

Univ of Victoria
UVic Motor Sports

2023 Cost Report

UV23e

Formula SAE Electric – Car #244

Table of Contents

Section	System > Assembly	Index #
Cost Summary		1
Master BOM		2
Brake System	Brake Master Cylinders	3
Brake System	Brake Lines	4
Brake System	Brake Calipers	5
Brake System	Brake Rotor	6
Brake System	Brake Rotor > Brake Rotor	7
Brake System	Brake Rotor > Brake retainer	8
Drivetrain	Differential	9
Drivetrain	Differential > Left Differential Plate	10
Drivetrain	Differential > Right Differential Plate	11
Drivetrain	Differential > Chain Guard top section	12
Drivetrain	Differential > Sprocket Adapter	13
Drivetrain	Differential > Driven Sprocket (Rear)	14
Drivetrain	Differential > Bearing Spacer	15
Drivetrain	Differential > Adapter Spacer	16
Drivetrain	Differential > Drexler Differential Gear Carrier	17
Drivetrain	Differential > Tripod housing	18
Drivetrain	Differential > Differential plate cross brace	19
Drivetrain	Differential > Turnbuckle	20
Drivetrain	Differential > Differential Tab Upper	21
Drivetrain	Differential > Differential Tab Lower	22
Drivetrain	Differential > Drive Sprocket (Front)	23
Drivetrain	Tractive Motor	24
Drivetrain	Tractive Motor > Emrax 228 HV	25
Drivetrain	Tractive Motor > Tamagawa TS2620N21E11	26
Drivetrain	Tractive Motor > Output shaft coupler	27
Frame & Body	Front Wing	28
Frame & Body	Front Wing > Wing elements	29
Frame & Body	Front Wing > Mounting	30
Frame & Body	Front Wing > Endplates	31
Frame & Body	Rear Wing	32

Section	System › Assembly	Index #
Frame & Body	Rear Wing › Wing Elements	33
Frame & Body	Rear Wing › Endplates	34
Frame & Body	Rear Wing › Mounting	35
Frame & Body	Side Wings	36
Frame & Body	Side Wings › Wing elements	37
Frame & Body	Side Wings › Endplates	38
Frame & Body	Side Wings › Mounting	39
Frame & Body	Body	40
Frame & Body	Body › Cowl-Nose	41
Frame & Body	Body › Sidepanels	42
Frame & Body	Chassis System	43
Frame & Body	Chassis System › Frame	44
Frame & Body	Chassis System › Floor Pan	45
Frame & Body	Chassis System › Main Firewall Bottom	46
Frame & Body	Chassis System › Main Firewall Top	47
Frame & Body	Chassis System › Seatback Firewall	48
Frame & Body	Chassis System › IA Bracket Long	49
Frame & Body	Chassis System › IA Bracket Short	50
Frame & Body	Chassis System › Plascore IA	51
Frame & Body	Chassis System › Frame Chain Guard	52
Frame & Body	Chassis System › Frame Welding Jig	53
Frame & Body	Pedal Box	54
Frame & Body	Pedal Box › Brake Pedal	55
Frame & Body	Pedal Box › Brake Pedal Mount	56
Frame & Body	Pedal Box › Brake Pedal Thrust Washers	57
Frame & Body	Pedal Box › Brake Foot Cup	58
Frame & Body	Pedal Box › Balance Bar Trunnion	59
Frame & Body	Pedal Box › Balance Bar Sleeve	60
Frame & Body	Pedal Box › Gas Pedal	61
Frame & Body	Pedal Box › Throttle Pedal Mount	62
Frame & Body	Pedal Box › Throttle Spring Top Mount	63
Frame & Body	Pedal Box › Throttle Foot Cup	64
Frame & Body	Pedal Box › Heel Stop	65
Frame & Body	Pedal Box › Pedal Box Base plate	66
Frame & Body	Pedal Box › Linear Potentiometer Mount	67
Frame & Body	Pedal Box › Throttle Stopper top	68

Section	System › Assembly	Index #
Frame & Body	Pedal Box › Throttle Stopper Bottom	69
Frame & Body	Pedal Box › Master Cylinder Mount	70
Frame & Body	Pedal Box › Brake Overtravel Switch Mount	71
Frame & Body	Pedal Box › Linear Sensor Spacer	72
Frame & Body	Pedal Box › Brake Pedal Pivot Sleeve	73
Frame & Body	Pedal Box › Throttle Pedal Pivot Sleeve	74
Instruments, Wiring & Accessories	Battery Management System	75
Instruments, Wiring & Accessories	Battery Management System › OrionBMS2-144	76
Instruments, Wiring & Accessories	Chassis Controls and Wiring	77
Instruments, Wiring & Accessories	Chassis Controls and Wiring › Steering Wheel Controller	78
Instruments, Wiring & Accessories	Chassis Controls and Wiring › Dash enclosure	79
Instruments, Wiring & Accessories	Chassis Controls and Wiring › Dash Display, Datalogger	80
Instruments, Wiring & Accessories	Chassis Controls and Wiring › Chassis Wiring	81
Instruments, Wiring & Accessories	Chassis Controls and Wiring › Accelerator Pedal Position	82
Instruments, Wiring & Accessories	GLV Battery	83
Instruments, Wiring & Accessories	GLV Battery › Battery Enclosure	84
Instruments, Wiring & Accessories	MCU module	85
Instruments, Wiring & Accessories	Motor Controller	86
Instruments, Wiring & Accessories	Motor Controller › Bamocar-D3-PG-700-400	87
Instruments, Wiring & Accessories	Power Distribution Unit	88
Instruments, Wiring & Accessories	Wiring Harness	89
Miscellaneous, Safety, Finish and Assembly	Accumulator	90
Miscellaneous, Safety, Finish and Assembly	Accumulator › Samsung 40T cell	91
Miscellaneous, Safety, Finish and Assembly	Accumulator › Accumulator Base	92
Miscellaneous, Safety, Finish and Assembly	Accumulator › Accumulator Top	93
Miscellaneous, Safety, Finish and Assembly	Accumulator › Accumulator Side Panel	94
Miscellaneous, Safety, Finish and Assembly	Accumulator › Accumulator Shelf	95
Miscellaneous, Safety, Finish and Assembly	Accumulator › Accumulator Lower Divider	96
Miscellaneous, Safety, Finish and Assembly	Accumulator › Accumulator Upper Divider	97
Miscellaneous, Safety, Finish and Assembly	Driver Harness	98
Miscellaneous, Safety, Finish and Assembly	Driver Harness › Mount tabs	99
Miscellaneous, Safety, Finish and Assembly	Driver Harness › Upper retainer	100
Miscellaneous, Safety, Finish and Assembly	Head Rest	101
Miscellaneous, Safety, Finish and Assembly	Head Rest › Back plate	102
Miscellaneous, Safety, Finish and Assembly	Head Rest › Foam	103
Miscellaneous, Safety, Finish and Assembly	Head Rest › Mounts	104

Section	System › Assembly	Index #
Miscellaneous, Safety, Finish and Assembly	Interlock circuit	105
Miscellaneous, Safety, Finish and Assembly	Interlock circuit › Brake Plausibility Device	106
Miscellaneous, Safety, Finish and Assembly	Interlock circuit › Insulation Monitoring Device	107
Miscellaneous, Safety, Finish and Assembly	Interlock circuit › Shutdown Button	108
Miscellaneous, Safety, Finish and Assembly	Main Hoop Padding	109
Miscellaneous, Safety, Finish and Assembly	Seat	110
Miscellaneous, Safety, Finish and Assembly	Seat › Seat	111
Miscellaneous, Safety, Finish and Assembly	Seat › Seat Mounts	112
Miscellaneous, Safety, Finish and Assembly	TSAL	113
Steering System	Steering Column	114
Steering System	Steering Column › Main Vertical Shaft	115
Steering System	Steering Column › Horizontal Steering Shaft	116
Steering System	Steering Column › Middle Steering Shaft	117
Steering System	Steering Column › Rack Weld Coupler	118
Steering System	Steering Column › Rack Spacer Tall	119
Steering System	Steering Column › Steering Centre Support Tubes	120
Steering System	Steering Column › Steering Bearing Support Tubes	121
Steering System	Steering Column › Clutch Handle	122
Steering System	Steering Rack	123
Steering System	Steering Rack › Steering Rack	124
Steering System	Steering Rack › Rack Mount	125
Steering System	Steering Rack › Rack Mount Tab	126
Steering System	Steering Wheel	127
Steering System	Steering Wheel › Steering Wheel Body	128
Steering System	Steering Wheel › Steering Wheel Front Panel	129
Steering System	Steering Wheel › Paddle Pivot	130
Steering System	Steering Wheel › Paddle Steel Actuator	131
Steering System	Steering Wheel › Quick Release	132
Steering System	Steering Wheel › Quick Release Spline	133
Steering System	Steering Wheel › Front Wheel Handles	134
Steering System	Steering Wheel › Rear Wheel Handles	135
Steering System	Steering Wheel › Left Paddle	136
Steering System	Steering Wheel › Right Paddle	137
Steering System	Steering Wheel › Clevice pins	138
Suspension & Shocks	Control Rods	139
Suspension & Shocks	Control Rods › Aluminium Insert	140

Section	System › Assembly	Index #
Suspension & Shocks	Control Arms	141
Suspension & Shocks	Control Arms › Threaded Inserts	142
Suspension & Shocks	Control Arms › Front A-Arm Node	143
Suspension & Shocks	Control Arms › Rear A-Arm Node	144
Suspension & Shocks	Corner Assembly	145
Suspension & Shocks	Corner Assembly › Upright	146
Suspension & Shocks	Corner Assembly › Upright top	147
Suspension & Shocks	Corner Assembly › Upright top shim (camber)	148
Suspension & Shocks	Corner Assembly › Front Tierod Pickup	149
Suspension & Shocks	Corner Assembly › Rear Toe Pickup	150
Suspension & Shocks	Rear Anti-Roll Bar	151
Suspension & Shocks	Rear Anti-Roll Bar › Rear ARB Actuators	152
Suspension & Shocks	Rear Anti-Roll Bar › Rear Anti-roll bar	153
Suspension & Shocks	Rear Anti-Roll Bar › High misalignment spacers	154
Suspension & Shocks	Rear Anti-Roll Bar › Rear ARB Lever Arm	155
Suspension & Shocks	Rear Anti-Roll Bar › Rear ARB Bushing	156
Suspension & Shocks	Rear Anti-Roll Bar › Rear ARB Chassis Tab	157
Suspension & Shocks	Spring and Shock	158
Suspension & Shocks	Tab Assembly	159
Suspension & Shocks	Tab Assembly › Suspension Tab	160
Suspension & Shocks	Tab Assembly › Damper Stud	161
Suspension & Shocks	Front Bellcrank Assembly	162
Suspension & Shocks	Front Bellcrank Assembly › Front Bellcrank	163
Suspension & Shocks	Front Bellcrank Assembly › Thrust Washer	164
Suspension & Shocks	Front Bellcrank Assembly › Pivot Shaft	165
Suspension & Shocks	Front Bellcrank Assembly › Bellcrank Bushing	166
Suspension & Shocks	Rear Bellcrank Assembly	167
Suspension & Shocks	Rear Bellcrank Assembly › Rear Bellcrank	168
Suspension & Shocks	Rear Bellcrank Assembly › Thrust Washer	169
Suspension & Shocks	Rear Bellcrank Assembly › Bellcrank Shaft	170
Suspension & Shocks	Pull and Push Rods	171
Suspension & Shocks	Pull and Push Rods › Aluminium Insert	172
Suspension & Shocks	Pull and Push Rods › Aluminium Shim Insert	173
Suspension & Shocks	Pull and Push Rods › Pullrod Shims	174
Wheels, Wheel Bearings & Tires	Hub	175
Wheels, Wheel Bearings & Tires	Hub › Hub	176

Section	System › Assembly	Index #
Wheels, Wheel Bearings & Tires	Hub › Hub nut	177
Wheels, Wheel Bearings & Tires	Hub › Wheel nut	178
Wheels, Wheel Bearings & Tires	Hub › Wheel Bearing	179
Wheels, Wheel Bearings & Tires	Hub › Lock Washer	180
Wheels, Wheel Bearings & Tires	Hub › Drive Pin	181
Wheels, Wheel Bearings & Tires	Hub › Wheel speed Pickup	182
Wheels, Wheel Bearings & Tires	Hub › Wheel Nut Spring Clip	183
Wheels, Wheel Bearings & Tires	Wheel and Tire	184

Cost Summary

System	Materials	Processes	Fasteners	Tooling	Totals
Brake System	2102.6700	68.0900	1.9400	0.0000	2172.7000
Drivetrain	8318.4900	98.6400	4.3500	0.3400	8421.8200
Frame & Body	1917.7500	1252.3700	118.1100	42.2500	3330.4800
Instruments, Wiring & Accessories	9124.0300	307.4900	1.1300	3.3300	9435.9800
Miscellaneous, Safety, Finish and Assembly	6003.6100	567.7100	50.8000	3.2800	6625.4000
Steering System	79.0600	144.2500	1.8600	0.0000	225.1700
Suspension & Shocks	2237.4300	597.4400	16.3000	0.2600	2851.4300
Wheels, Wheel Bearings & Tires	1464.4000	297.4800	0.0000	0.0000	1761.8800
	31247.4400	3333.4700	194.4900	49.4600	34824.8600

Bill of Materials

System	Asm/Part #	Rev. Lvl.	Assembly	Component	Description	Unit Cost	Quantity	Material Cost	Process Cost	Fastener Cost	Tooling Cost	Total Cost
	Brake System	OTH19-0028	A	Brake Master Cylinders		198.68	2	197.07	1.52	0.09		397.36
	Brake System	OTH19-0032	A	Brake Lines		127.02	1	112.61	14.41			127.02
	Brake System	SUC20-0006	A	Brake Calipers		402.56	4	397.21	5.10	0.25		1610.24
	Brake System	SUC21-00960	A	Brake Rotor		2.45	4		2.26	0.19		9.80
	Brake System	SUC21-00960	A	Brake Rotor		6.59	4	1.69	4.90			26.36
	Brake System			Brake retainer		0.12	16	0.02	0.10			1.92
	Brake System			[Area Total:]				2102.67	68.09	1.94		2172.70
	Drivetrain			Traction Motor		11.94	1	7.65	3.61	0.68		11.94
	Drivetrain			Differential	Differential and support plate assembly. Chain and sprocket included. Note that oil is added to the differential after stub axle installation, and is included in the Driveshaft Assembly.	85.52	1	64.80	16.84	3.54	0.34	85.52
	Drivetrain			Left Differential Plate		21.75	1	5.80	15.95			21.75
	Drivetrain			Emrax 228 HV		8000.00	1	8000.00				8000.00
	Drivetrain			Tamagawa TS2620N21E11	One pole resolver	23.07	1	22.00	1.02	0.05		23.07
	Drivetrain			Right Differential Plate		14.44	1	6.49	7.95			14.44
	Drivetrain			Chain Guard top section		4.38	1	1.22	3.16			4.38
	Drivetrain			Output shaft coupler			1					
	Drivetrain			Sprocket Adapter		9.38	1	5.41	3.97			9.38

System	Asm/Part #	Rev. Lvl.	Assembly	Component	Description	Unit Cost	Quantity	Material Cost	Process Cost	Fastener Cost	Tooling Cost	Total Cost
	Drivetrain			Driven Sprocket (Rear)		7.40	1	2.50	4.90			7.40
	Drivetrain			Bearing Spacer		1.07	1	0.63	0.44			1.07
	Drivetrain			Adapter Spacer		0.48	1	0.17	0.31			0.48
	Drivetrain			Drexler Differential Gear Carrier		194.46	1	173.70	20.76			194.46
	Drivetrain			Tripod housing		17.33	2	11.30	6.03			34.66
	Drivetrain			Differential plate cross brace		1.64	1	0.14	1.50			1.64
	Drivetrain			Turnbuckle		7.15	1	4.07	3.00	0.08		7.15
	Drivetrain			Differential Tab Upper		0.37	1	0.26	0.11			0.37
	Drivetrain			Differential Tab Lower		0.66	1	0.64	0.02			0.66
	Drivetrain			Drive Sprocket (Front)		3.45	1	0.41	3.04			3.45
	Drivetrain			[Area Total:]				8318.49	98.64	4.35	0.34	8421.82
	Frame & Body	AEA20-00032	A	Front Wing	3-element front wing with curved main element.	15.72	1		14.75	0.97		15.72
	Frame & Body			Wing elements		366.96	1	316.00	42.37		8.59	366.96
	Frame & Body			Mounting		44.04	1	24.34	19.31	0.29	0.10	44.04
	Frame & Body			Endplates		77.10	1	55.25	20.90		0.95	77.10
	Frame & Body	AEA21-00185	A	Rear Wing	Hollow carbon fiber wing elements.	11.21	1		10.53	0.68		11.21
	Frame & Body	AEC19-00197	A	Wing Elements		415.42	1	329.03	79.02	0.19	7.18	415.42
	Frame & Body	AEC19-00198	A	Endplates		271.33	1	232.75	38.28		0.30	271.33
	Frame & Body	AEC19-00199	A	Mounting		68.96	1	48.75	19.30	0.60	0.31	68.96
	Frame & Body	AEA21-00224	A	Side Wings		7.82	2		7.19	0.63		15.64
	Frame & Body	AEC19-00190		Wing elements		104.93	2	87.26	17.67			209.86
	Frame & Body	AEC19-00191		Endplates		66.20	4	48.77	17.33		0.10	264.80

System	Asm/Part #	Rev. Lvl.	Assembly	Component	Description	Unit Cost	Quantity	Material Cost	Process Cost	Fastener Cost	Tooling Cost	Total Cost
	Frame & Body	AEC20-00119		Mounting		36.87	2	14.59	20.98	0.27	1.03	73.74
	Frame & Body	AEA21-00228	A	Body		5.89	1	0.04	5.43	0.42		5.89
	Frame & Body	AEC21-01112		Cowl-Nose		145.20	1	120.00	16.77	0.63	7.80	145.20
	Frame & Body	AEC19-00373		Sidepanels		18.10	2	11.00	4.60	0.63	1.87	36.20
	Frame & Body	CHA21-0001	A	Chassis System		59.27	1	2.09	53.65	3.53		59.27
	Frame & Body	CHEV21-0001	A	Frame	TIG welded chromoly spaceframe	484.12	1	67.99	407.46		8.67	484.12
	Frame & Body	CHC20-0002	A	Floor Pan	Single piece sheet metal floorpan. Laser cut and bent	16.31	1	6.30	6.51	3.50		16.31
	Frame & Body	CHC19-0003	A	Main Firewall Bottom	Sheet metal aluminum firewall. Laser cut and bent	10.71	1	4.20	4.51	2.00		10.71
	Frame & Body	CHC19-0005	A	Main Firewall Top	Sheet metal aluminum firewall. Laser cut and bent	4.88	1	1.68	3.20			4.88
	Frame & Body	CHC19-0006	A	Seatback Firewall	Aluminum sheet, 2-piece	6.61	1		6.25	0.36		6.61
	Frame & Body	CHC19-0008	A	IA Bracket Long	Bent sheet metal strap	3.17	1	0.29	2.88			3.17
	Frame & Body	CHC19-0009	A	IA Bracket Short	Bent sheet metal strap	3.07	1	0.27	2.80			3.07
	Frame & Body	OTH-0025	Z	Plascore IA	Plascore Crushlite aluminum honeycomb impact attenuator	19.25	1	19.25				19.25
	Frame & Body	TAB19-0002	A	Frame Chain Guard	Section of chain guard, permanently attached to chassis	5.93	1	0.38	5.55			5.93
	Frame & Body	CHA21-0001	A_Weldin	Frame Welding Jig		401.74	1	168.57	192.80	38.37	2.00	401.74
	Frame & Body	ERA20-0002	A	Pedal Box	Ergonomics System - Gas and Pedal Assembly excluding master cylinders	179.65	1	68.14	50.54	60.97		179.65
	Frame & Body	ERC19-00098	A	Brake Pedal		16.95	1	4.31	12.64			16.95
	Frame & Body	ERC19-00097	A	Brake Pedal Mount		1.34	2	0.14	1.20			2.68
	Frame & Body			Brake Pedal Thrust Washers		0.93	2	0.02	0.91			1.86
	Frame & Body	ERC19-00095	A	Brake Foot Cup		2.03	2	0.33	1.70			4.06

System	Asm/Part #	Rev. Lvl.	Assembly	Component	Description	Unit Cost	Quantity	Material Cost	Process Cost	Fastener Cost	Tooling Cost	Total Cost
Frame & Body				Balance Bar Trunnion		3.60	1	0.33	3.27			3.60
				Balance Bar Sleeve		2.04	1	0.13	1.91			2.04
	ERC19-00089	A		Gas Pedal		20.68	1	16.33	4.20		0.15	20.68
				Throttle Pedal Mount		4.65	2	0.47	4.18			9.30
				Throttle Spring Top Mount		3.05	2	0.05	3.00			6.10
	ERC19-00094	A		Throttle Foot Cup		2.03	1	0.33	1.70			2.03
				Heel Stop		1.24	1	0.08	1.16			1.24
				Pedal Box Base plate		21.61	1	6.17	12.90	2.54		21.61
				Linear Potentiometer Mount		0.73	2	0.04	0.69			1.46
				Throttle Stopper top		3.20	1	0.28	2.92			3.20
				Throttle Stopper Bottom		1.41	1	0.04	1.37			1.41
				Master Cylinder Mount		3.01	2	0.43	2.58			6.02
				Brake Overtravel Switch Mount		0.02	1	0.01	0.01			0.02
				Linear Sensor Spacer		0.84	1	0.01	0.83			0.84
				Brake Pedal Pivot Sleeve		6.84	1	0.40	6.44			6.84
				Throttle Pedal Pivot Sleeve		1.76	1	0.27	1.49			1.76
	Frame & Body				[Area Total:]				1917.75	1252.37	118.11	42.25
Instruments, Wiring & Accessories			GLV Battery			45.70	1	39.00	6.60	0.10		45.70
			Motor Controller		Motor controller assembly including motor feedback sensor and power/signal cabling	69.85	1	65.60	4.12	0.13		69.85

System	Asm/Part #	Rev. Lvl.	Assembly	Component	Description	Unit Cost	Quantity	Material Cost	Process Cost	Fastener Cost	Tooling Cost	Total Cost
Instruments, Wiring & Accessories			MCU module			232.22	1	229.11	2.96	0.15		232.22
			Battery Management System			1436.76	1	1236.60	199.74	0.42		1436.76
			Power Distribution Unit			86.24	1	84.00	2.00	0.24		86.24
			Wiring Harness			275.39	1	234.00	41.39			275.39
			Chassis Controls and Wiring				1					
				Bamocar-D3-PG-700-400		3600.00	1	3600.00				3600.00
				OrionBMS2-144		2960.00	1	2960.00				2960.00
	ELA19-0011	A		Steering Wheel Controller		66.79	1	48.00	18.79			66.79
	ELC19-0012A	A		Battery Enclosure		5.06	1	0.14	1.52	0.07	3.33	5.06
	ELA19-0005	A		Dash enclosure		15.88	1	7.00	8.86	0.02		15.88
				Dash Display, Datalogger		594.58	1	594.58				594.58
	ELA20-0003	A		Chassis Wiring		43.51	1	22.00	21.51			43.51
				Accelerator Pedal Position		4.00	1	4.00				4.00
				[Area Total:]				9124.03	307.49	1.13	3.33	9435.98

System	Asm/Part #	Rev. Lvl.	Assembly	Component	Description	Unit Cost	Quantity	Material Cost	Process Cost	Fastener Cost	Tooling Cost	Total Cost
	Miscellaneous, Safety, Finish and Assembly		Head Rest			1.09	1		1.00	0.09		1.09
	Miscellaneous, Safety, Finish and Assembly		Interlock circuit				1					
	Miscellaneous, Safety, Finish and Assembly		Accumulator			455.72	1	54.13	401.59			455.72
	Miscellaneous, Safety, Finish and Assembly		Main Hoop Padding			2.77	2	2.50	0.27			5.54
	Miscellaneous, Safety, Finish and Assembly		TSAL			10.00	1	10.00				10.00
	Miscellaneous, Safety, Finish and Assembly		Seat			0.11	1			0.11		0.11
	Miscellaneous, Safety, Finish and Assembly		Driver Harness			50.65	1	45.00	4.55	1.10		50.65
	Miscellaneous, Safety, Finish and Assembly			Brake Plausibility Device		26.12	1	25.00	1.00	0.12		26.12
	Miscellaneous, Safety, Finish and Assembly			Samsung 40T cell		8.44	680	8.44				5739.20
	Miscellaneous, Safety, Finish and Assembly		Mount tabs			1.18	4	0.12	1.06			4.72
	Miscellaneous, Safety, Finish and Assembly		Seat			42.17	1	30.00	8.90		3.27	42.17
	Miscellaneous, Safety, Finish and Assembly		Back plate			9.77	1	9.30	0.46		0.01	9.77
	Miscellaneous, Safety, Finish and Assembly		Foam			9.15	1	8.41	0.74			9.15
	Miscellaneous, Safety, Finish and Assembly		Accumulator Base			31.33	1	8.30	15.42	7.61		31.33

System	Asm/Part #	Rev. Lvl.	Assembly	Component	Description	Unit Cost	Quantity	Material Cost	Process Cost	Fastener Cost	Tooling Cost	Total Cost
	Miscellaneous, Safety, Finish and Assembly			Insulation Monitoring Device		26.21	1	25.00	1.00	0.21		26.21
	Miscellaneous, Safety, Finish and Assembly			Seat Mounts		2.04	2	0.29	1.74	0.01		4.08
	Miscellaneous, Safety, Finish and Assembly			Upper retainer		2.13	2	0.03	2.10			4.26
	Miscellaneous, Safety, Finish and Assembly			Shutdown Button		3.00	3	3.00				9.00
	Miscellaneous, Safety, Finish and Assembly			Accumulator Top		28.74	1	8.29	14.30	6.15		28.74
	Miscellaneous, Safety, Finish and Assembly			Mounts		8.62	1	0.29	8.33			8.62
	Miscellaneous, Safety, Finish and Assembly			Accumulator Side Panel		18.83	2	3.48	15.35			37.66
	Miscellaneous, Safety, Finish and Assembly			Accumulator Shelf		10.60	1	3.46	5.55	1.59		10.60
	Miscellaneous, Safety, Finish and Assembly			Accumulator Lower Divider	Vertical walls which separate the 5 accumulator segment in the lower section.	17.72	4	1.95	11.70	4.07		70.88
	Miscellaneous, Safety, Finish and Assembly			Accumulator Upper Divider	Vertical accumulator segment dividers for upper level	13.26	3	2.45	4.97	5.84		39.78
	Miscellaneous, Safety, Finish and Assembly			[Area Total:]				6003.61	567.71	50.80	3.28	6625.40
	Steering System	ERA19-0003	A	Steering Column	Steering column	67.99	1	53.23	14.51	0.25		67.99
	Steering System	ERC19-0009	A	Main Vertical Shaft	Shaft connecting lower u-joint to rack weld coupler	0.77	1	0.22	0.55			0.77
	Steering System	ERC19-0010	A	Horizontal Steering Shaft	Shaft connecting first u-joint to quick release	1.98	1	0.27	1.71			1.98
	Steering System	ERC19-0012	A	Middle Steering Shaft	Shaft connecting the two U-joints	1.42	1	0.08	1.34			1.42

System	Asm/Part #	Rev. Lvl.	Assembly	Component	Description	Unit Cost	Quantity	Material Cost	Process Cost	Fastener Cost	Tooling Cost	Total Cost
Steering System	ERC19-0015	A		Rack Weld Coupler	Coupling the steering rack to the bottom shaft through a weld and two spring pins in the rack	1.36	1	0.04	1.32			1.36
Steering System	ERC-0013	A		Rack Spacer Tall	space steering rack for bump steer adjsutment	0.19	2	0.04	0.15			0.38
Steering System	ERC19-0016	A		Steering Centre Support Tubes	Support for IGUS bearing	0.55	2	0.07	0.48			1.10
Steering System	ERC19-0017	A		Steering Bearing Support Tubes	Tubes supporting the steering wheel	0.57	2	0.09	0.48			1.14
Steering System	ERC19-0039	A		Clutch Handle		4.87	1	0.62	4.25			4.87
Steering System	ERA19-0008	A	Steering Rack		Two u-joints with a dual bearing split clamp and plastic IGUS bearing for location	3.19	1		2.52	0.67		3.19
Steering System	OTH19-0010	A		Steering Rack	1 - housing 2 - rack 3 - pinion 4 - clevis This material list and make up is for a purchased steering rack	61.62	1	11.99	49.33	0.30		61.62
Steering System	ERC-0048	A		Rack Mount	Split clamp style	2.45	2	0.17	2.28			4.90
Steering System	TAB19-0001	A		Rack Mount Tab		3.16	2	0.11	3.05			6.32
Steering System	ERC19-0006	A	Steering Wheel		3D Printed steering wheel with replaceable grips and a vibrant display	24.47	1	9.32	14.51	0.64		24.47
Steering System	ERC19-0051	A		Steering Wheel Body	3D Printed steering wheel	8.78	1	0.70	8.08			8.78
Steering System	ERC19-0052	A		Steering Wheel Front Panel	3D Printed front cover for steering wheel body	2.36	1	0.10	2.26			2.36
Steering System	ERC19-0056	A		Paddle Pivot	3D Printed part	1.41	2	0.01	1.40			2.82
Steering System	ERC19-0058	A		Paddle Steel Actuator	To actuate the paddles with magnets	0.27	2	0.04	0.23			0.54
Steering System	ERC19-0053	A		Quick Release	LifeLine Formula electric 8-pin quick release	11.76	1	0.63	11.13			11.76
Steering System	ERC19-0063	A		Quick Release Spline	Spline for steering wheel	5.12	1	0.22	4.90			5.12
Steering System	ERC19-0054	A		Front Wheel Handles	3D Printed	0.80	2	0.07	0.73			1.60
Steering System	ERC19-0052	A		Rear Wheel Handles		0.80	2	0.07	0.73			1.60
Steering System	ERC19-0059	A		Left Paddle	3D Printed	2.06	1	0.13	1.93			2.06
Steering System	ERC19-0060	A		Right Paddle	3D printed	2.06	1	0.13	1.93			2.06

System	Asm/Part #	Rev. Lvl.	Assembly	Component	Description	Unit Cost	Quantity	Material Cost	Process Cost	Fastener Cost	Tooling Cost	Total Cost
Steering System	ERC19-0066-A			Clevice pins	Holds paddles onto wheel	2.48	2	0.02	2.46			4.96
	Steering System		[Area Total:]					79.06	144.25	1.86		225.17
Suspension & Shocks	SUA19-0002		Control Rods			20.66	4	18.03	2.29	0.34		82.64
	SUC20-001			Aluminium Insert		1.19	8	0.04	1.15			9.52
	SUA19-0009		Control Arms		Suspension A-Arms consisting of bonding carbon tube to aluminum nodes	55.03	4	48.48	5.76	0.79		220.12
	SUC19-0082			Threaded Inserts		0.25	8	0.04	0.21			2.00
	SUC19-0080			Front A-Arm Node		9.63	4	2.10	7.53			38.52
	SUC19-0081			Rear A-Arm Node		10.51	4	2.33	8.18			42.04
	SUA19-0010	A	Corner Assembly		Uprights are identical with modular mounting brackets for A-Arms and control arms (includes hubs which are accounted for in the wheel system)	112.72	4	107.52	4.06	1.14		450.88
	SUC19-0016	A		Upright	The uprights are mirrored right to left,. But remain the same between the front and rear	57.79	4	13.72	44.07			231.16
	SUC19-0013	A		Upright top		2.79	4	0.35	2.44			11.16
	SUC19-0011	A		Upright top shim (camber)	Camber adjustment	0.71	8	0.35	0.36			5.68
	SUC19-0015	A		Front Tierod Pickup		4.23	8	0.49	3.74			33.84
	SUC19-0002	A		Rear Toe Pickup		6.00	8	0.95	5.05			48.00
	SUA19-0011	A	Rear Anti-Roll Bar			10.64	1		9.50	1.14		10.64
	SUA19-0012	A		Rear ARB Actuators		15.93	2	14.12	1.81			31.86
	SUC19-0087	A		Rear Anti-roll bar		1.00	1	0.25	0.75			1.00
	SUC19-0077	A		High misalignment spacers	High misalignment spacers to allow ARB rod ends to pivot 48deg, allowing a full range of motion from the bellcrank.	0.56	8	0.01	0.55			4.48
	SUC20-0003	A		Rear ARB Lever Arm		2.12	4	0.13	1.99			8.48

System	Asm/Part #	Rev. Lvl.	Assembly	Component	Description	Unit Cost	Quantity	Material Cost	Process Cost	Fastener Cost	Tooling Cost	Total Cost
Suspension & Shocks	SUC19-0090	A		Rear ARB Bushing		0.92	2	0.04	0.88			1.84
Suspension & Shocks	TAB19-0050	A		Rear ARB Chassis Tab		4.45	2	0.21	4.24			8.90
Suspension & Shocks	SUA19-0013		Spring and Shock			341.38	4	330.00	10.88	0.50		1365.52
Suspension & Shocks	SUA20-0004	A	Tab Assembly		Suspension tabs for attaching the a-arms, bellcranks, dampers to the chassis	19.31	1		19.05		0.26	19.31
Suspension & Shocks	TAB20-0010	A		Suspension Tab	A-Arm tabs	0.59	48	0.18	0.41			28.32
Suspension & Shocks	SUC19-0052	B		Damper Stud	inboard damper mounting	2.46	2	0.23	2.23			4.92
Suspension & Shocks	SUA21-0006	A	Front Bellcrank Assembly			1.33	2		1.08	0.25		2.66
Suspension & Shocks	SUC21-00311	A		Front Bellcrank		4.76	2	0.84	3.92			9.52
Suspension & Shocks	SUC21-00995			Thrust Washer		0.37	4	0.01	0.36			1.48
Suspension & Shocks	SUC21-01043	A		Pivot Shaft		3.21	2	0.43	2.78			6.42
Suspension & Shocks	SUC21-01124	A		Bellcrank Bushing		1.46	2	0.28	1.18			2.92
Suspension & Shocks	SUA21-00242	A	Rear Bellcrank Assembly			7.05	2	5.47	1.33	0.25		14.10
Suspension & Shocks	SUC21-01110	A		Rear Bellcrank		7.09	2	1.53	5.56			14.18
Suspension & Shocks	SUC19-0084	A		Thrust Washer		0.53	4	0.01	0.52			2.12
Suspension & Shocks	SUC19-0074	A		Bellcrank Shaft		1.88	2	0.10	1.78			3.76
Suspension & Shocks	SUC19-0014	A	Pull and Push Rods		all tie/pull/push rods were designed with the same components for adjustability and to simplify manufacturing	24.09	4	18.03	5.29	0.77		96.36
Suspension & Shocks	SUC19-0082	A		Aluminium Insert		0.87	4	0.04	0.83			3.48
Suspension & Shocks	SUC19-0085	A		Aluminium Shim Insert	Shim interface to allow rapid adjustment of ride height and toe.	3.88	8	0.42	3.46			31.04
Suspension & Shocks	SUC19-0086	A		Pullrod Shims	Consists of 20 aluminum shims for 8 adjustable control arms. Waterjet from 1 sheet of aluminum.	0.64	4	0.16	0.48			2.56

System	Asm/Part #	Rev. Lvl.	Assembly	Component	Description	Unit Cost	Quantity	Material Cost	Process Cost	Fastener Cost	Tooling Cost	Total Cost
	Suspension & Shocks				[Area Total:]			2237.43	597.44	16.30	0.26	2851.43
	Wheels, Wheel Bearings & Tires	SUA19-0004		Hub	Live spindle center-lock hubs with drive pins	1.82	4		1.82			7.28
	Wheels, Wheel Bearings & Tires	SUC19-0003	A		Hub	61.43	4	15.06	46.37			245.72
	Wheels, Wheel Bearings & Tires	SUC19-0005		Hub nut	Hook spanner driven 7075 nuts	3.47	4	0.42	3.05			13.88
	Wheels, Wheel Bearings & Tires	SUC19-0004	A		Wheel nut	3.92	4	0.62	3.30			15.68
	Wheels, Wheel Bearings & Tires	OTH19-0040	A		Wheel Bearing SKF 71813 ACD HCP4. Other pressed into upright assembly	107.52	4	107.52				430.08
	Wheels, Wheel Bearings & Tires	SUC19-0010	A		Lock Washer Bearing lock washer	1.21	4	0.07	1.14			4.84
	Wheels, Wheel Bearings & Tires	SUC19-0013	A		Drive Pin Stainless pin pressed into hub to drive wheel	0.68	16	0.33	0.35			10.88
	Wheels, Wheel Bearings & Tires	SUC19-0001	A		Wheelspeed Pickup	11.85	4	5.07	6.78			47.40
	Wheels, Wheel Bearings & Tires				Wheel Nut Spring Clip	6.77	4	0.02	6.75			27.08
	Wheels, Wheel Bearings & Tires	SUA20-0002	A	Wheel and Tire	10" OZ magnesium wheel set with Hoosier tires. Center-lock	239.76	4	236.00	3.76			959.04
	Wheels, Wheel Bearings & Tires				[Area Total:]			1464.40	297.48			1761.88
					[Vehicle Total:]			31247.44	3333.47	194.49	49.46	34824.86

Global Vehicle Drawings

Brake System Section



Brake System › Brake Master Cylinders

P/N Base	Suffix	Details	Cost	Qty	Total
OTH19-0028	A		\$198.68	2	\$397.36

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Hydraulic Fluid Reservoir, Remote (Plastic)	Brake reservoir							1	5.00	5.00
Banjo Fitting, 45 Deg., Aluminum		0.1875 in						2	7.83	15.66
Master Cylinder, AP, CP7855								1	174.50	174.50
Hose, Rubber (per m)	Reservoir hose	0.325 in						0.5	1.49	0.74
Crush Washer		0.25 in						4	0.29	1.17

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Assemble, 1 kg, Line-on-Line	Fittings to master cylinders	1	Repeat 2	2	0.13	0.26
Ratchet <= 6.35 mm	tighten fittings	1	Repeat 2	2	0.50	1.00
Assemble, 1 kg, Line-on-Line	Fittings on hose	1		1	0.13	0.13
Assemble, 1 kg, Line-on-Line	Fittings on reservoir	1		1	0.13	0.13

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Hose Clamp, Spring Steel		0.25 in		1	0.09	0.09

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Brake System › Brake Lines

P/N Base	Suffix	Details	Cost	Qty	Total
OTH19-0032	A		\$127.02	1	\$127.02

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Tubing, Steel	Brake hardline	0.45 kg						1	1.01	1.01
Hose, High Pressure, Stainless Steel Braided Outer (per m)	Soft lines	0.325 in						2	17.68	35.36
Fluid, Oil	brake fluid	0.6 L						1	0.45	0.45
Fitting/H.P./Straight//Steel/	Hardline to T	0.1875 in						2	5.95	11.91
Adapter/L.P./Bulkhead Tee//Steel/	T for left right wheels	0.1875 in	0.1875 in					2	13.25	26.50
Adapter/L.P./Female Pipe Tee//Aluminum/Anodized	pressure sensor T	0.1875 in	0.1875 in					2	14.69	29.38
Sensor, Fluid Pressure	Brake pressure sensor							2	4.00	8.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Tube cut	cut hardline	1		1	0.15	0.38
Tube bends	Bending hardline	4		1	0.75	3.00
Tube Flare/Bead	Flaring hardline	1	Repeat 2	2	0.45	0.90
Assemble, 1 kg, Line-on-Line	Route lines	1		1	0.13	0.13
Wrench <= 6.35 mm	Tighten brake fittings	1	Repeat 8	8	1.00	8.00
Wrench <= 6.35 mm	Install pressure sensor	1	Repeat 2	2	1.00	2.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Brake System › Brake Calipers

P/N Base	Suffix	Details	Cost	Qty	Total
SUC20-0006	A		\$402.56	4	\$1610.24

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Brake Pad, Iron or Steel Rotor		5517.6 mm^3						2	1.10	2.21
Brake Caliper, Brembo, 120.A441.30								1	395.00	395.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Ratchet <= 25.4 mm	Fasten calipers to upright	1	Repeat 2	2	0.75	1.50
Safety Wire, Install	Secure Caliper bolts to eachother	1		1	0.60	0.60
Ratchet <= 6.35 mm	Fasten brake lines to caliper	1		1	0.50	0.50
Brake Bleed - Per Bleeder Valve		1		1	2.50	2.50

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 10.9 (SAE 8)		8 mm	25 mm	2	0.13	0.25

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Brake System › Brake Rotor

P/N Base	Suffix	Details	Cost	Qty	Total
SUC21-00960	A		\$9.52	4	\$38.08

Part	Cost	Quantity	Subtotal
Brake Rotor	6.5900	1	6.5900
Brake retainer	0.1200	4	0.4800

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
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Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Assemble, 1 kg, Loose	Rotor onto hub	1		1	0.06	0.06
Power Tool <= 6.35 mm	rotor retainer and bolt	1	Repeat 4	4	0.25	1.00
Safety Wire, Install	Rotor retainer bolts sets of two	1	Repeat 2	2	0.60	1.20

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 10.9 (SAE 8)	Rotor retainer bolts	6 mm	15 mm	4	0.05	0.19

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Brake System › Brake Rotor › Brake Rotor

P/N Base	Suffix	Details	Cost	Qty	Total
SUC21-00960	A		\$6.59	1	\$6.59

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (per kg)		0.75 kg						1	1.69	1.69

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Into milling machine	1		1	1.30	1.30
Machining	machine profile	1	Material - Steel	3	0.04	1.97
Machining Setup, Change	Flip rotor	1		1	0.65	0.65
Machining	Machine face	0.5	Material - Steel	3	0.04	0.98

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Brake System › Brake Rotor › Brake retainer

P/N Base	Suffix	Details	Cost	Qty	Total
			\$0.12	4	\$0.48

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)	6061-T6 Bar Stock	0.005 kg						1	0.02	0.02

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Lathe	0.0625		1	1.30	0.08
Machining	Turn OD, drill and Part	0.03		1	0.04	0.02

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Brake System Drawings

Powertrain System Section



Drivetrain › Differential

P/N	Base	Suffix	Details	Cost	Qty	Total
			Differential and support plate assembly. Chain and sprocket included. Note that oil is added to the differential after stub axle installation, and is included in the Driveshaft Assembly.	\$386.81	1	\$386.81

Part	Cost	Quantity	Subtotal
Left Differential Plate	21.7500	1	21.7500
Right Differential Plate	14.4400	1	14.4400
Chain Guard top section	4.3800	1	4.3800
Sprocket Adapter	9.3800	1	9.3800
Driven Sprocket (Rear)	7.4000	1	7.4000
Bearing Spacer	1.0700	1	1.0700
Adapter Spacer	0.4800	1	0.4800
Drexler Differential Gear Carrier	194.4600	1	194.4600
Tripod housing	17.3300	2	34.6600
Differential plate cross brace	1.6400	1	1.6400
Turnbuckle	7.1500	1	7.1500
Differential Tab Upper	0.3700	1	0.3700
Differential Tab Lower	0.6600	1	0.6600
Drive Sprocket (Front)	3.4500	1	3.4500

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Seal, Radial Lip Seal	Oil containment at stub axles	1						2	1.00	2.00
Bearing, Cylindrical Roller	Rotating Bearing Plate (90mm OD)	90 mm	20 mm					1	11.70	11.70
Bearing, Cylindrical Roller	Rotating Bearing Plate (78mm OD)	78 mm	20 mm					1	10.62	10.62
Chain	520 drive chain	31.875 in						1	40.48	40.48

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Ratchet <= 25.4 mm	Attach turnbuckles to diff plates	2		1	0.75	1.50
Reaction Tool <= 25.4 mm	Attach turnbuckles to diff plates	2		1	0.25	0.50
Power Tool <= 6.35 mm	Install chain guard chassis mounts	2		1	0.25	0.50
Assemble, 1 kg, Line-on-Line	Install driven sprocket to sprocket adapter	1		1	0.13	0.13
Power Tool <= 25.4 mm	Install sprocket bolts	3		1	0.25	0.75
Reaction Tool <= 25.4 mm	Sprocket bolts	3		1	0.25	0.75
Assemble, 1 kg, Interference	Press bearing in to rotating bearing plate	2		1	0.19	0.38
Assemble, 1 kg, Line-on-Line	Install bearing spacers on differential plates	1	Repeat 2	2	0.13	0.26
Assemble, 5 kg, Line-on-Line	Slide diff plates onto diff	2		1	0.63	1.26
Ratchet <= 25.4 mm	Install differential assembly onto car	4		1	0.75	3.00
Reaction Tool <= 25.4 mm	Assembly onto car	4		1	0.25	1.00
Power Tool <= 25.4 mm	Bolt drive sprocket	1		1	0.25	0.25
Assemble, 1 kg, Loose	Install 520 drive chain	1		1	0.06	0.06
Adjustment - Misc.	Tension chain	1		1	5.00	5.00
Reaction Tool <= 6.35 mm	Install chain guard chassis mounts	2		1	0.25	0.50
Ratchet <= 6.35 mm	Install chain guard engine mount	2		1	0.50	1.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Nut, Grade 8.8 (SAE 5)	Sprocket adapter to sprocket	10 mm	10 mm	6	0.07	0.40
Washer, Grade 8.8 (SAE 5)	Sprocket adapter to sprocket	20 mm		12	0.01	0.12
Bolt, Grade 8.8 (SAE 5)	Sprocket adapter to sprocket	10 mm	30 mm	6	0.20	1.19
Bolt, Grade 8.8 (SAE 5)	Turnbuckle mounting	8 mm	30 mm	6	0.12	0.71
Nut, Grade 8.8 (SAE 5)	Turnbuckle mounting	8 mm	8 mm	6	0.04	0.27
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Turnbuckle adjustment	0.5 in	0.25 in	4	0.09	0.36
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Chain guard chassis mounting	5 mm	20 mm	2	0.02	0.05
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Chain guard chassis mounting	5 mm	5 mm	2	0.02	0.04
Bolt, Grade 8.8 (SAE 5)	Diff plate cross member	10 mm	30 mm	2	0.20	0.40

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Welds - Welding Fixture	Diff tabs to frame	1	3000	1	500.00	0.17
Welds - Welding Fixture	Chain guard tab to frame tube	1	3000	1	500.00	0.17

Drivetrain › Differential › Left Differential Plate

P/N Base	Suffix	Details	Cost	Qty	Total
			\$21.75	1	\$21.75

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)	Diff plate material			Top	19570 mm^2	26 mm	2712 kg/m^3	1	5.80	5.80

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set up material on CNC mill	1		1	1.30	1.30
Machining Setup, Change	Flip over material	1		1	0.65	0.65
Machining	Machine top face of differential plate	200	Material - Aluminum	1	0.04	8.00
Machining	Machining bottom face of differential plate	150	Material - Aluminum	1	0.04	6.00
Anodizing	Anodize the plate black	290		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain › Differential › Right Differential Plate

P/N Base	Suffix	Details	Cost	Qty	Total
			\$14.44	1	\$14.44

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)	Material for diff plate				19000 mm^2	30 mm	2712 kg/m^3	1	6.49	6.49

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set up material on CNC mill	1		1	1.30	1.30
Machining Setup, Change	Flip over material	1		1	0.65	0.65
Machining	Machining top face of the plate	100	Material - Aluminum	1	0.04	4.00
Machining	Machining bottom face of the plate	50	Material - Aluminum	1	0.04	2.00
Anodizing	Anodize plate black	1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain › Differential › Chain Guard top section

P/N Base	Suffix	Details	Cost	Qty	Total
			\$4.38	1	\$4.38

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (by Dimensions)	Chain Guard			Rectangle	40 in^2	0.105 in	0.284 lb/in^3	1	1.22	1.22

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Sheet metal bends	Bend chain guard	1		1	0.25	0.25
Waterjet Cut	Waterjet shape of guard	97	Material - Steel	3	0.01	2.91

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain › Differential › Sprocket Adapter

P/N Base	Suffix	Details	Cost	Qty	Total
			\$9.38	1	\$9.38

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)				Round	29 in^2	1 in	0.098 lb/in^3	1	5.41	5.41

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Install material on CNC lathe w/ live tooling	1		1	1.30	1.30
Broach, Internal	Internal spline creation for differential interaction	3	Material - Aluminum	1	0.50	1.50
Machining	Mill the sprocket adapter profile and holes	13	Material - Aluminum	1	0.04	0.52
Machining Setup, Change	Flip	1		1	0.65	0.65
Anodizing	Anodize adapter black	1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain › Differential › Driven Sprocket (Rear)

P/N Base	Suffix	Details	Cost	Qty	Total
			\$7.40	1	\$7.40

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)	44-tooth drive sprocket			Round	38025 mm^2	5.77 mm	2712 kg/m^3	1	2.50	2.50

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set up on CNC	1		1	1.30	1.30
Machining	Mill center, bolt holes, profile	90	Material - Aluminum	1	0.04	3.60
Anodizing	Anodize the sprocket blue	1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain › Differential › Bearing Spacer

P/N Base	Suffix	Details	Cost	Qty	Total
			\$1.07	1	\$1.07

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)	Material for spacer			Round	4.52 in^2	0.75 in	0.098 lb/in^3	1	0.63	0.63

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining	Turn OD, bore, part	3		1	0.04	0.12
Machining Setup, Install and remove	Install stock onto lathe	0.25		1	1.30	0.32

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain › Differential › Adapter Spacer

P/N Base	Suffix	Details	Cost	Qty	Total
			\$0.48	1	\$0.48

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)	Adapter Spacer			Round	3.8 in^2	0.24 in	0.098 lb/in^3	1	0.17	0.17

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	remove Install round stock onto a lathe	0.2		1	1.30	0.26
Machining	Turn OD, bore, part	1.3	Material - Aluminum	1	0.04	0.05

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain › Differential › Drexler Differential Gear Carrier

P/N Base	Suffix	Details	Cost	Qty	Total
			\$194.46	1	\$194.46

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)	Gear Carrier			Round	18146 mm^2	256.1 mm	2712 kg/m^3	1	52.93	52.93
Differential Internals, Limited Slip, Salisbury or Powerflow or Clutch Style	Drexler Differential Gearing							1	110.00	110.00
Plug/L.P./Pipe/Allen Head/Aluminum/Anodized	1/8" NPT Plug	3.175 mm						3	2.92	8.77
Seal, Radial Lip Seal	Axle Seal							2	1.00	2.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Differential material set up on CNC lathe	3		1	1.30	3.90
Machining Setup, Change	Differential set up on CNC	6		1	0.65	3.90
Machining	All machining of housing	63	Material - Aluminum	1	0.04	2.52
Tapping holes	Differential NPT plug holes	3		1	0.35	1.05
Wrench <= 6.35 mm	NPT plugs	3		1	1.00	3.00
Assemble, 1 kg, Line-on-Line	Gears in, parts together	3		1	0.13	0.39
Power Tool <= 6.35 mm	Bolts	24		1	0.25	6.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain › Differential › Tripod housing

P/N Base	Suffix	Details	Cost	Qty	Total
			\$17.33	2	\$34.66

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (by Dimensions)	Material for housing			Face	6 in^2	6.5 in	0.284 lb/in^3	1	11.30	11.30

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	CNC lathe with live tooling	1		1	1.30	1.30
Machining	Turn OD, bore	17	Material - Steel	3	0.04	2.04
Machining Setup, Change	Flip over material for interior milling	1		1	0.65	0.65
Machining	Face milling, live tool cut splines	17	Material - Steel	3	0.04	2.04
Anodizing	Anodize the part black	1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain › Differential › Differential plate cross brace

P/N Base	Suffix	Details	Cost	Qty	Total
			\$1.64	1	\$1.64

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)				Tube	0.12 in^2	6.11 in	0.098 lb/in^3	1	0.14	0.14

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Saw or tubing cuts	Size the cross brace	1	Material - Aluminum	1	0.40	0.40
Drilled holes < 25.4 mm dia.	Drill before tapping	2	Material - Aluminum	1	0.35	0.70
Threading, Internal (machining)	Thread the ends of the brace	2	Repeat 2	2	0.10	0.40
Anodizing	Anodize the brace black	1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain › Differential › Turnbuckle

P/N Base	Suffix	Details	Cost	Qty	Total
			\$7.15	1	\$7.15

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Clevis	Mounting clevis	0.35 in						1	1.40	1.40
Rod End, Industrial		0.3 in						1	2.38	2.38
Aluminum, Normal (by Dimensions)	Body of the turnbuckle			Round	0.55 in^2	2.8 in	0.098 lb/in^3	1	0.29	0.29

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Drilled holes < 25.4 mm dia.	Holes drilled for the body of the turnbuckle	2	Material - Aluminum	1	0.35	0.70
Tapping holes	Threading the body	2	Material - Aluminum	1	0.35	0.70
Machining Setup, Install and remove	Set up mill for body	1		1	1.30	1.30
Machining	Mill body for wrench application	1	Material - Aluminum	1	0.04	0.04
Anodizing	Anodize the body black	1		1		
Assemble, 1 kg, Line-on-Line	Install clevis and rod end onto body	2		1	0.13	0.26

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Nut, Grade 10.9 (SAE 8)	Locking nut for turnbuckle adjustment	6 mm		2	0.04	0.08

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain > Differential > Differential Tab Upper

P/N Base	Suffix	Details	Cost	Qty	Total
			\$0.37	1	\$0.37

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (by Dimensions)				Rectangle	4.68 in^2	0.188 in	0.284 lb/in^3	1	0.26	0.26

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Waterjet Cut		11.223		1	0.01	0.11

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain › Differential › Differential Tab Lower

P/N Base	Suffix	Details	Cost	Qty	Total
			\$0.66	1	\$0.66

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (by Dimensions)	Diff tab			square	11.778 in^2	0.188 in	0.284 lb/in^3	1	0.64	0.64

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Waterjet Cut		2.5		1	0.01	0.02

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain › Differential › Drive Sprocket (Front)

P/N Base	Suffix	Details	Cost	Qty	Total
			\$3.45	1	\$3.45

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (by Dimensions)	11-tooth drive sprocket			Round	3176 mm^2	7.29 mm	7850 kg/m^3	1	0.41	0.41

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Mill teeth	1		1	1.30	1.30
Machining		2	Material - Steel	3	0.04	0.24
Broach, Internal	Make internal splines	1	Material - Steel	3	0.50	1.50

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain ➤ Tractive Motor

P/N Base	Suffix	Details	Cost	Qty	Total
			\$8035.01	1	\$8035.01

Part	Cost	Quantity	Subtotal
Emrax 228 HV	8000.0000	1	8000.0000
Tamagawa TS2620N21E11	23.0700	1	23.0700
Output shaft coupler	0.0000	1	0.0000

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Wire, Power	Motor power (3-phase)	0.5 m						3	1.50	4.50
Connector, HC-HV Lug Type		1 pin						3	1.00	3.00
Heat Shrink Tubing	Motor power lugs	0.1 m						3	0.05	0.15

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Cut wire		3		1	0.08	0.24
Strip Wire		3		1	0.08	0.24
Lay Wire - Power		0.5	Repeat 3	3	0.03	0.04
Connector Assembly, Crimp	Power connector - controller side	1	Repeat 3	3	0.36	1.08
Crimp Wire	Power connector - motor side	1	Repeat 3	3	0.17	0.51
Power Tool <= 25.4 mm	Motor mount	6		1	0.25	1.50

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 12.9	Motor mount	8 mm	16 mm	6	0.11	0.68

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain › Tractive Motor › Emrax 228 HV

P/N Base	Suffix	Details	Cost	Qty	Total
			\$8000.00	1	\$8000.00

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Motor, Tractive AC		80 kW						1	8000.00	8000.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
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Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain › Tractive Motor › Tamagawa TS2620N21E11

P/N Base	Suffix	Details	Cost	Qty	Total
		One pole resolver	\$23.07	1	\$23.07

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Sensor, Hall Effect								1	4.00	4.00
Wire, Signal		0.5 m						7	0.50	3.50
Connector, OEM Quality		7 pin						1	3.50	3.50
Sensor, Hall Effect								1	4.00	4.00
Wire, Signal		0.5 m						7	0.50	3.50
Connector, OEM Quality		7 pin						1	3.50	3.50

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Lay Wire - Signal		0.5		1	0.02	0.01
Lay Wire - Signal		0.5		1	0.02	0.01
Hand, Tight <= 6.35 mm		2		1	0.50	1.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Resolver mounting	5 mm	20 mm	2	0.02	0.05

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Drivetrain › Tractive Motor › Output shaft coupler

P/N Base	Suffix	Details	Cost	Qty	Total
				1	

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Process	Use	Qty	Multiplier			Mult. Val		Unit Cost		Subtotal
Fastener	Use	Size 1	Size 2			Qty		Unit Cost		Subtotal
Tooling	Use	Qty	PVF	Frac. Incl.				Unit Cost		Subtotal

Powertrain System Drawings

Frame System Section



Frame & Body › Front Wing

P/N Base	Suffix	Details	Cost	Qty	Total
AEA20-00032	A	3-element front wing with curved main element.	\$503.82	1	\$503.82

Part	Cost	Quantity	Subtotal
Wing elements	366.9600	1	366.9600
Mounting	44.0400	1	44.0400
Endplates	77.1000	1	77.1000

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal		
Process	Use							Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Power Tool <= 25.4 mm	Mounting rod - install to curved main element							2		1	0.25	0.50
Reaction Tool <= 25.4 mm	Mounting rod - install to curved main element							2		1	0.25	0.50
Power Tool <= 25.4 mm	Lower mounting bracket - install to curved main element							4		1	0.25	1.00
Tube end preperation for welding	Top mount tube - weld prep							1		1	0.75	0.75
Weld	Top mount tube - weld to frame (self-jigging)							4.8	Repeat 2	2	0.15	1.44
Weld	Lower mounting tabs - weld to frame (self jigging)							1.3	Repeat 8	8	0.15	1.56
Power Tool <= 25.4 mm	Wing elements - attach to endplates							20		1	0.25	5.00
Ratchet <= 25.4 mm	Inner endplates - attach to curved main element							4		1	0.75	3.00
Reaction Tool <= 25.4 mm	Inner endplates - attach to curved main element							4		1	0.25	1.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting rod, bottom	4.825 mm	25.4 mm	2	0.03	0.06
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting rod, bottom	4.825 mm		2	0.02	0.04
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Lower mounting bracket	4.825 mm	19 mm	4	0.02	0.09

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Washer, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Wing element fasteners	4.825 mm		20	0.01	0.20
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Wing element fasteners	4.825 mm	19 mm	20	0.02	0.44
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Inner endplate	4.825 mm	12.7 mm	4	0.02	0.07
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Inner endplate	4.825 mm	12.7 mm	4	0.02	0.07

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body > Front Wing > Wing elements

P/N Base	Suffix	Details	Cost	Qty	Total
			\$366.96	1	\$366.96

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Carbon Fiber, 1 Ply	Internal structure, dry carbon	0.43 kg					1580 kg/m^3	1	86.00	86.00
Carbon Fiber, 1 Ply	Wing elements, dry carbon	1.07 kg					1580 kg/m^3	1	214.00	214.00
Structural Foam	Wing element (1st flap) foam core	0.048 kg						2	6.00	12.00
Plastic, ABS (per kg)	Curved main element	0.255 kg						2	0.84	1.68
Plastic, ABS (per kg)	Main element endcaps	0.152 kg						2	0.50	1.00
Plastic, Acetal (per kg)	Wing endcaps	0.2 kg						2	0.66	1.32

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Resin application, Infusion Molding	Internal structure - wetting	0.876		1	2.50	2.19
Cure, Room Temperature	Internal structure - curing	0.67		1	10.00	6.70
Resin application, Infusion Molding	Wing elements - wetting	4.36		1	2.50	10.90
Cure, Room Temperature	Wing elements - curing	1.3		1	10.00	13.00
Resin application, Manual	Internal structures - bond to wing elements	0.14		1	5.00	0.70
Plastic injection molding	Curved main element insert and endcaps	0.407	Repeat 2	2	2.75	2.24
Resin application, Manual	Curved main element insert and endcaps - bond to main element sections	0.12	Repeat 2	2	5.00	1.20
Machining Setup, Install and remove	Wing endcaps - setup	1		1	1.30	1.30
Laser Cut	Wing endcaps	86	Repeat 4	4	0.01	3.44
Threading, External (machining)	Wing endcaps - tapping	5.1	Material - Plastic	0.5	0.10	0.26
Resin application, Manual	Wing endcaps - bonding to wing skins	0.022	Repeat 4	4	5.00	0.44

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Lamination - Mold Tool	Main element internal structure sections	0.21	3000	3	20000.00	0.47
Lamination - Mold Tool	2nd flap element internal structure	0.05	3000	2	20000.00	0.17
Lamination - Mold Tool	Main element wing skin sections	0.26	3000	3	20000.00	0.58
Lamination - Mold Tool	2nd flap element wing skins	0.21	3000	2	20000.00	0.70
Plastic injection molding - Die	Curved main element insert	2	3000	1	10000.00	6.67



Frame & Body › Front Wing › Mounting

P/N Base	Suffix	Details	Cost	Qty	Total
			\$44.04	1	\$44.04

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Carbon Fiber, 1 Ply	Mounting tubes	0.035 kg					1580 kg/m^3	2	7.00	14.00
Aluminum, Normal (per kg)	Mounting tube inserts	0.003 kg						4	0.01	0.05
Rod End, Industrial	Mounting tube, connection	4.825 mm						4	1.68	6.73
Aluminum, Normal (by Dimensions)	Lower mounting bracket			Longitudinal cross-section	14811 mm^2	9.525 mm	2712 kg/m^3	2	1.61	3.21
Steel, Mild (per kg)	Lower mount	0.06 kg						2	0.14	0.27
Steel, Mild (per kg)	Top mounting tube insert	0.01 kg						2	0.02	0.04
Tubing, Steel	Top mounting tube	0.01 kg						2	0.02	0.04

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Resin application, Infusion Molding	Mounting tube - wetting	0.0313	Repeat 2	2	2.50	0.16
Cure, Room Temperature	Mounting tube - curing	0.0175	Repeat 2	2	10.00	0.35
Machining Setup, Install and remove	Mounting tube insert - setup	1		1	1.30	1.30
Machining	Mounting tube insert - turning	3.04	Material - Aluminum	1	0.04	0.12
Threading, Internal (machining)	Mounting tube insert - tapping	6.6	Material - Aluminum	1	0.10	0.66
Resin application, Manual	Mounting tube - bond mounting inserts to tubes	3.5e-4	Repeat 4	4	5.00	0.01
Assemble, 1 kg, Loose	Mounting tube - thread rod ends and jam nuts	4		1	0.06	0.24
Waterjet Cut	Lower mounting bracket	134	Repeat 2	2	0.01	2.68
Machining Setup, Install and remove	Lower mount - setup	4		1	1.30	5.20
Machining	Lower mount - profile	0.77		1	0.04	0.03
Threading, Internal (machining)	Lower mount - tapping	1.5	Repeat 2	2	0.10	0.30
Power Tool <= 25.4 mm	Lower mounting bracket - attach to lower mount	2		1	0.25	0.50
Reaction Tool <= 25.4 mm	Lower mounting bracket - attach to lower mount	2		1	0.25	0.50
Machining Setup, Install and remove	Top mount insert - setup	1		1	1.30	1.30

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining	Top mount insert - turning	1.24	Material - Steel	3	0.04	0.15
Threading, Internal (machining)	Top mount insert - tapping	1	Material - Steel	3	0.10	0.30
Weld	Top mount insert - weld to top mount tube	4	Repeat 2	2	0.15	1.20
Tube cut	Top mount tube - cope to bulkhead	12.7	Repeat 2	2	0.15	3.81
Power Tool <= 25.4 mm	Top mount tube - attach to mounting rod	2		1	0.25	0.50

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Rod end jam nuts	4.825 mm		2	0.02	0.04
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Rod end jam nuts	6.35 mm		2	0.02	0.05
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Lower mounting bracket - attach to lower mount	4.825 mm	19 mm	2	0.02	0.04
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting rod - attach to endcaps and inserts	6.35 mm	12.7 mm	4	0.03	0.11
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting rod -Attach to endcaps	6.35 mm	12.7 mm	2	0.02	0.05

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Lamination - Mold Tool	Mounting tube	0.0313	3000	2	20000.00	0.10



Frame & Body › Front Wing › Endplates

P/N Base	Suffix	Details	Cost	Qty	Total
			\$77.10	1	\$77.10

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)	Wing angle adjuster	0.008 kg						4	0.03	0.13
Carbon Fiber, 1 Ply	Endplates, dry carbon	0.16 kg					1580 kg/m^3	1	32.00	32.00
Structural Foam	Endplates, foam core	0.185 kg						1	23.13	23.12

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Wing angle adjuster - setup	4		1	1.30	5.20
Machining	Wing angle adjuster - milling	5.4	Material - Aluminum	1	0.04	0.22
Resin application, Infusion Molding	Endplates - (bonding wing angle adjusters during layup)	2.257		1	2.50	5.64
Cure, Room Temperature	Endplates - curing	0.564		1	10.00	5.64
Drilled holes < 25.4 mm dia.	Endplate mounting	12		1	0.35	4.20

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Lamination - Flat Panel Tool	Endplates	0.564	3000	1	1500.00	0.28
Lamination - Mold Tool	Endplate features	0.1	3000	1	20000.00	0.67



Frame & Body › Rear Wing

P/N Base	Suffix	Details	Cost	Qty	Total
AEA21-00185	A	Hollow carbon fiber wing elements.	\$766.92	1	\$766.92

Part	Cost	Quantity	Subtotal
Wing Elements	415.4200	1	415.4200
Endplates	271.3300	1	271.3300
Mounting	68.9600	1	68.9600

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
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Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Power Tool <= 25.4 mm	Wing elements - attach to endplates	12		1	0.25	3.00
Power Tool <= 25.4 mm	Mounting rods and clevises (top and bottom) - install fasteners	10		1	0.25	2.50
Reaction Tool <= 25.4 mm	Mounting rods and clevises (top and bottom) - install fasteners	10		1	0.25	2.50
Weld	Mounting tabs - weld to frame (self-jigging)	16.84		1	0.15	2.53

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Flap wing element endcap, pivot screw	6.35 mm	12.7 mm	4	0.03	0.11
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Wing endcap screws	4.625 mm	12.7 mm	8	0.02	0.13
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Wing mounting clevis insert screw (left)	4.825 mm	31.75 mm	1	0.04	0.04
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Wing mounting clevis insert screw (right)	4.825 mm	25.4 mm	1	0.03	0.03
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Wing mounting clevis insert nut	4.825 mm		2	0.02	0.04
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting clevis screws - thru endplates	4.825 mm	19 mm	8	0.02	0.18
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting clevis nuts - thru endplates	4.825 mm		8	0.02	0.15

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal

Frame & Body › Rear Wing › Wing Elements

P/N Base	Suffix	Details	Cost	Qty	Total
AEC19-00197	A		\$415.42	1	\$415.42

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Structural Foam	Slat wing element, foam core	0.0018 kg						1	0.23	0.22
Carbon Fiber, 1 Ply	Wing element, dry carbon	1.14 kg					1580 kg/m^3	1	228.00	228.00
Carbon Fiber, 1 Ply	Wing element internal structures	0.43 kg					1580 kg/m^3	1	86.00	86.00
Carbon Fiber, 1 Ply	Main element endcaps	0.0154 kg					1580 kg/m^3	2	3.08	6.16
Aluminum, Normal (per kg)	Wing mounting clevis insert	0.04 kg						2	0.17	0.34
Carbon Fiber, 1 Ply	Wing mounting clevis, carbon tube	0.035 kg					1580 kg/m^3	1	7.00	7.00
Plastic, Acetal (per kg)	Wing endcaps	0.00319 kg						2	0.01	0.02
Aluminum, Normal (per kg)	Flap wing element endcap	0.024 kg						6	0.10	0.60
Aluminum, Normal (per kg)	Aluminum endcaps	0.082 kg						2	0.34	0.69

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Resin application, Infusion Molding	Wing elements - wetting	7.26		1	2.50	18.15
Cure, Room Temperature	Wing elements - cooling	1.6		1	10.00	16.00
Resin application, Infusion Molding	Wing internal structure - wetting	0.88		1	2.50	2.20
Cure, Room Temperature	Wing internal structure - cure	0.932		1	10.00	9.32
Resin application, Infusion Molding	Main element endcap - wetting	0.016	Repeat 2	2	2.50	0.08
Cure, Room Temperature	main element endcap - curing	0.016	Repeat 2	2	10.00	0.32
Machining Setup, Install and remove	Wing mounting clevis insert - 5 axis mill	1		1	1.30	1.30
Machining	Wing mounting clevis inserts - milling	28.29	Material - Aluminum	1	0.04	1.13
Resin application, Infusion Molding	Wing mounting clevis, carbon tube - wetting	0.016		1	2.50	0.04
Cure, Room Temperature	Wing mounting clevis, carbon tube - curing	0.016		1	10.00	0.16
Resin application, Manual	Wing mounting clevis insert - bond to carbon tube and inside wing	0.0023		1	5.00	0.01

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Resin application, Manual	Wing internal structure - bond to wing skins	0.342		1	5.00	1.71
Laser Cut	Wing endcaps	240		1	0.01	2.40
Machining Setup, Install and remove	Wing endcaps - setup	2		1	1.30	2.60
Threading, Internal (machining)	Wing endcaps - threading	2.54	Material - Plastic	0.5	0.10	0.13
Resin application, Manual	Wing endcaps - bonding to wing elements	0.008		1	5.00	0.04
Machining Setup, Install and remove	Flap wing endcaps - 5 axis mill	6		1	1.30	7.80
Machining	Flap wing element endcap - milling	53.28	Material - Aluminum	1	0.04	2.13
Threading, Internal (machining)	Flap wing element endcap - tapping	6	Material - Aluminum	1	0.10	0.60
Resin application, Manual	Flap wing element endcap - bonding	0.016		1	5.00	0.08
Machining Setup, Install and remove	Upper Flap endcaps - tapping setup	1	Repeat 4	4	1.30	5.20
Threading, Internal (machining)	Upper flap endcaps - tapping	0.64	Material - Aluminum	1	0.10	0.06
Assemble, 1 kg, Line-on-Line	Endcap assembly into wing	12		1	0.13	1.56
Power Tool <= 25.4 mm	Endcap - bolt to flap wing element endcap	24		1	0.25	6.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Endcap screws	4.165 mm	9.5 mm	16	0.01	0.19

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Lamination - Mold Tool	Main wing element skins	0.57	3000	1	20000.00	3.80
Lamination - Mold Tool	Flap wing element skins	0.282	3000	3	20000.00	0.63
Lamination - Mold Tool	Main wing element internal structure	0.33	3000	1	20000.00	2.20
Lamination - Mold Tool	Flap wing element internal structure	0.2	3000	3	20000.00	0.44
Lamination - Mold Tool	Wing mounting clevis, carbon tube	0.016	3000	1	20000.00	0.11



Frame & Body › Rear Wing › Endplates

P/N Base	Suffix	Details	Cost	Qty	Total
AEC19-00198	A		\$271.33	1	\$271.33

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Carbon Fiber, 1 Ply	Endplates, dry carbon	0.385 kg					1580 kg/m^3	2	77.00	154.00
Structural Foam	Endplates, foam core	0.315 kg						2	39.38	78.75

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Laser cut set up	1		1	1.30	1.30
Laser Cut	Endplates	644		1	0.01	6.44
Resin application, Infusion Molding	Endplate - wetting	1.24	Repeat 2	2	2.50	6.20
Cure, Room Temperature	Endplate - curing	2.434		1	10.00	24.34

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Lamination - Flat Panel Tool	Endplates	1.22	3000	2	1500.00	0.30



Frame & Body › Rear Wing › Mounting

P/N Base	Suffix	Details	Cost	Qty	Total
AEC19-00199	A		\$68.96	1	\$68.96

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Carbon Fiber, 1 Ply	Top mounting tube	0.012 kg					1580 kg/m^3	2	2.40	4.80
Carbon Fiber, 1 Ply	Top cross mounting tube	0.012 kg					1580 kg/m^3	2	2.40	4.80
Carbon Fiber, 1 Ply	Bottom front mounting tube	0.019 kg					1580 kg/m^3	2	3.80	7.60
Carbon Fiber, 1 Ply	Bottom rear mounting tube	0.018 kg					1580 kg/m^3	2	3.60	7.20
Aluminum, Normal (per kg)	Top tube mounting inserts	0.006 kg						4	0.03	0.10
Aluminum, Normal (per kg)	Bottom tube mounting inserts	0.01 kg						8	0.04	0.34
Aluminum, Normal (per kg)	Mounting clevis	0.01 kg						4	0.04	0.17
Rod End, Industrial	Mounting tube, connector	4.825 mm						14	1.68	23.54
Steel, Mild (per kg)	Mounting tabs	0.09 kg						1	0.20	0.20

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Resin application, Infusion Molding	Top mounting tubes - wetting	0.0364	Repeat 3	3	2.50	0.27
Cure, Room Temperature	Top mounting tubes - curing	0.0364	Repeat 3	3	10.00	1.09
Cure, Room Temperature	Bottom mounting tube - curing	0.0692	Repeat 2	2	10.00	1.38
Resin application, Infusion Molding	Bottom mounting tube - wetting	0.0692	Repeat 2	2	2.50	0.35
Machining Setup, Install and remove	Top mounting tube insert - setup	1		1	1.30	1.30
Machining	Top mounting tube insert - turning	4.56	Material - Aluminum	1	0.04	0.18
Threading, Internal (machining)	Top mounting tube insert - tapping	9.9		1	0.10	0.99
Resin application, Manual	Top mounting tube insert - bond to mounting tube	3.5e-4	Repeat 6	6	5.00	0.01
Machining Setup, Install and remove	Bottom mounting tube insert - setup	1		1	1.30	1.30
Machining	Bottom mounting tube insert - turning	7.2	Material - Aluminum	1	0.04	0.29
Threading, Internal (machining)	Bottom mounting tube insert - tapping	10.64	Material - Aluminum	1	0.10	1.06

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Resin application, Manual	Bottom mounting tube insert - bond to mounting tube	4.4e-4	Repeat 8	8	5.00	0.02
Machining Setup, Install and remove	Mounting clevis - 5 axis mill	1	Repeat 2	2	1.30	2.60
Machining	Mounting clevis - milling	18.08	Material - Aluminum	1	0.04	0.72
Assemble, 1 kg, Loose	Mounting tube inserts - thread end rod and jam nuts	28		1	0.06	1.68
Power Tool <= 25.4 mm	Mounting clevis - attach to rods	4		1	0.25	1.00
Reaction Tool <= 25.4 mm	Mounting clevis - attach to rods	4		1	0.25	1.00
Machining Setup, Install and remove	Waterjet mounting tabs	1		1	1.30	1.30
Waterjet Cut	Mounting tabs	76.45		1	0.01	0.76
Power Tool <= 25.4 mm	Mounting tabs - attach to rod ends	4		1	0.25	1.00
Reaction Tool <= 25.4 mm	Mounting tabs - attach to rod ends	4		1	0.25	1.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Rod end jam nuts	4.825 mm		14	0.02	0.26
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting clevis screws - thru end rods	4.825 mm	19 mm	4	0.02	0.09
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting clevis nuts - thru end rods	4.825 mm		4	0.02	0.07
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting tab, bottom screws	4.825 mm	25.4 mm	2	0.03	0.06
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting tab, top-left screw	4.825 mm	19 mm	1	0.02	0.02
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting tab, top-right screw	4.825 mm	25.4 mm	1	0.03	0.03
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting tab, nuts	4.825 mm		4	0.02	0.07

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Lamination - Mold Tool	Top mounting tubes	0.0364	3000	3	20000.00	0.08
Lamination - Mold Tool	Bottom mounting tubes	0.0692	3000	2	20000.00	0.23

Frame & Body › Side Wings

P/N Base	Suffix	Details	Cost	Qty	Total
AEA21-00224	A		\$282.02	2	\$564.04

Part	Cost	Quantity	Subtotal
Wing elements	104.9300	1	104.9300
Endplates	66.2000	2	132.4000
Mounting	36.8700	1	36.8700

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal		
Process	Use							Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Power Tool <= 25.4 mm	Wing elements- mount to endplates							12		1	0.25	3.00
Power Tool <= 25.4 mm	Mounting rod - attach clevis to endplate							4		1	0.25	1.00
Reaction Tool <= 25.4 mm	Mounting rod - attach clevis to endplate							4		1	0.25	1.00
Reaction Tool <= 25.4 mm	Sidewing mounting - attach to mounting tubes, side							4		1	0.25	1.00
Power Tool <= 25.4 mm	sidewing - attach to mounting tubes, side							4		1	0.25	1.00
Weld	Mounting tube tab - weld to frame (self-jigging)							1.25		1	0.15	0.19

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Wing element - mount to endplates	4.825 mm	12.7 mm	12	0.02	0.21
Washer, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Wing element - mount	4.825 mm		12	0.01	0.12
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting clevis screw - attach to endplate	4.825 mm	19 mm	4	0.02	0.09
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting clevis nut - attach to endplate	4.825 mm		4	0.02	0.07
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Sidewing mounting - attach to mounting tubes, side	4.825 mm	12.7 mm	4	0.02	0.07
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Sidewing mounting - attach to mounting tubes, side	4.825 mm		4	0.02	0.07

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal

Frame & Body › Side Wings › Wing elements

P/N Base	Suffix	Details	Cost	Qty	Total
AEC19-00190			\$104.93	1	\$104.93

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Structural Foam	Wing elements, foam core	0.216 kg						1	27.00	27.00
Carbon Fiber, 1 Ply	Wing elements, dry carbon	0.29 kg					1580 kg/m^3	1	58.00	58.00
Plastic, Acetal (per kg)	Wing endcaps	0.684 kg						1	2.26	2.26

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Resin application, Infusion Molding	Wing elements - wetting	0.594		1	2.50	1.48
Cure, Room Temperature	Wing elements - curing	0.59		1	10.00	5.90
Machining Setup, Install and remove	Wing endcaps - setup	1		1	1.30	1.30
Laser Cut	Wing endcaps	812		1	0.01	8.12
Threading, Internal (machining)	Wing endcaps - tapping	7.62		1	0.10	0.76
Resin application, Manual	Wing endcaps - bonding	0.021		1	5.00	0.11

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Side Wings › Endplates

P/N Base	Suffix	Details	Cost	Qty	Total
AEC19-00191			\$66.20	2	\$132.40

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)	Structural Inserts	0.0413 kg						1	0.17	0.17
Carbon Fiber, 1 Ply	Endplates, dry carbon	0.059 kg					1580 kg/m^3	2	11.80	23.60
Structural Foam	Endplates, foam core	0.1 kg						2	12.50	25.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Insert lathe set up	1		1	1.30	1.30
Machining	Lathe inserts	15.3	Material - Aluminum	1	0.04	0.61
Machining Setup, Install and remove	Laser cut set up	1		1	1.30	1.30
Laser Cut	Endplates	224		1	0.01	2.24
Resin application, Infusion Molding	Endplates - wetting	0.833		1	2.50	2.08
Cure, Room Temperature	Endplates- cure	0.42		1	10.00	4.20
Drilled holes < 25.4 mm dia.	Drill holes for mounting	16		1	0.35	5.60

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Lamination - Flat Panel Tool	Endplates	0.42	3000	2	1500.00	0.10



Frame & Body › Side Wings › Mounting

P/N Base	Suffix	Details	Cost	Qty	Total
AEC20-00119			\$36.87	1	\$36.87

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Carbon Fiber, 1 Ply	Mounting tubes	0.035 kg					1580 kg/m^3	1	7.00	7.00
Aluminum, Normal (per kg)	Mounting tube inserts	0.003 kg						4	0.01	0.05
Rod End, Industrial	Mounting tube, connectors	4.825 mm						4	1.68	6.73
Aluminum, Normal (per kg)	Mounting clevis	0.024 kg						2	0.10	0.20
Steel, Mild (per kg)	Mounting tube tabs	0.036 kg						2	0.08	0.16
Tubing, Steel	Mounting tubes, sides	0.2 kg						1	0.45	0.45

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Resin application, Infusion Molding	Mounting tube - wetting	0.03		1	2.50	0.08
Cure, Room Temperature	Mounting tube - curing	0.03		1	10.00	0.30
Machining Setup, Install and remove	Mounting tube insert	1		1	1.30	1.30
Machining	Mounting tube insert - turning	4.5	Material - Aluminum	1	0.04	0.18
Threading, Internal (machining)	Tube insert tapping	2.6	Material - Aluminum	1	0.10	0.26
Resin application, Manual	Tube insert bonding	0.0025		1	5.00	0.01
Assemble, 1 kg, Line-on-Line	Mounting tube - thread rod ends and jam nuts	4		1	0.13	0.52
Machining Setup, Install and remove	Clevis	1	Repeat 2	2	1.30	2.60
Machining	Clevis	9.04	Material - Aluminum	1	0.04	0.36
Waterjet Cut	Tabs	10.57	Repeat 2	2	0.01	0.21
Power Tool <= 25.4 mm	Attach tube to clevis.	2		1	0.25	0.50
Reaction Tool <= 25.4 mm	Attach tube to clevis	2		1	0.25	0.50
Tube cut	Mounting tubes, side - cut center tube	0.95		1	0.15	0.14
Laser Cut	Mounting tubes, coping	0.95	Repeat 10	10	0.01	0.10

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Tube end preperation for welding	Mounting tubes side - welding prep	10		1	0.75	7.50
Weld	Mounting tubes, side (weld	36.4		1	0.15	5.46
Weld	Weld tubes to frame (self-jigging)	3.19	Repeat 2	2	0.15	0.96

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Rod end jam nuts	4.825 mm		4	0.02	0.07
Washer, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting clevis	4.825 mm		4	0.01	0.04
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Clevis screws	4.825 mm	19 mm	4	0.02	0.09
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Mounting clevis nuts	4.825 mm		4	0.02	0.07

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Lamination - Mold Tool	Mounting tube	0.0105	300	1	20000.00	0.70
Welds - Welding Fixture	Mounting tube, side	2	3000	1	500.00	0.33



Frame & Body › Body

P/N Base	Suffix	Details	Cost	Qty	Total
AEA21-00228	A		\$187.29	1	\$187.29

Part	Cost	Quantity	Subtotal
Cowl-Nose	145.2000	1	145.2000
Sidepanels	18.1000	2	36.2000

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (per kg)	Mounting tabs	0.018 kg						1	0.04	0.04

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Waterjet Cut	Mounting tabs	28.7		1	0.01	0.29
Weld	Mouting tabs - weld	4.3		1	0.15	0.64
Riveting	Install rivet nuts to mounting tabs	9		1	0.25	2.25
Power Tool <= 25.4 mm	Secure sidepanel and cowl-nose to tabs	9		1	0.25	2.25

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Rivet, Pop	Sidepanel mounting, rivet nuts			9	0.03	0.27
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Cowl-nose mounting, screws	4.825 mm	12.7 mm	9	0.02	0.15

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Body › Cowl-Nose

P/N Base	Suffix	Details	Cost	Qty	Total
AEC21-01112			\$145.20	1	\$145.20

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Carbon Fiber, 1 Ply	Cowl-nose, dry carbon	0.3 kg					1580 kg/m^3	2	60.00	120.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Resin application, Infusion Molding	Infuse carbon skin	1.17		1	2.50	2.92
Cure, Room Temperature	Curing Carbon	1.17		1	10.00	11.70
Drilled holes < 25.4 mm dia.	Drill fastener holes	5		1	0.35	1.75
Tape	Apply Velcro	0.5		1	0.80	0.40

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Hook and Loop, Hook Side (Velcro)	Frame securement	125 cm^2		1	0.38	0.38
Hook and Loop, Loop Side (Velcro)	Frame securement	125 cm^2		1	0.25	0.25

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Lamination - Mold Tool	Cowl-nose mould	1.17	3000	1	20000.00	7.80



Frame & Body › Body › Sidepanels

P/N Base	Suffix	Details	Cost	Qty	Total
AEC19-00373			\$18.10	2	\$36.20

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Carbon Fiber, 1 Ply	Sidepanel, dry carbon	0.055 kg					1580 kg/m^3	1	11.00	11.00
Process		Use		Qty	Multiplier		Mult. Val		Unit Cost	Subtotal
Resin application, Infusion Molding		Wetting dry carbon		0.56			1		2.50	1.40
Cure, Room Temperature		curing carbon		0.28			1		10.00	2.80
Tape		Apply velcro		0.5			1		0.80	0.40
Fastener		Use		Size 1	Size 2		Qty		Unit Cost	Subtotal
Hook and Loop, Hook Side (Velcro)		Frame securement		125 cm^2			1		0.38	0.38
Hook and Loop, Loop Side (Velcro)		Frame securement		125 cm^2			1		0.25	0.25
Tooling		Use		Qty	PVF	Frac. Incl.			Unit Cost	Subtotal
Lamination - Mold Tool		Sidepanel mould		0.28	3000	1			20000.00	1.87



Frame & Body › Chassis System

P/N Base	Suffix	Details	Cost	Qty	Total
CHA21-0001	A		\$1015.06	1	\$1015.06

Part	Cost	Quantity	Subtotal
Frame	484.1200	1	484.1200
Floor Pan	16.3100	1	16.3100
Main Firewall Bottom	10.7100	1	10.7100
Main Firewall Top	4.8800	1	4.8800
Seatback Firewall	6.6100	1	6.6100
IA Bracket Long	3.1700	1	3.1700
IA Bracket Short	3.0700	1	3.0700
Plascore IA	19.2500	1	19.2500
Frame Chain Guard	5.9300	1	5.9300
Frame Welding Jig	401.7400	1	401.7400

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (per kg)	Floor pan rivet strips	0.93 kg						1	2.09	2.09

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Sheet metal shearing	Floor pan rivet strips	6		1	0.25	1.50
Weld	Floor pan rivet strips	50		1	0.15	7.50
Riveting	Floor pan rivet strips	150		1	0.25	37.50
Power Tool <= 25.4 mm	IA strap	4		1	0.25	1.00
Reaction Tool <= 25.4 mm	IA strap	4		1	0.25	1.00
Weld	Firewall mounting	12		1	0.15	1.80
Assemble, 1 kg, Line-on-Line	Main firewall install	1		1	0.13	0.13

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Power Tool <= 6.35 mm	Main firewall	6		1	0.25	1.50
Tape	Velcro for seatback	2		1	0.80	1.60
Assemble, 1 kg, Loose	Put firewall in car	1		1	0.06	0.06
Assemble, 1 kg, Loose	Put seatback in car	1		1	0.06	0.06

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 8.8 (SAE 5)	IA strap	8 mm	15 mm	4	0.07	0.27
Nut, Grade 8.8 (SAE 5)	IA strap	8 mm		4	0.04	0.18
Washer, Grade 8.8 (SAE 5)	IA strap	8 mm		8	0.01	0.08
Thread Insert	Main firewall	5 mm		6	0.50	3.00

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Chassis System › Frame

P/N Base	Suffix	Details	Cost	Qty	Total
CHEV21-0001	A	TIG welded chromoly spaceframe	\$484.12	1	\$484.12

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (per kg)	Raw tubing, total	66.622 lb						1	67.99	67.99

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Tube end preperation for welding	Cope all Tubes	99	Repeat 2	2	0.75	148.50
Tube bends	Main roll hoop 2	5		1	0.75	3.75
Tube bends	Front roll hoop 3	5		1	0.75	3.75
Weld - Round Tubing	Tube perimeter *#*2*1.5	99	Repeat 2	2	0.50	251.46
Non-functional Coating or Finishing	Powdercoat black	1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Welds - Welding Fixture	Frame	52	3000	1	500.00	8.67



Frame & Body › Chassis System › Floor Pan

P/N Base	Suffix	Details	Cost	Qty	Total
CHC20-0002	A	Single piece sheet metal floorpan. Laser cut and bent	\$16.31	1	\$16.31

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)	5052-H32 0.040" sheet	1.5 kg						1	6.30	6.30

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Sheet in cutter (with other parts)	0.166		1	1.30	0.22
Laser Cut	Cut external profile and internal holes	159	Material - Aluminum	1	0.01	4.04
Sheet metal bends	To follow profile of chassis bottom	2		1	0.25	0.50
Riveting	Riv nut	1	Repeat 7	7	0.25	1.75

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Thread Insert	Riv nut	5 mm		7	0.50	3.50

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Chassis System › Main Firewall Bottom

P/N Base	Suffix	Details	Cost	Qty	Total
CHC19-0003	A	Sheet metal aluminum firewall. Laser cut and bent	\$10.71	1	\$10.71

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)	5052-H32 sheet	1 kg						1	4.20	4.20

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Sheet in cutter (with other parts)	0.166		1	1.30	0.22
Laser Cut	External profile and internal holes	100	Material - Aluminum	1	0.01	2.54
Sheet metal bends	Top Flange	1		1	0.25	0.25
Sheet metal bends	Cross Break	1	Repeat 2	2	0.25	0.50
Riveting	Rivnut install	1	Repeat 4	4	0.25	1.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Thread Insert	Riv nut	5 mm		4	0.50	2.00

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Chassis System › Main Firewall Top

P/N Base	Suffix	Details	Cost	Qty	Total
CHC19-0005	A	Sheet metal aluminum firewall. Laser cut and bent	\$4.88	1	\$4.88

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)	5052-H32 0.040" sheet metal	0.4 kg						1	1.68	1.68

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Sheet in cutter (with other parts)	0.166		1	1.30	0.22
Laser Cut	External profile and internal holes	78	Material - Aluminum	1	0.01	1.98
Sheet metal bends		4		1	0.25	1.00
Non-functional Coating or Finishing	Black anodizing	1		1		
Non-functional Coating or Finishing	Laser engrave sponsor logo	1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Chassis System › Seatback Firewall

P/N Base	Suffix	Details	Cost	Qty	Total
CHC19-0006	A	Aluminum sheet, 2-piece	\$6.61	1	\$6.61

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)	5052-H32 sheet			538	0.032 mm^2	0.098 mm	2712 kg/m^3	1		
Process	Use			Qty	Multiplier		Mult. Val		Unit Cost	Subtotal
Machining Setup, Install and remove	Aluminum			1			1		1.30	1.30
Laser Cut	Cut aluminum profile			96.6	Material - Aluminum		1		0.01	2.45
Power Tool <= 6.35 mm	mounting firewall to frame			10			1		0.25	2.50
Fastener	Use			Size 1	Size 2		Qty		Unit Cost	Subtotal
Bolt, Grade 10.9 (SAE 8)	Mounts firewall to frame			0.1875 in	0.75 in		10		0.04	0.36
Tooling	Use	Qty	PVF		Frac. Incl.		Unit Cost			Subtotal



Frame & Body › Chassis System › IA Bracket Long

P/N Base	Suffix	Details	Cost	Qty	Total
CHC19-0008	A	Bent sheet metal strap	\$3.17	1	\$3.17

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)	5052-H32 0.050" sheet	0.07 kg						1	0.29	0.29

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Sheet in cutter (with other parts)	0.166		1	1.30	0.22
Laser Cut	External profile and internal holes	65.5	Material - Aluminum	1	0.01	0.66
Sheet metal bends	Bends	4		1	0.25	1.00
Sheet metal bends	End hem	2	Repeat 2	2	0.25	1.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Chassis System › IA Bracket Short

P/N Base	Suffix	Details	Cost	Qty	Total
CHC19-0009	A	Bent sheet metal strap	\$3.07	1	\$3.07

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)	5052-H32 0.050" sheet	0.065 kg						1	0.27	0.27

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Sheet in cutter (with other parts)	0.166		1	1.30	0.22
Laser Cut	External profile and internal holes	57.5	Material - Aluminum	1	0.01	0.58
Sheet metal bends	Bends	4		1	0.25	1.00
Sheet metal bends	End hem	2	Repeat 2	2	0.25	1.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Chassis System › Plascore IA

P/N Base	Suffix	Details	Cost	Qty	Total
OTH-0025	Z	Plascore Crushlite aluminum honeycomb impact attenuator	\$19.25	1	\$19.25

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Honeycomb, Aluminum	Purchased at finished size	0.385 kg						1	19.25	19.25

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
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Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Chassis System › Frame Chain Guard

P/N Base	Suffix	Details	Cost	Qty	Total
TAB19-0002	A	Section of chain guard, permanently attached to chassis	\$5.93	1	\$5.93

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (per kg)	Cold rolled sheet/plate	0.17 kg						1	0.38	0.38

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Sheet in cutter (with other parts)	0.5		1	1.30	0.65
Waterjet Cut	External profile	18.8	Material - Steel	3	0.01	0.56
Weld	Attach to chassis	5.7	Repeat 2	2	0.15	4.34

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Chassis System › Frame Welding Jig

P/N Base	Suffix	Details	Cost	Qty	Total
CHA21-0001	A_Weldin		\$401.74	1	\$401.74

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (per kg)	Raw material for welding jig	153.67 lb						1	156.83	156.83
Plastic, ABS (per kg)	Raw material for 3D printed pieces	7.84 lb						1	11.74	11.74

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Weld	Perimeter * # of pieces	12	Repeat 2	2	0.15	9.14
Tube end preperation for welding	Sanding welded sections	12	Repeat 2	2	0.75	18.00
Saw or tubing cuts	Cut tube to length	13		1	0.40	13.21
Sheet metal shearing	Cut bar to length	13		1	0.25	3.25
Rapid Prototype - Plastic	3D printing	7.84		1	32.00	113.80
Drilled holes <= 25.4 mm dia.	Steel members	59		1	0.35	20.65
Power Tool <= 25.4 mm	Bolted Connections	59		1	0.25	14.75

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 8.8 (SAE 5)	Steel posts	0.5 in	3.25 in	11	1.09	12.02
Bolt, Grade 8.8 (SAE 5)	3D printed clamps	0.25 in	2 in	28	0.13	3.75
Nut, Grade 8.8 (SAE 5)	Steel posts	0.5 in		13	0.11	1.48
Thread Insert	3D printed clamps	0.25 in		28	0.64	17.78
Bolt, Grade 8.8 (SAE 5)	Steel posts	0.5 in	4.5 in	2	1.67	3.34

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Welds - Welding Fixture	Frame welding jig	12	3000	1	500.00	2.00

Frame & Body › Pedal Box

P/N Base	Suffix	Details	Cost	Qty	Total
ERA20-0002	A	Ergonomics System - Gas and Pedal Assembly excluding master cylinders	\$293.35	1	\$293.35

Part	Cost	Quantity	Subtotal
Brake Pedal	16.9500	1	16.9500
Brake Pedal Mount	1.3400	2	2.6800
Brake Pedal Thrust Washers	0.9300	2	1.8600
Brake Foot Cup	2.0300	2	4.0600
Balance Bar Trunnion	3.6000	1	3.6000
Balance Bar Sleeve	2.0400	1	2.0400
Gas Pedal	20.6800	1	20.6800
Throttle Pedal Mount	4.6500	2	9.3000
Throttle Spring Top Mount	3.0500	2	6.1000
Throttle Foot Cup	2.0300	1	2.0300
Heel Stop	1.2400	1	1.2400
Pedal Box Base plate	21.6100	1	21.6100
Linear Potentiometer Mount	0.7300	2	1.4600
Throttle Stopper top	3.2000	1	3.2000
Throttle Stopper Bottom	1.4100	1	1.4100
Master Cylinder Mount	3.0100	2	6.0200
Brake Overtravel Switch Mount	0.0200	1	0.0200
Linear Sensor Spacer	0.8400	1	0.8400
Brake Pedal Pivot Sleeve	6.8400	1	6.8400
Throttle Pedal Pivot Sleeve	1.7600	1	1.7600

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Rod End, Industrial	Attaching master cylinder to balance bar	0.3125 in						1	2.48	2.48

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Bearing, Cylindrical Roller	Brake pedal pivot	0.8125 in	0.625 in					1	5.07	5.07
Bearing, Cylindrical Roller	Upper trunnion pivot	0.6875 in	0.5 in					1	4.60	4.60
Bearing, Cylindrical Roller	Lower trunnion pivot	0.8125 in	0.625 in					1	5.07	5.07
Bearing, Linear, Open	Pedalbox slider	0.67 in	14 in					2	25.46	50.92

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Assemble, 1 kg, Interference	Press upper bearing in for balance bar	1		1	0.19	0.19
Assemble, 1 kg, Loose	Insert balance bar trunnion and thrust washers	1		1	0.06	0.06
Assemble, 1 kg, Interference	Press lower bearing in for balance bar	1		1	0.19	0.19
Assemble, 1 kg, Interference	Press pivot bearing into pedal	1		1	0.19	0.19
Assemble, 1 kg, Interference	Insert snap ring into brake pedal	1		1	0.19	0.19
Assemble, 1 kg, Loose	Locate brake pedal mounts	2		1	0.06	0.12
Power Tool <= 25.4 mm	Insert brake pedal mount bolts into pedal and fasten (helicoil in baseplate)	4		1	0.25	1.00
Assemble, 1 kg, Line-on-Line	Insert brake pedal sleeve into brake pedal	1		1	0.13	0.13
Assemble, 1 kg, Loose	Insert brake pedal with delrin washers into baseplate and put brake pedal bolt through	1		1	0.06	0.06
Ratchet <= 25.4 mm	Brake pedal pivot	1		1	0.75	0.75
Reaction Tool <= 25.4 mm	Brake pedal pivot	1		1	0.25	0.25
Hand, Loose > 25.4 mm	Balance bar into trunnion	1		1	0.75	0.75
Assemble, 1 kg, Loose	Balance bar shoulder bolt through: washer, rod end, balance bar sleeve, rod end, washer	1		1	0.06	0.06
Ratchet <= 25.4 mm	Balance bar shoulder bolt	1		1	0.75	0.75
Reaction Tool <= 25.4 mm	Balance bar shoulder bolt	1		1	0.25	0.25
Ratchet <= 25.4 mm	Master cylinder mounts	4		1	0.75	3.00
Reaction Tool <= 25.4 mm	Master cylinder mounts	4		1	0.25	1.00
Power Tool <= 6.35 mm	Carriages to baseplate	16		1	0.25	4.00
Reaction Tool <= 25.4 mm	Carriages to baseplate	16		1	0.25	4.00
Hand - Start Only	Nut on quick release pin	4		1	0.12	0.48
Reaction Tool <= 25.4 mm	Nut on quick release pin	4		1	0.25	1.00
Wrench <= 25.4 mm	Nut on quick release pin and into baseplate	4		1	1.50	6.00
Power Tool <= 6.35 mm	IGUS Rails to welded angle	18		1	0.25	4.50
Reaction Tool <= 6.35 mm	IGUS Rails to welded angle	18		1	0.25	4.50
Ratchet <= 25.4 mm	Throttle pedal mounts	4		1	0.75	3.00
Reaction Tool <= 25.4 mm	Throttle pedal mounts	4		1	0.25	1.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Assemble, 1 kg, Interference	Press throttle sleeve into pedal	1		1	0.19	0.19
Assemble, 1 kg, Loose	Bottom and top throttle pedal stop	1		1	0.06	0.06
Wrench <= 25.4 mm	Throttle pedal stops	2		1	1.50	3.00
Reaction Tool <= 25.4 mm	Throttle pedal stops	2		1	0.25	0.50
Assemble, 1 kg, Loose	Throttle pedal bolt through: throttle pedal mount, throttle spacer and spring, throttle pedal sleeve, then other throttle spacer	1		1	0.06	0.06
Ratchet <= 25.4 mm	Throttle pedal bolt	1		1	0.75	0.75
Reaction Tool <= 25.4 mm	Throttle pedal bolt	1		1	0.25	0.25
Assemble, 10 kg, Line-on-Line	Fit the springs into the spring mounts and put both bolts through the mounts	2		1	1.25	2.50
Power Tool <= 25.4 mm	Spring mount fasteners	2		1	0.25	0.50
Reaction Tool <= 25.4 mm	Spring mount fasteners	2		1	0.25	0.50
Assemble, 1 kg, Interference	Bolt through: throttle pedal, linear sensor, spacer, linear sensor, pedal again	1		1	0.19	0.19
Ratchet <= 25.4 mm	Linear sensor bolt on pedal	1		1	0.75	0.75
Reaction Tool <= 25.4 mm	Linear sensor bolt on pedal	1		1	0.25	0.25
Assemble, 1 kg, Loose	Linear sensors to baseplate	2		1	0.06	0.12
Power Tool <= 25.4 mm	Linear sensor to baseplate	2		1	0.25	0.50
Reaction Tool <= 25.4 mm	Linear sensor to baseplate	2		1	0.25	0.50
Power Tool <= 25.4 mm	Heel Stops to baseplate	4		1	0.25	1.00
Power Tool <= 25.4 mm	Foot cup to brake pedal	2		1	0.25	0.50
Power Tool <= 25.4 mm	Foot cup to gas pedal	2		1	0.25	0.50
Reaction Tool <= 25.4 mm	Foot cup to gas pedal	2		1	0.25	0.50

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Pin, Quick Release	Fastening the pedal box to the linear rails	0.233 in	0.35 in	4	14.31	57.25
Bolt, Grade 10.9 (SAE 8)	Brake pedal mounting bolts	0.25 in	1 in	4	0.08	0.32
Bolt, Grade 10.9 (SAE 8)	Brake pedal pivot	0.3125 in	2.75 in	1	0.40	0.40
Nut, Grade 10.9 (SAE 8)	Brake pedal pivot	0.3125 in	0.35 in	1	0.06	0.06
Bolt, Shoulder Bolt	Balance bar	0.3125 in	3 in	1	1.05	1.05
Nut, Grade 10.9 (SAE 8)	Balance bar	0.25 in	0.3125 in	1	0.04	0.04
Washer, Grade 10.9 (SAE 8)	Single shear shoulder bolt for balance bar	0.75 in		2	0.02	0.04
Pin, Cotter, Hairpin	Sleeve to balance bar shoulder bolt			1	0.05	0.05
Bolt, Grade 10.9 (SAE 8)	Master cylinder mount	0.25 in	0.75 in	2	0.06	0.12

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 10.9 (SAE 8)	Master Cylinder mount	0.25 in	1.875 in	2	0.16	0.31
Washer, Grade 10.9 (SAE 8)	Single shear master cylinder mount	0.625 in		2	0.02	0.04
Nut, Grade 10.9 (SAE 8)	Master cylinder mounts	0.25 in	0.3125 in	4	0.04	0.17
Bolt, Grade 10.9 (SAE 8)	Throttle pedal mounts	0.1875 in	0.75 in	4	0.04	0.14
Bolt, Grade 10.9 (SAE 8)	Throttle pedal bolt	0.25 in	4.5 in	1	0.50	0.50
Nut, Grade 10.9 (SAE 8)	Throttle pedal bolt	0.25 in	0.3125 in	1	0.04	0.04
Bolt, Grade 10.9 (SAE 8)	Throttle spring mounts	0.1875 in	2.25 in	1	0.11	0.11
Nut, Grade 10.9 (SAE 8)	Throttle spring mounts	0.1875 in	0.1875 in	1	0.03	0.03
Bolt, Grade 10.9 (SAE 8)	Linear sensor to pedal bolt	0.13 in	1.375 in	1	0.03	0.03
Nut, Grade 10.9 (SAE 8)	Linear sensor to pedal nut	0.13 in	0.125 in	1	0.02	0.02
Bolt, Grade 10.9 (SAE 8)	Linear sensor to baseplate	0.13 in	1.75 in	2	0.04	0.08
Nut, Grade 10.9 (SAE 8)	Linear sensor to baseplate	0.13 in	0.125 in	2	0.02	0.05
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Foot cup to brake pedal	0.1875 in	0.25 in	2	0.01	0.03
Bolt, Grade 12.9	Foot cup to gas pedal	0.1875 in	1.25 in	1	0.07	0.07
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Foot cup to gas pedal	0.1875 in	0.1875 in	1	0.02	0.02

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Brake Pedal

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-00098	A		\$16.95	1	\$16.95

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)	Brake Pedal			Side View	23.1 in^2	1 in	0.098 lb/in^3	1	4.31	4.31

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	5-axis mill	1		1	1.30	1.30
Machining	Machine all features	17	Material - Aluminum	1	0.04	11.14
Hand Finish - Material Removal	Remove support tab stubs	1		1	0.20	0.20
Anodizing		1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Brake Pedal Mount

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-00097	A		\$1.34	2	\$2.68

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)				Extrude view	0.4 in^2	1.85 in	0.098 lb/in^3	1	0.14	0.14

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set up in 4-axis mill	0.5		1	1.30	0.65
Machining	Mil profile top down, mill holes and counterbore	0.2	Material - Aluminum	1	0.04	0.13
Machining Setup, Change	Flip to face	0.5		1	0.65	0.32
Machining	Face to finish	0.15		1	0.04	0.10
Anodizing		1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Brake Pedal Thrust Washers

P/N Base	Suffix	Details	Cost	Qty	Total
			\$0.93	2	\$1.86

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, Acetal (per kg)		0.0058 kg						1	0.02	0.02

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Put in lathe	1	Material - Plastic	0.5	1.30	0.65
Drilled holes < 25.4 mm dia.	Drill inner hole	1	Material - Plastic	0.5	0.35	0.18
Machining	Cut off	0.25	Material - Plastic	0.5	0.04	0.08

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Brake Foot Cup

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-00095	A		\$2.03	2	\$4.06

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)				Shear size	29.6 in^2	0.06 in	0.098 lb/in^3	1	0.33	0.33

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Waterjet Cut	Cutting profile and holes	27.5		1	0.01	0.70
Sheet metal bends	Bend edges	4		1	0.25	1.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Balance Bar Trunnion

P/N Base	Suffix	Details	Cost	Qty	Total
			\$3.60	1	\$3.60

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Stainless (by Dimensions)	17-4PH 7/8" bar stock			Cylindrical	0.6 in^2	1.9 in	0.284 lb/in^3	1	0.33	0.33

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set up in lathe with live tooling	1		1	1.30	1.30
Machining	Turn OD, drill and threadmill radial hole	0.8	Material - Stainless Steel	3.75	0.04	1.97

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Balance Bar Sleeve

P/N Base	Suffix	Details	Cost	Qty	Total
			\$2.04	1	\$2.04

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Stainless (by Dimensions)	17-4PH H900 0.5" bar stock			Diameter	0.2 in^2	2.2 in	0.284 lb/in^3	1	0.13	0.13

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	CNC lathe with live radial tooling	1		1	1.30	1.30
Machining	Cut threads, mill radial slot, drill center	0.25	Material - Stainless Steel	3.75	0.04	0.61

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Gas Pedal

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-00089	A		\$20.68	1	\$20.68

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Carbon Fiber, 1 Ply	Hockey stick	0.18 lb					0.057 lb/in^3	1	16.33	16.33

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Drilled holes < 25.4 mm dia.		6		1	0.35	2.10
Non-metallic cutting <= 50.8 mm	Cut ends and notch	3		1	0.70	2.10

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Lamination - Mold Tool	Rectangle	0.023	3000	1	20000.00	0.15

Frame & Body › Pedal Box › Throttle Pedal Mount

P/N Base	Suffix	Details	Cost	Qty	Total
			\$4.65	2	\$9.30

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)				Front	2 in^2	1.25 in	0.098 lb/in^3	1	0.47	0.47

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Fixture stock	1	Material - Aluminum	1	1.30	1.30
Machining	Do all top down	1.8		1	0.04	1.18
Drilled holes < 25.4 mm dia.	Holes that fix to baseplate	2		1	0.35	0.70
Machining Setup, Change	Flip	1		1	0.65	0.65
Drilled holes < 25.4 mm dia.	For throttle bolt	1		1	0.35	0.35
Anodizing		1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Throttle Spring Top Mount

P/N Base	Suffix	Details	Cost	Qty	Total
			\$3.05	2	\$6.10

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)				Top Down	0.65 in^2	0.45 in	0.098 lb/in^3	1	0.05	0.05

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove		1		1	1.30	1.30
Drilled holes < 25.4 mm dia.	Drill fastening holes	2		1	0.35	0.70
Machining Setup, Change		1		1	0.65	0.65
Drilled holes < 25.4 mm dia.	Drill spring hole	1		1	0.35	0.35
Anodizing		1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Throttle Foot Cup

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-00094	A		\$2.03	1	\$2.03

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)				Shear size	29.6 in^2	0.06 in	0.098 lb/in^3	1	0.33	0.33

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Waterjet Cut	Cutting profile and holes	27.5		1	0.01	0.70
Sheet metal bends	Bend edges	4		1	0.25	1.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Heel Stop

P/N Base	Suffix	Details	Cost	Qty	Total
			\$1.24	1	\$1.24

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)					6.66 in^2	0.063 in	0.098 lb/in^3	1	0.08	0.08
Process	Use				Qty	Multiplier	Mult. Val		Unit Cost	Subtotal
Sheet metal shearing	Cut to size				2		1		0.25	0.50
Machining Setup, Change	Setting up for slot milling				1		1		0.65	0.65
Machining	Mill slots				0.02		1		0.04	0.01
Fastener	Use	Size 1	Size 2		Qty		Unit Cost			Subtotal
Tooling	Use	Qty	PVF	Frac. Incl.			Unit Cost			Subtotal



Frame & Body › Pedal Box › Pedal Box Base plate

P/N Base	Suffix	Details	Cost	Qty	Total
			\$21.61	1	\$21.61

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)				Top	105.75 in^2	0.3125 in	0.098 lb/in^3	1	6.17	6.17

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Fixture baseplate	1		1	1.30	1.30
Machining	Face, pocket, mill holes, threadmill	6.5	Material - Aluminum	1	0.04	4.26
Machining Setup, Change	Flip baseplate	1		1	0.65	0.65
Machining	Face, pocket	10.2	Material - Aluminum	1	0.04	6.69
Anodizing		1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Thread Insert	1/4-28 helicoils for inset brake pedal mounting holes	0.25 in		4	0.64	2.54

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Linear Potentiometer Mount

P/N Base	Suffix	Details	Cost	Qty	Total
			\$0.73	2	\$1.46

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, Acetal (by Dimensions)				Diameter	0.442 in^2	1.2 in	0.051 lb/in^3	1	0.04	0.04

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Change	Put in lathe	1		1	0.65	0.65
Machining	drill, cut off	1		1	0.04	0.04

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Throttle Stopper top

P/N Base	Suffix	Details	Cost	Qty	Total
			\$3.20	1	\$3.20

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)				Top down	1.5 in^2	1 in	0.098 lb/in^3	1	0.28	0.28

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Fixture the bar stock	1		1	1.30	1.30
Machining	Machine profile	0.94		1	0.04	0.62
Machining Setup, Change	Flip	1		1	0.65	0.65
Tapping holes	Drill and tap bottom holes	1		1	0.35	0.35
Anodizing		1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Throttle Stopper Bottom

P/N Base	Suffix	Details	Cost	Qty	Total
			\$1.41	1	\$1.41

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)		0.009 kg						1	0.04	0.04

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Fixture	1		1	1.30	1.30
Machining	Cut to length	0.1		1	0.04	0.07
Anodizing		1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Master Cylinder Mount

P/N Base	Suffix	Details	Cost	Qty	Total
			\$3.01	2	\$6.02

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Stainless (by Dimensions)	17-4PH bar			Top down	1.5 in^2	1 in	0.284 lb/in^3	1	0.43	0.43

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set up for top down	1		1	1.30	1.30
Machining	Outer profile	0.25	Material - Stainless Steel	3.75	0.04	0.61
Machining Setup, Change	Flip	1		1	0.65	0.65
Machining	Counterbore and make holes	0.15	Material - Stainless Steel	3.75	0.04	0.02

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Brake Overtravel Switch Mount

P/N Base	Suffix	Details	Cost	Qty	Total
			\$0.02	1	\$0.02

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, ABS (per kg)		0.0035 kg						1	0.01	0.01

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Plastic injection molding	Form the part	0.0035		1	2.75	0.01

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Linear Sensor Spacer

P/N Base	Suffix	Details	Cost	Qty	Total
			\$0.84	1	\$0.84

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, Acetal (by Dimensions)					0.307 in^2	0.5 in	0.051 lb/in^3	1	0.01	0.01

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set up in lathe	1	Material - Plastic	0.5	1.30	0.65
Drilled holes < 25.4 mm dia.		1	Material - Plastic	0.5	0.35	0.18

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Brake Pedal Pivot Sleeve

P/N Base	Suffix	Details	Cost	Qty	Total
			\$6.84	1	\$6.84

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Stainless (by Dimensions)				Front	1.22 in^2	1.125 in	0.284 lb/in^3	1	0.40	0.40

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set in lathe	1	Material - Stainless Steel	3.75	1.30	4.88
Drilled holes < 25.4 mm dia.	Drill hole in sleeve	1	Material - Stainless Steel	3.75	0.35	1.31
Machining	cut off	0.1	Material - Stainless Steel	3.75	0.04	0.25

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame & Body › Pedal Box › Throttle Pedal Pivot Sleeve

P/N Base	Suffix	Details	Cost	Qty	Total
			\$1.76	1	\$1.76

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Brass (by Dimensions)				Diameter	0.78 in^2	1.125 in	0.307 lb/in^3	1	0.27	0.27

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set in lathe	1	Material - Brass	0.8	1.30	1.04
Machining	facing	0.32	Material - Brass	0.8	0.04	0.17
Drilled holes < 25.4 mm dia.	drill through	1	Material - Brass	0.8	0.35	0.28

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Frame System Drawings

Electrical System Section



Instruments, Wiring & Accessories › Battery Management System

P/N Base	Suffix	Details	Cost	Qty	Total
			\$4396.76	1	\$4396.76

Part	Cost	Quantity	Subtotal
OrionBMS2-144	2960.0000	1	2960.0000

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Wire, Signal	BMS Voltage taps and thermistor	0.3 m						102	0.30	30.60
Wire, Signal	BMS Voltage taps and thermistor	0.4 m						68	0.40	27.20
Wire, Signal	BMS Voltage taps and thermistor	0.5 m						102	0.50	51.00
Sensor, Thermocouple	Cell temperature monitoring							140	8.00	1120.00
Wire, Signal	MCU interface	0.3 m						6	0.30	1.80
Connector, Computer Type	MCU-BMS connector	6 pin						1	6.00	6.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Lay Wire - Signal	Voltage taps (segment 1-3)	0.3	Repeat 51	51	0.02	0.31
Cut wire	Voltage taps (segment 1-3)	0.3	Repeat 51	51	0.08	1.22
Lay Wire - Signal	Thermistors (segment 1-3) & MCU interface	0.3	Repeat 57	57	0.02	0.34
Cut wire	Thermistors (segment 1-3) & MCU interface	0.3	Repeat 57	57	0.08	1.37
Lay Wire - Signal	Voltage taps (segment 4 & 5)	0.4	Repeat 34	34	0.02	0.27
Cut wire	Voltage taps (segment 4 & 5)	0.4	Repeat 34	34	0.08	1.09
Lay Wire - Signal	Thermistors (segment 4 & 5)	0.4	Repeat 34	34	0.02	0.27
Cut wire	Thermistors (segment 4 & 5)	0.4	Repeat 34	34	0.08	1.09
Lay Wire - Signal	Voltage taps (segment 6-8)	0.5	Repeat 51	51	0.02	0.51
Cut wire	Voltage taps (segment 6-8)	0.5	Repeat 51	51	0.08	2.04
Lay Wire - Signal	Thermistors (segment 6-8)	0.5	Repeat 34	34	0.02	0.34

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Lay Wire - Signal	Thermistors (main power connectors)	0.5		1	0.02	0.01
Cut wire	Thermistors (segment 6-8) & power connectors	0.5		1	0.08	0.04
Strip Wire	Thermistor, Voltage tap and MCU interface wires	282		1	0.08	22.56
Connector Assembly, Solder	Thermistor connections	70	Repeat 2	2	0.24	33.60
Connector Assembly, Solder	Voltage taps	17	Repeat 8	8	0.24	32.64
Attach Wire, Solder wire, bent	Thermistor and Voltage tap cell connections	276		1	0.35	96.60
Power Tool <= 6.35 mm	BMS mounting	8		1	0.25	2.00
Reaction Tool <= 6.35 mm	BMS mounting	8		1	0.25	2.00
Connector Assembly, Solder	MCU interface	6		1	0.24	1.44

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 8.8 (SAE 5)	BMS mounting	5 mm	16 mm	8	0.03	0.22
Nut, Grade 8.8 (SAE 5)	BMS mounting	5 mm		8	0.02	0.20

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Instruments, Wiring & Accessories › Battery Management System › OrionBMS2-144

P/N Base	Suffix	Details	Cost	Qty	Total
			\$2960.00	1	\$2960.00

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Chassis Control Module, + Battery Management System		144 channel						1	2880.00	2880.00
Connector, OEM Quality	Thermistor expansion	80 pin						2	40.00	80.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
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Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Instruments, Wiring & Accessories > Chassis Controls and Wiring

P/N Base	Suffix	Details	Cost	Qty	Total
			\$724.76	1	\$724.76

Part	Cost	Quantity	Subtotal
Steering Wheel Controller	66.7900	1	66.7900
Dash enclosure	15.8800	1	15.8800
Dash Display, Datalogger	594.5800	1	594.5800
Chassis Wiring	43.5100	1	43.5100
Accelerator Pedal Position	4.0000	1	4.0000

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
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Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
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Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Instruments, Wiring & Accessories › Chassis Controls and Wiring › Steering Wheel Controller

P/N Base	Suffix	Details	Cost	Qty	Total
ELA19-0011	A		\$66.79	1	\$66.79

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Chassis Control Module, +Dashboard	Steering Wheel Controller							1	20.00	20.00
Connector, OEM Quality	Buttons, Switches	2 pin						10	1.00	10.00
Connector, OEM Quality	CAN	4 pin						1	2.00	2.00
Wire, Signal	Buttons	2 m						1	2.00	2.00
Switch, Pushbutton	Buttons							8	1.00	8.00
Switch, Rotary Multi-position Selector	Selector Switches							2	3.00	6.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Cut wire		25		1	0.08	2.00
Strip Wire		25		1	0.08	2.00
Crimp Wire		25		1	0.17	4.25
Connector Assembly, Crimp		25		1	0.36	9.00
Connector Install, Square, Friction		11		1	0.14	1.54

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Instruments, Wiring & Accessories › Chassis Controls and Wiring › Dash enclosure

P/N Base	Suffix	Details	Cost	Qty	Total
ELA19-0005	A		\$15.88	1	\$15.88

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Switch, Kill	E-Stop							1	3.00	3.00
Switch, Toggle	Power							1	1.00	1.00
Switch, Pushbutton	Ready to Drive							1	1.00	1.00
Honeycomb, Plastic	Dash Panel	0.1 kg						1	2.00	2.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Plastic injection molding		0.1		1	2.75	0.28
Hand, Tight <= 6.35 mm		5		1	0.50	2.50
Screwdriver > 1 Turn		4		1	0.50	2.00
Cut wire		6		1	0.08	0.48
Strip Wire		6		1	0.08	0.48
Crimp Wire		6		1	0.17	1.02
Attach Wire, Solder wire, bent		6		1	0.35	2.10

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8		5 mm	10 mm	1	0.02	0.02

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Instruments, Wiring & Accessories › Chassis Controls and Wiring › Dash Display, Datalogger

P/N Base	Suffix	Details	Cost	Qty	Total
			\$594.58	1	\$594.58

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Dash Panel, ECUMaster, ADU5 Advanced Display								1	594.58	594.58

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
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Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Instruments, Wiring & Accessories › Chassis Controls and Wiring › Chassis Wiring

P/N Base	Suffix	Details	Cost	Qty	Total
ELA20-0003	A		\$43.51	1	\$43.51

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Wire, Signal		10 m						1	10.00	10.00
Wire, Control		5 m						1	5.00	5.00
Wire, Power		2 m						1	6.00	6.00
Wire Sleeving, Split		2 m						1	1.00	1.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Lay Wire - Control		5		1	0.02	0.10
Lay Wire - Signal		10		1	0.02	0.20
Lay Wire - Power		2		1	0.03	0.06
Cut wire		30		1	0.08	2.40
Strip Wire		30		1	0.08	2.40
Crimp Wire		30		1	0.17	5.10
Lace		25		1	0.15	3.75
Wire Dressing (Install and route)		5		1	1.00	5.00
Install Tie Wrap (Zip Tie, Cable Clamp)		10		1	0.09	0.90
Tape		2		1	0.80	1.60

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Instruments, Wiring & Accessories › Chassis Controls and Wiring › Accelerator Pedal Position

P/N Base	Suffix	Details	Cost	Qty	Total
			\$4.00	1	\$4.00

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Sensor, Angular Position								1	4.00	4.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
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Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Instruments, Wiring & Accessories › GLV Battery

P/N Base	Suffix	Details	Cost	Qty	Total
			\$50.76	1	\$50.76

Part	Cost	Quantity	Subtotal
Battery Enclosure	5.0600	1	5.0600

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Battery, Advanced Chemistry (NiMH, Li-Ion, etc.)		0.5 kg						1	32.50	32.50
Switch, Kill	Master Switch							1	3.00	3.00
Wire, Power	Battery Gnd	0.25 m						1	0.75	0.75
Fuse, Power	GLV Fuse							1	1.00	1.00
Wire, Power	PDU	0.5 m						1	1.50	1.50
Connector, Single Wire	GND + GLV	5 wire						1	0.25	0.25

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Strip Wire		6		1	0.08	0.48
Crimp Wire		6		1	0.17	1.02
Attach Wire, Terminated wire with screw and nut		5		1	0.52	2.60
Power Tool <= 6.35 mm		5		1	0.25	1.25
Reaction Tool <= 6.35 mm		5		1	0.25	1.25

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8		6 mm	10 mm	2	0.02	0.05
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8		6 mm		2	0.02	0.05

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal

Instruments, Wiring & Accessories > GLV Battery > Battery Enclosure

P/N Base	Suffix	Details	Cost	Qty	Total
ELC19-0012A	A		\$5.06	1	\$5.06

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, ABS (by Dimensions)	Battery enclosure material				39 in^2	0.0625 in	0.038 lb/in^3	1	0.14	0.14

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Plastic injection molding	Forming battery box	0.0926		1	2.75	0.12
Drilled holes < 25.4 mm dia.	Fastener holes in battery box	4		1	0.35	1.40

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 8.8 (SAE 5)	Assembling battery box to frame	0.19 in	0.25 in	4	0.02	0.07

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Plastic injection molding - Die	Creating battery box	1	3000	1	10000.00	3.33



Instruments, Wiring & Accessories › MCU module

P/N Base	Suffix	Details	Cost	Qty	Total
			\$232.22	1	\$232.22

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
ECU, Student Built, +Traction Control	STM32 controller							1	150.00	150.00
Sensor to CAN Converter	Wheel speed and brake sensors							3	25.00	75.00
Plastic, ABS (per kg)	MCU housing	0.26 kg						1	0.86	0.86
Wire, Signal	MCU power	0.6 m						2	0.60	1.20
Heat Shrink Tubing	MCU power	0.1 m						1	0.05	0.05
Connector, Computer Type	MCO power	2 pin						1	2.00	2.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Plastic injection molding	MCU housing	0.26		1	2.75	0.72
Hand, Tight <= 6.35 mm		4		1	0.50	2.00
Connector Assembly, Solder	MCU power	1		1	0.24	0.24

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Aluminum	MCU housing mounts	4 mm	8 mm	4	0.02	0.09
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	MCU housing mount	4 mm		4	0.02	0.06

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Instruments, Wiring & Accessories › Motor Controller

P/N Base	Suffix	Details	Cost	Qty	Total
		Motor controller assembly including motor feedback sensor and power/signal cabling	\$3669.85	1	\$3669.85

Part	Cost	Quantity	Subtotal
Bamocar-D3-PG-700-400	3600.0000	1	3600.0000

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Wire, Power	accumulator - controller wires	0.5 m						2	1.50	3.00
Heat Shrink Tubing		0.1 m						2	0.05	0.10
Wire, Control	MCU/controller interface	0.5 m						5	0.50	2.50
Connector, HC-HV incl. Interlock	Accumulator power connector (Male)	2 pin						1	60.00	60.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Cut wire	Power and signal wires	7		1	0.08	0.56
Connector Assembly, Crimp	Power	2		1	0.36	0.72
Crimp Wire	Power connections	2		1	0.17	0.34
Shrink Tube	Power wires	2		1	0.15	0.30
Connector Assembly, Solder	MCU connect	5		1	0.24	1.20
Power Tool <= 6.35 mm	Controller mounting bolts	4		1	0.25	1.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 8.8 (SAE 5)	Controller mounts	5 mm	20 mm	4	0.03	0.13

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Instruments, Wiring & Accessories › Motor Controller › Bamocar-D3-PG-700-400

P/N Base	Suffix	Details	Cost	Qty	Total
			\$3600.00	1	\$3600.00

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Chassis Control Module, + Motor Controller AC		80 kW						1	3600.00	3600.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
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Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Instruments, Wiring & Accessories › Power Distribution Unit

P/N Base	Suffix	Details	Cost	Qty	Total
			\$86.24	1	\$86.24

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Chassis Control Module, + Power Distribution Module	PDU	12 channel						1	84.00	84.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Power Tool <= 6.35 mm	Tighten Bolt	4		1	0.25	1.00
Reaction Tool <= 6.35 mm	Hold Nut	4		1	0.25	1.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 8.8 (SAE 5)	Secure PDU	6 mm	10 mm	4	0.03	0.12
Nut, Grade 8.8 (SAE 5)	Secure PDU	6 mm		4	0.03	0.12

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Instruments, Wiring & Accessories › Wiring Harness

P/N Base	Suffix	Details	Cost	Qty	Total
			\$275.39	1	\$275.39

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Connector, OEM Quality		40 pin						10	20.00	200.00
Wire, Power		3 m						1	9.00	9.00
Wire, Signal		15 m						1	15.00	15.00
Wire, Control		10 m						1	10.00	10.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Lay Wire - Power		3		1	0.03	0.09
Lay Wire - Signal		15		1	0.02	0.30
Lay Wire - Control		10		1	0.02	0.20
Cut wire	Prepare for connectors	100		1	0.08	8.00
Strip Wire	Prepare for connectors	100		1	0.08	8.00
Crimp Wire	Prepare for connector	100		1	0.17	17.00
Lace	Secure wire bundles	25		1	0.15	3.75
Wire Dressing (Install and route)	Place wiring harness in car	2		1	1.00	2.00
Tape	Harness tape	2		1	0.80	1.60
Install Tie Wrap (Zip Tie, Cable Clamp)	Secure wiring harness	5		1	0.09	0.45

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Electrical System Drawings

Miscellaneous System Section



Miscellaneous, Safety, Finish and Assembly › Accumulator

P/N Base	Suffix	Details	Cost	Qty	Total
			\$6413.91	1	\$6413.91

Part	Cost	Quantity	Subtotal
Samsung 40T cell	8.4400	680	5739.2000
Accumulator Base	31.3300	1	31.3300
Accumulator Top	28.7400	1	28.7400
Accumulator Side Panel	18.8300	2	37.6600
Accumulator Shelf	10.6000	1	10.6000
Accumulator Lower Divider	17.7200	4	70.8800
Accumulator Upper Divider	13.2600	3	39.7800

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, ABS (per kg)	Cell Holders	0.00395 kg						272	0.01	3.54
Nickel (by Dimensions)	Busbars				50000 mm^2	0.3 mm	7850 kg/m^3	10	0.26	2.59
Wire, fusible link	Fuse Wire	32 m						1	48.00	48.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Plastic injection molding		1.074		1	2.75	2.95
Waterjet Cut		4032		1	0.01	40.32
Cut wire	Fuse Wire	640		1	0.08	51.20
Weld	Spot Weld	640		1	0.15	96.00
Cut wire	K-Type thermocouple	135		1	0.08	10.80
Cut wire	BMS voltage monitor	270		1	0.08	21.60
Lay Wire - Control	Thermocouples	54		1	0.02	1.08
Lay Wire - Control	BMS voltage sense	108		1	0.02	2.16

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Assemble, 1 kg, Loose	Install segment sections in accumulator	8		1	0.06	0.48
Screwdriver > 1 Turn	Fasten all 6mm screw in accumulator assembly	350		1	0.50	175.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Accumulator › Samsung 40T cell

P/N Base	Suffix	Details	Cost	Qty	Total
			\$8.44	680	\$5739.20

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Battery, Tractive Lithium		0.01406 kWh						1	8.44	8.44

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
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Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Accumulator › Accumulator Base

P/N Base	Suffix	Details	Cost	Qty	Total
			\$31.33	1	\$31.33

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (by Dimensions)	Base Material			Base	313470 mm^2	1.5 mm	7850 kg/m^3	1	8.30	8.30

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set Up material for Waterjet cutting	1		1	1.30	1.30
Machining	Waterjet cut the base maertial IAW the template	33		1	0.04	1.32
Machining Setup, Install and remove	Set up metal for bending jig	1		1	1.30	1.30
Sheet metal bends	Bend ends of sheet metal in to U shape with two flanges on both sides.	4		1	0.25	1.00
Drilled holes < 25.4 mm dia.	Drill holes for nutplate mounting	30		1	0.35	10.50
Anodizing	Paint Sheet Metal	6269.4		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Nutsert (J-Nut)	Captive nut for internal side	6 mm		30	0.22	6.72
Bolt, Grade 10.9 (SAE 8)	Clamping sheet metal in housing	5 mm	12 mm	30	0.03	0.89

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Accumulator › Accumulator Top

P/N Base	Suffix	Details	Cost	Qty	Total
			\$28.74	1	\$28.74

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (by Dimensions)	Top Material			Top	312850 mm^2	1.5 mm	7850 kg/m^3	1	8.29	8.29

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set up material for bending jig	1		1	1.30	1.30
Sheet metal bends	3 bends of base material	3		1	0.25	0.75
Drilled holes < 25.4 mm dia.	Drill holes for Nutserts	35		1	0.35	12.25
Anodizing	Paint material	6500		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Nutsert (J-Nut)	Clampping sheet metals together	5 mm		35	0.17	6.11
Bolt, Grade 10.9 (SAE 8)	For nutsert and joining of sheet metal	6 mm	12 mm	1	0.04	0.04

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Accumulator › Accumulator Side Panel

P/N Base	Suffix	Details	Cost	Qty	Total
			\$18.83	2	\$37.66

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (by Dimensions)	Panel material			Side panel	131495 mm^2	1.5 mm	7850 kg/m^3	1	3.48	3.48

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set up panel for waterjet cutting	1		1	1.30	1.30
Machining	Waterjet material to shape	170		1	0.04	6.80
Sheet metal bends	make one 10.5 degree bend	1		1	0.25	0.25
Drilled holes < 25.4 mm dia.	Bolt clearance holes	20		1	0.35	7.00
Anodizing	Paint material	2600		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Accumulator › Accumulator Shelf

P/N Base	Suffix	Details	Cost	Qty	Total
			\$10.60	1	\$10.60

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (by Dimensions)	Base material			Sheet	195650 mm^2	1 mm	7850 kg/m^3	1	3.46	3.46

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set up Material for waterjet cutting	1		1	1.30	1.30
Machining	Watjet cutting of material to shape	25		1	0.04	1.00
Machining Setup, Change	Set up material for bending jig	1		1	0.65	0.65
Sheet metal bends	Bend 2x flages down on either side	2		1	0.25	0.50
Drilled holes < 25.4 mm dia.	Drill Nutsert holes in flanges	6		1	0.35	2.10
Anodizing	Paint Material	4000		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Nutsert (J-Nut)	For sheet metal clamping/assembly	6 mm		6	0.22	1.34
Bolt, Grade 10.9 (SAE 8)	Clamping sheet metal for assembly	6 mm	12 mm	6	0.04	0.25

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Accumulator › Accumulator Lower Divider

P/N Base	Suffix	Details	Cost	Qty	Total
		Vertical walls which separate the 5 accumulator segment in the lower section.	\$17.72	4	\$70.88

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (by Dimensions)	Base Material			Sheet	73482 mm^2	1.5 mm	7850 kg/m^3	1	1.95	1.95

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set up material for waterjet cutting	1		1	1.30	1.30
Machining	Waterjet cutting to shape	45		1	0.04	1.80
Machining Setup, Install and remove	Setup for bending	1		1	1.30	1.30
Sheet metal bends	4x flange bends of sheet metal	4		1	0.25	1.00
Drilled holes < 25.4 mm dia.	Drill holes for nutserts	18		1	0.35	6.30
Anodizing	Paint material	1450		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Nutsert (J-Nut)	Used to clamp sheet metal together	6 mm		18	0.22	4.03
Bolt, Grade 10.9 (SAE 8)	Use with nutsert	6 mm	12 mm	1	0.04	0.04

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Accumulator › Accumulator Upper Divider

P/N Base	Suffix	Details	Cost	Qty	Total
Vertical accumulator segment dividers for upper level			\$13.26	3	\$39.78

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (by Dimensions)	Base material			base	92500 mm^2	1.5 mm	7850 kg/m^3	1	2.45	2.45

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set up material for waterjet cut	1		1	1.30	1.30
Machining	Waterjetcut to shape	18		1	0.04	0.72
Machining Setup, Change	Set up sheet metal for bending jig	1		1	0.65	0.65
Sheet metal bends	4x flange bends in sheet metal	4		1	0.25	1.00
Machining Setup, Install and remove	Remove sheet metal from jigs	1		1	1.30	1.30
Anodizing	paint material	1850		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Nutsert (J-Nut)	Clamp sheet metal together for assembly	6 mm		22	0.22	4.93
Bolt, Grade 10.9 (SAE 8)	Clamp sheet metal/use with nutsert	6 mm	12 mm	22	0.04	0.91

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Driver Harness

P/N Base	Suffix	Details	Cost	Qty	Total
			\$59.63	1	\$59.63

Part	Cost	Quantity	Subtotal
Mount tabs	1.1800	4	4.7200
Upper retainer	2.1300	2	4.2600

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Harness, Driver								1	45.00	45.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Power Tool <= 25.4 mm	Install lower harness bolts	1	Repeat 4	4	0.25	1.00
Reaction Tool <= 25.4 mm	Nylock	1	Repeat 4	4	0.25	1.00
Assemble, 1 kg, Line-on-Line	Install shoulder harness	1	Repeat 2	2	0.13	0.26
Weld	Weld in tube insert	3	Repeat 2	2	0.15	2.29

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 10.9 (SAE 8)	Lower harness	0.375 in	0.75 in	4	0.16	0.62
Nut, Grade 10.9 (SAE 8)	Lower harness	0.375 in	0.25 in	4	0.08	0.32
Washer, Grade 10.9 (SAE 8)	Lower harness	0.375 in		8	0.02	0.16

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Driver Harness › Mount tabs

P/N Base	Suffix	Details	Cost	Qty	Total
			\$1.18	4	\$4.72

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (per kg)		0.12 lb						1	0.12	0.12

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Waterjet Cut	Incl. bolt hole	4	Material - Steel	3	0.01	0.30
Weld	Install on chassis	2		1	0.15	0.76

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Driver Harness › Upper retainer

P/N Base	Suffix	Details	Cost	Qty	Total
			\$2.13	2	\$4.26

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (per kg)	0.375" round tube	0.033 lb						1	0.03	0.03

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Tube cut		1	Repeat 2	2	0.15	0.30
Tube bends		1	Repeat 2	2	0.75	1.50
Weld	Install on chassis	1	Repeat 2	2	0.15	0.30

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Head Rest

P/N Base	Suffix	Details	Cost	Qty	Total
			\$28.63	1	\$28.63

Part	Cost	Quantity	Subtotal
Back plate	9.7700	1	9.7700
Foam	9.1500	1	9.1500
Mounts	8.6200	1	8.6200

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
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Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Power Tool <= 6.35 mm	Mount back plate	1	Repeat 4	4	0.25	1.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Back plate mounts	0.19 in	0.75 in	4	0.02	0.09

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Head Rest › Back plate

P/N Base	Suffix	Details	Cost	Qty	Total
			\$9.77	1	\$9.77

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Carbon Fiber, 1 Ply	Carbon skin	0.075 lb					0.057 lb/in^3	1	6.80	6.80
Honeycomb, Nomex	Sandwich core	0.02 kg						1	2.50	2.50

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Cure, Oven	Cure plate	0.023		1	20.00	0.46

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Lamination - Flat Panel Tool		0.0074	1000	1	1500.00	0.01



Miscellaneous, Safety, Finish and Assembly › Head Rest › Foam

P/N Base	Suffix	Details	Cost	Qty	Total
			\$9.15	1	\$9.15

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Head Rest Padding		99 in^3						1	8.11	8.11
Fabric	Foam cover	0.118 m^2						1	0.29	0.30

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Aerosol Apply	Spray glue fabric onto foam	0.118		1	5.25	0.62
Assemble, 1 kg, Loose	Attach adhesive velcro	1	Repeat 2	2	0.06	0.12

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Head Rest › Mounts

P/N Base	Suffix	Details	Cost	Qty	Total
			\$8.62	1	\$8.62

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (per kg)	Round tube	0.281 lb						1	0.29	0.29

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Tube cut		3	Repeat 2	2	0.15	2.29
Tube bends		2	Repeat 2	2	0.75	3.00
Weld	Weld mount tubes to frame	1	Repeat 4	4	0.15	1.52
Weld	Install weld nuts	1	Repeat 4	4	0.15	1.52

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Interlock circuit

P/N Base	Suffix	Details	Cost	Qty	Total
			\$61.33	1	\$61.33

Part	Cost	Quantity	Subtotal
Brake Plausibility Device	26.1200	1	26.1200
Insulation Monitoring Device	26.2100	1	26.2100
Shutdown Button	3.0000	3	9.0000

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
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Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
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Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Interlock circuit › Brake
Plausibility Device

P/N Base	Suffix	Details	Cost	Qty	Total
			\$26.12	1	\$26.12

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Chassis Control Module, Baseline Enclosure	PCB							1	25.00	25.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Reaction Tool <= 6.35 mm	Hold nut	2		1	0.25	0.50
Power Tool <= 6.35 mm	Install bolt	2		1	0.25	0.50

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 8.8 (SAE 5)	Secure Brake Plausibility Device	6 mm	10 mm	2	0.03	0.06
Nut, Grade 8.8 (SAE 5)	Secure Brake Plausibility Device	6 mm		2	0.03	0.06

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Interlock circuit › Insulation Monitoring Device

P/N Base	Suffix	Details	Cost	Qty	Total
			\$26.21	1	\$26.21

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Chassis Control Module, Baseline Enclosure	IR155-3204							1	25.00	25.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Reaction Tool <= 6.35 mm	Hold Nut	2		1	0.25	0.50
Power Tool <= 6.35 mm	Install Bolt	2		1	0.25	0.50

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 8.8 (SAE 5)	Secure Insulation Monitoring Device	4 mm	10 mm	6	0.01	0.09
Nut, Grade 8.8 (SAE 5)	Secure Insulation Monitoring Device	4 mm		6	0.02	0.12

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Interlock circuit › Shutdown Button

P/N Base	Suffix	Details	Cost	Qty	Total
			\$3.00	3	\$9.00

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Switch, Kill	Shutdown buttons BOTS, TSMS, GLVMS							1	3.00	3.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
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Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Main Hoop Padding

P/N Base	Suffix	Details	Cost	Qty	Total
			\$2.77	2	\$5.54

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Roll Hoop Padding		50 cm						1	2.50	2.50

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Install Tie Wrap (Zip Tie, Cable Clamp)	Attach to main hoop	1	Repeat 3	3	0.09	0.27

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Seat

P/N Base	Suffix	Details	Cost	Qty	Total
			\$46.36	1	\$46.36

Part	Cost	Quantity	Subtotal
Seat	42.1700	1	42.1700
Seat Mounts	2.0400	2	4.0800

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
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Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
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Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 8.8 (SAE 5)	Seat mount bolts	0.25 in	1 in	1	0.06	0.06
Bolt, Grade 8.8 (SAE 5)	Outer seat bolt	0.3125 in	0.3125 in	1	0.05	0.05

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › Seat › Seat

P/N Base	Suffix	Details	Cost	Qty	Total
			\$42.17	1	\$42.17

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Carbon Fiber, 1 Ply	Seat contruction	0.15 kg					1580 kg/m^3	1	30.00	30.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Cure, Room Temperature	cure seat	0.4902		1	10.00	4.90
Hand Finish - Material Removal	clean edges	10	Material - Composite	2	0.20	4.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Lamination - Mold Tool	seat mold	0.4903	3000	1	20000.00	3.27



Miscellaneous, Safety, Finish and Assembly › Seat › Seat Mounts

P/N Base	Suffix	Details	Cost	Qty	Total
			\$2.04	2	\$4.08

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (per kg)	Tube and sheet	0.13 kg						1	0.29	0.29

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Waterjet Cut	Frame and seat tab	3.5		1	0.01	0.04
Saw or tubing cuts	Straight and miter	1	Repeat 2	2	0.40	0.80
Weld	Tab on frame, tube on seat tab	6		1	0.15	0.90

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Nut, Grade 6.8 (SAE 3) and All Grades less than Metric 8.8	Weld into tube	0.3125 mm	0.25 mm	1	0.01	0.01

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous, Safety, Finish and Assembly › TSAL

P/N Base	Suffix	Details	Cost	Qty	Total
			\$10.00	1	\$10.00

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Chassis Control Module, + TSAL								1	10.00	10.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
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Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Miscellaneous System Drawings

Steering System Section



Steering System › Steering Column

P/N Base	Suffix	Details	Cost	Qty	Total
ERA19-0003	A	Steering column	\$81.01	1	\$81.01

Part	Cost	Quantity	Subtotal
Main Vertical Shaft	0.7700	1	0.7700
Horizontal Steering Shaft	1.9800	1	1.9800
Middle Steering Shaft	1.4200	1	1.4200
Rack Weld Coupler	1.3600	1	1.3600
Rack Spacer Tall	0.1900	2	0.3800
Steering Centre Support Tubes	0.5500	2	1.1000
Steering Bearing Support Tubes	0.5700	2	1.1400
Clutch Handle	4.8700	1	4.8700

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Bearing, Ball, Deep Groove	For Bearing Holder	25 mm	7 mm					2	6.61	13.23
Steering Column Universal Joint	For transmitting the steering wheel motion to the rack							2	20.00	40.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Tube end preperation for welding	Prep tube ends for welds	2		1	0.75	1.50
Assemble, 1 kg, Interference	Cross pin splines to upper shaft	3		1	0.19	0.57
Assemble, 1 kg, Line-on-Line	Assemble Steering Shafts	2		1	0.13	0.26
Tube end preperation for welding	Prep Tube Ends For Welding Steering Supports to Frame and Block	4		1	0.75	3.00
Weld - Round Tubing	Weld steering supports to frame bearing	8		1	0.50	4.00
Weld - Round Tubing	Weld rack weld coupler to main vertical shaft	3.93		1	0.50	4.99
Assemble, 1 kg, Interference	install spring pins between rack weld coupler nad steering rack	1		1	0.19	0.19

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Pin, Cotter, Straight	rack to shaft, splines to shaft			5	0.05	0.25

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Column > Main Vertical Shaft

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0009	A	Shaft connecting lower u-joint to rack weld coupler	\$0.77	1	\$0.77

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Tubing, Steel	Vertical shaft material	0.097 kg						1	0.22	0.22

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Tube cut		1.22	Material - Steel	3	0.15	0.55

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Column > Horizontal Steering Shaft

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0010	A	Shaft connecting first u-joint to quick release	\$1.98	1	\$1.98

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (by Dimensions)	shaft			Tube face	0.471 in^2	2 in	0.284 lb/in^3	1	0.27	0.27

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Install on live tooling lathe	1		1	1.30	1.30
Machining	Machine profile	0.206	Material - Steel	3	0.04	0.41

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Column > Middle Steering Shaft

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0012	A	Shaft connecting the two U-joints	\$1.42	1	\$1.42

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (by Dimensions)	tube			Circular face	0.114 in^2	2.54 in	0.284 lb/in^3	1	0.08	0.08

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove		1		1	1.30	1.30
Machining	cut to length. Volume based on 2mm parting tool	0.018	Material - Steel	3	0.04	0.04

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Column > Rack Weld Coupler

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0015	A	Coupling the steering rack to the bottom shaft through a weld and two spring pins in the rack	\$1.36	1	\$1.36

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (by Dimensions)	tube			circular face	0.133 in^2	1 in	0.284 lb/in^3	1	0.04	0.04

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove		1		1	1.30	1.30
Machining	drilled holes	0.0123	Material - Steel	3	0.04	0.02

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System › Steering Column › Rack Spacer Tall

P/N Base	Suffix	Details	Cost	Qty	Total
ERC-0013	A	space steering rack for bump steer adjsutment	\$0.19	2	\$0.38

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)				top face	0.75 in^2	0.25 in	0.098 lb/in^3	1	0.04	0.04

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Laser Cut	cut profile	5.89		1	0.01	0.15

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Column > Steering Centre Support Tubes

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0016	A	Support for IGUS bearing	\$0.55	2	\$1.10

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (by Dimensions)	tubing			face	0.0578 in^2	4 in	0.284 lb/in^3	1	0.07	0.07

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Tube cut	notch end profiles	0.625	Repeat 2	2	0.15	0.48

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Column > Steering Bearing Support Tubes

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0017	A	Tubes supporting the steering wheel	\$0.57	2	\$1.14

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (by Dimensions)				circular face	0.0587 in^2	5 in	0.284 lb/in^3	1	0.09	0.09

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Tube cut	notch tube ends	0.625	Repeat 2	2	0.15	0.48

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Column > Clutch Handle

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0039	A		\$4.87	1	\$4.87

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)		0.148 kg						1	0.62	0.62

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove		1		1	1.30	1.30
Machining		4.5		1	0.04	2.95

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Rack

P/N Base	Suffix	Details	Cost	Qty	Total
ERA19-0008	A	Two u-joints with a dual bearing split clamp and plastic IGUS bearing for location	\$76.03	1	\$76.03

Part	Cost	Quantity	Subtotal
Steering Rack	61.6200	1	61.6200
Rack Mount	2.4500	2	4.9000
Rack Mount Tab	3.1600	2	6.3200

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
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Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Weld	Weld steering rack mounts to frame	4		1	0.15	1.52
Power Tool <= 25.4 mm	Steering Rack Mounts	1	Repeat 4	4	0.25	1.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 8.8 (SAE 5)	Steering Rack Mounting	0.25 in	2 in	4	0.13	0.54
Nut, Grade 8.8 (SAE 5)	Steering Rack Mount	0.25 in		4	0.03	0.13

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System › Steering Rack › Steering Rack

P/N Base	Suffix	Details	Cost	Qty	Total
OTH19-0010	A	1 - housing 2 - rack 3 - pinion 4 - clevis This material list and make up is for a purchased steering rack	\$61.62	1	\$61.62

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)	Housing 2.5" bar			Bar end	4.9 in^2	10.5 in	0.098 lb/in^3	1	9.61	9.61
Steel, Mild (by Dimensions)	Rack 5/8" Bar			Bar end	0.31 in^2	13.2 in	0.284 lb/in^3	1	1.19	1.19
Steel, Mild (by Dimensions)	Pinion 1.25" Bar			Bar end	1.23 in^2	2.5 in	0.284 lb/in^3	1	0.89	0.89
Steel, Mild (by Dimensions)	Clevis 1" Bar			Bar end	0.79 in^2	1.3 in	0.284 lb/in^3	1	0.30	0.30

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	CNC lathe with radial live tooling	1		1	1.30	1.30
Machining	Turn OD, bore ID, mill features	47		1	0.04	30.81
Machining Setup, Install and remove	CNC lathe with radial live tooling	1		1	1.30	1.30
Machining	Clean up OD, mill rack teeth	1.8	Material - Steel	3	0.04	3.54
Machining Setup, Install and remove	CNC lathe with radial live tooling	1		1	1.30	1.30
Machining	Turn OD profile, cross drill, bore ID, cut gear	2.1	Material - Steel	3	0.04	4.13
Machining Setup, Install and remove	CNC lathe with radial live tooling	0.5	Repeat 2	2	1.30	1.30
Machining	Turn OD, face, drill, bore. Both parts	1.5	Material - Steel	3	0.04	2.95
Ratchet <= 25.4 mm	Install end bolts	1	Repeat 2	2	0.75	1.50
Safety Wire, Install	Funk bolt into end clevis	1	Repeat 2	2	0.60	1.20

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 10.9 (SAE 8)	Funky torx bolt w/ safety wire	10 mm	15 mm	2	0.15	0.30

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System › Steering Rack › Rack Mount

P/N Base	Suffix	Details	Cost	Qty	Total
ERC-0048	A	Split clamp style	\$2.45	2	\$4.90

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)	6061-T6	0.04 kg						1	0.17	0.17

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Mill	1		1	1.30	1.30
Machining	Mill both ops	0.5		1	0.04	0.33
Machining Setup, Change	Flip Part	1		1	0.65	0.65
Anodizing	Black anodize	1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System › Steering Rack › Rack Mount Tab

P/N Base	Suffix	Details	Cost	Qty	Total
TAB19-0001	A		\$3.16	2	\$6.32

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (per kg)		0.05 kg						1	0.11	0.11

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	waterjet	0.5		1	1.30	0.65
Waterjet Cut	Profile and bolt holes	10	Material - Steel	3	0.01	0.76
Sheet metal bends	Stiffening	2		1	0.25	0.50
Weld	To frame	3		1	0.15	1.14

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System › Steering Wheel

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0006	A	3D Printed steering wheel with replaceable grips and a vibrant display	\$68.13	1	\$68.13

Part	Cost	Quantity	Subtotal
Steering Wheel Body	8.7800	1	8.7800
Steering Wheel Front Panel	2.3600	1	2.3600
Paddle Pivot	1.4100	2	2.8200
Paddle Steel Actuator	0.2700	2	0.5400
Quick Release	11.7600	1	11.7600
Quick Release Spline	5.1200	1	5.1200
Front Wheel Handles	0.8000	2	1.6000
Rear Wheel Handles	0.8000	2	1.6000
Left Paddle	2.0600	1	2.0600
Right Paddle	2.0600	1	2.0600
Clevice pins	2.4800	2	4.9600

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Magnet, neodymium high strength	Paddle Shifter Magnets	0.002 kg					7850 kg/m^3	2	0.16	0.32
Spring, Tension (General)	Resists Quick Release Pull							1	1.00	1.00
Switch, Pushbutton	Steering Wheel Buttons and Microswitches							8	1.00	8.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Ratchet <= 6.35 mm	Bolt Steering Wheel To Quick Release	3		1	0.50	1.50
Reaction Tool <= 25.4 mm	Quick release to wheel	3		1	0.25	0.75
Ratchet <= 6.35 mm	Steering wheel buttons	8		1	0.50	4.00
Reaction Tool <= 6.35 mm	Steering wheel buttons	8		1	0.25	2.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Ratchet <= 6.35 mm	Bolt paddles to brackets	4		1	0.50	2.00
Ratchet <= 6.35 mm	Bolt Steering wheel handle to steering wheel	6		1	0.50	3.00
Power Tool <= 6.35 mm	Bolt steering wheel front panel to body	4		1	0.25	1.00
Assemble, 1 kg, Line-on-Line	paddles into clevice pins	2		1	0.13	0.26

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 10.9 (SAE 8)	Steering Wheel to Quick Release Bolts	0.1875 in	1 in	3	0.05	0.14
Washer, Grade 10.9 (SAE 8)	Steering Wheel to Quick Release Washers	0.1875 in		3	0.02	0.06
Nut, Grade 10.9 (SAE 8)	Steering Wheel to Quick Release Nuts	0.1875 in		3	0.03	0.09
Bolt, Grade 10.9 (SAE 8)	Steering Wheel Front Panel Bolts	0.11 in	0.375 in	4	0.01	0.05
Bolt, Grade 10.9 (SAE 8)	Paddle Shifter Bolts	0.136 in	0.375 in	8	0.02	0.12
Bolt, Grade 10.9 (SAE 8)	Steering wheel handle bolts	0.136 in	0.375 in	6	0.02	0.09
Bolt, Grade 10.9 (SAE 8)	Steering wheel handle bolts	0.1 in	1 in	4	0.02	0.07
Nut, Grade 10.9 (SAE 8)	Microswitch	0.1 in		1	0.02	0.02

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Wheel > Steering Wheel Body

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0051	A	3D Printed steering wheel	\$8.78	1	\$8.78

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, ABS (per kg)		0.212 kg						1	0.70	0.70

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove		1		1	1.30	1.30
Rapid Prototype - Plastic		0.212		1	32.00	6.78

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Wheel > Steering Wheel Front Panel

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0052	A	3D Printed front cover for steering wheel body	\$2.36	1	\$2.36

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, ABS (per kg)		0.03 kg						1	0.10	0.10

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove		1		1	1.30	1.30
Rapid Prototype - Plastic	Rapid prototype steering wheel front panel	0.03		1	32.00	0.96

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Wheel > Paddle Pivot

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0056	A	3D Printed part	\$1.41	2	\$2.82

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, ABS (per kg)		0.003 kg						1	0.01	0.01

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove		1		1	1.30	1.30
Rapid Prototype - Plastic	Printing wheel	0.003		1	32.00	0.10

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Wheel > Paddle Steel Actuator

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0058	A	To actuate the paddles with magnets	\$0.27	2	\$0.54

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (per kg)	paddle material	0.04 lb						1	0.04	0.04

Process	Use	Qty	Multiplier		Mult. Val		Unit Cost	Subtotal
Waterjet Cut		3	Material - Steel		3		0.01	0.23

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Wheel > Quick Release

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0053	A	LifeLine Formula electric 8-pin quick release	\$11.76	1	\$11.76

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)		0.15 kg						1	0.63	0.63

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove		1		1	1.30	1.30
Machining	Machine quick release	15		1	0.04	9.83

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Wheel > Quick Release Spline

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0063	A	Spline for steering wheel	\$5.12	1	\$5.12

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (per kg)	Quick release spline material	0.1 kg						1	0.23	0.22

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove		1		1	1.30	1.30
Machining	Machine quick release spline	30	Material - Steel	3	0.04	3.60

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Wheel > Front Wheel Handles

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0054	A	3D Printed	\$0.80	2	\$1.60

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, ABS (per kg)		0.05 lb						1	0.07	0.07

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Rapid Prototype - Plastic		0.05		1	32.00	0.73

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Wheel > Rear Wheel Handles

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0052	A		\$0.80	2	\$1.60

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, ABS (per kg)		0.05 lb						1	0.07	0.07

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Rapid Prototype - Plastic		0.05		1	32.00	0.73

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Wheel > Left Paddle

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0059	A	3D Printed	\$2.06	1	\$2.06

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, ABS (per kg)		0.04 kg						1	0.13	0.13

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove		0.5		1	1.30	0.65
Rapid Prototype - Plastic		0.04		1	32.00	1.28

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Wheel > Right Paddle

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0060	A	3D printed	\$2.06	1	\$2.06

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, ABS (per kg)		0.04 kg						1	0.13	0.13

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove		0.5		1	1.30	0.65
Rapid Prototype - Plastic		0.04		1	32.00	1.28

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System > Steering Wheel > Clevice pins

P/N Base	Suffix	Details	Cost	Qty	Total
ERC19-0066-A		Holds paddles onto wheel	\$2.48	2	\$4.96

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Stainless (per kg)		0.01 kg						1	0.02	0.02

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove		0.5	Material - Stainless Steel	3.75	1.30	2.44
Machining	notch and cut off	0.01	Material - Stainless Steel	3.75	0.04	0.02

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Steering System Drawings

Suspension System Section



Suspension & Shocks › Control Rods

P/N Base	Suffix	Details	Cost	Qty	Total
SUA19-0002			\$23.04	4	\$92.16

Part	Cost	Quantity	Subtotal
Aluminium Insert	1.1900	2	2.3800

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Rod End, Suspension	Suspension attachment	0.25 in						2	7.02	14.03
Carbon Fiber, 1 Ply	Carbon tube, enough for 4 control rods	0.16 kg					1580 kg/m^3	0.125	32.00	4.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Tube cut	Cut carbon tube to legnth	1		1	0.15	0.15
Assemble, 1 kg, Loose	Bond inserts into CFRP	1	Repeat 2	2	0.06	0.12
Assemble, 1 kg, Line-on-Line	Rod ends into end of tubing	1	Repeat 2	2	0.13	0.26
Ratchet <= 6.35 mm	Fasten from upright to steering rack	1	Repeat 2	2	0.50	1.00
Reaction Tool <= 6.35 mm	Fasten from upright to steering rack	1	Repeat 2	2	0.25	0.50
Assemble, 1 kg, Line-on-Line	install jam nut	1	Repeat 2	2	0.13	0.26

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 10.9 (SAE 8)	Control rod to steering rack and upright	0.25 in	1 in	2	0.08	0.16
Nut, Grade 10.9 (SAE 8)	Control rod to steering rack and upright	0.25 in		2	0.04	0.09
Nut, Grade 10.9 (SAE 8)	Jam nut	0.25 in		2	0.04	0.09

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Control Rods › Aluminium Insert

P/N Base	Suffix	Details	Cost	Qty	Total
SUC20-001			\$1.19	2	\$2.38

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)		0.01 kg						1	0.04	0.04

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Setup material on lathe	0.03125		1	1.30	0.04
Machining	Lathe shoulder and hole	1.25		1	0.04	0.82
Threading, Internal (machining)	Thread Insert	0.5		1	0.10	0.13
Machining	Machine flats	0.25		1	0.04	0.16
Anodizing	black	1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Control Arms

P/N Base	Suffix	Details	Cost	Qty	Total
SUA19-0009		Suspension A-Arms consisting of bonding carbon tube to aluminum nodes	\$75.67	4	\$302.68

Part	Cost	Quantity	Subtotal
Threaded Inserts	0.2500	2	0.5000
Front A-Arm Node	9.6300	1	9.6300
Rear A-Arm Node	10.5100	1	10.5100

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Rod End, Suspension		0.25 in						4	7.02	28.06
Bearing, Spherical		0.25 in						2	6.21	12.42
Carbon Fiber, 1 Ply		0.32 kg					1580 kg/m^3	0.125	64.00	8.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Tube cut	Cut Carbon tube to length	1	Material - Composite	2	0.15	0.76
Assemble, 1 kg, Loose	Bond inserts into tubing	1	Repeat 4	4	0.06	0.24
Hand, Loose <= 6.35 mm	Thread rod-ends into a-arms	1	Repeat 4	4	0.25	1.00
Assemble, 1 kg, Interference	Press spherical into housing	2		1	0.19	0.38
Assemble, 1 kg, Interference	Install retaining clip	2		1	0.19	0.38
Ratchet <= 6.35 mm	install a-arm to car fasteners	1	Repeat 4	4	0.50	2.00
Reaction Tool <= 6.35 mm	Install a-arm to car fasteners	1	Repeat 4	4	0.25	1.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Retaining Ring, Internal	Hold spherical in place	1 in		1	0.14	0.14
Bolt, Grade 10.9 (SAE 8)		0.25 in	1.5 in	4	0.12	0.48
Nut, Grade 10.9 (SAE 8)		0.25 in		4	0.04	0.17

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Suspension & Shocks › Control Arms › Threaded Inserts

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0082			\$0.25	2	\$0.50

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)		0.01 kg						1	0.04	0.04
Process	Use							Qty	Unit Cost	Subtotal
Machining Setup, Install and remove	Install material on lathe							0.03125	1.30	0.04
Machining	Turn material for shape of inserts							1	0.04	0.04
Threading, Internal (machining)	Thread threaded fasteners							0.5	0.10	0.13
Fastener	Use	Size 1	Size 2					Qty	Unit Cost	Subtotal
Tooling	Use	Qty	PVF	Frac. Incl.					Unit Cost	Subtotal



Suspension & Shocks › Control Arms › Front A-Arm Node

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0080			\$9.63	1	\$9.63

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)					7.5 in^2	1.5 in	0.098 lb/in^3	1	2.10	2.10

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove		1		1	1.30	1.30
Machining		5-axis	9.5	1	0.04	6.23

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Control Arms › Rear A-Arm Node

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0081			\$10.51	1	\$10.51

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)					10 in^2	1.25 in	0.098 lb/in^3	1	2.33	2.33

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove		1		1	1.30	1.30
Machining	5 axis	10.5		1	0.04	6.88

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Corner Assembly

P/N Base	Suffix	Details	Cost	Qty	Total
SUA19-0010	A	Uprights are identical with modular mounting brackets for A-Arms and control arms (includes hubs which are accounted for in the wheel system)	\$195.18	4	\$780.72

Part	Cost	Quantity	Subtotal
Upright	57.7900	1	57.7900
Upright top	2.7900	1	2.7900
Upright top shim (camber)	0.7100	2	1.4200
Front Tierod Pickup	4.2300	2	8.4600
Rear Toe Pickup	6.0000	2	12.0000

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Wheel Bearing, Ball, Angular Contact		85 mm	10 mm					1	107.52	107.52

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Ratchet <= 6.35 mm	Upright top to upright and upright to a-arms	1	Repeat 4	4	0.50	2.00
Reaction Tool <= 6.35 mm	Upright top to upright and upright to a-arms	1		1	0.25	0.25
Ratchet <= 6.35 mm	Toe pickup to upright and upright to control rod	1	Repeat 2	2	0.50	1.00
Reaction Tool <= 6.35 mm	Toe pickup to upright and upright to control rod	1	Repeat 2	2	0.25	0.50
Assemble, 1 kg, Interference	Press wheel bearing into uprights	1		1	0.19	0.19
Assemble, 1 kg, Loose	Install camber shim	2		1	0.06	0.12

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 10.9 (SAE 8)	Upright top, toe pickup, a-arms, and control rod to upright	0.25 in	1.5 in	7	0.12	0.84
Nut, Grade 10.9 (SAE 8)	Upright top, toe pickup, a-arms, and control rod to upright	0.25 in		7	0.04	0.30

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Suspension & Shocks › Corner Assembly › Upright

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0016	A	The uprights are mirrored right to left,. But remain the same between the front and rear	\$57.79	1	\$57.79

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)	Upright				36.75 in^2	2 in	0.098 lb/in^3	1	13.72	13.72

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	set up 5-axis cnc	1		1	1.30	1.30
Machining	Mill pockets and holes	65.25	Material - Aluminum	1	0.04	42.77

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Corner Assembly › Upright top

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0013	A		\$2.79	1	\$2.79

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)	Upright top				1.5 in^2	1.25 in	0.098 lb/in^3	1	0.35	0.35

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Install on cnc mill	0.5		1	1.30	0.65
Machining	Mill pocket	1.2	Material - Aluminum	1	0.04	0.79
Machining Setup, Change	Flip to drill holes	1		1	0.65	0.65
Drilled holes < 25.4 mm dia.	Drill 1/4" holes	1	Material - Aluminum	1	0.35	0.35

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Corner Assembly › Upright top shim (camber)

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0011	A	Camber adjustment	\$0.71	2	\$1.42

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)	Camber shim			Face	15 in^2	0.125 in	0.098 lb/in^3	1	0.35	0.35

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Waterjet cut the shims. Quantity includes all shims	0.125		1	1.30	0.16
Waterjet Cut	Cut shims	8	Material - Aluminum	1	0.01	0.20

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Corner Assembly › Front Tierod Pickup

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0015	A		\$4.23	2	\$8.46

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)					3.5 in^2	0.75 in	0.098 lb/in^3	1	0.49	0.49

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	set up on CNC mill	1		1	1.30	1.30
Machining	Mill pockets	2.2	Material - Aluminum	1	0.04	1.44
Machining Setup, Change	flip to drill holes	1		1	0.65	0.65
Drilled holes < 25.4 mm dia.	Drill 1/4" hole	1	Material - Aluminum	1	0.35	0.35

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Corner Assembly › Rear Toe Pickup

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0002	A		\$6.00	2	\$12.00

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)					3.375 in^2	1.5 in	0.098 lb/in^3	1	0.95	0.95

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	set up on CNC Mill	1		1	1.30	1.30
Machining		4.2	Material - Aluminum	1	0.04	2.75
Machining Setup, Change	Flip to drill holes	1		1	0.65	0.65
Drilled holes < 25.4 mm dia.	drill 1/4" holes	1		1	0.35	0.35

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Rear Anti-Roll Bar

P/N Base	Suffix	Details	Cost	Qty	Total
SUA19-0011	A		\$67.20	1	\$67.20

Part	Cost	Quantity	Subtotal
Rear ARB Actuators	15.9300	2	31.8600
Rear Anti-roll bar	1.0000	1	1.0000
High misalignment spacers	0.5600	8	4.4800
Rear ARB Lever Arm	2.1200	4	8.4800
Rear ARB Bushing	0.9200	2	1.8400
Rear ARB Chassis Tab	4.4500	2	8.9000

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
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Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Assemble, 1 kg, Line-on-Line	Bushings onto Rear ARB	1	Repeat 2	2	0.13	0.26
Assemble, 1 kg, Loose	spacers into actuation linkages	1	Repeat 4	4	0.06	0.24
Ratchet <= 6.35 mm	fasten anti-roll bar to linkages, linkages to bellcranks, bushings to chassis	12		1	0.50	6.00
Reaction Tool <= 6.35 mm	fasten anti-roll bar to linkages, linkages to bellcranks, bushings to chassis	12		1	0.25	3.00

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 10.9 (SAE 8)	Lever arm fasteners	0.19 in	1 in	4	0.05	0.19
Bolt, Grade 10.9 (SAE 8)	Bushing fasteners	0.19 in	1.5 in	8	0.07	0.57
Nut, Grade 10.9 (SAE 8)		0.19 in	0.125 in	12	0.03	0.38

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Rear Anti-Roll Bar › Rear ARB Actuators

P/N Base	Suffix	Details	Cost	Qty	Total
SUA19-0012	A		\$15.93	2	\$31.86

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)	Adjustable actuation linkage				0.2 in^2	5 in	0.098 lb/in^3	0.5	0.19	0.09
Rod End, Suspension	Connects to anti-roll bar and rear bellcranks	0.25 in						2	7.02	14.03

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	set up on lathe	0.5		1	1.30	0.65
Drilled holes < 25.4 mm dia.	drill holes for tapping	1	Repeat 2	2	0.35	0.70
Threading, Internal (machining)	1/4-28 thread, one side LH, one side RH	1	Repeat 2	2	0.10	0.20
Assemble, 1 kg, Line-on-Line	thread rod ends into actuation linkage	1	Repeat 2	2	0.13	0.26

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Rear Anti-Roll Bar › Rear Anti-roll bar

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0087	A		\$1.00	1	\$1.00

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (per kg)	20" long Steel Tube for torsion bar	0.11 kg						1	0.25	0.25

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Tube end preperation for welding		1		1	0.75	0.75

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Rear Anti-Roll Bar › High misalignment spacers

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0077	A	High misalignment spacers to allow ARB rod ends to pivot 48deg, allowing a full range of motion from the bellcrank.	\$0.56	8	\$4.48

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)					0.2 in^2	3 in	0.098 lb/in^3	0.125	0.11	0.01

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	lathe	0.125		1	1.30	0.16
Machining	lathe grooves and profile	0.06	Material - Aluminum	1	0.04	0.04
Drilled holes < 25.4 mm dia.	Drill hole for fastener	1	Material - Aluminum	1	0.35	0.35

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Rear Anti-Roll Bar › Rear ARB Lever Arm

P/N Base	Suffix	Details	Cost	Qty	Total
SUC20-0003	A		\$2.12	4	\$8.48

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (by Dimensions)	4130 sheet				5 in^2	0.09 in	0.284 lb/in^3	1	0.13	0.13

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	waterjet	0.25		1	1.30	0.32
Waterjet Cut		14.5	Material - Steel	3	0.01	1.10
Weld	weld lever arms to roll bar	1.5		1	0.15	0.57

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Rear Anti-Roll Bar › Rear ARB Bushing

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0090	A		\$0.92	2	\$1.84

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, Acetal (by Dimensions)					0.75 in^2	0.75 in	0.051 lb/in^3	1	0.04	0.04

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Drilled holes < 25.4 mm dia.	Drill mounting holes and pivot hole into bushing	5	Material - Plastic	0.5	0.35	0.88

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Rear Anti-Roll Bar › Rear ARB Chassis Tab

P/N Base	Suffix	Details	Cost	Qty	Total
TAB19-0050	A		\$4.45	2	\$8.90

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (by Dimensions)	4130 Sheet				8 in^2	0.09 in	0.284 lb/in^3	1	0.21	0.21

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	waterjet	0.5		1	1.30	0.65
Waterjet Cut		10	Material - Steel	3	0.01	0.76
Sheet metal bends	bend to match copes to chassis	2	Material - Steel	3	0.25	1.50
Weld	weld to chassis	3.5		1	0.15	1.33

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Spring and Shock

P/N Base	Suffix	Details	Cost	Qty	Total
SUA19-0013			\$341.38	4	\$1365.52

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Damper, Ohlins TTX 25								1	305.00	305.00
Suspension Springs, Coil Spring, Steel								1	25.00	25.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Ratchet <= 25.4 mm	Shock to chassis and shock to bellcrank	1	Repeat 2	2	0.75	1.50
Reaction Tool <= 25.4 mm	Shock to chassis and shock to bellcrank	1	Repeat 2	2	0.25	0.50
Assemble, 1 kg, Line-on-Line	Spring onto shock and preload shock	1		1	0.13	0.13
Suspension Setup-Independent Susp. (per corner)	Includes setup for dampers, corner weight balancing, toe, camber alignment etc.	1		1	8.75	8.75

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Nut, Grade 10.9 (SAE 8)	Shock to chassis	0.3125 in		2	0.06	0.12
Bolt, Grade 10.9 (SAE 8)	Shock to bellcrank	0.3125 in	1.5 in	2	0.19	0.38

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Tab Assembly

P/N Base	Suffix	Details	Cost	Qty	Total
SUA20-0004	A	Suspension tabs for attaching the a-arms, bellcranks, dampers to the chassis	\$52.55	1	\$52.55

Part	Cost	Quantity	Subtotal
Suspension Tab	0.5900	48	28.3200
Damper Stud	2.4600	2	4.9200

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
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Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Weld	Tabs to chassis	50		1	0.15	19.05

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
Welds - Welding Fixture	Welding Tabs. Includes the damper tabs and bellcrank tabs	50	3000	32	500.00	0.26



Suspension & Shocks › Tab Assembly › Suspension Tab

P/N Base	Suffix	Details	Cost	Qty	Total
TAB20-0010	A	A-Arm tabs	\$0.59	48	\$28.32

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Alloy (per kg)	tab	0.08 kg						1	0.18	0.18

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Install sheet metal on waterjet cutter	0.0208		1	1.30	0.03
Waterjet Cut	Waterjet cut the tabs (average tab size)	5	Material - Steel	3	0.01	0.38

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Tab Assembly › Damper Stud

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0052	B	inboard damper mounting	\$2.46	2	\$4.92

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (by Dimensions)	16mm round stock				200 mm^2	65 mm	7850 kg/m^3	1	0.23	0.23

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set up on lathe	0.5		1	1.30	0.65
Machining	Lathe	10	Material - Steel	3	0.04	1.20
Threading, External (machining)		0.5	Material - Steel	3	0.10	0.38

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Front Bellcrank Assembly

P/N Base	Suffix	Details	Cost	Qty	Total
SUA21-0006	A		\$11.50	2	\$23.00

Part	Cost	Quantity	Subtotal
Front Bellcrank	4.7600	1	4.7600
Thrust Washer	0.3700	2	0.7400
Pivot Shaft	3.2100	1	3.2100
Bellcrank Bushing	1.4600	1	1.4600

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
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Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Assemble, 1 kg, Interference	Press bushing into bellcrank	1		1	0.19	0.19
Assemble, 1 kg, Line-on-Line	Put shaft and thrust washers onto bellcrank	1		1	0.13	0.13
Assemble, 1 kg, Line-on-Line	Washers onto bellcrank	1	Repeat 2	2	0.13	0.26
Power Tool <= 25.4 mm	Bolt bellcrank onto chassis	1		1	0.25	0.25
Reaction Tool <= 25.4 mm	Hold bellcrank nut	1		1	0.25	0.25

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 10.9 (SAE 8)	Bellcrank pivot mount	0.3125 in	1.5 in	1	0.19	0.19
Nut, Grade 10.9 (SAE 8)	Bellcrank nut	0.3125 in		1	0.06	0.06

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks > Front Bellcrank Assembly > Front Bellcrank

P/N Base	Suffix	Details	Cost	Qty	Total
SUC21-00311	A		\$4.76	1	\$4.76

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)		0.2 kg						1	0.84	0.84

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Put material into 4 axis	1		1	1.30	1.30
Machining		2		1	0.04	1.31
Machining Setup, Change	Flip part	1		1	0.65	0.65
Machining		1		1	0.04	0.66

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Front Bellcrank Assembly › Thrust Washer

P/N Base	Suffix	Details	Cost	Qty	Total
SUC21-00995			\$0.37	2	\$0.74

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, Acetal (by Dimensions)				face	0.785 in^2	0.02 in	0.051 lb/in^3	6	0.00	0.01

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	into lathe	0.25		1	1.30	0.32
Machining	Face and detach rod	2	Material - Plastic	0.5	0.04	0.04

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Front Bellcrank Assembly › Pivot Shaft

P/N Base	Suffix	Details	Cost	Qty	Total
SUC21-01043	A		\$3.21	1	\$3.21

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Stainless (by Dimensions)				Rod	804 mm^2	30 mm	7850 kg/m^3	1	0.43	0.43

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Into lathe	0.25		1	1.30	0.32
Machining	Centre hole and part	1	Material - Stainless Steel	3.75	0.04	2.46

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Front Bellcrank Assembly › Bellcrank Bushing

P/N Base	Suffix	Details	Cost	Qty	Total
SUC21-01124	A		\$1.46	1	\$1.46

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Bronze (by Dimensions)				Tube	716 mm^2	21 mm	8500 kg/m^3	1	0.28	0.28

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	into lathe	0.5		1	1.30	0.65
Machining	Turn to finish length, add grease groove	10	Material - Bronze	1.33	0.04	0.53

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Rear Bellcrank Assembly

P/N Base	Suffix	Details	Cost	Qty	Total
SUA21-00242	A		\$17.08	2	\$34.16

Part	Cost	Quantity	Subtotal
Rear Bellcrank	7.0900	1	7.0900
Thrust Washer	0.5300	2	1.0600
Bellcrank Shaft	1.8800	1	1.8800

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Bearing, Needle		26 mm	16 mm					1	5.47	5.47

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Assemble, 1 kg, Interference	Bearing into bellcrank	1		1	0.19	0.19
Assemble, 1 kg, Line-on-Line	shaft into bearing race	1		1	0.13	0.13
Assemble, 1 kg, Line-on-Line	washers onto bellcrank	2		1	0.13	0.26
Ratchet <= 6.35 mm	bellcrank to chassis	1		1	0.50	0.50
Reaction Tool <= 6.35 mm	bellcrank to chassis	1		1	0.25	0.25

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Nut, Grade 10.9 (SAE 8)	fasten bellcrank to chassis	0.3125 in	0.25 in	1	0.06	0.06
Bolt, Grade 10.9 (SAE 8)	fasten bellcrank to chassis	0.3125 in	1.5 in	1	0.19	0.19

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Rear Bellcrank Assembly › Rear Bellcrank

P/N Base	Suffix	Details	Cost	Qty	Total
SUC21-01110	A		\$7.09	1	\$7.09

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)				rectangle	10.25 in^2	0.8 in	0.098 lb/in^3	1	1.53	1.53

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Set up on 5-axis CNC mill	1		1	1.30	1.30
Machining	Mill	6.5		1	0.04	4.26

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Rear Bellcrank Assembly › Thrust Washer

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0084	A		\$0.53	2	\$1.06

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Plastic, Acetal (by Dimensions)	30mm Delrin round stock				706 mm^2	15 mm	1420 kg/m^3	0.25	0.05	0.01

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	lathe	0.25		1	1.30	0.32
Drilled holes < 25.4 mm dia.	drill 16mm hole	1	Material - Plastic	0.5	0.35	0.18
Machining	part off .125"	1	Material - Plastic	0.5	0.04	0.02

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Rear Bellcrank Assembly › Bellcrank Shaft

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0074	A		\$1.88	1	\$1.88

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Stainless (by Dimensions)	16mm dia ground shaft				200 mm^2	110 mm	7850 kg/m^3	0.25	0.39	0.10

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	lathe	0.25		1	1.30	0.32
Drilled holes < 25.4 mm dia.	5/16" hole	1	Material - Stainless Steel	3.75	0.35	1.31
Machining	Part off at 26mm	1	Material - Stainless Steel	3.75	0.04	0.15

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Pull and Push Rods

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0014	A	all tie/pull/push rods were designed with the same components for adjustability and to simplify manufacturing	\$33.36	4	\$133.44

Part	Cost	Quantity	Subtotal
Aluminium Insert	0.8700	1	0.8700
Aluminium Shim Insert	3.8800	2	7.7600
Pullrod Shims	0.6400	1	0.6400

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Rod End, Suspension	Suspension attachment	0.25 in						2	7.02	14.03
Carbon Fiber, 1 Ply	Carbon tube, enough for 8 control arms	0.16 kg					1580 kg/m^3	0.125	32.00	4.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Tube cut	Cut carbon tube to length	1		1	0.15	0.15
Assemble, 1 kg, Loose	Bond inserts into CFRP tubing	1	Repeat 2	2	0.06	0.12
Assemble, 1 kg, Line-on-Line	Rod ends into end of tubing	1	Repeat 2	2	0.13	0.26
Ratchet <= 6.35 mm	fasten from upright to bellcrank/chassis/steering rack	1	Repeat 4	4	0.50	2.00
Reaction Tool <= 6.35 mm	fasten from upright to bellcrank/chassis/steering rack	1	Repeat 4	4	0.25	1.00
Assemble, 1 kg, Line-on-Line	Install jam nuts	1	Repeat 2	2	0.13	0.26
Ratchet <= 6.35 mm	Fasten Shims	1	Repeat 2	2	0.50	1.00
Reaction Tool <= 6.35 mm	Fasten Shims	1	Repeat 2	2	0.25	0.50

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 10.9 (SAE 8)	push/pull rod shims	0.25 in	2 in	2	0.17	0.34
Nut, Grade 10.9 (SAE 8)	push/pull rod shims	0.25 in		2	0.04	0.09
Nut, Grade 10.9 (SAE 8)	Jam nut	0.25 in		2	0.04	0.09

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
Bolt, Grade 10.9 (SAE 8)	Control rod to chassis and upright	0.25 in	1 in	2	0.08	0.16
Nut, Grade 10.9 (SAE 8)	Control rod to chassis and upright	0.25 in		2	0.04	0.09

Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Pull and Push Rods › Aluminium Insert

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0082	A		\$0.87	1	\$0.87

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)		0.01 kg						1	0.04	0.04

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Setup material on lathe	0.03125		1	1.30	0.04
Machining	Lathe shoulder and hole	1		1	0.04	0.66
Threading, Internal (machining)	Thread insert	0.5		1	0.10	0.13
Anodizing	black	1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Pull and Push Rods › Aluminium Shim Insert

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0085	A	Shim interface to allow rapid adjustment of ride height and toe.	\$3.88	2	\$7.76

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (by Dimensions)	Aluminum shim inserts				1.5 in^2	1.5 in	0.098 lb/in^3	1	0.42	0.42

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove		1		1	1.30	1.30
Machining	Mill profile	1.5		1	0.04	0.98
Drilled holes < 25.4 mm dia.	drill 1/4" holes	1	Repeat 3	3	0.35	1.05
Threading, Internal (machining)	thread 1/4-28 hole	0.5	Material - Aluminum	1	0.10	0.13
Anodizing	Black	1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension & Shocks › Pull and Push Rods › Pullrod Shims

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0086	A	Consists of 20 aluminum shims for 8 adjustable control arms. Waterjet from 1 sheet of aluminum.	\$0.64	1	\$0.64

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Normal (per kg)	Raw material (20 shims/8 control rods)	0.0375 kg						1	0.16	0.16

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	1 sheet for all 8 control rods	0.125		1	1.30	0.16
Waterjet Cut	Waterjet Shim profile (20 total)	12.5		1	0.01	0.32

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Suspension System Drawings

Wheels System Section



Wheels, Wheel Bearings & Tires › Hub

P/N Base	Suffix	Details	Cost	Qty	Total
SUA19-0004		Live spindle center-lock hubs with drive pins	\$200.71	4	\$802.84

Part	Cost	Quantity	Subtotal
Hub	61.4300	1	61.4300
Hub nut	3.4700	1	3.4700
Wheel nut	3.9200	1	3.9200
Wheel Bearing	107.5200	1	107.5200
Lock Washer	1.2100	1	1.2100
Drive Pin	0.6800	4	2.7200
Wheelspeed Pickup	11.8500	1	11.8500
Wheel Nut Spring Clip	6.7700	1	6.7700

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
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Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Assemble, 1 kg, Interference	Press bearings onto hubs	1		1	0.19	0.19
Assemble, 1 kg, Line-on-Line	Bend hub nut lock washer tab	1		1	0.13	0.13
Ratchet > 25.4 mm	Tighten hub nut	1		1	1.50	1.50

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Wheels, Wheel Bearings & Tires › Hub › Hub

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0003	A		\$61.43	1	\$61.43

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)	Billet 7075				12.6 in^2	6.4 in	0.098 lb/in^3	1	15.06	15.06

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Lathe	1		1	1.30	1.30
Machining	Turn to profile	31		1	0.04	20.32
Threading, External (machining)	For wheel/hub nut	2		1	0.10	0.51
Machining Setup, Change	Mill	1		1	0.65	0.65
Machining	Mill hub face, mill pockets	20		1	0.04	13.11
Machining Setup, Change	Flip side	1		1	0.65	0.65
Machining	Mill pockets	15		1	0.04	9.83
Anodizing		1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Wheels, Wheel Bearings & Tires › Hub › Hub nut

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0005		Hook spanner driven 7075 nuts	\$3.47	1	\$3.47

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (per kg)		0.1 kg						1	0.42	0.42

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Lathe	1	Material - Aluminum	1	1.30	1.30
Machining	Turn profile, bore center	1.4	Material - Aluminum	1	0.04	0.92
Threading, Internal (machining)	To hubs	0.37		1	0.10	0.09
Machining Setup, Change	Mill	1		1	0.65	0.65
Machining	Cut wrench slots	0.14		1	0.04	0.09
Anodizing		1		1		

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Wheels, Wheel Bearings & Tires › Hub › Wheel nut

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0004	A		\$3.92	1	\$3.92

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Aluminum, Premium (by Dimensions)					5.3 in^2	2.5 in	0.098 lb/in^3	0.25	2.47	0.62

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	lathe	0.25		1	1.30	0.32
Machining	bore hole, lathe profile	2.75		1	0.04	1.80
Threading, Internal (machining)		0.8		1	0.10	0.20
Machining Setup, Change	Mill	1		1	0.65	0.65
Machining	Wrench grooves	0.5		1	0.04	0.33

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Wheels, Wheel Bearings & Tires › Hub › Wheel Bearing

P/N Base	Suffix	Details	Cost	Qty	Total
OTH19-0040	A	SKF 71813 ACD HCP4. Other pressed into upright assembly	\$107.52	1	\$107.52

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Wheel Bearing, Ball, Angular Contact		85 mm	10 mm					1	107.52	107.52

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
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Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Wheels, Wheel Bearings & Tires › Hub › Lock Washer

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0010	A	Bearing lock washer	\$1.21	1	\$1.21

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Stainless (per kg)		0.03 kg						1	0.07	0.07

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Waterjet 4-at-a-time	0.25		1	1.30	0.32
Waterjet Cut	internal external profile	31.2		1	0.01	0.79
Sheet metal stamping	Conical bend	1		1	0.03	0.03

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Wheels, Wheel Bearings & Tires › Hub › Drive Pin

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0013	A	Stainless pin pressed into hub to drive wheel	\$0.68	4	\$2.72

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Titanium (per kg)	Precision ground OD bar	0.015 kg						1	0.33	0.33

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Lathe	0.25		1	1.30	0.32
Machining	Drill, part, chamfer	0.04		1	0.04	0.03

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Wheels, Wheel Bearings & Tires › Hub › Wheelspeed Pickup

P/N Base	Suffix	Details	Cost	Qty	Total
SUC19-0001	A		\$11.85	1	\$11.85

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (by Dimensions)	3" round stock				7 in^2	2.5 in	0.284 lb/in^3	1	5.07	5.07

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Machining Setup, Install and remove	Into Mill	0.25		1	1.30	0.32
Machining	Bore hole cut profile	3	Material - Steel	3	0.04	5.90
Machining Setup, Change	Into lathe	0.25		1	0.65	0.16
Machining	Part off pickup	10		1	0.04	0.40

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Wheels, Wheel Bearings & Tires › Hub › Wheel Nut Spring Clip

P/N Base	Suffix	Details	Cost	Qty	Total
			\$6.77	1	\$6.77

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Steel, Mild (per kg)		0.007 kg						1	0.02	0.02

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Tube bends	Bend wire to spring into lock	3	Material - Steel	3	0.75	6.75

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Wheels, Wheel Bearings & Tires › Wheel and Tire

P/N Base	Suffix	Details	Cost	Qty	Total
SUA20-0002	A	10" OZ magnesium wheel set with Hoosier tires. Center-lock	\$239.76	4	\$959.04

Material	Use	Size 1	Size 2	Area Name	Area	Length	Density	Qty	Unit Cost	Subtotal
Wheel, 10", 1 Piece OZ, Magnesium								1	150.00	150.00
Tire, Hoosier, R25B, 10"-18.0 x 7.5								1	85.00	85.00
Valve Stem (and Tire Inflation)								1	1.00	1.00

Process	Use	Qty	Multiplier	Mult. Val	Unit Cost	Subtotal
Assemble, 1 kg, Line-on-Line	Install valve stems	1		1	0.13	0.13
Assemble, 10 kg, Interference	Mount tire to wheel	1		1	1.88	1.88
Assemble, 10 kg, Line-on-Line	Mount wheels to hubs	1		1	1.25	1.25
Power Tool > 25.4 mm	Fasten wheel nut	1		1	0.50	0.50

Fastener	Use	Size 1	Size 2	Qty	Unit Cost	Subtotal
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Tooling	Use	Qty	PVF	Frac. Incl.	Unit Cost	Subtotal
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Wheels System Drawings

