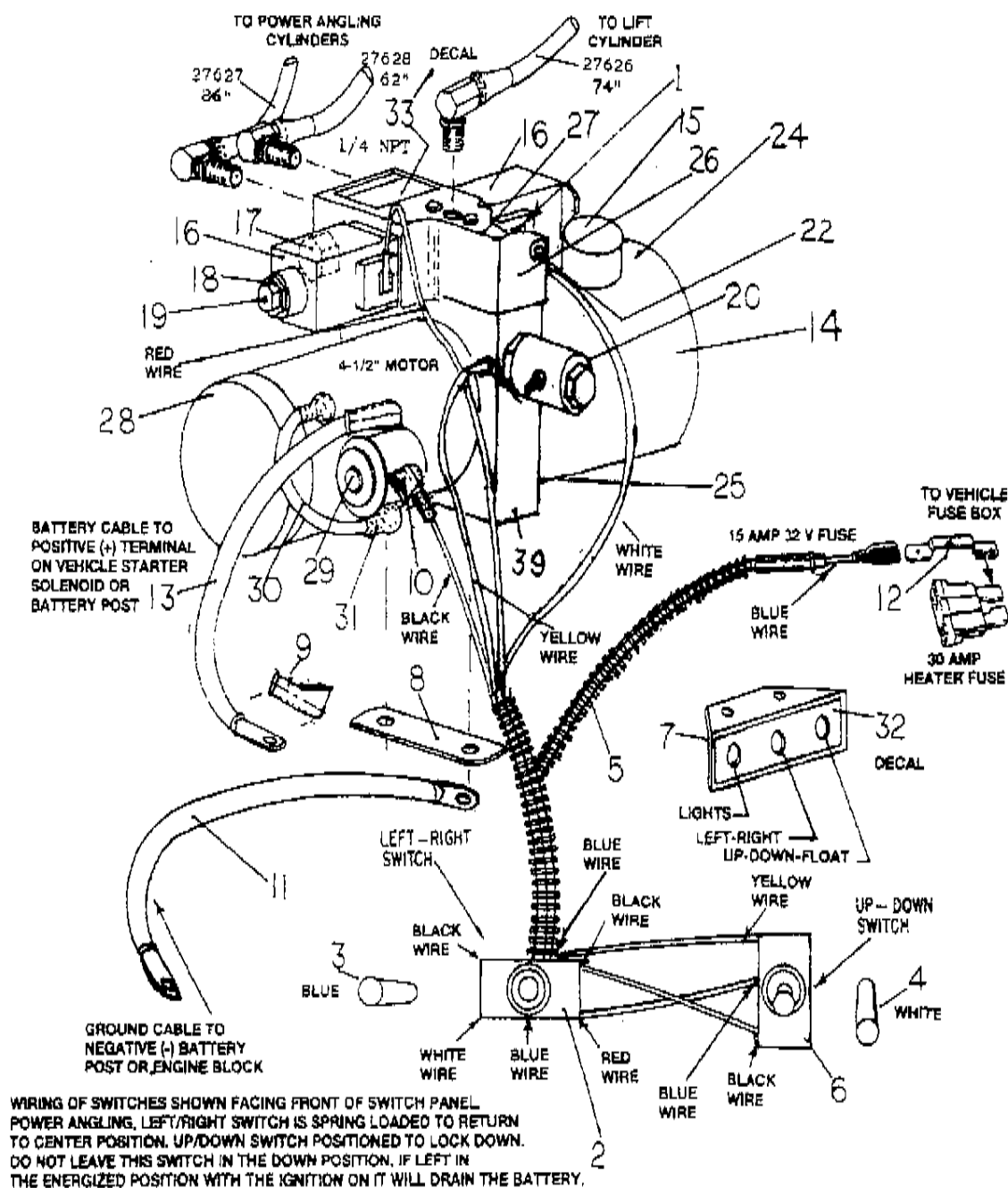


NORTHMAN SKN-C10813A

HYDRAULIC PUMP & CONTROLS

WIRING DIAGRAM & PARTS SHEET



**AFTER MOUNTING
PLEASE PLACE IN VEHICLE
GLOVE COMPARTMENT
FOR OWNERS USE**

NORTHMAN
SNOW PLOWS

NORTHMAN SNOWPLOWS • 712-258-5226 • 1600 W HIGHLAND AVE. • BOX 3008 • SIOUX CITY, IA 51102-3008

SKN-C10813A HYDRAULIC PUMP & CONTROLS PART LIST

REF NO:	DESCRIPTION:	PART NO:
1.	12 V. D.C. Hydraulic Pump Ass'y Only	10813A
2.	Power Angling Switch	26277
3.	Toggle Switch Extender, Blue	27070
4.	Toggle Switch Extender, White	27071
5.	Hyd Pump Wiring Harness Ass'y, 5 Wire, w/ Fuse	27606C
6.	Toggle Switch, Up/Down/Float position	27622
7.	In Cab Switch Bracket with Decal 30802	27687
8.	Spacer Plate, Installed beneath base of pump	27798
9.	Battery Cable Insulator Boot	38020
10.	Coil Nipple Insulator Boot	38021
11.	Ground Cable for Hydraulic Pump	38024
12.	Fuse Clip for Type ATO Automotive Fuse	38066
13.	Battery Cable, 72", 2 Gauge	40012
14.	Reservoir Plastic Only	997-685
15.	Breather Cap, Reservoir, Black Plastic	997-682
16.	Power Angling Solenoid, 12 Volt <i>OUT OF STOCK</i>	998-380 998-380
17.	Relief Cap Assembly, Power Angling	998-590
18.	Hex Nut, Power Angling Solenoid	998-385
19.	Pin, Internal, Power Angling Solenoid	998-383
20.	12 V D.C. NC 2P2W Poppet Cartridge Valve, Release	997-693
21.	Filter 100 Mesh Plastic Reservoir Only	997-683
22.	1/16 NPT Plumbing Plug, End Head Only	997-690
24.	Magnet, Located inside of Reservoir tank	998-125
25.	O-Ring, Reservoir Mounting	998-493
26.	Complete 4 Way Valve Ass'y w/ (2) Solenoids	998-113
27.	4 Way Valve Ass'y Less (2) 12 V. Solenoids	998-112
28.	12 V. D.C. 4 1/2" Diameter Electric Motor	998-126
29.	12 V. Solenoid Starter Switch Ass'y w/ Hardware	998-129
30.	Terminal Strap, Starter Switch to Motor	998-128
31.	Terminal Strap Boot	998-111
32.	Northman Switch Bracket Decal Only	30802
33.	10813A Hyd Pump Name Plate Decal, Northman	40091
34.	A.F.C. 2.0 Pump Ass'y only, In Reservoir	998-115
35.	Pump Shaft Oil Seal, Motor side of End Head	998-121
36.	5/16 NC-18 x 1 Torx Style Head Screw inside	997-694
37.	Pump Intake Cover & Filter Screen	998-119
38.	Washer, 5/8" O.D. (used w/Ref #36 & #37)	998-123
39.	Main End Head, Machined Valve Block only	997-699

PUMP PARTS NOT ILLUSTRATED ARE AS FOLLOWS:

Starter Solenoid Mtg. Screw 1/4 NC x 1/4" Hex Head	998-127
Northman Hydraulic Oil in one Quart Container	35355
Black Nylon Split Style Bushing	38028
Splined Coupling, 9 Tooth, Pump Shaft to Motor	998-118
O-Rings Under 4 Way Valve Complete Kit consists of:	997-689
(1) Large O-Ring 7/8" O.D.	999-015
(2) Medium O-Rings 5/8" O.D.	999-537
(1) Small O-Ring 3/8" O.D.	998-593
Fuse, 15 Amp 32 V, (311-3Ag) Wiring Harness	998-325
Spring & Ball Ass'y, Cross Over Relief Valve	998-589
Booster Spring for Cross Over Relief Valve	998-586
Fixed Relief Valve Ass'y (lower side of End Hd.)	997-695
Check Valve Ass'y	997-698
Spring & Ball Ass'y for Check Valve	997-691

**"TROUBLE SHOOTING SUGGESTIONS" FOR
THE NORTHMAN STOCK NUMBER 10813A
12 VOLT D.C. HYDRAULIC PUMP ASSEMBLY**



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NUMBER:**

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13. HOW TO REPLACE THE PUMP SHAFT SEAL.

NOTE: For Technical Information contact the Northman Product Office at 712-258-5226. For Hydraulic Pump Replacement Parts, contact your nearest Northman Distributor or call Northman direct at 712-258-5226 for information on the location of your nearest Northman Distributor.



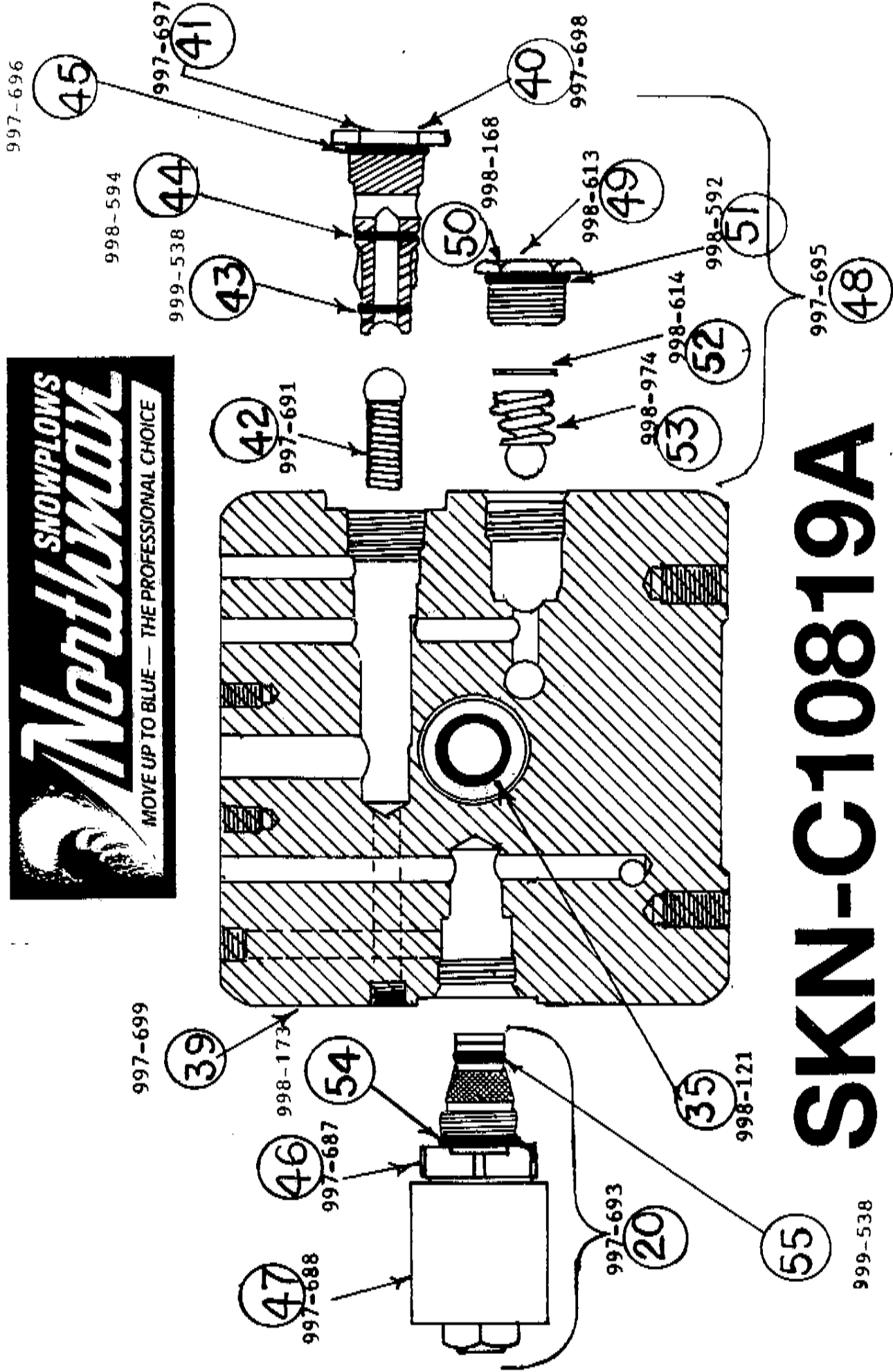
REGARDING NORTHMAN HYDRAULIC PUMP 10813A.
PROBLEM: PLOW WILL NOT STAY IN RAISED POSITION
SEE EXPLODED PARTS VIEW ON OPPOSITE SIDE.
SEE ALSO "TROUBLE SHOOTING" PROBLEM #1

REF:	PART NUMBER:	DESCRIPTION:
20.	997-693	DOWN/FLOAT CARTRIDGE VALVE ASS'Y WITH COIL
35.	998-121	PUMP SHAFT OIL SEAL (REFERENCE ONLY)
39.	997-699	MACHINED END HEAD CASTING FOR HYD PUMP
40.	997-698	CHECK & POWER BEYOND VALVE ASS'Y COMPLETE
41.	997-697	CHECK & POWER BEYOND VALVE, CAP ONLY
42.	997-691	SPRING & BALL ASSEMBLY FOR CHECK VALVE
43.	999-538	SMALL O-RING, 1/2" OD x 3/8" ID x 1/16" WALL
44.	998-594	MEDIUM O-RING, 5/8" OD x 1/2" ID x 1/16" WALL
45.	997-696	LARGE O-RING, .818" OD x .644" ID x .087" WALL
46.	997-687	DOWN/FLOAT CARTRIDGE VALVE ASS'Y, LESS COIL
47.	997-688	12 V D.C. COIL ONLY, FOR CARTRIDGE VALVE
48.	997-695	COMPLETE FIXED RELIEF VALVE ASS'Y, KIT
49.	998-613	FIXED RELIEF VALVE CAP WITH -O-RING
50.	998-168	FIXED RELIEF CAP ONLY, LESS O-RING
51.	998-592	RELIEF CAP O-RING, 5/16" OD 3/16" ID x 1/16"
52.	998-614	RELIEF VALVE SHIMS (USE QUANTITY AS NEEDED)
53.	998-974	SPRING & BALL ASS'Y, FOR FIXED RELIEF VALVE
54.	998-173	CARTRIDGE VALVE O-RING, 3/4" OD x 5/8" OD x 1/16"W
55.	999-538	SMALL O-RING, 1/2" OD x 3/8" ID x 1/16" WALL

1. If the Plow does not stay in the "RAISED POSITION" then you will need to check the following: (1.) Remove and inspect the Check Valve assembly (Ref #40). Use a thin wall 7/8" 1/2" Drive Socket Wrench and carefully turn the wrench counter clockwise. Place a container to catch the oil below the port. Check for possible Metal fillings on the very end of the Valve Seat and clean if necessary. Now check all of the o-rings as it may be possible for the Smallest one to be split, thus allowing the oil to bypass the valve assembly. Use a Pencil Magnet and remove the Spring & Ball Ass'y (Ref #42). Check it for possible metal fillings, clean it, and re-install it with the Spring in first and the Ball facing out. Re-fill the oil Reservoir, and then test the Hydraulic Pump for correct operation.

2. The Cartridge Valve Ass'y (Ref #46) may be stuck in the open position. It will have to be removed & checked if the Plow still refuses to stay in the raised position. Start by removing the Hex Nut on Valve Ass'y (Ref #20) and then slide the 12 Volt Coil (Ref #47) out of the way. Now Remove the Cartridge Valve (Ref #46) using a 7/8" Open End Wrench. Use caution and do not bend the stem portion of the Valve. Check the Screen for possible metal fillings or dirt and clean if necessary. Insert a small Phillips screwdriver into the small open end of the Cartridge Valve and gently move the inner plunger back and forth to make certain it moves freely. Check the two O-rings for possible damage. Replace any O-ring that may be broken in two. Now Replace the Cartridge Valve, The Coil, and the Hex Nut, using caution when doing so. Then Test Pump again.

3. Check for possible oil leaks in the Lift Cylinder Hose, The Quick Couplers on the Lift Hose, and the Lift Cylinder hose fitting as well as the Lift Cylinder Gland and seal. Loss of oil at any of these points will allow the plow to slowly drop.



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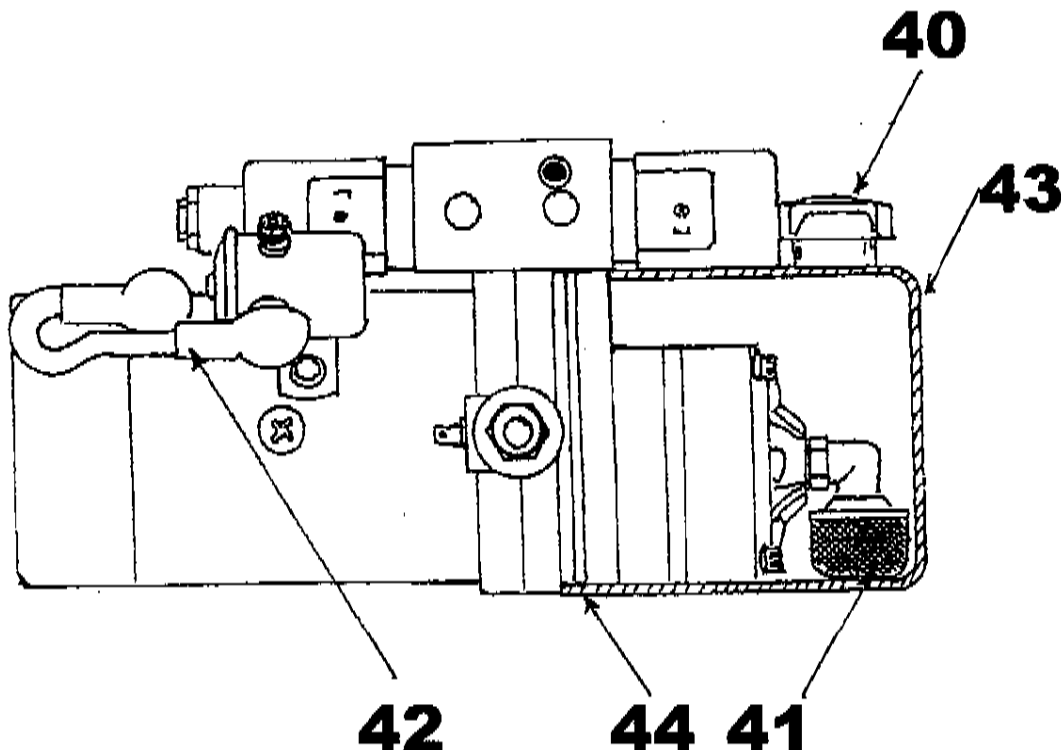
STOCK NUMBER 10813A

HYDRUALIC PUMP

NORTHMAN **SNOWPLOWS**

1997 NORTHMAN IMPROVEMENTS IN 12 VOLT D.C. HYDRAULIC PUMP ASSEMBLY, STOCK NUMBER 10813A PART OF COMPLETE HYDRAULIC PUMP BOX C10819A. FIVE NEW PART NUMBERS SHOWN BELOW.

NOTE: The five (5) part numbers listed below are for use exclusively with the 1997 Improved Hydraulic Pump Assembly with the new style see through plastic reservoir.



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STOCK NUMBER C10819A HYDRAULIC PUMP AND CONTROLS ADDITIONAL PARTS LIST FOR 1997 HYDRAULIC PUMP ONLY WITH PLACTIC RESERVOIR

<u>REF NO:</u>	<u>DESCRIPTION:</u>	<u>PART NUMBER:</u>
40.	Plastic Breather Cap for Reservoir	997-682
41.	Internal 100 Mesh Filter Screen	997-683
42.	Complete Cable Assembly with (2) Rubber Boots	997-684
43.	Clear Plastic Hydraulic Pump Reservoir	997-685
44.	#12-24 x .50" Hex Washer Head Reservoir Mounting Bolt (Not Shown)	997-686

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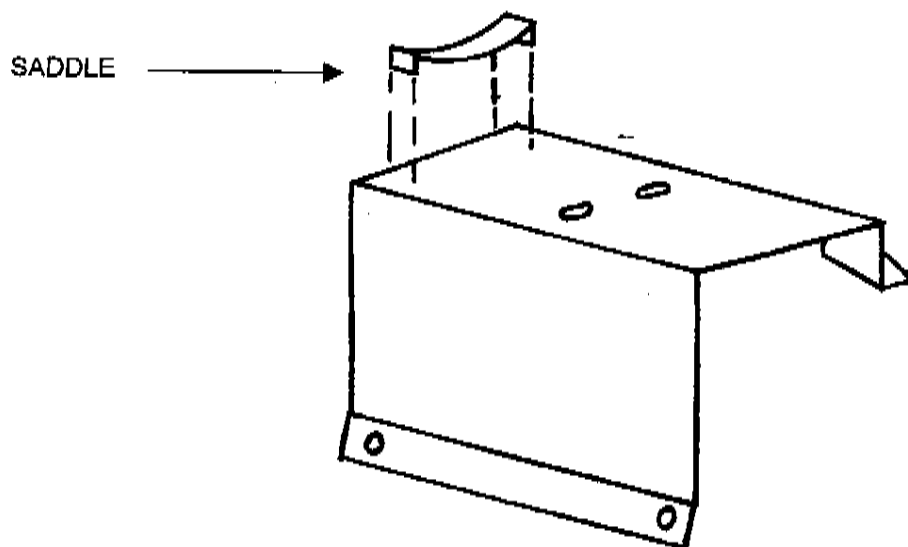
SNOWPLOWS

REGARDING NORTHMAN UNDERHOOD HYDRAULIC PUMP MOUNTING BRACKET WELDMENTS WHEN USED WITH THE 1997 HYDRAULIC PUMP ASSEMBLY 10813A WITH THE NEW STYLE PLASTIC RESERVOIR.

NOTE: On some Northman Hydraulic Underhood Pump Mounting Bracket Weldments it will be necessary to cut off the formed saddle where the Reservoir sets. The older 1996 Hydraulic Pump had a round black painted steel reservoir and would rest on the formed saddle.

The new style reservoir for the Northman 1997 Hydraulic Pump, Stock Number 10813A which is part of the final Hydraulic Pump Box and Controls, Stock Number C10819A, is a square style see through plastic reservoir. If this interferes with the saddle, cut it off and grind the weld down. Repaint with gloss black paint.

TYPICAL UNDERHOOD NORTHMAN HYDRAULIC PUMP MOUNTING BRACKET WELDMENT



NORTHMAN SNOWPLOWS • 712-258-5226 • 1600 W. HIGHLAND AVE. • BOX 3008 • SIOUX CITY, IA 51102-3008

PRODUCT UPDATE ISSUED 10/30/97
FORM 330651-01

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**"TROUBLE SHOOTING SUGGESTIONS" FOR
THE NORTHMAN STOCK NUMBER 10813A
12 VOLT D.C. HYDRAULIC PUMP ASSEMBLY**



PROBLEM # 1. LIFT CYLINDER WONT STAY UP.

1. Northman suggests that when you first mount the Snowplow, that you operate the Hydraulic Pump, with the Snowplow on, and raise and lower the Snowplow in rapid succession to get all of the accumulated air out of the Lift Cylinder and Lift Cylinder Hydraulic Hose. Now power angle the Plow from Left to Right for the same reason. Now lower the Plow to the ground placing the Switch in the "DOWN/FLOAT" position, and manually depress the Lift Channel. Always follow this procedure when checking the Oil level in the Reservoir. (Ref #29) Now add Northman Hydraulic Oil, if needed, to bring the Oil level up to within 1/2" to 3/4" from edge of Reservoir fill hole.
2. The most common cause of the Plow not staying in the Up position, can be found in the Hydraulic Pump Ass'y itself. The main problem can be traced to possible metal fillings in the Ball And Spring Ass'y (Ref #42). See Step # 2 of the "PRODUCT UPDATE", Form #330645-01.
3. The second most common cause of the Plow not staying in the up position can be traced to the O-Rings on the Check and Power Beyond Assembly. (Ref #40) The smallest O-Ring (Ref #43) could be the main culprit. See Step #2 of the "PRODUCT UPDATE", Form #330645-01 in regards to removal of the Check Valve Assembly. (Ref #40)- After you have removed the Check Valve, inspect all three of the O-Rings (Ref #43, Ref #44, & Ref #45). Reference #43 is the smallest of the Three O-Rings, and if it is in fact cut in two or broken, then it will allow oil to by pass the Ball & Spring Ass'y (Ref #42).
4. The "DOWN/FLOAT" Cartridge Valve Assembly, Less Coil, (Ref #46) may be stuck in the open position. See the "PRODUCT UPDATE" Form #330645, Step # 1 in regards to problems with the 12 Volt D.C. Normally Closed Cartridge Valve Assembly complete with the 12 Volt Coil. (Ref #20)
5. If further assistance or Technical help is needed, then call the Northman Product Office at Area Code 712-258-5226. Thank You.

**"TROUBLE SHOOTING SUGGESTIONS" FOR
THE NORTHMAN STOCK NUMBER 10813A
12 VOLT D.C. HYDRAULIC PUMP ASSEMBLY**



PROBLEM #2. PLOW RAISES TOO SLOWLY.

1. Make certain that the Hydraulic Lift Cylinder is in the fully retracted position with the Snowplow on the ground. With the Switch in the down, float position, completely depress the Lift Channel. Remove the Breather Cap (Ref #5) from the Oil Reservoir (Ref #29). Check the Oil level in the Reservoir. It should be within 1/2" to 3/4" down from the 3/8 NPT fill hole. Add Northman Hydraulic Oil only if necessary. Never check the oil level or add oil when the Lift Cylinder is in the "UP" position.

2. If the Oil level is extremely low, then check for leaks in the Hydraulic System. Check all hoses, Hydraulic Hose fittings, the Hydraulic Quick couplers at the ends of the Hydraulic Hoses, the three Hydraulic Hose ports on the Hydraulic Pump, and the Hydraulic Pump itself for Leaks. It may be possible for oil to be seeping out from under the Top Four Way Power Angling Valve Block Assembly. Adding oil to the Reservoir will not solve the problem if a leak exists. Low oil levels can starve the Pump and the Plow may raise very slowly, or not at all.

3. Check the Quick Coupler (If out front Pump Mounting Is used) on the Lift Cylinder Hose and make certain it is properly connected. Check inside of the Quick Coupler to determine if dirt or some other Contaminant is blocking the flow of oil. Clean out if needed.

4. Extreme below Zero Temperatures can Gel up some Hydraulic Oils or Transmission Fluid. Always use Northman Hydraulic Oil, Part Number 35355, as it is especially designed for cold temperatures, even as low as 50 Below Zero. When Hydraulic Oil begins to Gel up, it can not, and will not pump through the ports of the pump very fast, thus causing the plow to raise very slowly.

5. If the Inlet Filter Screen, (Ref #9) located inside of the Oil Reservoir (Ref #29) becomes plugged with dirt or other foreign matter, then the flow of oil will be restricted, thus causing the plow to raise or power angle slowly. See instructions on the "Cleaning of the Filter Screen inside of the Reservoir." This can be brought about by a Pump Being in Service for a long time and operated in dusty or dirty conditions.

6. Check the Vehicle Battery as very "Low Voltage" could cause a very slow operating 12 Volt D.C. Pump Motor.

7. The 12 Volt D.C. Motor may be near total failure or the Brushes may be almost worn out. Have your Distributor or an Electrical Service Center replace the Brushes if possible. Use Northman Brush Kit, Part Number 998-107, Field Kit Number (R-29). See also instructions following on "How to Replace the Brushes in the Hydraulic 12 Volt D.C. Pump Motor."

**"TROUBLE SHOOTING SUGGESTIONS" FOR
THE NORTHMAN STOCK NUMBER 10813A
12 VOLT D.C. HYDRAULIC PUMP ASSEMBLY**



PROBLEM #3. PLOW WILL NOT RAISE AT ALL.

1. The ignition switch must be turned on in order to operate the 12 Volt D.C. Hydraulic Pump Motor.
2. If you have the New Printed Circuit Board Northman Hand Held Electronic Pump Control, Part Number 45131, sold separately, then it too has to be turned on, as it has a "ON & OFF" switch located on the lower right side. When it is turned on a Green LED Light will come on and this means that the Snowplow can now be operated.
3. The wiring Harness inside of the Cab of the vehicle is hooked up to the Vehicle Fuse Box and has a 15 AMP Inline Fuse installed. If the Plow does not operate at all, then check this 15 AMP Fuse to determine if it is burnt out. If Necessary replace it with a Glass Type 15 AMP Automotive type fuse, Industry Standard Number 311-3AG, or Northman Part Number 998-325. If the Fuse continues to burn out, then this is a sign of other Electrical problems that will be covered later.
4. The Vehicle Battery may be dead, or the Battery Cable connections may be corroded or dirty, or the Ground Cable may also have rust or corrosion on it. Clean all Battery Cable & Ground Cable Connections.
5. The Harness Wire attached to the 12 Volt D.C. Coil (Ref #47) for the Down/Float Normally Closed Cartridge Valve Assembly (Ref #20) may be loose or disconnected. See the wiring instruction for the correct color of wire, either Yellow for Standard Northman Harnesses, or Brown for the Printed Circuit Board Type Controls.
6. Check the wiring on the back side of the Northman Toggle Switch (if applicable) in the Vehicle Cab on the Lift switch. There are only three wires on this switch, and if any one of them comes loose, or the wire breaks, then the plow will not raise. The color code for this wiring is as follows: Top: Yellow Center: Blue and Bottom: Black. All wires are to be on the same side and on the same set of three .250" Tab Connections for the switch.
7. The 12 Volt D.C. Start Solenoid Switch (Ref #14) may have Failed. You will hear a definite "CLICK" if it is operating properly. If you can hear the "CLICK" but the 12 Volt D.C. Motor won't run, then it may be possible for the Motor to be Burnt out, or the Brushes have worn out. Replace Brushes, if necessary, with Field Kit (R-29), Northman Part Number 998-107. See Instructions following on "How To Replace The Brushes in the Hydraulic 12 Volt D.C. Pump Motor."
8. Check Oil Reservoir to determine Hydraulic Oil Level. Only extremely low oil level would prevent the plow from raising. Fill oil level 1/2" to 3/4" from top of 3/8 NPT Reservoir fill hole if necessary. Make certain that the Lift Cylinder is in the down and fully depressed position before adding oil.

**"TROUBLE SHOOTING SUGGESTIONS" FOR
THE NORTHMAN STOCK NUMBER 10813A
12 VOLT D.C. HYDRAULIC PUMP ASSEMBLY**



PROBLEM #3. CONTINUED: PLOW WILL NOT RAISE AT ALL.

9. The Inlet Filter Screen (Ref #9) located inside of the Hydraulic Oil Reservoir may be plugged up and is not allowing the oil to be pumped out of the Reservoir with sufficient pressure to raise the Snowplow. This is very rare, and will only happen after years of use, or of use in extremely dusty or dirty conditions. See Instructions on "Cleaning of the Filter Screen inside of the Oil Reservoir."

10. Check the Outer Hex Nut on the 12 Volt D.C. Normally Closed Cartridge Valve Assembly (Ref #20). This must not be loose or the Down/Float Solenoid could loose it's ground and get stuck open in the Float Cycle. The hydraulic Oil will only circulate in the Pump and not raise the Plow.

11. See "PRODUCT UPDATE" Form Number 330645-01 for an Exploded Parts View of the Pump End Head Casting (Ref #39) and 12 Volt D.C. Down/Float Normally Closed Cartridge Valve Assembly for more information on why the plow will not go up or stay in the raised position.

12. If a Particle of Metal, or Casting gets trapped in the Ball & Spring Assembly, (Ref #42) this can also cause oil to circulate in the Pump and not allow the Plow to raise. To correct this problem, you will have to remove the Complete Check Valve Ass'y (Ref #40). Use a 1/2" Drive 7/8" Socket only, as an open end wrench will not fit on the thin headed Hex Head of the Check Valve. You may even have to grind the outer portion of the socket to fit if it is not a thin wall socket. Carefully set Check Valve aside. Use a pencil with a magnet on the end to get the Ball & Spring Ass'y (Ref #42) out. Clean it with a clean cloth and check for metal particles on the Ball and also check for a possible scratch as metal particles under pressure could scratch the Ball. Now replace the Ball & Spring. Check O-Rings (3) on Check Valve Ass'y (Ref #40) for possible dirt or metal Particles and also check the Valve Seat where the Ball from the Ball & Spring Sets for possible metal particles, and clean if necessary. Replace Check Valve and test Pump for Proper Operation.

Form-331228-01

**"TROUBLE SHOOTING SUGGESTIONS" FOR
THE NORTHMAN STOCK NUMBER 10813A
12 VOLT D.C. HYDRAULIC PUMP ASSEMBLY**



PROBLEM # 4. PLOW WILL NOT LOWER, OR LOWERS TOO SLOWLY.

1. The ignition Switch of the Vehicle must be on in order to operate the Hydraulic Pump Down/Float Solenoid (Ref #20) Cartridge Valve Ass'y. This Solenoid will make a definite "CLICK" when it is activated as it acts as a magnet and the inner plunger of the Valve will move, thus allowing the plow to drop.
2. Check the Outer Hex Nut on the 12 Volt D.C. Normally Closed Cartridge Valve Ass'y (Ref #20) as it must not be loose, or the Down/Float Solenoid could loose it's Ground and become inoperative when the plow is in the raised position.
3. The 12 Volt D.C. Coil (Ref #47) may have failed. This is not easy to determine, but, if you hit the Down/Float Switch, you should hear a "CLICK" and this sound means that the Solenoid Itself is in fact operating. If it has failed, then replace it with Part Number 997-688 (Ref #47).
4. The 12 Volt D.C. Normally Closed Cartridge Valve Assembly (Ref #46), Less Coil (Ref #47) may not be operating or may be simply stuck in the closed position and will not allow the oil to pass back through to the Reservoir thus lowering the Plow. To correct this problem, do the following: Remove the Outer Hex Nut and then remove the 12 Volt Coil (Ref #47) and set aside. Now remove the 12 Volt D.C. Cartridge Valve Only (Ref #46) from the End Head Casting (Ref #39) using a 1" Closed End Wrench. Be very careful when doing so and do not bend or damage the extended stem portion of the Valve when removing it. Now With the Cartridge Valve (Ref #46) in your hand insert into the open end a small Phillips Screw Driver and very gently move the Inner Plunger Back and forth to free it up. Check for possible metal particles on the small screen and clean off if necessary. Now replace the Cartridge Valve in the End Head Casting (Ref #39) and tighten securely using caution so as not to damage the Part. Replace the 12 Volt Coil (Ref #47) and secure with the Hex Nut. Now replace the Harness wire to the .250" Tab Extension of the 12 Volt Coil. Make certain that you replace any Hydraulic Oil in the Reservoir that was lost when you removed the 12 Volt D.C. Cartridge Valve. Now test the Pump again to determine if it will come down properly.
5. If the above does not solve the problem, then it may be necessary to replace the 12 Volt Cartridge Valve only, Less Coil.(Ref #46)
6. Check the Safety Chain that is normally hooked up out front for safety purposes. It may be simply possible that it is still hooked up and will not allow the plow to drop.

**"TROUBLE SHOOTING SUGGESTIONS" FOR
THE NORTHMAN STOCK NUMBER 10813A
12 VOLT D.C. HYDRAULIC PUMP ASSEMBLY**



PROBLEM #5. PLOW WILL NOT POWER ANGLE.

1. The Ignition Switch must be turned on in order to operate the 12 Volt D.C. Hydraulic Pump Motor. If you have the New Printed Circuit Board Northman Hand Held Electronic Pump Control, Part Number 45131, sold separately, then it too has to be turned on. It has an "ON/OFF" Switch located on the lower right side, and when the Green LED Light comes on, then the Snowplow can now be operated.
2. Check to see if the two wires are properly connected to the two 12 Volt D.C. Power Angling Coils (Ref #77). Check the Hex Nuts (Ref #80) and make certain that they are tightened securely and are not loose, as they can loose their ground and cause failure of the Power Angling Circuit.
3. If the Motor does not run (Ref #18), then it may be possible that the 12 Volt D.C. Starter Solenoid (Ref 14) to be burnt out. If you can hear the Solenoid "CLICK" when the Switch for Power Angling is activated, then this means that it is working. If the Lift Cycle fails to work at the same time, then this may mean that the 12 Volt D.C. Motor has failed. If the solenoid fails to operate, you can disconnect the Positive (+) Cable on one side of the Starter Solenoid (Ref #14) and touch it to the opposite post on the Starter Solenoid and the 12 Volt Motor should run. Hold this only for a second or two just to check the operation of the Motor. If the Motor does work, then replace the Solenoid Part Number 998-129.
4. If the Motor (Ref #18) and Starter Solenoid (Ref #14) are both working then the problem lies elsewhere. Check the Power angling Switch located inside of the Cab (Toggle Type only) and see if all of the six wires are properly connected. See the Northman Wiring Diagram for color coded wiring instructions for the Power Angling Toggle Switch. It is also possible for the switch to fail, if so replace with Northman Part Number 26277 Power angling Toggle Switch.
5. Check to see that the Hydraulic Quick Couplers on the Power Angling Hoses for the Power Angling Cylinders are properly connected. An improperly connected Quick Coupler will completely lock up the Hydraulic Cylinders by preventing the passage of Hydraulic Oil.
6. If the Motor is not operating, then it may be possible for the Inline 15 AMP Fuse on the wiring Harness inside of the vehicle Cab to be burnt out. This is located near the Vehicle Fuse Box on one wire leading to the Fuse Box itself. This is a 15 AMP Automotive Glass Type fuse, Industry Standard (311-3AG) or Part 998-325. Make certain that the wire leading to the Fuse Box is Properly connected to the Fuse Clip installed in the Fuse Box.
7. Check the Positive (+) Battery Cable to the Vehicle Battery and check for corrosion. Clean Cable if necessary. Also Check Ground Cable leading to the bottom of the Pump for corrosion and make certain that they are tight.

**"TROUBLE SHOOTING SUGGESTIONS" FOR
THE NORTHMAN STOCK NUMBER 10813A
12 VOLT D.C. HYDRAULIC PUMP ASSEMBLY**



PROBLEM #5 CONTINUED. PLOW WILL NOT POWER ANGLE.

8. One of the 12 Volt D.C. Power Angling Coils (Ref #77) may have burnt out and is not operating. You should be able to hear a "CLICK" when you activate the Power Angling Switch at the point of the Solenoid itself. (Ref #77) This means that it is operating. If you do not hear the "CLICK" on one side, then simply switch the two Solenoids (Ref #77) with each other. Now try angling the Plow again. If it now begins to angle in one direction only, then we can assume that one of the Coils is in fact burnt out. Replace the Coil with Northman Part 998-381.

9. If for some reason you find that the 15 AMP Inline Fuse in your Snowplow Wiring Harness continually burns out when you angle the Plow, then it is possible that the 12 Volt D.C. Coil (Ref #77) is shorting out inside. This is rare, but will normally happen on one side only. Switching the Solenoids with each other will normally help in locating the bad Solenoid. Replace it with Part 998-381.

10. One or more of the (4) main O-Rings for the 3 Position 4 Way Valve Assembly (Ref #72) may have blown out, thus causing loss of pressure. See O-Rings (Ref #65, #66, & #67). If a considerable amount of Hydraulic Oil can be seen running down on either the 12 Volt D.C. Motor (Ref #18) or the Oil Reservoir (Ref #29) then it is possible for one or more O-Rings to be leaking. Replace the O-rings if necessary. To do so, simply remove the two 1/4 NC-20 X 2 3/8" Hex Head Cap Screws (Ref #21) at the top of the 4 Way Valve Block Assembly (Ref #72). Be sure to replace them beneath the Valve Block (Ref #72) in the order shown, and securely tighten the two Hex Head Cap Screws. (Ref #21)

11. Check oil in Reservoir with the Plow down and the Lift Cylinder completely by pushing the Lift Channel down with the switch in the Down/Float position. Extremely low oil level could cause oil starvation and also could result with foaming of the Oil and loss of Hydraulic Pressure, as air can be pumped into the reservoir and displace the Hydraulic oil inside of it.

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PROBLEM #6. PLOW ANGLES TOO SLOW.

1. Always use Northman Hydraulic Oil, Part Number 35355, as it is especially designed for cold temperatures, even as low as 50 below Zero. Off brands of Hydraulic Oil and Transmission Fluid can gel up in severe cold weather, and thus make the Plow angle slower.
2. Check for low fluid level in Oil Reservoir (Ref #29) with the Plow down and the Lift Cylinder fully depressed. Put the lift switch in the Down/Float position and depress Lift Channel & Cylinder before checking oil. Add oil if necessary to within 1/2" to 3/4" of the Reservoir 3/8 NPT fill hole.
3. Check the Quick Couplers on the Hydraulic Hoses leading to the Power Angling Cylinders as the Quick Couplers may have dirt or some other foreign material in them causing them to stick half open. This can slow the flow of Hydraulic Oil to the Power Angling Cylinders. Make sure that they are clean inside and that the Ball portion of the Male Coupler is free of dirt or grit. Make certain that they are coupled together properly.
4. If the Vehicle Battery is extremely low on Voltage, then the 12 Volt D.C. Motor will run slow and the Hydraulic Pressure would be low because of it. This would in turn make the plow angle slow.
5. If the Battery is well charged and the 12 Volt D.C. Hydraulic Pump Motor (Ref #18) is running very slow then it's possible that the Brushes are almost worn out. Use Part Number 998-107 (Ref #3) Field Kit R-29. See trouble shooting suggestion on how to change the Brush Kit in the 12 Volt D.C. Hydraulic Pump Motor.
6. The Ball & Spring Ass'y (Ref #68) may be stuck open because of dirt or metal particles, or other foreign matter becoming stuck in the internal Valve Seat of the 4 Way Valve Ass'y. (Ref #72) The oil may be by passing the Ball & Spring. To check this out, Remove one Relief Cap Ass'y (Ref #69) on one side only. Next remove the Adjusting Screw (Ref #81) using a large Screwdriver and carefully count the turns of the slot and note how many turns it takes to remove it. Remove the two Springs (Ref #60 & Ref #68). Activate the Power Angling Circuit for one second to flush out the Valve Seat, while having someone hold a canister to capture the oil. Check the Ball and Spring (Ref # 68) and make certain that the Ball is not scratched, or that there are any metal particles on it. Replace all of the Parts and count the turns of the Adjusting Screw when you install it. Now close it off with the Relief Cap Ass'y (Ref #69). Now follow the same procedure for the opposite side.

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PROBLEM #7. PLOW WILL NOT REMAIN IN THE ANGLED POSITION.

1. It is normal for the Northman Plow to move or swing into a new angled position when you hit an obstruction. The Hydraulic Pump has a built in Safe Guard or Cross Over Relief System that allows the plow to angle when you hit an object and exceed the 2,100 PSI setting of the Cross Over Power Angling Relief Valves. This prevents injury to the occupants, and possible damage to the vehicle or the Snow Plow Mountings.
2. If for some reason the Relief Pressure setting falls way below 1100 PSI, for instance, you could experience conditions while simply plowing light snow that would allow the plow to angle by itself. The Cross Over Relief Pressure Settings can be adjusted by removing the two Relief Cap Ass'ys (Ref #69) from the 4 Way Valve Block (Ref #72), and turning the Adjusting Screws (Ref #81) in, using a large Screwdriver. For each complete full turn of the Screw, you will raise the Cross Over Relief Pressure Settings by as much as 100 PSI. Never turn this Screw in all the way, as it will bottom out the springs and may collapse them or damage them, and they will then have to be replaced. Do not exceed 2,100 PSI Factory Setting.
3. If the Cross Over Relief Settings can not be increased, then this may mean that after years of use the Springs have weakened. If Spring replacement is needed, then replace all of them, (2) Power Angling Cross Over Relief Booster Springs (Ref #60) and two Cross Over Relief Spring & Ball Ass'ys (Ref #68). A good rule of thumb when replacing the Springs is to simply turn the Adjusting Screws (Ref #81) in a full five (5) turns if you do not have a Pressure Gauge that you can install in the Power Angling Hoses at the point where they attach to the 4 Way Valve Block Assembly (Ref #72).
4. There is also the possibility that the Cross Over Relief Valves could be stuck open, and this would allow the plow to angle at any time, and could even be angled by hand with very little effort. To correct or check this out, you have to remove the Relief Cap Ass'y (Ref #69), the Adjusting Screws (Ref #81), and count the turns as you remove the Adjusting screw and write it down as you will have to reassemble it in the same manner. Now remove the Booster Spring (Ref #60) and Ball & Spring Assembly (Ref #68). NOTE: Do only one side at a time. Check the Ball and Spring and make certain that there no metal filings or dirt on the Ball itself, as this could cause the Valve to stick open. Now it will be necessary to flush out the Relief Valve seat in the 4 Way Valve Block (Ref #72) Use a container to catch the oil as it will be coming out under pressure. Hold the Can at the opening and have some one else hit the Power Angling Switch until you get a rush of oil out of the port. Do not hold the Angle Switch for more than two seconds. This will flush out any possible metal filing or dirt or other foreign material from the valve seat. Now reassemble the Cross Over Relief Valve by installing the Ball And Spring Ass'y (Ref #68), the Booster Spring (Ref #60), The Adjusting Screw (Ref #81) and the Relief Cap (Ref 69).

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PROBLEM #7. CONTINUED. PLOW WILL NOT REMAIN IN THE ANGLED POSITION.

5. Check for possible Hydraulic Oil leaks on Power Angling Hoses & Hose Fittings. Check for Leaks at the Hydraulic Hose Quick Couplers. Also check for leaks on the Power Angling Cylinder Glands & Packing. Make all repairs that are necessary as any loss of Hydraulic Pressure in any of the areas mentioned could allow the Plow to slowly move from any angled position when plowing snow.
6. Check for Hydraulic Leaks around and under the 4 Way Valve Block Ass'y (Ref #72) as it may be possible for one or more of the O-Rings (Ref #65, #66, or #67) to have extruded or moved out of position under pressure. This could also cause some other Hydraulic Problems such as loss of hydraulic Pressure in the entire system. If severe leakage is detected, then it will be necessary to remove the 4 Way Valve Block Ass'y (Ref #72). Start by Removing the two 1/4 NC-20 X 2 3/8" Hex Head Cap Screws (Ref #21). Carefully lift the 4 Way Valve Block (Ref #72) and inspect the O-Rings and be carefull not to drop them. If one or more look like they have been blown out of their position and are damaged, then they need to be replaced. (Ref #65) Smallest O-Ring is Part 998-593. (Ref #66) The two Medium size O-Rings are Part Number 999-537. (Ref #67) The Largest of the four O-Rings is Part Number 999-015. Replace the O-Rings if necessary and reassemble the 4 Way Valve Block to the Pump Ass'y.
7. NOTE: If the Problem persists and you need further Technical Assistance, please call the Northman Product Office at Area Code 712-258-5226. Thank You.

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PROBLEM #8. OWNER WANTS THE PLOW TO DROP SLOWER.

1. The amount of time the average 90" Snowplow takes to hit the ground from the fully raised position is about 1.2 Seconds. This is not as fast as you think as you can easily follow the plow to the ground with your eyes. Professional Snow Plow Operators want a "Fast" down time to reduce the amount of travel that the vehicle will take before the plow hits the ground while driving and plowing snow. They consider this lost time.
2. The taller Northman Magnum Snowplows and the 8 Ft and 104" Northman Magnum Snowplows are heavier and may drop a little faster, but the Hydraulic Pump itself restricts how fast the oil can return to the reservoir. Under very severe cold conditions the use of any other Hydraulic Oil than Northman Oil, which will not freeze up at even 50 Below Zero, may restrict the flow of oil to the Reservoir as it may thicken when severely cold. This oil, such as Dextron II, Transmission Fluid, is not recommended for severe cold weather performance. It will also restrict the Pumping action of the oil, and slower Power Angling & Lift Time will result.
3. The Northman Hydraulic Pump, Stock Number 10813A, has a Factory Set Down/Float Cartridge Valve and 12 Volt D.C. Coil Assembly (Ref #20) that can not be adjusted to slow the lowering time.
4. If as an Owner you still wish for a slower Snowplow Drop than you can order from Your Distributor Northman's Stock Number 11028A "Hydraulic Adjustable Flow Control Valve Kit." This can be installed to your Hydraulic Pump in the field or you could have your Northman Distributor install it. This Flow Control Valve restricts the return flow of Oil to the Reservoir and can be completely adjusted to suit your personal preference as to how slow you want your plow to drop. Instructions come with the Kit and may show it installed in a different Hydraulic Pump, but the principal is the same, simply install it in the top Port of your 10813A Hydraulic Pump. First remove the 1/4 NPT Lift Hose Fitting. Then install the 1/4 NPT 90 Degree Male Elbow Adapter, Part 36762, then the Adjustable Control Valve, Part 36761, with the Arrow showing the Flow pointing towards the Elbow Adapter & 1/4 NPT Port. Use Teflon Pipe Dope only on the Threads to prevent leakage. Never use Teflon Tape to seal the threads as minute portions could get into the pump and foul the Valves. Finally, reinstall the Lift Hose Fitting to the Flow Control Valve Part Number 36761. Install the flow control Handle on the Splined Shaft and loosen the Hex Nut to readjust the handle. Set the Flow by turning the handle either to the right or left. Now raise the Plow and let it drop. When it drops slow enough, tighten the Hex Nut on the Flow Control Valve to lock in the setting. Check for Hydraulic Leaks at all of the connections.

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PROBLEM #9. HOW TO CLEAN & FLUSH OUT THE HYDRAULIC PUMP ASS'Y

WITHOUT REMOVING IT FROM THE VEHICLE.

1. The Hydraulic Oil in the Reservoir of the Northman Hydraulic Pump may get dirty and contaminated from dirt particles from severe dusty conditions in times other than Winter. If the oil in the Reservoir needs to be changed, then it can be easily done without removing the Pump from the vehicle.
2. The easiest way to drain almost all of the Hydraulic Fluid out of the Reservoir (Ref #29) is to pump it out of the Lift Cylinder hose. Remove the Hydraulic Hose From the Lift Cylinder. In some cases this hose will have a Quick Coupler on it. If so, then remove the Quick Coupler so that the hose will be open inside. Now hold a clean can or canister under the Lift Hose and ask someone to hit the Lift Switch to pump out the Oil. Hold the switch only for a short time until Oil no longer comes out, then release switch. Replace the Quick Coupler, If applicable, and then replace the Lift Hose to the Lift Cylinder, using Teflon Pipe Dope on the Threads. Re-fill Reservoir with Northman Hydraulic Oil, Part 35355A to within 1/2" to 3/4" of the top of the fill hole.
3. To flush out the Port of the 12 Volt D.C. Normally Closed Down/Float Cartridge Valve Ass'y (Ref #20) do the following. Remove the 12 Volt D.C. Coil (Ref #47) by removing the Hex Nut first with an closed end wrench, and then sliding the Coil off of the Stem extension. To remove the 12 Volt D.C. Cartridge Valve Only (Ref #46), use a 1" Closed End Wrench with caution, and turn the wrench counter clockwise until the Valve Comes out. Handle it with care and do not drop it or bend it in any way. To flush out the Port, Hold a metal can or canister by the Port to catch the oil, and have someone else hit the Lift Switch to flush out the Port. Do not hold switch in the up position for more than 2 Seconds. Check the filter screen on the Cartridge Valve (Ref #46) for dirt or possible metal filings. Clean off if necessary with a clean dry rag. Now re-install the Cartridge Valve (Ref #46) to the Pump End Head (Ref #39) using the 1" Closed End Wrench. Replace the 12 Volt D.C. Coil (Ref #47) and secure with the Hex Nut removed earlier. Do not overtighten Hex Nut, but be sure it is secure.
4. To flush out the Check Valve Ass'y (Ref #40) you will need a 1/2" Drive 7/8" Thin Wall Socket. You may have to grind the outer portion of the socket to fit in the space of the End Head (Ref #39). Carefully remove the Check Valve Ass'y (Ref #40) and check it for possible metal particles. Wipe it clean with a clean dry rag. To remove the Ball & Spring Ass'y (Ref #42) you may need a Pencil Magnet to reach in the port and pull it out. After Removing it, carefully inspect if for metal particles or dirt and clean with a clean dry rag. Set it aside. Now use a metal can or canister to catch the oil at the open port, and have someone hit the Lift Switch to flush oil through the portage. Replace the Ball and Spring and Check Valve ass'y. Check Reservoir oil level and add Northman hydraulic oil if necessary to within 1/2" to 3/4" of fill hole.

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PROBLEM # 9 CONTINUED. HOW TO CLEAN & FLUSH OUT THE HYDRAULIC PUMP.

5. To flush out the 4 Way Valve Block Ass'y (Ref #34) and the two Cross Over Relief Valve Ports, remove the Relief Cap Ass'y (Ref #69) from one side of the 4 Way Valve block at a time. Remove the Adjusting Screw (Ref #81) using a large screw driver, and count the full turns as you remove it, in order to correctly re-install it. Remove both the Booster Spring (Ref #60) and the Ball & Spring Ass'y (Ref #68). Check for metal fillings, or a scratch on the Ball portion of the Ball & Spring Ass'y. Hold a metal can in front of the open Power Angling Relief Port and have someone activate the Power Angling Switch in the Cab of the Vehicle, for two seconds only, and flush out the Port with Hydraulic Oil. Replace all of the Parts starting with the Spring & Ball Ass'y (Ref #68), and Booster Spring (Ref #60), and then the Adjusting Screw (Ref #81). Turn the Adjusting Screw in counting the turns as you do so. A standard rule of thumb would be to turn it in 5 to 5 1/2 full turns. Now repeat the process with the other or opposite Relief Cap Assembly.

6. After Flushing the Ports check the Oil level in the Pump Reservoir making certain that the Plow is down and the Lift Cylinder depressed. To depress the Cylinder, put the Lift Switch in the Down "Float" position and press down on the Lift Channel until it stops. Remove the Breather Cap (Ref #5) from the Reservoir (Ref #29) and add Northman Hydraulic Oil, Part Number 35355A to Reservoir and bring the oil level up to within 1/2" to 3/4" from the edge of fill hole.

7. To clean the Reservoir, you have to drain out all of the oil first. See Item #2 on the preeceeding page for draining instructions. Start by removing the four Reservoir Mounting Screws (Ref #22) using a 5/16" Socket with a 1/4" Ratchet Wrench and a long extension. Use caution when replacing the Screws as you could break them off. Now with the Palm of your hand Tap the sides of the Reservoir to loosen it from the O-Ring (Ref #24) and draw it back being carefull not to spill any excess oil. Look for the Magnet (Ref #8) and remove it, clean it off, and return it to the mettalic part where it was attached. Now clean out the inside of the Reservoir. Check the Filter Screen (Ref #9) and clean if necessary. If the Filter Screen is collasped or totally plugged then replace it with a new Part Number 997-683. Replace the Screen. Re-install the Reservoir using the Mounting Screws removed earlier. Push Reservoir on over O-Ring and up against the End Head Casting (Ref #39) before installing screws. Add Northman Oil to Reservoir before running Hydraulic Pump Motor.

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PROBLEM # 10. RAISING THE PRESSURE SETTINGS ON THE POWER ANGLING

CROSS OVER RELIEF VALVES. (SEE ALSO PROBLEM #7)

1. In some instances of plowing in wet or heavy snow, the Operator of a Northman Snowplow will find that the Plow seems to angle on it's own. This is caused by exceeding the Cross Over Relief Pressure Settings set at the factory at 2,100 PSI. This is a normal occurrence as the Hydraulic Pump has this built in Safe Guard or Cross Over Relief System that allows the Plow to angle when you hit an object or exceed the Pressure Setting of 2,100 PSI. This prevents injury to the Occupants of the vehicle, and possible frame damage to the vehicle or the Snowplow Mountings, or to the Plow and other Snowplow Components.

2. To correct the problem of a Snow Plow that angles on its own too often, you can simply Adjust the Cross Over Relief Valve setting to a higher pressure setting. There two of these Relief Valve Adjusting Screws (Ref #81). In order to adjust them, you first have to remove the Relief Cap Ass'y with O-Ring (Ref #69). Use a 3/4" closed end wrench and carefully turn the Relief Caps counter clockwise and remove each one. For each 100 PSI setting of pressure, turn the Adjusting Screw (Ref #81) using a large screw driver, one full complete turn. Do not exceed more than 2,200 PSI Relief Valve Settings. Replace the Relief Caps (Ref #69) making certain that the O-Ring is properly in place when doing so. Tighten securely.

3. If the Relief Valve setting does not take affect, then it's possible for the Booster Spring (Ref #60) of the Ball & Spring Ass'y (Ref #68) to have Springs that have become weakened from years of use. If the Valves will not hold pressure, than it may be a good idea to replace both Parts, Booster Spring 998-586 ans Ball and Spring Ass'y (998-589). A good rule of thumb for setting the Adjusting Screw (Ref #81) is to turn it in a full 5 to 5 1/2 maximum turns to get close to the 2,100 PSI Factory Setting without using a inline Pressure Guage to check the pressure.

4. If metal filings get into the Cross Over Relief Valve Port, and on either the Ball from the Ball & Spring Ass'y (Ref #68) or the internal valve seat, then this could also be the cause of pressure drop on the Cross Over Relief Valve as this will hold the Ball away from the Valve Seat, thus allowing Oil to bypass the Relief Valve. This could result in a plow that would never stay in the angled position on one side only.

See Problem # 7 Step #4, Regarding Flushing of the Relief Valve.

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PROBLEM # 11. THE 12 VOLT D.C. ELECTRIC PUMP MOTOR DOESN'T RUN.

1. Make certain that the Vehicle Ignition is turned on, as it must be on in order for the Northman Hydraulic Pump To Run. In the case of the new style PCB Hand Held Northman Controls, there is an "ON, OFF" switch located on the lower right hand side of the In Cab Control and the "Green" LED Light will come on when the Hand Held Controls are operational. This also has to be turned on with the Vehicle Ignition.
2. Check the Vehicle Fuse Box where the Northman Main Wire Harness is connected, to determine if the Vehicle Automotive Fuse Has burnt out. Check also the 15 AMP Automotive Glass Type fuse in the wire leading to the Fuse box from the Northman Main Harness. It is located inside of the Black Plastic Fuse Retainer. Twist it to open and remove the Fuse. Replace it if necessary with an Industry Standard 15 AMP Automotive Type Glass Fuse Number 311-3AG.
3. Most failures of Motors not running can be traced to the Starter Solenoid. If a Starter Solenoid shorts out it can also burn out the 15 AMP Fuse in the Northman Harness. Have someone hit the Lift Switch as if to raise the Plow, making certain that the Ignition Switch is on, and listen at the Starter Solenoid on the Pump for a "CLICK". If you can hear it, then the Solenoid (Ref #14) is working properly, and the problem lies elsewhere. If you can not hear a "CLICK", then it's possible that the Starter Solenoid needs replaced. To simply test the Motor for operation, remove the Positive (+) long battery cable from the large Post of the Starter Solenoid (Ref #14). Pull back the Rubber Boot (Ref #26) from the other large Starter Solenoid Post and momentarily touch the Positive Battery Cable to this post, holding on to the black rubber outer casing of the Cable only. Now have someone hit the Lift Switch as if to raise the Plow, and if the Motor Runs, then the Starter Solenoid positively needs to be replaced. Replace with Part Number 998-129. This is also proof that the 12 Volt D.C. Electric Motor (Ref #18) is in fact operational.
4. Check all Battery Cables and Ground Connections. Clean all corroded Battery Cables, if necessary, and make sure that they are secure.
5. If your Vehicle has the Toggle Type Switches, then check all of the Wire Harness connections on the .250" Male Tabs at the rear of the Switches. Check also to determine if the Motor will run with all switches. It, for instance, the Motor will run for power angling the Plow, but will not run to lift the Plow, then this may mean that the Lift Switch, Part Number 27622, has failed. If the Power Angling does not operate, but the Lift Switch can start the 12 Volt Motor, then the Power Angling Switch may have failed. Replace it with Part Number 26277.
6. The Motor Brushes inside of the 12 Volt D.C. Motor may be worn out. This may happen after years of use. See Problem #13 on how to replace the Brushes Part Number 998-107 Field Kit (R-29).

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PROBLEM # 12. REPLACING THE 12 VOLT D.C. ELECTRIC MOTOR 998-126.

1. To replace the 12 Volt D.C. Electric Motor on Stock Number 10813A, do the following. Start by disconnecting the Positive (+) Battery cable from the Vehicle Battery, or disconnect the Positive (+) Battery Cable coming from the Hydraulic Pump Starter Solenoid to the Vehicle Battery. Pull back the Terminal Strap Boot (Ref 26) from the Terminal Post of the 4 1/2" Electric Motor (Ref #18) and remove the Hex Nut and the Terminal Strap (Ref #25) from the Motor.

2. Remove the 12 Volt D.C. Starter Solenoid Switch Ass'y (Ref #14) from the 4 1/2" diameter Electric Motor (Ref #18) by removing the two 1/4" Solenoid Mounting Screws (Ref #10). Retain the Screws. Allow the Solenoid & Terminal Strap to hang loose for now.

3. Remove the End Cap from the Electric Motor (Ref #18) by removing the two Phillips Head Screws. Now carefully remove the two long 1/4" Through Bolts holding the Motor to the End Head Casting (Ref #39). Slide the Motor back and away from the Pump End head Casting being careful not to drop the Pump Shaft Coupling (Ref #2). If the Coupling comes off with the Motor, then remove it from the Motor Armature Shaft and slide it back onto the splined shaft of the Pump Assembly (Ref #28).

4. Install the New Motor Ass'y (Ref #18), Part Number 998-126, remove the Electric Motor End Cap by removing the two Phillips Head Screws. Before Proceeding, remove the two Hex Nuts holding the two 1/4" Long Through Bolts to the Motor Ass'y. Use extreme Caution when removing these Hex Nuts so as not to allow the Motor to come apart. Now slide the splined shaft of the Motor Armature into the Splined Pump Shaft Coupling (Ref #2) that was installed earlier. Line up the two 1/4" Through Bolts of the Motor with the two threaded 1/4 NC-20 Holes in the End Head Casting (Ref #39). Tighten bolts securely making certain that the Terminal Post of the Motor is in the correct position. Replace the Motor End Cap using the two Phillips Head Screws removed earlier.

5. Install the 12 Volt D.C. Starter Solenoid Switch Assembly (Ref #14) with wiring attached, to the 12 Volt D.C. Motor (Ref #18) using the two 1/4" Solenoid Mounting Screws. (Ref #10) Attach the Terminal Strap (Ref #25) to the Side Post of the Motor Assembly using the existing Hex Nut on the Motor Post. Slide the Terminal Strap Boot (Ref #26) out over the end of the Terminal Strap and the Hex Nut on the Terminal Post of the Motor assembly.

6. Connect the Positive (+) Battery Cable of the Vehicle Battery, or the Positive Cable (+) coming from the Hydraulic Pump Assembly Starter Solenoid Post to the Vehicle Battery. Now turn on the Vehicle Ignition and test the Hydraulic Pump Ass'y to determine if the 12 Volt D.C. Electric Hydraulic Pump Motor is in fact running properly. Make certain that all wiring is connected before doing so. Make certain that all Battery Cable connections are clean.

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PROBLEM #13. HOW TO REPLACE THE PUMP SHAFT SEAL.

1. The Pump Shaft Seal is located in the Reservoir end of the End Head Casting (Ref #39) and prevents leakage of Hydraulic Oil past the 1/2" diameter shaft of the Hydraulic Pump Ass'y (Ref #28). If Hydraulic Oil is ever detected leaking out around the face of the 12 Volt Motor (Ref #18) where it is bolted to the End Head Casting (Ref #39), then it's possible that the Seal (Ref #35) is allowing oil to get past the Pump Shaft. If so, then it must be replaced immediately to prevent damage to the Armature of the 12 V D.C. Motor.
2. To remove the seal, it will be necessary to drain out all of the Hydraulic Oil in the Reservoir. You can pump it out of the Lift Hose out front by removing it from the Cylinder and taking off the Quick Coupler, or fitting. Then use the Lift Switch to activate the Pump Motor and pump out the oil into a clean container. Now Remove the four Reservoir Mounting Screws (Ref #22) and set them aside. Now gently tap the sides of the Reservoir (Ref #29) and remove it from the End Head Casting (Ref #39). NOTE: Remove Positive (+) Battery Cable from Vehicle Battery at this time.
3. Remove the two Torx Bolts (Ref #13 & Ref #17) along with the Flat Washer (Ref #6), and the Suction Cover (Ref #12) from the Pump Ass'y (Ref #28). Now remove the two 5/16 NF-24 X 3" Torx Head Bolts (Ref #4) from the 2.0 AFC Pump Ass'y (Ref #28) and pull the Pump Ass'y (Ref #28) carefully back out and away from the End Head Casting (Ref #39). On the opposite side of the End Head Casting is a 9 Tooth Coupling (Ref # 2), and if it falls out of place on the Armature Shaft of the Motor, then the 4 1/2" Motor (Ref 18) may have to be removed also because of it.
4. If it is necessary to remove the 12 Volt D.C. Electric Motor (Ref #18), then see Problem # 12 on previous page.
5. The Pump Shaft Seal (Ref #35) must be taken out on the side of the End Head Casting (Ref #39) where the Reservoir was. If the 12 Volt D.C. Motor has been removed, then you can tap the Seal out by using a flat end type of punch or round block of wood. Do not damage the casting where the Seal is Seated. Now Press, or tap in gently one New Seal (Ref 35), Part Number 998-121. Do not hammer directly on the Seal as it could be damaged or distorted. If the Motor has not been removed, then gently pry out the Seal (Ref #35).
6. Insert the Splined Shaft of the Pump Ass'y (Ref #28) very carefully through the center hole of the Seal (Ref 35) and into the Coupler (Ref #2), if the Motor is still in place, lining up splines of the Coupler and Shaft. The Hydraulic Pump must be installed, as shown, with the shaft extension at the top. Secure the Pump Ass'y (Ref #28) to the End Head Casting (Ref #39) using two 5/16" X 3" Torx Head Bolts (Ref #4). Then install the Suction Cover (Ref #12) using the two Suction Cover Bolts (Ref #13 & Ref #17) as shown.
7. Install the Reservoir (Ref #29) using four Reservoir Mounting Screws. (Ref #22) being careful not to over tighten the Screws.