TCC III, Fired, Spark Plug Region

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Acknowledgement Request for published use:

It is requested that ALL published use of the TCC engine simulation geometry and/or data be acknowledged with the following statement.

> "The study here used publicly available TCC engine data, which was created with funding by General Motors through the General Motors University of Michigan Automotive Cooperative Research Laboratory, Engine Systems Division."

This README document is an overview of the cataloged data in the Deep Blue Data work deposit "TCC-III, Fired, Spark Plug Region", which is a permanent unaltered archive of the data used in Dr. Philipp Schiffmann's Ph. D. dissertation (http://hdl.handle.net/2027.42/137636) and subsequent publications , such as Philipp Schiffmann, David L. Reuss, Volker Sick, International Journal of Engine Research, 2017, DOI: 10.1177/1468087417720558.

This archive includes all measured pressures, velocity distributions, OH* distributions and computed one-per-cycle parameters, which were used the statistical analysis in the thesis. This document includes descriptions of the following.

Measured parameter locations and nomenclature are provided in the Geometry slides.

The Deep Blue Data TCC-III "Collection README.pdf" file contains references and errata, and will be updated in time.

TCC-III Fired, Spark Plug Region: Test Operating Conditions

The thirty four tests contained in the Spark Plug Region Work Deposit were designed to study the causes of cycle-to-cycle variability during the flame initiation period. The Velocity measurements and flame-OH* images are restricted to a small region near the spark plug (slide 9). The tests were conducted at eleven different combinations of equivalence ratio, fuel types, and nitrogen dilution. There are repeated tests for a total of 34 tests with 754 cycles per test. The operating conditions were, chosen to systematically vary the Markstein number, Ma, and unstretched laminar flame speed, S_l as shown in the table below. Note that toluene was used at a fixed mass, thus varying as a percentage of primary fuel as noted in the table. Since these tests were conducted to study causes of glow-discharge spark ignition, all tests were conducted with fixed start of ignition, SOIgn, to maintain similar flow and thermodynamic conditions. It is noted that the start of ignition was the same for all tests, SOIgn = 342 ATDCE, which was the timing for Maximum Break Torque, MBT, for stoichiometric operation, $\phi = 1$. As a consequence, all of the lean, rich, and dilute operation here had very late combustion phasing.

	Methane				Propane						
	Air				Air			9 % N_2 (by mass)			19 % N_2
	Leanest	Lean	Stoich	Rich	Lean	Stoich	Rich	Lean	Stoich	Rich	Stoich
Equivaence Ratio	0.66	0.69	1.00	1.21	0.67	1.00	1.56	0.79	1.00	1.43	1.00
$\dot{m}$ O_2 [g/s]	0.48	0.48	0.47	0.47	0.48	0.47	0.46	0.44	0.43	0.42	0.38
$\dot{m}$ N_2 [g/s]	1.59	1.59	1.56	1.54	1.58	1.55	1.50	1.62	1.60	1.57	1.66
$\dot{m}$ Fuel [g/s]	0.070	0.075	0.109	0.132	0.078	0.119	0.185	0.084	0.108	0.154	0.096
$\dot{m}$ C_7H_8 [g/s]	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
A/F	25.3	24.0	16.8	14.0	23.0	15.5	10.0	19.6	15.5	10.8	15.5
C_7H_8, % fuel mass	14.1	13.4	9.6	8.1	12.9	8.8	5.9	12.2	9.7	6.9	11.1
Le (difficient)	1.0	1.0	na	1.14	1.75	na	0.97	1.86	na	0.99	na
S_l^o [m/s]	0.55	0.61	0.96	0.86	0.74	1.22	0.57	0.77	0.98	0.59	0.68
δ_L [mm]	0.028	0.027	0.017	0.019	0.020	0.012	0.024	0.019	0.015	0.024	0.022
Ma	-0.8	-0.5	2.7	4.8	6.2	3.4	-1.4	5.2	3.4	-0.3	3.4
L_{MA} [mm]	-0.015	-0.013	-0.045	0.09	0.125	0.040	-0.033	0.101	0.050	-0.007	0.074
IMEP [kPa]	212	250	328	287	234	337	259	250	311	278	212
COV_{IMEP} [%]	8.3	4.5	1.3	4.5	6.3	0.8	6.3	5.0	1.8	5.5	8.2

TCC-III Fired, Spark Plug Region: Engine Operation and Data Summary

Spark Plug Region Summary		
	RPM	1300
	MAP	40
	Pressure-Cycles/Test	850
	SOIgn, ATDCE	342
Flow Fields	Imaged-Cycles/Test	754
	CA/Image	2
	Images/Cyc	21
	Imaging Range, ATDCE	320-360
	PIV Spatial Resolution	1 mm
	PIV Grid	≈ 0.52 mm
	Common Grid	0.50 mm
	Image Plane	y = -4.5
	Field of view	x = -10.25 to 9.25
		z = -0.25 to -15.25
OH* Images	Imaged-Cycles/Test	754
	Images/Cycle	8
	Imaging Range, ATDCE	344 - 360
	Image-view direction	toward -x

RPM – Revolutions Per Minute,
MAP – Manifold Absolute Pressure
ATDCE – degrees After Top Dead Center Exhaust, all data use this crank angle convention.
Data ID – File name used in archive directory indicating when the data was data taken. S_year_month_day_test#

Files in **blue-bold** font indicate recommendations from Schiffmann PhD dissertation.

Flame-OH* images are not included for tests noted in the table due to laser-to-intensifier timing errors.

TCC-III Spark Plug Region File Summary

Fuel	Delivered N2 % Tot Mass	Delivered Phi	Delivered C7H8 % Fuel	IMEP	COV IMEP	OH* Images	Test ID
Propane	79%	0.67	14%	238	5.4%	Y	S_2015_06_18_05
		0.67	14%	233	6.3%	Y	S_2015_06_20_06
		0.67	14%	230	7.1%	Y	**S_2015_06_22_04**
		1.00	**10%**	**334**	**1.1%**	**Y**	**S_2015_06_18_03**
		1.00	**10%**	**338**	**0.8%**	**Y**	**S_2015_06_25_25**
		1.00	**10%**	**339**	**0.6%**	**Y**	**S_2015_06_26_13**
		1.59	6%	253	8.0%	N	S_2015_06_18_01
		1.56	6%	287	4.7%	Y	S_2015_06_25_21
		1.54	7%	293	3.8%	Y	**S_2015_06_26_17**
	81%	0.80	13%	265	3.6%	Y	S_2015_06_18_07
		0.78	13%	244	5.7%	Y	**S_2015_06_22_08**
		0.78	13%	242	5.8%	Y	S_2015_06_26_21
		1.00	11%	313	1.5%	Y	**S_2015_06_25_23**
		1.00	11%	312	1.9%	Y	S_2015_06_26_11
		1.00	11%	308	2.0%	Y	S_2015_06_26_19
		1.45	8%	240	8.2%	N	S_2015_06_18_11
		1.42	8%	267	5.4%	Y	S_2015_06_20_04
		1.43	8%	270	5.4%	Y	**S_2015_06_23_03**
	83%	1.01	12%	239	6.7%	N	S_2015_06_20_02
		1.00	12%	249	6.1%	Y	S_2015_06_22_06
		1.00	12%	264	5.5%	Y	**S_2015_06_26_15**
Methane	79%	0.66	15%	211	7.9%	Y	**S_2015_06_26_23**
		0.66	15%	214	8.4%	N	S_2015_06_26_25
		0.66	15%	210	8.4%	N	S_2015_06_26_27
		0.68	15%	224	6.1%	Y	S_2015_06_23_08
		0.69	15%	229	6.4%	Y	**S_2015_06_23_10**
		0.73	14%	267	3.4%	Y	S_2015_06_19_03
		0.70	15%	254	3.8%	Y	S_2015_06_19_05
		1.01	**10%**	**329**	**1.6%**	**Y**	**S_2015_06_26_01**
		1.00	**11%**	**330**	**1.0%**	**Y**	**S_2015_06_26_03**
		1.00	**11%**	**324**	**1.2%**	**Y**	**S_2015_06_26_09**
		1.20	9%	296	3.7%	Y	**S_2015_06_19_07**
		1.22	9%	285	4.7%	N	S_2015_06_26_05
		1.22	9%	280	5.1%	N	S_2015_06_26_07

Fired Spark Plug Region: Data Summary and File Structure

Slides 4 – 11 summarize the archive data-file **directory structure (Slide 6)**. There are four measured-data directories at the top level, engine **pressure data**, the **original** and **common grid flow fields**, and flame **OH* images**. The measurements were acquired simultaneously at multiple crank angles, during 754 contiguously engine cycles, during 34 tests from 11 operating conditions. Each of the top 4 top directory contains eleven sub-directories corresponding to the eleven **Test Conditions (Slide 2)**; The data for the 34 engine tests, cataloged by **Test ID (Slide 3)**, are found in these sub-directories.

Pressure data

Pressure data for each test is cataloged in Excel Workbooks, which contain worksheets with the following parameters.

Test Info	(pressure-data cycle number vs. imaged-data cycle numbers)
Per_Run_Summary	(test average & standard deviation)
Per_Cycle_Data	(cycle averaged pressure parameters, heat release, and spark-plasma energy and duration.)
Ensemble_Average	(cylinder volume and average pressures per crank angle)
P_IntakePlenIn (kPa)	(5 **measured pressures (Slide 7)** acquired each 0.5 crank angle degree)
P_IntkPort (kPa)	.
P_Cyl (kPa)	.
P_ExhPort (kPa)	.
P_ExhPlenOut (kPa)	
HR Rate (J per CAD)	Apparent Heat Release each 0.5 crank angle.
Cumulative HR (J)	Cumulative Apparent Heat Release each 0.5 crank angle

There is one Pressure-Data file for each test, located in the directory corresponding to its Test Condition. The Pressure files include parameters that were directly measured or computed as described in **Schiffmann's Dissertation (**http://hdl.handle.net/2027.42/137636**).**

The Pressure Data directory also contains the following three Excel workbooks.

1. The 1/test parameters compiled from each test in a single worksheet.
2. The 1/0.5CA ensemble-averaged pressure and heat-release parameters for all 34 tests (one worksheet per parameter).
3. The computed **1/cycle Parameters (Slide 8)** used in the statistical analysis (one worksheet per each of the 34 tests) located in …\Fired_Spark_Plug_Region-Schifmann\Pressure_Data\CC_1300RPM_40kPa_Fired_SpkPlg_1perCycle_Imaged+flowfielddata

Flow Field Files (original & common grids)

Velocity distributions were measured in a the plane near the spark plug shown in Slide 9. Each flow field is in a text file, B000##.txt, and has the x,y,z coordinates and u,v,w velocity components of the two-component PIV measurements. Each velocity file contains the velocity distribution from one image pair, taken with frame straddling. Thus, one image was taken at the beginning of the specified crank angle, and one was take Δt μs earlier (laser pulse separation), at the end of the previous crank angle.

The velocity data are located in the directories, **original_grid_flow_fields** or the **common_grid_flow_fields (Slide 11)**. The Common Grid was used to compute the 1cycle velocity parameters, which are the file

…\Fired_Spark_Plug_Region-Schifmann\Pressure_Data\CC_1300RPM_40kPa_Fired_SpkPlg_1perCycle_Imaged+flowfielddata …

The original and common grids are described in Slide 11, along with the **Resolution and Dynamic Range.**

The **PIV Data-File Directories (Slide 7)** are cataloged by

Test Condition	Fuel,_phi_yN2, (e.g., C3H8_Phi=1_yN2=009 where y is the mole fraction of added N_2 dilution).
Test ID,	S_year_month_day_test#, (e.g., S_2013_01_30_01).
Test cycle number,	Cycle=00001 to Cycle=0754
Crank angle,	B00001.txt – B00021.txt, where the 21 flow fields were measured every two crank angles between 320 – 360 ATDCE.

Flame OH* Images

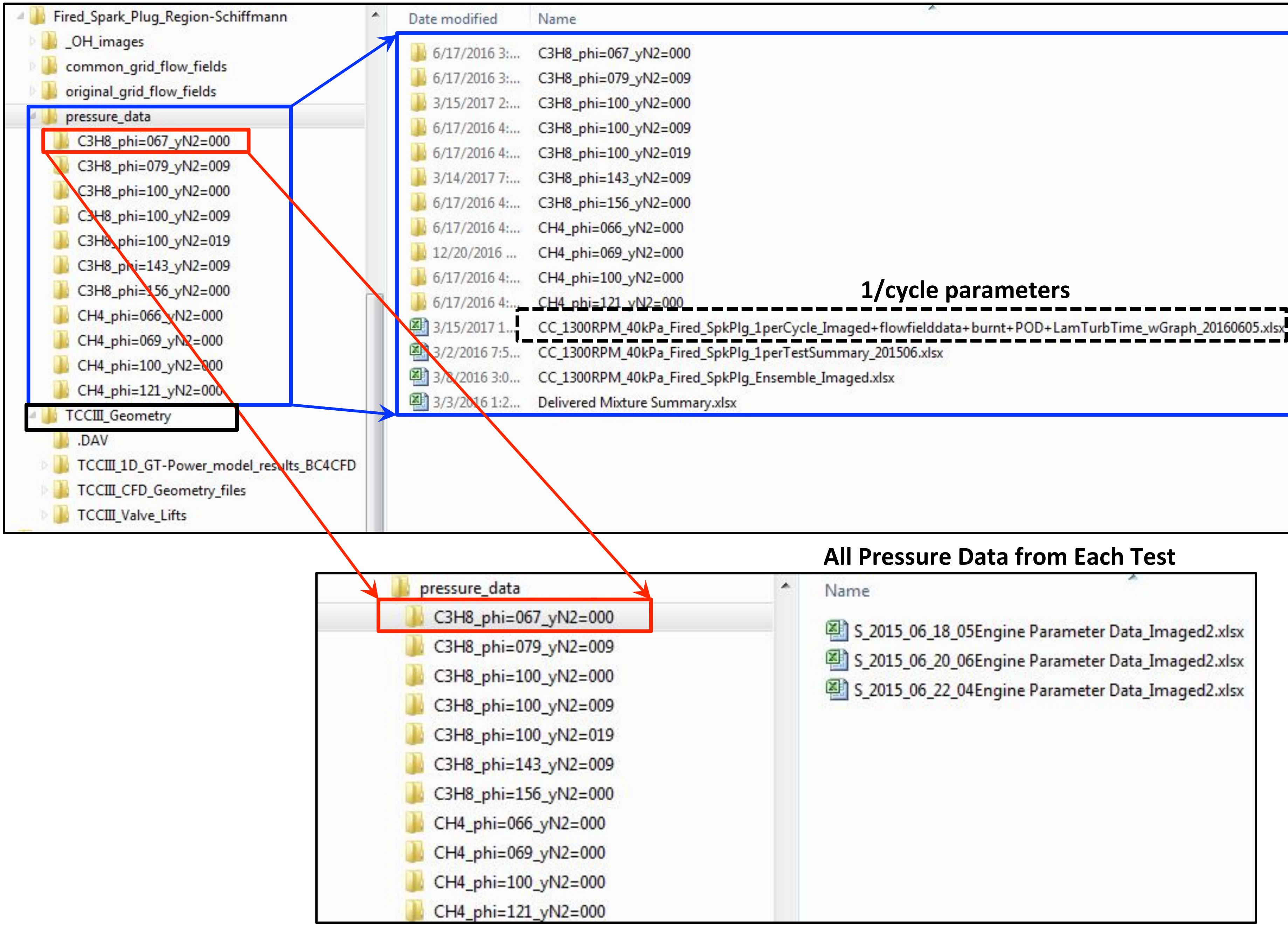
Directory _OH_Images contains text files of images, which recorded both the plasma discharge and early flame-kernel OH* chemiluminescence. The files contain the intensity of the 600 x 800 pixel camera array, recorded every 2 crank angles, from 344 – 360 ATDCE (2 degrees after SOIgn to TDC, where the flame became larger than the field of view), and every cycle. The images have had only white-field correction applied, to account for spatial variation of the image intensifier sensitivity. Images are catalogued by

Test Condition	Fuel,_phi_yN2, (e.g., C3H8_Phi=1_yN2=009 and y is the mole fraction of added N_2 dilution).
Test ID,	S_year_month_day_test#, (e.g., S_2013_01_30_01).
Test cycle number,	Cycle=00001 to Cycle=00754
Crank angle,	Cycle=0###_344[CA ATDCE].txt to Cycle=0###_360[CA ATDCE].txt .

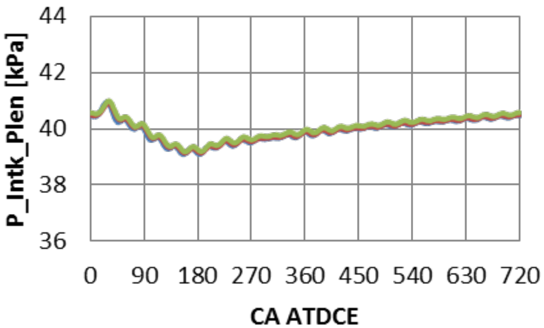
The file header is from LaVision Davis .imx files, interpreted as follows.

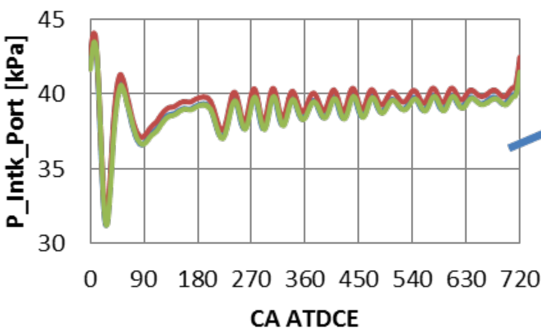
LaVision Davis version	camera chip size, pixels size	Scale Factor	Origin Offset	Coord. Direction	units	Scale Factor	Origin Offset	Coord. Direction	units
#DaVis 8.3.0 2-D image	800 600 800	0.433322	-19.5	"x"	"mm"	-0.0433322	2.2	"z"	"mm"

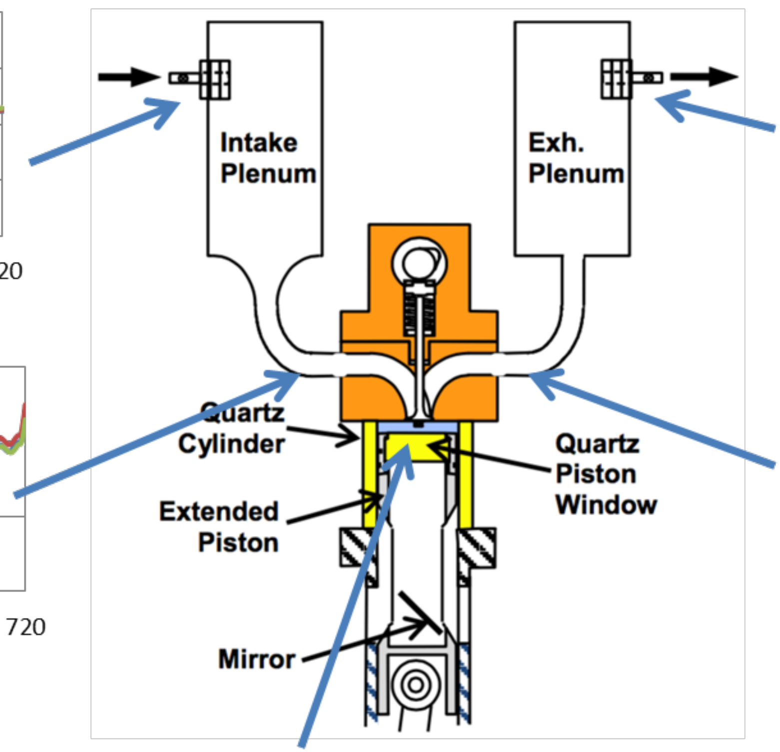
Fired Spark Plug Region : Pressure Data-File Directory Structure

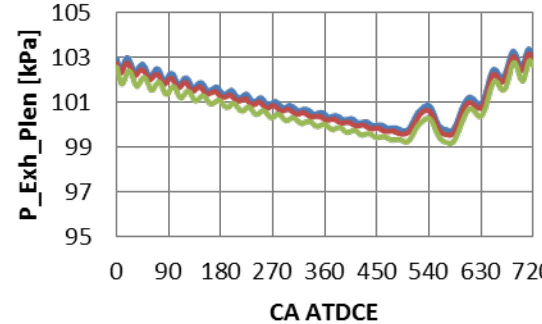


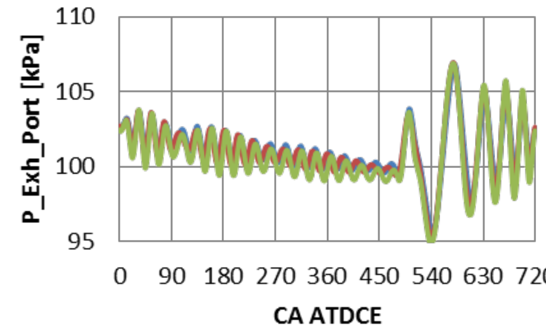
Pressure Measurement Locations, TCC-III

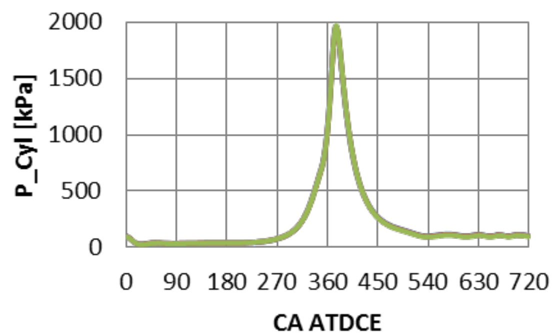












All Pressures posted for all tests, all cycles, all CA.

1/test, 1/cycle, 1/CA parameters for each test are cataloged in Microsoft Excel files.

TCC-III Fired, Spark Plug Region: 1/cycle Parameters

This table summarizes the computed 1/cycle parameters used for the statistical analysis in Schiffmann's dissertation, which are in the Microsoft Excel workbook

TCCIII DeepBlue CC_1300RPM_40kPa_fired_Cycle_Imaged+flowfielddata+burnt+POD+LamTurbTime_wGraph_20160605.xlsx

located in the Pressure Data directory.

Pressure		
P_Cyl	IMEP(cycle k)	cylinder pressure
P_Cyl	IMEP(cycle k-1)	
P_Cyl	Peak Location, aTDCE	
P_Cyl	Peak, kPa	
P_Intk_Port	Peak Location, aTDCE	pressure at the intake runner-port interface
P_Intk_Port	Peak	
P_Intk_Port	CycleAve	
P_Exh_Port	Peak Location, aTDCE	pressure at the exhaust runner-port interface
P_Exh_Port	Peak	
P_Exh_Port	CycleAvg	
P_Intk_Plen_In	Peak Location, aTDCE	pressure at the intake plenum inlet
P_Intk_Plen_In	Peak	
P_Intk_Plen_In	CycleAve	
P_Exh_Plen_Out	Peak Location, aTDCE	pressure at the exhaust plenum outlet
P_Exh_Plen_Out	Peak	
P_Exh_Plen_Out	CycleAve	
rpm	CycleAve	
γ compression		intake polytropic compression coefficient
γ expansion		exhaust polytropic expansion coefficient

AHR		
Burn0010	CAD	crank angles between SOIgn and 10% MFB
Burn1090	CAD	crank angles between 10% and 90% MFB
CA10	ATDCE	crank angle at 10% MFB
CA50	ATDCE	crank angle at 50% MFB
CA90	ATDCE	crank angle at 90% MFB
HR_Total	J	total heat release from AHR analysis

Spark Plasma		
Spark Duration		electrical discharge duration for each cycle
Spark Energy		electrical energy delivered to the spark plug each cycle
Spark Area	342-350 ATDCE	from images
Spark x-pos	342-350 ATDCE	from images
Spark z-pos	342-350 ATDCE	from images

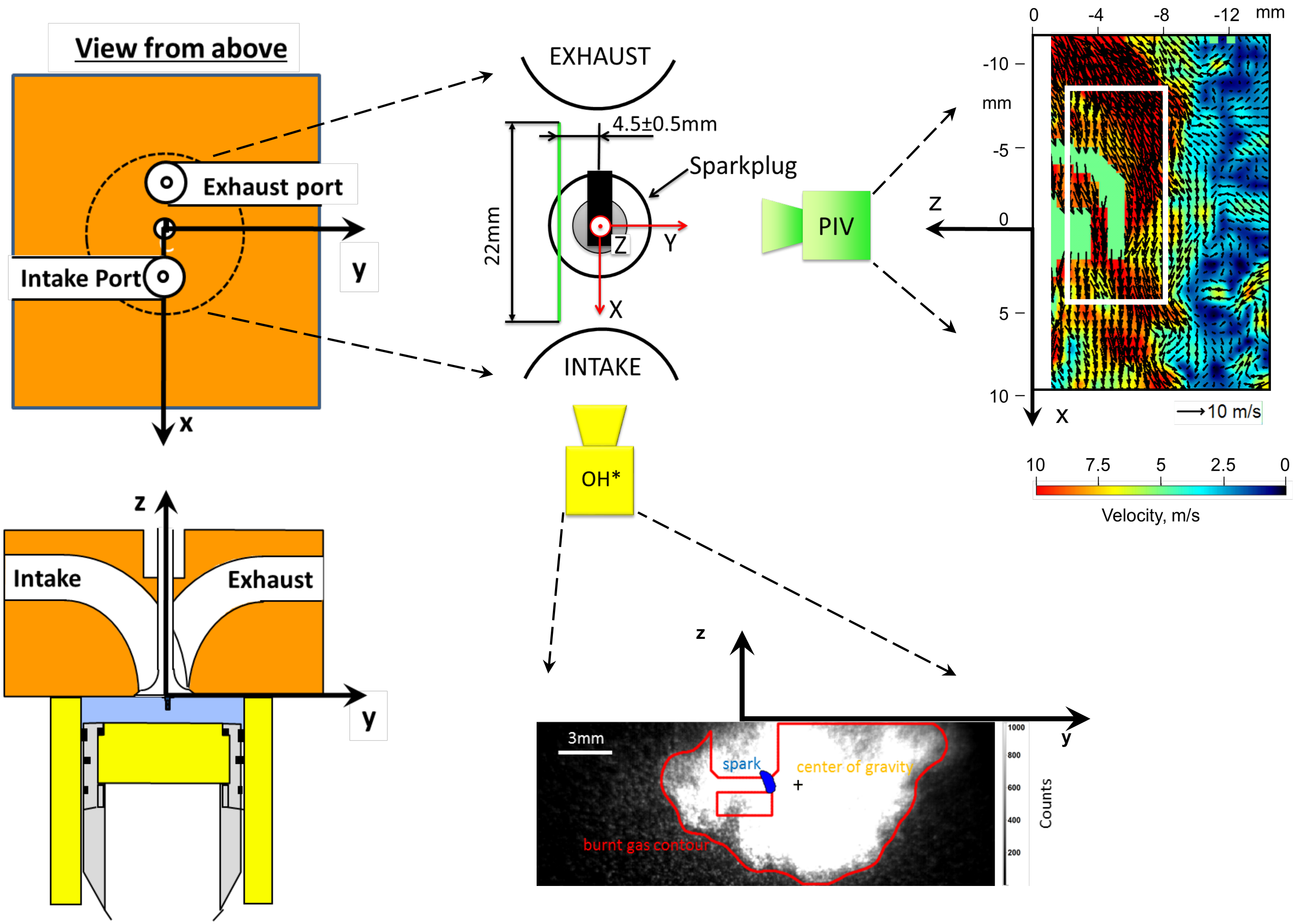
Flame, Mie scattering		
Ave Area	348-360 ATDCE	Burned gas area from images of 2-D laser sheet
Ave Wrinkledness	348-360 ATDCE	
Total Area	348-360 ATDCE	
Total Wrinkledness	348-360 ATDCE	
# Burnt-Gas Pockets	348-360 ATDCE	
dA/dCA	349-359 ATDCE	area change per CA

Flame, OH*		
OH* Area	344-360 ATDCE	2-D imge projection of 3-D OH*
Major/Minor axis length	342-350 ATDCE	
OH* cg. x-pos	344-360 ATDCE	
OH* cg. z-pos	344-360 ATDCE	
Avg OH* Intensity	344-360 ATDCE	
StdDev OH* Intensity	344-360 ATDCE	
OH* dA/dCA	345-359 ATDCE	
Area @ τ lam-turb size	mm^2	flame area at time of laminar to turbulent transition
Lam log slope	mm^2/s	Slope of log(A) vs log(t) during initial laminar growth
Turb log slope	mm^2/s	Slope of log(A) vs log(t) during turbulent growth
Inflection time [ms]		Location of maximum dA/dt
Lam log offset, [mm^2]		
Turb log offset		
τ lam-turb [ms]		time from SOIgn to laminar-turbulent transition
τ lam-turb [CAD]		CA from SOIgn to laminar-turbulent transition
τ lam-turb to CA10 [CAD]		

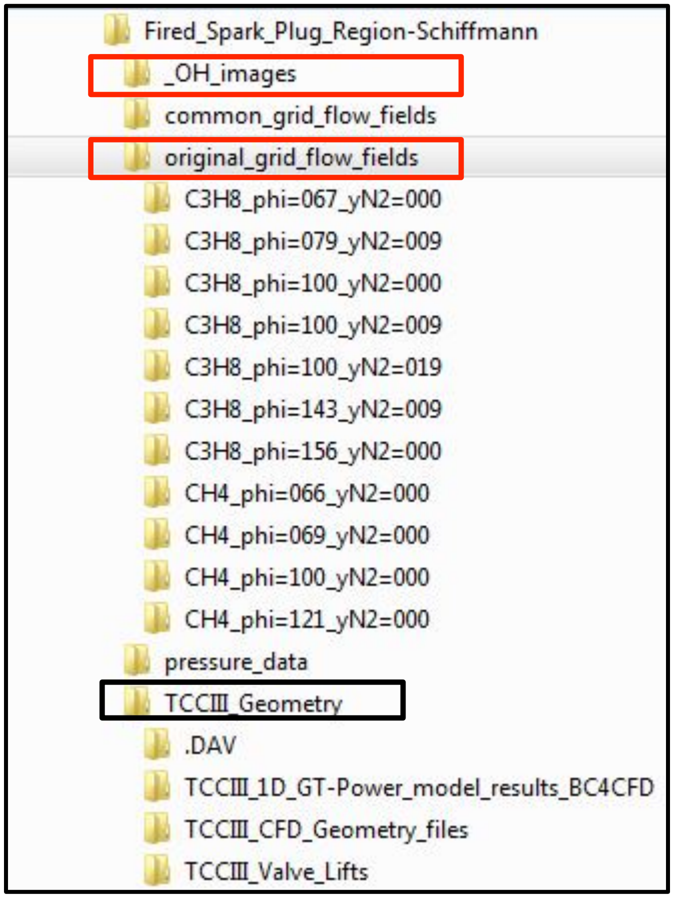
Velocity		
|V|	320-360 ATDCE	velocity magnitude averaged over sub area of Fig.1
Vz	320-360 ATDCE	z-vel. component, averaged over sub area of Fig.1
Vx	320-360 ATDCE	x-vel. Component, averaged over sub area of Fig.1
vonMises strain	320-360 ATDCE	(Appendix 1) averaged over sub area of Fig.1
Shear Strength	320-360 ATDCE	(Appendix 1) averaged over sub area of Fig.1
SwirlStrength	320-360 ATDCE	(Appendix 1) averaged over sub area of Fig.1

Details of the parameters and nomenclature can be found in Philipp Schiffmann's Ph. D. dissertation (http://hdl.handle.net/2027.42/137636) and in subsequent publications referenced in the Deep Blue Data TCC Engine Collection README.pdf file.

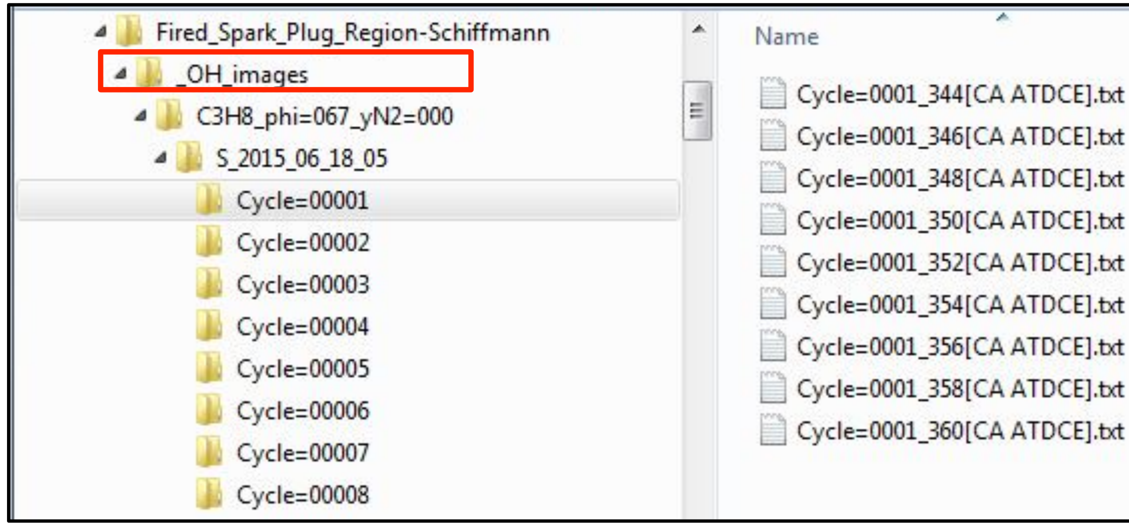
Spark Plug Region Coordinate System and Image Plane



Fired Spark Plug Region: Flame OH* and Flow Data-File Directory Structure

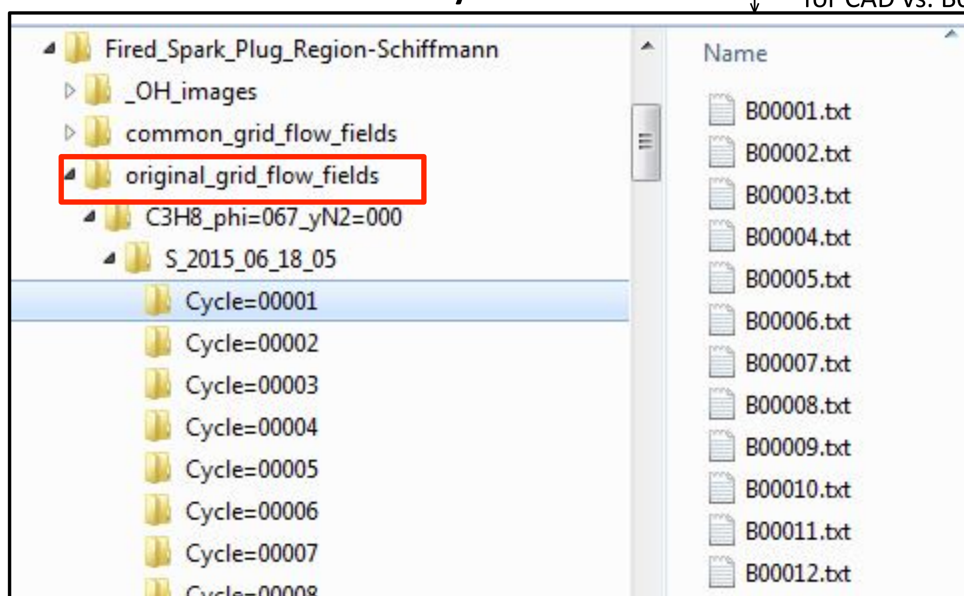


Flame OH* Image Files



Velocity Files

See Data Summary Table for CAD vs. B000n



Spark Plug Region: FOV, Velocity Resolution, and Dynamic Range

Original Grid:

The boundaries of the PIV The field of view (FOV) vary a bit from test to test but are about x = -12 to +10, and z = -1 to -14 mm and in the plane y = -4.5 mm for all PIV measurements in the Spark Plug Region. The interrogation window was 1.04 mm on a 0.52 mm grid. The laser-sheet thickness was measured to be 1mm.

Common Grid:

The original PIV grid and a re-gridded version of the data is available for direct comparison of velocity metrics. The re-gridded datasets loose one grid at edge of the FOV and at the edges of the burned gas regions. The re-gridded data sets also use interpolation to replace locally bad vectors.

Velocity Range:

The minimum and maximum resolved velocity are defined here using the criterion that PIV correlation-peak displacements, Δx_{piv} , need be limited to 0.2 pixels and 8 pixels, respectively, as described in Ref.1. A practical resolution limit of 0.2 pixels is used here, as demonstrated in Refs.2 & 3. Thus, an estimated dynamic range of 40:1 one is achieved. The laser-pulse separation for these tests was Δt = 10 ms, to achieve the 8 pixel maximum particle separation. The velocity dynamic range for any data set can be computed as follows. Since 32x32pixel interrogation spots and grid-spacing $(\Delta x)_{grid}$, of 50% overlap are used in all tests here) the resolution dynamic range can be estimated as

$$V_{min} = 0.2\left[2\Delta x_{grid} / 32\Delta t\right] \quad \text{and} \quad V_{max} = 8\left[2\Delta x_{grid} / 32\Delta t\right]$$

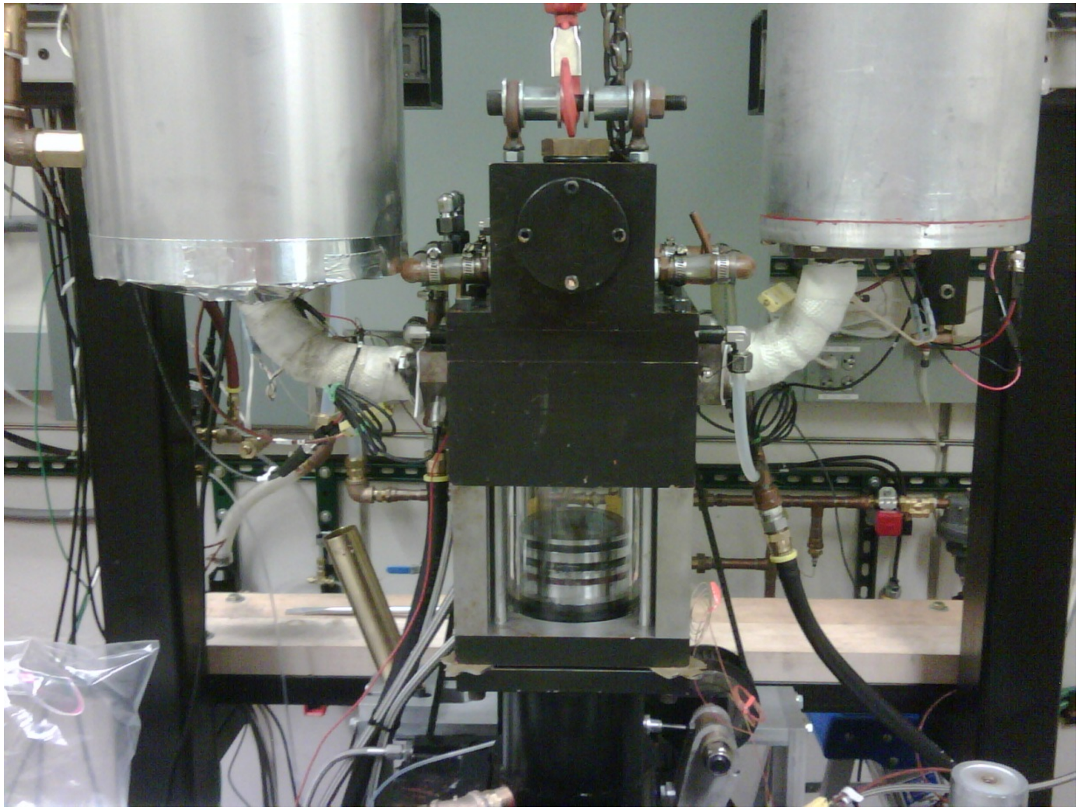
where V is m/s when Δx_{grid} is in meters (from the velocity data file) and Δt in seconds. For all tests in the Spark Plug Region, Δx_{grid} = 0.5mm and Δt =10 μs for a dynamic range from 0.6:25 m/s.

1. Adrian, R.J. and J. Westerweel, Particle image velocimetry. 2011: Cambridge University Press.
2. Reuss, D.L., M. Megerle, and V. Sick, Particle-image velocimetry Measurement Errors when Imaging through a Transparent Engine Cylinder. Measurement Science and Technology, 2002.
3. Megerle, M., V. Sick, and D.L. Reuss, Measurement of Digital PIV Precision using Electrooptically-Created Particle-Image Displacements. Measurement Science and Technology, 2002. 13: p. 997-1005.
4. Abraham, P.S., D.L. Reuss, and V. Sick. High-speed particle image velocimetry study of in-cylinder flows with improved dynamic range. in SAE Paper 2013-01-0542. 2013.

TCC-III Engine Geometry

The Slides 10 – 24 quantify the TCC-III engine geometry, that was used to create the CFD .stl and igs files. In addition, these geometry slides define the nomenclature and locations of the pressure transducers and thermocouples cataloged in the Pressure Data Files.

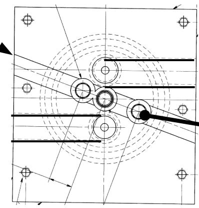
Scanned figures of original printed material are used to avoid transposition errors. The Deep Blue Data TCC-III Collection README file contains errata, which are updated as they become available.

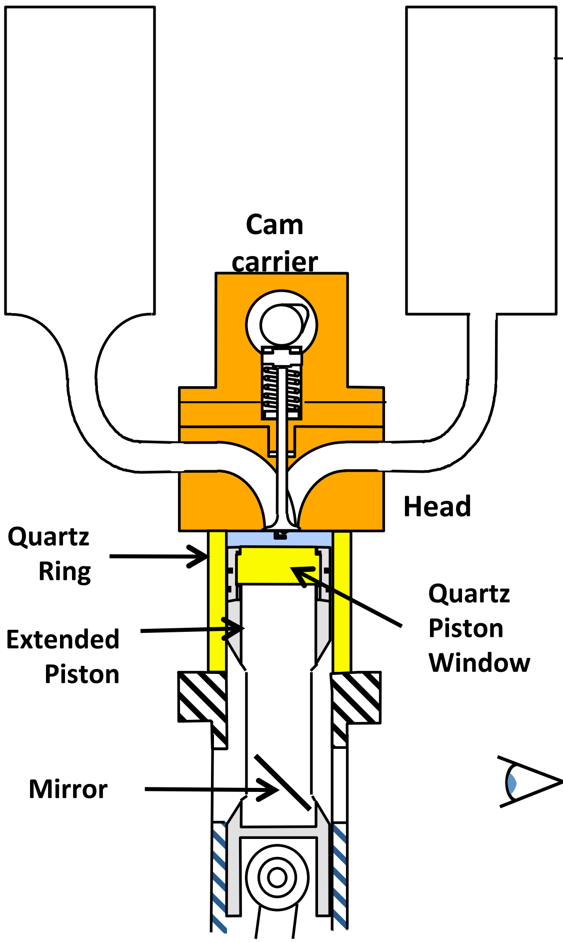


TCC-III Engine Geometry			
Bore, cm	9.20	Connecting-rod length, cm	23.1
Stroke, cm	8.60	Piston-pin offset, cm	0.0
Clearance @ TDC, cm	0.95	Conn rod offset, cm	0.0
Combustion chamber volume, cc	63.15	Exhaust Valve Closing, aTDCexh	12.8
Top-land crevice volume, cc	0.37	Intake Peak Lift, aTDCexh	114.8
Spark-plug crevice volume, cc	0.02	Intake Valve Closing, aTDCexh	240.8
TDC Volume, cc	63.54	Exhaust Valve Opening, aTDCexh	484.8
Swept volume, cc	571.7	Exhaust Peak Lift, aTDCexh	606.8
Geometric CR	10.0	Intake Valve Opening, aTDCexh	712.8
Effective (IVC) CR	8.0	Valve-seat angles, deg.	30/45/60/75
Steady-flow swirl ratio	0.4	Spark Plug	AC Delco R44LTS

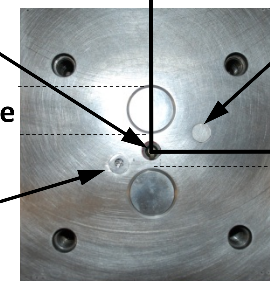
TCC-III Overview

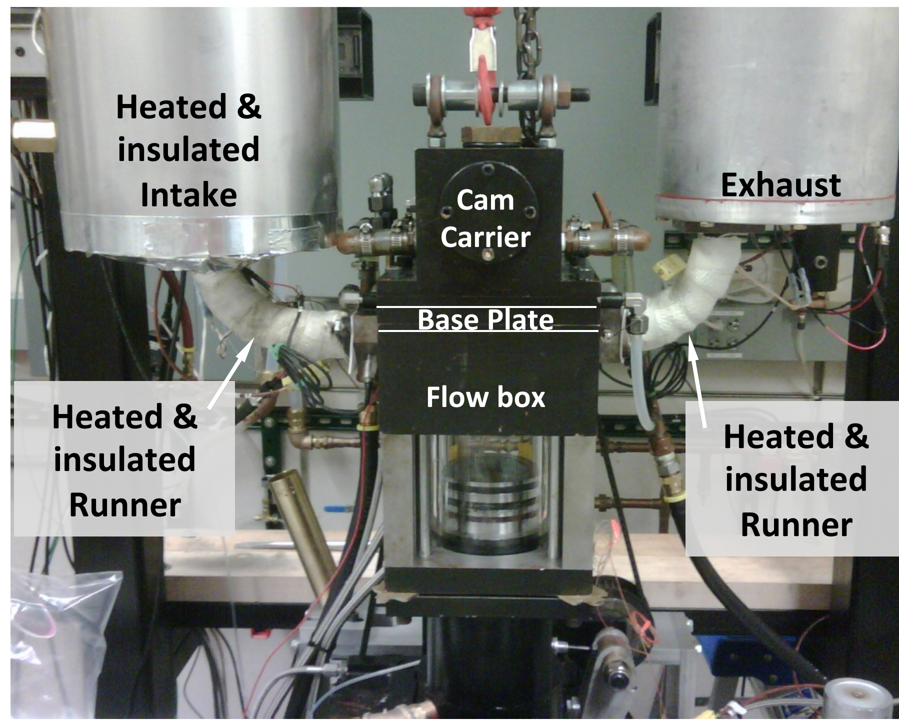
Slot cut in the head between the "flow-box" and "cam-carrier base plate" to allow spark plug and pressure transducer





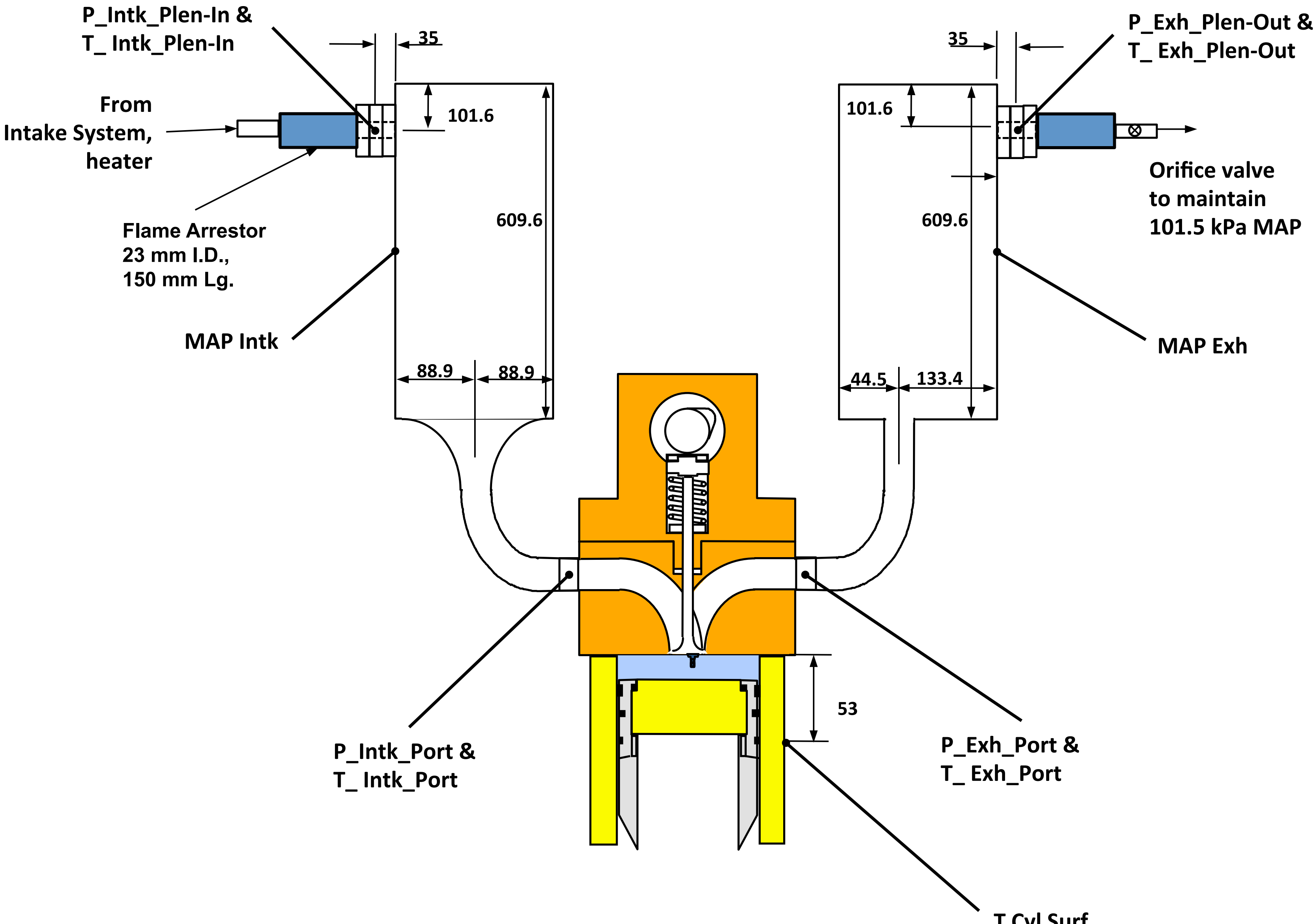
The three-piece head
"cam carrier" (cam and lifters)
"base plate" (valves & guides)
"flow box" (ports, plug, valve seats)



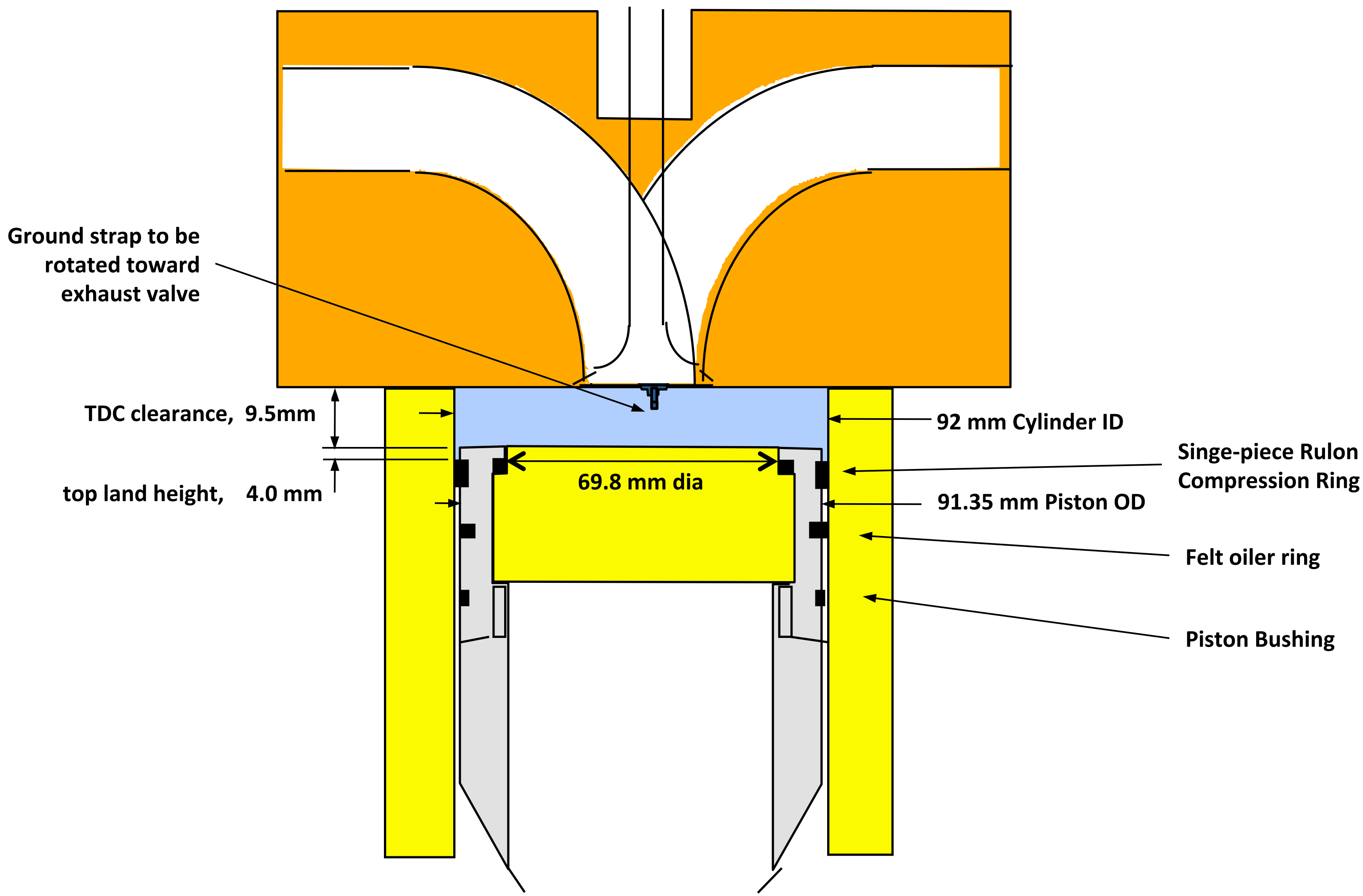


Plenum Interior Dimensions & Measurement Locations

Dimensions in mm

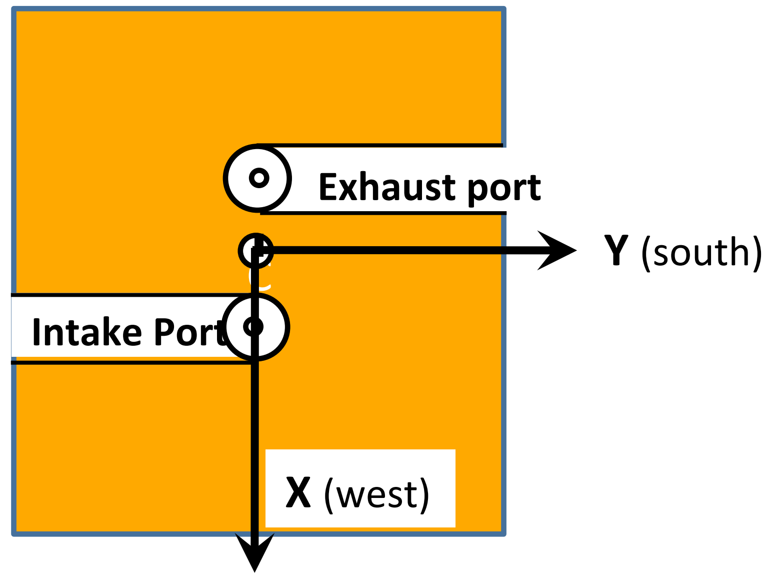


Combustion Chamber

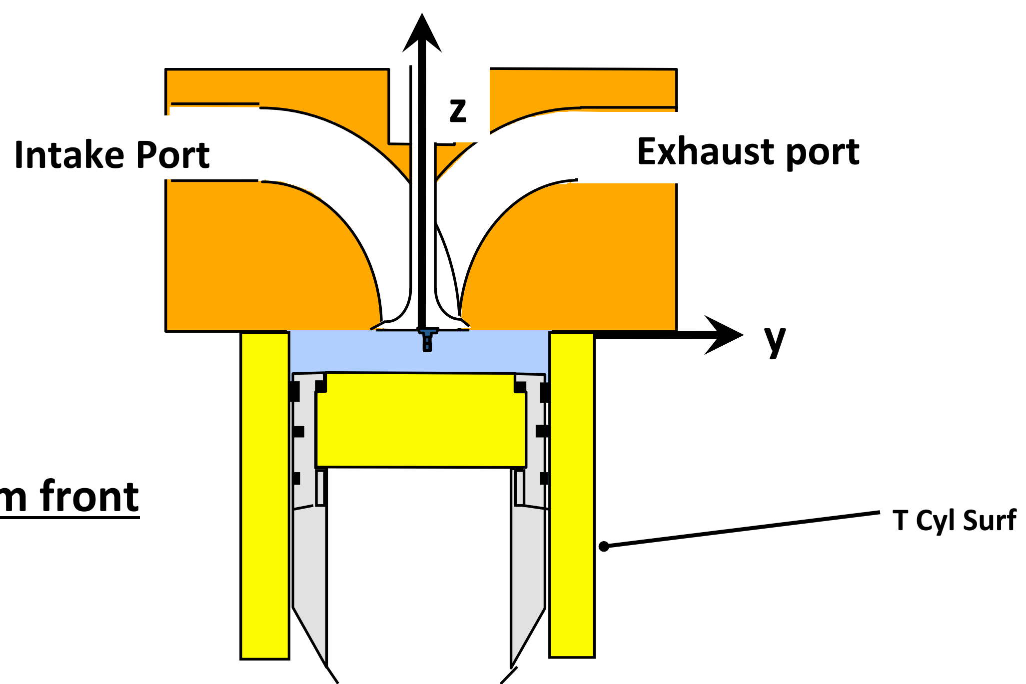


Coordinates

View from above

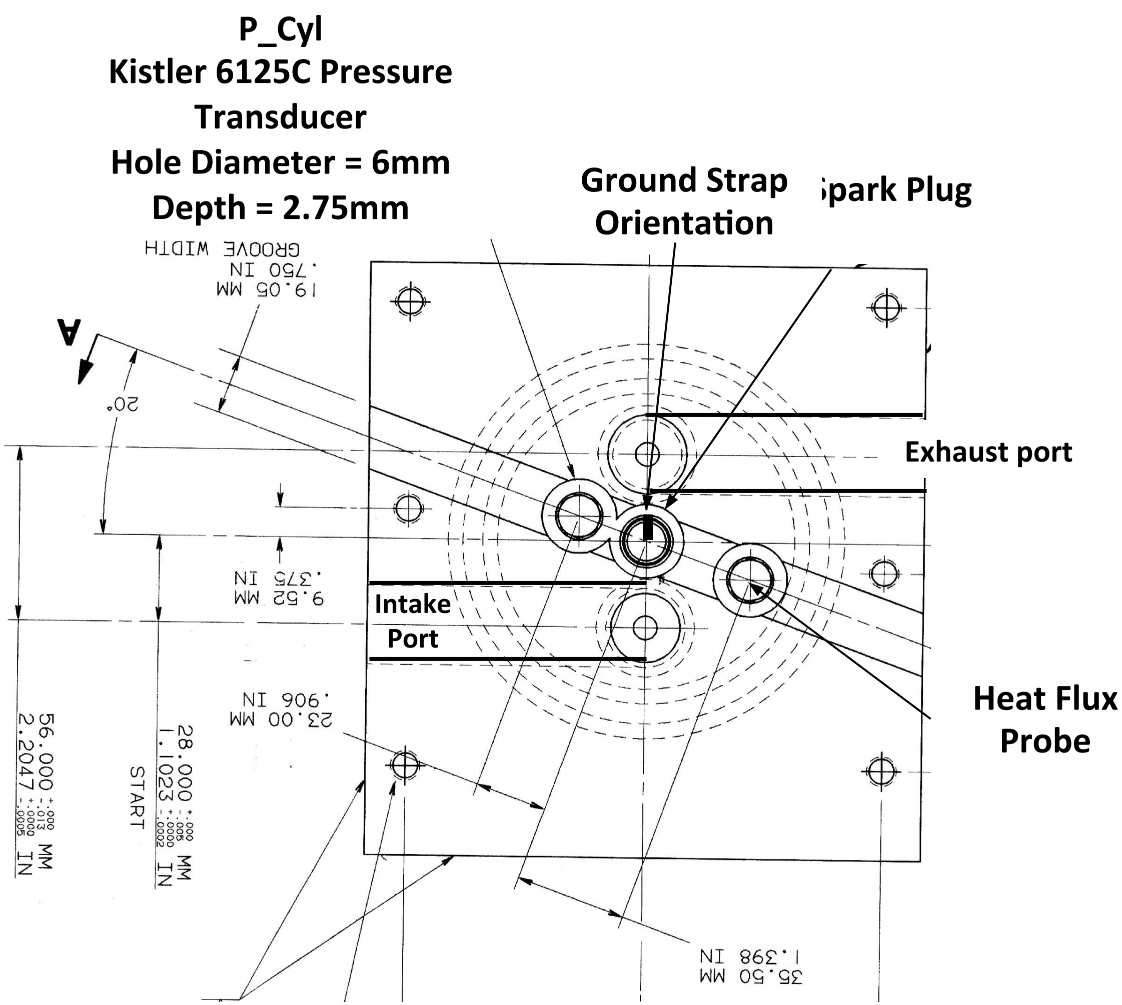


View from front

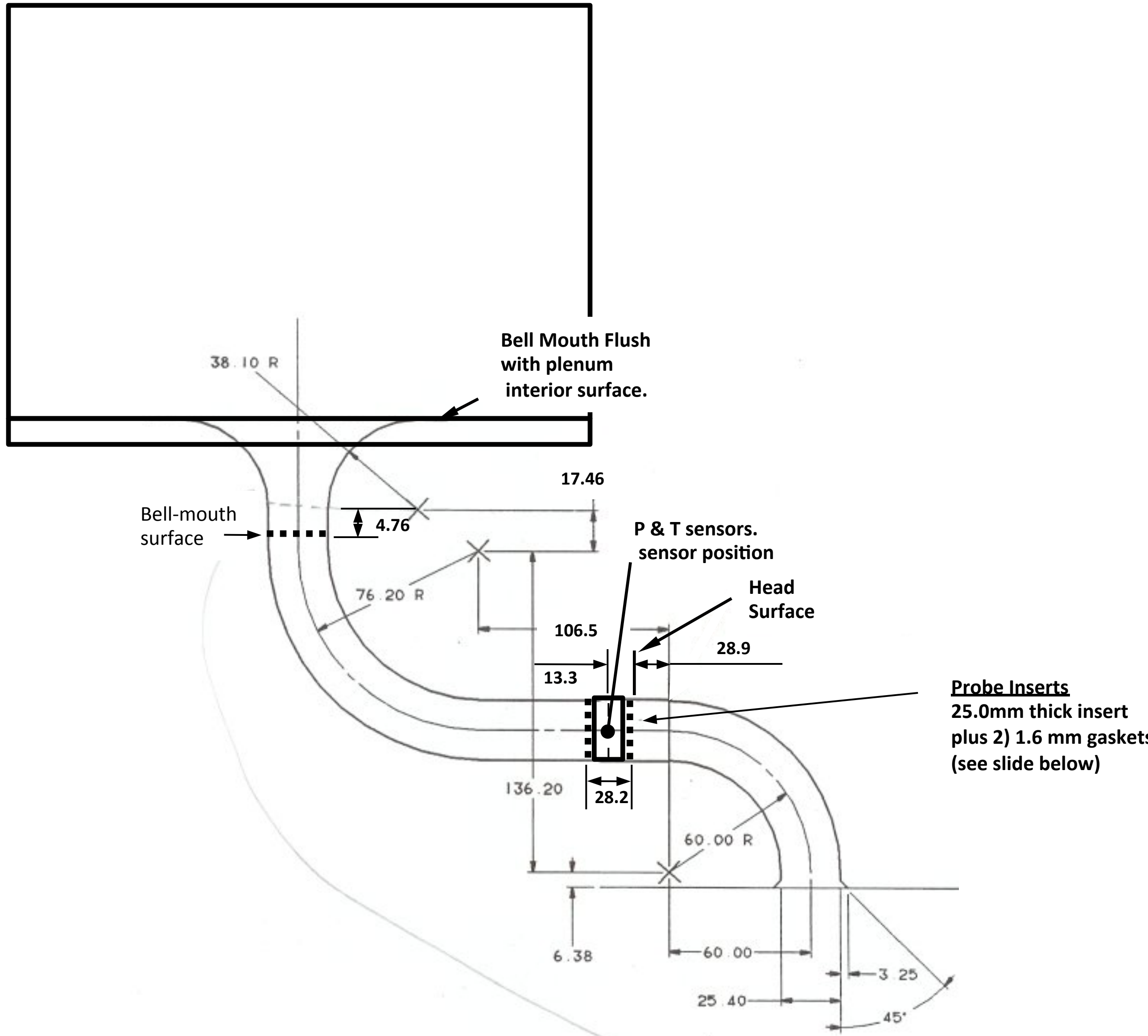


Head

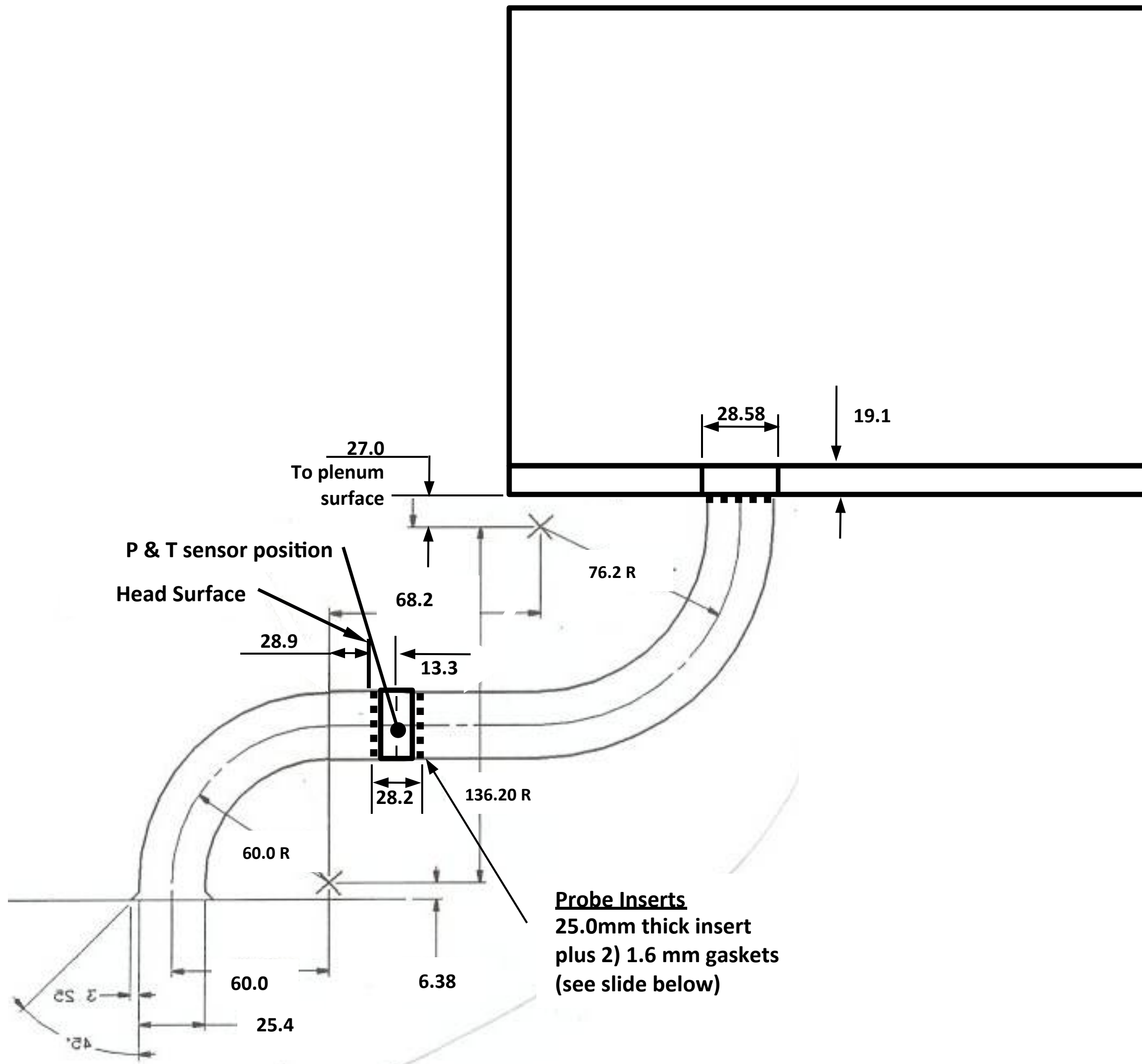
Top View



Intake Runner and Port



Exhaust Runner and Port



Probe Inserts

25.0mm thick insert plus 2) 1.6 mm gaskets (see slide below)

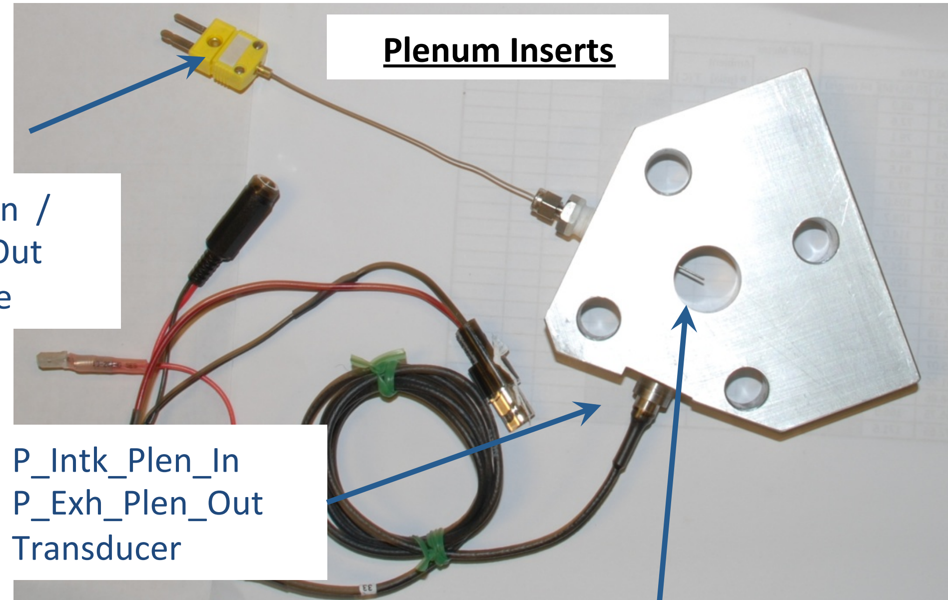
Intake and Exhaust Probe Inserts

For pressure transducers and thermocouples

TCC-II Kulite Transducers shown in photo

Replaced by Kistler transducers in TCC-III

Plenum Inserts

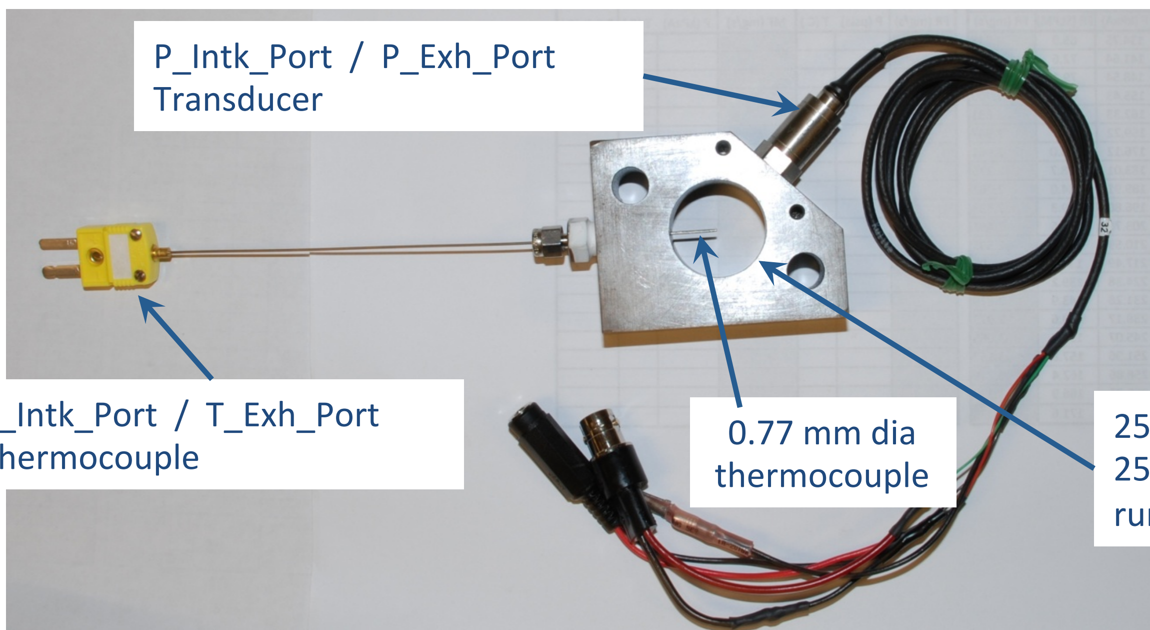


T_Intk_Plen_In / T_Exh_Plen_Out Thermocouple

P_Intk_Plen_In
P_Exh_Plen_Out
Transducer

25.4 mm thick insert
19.1 mm holes to match plenum outlet-pipe I.D.

Runner/port Inserts



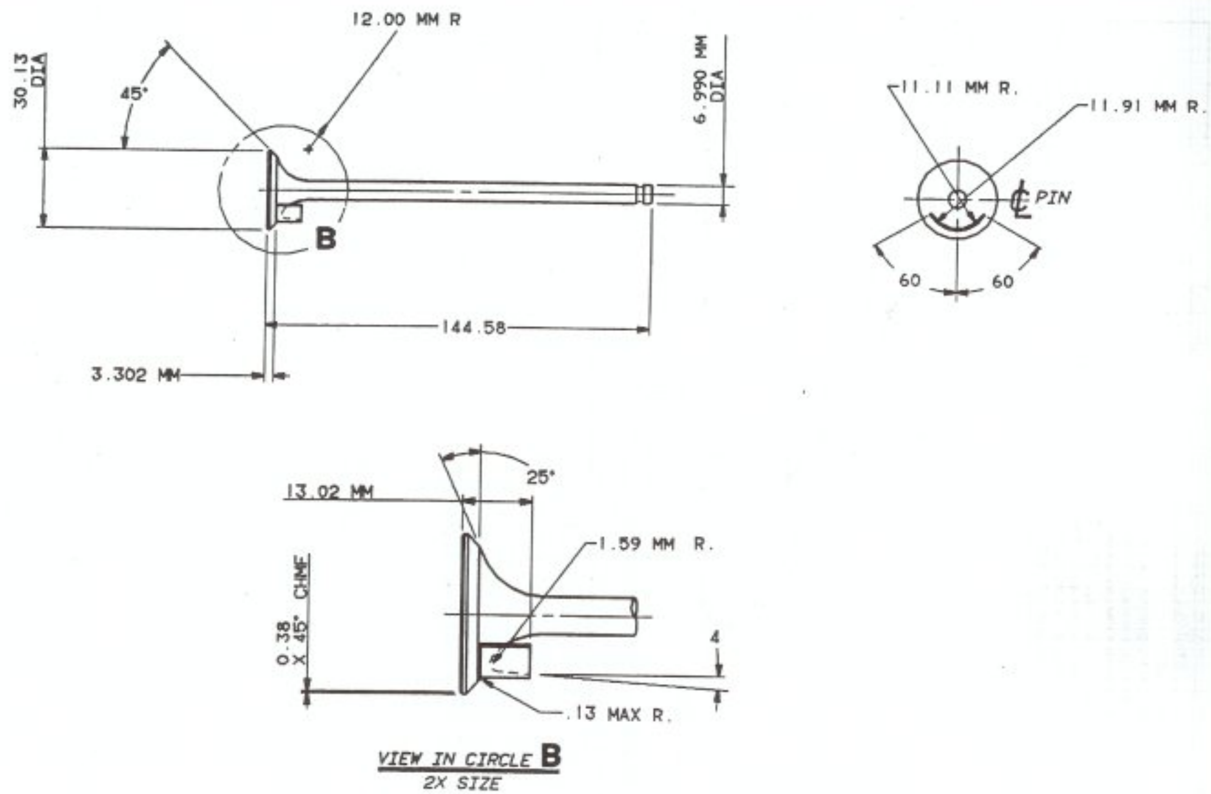
P_Intk_Port / P_Exh_Port Transducer

T_Intk_Port / T_Exh_Port Thermocouple

0.77 mm dia thermocouple

25.4 mm thick insert
25.4 mm holes to match runner and port diameters.

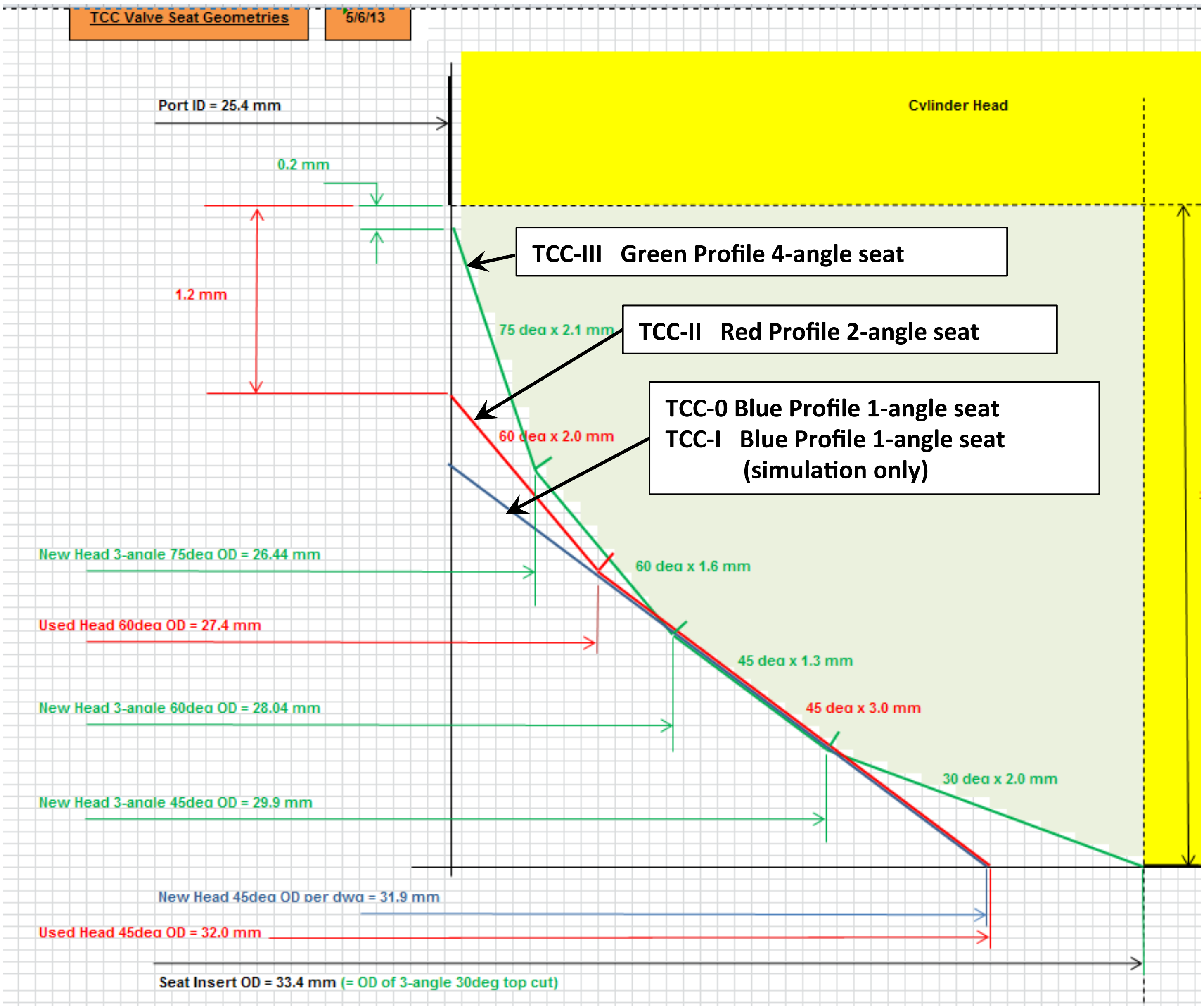
TCC-0 single-angle Valves



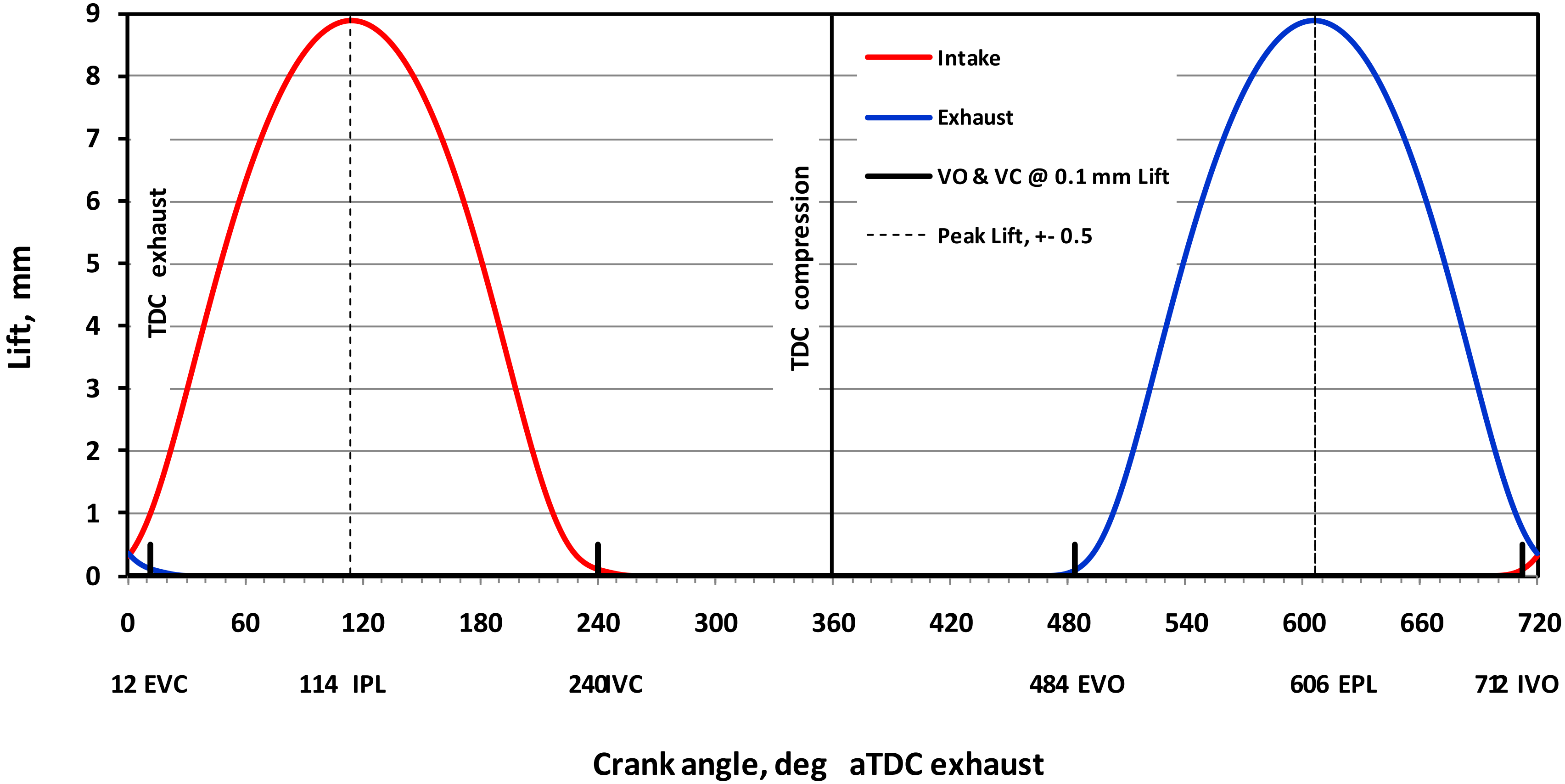
Unshrouded intake valve and exhaust valve are the same but with no shroud.

Figure 3 Details of the TCC-engine shrouded intake valve.

TCC Valve Seat Anthology



Nominal Cam Timing



Cam Profile

Original used for grinding cams

F-252

CAM CONTOUR DATA

ANGLE	OPENING	CLOSING	ANGLE	OPENING	CLOSING
0	8.8900	8.8900	40	3.4591	3.4647
1	8.8864	8.8864	41	3.2182	3.2246
2	8.8758	8.8758	42	2.9780	2.9853
3	8.8580	8.8580	43	2.7397	2.7481
4	8.8331	8.8331	44	2.5045	2.5141
5	8.8011	8.8011	45	2.2736	2.2846
6	8.7620	8.7620	46	2.0485	2.0610
7	8.7158	8.7158	47	1.8306	1.8448
8	8.6625	8.6625	48	1.6212	1.6374
9	8.6021	8.6021	49	1.4218	1.4402
10	8.5346	8.5346	50	1.2337	1.2547
11	8.4600	8.4600	51	1.0582	1.0820
12	8.3783	8.3783	52	0.8963	0.9233
13	8.2896	8.2896	53	0.7490	0.7793
14	8.1939	8.1939	54	0.6167	0.6508
15	8.0911	8.0911	55	0.4997	0.5379
16	7.9813	7.9813	56	0.3979	0.4404
17	7.8646	7.8646	57	0.3109	0.3578
18	7.7409	7.7409	58	0.2379	0.2892
19	7.6102	7.6102	59	0.1776	0.2331
20	7.4727	7.4728	60	0.1290	0.1882
21	7.3284	7.3286	61	0.0904	0.1525
22	7.1772	7.1775	62	0.0605	0.1242
23	7.0194	7.0197	63	0.0381	0.1016
24	6.8548	6.8552	64	0.0220	0.0830
25	6.6837	6.6842	65	0.0113	0.0669
26	6.5061	6.5067	66	0.0047	0.0522
27	6.3222	6.3229	67	0.0014	0.0384
28	6.1320	6.1329	68	0.0002	0.0259
29	5.9357	5.9367	69	0.0000	0.0153
30	5.7335	5.7347	70		0.0074
31	5.5256	5.5271	71		0.0025
32	5.3123	5.3140	72		0.0006
33	5.0939	5.0959	73		0.0000
34	4.8707	4.8730			
35	4.6431	4.6458			
36	4.4116	4.4148			
37	4.1768	4.1805			
38	3.9393	3.9435			
39	3.6998	3.7046			

TDC

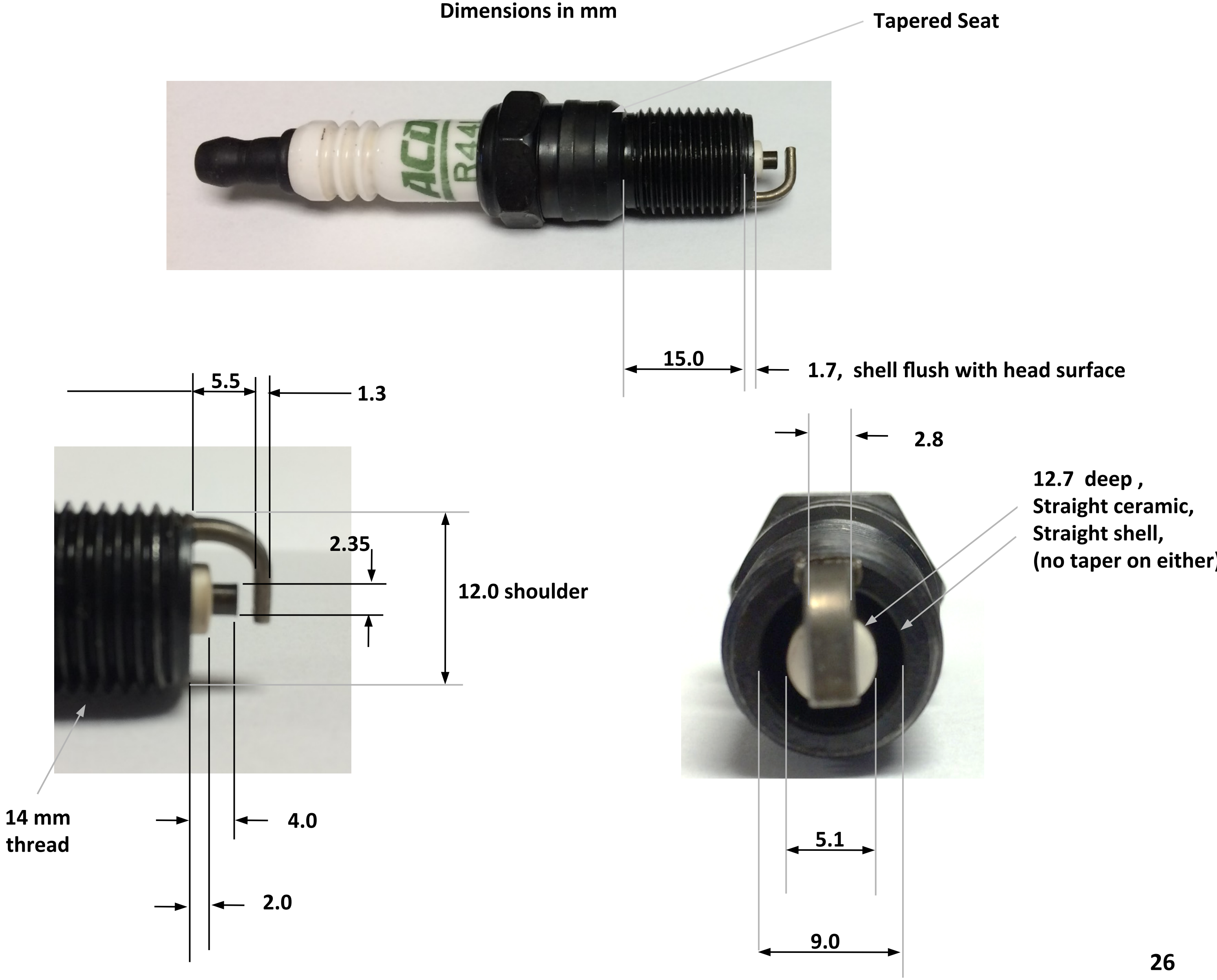
open

closed

Spark Plug

AC Delco R44LTS

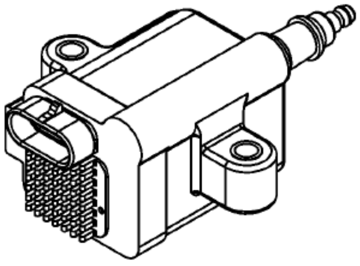
Dimensions in mm



HIGH OUTPUT IGBT COIL
30-2853

The model **30-2853 HO IGBT Coil** is specially designed for racing applications and does not require a CDI or external Igniter to function. This is a very high energy coil so you must take special attention to the quality of the connections. Make sure to apply a liberal amount of dielectric grease to the connector terminals and the tip and body of the spark plugs. Failure to do this may cause arcs to the cylinder head and cause a misfire.

The 30-2853 Kit Contains:
1 High Output IGBT Coil
1 Mating Connector & 6 Contacts



SPECIFICATIONS:

Output (no load):	40kV minimum
Output (50pF load):	40kV +/- 10%
Output Energy:	103 mJ +/- 7%
Peak Secondary Current:	102 mA +/- 10%
Arc Duration:	2.9mS +/- 10%
Turns Ratio	71:1
Maximum Current:	19 Amps
Maximum Battery Voltage:	17 Volts
Base Dwell:	3.0 mS
Max Continuous Dwell:	9 mS but don't exceed 40% duty cycle
Max Intermittent Dwell:	80% duty cycle, 5 seconds maximum
Mating Connector:	Packard/Delphi 12162825 "Pull to Seat"
Mating Contacts:	Packard/Delphi 12124075 "Pull to Seat"
High Tension Wire Terminal:	HEI "spark plug top" Style

PINOUT:
A: Coil Trigger (0-5V signal)
B: Coil Trigger (Ref Ground)
C: Ground to Cylinder Head
D: Battery Ground
E: Battery Positive (Relay or switched ignition)

IMPORTANT!
The contacts are "Pull to Seat" meaning you must feed the wire through the connector housing BEFORE you crimp on the contacts. The wire is then pulled back into the housing and the contact locks in place. The contact cannot be inserted or removed from the rear (wire side entry) of the housing

DWELL:
When setting the dwell the following guidelines should be used:

- Target a base dwell time of 3mS and *only* increase it when needed due to high cylinder pressures.
- The maximum individual coil dwell "ON" time must not exceed 9mS at any time, regardless of engine RPM. Exceeding this time will cause the coil to overheat and fail.
- For continuous duty the maximum "ON" time must remain below 40% duty (on 40% of the time, off 60% of the time). Exceeding this will cause the coil to overheat and fail.
- For short bursts, the coil dwell can go as high as 80% "ON" duty but these forays need to be short (under 5 seconds or so) and cannot be frequent.

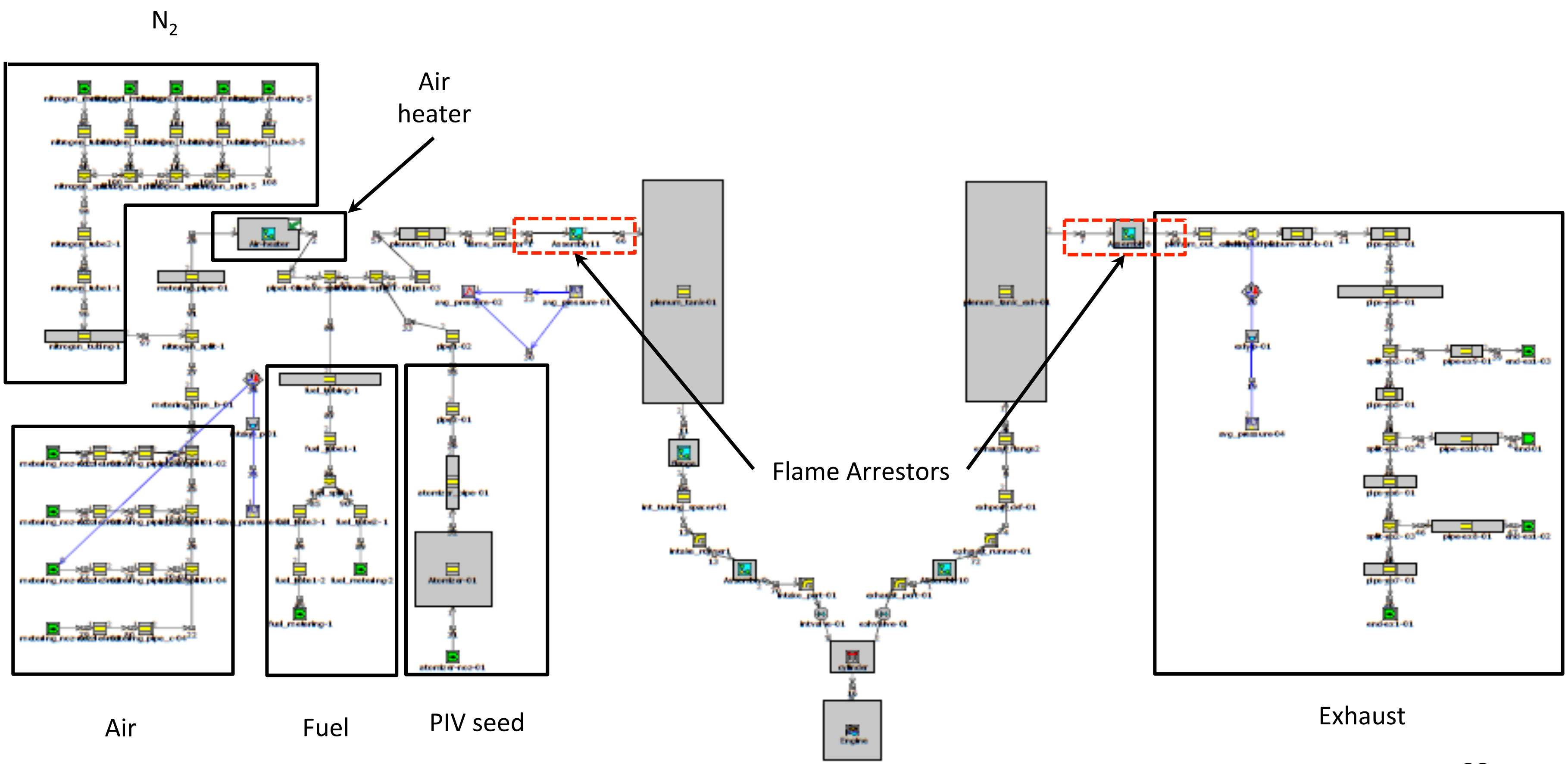
For technical assistance, contact AEM Tech support at emstech@aempower.com

ADVANCED ENGINE MANAGEMENT INC. HTTP://WWW.AEMELECTRONICS.COM
This product is legal in California for racing vehicles only and should never be used on public highways.
Advanced Engine Management, 2205 126th Street Unit A Hawthorne, CA. 90250, Phone: (310) 484-2322

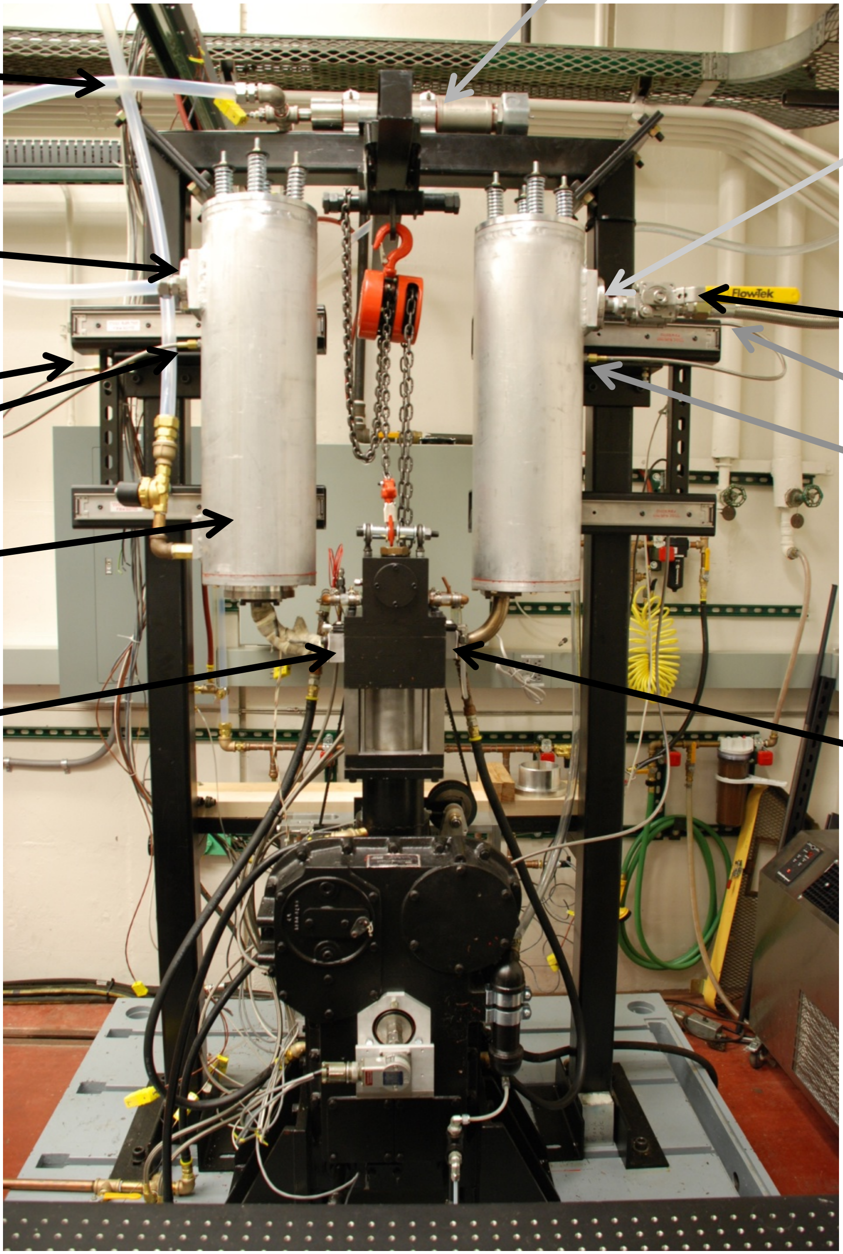
TCC-III GT-Power Summary of Intake and Exhaust Systems

The following slides provides detailed information on the intake and exhaust system geometries. This was used to create the GTPower 1-D model .gtm and .gdx files (located in the TCC-III_Geometry directory shown in Slide 10). In addition, the geometry slides define the nomenclature and locations of the pressure transducers and thermocouples cataloged in the Pressure Data Files.

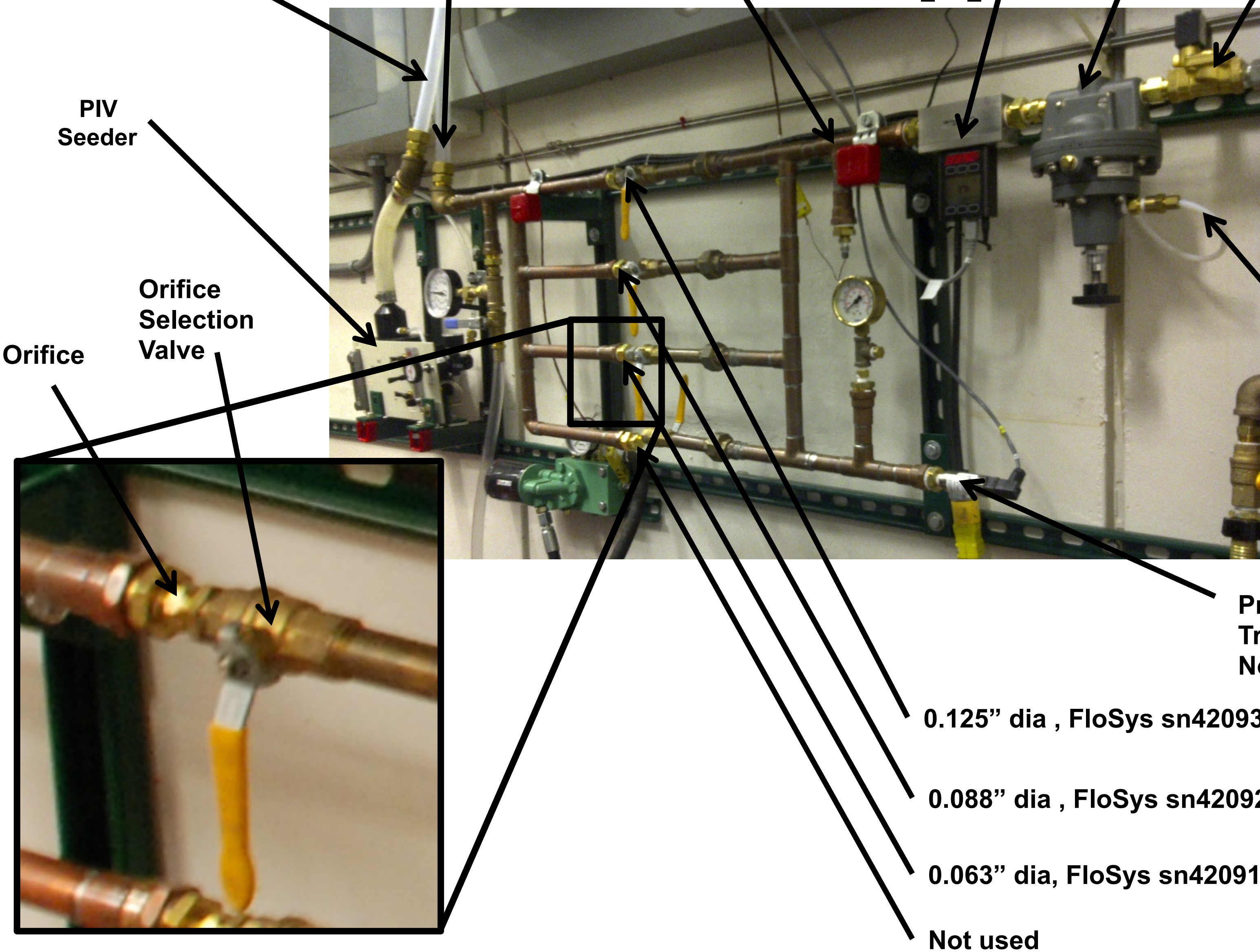
Scanned figures of original printed material are used to avoid transposition errors. The Deep Blue Data TCC-III Collection README file contains errata, which are updated as they become available.



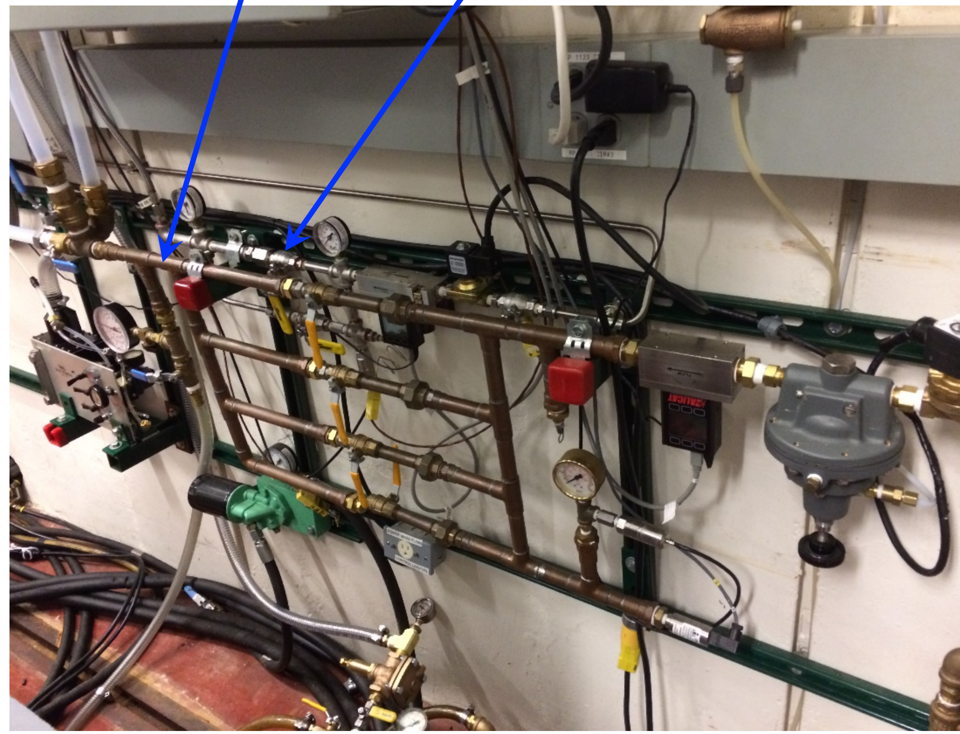
TCC-II Engine & Systems



TCC-II Critical Flow Metering System, Air only



TCC-III Critical Flow Fuel Metering Systems, Air & Fuel

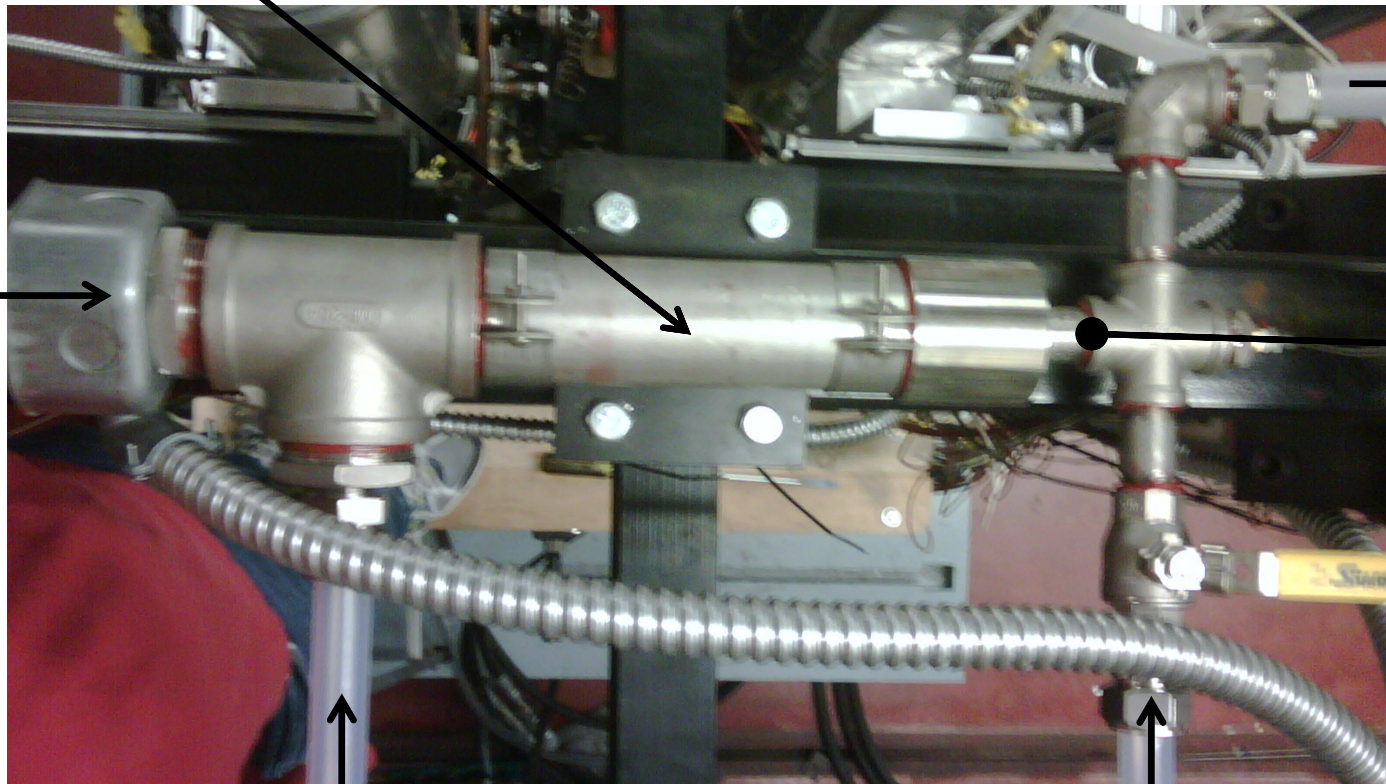


Air Heater

5.1 cm I.D., 34 cm Lg.

Insulation not shown

Immersion Heater

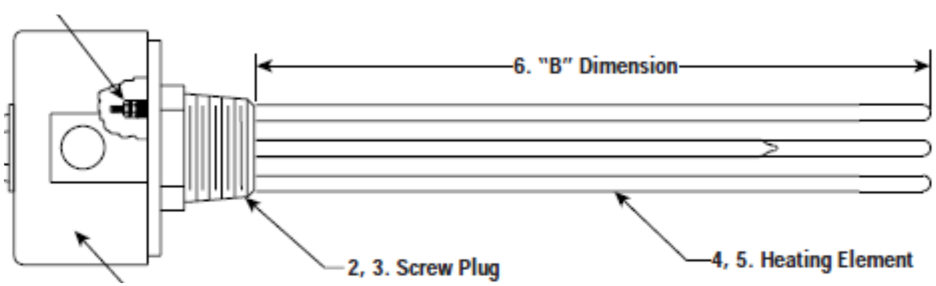


To Plenum Inlet
MF_Air_Tot

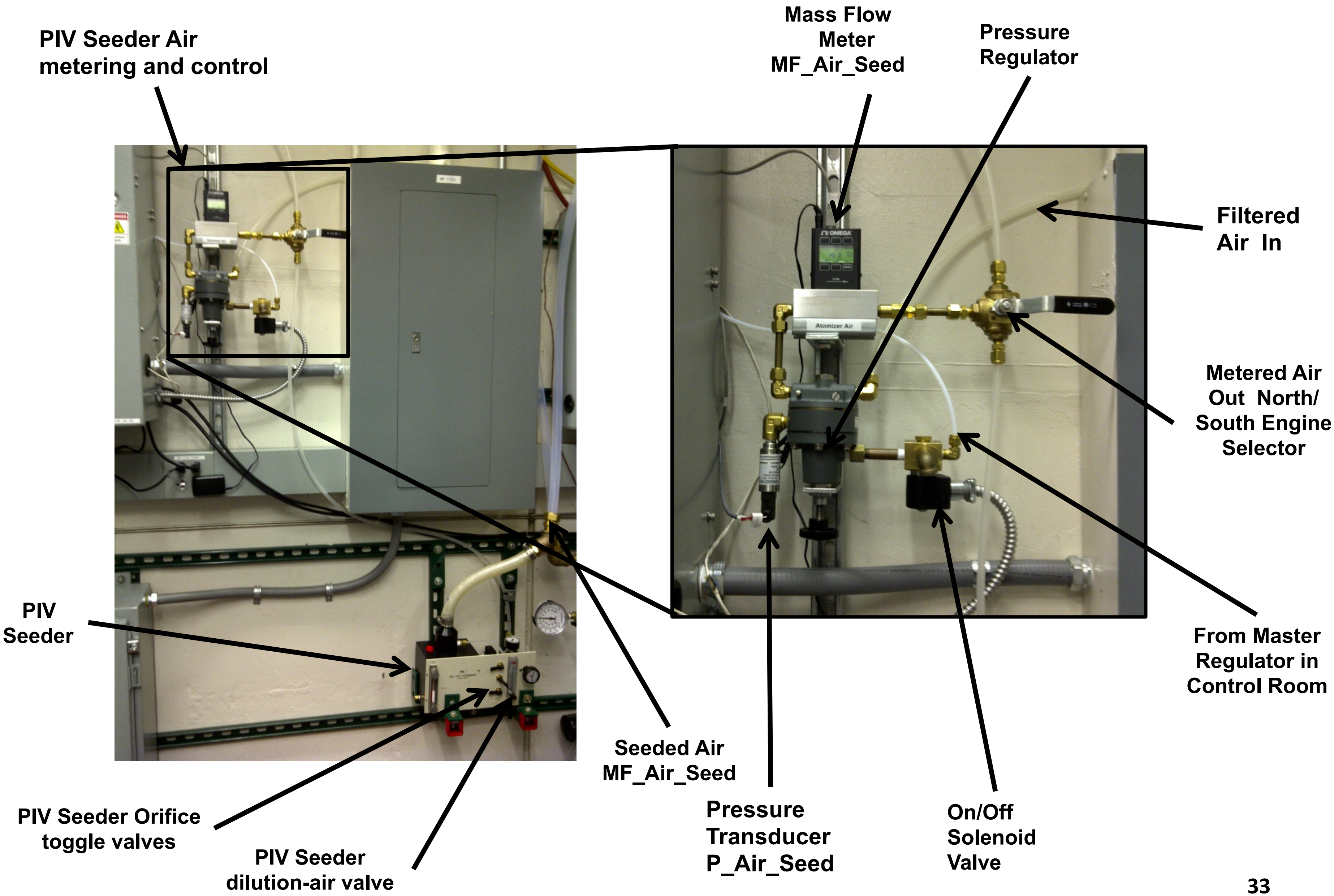
T_Air_Heater

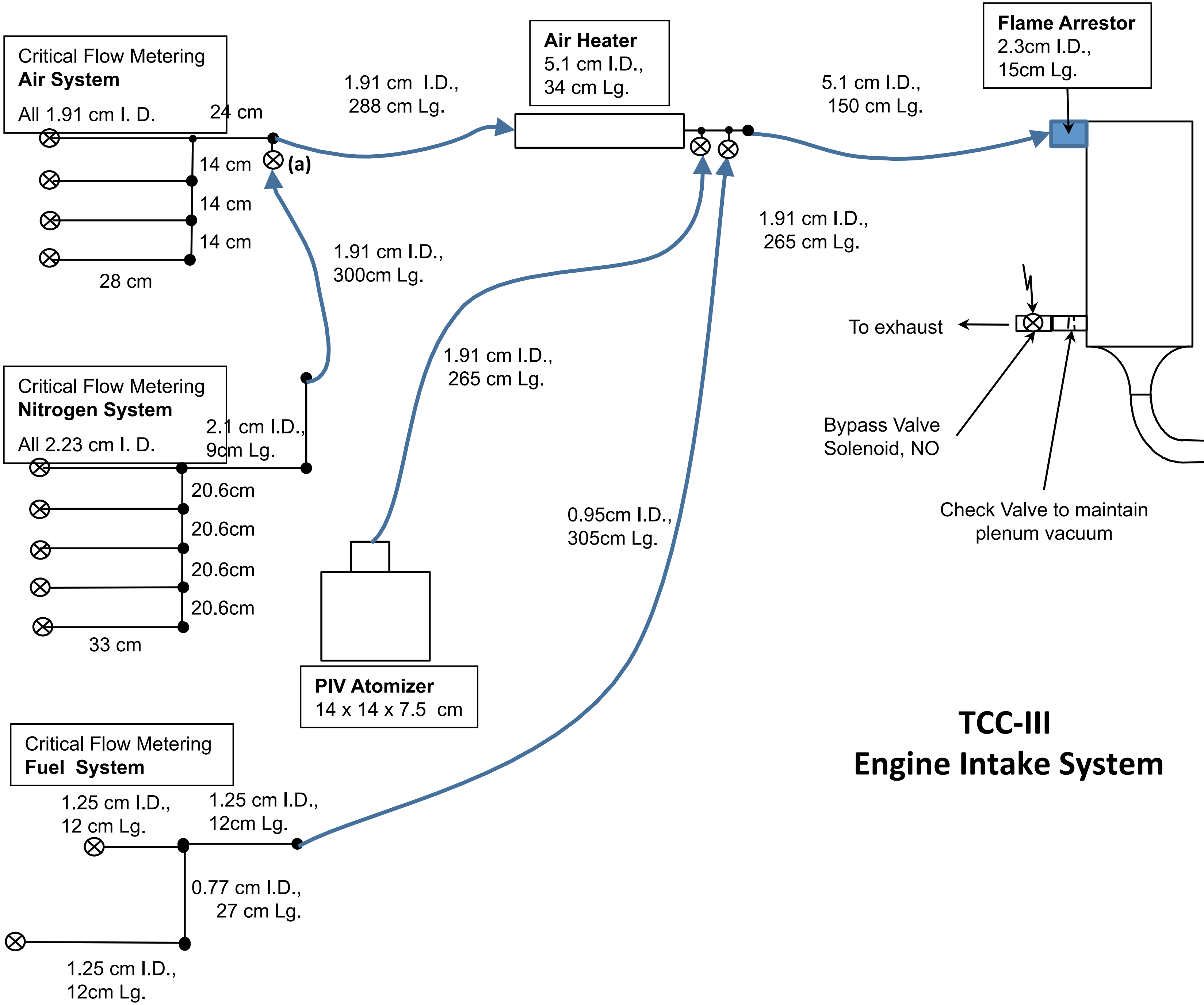
Metered Air From
Critical Flow Metering System
MF_Air_Crit, T≅ ambient

Metered Air From
PIV Atomizer
MF_Air_Seed, T≅ ambient



Seeder Flow-Metering System,





TCC-III
Engine Intake System

TCC-III Engine Exhaust System