Codes 10705 and Below

COMMANDER 500 ELECTRICAL TROUBLESHOOTING FLOWCHARTS

HOW TO USE THIS FLOWCHART BOOK

It's important to note that these flowcharts may not lead the troubleshooter to an exact cause of a problem, only to a general area where the exact cause may be found. Some additional troubleshooting without this manual may be required.

In the "Complaints" section, find the Table of Contents. Find the complaint that closest fits the problem with the machine you are working on, and go to that flowchart. The flowchart will direct you to make actions and decisions to help find the root cause of the complaint. The flowchart may also ask you to go to another flowchart in the "Components" section. When this happens, go to the Table of Contents in the "Components" section, and locate the flowchart that you need. Perform the actions and decisions in that flowchart, and when finished, go back to the flowchart in the "Complaints" section, and proceed to the next step. Once the root cause of the failure is found, troubleshooting is done, there is no need to follow the rest of the flowchart.

If none of the complaints in the "Complaints" Table of Contents fits your problem, proceed to the "Components" Table of Contents and locate the Component that you feel may be at fault. Go to that Component flowchart, and perform the actions and decisions in that flowchart. When finished, record your new complaint in the "Complaints" Table of Contents, what Component flowchart was used to fix the problem, and the exact component that failed. The new complaint will now be there for future reference.

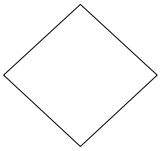
COMMANDER 500 ELECTRICAL TROUBLESHOOTING FLOWCHARTS

FLOWCHART BASICS

If you have never used a flowchart before, the first sight of a flowchart can be intimidating. Flowcharts are nothing more than roadmaps that use symbols and arrows to direct the user to perform tasks and make decisions to achieve an end result. In this case, that end result is finding the cause of failure in a failed Commander 500. Look at each symbol in the flowchart, read it's contents and follow them. Then, when done, follow the arrow to the next symbol and repeat. There are only three types of symbols used in these flowcharts. They are as follows:

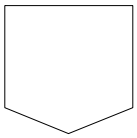
PROCESS SYMBOL

This symbol tells the troubleshooter that some action needs to take place. The text inside this symbol will tell you what task needs to be performed before proceeding to the next step in the flowchart.



DECISION SYMBOL

This symbol tells the troubleshooter that a "yes" or "no" decision needs to take place. The text inside the symbol will ask the question. Make your "yes" or "no" decision, then follow the arrow in the direction of your answer.



OFF-PAGE CONNECTOR

This symbol tells the troubleshooter to jump to another flowchart in the "Components" section. The text inside the symbol will tell you what flow chart to use. When you are finished with the flowchart you jumped to, return back to the flowchart in the "Complaints" section and proceed to the next step in the flowchart.

COMMANDER 500 ELECTRICAL TROUBLESHOOTING FLOWCHARTS

COMPLAINTS SECTION
TABLE OF CONTENTS

MACHINE WON'T MAKE MAX WELD OUTPUT.

TOOLS NEEDED

3/8" wrench
5/16" nutdriver
7/16" wrench
multi-meter
wiring diagram
tachometer
load grid
ammeter(capable of measuring 375A)

In CC & CV modes and low idle, attempt to load the machine to 575 amps at 40vdc. Rpm should be approximately 1800 RPM. Note any engine bogging, engine may be starving for fuel.

Check for loose or faulty connections at the weld studs & connections. Check for good clean work clamp connection at the work piece.

Turn the engine off. Open front control panel. Remove left & right side panels.

Check for loose or faulty connections on the heavy current carrying leads between the power modules, choke, and output terminals.

Start the engine. With machine settings at Hi idle, "Always On', "Local", Max Pot, check OCV's in CC mode (should be 79-84vdc) and CV mode(should be 78.5-83vdc)

WARNING!!

HIGH VOLTAGES ARE PRESENT IN THE CONTROL BOX AND BEHIND THE OUTPUT PANEL WHILE THE MACHINE IS RUNNING. THESE VOLTAGES ARE HIGH ENOUGH TO KILL. USE CAUTION WHEN MAKING VOLTAGE MEASUREMENTS.

Are the OCV readings OK?

NO

Measure the dc voltage across the terminals of the large capacitors.

YES

Is there approximately 90vdc at capacitor terminals?

YES

Replace the control pc board.

Perform the **Rotor Test** in the Components section.

Perform the **Feedback Input Test** in the Components section.

Perform the **Selector Switch & Control Dial Test** in the components section.

OK

NO

Check engine rpm at hi idle. Should be 1890-1910 rpm.

If rpm low, Perform the Engine Throttle Adjustment Test in SVM 145-A.

Check for poor connections between the stator, diode bridge, & large capacitors.

Perform the **Output Diode Bridge Test** in the Components section.

Perform the **Stator Voltage Test** in the Components section.

WELD OUTPUT FALLS OFF.
AUXILIARY OUTPUT IS NORMAL.

Check for loose or faulty connections at the weld studs & connections. Check for good clean work clamp connection at the work piece.

TOOLS NEEDED
3/8" wrench
7/16" wrench
5/16" nutdriver
multi-meter
wiring diagram

Open front control panel. Remove left & right side panels.

Check for loose or faulty connections on the heavy current carrying leads between the power modules, choke, and output terminals.

Start the engine. With machine settings at Hi idle, "Always On', "Local", control pot at max, check OCV's in CC mode (should be 79.5-84vdc) and CV mode(should be 78.5-83vdc).

WARNING!!
HIGH VOLTAGES ARE PRESENT IN THE CONTROL BOX AND BEHIND THE OUTPUT PANEL WHILE THE MACHINE IS RUNNING. THESE VOLTAGES ARE HIGH ENOUGH TO KILL. USE CAUTION WHEN MAKING VOLTAGE MEASUREMENTS.

Are the OCV readings OK?

NO

Measure the dc voltage across the terminals of the large capacitors.

YES

Perform the **Feedback Input Test** in the Components section.

YES

Is there approximately 90vdc at capacitor terminals?

NO

Check for poor connections between the stator, diode bridge, & large capacitors.

Perform the **Output Diode Bridge Test** in the Components section.

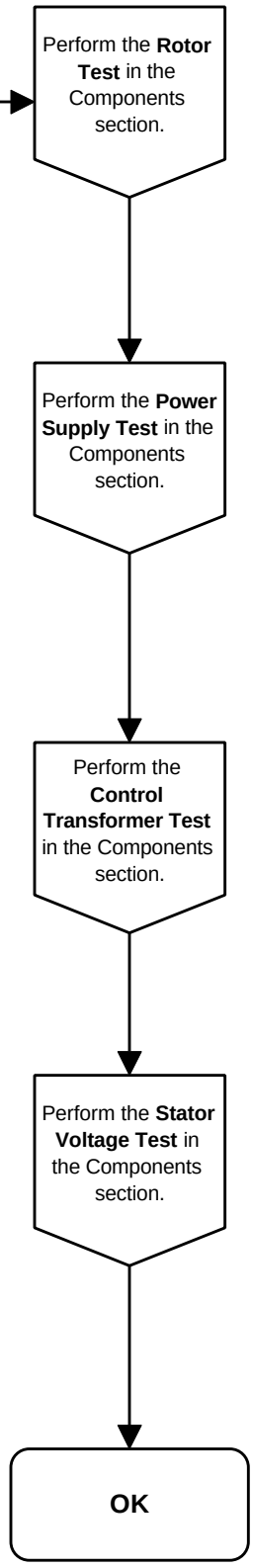
If no problems found to this point, turn the engine off. Replace both chopper pc boards.

Perform the **Stator Voltage Test** in the Components section.

OK

DISPLAY METERS ARE DEAD.
ENGINE OPERATION IS NORMAL.

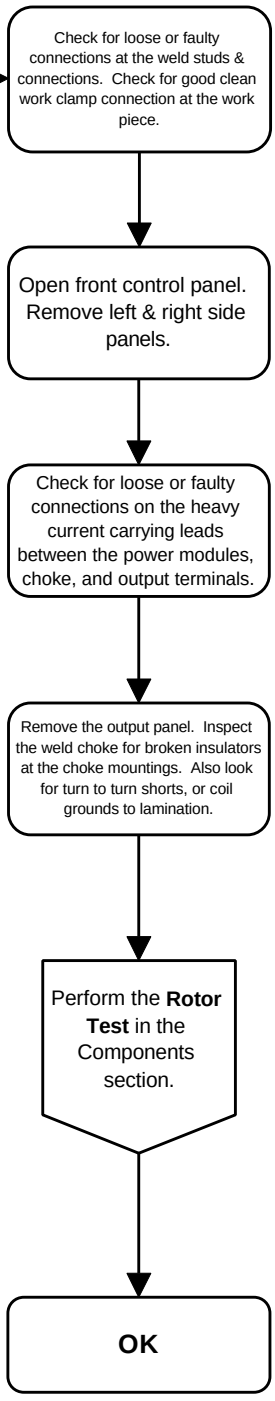
TOOLS NEEDED
3/8" wrench
5/16" nutdriver
multi-meter
wiring diagram
isolated 115vac supply



ARC CUTS OUT.
- OR -
INTERMITTENT ARC.

AUXILIARY OUTPUT IS NORMAL.

TOOLS NEEDED
3/8" wrench
5/16" nutdriver
multi-meter
wiring diagram
weld grid
ammeter(capable of measuring 575A)

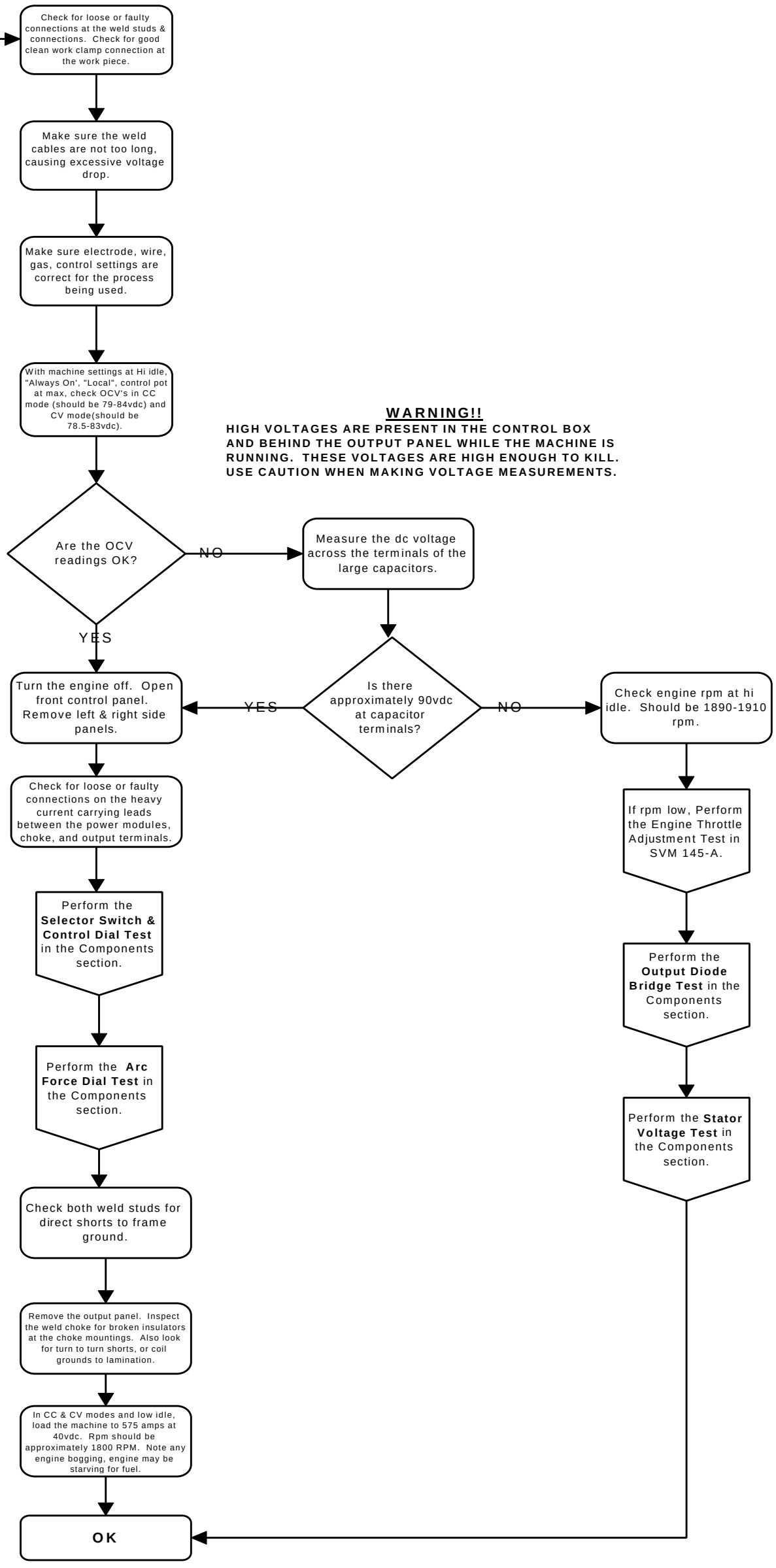


ARC IS ERRATIC.
- OR -
ARC IS TOO COLD.
- OR -
ELECTRODE STICKS, POPS OUT.

AUXILIARY OUTPUT IS NORMAL

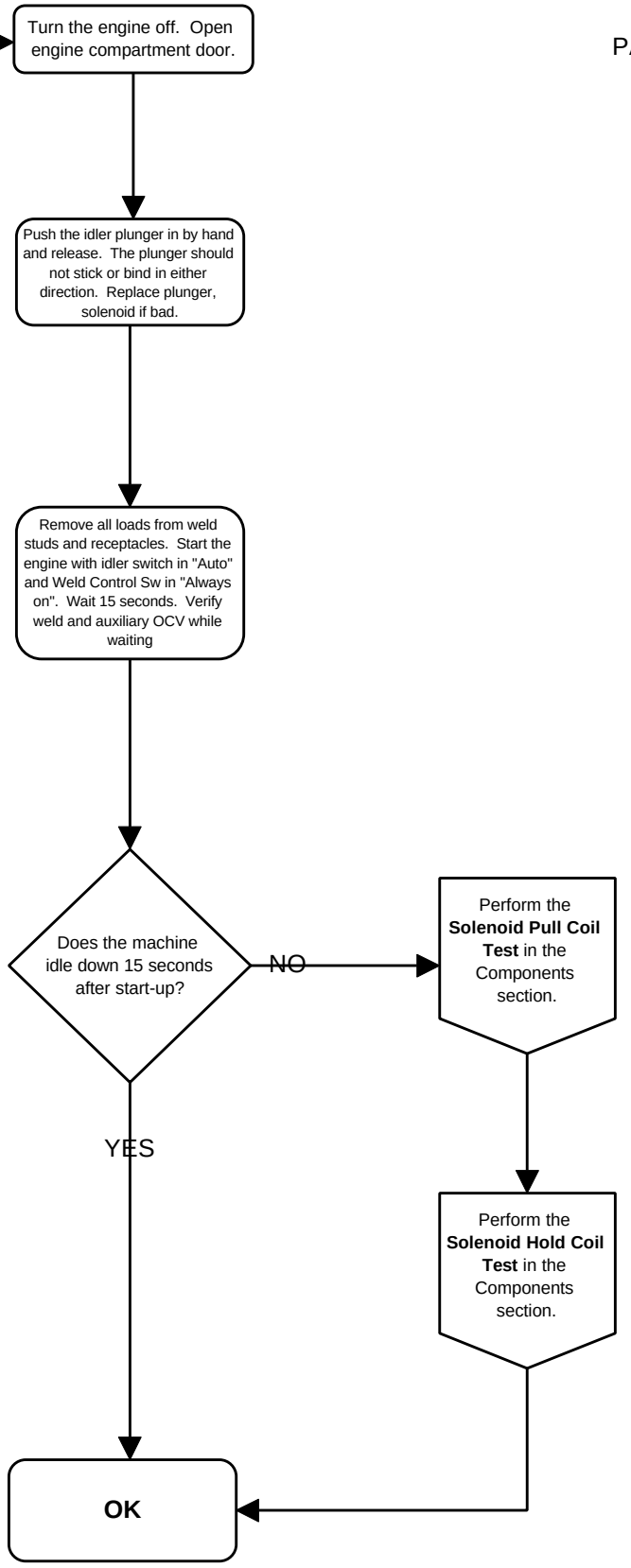
TOOLS NEEDED
3/8" wrench
7/16" wrench
5/16" nutdriver
multi-meter
wiring diagram
weld grid
ammeter(capable of measuring 575A)
tachometer

WARNING!!
HIGH VOLTAGES ARE PRESENT IN THE CONTROL BOX AND BEHIND THE OUTPUT PANEL WHILE THE MACHINE IS RUNNING. THESE VOLTAGES ARE HIGH ENOUGH TO KILL. USE CAUTION WHEN MAKING VOLTAGE MEASUREMENTS.



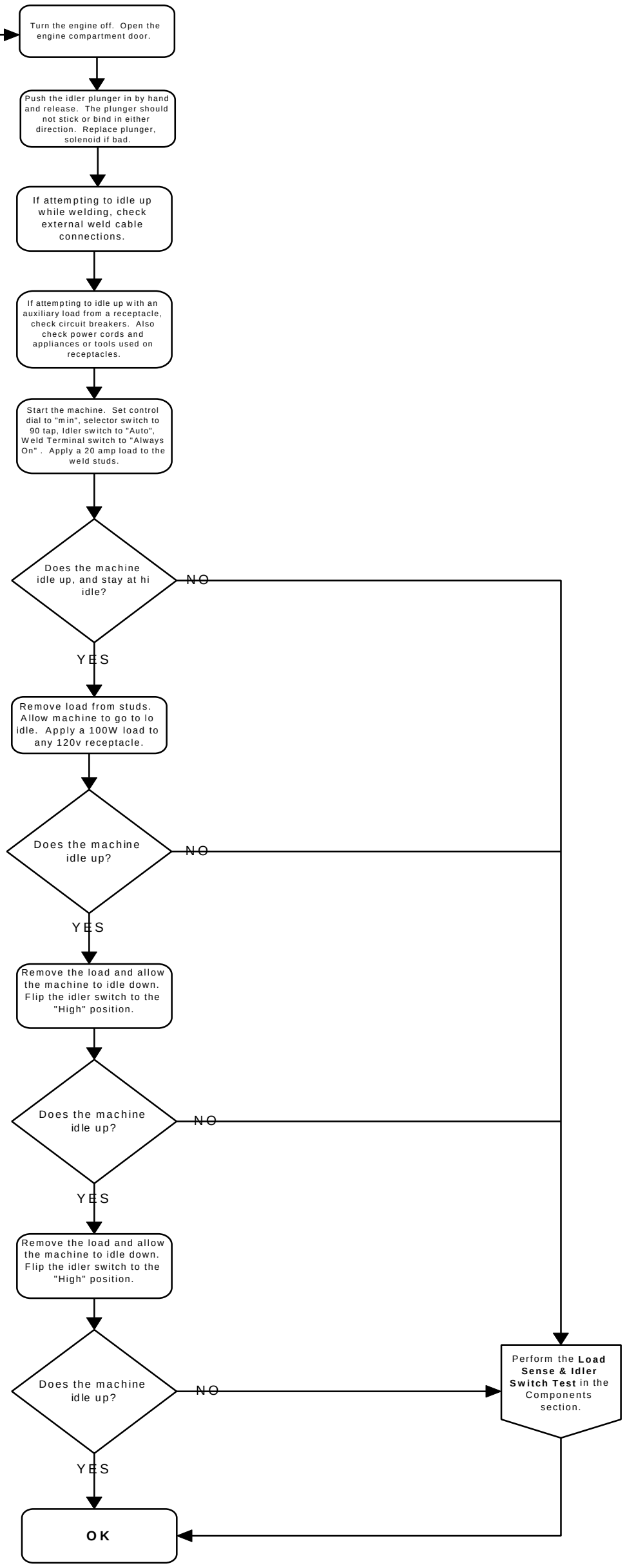
MACHINE WON'T IDLE DOWN.
WELD & AUXILIARY OUTPUT IS NORMAL.

TOOLS NEEDED
3/8" wrench
5/16" nutdriver
multi-meter
wiring diagram



THE MACHINE WON'T IDLE UP.
WELD & AUXILIARY OUTPUT IS NORMAL.

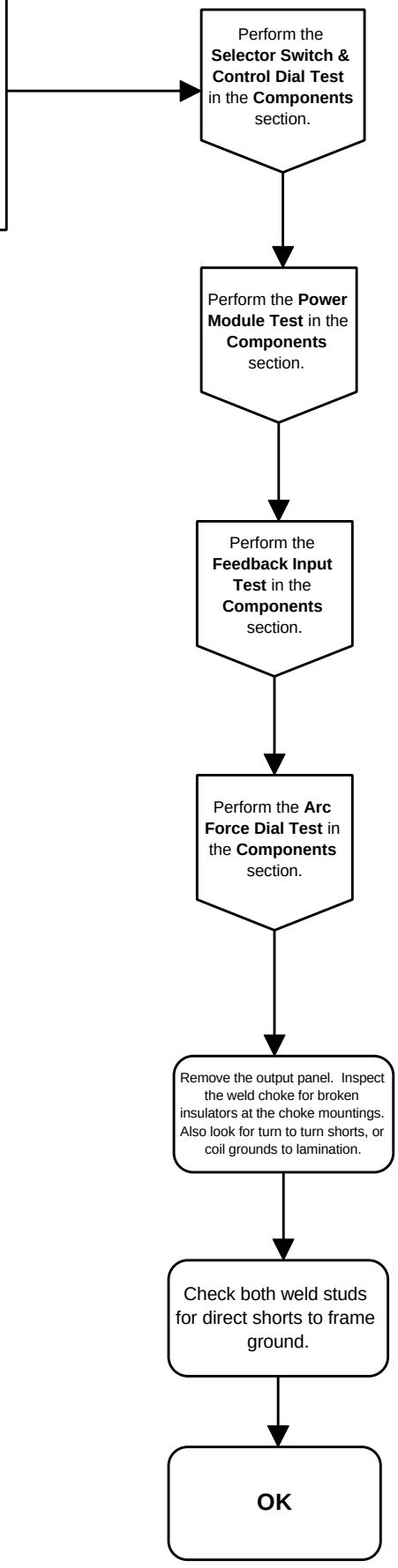
TOOLS NEEDED
3/8" wrench
5/16" nutdriver
multi-meter
wiring diagram
weld grid
ammeter(capable of measuring 20A)
trouble light w/ 100W bulb



NO WELD CONTROL.
- OR -
MACHINE GOES TO FULL OUTPUT.
- OR -
ARC IS TOO HOT, EXCESSIVE SPATTERING & CANNONBALLING.

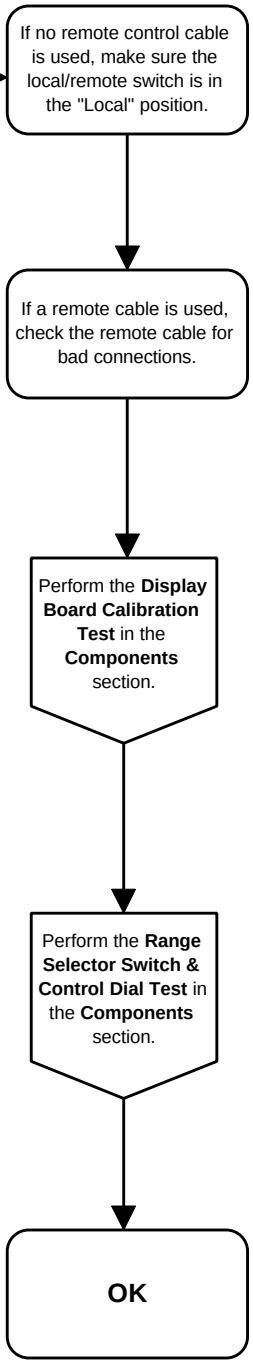
AUXILIARY OUTPUT IS NORMAL.

TOOLS NEEDED
3/8" wrench
5/16" nutdriver
multi-meter
wiring diagram



DISPLAY READS "010" ALL THE TIME.

TOOLS NEEDED
3/8" wrench
5/16" nutdriver
multi-meter
wiring diagram



RANGE ON DISPLAY METERS DOESN'T AGREE WITH NAMEPLATE.
- OR -
DISPLAY METER SETTINGS DON'T AGREE WITH ACTUAL AMPS/VOLTS.

WELDING OUTPUT IS NORMAL

Recalibrate the display per S24427

OR

Perform the **Display Board Calibration Test** in the **Components** section.

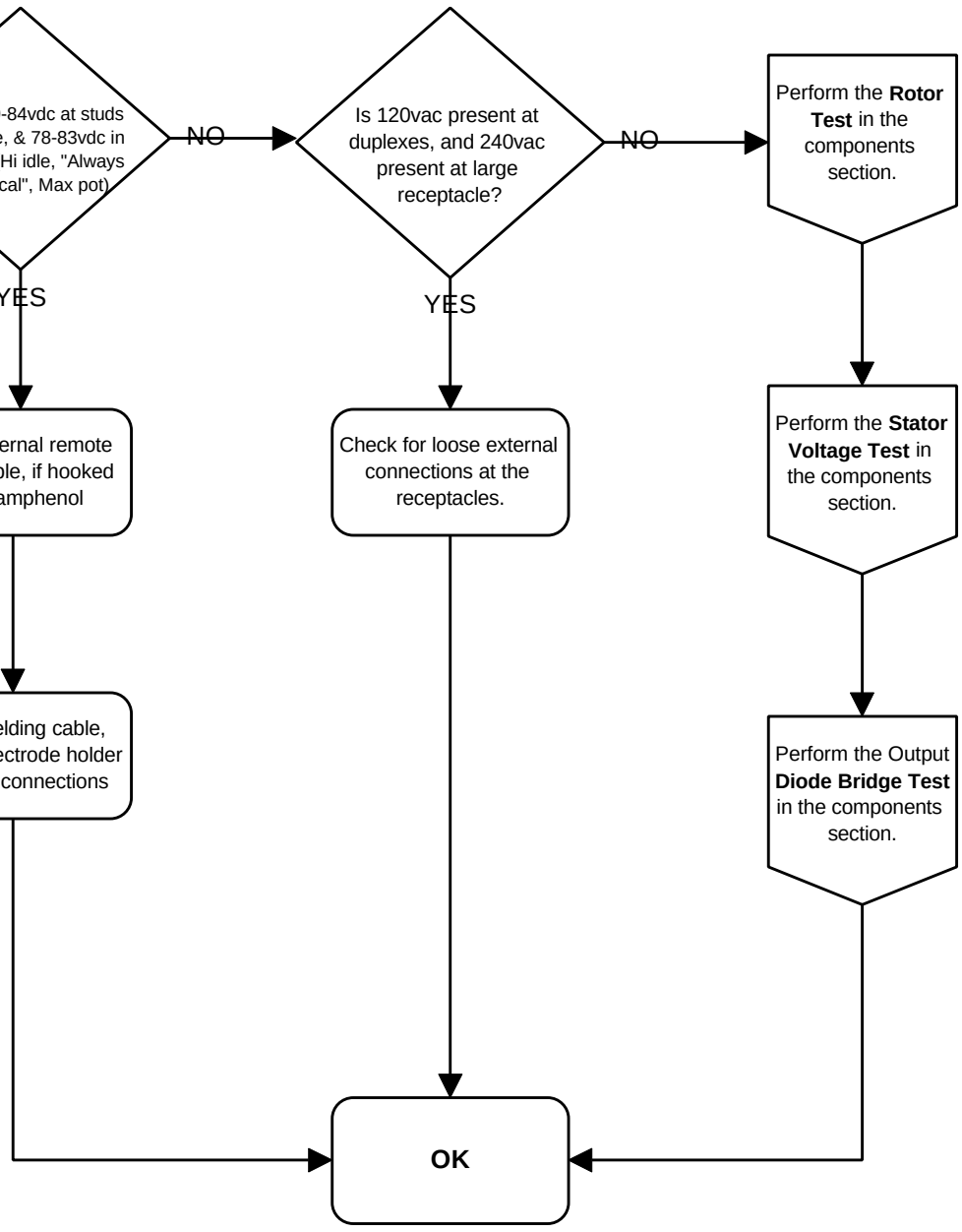
OK

TOOLS NEEDED

3/8" wrench
5/16" nutdriver
wiring diagram
multi-meter
ammeter (capable of measuring 200A)
load grid(capable of 200A @ 30v)

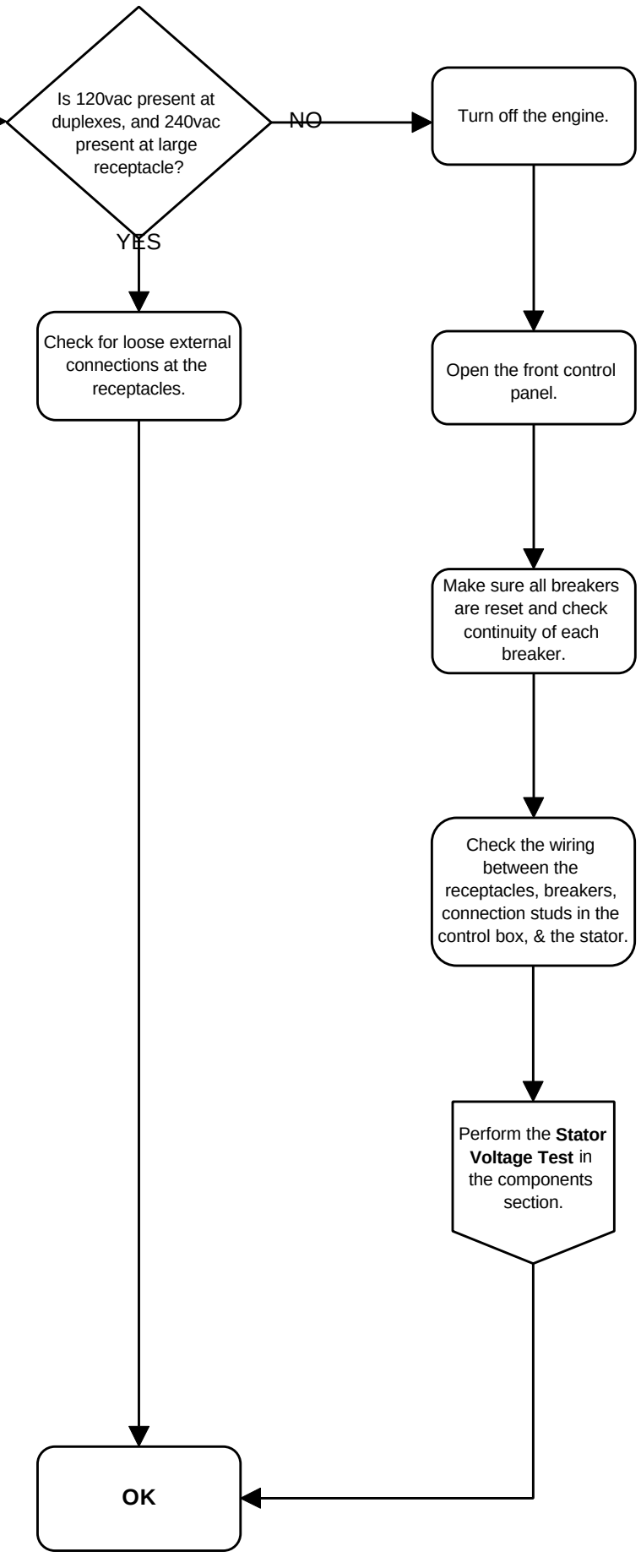
NO WELD OUTPUT OR AUXILIARY OUTPUT ENGINE OPERATION IS NORMAL.

TOOLS NEEDED
3/8" wrench
7/16" wrench
5/16" nutdriver
multi-meter
wiring diagram



NO AUXILIARY OUTPUT
WELD OUTPUT IS NORMAL.
ENGINE OPERATION IS NORMAL.

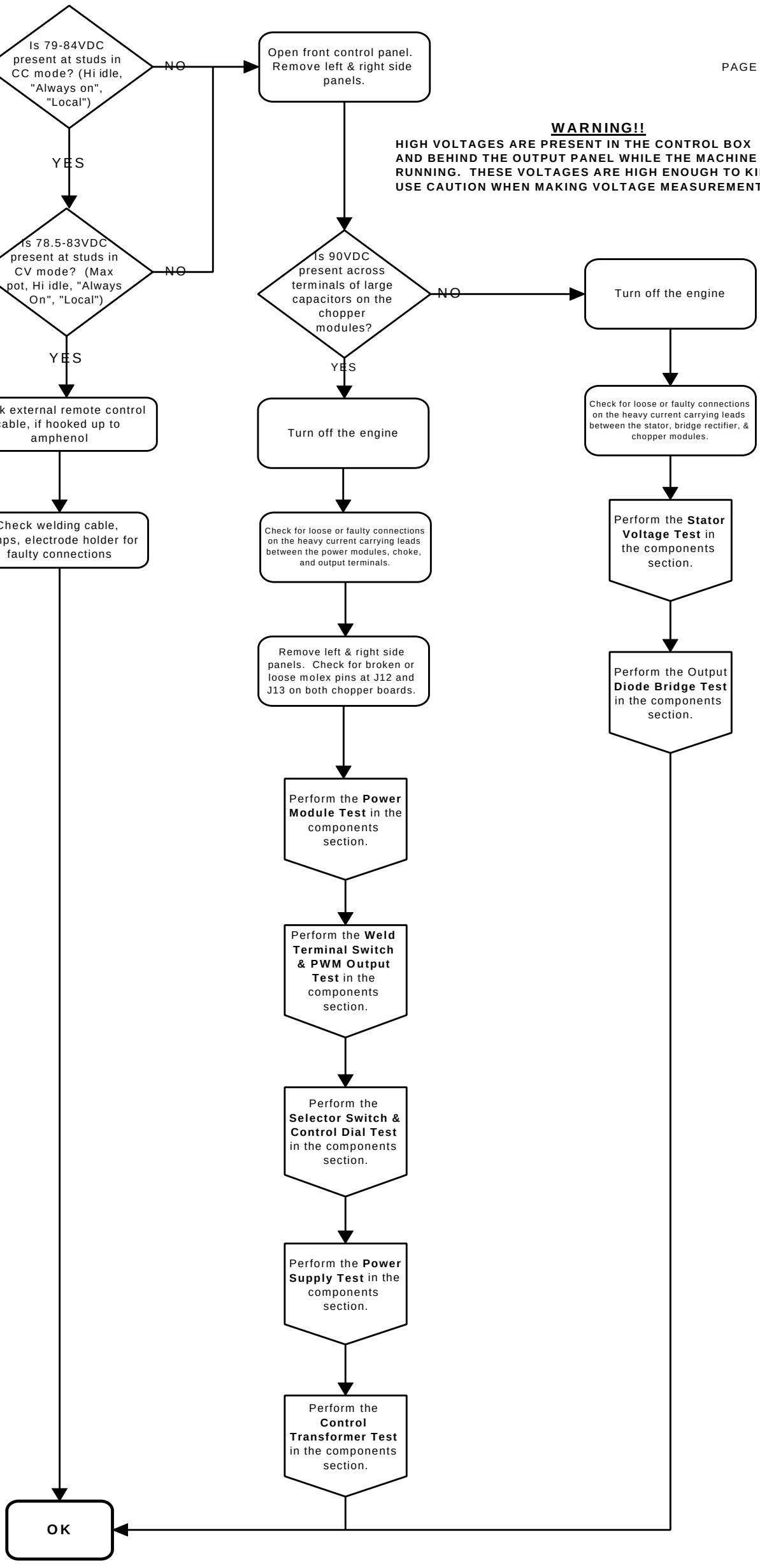
TOOLS NEEDED
3/8" wrench
7/16" wrench
5/16" nutdriver
multi-meter
wiring diagram



NO WELDING OUTPUT.
AUXILIARY OUTPUT IS NORMAL.
ENGINE OPERATION IS NORMAL.

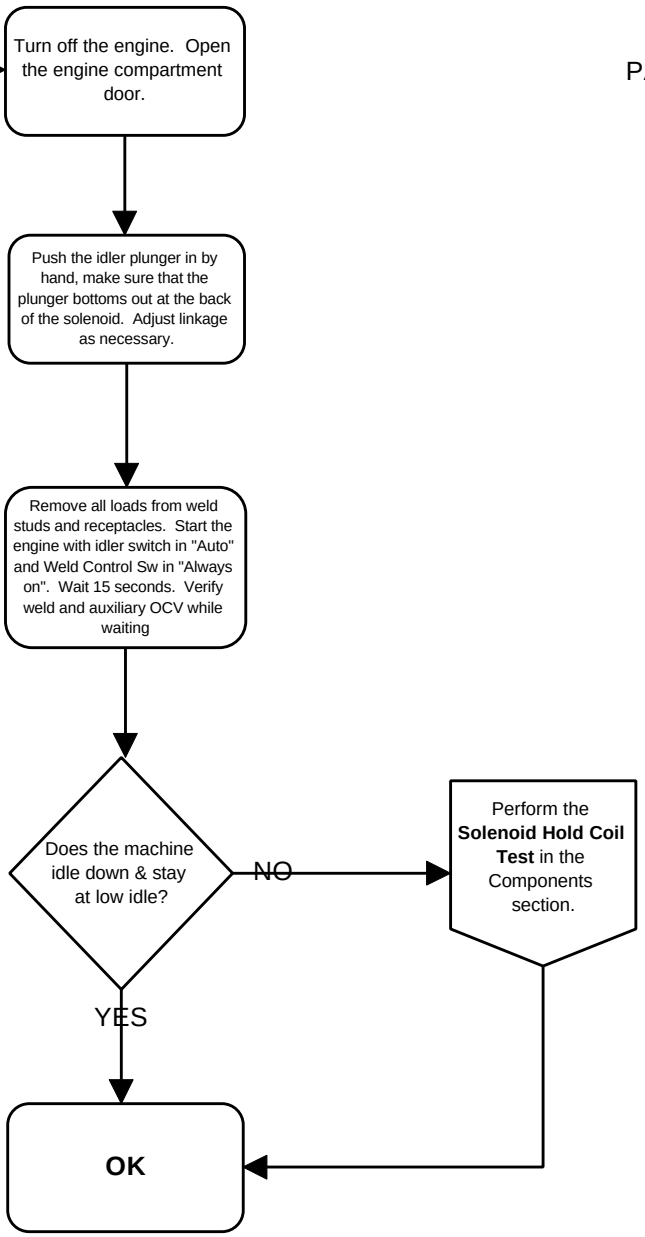
TOOLS NEEDED
3/8" wrench
7/16" wrench
1/2" wrench
3/4" wrench
5/16" nutdriver
multi-meter w/ diode check
wiring diagram
load grid
ammeter(capable of 575a)

WARNING!!
HIGH VOLTAGES ARE PRESENT IN THE CONTROL BOX AND BEHIND THE OUTPUT PANEL WHILE THE MACHINE IS RUNNING. THESE VOLTAGES ARE HIGH ENOUGH TO KILL. USE CAUTION WHEN MAKING VOLTAGE MEASUREMENTS.



THE MACHINE IDLES DOWN BRIEFLY, THEN BACK UP.
WELD & AUXILIARY OUTPUT IS NORMAL.

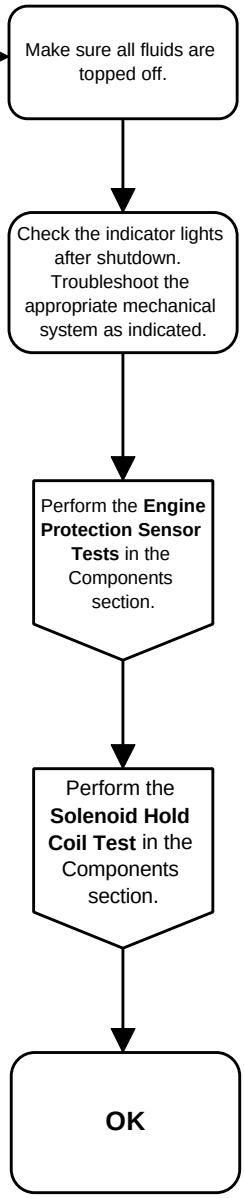
TOOLS NEEDED
3/8" wrench
5/16" nutdriver
multi-meter
wiring diagram
48" 18ga wire



ENGINE SHUTS DOWN SHORTLY AFTER START-UP.

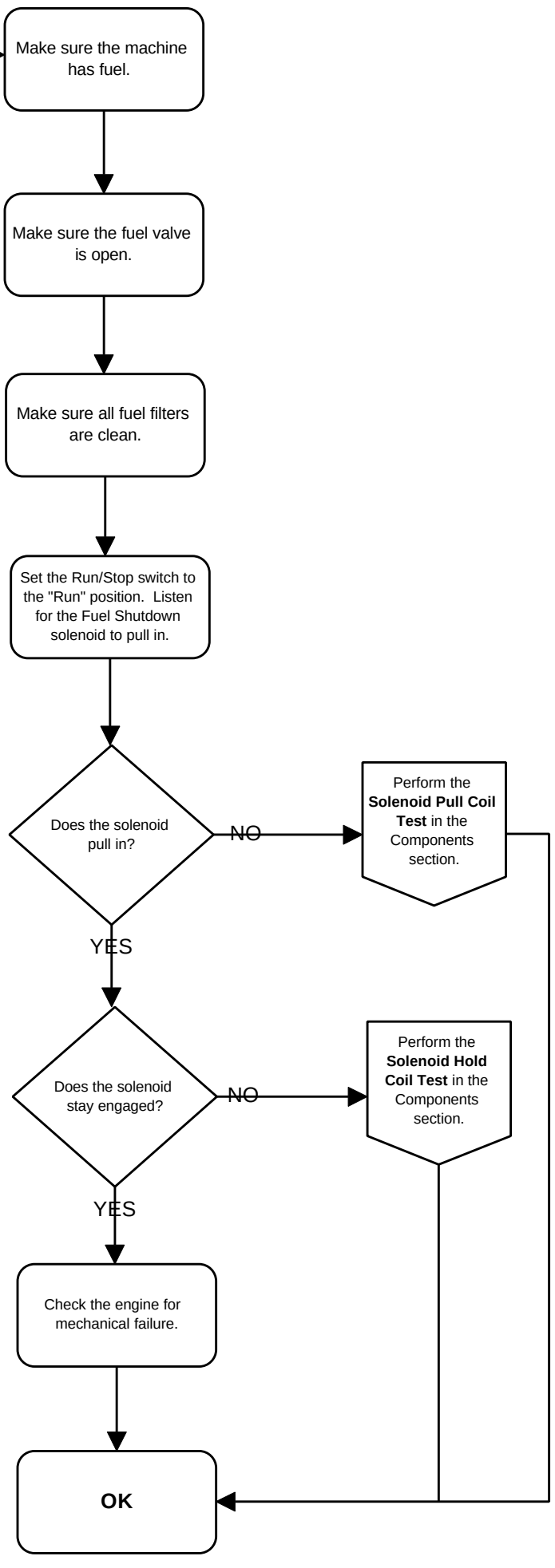
TOOLS NEEDED

3/8" wrench
5/16" nutdriver
multi-meter
wiring diagram
48" 18ga wire



ENGINE CRANKS BUT WILL NOT START.

TOOLS NEEDED
3/8" wrench
5/16" nutdriver
multi-meter
wiring diagram
48" 18ga wire
48" 16ga wire



MACHINE IDLES UP WITH NO LOAD APPLIED.

WELD & AUXILIARY OUTPUT IS NORMAL.

Turn off the engine. Open the engine compartment door.

Push the idler plunger in by hand, make sure that the plunger bottoms out at the back of the solenoid. Adjust linkage as necessary.

Perform the **Solenoid Hold Coil Test** in the Components section.

Replace the Engine Protection pc board.

OK

TOOLS NEEDED

3/8" wrench
5/16" nutdriver
multi-meter
wiring diagram
48" 18ga wire

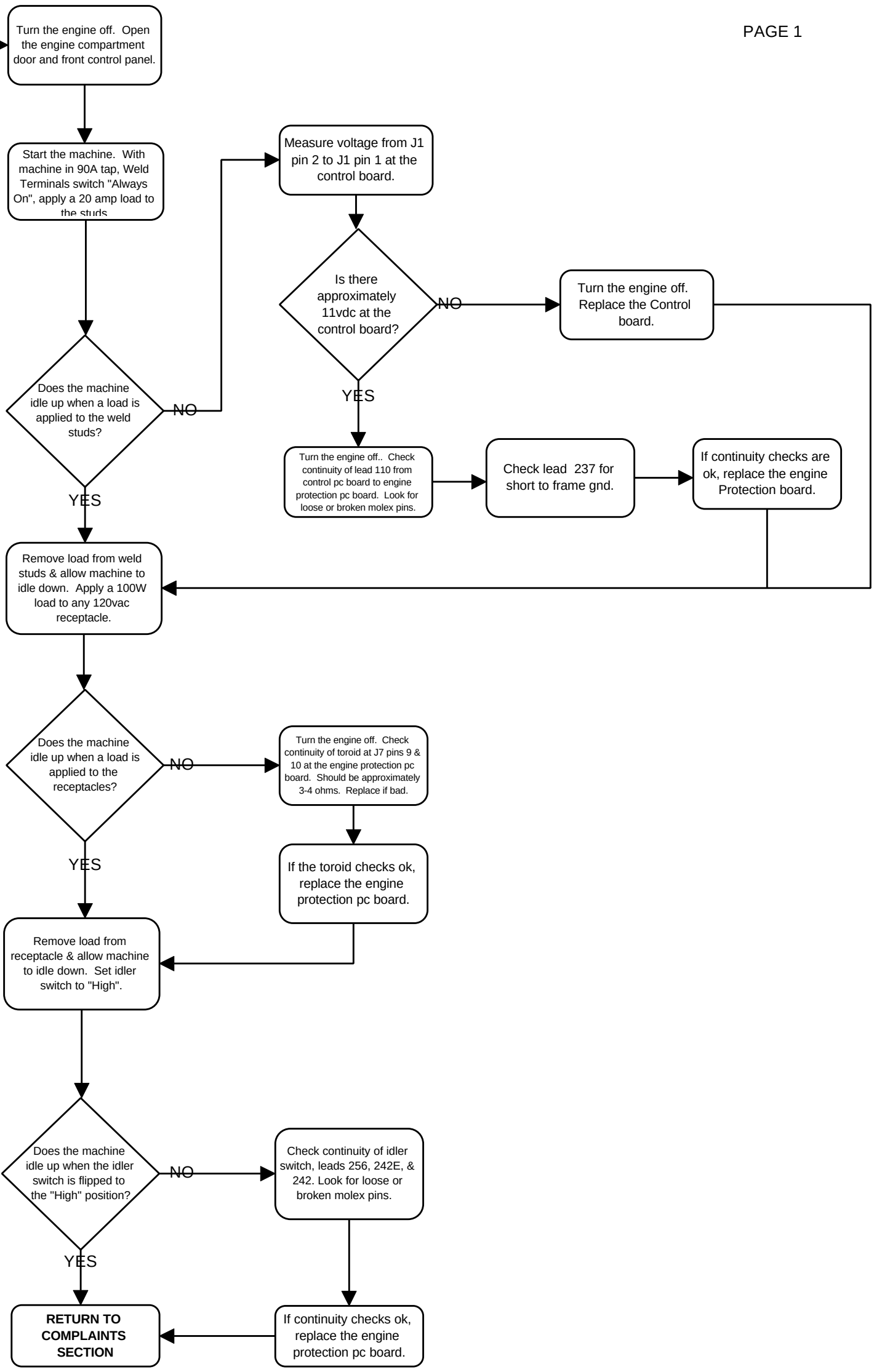
COMMANDER 500 ELECTRICAL TROUBLESHOOTING FLOWCHARTS

COMPONENT TEST SECTION
TABLE OF CONTENTS

LOAD SENSE (for idler) & IDLER SWITCH TEST

TOOLS NEEDED

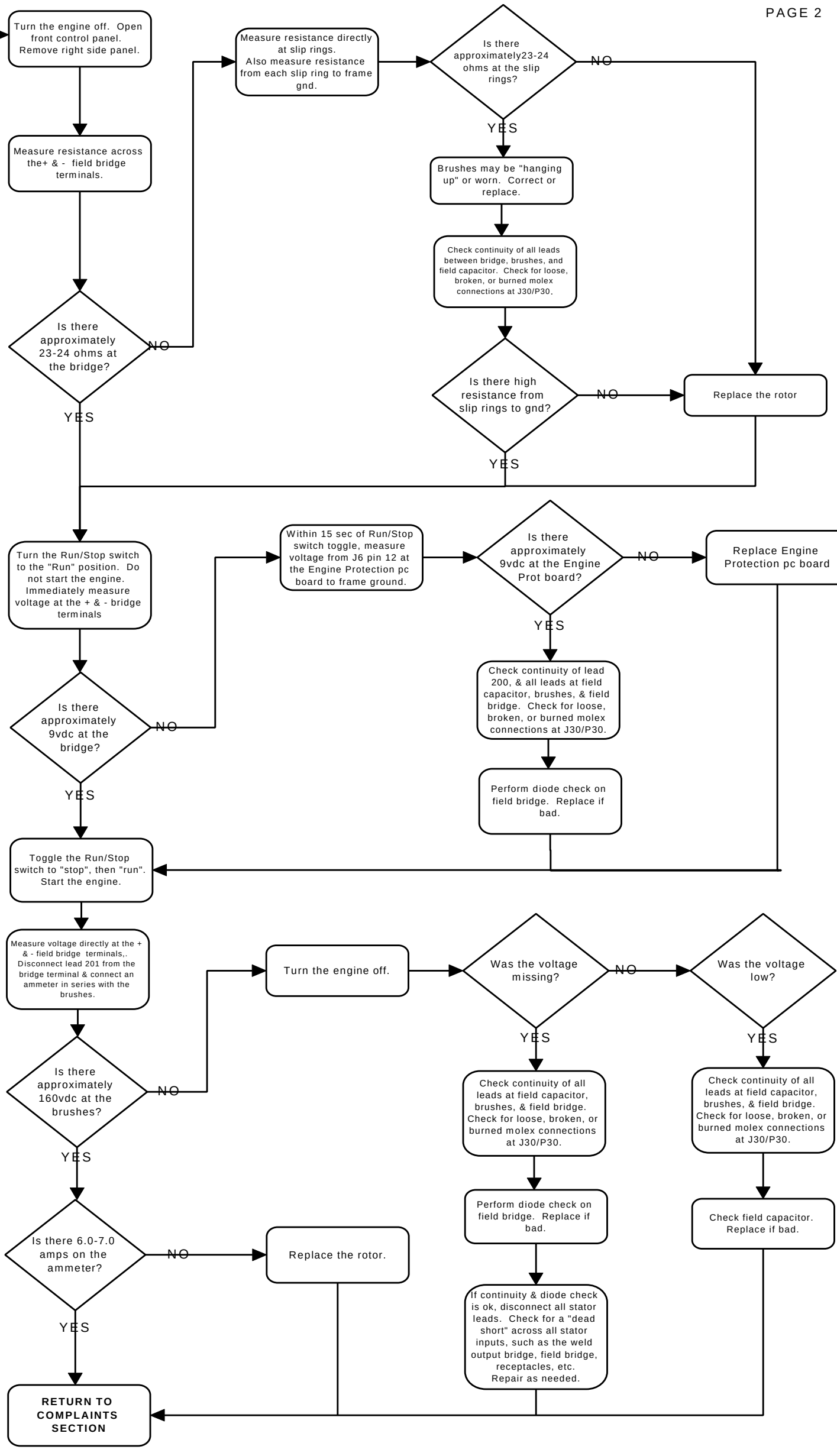
3/8" wrench
5/16" nutdriver
multi-meter
wiring diagram
load grid (20A load)
Ammeter (capable of measuring 20a)
10" crescent wrench
trouble light w/ 100w bulb



ROTOR TEST

TOOLS NEEDED
3/8" wrench
5/16" nutdriver
multi-meter
wiring diagram
ammeter(capable of 10a)

WARNING!!
HIGH VOLTAGES ARE PRESENT AT THE BRUSHES WHILE THE MACHINE IS RUNNING. THESE VOLTAGES ARE HIGH ENOUGH TO KILL. USE CAUTION WHEN MAKING VOLTAGE MEASUREMENTS.



STATOR VOLTAGE TEST

TOOLS NEEDED

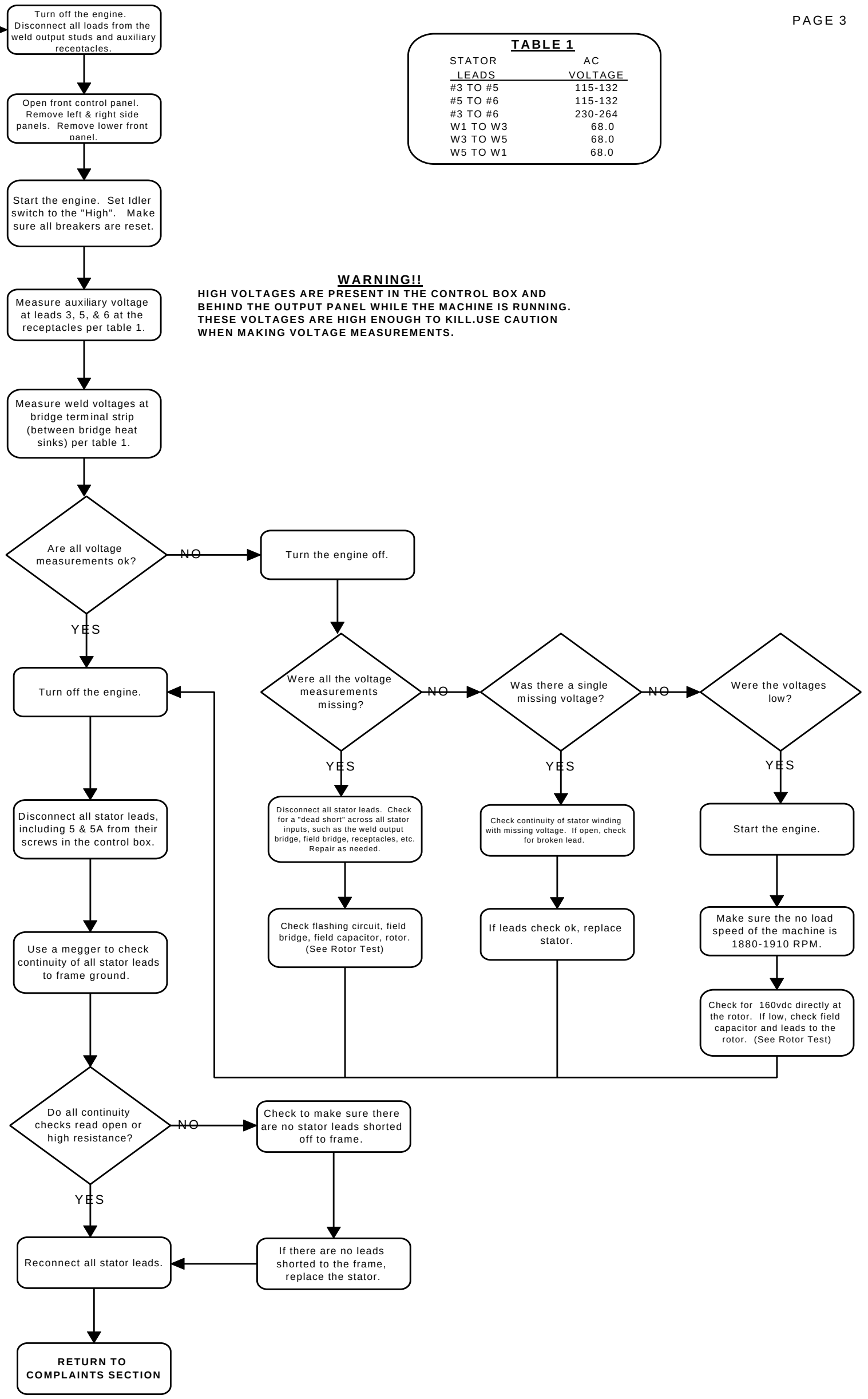
3/8" wrench
7/16" wrench
11/32" wrench
5/16" nutdriver
tachometer
multi-meter
wiring diagram
megger

TABLE 1

STATOR LEADS	AC VOLTAGE
#3 TO #5	115-132
#5 TO #6	115-132
#3 TO #6	230-264
W1 TO W3	68.0
W3 TO W5	68.0
W5 TO W1	68.0

WARNING!!

HIGH VOLTAGES ARE PRESENT IN THE CONTROL BOX AND BEHIND THE OUTPUT PANEL WHILE THE MACHINE IS RUNNING. THESE VOLTAGES ARE HIGH ENOUGH TO KILL.USE CAUTION WHEN MAKING VOLTAGE MEASUREMENTS.



ARC FORCE DIAL TEST

Turn off engine & open front control panel.

Set the Arc Force Dial to min, Control Dial to min, and the Selector switch to the CC position. Start the engine.

WARNING!!

HIGH VOLTAGES ARE PRESENT IN THE CONTROL BOX WHILE THE MACHINE IS RUNNING. THESE VOLTAGES ARE HIGH ENOUGH TO KILL.USE CAUTION WHEN MAKING VOLTAGE MEASUREMENTS.

TOOLS NEEDED

3/8" wrench
3/4" wrench
5/16" nutdriver
multi-meter
wiring diagram
5' heavy cable
ammeter(capable of 200A)

Short the output studs. Adjust the control pot to a current of 100A. Measure voltage at control board from J2 pin 7 (pos) to pin 2(neg) per table 2, & measure actual weld current.

Voltage and weld current readings ok?

NO

Turn off the engine.

Measure continuity at control bd from J3 pin 5 to pin 14. Turn Arc Force Dial from min to max.

Does the resistance change from 50k to 0 ohms as the pot is turned?

NO

Check leads 277, 278, & 278A for loose or broken molex pins/connections.

YES

Replace the Control PC board.

Replace 50k Arc Force pot if bad.

RETURN TO COMPLAINTS SECTION

TABLE 2

ARC FORCE DIAL POSITION	DC VOLTAGE
MIN	5.831-6.209
MAX	10.204-10.835

Short circuit weld current should change from 100-178 amps from min to max.

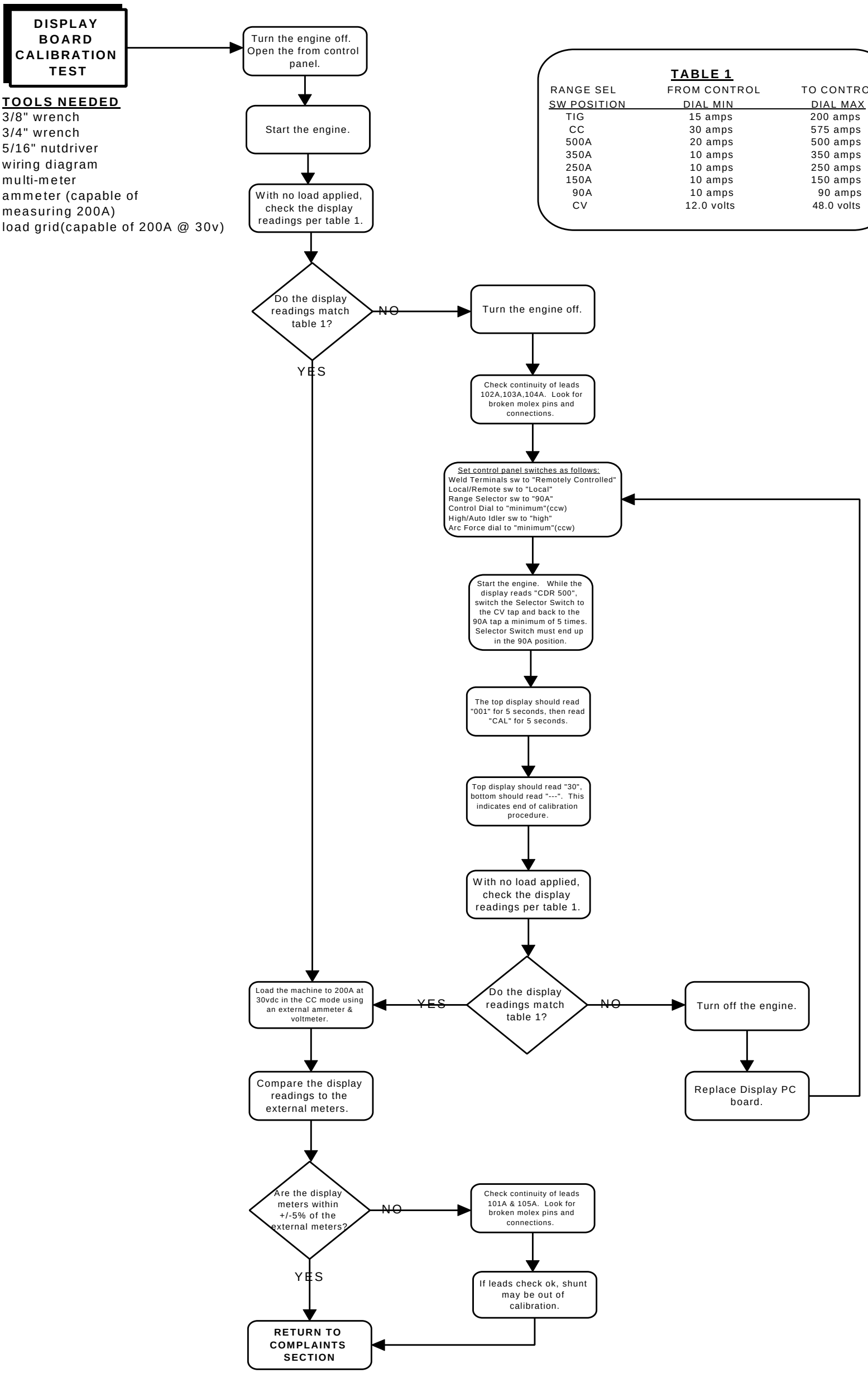
DISPLAY BOARD CALIBRATION TEST

TOOLS NEEDED

3/8" wrench
3/4" wrench
5/16" nutdriver
wiring diagram
multi-meter
ammeter (capable of measuring 200A)
load grid(capable of 200A @ 30v)

TABLE 1

RANGE SEL SW POSITION	FROM CONTROL DIAL MIN	TO CONTROL DIAL MAX
TIG	15 amps	200 amps
CC	30 amps	575 amps
500A	20 amps	500 amps
350A	10 amps	350 amps
250A	10 amps	250 amps
150A	10 amps	150 amps
90A	10 amps	90 amps
CV	12.0 volts	48.0 volts



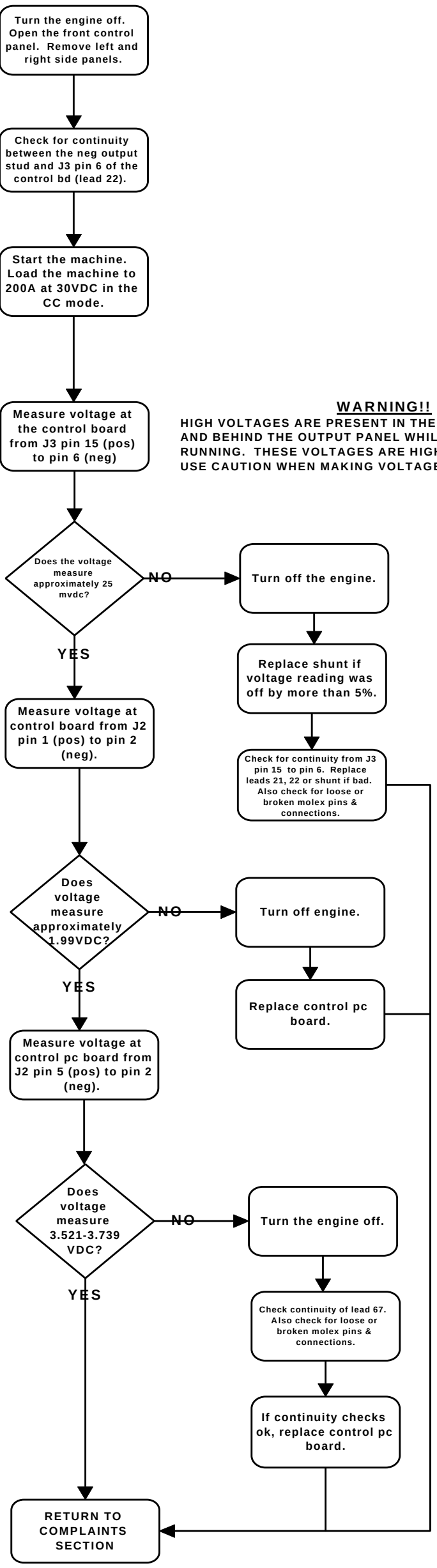
FEEDBACK INPUT TEST

TOOLS NEEDED

3/8" wrench
4/3" wrench
5/16" nutdriver
wiring diagram
multimeter
ammeter (capable of measuring 200A)
load grid

WARNING!!

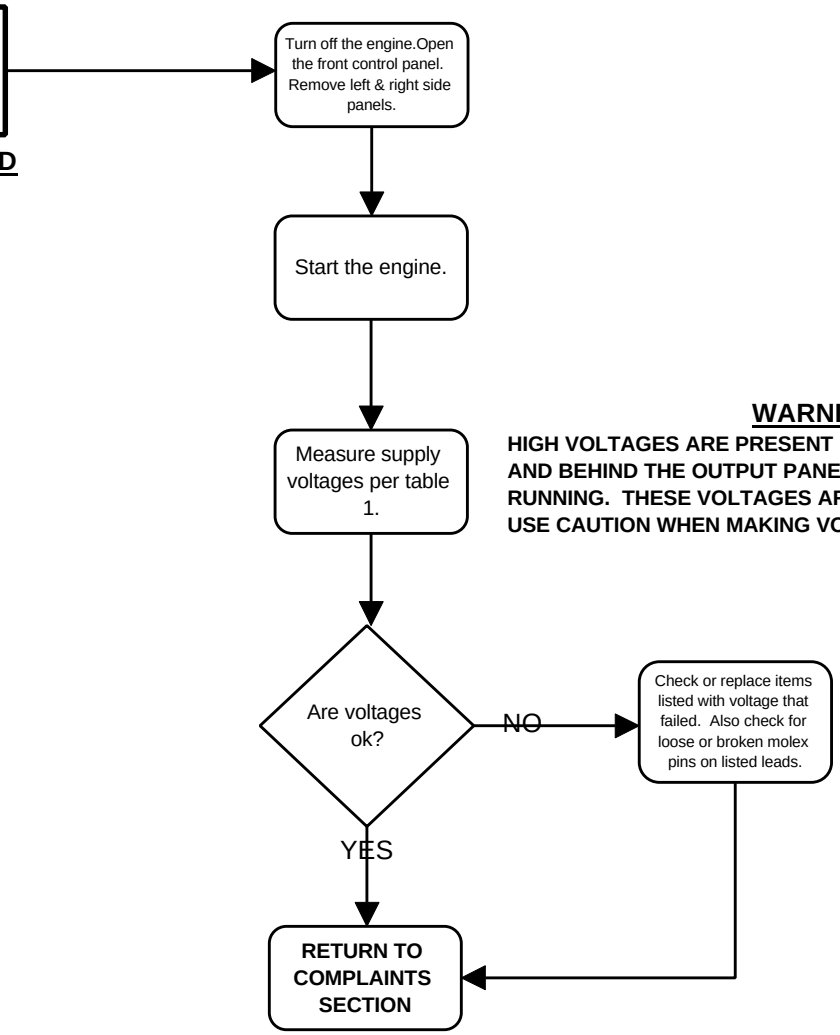
HIGH VOLTAGES ARE PRESENT IN THE CONTROL BOX AND BEHIND THE OUTPUT PANEL WHILE THE MACHINE IS RUNNING. THESE VOLTAGES ARE HIGH ENOUGH TO KILL. USE CAUTION WHEN MAKING VOLTAGE MEASUREMENTS.



POWER SUPPLY TEST.

TOOLS NEEDED

3/8" wrench
5/16" nutdriver
multi-meter
wiring diagram



WARNING!!

HIGH VOLTAGES ARE PRESENT IN THE CONTROL BOX AND BEHIND THE OUTPUT PANEL WHILE THE MACHINE IS RUNNING. THESE VOLTAGES ARE HIGH ENOUGH TO KILL. USE CAUTION WHEN MAKING VOLTAGE MEASUREMENTS.

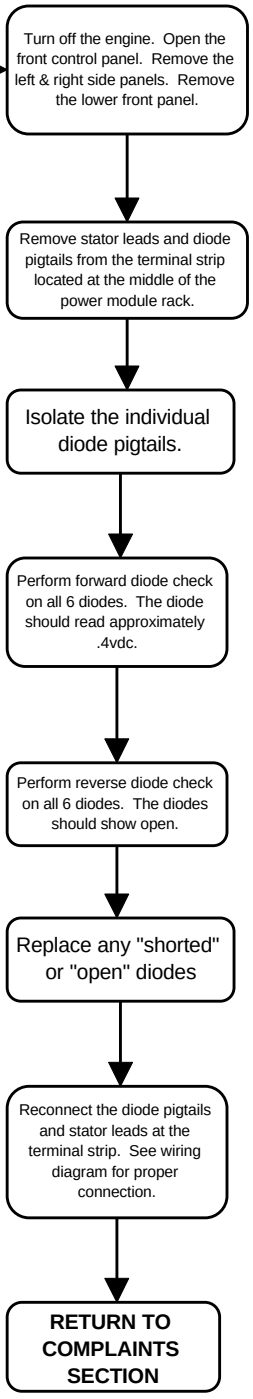
TABLE 1

SUPPLY VOLTAGE	MEASURE AT:	FUNCTION AFFECTED	CHECK/ REPLACE
115vac	aux studs to aux gnd screw in ctrl box	receptacle volts, weld output	stator, 3, 5, 5A, 6
12vdc batt	12v isolated stud in ctrl box to frm gnd	engine protection system	run/stop sw, 232A, 236, 236A, batt cables
115vac(hi idle)	P16 pin 7 to 8 @ ctrl transfmr	weld output	lead 5G,6E, flashing circuit, rotor, stator
30vac control(hi idle)	J12 pin 1 to 2 @ LT chop bd	Weld output	lead 15,16,control transformer
30vac control(hi idle)	J13 pin 1 to 2 @ RT chop bd	Weld output	lead 13,14,control transformer
42vac control(hi idle)	J3 pin 1 to 9 @ control bd	Weld Output/Display Output	lead 17,18,control transformer
+12vdc control	J2 pin 3 to 2 @ control bd	Weld output/Display Output	Control bd
+12vdc control	J5 pin 4 to 1 @ eng prot bd	Idler Control	lead 108,109,Control bd
+12vdc control	J9 pin 4 to 5 @ display bd	Display output(if equipped)	lead 106,107, control bd
+12vdc battery	J9 pin 1 to 2 @ display bd	Display output(if equipped)	lead 232,232J,5L,5N,5M,Battery
115vac (hi idle)	14 pin amph pin J to A	Wire feeder	lead 31,32,3B,CB5
42vac(hi idle)(if equipped)	14 pin amph pin I to K	Wire feeder	lead 41,42,CB6, 42VAC transformer

Output Diode Bridge Test

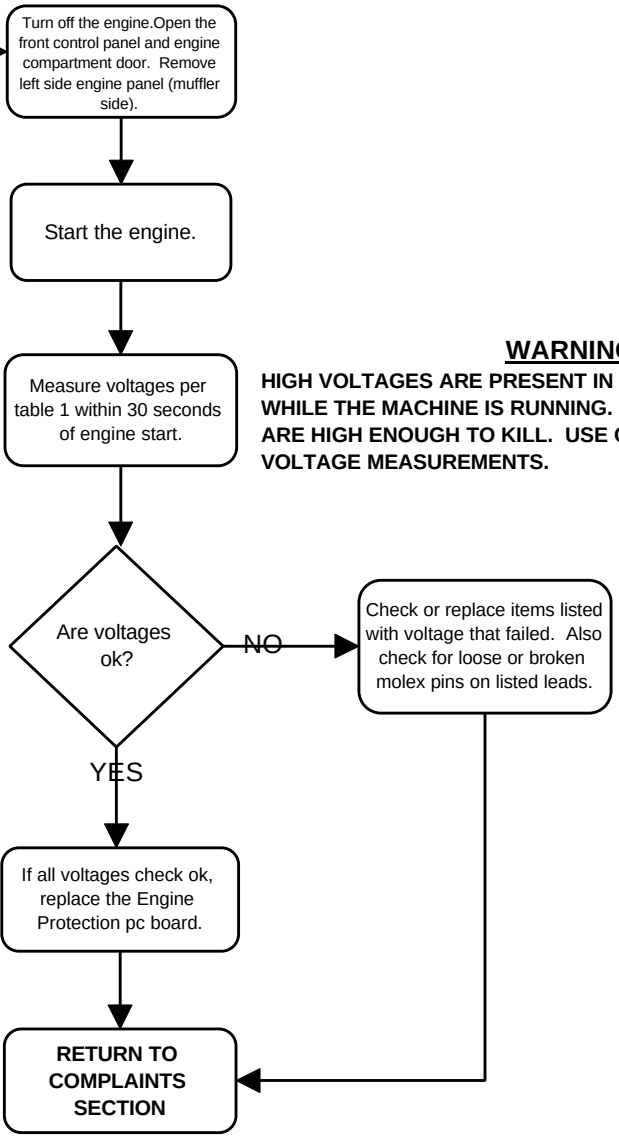
TOOLS NEEDED

5/16" nutdriver
3/8" wrench
7/16" wrench
1/2" wrench
3/4" wrench
wiring diagram
Multimeter w/ diode tester



ENGINE PROTECTION SENSOR TESTS

TOOLS NEEDED
3/8" wrench
5/16" nutdriver
multi-meter
wiring diagram



WARNING!!

HIGH VOLTAGES ARE PRESENT IN THE CONTROL BOX WHILE THE MACHINE IS RUNNING. THESE VOLTAGES ARE HIGH ENOUGH TO KILL. USE CAUTION WHEN MAKING VOLTAGE MEASUREMENTS.

TABLE 1

SENSOR VOLTAGE	MEASURE AT:	FUNCTION AFFECTED	CHECK/ REPLACE
9.0-10.0vdc	J7 pin 13 to frm gnd (at engine prot bd)	oil temp sense	oil temp switch, belt, 233, 233A, J30/P39
9.0-10.0vdc	J7 pin 11 to frm gnd (at engine prot bd)	oil pressure sense	oil pressure switch, 234, 234, J30/P30
*12.0-13.0vdc	EXC post on alternator to frm gnd	engine alternator flashing	engine protection board, alternator, 281A, 281, J30/P30
13.5-14.5vdc	J7 pin 12 to frm gnd (at engine prot bd)	engine alternator voltage sense	alternator, belt, 239, 239A, J30/P30
1.9-2.2vdc (at full tank)	J7 pin 14 to frm gnd (at engine prot bd)	fuel level sense	fuel gauge, 229, 229A, 229B, 229C, J18/P18

*6.0-7.0vdc with Run/Stop sw in Run, and engine not running

POWER MODULE TEST

TOOLS NEEDED

5/16" nutdriver
3/8" wrench
7/16" wrench
1/2" wrench
3/4" wrench
wiring diagram
multimeter w/ diode check

WARNING

OVERTORQUING OF BOLTS CAN CAUSE DAMAGE TO DEVICE. CONSULT TABLE 1 & 2 FOR PROPER TORQUE SPEC. COAT WITH THIN LAYER OF PENETROX BEFORE MOUNTING TO HEAT SINK

TABLE 1

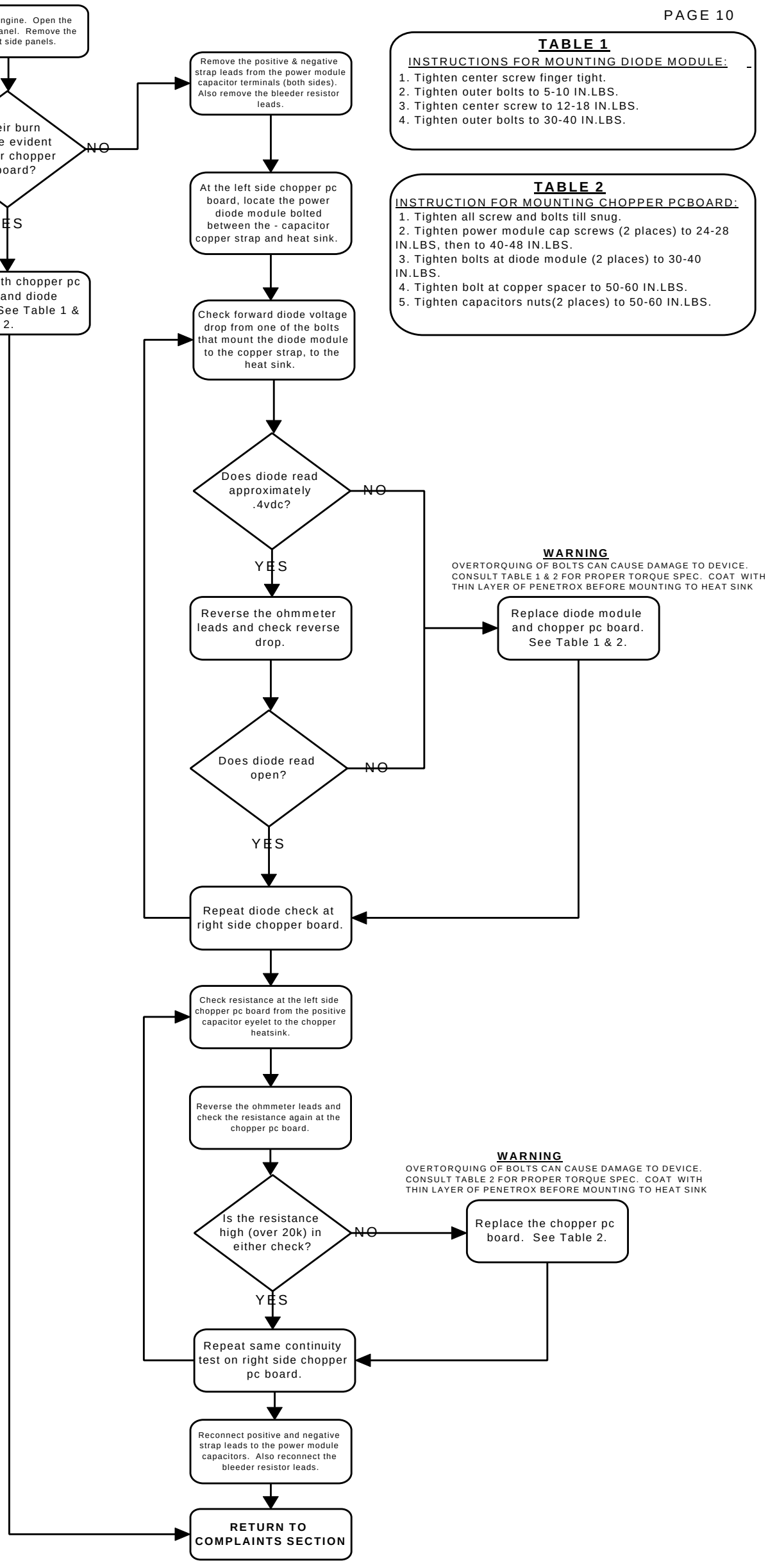
INSTRUCTIONS FOR MOUNTING DIODE MODULE:

1. Tighten center screw finger tight.
2. Tighten outer bolts to 5-10 IN.LBS.
3. Tighten center screw to 12-18 IN.LBS.
4. Tighten outer bolts to 30-40 IN.LBS.

TABLE 2

INSTRUCTION FOR MOUNTING CHOPPER PCBOARD:

1. Tighten all screw and bolts till snug.
2. Tighten power module cap screws (2 places) to 24-28 IN.LBS, then to 40-48 IN.LBS.
3. Tighten bolts at diode module (2 places) to 30-40 IN.LBS.
4. Tighten bolt at copper spacer to 50-60 IN.LBS.
5. Tighten capacitors nuts(2 places) to 50-60 IN.LBS.



WARNING

OVERTORQUING OF BOLTS CAN CAUSE DAMAGE TO DEVICE. CONSULT TABLE 1 & 2 FOR PROPER TORQUE SPEC. COAT WITH THIN LAYER OF PENETROX BEFORE MOUNTING TO HEAT SINK

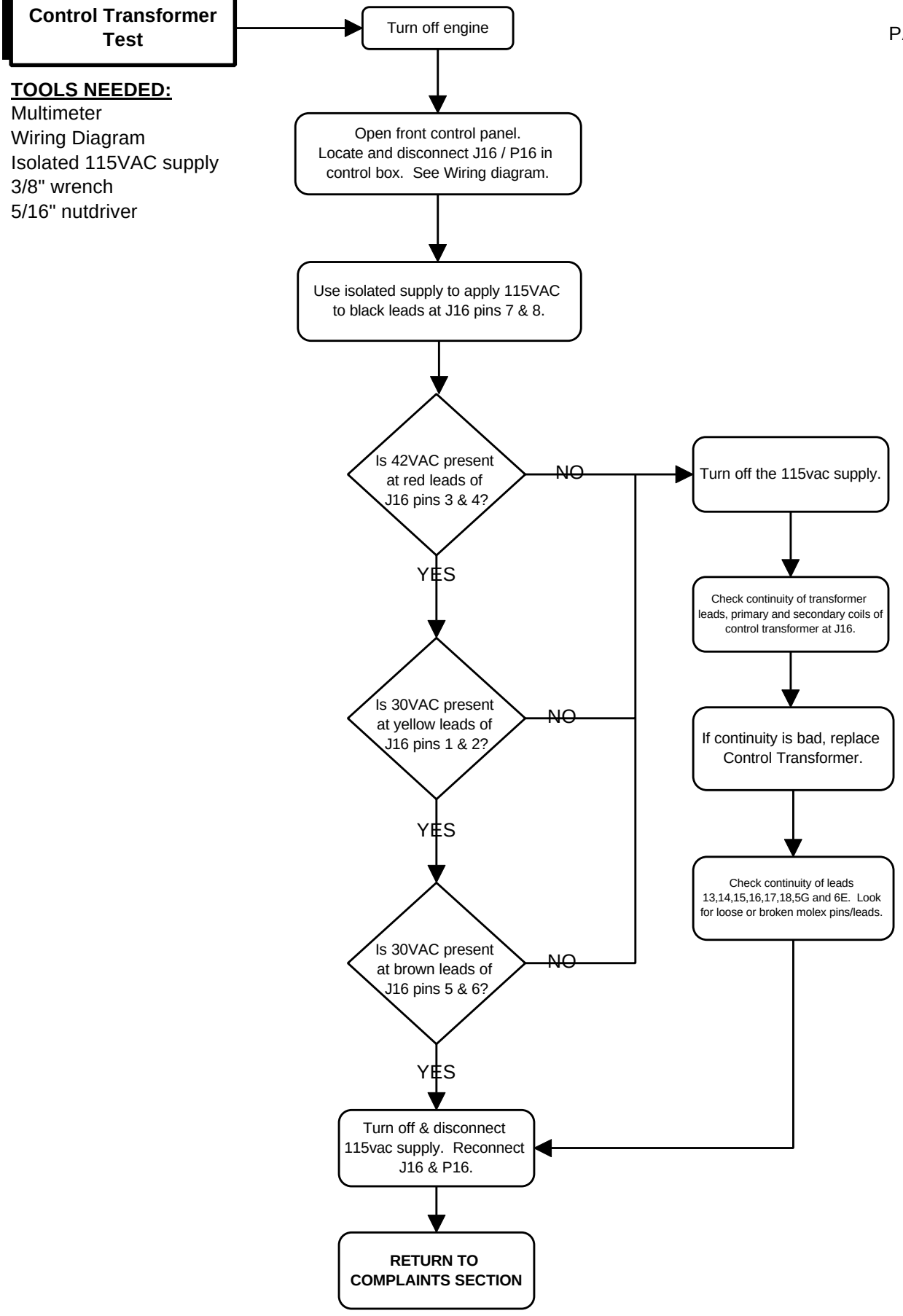
WARNING

OVERTORQUING OF BOLTS CAN CAUSE DAMAGE TO DEVICE. CONSULT TABLE 2 FOR PROPER TORQUE SPEC. COAT WITH THIN LAYER OF PENETROX BEFORE MOUNTING TO HEAT SINK

Control Transformer Test

TOOLS NEEDED:

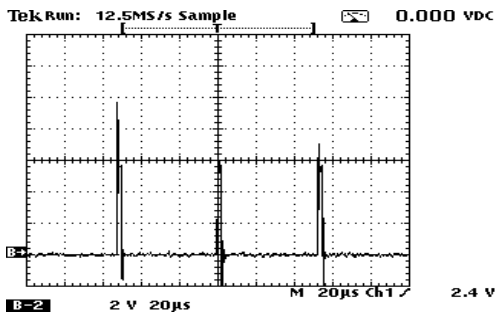
Multimeter
Wiring Diagram
Isolated 115VAC supply
3/8" wrench
5/16" nutdriver



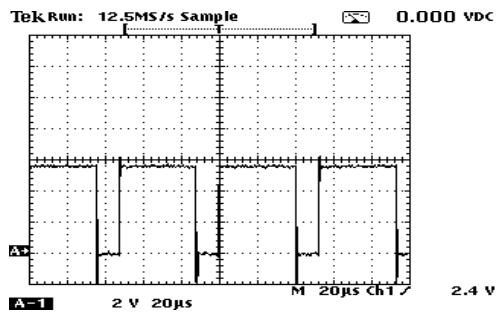
WELD TERMINAL SWITCH & PWM OUTPUT TEST

TOOLS NEEDED:

3/8" wrench
5/16" nutdriver
10" crescent wrench
wiring diagram
multi-meter w/ diode check
oscilloscope
load grid
ammeter(capable of 575a)



MIN POT



MAX POT

WARNING!!

HIGH VOLTAGES ARE PRESENT IN THE CONTROL BOX AND BEHIND THE OUTPUT PANEL WHILE THE MACHINE IS RUNNING. THESE VOLTAGES ARE HIGH ENOUGH TO KILL. USE CAUTION WHEN MAKING VOLTAGE MEASUREMENTS.

Turn off the engine. Open front control panel. Remove left & right side panels.

Start the engine.Set Weld Terminal Switch to the "Always On" position. In the CC mode, load the machine to 575a at 40 vdc.

Measure PWM waveforms at right side chopper bd from J13 pin 5 (probe) to pin 4 (gnd) and at left side chopper bd from J12 pin 5 (probe) to pin 4 (gnd). Make measurements at min and max pot on control dial.

Do both PWM waveforms match above waveforms?

NO

Measure voltage at control bd from J1 pin 6 (pos) to pin 3 (neg). Does voltage read approximately 1.1VDC?

NO

Turn off the engine.

Check continuity of leads 90, 91, 248,242, & Weld Terminal Sw. Look for loose or broken molex pins& connections.

Is continuity ok?

NO

Replace leads or switch as needed.

YES

Perform diode check at control bd from J1 pin 6(pos) to pin 3(neg).

Is diode drop ok?

NO

Replace control pc board.

YES

Replace engine protection pc board.

YES

Turn off the engine.

Check continuity of 23, 23A, 25, & 25A leads. Look for loose or broken molex pins/connections.

If continuity checks ok, replace Control pc board.

YES

Set the Weld Terminal Switch to the "Remotely Controlled" position. PWM waveform should go to zero.

Connect remote control to amphenol. Set the remote 2-4 switch to the "on" position.

Do both PWM waveforms match above waveforms?

NO

Turn off the engine.

Measure continuity of all 2 & 4 leads, & Amphenol RF Bypass pc board. Look for loose or broken molex connections

Is continuity ok?

NO

Replace leads or Bypass pc board as needed.

YES

Replace engine protection pc board.

YES

RETURN TO COMPLAINTS SECTION

RANGE SELECTOR SWITCH & CONTROL DIAL TEST

TOOLS NEEDED:
3/8" wrench
5/16" nutdriver
wiring diagram
multi-meter

WARNING!!
HIGH VOLTAGES ARE PRESENT IN THE CONTROL BOX WHILE THE MACHINE IS RUNNING. THESE VOLTAGES ARE HIGH ENOUGH TO KILL.USE CAUTION WHEN MAKING VOLTAGE MEASUREMENTS.

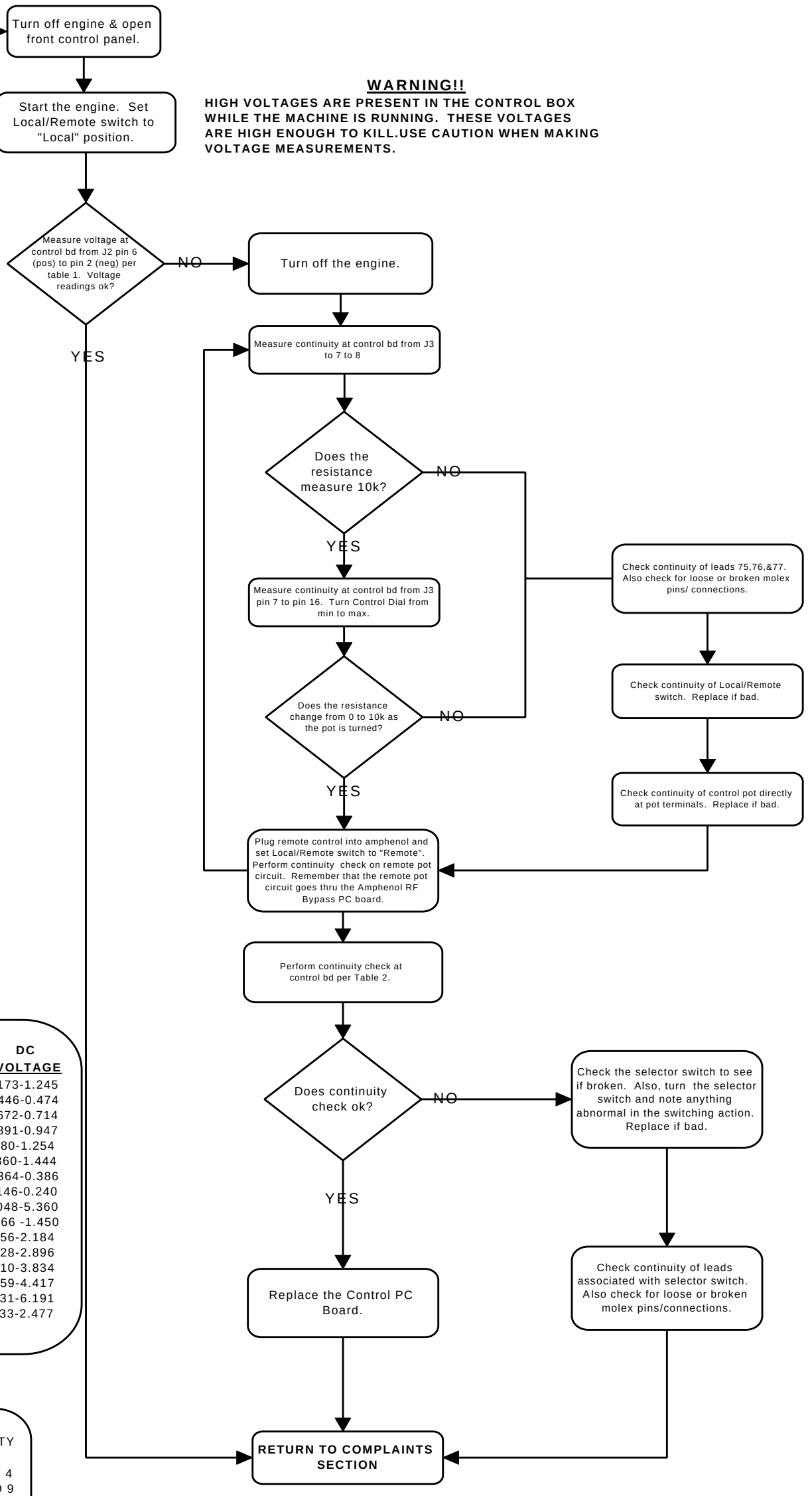


TABLE 1

CONTROL DIAL POSITION	RANGE SEL. SW POSITION	DC VOLTAGE
MIN	CV	1.173-1.245
MIN	90A	0.446-0.474
MIN	150A	0.672-0.714
MIN	250A	0.891-0.947
MIN	350A	1.180-1.254
MIN	500A	1.360-1.444
MIN	CC	0.364-0.386
MIN	TIG	0.146-0.240
MAX	CV	5.048-5.360
MAX	90A	1.366 -1.450
MAX	150A	2.056-2.184
MAX	250A	2.728-2.896
MAX	350A	3.610-3.834
MAX	500A	4.159-4.417
MAX	CC	5.831-6.191
MAX	TIG	2.333-2.477

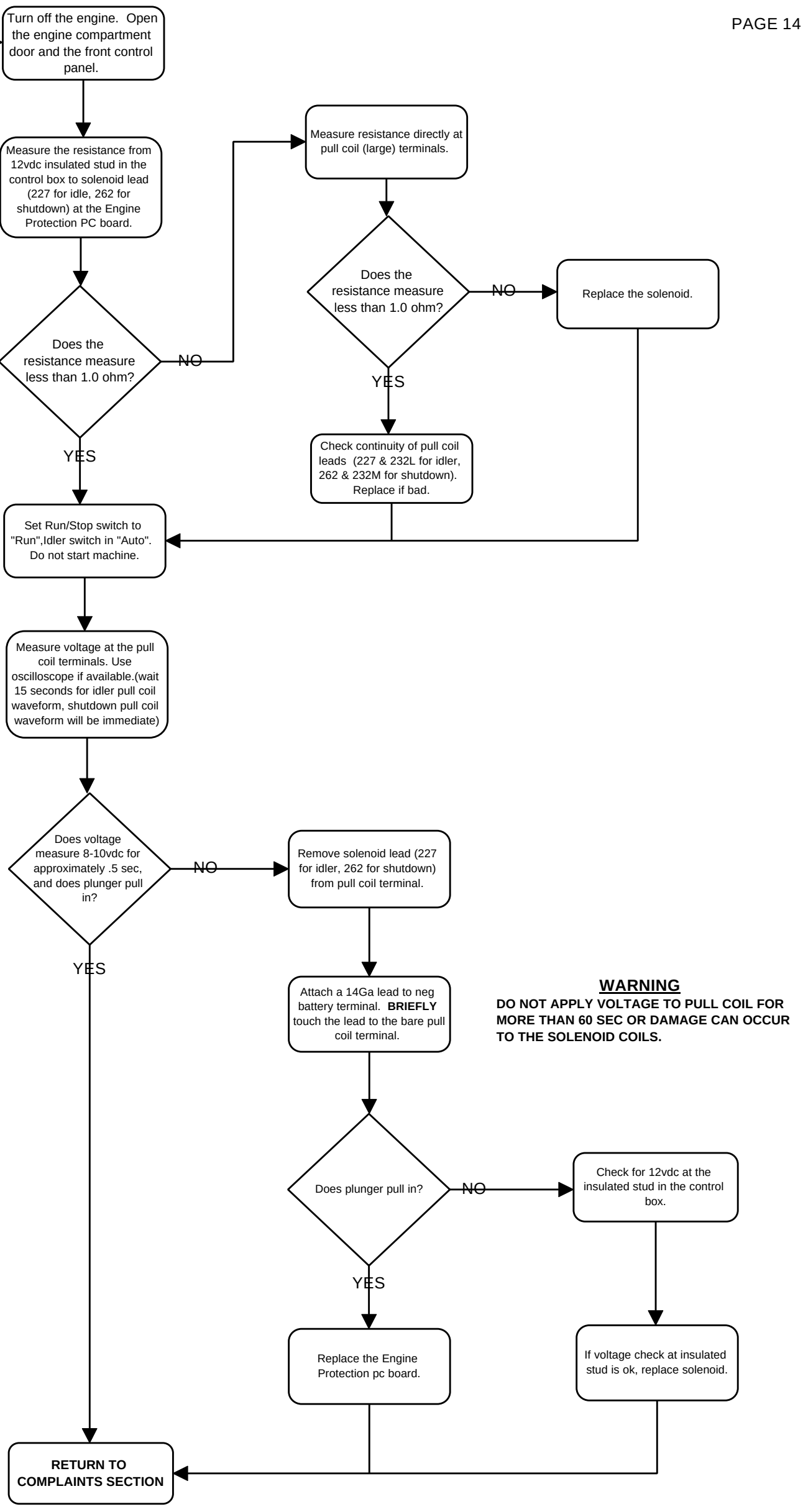
TABLE 2

RANGE SEL. SW POSITION	CONTINUITY FROM:
CV	J4 PIN 1 TO 4
90A	J4 PIN 1 TO 9
150A	J4 PIN 1 TO 6
250A	J4 PIN 1 TO 2
350A	J4 PIN 1 TO 5
500A	J4 PIN 1 TO 7
CC	J4 PIN 1 TO 8
TIG	J4 pin 1 TO 10

SOLENOID PULL COIL TEST

TOOLS NEEDED

3/8" wrench
5/16" nutdriver
multi-meter
48" 14 ga wire
wiring diagram



WARNING

DO NOT APPLY VOLTAGE TO PULL COIL FOR MORE THAN 60 SEC OR DAMAGE CAN OCCUR TO THE SOLENOID COILS.

SOLENOID HOLD COIL TEST

TOOLS NEEDED
3/8" wrench
5/16" nutdriver
multi-meter
wiring diagram
48" 18ga wire