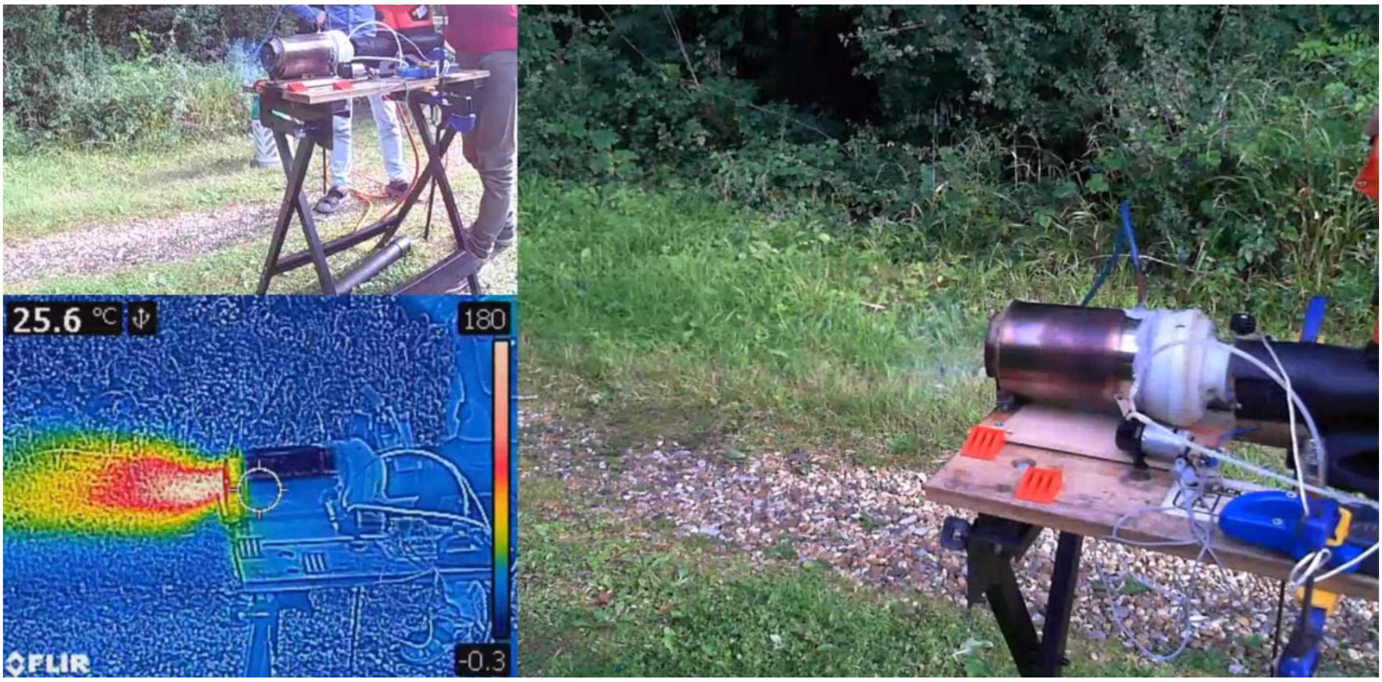
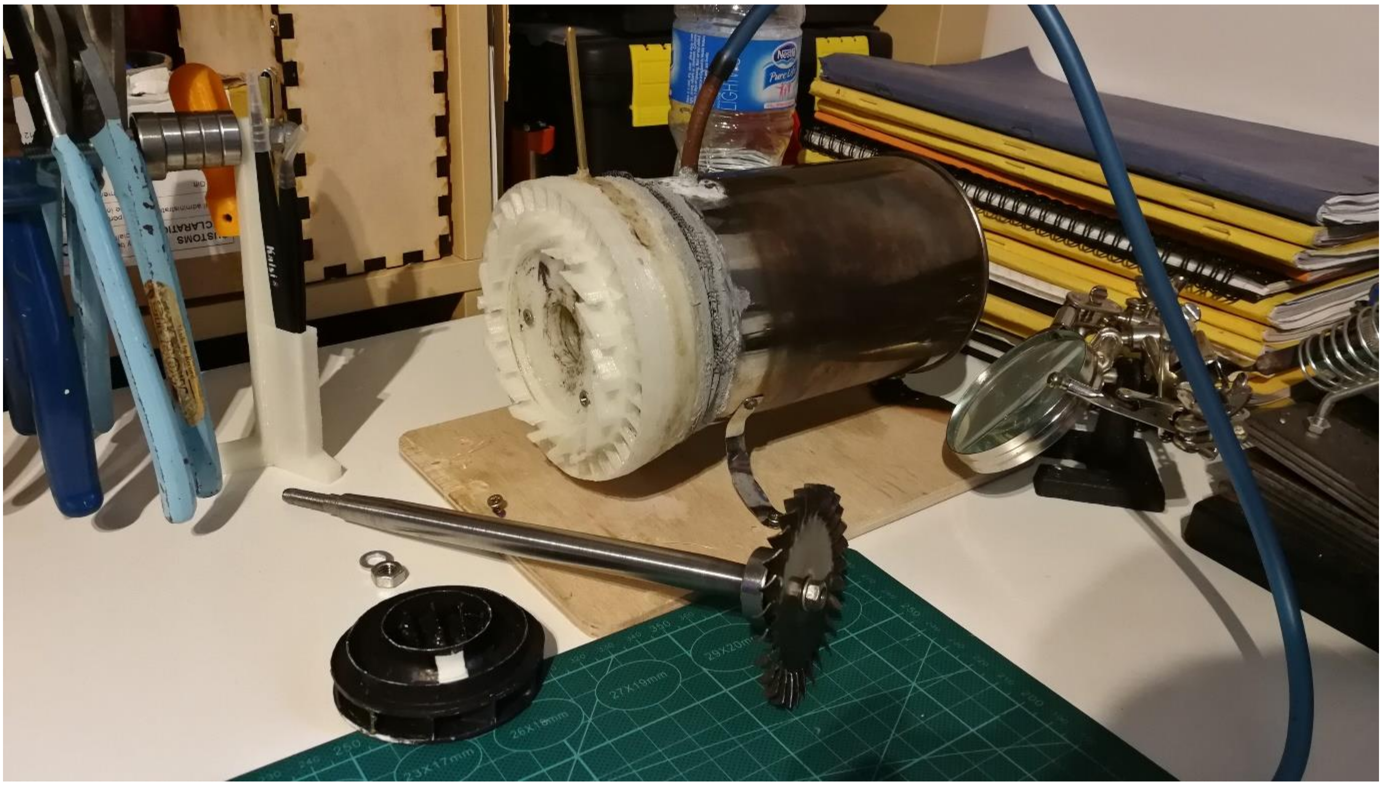
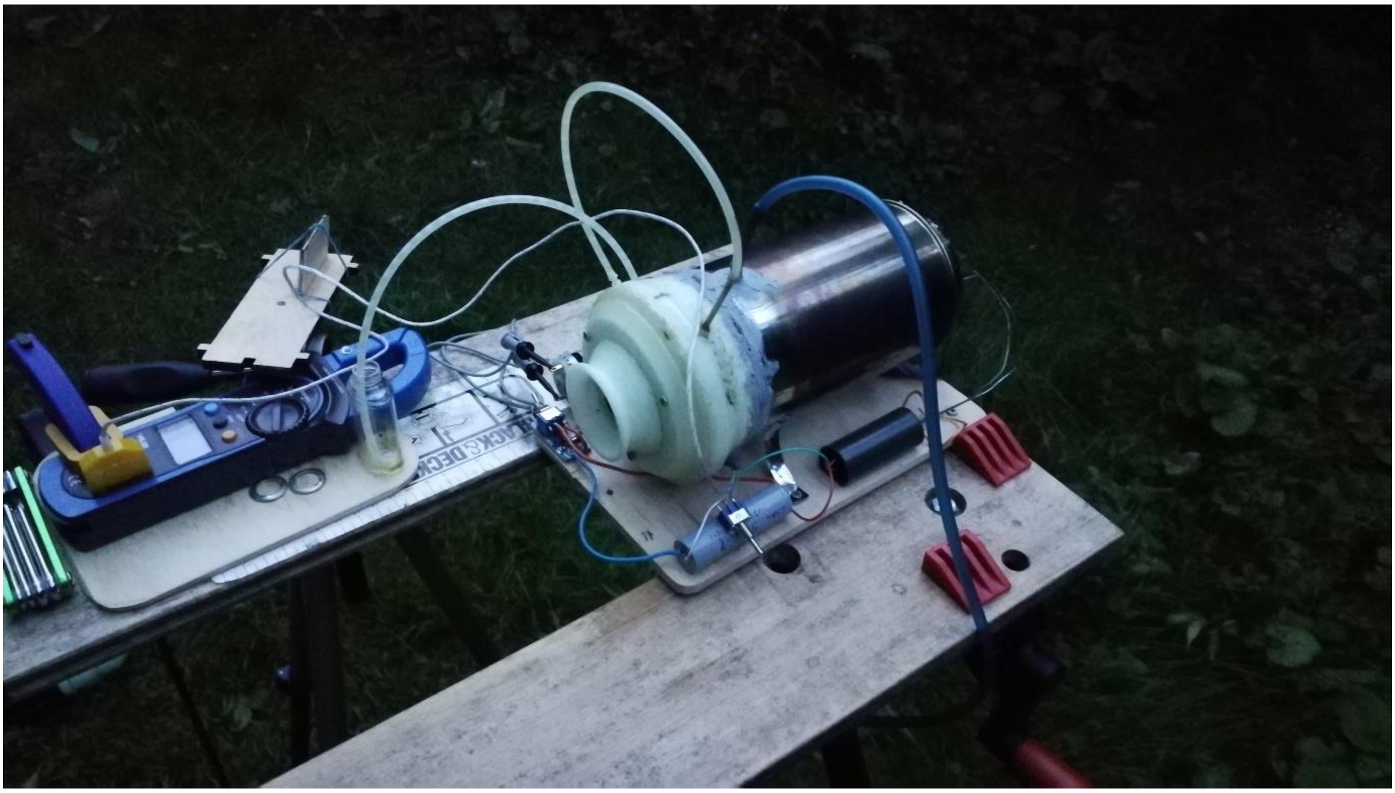


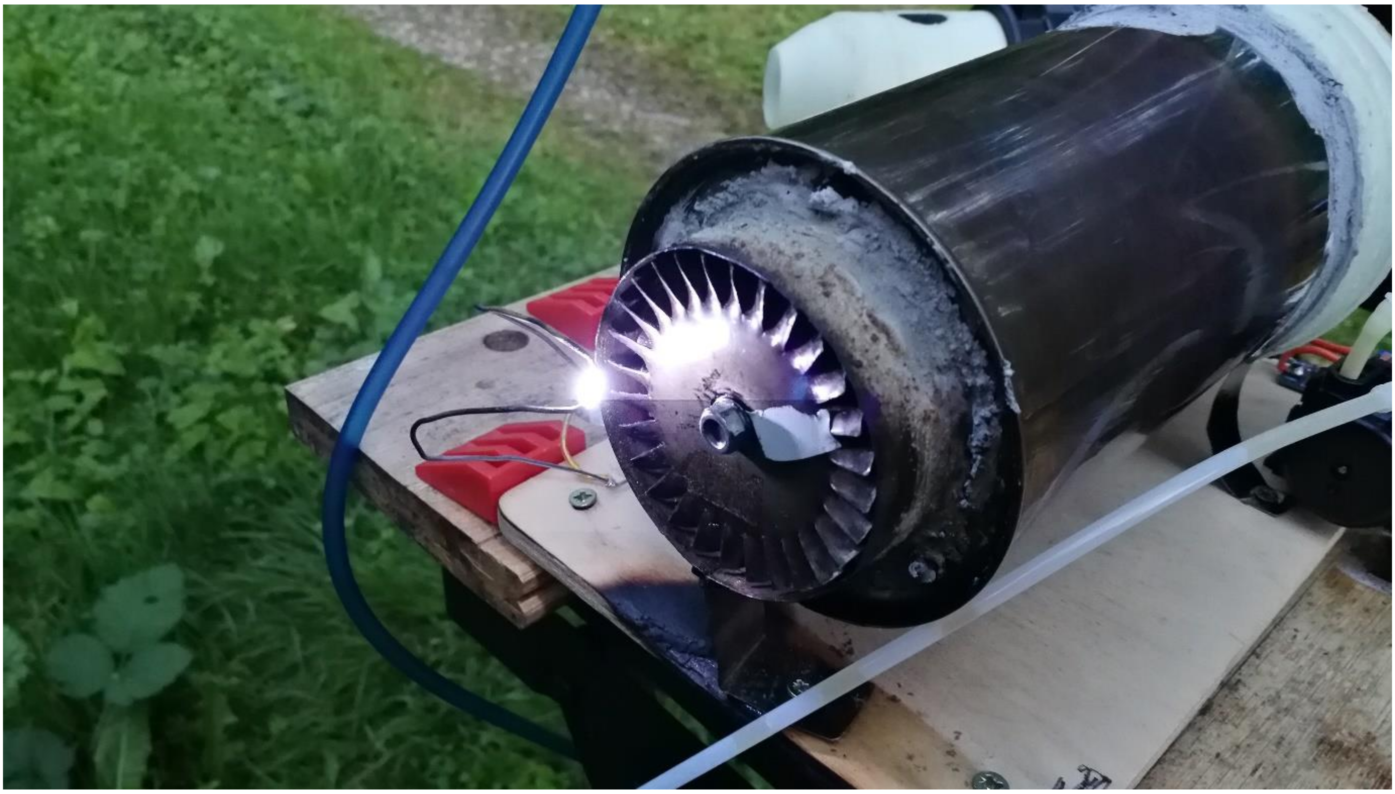
Testing on the Engine



Engine sitting on my desk



Testing apparatus



Taser module used as igniter

Shaft		
Diameter/mm	9.82	
Total length/mm	203	
Tip to center of gravity/mm	113.81	
Weight/g	125.9	
Young Mod/Pa	2.07E+11	
Sec. Mome. Area	4.565E-10	$I = \frac{1}{4}\pi \cdot r^4$
Stiffness/kgs-1	5.585E+05	$C_q = \frac{3 \cdot E \cdot I \cdot l}{a^2 \cdot b^2}$
N max/s-1	2106	$n_c = \sqrt{\frac{C_q}{m}}$
N max/rpm	126370	

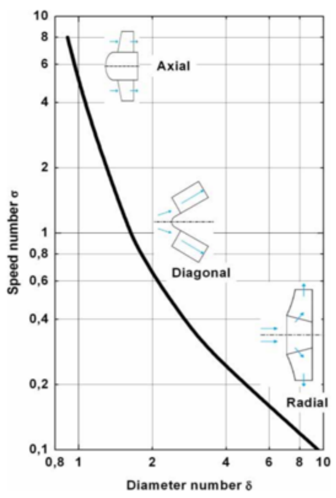
Turbine Fan		
D max/mm	64	
D middle/mm	53.5	
D inner/mm	42	
D bore/mm	5	
Density/kgm-3	8000	
Stress Limit/Pa	1.37E+08	
U max/ms-1	217.7	$u_{max} = \sqrt{\frac{3\sigma \cdot r_{blade}^2}{p(r_{blade}^2 + r_{blade} r_{bore} + r_{bore}^2)}}$
N max/s-1	1082.6	$n_{max} = \frac{u_{max}}{d_{outer} \cdot \pi}$
N max/rpm	64958.6	
U mean/ms-1	165.9	$u_{mean} = n_{max} \cdot d_{middle} \cdot \pi$

Compressor Wheel Strength		
Density/ kgm3	1300	
Yield stress/Pa	3.49E+07	
Radius at inner blade/mm	14.5	$s_{inlet} = \frac{2 \cdot p \cdot R_1 \cdot \pi^2 \cdot n_{max}^2 \cdot B_1^2 \cdot cos\theta_1}{\sigma}$
Height inner blade/mm	11.5	
Thickness inner blade/mm	1.373	
Radius at outer blade/mm	29	$s_{outlet} = \frac{2 \cdot p \cdot R_2 \cdot \pi^2 \cdot n_{max}^2 \cdot B_2^2 \cdot cos\theta_2}{\sigma}$
Height outer blade/mm	5.8	
Thickness outer blade/mm	0.591	
N max/s-1	987.0	$n_{max} = \sqrt{\frac{\sigma_{max}}{0.83 \cdot p \cdot 4 \cdot R_2^2 \cdot \pi^2}}$
Max Speed/krpm	59221	

Aerodynamics and Thrust		
C2/ms-1	134.3	$c_2 = u_{mean} \cdot tan\theta_2$
Exhaust density/kgm-3	0.440	$p_{exhaust} = p_{normal} \cdot \frac{T_{ambien}}{T_{exhaus}}$
M dot/kgs-1	0.1083	$\dot{m} = \frac{\pi(d_{outer}^2 - d_{inner}^2)}{4} \cdot c_2 \cdot p_{exhaust}$
Thrust/N	14.552	$F = \dot{m} \cdot c_2$

Fuel Consumption		
Q dot/Js-1	56918	
Energy Released J/kg	5.03E+07	
Mass needed kg/s	1.13E-03	$\dot{m_{propane}} = \frac{\dot{Q}}{E}$
g/s	1.13	
kg/h	4.07	

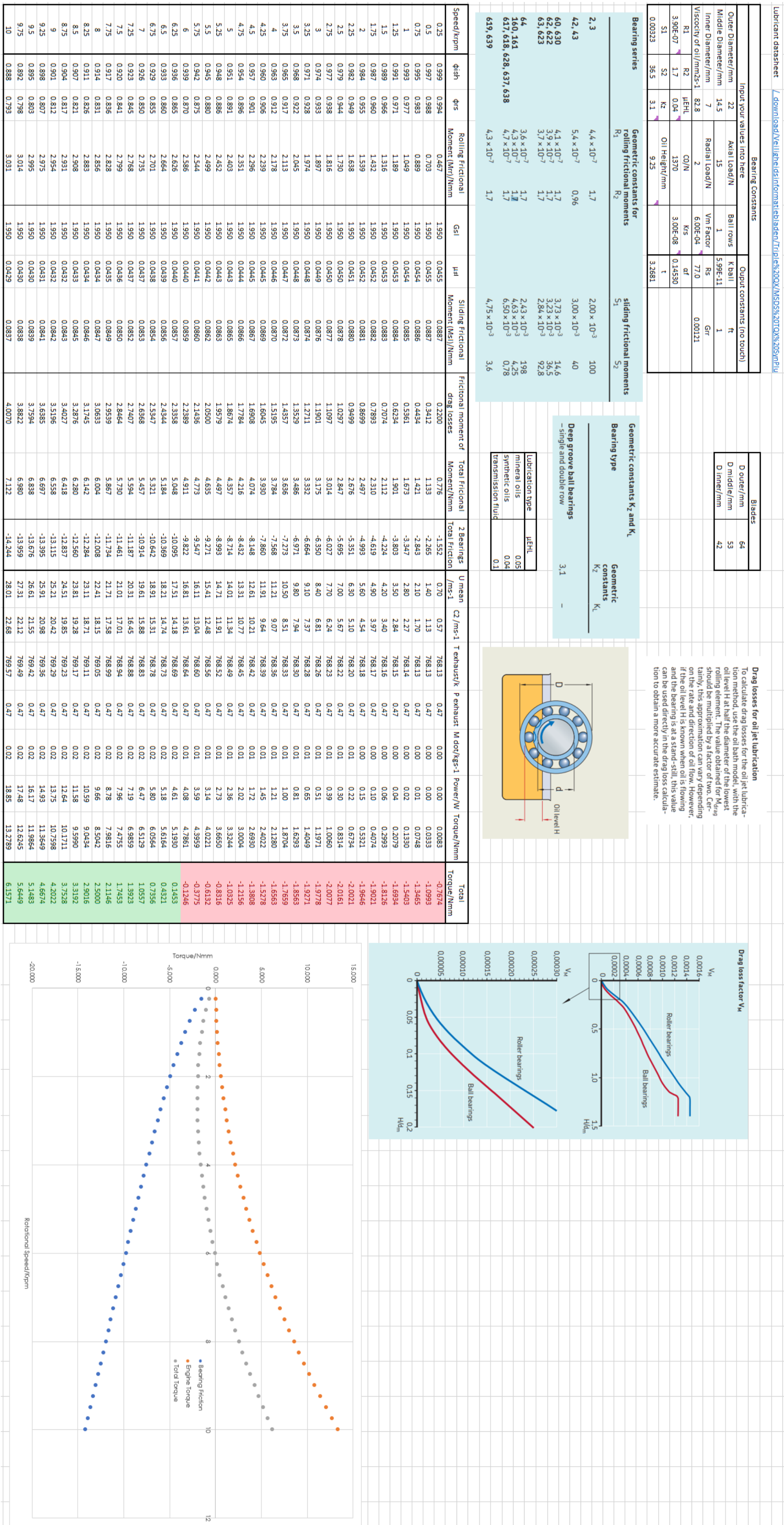
Power and Pressure		
P shaft/W	2981.1	$P_{shaft} = \dot{m} \cdot u_{mean}^2$
P shaft/hp	4.00	
λ/bar	1.250	$\lambda = \left(\frac{u_{mean}^2 \cdot \eta_V}{C_p \cdot T_1} + 1\right)^{\left(\frac{\gamma}{\gamma - 1}\right)}$
λ/psi	18.1	
T exhaust/K	818.6	$T_{exhaust} = \frac{u_{mean}^2\left(1 + \frac{tan^2\theta_2}{2}\right)}{C_p \cdot \eta_T \cdot \left(1 - \frac{1}{\frac{u_{mean}^2 \cdot \eta_V}{C_p \cdot T_1} + 1}\right)}$
T exhaust/C	545.5	



Expansion		
Diameter/mm	64	
Ther. Ex. Coeff.	1.73E-05	
ΔT/K	541	
ΔDiameter/mm	0.599	$\Delta l = l \cdot \Delta T \cdot \alpha$
Diameter/mm	65	
Ther. Ex. Coeff.	1.73E-05	
ΔT/K	485	
ΔDiameter/mm	0.545	$\Delta l = l \cdot \Delta T \cdot \alpha$
Total Expansion/mm	0.054	

Compressor Shape		
Running Factor σ	0.284	$\sigma = \frac{2n\sqrt{\frac{\dot{m}}{\lambda \cdot p_{normal}}}\pi}{(2 \cdot u_{mean}^2)^{3/4}}$
Diameter Factor δ	3.9	
Diameter/mm	76.43	$D = \frac{2\delta}{\sqrt[4]{\frac{2 \cdot u_{mean}^2 \cdot \pi^2}{\frac{\dot{m}}{\lambda \cdot p_{normal}}}}}$

Calculations from Kurt Schrekling



Bearings calculator using formulae from SKF's website

<https://www.skf.com/binary/68-299767/0901d1968065e9e7-The-SKF-model-for-calculating-the-frictional-movement_tcm_12-299767.pdf>