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MTDC Portable Vehicle Washer System

Operator's Manual



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**USDA Forest Service
Technology and Development Program
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Description

This manual is intended to be used with the operator's manuals for each of the different components of the system and with the illustrated report describing the system's development, *MTDC Portable Vehicle Washer* (0434-2819-MTDC). The report and the mechanical drawings for the washer (MTDC-1020) are available from the Missoula Technology and Development Center (MTDC).

The portable vehicle washer is a closed-loop system that uses a high volume of water under high pressure to wash vehicles, removing dirt, fragments of vegetation, spores, and weed seeds. The system recycles and filters the wash water, eliminating the need for a continuous supply of water. The washer's major components (figure 1) include a high-pressure/high-volume (800 pounds per square inch, 20 gallons per minute) diaphragm pump powered by a 25-horsepower Kohler engine, two 175-gallon settling tanks, two bag-type filter systems, a 550-gallon holding tank for supply water, an

industrial containment mat that contains the used wash water, and miscellaneous sump pumps and plumbing parts. The entire system is mounted on an 18-foot, tandem-axle trailer that can be pulled by a $\frac{3}{4}$ -ton pickup.

The basic flow of water through the system starts in the main holding tank. Water flows from the holding tank through a strainer that removes large particulate, preventing damage to the pump. A vacuum switch prevents the pump from operating without water. The pump forces water through a manifold to the underbody washers or to wands used to wash the vehicle. A containment mat with raised edges holds used wash water until a sump pump removes the water, pumping it through two cone-bottom settling tanks. Large, heavy particulate settles to the bottom of the first settling tank. Overflow from this tank flows into the second cone-bottom settling tank, where the largest of the remaining particulate will settle to the bottom. The overflow from the second settling tank flows through a coarse filter bag (that removes floating material) and into an overflow tank. A sump pump, activated by a float switch,



Figure 1—The MTDC portable vehicle washer allows vehicles to be cleaned thoroughly, removing fragments of vegetation, spores, and weed seeds that could spread noxious weeds.

pumps the water through two filter housings with filter bags and back to the main holding tank.

Wands are used to wash most of the vehicle. Operators should concentrate on the wheels, wheel wells, bumpers, axles, suspension parts, and inside of the wheels where mud and seeds can collect. Vehicles drive over one underbody washer when driving onto the mat and over another when driving off.

All tanks are fitted with valves for easy draining and

cleaning. Drain and sump pump hoses are fitted with cam-lock fittings for easy connections.

Although the system recycles wash water, the tanks will need to be “topped off” occasionally, because water will be lost as spray goes over the mat and as spray evaporates.

The portable vehicle washer is designed to clean vehicles with light to medium amounts of mud and dirt. Washing vehicles with large amounts of mud may clog the filter systems.

Warnings

Before operating the portable vehicle washer, please read all the operator's manuals for the individual components to familiarize yourself with the inherent dangers of each piece of equipment.

You should be aware of the following when operating the washer:

General Safety Items

- Wear eye protection to prevent debris from injuring your eyes.
- Wear hearing protection.
- Wear boots or shoes with nonslip soles. The containment mat is slippery when wet.
- Wear gloves to protect your hands.

Engine and Generator

- Avoid touching the muffler or guard near the exhausts from the Kohler engine and Dayton generator. They are extremely hot and you could be severely burned.
- Operate the vehicle washer only in a well-ventilated area. Operating internal combustion engines in confined areas can cause carbon monoxide poisoning.

- Refuel the washer's engines in a well-ventilated area after turning them off. Do not overfill the engines or spill gasoline.
- Ground the generator to prevent electrical shock.

Battery

- Wear leather gloves and use care when handling the battery used to start the Kohler engine, because it may be corroded.

High-Pressure Water

- Water from the water manifold (figure 1), wands, and underbody washer is under high pressure. **NEVER** point the wands at anyone.
- **NEVER** stand over the underbody washer when turning on the water.
- Ensure that the hoses are properly attached.
- Check hoses periodically for damage.

Sump Pumps

- Check the electrical cords to the sump pumps. Electrical shock can occur if the cords are damaged or frayed.

Containment Mat

- The containment mat can become slippery when wet. Wear shoes or boots with nonslip soles.

Major Components

Latimat Containment Mat

The containment mat (19 feet wide by 33 feet long, figure 2) is made of a tough, durable, chemically resistant material. Foam inserts are placed into slots on the underside of the containment mat, creating a lip on all sides. Two different types of foam inserts are used. The cylindrical blue inserts are used on the sides. The square foam inserts wrapped in plastic are used for the ends. Use the square foam in the ends because the round blue inserts will quickly deteriorate if they are used there.



Figure 2—The containment mat’s raised sides hold used water until it can be pumped from the mat and filtered for reuse.

A felt underlayment protects the containment mat from sharp objects that could poke holes through it. Use the felt underlayment at all times. Before washing tracked vehicles, place $\frac{1}{4}$ - or $\frac{1}{2}$ -inch conveyor belting on the mat to protect it from the tracks.

If the mat is punctured, it can be repaired. Follow the manufacturer’s instructions for more details.

Hydra-Cell Pump

The Hydra-Cell pump is a high-volume (20 gallons per minute), high-pressure (800 pounds per square inch) pump (figure 3). A couple of features have been installed to prevent premature wear. First, a strainer has been installed on the inlet hose from the main holding tank to keep large particulate from

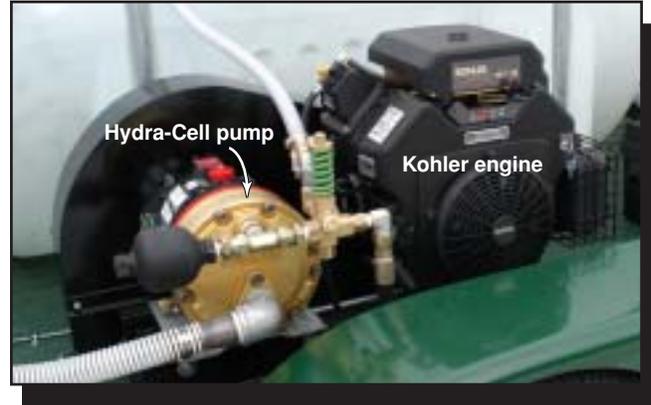


Figure 3—A Hydra-Cell pump, powered by a Kohler 25-horsepower engine, can pump 20 gallons of water a minute at a pressure of 800 pounds per square inch.

entering the pump. Second, a vacuum switch has been installed to prevent the pump from being run without water. The vacuum switch, which is wired to the Kohler engine, will stop the engine if the pump runs out of water. Follow the manufacturer’s maintenance schedule for the pump.

Kohler Engine

A 25-horsepower, electric-start engine (figure 3) powers the pump. Refer to the Kohler operator’s manual for more information. An external gas tank on the opposite side of the trailer from the engine supplies the gasoline. Belts that drive the pump can be purchased from a local parts store or from Grainger (part No. 6L279G, BX64, call 1-888-361-8649 or visit <http://www.grainger.com>). A 12-volt battery powers the electric starter.

Dayton Generator

A 5,000-watt Dayton generator (figure 4) powers the washer’s two sump pumps. The generator also has enough power for lights or other electrical appliances. Refer to the generator operator’s manual for maintenance and grounding requirements.

Filter Assemblies

Two filter assemblies (figure 5) remove particulate from the water. Filters for different sizes of particulate are available from Grainger. The filter size to be used depends on the size of the particulate that you wish to filter. The filters should be graduated so the first filter removes larger particulate (100 microns,



Figure 4—A Dayton generator powers the two sump pumps and could power other electrical appliances.

for instance) than the second filter (50 microns, for instance). Pressure gauges on the top of each housing show the approximate internal pressure. When the pressure reaches 15 to 20 pounds per square inch, the filters are clogged.



Figure 5—Two filter assemblies remove particulate from the wash water before the water flows back into the main holding tank for reuse.

Sump Pumps

The vehicle washer has two sump pumps. A switched outlet on the trailer supplies power to the sump pumps.

A sump pump in the overflow tank (figure 6) forces water through the two filter assemblies and into the main holding tank. A float switch controls the operation of this sump pump.

The other sump pump is placed on the containment mat (figure 2). It pumps water from the mat to the settling tanks. This pump should be at the lowest point on the containment mat, but close to the trailer so vehicles do not drive over the hose. In addition, a small valve has been added to the pump's outlet to help prime it. Simply open the valve (figure 7) to start the flow of water (priming the pump). Close the valve to start the flow to the settling tanks.

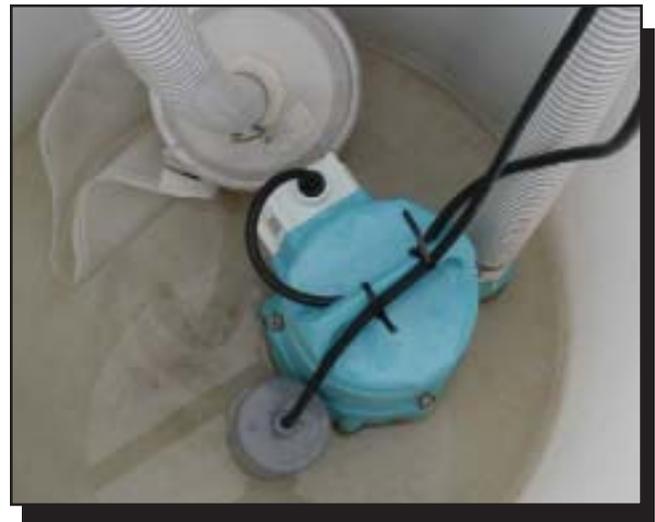


Figure 6—The sump pump in the overflow tank forces water through the two filter assemblies and into the main holding tank.



Figure 7—The sump pump on the containment mat pumps water to the settling tanks. Open the priming valve to prime the pump.

Settling Tanks

The primary settling tanks for the wash water are two 175-gallon, cone-bottom tanks (figure 1). Heavy particulate should settle in the tanks. They can be drained independently through the cam-lock fitting and drain hose.

Wash water from the containment mat sump pump enters the first settling tank about two-thirds down from the top of the tank. Overflow from the first settling tank flows to the second settling tank, also entering the tank about two-thirds down from the top. Overflow from the second settling tank flows to an overflow tank where the filter sump pump is located. A screen on the overflow tubing filters out large floating objects, such as pine needles and grass that don't settle in the settling tanks.

Main Holding Tank

The main holding tank (figure 1) holds about 550 gallons of water. A cam-lock valve on the bottom of the tank allows it to be drained.

Wash Wands

The wash wands are the main washing tools. Each wand comes with a specialized nozzle that directs a single flow of water into a 25-degree spray pattern. The wands can be used aggressively to knock mud and other debris from vehicles, but take care that the high-pressure spray does not remove paint or otherwise damage the vehicles.

Underbody Washers

The vehicle washer has two underbody washers (figure 8) that wash the underside of the vehicles. One sprayer should be placed where vehicles enter the containment mat. The second washer should be placed at the other end of the containment mat, washing the undercarriage a second time as vehicles exit. Plastic ramps protect the hoses to the underbody washers.

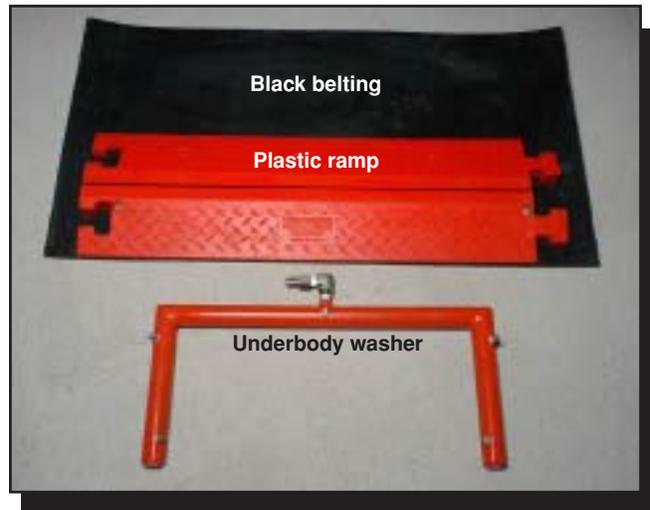


Figure 8—The underbody washer washes the underside of vehicles. The plastic ramp protects the hose to the sprayer. The black belting ensures that a vehicle's weight will hold the ramp in place when the vehicle drives over the belting and onto the ramp.

Site Selection

The washer should be set up on a fairly flat location that is free from sharp rocks or other debris that can puncture the containment mat. The trailer should be on one side of the containment mat. Make sure there is plenty of room around the trailer, because you will need room when filling and

draining tanks, changing filters, and so forth. Also, find a location that has plenty of room for the vehicles to line up before they drive onto the containment mat.

Ideally, the containment mat's lowest point (figure 2) will be on the side where the trailer is located. Otherwise, vehicles will drive over the hose to the sump pump.

Setup

Setting Up the Containment Mat

- Read the manufacturer's instructions before starting to set up the mat.
- Look over the location and toss aside any sharp rocks, sticks, or other items that may puncture the mat.
- Lay out the felt underlayment.
- With the containment mat still on the trailer reel, position the trailer over the underlayment so that one end is in the correct location. Unlock and remove the reel handle by removing the two pins on the handle. With one person holding the containment mat, *slowly* drive the trailer over the underlayment to unreel the mat. Stop before unreeling the entire mat. Remove the rod holding the mat to the reel by removing the cotter pin and sliding the rod out. The containment mat now may be fully removed from the reel.
- Unfold the containment mat, being careful not to drag it.
- Place foam inserts in the pockets on the underside of the mat to create the lip that will keep water on the mat. The blue cylindrical tubes go in the side pockets, while the square foam in plastic bags goes in the end pockets. The cylindrical tubes will deteriorate very quickly if they are used on the ends rather than on the sides, where they belong.
- Position the containment mat. If necessary, stake its corners and sides with the tiedowns and stakes that are supplied.

Positioning the Trailer

The trailer should be positioned so that its right side (looking from the back to the front of the trailer) is close to the containment mat, allowing the operators easy access to the water control valves, pump, and engine. The hoses to the underbody washers, wands, and sump pump may not be long enough if the trailer is too far from the mat or is not positioned with its right side by the mat.

Underbody Washers and Wash Wands

- The wash system comes with two high-pressure underbody washers and two wash wands.

- Connect the ½-inch hose lines to the underbody washers and place one washer at each end of the containment mat.
- Insert the hose from each underbody washer into the slot of the orange hose protection ramps. One ramp is needed for each underbody washer.
- Position the ramps so that the black belting attached to the ramp (figure 8) is in front of the ramp. That way, the vehicle's weight on the belting will keep the ramp from slipping.
- Connect the other end of each ½-inch hose from the underbody washer to the high-pressure water manifold.
- Connect a ¾-inch hose to each wash wand and to the water manifold.

Sump Pumps

The vehicle washer includes two sump pumps. One pumps water from the containment mat to the settling tanks. The other sump pump is in the overflow tank. It pumps water through the filters to the main holding tank.

Containment Mat Sump Pump

- Place the sump pump on the lowest part of the containment mat. This spot should be close to the trailer so vehicles do not run over the hose between the sump pump and the settling tanks.
- Connect the 1-inch hose to the sump pump's cam-lock fitting.
- Connect the other end of the hose to the cam-lock fitting on the trailer bed near the filter assemblies.
- Plug the sump pump into the switched outlet on the trailer (located near the water manifold). Make sure that the switch is in the *OFF* position.
- Plug the blue cord from the outlet box into the ground fault circuit on the generator.

Overflow Tank Sump Pump

The overflow tank sump pump should be in the overflow tank. Plug the black cord from the sump pump into the generator.

Filter Housings

Two filter housings on the trailer allow filters designed to remove different sizes of particulate to be used in each housing. The first filter should remove the larger particulate (larger than 100 microns, for instance) and the second should remove smaller particulate (larger than 50 microns, for instance).

- Open the filter housing by unscrewing the four screws on the lid and lifting the lid.
- Place the appropriate size filter into the filter basket and ensure that the filter seats properly at the top. If the filter is not seated properly, particulate may not be filtered from the wash water.
- Ensure that the O-ring is seated in the groove at the top of the filter housing and replace the lid.
- Secure the lid and tighten the four screws hand tight.
- Follow the above procedure for the other filter housing.

Filling the Tanks

Fill all the tanks with water before operation. The main holding tank can be full. The settling tanks should be filled to the overflow level. The overflow tank can be filled about halfway.

Empty water from the tanks before towing the vehicle washer. The washer weighs 3,800 pounds empty and 11,000 pounds when the tanks are full.

Grounding the Generator

To prevent electrical shock, the generator should be grounded at all times. See the generator operator's manual for guidance.

Fuel

Fill the generator fuel tank and the external fuel tank for the Kohler engine with gasoline.

Operation

Before operation, the operators should be thoroughly familiar with all the equipment and have reviewed the operator's manuals for the Hydra-Cell pump, Kohler engine, and generator.

Once setup is complete, you should be ready to begin washing vehicles. If you have many vehicles to wash, you'll want to leave the generator and Hydra-Cell pump engine running all the time. However, if vehicles show up sporadically, it is best to shut off the Kohler pump engine when you're not busy. Shutting off the engine reduces the wear on the overflow bypass valve (which has a yellow or green spring) and on the pump and engine. Constant flow over the bypass valve will wear its seals and internal stainless steel parts, which will have to be replaced.

The containment mat sump pump only needs to be running when the containment mat has enough water to pump. During washing, watch the water level on the containment mat. Turn the pump on only when there is enough water to pump. When you start the pump, you may have to turn the priming valve (figure 7) on the pump's outlet to prime the pump.

During operation, monitor the flow of water from the settling tank overflow tank. If water is flowing over the sides of the overflow tank:

- Check to see if the sump pump is operating. If not, check to make sure it is plugged in, the generator is on, and the float is set correctly.
- Check the pressure gauge (figure 9) on the filter housing. If the pressure is higher than 15 to 20 pounds per square inch, the filters are clogged and need to be replaced.



Figure 9—If the pressure at the filter assembly is higher than 15 to 20 pounds per square inch, the filters are probably clogged.

Washing Procedure

1—Start the generator (refer to the operator’s manual if you have questions). Make sure that all cords are plugged into the generator.

2—Check all hose connections from the manifold, wash wands, and underbody washers.

3—Start the Kohler pump engine (see the operator’s manual if you have questions).

- If the engine will not start, make sure the supply line to the pump has water. A vacuum switch (figure 10) in the supply line prevents the engine from starting or running the pump when the supply line is dry.
- Check the battery and check the fuel and oil levels.



Figure 10—The vacuum switch stops the engine when the supply line is dry. The strainer removes floating materials before filtered water enters the main holding tank.

4—Direct the driver of the vehicle to *slowly* drive onto the containment mat with the underbody washer centered under the vehicle. The more slowly the driver drives the vehicle over the sprayer, the cleaner the vehicle will be underneath.

5—Open (*down* position) the appropriate valve on the manifold, allowing water to flow when the front of the vehicle crosses the underbody washer.

6—Continue directing the driver to drive forward until the vehicle is centered on the containment mat. Turn the underbody washer off by closing (*up* position) the valve.

7—Open (*down* position) the valves supplying water to the wands.

8—Use the wands to spray the vehicle, removing all dirt. Concentrate on the wheels, wheel wells, and bumpers. On the underside, concentrate on cleaning all drive axles, suspension parts, and the inside of the wheels, removing all mud from these areas.

9—When the vehicle is thoroughly clean, close (*up* position) the valves supplying water to the wands. Move the wands out of the way so the vehicle does not drive over the hoses leading to the wands or over the wands themselves.

10—Open (*down* position) the valve to the front underbody washer and direct the driver to drive *slowly* off the containment mat.

11—Close (*up* position) the valve to the underbody washer.

12—When another vehicle is ready to be washed, repeat steps 4 through 11.

13—When no vehicles are waiting, turn the throttle on the Kohler pump engine to *slow* (picture of turtle) momentarily. Turn the engine off.

14—Turn the generator off when power is no longer needed for the sump pump or other appliances.

Periodic and Daily Maintenance

Cleaning the Containment Mat

Whenever time permits, or at least daily, clean mud and debris from the containment mat. Use the wash wands to push the used water to the sump pump on the mat. Wide squeegees can effectively push the water to the sump pump or, if acceptable, off the containment mat. Be careful not to scrape the containment mat too hard with the squeegees to prevent ripping or tearing the mat. Plastic shovels can be used to scrape mud off the mat. Again, be careful not to damage the mat.

Settling Tanks

The settling tanks should be partially drained to remove particulate before it sets up and makes the tanks difficult to drain. The frequency at which tanks need to be drained depends on how many vehicles are being washed and how muddy they are. You may be able to let the particulate settle overnight, and then drain the particulate into 5-gallon buckets the next morning.

Filter Bags

The filter bags should be changed whenever they become clogged. Monitor the pressure gauges on the top of the filter housings. When the pressure reaches 15 to 20 pounds per square inch, the filters are beginning to fill with particulate and should be changed. Another indication that the filters are clogged is when the overflow tank begins to overflow. This happens because the sump pump no longer has enough power to pump water through the filters. Change the filters immediately.

The filters can be backwashed and reused.

Main Water Tank Strainer

Close (*up* position) the valve supplying water from the main tank to the pump. Remove the strainer housing (figure 10) and inspect and clean the strainer as necessary. Replace the strainer and housing. Open (*down* position) the supply valve.

Generator and Kohler Engine

Check the fuel and engine oil levels periodically. Follow the maintenance schedule for each engine as shown in its operator's manual.

Hydra-Cell Pump

Check the oil as directed in the operator's manual.

Bypass Valve

The bypass valve (figure 11) diverts water from the pump back to the main holding tank when the wands or underbody washers are not in use. Over time, if the pump is operated at high speed and the wands or underbody washers are not being used, the internal components of the bypass valve will wear and no longer seat properly. The result is very low pressure, with reduced water flow to the wands and underbody washers. If this should happen, the bypass valve will need to be replaced. Remove the bypass valve by loosening the three hydraulic fittings (water inlet, outlet to the manifold, and

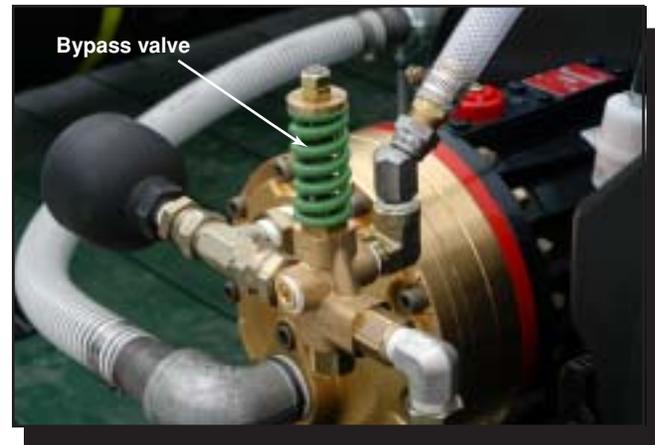


Figure 11—The bypass valve diverts water from the pump back to the main holding tank when the wands and underbody washers are not being used.

outlet to the main holding tank). Replace the fittings with appropriate components. The following page has information on obtaining replacement components.

Engine and Pump Drive Belts

You may need to replace the drive belts between the Kohler engine and the Hydra-Cell pump. Remove the protective shield surrounding the belts. Using a wrench or ratchet, loosen the four bolts securing the pump to the stand for the engine and pump. Turn the adjustment rod (figure 12) in the center

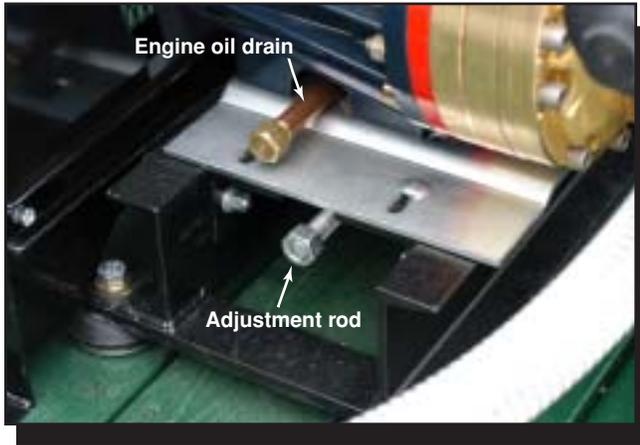


Figure 12—The adjustment rod can be used to loosen or tighten belts that connect the engine to the pump.

of the stand, loosening the belts so you can remove them. Reverse the procedure to install the belts.

The adjustment rod may also be used to adjust the tension on the belts without removing the guard.

Winterizing

The vehicle washer should be winterized to prevent damage from freezing. This procedure is especially important for the Hydra-Cell pump. Follow the winterizing instructions in the pump operator's manual. All other parts (hoses, tanks, and so forth) should be drained of water and the mat should be thoroughly cleaned and dried before storage.

Suppliers for Miscellaneous Parts

Filters for filter housings, filter bag size No. 2

Grainger, Inc.

Web site: <http://www.grainger.com>

Phone: 888-361-8649

High-pressure bypass valve (part No. IPYU2121), and miscellaneous plumbing parts

Dultmeier Sales

Web site: <http://www.dultmeier.com>

Phone: 800-228-9666

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from the University of Minnesota. He worked for private industry before coming to the MTDC in 1977.

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Library Card

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Describes how to operate a portable vehicle washer developed by the Missoula Technology and Development Center. The washer is mounted on a trailer that can be towed by a $\frac{3}{4}$ -ton pickup truck. A separate report, *MTDC Portable Vehicle Washer* (0434-2819-MTDC), describing the development of the washer and mechanical drawings for the washer (MTDC-1020) are available from the center. The washer is

intended to reduce the spread of weeds by thoroughly cleaning fragments of vegetation, spores, and weed seeds from vehicles when they arrive and leave a fire camp or worksite. Operators clean the vehicle with two wands and two underbody washers that spray water under high pressure. Wash water is captured on a containment mat and filtered for reuse. Persons using the washer will need to read and understand the operator's manuals for the washer's different components (such as the generator, engine, and pump) in addition to this manual.

Keywords: cleaning, fire camps, fire fighting, firefighting, washing, weed control, weeds

Additional single copies of this document may be ordered from:

USDA Forest Service, MTDC
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Missoula, MT 59808-9361
Phone: 406-329-3978
Fax: 406-329-3719
E-mail: wo_mtdc_pubs@fs.fed.us

Copies of the mechanical drawings for the MTDC portable vehicle washer system may be ordered by contacting Deb Mucci at MTDC:

Phone: 406-329-3999
Fax: 406-329-3719
E-mail: dmucci@fs.fed.us

For additional information about the portable vehicle washer operator's manual, contact Andy Trent or Chuck Harding at MTDC:

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E-mail: atrent@fs.fed.us	E-mail: charding@fs.fed.us

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