



**DS 350 G
Boom Control**

Troubleshooting Manual
TM 9150

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1. General Information

The DS 350 load moment indicator (LMI) with boom control extension is designed to aid the crane operator through the crane operations. The DS 350 with boom control extension is not, and shall not, be a substitute for good operator judgment, experience and use of accepted safe crane operating procedure.

2. Reference Material

Parts & Installation Manual:

PAT- Part number
031-300-150-651

Grove- Part number
9-333-102985

Operator's Handbook :

PAT- Part number
GW5SEC9150

3. Warnings

The DS 350 load moment indicator (LMI) with boom control extension is an operational aid that warns the crane operator when he approaches an overload condition, a two block condition and an out of boom sequence condition. The boom control extension controls the sequence of the boom during operation. It still remains the operator's responsibility to verify the operation and to select the correct mode during crane operations.

The manual mode is a rigging mode. Lifting loads with manual mode programmed is prohibited.

Should an out of sequence condition occur, the crane operator is responsible to select manual mode to return the sections into sequence before continuing the lift.

The responsibility for safe crane operation shall remain with the crane operator who shall ensure that all warnings and instructions supplied are fully understood and observed.

Prior to operating the crane, the operator must carefully and thoroughly read and understand the information provided by the crane and load moment indicator manufacturer.

Proper functioning depends upon proper daily inspection and observance of the operating instructions provided with the crane and load moment indicator.



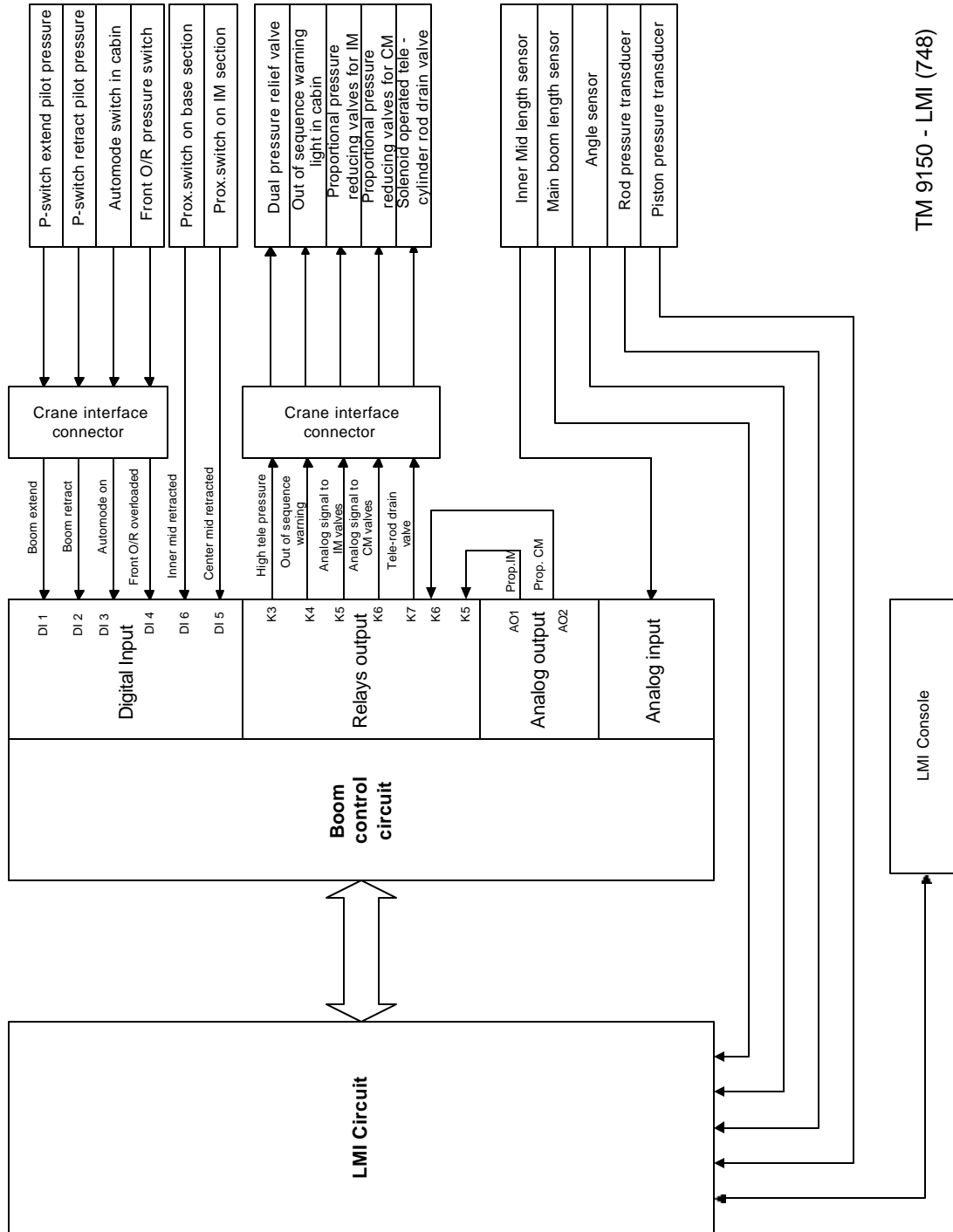
4. Service and Maintenance

Daily maintenance of the load moment indicator consists of inspecting:

1. The electrical wiring connecting the various parts of the system.
If electrical wiring is damaged, it shall be replaced immediately.
2. If the insulation is worn on the length sensor cable or cable guides are damaged, these parts shall be replaced.
3. Check the anti two-block limit switches for freedom of movement.
4. The cable reel shall be under tension to operate properly.
5. Check the pressure transducers at the hoist cylinder(s) and the connecting hoses for oil leakage.

Other than correcting the problems identified in the Malfunctions Table and replacing faulty mechanical parts and cables, no other repairs shall be performed by non expert personnel.

5. Boom Control Interface



Drawing 1.

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*Auto mode / Manual mode:*

The operator selects auto mode or manual mode using the rocker switch in the dash board. Auto mode is the working mode and manual mode is used for rigging or sequencing purpose only.

Pilot pressure switch signal / Analog output signal:

Two pressure switches in the pilot pressure circuit are used to distinguish between boom extend or boom retract. The two circuits are wired through the crane interface connector into the DS 350 G central unit.

When the operator extends the boom, the pressure switch signal at central unit terminal A101-X1/38 changes from 0V to 12V. The boom control logic allows electrical current to flow to the pressure reducing valve coil for the appropriate section to extend. The minimum current equals 0 mA with the control in neutral position. The maximum current output equals 1200 mA.

To measure the coil current for the inner mid section while extending, remove wire #12 from central unit terminal A101-X1/63. Connect the Amp-meter in series with wire # 12 to terminal X1/63.

To measure the coil current for the center mid section while extending, remove wire #10 from central unit terminal A101-X1/66. Connect the Amp-meter in series with wire # 10 to terminal X1/66.

While the operator retracts the boom, the pressure switch signal at central unit terminal A101-X1/40 changes from 0V to +12V. The boom control logic allows electrical current to flow to the pressure reducing valve coil for the appropriate section to retract. The minimum current equals 0 mA with the control in neutral position. The maximum current output equals 1200 mA.

To measure the coil current for the inner mid section while retracting, remove wire #13 from central unit terminal A101-X1/64. Connect the Amp-meter in series with wire # 13 to terminal X1/64.

To measure the coil current for the center mid section while retracting, remove wire #11 from central unit terminal A101-X1/67. Connect the Amp-meter in series with wire # 11 to terminal X1/67.

*Length sensors:*

Two length sensors are mounted to the boom base section to measure the overall length and the inner mid section length. The software utilizes the signals to calculate the center mid, outer mid and fly section length.

With retracted main boom the overall boom length signal is -500mV (A101-X1/10). Use the test pin MP 15 (AGND) or terminal A101-X1/8 (AGND) for reference ground.

With retracted main boom the inner mid section length signal is -500mV (A101-X1/73). Use the test pin MP 15 (AGND) or terminal A101-X1/8 (AGND) for reference ground.

Keep the cable on the length transducer drum spooled properly. A poorly spooled cable may causes the boom to become out of sequence. If the boom becomes out of sequence, select manual mode and correct the length by operating individual sections. Once the sections are sequenced again the operator may return to the automode. Refer to section 9.1 for boom components installation and set up.

Inner mid retract and % reset switch:

The proximity switch on the base section provides a (+12V) signal to central unit terminal A 104 X1/80 when the inner mid section is retracted. The signal resets the inner mid percentage to 0%.

Center mid retract and % reset switch:

The proximity switch on the inner mid section provides a (+12V) signal to central unit terminal A 104 X1/80 when the center mid section is retracted. The signal resets the center mid percentage to 0% and enables the rated load chart for retracted boom.

*Digital inputs:*

DI #	Description	Central Unit Terminal	Signal (DI=on)
1	Pressure switch - boom extend GND	A101 - X1/38 A101 - X1/37	+12 V 0V
2	Pressure switch - boom retract GND	A101 - X1/40 A101 - X1/39	+12V 0V
3	Automode switched on GND	A101 - X1/42 A101 - X1/41	+12V 0V
4	Positive voltage supply for DI 4 Front outrigger overload -pressure switch	A101 - X1/76 A101 - X1/75	+12V 0V
5	Center mid retract and % reset switch GND	A101 - X1/78 A101 - X1/77	+12V 0V
6	Inner mid retract and % reset switch GND	A101 - X1/80 A101 - X1/79	+12V 0V

*Relay outputs:*

Relay	Fuse	Description	Central Unit Terminal	Signal
K1	F2	not used not used		
K2	F3	not used not used		
K3	F4	High tele pressure on - refer to table below GND	A101 - X1/57 A101 - X1/3	+12V 0V
K4	F5	Tele out of sequence - Warning light in cabin GND	A101 - X1/61 A101 - X1/3	+12V 0V
K5	F6	Signal from IM analog output board	A101 - X1/62	0-1200mA
K5		Directs the analog signal to IM extend valve	A101 - X1/63	0-1200mA
K5		Directs the analog signal to IM retract valve	A101 - X1/64	0-1200mA
K6	F7	Signal from CM analog output board	A101 - X1/65	0-1200mA
K6		Directs the analog signal to CM extend valve	A101 - X1/66	0-1200mA
K6		Directs the analog signal to CM retract valve	A101 - X1/67	0-1200mA
K7	F8	Tele rod drain valve - prevents tele creeping GND	A101 - X1/69 A101 - X1/3	+12V 0V
K8	none	Internal LMI use (overload, error)	A101 - X1/44	+ 12V
K9	none	Internal LMI use (A2B)	A101 - X1/46	+ 12V
K10	external	Motion cut (Bosch relay)	A101 - X1/48	+ 12V

*High tele pressure*

Relay K3 in the central unit controls the high tele pressure valve in the hydraulic circuit.

Mode	Boom	Pressure	Relay K3	Pressure	Relay K3	Pressure	Relay K3
Auto	Extend	IM	A101-X1/57	CM	A101-X1/57	OM	A101-X1/57
		Low	0V	Low	0V	High@ <4% extended	12 V @ <4% extended
Auto	Retract	High	12V	High	12V	High	12V
Manual	Extend	Low	0V	Low	0V	Low	0V
Manual	Retract	High	12V	High	12V	High	12V

Note: IM = inner mid section
 CM = center mid section
 OM = outer mid section

Tele rod drain relay K7:

Relay K7 controls the rod side dump valve. K 7 energizes when the boom is extending or retracting and not fully retracted already. K7 de-energizes when the controller is in neutral position or in retract position but the boom is fully retracted.

Controller	Relay K7 A101 x1/ 69
Extend on	+12V
Retract on	+12V
Neutral	0V
Retracted/ retract on	0V



6. Boom Sequence

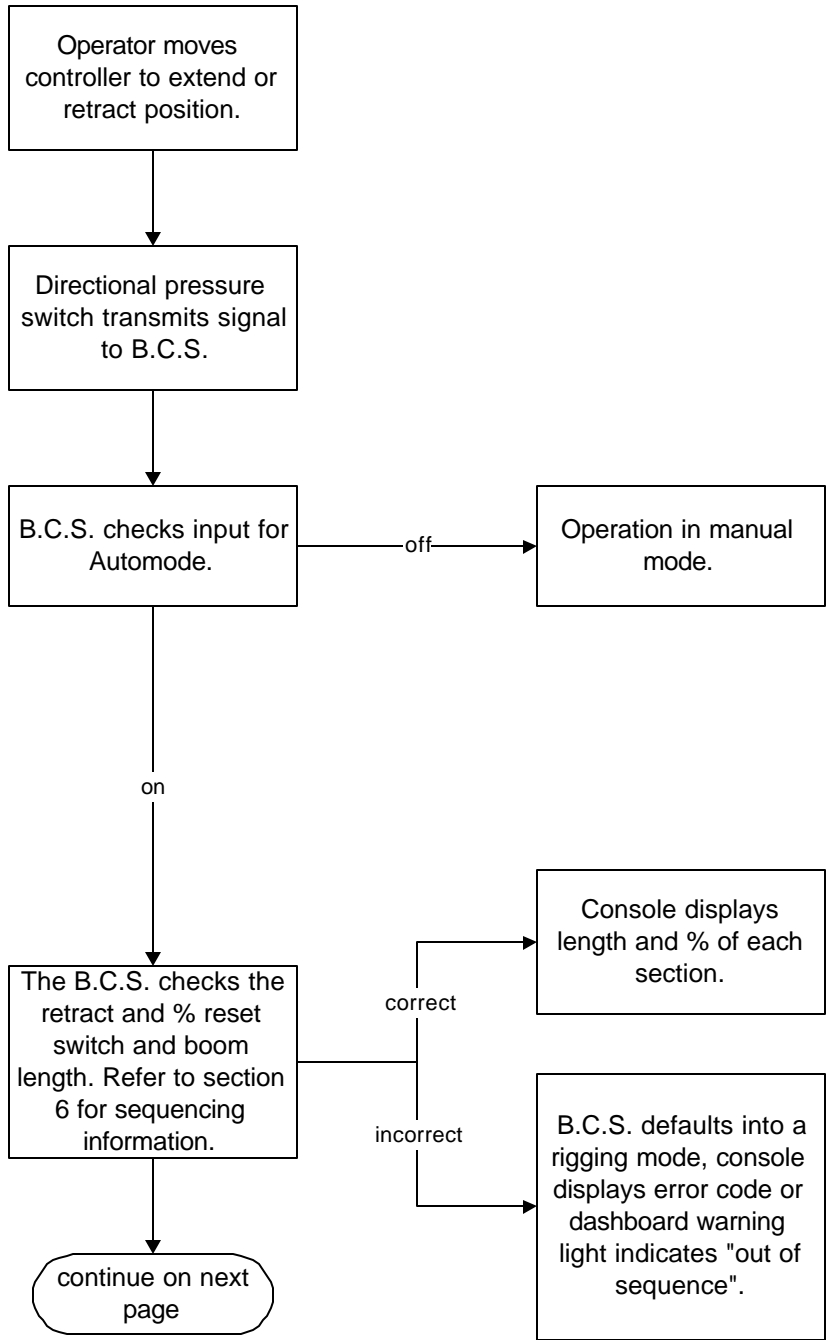
Main Boom:

Mode	IM %	CM %	OM %	FLY %
Auto	0	0	0	0
Auto	75	50	0	0
Auto	75	75	0	0
Auto	100	75	0	0
Auto	100	100	0	0
Auto	100	100	100	100

Extensions:

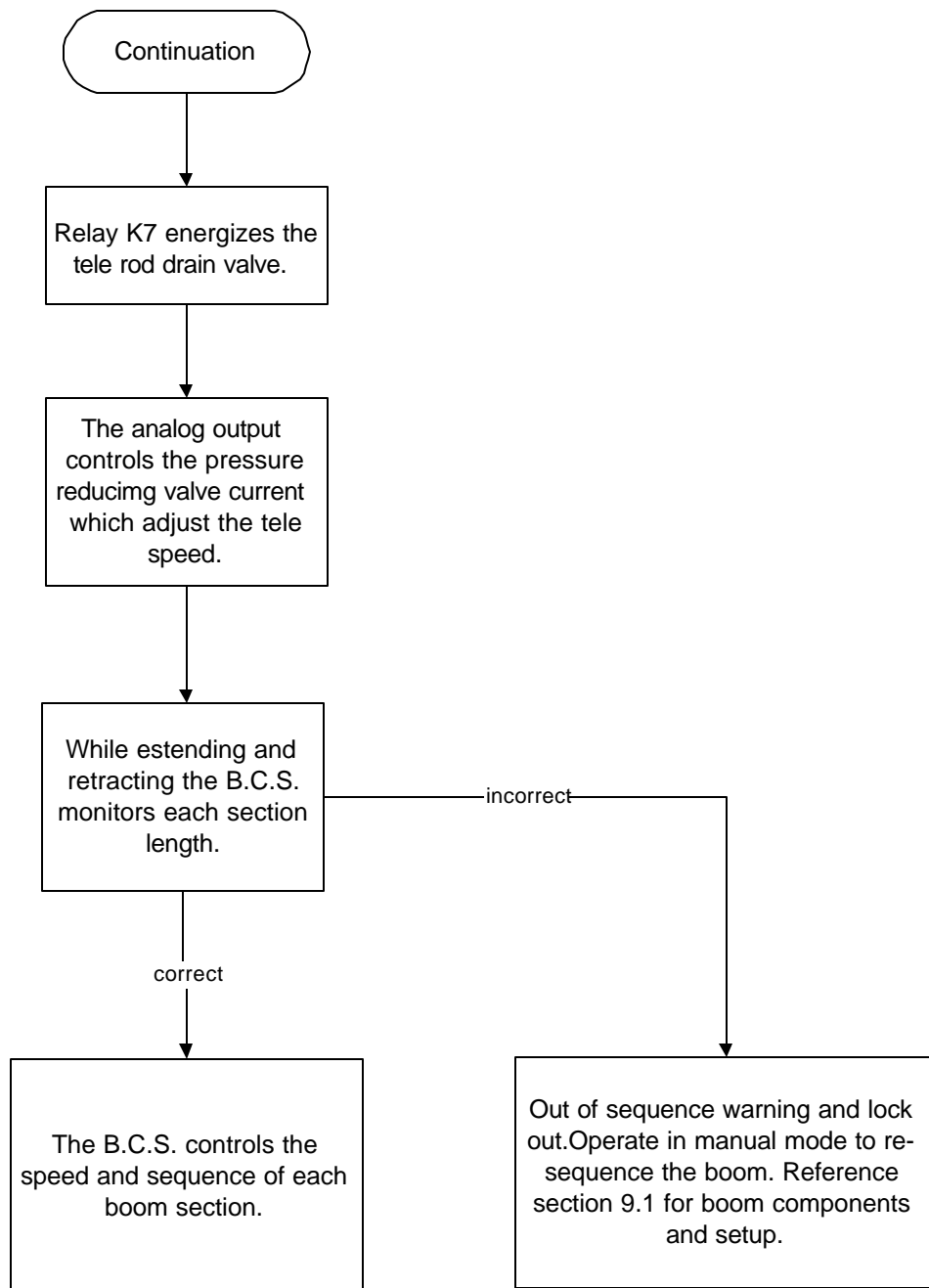
Mode	IM %	CM %	OM %	FLY %
Auto	0	0	0	0
Auto	100	0	0	0
Auto	100	100	0	0
Auto	100	100	100	100

7. Boom Control Flowchart



Drawing 2.a

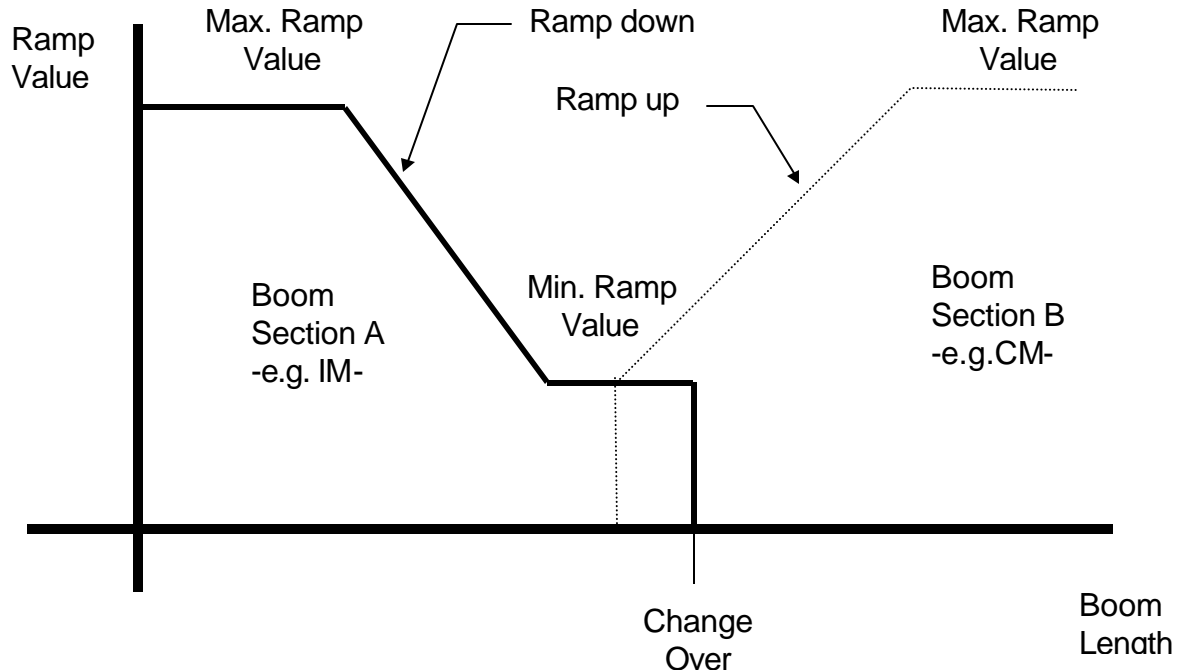
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Drawing 2.b

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8. Ramping

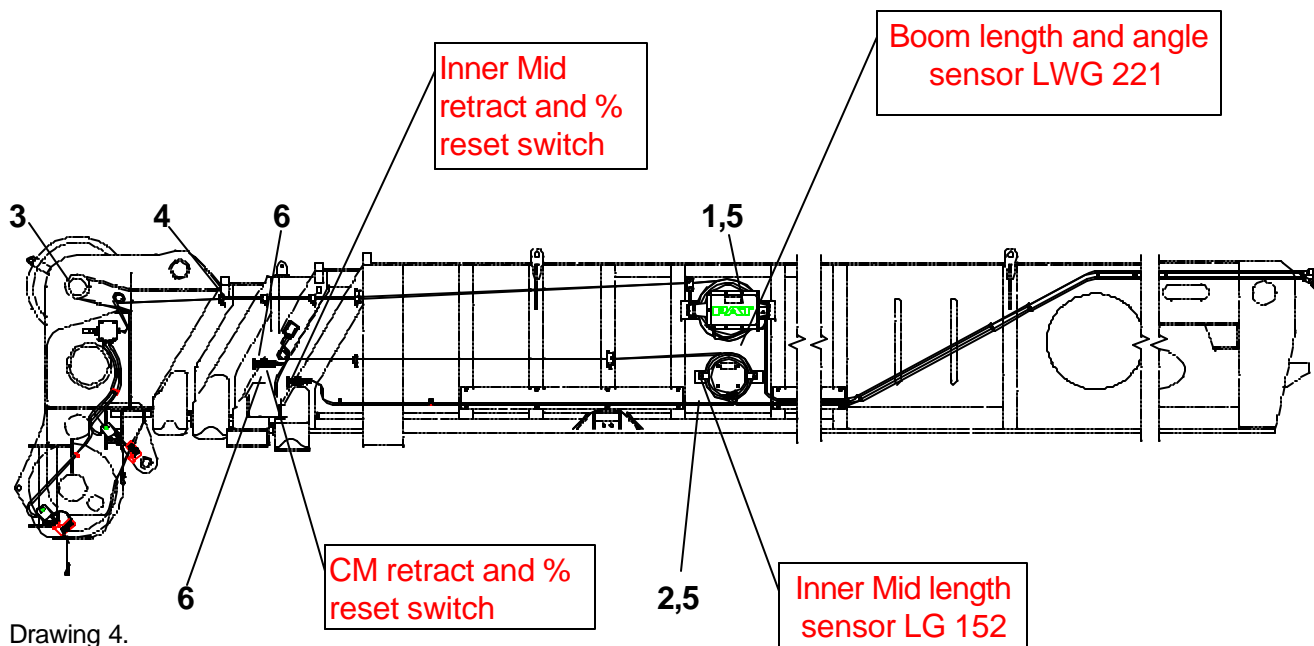


Drawing 3.

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- Ramp value: A hex value in the software which determines the output current to the proportional valve.
- Max. ramp value: The maximum hex value (hex 255) equals to 1200 mA valve (pressure reducing valve). This current is required to open the valve for maximum tele speed.
- Min. ramp value: The minimum hex value that is required to move a section in the ramping area. These values may differ for each ramping area.
- Change over: The previous section comes to a complete stop and the next section ramps up (accelerates speed).
- Overlapping: The next section ramps up (accelerates speed) before the previously moved section completely stops. Overlapping begins 2% prior to the change over point.
- IM: Inner Mid Section
- CM: Center Mid Section
- OM/Fly: Outer Mid Section & Fly

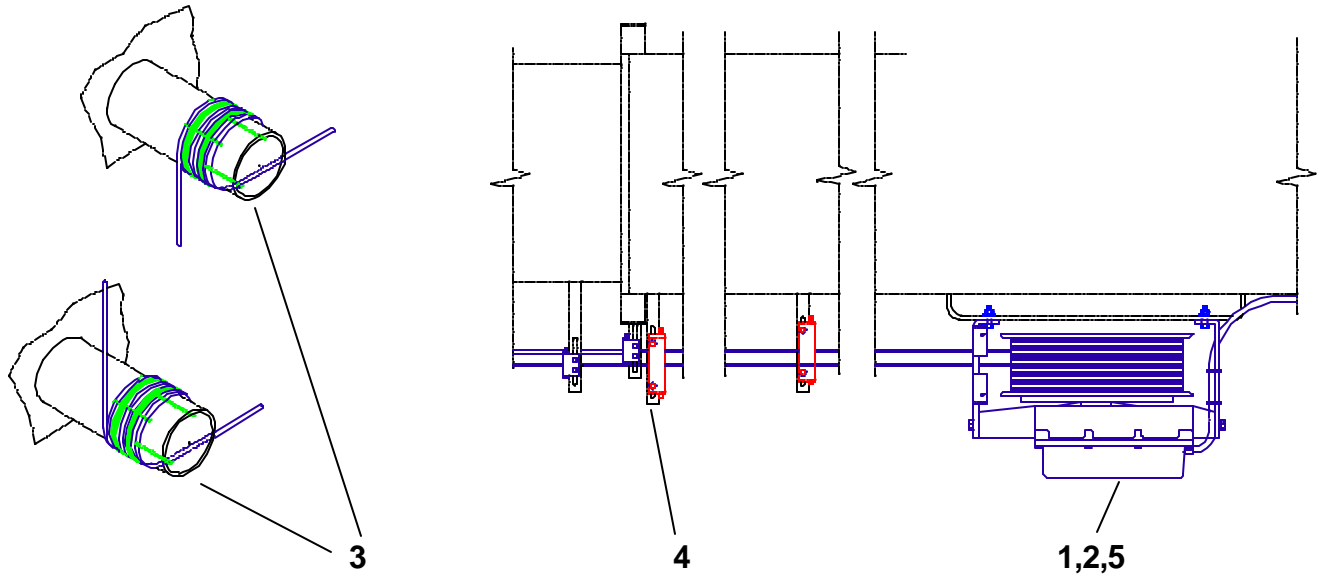
9.1 DS 350 G - Boom Components and Setup



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Setup:

1. Pre-tension cable reel spring by rotating drum (6) revolutions counter clockwise. If replacing the LWG 221 unspool the length cable and secure to bushing on the boom nose as noted in the installation drawing. Zero the length potentiometer as described on page 18.
2. Pre-tension cable reel spring by rotating drum (1) revolutions counter clockwise. If replacing the LG 152 unspool the length cable and secure to bushing on the boom nose as noted in the installation drawing. Zero the length potentiometer as described on page 18.
3. Place (3) tie wraps, 120 degrees apart around bushing. Wrap cable (8 to 10) revolutions over the tie wraps starting from the outside and working inward. Allow ample cable to reach the junction box. Secure cable with (2) additional tie wraps.
4. Remove 1/4-20 nuts on bottom of cable guide, insert cable guide screws through existing angle bracket and secure in place with 1/4-20 nuts removed previously.
5. On a regular basis inspect the chemical moisture pack. If required replace the pack. Remove protective paper from the moisture pack and adhere to inside surface of length sensor or length angle sensor cover.
6. Check proximity switch installation (0.44 inch from target) when boom sections are fully retracted.

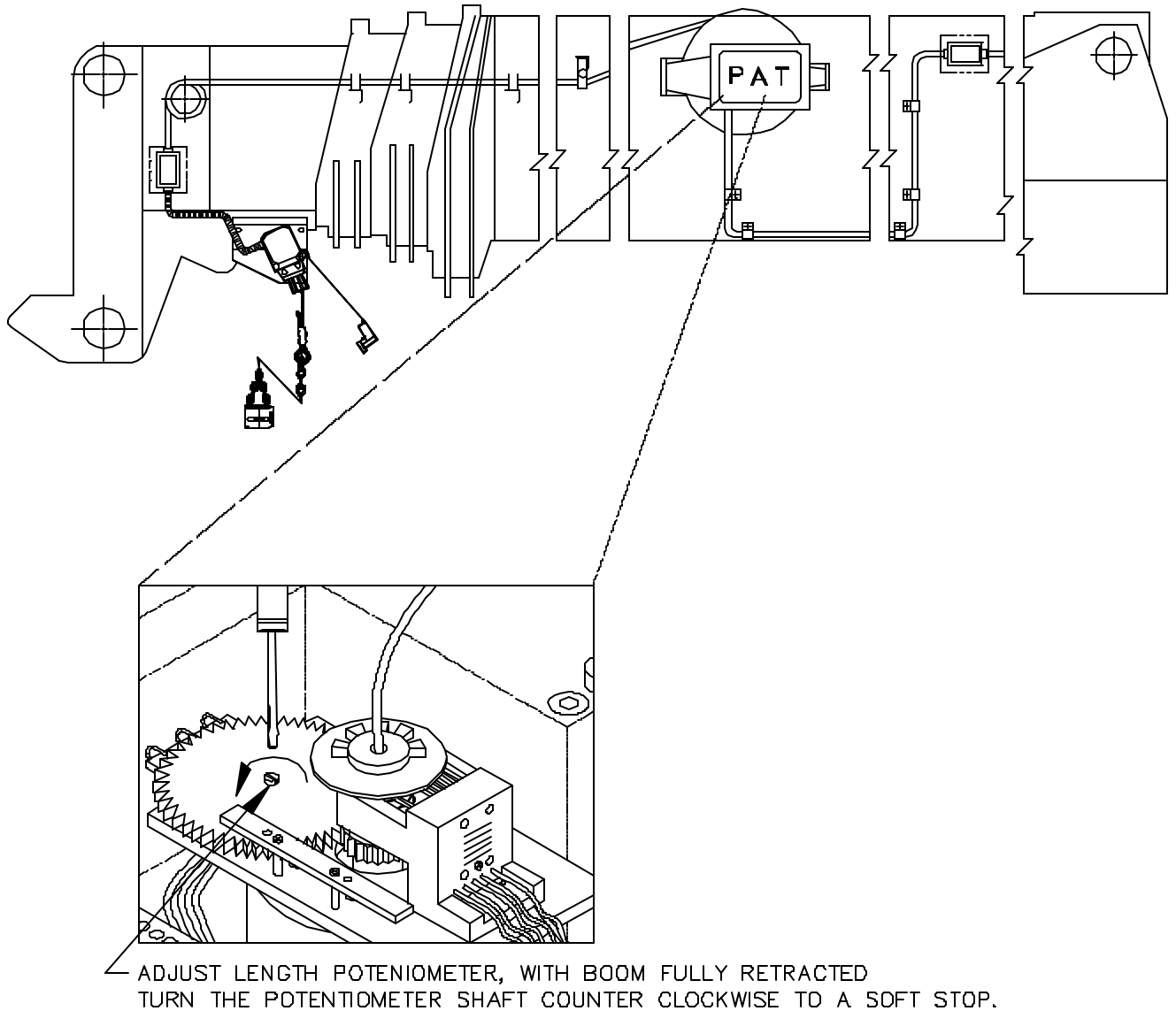


Note: For setup information refer to page 13.

Drawing 5.

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9.2 Length Transducer Adjustment

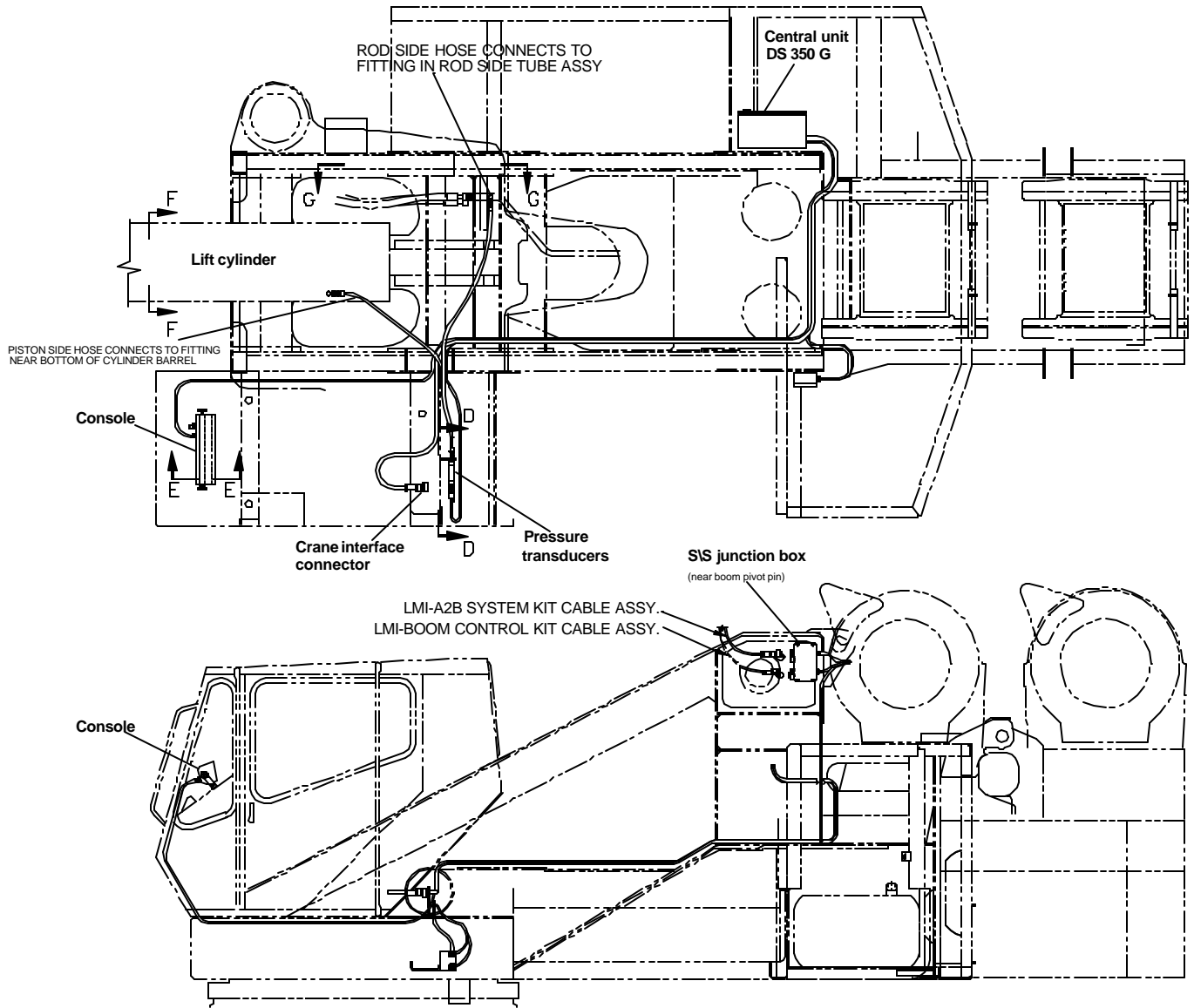


Drawing 6.

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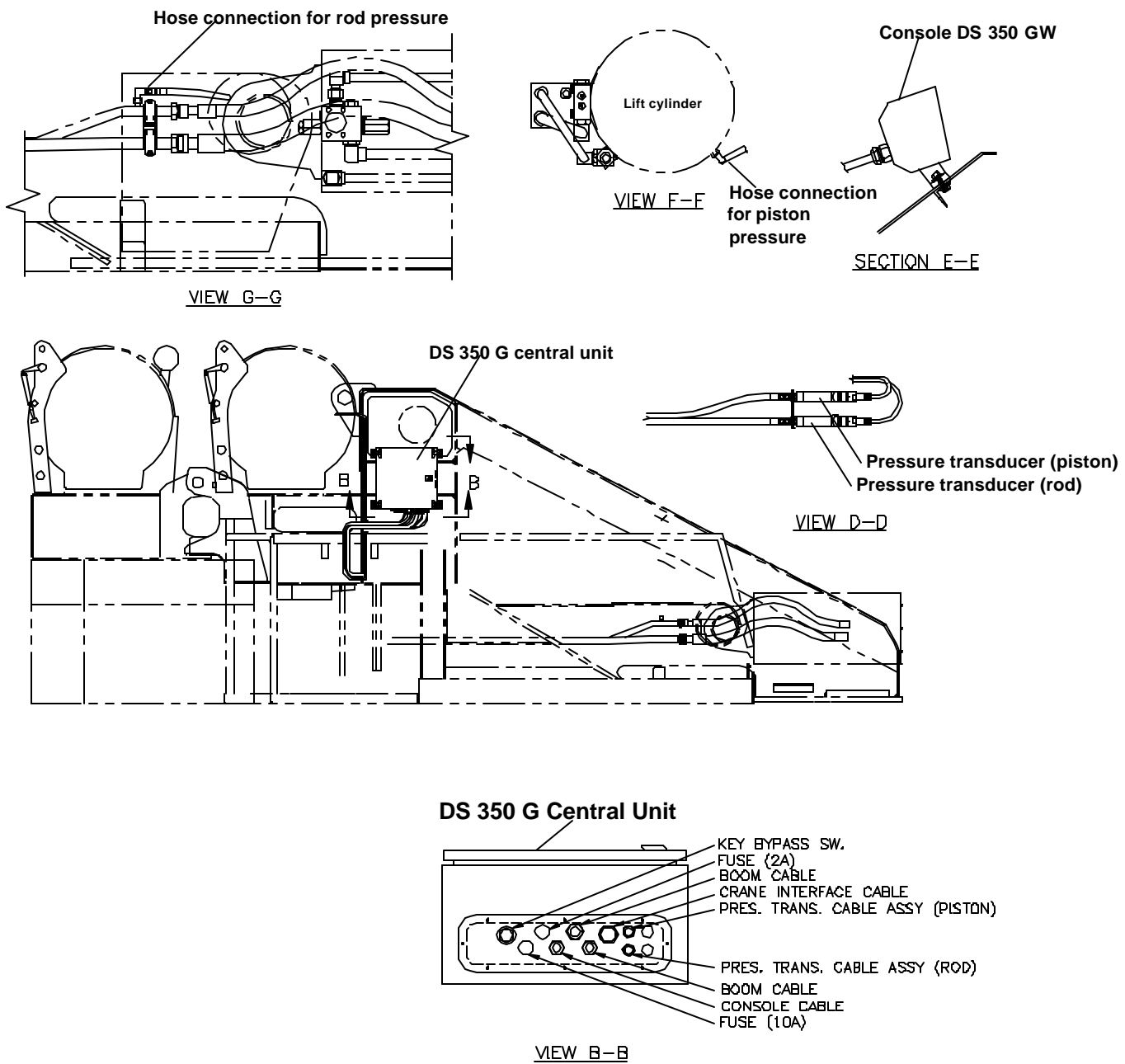


9.3 DS 350 G Turntable Components



Drawing 7.

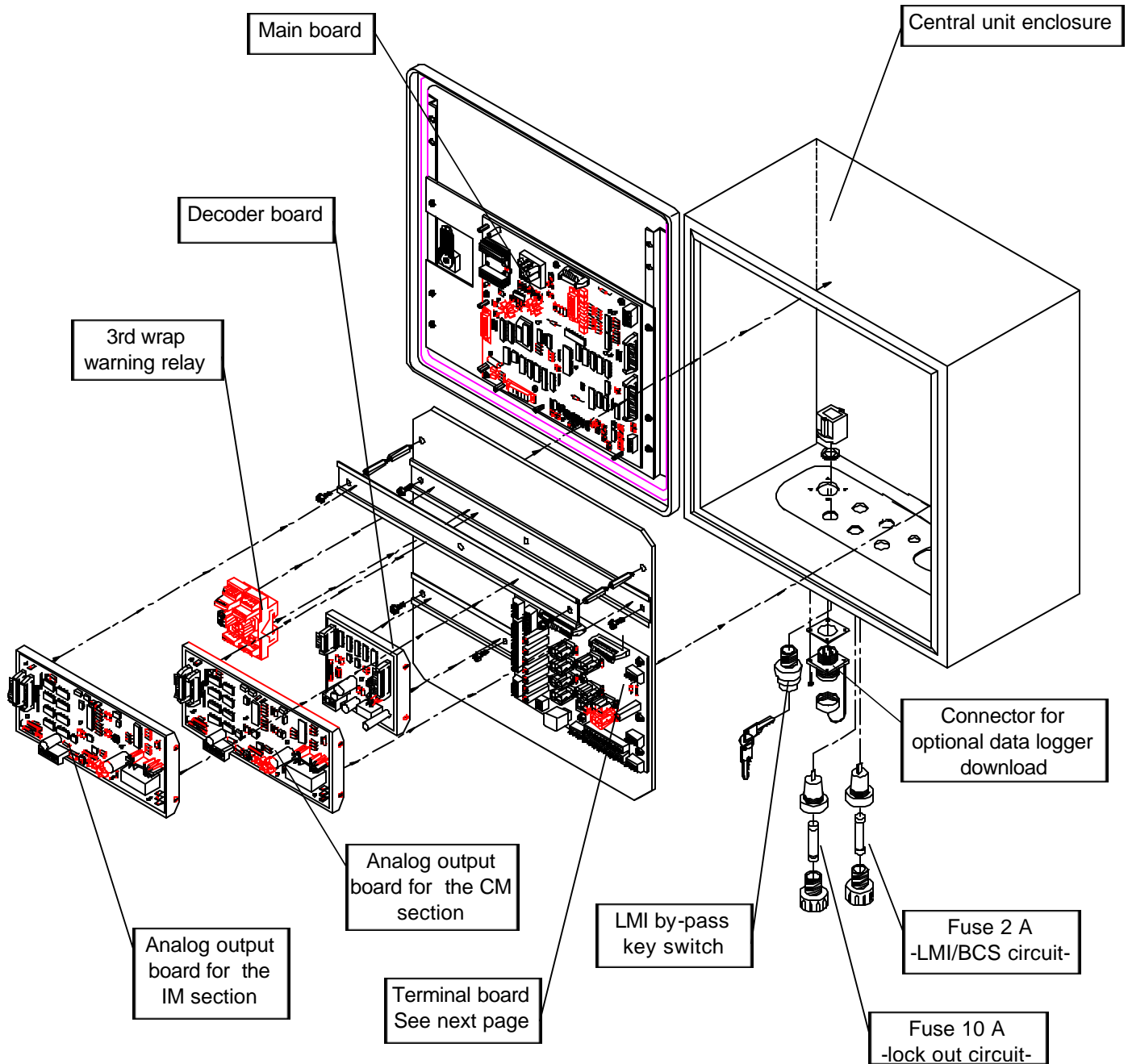
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Drawing 8.

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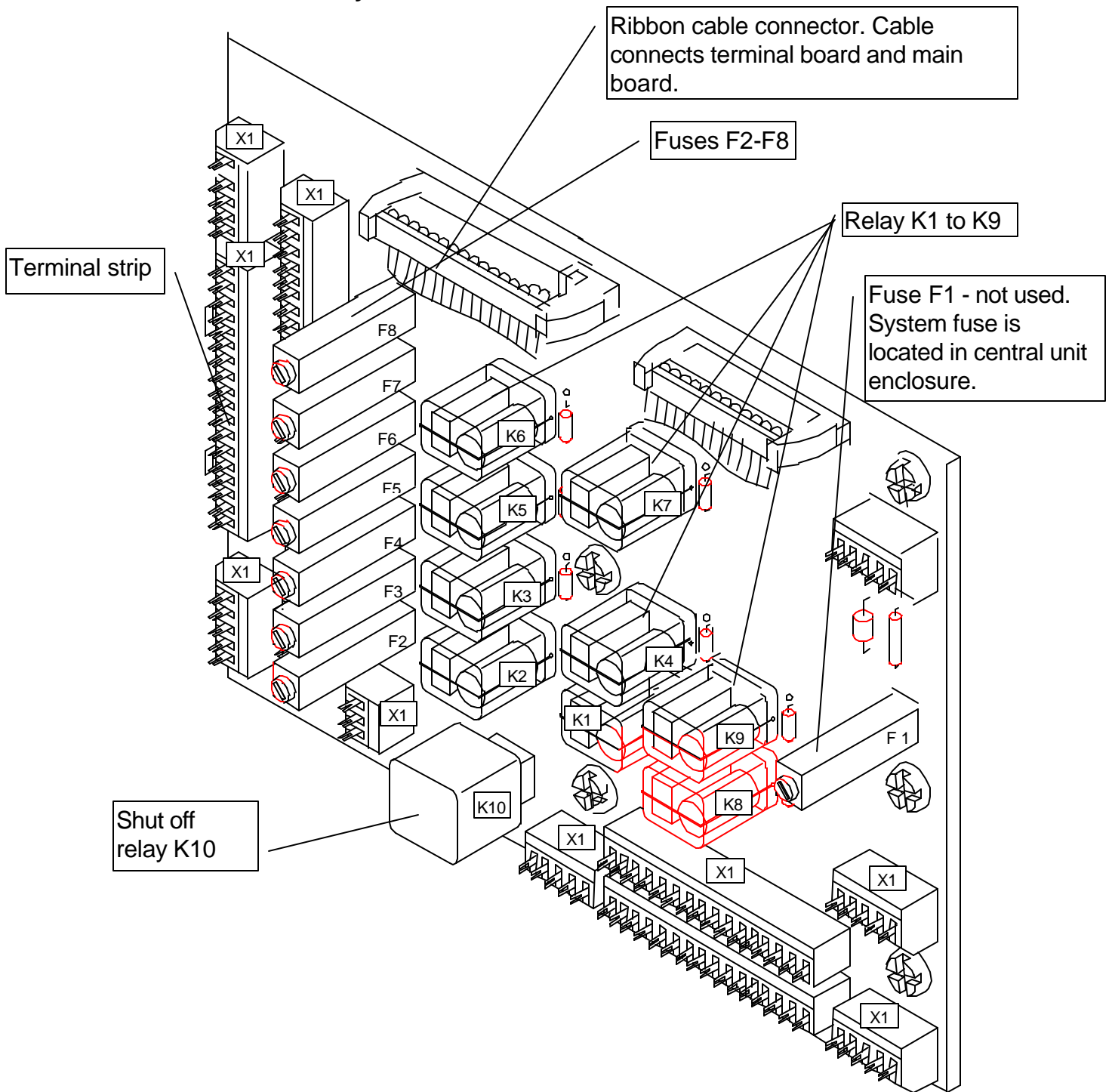
10.1 DS 350 G Central Unit Assembly - Layout



Drawing 9.

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

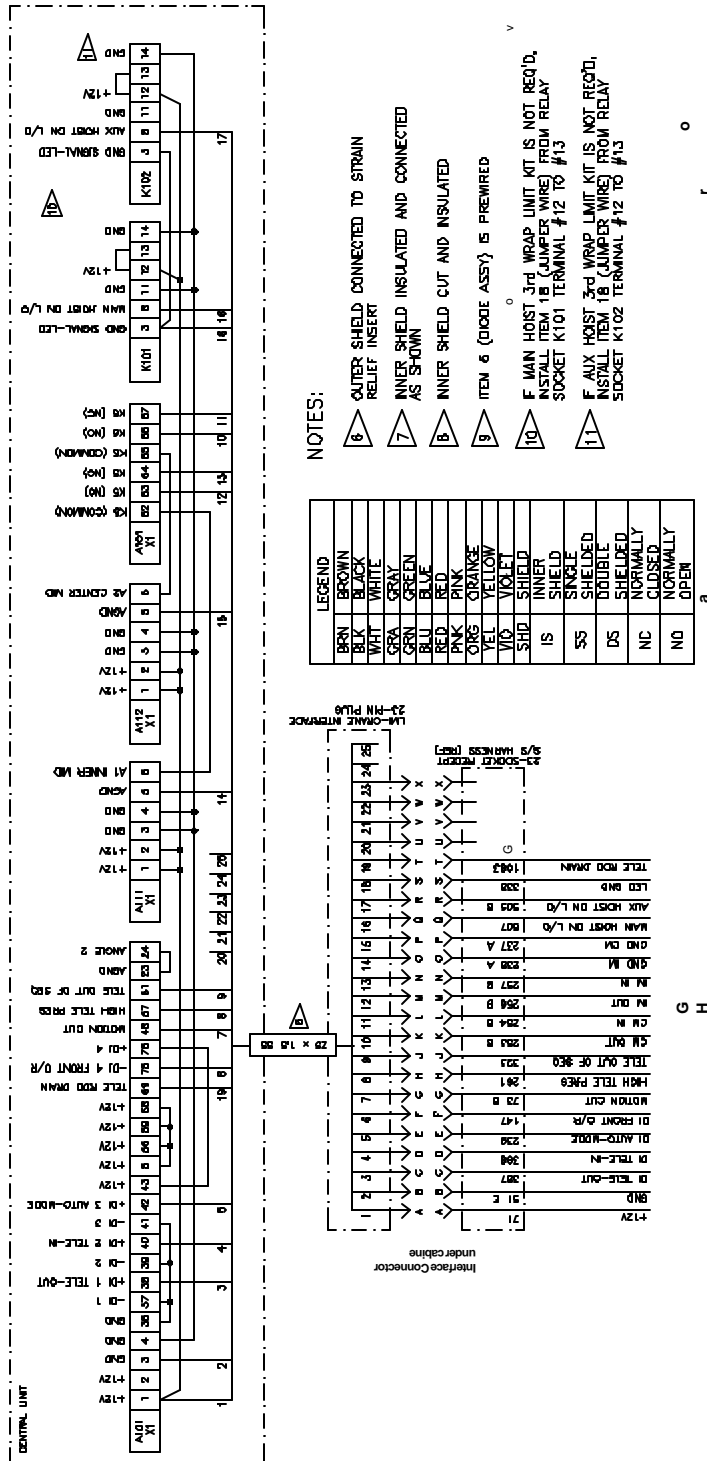
10.2 Terminal Board Layout



Drawing 10.

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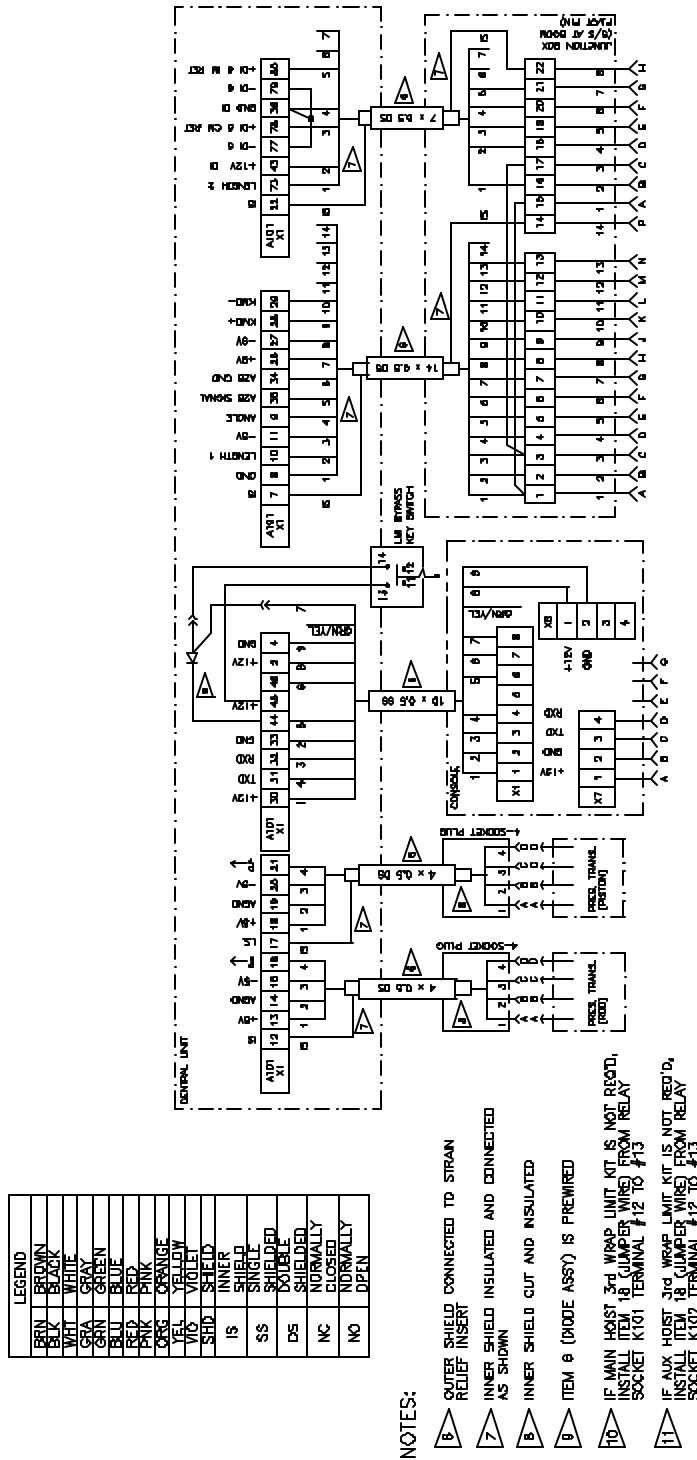
11.2 DS 350 G - LMI/ Crane Interface Wiring



Drawing 12.

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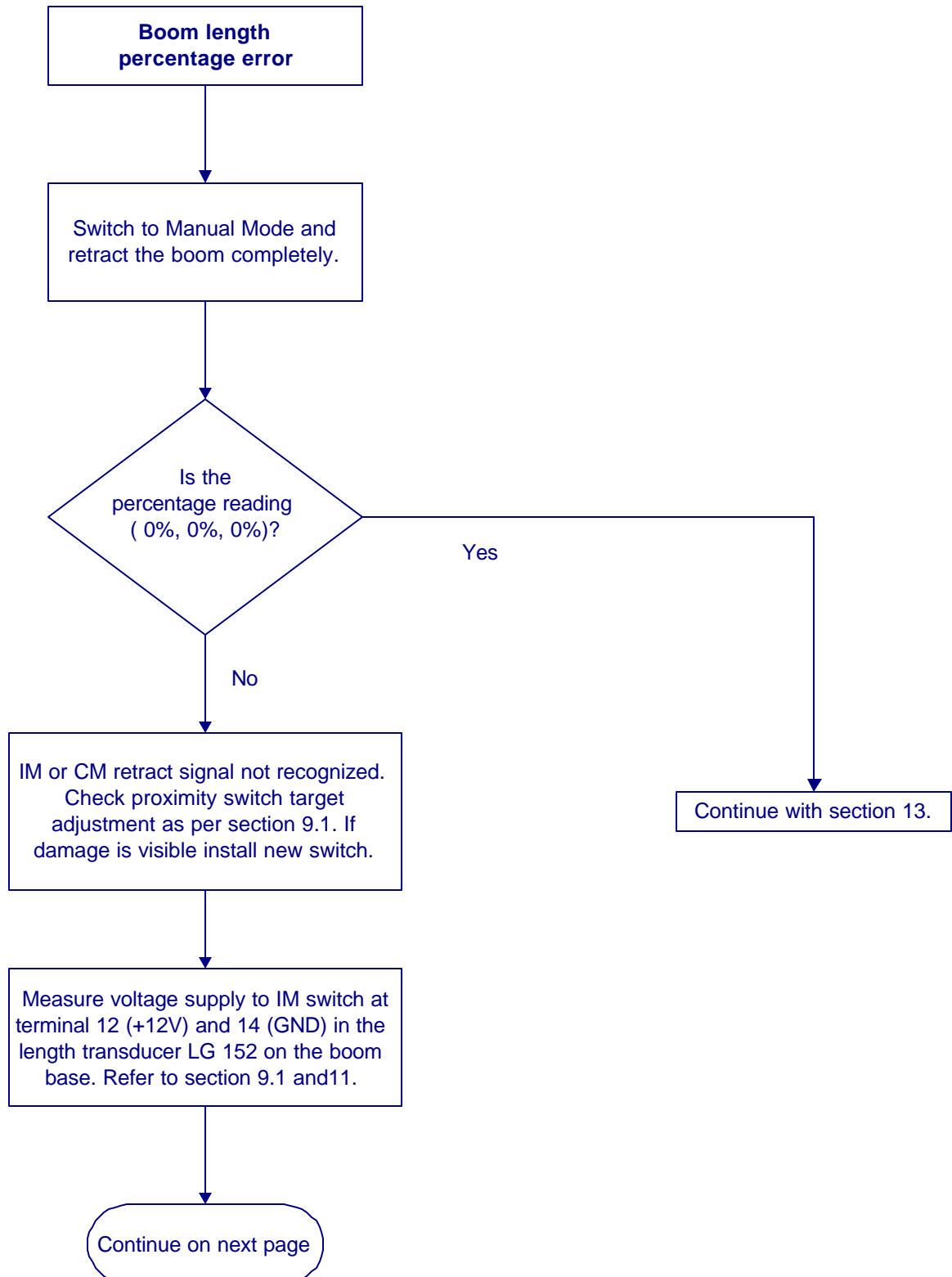
11.3 DS 350 G - LMI/ Turn Table Wiring



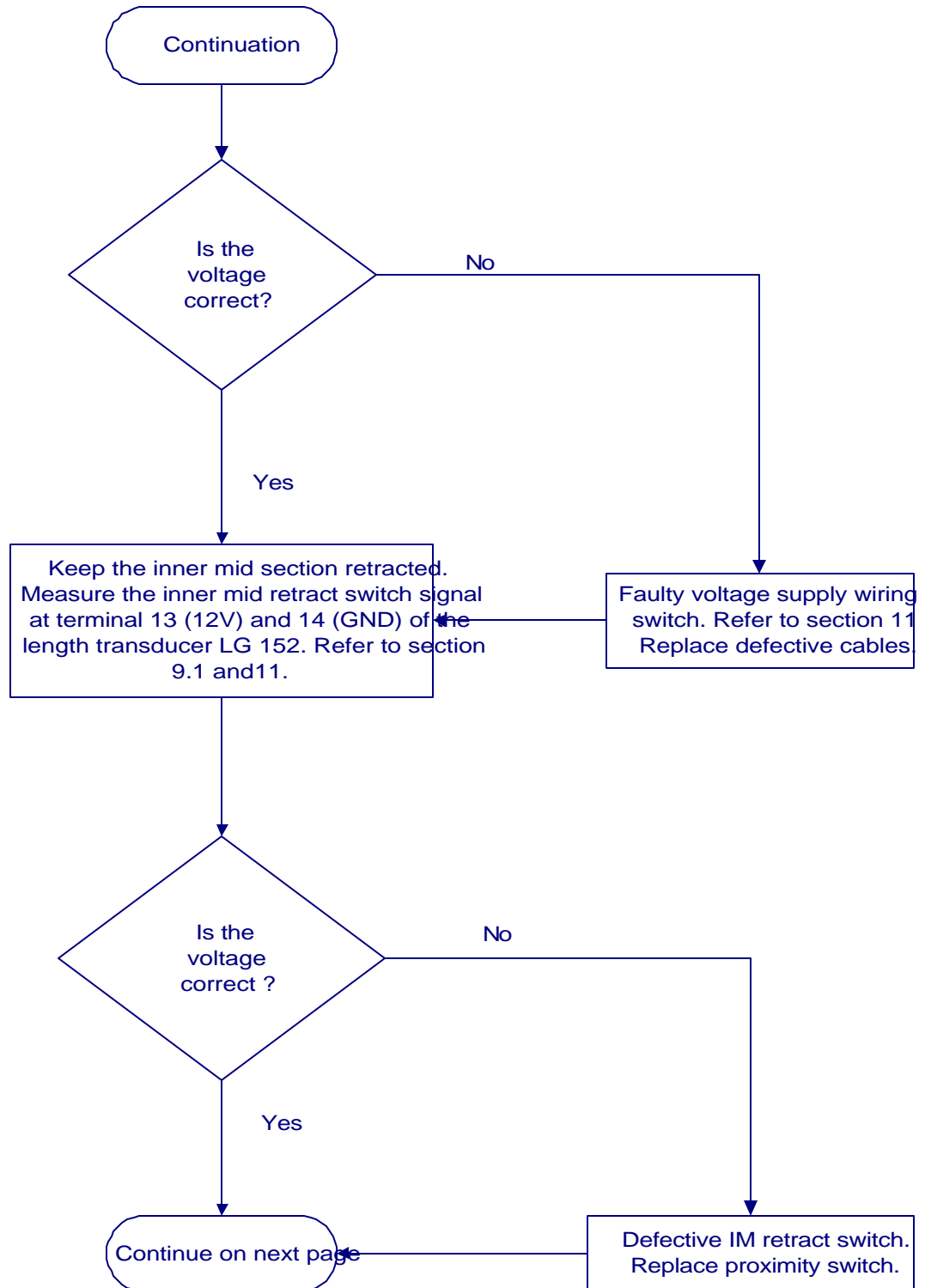
Drawing 13.

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

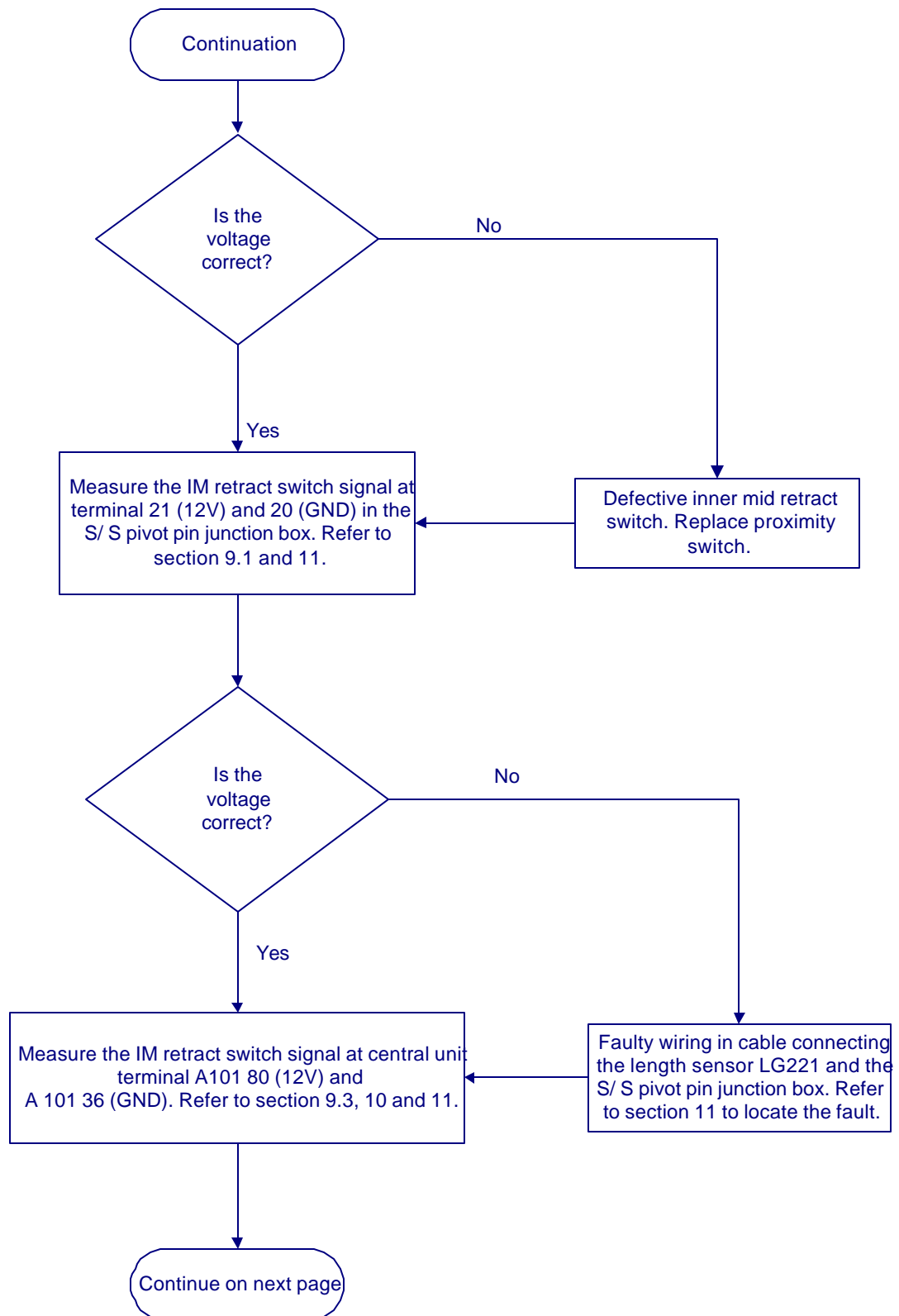
12. Boom Length Percentage Error



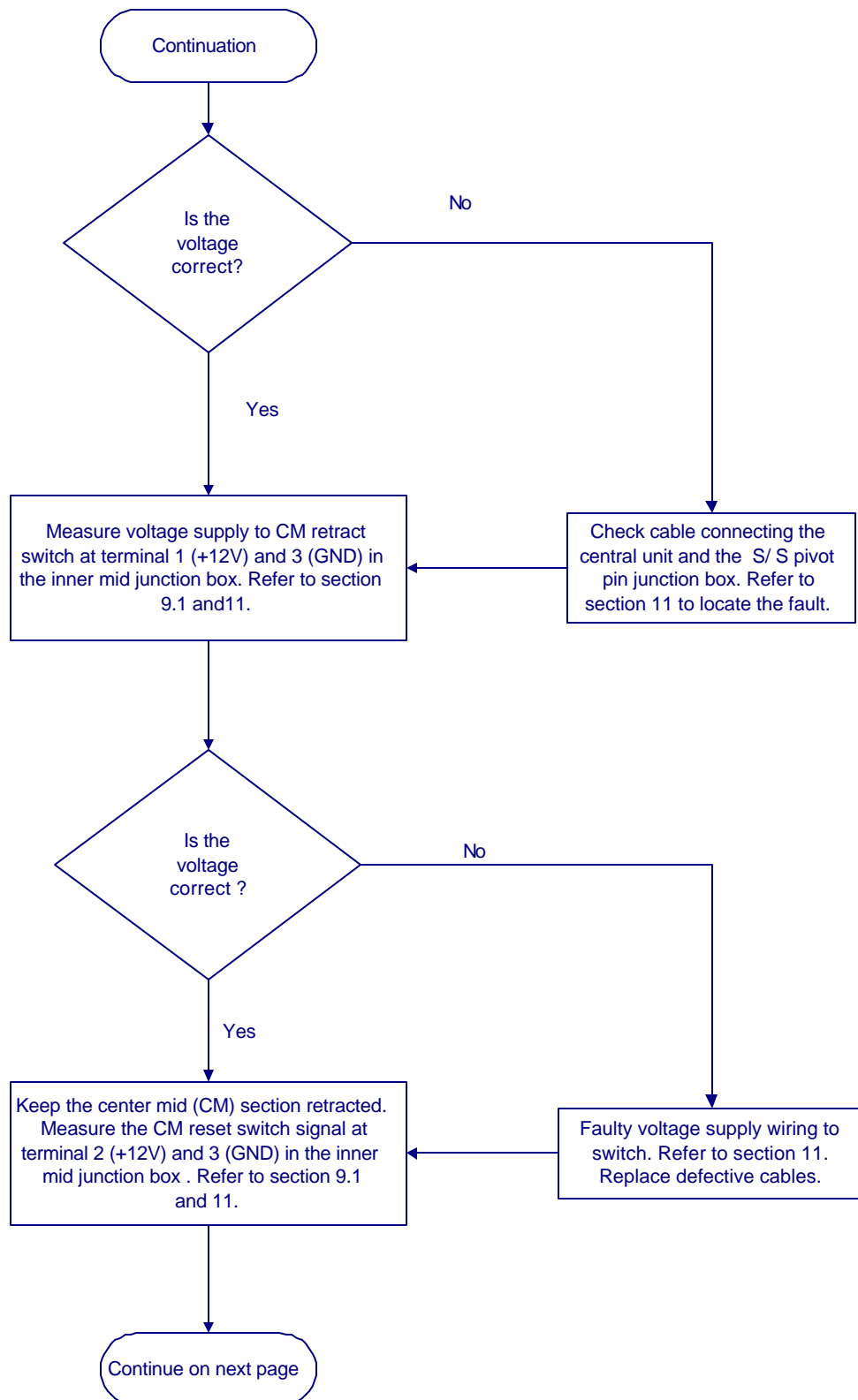
12. Continuation



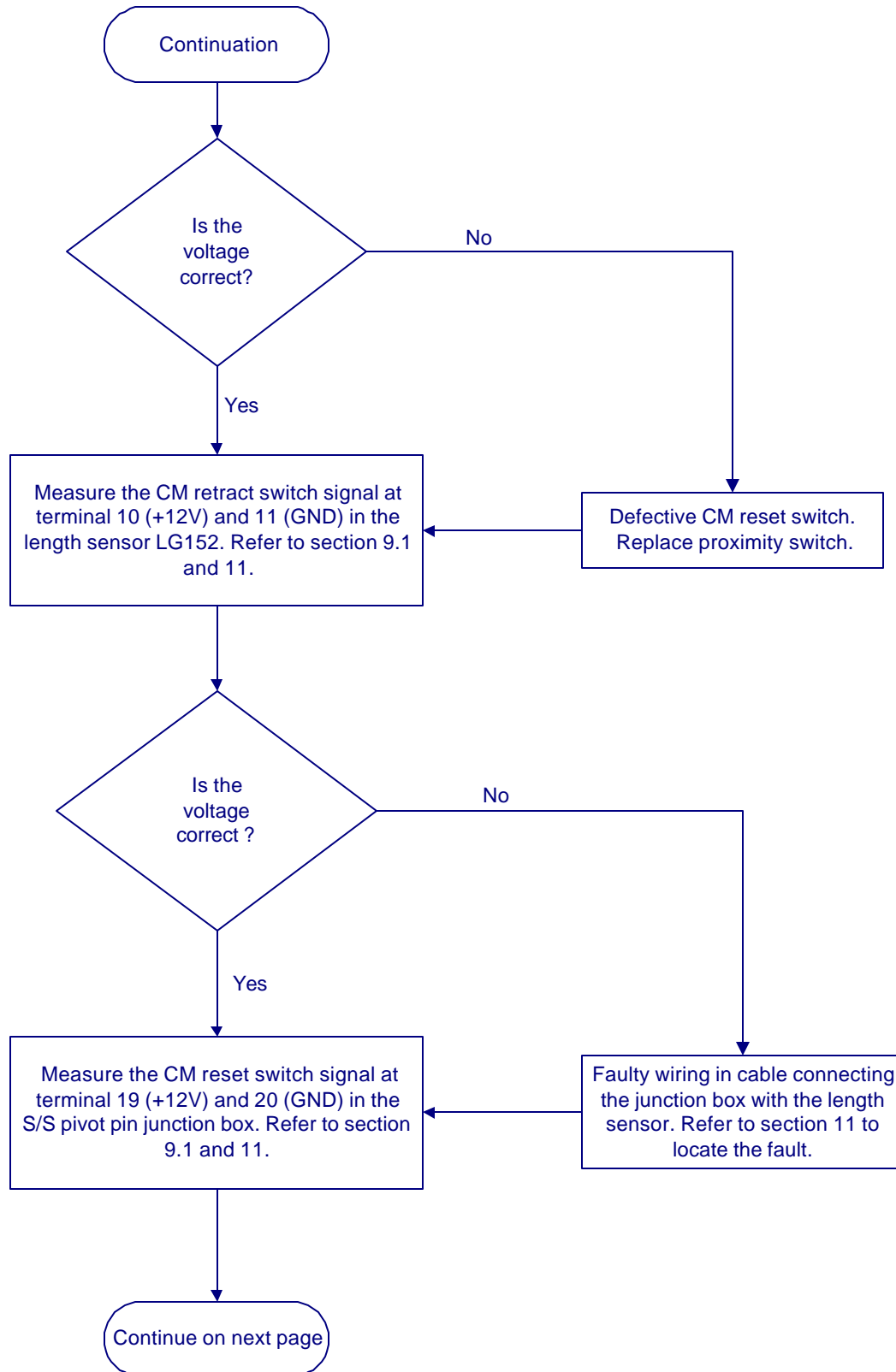
12. Continuation



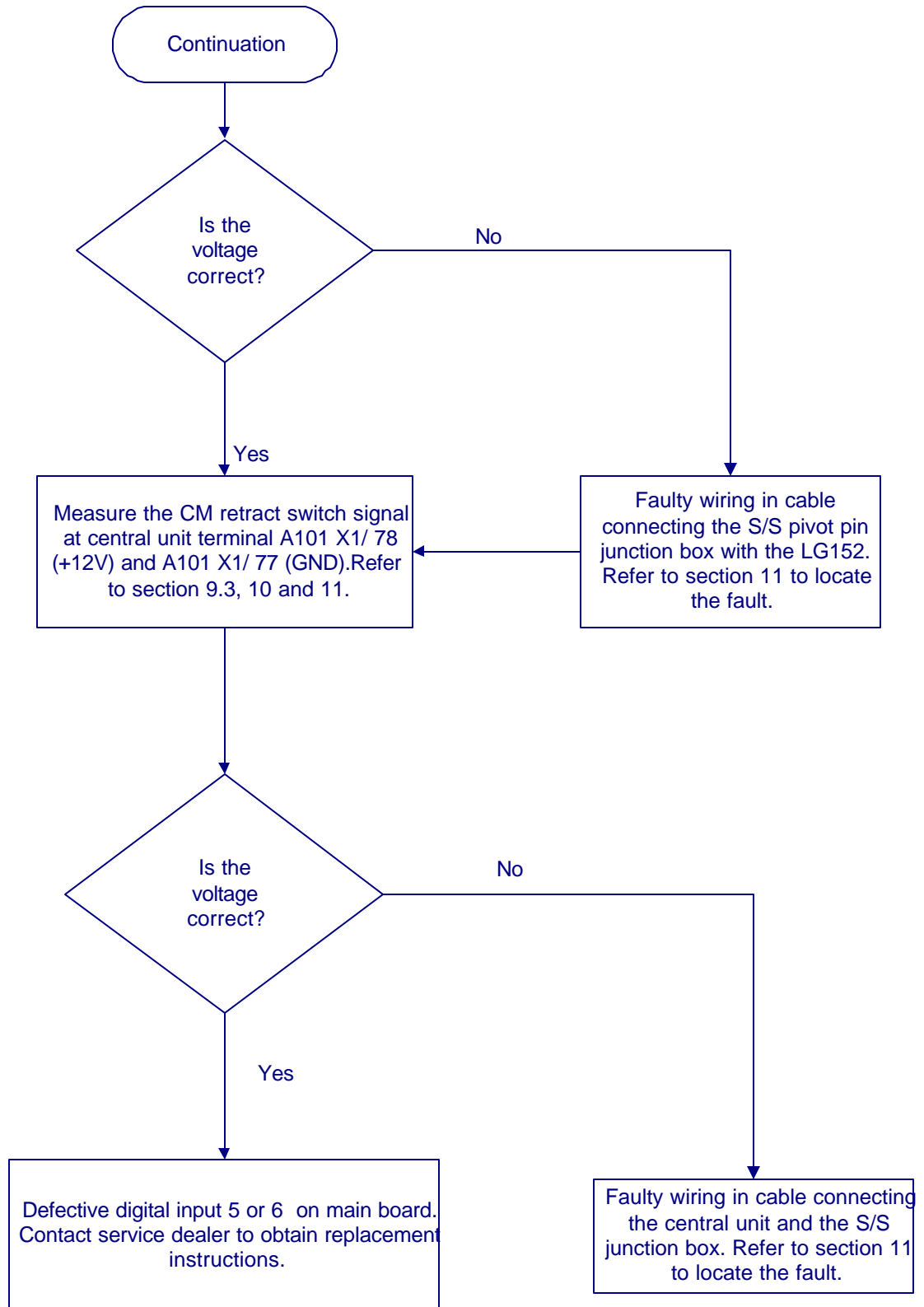
12. Continuation



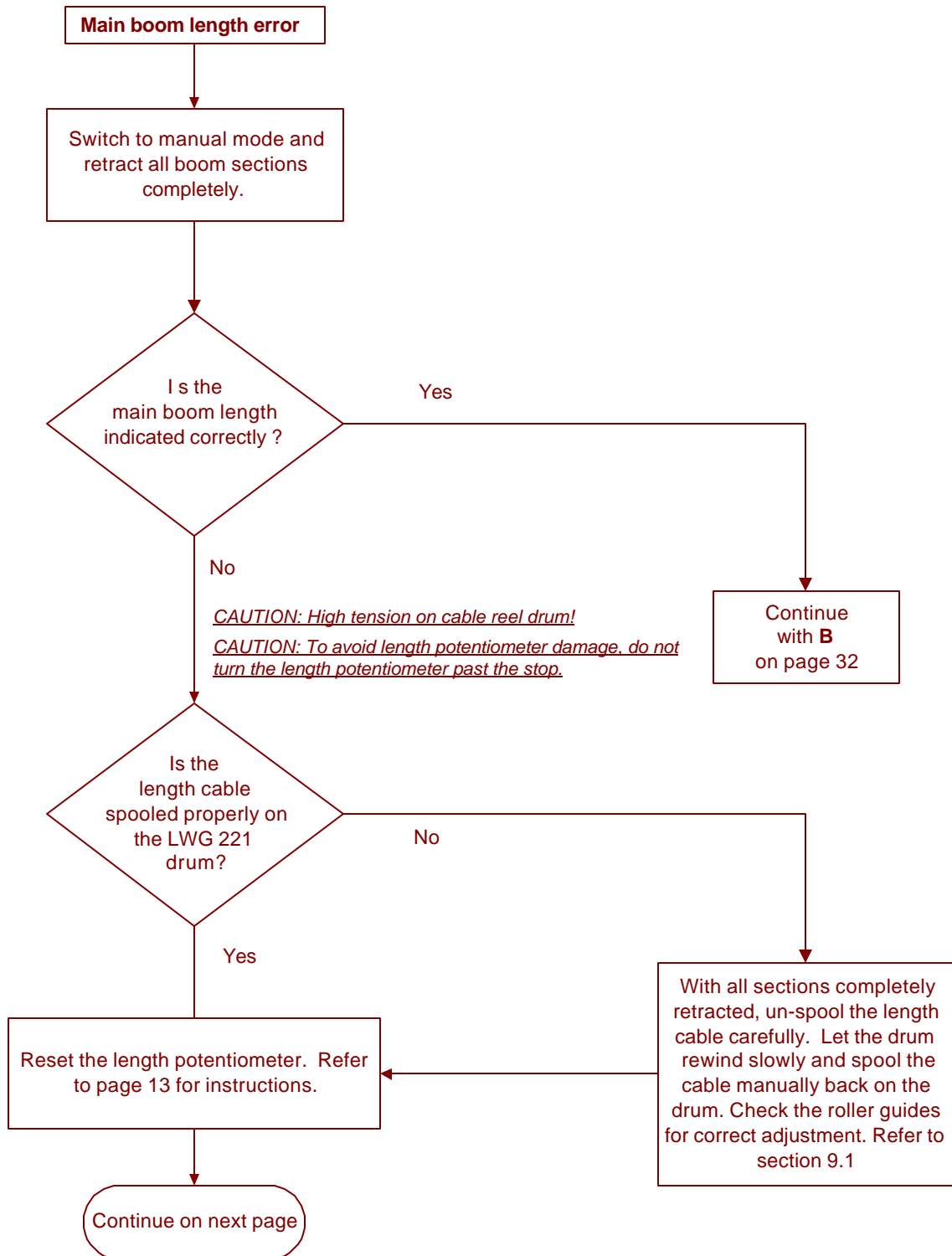
12. Continuation



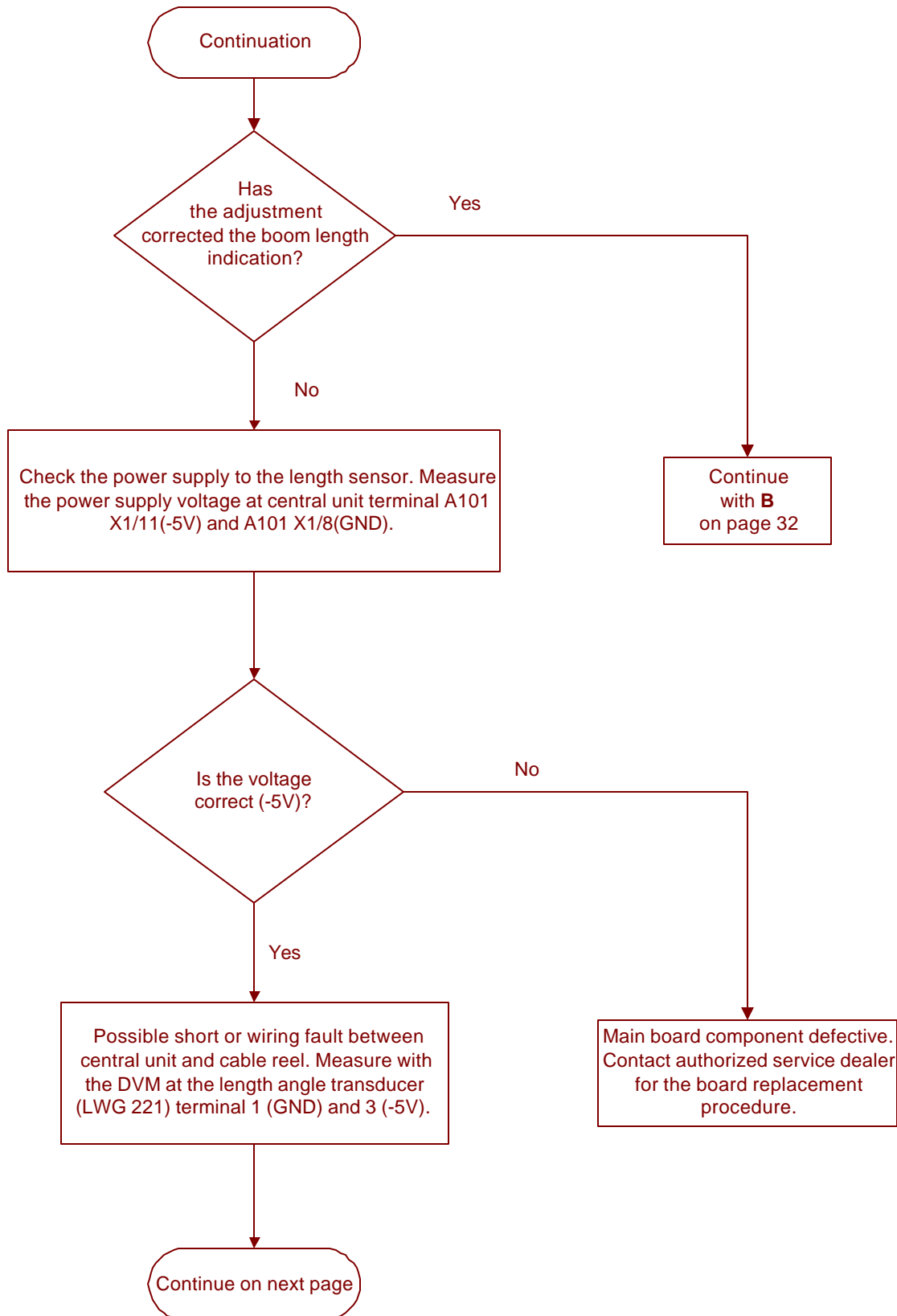
12. Continuation



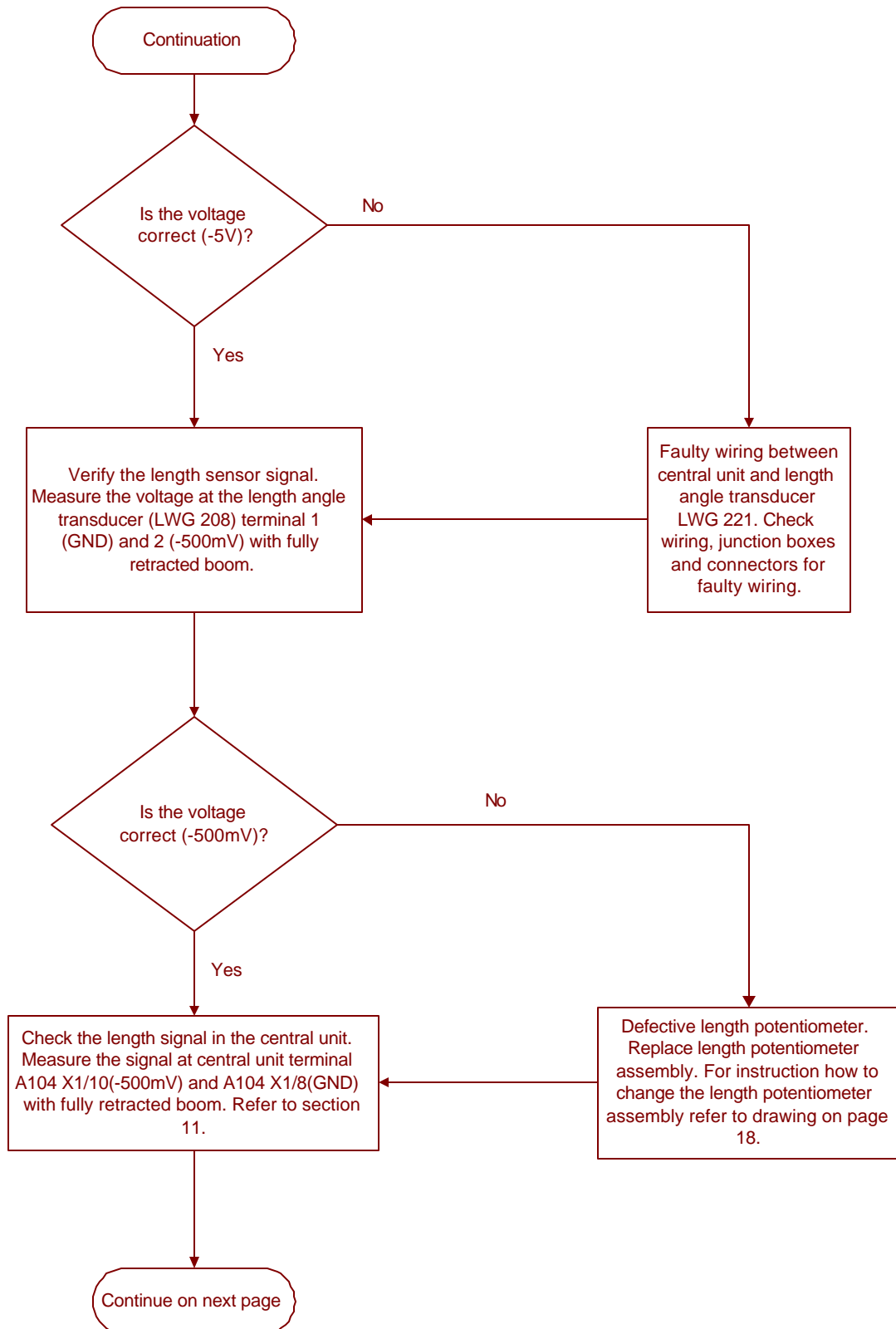
13. Main Boom Length Error



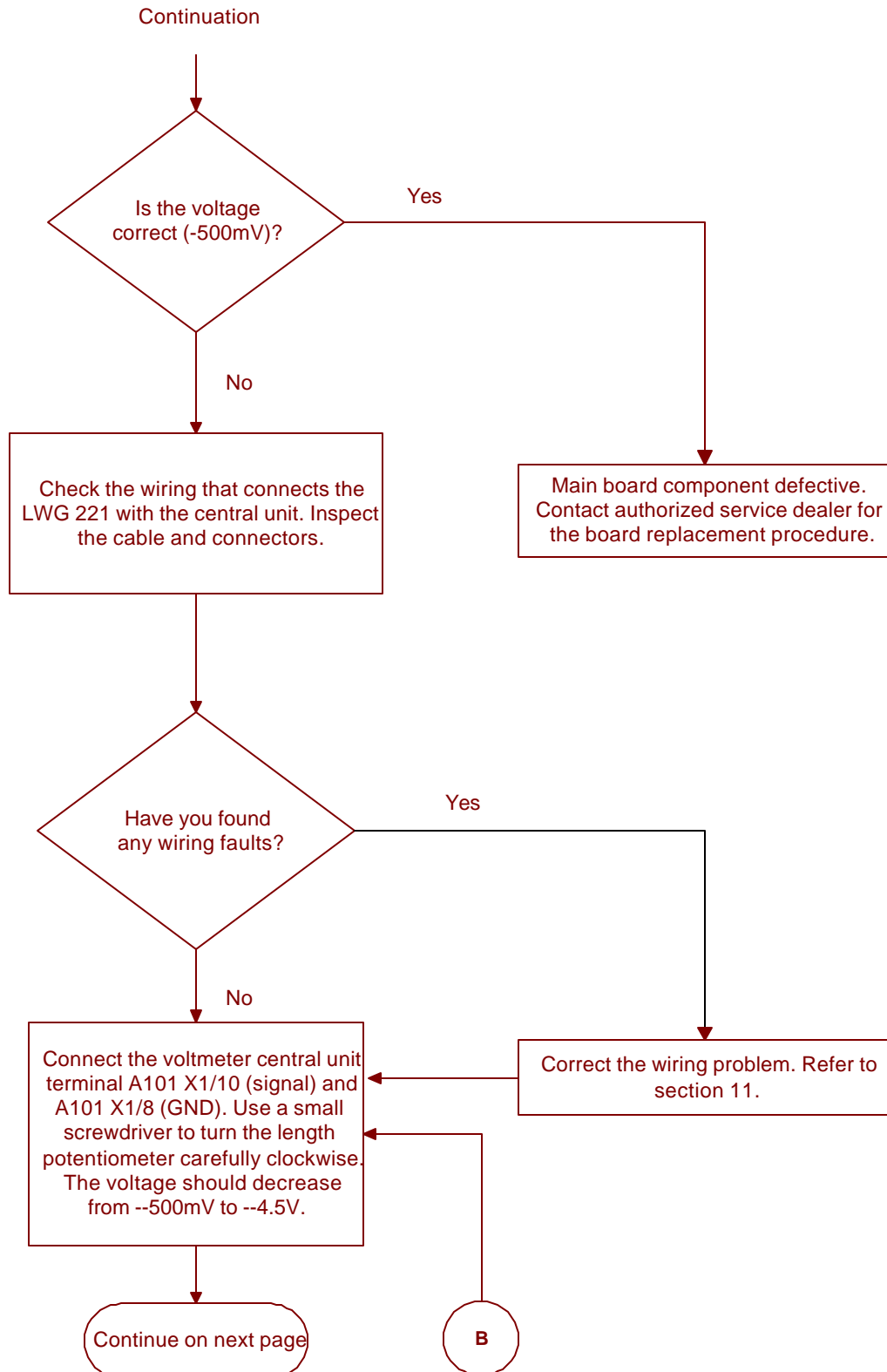
13. Continuation



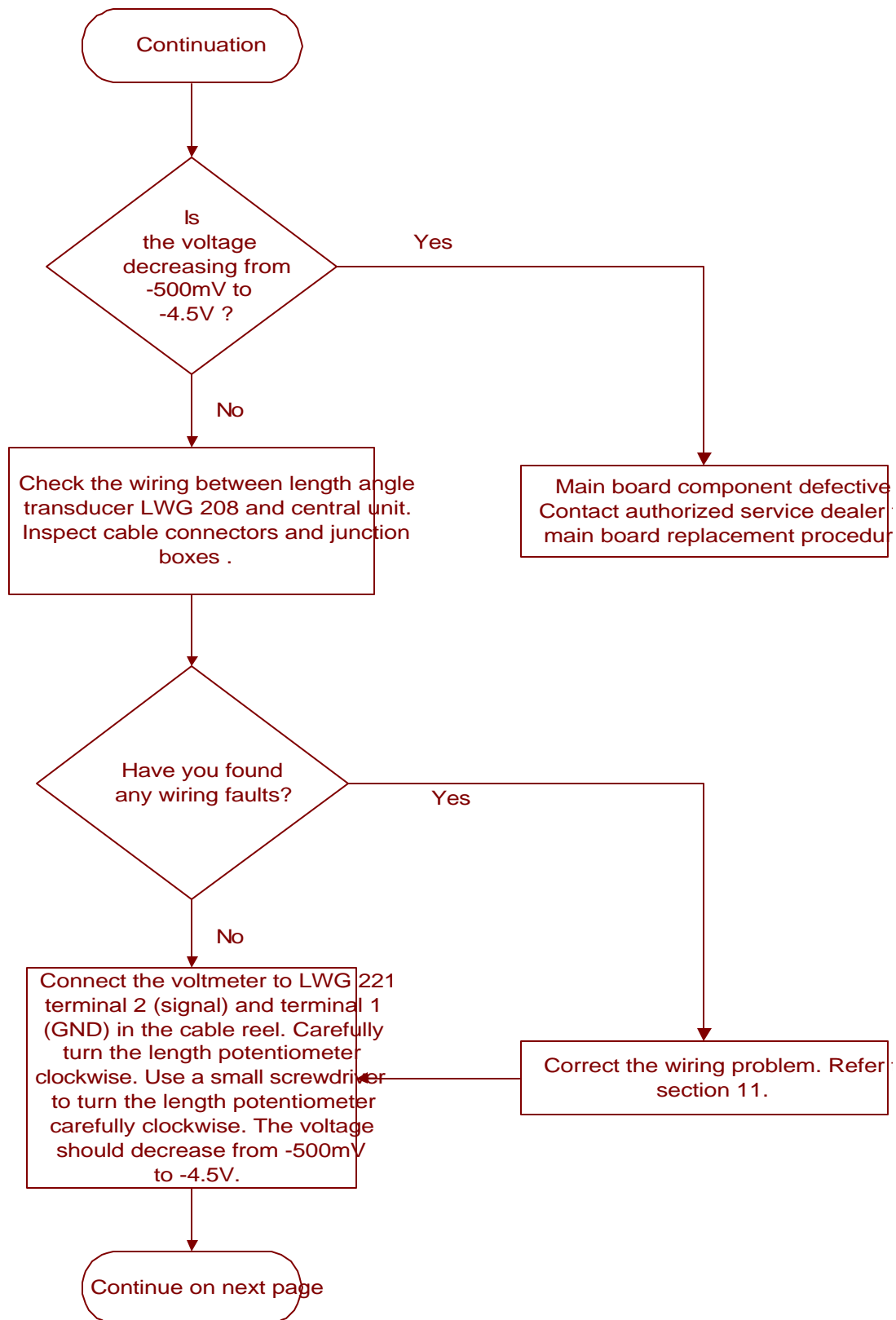
13. Continuation



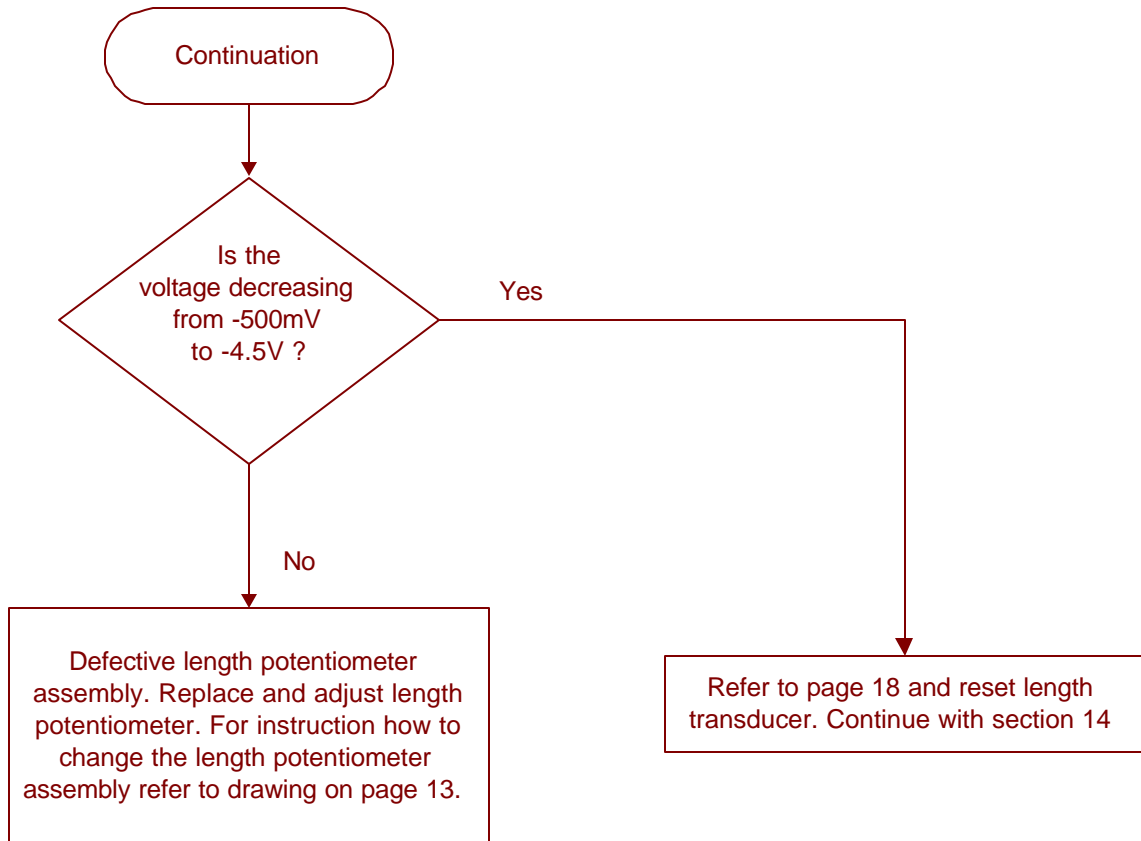
13. Continuation



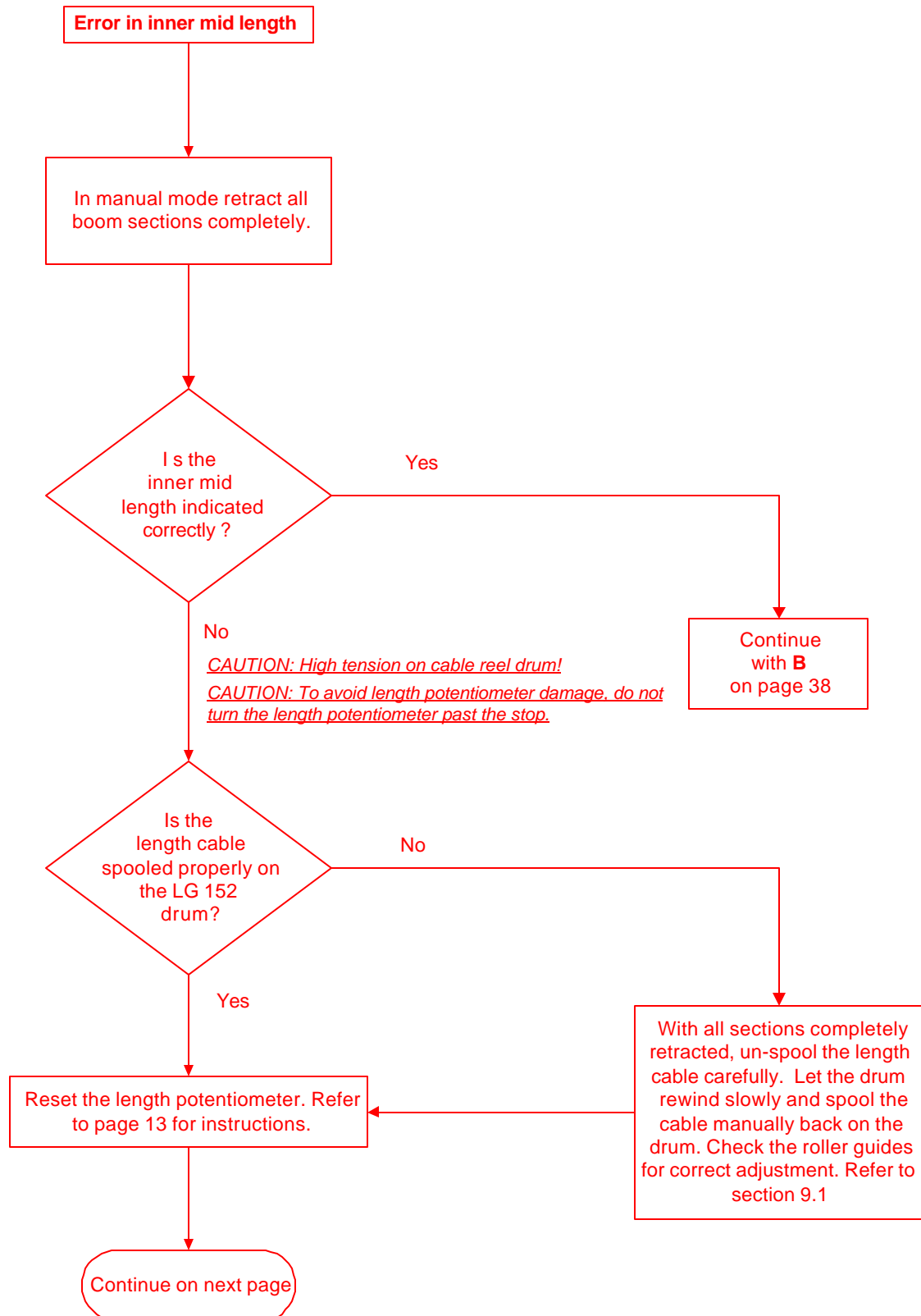
13. Continuation



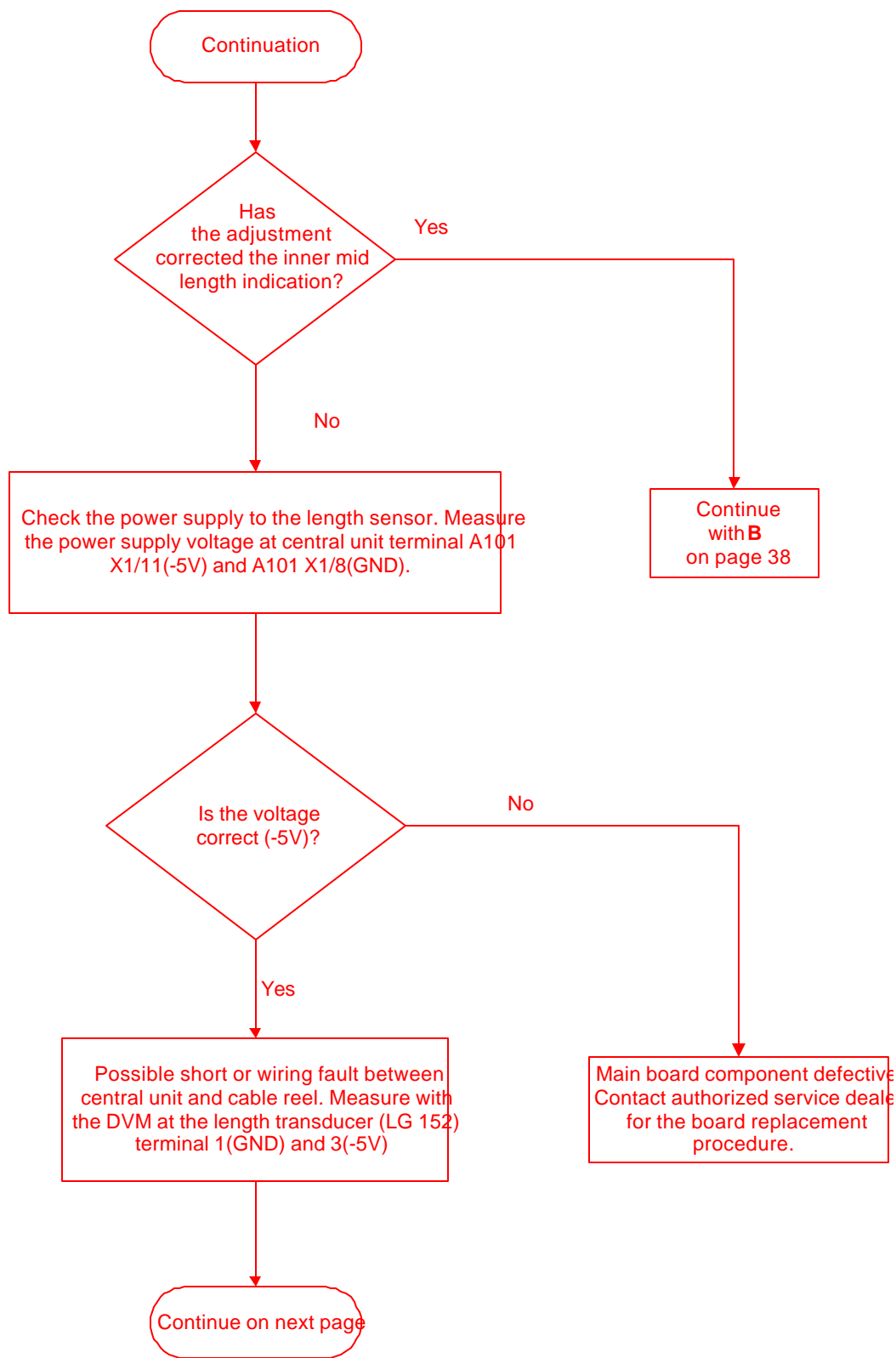
13. Continuation



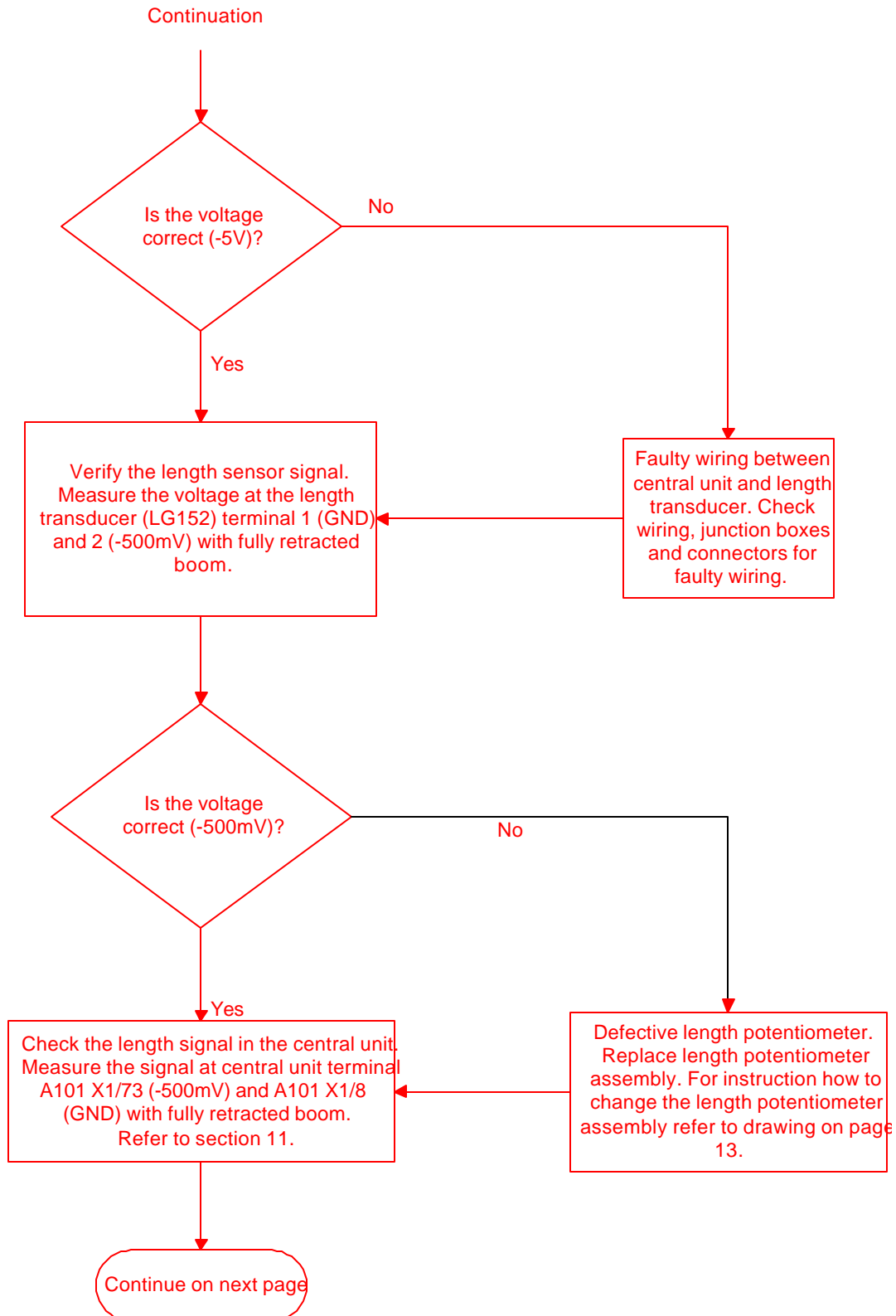
14. Inner Mid Length Error



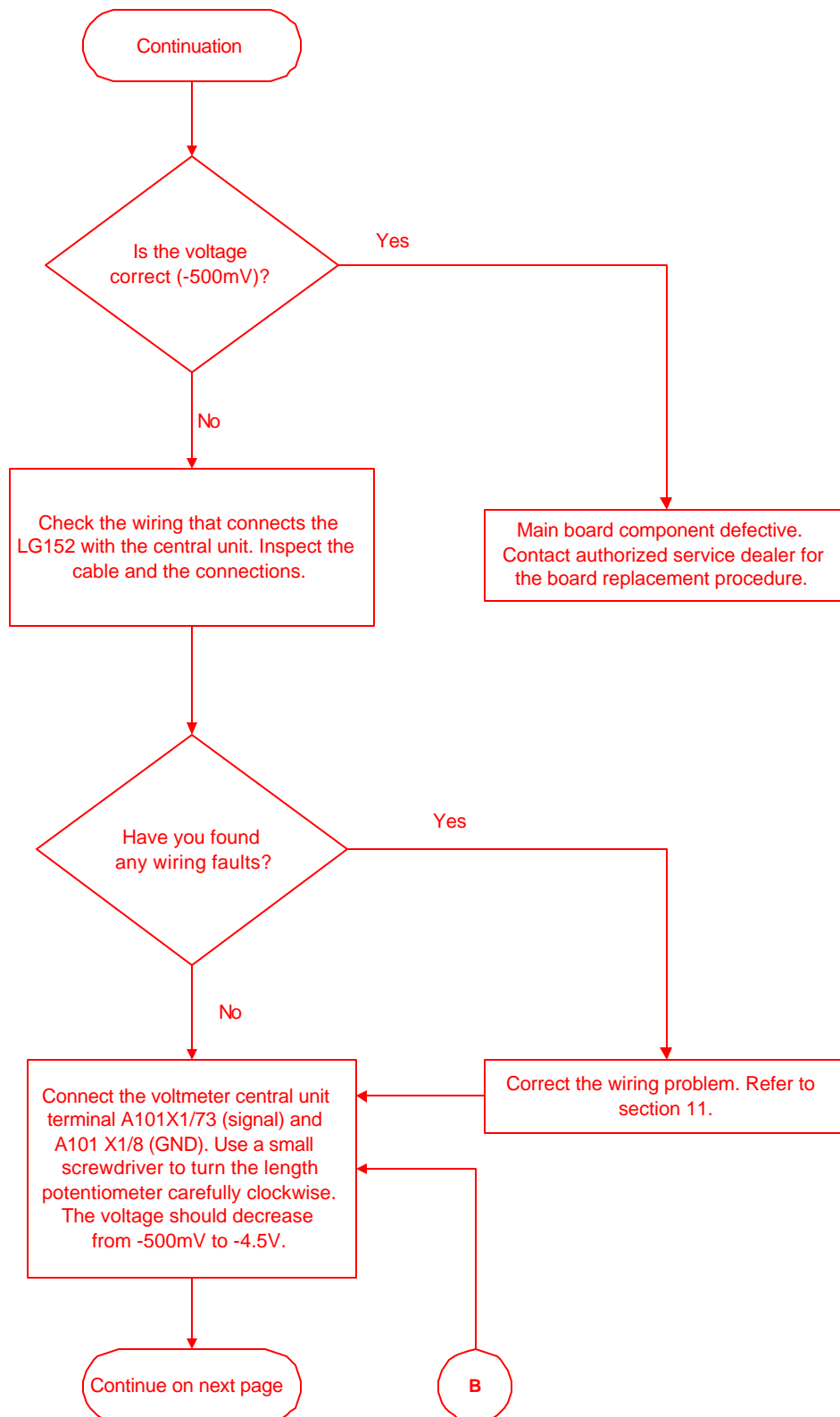
14. Continuation



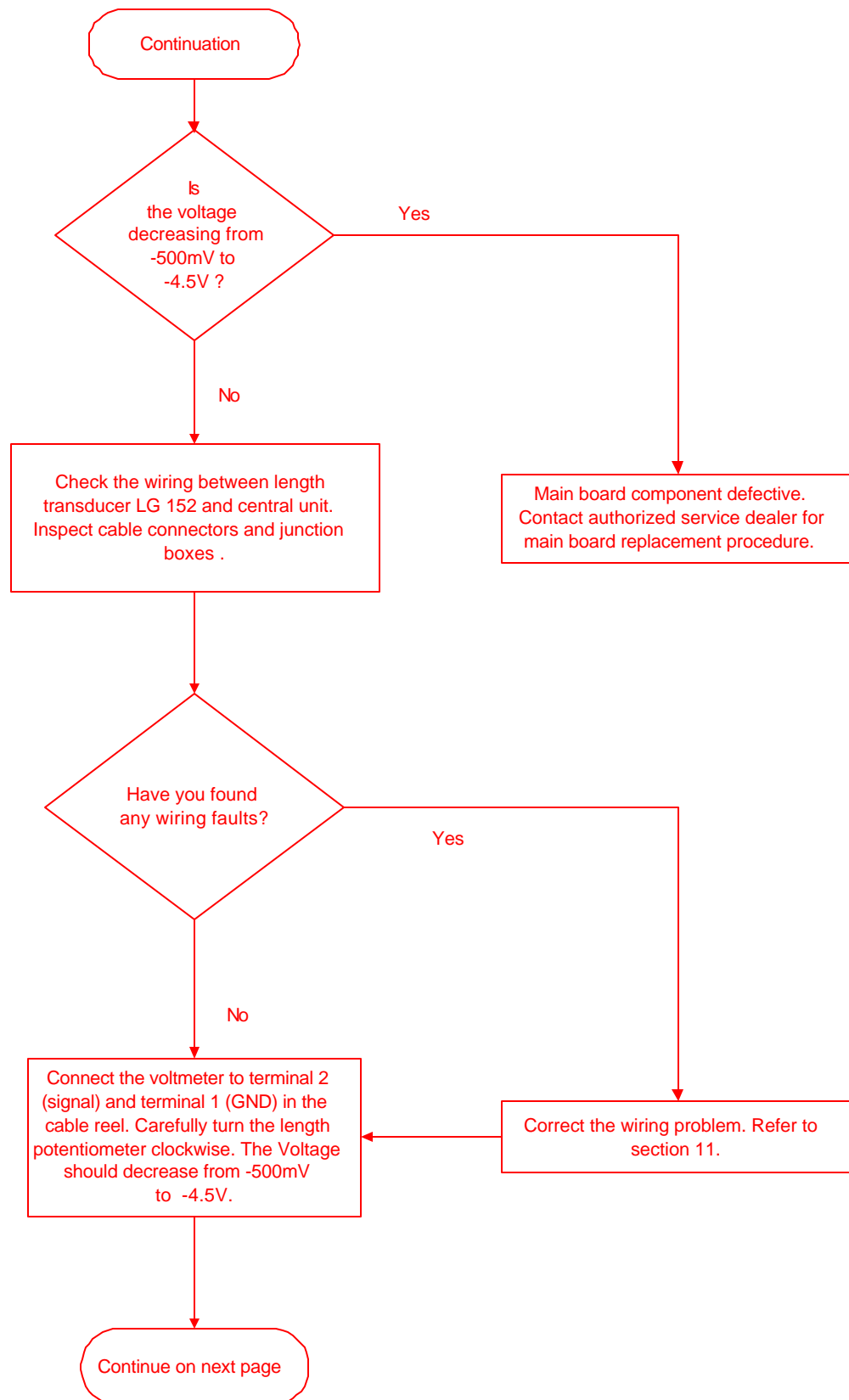
14. Continuation



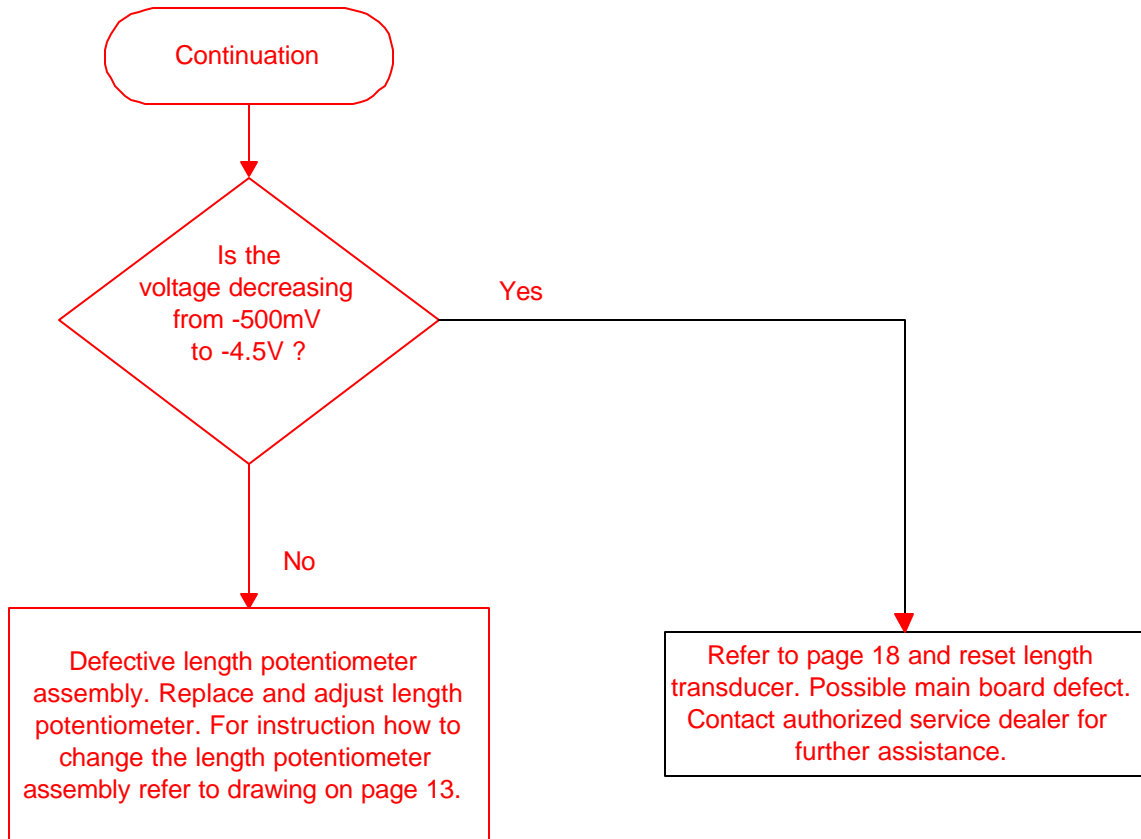
14. Continuation



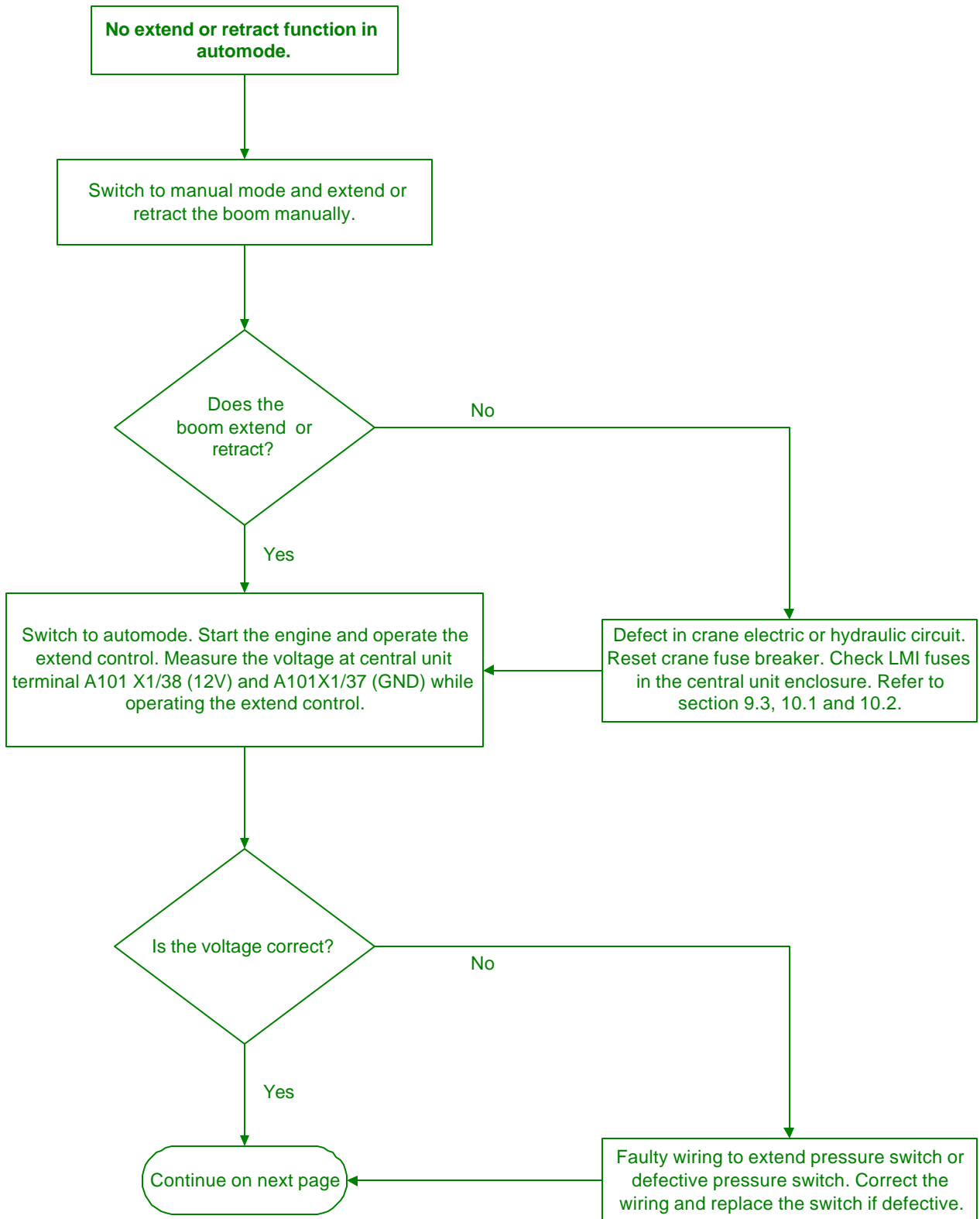
14. Continuation



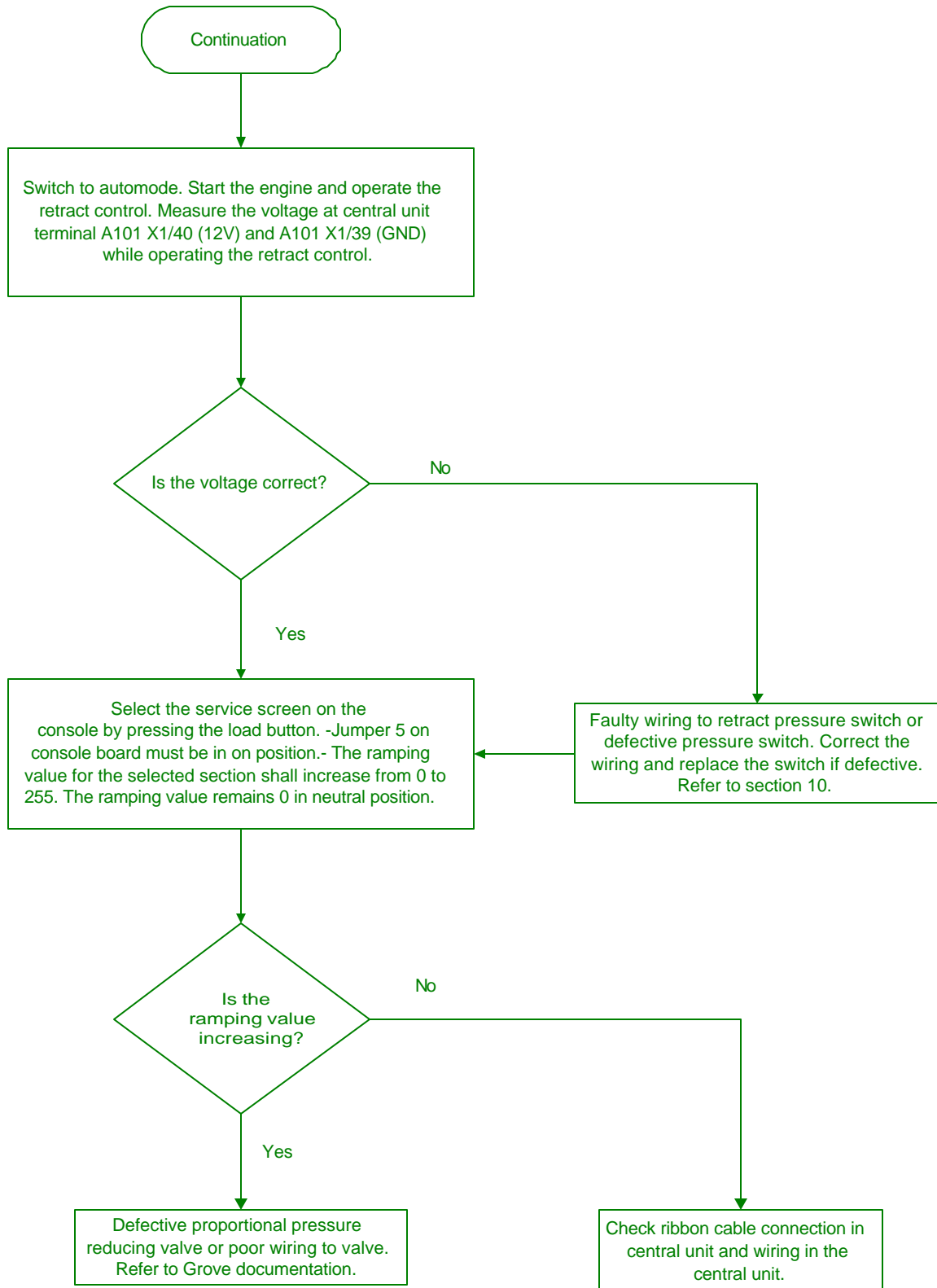
14. Continuation



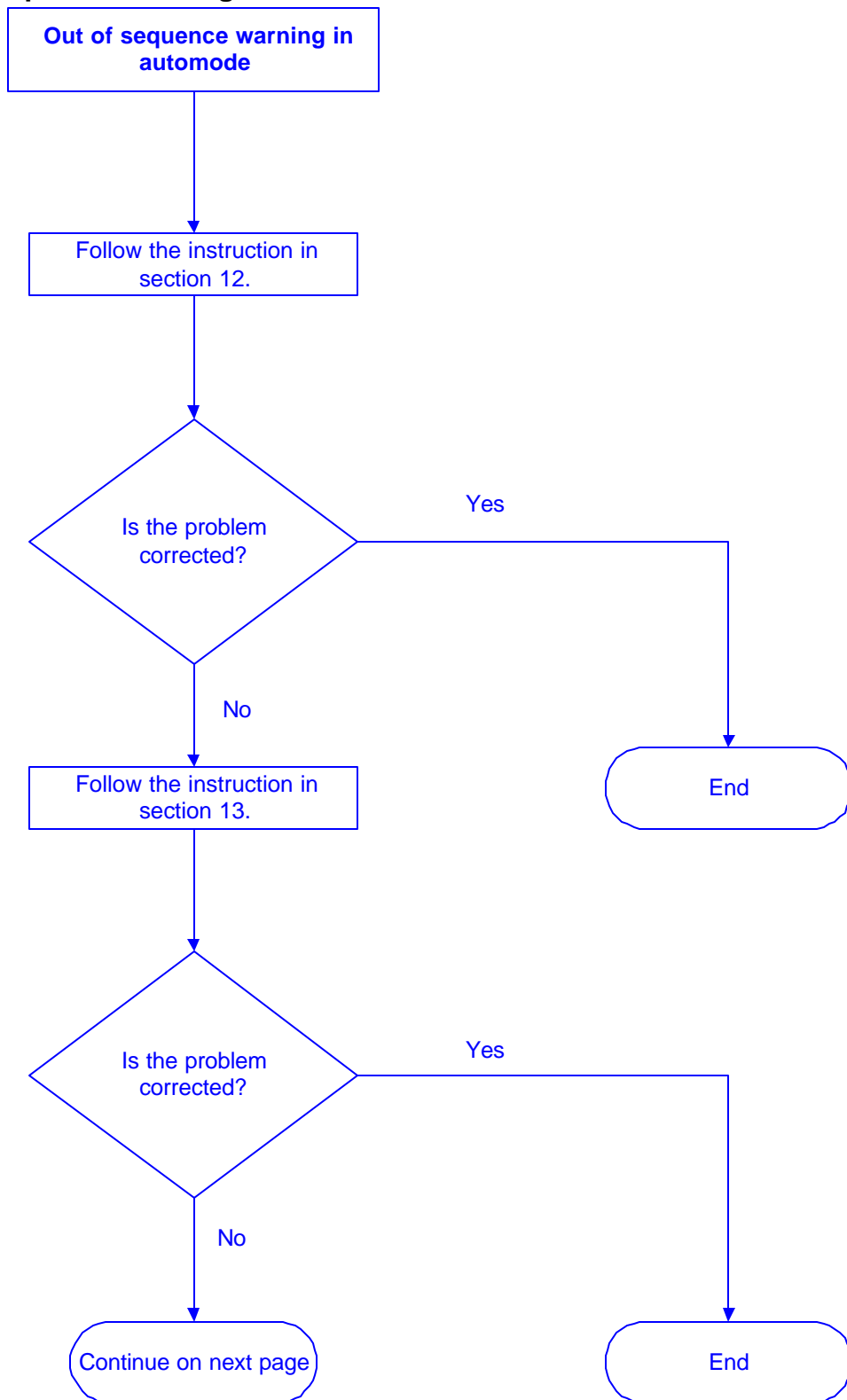
15. No Extend or Retract Function in Automode



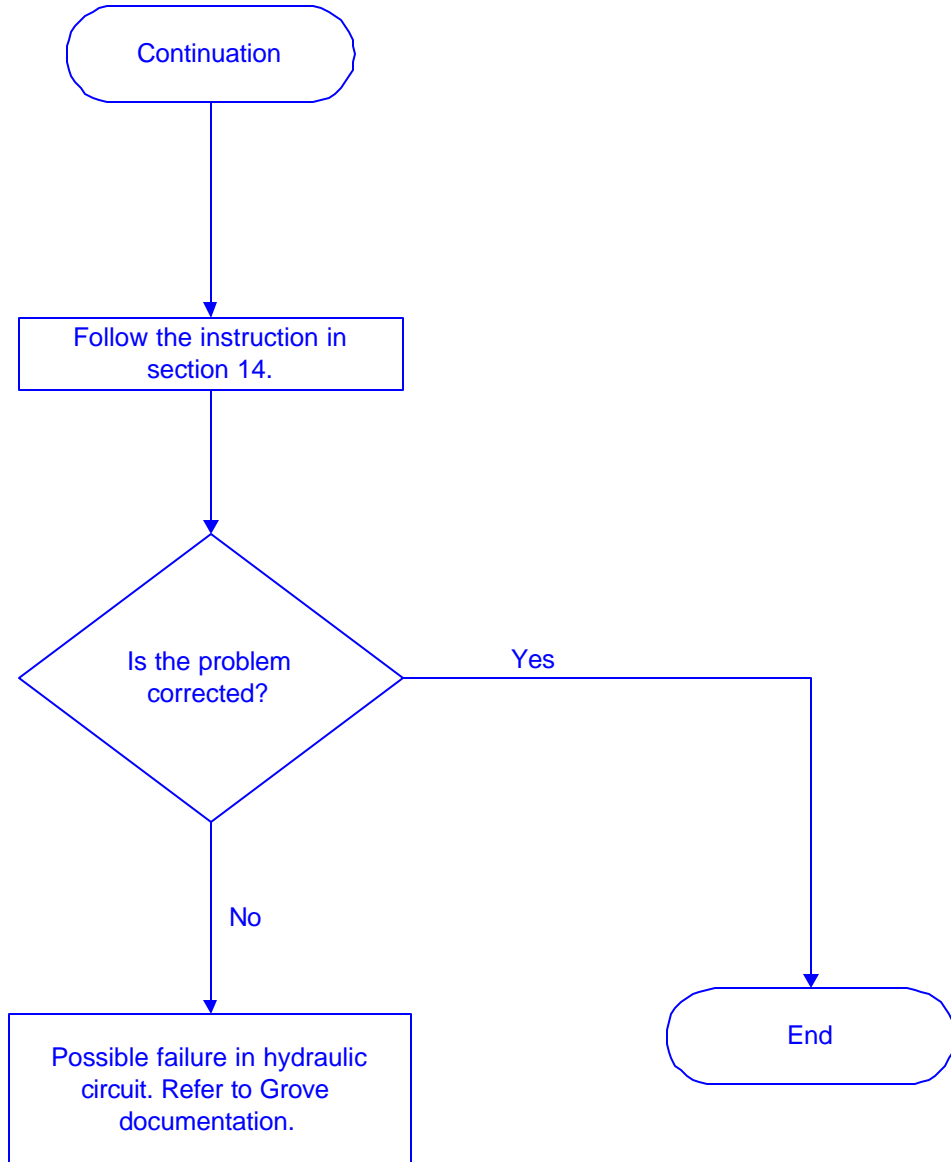
15. Continuation



16. Out of Sequence Warning



16. Continuation





17.1 Additional Error Codes - Operational

Error code	Description	Solution
E18	Front Stabilizer overloaded	Achieve a safe working area immediately.
E83	The outer mid section and fly section are not fully retracted while the center mid section or the inner mid section retracts or extends. No cut off with E83, but <i>flashing pre-warning light</i> in console and <i>reduced capacity chart</i> (rigging mode).	Select manual mode. Manually retract the outer mid and fly section until fully retracted. Return to auto mode. Check fly section cable adjustment. The fly section shall not be extended when center mid section is fully retracted.
Flashing % indication	Out of telescope sequence (rigging mode selected). The red warning light "Out of sequence" in the console panel lights up.	Select manual mode. Rectify the solution by manually operating each telescope until % indication stops flashing and the red warning light "Out of sequence" in the console panel is dim. Return to auto mode.



17.2 Additional Error Codes - System

Error code	Description	Solution
E 47	Processor can not locate analog output circuit for center mid section	Analog output circuit defective. Replace module. Ribbon cable (DS 350G only) defective or bad connection. Replace cable. Decoder circuit defective. Replace decoder module(DS 350G only).
E 60	<i>DATA- EPROM</i> is not plugged into the correct socket or location is not programmed correctly in the <i>EPROM</i> .	Refer to the trouble shooting manual and identify the correct location for the data eprom.
E70	No or wrong return signal from digital input extension module to processor.	Digital input circuit defective. Replace module. Ribbon cable (DS 350G only) defective or bad connection. Replace cable. Decoder circuit defective. Replace decoder module(DS 350G only). Defective input circuit on main board. Call authorized service personnel.
E80 / E98	No or wrong return signal from analog output extension module (for inner mid section) to processor.	Analog output circuit defective. Replace module. Ribbon cable (DS 350G only) defective or bad connection. Replace cable. Decoder circuit defective. Replace decoder module(DS 350G only). Defective input circuit on main board. Call authorized service personnel.