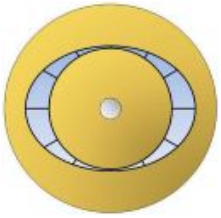

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Design Analysis
Circle Ellipse Engine

Author: **Robert Grisar**
Circle Ellipse Engine Company
Founder and President

Table of Contents

Abstract

The Circle Ellipse Engine is a unique, patented, internal combustion engine design based on my life experience. I have been fortunate to receive several patent awards throughout my 40 years of experience as an engineer and scientist in radar, sonar, satellite communications, medical devices, space transportation, and military parts reinvention. I capped my career with 10 years of continuous work developing another patented rotary engine. These past 5 years, now retired, I crystallized my thinking and approach to invent this incredibly simple, low-cost fossil-fuel Circle Ellipse Engine.

The Circle Ellipse Engine reinvents the functionality of the centuries-old reciprocating engine. Instead of pistons, driven by the rotation of a crankshaft, the Circle Ellipse Engine offers continuous power every revolution. Its relationship of an elliptical surface surrounding a round rotor forms the necessary 4-step Otto-Cycle geometry every rotation, at half the RPM of a reciprocating engine. This eliminates the crankshaft, camshaft, valve lifters, rocker arms, connecting rods, wrist pins, timing chains, and a host of other components, significantly reducing engine size and weight. It is ideal for insertion into every application where small size and weight are primary factors, such as unmanned aerial vehicles (drones). The secondary obvious advantage is a marked reduction in host size and weight, generally translating to the ability to carry increased fuel and/or payload.

This is a comprehensive design analysis. The analysis includes technical formulae based a small number of assumption, and leverages heavily on industry documented constants for fuel, air, density, etc.

I am confident that you will have a positive reaction to this design analysis. It allows technical evaluation to measure the effects on changes to the baseline engine design, such as size, RPM, fuel, etc, and quickly determine the estimated horsepower, torque, and fuel consumption values.

Because the entire Circle Ellipse Engine is 3D modeled in parametric equations, a drawing package is readily available in days, with complete and accurate estimates of performance, weight, and cost.

Robert Grisar
Circle Ellipse Engine Company
Founder and President

Inputs

Gasoline Engines Enter G, Diesel Engines Enter D	D

Constants	Value	Units
1 kJ/kg	0.43	BTU/lb
Pi	3.1416	:1 ratio
1 Horsepower	2542	BTU/hr
1 Horsepower	550	ft-lb/sec
Universal Gas Constant	0.287	kJ/kg °K
Minutes per Hour	60	min/hr
Number cubic inches per cubic foot	1728	:1 ratio

Initial Tem & Pressure Environment	Value	Units
Initial Temperature *(32F for STP)* (T1)	32	°F
Initial Temperature *(273K for STP)* (T1)	273	°K
Initial Pressure *(14.696 for STP)* (P1)	14.7	lb/in^2
Initial Pressure *(1 atm for STP)* (P1)	1	atm
Air Density *(0.0807 at STP)*	0.0807	lbs/cu ft
Est Peak temp during Combustion	1500	°K
Ave. Gas Specific Heat Air (Cp)	1.400	kJ/kg °K
Ave. Gas Specific Heat Air (Cv)	1.057	kJ/kg °K
Ratio of Specific Heats (cp/cv) K=	1.325	ratio

Fuel: Gasoline	Value	Units
Fuel Density	7.079	lbs/gal
Fuel Heating Energy (Qr)	139,000	BTU/gal
Fuel Heating Energy (Qr)	19,636	BTU/lb
Stoich. Fuel Mass Fraction (f)	0.064	lb fuel/lb air
Air to Fuel Ratio	18.0	:1 ratio
Stoichiometric Ratio	14.5	:1 ratio
Equivalence Fuel Ratio (f)	0.806	:1 ratio
1 cu ft fuel =	7.4805	gal

Efficiency Factors & Assumptions		
Est Volumetric Efficiency *(Typ = 0.85)*	0.85	Handbook
Est. Friction Factor *(Piston = 0.10)*	0.1	Handbook
Est. Engine Heat Loss Factor	0.1	Handbook
Est Losses (pressure, efficiency)	0.2	Estimate

RPM	Value	Units
RPM	2200	rev/min

Material Density	Value	Units
Material Factor Steel lb/cu in	0.286	Handbook
Material Factor Alum lb/cu in	0.095	Handbook

Vane	Value	Units
Number of Vanes	12	number
Number Combust Chambers	12	number
Vane Length (b-a)*2	4	in
Vane Travel 50%	2.000	in
Vane Thickness	0.250	in
Rotor & Vane Width	10.000	in

Rotor	Value	Units
Ellipse Minor Axis (in)	5.000	in
Ellipse Major Axis (in)	7.000	in
Rotor Radius	5.000	in

End Plate / Housing	Value	Units
Number End Plates	2	#
End Plate Thickness	1	in
Housing Thickness	1	in

Combustion Layer	Value	Units
Hemisphere depth =	0.75	in
Layer L indent Tl =	0.5	in
Layer W indent Tw =	0.1875	in

Color Legend for All Workbook Values

	Universal Constants
	CE Engine Constants
	Calculated Value
	Gasoline or Diesel
	Desired Value

Outputs

Engine Size	Value	Units
Engine Displacement	284.160	cu in
One Combustion Chamber Disp	23.680	cu in
Engine Width	12.000	in
Engine Diameter	16.000	in

Volume and Weight	Value	Units
Engine Volume	2412.749	cu in
Engine Weight	373.411	lb
Auxiliary Equipment Weight	135.000	lb
Total Engine Weight w/Accessories & Fluids	508.411	lb

Fuel Utilization & Efficiency	Value	Units
Fuel Consumption	10.850	gal/hr
Mass of Air through Engine (minute)	24.816	lbs air/min
Mass of Air through Engine (hr)	1488.969	lbs air/hr
Engine Air Flow	307.511	cfm
Available Time for Combustion/Expansion	27.273	msec
Available Time for Fuel Injection	9.091	msec
Combustion Thermal Efficiency tEc)	55.080	%

Horsepower & Torque	Value	Units
Compression Ratio	24.017	ratio
Gross Theoretical Horsepower (calculated)	326.792	HP
Power to Compress Air	17.326	HP
Power Lost to Exhaust	5.784	HP
Net Theoretical Horsepower (calculated)	303.683	HP
Gross Theoretical Torque	780.143	ft-lb
Fuel Flow Rate (Ma x f x f)	10.850	ga//hr
Estimated Combustion Thermal Efficiency	55.080	%
Estimated Horsepower per Pound	0.875	HP/lb
Estimated HP per cu in Displacement	1.150	HP/cu in

Displacement

Variable	Description	Value	Units
Pi	Pi Constant	3.1416	:1 ratio
VE	Est. Volumetric Efficiency *(Typical = 0.85)*	0.85	#
	Est. Friction Factor *(Typical = 0.10)*	0.1	#
	Est. Engine Heat Loss Factor	0.1	#
	Est. Engine Losses (pressure, efficiencies)	0.2	#
VT	Vane Travel (VT)	2.00	in
Vt	Vane Thickness (Vt)	0.25	in
CR	Compression Ratio	24.0	:1 ratio
RPM	Engine Speed (RPM)	2200	rev/min
a	Ellipse Major Axis (a)	7.00	in
b	Ellipse Minor Axis (b)	5.00	in
r	Rotor Radius (r)	5.00	in
VN	Number of Vanes (VN)	12	#
Vw	Rotor & Vane Width (Vw)	10.00	in

HP = Displacement x Pressure x RPM x (Est. Combustion Thermal Efficiency)

Therefore:

Solving for Displacement (Dt)
Dt (displacement) = (ellipse cross section - rotor cross section - no. vanes * average vane travel) * vane width

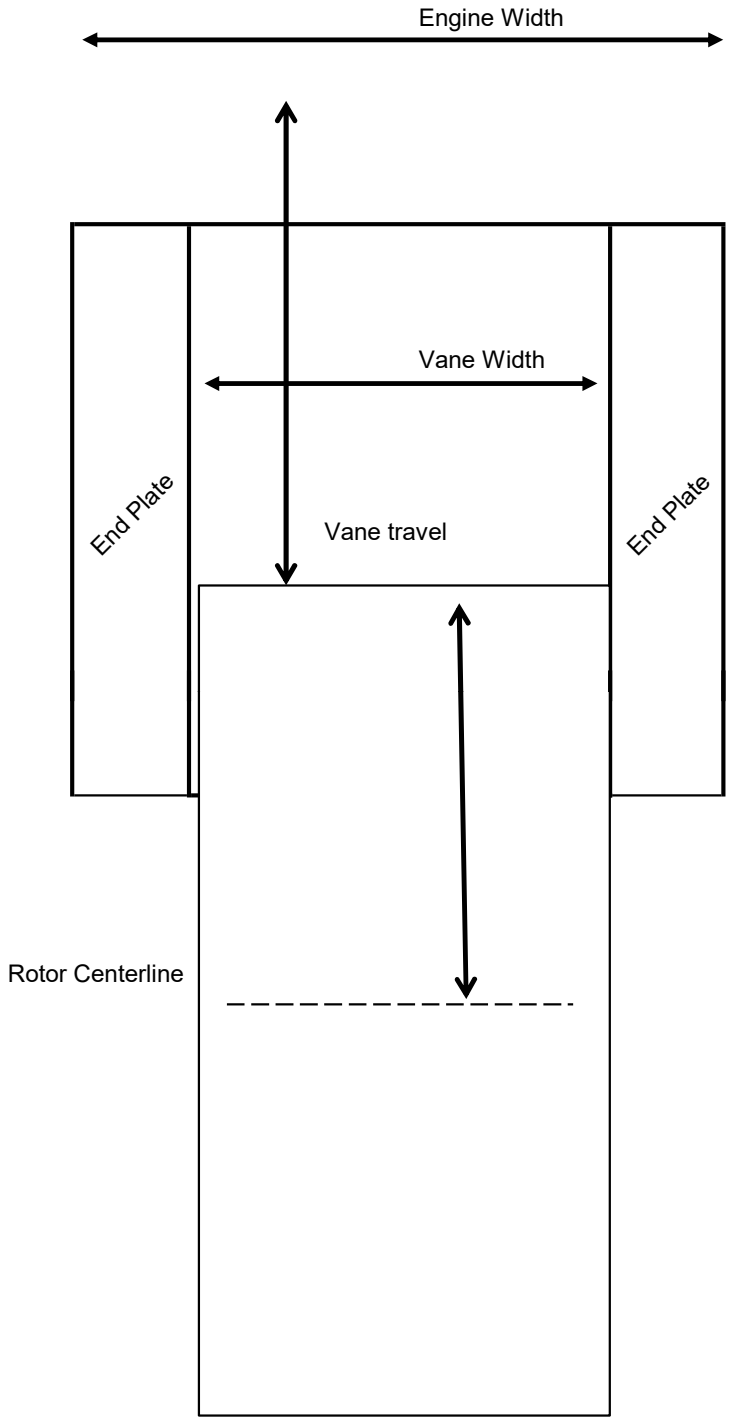
Dt (displacement) = (π*a*b - π*r^2 - # vanes (VN) x vane thickness (Vt) x average vane travel (VT/2)) * vane width (Vw)

Dc (Single Chamber Displacement (cu in)) = Dt / VN

Solutions

Dt = (Pi*a*b - Pi*r*r - VN*VT / 2 * Vt) * Vw	**284.160**	cu in
Dc = Single Chamber Displacement (cu in)	**23.680**	cu in
Est. Combustion Thermal Efficiency {VE * (1-Friction) * (1-Heat Loss) * (1-Engine Losses) * 100}	**55.080**	%

Cross Section



Description	Value	Units
Vane Width	10.000	in
Vane Travel	2.000	in
Rotor Radius	5.000	in
Ellipse Major Axis	7.000	in
End Plate Width	1.000	in
Housing Thickness	1.000	in
Engine Diameter =	16.000	in
Engine Width =	12.000	in

Air-Water-Oil Passageways

Constants	PI	3.1416
Volume	cu in/cu ft	1728

AIR/EXHAUST			
	End Plate Inl	units	ousing outlet
Diameter	0.50	size	0.25
quantity	4	qty	18
tot dia	0.7854	sq in	0.88358

Air density	0.0807	lb/cu ft
rpm	2200	rev/min
flow	0.0807	lb air/min

WATER			
	End Plate Inl	units	outlet
threads	5/8-18	size	5/8-18
quantity	2	qty	2
tot dia	0.614	sq in	0.614

density	62.4	lb/cu ft
rpm	2200	rev/min
flow	48.74661	lb H2O/min

MANIFOLD OIL				
inlet			outlet	
quantity	1	quantity	1	6
diameter	0.25	diameter	0.25	0.05
sq in	0.049	sq in	0.049	0.012

LUBRICATION OIL IN FITTINGS			
	inlet	units	outlet
threads	0.05	size	0.05
quantity	6	qty	6
tot dia	0.011781	sq in	0.011781

density	7.079	lb/cu ft
rpm	2200	rev/min
flow	0.106178	lb oil/min

LUBRICATION OIL THRU DRIVESHAFT			
	inlet	units	outlet
threads	0.25	size	0.1
quantity	1	qty	36
tot dia	0.049088	sq in	0.282744

density	7.079	lb/sq in
rpm	2200	rev/min
flow	0.442407	lb oil/min

Weight

Engine Component

Basic Engine	Value	Units
Pi	3.14160	:1 ratio
Ellipse Minor Axis (in)	5.0	in
Ellipse Major Axis	7.0	in
Engine Width (h)	12.0	in
Engine Diameter	16.0	in
Engine Total Volume (PI x R^2 x h)	2413	in^3
Less Calculated displacement	284.2	in^3
Material Factor *(Steel=.286)*	0.286	factor
Material Factor *(Al=.095)*	0.095	factor
Engine Dry Weight (Volume x Density)	373.4	lbs
Auxiliary Equipment Weight	135.0	lbs
Engine Dry Weight w/Accessories	508.4	lbs

Note: Estimated weight does not account for voids, and liquids (oil, water).

End Plate /	Value	Units
Number En	2	#
End Plate T	1	in
Housing Th	1	in

Accessory Components

Lubrication System:	Weight	Units
Oil	10	lbs
Oil Radiator	5	lbs
Pump, Filter/Housing, Lube oil reser	10	lbs

Fuel pump/accumulator/control system

Pump / Injectors	10	lbs
Filter, Accumulator & Misc. Plumbing	5	lbs
Sensors & Misc. Controls	5	lbs

Engine Cooling System:

Coolant	20	lbs
Radiator	20	lbs
Coolant Pump & Plumbing	10	lbs

Electrical & Control System

Starter/Alternator	10	lbs
Battery	15	lbs
Wiring	5	lbs
Instrumentation	5	lbs
Controls, Sensors & Misc.	5	lbs

Auxiliary Equipment Weight 135 lbs

Compression Ratio

Variables	
PI =	3.1416
ellipse major a =	5.000
ellipse minor b =	7.000
rotor r =	5.000
width w =	10.000
hemisphere depth =	0.75
Layer L indent TI =	0.5
Layer W indent Tw =	0.1875
Number of Vanes =	12
Vane Thickness =	0.25

Area One Circle Sector	
Circle Sector =	PI x r^2/12
A-circle =	6.545

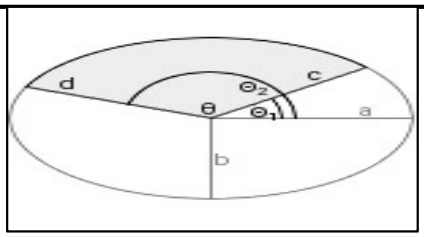
Combustion Layer Volume	
length L =	2 x r - 2 x TI
L =	9.000
width W =	PI 2r/#V-Vt-2Tw
W =	1.993
height H =	average depth
H =	0.055
volume V1 =	L x W x H
V1 =	0.987

Hemisphere Pocket	
sphere volume =	4/3*s^3
sphere volume =	1.767
hemi volume =	sphere volum/2
hemi volume =	0.884

Compress Ratio Summary		
ellipse sector =	12.561	6.619
circle sector =	-6.545	-6.545
minus vane =	-0.446	-0.021
subtotal area =	5.570	0.053
width =	10.000	10.000
width x area =	55.696	0.527
+ combust layer =	0.987	0.987
+ hemisphere =	0.884	0.884
totals =	57.567	2.397
Compress Ratio =	24.017	

Maximum Ellipse Sector Area (-15° to +15°)

Θ1 (degrees) =	-15.000
Θ1 (radians) =	-0.262
Θ2 (degrees) =	15.000
Θ2 (radians) =	0.262
Θ2 - Θ1 (degrees) =	30.000
Θ2 - Θ1 (radians) =	0.524
a =	7.000
b =	5.000



Maximum Vane Area	
Vane-length =	c - b
V-length =	1.785
Vane thickness =	0.25
Vane Area =	0.446

where c = √ a^2 * b^2 / [a^2 * $\sin^2(\Theta 1)$ + b^2 * $\cos^2(\Theta 1)$]

c = 6.785

where d = √ a^2 * b^2 / [a^2 * $\sin^2(\Theta 2)$ + b^2 * $\cos^2(\Theta 2)$]

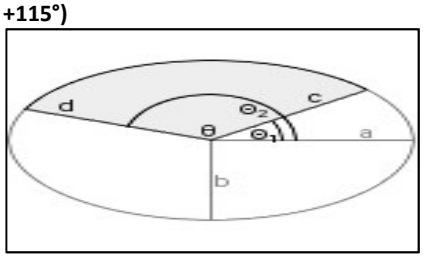
d = 6.785

where A-max = ab/2 * { θ - atan[(b-a)sin(2Θ2) / (a+b+(b-a)cos(2Θ2))] + atan[(b-a)sin(2Θ1) / (a+b+(b-a)cos(2Θ1))] }

A-max = 12.561

Minimum Ellipse Sector Area (75° to +115°)

Θ1 (degrees) =	75.000
Θ1 (radians) =	1.309
Θ2 (degrees) =	105.000
Θ2 (radians) =	1.833
Θ (degrees) =	30.000
Θ (radians) =	0.524
a =	7.000
b =	5.000



Minimum Vane Area	
Vane-length =	c - b
V-length =	0.084
Vane thickness =	0.25
Vane Area =	0.021

where c = √ a^2 * b^2 / [a^2 * $\sin^2(\Theta 1)$ + b^2 * $\cos^2(\Theta 1)$]

c = 5.084

where d = √ a^2 * b^2 / [a^2 * $\sin^2(\Theta 2)$ + b^2 * $\cos^2(\Theta 2)$]

d = 5.084

where A-min = ab/2 * { θ - atan[(b-a)sin(2Θ2) / (a+b+(b-a)cos(2Θ2))] + atan[(b-a)sin(2Θ1) / (a+b+(b-a)cos(2Θ1))] }

A-min = 6.619

Combustion Time

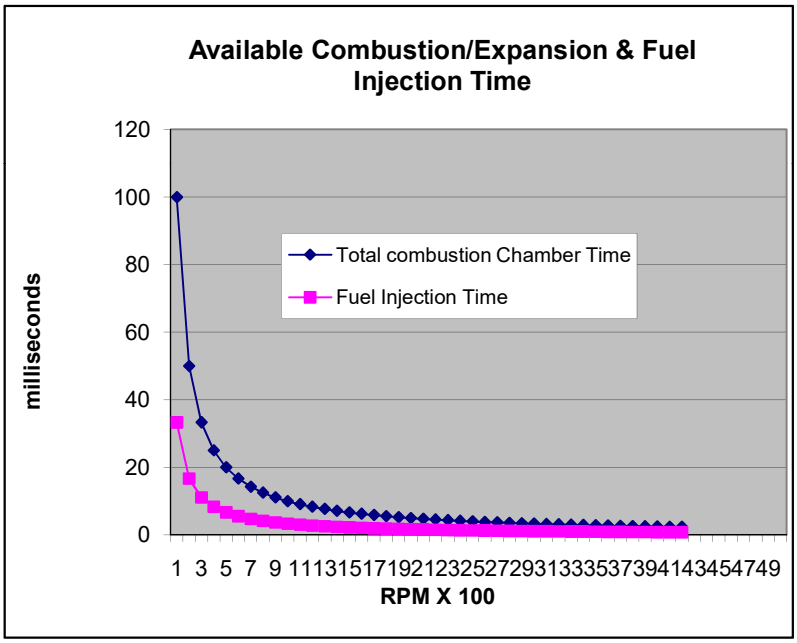
RPM	Combustion Chamber Time (msec)	Available Fuel Injection Time (msec)
100	100.000	33.333
200	50.000	16.667
300	33.333	11.111
400	25.000	8.333
500	20.000	6.667
600	16.667	5.556
700	14.286	4.762
800	12.500	4.167
900	11.111	3.704
1000	10.000	3.333
1100	9.091	3.030
1200	8.333	2.778
1300	7.692	2.564
1400	7.143	2.381
1500	6.667	2.222
1600	6.250	2.083
1700	5.882	1.961
1800	5.556	1.852
1900	5.263	1.754
2000	5.000	1.667
2100	4.762	1.587
2200	4.545	1.515
2300	4.348	1.449
2400	4.167	1.389
2500	4.000	1.333
2600	3.846	1.282
2700	3.704	1.235
2800	3.571	1.190
2900	3.448	1.149
3000	3.333	1.111
3100	3.226	1.075
3200	3.125	1.042
3300	3.030	1.010
3400	2.941	0.980
3500	2.857	0.952
3600	2.778	0.926
3700	2.703	0.901
3800	2.632	0.877
3900	2.564	0.855
4000	2.500	0.833
4100	2.439	0.813
4200	2.381	0.794

Description	Value	Units
Number of Engine Vanes	12	number
Number Vanes In Combustion	2	number
Engine Speed (RPM)	2200	rev/min

Total Combustion Chamber Available

1/(Rev/min x 4 cycle segments/Rev) x	**27.273**	msec

Total Combustion Chamber Time er of Vanes in Combustion Quadrant =		
Time Available for Fuel Injection per	**9.091**	msec



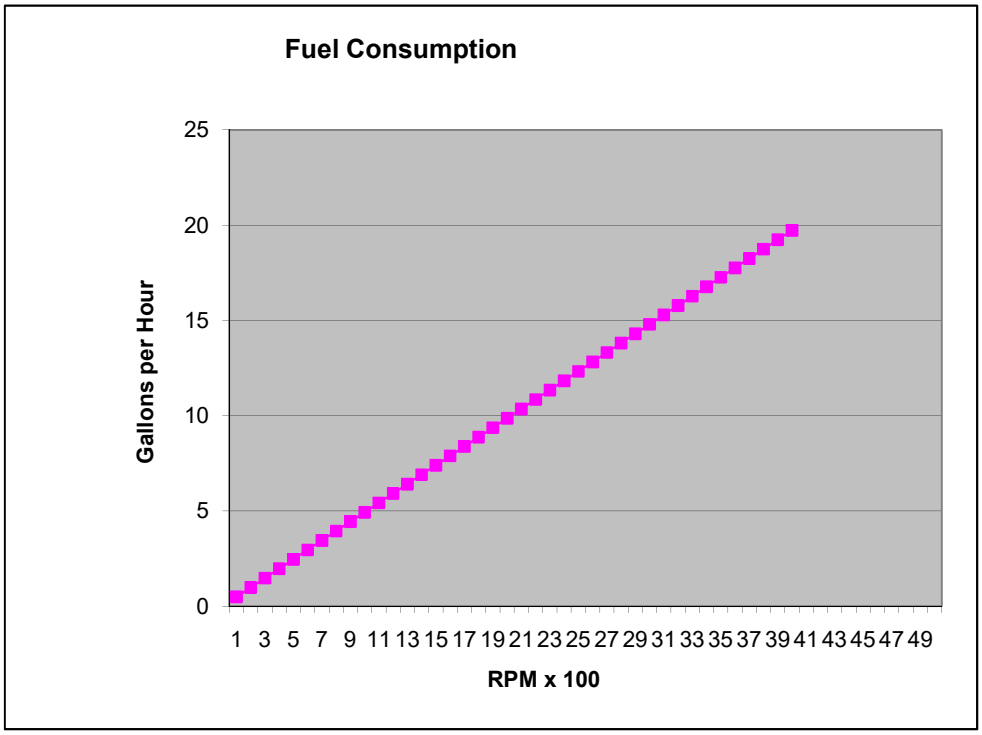
Fuel Consumption

Description	Value	Units	Formula
Engine Speed (RPM)	2200	rev/min	
Total Displacement (DISP)	284.160	cu in	
Displacement per Combustion Chamber	23.680	cu in	Displacement (cu in) / chambers
Number of Vanes	12	#	
Air Fuel Ratio (AFR)	18	:1 ratio	
Stoichiometric Ratio (AFRs)	14.5	:1 ratio	
Equivalence Fuel Ratio (f)	0.806	:1 ratio	Stoichiometric Ratio (AFRs) / Air Fuel Ratio (AFR)
Initial Temperature (32F for STP) (T1)	32	°F	
Initial Temperature (273K for STP) (T1)	273	°K	
Initial Pressure (14.696 for STP) (P1)	14.7	lb/in^2	
Initial Pressure (1 atm for STP) (P1)	1.000	atm =	
Air Density (0.0807 at STP)	101.325	kPa	atm x 101.325 kPa per atm
Volumetric Efficiency (VE)	0.85	%	
Air Density (0.0807 at STP)	0.0807	lbs/cu ft	(P1/(R x T1) x kg/cu m))
Mass of Air (Ma) through Engine	24.816	lbs/min	(VE x Pa x DISP X RPM / 1728)
Stoichiometric Fuel Mass Fraction (f)	0.064	lbs fuel/lbs air	
Fuel Density	7.079	lbs/gal =	
Fuel Density	52.95	lbs/cu ft	Fuel Density (lb/gal) x 7.408 gal/cu ft
Fuel Flow Rate (FFR) (Ma x f x f)	1.280	lb/min =	Mass Air (Ma)xEquiv Fuel Ratio(f)xStoich Fuel Mass (f)
Fuel Flow Rate (Ma x f x f)	0.181	gal/min =	FFR / Fuel Density (gal/min)
Fuel Flow Rate (Ma x f x f)	10.850	gal/hr	FFR gal/min x 60 min/hr (gal/hr)
Engine Air Flow	307.511	cfm =	Mass of Air (Ma) / Air Density
Engine Air Flow	1488.969	lbs air/hr	Engine Air Flow (lb/min) x 60 min/hr (lb/hr)

Conversion Factors		
1 cu ft =	7.4805	gal
1 cu ft =	1728	cu in/cu ft
1 cu in =	16.3871	cc
1 gal =	3.7854	liter
1 cu ft =	28316.8	cc
1 atm =	101.325	kPa
UGC (R) =	0.287	kJ/kg °K
lbs/cu ft =	0.0624	kg/cu m

Fuel Consumption Chart

RPM	(gal/hr)
100	0.493
200	0.986
300	1.480
400	1.973
500	2.466
600	2.959
700	3.452
800	3.945
900	4.439
1000	4.932
1100	5.425
1200	5.918
1300	6.411
1400	6.905
1500	7.398
1600	7.891
1700	8.384
1800	8.877
1900	9.370
2000	9.864
2100	10.357
2200	10.850
2300	11.343
2400	11.836
2500	12.330
2600	12.823
2700	13.316
2800	13.809
2900	14.302
3000	14.795
3100	15.289
3200	15.782
3300	16.275
3400	16.768
3500	17.261
3600	17.755
3700	18.248
3800	18.741
3900	19.234
4000	19.727



Horsepower

Description	Value	Units
Fuel Density (FD) =	7.079	lbs/gal
Fuel Heating Energy (FE) =	19,636	BTU/lb
Engine Speed (RPM) =	2,200	rev/min
Fuel Flow at Specified RPM =	10.850	gal/hr
Combustion Thermal Efficiency (TEc) =	55.080	%
HP / BTU (HPE) =	2542	HP / BTU/hr
Air to Fuel Ratio =	18	: 1
Engine Displacement =	284.160	cu in
Volumetric Efficiency (VE) =	0.85	%

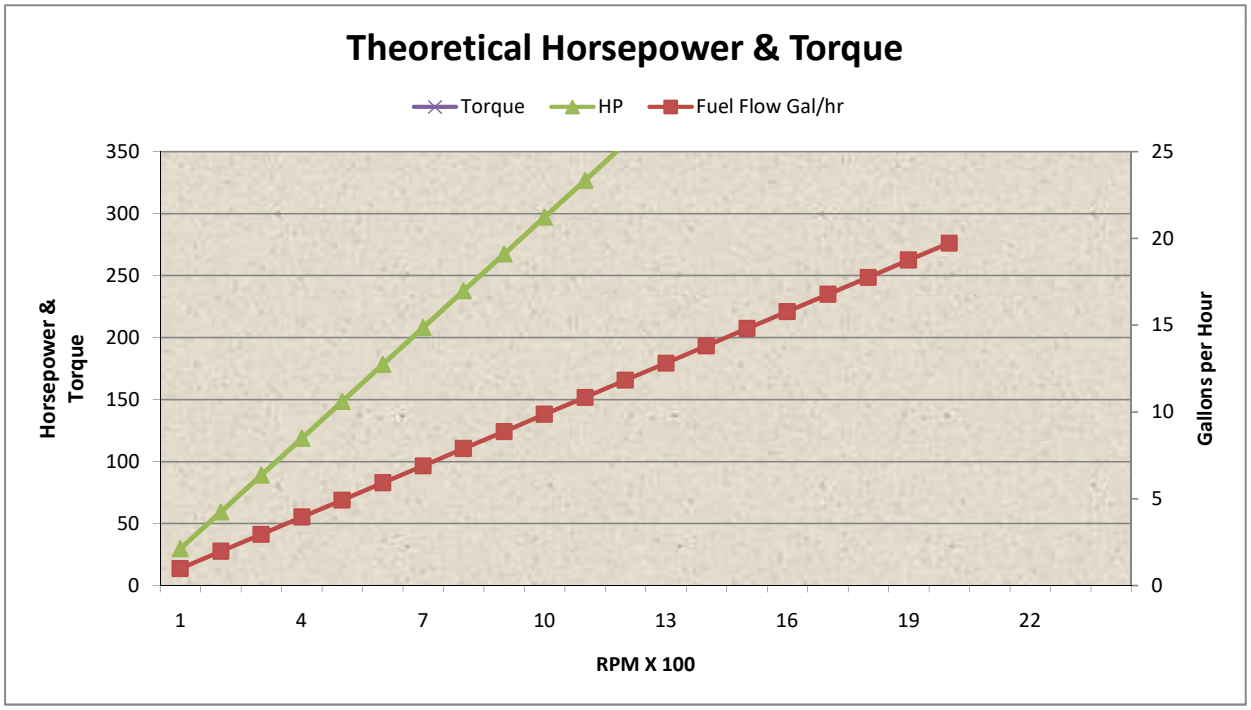
Combustion Thermal Efficiency (TEc) x Fuel Flow (gph) x FD (lb/gal) x FE (BTU/lb) / HPE = **326.792** **HP**

Torque = **780.143** **ft-lb**

TEc/100	Fuel Flow at Specified RPM	FD	FE	HP/BTU (HPE)
0.551	2.573	6.073	20853	2542 HP/hr

Fuel Flow

RPM	gal/hr	HP	Torque
200	0.986	29.708	780.143
400	1.973	59.417	780.143
600	2.959	89.125	780.143
800	3.945	118.834	780.143
1000	4.932	148.542	780.143
1200	5.918	178.250	780.143
1400	6.905	207.959	780.143
1600	7.891	237.667	780.143
1800	8.877	267.376	780.143
2000	9.864	297.084	780.143
2200	10.850	326.792	780.143
2400	11.836	356.501	780.143
2600	12.823	386.209	780.143
2800	13.809	415.918	780.143
3000	14.795	445.626	780.143
3200	15.782	475.334	780.143
3400	16.768	505.043	780.143
3600	17.755	534.751	780.143
3800	18.741	564.460	780.143
4000	19.727	594.168	780.143



Combustion

Air Standard Cycles

The air standard cycle is a cycle followed by a heat engine which uses air as the working medium. Since the air standard analysis is the simplest and most idealistic, such cycles are also called ideal cycles and the engine running on such cycles are called *ideal engines.*

In order that the analysis is made as simple as possible, certain assumptions have to be made. These assumptions result in an analysis that is far from correct for most actual combustion engine processes, but the analysis is of considerable value for indicating the upper limit of performance. The analysis is also a simple means for indicating the relative effects of principal variables of the cycle and the relative size of the apparatus.

Assumptions

1. The working medium is a perfect gas with constant specific heats and molecular weight corresponding to values at room temperature.
2. No chemical reactions occur during the cycle. The heat addition and heat rejection processes are merely heat transfer processes.
3. The processes are reversible.
4. Losses by heat transfer from the apparatus to the atmosphere are assumed to be zero in this analysis.
5. The working medium at the end of the process (cycle) is unchanged and is at the same condition as at the beginning of the process (cycle).

Using an Air Standard Cycle Analysis, estimate work per unit mass of air, thermal efficiency, combustion pressure, and cutoff ratio.

Basis of estimate:	**Value**	**Units**
T_1 =	273	K
T_3 =	1500	K
P_1 =	1	atm
V_1 / V_2 =	24.0	**:1**
Cp =	1.400	kJ/kg °K
Cv =	1.057	kJ/kg °K
K =	1.325	ratio
RPM =	2200	rev/min
Fuel Density =	7.079	lb/gal
1 cu ft fuel =	7.4805	gal

Calculated Displacement

V_1 =	284.160	cu in

Applying the Compression Ratio to the Chamber Volume

V_2 = Displacement/Compression Ratio =	11.832	cu in

then, temperature at end of compression stroke is

$T_2 = T_1 \times (V_1/V_2)^{1.4-1}$ =	973.578	K

and the combustion pressure is

$P_2 = P_1 \times$ (compression ratio)$^{1.4}$	85.650	atm

Then the cutoff ratio (COR) is

$V_3 / V_2 = T_3 / T_2$	1.541	ratio
$V_3 = T_3 / T_2 * V_2$	18.229	cu in
P3 =	1	atm
$P_4 = P_2 \times V_2 \times T_4 / (T_2 \times V_4)$	1.831508	atm

Basis of estimate (continued):	**Value**	**Units**
The expansion ratio is calculated as follows:		
$V_4 / V_3 = (V_1 / V_2)/(V_3 / V_2)$	15.588	ratio
$V_4 = (V_1 / V_2)/(V_3 / V_2) * V_3$	284.160	cu in
$T_4 = T_3 * (V_3 / V_4)^{1.4-1}$	500.002	K
work per unit mass of air		
w = 1.005 x (T_3 -T_2) + (1.005/1.4) x (T_1 - T_4)	366.099	kJ/kg
constant volume heat addition		
q_a = 1.005 x (T_3 - T_2)	529.054	kJ/kg
and cycle thermal efficiency		
$N_{th} = w/q_a$	69.199	%

Power to compress air P_1 to P_2

CFM (single chamber volume)	30.148	CFM
0.2267 x Quantity cfm x {[(P_2/P_1)+1]$^{0.283-1}$}	17.326	HP
q_b = 1.005 x (T_1 - T_4) =	-228.137	
Fuel Rate (gal/hr) =	10.850	gal/hr
Fuel Rate/min=gal/hr/60xfuel density(lb/gal)	1.280	lb/min

Power Lost to Exhaust

(-1) x q_b x Fuel Rate/min/1 HP x vane height	5.784	HP

Summary:

T_1 =	273.000	P_1 =	1.000	V_1 =	284.160
T_2 =	973.578	P_2 =	85.650	V_2 =	11.832
T_3 =	1500.000	P_3 =	1.000	V_3 =	18.229
T_4 =	500.002	P_4 =	1.832	V_4 =	284.160

Given Displacement, Calculate HP, Torque & Weight #1

NOTE: This independent spreadsheet determines HP, torque & weight based on a desired displacement.

Gasoline: Enter G Diesel: Enter D	D	Displacement (cu in)	728	RPM	1200	b/a ratio	1.800

Pi (π)	3.14159	Ratio, Circle circumference to Diameter
cu in/cu ft	1728	Number cu in per cu ft
min/hr	60	Number minutes per hour
Steel Density	0.286	Pounds per cu in
Aluminum Density	0.095	Pounds per cu in
Pa (lb/cu ft)	0.081	Air Density (0.0807 at STP)
EFR (f)	0.806	Equivalence Fuel Ratio (f)
SFMF (f)	0.064	Stoichiometric Fuel Mass Fraction (f)
HP / BTU (HPE)	2542	Horse Power per BTU
VE	0.85	Est Volumetric Efficiency (Typical = 0.85)
Friction	0.1	Est Friction Factor (Typical = 0.10)
Heat Loss	0.1	Est Engine Heat Loss Factor (Typical = 0.10)
Engine Loss	0.2	Est Engine Loss (pressure, efficiencies) (Typical=0.10)
Rotor Hub Radius	1	inch
Vane Quantity (#V)	12	Number Vanes
Average Vane Ext (V%)	0.500	Average Vane Extension (%)
Vane thickness (Vt)	0.250	Vane thickness (in)
End Plates	2	Quantity
End Plates Thickness (Et)	1	Thickness of End Plates (in)
Housing Thickness (Ht)	1	Thickness of Housing (in)
Compression Ratio	18.5	Combustion Ratio (Gasoline=8.5, Diesel=18.5)
BTU/Gal	137452	BTU/Gal (Gasoline=120476, Diesel=137452)
Fuel Density (FD)	6.943	Fuel Density (lb/gal) (Gasoline=6.217, Diesel=6.943)
Fuel Heat Energy (FE)	19604	Fuel Heat Energy (FE-BTU/lb) Gas=19948, Diesel=19604

SOLUTION	VALUE	DESCRIPTION
Desired Engine Type	Diesel	Diesel Engine Selected
Desired DISP (cu in)	728.000	w[πab-πr^2-#vanes x vane length x vane width x % use]
Desired RPM	1200	RPM
Desired Major/Minor Axis Ratio	1.800	Ratio b/a
Major Axis (a)	5.415	Ellipse Minor Axis & Circle Radius, a, r (in)
Minor Axis (b)	9.747	Ellipse Major Axis, b (in)
VH =	8.664	Vane Height (in) = Ellipse Minor Axis - Hub
VT =	4.332	Vane Travel (in) = Vane Height / 2
W =	10.830	Rotor Depth = 2 x Ellipse Major Axis
Housing Dia =	21.494	Housing Diameter = 2 x (Minor Axis + Housing Width)
CTE (TEc)	0.5508	VE (1-Friction Loss)x(1-Heat Loss)x(1-Engine Loss)
Mass of Air (Ma) =	34.808	lb/min
Fuel Flow Rate =	15.516	gal/hr
Approx weight (w) lb =	540.737	Approx Weight (lb)
Calculated HP @ RPM	457.617	Calculated Horsepower
Torque =	2002.837	Torque (lbf·ft)

Given Displacement, Calculate HP, Torque & Weight #2

This independent spreadsheet determines HP, torque & weight based on a desired displacement.

Displacement Calculation

Convert displacement volume into cubic equation ax^3 + bx^2 + cx + d = 0
w[πab-πr^2-# vanes x vane length (b-a) x vane thickness x % effective] - disp = 0
substitutimg for w, r, b and disp

2a[πaka-πa^2-#V x (ka-a) - Vt x V%] - 728 = 0

expanding

2πa^3x(k-1)-2a[#Vx(ka-a)xVtxV%] - 728 = 0

substituting desired vane constants values

2πa^3 x (1.800 -1) - 2a^2 - [12*.5x .25 x (1.800 -1)] - 728

consolidating

2πa^3 x (1.800 -1) - 3a^2 x (1.800 -1)) - 728 = 0

6.283 x (1.800 -1) - 3a^2 x (728 = 0

threfore a, b, c, d coefficients of cubic equation ax^3 + bx^2 + cx + d = 0

coeff a =	6.283 x (	1.800	-1) =	5.027
coeff b =	-3.000 x (	1.800	-1) =	-2.400
coeff c =				0.000
coeff d =				-728.000

for cubic equation ax^3 + bx^2 + cx + d = 0, using the on line cubic equation calculator at:

https://www.1728.org/cubic.htm major axis a 4.606

Weight	Value	Description
Aluminum x w x [π(b+thickness)^2 - πab]		
inserting values		
lb Aluminum =	202.719	
Steel x w x π r^2		
inserting values		
lb steel =	338.018	
total weight = Aluminum + Steel		
lb total =	540.737	lb Aluminum + lb steel

Horsepower, calculate Ma and FFR

First calculate Fuel Flow as function of Displacement and RPM
where Fuel Flow = Mass of Air (Ma)xEquivalence Fuel Ratio (f)xStoichiometric Fuel Mass Fraction (f)
and Mass of Air (Ma) = Est Volumetric Efficiency (VE) x Air Density (Pa) x Disp x RPM / (cu in/cu ft)

substituting:	Ma =	34.808	lb/min
and Fuel Flow Rate:	FFR =	1.796	lb/min
divide by FD		0.259	gal/min
divide by 60 min/hr		15.516	gal/hr

Calculate Horsepower

HP = TEc x FFR x Fuel Density (FD) x Fuel Energy (FE) / BTU/hr =	457.617	
Torque = HP x 5252 / RPM =	2002.837	

Given HP, Calculate Torque, Displacement & Weight #1

This independent spreadsheet determines displacement, weight & torque based on a desired HP

Desired Values	Gasoline: Enter G Diesel: Enter D	D	HP	400	RPM	2000	CR	22.0	b/a ratio	1.400

Description	Value	Units
Pi	3.1415927	:1 ratio
1 Horsepower	2542	BTU/hr, aka HPE
1 Horsepower	550	ft-lb/sec
1 Horsepower	6600	in-lb/sec
Minutes per Hour	60	min/hr
1 Atmosphere	14.7	psi
Efficiency Factors & Assumptions		
Est Volumetric Efficiency *(VE)*	0.85	Est Volumetric Efficiency (Typical = 0.85)
Friction	0.1	Est Friction Factor (Typical = 0.10)
Heat Loss	0.1	Est Engine Heat Loss Factor (Typical = 0.10)
Engine Loss	0.2	Est Engine Loss (pressure, efficiencies) (Typical=0.10)
Combustion Thermal Efficiency (TEc)	0.5508	factor
Material Density	**Value**	Units
Material Factor Steel=0.286	0.286	Handbook, lb/cu in
Material Factor Alum=0.095	0.095	Handbook, lb/cu in
Ellipse		
Ellipse Minor Axis, a	5.778	in
Ellipse Major Axis, b	8.089	in
Rotor		
Rotor Radius, r = a	5.778	in
Rotor and vane depth (w = 2 x a)	11.556	in
Vanes		
Number of Vanes	12	Average Vane Extension (%)
Vane thickness (Vt)	0.250	in
Vane Travel (VT = b-a)	2.311	in
Average Vane Ext (V%)	0.500	percent/100
End Plate / Housing		
Number End Plates	2	#
End Plate Thickness	1	in
Housing Thickness	1	in
Outputs		
Desired Horsepower	400	HP
Torque at Given HP and RPM	1050.400	lbf-ft
Displacement	444.622	cu in
Weight	530.359	lb

Given HP, Calculate Torque, Displacement & Weight #2

Calculate Displacement

Max Air Pressure = 1 atmosphere x compression ratio

P-max =

HP = Displacement x Pressure x RPM x (Est. Combustion Thermal Efficiency)

Disp = HP (ft-lb/sec) x HP/(in-lb/sec) / [P-max x RPM/(min/hr) x TEc]

Disp = 444.622293 cu in

Displacement Detail Calculation

Convert displacement volume into cubic equation ax^3 + bx^2 + cx + d = 0

w[πab-πr^2-# vanes x vane length (b-a) x vane thickness x % effective] - disp = 0

substitutimg for w, r, b and disp

2a[πaka-πa^2-#V x (ka-a) - Vt x V%] - 444.6223 = 0

expanding

2πa^3x(k-1)-2a[#Vx(ka-a)xVtxV%] - 444.6223 = 0

substituting desired vane constants values

2πa^3 x (1.400 -1) - 2a^2 - [12*.5x .25 x (1.400 -1)] - 444.622

consolidating

2πa^3 x (1.400 -1) - 3a^2 x 1.400 -1)) - 444.622 = 0

6.283 x (1.400 -1) - 3a^2 x 444.622 = 0

threfore a, b, c, d coefficients of cubic equation ax^3 + bx^2 + cx + d = 0

coeff a = 6.283 x (1.400 -1) = 2.513

coeff b = -3.000 x (1.400 -1) = -1.200

coeff c = 0.000

coeff d = -444.622

for cubic equation ax^3 + bx^2 + cx + d = 0, use the cubic equation calculator tab.

major axis a = 5.800

Weight	Value	Description
Aluminum x w x [π x (b+thickness)^2 - π x a x b]		
inserting values		
lb Aluminum =	123.727	lb
Steel x (w + 2 end plates) x π r^2		
inserting v inserting values		
lb steel =	406.633	steel*w*π*a^2
total weight = Aluminum + Steel		
lb total =	530.359	lb Aluminum + lb steel

Cubic Equation Solution

Given cubic equation ax^3 + bx^2 + cx + d = 0 and coefficients a, b, c and d, find solution x

$$x = \sqrt[3]{\left(\frac{-b^3}{27a^3}+\frac{bc}{6a^2}-\frac{d}{2a}\right)+\sqrt{\left(\frac{-b^3}{27a^3}+\frac{bc}{6a^2}-\frac{d}{2a}\right)^2+\left(\frac{c}{3a}-\frac{b^2}{9a^2}\right)^3}} + \sqrt[3]{\left(\frac{-b^3}{27a^3}+\frac{bc}{6a^2}-\frac{d}{2a}\right)-\sqrt{\left(\frac{-b^3}{27a^3}+\frac{bc}{6a^2}-\frac{d}{2a}\right)^2+\left(\frac{c}{3a}-\frac{b^2}{9a^2}\right)^3}} - \frac{b}{3a}$$

Here are the values of coefficients a, b, c and d for the cubic equation ax^3 + bx^2 + cx + d = 0	
a =	2.513
b =	-1.200
c =	0.000
d =	-444.600

First we define a variable 'F':	
F =[(3c/a) - (b²/a²)]/3 =	-0.076
Next we define a variable 'G':	
G = [(2b³/a³) - (9bc/a²) + (27d/a)]	-176.928
Then we define variable 'H':	
H = (G²/4) + (F³/27) =	7825.886

If H <= 0, all 3 roots are real, and we process variables I through P as follows:

First we define a variable 'I':	
I = ((G²/4) - H)^½ =	
Next we define a variable 'J':	
J = (I)^⅓ =	
Then we define a variable 'K' (in radians):	
K = arc cosine (- (G / 2I)) =	
Next we define a variable 'L':	
L = J • -1 =	
Next we define a variable 'M':	
M = cosine (K/3) =	
Next we define a variable 'N':	
N = (Square Root of 3) • sine (K/3) =	
Last we define a variable 'P':	
P = (b/3a) • -1 =	

If H > 0, there is only 1 real root, and we process variables R through U as follows:

First we define a variable 'R':	
R = -(g/2) + (h)^½ =	176.928
Next we define a variable 'S':	
S = (R)^⅓ =	5.614
Then we define a variable 'T':	
T = -(g/2) - (h)^½ =	0.000
Last we define a variable 'U':	
U = (T)^⅓ =	0.005

Solutions:	
x_1 = 2j • cosine(K/3) -(b/3a) =	
x_2 = L • (M + N) + P =	
x_3 = L • (M - N) + P =	

Solution:	
x_1 = (S + U) - (b/3a)	5.778

Pin Track Definition and Variables

Create a generalized equation for the locus of the pivot point of a vane length L.

The vane location is driven by a rotor of radius r. It is housed in each of 12 vane slots, also of length L.

As the rotor turns, the tip of the vane always is tangent to the inner surface of an ellipse.

The ellipse has a major semi-axis of a, and a minor semi-axis of b.

The precise equation is highly specialized.

It depends on solving a system of five interdependent equations related to the contact points and angles.

The general kinematic analysis involves using vector equations to define the position of all points in the mechanism.

Make sure you consider angles, radii, and specific geometric constraints.

We must account for the fact that the contact point on the ellipse is not always aligned with the vane's centerline.

Geometrically, the center of the vane's outer tip radius traces an offset curve (specifically, an interior parallel curve) of the ellipse.

The following generalized equations define the coordinates (x, y) of the inner tip of the vane for any point along the rotation.

1. Variables and Inputs

a=7.51 = (Semi-major axis)
b=5.51 = (Semi-minor axis)
L=4.0 = (Total vane length)
r=0.125 = (Tip radius)
k=L−r = 3.875 (Distance from the outer tip's center to the physical inner tip)
θ (Parametric Angle): From 0 to 360 degrees, used to iterate along the ellipse boundary.

2. Intermediate Calculations

First, calculate the helper value

S, which relates to the local curvature of the ellipse:

$S = SQRT\ [(a\cdot\sin\phi)^2+(b\cdot\cos\phi)^2]$

Next, calculate the coordinates of the center of the outer tip circle

(Xc,Yc)

$Xc=\cos\theta\cdot a-r\cdot bS$

$Yc=\sin\theta\cdot b-r\cdot aS$

3. The Locus of the Inner Tip

The distance from the origin to the center of the outer tip is

R=SQRT(Xc^2+Yc^2)

The inner physical tip (Xi,Yi) lies on the same line but is k inches closer to the origin:

$Xi=Xc\cdot 1-kR$

$Yi=Yc\cdot 1-kR$

Answer:

The equations for Xi and Yi in Step 3 define the locus of points representing the location of the vane's inner end.

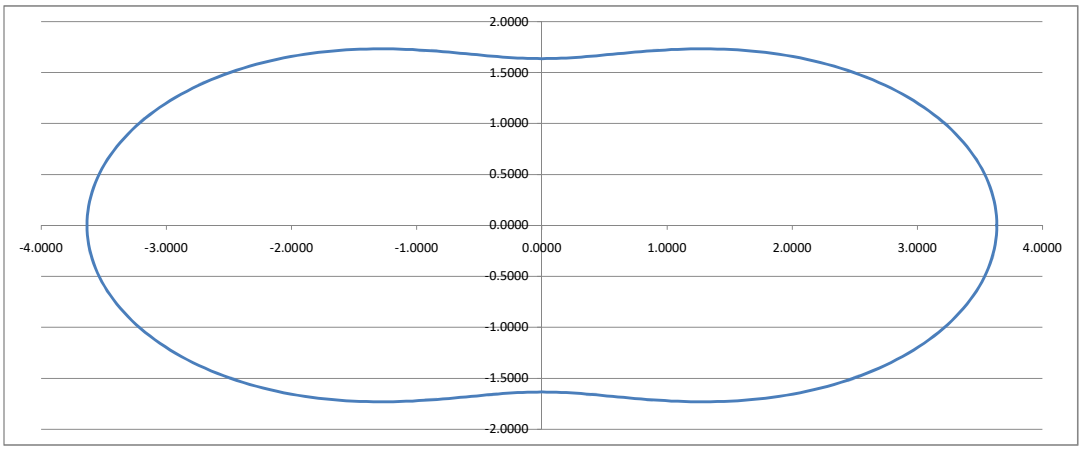
Excel Spreadsheet Implementation

To generate the locus of points, set up your spreadsheet with the following columns. Assume your variables a, b L, r are in fixed cells.

Pin Track Chart and Values for X Y and Z

CONSTANTS:

a=	7.51	major axis
b=	5.51	minor axis
L=	4	Vane length
r=	0.125	tip radius



Angle	Angle	Xc	Yc	Nx	Ny	arm_Mag	Xo	Yo	Po_Mag	Ui_X	Ui_Y	Xi_Locus	Yi_Locus	Zi_Locus
Degrees	Radians	a cos(θ)	b sin(θ)	Xc / a^2	Yc / b^2	√ (Nx^2 + Ny^2)	Xc + r *Nx / arm_Mag	Yc +r*Ny / arm_Mag	√ (Xo^2 + Yo^2)	Xo / Po_Mag	Yo / Po_Mag	Ui_x*(Po_Mag-VI)	Ui_y*(Po_Mag-VI)	z plane
0	0.0000	7.5100	0.0000	0.1332	0.0000	0.1332	7.6350	0.0000	7.6350	1.0000	0.0000	3.6350	0.0000	0.0000
1	0.0175	7.5089	0.0962	0.1331	0.0032	0.1332	7.6338	0.0991	7.6345	0.9999	0.0130	3.6342	0.0472	0.0000
2	0.0349	7.5054	0.1923	0.1331	0.0063	0.1332	7.6303	0.1982	7.6329	0.9997	0.0260	3.6316	0.0944	0.0000
3	0.0524	7.4997	0.2884	0.1330	0.0095	0.1333	7.6244	0.2973	7.6302	0.9992	0.0390	3.6274	0.1414	0.0000
4	0.0698	7.4917	0.3844	0.1328	0.0127	0.1334	7.6161	0.3962	7.6264	0.9986	0.0520	3.6215	0.1884	0.0000
5	0.0873	7.4814	0.4802	0.1326	0.0158	0.1336	7.6055	0.4950	7.6216	0.9979	0.0650	3.6140	0.2352	0.0000
6	0.1047	7.4689	0.5760	0.1324	0.0190	0.1338	7.5926	0.5937	7.6158	0.9970	0.0780	3.6048	0.2819	0.0000
7	0.1222	7.4540	0.6715	0.1322	0.0221	0.1340	7.5773	0.6921	7.6089	0.9959	0.0910	3.5939	0.3283	0.0000
8	0.1396	7.4369	0.7668	0.1319	0.0253	0.1343	7.5597	0.7904	7.6009	0.9946	0.1040	3.5814	0.3744	0.0000
9	0.1571	7.4175	0.8620	0.1315	0.0284	0.1345	7.5397	0.8883	7.5919	0.9931	0.1170	3.5672	0.4203	0.0000
10	0.1745	7.3959	0.9568	0.1311	0.0315	0.1349	7.5174	0.9860	7.5818	0.9915	0.1300	3.5514	0.4658	0.0000
11	0.1920	7.3720	1.0514	0.1307	0.0346	0.1352	7.4929	1.0834	7.5708	0.9897	0.1431	3.5340	0.5110	0.0000
12	0.2094	7.3459	1.1456	0.1302	0.0377	0.1356	7.4660	1.1804	7.5587	0.9877	0.1562	3.5150	0.5557	0.0000
13	0.2269	7.3175	1.2395	0.1297	0.0408	0.1360	7.4368	1.2770	7.5456	0.9856	0.1692	3.4945	0.6000	0.0000
14	0.2443	7.2869	1.3330	0.1292	0.0439	0.1365	7.4053	1.3732	7.5315	0.9832	0.1823	3.4723	0.6439	0.0000
15	0.2618	7.2541	1.4261	0.1286	0.0470	0.1369	7.3715	1.4690	7.5165	0.9807	0.1954	3.4487	0.6872	0.0000
16	0.2793	7.2191	1.5188	0.1280	0.0500	0.1374	7.3355	1.5643	7.5004	0.9780	0.2086	3.4235	0.7300	0.0000
17	0.2967	7.1818	1.6110	0.1273	0.0531	0.1380	7.2972	1.6590	7.4835	0.9751	0.2217	3.3968	0.7723	0.0000
18	0.3142	7.1424	1.7027	0.1266	0.0561	0.1385	7.2567	1.7533	7.4655	0.9720	0.2349	3.3686	0.8139	0.0000
19	0.3316	7.1008	1.7939	0.1259	0.0591	0.1391	7.2140	1.8470	7.4467	0.9688	0.2480	3.3390	0.8549	0.0000
20	0.3491	7.0571	1.8845	0.1251	0.0621	0.1397	7.1691	1.9401	7.4269	0.9653	0.2612	3.3080	0.8952	0.0000
21	0.3665	7.0112	1.9746	0.1243	0.0650	0.1403	7.1219	2.0326	7.4063	0.9616	0.2744	3.2755	0.9348	0.0000
22	0.3840	6.9632	2.0641	0.1235	0.0680	0.1409	7.0726	2.1244	7.3848	0.9577	0.2877	3.2417	0.9737	0.0000
23	0.4014	6.9130	2.1529	0.1226	0.0709	0.1416	7.0212	2.2155	7.3624	0.9536	0.3009	3.2066	1.0118	0.0000
24	0.4189	6.8607	2.2411	0.1216	0.0738	0.1423	6.9676	2.3060	7.3393	0.9494	0.3142	3.1702	1.0492	0.0000
25	0.4363	6.8064	2.3286	0.1207	0.0767	0.1430	6.9119	2.3957	7.3153	0.9449	0.3275	3.1324	1.0857	0.0000
26	0.4538	6.7499	2.4154	0.1197	0.0796	0.1437	6.8540	2.4846	7.2905	0.9401	0.3408	3.0935	1.1214	0.0000
27	0.4712	6.6915	2.5015	0.1186	0.0824	0.1444	6.7941	2.5728	7.2649	0.9352	0.3541	3.0534	1.1562	0.0000
28	0.4887	6.6309	2.5868	0.1176	0.0852	0.1452	6.7322	2.6601	7.2387	0.9300	0.3675	3.0120	1.1902	0.0000
29	0.5061	6.5684	2.6713	0.1165	0.0880	0.1460	6.6681	2.7467	7.2117	0.9246	0.3809	2.9696	1.2232	0.0000
30	0.5236	6.5039	2.7550	0.1153	0.0907	0.1467	6.6021	2.8323	7.1840	0.9190	0.3943	2.9261	1.2553	0.0000
31	0.5411	6.4373	2.8379	0.1141	0.0935	0.1475	6.5340	2.9171	7.1556	0.9131	0.4077	2.8815	1.2864	0.0000
32	0.5585	6.3688	2.9199	0.1129	0.0962	0.1483	6.4640	3.0009	7.1266	0.9070	0.4211	2.8359	1.3166	0.0000
33	0.5760	6.2984	3.0010	0.1117	0.0988	0.1491	6.3920	3.0838	7.0970	0.9007	0.4345	2.7894	1.3457	0.0000
34	0.5934	6.2261	3.0812	0.1104	0.1015	0.1500	6.3181	3.1658	7.0668	0.8940	0.4480	2.7419	1.3739	0.0000
35	0.6109	6.1518	3.1604	0.1091	0.1041	0.1508	6.2423	3.2467	7.0361	0.8872	0.4614	2.6936	1.4010	0.0000
36	0.6283	6.0757	3.2387	0.1077	0.1067	0.1516	6.1645	3.3267	7.0049	0.8800	0.4749	2.6444	1.4270	0.0000
37	0.6458	5.9978	3.3160	0.1063	0.1092	0.1524	6.0850	3.4056	6.9731	0.8726	0.4884	2.5944	1.4520	0.0000
38	0.6632	5.9180	3.3923	0.1049	0.1117	0.1533	6.0035	3.4834	6.9409	0.8649	0.5019	2.5437	1.4760	0.0000
39	0.6807	5.8364	3.4676	0.1035	0.1142	0.1541	5.9203	3.5602	6.9083	0.8570	0.5153	2.4924	1.4988	0.0000
40	0.6981	5.7530	3.5418	0.1020	0.1167	0.1550	5.8353	3.6359	6.8753	0.8487	0.5288	2.4404	1.5205	0.0000
41	0.7156	5.6679	3.6149	0.1005	0.1191	0.1558	5.7485	3.7104	6.8420	0.8402	0.5423	2.3878	1.5412	0.0000
42	0.7330	5.5810	3.6869	0.0990	0.1214	0.1567	5.6600	3.7838	6.8083	0.8313	0.5558	2.3346	1.5607	0.0000
43	0.7505	5.4925	3.7578	0.0974	0.1238	0.1575	5.5698	3.8560	6.7743	0.8222	0.5692	2.2810	1.5792	0.0000
44	0.7679	5.4022	3.8276	0.0958	0.1261	0.1583	5.4779	3.9271	6.7401	0.8127	0.5826	2.2270	1.5965	0.0000
45	0.7854	5.3104	3.8962	0.0942	0.1283	0.1592	5.3843	3.9969	6.7057	0.8029	0.5961	2.1725	1.6127	0.0000
46	0.8029	5.2169	3.9636	0.0925	0.1306	0.1600	5.2891	4.0656	6.6711	0.7928	0.6094	2.1178	1.6279	0.0000
47	0.8203	5.1218	4.0298	0.0908	0.1327	0.1608	5.1924	4.1329	6.6364	0.7824	0.6228	2.0628	1.6419	0.0000
48	0.8378	5.0252	4.0947	0.0891	0.1349	0.1616	5.0941	4.1990	6.6016	0.7716	0.6361	2.0075	1.6548	0.0000
49	0.8552	4.9270	4.1584	0.0874	0.1370	0.1625	4.9942	4.2638	6.5668	0.7605	0.6493	1.9521	1.6666	0.0000
50	0.8727	4.8273	4.2209	0.0856	0.1390	0.1633	4.8929	4.3274	6.5319	0.7491	0.6625	1.8966	1.6774	0.0000
51	0.8901	4.7262	4.2821	0.0838	0.1410	0.1641	4.7900	4.3895	6.4971	0.7373	0.6756	1.8410	1.6871	0.0000
52	0.9076	4.6236	4.3419	0.0820	0.1430	0.1648	4.6858	4.4504	6.4624	0.7251	0.6887	1.7854	1.6957	0.0000
53	0.9250	4.5196	4.4005	0.0801	0.1449	0.1656	4.5801	4.5099	6.4278	0.7125	0.7016	1.7299	1.7034	0.0000
54	0.9425	4.4143	4.4577	0.0783	0.1468	0.1664	4.4731	4.5680	6.3933	0.6996	0.7145	1.6745	1.7100	0.0000
55	0.9599	4.3076	4.5135	0.0764	0.1487	0.1671	4.3647	4.6247	6.3591	0.6864	0.7273	1.6192	1.7157	0.0000
56	0.9774	4.1995	4.5680	0.0745	0.1505	0.1679	4.2550	4.6800	6.3252	0.6727	0.7399	1.5641	1.7204	0.0000
57	0.9948	4.0902	4.6211	0.0725	0.1522	0.1686	4.1440	4.7339	6.2915	0.6587	0.7524	1.5093	1.7242	0.0000
58	1.0123	3.9797	4.6727	0.0706	0.1539	0.1693	4.0318	4.7864	6.2582	0.6442	0.7648	1.4548	1.7271	0.0000
59	1.0297	3.8679	4.7230	0.0686	0.1556	0.1700	3.9184	4.8374	6.2252	0.6294	0.7771	1.4006	1.7291	0.0000
60	1.0472	3.7550	4.7718	0.0666	0.1572	0.1707	3.8038	4.8869	6.1928	0.6142	0.7891	1.3469	1.7304	0.0000
61	1.0647	3.6409	4.8192	0.0646	0.1587	0.1714	3.6880	4.9349	6.1608	0.5986	0.8010	1.2935	1.7308	0.0000
62	1.0821	3.5257	4.8650	0.0625	0.1602	0.1720	3.5712	4.9815	6.1293	0.5826	0.8127	1.2406	1.7306	0.0000
63	1.0996	3.4095	4.9094	0.0605	0.1617	0.1726	3.4532	5.0265	6.0984	0.5663	0.8242	1.1882	1.7296	0.0000
64	1.1170	3.2922	4.9524	0.0584	0.1631	0.1732	3.3343	5.0700	6.0682	0.5495	0.8355	1.1364	1.7280	0.0000
65	1.1345	3.1739	4.9938	0.0563	0.1645	0.1738	3.2143	5.1120	6.0386	0.5323	0.8466	1.0851	1.7258	0.0000
66	1.1519	3.0546	5.0336	0.0542	0.1658	0.1744	3.0934	5.1525	6.0097	0.5147	0.8574	1.0345	1.7231	0.0000
67	1.1694	2.9344	5.0720	0.0520	0.1671	0.1750	2.9716	5.1913	5.9816	0.4968	0.8679	0.9844	1.7198	0.0000
68	1.1868	2.8133	5.1088	0.0499	0.1683	0.1755	2.8488	5.2286	5.9544	0.4784	0.8781	0.9350	1.7162	0.0000

69	1.2043	2.6913	5.1440	0.0477	0.1694	0.1760	2.7252	5.2643	5.9279	0.4597	0.8881	0.8863	1.7121	0.0000
70	1.2217	2.5686	5.1777	0.0455	0.1705	0.1765	2.6008	5.2985	5.9024	0.4406	0.8977	0.8383	1.7077	0.0000
71	1.2392	2.4450	5.2098	0.0434	0.1716	0.1770	2.4756	5.3310	5.8778	0.4212	0.9070	0.7909	1.7031	0.0000
72	1.2566	2.3207	5.2403	0.0411	0.1726	0.1774	2.3497	5.3619	5.8542	0.4014	0.9159	0.7442	1.6983	0.0000
73	1.2741	2.1957	5.2692	0.0389	0.1736	0.1779	2.2231	5.3912	5.8316	0.3812	0.9245	0.6982	1.6933	0.0000
74	1.2915	2.0700	5.2966	0.0367	0.1745	0.1783	2.0958	5.4189	5.8100	0.3607	0.9327	0.6529	1.6882	0.0000
75	1.3090	1.9437	5.3223	0.0345	0.1753	0.1787	1.9678	5.4449	5.7896	0.3399	0.9405	0.6083	1.6830	0.0000
76	1.3265	1.8168	5.3463	0.0322	0.1761	0.1790	1.8393	5.4693	5.7703	0.3188	0.9478	0.5643	1.6779	0.0000
77	1.3439	1.6894	5.3688	0.0300	0.1768	0.1794	1.7103	5.4920	5.7522	0.2973	0.9548	0.5210	1.6729	0.0000
78	1.3614	1.5614	5.3896	0.0277	0.1775	0.1797	1.5807	5.5131	5.7352	0.2756	0.9613	0.4782	1.6680	0.0000
79	1.3788	1.4330	5.4088	0.0254	0.1782	0.1800	1.4506	5.5325	5.7195	0.2536	0.9673	0.4361	1.6633	0.0000
80	1.3963	1.3041	5.4263	0.0231	0.1787	0.1802	1.3201	5.5503	5.7051	0.2314	0.9729	0.3946	1.6588	0.0000
81	1.4137	1.1748	5.4422	0.0208	0.1793	0.1805	1.1893	5.5663	5.6920	0.2089	0.9779	0.3535	1.6546	0.0000
82	1.4312	1.0452	5.4564	0.0185	0.1797	0.1807	1.0580	5.5807	5.6801	0.1863	0.9825	0.3129	1.6507	0.0000
83	1.4486	0.9152	5.4689	0.0162	0.1801	0.1809	0.9265	5.5934	5.6696	0.1634	0.9866	0.2728	1.6472	0.0000
84	1.4661	0.7850	5.4798	0.0139	0.1805	0.1810	0.7946	5.6044	5.6605	0.1404	0.9901	0.2331	1.6441	0.0000
85	1.4835	0.6545	5.4890	0.0116	0.1808	0.1812	0.6625	5.6138	5.6527	0.1172	0.9931	0.1937	1.6413	0.0000
86	1.5010	0.5239	5.4966	0.0093	0.1810	0.1813	0.5303	5.6214	5.6464	0.0939	0.9956	0.1546	1.6391	0.0000
87	1.5184	0.3930	5.5024	0.0070	0.1812	0.1814	0.3978	5.6274	5.6414	0.0705	0.9975	0.1158	1.6373	0.0000
88	1.5359	0.2621	5.5066	0.0046	0.1814	0.1814	0.2653	5.6316	5.6378	0.0471	0.9989	0.0771	1.6360	0.0000
89	1.5533	0.1311	5.5092	0.0023	0.1815	0.1815	0.1327	5.6342	5.6357	0.0235	0.9997	0.0385	1.6353	0.0000
90	1.5708	0.0000	5.5100	0.0000	0.1815	0.1815	0.0000	5.6350	5.6350	0.0000	1.0000	0.0000	1.6350	0.0000
91	1.5882	-0.1311	5.5092	-0.0023	0.1815	0.1815	-0.1327	5.6342	5.6357	-0.0235	0.9997	-0.0385	1.6353	0.0000
92	1.6057	-0.2621	5.5066	-0.0046	0.1814	0.1814	-0.2653	5.6316	5.6378	-0.0471	0.9989	-0.0771	1.6360	0.0000
93	1.6232	-0.3930	5.5024	-0.0070	0.1812	0.1814	-0.3978	5.6274	5.6414	-0.0705	0.9975	-0.1158	1.6373	0.0000
94	1.6406	-0.5239	5.4966	-0.0093	0.1810	0.1813	-0.5303	5.6214	5.6464	-0.0939	0.9956	-0.1546	1.6391	0.0000
95	1.6581	-0.6545	5.4890	-0.0116	0.1808	0.1812	-0.6625	5.6138	5.6527	-0.1172	0.9931	-0.1937	1.6413	0.0000
96	1.6755	-0.7850	5.4798	-0.0139	0.1805	0.1810	-0.7946	5.6044	5.6605	-0.1404	0.9901	-0.2331	1.6441	0.0000
97	1.6930	-0.9152	5.4689	-0.0162	0.1801	0.1809	-0.9265	5.5934	5.6696	-0.1634	0.9866	-0.2728	1.6472	0.0000
98	1.7104	-1.0452	5.4564	-0.0185	0.1797	0.1807	-1.0580	5.5807	5.6801	-0.1863	0.9825	-0.3129	1.6507	0.0000
99	1.7279	-1.1748	5.4422	-0.0208	0.1793	0.1805	-1.1893	5.5663	5.6920	-0.2089	0.9779	-0.3535	1.6546	0.0000
100	1.7453	-1.3041	5.4263	-0.0231	0.1787	0.1802	-1.3201	5.5503	5.7051	-0.2314	0.9729	-0.3946	1.6588	0.0000
101	1.7628	-1.4330	5.4088	-0.0254	0.1782	0.1800	-1.4506	5.5325	5.7195	-0.2536	0.9673	-0.4361	1.6633	0.0000
102	1.7802	-1.5614	5.3896	-0.0277	0.1775	0.1797	-1.5807	5.5131	5.7352	-0.2756	0.9613	-0.4782	1.6680	0.0000
103	1.7977	-1.6894	5.3688	-0.0300	0.1768	0.1794	-1.7103	5.4920	5.7522	-0.2973	0.9548	-0.5210	1.6729	0.0000
104	1.8151	-1.8168	5.3463	-0.0322	0.1761	0.1790	-1.8393	5.4693	5.7703	-0.3188	0.9478	-0.5643	1.6779	0.0000
105	1.8326	-1.9437	5.3223	-0.0345	0.1753	0.1787	-1.9678	5.4449	5.7896	-0.3399	0.9405	-0.6083	1.6830	0.0000
106	1.8500	-2.0700	5.2966	-0.0367	0.1745	0.1783	-2.0958	5.4189	5.8100	-0.3607	0.9327	-0.6529	1.6882	0.0000
107	1.8675	-2.1957	5.2692	-0.0389	0.1736	0.1779	-2.2231	5.3912	5.8316	-0.3812	0.9245	-0.6982	1.6933	0.0000
108	1.8850	-2.3207	5.2403	-0.0411	0.1726	0.1774	-2.3497	5.3619	5.8542	-0.4014	0.9159	-0.7442	1.6983	0.0000
109	1.9024	-2.4450	5.2098	-0.0434	0.1716	0.1770	-2.4756	5.3310	5.8778	-0.4212	0.9070	-0.7909	1.7031	0.0000
110	1.9199	-2.5686	5.1777	-0.0455	0.1705	0.1765	-2.6008	5.2985	5.9024	-0.4406	0.8977	-0.8383	1.7077	0.0000
111	1.9373	-2.6913	5.1440	-0.0477	0.1694	0.1760	-2.7252	5.2643	5.9279	-0.4597	0.8881	-0.8863	1.7121	0.0000
112	1.9548	-2.8133	5.1088	-0.0499	0.1683	0.1755	-2.8488	5.2286	5.9544	-0.4784	0.8781	-0.9350	1.7162	0.0000
113	1.9722	-2.9344	5.0720	-0.0520	0.1671	0.1750	-2.9716	5.1913	5.9816	-0.4968	0.8679	-0.9844	1.7198	0.0000
114	1.9897	-3.0546	5.0336	-0.0542	0.1658	0.1744	-3.0934	5.1525	6.0097	-0.5147	0.8574	-1.0345	1.7231	0.0000
115	2.0071	-3.1739	4.9938	-0.0563	0.1645	0.1738	-3.2143	5.1120	6.0386	-0.5323	0.8466	-1.0851	1.7258	0.0000
116	2.0246	-3.2922	4.9524	-0.0584	0.1631	0.1732	-3.3343	5.0700	6.0682	-0.5495	0.8355	-1.1364	1.7280	0.0000
117	2.0420	-3.4095	4.9094	-0.0605	0.1617	0.1726	-3.4532	5.0265	6.0984	-0.5663	0.8242	-1.1882	1.7296	0.0000
118	2.0595	-3.5257	4.8650	-0.0625	0.1602	0.1720	-3.5712	4.9815	6.1293	-0.5826	0.8127	-1.2406	1.7306	0.0000
119	2.0769	-3.6409	4.8192	-0.0646	0.1587	0.1714	-3.6880	4.9349	6.1608	-0.5986	0.8010	-1.2935	1.7308	0.0000
120	2.0944	-3.7550	4.7718	-0.0666	0.1572	0.1707	-3.8038	4.8869	6.1928	-0.6142	0.7891	-1.3469	1.7304	0.0000
121	2.1118	-3.8679	4.7230	-0.0686	0.1556	0.1700	-3.9184	4.8374	6.2252	-0.6294	0.7771	-1.4006	1.7291	0.0000
122	2.1293	-3.9797	4.6727	-0.0706	0.1539	0.1693	-4.0318	4.7864	6.2582	-0.6442	0.7648	-1.4548	1.7271	0.0000
123	2.1468	-4.0902	4.6211	-0.0725	0.1522	0.1686	-4.1440	4.7339	6.2915	-0.6587	0.7524	-1.5093	1.7242	0.0000
124	2.1642	-4.1995	4.5680	-0.0745	0.1505	0.1679	-4.2550	4.6800	6.3252	-0.6727	0.7399	-1.5641	1.7204	0.0000
125	2.1817	-4.3076	4.5135	-0.0764	0.1487	0.1671	-4.3647	4.6247	6.3591	-0.6864	0.7273	-1.6192	1.7157	0.0000
126	2.1991	-4.4143	4.4577	-0.0783	0.1468	0.1664	-4.4731	4.5680	6.3933	-0.6996	0.7145	-1.6745	1.7100	0.0000
127	2.2166	-4.5196	4.4005	-0.0801	0.1449	0.1656	-4.5801	4.5099	6.4278	-0.7125	0.7016	-1.7299	1.7034	0.0000
128	2.2340	-4.6236	4.3419	-0.0820	0.1430	0.1648	-4.6858	4.4504	6.4624	-0.7251	0.6887	-1.7854	1.6957	0.0000
129	2.2515	-4.7262	4.2821	-0.0838	0.1410	0.1641	-4.7900	4.3895	6.4971	-0.7373	0.6756	-1.8410	1.6871	0.0000
130	2.2689	-4.8273	4.2209	-0.0856	0.1390	0.1633	-4.8929	4.3274	6.5319	-0.7491	0.6625	-1.8966	1.6774	0.0000
131	2.2864	-4.9270	4.1584	-0.0874	0.1370	0.1625	-4.9942	4.2638	6.5668	-0.7605	0.6493	-1.9521	1.6666	0.0000
132	2.3038	-5.0252	4.0947	-0.0891	0.1349	0.1616	-5.0941	4.1990	6.6016	-0.7716	0.6361	-2.0075	1.6548	0.0000
133	2.3213	-5.1218	4.0298	-0.0908	0.1327	0.1608	-5.1924	4.1329	6.6364	-0.7824	0.6228	-2.0628	1.6419	0.0000
134	2.3387	-5.2169	3.9636	-0.0925	0.1306	0.1600	-5.2891	4.0656	6.6711	-0.7928	0.6094	-2.1178	1.6279	0.0000
135	2.3562	-5.3104	3.8962	-0.0942	0.1283	0.1592	-5.3843	3.9969	6.7057	-0.8029	0.5961	-2.1725	1.6127	0.0000
136	2.3736	-5.4022	3.8276	-0.0958	0.1261	0.1583	-5.4779	3.9271	6.7401	-0.8127	0.5826	-2.2270	1.5965	0.0000
137	2.3911	-5.4925	3.7578	-0.0974	0.1238	0.1575	-5.5698	3.8560	6.7743	-0.8222	0.5692	-2.2810	1.5792	0.0000
138	2.4086	-5.5810	3.6869	-0.0990	0.1214	0.1567	-5.6600	3.7838	6.8083	-0.8313	0.5558	-2.3346	1.5607	0.0000
139	2.4260	-5.6679	3.6149	-0.1005	0.1191	0.1558	-5.7485	3.7104	6.8420	-0.8402	0.5423	-2.3878	1.5412	0.0000
140	2.4435	-5.7530	3.5418	-0.1020	0.1167	0.1550	-5.8353	3.6359	6.8753	-0.8487	0.5288	-2.4404	1.5205	0.0000
141	2.4609	-5.8364	3.4676	-0.1035	0.1142	0.1541	-5.9203	3.5602	6.9083	-0.8570	0.5153	-2.4924	1.4988	0.0000
142	2.4784	-5.9180	3.3923	-0.1049	0.1117	0.1533	-6.0035	3.4834	6.9409	-0.8649	0.5019	-2.5437	1.4760	0.0000
143	2.4958	-5.9978	3.3160	-0.1063	0.1092	0.1524	-6.0850	3.4056	6.9731	-0.8726	0.4884	-2.5944	1.4520	0.0000
144	2.5133	-6.0757	3.2387	-0.1077	0.1067	0.1516	-6.1645	3.3267	7.0049	-0.8800	0.4749	-2.6444	1.4270	0.0000
145	2.5307	-6.1518	3.1604	-0.1091	0.1041	0.1508	-6.2423	3.2467	7.0361	-0.8872	0.4614	-2.6936	1.4010	0.0000
146	2.5482	-6.2261	3.0812	-0.1104	0.1015	0.1500	-6.3181	3.1658	7.0668	-0.8940	0.4480	-2.7419	1.3739	0.0000
147	2.5656	-6.2984	3.0010	-0.1117	0.0988	0.1491	-6.3920	3.0838	7.0970	-0.9007	0.4345	-2.7894	1.3457	0.0000
148	2.5831	-6.3688	2.9199	-0.1129	0.0962	0.1483	-6.4640	3.0009	7.1266	-0.9070	0.4211	-2.8359	1.3166	0.0000
149	2.6005	-6.4373	2.8379	-0.1141	0.0935	0.1475	-6.5340	2.9171	7.1556	-0.9131	0.4077	-2.8815	1.2864	0.0000
150	2.6180	-6.5039	2.7550	-0.1153	0.0907	0.1467	-6.6021	2.8323	7.1840	-0.9190	0.3943	-2.9261	1.2553	0.0000
151	2.6354	-6.5684	2.6713	-0.1165	0.0880	0.1460	-6.6681	2.7467	7.2117	-0.9246	0.3809	-2.9696	1.2232	0.0000
152	2.6529	-6.6309	2.5868	-0.1176	0.0852	0.1452	-6.7322	2.6601	7.2387	-0.9300	0.3675	-3.0120	1.1902	0.0000
153	2.6704	-6.6915	2.5015	-0.1186	0.0824	0.1444	-6.7941	2.5728	7.2649	-0.9352	0.3541	-3.0534	1.1562	0.0000
154	2.6878	-6.7499	2.4154	-0.1197	0.0796	0.1437	-6.8540	2.4846	7.2905	-0.9401	0.3408	-3.0935	1.1214	0.0000
155	2.7053	-6.8064	2.3286	-0.1207	0.0767	0.1430	-6.9119	2.3957	7.3153	-0.9449	0.3275	-3.1324	1.0857	0.0000
156	2.7227	-6.8607	2.2411	-0.1216	0.0738	0.1423	-6.9676	2.3060	7.3393	-0.9494	0.3142	-3.1702	1.0492	0.0000
157	2.7402	-6.9130	2.1529	-0.1226	0.0709	0.1416	-7.0212	2.2155	7.3624	-0.9536	0.3009	-3.2066	1.0118	0.0000
158	2.7576	-6.9632	2.0641	-0.1235	0.0680	0.1409	-7.0726	2.1244	7.3848	-0.9577	0.2877	-3.2417	0.9737	0.0000
159	2.7751	-7.0112	1.9746	-0.1243	0.0650	0.1403	-7.1219	2.0326	7.4063	-0.9616	0.2744	-3.2755	0.9348	0.0000
160	2.7925	-7.0571	1.8845	-0.1251	0.0621	0.1397	-7.1691	1.9401	7.4269	-0.9653	0.2612	-3.3080	0.8952	0.0000
161	2.8100	-7.1008	1.7939	-0.1259	0.0591	0.1391	-7.2140	1.8470	7.4467	-0.9688	0.2480	-3.3390	0.8549	0.0000
162	2.8274	-7.1424	1.7027	-0.1266	0.0561	0.1385	-7.2567	1.7533	7.4655	-0.9720	0.2349	-3.3686	0.8139	0.0000
163	2.8449	-7.1818	1.6110	-0.1273	0.0531	0.1380	-7.2972	1.6590	7.4835	-0.9751	0.2217	-3.3968	0.7723	0.0000
164	2.8623	-7.2191	1.5188	-0.1280	0.0500	0.1374	-7.3355	1.5643	7.5004	-0.9780	0.2086	-3.4235	0.7300	0.0000
165	2.8798	-7.2541	1.4261	-0.1286	0.0470	0.1369	-7.3715	1.4690	7.5165	-0.9807	0.1954	-3.4487	0.6872	0.0000
166	2.8972	-7.2869	1.3330	-0.1292	0.0439	0.1365	-7.4053	1.3732	7.5315	-0.9832	0.1823	-3.4723	0.6439	0.0000
167	2.9147	-7.3175	1.2395	-0.1297	0.0408	0.1360	-7.4368	1.2770	7.5456	-0.9856	0.1692	-3.4945	0.6000	0.0000
168	2.9322	-7.3459	1.1456	-0.1302	0.0377	0.1356	-7.4660	1.1804	7.5587	-0.9877	0.1562	-3.5150	0.5557	0.0000
169	2.9496	-7.3720	1.0514	-0.1307	0.0346	0.1352	-7.4929	1.0834	7.5708	-0.9897	0.1431	-3.5340	0.5110	0.0000
170	2.9671	-7.3959	0.9568	-0.1311	0.0315	0.1349	-7.5174	0.9860	7.5818	-0.9915	0.1300	-3.5514	0.4658	0.0000
171	2.9845	-7.4175	0.8620	-0.1315	0.0284	0.1345	-7.5397	0.8883	7.5919	-0.9931	0.1170	-3.5672	0.4203	0.0000

172	3.0020	-7.4369	0.7668	-0.1319	0.0253	0.1343	-7.5597	0.7904	7.6009	-0.9946	0.1040	-3.5814	0.3744	0.0000
173	3.0194	-7.4540	0.6715	-0.1322	0.0221	0.1340	-7.5773	0.6921	7.6089	-0.9959	0.0910	-3.5939	0.3283	0.0000
174	3.0369	-7.4689	0.5760	-0.1324	0.0190	0.1338	-7.5926	0.5937	7.6158	-0.9970	0.0780	-3.6048	0.2819	0.0000
175	3.0543	-7.4814	0.4802	-0.1326	0.0158	0.1336	-7.6055	0.4950	7.6216	-0.9979	0.0650	-3.6140	0.2352	0.0000
176	3.0718	-7.4917	0.3844	-0.1328	0.0127	0.1334	-7.6161	0.3962	7.6264	-0.9986	0.0520	-3.6215	0.1884	0.0000
177	3.0892	-7.4997	0.2884	-0.1330	0.0095	0.1333	-7.6244	0.2973	7.6302	-0.9992	0.0390	-3.6274	0.1414	0.0000
178	3.1067	-7.5054	0.1923	-0.1331	0.0063	0.1332	-7.6303	0.1982	7.6329	-0.9997	0.0260	-3.6316	0.0944	0.0000
179	3.1241	-7.5089	0.0962	-0.1331	0.0032	0.1332	-7.6338	0.0991	7.6345	-0.9999	0.0130	-3.6342	0.0472	0.0000
180	3.1416	-7.5100	0.0000	-0.1332	0.0000	0.1332	-7.6350	0.0000	7.6350	-1.0000	0.0000	-3.6350	0.0000	0.0000
181	3.1590	-7.5089	-0.0962	-0.1331	-0.0032	0.1332	-7.6338	-0.0991	7.6345	-0.9999	-0.0130	-3.6342	-0.0472	0.0000
182	3.1765	-7.5054	-0.1923	-0.1331	-0.0063	0.1332	-7.6303	-0.1982	7.6329	-0.9997	-0.0260	-3.6316	-0.0944	0.0000
183	3.1940	-7.4997	-0.2884	-0.1330	-0.0095	0.1333	-7.6244	-0.2973	7.6302	-0.9992	-0.0390	-3.6274	-0.1414	0.0000
184	3.2114	-7.4917	-0.3844	-0.1328	-0.0127	0.1334	-7.6161	-0.3962	7.6264	-0.9986	-0.0520	-3.6215	-0.1884	0.0000
185	3.2289	-7.4814	-0.4802	-0.1326	-0.0158	0.1336	-7.6055	-0.4950	7.6216	-0.9979	-0.0650	-3.6140	-0.2352	0.0000
186	3.2463	-7.4689	-0.5760	-0.1324	-0.0190	0.1338	-7.5926	-0.5937	7.6158	-0.9970	-0.0780	-3.6048	-0.2819	0.0000
187	3.2638	-7.4540	-0.6715	-0.1322	-0.0221	0.1340	-7.5773	-0.6921	7.6089	-0.9959	-0.0910	-3.5939	-0.3283	0.0000
188	3.2812	-7.4369	-0.7668	-0.1319	-0.0253	0.1343	-7.5597	-0.7904	7.6009	-0.9946	-0.1040	-3.5814	-0.3744	0.0000
189	3.2987	-7.4175	-0.8620	-0.1315	-0.0284	0.1345	-7.5397	-0.8883	7.5919	-0.9931	-0.1170	-3.5672	-0.4203	0.0000
190	3.3161	-7.3959	-0.9568	-0.1311	-0.0315	0.1349	-7.5174	-0.9860	7.5818	-0.9915	-0.1300	-3.5514	-0.4658	0.0000
191	3.3336	-7.3720	-1.0514	-0.1307	-0.0346	0.1352	-7.4929	-1.0834	7.5708	-0.9897	-0.1431	-3.5340	-0.5110	0.0000
192	3.3510	-7.3459	-1.1456	-0.1302	-0.0377	0.1356	-7.4660	-1.1804	7.5587	-0.9877	-0.1562	-3.5150	-0.5557	0.0000
193	3.3685	-7.3175	-1.2395	-0.1297	-0.0408	0.1360	-7.4368	-1.2770	7.5456	-0.9856	-0.1692	-3.4945	-0.6000	0.0000
194	3.3859	-7.2869	-1.3330	-0.1292	-0.0439	0.1365	-7.4053	-1.3732	7.5315	-0.9832	-0.1823	-3.4723	-0.6439	0.0000
195	3.4034	-7.2541	-1.4261	-0.1286	-0.0470	0.1369	-7.3715	-1.4690	7.5165	-0.9807	-0.1954	-3.4487	-0.6872	0.0000
196	3.4208	-7.2191	-1.5188	-0.1280	-0.0500	0.1374	-7.3355	-1.5643	7.5004	-0.9780	-0.2086	-3.4235	-0.7300	0.0000
197	3.4383	-7.1818	-1.6110	-0.1273	-0.0531	0.1380	-7.2972	-1.6590	7.4835	-0.9751	-0.2217	-3.3968	-0.7723	0.0000
198	3.4558	-7.1424	-1.7027	-0.1266	-0.0561	0.1385	-7.2567	-1.7533	7.4655	-0.9720	-0.2349	-3.3686	-0.8139	0.0000
199	3.4732	-7.1008	-1.7939	-0.1259	-0.0591	0.1391	-7.2140	-1.8470	7.4467	-0.9688	-0.2480	-3.3390	-0.8549	0.0000
200	3.4907	-7.0571	-1.8845	-0.1251	-0.0621	0.1397	-7.1691	-1.9401	7.4269	-0.9653	-0.2612	-3.3080	-0.8952	0.0000
201	3.5081	-7.0112	-1.9746	-0.1243	-0.0650	0.1403	-7.1219	-2.0326	7.4063	-0.9616	-0.2744	-3.2755	-0.9348	0.0000
202	3.5256	-6.9632	-2.0641	-0.1235	-0.0680	0.1409	-7.0726	-2.1244	7.3848	-0.9577	-0.2877	-3.2417	-0.9737	0.0000
203	3.5430	-6.9130	-2.1529	-0.1226	-0.0709	0.1416	-7.0212	-2.2155	7.3624	-0.9536	-0.3009	-3.2066	-1.0118	0.0000
204	3.5605	-6.8607	-2.2411	-0.1216	-0.0738	0.1423	-6.9676	-2.3060	7.3393	-0.9494	-0.3142	-3.1702	-1.0492	0.0000
205	3.5779	-6.8064	-2.3286	-0.1207	-0.0767	0.1430	-6.9119	-2.3957	7.3153	-0.9449	-0.3275	-3.1324	-1.0857	0.0000
206	3.5954	-6.7499	-2.4154	-0.1197	-0.0796	0.1437	-6.8540	-2.4846	7.2905	-0.9401	-0.3408	-3.0935	-1.1214	0.0000
207	3.6128	-6.6915	-2.5015	-0.1186	-0.0824	0.1444	-6.7941	-2.5728	7.2649	-0.9352	-0.3541	-3.0534	-1.1562	0.0000
208	3.6303	-6.6309	-2.5868	-0.1176	-0.0852	0.1452	-6.7322	-2.6601	7.2387	-0.9300	-0.3675	-3.0120	-1.1902	0.0000
209	3.6477	-6.5684	-2.6713	-0.1165	-0.0880	0.1460	-6.6681	-2.7467	7.2117	-0.9246	-0.3809	-2.9696	-1.2232	0.0000
210	3.6652	-6.5039	-2.7550	-0.1153	-0.0907	0.1467	-6.6021	-2.8323	7.1840	-0.9190	-0.3943	-2.9261	-1.2553	0.0000
211	3.6826	-6.4373	-2.8379	-0.1141	-0.0935	0.1475	-6.5340	-2.9171	7.1556	-0.9131	-0.4077	-2.8815	-1.2864	0.0000
212	3.7001	-6.3688	-2.9199	-0.1129	-0.0962	0.1483	-6.4640	-3.0009	7.1266	-0.9070	-0.4211	-2.8359	-1.3166	0.0000
213	3.7176	-6.2984	-3.0010	-0.1117	-0.0988	0.1491	-6.3920	-3.0838	7.0970	-0.9007	-0.4345	-2.7894	-1.3457	0.0000
214	3.7350	-6.2261	-3.0812	-0.1104	-0.1015	0.1500	-6.3181	-3.1658	7.0668	-0.8940	-0.4480	-2.7419	-1.3739	0.0000
215	3.7525	-6.1518	-3.1604	-0.1091	-0.1041	0.1508	-6.2423	-3.2467	7.0361	-0.8872	-0.4614	-2.6936	-1.4010	0.0000
216	3.7699	-6.0757	-3.2387	-0.1077	-0.1067	0.1516	-6.1645	-3.3267	7.0049	-0.8800	-0.4749	-2.6444	-1.4270	0.0000
217	3.7874	-5.9978	-3.3160	-0.1063	-0.1092	0.1524	-6.0850	-3.4056	6.9731	-0.8726	-0.4884	-2.5944	-1.4520	0.0000
218	3.8048	-5.9180	-3.3923	-0.1049	-0.1117	0.1533	-6.0035	-3.4834	6.9409	-0.8649	-0.5019	-2.5437	-1.4760	0.0000
219	3.8223	-5.8364	-3.4676	-0.1035	-0.1142	0.1541	-5.9203	-3.5602	6.9083	-0.8570	-0.5153	-2.4924	-1.4988	0.0000
220	3.8397	-5.7530	-3.5418	-0.1020	-0.1167	0.1550	-5.8353	-3.6359	6.8753	-0.8487	-0.5288	-2.4404	-1.5205	0.0000
221	3.8572	-5.6679	-3.6149	-0.1005	-0.1191	0.1558	-5.7485	-3.7104	6.8420	-0.8402	-0.5423	-2.3878	-1.5412	0.0000
222	3.8746	-5.5810	-3.6869	-0.0990	-0.1214	0.1567	-5.6600	-3.7838	6.8083	-0.8313	-0.5558	-2.3346	-1.5607	0.0000
223	3.8921	-5.4925	-3.7578	-0.0974	-0.1238	0.1575	-5.5698	-3.8560	6.7743	-0.8222	-0.5692	-2.2810	-1.5792	0.0000
224	3.9095	-5.4022	-3.8276	-0.0958	-0.1261	0.1583	-5.4779	-3.9271	6.7401	-0.8127	-0.5826	-2.2270	-1.5965	0.0000
225	3.9270	-5.3104	-3.8962	-0.0942	-0.1283	0.1592	-5.3843	-3.9969	6.7057	-0.8029	-0.5961	-2.1725	-1.6127	0.0000
226	3.9444	-5.2169	-3.9636	-0.0925	-0.1306	0.1600	-5.2891	-4.0656	6.6711	-0.7928	-0.6094	-2.1178	-1.6279	0.0000
227	3.9619	-5.1218	-4.0298	-0.0908	-0.1327	0.1608	-5.1924	-4.1329	6.6364	-0.7824	-0.6228	-2.0628	-1.6419	0.0000
228	3.9794	-5.0252	-4.0947	-0.0891	-0.1349	0.1616	-5.0941	-4.1990	6.6016	-0.7716	-0.6361	-2.0075	-1.6548	0.0000
229	3.9968	-4.9270	-4.1584	-0.0874	-0.1370	0.1625	-4.9942	-4.2638	6.5668	-0.7605	-0.6493	-1.9521	-1.6666	0.0000
230	4.0143	-4.8273	-4.2209	-0.0856	-0.1390	0.1633	-4.8929	-4.3274	6.5319	-0.7491	-0.6625	-1.8966	-1.6774	0.0000
231	4.0317	-4.7262	-4.2821	-0.0838	-0.1410	0.1641	-4.7900	-4.3895	6.4971	-0.7373	-0.6756	-1.8410	-1.6871	0.0000
232	4.0492	-4.6236	-4.3419	-0.0820	-0.1430	0.1648	-4.6858	-4.4504	6.4624	-0.7251	-0.6887	-1.7854	-1.6957	0.0000
233	4.0666	-4.5196	-4.4005	-0.0801	-0.1449	0.1656	-4.5801	-4.5099	6.4278	-0.7125	-0.7016	-1.7299	-1.7034	0.0000
234	4.0841	-4.4143	-4.4577	-0.0783	-0.1468	0.1664	-4.4731	-4.5680	6.3933	-0.6996	-0.7145	-1.6745	-1.7100	0.0000
235	4.1015	-4.3076	-4.5135	-0.0764	-0.1487	0.1671	-4.3647	-4.6247	6.3591	-0.6864	-0.7273	-1.6192	-1.7157	0.0000
236	4.1190	-4.1995	-4.5680	-0.0745	-0.1505	0.1679	-4.2550	-4.6800	6.3252	-0.6727	-0.7399	-1.5641	-1.7204	0.0000
237	4.1364	-4.0902	-4.6211	-0.0725	-0.1522	0.1686	-4.1440	-4.7339	6.2915	-0.6587	-0.7524	-1.5093	-1.7242	0.0000
238	4.1539	-3.9797	-4.6727	-0.0706	-0.1539	0.1693	-4.0318	-4.7864	6.2582	-0.6442	-0.7648	-1.4548	-1.7271	0.0000
239	4.1713	-3.8679	-4.7230	-0.0686	-0.1556	0.1700	-3.9184	-4.8374	6.2252	-0.6294	-0.7771	-1.4006	-1.7291	0.0000
240	4.1888	-3.7550	-4.7718	-0.0666	-0.1572	0.1707	-3.8038	-4.8869	6.1928	-0.6142	-0.7891	-1.3469	-1.7304	0.0000
241	4.2062	-3.6409	-4.8192	-0.0646	-0.1587	0.1714	-3.6880	-4.9349	6.1608	-0.5986	-0.8010	-1.2935	-1.7308	0.0000
242	4.2237	-3.5257	-4.8650	-0.0625	-0.1602	0.1720	-3.5712	-4.9815	6.1293	-0.5826	-0.8127	-1.2406	-1.7306	0.0000
243	4.2412	-3.4095	-4.9094	-0.0605	-0.1617	0.1726	-3.4532	-5.0265	6.0984	-0.5663	-0.8242	-1.1882	-1.7296	0.0000
244	4.2586	-3.2922	-4.9524	-0.0584	-0.1631	0.1732	-3.3343	-5.0700	6.0682	-0.5495	-0.8355	-1.1364	-1.7280	0.0000
245	4.2761	-3.1739	-4.9938	-0.0563	-0.1645	0.1738	-3.2143	-5.1120	6.0386	-0.5323	-0.8466	-1.0851	-1.7258	0.0000
246	4.2935	-3.0546	-5.0336	-0.0542	-0.1658	0.1744	-3.0934	-5.1525	6.0097	-0.5147	-0.8574	-1.0345	-1.7231	0.0000
247	4.3110	-2.9344	-5.0720	-0.0520	-0.1671	0.1750	-2.9716	-5.1913	5.9816	-0.4968	-0.8679	-0.9844	-1.7198	0.0000
248	4.3284	-2.8133	-5.1088	-0.0499	-0.1683	0.1755	-2.8488	-5.2286	5.9544	-0.4784	-0.8781	-0.9350	-1.7162	0.0000
249	4.3459	-2.6913	-5.1440	-0.0477	-0.1694	0.1760	-2.7252	-5.2643	5.9279	-0.4597	-0.8881	-0.8863	-1.7121	0.0000
250	4.3633	-2.5686	-5.1777	-0.0455	-0.1705	0.1765	-2.6008	-5.2985	5.9024	-0.4406	-0.8977	-0.8383	-1.7077	0.0000
251	4.3808	-2.4450	-5.2098	-0.0434	-0.1716	0.1770	-2.4756	-5.3310	5.8778	-0.4212	-0.9070	-0.7909	-1.7031	0.0000
252	4.3982	-2.3207	-5.2403	-0.0411	-0.1726	0.1774	-2.3497	-5.3619	5.8542	-0.4014	-0.9159	-0.7442	-1.6983	0.0000
253	4.4157	-2.1957	-5.2692	-0.0389	-0.1736	0.1779	-2.2231	-5.3912	5.8316	-0.3812	-0.9245	-0.6982	-1.6933	0.0000
254	4.4331	-2.0700	-5.2966	-0.0367	-0.1745	0.1783	-2.0958	-5.4189	5.8100	-0.3607	-0.9327	-0.6529	-1.6882	0.0000
255	4.4506	-1.9437	-5.3223	-0.0345	-0.1753	0.1787	-1.9678	-5.4449	5.7896	-0.3399	-0.9405	-0.6083	-1.6830	0.0000
256	4.4680	-1.8168	-5.3463	-0.0322	-0.1761	0.1790	-1.8393	-5.4693	5.7703	-0.3188	-0.9478	-0.5643	-1.6779	0.0000
257	4.4855	-1.6894	-5.3688	-0.0300	-0.1768	0.1794	-1.7103	-5.4920	5.7522	-0.2973	-0.9548	-0.5210	-1.6729	0.0000
258	4.5029	-1.5614	-5.3896	-0.0277	-0.1775	0.1797	-1.5807	-5.5131	5.7352	-0.2756	-0.9613	-0.4782	-1.6680	0.0000
259	4.5204	-1.4330	-5.4088	-0.0254	-0.1782	0.1800	-1.4506	-5.5325	5.7195	-0.2536	-0.9673	-0.4361	-1.6633	0.0000
260	4.5379	-1.3041	-5.4263	-0.0231	-0.1787	0.1802	-1.3201	-5.5503	5.7051	-0.2314	-0.9729	-0.3946	-1.6588	0.0000
261	4.5553	-1.1748	-5.4422	-0.0208	-0.1793	0.1805	-1.1893	-5.5663	5.6920	-0.2089	-0.9779	-0.3535	-1.6546	0.0000
262	4.5728	-1.0452	-5.4564	-0.0185	-0.1797	0.1807	-1.0580	-5.5807	5.6801	-0.1863	-0.9825	-0.3129	-1.6507	0.0000
263	4.5902	-0.9152	-5.4689	-0.0162	-0.1801	0.1809	-0.9265	-5.5934	5.6696	-0.1634	-0.9866	-0.2728	-1.6472	0.0000
264	4.6077	-0.7850	-5.4798	-0.0139	-0.1805	0.1810	-0.7946	-5.6044	5.6605	-0.1404	-0.9901	-0.2331	-1.6441	0.0000
265	4.6251	-0.6545	-5.4890	-0.0116	-0.1808	0.1812	-0.6625	-5.6138	5.6527	-0.1172	-0.9931	-0.1937	-1.6413	0.0000
266	4.6426	-0.5239	-5.4966	-0.0093	-0.1810	0.1813	-0.5303	-5.6214	5.6464	-0.0939	-0.9956	-0.1546	-1.6391	0.0000
267	4.6600	-0.3930	-5.5024	-0.0070	-0.1812	0.1814	-0.3978	-5.6274	5.6414	-0.0705	-0.9975	-0.1158	-1.6373	0.0000
268	4.6775	-0.2621	-5.5066	-0.0046	-0.1814	0.1814	-0.2653	-5.6316	5.6378	-0.0471	-0.9989	-0.0771	-1.6360	0.0000
269	4.6949	-0.1311	-5.5092	-0.0023	-0.1815	0.1815	-0.1327	-5.6342	5.6357	-0.0235	-0.9997	-0.0385	-1.6353	0.0000
270	4.7124	0.0000	-5.5100	0.0000	-0.1815	0.1815	0.0000	-5.6350	5.6350	0.0000	-1.0000	0.0000	-1.6350	0.0000
271	4.7298	0.1311	-5.5092	0.0023	-0.1815	0.1815	0.1327	-5.6342	5.6357	0.0235	-0.9997	0.0385	-1.6353	0.0000
272	4.7473	0.2621	-5.5066	0.0046	-0.1814	0.1814	0.2653	-5.6316	5.6378	0.0471	-0.9989	0.0771	-1.6360	0.0000
273	4.7647	0.3930	-5.5024	0.0070	-0.1812	0.1814	0.3978	-5.6274	5.6414	0.0705	-0.9975	0.1158	-1.6373	0.0000
274	4.7822	0.5239	-5.4966	0.0093	-0.1810	0.1813	0.5303	-5.6214	5.6464	0.0939	-0.9956	0.1546	-1.6391	0.0000

275	4.7997	0.6545	-5.4890	0.0116	-0.1808	0.1812	0.6625	-5.6138	5.6527	0.1172	-0.9931	0.1937	-1.6413	0.0000
276	4.8171	0.7850	-5.4798	0.0139	-0.1805	0.1810	0.7946	-5.6044	5.6605	0.1404	-0.9901	0.2331	-1.6441	0.0000
277	4.8346	0.9152	-5.4689	0.0162	-0.1801	0.1809	0.9265	-5.5934	5.6696	0.1634	-0.9866	0.2728	-1.6472	0.0000
278	4.8520	1.0452	-5.4564	0.0185	-0.1797	0.1807	1.0580	-5.5807	5.6801	0.1863	-0.9825	0.3129	-1.6507	0.0000
279	4.8695	1.1748	-5.4422	0.0208	-0.1793	0.1805	1.1893	-5.5663	5.6920	0.2089	-0.9779	0.3535	-1.6546	0.0000
280	4.8869	1.3041	-5.4263	0.0231	-0.1787	0.1802	1.3201	-5.5503	5.7051	0.2314	-0.9729	0.3946	-1.6588	0.0000
281	4.9044	1.4330	-5.4088	0.0254	-0.1782	0.1800	1.4506	-5.5325	5.7195	0.2536	-0.9673	0.4361	-1.6633	0.0000
282	4.9218	1.5614	-5.3896	0.0277	-0.1775	0.1797	1.5807	-5.5131	5.7352	0.2756	-0.9613	0.4782	-1.6680	0.0000
283	4.9393	1.6894	-5.3688	0.0300	-0.1768	0.1794	1.7103	-5.4920	5.7522	0.2973	-0.9548	0.5210	-1.6729	0.0000
284	4.9567	1.8168	-5.3463	0.0322	-0.1761	0.1790	1.8393	-5.4693	5.7703	0.3188	-0.9478	0.5643	-1.6779	0.0000
285	4.9742	1.9437	-5.3223	0.0345	-0.1753	0.1787	1.9678	-5.4449	5.7896	0.3399	-0.9405	0.6083	-1.6830	0.0000
286	4.9916	2.0700	-5.2966	0.0367	-0.1745	0.1783	2.0958	-5.4189	5.8100	0.3607	-0.9327	0.6529	-1.6882	0.0000
287	5.0091	2.1957	-5.2692	0.0389	-0.1736	0.1779	2.2231	-5.3912	5.8316	0.3812	-0.9245	0.6982	-1.6933	0.0000
288	5.0265	2.3207	-5.2403	0.0411	-0.1726	0.1774	2.3497	-5.3619	5.8542	0.4014	-0.9159	0.7442	-1.6983	0.0000
289	5.0440	2.4450	-5.2098	0.0434	-0.1716	0.1770	2.4756	-5.3310	5.8778	0.4212	-0.9070	0.7909	-1.7031	0.0000
290	5.0615	2.5686	-5.1777	0.0455	-0.1705	0.1765	2.6008	-5.2985	5.9024	0.4406	-0.8977	0.8383	-1.7077	0.0000
291	5.0789	2.6913	-5.1440	0.0477	-0.1694	0.1760	2.7252	-5.2643	5.9279	0.4597	-0.8881	0.8863	-1.7121	0.0000
292	5.0964	2.8133	-5.1088	0.0499	-0.1683	0.1755	2.8488	-5.2286	5.9544	0.4784	-0.8781	0.9350	-1.7162	0.0000
293	5.1138	2.9344	-5.0720	0.0520	-0.1671	0.1750	2.9716	-5.1913	5.9816	0.4968	-0.8679	0.9844	-1.7198	0.0000
294	5.1313	3.0546	-5.0336	0.0542	-0.1658	0.1744	3.0934	-5.1525	6.0097	0.5147	-0.8574	1.0345	-1.7231	0.0000
295	5.1487	3.1739	-4.9938	0.0563	-0.1645	0.1738	3.2143	-5.1120	6.0386	0.5323	-0.8466	1.0851	-1.7258	0.0000
296	5.1662	3.2922	-4.9524	0.0584	-0.1631	0.1732	3.3343	-5.0700	6.0682	0.5495	-0.8355	1.1364	-1.7280	0.0000
297	5.1836	3.4095	-4.9094	0.0605	-0.1617	0.1726	3.4532	-5.0265	6.0984	0.5663	-0.8242	1.1882	-1.7296	0.0000
298	5.2011	3.5257	-4.8650	0.0625	-0.1602	0.1720	3.5712	-4.9815	6.1293	0.5826	-0.8127	1.2406	-1.7306	0.0000
299	5.2185	3.6409	-4.8192	0.0646	-0.1587	0.1714	3.6880	-4.9349	6.1608	0.5986	-0.8010	1.2935	-1.7308	0.0000
300	5.2360	3.7550	-4.7718	0.0666	-0.1572	0.1707	3.8038	-4.8869	6.1928	0.6142	-0.7891	1.3469	-1.7304	0.0000
301	5.2534	3.8679	-4.7230	0.0686	-0.1556	0.1700	3.9184	-4.8374	6.2252	0.6294	-0.7771	1.4006	-1.7291	0.0000
302	5.2709	3.9797	-4.6727	0.0706	-0.1539	0.1693	4.0318	-4.7864	6.2582	0.6442	-0.7648	1.4548	-1.7271	0.0000
303	5.2883	4.0902	-4.6211	0.0725	-0.1522	0.1686	4.1440	-4.7339	6.2915	0.6587	-0.7524	1.5093	-1.7242	0.0000
304	5.3058	4.1995	-4.5680	0.0745	-0.1505	0.1679	4.2550	-4.6800	6.3252	0.6727	-0.7399	1.5641	-1.7204	0.0000
305	5.3233	4.3076	-4.5135	0.0764	-0.1487	0.1671	4.3647	-4.6247	6.3591	0.6864	-0.7273	1.6192	-1.7157	0.0000
306	5.3407	4.4143	-4.4577	0.0783	-0.1468	0.1664	4.4731	-4.5680	6.3933	0.6996	-0.7145	1.6745	-1.7100	0.0000
307	5.3582	4.5196	-4.4005	0.0801	-0.1449	0.1656	4.5801	-4.5099	6.4278	0.7125	-0.7016	1.7299	-1.7034	0.0000
308	5.3756	4.6236	-4.3419	0.0820	-0.1430	0.1648	4.6858	-4.4504	6.4624	0.7251	-0.6887	1.7854	-1.6957	0.0000
309	5.3931	4.7262	-4.2821	0.0838	-0.1410	0.1641	4.7900	-4.3895	6.4971	0.7373	-0.6756	1.8410	-1.6871	0.0000
310	5.4105	4.8273	-4.2209	0.0856	-0.1390	0.1633	4.8929	-4.3274	6.5319	0.7491	-0.6625	1.8966	-1.6774	0.0000
311	5.4280	4.9270	-4.1584	0.0874	-0.1370	0.1625	4.9942	-4.2638	6.5668	0.7605	-0.6493	1.9521	-1.6666	0.0000
312	5.4454	5.0252	-4.0947	0.0891	-0.1349	0.1616	5.0941	-4.1990	6.6016	0.7716	-0.6361	2.0075	-1.6548	0.0000
313	5.4629	5.1218	-4.0298	0.0908	-0.1327	0.1608	5.1924	-4.1329	6.6364	0.7824	-0.6228	2.0628	-1.6419	0.0000
314	5.4803	5.2169	-3.9636	0.0925	-0.1306	0.1600	5.2891	-4.0656	6.6711	0.7928	-0.6094	2.1178	-1.6279	0.0000
315	5.4978	5.3104	-3.8962	0.0942	-0.1283	0.1592	5.3843	-3.9969	6.7057	0.8029	-0.5961	2.1725	-1.6127	0.0000
316	5.5152	5.4022	-3.8276	0.0958	-0.1261	0.1583	5.4779	-3.9271	6.7401	0.8127	-0.5826	2.2270	-1.5965	0.0000
317	5.5327	5.4925	-3.7578	0.0974	-0.1238	0.1575	5.5698	-3.8560	6.7743	0.8222	-0.5692	2.2810	-1.5792	0.0000
318	5.5501	5.5810	-3.6869	0.0990	-0.1214	0.1567	5.6600	-3.7838	6.8083	0.8313	-0.5558	2.3346	-1.5607	0.0000
319	5.5676	5.6679	-3.6149	0.1005	-0.1191	0.1558	5.7485	-3.7104	6.8420	0.8402	-0.5423	2.3878	-1.5412	0.0000
320	5.5851	5.7530	-3.5418	0.1020	-0.1167	0.1550	5.8353	-3.6359	6.8753	0.8487	-0.5288	2.4404	-1.5205	0.0000
321	5.6025	5.8364	-3.4676	0.1035	-0.1142	0.1541	5.9203	-3.5602	6.9083	0.8570	-0.5153	2.4924	-1.4988	0.0000
322	5.6200	5.9180	-3.3923	0.1049	-0.1117	0.1533	6.0035	-3.4834	6.9409	0.8649	-0.5019	2.5437	-1.4760	0.0000
323	5.6374	5.9978	-3.3160	0.1063	-0.1092	0.1524	6.0850	-3.4056	6.9731	0.8726	-0.4884	2.5944	-1.4520	0.0000
324	5.6549	6.0757	-3.2387	0.1077	-0.1067	0.1516	6.1645	-3.3267	7.0049	0.8800	-0.4749	2.6444	-1.4270	0.0000
325	5.6723	6.1518	-3.1604	0.1091	-0.1041	0.1508	6.2423	-3.2467	7.0361	0.8872	-0.4614	2.6936	-1.4010	0.0000
326	5.6898	6.2261	-3.0812	0.1104	-0.1015	0.1500	6.3181	-3.1658	7.0668	0.8940	-0.4480	2.7419	-1.3739	0.0000
327	5.7072	6.2984	-3.0010	0.1117	-0.0988	0.1491	6.3920	-3.0838	7.0970	0.9007	-0.4345	2.7894	-1.3457	0.0000
328	5.7247	6.3688	-2.9199	0.1129	-0.0962	0.1483	6.4640	-3.0009	7.1266	0.9070	-0.4211	2.8359	-1.3166	0.0000
329	5.7421	6.4373	-2.8379	0.1141	-0.0935	0.1475	6.5340	-2.9171	7.1556	0.9131	-0.4077	2.8815	-1.2864	0.0000
330	5.7596	6.5039	-2.7550	0.1153	-0.0907	0.1467	6.6021	-2.8323	7.1840	0.9190	-0.3943	2.9261	-1.2553	0.0000
331	5.7770	6.5684	-2.6713	0.1165	-0.0880	0.1460	6.6681	-2.7467	7.2117	0.9246	-0.3809	2.9696	-1.2232	0.0000
332	5.7945	6.6309	-2.5868	0.1176	-0.0852	0.1452	6.7322	-2.6601	7.2387	0.9300	-0.3675	3.0120	-1.1902	0.0000
333	5.8119	6.6915	-2.5015	0.1186	-0.0824	0.1444	6.7941	-2.5728	7.2649	0.9352	-0.3541	3.0534	-1.1562	0.0000
334	5.8294	6.7499	-2.4154	0.1197	-0.0796	0.1437	6.8540	-2.4846	7.2905	0.9401	-0.3408	3.0935	-1.1214	0.0000
335	5.8469	6.8064	-2.3286	0.1207	-0.0767	0.1430	6.9119	-2.3957	7.3153	0.9449	-0.3275	3.1324	-1.0857	0.0000
336	5.8643	6.8607	-2.2411	0.1216	-0.0738	0.1423	6.9676	-2.3060	7.3393	0.9494	-0.3142	3.1702	-1.0492	0.0000
337	5.8818	6.9130	-2.1529	0.1226	-0.0709	0.1416	7.0212	-2.2155	7.3624	0.9536	-0.3009	3.2066	-1.0118	0.0000
338	5.8992	6.9632	-2.0641	0.1235	-0.0680	0.1409	7.0726	-2.1244	7.3848	0.9577	-0.2877	3.2417	-0.9737	0.0000
339	5.9167	7.0112	-1.9746	0.1243	-0.0650	0.1403	7.1219	-2.0326	7.4063	0.9616	-0.2744	3.2755	-0.9348	0.0000
340	5.9341	7.0571	-1.8845	0.1251	-0.0621	0.1397	7.1691	-1.9401	7.4269	0.9653	-0.2612	3.3080	-0.8952	0.0000
341	5.9516	7.1008	-1.7939	0.1259	-0.0591	0.1391	7.2140	-1.8470	7.4467	0.9688	-0.2480	3.3390	-0.8549	0.0000
342	5.9690	7.1424	-1.7027	0.1266	-0.0561	0.1385	7.2567	-1.7533	7.4655	0.9720	-0.2349	3.3686	-0.8139	0.0000
343	5.9865	7.1818	-1.6110	0.1273	-0.0531	0.1380	7.2972	-1.6590	7.4835	0.9751	-0.2217	3.3968	-0.7723	0.0000
344	6.0039	7.2191	-1.5188	0.1280	-0.0500	0.1374	7.3355	-1.5643	7.5004	0.9780	-0.2086	3.4235	-0.7300	0.0000
345	6.0214	7.2541	-1.4261	0.1286	-0.0470	0.1369	7.3715	-1.4690	7.5165	0.9807	-0.1954	3.4487	-0.6872	0.0000
346	6.0388	7.2869	-1.3330	0.1292	-0.0439	0.1365	7.4053	-1.3732	7.5315	0.9832	-0.1823	3.4723	-0.6439	0.0000
347	6.0563	7.3175	-1.2395	0.1297	-0.0408	0.1360	7.4368	-1.2770	7.5456	0.9856	-0.1692	3.4945	-0.6000	0.0000
348	6.0737	7.3459	-1.1456	0.1302	-0.0377	0.1356	7.4660	-1.1804	7.5587	0.9877	-0.1562	3.5150	-0.5557	0.0000
349	6.0912	7.3720	-1.0514	0.1307	-0.0346	0.1352	7.4929	-1.0834	7.5708	0.9897	-0.1431	3.5340	-0.5110	0.0000
350	6.1087	7.3959	-0.9568	0.1311	-0.0315	0.1349	7.5174	-0.9860	7.5818	0.9915	-0.1300	3.5514	-0.4658	0.0000
351	6.1261	7.4175	-0.8620	0.1315	-0.0284	0.1345	7.5397	-0.8883	7.5919	0.9931	-0.1170	3.5672	-0.4203	0.0000
352	6.1436	7.4369	-0.7668	0.1319	-0.0253	0.1343	7.5597	-0.7904	7.6009	0.9946	-0.1040	3.5814	-0.3744	0.0000
353	6.1610	7.4540	-0.6715	0.1322	-0.0221	0.1340	7.5773	-0.6921	7.6089	0.9959	-0.0910	3.5939	-0.3283	0.0000
354	6.1785	7.4689	-0.5760	0.1324	-0.0190	0.1338	7.5926	-0.5937	7.6158	0.9970	-0.0780	3.6048	-0.2819	0.0000
355	6.1959	7.4814	-0.4802	0.1326	-0.0158	0.1336	7.6055	-0.4950	7.6216	0.9979	-0.0650	3.6140	-0.2352	0.0000
356	6.2134	7.4917	-0.3844	0.1328	-0.0127	0.1334	7.6161	-0.3962	7.6264	0.9986	-0.0520	3.6215	-0.1884	0.0000
357	6.2308	7.4997	-0.2884	0.1330	-0.0095	0.1333	7.6244	-0.2973	7.6302	0.9992	-0.0390	3.6274	-0.1414	0.0000
358	6.2483	7.5054	-0.1923	0.1331	-0.0063	0.1332	7.6303	-0.1982	7.6329	0.9997	-0.0260	3.6316	-0.0944	0.0000
359	6.2657	7.5089	-0.0962	0.1331	-0.0032	0.1332	7.6338	-0.0991	7.6345	0.9999	-0.0130	3.6342	-0.0472	0.0000
360	6.2832	7.5100	0.0000	0.1332	0.0000	0.1332	7.6350	0.0000	7.6350	1.0000	0.0000	3.6350	0.0000	0.0000