Design and simulation of E-CIGARETTE

E - CIGARETTE

ELECTRONIC CIGARETTE COMPONENT SPECIFICATION

AIR VENT(ATMOSPHERIC PRESSURE)

ATOMIZER BASE
MATERIAL: STAINLESS STEEL

POWER BUTTON
MATERIAL: STAINLESS STEEL

LITHIUM ION BATTERY

ATOMIZER

USB CHARGING

MOUTH PIECE
MATERIAL: ACRYLIC

HOUSING
MATERIAL: STAINLESS STEEL

ELECTRICAL CONNECTOR
MATERIAL: COPPER

SENSOR

MICRO PROCESSOR
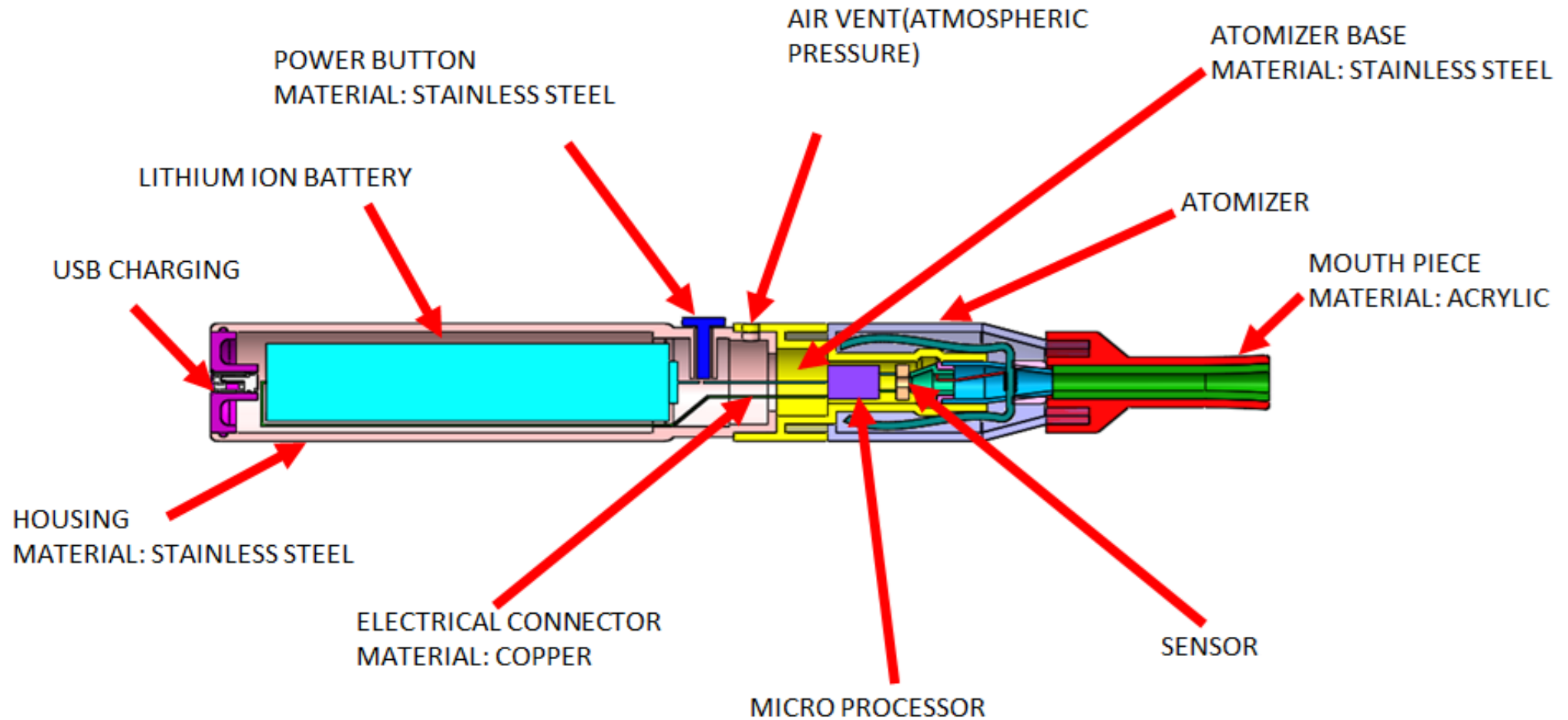
E - CIGARETTE

E-Cigarette and vaping process facts and governing parameters:

❖ Normally E-Liquid contains propylene glycol, glycerin, water, nicotine, and flavors.
❖ 95 % of e-liquid consists of propylene glycol , and glycerin.
❖ 1 ml of e-Liquid contains 10 mg of nicotine on average.
❖ A pen-style E-Cigarette can have 1ml of E-liquid in its cartridge.
❖ On Average each puff lasts for 2-2.5seconds.
❖ Average smoker takes 0.15mg of Nicotine /puff
❖ This means a total of 0.015 grams of E-liquid per puff.
❖ Density of E-liquid considered is 965.3 Kg/m3

E-Liquid Composition and Properties

❖ Normally E-Liquid contains propylene glycol, glycerin, water, nicotine, and flavors.
❖ The Propylene Glycol and Glycerol are in a 50:50 ratio of E-Liquid.
❖ 95 % of e-liquid consists of propylene Glycol and Glycerol.

Fluid Chemical name	Boiling point (K)	Boiling point (°F)	density (g/mL)
Glycerol	563	490	1.26
Propylene glycol	523	418	1.01
water	373	148	0.995
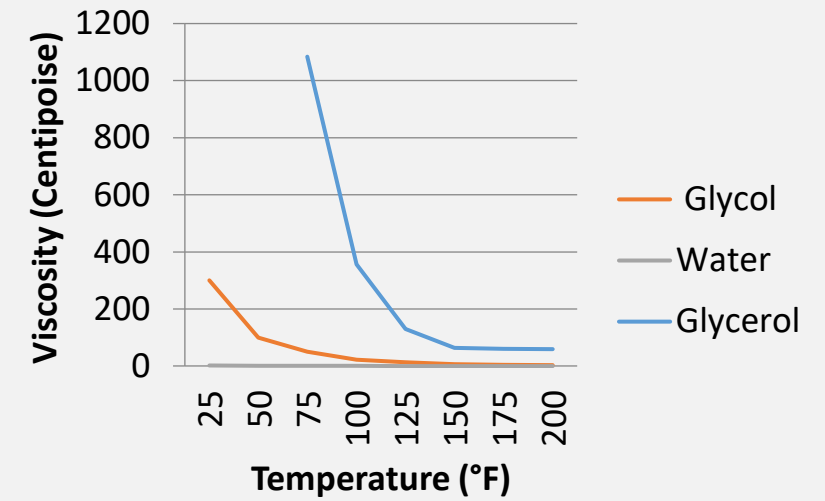
Temperature (°F)	Viscosity (Centipoise)		
	Glycol	Water	Glycerol
25	300	1.75	
50	100	1.5	
75	50	0.9	1083.3
100	22	0.7	356.7
125	13	0.5	130.0
150	7	0.4	63.3
175	4.5	0.35	60
200	3	0.29	59

E - CIGARETTE

Contour of Velocity ISO View
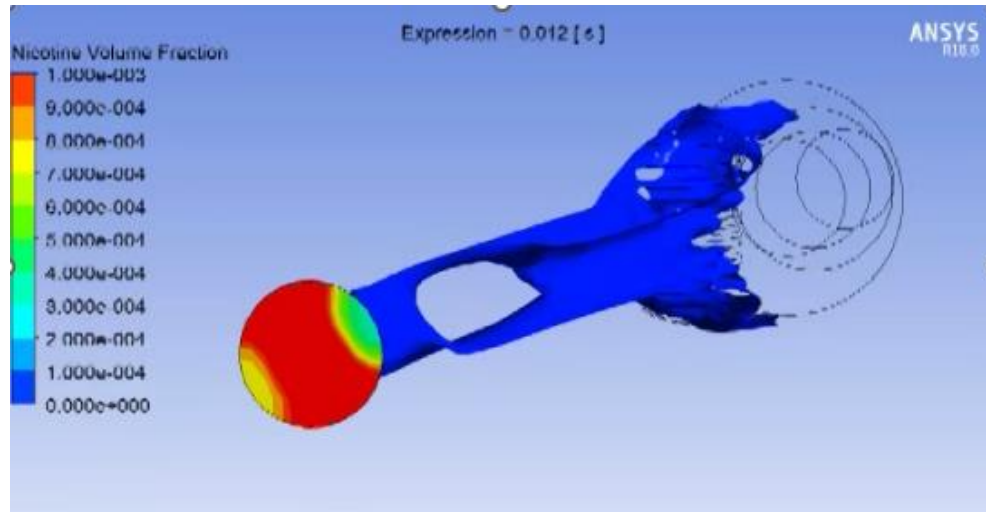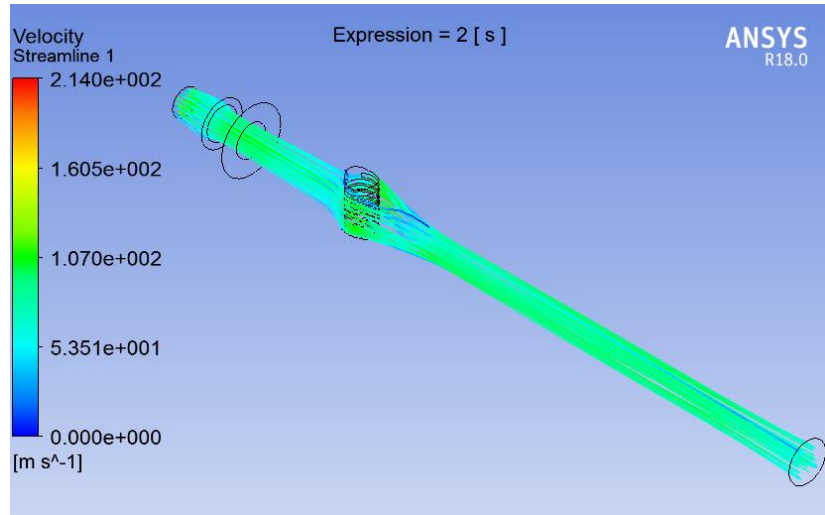
Case 1
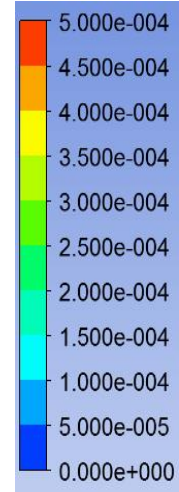
Contour of Volume fraction Front View

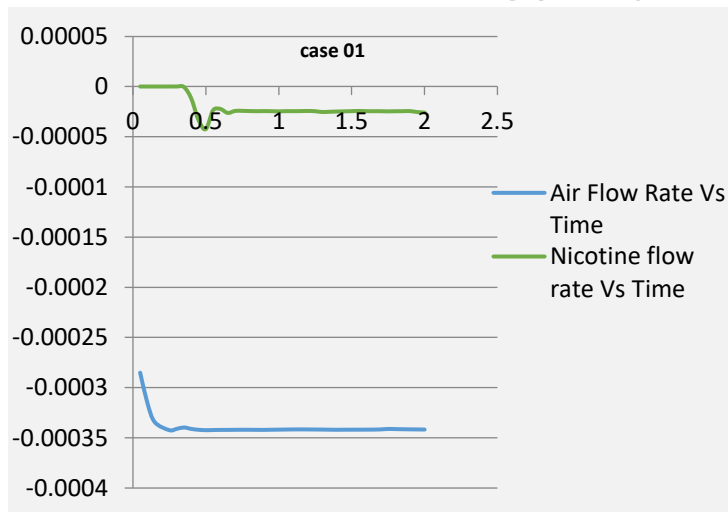
0.05 sec

0.5 sec

2 sec
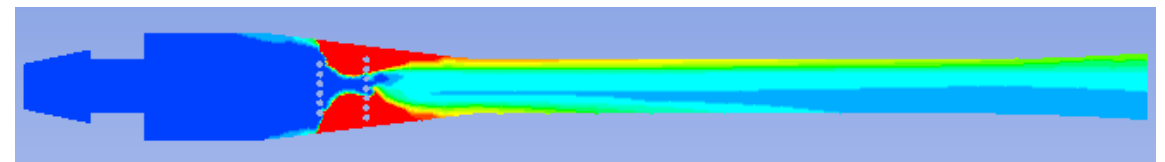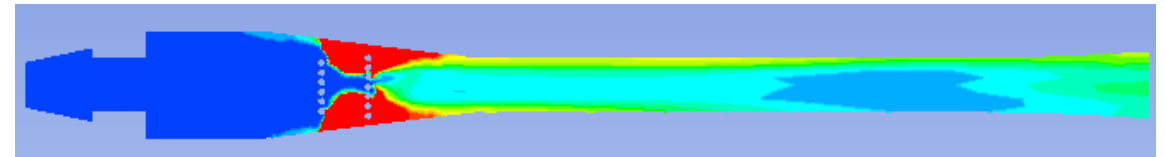
E - CIGARETTE

Input Parameters

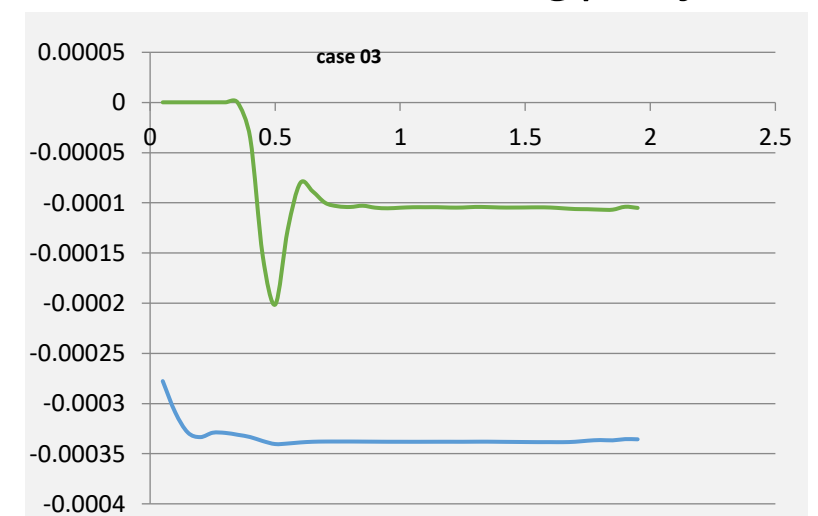| Case No.	Porosity	Sphericity	Eq. Diameter	Bead radius	Flow Rate	Viscous Resistance	Inertial Resistance
			(m)	(μ.m)	mm^3/sec	(1/m^2)	(1/m)
Case 1	0.2	0.75	1.00E-04	50	4	2.13E+12	4.67E+06
Case 2	0.3	0.75	1.00E-04	50	10	4.84E+11	1.21E+06
Case 3	0.5	0.75	2.00E-04	100	7.5	1.33E+10	9.33E+04

Output Flow rate Graph

### Case 1 flow rate=0.04 mg per cycle   Case 2 flow rate=0.188 mg per cycle   Case 3 flow rate=0.149 mg per cycle
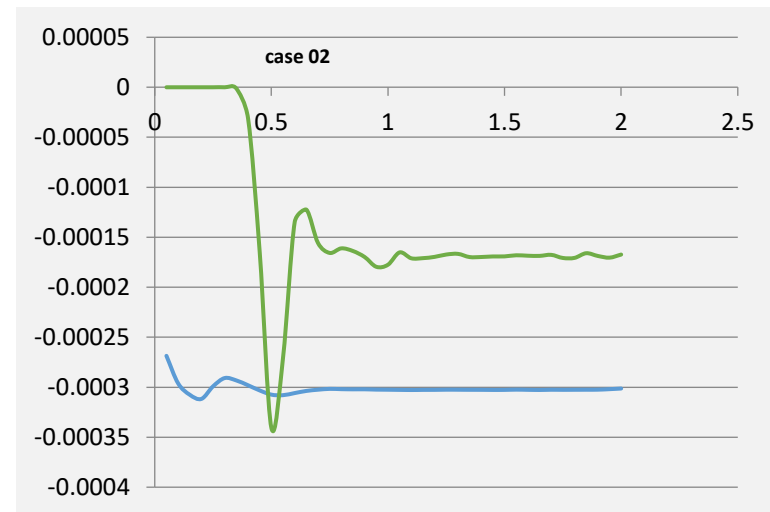
CONCLUSION

❖ Temperature at the intake is around 95°F (308°K) for all cases.

❖ It's observed that with a Wick porosity of 0.2 and bead radius of 50μm (case 1), the total flow of Nicotine is 0.04 mg per cycle which is the average nicotine intake per puff. This is a very low value compared to a requirement of 0.15mg.

❖ After several trial runs, It's observed that with a wick porosity of 0.3 and with a bead radius of 50μm (case 2), the total flow of Nicotine is 0.188 mg per cycle which is the average nicotine intake per puff. But it can also be noticed from the graph that a spike of nicotine happens at 0.05 seconds which can be detrimental as a local concentration of nicotine happens at 0.05 seconds.

❖ Where as with a wick porosity of 0.5 and a bead radius of 100μm (case 3), the total flow of Nicotine is 0.149 mg per cycle the spike is very small compared to the net air flow rate. Case 3 fetched the optimal flow rate at the same time without having severe spikes during puffing.

DROP TEST

❖ Mesh - Tetrahedral

❖ Distance between RigidWall and e-Cig is 2m (Assumed)
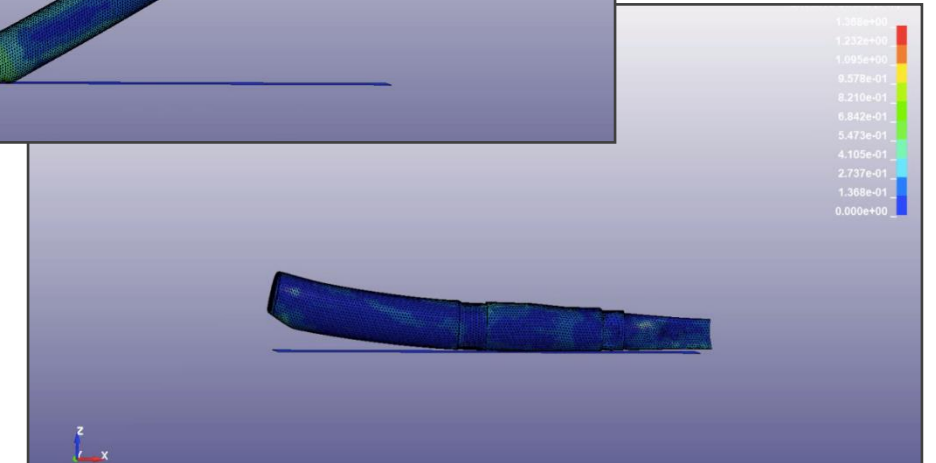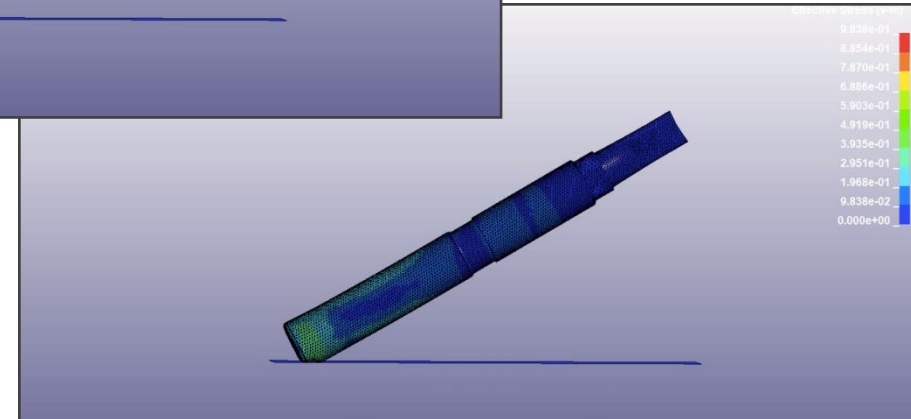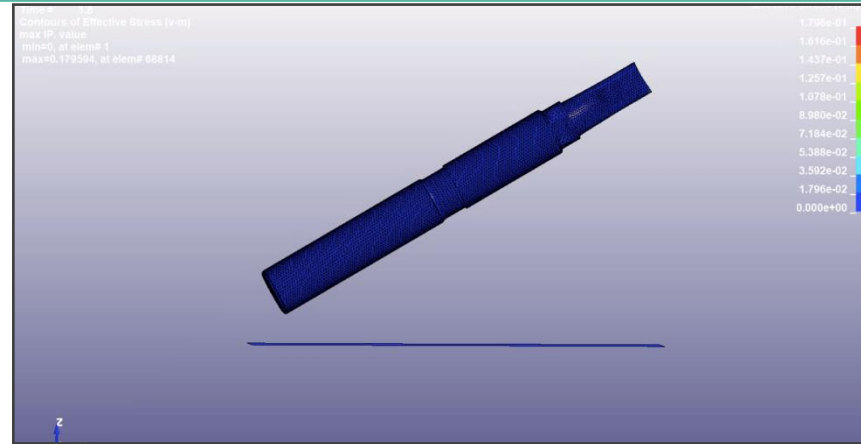
❖ Angle of e-Cig with respect to ground 30°

Atomiser

Battery

Cartridge

Internal Electromechanical Assembly
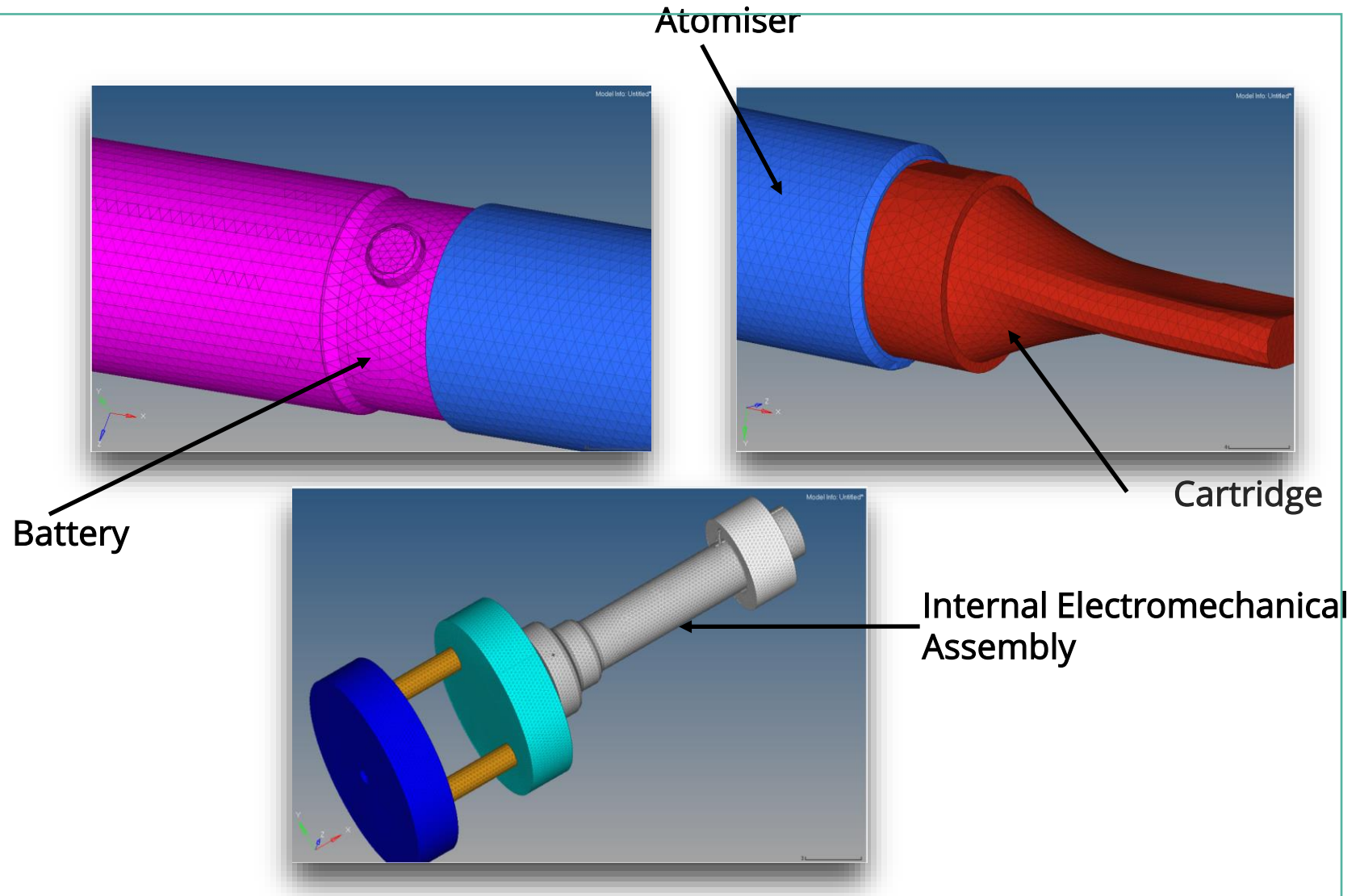
DROP TEST

Post strengthening the thread portion

Effective Stress at
different time steps

Advanced Engineering Services

https://aesgs.com

THANK YOU