Table of Contents

General Information........................................................................................................................................2
Hydraulic & Electrical Operation Diagrams.................................................................................................8
Hydraulic & Electrical Installation..................................................................................................................13
Parts List.........................................................................................................................................................19
Troubleshooting............................................................................................................................................22
M200
Operating Information
General Information about Power Unit M200

Warranty Identification

For purposes of warranty consideration, recording the serial number of the power unit is necessary. This serial number is displayed on a reservoir of the power unit.

Maintenance

Under normal operating conditions, the M200 should not require servicing during the plowing season, provided post season maintenance has been carried out. It is recommended that after every season the hydraulic fluid to be changed. The replacement fluid recommended is UNIVIS J13 (HVI 13) hydraulic fluid. Automatic transmission fluid is not recommended for this system and may lead to aeration of the oil in very cold weather conditions. The oil level in the reservoir is to within ½" from the top surface (when lift cylinder is collapsed).

When draining the hydraulic fluid, the hoses at the cylinders should be disconnected and drained. With the hose disconnected, the cylinders should be collapsed to displace the oil out of the cylinder.

Periodically, and during post season maintenance, make sure the electrical connections are tight and free of corrosion. The terminals may be covered with grease for additional protection from corrosion. Sometimes, in order to release pressure in angling cylinders it is necessary to follow these instructions: when blade is angled to the right (curb side), angle blade to the left (driver side) and as blade is going to right side press release button.

Electrical System

Frequently problems develop due to an undersized electrical charging and storage system. Generally, the heavier the usage, the heavier the system should be. For a moderately light duty, the battery should not be less than 70 ampere-hours and the alternator should charge at a rate of not less than 60 amperes. For heavy usage and in the case where a number of other devices are run off the battery simultaneously, heavier ratings are strongly recommended.

Electric Motor

The 8053 electric motor is permanent magnet motor which consists of 3" diameter steel
frame, armature, brushes and permanent magnet fields. Because fields are permanent magnets, they do not require electrical current to operate.

The power unit with this motor is equipped with the 190 pump. This combination of pump and motor offers optimum performance.

Hydraulic Pump

The hydraulic pump converts mechanical energy transmitted by the prime mover (in this case a 12 volt DC electric motor) into hydraulic energy. The hydraulic energy is due to flow (kinetic energy) and pressure (potential energy). The rate of energy output is expressed in horsepower.

At the inlet, as the gears unmesh, the volume in the cavity increases thereby causing fluid to enter. This fluid is then carried between the gears and the housing to the other side of the gears into the outlet cavity. At this point the gear teeth mesh. The outlet cavity volume decreases, causing fluid to flow into the system. Note that without a load, the pressure at the outlet port is nil.

The pressure at the outlet of the pump is due to external loads placed on the system. These loads can be transmitted through cylinders and linear actuators as well as hydraulic motors and rotary actuators. In practice, system components by virtue of orifice and line sizes, offer some resistance to the flow of fluid. This translates into pressure at the outlet of the pump.

Valve Information

Pressure Relief Valve

The pressure relief valve consists of a ball, a retaining spring and a seat. The ball is exposed to the pressure in the outlet line from the pump. This pressure acting on the exposed area of the ball, causes a force on the retaining spring. When the pressure is such that the force on the ball exceeds the force in the spring (due to a preset amount of precompression) the ball lifts off the seat and the fluid from the outlet of the pump is allowed to flow back to the reservoir. The “standard relief valve setting” for the M200 is 1500 psi.

Directional Valves

and ‘D’ are 3 way, 2 position spool valves. Valves ‘B’ and ‘C’ is a 2 way 2 position normally closed poppet valve.

A basic directional valve consists of a valve cartridge and a coil. Inside the cartridge valve, an armature is attached to the valve mechanism. The coil consists of a wire wrapped around a spool. When power is applied to the coil (the coil is energized), the magnetic field created by coil pulls the armature into the coil. The armature shifts the valve mechanism into the energized position. When power is removed from the coil, a spring inside the valve cartridge pushes the armature and valve mechanism to the de-energized position.

**Directional Valve ‘B’ & ‘C’**

Directional valve ‘C’ operates the lift cylinder on C3 port (See Figure 1). Valve ‘B’ is used for lowering the plow. In the de-energized position, valve B acts as a check valve allowing pump flow to the lift cylinder but preventing return flow from the lift cylinder to the reservoir. Energizing valve B opens the valve and allows flow from the lift cylinder to the reservoir thereby lowering the plow. See figure 2. Note: the lift cylinder is connected to C3.
Directional Valves ‘A’ & ‘D’

Directional Valves ‘A’ and ‘D’ are 3 way, 2 position spool valves. Directional Valves ‘A’ and ‘D’ operate the left and right angling cylinders. Valve ‘A’ operates the angling cylinder on the right side of vehicle on C2 port (See Figure 3). Valve ‘D’ operates the angling cylinder on the left side of vehicle on C1 port (See Figure 4).

In the de-energized position, the valves block flow from pump to the cylinder but allow return flow from the cylinder to the reservoir. In the energized position, flow from the pump to the cylinder is permitted but flow from the cylinder to the reservoir is not.

Note: When angling the plow, one cylinder is extending and the other is retracting therefore one cylinder is receiving oil from the pump and the other is returning oil to the reservoir. Valves ‘A’ and ‘D’ must work together.

Pressure Compensated Flow Control

When B valve is energized oil from a lift cylinder is going through the pressure compensated flow control in the tank. A pressure compensated flow control valve automatically compensates for pressure changes and maintains its setting even as work load changes.

Cross Over Relief Valve

The cross over relief valves are provided to protect the valves and manifold from the pressure spikes created when the plow strikes an object. The cross over relief valves are similar in construction to a regular direct acting relief valve. Cross over valves when activated, bleed fluid from C1 to C2 or vice versa. In this manner both the angling cylinders, the plow frame and the truck frame are offered some protection from the normal impact forces associated with plowing. Striking a fixed object while plowing at high speeds will damage the cylinders and perhaps the plow. The cross over relief valves are adjustable and are normally set at about 2000 psi. See figure 3 and 4.

Pilot Operated (PO) Check Valve

A dual pilot operated check valve (PO Check Valve) is provided on ports C1 and C2 to hold the plow at the desired angle. Without the PO Check valves, leakage through directional valves ‘A’ and ‘D’ would allow the plow to drift.

Without pilot pressure, a pilot operated check valve (PO check valve) allows flow in only one direction. In the free flow direction, oil flowing through the valve lifts the poppet of the
seat. In the opposite direction, returning oil pushes the poppet against the seat thereby blocking flow. When pressure is applied to the pilot piston, the poppet is lifted off the seat and flow in both directions is permitted. When angling, pilot pressure is provided for the check valve returning oil to the reservoir. For example; when valve ‘D’ is energized pump flows oil to C1. Oil is allowed to return oil through the check valve to the reservoir because the pressure on C1 is acting on the pilot piston of the C2 PO Check Valve. See figures 3 & 4.

Control Switch

The M200 uses five different control boxes: control box with rocker switches, touchpad control box, handheld controller and joystick control box (big and small). Each control box performs same functions: up, down, angle left and angle right.
M200 PLOW GOES UP
M200 FLOW ANGLES TO RIGHT (PASSENGER SIDE)
M200 power unit installation
M200 Installation Instructions

**Warning:**
- Top of battery needs to be protected. If positive side of battery is accidentally grounded person could be burnt or wiring system can be damaged, or battery gasses could explode causing injuries.
- Disconnect cable from negative battery terminal before starting installation.
- Always wear eye protection and protective clothing when working around hydraulic systems.
- Remove jewelry and objects that might conduct electricity while working on power units.
- Fluid under pressure can pierce the skin and enter the bloodstream causing death or serious injury.
- Hydraulic hoses and electrical cables (harnesses) must be tied and routed safely to avoid any damage and pinching (away from hot places, sharp objects etc.).

Note: **Do not use** teflon tape on hydraulic fittings as it can easily jam valves and plug the filters in the system.

**All electrical connections must have die electric grease applied frequently**

1. Install straight swivel (14) in C3 port of power unit and 18” hose (16) in port C3. Install power unit (1) on mounting plate with motor toward driver’s side of truck. Power unit should be secure with three bolts 5/16”, flat washer and lock washer (17)(18)(19) to the back of mounting plate.

2. Install colour co-ordinated weather cover on cable and plug assembly (9). Attach red lead to positive motor stud and black lead to the front of pump base using 5/16” x 3/4” bolt, flat washer and lock washer (17,18,19). Liberally coat connections with die electric grease then slide cover over the positive motor stud.

3. Route power unit harness through grommet in driver’s side of mounting plate and secure using cable clamp and ¼” x 1” bolt, lock washer and nut (20)(21)(22).

4. Mount solenoid (24) to metal surface in engine compartment bending bracket if necessary. Be sure to locate the solenoid so that there is sufficient cable to reach to both the battery and the cable and plug assembly (9) on the power unit.

   NOTE: Solenoid must be well grounded in order to function properly.

5. Slide weather cover over power (11) and ground (10) cables and route through grille of truck leaving sufficient length to attach to the cable and plug assembly (9). Secure the red power cable (11) to the large terminal on the solenoid and the black ground cable (10) to the negative terminal on the battery.

6. Secure power cable (5) from other large terminal on solenoid to positive terminal on battery.
7. Plug intermediate harness into power unit harness and follow battery cable routing toward firewall. Locate a pass through hole in the firewall near the driver’s side of the truck. Route other end of intermediate harness through the hole in firewall and attach control station.
   NOTE: A smaller hole in the firewall can be used if the cable is fed into the engine compartment from the cab as the plug at the power unit end is smaller than at the control station end.

8. Attach white wire to ground, black wire to positive side of solenoid and brown wire to small terminal on top of the solenoid.


   Note: Be sure all cables are properly protected from any sharp edges or hot or moving parts.

10. Install 18” hoses (15) from the back of mounting bracket into elbow swivels already attached to power unit.

11. Install two 90 deg swivel elbows (13) into angle cylinders.

12. Route hoses from port C2 through the driver side and from port C1 to passenger side on the back of mounting plate and loosely attach to the angle cylinders.

13. Install straight swivel (14) in lift cylinder. Route 18” hose (16) from port C3 through the hole on side of pump base cover and loosely attach to lift cylinder.

14. Remove vent cap and fill reservoir with J13 (HVI 13) hydraulic oil. DO NOT USE AUTOMATIC TRANSMISSION FLUID IN THIS SYSTEM as it may lead to aeration of the oil in very cold weather conditions. Use of any fluid other than J13 will void warranty.

15. Jog the lift switch until no air is seen in the fluid passing through the loose connection. Tighten fittings.

16. Refill power unit so that oil level is 1/2” from the top of the reservoir. Clean up any spilled oil and check all functions several times making sure there is not excessive foaming in the reservoir. Compress the lift cylinder and double check the oil level. Check for leaks at all fittings.

17. Install power unit cover (2).

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* Item 24 was FP7518     **not shown on drawing     ***Item 26 was 52754-01-A
M200
Wiring Installation

NOTES:
1) THE HARNESSES FPN0457-SA & FPN0670 ARE USED WITH ALL CONTROL BOXES: SWITCH TYPE FPN0455-SA (SHOWN), TOUCHPAD CONTROL BOX FPN0478-SA, LARGE JOYSTICK CONTROL BOX 52388-M AND SMALL JOYSTICK CONTROL BOX 52524-N.
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## M200 parts List

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<td>Control box (rocker type switches)</td>
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<tr>
<td></td>
<td>46</td>
<td>1</td>
<td>761656</td>
<td>Spade connector, male ¼” tab insulated, 20g wire</td>
</tr>
<tr>
<td></td>
<td>47</td>
<td>1</td>
<td>FP2159</td>
<td>Pump seal</td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>1</td>
<td>53276-N</td>
<td>Handheld controller</td>
</tr>
</tbody>
</table>

*R01: FP7249-D replaces FP7249
If Parker cartridge FP0679 is replaced with Deltrol cartridge FP0679-D Parker coil FP10977 must also be replaced with Deltrol coil FP18835-D
- FP18335-D replaces FP10977
- FP0490-D replaces FP0490
- FP10907-D replaces FP0307 *note: if Deltrol cartridge FP0307 is replaced with Deltrol cartridge FP10907-D Deltrol coil FP0496 must also be replaced with Deltrol coil FP10861-D
- FP10861—D replaces FP0496 *note: if Deltrol coil FP0496 is replaced with Deltrol Coil FP10861-D Deltrol cartridge FP0307 must also be replaced with FP10907-D

*R02 FP17757 replaces FP7518
Valves 2 way /2 position (2w/2p) cavity (O-ring) change

1. Power units manufactured prior to 2010
Typically manufactured with "Monarch-style" valve cavity, identifiable by:
a) Cavity without identification mark (without Greek letter delta (triangle)) (see picture 1)
b) Black O-ring, with 0.070" cross-section (see picture 3)

2. Units manufactured in 2010 and beyond
Typically manufactured with "Industry standard" valve cavity, identifiable by:
a) Cavity with identification mark - Greek letter delta (triangle) (see picture 2)
b) Blue O-ring, with 0.087" cross-section (see picture 3)

Valve replacement
a) Cavity and O-ring must be selected correctly for proper sealing function, the rest of the valve is the same.
If necessary, replace O-ring with the proper O-ring to match the valve cavity:
b) Cavity without identification mark requires black O-ring, with 0.070" cross-section (see picture 3)
c) Cavity with identification mark requires blue O-ring, with 0.087" cross-section (see picture 3)
*WARNING*

- Fluid under pressure can pierce the skin and enter the bloodstream resulting in serious injury or death.
- Eye protection and protective clothing must be worn when working on any portion of the snowplow.
- Remove any jewellery (rings, bracelets, watches, necklaces) that could conduct electricity while working with electrical system.
- Lifted blade should be securely propped or immobilized while working on it or any other suspended part so it cannot fall.
- Do not operate blade when anyone is within a 10 foot radius of it.
- Do not use Teflon tape on hydraulic fittings as it can easily jam valves and plug the filters in the system.

*Use of any fluid other than J13 will void warranty*

Specification:
- Max Amp Draw 90 AMP (AMP draw of motor should be measured at maximum raise or maximum angle when motor is running at pressure setting at 1500psi).
Note: Do not operate motor continuously for more than 30 sec.
- Relief valve setting 1500 psi.
- X-over relief valve setting 2000 psi.

Note: Quick couplers are an optional item. If unit is not equipped with quick couplers, disregard troubleshooting steps involving them.
Troubleshooting tips M200:

1. Pump shaft can be turned freely (smoothly) using two fingers. If it can’t be turned replace pump. Proper pump rotation is clockwise looking from the motor end.
2. Use a screwdriver to check magnetism of solenoid coils. Place screwdriver on the nut securing the coil and have the switch operated. Strong magnetic attraction should be felt.
3. Measure pump pressure at an angle hose (at full angle) it has to be 1500 psi (assuming that cross over relief valve setting is 2000 psi, if X-over relief valve setting is less than relief valve setting pressure gage will read lowest reading). The most accurate reading of system pressure is reading pressure on lift cylinder. When testing or making adjustments on the relief valve the system must be “dead headed” (cylinder at full stroke or in a position where cylinder movement is zero).
4. AMP draw of motor should be measured at maximum raise or maximum angle when motor is running at 1500 psi.
5. Use volt meter or test light to test for power in a harness or continuity in a switch. A test light is simply a light bulb which has one end connected by a wire to an alligator clip and the other end connected to a metal probe. It is used to check the electrical circuit when the battery is connected to the system. The alligator clip is grounded and the light glows when the probe comes in contact with a “live” electrical component.
6. Do not screw cartridge valves into cavity too fast; use a back and forth motion and have O-rings well lubricated.
7. Clean all parts thoroughly before assembly and lubricate with clean oil.
8. Do not use Teflon tape on hydraulic connections as it can easily jam the valves and plug the filters in the system, use pipe sealant. Never apply pipe sealant at the end of fitting, always 2-3 threads back.
9. X-over pressure could be set using hand (hydraulic) pump. Example: If you want to set the pressure at x-over X1 insert hand pump hose in the C1 port together with pressure gage. Loosen the jam nut and turn adjusting screw clockwise a turn or two and watch the gauge; if it goes up, continue to turn the screw until the required setting is reached. Retighten the jam nut. To set X-over X2 repeat the same steps as setting X1.
10. To adjust relief valve:
   a. Loosen jam nut counter-clockwise.
   b. Turn screw clockwise to increase pressure or turn screw counter-clockwise to decrease pressure.
   c. Tighten jam nut clockwise to 50in.lb. torque.
   d. Check system pressure after jam nut is tight. Readjust pressure if screw is moved during tightening of jam nut.
MOTOR OPERATES CONTINUOUSLY M200

If motor operates continuously, change solenoid.
SNOW PLOW DOES NOT RAISE M200

Does the motor operate when up switch is pressed?  
No  
Is fluid level 1/2" below filler hole?  
Yes  
Add UNIVS J13 oil.  
No  
See chart - Motor does not operate.  
Yes  

Does motor operate when angle switch (left/right) is pressed?  
No  
Is suction filter plugged?  
Yes  
Replace suction filter. Change oil and flush system. Is there pressure?  
No  
Replace pump.  
Yes  

Is there pressure in angle cylinder port when angle switch is pressed? (Use pressure gauge) (Hint: Check relief valve condition.)  
No  
Adjust relief valve to 1500 psi. Can it be done? Using a gauge in the pressure line, loosen the jam nut and turn adjusting screw clockwise a turn or two and watch the gauge; if it goes up, continue to turn the screw until the required setting is reached. Retighten the jam nut.  
Yes  

Does pump shaft turn freely?  
No  
Does the motor armature turn tightly?  
Yes  
Replace motor.  
No  
Replace pump.  

Is there power leaving switch (control box) when?  
No  
Replace switch (control box).  
Yes  
Are harness connectors plugged into each other properly?  
No  
Repair/replace harness that does not have  
Yes  

Is there power to C coil (blue wire) when up switch is pressed?  
No  
Is there magnetism on C coil.  
Yes  
 Replace C valve cartridge.  
No  
Replace C valve coil.  

Is there power in each harness?  
No  
Replace switch (control box).  
Yes  
Are harness connectors plugged into each other properly?  
No  
Repair/replace harness that does not have  
Yes  

Does plow raise up?  
No  

See chart - Motor does not operate.
SNOW PLOW RAISE VERY SLOW M200

- Is fluid level 1/2" below filler hole?
  - Yes: Add UNiVS J13 oil.
  - No: Adjust relief valve to 1500 psi. Can it be done? Using a gauge in the pressure line, loosen the jam nut and turn adjusting screw clockwise a turn or two and watch the gauge; if it goes up, continue to turn the screw until the required setting is reached. Retighten the jam nut. (Hint: Check relief valve condition.)
  - Yes: Does pump shaft turn freely?
    - No: Replace pump. Clean/ replace suction filter. Change oil and flush system.
    - Yes: Does the motor armature turn tightly?
      - Yes: Replace motor.
      - No: Replace C cartridge valve.

R0
**SNOW PLOW WILL NOT LOWER M200**

Does B (valve) coil (yellow wire) have magnetism?  
- No
  - Replace cartridge valve B. Does plow lower down?  
    - No
      - Clean/replace flow control valve FC1. Does plow lower down?  
      - Yes
        - Replace coil B.  
          - Yes
            - Replace switch (control box).  
          - No
            - Is there power in each harness?  
              - Yes
                - Are harness connectors plugged into each other properly?  
              - No
                - Repair/replace harness that does not have power.  
        - No
          - Is there power to the B coil?  
            - Yes
              - Replace coil B.  
            - No
              - Is there power leaving switch (control box)?  
                - Yes
                  - Replace switch (control box).  
                - No
                  - Replace cartridge valve B. Does plow lower down?  

**SNOW PLOW LEAKS DOWN M200**

Fix any leakage from cylinder or fittings or hose. Is plow still going down?  
- Yes
  - Clean/replace B valve cartridge. Is plow still going down?  
    - Yes
      - Check check valve located at the bottom of pump base for dirt. Take out pieces and clean them. Does it still leak down?  
    - No
      - Lightly tap steel ball of check valve against aluminum seat in the pump base. Does it still leak down?  
        - Yes
          - Replace pump base.  
        - No
          - Check for bent or seized cylinder.  

**SNOW PLOW ANGLES BEFORE GOING UP WHEN UP SWITCH IS PRESSED M200**

If snow plow angles left before going up change D valve and if snow plow angles to right side change A valve.

**SNOW PLOW WHEN IT IS FULLY ANGLED GOES UP (WHEN ANGLE SWITCH IS PRESSED) M200**

Change C Valve cartridge.
SNOW PLOW DOES NOT ANGLE TO RIGHT SIDE M200

- Does the motor operate when angle switch is pressed?
  - No
  - Replace switch or replace control box.
  - Yes
  - Does motor operate when up switch (left/right) is pressed?
    - No
    - See chart - Motor does not operate.
    - Yes
      - No
      - Yes
      - Replace switch (control box).
      - No
      - See chart - Motor does not operate.

- Does A coil (green wire) have magnetism?
  - No
  - Is there power to A coil (green wire)?
    - Yes
    - Replace A coil.
    - No
    - Is there power leaving switch (control box)?
      - Yes
      - Is there power in each harness?
        - No
        - Are harness connectors plugged into each other properly?
          - Yes
          - Repair/replace harness that does not have power.
          - No
          - Change D cartridge valve. Does it angle to right side?
            - Yes
            - No
            - Change quick couplings. Does it angle to right side?
              - Yes
              - Check for a bent or seized cylinder.
              - No
              - Clean/replace cross over relief valves. Check setting 2000 psi. Does it angle to right side?
SNOW PLOW DOES NOT ANGLE TO LEFT SIDE M200

Does the motor operate when angle switch is pressed?

No

Does motor operate when up switch (left/right) is pressed?

Yes

Replace switch or replace control box.

No

See chart - Motor does not operate.

Is there power to D coil (red wire)?

Yes

Replace D coil.

No

Is there power leaving switch (control box)?

Yes

Are harness connectors plugged into each other properly?

No

Repair/replace harness that does not have power.

Is there power in each harness?

Yes

Change A cartridge valve. Does it angle to left side?

No

Change quick couplings. Does it angle to left side?

Check for a bent or seized cylinder.

No

Clean/replace cross over relief valves. Check setting 2000 psi. Does it angle to left side?

Yes

Does D coil (red wire) have magnetism?

No

Clean/replace PO check valve. Does it angle to left side?

No

Does D coil (red wire) have magnetism?

Yes

Replace D cartridge valve. Does it angle to left side?

Note: Before start troubleshooting check that plow moves up and down. If plow does not move up and down see "plow does not raise". 
PLOW DOES NOT HOLD ANGLE M200

Are cylinders spongy? Can blade be moved 2" to 6" by hand?

- No
  - Check cross over valves X1 and X2. Clean/replace. Replace seat if necessary. Check setting to 2000 psi. Does it hold angle?
  - No
    - Check pressure operated check valve PO. Clean/replace.

- Yes
  - Bleed air from cylinders. Check for any loose connections.