Results for both engines. Go to the engine that you disasembled.

These are the results for the Ford Duratech engine.

Engine (just fill in this form for the engine that you are working on)	Measurements and estimates (units required)	Comments
Intake runner length	49.53 cm	
organ pipe frequency (lowest)	177 Hz	Wavelength λ =4*49.53cm=1.98m; f=c/λ =(350/1.98) Hz
Manifold volume	1.548 L	3”*5.5”*9”=94.5 in^3=1.548 L
Ratio of above to displacement	2.75 for each cylinder	Manifold vol = 0.7 x total displacement of 4 cyl
Bore (B)	87.4 mm	
Stroke (2a)	93.8 mm	
Connecting Rod Length (ℓ)	147 mm	
Displacement (V_D)	563 cc	
Piston mass	290 g	
Piston diameter at first land (B_1)	87.2 mm	
Inertia force required to move piston at 6000 rpm	1088 N	F=ma; a~Stroke/τ^2; τ ~ 60/(2*rpm)
Piston diameter at second land (B_2)	87.02 mm	Piston/liner clearance decreases from B_1 to B_3
Piston diameter at third land (B_3)	84.20 mm	because top land is much hotter; more thermal
Piston diameter at skirt (B_s)	87.60 mm	expansion
Top land height (h_1)	4.50 mm	
Second land height (h_2)	4.65 mm	
Third land height (h_3)	2.30 mm	
Skirt height (h_s)	3.057 cm	
Top ring groove gap (g_1)	1.19 mm	.047”
Second ring groove gap (g_2)	1.19 mm	.047”
Control ring groove gap (g_3)	2.44 mm	
Top ring groove depth (d_1)	3.3 mm	
Second ring groove depth (d_2)	3.5 mm	
Control ring groove depth (d_3)	2.44 mm	
Top ring width (w_1)	3.23 mm	
Top ring thickness (t_1)	1.16 mm	
Second ring width (w_2)	2.78 mm	
Second ring thickness (t_2)	1.26 mm	
Piston temperature at which top land would interfere with liner	158^o C	See note 1
Intake valve mass	47.8 g	
Intake valve diameter	3.54 cm	Intake valve larger than exhaust value because pressure drop there is higher due to the higher air density than the exhaust gas which is hot
Intake valve Lift	7.5 mm	
Spring force estimate for 1000 rpm	0.896 N	Force=mass*lift/τ^2, where τ is valve movement time, which corresponds to ~120^o crank angle
Spring force estimate for 6000 rpm	3.23 N	36* above
Exhaust valve mass	40.7 g	
Exhaust valve diameter	3.54 cm	
Exhaust valve lift	7.5 mm	
Spring force estimate for 1000 rpm	0.73 N	
Spring force estimate for 6000 rpm	27.4 N	

Note 1:
The following notation is used:
Bore B; top land diameter d
Coefficient of thermal expansion for bore (cast iron) is α_B (=1.1x10^{-5}/^{o} C), and for piston (aluminum) is α_d (=2.3x10^{-5}/^{o} C).
Temperature rise of piston top land is ΔT; that of bore is ΔT_B.
Cold component temperature is 20^o C.
Bore is kept at 100^o C by the coolant water. So ΔT_B = 80^o C.

Top land will touch cylinder when

$$B(1+\alpha_B \Delta T_B) = d(1+\alpha_d \Delta T);\ \text{or}\ \Delta T = \frac{(B-d)+B\alpha_B \Delta T_B}{d\alpha_d}$$

The diametric clearance (B-d) is 200 μm. B and d are both approximately 87 mm. Then ΔT=138^o C, or T = 158^o C.

This value is a bit low, plausibly due to measurement accuracy on the clearance (B-d).

These are the results for the GM Ecotec engine.

Engine (just fill in this form for the engine that you are working on)	Measurements and estimates (units required)	Comments
Intake runner length	45.7 cm	
organ pipe frequency (lowest)	192 Hz	Wavelength λ =4*45.7cm=1.83m; f=c/λ =(350/1.83) Hz
Manifold volume	2.173 L	
Ratio of above to displacement/cyl	3.9	Manifold vol ~ total displacement of 4 cyl
Bore (B)	85.70 mm	
Stroke (2a)	96.34 mm	
Connecting Rod Length (ℓ)	147 mm	
Displacement (V_D)	555.7 cc	
Piston mass	410.8 g	
Piston diameter at first land (B_1)	85.35 mm	
Inertia force required to move piston at 6000 rpm	1584 N	F=ma; a~Stroke/τ^2; τ ~ 60/(2*rpm)
Piston diameter at second land (B_2)	85.55 mm	Piston/liner clearance decreases from B_1 to B_3
Piston diameter at third land (B_3)	85.94 mm	because top land is much hotter; more thermal
Piston diameter at skirt (B_s)	86.25 mm	expansion
Top land height (h_1)	2.97 mm	
Second land height (h_2)	3.83 mm	
Third land height (h_3)	2.50 mm	
Skirt height (h_s)	2.70 cm	
Top ring groove gap (g_1)	1.30 mm	
Second ring groove gap (g_2)	1.84 mm	
Control ring groove gap (g_3)	3.00 mm	
Top ring groove depth (d_1)	3.92 mm	
Second ring groove depth (d_2)	3.80 mm	
Control ring groove depth (d_3)	3.66 mm	
Top ring width (w_1)	3.23 mm	
Top ring thickness (t_1)	1.16 mm	
Second ring width (w_2)	3.57 mm	
Second ring thickness (t_2)	1.48 mm	
Piston temperature at which top land would interfere with liner	135^o C	See note 1
Intake valve mass	44.6 g	
Intake valve diameter	3.55 cm	Intake valve larger than exhaust value because pressure drop there is higher due to the higher air density than the exhaust gas which is hot
Intake valve Lift	6 mm	
Spring force estimate for 1000 rpm	0.67N	Force=mass*lift/τ^2, where τ is valve movement time, which corresponds to ~120^o crank angle
Spring force estimate for 6000 rpm	24 N	
Exhaust valve mass	40 g	
Exhaust valve diameter	3.08 cm	
Exhaust valve lift	6mm	
Spring force estimate for 1000 rpm	0.6N	
Spring force estimate for 6000 rpm	22N	

Note 1:
The following notation is used:
Bore B; top land diameter d
Coefficient of thermal expansion for bore (cast iron) is α_B (=1.1x10^{-5}/^{o} C), and for piston (aluminum) is α_d (=2.3x10^{-5}/^{o} C).
Temperature rise of piston top land is ΔT; that of bore is ΔT_B.
Cold component temperature is 20^o C.
Bore is kept at 100^o C by the coolant water. So ΔT_B = 80^o C.

Top land will touch cylinder when

$$B(1+\alpha_B\Delta T_B) = d(1+\alpha_d\Delta T);\ \text{or}\ \Delta T = \frac{(B-d)+B\alpha_B\Delta T_B}{d\alpha_d}$$

The diametric clearance (B-d) is 150 μm. B and d are both approximately 86 mm. Then ΔT=115^o C, or T = 135^o C.

This value is a bit low, plausibly due to measurement accuracy on the clearance (B-d).