

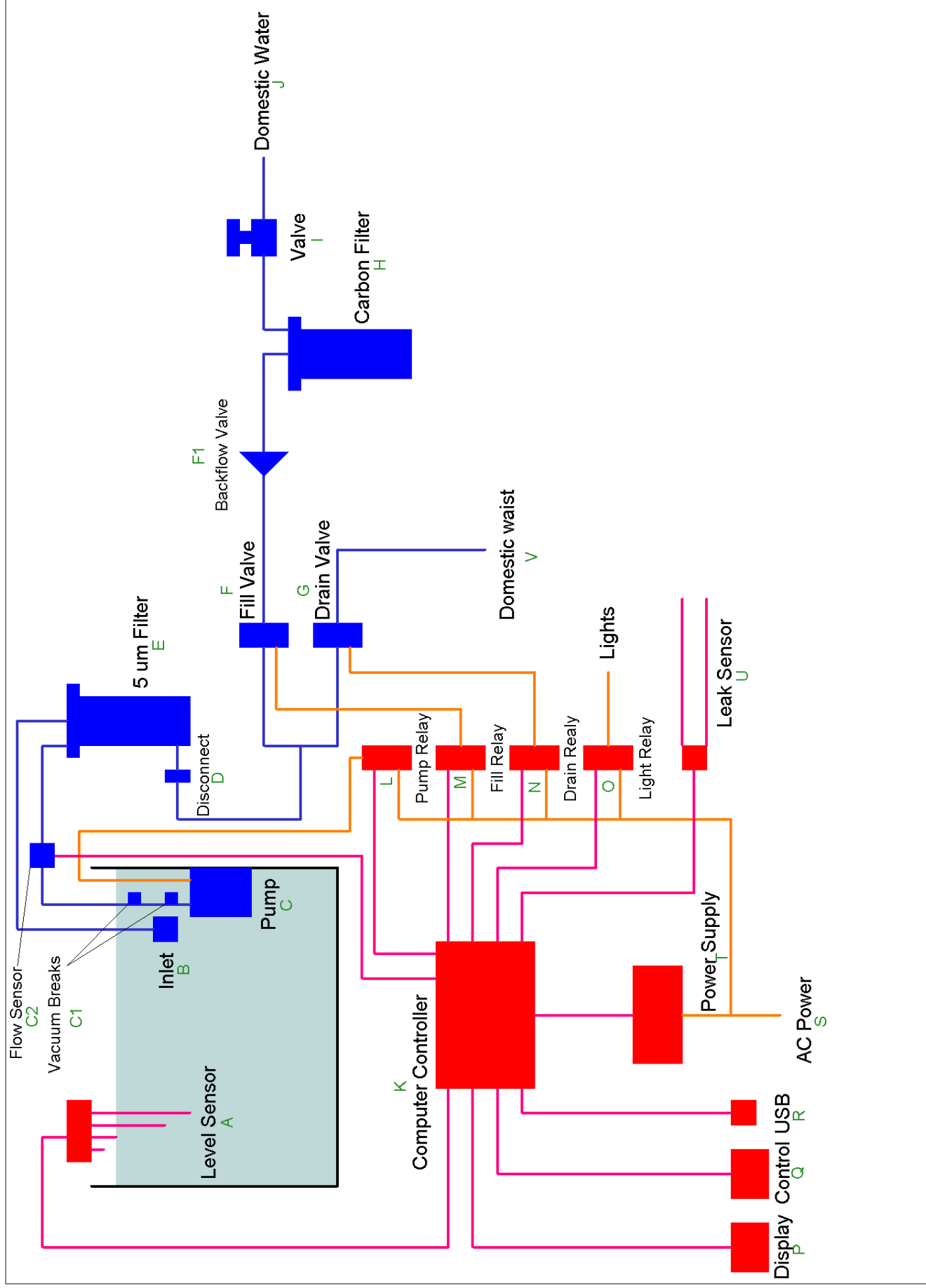
# Fully Automated Fish Tank System

April 10, 2006

Terry Fritz

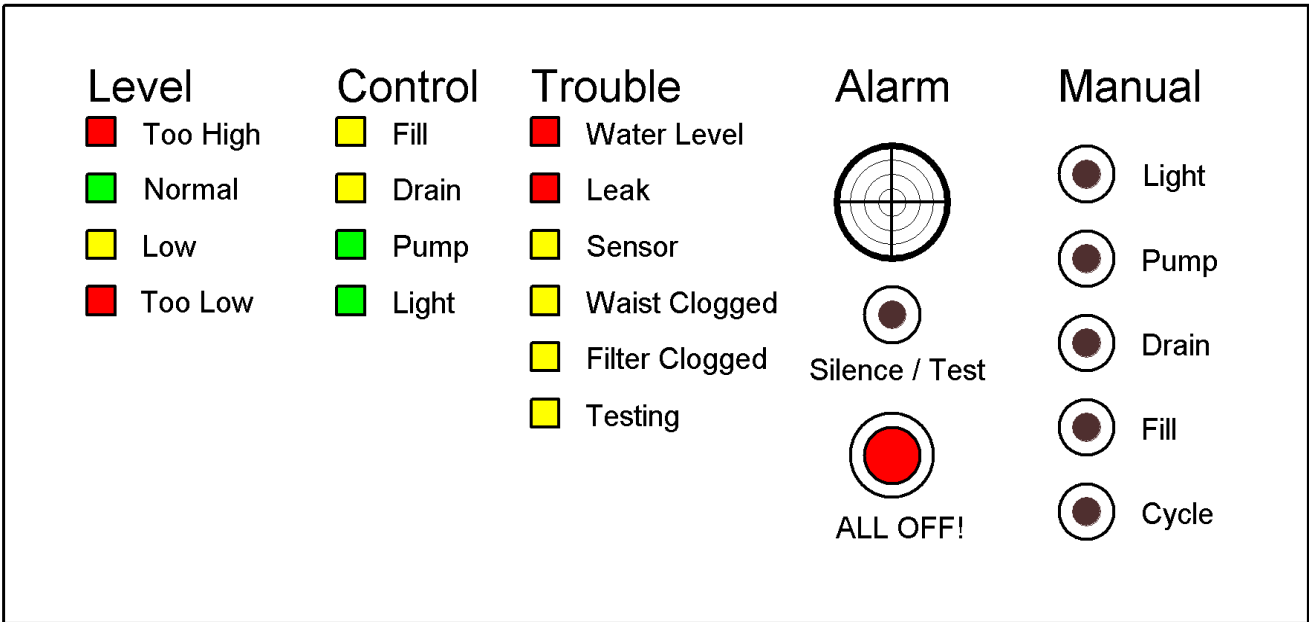
It would be nice never (vary rarely) having to do any maintenance on an aquarium. With a small microprocessor, electric valves, pumps, sensors, etc., it should be possible to do the following:

1. Automatic water changes every day.
2. Automatic back flushing of debris from filter elements.
3. Solid wastes could be automatically collected and discarded with a "glass bottom" style aquarium.
4. The input water filter could last up to 10,000 gallons (rated at >20,000 gallons). At a 10 gallon/day change rate, it would last about three years. The spun filter will last longer since solid wastes are purged from it and possibly the entire tank. It may last months with solid debris removal and daily 25% water changes...
5. The computer system could easily control lights too with just another relay.
6. The computer system would monitor and control fault conditions and sound a level specific warning. It would also monitor the system and detect failing components.



- A. Four electrode water level sensor. Made from stainless steel or titanium thin rod. Buffered with Darlington transistors to 5V digital levels.
- B. Inlet filter with activated carbon. Easy to twist off and replace carbon.
- C. Small ~5W submersible fountain pump.
- C1. Redundant vacuum breaks to prevent drainback.
- C2. Flow Sensor (0.5 GPM).
- D. Disconnect so filter body can be removed. This port is drilled and threaded into the base of the filter body to allow back flushing of collected debris on the dirty side of the filter.
- E. Common 10 inch filter body (preferably clear).
- F - G. Fill and drain solenoid valves as used on Maytag and many other clothes washers. The drain valve should have the screen removed.
- F1. Anti-Backflow valve to prevent water supply contamination.
- H. 0.5um carbon 10 inch drinking water filter with 0.6 GPM flow.
- I. Main water shutoff valve.
- J. Domestic water supply line.
- K. Computer controller probably using the Basic Stamp BS2p-40. Might need real time clock IC.
- L - O. Low level 5V to 120VAC control relays.
- P. Led display and sonolert panel lights. Could also have LCD display.
- Q. Control switches.
- R. Computer programming or communications port.

- S. AC line power. Fused and note water hazard area...
- T. Battery backup 120VAC to ~7VDC power supply to run electronics.
- U. String water sensor loop to detect water leak.
- V. Domestic drain.



Control Panel with LED indicator lights, switches, and alarm system.



Present undersink style carbon drinking water filter.



Present 5um spun aquarium filter



Clear style "whole house" 10 inch water filter body.

Water filter cartridge specifications.

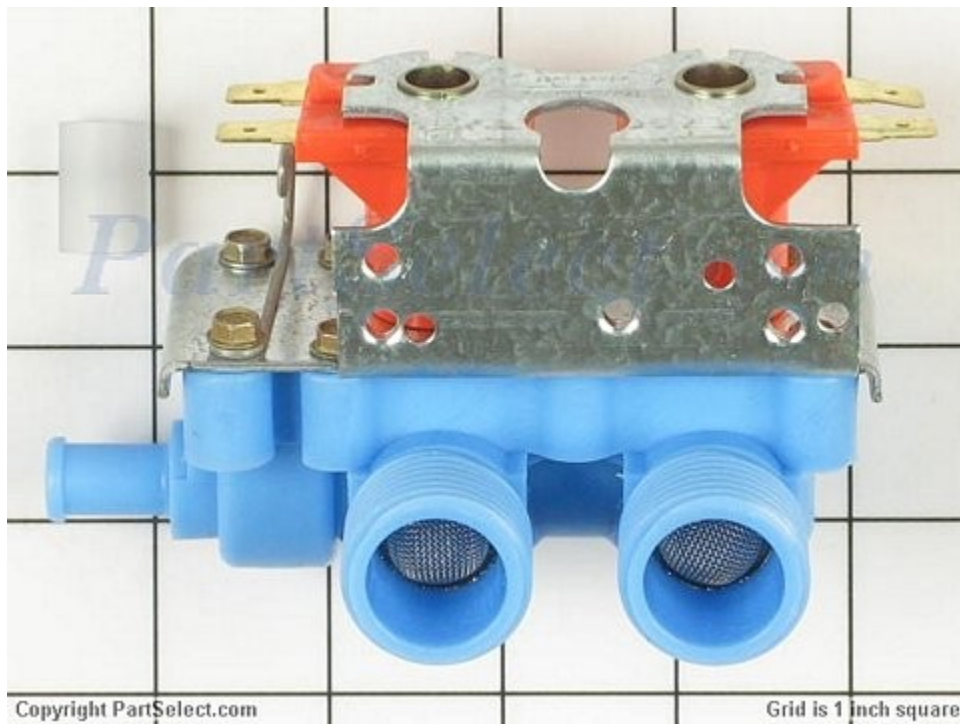
[http://www.waterfilters.net/PDF/Sediment\\_Filters/P\\_Filter\\_Series.pdf](http://www.waterfilters.net/PDF/Sediment_Filters/P_Filter_Series.pdf)

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Present pump and inlet filter system.





Maytag style clothes washer dual solenoid electric water valve

Relays:

[http://www.parallax.com/detail.asp?product\\_id=400-00010](http://www.parallax.com/detail.asp?product_id=400-00010)

Flow Sensors:

<http://www.digikey.com/scripts/DkSearch/dksus.dll?Detail?Ref=472992&Row=126475&Site=US>

<http://www.digikey.com/scripts/DkSearch/dksus.dll?Criteria?Ref=391&Site=US&Cat=34538252>

Item / Function	Failure Mode	Cause(s) / Mechanism(s) of Failure	Effect(s) of Failure	End Result(s) of Failure	S e r v i c e	D e t e r m i n e d	R e p a r t	C o d e	Current Design Controls	C o d e	Recommended Actions	C o d e
A. Level Sensor	Wrong Location (in tank) Wrong Location (out tank) Erroneous Reading Intermittent Reading	Out Of Position Out Of Position Any Reason Bubbles	Sensor Level Too High Sensor Level Too Low Sensor Makes No Sense Sensor Gives Random Readings	Sensor Level Too High Sensor Level Too Low Sensor Makes No Sense Wrong Action (oscillation)	3 3 1 3 3 1 3 2 1 5 2 2	9 9 6 20		On High Level - Close Fill, Open Drain, fill slower than drain On Low Level - Close Valves, turn off pump On Bad Sensor - Close Valves, turn off pump STOP Always check sensor multiple times	<div></div>			
B. Inlet	Clogged Not In Tank	Any Reason Out Of Position	No Filter Flow Flood	No Filter Flow Flood	2 3 3 5 2 4	18 40		Visual Check - Not a big problem which will be found in time Visual Check - Leak Sensor - Low Level Action	<div></div> <div></div>	Flow Sensor/Indicator Tie lines together		
C. Pump	Not Pumping Tube Disconnected  Not In Tank	Any Reason Out Of Position  Out Of Position	No Filter Flow Drain May Not Work No Filter Flow Drain May Not Work Flood No Filter Flow Drain May Not Work Flood	No Filter Flow No Filter Flow No Filter Flow Flood No Filter Flow Flood	3 2 1 3 2 1 3 2 2 3 2 1 5 2 4 3 2 2 3 2 1 5 1 1	6 6 12 6 40 12 6 5		Visual Check - Not a big problem which will be found in time Visual Check - Not a big problem which will be found in time Visual Check - Not a big problem which will be found in time Visual Check - Not a big problem which will be found in time On Low Level - Close Valves, turn off pump Visual Check - Not a big problem which will be found in time Visual Check - Not a big problem which will be found in time Visual Check - Leak Sensor - Low Level Action	<div></div> <div></div> <div></div> <div></div>	Flow Sensor/Indicator Flow Sensor/Indicator Tie lines together Flow Sensor/Indicator		
C1. Vacuum Break	Clogged Leaks (too big)	Any Reason Holes too big	Tank Drain Poor Filter Flow	Dead Fish	5 1 3 2 1 3	15 6		Redundant Vacuum Breaks - Low Level Action Visual Check	<div></div> <div></div>			
C2. Flow Sensor	Clogged Leaks Wrong Reading (flow when noflow) Wrong Reading (noflow when flow)	Any Reason Any Reason Any Reason Any Reason	No Filter Flow Flood Flow when no flow No flow when flow	No Filter Flow Flood Might trigger wrong error Might trigger wrong error	2 3 3 4 2 3 2 3 2 3	18 24 3 3		Visual Check - Not a big problem which will be found in time Redundant Vacuum Breaks - Low Level Action Easily Testable Easily Testable	<div></div> <div></div> <div></div> <div></div>	Flow Sensor/Indicator Position above water level		
D. Disconnect	Comes Loose Clogged Leaks	Any Reason Any Reason Any Reason	Flood No Drain No Fill Flood	Flood	5 1 3 3 1 2 3 1 2 4 2 3	15 6 6 24		Redundant Vacuum Breaks - Low Level Action Drain timeout Error Fill timeout Error Redundant Vacuum Breaks - Low Level Action	<div></div> <div></div> <div></div> <div></div>	Position above water level Position above water level Position above water level		
E. 5um Filter	Clogged Leaks	Any Reason Any Reason	No Filter Flow Flood	No Filter Flow Flood	3 4 2 4 2 2	24 16		Visual Check - Not a big problem which will be found in time Redundant Vacuum Breaks - Low Level Action	<div></div> <div></div>	Flow Sensor/Indicator Position above water level		
F. Fill Valve	Stuck Open Stuck Closed (clogged) Leaks	Any Reason Any Reason Any Reason	Flood No Fill Flood	Flood No Fill Flood	5 2 4 3 2 2 4 2 2	40 12 16		On High Level - Close Fill, Open Drain, fill slower than drain Fill timeout Error Redundant Vacuum Breaks - Low Level Action	<div></div> <div></div> <div></div>	Position above water level		
F1. Backflow Valve	Stuck Open Stuck Closed (clogged) Leaks	Any Reason Any Reason Any Reason	Water Contamination No Fill Flood	Water Contamination No Fill Flood	4 1 4 3 1 2 4 1 2	16 6 8		Unlikely Fill timeout Error Leak Sensor	<div></div> <div></div> <div></div>	Position above water level		
G. Drain valve	Stuck Open Stuck Closed (clogged) Leaks	Any Reason Any Reason Any Reason	Dry Tank No Drain Flood	Dead Fish No Drain Flood	3 2 3 3 2 3 4 2 2	18 18 16		Redundant Vacuum Breaks - Low Level Action Drain timeout Error Redundant Vacuum Breaks - Low Level Action	<div></div> <div></div> <div></div>	Position above water level		
H. Carbon Filter	Clogged Leaks Old (Carbon Dead)	Any Reason Any Reason Left in too long	No Fill Flood Water Contamination	No Fill Flood Water Contamination	3 1 1 4 2 2 4 2 1	3 16 8		Fill timeout Error Leak Sensor Change every year	<div></div> <div></div> <div></div>	Slow leak - Leak Sensor		
I. Input Valve	Stuck Open Stuck Closed Leaks	Any Reason Any Reason Any Reason	Can't Shut Off Water (there) No Fill Flood	Can't Shut Off Water (there) No Fill Flood	1 1 1 3 1 1 4 2 2	1 3 16		Unlikely and easy to spot with no damage Unlikely and easy to spot with no damage Leak Sensor	<div></div> <div></div> <div></div>	Slow leak - Leak Sensor		
J. Domestic Water	Loss Of Pressure	Any Reason	No Fill Back Flow	No Fill Back Flow	3 3 2 4 2 4	18 32		Fill timeout Error Anti-backflow Valve	<div></div>			
K. Computer Controller	Shorted Control Line Open Control Line Loss Of DC Power	Any Reason Any Reason Any Reason	Driver Damage No Function System Off	Driver Damage No Function System Off	4 0 3 3 2 2 3 2 3	0 12 18		Proper design Unlikely and easy to spot with no damage Fails in place	<div></div> <div></div> <div></div>			
L. Pump Relay	Stuck Short Stuck Open	Any Reason Any Reason	Pump Always On Pump Always Off	Pump Always On Pump Always Off	2 1 2 3 1 2	4 6		Unlikely and easy to spot with no damage Unlikely and easy to spot with no damage	<div></div>	Flow Sensor/Indicator		
M. Fill Relay	Stuck Short Stuck Open	Any Reason Any Reason	Fill Relay Always On Fill Relay Always Off	System Overflow System Low Level	5 1 4 3 1 2	20 6		On High Level - Close Fill, Open Drain, fill slower than drain Fill timeout Error	<div></div>			
N. Drain Relay	Stuck Short Stuck Open	Any Reason Any Reason	Drain Relay Always On Drain Relay Always Off	Dead Fish System won't drain	3 1 3 3 1 3	9 9		Redundant Vacuum Breaks - Low Level Action Drain timeout Error	<div></div>			
O. Light Relay	Stuck Short Stuck Open	Any Reason Any Reason	Lights Always On Lights Always Off	Lights Always On Lights Always Off	1 1 1 1 1 1	1 1		Unlikely and easy to spot with no damage Unlikely and easy to spot with no damage	<div></div>			

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
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22297	PVC Check Valves EPDM Seals 3/8" OD Tube-J. Guest, 2 3/4" x 1" <small>Qty 12: 5% off; Qty 24: 10% off; Qty 72: 15% off;</small>	<input type="text" value="1"/>	\$7.45	N/A	\$7.45	\$7.45	
63009	Female GHT And Male NPT Nylon Fitting <small>Qty 50: 5% off; Qty 100: 10% off; Qty 300: 15% off;</small>	<input type="text" value="1"/>	\$1.11	N/A	\$1.11	\$1.11	
27220	Schedule 80; Gray Coupling PVC Threaded <small>Qty 12: 5% off; Qty 24: 10% off; Qty 72: 15% off;</small>	<input type="text" value="1"/>	\$1.76	N/A	\$1.76	\$1.76	
63010	Female GHT And Male NPT Nylon Fitting <small>Qty 50: 5% off; Qty 100: 10% off; Qty 300: 15% off;</small>	<input type="text" value="1"/>	\$1.15	N/A	\$1.15	\$1.15	
58302	Speedfit Polypropylene Shut-Off Valve-Speedfit To Male NPT Adaptor <small>Qty 25: 5% off; Qty 50: 10% off; Qty 150: 15% off;</small>	<input type="text" value="1"/>	\$5.48	N/A	\$5.48	\$5.48	
58234	Tube OD 3/8" John Super Speedfit® Locking Clip <small>Qty 25: 5% off; Qty 50: 10% off; Qty 150: 15% off;</small>	<input type="text" value="20"/>	\$0.16	N/A	\$0.16	\$3.20	
59036	5/8" to 23/32" Holding Range T-Clip <small>Qty 36: 5% off; Qty 72: 10% off; Qty 216: 15% off;</small>	<input type="text" value="3"/>	\$0.75	N/A	\$0.75	\$2.25	
62052	Black High Density Polyethylene Elbow Fitting <small>Qty 50: 5% off; Qty 100: 10% off; Qty 300: 15% off;</small>	<input type="text" value="2"/>	\$0.41	N/A	\$0.41	\$0.82	
62072	Black High Density Polyethylene Connector Fitting <small>Qty 50: 5% off; Qty 100: 10% off; Qty 300: 15% off;</small>	<input type="text" value="2"/>	\$0.21	N/A	\$0.21	\$0.42	
60669	1/2" Polysulfone Male Pipe Thread Body NPT Straight Thru - 2.72 Lgt - Coupling Body <small>Qty 20: 5% off; Qty 40: 10% off; Qty 120: 15% off;</small>	<input type="text" value="1"/>	\$9.82	N/A	\$9.82	\$9.82	
60669	1/2" Polysulfone Male Pipe Thread Body NPT Straight Thru - 2.72 Lgt - Coupling Body <small>Qty 20: 5% off; Qty 40: 10% off; Qty 120: 15% off;</small>	<input type="text" value="1"/>	\$9.82	N/A	\$9.82	\$9.82	
60801	1/2" Polysulfone Hose Barb Straight Thru - 1.86 Lgt - Coupling Insert <small>Qty 20: 5% off; Qty 40: 10% off; Qty 120: 15% off;</small>	<input type="text" value="1"/>	\$4.92	N/A	\$4.92	\$4.92	
60800	3/8" Polysulfone Hose Barb Straight Thru - 1.86 Lgt - Coupling Insert <small>Qty 20: 5% off; Qty 40: 10% off; Qty 120: 15% off;</small>	<input type="text" value="1"/>	\$4.92	N/A	\$4.92	\$4.92	
61142	Nylon Tube And Hose Fitting <small>Qty 50: 5% off; Qty 100: 10% off; Qty 300: 15% off;</small>	<input type="text" value="5"/>	\$0.35	N/A	\$0.35	\$1.75	
Enter your zip code for an Internet only shipping cost estimate: <input type="text"/>				<a href="#">Update</a>	Order Sub-Total:	\$54.87	<a href="#">Remove all</a>

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