

## METERED LIQUID APPLICATOR

### Problem:

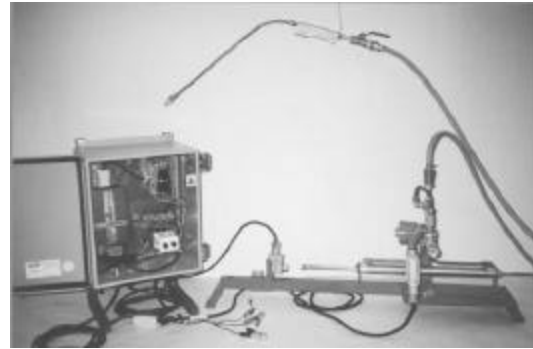
Manual application of liquids (such as growth regulators) with a spray-wand can cause worker injury as well as chemical waste and plant loss.



- Worker must squeeze and hold spray-wand trigger up to 25 times per minute.
- Highly repetitive hand closure can cause tendon inflammation in the carpal tunnel.
- Mental counts to "time" the discharge can result in inconsistent or improper amounts.
- Many spray-wands currently in use are not appropriate for long reaches, resulting in prolonged poor wrist posture.

### One Solution:

Use a semi-automated, metered liquid applicator to provide a precise dose to each plant and to eliminate repetitive hand closure.



- Eliminates virtually all of the repetitive hand squeezing motion.
- Makes application more consistent, reducing chemical waste and plant loss.
- Curved wand improves wrist posture for long reaches into center of plant beds.
- Can improve productivity.
- Can document production, if fitted with a counter.

#### Operational tips:

Trapped air in the solenoid valve, tubing, cylinder, or hose will affect the accuracy of the system. To help avoid this problem, the cylinder ports face upward, and the 4-way valve is located directly above the cylinder. A bypass valve for purging air from the hose is provided. Rough handling of the discharge hose can cause unwanted discharge; handle the hose relatively gently unless the spray wand valve is closed. For more information about this system, please visit the UC-AERC web site at <http://ag-ergo.ucdavis.edu>.

University of California Agricultural Ergonomics Research Center  
TIP SHEET 005 Nursery Liquid Applicator

## HOW DOES THE APPLICATOR WORK?

The system has three parts: a) the electric controls box, b) the metering cylinder assembly and c) the check valve-fitted spray-wand. It uses a tractor's 12-volt battery to power the timer module and to create 120-volt electricity that powers the solenoid valve. Supply liquid is alternately applied to each side of the double-acting cylinder that meters a precise dose of liquid through the discharge hose. An adjustable momentary delay provides time between discharges to move the wand to the next plant. A spring-loaded check valve at the end of the spray-wand ensures that excess liquid does not flow out of the spray gun between discharges.

## HOW TO MAKE A METERED LIQUID APPLICATOR?

The applicator is composed of off-the-shelf components with the exception of the steel frame. Material costs are about \$500.

**Caution!**  
Proper assembly requires specific expertise.  
Consult a trained electrician or engineer!

The electric controls box houses the power converter, ground fault interrupter, system toggle switch, terminal strip, fuses, and timer module.

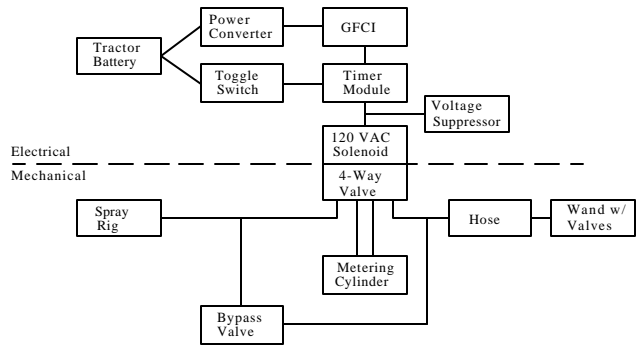
The cylinder metering assembly consists of a steel frame with a double-acting double-rod cylinder, an adjustable stop for the cylinder, an air purging valve, and a solenoid valve with inlet/outlet hose adapters. The materials and dimensions specified here can be altered to accommodate different cylinders or available materials.

The spray gun can be any pistol-style wand, or one modified to pistol style, to allow for a neutral wrist position with an outstretched arm. The traditional bend of the wand should be near the grip of the wand and not near the discharge of the wand. To attach the check valve, some modification may be needed at the end of the wand.

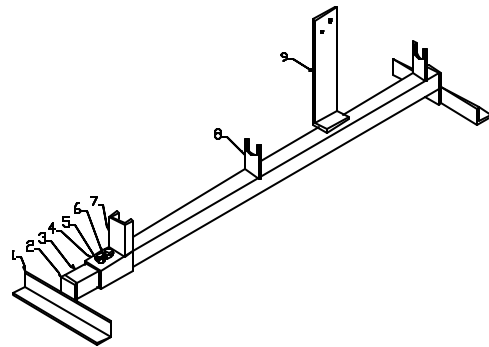
**Note:** Supply pressure must not exceed rating of the lowest rated component.

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### System Block Diagram:



### Frame:



### Frame Components:

1. 1"x1"x1/8"x6" steel angle, 2 each.
2. 1-1/4"x1/8"x2-1/4" steel flat bar, 2 each.
3. 1-1/4"x0.065"x34" steel sq. tube.
4. 1-1/2"x0.083"x2-1/2" steel sq. tube, 3/8" holes.
5. 3/8-16 steel hex nut, welded over drilled holes, 2 each.
6. 3/8-16 x1" steel hex bolt, 2 each.
7. 1-1/2"x3/4"x1/8"x2-1/2" steel channel.
8. 1-1/4"x1/8"x2" steel flat bar, notched, 2 each.
9. 2"x3/16" steel flat bar, bent, drilled, and welded to tube.

### Electrical Components:

ENCLOSURE: Hoffman A-14128CH plus back panel.  
POWER CONVERTER: 300W/600W surge.  
GFCI: Pass & Seymour 1591-F.  
SUPPRESSOR (for solenoid voltage spikes): ZNR 7K201U.  
SOLENOID VALVE: ASCO 8342C1, 120 VAC, 4-way.  
OTHER COMPONENTS: 3-wire cord, cord grips, toggle switch, in-line fuse and holder, terminal strip, wire, wire connectors, custom clamp to hold power converter, box for GFCI, cigarette lighter plug adapter, small battery clamps, 120V male and female plugs, conduit.

### Mechanical Components:

CYLINDER: Shrader 1.06KDXSR12.00, 1-1/16 bore, double rod, double acting, stainless steel.  
CHECK VALVE: Ryan Herco 5162-003, spring loaded.  
OTHER COMPONENTS: ball valve, appropriate hose-to-pipe adapters, check valve-to-wand adapter, copper tubing and fittings, small valve for bypass line, nuts and bolts, and various steel shapes for main frame.

(These are not exclusive vendor suggestions nor endorsements; substitute products are available.)