

INTRODUCTORY FUEL CELL DESIGN GUIDE

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WORLD HEADQUARTERS

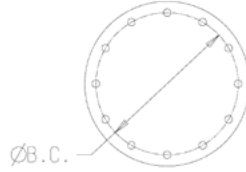
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EUROPEAN OPERATIONS

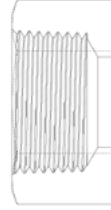
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SECTION I: NOMENCLATURE

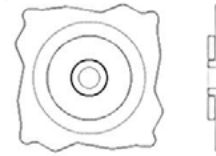
- 1.) B.C.- Bolt circle diameter



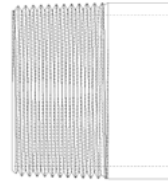
- 2.) FNPT- Female national pipe thread, Tapered



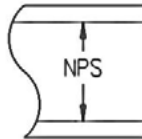
- 3.) ISO - Integrated Structure Option: A rigid "Hard Point" which can be readily machined and then vulcanized or "Integrated" into the bladder skin. Hard points are used to accommodate bulkhead fittings, sensors, inspection ports, and tether points on the bladder.



- 4.) MNPT - Male national pipe thread, Tapered



- 5.) NPS - Nominal pipe size



- 6.) Obround - two semi-circles connected by parallel lines

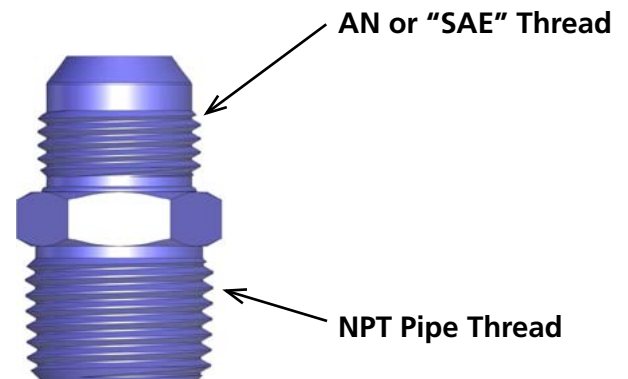


- 7.) S S - Stainless Steel (Corrosion Resistant Metal)

- 8.) Adaptors

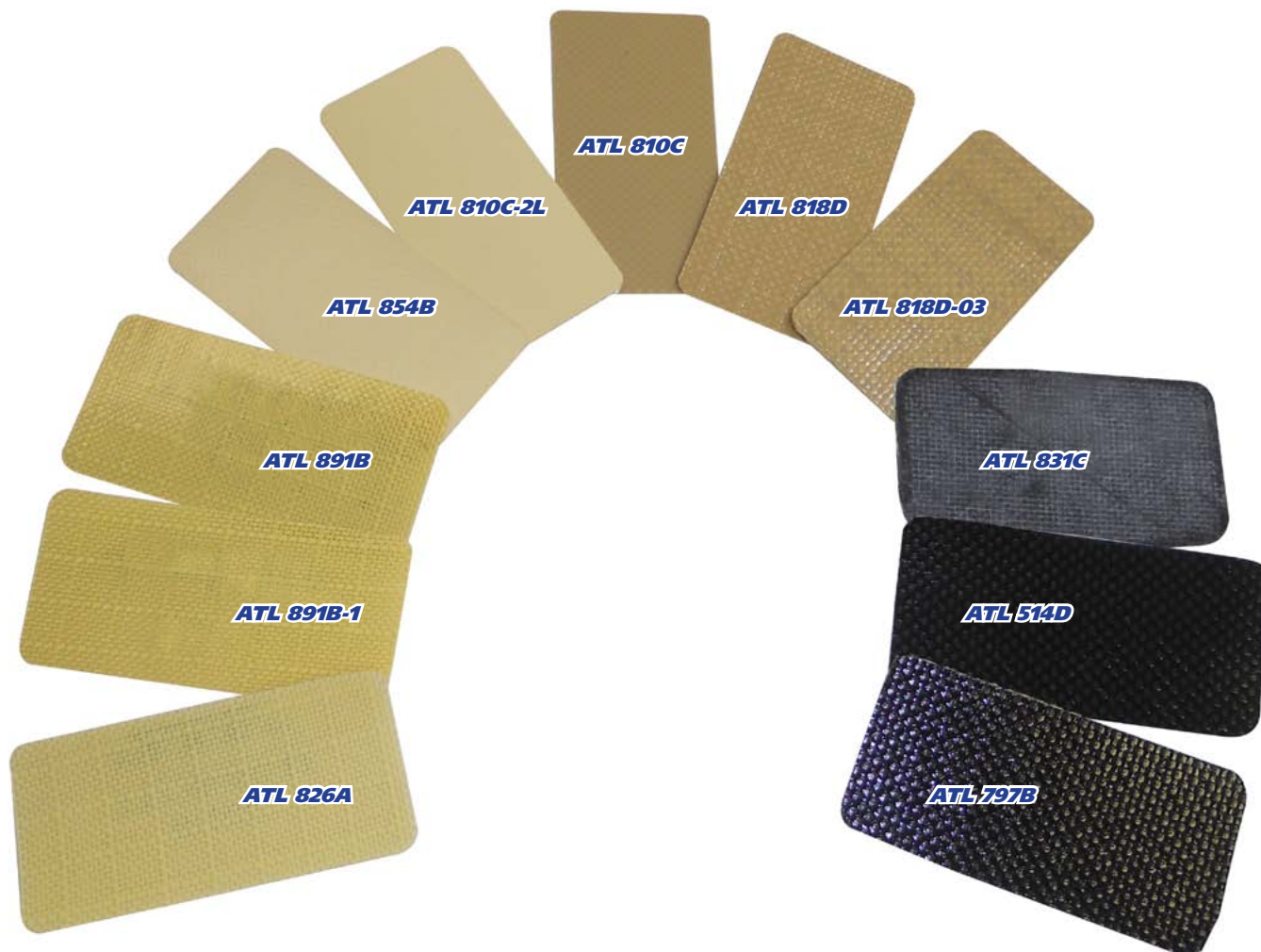
"AN" to NPT Adapter Sizing Chart				
AN Number	SAE Thread	Nominal ID (inches)	Nominal ID (cm)	NPT
-4	7/16-20	1/4	0.635	1/4-18
-5	1/2-20	5/16	0.794	N/A*
-6	9/16-18	3/8	0.953	3/8-18
-8	3/4-16	1/2	1.27	1/2-14
-10	7/8-14	5/8	1.588	N/A*
-12	1 1/16-12	3/4	1.905	3/4-14
-16	1 5/16-12	1	2.54	1-11.5

**Upsize to the next largest pipe thread*



SECTION II: MATERIALS

ATL offers many different bladder materials to suit customer needs for NASCAR, FIA, SCORE, SCCA, IMSA, Grand AM, ALMS, World of Outlaws, or any specific requirements you might have.



ATL Rubberized Fabric Materials

Part No.	Minimum Tensile (lbs/in)	Nominal Weight		Nominal Thickness		Fuel Compatability	
		oz/sq. yd	kg/sq. m	in	mm		
ATL 514D	1000	49	1.661	0.060	1.524	Petroleum Fuels Only Max 15% Ethanol	FIA FT 3.5
ATL 797B	1000	29	0.983	0.032	0.813	Petroleum Fuels Only Max 15% Ethanol	FIA FT 3.5
ATL 810C	500	40	1.356	0.055	1.397	Petroleum Fuels Only Max 15% Ethanol	FIA FT 3
ATL 810C-2	500	50	1.695	0.061	1.549	Petroleum Fuels Only Max 15% Ethanol	FIA FT 3
ATL 810C-2L	500	40	1.356	0.050	1.270	Petroleum Fuels Only Max 15% Ethanol	FIA FT 3
ATL 818D	2000	37	1.255	0.045	1.143	Petroleum Fuels Only Max 15% Ethanol	FIA FT 5
ATL 818D-03	2000	37	1.255	0.050	1.270	Petroleum Fuels Only Max 15% Ethanol	FIA FT 5
ATL 826A	500	25	0.848	0.026	0.660	Petroleum Fuels Only Max 15% Ethanol	FIA FT 3
ATL 891B	1000	30	1.017	0.033	0.838	All Fuels Except Nitromethane	FIA FT 3.5
ATL 891B-1	1000	33	1.119	0.033	0.838	All Fuels Except Nitromethane	FIA FT 3.5
ATL 893B	300	56	1.899	0.045	1.143	All Fuels Except Nitromethane	N/A
ATL 831C	500	40	1.356	0.046	1.168	Methanol and Ethanol	FIA FT 3 EQUIV.

EXAMPLES OF CUSTOM FUEL BLADDERS MADE FROM VARIOUS ATL MATERIALS



ATL 818D BLADDER MATERIAL



ATL 797B BLADDER MATERIAL



ATL 810C-2L BLADDER MATERIAL



ATL 810C BLADDER MATERIAL



ATL 826A BLADDER MATERIAL



ATL 891B BLADDER MATERIAL

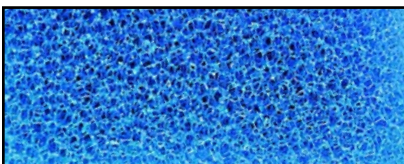
SECTION III: SAFETY FOAM BAFFLING

ATL's foam baffling materials are sponge-like "blocks" which fill the interior of a fuel cell bladder tank. These "reticulated" (open cell) foam rubber "blocks" serve to suppress explosion and damp out fuel surging or sloshing while supporting the rubber bladder in its container. Foam baffling is sold by the cubic foot ($1.0\text{ft}^3 = 7.5$ U.S. gallons) or by the cubic meter ($0.1\text{m}^3 = 100$ liters or 26 U.S. gallons). Generally speaking, ATL safety foam displaces about 2% of fuel tank volume and retains about 1/2% of fuel load as "clingage".

ATL Foam Baffling:



SF103: 10 to 18 pores per inch, 1.4 lb/ft³ nominal. Accepts gasoline, oil, diesel, kerosene, race gas, Avgas and JP fuels.



SF105: 10 to 18 pores per inch, 1.4 lb/ft³ nominal. Accepts gasoline, oil, diesel, JP fuels, kerosene, race gas, Avgas, oxygenated gasoline with some tolerance for methanol and ethanol (inspect regularly).
***SPECIAL ORDER ONLY**



SF110: 15 to 25 pores per inch, 1.5 lb/ft³ nominal. Accepts gasoline or alcohol. Special "Conductive" compound for anti-static in fast-fill applications. Required by FIA in all cars designed for pit-stop refueling.



SF112: 4 to 8 pores per inch, 1.2 lb/ft³ nominal. Accepts gasoline, oil, diesel, JP fuels, race gas and Avgas. Special low density for minimum clingage plus faster filling and venting during pit stops.

Military Specification Foam Baffling:

- Per Mil-B-83054 Type I through Type V
- Per Mil-F-87260 Type VI through Type IX

See Chart on Next Page



TYPICAL SAFETY FOAM BAFFLING SPECIFICATIONS
*Physical Properties and Characteristics of Types I through V per **Mil-B-83054***

Property	Type I	Type II	Type III	Type IV	Type V
Color	Orange	Yellow	Red	Dark Blue	Light Blue
Polyol Type	Polyester	Polyester	Polyester	Polyether	Polyether
Density Range (lb/ft ³)	1.70 - 2.00	1.20 - 1.45	1.20 - 1.45	1.20 - 1.45	1.20 - 1.45
Porosity, Pore Size (ppi)	7 - 15	8 - 18	20 - 30	8 - 18	24 - 34
Air Pressure Drop (in. of water)	.190 - .285	.140 - .230	.250 - .330	.14 - .230	.270 - .370
Tensile Strength (psi) Min	15	15	15	10	15
Tensile Strength at 200% Elongation (%) Min	10	10	10	---	---
Ultimate Elongation (%) Min	220	220	220	100	100
Tear Resistance (lb/in) Min	5	5	5	3	3
Constant Deflection Compression Set (%) Max	30	35	35	30	30
Compression Load Deflection at:					
25% Deflection (psi) Min	.40	.30	.30	.35	.35
65% Deflection (psi) Min	.60	.50	.50	.60	.60
Fuel Displacement (Max Vol. %)	3.0	2.5	2.5	2.5	2.5
Fuel Retention (Max Vol. %)	2.5	2.5	4.5	2.5	5.0
Flammability (in/min) Max	10	15	15	15	15
Extractable Materials (Wt.%) Max	3.0	3.0	3.0	3.0	3.0
Low Temperature Flexibility (-55°F)	/1/	/1/	/1/	/1/	/1/
Entrained Solid Contamination (mg/ft ³) Max	11.0	11.0	11.0	11.0	11.0
Steam Autoclave Exposure (% Tensile Loss) Max					
Type I, II, III, 5 h @ 250°F	40	40	40	---	---
Type IV, and V 10 h @ 250°F	---	---	---	30	30
Typical Electrical Resistivity (OHM - CM)	1 x 10 ¹³	8 x 10 ¹³	8 x 10 ¹³	1 x 10 ¹⁵	1 x 10 ¹⁵
Projected Life Expectancy (Years)	2 - 10	2.5 - 10	2.5 - 10	10 - 50	10 - 50
Recomm. for New Aircraft Design App.	No	No	No	No	No

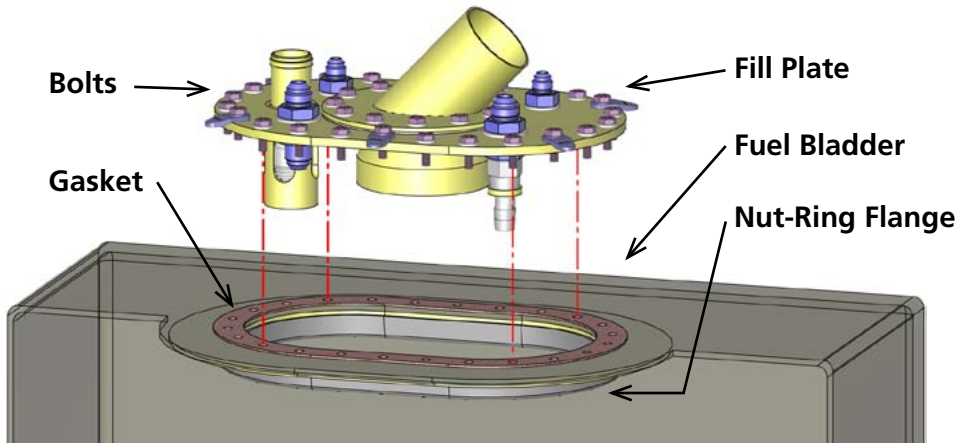
TYPICAL SAFETY FOAM BAFFLING SPECIFICATIONS
Physical Properties and Characteristics of Types VI through IX per *Mil-F-87260*

Property	Type VI	Type VII	Type VIII (In Situ Grade)	Type IX (In Situ Grade)
Color	Dark Beige	Light Beige	Black	Grey
Polyol Type	Polyether	Polyether	Polyether	Polyether
Density Range (lb/ft ³)	1.20 - 1.55	1.20 - 1.55	1.20 - 1.55	1.20 - 1.55
Porosity, Pore Size (ppi)	8 - 18	24 - 34	8 - 18	24 - 34
Air Pressure Drop (in. of water)	.140 - .230	.270 - .370	.250 - .330	.270 - .370
Tensile Strength (psi) Min	15	15	15	10
Tensile Strength at 200% Elongation (%) Min	10	15	10	15
Ultimate Elongation (%) Min	100	100	100	100
Tear Resistance (lb/in) Min	3	3	3	3
Constant Deflection Compression Set (%) Max	45	45	45	45
Compression Load Deflection at:				
25% Deflection (psi) Min	.35	.35	.35	.35
65% Deflection (psi) Min	.60	.60	.60	.60
Fuel Displacement (Max Vol. %)	2.5	2.5	2.5	2.5
Fuel Retention (Max Vol. %)	2.5	5.0	2.5	5.0
Flammability (in/min) Max	15	15	15	15
Extractable Materials (Wt.%) Max	3.0	3.0	3.0	3.0
Low Temperature Flexibility (-55°F)	/1/	/1/	/1/	/1/
Entrained Solid Contamination (mg/ft ³) Max	11.0	11.0	11.0	11.0
Steam Autoclave Exposure (% Tensile Loss) Max				
Type VI, and VII 10 h @ 250°F	30	30	30	30
Typical Electrical Resistivity (OHM - CM)	1 x 10 ⁷ to 5 x 10 ¹¹	1 x 10 ⁷ to 5 x 10 ¹	1 x 10 ⁷ to 5 x 10 ¹	1 x 10 ⁷ to 5 x 10 ¹
Resistivity Uniformity	/2/	/2/	/2/	/2/
Projected Life Expectancy (Years)	10 - 50	10 - 50	10 - 50	10 - 50
Recomm. for New Aircraft Design App.	Yes	Yes	Yes	Yes

/1/ No Cracking or Breaking of Strands
/2/ Two Orders of Magnitude From Top of Foam Bun to Bottom of Foam Bun

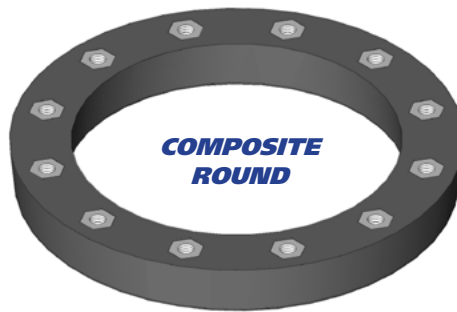
SECTION III: NUT-RING FLANGES AND COVER PLATES

Nut-Rings are attachment flanges for securing access plates, fill necks, gauges, vents, etc. ATL provides Composite, Cast Aluminum, and Machined Aluminum Nut-Rings in a variety of sizes, thread standards, and shapes to meet your needs. Composite Nut-rings can be cross drilled in order to aid in optimum venting. This fuel cell bladder cut-away drawing displays a typical Nut-Ring application.



ATL Standard Round Nut-Ring Flanges (All Insert Threads SAE 1/4-28)								
Part No.	B.C. (in)	No. Inserts	I.D. (in)	O.D. (in)	Material	Availability	Insert Type	Color
162-4	1.625	4	1.000	2.312	Cast Alum.	Stock	Steel	Natural
200-6	2.000	6	1.365	2.756	Fabricated Alum.	Stock	Steel	Natural
TF489	2.188	6	1.440	2.937	Composte	Stock	Steel	Black
TF489-BR	2.188	6	1.440	2.937	Composite	Stock	Brass	Black
237-6	2.375	6	1.750	3.062	Fabricated Alum.	Stock	Steel	Natural
275-8	2.750	8	2.125	3.437	Fabricated Alum.	Special Order	Steel	Natural
TF435	3.000	6	2.375	3.625	Composite	Stock	Steel	Black
TF435-BR	3.000	6	2.375	3.625	Composite	Stock	Brass	Black
312-10	3.125	10	2.500	3.812	Fabricated Alum.	Stock	Steel	Natural
350-8	3.500	8	2.875	4.188	Fabricated Alum.	Special Order	Steel	Natural
400-8	4.000	8	3.250	4.750	Fabricated Alum.	Special Order	Steel	Natural
425-9	4.250	9	3.625	4.875	Fabricated Alum.	Stock	Steel	Natural
TF412	4.750	12	4.00	5.500	Composite	Stock	Steel	Black
TF412-BR	4.750	12	4.00	5.500	Composite	Stock	Brass	Black
512-16	5.125	16	4.375	5.875	Fabricated Alum.	Special Order	S.S.	Natural
600-16	6.000	16	5.250	6.750	Fabricated Alum.	Stock	S.S.	Natural
725-16	7.250	16	6.500	8.000	Fabricated Alum.	Special Order	S.S.	Natural
787-18	7.875	18	7.125	9.125	Fabricated Alum.	Special Order	S.S.	Natural
912-20	9.125	20	9.500	8.750	Fabricated Alum.	Special Order	S.S.	Natural

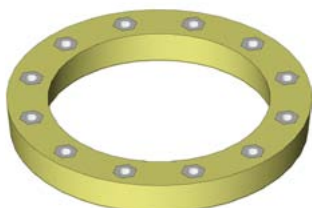
TYPICAL SAE ROUND NUT-RINGS



ATL Standard Metric Round Nut-Ring Flanges (All Insert Threads Metric M6 x 1)

Part No.	B.C. (mm)	No. Inserts	I.D. (mm)	O.D. (mm)	Material	Availability	Insert Type	Color
TF489M	55.575	6	36.576	74.600	Composite	Stock	Steel	Yellow
TF435M	76.200	6	60.325	92.075	Composite	Stock	Steel	Yellow
TF412M	120.650	12	101.600	139.700	Composite	Stock	Steel	Yellow

TYPICAL METRIC ROUND NUT-RINGS



**METRIC
COMPOSITE
ROUND**

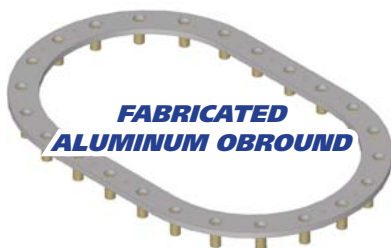


**METRIC
COMPOSITE ROUND
W/ CROSS DRILLING**

ATL Standard Obround Nut-Rings (All Insert Threads SAE 1/4 - 28)

Part No.	No. Inserts	Outside Dimensions	Material	Insert Type	Color
TF447	12	5.00" x 7.14"	Composite	Steel	Black
TF447-BR	12	5.00" x 7.14"	Composite	Brass	Black
TF386	24	7.63" x 11.63"	Composite	Steel	Black
TF386-BR	24	7.63" x 11.63"	Composite	Brass	Black
TF583	26	340 x 240 mm	Fabricated Alum.	Steel	Natural
TF656	36	420 x 220 mm	Fabricated Alum.	Steel	Natural
TF337	36	11.60" x 17.60"	Fabricated Alum.	Steel	Natural
TF337-WF	36	12.63" x 18.63"	Fabricated Alum.	Steel	Natural

TYPICAL SAE OBROUND NUT-RINGS



**FABRICATED
ALUMINUM OBROUND**



**COMPOSITE
OBROUND**

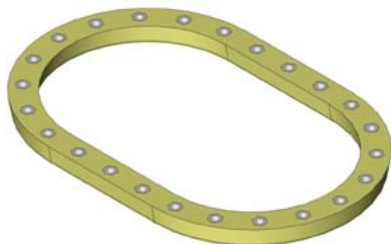


**COMPOSITE OBROUND
W/ CROSS DRILLING**

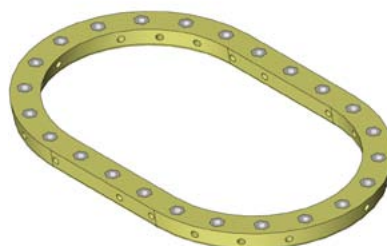
ATL Standard Metric Obround Nut-Ring Flanges (All Insert Threads Metric M6 x 1)

Part No.	No. Inserts	Outside Dimensions	Material	Insert Type	Color
TF447M	12	127.0 x 181.4 mm	Composite	Steel	Yellow
TF386M	24	193.8 x 295.4 mm	Composite	Steel	Yellow

TYPICAL METRIC OBROUND NUT-RINGS



**METRIC
COMPOSITE
OBROUND**



**METRIC
COMPOSITE OBROUND
W/ CROSS DRILLING**

TYPICAL CUSTOM DESIGNED NUT-RING FLANGES**LARGE ACCESS****AIRFOIL
SHAPE****LIMITED
ACCESS**

ACCESS/COVER PLATES

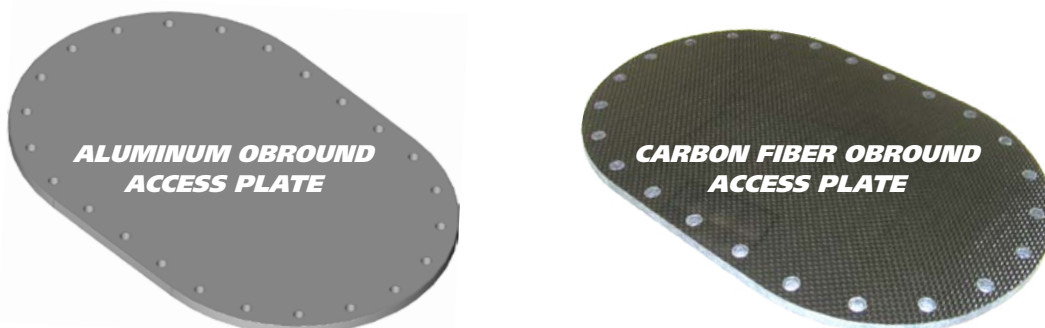
ATL Standard Blank Access Plates, Circular					
Part No.	B.C. (in)	O.D. (in)	Thickness (in)	Material	Fits Nut-Ring(s)
TF266	1.625	2.305	0.19	Alodined Aluminum	162-4
TF494	2.188	2.935	0.19	Alodined Aluminum	ALL TF489
TF338	2.375	3.053	0.19	Alodined Aluminum	237-6
TF108	3.000	3.625	0.19	Alodined Aluminum	ALL TF435
TF485 **	3.125	3.765	0.19	Alodined Aluminum	312-10
TF107	4.750	5.500	0.19	Alodined Aluminum	ALL TF412
TF486 **	6.000	6.750	0.19	Alodined Aluminum	600-16
TF440 **	7.250	8.000	0.19	Alodined Aluminum	725-16

** - Denotes Special Order Item

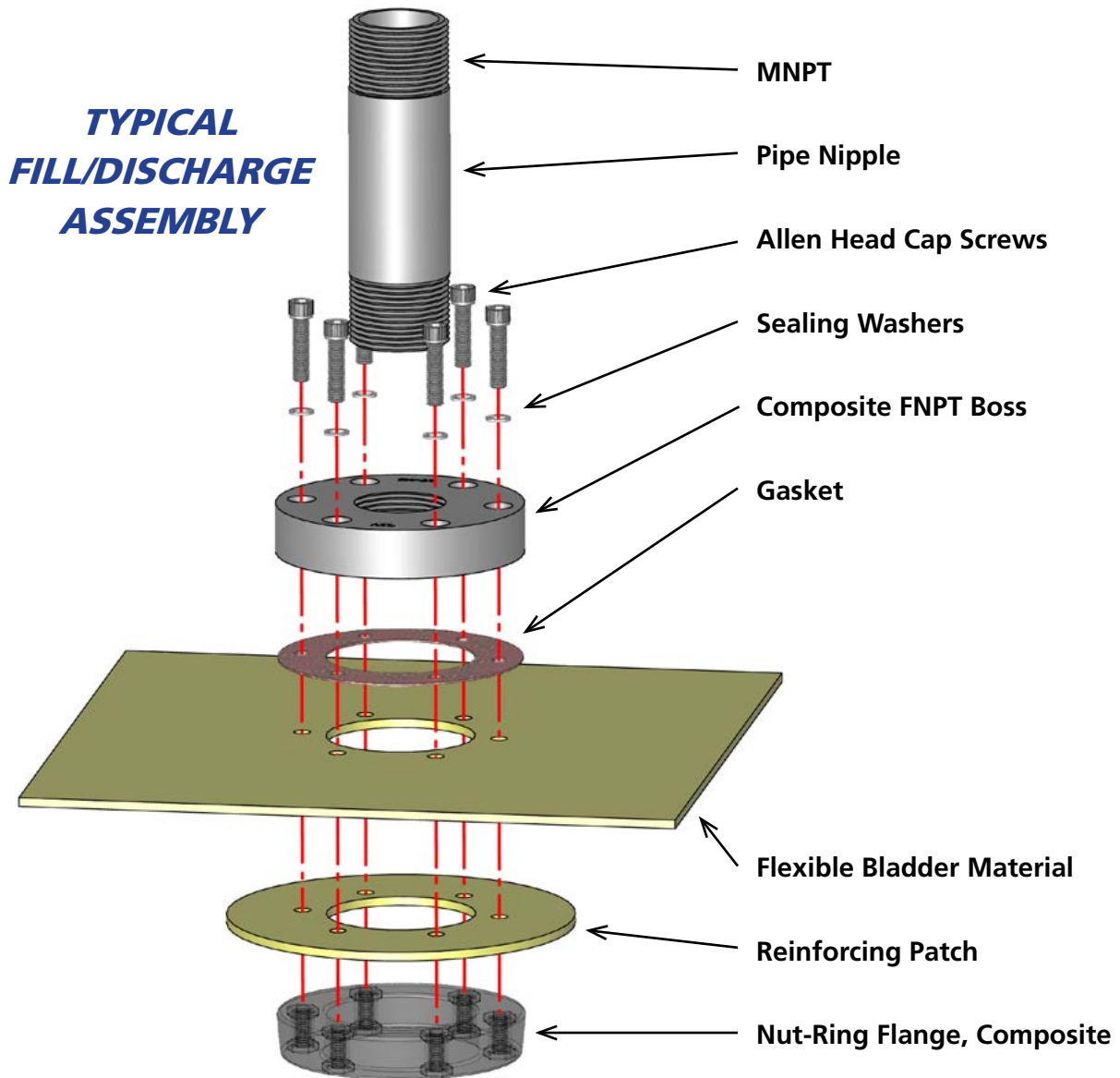
TYPICAL BLANK CIRCULAR ACCESS PLATES


ATL Standard Blank Access Plates, Obround				
Part No.	Dimensions	Thickness	Material	Fits Nut-Ring(s)
TF109	5.00" x 7.14"	0.19"	Alodined Aluminum	ALL TF447
TF110A	7.63" x 11.63"	0.19"	Alodined Aluminum	ALL TF386
TF110A-250	7.63" x 11.63"	0.25"	Alodined Aluminum	ALL TF386
TF406	10" x 16"	0.19"	Alodined Aluminum	TF337
TF542	340 x 240 mm	4.83 mm	Alodined Aluminum	TF583
TF657	420 x 220 mm	4.83 mm	Alodined Aluminum	TF656
TF109CF **	5.00" x 7.14"	0.19"	Carbon Fiber	ALL TF447
TF110CF **	7.63" x 11.63"	0.19"	Carbon Fiber	ALL TF386

** - Denotes Special Order Item

TYPICAL BLANK OBROUND ACCESS PLATES


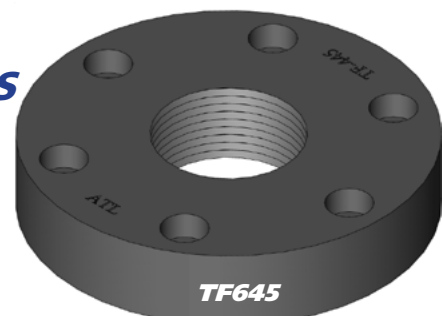
ATL STANDARD FNPT BOSSES



ATL Standard FNPT Bosses					
FNPT Boss Part No.	FNPT Boss Thread	Nut-Ring Part No.	Nut-Ring Thread	Material	B.C. (in)
TF509	1"	ALL TF489	1/4-28	Composite	2.188
TF645	1-1/2"	ALL TF435	1/4-28	Composite	3.000
TF445	2"	ALL TF435	1/4-28	Composite	3.000

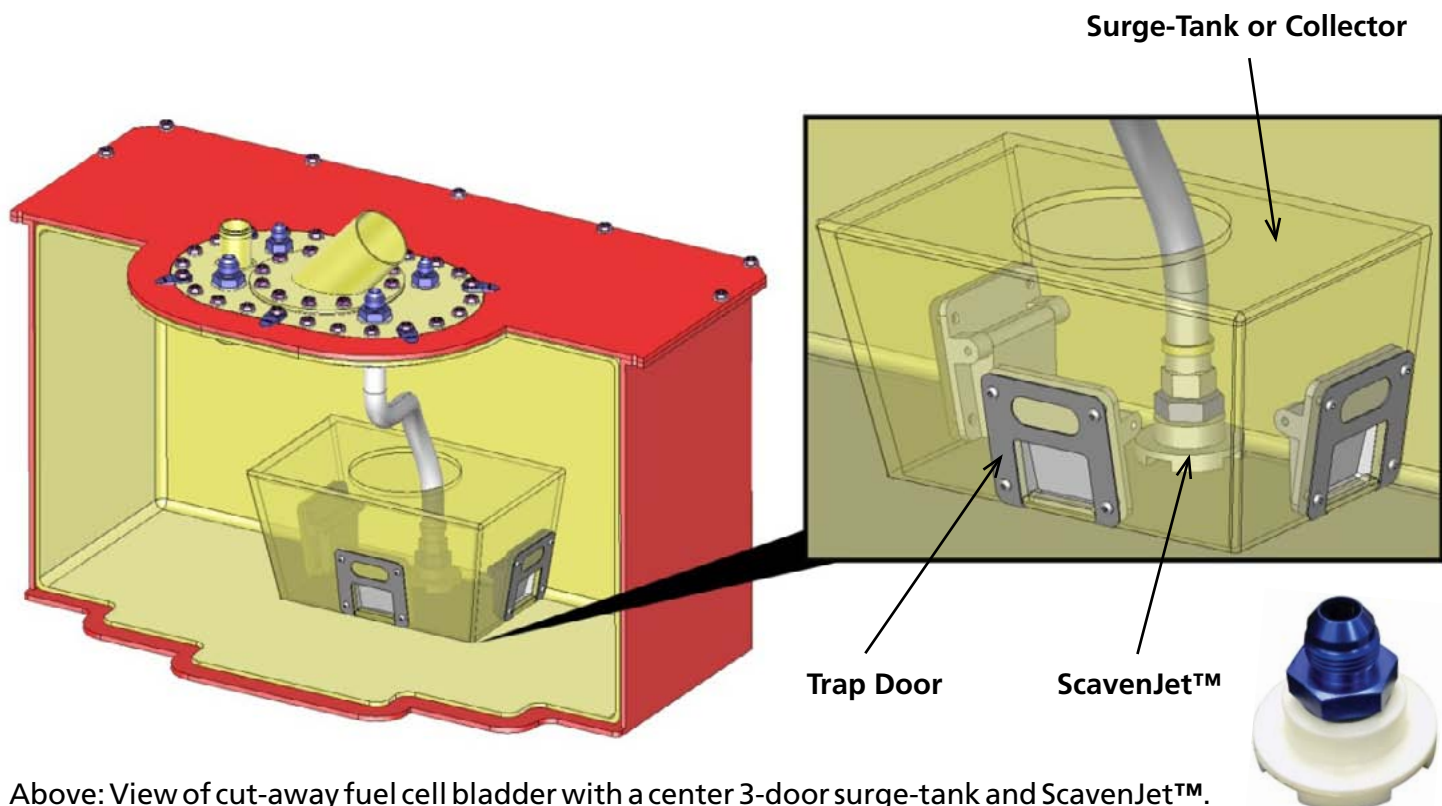


TYPICAL FNPT BOSSES COMPOSITE



SECTION IV: FUEL PICK-UPS

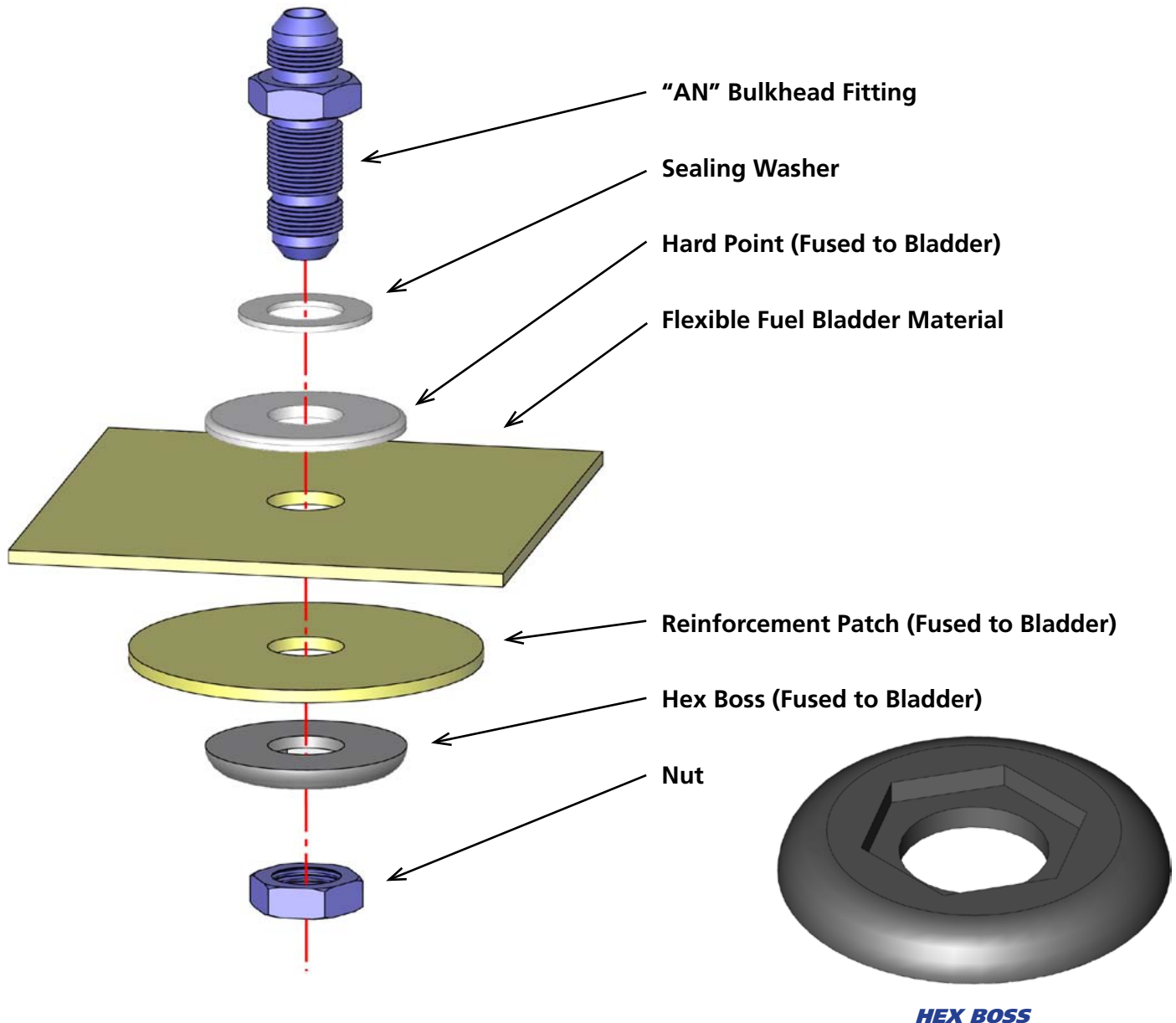
ATL fuel pick-ups scavenge fuel down to the bottom of the bladder. ScavenJet™'s are used in both surge tanks and mounted at the corners of the bladder. They are permanently fixed to the floor as shown in these cut-aways.



ATL ScavenJet™ Fuel Pick-Ups		
Part No.	Description	Thread
TF497-6	Fuel Pickup, ScavenJet, Round, For -6 "AN" Fuel Pick-Up	7/8" - 14 UNF
TF497-8	Fuel Pickup, ScavenJet, Round, For -8 "AN" Fuel Pick-Up	7/8" - 14 UNF
TF497-10	Fuel Pickup, ScavenJet, Round, For -10 "AN" Fuel Pick-Up	7/8" - 14 UNF

SECTION V: HEX BOSSES

Hex Bosses are used to mount "AN" bulkhead fittings directly through the bladder. The hex boss is permanently adhered to the bladder and provides a rigid mounting point for fittings and inspection ports, while preventing the nut from spinning during installation and removal. A typical Hex Boss assembly is shown below:

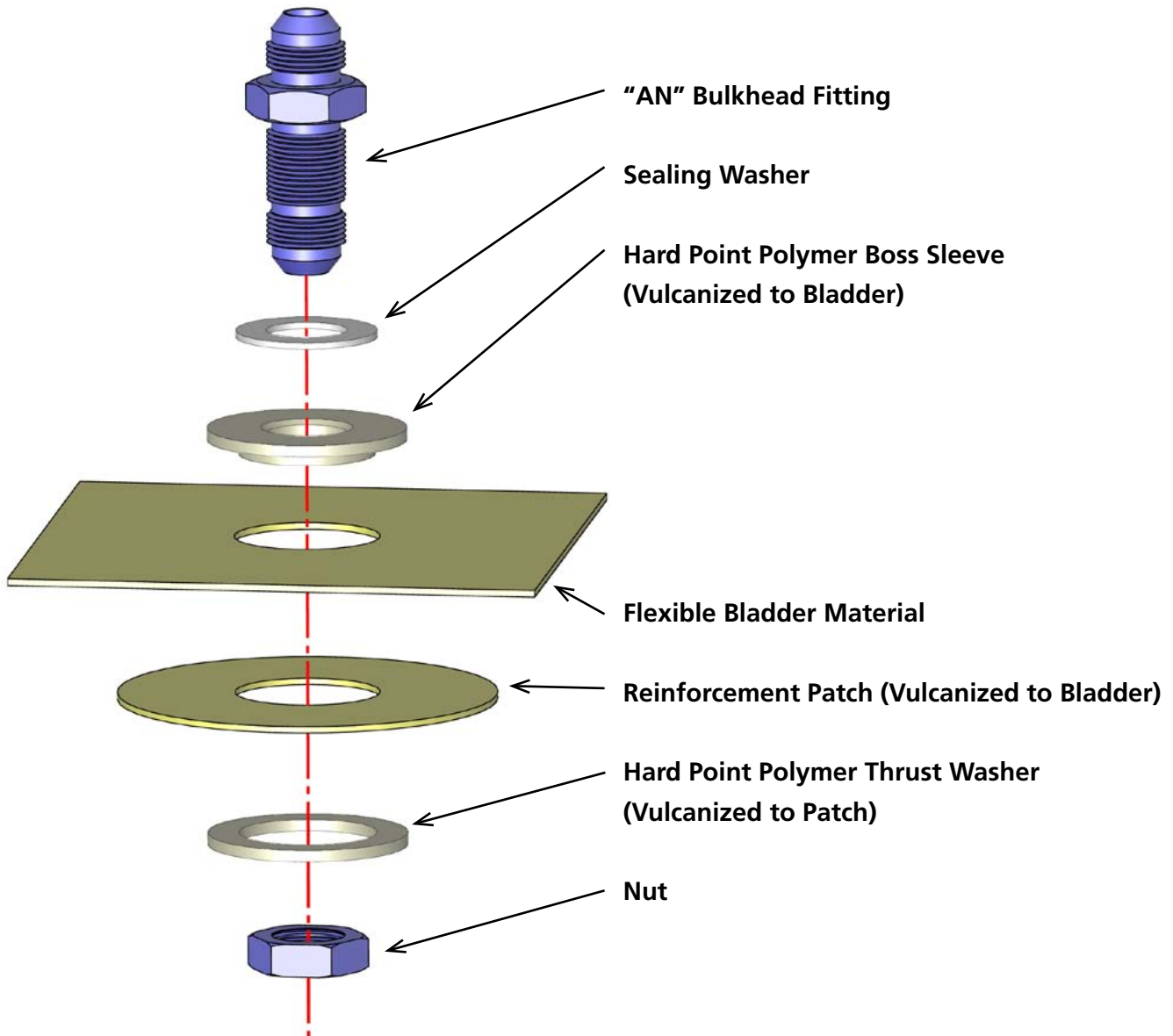


ATL Hex Bosses	
Part No.	Description
TF680	Boss, #4 Hex Boss, Composite
TF490	Boss, #6 Hex Boss, Composite
TF491	Boss, #8 Hex Boss, Composite

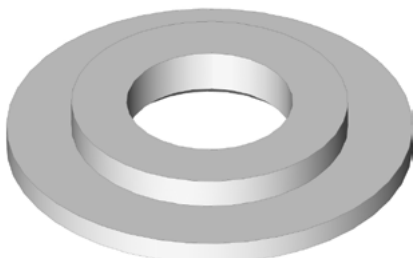


SECTION VI: HARD POINTS

ATL Lightweight rigid polymer fittings vulcanized into skin of fuel cell bladder for bulkhead installation.



ATL Hard Point Fittings	
Part No.	Description
10-5897	Fitting, ISO, -6 Polymer Boss
10-5898	Fitting, ISO, -6 Polymer Washer, works with 10-5897 boss 1.9" OD
10-3806	Fitting, ISO, -8 Polymer Boss
10-3807	Fitting, ISO, -8 Polymer Washer, works with 10-3806 boss, 1.9" OD



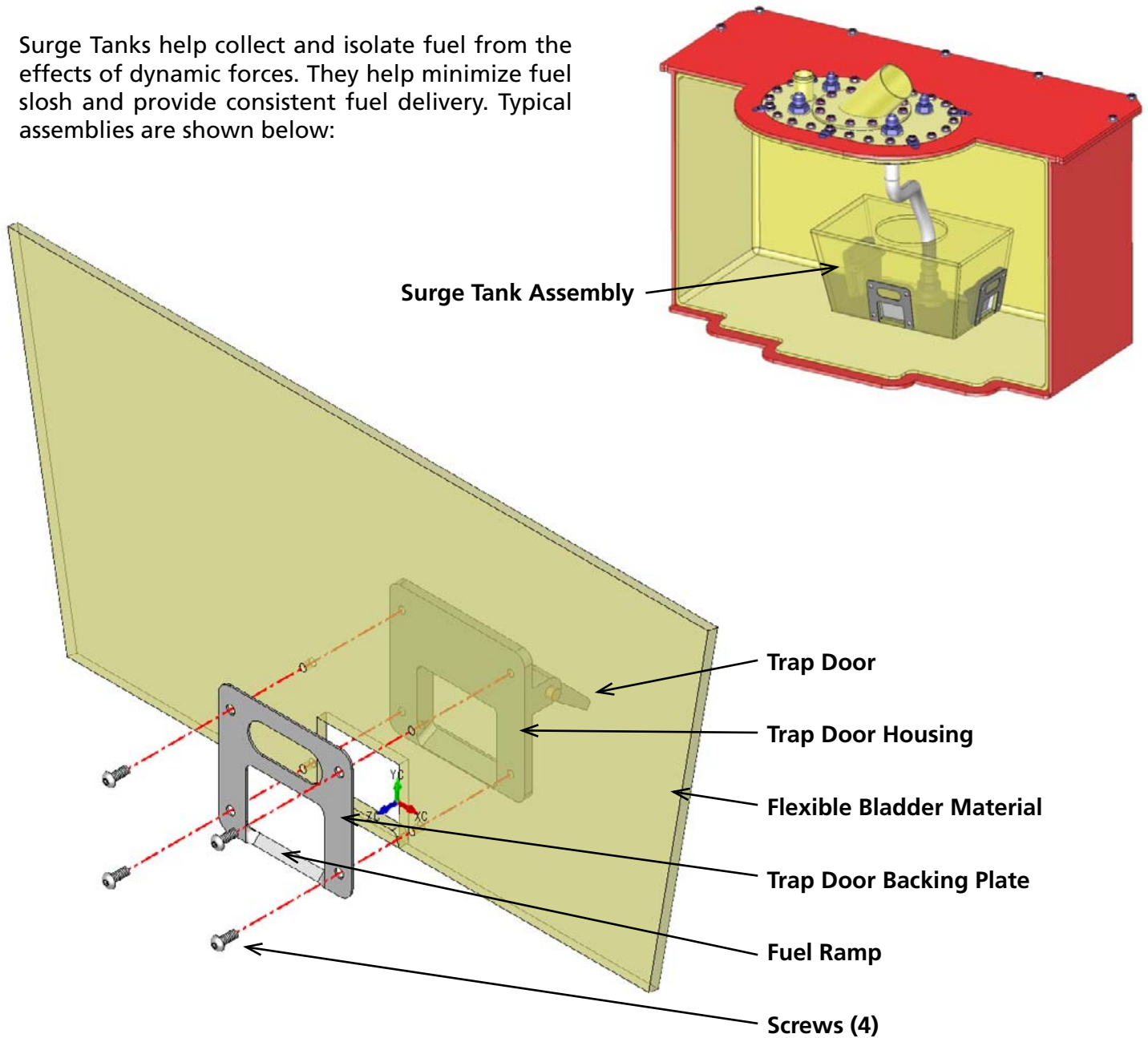
**POLYMER
BOSS**



**POLYMER
THRUST WASHER**

SECTION VII: TRAP DOORS

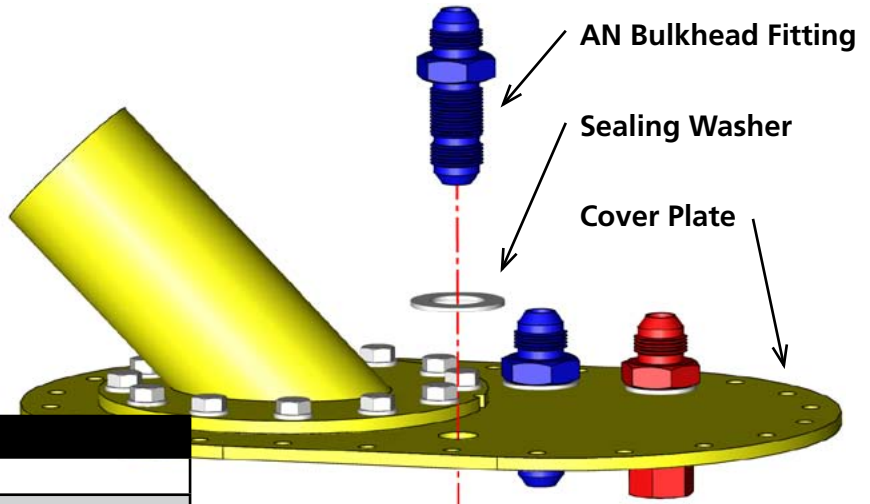
Surge Tanks help collect and isolate fuel from the effects of dynamic forces. They help minimize fuel slosh and provide consistent fuel delivery. Typical assemblies are shown below:



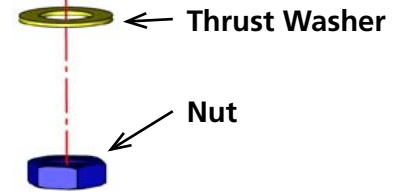
ATL Trap Door			
Part No.	Description	Outside Dimensions	Door Swing Clearance
KS145	Trap Door, Composite, alcohol and petroleum resistant	2.65 W, 2.75" H	2.25"

SECTION VIII: "AN" FITTINGS

"AN" fittings are used mostly on cover plates as a means of connecting fuel pick-ups, returns, dip-sticks, vents, etc. A variety of "AN" sizes are available and they can be configured to suit most any need. Typically "AN" fittings require a sealing washer, thrust washer, and a nut. A basic "AN" assembly is shown to the right:



Bulkheads and Unions			
Part No.	AN Size	Nominal I.D. (in)	Description
AN832-4D	4	1/4	Fitting, #4 Bulkhead, Aluminum
AN832-6D	6	3/8	Fitting, #6 Bulkhead, Aluminum
AN832-8D	8	1/2	Fitting, #8 Bulkhead, Aluminum
AN832-10D	10	5/8	Fitting, #10 Bulkhead, Aluminum
AN832-12D	12	3/4	Fitting, #12 Bulkhead, Aluminum
AN832-16D	16	1	Fitting, #16 Bulkhead, Aluminum
AN832-20D	20	1-1/4	Fitting, #20 Bulkhead, Aluminum
AN815-4D	4	1/4	Fitting, #4 Union, Aluminum
AN815-6D	6	3/8	Fitting, #6 Union, Aluminum
AN815-8D	8	1/2	Fitting, #8 Union, Aluminum
AN815-10D	10	5/8	Fitting, #10 Union, Aluminum
AN815-12D	12	3/4	Fitting, #12 Union, Aluminum
AN815-16D	16	1	Fitting, #16 Union, Aluminum
AN815-20D	20	1-1/4	Fitting, #20 Union, Aluminum
AN924-4D	4	1/4	Fitting, #4 Nut, Aluminum
AN924-6D	6	3/8	Fitting, #6 Nut, Aluminum
AN924-8D	8	1/2	Fitting, #8 Nut, Aluminum
AN924-10D	10	5/8	Fitting, #10 Nut, Aluminum
AN924-12D	12	3/4	Fitting, #12 Nut, Aluminum
AN924-16D	16	1	Fitting, #16 Nut, Aluminum
AN924-20D	20	1-1/4	Fitting, #20 Nut, Aluminum
AN960-716	4	1/4	Thrust Washer, #4 Steel
AN960-916	6	3/8	Thrust Washer, #6 Steel
AN960-1216	8	1/2	Thrust Washer, #8 Steel
AN960-1416	10	5/8	Thrust Washer, #10 Steel
AN960-1716	12	3/4	Thrust Washer, #12 Steel
AN960-2216	16	1	Thrust Washer, #16 Steel
TF391	4	1-1/4	Sealing Washer, #4 Nylon
TF162	6	3/8	Sealing Washer, #6 Nylon
TF198	8	1/2	Sealing Washer, #8 Nylon
TF389	10	5/8	Sealing Washer, #10 Nylon
TF390	12	3/4	Sealing Washer, #12 Nylon
TF370	16	7/8	Sealing Washer, #16 Nylon



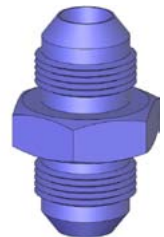
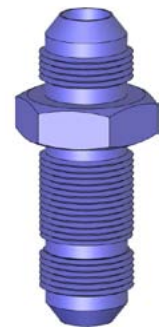
**AN831
BULKHEAD
FITTING**

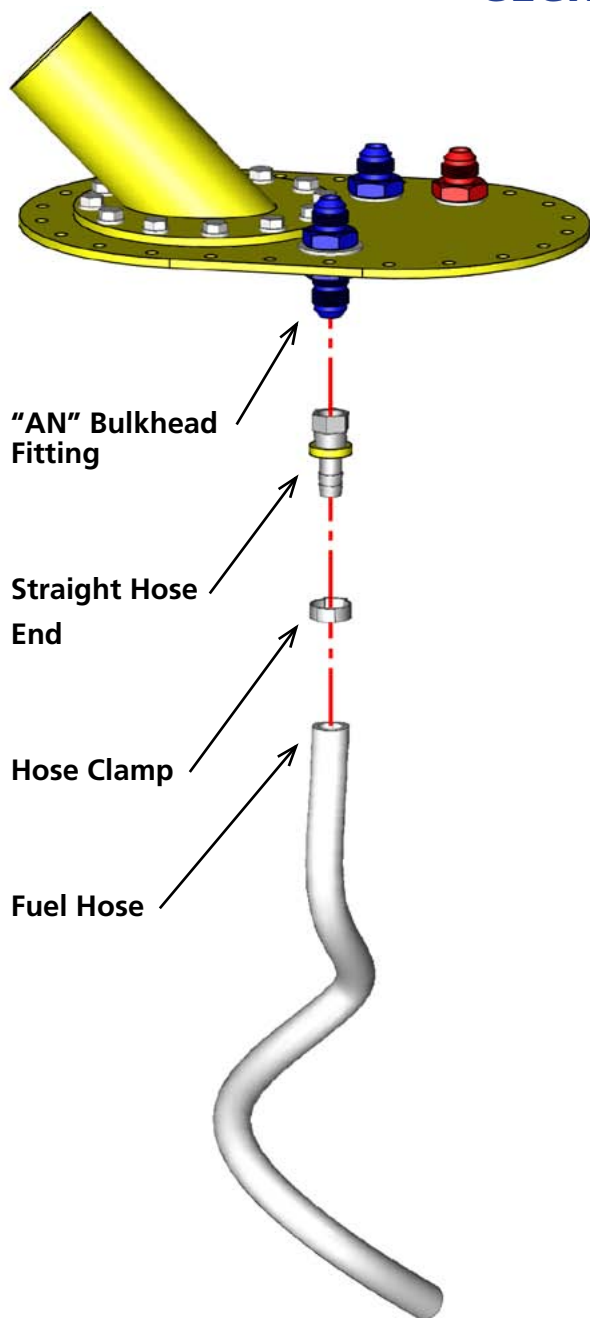
**AN815
UNION**

**AN924
NUT**

**SEALING
WASHER**

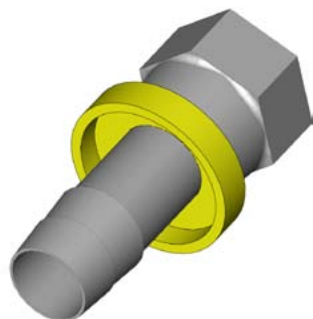
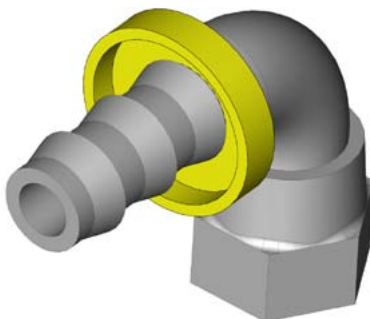
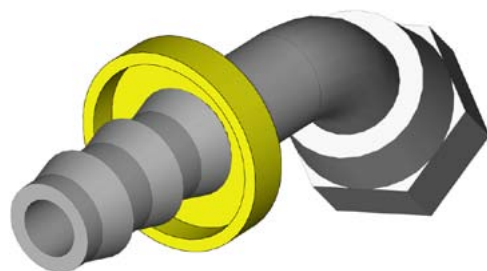
**AN960 THRUST
WASHER**



SECTION IX: HOSE ENDS


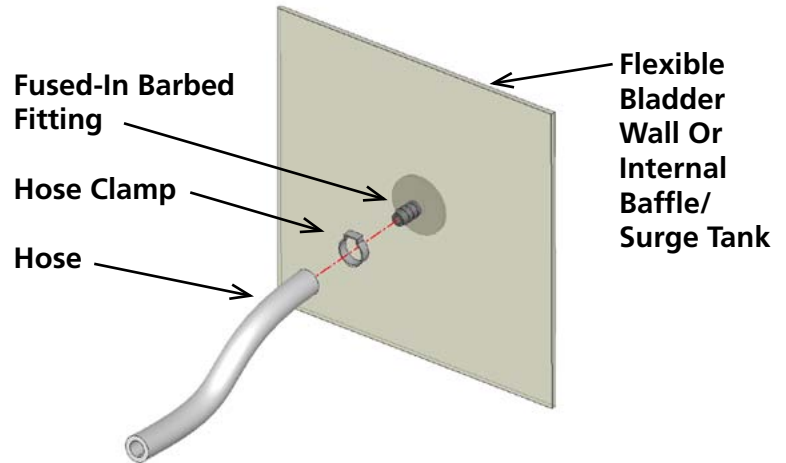
Hose ends attach the fuel pick-up hose and attach to "AN" bulkhead fittings mounted in the cover plate. Typical "AN" hose ends and fittings exhibit a 37 1/2° seat. The basic setup is shown to the left:

Hose Ends			
Part No.	AN Size	Nominal I.D. (in)	Description
TF361	4	1/4	Straight Steel Hose End
TF161	6	3/8	Straight Steel Hose End
FCM1512	6	3/8	Straight Aluminum Hose End
TF203	8	1/2	Straight Steel Hose End
FCM1513	8	1/2	Straight Aluminum Hose End
TF153	10	5/8	Straight Steel Hose End
FCM1514	10	5/8	Straight Aluminum Hose End
TF670	12	3/4	Straight Steel Hose End
FCM1515	12	3/4	Straight Aluminum Hose End
TF362	4	1/4	90° Steel Hose End
TF246	6	3/8	90° Steel Hose End
TF247	8	1/2	90° Steel Hose End
TF384	10	5/8	90° Steel Hose End
FBM1534	10	5/8	90° Aluminum Hose End
33982-12	12	3/4	90° Steel Hose End
FCM1535	12	3/4	90° Aluminum Hose End
33782-4	4	1/4	45° Steel Hose End
TF364	6	3/8	45° Steel Hose End
TF208	8	1/2	45° Steel Hose End
FBM1523	8	1/2	45° Aluminum Hose End
33782-10	10	5/8	45° Steel Hose End
33782-12	12	3/4	45° Steel Hose End
FBM1525	12	3/4	45° Aluminum Hose End


STRAIGHT HOSE END

90 DEGREE HOSE END

45 DEGREE HOSE END

SECTION X: PERMANENT BARBED INTERNAL FITTINGS

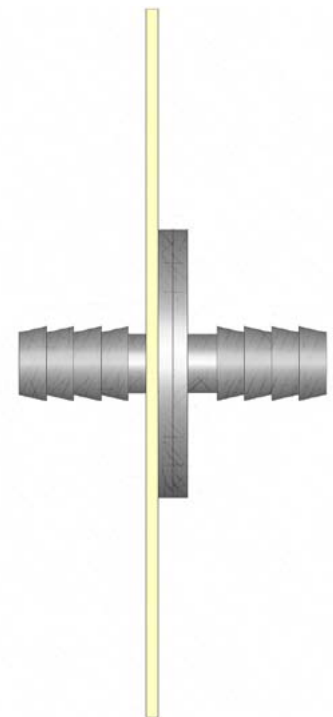
Barbed fittings are permanently vulcanized to the bladder and provide a means of attaching hoses directly to the bladder. Barbed fittings are used externally in non-hazardous applications and internally (between baffles and compartments) in crashworthy cells. This Example bladder section shows an arrangement of the barbed fitting installed:



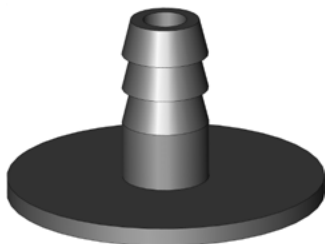
Barbed Hard Rubber Fittings

Part No.	OD (In)	ID (In)	Description	Application
TF399	0.125	0.06	Synthetic Elastomer	Hydrocarbon fuel resistant
TF399-FEP **	0.125	0.06	Fluoropolymer	Chemical Resistance
TF399-NSF	0.125	0.06	Synthetic Elastomer	Potable Water
TF399-THV **	0.125	0.06	Fluoropolymer	Chemical Resistance
TF400	0.250	0.15	Synthetic Elastomer	Hydrocarbon fuel resistant
TF400-FEP **	0.250	0.15	Fluoropolymer	Chemical Resistance
TF400-I	0.250	0.15	Rigid Polymer	High Pressure
TF400-NSF	0.250	0.15	Synthetic Elastomer	Potable Water
TF400-THV	0.250	0.15	Fluoropolymer	Chemical Resistance
TF401	0.375	0.24	Synthetic Elastomer	Hydrocarbon fuel resistant
TF401-I	0.375	0.24	Rigid Polymer	High Pressure
TF401-NSF	0.375	0.24	Synthetic Elastomer	Potable Water
TF401-THV	0.375	0.24	Fluoropolymer	Chemical Resistance
TF402	0.5	0.36	Synthetic Elastomer	Hydrocarbon fuel resistant
TF402-I	0.5	0.36	Rigid Polymer	High Pressure
TF402-NSF	0.5	0.36	Synthetic Elastomer	Potable Water
TF402-THV **	0.5	0.36	Fluoropolymer	Chemical Resistance
TF405	0.625	0.50	Synthetic Elastomer	Hydrocarbon fuel resistant
TF405-I	0.625	0.50	Rigid Polymer	High Pressure
TF405-NSF	0.625	0.50	Synthetic Elastomer	Potable Water
TF403	0.75	0.60	Synthetic Elastomer	Hydrocarbon fuel resistant
TF403-NSF	0.75	0.60	Synthetic Elastomer	Potable Water
TF403-NSF/70D	0.75	0.60	Synthetic Elastomer w/70D Durometer	Potable Water
TF404	1	0.84	Synthetic Elastomer	Hydrocarbon fuel resistant
TF404-NSF	1	0.84	Synthetic Elastomer	Potable Water

** - Denotes Special Order Item

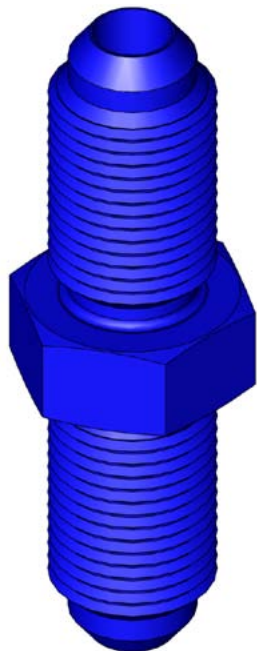
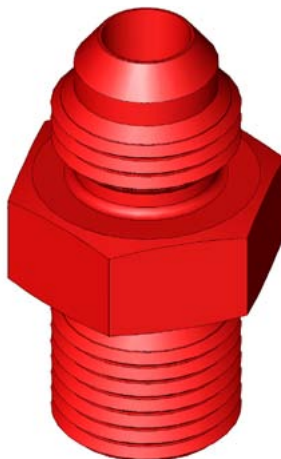
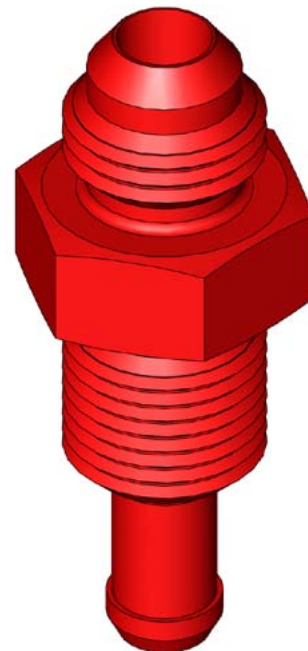
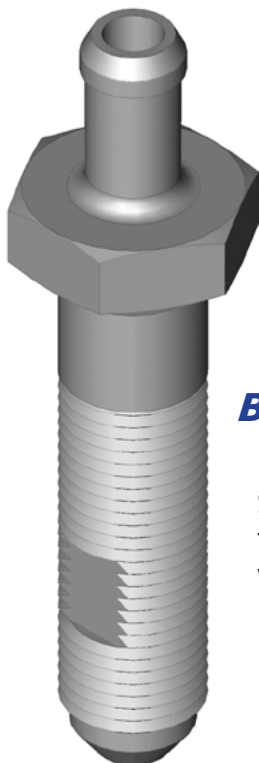


THROUGH NIPPLE



TYPICAL BARBED FITTINGS



SECTION XI: CUSTOM FITTINGS**TYPICAL CUSTOM-MADE
FITTINGS BY ATL****10-2535
DOUBLE BULKHEAD****10-0686
VALVE BODY****10-2309
AN TO BARB
BULKHEAD ADAPTER****10-5146****DEFENSE DEPT.
BLADDER HARDWARE**

Send ATL a sketch of your fitting requirement and ATL will create it in Aluminum, Brass, Steel, Stainless Steel or material of your choice.

**10-5147**

SECTION XII: FUEL PUMPS

Fuel pumps are used to deliver fuel to the engine or into a surge tank. They are suitable for use with gasoline fuel with an ethanol content of 10% or 85% and require a 12 volt electrical connection for operation. Mounting cradles, tie downs, flex tubes, and wire harnesses available.

ATL Fuel Pumps								
Part No.	Description	Diameter (in)	Length (in)	Pressure (PSI)	Max Flow Rate (Liters/Hour)	Amps	Weight (oz)	Orientation
CFD-106	Low Pressure Pump	1.44	4	4	100	8	4	Upright
CFD-104	High Pressure Pump	1.56	5.2	100	100	14	12.8	Upright
CFD-108	Bosch High Pressure Pump	1.81	5.6	43	350	18	20.8	Upright
KS163	Bosch High Pressure Pump	2.44	8.1	72.5	210	16	36.8	Upright / Prone



CFD-106
LOW PRESSURE
CARBURETOR OR
"LIFT" PUMP



CFD-104
HIGH PRESSURE
FUEL INJECTION PUMP



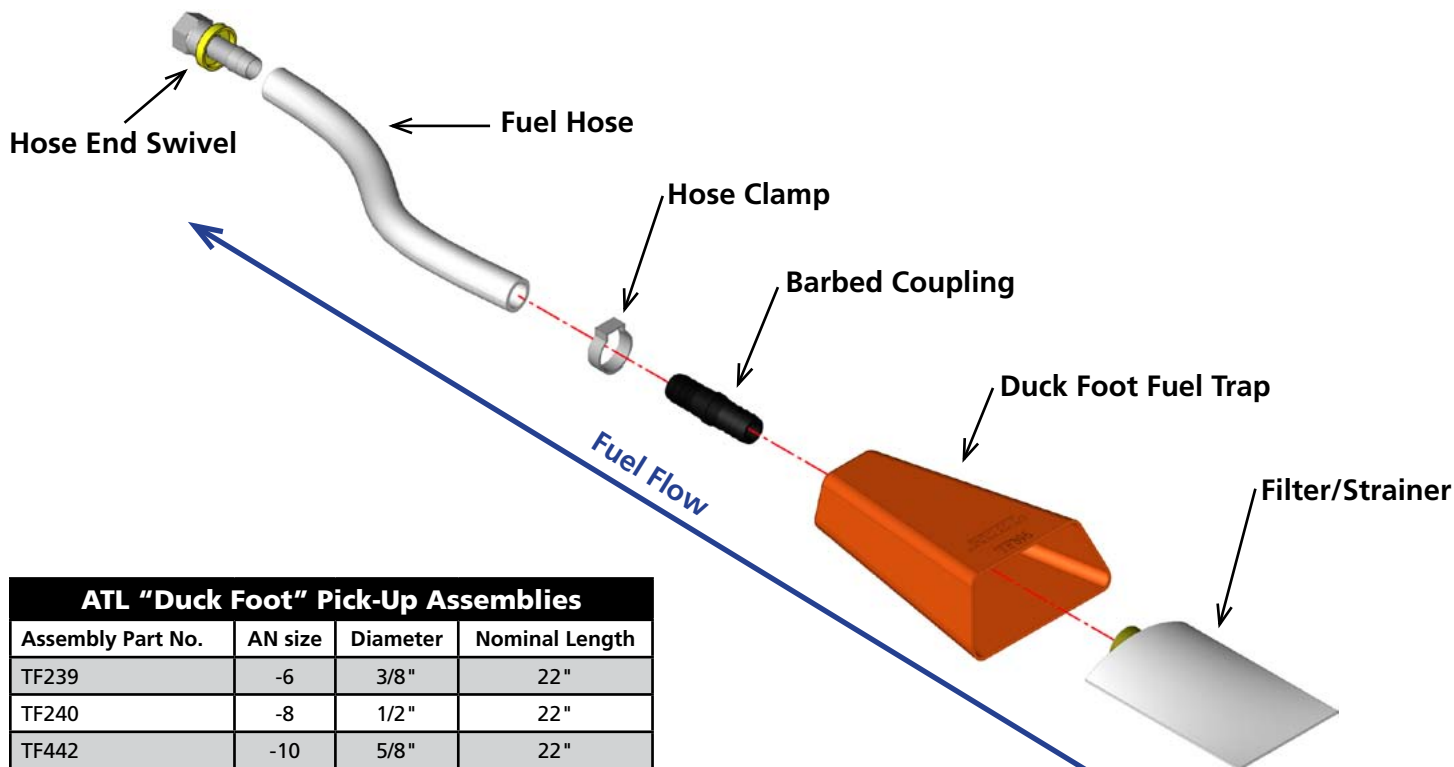
CFD-108
BOSCH HIGH PRESSURE
FUEL INJECTION PUMP



KS-163
BOSCH -044 HIGH PRESSURE
FUEL INJECTION PUMP

SECTION XIII: "DUCK FOOT"

"Duck Foot" fuel-trap pickups are used to trap, funnel and filter fuel into the pickup hose.



ATL "Duck Foot" Pick-Up Assemblies			
Assembly Part No.	AN size	Diameter	Nominal Length
TF239	-6	3/8"	22"
TF240	-8	1/2"	22"
TF442	-10	5/8"	22"

SECTION XIV: FILL NECKS

Fill necks are the ports by which a bladder is filled with fuel. Most Fill Necks are integrated with a rollover check valve or flapper to prevent fuel spill in an accident.

TYPICAL FILL NECKS WITH AND WITHOUT CHECK VALVES

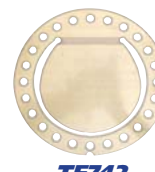

TF523-570
2 1/2" O.D.



TF689-570
3" O.D.



TF669-742
1 1/2" O.D.



TF742
PADDLE
VALVE



TF570
PADDLE
VALVE

ATL Fill Necks									
Part No.	Description	Plate Diameter	Bolt Circle	Number of Holes	Fill Neck O.D	Fill Neck Angle	Cap	Overall Height	External Height
TF523-570	Ultra-Quick Fill Neck w/ "Paddle Valve"	5.5"	4-3/4"	12	2.5"	22°	No	5.9"	5.9"
TF689-570	Ultra-Quick Fill Neck w/ "Paddle Valve"	5.5"	4-3/4"	12	3.0"	22°	No	4.5"	4.5"
TF131-742	Ultra-Quick Fill Neck w/ "Paddle Valve"	5.5"	4-3/4"	12	2.25"	45°	No	4.0"	4.0"
TF669-742	Ultra-Quick Fill Neck w/ "Paddle Valve"	5.5"	4-3/4"	12	1.5"	45°	No	3.75"	3.75"
TF603-742	Ultra-Quick Fill Neck w/ "Paddle Valve"	5.5"	4-3/4"	12	2.25"	90°	Yes	1.3"	1.3"
TF222-742	Quick Fill Neck w/ "Paddle Valve"	5.5"	4-3/4"	12	2.25"	90°	No	2.5"	2.5"
TF348	Quick Fill Neck w/ GT Vent Valve	5.5"	4-3/4"	12	2.25"	90°	No	2.4"	2.4"
TF183A	Quick Fill Neck w/ "Flapper-Valve"	5.5"	4-3/4"	12	2.25"	90°	No	4.5"	2.5"
TF183S	Regular-Fill Neck w/ "Flapper-Valve"	5.5"	4-3/4"	12	2.25"	90°	Yes	5.5"	3.5"
TF184A	Quick Fill Neck w/ "Flapper-Valve"	5.5"	4-3/4"	12	2.25"	45°	No	6.25"	4.25"
TF184S	Regular-Fill Neck w/ "Flapper-Valve"	5.5"	4-3/4"	12	2.25"	45°	Yes	5.75"	3.75"
TF461	Ultra-Quick Fill Neck w/ "Paddle Valve"	5.5"	4-3/4"	24	2.5"	22°	No	4.8"	4.8"



TF183A
2 1/4" O.D.



TF183S
2 1/4" O.D.



TF184A
2 1/4" O.D.



TF184A
2 1/4" O.D.

SECTION X V: VENT VALVES

Vents allow for air to pass in and out of the bladder allowing for smooth filling and discharging. All contain valves that prevent fuel leakage in the event of a rollover.



**TF682
BULLET**



**TF683
BULLET**



**TF257
BALL**



**TF210
SLEEVE**



**TF350
BALL**



**TF350-8
BALL**



**TF475
BALL**

ATL Vent Valves						
Part No.	Mounting Type	Vent O.D.	Valve Type	Overall Height	External Height	Vent Angle
TF682	2.5" B.C. Flange	1.5"	Poppet	6.7"	2.5"	0°
TF683	2.5" B.C. Flange	1.5"	Poppet	6.25"	2.5"	92°
TF257	3" B.C. Flange	1"	Ball	4.25"	1.7"	0°
TF210	Push in #6 Hose	3/8"	Poppet	0.97"	N/A	0°
TF350	#6 Bulkhead	3/8"	Ball	2.725"	0.97"	0°
TF350-8	#8 Bulkhead	1/2"	Ball	2.37"	1"	0°
TF475	#6 Bulkhead	3/8"	Discriminator	2.17"	1.1"	0°

SECTION XVI: FUEL SYSTEM CIRCUIT DIAGRAMS

Below are examples of typical fuel system circuits that are used in various types of motorsports.

