



Rig Mass Flow Rate Calculations

Please Enter Parameters in highlighted boxes below

Engine Data File		
Ambient Conditions		
Air Temperature	10	[C]
Atmospheric Pressure	976	[mBar]
Air Humidity	78	[%]
Viper Engine Parameters		
Engine Air Intake Mass Flow	18.4	[Kg/s]
Butane Flow Rate	1785	[Ltr/h]
Engine Speed	12180	[RPM]
ETC	650	[C]
Gas Delivery System Data File		
Gas Delivery System		
Mixed Gas (Fuel) Mass Flow rate	0.045	[Kg/s]
Oxygen Mass Flow rate	0.158	[Kg/s]

Please do not change anything in this box

Test Date and Time = 03.09.2014 16:22:07.3

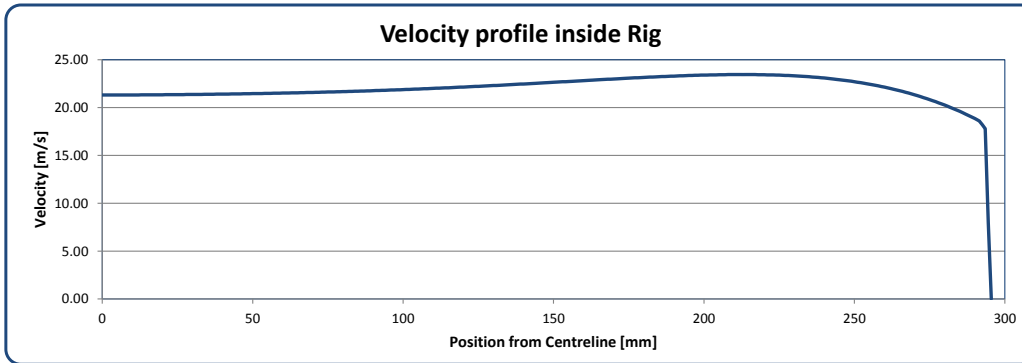
Calculated Parameters		
Air density	1.197011	[Kg/m3]
Liquid Butane density	584	[Kg/m3]
Butane mass Flow rate	0.289567	[Kg/s]
Air Fuel Ratio	75.6467	[]
Calculated Exhaust gas properties (Reaction Engines)		
Exhaust products density	0.389	[Kg/m3]
Pitot Traverse Results		
Rig Gas flow rate - Integrated	2.344385	[Kg/s]
Total Rig Mass flow	2.547385	[Kg/s]
Rig Gas Temperature as read from TC 8?		
Gas Temperature	506	[C]

Bruce Ewan to fill in

Note

Manual for viper 201 gives figures for fuel flow rate to be as follows at maximum power

Fuel Flow	2035	lb/hr	to	2920	lb/hr
	925	Kg/hr		1327.273	Kg/hr
	1156.25	ltr/hr		1659.091	ltr/hr



Data Acquisition Parameters

Sampling Rate	1000	[Hz]
No of samples recorded	100	Samples
Averaged samples sampling rate	10	[Hz]
Pitot Traverse speed	7	[mm/s]
Distance Travelled every 0.1sec	0.7	[mm]

Averaged Pitot dp

0.931981974

Average Vel

21.8536624 [m/s]

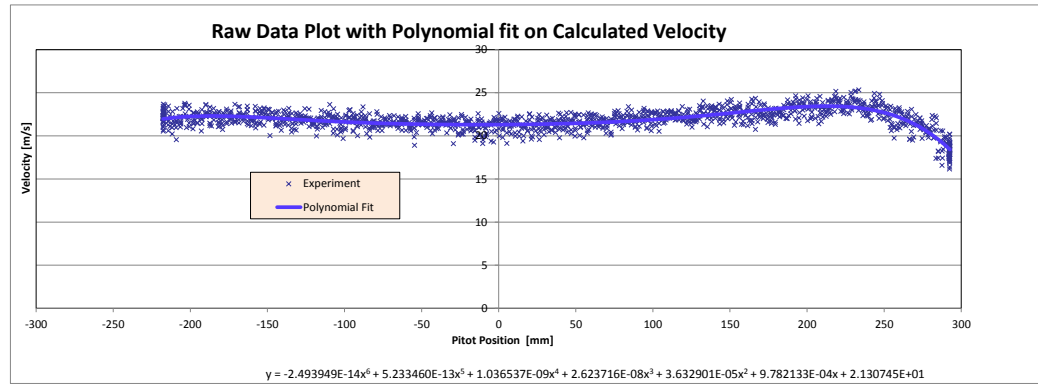
Raw Data from CSV File

Date and time [dd:mm:yyyy hh:mm:ss.ms]	Pitot Position from rig centre [mm]	TC11 - Pitot [deg C]	Pitot dP [mBar]
03.09.2014 16:22:07.3	-217.51	507.5	0.9116
03.09.2014 16:22:07.4	-217.46	507.5	0.978
03.09.2014 16:22:07.5	-217.57	507.4	1.0669
03.09.2014 16:22:07.6	-217.5	507.4	1.0383
03.09.2014 16:22:07.7	-217.43	507.6	0.9051
03.09.2014 16:22:07.8	-217.51	507.7	0.9064
03.09.2014 16:22:07.9	-217.58	507.6	0.8599
03.09.2014 16:22:08.0	-217.45	507.7	0.9572
03.09.2014 16:22:08.1	-217.44	507.8	0.9443
03.09.2014 16:22:08.2	-217.61	507.8	0.9465
03.09.2014 16:22:08.3	-217.57	507.8	0.9574
03.09.2014 16:22:08.4	-217.44	507.9	1.0335
03.09.2014 16:22:08.5	-217.45	507.9	0.9945
03.09.2014 16:22:08.6	-217.55	507.9	0.8609
03.09.2014 16:22:08.7	-217.31	507.8	0.8817
03.09.2014 16:22:08.8	-217.16	508	0.9432
03.09.2014 16:22:08.9	-217.15	508	0.9116
03.09.2014 16:22:09.0	-216.59	507.8	1.0828
03.09.2014 16:22:09.1	-214.05	507.8	1.0124
03.09.2014 16:22:09.2	-214.3	508	0.8799
03.09.2014 16:22:09.3	-214.18	508	0.8253
03.09.2014 16:22:09.4	-213.56	507.9	0.9676
03.09.2014 16:22:09.5	-211.49	507.8	1.0128
03.09.2014 16:22:09.6	-211.7	508	0.8546
03.09.2014 16:22:09.7	-211.7	508	0.8907
03.09.2014 16:22:09.8	-209.89	507.8	0.8808
03.09.2014 16:22:09.9	-209.12	507.8	0.9221
03.09.2014 16:22:10.0	-209.07	507.9	0.7436
03.09.2014 16:22:10.1	-209.2	507.9	0.8544
03.09.2014 16:22:10.2	-206.81	507.8	0.9458
03.09.2014 16:22:10.3	-206.14	507.8	0.8899
03.09.2014 16:22:10.4	-206.15	507.8	0.9134
03.09.2014 16:22:10.5	-204.79	507.7	1.0444
03.09.2014 16:22:10.6	-203.26	507.6	1.0803
03.09.2014 16:22:10.7	-203.31	507.6	1.0859
03.09.2014 16:22:10.8	-203.31	507.7	0.9885
03.09.2014 16:22:10.9	-201.77	507.6	0.9346
03.09.2014 16:22:11.0	-200.75	507.6	0.9664
03.09.2014 16:22:11.1	-200.79	507.7	1.0382
03.09.2014 16:22:11.2	-200.72	507.8	1.0798
03.09.2014 16:22:11.3	-197.8	507.6	0.9968
03.09.2014 16:22:11.4	-197.98	507.6	0.9963
03.09.2014 16:22:11.5	-197.88	507.8	1.0027
03.09.2014 16:22:11.6	-197.61	507.8	0.9336
03.09.2014 16:22:11.7	-195.23	507.7	0.9851
03.09.2014 16:22:11.8	-195.36	507.6	0.9024
03.09.2014 16:22:11.9	-195.32	507.8	0.9498
03.09.2014 16:22:12.0	-192.82	507.8	0.8223
03.09.2014 16:22:12.1	-192.48	507.7	1.0324
03.09.2014 16:22:12.2	-192.45	507.7	0.8923
03.09.2014 16:22:12.3	-192.37	507.8	0.9371
03.09.2014 16:22:12.4	-190.04	507.7	0.9891
03.09.2014 16:22:12.5	-189.96	507.6	1.0799
03.09.2014 16:22:12.6	-189.84	507.7	1.0865
03.09.2014 16:22:12.7	-189.07	507.7	1.0039
03.09.2014 16:22:12.8	-187.21	507.6	1.0163
03.09.2014 16:22:12.9	-187.45	507.4	0.9649
03.09.2014 16:22:13.0	-187.31	507.5	0.8965
03.09.2014 16:22:13.1	-186.18	507.5	0.87
03.09.2014 16:22:13.2	-184.28	507.2	0.9626

506.17841

Calculated Velocity [m/s]
21.6492251
22.4238213
23.4208178
23.1047686
21.571904
21.5873904
21.0263637
22.1840861
22.0340937
22.0597459
22.1864036
23.0513008
22.6121882
21.0385862
21.2912234
22.0212564
21.6492251
23.5946924
22.814779
21.2694792
20.5989992
22.3042758
22.8192856
20.9614654
21.3996132
21.2803541
21.7735483
19.5528419
20.9590125
22.0515871
21.3900008
21.6705883
23.1725394
23.5674387
23.6284435
22.5438732
21.9206327
22.2904408
23.103656
23.5619841
22.6383209
22.6326424
22.7052195
21.9089023
22.5050694
21.5397045
22.0981684
20.561526
23.0990303
21.4188251
21.9499313
22.5507141
23.5630751
23.6349704
22.7188019
22.8586806
22.2731351
21.4691744
21.1494863
22.2465733

Raw Data Plot with Polynomial fit on Calculated Velocity



03.09.2014 16:22:13.3	-184.46	507.2	0.9635	22.2569708
03.09.2014 16:22:13.4	-184.02	507.2	0.9927	22.5917154
03.09.2014 16:22:13.5	-181.32	507.2	1.0119	22.8091444
03.09.2014 16:22:13.6	-181.56	507	0.9377	21.9569572
03.09.2014 16:22:13.7	-181.55	506.9	1.0121	22.8113984
03.09.2014 16:22:13.8	-181	507.1	0.8679	21.1239456
03.09.2014 16:22:13.9	-178.78	507.2	0.9982	22.654213
03.09.2014 16:22:14.0	-179.02	507	0.8358	20.7296219
03.09.2014 16:22:14.1	-178.97	506.9	0.8743	21.2016879
03.09.2014 16:22:14.2	-177.26	507.1	0.9667	22.2939004
03.09.2014 16:22:14.3	-176.38	507.1	0.8926	21.4224254
03.09.2014 16:22:14.4	-176.51	506.9	0.9593	22.2084076
03.09.2014 16:22:14.5	-175.4	506.9	0.9719	22.3537808
03.09.2014 16:22:14.6	-173.26	507	0.8963	21.4667795
03.09.2014 16:22:14.7	-173.62	506.9	0.9691	22.3215575
03.09.2014 16:22:14.8	-173.6	506.8	1.0197	22.8968852
03.09.2014 16:22:14.9	-171.39	506.8	0.9565	22.175973
03.09.2014 16:22:15.0	-170.88	506.8	0.9051	21.571904
03.09.2014 16:22:15.1	-171.06	506.6	0.9081	21.607625
03.09.2014 16:22:15.2	-171.05	506.5	1.0893	23.6654054
03.09.2014 16:22:15.3	-168.62	506.6	0.9311	21.8795487
03.09.2014 16:22:15.4	-168.46	506.5	0.9738	22.3756202
03.09.2014 16:22:15.5	-168.48	506.4	0.8996	21.5062614
03.09.2014 16:22:15.6	-166.61	506.3	0.9533	22.1388467
03.09.2014 16:22:15.7	-165.45	506.5	0.97	22.33192
03.09.2014 16:22:15.8	-165.53	506.5	0.9147	21.6860042
03.09.2014 16:22:15.9	-165.44	506.2	0.9455	22.0480895
03.09.2014 16:22:16.0	-162.9	506.2	0.9189	21.7357346
03.09.2014 16:22:16.1	-163.05	506.5	0.8909	21.4020156
03.09.2014 16:22:16.2	-162.99	506.5	1.0341	23.057991
03.09.2014 16:22:16.3	-161.02	506.3	0.9247	21.8042235
03.09.2014 16:22:16.4	-160.44	506.4	0.8732	21.1883462
03.09.2014 16:22:16.5	-160.4	506.6	0.9432	22.0212564
03.09.2014 16:22:16.6	-160.48	506.6	0.949	22.08886
03.09.2014 16:22:16.7	-158.26	506.5	0.9247	21.8042235
03.09.2014 16:22:16.8	-157.88	506.5	1.0196	22.8957625
03.09.2014 16:22:16.9	-157.84	506.5	1.0672	23.4241104
03.09.2014 16:22:17.0	-157.33	506.4	1.0167	22.8631786
03.09.2014 16:22:17.1	-154.8	506.3	1.0457	23.1869567
03.09.2014 16:22:17.2	-154.95	506.3	0.9759	22.3997337
03.09.2014 16:22:17.3	-154.97	506.3	1.0086	22.7719216
03.09.2014 16:22:17.4	-154.29	506.1	0.9096	21.6254634
03.09.2014 16:22:17.5	-152.23	506.1	0.8775	21.2404523
03.09.2014 16:22:17.6	-152.43	506.2	0.9999	22.6734956
03.09.2014 16:22:17.7	-152.26	506.2	0.9663	22.2892875
03.09.2014 16:22:17.8	-149.4	506.1	0.9278	21.8407416
03.09.2014 16:22:17.9	-149.57	506	0.9769	22.4112073
03.09.2014 16:22:18.0	-149.56	506.2	0.9462	22.0562497
03.09.2014 16:22:18.1	-148.3	506.2	0.7814	20.0436542
03.09.2014 16:22:18.2	-146.84	506	1.0061	22.7436819
03.09.2014 16:22:18.3	-147	505.9	0.9378	21.9581279
03.09.2014 16:22:18.4	-146.54	506.1	0.9603	22.2199799
03.09.2014 16:22:18.5	-144.26	506	0.8741	21.1992627
03.09.2014 16:22:18.6	-144.52	505.8	0.8697	21.1458395
03.09.2014 16:22:18.7	-144.46	505.8	0.8954	21.4559991
03.09.2014 16:22:18.8	-142.75	505.9	1.0166	22.8620542
03.09.2014 16:22:18.9	-141.88	505.7	0.937	21.9487601
03.09.2014 16:22:19.0	-141.98	505.6	0.8742	21.2004753
03.09.2014 16:22:19.1	-140.99	505.6	0.8296	20.6525922
03.09.2014 16:22:19.2	-139.08	505.7	0.9833	22.4844991
03.09.2014 16:22:19.3	-139.5	505.6	0.9376	21.9557864
03.09.2014 16:22:19.4	-139.44	505.5	1.0279	22.9887644
03.09.2014 16:22:19.5	-137.24	505.6	0.9299	21.865445
03.09.2014 16:22:19.6	-136.79	505.6	0.9687	22.3169503
03.09.2014 16:22:19.7	-136.85	505.5	0.9491	22.0900238
03.09.2014 16:22:19.8	-136.39	505.4	0.8789	21.2573895
03.09.2014 16:22:19.9	-134.09	505.5	0.9935	22.6008167
03.09.2014 16:22:20.0	-134.32	505.5	0.846	20.8557292
03.09.2014 16:22:20.1	-134.27	505.3	0.8131	20.4461799
03.09.2014 16:22:20.2	-132.53	505.2	0.8383	20.7606014
03.09.2014 16:22:20.3	-131.31	505.3	0.8303	20.6613034
03.09.2014 16:22:20.4	-131.37	505.3	0.9169	21.7120677

03.09.2014 16:22:20.5	-131.34	505.1	0.9997	22.6712279
03.09.2014 16:22:20.6	-129.62	505.1	0.9446	22.0375935
03.09.2014 16:22:20.7	-128.75	505.2	0.9936	22.6019541
03.09.2014 16:22:20.8	-128.8	505.2	0.9475	22.0713962
03.09.2014 16:22:20.9	-128.68	505.1	0.9652	22.2765973
03.09.2014 16:22:21.0	-126.13	505	0.9578	22.1910378
03.09.2014 16:22:21.1	-126.23	505.1	0.9423	22.0107476
03.09.2014 16:22:21.2	-126.33	505.1	0.906	21.5826265
03.09.2014 16:22:21.3	-124.94	505	0.9435	22.0247582
03.09.2014 16:22:21.4	-123.16	505.1	0.9214	21.7652821
03.09.2014 16:22:21.5	-123.33	505.1	0.9316	21.8854226
03.09.2014 16:22:21.6	-122.94	505.1	0.8648	21.0861862
03.09.2014 16:22:21.7	-120.67	505.1	0.8731	21.1871329
03.09.2014 16:22:21.8	-120.83	505.2	0.8897	21.387597
03.09.2014 16:22:21.9	-120.86	505.2	0.9046	21.5659448
03.09.2014 16:22:22.0	-120.09	505.1	0.8905	21.3972105
03.09.2014 16:22:22.1	-118.05	505	0.868	21.1251626
03.09.2014 16:22:22.2	-118.31	505.1	0.9139	21.6765188
03.09.2014 16:22:22.3	-118.16	505.2	0.7772	19.9897146
03.09.2014 16:22:22.4	-115.17	505	0.903	21.5468641
03.09.2014 16:22:22.5	-115.46	505	0.9408	21.9932217
03.09.2014 16:22:22.6	-115.42	505.1	0.9016	21.5301546
03.09.2014 16:22:22.7	-114.22	505.1	0.8567	20.9872038
03.09.2014 16:22:22.8	-112.68	504.9	0.8804	21.2755215
03.09.2014 16:22:22.9	-112.85	504.7	0.9536	22.14233
03.09.2014 16:22:23.0	-112.77	504.8	1.0109	22.7978712
03.09.2014 16:22:23.1	-111.44	504.6	0.8855	21.3370552
03.09.2014 16:22:23.2	-110.26	504.4	1.0061	22.7436819
03.09.2014 16:22:23.3	-110.26	504.3	0.922	21.7723676
03.09.2014 16:22:23.4	-109.53	504.3	0.8928	21.4248252
03.09.2014 16:22:23.5	-107.19	504.2	0.8399	20.7804041
03.09.2014 16:22:23.6	-107.42	504.1	0.9685	22.3146464
03.09.2014 16:22:23.7	-107.29	504.2	0.8028	20.3162655
03.09.2014 16:22:23.8	-105.56	504.1	0.9622	22.2419507
03.09.2014 16:22:23.9	-104.83	504	0.9249	21.8065814
03.09.2014 16:22:24.0	-104.83	503.9	0.8396	20.7766925
03.09.2014 16:22:24.1	-104.61	503.9	0.7863	20.1064008
03.09.2014 16:22:24.2	-102.19	504	0.8503	20.9086641
03.09.2014 16:22:24.3	-102.3	503.8	0.8127	20.4411501
03.09.2014 16:22:24.4	-102.3	503.8	0.886	21.3430783
03.09.2014 16:22:24.5	-100.88	503.9	0.755	19.7021523
03.09.2014 16:22:24.6	-99.22	503.8	0.851	20.9172688
03.09.2014 16:22:24.7	-99.37	503.5	0.927	21.8313235
03.09.2014 16:22:24.8	-99.43	503.4	0.8357	20.7283817
03.09.2014 16:22:24.9	-96.93	503.5	0.9508	22.1097985
03.09.2014 16:22:25.0	-96.84	503.4	0.9518	22.1214223
03.09.2014 16:22:25.1	-96.89	503.2	0.9059	21.5814354
03.09.2014 16:22:25.2	-95.12	503.1	0.9089	21.6171407
03.09.2014 16:22:25.3	-94.13	503.1	0.9628	22.2488843
03.09.2014 16:22:25.4	-94.32	503.1	0.8263	20.6114751
03.09.2014 16:22:25.5	-94.38	502.9	0.8193	20.5239843
03.09.2014 16:22:25.6	-92.31	503	0.902	21.5349301
03.09.2014 16:22:25.7	-91.65	503	0.9767	22.408913
03.09.2014 16:22:25.8	-91.83	503	0.8719	21.172568
03.09.2014 16:22:25.9	-91.46	502.9	0.7799	20.0244067
03.09.2014 16:22:26.0	-89.01	503.1	0.9646	22.2696723
03.09.2014 16:22:26.1	-89.25	503.1	0.9144	21.6824476
03.09.2014 16:22:26.2	-89.22	503	0.8794	21.2634352
03.09.2014 16:22:26.3	-86.5	502.9	0.9716	22.3503305
03.09.2014 16:22:26.4	-86.32	503	0.9178	21.722721
03.09.2014 16:22:26.5	-86.3	503.1	0.9155	21.6954854
03.09.2014 16:22:26.6	-85.61	502.9	0.7986	20.2630516
03.09.2014 16:22:26.7	-83.55	502.9	0.7667	19.8542245
03.09.2014 16:22:26.8	-83.84	503	0.8495	20.8988259
03.09.2014 16:22:26.9	-83.68	503	0.8291	20.6463676
03.09.2014 16:22:27.0	-81.89	502.8	0.8752	21.2125975
03.09.2014 16:22:27.1	-81.19	502.9	0.8536	20.9491979
03.09.2014 16:22:27.2	-81.18	502.9	0.8742	21.2004753
03.09.2014 16:22:27.3	-80.93	502.9	0.8984	21.4919127
03.09.2014 16:22:27.4	-78.16	502.7	0.8982	21.4895204
03.09.2014 16:22:27.5	-78.33	502.7	0.8273	20.6239435
03.09.2014 16:22:27.6	-78.2	502.9	0.8655	21.0947185

03.09.2014 16:22:27.7	-77.05	502.7	0.8952	21.4536027
03.09.2014 16:22:27.8	-75.68	502.6	0.8884	21.3719659
03.09.2014 16:22:27.9	-75.68	502.6	0.8269	20.618957
03.09.2014 16:22:28.0	-75.71	502.7	0.8751	21.2113856
03.09.2014 16:22:28.1	-73.38	502.6	0.9308	21.8760237
03.09.2014 16:22:28.2	-73.27	502.4	0.9004	21.5158219
03.09.2014 16:22:28.3	-73.17	502.5	0.8994	21.5038706
03.09.2014 16:22:28.4	-72.36	502.4	0.8839	21.3177696
03.09.2014 16:22:28.5	-70.07	502.2	0.8933	21.4308237
03.09.2014 16:22:28.6	-70.29	502.2	0.8966	21.4703718
03.09.2014 16:22:28.7	-70.33	502.2	0.8711	21.1628525
03.09.2014 16:22:28.8	-68.34	502.2	0.9007	21.519406
03.09.2014 16:22:28.9	-67.71	502.1	0.8855	21.3370552
03.09.2014 16:22:29.0	-67.77	502	0.9716	22.3503305
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03.09.2014 16:22:53.4	114.4	502.7	0.9929	22.5939911
03.09.2014 16:22:53.5	114.38	502.8	0.9647	22.2708266
03.09.2014 16:22:53.6	114.46	502.9	0.9276	21.8383875
03.09.2014 16:22:53.7	116.91	502.9	1.0197	22.8968852
03.09.2014 16:22:53.8	116.77	502.8	1.0212	22.9137199
03.09.2014 16:22:53.9	116.94	503	0.9313	21.8818985
03.09.2014 16:22:54.0	117.95	503	0.9484	22.0818762
03.09.2014 16:22:54.1	119.53	502.9	0.9314	21.8830732
03.09.2014 16:22:54.2	119.42	502.8	0.9281	21.8442724
03.09.2014 16:22:54.3	119.45	503	0.9272	21.8336784
03.09.2014 16:22:54.4	121.97	502.9	0.8878	21.3647477
03.09.2014 16:22:54.5	122.31	502.8	0.9543	22.1504554
03.09.2014 16:22:54.6	122.32	502.7	0.9138	21.6753328
03.09.2014 16:22:54.7	122.87	502.8	0.9231	21.7853516
03.09.2014 16:22:54.8	125.1	502.9	0.9238	21.7936101
03.09.2014 16:22:54.9	124.87	502.7	0.9702	22.3342222
03.09.2014 16:22:55.0	124.88	502.7	0.8982	21.4895204
03.09.2014 16:22:55.1	126.62	502.9	0.914	21.6777047
03.09.2014 16:22:55.2	127.49	503	0.9304	21.8713227
03.09.2014 16:22:55.3	127.38	502.8	0.9386	21.9674918
03.09.2014 16:22:55.4	128.49	502.8	0.9846	22.4993573
03.09.2014 16:22:55.5	130.58	503	0.9687	22.3169503
03.09.2014 16:22:55.6	130.27	503	0.9366	21.9440747
03.09.2014 16:22:55.7	130.23	502.8	0.9701	22.3330711
03.09.2014 16:22:55.8	131.44	502.8	1.0561	23.3019743
03.09.2014 16:22:55.9	132.69	502.9	1.1233	24.0318983
03.09.2014 16:22:56.0	132.42	502.8	1.0565	23.3063867
03.09.2014 16:22:56.1	133	502.8	0.9881	22.5393116
03.09.2014 16:22:56.2	135.71	502.8	0.9925	22.5894395
03.09.2014 16:22:56.3	135.35	502.8	0.9475	22.0713962
03.09.2014 16:22:56.4	135.34	502.6	0.8632	21.066671

03.09.2014 16:22:56.5	137.08	502.5	0.9672	22.2996651
03.09.2014 16:22:56.6	138.12	502.6	0.9123	21.6575355
03.09.2014 16:22:56.7	137.9	502.7	0.9447	22.03876
03.09.2014 16:22:56.8	138.08	502.5	1.0324	23.0390303
03.09.2014 16:22:56.9	140.64	502.5	0.9445	22.036427
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03.09.2014 16:22:57.1	140.48	502.6	0.973	22.3664273
03.09.2014 16:22:57.2	141.76	502.3	1.0043	22.7233275
03.09.2014 16:22:57.3	143.6	502.3	0.9447	22.03876
03.09.2014 16:22:57.4	143.42	502.5	0.8909	21.4020156
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03.09.2014 16:22:58.6	152.96	502.7	0.8769	21.2331893
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03.09.2014 16:22:59.5	158.61	502.5	0.9157	21.6978551
03.09.2014 16:22:59.6	158.67	502.5	0.9875	22.5324673
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03.09.2014 16:23:00.3	164.31	502.7	0.9207	21.7570129
03.09.2014 16:23:00.4	166.91	502.8	0.9999	22.6734956
03.09.2014 16:23:00.5	166.66	502.9	0.9532	22.1376855
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03.09.2014 16:23:00.7	168	502.7	0.9097	21.6266521
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03.09.2014 16:23:01.7	175.26	503.3	1.0223	22.9260575
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03.09.2014 16:23:02.6	181.88	503.5	1.0051	22.7323762
03.09.2014 16:23:02.7	182.02	503.6	1.0264	22.9719847
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03.09.2014 16:23:03.3	187.02	503.8	0.9415	22.0014022
03.09.2014 16:23:03.4	188.03	503.7	0.972	22.3549308
03.09.2014 16:23:03.5	189.73	503.9	1.093	23.7055632
03.09.2014 16:23:03.6	189.54	504	1.0253	22.9596718

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03.09.2014 16:23:03.8	191.8	503.7	1.0991	23.7716212
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03.09.2014 16:23:04.4	194.52	503.9	1.0912	23.6860355
03.09.2014 16:23:04.5	197.21	503.9	1.0285	22.9954729
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03.09.2014 16:23:05.8	205.43	504.1	0.9447	22.03876
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03.09.2014 16:23:06.1	207.35	503.8	1.0594	23.3383518
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03.09.2014 16:23:06.3	209.97	503.9	1.0607	23.3526667
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03.09.2014 16:23:06.5	210.21	503.9	0.9556	22.1655375
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03.09.2014 16:23:06.7	212.34	503.9	0.996	22.6292347
03.09.2014 16:23:06.8	212.43	503.8	0.9651	22.2754433
03.09.2014 16:23:06.9	214	503.9	1.0519	23.2555934
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03.09.2014 16:23:07.7	220.69	504.4	1.1357	24.1641771
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03.09.2014 16:23:07.9	220.64	504.4	1.1208	24.0051408
03.09.2014 16:23:08.0	223.52	504.5	1.0634	23.3823698
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03.09.2014 16:23:10.7	241.93	505	0.9322	21.8924692
03.09.2014 16:23:10.8	244.07	505.2	1.074	23.4986189

03.09.2014 16:23:10.9	243.57	505.1	1.1573	24.3928853
03.09.2014 16:23:11.0	243.78	505	1.2079	24.920439
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03.09.2014 16:23:12.5	256.51	504.9	0.8512	20.9197266
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03.09.2014 16:23:14.2	268.47	505	0.7408	19.5159944
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03.09.2014 16:23:17.9	292.5	504.8	0.5539	16.8754701
03.09.2014 16:23:18.0	292.47	505	0.5076	16.1547784

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03.09.2014 16:24:31.4	-217.47	513.7	0.9489	22.0876962
03.09.2014 16:24:31.5	-217.53	513.6	0.9719	22.3537808
03.09.2014 16:24:31.6	-217.49	513.6	0.9637	22.2592807
03.09.2014 16:24:31.7	-217.51	513.8	0.9466	22.0609112
03.09.2014 16:24:31.8	-217.49	513.9	1.016	22.8553066
03.09.2014 16:24:31.9	-217.48	513.9	0.9396	21.9791909
03.09.2014 16:24:32.0	-217.51	513.9	0.919	21.7369173
03.09.2014 16:24:32.1	-217.5	514.2	0.821	20.5452663
03.09.2014 16:24:32.2	-217.44	514.3	0.9518	22.1214223
03.09.2014 16:24:32.3	-217.5	514.2	1.0481	23.2135498
03.09.2014 16:24:32.4	-217.5	514.2	0.9605	22.2222936
03.09.2014 16:24:32.5	-217.43	514.3	0.9108	21.6397235
03.09.2014 16:24:32.6	-217.54	514.4	1.0146	22.8395544
03.09.2014 16:24:32.7	-217.59	514.3	0.9462	22.0562497
03.09.2014 16:24:32.8	-217.44	514.2	0.8337	20.7035633
03.09.2014 16:24:32.9	-217.42	514.4	1.0908	23.6816938
03.09.2014 16:24:33.0	-217.56	514.3	1.0068	22.7515925
03.09.2014 16:24:33.1	-217.55	514.3	0.916	21.7014091

Calculation of mass flow rate based on polynomial equation fitted to the experimental data

$$y = -2.493949E-14x^6 + 5.233460E-13x^5 + 1.036537E-09x^4 + 2.623716E-08x^3 + 3.632901E-05x^2 + 9.782133E-04x + 2.130745E+01$$

Please enter below Polynomial Coefficients

Order no	Coeff
6	-2.493949E-14
5	5.233460E-13
4	1.036537E-09
3	2.623716E-08
2	3.632901E-05
1	9.782133E-04
0	2.130745E+01

Polynomial curve (dP vs position)

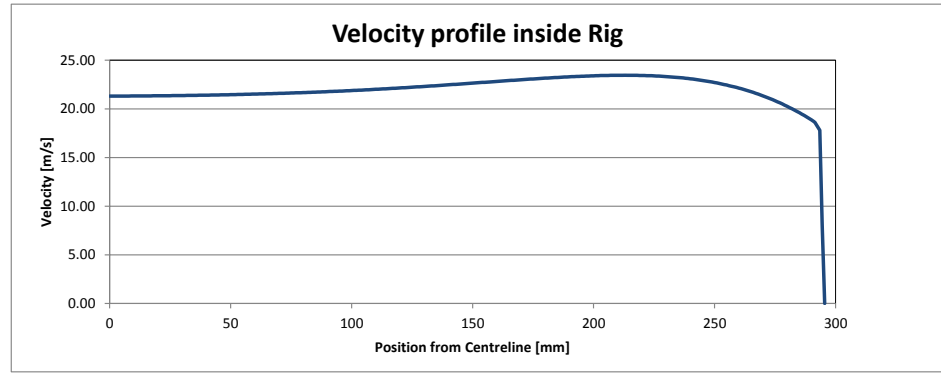
Please do NOT alter any of the figures below

position [mm]	Velocity [m/s]
0	21.307450
1	21.308465
2	21.309552
3	21.310712
4	21.311946
5	21.313253
6	21.314634
7	21.316089
8	21.317618
9	21.319223
10	21.320902
11	21.322656
12	21.324487
13	21.326394
14	21.328377
15	21.330438
16	21.332577
17	21.334794
18	21.337090
19	21.339466
20	21.341922
21	21.344458
22	21.347076
23	21.349776
24	21.352559
25	21.355425
26	21.358375
27	21.361411
28	21.364532
29	21.367740
30	21.371035
31	21.374419
32	21.377891
33	21.381454
34	21.385107
35	21.388853
36	21.392691
37	21.396622
38	21.400649
39	21.404771
40	21.408989

Actual Area	0.274324656	[m2]
Integrated area	0.274324656	[m2]
Area Error	0	[%]
Integrated Mass flow	2.34438462	[Kg/s]

Delta Area [m2]	Delta Mass flow [Kg/s]
0	0
3.14159E-06	2.60406E-05
9.42478E-06	7.81259E-05
1.5708E-05	0.000130217
2.19911E-05	0.000182314
2.82743E-05	0.000234418
3.45575E-05	0.00028653
4.08407E-05	0.000338649
4.71239E-05	0.000390777
5.34071E-05	0.000442914
5.96903E-05	0.000495061
6.59734E-05	0.000547218
7.22566E-05	0.000599385
7.85398E-05	0.000651564
8.4823E-05	0.000703754
9.11062E-05	0.000755957
9.73894E-05	0.000808173
0.000103673	0.000860403
0.000109956	0.000912647
0.000116239	0.000964905
0.000122522	0.00101718
0.000128805	0.00106947
0.000135088	0.001121776
0.000141372	0.001174101
0.000147655	0.001226443
0.000153938	0.001278803
0.000160221	0.001331183
0.000166504	0.001383583
0.000172788	0.001436004
0.000179071	0.001488445
0.000185354	0.001540909
0.000191637	0.001593396
0.00019792	0.001645905
0.000204204	0.001698439
0.000210487	0.001750998
0.00021677	0.001803583
0.000223053	0.001856193
0.000229336	0.001908831
0.000235619	0.001961497
0.000241903	0.002014192
0.000248186	0.002066916

Based on density in input/output



41	21.413305
42	21.417720
43	21.422235
44	21.426850
45	21.431567
46	21.436386
47	21.441310
48	21.446339
49	21.451473
50	21.456715
51	21.462065
52	21.467525
53	21.473094
54	21.478776
55	21.484570
56	21.490478
57	21.496501
58	21.502640
59	21.508897
60	21.515271
61	21.521765
62	21.528380
63	21.535116
64	21.541976
65	21.548958
66	21.556066
67	21.563300
68	21.570661
69	21.578151
70	21.585769
71	21.593518
72	21.601398
73	21.609410
74	21.617556
75	21.625835
76	21.634250
77	21.642801
78	21.651489
79	21.660315
80	21.669280
81	21.678384
82	21.687629
83	21.697014
84	21.706542
85	21.716212
86	21.726026
87	21.735983
88	21.746085
89	21.756332
90	21.766725
91	21.777263
92	21.787949
93	21.798781
94	21.809761
95	21.820888
96	21.832163
97	21.843586

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0.000292168	0.002436878
0.000298451	0.002489868
0.000304734	0.002542894
0.000311018	0.002595959
0.000317301	0.002649063
0.000323584	0.002702207
0.000329867	0.002755392
0.00033615	0.002808619
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0.000348717	0.002915201
0.000355	0.002968559
0.000361283	0.003021963
0.000367566	0.003075413
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0.000380133	0.003182458
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0.000405265	0.003397156
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0.000455531	0.003829221
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0.000468097	0.003937845
0.00047438	0.003992255
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0.000518363	0.004375054
0.000524646	0.004430029
0.000530929	0.004485081
0.000537212	0.004540209
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0.000549779	0.004650703
0.000556062	0.00470607
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0.000568628	0.004817052
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0.000581195	0.004928371
0.000587478	0.00498416
0.000593761	0.005040037
0.000600044	0.005096002
0.000606327	0.005152058

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100	21.878746
101	21.890763
102	21.902928
103	21.915242
104	21.927703
105	21.940312
106	21.953069
107	21.965973
108	21.979023
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110	22.005562
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112	22.032680
113	22.046455
114	22.060372
115	22.074430
116	22.088628
117	22.102966
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119	22.132054
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121	22.161682
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146	22.570454
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177	23.105644
178	23.121417
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180	23.152361
181	23.167508
182	23.182423
183	23.197093
184	23.211506
185	23.225650
186	23.239511
187	23.253076
188	23.266332
189	23.279264
190	23.291859
191	23.304103
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194	23.338575
195	23.349262
196	23.359522
197	23.369337
198	23.378692
199	23.387570
200	23.395953
201	23.403825
202	23.411167
203	23.417961
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214	23.451075
215	23.449770
216	23.447652
217	23.444697
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271	21.239590
272	21.142545
273	21.042652
274	20.939858
275	20.834112
276	20.725362
277	20.613553
278	20.498633
279	20.380546
280	20.259238
281	20.134653
282	20.006735
283	19.875425
284	19.740668
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286	19.460572
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0.001712168	0.014015108
0.001718451	0.013997824
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0.001775	0.013723483
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0.001793849	0.013579732
0.001800133	0.01352544
0.001806416	0.013467847
0.001812699	0.013406882
0.001818982	0.013342475
0.001825265	0.013274552
0.000914989	0.00662031
0.00183469	0.012989239
0.001840973	0.012747267
0.001847256	0.005748662
0.00185354	0

Please do not change any of the values in this sheet

Patm	Atmpsheric air pressure - (As recorded from engine data)	976 [mBar]
Patm		97600 [Pa]
Tatm		10 [C]
Tatm		283 [K]
Relative Humidity		78 [%]

$$\rho_{\text{humid air}}^{[1]} = \frac{p_d}{R_d T} + \frac{p_v}{R_v T} = \frac{p_d M_d + p_v M_v}{RT}$$

where:

$\rho_{\text{humid air}}$	Density of the humid air (kg/m ³)
p_d	Partial pressure of dry air (Pa)
R_d	Specific gas constant for dry air, 287.058 J/(kg·K)
T	Temperature (K)
p_v	Pressure of water vapor (Pa)
R_v	Specific gas constant for water vapor, 461.495 J/(kg·K)
M_d	Molar mass of dry air, 0.028964 (kg/mol)
M_v	Molar mass of water vapor, 0.018016 (kg/mol)
R	Universal gas constant, 8.314 J/(K·mol)

$$\rho_{\text{humid air}} = 1.197011 \text{ Kg/m}^3$$

$$0.368101713$$

The vapor pressure of water may be calculated from the [saturation vapor pressure](#) and [relative humidity](#). It is found by:

$$p_v = \phi p_{\text{sat}}$$

$$p_u = 957.7558 \text{ [Pa]}$$

Where:

p_v	Vapor pressure of water
ϕ	Relative humidity
p_{sat}	Saturation vapor pressure

The [saturation vapor pressure of water](#) at any given temperature is the vapor pressure when relative humidity is 100%. One formula ^[1] used to find the saturation vapor pressure is:

$$p_{\text{sat}} = 6.1078 \times 10^{\frac{7.5T}{T+237.3}}$$

$$p_{\text{sat}} = 12.27892 \text{ hPa}$$

$$p_{\text{sat}} = 1227.892 \text{ [Pa]}$$

where T is in degrees C. Note:

$$\rho = \frac{p}{R_{\text{specific}} T} \quad 1.20142 \text{ [kg/m}^3]$$

$$R = 287.058 \text{ J/Kg K}$$

$$T = \text{Temperature in degrees Kelvin}$$

$$P = \text{Absolute Pressure in Pa}$$