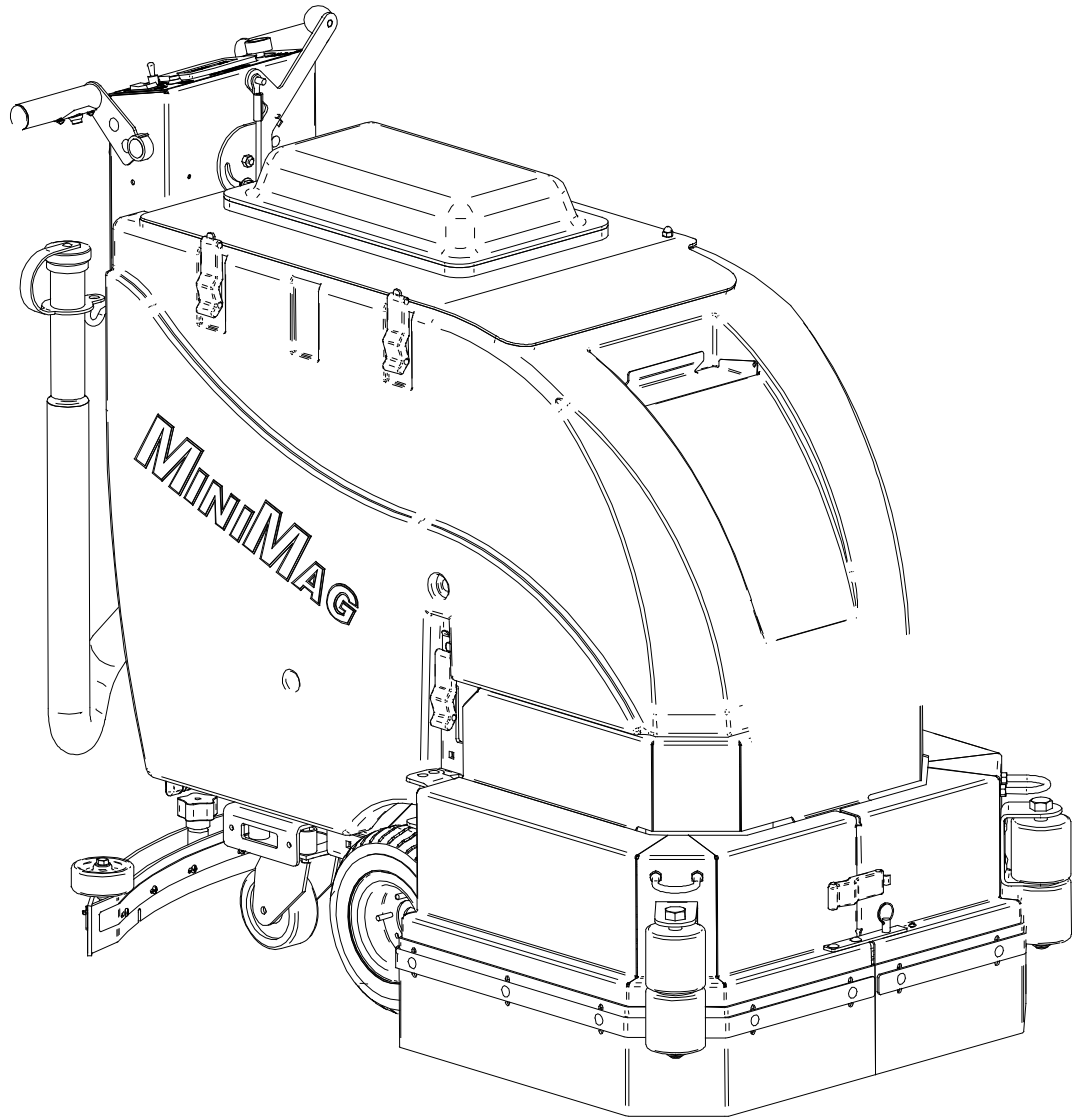


MINI-MAG SERIES



R.P.S. Corporation
P.O. Box 241
Racine, Wisconsin

Phone: 1-800-634-4060
Fax: 1-866-632-6961

Factory Cat/Tomcat service manuals are intended for use by professional, qualified technicians. Attempting repairs or service without the appropriate training, tools, and equipment could cause injury to you or others and damage to your piece of equipment that may cause it not to operate properly

This manual should be kept in a convenient place for easy reference. When properly used, it will meet the needs of technicians and equipment owners.

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As our policy is one of constant improvement, all specifications are subject to change without notice.

CAUTION!

To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed:

Proper service and repair are important to the safety of the service technician and the safe reliable operation of all cleaning equipment. If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part. Do not use replacement parts of lesser quality.

The service procedures recommended and described in this service manual are effective methods of performing service and repair. Some of these procedures require the use of tools specifically designed for the purpose.

Accordingly anyone who intends to use a replacement part, service procedure or tool which is not recommended by the equipment manufacturer, must determine that neither his safety nor the safe operation of the equipment will be jeopardized by the replacement part, service procedure or tool selected.

It is important to note that this manual contains various cautions and notices that must be carefully observed in order to reduce the risk of personal injury during service or repair, or the possibility that improper service or repair may damage the piece of equipment or render it unsafe. It is also important to note that these 'Cautions' and 'Notices' are not exhaustive, because it is impossible to warn of all the possible hazardous consequences that might result from failure to follow these instructions.

SAFETY PRECAUTIONS

- Hazardous voltage. Shock, Burns or electrocution can result. ALWAYS disconnect the batteries before servicing machine.
- Batteries emit hydrogen gases, explosion or fire can result. Keep sparks and open flame away!
- Charge unit in a well ventilated area and keep battery compartment open when charging or explosion or fire could result.
- Battery acid can cause burns. Wear protective face-shield and gloves when servicing batteries.
- Do not store outdoors or pressure wash. Prevent from getting electrical components wet.
- The use of parts and solutions other than recommended by the manufacturer may cause property damage, bodily injury or death to yourself or others.
- Dress safely. Do not wear rings, watches or other jewelry while working on this machine. They can cause an electrical short which can cause serious burns, other injury or death.
- Do not work on this machine while wearing a tie, scarf, hat or any other loose or dangling neck wear or clothing. Loose clothing can tangle or catch on rotating parts causing serious injury or death.
- Do not use this machine as a ladder or a chair.
- Operate this machine only from the operators position.
- This machine was not designed to carry passengers or transport cargo.
- Do not operate this machine on steep ramps or uneven surfaces. When climbing a ramp always drive the machine forward straight up or down the ramp. Never drive across the incline.
- Do not back down or turn on ramps!
- Always use the charger provided by the manufacturer to charge the machine. It is an automatic charger specifically designed to charge at the appropriate rate. If you must use a different charger, disconnect the batteries from the machine as this will protect the on-board electronics.
- Understand the dynamic breaking system before you operate the machine on ramps or slopes.
- Do not park the machine on ramps or slopes
- Do not operate the machine if any parts have been removed or damaged.
- Do not remove, paint over, or destroy warning decals. If warning decals become damaged they must be replaced.
- Do not operate machine in an unsafe condition. If the machine is need of repair or is in anyway unsafe to operate, the matter should be reported immediately to the shift supervisor. Do not operate the machine until it is returned to proper operating condition.
- This machine must be operated only by a trained operator. As part of their training they must read the operators manual thoroughly. If extra copies are needed contact your local dealer.
- Always park machine on a level surface and turn the power off before leaving it unattended.
- Do not operate over electrical floor outlets. This may result in serious injury or death to the operator and others.
- Do not work under machine without it properly supported on suitable safety stands.
- Do not try and lift this machine unaided it is very heavy.
- Do not use handle bars or steering mechanism as a lifting point

SAFETY MESSAGE

Your safety and the safety of others is very important and operating this unit safely is an important responsibility.

To help you make informed decisions about safety, we have provided operation procedures and other safety information in this manual. This information informs you of potential hazards that could hurt you or others.

It is not practical or possible to warn you of all the hazards associated with operating this unit. You must use your own good judgement.

This machine is intended for commercial use. It is designed to be used on hard floors only and in an indoor environment, with the recommended pads and brushes with approved cleaning solutions.

DO NOT OPERATE THE UNIT:

UNLESS TRAINED AND AUTHORIZED.
UNLESS OPERATOR MANUAL IS READ AND UNDERSTOOD.
IF UNIT IS NOT IN PROPER OPERATING CONDITION.

WHEN OPERATING UNIT:

WEAR PROPER PROTECTIVE EQUIPMENT.
REMOVE LOOSE OBJECTS FROM THE FLOOR THAT MAY BE PROJECTED FROM THE REVOLVING BRUSHES.
DO NOT OPERATE THE MACHINE WHERE FLAMMABLE LIQUIDS OR GASES ARE PRESENT.
USE EXTREME CAUTION WHEN MANEUVERING.
MAKE SURE ALL PERSONS ARE A SAFE DISTANCE FROM THE MACHINE WHILE IN OPERATION.

BEFORE LEAVING THE UNIT:

PARK MACHINE ON A LEVEL SURFACE.
MAKE SURE MACHINE IS TURNED OFF.
DISCONNECT BATTERIES.

BEFORE SERVICING:

STOP ON A LEVEL SURFACE AND SECURE MACHINE.
DISCONNECT BATTERIES.

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MAINTENANCE

MAINTENANCE SCHEDULE

MAINTENANCE SCHEDULE	DAILY	WEEKLY	MONTHLY	EVERY 200 HRS
Charge the batteries	X			
Inspect pad or brush condition	X			
Drain and clean out tanks and hoses	X			
Clean float screen & drain saver in recovery tank	X			
Remove and clean squeegee tool. Inspect for wear or damage.	X			
Wipe down outside of machine	X			
Check battery electrolyte level in all cells		X		
Check all skirts and wipers on machine		X		
Check batteries and terminals for irregularities		X		
Lubricate machine			X	
Check carbon brushes on motors				X
Blow out dust from motors			X	

ATTENTION!

Make sure machine is turned off and the batteries are disconnected before performing any repairs or service on the machine!

Your machine is equipped with up to four brush-type electric motors that require periodic inspection to assess wear. Failure to inspect on regular intervals can result in motor damage that is not covered under warranty.

LUBRICATION

The machine requires periodic lubrication on each grease fitting on the machine and oiling of some pivot points and threads. Once a month is generally acceptable unless the machine is used in a severe duty application.

The grease fittings are located on:
Rear casters

The following points to be oiled lightly are:
Squeegee knob threads
Squeegee adjustment threads
Squeegee pivot points
Brush head pivot points

1 MAINTENANCE

MINI-MAG Series PREVENTIVE MAINTENANCE WORKSHEET

CUSTOMER INFORMATION		
CUSTOMER		
ADDRESS		
CITY	STATE	ZIP CODE

MACHINE INFORMATION	
MODEL #	SERIAL #
WORK ORDER#	HOUR METER:

BATTERY CONDITION	Cell #1	Cell #2	Cell #3	Cell #4	Cell #5	Cell #6
Battery # 1 Hydrometer						
Battery # 1 Water Condition						
Battery # 2 Hydrometer						
Battery # 2 Water condition						

Clean Battery Tops. Check Battery Cable and Terminal Condition
NOTES:

BRUSH CONDITION			
Scrub Brush Fiber Length		Rotated Brushes	
Brush Drive Sockets	Good	Worn	Needs Replacement
Drive Hubs	Good	Worn	Needs Replacement

CHECK OPERATION AND CONDITION OF:	IN SPEC	REPAIR	PROBLEM
Main Power Switch or Key Switch			
Handle Bar Switches			
Speed Potentiometer			
Reverse Switch			
LCD Display			
Page Switch			
Brush Pressure Switch			
Brush Pressure Managers Lock Out			
Reverse Switch			
Brush Switch			
Brush Deck Lift System			
Brush Motor			
Brush Drive Belt			
Solution Potentiometer			
Solution Solenoid			
Vacuum Switch			
Vacuum Motor Performance			
Vacuum Filter			
Recovery Drain Hose & Plug			
Squeegee Lift System			
Squeegee Adjustment			

MINI-MAG Series
PREVENTIVE MAINTENANCE WORKSHEET

CHECK OPERATION AND CONDITION OF:	IN SPEC	REPAIR	PROBLEM
Spray Jet Switch			
Spray Jet Pump, Hose & Nozzle			
Battery Charger Connectors			
Battery Charger			

CLEAN AND/OR LUBRICATE	IN SPEC	REPAIR	PROBLEM
Solution Filter			
Squeegee Pivot Points & Knobs			
Scrub Deck Linkage			
Caster grease fittings			
Squeegee Knob Threads			
Squeegee Pivot Points			
Brush Head Pivot Points			

VISUALLY INSPECT:	IN SPEC	REPAIR	PROBLEM
Solution Tank Condition			
Recovery Tank & Lid Condition			
Drain Saver			
Vacuum Float			
Vacuum Motor Brushes			
Vacuum Hoses			
Vacuum Filter			
Solution Hoses			
Squeegee Tool and Throat			
Squeegee Blades			
Blade retainers & Hardware			
Squeegee Wheels			
Brush Skirts			
Brush Motor Brushes			
Brush or Pad Driver Condition			
Drive Wheel Condition			
Caster Condition			

COMMENTS

Technician's Name _____

Technician's Signature _____

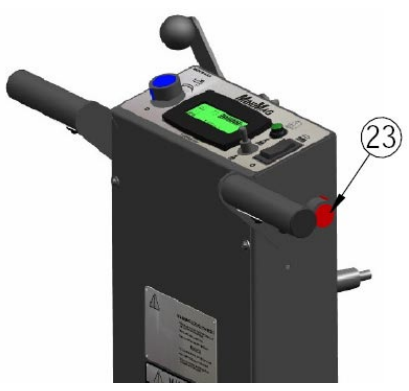
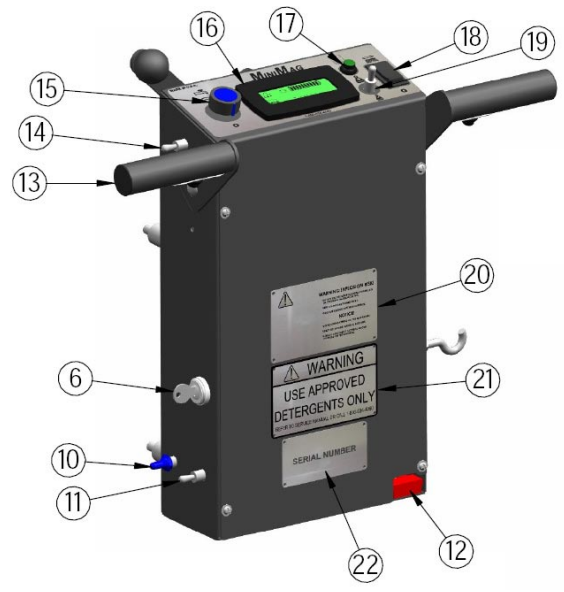
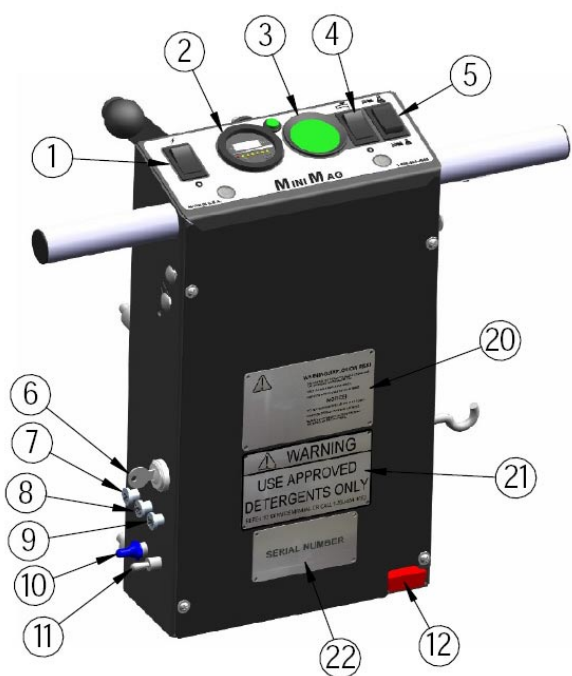
Date _____

Customer's Name: _____

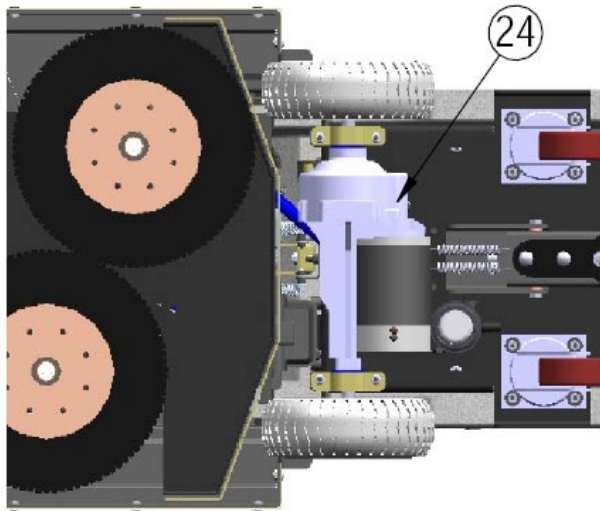
Customer's Signature _____

Date _____

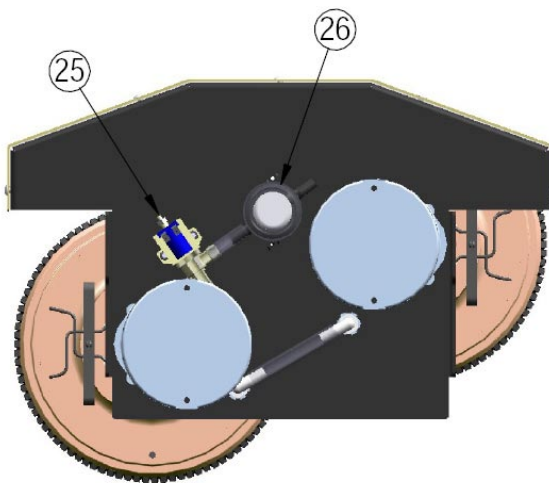
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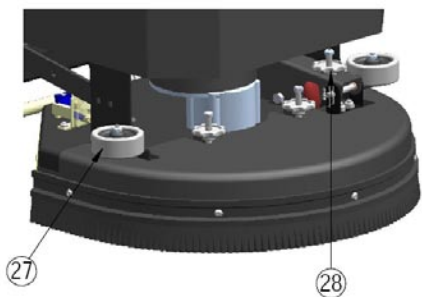
1. MAIN POWER SWITCH
2. BATTERY GAUGE
3. SCRUB DECK DOWN PRESSURE GAUGE
4. SPRAY JET SWITCH
5. SCRUB DECK SWITCH
6. KEY SWITCH (OPTIONAL)
7. CIRCUIT BREAKER - 2 AMP
8. CIRCUIT BREAKER - 25 AMP
9. CIRCUIT BREAKER - 40 AMP
10. SPRAY JET SWITCH - (BLUE)
11. FUTURE USE
12. CHARGER PORT
13. HANDLE BAR
14. FORWARD/REVERSE SWITCH - (RED)
15. SOLUTION FLOW CONTROL KNOB
16. LCD SCREEN
17. PAGE BUTTON
18. SCRUB DECK SWITCH
19. DOWN PRESSURE TOGGLE SWITCH
20. WARNING PLATE
21. WARNING PLATE
22. SERIAL NUMBER PLATE
23. SPEED CONTROL KNOB



24. TRACTION DRIVE

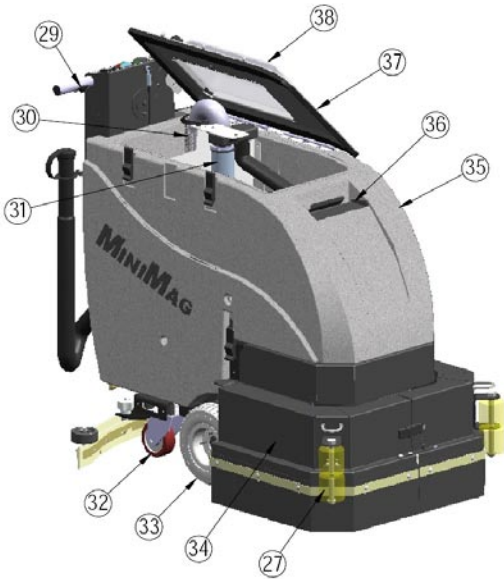


25. SOLUTION FLOW VALVE
26. SOLUTION FILTER

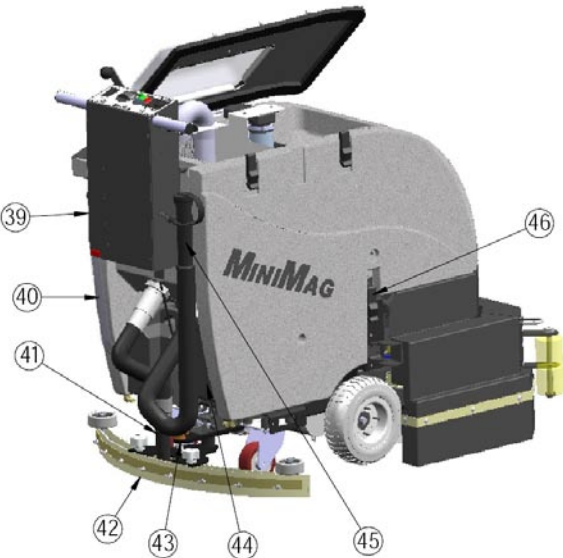


27. WALL ROLLERS
28. "PAD ASSIST" DRIVE ADJUSTMENT KNOB

BODY



- 29. DRIVE BUTTON
- 30. "DRAIN SAVER" STRAINER
- 31. VAC SCREEN
- 32. CASTER
- 33. MAIN TIRE
- 34. JAWS
- 35. TANK IN A TANK
- 36. SOLUTION FILL ID
- 37. RECOVERY LID
- 38. CLEAR COVER



- 39. CONTROL PANEL
- 40. SOLUTION LEVEL DRAIN TUBE
- 41. VACUUM HOSE
- 42. SQUEEGEE BLADE
- 43. SQUEEGEE PITCH ADJUSTMENT
- 44. "ON-BOARD" BATTERY CHARGER
- 45. RECOVERY DRAIN HOSE
- 46. TANK LATCH

1. MAIN POWER SWITCH: Turns the machine on and off.
2. BATTERY GAUGE: Indicates the amount of battery charge remaining.
3. SCRUB DECK DOWN PRESSURE GAUGE: Indicates the amount of down pressure being applied to scrub deck.
4. SPRAY JET SWITCH (BLUE): Turns spray jet pump on,
5. SCRUB DECK SWITCH: Raises and lowers the scrub deck and controls amount of down pressure being applied.
6. KEY SWITCH (OPTIONAL): Provides key access to turn machine on and off.
7. CIRCUIT BREAKER - 2 AMP resetable circuit breaker - Brush deck actuator
8. CIRCUIT BREAKER - 25 AMP resetable circuit breaker - Vacuum motor
9. CIRCUIT BREAKER - 40 AMP resetable circuit breaker - Brush deck motor
10. SPRAY JET SWITCH - (BLUE): Turns spray jet pump on,
11. FUTURE USE
12. CHARGER PORT: Connection port for attaching external battery charger. NOTE: Only use charger provided (24 VOLT ONLY!).
13. HANDLE BAR: Adjustable handle bar.
14. FORWARD/REVERSE SWITCH - (RED): Controls the direction of travel for the machine.
15. SOLUTION FLOW CONTROL KNOB: Controls the volume of solution dispensed by the scrubber.
16. LCD SCREEN: Displays status, settings and function states of the machine.
17. PAGE BUTTON: Scrolls through information on the LCD Screen.
18. SCRUB DECK SWITCH: Raises and lower the scrub deck
19. DOWN PRESSURE TOGGLE SWITCH: Controls the down pressure placed on the scrub deck.
20. WARNING PLATE: Relays precautions regarding the machine and/or its operation.
21. WARNING PLATE: Relays precautions regarding the machine and/or its operation.
22. SERIAL NUMBER PLATE: Machine identification
23. SPEED CONTROL KNOB: Controls the speed of the traction drive.
24. TRACTION DRIVE: Propels machine forward and backward
25. SOLUTION FLOW VALVE: Meters the flow of solution out the machine.
26. SOLUTION FILTER: Filters particles out of the solution to protect the solution valve.
27. WALL ROLLERS: Helps protect machine and walls when scrubbing in close proximity.
28. "PAD ASSIST" DRIVE ADJUSTMENT KNOB: Adjusts the amount of brush assist given to then machine. (BRUSH ASSIST MODELS ONLY).
29. DRIVE BUTTON: Controls the drive function of the machine.
30. "DRAIN SAVER" STRAINER: Collects large debris that is picked up by the squeegee.
31. VAC SCREEN: Protects the vacuum motor from debris
32. CASTER: Twin casters for stability.
33. MAIN TIRE: Main tires - Drive tires on traction models.
34. JAWS: Protects scrub deck from collision damage.
35. TANK IN A TANK: Solution/Recovery tank (30 gallons capacity each).
36. SOLUTION FILL LID: Fill port for filling solution tank.
37. RECOVERY LID: Opens to provide full access to the recovery tank.

- 38. CLEAR COVER: Allows observation inside the recovery tank.
- 39. CONTROL PANEL: Houses machine controls and electrical components.
- 40. SOLUTION LEVEL INDICATOR & DRAIN TUBE: Indicates the level of solution in the tank and act as a drain.
- 41. VACUUM HOSE: Provides vacuum path from the squeegee to the recovery tank.
- 42. SQUEEGEE BLADE: Recovers dirty water from the floor and directs it into the vacuum hose.
- 43. SQUEEGEE PITCH ADJUSTMENT: Provides adjustment of the squeegee pitch forward and rearward.
- 44. "ON-BOARD" BATTERY CHARGER: Recharges batteries.
- 45. RECOVERY DRAIN HOSE: Allows for controlled draining of recovery tank.
- 46. TANK LATCH: Secures tank to frame.

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SQUEEGEE SYSTEM

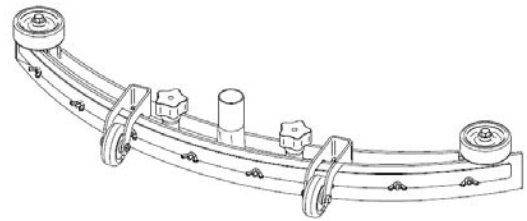
The MiniMAG's squeegee system is designed to work with the recovery system to pick up water and dirt from the floor using airflow created by the vacuum motor. The front blade of the squeegee tool is designed with notches that allow the air, water and dirt to pass through it while metering the air, increasing its speed through the tool and recovery system.

The optimal performance of a squeegee is very dependent on proper adjustment and maintenance. The machine's recovery system also must be operating properly for the squeegee to perform well.

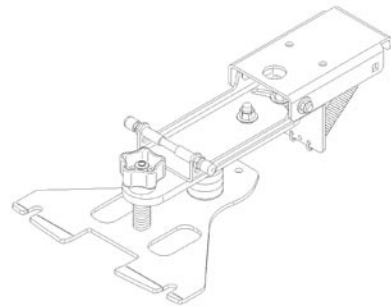
A vacuum gauge is a handy tool for checking recovery system operation. You should be able to achieve 65" of water lift on most models. Put the vacuum gauge in the end of the squeegee hose to check. If you have questions on this tool setup call the factory at 800-634-4060.

SQUEEGEE SYSTEM COMPONENTS

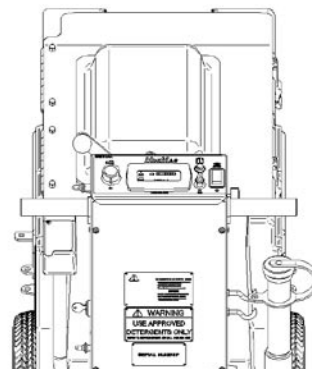
The squeegee tool with replaceable rollers & blades.



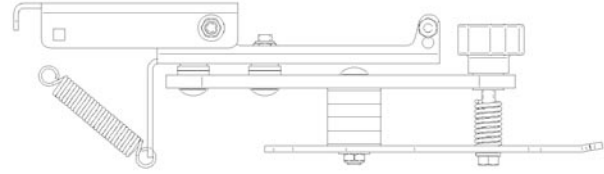
A suspension that mounts the squeegee to the machine, and allows the squeegee to move up and down with variations in the floor, and pivot in turns.



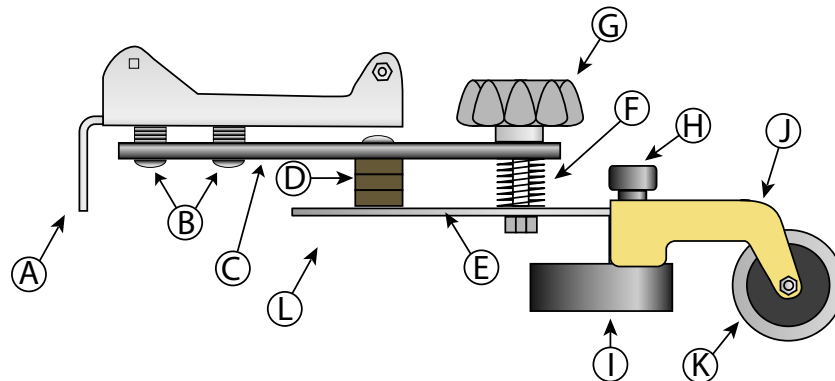
A lift system that allows the operator to raise the squeegee off the floor. The machine has a manual lift lever standard but an electric lift option is available.



A pitch adjustment that allows the operator to adjust the squeegee for different floor surfaces. This is used for creating more of a leak under the front blade for smooth floors or less of one for rough floors.



SQUEEGEE SUSPENSION BREAKDOWN

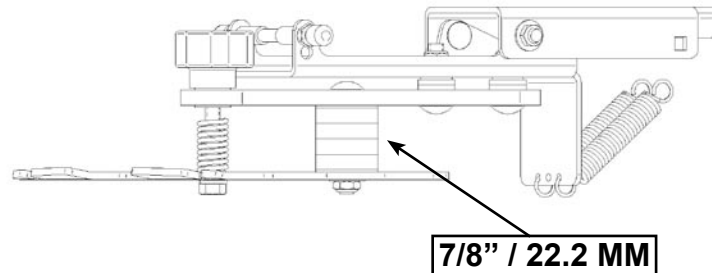


- A. SQUEEGEE SWING PLATE – The swing plate is vulnerable to bending if the machine is driven over a curb or large bump. Always check this for straightness. If it is bent at all it must be replaced. Make sure the plate moves up and down easily at its pivot points.
- B. PIVOT BOLTS - The squeegee pivots left and right at these bolts. If they are over tightened or not lubricated the squeegee will not track properly.
- C. SQUEEGEE TRAIL ARM – This arm is made of ½” plate steel but is still possible to bend. If it is bent at all it must be replaced.
- D. GROMMETS –These grommets maintain the proper spacing between the triangle plate and the trail Arm.
- E. SQUEEGEE TRIANGLE PLATE – The squeegee is mounted to the triangle plate and ties it to the trail arm.
- F. SPRING – Supplies pressure between the Triangle plate and the trail arm. Helps hold the adjustment. The squeegee will not operate without this spring.
- G. PITCH ADJUSTMENT KNOB – The knob used to pitch the squeegee frontward or backwards. The squeegee should be adjusted to be flat to the floor.
- H. SQUEEGEE HOLD DOWN KNOB – These knobs anchor the squeegee to the triangle plate. DO NOT OVER TIGHTEN!
- I. SQUEEGEE TOOL BODY (SHOWN HERE WITHOUT BLADES) – The squeegee tool body is laser cut from ½” steel and must be perfectly straight and flat.
- J. SQUEEGEE WHEEL TRAIL MOUNTS – The squeegee trail mounts attach the wheels to the squeegee. They can be adjusted by shimming them with flat washers.
- K. SQUEEGEE WHEELS – The squeegee wheels should both touch the floor during operation and roll freely. They should both be adjusted to the same height. These wheels are wear items and should be replaced when squeegee blades are replaced.

TRIANGLE PLATE & TOW BAR

These parts cannot be bent at all. They must be completely straight and flat. If either is bent replace it.

If you replace the triangle plate, adjust the clearance between the bottom of the plate and the top of the tow bar so clearance is 7/8" (22 mm). Squeegee will not work properly if this adjustment is off!



UP/DOWN MOVEMENT

The squeegee must be able to travel up and down freely so it can glide over bumps and uneven floors. It is hinged at the front as shown.

If the squeegee suspension does not move up and down properly check the bolts and the Oilite bushings at the pivot point. If the bolts are too tight (may have been tightened by customer by mistake) or the bushings are dried out or worn the squeegee will not be able to float properly.

SIDEWAYS MOVEMENT

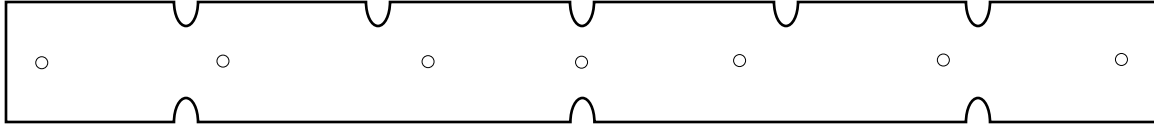
The squeegee must be allowed to move from side to side so that if it hits an obstacle it can move out of the way. If squeegee does not move freely from side to side check the bolt tension on the two pivot bolts. Check that the white plastic washers between the pivot plate and the trailing arm to make sure they are not damaged.

In order for the squeegee system to operate properly the parts have to be assembled properly. **The space between the bottom of the “Squeegee triangle plate” – E, and the “squeegee trail arm” – C, must be exactly 7/8” on all models but the 390, the 390 measurement is 1 3/8”.** If this dimension is incorrect you will never get the squeegee blade adjusted properly. If you believe you are having problems with this adjustment, please call the factory @ 800-634-4060.

SQUEEGEE BLADES

Squeegee blades are wear items. The back blade wears fastest on the edge that contacts the floor (lower front edge). This blade can ideally be turned four times. It is important to have a sharp squeegee edge on the floor; otherwise the squeegee does not scrape the water off the floor but instead glides right over it.

The front blade wears very well when properly adjusted, but it can get torn. It can be installed one of two ways: “3 notches down” for normal floors, and “5 notches down” for extremely smooth floors.

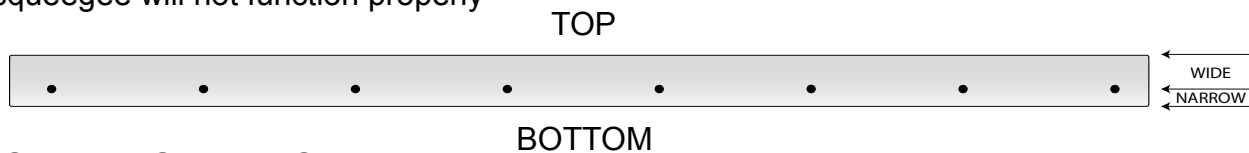


REPLACING BLADES

We stock individual blades or blade kits that include a blade set and new set of squeegee wheels. We recommend changing wheels when you change blades as they are wear items and they are critical to the proper operation of the squeegee.

When installing blades they must be put on without bumps or ripples. The squeegee should have a smooth edge that rides on the floor. When adjusting the blades you need to achieve a uniform “fanning” of the blade from one tip to the other. If the blade does not do this it is installed incorrectly or misadjusted.

When changing or turning squeegee blades it is very important to note the orientation of the stainless steel retaining band for re-installation. The holes are offset to make a wide side and narrow side. The wide side always goes UP. If the band is installed incorrectly the squeegee will not function properly



ORDERING BLADES

1. Find the squeegee size:

Check the stamped number on the top of the squeegee body and order blades the corresponding blade size: (32, 35 or 38 inches).

2. Choose the appropriate material:

Gum rubber - These blades are tan in color and best for most applications including irregular floors. They wear out quickly on rough floors however and do not tolerate oil, other petroleum products or heavy citrus cleaners. The kit number suffix for gum rubber is “G”. (Example 28-770-G)

Linatex - These blades are red in color and designed to be very durable while at the same time giving optimum performance. They are very abrasion resistant and perform acceptably on irregular floors. They tolerate oil, petroleum products and heavy citrus cleaners better than gum rubber. The kit number suffix for Linatex is “L”.

Polyurethane - These blades are nearly clear and are recommended for oil, petroleum or heavy citrus cleaner applications where Gum or Linatex would fail. It rarely works as efficiently as Gum or Linatex but is somewhat abrasion resistant. The kit number suffix for polyurethane is “U”.

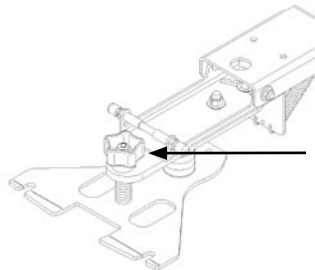
SQUEEGEE ADJUSTMENT

A squeegee needs to be adjusted to the type of surface that it is operating on. This means the adjustments that pick up well on rough concrete will probably not work well on glass-smooth vinyl tile or ceramic tile. The reverse would hold true also, a squeegee set up for a smooth surface will not work well on rough surfaces. As a squeegee wears, the dynamics or condition of the blades change, sometimes requiring small adjustments or sometimes requiring a blade turning or change.

Our squeegee system has only one operator-serviceable adjustment. That adjustment is the thumb wheel directly in front of the squeegee blade. By turning this knob you pivot the squeegee back and forth increasing or decreasing the amount of air allowed into the squeegee under the bottom of the front blade. The basic adjustment you are trying to achieve is to have the squeegee PERFECTLY parallel with the floor. From that point, rocking the squeegee forward about one half degree of pitch will reduce air leak. Rocking the squeegee backwards about one half degree will increase the air leak.

PITCH ADJUSTMENT KNOB

The triangular shaped plate that the squeegee bolts to is adjustable for a slight amount of up/down pitch. As you turn the knob the pitch of the squeegee changes.



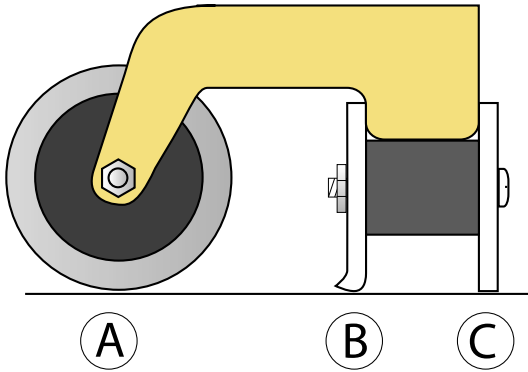
Turning the knob clockwise lowers the front blade of the squeegee thereby closing off the air holes against the floor. This increases suction on the floor. If you adjust it too far forward you can cause chattering problems or excessive front squeegee blade wear.

If too much suction is created the squeegee will “chatter”, and may come off the machine. If this happens the suction must be reduced by turning the knob counterclockwise 1 to 2 turns to create more of an air leak at the front blade.

You can over adjust in either direction. The squeegee will not work if the back blade is not evenly deflected across the rear, and if wheels do not touch the floor.

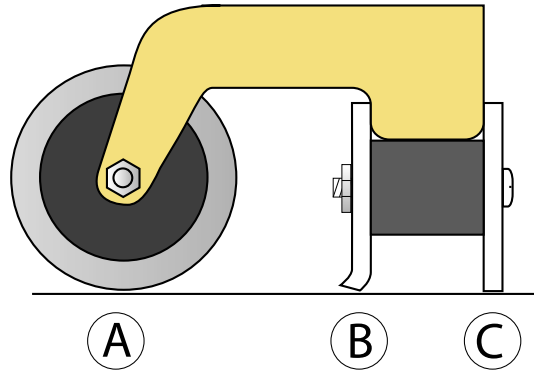
SQUEEGEE ADJUSTMENT EXAMPLES

FIGURE 1



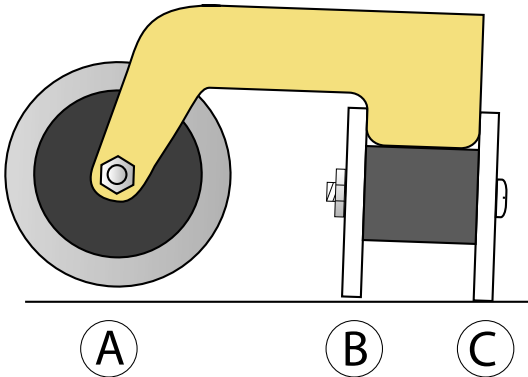
Worn Blade: Squeegee wiping edge "B" has worn so the square edge is gone. The squeegee now runs over the water instead of scraping it off the floor.

FIGURE 2



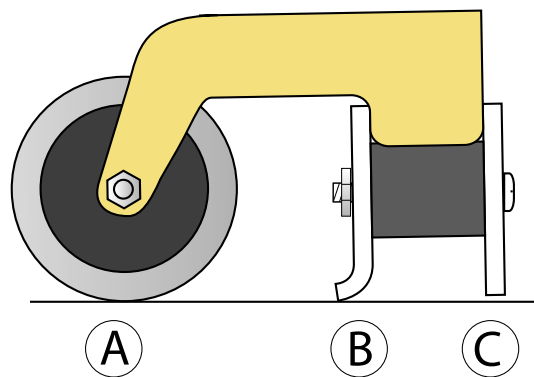
Properly Adjusted Squeegee: Front blade "C" just contacts the floor rear blade "B" is slightly flared outward

FIGURE 3



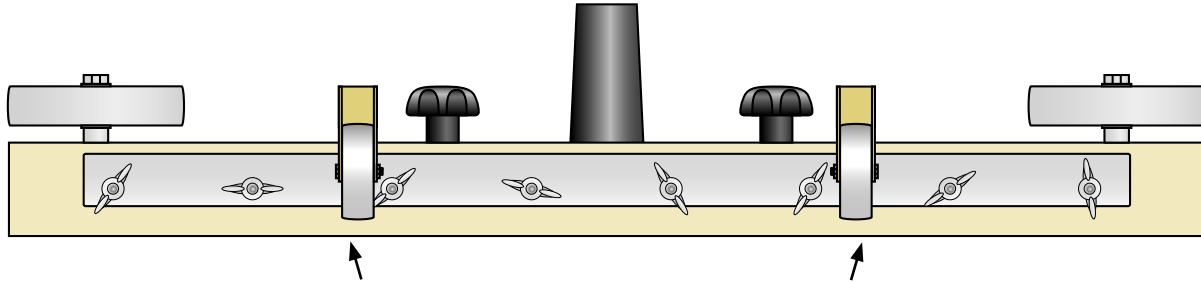
Too much forward pitch on this squeegee. The Rear blade "B" is barely making contact with the floor. The rear wheels "A" are not touching the floor.

FIGURE 4



Too much backward pitch on this squeegee. The rear blade "B" is laying over and the front blade "C" is not touching the floor.

The squeegee has trailing wheels that **MUST** touch the floor and roll as the machine is traveling forward. They **MUST** both be adjusted to the same height. You can check their adjustment by removing the squeegee from the machine, making sure the squeegee has good blades on it and setting the squeegee on a flat surface.



The wheels will wear down under normal use and their diameter will change. To maintain the system properly, the customer receives new trailing wheels with the squeegee blade kit. The trailing wheels should be changed when the blades are changed or immediately if they become damaged.

Our squeegee trailing wheel system is theoretically “not adjustable” meaning that it is not intended for end-users to adjust it.

If you have good wheels of the correct diameter on the squeegee, and they contact the floor incorrectly, then observe the space between the wheels and a flat surface with the squeegee tool off of the machine. Adjust the rear wheel bracket heights as necessary to make them equal using washers or shims.

NOTE:

To make a wheel lower toward the floor, insert a washer under its **FRONT** bracket bolt.

To make the wheel raise from the floor, insert a washer under each **FRONT** and **REAR** bolt.

SQUEEGEE TROUBLESHOOTING

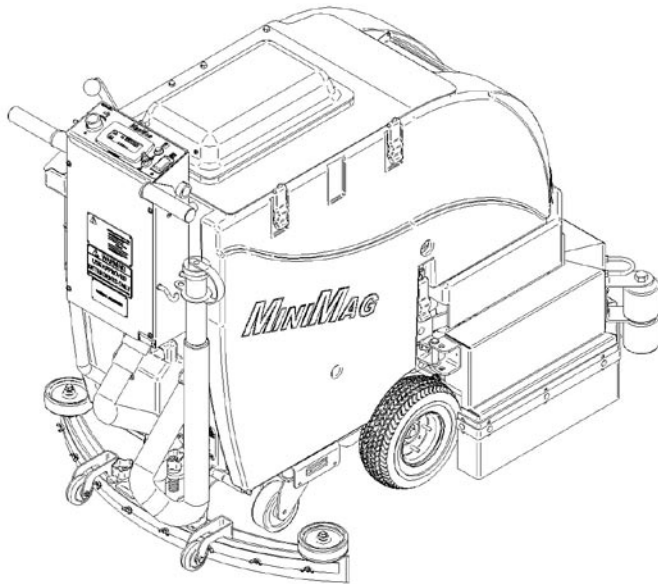
SQUEEGEE PROBLEM:	CAUSE / (SOLUTION)
Not picking up water	Is the squeegee or vac system clogged?
	Are the blades worn out?
	Is the machine straight from side to side? (No pitch or lean to either side because of tire problems?)
	Does machine have a slight pitch/lean backwards? (The unit should have about a 1-2 degree pitch/lean to the rear.)
	Is the squeegee or suspension bent or missing parts?
Leaving streaks	Dirt on blades. Wipe off with rags.
	Chip or tear in rear squeegee blade. (Turn blade or replace)
Sways back & forth	One or both wheels not touching floor. (Replace wheels and/or their brackets, shim as necessary.)
	Front or rear bolt missing or loose in triangle plate. Tighten or replace.
	Clearance between triangle and tow bar is 7/8".
Falls off frequently	Plastic knobs are loose. (Tighten)
	Operator hand strength is too low to tighten squeegee knobs adequately causing squeegee to fall off regularly. (Add a bevel washer <preferred> or a flat washer between each knob and the squeegee.)
	Squeegee is creating too much suction on the floor. (This creates squeegee "chatter" Refer to squeegee adjustment section pg. 3-5)
	Triangle plate is bent where the squeegee attaches. (Replace)
Squeegee Leaves Water:	Squeegee is actually working properly but the operator has unreal expectations. (Educate the operator)
	Squeegee pitch out of adjustment (Adjust)
	Floor is extremely rough. (Use a solid front blade to control air better.)
	Back blade is worn out. (Rotate or replace blade)
	Squeegee tool is bent & leaking. (Replace tool)
	Squeegee suspension is bent. (Replace bent components)
	Operator sees water left on very hard turns. (Educate the operator on making more gradual turns or to shut off the water before entering a turn.)
Squeegee howls or trumpets	Squeegee is creating too much a suction on the floor. (Adjust squeegee to allow more air to enter from the front blade. Counter-clockwise adjustment.)
	Squeegee is creating too much a suction on the floor. (Reverse front blade so five notches face downward to allow more air flow)
Squeegee needs too much adjustment	Customer has a varied floor surface. Some of the floor is smooth other parts are very rough. (Frequent adjustment is normal and will be required.)
	Adjustment knob spring is missing , incorrect or damaged. (Replace)
Blades wear out very quickly	Floor is very rough. Switch to Linatex rubber (red blades) which is very resistant to abrasion.
	Floor is oily or a harsh cleaning chemical has made the blade deform. Change to polyurethane blades (clear blades), they resist chemical best

SQUEEGEE LIFT SYSTEM

The squeegee lift system on the Magnum was designed with simplicity in mind. It has very straight forward operation and minimal parts to assure consistent and highly reliable operation.

TO OPERATE

Move the squeegee lift lever from right to left. The squeegee will drop and the vacuum motor will then run. To turn off the vacuum motor, move the squeegee lift lever from left to right. The squeegee will be raised and the vacuum motor will turn off immediately on the brush assist models and after a time delay on the traction drive models.



SQUEEGEE LIFT ADJUSTMENTS

There are no provisions for adjustment of the squeegee lift. If the squeegee is not raising and lowering properly it is due to a bent or worn part or parts. Inspect the lift assembly and other related systems for bent or worn parts and replace as necessary.

SQUEEGEE LIFT ELECTRICAL CIRCUIT

BRUSH DRIVE

Although the squeegee lift is a manual lift there is an electrical circuit that the lift lever is tied to. When the squeegee lever is moved it actuates a switch. This switch sends a signal to the vacuum motor contactor. The contactor closes and sends power to the vacuum motor. When the squeegee lever is moved to lift the squeegee up, the switch is no longer depressed and the signal to the vacuum contactor is interrupted and the contactor stops sending power to the vacuum motor.

TRACTION DRIVE

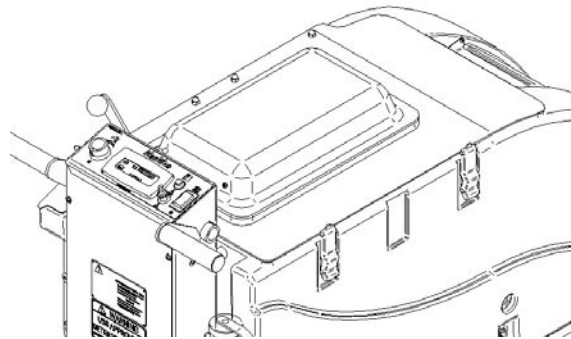
Although the squeegee lift is a manual lift there is an electrical circuit that the lift lever is tied to. When the squeegee lever is moved it actuates a switch. This switch send a signal to the controller telling it that the squeegee is down on the floor. When it sees this signal it turns on the vacuum motor. When the squeegee lever is moved to lift the squeegee up, the switch is no longer depressed and the signal going to the controller is interrupted. When the controller no longer sees the signal for the vacuum motor it runs the vacuum motor for 21 additional seconds to clear any excess water from the squeegee hose and then it turns off the vacuum motor.

RECOVERY SYSTEM

The recovery system of the MiniMag series is powered by a 24 volt 650 watt vacuum motor. The recovery tank is designed with a large lid to facilitate 100% access for complete cleaning out the recovery tank when use of the machine is finished. The vacuum motor draws air in through the squeegee tool, through the squeegee hose and into recovery tank. The water travels with the air flowing through the system and falls out of the air when it reaches the recovery tank. The air then passes through the vacuum saver and out through the vacuum motor. The recovery tank is equipped with a clear lid that allows the operator to observe the conditions inside the recovery tank as well as the recovery water level inside. Inside the recovery tank there are 4 major components. The recovery lid, drain saver, vacuum float and the water baffle.

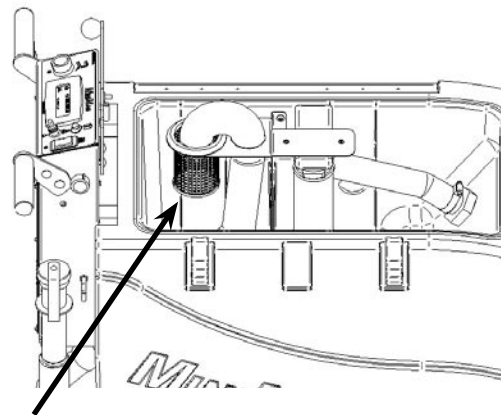
RECOVERY LID

The recovery lid is made from 10 gauge stainless steel with a clear dome. The dome is to provide you with the ability to see the condition of the recovery tank during operation.



DRAIN SAVER

The drain saver is located inside the recovery tank and is accessed by opening the recovery lid. It is designed to collect large debris that is picked up by the squeegee so it does not settle in your recovery tank or clog the drain hose.



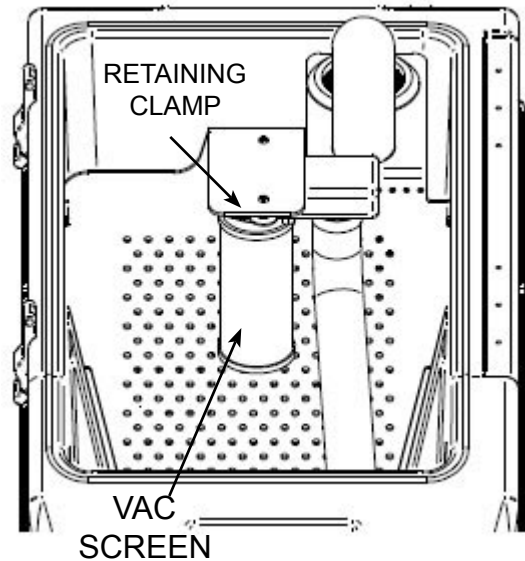
DRAIN
SAVER

VACUUM FLOAT

The vacuum float assembly is located inside the recovery tank and is accessed by opening the recovery tank lid. The float assembly stops the flow of air to the vacuum motor in the event that the recovery tank is filled to capacity.

BAFFLE ASSEMBLY

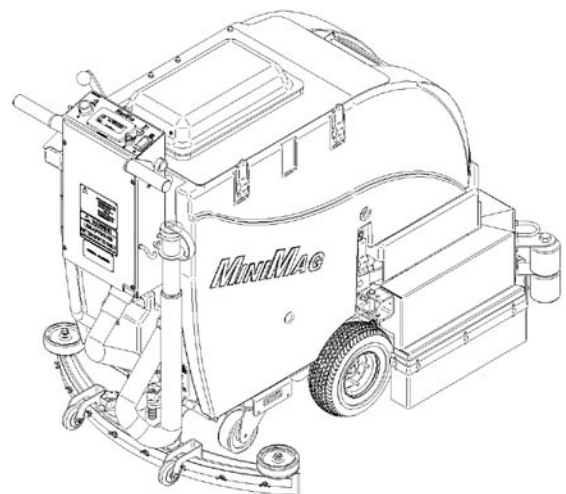
The baffle assembly is also located inside the recovery tank and accessed by opening the recovery tank lid. The baffle adds rigidity to the tank walls and lessens the sloshing of the water inside the recovery tank.



- To clean the vacuum float:
- Remove the white retaining clamp from the screen.
 - Pull the vac screen / float ball assembly off the vac box.
 - Rinse with hot water. Scrub with a brush if necessary
 - Dry thoroughly.
 - Replace vac screen / float ball assembly onto vac box.
 - Replace and tighten clamp.

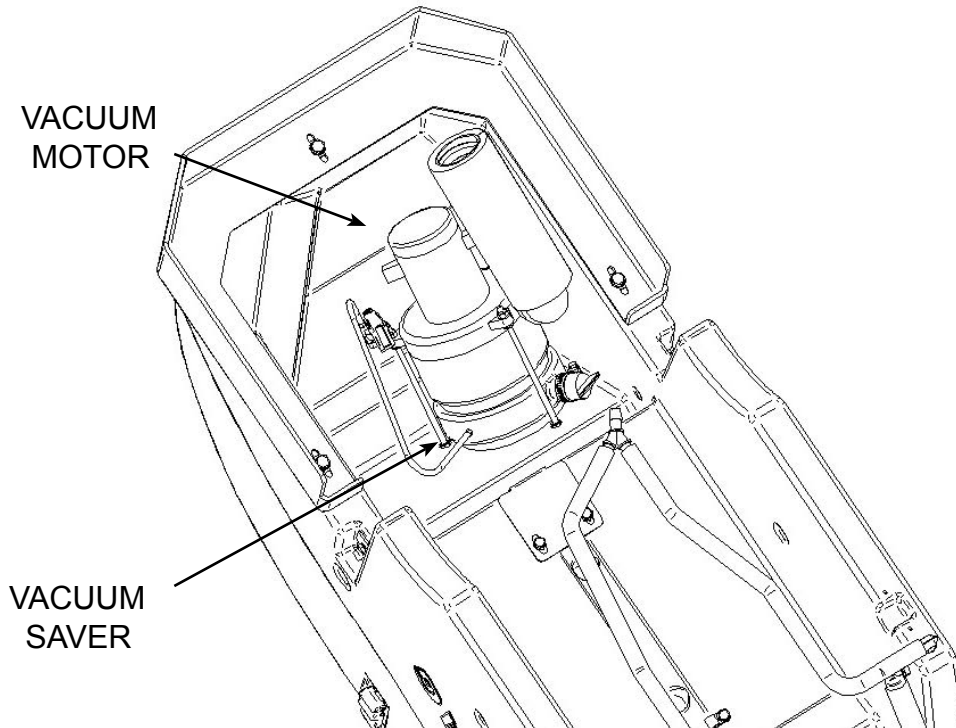
DRAIN HOSE

To drain the recovery system we have a poly hose with an integrated flow control feature. By squeezing the hose you can control the flow of the recovery tank as it is being emptied. The hose cap is attached to the hose with a tether to help prevent losing it.



VACUUM MOTOR

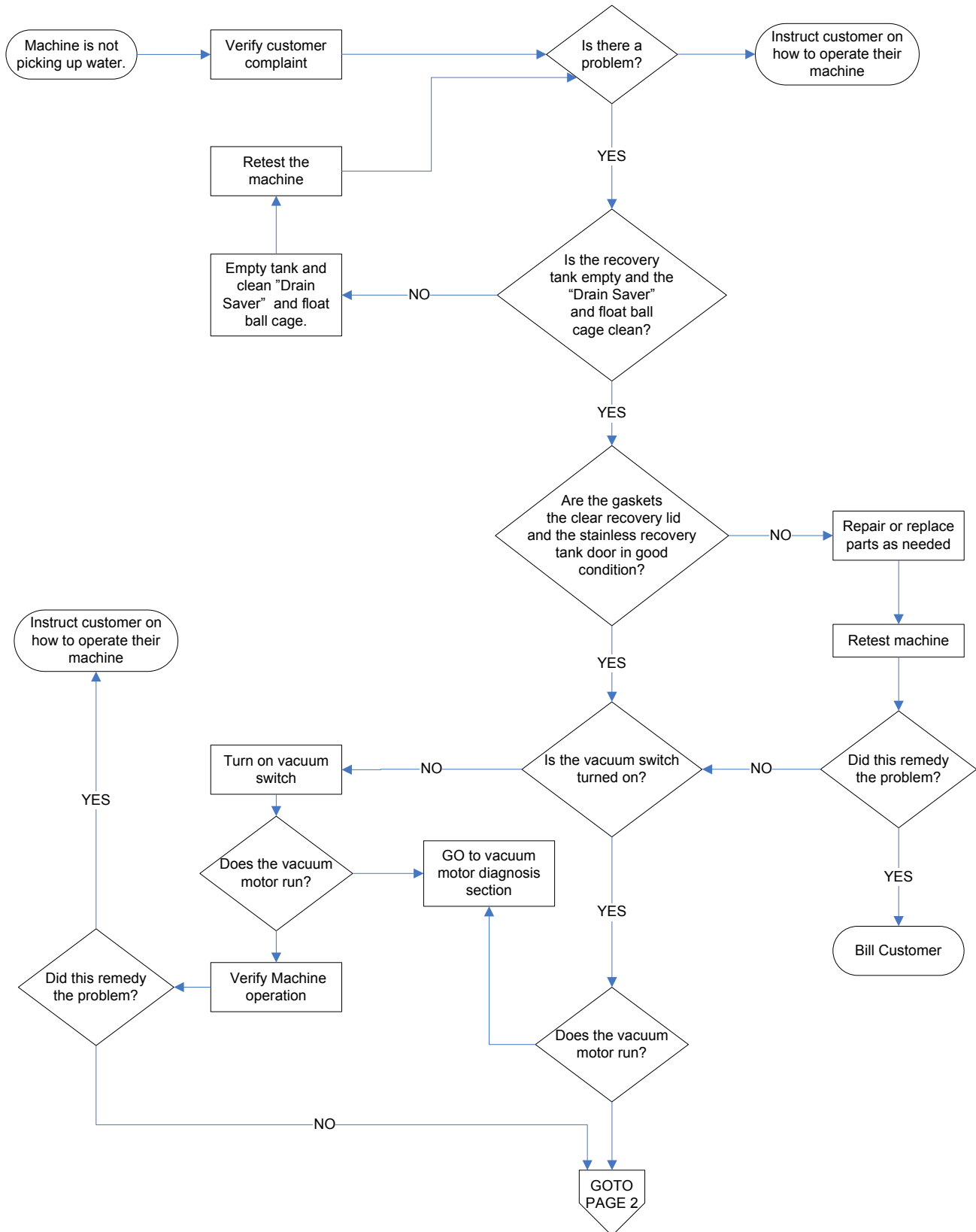
The vacuum motor used on the MiniMAG series scrubbers is a high efficiency, shunt wound motor. The motor runs a approximately 14,300 RPM. The motor is rated at 650 watts and has 72" of water lift. Although the motor has limited service parts available it is advised to replace the entire motor as all the motor parts have about the same life and repairs of the motor unit are usually cost prohibitive.



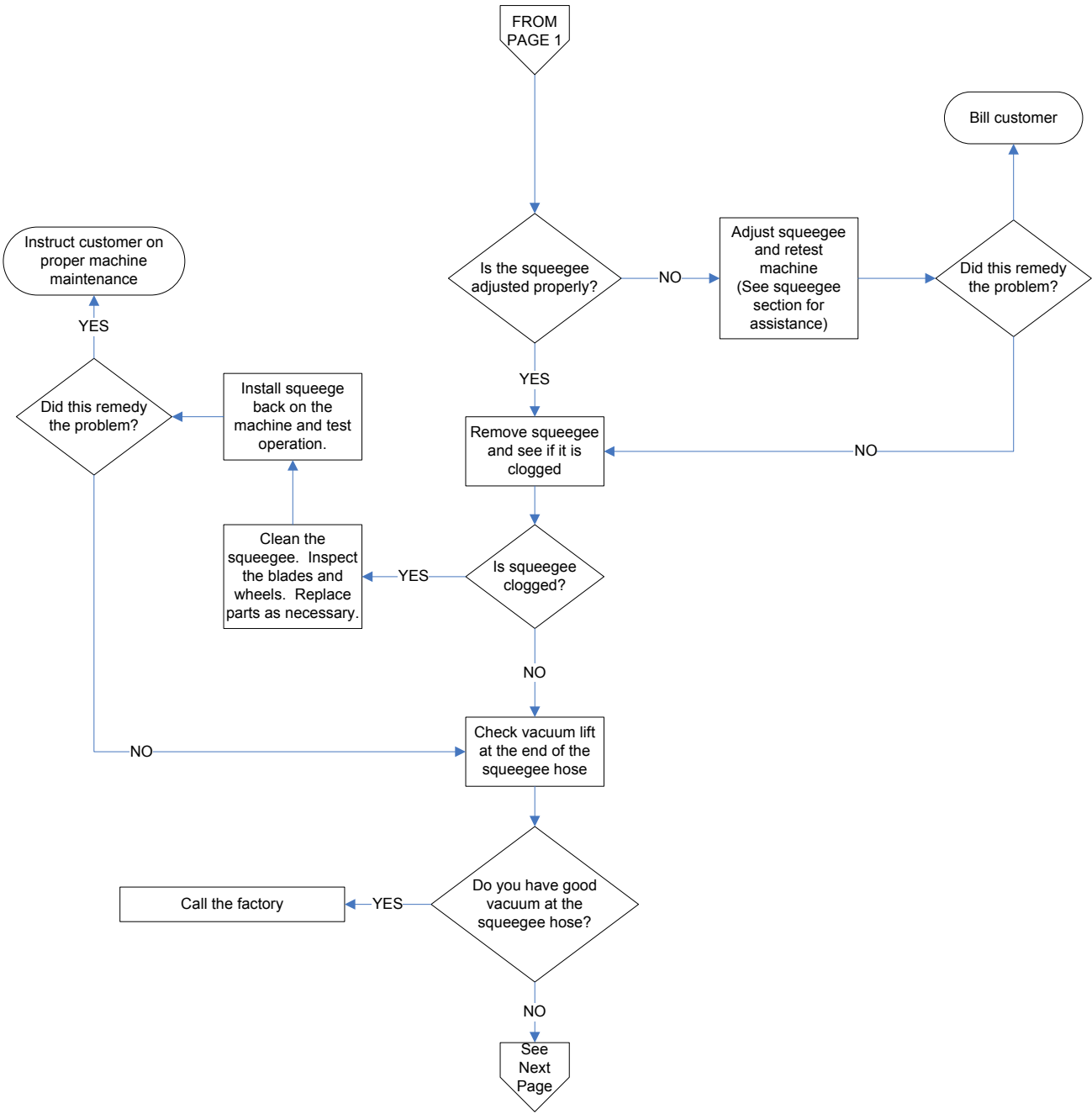
VACUUM SAVER

The MiniMAG is equipped with a vacuum saver demisting chamber that prevents moisture that gets through the recovery system from reaching the vacuum motor. The vacuum saver is a chamber that allows moist air to condense and has an automatic drain valve to empty the chamber each time the vacuum motor is turned off.

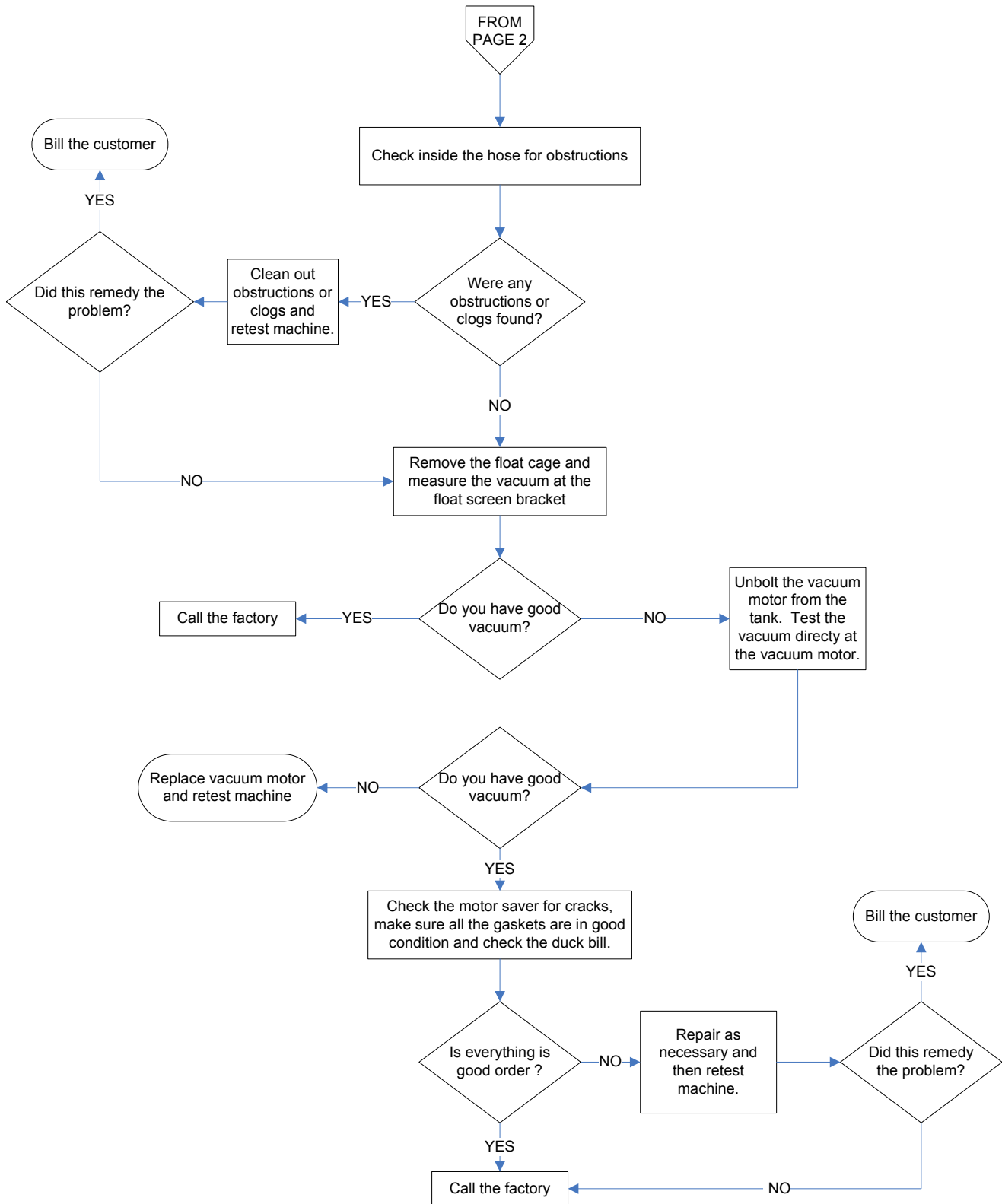
MiniMAG – ALL RECOVERY SYSTEM FLOW CHART 1 of 3



MiniMAG – ALL
 RECOVERY SYSTEM FLOW CHART
 2 of 3



MiniMAG – ALL RECOVERY SYSTEM FLOW CHART 3 of 3



SOLUTION SYSTEM

The solution system on the MiniMag series consists of main body of the machine which is also the solution tank, the fill opening, sight gauge/drain, filter, potentiometer, controller on traction drive machines or switch on brush drive machines and the solution solenoid valve.

BRUSH DRIVE

When the solution switch on the central command is switched on the solution is turned on automatically when the brush deck is turned on and turns off automatically when the brush deck turns off. On brush drive machines the solution volume is controlled by a ball valve directly after the solution solenoid.

TRACTION DRIVE

The solution is turned on automatically when the brush deck is turned on and turns off automatically when the brush deck turns off. The volume of solution is controlled by the solution potentiometer located on the control panel. The potentiometer sends a varied voltage signal to the controller and the controller interprets this signal and sends power pulses down to the solution solenoid valve. The more solution that is called for, the longer the length of the power pulse. When the potentiometer is turned to the MAX solution setting the valve receives constant power when the scrub deck is running. When the potentiometer is set to the MIN. position the solution solenoid valve receives no power even when the brushes are running.

FILTRATION

The solution runs through an in-line filter with a screen and a bowl attached to capture particles or debris that moves through the solution system. The screen and bowl need to be cleaned on a regular basis.

THE SOLUTION TANK IS MADE OF HIGH DENSITY PLASTIC. THIS PLASTIC STARTS TO DEFORM AND LOOSE ITS SHAPE AT 135 DEGREES FAHRENHEIT. NEVER USE WATER HOTTER THAN 135 DEGREES FAHRENHEIT!



DISPENSING SOLUTION

Make sure the recovery tank is at least 1/2 full with desired scrubbing solution. Adjust solution control knob near the center of travel. Turn on the brush deck switch. Activate the machine by pressing either of the green handlebar buttons. The solution will start to flow when the brushes start and stops flowing when the brushes stop. On traction drive units turn the solution control potentiometer while scrubbing to adjust solution volume. On brush drive units turn the ball valve located on the scrub head directly in front of the solution solenoid.

SOLUTION SYSTEM ELECTRICAL CIRCUIT

The two types of MiniMAGs have very different solution system circuits.

BRUSH ASSIST

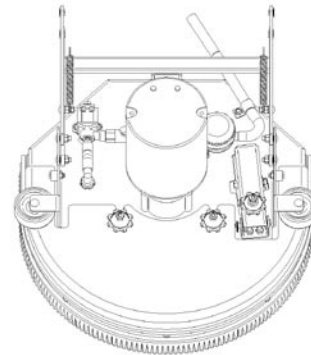
The electrical circuit of the MiniMAG brush assist series is a very basic design. It consists of the handlebar button, the solution switch, the brush switch and the brush relay. When the brush switch and the solution switch are turned on and the handle bar button is depressed a signal is sent to the brush relay causing it to turn on. When the brush relay turns on it sends power to both the brush motor and through the solution switch to the solution solenoid. When the solution solenoid is energized it opens the liquid valve allowing solution to run out of the machine onto the floor.

TRACTION DRIVE

The electrical circuit of the MiniMAG traction drive series is divided into two parts. The input circuit and the output circuit. The input circuit consists of the controller, the scrub switch and the solution potentiometer. The controller produces a high (5 volt) and a low (0 volt) signal that is sent to the potentiometer the potentiometer outputs a varied voltage from 0 to 5 volts. The controller also sends a 5 volt signal to the scrub switch. When the scrub switch is turned on this 5 volt signal is sent to the scrub input on the controller and the controller then looks at the input from the solution potentiometer. When either handle bar button is pushed the controller then starts the scrub brushes and sends pulses of electricity to the valve. The

ADJUSTING SOLUTION FLOW - BRUSH ASSIST

To adjust the solution flow use the solution knob located on top of the solution solenoid on the brush deck. To increase the amount of solution turn it counter clock wise. To decrease the amount of solution being dispensed turn it clockwise.



ADJUSTING SOLUTION FLOW - TRACTION DRIVE

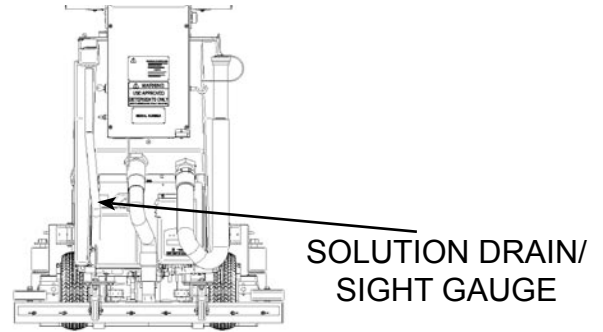
To adjust the solution flow use the solution potentiometer located on the control panel. To increase the amount of solution turn it counter clock wise. To decrease the amount of solution being dispensed turn it clockwise. Changing the amount of solution dispensed is done by changing the amount of time the solution solenoid valve is open for every second.



SOLUTION
KNOB

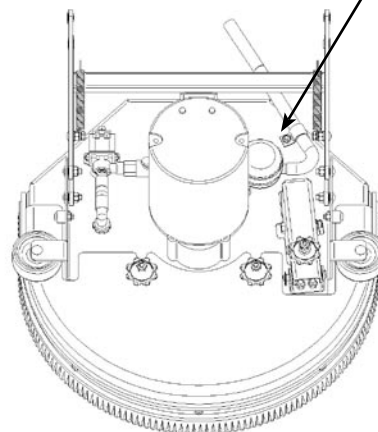
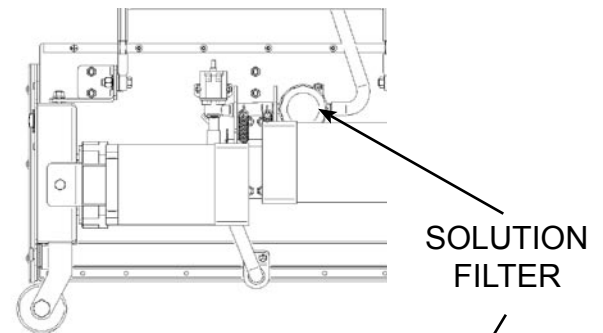
DRAINING SOLUTION TANK

Detach the solution drain / sight gauge hose from the upper barb and lower into a suitable drain or receptacle. When the solution has emptied reattach the hose to the upper barb.



CLEANING SOLUTION FILTER

Drain solution tank with the drain hose. Reach under the machine and unscrew and remove the clear part of the plastic filter housing. Remove screen and clean. Replace screen and clear part of filter housing.



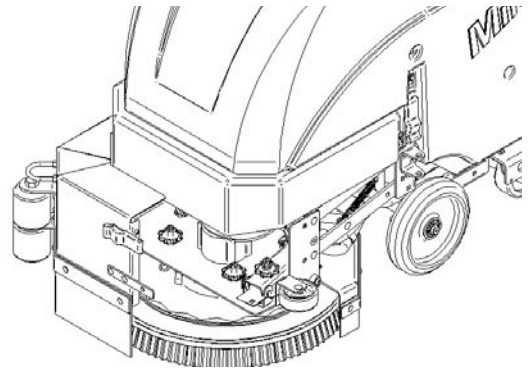
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BRUSH DRIVE SYSTEM

The brush drive system on the MiniMAG Series comes in three versions. The disc type, disc type with brush assist and the cylindrical type. Each one is different although they do the same thing which is turn the scrub brush or scrub pad.

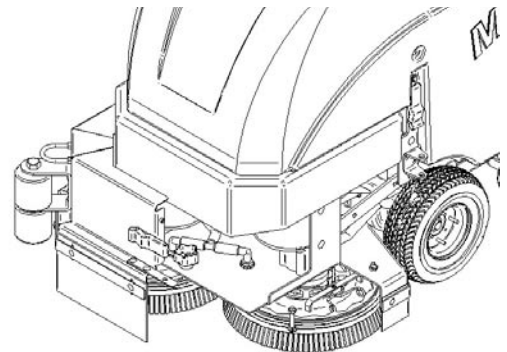
DISC

The disc brush drive system consists of the controller, 1 or 2 brush drive motors, 1 or 2 brush driver hubs and 1 or 2 scrub brushes or pad holders. The drive hub is a “gimbaled” design that helps compensate for irregularities of the floor. Only original factory equipment brushes should be used on this machine or premature scrub motor failure may occur. “Will-Fit” brushes are usually not concentric and promote bearing failure.



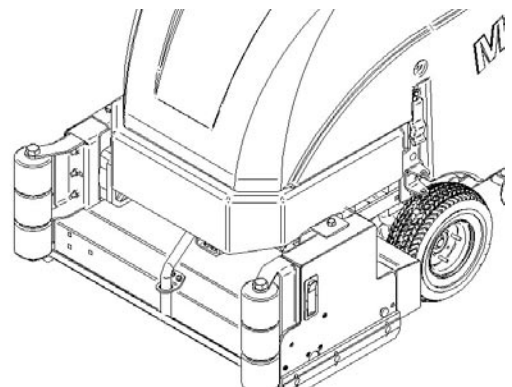
DISC WITH BRUSH ASSIST

The disc brush drive system consists of the brush relay, 1 brush drive motor, 1 brush driver hub, a scrub brush or a pad holder and the brush assist adjustment. The drive hub is a “gimbaled” design that helps compensate for irregularities of the floor. Only original factory equipment brushes should be used on this machine or premature scrub motor failure may occur. “Will-Fit” brushes are usually not concentric and promote bearing failure.



CYLINDRICAL

The cylindrical brush drive system consists of the controller, 2 brush drive motors, 2 drive belts, 2 brush idlers and two scrub brushes. The brushes counter rotate and sweep debris into a hopper as well as scrub the floor. “Will-Fit” brushes are usually out of round and/or fit the driver or idler poorly loosely and will bounce promoting bearing and belt failure.



BRUSH DRIVE ELECTRICAL CIRCUITS

BRUSH ASSIST MODELS

The negative side of the battery connects directly to the scrub brush motor. The positive side of the battery passes through a relay, from the relay to the 30 amp push button circuit breaker located on the rear of the control panel and then to the scrub brush motor. The relay is located on the right front side of the brush wall compartment.

When the operator pushes the green button in the handle bar, this switch sends positive battery power to the relay's coil terminal. The negative side of the coil is connected to a battery negative. When the positive power is received by the relay coil it pulls the relay contacts closed and turns on the brush motor.

Therefore, when the master switch is on, pushing the green button will turn on the brush motor. This is true whether the brush is down on the floor or up in the air.

DISC & CYLINDRICAL WITH CENTRAL COMMAND II

The brush drive circuit is a very simple circuit that consists of the brush deck switch, handle bar buttons, controller and brush deck motor(s). When the brush deck switch is turned on and the handle bar button is depressed the controller sends power to the brush. The controller then watches the amperage draw on the scrub deck motor(s) and regulates the brush deck pressure to keep the motors operating at a consistent amp draw thus maintaining a consistent deck pressure.

SETTING BRUSH PRESSURE

BRUSH ASSIST

On the brush assist models the brush pressure is set with a rocker switch on the control panel. By pressing the switch one way or the other the brush deck is either raised or lowered. The brush pressure is reflected on the brush pressure gauge on the control panel and should always be kept in the green area of the gauge during operation.

SETTING BRUSH PRESSURE

Lower the scrub deck to the floor. Turn on the solution switch and turn on the brush by using the green handle-bar button. Observe the brush pressure gauge on the control panel and make sure it does not enter the red zone while scrubbing. If the machine is operated in the red zone, the motor is being over-worked, and it will blow the brush circuit breaker. If this breaker blows, wait until it cools and reset it. Reduce brush pressure and resume scrubbing.



TRACTION DRIVE MODELS with CENTRAL COMMAND II

The scrub deck pressure is adjusted continuously while scrubbing. Using the brush pressure switch on the control panel you set the desired scrubbing pressure. The desired brush pressure is shown on a bar graph on the LCD display. There are 5 different settings to choose from. The controller is programmed with an amp value for each of 5 brush pressure settings. When the scrub deck starts the controller calculates the amp draw of the motors and compares it to the amp value of the current brush pressure setting. If the motors are not drawing enough amps the controller lowers the brush deck to increase the brush pressure on the ground and therefore raise the amp draw of the motors. If the amp draw of the motors is higher than the target amp value the controller raises the brush deck to relieve down pressure from the brush deck therefor reducing the amp draw of the brush motors because they can then turn more easily.

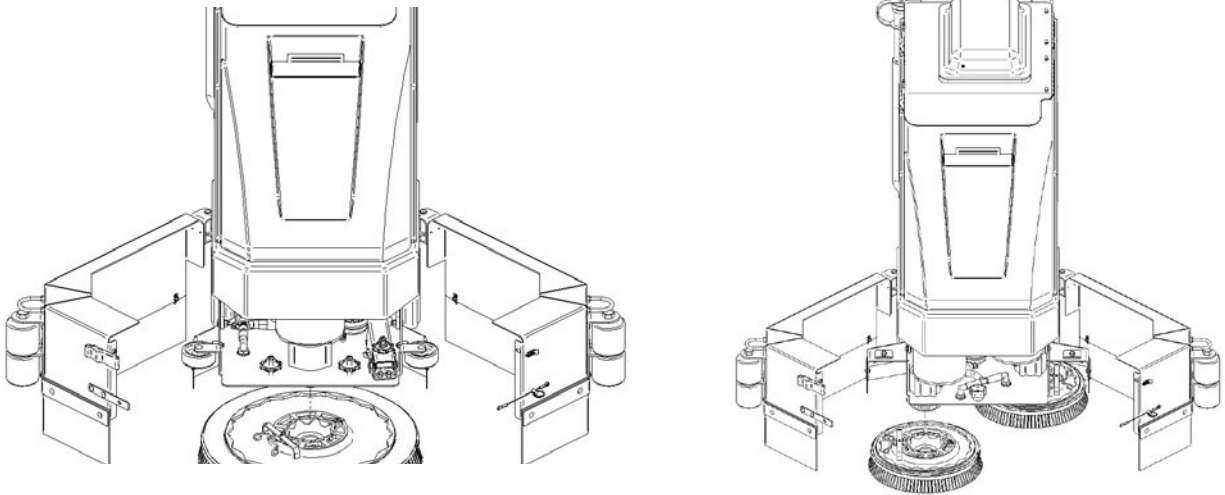
BAR GRAPH
DISPLAYBRUSH PRESSURE
SWITCH

INSTALLING & REMOVING BRUSHES

DISC MACHINES

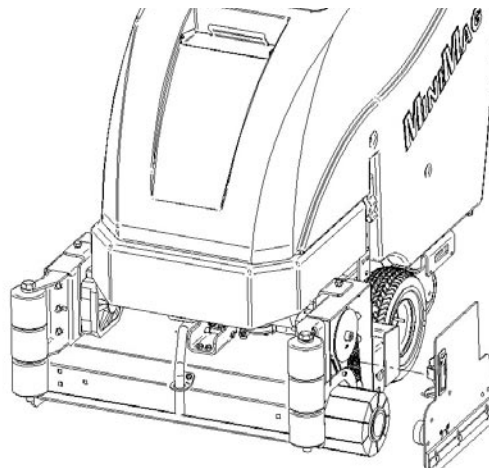
With the machine turned on, turn off the brush deck switch. Turn machine power off. Open the two latches on the jaws and swing them aside or loosen the knob and slide the shroud off. Rotate the brush(s) until both tabs of the spring clip(s) are accessible. Squeeze the two tabs together and the brush will drop off. If the brush deck does not raise high enough to remove the brushes. Turn the machine power on for 10 seconds and then off again. Then try removing the brushes again. If the brushes still can not be removed due to lack of space the actuator or linkage must be adjusted.

To install a brush, reverse the procedure.



CYLINDRICAL DECK

With the brush deck raised, remove the side access door from the scrub deck. Grasp the scrub brush and pull and it will slide off the brush driver and out from under the scrub deck. To install brushes align brush with the brush drive and push until the brush slides down onto the driver. Install the access door back onto the brushes. If the access door does not fit up to the brush deck completely the brushes are not situated on the drivers properly. Re-align the brushes until they slip onto the drivers completely and the access door sits tightly against the brush deck and latch will close easily.

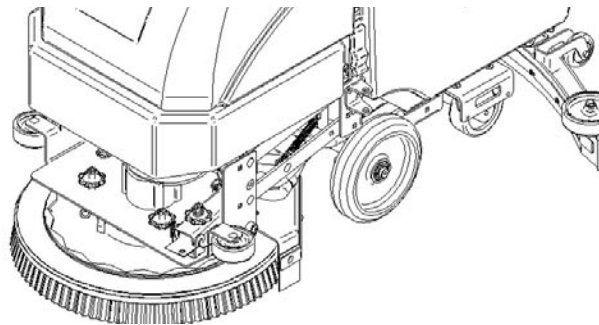


BRUSH ASSIST SYSTEM

The brush drive system on the MiniMAG series is also a machine drive assist system. This means that the force created by the pad on the floor is also used to help propel the machine forward when scrubbing. The system consists of the brush drive motor, brush driver hub, scrub brush or pad holder, the idler wheel and the adjustment knob. The drive hub is a “gimbaled” design that helps compensate for irregularities of the floor. Only original factory equipment brushes should be used on this machine or premature scrub motor failure may occur. “Will-Fit” brushes are usually not concentric and promote bearing failure”

BRUSH ASSIST

The scrub brush or pad driver is used to propel the machine forward. There is a knob on the left side of the scrub deck that allows the operator to adjust the amount of propulsion. The knob applies pressure to a wheel that runs on the top of the scrub brush or pad holder applying pressure to one side of the brush or pad holder causing the brush or holder to pull the machine forward.



BRUSH ASSIST STRENGTH

First adjust the brush deck pressure to assure it is operating in the green area. Next, adjust the propulsion strength on a flat level part of the surface you are scrubbing. With the brush motor off, the brush head down and with the scrub brush or pad driver/pad combination you will be using adjust the propulsion strength. Test the amount of propulsion and readjust as necessary making sure to keep the brush pressure in the green area, Be careful that you do not set the propulsion level too high or the machine may become uncontrollable and unsafe or not perform acceptably.

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BRUSH LIFT SYSTEM

The brush lift system for the MiniMag comes in two configurations. The brush assist model uses one system and the traction drive model with Central Command II uses another.

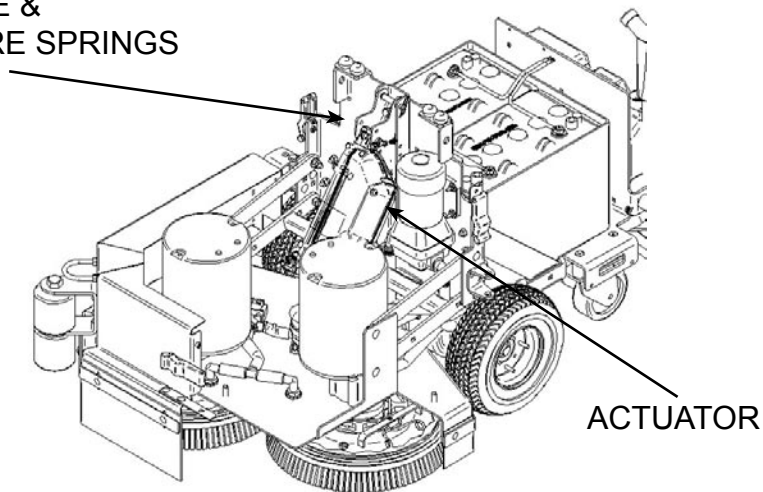
BRUSH ASSIST

The brush lift system on the brush assist models consists of an actuator, a rocker switch, circuit breaker, lifting linkage and down pressure springs. The brush deck and motor are raised and lowered by the brush deck actuator. The actuator is controlled by a switch on the control panel. The actuator circuit is protected by a 2 amp, push-to-reset, circuit breaker on the back of the control panel.

BRUSH LIFT ELECTRICAL CIRCUIT

The negative side of the battery is connected to the brush deck lift switch. Positive power from the main power switch is fed to the brush deck lift switch. The switch is then wired to the brush deck actuator with a 2 amp circuit breaker in line on the positive side. When the switch is depressed to lower the brush current is sent to the brush deck actuator to drive the brush deck down. When the switch is depressed to raise the brush deck current is sent in the other direction through the actuator raising the brush deck. The actuators travel is limited in both direction by internal limit switches. The limit switch for the raised position is fixed and the switch for the lowered position is adjustable.

LIFTING LINKAGE &
DOWN PRESSURE SPRINGS

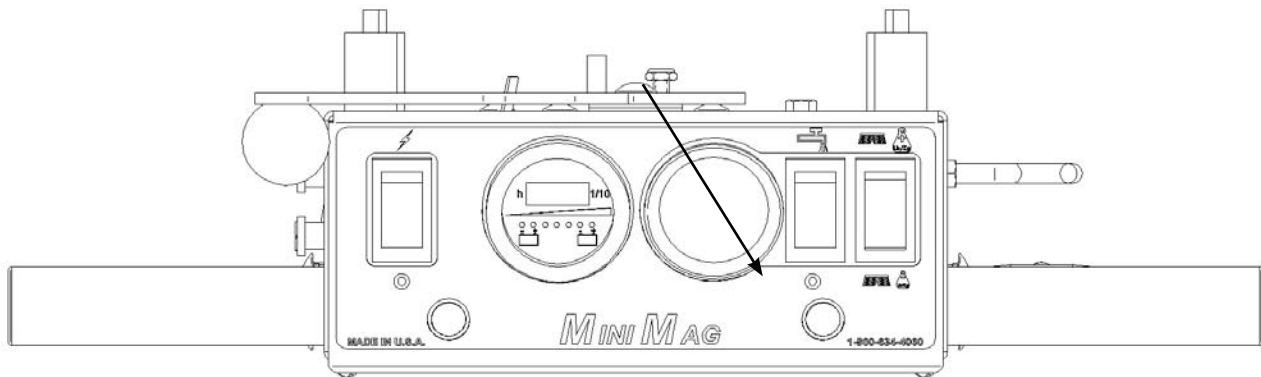


DOWN PRESSURE ADJUSTMENT

Down pressure is controlled manually by the operator raising or lowering the deck. The amount of down pressure is monitored using the brush pressure gauge located on the lower right corner of the control panel. This gauge should always be in the green when operating. If the gauge goes into the red there is too much brush pressure being applied.



The brush deck is raised and lowered using the rocker switch on the top of the control panel.



TRACTION DRIVE WITH CENTRAL COMMAND II

The active brush lift system on the MiniMAG series consists of an actuator, down pressure springs, scrub switch and the controller. The brush deck is raised and lowered by the brush deck actuator which is driven by the controller. The actuator circuit is internally protected from electrical overload by the controller. The active brush lift system is used to lower the brush deck when scrubbing is started and raise it when stopped. The controller continually monitors the amperage draw of the scrub brushes and raises and lowers the scrub deck accordingly to keep the motors drawing a consistent amount of amperage thus keeping the scrub pressure uniform.

BRUSH LIFT ELECTRICAL CIRCUIT

The brush lift electrical circuit consists of two wires that run from the controller to the actuator. Power is applied to the actuator with the polarity in one direction to raise the brush deck and the opposite direction to lower the brush deck. The actuator has internal limit switches that prevent it from moving too far in either direction. While the circuit itself is very simple, the control of this circuit is very complicated. The controller operates the output of this circuit by monitoring a number of variables. It is important to know this circuit energizes the brush deck actuator to raise the brush deck for 4 seconds each time the controller is powered up. For this reason it is important to make sure all body parts are clear from under the scrub deck when the machine is powered on. When the scrub switch is turned on the controller runs the scrub brushes down toward the floor for a predetermined amount of time, typically about 4 seconds. This is known as dock time and can be modified by changing the parameters of the controller. When the throttle button is depressed the controller monitors the amp draw of the brush motor and adjusts the scrub deck height to obtain the target amp draw on the scrub motors. The target amp draw of the motors is set using the brush pressure switch on the control panel. The brush pressure setting is shown on the LCD display in the form of a bar graph. The target amps for each of the brush pressure settings are defined by the parameters that are programmed into the controller. When the throttle of the machine is released the scrub brushes raise up off the floor for 2 seconds. This is called raise time. The purpose of this is so the scrub brushes start up under reduced load which leads to much longer motor life. Raise time can be modified and is set through programming. If scrubbing begins again the brushes drop back down to the floor and the controller again starts analyzing the brush motor amp draw and adjusting the scrub deck pressure accordingly. When the scrub deck switch is turned off the scrub head raises for four seconds to its fully raised position,

DOWN PRESSURE ADJUSTMENT

Down pressure is regulated by the controller on the machine as. The desired brush pressure is selected by using the brush pressure switch on the control panel. The brush pressure selection is read out on the LCD display in the form of a bar graph. The bar graph is segmented into 5 levels the lowest being 1 bar and the highest being 5 bars. The pressure relative to each of the settings is programmed into the controller and are fully adjustable.

BRUSH LIFT SYSTEM ADJUSTMENTS

The brush lift system has two adjustments that can be made. The first adjustment is the length of travel of the actuator ram. This controls how far down it will allow the brush deck to go. The second adjustment is the upper linkage adjustment that controls how high the brush deck will lift off the floor .

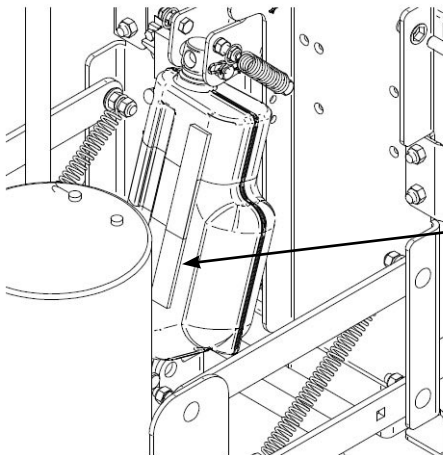
To access the actuator and its linkage the body of the machine must be tipped back. To do this you must first drain the solution and recovery tanks completely. Then release the 2 soft latches directly above the scrub deck on either side of the machine. Now use the handle bars to tip the body of the machine backwards carefully until the strap stops it. After the adjustments have been made, tip up the body, secure the two soft latches and test the machine.

BRUSH LIFT ACTUATOR

The actuator must be able to extend enough to lower the brush head down so that it can reach slight dips in the floor. If the head can not do this the actuator may not be extending enough. The distance the actuator extends is controlled by a limit switch that is housed internally in the actuator.

ACTUATOR ADJUSTMENT

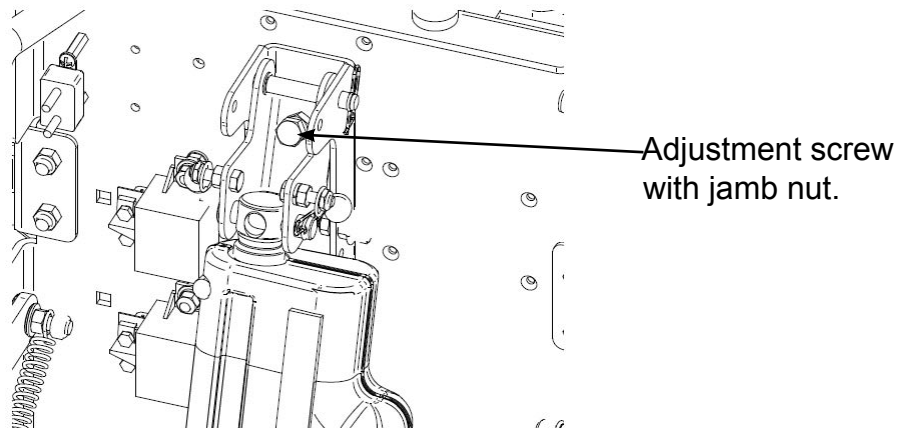
To access the limit switch in the actuator remove the black rubber strip on the face of it. Loosen the set screw just enough for the switch to slide. To increase the travel of the deck slide the limit switch down toward the floor. To increase the travel slide the limit switch up towards the top of the machine. When the switch is repositioned gently tighten the set screw and replace the black rubber strip.



Remove this black rubber strip to gain access to the limit switch.

LINKAGE ADJUSTMENT

If the brush deck is out of adjustment and it can not be remedied with the limit switch adjustment there is a provision for adjusting the linkage. At the top of the brush deck lift linkage there is a bolt that is secured with a jamb nut. This bolt is used to increase or decrease the raised height of the deck. If too much adjustment is made to this screw to lift the brush deck, the deck may not have enough travel to reach and put pressure on the ground.



If the brush head lifts too high when it is in the full-raised position it may not have enough travel to extend low enough to reach into recesses in the floor. If the machine exhibits this condition, lower the overall brush height by backing out the screw on the upper suspension arm.

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TRACTION DRIVE SYSTEM

The MiniMAG TD series of scrubbers with Central Command II is powered by an and electric transaxle system. The trans-axle is self contained and bolts to the bottom of the frame. The trans-axle is equipped with a 1/2 horsepower motor that transfers power through a shear key into the differential assembly. The power is then transferred out to the wheels via the axle shafts. The transaxle with the differential powers the machine while allowing the machine to turn easily.

TRACTION DRIVE ELECTRICAL CIRCUIT

The traction drive electrical circuit consists of the traction drive motor, controller, handle bar buttons, potentiometer and the reverse switch. When you engage the handlebar button it sends a signal to the controller and the controller then energizes the traction motor propelling the machine forward. When the reverse switch is engaged it sends 2 signals to the controller. One signal instructing the machine to move backwards and one signal instructing it to move. The controller then energizes the drive motor to propel the machine in reverse. Both the forward and reverse speeds are regulated by the potentiometer located on the control panel. The controller has internal protection for the drive motor. It will slow the machine down if the traction motor draws too many amps for more than 60 seconds. If the overload continues the controller will shut off the motor and show a diagnostic code on the LCD display. The motor can be damaged if repeatedly overloaded in a short time. The average amp draw for transport is 7-9 amps at full speed with all other functions off.

AXLE

The transaxle we use on the magnum scrubber has a 1/2 HP motor mated to a differential assembly. The axle has only 4 serviceable parts on it; the motor, the shear key, the wheel mounts and the tires.

DRIVE MOTOR

The drive motor is a separately serviced part and is easily replaced.

TIRES & WHEELS

The tires are available in 2 styles. The standard equipment is a pneumatic tire that provides very good traction in most applications but is subject to puncture from sharp objects. The optional tire is a solid rubber tire with a steel hub. This solid tire offers superior traction and it will not go flat.

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CHASSIS SYSTEM

The chassis system on the Magnum series is built on a heavy duty 7 gauge powder-coated full frame. The frame gives the machine great strength and durability. Everything is fastened to the frame using stainless steel hardware allowing for easy servicing should a repair be needed. .

CHASSIS REPLACEMENT

In the unlikely even that the chassis must be replaced due to collision or damage it can easily be done. We recommend transferring the components piece by piece from the old chassis to the new chassis and installing the tank last on the new chassis.

TIRES

There are 5 different tire options for the Magnum series of scrubbers. We offer pneumatic tires as a standard tire, grey tires for non marking applications. Both the black and grey tires are available foam filled but come with a 90 day warranty. There is also a HD tire option which is a solid tire

CASTERS

There are 2 different types of casters available on the Magnum series. There are the red polyurethane casters which provide very good resistance to oil and grease and roll very well making the machine easier to steer. There are also grey rubber tires which are a softer tire making the machine roll a bit smoother but they do not hold up well in solvents or harsh environments.

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BATTERY SAFETY

DANGER OF EXPLODING BATTERIES

Batteries contain sulfuric acid and produce explosive mixtures of hydrogen and oxygen. Because self-discharge action generates hydrogen gas even when the battery is not in operation. Make sure batteries are stored and worked on in a well ventilated area. ALWAYS wear ANSI Z87.1 (U.S. Standard) approved safety glasses and face shield or splash proof goggles when working on or near batteries.

Always wear proper face, eye and hand protection.

Keep all sparks, flames and forms of combustion away from the battery.

Never try to open a battery with non-removeable vents.

Keep removable vents tight and level except when servicing electrolyte.

Make sure work area is well ventilated.

Never lean over battery while boosting, testing or charging.

Exercise caution when working with metallic tools or conductors to prevent short circuits and sparks.

SAFE CHARGING

Never attempt to charge a battery without first reviewing the instructions for the charger being used. In addition to the manufacturer's instructions, these general precautions should be followed:

Always wear proper eye, face and hand protection.

Always charge batteries in a well ventilated area.

Keep vents tight and level.

Turn the charger and timer "OFF" before connecting the leads to the battery to avoid dangerous sparks.

Never try to charge a visibly damaged or frozen battery.

Connect the charger leads to the battery; red positive (+) lead to the positive(+) terminal and black negative(-) lead to the negative (-) terminal. If the charger is equipped with a quick disconnect plug use that to connect it to the machine.

Make sure that the machine and all its accessories are turned off.

Make sure that the charger leads to the battery are not broken, frayed or loose.

Set the timer, turn the charger on and slowly increase the charging rate until the desired charging rate is reached.

If the battery becomes hot, or if violent gassing or spewing of electrolyte occurs reduce the charging rate or turn off the charger temporarily.

Always turn the charger "OFF" or unplug it from the AC power before removing the charger leads from the battery or disconnecting the quick disconnect plug to avoid dangerous sparks.

HANDLING BATTERY ACID

Battery acid, or electrolyte, is a solution of sulfuric acid and water that can destroy clothing and burn the skin. Use extreme caution when handling electrolyte and keep an acid neutralizing solution - such as baking soda or house hold ammonia mixed with water - readily available. When handling batteries:

Always wear proper eye, face and hand protection.

If the electrolyte is splashed into an eye, immediately force the eye open and flood it with clean, cool water for at least 15 minutes. Get prompt medical attention.

If electrolyte is taken internally, drink large quantities of water or milk. DO NOT induce vomiting. GET IMMEDIATE MEDICAL ATTENTION.

Neutralize with baking soda any electrolyte that spills on a machine or in a work area. After neutralizing, rinse contaminated area clean with water.

WATER

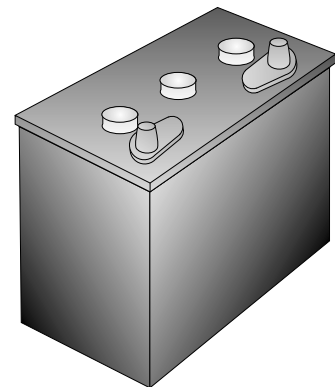
When servicing batteries the recommended water to use is distilled water when adding it to the electrolyte. However, any water that is safe to drink, with the exception of mineral or flavored waters, is safe to use in a battery. Do not use water with a high mineral content. Avoid using metal containers to store acid or water. The metal impurities in the water will diminish the performance of the battery. Liquids besides water such as vinegar, anti-freeze, salt water and alcohol or harmful acids such as nitric, hydrochloric or acetic will cause severe grid damage and completely ruin a battery.

BATTERY TERMINAL TYPES

Batteries are made with an assortment of different battery terminal configurations. The most common in the industry are listed here. It is best to replace batteries with the exact type of battery that was in the machine including the battery terminal type. If you change battery terminal types the battery cables must be changed to match the new style terminals..

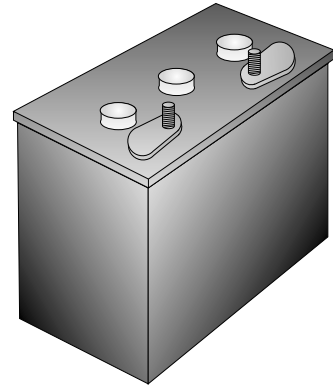
TAPERED TOP TERMINAL (S.A.E. POST)

The tapered top design uses terminal posts built to SAE standards so that all SAE style clamps will fit any battery with these posts. The negative terminal is made slightly smaller than the positive to reduce the possibility of hooking up a battery in reverse.



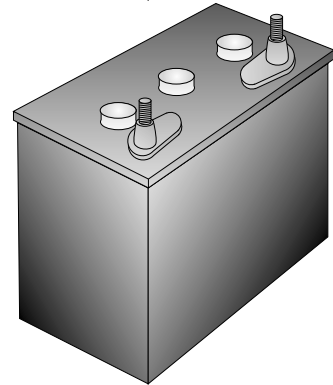
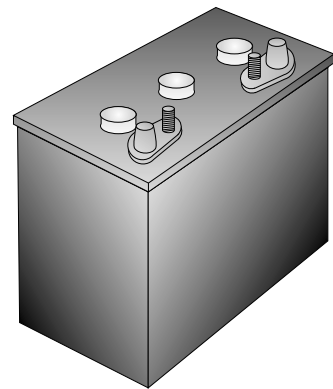
STUD TERMINAL

The stud terminal is typically used on heavy duty batteries. The terminals have a stainless steel threaded stud embedded in them that the connections are made to.



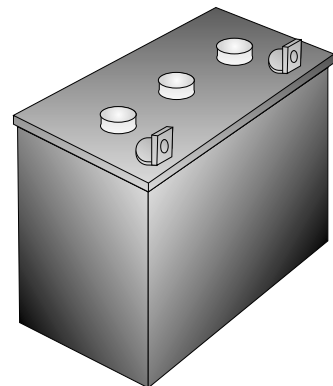
COMBINATION TERMINAL

The combination terminals come in a few different configurations. The two most common configurations are the “side by side” and the stacked. In the side by side there is a tapered top terminal with a stud terminal right next to it. In the stacked configuration the stainless steel stud is embedded into the tapered top terminal. The combination terminals make it possible to use the battery with a variety of equipment without having to change the cables on it. CAUTION: The “stacked type” combination battery terminals are very tall in comparison to all other configurations. Make sure to check all clearances before trying to close a cover or a tank on top of these types of batteries.



THE “L” TERMINAL

The “L” type terminal is used on many special application batteries.



BATTERY SYSTEM

The battery system for the MiniMAG series consists of 2 - 12 volt deep cycle batteries. They are offered in 2 different sizes of lead acid and 1 size of maintenance free AGM batteries. The batteries are the power source for all of the working parts of the machine and must be maintained properly to realize optimal run time as well as longevity.

Deep cycle batteries provide large storage capacity of the electricity that powers the scrubber. There are two types of batteries that we use in our scrubber and each one has different needs to keep it performing optimally.

BATTERY MAINTENANCE & CARE

LEAD ACID BATTERIES (TRADITIONAL)

Lead Acid Batteries are the most common battery installed in our machines. They are filled with water and battery acid and require periodic care. The most important item to attend to is the battery water level. This must be checked on a weekly basis because if the batteries run low on water they will be ruined. Batteries should be checked before you charge them to make sure they have enough water to cover the plates inside them. In the event that the water is below the tops of the plates water should be added to bring the level just above the top of the plates. When adding water ALWAYS use distilled water. Tap water contains things like minerals and chlorine that is detrimental to a battery. Batteries should be charged each time the machine is used for any significant time. Batteries should never be discharged more than 80% of their capacity. The battery gauge is to alert you when it is time to stop using the machine and recharge it. The tops of the batteries must be kept clean and dry or they will induce a current leak across the top of the battery.

LEAD ACID BATTERIES (MAINTENANCE FREE)

Some of our machines are equipped with ‘Maintenance free’ lead acid batteries. The major difference between these and the “traditional” type of lead acid battery is that you can not check or fill the water in them.

AGM BATTERIES

Gel Cell batteries are a maintenance free battery design that has no liquid to spill out in the event that a machine would be tipped over or some other disaster were to occur. The batteries perform well but not as well as a “traditional” flooded wet cell. With AGM batteries there is no water level to check so there is less maintenance involved. With AGM batteries the machine should be charged anytime it is used for any significant length of time. AGM batteries should never be discharged below 80% of their capacity, 19 volts on this machine, or it will cause rapid failure of the battery.

DRY SHIPPED BATTERIES

SEE NOTE AT END OF THIS CHAPTER.

BATTERY CABLES & TERMINALS

The battery cable connections must remain tight and corrosion free. In the event that the battery cables or terminals become corroded follow accepted battery safety precautions, disassemble and clean the terminals with a baking soda and water solution and a wire brush, making sure not to get any INSIDE the battery. Once the terminals and cables are clean and dry, inspect them thoroughly for any damage or signs of arcing or over-heating. Replace and damaged cables, terminals or batteries. Reassemble the cables and batteries and coat terminals and connections with a battery terminal protectant.

IMPORTANT NOTE! Make sure to apply the protectant AFTER the batteries and cables are reassembled and tightened. Putting protectant on before assembly and tightening can lead to a fire.

BATTERY TESTING

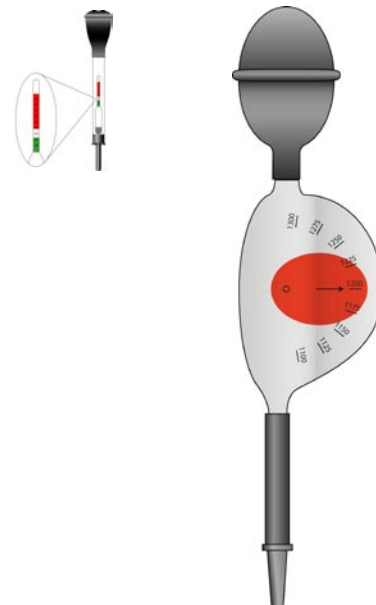
As a battery pack ages, the batteries will slowly lose their ability to accept and hold a charge. This will usually be noticed by a decrease in run time of the machine. Neglected batteries will “wear out” much faster than well-maintained batteries but give you similar symptoms when they do fail. The proper way to check a battery pack’s condition is with a battery discharge unit. To use the discharge unit make sure the batteries are maintained properly and fully charged. Attach the discharge unit to the machine’s battery pack and turn the machine on. Record your results and compare them to your battery’s rated capacity. This will let you know how much capacity your battery pack has left. If you find through the battery discharge meter that you have reduced capacity you can test each individual battery to find out if you have one bad battery or multiple bad batteries. To test each battery you have 2 options, a hydrometer test or a load test.

Hydrometer test:

Use a hydrometer on each cell in the battery pack to check its specific gravity.

HYDROMETERS

There are 3 types of hydrometers typically available. We do not recommend the floating ball type as they are not very accurate and give minimal information regarding the batteries condition. The traditional “float type” hydrometer and the “EZ Red” or dial type hydrometer give a numeric reading of each battery cell’s state of charge.



The state-of-charge of a lead acid battery can be determined by the specific gravity of the electrolyte (its weight compared to water). The specific gravity can be measured directly with a hydrometer or determined by the stabilizing voltage.

A hydrometer is a bulb-type syringe which will extract electrolyte from a cell. A glass float or a plastic disk in the hydrometer body is calibrated to read in terms of specific gravity. A common range of specific gravity used on these floats is 1.160 to 1.325. Do not assume a battery will not take a charge because you have been charging it for a while and the float will not rise. The battery may have been fully discharged and will require considerable charging time before reaching the minimum specific gravity on the float.

The lower the float sinks in the electrolyte, the lower its specific gravity. The proper way to read a hydrometer is to draw electrolyte into the body of the hydrometer while holding it vertically so the float is not rubbing on the side of it. Draw an amount of acid into the body so that with the bulb fully expended, the float will be lifted free not touching either side, the top or the bottom. Your eye should be level with the surface of the liquid in the hydrometer body. Disregard the curvature of the liquid where the surface rises against the float stem and the barrel due to surface tension. Keep your hydrometer and its float clean. Check them frequently for cracks.

The following table illustrates typical specific gravity values for a cell in various stages of charge with corresponding voltage readings.

OPEN CIRCUIT VOLTS	STATE OF CHARGE	HYDROMETER READING
12.65	100%	1.260 or more
12.45	75%	1.225 - 1.260
12.24	50%	1.190 - 1.225
12.06	25%	1.120 - 1.190
11.89	Totally Discharged	1.120 or less

When testing with a load tester you are looking for a difference between cells of the batteries. All the battery cells should have similar readings. Any battery that contains a cell that has a value lower than .050 of the rest of the cells indicates you have a bad battery.

Load test with a load tester:

Make sure batteries are fully charged. Disconnect batteries from the machine and each other so each battery can be tested individually. Using a battery load tester test each battery at either the fixed load of the tester or a 120 amp of load on a variable tester. The batteries should be able to maintain a voltage of 10.8 volts or greater for 15 seconds on 12 volt batteries and 4.9 volts or greater for 15 seconds on a 6 volt battery. If they can not maintain their voltage while under load they are bad.



Load test using machine systems as a load:

Using a volt meter measure the voltage of each battery while the machine is under full load (all systems operating). If any battery shows a voltage of less than 80% of the battery with the highest voltage that battery is bad.

BATTERY REPLACEMENT

When replacing batteries in a machine it is important to replace them with quality batteries that are designed for high-output deep-cycle applications, such as the ones furnished by the factory when the machine was new. All batteries are NOT created equal. In the event you are considering other manufactures batteries make sure to compare their 75 AMP RESERVE CAPACITY. That is the ONLY specification that corresponds to the usage the batteries will be seeing.

When a battery fails in the first 12 months of operation replacing a single battery may be acceptable if the failure was caused do to manufacturing defect. If the battery pack is older than 12 months or the battery has failed due to neglect the entire battery pack should be replaced as the batteries operate as a system.

When replacing batteries it is important to neutralize any battery acid that is in or on the machine after battery removal. Clean and dry the machine after neutralization and removal of any acid. The batteries should be installed in a clean and dry machine.

When installing batteries a terminal protectant should be used to help inhibit battery terminal corrosion. It is important to use a product specifically designed for this and not things like grease, silicone or paint. Read and follow the directions on the can of protectant exactly to prevent terminal or cable failure.

BATTERY CHARGER

The standard charger supplied with the MiniMAG is an on-board fully automatic charger. To operate the charger all that needs to be done is plug in the charger cord into a wall outlet of the proper voltage. The charger will run until the batteries are fully charged and then automatically shut off. It is important to let the charger finish its charge cycle before disconnecting it as the last few hours of a charge cycle are very important.

The charger has a digital readout that scrolls the charging information across it as well as displays fault codes in the event there is a failure with the charger.

DRY SHIPPED BATTERIES

Overseas users will usually receive units from us equipped with dry batteries. These are, in fact, wet batteries that had their acid removed at the factory. The technical term is “damp” battery. The cells are sealed with tape.

These batteries should come with instructions on how to charge them.

These batteries should not be stored for a long period of time. They must be filled and charged within six months of their date of manufacture.

To prepare the batteries, you will fill the batteries with a mixture of dilute sulfuric acid. This Can normally be purchased premixed from your local battery supplier. Fill the battery with a solution so the plates are covered but so that the electrolyte (acid) does not reach the “ring” inside the battery. The batteries should be charged for about 24 hours on a low slow charge after this..

ELECTRICAL SYSTEM

The electrical system on the MiniMAG series is a 24 volt system. This is not a chassis ground system there is a separate positive and ground wire that runs to each component.

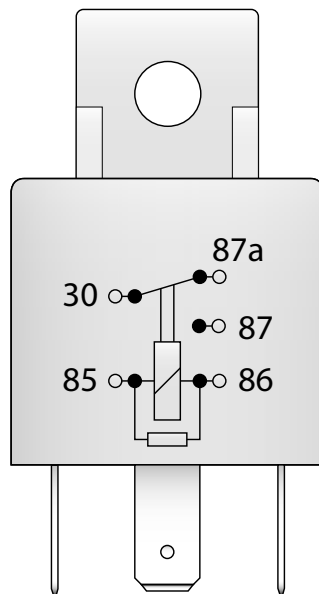
SWITCHES

The switches we use all have a similar face but are configured differently internally. Majority of them interface directly with the machine controller and carry low voltage signals. It is important to not that when diagnosing these machines, NEVER jump battery power to the switches to test them as the controller can be instantaneously destroyed.

RELAYS

The MiniMAG series uses only one relay. This relay is used to power the positive buss bar and isolate it from the controller. There are relays internally mounted in the controller but these are not serviceable.

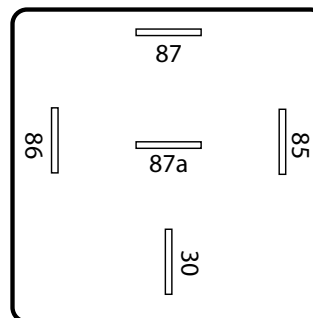
The relay we use is a 24V 15A Hella relay. This relay is energized by the key switch and it relays power to the positive buss bars.



COIL SECTION

85 COIL LEAD

86 COIL LEAD



SWITCH SECTION

30 COMMON

87 NORMALLY OPEN

87a NORMALLY CLOSED

MOTORS

The motors that are used through out the machine are designed to be very durable and give long service life.

BRUSH DECK MOTORS

The brush deck motors are DC permanent magnet gear reduction type, they output large amounts of power for scrubbing. The motor brushes are replaceable and are rated to give 2000 hours of service life. See the "Brush Drive System" chapter 7 for more information.

VACUUM MOTOR

The vacuum motor is a very high speed motor that develops vacuum for the recovery system. The motors are designed to give a service life of about 500 hours. See the “Recovery System” chapter 5 for more information.

ACTUATORS

The MiniMAG uses only one actuator. This actuator is for lifting the brush deck. This is a heavy duty 500 lb. actuator that has internal limit switches. See the “Brush Lift Section” Chapter 8 for more information.

WIRING

The wiring on the machine is numbered for easy circuit determination and to be easy to trace. We over size our wiring to eliminate failures and for safety reasons.

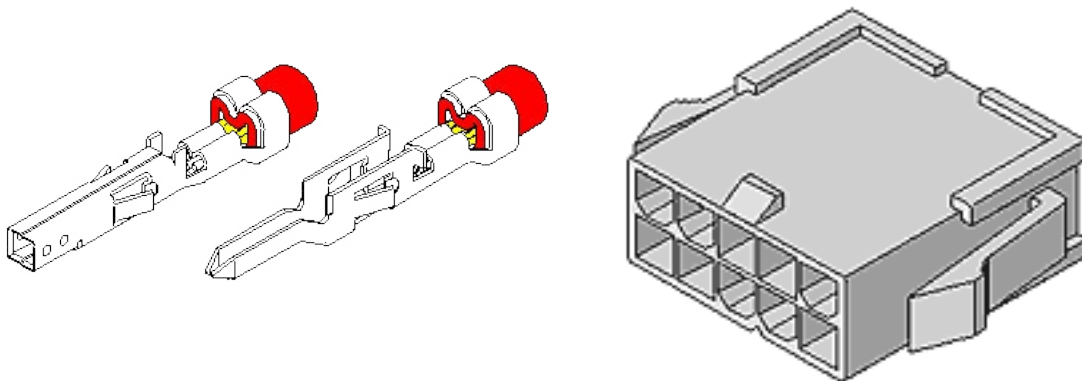
We use a number of different wire terminals on our machines and some require special tools to properly service or replace them.

STANDARD CRIMP ON TERMINALS

The standard crimp on terminals we use on our equipment should be crimped with a positive stop ratchet type crimpers. The correct color coded terminal must be installed for the machine to operate properly with its original integrity. It is important to use the Ratchet style crimpers to assure the connector is installed properly. The ratchet style crimpers regulates the crimp so it is not too tight or too loose. Using standard pliers style crimping tools does not assure a consistent connection.

MOLEX CONNECTORS

Molex Mini Fit Jr. wire terminals are used where the wiring harness plugs into the controller and the LCD display. These terminals require a special removal tool. If an attempt to remove them is made without the removal tool it is very likely that the terminal and perhaps the connector will be damaged and need to be replaced. To replace a Molex Mini Fit Jr. terminal a special set of Molex brand crimpers is required to achieve an acceptable crimp.





REMOVAL TOOL



MOLEX MINI-FIT JR. CRIMPING TOOL

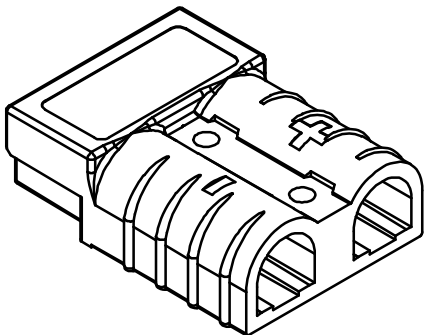
CONTROLLER HIGH AMP OUTPUT TERMINALS

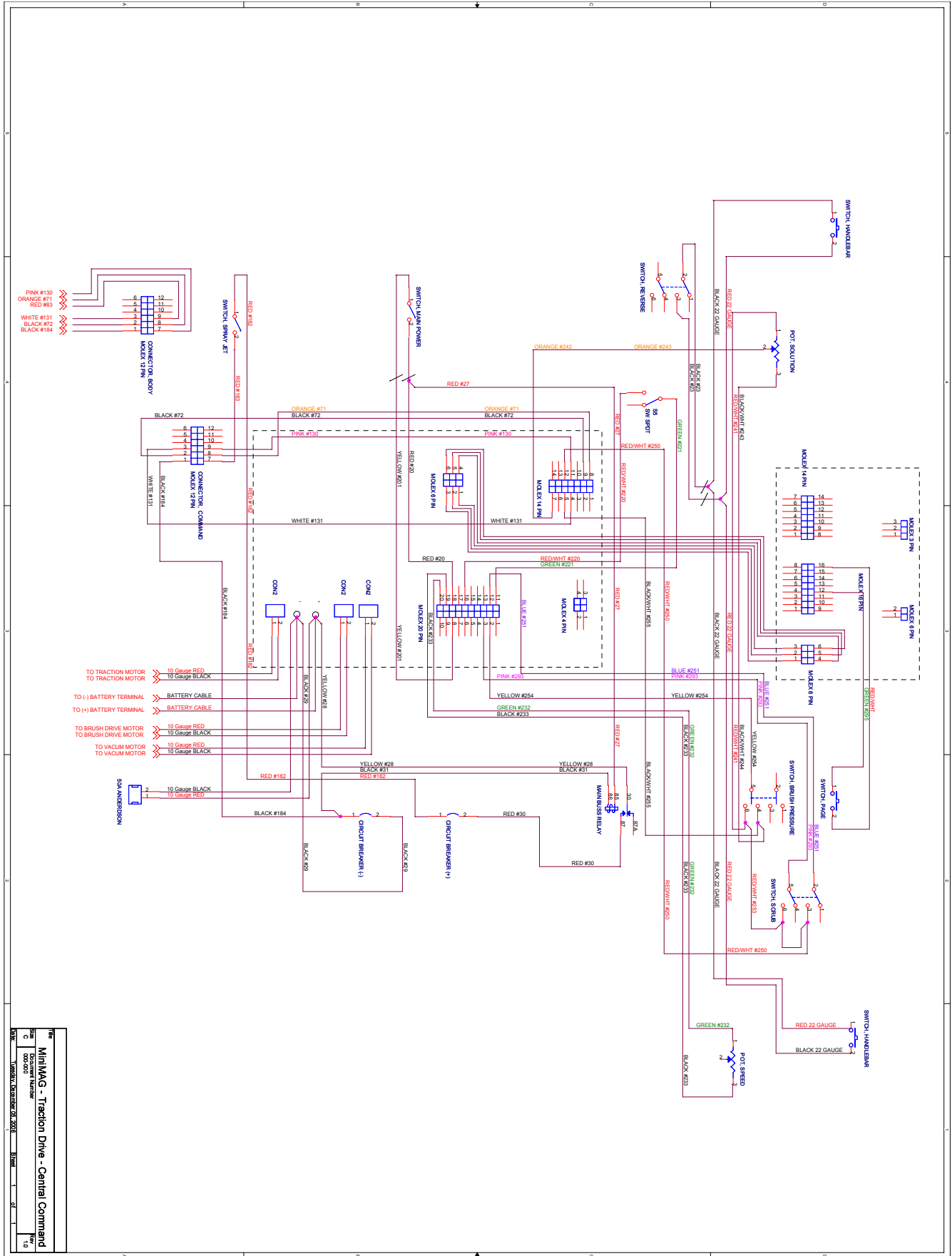
(Brush, Vacuum, Traction)

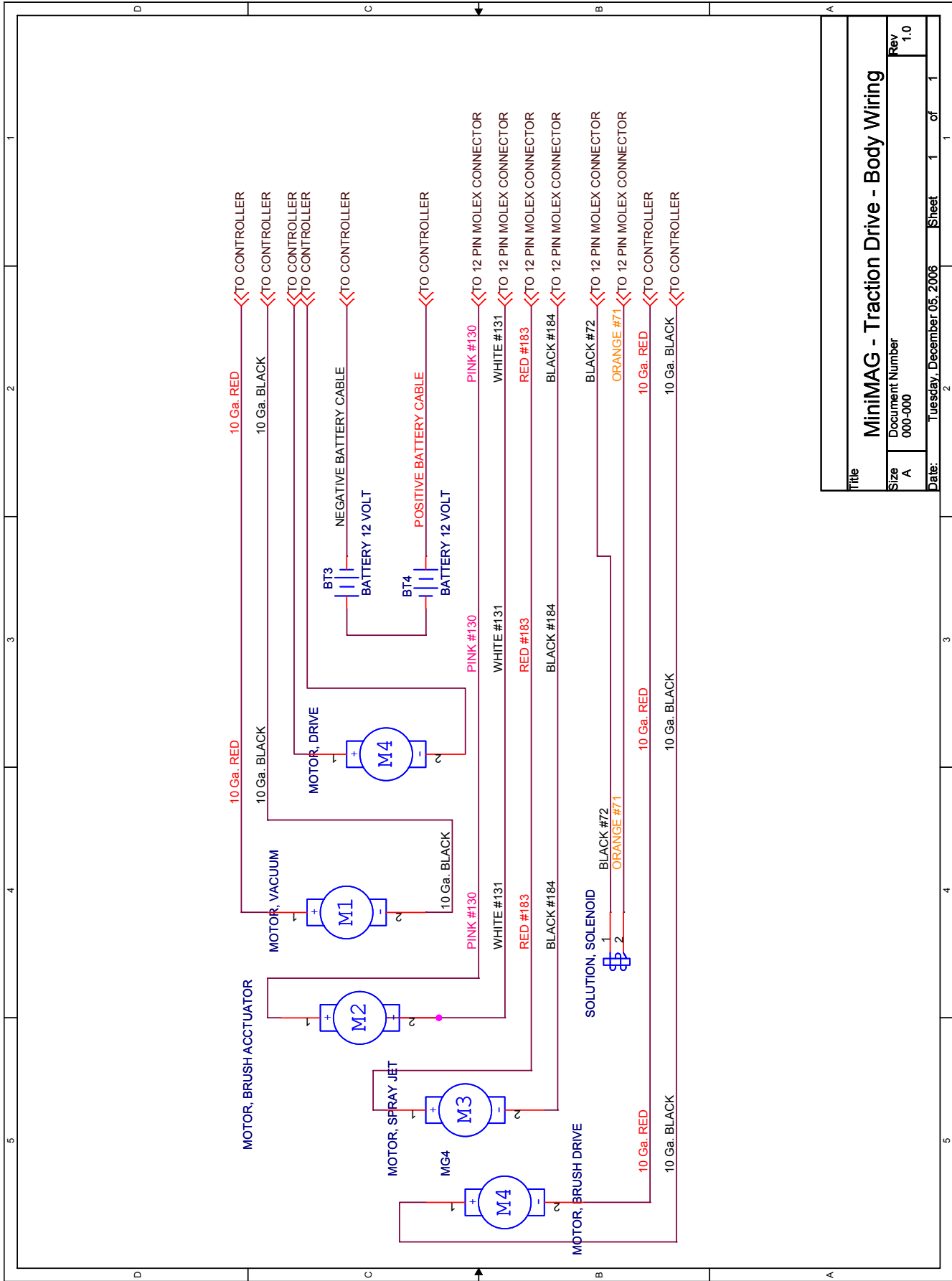
The controller high amp output connectors are crimped with a special crimping tool at the factory. The tool is not practical to use in the field so in the event that a new terminal is needed a wire end kit is available that is field installable. This kit is available through the parts department.

ANDERSON BATTERY CONNECTORS

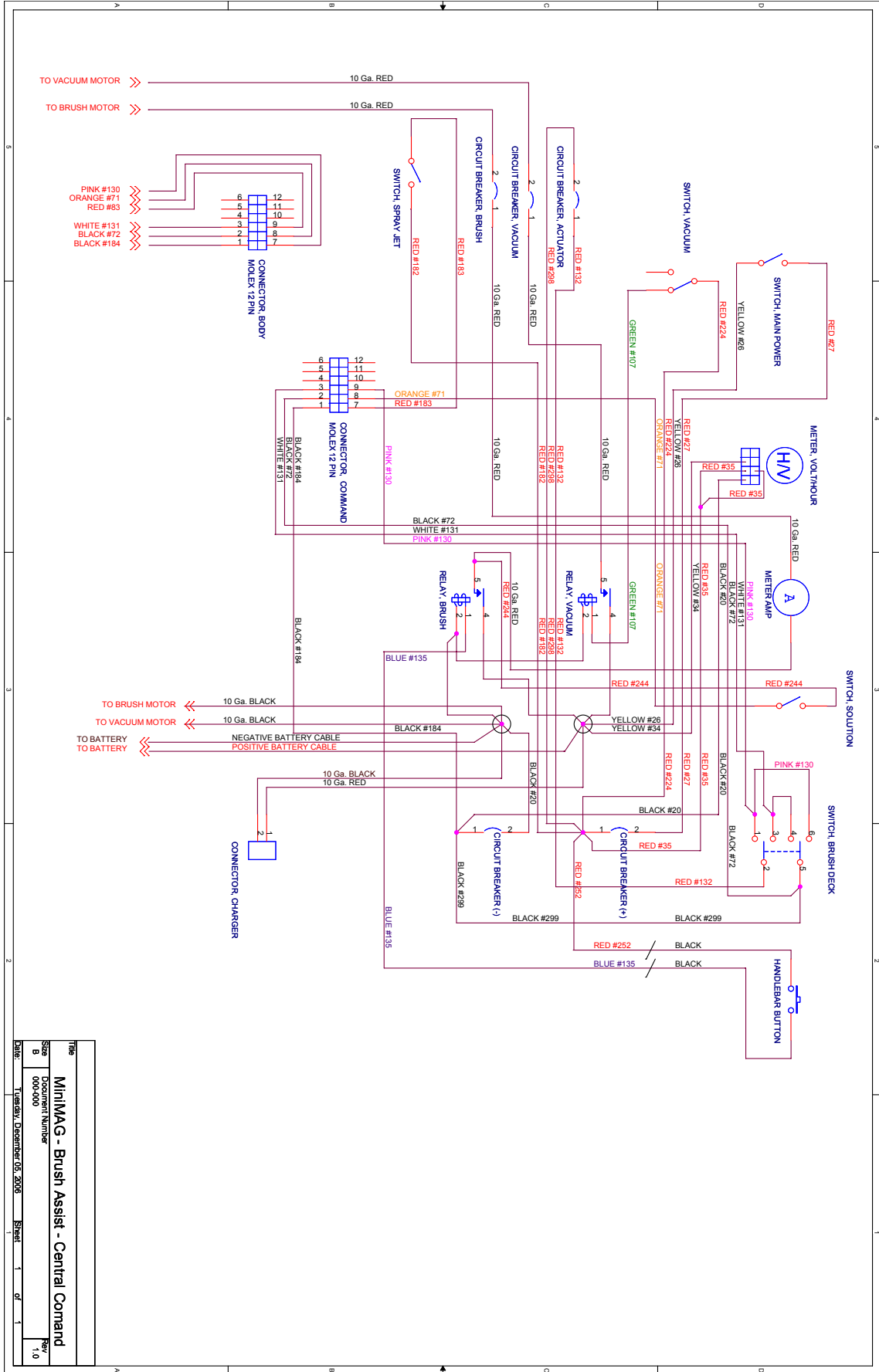
Anderson connectors are crimped by a hydraulic crimping machine at the factory. This is not practical in the field. We recommend using a manual staking tool and then soldering the terminal to assure a good solid connection.

ANDERSON
CONNECTORANDERSON
CONTACTMANUAL
STAKING TOOL

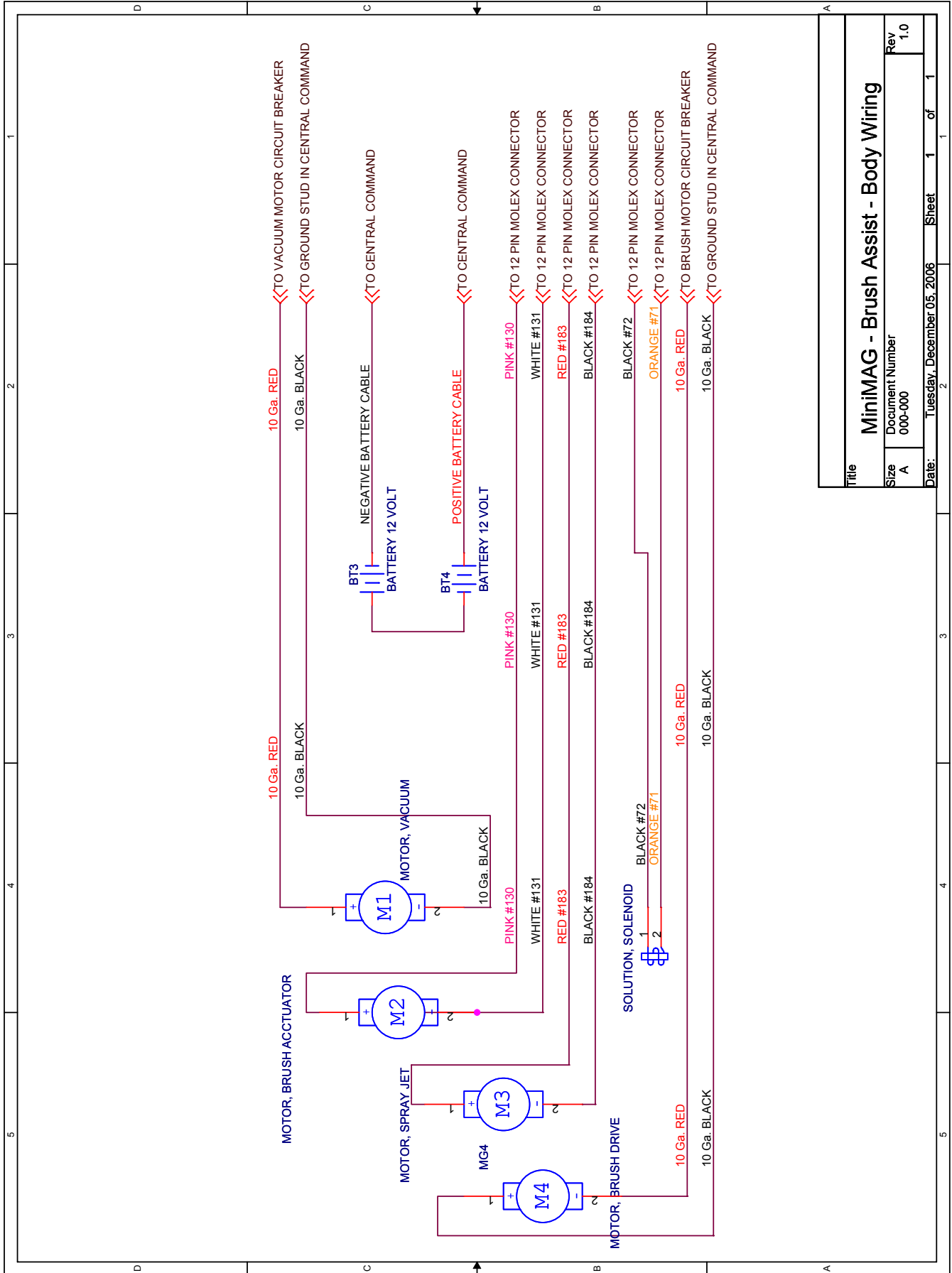




Title		MiniMAG - Traction Drive - Body Wiring	
Size	Document Number	Rev	1.0
A	000-000		
Date:	Tuesday, December 05, 2006	Sheet	1 of 1



Title	MiniMAG - Brush Assist - Central Command
Size	B
Document Number	000-000
Date	Tuesday, December 05, 2006
Sheet	1 of 1
Rev	1.0



Wire Number	Terminal or Pin #	Component
1-19 Battery Cables		
1		Main + cable to the battery pack #1
2		Cable from 1st to 2nd battery
3		Cable from 2nd to 3rd battery
4		Cable from 3rd to 4th battery
5		Cable from 4th to 5th battery
6		Cable from 5th to 6th battery
7		Main - cable to the battery pack #1
8		Main + cable to the battery pack #2
9		Main - cable to the battery pack #2
10		Rapid Charge #1
11		Rapid Charge #2
12		Rapid Charge #3
13		Rapid Charge #4
20-39 Main Power		
20	- Buss	General 16 Gauge ground
23		General 16 Gauge (+) Positive
26		Pos (+) Battery Power to Key or Master switch
27		Power from main or key switch to main relay
28		Battery (+) to hella relay Pin 30
29		(-) battery to (-) buss breaker in
30		(+) Pin #87 on hella relay to (+) buss breaker in
31		(-) Pin #85 to (-) breaker out
32		(+) Buss breaker out
33		(-) Buss breaker out
40-59 Drive System		
50		Drive motor + 1
51		Drive motor - 1
52		Drive Motor + 2
53		Drive Motor - 2
54		Parking brake +
55		Parking brake -

60-79	Solution System	
65		Low solution output from switch
66		Low solution power to switch
67		Solution Pump Power Controlled (390 420 430)
68		Solution Pump Negative (390 420 430)
70		Supply voltage to switch (Non electronic controller machines only)
71		Deltrol valve + power
72		Deltrol valve - switched power

80-119	Vacuum System	
85		Vac Motor #1+
86		Vac motor #1 -
87		Vac motor #2 +
88		Vac motor #2 -
89		Vac Motor #1+
90		Vac motor #1 -
91		Vac motor #1 Control +
92		Vac motor #1 Control -
93		Vac motor #2 +
94		Vac motor #2 -
95		Vac motor #2 Control +
96		Vac motor #2 Control -
97		Vac Motor Cut Vac Switch Input
98		Vac Motor Cut Vac Switch Output
99		High Vac horn +
100		High Vac horn -
101		Vac Motor Relay (ONLY 390, 420, 430)
102		Vac Motor Relay (all except 390, 420, 430)
103		High recovery light +
104		High recovery light -
105	C2 / 10	Squeegee actuator +
106	C2 / 3	Squeegee actuator -
107		Vacuum "on" signal to relay (For Non Solid State controlled machines)
108		Vacuum power to circuit breaker
109		Vac Switch Input (Air Logic)
110		Vac Switch Output

USED ON ONLY 390, 420 and 430

120-139	Brush Drive / Main Broom System
125	Brush drive motor +
126	Brush Motor to meter
127	Brush motor meter to circuit breaker
128	Brush motor solenoid to circuit breaker
129	Brush drive motor -
130	C2 / 11 Deck Actuator +
131	C2 / 4 Deck Actuator -
132	Deck actuator (+) power to the circuit breaker
133	Worn Motor Brush Indicator +
134	Worn Motor Brush Indicator -

140-159	Side Broom System
145	Side Broom Motor (Right) +
146	Side Broom Motor (Right) -
147	Side Broom Motor (Left) +
148	Side Broom Motor (Left) -
149	Side broom Switch
150	Side broom Diode
151	Side broom switch input
152	Side broom switch output
153	Side broom diode input
154	side broom diode output

160-199	AUX / options	
170		Back up alarm B+ Power
171	C3 / 17	Back up alarm
172		Strobe +
173		Strobe -
174		Horn -
175		Horn Switch B+
176		Horn Switch output
177	+ Buss	Headlight +
178	- Buss	Headlight -
179		Filter Shaker Switch Input B+
180		Filter Shaker Switch Output
181		Filter shaker motor -
182		Spray Jet Switch B+
183		Spray Jet Switch Output
184		Spray Jet -
185		B+ to recycling switch
186		Recycling Switch output
187		Recycling B-
188		B+ to side broom water switch
189		Output from side broom water switch
190		Side broom water B-

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COMPUTER CONTROL SYSTEM

The Magnum series of machines is equipped with the Central Command II control system. Central Command II is designed around a very powerful controller that has an industrial computer integrated into it. The controller is linked to a Liquid Crystal Display (LCD) to relay information to the operator or the service technician. The same controller is used in majority of our equipment, both 24 and 36 volt, but runs a different “program” for each machine. The controller utilizes unitized construction eliminating many excess components from the control panel. The switches on the dash board send input signals to the controller. The controller then interprets the inputs via the program and operates the machine accordingly. The controller has internal protection for both current overload as well as thermal protection. A large circuit breaker is used on the power feed to the controller for extra safety against overload. In the event of a malfunction the Central Command II will display a diagnostic trouble code to aid in the repairing the machine.

CONTROLLER OVERVIEW

INPUTS

The controller's input section uses a technology called tri-state logic to interpret the input from the switches. The tri-state logic is comprised of low, medium and high voltages. The inputs have the mid voltage present at them until they are either drawn low or high by a switch.

OUTPUTS

The controller has a number of outputs and each one of them is electronically protected from overload. In the event of an overload the machine is shut down by the controller and a diagnostic trouble code is displayed on the LCD screen. On some of the outputs the current limit can be adjusted via software to control the amount of current available to the circuit.

PULSE WIDTH MODULATION

The controller uses a technology called pulse width modulation to control some of the output circuits. Motors and accessories can be run using this technology in more than one way. We can change the speed of a motor as well as control the amount of time a valve is open over one second, such as in our solution system. Pulse width modulation works by sending pulses of full battery voltage to the device 14,000 times a second. The length of the pulses determines the speed of the motor. This is a much more efficient way of running an electrical device at less than 100% operation.

CONTINUITY TESTING

Four of the outputs; traction drive, parking brake, brush & vacuum have a continuity checking feature that monitors the device and the wiring to it from the controller for an open circuit. This monitoring can be turned on and off for each circuit independently through the programming of the controller.

SOFT START

Three of the outputs; traction, brush & vacuum, have a soft start function on them. This function provides the ability to start and stop a motor gradually over a measured period of time, 0-10 seconds. This aids in the longevity of the motors and anything driven by them as it greatly decreases the shock load on them. The soft start settings are changed through the controller programming.

CONNECTIONS

There are 3 different types of connections that are used on the controller.

MOLEX MINI FIT JR.

The Molex Mini Fit Jr. connectors are used for all of the inputs and the low amperage outputs. They require special tools to service and replace them. See the “Electrical System” Section 12 for serving information.

AMP TERMINALS

The AMP terminals are specially designed terminals capable of handling high amperage connections. These are used on the high amp outputs on the V.3 controls. See the “Electrical System” Section 12 for serving information.

BINDING POST TERMINALS

Binding post terminals offer the best connection available and are used for the main battery terminals on both the V.3 & V.4 controllers. On the V.4 controllers the high output connections have been changed to the binding post type.

TIMED CIRCUITS

The controller has the capability to control a circuit with a certain amount of logic. We can customize the operation of a component beyond the simple on off operation. Timers are used for our vacuum motors and our squeegee actuators to make the machine operation more user friendly. The timer settings are changed through the controller programming.

BATTERY METER

The battery meter is integrated into the controller and the status of the battery is displayed on the LCD screen. The battery condition is monitored very differently from a traditional battery meter. The battery condition is calculated by measuring the internal resistance of the battery pack. The battery meter is designed to read properly when the battery is under load. It is not uncommon for the battery gauge to climb when the machine is under load.

DOWN PRESSURE CONTROL

The down pressure of the scrub deck is monitored and maintained by the controller. It is adjusted many times a second to deliver consistent brush pressure with changing floor conditions. The controller monitors the amp draw of the scrub motors which increases and decreases with brush deck pressure and floor surface change. The amp draw has a target value and the controller works to keep the motors at the selected amp draw by increasing or decreasing brush pressure. The target pressure is represented on the LCD display and changed using the brush pressure switch on the control panel.

LCD DISPLAY

The LCD display is a multi function display that conveys machine information to the operator about the operation state of the machine and diagnostic information in the event of a malfunction. The LCD display communicates to the controller on a serial data connection that is made via the 6 wire connector running from the display to the controller. The LCD display has 4 different screens with different information presented on each.

SCREEN 1

Screen 1 is the default screen that appears after the machine has powered up.

1: BATTERY METER - This meter shows the charge level of the batteries in the machine. This gauge is designed to read properly while the machine is in use and therefore will vary during usage of the machine.

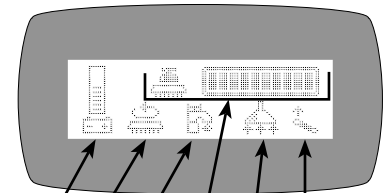
2: BRUSHES RUNNING - This icon shows when the controller receives an input to run the scrub brushes.

3: SOLUTION DISPENSING - This icon indicates that the controller is receiving an input to dispense water. The icon flashes in relationship to the amount of time the valve is on for. This is controlled by the solution potentiometer on the control panel.

4: BRUSH PRESSURE GAUGE - This icon is a bar graph representation of the desired brush pressure. It is divided into 5 segments and each segment indicates more pad pressure.

5: VACUUM MOTOR - This icon indicates the controller is receiving an input to run the vacuum motor.

6: HIGH THROTTLE - This icon indicates one or more throttle inputs, such as the green handle bar buttons or the reverse switch, were activated when the machine was powered on. Make sure no buttons or switches are depressed and cycle the power to the machine.



1. BATTERY METER
2. BRUSHES RUNNING
3. WATER OPERATING
4. BRUSH PRESSURE GAUGE
5. VACUUM MOTOR OPERATING
6. HIGH THROTTLE

SCREEN 2

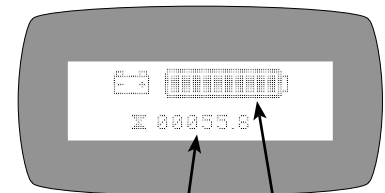
To access screen 2, push the green page button on the control panel once.

7: KEY SWITCH HOUR METER

This hour meter represents the total number of hours the machine has been powered on. This does not mean however that the machine has been used this long just that it has had the power on for the time indicated.

8: BATTERY METER

This meter shows the charge level of the batteries in the machine. This gauge is designed to read properly while the machine is in use and therefore will vary during usage of the machine.



7. KEY SWITCH HOUR METER
8. BATTERY METER

SCREEN 3

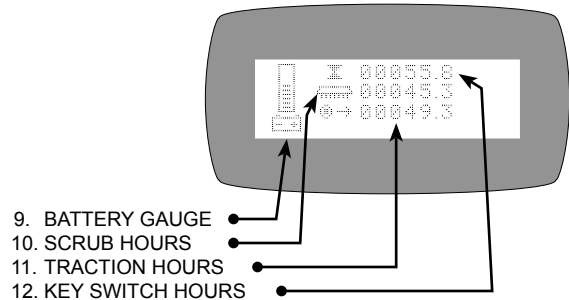
To access this from screen 1 press the green page button twice.

9: BATTERY METER - This meter shows the charge level of the batteries in the machine. This gauge is designed to read properly while the machine is in use and therefore will vary during usage of the machine.

10: SCRUB HOURS - The hour total listed here indicates the total number of hours the brush deck has been operated on the machine.

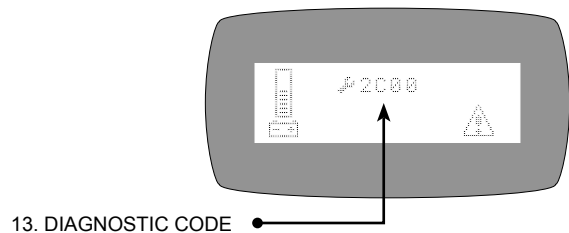
11: TRACTION HOURS - The hour total listed here indicates the total number of hours the traction drive has been operated on the machine.

12: KEY SWITCH HOUR METER - This hour meter represents the total number of hours the machine has been powered on. This does not mean however that the machine has been used this long just that it has had the power on for the time indicated.



SCREEN 4

This screen will appear automatically in the event of a fault being present in the machine. Machine operation will be suspended until the cause of the code is remedied.



ON BOARD DIAGNOSTICS

The Central Command II control system utilizes a Diagnostic Code system that displays diagnostic codes on the LCD display should a malfunction of the machine occur. The diagnostic code can be looked up in the diagnostic code chart and it will assist you in determining the cause of malfunction.

DIAGNOSING THE CONTROL SYSTEM

The Central Command II system with all its robust capabilities is also very easy to diagnose and repair. To diagnose the system a clamp type DC amp meter and high impedance DC Volt meter are required. The machine's LCD display will also be utilized. It is important never to use jumper wires connected to battery power or ground for testing as this can instantly destroy the controller.

The controller is not field serviceable in any way and needs to be replaced in the event of failure.

METERS

It is important to use a high quality meter when diagnosing the control systems on our equipment as a low quality meter can ruin a controller just by taking a measurement. A good rule of thumb is if you didn't pay at least \$50 for your meter don't use it on our equipment. NEVER use analog meters for diagnosing the controller systems on our machines as they WILL damage the machine. A DC amp clamp is imperative for diagnosis of the control systems, most DC amp clamps have a built in DC volt meter too. In addition to your meter(s) you should have a quality set of test leads that have alligator clamps on the ends.

MEASUREMENTS

When measuring for voltage in the control system unless otherwise specified you will always set your meter to the DC volts scale and connect your negative (-) test lead to the negative (-) battery cable or buss bar. When measuring for amp draw you will always measure around ONLY 1 wire (+) OR (-) going to the device in question. Place the meter clamp on the wire with power off to the device. Zero out the meter and then power up the device and take your readings.

LCD DISPLAY

The LCD is a critical component and can cause the machine to operate improperly or not operate at all, There is a computer data link that is established between the LCD and the computer when the machine is powered on and all the computer information is routed in a loop through the LCD display. For this reason if an LCD fails it can cause a variety of results from making the machine not turn on to making it not turn off.

INPUTS

The switches in the Central Command II System receive reference voltages from the controller and then send signals, in the form of low or high voltage, to the controller. The controller interprets these signals and then the computer and it's program inside the controller

Decide what device there is a request for and how it should operate the device.

TRI-STATE LOGIC

The Central Command II system uses very low voltage throughout it's control system. This voltage is less than battery voltage and the controller will be destroyed if battery voltage is induced into the control circuits. The tri-state logic uses 3 voltages as follows;

LOW = 0.0 - 0.3 volts

MID = 0.8 - 2.7 volts

HIGH = 4.8 - 5.2 volts

The low and high voltages are reference voltages created by the controller. These voltages are sent to the various controller inputs via the control panel switches. The controller then makes the machine operate a certain way. All inputs at the controller, with the exception of the throttle input, are at a voltage of 0.8 to 2.6 volts when they are at a "neutral" or un-switched state. When a signal is sent to an input via a switch it is either a "LOW" or "HIGH" reference signal. The computer monitors the input terminal many times a second and when the voltage of it changes the computer reacts accordingly to the program in it changing the outputs of the controller.

INPUTS- VARIABLE VOLTAGE

In addition to the standard tri-state logic inputs the controller also used varied voltage inputs. Examples of these inputs would be the throttle and the solution circuit. On these inputs the a high and low signal are fed to a 5K potentiometer on each of the outside terminals. The voltage is summed by the potentiometer and the summed voltage is sent out the center terminal of the potentiometer to the input terminal on the controller. As the potentiometer is rotated the center wiper contact inside increases or decreases it's distance from the high reference signal creating a sweeping voltage from about 0.0 volts to 5.1 volts. This sweeping voltage is interpreted by the controller and the outputs are then controlled according to the program.

OUTPUTS

The outputs of the controller are controlled by the embedded computer and its program. It interprets the inputs and energizes the out puts accordingly. The outputs on the controller are driven by transistors and not relays so they are different to diagnose than a traditional control system. An important thing to be aware of is when an output is turned off there can be as much of 80% of the voltage present at the output when you measure it with a meter. The voltage that is present comes from the continuity test that the controller continually runs on some of the output circuits. This a very low amp signal that can register on your meter but is not enough amperage to power a motor or other accessory. To consider an output to be "on" or activated it must be 95% of battery voltage.

SOLUTION SOLENOID: AUX 3

The solution solenoid output of the controller provides a ground to the solution solenoid valve. The positive voltage feed to the solenoid valve comes from the switched B+ power from the controller on pin #8 of the 14 pin Molex connector at the controller.

PROGRAMMING

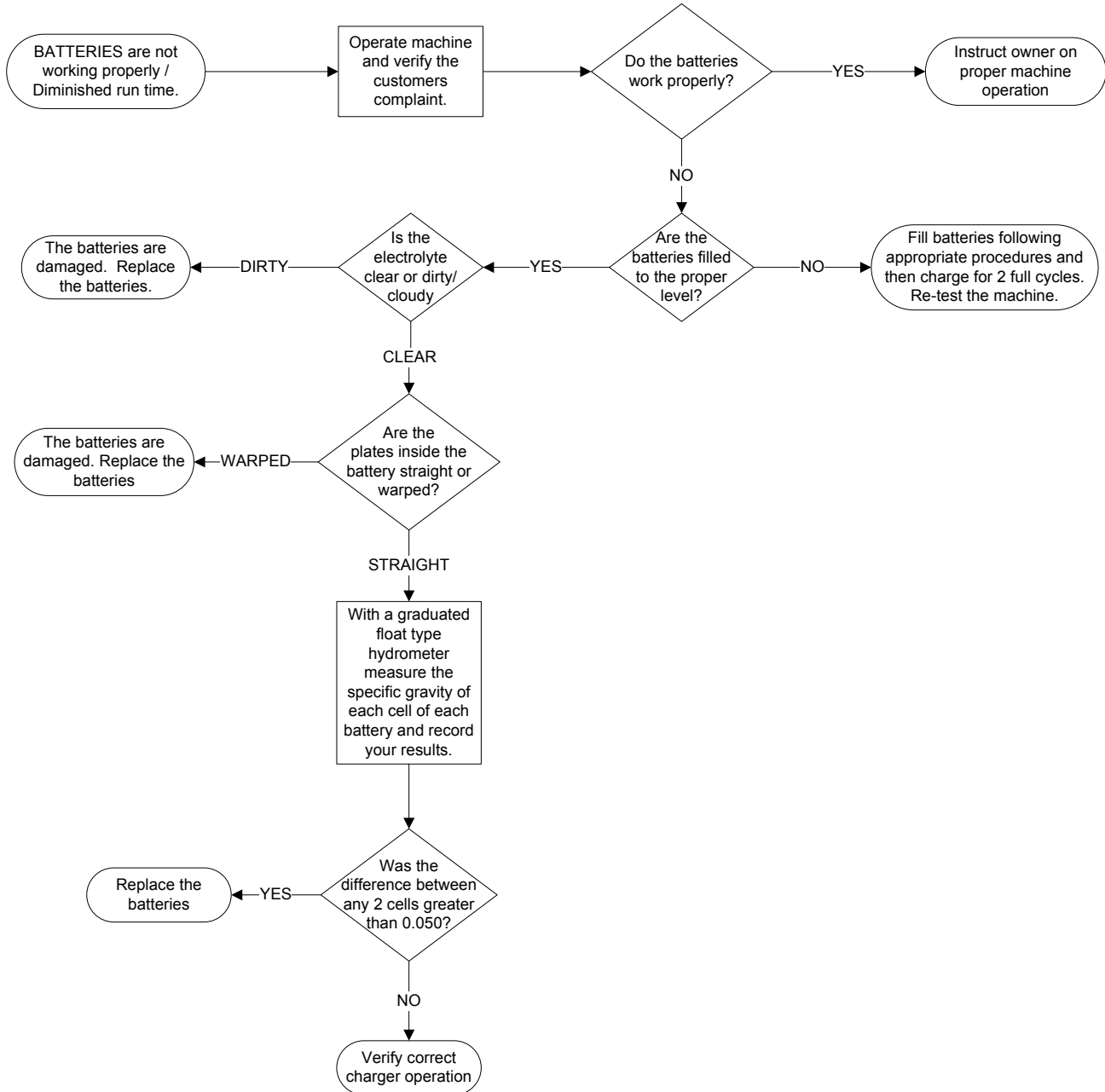
We use the same controllers on nearly all of our machines. The controller's embedded computer needs a set of instructions to operate the machine. The instructions are the program the computer runs and we can modify this program by changing its "parameters". This is what makes it possible to use the same controller in most of our machines but have each one of them react differently. By changing these parameters we can make the piece of equipment function in different ways. An example of this is by changing the parameters we can make brush deck of a machine drop to the floor when the machine starts scrubbing and then pick itself up when the machine stops. If we adjusted another parameter we could make the brushes raise up when the machine went in reverse without having the operator manipulate a switch. In order to change the parameters in a controller a T-194 programming kit is necessary. With a laptop computer and the programming kit access can be gained to the parameters of the machine and they can be modified to make the machine react differently.

The controller has 135 parameters that can be modified through programming. To program the controller a programming kit and special software are necessary. The kit for this is available from the factory. The part number for the kit is T-194 and it includes the following:

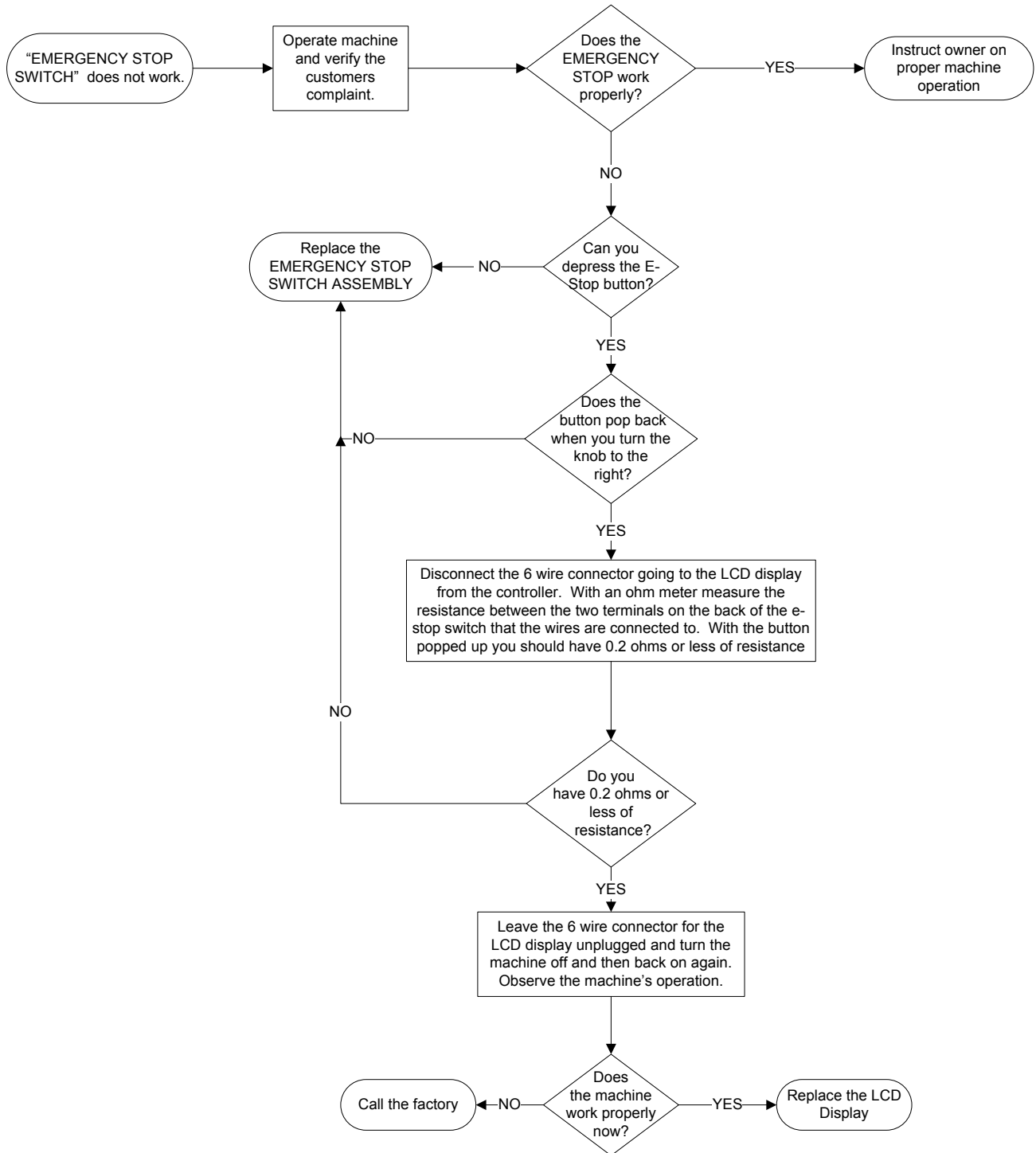
- 1 Central Command II Programmer CD
- 1 Controller computer interface cable
- 1 USB serial port adapter
- 1 Controller protected power cable
- 1 Jumper key
- 1 Latest version of the Electrical Service Guide
- 1 T-194 programming guide
- 1 Aluminum briefcase

This kit is required to make any changes in the program for the computer.

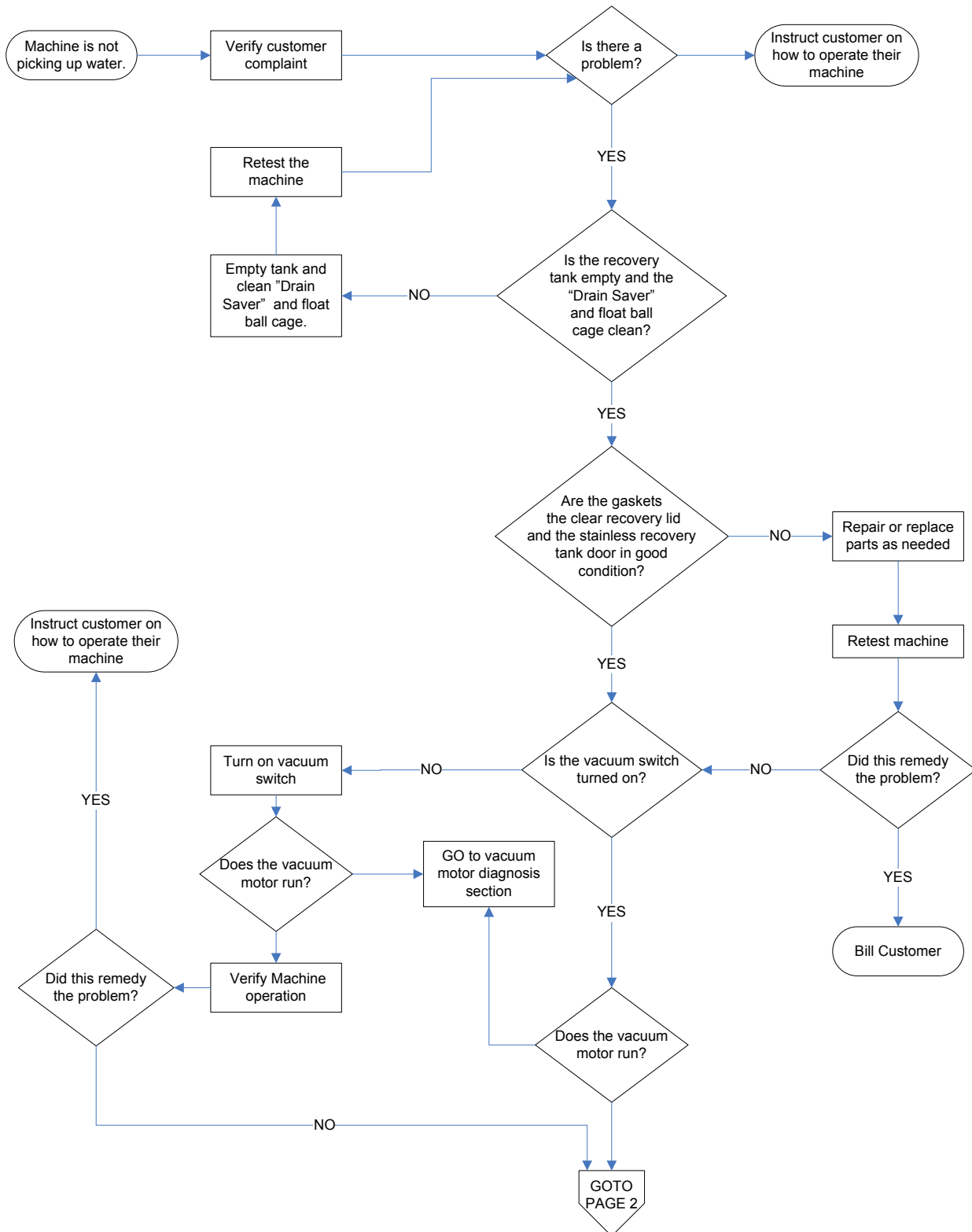
MiniMAG - ALL BATTERY DIAGNOSTIC FLOW CHART 1 of 1



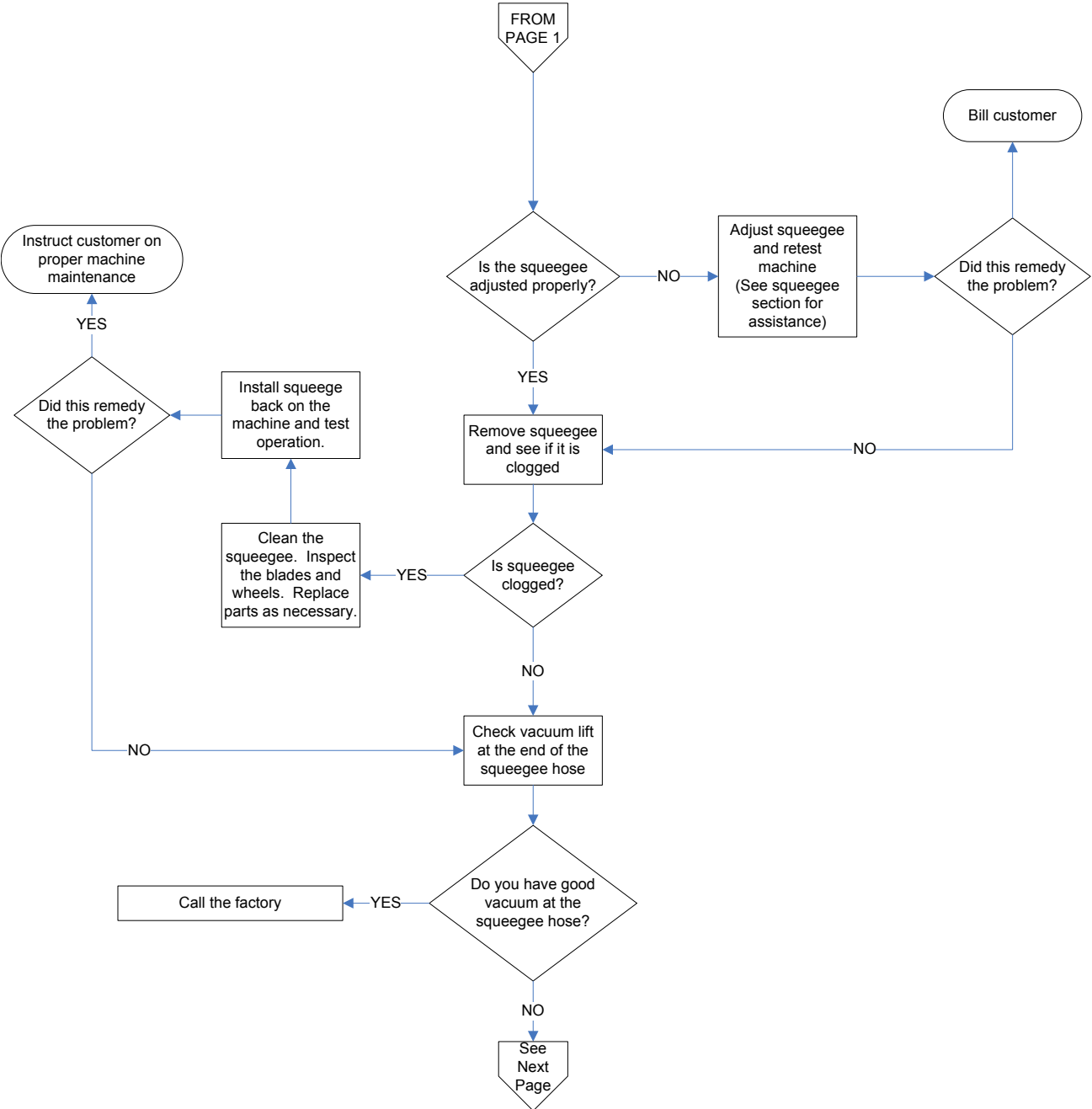
MiniMAG- ALL
EMERGENCY STOP DIAGNOSIS
1 of 1



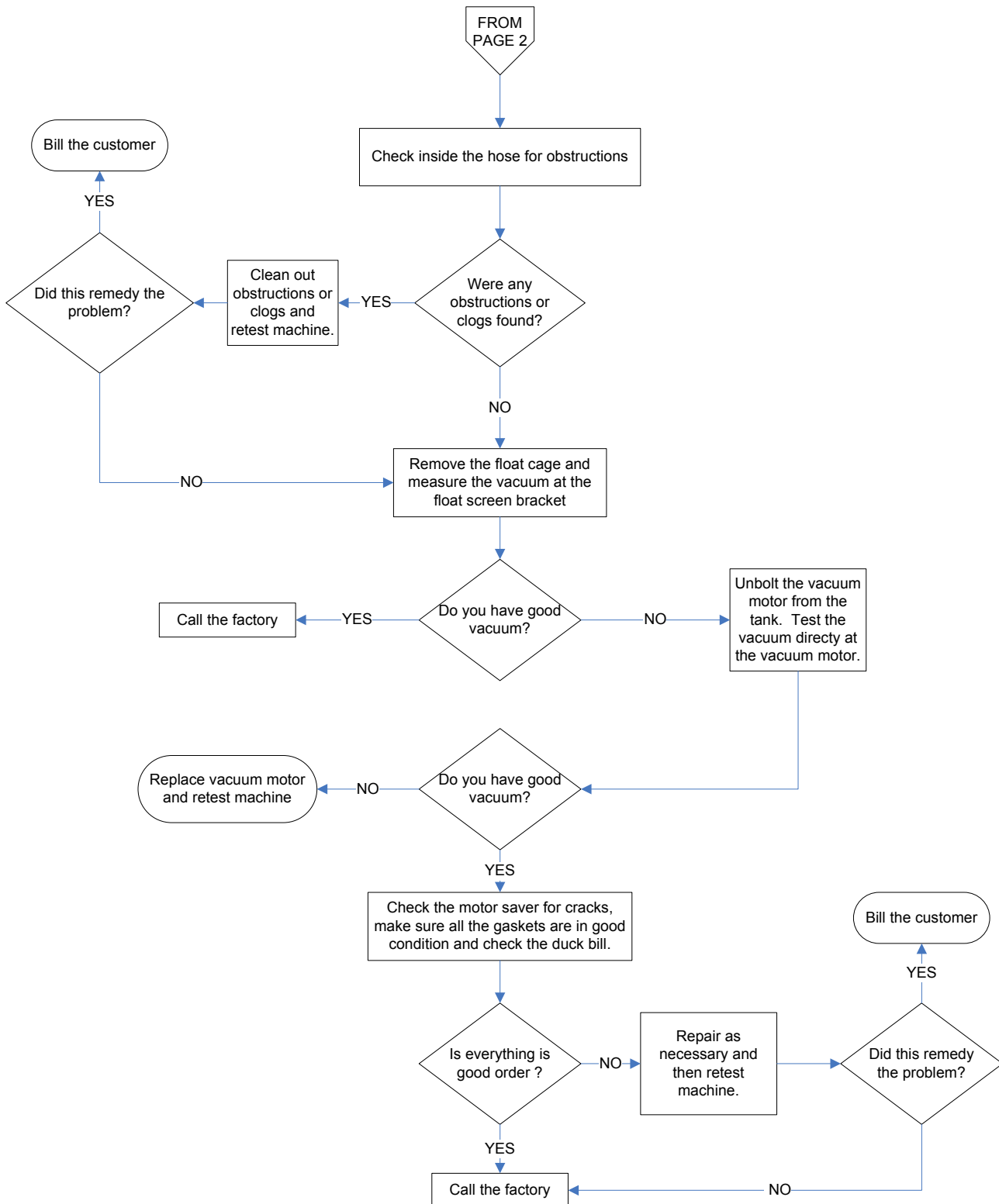
MiniMAG – ALL RECOVERY SYSTEM FLOW CHART 1 of 3



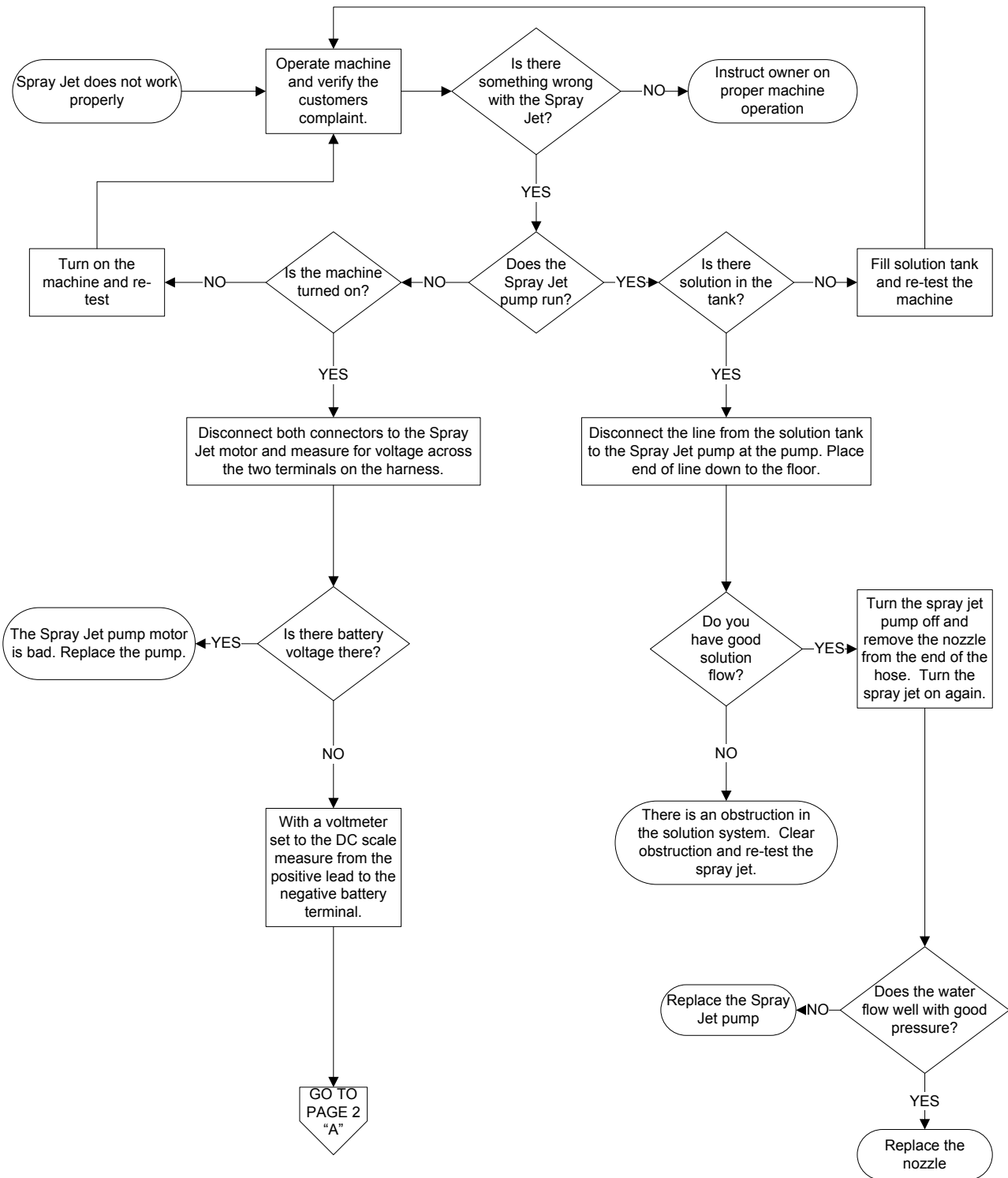
MiniMAG – ALL
 RECOVERY SYSTEM FLOW CHART
 2 of 3



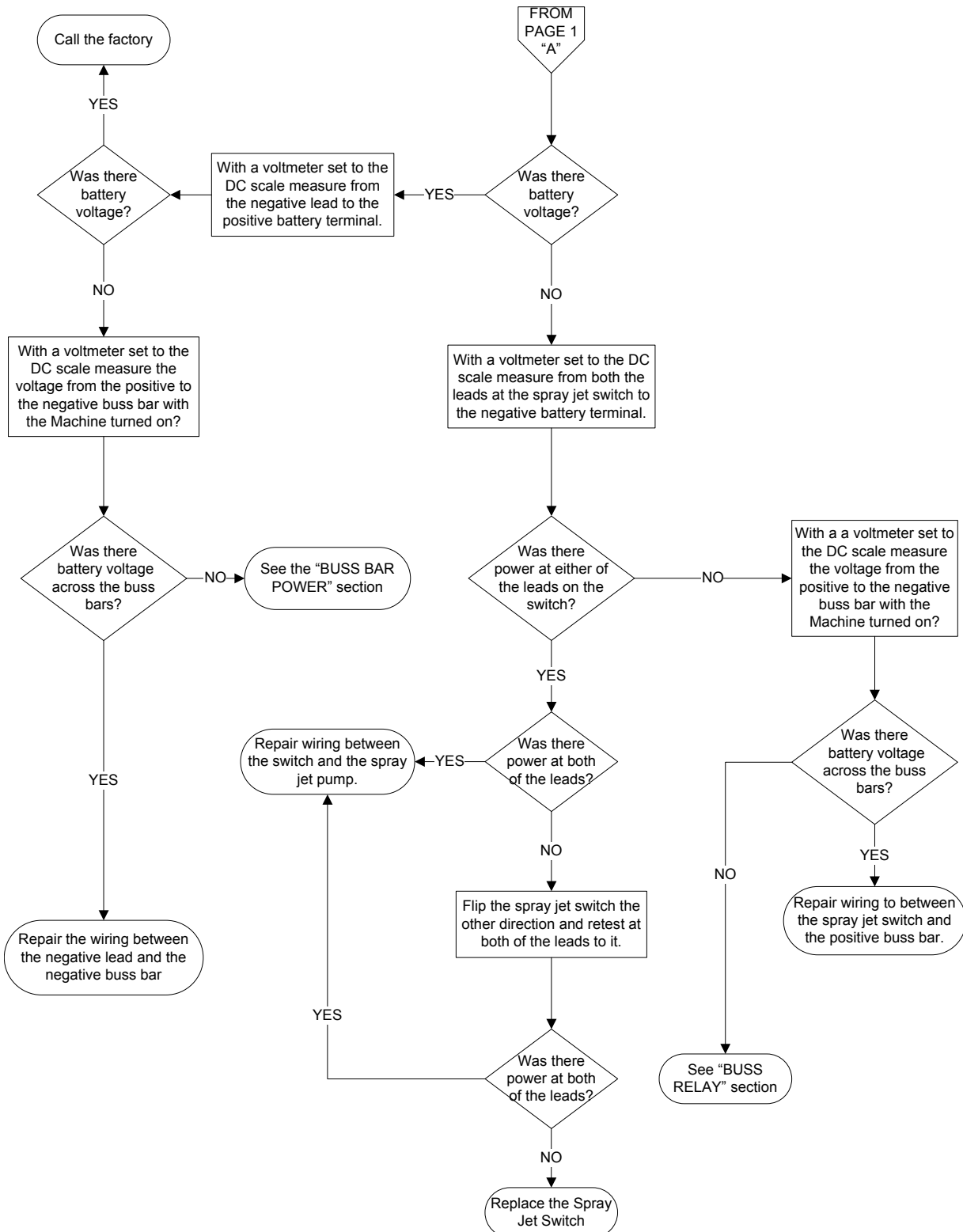
MiniMAG – ALL
RECOVERY SYSTEM FLOW CHART
3 of 3



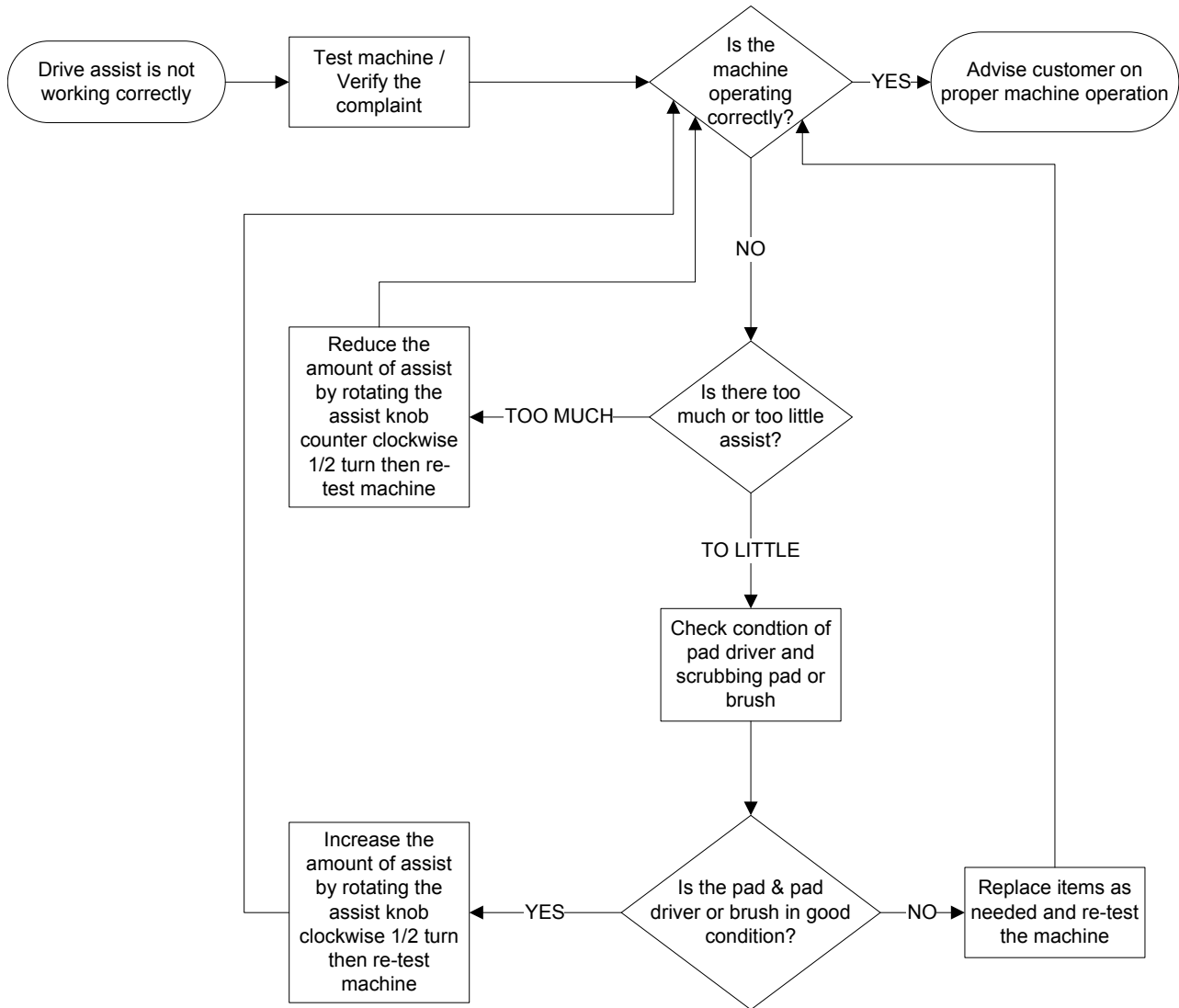
MiniMAG – ALL
 SPRAY JET DIAGNOSTICS
 1 of 2



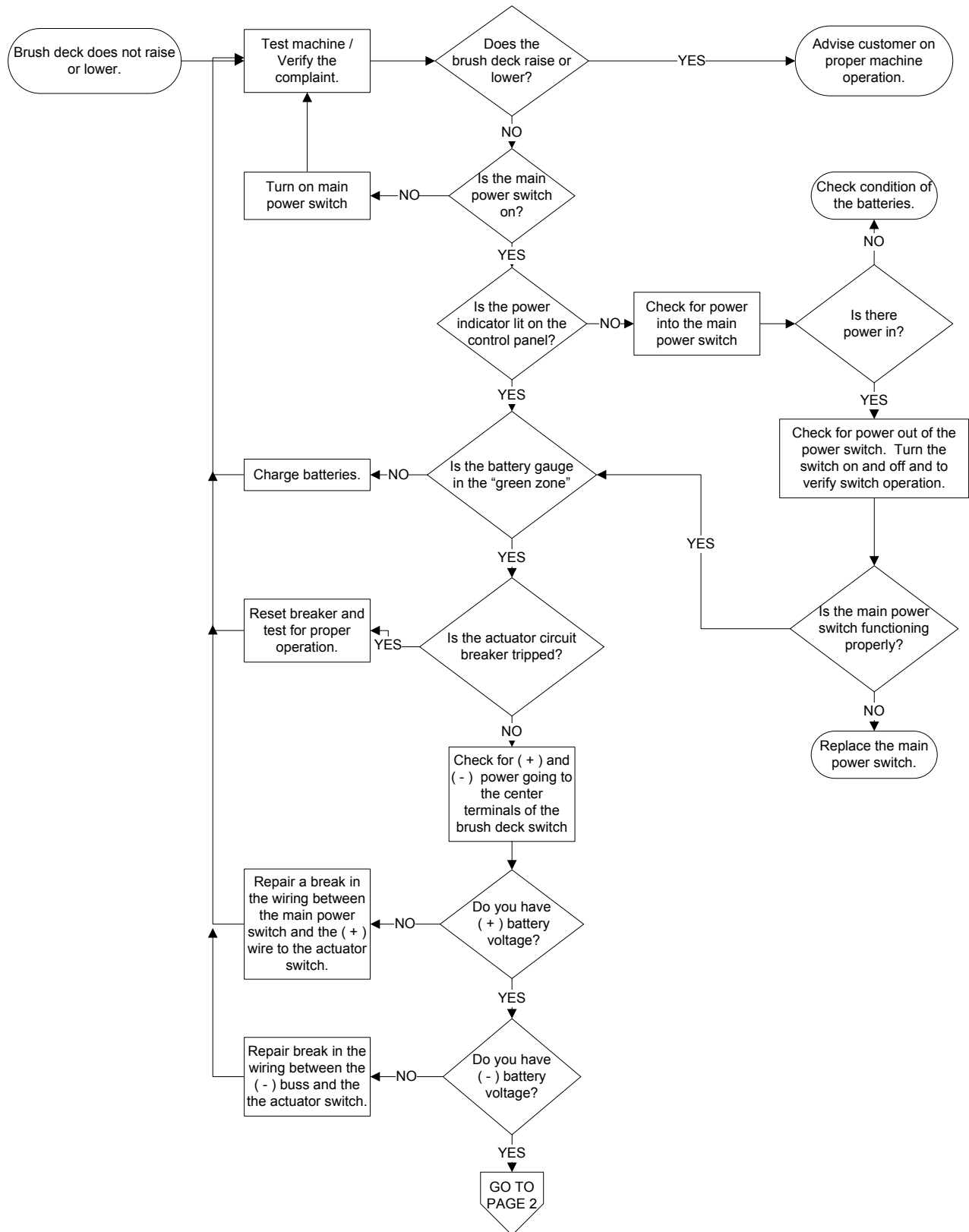
MiniMAG – ALL SPRAY JET DIAGNOSTICS 2 of 2



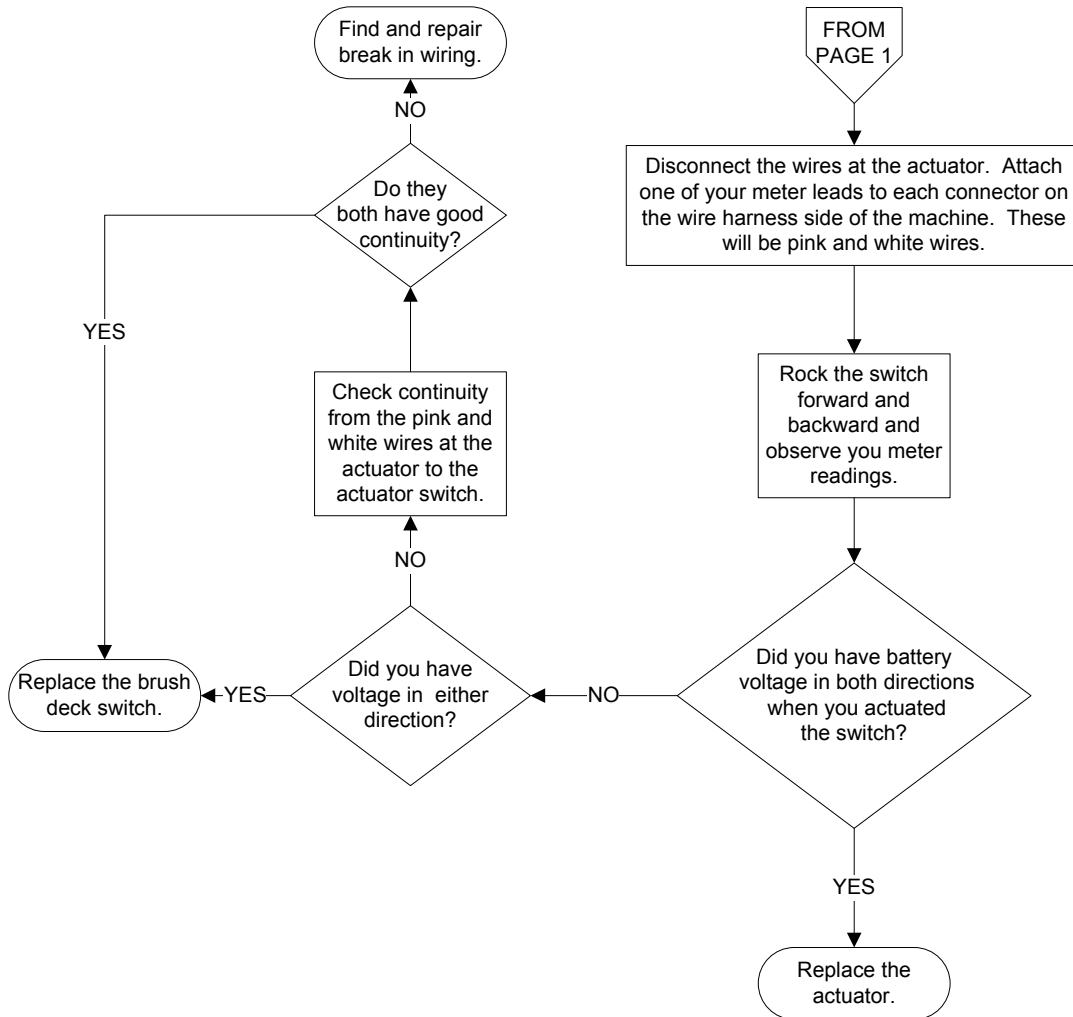
MiniMAG – BRUSH ASSIST
BRUSH ASSIST DIAGNOSIS
1 of 1



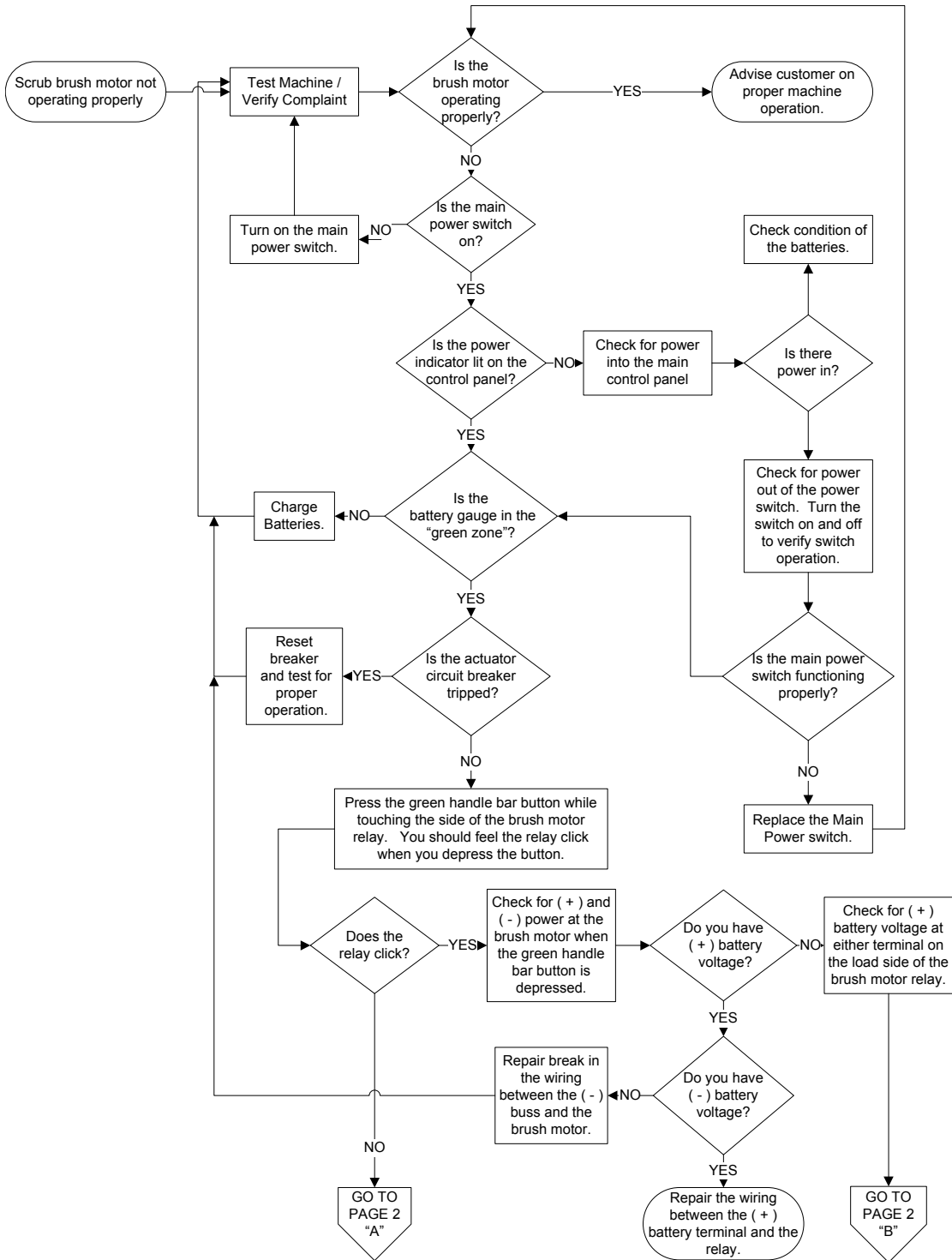
MiniMAG – BRUSH ASSIST BRUSH DECK ACTUATOR FLOW CHART 1 of 2



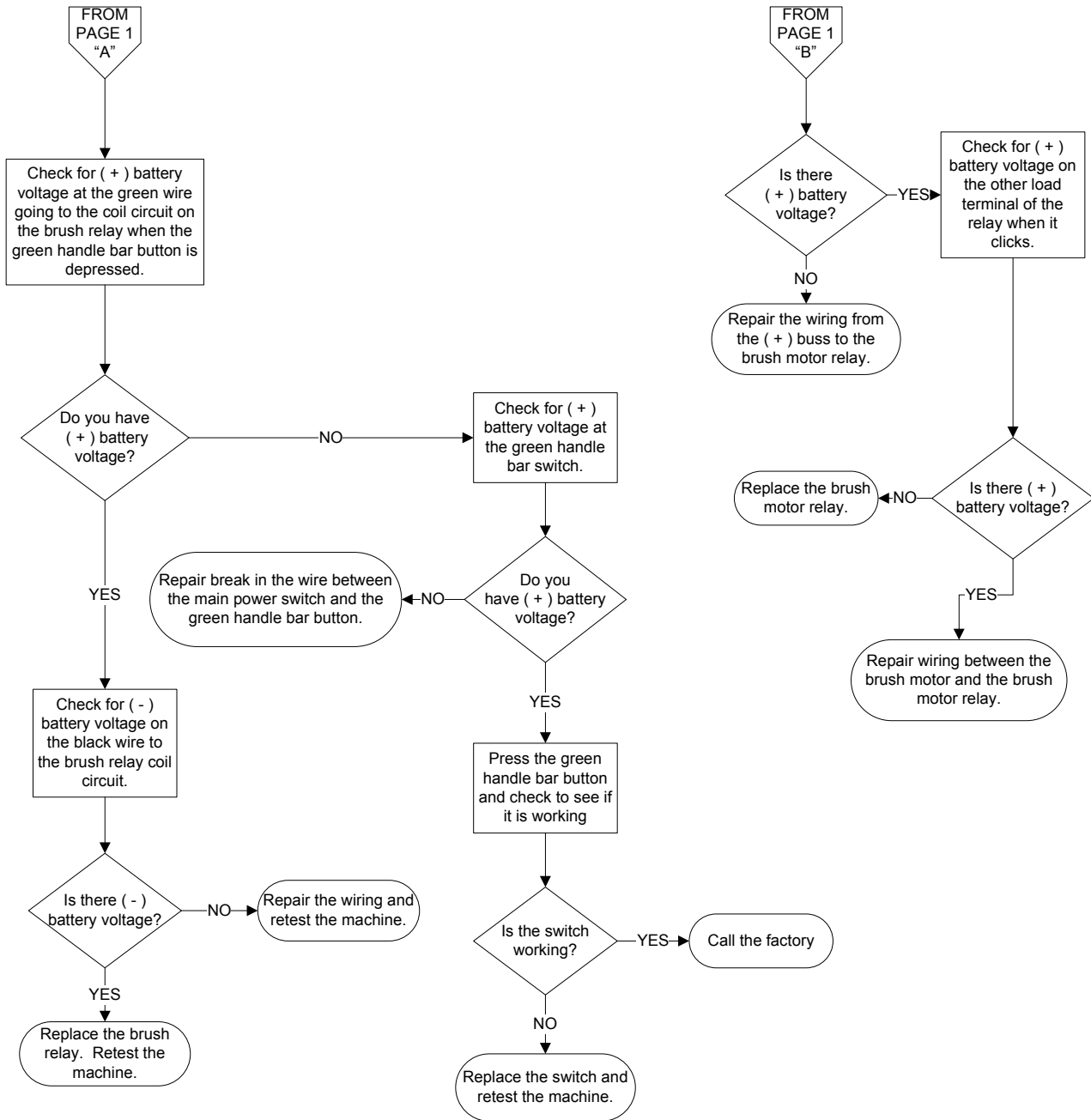
MiniMAG – BRUSH ASSIST
BRUSH DECK ACTUATOR FLOW CHART
2 of 2



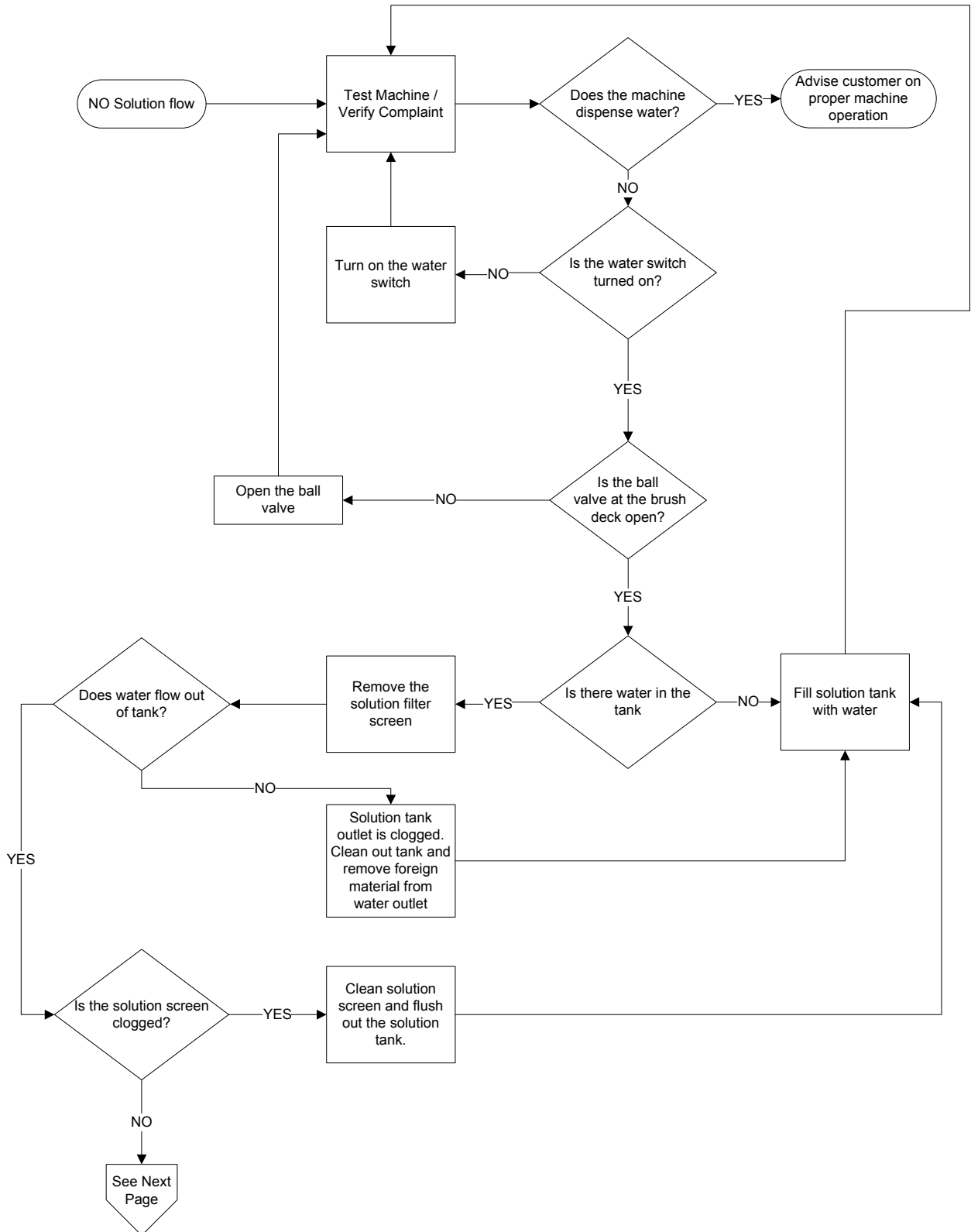
MiniMAG – BRUSH ASSIST BRUSH DRIVE MOTOR FLOW CHART 1 of 2



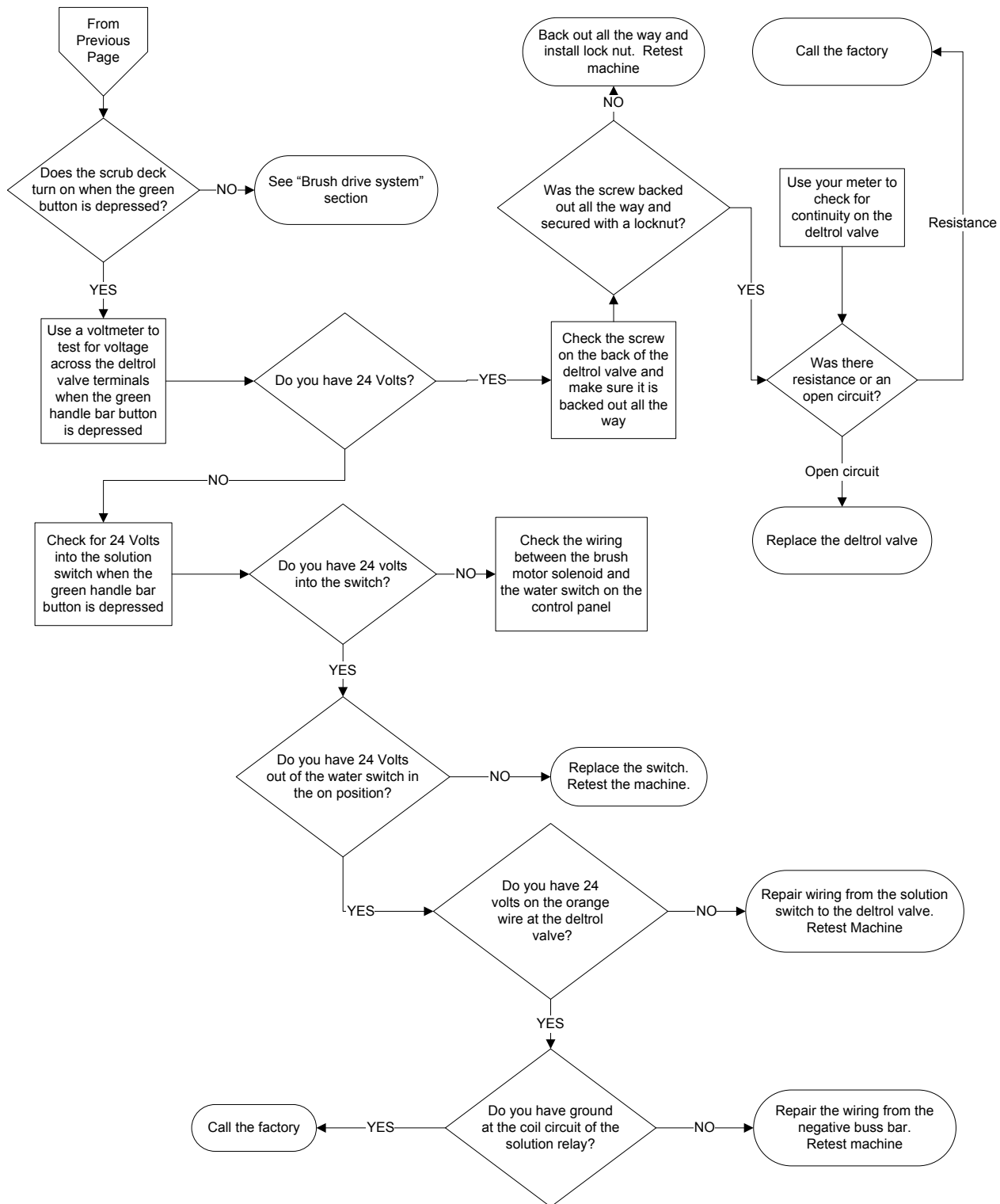
MiniMAG – BRUSH ASSIST
BRUSH DRIVE MOTOR FLOW CHART
2 of 2



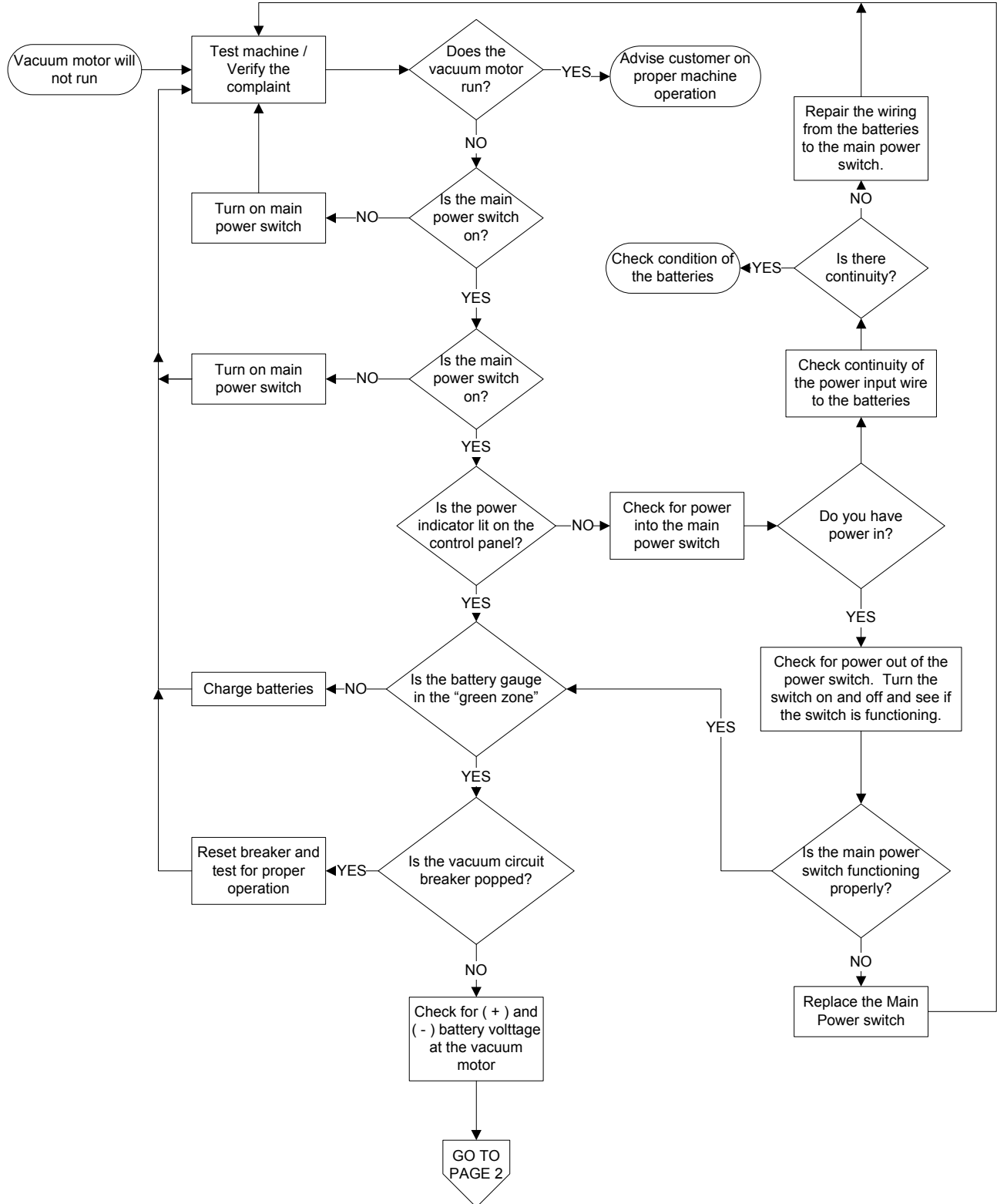
MiniMAG – BRUSH ASSIST SOLUTION SYSTEM FLOW CHART 1 of 2



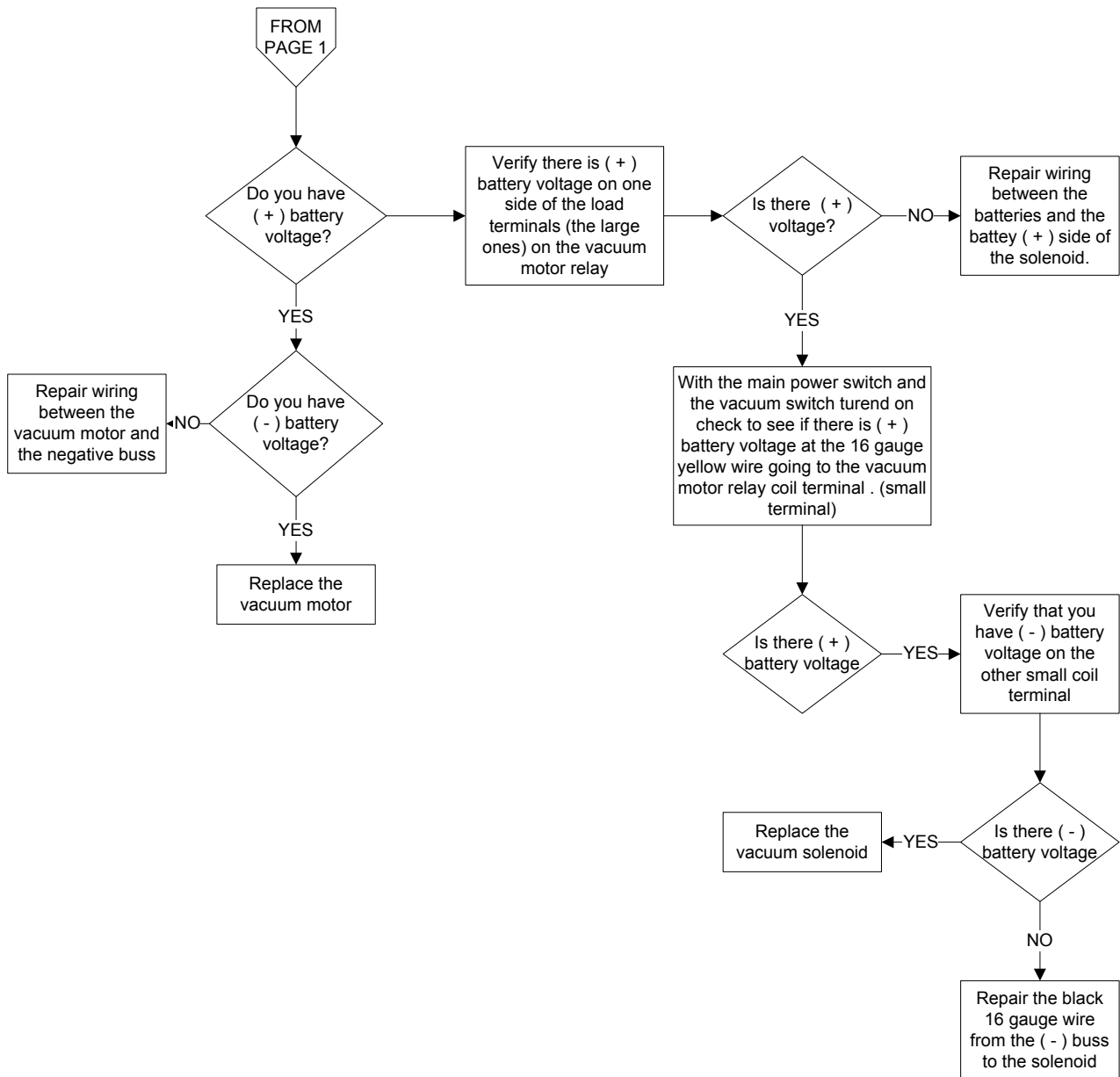
MiniMAG – BRUSH ASSIST
SOLUTION SYSTEM FLOW CHART
2 of 2



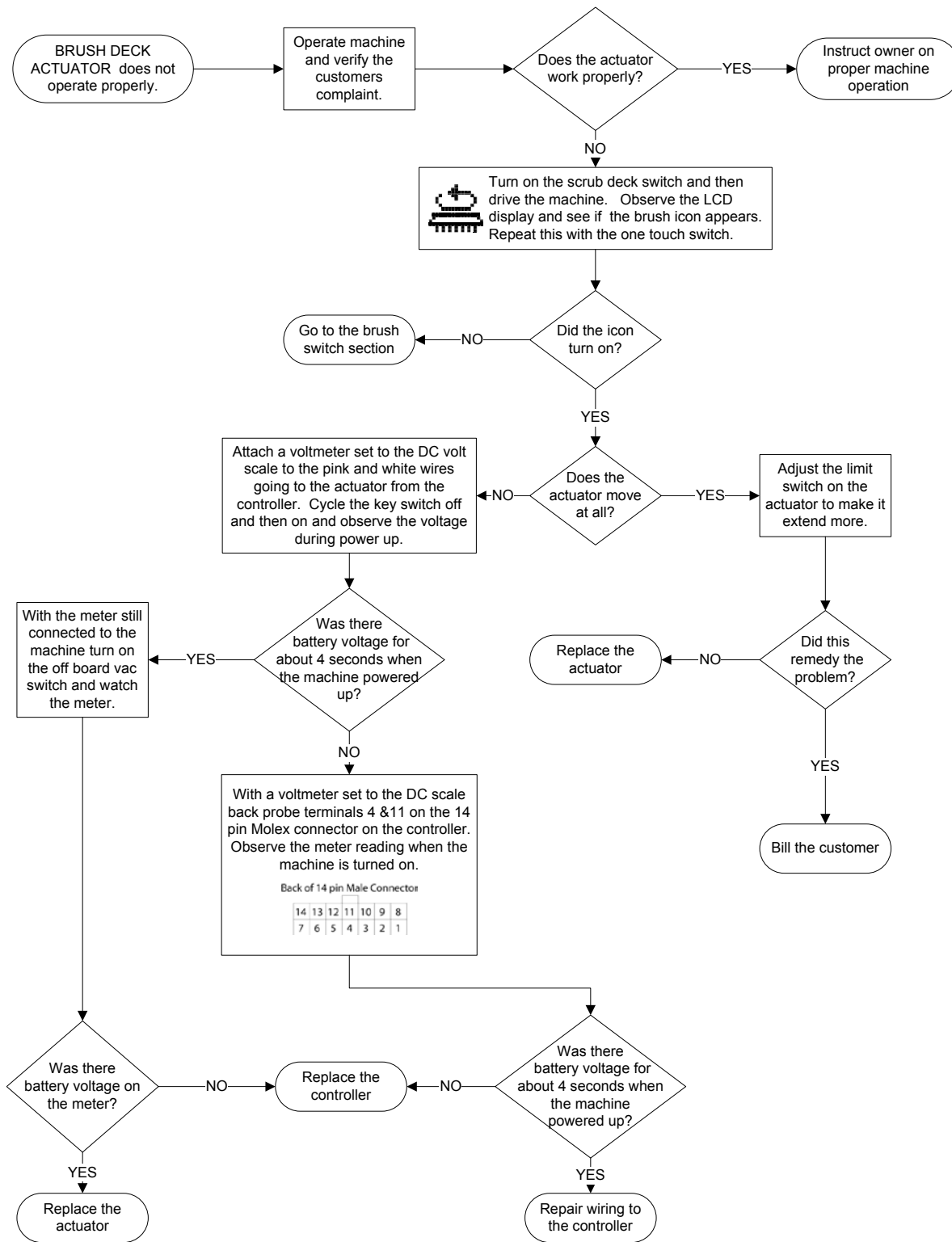
MiniMAG – BRUSH ASSIST VACUUM MOTOR FLOW CHART 1 of 2



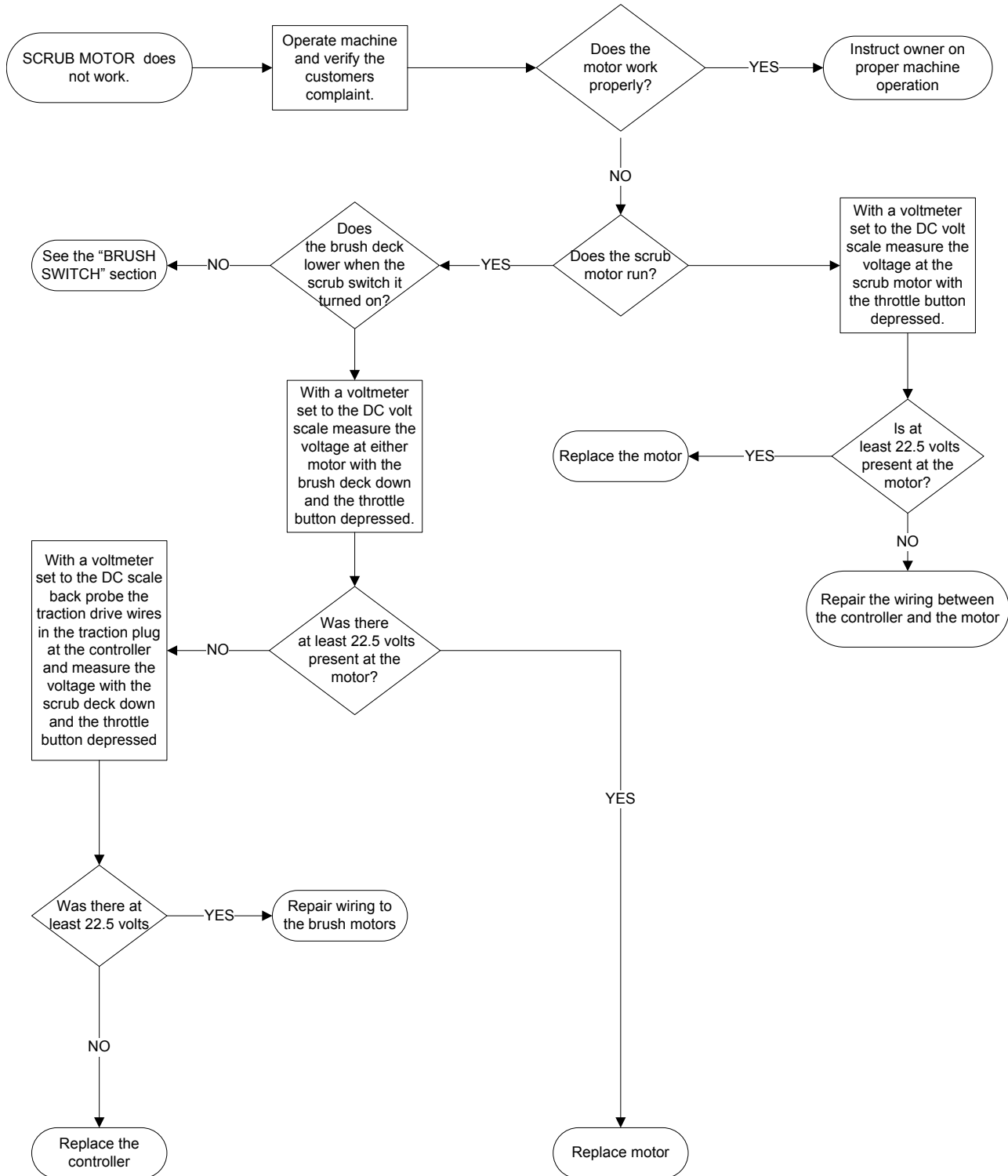
MiniMAG – BRUSH ASSIST
VACUUM MOTOR FLOW CHART
2 of 2



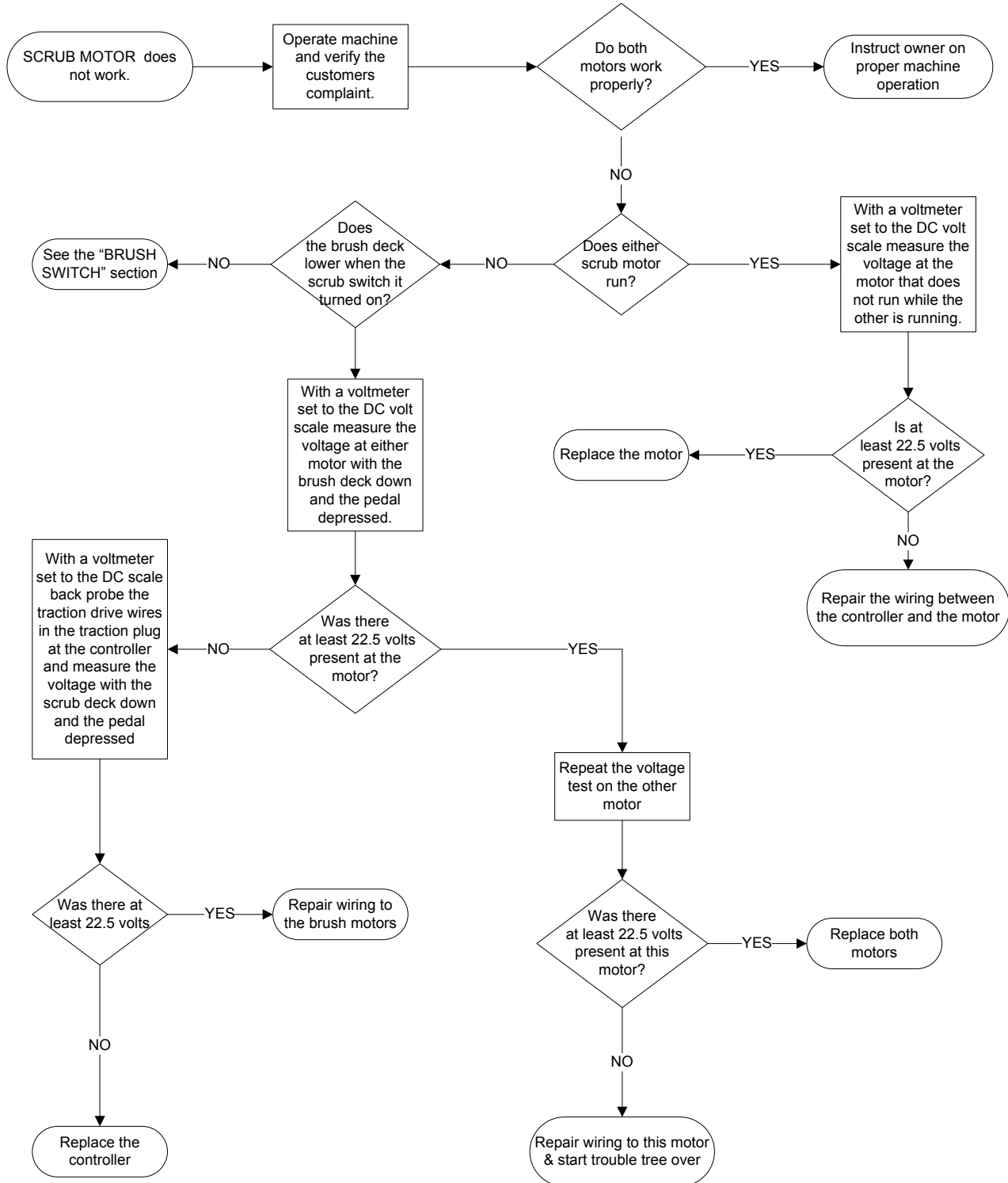
MiniMAG – TRACTION DRIVE w/CCII BRUSH DECK ACTUATOR FLOW CHART 1 of 1



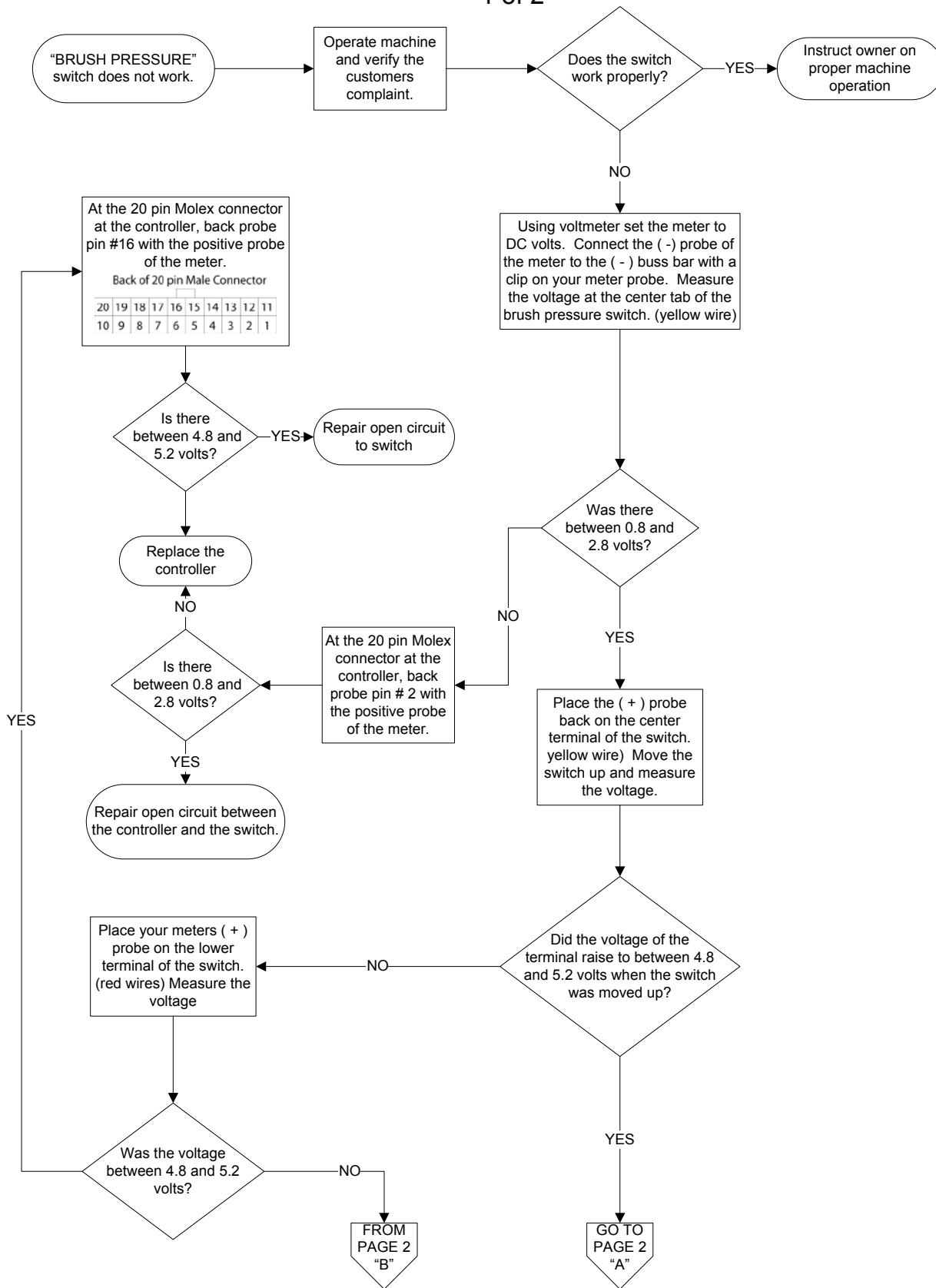
MiniMAG – TRACTION DRIVE w/CCII
BRUSH MOTOR /SINGLE - FLOW CHART
1 of 1



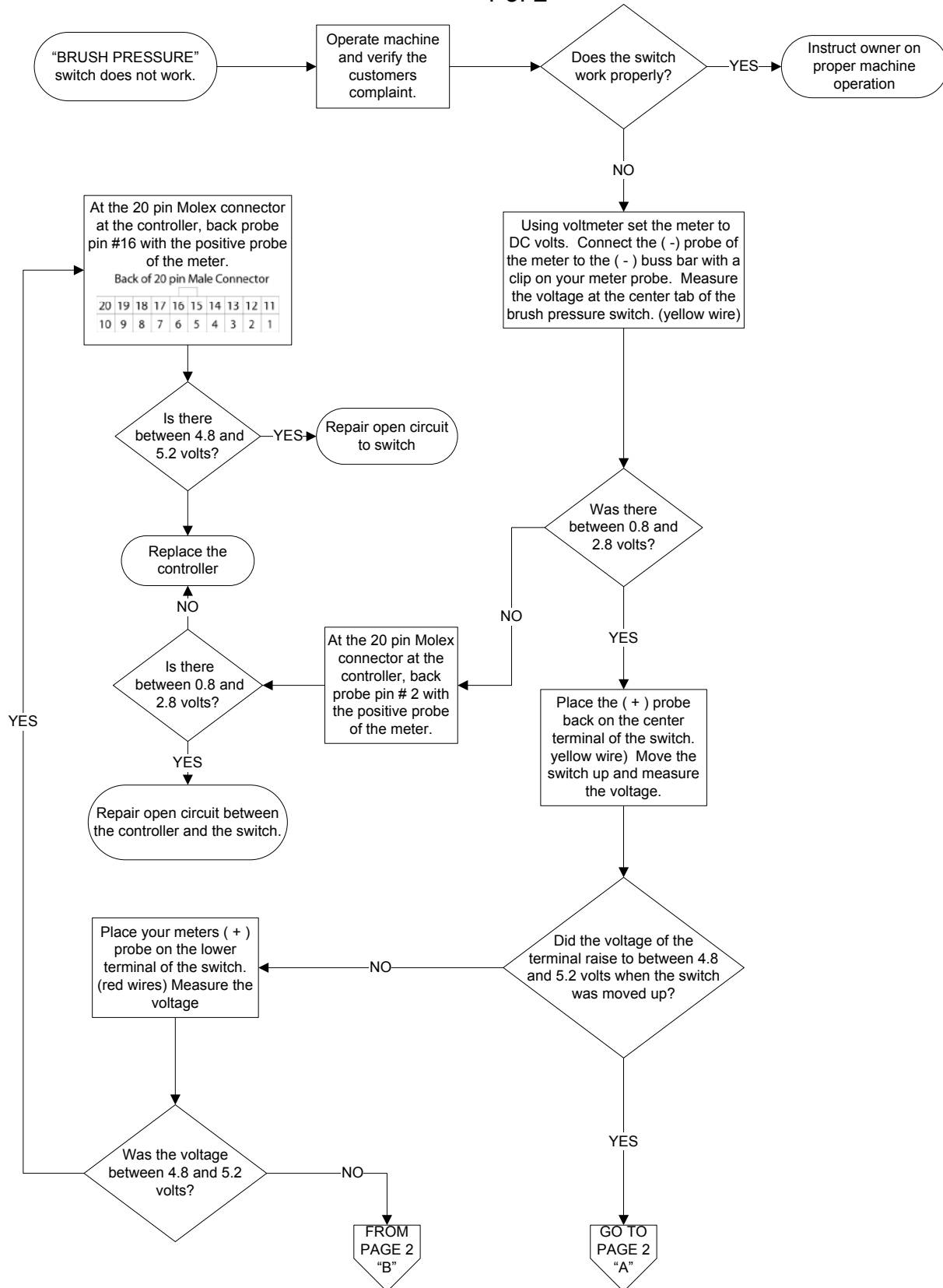
MiniMAG – TRACTION DRIVE w/CCII BRUSH MOTOR / DUAL - FLOW CHART 1 of 1



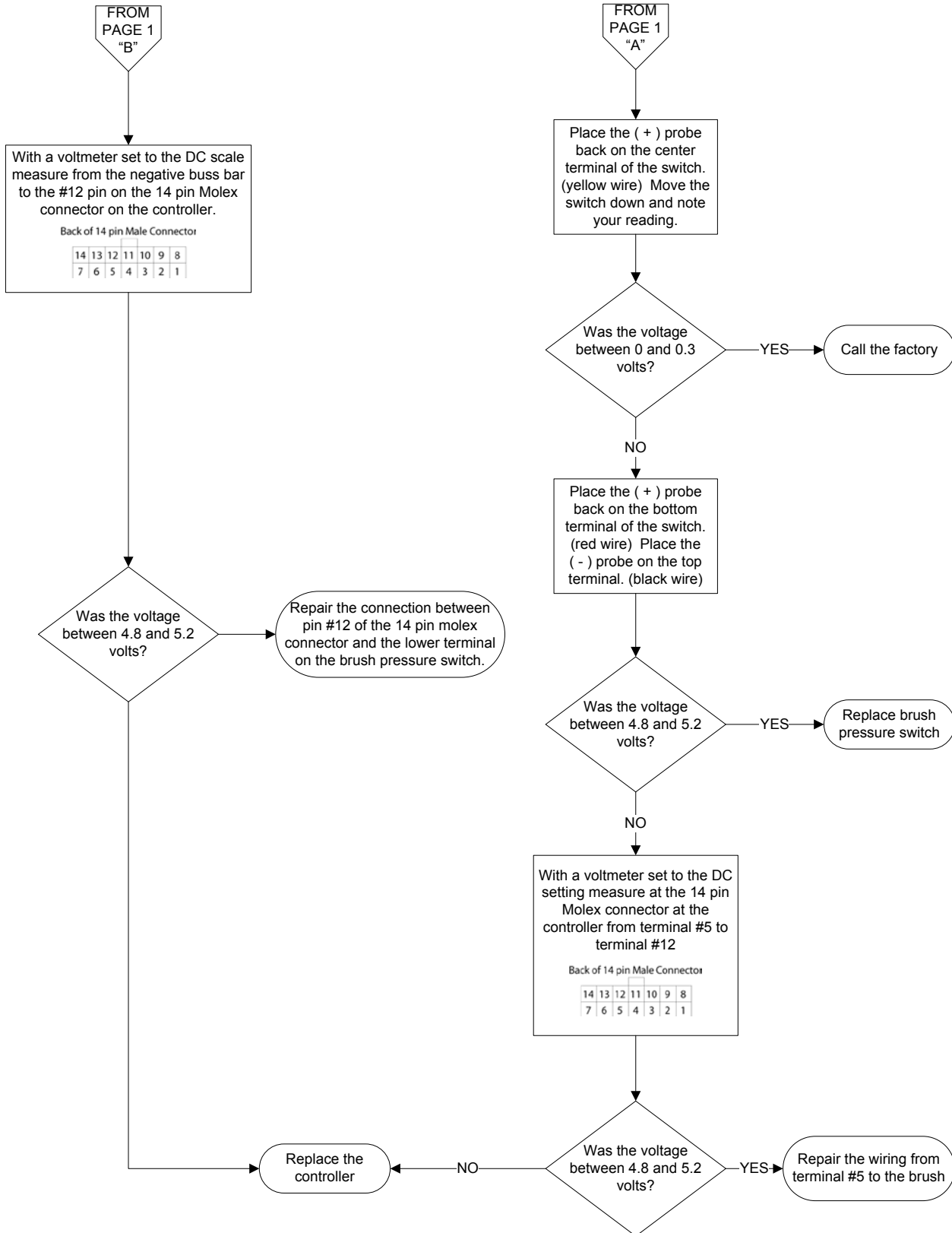
MiniMAG – TRACTION DRIVE w/CCII
BRUSH PRESSURE SWITCH DIAGNOSIS
1 of 2



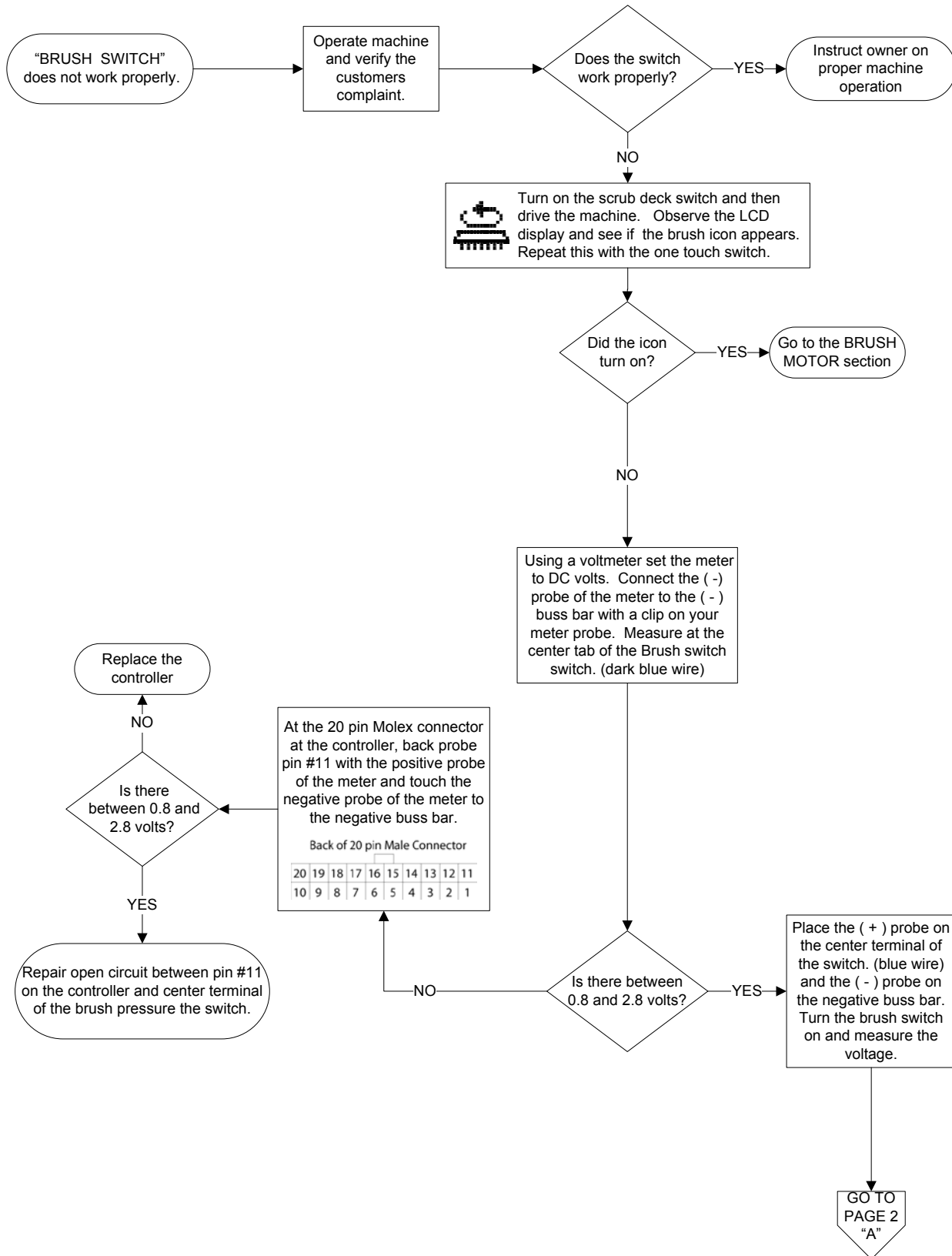
MiniMAG – TRACTION DRIVE w/CCII BRUSH PRESSURE SWITCH DIAGNOSIS 1 of 2



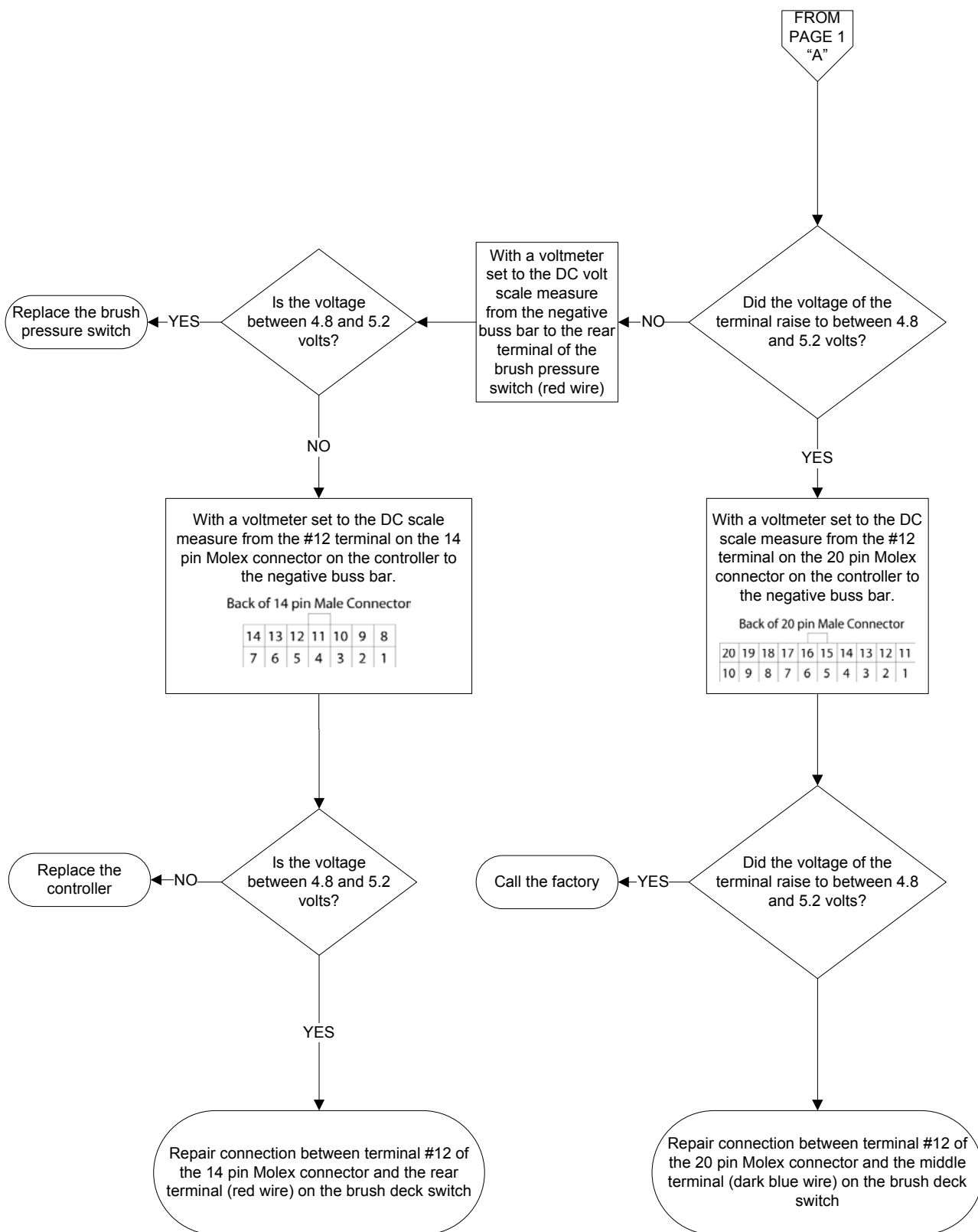
MiniMAG – TRACTION DRIVE w/CCII
BRUSH PRESSURE SWITCH DIAGNOSIS
2 of 2



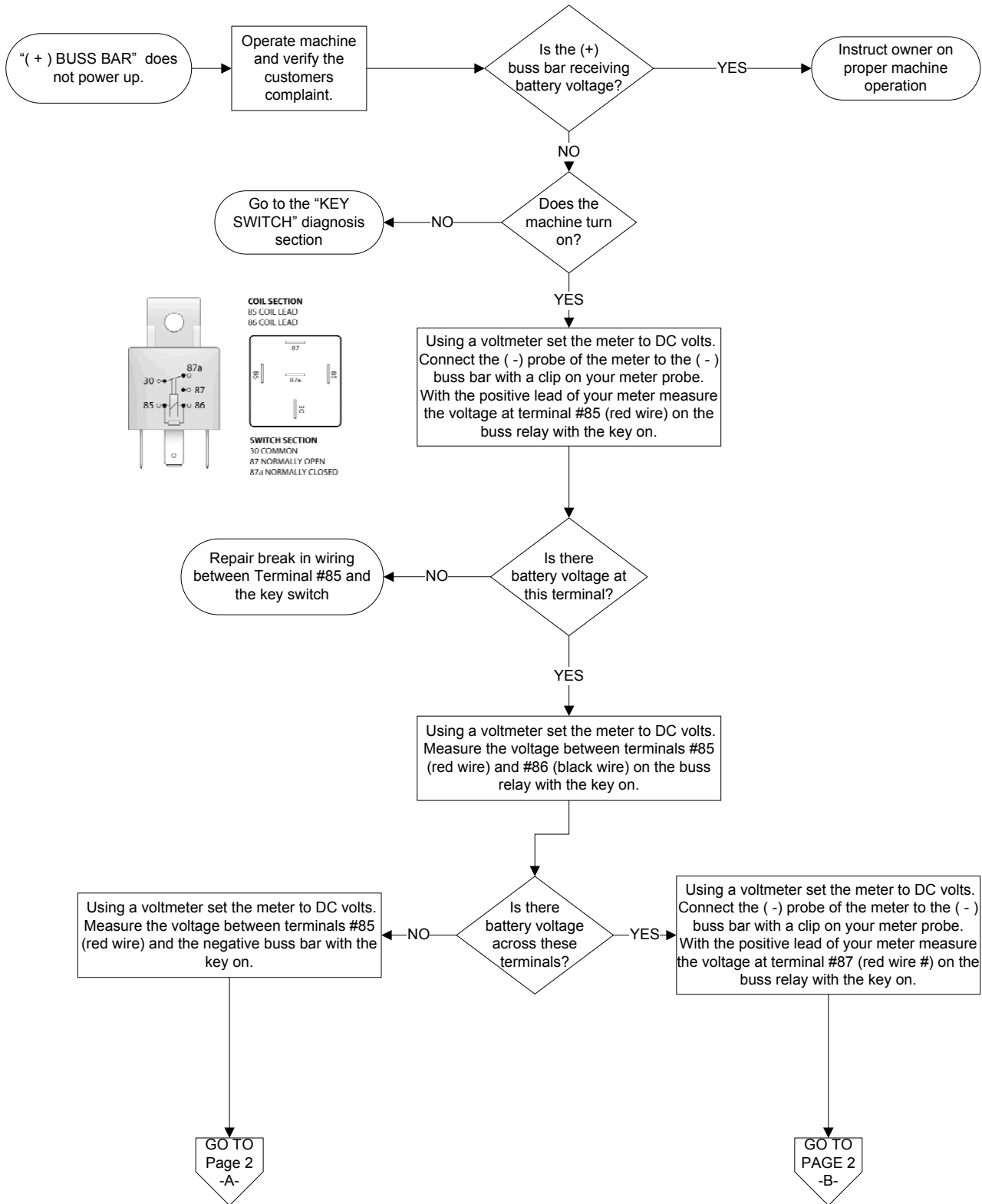
MiniMAG – TRACTION DRIVE w/CCII BRUSH SWITCH DIAGNOSIS 1 of 2



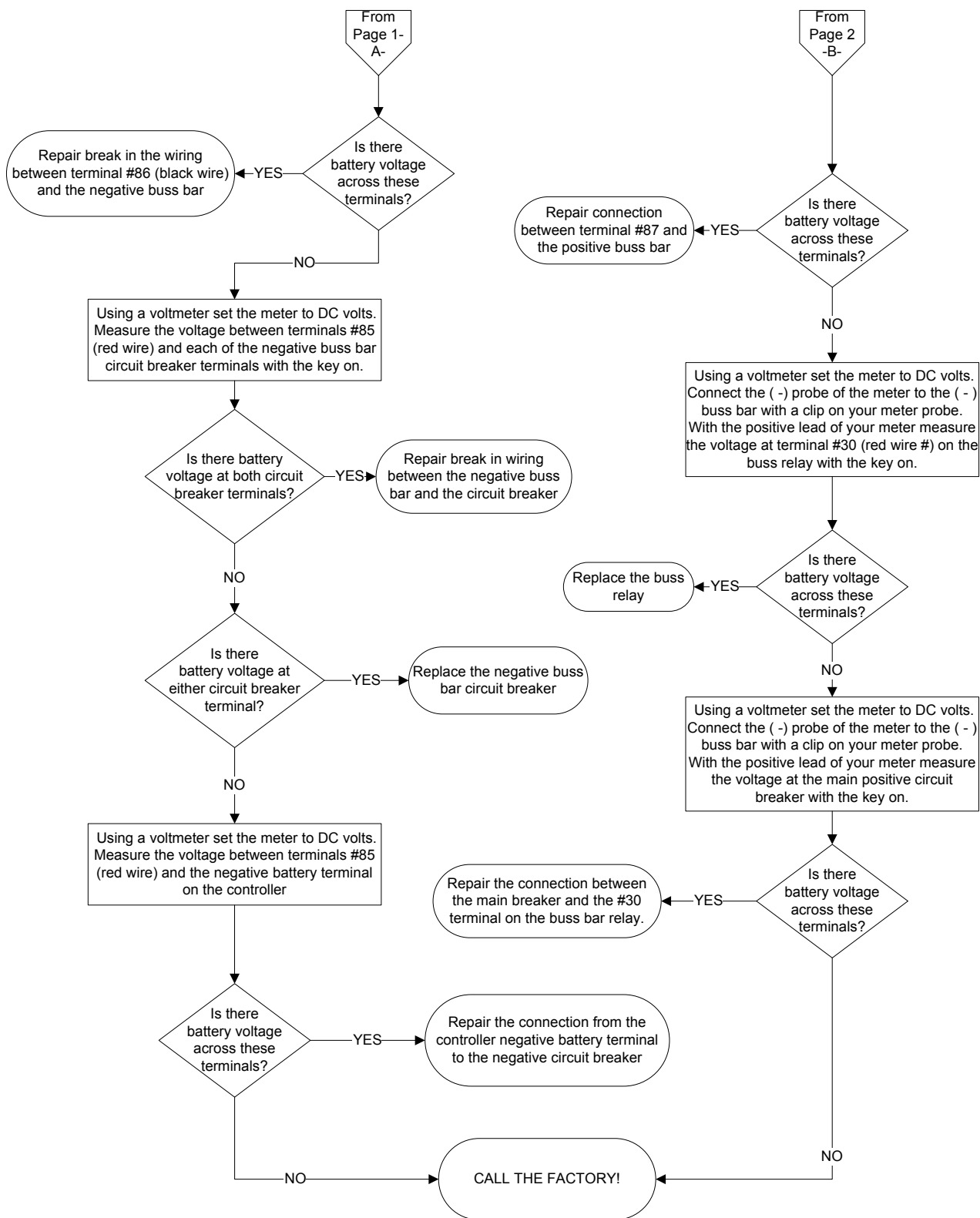
MiniMAG – TRACTION DRIVE w/CCII
BRUSH SWITCH DIAGNOSIS
2 of 2



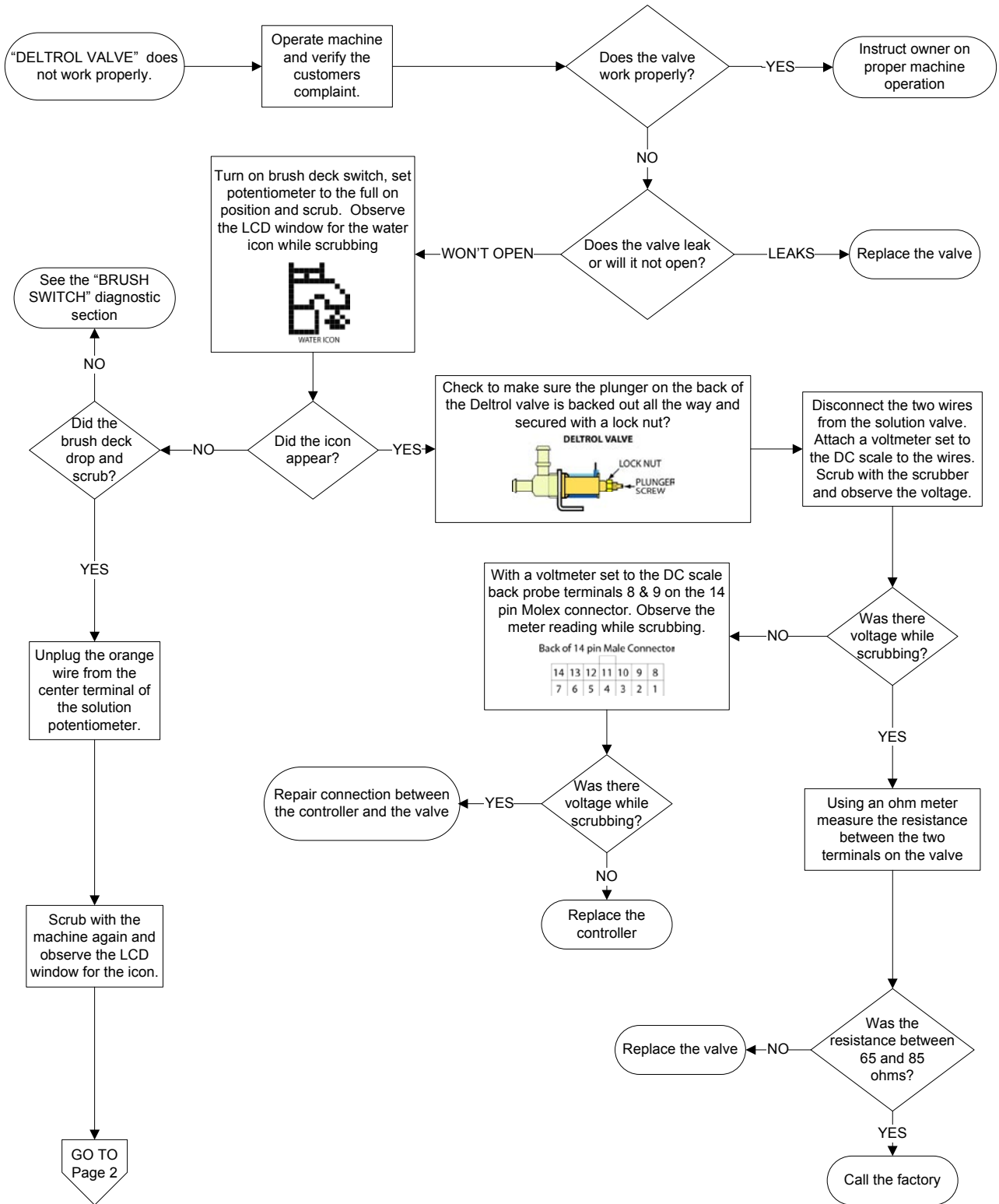
MiniMAG – TRACTION DRIVE w/CCII BUSS RELAY DIAGNOSIS 1 of 2



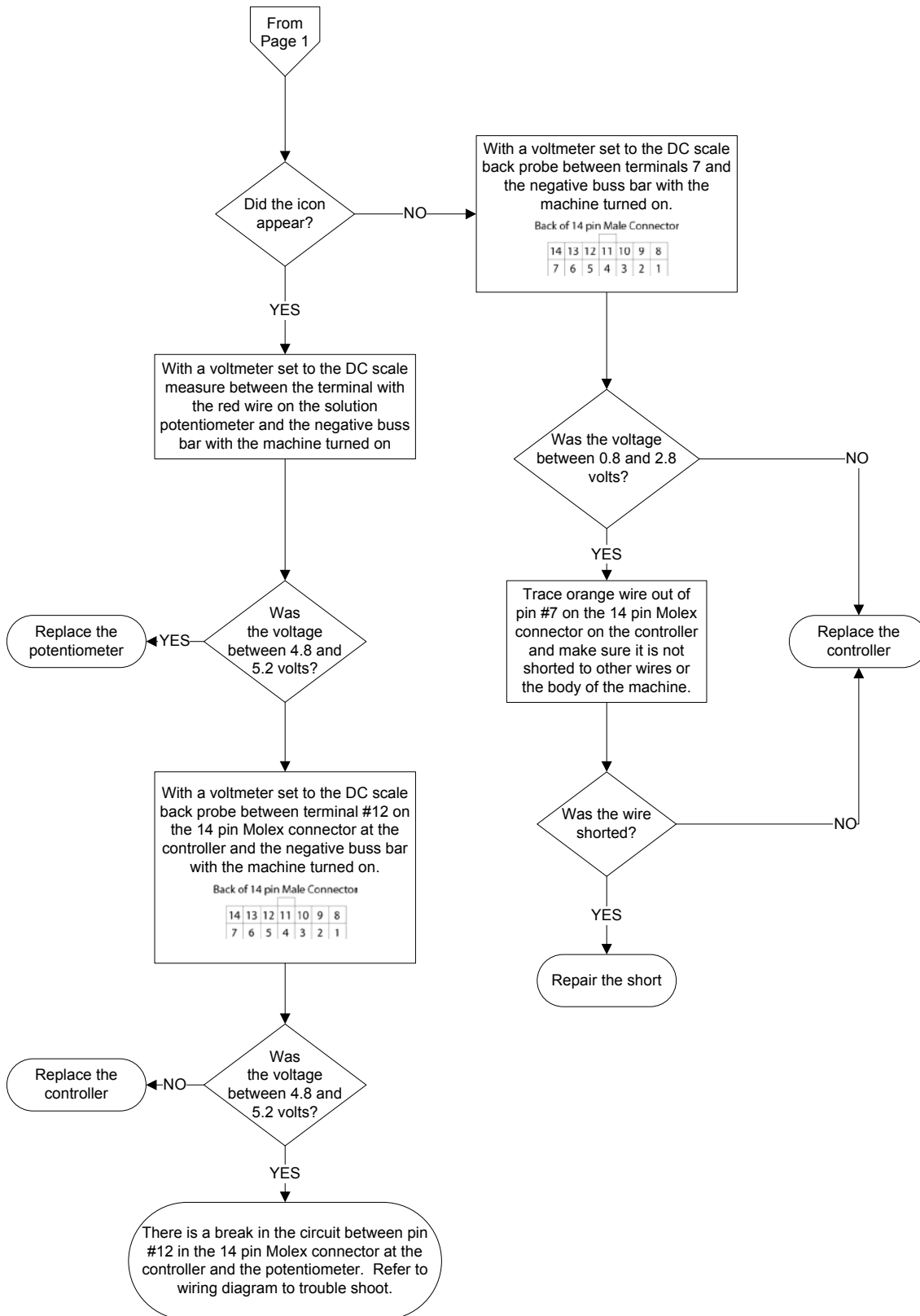
MiniMAG – TRACTION DRIVE w/CCII
 BUSS RELAY DIAGNOSIS
 2 of 2



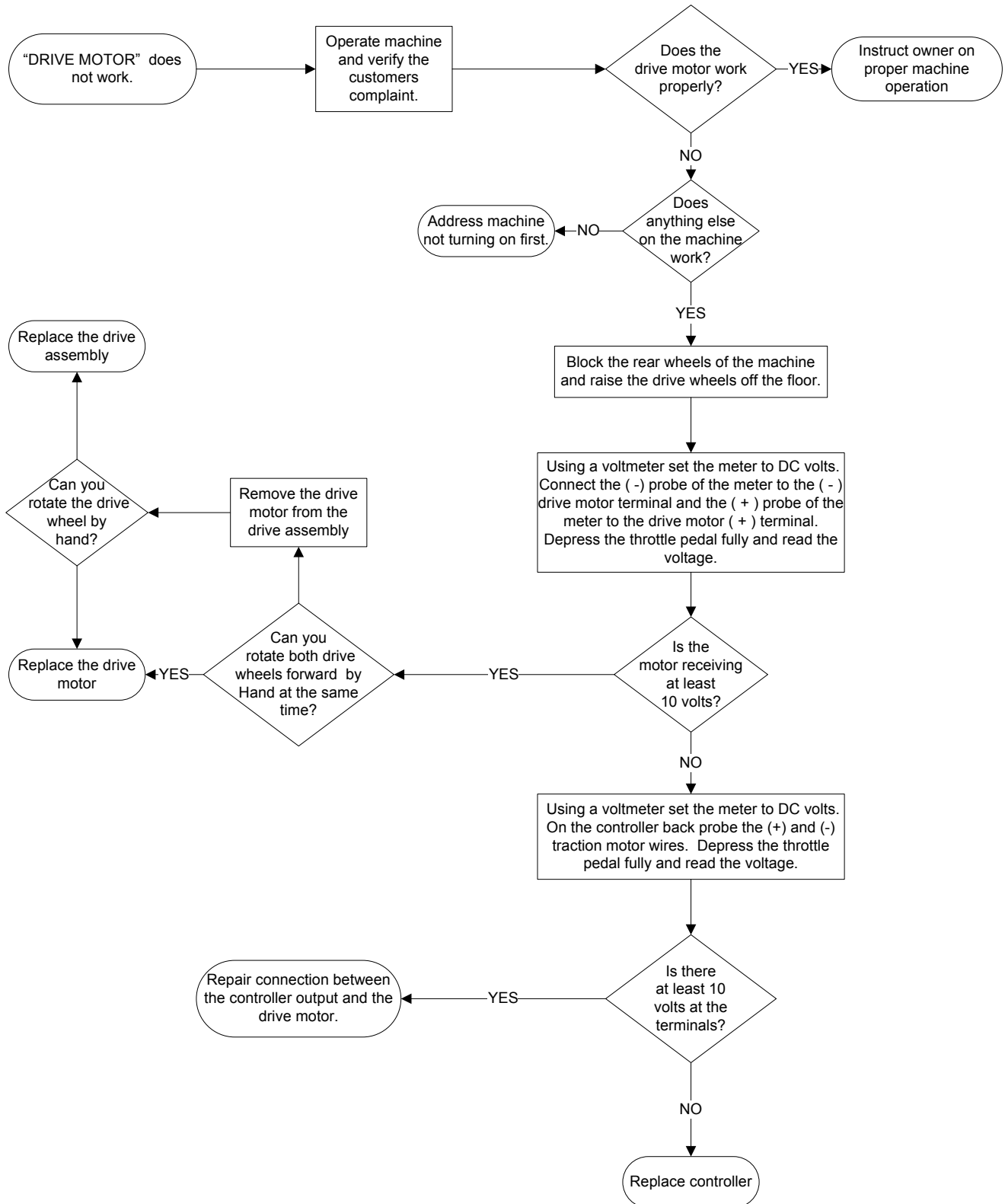
MiniMAG – TRACTION DRIVE w/CCII SOLUTION SOLENOID FLOW CHART 1 of 2



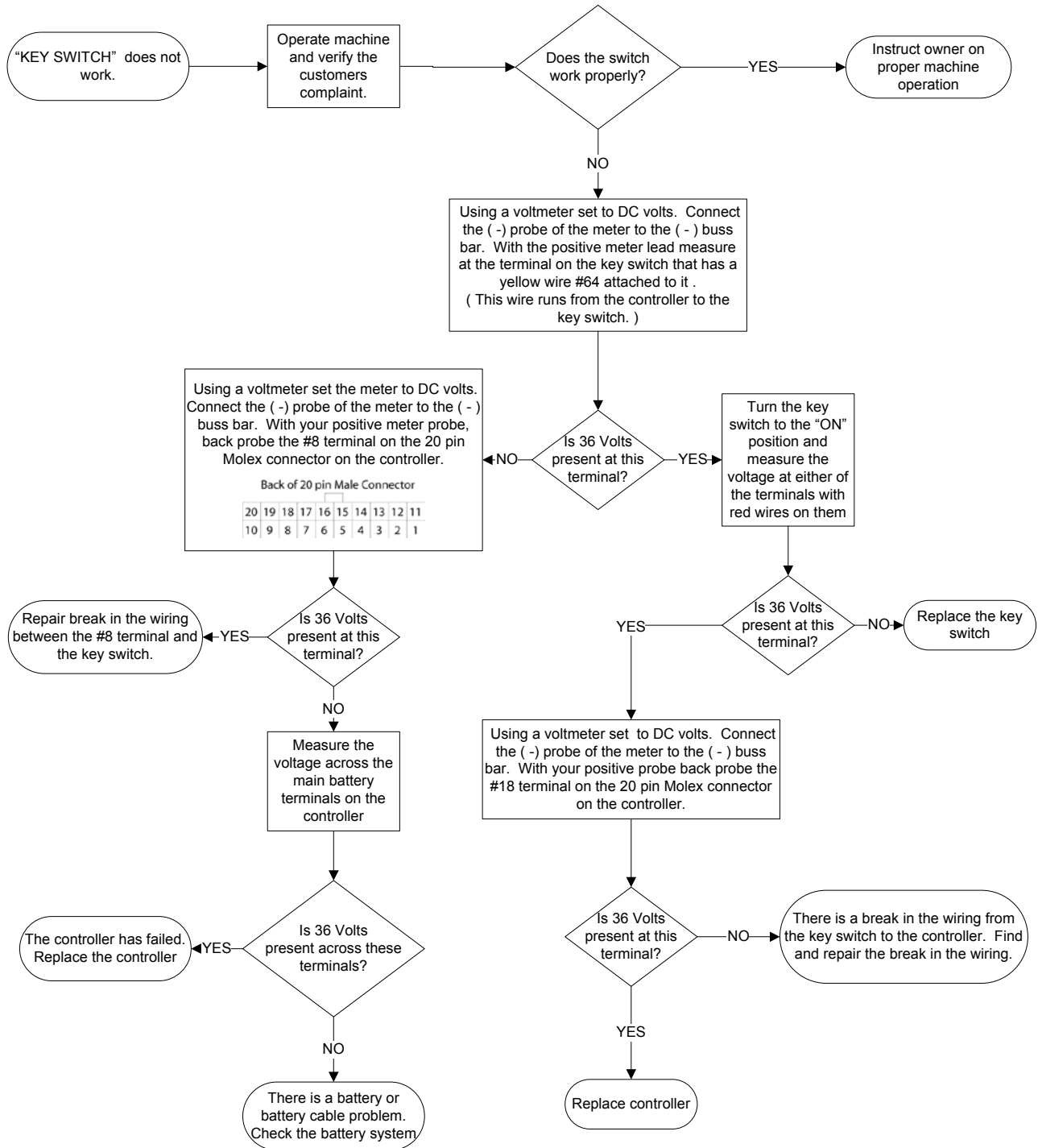
MiniMAG – TRACTION DRIVE w/CCII
 SOLUTION SOLENOID FLOW CHART
 2 of 2



MiniMAG – TRACTION DRIVE w/CCII DRIVE MOTOR DIAGNOSTICS 1 of 1

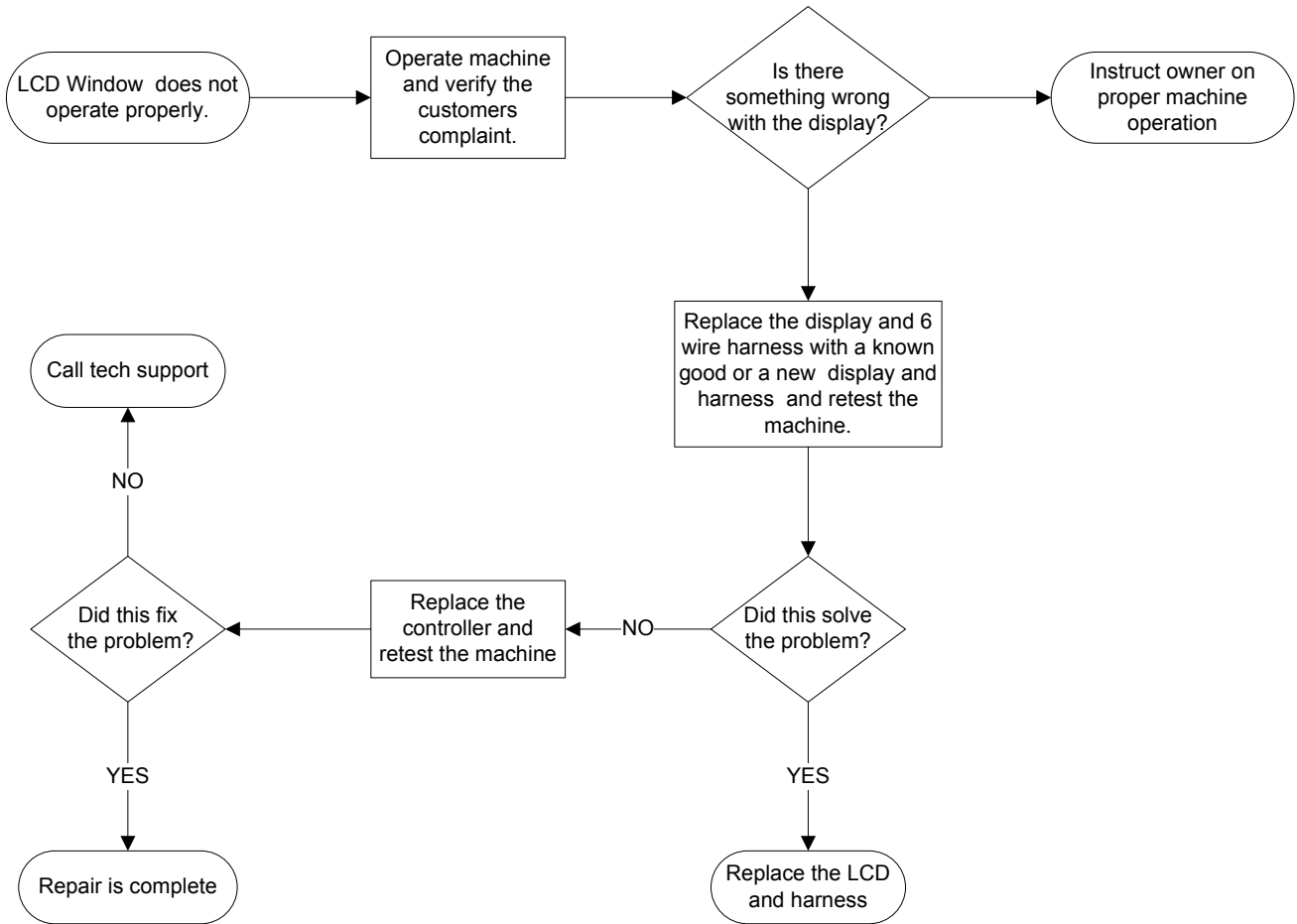


MiniMAG – TRACTION DRIVE w/CCII
KEY SWITCH DIAGNOSTICS
1 of 1



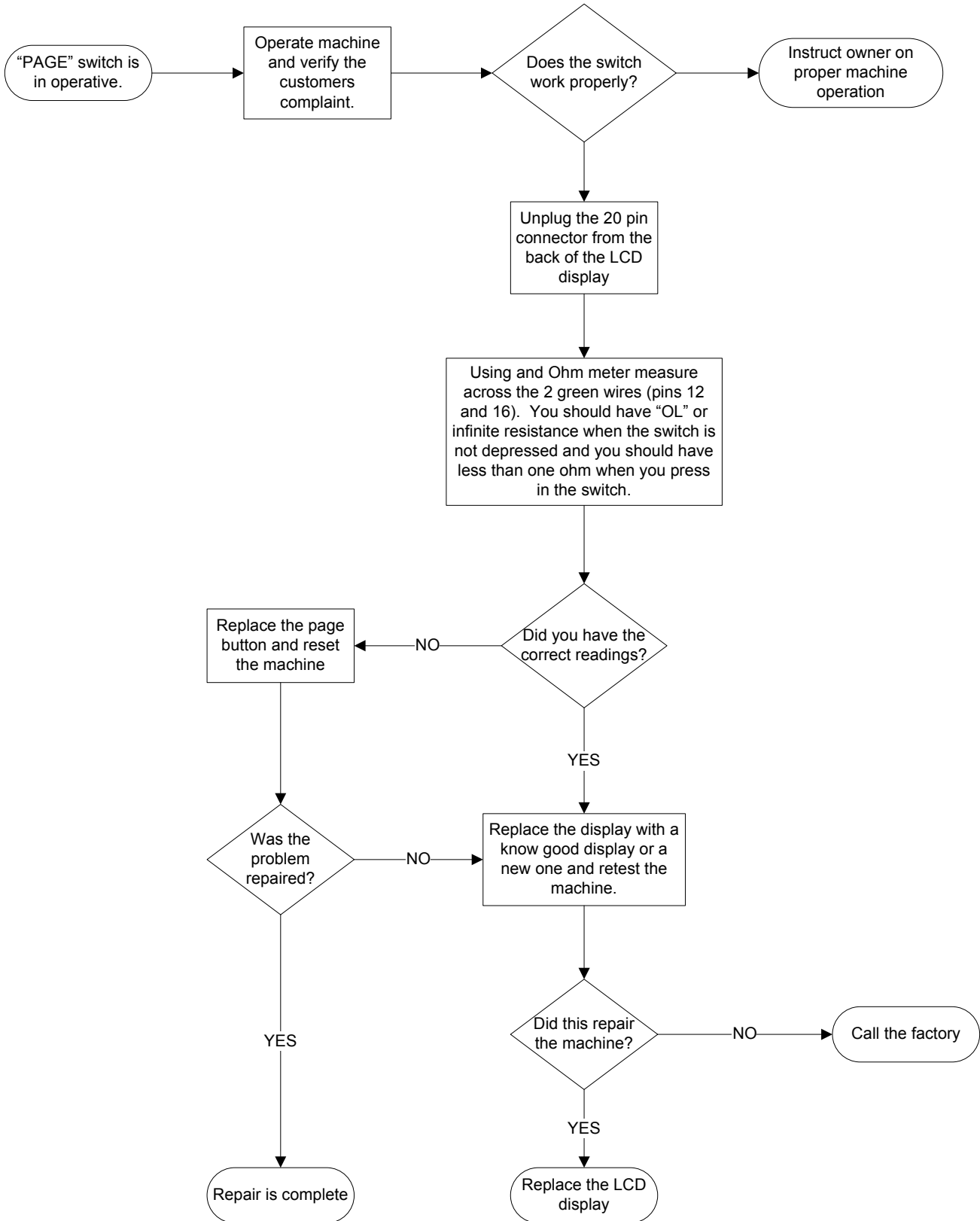
MiniMAG – TRACTION DRIVE w/CCII
LCD DIAGNOSTICS

1 of 1

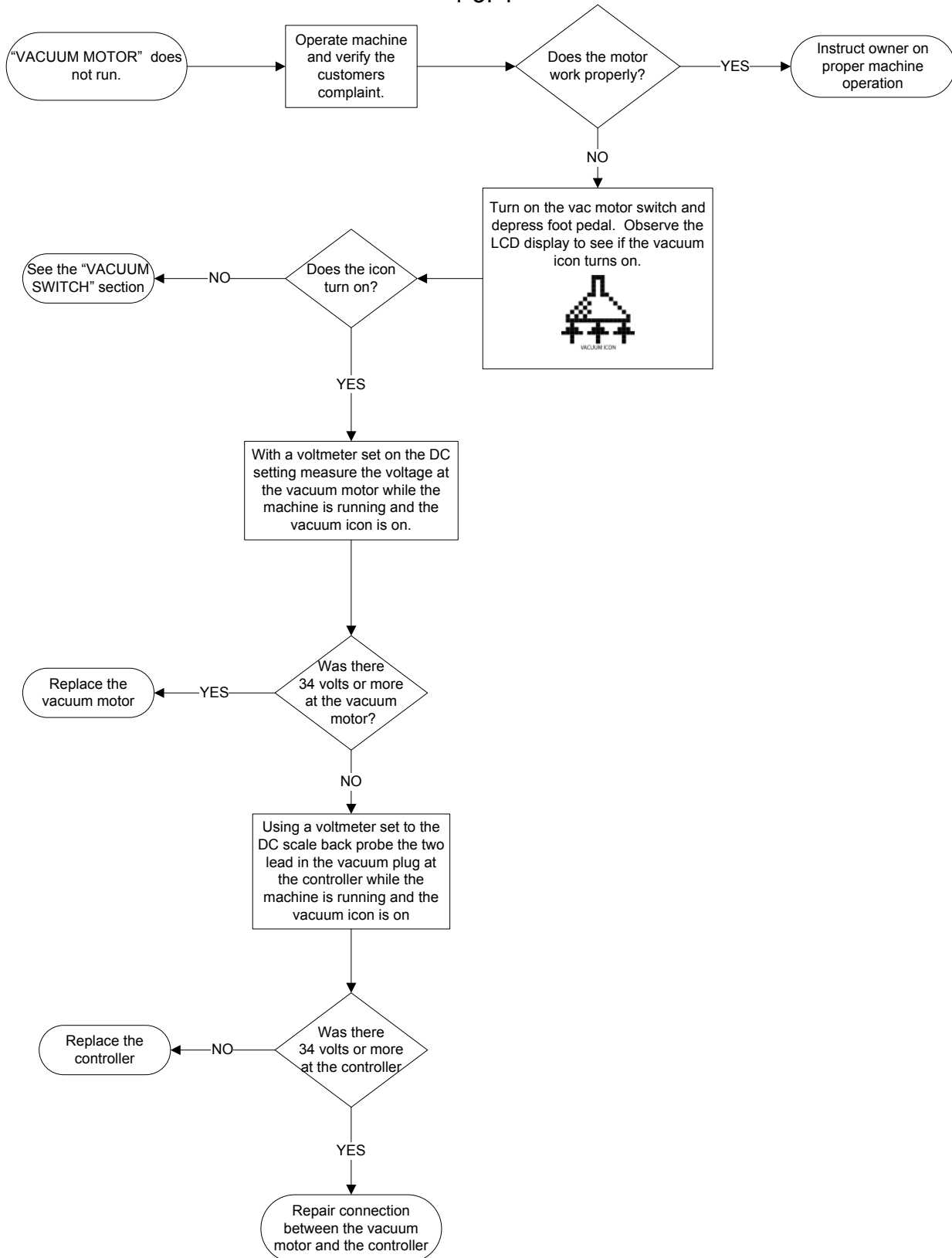


MiniMAG- TRACTION DRIVE w/CCII PAGE SWITCH DIAGNOSIS

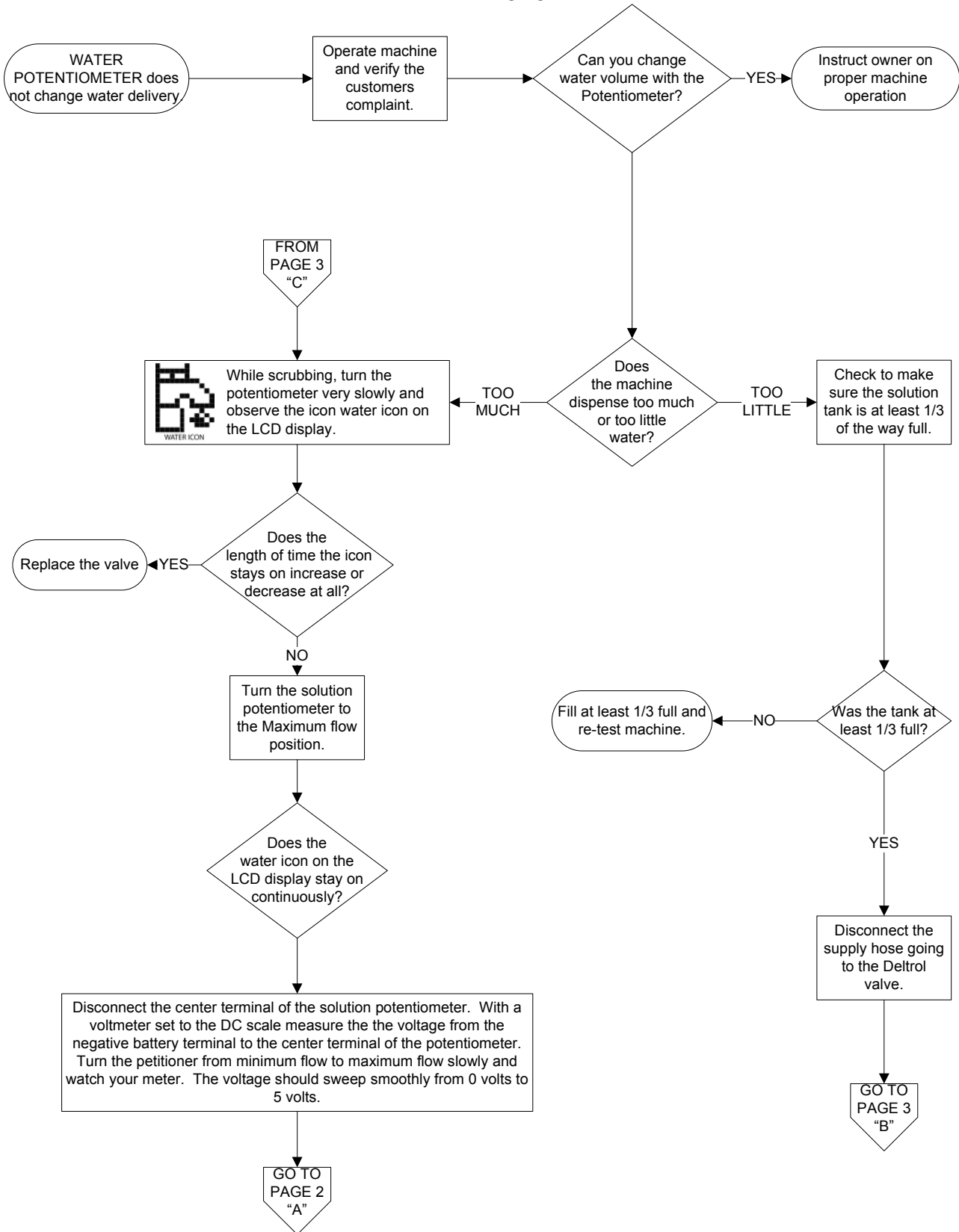
1 of 1



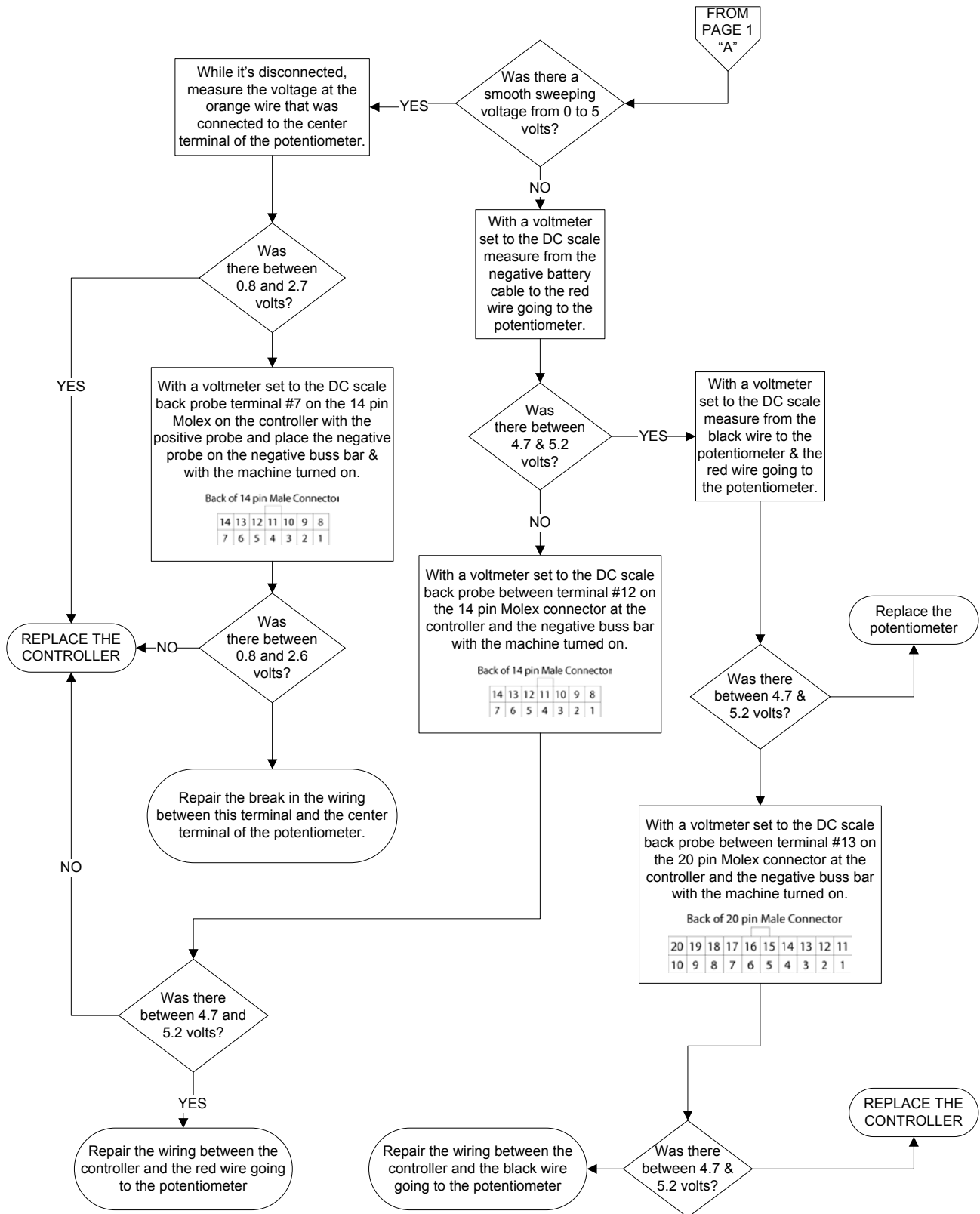
MiniMAG – TRACTION DRIVE w/CCII VACUUM MOTOR FLOW CHART 1 of 1



MiniMAG – TRACTION DRIVE w/CCII
 SOLUTION POTENTIOMETER DIAGNOSIS
 1 of 3



MiniMAG – TRACTION DRIVE w/CCII SOLUTION POTENTIOMETER DIAGNOSIS 2 of 3



MiniMAG – TRACTION DRIVE w/CCII
 SOLUTION POTENTIOMETER DIAGNOSIS
 3 of 3

