

| Fusee a eau. (Compressed air over water rockets) misc | | Comparison Table showing how parameters change when you vary one parameter at a time- In this case Launch pressure in Bar | | | | | | | | | | | | | | | | | |
|-----------------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------------------------|--|---------------|--|---------------|--|-------------|--|-------------|--|-------------|--|-------------|--|-------------|--|-------------|--|
| Performance parameters | | | | | | | | | | | | | | | | | | | |
| Created by John Gwynn September 2002 | | | | | | | | | | | | | | | | | | | |
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| Launcher Physical characteristics | | Badol 0.33L | | | | | | | | | | | | | | | | | |
| Nozzle Diameter mm d | | 22 | | 22 | | 22 | | 22 | | 22 | | 22 | | 22 | | 22 | | 22 | |
| Nozzle Area m ² Na (a ²) | | 0.000380133 | | 0.000380133 | | 0.000380133 | | 0.000380133 | | 0.000380133 | | 0.000380133 | | 0.000380133 | | 0.000380133 | | 0.000380133 | |
| Length of rocket body from tip to nozzle(L) mm | | 520 | | 520 | | 520 | | 520 | | 520 | | 520 | | 520 | | 520 | | 520 | |
| Diameter of rocket body (D) mm | | 80 | | 80 | | 80 | | 80 | | 80 | | 80 | | 80 | | 80 | | 80 | |
| Aerodynamic ratio L/D | | 6.5 | | 6.5 | | 6.5 | | 6.5 | | 6.5 | | 6.5 | | 6.5 | | 6.5 | | 6.5 | |
| Type of bottle used for main reservoir | | Badol 1L | | Badol 1L | | Badol 0.33L | | Badol 1L | | Badol 1L | | Badol 1L | | Badol 1L | | Badol 1L | | Badol 1L | |
| Volume of bottle | | 1000 | | 1000 | | 350 | | 1000 | | 1000 | | 1000 | | 1000 | | 1000 | | 1000 | |
| Type of bottle used for payload capsule/ Coffie | | Aix les Bains | | Aix les Bains | | Aix les Bains | | Aix | | Aix | | Aix | | Aix | | Aix | | Aix | |
| Height of liquid level Hydraulic head (h) mm | | 230 | | 230 | | 125 | | 230 | | 230 | | 230 | | 230 | | 230 | | 230 | |
| Rocket launch pressure Pa or N/m ² | | 709275 | | 709275 | | 911925 | | 20265 | | 303975 | | 405300 | | 506625 | | 607950 | | 709275 | |
| Launch pressure in Pa or N/m ² | | 709275 | | 709275 | | 911925 | | 20265 | | 303975 | | 405300 | | 506625 | | 607950 | | 709275 | |
| Density of liquid Kg/m ³ Dn (ρ) | | 1000 | | 1000 | | 1000 | | 1000 | | 1000 | | 1000 | | 1000 | | 1000 | | 1000 | |
| Density of airgas Kg/m ³ m ³ | | 1.1614 | | 1.1614 | | 1.1614 | | 1.1614 | | 1.1614 | | 1.1614 | | 1.1614 | | 1.1614 | | 1.1614 | |
| Acceleration due to gravity (g) 9.81 m/s ² | | 9.81 | | 9.81 | | 9.81 | | 9.81 | | 9.81 | | 9.81 | | 9.81 | | 9.81 | | 9.81 | |
| Discharge coefficient 0.97 > 0.995 W | | 0.97 | | 0.97 | | 0.97 | | 0.97 | | 0.97 | | 0.97 | | 0.97 | | 0.97 | | 0.97 | |
| Coefficient of contraction 0.52 > 0.95 X | | 0.52 | | 0.52 | | 0.52 | | 0.52 | | 0.52 | | 0.52 | | 0.52 | | 0.52 | | 0.52 | |
| Z-g | | 4.5126 | | 4.5126 | | 4.5126 | | 4.5126 | | 4.5126 | | 4.5126 | | 4.5126 | | 4.5126 | | 4.5126 | |
| Z-Path | | 1415.25 | | 1415.25 | | 1923.85 | | 1923.85 | | 1923.85 | | 1923.85 | | 1923.85 | | 1923.85 | | 1923.85 | |
| 1 Jet velocity V1 from a pressurised reservoir | | 37.72350196 | | 37.72350196 | | 42.7593569 | | 42.7593569 | | 42.7593569 | | 42.7593569 | | 42.7593569 | | 42.7593569 | | 42.7593569 | |
| V1=√(2gh+2Pa/Dn) Note to power 0.5 | | 36.5917969 | | 36.5917969 | | 41.4765762 | | 41.4765762 | | 41.4765762 | | 41.4765762 | | 41.4765762 | | 41.4765762 | | 41.4765762 | |
| Velocity of water jet discharged V1 m/s | | 36.5917969 | | 36.5917969 | | 41.4765762 | | 41.4765762 | | 41.4765762 | | 41.4765762 | | 41.4765762 | | 41.4765762 | | 41.4765762 | |
| Air jet 2Pa/Da | | 305353.4527 | | 305353.4527 | | 392927.296 | | 392927.296 | | 392927.296 | | 392927.296 | | 392927.296 | | 392927.296 | | 392927.296 | |
| Air jet V1=√(2Pa/Dn) Note to power 0.5 | | 305353.4527 | | 305353.4527 | | 392927.296 | | 392927.296 | | 392927.296 | | 392927.296 | | 392927.296 | | 392927.296 | | 392927.296 | |
| 3 Tsolkovski Parameter V2=√(LNM1/M2) m/s | | 600 | | 750 | | 750 | | 245 | | 600 | | 600 | | 600 | | 600 | | 600 | |
| Mass initial gms M1 | | 600 | | 750 | | 750 | | 245 | | 600 | | 600 | | 600 | | 600 | | 600 | |
| Mass final gms M2 | | 100 | | 118 | | 118 | | 10 | | 100 | | 100 | | 100 | | 100 | | 100 | |
| Ratio M1/M2 | | 6.05982203 | | 6.355932203 | | 6.355932203 | | 24.5 | | 6.0 | | 6.0 | | 6.0 | | 6.0 | | 6.0 | |
| LN(M1/M2) | | 1.791759469 | | 1.849388586 | | 1.849388586 | | 3.20762869 | | 1.791759469 | | 1.791759469 | | 1.791759469 | | 1.791759469 | | 1.791759469 | |
| Volume of liquid ml cm ³ | | 500 | | 632 | | 632 | | 175 | | 500 | | 500 | | 500 | | 500 | | 500 | |
| Volume of air ml cm ³ | | 500 | | 368 | | 368 | | 175 | | 500 | | 500 | | 500 | | 500 | | 500 | |
| Final velocity of fuselerocket V2 | | 65.5639859 | | 67.6724538 | | 76.7063064 | | 51.93103739 | | 35.1939959 | | 43.0121577 | | 49.2639828 | | 55.44657015 | | 60.71622812 | |
| Tsolkovski formula V2=√(LNM1/M2) m/s | | 65.5639859 | | 67.6724538 | | 76.7063064 | | 51.93103739 | | 35.1939959 | | 43.0121577 | | 49.2639828 | | 55.44657015 | | 60.71622812 | |
| Pa/Pa/ACI Cf divergent expansion nozzle coil 1.6x2.0 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | |
| 4.DischargeFlow Rate Qs m/s | | 0.011277911 | | 0.011277911 | | 0.01261328 | | 0.01261328 | | 0.00971585 | | 0.00730023 | | 0.00421816 | | 0.009410663 | | 0.010305055 | |
| Qs= XA*V1 m/s | | 0.011277911 | | 0.011277911 | | 0.01261328 | | 0.01261328 | | 0.00971585 | | 0.00730023 | | 0.00421816 | | 0.009410663 | | 0.010305055 | |
| Qs Equivalent m/s | | 1127.79117 | | 1127.79117 | | 1261.3287 | | 1261.3287 | | 971.58499 | | 730.2335 | | 421.816395 | | 941.066272 | | 10305.0548 | |
| Mass flow rate m Kg/s | | 0.011277911 | | 0.011277911 | | 0.01261328 | | 0.01261328 | | 0.00971585 | | 0.00730023 | | 0.00421816 | | 0.009410663 | | 0.010305055 | |
| T1 Duration of jet stream QsB23 Seconds | | 0.044932547 | | 0.056794739 | | 0.05010591 | | 0.01272296 | | 0.053121221 | | 0.048519878 | | 0.053121221 | | 0.048519878 | | 0.053121221 | |
| Air Qs XA*V1 m/s | | 0.163004045 | | 0.163004045 | | 0.18482921 | | 0.18482921 | | 0.136830928 | | 0.10575443 | | 0.136830928 | | 0.148304335 | | 0.15975943 | |
| Air Qs Equivalent m/s | | 16300.045 | | 16300.045 | | 18482.921 | | 18482.921 | | 13683.0928 | | 10575.443 | | 13683.0928 | | 14830.4335 | | 15975.943 | |
| Air Mass flow rate m Kg/s | | 0.199390862 | | 0.199390862 | | 0.22216472 | | 0.22216472 | | 0.169831722 | | 0.127944529 | | 0.169831722 | | 0.18482921 | | 0.199390862 | |
| Created by John Gwynn for Alex and Gabriel | | 0.006134817 | | 0.004515225 | | 0.00398205 | | 0.00189364 | | 0.186983172 | | 0.27944529 | | 0.371907403 | | 0.464369518 | | 0.56831634 | |
| jet a gwynn@wanadoo.fr | | 0.006134817 | | 0.004515225 | | 0.00398205 | | 0.00189364 | | 0.186983172 | | 0.27944529 | | 0.371907403 | | 0.464369518 | | 0.56831634 | |
| © All rights reserved | | 0.006134817 | | 0.004515225 | | 0.00398205 | | 0.00189364 | | 0.186983172 | | 0.27944529 | | 0.371907403 | | 0.464369518 | | 0.56831634 | |
| Kinematic viscosity of air at 200m Vis 14* 10 ⁻⁶ m/s | | 0.006134817 | | 0.004515225 | | 0.00398205 | | 0.00189364 | | 0.186983172 | | 0.27944529 | | 0.371907403 | | 0.464369518 | | 0.56831634 | |
| L/Vis | | 37142.85714 | | 37142.85714 | | 37142.85714 | | 20500 | | 37142.85714 | | 37142.85714 | | 37142.85714 | | 37142.85714 | | 37142.85714 | |
| Density of air (del) at 200m Kg/m ³ | | 1.202 | | 1.202 | | 1.202 | | 1.202 | | 1.202 | | 1.202 | | 1.202 | | 1.202 | | 1.202 | |
| Coefficient of drag Cd 0.05 Equiv L/D=6 | | 0.05 | | 0.05 | | 0.05 | | 0.07 | | 0.05 | | 0.05 | | 0.05 | | 0.05 | | 0.05 | |
| Cd varies from 0.05 > 0.05 | | 0.05 | | 0.05 | | 0.05 | | 0.07 | | 0.05 | | 0.05 | | 0.05 | | 0.05 | | 0.05 | |
| Cd depends on aerodynamic pure form shape | | 0.05 | | 0.05 | | 0.05 | | 0.07 | | 0.05 | | 0.05 | | 0.05 | | 0.05 | | 0.05 | |
| Cross section area A m ² | | 0.00026548 | | 0.00026548 | | 0.00026548 | | 0.00026548 | | 0.00026548 | | 0.00026548 | | 0.00026548 | | 0.00026548 | | 0.00026548 | |
| V2 Velocity of fuselerocket m/s | | 65.5639859 | | 67.6724538 | | 76.7063064 | | 51.93103739 | | 35.1939959 | | 43.0121577 | | 49.2639828 | | 55.44657015 | | 60.71622812 | |
| V2r Head on wind velocity m/s | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | |
| Reynolds Number Re =√(2gh+2Pa/Dn) L/Vis m/s | | 243523.091 | | 251358.148 | | 294991.38 | | 1064586.267 | | 1306830.928 | | 1597594.43 | | 1843043.365 | | 2098444.034 | | 2255174.187 | |
| Reynolds Number Re =√(2gh+2Pa/Dn) L/Vis m/s | | 243523.091 | | 251358.148 | | 294991.38 | | 1064586.267 | | 1306830.928 | | 1597594.43 | | 1843043.365 | | 2098444.034 | | 2255174.187 | |
| Reynolds Number Re =√(2gh+2Pa/Dn) L/Vis m/s | | 2454704.875 | | 2533656.58 | | 2871884.11 | | 1073102.957 | | 1317285.578 | | 1610375.18 | | 1857787.712 | | 2075919.588 | | 2272425.581 | |
| (V2+Var) ² | | 4298.598573 | | 4579.560676 | | 5883.84764 | | 2696.832645 | | 1237.907494 | | 1850.04571 | | 2462.183926 | | 3074.321242 | | 3686.460354 | |
| 5.Aerodynamic drag Force Fd = 0.5del(Cd)AV2+Var ² N | | 0.69173245 | | 0.88874357 | | 0.299759101 | | 0.186983172 | | 0.27944529 | | 0.371907403 | | 0.464369518 | | 0.56831634 | | 0.642923749 | |
| 6.Thrust Force Fx = Qs V1 + (Pa-Pa)Se N | | 111.2779117 | | 111.2779117 | | 126.13287 | | 126.13287 | | 97.158499 | | 73.02335 | | 42.1816395 | | 94.1066272 | | 103.0548 | |
| Mass flow from nozzle Debit Qn Q Kg/s | | 0.011277911 | | 0.011277911 | | 0.01261328 | | 0.01261328 | | 0.00971585 | | 0.00730023 | | 0.00421816 | | 0.009410663 | | 0.010305055 | |
| QV2 N | | 729.5791461 | | 753.0449068 | | 967.52 | | 654.6517292 | | 210.1037064 | | 333.998794 | | 417.8938823 | | 517.7889702 | | 625.6840523 | |
| Velocity of fluid (gas) V1 | | 407.1858743 | | 407.1858743 | | 453.15578 | | 522.566316 | | 117.261112 | | 175.246064 | | 233.2310165 | | 291.2159691 | | 349.2009217 | |
| F= Q V1 + (Pa-Pa)Se N | | 407.1858743 | | 407.1858743 | | 453.15578 | | 522.566316 | | 117.261112 | | 175.246064 | | 233.2310165 | | 291.2159691 | | 349.2009217 | |
| Note: For ideal nozzle Pa=Pa | | 407.1858743 | | 407.1858743 | | 453.15578 | | 522.566316 | | 117.261112 | | 175.246064 | | 233.2310165 | | 291.2159691 | | 349.2009217 | |
| F= Q V2 + (Pa-Pa)Se N | | 523.15578 | | 522.566316 | | 523.15578 | | 522.566316 | | 523.15578 | | 522.566316 | | 523.15578 | | 522.566316 | | 523.15578 | |
| I/g | | 0.101936799 | | 0.101936799 | | 0.101936799 | | 0.101936799 | | 0.101936799 | | 0.101936799 | | 0.101936799 | | 0.101936799 | | 0.101936799 | |
| 7. Specific impulse | | 3.73005052 | | 3.73005052 | | 4.27798402 | | 4.27798402 | | 2.00168367 | | 2.44708414 | | 2.823004238 | | 3.154466871 | | 3.45249831 | |
| Specific impulse 2 for water jet period 1 F1 (g/m) | | 3.73005052 | | 3.73005052 | | 4.27798402 | | 4.27798402 | | 2.00168367 | | 2.44708414 | | 2.823004238 | | 3.154466871 | | 3.45249831 | |
| Specific impulse due to comp air | | 3.73005052 | | 3.73005052 | | 4.27798402 | | 4.27798402 | | 2 | | | | | | | | | |