

Designs and Improvements in Closed Systems

Report to:

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Summary: The development of closed mixing and handling systems for agricultural pesticides has been addressed by commercial activities toward design and marketing of multi-function systems, often utilizing custom-made, unique components. Particularly, the use of container probes, intermediate mix tanks and other designs are somewhat common for commercial and high volume applicators. This report focuses on design and availability of systems for individual growers and other lower-volume users of pesticides. A number of designs have been devised for use with industry standard (e.g., 2.5 gallon) liquid containers.

Meetings were conducted with a number of California manufacturers and marketers of closed systems. It was identified that a key component for closed systems what would be suitable for individual growers or lower volume users is the plumbing interface to a standard disposable pesticide container (2.5 gal and similar sizes). Ideally, the plumbing interface would allow a dry break connection to the container and also allow removal of any desired volume of material from the container, in contrast to “punch and drain” type systems in which the integrity of the original pesticide container is destroyed and all contents are removed. This key component is currently available commercially and at reasonable cost. This allows manufacturers to easily fabricate and market simple closed systems. Additionally, it allows individual users to, if they desire, construct their own closed systems. While the container-to-plumbing interface component does require compromises, such as purchase of individual, additional enclosures for partially used containers, it does provide significant benefits. Using this component, a number of potential grower-built system designs were developed and are described in this report.

Example Closed Systems: For use with standard liquid pesticide containers (e.g. 2.5 gal “jugs”), the standard interface consists of a two-part assembly (Figure 1 and Appendix 1) in which one part connects to the 63 mm pesticide container openings and terminates with a dry break. The mating part is a dry break connection that terminates in a standard NPT pipe thread, allowing standard pipe parts to be used for any downstream connections. The vendor of the component is Banjo Corp., an established and well-known manufacturer of agricultural spraying system components.

Cost of the component is modest with a list price of the entire (two part) assembly being \$293 (2013 price). The parts are commonly available in California with a typical discounted price of apprx. \$250. Due to the design of the component, the two parts are available separately and can be purchased individually. This would allow a user to have a number of dry break sealing connectors to be kept on hand so that partially used containers could be stored, sealed, and readily connected to the closed system when needed.



Figure 1. Closed system mating component for standard 63 mm liquid container fitting. (Banjo Corp.)

I. Basic System: The most simple and basic closed loading system (Figure 2) could be built to allow the contents of an entire pesticide container to be loaded directly into the sprayer. This system would be used to transfer an entire container of material into a sprayer tank and then rinse the container. In use, the sprayer would be filled to approx. 80% of the application volume of water before active ingredient was added. A 2" NPT bulkhead fitting would be installed on the sprayer or mix tank and the closed system connector plumbed into it. After emptying the container, a standard garden hose would be attached to the container and used to rinse the container with the rinsate going into the spray tank.

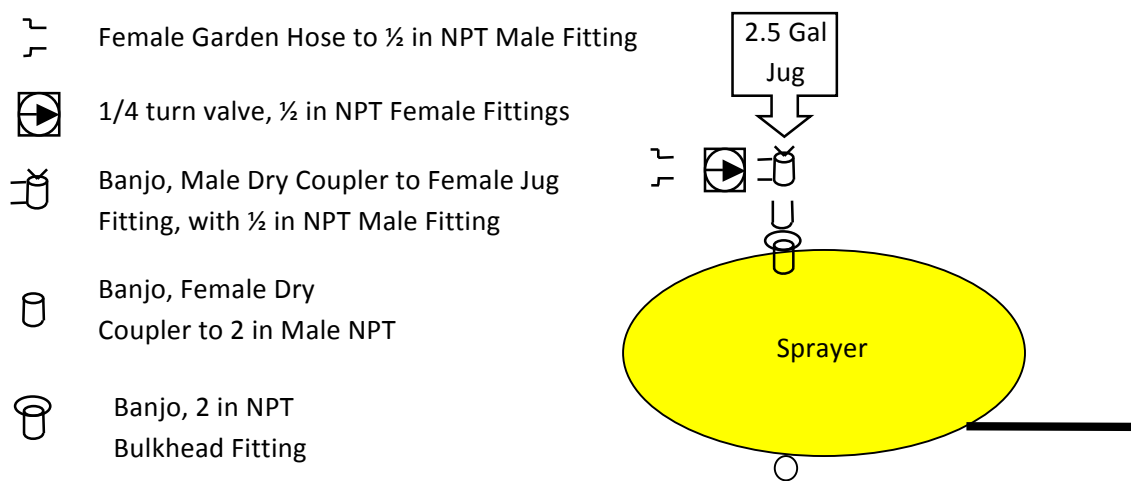


Figure 2. Basic closed system for loading and rinsing an entire container.

Parts list:

Part Number	Description	Quantity	Price (\$)	Total (\$)
70815T45	McMaster-Carr, Bras garden hose-to-pipe swivel adapter 3/4" NPTF Garden Hose to 1/2" NPTM	1	7.63	7.63
47865K23	MC Master, Brass Ball Valve 1/2" NPTF	1	9.84	9.84
CST200AR	Banjo, Closed Mix Adapter	1	110.32	110.32
CSTS200D	Banjo, Adapter W/2' Male NPT	1	183.86	183.86
TF200	Banjo, 2" Poly Bulkhead Tank Fitting	1	21.97	21.97

Total 333.62

II. System with Measurement and Partial Container Use Capability: An expansion of the basic system is shown in Figure 3. This is a sprayer-mounted system with measuring capability. The operation is similar to that of the basic system except a valve allows any desired quantity of material to be withdrawn from the original container and measured into a measurement tank. The partially used container can be removed and stored. When empty the container can be rinsed. The measurement tank can be rinsed separately. When using this system for measuring active ingredient, approximately 4 oz (100 mL) of active ingredient is captured between the 1/4 turn ball valve (*3) and the bottom of the Banjo Female Dry Coupler and the male NPT Fitting. This volume needs to be included in final mixing measurements if the container is going to be removed and a different container added for additional mixing.

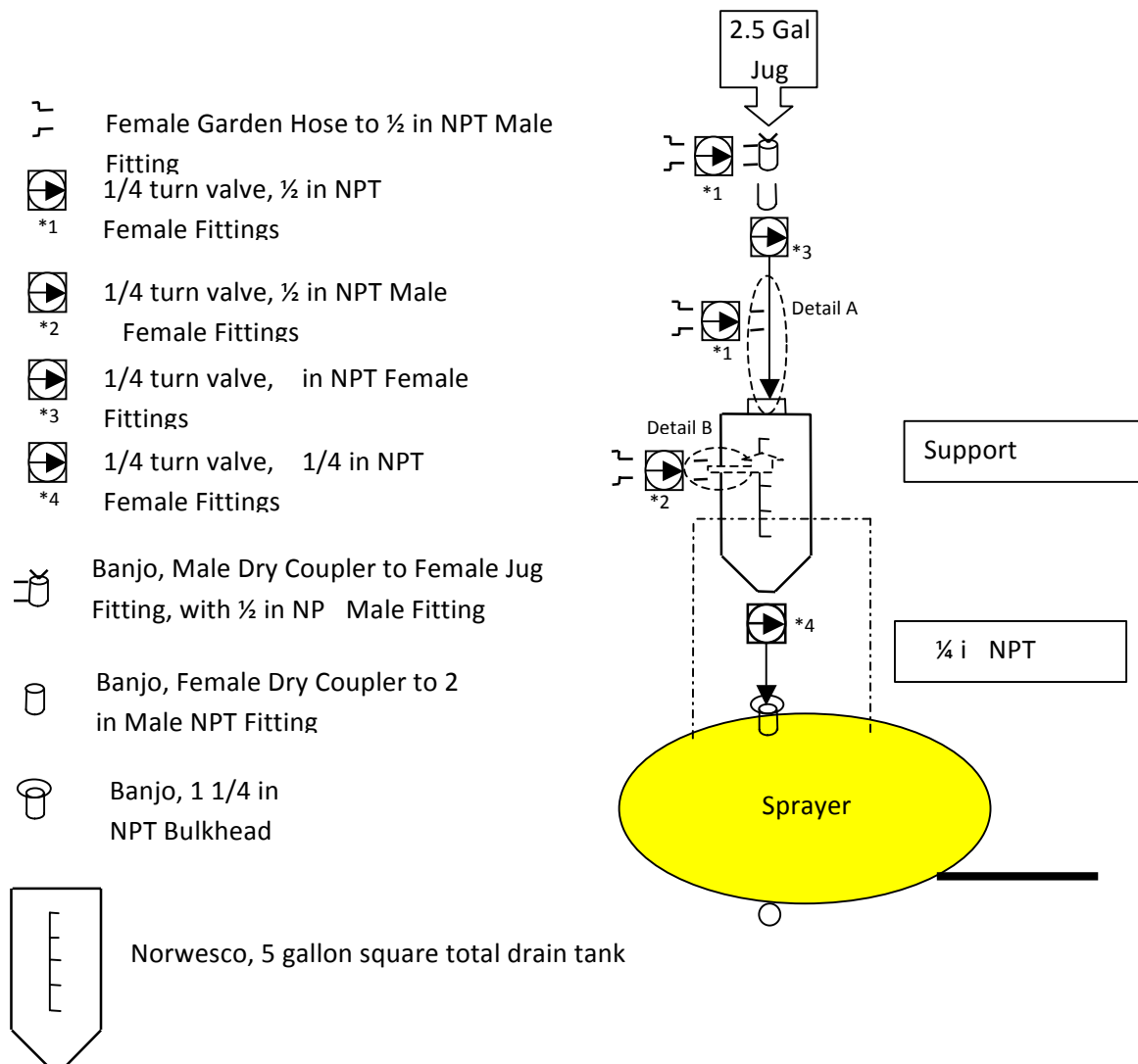
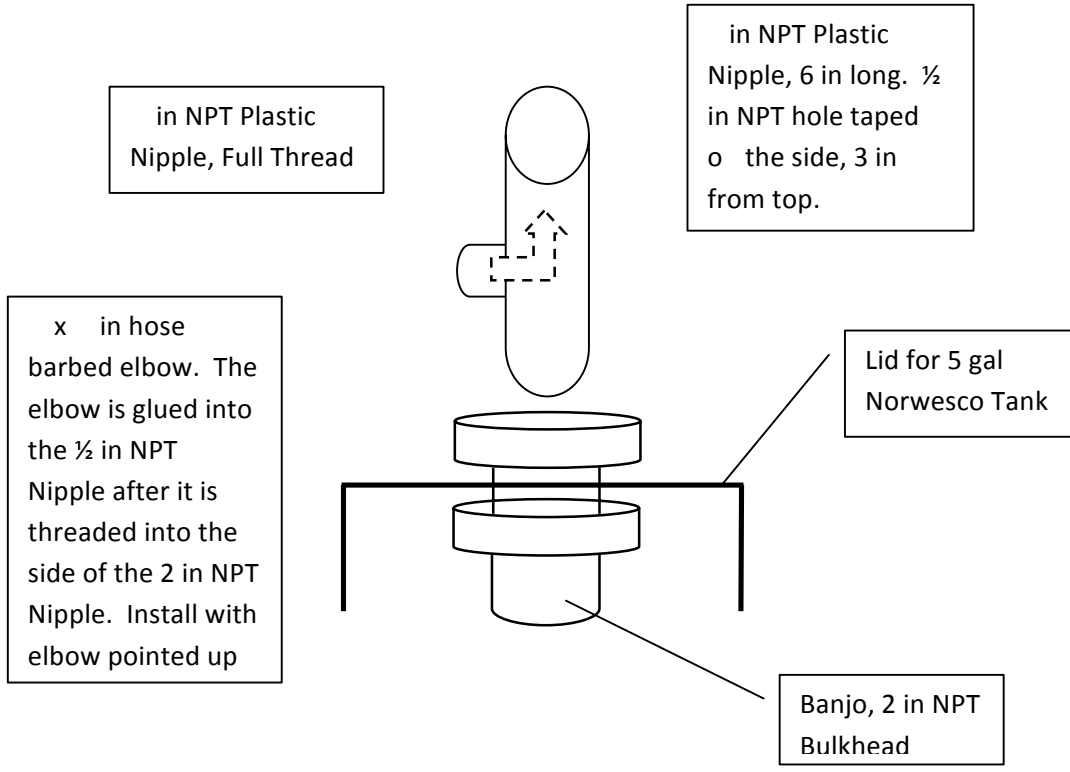


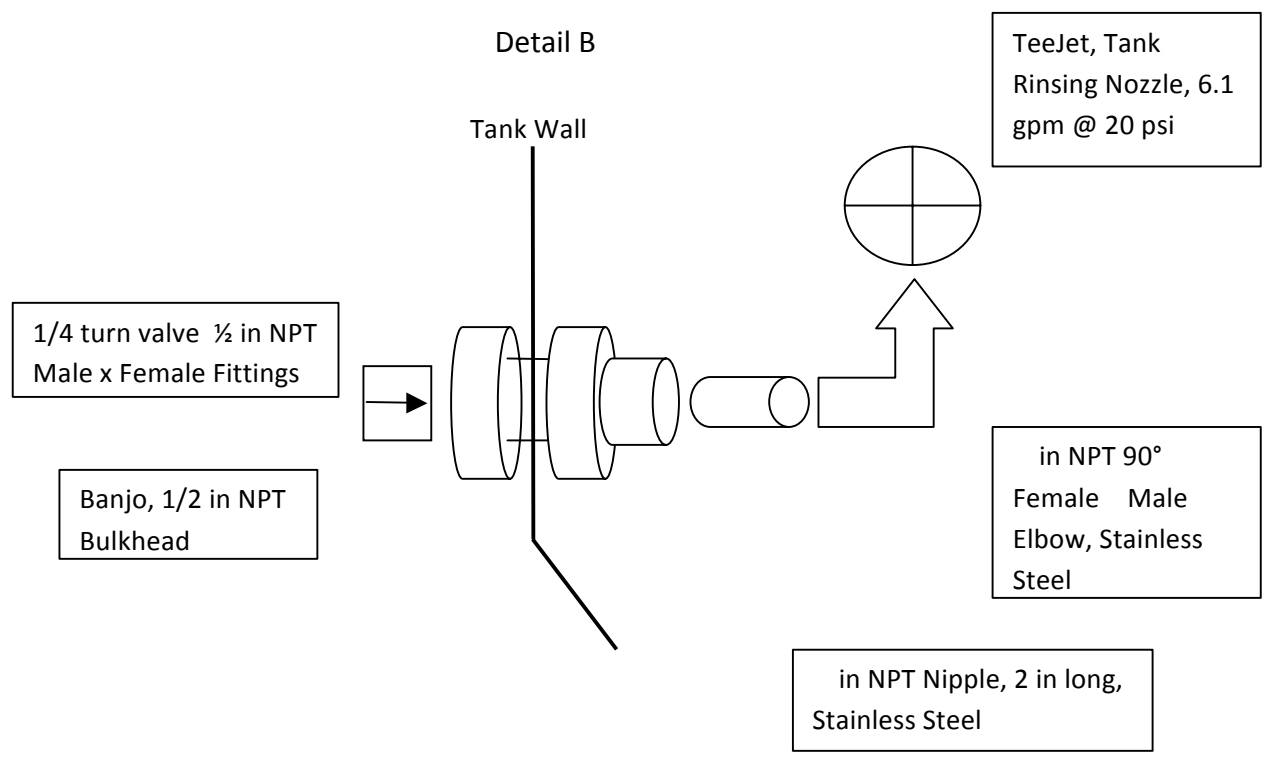
Figure 3. Mixing, measurement, loading and rinsing system.

Drawing Details:

Detail A



Detail B



Parts list:

Part Number	Description	Quantity	Price (\$)	Total (\$)
70815T45	MC Master, Brass Garden Hose-to-Pipe Swivel Adapter 3/4 in Female Garden Hose, 1/2 in NPT Male Connections	3	7.63	22.89
47865K23	MC Master, Brass Ball Valve 1/2 in NPT Female Connections	2	9.84	19.68
47865K43	MC Master, Brass Ball Valve 1/2 in NPT Female x Male Connections	1	11.18	11.18
CST200AR	Banjo, Male Dry Coupler to Female Jug Fitting, with 1/2 in NPT Male Fitting	1	110.32	110.32
CSTS200D	Banjo, Female Dry Coupler to 2 in Male NPT	1	183.86	183.86
V200	Banjo, 2" NPT Ball Valve	1	56.24	56.24
4882K69	MC Master, Thick-Wall (Schedule 80) Dark Gray PVC Threaded Pipe Nipple, 1/2 in NPT, 2 in Long	1	5.00	5.00
46825K21	MC Master, Thick-Wall (Schedule 80) Black Polypropylene Threaded Pipe Nipple, 1/2 in NPT	1	1.25	1.25
NYEL12HB	TeeJet, 1/2 x 1/2 barbed elbow	1	0.60	0.60
TF200	Banjo, 2" Poly Bulkhead Tank Fitting	1	21.97	21.97
TD-5	Norwesco, 5 gallon square total drain tank with a 1/4" poly spinweld fitting and 8" lid.	1	40.28	40.28
TF050	Banjo, 1/2 in NPT Poly Bulkhead Tank Fitting	1	10.31	10.31
VSM-1/2-44	TeeJet, Tank Rinsing Nozzle, 6.1 gpm @ 2 psi	1	43.00	43.00
4464K38	MC Master, 1/2" NPT 90° Female x Male Elbow, Stainless Steel	1	10.62	10.62
4830K173	MC Master, 1/2" NPT Pipe Nipple, 2" Length, Stainless Steel	1	3.00	3.00
V125FP	Banjo, 1 1/4" NPT Ball Valve	1	56.24	56.24
46825K71	MC Master, Thick-Wall Black Polypro Threaded Pipe Nipple 1/2 NPT, Hex Nipple	1	3.91	3.91
TF125	Banjo, 1 1/4 in NPT Poly Bulkhead Tank Fitting	1	14.28	14.28

Total 614.63

III. Pallet-mounted, powered induction and closed mixing system. The system described in Option II, the measurement and mixing system, can be expanded (Figure 4) to include an inductor and rinse water system for direct loading into a sprayer. In this system, operation is similar to Option II except a water tank and engine drive pump is used for mixing and rinsing. An inductor is used to mix chemical and load via hoses to the sprayer. Note that approximately 50% of the estimated cost is due to the engine driven pump.

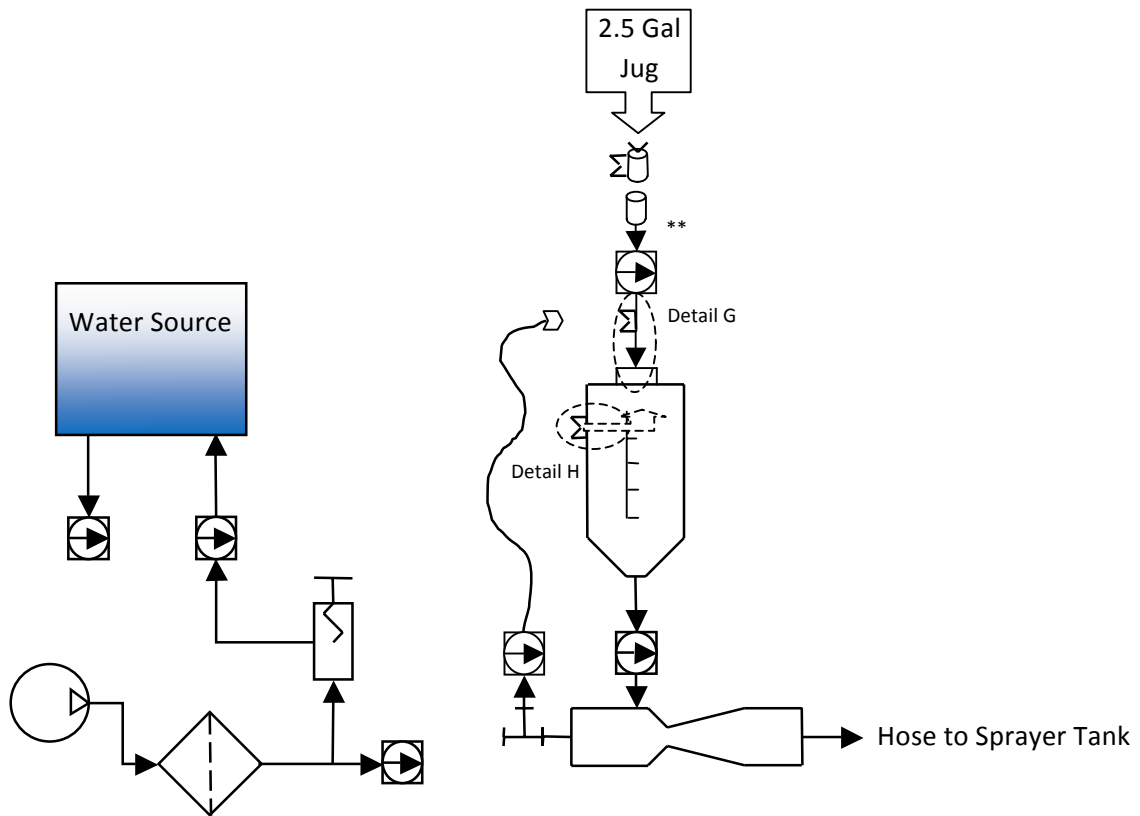
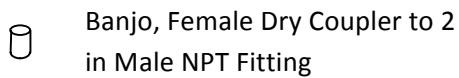
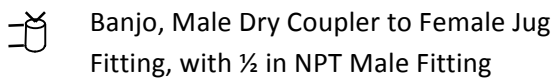
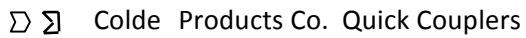
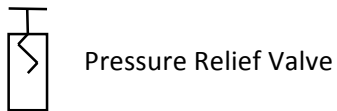
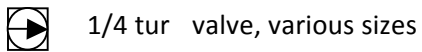
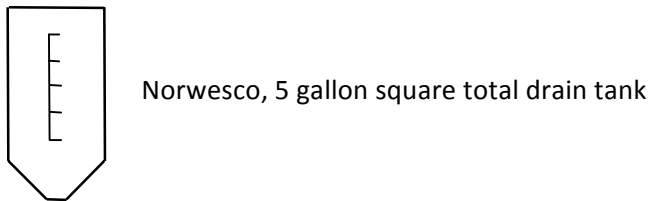
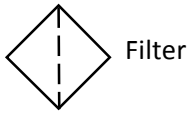


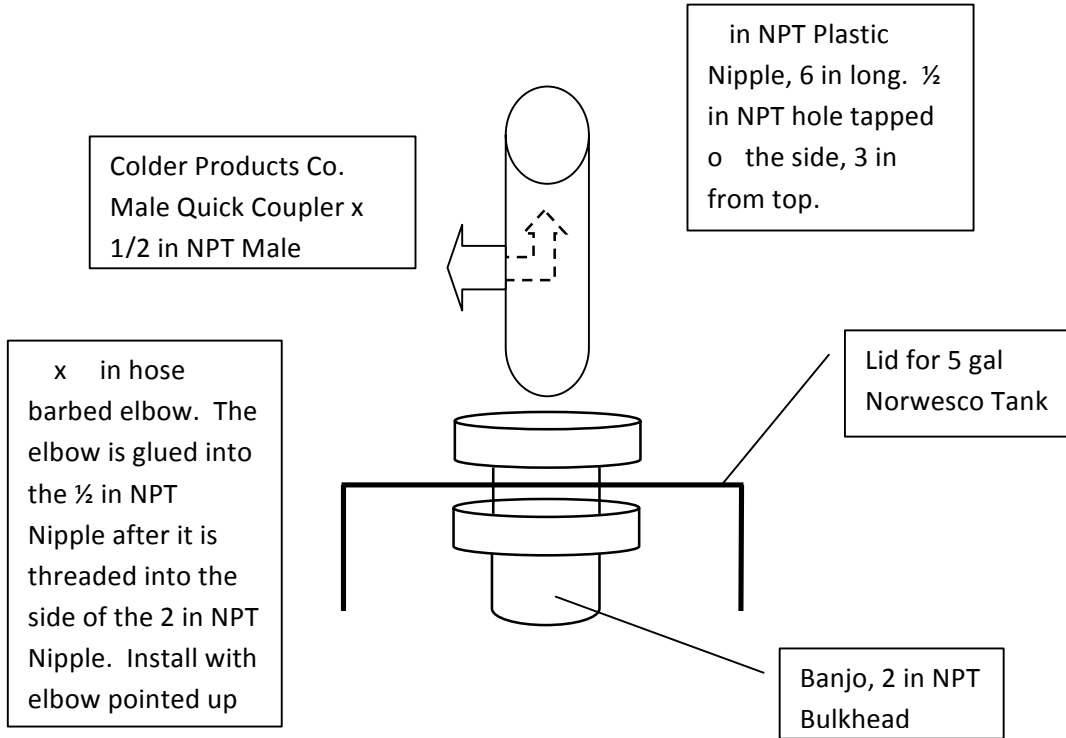
Figure 4. Induction and mixing system using a closed container coupling.

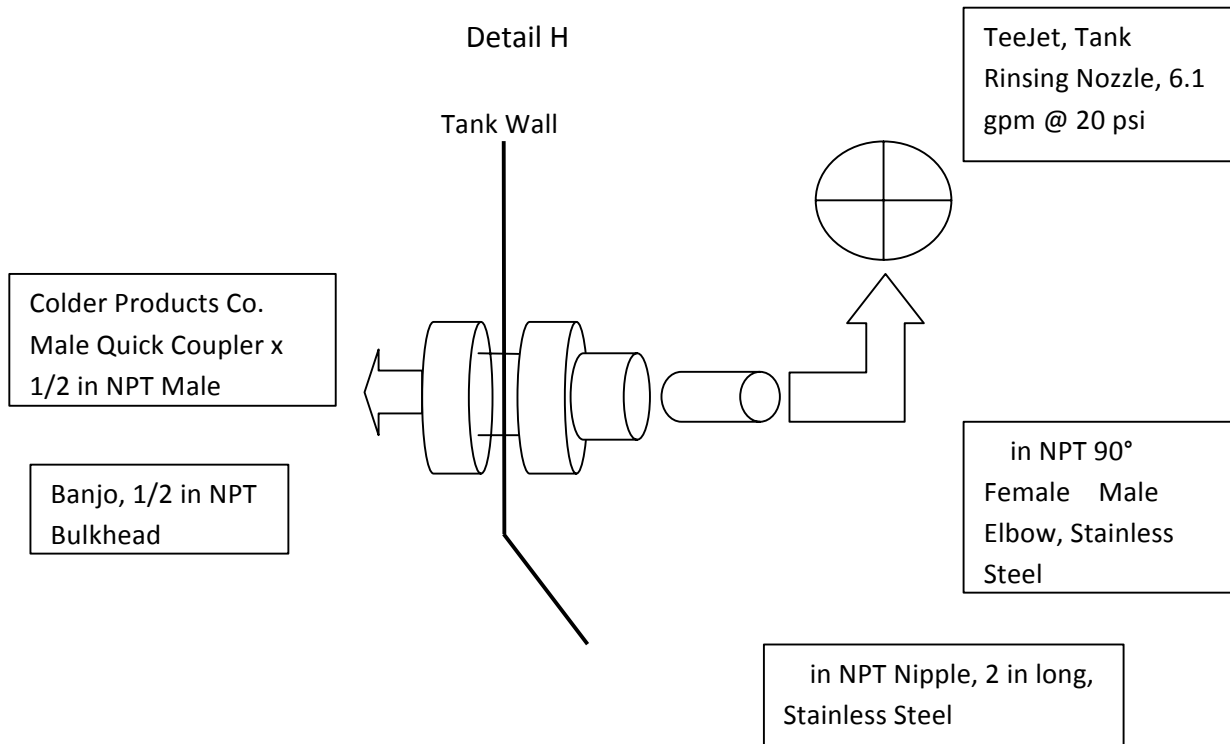
Symbol Key:



Drawing Details:

Detail G





Parts list:

Part Number	Description	Quantity	Price (\$)	Total (\$)
1537	Schaben, Honda 5.5 hp gas engine with 1/2 x 1/4 in NPT Hypro Centrifugal Pump	1	1058.00	1058.00
TF150	Banjo, 1 1/2 in NPT, Poly Bulkhead Tank Fitting	1	21.97	21.97
V150	Banjo, 1 1/2 in NPT Ball Valve	1	56.24	56.24
SL150-90	Banjo, 1 1/2 in NPT Poly Street Elbow	1	9.08	9.08
TF125	Banjo, 1 1/4 in NPT, Poly Bulkhead Tank Fitting	1	14.28	14.28
V125FP	Banjo, 1 1/4 in NPT Ball Valve	4	56.24	224.96
SL125-90	Banjo, 1 1/4 in NPT Poly Street Elbow	1	5.83	5.83
HB125	Banjo, 1 1/4 in NPT x 1 1/4 in Hose Barb, Poly	4	2.02	8.08
HB150	Banjo, 1 1/2 in NPT x 1 1/2 in Hose Barb, Poly	2	3.37	6.74
AA110-1-1/4	TeeJet, Brass 1/4 in NPT Pressure Relief Valve	1	267.81	267.81
TEE125	Banjo, 1 1/4 in NPT Poly Tee	1	7.29	7.29
LST125-50	Banjo, 1 1/4 in NPT T Strainer w/50 Mesh SS Screen	1	73.85	73.85
NIP125-6	Banjo, 1 1/4 in NPT x 6 in Poly Nipple	2	3.94	7.88
M220TEE	in Full Port Flanged Tee	1	13.16	13.16
MHV220A	in F Manifold Poly Venturi	1	128.34	128.34
FC220	22 Series Worm Screw Clamp	5	12.52	62.60

200G	in EPDM Coupling Gasket	5	1.06	5.30
HB075-050	Banjo, 3/4 in NPT x 1/2 in Hose Barb, Poly	1	1.33	1.33
46885K263	MC Master, 1 1/4 in NPT x 3/4 in NPT Bushing	1	2.71	2.71
0883-104	Colder Products Co. Female Quick Coupler x 1/2 in Hose Barb	1	20.00	20.00
0882-004	Colder Products Co. Male Quick Coupler x 1/2 in NPT Male	3	15.00	45.00
46885K182	MC Master 1/2 in NPT female coupling	1	3.84	3.84
CST200AR	Banjo, Male Dry Coupler to Female Jug Fitting, with in NPT Male Fitting	1	110.32	110.32
CSTS200D	Banjo, Female Dry Coupler to 2 in Male NPT	1	183.86	183.86
V200	Banjo, 2" NPT Ball Valve	1	56.24	56.24
4882K69	MC Master, Thick-Wall (Schedule 80) Dark Gray PVC Threaded Pipe Nipple, in NPT, in Long	1	5.00	5.00
NYEL12HB	TeeJet, 1/2 x 1/2 barbed elbow	1	0.60	0.60
TF200	Banjo, 2" Poly Bulkhead Tank Fitting	1	21.97	21.97
TD-5	Norwesco, 5 gallon square total drain tank with 1/4" poly spinweld fitting and 8" lid.	1	40.28	40.28
TF050	Banjo, 1/2 in NPT Poly Bulkhead Tank Fitting	1	10.31	10.31
VSM-1/2-44	TeeJet, Tank Rinsing Nozzle, 6.1 gpm @ 2 psi	1	43.00	43.00
4464K38	MC Master, 1/2" NPT 90° Female x Male Elbow, Stainless Steel	1	10.62	10.62
4830K173	MC Master, 1/2" NPT Pipe Nipple, 2" Length, Stainless Steel	1	3.00	3.00
M200125MPT	in Flange x 1/4 Male NPT	4	4.30	17.20
46825K71	MC Master, Thick-Wall Black Polypro Threaded Pipe Nipple NPT, Hex Nipple	1	3.91	3.91
TF125	Banjo, 1 1/4 in NPT Poly Bulkhead Tank Fitting	1	14.28	14.28

Total 2564.88

Appendix No. 1 – Component Description for Closed System (Banjo Corp).

Closed Transfer System

FEATURES

- Allows to safely and properly flush chemical containers.



Banjo's Closed Mix Fitting system consist of three parts, closed mix bottle adapter (CTS200AR), closed mix tank adapter (CTS200D) and a Banjo ball valve.

1. Attach Banjo ball valve to side port of CTS200AR.
2. Attach fresh water rinse source to Banjo ball valve, your CTS200AR is now properly plumbed to safely dispense and flush a chemical container.
3. Remove the cap from your chemical container without damaging the aluminum safety seal underneath.
4. Screw CT200AR onto the chemical container. Be sure that it is properly threaded and tight.
5. Tip chemical container with CT200AR over and thread CT200AR into CTS200D. This releases chemical into your mix tank.
6. Once all chemical has been dispensed into mix tank open Banjo ball valve to flush chemical container, of all chemical residue.
7. This flushing process should be repeated three times for a complete rinse.
8. Remove fitting from chemical container, fittings are reusable. Discard empty container per county specifications.

CLOSED TRANSFER SYSTEM ADAPTERS					
PART NO	DESCRIPTION	MAX PSI	PIPE SIZE	QTY	PRICE
CTS200AR	Closed Mix Bottle Adapter	40	63 mm btl	1	\$107.10
CTS200D	Tank Adapter w/2" Male NPT Threads	40	2"	1	\$178.50

