2009 Formula Society of Automotive Engineers Cost Report

An Interactive Qualifying Project proposal to be submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the Degree of Bachelor of Science

Submitted by:

Patrick Napier

Submitted to:

Project Advisors:
Prof. Eben Cobb

October 27th, 2010

The Society of Automotive Engineers (SAE) hosts an annual engineering design competition for college students known as Formula SAE (FSAE). The competition assumes a fictitious automotive company would like to produce a race car that the typical racing enthusiast could purchase for $25,000 and use on the weekends at a casual track setting.

In order to ensure the production price, assuming four vehicles will be manufactured each day in a dedicated factory, a cost report was completed. This cost report is the subject of this Interactive Qualifying Project. The completed cost report was filed according to the guidelines mandated by the SAE and sent to their headquarters by the required deadline.

The cost report was completed by assigning every component of the race car into one assembly. These assemblies were the Brake System, Engine & Drivetrain, Frame & Body, Electrical, Miscellaneous Fit & Finish, Steering System, Suspension, and Wheels & Tires. These assemblies were then decomposed into smaller sub-assemblies. Finally, the individual components are found within these sub-assemblies.

For each component, the material cost, process cost, fastener cost, and tooling cost were all calculated. Using the Materials Table found in Appendix A, the cost of the stock material can be easily calculated. This typically involves calculating the volume of the piece of stock material and multiplying it by a constant that varies from material to material that will result in the material's cost.

The process cost was calculated by using the tables found in Appendix B. First, a though listing of all processes required to bring the component from stock material to finished component that is properly mounted onto the race car was compiled. Next, each of these process was converted into a price using the information found in the Processes Table found in Appendix B. Then, each individual was multiplied by any factors dictated by the Multipliers Table, also found in Appendix B. An example of this would be multiplying the total cost by 1.25 if an object greater than 0.5m in length had to be assembled. Finally, the total cost of all these processes was computed.

The fastener cost was computed by using the last page of Appendix A. This shows all of the available fasteners and their costs. The cost of any fastener the team wished to used that was not contained on this list had to computed by Society.

Finally, the tooling price was computed using the tables found in Appendix C. After all these prices were computed, the total for each sub-assembly, and then assembly, and then the entire race car was computed.

It must be noted that the MQP team that was responsible for the completion of the 2009 FSAE race car did not complete designing the race car by the deadline for this cost report. Due to that fact, the IQP team was forced to make very vague approximations for a number of components. This resulted in figures that are not accurate.

It must also be noted that the original version of this paper explains in great detail all of the estimated costs behind every component in the 2009 FSAE race car. However, this paper was mailed to the competition and never submitted to the WPI Archives. In order to correct this mistake, this much abridged version was created.

Appendix A –
Materials and Fasteners Charts

Material ID	Material	Supplier	Category	Table Price	Unit 1	Unit 2	C1	C2	Modified	Comments
	~~Bearing, Angular Contact Ball~~	Any	Bearings	AIR	unit				23-Feb-09	Replaced by parametric bearing model
	~~Bearing, Ball~~	Any	Bearings	AIR	unit				23-Feb-09	Replaced by parametric bearing model
	Bearing, Ball, Angular Contact	Any	Bearings	[C1]*(([Size1]^2*[Size2]))^([C2]))	mm	mm	0.1	0.5	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Not to be used for whe
	Bearing, Ball, Deep Groove	Any	Bearings	[C1]*(([Size1]^2*[Size2]))^([C2]))	mm	mm	0.1	0.5	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Not to be used for whe
	~~Bearing, Ball, NTN, 50/32LLB/3A~~	NTN	Bearings	$ 0.62	unit				23-Feb-09	Replaced by parametric bearing model
	~~Bearing, Ball, NTN, 50/28/2AS~~	NTN	Bearings	$ 0.72	unit				23-Feb-09	Replaced by parametric bearing model
	~~Bearing, Ball, NTN, 6006~~	NTN	Bearings	$ 3.65	unit				23-Feb-09	Replaced by parametric bearing model
	~~Bearing, Ball, NTN, 7004UCP5~~	NTN	Bearings	$ 6.53	unit				23-Feb-09	Replaced by parametric bearing model
	~~Bearing, Ball, NTN, 7204DB~~	NTN	Bearings	$ 11.12	unit				23-Feb-09	Replaced by parametric bearing model
	~~Bearing, Ball, NTN, 7205CP5~~	NTN	Bearings	$ 5.51	unit				23-Feb-09	Replaced by parametric bearing model
	~~Bearing, Ball, NTN, Steel AELPP205~~	NTN	Bearings	$ 4.65	unit				23-Feb-09	Replaced by parametric bearing model
	Bearing, Ball, Radial	Any	Bearings	[C1]*(([Size1]^2*[Size2]))^([C2]))	mm	mm	0.1	0.5	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Not to be used for whe
	~~Bearing, Boca, EMR6814-2RS~~		Bearings	$80.00					23-Feb-09	
	Bearing, Cylindrical Roller	Any	Bearings	[C1]*[Size1]*[Size2]+[C2]	mm	mm	0.0045	3.6	23-Feb-09	[Size1]=Outer Diameter (mm). [Size2]=Length of bearing (mm). Not for wheel
	Bearing, Double Row, Ball, Angular Contact	Any	Bearings	[C1]*(([Size1]^2*[Size2]))^([C2]))	mm	mm	0.1	0.5	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Not to be used for whe
	Bearing, Double Row, Ball, Deep Groove	Any	Bearings	[C1]*(([Size1]^2*[Size2]))^([C2]))	mm	mm	0.1	0.5	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Not to be used for whe
	Bearing, Double Row, Ball, Radial	Any	Bearings	[C1]*(([Size1]^2*[Size2]))^([C2]))	mm	mm	0.1	0.5	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Not to be used for whe
	Bearing, Needle	Any	Bearings	[C1]*[Size1]*[Size2]+[C2]	mm	mm	0.0045	3.6	23-Feb-09	[Size1]=Outer Diameter (mm). [Size2]=Length of bearing (mm). Any style of ne
	~~Bearing, Needle (Thrust)~~	Any	Bearings	AIR	unit				23-Feb-09	Replaced by parametric bearing model
	Bearing, Spherical	Any	Bearings	[C1]*[Size1]^2+[C2]	mm		0.03	5.00		Size1=bore size (diameter of hole in spherical bearing).
	~~Bearing, Tapered Needle~~		Bearings	AIR					23-Feb-09	Replaced by parametric bearing model
	Bearing, Tapered Needle	Any	Bearings	[C1]*[Size1]*[Size2]+[C2]	mm	mm	0.0045	10.45	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Cost includes outer rin
	~~Bearing, Tapered Roller~~		Bearings	AIR					23-Feb-09	Replaced by parametric bearing model
	Bearing, Tapered Roller	Any	Bearings	[C1]*[Size1]*[Size2]+[C2]	mm	mm	0.0045	10.45	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Cost includes outer rin
	Bearing, Thrust Needle Roller, Cage Assembly	Any	Bearings	[C1]*[Size1]*[Size2]+[C2]	mm	mm	0.02	0.15	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Cost includes cage asse
	Bearing, Thrust Needle Roller, Washers	Any	Bearings	[C1]*[Size1]^2*[Size2]+[C2]	mm	mm	0.0003	0.13	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). For thrust bearings. N
	Bushing, Student Built	Student Built	Bearings	$ -	unit					Solid material (metal, plastic, etc.). No moving elements (ball, needle, etc.)
	Rod End, Aluminum	Any	Bearings	[C1]*[Size1]^2+[C2]	mm		0.05	3.80		Size1=bore size (diameter of hole in spherical bearing). Includes male/female and left/right threads.
	Rod End, Industrial	Any	Bearings	[C1]*[Size1]^2+[C2]	mm		0.02	1.22		Size1=bore size (diameter of hole in spherical bearing). Includes male/female and left/right threads.
	Rod End, Precison (Aircraft)	Any	Bearings	[C1]*[Size1]^2+[C2]	mm		0.05	5.00		Size1=bore size (diameter of hole in spherical bearing). Includes male/female and left/right threads.
	Wheel Bearing, Ball, Angular Contact	Any	Bearings	[C1]*(([Size1]^2*[Size2]))^([C2]))	mm	mm	0.4	0.5	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Higher load capacity be
	Wheel Bearing, Ball, Deep Groove	Any	Bearings	[C1]*(([Size1]^2*[Size2]))^([C2]))	mm	mm	0.4	0.5	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Higher load capacity be
	Wheel Bearing, Ball, Radial	Any	Bearings	[C1]*(([Size1]^2*[Size2]))^([C2]))	mm	mm	0.4	0.5	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Higher load capacity be
	Wheel Bearing, Double Row, Ball, Angular Contact	Any	Bearings	[C1]*(([Size1]^2*[Size2]))^([C2]))	mm	mm	0.4	0.5	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Higher load capacity be
	Wheel Bearing, Double Row, Ball, Deep Groove	Any	Bearings	[C1]*(([Size1]^2*[Size2]))^([C2]))	mm	mm	0.4	0.5	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Higher load capacity be
	Wheel Bearing, Double Row, Ball, Radial	Any	Bearings	[C1]*(([Size1]^2*[Size2]))^([C2]))	mm	mm	0.4	0.5	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Higher load capacity be
	Wheel Bearing, Tapered Needle	Any	Bearings	[C1]*[Size1]*[Size2]+[C2]	mm	mm	0.009	20.9	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Higher load capacity be
	Wheel Bearing, Tapered Roller	Any	Bearings	[C1]*[Size1]*[Size2]+[C2]	mm	mm	0.009	20.9	23-Feb-09	[Size1]=Outer diameter (mm), [Size2]=Thickness (mm). Higher load capacity be
	Balance Bar, AP, CP5500-9	AP	Brake System	$ 270.00	unit					
	Balance Bar, Brake, Student Built	Student Built	Brake System	$ -	unit					
	Balance Bar, Tilton, 72-250	Tilton	Brake System	$ 30.00	unit					
	Balance Bar, Tilton, 72-260	Tilton	Brake System	$ 30.00	unit					
	Balance Bar, Tilton, 72-260	Tilton	Brake System	$ 52.50	unit					
	Balance Bar, Tilton, 72-280	Tilton	Brake System	$ 312.50	unit					
	Balance Bar, Tilton, 72-281	Tilton	Brake System	$ 325.00	unit					
	Brake Caliper Piston, Student Built	Student Built	Brake System	$ 5.00	unit					
	Brake Caliper, AP, CP2577	AP	Brake System	$ 125.00	unit					
	Brake Caliper, AP, CP3696-6E0	AP	Brake System	$ 77.50	unit					
	Brake Caliper, AP, CP4226	AP	Brake System	$ 112.50	unit					
	Brake Caliper, AP, CP4227	AP	Brake System	$ 200.00	unit					
	Brake Caliper, AP, CP4488	AP	Brake System	$ 490.00	unit					
	Brake Caliper, AP, CP7003	AP	Brake System	$ 100.00	unit					
	Brake Caliper, Brembo, 20.5161.46/P32F	Brembo	Brake System	$ 50.00	unit					
	Brake Caliper, Brembo, 20.6101/GP4-24	Brembo	Brake System	$ 450.00	unit					
	Brake Caliper, Brembo, 20.6950.10	Brembo	Brake System	$ 70.00	unit				23-Feb-09	
	Brake Caliper, Brembo, 20.6950.10	Brembo	Brake System	$ 70.00	unit				3-Mar-09	
	Brake Caliper, Brembo, 20.6950.21/P32G	Brembo	Brake System	$ 70.00	unit					
	Brake Caliper, Brembo, 20.6951.12/P34G	Brembo	Brake System	$ 70.00	unit				24-Feb-09	
	Brake Caliper, Brembo, 20.6951.50/P34C	Brembo	Brake System	$ 70.00	unit					
	Brake Caliper, ISR, 22-028	ISR	Brake System	$ 65.00	unit					
	Brake Caliper, ISR, 22-048	ISR	Brake System	$ 96.00						
	Brake Caliper, Motorcycle, OEM (Any)	Any	Brake System	AIR	unit				24-Feb-09	
	Brake Caliper, NISSIN, 08-1CP-32-15	Nissin	Brake System	82						
	Brake Caliper, NISSIN, 08-2CP-25-08	Nissin	Brake System	96						
	Brake Caliper, NISSIN, 08-2CT-25-06	Nissin	Brake System	109						
	Brake Caliper, NISSIN, 08-2CT-38-07	Nissin	Brake System	109						
	Brake Caliper, Polaris, 1910825/1910826	Polaris	Brake System	$ 66.00	unit				1-Mar-09	Cost applies to either part number (similar part one left hand one right hand)
	Brake Caliper, Student Built	Student Built	Brake System	$ -	unit					
	Brake Caliper, Tokico, 45150-MEL-023	Tokico	Brake System	$ 75.00	unit				2-Mar-09	
	Brake Caliper, Wilwood, Billet Dynalite Single	Wilwood	Brake System	$ 50.00	unit					
	Brake Caliper, Wilwood, Billet NDL	Wilwood	Brake System	$ 78.00	unit					
	Brake Caliper, Wilwood, Dynalite Single Floater	Wilwood	Brake System	$ 50.00	unit					
	Brake Caliper, Wilwood, DynaPro Radial	Wilwood	Brake System	$ 110.00	unit					
	Brake Caliper, Wilwood, Forged Dynalite	Wilwood	Brake System	$ 68.00	unit					
	Brake Caliper, Wilwood, GP310	Wilwood	Brake System	$ 105.00	unit					
	Brake Caliper, Wilwood, GP320	Wilwood	Brake System	$ 98.00	unit					
	Brake Caliper, Wilwood, Kart	Wilwood	Brake System	$ 58.00	unit					
	Brake Caliper, Wilwood, NDL	Wilwood	Brake System	$ 70.00	unit					
	Brake Caliper, Wilwood, PS-1	Wilwood	Brake System	$ 46.00	unit					
	Brake Hard Line, Any Material (All Cost as Made)	Any	Brake System	$ -	unit					Cost from raw material costs and incude labor to flare tube ends

Material ID	Material	Supplier	Category	Table Price	Unit 1	Unit 2	C1	C2	Modified	Comments
	Brake Light Pressure Switch Banjo Bolt	Any	Brake System	$ 8.00	unit				8-Mar-09	
	Brake Pad, Aluminum or MMC Rotor	Any	Brake System	$ 0.0004	mm^3					Volume of pad and backing plate to be included in calculation
	Brake Pad, Carbon Rotor	Any	Brake System	AIR	mm^3					Please submit Add Item Request
	Brake Pad, Iron or Steel Rotor	Any	Brake System	$ 0.0002	mm^3					Volume of pad and backing plate to be included in calculation.
	Brake Rotor (All Cost as Made)	Any	Brake System	$ -	unit					This item should be cost as made whether the team made it or bought it. Plea
	Caliper, Comet 650, Front		Brake System	$ 43.00	unit				1-Mar-09	
	Master Cylinder, AP, CP2623	AP	Brake System	$ 81.50	unit					
	Master Cylinder, AP, CP4400	AP	Brake System	$ 117.50	unit					
	Master Cylinder, AP, CP5854	AP	Brake System	$ 203.50	unit					
	Master Cylinder, AP, CP5855	AP	Brake System	$ 260.00	unit					
	Master Cylinder, AP, CP6465	AP	Brake System	$ 203.50	unit					
	Master Cylinder, Brembo, 10.4776.10	Brembo	Brake System	$ 26.00	Unit					
	Master Cylinder, Brembo, 10.4776.65	Brembo	Brake System	$ 46.50	Unit					
	Master Cylinder, Centric Parts, CE130.51017	Centric	Brake System	$ 51.00	unit				1-Mar-09	
	Master Cylinder, Girling	Girling	Brake System	$ 44.00	unit				3-Aug-09	
	Master Cylinder, NISSIN, 08-2RM-14-02	Nissin	Brake System	55						
	Master Cylinder, NISSIN, 08-4RM-15-05	Nissin	Brake System	57						
	Master cylinder, Nissin, 153-M00-125B	Nissin	Brake System	$ 55.00	unit				1-Mar-09	
	Master Cylinder, Student Made	Student Built	Brake System	$ -	unit					
	Master Cylinder, Tilton, Model 73	Tilton	Brake System	$ 27.50	unit					
	Master Cylinder, Tilton, Model 74	Tilton	Brake System	$ 39.50	unit					
	Master Cylinder, Tilton, Model 75	Tilton	Brake System	$ 49.50	unit					
	Master Cylinder, Tilton, Model 76	Tilton	Brake System	$ 62.50	unit					
	Master Cylinder, Tilton, Model 77	Tilton	Brake System	$ 197.50	unit					
	Master Cylinder, Wilwood, 260-5520	Wilwood	Brake System	$ 39.40	unit				24-Feb-09	
	Proportioning Valve, Hydraulic	Any	Brake System	$ 35.00	unit					
	Proportioning Valve, Tilton, 90-1000	Tilton	Brake System	$ 49.50	unit					
	Proportioning Valve, Tilton, 90-1003	Tilton	Brake System	$ 49.50	unit					
	Proportioning Valve, Tilton, 90-2000	Tilton	Brake System	$ 49.50	unit					
	Proportioning Valve, Tilton, 90-2003	Tilton	Brake System	$ 49.50	unit					
	Slave Cylinder, CNC, SERIES 305	CNC	Brake System	$ 35.00	unit				3-Aug-09	
	Tilton 72-501, Remote Brake Bias Adjuster	Tilton	Brake System	$ 33.25	unit					
	Tilton 72-560, 90-Degree Coupler	Tilton	Brake System	$ 45.00						
	Hydraulic Fluid Reservoir, Remote (Plastic)	Any	Brakes	$ 5.00	unit				22-Feb-09	Includes lid
	Adhesive Film	Any	Composite	$ -	m^2					Included in composite cost
	Aramid (Kevlar) Fiber, 1 Ply	Any	Composite	$ 150.00	kg					Dry or Pre-Preg. Both include resin. Hand trimming allowed.
	Carbon Fiber, 1 Ply	Any	Composite	$ 200.00	kg					Dry or Pre-Preg. Both include resin. Hand trimming allowed.
	Glass Fiber, 1 Ply	Any	Composite	$ 100.00	kg					e.g. S-Glass. Dry or Pre-preg. Both include resin. Hand trimming allowed.
	Honeycomb, Aluminum	Any	Composite	$ 50.00	kg					Any cell size and density. Hand trimming allowed.
	Honeycomb, Cardboard	Any	Composite	$ 10.00	kg				1-Mar-09	Any cell size and density. Hand trimming allowed.
	Honeycomb, Nomex	Any	Composite	$ 125.00	kg					Any cell size and density. Hand trimming allowed.
	Structural Foam	Any	Composite	$ 125.00	kg					Any cell size and density. Hand trimming allowed.
	Carbon Fiber Tubes, Purchased (All Cost as Made)	Any	Composites	$ -	unit				8-Mar-09	This item should be cost as made whether the team made it or bought it. Plea
	Composite Tubes, Purchased (All Cost as Made)	Any	Composites	$ -	unit				8-Mar-09	This item should be cost as made whether the team made it or bought it. Plea
	Controller, Active Differential	Any	Control Module	$ 200.00	unit					
	Controller, Active Suspension	Any	Control Module	$ 200.00	unit					
	Controller, Chassis Control Module, +Active Differential	Student Built	Control Module	$ 125.00	unit				2-Mar-09	Includes necessary inputs (wheel speed, axle speed, etc) and differential control outputs. Required Chassis Control Module, Baseline Enclosure.
	Controller, Chassis Control Module, +Active Suspension	Student Built	Control Module	$ 150.00	unit				2-Mar-09	Includes necessary inputs (damper position, velocity, etc) and damper control outputs. Required Chassis Control Module, Baseline Enclosure.
	Controller, Chassis Control Module, +Advanced Chemistry Battery Charger	Student Built	Control Module	$ 10.00	unit				2-Mar-09	Includes battery health input from pack and charging outputs. Required Chassis Control Module, Baseline Enclosure.
	Controller, Chassis Control Module, +Automatic Shifter	Student Built	Control Module	$ 5.00	unit				2-Mar-09	Includes sensor input from engine, output to shifter. Required Chassis Control Module, Baseline Enclosure.
	Controller, Chassis Control Module, +Dashboard	Student Built	Control Module	$ 20.00	unit				2-Mar-09	Includes sensor inputs and dashbboard outputs. Required Chassis Control Mo
	Controller, Chassis Control Module, +Engine Actuator	Student Built	Control Module	$ 5.00	unit				2-Mar-09	Includes sensor input and output to one engine actuator device (intake runner
	Controller, Chassis Control Module, +Fan Controller	Student Built	Control Module	$ 5.00	unit				2-Mar-09	Includes engine coolant temp input and fan power output. Required Chassis C
	Controller, Chassis Control Module, +Traction Control	Student Built	Control Module	$ 150.00	unit				2-Mar-09	Includes sensor input from engine, output to shifter. Required Chassis Control Module, Baseline Enclosure.
	Controller, Chassis Control Module, Baseline Enclosure	Student Built	Control Module	$ 25.00	unit				2-Mar-09	Includes enclosure. This item must be included for all chassis control modules
	ECU, AEM Plug & Play, AVM-30-1052U	AEM	Control Module	$ 725.00	unit					
	ECU, AEM Wire & Play	AEM	Control Module	$ 751.93	unit					
	ECU, DTA S40	DTA	Control Module	$ 430.00	unit				23-Feb-09	ECU Only
	ECU, DTA, S60 Pro	DTA	Control Module	$ 950.00	unit				1-Mar-09	
	ECU, Dynojet, Power Commender III USB	Dynojet	Control Module	$ 175.00	unit					Requires OEM ECU to also be included in cost
	ECU, Electromotive, TEC-GT	Electromotive	Control Module	$ 1,000.00	unit					-
	ECU, Haltech, E11v2	Haltech	Control Module	$ 966.00	unit					6,8 c seq
	ECU, Haltech, E6x	Haltech	Control Module	$ 590.00	unit					4,6,8 c
	ECU, Haltech, E8	Haltech	Control Module	$ 762.00	unit					4 c seq
	ECU, Haltech, Platinum Sport 2000 Long Flying Lead Kit	Haltech	Control Module	$ 850.00						
	ECU, Megasquirt	Megasquirt	Control Module	$ 400.00	unit					Assembled with case
	ECU, Microsquirt	Megasquirt	Control Module	$ 400.00	unit					Assembled with case
	ECU, MoTeC, M4	MoTeC	Control Module	$ 1,050.00	unit					
	ECU, MoTeC, M400	MoTeC	Control Module	$ 1,615.00	unit					
	ECU, MoTeC, M48	MoTeC	Control Module	$ 1,236.00	unit					
	ECU, MoTeC, M800	MoTeC	Control Module	$ 1,650.00	unit				8-Mar-09	
	ECU, OEM Spark & Fuel	Any OEM	Control Module	$ 500.00	unit					
	ECU, OEM Spark Only	Any OEM	Control Module	$ 250.00	unit					
	ECU, OEM Spark, Fuel & Traction Control	Any OEM	Control Module	$ 750.00	unit					
	ECU, Pectel, SQ-6 ECU		Control Module	$ 1,990.00						
	ECU, Performance Electronics, PE-ECU-1	Performance Electronics	Control Module	$ 500.00	unit					

Material ID	Material	Supplier	Category	Table Price	Unit 1	Unit 2	C1	C2	Modified	Comments
	ECU, Simple Digital Systems, EM-4 D	Simple Digital Systems	Control Module	$ 486.50	unit					
	ECU, Simple Digital Systems, EM-4 E/MSD	Simple Digital Systems	Control Module	$ 582.50	unit					e.g. 1010, 1025 etc.
	ECU, Simple Digital Systems, EM-4 F	Simple Digital Systems	Control Module	$ 572.50	unit					e.g. 4130, Chrome Moly, etc.
	ECU, Student Built, +Active Diff	Student Built	Control Module	$ 125.00	unit					In addition to cost of base student built ECU
	ECU, Student Built, +Traction Control	Student Built	Control Module	$ 150.00	unit					In addition to cost of base student built ECU
	ECU, Student Built, Spark & Fuel	Student Built	Control Module	$ 375.00	unit					Housing, connector included
	ECU, Student Built, Spark Only	Student Built	Control Module	$ 190.00	unit					Housing, connector included
	Cable, Pull	Any	Controls	$ 15.00	m					Includes cable and housing and integral moutnings at both ends. Mounting ha
	Cable, Push/Pull	Any	Controls	$ 30.00	m					Includes cable and housing and integral moutnings at both ends. Mounting ha
	Damper, Cane Creek Double Barrel	Cane Creek	Damper	$ 300.00	unit					
	Damper, Elka Stage-5 MTB	Elka	Damper	$ 225.00	unit				23-Feb-09	
	Damper, Fox DHX 5.0	Fox	Damper	$ 210.00	unit					
	Damper, Fox Van R	Fox	Damper	$ 125.00	unit					
	Damper, Fox Vanilla R	Fox	Damper	$ 190.00	unit					
	Damper, Koni 3012	Koni	Damper	$ 250.00	unit				1-Mar-09	
	Damper, Marzocchi, Roco TST R	Marzocchi	Damper	$ 135.00	unit				1-Mar-09	Damper cost without spring
	Damper, Ohlnis ST44	Ohlins	Damper	$ 325.00	unit					
	Damper, Penske 7800	Penske	Damper	$ 117.50	unit					
	Damper, Penske 8100	Penske	Damper	$ 400.00	unit				23-Feb-09	
	Damper, Penske 8300	Penske	Damper	$ 412.50	unit					
	Damper, Penske 8760	Penske	Damper	$ 660.00	unit					
	Damper, Risse Jupiter 5	Risse Racing	Damper	$ 175.00	unit					
	Damper, Risse Jupiter 5R	Risse Racing	Damper	$ 200.00	unit					
	Damper, Risse Jupiter 7R	Risse Racing	Damper	$ 300.00	unit					
	Damper, Tanner	Tanner	Damper	$ 85.00	unit					
	Damper, ZF Sachs, ETX36/15x	ZF Sachs	Damper	$ 360.00	unit				23-Feb-09	
	Dampers, Team Built	Team	Damper	$ -	unit					
	Belt	Any	Drivetrain	$ 0.05	mm					
	Chain	Any	Drivetrain	$ 0.05	mm					Master link included in price of chain.
	Constant Velocity Joint, Boot	Any	Drivetrain	$ 5.00	unit					
	Constant Velocity Joint, Rzepa Plunging	Any	Drivetrain	$ 20.00	unit				1-Mar-09	6-Ball plunging, includes grease
	Constant Velocity Joint, Rzeppa Fixed	Any	Drivetrain	$ 20.00	unit					6-Ball Non-plunging, includeas grease
	Constant Velocity Joint, Tripod	Any	Drivetrain	$ 45.00	unit					3-Needle bearing plunging, includes grease
	Differential Housing (All Cost as Made)	Any	Drivetrain	$ -	unit					This item should be cost as made whether the team made it or bought it. Plea
	Differential Internals, Limited Slip, Cam & Pawl	Any	Drivetrain	$ 110.00	unit				1-Mar-09	
	Differential Internals, Limited Slip, Quaife	Quaife	Drivetrain	AIR	unit					
	Differential Internals, Limited Slip, Salisbury or Powerflow or Clutch Style	Any	Drivetrain	$ 110.00	unit					
	Differential Internals, Limited Slip, Torsen T1	Torsen	Drivetrain	$ 165.00	unit					
	Differential Internals, Limited Slip, Torsen T2	Torsen	Drivetrain	$ 165.00	unit					
	Differential Internals, Open Gearset (Any)	Any	Drivetrain	$ 60.00	unit					
	Pulley (All Cost as Made)	Any	Drivetrain	$ -	unit					This item should be cost as made whether the team made it or bought it. Plea
	Sprocket (All Cost as Made)	Any	Drivetrain	$ -	unit					This item should be cost as made whether the team made it or bought it. Plea
	Universal Joint	Any	Drivetrain	$ 20.00	unit					
	Battery, Advanced Chemistry (NiMH, Li-Ion, etc.)	Any	Electronics	$ 65.00	kg					
	Battery, Lead Acid	Any	Electronics	$ 3.00	kg					
	Connector, Aerospace Quality	Any	Electronics	$ 1.00	pin(s)					
	Connector, Computer Type	Any	Electronics	$ 1.00	pin(s)					Seriel, Parallel, USB, Firewire, etc.
	Connector, High Power, > 2 Amps	Any	Electronics	$ 2.00	pin(s)					Vehicle power, starter, alternator, etc.
	Connector, OEM Quality	Any	Electronics	$ 0.50	pin(s)					
	Connector, Single Wire	Any	Electronics	$ 0.05	wire					Any style, any size, per wire end. Includes, ring, spade, bullet, etc.
	Display, 7 Segment	Any	Electronics	$ 1.00	digit					Each digit can represent a single character alpha or numeric
	Display, LCD (for Student Built Electronics Only), Any Shape	Any	Electronics	[C1]*[Size1]+[C2]	cm^2		1.25	0	2-Mar-09	LCD Display when incorporated into or driven off student built electroincs. Not
	Display, LCD (for Student Built Electronics Only), Rectangular	Any	Electronics	[C1]*[Size1]*[Size2]+[C2]	cm	cm	1.25	0	25-Feb-09	LCD Display when incorporated into or driven off student built electroincs. Not
	Display, Matrix	Any	Electronics	$ 2.00	digit					Each digit can represent a single character alpha or numeric
	Fuse Box	Any	Electronics		pin(s)					Use 2 x Number of Fuses and relays to calculate number of pins
	Fuse, Control	Any	Electronics	$ 0.50	unit					
	Fuse, Power	Any	Electronics	$ 1.00	unit					
	Fuse, Signal	Any	Electronics	$ 0.50	unit					
	Gauge, Analog	Any	Electronics	$ 5.00	unit					Any use such as RPM, pressure, temperature, etc. Includes driver (motor, etc)
	Gauge, Analog Housing	Any	Electronics	$ 8.00	unit					Used with Gauge, Analog when mounted not integrated into the instrument pa
	Heat Shrink Tubing	Any	Electronics	$ 0.50	m					
	Lamp, Brake with Housing	Any	Electronics	$ 4.00	unit					
	Lamp, Incandescent	Any	Electronics	$ 2.00	unit					
	Lamp, LED	Any	Electronics	$ 0.50	unit					
	Motor, 12 Volt, DC Brush	Any	Electronics	$ 20.00	unit					Used for general actuation. For more specefic motors please submit an Add Ite
	Motor, 12 Volt, DC Brushless Servo	Any	Electronics	$ 40.00	unit					Used for general actuation. For more specefic motors please submit an Add Ite
	Relay, Control	Any	Electronics	$ 2.00	unit					
	Relay, Power	Any	Electronics	$ 4.00	unit					
	Relay, Signal	Any	Electronics	$ 2.00	unit					
	Sensor to CAN Converter	Any	Electronics	$ 25.00	unit					Converts analog or digital sensor input to CAN output
	Servo, 12V	Any	Electronics	$ 25.00	unit				3-Mar-09	Radio Controlled Hobby style servo with built in gear reduction.
	Solenoid, 12 Volt	Any	Electronics	$ 7.50	unit					
	Switch, Kill	Any	Electronics	$ 3.00	unit					
	Switch, Pushbutton	Any	Electronics	$ 1.00	unit					
	Switch, Rotary Multi-position Selector	Any	Electronics	$ 3.00						
	Switch, Toggle	Any	Electronics	$ 1.00	unit					
	Terminal Block, Wiring	Any	Electronics	$ 0.25	pin(s)					
	Wire Sleeving, Split	Any	Electronics	$ 0.50	m					
	Wire, Control	Any	Electronics	$ 1.00	m					
	Wire, Power	Any	Electronics	$ 3.00	m					
	Wire, Signal	Any	Electronics	$ 1.00	m					
	Air Filter	Any	Engine	$ 0.15	cm^2					Paper or foam element only

Material ID	Material	Supplier	Category	Table Price	Unit 1	Unit 2	C1	C2	Modified	Comments
	Carburetor	Any	Engine	$ 50.00	unit					
	Coolant Pump, External Electric	Any	Engine	$ 20.00						
	Dry Sump Pump, Dailey Engineering, 04-00-2162	Dailey Engineering	Engine	$ 726.00	unit				22-Feb-09	
	Dry Sump Pump, Student Made	Student Built	Engine	$ -	unit				22-Feb-09	
	Engine and Transmission, High Performance (5-10 HP/100 cc)	Any	Engine	$ 2.00	cc					Normal motorcycle engines with 2 valves per cylinder, etc. Engine cost includes tranmission (whether integral or not by design) and all components necessary to run including spark plugs, coils, wires, oil filter. Cost includes engine as received by manufacturer but not custom parts such as dry sump pans, PCV changes, etc. Fully internal engine changes are free. If covers or other parts are removed disassembly labor must be included in labor cost.
	Engine and Transmission, Low Performance (<5 HP/100 cc)	Any	Engine	$ 1.20	cc					Industrial engines, etc. Engine cost includes tranmission (whether integral or not by design) and all components necessary to run including spark plugs, coils, wires, oil filter. Cost includes engine as received by manufacturer but not custom parts such as dry sump pans, PCV changes, etc. Fully internal engine changes are free. If covers or other parts are removed disassembly labor must be included in labor cost.
	Engine and Transmission, Ultra High Performance (>10 HP/100 cc)	Any	Engine	$ 2.50	cc					New high tech engines, 3-5 valves per cylinder, etc. Engine cost includes tranmission (whether integral or not by design) and all components necessary to run including spark plugs, coils, wires, oil filter. Cost includes engine as received by manufacturer but not custom parts such as dry sump pans, PCV changes, etc. Fully internal engine changes are free. If covers or other parts are removed disassembly labor must be included in labor cost.
	Fuel Check Valve	Any	Engine	$ 8.00	unit					
	Fuel Filter	Any	Engine	$ 8.00	unit					
	Fuel Injector, E85	Any	Engine	$ 13.00	unit					
	Fuel Injector, Gasoline	Any	Engine	$ 10.00	unit					
	Fuel Pressure Regulator, E85	Any	Engine	$ 19.50	unit			355	10-Jan-00	
	Fuel Pressure Regulator, Gasoline	Any	Engine	$ 15.00	unit			470	15-Jan-00	
	Fuel Pump, Carburetor, Gasoline or E85	Any	Engine	$ 20.00	unit					
	Fuel Pump, Fuel Injected, E85	Any	Engine	$ 45.50	unit					
	Fuel Pump, Fuel Injected, Gasoline	Any	Engine	$ 35.00	unit					
	Fuel Rail (All Cost as Made)	Any	Engine	$ -	unit					This item should be cost as made whether the team made it or bought it. Plea
	Heat Exchanger Fan	Any	Engine	$ 30.00	unit					Includes motor and blades
	Heat Exchanger Fan Shroud (All Cost as Made)	Any	Engine	$ -	unit					This item should be cost as made whether the team made it or bought it. Plea
	Heat Exchanger, Air-to-Air	Any	Engine	$ 0.0035	cm^3					Includes radiator, oil cooler and others
	Heat Exchanger, Air-to-Liquid	Any	Engine	$ 0.0035	cm^3				2-Mar-09	Includes radiator, oil cooler and others
	Muffler (All Cost as Made)	Any	Engine	$ -	unit					This item should be cost as made whether the team made it or bought it. Plea
	Muffler Batting	Any	Engine	$ 0.003	cm^3					Cost based on total volume of muffler
	Oil Filter	Any	Engine	$ -	unit					Included in engine cost - Shown only for reference
	Overflow Bottle, Aluminum Drinking Bottle	Any	Engine	$ 10.00	unit					
	Overflow Bottle, JAX 1 Qt. Oil Breather Tank	Jax	Engine	$ 28.50	unit				3-Aug-09	
	Overflow Bottle, JAX, 1 Qt. Recirculating Catch Can	Jax	Engine	$ 12.00	unit				3-Aug-09	
	Overflow Bottle, Nalgene Bottle	Any	Engine	$ 5.00	unit					
	Overflow Bottle, Plastic Drinking Bottle	Any	Engine	$ 5.00	unit					
	Overflow Bottle, Student Built	Student Built	Engine	$ -	unit					
	Spark Plug Coil	Any	Engine	$ -	unit					Included in engine cost - Shown only for reference
	Spark Plug Wire	Any	Engine	$ -	unit					Included in engine cost - Shown only for reference
	Supercharger	Any	Engine	$ 300.00	unit					Includes pulley and bypass valve (if fitted) but no plumbing.
	Throttle Body (All Cost as Made)	Any	Engine	$ -	unit					This item should be cost as made whether the team made it or bought it. Plea
	Turbocharger	Any	Engine	$ 300.00	unit					Includes waste gate but no plumbing
	Fluid, Coolant	Any	Fluid	$ 0.00	liter					Water or water wetter mixture. Free.
	Fluid, Oil	Any	Fluid	$ 0.75	liter					Engine oil, differential, hydraulic (brake/clutch), etc.
	Foam, Fuel Anti-Surge	Any	Fuel System	$ 1.00	liter				22-Feb-09	
	Fuel Check Valve, In-line, Plastic Rollover	Any	Fuel System	$ 7.00	unit				1-Mar-09	
	Grommet, Elastomer	Any	Hardware	$ 0.05	unit					Any size, any material
	Locating Pin, Bullet-Nose Dowel, Steel	Any	Hardware	[C1]*[Size1]+[C2]	mm		0.032	1.12		
	Locating Pin, Liner, Steel	Any	Hardware	[C1]*[Size1]+[C2]	mm		0.05	2.34		
	Adhesive	Any	Misc.	$ -	unit					Included in process cost
	Cable Adjuster	Any	Misc.	$1.00	unit				1-Mar-09	
	Clevis	Any	Misc.	[C1]*[Size1]^2+[C2]	mm		0.01	0.61	22-Feb-09	[Size1]=bore size (diameter of hole). Includes male/female and left/right threads.
	Filler Cap	Any	Misc.	$ 3.00	unit					Fuel, cooling system, etc.
	Gearbox Oil Temperature Control Valve, Automated	GearZmo	Misc.	$ 232.00	unit				22-Feb-09	
	Head Rest Padding	Any	Misc.	$ 0.005	cm^3					
	Heat Barrier	Any	Misc.	$ 50.00	m^2					Adhesive film (foil) or matting for reflecting head.
	Mirror Lens	Any	Misc.	$ 0.15	cm^2					
	Mirror, Rear View, Housing (All Cost as Made)	Any	Misc.	$ -	in^2					This item should be cost as made whether the team made it or bought it. Plea
	Paint	Any	Misc.	$ 10.00	m^2					
	Roll Hoop Padding	Any	Misc.	$ 0.05	cm					
	Seat (All Cost as Made)	Any	Misc.	$ -	unit					This item should be cost as made whether the team made it or bought it. Plea
	Throttle Linkage, Tilton, 72-790	Tilton	Misc.	$85.00	unit				1-Mar-09	
	Pedal Assembly, Tilton, 72-680	Tilton	Pedals	$360.00	unit				1-Mar-09	
	Adapter, Hex Nipple, Brass	Any	Plumbing	[C1]*[Size1]+[C2]	mm		1.1	0.22	8-Mar-09	[Size1]=Pipe Size (mm)
	Adapter, Hex Nipple, Reducing, Brass	Any	Plumbing	[C1]*[Size1]*[Size2]+[C2]	mm		0.02	2.23	8-Mar-09	[Size1]=Inlet Pipe Size (mm). [Size2]=Outlet Pipe Size (mm)
	Banjo Bolt, Aluminum	Any	Plumbing	[C1]*[Size1]+[Size2]	mm		0.68	0	3-Mar-09	[Size1]=Thread Size (mm).
	Banjo Bolt, Steel	Any	Plumbing	[C1]*[Size1]+[Size2]	mm		0.68	0	3-Mar-09	[Size1]=Thread Size (mm).
	Banjo Fitting, 45 Deg., Aluminum	Any	Plumbing	[C1]*[Size1]+[Size2]	mm		1.25	1.875	3-Mar-09	[Size1]=Inlet Fitting Size (mm).
	Banjo Fitting, 45 Deg., Steel	Any	Plumbing	[C1]*[Size1]+[Size2]	mm		2.625	0	3-Mar-09	[Size1]=Inlet Fitting Size (mm).
	Banjo Fitting, 90 Deg., Aluminum	Any	Plumbing	[C1]*[Size1]+[Size2]	mm		1.5	2.25	3-Mar-09	[Size1]=Inlet Fitting Size (mm).
	Banjo Fitting, 90 Deg., Steel	Any	Plumbing	[C1]*[Size1]+[Size2]	mm		3.15	0	3-Mar-09	[Size1]=Inlet Fitting Size (mm).

Material ID	Material	Supplier	Category	Table Price	Unit 1	Unit 2	C1	C2	Modified	Comments
	Banjo Fitting, Aluminum	Any	Plumbing	[C1]*[Size1]+[Size2]	mm		1	1.5	3-Mar-09	[Size1]=Inlet Fitting Size (mm).
	Banjo Fitting, Double, Aluminum	Any	Plumbing	[C1]*[Size1]+[Size2]	mm		1.5	2.25	3-Mar-09	[Size1]=Largest Inlet Fitting Size (mm).
	Banjo Fitting, Double, Steel	Any	Plumbing	[C1]*[Size1]+[Size2]	mm		3.15	0	3-Mar-09	[Size1]=Largest Inlet Fitting Size (mm).
	Banjo Fitting, Steel	Any	Plumbing	[C1]*[Size1]+[Size2]	mm		2.1	0	3-Mar-09	[Size1]=Inlet Fitting Size (mm).
	Crush Washer	Any	Plumbing	[C1]*[Size1]+[Size2]	mm		0.027	0.12	3-Mar-09	[Size1]=Inner Diameter (mm). Any material (steel, aluminum, copper, etc.)
	Drain Plug, Hex Head, Magnetic	Any	Plumbing	[C1]*[Size1]+[C2]	mm		0.093	0.05	8-Mar-09	[Size1]=Threaded Diameter (mm)
	Drain Plug, Hex Head, Magnetic	Any	Plumbing	[C1]*[Size1]+[C2]	mm		0.093	0.05	8-Mar-09	[Size1]=Threaded Diameter (mm)
	Fitting, Push-to-Connect, Plastic, Male Pipe Straight	Any	Plumbing	[C1]*[Size1]+[C2]*[Size2]	mm		0.25	0.04	8-Mar-09	[Size1]=Tube Outer Diameter (mm)
	Fitting, Push-to-Connect, Plastic, Male Pipe Swivel 90° Elbow	Any	Plumbing	[C1]*[Size1]+[C2]*[Size2]	mm	mm	0.25	0.04	8-Mar-09	[Size1]=Tube Outer Diameter (mm). [Size2]=Pipe Diameter (mm)
	Fitting, Push-to-Connect, Plastic, Tee	Any	Plumbing	[C1]*[Size1]+[C2]	mm		0.2	0.95	8-Mar-09	[Size1]=Tube Outer Diameter (mm)
	Fitting, Push-to-Connect, Plastic, Wye	Any	Plumbing	[C1]*[Size1]+[C2]	mm		0.2	0.95	8-Mar-09	[Size1]=Tube Outer Diameter (mm)
	Fitting, Fuel Pressure Gauge, 12.7mm Barb End (x2), 3.175mm NPT Female	Any	Plumbing	$ 3.00	unit				1-Mar-09	
	Fitting, Jiffy-Tite 2000 Series, Quick-Disconnect Plug to Flare, 45 Deg.	Jiffy-Tite	Plumbing	$ 14.50	unit				1-Mar-09	Sizes up to 12.7mm Flare
	Fitting, Jiffy-Tite 2000 Series, Quick-Disconnect Plug to Flare, 90 Deg.	Jiffy-Tite	Plumbing	$ 14.50	unit				1-Mar-09	Sizes up to 12.7mm Flare
	Fitting, Jiffy-Tite 2000 Series, Quick-Disconnect Plug to Flare, Straight	Jiffy-Tite	Plumbing	$ 11.50	unit				1-Mar-09	Sizes up to 12.7mm Flare
	Fitting, Jiffy-Tite 2000 Series, Quick-Disconnect Socket to Flare, 45 Deg.	Jiffy-Tite	Plumbing	$ 16.00	unit				1-Mar-09	Sizes up to 12.7mm Flare
	Fitting, Jiffy-Tite 2000 Series, Quick-Disconnect Socket to Flare, 90 Deg.	Jiffy-Tite	Plumbing	$ 18.50	unit				1-Mar-09	Sizes up to 12.7mm Flare
	Fitting, Jiffy-Tite 2000 Series, Quick-Disconnect Socket to Flare, Straight	Jiffy-Tite	Plumbing	$ 17.50	unit				1-Mar-09	Sizes up to 12.7mm Flare
	Hose, Rubber	Any	Plumbing	[C1]*[Size1]*[Size2]	mm	m	0.18	0	23-Feb-09	[Size1]=Outer Diameter (mm). [Size2]=Length (m). Same cost with and withou
	Hose, Silicone	Any	Plumbing	[C1]*[Size1]*[Size2]	mm	m	0.47	0	1-Mar-09	[Size1]=Outer Diameter (mm). [Size2]=Length (m). Same cost with and withou
	Aluminum Metal Matrix Composite	Any	Raw Material	$ 33.00	kg					
	Aluminum, Normal	Any	Raw Material	$ 4.20	kg					e.g. 2024, 6061, A356, A380
	Aluminum, Premium	Any	Raw Material	$ 4.20	kg					e.g. 7075
	Brass	Any	Raw Material	$ 2.20	kg					
	Bronze	Any	Raw Material	$ 2.20	kg					
	Copper	Any	Raw Material	$ 2.20	kg					
	Fabric	Any	Raw Material	$2.50	m^2				1-Mar-09	Any fabric including dacron for body covering, seats, etc.
	Glass	Any	Raw Material	$ 10.00	m^2					
	Inconel	Any	Raw Material	AIR	kg					Please submit an Add Item Request
	Iron	Any	Raw Material	$ 1.00	kg					
	Leather	Any	Raw Material	$100.00	m^2				1-Mar-09	
	Magnesium	Any	Raw Material	$ 6.00	kg					
	Nickel	Any	Raw Material	$ 2.20	kg					
	Plastic, ABS	Any	Raw Material	$ 3.30	kg					PVC, Thermoplastic
	Plastic, Acetal	Any	Raw Material	$ 3.30	kg					Delrin, Turcite, Acetal Copolymer
	Plastic, Acrylic	Any	Raw Material	$ 3.30	kg					Extruded, Cast
	Plastic, Flouropolymers	Any	Raw Material	$ 3.30	kg					Teflon® PTFE, PTFE (polytetrafluoroethylene), ETFE (ethylene tetrafluoroethyle
	Plastic, Garolite	Any	Raw Material	$ 3.30	kg					Industrial Laminates, Phenolics, Thermosets
	Plastic, Nylon	Any	Raw Material	$ 3.30	kg					Nylon 6/6, Nylon 6/12
	Plastic, PEEK	Any	Raw Material	$ 3.30	kg					
	Plastic, Polycarbonate	Any	Raw Material	$ 3.30	kg					
	Plastic, Polyethelene	Any	Raw Material	$ 3.30	kg					LDPE (low density polyethylene), UHMW (ultra high molecular weight), HDPE (
	Plastic, Polypropolene	Any	Raw Material	$ 3.30	kg					
	Plastic, PVC	Any	Raw Material	$ 3.30	kg					Type I, Type II, CPVC, Expanded Rigid PVC
	Rubber	Any	Raw Material	$ 3.30	kg					
	Silicon Carbide (or any ceramic)	Any	Raw Material	AIR	kg					Please submit an Add Item Request
	Steel, Alloy	Any	Raw Material	$ 2.25	kg					e.g. 4130, Chrome Moly, etc.
	Steel, Mild	Any	Raw Material	$ 2.25	kg					e.g. 1010, 1025 etc.
	Steel, Stainless	Any	Raw Material	$ 2.25	kg				2-Mar-09	
	Suede	Any	Raw Material	$100.00	m^2				1-Mar-09	
	Titanium	Any	Raw Material	$ 22.00	kg					e.g. Ti6Al4V
	Wood, Hard	Any	Raw Material	$ 0.004	cm^3					Oak, Maple, Birch
	Wood, Soft	Any	Raw Material	$ 0.003	cm^3					Balsa, Bass
	Harness, Driver	Any	Safety	$ 45.00	unit					Any harness, any latch style, any number of belts. Includes harness with built in attachment points but no hardware.
	Seal, O-Ring, Elastomer	Any	Seals	$ 0.05	unit					Any size, any material
	Seal, Radial Lip Seal	Any	Seals	$ 1.00	unit					Any Size, any style
	Sensor, Accelerometer, 1 Axis	Any	Sensors	$ 4.00	unit					
	Sensor, Accelerometer, 3 Axis	Any	Sensors	$ 8.00	unit					
	Sensor, Air Temperature	Any	Sensors	$ 4.00	unit					OEM quality sensor
	Sensor, Angular Position	Any	Sensors	$ 4.00	unit					e.g. Throttle Position Sensor (TPS)
	Sensor, Fluid Pressure	Any	Sensors	$ 4.00	unit					
	Sensor, Hal Effect	Any	Sensors	$ 4.00	unit					e.g. Wheel Speed Sensor
	Sensor, LVDT	Any	Sensors	$ 12.00	unit					
	Sensor, Manifold Absolute Pressure (MAP)	Any	Sensors	$ 4.00	unit					OEM quality sensor
	Sensor, Mass Air Flow (MAF)	Any	Sensors	$ 25.00	unit					OEM quality sensor
	Sensor, Switching Air Fuel Ratio	Any	Sensors	$ 15.00	unit					Switches output (high/low) when transition from rich to lean detected
	Sensor, Thermocouple	Any	Sensors	$ 8.00	unit					
	Sensor, Two State Position	Any	Sensors	$ 4.00	unit					
	Sensor, Wide Band Air Fuel Ratio	Any	Sensors	$ 35.00	unit					Output proportional to air fuel ratio
	CO2 Regulator	Any	Shifter	$ 50.00	unit				22-Feb-09	
	CO2 Tank, Composite	Any	Shifter	[C1]*[Size1]+[C2]	cc		0.05	0.85	2-Feb-09	
	CO2 Tank, Metallic	Any	Shifter	[C1]*[Size1]+[C2]	cc		0.044	-5.44	2-Feb-09	
	N2 Regulator	Any	Shifter	$ 50.00	unit				22-Feb-09	
	N2 Tank, Composite	Any	Shifter	[C1]*[Size1]+[C2]	cc		0.05	0.85	2-Feb-09	
	N2 Tank, Metallic	Any	Shifter	[C1]*[Size1]+[C2]	cc		0.044	-5.44	2-Feb-09	
	Pneumatic Cylinder, Double Acting	Any	Shifter	$ 25.00	unit				22-Feb-09	
	Pneumatic Cylinder, Single Acting	Any	Shifter	$ 20.00	unit				22-Feb-09	
	Pneumatic Valve, Two Position	Any	Shifter	$ 25.00	unit				22-Feb-09	Two position valve (open/closed).
	Shifter, Automatic, Kartech	Kartech	Shifter	$590.00	unit				1-Mar-09	
	Shifter, Automatic, Kartech, Me-Shifter F1	Kartech	Shifter	$ 590.00	unit				1-Mar-09	

Material ID	Material	Supplier	Category	Table Price	Unit 1	Unit 2	C1	C2	Modified	Comments
	Shifter, Automatic, Kliktronics	Kliktronics	Shifter	$ 360.00	unit				1-Mar-09	
	Shifter, Automatic, Pingel Easy Shift Kit	Pingel	Shifter	$ 375.00	unit				1-Mar-09	
	Shifter, Automatic, TransLogic TLS-PS1	TransLogic	Shifter	$ 400.00	units					Includes actuator, wiring and 2 buttons.
	Spring, Compression (General)	Any	Springs	$ 1.00	unit					For all uses requiring forces < 100 N. Not for suspensions.
	Spring, Tension (General)	Any	Springs	$ 1.00	unit					For all uses requiring forces < 100 N. Not for suspensions.
	Suspension Springs, Coil Spring, Steel	Any	Springs	$ 25.00	unit					Any Steel coil compression spring
	Suspension Springs, Coil Spring, Titanium	Any	Springs	$ 110.00	unit					Titanium Spring
	Steering Column Universal Joint	Any	Steering	$ 20.00	unit					
	Steering Pinion (All Cost as Made)	Any	Steering	$ -	unit					This item should be cost as made whether the team made it or bought it. Plea
	Steering Rack (All Cost as Made)	Any	Steering	$ -	unit					This item should be cost as made whether the team made it or bought it. Plea
	Steering Rack Housing (All Cost as Made)	Any	Steering	$ -	unit					This item should be cost as made whether the team made it or bought it. Plea
	Steering Wheel (All Cost as Made)	Any	Steering	$ -	unit					This item should be cost as made whether the team made it or bought it. Plea
	Steering Wheel, Quick Release (All Cost as Made)	Any	Steering	$ -	unit					This item should be cost as made whether the team made it or bought it. Plea
	Balance Bar, Tilton, 72-300	Any	Suspension	$ 32.00	unit				22-Feb-09	
	Tire, Avon, A45, 13"-20.0 x 6.2	Avon	Tire	$ 100.00	unit					
	Tire, Avon, A45, 13"-20.0 x 7.2	Avon	Tire	$ 100.00	unit					
	Tire, Avon, A45, 13"-20.0 x 8.2	Avon	Tire	$ 100.00	unit					
	Tire, Bridgestone, 13"-180mm/510mm	Bridgestone	Tire	$ 100.00	unit					
	Tire, Goodyear, D2692, 13"-20.0 x 7.0	Goodyear	Tire	$ 100.00	unit				22-Feb-09	
	Tire, Goodyear, R065, 13"-20.0 x 7.0	Goodyear	Tire	$ 100.00	unit					
	Tire, Goodyear, R075, 13"-20.0 x 7.0	Goodyear	Tire	$ 100.00	unit					
	Tire, Hoosier, R25B, 10"-18.0 x 6.0	Hoosier	Tire	$ 85.00	unit					
	Tire, Hoosier, R25B, 10"-18.0 x 7.5	Hoosier	Tire	$ 85.00	unit					
	Tire, Hoosier, R25B, 10"-19.5 x 6.5	Hoosier	Tire	$ 85.00	unit					
	Tire, Hoosier, R25B, 10"-19.5 x 7.5	Hoosier	Tire	$ 85.00	unit					
	Tire, Hoosier, R25B, 13"-20.0 x 7.5	Hoosier	Tire	$ 85.00	unit					
	Tire, Hoosier, R25B, 13"-20.0 x 8.0	Hoosier	Tire	$ 85.00	unit				22-Feb-09	
	Tire, Hoosier, R25B, 13"-20.0 x 9.0	Hoosier	Tire	$ 85.00	unit				22-Feb-09	
	Tire, Hoosier, R25B, 13"-20.5 x 6.0	Hoosier	Tire	$ 85.00	unit					
	Tire, Hoosier, R25B, 13"-20.5 x 7.0	Hoosier	Tire	$ 85.00	unit					
	Tire, Hoosier, Wet, 10"-19.5 x 6.5	Hoosier	Tire	$ 80.00	unit					
	Tire, Hoosier, Wet, 13"-20.0 x 7.5	Hoosier	Tire	$ 100.00	unit					
	Tire, Hoosier, Wet, 13"-21.0 x 6.5	Hoosier	Tire	$ 100.00	unit					
	Tire, Michelin, P220, 13"-20.9 x 6.3	Michelin	Tire	$ 100.00	unit					
	Tire, Michelin, S6B, 13"-20.9 x 6.3	Michelin	Tire	$ 100.00	unit					
	Tire, Treaded Production Car Not Listed Above	Any	Tire	$ 40.00	unit					
	Valve Stem (and Tire Inflation)	Any	Tire	$ 1.00	unit				22-Feb-09	Includes tire inflation
	Wheel Shells, 10", 3 Piece, Keizer, Aluminum	Keizer	Wheel	$ 57.50	unit				8-Mar-09	Wheel shells include outer rim but no center
	Wheel Shells, 13" Inner Shell, 4" Wide, Kodiak, Aluminum	Kodiak	Wheel	$ 93.00	unit				3-Aug-09	Kodiak Part Number I13406
	Wheel Shells, 13" Inner Shell, 4.5" Wide, Kodiak, Aluminum	Kodiak	Wheel	$ 93.00	unit				3-Aug-09	Kodiak Part Number I134506
	Wheel Shells, 13" Inner Shell, 5" Wide, Kodiak, Aluminum	Kodiak	Wheel	$ 100.00	unit				3-Aug-09	Kodiak Part Number I113506
	Wheel Shells, 13" Inner Shell, 6" Wide, Kodiak, Aluminum	Kodiak	Wheel	$ 104.00	unit				3-Aug-09	Kodiak Part Number I13606
	Wheel Shells, 13" Outer Shell, 1" Wide, Kodiak, Aluminum	Kodiak	Wheel	$ 85.00	unit				3-Aug-09	Kodiak Part Number O13106
	Wheel Shells, 13" Outer Shell, 1.5" Wide, Kodiak, Aluminum	Kodiak	Wheel	$ 91.50	unit				3-Aug-09	Kodiak Part Number O131506
	Wheel Shells, 13" Outer Shell, 2" Wide, Kodiak, Aluminum	Kodiak	Wheel	$ 91.50	unit				3-Aug-09	Kodiak Part Number O13206
	Wheel Shells, 13", 3 Piece, Jongbloed, Aluminum	Jongbloed	Wheel	$ 287.50	unit				8-Mar-09	Wheel comes with solid center, no machining for hub attachment
	Wheel Shells, 13", 3 Piece, Jongbloed, Magnesium	Jongbloed	Wheel	$ 287.50	unit				8-Mar-09	Wheel comes with solid center, no machining for hub attachment
	Wheel Shells, 13", 3 Piece, Keizer, Aluminum	Keizer	Wheel	$ 82.50	unit				8-Mar-09	Wheel shells include outer rim but no center
	Wheel Shells, 13", 3 Piece, Weld, Aluminum	Weld	Wheel	$ 114.00	unit				3-Aug-09	Includes Inner (P850-3478) and Outer (P851-3318)
	Wheel Weights (and Balancing)	Any	Wheel	$ 4.00	unit					Includes weights, balancing and installation labor for wheel weight
	Wheel, 10", 1 Piece OEM, Aluminum	Any	Wheel	$ 77.50	unit					Wheel comes with solid center, no machining for hub attachment
	Wheel, 10", 1 Piece OEM, Magnesium	Any	Wheel	$ 108.00	unit					Wheel comes with solid center, no machining for hub attachment
	Wheel, 10", 1 Piece OEM, Steel	Any	Wheel	$ 40.00	unit					Wheel comes with solid center, no machining for hub attachment
	Wheel, 10", 1 Piece, Carbon Fiber, Purchased	Any	Wheel	AIR	unit					Please submit Add Item Request
	Wheel, 10", 1 Piece, Carbon Fiber, Student Made	Student Built	Wheel	$ -	unit					
	Wheel, 10", 3 Piece, Keizer, Aluminum	Keizer	Wheel	$ 77.50	unit					Wheel comes with solid center, no machining for hub attachment
	Wheel, 13", 1 Piece OEM, Aluminum	Any	Wheel	$ 115.00	unit					Wheel comes with solid center, no machining for hub attachment
	Wheel, 13", 1 Piece OEM, Magnesium	Any	Wheel	$ 161.00	unit					Wheel comes with solid center, no machining for hub attachment
	Wheel, 13", 1 Piece OEM, Steel	Any	Wheel	$ 50.00	unit					Wheel comes with solid center, no machining for hub attachment
	Wheel, 13", 1 Piece, Carbon Fiber, Purchased	Any	Wheel	AIR	unit					Please submit Add Item Request
	Wheel, 13", 1 Piece, Carbon Fiber, Student Made	Student Built	Wheel	$ -	unit					
	Wheel, 13", 1 Piece, Volk TE37, Aluminum	Volk	Wheel	$ 200.00	unit					
	Wheel, 13", 3 Piece, Bogar RT-4, Aluminum	Bogar	Wheel	$ 150.00	unit				1-Mar-09	
	Wheel, 13", 3 Piece, Jongbloed, Aluminum	Jongbloed	Wheel	$ 287.50	unit					Wheel comes with solid center, no machining for hub attachment
	Wheel, 13", 3 Piece, Jongbloed, Magnesium	Jongbloed	Wheel	$ 287.50	unit					Wheel comes with solid center, no machining for hub attachment
	Wheel, 13", 3 Piece, Keizer, Aluminum	Keizer	Wheel	$ 115.00	unit					Wheel comes with solid center, no machining for hub attachment
	Wheel, 13", 3 Piece, Keizer, Magnesium	Keizer	Wheel	$ 140.00	unit					Wheel comes with solid center, no machining for hub attachment
	Wheel, 13", 3 Piece, Weld, Aluminum	Weld	Wheel	$ 201.50	unit				8-Mar-09	Includes center (P613-7096), Inner (P850-3478) and Outer (P851-3318)
	Wheel, 13", BBS, Magnesium, Cast, R-RE-325	BBS	Wheel	$ 340.00	unit				1-Mar-09	
	Wheel, 13", Magnesium, BBS, Forged	BBS	Wheel	AIR	unit					Please submit Add Item Request
	Wheel, 15", 1 Piece OEM, Aluminum	Any	Wheel	$ 140.00	unit					
	Wheel, 15", 1 Piece OEM, Magnesium	Any	Wheel	$ 196.00	unit					
	Wheel, 15", 1 Piece OEM, Steel	Any	Wheel	$ 60.00	unit					
	Wheel, 15", 1 Piece, Carbon Fiber, Purchased		Wheel	AIR	unit					
	Wheel, 15", 1 Piece, Carbon Fiber, Student Made	Student Built	Wheel	$ -	unit					

version 1.1, 08-Mar-2009

						Application						
						Low Pressure		High Pressure				
Category	Geometry	Angle	Material	Finish	AN #	[C1]	[C2]	[C1]	[C2]	Equation	Units	Comments
Hose	Hose, Low Pressure, Stainless Steel Braided Outer					2.23	3.52	-	-	[C1]*[Size1]+[C2]	mm,m	[Size1]=Hose Size (mm). Cost is per meter of hose. Fuel, oil, coolant, air, etc. up to 7 Mpa.
Hose	Hose, Low Pressure, Fabric Outer					3.24	9.72	-	-	[C1]*[Size1]+[C2]	mm,m	[Size1]=Hose Size (mm). Cost is per meter of hose. Fuel, oil, coolant, air, etc. up to 7 Mpa.
Hose	Hose, Low Presure, Fabric Outer, Socketless					0.99	4.50	-	-	[C1]*[Size1]+[C2]	mm,m	[Size1]=Hose Size (mm). Cost is per meter of hose. Fuel, oil, coolant, air, etc. up to 1.7 Mpa.
Hose	Hose, High Pressure, Stainless Steel Braided Outer					-	-	2.47	-2.71	[C1]*[Size1]+[C2]	mm,m	[Size1]=Hose Size (mm). Cost is per meter of hose. Hydraulic, CO2, etc. up to 20.7 Mpa.
Hose	Hose, Rubber					0.18	0			[C1]*[Size1]+[C2]	mm,m	[Size1]=Outer Diameter (mm). Cost is per meter of hose. Same cost with and without fiber reinf
Tubing	Tubing, Steel					2.25				Unit Cost	kg	Cost using area, length and density and include process cost for flaring of tube ends
Fitting	Straight		Aluminum	Anodized		1.32	-6.08	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Straight		Steel			6.5200	-27.1800	0.53	3.43	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Straight		Aluminum	Nickel-Plated		1.8000	-6.4500	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Straight		Aluminum	Crimp		1.6400	-3.1500	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	30 deg.	Aluminum	Anodized		2.1000	4.5900	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	30 deg.	Steel			-	-	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	30 deg.	Aluminum	Nickel-Plated		-	-	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	30 deg.	Aluminum	Crimp		1.5900	19.0000	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	45 deg.	Aluminum	Anodized		2.1100	-2.6800	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	45 deg.	Steel			4.7200	-8.0400	0.90	7.30	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	45 deg.	Aluminum	Nickel-Plated		1.6000	13.4000	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	45 deg.	Aluminum	Crimp		2.2400	3.8600	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	60 deg.	Aluminum	Anodized		2.1000	4.5900	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	60 deg.	Steel			-	-	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	60 deg.	Aluminum	Nickel-Plated		-	-	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	60 deg.	Aluminum	Crimp		1.0600	29.5300	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	90 deg.	Aluminum	Anodized		1.4600	5.8500	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	90 deg.	Steel			4.7800	-12.5300	0.60	9.50	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	90 deg.	Aluminum	Nickel-Plated		1.6000	13.6000	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	90 deg.	Aluminum	Crimp		2.3700	1.2200	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	120 deg.	Aluminum	Anodized		0.3500	34.4000	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	120 deg.	Steel			-	-	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	120 deg.	Aluminum	Nickel-Plated		-	-	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	120 deg.	Aluminum	Crimp		2.2300	13.1100	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	150 deg.	Aluminum	Anodized		1.3400	25.3400	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	150 deg.	Steel			-	-	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	150 deg.	Aluminum	Nickel-Plated		-	-	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	150 deg.	Aluminum	Crimp		2.5200	10.2000	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	180 deg.	Aluminum	Anodized		1.7700	19.7500	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	180 deg.	Steel			-	-	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	180 deg.	Aluminum	Nickel-Plated		-	-	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Elbow	180 deg.	Aluminum	Crimp		4.4200	-19.2100	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Male Pipe		Aluminum			2.7300	6.7000	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Orb	45 deg.	Aluminum			2.2000	24.0000	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Orb	90 deg.	Aluminum			0.0000	65.0000	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Male Pipe		Brass			-	-	0.67	-2.10	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Male Flare		Brass			-	-	0.00	11.00	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Straight		Brass			-	-	0.87	-3.64	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Male Inverted Flare		Brass			-	-	1.04	-0.41	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Male Pipe		Steel			-	-	0.00	8.00	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Male Inverted Flare		Steel			-	-	0.43	6.80	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Male Inverted Flare	45 deg.	Steel			-	-	0.00	12.00	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Male Inverted Flare	90 deg.	Steel			-	-	0.00	15.00	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Tube Nut		Aluminum	Anodized	(AN 818)	0.3680	-1.3400	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Tube Nut		Steel		(AN 818)	0.1100	1.7100	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Tube Sleeve		Aluminum	Anodized	(AN 819)	0.1800	0.0000	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Tube Sleeve		Steel		(AN 819)	0.2300	0.0000	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Cap		Aluminum	Anodized	(AN 929)	0.6600	-2.1400	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Cap		Steel		(AN 929)	0.3200	0.0000	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Fitting	Male Flare to Pipe		Aluminum	Anodized	(AN 816)	0.0320	1.3300	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Male Flare to Pipe		Aluminum	Nickel-Plated	(AN 816)	0.0040	4.3400	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Male Flare to Pipe		Steel		(AN 816)	0.0006	1.4700	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Male Flare to Pipe	45 deg.	Aluminum	Anodized	(AN 823)	0.0002	11.5500	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Male Flare to Pipe	45 deg.	Aluminum	Nickel-Plated	(AN 823)	0.0004	18.5900	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Male Flare to Pipe	45 deg.	Steel		(AN 823)	0.0006	6.7800	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Male Flare to Pipe	90 deg.	Aluminum	Anodized	(AN 822)	0.0004	5.2800	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Male Flare to Pipe	90 deg.	Aluminum	Nickel-Plated	(AN 822)	0.0006	9.0000	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Male Flare to Pipe	90 deg.	Steel		(AN 822)	0.0003	1.8800	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Union		Aluminum	Anodized	(AN 812)	0.0063	1.7500	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Union	90 deg.	Aluminum	Anodized	(AN 815)	0.0124	9.3300	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Union Reducer		Aluminum	Anodized	(AN 919)	0.0063	1.7500	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Elbow, Female to Male Pipe	90 deg.	Aluminum	Anodized	(AN 914)	0.1440	8.6300	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Union, Female Flare		Aluminum	Anodized		0.0089	4.2000	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Male Pip Nipple		Aluminum	Anodized	(AN 911)	0.0350	3.5000	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Pipe Coupling		Aluminum	Anodized	(AN 910)	0.0670	3.9300	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Union Tee		Aluminum	Anodized	(AN 824)	0.0120	7.1300	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Largest Hose Size (mm), [Size2]=2nd Largest Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35n
Adapter	Male Branch Tee		Aluminum	Anodized	(AN 825)	0.0800	8.9200	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Largest Hose Size (mm), [Size2]=Largest Pipe Size (mm), e.g. AN4 = 4/16 inch = 6.35mm (L
Adapter	Male Run Tee		Aluminum	Anodized	(AN 826)	0.0660	9.7900	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Largest Hose Size (mm), [Size2]=Largest Pipe Size (mm), e.g. AN4 = 4/16 inch = 6.35mm (L
Adapter	Male Run Tee		Steel		(AN 826)	0.0690	10.9800	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Largest Hose Size (mm), [Size2]=Largest Pipe Size (mm), e.g. AN4 = 4/16 inch = 6.35mm (L
Adapter	Female Flare Tee		Aluminum	Anodized		0.0240	7.5500	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Largest Hose Size (mm), [Size2]=2nd Largest Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35n
Adapter	Female Pipe Tee		Aluminum	Anodized	(AN 917)	0.0700	13.1000	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Largest Pipe Size (mm), [Size2]=2nd Largest Pipe Size (mm), e.g. AN4 = 4/16 inch = 6.35m
Adapter	Bulkhead Union		Aluminum	Anodized	(AN 832)	0.0080	3.3000	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Bulkhead Union		Steel		(AN 832)	0.0072	5.4700	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Bulkhead Union	45 deg.	Aluminum	Anodized	(AN 837)	0.0240	2.3600	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.

Bolt, Grade 12.9		12.7	mm	0 mm	1.25	0.0050	{C1}/105154*[Size1]^2*[Size2]*SQRT([Size2])+{[C2]*EXP(0.319*[Size1])}	$ 0.29		[Size1]=diameter (mm). [Size2]=length (mm). Strength 1170 Mpa. Special varities included (drilled head, locking, etc.).
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8		12.7	mm	0 mm	0.60	0.0024	{C1}/105154*[Size1]^2*[Size1]2*SQRT([Size1]2)+{[C2]*E[Size1]P(0.319*[Size1]1)}	$ 0.14		[Size1]=diameter (mm). [Size2]=length (mm). Strength 670 Mpa. Special varities included (drilled head, locking, etc.)
Bolt, Grade 8.8 (SAE 5)		12.7	mm	0 mm	0.80	0.0030	{C1}/105154*[Size1]^2*[Size2]*SQRT([Size2])+{[C2]*EXP(0.319*[Size1])}	$ 0.17		[Size1]=diameter (mm). [Size2]=length (mm). Strength 830 Mpa. Special varities included (drilled head, locking, etc.).
Bolt, Grade AN		12.7	mm	0 mm	2.00	0.02	{C1}/105154*[Size1]^2*[Size2]*SQRT([Size2])+{[C2]*EXP(0.319*[Size1])}	$ 1.15		[Size1]=diameter (mm). [Size2]=length (mm). Strength 830 Mpa. Special varities included (drilled head, locking, etc.).
Bolt, Grade NAS 12-Point		12.7	mm	0 mm	6.25	0.10	{C1}/105154*[Size1]^2*[Size2]*SQRT([Size2])+{[C2]*EXP(0.319*[Size1])}	$ 5.75		[Size1]=diameter (mm). [Size2]=length (mm). Strength 1240 Mpa. Special varities included (drilled head, locking, etc.).
Bolt, Grade NAS 6-Point		12.7	mm	0 mm	2.50	0.04	{C1}/105154*[Size1]^2*[Size2]*SQRT([Size2])+{[C2]*EXP(0.319*[Size1])}	$ 2.30		[Size1]=diameter (mm). [Size2]=length (mm). Strength 1100 Mpa. Special varities included (drilled head, locking, etc.).
Dzus Fastener, 1/4 Turn, Slotted Head	$	1.20	unit						24-Feb-09	Includes 1/4 Turn stud, plate, spring and spring receptacle
Dzus Fastener, 1/4 Turn, Wing Head	$	1.30	unit						24-Feb-09	Includes 1/4 Turn stud, plate, spring and spring receptacle
Nut, Custom Design, Student Made	$	-	unit						11-Feb-09	To be used for designs that do not match standard nut configurations, such as
Nut, Grade 10.9 (SAE 8)			mm	mm	0.0120	0.2000	{[C1]*EXP([C2]*[Size1])}	$ 0.01	11-Feb-09	[Size1]=diameter (mm). Special varities included (drilled head, locking, etc.).
Nut, Grade 12.9			mm	mm	0.0150	0.2000	{[C1]*EXP([C2]*[Size1])}	$ 0.02	11-Feb-09	[Size1]=diameter (mm). Special varities included (drilled head, locking, etc.).
Nut, Grade 6.8 (SAE 3) and All Grades			mm	mm	0.0070	0.2000	{[C1]*EXP([C2]*[Size1])}	$ 0.01	11-Feb-09	Comments
Nut, Grade 8.8 (SAE 5)			mm	mm	0.0090	0.2000	{[C1]*EXP([C2]*[Size1])}	$ 0.01	11-Feb-09	[Size1]=diameter (mm). Special varities included (drilled head, locking, etc.).
Nut, Grade AN			mm	mm	0.0600	0.2000	{[C1]*EXP([C2]*[Size1])}	$ 0.06	11-Feb-09	[Size1]=diameter (mm). Special varities included (drilled head, locking, etc.).
Nut, Grade NAS 12-Point			mm	mm	0.3000	0.2000	{[C1]*EXP([C2]*[Size1])}	$ 0.30	11-Feb-09	[Size1]=diameter (mm). Special varities included (drilled head, locking, etc.).
Nut, Grade NAS 6-Point			mm	mm	0.1200	0.2000	{[C1]*EXP([C2]*[Size1])}	$ 0.12	11-Feb-09	[Size1]=diameter (mm). Special varities included (drilled head, locking, etc.).
Nut, Lug	$	0.40	unit						17-Feb-09	Any size
Nut, Panel Retained			unit	mm	0.050	0.250	{C1}*EXP([C2]*[Size1])	$ 0.050	01-Mar-09	Any type of nut with a retaining or anti-rotation feature for a panel (weldnut, c
Nutsert (J-Nut)			unit	mm	0.050	0.250	{C1}*EXP([C2]*[Size1])	$ 0.050	24-Feb-09	
Pin, Quick Release			mm	mm	0.001	14.000	{C1}*[Size1]^2*[Size2]+{C2}	$ 14.000	08-Mar-09	[Size1]=Diameter (mm). [Size2]=Usable Length. Any style pin (T-handle, Ring C
Rivet, Pop	$	0.03	unit						11-Feb-09	Any diameter and length
Safety Wire	$	-	unit						17-Feb-09	Included in labor cost.
Stud, Grade 10.9 (SAE 8)			mm	mm	1.00	0.0040	{C1}/105154*[Size1]^2*[Size2]*SQRT([Size2])+{[C2]*EXP(0.319*[Size1])}	$ 0.00		[Size1]=diameter (mm). [Size2]=length (mm). Strength 1030 Mpa. Special varities included (drilled head, locking, etc.).
Stud, Grade 12.9			mm	mm	1.25	0.0050	{C1}/105154*[Size1]^2*[Size2]*SQRT([Size2])+{[C2]*EXP(0.319*[Size1])}	$ 0.01		[Size1]=diameter (mm). [Size2]=length (mm). Strength 1170 Mpa. Special varities included (drilled head, locking, etc.).
Stud, Grade 8.8 (SAE 5)			mm	mm	0.80	0.0030	{C1}/105154*[Size1]^2*[Size2]*SQRT([Size2])+{[C2]*EXP(0.319*[Size1])}	$ 0.00		[Size1]=diameter (mm). [Size2]=length (mm). Strength 830 Mpa. Special varities included (drilled head, locking, etc.).
Tie Wrap	$	0.04	unit						17-Feb-09	Includes all styles and sizes of plastic cable ties including Cable Clamp, Zip Tie,
Washer, Crush			mm						08-Mar-09	This item is in the materials table under plumbing
Washer, Grade 10.9 (SAE 8)	$	0.02	unit						11-Feb-09	[Size1]=diameter (mm). Any thickness. Special varities included (drilled head, locking, etc.).
Washer, Grade 12.9	$	0.02	unit						11-Feb-09	[Size1]=diameter (mm). Any thickness. Special varities included (drilled head, locking, etc.).
Washer, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	$	0.01	unit						11-Feb-09	[Size1]=diameter (mm). Any thickness. Special varities included (drilled head, locking, etc.).
Washer, Grade 8.8 (SAE 5)	$	0.01	unit						11-Feb-09	[Size1]=diameter (mm). Any thickness. Special varities included (drilled head, locking, etc.).
Washer, Grade AN			mm	mm	0.005	0.180	{[C1]*EXP([C2]*[Size1])}	$ 0.005	11-Feb-09	[Size1]=diameter (mm). Any thickness. Special varities included (drilled head, locking, etc.).
Washer, Grade NAS 12-Point			mm	mm	0.005	0.360	{[C1]*EXP([C2]*[Size1])}	$ 0.005	11-Feb-09	
Washer, Grade NAS 6-Point			mm	mm	0.005	0.360	{[C1]*EXP([C2]*[Size1])}	$ 0.005	11-Feb-09	[Size1]=diameter (mm). Any thickness. Special varities included (drilled head, locking, etc.).

Adapter	Bulkhead Union	45 deg.	Steel		(AN 837)	0.0240	2.3600	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Bulkhead Union	90 deg.	Aluminum	Anodized	(AN 833)	0.0130	6.4700	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Bulkhead Union	90 deg.	Steel		(AN 833)	0.0100	12.1500	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Bulkhead Tee		Aluminum	Anodized	(AN 834)	0.0140	10.5400	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Largest Hose Size (mm), [Size2]=2nd Largest Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35n
Adapter	Bulkhead Tee		Steel		(AN 834)	0.0150	12.9100	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Largest Hose Size (mm), [Size2]=2nd Largest Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35n
Adapter	Bulkhead Run Tee		Aluminum	Anodized	(AN 804)	0.0190	10.6700	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Largest Hose Size (mm), [Size2]=2nd Largest Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35n
Adapter	Bulkhead Run Tee		Steel		(AN 804)	0.0155	15.2400	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Largest Hose Size (mm), [Size2]=2nd Largest Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35n
Adapter	Bulkhead Male Connector		Steel			0.0155	5.8200	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Female Pipe to Male Flare		Steel		(AN 929)	0.0180	6.4500	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Hose Size (mm), [Size2]=Outlet Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter	Pipe to Pipe		Aluminum	Anodized	(AN 912)	0.0160	7.2000	-	-	[C1]*[Size1]*[Size2]+[C2]	mm,mm	[Size1]=Inlet Pipe Size (mm), [Size2]=Outlet Pipe Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Adapter			Aluminum	Anodized	(AN 924)	0.1760	0.0560	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Locknut			Steel		(AN 924)	0.1260	1.5700	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Locknut	Flare		Aluminum	Anodized	(AN 806)	0.3850	0.8000	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Plug	Flare		Steel		(AN 806)	0.3120	0.9050	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Plug	O-Ring Boss		Aluminum	Anodized	(AN 814)	0.3800	5.4180	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.
Plug	Pipe	Allen Head	Aluminum	Anodized	(AN 932)	0.3600	1.7800	-	-	[C1]*[Size1]+[C2]	mm	[Size1]=Hose Size (mm), e.g. AN4 = 4/16 inch = 6.35mm.

Fastener	Size 1	Unit 1	Size 2	Unit 2	c1	c2	Table Price	Calc Price	Attachment	DateAdded/Modified	Mass	Comments
Steel Loop Straps, Rubber-Cushioned	25.40	mm			0.0100	0.0100	[C1]*[Size1]+[C2]	$ 0.26		11-Feb-09		[Size1]=final clamped diameter [mm]
Galvanized Steel Loop Straps	25.40	mm			0.0020	0.0800	[C1]*[Size1]+[C2]	$ 0.13		11-Feb-09		[Size1]=final clamped diameter [mm]
Galvanized Steel Loop Straps, Rubber coated	25.40	mm			0.0040	0.0800	[C1]*[Size1]+[C2]	$ 0.18		11-Feb-09		[Size1]=final clamped diameter [mm]
Hose Clamp, Spring Steel	25.40	mm			0.0140	0.0000	[C1]*[Size1]	$ 0.36		11-Feb-09		[Size1]=final clamped diameter [mm]
Hose Clamp, Constant Tension	25.40	mm			0.1230	2.6000	[C1]*[Size1]+[C2]	$ 5.72		11-Feb-09		[Size1]=final clamped diameter [mm]
Hose Clamp, Miniature Bolt	25.40	mm			0.0040	0.5000	[C1]*[Size1]+[C2]	$ 0.60		23-Feb-09		[Size1]=final clamped diameter [mm]
Hose Clamp, Single Wire	6.35	mm			0.0040	0.0200	[C1]*[Size1]+[C2]	$ 0.045		23-Feb-09		[Size1]=final clamped diameter [mm]
Hose Clamp, V-Band Quick Release	50.00	mm			0.118	10.46	[C1]*[Size1]+[C2]	$ 16.36		24-Feb-09		[Size1]=final clamped diameter [mm]
Hose Clamp, Worm Drive	25.40	mm			0.0040	0.5000	[C1]*[Size1]+[C2]	$ 0.60		11-Feb-09		[Size1]=final clamped diameter [mm]
Retaining Ring, R-ring	6.00	mm			0.0002	0.0130	[C1]*([Size1]^2)+[C2]	$0.02		11-Feb-09		[Size1]=shaft diameter [mm]
Retaining Ring, Internal	6.00	mm			0.0002	0.0130	[C1]*([Size1]^2)+[C2]	$0.02		11-Feb-09		[Size1]=shaft diameter [mm]
Retaining Ring, External	6.00	mm			0.0002	0.0130	[C1]*([Size1]^2)+[C2]	$0.02		11-Feb-09		[Size1]=shaft diameter [mm]
Retaining Ring, Spiral	6.00	mm			0.0002	0.0250	[C1]*([Size1]^2)+[C2]	$0.03		11-Feb-09		[Size1]=shaft diameter [mm]
Bolt, Aluminum		mm		mm	1.00	0.0050	{C1}/105154*[Size1]^2*[Size2]*SQRT([Size2])+([C2]*EXP(0.319*[Size1]))	$ 0.01		24-Feb-09		[Size1]=diameter (mm). [Size2]=length (mm). Strength 255 Mpa. Special varities included (drilled head, locking, etc.).
Bolt, Banjo		unit								08-Mar-09		This item is in the materials table under plumbing
Bolt, Custom Design, Student Made	$ -	unit								11-Feb-09		To be used for designs that do not match standard bolt configurations, such as
Bolt, Grade 10.9 (SAE 8)	12.7	mm	0	mm	1.00	0.0040	{C1}/105154*[Size1]^2*[Size2]*SQRT([Size2])+([C2]*EXP(0.319*[Size1]))	$ 0.23				[Size1]=diameter (mm). [Size2]=length (mm). Strength 1030 Mpa. Special varities included (drilled head, locking, etc.).

Appendix B –
Processes Chart

Process	Unit Cost	Unit	Category	Tooling Required	Near Net Shape	Multiplier Type Used	Modified	Comments
None	$ -							
Die Casting	$ 4.00	kg	Basic Forming	Yes	Yes			
Investment Casting	$ 8.00	kg	Basic Forming		Yes			
Plastic injection molding	$ 2.75	kg	Basic Forming	Yes	Yes			
Powder Metal Forming	$ 3.00	kg	Basic Forming	Yes	Yes			
Rapid Prototype - Stereo Lith.	$ 32.00	kg	Basic Forming		Yes			
Sand Casting	$ 3.00	kg	Basic Forming	Yes				
Exhaust System Ceramic Coating	$ 25.00	m	Coating				24-Feb-09	Linear distance of coating on exhaust header and tubing including all runners, etc.
Cure, Autoclave	$ 50.00	m^2	Composite	Yes				Includes all consumable materials and labor.
Cure, Oven	$ 20.00	m^2	Composite	Yes				Includes all consumable materials and labor.
Cure, Room Temperature	$ 10.00	m^2	Composite	Yes			24-Feb-09	Includes all consumable materials and labor.
Lamination, Manual	$ 35.00	m^2	Composite					
Potting	$ 0.50	cm	Composite					
Resin application, Infusion Molding	$ 2.50	m^2	Composite					
Resin application, Manual	$ 5.00	m^2	Composite					If prepreg composites are used do not included the resin application step.
Attach Wire, Fork	$ 0.25	unit	Electrical - Attach Wires					
Attach Wire, Quick connect terminal	$ 0.10	unit	Electrical - Attach Wires					
Attach Wire, Ring	$ 0.48	unit	Electrical - Attach Wires					
Attach Wire, Solder wire, bent	$ 0.35	unit	Electrical - Attach Wires					
Attach Wire, Solder wire, not bent	$ 0.52	unit	Electrical - Attach Wires					
Attach Wire, Terminated wire with screw	$ 0.35	unit	Electrical - Attach Wires					
Attach Wire, Terminated wire with screw a	$ 0.52	unit	Electrical - Attach Wires					
Attach Wire, Wire to screw	$ 0.48	unit	Electrical - Attach Wires					
Attach Wire, Wire to screw with nut	$ 0.65	unit	Electrical - Attach Wires					
Attach Wire, Wire to terminal block	$ 0.35	unit	Electrical - Attach Wires					
Attach Wire, Wire wrap around terminal p	$ 0.27	unit	Electrical - Attach Wires					
Install Tie Wrap (Zip Tie, Cable Clamp)	$ 0.09	unit	Electrical - Bundle Install				17-Feb-09	
Wire Dressing (Install and route)	$ 1.00	m	Electrical - Bundle Install					
Insert Bundle Into Tube or Sleeve	$ 0.02	m	Electrical - Bundle Processing				24-Jan-09	
Install Adhesive Cable Clamp	$ 0.19	unit	Electrical - Bundle Processing					
Lace	$ 0.15	unit	Electrical - Bundle Processing					
Shrink Tube	$ 0.15	cm	Electrical - Bundle Processing					
Taping Wire Bundle	$ 0.04	m	Electrical - Bundle Processing				24-Jan-09	
Connector Install, Circular, Bayonet	$ 0.11	unit	Electrical - Connections					
Connector Install, Circular, Friction	$ 0.14	unit	Electrical - Connections					
Connector Install, Circular, Screw Thread	$ 0.24	unit	Electrical - Connections					
Connector Install, Square, Friction	$ 0.14	unit	Electrical - Connections					
Connector Install, Square, Latch/Snap-on T	$ 0.17	unit	Electrical - Connections					
Connector Install, Square, Screw (x2)	$ 0.50	unit	Electrical - Connections					
Connector Install, Square, Spring Clip	$ 0.20	unit	Electrical - Connections					
Lay Wire - Control	$ 0.02	m	Electrical - Layout				25-Jan-09	
Lay Wire - Power	$ 0.03	m	Electrical - Layout				25-Jan-09	
Lay Wire - Signal	$ 0.02	m	Electrical - Layout				25-Jan-09	
Crimp Wire	$ 0.17	unit	Electrical - Prep					
Cut wire	$ 0.08	unit	Electrical - Prep					
Strip Multi-Conductor	$ 0.13	wire(s)	Electrical - Prep				24-Jan-09	
Strip Wire	$ 0.08	unit	Electrical - Prep					
Tin Wire	$ 0.13	unit	Electrical - Prep					
Connector Assembley, Crimp	$ 0.36	contacts	Electrical - Wire in Connector				24-Jan-09	
Connector Assembley, Solder	$ 0.24	contacts	Electrical - Wire in Connector				24-Jan-09	
Hand - Start Only	$ 0.12	unit	Fasteners					
Hand, Loose <= 25.4 mm	$ 0.50	unit	Fasteners					
Hand, Loose <= 6.35 mm	$ 0.25	unit	Fasteners					
Hand, Loose > 25.4 mm	$ 0.75	unit	Fasteners					
Hand, Tight <= 6.35 mm	$ 0.50	unit	Fasteners					
Power Tool <= 25.4 mm	$ 0.25	unit	Fasteners			Fastener Installation		
Power Tool <= 6.35 mm	$ 0.25	unit	Fasteners			Fastener Installation		
Power Tool > 25.4 mm	$ 0.50	unit	Fasteners			Fastener Installation		
Ratchet <= 25.4 mm	$ 0.75	unit	Fasteners			Fastener Installation		
Ratchet <= 6.35 mm	$ 0.50	unit	Fasteners			Fastener Installation		
Ratchet > 25.4 mm	$ 1.50	unit	Fasteners			Fastener Installation		
Reaction Tool <= 25.4 mm	$ 0.25	unit	Fasteners					
Reaction Tool <= 6.35 mm	$ 0.25	unit	Fasteners					
Reaction Tool > 25.4 mm	$ 0.50	unit	Fasteners					
Screwdriver < 1 Turn	$ 0.12	unit	Fasteners			Fastener Installation		
Screwdriver > 1 Turn	$ 0.50	unit	Fasteners			Fastener Installation		
Wrench <= 25.4 mm	$ 1.50	unit	Fasteners			Fastener Installation		
Wrench <= 6.35 mm	$ 1.00	unit	Fasteners			Fastener Installation		
Wrench > 25.4 mm	$ 2.00	unit	Fasteners			Fastener Installation		
Sewing	$ 0.08	cm	Joining					
Braze	$ 0.15	cm	Joining	Yes			8-Mar-09	
Weld	$ 0.15	cm	Joining	Yes			24-Feb-09	
Annodize	$ -	unit	Labor				25-Feb-09	It is not necessary to include any cost for annodizing. Included for reference only.
Adjustment - Misc.	$ 5.00	unit	Labor					Chain tension, etc.
Aerosol Apply	$ 5.25	m^2	Labor					
Assemble, >20 kg, Interference	$ 5.63	unit	Labor			Assembly		
Assemble, >20 kg, Line-on-Line	$ 3.75	unit	Labor			Assembly		
Assemble, >20 kg, Loose	$ 1.88	unit	Labor			Assembly		
Assemble, 1 kg, Interference	$ 0.19	unit	Labor			Assembly		
Assemble, 1 kg, Line-on-Line	$ 0.13	unit	Labor			Assembly		
Assemble, 1 kg, Loose	$ 0.06	unit	Labor			Assembly		
Assemble, 10 kg, Interference	$ 1.88	unit	Labor			Assembly		
Assemble, 10 kg, Line-on-Line	$ 1.25	unit	Labor			Assembly		
Assemble, 10 kg, Loose	$ 0.63	unit	Labor			Assembly		
Assemble, 15 kg, Interference	$ 2.81	unit	Labor			Assembly		
Assemble, 15 kg, Line-on-Line	$ 1.88	unit	Labor			Assembly		

Assemble, 15 kg, Loose	$	0.94	unit	Labor	Assembly		
Assemble, 20 kg, Interference	$	3.75	unit	Labor	Assembly		
Assemble, 20 kg, Line-on-Line	$	2.50	unit	Labor	Assembly		
Assemble, 20 kg, Loose	$	1.25	unit	Labor	Assembly		
Assemble, 3 kg, Interference	$	0.56	unit	Labor	Assembly		
Assemble, 3 kg, Line-on-Line	$	0.38	unit	Labor	Assembly		
Assemble, 3 kg, Loose	$	0.19	unit	Labor	Assembly		
Assemble, 5 kg, Interference	$	0.94	unit	Labor	Assembly		
Assemble, 5 kg, Line-on-Line	$	0.63	unit	Labor	Assembly		
Assemble, 5 kg, Loose	$	0.31	unit	Labor	Assembly		
Brake Bleed - Per Bleeder Valve	$	2.50	unit	Labor			
Brush Apply	$	0.02	cm^2	Labor			
Cut (scissors, knife)	$	0.06	cm	Labor			
Liquid Applicator Gun	$	0.02	cm	Labor			
Liquid Apply - Spot	$	0.10	unit	Labor			
Machining Setup, Change	$	0.65	unit	Labor		1-Mar-09	The quantity for this process may be used to scale the cost to the number of parts yielded from ea
Machining Setup, Install and remove	$	1.30	unit	Labor		1-Mar-09	The quantity for this process may be used to scale the cost to the number of parts yielded from ea
Riveting	$	0.25	unit	Labor		17-Feb-09	
Safety Wire, Install	$	0.60	unit	Labor		17-Feb-09	Unit includes each item or hole included in safety wire path. One item could include bolt, nut, hole
Suspension Setup - Solid Axle (per corner)	$	4.50	unit	Labor			
Suspension Setup-Independent Susp. (per corner)	$	8.75	unit	Labor			
Tape	$	0.80	m	Labor			
Broach, External	$	0.50	cm	Material Removal		17-Feb-09	Linear distance of broach
Broach, Internal	$	0.50	cm	Material Removal		17-Feb-09	Linear distance of broach
Drilled hole < 50.8 mm dia.	$	0.70	hole	Material Removal	Drill & Tap		Holes >= 50.8 mm must be machined
Drilled holes < 25.4 mm dia.	$	0.35	hole	Material Removal	Drill & Tap		
EDM - Plunge		$0.30	cm^3	Material Removal	Machining		
EDM - Wire	$	0.20	cm	Material Removal	Machining		
Grind, Cylindrical	$	0.15	cm^2	Material Removal	Machining		0.25mm machine stock
Grind, Flat	$	0.15	cm^2	Material Removal	Machining		0.25mm machine stock
Grind, Profile	$	0.15	cm^2	Material Removal	Machining		0.25mm machine stock
Hand Finish - Material Removal	$	0.20	cm^3	Material Removal	Machining	20-Feb-09	Hand sanding, grinding, shaping. Any manual material removal process.
Hand Finish - Surface Preperation	$	0.02	cm^2	Material Removal	Machining	20-Feb-09	Hand sanding, cleaning or other operations used to prepare the surface, such as for bonding.
Knurling	$	0.10	cm	Material Removal	Machining	24-Feb-09	Linear distance of knurl on part (length of knurl, not diameter)
Laser Cut	$	0.10	cm	Material Removal	Machining		
~~Lathe - Face, Finish~~	$	0.04	cm^3	Material Removal	Machining	2/24/2009	0.5mm machine stock min.
~~Lathe - Face, Rough~~				ial Removal	Machining	2/24/2009	1.0mm machine stock min., Tol +/- 0.5mm
~~Lathe - Face, Rough & Finish~~				ial Removal	Machining	2/21/2009	1.5mm machine stock min., Tol +/- 0.5mm
~~Lathe - Turn, Finish~~				ial Removal	Machining	2/24/2009	0.5mm machine stock min.
~~Lathe - Turn, Rough~~				ial Removal	Machining	2/24/2009	1.0mm machine stock min., Tol +/- 0.5mm
~~Lathe - Turn, Rough & Finish~~				terial Removal	Machining	2/21/2009	1.5mm machine stock min., Tol +/- 0.5mm
							Machining can include roughing (1.5mm machine stock min., Tol +/- 0.5mm) and/or finishing
							(0.5mm machine stock min.). All parts should include the minimum 1.5mm material stock except
Machining	$	0.04	cm^3	Material Removal	Machining	2/24/2009	parts produced by "near net shaped" basic forming processes.
~~Mill - End, Finish~~				terial Removal	Machining	2/24/2009	0.5mm machine stock min.
~~Mill - End, Rough~~				terial Removal	Machining	2/24/2009	1.0mm machine stock min., Tol +/- 0.5mm
~~Mill - End, Rough & Finish~~				terial Removal	Machining	2/21/2009	1.5mm machine stock min., Tol +/- 0.5mm
~~Mill - Face, Finish~~				terial Removal	Machining	2/24/2009	0.5mm machine stock min.
~~Mill - Face, Rough~~				terial Removal	Machining	2/24/2009	1.0mm machine stock min., Tol +/- 0.5mm
~~Mill - Face, Rough & Finish~~				terial Removal	Machining	2/21/2009	1.5mm machine stock min., Tol +/- 0.5mm
Mill - Form Cutter	$	0.10	cm	Material Removal	Machining		0.5mm machine stock min. Linear distance of cutter motion.
Non-metallic cutting <= 25.4 mm	$	0.35	cut	Material Removal	Machining		
Non-metallic cutting <= 50.8 mm	$	0.70	cut	Material Removal	Machining		
Non-metallic cutting <= 76.2 mm	$	1.05	cut	Material Removal	Machining		
Non-metallic cutting > 76.2 mm	$	1.40	cut	Material Removal	Machining		
Plasma Cutting	$	0.10	cm	Material Removal	Machining		
Reemed hole	$	0.35	hole	Material Removal	Machining		Reemed holes must first be drilled or machined
Saw or tubing cuts	$	0.40	cm	Material Removal	Machining		
Tapping holes	$	0.35	hole	Material Removal	Drill & Tap		
Threading, External (machining)	$	0.10	cm	Material Removal		17-Feb-09	Linear distance of thread (length of bolt thread, not diameter)
Threading, Internal (machining)	$	0.10	cm	Material Removal		17-Feb-09	Linear distance of thread (length of bolt thread, not diameter)
Waterjet Cut	$	0.10	cm	Material Removal	Machining		
Sheet metal bends	$	0.25	bend	Sheet Materials			
Sheet metal punching	$	0.03	cm^2	Sheet Materials			
Sheet Metal Saw Cut	$	0.20	cm	Sheet Materials		17-Feb-09	Includes linear saw cuts and hole saw cuts. Linear cuts by linear distance and hole saw cuts by hole
Sheet metal shearing	$	0.25	cut	Sheet Materials			
Sheet metal stamping	$	0.03	cm^2	Sheet Materials			
Tube bends	$	0.75	bend	Tubing		24-Jan-09	Use diameter of tube
Tube cut	$	0.15	cm	Tubing			Includes metering, nothing, sanding, wire wheeling and surface prep. All steps necessary for weldir
Tube end preperation for welding	$	0.75	end	Tubing		24-Feb-09	Form flare or bead for brake lines, cooling lines, etc. in hard lines
Tube Flare/Bead	$	0.45	end	Tubing		24-Jan-09	Use diameter for dimension. Ratio of pi included.
Weld - Round Tubing	$	0.38	cm	Tubing			

Superseeded by new "machining" process - includes lathe/mill and rough/finish. We did this to try to help you and reduce work load. If you already used the old entires, you don't have to change.

Superseeded by new "machining" process - includes lathe/mill and rough/finish. We did this to try to help you and reduce work load. If you already used the old entires, you don't have to change.

Process Multipliers Table. Posted Version 1.0, 14Sep08

ProcessMultiplierID	Process Multiplier	Multiplier
1	Assemble - Length > 0.5m	1.25
2	Disassemble	0.8
3	Fastener Engagement Length > 2D	1.25
4	Fastener Engagement Length > 4D	1.5
5	Machine - Hole Length >= 4D	1.5
6	Machine - Hole Length >= 8D	3
7	Material - Composite	2
8	Material - Aluminum	1
9	Material - Brass	0.8
10	Material - Bronze	1.33
11	Material - Cast Iron	2.5
12	Material - Foam	0.33
13	Material - Inconel	4
14	Material - Magnesium	0.8
15	Material - MMC	4.25
16	Material - Nickel	1.33
17	Material - Plastic	0.5
18	Material - Stainless Steel	3.75
19	Material - Steel	3
20	Material - Titanium	3.65
21	Material - Wood (Hard or soft)	0.5

Use	Comments
Assembly	
Assembly	To be used when removing parts or fasteners
Fastener Installation	Thread length divided by fastener diameter
Fastener Installation	Thread length divided by fastener diameter
Drill, Tap	
Drill, Tap	
Machining	
Machining	
Machining	
Machining	
Machining	
Machining	
Machining	
Machining	
Machining	
Machining	
Machining	
Machining	
Machining	
Machining	

Appendix C –
Tooling Chart

Tooling Table. Posted Version 1.1, 16Nov08

ID	Process	Tool	Cost	Unit
1	All	None	$ -	
2	Die Casting	Die	$ 10,000	die
3	Lamination	Aluminum Tool	$ 20,000	m^2
4	Lamination	Composite Tool	$ 10,000	m^2
5	Lamination	Steel Tool	$ 40,000	m^2
6	Plastic injection molding	Die	$ 10,000	die
7	Powder Metal Forming	Die	$ 10,000	die
8	Sand Casting	Die	$ 10,000	die
9	Sand Casting	Sand Core Package	$ 5,000	core
10	Welds	Welding Fixture	$ 500	point

Comments
Per die not die set. Minimum number of dies is 2 per die set.
Use surface area of tool that is used to form part geometry.
Use surface area of tool that is used to form part geometry.
Use surface area of tool that is used to form part geometry.
Per die not die set.
Per die not die set.
Per die not die set.
Per core not core package.
Each point is a pickup or support point.