05}	1.68×10^{-04}
Formaldehyde	µg	0.01	0.02
Furfural	µg	0.08	0.28
Glycerol	mg	1.44×10^{-03}	4.80×10^{-03}
Glycidol	µg	NA	NA
Gold	ng	0.01	0.04
Isoamyl Acetate	µg	0.10	0.32
Isobutyl Acetate	µg	0.06	0.20
Isobutyraldehyde	µg	1.65×10^{-03}	0.01
Isoprene	µg	8.12×10^{-03}	0.03
Lead	ng	0.02	0.07
Menthol	mg	2.44×10^{-04}	8.14×10^{-04}
Methyl Acetate	µg	0.07	0.24
Myosmine	µg	0.01	0.03
n-Butyraldehyde	µg	3.51×10^{-03}	0.01
Nickel	ng	0.21	0.70
Nicotine	mg	1.35×10^{-04}	4.49×10^{-04}
Nicotine-N-Oxide	µg	0.02	0.06
NNK	ng	0.02	0.05
NNN	ng	0.01	0.03
Nornicotine	µg	4.76×10^{-03}	0.02
pH	Unitless	NA	NA
Propionic Acid	µg	0.04	0.12
Propylene Glycol	mg	2.40×10^{-04}	8.01×10^{-04}
Propylene Oxide	ng	3.12	10.40
Toluene	µg	0.01	0.04
Water	mg	3.83×10^{-03}	0.01

Table S4. Comparison of HPHC and Chemical Intense Aerosol Levels in Virginia Tobacco 5.0% and Smoke Levels in 3R4F Reference Cigarette.

HPHC or Chemical	**JUUL Virginia Tobacco 5.0% (mg/puff)**		**3R4F (mg/cig)**			**Chemical and HPHC Normalized by Nicotine (mg/mg)**		**% Difference**
	HPHC or Chemical	**Nicotine**	**HPHC or Chemical**	**Nicotine**	**Source Journal**	**JUUL Virginia Tobacco 5.0%**	**3R4F**	**vs_3R4F**
1-Aminonaphthalene	$\leq8.19\times10^{-10}$	0.04	2.91×10^{-05}	1.99	a	$\leq1.96\times10^{-08}$	1.46×10^{-05}	↓ ≥99.87
1-Butanol	$\leq3.00\times10^{-05}$	0.10	N/A	N/A	N/A	$\leq3.00\times10^{-04}$	N/A	N/A
1,3-Butadiene	$\leq2.85\times10^{-06}$	0.04	1.00×10^{-01}	1.99	a	$\leq6.83\times10^{-05}$	5.03×10^{-02}	↓ ≥99.86
2-Aminonaphthalene	$\leq3.56\times10^{-10}$	0.04	1.81×10^{-05}	1.99	a	$\leq8.53\times10^{-09}$	9.10×10^{-06}	↓ ≥99.91
4-Aminobiphenyl	$\leq6.20\times10^{-10}$	0.04	3.91×10^{-06}	1.99	a	$\leq1.48\times10^{-08}$	1.96×10^{-06}	↓ ≥99.24

Acetaldehyde	≤2.16×10^{-05}	0.10	1.84×10^{+00}	1.99	a	≤2.16×10^{-04}	9.24×10^{-01}	↓ ≥99.98
Acetyl Propionyl	≤1.76×10^{-06}	0.10	9.19×10^{-02}	1.99	b	≤1.76×10^{-05}	4.62×10^{-02}	↓ ≥99.96
Acrolein	≤2.01×10^{-05}	0.17	1.80×10^{-01}	1.99	a	≤1.17×10^{-04}	9.05×10^{-02}	↓ ≥99.87
Acrylonitrile	≤3.20×10^{-06}	0.10	2.05×10^{-02}	1.99	a	≤3.20×10^{-05}	1.03×10^{-02}	↓ ≥99.69
Ammonia	NDFB	0.04	3.40×10^{-02}	1.99	a	NDFB	1.71×10^{-02}	NC
Anabasine	≤1.24×10^{-05}	0.04	N/A	N/A	N/A	≤2.98×10^{-04}	N/A	N/A
Anatabine	≤2.38×10^{-06}	0.04	N/A	N/A	N/A	≤5.70×10^{-05}	N/A	N/A
Benzene	≤1.71×10^{-06}	0.10	8.88×10^{-02}	1.99	a	≤1.71×10^{-05}	4.46×10^{-02}	↓ ≥99.96
Benzo(a)pyrene	≤5.31×10^{-09}	0.04	1.51×10^{-05}	1.99	a	≤1.27×10^{-07}	7.59×10^{-06}	↓ ≥98.32
Benzoic Acid	1.37×10^{-01}	0.17	N/A	N/A	N/A	7.94×10^{-01}	N/A	N/A
Benzyl Acetate	≤3.00×10^{-05}	0.10	N/A	N/A	N/A	≤3.00×10^{-04}	N/A	N/A
β-Nicotyrine	≤8.25×10^{-06}	0.17	N/A	N/A	N/A	≤4.79×10^{-05}	N/A	N/A
Cadmium	≤5.25×10^{-09}	0.10	9.32×10^{-05}	1.99	a	≤5.26×10^{-08}	4.68×10^{-05}	↓ ≥99.89
Carbon Monoxide	≤5.25×10^{-03}	0.04	3.05×10^{+01}	1.99	a	≤1.26×10^{-01}	1.53×10^{+01}	↓ ≥99.18
Chromium	NDFB	0.10	≤1.19×10^{-05}	1.74	c	NDFB	≤6.84×10^{-06}	NC
Copper	≤6.56×10^{-08}	0.10	N/A	N/A	N/A	≤6.57×10^{-07}	N/A	N/A
Cotinine	6.57×10^{-06}	0.17	N/A	N/A	N/A	3.81×10^{-05}	N/A	N/A
Crotonaldehyde	≤3.11×10^{-06}	0.10	5.95×10^{-02}	1.99	a	≤3.12×10^{-05}	2.99×10^{-02}	↓ ≥99.90
Diacetyl	≤8.70×10^{-07}	0.10	3.37×10^{-01}	1.99	a	≤8.71×10^{-06}	1.69×10^{-01}	↓ ≥99.99
Diethylene Glycol	≤1.20×10^{-04}	0.10	N/A	N/A	N/A	≤1.20×10^{-03}	N/A	N/A
Ethyl Acetate	≤1.30×10^{-04}	0.04	N/A	N/A	N/A	≤3.45×10^{-03}	N/A	N/A
Ethyl Acetoacetate	≤2.40×10^{-06}	0.10	N/A	N/A	N/A	≤2.40×10^{-05}	N/A	N/A
Ethylene Glycol	≤1.09×10^{-04}	0.10	N/A	N/A	N/A	≤1.09×10^{-03}	N/A	N/A
Formaldehyde	6.03×10^{-05}	0.17	8.71×10^{-02}	1.99	a	3.50×10^{-04}	4.38×10^{-02}	↓ 99.2
Furfural	≤4.20×10^{-05}	0.10	2.59×10^{-02}	1.74	c	≤4.20×10^{-04}	1.49×10^{-02}	↓ ≥97.18
Glycerol	2.12×10^{+00}	0.17	2.70×10^{+00}	1.99	a	1.23×10^{+01}	1.36×10^{+00}	808.58
Glycidol	NR	0.10	1.76×10^{-03}	1.99	a	NR	8.84×10^{-04}	N/A
Gold	≤6.33×10^{-09}	0.04	N/A	N/A	N/A	≤1.52×10^{-07}	N/A	N/A
Isoamyl Acetate	≤4.80×10^{-05}	0.10	N/A	N/A	N/A	≤4.80×10^{-04}	N/A	N/A
Isobutyl Acetate	≤3.00×10^{-05}	0.10	N/A	N/A	N/A	≤3.00×10^{-04}	N/A	N/A
Isobutyraldehyde	≤8.26×10^{-07}	0.10	N/A	N/A	N/A	≤8.27×10^{-06}	N/A	N/A
Isoprene	≤4.06×10^{-06}	0.04	7.99×10^{-01}	1.99	a	≤9.72×10^{-05}	4.02×10^{-01}	↓ ≥99.98
Lead	≤4.55×10^{-08}	0.10	3.12×10^{-05}	1.74	c	≤4.55×10^{-07}	1.79×10^{-05}	↓ ≥97.46
Menthol	≤1.22×10^{-04}	0.10	≤1.00×10^{-05}	2.10	d	≤1.22×10^{-03}	≤4.76×10^{-06}	NC
Methyl Acetate	≤3.60×10^{-05}	0.10	N/A	N/A	N/A	≤3.60×10^{-04}	N/A	N/A
Myosmine	≤1.93×10^{-05}	0.04	N/A	N/A	N/A	≤4.62×10^{-04}	N/A	N/A
n-Butyraldehyde	≤1.76×10^{-06}	0.10	9.30×10^{-02}	1.99	a	≤1.76×10^{-05}	4.67×10^{-02}	↓ ≥99.96
Nickel	≤1.05×10^{-07}	0.10	≤1.29×10^{-05}	1.74	c	≤1.05×10^{-06}	≤7.41×10^{-06}	NC
Nicotine	1.72×10^{-01}	0.17	1.99×10^{+00}	1.99	a	1.00×10^{+00}	1.00×10^{+00}	N/A

Nicotine-N-Oxide	≤8.72×10^{-06}	0.10	N/A	N/A	N/A	≤8.73×10^{-05}	N/A	N/A
NNK	≤7.53×10^{-09}	0.10	2.95×10^{-04}	1.99	a	≤7.54×10^{-08}	1.48×10^{-04}	↓ ≥99.95
NNN	≤4.92×10^{-09}	0.10	3.37×10^{-04}	1.99	a	≤4.93×10^{-08}	1.69×10^{-04}	↓ ≥99.97
Nornicotine	2.42×10^{-05}	0.04	N/A	N/A	N/A	5.78×10^{-04}	N/A	N/A
Propionic Acid	≤1.80×10^{-05}	0.10	N/A	N/A	N/A	≤1.80×10^{-04}	N/A	N/A
Propylene Glycol	8.30×10^{-01}	0.17	2.37×10^{-02}	1.74	c	4.82×10^{+00}	1.36×10^{-02}	35265.37
Propylene Oxide	≤1.56×10^{-06}	0.10	1.00×10^{+00}	1.99	a	≤1.56×10^{-05}	5.03×10^{-01}	↓ ≥100.00
Toluene	≤6.12×10^{-06}	0.10	1.53×10^{-01}	1.99	a	≤6.12×10^{-05}	7.69×10^{-02}	↓ ≥$^{-99}$.92
Water	4.31×10^{-01}	0.17	1.58×10^{+01}	1.89	e	2.50×10^{+00}	8.36×10^{+00}	↓ 70.11

Average % Difference, Excluding Glycerol, PG and Water. a: Jaccard et al. 2019 b: Moldoveanu et al. 2017 c: Helen et al. 2018 d: Uchiyama et al. 2018 e: Schaller et al. 2016 f: Pappas et al. 2014 g: Roemer et al. 2012 h: IQOS PMTA, 2019.

Table S5. Comparison of HPHC and Chemical Non-Intense Aerosol Levels in Virginia Tobacco 5.0% and Smoke Levels in 3R4F Reference Cigarette.

HPHC or Chemical	**JUUL Virginia Tobacco 5.0% (mg/puff)**		**3R4F (mg/cig)**			**Chemical and HPHC Normalized byNicotine (mg/mg)**		**% Difference**
	HPHC or Chemical	**Nicotine**	**HPHC or Chemical**	**Nicotine**	**Source Journal**	**JUUL Virginia Tobacco 5.0%**	**3R4F**	**vs_3R4F**
1-Aminonaphthalene	≤8.19×10^{-10}	0.04	1.42×10^{-05}	0.70	a	≤1.96×10^{-08}	2.02×10^{-05}	↓ ≥99.90
1-Butanol	≤3.00×10^{-05}	0.05	N/A	N/A	N/A	≤5.52×10^{-04}	N/A	N/A
1,3-Butadiene	≤2.85×10^{-06}	0.04	3.79×10^{-02}	0.70	a	≤6.83×10^{-05}	5.40×10^{-02}	↓ ≥99.87
2-Aminonaphthalene	≤3.56×10^{-10}	0.04	8.77×10^{-06}	0.70	a	≤8.53×10^{-09}	1.25×10^{-05}	↓ ≥99.93
4-Aminobiphenyl	≤6.20×10^{-10}	0.04	1.54×10^{-06}	0.70	a	≤1.48×10^{-08}	2.19×10^{-06}	↓ ≥99.32
Acetaldehyde	≤2.16×10^{-05}	0.05	5.97×10^{-01}	0.70	a	≤3.97×10^{-04}	8.50×10^{-01}	↓ ≥99.95
Acetyl Propionyl	≤1.76×10^{-06}	0.05	2.95×10^{-02}	0.70	b	≤3.23×10^{-05}	4.21×10^{-02}	↓ ≥99.92
Acrolein	≤2.01×10^{-05}	0.10	5.32×10^{-02}	0.70	a	≤1.92×10^{-04}	7.58×10^{-02}	↓ ≥99.75
Acrylonitrile	≤3.20×10^{-06}	0.05	5.23×10^{-03}	0.70	a	≤5.89×10^{-05}	7.45×10^{-03}	↓ ≥99.21
Ammonia	NDFB	0.04	9.64×10^{-03}	0.70	a	NDFB	1.37×10^{-02}	NC
Anabasine	≤1.24×10^{-05}	0.04	N/A	N/A	N/A	≤2.98×10^{-04}	N/A	N/A
Anatabine	≤2.38×10^{-06}	0.04	N/A	N/A	N/A	≤5.70×10^{-05}	N/A	N/A
Benzene	≤1.71×10^{-06}	0.05	3.36×10^{-02}	0.70	a	≤3.14×10^{-05}	4.79×10^{-02}	↓ ≥99.93
Benzo(a)pyrene	≤5.31×10^{-09}	0.04	6.30×10^{-06}	0.70	a	≤1.27×10^{-07}	8.97×10^{-06}	↓ ≥98.58
Benzoic Acid	7.81×10^{-02}	0.10	N/A	N/A	N/A	7.45×10^{-01}	N/A	N/A
Benzyl Acetate	≤3.00×10^{-05}	0.05	N/A	N/A	N/A	≤5.52×10^{-04}	N/A	N/A
β-Nicotyrine	≤8.25×10^{-06}	0.08	N/A	N/A	N/A	≤9.72×10^{-05}	N/A	N/A
Cadmium	≤5.25×10^{-09}	0.05	2.45×10^{-05}	0.70	a	≤9.66×10^{-08}	3.49×10^{-05}	↓ ≥99.72
Carbon Monoxide	≤5.25×10^{-03}	0.04	1.00×10^{+01}	0.70	a	≤1.26×10^{-01}	1.42×10^{+01}	↓ ≥99.12
Chromium	NDFB	0.05	≤8.80×10^{-07}	0.70	f	NDFB	≤1.25×10^{-06}	NC

Copper	≤2.84×10^{-07}	0.10	N/A	N/A	N/A	≤2.71×10^{-06}	N/A	N/A
Cotinine	≤4.06×10^{-06}	0.05	N/A	N/A	N/A	≤7.48×10^{-05}	N/A	N/A
Crotonaldehyde	≤3.11×10^{-06}	0.05	9.89×10^{-03}	0.70	a	≤5.73×10^{-05}	1.41×10^{-02}	↓ ≥99.59
Diacetyl	≤8.70×10^{-07}	0.05	1.15×10^{-01}	0.70	b	≤1.60×10^{-05}	1.64×10^{-01}	↓ ≥99.99
Diethylene Glycol	≤1.20×10^{-04}	0.05	N/A	N/A	N/A	≤2.21×10^{-03}	N/A	N/A
Ethyl Acetate	≤3.00×10^{-05}	0.05	N/A	N/A	N/A	≤5.52×10^{-04}	N/A	N/A
Ethyl Acetoacetate	≤2.40×10^{-06}	0.05	N/A	N/A	N/A	≤4.42×10^{-05}	N/A	N/A
Ethylene Glycol	≤1.09×10^{-04}	0.05	N/A	N/A	N/A	≤2.01×10^{-03}	N/A	N/A
Formaldehyde	8.33×10^{-05}	0.08	2.47×10^{-02}	0.70	a	9.82×10^{-04}	3.52×10^{-02}	↓ 97.21
Furfural	≤4.20×10^{-05}	0.05	1.40×10^{-02}	0.76	d	≤7.73×10^{-04}	1.84×10^{-02}	↓ ≥95.80
Glycerol	$1.24\times10^{+00}$	0.10	$2.70\times10^{+00}$	0.70	a	$1.19\times10^{+01}$	$3.85\times10^{+00}$	208.86
Glycidol	NR	0.05	N/A	N/A	N/A	NR	N/A	N/A
Gold	≤6.33×10^{-09}	0.04	N/A	N/A	N/A	≤1.52×10^{-07}	N/A	N/A
Isoamyl Acetate	≤4.80×10^{-05}	0.05	N/A	N/A	N/A	≤8.83×10^{-04}	N/A	N/A
Isobutyl Acetate	≤3.00×10^{-05}	0.05	N/A	N/A	N/A	≤5.52×10^{-04}	N/A	N/A
Isobutyraldehyde	≤8.26×10^{-07}	0.05	N/A	N/A	N/A	≤1.52×10^{-05}	N/A	N/A
Isoprene	≤4.06×10^{-06}	0.04	2.88×10^{-01}	0.70	a	≤9.72×10^{-05}	4.10×10^{-01}	↓ ≥99.98
Lead	≤4.55×10^{-08}	0.10	9.20×10^{-06}	0.70	f	≤4.34×10^{-07}	1.31×10^{-05}	↓ ≥96.69
Menthol	≤1.22×10^{-04}	0.05	≤1.00×10^{-05}	0.76	a	≤2.25×10^{-03}	≤1.32×10^{-05}	NC
Methyl Acetate	≤3.60×10^{-05}	0.05	N/A	N/A	N/A	≤6.62×10^{-04}	N/A	N/A
Myosmine	≤1.93×10^{-05}	0.04	N/A	N/A	N/A	≤4.62×10^{-04}	N/A	N/A
n-Butyraldehyde	≤1.76×10^{-06}	0.05	2.84×10^{-02}	0.70	a	≤3.23×10^{-05}	4.05×10^{-02}	↓ ≥99.92
Nickel	≤4.55×10^{-07}	0.05	≤3.80×10^{-07}	0.70	f	≤8.37×10^{-06}	≤5.41×10^{-07}	NC
Nicotine	1.05×10^{-01}	0.10	7.02×10^{-01}	0.70	a	$1.00\times10^{+00}$	$1.00\times10^{+00}$	N/A
Nicotine-N-Oxide	≤8.72×10^{-06}	0.05	N/A	N/A	N/A	≤1.60×10^{-04}	N/A	N/A
NNK	≤7.53×10^{-09}	0.05	1.13×10^{-04}	0.70	a	≤1.39×10^{-07}	1.61×10^{-04}	↓ ≥99.91
NNN	≤4.92×10^{-09}	0.05	1.31×10^{-04}	0.70	a	≤9.06×10^{-08}	1.87×10^{-04}	↓ ≥99.95
Nornicotine	2.42×10^{-05}	0.04	N/A	N/A	N/A	5.78×10^{-04}	N/A	N/A
Propionic Acid	≤1.80×10^{-05}	0.05	N/A	N/A	N/A	≤3.31×10^{-04}	N/A	N/A
Propylene Glycol	5.32×10^{-01}	0.10	3.20×10^{-03}	0.76	d	$5.07\times10^{+00}$	4.21×10^{-03}	120417.77
Propylene Oxide	≤1.56×10^{-06}	0.05	2.97×10^{-01}	0.70	a	≤2.87×10^{-05}	4.23×10^{-01}	↓ ≥99.99
Toluene	≤6.12×10^{-06}	0.05	5.14×10^{-02}	0.70	a	≤1.13×10^{-04}	7.32×10^{-02}	↓ ≥99.85
Water	2.82×10^{-01}	0.10	$3.20\times10^{+00}$	0.76	d	$2.69\times10^{+00}$	$4.21\times10^{+00}$	↓ 36.14

Average % Difference, Excluding Glycerol, PG and Water. a: Jaccard et al. 2019 b: Moldoveanu et al. 2017 c: Helen et al. 2018 d: Uchiyama et al. 2018 e: Schaller et al. 2016 f: Pappas et al. 2014 g: Roemer et al. 2012 h: IQOS PMTA, 2019.

Table S6. Comparison of HPHC and Chemical Non-Intense Aerosol Levels in Virginia Tobacco 5.0% and Smoke Levels in IQOS regular.

HPHC or Chemical	JUUL Virginia Tobacco 5.0% (mg/puff)		IQOS (mg/cig)			Chemical and HPHC Normalized byNicotine (mg/mg)		% Difference
	HPHC or Chemical	Nicotine	HPHC or Chemical	Nicotine	Source Journal	JUUL Virginia Tobacco 5.0%	IQOS	vs_IQOS
1-Aminonaphthalene	≤8.19×10^{-10}	0.04	7.70×10^{-08}	1.32	e	≤1.96×10^{-08}	5.83×10^{-08}	↓ ≥66.39
1-Butanol	≤3.00×10^{-05}	0.10	N/A	N/A	N/A	≤3.00×10^{-04}	N/A	N/A
1,3-Butadiene	≤2.85×10^{-06}	0.04	2.94×10^{-04}	1.32	e	≤6.83×10^{-05}	2.23×10^{-04}	↓ ≥69.34
2-Aminonaphthalene	≤3.56×10^{-10}	0.04	4.60×10^{-08}	1.32	e	≤8.53×10^{-09}	3.48×10^{-08}	↓ ≥75.53
4-Aminobiphenyl	≤6.20×10^{-10}	0.04	9.00×10^{-09}	1.29	c	≤1.48×10^{-08}	6.98×10^{-09}	NC
Acetaldehyde	≤2.16×10^{-05}	0.10	2.19×10^{-01}	1.32	e	≤2.16×10^{-04}	1.66×10^{-01}	↓ ≥99.87
Acetyl Propionyl	≤1.76×10^{-06}	0.10	N/A	N/A	N/A	≤1.76×10^{-05}	N/A	N/A
Acrolein	≤2.01×10^{-05}	0.17	1.13×10^{-02}	1.32	e	≤1.17×10^{-04}	8.56×10^{-03}	↓ ≥98.64
Acrylonitrile	≤3.20×10^{-06}	0.10	2.58×10^{-04}	1.32	e	≤3.20×10^{-05}	1.95×10^{-04}	↓ ≥83.61
Ammonia	NDFB	0.04	1.42×10^{-02}	1.32	e	NDFB	1.08×10^{-02}	NC
Anabasine	≤1.24×10^{-05}	0.04	N/A	N/A	N/A	≤2.98×10^{-04}	N/A	N/A
Anatabine	≤2.38×10^{-06}	0.04	N/A	N/A	N/A	≤5.70×10^{-05}	N/A	N/A
Benzene	≤1.71×10^{-06}	0.10	6.49×10^{-04}	1.32	e	≤1.71×10^{-05}	4.92×10^{-04}	↓ ≥96.53
Benzo(a)pyrene	≤5.31×10^{-09}	0.04	7.36×10^{-07}	1.29	c	≤1.27×10^{-07}	5.71×10^{-07}	↓ ≥77.70
Benzoic Acid	1.37×10^{-01}	0.17	N/A	N/A	N/A	7.94×10^{-01}	N/A	N/A
Benzyl Acetate	≤3.00×10^{-05}	0.10	N/A	N/A	N/A	≤3.00×10^{-04}	N/A	N/A
β-Nicotyrine	≤8.25×10^{-06}	0.17	N/A	N/A	N/A	≤4.79×10^{-05}	N/A	N/A
Cadmium	≤5.25×10^{-09}	0.10	≤3.50×10^{-07}	1.32	e	≤5.26×10^{-08}	≤2.65×10^{-07}	NC
Carbon Monoxide	≤5.25×10^{-03}	0.04	5.31×10^{-01}	1.32	e	≤1.26×10^{-01}	4.02×10^{-01}	↓ ≥68.75
Chromium	NDBF	0.10	≤5.50×10^{-07}	1.32	e	NDFB	≤4.17×10^{-07}	NC
Copper	≤6.56×10^{-08}	0.10	N/A	N/A	N/A	≤6.57×10^{-07}	N/A	N/A
Cotinine	6.57×10^{-06}	0.17	N/A	N/A	N/A	3.81×10^{-05}	N/A	N/A
Crotonaldehyde	≤3.11×10^{-06}	0.10	4.14×10^{-03}	1.32	e	≤3.12×10^{-05}	3.14×10^{-03}	↓ ≥99.01
Diacetyl	≤8.70×10^{-07}	0.10	4.30×10^{-02}	1.2	d	≤8.71×10^{-06}	3.58×10^{-02}	↓ ≥99.98
Diethylene Glycol	≤1.20×10^{-04}	0.10	N/A	N/A	N/A	≤1.20×10^{-03}	N/A	N/A
Ethyl Acetate	≤1.30×10^{-04}	0.04	N/A	N/A	N/A	≤3.45×10^{-03}	N/A	N/A
Ethyl Acetoacetate	≤2.40×10^{-06}	0.10	N/A	N/A	N/A	≤2.40×10^{-05}	N/A	N/A
Ethylene Glycol	≤1.09×10^{-04}	0.10	N/A	N/A	N/A	≤1.09×10^{-03}	N/A	N/A
Formaldehyde	6.03×10^{-05}	0.17	5.53×10^{-03}	1.32	e	3.50×10^{-04}	4.19×10^{-03}	↓ 91.64
Furfural	≤4.20×10^{-05}	0.10	3.11×10^{-02}	1.29	c	≤4.20×10^{-04}	2.41×10^{-02}	↓ ≥98.26
Glycerol	2.12×10^{+00}	0.17	4.63×10^{+00}	1.32	e	1.23×10^{+01}	3.51×10^{+00}	251.45

Glycidol	NR	0.10	5.71×10^{-03}	1.29	c	NR	4.43×10^{-03}	N/A
Gold	$\leq6.33\times10^{-09}$	0.04	N/A	N/A	N/A	$\leq1.52\times10^{-07}$	N/A	N/A
Isoamyl Acetate	$\leq4.80\times10^{-05}$	0.10	N/A	N/A	N/A	$\leq4.80\times10^{-04}$	N/A	N/A
Isobutyl Acetate	$\leq3.00\times10^{-05}$	0.10	N/A	N/A	N/A	$\leq3.00\times10^{-04}$	N/A	N/A
Isobutyraldehyde	$\leq8.26\times10^{-07}$	0.10	N/A	N/A	N/A	$\leq8.27\times10^{-06}$	N/A	N/A
Isoprene	$\leq4.06\times10^{-06}$	0.04	2.35×10^{-03}	1.32	e	$\leq9.72\times10^{-05}$	1.78×10^{-03}	↓ ≥94.54
Lead	$\leq4.55\times10^{-08}$	0.10	2.23×10^{-06}	1.29	c	$\leq4.55\times10^{-07}$	1.73×10^{-06}	↓ ≥73.65
Menthol	$\leq1.22\times10^{-04}$	0.10	4.10×10^{-04}	1.20	d	$\leq1.22\times10^{-03}$	3.42×10^{-04}	NC
Methyl Acetate	$\leq3.60\times10^{-05}$	0.10	N/A	N/A	N/A	$\leq3.60\times10^{-04}$	N/A	N/A
Myosmine	$\leq1.93\times10^{-05}$	0.04	N/A	N/A	N/A	$\leq4.62\times10^{-04}$	N/A	N/A
n-Butyraldehyde	$\leq1.76\times10^{-06}$	0.10	2.61×10^{-02}	1.32	e	$\leq1.76\times10^{-05}$	1.98×10^{-02}	↓ ≥99.91
Nickel	$\leq1.05\times10^{-07}$	0.10	$\leq5.50\times10^{-07}$	1.32	e	$\leq1.05\times10^{-06}$	$\leq4.17\times10^{-07}$	NC
Nicotine	1.72×10^{-01}	0.17	$1.32\times10^{+00}$	1.32	e	$1.00\times10^{+00}$	$1.00\times10^{+00}$	N/A
Nicotine-N-Oxide	$\leq8.72\times10^{-06}$	0.10	N/A	N/A	N/A	$\leq8.73\times10^{-05}$	N/A	N/A
NNK	$\leq7.53\times10^{-09}$	0.10	6.70×10^{-06}	1.32	e	$\leq7.54\times10^{-08}$	5.08×10^{-06}	↓ ≥98.52
NNN	$\leq4.92\times10^{-09}$	0.10	1.72×10^{-05}	1.32	e	$\leq4.93\times10^{-08}$	1.30×10^{-05}	↓ ≥99.62
Nornicotine	2.42×10^{-05}	0.04	N/A	N/A	N/A	5.78×10^{-04}	N/A	N/A
Propionic Acid	$\leq1.80\times10^{-05}$	0.10	N/A	N/A	N/A	$\leq1.80\times10^{-04}$	N/A	N/A
Propylene Glycol	8.30×10^{-01}	0.17	1.75×10^{-01}	1.29	c	$4.82\times10^{+00}$	1.36×10^{-01}	3450.82
Propylene Oxide	$\leq1.56\times10^{-06}$	0.10	1.48×10^{-04}	1.32	e	$\leq1.56\times10^{-05}$	1.12×10^{-04}	↓ ≥86.07
Toluene	$\leq6.12\times10^{-06}$	0.10	2.59×10^{-03}	1.32	e	$\leq6.12\times10^{-05}$	1.96×10^{-03}	↓ ≥96.88
Water	4.31×10^{-01}	0.17	$3.65\times10^{+01}$	1.32	e	$2.50\times10^{+00}$	$2.77\times10^{+01}$	↓ 90.96

Average % Difference, Excluding Glycerol, PG and Water. a: Jaccard et al. 2019 b: Moldoveanu et al. 2017 c: Helen et al. 2018 d: Uchiyama et al. 2018 e: Schaller et al. 2016 f: Pappas et al. 2014 g: Roemer et al. 2012 h: IQOS PMTA, 2019.

Table S7. Comparison of HPHC and Chemical Intense Aerosol Levels in Virginia Tobacco 3.0% and Smoke Levels in 3R4F Reference Cigarette.

HPHC or Chemical	JUUL Virginia Tobacco 3.0% (mg/puff)		3R4F (mg/cig)			Chemical and HPHC Normalized byNicotine (mg/mg)		% Difference
	HPHC or Chemical	Nicotine	HPHC or Chemical	Nicotine	Source Journal	JUUL Virginia Tobacco 3.0%	3R4F	vs_3R4F
1-Aminonaphthalene	$\leq8.19\times10^{-10}$	0.07	2.91×10^{-05}	1.99	a	$\leq1.22\times10^{-08}$	1.46×10^{-05}	↓ ≥99.92
1-Butanol	$\leq3.00\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq5.68\times10^{-04}$	N/A	N/A
1,3-Butadiene	$\leq2.85\times10^{-06}$	0.07	1.00×10^{-01}	1.99	a	$\leq4.23\times10^{-05}$	5.03×10^{-02}	↓ ≥99.92
2-Aminonaphthalene	$\leq3.56\times10^{-10}$	0.07	1.81×10^{-05}	1.99	a	$\leq5.29\times10^{-09}$	9.10×10^{-06}	↓ ≥99.94
4-Aminobiphenyl	$\leq1.43\times10^{-10}$	0.07	3.91×10^{-06}	1.99	a	$\leq2.12\times10^{-09}$	1.96×10^{-06}	↓ ≥99.89

Acetaldehyde	4.35×10^{-05}	0.11	$1.84\times10^{+00}$	1.99	a	4.13×10^{-04}	9.24×10^{-01}	↓ 99.96
Acetyl Propionyl	$\leq1.76\times10^{-06}$	0.05	9.19×10^{-02}	1.99	b	$\leq3.33\times10^{-05}$	4.62×10^{-02}	↓ ≥99.93
Acrolein	$\leq2.01\times10^{-05}$	0.11	1.80×10^{-01}	1.99	a	$\leq1.91\times10^{-04}$	9.05×10^{-02}	↓ ≥99.79
Acrylonitrile	$\leq3.20\times10^{-06}$	0.05	2.05×10^{-02}	1.99	a	$\leq6.06\times10^{-05}$	1.03×10^{-02}	↓ ≥99.41
Ammonia	$\leq3.99\times10^{-05}$	0.07	3.40×10^{-02}	1.99	a	$\leq5.92\times10^{-04}$	1.71×10^{-02}	↓ ≥96.53
Anabasine	$\leq2.87\times10^{-06}$	0.07	N/A	N/A	N/A	$\leq4.27\times10^{-05}$	N/A	N/A
Anatabine	$\leq2.38\times10^{-06}$	0.07	N/A	N/A	N/A	$\leq3.53\times10^{-05}$	N/A	N/A
Benzene	$\leq1.71\times10^{-06}$	0.05	8.88×10^{-02}	1.99	a	$\leq3.23\times10^{-05}$	4.46×10^{-02}	↓ ≥99.93
Benzo(a)pyrene	$\leq5.31\times10^{-09}$	0.07	1.51×10^{-05}	1.99	a	$\leq7.89\times10^{-08}$	7.59×10^{-06}	↓ ≥98.96
Benzoic Acid	8.41×10^{-02}	0.11	N/A	N/A	N/A	7.97×10^{-01}	N/A	N/A
Benzyl Acetate	$\leq3.00\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq5.68\times10^{-04}$	N/A	N/A
β-Nicotyrine	$\leq8.25\times10^{-06}$	0.11	N/A	N/A	N/A	$\leq7.82\times10^{-05}$	N/A	N/A
Cadmium	$\leq5.25\times10^{-09}$	0.05	9.32×10^{-05}	1.99	a	$\leq9.94\times10^{-08}$	4.68×10^{-05}	↓ ≥99.79
Carbon Monoxide	$\leq5.25\times10^{-03}$	0.07	$3.05\times10^{+01}$	1.99	a	$\leq7.80\times10^{-02}$	$1.53\times10^{+01}$	↓ ≥99.49
Chromium	NDFB	0.05	$\leq1.19\times10^{-05}$	1.74	c	NDFB	$\leq6.84\times10^{-06}$	NC
Copper	$\leq2.84\times10^{-07}$	0.05	N/A	N/A	N/A	$\leq5.39\times10^{-06}$	N/A	N/A
Cotinine	$\leq9.37\times10^{-07}$	0.05	N/A	N/A	N/A	$\leq1.78\times10^{-05}$	N/A	N/A
Crotonaldehyde	$\leq3.11\times10^{-06}$	0.05	5.95×10^{-02}	1.99	a	$\leq5.90\times10^{-05}$	2.99×10^{-02}	↓ ≥99.80
Diacetyl	$\leq8.70\times10^{-07}$	0.05	3.37×10^{-01}	1.99	a	$\leq1.65\times10^{-05}$	1.69×10^{-01}	↓ ≥99.99
Diethylene Glycol	$\leq1.20\times10^{-04}$	0.05	N/A	N/A	N/A	$\leq2.27\times10^{-03}$	N/A	N/A
Ethyl Acetate	$\leq1.30\times10^{-04}$	0.11	N/A	N/A	N/A	$\leq1.23\times10^{-03}$	N/A	N/A
Ethyl Acetoacetate	$\leq2.40\times10^{-06}$	0.05	N/A	N/A	N/A	$\leq4.54\times10^{-05}$	N/A	N/A
Ethylene Glycol	$\leq1.09\times10^{-04}$	0.05	N/A	N/A	N/A	$\leq2.07\times10^{-03}$	N/A	N/A
Formaldehyde	8.72×10^{-05}	0.11	8.71×10^{-02}	1.99	a	8.27×10^{-04}	4.38×10^{-02}	↓ 98.11
Furfural	$\leq4.20\times10^{-05}$	0.05	2.59×10^{-02}	1.74	c	$\leq7.95\times10^{-04}$	1.49×10^{-02}	↓ ≥94.66
Glycerol	$2.40\times10^{+00}$	0.11	$2.70\times10^{+00}$	1.99	a	$2.27\times10^{+01}$	$1.36\times10^{+00}$	1574
Glycidol	NR	0.05	1.76×10^{-03}	1.99	a	NR	8.84×10^{-04}	N/A
Gold	$\leq6.33\times10^{-09}$	0.07	N/A	N/A	N/A	$\leq9.40\times10^{-08}$	N/A	N/A
Isoamyl Acetate	$\leq4.80\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq9.09\times10^{-04}$	N/A	N/A
Isobutyl Acetate	$\leq3.00\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq5.68\times10^{-04}$	N/A	N/A
Isobutyraldehyde	$\leq8.26\times10^{-07}$	0.05	N/A	N/A	N/A	$\leq1.57\times10^{-05}$	N/A	N/A
Isoprene	$\leq4.06\times10^{-06}$	0.07	7.99×10^{-01}	1.99	a	$\leq6.03\times10^{-05}$	4.02×10^{-01}	↓ ≥99.98
Lead	NDFB	0.05	3.12×10^{-05}	1.74	c	NDFB	1.79×10^{-05}	NC
Menthol	$\leq1.22\times10^{-04}$	0.05	$\leq1.00\times10^{-05}$	2.10	d	$\leq2.31\times10^{-03}$	$\leq4.76\times10^{-06}$	NC
Methyl Acetate	$\leq3.60\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq6.82\times10^{-04}$	N/A	N/A
Myosmine	$\leq1.93\times10^{-05}$	0.07	N/A	N/A	N/A	$\leq2.86\times10^{-04}$	N/A	N/A
n-Butyraldehyde	$\leq1.76\times10^{-06}$	0.05	9.30×10^{-02}	1.99	a	$\leq3.33\times10^{-05}$	4.67×10^{-02}	↓ ≥99.93
Nickel	$\leq4.55\times10^{-07}$	0.05	$\leq1.29\times10^{-05}$	1.74	c	$\leq8.62\times10^{-06}$	$\leq7.41\times10^{-06}$	NC
Nicotine	1.05×10^{-01}	0.11	$1.99\times10^{+00}$	1.99	a	$1.00\times10^{+00}$	$1.00\times10^{+00}$	N/A

Nicotine-N-Oxide	≤8.72×10^{-06}	0.05	N/A	N/A	N/A	≤1.65×10^{-04}	N/A	N/A
NNK	≤7.53×10^{-09}	0.05	2.95×10^{-04}	1.99	a	≤1.43×10^{-07}	1.48×10^{-04}	↓ ≥99.90
NNN	≤4.92×10^{-09}	0.05	3.37×10^{-04}	1.99	a	≤9.32×10^{-08}	1.69×10^{-04}	↓ ≥99.94
Nornicotine	1.66×10^{-05}	0.07	N/A	N/A	N/A	2.47×10^{-04}	N/A	N/A
Propionic Acid	≤7.80×10^{-05}	0.04	N/A	N/A	N/A	≤1.79×10^{-03}	N/A	N/A
Propylene Glycol	9.19×10^{-01}	0.11	2.37×10^{-02}	1.74	c	8.71×10^{+00}	1.36×10^{-02}	63861.53
Propylene Oxide	≤1.56×10^{-06}	0.05	1.00×10^{+00}	1.99	a	≤2.96×10^{-05}	5.03×10^{-01}	↓ ≥99.99
Toluene	≤6.12×10^{-06}	0.05	1.53×10^{-01}	1.99	a	≤1.16×10^{-04}	7.69×10^{-02}	↓ ≥99.85
Water	4.57×10^{-01}	0.11	1.58×10^{+01}	1.89	e	4.33×10^{+00}	8.36×10^{+00}	↓ 48.2

Average % Difference, Excluding Glycerol, PG and Water. a: Jaccard et al. 2019 b: Moldoveanu et al. 2017 c: Helen et al. 2018 d: Uchiyama et al. 2018 e: Schaller et al. 2016 f: Pappas et al. 2014 g: Roemer et al. 2012 h: IQOS PMTA, 2019.

Table S8. Comparison of HPHC and Chemical Non-Intense Aerosol Levels in Virginia Tobacco 3.0% and Smoke Levels in 3R4F Reference Cigarette.

HPHC or Chemical	**JUUL Virginia Tobacco 3.0% (mg/puff)**		**3R4F (mg/cig)**			**Chemical and HPHC Normalized by Nicotine (mg/mg)**		**% Difference**
	HPHC Chemical	**Nicotine**	**HPHC Chemical**	**Nicotine**	**Source Journal**	**JUUL Virginia Tobacco 3.0%**	**3R4F**	**vs_3R4F**
1-Aminonaphthalene	≤8.19×10^{-10}	0.07	1.42×10^{-05}	0.70	a	≤1.22×10^{-08}	2.02×10^{-05}	↓ ≥99.94
1-Butanol	≤3.00×10^{-05}	0.03	N/A	N/A	N/A	≤1.02×10^{-03}	N/A	N/A
1,3-Butadiene	≤2.85×10^{-06}	0.07	3.79×10^{-02}	0.70	a	≤4.24×10^{-05}	5.40×10^{-02}	↓ ≥99.92
2-Aminonaphthalene	≤3.56×10^{-10}	0.07	8.77×10^{-06}	0.70	a	≤5.29×10^{-09}	1.25×10^{-05}	↓ ≥99.96
4-Aminobiphenyl	≤1.43×10^{-10}	0.07	1.54×10^{-06}	0.70	a	≤2.13×10^{-09}	2.19×10^{-06}	↓ ≥99.90
Acetaldehyde	3.47×10^{-05}	0.05	5.97×10^{-01}	0.70	a	6.49×10^{-04}	8.50×10^{-01}	↓ 99.92
Acetyl Propionyl	≤1.76×10^{-06}	0.03	2.95×10^{-02}	0.70	b	≤5.99×10^{-05}	4.21×10^{-02}	↓ ≥99.86
Acrolein	≤2.01×10^{-05}	0.06	5.32×10^{-02}	0.70	a	≤3.55×10^{-04}	7.58×10^{-02}	↓ ≥99.53
Acrylonitrile	≤3.20×10^{-06}	0.03	5.23×10^{-03}	0.70	a	≤1.09×10^{-04}	7.45×10^{-03}	↓ ≥98.53
Ammonia	≤3.99×10^{-05}	0.07	9.64×10^{-03}	0.70	a	≤5.92×10^{-04}	1.37×10^{-02}	↓ ≥95.69
Anabasine	≤2.87×10^{-06}	0.07	N/A	N/A	N/A	≤4.27×10^{-05}	N/A	N/A
Anatabine	≤2.38×10^{-06}	0.07	N/A	N/A	N/A	≤3.53×10^{-05}	N/A	N/A
Benzene	≤1.71×10^{-06}	0.03	3.36×10^{-02}	0.70	a	≤5.82×10^{-05}	4.79×10^{-02}	↓ ≥99.88
Benzo(a)pyrene	≤5.31×10^{-09}	0.07	6.30×10^{-06}	0.70	a	≤7.89×10^{-08}	8.97×10^{-06}	↓ ≥99.12
Benzoic Acid	4.79×10^{-02}	0.06	N/A	N/A	N/A	8.46×10^{-01}	N/A	N/A
Benzyl Acetate	≤3.00×10^{-05}	0.03	N/A	N/A	N/A	≤1.02×10^{-03}	N/A	N/A
β-Nicotyrine	≤8.25×10^{-06}	0.06	N/A	N/A	N/A	≤1.46×10^{-04}	N/A	N/A
Cadmium	≤5.25×10^{-09}	0.03	2.45×10^{-05}	0.70	a	≤1.79×10^{-07}	3.49×10^{-05}	↓ ≥99.49
Carbon Monoxide	≤5.25×10^{-03}	0.07	1.00×10^{+01}	0.70	a	≤7.80×10^{-02}	1.42×10^{+01}	↓ ≥99.45
Chromium	NDFB	0.03	≤8.80×10^{-07}	0.70	f	NDFB	≤1.25×10^{-06}	NC

Copper	≤2.84×10^{-07}	0.03	N/A	N/A	N/A	≤9.70×10^{-06}	N/A	N/A
Cotinine	≤4.06×10^{-06}	0.03	N/A	N/A	N/A	≤1.39×10^{-04}	N/A	N/A
Crotonaldehyde	≤3.11×10^{-06}	0.03	9.89×10^{-03}	0.70	a	≤1.06×10^{-04}	1.41×10^{-02}	↓ ≥99.25
Diacetyl	≤8.70×10^{-07}	0.03	1.15×10^{-01}	0.70	b	≤2.97×10^{-05}	1.64×10^{-01}	↓ ≥99.98
Diethylene Glycol	≤1.20×10^{-04}	0.03	N/A	N/A	N/A	≤4.09×10^{-03}	N/A	N/A
Ethyl Acetate	≤1.30×10^{-04}	0.03	N/A	N/A	N/A	≤4.43×10^{-03}	N/A	N/A
Ethyl Acetoacetate	≤2.40×10^{-06}	0.03	N/A	N/A	N/A	≤8.19×10^{-05}	N/A	N/A
Ethylene Glycol	≤1.09×10^{-04}	0.03	N/A	N/A	N/A	≤3.73×10^{-03}	N/A	N/A
Formaldehyde	7.24×10^{-05}	0.05	2.47×10^{-02}	0.70	a	1.35×10^{-03}	3.52×10^{-02}	↓ 96.16
Furfural	≤4.20×10^{-05}	0.03	1.40×10^{-02}	0.76	d	≤1.43×10^{-03}	1.84×10^{-02}	↓ ≥92.22
Glycerol	1.23×10^{+00}	0.05	2.70×10^{+00}	0.70	a	2.31×10^{+01}	3.85×10^{+00}	499.45
Glycidol	NR	0.03	N/A	N/A	N/A	NR	N/A	N/A
Gold	≤6.33×10^{-09}	0.07	N/A	N/A	N/A	≤9.41×10^{-08}	N/A	N/A
Isoamyl Acetate	≤4.80×10^{-05}	0.03	N/A	N/A	N/A	≤1.64×10^{-03}	N/A	N/A
Isobutyl Acetate	≤3.00×10^{-05}	0.03	N/A	N/A	N/A	≤1.02×10^{-03}	N/A	N/A
Isobutyraldehyde	≤8.26×10^{-07}	0.03	N/A	N/A	N/A	≤2.82×10^{-05}	N/A	N/A
Isoprene	≤4.06×10^{-06}	0.07	2.88×10^{-01}	0.70	a	≤6.03×10^{-05}	4.10×10^{-01}	↓ ≥99.99
Lead	≤4.55×10^{-08}	0.03	9.20×10^{-06}	0.70	f	≤1.55×10^{-06}	1.31×10^{-05}	↓ ≥88.16
Menthol	≤1.22×10^{-04}	0.03	≤1.00×10^{-05}	0.76	a	≤4.17×10^{-03}	≤1.32×10^{-05}	NC
Methyl Acetate	≤3.60×10^{-05}	0.03	N/A	N/A	N/A	≤1.23×10^{-03}	N/A	N/A
Myosmine	≤1.93×10^{-05}	0.07	N/A	N/A	N/A	≤2.86×10^{-04}	N/A	N/A
n-Butyraldehyde	≤1.76×10^{-06}	0.03	2.84×10^{-02}	0.70	a	≤5.99×10^{-05}	4.05×10^{-02}	↓ ≥99.85
Nickel	≤4.55×10^{-07}	0.06	≤3.80×10^{-07}	0.70	f	≤8.03×10^{-06}	≤5.41×10^{-07}	NC
Nicotine	5.67×10^{-02}	0.06	7.02×10^{-01}	0.70	a	1.00×10^{+00}	1.00×10^{+00}	N/A
Nicotine-N-Oxide	≤8.72×10^{-06}	0.03	N/A	N/A	N/A	≤2.97×10^{-04}	N/A	N/A
NNK	≤7.53×10^{-09}	0.03	1.13×10^{-04}	0.70	a	≤2.57×10^{-07}	1.61×10^{-04}	↓ ≥99.84
NNN	≤4.92×10^{-09}	0.03	1.31×10^{-04}	0.70	a	≤1.68×10^{-07}	1.87×10^{-04}	↓ ≥99.91
Nornicotine	1.66×10^{-05}	0.07	N/A	N/A	N/A	2.47×10^{-04}	N/A	N/A
Propionic Acid	≤7.80×10^{-05}	0.03	N/A	N/A	N/A	≤2.66×10^{-03}	N/A	N/A
Propylene Glycol	5.01×10^{-01}	0.06	3.20×10^{-03}	0.76	d	8.85×10^{+00}	4.21×10^{-03}	210011.2
Propylene Oxide	≤1.56×10^{-06}	0.03	2.97×10^{-01}	0.70	a	≤5.32×10^{-05}	4.23×10^{-01}	↓ ≥99.99
Toluene	≤6.12×10^{-06}	0.03	5.14×10^{-02}	0.70	a	≤2.09×10^{-04}	7.32×10^{-02}	↓ ≥99.72
Water	2.75×10^{-01}	0.05	3.20×10^{+00}	0.76	d	5.13×10^{+00}	4.21×10^{+00}	21.78

Average % Difference, Excluding Glycerol, PG and Water. a: Jaccard et al. 2019 b: Moldoveanu et al. 2017 c: Helen et al. 2018 d: Uchiyama et al. 2018 e: Schaller et al. 2016 f: Pappas et al. 2014 g: Roemer et al. 2012 h: IQOS PMTA, 2019.

Table S9. Comparison of HPHC and Chemical Intense Aerosol Levels in Virginia Tobacco 3.0% and Aerosol Levels in IQOS Regular.

HPHC or Chemical	JUUL Virginia Tobacco 3.0% (mg/puff)		IQOS (mg/cig)			Chemical and HPHC Normalized by Nicotine (mg/mg)		% Difference
	HPHC or Chemical	Nicotine	HPHC or Chemical	Nicotine	Source Journal	JUUL Virginia Tobacco 3.0%	3R4F	vs_3R4F
1-Aminonaphthalene	≤8.19×10^{-10}	0.07	7.70×10^{-08}	1.32	e	≤1.22×10^{-08}	5.83×10^{-08}	↓ ≥79.16
1-Butanol	≤3.00×10^{-05}	0.05	N/A	N/A	N/A	≤5.68×10^{-04}	N/A	N/A
1,3-Butadiene	≤2.85×10^{-06}	0.07	2.94×10^{-04}	1.32	e	≤4.23×10^{-05}	2.23×10^{-04}	↓ ≥80.99
2-Aminonaphthalene	≤3.56×10^{-10}	0.07	4.60×10^{-08}	1.32	e	≤5.29×10^{-09}	3.48×10^{-08}	↓ ≥84.82
4-Aminobiphenyl	≤1.43×10^{-10}	0.07	9.00×10^{-09}	1.29	c	≤2.12×10^{-09}	6.98×10^{-09}	↓ ≥69.55
Acetaldehyde	4.35×10^{-05}	0.11	2.19×10^{-01}	1.32	e	4.13×10^{-04}	1.66×10^{-01}	$^{-99}$.75
Acetyl Propionyl	≤1.76×10^{-06}	0.05	N/A	N/A	N/A	≤3.33×10^{-05}	N/A	N/A
Acrolein	≤2.01×10^{-05}	0.11	1.13×10^{-02}	1.32	e	≤1.91×10^{-04}	8.56×10^{-03}	↓ ≥97.77
Acrylonitrile	≤3.20×10^{-06}	0.05	2.58×10^{-04}	1.32	e	≤6.06×10^{-05}	1.95×10^{-04}	↓ ≥68.99
Ammonia	≤3.99×10^{-05}	0.07	1.42×10^{-02}	1.32	e	≤5.92×10^{-04}	1.08×10^{-02}	↓ ≥94.50
Anabasine	≤2.87×10^{-06}	0.07	N/A	N/A	N/A	≤4.27×10^{-05}	N/A	N/A
Anatabine	≤2.38×10^{-06}	0.07	N/A	N/A	N/A	≤3.53×10^{-05}	N/A	N/A
Benzene	≤1.71×10^{-06}	0.05	6.49×10^{-04}	1.32	e	≤3.23×10^{-05}	4.92×10^{-04}	↓ ≥93.43
Benzo(a)pyrene	≤5.31×10^{-09}	0.07	7.36×10^{-07}	1.29	c	≤7.89×10^{-08}	5.71×10^{-07}	↓ ≥86.17
Benzoic Acid	8.41×10^{-02}	0.11	N/A	N/A	N/A	7.97×10^{-01}	N/A	N/A
Benzyl Acetate	≤3.00×10^{-05}	0.05	N/A	N/A	N/A	≤5.68×10^{-04}	N/A	N/A
β-Nicotyrine	≤8.25×10^{-06}	0.11	N/A	N/A	N/A	≤7.82×10^{-05}	N/A	N/A
Cadmium	≤5.25×10^{-09}	0.05	≤3.50×10^{-07}	1.32	e	≤9.94×10^{-08}	≤2.65×10^{-07}	NC
Carbon Monoxide	≤5.25×10^{-03}	0.07	5.31×10^{-01}	1.32	e	≤7.80×10^{-02}	4.02×10^{-01}	↓ ≥80.62
Chromium	NDFB	0.05	≤5.50×10^{-07}	1.32	e	NDFB	≤4.17×10^{-07}	NC
Copper	≤2.84×10^{-07}	0.05	N/A	N/A	N/A	≤5.39×10^{-06}	N/A	N/A
Cotinine	≤9.37×10^{-07}	0.05	N/A	N/A	N/A	≤1.78×10^{-05}	N/A	N/A
Crotonaldehyde	≤3.11×10^{-06}	0.05	4.14×10^{-03}	1.32	e	≤5.90×10^{-05}	3.14×10^{-03}	↓ ≥98.12
Diacetyl	≤8.70×10^{-07}	0.05	4.30×10^{-02}	1.20	d	≤1.65×10^{-05}	3.58×10^{-02}	↓ ≥99.95
Diethylene Glycol	≤1.20×10^{-04}	0.05	N/A	N/A	N/A	≤2.27×10^{-03}	N/A	N/A
Ethyl Acetate	≤1.30×10^{-04}	0.11	N/A	N/A	N/A	≤1.23×10^{-03}	N/A	N/A
Ethyl Acetoacetate	≤2.40×10^{-06}	0.05	N/A	N/A	N/A	≤4.54×10^{-05}	N/A	N/A
Ethylene Glycol	≤1.09×10^{-04}	0.05	N/A	N/A	N/A	≤2.07×10^{-03}	N/A	N/A
Formaldehyde	8.72×10^{-05}	0.11	5.53×10^{-03}	1.32	e	8.27×10^{-04}	4.19×10^{-03}	↓ 80.27
Furfural	≤4.20×10^{-05}	0.05	3.11×10^{-02}	1.29	c	≤7.95×10^{-04}	2.41×10^{-02}	↓ ≥96.70
Glycerol	2.40×10^{+00}	0.11	4.63×10^{+00}	1.32	e	2.27×10^{+01}	3.51×10^{+00}	547.53

Glycidol	NR	0.05	5.71×10^{-03}	1.29	c	NR	4.43×10^{-03}	N/A
Gold	$\leq6.33\times10^{-09}$	0.07	N/A	N/A	N/A	$\leq9.40\times10^{-08}$	N/A	N/A
Isoamyl Acetate	$\leq4.80\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq9.09\times10^{-04}$	N/A	N/A
Isobutyl Acetate	$\leq3.00\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq5.68\times10^{-04}$	N/A	N/A
Isobutyraldehyde	$\leq8.26\times10^{-07}$	0.05	N/A	N/A	N/A	$\leq1.57\times10^{-05}$	N/A	N/A
Isoprene	$\leq4.06\times10^{-06}$	0.07	2.35×10^{-03}	1.32	e	$\leq6.03\times10^{-05}$	1.78×10^{-03}	↓ ≥96.61
Lead	NDFB	0.05	2.23×10^{-06}	1.29	c	NDFB	1.73×10^{-06}	NC
Menthol	$\leq1.22\times10^{-04}$	0.05	4.10×10^{-04}	1.20	d	$\leq2.31\times10^{-03}$	3.42×10^{-04}	NC
Methyl Acetate	$\leq3.60\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq6.82\times10^{-04}$	N/A	N/A
Myosmine	$\leq1.93\times10^{-05}$	0.07	N/A	N/A	N/A	$\leq2.86\times10^{-04}$	N/A	N/A
n-Butyraldehyde	$\leq1.76\times10^{-06}$	0.05	2.61×10^{-02}	1.32	e	$\leq3.33\times10^{-05}$	1.98×10^{-02}	↓ ≥99.83
Nickel	$\leq4.55\times10^{-07}$	0.05	$\leq5.50\times10^{-07}$	1.32	e	$\leq8.62\times10^{-06}$	$\leq4.17\times10^{-07}$	NC
Nicotine	1.05×10^{-01}	0.11	$1.32\times10^{+00}$	1.32	e	$1.00\times10^{+00}$	$1.00\times10^{+00}$	N/A
Nicotine-N-Oxide	$\leq8.72\times10^{-06}$	0.05	N/A	N/A	N/A	$\leq1.65\times10^{-04}$	N/A	N/A
NNK	$\leq7.53\times10^{-09}$	0.05	6.70×10^{-06}	1.32	e	$\leq1.43\times10^{-07}$	5.08×10^{-06}	↓ ≥97.19
NNN	$\leq4.92\times10^{-09}$	0.05	1.72×10^{-05}	1.32	e	$\leq9.32\times10^{-08}$	1.30×10^{-05}	↓ ≥99.28
Nornicotine	1.66×10^{-05}	0.07	N/A	N/A	N/A	2.47×10^{-04}	N/A	N/A
Propionic Acid	$\leq7.80\times10^{-05}$	0.04	N/A	N/A	N/A	$\leq1.79\times10^{-03}$	N/A	N/A
Propylene Glycol	9.19×10^{-01}	0.11	1.75×10^{-01}	1.29	c	$8.71\times10^{+00}$	1.36×10^{-01}	6321.99
Propylene Oxide	$\leq1.56\times10^{-06}$	0.05	1.48×10^{-04}	1.32	e	$\leq2.96\times10^{-05}$	1.12×10^{-04}	↓ ≥73.64
Toluene	$\leq6.12\times10^{-06}$	0.05	2.59×10^{-03}	1.32	e	$\leq1.16\times10^{-04}$	1.96×10^{-03}	↓ ≥94.10
Water	4.57×10^{-01}	0.11	$3.65\times10^{+01}$	1.32	e	$4.33\times10^{+00}$	$2.77\times10^{+01}$	↓ 84.34

Average % Difference, Excluding Glycerol, PG and Water. a: Jaccard et al. 2019 b: Moldoveanu et al. 2017 c: Helen et al. 2018 d: Uchiyama et al. 2018 e: Schaller et al. 2016 f: Pappas et al. 2014 g: Roemer et al. 2012 h: IQOS PMTA, 2019.

Table S10. Comparison of HPHC and Chemical Intense Aerosol Levels in 10enthol 5.0% and Smoke Levels 3R4F Reference Cigarette.

HPHC or Chemical	**JUUL Menthol 5.0% (mg/puff)**		**3R4F (mg/cig)**			**Chemical and HPHC Normalized by Nicotine (mg/mg)**		**% Difference**
	HPHC Chemical	**Nicotine**	**HPHC Chemical**	**Nicotine**	**Source Journal**	**JUUL Virginia Tobacco 3.0%**	**3R4F**	**vs_3R4F**
1-Aminonaphthalene	$\leq8.19\times10^{-10}$	0.04	2.91×10^{-05}	1.99	a	$\leq2.25\times10^{-08}$	1.46×10^{-05}	↓ ≥99.85
1-Butanol	$\leq3.00\times10^{-05}$	0.07	N/A	N/A	N/A	$\leq4.33\times10^{-04}$	N/A	N/A
1,3-Butadiene	$\leq2.85\times10^{-06}$	0.04	1.00×10^{-01}	1.99	a	$\leq7.85\times10^{-05}$	5.03×10^{-02}	↓ ≥99.84
2-Aminonaphthalene	$\leq3.56\times10^{-10}$	0.04	1.81×10^{-05}	1.99	a	$\leq9.80\times10^{-09}$	9.10×10^{-06}	↓ ≥99.89
4-Aminobiphenyl	$\leq1.43\times10^{-10}$	0.04	3.91×10^{-06}	1.99	a	$\leq3.94\times10^{-09}$	1.96×10^{-06}	↓ ≥99.80

Acetaldehyde	3.57×10^{-05}	0.16	$1.84\times10^{+00}$	1.99	a	2.30×10^{-04}	9.24×10^{-01}	↓ 99.98
Acetyl Propionyl	$\leq1.76\times10^{-06}$	0.07	9.19×10^{-02}	1.99	b	$\leq2.54\times10^{-05}$	4.62×10^{-02}	↓ ≥99.95
Acrolein	$\leq2.01\times10^{-05}$	0.16	1.80×10^{-01}	1.99	a	$\leq1.29\times10^{-04}$	9.05×10^{-02}	↓ ≥99.86
Acrylonitrile	$\leq3.20\times10^{-06}$	0.07	2.05×10^{-02}	1.99	a	$\leq4.63\times10^{-05}$	1.03×10^{-02}	↓ ≥99.55
Ammonia	NDFB	0.04	3.40×10^{-02}	1.99	a	NDFB	1.71×10^{-02}	NC
Anabasine	$\leq1.24\times10^{-05}$	0.04	N/A	N/A	N/A	$\leq3.43\times10^{-04}$	N/A	N/A
Anatabine	$\leq1.03\times10^{-05}$	0.04	N/A	N/A	N/A	$\leq2.84\times10^{-04}$	N/A	N/A
Benzene	$\leq1.71\times10^{-06}$	0.07	8.88×10^{-02}	1.99	a	$\leq2.46\times10^{-05}$	4.46×10^{-02}	↓ ≥99.94
Benzo(a)pyrene	$\leq5.31\times10^{-09}$	0.04	1.51×10^{-05}	1.99	a	$\leq1.46\times10^{-07}$	7.59×10^{-06}	↓ ≥98.07
Benzoic Acid	1.17×10^{-01}	0.16	N/A	N/A	N/A	7.48×10^{-01}	N/A	N/A
Benzyl Acetate	$\leq3.00\times10^{-05}$	0.07	N/A	N/A	N/A	$\leq4.33\times10^{-04}$	N/A	N/A
β-Nicotyrine	1.33×10^{-05}	0.16	N/A	N/A	N/A	8.49×10^{-05}	N/A	N/A
Cadmium	$\leq5.25\times10^{-09}$	0.07	9.32×10^{-05}	1.99	a	$\leq7.59\times10^{-08}$	4.68×10^{-05}	↓ ≥99.84
Carbon Monoxide	$\leq5.25\times10^{-03}$	0.04	$3.05\times10^{+01}$	1.99	a	$\leq1.44\times10^{-01}$	$1.53\times10^{+01}$	↓ ≥99.06
Chromium	NDFB	0.07	$\leq1.19\times10^{-05}$	1.74	c	NDFB	$\leq6.84\times10^{-06}$	NC
Copper	$\leq6.56\times10^{-08}$	0.07	N/A	N/A	N/A	$\leq9.48\times10^{-07}$	N/A	N/A
Cotinine	$\leq4.06\times10^{-06}$	0.07	N/A	N/A	N/A	$\leq5.87\times10^{-05}$	N/A	N/A
Crotonaldehyde	$\leq3.11\times10^{-06}$	0.07	5.95×10^{-02}	1.99	a	$\leq4.50\times10^{-05}$	2.99×10^{-02}	↓ ≥99.85
Diacetyl	$\leq8.70\times10^{-07}$	0.07	3.37×10^{-01}	1.99	a	$\leq1.26\times10^{-05}$	1.69×10^{-01}	↓ ≥99.99
Diethylene Glycol	$\leq1.20\times10^{-04}$	0.07	N/A	N/A	N/A	$\leq1.73\times10^{-03}$	N/A	N/A
Ethyl Acetate	$\leq1.30\times10^{-04}$	0.16	N/A	N/A	N/A	$\leq8.32\times10^{-04}$	N/A	N/A
Ethyl Acetoacetate	$\leq2.40\times10^{-06}$	0.07	N/A	N/A	N/A	$\leq3.47\times10^{-05}$	N/A	N/A
Ethylene Glycol	$\leq1.09\times10^{-04}$	0.16	N/A	N/A	N/A	$\leq7.05\times10^{-04}$	N/A	N/A
Formaldehyde	7.56×10^{-05}	0.16	8.71×10^{-02}	1.99	a	4.88×10^{-04}	4.38×10^{-02}	↓ 98.89
Furfural	$\leq4.20\times10^{-05}$	0.07	2.59×10^{-02}	1.74	c	$\leq6.07\times10^{-04}$	1.49×10^{-02}	↓ ≥95.92
Glycerol	$1.99\times10^{+00}$	0.16	$2.70\times10^{+00}$	1.99	a	$1.29\times10^{+01}$	$1.36\times10^{+00}$	847.29
Glycidol	NR	0.07	1.76×10^{-03}	1.99	a	NR	8.84×10^{-04}	N/A
Gold	$\leq6.33\times10^{-09}$	0.04	N/A	N/A	N/A	$\leq1.74\times10^{-07}$	N/A	N/A
Isoamyl Acetate	$\leq4.80\times10^{-05}$	0.07	N/A	N/A	N/A	$\leq6.94\times10^{-04}$	N/A	N/A
Isobutyl Acetate	$\leq3.00\times10^{-05}$	0.07	N/A	N/A	N/A	$\leq4.33\times10^{-04}$	N/A	N/A
Isobutyraldehyde	$\leq3.58\times10^{-06}$	0.07	N/A	N/A	N/A	$\leq5.17\times10^{-05}$	N/A	N/A
Isoprene	$\leq4.06\times10^{-06}$	0.04	7.99×10^{-01}	1.99	a	$\leq1.12\times10^{-04}$	4.02×10^{-01}	↓ ≥99.97
Lead	$\leq4.55\times10^{-08}$	0.07	3.12×10^{-05}	1.74	c	$\leq6.57\times10^{-07}$	1.79×10^{-05}	↓ ≥96.33
Menthol	2.90×10^{-02}	0.16	$\leq1.00\times10^{-05}$	2.10	d	1.87×10^{-01}	$\leq4.76\times10^{-06}$	NC
Methyl Acetate	$\leq3.60\times10^{-05}$	0.07	N/A	N/A	N/A	$\leq5.20\times10^{-04}$	N/A	N/A
Myosmine	$\leq1.93\times10^{-05}$	0.04	N/A	N/A	N/A	$\leq5.30\times10^{-04}$	N/A	N/A
n-Butyraldehyde	$\leq1.76\times10^{-06}$	0.07	9.30×10^{-02}	1.99	a	$\leq2.54\times10^{-05}$	4.67×10^{-02}	↓ ≥99.95
Nickel	$\leq4.55\times10^{-07}$	0.07	$\leq1.29\times10^{-05}$	1.74	c	$\leq6.57\times10^{-06}$	$\leq7.41\times10^{-06}$	NC
Nicotine	1.56×10^{-01}	0.16	$1.99\times10^{+00}$	1.99	a	$1.00\times10^{+00}$	$1.00\times10^{+00}$	N/A

Nicotine-N-Oxide	≤8.72×10^{-06}	0.07	N/A	N/A	N/A	≤1.26×10^{-04}	N/A	N/A
NNK	≤7.53×10^{-09}	0.07	2.95×10^{-04}	1.99	a	≤1.09×10^{-07}	1.48×10^{-04}	↓ ≥99.93
NNN	≤4.92×10^{-09}	0.07	3.37×10^{-04}	1.99	a	≤7.11×10^{-08}	1.69×10^{-04}	↓ ≥99.96
Nornicotine	1.99×10^{-05}	0.04	N/A	N/A	N/A	5.48×10^{-04}	N/A	N/A
Propionic Acid	≤7.80×10^{-05}	0.07	N/A	N/A	N/A	≤1.13×10^{-03}	N/A	N/A
Propylene Glycol	7.83×10^{-01}	0.16	2.37×10^{-02}	1.74	c	5.05×10^{+00}	1.36×10^{-02}	37003.23
Propylene Oxide	≤1.56×10^{-06}	0.07	1.00×10^{+00}	1.99	a	≤2.26×10^{-05}	5.03×10^{-01}	↓ ≥99.996
Toluene	≤6.12×10^{-06}	0.07	1.53×10^{-01}	1.99	a	≤8.84×10^{-05}	7.69×10^{-02}	↓ ≥99.89
Water	3.84×10^{-01}	0.16	1.58×10^{+01}	1.89	e	2.47×10^{+00}	8.36×10^{+00}	↓ 70.40

Average % Difference, Excluding Glycerol, PG and Water. a: Jaccard et al. 2019 b: Moldoveanu et al. 2017 c: Helen et al. 2018 d: Uchiyama et al. 2018 e: Schaller et al. 2016 f: Pappas et al. 2014 g: Roemer et al. 2012 h: IQOS PMTA, 2019.

Table S11. Comparison of HPHC and Chemical Non-Intense Aerosol Levels in Menthol 5.0% and Smoke Levels in 3R4F Reference Cigarette.

HPHC or Chemical	**JUUL Menthol 5.0% (mg/puff)**		**3R4F (mg/cig)**			**Chemical and HPHC Normalized by Nicotine (mg/mg)**		**% Difference**
	HPHC or Chemical	**Nicotine**	**HPHC or Chemical**	**Nicotine**	**Source Journal**	**JUUL Virginia Tobacco 3.0%**	**3R4F**	**vs_3R4F**
1-Aminonaphthalene	≤8.19×10^{-10}	0.04	1.42×10^{-05}	0.70	a	≤2.25×10^{-08}	2.02×10^{-05}	↓ ≥99.89
1-Butanol	≤3.00×10^{-05}	0.04	N/A	N/A	N/A	≤7.45×10^{-04}	N/A	N/A
1,3-Butadiene	≤2.85×10^{-06}	0.04	3.79×10^{-02}	0.70	a	≤7.85×10^{-05}	5.40×10^{-02}	↓ ≥99.85
2-Aminonaphthalene	≤3.56×10^{-10}	0.04	8.77×10^{-06}	0.70	a	≤9.80×10^{-09}	1.25×10^{-05}	↓ ≥99.92
4-Aminobiphenyl	≤1.43×10^{-10}	0.04	1.54×10^{-06}	0.70	a	≤3.94×10^{-09}	2.19×10^{-06}	↓ ≥99.82
Acetaldehyde	≤2.16×10^{-05}	0.04	5.97×10^{-01}	0.70	a	≤5.35×10^{-04}	8.50×10^{-01}	↓ ≥99.94
Acetyl Propionyl	≤1.76×10^{-06}	0.04	2.95×10^{-02}	0.70	b	≤4.36×10^{-05}	4.21×10^{-02}	↓ ≥99.90
Acrolein	≤2.01×10^{-05}	0.08	5.32×10^{-02}	0.70	a	≤2.44×10^{-04}	7.58×10^{-02}	↓ ≥99.68
Acrylonitrile	≤3.20×10^{-06}	0.04	5.23×10^{-03}	0.70	a	≤7.95×10^{-05}	7.45×10^{-03}	↓ ≥98.93
Ammonia	NDFB	0.04	9.64×10^{-03}	0.70	a	NDFB	1.37×10^{-02}	NC
Anabasine	≤1.24×10^{-05}	0.04	N/A	N/A	N/A	≤3.43×10^{-04}	N/A	N/A
Anatabine	≤1.03×10^{-05}	0.04	N/A	N/A	N/A	≤2.84×10^{-04}	N/A	N/A
Benzene	≤1.71×10^{-06}	0.04	3.36×10^{-02}	0.70	a	≤4.24×10^{-05}	4.79×10^{-02}	↓ ≥99.91
Benzo(a)pyrene	≤5.31×10^{-09}	0.04	6.30×10^{-06}	0.70	a	≤1.46×10^{-07}	8.97×10^{-06}	↓ ≥98.37
Benzoic Acid	7.30×10^{-02}	0.09	N/A	N/A	N/A	8.17×10^{-01}	N/A	N/A
Benzyl Acetate	≤3.00×10^{-05}	0.04	N/A	N/A	N/A	≤7.45×10^{-04}	N/A	N/A
β-Nicotyrine	≤8.25×10^{-06}	0.09	N/A	N/A	N/A	≤9.24×10^{-05}	N/A	N/A
Cadmium	≤5.25×10^{-09}	0.04	2.45×10^{-05}	0.70	a	≤1.30×10^{-07}	3.49×10^{-05}	↓ ≥99.63
Carbon Monoxide	≤5.25×10^{-03}	0.04	1.00×10^{+01}	0.70	a	≤1.44×10^{-01}	1.42×10^{+01}	↓ ≥98.99
Chromium	NDFB	0.04	≤8.80×10^{-07}	0.70	f	NDFB	≤1.25×10^{-06}	NC

Copper	≤6.56×10^{-08}	0.04	N/A	N/A	N/A	≤1.63×10^{-06}	N/A	N/A
Cotinine	≤4.06×10^{-06}	0.04	N/A	N/A	N/A	≤1.01×10^{-04}	N/A	N/A
Crotonaldehyde	≤3.11×10^{-06}	0.04	9.89×10^{-03}	0.70	a	≤7.73×10^{-05}	1.41×10^{-02}	↓ ≥99.45
Diacetyl	≤8.70×10^{-07}	0.04	1.15×10^{-01}	0.70	b	≤2.16×10^{-05}	1.64×10^{-01}	↓ ≥99.99
Diethylene Glycol	≤1.20×10^{-04}	0.04	N/A	N/A	N/A	≤2.98×10^{-03}	N/A	N/A
Ethyl Acetate	≤3.00×10^{-05}	0.04	N/A	N/A	N/A	≤7.45×10^{-04}	N/A	N/A
Ethyl Acetoacetate	≤2.40×10^{-06}	0.04	N/A	N/A	N/A	≤5.96×10^{-05}	N/A	N/A
Ethylene Glycol	≤1.09×10^{-04}	0.04	N/A	N/A	N/A	≤2.71×10^{-03}	N/A	N/A
Formaldehyde	3.94×10^{-05}	0.09	2.47×10^{-02}	0.70	a	4.41×10^{-04}	3.52×10^{-02}	↓ 98.75
Furfural	≤4.20×10^{-05}	0.04	1.40×10^{-02}	0.76	d	≤1.04×10^{-03}	1.84×10^{-02}	↓ ≥94.34
Glycerol	$1.23\times10^{+00}$	0.09	$2.70\times10^{+00}$	0.70	a	$1.38\times10^{+01}$	$3.85\times10^{+00}$	258.69
Glycidol	NR	0.04	N/A	N/A	N/A	NR	N/A	N/A
Gold	≤6.33×10^{-09}	0.04	N/A	N/A	N/A	≤1.74×10^{-07}	N/A	N/A
Isoamyl Acetate	≤4.80×10^{-05}	0.04	N/A	N/A	N/A	≤1.19×10^{-03}	N/A	N/A
Isobutyl Acetate	≤3.00×10^{-05}	0.04	N/A	N/A	N/A	≤7.45×10^{-04}	N/A	N/A
Isobutyraldehyde	≤8.26×10^{-07}	0.04	N/A	N/A	N/A	≤2.05×10^{-05}	N/A	N/A
Isoprene	≤4.06×10^{-06}	0.04	2.88×10^{-01}	0.70	a	≤1.12×10^{-04}	4.10×10^{-01}	↓ ≥99.97
Lead	≤4.55×10^{-08}	0.08	9.20×10^{-06}	0.70	f	≤5.52×10^{-07}	1.31×10^{-05}	↓ ≥95.79
Menthol	1.81×10^{-02}	0.09	≤1.00×10^{-05}	0.76	a	2.02×10^{-01}	≤1.32×10^{-05}	NC
Methyl Acetate	≤3.60×10^{-05}	0.04	N/A	N/A	N/A	≤8.94×10^{-04}	N/A	N/A
Myosmine	≤1.93×10^{-05}	0.04	N/A	N/A	N/A	≤5.30×10^{-04}	N/A	N/A
n-Butyraldehyde	≤1.76×10^{-06}	0.04	2.84×10^{-02}	0.70	a	≤4.36×10^{-05}	4.05×10^{-02}	↓ ≥99.89
Nickel	≤4.55×10^{-07}	0.04	≤3.80×10^{-07}	0.70	f	≤1.13×10^{-05}	≤5.41×10^{-07}	NC
Nicotine	8.93×10^{-02}	0.09	7.02×10^{-01}	0.70	a	$1.00\times10^{+00}$	$1.00\times10^{+00}$	N/A
Nicotine-N-Oxide	≤8.72×10^{-06}	0.04	N/A	N/A	N/A	≤2.16×10^{-04}	N/A	N/A
NNK	≤7.53×10^{-09}	0.04	1.13×10^{-04}	0.70	a	≤1.87×10^{-07}	1.61×10^{-04}	↓ ≥99.88
NNN	≤4.92×10^{-09}	0.04	1.31×10^{-04}	0.70	a	≤1.22×10^{-07}	1.87×10^{-04}	↓ ≥99.93
Nornicotine	1.99×10^{-05}	0.04	N/A	N/A	N/A	5.48×10^{-04}	N/A	N/A
Propionic Acid	≤7.80×10^{-05}	0.04	N/A	N/A	N/A	≤1.94×10^{-03}	N/A	N/A
Propylene Glycol	4.24×10^{-01}	0.08	3.20×10^{-03}	0.76	d	$5.14\times10^{+00}$	4.21×10^{-03}	122083.26
Propylene Oxide	≤1.56×10^{-06}	0.04	2.97×10^{-01}	0.70	a	≤3.87×10^{-05}	4.23×10^{-01}	↓ ≥99.99
Toluene	≤6.12×10^{-06}	0.04	5.14×10^{-02}	0.70	a	≤1.52×10^{-04}	7.32×10^{-02}	↓ ≥99.79
Water	2.52×10^{-01}	0.09	$3.20\times10^{+00}$	0.76	d	$2.82\times10^{+00}$	$4.21\times10^{+00}$	↓ 33.00

Average % Difference, Excluding Glycerol, PG and Water. a: Jaccard et al. 2019 b: Moldoveanu et al. 2017 c: Helen et al. 2018 d: Uchiyama et al. 2018 e: Schaller et al. 2016 f: Pappas et al. 2014 g: Roemer et al. 2012 h: IQOS PMTA, 2019.

Table S12. Comparison of HPHC and Chemical Intense Aerosol Levels in Menthol 5.0% and Aerosol in IQOS Menthol.

HPHC or Chemical	JUUL Menthol 5.0% (mg/puff)		IQOS Menthol (mg/cig)			Chemical and HPHC Normalized by Nicotine (mg/mg)		% Difference
	HPHC or Chemical	Nicotine	HPHC or Chemical	Nicotine	Source Journal	JUUL Virginia Tobacco 3.0%	3R4F	vs_3R4F
1-Aminonaphthalene	≤8.19×10^{-10}	0.04	8.60×10^{-08}	1.21	e	≤2.25×10^{-08}	7.11×10^{-08}	↓ ≥68.30
1-Butanol	≤3.00×10^{-05}	0.07	N/A	N/A	N/A	≤4.33×10^{-04}	N/A	N/A
1,3-Butadiene	≤2.85×10^{-06}	0.04	2.65×10^{-04}	1.21	e	≤7.85×10^{-05}	2.19×10^{-04}	↓ ≥64.17
2-Aminonaphthalene	≤3.56×10^{-10}	0.04	≤3.50×10^{-08}	1.21	e	≤9.80×10^{-09}	≤2.89×10^{-08}	NC
4-Aminobiphenyl	≤1.43×10^{-10}	0.04	≤5.10×10^{-08}	1.21	e	≤3.94×10^{-09}	≤4.21×10^{-08}	NC
Acetaldehyde	3.57×10^{-05}	0.16	2.05×10^{-01}	1.21	e	2.30×10^{-04}	1.69×10^{-01}	↓ 99.86
Acetyl Propionyl	≤1.76×10^{-06}	0.07	N/A	N/A	N/A	≤2.54×10^{-05}	N/A	N/A
Acrolein	≤2.01×10^{-05}	0.16	9.15×10^{-03}	1.21	e	≤1.29×10^{-04}	7.56×10^{-03}	↓ ≥98.30
Acrylonitrile	≤3.20×10^{-06}	0.07	2.20×10^{-04}	1.21	e	≤4.63×10^{-05}	1.82×10^{-04}	↓ ≥74.56
Ammonia	NDFB	0.04	1.38×10^{-02}	1.21	e	NDFB	1.14×10^{-02}	NC
Anabasine	≤1.24×10^{-05}	0.04	N/A	N/A	N/A	≤3.43×10^{-04}	N/A	N/A
Anatabine	≤1.03×10^{-05}	0.04	N/A	N/A	N/A	≤2.84×10^{-04}	N/A	N/A
Benzene	≤1.71×10^{-06}	0.07	6.40×10^{-04}	1.21	e	≤2.46×10^{-05}	5.29×10^{-04}	↓ ≥95.34
Benzo(a)pyrene	≤5.31×10^{-09}	0.04	1.29×10^{-06}	1.21	e	≤1.46×10^{-07}	1.07×10^{-06}	↓ ≥86.29
Benzoic Acid	1.17×10^{-01}	0.16	N/A	N/A	N/A	7.48×10^{-01}	N/A	N/A
Benzyl Acetate	≤3.00×10^{-05}	0.07	N/A	N/A	N/A	≤4.33×10^{-04}	N/A	N/A
β-Nicotyrine	1.33×10^{-05}	0.16	N/A	N/A	N/A	8.49×10^{-05}	N/A	N/A
Cadmium	≤5.25×10^{-09}	0.07	≤3.50×10^{-07}	1.21	e	≤7.59×10^{-08}	≤2.89×10^{-07}	NC
Carbon Monoxide	≤5.25×10^{-03}	0.04	5.94×10^{-01}	1.21	e	≤1.44×10^{-01}	4.91×10^{-01}	↓ ≥70.57
Chromium	NDFB	0.07	≤5.50×10^{-07}	1.21	e	NDFB	≤4.55×10^{-07}	NC
Copper	≤6.56×10^{-08}	0.07	N/A	N/A	N/A	≤9.48×10^{-07}	N/A	N/A
Cotinine	≤4.06×10^{-06}	0.07	N/A	N/A	N/A	≤5.87×10^{-05}	N/A	N/A
Crotonaldehyde	≤3.11×10^{-06}	0.07	3.24×10^{-03}	1.21	e	≤4.50×10^{-05}	2.68×10^{-03}	↓ ≥98.32
Diacetyl	≤8.70×10^{-07}	0.07	6.50×10^{-02}	1.20	d	≤1.26×10^{-05}	5.42×10^{-02}	↓ ≥99.98
Diethylene Glycol	≤1.20×10^{-04}	0.07	N/A	N/A	N/A	≤1.73×10^{-03}	N/A	N/A
Ethyl Acetate	≤1.30×10^{-04}	0.16	N/A	N/A	N/A	≤8.32×10^{-04}	N/A	N/A
Ethyl Acetoacetate	≤2.40×10^{-06}	0.07	N/A	N/A	N/A	≤3.47×10^{-05}	N/A	N/A
Ethylene Glycol	≤1.09×10^{-04}	0.16	N/A	N/A	N/A	≤7.05×10^{-04}	N/A	N/A
Formaldehyde	7.56×10^{-05}	0.16	4.55×10^{-03}	1.21	e	4.88×10^{-04}	3.76×10^{-03}	↓ 87.03
Furfural	≤4.20×10^{-05}	0.07	N/A	N/A	N/A	≤6.07×10^{-04}	N/A	N/A
Glycerol	1.99×10^{+00}	0.16	3.94×10^{+00}	N/A	N/A	1.29×10^{+01}	3.26×10^{+00}	294.71

Glycidol	NR	0.07	1.10×10^{-03}	1.19	h	NR	9.24×10^{-04}	N/A
Gold	$\leq6.33\times10^{-09}$	0.04	N/A	N/A	N/A	$\leq1.74\times10^{-07}$	N/A	N/A
Isoamyl Acetate	$\leq4.80\times10^{-05}$	0.07	N/A	N/A	N/A	$\leq6.94\times10^{-04}$	N/A	N/A
Isobutyl Acetate	$\leq3.00\times10^{-05}$	0.07	N/A	N/A	N/A	$\leq4.33\times10^{-04}$	N/A	N/A
Isobutyraldehyde	$\leq3.58\times10^{-06}$	0.07	N/A	N/A	N/A	$\leq5.17\times10^{-05}$	N/A	N/A
Isoprene	$\leq4.06\times10^{-06}$	0.04	2.11×10^{-03}	1.21	e	$\leq1.12\times10^{-04}$	1.74×10^{-03}	↓ ≥93.59
Lead	$\leq4.55\times10^{-08}$	0.07	$\leq3.35\times10^{-06}$	1.21	e	$\leq6.57\times10^{-07}$	$\leq2.77\times10^{-06}$	NC
Menthol	2.90×10^{-02}	0.16	$2.62\times10^{+00}$	1.21	e	1.87×10^{-01}	$2.17\times10^{+00}$	↓ 91.37
Methyl Acetate	$\leq3.60\times10^{-05}$	0.07	N/A	N/A	N/A	$\leq5.20\times10^{-04}$	N/A	N/A
Myosmine	$\leq1.93\times10^{-05}$	0.04	N/A	N/A	N/A	$\leq5.30\times10^{-04}$	N/A	N/A
n-Butyraldehyde	$\leq1.76\times10^{-06}$	0.07	2.67×10^{-02}	1.21	e	$\leq2.54\times10^{-05}$	2.21×10^{-02}	↓ ≥99.89
Nickel	$\leq4.55\times10^{-07}$	0.07	$\leq5.50\times10^{-07}$	1.21	e	$\leq6.57\times10^{-06}$	$\leq4.55\times10^{-07}$	NC
Nicotine	1.56×10^{-01}	0.16	$1.21\times10^{+00}$	1.21	e	$1.00\times10^{+00}$	$1.00\times10^{+00}$	N/A
Nicotine-N-Oxide	$\leq8.72\times10^{-06}$	0.07	N/A	N/A	N/A	$\leq1.26\times10^{-04}$	N/A	N/A
NNK	$\leq7.53\times10^{-09}$	0.07	5.90×10^{-06}	N/A	N/A	$\leq1.09\times10^{-07}$	4.88×10^{-06}	↓ ≥97.77
NNN	$\leq4.92\times10^{-09}$	0.07	1.37×10^{-05}	1.21	e	$\leq7.11\times10^{-08}$	1.13×10^{-05}	↓ ≥99.37
Nornicotine	1.99×10^{-05}	0.04	N/A	N/A	N/A	5.48×10^{-04}	N/A	N/A
Propionic Acid	$\leq7.80\times10^{-05}$	0.07	N/A	N/A	N/A	$\leq1.13\times10^{-03}$	N/A	N/A
Propylene Glycol	7.83×10^{-01}	0.16	3.90×10^{-01}	1.20	d	$5.05\times10^{+00}$	3.25×10^{-01}	1454.99
Propylene Oxide	$\leq1.56\times10^{-06}$	0.07	1.49×10^{-04}	1.21	e	$\leq2.26\times10^{-05}$	1.23×10^{-04}	↓ ≥81.69
Toluene	$\leq6.12\times10^{-06}$	0.07	2.39×10^{-03}	1.21	e	$\leq8.84\times10^{-05}$	1.98×10^{-03}	↓ ≥95.53
Water	3.84×10^{-01}	0.16	$2.97\times10^{+01}$	1.21	e	$2.47\times10^{+00}$	$2.45\times10^{+01}$	↓ 89.92

Average % Difference, Excluding Glycerol, PG and Water. a: Jaccard et al. 2019 b: Moldoveanu et al. 2017 c: Helen et al. 2018 d: Uchiyama et al. 2018 e: Schaller et al. 2016 f: Pappas et al. 2014 g: Roemer et al. 2012 h: IQOS PMTA, 2019.

Table S13. Comparison of HPHC and Chemical Intense Aerosol Levels in Menthol 13.0% and Smoke Levels 3R4F Reference Cigarette.

HPHC or Chemical	**JUUL Menthol 3.0% (mg/puff)**		**3R4F (mg/cig)**			**Chemical and HPHC Normalized by Nicotine (mg/mg)**		**% Difference**
	HPHC Chemical	**Nicotine**	**HPHC Chemical**	**Nicotine**	**Source Journal**	**JUUL Virginia Tobacco 3.0%**	**3R4F**	**vs_3R4F**
1-Aminonaphthalene	$\leq3.31\times10^{-10}$	0.03	2.91×10^{-05}	1.99	a	$\leq9.66\times10^{-09}$	1.46×10^{-05}	↓ ≥99.93
1-Butanol	$\leq3.00\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq6.58\times10^{-04}$	N/A	N/A
1,3-Butadiene	$\leq1.61\times10^{-05}$	0.03	1.00×10^{-01}	1.99	a	$\leq4.69\times10^{-04}$	5.03×10^{-02}	↓ ≥99.07
2-Aminonaphthalene	$\leq3.37\times10^{-10}$	0.03	1.81×10^{-05}	1.99	a	$\leq9.84\times10^{-09}$	9.10×10^{-06}	↓ ≥99.89
4-Aminobiphenyl	$\leq1.66\times10^{-10}$	0.03	3.91×10^{-06}	1.99	a	$\leq4.85\times10^{-09}$	1.96×10^{-06}	↓ ≥99.75

Acetaldehyde	3.56×10^{-05}	0.11	$1.84\times10^{+00}$	1.99	a	3.31×10^{-04}	9.24×10^{-01}	↓ 99.96
Acetyl Propionyl	$\leq1.76\times10^{-06}$	0.05	9.19×10^{-02}	1.99	b	$\leq3.85\times10^{-05}$	4.62×10^{-02}	↓ ≥99.92
Acrolein	$\leq2.01\times10^{-05}$	0.09	1.80×10^{-01}	1.99	a	$\leq2.14\times10^{-04}$	9.05×10^{-02}	↓ ≥99.76
Acrylonitrile	$\leq3.20\times10^{-06}$	0.05	2.05×10^{-02}	1.99	a	$\leq7.02\times10^{-05}$	1.03×10^{-02}	↓ ≥99.32
Ammonia	$\leq6.64\times10^{-05}$	0.03	3.40×10^{-02}	1.99	a	$\leq1.94\times10^{-03}$	1.71×10^{-02}	↓ ≥88.65
Anabasine	$\leq3.64\times10^{-06}$	0.03	N/A	N/A	N/A	$\leq1.06\times10^{-04}$	N/A	N/A
Anatabine	$\leq3.30\times10^{-06}$	0.03	N/A	N/A	N/A	$\leq9.62\times10^{-05}$	N/A	N/A
Benzene	$\leq1.71\times10^{-06}$	0.05	8.88×10^{-02}	1.99	a	$\leq3.74\times10^{-05}$	4.46×10^{-02}	↓ ≥99.92
Benzo(a)pyrene	$\leq9.31\times10^{-10}$	0.03	1.51×10^{-05}	1.99	a	$\leq2.72\times10^{-08}$	7.59×10^{-06}	↓ ≥99.64
Benzoic Acid	8.57×10^{-02}	0.11	N/A	N/A	N/A	7.97×10^{-01}	N/A	N/A
Benzyl Acetate	$\leq3.00\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq6.58\times10^{-04}$	N/A	N/A
β-Nicotyrine	$\leq8.25\times10^{-06}$	0.09	N/A	N/A	N/A	$\leq8.79\times10^{-05}$	N/A	N/A
Cadmium	$\leq5.25\times10^{-09}$	0.05	9.32×10^{-05}	1.99	a	$\leq1.15\times10^{-07}$	4.68×10^{-05}	↓ ≥99.75
Carbon Monoxide	NT	0.03	$3.05\times10^{+01}$	1.99	a	NT	$1.53\times10^{+01}$	N/A
Chromium	NDFB	0.05	$\leq1.19\times10^{-05}$	1.74	c	NDFB	$\leq6.84\times10^{-06}$	NC
Copper	$\leq2.84\times10^{-07}$	0.09	N/A	N/A	N/A	$\leq3.03\times10^{-06}$	N/A	N/A
Cotinine	$\leq4.06\times10^{-06}$	0.05	N/A	N/A	N/A	$\leq8.92\times10^{-05}$	N/A	N/A
Crotonaldehyde	$\leq3.11\times10^{-06}$	0.05	5.95×10^{-02}	1.99	a	$\leq6.83\times10^{-05}$	2.99×10^{-02}	↓ ≥99.77
Diacetyl	$\leq8.70\times10^{-07}$	0.05	3.37×10^{-01}	1.99	a	$\leq1.91\times10^{-05}$	1.69×10^{-01}	↓ ≥99.99
Diethylene Glycol	$\leq1.20\times10^{-04}$	0.05	N/A	N/A	N/A	$\leq2.63\times10^{-03}$	N/A	N/A
Ethyl Acetate	$\leq1.30\times10^{-04}$	0.05	N/A	N/A	N/A	$\leq2.85\times10^{-03}$	N/A	N/A
Ethyl Acetoacetate	$\leq2.40\times10^{-06}$	0.05	N/A	N/A	N/A	$\leq5.27\times10^{-05}$	N/A	N/A
Ethylene Glycol	$\leq2.52\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq5.54\times10^{-04}$	N/A	N/A
Formaldehyde	4.47×10^{-05}	0.11	8.71×10^{-02}	1.99	a	4.16×10^{-04}	4.38×10^{-02}	↓ 99.05
Furfural	$\leq4.20\times10^{-05}$	0.05	2.59×10^{-02}	1.74	c	$\leq9.22\times10^{-04}$	1.49×10^{-02}	↓ ≥93.81
Glycerol	$2.46\times10^{+00}$	0.11	$2.70\times10^{+00}$	1.99	a	$2.29\times10^{+01}$	$1.36\times10^{+00}$	1584.45
Glycidol	NR	0.05	1.76×10^{-03}	1.99	a	NR	8.84×10^{-04}	N/A
Gold	NT	0.03	N/A	N/A	N/A	NT	N/A	N/A
Isoamyl Acetate	$\leq4.80\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq1.05\times10^{-03}$	N/A	N/A
Isobutyl Acetate	$\leq3.00\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq6.58\times10^{-04}$	N/A	N/A
Isobutyraldehyde	$\leq8.26\times10^{-07}$	0.05	N/A	N/A	N/A	$\leq1.81\times10^{-05}$	N/A	N/A
Isoprene	$\leq1.61\times10^{-04}$	0.03	7.99×10^{-01}	1.99	a	$\leq4.69\times10^{-03}$	4.02×10^{-01}	↓ ≥98.83
Lead	$\leq4.55\times10^{-08}$	0.05	3.12×10^{-05}	1.74	c	$\leq9.99\times10^{-07}$	1.79×10^{-05}	↓ ≥94.43
Menthol	3.44×10^{-02}	0.11	$\leq1.00\times10^{-05}$	2.10	d	3.20×10^{-01}	$\leq4.76\times10^{-06}$	NC
Methyl Acetate	$\leq3.60\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq7.90\times10^{-04}$	N/A	N/A
Myosmine	$\leq3.28\times10^{-06}$	0.03	N/A	N/A	N/A	$\leq9.56\times10^{-05}$	N/A	N/A
n-Butyraldehyde	$\leq1.76\times10^{-06}$	0.05	9.30×10^{-02}	1.99	a	$\leq3.85\times10^{-05}$	4.67×10^{-02}	↓ ≥99.92
Nickel	$\leq4.55\times10^{-07}$	0.11	$\leq1.29\times10^{-05}$	1.74	c	$\leq4.23\times10^{-06}$	$\leq7.41\times10^{-06}$	NC
Nicotine	1.07×10^{-01}	0.11	$1.99\times10^{+00}$	1.99	a	$1.00\times10^{+00}$	$1.00\times10^{+00}$	N/A

Nicotine-N-Oxide	≤8.72×10^{-06}	0.05	N/A	N/A	N/A	≤1.91×10^{-04}	N/A	N/A
NNK	≤7.53×10^{-09}	0.05	2.95×10^{-04}	1.99	a	≤1.65×10^{-07}	1.48×10^{-04}	↓ ≥99.89
NNN	≤4.92×10^{-09}	0.05	3.37×10^{-04}	1.99	a	≤1.08×10^{-07}	1.69×10^{-04}	↓ ≥99.94
Nornicotine	≤3.41×10^{-06}	0.03	N/A	N/A	N/A	≤9.96×10^{-05}	N/A	N/A
Propionic Acid	≤1.80×10^{-05}	0.05	N/A	N/A	N/A	≤3.95×10^{-04}	N/A	N/A
Propylene Glycol	9.92×10^{-01}	0.11	2.37×10^{-02}	1.74	c	9.23×10^{+00}	1.36×10^{-02}	67634.83
Propylene Oxide	≤1.56×10^{-06}	0.05	1.00×10^{+00}	1.99	a	≤3.43×10^{-05}	5.03×10^{-01}	↓ ≥99.99
Toluene	≤6.12×10^{-06}	0.05	1.53×10^{-01}	1.99	a	≤1.34×10^{-04}	7.69×10^{-02}	↓ ≥99.83
Water	4.95×10^{-01}	0.11	1.58×10^{+01}	1.89	e	4.61×10^{+00}	8.36×10^{+00}	↓ 44.87

Average % Difference, Excluding Glycerol, PG and Water. a: Jaccard et al. 2019 b: Moldoveanu et al. 2017 c: Helen et al. 2018 d: Uchiyama et al. 2018 e: Schaller et al. 2016 f: Pappas et al. 2014 g: Roemer et al. 2012 h: IQOS PMTA, 2019.

Table S14. Comparison of HPHC and Chemical Non-Intense Aerosol Levels in Menthol 3.0% and Smoke Levels in 3R4F Reference Cigarette.

HPHC or Chemical	**JUUL Menthol 3.0% (mg/puff)**		**3R4F (mg/cig)**			**Chemical and HPHC Normalized by Nicotine (mg/mg)**		**% Difference**
	HPHC or Chemical	**Nicotine**	**HPHC or Chemical**	**Nicotine**	**Source Journal**	**JUUL Virginia Tobacco 3.0%**	**3R4F**	**vs_3R4F**
1-Aminonaphthalene	≤3.31×10^{-10}	0.03	1.42×10^{-05}	0.70	a	≤9.66×10^{-09}	2.02×10^{-05}	↓ ≥99.95
1-Butanol	≤3.00×10^{-05}	0.03	N/A	N/A	N/A	≤1.18×10^{-03}	N/A	N/A
1,3-Butadiene	≤1.61×10^{-05}	0.03	3.79×10^{-02}	0.70	a	≤4.69×10^{-04}	5.40×10^{-02}	↓ ≥99.13
2-Aminonaphthalene	≤3.37×10^{-10}	0.03	8.77×10^{-06}	0.70	a	≤9.84×10^{-09}	1.25×10^{-05}	↓ ≥99.92
4-Aminobiphenyl	≤1.66×10^{-10}	0.03	1.54×10^{-06}	0.70	a	≤4.85×10^{-09}	2.19×10^{-06}	↓ ≥99.78
Acetaldehyde	≤2.16×10^{-05}	0.03	5.97×10^{-01}	0.70	a	≤8.45×10^{-04}	8.50×10^{-01}	↓ ≥99.90
Acetyl Propionyl	≤1.76×10^{-06}	0.03	2.95×10^{-02}	0.70	b	≤6.88×10^{-05}	4.21×10^{-02}	↓ ≥99.84
Acrolein	≤2.01×10^{-05}	0.05	5.32×10^{-02}	0.70	a	≤4.03×10^{-04}	7.58×10^{-02}	↓ ≥99.47
Acrylonitrile	≤3.20×10^{-06}	0.03	5.23×10^{-03}	0.70	a	≤1.25×10^{-04}	7.45×10^{-03}	↓ ≥98.32
Ammonia	≤6.64×10^{-05}	0.03	9.64×10^{-03}	0.70	a	≤1.94×10^{-03}	1.37×10^{-02}	↓ ≥85.88
Anabasine	≤3.64×10^{-06}	0.03	N/A	N/A	N/A	≤1.06×10^{-04}	N/A	N/A
Anatabine	≤3.30×10^{-06}	0.03	N/A	N/A	N/A	≤9.62×10^{-05}	N/A	N/A
Benzene	≤1.71×10^{-06}	0.03	3.36×10^{-02}	0.70	a	≤6.68×10^{-05}	4.79×10^{-02}	↓ ≥99.86
Benzo(a)pyrene	≤9.31×10^{-10}	0.03	6.30×10^{-06}	0.70	a	≤2.72×10^{-08}	8.97×10^{-06}	↓ ≥99.70
Benzoic Acid	4.10×10^{-02}	0.05	N/A	N/A	N/A	8.24×10^{-01}	N/A	N/A
Benzyl Acetate	≤3.00×10^{-05}	0.03	N/A	N/A	N/A	≤1.18×10^{-03}	N/A	N/A
β-Nicotyrine	≤8.25×10^{-06}	0.05	N/A	N/A	N/A	≤1.66×10^{-04}	N/A	N/A
Cadmium	≤5.25×10^{-09}	0.03	2.45×10^{-05}	0.70	a	≤2.06×10^{-07}	3.49×10^{-05}	↓ ≥99.41
Carbon Monoxide	NT	0.03	1.00×10^{+01}	0.70	a	NT	1.42×10^{+01}	N/A
Chromium	NDFB	0.03	≤8.80×10^{-07}	0.70	f	NDFB	≤1.25×10^{-06}	NC

Copper	≤6.56×10^{-08}	0.03	N/A	N/A	N/A	≤2.57×10^{-06}	N/A	N/A
Cotinine	≤4.06×10^{-06}	0.05	N/A	N/A	N/A	≤8.16×10^{-05}	N/A	N/A
Crotonaldehyde	≤3.11×10^{-06}	0.03	9.89×10^{-03}	0.70	a	≤1.22×10^{-04}	1.41×10^{-02}	↓ ≥99.13
Diacetyl	≤8.70×10^{-07}	0.03	1.15×10^{-01}	0.70	b	≤3.41×10^{-05}	1.64×10^{-01}	↓ ≥99.98
Diethylene Glycol	≤1.20×10^{-04}	0.03	N/A	N/A	N/A	≤4.70×10^{-03}	N/A	N/A
Ethyl Acetate	≤1.30×10^{-04}	0.03	N/A	N/A	N/A	≤5.09×10^{-03}	N/A	N/A
Ethyl Acetoacetate	≤2.40×10^{-06}	0.03	N/A	N/A	N/A	≤9.40×10^{-05}	N/A	N/A
Ethylene Glycol	≤1.09×10^{-04}	0.03	N/A	N/A	N/A	≤4.28×10^{-03}	N/A	N/A
Formaldehyde	2.19×10^{-05}	0.05	2.47×10^{-02}	0.70	a	4.35×10^{-04}	3.52×10^{-02}	↓ 98.76
Furfural	≤4.20×10^{-05}	0.03	1.40×10^{-02}	0.76	d	≤1.65×10^{-03}	1.84×10^{-02}	↓ ≥91.07
Glycerol	$1.22\times10^{+00}$	0.05	$2.70\times10^{+00}$	0.70	a	$2.45\times10^{+01}$	$3.85\times10^{+00}$	536.05
Glycidol	NR	0.03	N/A	N/A	N/A	NR	N/A	N/A
Gold	NT	0.03	N/A	N/A	N/A	NT	N/A	N/A
Isoamyl Acetate	≤4.80×10^{-05}	0.03	N/A	N/A	N/A	≤1.88×10^{-03}	N/A	N/A
Isobutyl Acetate	≤3.00×10^{-05}	0.03	N/A	N/A	N/A	≤1.18×10^{-03}	N/A	N/A
Isobutyraldehyde	≤8.26×10^{-07}	0.03	N/A	N/A	N/A	≤3.24×10^{-05}	N/A	N/A
Isoprene	≤1.61×10^{-04}	0.03	2.88×10^{-01}	0.70	a	≤4.69×10^{-03}	4.10×10^{-01}	↓ ≥98.86
Lead	≤4.55×10^{-08}	0.03	9.20×10^{-06}	0.70	f	≤1.78×10^{-06}	1.31×10^{-05}	↓ ≥86.39
Menthol	1.79×10^{-02}	0.05	≤1.00×10^{-05}	0.76	a	3.55×10^{-01}	≤1.32×10^{-05}	NC
Methyl Acetate	≤3.60×10^{-05}	0.03	N/A	N/A	N/A	≤1.41×10^{-03}	N/A	N/A
Myosmine	≤3.28×10^{-06}	0.03	N/A	N/A	N/A	≤9.56×10^{-05}	N/A	N/A
n-Butyraldehyde	≤1.76×10^{-06}	0.03	2.84×10^{-02}	0.70	a	≤6.88×10^{-05}	4.05×10^{-02}	↓ ≥99.83
Nickel	≤1.05×10^{-07}	0.03	≤3.80×10^{-07}	0.70	f	≤4.11×10^{-06}	≤5.41×10^{-07}	NC
Nicotine	5.04×10^{-02}	0.05	7.02×10^{-01}	0.70	a	$1.00\times10^{+00}$	$1.00\times10^{+00}$	N/A
Nicotine-N-Oxide	≤8.72×10^{-06}	0.03	N/A	N/A	N/A	≤3.42×10^{-04}	N/A	N/A
NNK	≤7.53×10^{-09}	0.03	1.13×10^{-04}	0.70	a	≤2.95×10^{-07}	1.61×10^{-04}	↓ ≥99.82
NNN	≤4.92×10^{-09}	0.03	1.31×10^{-04}	0.70	a	≤1.93×10^{-07}	1.87×10^{-04}	↓ ≥99.90
Nornicotine	≤3.41×10^{-06}	0.03	N/A	N/A	N/A	≤9.96×10^{-05}	N/A	N/A
Propionic Acid	≤7.80×10^{-05}	0.03	N/A	N/A	N/A	≤3.06×10^{-03}	N/A	N/A
Propylene Glycol	4.55×10^{-01}	0.05	3.20×10^{-03}	0.76	d	$9.02\times10^{+00}$	4.21×10^{-03}	214132.49
Propylene Oxide	≤1.56×10^{-06}	0.03	2.97×10^{-01}	0.70	a	≤6.12×10^{-05}	4.23×10^{-01}	↓ ≥99.99
Toluene	≤6.12×10^{-06}	0.03	5.14×10^{-02}	0.70	a	≤2.40×10^{-04}	7.32×10^{-02}	↓ ≥99.67
Water	2.51×10^{-01}	0.05	$3.20\times10^{+00}$	0.76	d	$5.04\times10^{+00}$	$4.21\times10^{+00}$	19.67

Average % Difference, Excluding Glycerol, PG and Water. a: Jaccard et al. 2019 b: Moldoveanu et al. 2017 c: Helen et al. 2018 d: Uchiyama et al. 2018 e: Schaller et al. 2016 f: Pappas et al. 2014 g: Roemer et al. 2012 h: IQOS PMTA, 2019.

Table S15. Comparison of HPHC and Chemical Intense Aerosol Levels in Menthol 3.0% and Aerosol Levels in IQOS Menthol.

HPHC or Chemical	JUUL Menthol 3.0% (mg/puff)		IQOS Menthol (mg/cig)			Chemical and HPHC Normalized by Nicotine (mg/mg)		% Difference
	HPHC or Chemical	Nicotine	HPHC or Chemical	Nicotine	Source Journal	JUUL Virginia Tobacco 3.0%	3R4F	vs_3R4F
1-Aminonaphthalene	≤3.31×10^{-10}	0.03	8.60×10^{-08}	1.21	e	≤9.66×10^{-09}	7.11×10^{-08}	↓ ≥86.41
1-Butanol	≤3.00×10^{-05}	0.05	N/A	N/A	N/A	≤6.58×10^{-04}	N/A	N/A
1,3-Butadiene	≤1.61×10^{-05}	0.03	2.65×10^{-04}	1.21	e	≤4.69×10^{-04}	2.19×10^{-04}	NC
2-Aminonaphthalene	≤3.37×10^{-10}	0.03	≤3.50×10^{-08}	1.21	e	≤9.84×10^{-09}	≤2.89×10^{-08}	NC
4-Aminobiphenyl	≤1.66×10^{-10}	0.03	≤5.10×10^{-08}	1.21	e	≤4.85×10^{-09}	≤4.21×10^{-08}	NC
Acetaldehyde	3.56×10^{-05}	0.11	2.05×10^{-01}	1.21	e	3.31×10^{-04}	1.69×10^{-01}	↓ 99.80
Acetyl Propionyl	≤1.76×10^{-06}	0.05	N/A	N/A	N/A	≤3.85×10^{-05}	N/A	N/A
Acrolein	≤2.01×10^{-05}	0.09	9.15×10^{-03}	1.21	e	≤2.14×10^{-04}	7.56×10^{-03}	↓ ≥97.17
Acrylonitrile	≤3.20×10^{-06}	0.05	2.20×10^{-04}	1.21	e	≤7.02×10^{-05}	1.82×10^{-04}	↓ ≥61.36
Ammonia	≤6.64×10^{-05}	0.03	1.38×10^{-02}	1.21	e	≤1.94×10^{-03}	1.14×10^{-02}	↓ ≥83.00
Anabasine	≤3.64×10^{-06}	0.03	N/A	N/A	N/A	≤1.06×10^{-04}	N/A	N/A
Anatabine	≤3.30×10^{-06}	0.03	N/A	N/A	N/A	≤9.62×10^{-05}	N/A	N/A
Benzene	≤1.71×10^{-06}	0.05	6.40×10^{-04}	1.21	e	≤3.74×10^{-05}	5.29×10^{-04}	↓ ≥92.92
Benzo(a)pyrene	≤9.31×10^{-10}	0.03	1.29×10^{-06}	1.21	e	≤2.72×10^{-08}	1.07×10^{-06}	↓ ≥97.45
Benzoic Acid	8.57×10^{-02}	0.11	N/A	N/A	N/A	7.97×10^{-01}	N/A	N/A
Benzyl Acetate	≤3.00×10^{-05}	0.05	N/A	N/A	N/A	≤6.58×10^{-04}	N/A	N/A
β-Nicotyrine	≤8.25×10^{-06}	0.09	N/A	N/A	N/A	≤8.79×10^{-05}	N/A	N/A
Cadmium	≤5.25×10^{-09}	0.05	≤3.50×10^{-07}	1.21	e	≤1.15×10^{-07}	≤2.89×10^{-07}	NC
Carbon Monoxide	NT	0.03	5.94×10^{-01}	1.21	e	NT	4.91×10^{-01}	N/A
Chromium	NDFB	0.05	≤5.50×10^{-07}	1.21	e	NDFB	≤4.55×10^{-07}	NC
Copper	≤2.84×10^{-07}	0.09	N/A	N/A	N/A	≤3.03×10^{-06}	N/A	N/A
Cotinine	≤4.06×10^{-06}	0.05	N/A	N/A	N/A	≤8.92×10^{-05}	N/A	N/A
Crotonaldehyde	≤3.11×10^{-06}	0.05	3.24×10^{-03}	1.21	e	≤6.83×10^{-05}	2.68×10^{-03}	↓ ≥97.45
Diacetyl	≤8.70×10^{-07}	0.05	6.50×10^{-02}	1.20	d	≤1.91×10^{-05}	5.42×10^{-02}	↓ ≥99.96
Diethylene Glycol	≤1.20×10^{-04}	0.05	N/A	N/A	N/A	≤2.63×10^{-03}	N/A	N/A
Ethyl Acetate	≤1.30×10^{-04}	0.05	N/A	N/A	N/A	≤2.85×10^{-03}	N/A	N/A
Ethyl Acetoacetate	≤2.40×10^{-06}	0.05	N/A	N/A	N/A	≤5.27×10^{-05}	N/A	N/A
Ethylene Glycol	≤2.52×10^{-05}	0.05	N/A	N/A	N/A	≤5.54×10^{-04}	N/A	N/A
Formaldehyde	4.47×10^{-05}	0.11	4.55×10^{-03}	1.21	e	4.16×10^{-04}	3.76×10^{-03}	↓ 88.94
Furfural	≤4.20×10^{-05}	0.05	N/A	N/A	N/A	≤9.22×10^{-04}	N/A	N/A
Glycerol	2.46×10^{+00}	0.11	3.94×10^{+00}	1.21	N/A	2.29×10^{+01}	3.26×10^{+00}	601.87

Glycidol	NR	0.05	1.10×10^{-03}	1.19	h	NR	9.24×10^{-04}	N/A
Gold	NT	0.03	N/A	N/A	N/A	NT	N/A	N/A
Isoamyl Acetate	$\leq4.80\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq1.05\times10^{-03}$	N/A	N/A
Isobutyl Acetate	$\leq3.00\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq6.58\times10^{-04}$	N/A	N/A
Isobutyraldehyde	$\leq8.26\times10^{-07}$	0.05	N/A	N/A	N/A	$\leq1.81\times10^{-05}$	N/A	N/A
Isoprene	$\leq1.61\times10^{-04}$	0.03	2.11×10^{-03}	1.21	e	$\leq4.69\times10^{-03}$	1.74×10^{-03}	NC
Lead	$\leq4.55\times10^{-08}$	0.05	$\leq3.35\times10^{-06}$	1.21	e	$\leq9.99\times10^{-07}$	$\leq2.77\times10^{-06}$	NC
Menthol	3.44×10^{-02}	0.11	$2.62\times10^{+00}$	1.21	e	3.20×10^{-01}	$2.17\times10^{+00}$	↓ 85.22
Methyl Acetate	$\leq3.60\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq7.90\times10^{-04}$	N/A	N/A
Myosmine	$\leq3.28\times10^{-06}$	0.03	N/A	N/A	N/A	$\leq9.56\times10^{-05}$	N/A	N/A
n-Butyraldehyde	$\leq1.76\times10^{-06}$	0.05	2.67×10^{-02}	1.21	e	$\leq3.85\times10^{-05}$	2.21×10^{-02}	↓ ≥99.83
Nickel	$\leq4.55\times10^{-07}$	0.11	$\leq5.50\times10^{-07}$	1.21	e	$\leq4.23\times10^{-06}$	$\leq4.55\times10^{-07}$	NC
Nicotine	1.07×10^{-01}	0.11	$1.21\times10^{+00}$	1.21	e	$1.00\times10^{+00}$	$1.00\times10^{+00}$	N/A
Nicotine-N-Oxide	$\leq8.72\times10^{-06}$	0.05	N/A	N/A	N/A	$\leq1.91\times10^{-04}$	N/A	N/A
NNK	$\leq7.53\times10^{-09}$	0.05	5.90×10^{-06}	1.21	N/A	$\leq1.65\times10^{-07}$	4.88×10^{-06}	↓ ≥96.61
NNN	$\leq4.92\times10^{-09}$	0.05	1.37×10^{-05}	1.21	e	$\leq1.08\times10^{-07}$	1.13×10^{-05}	↓ ≥99.05
Nornicotine	$\leq3.41\times10^{-06}$	0.03	N/A	N/A	N/A	$\leq9.96\times10^{-05}$	N/A	N/A
Propionic Acid	$\leq1.80\times10^{-05}$	0.05	N/A	N/A	N/A	$\leq3.95\times10^{-04}$	N/A	N/A
Propylene Glycol	9.92×10^{-01}	0.11	3.90×10^{-01}	1.20	d	$9.23\times10^{+00}$	3.25×10^{-01}	2738.75
Propylene Oxide	$\leq1.56\times10^{-06}$	0.05	1.49×10^{-04}	1.21	e	$\leq3.43\times10^{-05}$	1.23×10^{-04}	↓ ≥72.19
Toluene	$\leq6.12\times10^{-06}$	0.05	2.39×10^{-03}	1.21	e	$\leq1.34\times10^{-04}$	1.98×10^{-03}	↓ ≥93.20
Water	4.95×10^{-01}	0.11	$2.97\times10^{+01}$	1.21	e	$4.61\times10^{+00}$	$2.45\times10^{+01}$	↓ 81.22

Average % Difference, Excluding Glycerol, PG and Water. a: Jaccard et al. 2019 b: Moldoveanu et al. 2017 c: Helen et al. 2018 d: Uchiyama et al. 2018 e: Schaller et al. 2016 f: Pappas et al. 2014 g: Roemer et al. 2012 h: IQOS PMTA, 2019.

Table S16. Comparison of HPHCs in VT3 aerosol vs. comparator products.

Chemical and HPHC	**HPHC or Chemical Normalized by Nicotine (mg/mg)**					**% Difference**		
	VT3		**3R4F**		**IQOS**	**vs 3R4F**		**vs IQOS**
	NI	**Intense**	**NI**	**Intense**	**Intense**	**NI**	**Intense**	**Intense**
1-Aminonaphthalene	*$\leq1.22\times10^{-08}$[a]*	*$\leq1.22\times10^{-08}$[a]*	2.02×10^{-05}	1.46×10^{-05}	5.83×10^{-08}	↓ ≥99.94	↓ ≥99.92	↓ ≥79.16
1-Butanol	$\leq1.02\times10^{-03}$[a]	$\leq5.68\times10^{-04}$[a]	N/A	N/A	N/A	N/A	N/A	N/A
1,3-Butadiene	*$\leq4.24\times10^{-05}$[a]*	*$\leq4.23\times10^{-05}$[a]*	5.40×10^{-02}	5.03×10^{-02}	2.23×10^{-04}	↓ ≥99.92	↓ ≥99.92	↓ ≥80.99
2-Aminonaphthalene	*$\leq5.29\times10^{-09}$[a]*	*$\leq5.29\times10^{-09}$[a]*	1.25×10^{-05}	9.10×10^{-06}	3.48×10^{-08}	↓ ≥99.96	↓ ≥99.94	↓ ≥84.82
4-Aminobiphenyl	*$\leq2.13\times10^{-09}$[a]*	*$\leq2.12\times10^{-09}$[a]*	2.19×10^{-06}	1.96×10^{-06}	6.98×10^{-09}	↓ ≥99.90	↓ ≥99.89	↓ ≥69.55
Acetaldehyde	**6.49×10^{-04}**	**4.13×10^{-04}**	8.50×10^{-01}	9.24×10^{-01}	1.66×10^{-01}	↓ 99.92	↓ 99.96	↓ 99.75
Acetyl Propionyl	$\leq5.99\times10^{-05}$[a]	$\leq3.33\times10^{-05}$[a]	4.21×10^{-02}	4.62×10^{-02}	N/A	↓ ≥99.86	↓ ≥99.93	N/A
Acrolein	$\leq3.55\times10^{-04}$[a,b]	$\leq1.91\times10^{-04}$[a,b]	7.58×10^{-02}	9.05×10^{-02}	8.56×10^{-03}	↓ ≥99.53	↓ ≥99.79	↓ ≥97.77

Acrylonitrile	≤1.09×10^{-04}[a]	≤6.06×10^{-05}[a]	7.45×10^{-03}	1.03×10^{-02}	1.95×10^{-04}	↓ ≥98.53	↓ ≥99.41	↓ ≥68.99
Ammonia	*≤5.92×10^{-04}[a]*	*≤5.92×10^{-04}[a]*	1.37×10^{-02}	1.71×10^{-02}	1.08×10^{-02}	↓ ≥95.69	↓ ≥96.53	↓ ≥94.50
Anabasine	*≤4.27×10^{-05}[a]*	*≤4.27×10^{-05}[a]*	N/A	N/A	N/A	N/A	N/A	N/A
Anatabine	*≤3.53×10^{-05}[a]*	*≤3.53×10^{-05}[a]*	N/A	N/A	N/A	N/A	N/A	N/A
Benzene	≤5.82×10^{-05}[a]	≤3.23×10^{-05}[a]	4.79×10^{-02}	4.46×10^{-02}	4.92×10^{-04}	↓ ≥99.88	↓ ≥99.93	↓ ≥93.43
Benzo(a)pyrene	*≤7.89×10^{-08}[a]*	*≤7.89×10^{-08}[a]*	8.97×10^{-06}	7.59×10^{-06}	5.71×10^{-07}	↓ ≥99.12	↓ ≥98.96	↓ ≥86.17
Benzoic Acid	**8.46×10^{-01}**	**7.97×10^{-01}**	N/A	N/A	N/A	N/A	N/A	N/A
Benzyl Acetate	≤1.02×10^{-03}[a]	≤5.68×10^{-04}[a]	N/A	N/A	N/A	N/A	N/A	N/A
β-Nicotyrine	≤1.46×10^{-04}[a,b]	≤7.82×10^{-05}[a,b]	N/A	N/A	N/A	N/A	N/A	N/A
Cadmium	≤1.79×10^{-07}[a]	≤9.94×10^{-08}[a]	3.49×10^{-05}	4.68×10^{-05}	≤2.65×10^{-07}	↓ ≥99.49	↓ ≥99.79	NC
Carbon Monoxide	*≤7.80×10^{-02}[a]*	*≤7.80×10^{-02}[a]*	1.42×10^{+01}	1.53×10^{+01}	4.02×10^{-01}	↓ ≥99.45	↓ ≥99.49	↓ ≥80.62
Chromium	NDFB	NDFB	≤1.25×10^{-06}	≤6.84×10^{-06}	≤4.17×10^{-07}	NC	NC	NC
Copper	≤9.70×10^{-06}[a,b]	≤5.39×10^{-06}[a,b]	N/A	N/A	N/A	N/A	N/A	N/A
Cotinine	≤1.39×10^{-04}[b]	≤1.78×10^{-05}[a]	N/A	N/A	N/A	N/A	N/A	N/A
Crotonaldehyde	≤1.06×10^{-04}[a]	≤5.90×10^{-05}[a]	1.41×10^{-02}	2.99×10^{-02}	3.14×10^{-03}	↓ ≥99.25	↓ ≥99.80	↓ ≥98.12
Diacetyl	≤2.97×10^{-05}[a]	≤1.65×10^{-05}[a]	1.64×10^{-01}	1.69×10^{-01}	3.58×10^{-02}	↓ ≥99.98	↓ ≥99.99	↓ ≥99.95
Diethylene Glycol	≤4.09×10^{-03}[a]	≤2.27×10^{-03}[a]	N/A	N/A	N/A	N/A	N/A	N/A
Ethyl Acetate	≤4.43×10^{-03}[a,b]	≤1.23×10^{-03}[a,b]	N/A	N/A	N/A	N/A	N/A	N/A
Ethyl Acetoacetate	≤8.19×10^{-05}[a]	≤4.54×10^{-05}[a]	N/A	N/A	N/A	N/A	N/A	N/A
Ethylene Glycol	≤3.73×10^{-03}[b]	≤2.07×10^{-03}[b]	N/A	N/A	N/A	N/A	N/A	N/A
Formaldehyde	**1.35×10^{-03}**	**8.27×10^{-04}**	3.52×10^{-02}	4.38×10^{-02}	4.19×10^{-03}	↓ **96.16**	↓ **98.11**	↓ **80.27**
Furfural	≤1.43×10^{-03}[a]	≤7.95×10^{-04}[a]	1.84×10^{-02}	1.49×10^{-02}	2.41×10^{-02}	↓ ≥92.22	↓ ≥94.66	↓ ≥96.70
Glycerol	**2.31×10^{+01}**	**2.27×10^{+01}**	3.85×10^{+00}	1.36×10^{+00}	3.51×10^{+00}	4.99×10^{+02}	1.57×10^{+03}	5.47×10^{+02}
Glycidol	NR	NR	N/A	8.84×10^{-04}	4.43×10^{-03}	NC	NC	NC
Gold	*≤9.41×10^{-08}[a]*	*≤9.40×10^{-08}[a]*	N/A	N/A	N/A	N/A	N/A	N/A
Isoamyl Acetate	≤1.64×10^{-03}[a]	≤9.09×10^{-04}[a]	N/A	N/A	N/A	N/A	N/A	N/A
Isobutyl Acetate	≤1.02×10^{-03}[a]	≤5.68×10^{-04}[a]	N/A	N/A	N/A	N/A	N/A	N/A
Isobutyraldehyde	≤2.82×10^{-05}[a]	≤1.57×10^{-05}[a]	N/A	N/A	N/A	N/A	N/A	N/A
Isoprene	*≤6.03×10^{-05}[a]*	*≤6.03×10^{-05}[a]*	4.10×10^{-01}	4.02×10^{-01}	1.78×10^{-03}	↓ ≥99.99	↓ ≥99.98	↓ ≥96.61
Lead	≤1.55×10^{-06}[b]	NDFB	1.31×10^{-05}	1.79×10^{-05}	1.73×10^{-06}	↓ ≥88.16	NC	NC
Menthol	≤4.17×10^{-03}[a]	≤2.31×10^{-03}[a]	≤1.32×10^{-05}	≤4.76×10^{-06}	3.42×10^{-04}	NC	NC	NC
Methyl Acetate	≤1.23×10^{-03}[a]	≤6.82×10^{-04}[a]	N/A	N/A	N/A	N/A	N/A	N/A
Myosmine	*≤2.86×10^{-04}[a]*	*≤2.86×10^{-04}[a]*	N/A	N/A	N/A	N/A	N/A	N/A
n-Butyraldehyde	≤5.99×10^{-05}[a]	≤3.33×10^{-05}[a]	4.05×10^{-02}	4.67×10^{-02}	1.98×10^{-02}	↓ ≥99.85	↓ ≥99.93	↓ ≥99.83
Nickel	≤8.03×10^{-06}[b]	≤8.62×10^{-06}[b]	≤5.41×10^{-07}	≤7.41×10^{-06}	≤4.17×10^{-07}	NC	NC	NC
Nicotine	**1.00×10^{+00}**	**1.00×10^{+00}**	1.00×10^{+00}	1.00×10^{+00}	1.00×10^{+00}	N/A	N/A	N/A
Nicotine-N-Oxide	≤2.97×10^{-04}[a]	≤1.65×10^{-04}[a]	N/A	N/A	N/A	N/A	N/A	N/A

NNK	≤2.57×10^{-07}[a]	≤1.43×10^{-07}[a]	1.61×10^{-04}	1.48×10^{-04}	5.08×10^{-06}	↓ ≥99.84	↓ ≥99.90	↓ ≥97.19
NNN	≤1.68×10^{-07}[a]	≤9.32×10^{-08}[a]	1.87×10^{-04}	1.69×10^{-04}	1.30×10^{-05}	↓ ≥99.91	↓ ≥99.94	↓ ≥99.28
Nornicotine	***2.47×10^{-04}***[a]	***2.47×10^{-04}***[a]	N/A	N/A	N/A	N/A	N/A	N/A
Propionic Acid	≤2.66×10^{-03}[b]	≤1.79×10^{-03}[a,b]	N/A	N/A	N/A	N/A	N/A	N/A
Propylene Glycol	**8.85×10^{+00}**	**8.71×10^{+00}**	4.21×10^{-03}	1.36×10^{-02}	1.36×10^{-01}	2.10×10^{+05}	6.39×10^{+04}	6.32×10^{+03}
Propylene Oxide	≤5.32×10^{-05}[a]	≤2.96×10^{-05}[a]	4.23×10^{-01}	5.03×10^{-01}	1.12×10^{-04}	↓ ≥99.99	↓ ≥99.99	↓ ≥73.64
Toluene	≤2.09×10^{-04}[a]	≤1.16×10^{-04}[a]	7.32×10^{-02}	7.69×10^{-02}	1.96×10^{-03}	↓ ≥99.72	↓ ≥99.85	↓ ≥94.10
Water	**5.13×10^{+00}**	**4.33×10^{+00}**	4.21×10^{+00}	8.36×10^{+00}	2.77×10^{+01}	**21.78**	↓ **48.20**	↓ **84.34**
						Average[c]	Average[c]	Average[c]
						↓ 98.59	↓ 99.37	↓ 89.12

BLOD = Below limit of quantitation; BLOQ=Below limit of quantitation; NDFB=Not different from background, ↓= less than, Bolded reductions were based on quantifiable values. Analytes in italics were tested under a single modified puffing regimen: 70mL puff, 3 second duration, 30 second interval[a] analyte was BLOD for all three 50 puff blocks [b] analyte was BLOQ for all three 50 puff blocks [a,b] analyte was either BLOD or BLOQ for all three 50 puff blocks [c] excluding PG,VG and water.

Table S17. Comparison of HPHCs in Me3 aerosol vs. comparator products.

Chemical and HPHC	HPHC or Chemical Normalized by Nicotine (mg/mg)					% Difference		
	VT3		3R4F		IQOS			vs IQOS
	NI	Intense	NI	Intense	Intense	NI	Intense	Intense
1-Aminonaphthalene	*≤9.66×10^{-09}*[a]	*≤9.66×10^{-09}*[a]	2.02×10^{-05}	1.46×10^{-05}	7.11×10^{-08}	↓ ≥99.95	↓ ≥99.93	↓ ≥86.41
1-Butanol	≤1.18×10^{-03}	≤6.58×10^{-04}	N/A	N/A	N/A	N/A	N/A	N/A
1,3-Butadiene	*≤4.69×10^{-04}*[a]	*≤4.69×10^{-04}*[a]	5.40×10^{-02}	5.03×10^{-02}	2.19×10^{-04}	↓ ≥99.13	↓ ≥99.07	NC
2-Aminonaphthalene	*≤9.84×10^{-09}*[a]	*≤9.84×10^{-09}*[a]	1.25×10^{-05}	9.10×10^{-06}	≤2.89×10^{-08}	↓ ≥99.92	↓ ≥99.89	NC
4-Aminobiphenyl	*≤4.85×10^{-09}*[a]	*≤4.85×10^{-09}*[a]	2.19×10^{-06}	1.96×10^{-06}	≤4.21×10^{-08}	↓ ≥99.78	↓ ≥99.75	NC
Acetaldehyde	≤8.45×10^{-04}[b]	**3.31×10^{-04}**	8.50×10^{-01}	9.24×10^{-01}	1.69×10^{-01}	↓ ≥99.90	↓ 99.96	↓ 99.80
Acetyl Propionyl	≤6.88×10^{-05}[a]	≤3.85×10^{-05}[a]	4.21×10^{-02}	4.62×10^{-02}	N/A	↓ ≥99.84	↓ ≥99.92	N/A
Acrolein	≤4.03×10^{-04}[a,b]	≤2.14×10^{-04}[a,b]	7.58×10^{-02}	9.05×10^{-02}	7.56×10^{-03}	↓ ≥99.47	↓ ≥99.76	↓ ≥97.17
Acrylonitrile	≤1.25×10^{-04}[a]	≤7.02×10^{-05}[a]	7.45×10^{-03}	1.03×10^{-02}	1.82×10^{-04}	↓ ≥98.32	↓ ≥99.32	↓ ≥61.36
Ammonia	≤1.94×10^{-03}[a]	≤1.94×10^{-03}[a]	1.37×10^{-02}	1.71×10^{-02}	1.14×10^{-02}	↓ ≥85.88	↓ ≥88.65	↓ ≥83.00
Anabasine	*≤1.06×10^{-04}*[a]	*≤1.06×10^{-04}*[a]	N/A	N/A	N/A	N/A	N/A	N/A
Anatabine	*≤9.62×10^{-05}*[a]	*≤9.62×10^{-05}*[a]	N/A	N/A	N/A	N/A	N/A	N/A
Benzene	≤6.68×10^{-05}[a]	≤3.74×10^{-05}[a]	4.79×10^{-02}	4.46×10^{-02}	5.29×10^{-04}	↓ ≥99.86	↓ ≥99.92	↓ ≥92.92
Benzo(a)pyrene	*≤2.72×10^{-08}*[a]	*≤2.72×10^{-08}*[a]	8.97×10^{-06}	7.59×10^{-06}	1.07×10^{-06}	↓ ≥99.70	↓ ≥99.64	↓ ≥97.45
Benzoic Acid	**8.24×10^{-01}**	**7.97×10^{-01}**	N/A	N/A	N/A	N/A	N/A	N/A
Benzyl Acetate	≤1.18×10^{-03}[a]	≤6.58×10^{-04}[a]	N/A	N/A	N/A	N/A	N/A	N/A
β-Nicotyrine	≤1.66×10^{-04}[a,b]	≤8.79×10^{-05}[a,b]	N/A	N/A	N/A	N/A	N/A	N/A
Cadmium	≤2.06×10^{-07}[a]	≤1.15×10^{-07}[a]	3.49×10^{-05}	4.68×10^{-05}	≤2.89×10^{-07}	↓ ≥99.41	↓ ≥99.75	NC
Carbon Monoxide	NT	NT	1.42×10^{+01}	1.53×10^{+01}	4.91×10^{-01}	N/A	N/A	N/A
Chromium	NDFB	NDFB	≤1.25×10^{-06}	≤6.84×10^{-06}	≤4.55×10^{-07}	NC	NC	NC

Copper	≤2.57×10^{-06}[a]	≤3.03×10^{-06}[a,b]	N/A	N/A	N/A	N/A	N/A	N/A
Cotinine	≤8.16×10^{-05}[a,b]	≤8.92×10^{-05}[b]	N/A	N/A	N/A	N/A	N/A	N/A
Crotonaldehyde	≤1.22×10^{-04}[a]	≤6.83×10^{-05}[a]	1.41×10^{-02}	2.99×10^{-02}	2.68×10^{-03}	↓ ≥99.13	↓ ≥99.77	↓ ≥97.45
Diacetyl	≤3.41×10^{-05}[a]	≤1.91×10^{-05}[a]	1.64×10^{-01}	1.69×10^{-01}	5.42×10^{-02}	↓ ≥99.98	↓ ≥99.99	↓ ≥99.96
Diethylene Glycol	≤4.70×10^{-03}[a]	≤2.63×10^{-03}[a]	N/A	N/A	N/A	N/A	N/A	N/A
Ethyl Acetate	≤5.09×10^{-03}[b]	≤2.85×10^{-03}[a,b]	N/A	N/A	N/A	N/A	N/A	N/A
Ethyl Acetoacetate	≤9.40×10^{-05}[a]	≤5.27×10^{-05}[a]	N/A	N/A	N/A	N/A	N/A	N/A
Ethylene Glycol	≤4.28×10^{-03}[b]	≤5.54×10^{-04}[b]	N/A	N/A	N/A	N/A	N/A	N/A
Formaldehyde	**4.35×10^{-04}**	**4.16×10^{-04}**	3.52×10^{-02}	4.38×10^{-02}	3.76×10^{-03}	↓ **98.76**	↓ **99.05**	↓ **88.94**
Furfural	≤1.65×10^{-03}[a]	≤9.22×10^{-04}[a]	1.84×10^{-02}	1.49×10^{-02}	N/A	↓ ≥91.07	↓ ≥93.81	N/A
Glycerol	**2.45×10^{+01}**	**2.29×10^{+01}**	3.85×10^{+00}	1.36×10^{+00}	3.26×10^{+00}	5.36×10^{+02}	1.58×10^{+03}	6.01×10^{+02}
Glycidol	NR	NR	N/A	8.84×10^{-04}	9.24×10^{-04}	NC	NC	NC
Gold	NT	NT	N/A	N/A	N/A	N/A	N/A	N/A
Isoamyl Acetate	≤1.88×10^{-03}[a]	≤1.05×10^{-03}[a]	N/A	N/A	N/A	N/A	N/A	N/A
Isobutyl Acetate	≤1.18×10^{-03}[a]	≤6.58×10^{-04}[a]	N/A	N/A	N/A	N/A	N/A	N/A
Isobutyraldehyde	≤3.24×10^{-05}[a]	≤1.81×10^{-05}[a]	N/A	N/A	N/A	N/A	N/A	N/A
Isoprene	*≤4.69×10^{-03}[a]*	*≤4.69×10^{-03}[a]*	4.10×10^{-01}	4.02×10^{-01}	1.74×10^{-03}	↓ ≥98.86	↓ ≥98.83	NC
Lead	≤1.78×10^{-06}[b]	≤9.99×10^{-07}[a,b]	1.31×10^{-05}	1.79×10^{-05}	≤2.77×10^{-06}	↓ ≥86.39	↓ ≥94.43	NC
Menthol	3.55×10^{-01}	3.20×10^{-01}	≤1.32×10^{-05}	≤4.76×10^{-06}	2.17×10^{+00}	NC	NC	↓ 85.22
Methyl Acetate	≤1.41×10^{-03}[a]	≤7.90×10^{-04}[a]	N/A	N/A	N/A	N/A	N/A	N/A
Myosmine	*≤9.56×10^{-05}[a]*	*≤9.56×10^{-05}[a]*	N/A	N/A	N/A	N/A	N/A	N/A
n-Butyraldehyde	≤6.88×10^{-05}[a]	≤3.85×10^{-05}[a]	4.05×10^{-02}	4.67×10^{-02}	2.21×10^{-02}	↓ ≥99.83	↓ ≥99.92	↓ ≥99.83
Nickel	≤4.11×10^{-06}[a]	≤4.23×10^{-06}[a,b]	≤5.41×10^{-07}	≤7.41×10^{-06}	≤4.55×10^{-07}	NC	NC	NC
Nicotine	**1.00×10^{+00}**	**1.00×10^{+00}**	1.00×10^{+00}	1.00×10^{+00}	1.00×10^{+00}	N/A	N/A	N/A
Nicotine-N-Oxide	≤3.42×10^{-04}[a]	≤1.91×10^{-04}[a]	N/A	N/A	N/A	N/A	N/A	N/A
NNK	≤2.95×10^{-07}[a]	≤1.65×10^{-07}[a]	1.61×10^{-04}	1.48×10^{-04}	4.88×10^{-06}	↓ ≥99.82	↓ ≥99.89	↓ ≥96.61
NNN	≤1.93×10^{-07}[a]	≤1.08×10^{-07}[a]	1.87×10^{-04}	1.69×10^{-04}	1.13×10^{-05}	↓ ≥99.90	↓ ≥99.94	↓ ≥99.05
Nornicotine	*≤9.96×10^{-05}[a]*	*≤9.96×10^{-05}[a]*	N/A	N/A	N/A	N/A	N/A	N/A
Propionic Acid	≤3.06×10^{-03}[b]	≤3.95×10^{-04}[a]	N/A	N/A	N/A	N/A	N/A	N/A
Propylene Glycol	**9.02×10^{+00}**	**9.23×10^{+00}**	4.21×10^{-03}	1.36×10^{-02}	3.25×10^{-01}	2.14×10^{+05}	6.76×10^{+04}	2.73×10^{+03}
Propylene Oxide	≤6.12×10^{-05}[a]	≤3.43×10^{-05}[a]	4.23×10^{-01}	5.03×10^{-01}	1.23×10^{-04}	↓ ≥99.99	↓ ≥99.99	↓ ≥72.19
Toluene	≤2.40×10^{-04}[a]	≤1.34×10^{-04}[a]	7.32×10^{-02}	7.69×10^{-02}	1.98×10^{-03}	↓ ≥99.67	↓ ≥99.83	↓ ≥93.20
Water	**5.04×10^{+00}**	**4.61×10^{+00}**	4.21×10^{+00}	8.36×10^{+00}	2.45×10^{+01}	**19.67**	**$^{-44}$.87**	**$^{-81}$.22**
						Average[c] ↓ 98.02	**Average[c] ↓ 98.74**	**Average[c] ↓ 90.66**

BLOD=Below limit of quantitation; BLOQ=Below limit of quantitation; NDFB=Not different from background, ↓= less than, Bolded reductions were based on quantifiable values. Analytes in italics were tested under a single modified puffing

regimen: 70mL puff, 3 second duration, 30 second interval [a] analyte was BLOD for all three 50 puff blocks [b] analyte was BLOQ for all three 50 puff blocks [a,b] analyte was either BLOD or BLOQ for all three 50 puff blocks [c] excluding PG,VG and water.