UniCarriers Americas Corporation

SERVICE MANUAL

MODELS E2W3/E2W4

SPXE Series Center Control Walkie Rider Pallet &
TGXE Series Walkie Rider Tow Tractor
24V AC Powered Electric / Electric Power Steering
SPXE - 6,000 & 8,000 lb. Capacities
TGXE - 10,000 lb. Rolling Capacity/225 lb. Drawbar Pull

SERVICE

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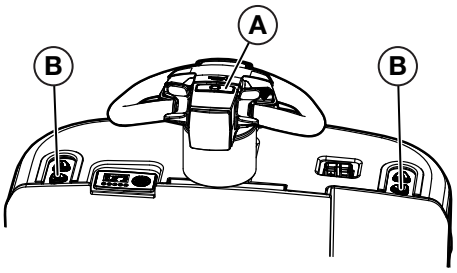


Spring Applied Electromagnetic Release Brake (Cont'd)

Electric Brake

Braking

The service/park brake can be activated by pressing the Brake Button (A) on the Steerhead. The recommended way of slowing down or stopping the E2W3/E2W4 in the travel mode with the operator standing on the operator's platform is controlled reversing or plugging. When walking alongside the E2W3/E2W4 in a picking operation, one of two Brake Switches (B) can be easily depressed from either side of the Dashboard to stop the lift truck. When riding the E2W3/E2W4, the Brake Switch (A) located on the top of the Steerhead can be depressed to stop the lift truck.

⚠ WARNING

- **The lift truck will not stop unless the operator manually applies the brake or does not operate a control for approximately 1 minute. This lift truck has an electronically released, spring applied brake.**

ELECTRICAL SYSTEM

SECTION ES

CONTENTS

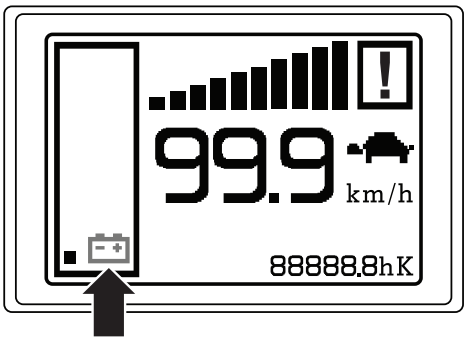
EPS AC0 Operational Features (Cont'd)

13. Redundant set point and feedback sensors fulfil the Category #3 requirement.
14. Redundant safety-contact fulfils the Category #3 requirement in a stand-alone configuration.

Diagnosis

According to EN1175, most of the diagnoses deenergize steer and traction in less then 100 msec. Few secondary alarm conditions require longer time for detection. They too deenergize steer and traction: it is better to have delayed alarm than no alarm at all.

Diagnosis is provided in two ways. The digital console can be used, which gives a detailed information about the failure; the failure code is also sent on the Can-Bus.



Low Voltage Lock Warning

If the Lift Truck is subjected to continuous operation after the Battery Low message was activated, the Low Voltage Lock Warning will be activated. Then, the display will appear as shown. The Lift Truck cannot be operated during the Low Voltage Lock Warning.

NOTE:

The interval between the first appearance of the Battery Warning Mark and interruption of the operation is dependent of the charge/ condition of the Battery.

⚠ WARNING

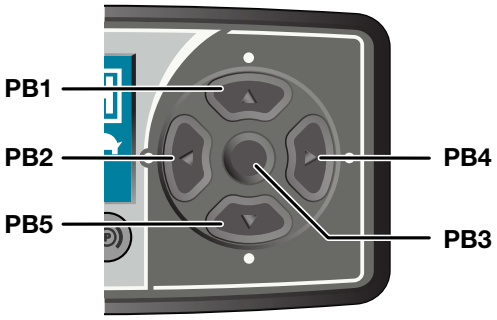
- **When the malfunction is indicated, immediately suspend Lift Truck operation. Contact your Local Authorized UCA Dealer for inspection and necessary repair.**

Diagnostic Mode, Diagnose, EPS

PB1 PB5

SET POINT ONE 2636mV	→	Measurement of the potentiometer connected to CNA#20 (CPOC1).
SET POINT TWO 2377mV	→	Measurement of the potentiometer connected to CNA#17 (CPOC2).
STEERED ANGLE 1.64º	→	Angle of the traction motor.
FEEDBACK POT 1 2521mV	→	Measurement of the feedback potentiometer connected TO CNA#1 (CPOCT).
ZERO SCL CPOC IN 2644mV	→	Scaled value of "Zero SP Pot 1"
SCALED CPOC 2497mV	→	Scaled value of Steer Angle Set Point -180 => 0V 0 => 2.5V 180 => 5V
FEEDBACK ENC 2519mV	→	Measurement (scaled in the range 0 to 5 Vdc) of the position of the feedback encoder connected to CNA#3 and CNA#4.
ENC COUNTING 139	→	Counts of the encoder vs. the real straight ahead direction (Steer Angle to 0 deg.). At key-on the Encoder count is near Zero.
ENC 2 COUNTING 0	→	NOT USED - NO 2nd encoder.
ENC SPEED 0.00Hz	→	This is the speed of the motor measured with the encoder on the motor shaft.
FREQUENCY 0.00Hz	→	This is the frequency applied to the steering motor
MOTOR VOLTAGE 0%	→	100% means the sine waves in the motor have the maximum PWM amplitude.
MOTOR CURRENT 0.0A	→	Root Mean Square value of the line current in the motor
IQ RMS 0.0A	→	Root Mean Square value of the quadrant component of the current
ID RMS 0.0A	→	Root Mean Square value of the direct component of the current
TEMPERATURE 11ºC	→	Temperature of the controller base plate.
MOTOR TEMPERAT. 35ºC	→	Temperature of the motor windings measured with the thermal sensor inside the motor and connected to CNA# 6 & 7.
I TFD 0mA	→	NOT USED - NO TFD
TORQUE NM X 100 0	→	Torque request calculated by s/w.
MOT POWER WATT 0.0	→	Estimated electrical power supplied by the motor
STATUS #5 12.28V	→	Try to disconnect all the motor terminals from the controller, recycle the key and read Status #5. If the long duration instance is in a window 8 to 13.5Vdc, the problem could be dissipation (loss of insulation of the motor). Otherwise internal hardware fault of the inverter.
STATUS #2 0.00	→	DNA (Parameters tab says this is tied to Parameter SELFCHK STATUS - LEVEL #2)
STATUS #1 0	→	DNA (Parameters tab says this is tied to Parameter SELFCHK STATUS - LEVEL #1)
TRUCK SPEED 0%	→	Truck speed represented as a percentage of the full drive speed. It is used for the dynamic numbness (i.e. the steering sensitivity reduces when the truck speed increases).
NCOIL IN/OUT1 V 0.00V	→	Not used
PCOIL IN/OUT2 V 0.13V	→	Not used

PB1 PB5



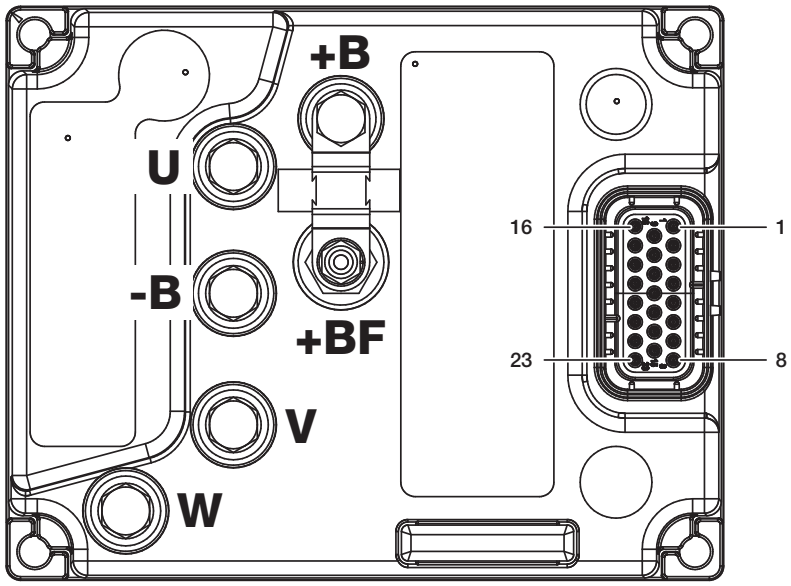
Adjustments Menu (Cont'd)

1. Use PB1 and PB5 to scroll through available Parameters. Use PB3 to select a Parameter to change.
2. Use PB1 and PB5 to make changes to the selected Parameter.
3. Use PB4 to exit/escape to the previous Menu.

EPS Adjustments (Cont'd)

Screen	Default Setting	Range		Description
SET BATTERY TYPE	24V	24	36	Set this adjustment to the nominal battery voltage.
SET STEER 0-POS.	0.00 °		ACQUIRED	This adjustment is used to compensate for the offset between the actual wheel position and the real straight ahead direction of the truck. It is set in steps of 0.351 degrees. Use the 0-POS TEACHING procedure to properly set SET STEER 0-POS.
ANLALOG 0 FBPOT1	2.5 V		ACQUIRED	Teachable parameter for Zero position of Steered Wheel (Tire).
FB POT RANGE ACQ	4.7 V		ACQUIRED	When entering this adjustment by pushing ENTER Button on the hand set, the current value of FBPOT1 is monitored against the encoder counting. Then the driver must turn the steered wheel at least for 90 degrees (measured with the encoder counting) and the span of the encoder counting compared with the span of the steered axle sensor within this covered angle. Then the span of the steered axle sensor will be projected to an angle of 180 degrees (using the span of the encoder counting for determining the scaling factor between covered angle and 180degrees). The span of the steered axle sensor corresponding to a 180 degrees axle rotation will be shown on this adjustment. The acquired value will be used to check real time the angle measured with the steered angle sensor is matched with the one measured with the encoder counting. Push OUT and ENTER buttons to save the new value. Can Bus Object Dictionary of the final customer can include an SDO and a procedure for acquiring this adjustment on VMC demand."
AUX OUT 2 D.C.	100%	0	100	This parameter sets the max PWM (in percentage of the full conduction) on output CNA#14. This output is driven with a PWM by the Slave uC.
ZERO SP POT 1	2.6 V		ACQUIRED	When entering this adjustment by pushing ENTER Button on the hand set, the current value of SPPOT1 is acquired and shown on the hand set display. Enter and Save this adjustment with the tiller in the straight ahead orientation. The acquired value will be used to match the straight ahead orientation for tiller and steered axle. at the sametime also ZERO SP POT 2 is acquired.
ZERO SP POT 2	2.4 V		ACQUIRED	See ZERO SP POT 1.
ACW MIN SP VALUE	0.6 V		ACQUIRED	Minimum analog value for the analog setpoint command. It is an acquired value.
CW MAX SP VALUE	4.7 V		ACQUIRED	Maximum analog value for the analog setpoint command. It is an acquired value.

Pin Assignment	
PIN	**Function**
01	Feedback Sensor Signal
02	Feedback Sensor +5V
03	Steering Motor Encoder Channel A
04	Steering Motor Encoder Channel B
05	Steering Motor Encoder Ground
06	Steering Motor Thermistor (+)
07	Steering Motor Thermistor (-)
08	N/A
09	N/A
10	N/A
11	Pick Switch Input
12	N/A
13	Steering Input Sensor GND
14	N/A
15	Key Switch Input
16	Steer Motor Encoder Power (+15v)
17	Steering Input Sensor Signal 2
18	Steering Input Sensor +5V
19	Steering Input Sensor GND
20	Steering Input Sensor Signal 1
21	Steering Input Sensor +5V 2
22	CAN LO
23	CAN HI



EPS AC0 Controller

-B - Negative of the Battery.
+B - Positive of the Battery.
+BF - Positive of the Battery, before the Fuse.
U, V, W - Connection bars of the three motor phases; follow this sequence (U, V, W) and the indication of the motor.

Power cables must be tightened on controller power posts as follows:

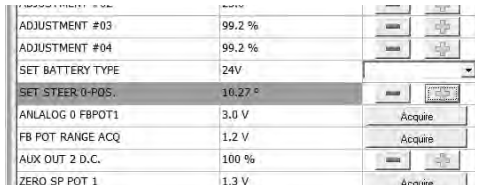
Torque:

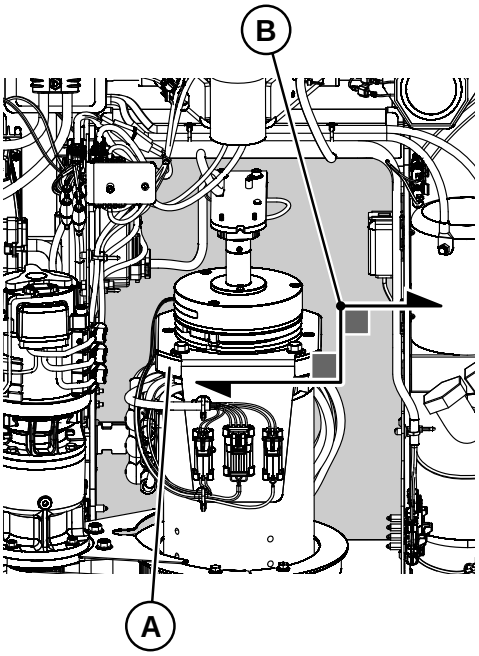
EPS AC0 Controller:

2.5-3.0 Nm (22.12 in-lbs to 26.5 in-lbs)

⚠ CAUTION

- **Exceeding specifications could damage the Bus Bars' internal threads, resulting in loose connections.**
- **The order of phase cables (U, V, W) will effect the operation of forward and reverse. Confirm the operation of direction control with the Drive Tire off of floor.**





25. Select the Parameter icon or select it from the Function pulldown menu.
26. Select the Adjustments tab on the Parameters screen
27. Change the SET STEER 0-POS value until the Drive Motor Upper Casement (A) sides appear to be perpendicular with the Back Frame Plate (B).
28. Select Store when satisfied with the new position.
29. Disconnect the laptop and test drive the Lift Truck. Repeat Steps 18 through 29 until the test drive verifies the Lift Truck travels in a straight line.
30. Power the Lift Truck OFF, then Power the Lift Truck back ON.
31. Re-establish connection to the Lift Truck using the laptop and ZAPI CAN Console software. (Refer to Steering Sensor: Establishing Lift Truck Connection earlier in this Section)
32. Select the Parameter icon or select it from the Function pulldown menu.
33. Select the Adjustments tab on the Parameters screen. Verify that all parameter changes have been saved.

MDI Drive Parameters (Cont'd)

Hardware Settings Menu (Cont'd)

Name	Default Value	Increment	Range	Description	User Access
MAXSLIP 1 BRK	3.5 HZ	0.1	0.0 - 20.0	Reserved for ZAPI	FACTORY
FREQSLIP 1 BRK	15 HZ	1	0 - 200	Reserved for ZAPI	FACTORY
MAXSLIP 2 BRK	3.5 HZ	0.1	0.0 - 20.0	Reserved for ZAPI	FACTORY
FREQSLIP 2 BRK	30 HZ	1	0 - 200	Reserved for ZAPI	FACTORY
MAXSLIP 3 BRK	4.0 HZ	0.1	0.0 - 20.0	Reserved for ZAPI	FACTORY
FREQSLIP 3 BRK	64 HZ	1	0 - 200	Reserved for ZAPI	FACTORY
MAXSLIP 4 BRK	3.5 HZ	0.1	0.0 - 20.0	Reserved for ZAPI	FACTORY
FREQSLIP 4 BRK	120 HZ	1	0 - 200	Reserved for ZAPI	FACTORY
OPTION 07	Level = 1	1	Level = 0 - 9	Reserved for ZAPI	FACTORY
OPTION 08	Level = 6	1	Level = 0 - 9	Reserved for ZAPI	FACTORY
OPTION 06	Level = 6	1	Level = 0 - 9	Reserved for ZAPI	FACTORY

MDI Pump Parameters

Parameter Change Menu

Name	Default Value	Increment	Range	Description	User Access
PUMP IMAX	Level=5	-	0 - 9	Sets maximum available dc current as percentage of current capacity rating of controller	FACTORY
SPEED LIMIT	100%	1%	0 - 100	Sets the maximum speed allowed for any pump related function. It is a percentage of maximum voltage applied to the motor.	FACTORY
MIN PUMP SPEED	30%	1%	0 - 100	Sets minimum speed of pump motor. Percentage of maximum voltage applied to pump motor	FACTORY
PUMP ACCEL RAMP	0.1	0.1	0.1 - 25.5	Sets acceleration ramp for pump motor	FACTORY
PUMP DECEL RAMP	0.1	0.1	0.1 - 25.5	Sets deceleration ramp for pump motor	FACTORY
LIFT MAX. TIME	5.0	0.1	1.0 - 15.0	Sets the maximum time for lift function	FACTORY
LIFT TOTAL TIME	8.0	0.1	1.0 - 15.0	Sets the total time for accumulated lift functions	FACTORY
MAX EVP	100.0%	0.4%	0 - 100	This parameter determines the maximum current applied to the EVP when the position of the potentiometer is at the maximum. This parameter also determines the current value when the EVP is programmed like an ON/OFF valve.	FACTORY
LOWERING SPEED	100%	1%	0 - 100	It defines the PWM of the EVP, in order to set the lowering speed of the forks.	FACTORY
EVP OPEN RAMP	0.00	0.05	0 - 12.75	It determines the acceleration ramp on EVP. The parameter sets the time needed to increase the current to the maximum possible value.	FACTORY
EVP CLOSE RAMP	0.00	0.05	0 - 12.75	It determines the deceleration ramp on EVP. The parameter sets the time needed to decrease the current from the maximum possible value to zero.	FACTORY

E = Economy Mode (Standard), **H** = High Mode, **E2W4** = Tow Tractor

"Factory" Setting = not adjustable in the field

MDI EPS Parameters (Cont'd)

Hardware Settings Menu (Cont'd)

Name	Default Value	Increment	Range	Description	User Access
POLE PAIRS SET-A	2	1	1 - 3	Pole Pair of Steering Motor	FACTORY
POLE PAIRS SET-B	2	1	1 - 3	Pole Pair of Steering Motor	FACTORY
SELFCHK STATUS	Level = 0	-	Level = 0 - 2	This testing is to be performed with the traction wheel lifted off the ground. This option enables a selfchecking routine to test the motor and the power drives selfcheck #1 or SelfCheck #2. SELFCHECK #1 - When Option set to On and unit rekey an alarm occurs SELFCHECK#1 and a selftest routine is raised to check the functionality of the motor and power drives. a fixed 14.7Adc current is injected and measured and the resistances at the motor terminals are measured. The results of the selfcheck #1 are shown in real time in the Tester Menu reading Status #1. SELFCHECK #2 - When Option set to On and unit rekey an alarm occurs SELFCHECK#2 and a selftest routine is raised to check the functionality of the Encoder and transmission. A fixed speed of 25Hz is commanded in the motor and the speed and current in the motor are measured. The results of the selfcheck#2 are shown in real time in the Tester Menu reading Status #2.	FACTORY

MDI Display Parameters

Set Options Menu

Name	Default Value	Increment	Range	Description	User Access
OPERATOR PASSW.	OFF	-	OFF/ON	Turn ON or OFF operator password function.	FACTORY/ SERVICE
PERFORMANCE TYPE	Level 1	-	Level 1-3	1 = HIGH 2 = ECONOMY 3 = MANUAL	FACTORY/ SERVICE
PERFORM ENABLE	OFF	-	OFF/ON	Turn ON or OFF the operator's ability to change Performance type.	FACTORY/ SERVICE
SPEED UNIT	Option #2	1	Option #1-2	OPTION #1 = KPH OPTION #2 = MPH	FACTORY/ SERVICE
REMA/FREI	Option #2	1	Option #1-2	OPTION #1 = Rema tiller handle OPTION #2 = Frei tiller handle	

Adjustments Menu

Name	Default Value	Increment	Range	Description	User Access
CAN SPEED	Option #2	-	Option #1-2	Sets Can Bus Speed of Eco Smart Option #1 = 125Kbps Option #2 = 250Kbps	FACTORY/ SERVICE
SPEED FACTOR	95	1	0 - 255	Factor to adjust displayed speed depending on gear ratio of truck.	FACTORY/ SERVICE

E = Economy Mode (Standard), **H** = High Mode, **E2W4** = Tow Tractor

"Factory" Setting = not adjustable in the field

MDI (Cont'd)

Drive Warning Index

MDI Alarm	Alarm Node	EcoSmart Alarm	Name
02A15	02	W215	SAFETY STEER
02A66	02	W66	BATTERY LOW
02A67	02	W247	WAITING FOR NODE
02A68	02	W217	TORQUE LIMITED
02A68	02	W218	BAD BATTERY
02A79	02	W79	INCORRECT START
02A94	02	W219	HOURMTR MISMTCH
02A95	02	W213	RETURN TO CENTER
	02	W214	CURVE CTB KO
02A98	02		CHECK UP NEEDED

Pump and Valve Alarm Index

MDI Alarm	Alarm Node	EcoSmart Alarm	Name
05A08	05	A08	WATCHDOG
05A19	05	A19	LOGIC FAILURE #1
05A28	05	A28	PUMP VMN LOW
05A29	05	A29	PUMP VMN HIGH
05A50	05	A228	TRUCK MISMATCH
05A53	05	A230	OUT. MISMATCH
05A54	05	A231	SAFETY FEEDBACK
05A54	05	A231	SAFETY FEEDBACK
05A57	05	A57	CAN IN. MISMATCH
05A58	05	A234	INPUT MISMATCH
05A59	05	A232	WRONG SETPOINT1
05A67	05	A229	WRONG ZERO
05A69	05	A241	CANBUS KO TILLER
05A83	05	A83	HW FAULT
05A93	05	A247	EVP DRIV SHORTED
05A97	05	A248	ANALOG INPUT
05A99	05	A226	NO CAN MSG. 06

Pump and Valve Warning Index

MDI Alarm	Alarm Node	EcoSmart Alarm	Name
05A13	05	W13	EEPROM KO
05A52	05	W52	PUMP I=0 EVER
05A56	05	W56	STBY I HIGH
05A56	05	W56	I = NO ZERO
05A86	05	W224	LIFT + LOWER

Steer Alarms (Cont'd)

MDI Alarm	EcoSmart Alarm	Name	Description	Alarm Node	Effect	Restart Procedure
06A25 (Cont'd)	A241	FB SENSOR LOCKED	This alarm occurs if the actual speed (measured with the Motor Encoder) is more than 30% different than the commanded speed (set point) for a period longer than 500msec, when Traction Speed is higher than 15%. At lower Traction Speed (< 5%), the time delay increases up to 2.5secs. If the displacment between between the commanded and actual speed stays higher than 30% of the commanded speed and higher than 5Hz longer than a time delay of 500msec. this alarm occurs.		At least 1 Encoder Channel damaged. Too much friction in the transmission/gears. Internal hardware fault. Motor Failure (Encoder damaged motor phase broken).	
	A249	F.B OUT OF RANGE	This alarm occurs if the Feedback Wiper input exits the range of .3V to 4.7V.		Verify connection of Feedback potentiometer.	
	A250	BREAKPOINT ERROR	This alarm occurs when it is an angle greater than the angle limit of the feedback angle sensor.		Verify parameters are calibrated correctly for your application.	
06A26	A225	CURRENT GAIN	This alarm occurs when the parameters to compensate for the gain of the current amplifiers (ADJUSTMENT #03 and ADJUSTMENT #04) have the default values (i.e. the maximum current was not regulated).		Replace the Controller. Controller not calibrated from factory - return controller to Zapi.	
06A29	A29	VMN NOT OK	This alarm occurs in the initial rest state after Power Switch on, if the outputs of the motor voltage amplifiers are not in the window from 2.2 to 2.8 Vdc.		It is neccesary to check motor cable connections for open wiring or shorts to frame. Replace the controller.	
	A251	INIT VMN NOT OK	After Power Switch On, with the 3 phase power bridge off, the DC bus voltage is expected to raise up to 14Vdc within 3.2secs. In the same time, steering controller monitors the common voltage at the motor terminals and raises the alarm when the 3.2sec Time-out is expired and: a.) The common voltage is lower than 7Vdc (bottom power mosfets short circuited to -B). or b.) the common voltage is stuck to the DC Bus (top power mosfet short circuited to +B.) (It is considered stuck in case it is in a window of +/- 1Vdc around the DC Bus).		Try to disconnect all the motor terminals from the controller, recycle the Power Switch and read Status #5. If the long duration instance is in a window 8 to 13.5Vdc, the problem could be dissipation (loss of insulation of the motor). Otherwise internal hardware fault of the inverter.	

Drive Alarm Descriptions (Cont'd)

02A60 (Cont'd)	**Troubleshooting:** A. There is an external load in parallel to capacitor bank, which sinks current from the controller capacitors precharging circuit, thus preventing the caps from charging. Check if a lamp or a DC/DC converter or a auxiliary load is placed in // to capacitor bank. B. The charging resistance is opened; insert a power resistance across line contactor power terminals; if the alarm disappears, it means the controller internal charging resistance is damaged. C. The charging circuit has a failure, inside the controller. D. There is a problem in the controller power section.
02A65	**“MOTOR TEMPERATURE” / “MOTOR SHUTDOWN” / “MOTOR THERM KO”** **Cause:** This warning occurs when the temperature sensor is opened (if digital) or has overtaken the threshold of 150°C (if analog). **Troubleshooting:** Check the thermal sensor inside the motor (use the MOTOR TEMPERATURE reading in the TESTER menu); check the sensor ohmic value and the sensor wiring. If the sensor is OK, improve the air cooling of the motor. If the warning is present when the motor is cool, then the problem is inside the controller.
02A66	**“BATTERY LOW WARNING”** "Battery is <= 10% when the parameter BATTERY CHECK is set >0"
02A67	**"NO CAN MSG. 60 / NO CAN MSG 10"** **Cause**: No Can messages from the slave microcontroller. **Troubleshooting:** This alarm could be caused by a CANBUS malfunction, which obscures master-slave communication. Otherwise it is an internal fault of the Controller which must be replaced.
	“WAITING FOR NODE” A Canbus network node is in alarm condition. uC is waiting for it to resolve its error condition
02A68	**“TORQUE LIMITED”** Cutback performance for low battery Voltage < 15v.
	“BAD BATTERY” Controller senses low battery voltage <15v.

Steer Alarm Descriptions

06A02	**“POWER FAILURE #1”** **Cause:** This alarm occurs when the current in the phase W of the motor is zero and the motor is commanded for moving. **Troubleshooting:** Check the power fuse is OK. Check the battery positive arrives to the controller. Check the continuity of the wire in the phase W of the motor. Otherwise it is necessary to replace the controller.
06A03	**“POWER FAILURE #2”** **Cause:** This alarm occurs when the current in the phase U of the motor is zero and the motor is commanded for moving. **Troubleshooting:** Check the power fuse is OK. Check the battery positive arrives to the controller. Check the continuity of the wire in the phase U of the motor. Otherwise it is necessary to replace the controller.
06A04	**“POWER FAILURE #3”** **Cause:** This alarm occurs when the current in the phase V of the motor is zero and the motor is commanded for moving. **Troubleshooting:** Check the power fuse is OK. Check the battery positive arrives to the controller. Check the continuity of the wire in the phase V of the motor. Otherwise it is necessary to replace the controller.
06A08	**“WATCHDOG”** Master uC & Slave uC communicate on a local can bus. Communcation between them requires a stuffing bit which flip flops between every new frame. The alarm is triggered if this stuffing bit is frozen longer than 100msec.
06A09	**“WD SYNCRO”** Internal communication error within the controller. Only option is to replace controller
06A11	**“DATA ACQUISITION”** **Cause:** This alarm occurs when the acquiring the motor resistance or when adjusting the parameters to compensate for the gain of the current amplifiers (maximum current factory adjusted). **Troubleshooting:** Recycle the Power Switch .

E2W4

NO.	J	P	APPLICATION
PA0	X		ZAPI EPS AC0 CONTROLLER
PA0		X	CHASSIS HARNESS
PA1	X		ZAPI COMBI AC1 CONTROLLER
PA1		X	CHASSIS HARNESS
B	X		HANDLE CONTROL
B		X	HANDLE SUBHARNESS
4	X		CHASSIS HARNESS
4		X	STEERING HANDLE SUBHARNESS
6	X		ZAPI MDI DISPLAY
6		X	CHASSIS HARNESS
7	X		CHASSIS HARNESS
7		X	ENC,BRAKE,TEMP SUBHARNESS
9	X		BRAKE/ENC/TEMP SUBHARNESS
9		X	ELECTRIC BRAKE
11	X		CHASSIS HARNESS
11		X	CAN INTERFACE
23	X		CHASSIS HARNESS
23		X	FAN
24	X		CHASSIS HARNESS
24		X	FAN
25	X		BRAKE/ENC/TEMP SUBHARNESS
25		X	ENCODER
28	X		CHASSIS HARNESS
28		X	BATTERY GATE SWITCH - LEFT
29	X		CHASSIS HARNESS
29		X	BATTERY GATE SWITCH - RIGHT
30	X		BRAKE/ENC/TEMP SUBHARNESS
30		X	TEMPERATURE SENSOR - DRIVE MOTOR
31	X		E2 ECO SMART DISPLAY
31		X	CHASSIS HARNESS
32	X		CHASSIS HARNESS
32		X	COAST/HIGH SPEED SWITCH (PLATFORM)
33	X		H2 TRAVEL ALARM
33		X	CHASSIS HARNESS
34	X		CHASSIS HARNESS
34		X	FAN
35	X		FEEDBACK ANGLE SENSOR ON DRIVE TIRE
35		X	CHASSIS HARNESS
36	X		STEERING MOTOR ENCODER
36		X	CHASSIS HARNESS
37	X		THERMISTOR(STEERING MOTOR)
37		X	CHASSIS HARNESS
38	X		CHASSIS HARNESS
38		X	FORWARD PICK SWITCH RIGHT
39	X		CHASSIS HARNESS
39		X	FORWARD PICK SWITCH LEFT
40	X		CHASSIS HARNESS
40		X	BRAKE/STOP PICK SWITCH LEFT
41	X		CHASSIS HARNESS
41		X	BRAKE/STOP PICK SWITCH RIGHT
42	X		STEERING INPUT SENSOR
42		X	CHASSIS HARNESS

CONTACTORS AND RELAYS

NO.	APPLICATION
K1	LINE CONTACTOR

FUSES

NO.	APPLICATION
F1	TRACTION/PUMP MOTOR
F2	CONTROL CIRCUITS
F3	COMPONENT CIRCUITS
F4	ENCODER/MDI
F5	TRACTION MOTOR TEMP SENSOR
F6	EPS
F7	STEERING INPUT SENSOR
F8	STEERING INPUT SENSOR
F9	DRIVE TIRE ANGLE SENSOR

MOTORS

NO.	APPLICATION
M1	TRACTION DRIVE
M3	FAN
M4	STEERING MOTOR

SWITCHES

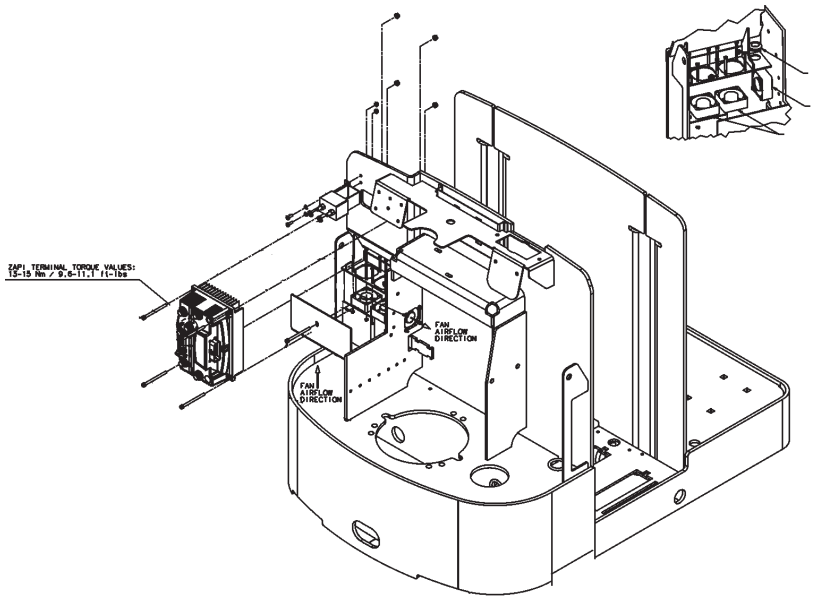
NO.	APPLICATION
S4	KEY SWITCH
S4-1	TOGGLE SWITCH
S12	PICK MODE/HIGH SPEED (PLATFORM)
S13	PICK - LEFT FORWARD
S14	PICK - RIGHT FORWARD
S17	PICK - BRAKE/STOP LEFT
S18	PICK - BRAKE/STOP RIGHT
S20	BATTERY GATE SWITCH - LEFT
S21	BATTERY GATE SWITCH - RIGHT

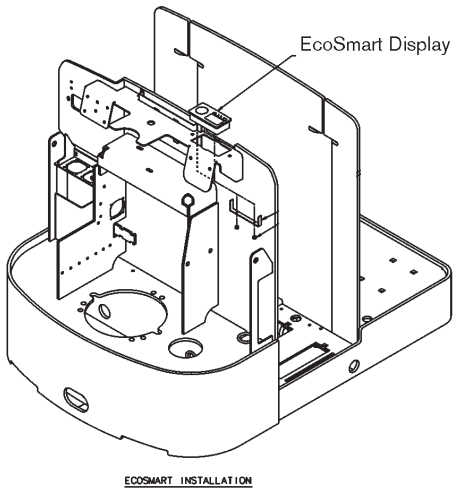
MISCELLANEOUS

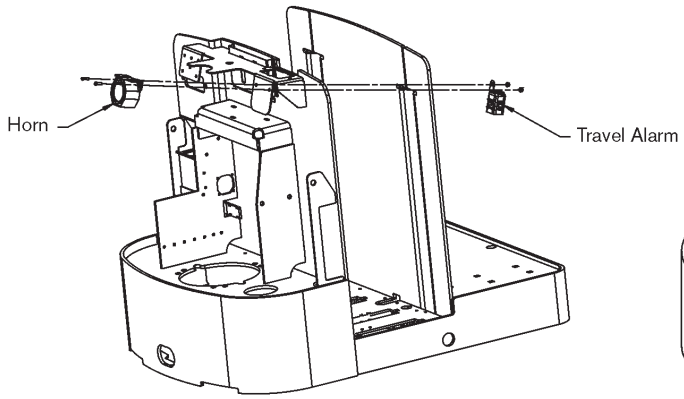
NO.	APPLICATION
AC0	ZAPI EPS CONTROLLER
AC1	ZAPI COMBI CONTROLLER
IC3	ENCODER - MOTOR SPEED/DIRECTION
RT1	TEMPERATURE SENSOR - DRIVE MOTOR
RT2	THERMISTOR - STEERING MOTOR
E1	ZAPI MULTIFUNCTION DIGITAL INDICATOR (HOURS/BDI)
E2	ZAPI ECO SMART DISPLAY (HOURS/BDI/SETTINGS)
H1	HORN
H2	TRAVEL ALARM

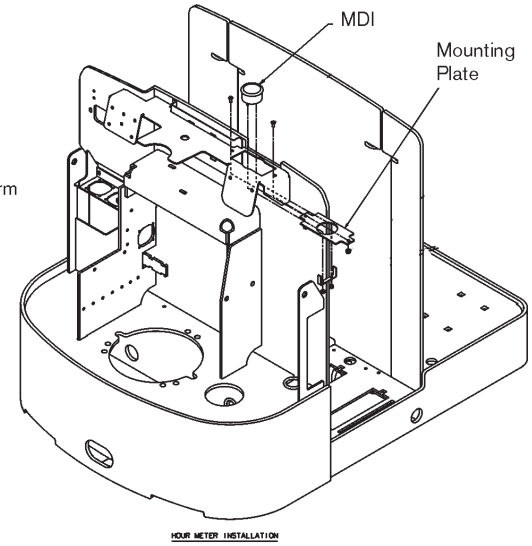
SOLENOIDS

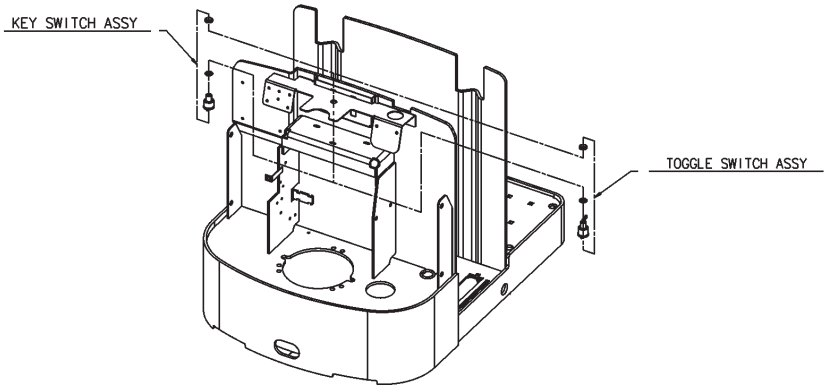
NO.	APPLICATION
L1	K1 LINE CONTACTOR COIL
L2	BRAKE


ZAPI TERMINAL TORQUE VALUES:
15-15 Nm / 9.6-11.1 ft-lbs
FAN AIRFLOW DIRECTION
FAN AIRFLOW DIRECTION


EcoSmart Display
ECOSMART INSTALLATION


Horn
Travel Alarm


MDI
Mounting Plate
HOUR METER INSTALLATION


KEY SWITCH ASSY
TOGGLE SWITCH ASSY

Sometimes, things unseen are difficult to understand. Such is the case with electricity. But, we can certainly see the results of electricity at work. In electric Lift Truck drive control systems, when electricity is able to “flow” properly, the Traction Motor runs and the Lift Truck operates properly. When the electrical flow is interrupted, strange things can happen. Components do not work or work intermittently, fuses blow and in extreme cases, wires can become so hot they could cause the insulation to brake down and melt.

This section provides a guide through basic electrical troubleshooting. As with any other aspect of service work, it takes time and patience to develop skills. Taking time to read the Service Manual carefully, and follow the steps recommended by UCA will provide the information necessary to troubleshoot and repair even complicated and involved problems.

The Logic of Electrical Troubleshooting

For some technicians, electrical problems are what they like to work on the least. It’s easier to fix a problem that can be “seen” as some electrical problems can be elusive. However, taking time to carefully analyze the problem and outline some logical steps to solve it, most electrical problems are pretty basic. Remember, for current to work, a Battery or a Source for electrical power, a Load such as a Motor or Contactor and Continuity (which means wires and conductors that are free of resistance) are required. If any of these factors are missing, the circuit is broken and current will not flow.

Troubleshooting Procedure

It’s helpful to have a routine procedure or approach when troubleshooting a problem, a familiar method with which provides the most information with minimum time and effort. A general rule of thumb when performing electrical troubleshooting is to: “Do the easiest and quickest checks first.” (i.e., Is the Lift Truck’s Battery charged?)

This approach means looking for the obvious things first, such as damage to wires or buss bars and excessive corrosion on wires and connectors. Fuses should be checked with a VOM meter. Don’t trust only a visual check! A fuse that may “look good” may be blown. After this step, begin developing a sound “plan of attack” before going any further on the Lift Truck. Some of the most frustrating and confusing electrical problems are made more difficult with a haphazard and random troubleshooting approach. It is important that the checks performed will yield the answers needed. If the wrong component is tested, the wrong test equipment is used or a meter is not properly calibrated, incorrect or useless information may result.

Don’t forget, there is a time to “walk away from the problem”. When that “time” occurs is different for each person but, the important point to remember is that it is very easy to become confused when troubleshooting electrical problems. If, after 30 to 45 minutes, a solution to an electrical problem has not been reached, it’s usually a good idea to take a break and walk away from the problem to think about it for a few minutes. This is when a review of the “plan of attack” is helpful to determine exactly what is known about the problem.

Fuse F6 Check (Cont'd)

Check for Battery voltage at the Steer controller BF+.

Voltage present?

Yes	No
⬇	Check connections, repair or replace B+T cable.
	⬇

Check for battery voltage at B+ on Steer controller.

Voltage present?

Yes	No
⬇	Replace Fuse F6.
	⬇

End of Fuse F6 check.

Fuse F7 and F8 Check

Check for 5vdc at the Steer Controller Connector A18 (wire #100) and A21 (wire #101).

5v present?

Yes	No
⬇	Verify Power Switch on, power and ground to the steer controller through fuse F6. Replace the controller.
	⬇

Check for 5vdc at fuse F7 (wire #100) and fuse F8 (wire #101).

5v present?

Yes	No
⬇	Check connections, repair or replace wire #100 or #101.
	⬇

Check for 5vdc after fuse F7 wire #108 and fuse F8 wire #109.

5v present?

Yes	No
⬇	Replace applicable failing Fuse.
	⬇

Fuse F7 and F8 Check Continued ⬇

Safety Notifications

DANGER

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

WARNING

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

CAUTION

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

NOTE:

Marks the risk of a breakdown and/or material damage if the instructions are not followed. Also may define a service procedure.

Standard Value or Specifications:
The allowable range for a given measured value during inspection and adjustment.

Limit Value:
The maximum or minimum acceptable measured value during inspection and adjustment.

Locating Directions

The directions (front, rear, left, right) shown in this manual references directions when standing on the operator's platform facing front (forks behind or load trailing = facing front).

General Precautions

DANGER

- **The lift truck service area must be well ventilated and free of flammable objects and materials.**
- **If servicing the lift truck in an area that has previously been closed off or poorly ventilated, open all windows and doors prior to servicing and thoroughly ventilate the area to ensure there is no buildup of hydrogen gas or carbon monoxide.**
- **Be extremely careful whenever handling flammable materials and other dangerous objects.**
- **Do not smoke during service operations.**
- **Before beginning disassembly and inspection, remove all rings, watches and other metallic objects from your body to prevent accidental short circuits.**
- **Turn the Power Switch to the OFF position and disconnect the Battery Plugs before beginning any disassembly and inspection procedure.**
- **When removing the Battery, chock the wheels. Never remove the Battery when the lift truck is raised on jacks.**

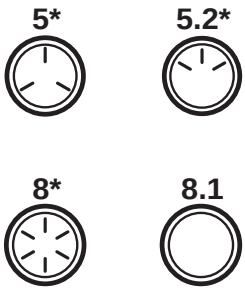
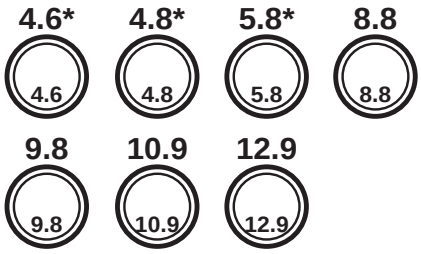
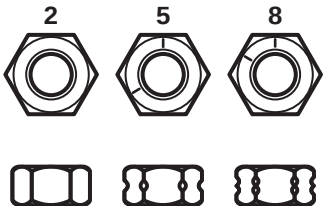
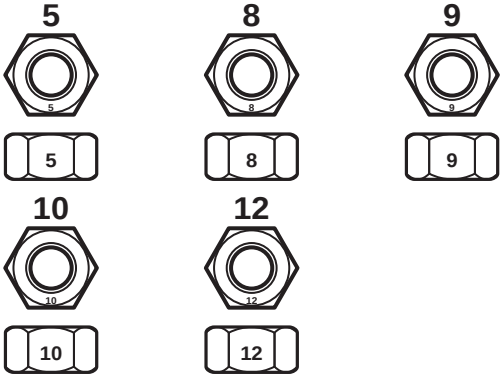
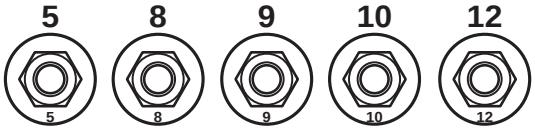
WARNING

- **Exercise care when working around high-temperature, rotating or sliding areas of the lift truck. Avoid burns and other serious injuries.**
- **Use the proper tools for the disassembly and inspection procedures. Use the designated special service tools, if required.**
- **When disconnecting pressurized pipes or hoses, release the pressure from the line before removing.**
- **Use only the specified nuts, bolts or other fasteners to install parts. Tighten the nuts and bolts to the specified torque as required.**
- **Do not carelessly dispose of discarded oil from oil changes and part cleaning operations. Dispose of oil following established procedures. Always contact local agencies.**

CAUTION

- **Carefully analyze all symptoms during troubleshooting. This will allow for safe and efficient repairs. After completing a troubleshooting and repair procedure, carefully check to ensure all existing problems have been rectified.**
- **As required, make alignment marks on parts to be disassembled to facilitate a more efficient reassembly process. Marks should be made on areas of parts that will not affect function.**
- **When removing wires, note the color codes and remember the wiring configuration before removal. Make written notes if necessary.**
- **Under no circumstances should electrical components (Controllers, Motors, Battery Charging Units and Wiring) be steam-cleaned.**

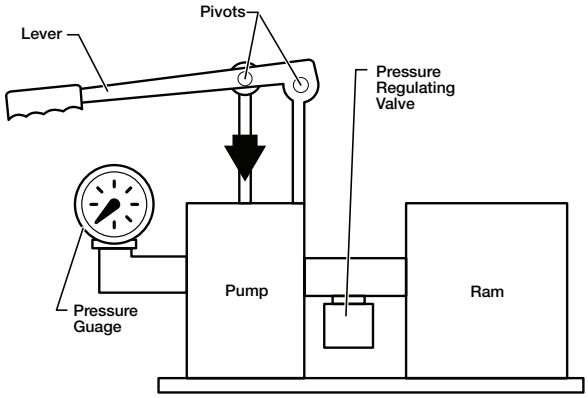
Chart 2. Stud and Nut Designations

Type of Fasteners	Inch Fasteners Strength Levels: SAE Grades * Markings not required	Metric Fasteners Strength Levels: Property Classes * Markings not required
 Studs		 Markings for size M5 and larger OR  Optional geometric symbols for size M5 through M11 ONLY
 Hex Nuts	OR 	OR 
 Hex Slotted Nuts	Markings Not Required	
 Hex Flange Nuts	Markings Not Required	

Pascal's Hydraulic Lever

The hydraulic lever Pascal invented didn't make him rich by any means. In fact, his fame came long after he departed this world. Records show that it took more than 200 years before anyone made use of it in a practical way, by inventing the Hydraulic Press (as shown below).

A brief overview of the Hydraulic Press will likely help explain the tremendous forces that can be obtained from a hydraulic lever. So, let's take a quick look at how it works. It's really very simple!



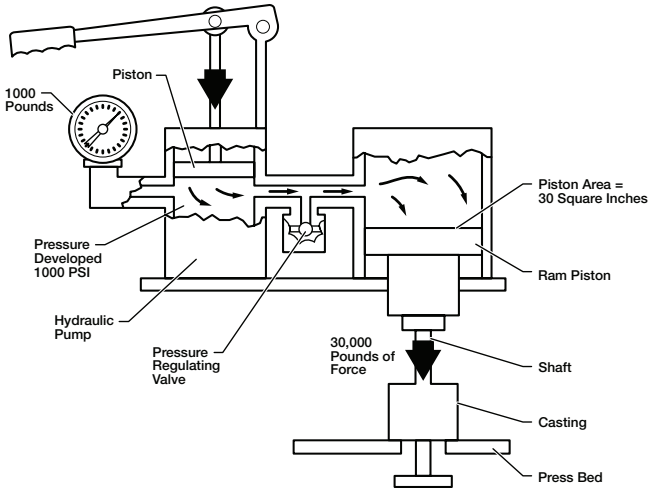
Multiplying Hydraulic Pressure

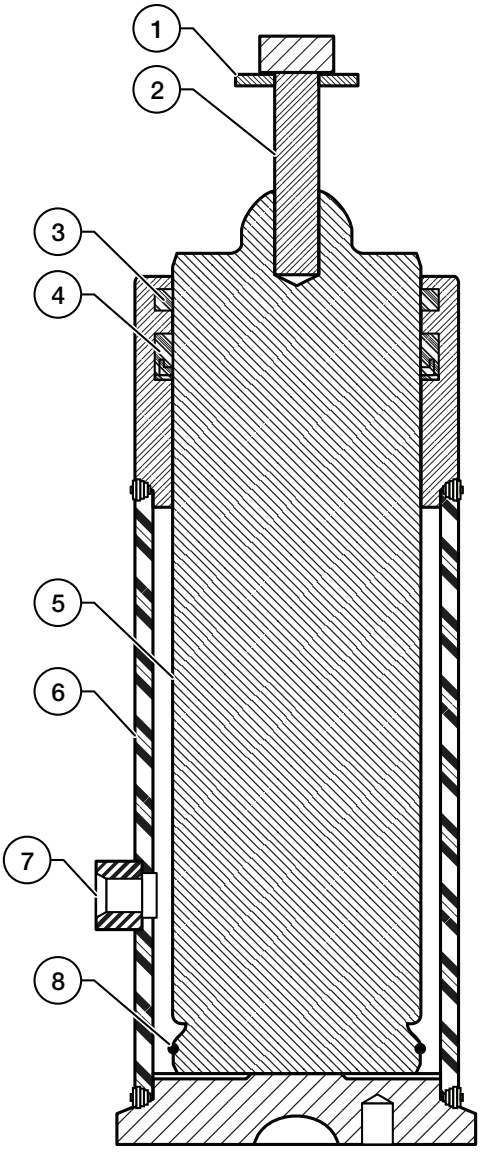
In this example, a shaft from a large casting is "locked" to the bore of the casting and will likely take near 20 tons of force to remove the shaft.

With the casting placed on the "bed" of the Hydraulic Press and the end of the shaft centered against the Ram Head, fluid can be pumped into a constraining chamber at the opposite end of the Ram (as shown below).

In above illustration of a Hydraulic Press, note how 1000 pounds of fluid pressure developed by the Hydraulic Pump will apply a total force of 30,000 pounds to the end of the Ram in contact with the shaft. The pressure-apply area at the fluid end of the Ram is 30 square inches and the pressure developed is 1000 psi. The total force applied to the end of the Ram in contact with the shaft is then 30,000 pounds (or 15 tons of force).

A valve in the line is needed to regulate developing pressure. In other words, if the developed pressure is too great, the valve will open (release excess fluid) to maintain a predetermined (and safe) pressure level.





Cylinder Components

1. Washer
2. Bolt
3. Wiper
4. Rod Seal
5. Rod
6. Shell Assembly
7. Port
8. Stop Ring

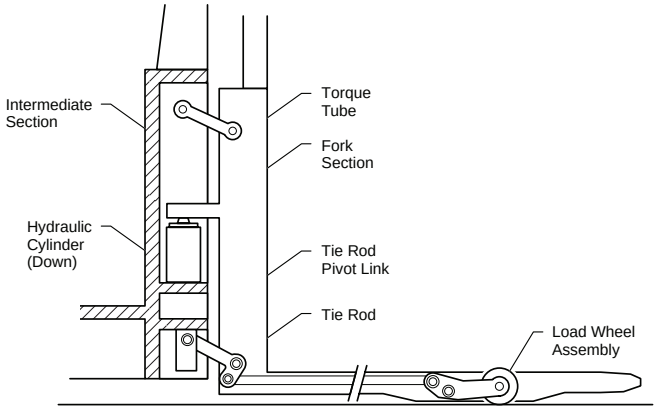
SERVICE NOTE:

Refer to the parts manual for the part numbers.

Load Wheel Operation

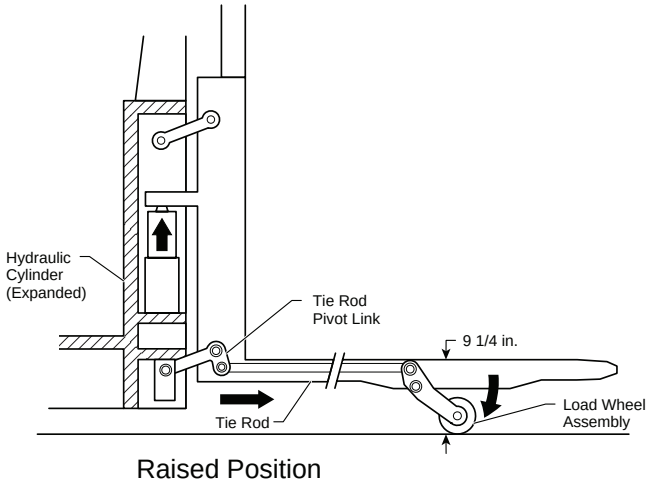
As mentioned earlier, the Load Carrying Device (Forks) are raised by both the Lift Cylinder and Load Wheel Assembly. The Load Wheel Assembly uses a pushing motion to lift or raise. The key advantages of this design are; 1) the reduced number of moving parts, and; 2) the Tie Rod always stays even with the bottom of the forks. This means the Tie Rods are not exposed as the forks are slid in and out of pallets so it is very unlikely they ever get damaged or bent. In most cases, any damage that does occur is from a lack of planned maintenance.

As shown in the diagram below, with the forks in the lowered position, the Lift Cylinder is lowered and the Tie Rod Pivot Link is angled up toward the operator. This results in the Tie Rod being pulled out toward the Powerhead and the Load Wheels set in the lowered position.

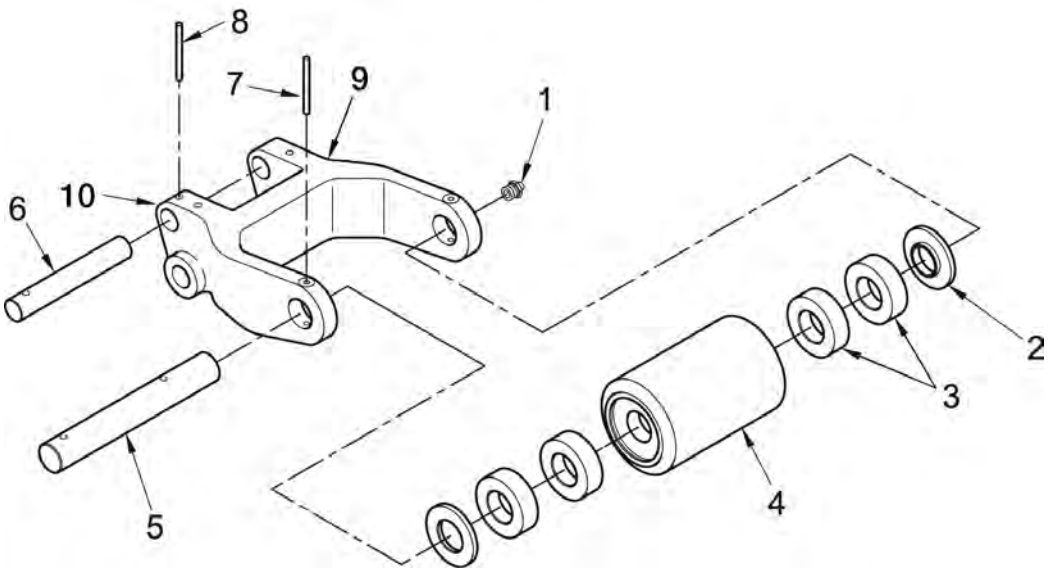


Down Position

When lift is engaged, the Lift Cylinder starts extending upward, lifting the heel or backrest side of the forks. This movement, in turn, causes the Tie Rod Pivot Link to push out on the Tie Rod toward the fork tip. As the Tie Rod pushes out, the Load Wheel Assembly is pushed down, lifting the forks. In the full lift position, the Lift Cylinder is fully extended and the Tie Rod Pivot Link is angled toward the floor. Normal lift height at the Load Wheel should be 9-1/4".



Raised Position



Item	Description	Item	Description
1	Nipple, Grease	6	Shaft, Pivot
2	Guard, String Cutter	7	Pin, Lock
3	Bearing	8	Pin, Spring 0.25 Dia. x 2.0 Lg.
4	Wheel Assembly	9	Link, RR Lift Assembly
5	Axle, Load	10	Nipple, Grease

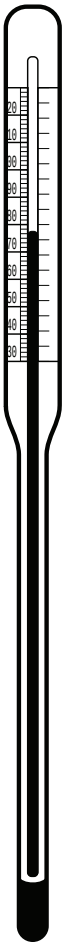
SERVICE NOTE:

Refer to the parts manual for the part numbers..

PERIODIC MAINTENANCE AND LUBRICATION SCHEDULE (CONT'D)

		Inspection Items	Interval												How to check
			Months	1	2	3	4	5	6	7	8	9	10	11	12	
			100s of hours	2	4	6	8	10	12	14	16	18	20	22	24	
Chassis and body maintenance	Transmission/ drive unit	Crack, damage and leakage		I		I			I			I			I	Visual
		Differential/drive unit oil level		R	I	I	I	I	I	I	I	I	I	I	R	Visual/ replace
		Drive tire nut torque to 135 Nm / 100 ft-lbs		Q		Q		Q		Q		Q		Q	Q	Re-Torque
	Chassis	Lubricate entire lift truck		L	L	L	L	L	L	L	L	L	L	L	L	Grease
		Cracks or damage to chassis		I		I			I			I			I	Visual
	Lifting mechanism	Hydraulic Motor Brushes (E2W3)			I		I		I		I		I		I	Visual
		Lubricate entire lift truck		L	L	L	L	L	L	L	L	L	L	L	L	Grease
		Hydraulic oil pump operation (E2W3)		T		T			T			T			T	Test
		Cracks or damage to chassis and fork area (E2W3)		I		I			I			I			I	Visual
		Lift linkage and tie rod for worn bearings (E2W3)							I						I	Visual
		Hydraulic system for leaks (E2W3)		I	I	I	I	I	I	I	I	I	I	I	I	Visual
		Hydraulic oil level (forks fully lowered) (E2W3)		I	I	I	I	I	I	I	I	I	I	I	I	Visual
		Hydraulic oil replacement (E2W3)							R						R	Replace
		Suction oil filter (E2W3)							R						R	Replace
		Lift cylinder (E2W3)		I		I			I			I			I	Visual
		Jaw Coupler lubrication (E2W4)		L	L	L	L	L	L	L	L	L	L	L	L	Lubricate
	Wheels/tires	Wheels and tires: wear, damage and foreign material		I	I	I	I	I	I	I	I	I	I	I	I	Visual
		Caster, check for looseness (E2W3)		I		I		I		I		I		I	I	Visual/ Adjust
		Wheel bearing grease		L	L	L	L	L	L	L	L	L	L	L	L	Grease
	Steering system	Using the Steer handle, steer left, right, and return to center, ensure the drive tire follows the steer head movement and no error codes are displayed.		T	T	T	T	T	T	T	T	T	T	T	T	Test
		Mounting of steer handle		I	I	I	I	I	I	I	I	I	I	I	I	Visual
		Steering tiller (movement and play)		I	I	I	I	I	I	I	I	I	I	I	I	Visual
		Belt tension (Refer to Steer Belt Tensioning" in "MD" Section)		T		T			T			T			T	Test
		Belt area for debris, belt and sprocket for wear or damage		I		I			I			I			I	Visual
		Lower steering bearing		L	L	L	L	L	L	L	L	L	L	L	L	Grease
	Brake system	With power off/brake on, verify that the unit will not move freely.		T	T	T	T	T	T	T	T	T	T	T	T	Test
		Verify Brake Rotor gap per instructions in "BR" Section.		T		T			T			T			T	Test

Abbreviations: I = Inspect (correct or replace if necessary), R: Replacement, A: Adjustment, C: Clean, T: Test, L: Lubricate/Grease, Q:Re-Torque



Battery Temperature

The temperature of the electrolyte will affect the specific gravity reading. As an approximation, it is known that every increase of 10 degrees F (5.6 degrees C) in temperature will lower the specific gravity reading by about 3/1000th (0.003). The opposite is also true, ten degrees lower will raise the specific gravity reading by 0.003 (See Fig. 8).

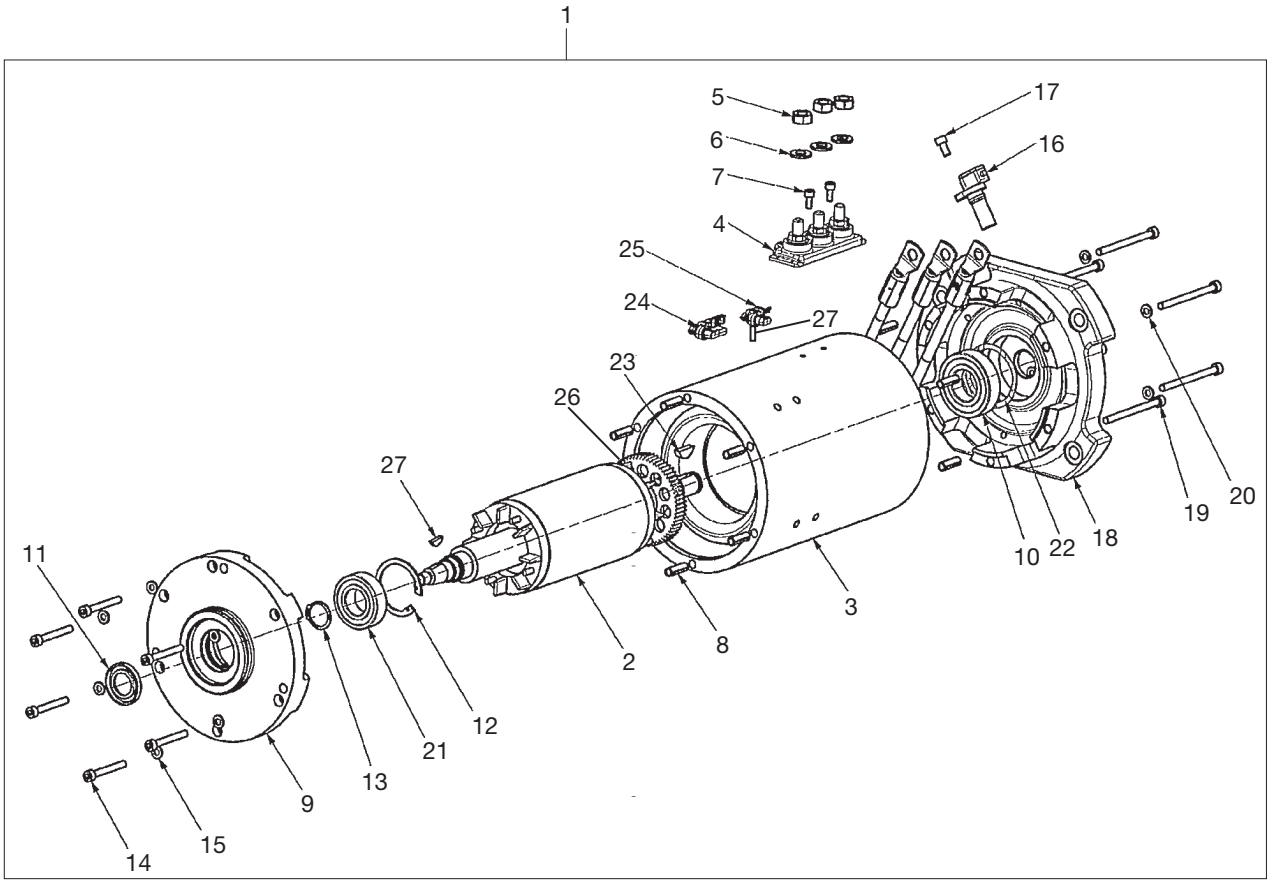
Battery electrolyte temperature should not exceed 120 degrees F (49 degrees C) or permanent Battery damage will occur. The center cells of the Battery are usually the hottest. An eight hour cooling time is recommended after charging. A cool Battery accepts the correct charging rate. Electrolyte temperature above 120 degrees F indicates a need to: 1) provide better ventilation for the Battery in the lift truck; 2) check for higher than normal discharge rate or 3) provide increased cooling time before charging. Recommended Battery cycles includes: 1) eight hours working (Discharge); 2) eight hours cooling and 3) eight hours charging.

The average or normal temperature reference point is when the electrolyte is at 77 degrees F (25 degrees C). In a fully charged state the electrolyte will give a specific gravity reading of 1.285 to 1.295 (no temperature correction). If the hydrometer being used is not temperature correcting, a thermometer must be used. Special Battery thermometers are available that incorporate the correction factor directly and add or subtract the correct number of points (See Figure).

Hydrometer Reading	Temperature ºF	Points Correction for Hydrometer
1.278	117	+12
1.281	107	+ 9
1.284	97	+ 6
1.287	87	+ 3
1.290	77	(Normal ref. cell) 0
1.293	67	- 3
1.296	57	- 6
1.299	47	- 9
1.302	37	-12

The graph above indicates shows the specific gravity of the electrolyte diminishes as the Battery discharges. Whenever in doubt as to how much a Battery has been discharged, use the hydrometer.

AC DRIVE MOTOR

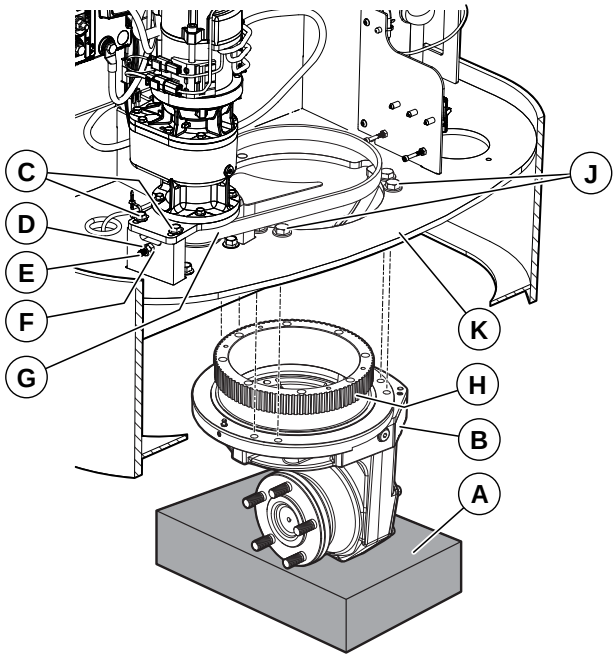


Item	Description	Qty	Item	Description	Qty
1	Motor Assembly		15	Spring Washer	6
2	Rotor CPL	1	16	Speed Sensor for Target InSense	1
3	Frame CPL	1	17	Screw M6X12	1
4	Terminal CPL 3-Poles M10X30	1	18	Endshield Non Drive End	1
5	Hex Nut	3	19	Screw M6x80	6
6	Spring Washer	3	20	Spring Washer	6
7	Screw M5x12 8,8	2	21	Ball - Bearing	1
8	Pin Dowel Bushing 6x25	12	22	Springwasher Waved	1
9	Endshield Drive End	1	23	Woodruff Key	1
10	Ball - Bearing	1	24	Connector	1
11	Oil Seal	1	25	Connector	1
12	Locking Ring	1	26	Sensor Target	1
13	Locking Ring	1	27	Woodruff Key	1
14	Screw M6x50	6			

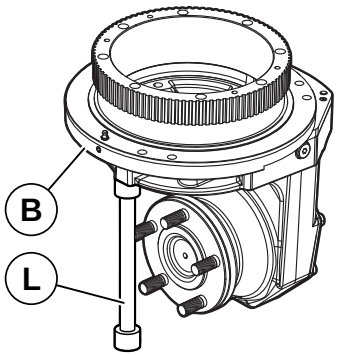
Required Tools:

- 19mm Wrench (Upper Transmission Mounting Bolts)
- 8mm Allen Wrench (Lower Transmission Mounting Bolts)

1. Remove the Motor (Refer to “Motor Removal and Installation: Removal” earlier in this Section).
2. Place a Block (A) under the Transmission (B).



3. Remove the side Blocks and lower the lift truck until the Transmission (B) just touches the center Block (A).
4. Drain fluid from the Transmission (B).
5. Loosen the four Steer Motor Slide Plate Bolts (C).
6. Remove the Locknut (D) from the Tensioning Bolt (E).
7. Loosen the Tensioning Nut (F) until the there is enough slack in the Steer Belt (G) that it disengages from the Drive Gear (H).
8. Remove the six Upper Transmission Mounting Bolts (J).
9. Carefully jack the lift truck upward separating the Frame (K) from the Transmission (B).



⚠ CAUTION

- **The Transmission (B) is heavy and oddly balanced. Use care in handling the Transmission when lifting the lift truck Frame (K) to avoid pinching fingers or hand.**

10. Slide the Transmission (B) out from under the lift truck.

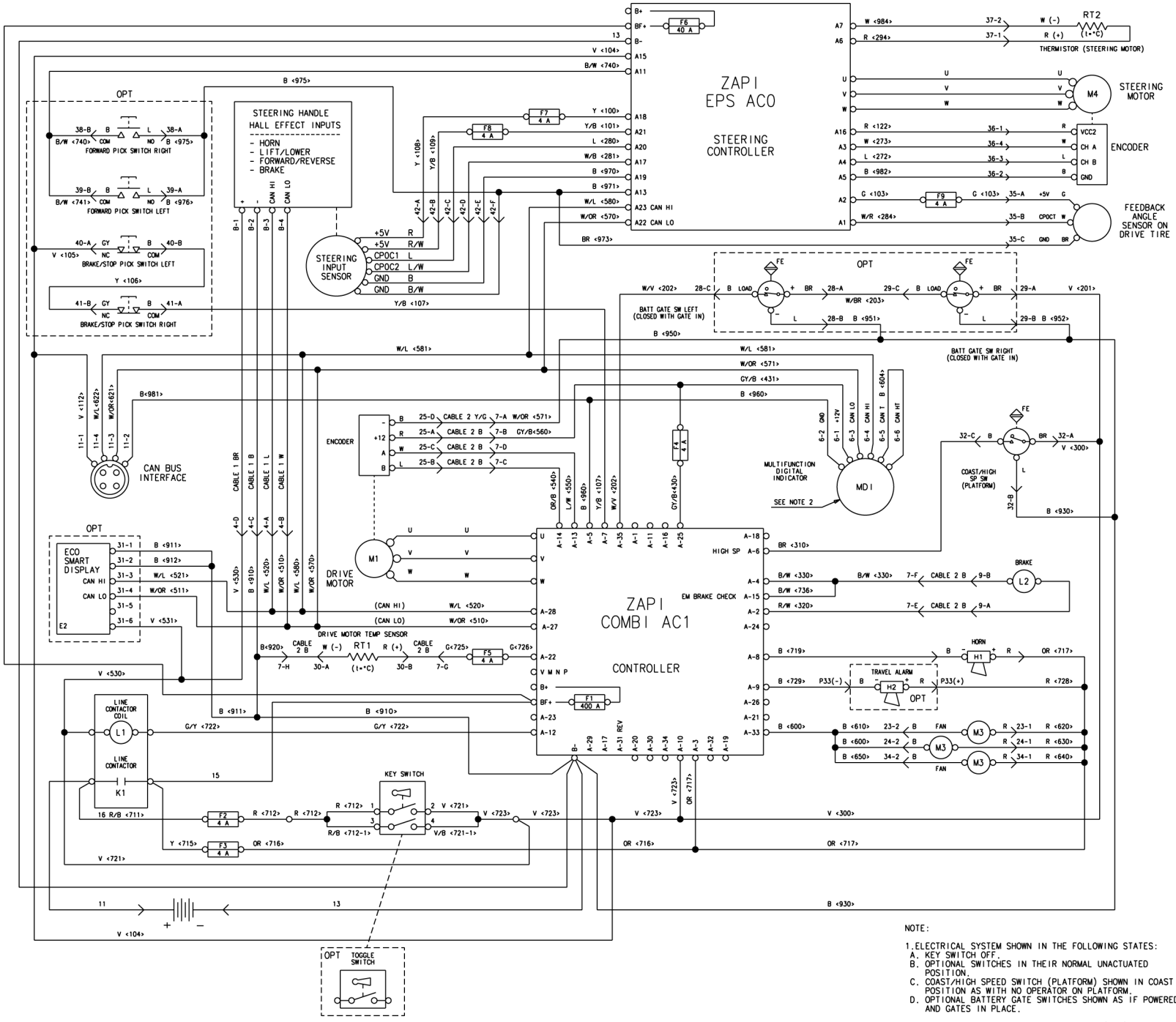
NOTE:

To stabilize the Transmission (B), it may be helpful to place an 8” Socket Extension (L), or something similar, under the upper flange.

OPTIONAL EQUIPMENT

SECTION OE

CONTENTS

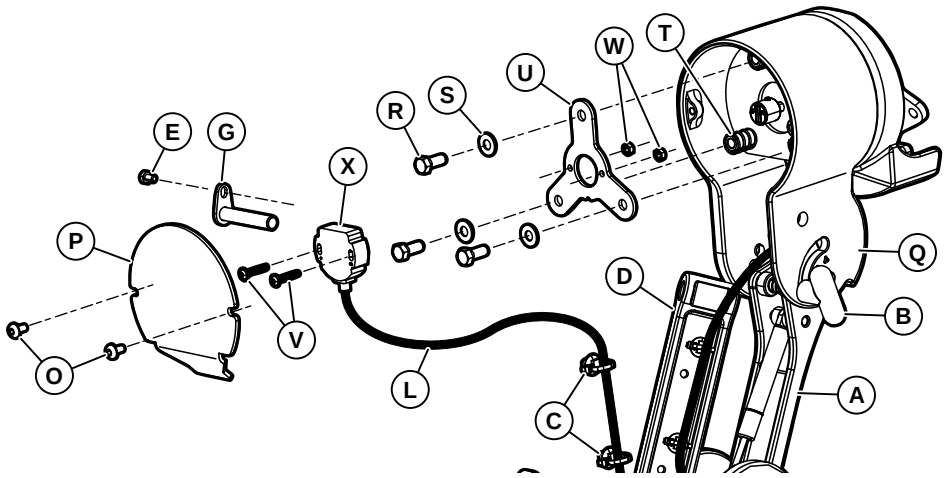


NOTE:

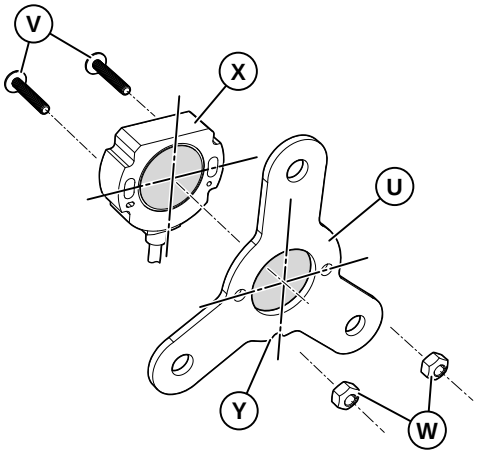
1. ELECTRICAL SYSTEM SHOWN IN THE FOLLOWING STATES:
   A. KEY SWITCH OFF.
   B. OPTIONAL SWITCHES IN THEIR NORMAL UNACTUATED POSITION.
   C. COAST/HIGH SPEED SWITCH (PLATFORM) SHOWN IN COAST POSITION AS WITH NO OPERATOR ON PLATFORM.
   D. OPTIONAL BATTERY GATE SWITCHES SHOWN AS IF POWERED AND GATES IN PLACE.

2. THE MULTIFUNCTION DIGITAL INDICATOR (MDI) IS NOT USED WHEN THE OPTIONAL ECO SMART DISPLAY IS USED.

E2W4 ELECTRICAL SCHEMATIC OPTIONAL



11. Remove the two Screws (O) securing the Steer Head Pivot Casting Bottom Plate (P) to the Steer Head Pivot Casting (Q) and remove the Bottom Plate.
12. Slowly remove the three Spring Plate Screws (R) and Washers (S) in an alternating pattern to slowly release Spring (T) tension. Remove the Spring Plate (U)



⚠ CAUTION

- **Once the Spring Plate Screws (R) are removed, the Springs (T) will be free. Be careful not to lose the Springs.**

13. Using a 4mm Allen Wrench and 7mm Box Wrench, remove the two Screws (V) and Nuts (W) securing the Steer Sensor (X) to the Spring Plate (U).

Installation

1. Perform removal Steps 1-12 in reverse order to install the Steer Sensor (W) and all other parts.

⚠ CAUTION

- **When assembling the new Steer Sensor (X) to the Spring Plate (U), be sure the center hole in the Spring Plate is aligned with the circular mark on the rear of the Steer Sensor. Also ensure the Steer Sensor Wire Harness (L) is oriented in line with the notch in the Spring Plate (Y).**

Torque:

Steer Sensor Screws (T):
2.0 - 2.5 Nm, 17.7 - 22.1 in/lb

Spring Plate Screws (R):
13 - 16 Nm, 115 - 141.6 in/lb

Steerhead Pivot Casting Bottom Plate Screws (O):
7.4 - 11 Nm, 65.5 - 97.3 in/lb

Pivot Pin Screws (E & F):
7.4 - 11 Nm, 65.5 - 97.3 in/lb

2. Perform Steering Calibration procedures. (Refer to “Steering Sensor” in “ES” Section).