



Harness Makes Backpack Sprayers Easier to Pack and Less Likely to Leak

Gary Kees, Project Leader

The backpack sprayer is one of the most effective pieces of equipment in the fight against noxious weeds, especially in areas that are not accessible by vehicles, tractors, ATVs, or UTVs. Backpack sprayers work well because the operator can pump them to maintain nozzle pressure while walking at a steady pace. Backpack sprayers also hold more herbicide solution than unwieldy hand-held sprayers.

Toting a backpack sprayer with 4 gallons of herbicide sloshing in the tank is not ideal because the sprayer may leak, straps often are poorly designed, and back supports may be uncomfortable. The Missoula Technology and Development

Center (MTDC) purchased three backpack sprayers (Solo 425, SP Systems SP0, and D.B. Smith Field King Deluxe), figure 1. Backpack sprayer issues covered in this tech tip include:

- Applicator comfort
- New harness designs
- Leakage problems and sprayer maintenance
- Constant flow regulators
- Sprayer specifications (Solo, SP Systems, and D.B. Smith sprayers)
- Sprayer calibration references
- Vendor information

Highlights...

- Backpack sprayers can be uncomfortable to wear, especially if fluid sloshes and leaks on the applicator.
- A new harness was developed with a well-padded back panel, waist belt, and shoulder harness yoke.
- Drawing MTDC-1065 shows how to construct the backpack harness. Patterns are included. Drawing MTDC-1074 shows how to modify a rubber plug to prevent a sprayer's tank lid from leaking. Both drawings are available from MTDC.



Figure 1—The Solo 425, SP Systems SP0, and D.B. Smith Field King Deluxe backpack sprayers were evaluated for comfort and leakage by MTDC.

Applicator Comfort

Most backpack sprayers can hold up to 4 gallons of herbicide solution weighing about 33 pounds. This weight could be carried comfortably in a standard backpack, but poorly designed straps and back supports and leaky tank lids can make backpack sprayers miserable to carry and messy to use.

Backpack sprayers typically come standard with a molded plastic tank that fits against the applicator's back and narrow, lightly padded straps that carry the weight of the sprayer on the applicator's shoulders (figure 2). This might be okay for applicators carrying one or two tank loads, but not for field employees spraying all day in rough terrain. Some strap and waist belt upgrades are available, but even the upgrades could be improved.



Figure 2—The narrow straps and hard plastic back supports on commercial backpack sprayers are not comfortable for field employees who may carry up to 4 gallons of liquid in the sprayers throughout the day.

New Harness Design

MTDC developed a new harness that can attach to either a Solo or SP Systems backpack sprayer, but not to the D.B. Smith Field King sprayer, which has a 3-point harness attachment. The new harness design includes a well-padded back panel, waist belt, and shoulder harness yoke (figure 3). The yoke portion of the harness comes



Figure 3—A new backpack sprayer harness designed by MTDC has a padded back, a shoulder harness yoke, and a wide, padded waist belt. The modified plug is shown installed in the sprayer's tank.

from an existing firefighter pack design. The drawing MTDC-1065 "Backpack Sprayer Harness" is available from MTDC. Drawings include full-size patterns. The harnesses themselves are not available through MTDC, but a local industrial sewing shop such as a tent, awning, or canvas shop should be able to assemble the harness from the patterns.

Benchmark Manufacturing in Helena, MT, will be fabricating the new backpack sprayer harness, which is expected to cost about \$45. Benchmark's address and phone number are listed in the "Vendor Information" section.

Leakage Problems and Sprayer Maintenance

Fluid leaking from backpack sprayers is a common problem. Leaks may come from the lid seal, the vent, pump, or wand. Often, leaks are caused by improper or no maintenance. Lid seals and rubber vent seals should be lubricated with silicone grease or petroleum jelly. Damaged or hardened lid seals and vent seals should be replaced. Leaking pumps or wands should be rebuilt using the manufacturer's repair kits and recommended repair and maintenance procedures.

A few hours of maintenance spent before the spraying season prevent lost time in the field and reduce herbicide leaks. Remember to clean the tanks thoroughly after spraying. Run plenty of clean water through the pump and wand. Keep all wand and tank strainers clean. Do not store herbicide solutions in the tank.

Poor manufacturing quality can contribute to leaking. Two of the sprayers that were evaluated had very rough edges around the opening of the tank and did not seal well. After the edges of the opening were smoothed out, the tank's lid made a better seal. The opening of one of the tanks was slightly egg shaped, which made it nearly impossible to seal the lid.

MTDC performed a simple leak evaluation by filling the backpack sprayers with water and laying them on their sides (figure 4). The D.B. Smith Field King Deluxe began



Figure 4—Poorly fitted seals and leaking lid vents may allow herbicides to drip onto the applicator. When the three backpack sprayers being evaluated were laid on their sides, all of them leaked fluid from the lids and vents.

leaking at once with a steady drip out the lid vent and the seal. The Solo 425 leaked about 1 drop every 30 seconds out the vent. The SP Systems SP0 sprayer did not leak. Later a surfactant was added to the water, increasing leakage from the D.B. Smith Field King Deluxe and Solo 425 sprayers and contributing to a small amount of leakage out of the SP Systems SP0 sprayer. None of the pumps, wands, or hoses leaked during our evaluation.

A rubber pipe plug can be modified slightly and used to tightly seal the top of a Solo sprayer or other spray tanks, such as those used on an ATV (figure 5). The plug should be drilled and tapped so a one-way check valve can be installed. A diagram with information on materials and directions for making the plug are shown in figure 6 (drawing MTDC-1074). The plug's components cost about \$13.

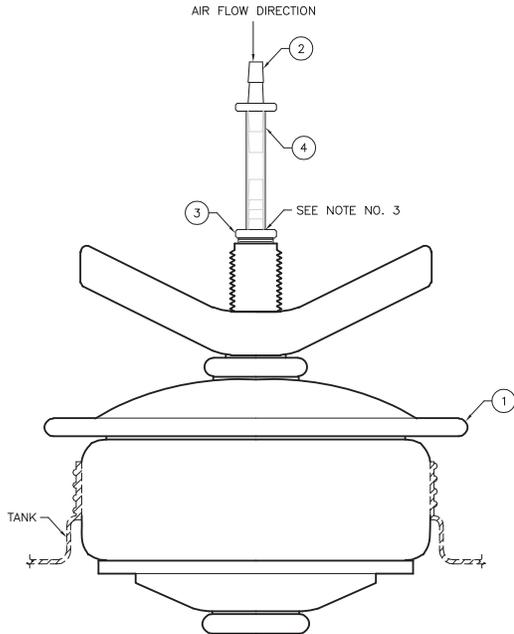
The new harness also helps reduce leakage. Applicators are less likely to shift the weight of the sprayer on their back, so the contents of the tank are less likely to be sloshing around.



Figure 5—Replacing the original backpack sprayer's cap with a rubber pipe plug fitted with a one-way check valve to allow air into the sprayer helped reduce the amount of leakage. A similarly configured pipe plug also could replace the lids of some ATV or UTV spray tanks.

MATERIAL LIST

NO	PART NAME	REQD	MATERIAL-DESCRIPTION
1	PLUG	1	PLUG, MECH, HAND TIGHT, HEAD TEST, w/SHOULDER, 3.75 - 5-INCH DIA., PETERSEN PRODUCTS CO., PART NO. 142-004-MC0003 OR EQUAL
2	CHECK VALVE	1	1/4-INCH KYNAR LIQUID/GAS CHECK VALVE, UNITED STATES PLASTIC CORP., PART NO. 64174 OR EQUAL
3	FITTING	1	3/8 NPT X 1/4 ID NYLON TUBE AND HOSE FITTING, UNITED STATES PLASTIC CORP., PART NO. 61131 OR EQUAL
4	TUBING	AR	1/4-INCH VINYL TUBING



NOTES

1. OTHER PLUG SIZES ARE AVAILABLE. MAKE SURE PLUG SIZE ORDERED FITS TANK OPENING.
2. INSIDE OF TANK OPENING SHOULD BE SMOOTH. SOME TANK OPENINGS SUCH AS ON SOLO BACKPACK SPRAYERS HAVE SMALL RIBS OR PROTRUSIONS INSIDE TANK OPENING WHICH MUST BE FILED OR GROUND DOWN.
3. THE TOP OF THE PLUG (PART NO. 1) MUST BE DRILLED AND TAPPED FOR (PART NO. 3) DRILL SIZE 37/64, TAP SIZE 3/8-18 NPT TAPERED.
4. OVER TIGHTENING PLUG (PART NO. 1) IN TANK OPENING COULD SPLIT THE TANK.
5. ADDITIONAL VINYL TUBING (PART NO. 4) CAN BE ATTACHED TO THE CHECK VALVE (PART NO. 2) TO DIVERT LEAKAGE AWAY FROM THE OPERATOR OR EQUIPMENT.
6. FLUSH THE CHECK VALVE WITH CLEAN WATER WHEN RINSING THE TANK.
7. INSTALL CHECK VALVE SO THAT AIR FLOWS INTO THE TANK AND KEEPS LIQUID FROM ESCAPING.

UNLESS OTHERWISE SPECIFIED	DATE	REVISION	BY
TOLERANCES: FRACTIONS +/- _____ DECIMALS +/- _____ ANGLES +/- _____ DIMENSIONS ARE IN INCHES BREAK SHARP EDGES			
		U. S. DEPT. OF AGRICULTURE FOREST SERVICE TECHNOLOGY & DEVELOPMENT CENTER MISSOULA, MONTANA	
USE WITH DRAWING MTDC-1065		TITLE PLUG BACKPACK OR ATV SPRAYER TANK	
		1074-01.dwg	
	DATE JUN 2008	SHEET 1 OF 1	MTDC-1074

Figure 6—A rubber pipe plug can be modified slightly and used to tightly seal the top of a Solo sprayer or other spray tanks such as those used on an ATV.

Constant Flow Regulators

A CFValve constant flow regulator attaches to the end of the spray wand. The constant flow regulator helps maintain a constant application rate, reduces drift, and decreases the amount of pumping required. The CFValve (figure 7) is available for several different brands of backpack sprayers and comes in models with different colors indicating different pressures. It costs about \$20. One disadvantage of using the CFValve is that it must be removed during cleaning to fully relieve pressure from the wand.

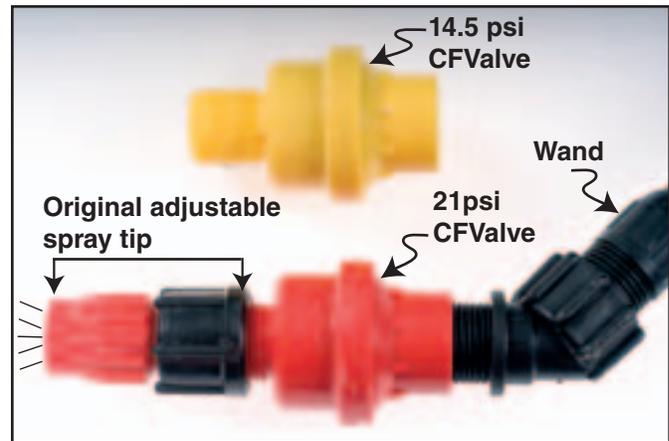


Figure 7—A CFValve constant flow regulator, attached between the wand and spray nozzle, helps maintain a constant application rate and reduces the amount of pumping required when spraying herbicides.

Sprayer Specifications

Manufacturer	SP Systems	Solo	D.B. Smith
Model No.	SP0	425	Field King Deluxe
Capacity (gallons)	4	4	4
Pump type	Multifunction	Piston	Piston
Maximum pressure (psi)	150	90	160
Gasket/seal/O-ring type	Viton/Nytril	Viton	Viton
Strap configuration	Shoulder	Shoulder	Shoulder/Waist
Dry weight (pounds)	13	9.5	10
Price (from Gempler's)	\$170	\$95	\$100
Pump strokes*	6	4	3
Unregulated spray time**	17	22	12
Regulated spray time***	21	27	18

* Pump strokes (up once, down once is a single stroke) required to raise the wand pressure from 21 to 60 pounds per square inch.

** Unregulated spray time is the time in seconds it takes for wand pressure to drop from 60 to 21 pounds per square inch while spraying without pumping and without a CFValve constant flow regulator.

*** Regulated spray time is the amount of time in seconds it takes to drop wand pressure from 60 to 21 pounds per square inch while spraying without pumping when using a CFValve constant flow regulator.

Sprayer Calibration References

Applying herbicides at recommended rates with a backpack sprayer is very difficult. The applicator's speed, the height of the spray nozzle, the type and adjustment of the nozzle, the amount of herbicide added to the tank, and wand pressure all affect the rate at which herbicide is applied. Often, more herbicide is applied than permitted by the label, wasting money and increasing the applicator's and the environment's exposure to chemicals. Several good references on calibrating and operating backpack sprayers include:

Single-Nozzle Backpack or ATV Sprayer Calibration

Florida Cooperative Extension Publication SS–AGR–108 by B.A. Sellers, J.A. Ferrell, C.R. Rainbolt, and G.E. MacDonald

Available at <http://edis.ifas.ufl.edu/WG217> (HTML file for viewing)

or

<http://edis.ifas.ufl.edu/pdf/WG/WG21700.pdf>
(Acrobat file for printing)

Calibrating and Using Backpack Sprayers

Pacific Northwest Extension Publication 320 by C.G. Landgren

Available at <http://extension.oregonstate.edu/catalog/html/pnw/pnw320/> (HTML file for viewing)

or

<http://extension.oregonstate.edu/catalog/pdf/pnw/pnw320.pdf> (Acrobat file for printing)

Calibrating Hand-Held and Backpack Sprayers for Applying Pesticides

Virginia Cooperative Extension Publication 456–502 by S.M. Zedaker

Available at <http://www.ext.vt.edu/pubs/forestry/456-502/456-502.html> (HTML file for viewing)

or

<http://www.ext.vt.edu/pubs/forestry/456-502/456-502.pdf> (Acrobat file for printing)

Vendor Information

The suppliers of materials discussed in this tech tip are listed below:

Harness for Backpack Sprayers

Benchmark Manufacturing
1325 Helena Ave.
Helena, MT 59601
Phone: 800–735–8632
Fax: 406–449–6200
Web site: <http://benchmarkmfg.com>

SP Systems SP0 Sprayer

SP Systems, LLC
P.O. Box 7098
Santa Monica, CA 90406
Phone: 800–457–3440
Fax: 310–449–6912
Web site: <http://www.spsystemsllc.com>
Technical information: <http://www.spsystemsllc.com/professional/sp0.html>

Solo 425 Sprayer

Solo
5100 Chestnut Ave.
Newport News, VA 23605
Phone: 757–245–4228
Fax: 757–245–0800
Web site: <http://www.solousa.com/>
Technical information: http://www.solousa.com/store/flypage/backpack_sprayers/4525%99_backpack_sprayer.htm

D.B. Smith Field King Deluxe Sprayer

D.B. Smith
23 Garden St.
Mills, NY 13417
Phone: 315–736–0037
Fax: 315–768–4220
Web site: <http://www.dbsmith.com>
Technical information: <http://www.dbsmith.com/products/backpacksprayers.php>

CFValve

G.A.T.E., LLC
6245 105th Place
Sebastian, FL 32958-4706
Phone: 772-388-3387

Fax: 315-388-3443
Web site: <http://www.cfvalve.com>
Technical information: <http://www.cfvalve.com/cfvalve001.htm>



Pesticide Precautionary Statement

This publication does not contain recommendations for the use of pesticides, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.



About the Author

Gary Kees joined MTDC in 2002 as a project leader. Gary works in the reforestation and nursery, forest health, fire, and GPS programs. His current projects involve laser guidance systems, ATV and backpack sprayers, nursery seeders, and remote weather stations. Gary, who has a degree in mechanical engineering from the University of Idaho, worked for 10 years as a mechanical and structural engineer, project manager, and engineering group leader for the Monsanto Co. in Soda Springs, ID.

Library Card

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The Missoula Technology and Development Center (MTDC) developed an improved harness that could attach to either a Solo or SP Systems backpack sprayer. The new design includes a well-padded back panel, waist belt, and shoulder harness yoke that make the sprayers easier to carry and reduces the amount of sloshing. Proper maintenance can help prevent leaks: clean wands, tanks, and tank strainers; lubricate lid seals and vent seals. Drawing MTDC–1065 “Backpack Sprayer Harness” is available from MTDC. A rubber pipe plug with a one-way check valve was developed to prevent herbicide from leaking out of the sprayer tank lids. Drawing MTDC–1074 “Plug: Backpack or ATV Sprayer Tank,” is available from MTDC.

Keywords: equipment development, evaluations, herbicides, lids, mechanical drawings, safety at work



Additional single copies of this document may be ordered from:

USDA Forest Service
Missoula Technology and Development Center
5785 Hwy. 10 West
Missoula, MT 59808–9361
Phone: 406–329–3978
Fax: 406–329–3719
E-mail: wo_mtdc_pubs@fs.fed.us

Electronic copies of MTDC’s documents are available on the Internet at:

<http://www.fs.fed.us/eng/t-d.php>

For additional information about backpack sprayers, contact Gary Kees at MTDC:

Phone: 406–829–6753
Fax: 406–329–3719
E-mail: gkees@fs.fed.us

Forest Service and Bureau of Land Management employees can search a more complete collection of MTDC’s documents, CDs, DVDs, and videos on their internal computer networks at:

<http://fsweb.mtdc.wo.fs.fed.us/search/>



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