

Service Manual

LX31 / LX41

Electric and Bi-Energy Models

Serial Numbers 4022 - Current

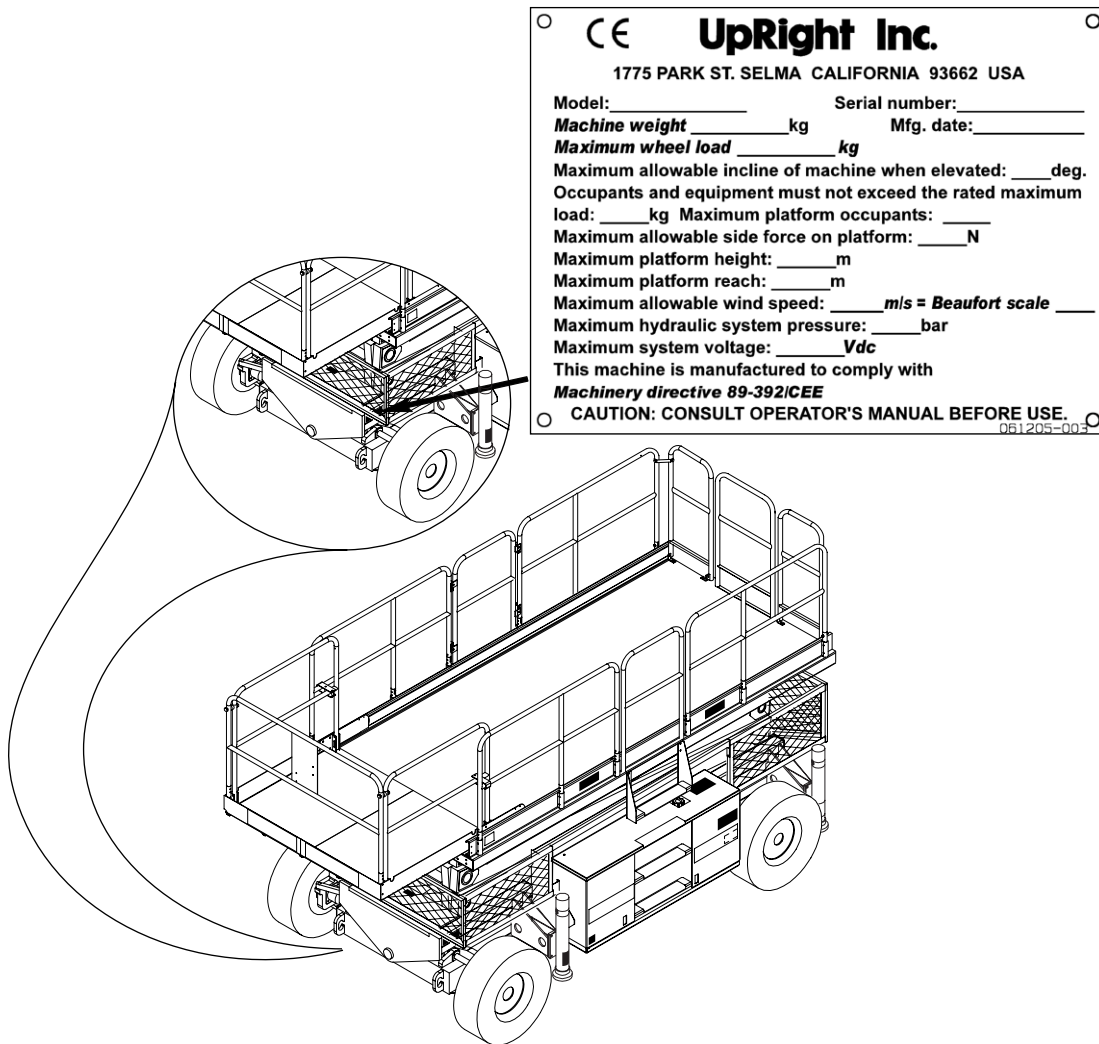
P/N 067448-023

UpRight

LX31 / LX41

Electric and Bi-Energy

When contacting UpRight for service or parts information, be sure to include the MODEL and SERIAL NUMBERS from the equipment nameplate. Should the nameplate be missing, the SERIAL NUMBER is also stamped on top of the chassis above the front axle pivot.



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EC Declaration of Conformity of Machinery
EC-Konformitätserklärung für Maschinen
Declaration De Conformite CE pour les Machines
Declaracion De Conformidad CE Para Maquinaria
Dichiarazione Di Conformità CE Per Le Macchine
CE Conformiteitsverklaring voor Machinery
EU Deklaration Avseende Överensstämelse För Maskinutrustni
EF-Samsvarserklæring For Maskiner
EF-Overensstemmelseserklæring for Maskiner
EU Vaatimustenmukaisuusvakuutus

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Description..... Aerial Work Platform
Bezeichnung..... Arbeitsbühne
Description..... Plate-forme elevatrice de personnel
Descripcion..... Plataforma aerea de trabajo con motor
Descrizione..... Piattaforma di sollevamento motorizzato
Beschrijving..... Mechanisch aangedreven werkplatform
Beskrivning..... Hög-och sänkbar arbetsplattform
Beskrivelse..... Selvgående arbeidsplattform
Beskrivelse..... Motordrevet løfteplatform
Kuvaus..... Konevoimalla toimiva nostolava
Selvgående personarbetslift

Model
Modell
Modelle
Modelo
Modello
Verticaal model
Malli
LX31 / LX41

Serial number
Matricola
Sarajanumero
Seriennummer
Numero de serie
Matricola
4275 +

Technische Prüfstelle
Dienstbier & Pix
Hundert Beete 13
D-91334 Hemhofen
DEUTSCHLAND

ID Number CE 0533

LX31 0533 86 01
LX41 0533 87 01

March 2001

Date
Datum
Fecha
Data
Dato
Paivamaara

Notified body
Notifizierte Stelle
Organisme notifie
Organismo notificado
Aangemelde instantie
Myndighet
Avendte harmoniserde standarder
Udpeget organ
Asiasta on tehty ilmoitus seuraaville taholle
Ente Notificatore
EC Type Examination Certificate number
EC-Typenprüfung Zertifikat-Nr
Examen type CE Numero de Certificat
Inspeccion tipo CE Numero de certificado
Attestato di certificazione CE nr
Onderzoek van het type EC Certificaatnummer
EU typkontroll Certifieringsnummer
EF-typeproving Sertifikatnummer
EF-typegodkendelse Nummer pa typeattest
EU-typitarkastuksen nr.

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Laadunvalvoja

SUOMI

Yllämainittu laite täyttää seuraavat vaatimukset:

Direktiivi
98/37/EC Muutettuna direktiivieillä
EN60204-1:1997 Koneiturvallisuus

89/336/EEC 93/68/EEC EN50081-1:1992 EN50082-1:1992 Sähkömagneettinen yhteensopivuus

SVENSKA

Maskinen som specificeras ovan överensstämmer med följande bestämmelser:

Direktiv
98/37/EC Med ändringar enligt direktiven

Harmoniserade standarder som har tillämpats:
EN60204-1:1997 Säkerhet hos maskinutrustning

89/336/EEC 93/68/EEC EN50081-1:1992 EN50082-1:1992 Elektromagnetisk kompatibilitet

DANSK

Den anførte maskine er i overensstemmelse med følgende bestemmelser:

Direktiv
98/37/EC Som ændret ved Rådets direktiver

Anvendte harmoniserede standarder:
EN60204-1:1997 Maskinsikkerhed

89/336/EEC 93/68/EEC EN50081-1:1992 EN50082-1:1992 EMC

NORSK

Den ovenfor angitte maskinen samsvarer med følgende bestemmelser:

Direktiv
98/37/EC Med endringer i Rådets direktiv

Anvendte harmoniserte standarder:
EN60204-1:1997 Maskinsikkerhet

89/336/EEC 93/68/EEC EN50081-1:1992 EN50082-1:1992 Elektromagnetisk kompatibilitet

ESPAÑOL

La máquina especificada arriba de estas líneas cumple con las disposiciones indicadas a continuación:

Directiva
98/37/EC Según las enmiendas de las Directivas

Estándares armonizados adoptados:
EN60204-1:1997 Seguridad de la maquinaria

89/336/EEC 93/68/EEC EN50081-1:1992 EN50082-1:1992 Compatibilidad electromagnética

ENGLISH

The Machine specified herein complies with the following provisions:

Directive
98/37/EC As amended by Directive
EN60204-1:1997 Safety of Machinery

89/336/EEC 93/68/EEC EN50081-1:1992 EN50082-1:1992 Electromagnetic compatibility

DEUTSCH

Die obengenannte Maschine entspricht den folgenden Bestimmungen:

Richtlinie
98/37/EC Geändert durch Richtlinien
EN60204-1:1997 Maschinensicherheit – Elektrische Maschinenausrüstung

89/336/EEC 93/68/EEC EN 50081-1:1992 EN 50082-1:1992 Elektromagnetische Kompatibilität

NEDERLANDS

De bovenvermelde machine voldoet aan de volgende voorwaarden:

Richtlijn
98/37/EC Zoals gewijzigd door richtlijnen
EN60204-1:1997 Veiligheid van machine

89/336/EEC 93/68/EEC EN50081-1:1992 EN50082-1:1992 Elektromagnetische compatibiliteit

FRANCAIS

La machine décrite ci-dessus est conforme aux normes ci-dessous:

Directive
98/37/EC Amendée par la directive
EN60204-1:1997 Normes harmonisées adoptées
EN60204-1:1997 Sécurité des machines

89/336/EEC 93/68/EEC EN50081-1:1992 EN50082-1:1992 Compatibilité électromagnétique

ITALIANO

La macchina sopra specificata è conforme alle seguenti disposizioni:

Direttiva
98/37/EC Modificata dalle Direttive
EN60204-1:1997 Norme armonizzate adottate
EN60204-1:1997 Sicurezza del macchinario

89/336/EEC 93/68/EEC EN50081-1:1992 EN50082-1:1992 Compatibilità elettromagnetica

FOREWORD

This manual contains instructions for the maintenance of the machine. Referring to the Operator Manual will aid in understanding the operation and function of the various components and systems of the machine, and help in diagnosing and repair of the machine.

All information contained in this manual is based on the latest product information available at the time of printing. We reserve the right to make changes at any time without notice. No part of this publication may be reproduced, stored in retrieval system, or transmitted, in any form by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher. This includes text, figures and tables.

This manual consists of five (5) parts.

OPERATOR MANUAL

A copy of the Operator Manual that is stored on every UpRight Aerial Work Platform.

SECTION 1 - GENERAL INFORMATION

Contains generic information relevant to all UpRight Aerial Work Platforms.

SECTION 2 - SERVICE AND REPAIR

Detailed information specific to this UpRight Aerial Work Platform.

SECTION 3 - TROUBLESHOOTING

Causes and solutions to typical problems.

SECTION 4 - SCHEMATICS

Electric and Hydraulic schematics.

NOTES:

OPERATOR MANUAL

WARNING

All personnel shall carefully read, understand and follow all safety rules and operating instructions before operating or performing maintenance on any UpRight aerial work platform.

Safety Rules

Electrocution Hazard



THIS MACHINE IS NOT INSULATED!

Tip Over Hazard



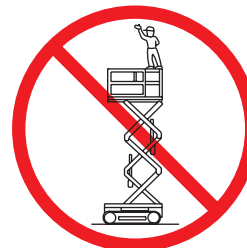
NEVER elevate the platform or drive the machine while elevated unless the machine is on a firm, level surface.

Collision Hazard



NEVER position the platform without first checking for overhead obstructions or other hazards.

Fall Hazard



NEVER climb, stand or sit on platform guardrails or midrail.

USE OF THE AERIAL WORK PLATFORM: This aerial work platform is intended to lift persons and his tools as well as the material used for the job. It is designed for repair and assembly jobs and assignments at overhead workplaces (ceilings, cranes, roof structures, buildings etc.). All other uses of the aerial work platform are prohibited!

THIS AERIAL WORK PLATFORM IS NOT INSULATED! For this reason it is imperative to keep a safe distance from live parts of electrical equipment!

Exceeding the specified permissible maximum load **is prohibited!** See "Special Limitations" on page 4 for details.

The use and operation of the aerial work platform as a lifting tool or a crane (lifting of loads from below upwards or from up high on down) **is prohibited!**

NEVER exceed the manual force allowed for this machine. See "Special Limitations" on page 4 for details.

DISTRIBUTE all platform loads evenly on the platform.

NEVER operate the machine without first surveying the work area for surface hazards such as holes, drop-offs, bumps, curbs, or debris; and avoiding them.

OPERATE machine only on surfaces capable of supporting wheel loads.

NEVER operate the machine when wind speeds exceed this machine's wind rating. See "Beaufort Scale" on page 4 for details.

IN CASE OF EMERGENCY push EMERGENCY STOP switch to deactivate all powered functions.

IF ALARM SOUNDS while platform is elevated, STOP, carefully lower platform. Move machine to a firm, level surface.

Climbing up the railing of the platform, standing on or stepping from the platform onto buildings, steel or prefab concrete structures, etc., **is prohibited!**

Dismantling the swing gate or other railing components **is prohibited!** Always make certain that the swing gate is closed and securely locked!

It is prohibited to keep the swing gate in an open position (held open with tie-straps) when the platform is raised!

To extend the height or the range by placing of ladders, scaffolds or similar devices on the platform **is prohibited!**

NEVER perform service on machine while platform is elevated without blocking elevating assembly.

INSPECT the machine thoroughly for cracked welds, loose or missing hardware, hydraulic leaks, loose wire connections, and damaged cables or hoses before using.

VERIFY that all labels are in place and legible before using.

NEVER use a machine that is damaged, not functioning properly, or has damaged or missing labels.

To bypass any safety equipment **is prohibited** and presents a danger for the persons on the aerial work platform and in its working range.

NEVER charge batteries near sparks or open flame. Charging batteries emit explosive hydrogen gas.

Modifications to the aerial work platform **are prohibited** or permissible only at the approval by UpRight.

AFTER USE, secure the work platform from unauthorized use by turning both keyswitches off and removing key.

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INTRODUCTION

This manual covers the operation of the LX 31 and LX 41 Electric and BiEnergy machines. **This manual must be stored on the machine at all times.**

GENERAL DESCRIPTION

1. Platform

The platform has a reinforced steel floor, guardrails with midrail, toeboards and an entrance gate at the rear and both sides of the platform. The guardrails can be folded down for access through doors or for shipment.

2. Slide-out Deck

⚠ WARNING ⚠

DO NOT use the maintenance platform without guardrails properly assembled and in place

3. Platform Controls

The platform controls contain the controls to operate the machine. It should be hung on the front, left, or right guardrail.

4. Manual Case

5. Elevating Assembly

The platform is raised and lowered by the elevating assembly; a five section scissor assembly powered by two single-stage lift cylinders.

6. Scissor Guard

7. Control Module

The control module contains the fuel tank, hydraulic valve manifold, horn/alarms, batteries, and chassis control panel.

8. Power Module

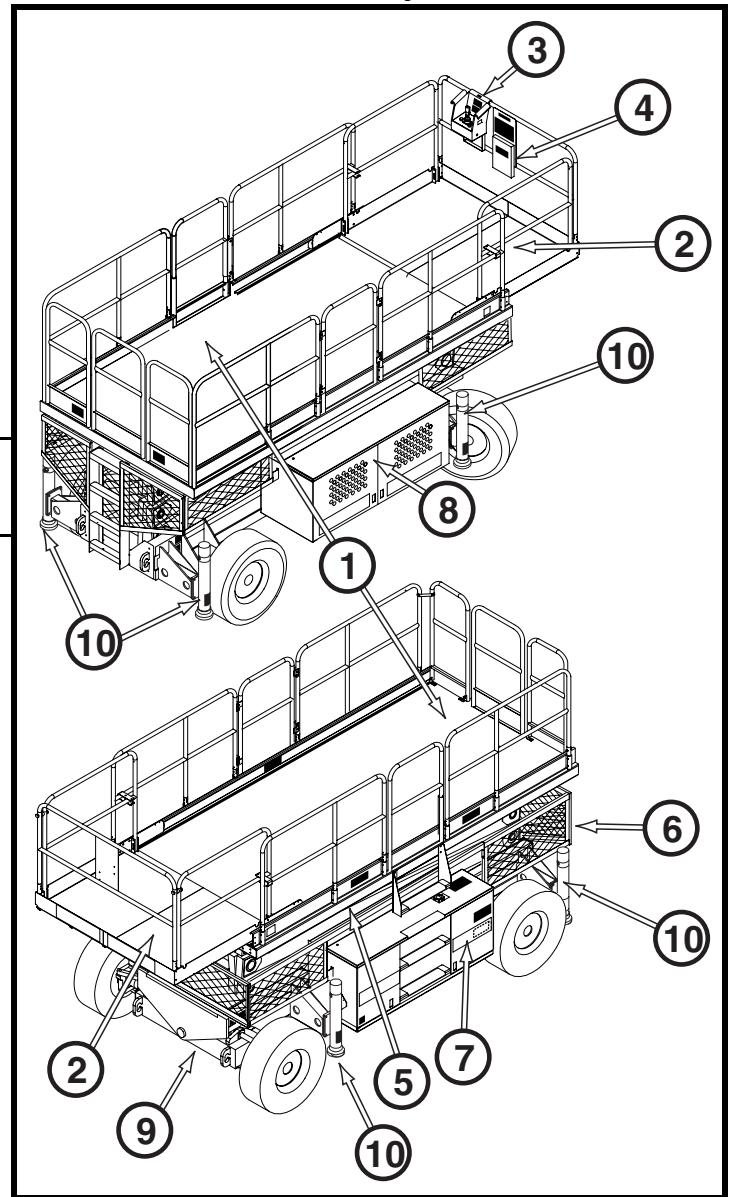
The power module contains the engine, generator, hydraulic pumps, and hydraulic reservoir.

9. Chassis

The chassis is a structural frame that supports all the components of the Work Platform.

10. Outriggers (optional)

Figure 1: LX Serie7s Work Platform



SPECIAL LIMITATIONS

ALL MODELS:

Travel with the platform raised is limited to a creep speed range.

Elevating of the Work Platform is limited to firm, level surfaces only.



The elevating function shall ONLY be used when the work platform is level and on a firm surface.

The work platform is NOT intended to be driven over uneven, rough, or soft terrain.

PLATFORM CAPACITY

The maximum capacity for the MACHINE, including occupants is determined by model and options, and is listed in "Specifications" on page 20.



DO NOT exceed the maximum platform capacity or the platform occupancy limits for this machine.

MANUAL FORCE

Manual force is the force applied by the occupants to objects such as walls or other structures outside the work platform.

The maximum allowable manual force is limited to 200 N (45 lbs.) of force per occupant, with a maximum of 400 N (90 lbs.) for two or more occupants.



DO NOT exceed the maximum amount of manual force for this machine.

BEAUFORT SCALE

Never operate the machine when wind speeds exceed 45 km/h (28 mph) [Beaufort scale 6].

BEAUFORT RATING	WIND SPEED				GROUND CONDITIONS
	m/s	km/h	ft/s	mph	
3	3,4-5,4	12,25-19,4	11.5-17.75	7.5-12.0	Papers and thin branches move, flags wave.
4	5,4-8,0	19,4-28,8	17.75-26.25	12.0-18	Dust is raised, paper whirls up, and small branches sway.
5	8,0-10,8	28,8-38,9	26.25-35.5	18-24.25	Shrubs with leaves start swaying. Wave crests are apparent in ponds or swamps.
6	10,8-13,9	38,9-50,0	35.5-45.5	24.5-31	Tree branches move. Power lines whistle. It is difficult to open an umbrella.
7	13,9-17,2	50,0-61,9	45.5-56.5	31.-38.5	Whole trees sway. It is difficult to walk against the wind.

LIFT OVERLOAD ALARM

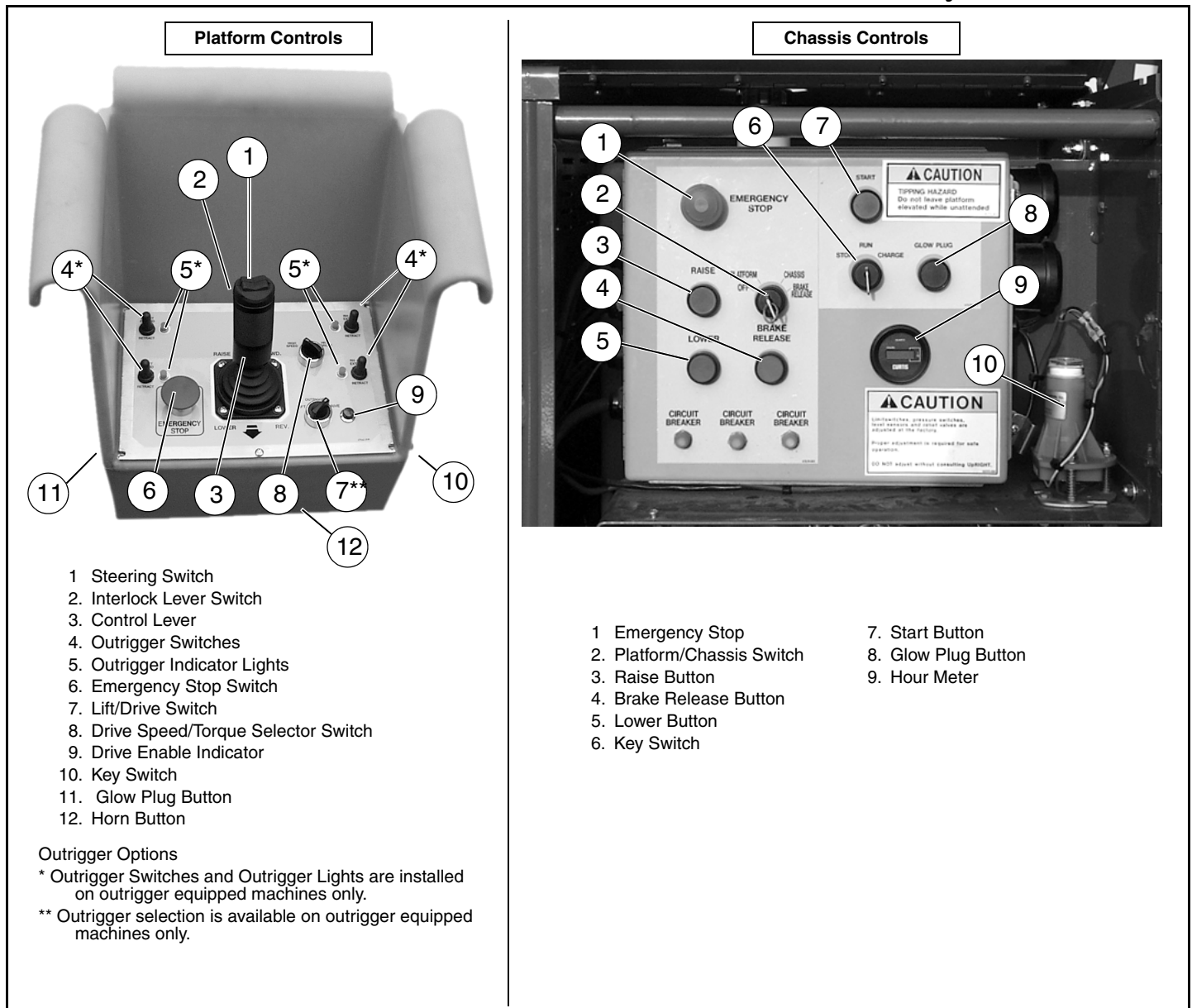
All models include a feature that alerts the operator when the platform load is exceeded. If the alarm sounds during the lift function, lower the platform and reduce the platform load.



Never operate the machine with a platform load greater than the rated capacity.

CONTROLS AND INDICATORS

Figure 2: Controls and Indicators



PRE-OPERATION & SAFETY INSPECTION

NOTE: Carefully read, understand and follow all safety rules, operating instructions, labels and National Safety Instructions/Requirements. Perform the following steps each day before use.

1. Open modules and inspect for damage, fluid leaks or missing parts.
2. Check the hydraulic fluid level sight gauge on the hydraulic tank with the platform fully lowered. Add fluid if necessary.
3. Check that fluid level in the batteries is correct (see "Battery Maintenance" on page 15).
4. **BiEnergy Models** - Check the engine oil level and fuel level.
5. Check that all guardrails are in place, the slide-out deck extension is secured with the pin, and all fasteners are properly tightened.
6. Check tire pressure: 5,2 bar (**75 psi**).
7. Carefully inspect the entire work platform for damage such as cracked welds or structural members, loose or missing parts, fluid leaks, damaged cables or hoses, loose connections and tire damage.
8. **BiEnergy Models** - While the engine is cool, check the engine coolant level.

CAUTION

DO NOT check coolant when engine or radiator is hot; hot coolant can cause severe burns.

SYSTEM FUNCTION INSPECTION

WARNING

STAND CLEAR of the work platform while performing the following checks.

Before operating the work platform, survey the work area for surface hazards such as holes, drop-offs, bumps and debris.

*Check in **ALL** directions, including above the work platform, for obstructions and electrical conductors.*

Protect control console cable from possible damage while performing checks.

1. Move the machine, if necessary, to an unobstructed area to allow for full elevation.
2. Place chassis and platform emergency stop switches in the ON position (Figure 2) by pulling the buttons out.
3. Verify that the Platform/Chassis switch is set to PLATFORM.
4. Turn the Platform Controls key switch clockwise to ON.
 - A. BiEnergy may be powered by batteries or engine. To power by engine:
 - a. Set the Chassis Controls key switch to RUN.
 - b. Start from Chassis Controls**
 - Press the START button to start the engine, releasing the button once the engine starts.
 - c. Start from Platform Controls**
 - Turn the key fully clockwise to start the engine, releasing the key once the engine starts.

NOTE: If the engine is cold, depress the glow plug button and hold for 6 seconds to heat the glow plugs.

5. Position the Lift/Drive switch to the DRIVE position. The drive enable light should be ON.
6. With the speed range switch first in HIGH TORQUE and then in HIGH SPEED, depress the interlock lever switch and slowly push the control lever to FORWARD then REVERSE positions to check for speed and directional control. The farther you push or pull the control lever, the faster the machine will travel.

7. Depress the interlock lever switch and push the steering switch RIGHT then LEFT to check for steering control.
8. Optional Outrigger Equipped Machines:
 - a. With the Lift/Outrigger/Drive switch in DRIVE, depress the interlock lever switch on the control lever and position each Outrigger switch to the EXTEND position.
 - Outriggers should be disabled. If an outrigger extends during this test **STOP**. Remove the machine from service until it is repaired.
 - b. Turn the Drive/Outrigger/Lift switch to OUTRIGGER.
 - c. Depress the interlock lever switch on the control lever and position each Outrigger switch to the EXTEND position to deploy all four (4) outriggers.
 - Check the outrigger indicator lights; they should be ON.
 - d. Depress the Interlock Lever switch on the control lever and position each Outrigger switch to the RETRACT position.
 - Partially retract all four (4) outriggers. The outrigger indicator lights should FLASH.
 - Fully retract all four (4) outriggers. The outrigger indicator lights should be OFF.
9. Open the Control Module covers to gain access to the chassis controls and level sensor.
10. Turn the Platform/Chassis switch to CHASSIS.
11. Push the Raise button to elevate platform while pushing the level sensor off of level. The platform should only partially elevate and the tilt alarm should sound. If the platform continues to elevate and/or there is no alarm, **STOP** and remove the machine from service until it is repaired.
12. Release the level sensor and fully elevate the platform.
13. Visually inspect the elevating assembly, lift cylinder, cables and hoses for damage or erratic operation. Check for missing or loose parts.
14. Lower the platform partially by pushing in on the Lower button, and check operation of the audible lowering alarm.
15. Open the chassis emergency lowering valve to check for proper operation (refer to “Emergency Lowering” on page 10). Once the platform is fully lowered, close the valve by releasing the knob.
16. Turn the Platform/Chassis switch to PLATFORM.
17. Close and secure the module covers.
18. Enter the platform making sure the gate is latched.
19. Position the Lift/Drive switch to LIFT.
20. Depress the interlock lever switch and slowly push the control lever to UP to raise the platform; fully actuate the control lever to check proportional lift speed. Slowly pull the control lever to the DOWN position to lower the platform. Check that the lowering alarm sounds.
21. Optional Outrigger Equipped Machines:
 - a. With the Lift/Outrigger/Drive switch in LIFT, depress the interlock lever switch on the control lever and position any outrigger switch to the EXTEND position.
 - Outriggers should be disabled. If an outrigger extends during this test, **STOP**. Lower the platform and remove the machine from service until it is repaired.
22. Turn the controller key switch to OFF, push the Emergency Stop button, and dismount the platform.

OPERATION

NOTE: Before operating the work platform, ensure that the pre-operation and safety inspection has been completed, any deficiencies have been corrected, and the operator has been thoroughly trained on this machine.

WARNING

Never operate the work platform with the parking brakes released. Serious injury or damage could result.

TRAVEL WITH PLATFORM LOWERED

1. Verify the following:

- the chassis Emergency Stop button is in the ON position (pull out)
- the Drive Enable indicator is ON
- the Platform/Chassis switch is on PLATFORM.

NOTE: If the drive enable indicator is OFF, verify that the platform is fully lowered and (if so equipped) the outriggers are fully retracted.

2. After mounting the platform, close and latch the gate. Check that the guardrails are in position and properly assembled, with the fasteners properly torqued.
3. Check that the route is clear of persons, obstructions, holes and drop-offs, and is capable of supporting the wheel loads.
4. Check clearances above, below and to the sides of the platform.
5. Pull the controller Emergency Stop button out to the ON position.
6. Turn the Platform Controls key switch clockwise to ON.
 - A. BiEnergy may be powered by batteries or engine. To power by engine:
 - a. Set the Chassis Controls key switch to RUN.
 - b. Start from Chassis Controls**
 - Press the START button to start the engine, releasing the button once the engine starts.
 - c. Start from Platform Controls**
 - Turn the key fully clockwise to start the engine, releasing the key once the engine starts.

NOTE: If the engine is cold, depress the glow plug button and hold for 6 seconds to heat the glow plugs.

7. Set the Lift/Drive switch to DRIVE.
8. Set the speed range switch to HIGH TORQUE.
9. Grasp the control lever so that the interlock lever switch is depressed (releasing the interlock lever switch cuts power to controller). Slowly push or pull the control lever to FORWARD or REVERSE to travel in the desired direction. The farther you push or pull the control lever from center, the faster the machine will travel.
10. While moving, push the speed range switch to HIGH SPEED for travel on level surfaces or to HIGH TORQUE for climbing grades or traveling in confined areas.

TRAVEL WITH WORK PLATFORM ELEVATED

Travel with the platform elevated **ONLY** on firm and level surfaces.

NOTE: The work platform will travel at reduced speed when in the elevated position, and only if the front axle is parallel with the rear axle.

1. Check that the route is clear of persons, obstructions, holes and drop-offs, is level and capable of supporting the wheel loads.
2. Check clearances above, below and to the sides of the platform.
3. Position the Lift/Drive switch to the DRIVE position.
4. Push the control lever to FORWARD or REVERSE for the desired direction of travel.
5. If the machine quits driving and the tilt alarm sounds, immediately lower the platform and move the machine to a level location before re-elevating the platform.

STEERING

Push the steering switch **RIGHT** or **LEFT** to turn the wheels. Observe the tires while maneuvering to insure proper direction.

NOTE: Steering is not self-centering. Wheels must be returned to the straight ahead position by operating the steering switch.

RAISING AND LOWERING THE PLATFORM

The machine must be on a firm, level surface, capable of supporting the weight of the machine. On machines equipped with optional outriggers, use the outriggers to level the machine (refer to “Leveling the Platform (Outrigger equipped machines only)” on page 10.

1. Position the Lift/Drive switch to LIFT.
2. While holding the control lever so the interlock lever switch is depressed, push the control lever slowly to UP to raise the platform. Pushing the control lever farther increases the lift speed.
3. When the work task is completed, position the Lift/Drive switch to LIFT, and lower the platform by pulling back on the control lever until the platform is fully lowered.

LEVELING THE PLATFORM (OUTRIGGER EQUIPPED MACHINES ONLY)

⚠ WARNING ⚠

When using outriggers, all four (4) outriggers must be in firm contact with the supporting surface.

OUTRIGGER SWITCHES AND INDICATOR LIGHTS

For each outrigger, there is an outrigger switch and an outrigger indicator light (refer to Figure 2).

Each outrigger switch will raise and lower one outrigger.

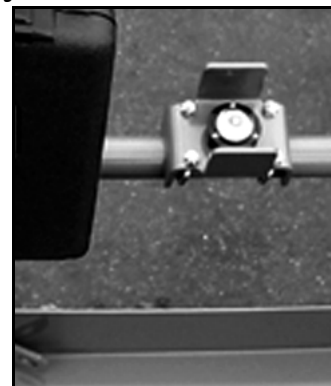
Each outrigger indicator light will indicate the position of one outrigger.

- When the indicator light is OFF - the outrigger is fully retracted.
- When the indicator light is FLASHING - the outrigger is partially extended.
- When the indicator light is ON - the outrigger is in firm contact with the supporting surface.

TO LEVEL THE PLATFORM (EXTEND THE OUTRIGGERS)

Figure 3: Platform Orbit Bubble Level

1. Make sure that the extension deck is retracted before operating the outriggers.
2. Look around the machine; make sure that there is nothing obstructing the outriggers, and that the surface beneath them is suitable to support the weight of the machine.
3. Position the Lift/Outrigger/Drive switch set to OUTRIGGER.
4. Depress the interlock lever switch on the control lever, and operate the outrigger switches to extend each outrigger until it is making firm contact with the supporting surface.
5. While observing the bubble level on the guardrail, extend the outrigger opposite the position of the bubble until the platform is level. For example: if the bubble is to the front and left in the orbit, extend the rear right outrigger. Continue to adjust until the bubble is centered in the small circle indicating that the platform is level.
6. Confirm that all four (4) outriggers are in firm contact with the supporting surface. The outriggers are in contact with the supporting surface when the indicator lights are ON.



TO RETRACT THE OUTRIGGERS

1. Fully lower the platform.
2. Position the Lift/Outrigger/Drive switch set to OUTRIGGER.
3. Depress the interlock lever switch on the control lever, and position each outrigger switch to RETRACT.
 - The outrigger indicator lights will be OFF when the outriggers are fully retracted.
 - The drive enable indicator light will not come on until all four outriggers are fully retracted.

EMERGENCY LOWERING

The emergency lowering control knob is located at the rear of the machine at the base of the scissor assembly.

1. Open the emergency lowering valve by pulling on the knob and holding it.
2. Once the platform is fully lowered, release the knob to close the valve.

Figure 4: Emergency Lowering Valve,



TOWING OR WINCHING

Perform the following only when the machine will not operate under its own power and it is necessary to move the machine or when winching onto a transport vehicle (see “Transporting the Work Platform” on page 13).

CAUTION

DO NOT tow or winch the machine faster than 0,3 m/s (1 ft./s). Faster speeds will damage drive components and void the warranty.

PARKING BRAKE RELEASE

WARNING

Never operate the work platform with the parking brakes released. Serious injury or damage could result.

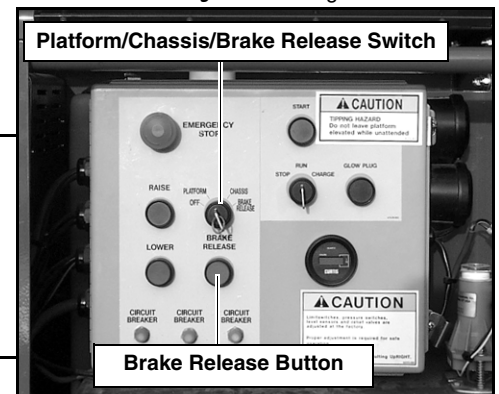
Never release the brakes if the machine is on a slope.

Chock the wheels before releasing the parking brakes.

Hook the machine to a towing vehicle before releasing the parking brakes.

1. Turn the Chassis/Platform/Brake Release switch to the Brake Release position.
 - Alarm will sound
2. Momentarily push the Brake Release button.
3. The machine will now roll when pushed or pulled.
4. For normal operation, turn the Platform/Chassis/Brake Release switch to Platform.
5. Verify that the parking brakes have engaged before the machine is operated.

Figure 5: Parking Brake Release



AFTER USE EACH DAY

1. Ensure that the platform is fully lowered.
2. Park the machine on level ground, preferably under cover, secure against vandals, children or unauthorized operation.
3. Turn the key switch to OFF and remove the key to prevent unauthorized operation.

FOLD DOWN GUARDRAILS

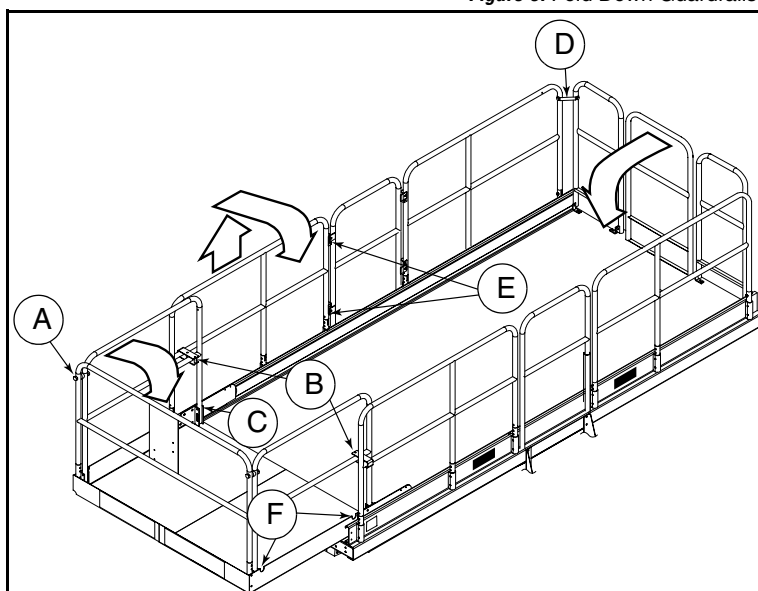
This procedure is only for passing through doorways. Guardrails must be returned to proper position before using the machine.

Figure 6: Fold Down Guardrails

FOLD DOWN PROCEDURE

NOTE: When performing the following procedures, retain all fasteners.

1. Place the controller on the platform.
2. Starting at the slide-out deck:
 - remove nuts, bolts and washers from the top front corners of guardrails (A)
 - remove the nuts, bolts and washers from the slide-out deck side guardrail mid-rails (B)
 - remove nuts, bolts and washers located at the top of the sockets that hold the slide-out deck side guardrails to the deck (C)
 - fold the side guardrails down onto the slide-out deck platform
 - leave the end rail up and slide the deck all the way in.
3. Go to the rear of the platform:
 - close and latch the rear gate
 - remove the nuts, bolts, washers, and corner brackets from the top of the rear guardrail
 - fold the rear guardrail down onto the platform, being careful to keep the gate latched.
4. Unlatch the side gate so the left side guardrails can be folded down in two separate pieces. Also remove the nuts, bolts and washers opposite the gate latch on the right side guardrail so it too can be separated into two pieces (E).
5. Fold the rear half of the side guardrails onto the deck:
 - lift up and fold down so the guardrails rest on the deck, on top of the rear guardrail.
6. Fold the front half of the side guardrails onto the deck:
 - lift up and fold down so the guardrails rest on the slide-out deck, with the guardrail posts resting in the cutouts on the slide-out deck toeboard (F).
7. Lift up and fold down the front slide-out deck guardrail.



ERECTION PROCEDURE

1. Raise the front guardrail, making sure it is pushed down to secure the guardrail in the vertical position.
2. Raise the side guardrails, making sure each is pushed down to secure the guardrail in the vertical position; align holes and install bolts, washers and nuts. Tighten securely.
3. Raise one of the slide-out deck side guardrail assemblies; align holes and install bolts, washers and nuts. Tighten securely. Repeat this procedure for the other slide-out deck side guardrails.
4. Raise the rear guardrail, and install the corner brackets, nuts, bolts and washers.
5. Hang the controller from the front guardrail.
6. Before operating work platform check that all fasteners are in place and properly torqued.

⚠ WARNING ⚠

Before operating machine, guardrails must be securely fastened in their proper position.

TRANSPORTING THE WORK PLATFORM

PREPARATION FOR SHIPMENT

1. Fully lower the platform.
2. Disconnect the battery negative (-) lead from the battery terminal.
3. Band the controller to the front guardrail.
4. Band the elevating linkage to the frame.

LIFTING BY CRANE

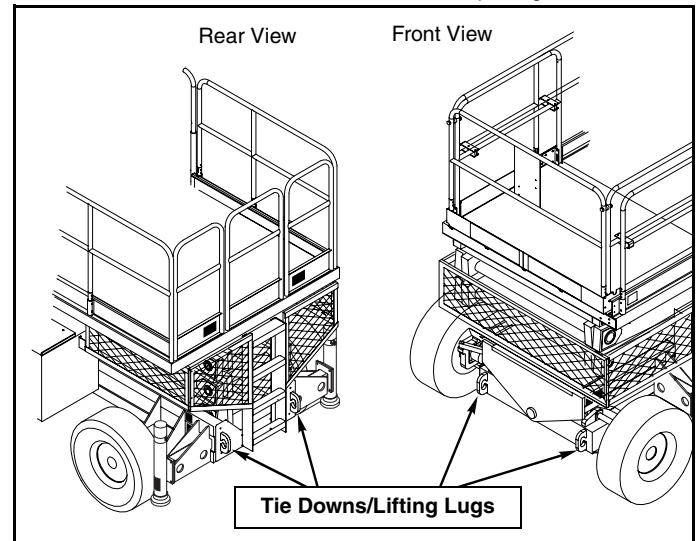
1. Secure straps to chassis tie down/lifting lugs only.
2. Place the platform onto the transport vehicle in transport position.
3. Chock the wheels.
4. Secure the work platform to the transport vehicle with chains or straps of adequate load capacity attached to the chassis tie down/lifting lugs.

DRIVING OR WINCHING ONTO A TRUCK OR TRAILER

NOTE: Do not winch faster than 0,3 m/s (1 ft/s).

1. Move the machine onto the truck or trailer;
 - A. To **Drive** the machine onto the transport vehicle:
 - a. Move the work platform up the ramp and into transport position.
 - b. Set the wheels straight and turn off the machine.
 - c. Chock the wheels.
 - B. To **Winch** the machine onto the transport vehicle:
 - a. Move the work platform up to the ramp.
 - b. Attach the winch cable to the tie down/lifting lugs.
 - c. Release the parking brakes (refer to "Towing or Winching" on page 11).
 - d. Winch the platform into transport position
 - e. Chock the wheels.
2. Secure the work platform to the transport vehicle with chains or straps of adequate load capacity attached to the chassis tie down/lifting lugs.

Figure 7: Transporting Work Platform



CAUTION

Overtightening of chains or straps through tie down/lifting lugs may result in damage to the work platform.

MAINTENANCE

BLOCKING THE ELEVATING ASSEMBLY

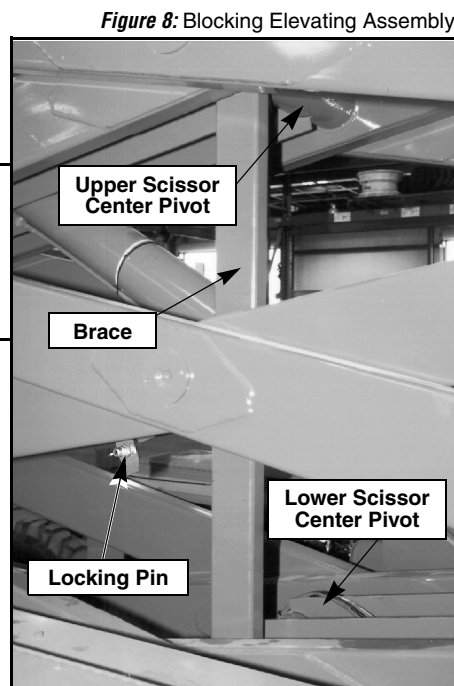
⚠ WARNING ⚠

Never perform service on the work platform in the elevating assembly area while the platform is elevated without first blocking the elevating assembly.

DO NOT stand in elevating assembly area while deploying or storing brace.

BRACE INSTALLATION

1. Park the work platform on firm, level ground.
2. Verify that the platform Emergency Stop button is ON.
3. Turn the Platform/Chassis switch to CHASSIS.
4. Start the engine, using the chassis controls.
5. Push the Throttle button in. The button will stay in and the engine speed will increase. Using the Raise button, elevate the platform until the scissor brace can be rotated to the vertical position.
6. From the left side of the machine, disengage the locking pin securing the brace. Rotate the scissor brace counterclockwise until it is vertical and between the two scissor center pivots.
7. Push the Lower button and gradually lower the platform until the brace is supporting the platform.
8. Disengage the throttle by pushing the Throttle button in again. The button will retract and the engine will come to idle speed.



BRACE REMOVAL

1. Using the chassis controls, gradually raise the platform until the scissor brace clears the two scissor center pivots.
2. Rotate the scissor brace clockwise until the locking pin engages.
3. Push the Lower button to completely lower the platform.
4. Make sure the Throttle button is disengaged and Platform/Chassis switch is on PLATFORM.

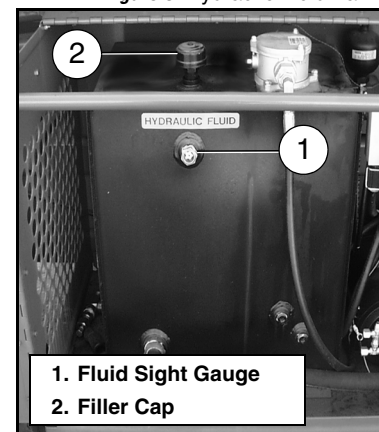
HYDRAULIC FLUID

The hydraulic fluid tank is located in the Power Module.

NOTE: Never add fluid if the platform is elevated.

1. Make sure that the platform is fully lowered.
2. Check fluid level by observing the fluid sight gauge
3. Remove the filler cap to fill with the appropriate fluid.

Figure 9: Hydraulic Fluid Tank



BATTERY MAINTENANCE

The batteries are located in the Control Module.

⚠ WARNING ⚠

Hazard of explosive gas mixture. Keep sparks, flame, and smoking material away from battery.

Always wear safety glasses when working with batteries.

Battery fluid is highly corrosive. Thoroughly rinse away any spilled fluid with clean water.

Always replace batteries with UpRight batteries or manufacturer approved replacements weighing 48 kg (106 lbs.) each.

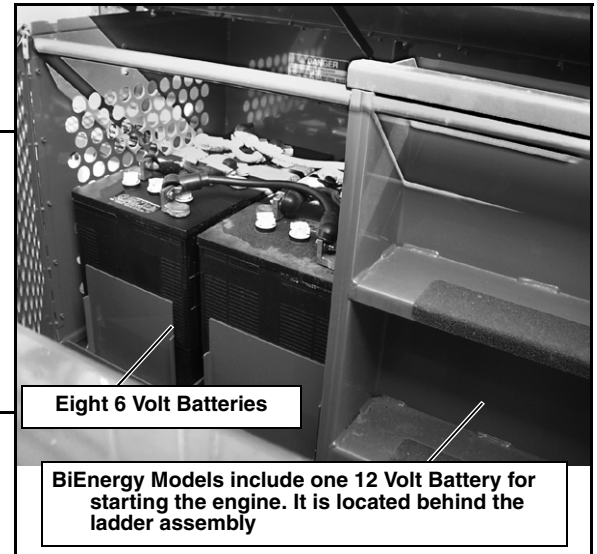
Check battery fluid level daily, especially if the work platform is being used in a warm, dry climate.

If the electrolyte level is lower than 10 mm (3/8 in.) above plates, add distilled water ONLY. Do not use tap water with high mineral content; it will shorten battery life.

The battery and cables should be inspected regularly for signs of cracks in the case, electrolyte leakage and corrosion of the terminals. Inspect the cables for worn spots or breaks in the insulation and for broken cable terminals.

Refer to the Service Manual to extend battery life and for complete service instructions.

Figure 10: Battery Location



ENGINE AND GENERATOR (BIENERGY MODELS)

Figure 11: Engine

COOLANT

The coolant recovery tank is mounted on the inside of the door of the power module.

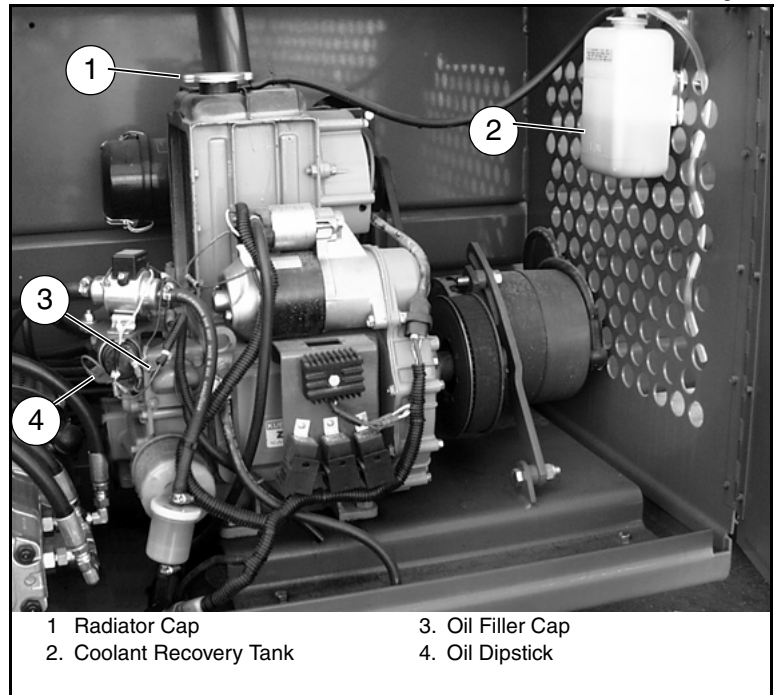
1. Remove the cap on the coolant recovery tank.
2. Add coolant to the "FULL" mark.

NOTE: Never remove the radiator cap when the engine is hot.

OIL

The engine **must not be running** when you check and replenish the engine oil. Refer to the Service Manual to change the oil filter.

1. Remove the oil dipstick and check the level indicator marks.
2. If the level is low, remove the oil filler cap.
3. Replenish with the proper engine oil (refer to the engine service manual that came with the machine).



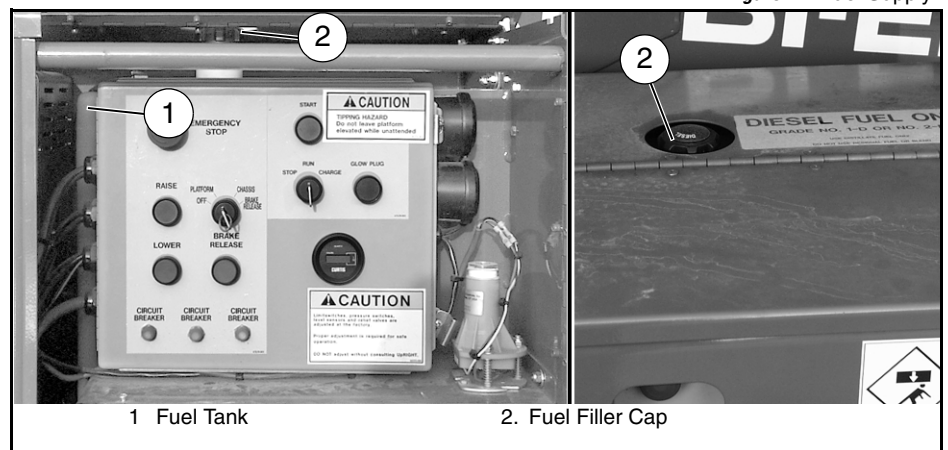
CAUTION

DO NOT check coolant when engine or radiator is hot; hot coolant can cause severe burns.

FUEL

The fuel tank for is located in the Control Module, behind the chassis controls. The tank is translucent. Check the fuel level by observing the level of the liquid through the tank.

Figure 12: Fuel Supply



PREVENTATIVE MAINTENANCE SCHEDULE

The complete inspection consists of periodic visual and operational checks, along with periodic minor adjustments to assure proper performance. Daily inspection will prevent abnormal wear and prolong the life of all systems. The inspection and maintenance schedule is to be performed at regular intervals. Inspection and maintenance shall be performed by personnel who are trained and familiar with mechanical and electrical procedures.

! WARNING !

Before performing preventative maintenance, familiarize yourself with the operation of the machine.

Always block the elevating assembly whenever it is necessary to enter the scissor assembly to perform maintenance while the platform is elevated (see page 14).

The daily preventative maintenance table has been designed for machine service and maintenance repair. Please photocopy the Daily Preventative Maintenance Check List and use the table as a checklist when inspecting the machine for service.

DAILY PREVENTATIVE MAINTENANCE CHECK LIST

MAINTENANCE TABLE KEY

Y = Yes/Acceptable

N = No/Not Acceptable

R = Repaired/Acceptable

MAINTENANCE REPORT

Date: _____

Owner: _____

Model No: _____

Serial No: _____

Serviced By: _____

COMPONENT	INSPECTION OR SERVICES	Y	N	R
Batteries	Check electrolyte level			
Chassis	Check hoses for pinch or rubbing points			
	Check welds for cracks			
Control Cable	Check the exterior of the cable for pinching, binding or wear			
Controller	Check switch operation			
Drive Motors	Check for operation			
Elevating Assembly	Inspect for structural cracks			
Emergency Lowering System	Operate the emergency lowering valve and check for serviceability			
Entire Unit	Check for and repair collision damage			
Hydraulic fluid	Check fluid level			
Hydraulic Pump	Check for hose fitting leaks			
Hydraulic System	Check for leaks			

COMPONENT	INSPECTION OR SERVICES	Y	N	R
Labels	Check for peeling, missing, or unreadable labels & replace			
Platform Deck and Rails	Check welds for cracks			
	Check condition of deck			
Tires and Wheels	Check for damage			
Engine Oil and Filter	Check level and condition			
	Check for leaks			
Engine Fuel System	Check fuel level			
	Check for leaks			
	Check air cleaner			
Engine Coolant	Check coolant level (with engine cold)			

LABELS

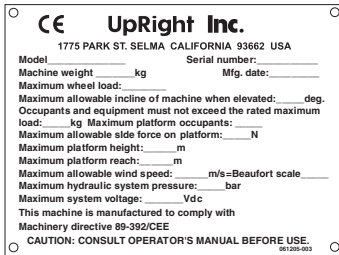
These labels shall be present and in good condition before operating the work platform. Be sure to read, understand and follow these labels when operating the work platform.



2 010076-001



4 060197-000



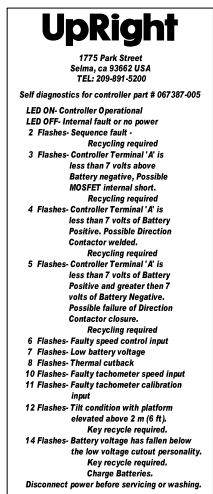
5 061205-003



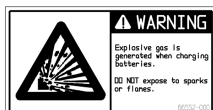
6 030768-002



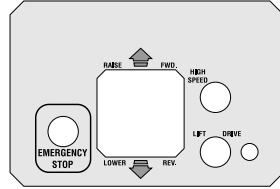
7 067822-001



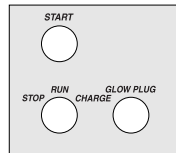
8 067365-000



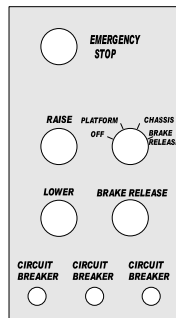
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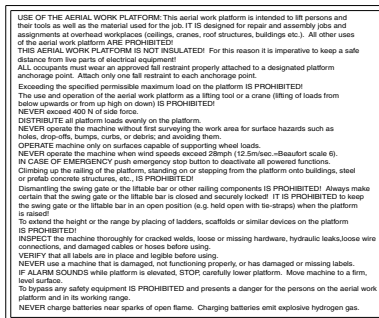
11 067642-012
(Outrigger Units:
067642-010)



12 067638-002



13 067639-001



14 067195-001



17 062562-002



22 066562-000



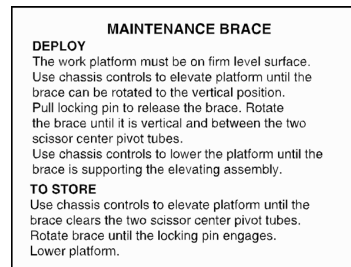
25 027898-001



26 LX31: 066557-060



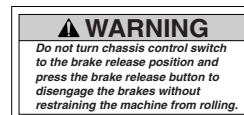
26 LX41: 066557-057



38 066561-001



40 066558-001



41 068641-003



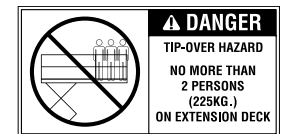
42 064936-099



43 068639-000



44 066556-000



45 066551-051

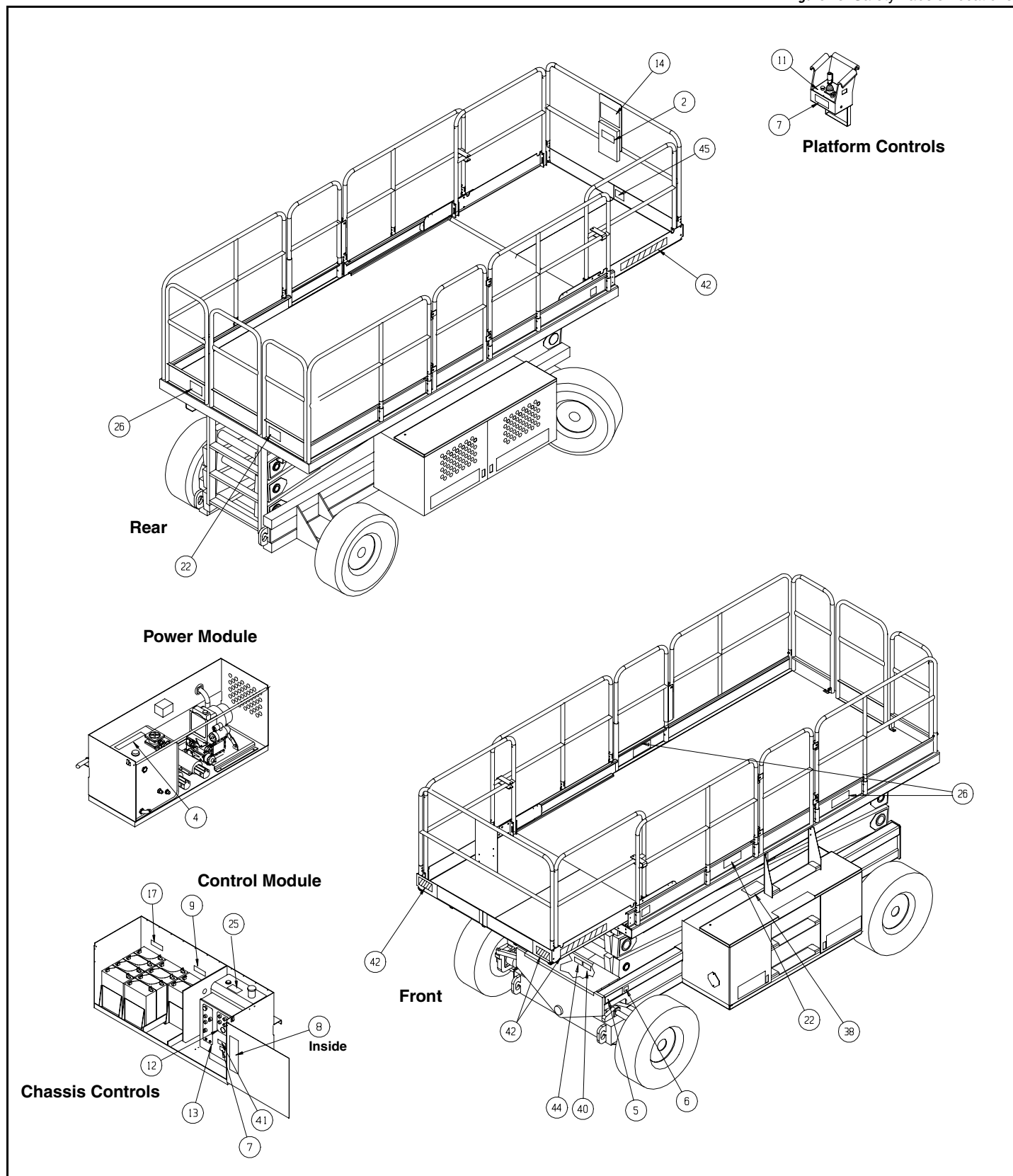


46 066556-001
(Outrigger Units)



47 066551-003
(Outrigger Units)

Figure 13: Safety Labels Locations



SPECIFICATIONS

Specifications subject to change without notice. Refer to the Service Manual for service and repair information. Refer to the Parts Manual for illustrated parts breakdown. Hot weather or heavy use may reduce performance. Meets or exceeds all applicable national safety requirements

ITEM	LX31	LX41
Platform Size (Inside toeboards)		
Standard	3,96 m x 1,73 m [156 in x 68 in.]	3,96 m x 1,73 m [156 in x 68 in.]
Slide-out Deck Extended	4,83 m x 1,73 [190 in. x 68 in.]	4,83 m x 1,73 [190 in. x 68 in.]
Max. Platform Capacity		
Standard	907 kg [2,000 lbs.]	680 kg [1,500 lbs.]
With Rear Deck Option	794 kg [1750 lbs.]	567 kg [1,250 lbs.]
On Extension	227 kg [500 lbs.]	227 kg [500 lbs.]
Max. No. of occupants		
Standard	5 people	5 people
With Rear Deck Option	5 people	4 people
Height		
Working Height	11,45 m [37 ft. 6 in.]	14,34 m [47 ft. 3 in.]
Max. Platform Height	9,45 m [31 ft.]	12,34 m [40 ft. 6 in.]
Min. Platform Height	1,43 m [56.3 in.]	1,66 m [65.3 in.]
Drivable Height	9,45 m [31 ft.]	12,34 m [40 ft. 6 in.]
Dimensions		
Weight, Standard	4586 kg [10,110 lbs.]	5298 kg [11,680 lbs.]
Electric	4745 kg [10,461 lbs.]	5457 kg [12,031 lbs.]
Weight, Dual Deck	4917 kg [10,840 lbs.]	5629 kg [12,410 lbs.]
Electric	5076 kg [11,191 lbs.]	5788 kg [12,760 lbs.]
BiEnergy		
Overall Width	2,29 m [90 in.]	2,29 m [90 in.]
Overall Height, guardrails up	2,53 m [99.8 in.]	2,76 m [109 in.]
Overall Height, guardrails lowered	1,64 m [64.5 in.]	1,87 m [73.5 in.]
Overall Length, deck in	4,02 m [160 in.]	4,02 m [160 in.]
Overall Length, deck extended	4,89 m [192 in.]	4,89 m [192 in.]
Surface Speed		
Platform Lowered	0 to 5,0 km/h [0 to 3.1 mph]	0 to 5,0 km/h [0 to 3.1 mph]
Platform Raised	0 to 0,48 km/h [0 to 0.5 mph]	0 to 0,48 km/h [0 to 0.5 mph]
System Voltage	48 Volt DC	48 Volt DC
Hydraulic Tank Capacity	107 liters [28.3 US Gallons]	107 liters [28.3 US Gallons]
Maximum Hydraulic System Pressure	207 bar [3000 psi]	207 bar [3000 psi]
Hydraulic Fluid		
Normal Temperature: above 0° C [32° F]	ISO #46	ISO #46
Low Temperature: below 0° C [32° F]	ISO #32	ISO #32
Extreme Temperature: below -17° C [0° F]	ISO #15	ISO #15
Lift System	One Single Stage Lift Cylinder	One Single Stage Lift Cylinder
Lift Speed	Raise: 50 sec. Lower: 52 sec.	Raise: 57 sec. Lower: 60 sec.
Power Source	Eight 6V 350 AH Batteries	Eight 6V 350 AH Batteries
Electric	Diesel 12 HP Kubota	Diesel 12 HP Kubota
BiEnergy includes		
Drive Control	Proportional	Proportional
Control System	Smooth one-hand Joystick	Smooth one-hand Joystick
Horizontal Drive	Two Electric Wheel Motors	Two Electric Wheel Motors
Tires	10-16.5 NHS 8 Ply	10-16.5 NHS 8 Ply
Tire Air Pressure	5,2 bar [75 psi.]	5,2 bar [75 psi.]
Parking Brakes	Dual Disc, Spring Applied, Hydraulic Release	Dual Disc, Spring Applied, Hydraulic Release
Turning Radius (inside)	1,22 m [48 in.]	1,22 m [48 in.]
Maximum Gradeability	17° [30%]	17° [30%]
Wheel Base	2,9 m [114.5 in.]	2,9 m [114.5 in.]
Ground Clearance	0,24 m [9.5 in.]	0,24 m [9.5 in.]
Guardrails	1.1 m [43.5 in.] high, Fold Down with gate.	1.1 m [43.5 in.] high, Fold Down with gate.
Noise Level	BiEnergy Model	

GENERAL INFORMATION

This section contains generic instructions for the repair and maintenance of UpRight Aerial Work Platforms. Referring to the Operator Manual will aid in understanding the operation and function of the various components and systems of the machine, and help in diagnosing and repair of the machine.

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1-1 HAZARD INDICATORS



Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.



Indicates a potentially hazardous situation which, if not avoided, may result in damage to the machine.

1-2 WORKSHOP PROCEDURES

Detailed descriptions of standard workshop procedures, safety principles and service operations are not included. Please note that this manual does contain warnings and cautions against some specific service methods which could cause personal injury, or could damage a machine or make it unsafe. Please understand that these warnings cannot cover all conceivable ways in which service, whether or not recommended by UpRight, Inc., might be done, or of the possible hazardous consequences of each conceivable way, nor could UpRight Inc. investigate all such ways. Anyone using service procedures or tools, whether or not recommended by UpRight Inc., must satisfy themselves thoroughly that neither personal safety nor machine safety will be jeopardized.



Be sure to read, understand and follow all safety rules, operating instructions, and the Scaffold Industry Association's MANUAL OF RESPONSIBILITIES of ANSI A92.6-1999 before performing maintenance on or operating any UpRight Aerial Work Platform.



Never perform service on the machine in the elevating assembly area while platform is elevated without first blocking the elevating assembly.

DO NOT stand in elevating assembly area while deploying or storing brace.

Refer to the Operator Manual for elevating assembly blocking instructions.

1-3 TORQUE SPECIFICATIONS

HYDRAULIC COMPONENTS

NOTE: Always lubricate threads with clean hydraulic fluid prior to installation

Use the following values to torque hydraulic components used on UpRight Aerial Work Platforms.

Table 1-1: Torque Specifications for Hydraulic Components

Type: SAE Port Series	Cartridge Poppet		Fittings		Hoses	
	Ft/Lbs	Nm	Ft/Lbs	Nm	In/Lbs	Nm
#4	N/A	N/A	N/A	N/A	135-145	15-16
#6	N/A	N/A	10-20	14-27	215-245	24-28
#8	25-30	34-41	25-30	34-41	430-470	49-53
#10	35-40	47-54	35-40	47-54	680-750	77-85
#12	85-90	115-122	85-90	115-122	950-1050	107-119
#16	130-140	176-190	130-140	176-190	1300-1368	147-155

FASTENERS

This standard applies to the preloading of fasteners measured by installation torque.

NOTE: For other preloading methods or fasteners consult UpRight Engineering Department.

This general standard applies to all SAE and Metric fasteners unless otherwise specified.

THREAD CONDITION

- For lubricated or zinc plated fasteners use $K = .15$
- For dry unplated fasteners use $K = .20$

TORQUE TABLES

Table 1-2: Torque Specifications for SAE Fasteners



		 SAE J429 Grade 5			 SAE J429 Grade 8		
Nominal Thread Size		Clamp Load	Tightening Torque		Clamp Load	Tightening Torque	
			$K = .15$	$K = .20$		$K = .15$	$K = .20$
		lbs.	in-lbs.	in-lbs.	lbs.	in-lbs.	in-lbs.
Unified Coarse Thread Series	1/4 -20	2,000	75	100	2850	107	143
	5/16 - 18	3,350	157	210	4700	220	305
		lbs.	ft-lbs.	ft-lbs.	lbs.	ft-lbs.	ft-lbs.
	3/8-16	4,950	23	31	6950	32.5	44
	7/16-14	6,800	37	50	9600	53	70
	1/2-13	9,050	57	75	12800	80	107
	9/16-12	11,600	82	109	16400	115	154
	5/8-11	14,500	113	151	20300	159	211
	3/4-10	21,300	200	266	30100	282	376
	7/8-9	29,435	321	430	41550	454	606
	1-8	38,600	483	640	54540	680	900
Nominal Thread Size		Clamp Load	Tightening Torque		Clamp Load	Tightening Torque	
			$K = .15$	$K = .20$		$K = .15$	$K = .20$
		lbs.	in-lbs.	in-lbs.	lbs.	in-lbs.	in-lbs.
Unified Fine Thread Series	1/4 -28	2,300	85	115	3250	120	163
	5/16-24	3,700	173	230	5200	245	325
		lbs.	ft-lbs.	ft-lbs.	lbs.	ft-lbs.	ft-lbs.
	3/8-24	5,600	26	35	7900	37	50
	7/16-20	7,550	42	55	10700	59	78
	1/2-20	10,200	64	85	14400	90	120
	9/16-18	13,000	92	122	18300	129	172
	5/8-18	16,300	128	170	23000	180	240
	3/4-16	23,800	223	298	33600	315	420
	7/8-14	32,480	355	473	45855	500	668
	1-12	42,270	528	704	59670	745	995

Table 1-3: Torque Specifications for Metric Fasteners, U.S. Customary Units

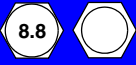
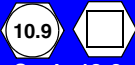

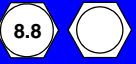
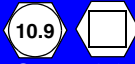

Nominal Thread Size	 Grade 8.8			 Grade 10.9			 Grade 12.9		
	Clamp Load	Tightening Torque		Clamp Load	Tightening Torque		Clamp Load	Tightening Torque	
		K =,15	K =,20		K =,15	K =,20		K =,15	K =,20
mm	lbs.	in-lbs.	in-lbs.	lbs.	in-lbs.	in-lbs.	lbs.	in-lbs.	in-lbs.
3	-	-	-	-	-	-	823	14.6	19.5
3.5	-	-	-	-	-	-	1,109	22.9	30.5
4	-	-	-	-	-	-	1,436	33.9	45.2
5	1,389	41.0	54.7	1,987	58.7	78.2	2,322	68.6	91.2
6	1,966	69.7	92.9	2,813	100.0	132.8	3,287	116.8	155.8
7	2,826	116.8	155.8	4,044	167.3	223.0	4,727	195.6	260.2
		ft-lbs.	ft-lbs.		ft-lbs.	ft-lbs.		ft-lbs.	ft-lbs.
8	3,579	14.1	18.8	5,122	20.1	26.9	5,986	23.6	31.4
10	11,742	27.9	37.2	8,117	39.9	53.3	9,486	46.7	62.3
12	8,244	48.7	64.9	11,797	69.7	92.2	13,787	81.1	108.4
14	11,246	77.4	103.3	16,093	110.6	147.5	18,808	129.1	172.6
16	15,883	125.4	166.7	21,971	173.3	230.9	25,677	202.1	269.2
18	19,424	171.9	229.4	26,869	238.2	317.2	31,401	278.1	371.0
20	2,304	243.4	325.3	34,286	337.8	449.9	40,070	394.6	525.9
22	30,653	331.9	442.5	42,403	458.8	612.2	49,556	536.2	715.4
24	35,711	420.4	562.0	49,400	583.4	778.1	57,733	682.2	909.4
27	46,435	617.3	84.8	64,235	853.4	1138.1	75,069	997.2	1329.8
30	56,753	837.9	1117.4	78,509	1159.4	1545.2	91,751	1354.9	1807.0
33	70,208	1140.3	1520.1	97,121	1576.9	2102.8	113,503	1843.9	2457.5
36	82,651	1464.1	1952.3	114,334	2025.3	2700.9	133,620	2367.6	3156.0

Table 1-4: Torque Specifications for Metric Fasteners, SI Units

Nominal Thread Size	 Grade 8.8			 Grade 10.9			 Grade 12.9		
	Clamp Load	Tightening Torque		Clamp Load	Tightening Torque		Clamp Load	Tightening Torque	
		K =,15	K =,20		K =,15	K =,20		K =,15	K =,20
mm	N	N-m	N-m	N	N-m	N-m	N	N-m	N-m
3	-	-	-	-	-	-	3660	1,65	2,2
3,5	-	-	-	-	-	-	4932	2,59	3,45
4	-	-	-	-	-	-	6387	3,83	5,11
5	6177	4,63	6,18	8840	6,63	8,84	10330	7,75	10,3
6	8743	7,87	10,5	12512	11,3	15	14623	13,2	17,6
7	12570	13,2	17,6	17990	18,9	25,2	21025	22,1	29,4
8	15921	19,1	25,5	22784	27,3	36,5	26626	32	42,6
10	52230	37,8	50,5	36105	54,1	72,2	42195	63,3	84,4
12	36670	66	88	52475	94,5	125	61328	110	147
14	50025	105	140	71587	150	200	83663	175	234
16	70650	170	226	97732	235	313	114218	274	365
18	86400	233	311	119520	323	430	139680	377	503
20	10250	330	441	152513	458	610	178238	535	713
22	136350	450	600	188618	622	830	220433	727	970
24	158850	570	762	219743	791	1055	256808	925	1233
27	206550	837	115	285728	1157	1543	333923	1352	1803
30	252450	1136	1515	349223	1572	2095	408128	1837	2450
33	312300	1546	2061	432015	2138	2851	504885	2500	3332
36	367650	1985	2647	508582	2746	3662	594368	3210	4279

1-4 DATE CODE IDENTIFICATION ON HOSES

GATES uses an eight digit code: Plant, Month, Day, Year.
i.e.: XX 01 07 01 - means Plant XX January 07 2001.

PARKER uses a 4 digit code indicating Quarter and Year.
i.e.: 2Q01 - means Second Quarter of 2001.

DAYCO stamps month, day and year on each hose.

1-5 SPECIAL TOOLS

The following is a list of special tools which may be required to perform certain maintenance procedures on the machine.

- 0-100 bar (**0-1000 psi**) Hydraulic Pressure Gauge with Adapter Fittings
- 0-200 bar (**0-3000 psi**) Hydraulic Pressure Gauge with Adapter Fittings
- 0-500 bar (**0-6000 psi**) Hydraulic Pressure Gauge with Adapter Fittings
- Small UpRight Connector Field Kit (UpRight P/N 030899-000)
- Large UpRight Connector Field Kit (UpRight P/N 030898-000)
- Inclinator (UpRight P/N 010199-000-00)
- MOS90 Calibrator (UpRight P/N 057128-000)
- Optimizer with adapter (UpRight P/N 100329-000)
- Flow Meter Kit (UpRight P/N 067040-000)
- Quadragauge with fitting (UpRight P/N 063971-000)
- 0-25 kg (**0-50 Lbs.**) Chain Tension Scale (UpRight P/N 107078-000)

UPRIGHT LIFT TOOL LIST

- Gland Nut Wrench (UpRight P/N 062521-000)
- Strap Wrench (UpRight P/N 062482-000)
- Tierod Tensioner (2 required) (UpRight P/N 062738-000)
- Tensioner Bracket (2 required) (UpRight P/N 062739-000)

1-6 UPRIGHT CONNECTORS

UpRight connectors are designed so that connector parts, contacts or electrical cables may be replaced without replacing the entire connector.

Figure 1-1: UpRight Connector Kits



Small Kit

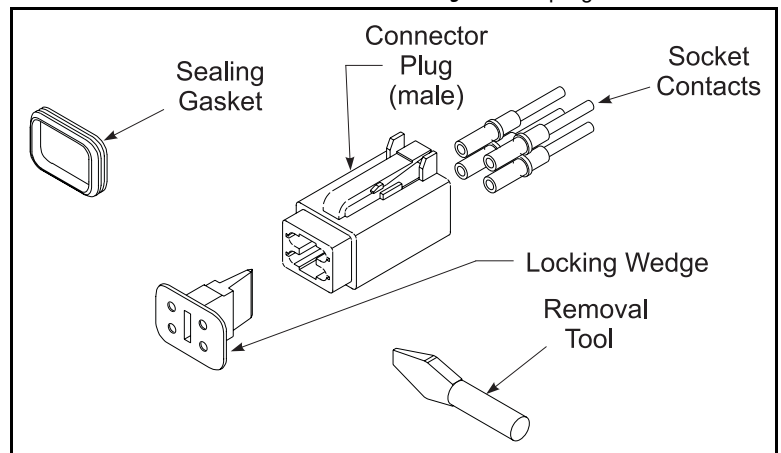


Large Kit

MALE CONNECTOR (PLUG)

1. Disconnect the male connector (plug) from the female connector (receptacle).
2. Using the flat end of the Removal Tool (or flat blade screwdriver), pry the Locking Wedge from the Male Connector. Care should be taken that the Sealing Gasket is not damaged during this procedure.
3. Check all parts for damage. Replace all parts which are damaged or worn.
4. Replace or re-crimp the wires and contacts. Refer to "Crimping" procedure.

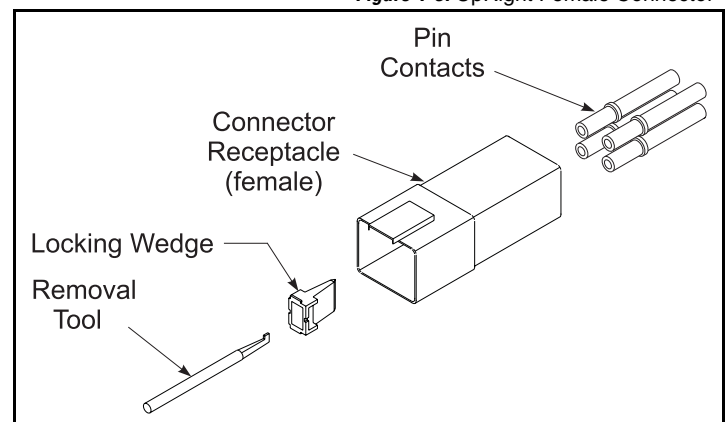
Figure 1-2: UpRight Male Connector



FEMALE CONNECTOR (RECEPTACLE)

1. Disconnect the male connector (plug) from the female connector (receptacle).
2. Using the notched end of the Removal Tool (or a wire hook), pull the Locking Wedge from the Female Connector.
3. Check all parts for damage. Replace all parts which are damaged or worn.
4. Replace or re-crimp the wires and contacts. Refer to "Crimping" procedure.

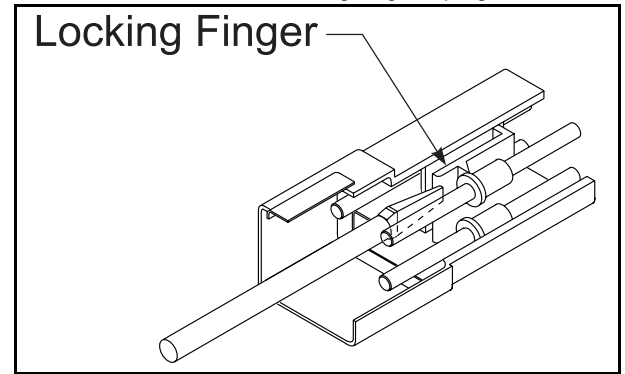
Figure 1-3: UpRight Female Connector



RELEASING LOCKING FINGERS

1. The Locking Fingers can be released following the removal of the Locking Wedge of either the male or female connector.
2. Use the removal tool (or flat bladed screwdriver) to push the Locking Fingers aside. This will release the grip on the contact.
3. Pull the wire and contact out of the connector.

Figure 1-4: Locking Finger, UpRight Connector



CRIMPING

1. Strip 6 mm ($\frac{1}{4}$ in.) from the wire.

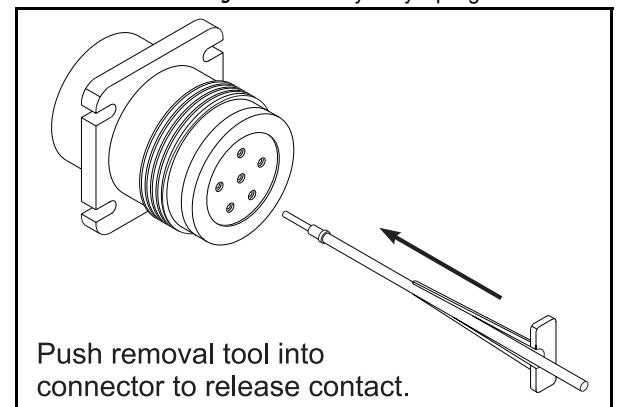
NOTE: Complete crimping instructions are included in each Field Kit.

2. Insert the contact into the crimping tool.
3. Insert the stripped wire into the contact. Copper strands should be visible in the bleed hole of the contact and no copper strands should be loose (outside) of the contact barrel.
4. Completely close the handles of the crimping tool. Release the handles of the crimping tool and remove the crimped contact.
5. Inspect the crimped contact to ensure that all strands are secure in the crimp barrel.

REMOVING CONTACT FROM HEAVY DUTY PLUG

Figure 1-5: Heavy Duty UpRight Connector

1. Slip the removal tool along the wire to be replaced.
2. Push the removal tool into the connector until the contact is released.
3. Pull the wire and contact out of the plug.



1-7 HYDRAULIC MANIFOLD REPAIR

REMOVAL

Refer to the *Service and Repair* section for model specific information.

1. Disconnect the battery.
2. Tag and disconnect the solenoid valve leads.
3. Tag, disconnect, and plug hydraulic hoses.
4. Remove the bolts that hold the manifold to the mounting bracket.
5. Remove the manifold block.

DISASSEMBLY

NOTE: Mark all components as they are removed so as not to confuse their location during assembly.

1. Remove coils from solenoid valves.
2. Remove valves.
3. Remove fittings, plugs, springs, balls, and orifices.

CLEANING AND INSPECTION

1. Wash the manifold in cleaning solvent to remove built-up contaminants, then blow out all passages with clean compressed air.
2. Inspect the manifold for cracks, thread damage and scoring where O-rings seal against internal and external surfaces.
3. Wash and dry each component and check for thread damage, torn or cracked O-rings, and proper operation.
4. Replace parts and O-rings found unserviceable.

ASSEMBLY

Refer to the *Service and Repair* section for assembly drawings, and the *Parts Manual* for illustrated parts breakdowns.

NOTE: Lubricate all O-rings before installation to prevent damage to O-rings. Seat all balls in manifold block by lightly tapping on the ball with a brass drift punch.

1. Install fittings, plugs, springs, balls, and orifices. Use one drop of Loctite #242 on each screw-in orifice.
2. Install valves.

INSTALLATION

Refer to the *Service and Repair* section for model specific information.

1. Attach manifold assembly to mounting plate with bolts.
2. Connect solenoid leads (as previously tagged).
3. Connect hydraulic hoses. Be certain to tighten hoses to manifold.
4. Reconnect the battery.
5. Operate each hydraulic function and check for proper operation and leaks.
6. Adjust valve pressures according to the *Service and Repair* section.

1-8 CYLINDER REPAIR



Cylinders may be very heavy. Support heavy cylinders before removing pins which secure the cylinder to the machine.

REMOVAL

NOTE: Refer to the *Service and Repair* section for the location of cylinders, and the *Parts Manual* for a list of parts which secure the cylinders.

1. Mark and disconnect hoses and IMMEDIATELY cap the openings to prevent contamination.
2. Remove the cylinder from the machine as described in the *Service and Repair* section.

DISASSEMBLY

1. Remove the head from the cylinder body.
2. Carefully slide the rod assembly out of the cylinder.
3. Remove the seal kit components (wipers, rod seals, o-rings and backup rings) from the head and piston.
4. Inspect parts for scratches, pits or polishing. Check seal grooves and sealing surfaces. Scratches or pits deep enough to catch the fingernail are unacceptable; replace the cylinder. Polishing is a sign of uneven loading. When this occurs, the surface should be checked for roundness. Cylinders not round within 0,18 mm (.007 in.) should be replaced.

ASSEMBLY

Refer to the *Service and Repair* section for seal-kit assembly drawings, and the *Parts Manual* for illustrated parts breakdowns.

NOTE:

- To avoid cutting the seals, do not use sharp edged tools during seal replacement. After installing seals allow at least one hour for the seals to elastically restore to their original shape before assembling the cylinder.
- Torque all hardware to torques according to Table 1-1, "Torque Specifications for Hydraulic Components," on Page 1-3 unless otherwise specified.

1. Lubricate all components with clean hydraulic fluid.
2. Install new seal kit components.
3. Lubricate the rod wiper and seal with hydraulic fluid and slide the head onto the rod.
4. Lubricate the seals on the piston and head.
5. Carefully slide the rod assembly into the cylinder.
6. Secure the head into the cylinder.

INSTALLATION

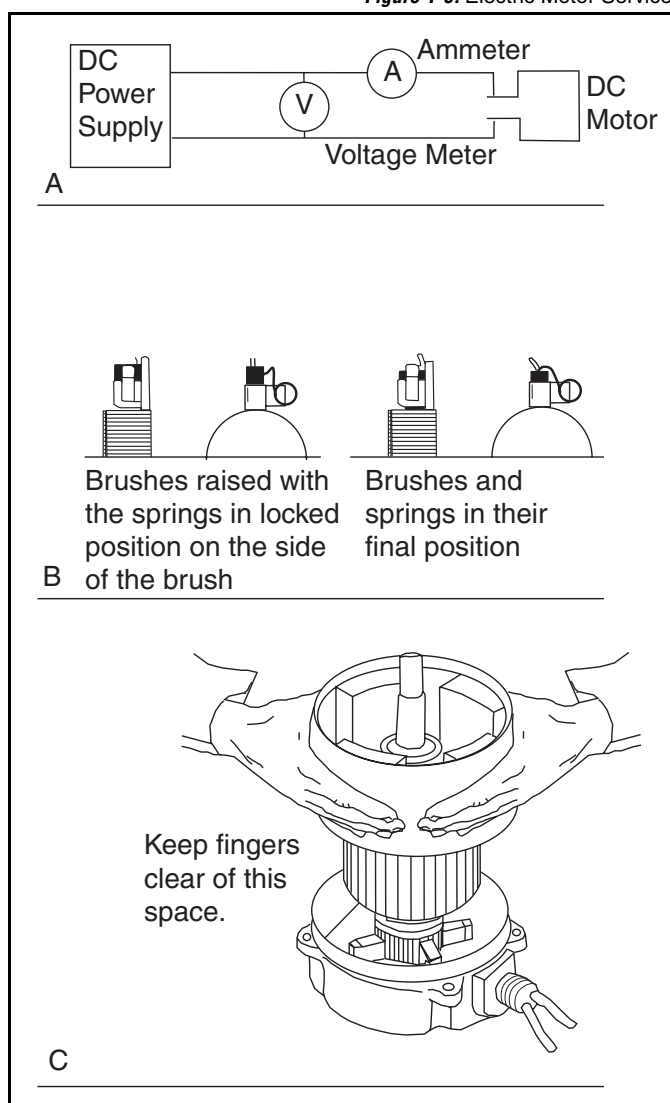
1. Installation is reverse of removal.
2. Carefully remove the elevating assembly support.
3. Slowly cycle the cylinder several times to remove air from the hydraulic system.
4. Check for proper cylinder operation. Check hydraulic connections for leaks.

1-9 ELECTRIC MOTORS

TROUBLESHOOTING

1. Read the nameplate to become familiar with the motor, especially the rated voltage.
2. Try to turn the shaft by hand. Keep motor leads separated while doing this. If the shaft turns freely go to Step 3. If the shaft won't turn, proceed to Step A.
- A. The shaft could be tight for a number of reasons, this check is to determine if the tightness is of a temporary nature only.
 - a. Obtain power to produce the nameplate voltage. **Do not Make a Permanent Connection.**
 - b. First touch the motor leads quickly to the power supply just long enough to observe if the shaft turns.
 - c. If it does turn, then hold the motor leads on the power supply for a longer time. If the motor sounds normal, go to Step 3..
 - d. If the motor sounds noisy, it should be taken apart as described in the disassembly section.
3. If the motor turned freely, connect an ammeter in the circuit as shown in Figure 1-6A. With rated voltage applied and the shaft running free, the ammeter should read less than 20% of the nameplate full load current. If the motor meets the above conditions, then it can be assumed that the original problem is external to the motor.

Figure 1-6: Electric Motor Service



DISASSEMBLY

1. Remove the through bolts.
2. Remove the pulley end cover.
3. Pull the armature out of the assembly in one swift motion.
4. Remove the commutator end cover.

NOTE: Do not place the stator ring in any mechanical holding device during the disassembly or assembly operation. Permanent distortion or other damage will result.

INSPECTION

Once the motor has been disassembled, go through the following check-list steps to determine where the problem lies.

1. Bearings should spin smoothly and easily and have ample lubrication and be free of corrosion.
2. The armature should be checked for grounds and shorted turns. Re-finish the commutator surface if it is pitted or excessively worn. (This procedure should be performed by a qualified electric motor shop.)
3. Brushes should be checked for wear and to ensure that they are free in the brush holders.

NOTE: Observe how the brushes are assembled in the brush holders, and the position of the brush lead. New brushes must be installed in the same manner. Brushes should be removed as follows:

- a. Remove the brush spring clip from its mounting on the brush assembly.
 - b. Lift the brush assembly from the brush holder.
 - c. Disconnect the brush assembly lead.
 - d. Install the new brush assembly by reversing the above procedure.
4. Inspect the wire harness and all connections for signs of damage due to overheating.
 5. Check the stator to see if it is securely mounted.

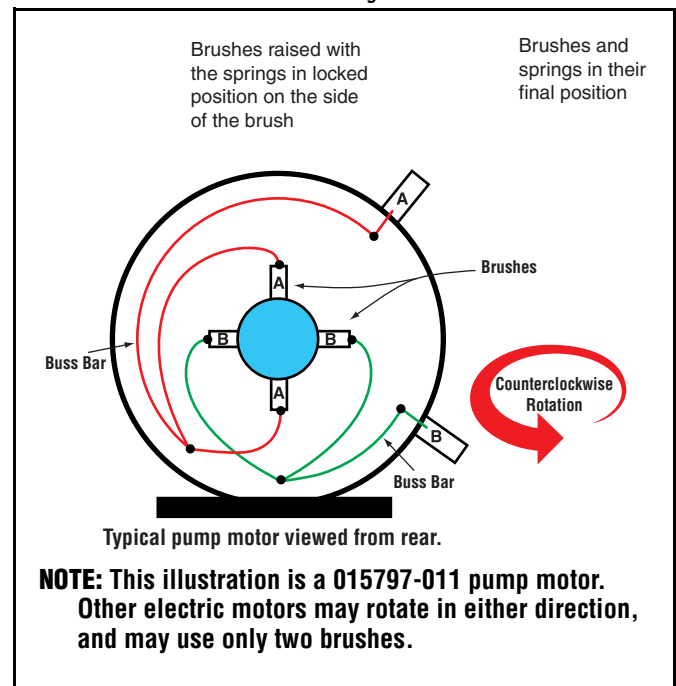
REASSEMBLY

1. Install new brushes and be sure they are free in the holder. Install the brush with the lead wires positioned as when received. Raise all brushes to the locked position. (See Figure 1-7 and **Inspection** Step 3.)
2. Place the commutator cover on a work bench with the brush assembly facing upward.
3. Place the bearing spring into the bearing bore.
4. Take a complete armature assembly, including bearings, and insert the commutator end bearing into the bearing bore.

NOTE: Do not re-use bearings which have been removed from the armature shaft. Keep the assembly in a vertical position. Use extreme care not to damage the armature with bearing pullers. New bearings should be installed by pressing the inner race of the bearing onto proper position on the armature shaft.

5. Set the brushes into their final position as shown in Figure 1-7.
6. Place the complete stator down over the vertical armature, and into position on the commutator cover.
7. The stator assembly must be placed in a definite relationship with the commutator covers in order to obtain a neutral brush setting. There is a match-mark on both items. These two marks must line up exactly. Rotate until they do.
8. Assemble the pulley end cover in the proper relationship. Insert the mounting bolts and tighten alternately to ensure a good mechanical alignment.
9. Spin the shaft by hand to see if it is free. Be sure motor leads (if used) are not touching together. If the leads are touching, a generator action will give the effect of friction in the motor. A no-load test can now be performed. At the rated voltage, observe the no-load current. It should be less than 20% of the name-plate full load current. Anything higher indicates:
 - Brushes are not on neutral setting (check match-marks for exact alignment).
 - Faulty armature.

Figure 1-7: Electric Motor Brushes



1-10 BATTERY MAINTENANCE

CAUTION

If battery water level is not maintained, batteries will not fully charge, creating a low discharge rate.

⚠ WARNING ⚠

Hazard of explosive gas mixture. Keep sparks, flame and smoking materials away from batteries.

Always wear safety glasses when working with batteries.

Battery fluid is highly corrosive. Thoroughly rinse away any spilled fluid with clean water.

Always replace batteries with UpRight batteries or manufacturer approved replacements.

Before disconnecting the battery negative (-) lead, make sure all switches are OFF. If ON, a spark will occur at the ground terminal which could cause an explosion if hydrogen gas or fuel vapors are present.

- Check battery fluid level daily.
- If electrolyte level is lower than 10 mm (**3/8 in.**) above plates, add distilled water only.
DO NOT use tap water with high mineral content. It will shorten battery life.
DO NOT overfill. Battery acid expands during charging and can overflow.
- Keep terminals and tops of batteries clean.
- The battery and cables should be inspected regularly for signs of cracks in the case, electrolyte leakage and corrosion of the terminals. Inspect the cables for worn spots or breaks in the insulation and for broken cable terminals.
- Clean batteries whenever there are signs of corrosion at the terminals, or when electrolyte has overflowed during charging. Use a baking soda solution to clean batteries, taking care not to get the solution inside the cells. Rinse thoroughly with clean water.
- Clean battery and cable contact surfaces to a bright metal finish whenever a cable is removed.

BATTERY CHECK

Electric UpRight Aerial Work Platforms use deep cycle batteries. If poor service life is experienced, batteries should be checked for bad cells. Fully charge batteries for 14 hours minimum, ensuring that the charger has completed its cycle (see 'Battery Charging' on page 1-14).

Deep cycle batteries do not have their full potential until they have been through 50 charge/discharge cycles. Normal 5-day weeks, charging batteries every day, equals 50 cycles in ten weeks.

If bad cells are found in any battery in a battery pack more than two years old, all batteries in the pack should be replaced for balance.

BATTERY CELL EQUALIZATION

The specific gravity of the electrolyte in the battery cells should be equalized monthly. To do this, charge batteries as outlined in 'Battery Charging' on page 1-14. After this initial charge, recheck the electrolyte level in all cells and add distilled water as necessary. Then, turn on the charger for an additional eight hours.

SPECIFIC GRAVITY

Check the specific gravity of all cells with a hydrometer. The temperature corrected specific gravity of a fully charged battery should be 1.260. If any corrected readings are below 1.230, the batteries containing such cells should be replaced.

Do not check the specific gravity in a cell to which water has just been added. If there is not enough electrolyte in a fully charged cell to obtain a sample for the hydrometer, add water and complete a discharge/charge cycle before checking.

Table 1-5: Specific Gravity and Battery Voltage

SPECIFIC GRAVITY		VOLTS DC				
	Each Cell	Per Cell	6V Battery	12V Battery	24V Battery Pack	48V Battery Pack
Fully Charged	1.270	2.10	6.30	12.60	25.20	50.40
Fully Discharged	1.130	1.75	5.25	10.50	21	42

LOAD TESTING BATTERY PACKS

1. Fully charge the battery pack.
2. With the battery pack at rest and under full load, perform steps 3 and 4.
 - a. To put the battery pack under full load,
 - Activate the steering switch to turn the wheels fully in either direction.
 - Continue to hold the steering switch while performing steps 3 and 4.
3. Measure the potential across each battery.
4. Measure the potential across the entire battery pack.
5. Compare the measured results

Any battery that measures 10% lower voltage than the others has a bad cell and should be replaced.

BATTERY CHARGING

CAUTION

Permanent damage will result if the battery is not immediately recharged after discharging.

WARNING

Charge batteries only in a well ventilated area.

DO NOT charge batteries when sparks or open flames are present.

Never leave the connected charger unattended for more than two days.

Never disconnect the cables from the battery when the charger is operating.

Keep the charger dry.




- Charge batteries at the end of each work shift or sooner if the batteries have been discharged.
- Discharging a deep cycle battery to less than 1.75 Volts per cell can cause permanent damage.

NOTE: Do not operate the machine when the battery charger is plugged in.

When night temperatures fall below 65°F (18°C), batteries charged in unheated areas should be charged as soon after use as possible. Under such conditions a four hour charge cycle once a week in the early afternoon will improve the state of charge and battery life.

1. Check the battery fluid level. If electrolyte level is lower than 10 mm (**3/8 in.**) above plates, add distilled water only.
2. Check the charger to determine the AC charging current. If equipped, set the AC voltage selector switch to match the AC power source.
3. Connect an extension cord that meets or exceeds the charger AC current onto the charger plug.
4. Connect the other end of the extension cord to a grounded AC outlet of proper current, voltage and frequency rating.
5. The charger turns on automatically after a short delay. Table 1-6 illustrates charging indicators.

Table 1-6: Battery Charging, UpRight Electric and BiEnergy Machines

Charger Display	AC Charging Current		Charging Indicator	Charger Shutdown
	068574-000	8 Amp - 115 VAC	Ammeter <ul style="list-style-type: none"> • Charging current is displayed on ammeter. • Current drops off as batteries charge. 	<ul style="list-style-type: none"> • Charger shuts off automatically. • Ammeter shows "0" current.
	069112-000	4 Amp - 230 VAC		
	063944-001	7 Amp - 115 VAC	Green Light <ul style="list-style-type: none"> • ON during charging cycle. • Blinking at charge completion. 	<ul style="list-style-type: none"> • Charger automatically shuts down to 1 amp trickle charge. • Green Light continues to blink.
	063948-003	4 Amp - 230 VAC		
	069199-000 & 069199-001 Dual Voltage	8 Amp - 115 VAC 4 Amp - 230 VAC	Three Lights <ul style="list-style-type: none"> • 0 - 50% charge: First Light -Blinking- Second and Third Light -OFF- • 50% - 75% Charge: First Light -ON- Second Light -Blinking- Third Light -OFF- • 75% - 100% Charge: First and Second Light -ON- Third Light - Blinking- • Charge Complete All Lights -ON- 	<ul style="list-style-type: none"> • Charger automatically shuts down to low current after charging is complete and all Lights turn ON. • Charger continues at low current (equalizing charge) for 3-4 hours, then charging current shuts off completely. • Lights remain ON until the AC power supply is disconnected.

BATTERY CHARGER TROUBLESHOOTING

CAUTION

Ensure that battery chargers with voltage selector switches are set on the correct AC line voltage before placing chargers in service to avoid charger failure.

Connect battery leads in correct polarity to avoid charger damage.

WARNING




Remove all power before working on electrical parts to avoid shock.

Shock hazard can exist if AC plugs are wired incorrectly.

The battery charger troubleshooting procedure is outlined in Table 1-7. The table shows various conditions for each charger type with the problem to be investigated. Follow the table from the top down when troubleshooting. If the problem is not resolved after going through the entire table, the charger should be replaced.

NOTE: The majority of chargers returned to UpRight as “failed” test good. Please follow the troubleshooting procedures carefully.

Table 1-7: Battery Charger Troubleshooting

				
Problem	068574-000 (115V) 069112-000 (110/230V)	063944-001 (115V) 063948-003 (110/230V)	069199-000 & 069199-001 (115/230V auto)	Solution
Battery voltage is below 18 Volts (too low to allow the charger to turn on).	<ul style="list-style-type: none"> Ammeter does not move. No hum from charger. 	<ul style="list-style-type: none"> No green Light. No hum from charger. 	<ul style="list-style-type: none"> Not Applicable. Charger turns on even with very low battery voltage. 	Charge batteries to at least 24 Volts with an external charger, then disconnect the external charger and plug in the internal charger.
The charger has been plugged into an AC outlet with different voltage than the AC switch setting on the charger.	<ul style="list-style-type: none"> Ammeter does not move. No hum from charger. 	<ul style="list-style-type: none"> No green Light. No hum from charger. 	<ul style="list-style-type: none"> Not Applicable. Charger automatically adjusts to the incoming AC current. 	063944-001 ONLY <ul style="list-style-type: none"> Check the fuse inside the switch box - replace if bad. If the fuse is good, the charger has failed. All Others <ul style="list-style-type: none"> Check the AC main circuit breaker and reset if necessary. Set the voltage selector switch to the proper voltage.
Fuse visible on front of charger has failed.	<ul style="list-style-type: none"> Ammeter does not move. No hum from charger. 	<ul style="list-style-type: none"> Not Applicable. 	<ul style="list-style-type: none"> Not Applicable. 	Check for DC output short circuit and replace the fuse.
AC power problem.	<ul style="list-style-type: none"> Ammeter does not move. No hum from charger. 	<ul style="list-style-type: none"> No green Light. No hum from charger. 	<ul style="list-style-type: none"> No Lights ON. No Lights blinking. 	<ul style="list-style-type: none"> AC outlet is bad. Extension cord is bad Plug is bad or wired wrong. AC wire is broken. Check and repair as necessary.
DC connection to batteries.	<ul style="list-style-type: none"> Ammeter does not move. No hum from charger. 	<ul style="list-style-type: none"> No green Light. No hum from charger. 	<ul style="list-style-type: none"> All three Lights blink once. 	Connection to battery; <ul style="list-style-type: none"> missing. corroded. wrong polarity. DC wire broken. Check and repair as necessary, and check Fuse.
One or more batteries is bad.	<ul style="list-style-type: none"> Ammeter never shuts off, even after 14 hours of charging. 	<ul style="list-style-type: none"> Green Light ON but never starts blinking, even after 14 hours of charging. 	<ul style="list-style-type: none"> Lights one and two are ON or blinking, but all three Lights ON never occurs, even after 14 hours of charging. 	<ul style="list-style-type: none"> Check water level. Check for shorted cells. Replace bad batteries.
AC input voltage too high.	<ul style="list-style-type: none"> Not Applicable. 	<ul style="list-style-type: none"> Not Applicable. 	<ul style="list-style-type: none"> All three Lights blink two times. 	Check and correct AC source.
Overheated charger.	<ul style="list-style-type: none"> Not Applicable. 	<ul style="list-style-type: none"> Not Applicable. 	<ul style="list-style-type: none"> All three Lights blink three times. 	Move the machine to a cooler area. Allow the machine to cool before connecting to AC source.
High current in DC charging output.	<ul style="list-style-type: none"> Not Applicable. 	<ul style="list-style-type: none"> Not Applicable. 	<ul style="list-style-type: none"> All three Lights blink four times. 	<ul style="list-style-type: none"> Check for shorted DC output wires. Check for bad batteries.

1-11 FLOOR LOADING

Floor Loading is defined as pressure imposed onto load-bearing surfaces, and can be measured as **Localized Pressure** or **Occupied Pressure**. To calculate Floor Loading, find the Total Weight of the machine.

TOTAL WEIGHT = MACHINE WEIGHT + MAXIMUM PLATFORM CAPACITY.

Refer to the machine specifications or contact UpRight or your UpRight dealer.

LOCALIZED PRESSURE

KG/CM² OR PSI

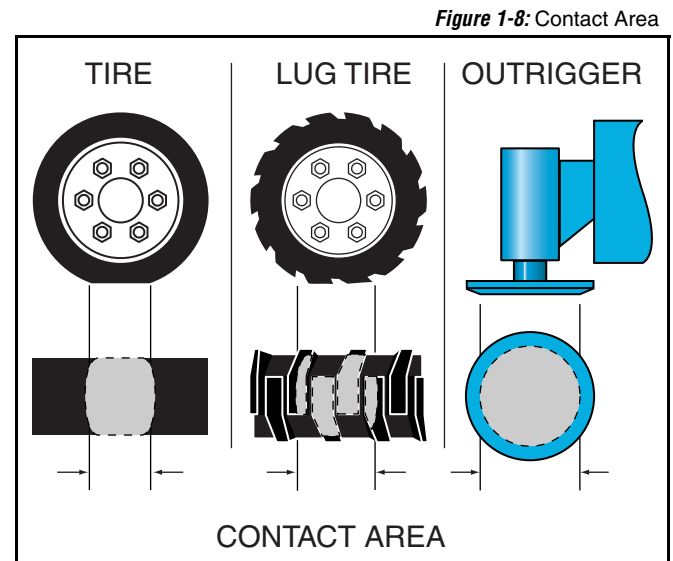
Localized Pressure is measured in *kilograms per square centimeter (pounds per square inch)*. It is the pressure exerted onto a small area (contact area). Each tire and/or outrigger imposes Localized Pressure which can cause damage to the load-bearing surface.

NOTE: The formulas shown here are for vertical lift machines. Applying these formulas to machines with extending platforms will yield average pressures for machines in stowed position. Extending a platform causes increased localized pressure in the direction of extension, and decreased localized pressure at the opposite end.

MEASURE THE CONTACT AREA

Measure the contact area of the contacting surface (tire or outrigger).

The tire contact area can be determined by placing the loaded tire on a clean surface. The tire will leave an imprint from which an area can be determined.



CALCULATE THE LOCALIZED PRESSURE

Find the pressure exerted at each contacting surface.

NOTE: The wheel load can usually be found on a label on the machine, or on the serial plate.

If you know the wheel load, use this formula:

LOCALIZED PRESSURE = WHEEL LOAD ÷ CONTACT AREA

If you do not know the wheel load, use this formula:

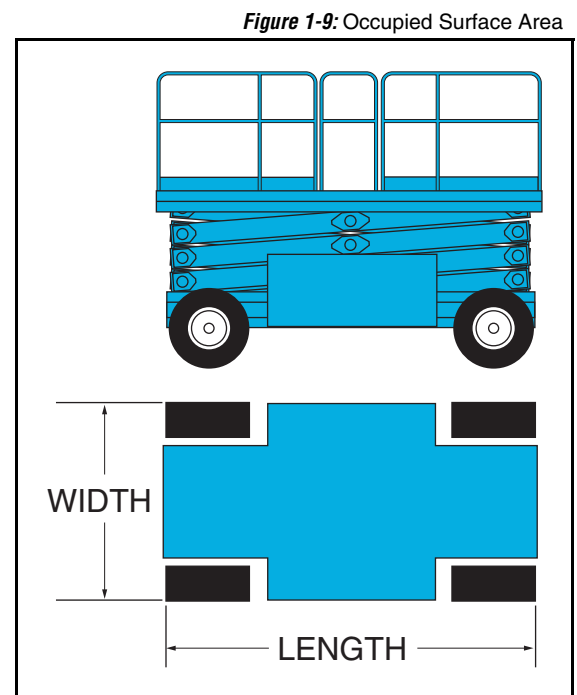
LOCALIZED PRESSURE = (TOTAL WEIGHT ÷ 4) ÷ CONTACT AREA

OCCUPIED PRESSURE

KPA OR PSF

Occupied Pressure is measured in *kilopascals or pounds per square foot*. It is the total pressure imposed onto the work surface over the area of the machine (occupied surface area). This is especially important when the work surface is supported by beams. The Occupied Pressure *must not exceed* the maximum load that the surface can support.

OCCUPIED PRESSURE = TOTAL WEIGHT ÷ (LENGTH X WIDTH)



1-12 HYDRAULIC FLUID

FLUID LEVEL

With the platform fully lowered, check the hydraulic fluid level. If the fluid is NOT in operating range, add hydraulic fluid until the fluid level is in operating range.

- DO NOT fill above operating range.
- DO NOT add fluid when the platform is elevated.

RECOMMENDED HYDRAULIC FLUID

CAUTION

Unless recommended by UpRight, do not mix hydraulic fluids of different brands or types. The required additives and fluid viscosities may vary.

If the use of hydraulic fluids other than listed below is desired please contact UpRight Product Support.

MOBILFLUID 424

- Viscosity Grade: ISO 46 High V.I. (similar to SAE 10W-30).
- Viscosity index: 152.
- Operating Range: -10° C to +96° C (+15° F to +205° F) Reservoir Temperature.
- Ambient Conditions*: Above -10° C (+15° F).

MOBIL DTE 13 M

- Viscosity Grade: ISO 32 High V.I. (similar to SAE 5W-20).
- Viscosity index: 140.
- Operating Range: -18° C to +80° C (-4° F to +176° F) Reservoir Temperature.
- Ambient Conditions*: -18° C to +30° C (-4° F to +86° F).

MOBIL DTE 11 M

- Viscosity Grade: ISO 15.
- Viscosity index: 140.
- Operating Range: -35° C to +45° C (-30° F to +115° F) Reservoir Temperature.
- Ambient Conditions*: -35° C to +20° C (-30° F to +70° F).

MOBIL EAL ENVIROSYN 46 H

For use where a *biodegradable non-toxic hydraulic fluid is required*.

- Viscosity Grade: ISO 46 High V.I. (similar to SAE 10W-20).
- Viscosity Index: 153.
- Operating Range: -14° C to +90° C (+6° F to +195° F) Reservoir Temperature.
- Ambient Conditions*: -14° C to +41° C (+6° F to +105° F).
- Synthetic Ester Base.

The anti-wear quality of hydraulic fluid must meet or exceed API Service Classification GL-3. The chemical stability of the hydraulic fluid must be sufficient for mobile hydraulic system service.

*Ambient Conditions are for reference only and may vary by model. Refer to operating temperature for final determination of correct fluid.

1-13 LONG TERM STORAGE

NOTE: Do not drain the hydraulic system prior to long term storage.

If the machine is to be placed in long term storage, follow these recommended preservation procedures.

PRESERVATION

1. Clean painted surfaces. If paint is damaged, repaint.
2. Fill the hydraulic reservoir to operating level.

IMPORTANT: Do not fill the hydraulic reservoir while the platform is elevated.

3. Coat exposed portions of cylinder rods with a preservative such as multipurpose grease and wrap with a barrier material.
4. Coat all exposed unpainted metal surfaces with preservative.
5. **Internal Combustion Models:** Service the engine according to the manufacturers recommendations.
6. **Electric And BiEnergy Models:** Remove the batteries and place them in alternative service.

SERVICE AND REPAIR

This section contains instructions for the maintenance of the machine. Refer to the General Information section for information relevant to all UpRight work platforms. Referring to the Operator Manual will aid in understanding the operation and function of the various components and systems of the machine, and help in diagnosing and repair of the machine.

WARNING

Be sure to read, understand and follow all information in the Operation Section of this manual before attempting to operate or perform service on any UpRight Aerial Work Platform.

DANGER

Never perform service on the machine in the elevating assembly area while platform is elevated without first blocking the elevating assembly.

DO NOT stand in elevating assembly area while deploying or storing brace.

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2-1 GENERAL DESCRIPTION

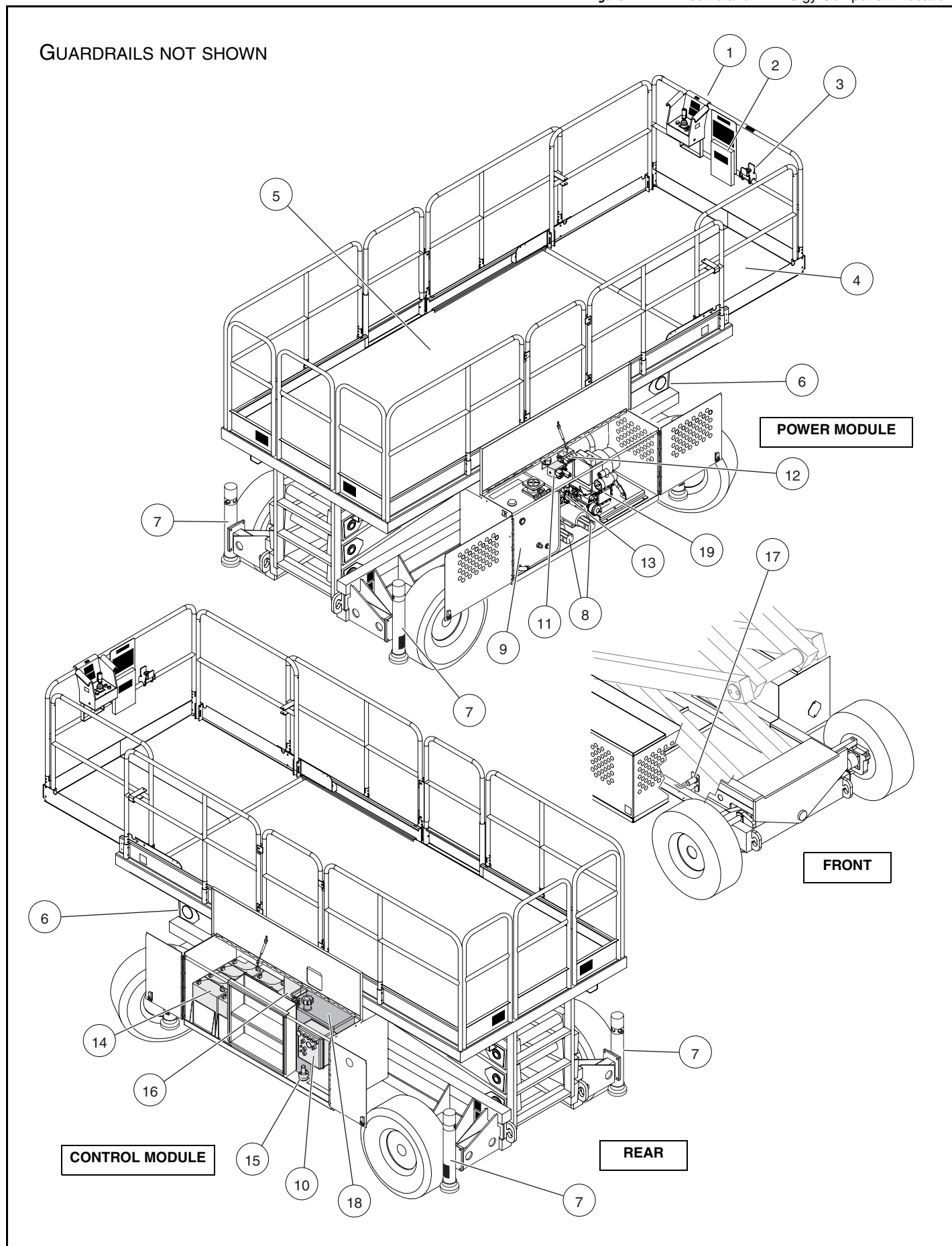
The LX 31 and LX 41 Electric and Bi-Energy Work Platforms are available with optional outriggers.

COMPONENT LOCATIONS

Refer to Figure 2-1 to locate the components of the LX Electric Work Platforms.

1. Platform Controls
2. Document Case
3. Bubble Level (with outrigger option)
4. Platform Extension
5. Work Platform
6. Elevating Assembly
7. Outriggers (optional)
8. Hydraulic Pump
9. Hydraulic Reservoir
10. Chassis Controls
11. Hydraulic Manifold
12. Outrigger Control Manifold (optional)
13. Brake Manifold
14. Batteries
15. Level Sensor
16. Outrigger Relay Box (optional)
17. Proximity Switch
18. Diesel Fuel Tank
19. Diesel Motor and Generator

Figure 2-1: LX Electric and Bi-Energy Component Location



2-2 PREVENTATIVE MAINTENANCE

The complete inspection consists of periodic visual and operational checks, along with periodic minor adjustments to assure proper performance. Daily inspection will prevent abnormal wear and prolong the life of all systems. The inspection and maintenance schedule is to be performed at regular intervals. Inspection and maintenance shall be performed by personnel who are trained and familiar with mechanical and electrical procedures.



Before performing preventative maintenance, familiarize yourself with the operation of the machine.

Always block the elevating assembly whenever it is necessary to enter the elevating assembly to perform maintenance while the platform is elevated.

The preventative maintenance table has been designed for machine service and maintenance repair. Please photocopy the following page and use the table as a checklist when inspecting the machine for service.

PREVENTATIVE MAINTENANCE CHECK LIST

PREVENTATIVE MAINTENANCE KEY

Interval

Daily=each shift or every day

50h/30d=every 50 hours or 30 days

250h/6m=every 250 hours or 6 months

1000h/2y=every 1000 hours or 2 years

Y=Yes/Acceptable

N=No/Not Acceptable

R=Repaired/Acceptable

PREVENTATIVE MAINTENANCE REPORT

Date: _____

Owner: _____

Model No: _____

Serial No: _____

Serviced By: _____

Service Interval: _____

COMPONENT	INSPECTION OR SERVICES	INTERVAL	Y	N	R
Engine Oil (Bi-Energy Models)	Check level and condition	Daily			
	Check for leaks	Daily			
	Change oil and filter	100 Hours			
Engine Fuel System (Bi-Energy Models)	Check fuel level	Daily			
	Check for leaks	Daily			
	Check air filter	Daily			
	Replace fuel filter	100 Hours			
Batteries	Check electrolyte level	6m			
	Check specific gravity	6m			
	Clean exterior	6m			
	Check battery cable condition	Daily			
	Clean terminals	6m			
Hydraulic Fluid	Check fluid level	Daily			
	Change filter	6m			
	Drain and replace fluid	2y			
Hydraulic System	Check for leaks	Daily			
	Check hose connections	30d			
	Check hoses for exterior wear	30d			
Emergency Hydraulic System	Operate the emergency lowering valve and check for serviceability	Daily			
Controller	Check Switch operation	Daily			
Control Cable	Check the exterior of the cable for pinching, binding or wear	Daily			
Platform Deck and Rails	Check fasteners for proper torque	Daily			
	Check welds for cracks	Daily			
	Check condition of deck	Daily			
Tires	Check for damage	Daily			
	Check lug nuts (torque to 205 Nm [150 ft. lbs.])	30d			
	Check Tire Pressure (5 bar [75 PSI])	Daily			

COMPONENT	INSPECTION OR SERVICES	INTERVAL	Y	N	R
Hydraulic Pump	Wipe clean	30d			
	Check for leaks at mating surfaces	30d			
	Check for hose fitting leaks	Daily			
	Check mounting bolts for proper torque	30d			
Drive Motors	Check for operation and leaks	Daily			
Torque Hubs	Check for leaks	Daily			
	Check oil level	250h/6m			
	Change oil after break-in	50h/30d			
	Change oil	1000h/2y			
Steering System	Check hardware & fittings for proper torque	6m			
	Grease steering pivots	30d			
	Check steering cylinder for leaks	30d			
Elevating Assembly	Inspect for structural cracks	Daily			
	Check pivot points for wear	30d			
	Check mounting pin pivot bolts for proper torque	30d			
	Check elevating arms for bending	6m			
	Grease linkage pins	30d			
Chassis	Check hoses for pinch or rubbing points	Daily			
	Check component mounting for proper torque	6m			
	Check welds for cracks	Daily			
Lift Cylinder	Check the cylinder rod for wear	30d			
	Check mounting pin pivot bolts for proper torque	30d			
	Check seals for leaks	30d			
	Inspect pivot points for wear	30d			
	Check fittings for proper torque	30d			
Entire Unit	Check for and repair collision damage	Daily			
	Check fasteners for proper torque	3m			
	Check for corrosion - remove and repaint	6m			
	Lubricate	30d			
Labels	Check for peeling, missing, or unreadable labels & replace	Daily			

2-3 BLOCKING THE ELEVATING ASSEMBLY

⚠ WARNING ⚠

Never perform service on the machine in the elevating assembly area while platform is elevated without first blocking the elevating assembly.

DO NOT stand in elevating assembly area while deploying or storing the brace.

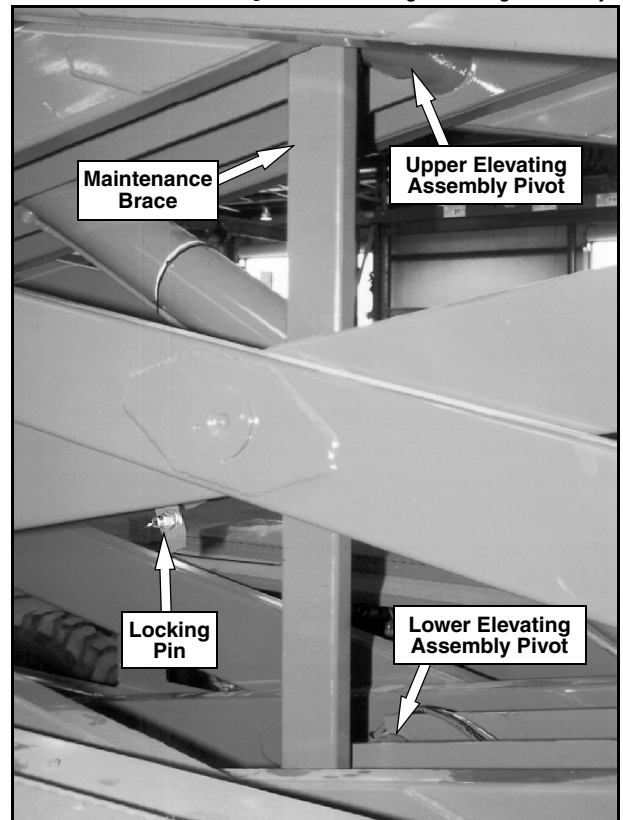
INSTALLATION

1. Place the machine on a firm level surface.
2. Pull the Platform Emergency Stop Switch ON.
3. Turn the Chassis Key Switch to CHASSIS.
4. Press the Raise Button and elevate the work platform until the maintenance brace can be rotated to the vertical position.
5. From the left side of the machine, disengage the locking pin securing the brace. Rotate the maintenance brace counterclockwise until it is vertical and between the two elevating assembly center pivots.
6. Press the Lower Button and gradually lower the platform until the brace is supporting the platform.

REMOVAL

1. Using the Chassis Controls, gradually elevate the work platform until the maintenance brace clears the two elevating assembly center pivots.
2. Rotate maintenance brace clockwise until the locking pin engages.
3. Press the Lower Button to completely lower the platform.

Figure 2-2: Blocking Elevating Assembly



2-4 LUBRICATION

Refer to "Preventative Maintenance Check List" on page 2-7 for lubrication intervals and Figure 2-3 for location of items that require lubrication service. Refer to the appropriate sections for lubrication information on the steering linkage, torque hubs, hydraulic fluid and filter, and engine oil and filter.

GREASE FITTINGS

Grease fittings at;

- the pivot points on the elevating assembly and
- the top and bottom of the steering pivots next to the front wheels.

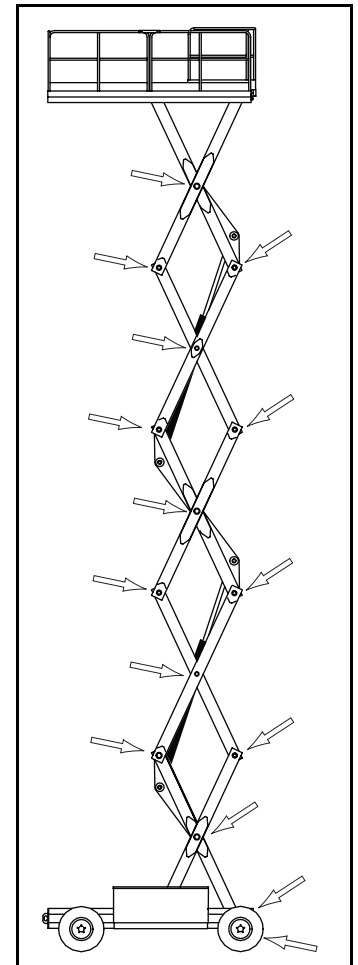
Wipe each grease fitting before and after applying grease. Using multipurpose grease in a grease gun. Pump the grease into the fitting until grease just begins to appear at the edges of the pivot and wipe off any excess grease.

TORQUE HUBS

NOTE: Change oil in torque hubs after the first 50 hours of operation. Change every 1000 hours thereafter.

1. Remove the torque hub (refer to "Torque Hub Removal" on page 2-20).
2. Remove the drain plug from the underside of the torque hub.
3. Drain the oil from the unit.
4. Replace the drain plug.
5. Remove the fill plug from the top of the torque hub.
6. Using 90 weight gear lube with EP additive, fill the torque hub through the top plug hole in the rear cover until oil comes out of the 90° fitting on the side. Plug the 90° fitting.
7. Replace the fill plug.
8. Install the torque hub (refer to "Torque Hub Installation" on page 2-21).

Figure 2-3: Lubrication Points



HYDRAULIC FLUID RESERVOIR AND FILTER

FLUID LEVEL

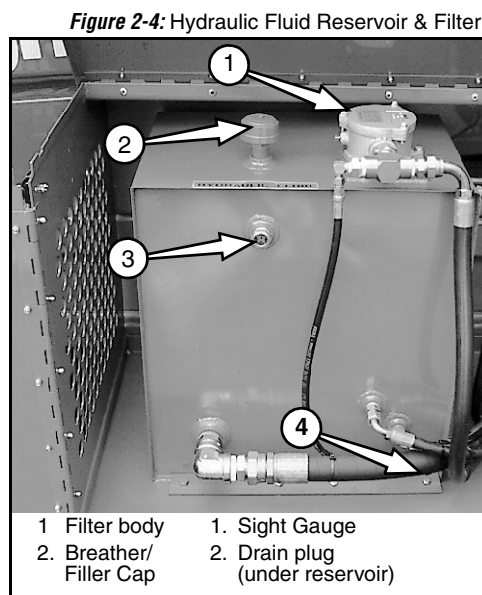
With the platform fully lowered, the fluid should be visible in the sight gauge. If the fluid is *NOT* visible, fill the reservoir until the fluid can be seen.

- *DO NOT* fill above the sight gauge.
- *DO NOT* fill when the platform is elevated.

FLUID AND FILTER REPLACEMENT

NOTE: To change the filter only, follow Step 5. through Step 8.

1. Operate the machine for 10-15 minutes to bring the hydraulic fluid up to normal operating temperature.
2. Provide a suitable container to catch the drained fluid. The hydraulic reservoir has a capacity of 46,5 l (**12.3 U.S. gal.**).
3. Remove the drain plug and allow all fluid to drain into the container. Dispose of used fluid properly.
4. Reinstall the drain plug.
5. Remove the three screws from the filter body cover and open the filter body.
6. Lift the filter element from the filter body. Dispose of used filters properly.
7. Insert the replacement filter element into the filter body and press into position.
8. Replace the filter body cover and screws.
9. Fill the hydraulic fluid reservoir to the level of the sight gauge with the appropriate hydraulic fluid (refer to "Specifications" in the *Operator Manual*).



! CAUTION !

The hydraulic fluid may be hot enough to cause burns. Wear safety gloves and protective eye-wear when handling hot fluid.

ENGINE

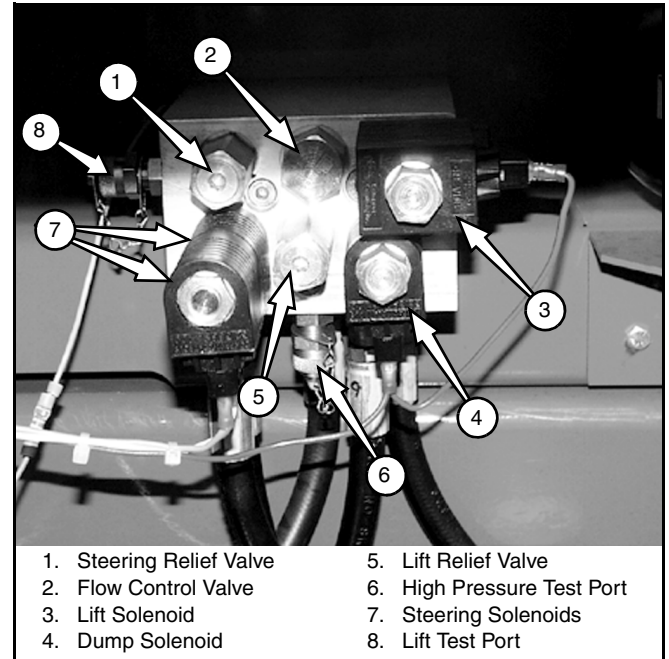
Change oil filter and fuel filter after every 100 hours of operation. Refer to the engine manufacturer documentation that was included with the machine.

2-5 SETTING HYDRAULIC PRESSURES

LIFT RELIEF VALVE

1. Operate the hydraulic system 10-15 minutes to warm the fluid.
2. Remove the cap on the Lift Relief Valve.
3. Turn the Lift Relief Valve adjustment screw counterclockwise two full turns.
4. Place the rated load on the platform (refer to "Specifications" in the *Operator Manual*).
5. Press the Raise Button to elevate the work platform.
6. Slowly turn the Lift Relief Valve adjustment screw clockwise until the platform begins to elevate.
7. Replace the cap, on the Lift Relief Valve, and remove the load from the platform

Figure 2-5: Valve Manifold



STEERING RELIEF VALVES

1. Operate the hydraulic system 10-15 minutes to warm the fluid.
2. Install a 0-200 bar (**0-3000 PSI**) gauge at the Main Pressure Test Port.
3. Remove the cap on the Left Steer Relief Valve.
4. Turn the adjustment screw two full turns counterclockwise.
5. Press the Steering Switch to the left and hold until the system bypasses.
6. Turn the Steering Relief Valve adjustment screw clockwise until the gauge reads 105 bar (**1500 PSI**).
7. Replace the cap on the Steering Relief Valve.

2-6 SWITCH ADJUSTMENTS

PROXIMITY SWITCH - SERIAL NUMBER 4022-4274

The Proximity Switch is located near the front right corner of the chassis under the elevating assembly. Its function is determined by the location of the lower elevating assembly tube.

PROXIMITY SWITCH FUNCTION, SERIAL NUMBER 4022-4274

The Proximity Switch controls the machine operation.

Platform Elevated:

- The switch is open.
- The Level Sensor is enabled.
- Power to the High Speed Circuit is cut, preventing the machine from travel faster than 0,8 km/h (0.5 mph).

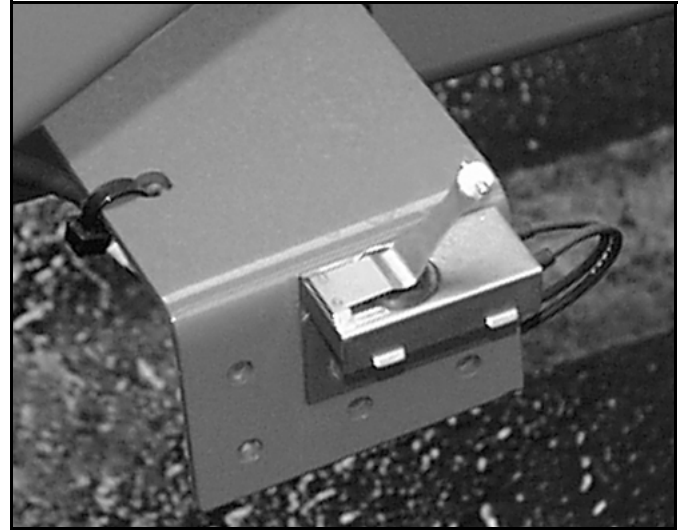
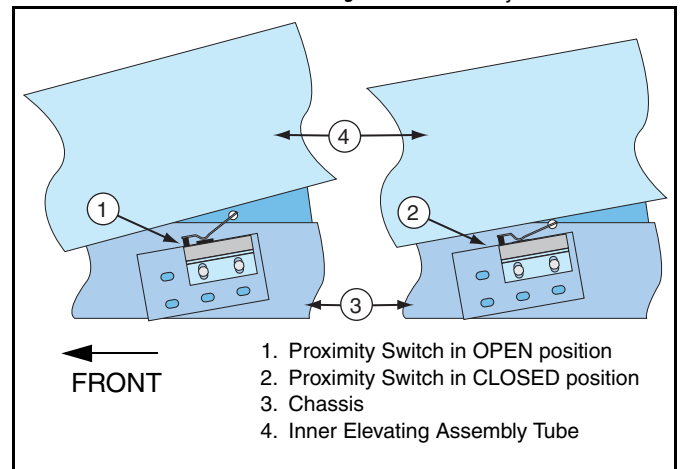


Figure 2-6: Proximity Switch, Serial Number 4022-4274

Platform Lowered:

- The switch is closed.
- Power is supplied to the High Speed Circuit, allowing the machine to travel up to 3,2 km/h (2.0 mph) when the Platform Controls Drive Speed Switch is set to HI SPEED.

Figure 2-7: Proximity Switch Position



TEST THE PROXIMITY SWITCH, SERIAL NUMBER 4022-4274

1. Place the machine on a firm, level surface.
2. Use an inclinometer to ensure that the chassis is level from front to rear and side to side.
3. Deploy the maintenance brace (see "Blocking The Elevating Assembly" on page 2-8).
4. Disconnect the switch leads and connect a multimeter to the switch.
 - The switch contacts should be OPEN (no continuity).
 - Push the lever down to close the switch contacts. If there is no continuity, the switch is defective.
5. Connect the switch leads, store the maintenance brace and lower the work platform.
6. Elevate the work platform not more than 1 m (3 ft.).
7. With the Platform/Chassis switch on CHASSIS, push the Tilt Sensor base to test the alarm circuit.
 - If the alarm does not sound, the switch is out of adjustment.
8. Turn the Drive Speed Switch to HI SPEED and attempt to drive the machine.
 - If the machine will drive faster than 0,8 km/h (0.5 mph), the switch is out of adjustment.
9. Lower the work platform completely.

REMOVAL AND INSTALLATION, SERIAL NUMBER 4022-4274**! WARNING !**

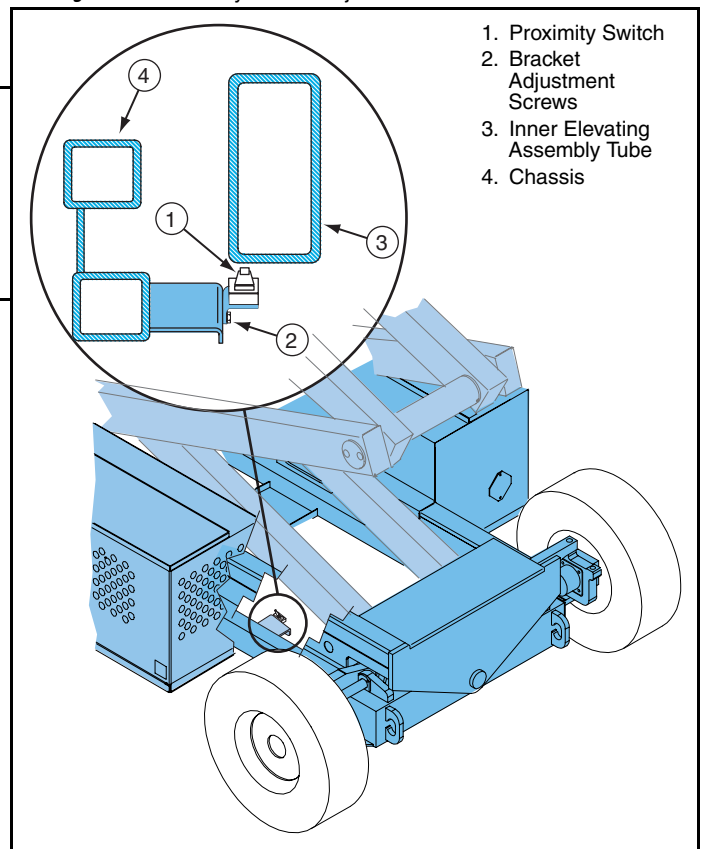
*Never perform service while the platform is elevated without first blocking the elevating assembly.
DO NOT stand in the elevating assembly area while deploying or storing the maintenance brace.*

1. Place the machine on a firm, level surface.
2. Deploy the maintenance brace (see "Blocking The Elevating Assembly" on page 2-8).
3. Disconnect the switch leads.
4. Remove the defective switch and install a new one.
5. Connect the switch leads.
6. Store the maintenance brace and lower the platform.
7. Adjust the Proximity Switch.

PROXIMITY SWITCH ADJUSTMENT, SERIAL NUMBER 4022-4274**Figure 2-8:** Proximity Switch Adjustment - Serial Number 4022-4274**! WARNING !**

*Never perform service while the platform is elevated without first blocking the elevating assembly.
DO NOT stand in the elevating assembly area while deploying or storing the maintenance brace.*

1. Place the machine on a firm, level surface.
2. Deploy the maintenance brace (see "Blocking The Elevating Assembly" on page 2-8).
3. Disconnect the switch leads and connect a multimeter or continuity tester to the switch.
4. Place a reference mark on the switch bracket to establish its position.
5. Store the maintenance brace and fully lower the platform.
6. Measure and record the distance from the top of the chassis to the base of the work platform.
7. Elevate the work platform until the Proximity Switch is OPEN (no continuity).
8. Measure the distance from the top of the chassis to the base of the work platform and compare with Step 6..
 - If the platform elevated 50 - 60 cm (1.75 - 2 ft.), no adjustment is necessary. Otherwise, continue.
9. Deploy the maintenance brace. Loosen the bracket adjustment screws and move the switch up to increase or down to decrease the platform height. Tighten the adjustment screws.
10. Repeat Step 5. through Step 8..



1. Proximity Switch
2. Bracket Adjustment Screws
3. Inner Elevating Assembly Tube
4. Chassis

PROXIMITY SWITCH - SERIAL NUMBER 4275-CURRENT

Refer to Figure 2-9.

The Proximity Switch is located near the front right corner of the chassis under the elevating assembly. Its function is determined by the location of the lower elevating assembly tube.

PROXIMITY SWITCH FUNCTION, SERIAL NUMBER 4275-CURRENT

A red LED at the rear of the switch should be ON when the elevating assembly tube is next to the switch (the platform is lowered). The Proximity Switch controls the machine operation based upon the proximity of the lower elevating assembly tube to the Proximity Switch.

When Elevating:

- The Level Sensor is enabled.
- Power to the High Speed Circuit is cut, preventing the machine from travel faster than 0,8 km/h (0.5 mph).

When Completely Lowered:

- Power is supplied to the High Speed Circuit, allowing the machine to travel up to 5 km/h (3.0 mph) when the Platform Controls Drive Speed Switch is set to HI SPEED.

TEST THE PROXIMITY SWITCH, SERIAL NUMBER 4275-CURRENT



*Never perform service while the platform is elevated without first blocking the elevating assembly.
DO NOT stand in the elevating assembly area while deploying or storing the maintenance brace.*

1. Place the machine on a firm, level surface.
2. Deploy the maintenance brace (see “Blocking The Elevating Assembly” on page 2-8).
3. Disconnect the switch leads and connect a multimeter to the switch.
 - The switch contacts should be OPEN (no continuity).
 - Place a piece of metal near the face of the switch. This should close the switch contacts. If there is no continuity, the switch is defective.
4. Connect the switch leads, store the maintenance brace and lower the work platform.
5. With the work platform fully lowered, look at the Proximity Switch.
 - When the Platform Controls key Switch is ON, the red LED at the rear of the Proximity Switch is ON.
 - If the red LED is OFF, the Proximity Switch is out of adjustment.
6. Elevate the work platform not more than 1 m (3 ft.).
 - The red LED should turn OFF when the machine reaches 50 - 60 cm (1.75 - 2 ft.). If it remains ON, the switch is out of adjustment.

TEST HIGH SPEED CIRCUIT, SERIAL NUMBER 4275-CURRENT

1. Elevate the work platform 0,75 m (2.5 ft.).
2. Turn the Drive Speed Switch to HI SPEED and attempt to drive the machine.
 - If the machine will drive faster than 0,8 km/h (0.5 mph), the switch is out of adjustment or defective.

REMOVAL AND INSTALLATION, SERIAL NUMBER 4275-CURRENT

⚠ WARNING ⚠

*Never perform service while the platform is elevated without first blocking the elevating assembly.
DO NOT stand in the elevating assembly area while deploying or storing the maintenance brace.*

1. Place the machine on a firm, level surface.
2. Use an inclinometer to ensure that the chassis is level from front to rear and side to side.
3. Deploy the maintenance brace (see "Blocking The Elevating Assembly" on page 2-8).
4. Disconnect the switch leads.
5. Remove the defective switch and install a new one.
6. Adjust the switch to elevating assembly tube clearance (see "Proximity Switch Clearance Adjustment - Serial Number 4275-Current" on page 2-15).
7. Connect the switch leads.
8. Store the maintenance brace and lower the platform.
9. Adjust the Proximity Switch height (see "Proximity Switch Height Adjustment - Serial Number 4275-Current" on page 2-16).

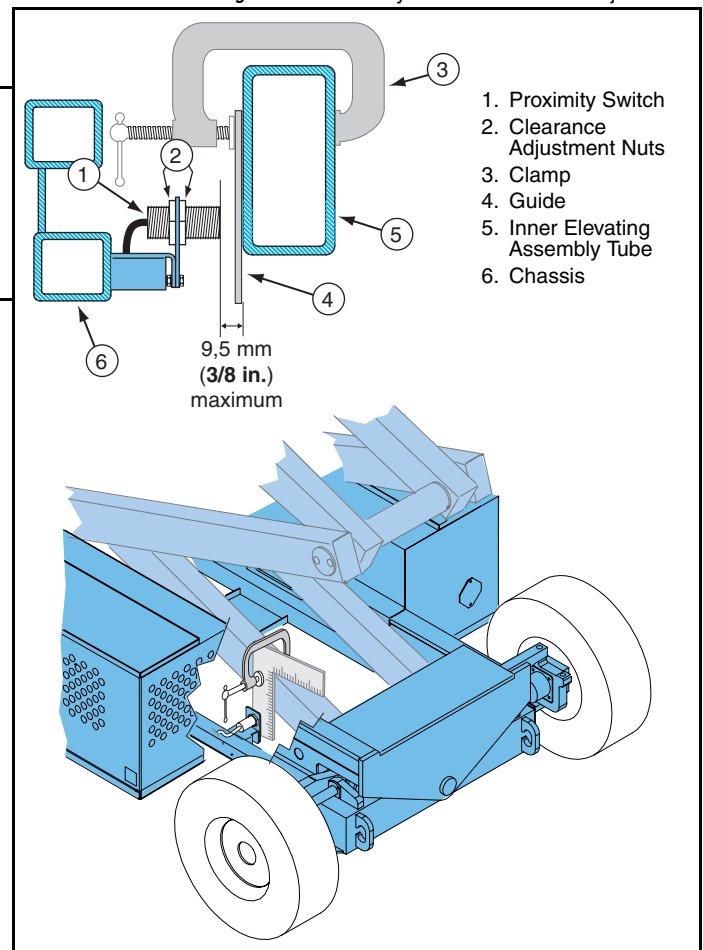
PROXIMITY SWITCH CLEARANCE ADJUSTMENT - SERIAL NUMBER 4275-CURRENT

⚠ WARNING ⚠

*Never perform service while the platform is elevated without first blocking the elevating assembly.
DO NOT stand in the elevating assembly area while deploying or storing the maintenance brace.*

1. Place the machine on a firm, level surface.
2. Deploy the maintenance brace (see "Blocking The Elevating Assembly" on page 2-8).
3. Use an Inclinometer to ensure that the chassis is level from front to rear and side to side.
4. Use a clamp to attach a straight guide to the elevating assembly tube.
5. Measure the distance from the face of the Proximity Switch to the side of the guide that faces the elevating assembly tube.
6. Turn the adjusting nuts to set the clearance to 9,5 mm (0.375 in.) maximum.
7. Remove the clamp and guide and repeat Step 5. and Step 6. of "Test the Proximity Switch, Serial Number 4275-Current" on page 2-14).

Figure 2-9: Proximity Switch Clearance Adjustment



PROXIMITY SWITCH HEIGHT ADJUSTMENT - SERIAL NUMBER 4275-CURRENT

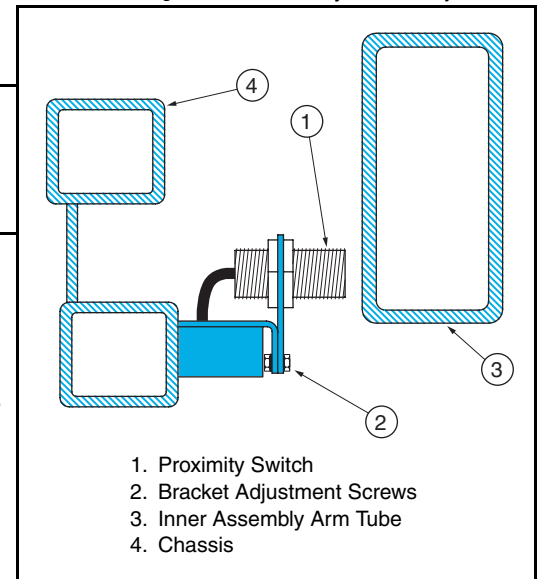
Figure 2-10: Proximity Switch Adjustment

⚠ WARNING ⚠

Never perform service while the platform is elevated without first blocking the elevating assembly.

DO NOT stand in the elevating assembly area while deploying or storing the maintenance brace.

1. Place the machine on a firm, level surface.
2. Use an Inclinometer to ensure that the chassis is level from front to rear and side to side.
3. Measure and record the distance from the top of the chassis to the base of the work platform.
4. Elevate the work platform until the red LED at the rear of the Proximity Switch turns OFF.
5. Measure the distance from the top of the chassis to the base of the work platform and compare with Step 3..
 - If the platform elevated 50 - 60 cm (1.75 - 2 ft.) no adjustment is necessary. Otherwise, continue.
6. Deploy the maintenance brace (see "Blocking The Elevating Assembly" on page 2-8).
7. Place a reference mark on the bracket to establish its position.
8. Loosen the bracket adjustment screws and move the switch up to increase or down to decrease platform height. Tighten the adjustment screws.
9. Store the maintenance brace and fully lower the platform.
10. Repeat Step 4. and Step 5..

**LEVEL SENSOR**

The Level Sensor has three wires;

- red-power in (12v),
- black-ground,
- white-power out (12v).

To verify the sensor is working properly there is one red LED under the sensor. When the LED is ON, the sensor is out of level, turning OFF the power to the white wire.

1. Check tires for proper pressure.
2. Place the machine on a firm level surface.
3. Use an inclinometer to ensure that the front and rear of the Chassis are level.
4. Open the control module door to gain access to the Level Sensor.
5. Adjust the three leveling locknuts until the bubble is centered in the circle on the attached bubble level.
6. Deploy the maintenance brace (see "Blocking The Elevating Assembly" on page 2-8).
7. Push the Level Sensor base to test the alarm circuit. The red LED under the Level Sensor should turn ON and the alarm should sound.

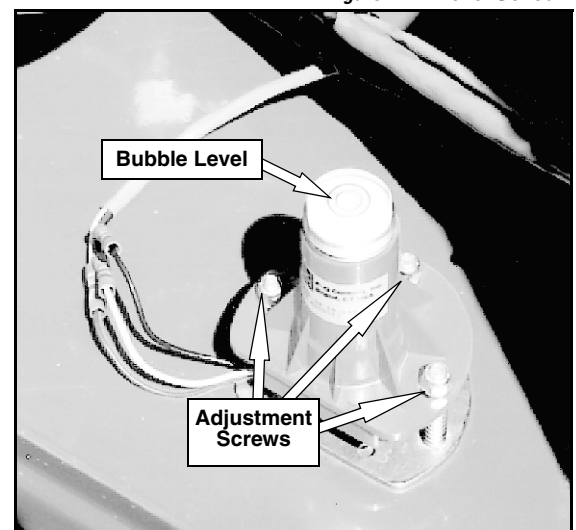


Figure 2-11: Level Sensor

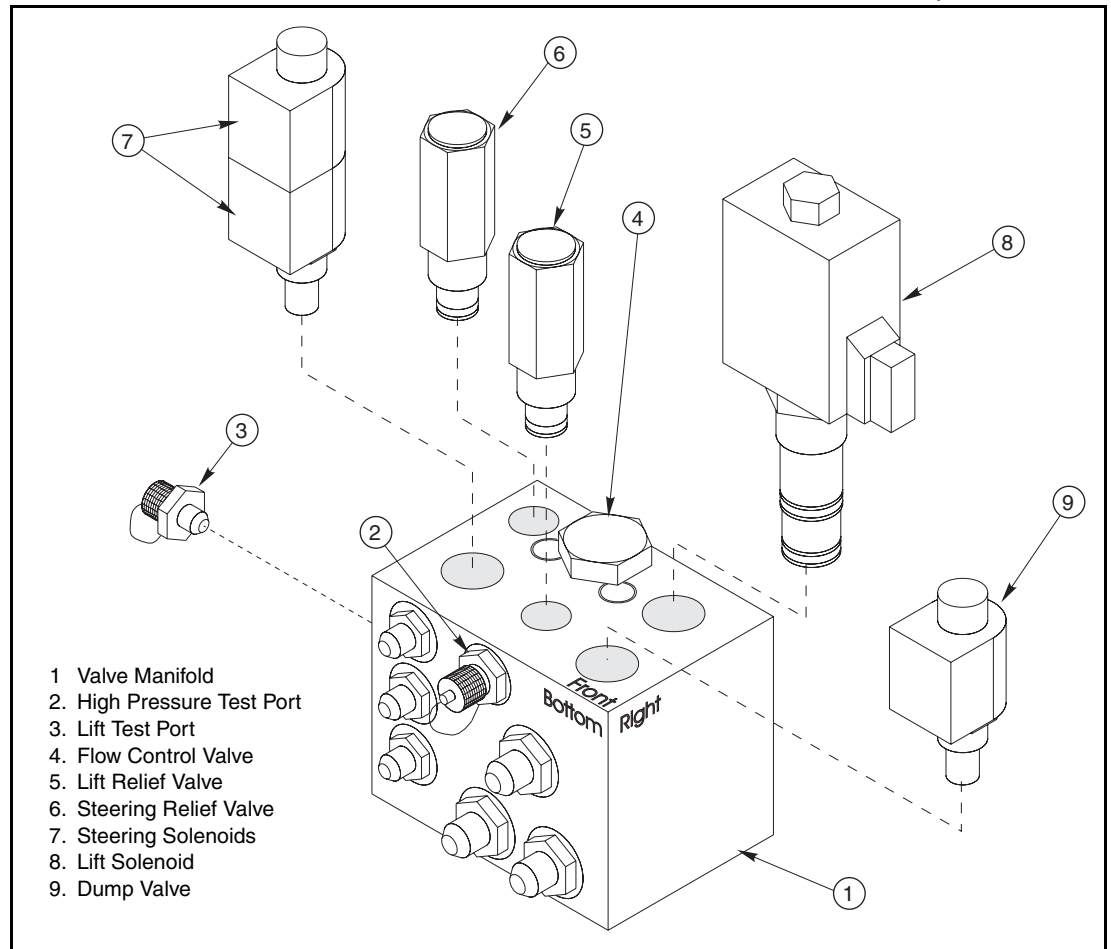
2-7 HYDRAULIC MANIFOLDS

Though it is not necessary to remove the manifold to perform all maintenance procedures, a determination should be made prior to beginning as to whether or not the manifold should be removed before maintenance procedures begin. Refer to the General Information Section for remove and replace instructions.

MAIN HYDRAULIC MANIFOLD

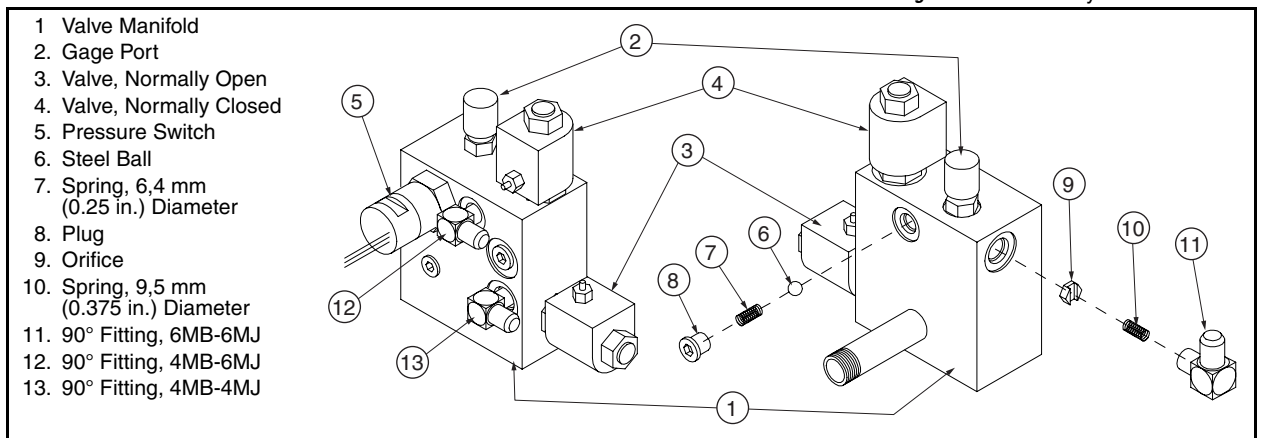
Refer to "Setting Hydraulic Pressures" on page 2-11 for adjustment instructions.

Figure 2-12: Hydraulic Manifold



BRAKE HYDRAULIC MANIFOLD

Figure 2-13: Brake Hydraulic Manifold



2-8 HYDRAULIC POWER UNIT

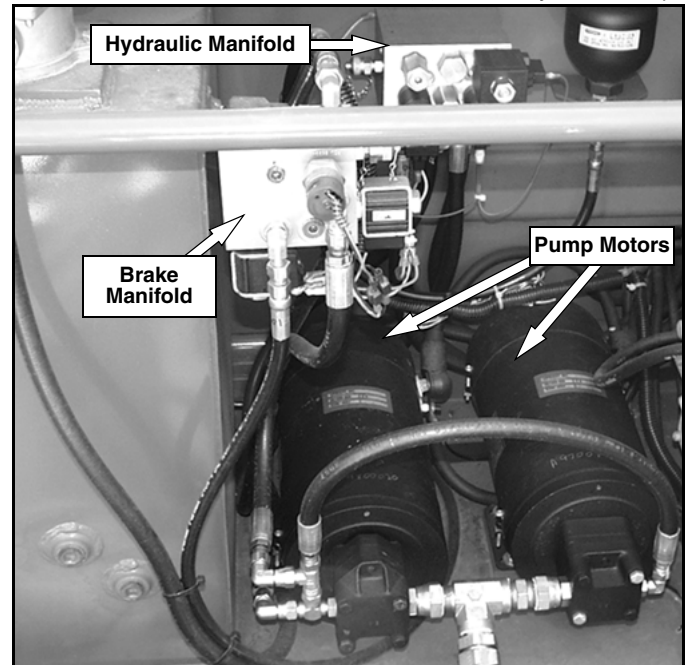
REMOVAL

1. Mark, disconnect and plug the hose assemblies.
2. Mark and disconnect the electric cables.
3. Remove hardware which secures power unit and remove from chassis.

INSTALLATION

1. Install power unit using hardware previously removed.
2. Unplug and reconnect the hydraulic hoses.
3. Reconnect the electric cables.
4. Fill the tank with clean hydraulic fluid.
5. Check the oil level in the hydraulic tank before operating the work platform.
6. Operate the pump and check for leaks and proper operation.
7. Replenish hydraulic fluid if necessary.

Figure 2-14: Hydraulic Pump



2-9 HYDRAULIC BRAKES

REMOVAL

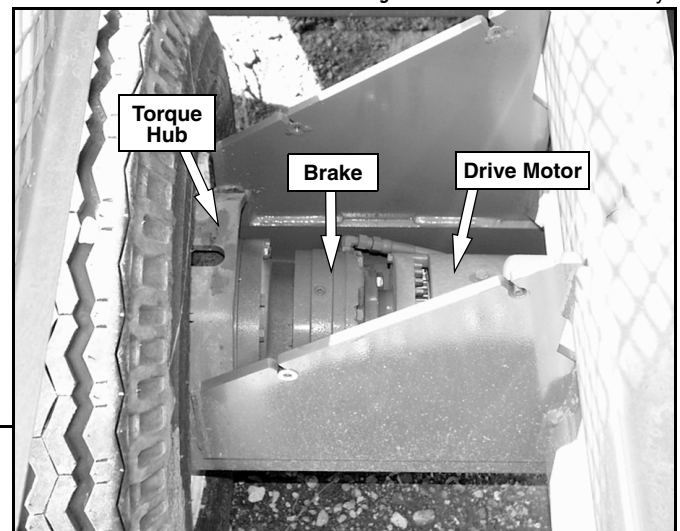
1. Park the work platform on firm level ground and block the wheels to prevent the work platform from rolling.
2. Disconnect and plug the hydraulic brake lines.
3. Tag and disconnect electric cables from drive motors.



Clean all fittings before disconnecting the hose assemblies.

Plug all port holes and hose assemblies IMMEDIATELY to prevent contamination from dust and debris.

Figure 2-15: Rear Axle Assembly

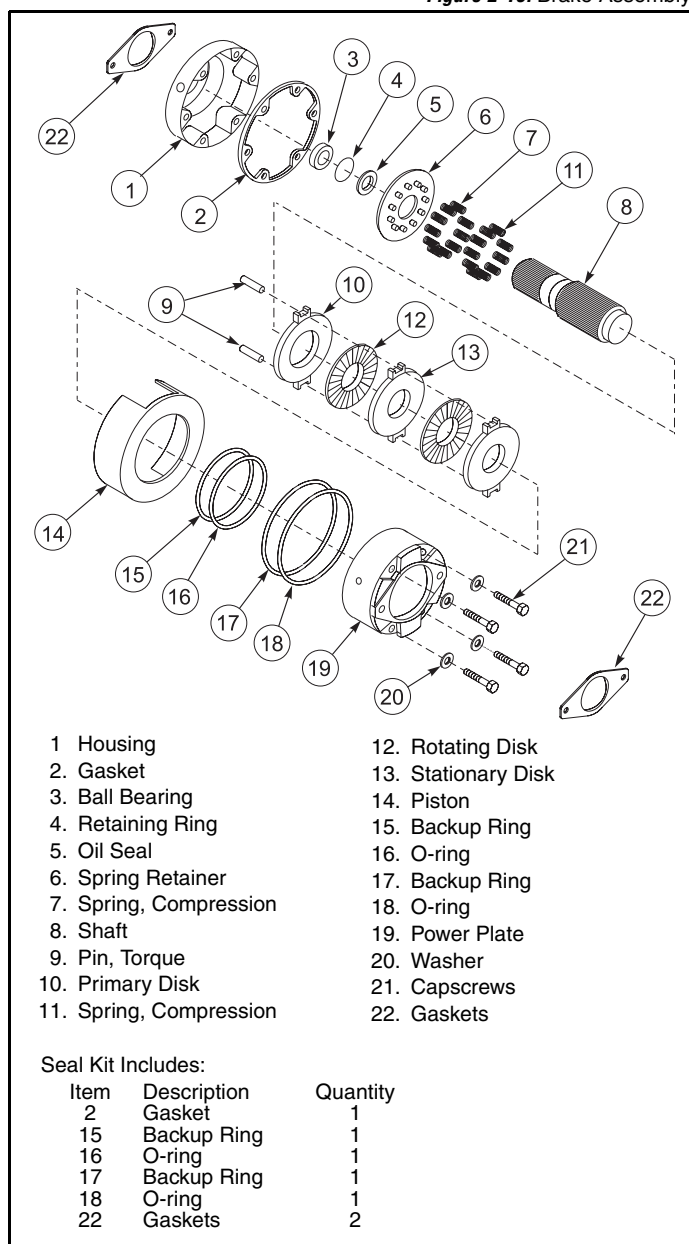


4. Remove capscrews and washers holding the motor and brake to torque hub.
5. Remove the motor.
6. Remove the brake.

BRAKE SEAL REPLACEMENT

Figure 2-16: Brake Assembly

1. With shaft protrusion downward, remove capscrews (21) and washers (20) from brake assembly.
2. Remove power plate (19) from housing (1). Remove gasket (2).
3. Remove piston (14) from power plate (19) by introducing low pressure air [1,0 bar (15 PSI)] into the hydraulic inlet. Make sure piston is not pointed at anyone.
4. Remove o-rings (16 & 18) and backup rings (15 & 17) from inner and outer diameter grooves of piston.
5. Clean piston (14) and power plate (19) assemblies with solvent. Inspect the sealing surfaces of the piston (14) and power plate (19). Inspect seal grooves in the piston. Replace brake assembly if they are damaged or scratched deeply. Lubricate piston (14), power plate (19), and seals (15, 16, 17, & 18) with clean hydraulic oil prior to assembly.
6. Install the backup rings (15 & 17) and o-rings (16 & 18) into the seal grooves in the piston.
7. Install piston into power plate using a shop press. Be careful not to damage the seals during assembly. Center cutouts in piston with torque pin holes in the power plate. Press piston to a depth no less than flush, but not exceeding [3 mm (0.120 in.)] below the surface of the power plate at cutouts in piston. This depth is critical. The brake will not hold if it is exceeded.
8. Install gasket (2).
9. Install power plate/piston assembly (14 & 19) to housing (1) using capscrews (21) and washers (20). Tighten sequentially, one turn at a time, to press the two assemblies together. Torque capscrews 65 - 80 N-m (50 - 60 ft.-lbs.).



INSTALLATION

1. Coat output shafts of brake and drive motor with high pressure molybdenum grease and install gasket (22) and brake onto torque hub.
2. Install gasket (22) and drive motor. Align holes and install the two cap screws and lock washers.
3. Reinstall cables to drive motor and hoses to the brake.
4. Install the wheel. Torque the wheel nuts to 205 N-m (150 ft. lbs.).
5. Remove the jack stands and lower chassis to the ground.
6. Position chassis switch to parking brake release position. Alarm will sound.
7. Depress the electric motor start switch to energize brake hydraulic system.
8. Check for leaks and bleed air out of brake hydraulic system using bleed valve located on brake housing.

2-10 TORQUE HUB

CAUTION

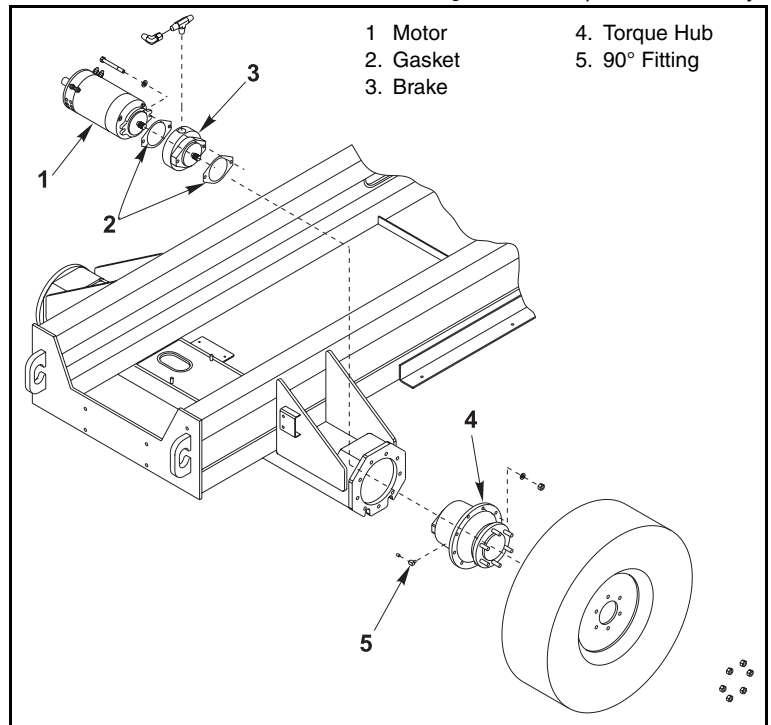
Clean all fittings before disconnecting the hose assemblies.

Plug all port holes and hose assemblies IMMEDIATELY to prevent contamination from dust and debris.

TORQUE HUB REMOVAL

1. Park the work platform on firm level ground and block the wheels to prevent the work platform from rolling.
2. Disconnect battery negative terminals or Anderson connectors (both sides on electric model).
3. Loosen the wheel lug nuts on the torque hub to be removed.
4. Raise the rear of the work platform using a 2-ton jack.
5. Position two 2-ton jack stands under the rear axle to prevent the work platform from falling if the jack fails.
6. Remove the wheel nuts and wheel.
7. Disconnect hydraulic brake line from brake.
8. Remove 90° fitting from side of torque hub.
9. Tag and remove electric cables from drive motors.
10. Remove mounting bolts from electric motor.
11. Separate electric motor from brake. Discard gasket.
12. Separate brake from torque hub. Discard gasket.
13. Remove ½-20 nuts and washers from torque hub.
14. Remove torque hub.

Figure 2-17: Torque Hub Assembly



IMPORTANT: Note position of 90° fitting on torque hub body. Hub must be installed with fitting in same position.

TORQUE HUB INSTALLATION

IMPORTANT: Hub must be installed with 90° fitting in same position as when it was removed.

NOTE: Unless otherwise specified, torque all fittings according to *Torque Specifications* in “Section 1 - General Information”.

1. Install torque hub using ½-20 nuts and ½ washers.
2. Remove plug from 90° fitting and install fitting in side of torque hub. Point fitting towards rear of hub.
3. Using 90 weight gear lube with EP additive, fill torque hub through top plug hole in rear cover until oil comes out of 90° fitting in side. Plug 90° fitting and top of rear cover.
4. Install new gasket and brake.
5. Install new gasket and electric motor.
6. Secure assembly using washers and bolts.
7. Connect hydraulic brake lines.
8. Connect electric cables.
9. Install wheels. Torque lug nuts to 205 Nm (**150 ft. lbs.**).
10. Bleed brake lines if necessary.
11. Remove jack stands and lower rear end.
12. Connect battery terminals or Anderson connectors.
13. Check function of brake.

TORQUE HUB SEAL REPLACEMENT

ROLL AND LEAK TESTING

IMPORTANT: Torque hubs should always be roll and leak tested before disassembly and after assembly to make sure gears and sealants are working properly.

ROLL TEST

Gears should be able to rotate by applying a constant force to the axle. Some gear packages roll with more difficulty than others.

Do not be concerned if gears seem to roll hard as long as they roll with consistency. If you feel more drag only at certain points the gears are not rolling freely and should be checked for improper installation or defects.

LEAK TEST

The purpose of a leak test is to make sure the unit is air tight. Pressurize hub to 0,35 bar (**5 PSI**). Torque hub has a leak if the air pressure starts to fall after hub has been pressurized.

Use soap and water on hub to detect location of leaks. If a leak is detected, seal or O-ring must be replaced.

PRESSING TOOLS

Use pressing tools to remove the seal, cup and cone.

TORQUE HUB DISASSEMBLY



Safety glasses should be used during disassembly of hub.

1. Remove two pipe plugs in cover and drain the oil from the unit.
2. Loosen and remove shoulder bolts and cap screws from cover. Remove cover from hub.
3. Remove O-ring. Remove thrust washer from counterbore in cover.
4. Remove input gear from planet gears.
5. Using a punch, remove retaining ring from groove around inside of input gear.
6. Lift carrier sub-assembly from hub. Lift ring gear from hub. Remove O-ring from counterbore in hub.
7. Remove pipe plugs from side of hub body.
8. Apply a preload to output shaft to remove retaining ring. Follow steps a & b.
 - a. Place bearing cone pressing tool on retaining ring.
 - b. Apply pressure to fixture using a hydraulic ram or by striking the fixture with a soft face hammer. Pressure should be applied until hub rotates with difficulty.
9. Using retaining ring pliers remove retaining ring. Remove spacer from output shaft.
10. Place spacer under hub so output shaft will fall through bottom when pressed out.
11. Press output shaft out of hub. Output shaft may come out with bearing cone and seal attached. Remove seal and discard. Use a punch and hammer to remove bearing cone. Be careful not to strike shaft with punch.
12. If seal and cone remain in hub, press them out using a pressing tool.
13. Lift bearing cone out of hub.
14. Stand hub on its small end. Using a punch and hammer, remove bearing cup from counterbore of hub. Be careful not to strike counterbore with punch.
15. Turn hub over on larger end. Using a punch and hammer, remove bearing cup from counterbore of hub. Be careful not to strike counterbore.

NOTE: Carrier sub-assembly does not need to be disassembled to replace seals.

TORQUE HUB ASSEMBLY

Figure 2-18: Measuring Hub End Play

NOTE: Unless otherwise specified, torque all fittings according to *Torque Specifications* in “Section 1 - General Information”.

1. Oil output shaft and bearing cone. Using cone press, press bearing cone onto end of output shaft with retaining ring groove.
2. Stand hub on its small end. Using bearing cup pressing tool press bearing cup down into hub.

NOTE: Make sure cup sits square with counterbore.

3. Turn hub over so it sit on large end. Using bearing cup pressing tool press bearing cup into small end of hub.



NOTE: Make sure cup sits square with counterbore.

4. Place output shaft into hub so end of shaft with retaining ring groove points down.
5. Oil output shaft. Using seal pressing tool press seal into counterbore in small end of hub. The closed face of the seal should be up.
6. Turn hub over so small end points down. Using bearing cone pressing tool, press bearing cone onto output shaft. Rotate hub while pressing bearing. Stop pressing when hub starts to resist rotating.
7. Place spacer onto output shaft so it rests on top of bearing cone. Using retaining ring pliers, place retaining ring to make sure it is seated.
8. Hit the end of output shaft once or twice with a soft face hammer. Turn the shaft in both clockwise and counter clockwise directions while hitting. This will seat the bearing cone against the spacer and retaining ring allowing necessary endplay in the hub-shaft sub-assembly.
9. Turn hub over so it rests on large end. Measure endplay in hub-shaft sub-assembly. Follow steps a-c.
 - a. Mount a dial indicator on hub. Locate the dial rod on top of output shaft.
 - b. Lift up on output shaft until the needle on the dial stops moving.
 - c. Read the dial. Reading should be no greater than 0,203 mm (.008 in.).
 - If dial reads less than 0,203 mm (.008 in.), continue on to step 10.
 - If dial reads more than 0,203 mm (.008 in.), repeat steps 8.-15. of “Torque Hub Assembly” on page 2-23.
 - d. Remove spacer and replace it with thicker spacer (SK91 068570-011).
 - e. Repeat steps 6.-9. and remeasure end play (Figure).
10. Apply a light coat of “Never Seize” to the pipe plugs and install into pipe plug holes in hub.

NOTE: Leave hole for 90° fitting open.

MAIN ASSEMBLY

1. Position hub on its output shaft so that hubs small diameter end points down.
2. Using a marker, mark the four shoulder bolt holes in hub.
3. Grease O-ring and place in counterbore in hub.

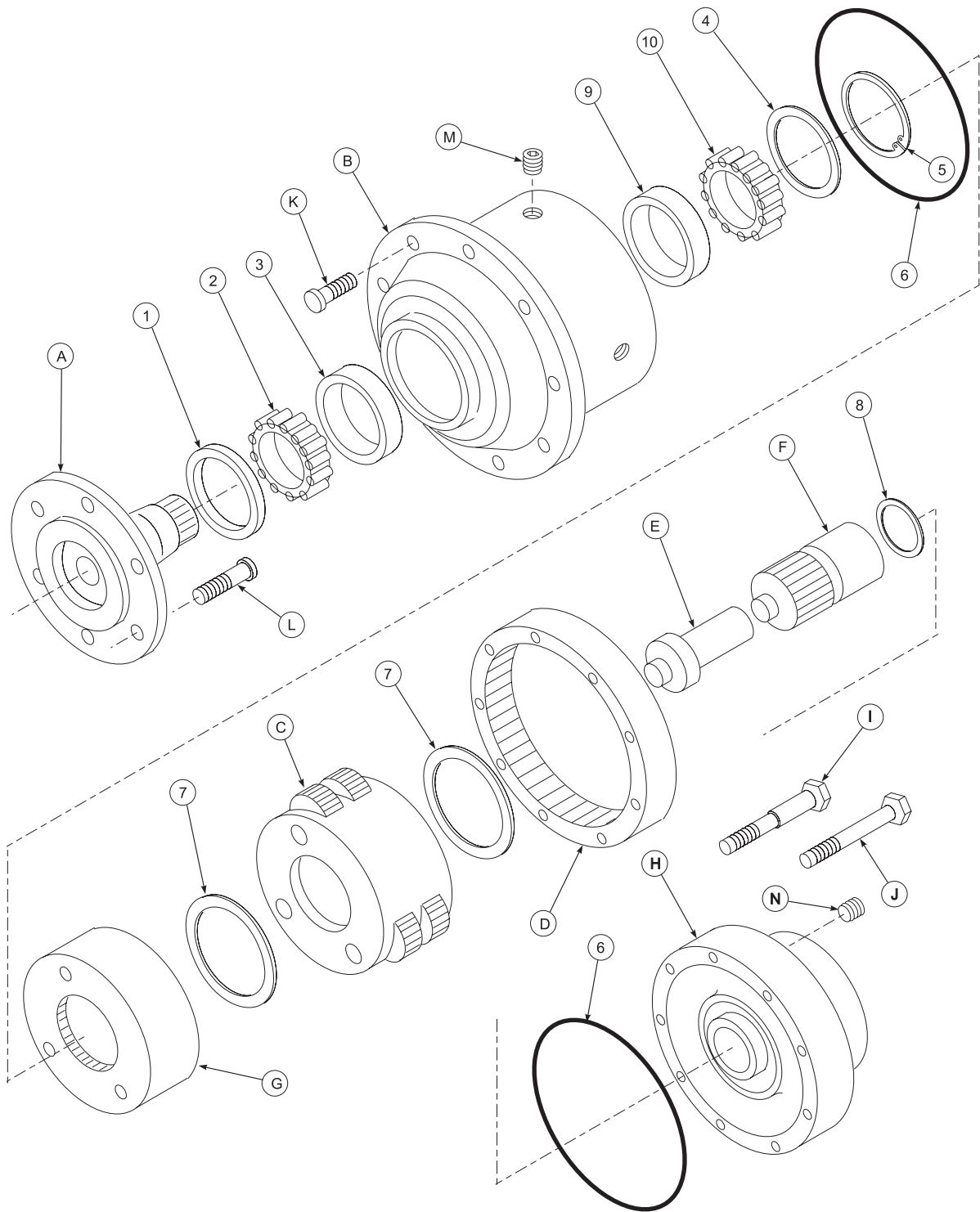
NOTE: O-rings may be stretched or squeezed together in order to fit exactly in counterbore.

4. Oil all exposed surfaces inside hub. Oil carrier sub-assembly.
5. Place carrier sub-assembly, with spline connections down, into mesh with output shaft.
6. Place ring gear, with squared shoulder down, into mesh with the planet gears of the carrier sub-assembly. Make sure that marked shoulder bolt hole on ring gear aligns with any of the marked shoulder bolt holes on the hub. "X" mark should be on the cover side of ring gear.
7. Start one half of retaining ring into groove inside input gear. Use a soft punch to press the remaining half of the retaining ring into the groove.
8. Insert input gear, with large diameter end down, into mesh with planet gears.
9. Place large thrust washer over input gear so it rests on carrier housing. Oil all exposed surfaces inside hub.
10. Grease O-ring and place into counterbore of cover.

NOTE: O-rings may be stretched or squeezed together in order to fit exactly in counterbore.

11. Place cover on top of ring gear so the fill hole will be at top of hub when it is installed.
12. Install four shoulder bolts into shoulder bolt holes and tighten.
13. Install eight cap screws in remaining holes and tighten.
14. Apply 30-35 N-m (**23-27 ft. lbs**) of torque to all bolts.
15. Apply a light coat of "Never Seize" to both pipe plugs and install into the two holes in cover.
16. Roll test the unit in both clockwise and counterclockwise directions. Turn hub nine full revolutions in each direction.
17. Leak test the hub at 0,35 bar (**5 PSI**) for two to three minutes.

Figure 2-19: Torque Hub



- 1 Spindle
- 2. Housing
- 3. Carrier Assembly
- 4. Gear ring
- 5. Spaces, Input
- 6. sun Gear
- 7. Gear, Internal

- 8. Cover
- 9. Shoulder Bolt
- 10. Bolt
- 11. Stud
- 12. Stud
- 13. Pipe Plug
- 14. Pipe Plug

Repair Kit contains:

- 1 Lip Seal
- 2. Bearing, Cone
- 3. Bearing, Cup
- 4. Thrust Washer
- 5. Retaining Ring
- 6. O-ring (2)
- 7. Washer (2)
- 8. Thrust Washer - SK91 (068570-011)
- 9. Bearing, Cup
- 10. Bearing, Cone

2-11 DRIVE MOTORS

REMOVAL

1. Disconnect battery negative terminals or Anderson connectors (both sides on electric model).
2. Tag and disconnect electric cables from motor.
3. Remove and save hardware which secures drive motor to torque hub.

INSTALLATION

NOTE: Unless otherwise specified, torque all fittings according to *Torque Specifications* in "Section 1 - General Information".

1. Install drive motor to torque hub using original hardware.
2. Connect electric cables to motor.
3. Connect Anderson connectors or negative terminals on batteries.

PUMP MOTOR

REMOVAL

1. Disconnect battery negative terminals or Anderson connectors (both sides on electric model).
2. Tag and disconnect electric cables from motor.
3. Remove and save hardware which secures pump motor to pump assembly.

INSTALLATION

NOTE: Unless otherwise specified, torque all fittings according to *Torque Specifications* in "Section 1 - General Information".

1. Install motor using original hardware.
2. Connect electric cables to motor.
3. Connect Anderson connectors or negative terminals on batteries.

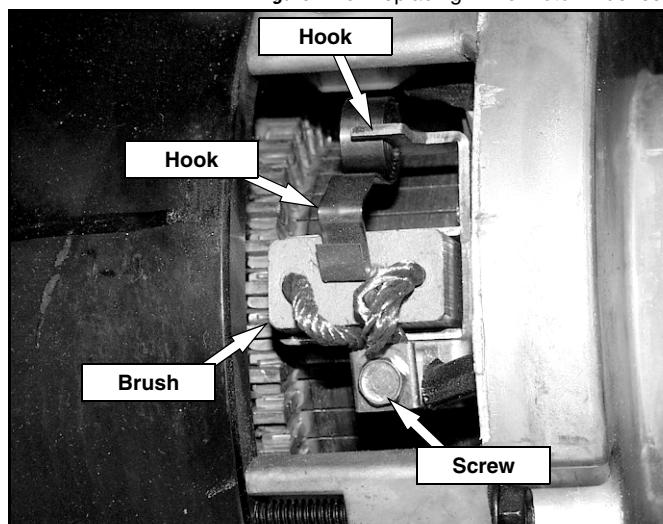
DRIVE MOTOR BRUSHES

1. If necessary, remove electric motor (Refer to previous section).
2. Release latch and remove headband.
3. Pull back brush spring and latch on hook.
4. Remove screw and set aside.

IMPORTANT: Be sure screw does not fall inside motor.

5. Remove old brush and replace with new brush.
6. Replace screw, unhook brush spring and return to original position.
7. Install and relatch headband.

Figure 2-20: Replacing Drive Motor Brushes



2-12 STEERING CYLINDER

REMOVAL

1. Remove and cap the hoses. Mark them for reference.
2. Remove the hair pin retainers from the clevis pins at each end of the cylinder.
3. Remove the clevis pins.
4. Remove the cylinder from the chassis.

SEAL REPLACEMENT

Refer to "Cylinder Repair" in the General Information section, and Figure 2-22.

INSTALLATION

1. Align the ends of the cylinder with the mounts on the chassis.
2. Install the clevis pins.
3. Install the hair pin retainers into the clevis pins at each end of the cylinder.
4. Install the hoses, noting their orientation markings from disassembly.

Figure 2-21: Front Axle Assembly, 4WD

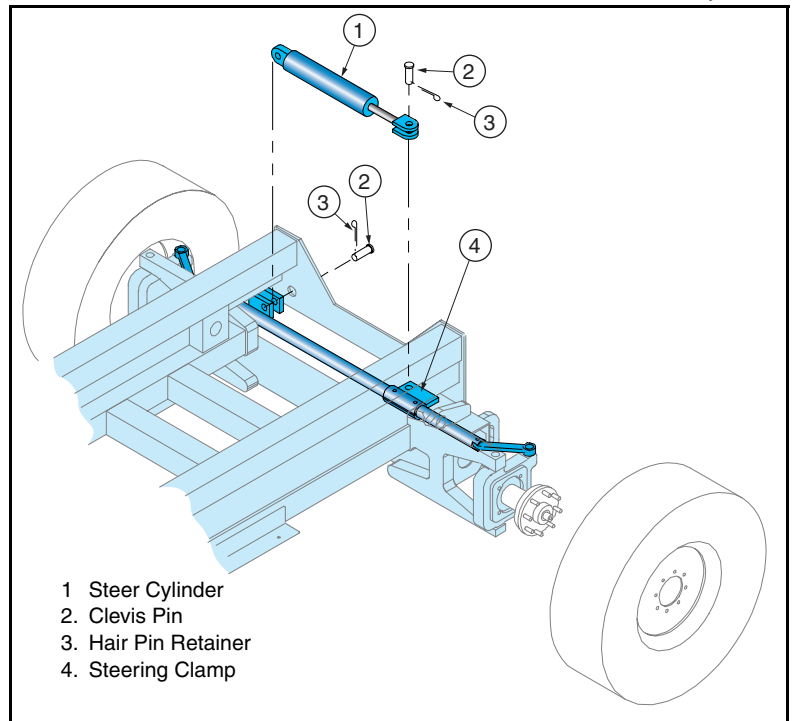
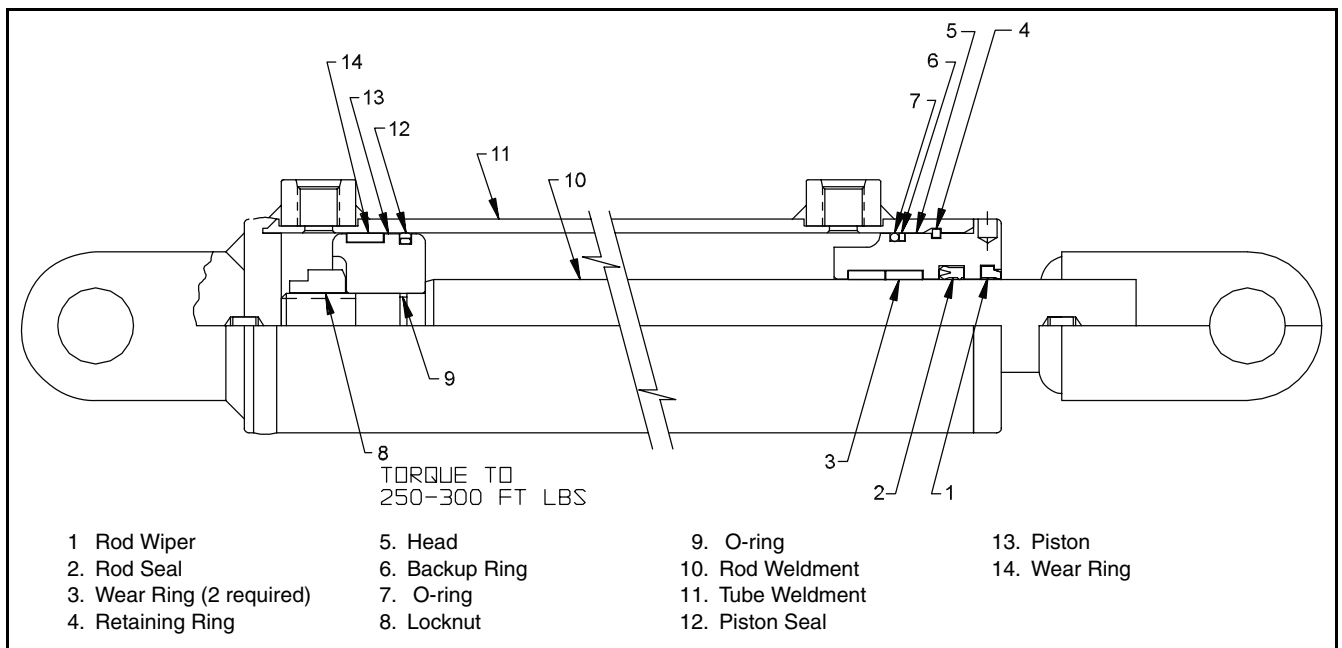


Figure 2-22: Steering Cylinder Cross Section



2-13 LIFT CYLINDERS

REMOVAL

1. Elevate and block the elevating assembly (See Figure 2-2).
2. Open emergency lowering valve to be sure all pressure is out of the lift cylinder.
3. Remove and cap both hoses and fittings.
4. Remove the down valve and cable assembly.
5. Support the lift cylinder with a suitable lifting device to prevent falling.
6. Remove the retaining bolts from the upper and lower pivot pins.
7. Drive out the pivot pins, upper one first, then the lower one.
8. Hoist the cylinder out of the elevating assembly from the front. **DO NOT sling the cylinder by the rod end pivot, this will cause the cylinder to extend when hoisted.**

SEAL REPLACEMENT

Refer to "Cylinder Repair" in the General Information section, and Figure 2-23 or Figure 2-24.

INSTALLATION

NOTE: Before installing the cylinder, check the pins and bearings for excessive wear. Replace if necessary.

1. Using a suitable lifting device, lower the cylinder into the elevating assembly from the front. **DO NOT sling the cylinder by the rod end pivot, this will cause the cylinder to extend when hoisted.**
2. Align the pivots and install the pivot pins, lower one first, then the upper one.
3. Install the retaining bolts into the pivot pins.
4. Install the down valve and cable assembly. Adjust the cable to stop on the collar of the cable jacket, before the down valve reaches the full extent of its pull. The down valve may leak if the cable is allowed to pull the spool of the valve beyond its limit.
5. Install the hoses.
6. Lift and lower the machine for several cycles to work out the air. Check for leaks, repair as necessary.

Figure 2-23: Lift Cylinder Cross Section - Serial Number 4022 to 4129

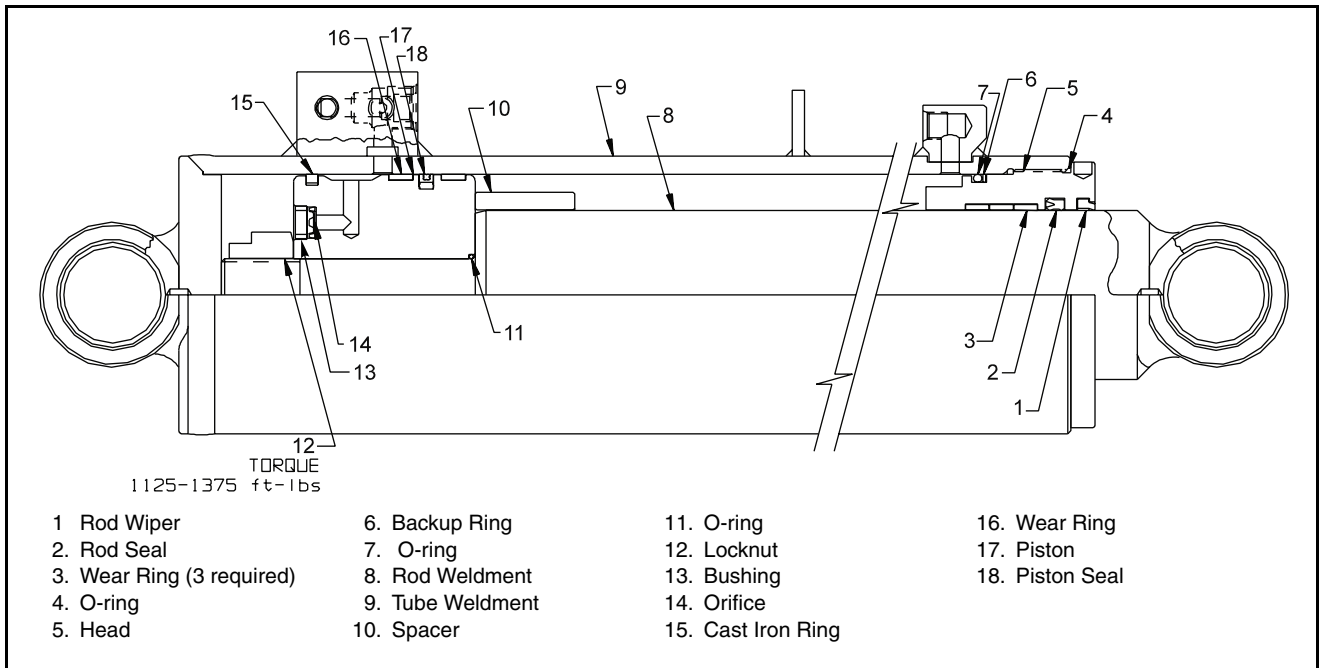
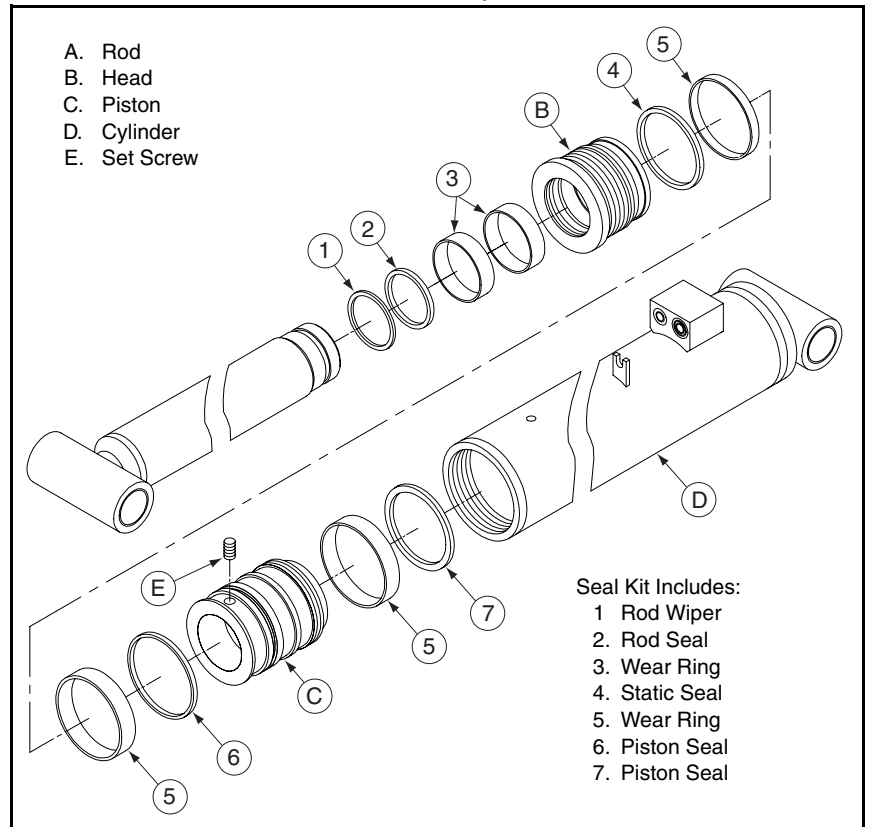


Figure 2-24: Lift Cylinder - Serial Number 4130 to Current



2-14 OUTRIGGER CYLINDER (OPTIONAL)

REMOVAL

Refer to Figure 2-25.

1. Remove the plug from the top of the outrigger cylinder.
2. Disconnect the wires from the pressure Switch and the ball Switch. Tag them for identification during reassembly.
3. Unscrew the strain relief and pull the wires out of the top of the cylinder.
4. Remove and cap the hoses. Tag them for identification during reassembly.
5. Remove the four capscrews, nuts, and washers holding the outrigger cylinder to the outrigger support weldment.
6. Remove the outrigger cylinder.

SEAL REPLACEMENT

Refer to "Cylinder Repair" in the General Information section, and Figure 2-26.

INSTALLATION

1. Install the outrigger cylinder to the outrigger support weldment using the four capscrews, nuts, and washers; tighten.
2. Install the hoses exactly as disassembled.
3. Thread the wires for the pressure Switch and the ball Switch through the strain relief.
4. Reattach the wires to the Switches exactly as disassembled.
5. Tighten strain relief.
6. Install plug to top of outrigger cylinder.

Figure 2-25: Outrigger Cylinder Installation

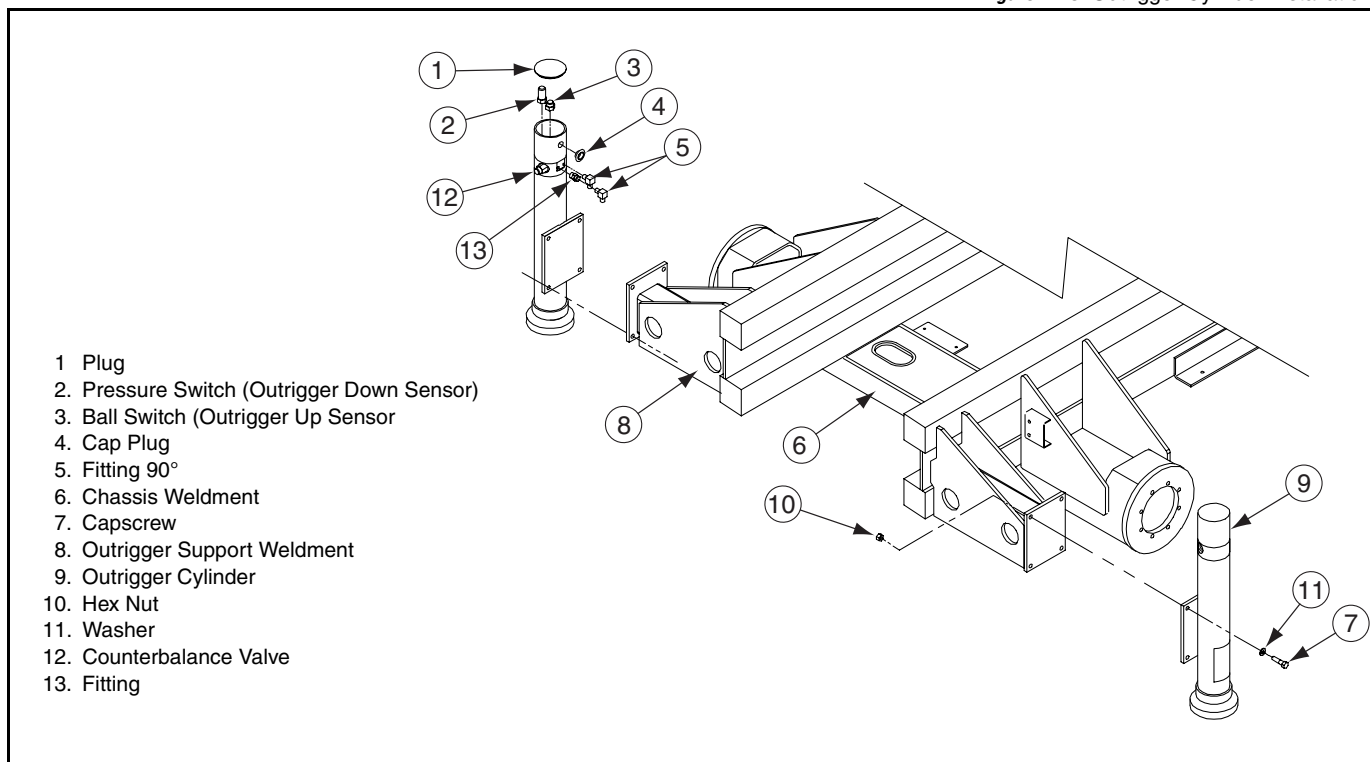
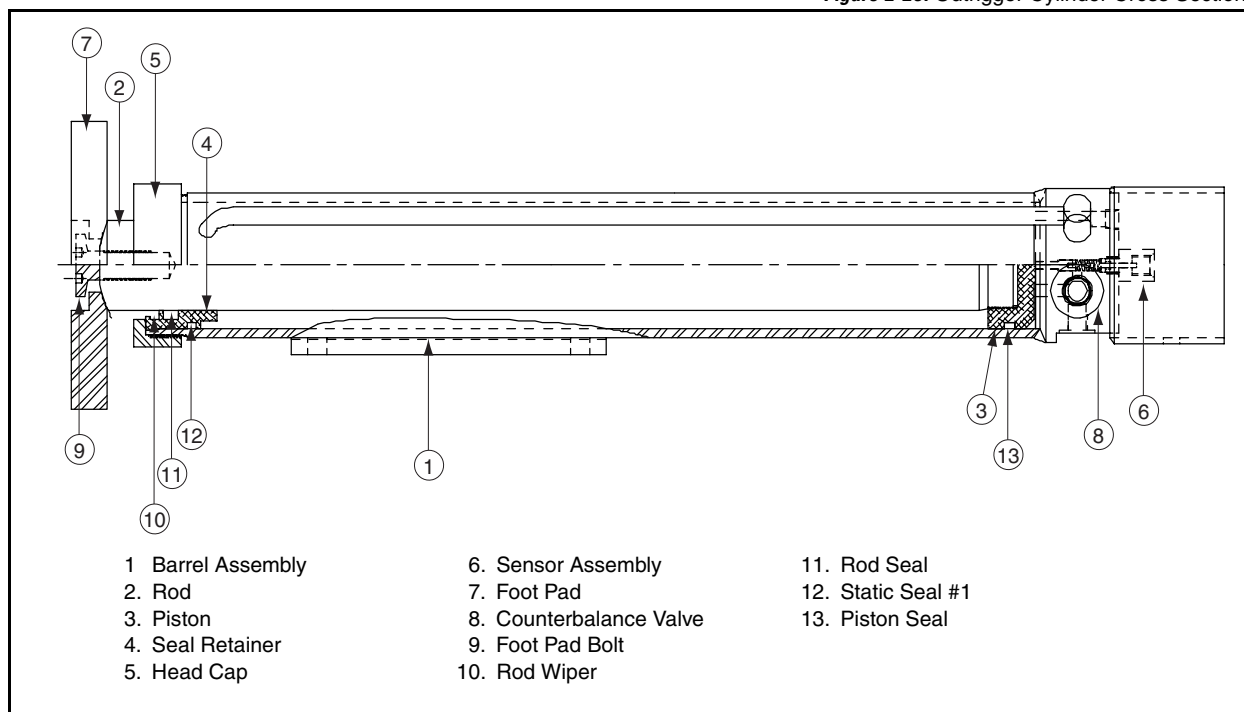


Figure 2-26: Outrigger Cylinder Cross Section



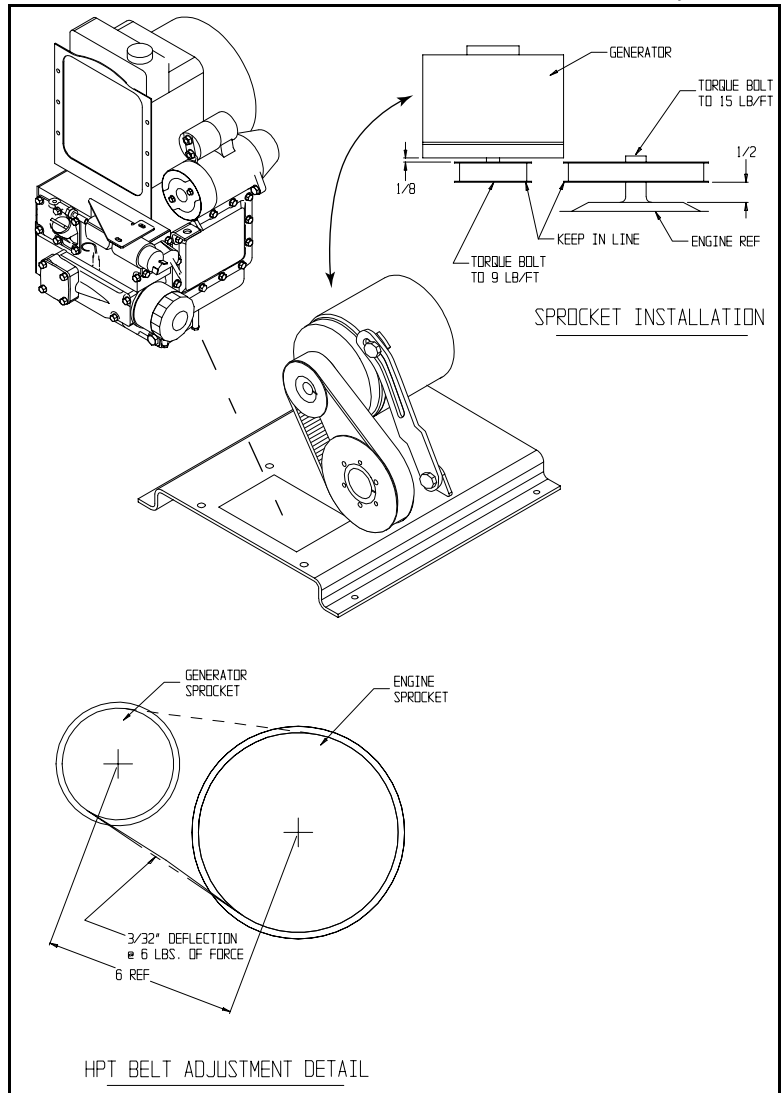
2-15 GENERATOR, BI-ENERGY MODELS ONLY

Bi-Energy work platform is equipped with a diesel powered 48 volt, 100 amp generator. There are no brushes or springs to replace.

DRIVE BELT ADJUSTMENT

1. Open the power module to gain access to the generator.
2. Loosen the bolt and nut at both ends of the adjustment arm.
3. Pry the generator back until the drive belt can be deflected 2,5 mm (**3/32 in.**) with 8 N-m (**6 lb/ft**) of force.
4. Tighten the bolts at both ends of the adjustment arm.

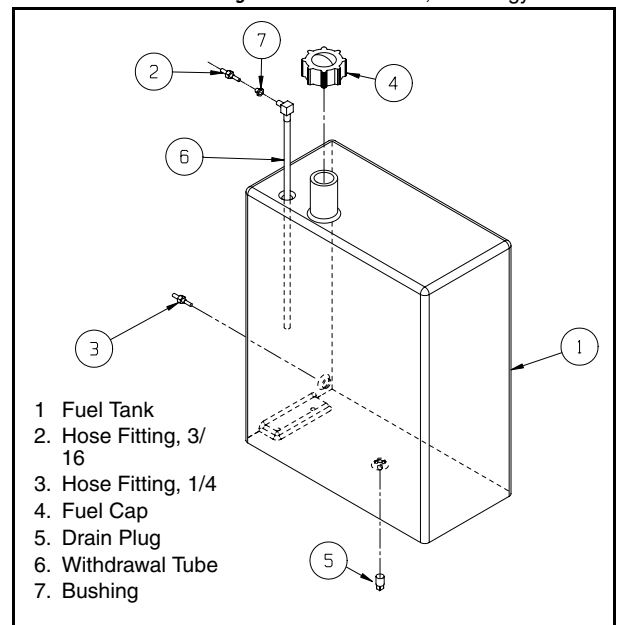
Figure 2-27: Drive Belt Adjustments



FUEL TANK, BI-ENERGY MODELS

The fuel tank is located in the control module on Bi-Energy models.

Figure 2-28: Fuel Tank, Bi-Energy Models



TROUBLESHOOTING

3-1 INTRODUCTION

This section contains troubleshooting Truth Tables for the LX 31 and LX41 Electric Work Platforms.

Careful inspection and accurate analysis of the symptoms listed in the Troubleshooting Guide will localize the trouble more quickly than any other method. This manual cannot cover all possible problems that may occur. If a specific problem is not covered in this manual, call our toll free number for service assistance.

Referring to the Operator Manual and the Schematics section will aid in understanding the operation and function of the various components and systems of the Work Platform and help in diagnosing and repair of the machine.



When troubleshooting, ensure that the work platform is resting on a firm, level surface.

When performing any service which requires the platform to be raised, the Elevating Assembly must be blocked.

Disconnect the battery when replacing or testing the continuity of any electrical component.

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3-2 TECHNICAL SUPPORT

Technical Support is available by telephone or FAX.

UPRIGHT USA

Tel: 1-800-926-5438
FAX: 1-559-662-4785

UPRIGHT EUROPE

Tel: +353-1-620-9300
FAX: +353-1-620-9301

3-3 GENERAL PROCEDURE

Thoroughly study hydraulic and electronic schematics in **the Schematics section**. Check for loose connections and short circuits. Check/repair/replace each component in the Truth Table which is listed under each machine function which does not operate properly.

Determine whether the problem is mechanical (interference), electrical or hydraulic. Some functions require power at more than one solenoid.

Use the charts on the following pages to help determine the cause of a fault in your UpRight work platform

NOTE: Spike protection diodes at components have been left out of the charts to eliminate confusion.

3-4 TROUBLESHOOTING PROCEDURES

1. Verify your problem.
 - Do a full function test from both platform controls and chassis controls and note all functions that are not operating correctly.
2. Narrow the possible causes of the malfunction.
 - Use the troubleshooting guide to determine which components are common to all circuits that are not functioning correctly.
3. Identify the problem component.
 - Test components that are common to all circuits that are not functioning correctly. Remember to check wires and terminals between suspect components. Be sure to check connections to battery negative.
4. Repair or replace component found to be faulty.
5. Verify that repair is complete.
 - Do a full function test from both platform and chassis controls to verify that all functions are operating correctly and machine is performing to specified values

3-5 ADJUSTMENT PROCEDURES

- Hydraulic settings must be checked whenever a component is repaired or replaced.
- Connect a pressure meter of appropriate range to the test port located on the hydraulic manifold.
- Correct pressure settings are listed in the hydraulic schematic.

3-6 CHECKING PUMP PRESSURES

- Remove hose from pump port, and connect pressure tester.

3-7 ELECTRIC TRUTH TABLES

ELECTRICAL SCHEMATICS

COMPONENT		FUNCTION	LOWER CONTROLS	UPPER CONTROLS	DRIVE FORWARD	DRIVE REVERSE	RAISE PLATFORM	LOWER PLATFORM	STEER RIGHT	STEER LEFT	BRAKES	LEVEL SENSOR ALARM	DOWN ALARM	HIGH/LOW SPEED	BATTERY CHARGER	ENGINE (BI-ENERGY)	GENERATOR (BI-ENERGY)
ALM1	Level Sensor Alarm											X					
ALM2	Down Alarm												X				
BAT1	Battery		X	X	X	X									X		
BAT2	(Bi-Energy) Battery															X	X
C1	Main Power Contactor		X	X	X	X											
C2	Forward Contactor				X												
C3	Reverse Contactor					X											
C4	Pump Override Contactor				X	X	X		X	X							
C5	Pump/Traction Contactor								X	X							
CB1	Circuit Breaker		X	X													
CB2	Circuit Breaker		X	X													
CB3	(Bi-Energy) Circuit Breaker															X	X
CH1	Battery Charger														X		
CONT	Controller		X	X	X	X	X		X	X		X	X	X			
F1	Main Fuse		X	X											X		
F2	Main Fuse		X	X											X		
F9	(Bi-Energy) Engine Fuse															X	X
MOT1	Power Unit Motor		X	X	X	X	X			X	X						
MOT2	Power Unit Motor		X	X	X	X	X			X	X						
MOT3	Left Traction Motor				X	X				X							
MOT4	Right Traction Motor				X	X			X								
P1	(Bi-Energy) Fuel Pump															X	
R1	Drive/Lift Relay		X	X	X	X	X										
R2	8 Meter Cutout Relay				X	X								X			
	Platform Stowed Relay				X	X	X	X						X			
R3	Level Sensor Alarm Relay											X					
R4	Up Relay						X										
R5	Down Relay		X	X				X					X				
R6	Down Alarm Relay												X				
R7	Steer Right Relay								X								
R8	Steer Left Relay									X							
R9	Pump Start Relay		X	X													
R10	Brake Relay				X	X					X						
R11	Brake Release Relay				X	X					X						
R12	Power Relay		X	X	X	X											
R13	(Bi-Energy) Start Relay															X	
R14	(Bi-Energy) Charge Relay																X
R15	Serial #4022-4274 Brake Release Relay										X						
	Serial #4275-Up (Bi-Energy) 12V Charge Relay																X
R16	Platform Power Relay		X	X	X	X	X										
R17	Prevent Pump Start Relay						X	X	X	X							
R18	(Bi-Energy) Starter Relay															X	
R19	(Bi-Energy) Glow Plug Relay															X	

COMPONENT		FUNCTION	LOWER CONTROLS	UPPER CONTROLS	DRIVE FORWARD	DRIVE REVERSE	RAISE PLATFORM	LOWER PLATFORM	STEER RIGHT	STEER LEFT	BRAKES	LEVEL SENSOR ALARM	DOWN ALARM	HIGH/LOW SPEED	BATTERY CHARGER	ENGINE (BI-ENERGY)	GENERATOR (BI-ENERGY)
R20	(Bi-Energy) Oil Pressure Relay															X	
RES1	Resistor Pack		X	X	X	X											
S1	Control Handle Interlock Switch			X	X	X			X	X							
S2	Forward Micro Switch				X												
S3	Reverse Micro Switch					X											
S4	Lower Controls Emergency Stop Switch		X		X	X	X		X	X							
S5	Lift Button						X	X									
S6	Lower Button						X	X									
S7	Brake Release Button				X	X					X						
S8	Lift/Drive Switch				X	X	X	X									
S9	High/Low Switch													X			
S10 – S13	Serial #4022-4275 Platform Down Switches				X	X		X									
S10	Serial #4275–Up Proximity Switch				X	X	X	X									
S14	Serial #4022-4275 8 Meter Cutout Switch				X	X								X			
S15	Serial #4022-4275 Up Limit Switch				X	X	X										
S16	Pump Start Switch		X	X	X	X	X										
S17	Chassis/Platform/Brake Release Switch		X	X							X						
S18	Platform Controls Emergency Stop Switch			X	X	X	X		X	X							
S19	Steering Rocker Switch								X	X							
S20	Proportional Speed Control Switch				X	X	X	X	X	X							
S21	Keyswitch			X												X	
S22	(Bi-Energy) Start Switch															X	
S23	(Bi-Energy) Oil Pressure Switch															X	
S24	(Bi-Energy) Glow Plug Switch															X	
S25	(Bi-Energy) Engine Run Switch															X	X
S26	(Bi-Energy) Charge Switch																X
S27	(Bi-Energy) Starter Button															X	
S28	(Bi-Energy) Glow Plug Button															X	
SEN1	Level Sensor		X	X	X	X	X										
SOL1 & SOL2	Up Solenoids						X										
SOL3	Down Solenoid							X									
SOL5	Steer Right Solenoid								X								
SOL6	Steer Left Solenoid									X							
SOL8	Brake Solenoid				X	X					X						
SOL11	Brake Release Solenoid				X	X					X						
SOL12	(Bi-Energy) Stop/Run Solenoid															X	
TG1 & TG2	Tachometer-Generator				X	X								X			

OUTRIGGER OPTION

COMPONENT		FUNCTION	OUTRIGGER INDICATOR LIGHTS	DEPLOY OUTRIGGERS	RETRACT OUTRIGGERS	DRIVE FORWARD	DRIVE REVERSE	LIFT	LOWER
OR-LB	Outrigger Light Board		X	X	X				
OR-L1	LED, Outrigger Indicator, Left Front		X	X	X				
OR-L2	LED, Outrigger Indicator, Left Rear		X	X	X				
OR-L3	LED, Outrigger Indicator, Right Rear		X	X	X				
OR-L4	LED, Outrigger Indicator, Right Front		X	X	X				
OR-R1	Relay, Outrigger Extend, Left Front			X					
OR-R2	Relay, Outrigger Retract, Left Front				X				
OR-R3	Relay, Outrigger Extend, Left Rear			X					
OR-R4	Relay, Outrigger Retract, Left Rear				X				
OR-R5	Relay, Outrigger Extend, Right Front			X					
OR-R6	Relay, Outrigger Retract, Right Front				X				
OR-R7	Relay, Outrigger Extend, Right Rear			X					
OR-R8	Relay, Outrigger Retract, Right Rear				X				
OR-R9	Relay, Drive Override					X	X		
OR-R16	Relay, Drive Cutout					X	X		
OR-R18	Relay, Outrigger Power		X	X	X	X	X	X	X
OR-S1	Switch, Outrigger Extend/Retract, Left-Front		X	X	X				
OR-S2	Switch, Outrigger Extend/Retract, Left-Rear		X	X	X				
OR-S3	Switch, Outrigger Extend/Retract, Right-Rear		X	X	X				
OR-S4	Switch, Outrigger Extend/Retract, Right-Front		X	X	X				
OR-S5	Outrigger Switch		X	X	X	X	X	X	X
OR-S6 – OR-S9	Ball Switch, Outrigger				X				
OR-S10 – OR-S13	Pressure Switches, Outrigger			X					
OR-SOL1	Solenoid, Outrigger Extend, Left-Front			X		X	X	X	X
OR-SOL2	Solenoid, Outrigger Retract, Left-Front				X	X	X	X	X
OR-SOL3	Solenoid, Outrigger Extend, Left-Rear			X		X	X	X	X
OR-SOL4	Solenoid, Outrigger Retract, Left-Rear				X	X	X	X	X
OR-SOL5	Solenoid, Outrigger Extend, Right-Front			X		X	X	X	X
OR-SOL6	Solenoid, Outrigger Retract, Right-Front				X	X	X	X	X
OR-SOL7	Solenoid, Outrigger Extend, Right-Rear			X		X	X	X	X
OR-SOL8	Solenoid, Outrigger Retract, Right-Rear				X	X	X	X	X

3-8 HYDRAULIC TRUTH TABLE

	COMPONENT	FUNCTION	RAISE PLATFORM	LOWER PLATFORM	STEER RIGHT	STEER LEFT	RIGHT BRAKE	LEFT BRAKE	DEPLOY OUTRIGGERS
ACC	Accumulator						X	X	
CV1	Check Valve						X	X	
BK1	Left Brake Cylinder							X	
BK2	Right Brake Cylinder						X		
CYL1	Lift Cylinder	X	X						
CYL2	Steering Cylinder			X	X				
CYL3-6	Cylinder, Outrigger								X
F1	Return Filter	X	X	X	X	X	X	X	X
F2	Suction Strainer	X	X	X	X	X	X	X	X
FD1	Flow Divider	X	X	X	X				
LV1-4	Load Holding Valve, Outrigger								X
ORF1	Brake Orifice						X	X	
ORF2	Lift Orifice	X	X						
P1	Hydraulic Pump	X	X	X	X	X	X	X	X
P2	Hydraulic Pump	X	X	X	X	X	X	X	X
PS1	Pressure Switch						X	X	
RV1	Main Relief Valve	X	X	X	X				
RV2	Steering Relief Valve			X	X				
V1	Brake Apply Valve						X	X	
V2	Brake Release Valve						X	X	
V3	Steering Valve			X	X				
V4	Lift Valve	X	X						
V5	Dump Valve	X	X	X	X				
V6	Down Valve	X	X						
V7-V10	Outrigger Valve								X

3-9 TROUBLESHOOTING THE MOS90

Important basics applicable to the motor control unit.

- The MOS90 has a green diagnostics L.E.D. in the front panel.
- The green L.E.D. will turn on and shine continuously when the MOS90 is powered up and working correctly.
- The green L.E.D. will be off if no power is supplied to the MOS90.
- The green L.E.D. will flash a sequence of flashes if the MOS90 is damaged or is receiving an improper signal. An explanation of the flash sequences "flash faults" is shown on the following pages.
- The MOS90 is high temperature protected by "thermal cutback". The cutback operates between 80°C (176°F) and 90°C (194°F). Powered functions will gradually operate slower and slower until 90°C (194°F). The MOS90 will shut down at 90°C (194°F). Continued operation at high temperature will damage the MOS90.
- The MOS90 is low voltage protected by "low voltage cutout". The MOS90 shuts down at 14.0 VDC. Powered functions suddenly stop. When input voltage goes above 14.0 VDC turns back on.

WHEN A FLASH ERROR OCCURS

STEP 1. Disconnect the 17 pin connector from the MOS90. Wait Five (5) seconds and plug it back in again. If the flash error repeats go to step Two (2). If the green L.E.D. lights up and stays on continuously - operate machine. Note which functions are being used when problem repeats itself.

STEP 2. Disconnect the 17 pin connector from the MOS90. Connect pin Six (6) to a fused battery supply (14.0 VDC minimum) and observe the green L.E.D. If flash error stays, replace MOS90. If green L.E.D. lights up and remains on continuously, check wiring.

NOTE: NOTE: Troubleshoot the possible cause of the flash error before replacing the MOS90, for example an Eight (8) flash error will cure itself when the MOS90 cools down.

3-10 USING THE CALIBRATOR

The calibrator has 20 L.E.D. segments marked as shown.

The values which should be expected when checking the machine are shown on the following page.

There are three buttons on the calibrator:

- increment, marked +
- decrement, marked -
- select

When select is pressed, each L.E.D. will light in sequence until the select button is released. Each setting can be incremented or decremented using the + or - buttons when the adjacent L.E.D. is lit.

When "Test" L.E.D. is lit, the state of the MOS90 inputs is displayed. The first input displayed is the accelerator which can vary from 0-100%. When the + button is pressed once the switch Input 1 is displayed. This will be seen as "1.0P" until the switch Input voltage changes. "1.CL" will then be displayed. This is repeated for all the switch inputs.

When BATTV, MOTORV, MOTORA and TEMPC are selected, the controller shows their values. When BATTV is selected and the "+" button is held in, the highest voltage that the MOS90 has recorded will be displayed. When TEMPC is selected and the "+" button is held in, the highest temperature that the MOS90 has recorded will be displayed. The "-" button will display the lowest values.

When the MOS90 is first powered up, the recorded minutes of run time is displayed. The "+" button displays thousands of hours and the "-" button displays hundreds of hours. When the MOS90 is pulsing (being used) run time is being incremented and stored. The "dot" in the time display is blinking when MOS90 is being used, steady when idle.

Figure 3-1: MOS90 Calibrator LED Segments

TRACTION		
IMAX	■	AMP
PLUG	■	AMP
ACCEL	■	SEC
CREEP	■	%VB
BYPASS	■	AMP
SPEED	■	%MAX
SPEED1	■	%
SPEED2	■	%
F.WEAK	■	AMP
TIMER	■	SEC
SEAT	■	SEC
X2	■	
X3	■	
X4	■	
X5	■	
BATT	■	V
MOTOR	■	V
MOTOR	■	AMP
TEMP	■	C
TEST	■	

CALIBRATOR SETTINGS

LED	Function	Unit	Setting	Comments
1	MOS90 Maximum Amp. Capacity	Amps	600	Adjustable from 50 amps to 600 amps
2	Acceleration Delay	Seconds	1.0	Adjustable from 1.0 sec to 3.0 sec.
3	Deceleration Delay	Seconds	0.5	Adjustable from 0.5 sec. to 3.0 sec.
4	Traction Creep	%	0	Adjustable from 0% to 10%
5	Max. allowed Speed	%	65	Adjustable from 5% to 100%
6	Cutback Speed 1	%	20	Adjustable from 5% to 25%
7	Cutback Speed 2	%	75	Adjustable from 20% to 75%
8	Pump Current limit	Amps	270	Adjustable from 50 amps to 600 amps
9	Cutback1 Plug Current	Amps	400	Adjustable from 180 amps to 750 amps
10	CSC Proportional Gain	1	30	Adjustable from 1 to 100
11	CSC Integral Gain	1	20	Adjustable from 1 to 100
12	Low Voltage Cutout	Volts	25	Adjustable from 25 Volts to 40 Volts
13	Pump Acceleration Delay	Seconds	2.0	Adjustable from 1.0 to 3.0
14	Pump Creep	%	0%	Adjustable from 0% to 30%

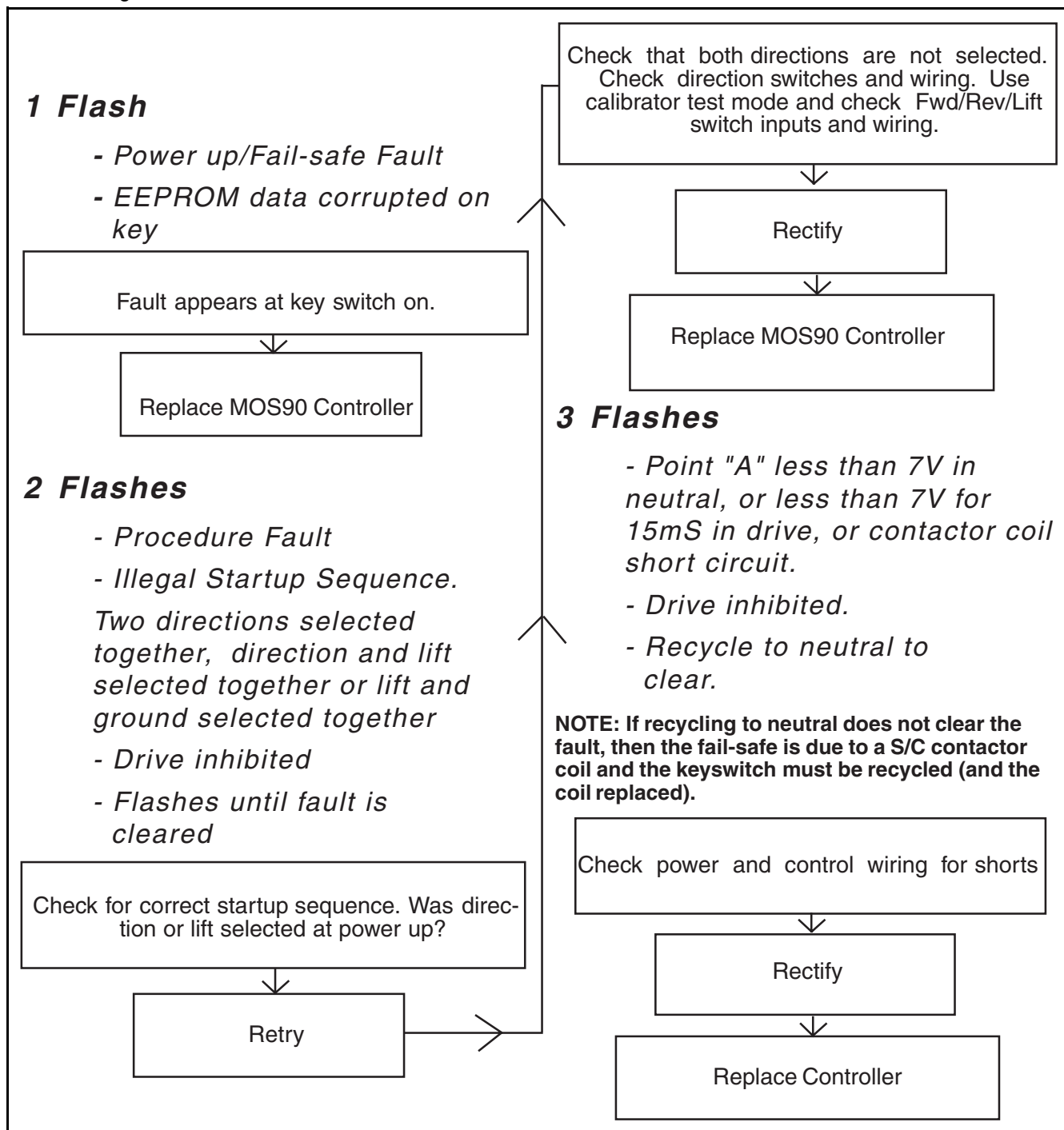
UPRIGHT TRACTION CONTROLLER DISPLAY

Sequence No.	Test	Display	Input #
-	Acc. Input	0-100%	14
1	Forward	CL/OP	8
2	Reverse	CL/OP	11
3	Tach Input	0-100%	12
4	Elev. Pos.	CL=Clpsd. OP=Lifted	4
5	Tilt Switch	CL=Level OP=Tilt	7
6	Pump Switch	CL= Pump OP=Trac.	16
7	Act. Direction Tacho Output	OP=FWD CL=REV	2
8	High/Low Speed	CL=High OP=Low	13
9	Direction Flag	OP=No Dr. CL=Drv actv.	-
10	First Error Latch	Value= Flash Code	0-255

NOTE: CL = Switch Closed
OP = Switch Open

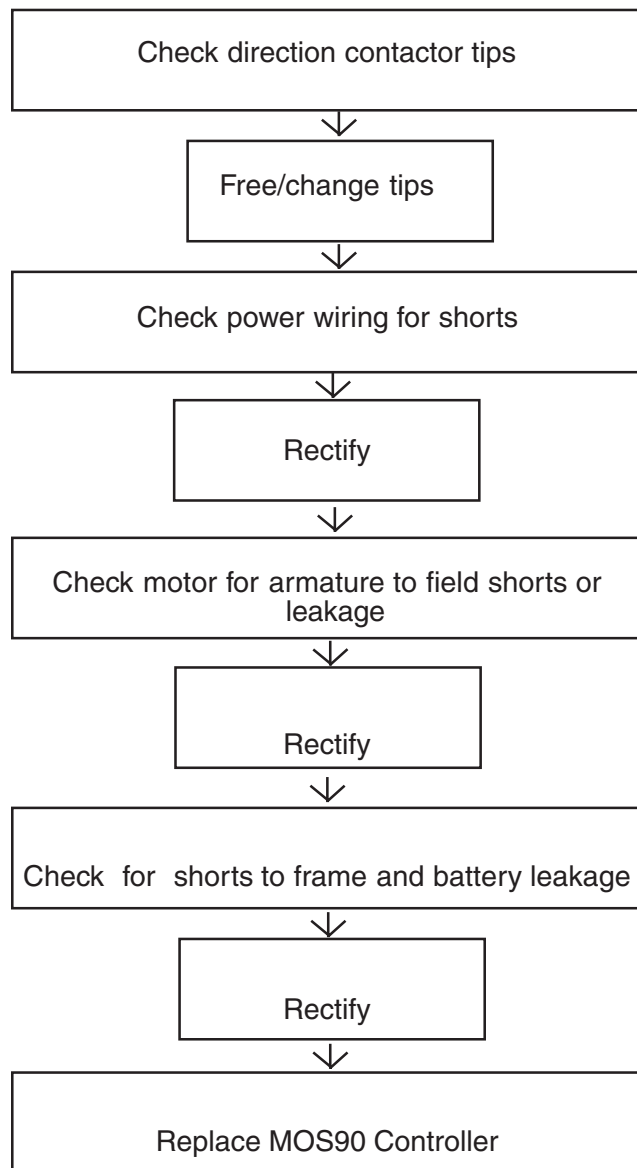
3-11 MOS90 FAULT FINDING FLOW CHARTS

At battery connection, the LED should not illuminate. At key ON, the LED should illuminate steadily. If the LED illuminates and remains steady, but no drive can be selected, the calibrator can be used to test the wiring harness.

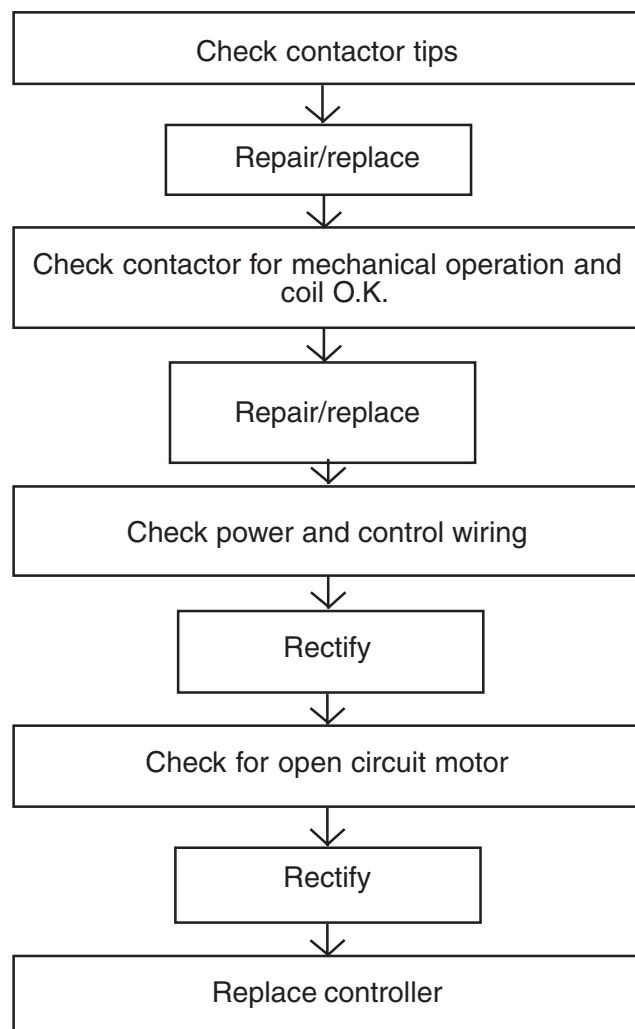


4 Flashes

- Direction contactor welded.
(Point "A" within 6V of B+ve in neutral)
- Leakage between motor armature and field.
- Drive inhibited.
- Flashes in neutral until fault is cleared

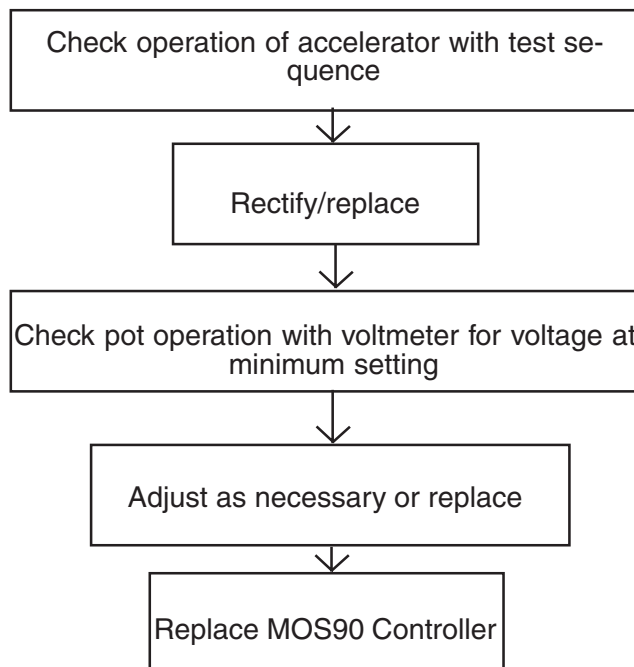
**5 Flashes**

- Direction contactors (or line contactor) did not close.
- Motor armature or field open circuit.
- Point "A" not within 6V of B+ve within one second of selecting direction.
- Drive inhibited.
- Flashes until fault is cleared, when contactor closes.

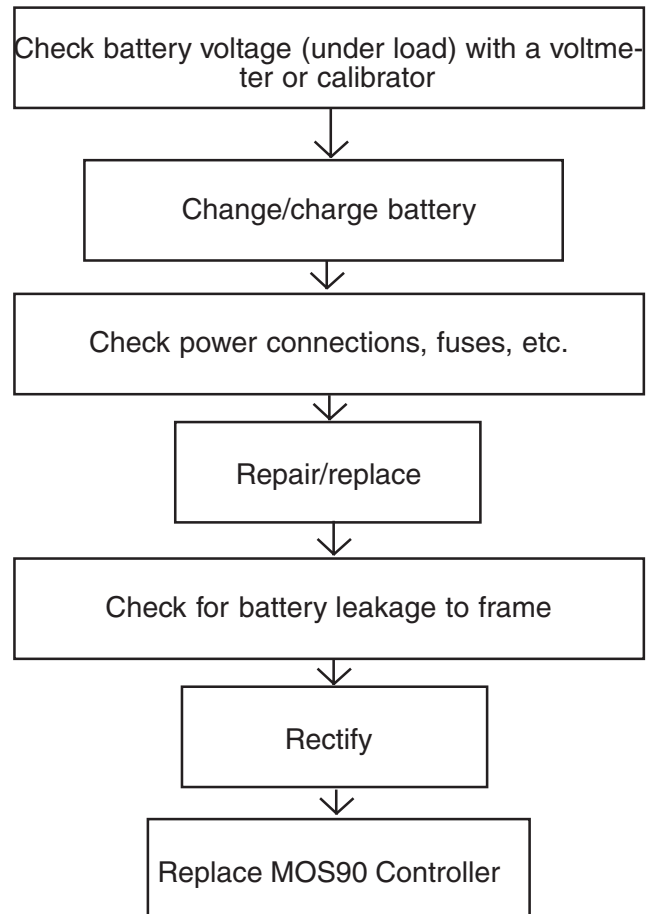


6 Flashes

- Accelerator faults
- 3.5 Volts to 0 Volts = Min. to Max. Speed on accelerator input (pin 14). Greater than 4.5 volts can mean an open accelerator pot. Less than 2.5 Volts on power up, indicates more than 30% demand
- Controller pulses at creep setting
- Flashes until fault cleared

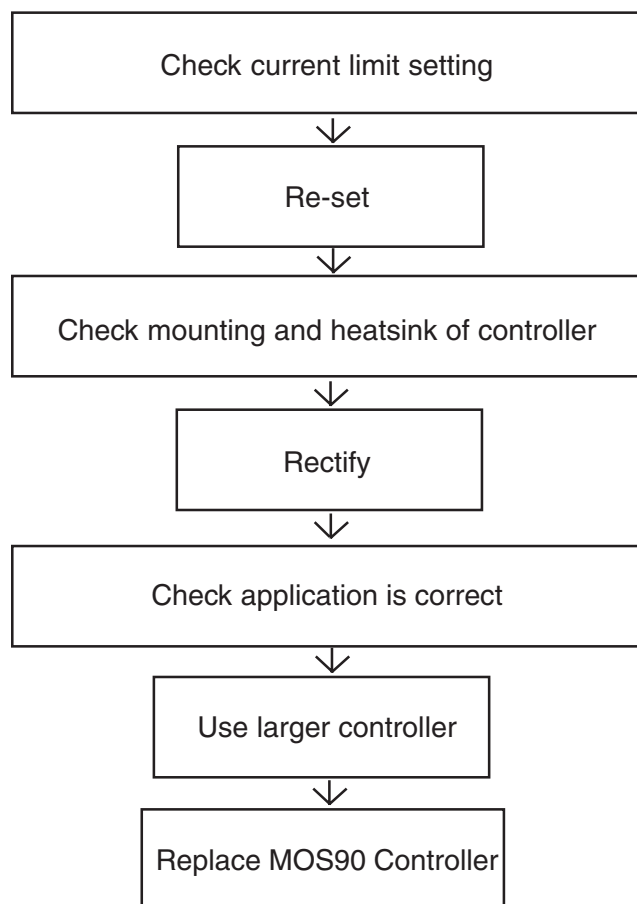
**7 Flashes**

- Battery voltage dipped below 14 volts
- Drive inhibited
- Turn key switch off and on to clear flash

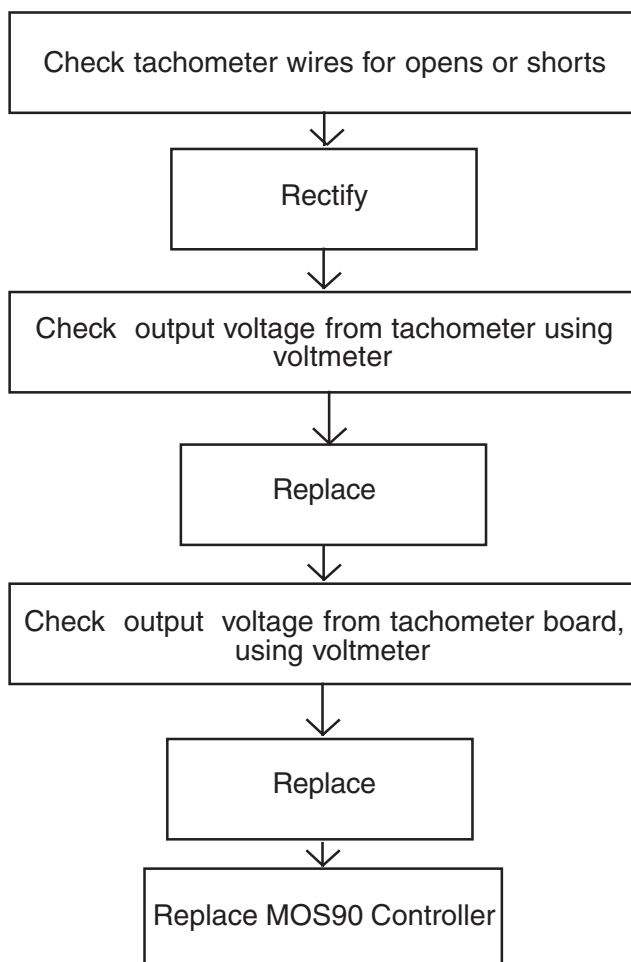


8 Flashes

- Thermal cutback
- Heatsink temperature less than 80°C (176°F) (Current limit will be zero at 90°C (194°F))
- Allow unit to cool down, to clear flashing

**10 Flashes**

- Tachometer fault
- Drive inhibited
- Recycle key to clear fault



11 Flashes

- Tachometer signal out of range
- Drive inhibited
- Flashes until fault cleared

Check tachometer wires for shorts to frame or a voltage source

Rectify

Check output voltage from tachometer using voltmeter

Replace

Replace MOS90 Controller

12 Flashes

- Severe tilt condition with platform raised above 2 meters
- Vehicle goes into emergency stop (forced neutral state) and plug brakes to a stop
- Recycle neutral to clear fault

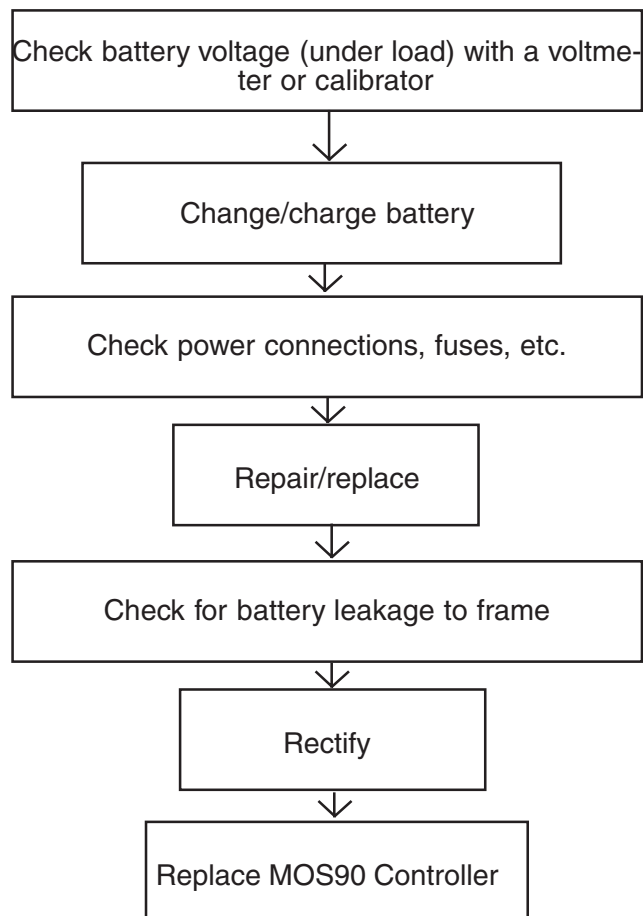
Use calibrator test mode and check platform up switch and severe tilt switch inputs and wiring

Rectify

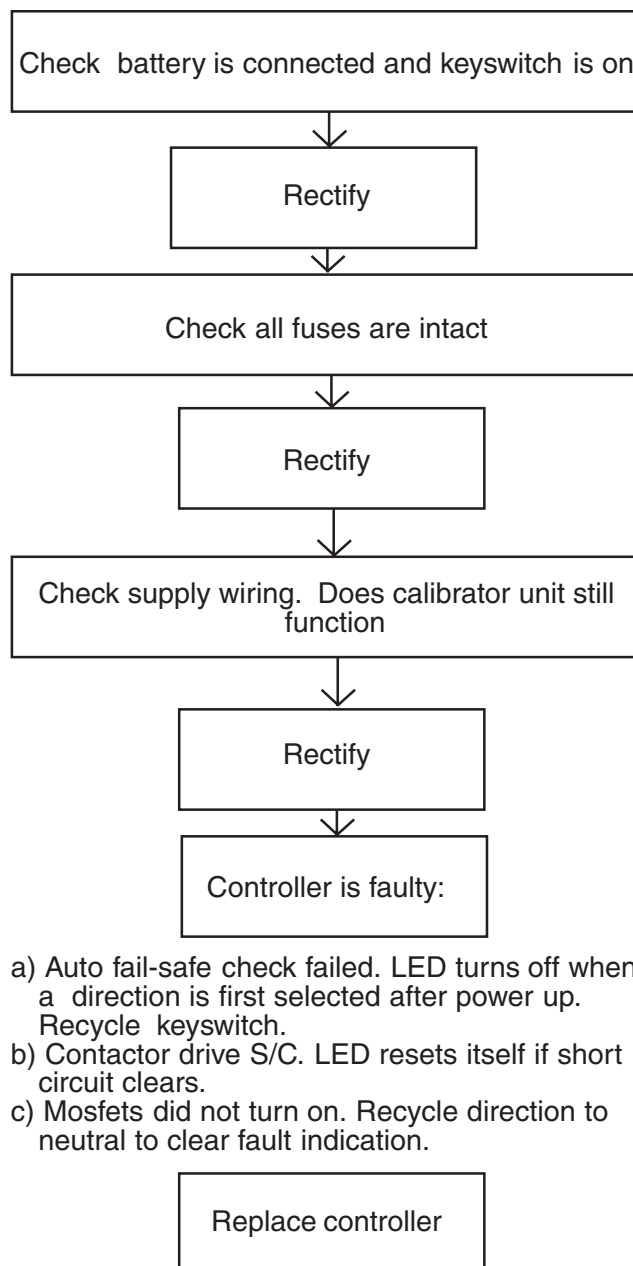
Replace MOS90 Controller

14 Flashes

- Battery voltage has fallen out of range.
- Traction and pump mode will not be allowed
- Requires key recycle to clear fault

**LED off**

- Unit not powered up or controller faulty, or LED faulty



3-12 ACTIVATING "TEST"

Position red LED at TEST. Press "+" or "-" to select the switch to be viewed.

The zero position input "-" should read zero and is set by adjusting the sensitivity threshold trim pot in the upper control box. Step on the foot switch and keeping the Control Handle centered, adjust the pot to give a readout of 1 or 2. Slowly back the pot down until the reading has just dropped to zero.

Connect voltmeter between B- and pin 14 on MOS90. Voltage at pin 14 in neutral should not be lower than +3.5 volts D.C.

- 3.5 VDC = 0% speed input, 0.0 VDC=100% speed input.

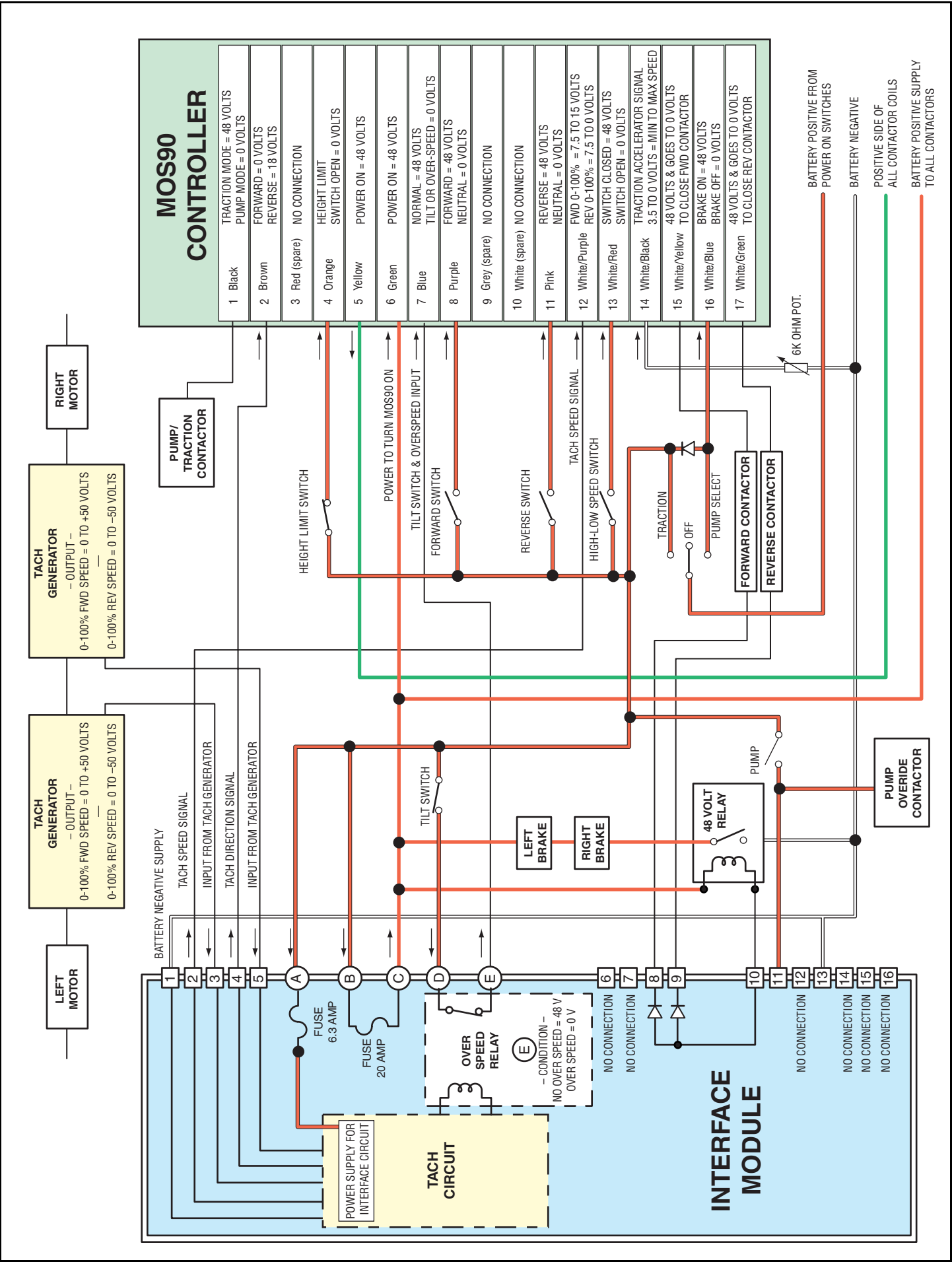
If set at an extremely high value MOS90 will read as fault and shut down.

Properly set the LX31/41 should start to move slowly with a small movement of the Control Handle after a very small "deadband" zone.

Figure 3-2: MOS90 17 Way Connector Pinout Designation

Pump/Traction	1	Black	MOS90
	2	Brown	
Tachometer direction input from tach board	3	Red (spare)	
No connection	4	Orange	
Height Limit	5	Yellow	
Battery + side of direction & brake contactors for coil suppression (48 Volts)	6	Green	
+ 48 Volt supply to power up controller	7	Blue	
Tilt	8	Purple	
48 Volts when forward is selected & 0 Volts in neutral	9	Grey (spare)	
No connection	10	White (spare)	
No connection	11	Pink	
48 Volts when reverse is selected & 0 Volts in neutral	12	White/Purple	
Tach signal from tach gen. 7.5 Volts to 15 Volts = FWD. 0-100% 7.5 Volts to 0 Volts = REV. 0-100%	13	White/Red	
High/Low Speed	14	White/Black	
Traction accelerator signal (3.5 Volts to 0 Volts = min. to max. speed)	15	White/Yellow	
Forward contactor driver - goes to battery negative to energize contactor	16	White/Blue	
Brake applied input 48 Volts = brake on 0 Volts = brake off	17	White/Green	
Reverse contactor driver - goes to battery negative to energise contactor			

Figure 3-3: MOS90 Wiring Diagram



SCHMATICS

This section contains electrical and hydraulic power schematics and associated information for maintenance purposes.

The diagrams are to be used in conjunction with the *Troubleshooting Truth Tables* in *Section 3*. They allow understanding of the makeup and functions of the systems for checking, tracing, and faultfinding during troubleshooting analysis.

The components that comprise the electrical and hydraulic systems are given a reference designation and are explained as to function and location in the following tables.

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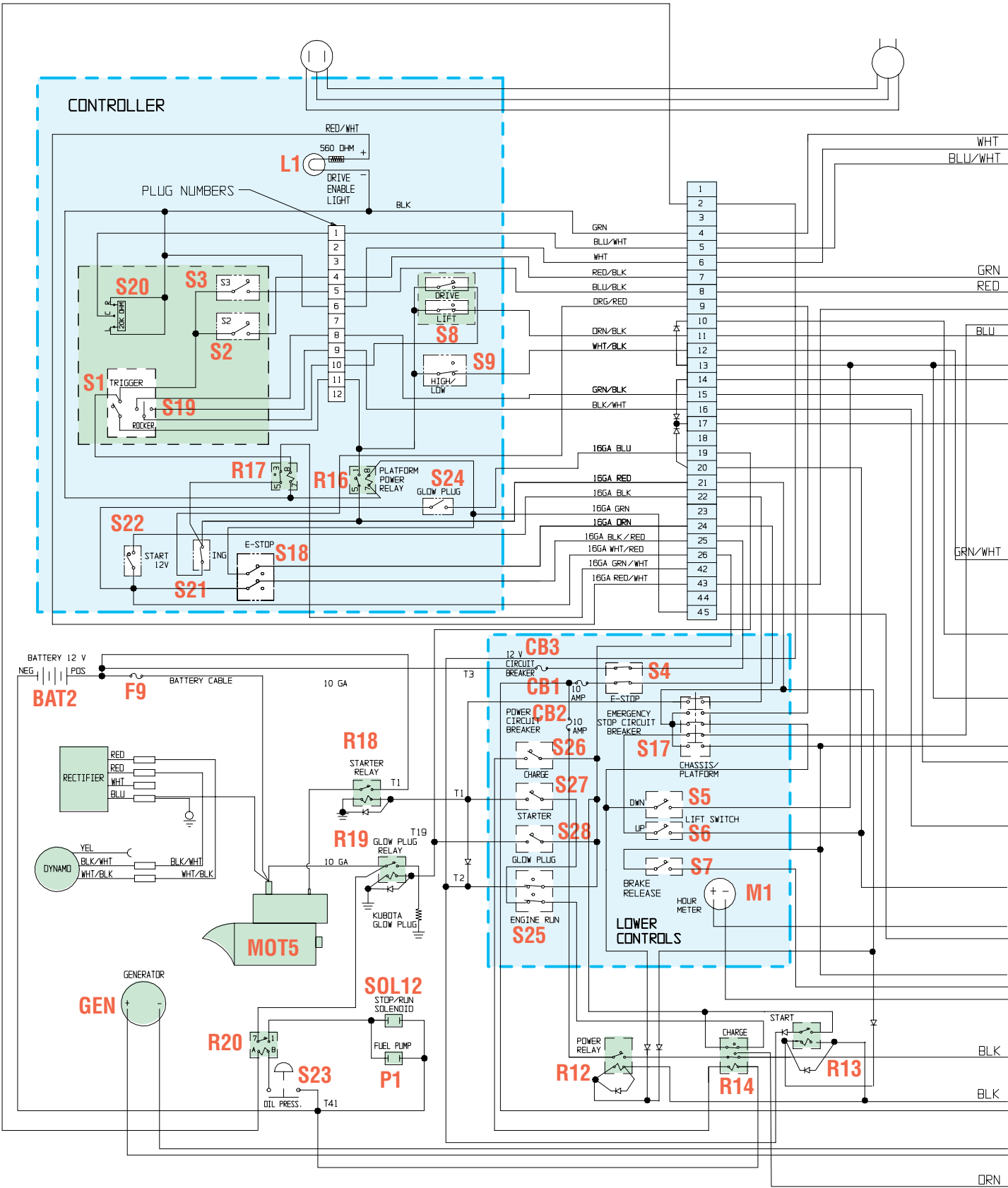
4-1 ELECTRICAL SCHEMATIC, LX BI-ENERGY
SERIAL # 4022-4274

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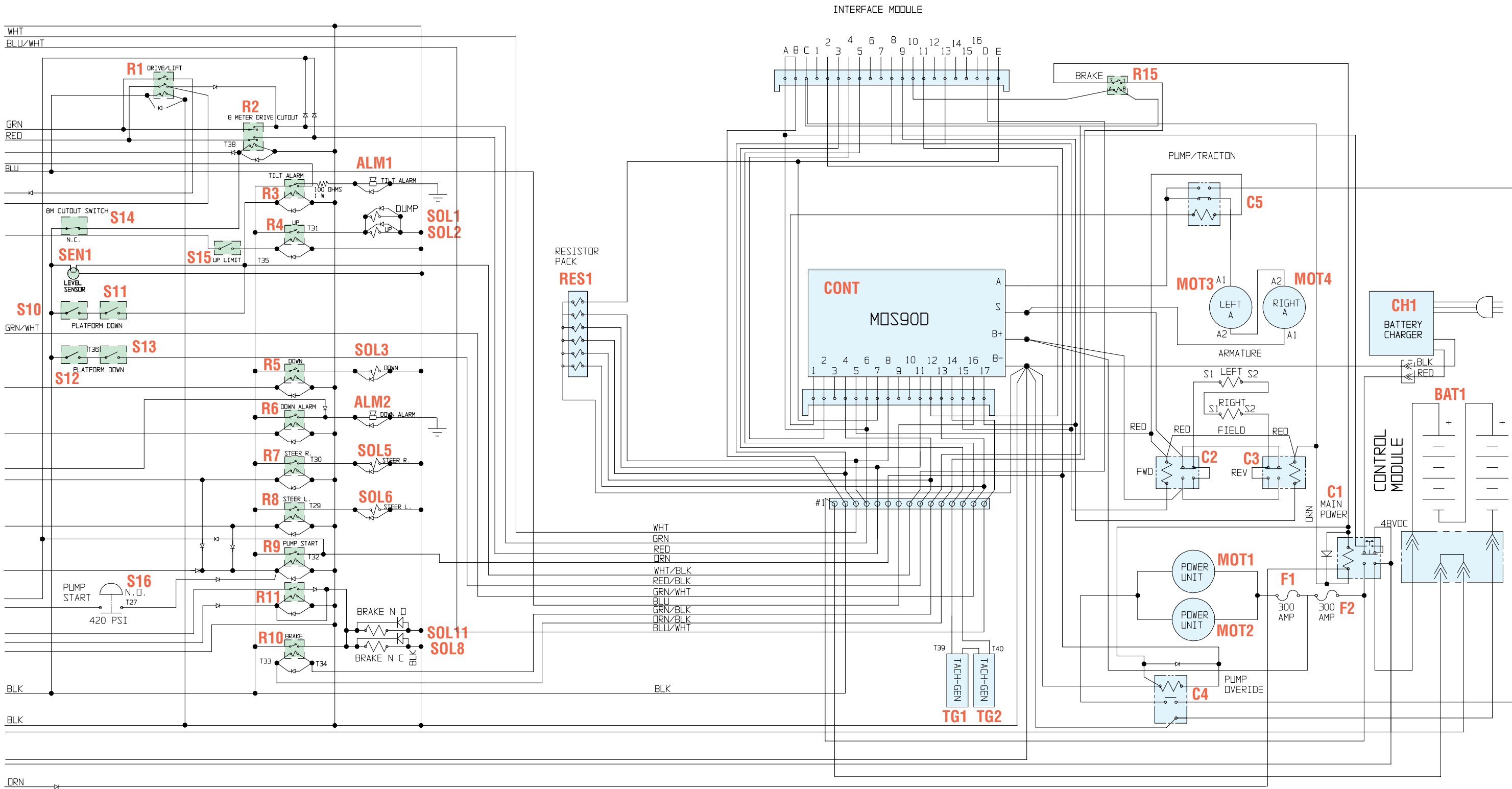
Table 4-1: Electrical Schematic - 067447-002

REFERENCE	NAME	FUNCTION	LOCATION
ALM1	Alarm, Level Sensor	Warning sound when machine is off-level	Lower Control Box
ALM2	Alarm, Down	Warning sound when platform is lowering	Lower Control Box
BAT1	48 VDC Battery Pack	Electric Power	Control Module
BAT2	12 VDC Battery	Start Engine	Control Module
C1	Main Power Contactor	Switch Power to All Solenoids and Motors	Relay Panel
C2	Forward Contactor	Switch Drive Motors to Forward	Relay Panel
C3	Reverse Contactor	Switch Drive Motors to Reverse	Relay Panel
C4	Pump Override Contactor	Override Pump Motors	Relay Panel
C5	Pump/Traction Contactor	Switch Power Between Drive Motors and Pump Motors	Relay Panel
CB1	Circuit Breaker	Protect Emergency Stop Switch	Lower Control Box
CB2	Circuit Breaker	Protect Power Relay R9	Lower Control Box
CB3	Circuit Breaker	Protect Engine Wiring	Lower Control Box
CH1	Battery Charger	Charge Batteries	Control Module
CONT	Controller	Control Logic Module	Relay Panel
F1 & F2	Fuse, Main	Protect Circuit Wiring	Relay Panel
F9	Fuse	Protect Engine Wiring	Control Module
GEN	Generator	Power Supply, Bi-Energy	Power Module
L1	Drive Enable Light	Indicate Power to Drive Circuit	Upper Controls
M1	Hour Meter	Record Operating Time	Lower Control Box
MOT1 & 2	Electric Motor	Drive Hydraulic Pump	Power Module
MOT3	Electric Motor	Drive Left Rear Wheel	Chassis
MOT4	Electric Motor	Drive Right Rear Wheel	Chassis
MOT5	Starter Motor	Start Engine	Engine Module
P1	Fuel Pump	Supply Fuel to Engine	Engine Assembly
R1	Drive/Lift Relay	Start Hydraulic Pumps	Lower Control Box
R2	8 Meter Cutout Relay	High Speed Drive Cutout	Lower Control Box
R3	Level Sensor Alarm Relay	Switch Power to ALM1	Lower Control Box
R4	Up Relay	Switch Power to SOL1 & 2	Lower Control Box
R5	Down Relay	Switch Power to SOL3	Lower Control Box
R6	Down Alarm Relay	Switch Power to ALM2	Lower Control Box
R7	Steer Right Relay	Switch Power to SOL5	Lower Control Box
R8	Steer Left Relay	Switch Power to SOL6	Lower Control Box
R9	Pump Start Relay	Power to S1	Lower Control Box
R10	Brake Relay	Switch Power to SOL8	Lower Control Box
R11	Brake Release Relay	Switch Power to SOL11	Lower Control Box
R12	Power Relay	Switch Power to All Relays	Lower Control Box
R13	Start Relay	Start Engine	Lower Control Box
R14	Charge Relay	Charge Battery Pack	Lower Control Box
R15	Brake Release Relay	Power to Brake Relay R10	Relay Panel
R16	Platform Power Relay	Power to Upper Controls	Upper Controls
R17	Prevent Pump Start Relay	Power to Pump Start Switch	Upper Controls
R18	Starter Relay	Power to Starter Motor	Engine Assembly

REFERENCE	NAME	FUNCTION	LOCATION
R19	Glow Plug Relay	Power to Glow Plug	Engine Assembly
R20	Oil Pressure Relay	Power to S23	Engine Assembly
RES1	Resistor Pack	Current Protection	Relay Panel
S1	Control Handle Interlock Switch	Enable Upper Control Functions	Front of Control Handle
S2	Forward	Enable Forward	Upper Controls
S3	Reverse	Enable Reverse	Upper Controls
S4	Lower Emergency Stop Switch	Stop All Functions	Lower Controls
S5	Lift Button	Power to Up Relay	Lower Controls
S6	Lower Button	Power to Down Relay	Lower Controls
S7	Brake Release Button	Power to Brake Release Relay	Lower Controls
S8	Lift/Drive Switch	Activate Lift or Drive	Upper Controls
S9	High/Low Switch	Speed Control	Upper Controls
S10 - S13	Platform Down Switch	Close when Platform is Fully Down	Bottom of Elevating Assembly
S14	8 Meter Cutout Switch	Stop Drive Function when Platform Reaches 8 Meters	Chassis
S15	Up Limit Switch	Stop Lift Function	Chassis
S16	Pump Start Switch	Power to Pump Start Relay	Brake Valve Block
S17	Chassis/Platform/Brake Release Switch	Power to Upper or Lower Controls, or Brake Release Button	Lower Control Box
S18	Upper Emergency Stop Switch	Stop All Functions	Upper Controls
S19	Steering Rocker Switch	Power to Steering Relays	Top of Control Handle
S20	Proportional Speed Control	Control Speed of Motors for Drive and Lift	Control Handle
S21	Power Switch (Key)	Power to Upper Controls & Motors	Upper Controls
S22	Start Switch (Key)	Start Generator Engine	Upper Controls
S23	Oil Pressure Switch	Stop Engine when Oil Pressure Too Low	Engine Assembly
S24	Glow Plug Switch	Power to Glow Plug	Upper Controls
S25	Run Switch (Key)	Power to Engine	Lower Control Box
S26	Charge Switch (Key)	Switch to Charge Only mode	Lower Control Box
S27	Starter Button	Power to Starter Relay	Lower Control Box
S28	Glow Plug Button	Power to Glow Plug Relay	Lower Control Box
SEN1	Level Sensor	Stop Drive Function	Control Module
SOL 1 & 2	Up Solenoid	Control Lift Valve	Valve Block
SOL3	Down Solenoid	Control Down Valve	Lift Cylinder
SOL5	Steer Right Solenoid	Control Steer Right Valve	Top of Valve Block
SOL6	Steer Left Solenoid	Control Steer Left Valve	Top of Valve Block
SOL8	Brake Solenoid	Control Brake Valve (powers on)	Valve Block
SOL11	Brake Release Solenoid	Control Brake Valve (powers off)	Valve Block
SOL12	Stop/Run Solenoid	Allow Engine to run	Engine Assembly
TG1 & TG2	Tachometer - Generator	Monitor Drive Motor Speed	MOS90"D"



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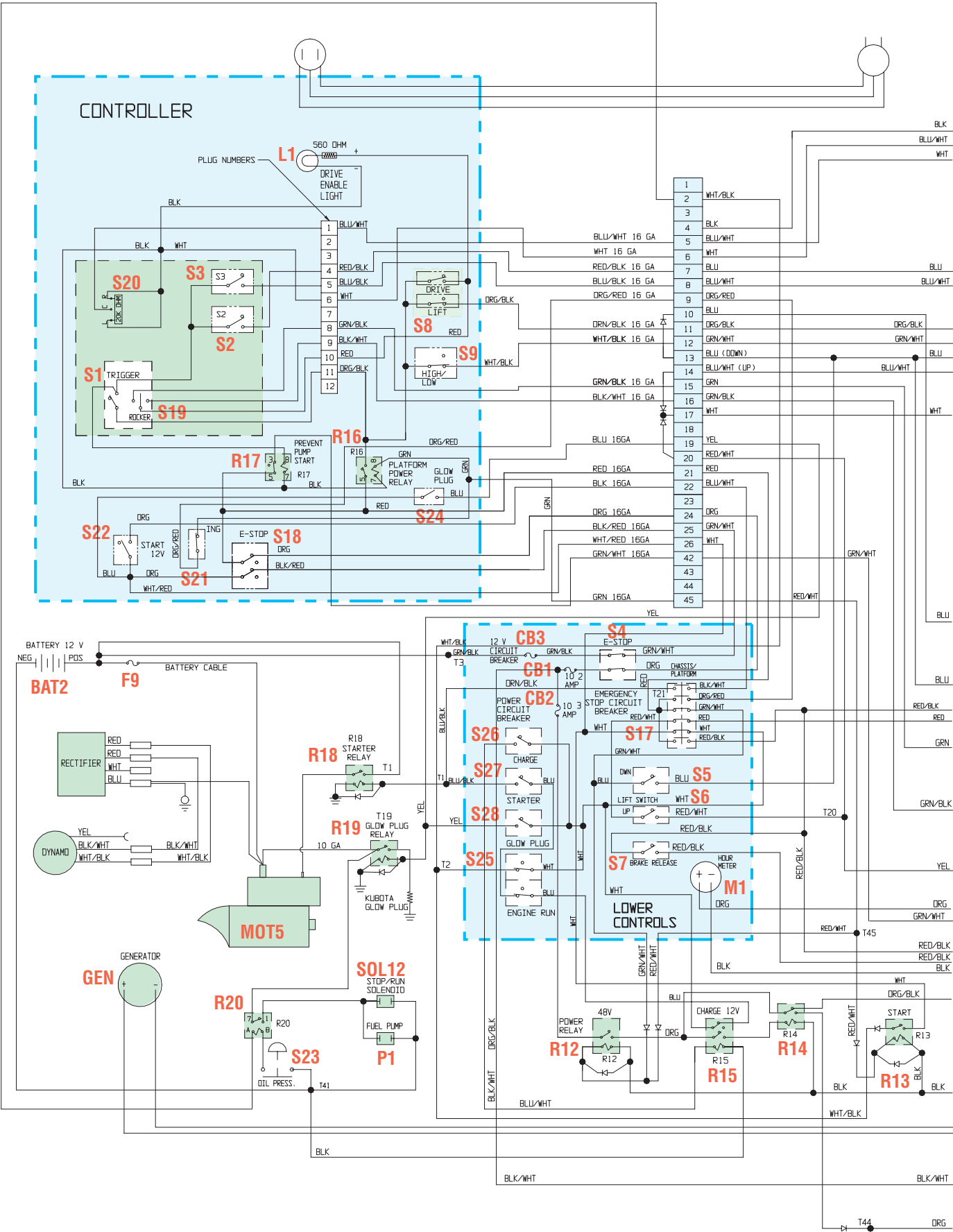
4-2 ELECTRICAL SCHEMATIC, LX BI-ENERGY:
SERIAL # 4275-4390

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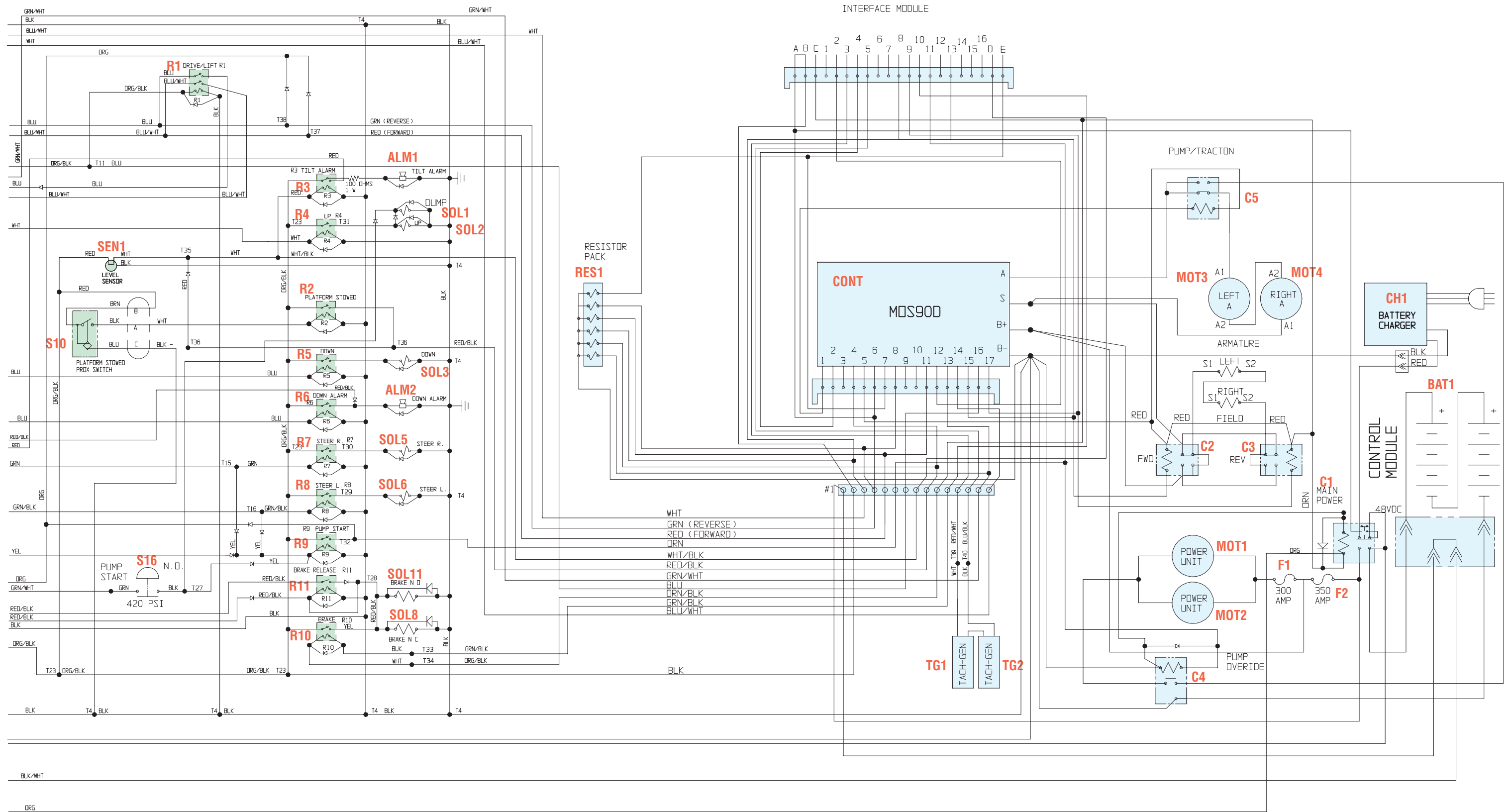
Table 4-2: Electrical Schematic - 067447-002

Table with 4 columns: REFERENCE, NAME, FUNCTION, LOCATION. Rows include components like ALM1 (Alarm, Level Sensor), BAT1 (48 VDC Battery Pack), C1 (Main Power Contactor), and various relays and switches.

Table with 4 columns: REFERENCE, NAME, FUNCTION, LOCATION. Rows include components like R17 (Prevent Pump Start Relay), R18 (Starter Relay), R19 (Glow Plug Relay), and various switches and sensors.



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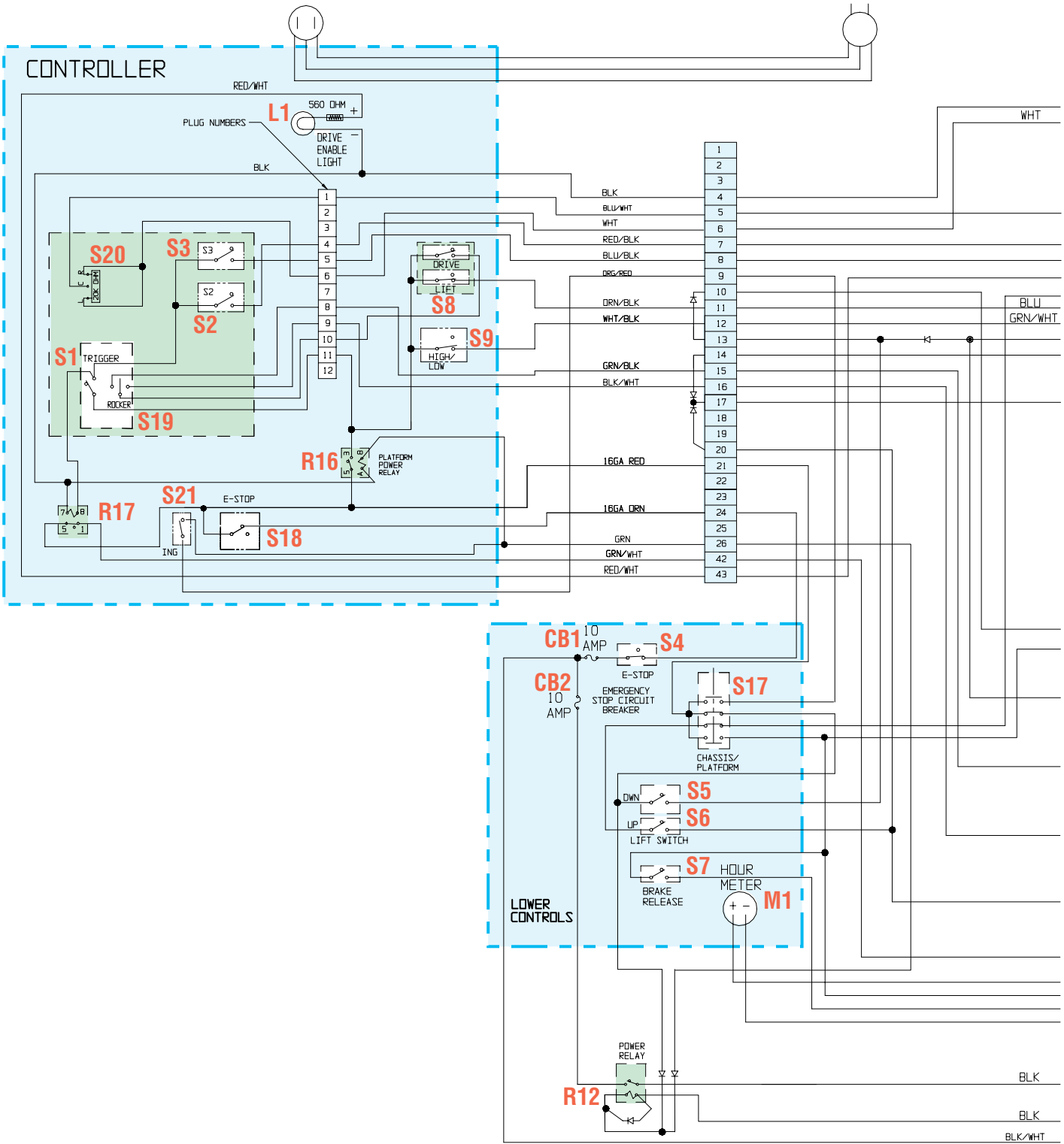
4-3 ELECTRICAL SCHEMATIC, LX ELECTRIC:
SERIAL # 4022-4274

Table 4-3: Electrical Schematic, 067447-003

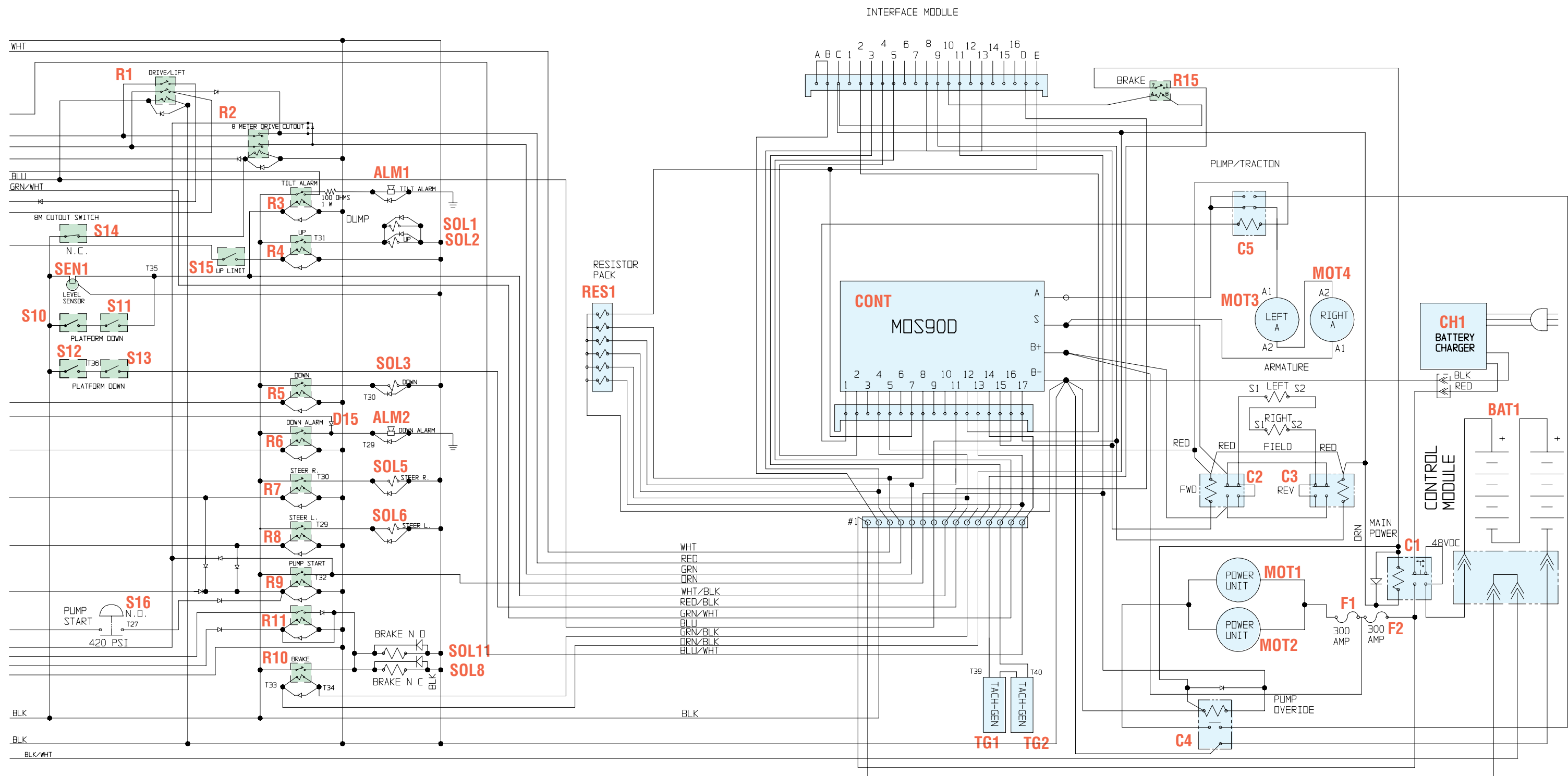
REFERENCE	NAME	FUNCTION	LOCATION
ALM1	Alarm, Level Sensor	Warning sound when machine is off-level	Lower Control Box
ALM2	Alarm, Down	Warning sound when platform is lowering	Lower Control Box
BAT1	48 VDC Battery Pack	Electric Power	Control Module
C1	Main Power Contactor	Switch Power to All Solenoids and Motors	Relay Panel
C2	Forward Contactor	Switch Drive Motors to Forward	Relay Panel
C3	Reverse Contactor	Switch Drive Motors to Reverse	Relay Panel
C4	Pump Override Contactor	Override Pump Motors	Relay Panel
C5	Pump/Traction Contactor	Switch Power <i>Between</i> Drive Motors and Pump Motors	Relay Panel
CB1	Circuit Breaker	Protect Emergency Stop Switch	Lower Control Box
CB2	Circuit Breaker	Protect Power Relay R9	Lower Control Box
CH1	Battery Charger	Charge Batteries	Control Module
CONT	Controller	Control Logic Module	Relay Panel
F1 & F2	Fuse, Main	Protect Circuit Wiring	Relay Panel
L1	Drive Enable Light	Indicate Power to Drive Circuit	Upper Controls
M1	Hour Meter	Record Operating Time	Lower Control Box
MOT1 & 2	Electric Motor	Drive Hydraulic Pump	Power Module
MOT3	Electric Motor	Drive Left Rear Wheel	Chassis
MOT4	Electric Motor	Drive Right Rear Wheel	Chassis
R1	Drive/Lift Relay	Start Hydraulic Pumps	Lower Control Box
R2	8 Meter Cutout Relay	High Speed Drive Cutout	Lower Control Box
R3	Level Sensor Alarm Relay	Switch Power to ALM1	Lower Control Box
R4	Up Relay	Switch Power to SOL1 & 2	Lower Control Box
R5	Down Relay	Switch Power to SOL3	Lower Control Box
R6	Down Alarm Relay	Switch Power to ALM2	Lower Control Box
R7	Steer Right Relay	Switch Power to SOL5	Lower Control Box
R8	Steer Left Relay	Switch Power to SOL6	Lower Control Box
R9	Pump Start Relay	Power to S1	Lower Control Box
R10	Brake Relay	Switch Power to SOL8	Lower Control Box
R11	Brake Release Relay	Switch Power to SOL11	Lower Control Box
R12	Power Relay	Switch Power to All Relays	Lower Control Box
R15	Brake Release Relay	Power to Brake Relay R10	Relay Panel
R16	Platform Power Relay	Power to Upper Controls	Upper Controls

REFERENCE	NAME	FUNCTION	LOCATION
R17	Prevent Pump Start Relay	Power to Pump Start Switch	Upper Controls
RES1	Resistor Pack	Current Protection	Relay Panel
S1	Control Handle Interlock Switch	Enable Upper Control Functions	Front of Control Handle
S2	Forward	Enable Forward	Upper Controls
S3	Reverse	Enable Reverse	Upper Controls
S4	Lower Emergency Stop Switch	Stop All Functions	Lower Controls
S5	Lift Button	Power to Up Relay	Lower Controls
S6	Lower Button	Power to Down Relay	Lower Controls
S7	Brake Release Button	Power to Brake Release Relay	Lower Controls
S8	Lift/Drive Switch	Activate Lift or Drive	Upper Controls
S9	High/Low Switch	Speed Control	Upper Controls
S10 - S13	Platform Down Switch	Close when Platform is Fully Down	Bottom of Elevating Assembly
S14	8 Meter Cutout Switch	Stop Drive Function when Platform Reaches 8 Meters	Chassis
S15	Up Limit Switch	Stop Lift Function	Chassis
S16	Pump Start Switch	Power to Pump Start Relay	Brake Valve Block
S17	Chassis/Platform/Brake Release Switch	Power to Upper or Lower Controls, or Brake Release Button	Lower Control Box
S18	Upper Emergency Stop Switch	Stop All Functions	Upper Controls
S19	Steering Rocker Switch	Power to Steering Relays	Top of Control Handle
S20	Proportional Speed Control	Control Speed of Motors for Drive and Lift	Control Handle
S21	Key Switch	Power to Upper Controls & Motors	Upper Controls
SEN1	Level Sensor	Stop Drive Function	Control Module
SOL 1 & 2	Up Solenoid	Control Lift Valve	Valve Block
SOL3	Down Solenoid	Control Down Valve	Lift Cylinder
SOL5	Steer Right Solenoid	Control Steer Right Valve	Top of Valve Block
SOL6	Steer Left Solenoid	Control Steer Left Valve	Top of Valve Block
SOL8	Brake Solenoid	Control Brake Valve (powers on)	Valve Block
SOL11	Brake Release Solenoid	Control Brake Valve (powers off)	Valve Block
TG1 & TG2	Tachometer - Generator	Monitor Drive Motor Speed	MOS90"D"

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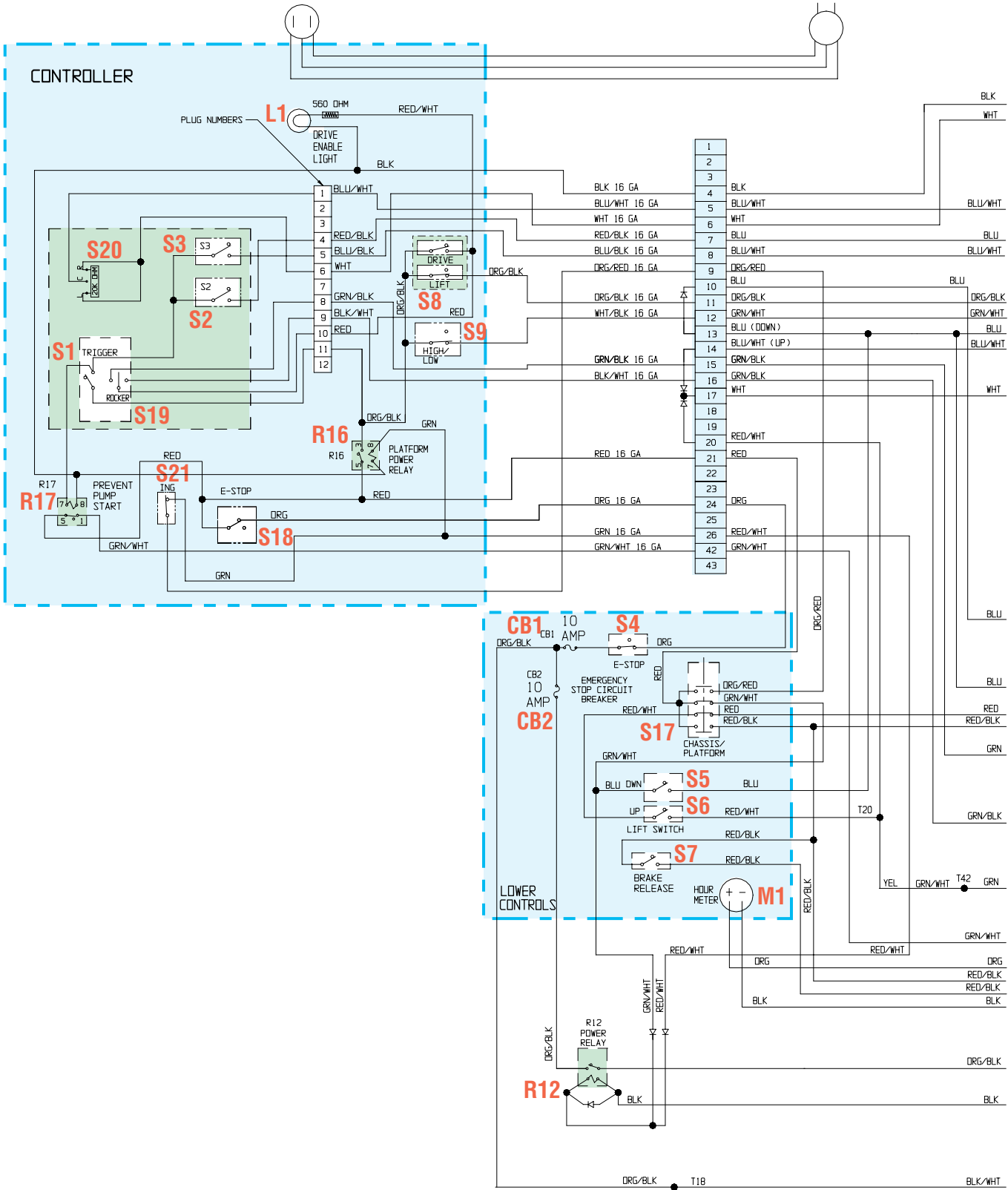
4-4 ELECTRICAL SCHEMATIC, LX ELECTRIC:
SERIAL # 4275-4390

Table 4-4: Electrical Schematic, 067447-003

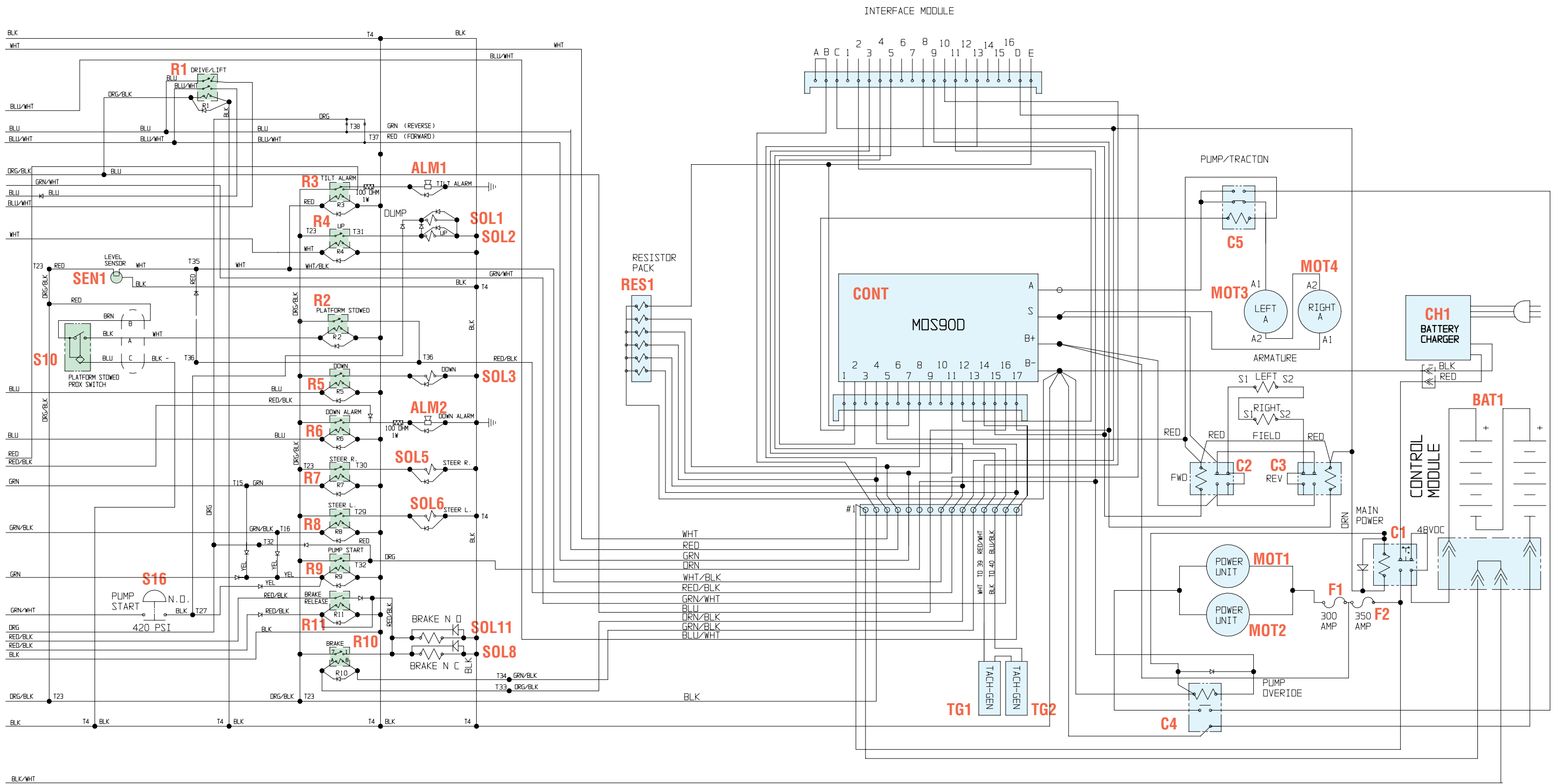
REFERENCE	NAME	FUNCTION	LOCATION
ALM1	Alarm, Level Sensor	Warning sound when machine is off-level	Lower Control Box
ALM2	Alarm, Down	Warning sound when platform is lowering	Lower Control Box
BAT1	48 VDC Battery Pack	Electric Power	Control Module
C1	Main Power Contactor	Switch Power to All Solenoids and Motors	Relay Panel
C2	Forward Contactor	Switch Drive Motors to Forward	Relay Panel
C3	Reverse Contactor	Switch Drive Motors to Reverse	Relay Panel
C4	Pump Override Contactor	Override Pump Motors	Relay Panel
C5	Pump/Traction Contactor	Switch Power <i>Between</i> Drive Motors and Pump Motors	Relay Panel
CB1	Circuit Breaker	Protect Emergency Stop Switch	Lower Control Box
CB2	Circuit Breaker	Protect Power Relay R9	Lower Control Box
CH1	Battery Charger	Charge Batteries	Control Module
CONT	Controller	Control Logic Module	Relay Panel
F1 & F2	Fuse, Main	Protect Circuit Wiring	Relay Panel
L1	Drive Enable Light	Indicate Power to Drive Circuit	Upper Controls
M1	Hour Meter	Record Operating Time	Lower Control Box
MOT1 & 2	Electric Motor	Drive Hydraulic Pump	Power Module
MOT3	Electric Motor	Drive Left Rear Wheel	Chassis
MOT4	Electric Motor	Drive Right Rear Wheel	Chassis
R1	Drive/Lift Relay	Start Hydraulic Pumps	Lower Control Box
R2	Platform Stowed Relay	Enable High Speed when Platform Lowered	Lower Control Box
R3	Level Sensor Alarm Relay	Switch Power to ALM1	Lower Control Box
R4	Up Relay	Switch Power to SOL1 & 2	Lower Control Box
R5	Down Relay	Switch Power to SOL3	Lower Control Box
R6	Down Alarm Relay	Switch Power to ALM2	Lower Control Box
R7	Steer Right Relay	Switch Power to SOL5	Lower Control Box
R8	Steer Left Relay	Switch Power to SOL6	Lower Control Box
R9	Pump Start Relay	Power to S1	Lower Control Box
R10	Brake Relay	Switch Power to SOL8	Lower Control Box
R11	Brake Release Relay	Switch Power to SOL11	Lower Control Box
R12	Power Relay	Switch Power to All Relays	Lower Control Box

REFERENCE	NAME	FUNCTION	LOCATION
R14	Charge Relay	Charge Battery Pack	Lower Control Box
R16	Platform Power Relay	Power to Upper Controls	Upper Controls
R17	Prevent Pump Start Relay	Power to Pump Start Switch	Upper Controls
RES1	Resistor Pack	Current Protection	Relay Panel
S1	Control Handle Interlock Switch	Enable Upper Control Functions	Front of Control Handle
S2	Forward	Enable Forward	Upper Controls
S3	Reverse	Enable Reverse	Upper Controls
S4	Lower Emergency Stop Switch	Stop All Functions	Lower Controls
S5	Lift Button	Power to Up Relay	Lower Controls
S6	Lower Button	Power to Down Relay	Lower Controls
S7	Brake Release Button	Power to Brake Release Relay	Lower Controls
S8	Lift/Drive Switch	Activate Lift or Drive	Upper Controls
S9	High/Low Switch	Speed Control	Upper Controls
S10	Proximity Switch	Disable High Speed when Platform Elevated	Bottom of Elevating Assembly
S16	Pump Start Switch	Power to Pump Start Relay	Brake Valve Block
S17	Chassis/Platform/Brake Release Switch	Power to Upper or Lower Controls, or Brake Release Button	Lower Control Box
S18	Upper Emergency Stop Switch	Stop All Functions	Upper Controls
S19	Steering Rocker Switch	Power to Steering Relays	Top of Control Handle
S20	Proportional Speed Control	Control Speed of Motors for Drive and Lift	Control Handle
S21	Key Switch	Power to Upper Controls & Motors	Upper Controls
SEN1	Level Sensor	Stop Drive Function	Control Module
SOL 1 & 2	Up Solenoid	Control Lift Valve	Valve Block
SOL3	Down Solenoid	Control Down Valve	Lift Cylinder
SOL5	Steer Right Solenoid	Control Steer Right Valve	Top of Valve Block
SOL6	Steer Left Solenoid	Control Steer Left Valve	Top of Valve Block
SOL8	Brake Solenoid	Control Brake Valve (powers on)	Valve Block
SOL11	Brake Release Solenoid	Control Brake Valve (powers off)	Valve Block
TG1 & TG2	Tachometer - Generator	Monitor Drive Motor Speed	MOS90"D"

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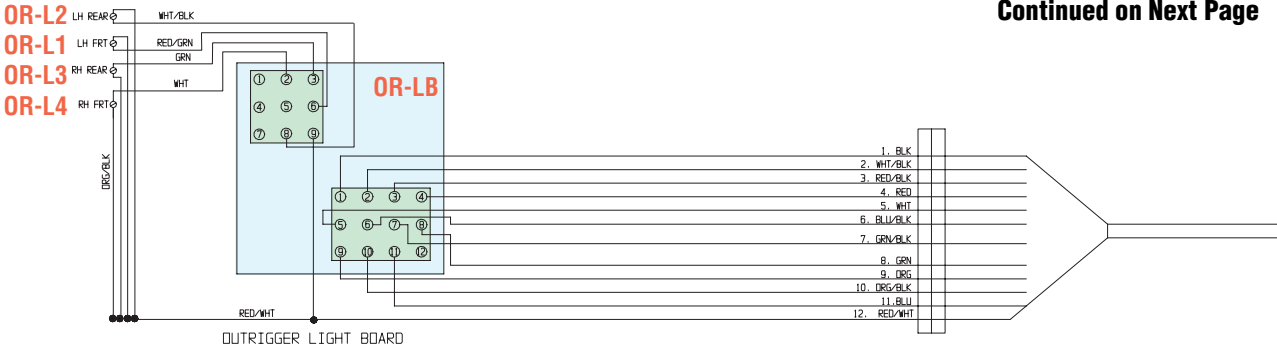


4-5 ELECTRICAL SCHEMATIC, LX BI-ENERGY – OUTRIGGERS

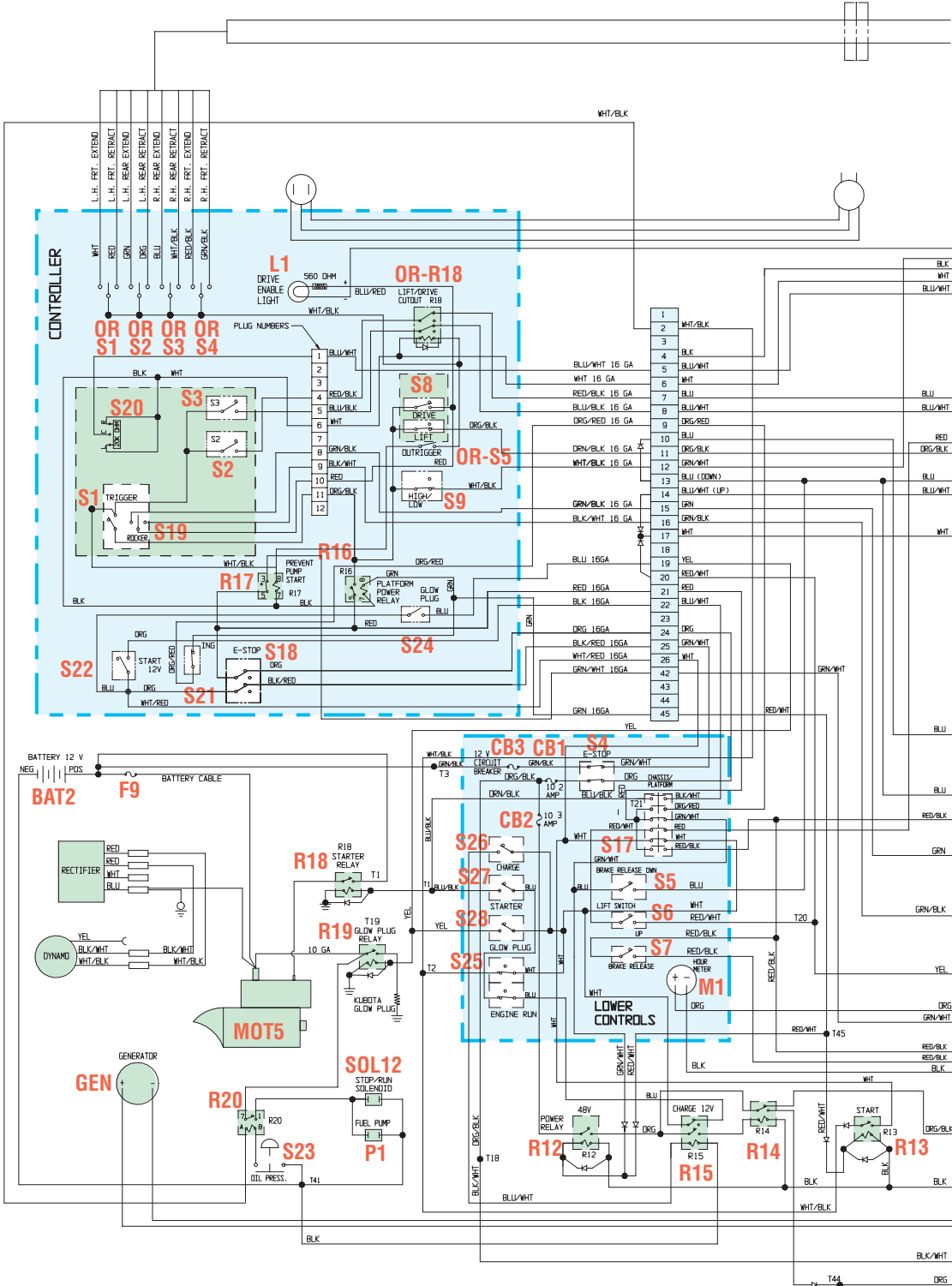
Table 4-5: Electrical Schematic - 067455-015

REFERENCE	NAME	FUNCTION	LOCATION
ALM1	Alarm, Level Sensor	Warning sound when machine is off-level	Lower Control Box
ALM2	Alarm, Down	Warning sound when platform is lowering	Lower Control Box
BAT1	48 VDC Battery Pack	Electric Power	Control Module
BAT2	12 VDC Battery	Start Engine	Control Module
C1	Main Power Contactor	Switch Power to All Solenoids and Motors	Relay Panel
C2	Forward Contactor	Switch Drive Motors to Forward	Relay Panel
C3	Reverse Contactor	Switch Drive Motors to Reverse	Relay Panel
C4	Pump Override Contactor	Override Pump Motors	Relay Panel
C5	Pump/Traction Contactor	Switch Power <i>Between</i> Drive Motors and Pump Motors	Relay Panel
CB1	Circuit Breaker	Protect Emergency Stop Switch	Lower Control Box
CB2	Circuit Breaker	Protect Power Relay R9	Lower Control Box
CB3	Circuit Breaker	Protect Engine Wiring	Lower Control Box
CH1	Battery Charger	Charge Batteries	Control Module
CONT	Controller	Control Logic Module	Relay Panel
F1 & F2	Fuse, Main	Protect Circuit Wiring	Relay Panel
F9	Fuse	Protect Engine Wiring	Control Module
GEN	Generator	Power Supply, Bi-Energy	Power Module
L1	Drive Enable Light	Indicate Power to Drive Circuit	Upper Controls
M1	Hour Meter	Record Operating Time	Lower Control Box
MOT1 & 2	Electric Motor	Drive Hydraulic Pump	Power Module
MOT3	Electric Motor	Drive Left Rear Wheel	Chassis
MOT4	Electric Motor	Drive Right Rear Wheel	Chassis
MOT5	Starter Motor	Start Engine	Engine Module
OR-LB	Outrigger Light Board	Power for Outrigger Indicators	Upper Controls
OR-L1	Outrigger Indicator LH-F	Lights when Outrigger Down	Upper Controls
OR-L2	Outrigger Indicator LH-R	Lights when Outrigger Down	Upper Controls
OR-L3	Outrigger Indicator RH-R	Lights when Outrigger Down	Upper Controls
OR-L4	Outrigger Indicator RH-F	Lights when Outrigger Down	Upper Controls
OR-R1	Outrigger Extend Relay LH-F	Lower Outrigger	Outrigger Control Box
OR-R2	Outrigger Retract Relay LH-F	Raise Outrigger	Outrigger Control Box
OR-R3	Outrigger Extend Relay LH-R	Lower Outrigger	Outrigger Control Box
OR-R4	Outrigger Retract Relay LH-R	Raise Outrigger	Outrigger Control Box
OR-R5	Outrigger Extend Relay RH-F	Lower Outrigger	Outrigger Control Box
OR-R6	Outrigger Retract Relay RH-F	Raise Outrigger	Outrigger Control Box
OR-R7	Outrigger Extend Relay RH-R	Lower Outrigger	Outrigger Control Box
OR-R8	Outrigger Retract Relay RH-R	Raise Outrigger	Outrigger Control Box
OR-R9	Drive Override Relay	Cut Drive Power when Outriggers Down	Outrigger Control Box
OR-R16	Drive Cutout Relay	Cut Drive Power when Outriggers Down	Lower Control Box
OR-R18	Lift/Drive Cutout Relay	Switch Control based on Outrigger Position	Upper Controls
OR-S1	Outrigger Switch LH-F	Control Outrigger Position	Upper Controls
OR-S2	Outrigger Switch LH-R	Control Outrigger Position	Upper Controls
OR-S3	Outrigger Switch RH-F	Control Outrigger Position	Upper Controls
OR-S4	Outrigger Switch RH-R	Control Outrigger Position	Upper Controls
OR-S5	Outrigger Switch	Power to OR-R18	Upper Controls
OR-S6	Outrigger Ball Switch	Control Outrigger Position	LH-F Outrigger
OR-S7	Outrigger Ball Switch	Control Outrigger Position	LH-R Outrigger
OR-S8	Outrigger Ball Switch	Control Outrigger Position	RH-R Outrigger
OR-S9	Outrigger Ball Switch	Control Outrigger Position	RH-F Outrigger
OR-S10	Outrigger Pressure Switch	Control Outrigger Position	LH-F Outrigger
OR-S12	Outrigger Pressure Switch	Control Outrigger Position	RH-R Outrigger
OR-S13	Outrigger Pressure Switch	Control Outrigger Position	RH-F Outrigger
OR-SOL1	Extend Solenoid LH-F	Control Outrigger Position	Outrigger Valve Block
OR-SOL2	Retract Solenoid LH-F	Control Outrigger Position	Outrigger Valve Block
OR-SOL3	Extend Solenoid LH-R	Control Outrigger Position	Outrigger Valve Block
OR-SOL4	Retract Solenoid LH-R	Control Outrigger Position	Outrigger Valve Block
OR-SOL5	Extend Solenoid RH-F	Control Outrigger Position	Outrigger Valve Block
OR-SOL6	Retract Solenoid RH-F	Control Outrigger Position	Outrigger Valve Block
OR-SOL7	Extend Solenoid RH-R	Control Outrigger Position	Outrigger Valve Block

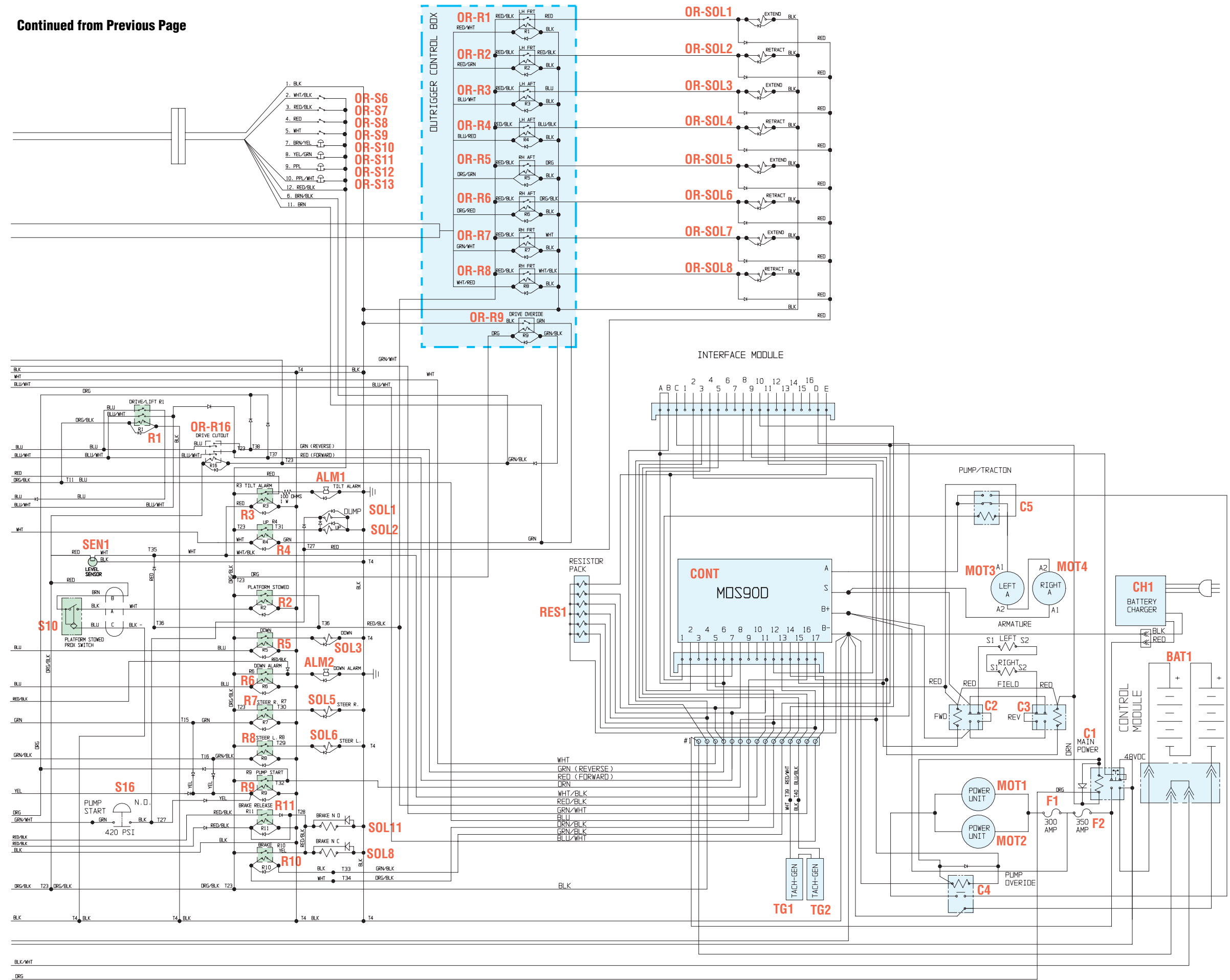
REFERENCE	NAME	FUNCTION	LOCATION
OR-SOL8	Retract Solenoid RH-R	Control Outrigger Position	Outrigger Valve Block
P1	Fuel Pump	Supply Fuel to Engine	Engine Assembly
R1	Drive/Lift Relay	Start Hydraulic Pumps	Lower Control Box
R2	Platform Stowed Relay	Enable High Speed when Platform Lowered	Lower Control Box
R3	Level Sensor Alarm Relay	Switch Power to ALM1	Lower Control Box
R4	Up Relay	Switch Power to SOL1 & 2	Lower Control Box
R5	Down Relay	Switch Power to SOL3	Lower Control Box
R6	Down Alarm Relay	Switch Power to ALM2	Lower Control Box
R7	Steer Right Relay	Switch Power to SOL5	Lower Control Box
R8	Steer Left Relay	Switch Power to SOL6	Lower Control Box
R9	Pump Start Relay	Power to S1	Lower Control Box
R10	Brake Relay	Switch Power to SOL8	Lower Control Box
R11	Brake Release Relay	Switch Power to SOL11	Lower Control Box
R12	Power Relay	Switch Power to All Relays	Lower Control Box
R13	Start Relay	Start Engine	Lower Control Box
R14	Charge Relay	Charge Battery Pack	Lower Control Box
R15	12V Charge Relay	Activate R14	Lower Control Box
R16	Platform Power Relay	Power to Upper Controls	Upper Controls
R17	Prevent Pump Start Relay	Power to Pump Start Switch	Upper Controls
R18	Starter Relay	Power to Starter Motor	Engine Assembly
R19	Glow Plug Relay	Power to Glow Plug	Engine Assembly
R20	Oil Pressure Relay	Power to S23	Engine Assembly
RES1	Resistor Pack	Current Protection	Relay Panel
S1	Control Handle Interlock Switch	Enable Upper Control Functions	Front of Control Handle
S2	Forward	Enable Forward	Upper Controls
S3	Reverse	Enable Reverse	Upper Controls
S4	Lower Emergency Stop Switch	Stop All Functions	Lower Controls
S5	Lift Button	Power to Up Relay	Lower Controls
S6	Lower Button	Power to Down Relay	Lower Controls
S7	Brake Release Button	Power to Brake Release Relay	Lower Controls
S8	Lift/Drive Switch	Activate Lift or Drive	Upper Controls
S9	High/Low Switch	Speed Control	Upper Controls
S10	Proximity Switch	Disable High Speed when Platform Elevated	Bottom of Elevating Assembly
S16	Pump Start Switch	Power to Pump Start Relay	Brake Valve BlockValve Block
S17	Chassis/Platform/Brake Release Switch	Power to Upper or Lower Controls, or Brake Release Button	Lower Control Box
S18	Upper Emergency Stop Switch	Stop All Functions	Upper Controls
S19	Steering Rocker Switch	Power to Steering Relays	Top of Control Handle
S20	Proportional Speed Control	Control Speed of Motors for Drive and Lift	Control Handle
S21	Power Switch (Key)	Power to Upper Controls & Motors	Upper Controls
S22	Start Switch (Key)	Start Generator Engine	Upper Controls
S23	Oil Pressure Switch	Stop Engine when Oil Pressure Too Low	Engine Assembly
S24	Glow Plug Switch	Power to Glow Plug	Upper Controls
S25	Run Switch (Key)	Power to Engine	Lower Control Box
S26	Charge Switch (Key)	Switch to Charge Only mode	Lower Control Box
S27	Starter Button	Power to Starter Relay	Lower Control Box
S28	Glow Plug Button	Power to Glow Plug Relay	Lower Control Box
SEN1	Level Sensor	Stop Drive Function	Control Module
SOL 1 & 2	Up Solenoid	Control Lift Valve	Valve Block
SOL3	Down Solenoid	Control Down Valve	Lift Cylinder
SOL5	Steer Right Solenoid	Control Steer Right Valve	Top of Valve Block
SOL6	Steer Left Solenoid	Control Steer Left Valve	Top of Valve Block
SOL8	Brake Solenoid	Control Brake Valve (powers on)	Valve Block
SOL11	Brake Release Solenoid	Control Brake Valve (powers off)	Valve Block
SOL12	Stop/Run Solenoid	Allow Engine to run	Engine Assembly
TG1 & TG2	Tachometer - Generator	Monitor Drive Motor Speed	MOS90"D"



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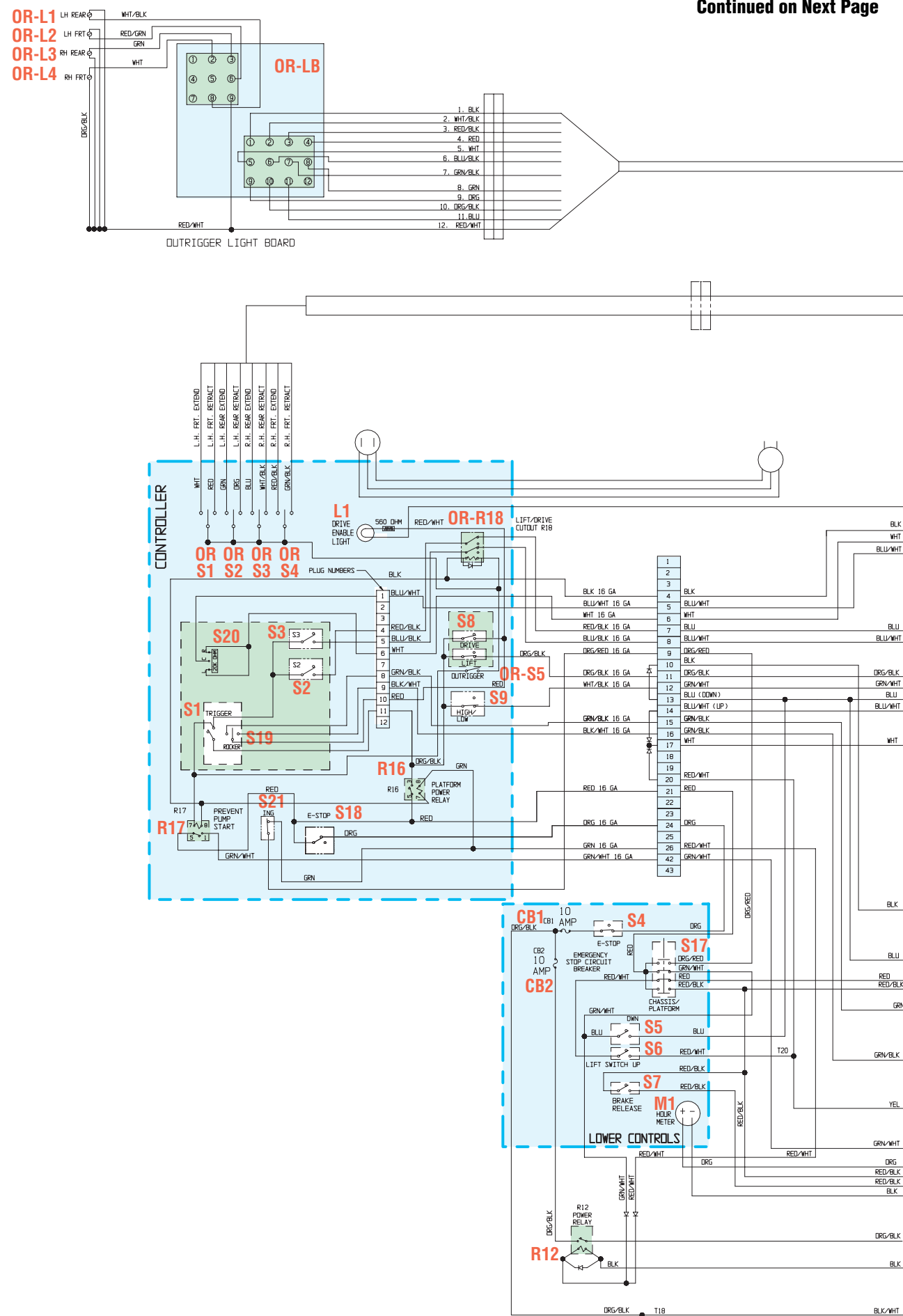
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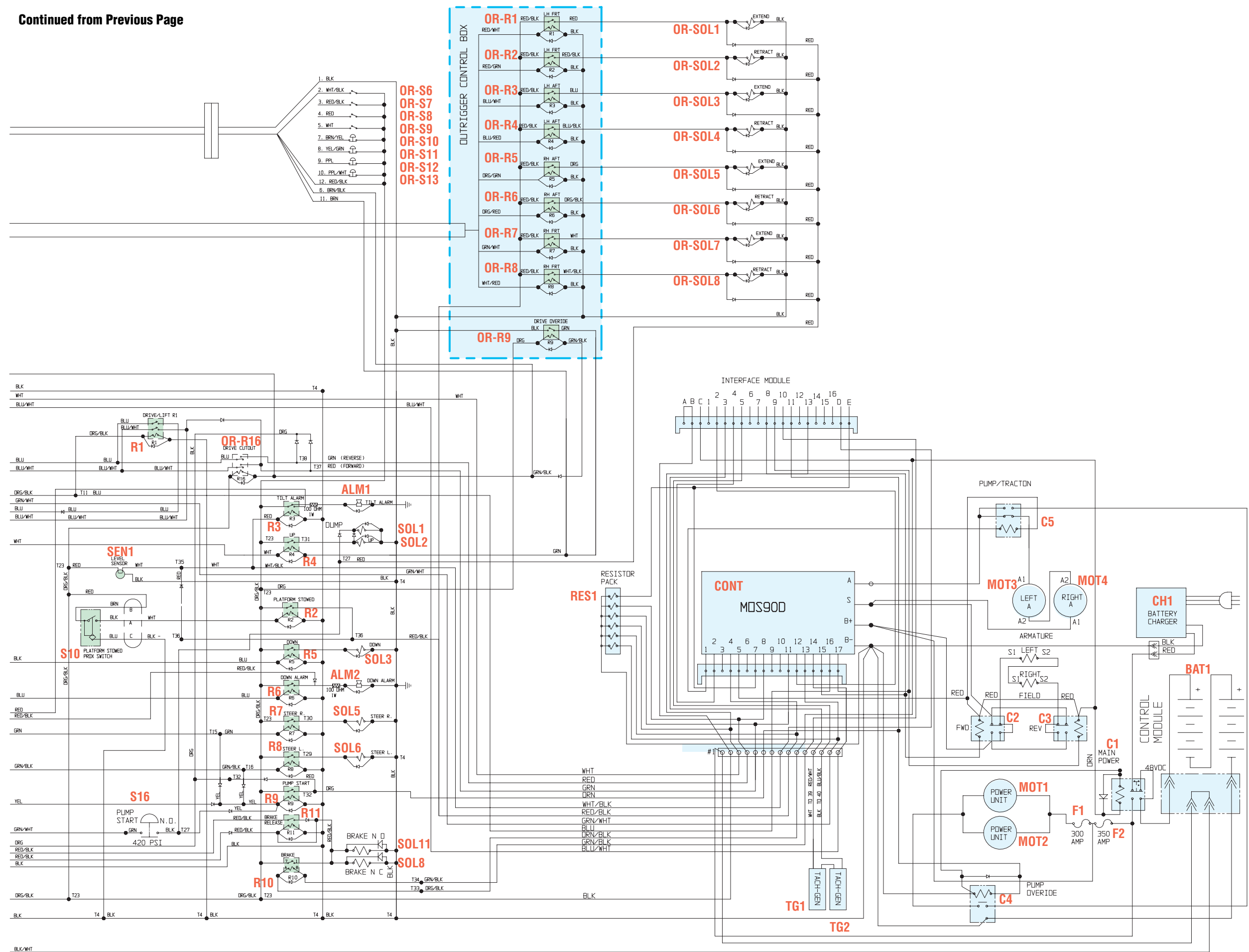
4-6 ELECTRICAL SCHEMATIC, LX ELECTRIC – OUTRIGGERS

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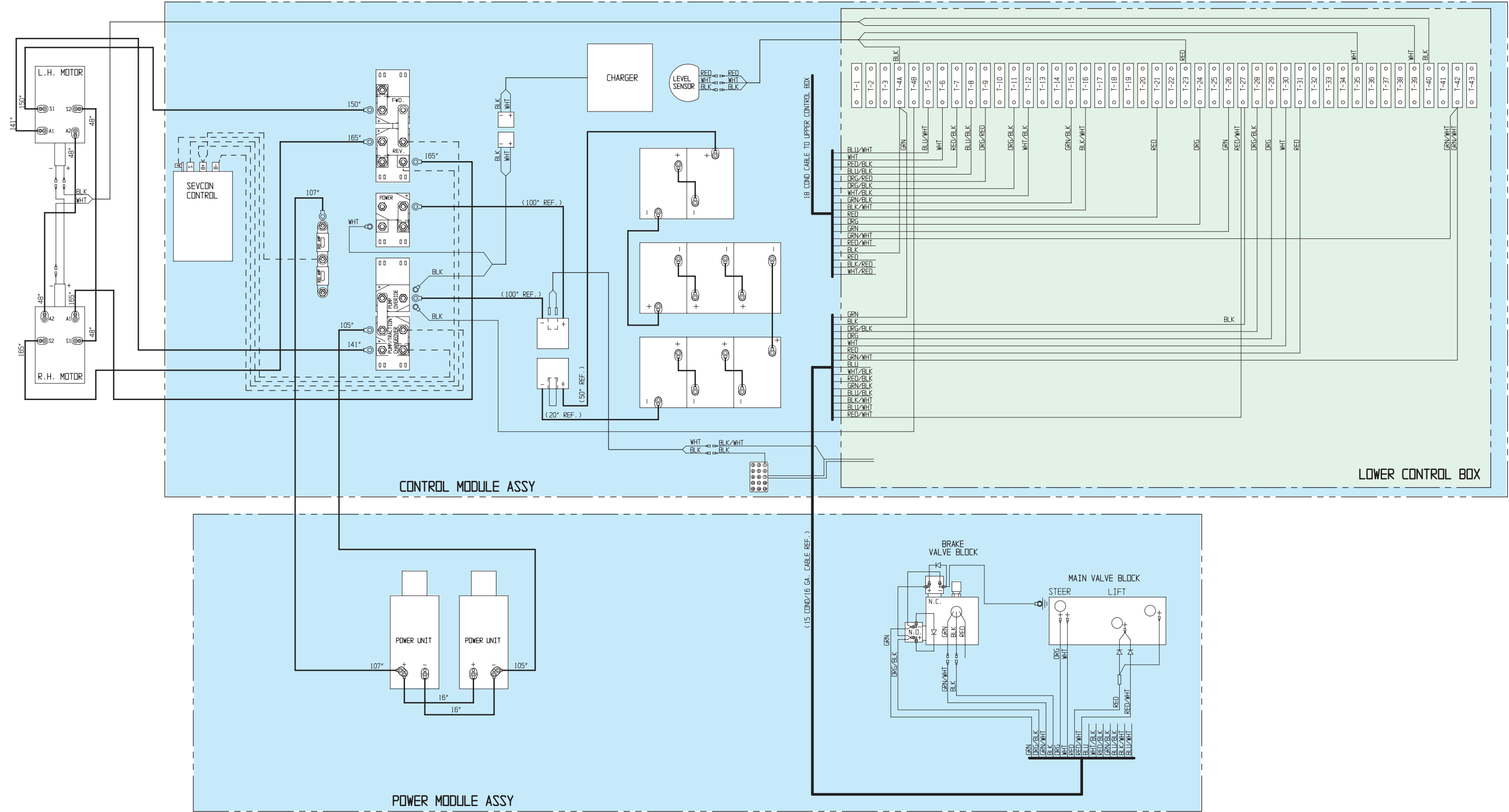
REFERENCE	NAME	FUNCTION	LOCATION
OR-SOL2	Retract Solenoid LH-F	Control Outrigger Position	Outrigger Valve Block
OR-SOL3	Extend Solenoid LH-R	Control Outrigger Position	Outrigger Valve Block
OR-SOL4	Retract Solenoid LH-R	Control Outrigger Position	Outrigger Valve Block
OR-SOL5	Extend Solenoid RH-F	Control Outrigger Position	Outrigger Valve Block
OR-SOL6	Retract Solenoid RH-F	Control Outrigger Position	Outrigger Valve Block
OR-SOL7	Extend Solenoid RH-R	Control Outrigger Position	Outrigger Valve Block
OR-SOL8	Retract Solenoid RH-R	Control Outrigger Position	Outrigger Valve Block
R1	Drive/Lift Relay	Start Hydraulic Pumps	Lower Control Box
R2	Platform Stowed Relay	Enable High Speed when Platform Lowered	Lower Control Box
R3	Level Sensor Alarm Relay	Switch Power to ALM1	Lower Control Box
R4	Up Relay	Switch Power to SOL1 & 2	Lower Control Box
R5	Down Relay	Switch Power to SOL3	Lower Control Box
R6	Down Alarm Relay	Switch Power to ALM2	Lower Control Box
R7	Steer Right Relay	Switch Power to SOL5	Lower Control Box
R8	Steer Left Relay	Switch Power to SOL6	Lower Control Box
R9	Pump Start Relay	Power to S1	Lower Control Box
R10	Brake Relay	Switch Power to SOL8	Lower Control Box
R11	Brake Release Relay	Switch Power to SOL11	Lower Control Box
R12	Power Relay	Switch Power to All Relays	Lower Control Box
R14	Charge Relay	Charge Battery Pack	Lower Control Box
R16	Platform Power Relay	Power to Upper Controls	Upper Controls
R17	Prevent Pump Start Relay	Power to Pump Start Switch	Upper Controls
RES1	Resistor Pack	Current Protection	Relay Panel
S1	Control Handle Interlock Switch	Enable Upper Control Functions	Front of Control Handle
S2	Forward	Enable Forward	Upper Controls
S3	Reverse	Enable Reverse	Upper Controls
S4	Lower Emergency Stop Switch	Stop All Functions	Lower Controls
S5	Lift Button	Power to Up Relay	Lower Controls
S6	Lower Button	Power to Down Relay	Lower Controls
S7	Brake Release Button	Power to Brake Release Relay	Lower Controls
S8	Lift/Drive Switch	Activate Lift or Drive	Upper Controls
S9	High/Low Switch	Speed Control	Upper Controls
S10	Proximity Switch	Disable High Speed when Platform Elevated	Bottom of Elevating Assembly
S16	Pump Start Switch	Power to Pump Start Relay	Brake Valve Block
S17	Chassis/Platform/Brake Release Switch	Power to Upper or Lower Controls, or Brake Release Button	Lower Control Box
S18	Upper Emergency Stop Switch	Stop All Functions	Upper Controls
S19	Steering Rocker Switch	Power to Steering Relays	Top of Control Handle
S20	Proportional Speed Control	Control Speed of Motors for Drive and Lift	Control Handle
S21	Key Switch	Power to Upper Controls & Motors	Upper Controls
SEN1	Level Sensor	Stop Drive Function	Control Module
SOL 1 & 2	Up Solenoid	Control Lift Valve	Valve Block
SOL3	Down Solenoid	Control Down Valve	Lift Cylinder
SOL5	Steer Right Solenoid	Control Steer Right Valve	Top of Valve Block
SOL6	Steer Left Solenoid	Control Steer Left Valve	Top of Valve Block
SOL8	Brake Solenoid	Control Brake Valve (powers on)	Valve Block
SOL11	Brake Release Solenoid	Control Brake Valve (powers off)	Valve Block
TG1 & TG2	Tachometer - Generator	Monitor Drive Motor Speed	MOS90"D



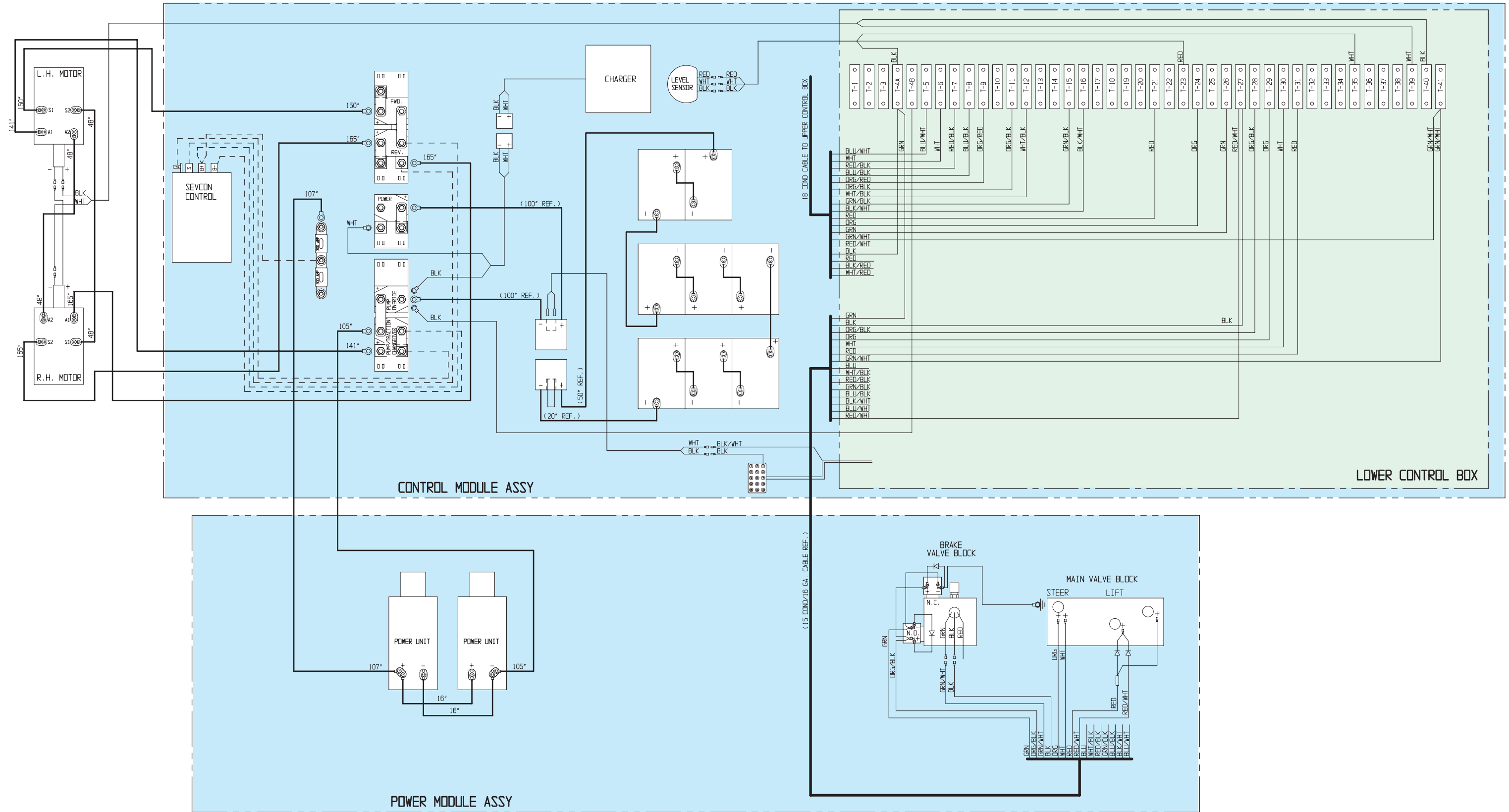
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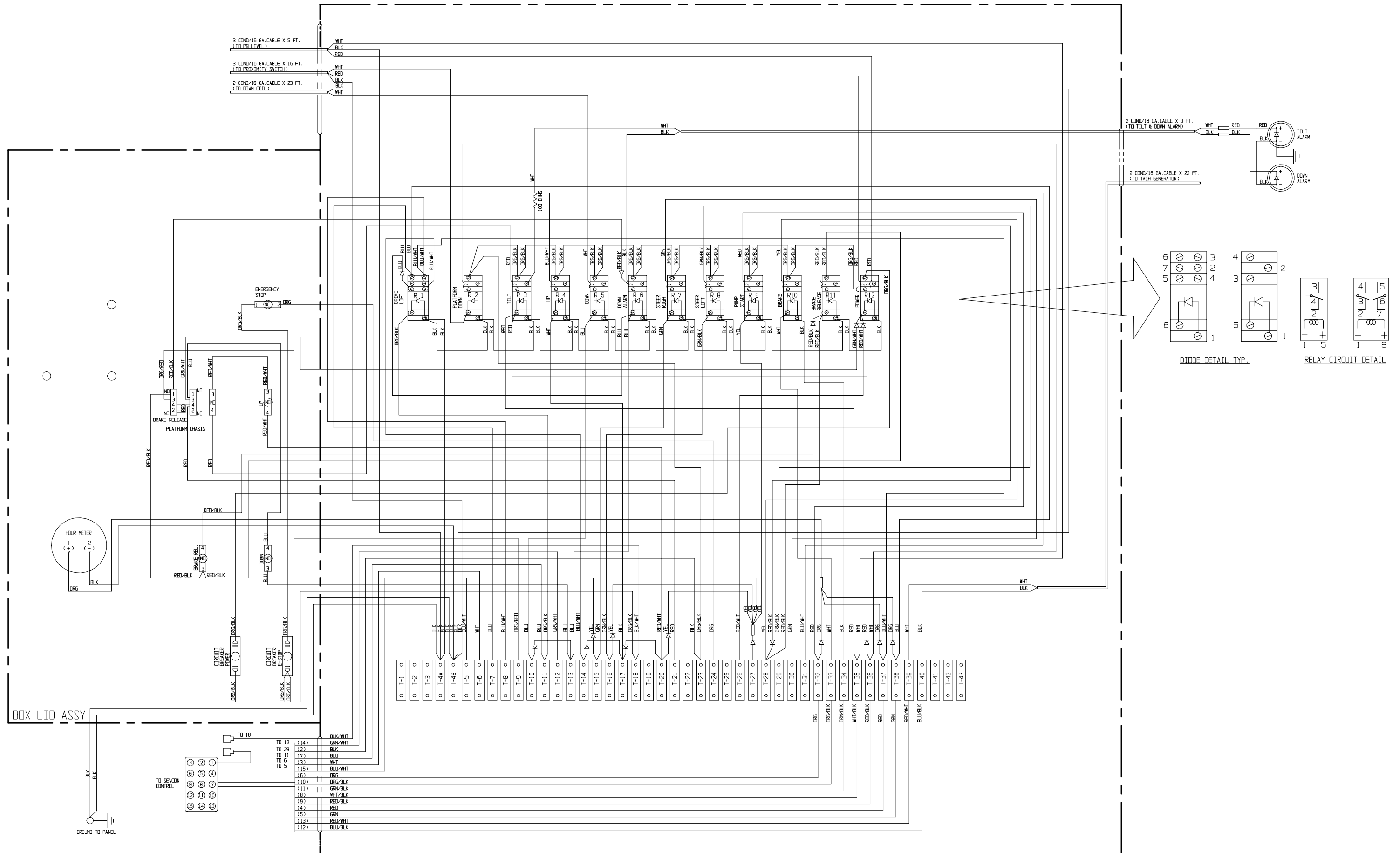
4-7 WIRE ROUTING
ELECTRIC



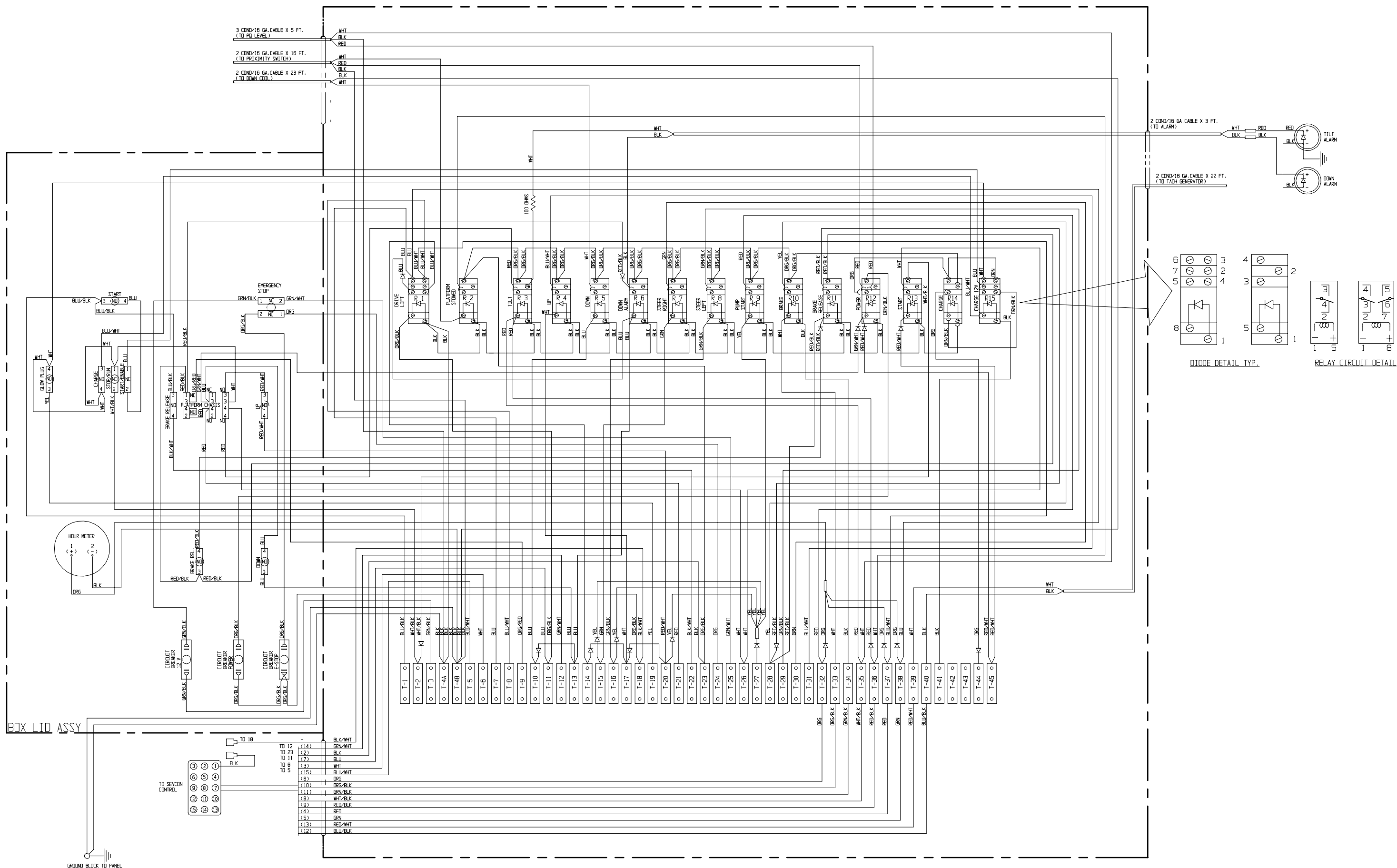
BI-ENERGY



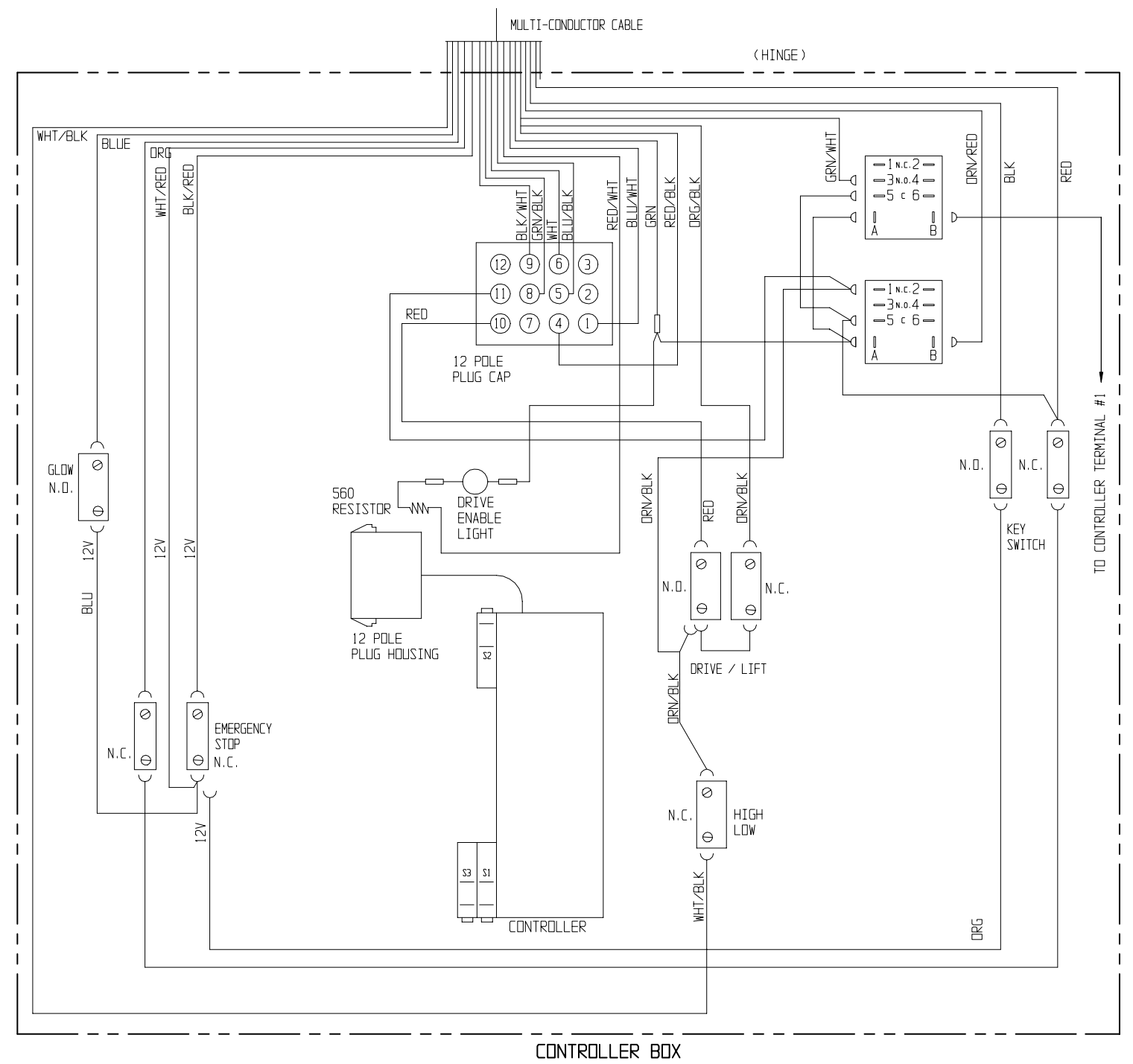
067448-023 LX31/LX41 Electric and Bi-Energy Work Platform | European Specifications



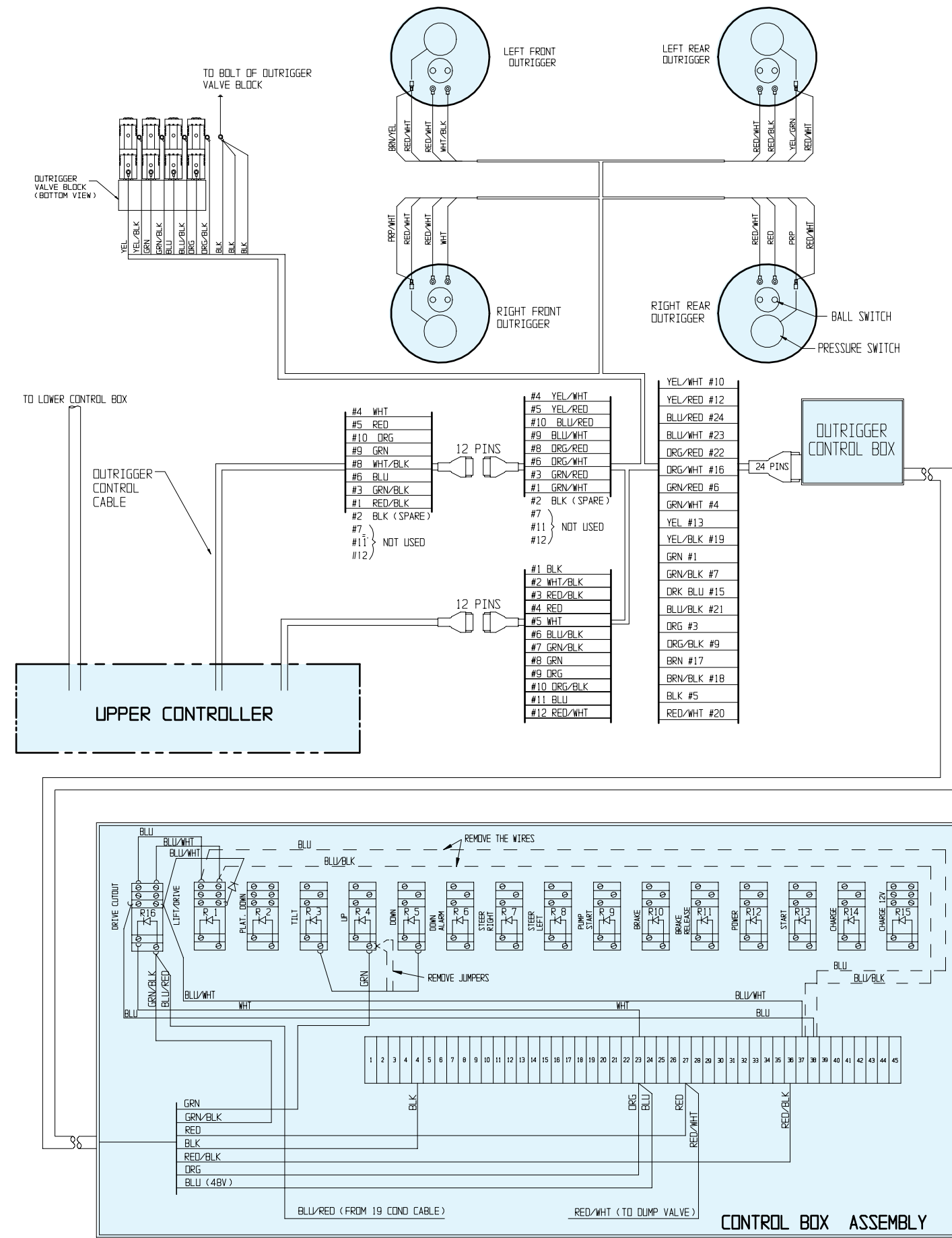
CONTROL BOX, BI-ENERGY



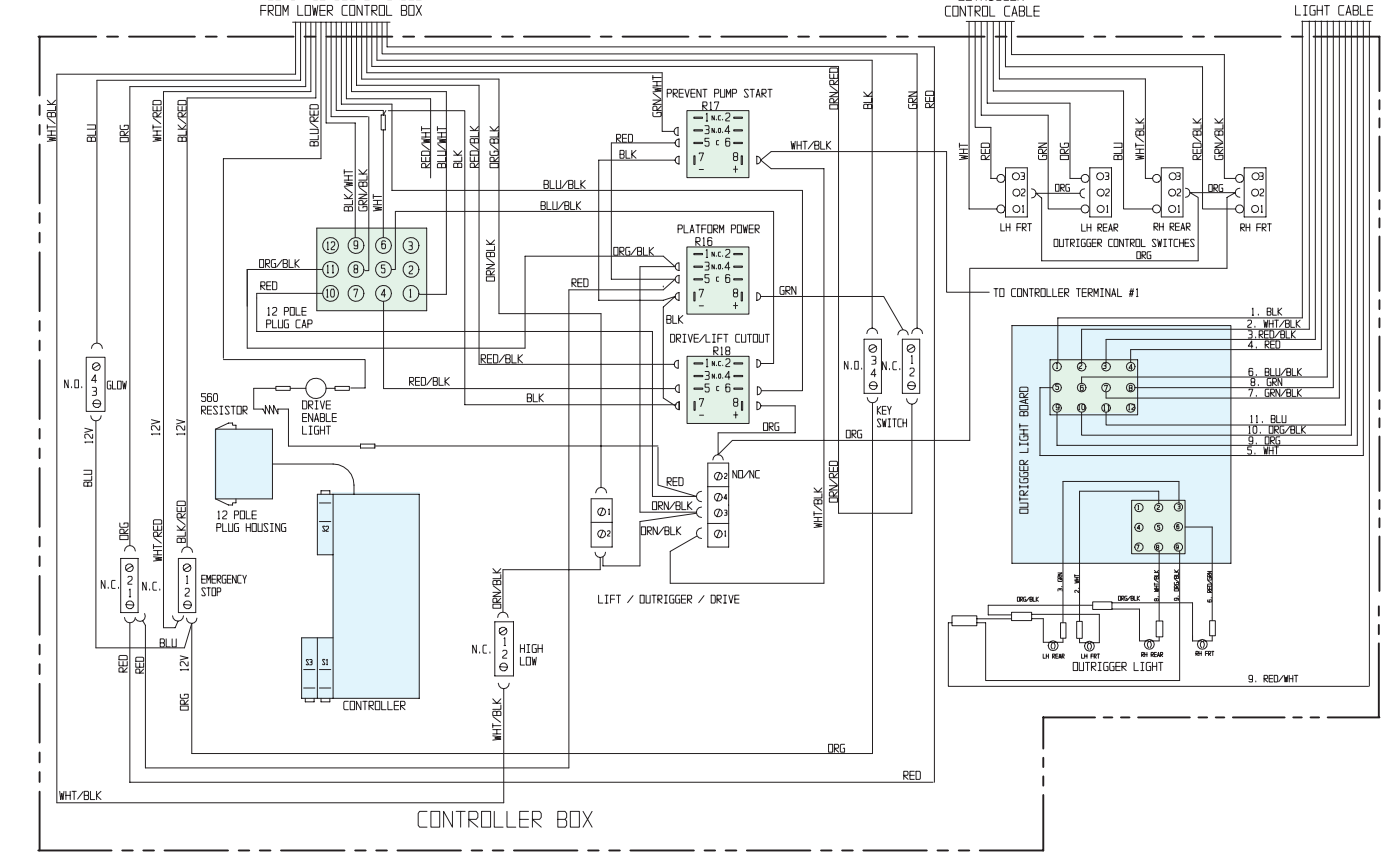
UPPER CONTROLS, BI-ENERGY



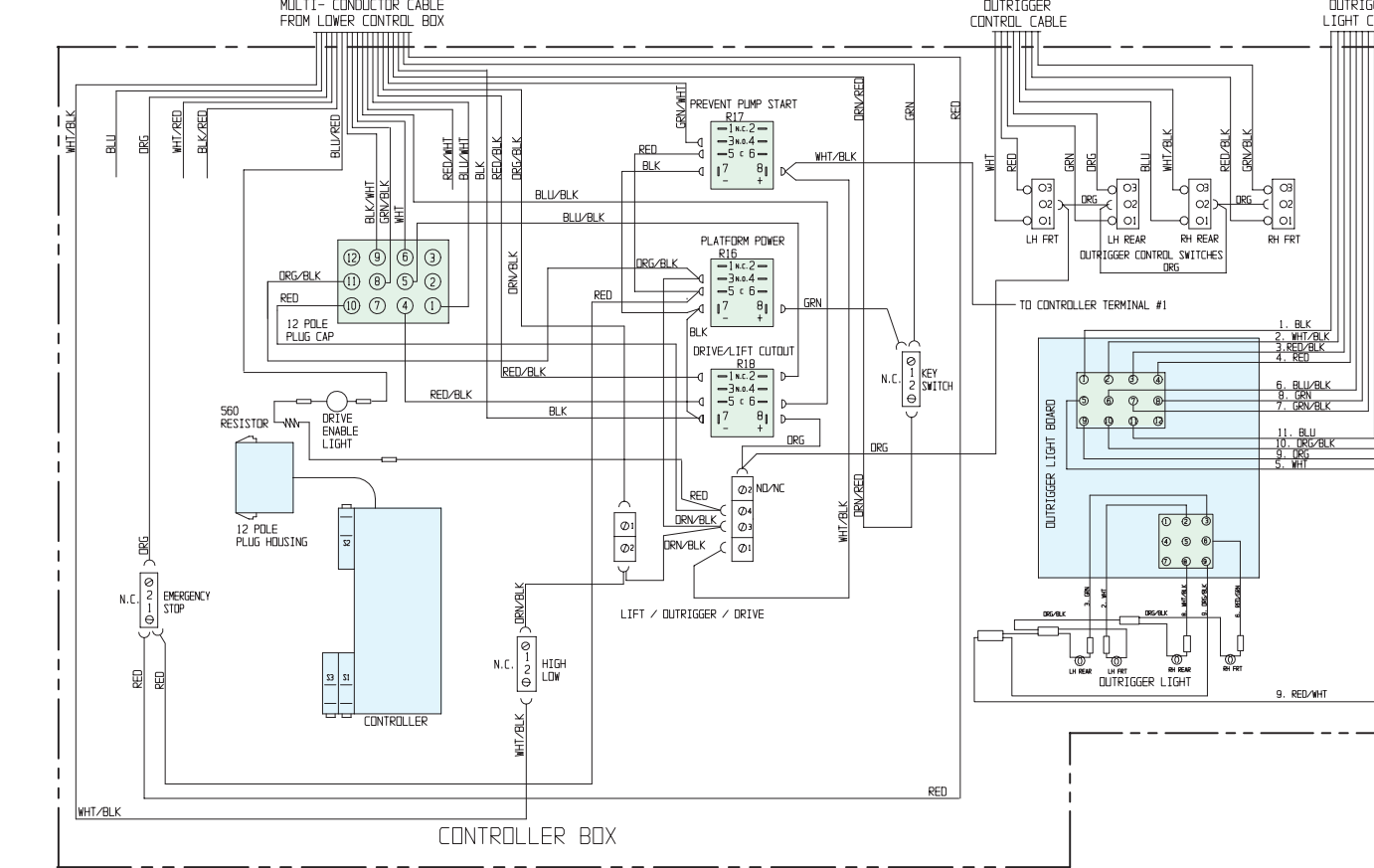
OUTRIGGER OPTION



UPPER CONTROLS, OUTRIGGER OPTION, BI-ENERGY



UPPER CONTROLS, OUTRIGGER OPTION, ELECTRIC



4-8 HYDRAULIC SCHEMATIC

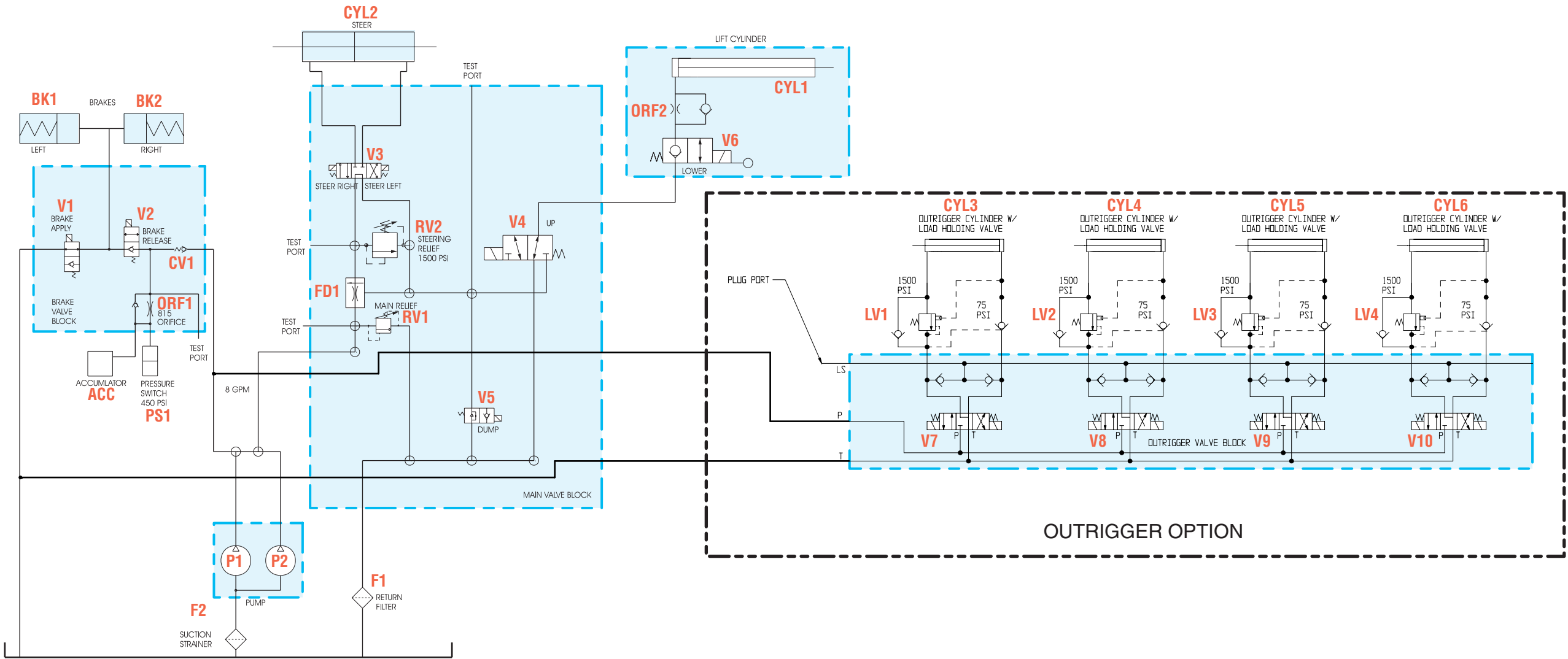
Table 4-7: Hydraulic Schematic - 067446-000/067454-000

REFERENCE	NAME	FUNCTION	LOCATION
ACC	Accumulator	Accumulate Hydraulic Fluid	Brake Valve Block
CV1	Check Valve	Slow Brake Release	Brake Valve Block
BK1	Left Brake	Apply Left Brake Pressure	Left Brake
BK2	Right Brake	Apply Right Brake Pressure	Right Brake
CYL1	Cylinder, Lift	Actuate Scissor Linkage to Lift Platform	Chassis
CYL2	Cylinder, Steering	Actuate Steering Linkage to Steer Front Wheels	Chassis
CYL3-CYL6	Outrigger Cylinder	Level and Support the Machine	Chassis
LV1-LV4	Load Holding Valve		Outrigger
F1	Filter, Return	Filter Hydraulic Line	Tank

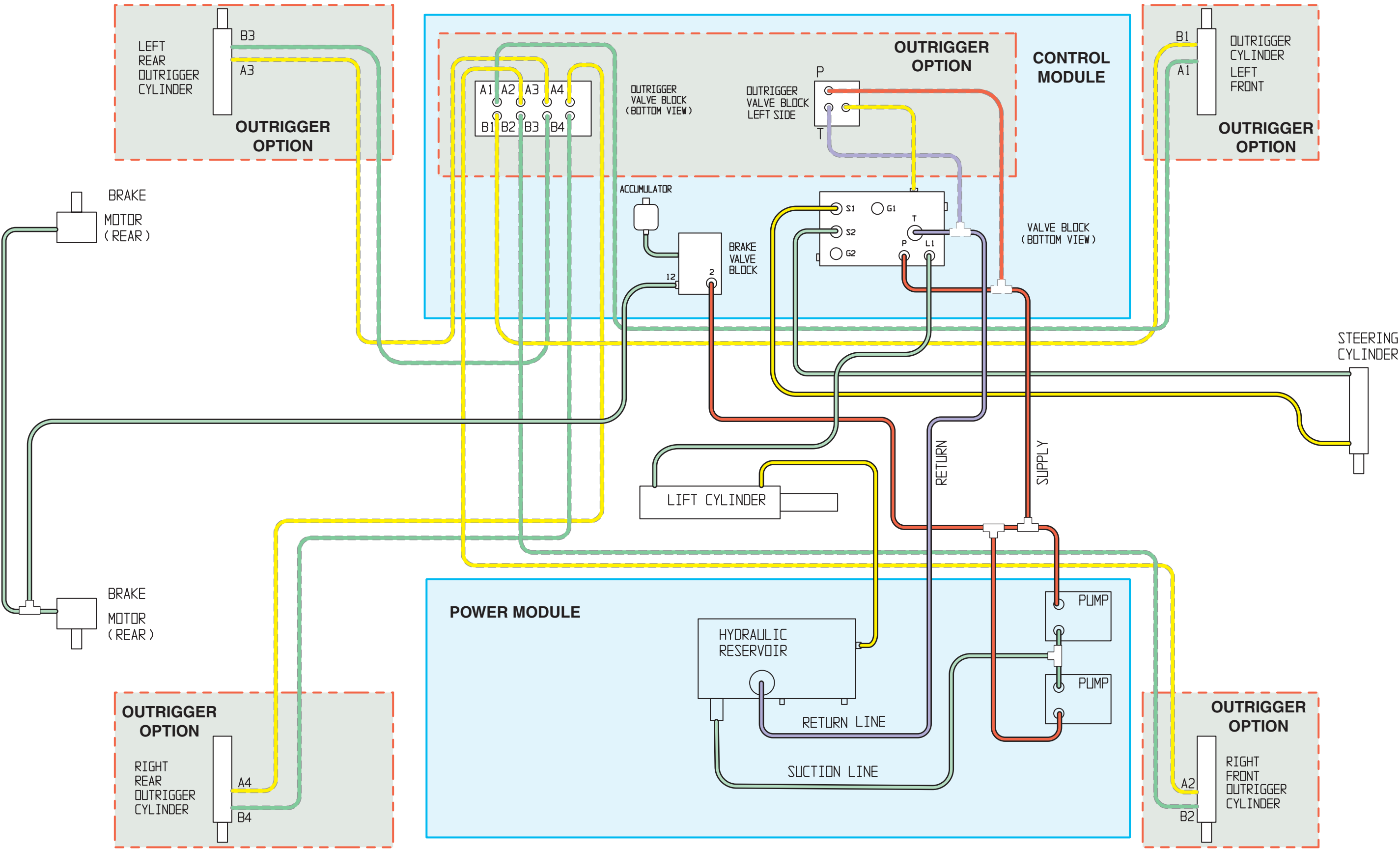
REFERENCE	NAME	FUNCTION	LOCATION
F2	Filter, Tank	Filter Contaminants	Tank
FD1	Flow Divider	Allows Lift and Steer Functions Together	Main Valve Block
ORF1	Orifice, One-way, Brake	Allow Brakes to Release Quickly and Apply Slowly	Brake Valve Block
ORF2	Orifice, One-way, Lift Cylinder	Limit Hydraulic Oil Flow at Lift Cylinder	Lift Cylinder
P1 & P2	Hydraulic Pump	Fluid Power for Hydraulic System	Chassis
PS1	Pressure Switch	Disable Machine	Brake Valve Block
RV1	Valve, Main Relief	Over Pressure Protection for the Main Hydraulic Line	Main Valve Block

REFERENCE	NAME	FUNCTION	LOCATION
RV2	Valve, Steering Relief	Over Pressure Protection for the Steering Components	Main Valve Block
V1	Valve, Brake Apply	Direct Hydraulic Oil to the Brake Cylinders	Brake Valve Block
V2	Valve, Brake Release	Release Hydraulic Oil Pressure from Brakes	Brake Valve Block
V3	Valve, Steering	Control Hydraulic Oil Flow to Steering Cylinder	Main Valve Block
V4	Valve, Lift	Control Hydraulic Oil Flow to Lift Cylinder	Main Valve Block
V5	Valve, Dump	Divert Excess Oil	Main Valve Block

REFERENCE	NAME	FUNCTION	LOCATION
V6	Valve, Down	- Hold Oil in Lift Cylinder when Deck is Elevated. - Release Oil from Lift Cylinder to Lower Deck - Has Cable Actuated Manual Override for Emergency Lowering	Lift Cylinder
V7-V10	Valve, Outrigger	Control Hydraulic Flow to Outrigger Cylinders	Outrigger Valve Block



4-9 HOSE ROUTING



4-10 COMPONENT IDENTIFICATION

Figure 4-1: Lower Control Box Assembly

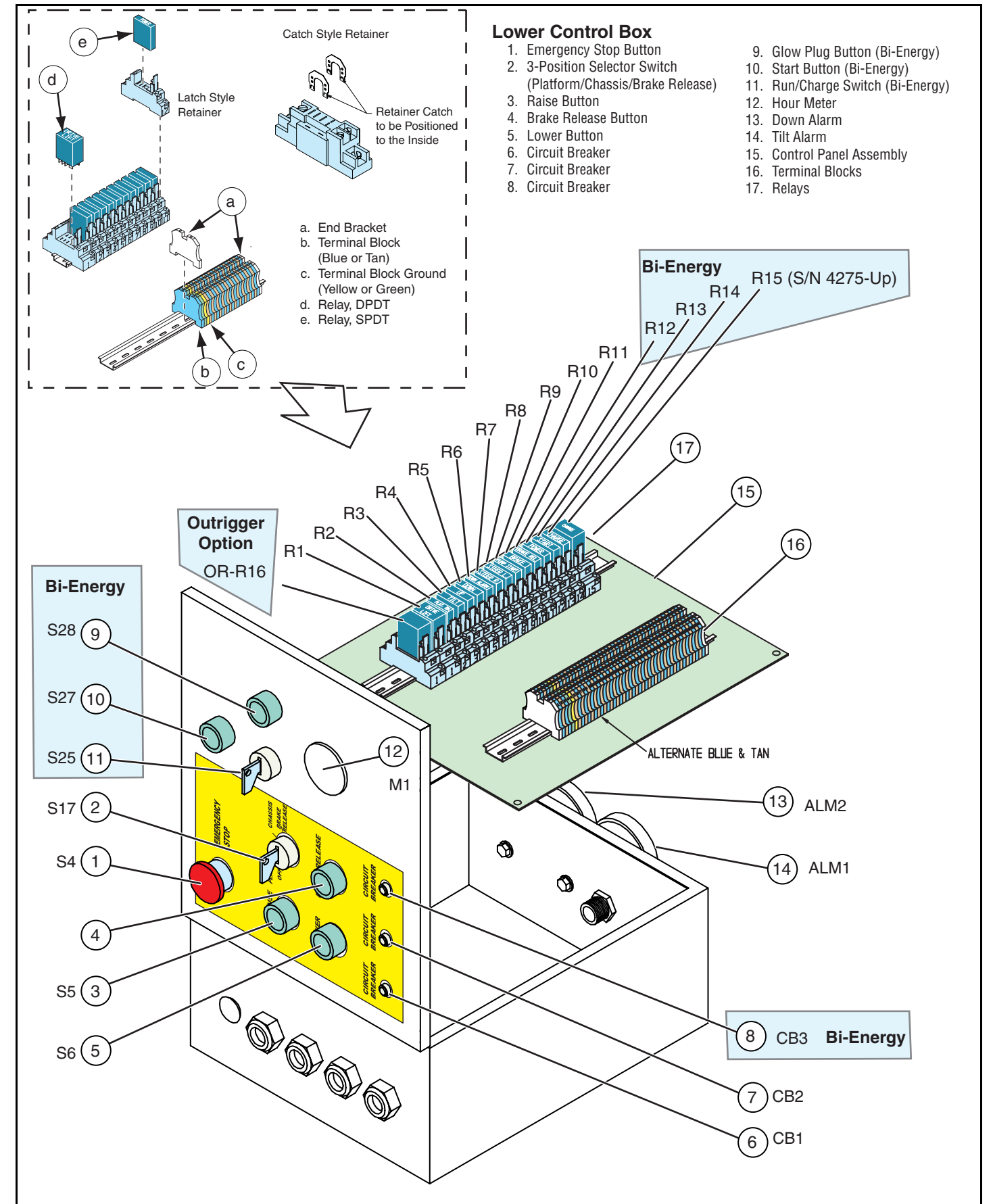


Figure 4-2: Upper Control Box Assembly

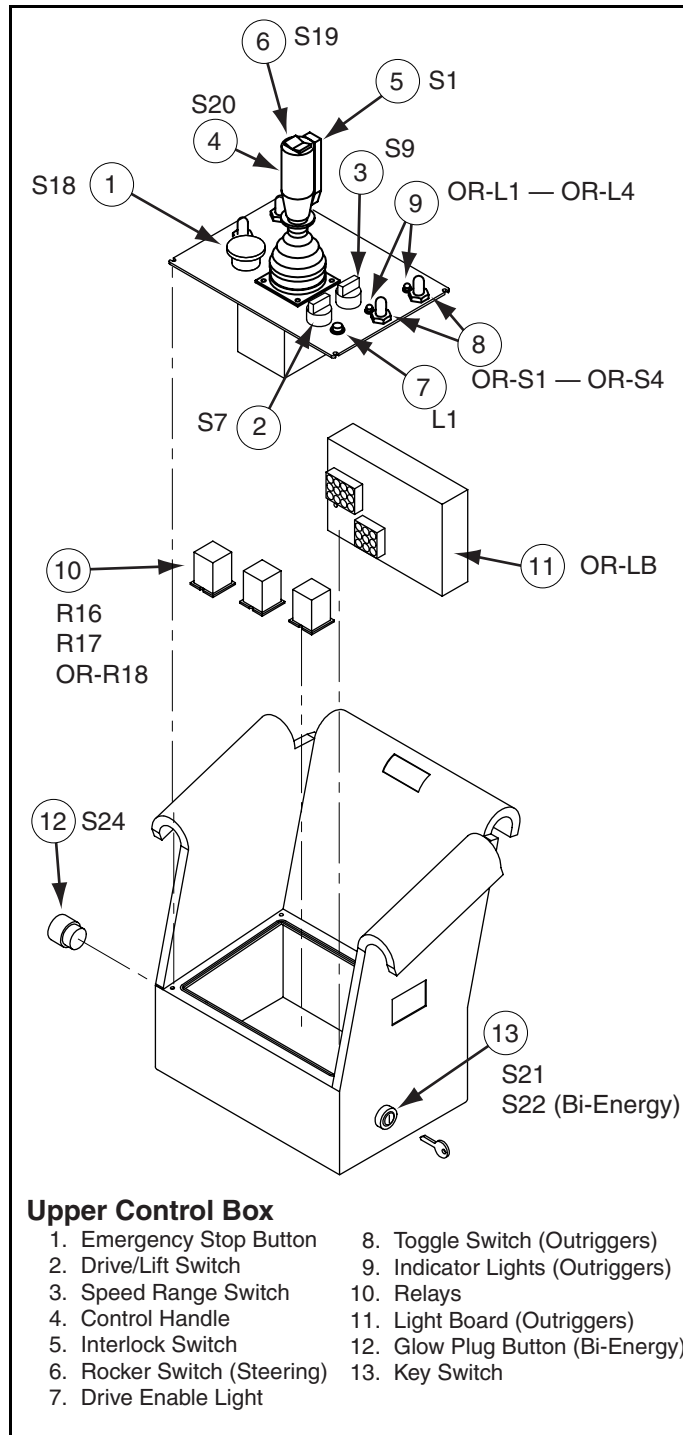


Figure 4-3: Outrigger Relays

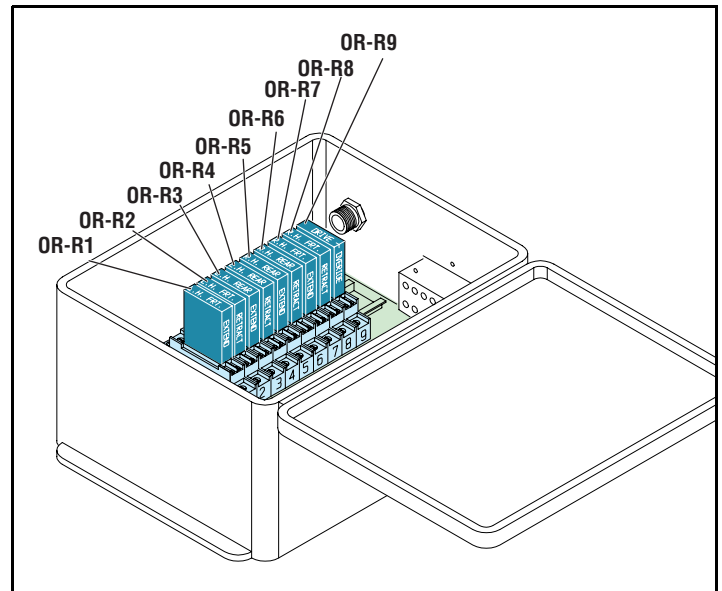


Figure 4-4: Relay Panel Assembly

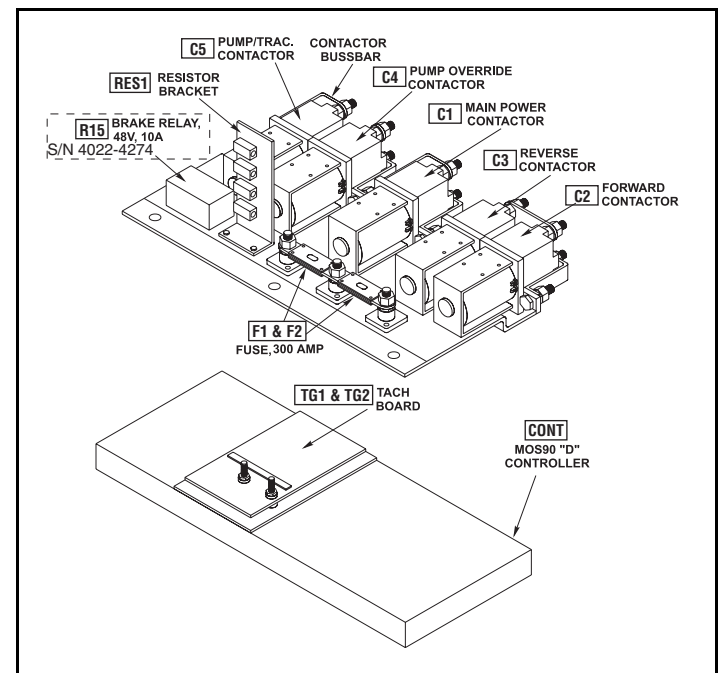


Figure 4-5: Engine Relays (Bi-Energy)

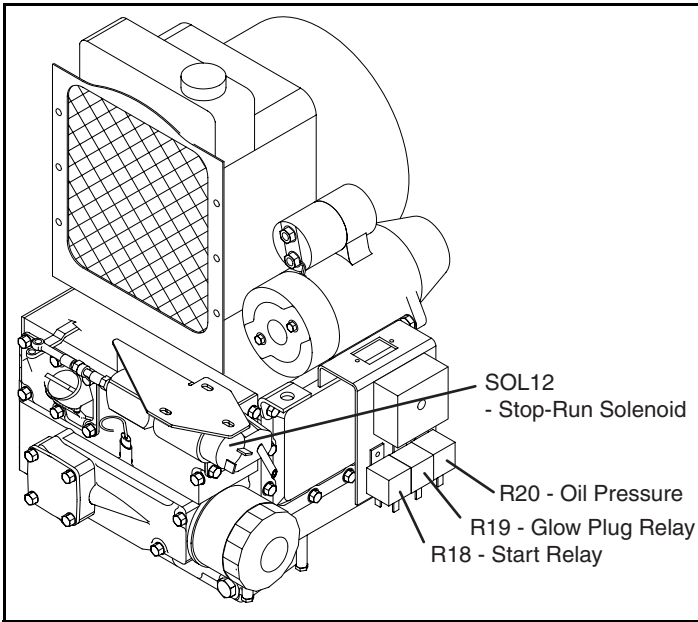


Figure 4-6: Valve Manifold, Main

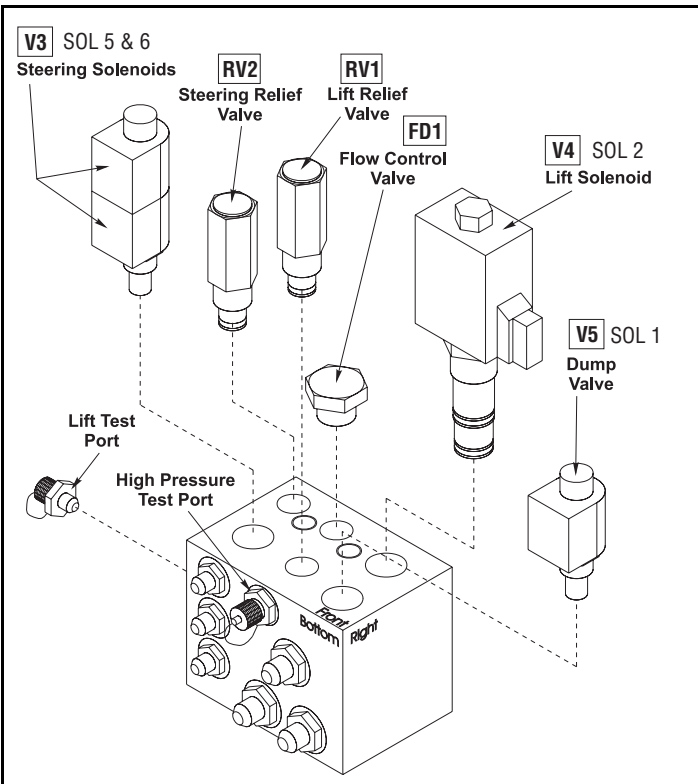


Figure 4-7: Valve Manifold, Brakes

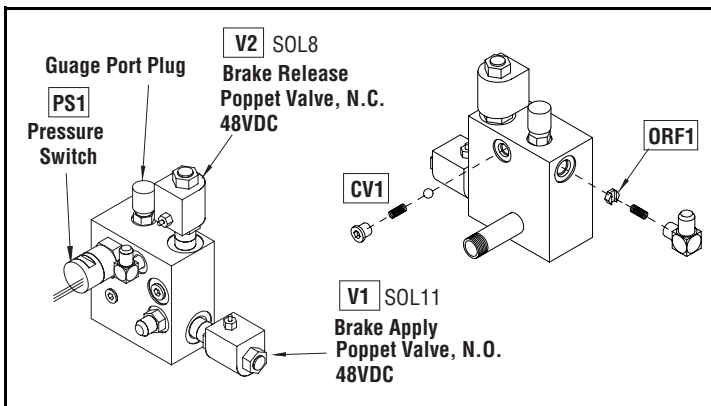


Figure 4-8: Lift Cylinder

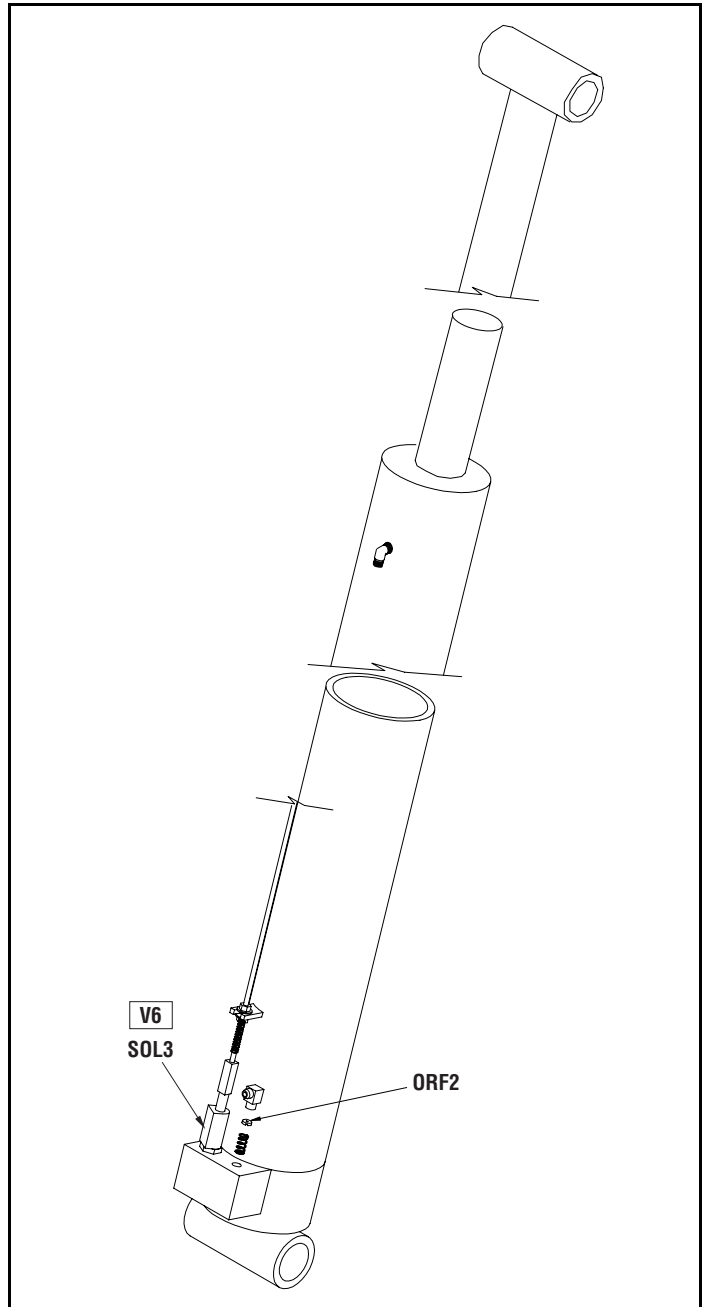
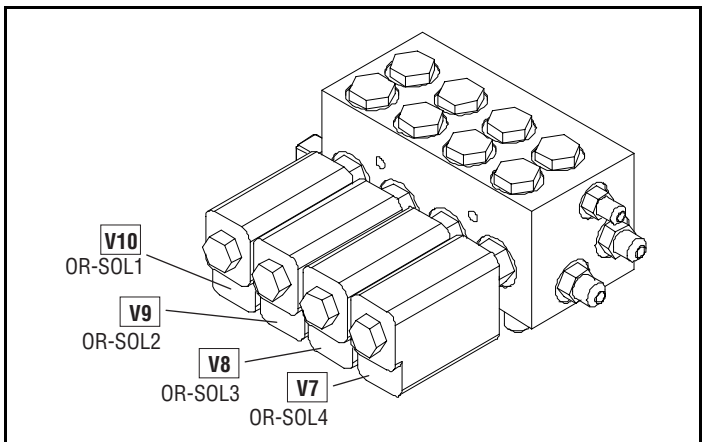


Figure 4-9: Valve Manifold, Outriggers



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