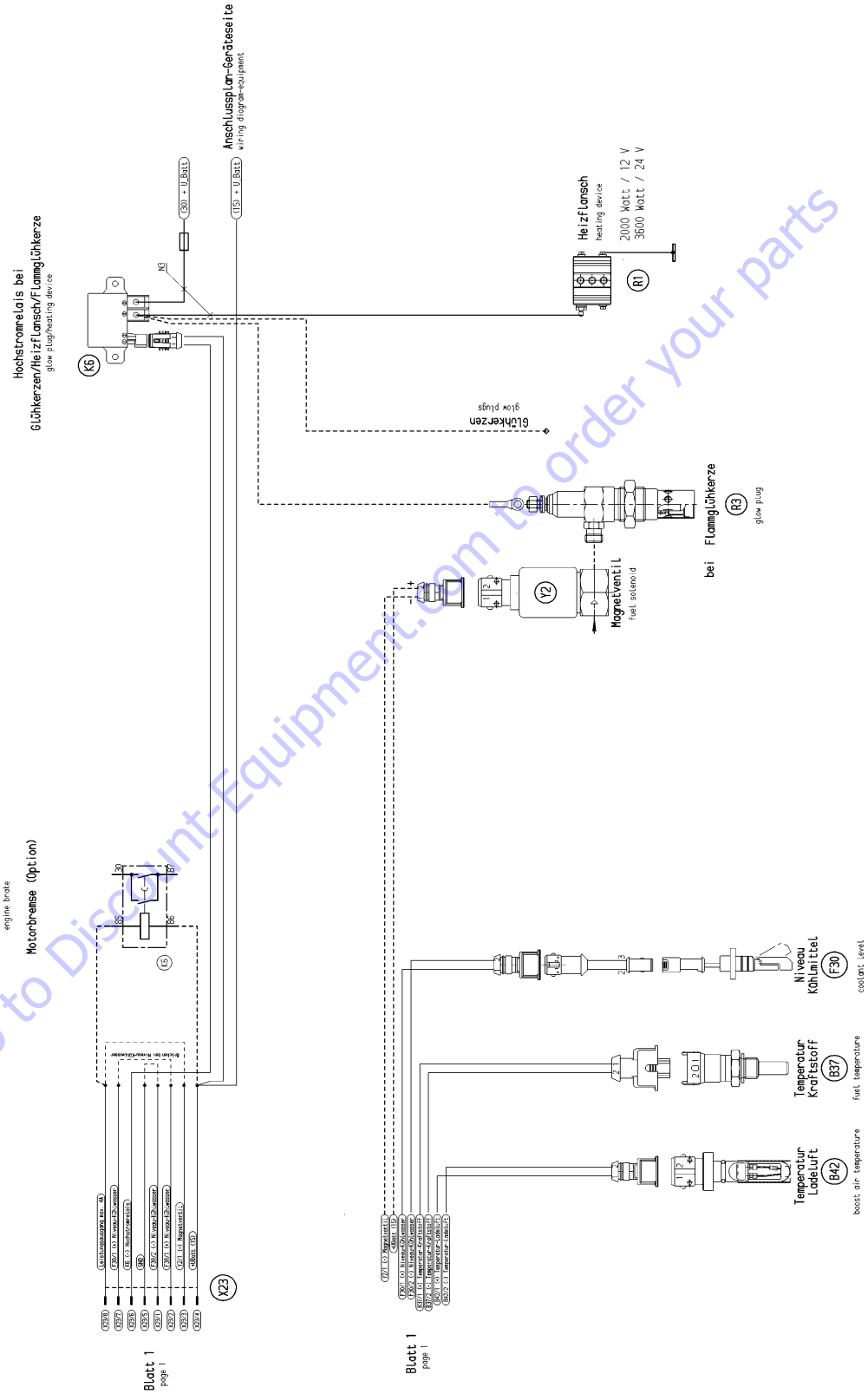
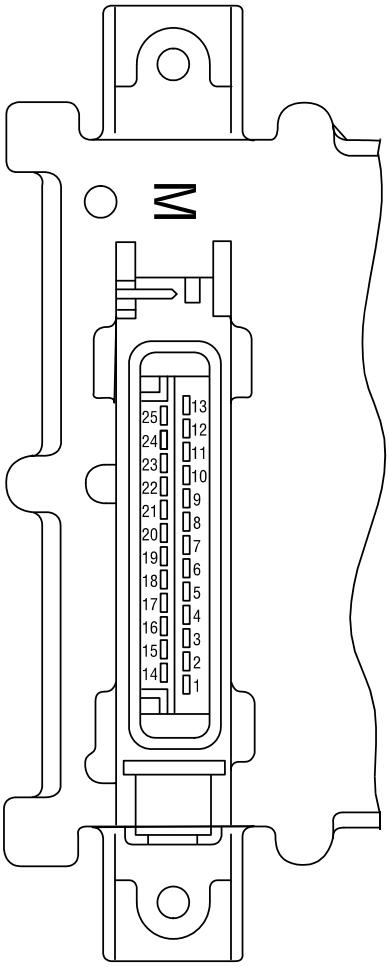


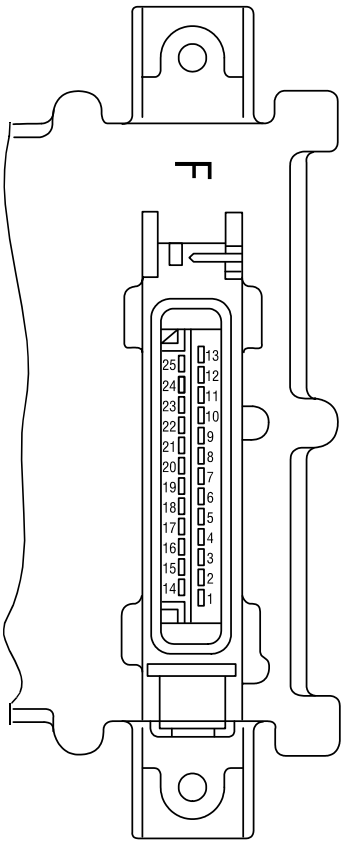
Figure 3-87. Deutz EMR 2 Engine Side Connection Diagram - Sheet 2 of 2



Pin No.	Designation	Description
1	Reserve	Reserve
2	Output: digital 3	Digital output for solenoid [1)]
3	Output: digital 4	For heating flange (optional)/ glow plug (optional)
4	Input (optional) Temp 1	Fuel temperature [2)]
5	Input (optional) Temp 2	Charge air temperature
6	Input (optional) DigIn 5	Coolant level / oil level
7	Output: PWM2/digital 6	
8	GND	Reference potential for analog signal at pin 9
9	Input: analog 7	Analog input for Coolant temperature sensor (NTC)
10	GND	Reference potential for analog signal at pin 11
11	Multi-function input: speed 2/DigIn 2	Digital input second engine speed (crankshaft) (optional) and speed signal (optional)
12	GND	Reference potential for analog signal at pin 13
13	Input: speed 1	Digital input first engine speed (camshaft)
14	STG -	PWM output, signal for actuator coil
15	STG +	PWM output, signal for actuator coil
16	Screen	Screening regulating rod travel sensor (for lines 17, 18, 19)
17	RF -	General connection for reference and measuring coil
18	RF REF	Analog input, reference signal of the reference coil
19	RF MESS	Analog input, measuring signal of the measuring coil
20	GND	Reference potential for signal at pin 21
21	Input: analog 4/digital 9	Analog input 4 (sensor signal oil pressure sensor) or digital input 9
22	+5 V REF	+5 V Reference voltage for signal at pin 21 (max. 15 mA)
23	GND	Reference potential for signal at pin 24
24	Input: analog 2/digital 7	Analog input 2 (sensor signal charge air) or digital input 7
25	+5 V LDA	+5 V Reference potential for signal at pin 24 (max. 15 mA)

1) For continuous power: < 4 A
2) Corresponds to special function"fuel temperature compensation at the EMR (0211 2571)

Figure 3-88. EMR 2 Engine Plug Pin Identification



Pin-No.	Designation	Description
1	U Batt -	Negative pole at battery (clamp 31)
2	GND	Reference potential for signal
3	Output: digital 2	PWM or digital output, various functions
4	Input / output: DigInOut	Fault lamp and diagnostic button
5	Output: PWM 1/Dig 1	PWM or digital output, various functions
6	Multi-function input: DigIn 3	Genset applications/gear shift/motor brake
7	Input: digital 10/velocity	Speed signal (tacho input)
8	NC	Not occupied
9	NC	Not occupied
10	L-line	Serial ISO 9141 interface
11	K-line	Serial ISO 9141 interface
12	CAN high	Interface for CAN-Bus
13	CAN low	Interface for CAN-Bus
14	U Batt +	Positive pole for battery (clamp 15)
15	Output: digital 5	Digital output, various functions
16	Output: digital 7/Frequency	Frequency, PWM or digital output, various functions
17	Ground	Reference potential for signal at pins 18, 19 and 21
18	Input: digital 1 / PWM 1	PWM 1 or digital input 1, various functions
19	Multi-function input: DigIn 4	Performance curve switching/genset applications
20	Multi-function input: digital 8 / analog 3	Hand hand throttle/genset applications, Digital (8) or analog input (3)
21	Input: digital 2 / PWM 2	PWM 2 or digital input 2, various functions
22	Screen	Screening (e.g. for lines hand throttle or PWG)
23	GND	Reference potential for signal at pin 24
24	Input: analog 1 / digital 6	Analog input 1 (pedal value sensor, PWG) or digital input 6
25	+5 V REF	+5 V Reference voltage for signal at pin 24

Figure 3-89. EMR 2 Vehicle Plug Pin Identification

Fault group	Fault no. (in SERDIA)	Fault locality/ Fault description	SPN	FMI	Cause	Remarks	Help
Zero error display	-	No faults	524287	31	No **active** faults present		
Revolutions / speed acquisition	01	Speed sensor 1	190	8	Sensor failure. Distance from gear too far. Additional fault impulses. Cable joint interrupted.	Governor in emergency operation (if sensor 2 available). Emergency switch-off (if sensor 2 not available or failed).	Check distance. Check cable connection. Check sensor and replace if required.
						Governor in emergency operation (with sensor 1) Emergency switch-off (if sensor 1 not available or failed).	
	03	Speed sensor	84	8	Tacho failed. Additional fault impulses. Cable connection interrupted.	Governor in emergency operation.	Check cable connection and Tacho. Replace if required.
	04	Excess speed switch-off	190	0	Speed was/is in excess of limit.e.	Engine stop.	Check parameter (21). Check speed settings.
					Check PID setting. Check rods. Check actuator and replace if required. Check cable to actuator (impulse on incorrect speed). Check No. of teeth. For vehicles check for possible thrust mode.		
Sensors	07	Charge air pressure	102	2	Fault at corresponding sensor entry (e.g. short circuit or cable break).	With failure of the sensor, the associated monitoring function is de-activated.	Check sensor cable. Check sensor and replace if required. Check fault limits for sensor.
	08	Oil pressure	100	2			
	09	Coolant temperature	110	2			
	10	Charge air temperature	105	2			
	11	Fuel temperature	174	2			

NOTE: SID is equal to 512. To get SPN #, add 512 + number. For example, SID 254 would be 512+254 or an SPN of 766.

Figure 3-90. EMR2 Fault Codes - Sheet 1 of 5

Fault group	Fault no. (in SERDIA)	Fault locality/ Fault description	SPN	FMI	Cause	Remarks	Help
Functional fault warning	30	Oil pressure warning	100	1	Oil pressure below speed-dependent warning line characteristic	Fault message (disappears when oil pressure is again above recovery limit). After a delay time - fill limitation.	Check engine (oil level, oil pump). Check oil pressure sensor and cable. Check oil pressure warning line characteristic.
	31	Coolant temperature warning	110	0	Coolant temperature has exceeded warning level.	Fault message (disappears when coolant temperature again drops below recovery level). After a delay time - fill limitation.	Check coolant. Check coolant temperature sensor and cable.
	32	Charge air temperature warning	105	0	Charge air temperature has exceeded warning level.	Fault message (disappears when charge air temperature gain drops below recovery level). After a delay time - fill limitation.	Check charge air. Check charge air-temperature sensor and cable.
	34	Coolant level warning	111	1	Switch input “Low coolant level” is active.	Fault message.	Check coolant level. Check coolant level sensor and cable.
	35	Speed warning (with thrust mode operation).	SID 190	14	revolutions was/is above (top) revolution speed limit. “Thrust mode” function is active.		Check parameters. Check speed settings.
					Check PID setting. Check rods. Check actuator and replace if required. Check cable to actuator. Check speed sensor (impulses on incorrect speed). Check No. of teeth. For vehicles check for possible thrust mode.		
	36	Fuel temperature warning	174	0	Fuel-temperature has exceeded warning level.	Fault message (disappears when fuel temperature again drops below recovery level).	Check fuel. Check fuel temperature sensor and cable.

NOTE: SID is equal to 512. To get SPN #, add 512 + number. For example, SID 254 would be 512+254 or an SPN of 766.

Figure 3-91. EMR2 Fault Codes - Sheet 2 of 5

Fault group	Fault no. (in SERDIA)	Fault locality/ Fault description	SPN	FMI	Cause	Remarks	Help
Functional fault, switch-off	42	Charge air temperature switch-off	105	0	Charge air temperature has exceeded switch-off limit.	Emergency stop	Check charge air. Check charge air-temperature sensor and cable. Check switch-off limit.
	44	Coolant level switch-off	111	1	Switch input “Low coolant level” is active.	Emergency stop. Start lock.	Check coolant level. Check coolant level sensor and cable.
Actuator	50	Feedback	SID 24	12	Actuator not connected. Fault in actuator confirmation.	Emergency switch-off. Actuator cannot be operated.	Check actuator, replace if required. Check cable, check fault limits for “Confirmation”.
	52	Reference feedback	SID 24	13			Check actuator, replace if required. Check cable, check fault limits for “Rifeness confirmation”.
	53	Control travel difference	SID 23	7	Injection pump/actuator jammed or not connected. Difference between nominal/actual control travel is > 10 % of the overall control path.	Fault message (disappears when difference is < 10 %).	Check actuator/actuator rods / injection pump, replace if required. Check actuator cable.
	59	Auto calibration BOSCH-EDC pumps faulty operation	SID 23	13	No automatic actuator equalization possible. Incorrect input of the actuator reference values.	Engine stop / start lock. Governor cannot be taken into use. EDC actuator calibration required.	Check actuator and replaced if required. Check feedback cable. Check fault limits and reference values of the feedback. Program the fault limits for feedback, save values. Switch ignition off and on again.Check again. If faulty, inform DEUTZ-Service and carry out automatic equalization again. Set fault limits again.

NOTE: SID is equal to 512. To get SPN #, add 512 + number. For example, SID 254 would be 512+254 or an SPN of 766.

Figure 3-92. EMR2 Fault Codes - Sheet 3 of 5

Fault group	Fault no. (in SERDIA)	Fault locality/ Fault description	SPN	FMI	Cause	Remarks	Help
Hardware inputs/ outputs	60	Digital output 3 (Switch-off solenoid, pin M 2)	SID 51	2	Fault (short circuit / cable break) at digital output.	Driver level is switched off.	Check cable of digital output (cable break or short circuit).
	62	Digital output 6, pin M 7	SID 60	2		Fault message.	
	63	Excess voltage switch-off solenoid	SID 51	6			
	67	Error Hand Setp1	91	11			
	68	Error CAN Setp1	898	2			
Communi-cation	70	CAN-Bus controller	SID 231	12	CAN-controller for CAN-bus is faulty. Fault removal despite re-initialising continuously not possible	Application-dependent.	Check CAN connection, terminating resistor (see Chapter 12.4), Check control unit.
	71	CAN interface SAE J 1939	SID 231	9	Overflow in input buffer or a transmission cannot be placed on the bus.		
	74	Cable break, short circuit or bus-error	SID 231	14			Check CAN connection, cable connection. Check sensor and replace if required.
Memory	76	Parameter programming (write EEPROM)	SID 253	12	Fault in parameter programming in the governor fixed value memory.	Emergency switch-off. engine cannot be started.	Switch ignition off and on again. Check again. If faulty inform DEUTZ Service
	77	Cyclic program test	SID 240	12	Constant monitoring of program memory shows error (so-called “Flash-test”).		
	78	Cyclic RAM test	SID 254	2	Constant monitoring of working memory shows error.		Note values of parameters (3895 and 3896). Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.

NOTE: SID is equal to 512. To get SPN #, add 512 + number. For example, SID 254 would be 512+254 or an SPN of 766.

Figure 3-93. EMR2 Fault Codes - Sheet 4 of 5

Fault group	Fault no. (in SERDIA)	Fault locality/ Fault description	SPN	FMI	Cause	Remarks	Help
Control unit hardware	80	Power supply (Actuator)	SID 254	2	Power supply for actuator not in the permissible range.	Fault message (disappears when power again in the normal range).	Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
	83	Reference voltage 1	SID 254	2	Reference voltage for actuator not in the permissible range.	Fault message (disappears when power again in the normal range). Auxiliary value 5 V	Check voltage supply. Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
	84	Reference voltage 2	SID 254	2			
	85	Reference voltage 4	SID 254	2			
	86	Internal temperature	171	12	Internal temperature for control unit not in permissible range.	Fault message (disappears when power again in the normal range).	Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
	87	Atmospheric pressure	108	12	Atmospheric pressure not in permissible range.	Fault message (disappears when power again in normal range). Atmospheric pressure monitoring function de-activated.	
Program logic	90	Parameter fault (EEPROM retrieval or checksum faulty).	SID 253	2	No data found or checksum of data is faulty (note: fault only occurs during setting of parameter / saving or reset.).	Engine cannot be started.	Check data for correct settings. Save parameters. Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
	93	Stack overflow	SID 240	2	Internal calculation fault (so-called “Stack overflow” fault).	Emergency switch-off. Engine cannot be started.	Note parameters (3897 and 3898). Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
	94	Internal fault	SID 254	2			

NOTE: SID is equal to 512. To get SPN #, add 512 + number. For example, SID 254 would be 512+254 or an SPN of 766.

Figure 3-94. EMR2 Fault Codes - Sheet 5 of 5

Table 3-12. DTC to SPN/FMI Cross Reference Chart

SPN Code	FMI Code	DTC	Description
51		2112	Unable to Reach Higher TPS
51	0	221	TPS 2 Signal Voltage Low
51	1	121	TPS 1 Lower Than TPS 2
51	3	123	TPS 1 Signal Voltage High
51	4	122	TPS 1 Signal Voltage Low
51	7	2111	Unable to Reach Lower TPS
51	31	2135	TPS 1/2 Simultaneous Voltages
94	3	92	Fuel Pump High Voltage
100	1	524	Oil Pressure Low
105	0	127	IAT Higher Than Expected 2
105	3	113	IAT High Voltage
105	4	112	IAT Low Voltage
105	15	111	IAT Higher Than Expected 1
106	4	107	MAP Low Voltage
106	16	108	MAP High Pressure
108	0	2229	BP Pressure High
108	1	129	BP Low Pressure
110	0	217	ECT Higher Than Expected 2
110	3	118	ECT High Voltage
110	4	117	ECT Low Voltage
110	15	116	ECT Higher Than Expected 1
168	15	563	System Voltage High
168	17	562	System Voltage Low
174	3	183	Fuel Temp Gasoline High Voltage
174	4	182	Fuel Temp Gasoline Low Voltage
515	0	1112	Spark Rev Limit
515	15	219	Max Govern Speed Override
515	16	1111	Fuel Rev Limit
628	13	601	Flash Checksum Invalid
629	31	606	COP Failure
629	31	1612	RTI 1 loss
629	31	1613	RTI 2 Loss
629	31	1614	RTI 3 Loss
629	31	1615	A/D Loss
629	31	1616	Invalid Interrupt
630	12	604	RAM Failure
636	2	336	Crank Sync Noise
636	4	337	Crank Loss
636	8	16	Crank Never Synced at Start
639	12	1626	CAN Tx Failure
639	12	1627	CAN Rx Failure

Table 3-12. DTC to SPN/FMI Cross Reference Chart

SPN Code	FMI Code	DTC	Description
639	13	1628	CAN Address Conflict Failure
639	31	1629	Loss of TSC 1
651	5	261	Injector Driver 1 Open
651	6	262	Injector Driver 1 Shorted
652	5	264	Injector Driver 2 Open
652	6	265	Injector Driver 2 Shorted
653	5	267	Injector Driver 3 Open
653	6	268	Injector Driver 3 Shorted
654	5	270	Injector Driver 4 Open
654	6	271	Injector Driver 4 Shorted
723	2	341	Cam Sync Noise
723	4	342	Cam Sensor Loss
724	10	134	EGO 1 Open/Inactive
1079	3	643	External 5V Reference High
1079	4	642	External 5V Reference Low
1384	31	1625	Shutdown Request
1485	3	687	Power Relay Short to Power
1485	4	686	Power Relay Shorted
1485	5	685	Power Relay Open
5294	4	91	Fuel Pump Low Voltage
520200	0	171	Adaptive Learn High Gasoline
520200	1	172	Adaptive Learn Low Gasoline
520202	0	1161	Adaptive Learn High LPG
520202	1	1162	Adaptive Learn Low LPG
520204	0	1155	Closed Loop Multiplier High Gasoline
520204	1	1156	Closed Loop Multiplier Low Gasoline
520206	0	1151	Closed Loop Multiplier High LPG
520206	1	1152	Closed Loop Multiplier Low LPG
520208	10	154	EGO 2 Open/Inactive
520211	10	420	Gasoline Cat Monitor
520213	10	1165	LPG Cat Monitor
520240	3	188	Fuel Temp LPG High Voltage
520240	4	187	Fuel Temp LPG Low Voltage
520251	3	223	TPS 2 Signal High Voltage
520251	4	222	TPS 2 Signal Low Voltage
520260	0	1171	LPG Pressure Higher Than Expected
520260	1	1172	LPG Pressure Lower Than Expected
520260	3	1174	EPR Voltage Supply High
520260	4	1175	EPR Voltage Supply Low
520260	12	1176	EPR Internal Actuator Fault
520260	12	1177	EPR Internal Circuitry Fault
520260	12	1178	EPR Internal Comm Fault
520260	31	1173	EPR Comm Lost

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
29	2	978	1-2-6	Diagnostic fault check of synchronism of hand throttle and Low idle switch(LIS).	Plausibility error between sensor and idle switch	Threshold for error detection is an internal ECU threshold. The accelerator pedal must have detected full load and idle plausibility at least once.
29	3	932	1-2-6	Diagnostic fault check of short circuit to supply voltage (signal range check high) of acceleration pedal signal.	The signal exceeds the applicatable threshold; signal range violation	If the signal is below the applicatable threshold APP_uRawSRCHiHTLIS_C, the signal range violation is reset after the healing debouncing. In case when the CCP is active (CCP_stActive = 1)and the reading from the EEPROM memory is successful, the signal is below the threshold APP_uHTLISCCPHi[1], a signal range violation is reset after debouncing.
29	4	937	1-2-6	Diagnostic fault check of short circuit to ground (signal range check low) of acceleration pedal signal	The signal is below the applicatable threshold; signal range violation	If the signal exceeds the applicatable threshold APP_uRawSRCLoHTLIS_C, the signal range violation is reset after the healing debouncing. In case when the CCP is active (CCP_stActive = 1)and the reading from the EEPROM memory is successful, the signal exceeds the threshold APP_uHTLISCCPLo[1], a signal range violation is reset after debouncing.
91	3	935	2-2-6	Analog accelerator pedal sensor 1 or double accelerator pedal sensor: the voltage measured by ECU is out of the target range or the calculated pedal position is implausible compared with the position of the second pedal	Sensor defect. Short cut to battery or open loop.	Check cabling, check accelerator pedal sensor and if necessary replace it, check connection cable and if necessary repair or replace it. If the signal is below the applicatable threshold APP_uRaw1SRCHigh_C, the signal range violation is reset after the healing debouncing.
91	4	940	2-2-6	Analog accelerator pedal sensor 1 or double accelerator pedal sensor: the voltage measured by ECU is out of the target range or the calculated pedal position is implausible compared with the position of the second pedal	Short circuit to ground.	Check cabling, check accelerator pedal sensor and if necessary replace it, check connection cable and if necessary repair or replace it If the signal exceeds the applicatable threshold APP_uRaw1SRCLow_C, the signal range violation is reset after the healing

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
91	11	976	2-2-6	Diagnostic fault check of synchronism of single potentiometer and Low idle switch(LIS).	Measured voltage of accelerator pedal 1 is out of plausible range.	Threshold for error detection is an internal ECU threshold. Check cabling, check accelerator pedal and pedal sensor and if necessary replace it, check connection cable and if necessary repair or replace it. When the PWM period APP_tiPWMPer is in between APP_tiSRCLoPWMPer_C and APP_tiSRCHiPWMPer_C.
94	1	474	216	Low fuel pressure: the low fuel pressure calculated by ECU is underneath the target range; the ECU activates a system reaction	Fuel pressure below warning threshold	Check low fuel pressure system (fuel feed pump, relay , fuse, wiring, sensor) and if necessary repair or replace it.
94	3	472	216	Low fuel pressure sensor: the voltage of sensor measured by ECU is out of the target range	cable break or short circuit, sensor defective, connection cable damaged Short cut to battery or open loop	Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it
94	4	473	216	Low fuel pressure sensor: the voltage of sensor measured by ECU is out of the target range	cable break or short circuit, sensor defective, connection cable damaged short cut to ground	Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it
97	3	464	228	Fuel filter water level sensor: the voltage of sensor measured by ECU is out of the target range	Sensor not connected or sensor defect.	Check of wiring and water in fuel sensor. Check cabling, if charge Water in Fuel sensor is not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
97	4	465	228	Fuel filter water level sensor: the voltage of sensor measured by ECU is out of the target range.	cable break or short circuit, sensor defective, connection cable damaged. Short cut to ground.	Check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
97	12	1157	228	Fuel filter water level sensor: the maximum level is exceeded	Water level in fuel pre-filter reservoir over limit (bad fuel quality)	Measure Voltage at Water in Fuel Sensor and renew harness if needed.
100	1	736	231	Oil pressure is below the target range (warning threshold)	Oilpressure too low (pressure below warning threshold)	Threshold for error detection is an internal ECU threshold. Check oil level, check engine for oil leckage, measure oil pressure external to evaluate sensor value
100	1	737	231	Oil pressure is below the target range (shut off threshold)	Oilpressure too low (pressure below shut off threshold).	Threshold for error detection is an internal ECU threshold. Check oil level, check engine for oil leckage, measure oil pressure external to evaluate sensor value.
100	3	732	224	Oil pressure sensor: the voltage of sensor measured by ECU is out of the target range	short circuit to battery or cable break	check battery and wiring Check cabling. If sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
100	4	733	224	Oil pressure sensor: the voltage of sensor measured by ECU is out of the target range	Short circuit to ground	The sensed raw voltage value Oil_uRawPSwmp is above Oil_SRCPSwmp.uMin_C Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it No detail informationen!
102	1	774	223	charge air pressure below lower limit	measured charge air pressure below the threshold.	Check complete air system of engine for massive leakage, especially from compressor to intake air manifold. Check air filter. Exchange charge air presure sensor.
102	2	88	223	Charge air pressure messured by sensor is above the shut off threshold.	Charged air cooler pressure below threshold.	Check waste gate system if necessary replace TC, check CAC if all channels are clean,check charge air piping if nececery.
102	2	89	223	Charge air pressure messured by sensor is above the warning threshold	Charge air pressure above shut off threshold	Check waste gate system if necessary replace TC, check CAC if all channels are clean, check charge air piping if necessery.
102	2	772	223	Deviation between sensed intake manifold pressure is not plausible compared to environment pressure. Which sensor is not okay can not be said.	deviation between ambient pressure sensor and charge air pressure sensor at not running engine to high	1) Exchange boost pressure sensor 2) Exchange ECU
102	3	776	223	Charge air pressure sensor: the measured voltage of sensor by ECU is out of the target range	The Sensor Voltage is above the Threshold.	Check cabling, if charge air pressure/temperature sensor is not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
102	4	777	223	Charge air pressure sensor: the measured voltage of sensor by ECU is out of the target range	The Sensor Voltage is below the Threshold.	Check cabling, if charge air pressure/temperature sensor is not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it
105	0	996	233	Charge air temperature downstream calculated by ECU is above the target range. The ECU activates a system reaction.	Charge air temperature (downstream) over warning threshold.	Check CAC system and clean it. Check fan functionality. Check cooling perfomance with temperature measurement.
105	0	997	233	Charge air temperature downstream calculated by ECU is under the shut down threshold. The ECU activates a system reaction.	Charge air temperature (downstream) over the low threshold.	Check CAC system and clean it. Check fan functionality. Check cooling perfomance with temperature measurement.
105	1	992	128	Charged Air cooler down stream temperature. Temperature below lower physical threshold.	Sensed temperature within intake air manifold < threshold.	actual temperature below -40°C? exchange sensor
105	3	994	128	Charge air temperature sensor: the voltage of sensor measured by ECU is out of the target range.	Short circuit to battery. sensor voltage > limit	The sensor raw signal Air_uRawTCACDs (voltage) > Air_SRCTCACDs.uMin_C. Check CAC-sensor and if necessary replace it, check connection cable and if necessary repair or replace it.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
105	4	995	128	Charge air temperature sensor: the voltage of sensor measured by ECU is out of the target range.	Short circuit to ground or open load. sensor voltage < limit.	The sensor raw signal Air_uRawTCACDs (voltage) is below Air_SRCTCACDs.uMin_C. Check CAC-sensor and if necessary replace it, check connection cable and if necessary repair or replace it
107	0	752	136	Air filter differential pressure: the pressure difference of the intake air between the filter inlet and outlet calculated by ECU is above the target range and the ECU activates a system reaction	Pressure loss above target range with system reaction, air filter clogged or defective, sensor not working, connection cable damaged Pressure value above warning threshold	Check air filter and if necessary clean or renew it, check cabling, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it
110	0	98	232	Coolant temperature: the coolant temperature calculated by ECU is above the target range; the ECU activates a system reaction	Cooling temperature too high. Coolant temperature above warning threshold	Clean radiator, check fan drive, check coolant level, check cooling system in general, check thermostat function, check water pump
110	0	99	232	Coolant temperature: the coolant temperature calculated by ECU is above the target range. The ECU activates a system reaction	Coolant temperature above shut off threshold.	Clean radiator, check fan drive, check coolant level, check cooling system in general, check thermostat function, check water pump
110	1	93	225	Coolant temperature sensor: the voltage of the sensor measured by ECU is out of the target range.	Suspected components: wiring harness, coolant temperature sensor.	Check wiring harness and connected Coolant Temp Sens.
110	3	96	225	Coolant temperature sensor: the voltage of the sensor measured by ECU is out of the target range	Short cut to battery or open load.	Check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
110	4	97	225	Coolant temperature sensor: the voltage of the sensor measured by ECU is out of the target range	Voltage Surveillance has found shortcut to Ground at Coolant Temperatur Sensor.	Check sensor and if necessary replace it, check connection cable and if necessary repair or replace it Measure Voltage at Coolant Temperature Sensor and renew harness if needed.
111	1	101	235	Coolant level: the coolant level calculated by ECU is underneath the allowed minimum.	Coolant level too low, leakage in cooling system, sensor defective, wiring damaged.	Check coolant level, inspect cooling system for leakage and if necessary repair it, check sensor and wiring
157	3	877	147	Rail pressure sensor: the voltage of sensor measured by ECU is out of the target range.	Short cut to battery. Damaged rail pressure sensor.	Check cabling, check rail pressure sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
157	4	878	147	Rail pressure sensor: the voltage of sensor measured by ECU is out of the target range.	Check cabling, check rail pressure sensor and if necessary replace it, check connection cable and if necessary repair or replace it.	Check cabling, check rail pressure sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
164	2	1381	839	Rail pressure safety function is not executed correctly	Rail pressure is still above threshold.	Threshold for error detection is an internal ECU threshold. Reset the fault and at reappearance check ECU and injection system
168	0	1180	318	Battery voltage: the voltage measured by ECU is out of the target range	Battery voltage over limit	Check alternator, regulator of alternator and if necessary replace it, check wiring and voltage of alternator
168	1	1181	318	Battery voltage: the voltage measured by ECU is out of the target range	Battery voltage below limit	Check alternator, cabling, contact resistance, safety fuses, too high load in energy system, check battery and if necessary replace it

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
168	2	47	318	Battery voltage: the voltage measured by ECU is out of the target range, system reaction is initiated	If Batteryvoltage (Ubatt_U) > 17V or 31V for mor than =0.5sec a warning is generated Battery voltage above warning threshold	Check wiring harness and connected alternator.
168	3	45	318	Battery voltage: the voltage measured by ECU is out of the target range, system reaction is initiated	Battery voltage above warning threshold (~38,9Volt), Short cut to battery possible.	Check wiring harness and connected alternator.
168	4	46	318	Battery voltage: the voltage measured by ECU is out of the target range, system reaction is initiated	Battery voltage below warning threshold, Short cut to ground	Check wiring harness and connected alternator.
171	3	417	312	Sensor error SCR-System environment temperature; DPF-System air inlet temperature; signal range check high	open loop to sensor	Check cabling, if environment temperature sensor is not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
171	4	418	312	Sensor error SCR-System environment temperature; DPF-System air inlet temperature; signal range check low	short circuit to Ground	Check cabling, if environment temperature sensor is not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it
172	0	1425	226	sensed intake air temperature at air filter > physical high limit	sensed intake air temperature at air filter > physical high limit	Check outside conditions: Temperature > Threshold within the intake air system of the engine? E.G: engine sucks in air from hot asphalt out of paver bucket Sensor positioned within black air filter housing above engine lid at hot environmental conditions and idling or similar? => if yes check with application team to adapt limits if not check sensor and wiring harness exchange sensor
172	1	1183	226	sensed air temperature within air intake path of engine below physical low limit	sensed air temperature within air intake path of engine below physical low limit	Cold start and ambient temperature < threshold Check wiring harness to AFST-sensor Exchange AFST-sensor
190	0	389	214	Engine speed: the engine speed calculated by ECU is above the target range; the ECU activates a system reaction	Overspeed monitoring during 1 level of FOC (Failure overrun condition) if engine speed was over Limit.	check powertrain settings regarding overspeed
190	2	421	213	ECU measures a deviation between camshaft and crankshaft angle to target.	Offset error between crankshaft and camshaft.	Threshold for error detection is an internal ECU threshold, occurs by offset between crankshaft and camshaft. Check increment wheel position, clean and adjust if necessary, check sensor postition. Check Camshaft and Crankshaft senor or wiring.
190	8	419	212	Camshaft speed sensor: the ECU receives no signal and uses the signal from crankshaft speed sensor as alternative to calculate the engine speed	When disturbed camshaft signal detected. Error in sensor or wiring.	Threshold for error detection is an internal ECU threshold, occurs by disturbed camshaft signal. Check increment wheel position, clean and adjust if necessary, check sensor postition. Check Camshaft Sensor or wiring.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
190	8	422	212	Sensor crankshaft speed; disturbed signal	Error in sensor or wiring. Crankshaft sensor defect.	Threshold for error detection is an internal ECU threshold, occurs by disturbed crankshaft signal. Check increment wheel position, clean and adjust if necessary, check sensor postition. Check Crankshaft Sensor or wiring.
190	11	390	214	Engine speed: the engine speed calculated by ECU is above the target range; the ECU activates a system reaction	Overspeed monitoring during 2 level of FOC (Failure overrun condition) if engine speed was over limit.	check powertrain settings regarding overspeed
190	12	420	212	Camshaft speed sensor: the ECU receives no signal and uses the signal from camshaft speed sensor as alternative to calculate the engine speed Threshold:	Error in sensor or wiring.	Threshold for error detection is an internal ECU threshold, occurs by disturbed or no camshaft signal. Check increment wheel position, clean and adjust if necessary, check sensor postition. Check Camshaft Sensor or wiring.
190	12	423	212	Crankshaft speed sensor: the ECU receives no signal and uses the signal from camshaft speed sensor as alternative to calculate the engine speed.	Error in sensor or wiring.	Threshold for error detection is an internal ECU threshold, occurs by disturbed or no Crankshaft signal. Check increment wheel position, clean and adjust if necessary, check Crankshaft sensor postition or wiring.
190	14	391	214	Engine speed: the engine speed calculated by ECU is above the target range; the ECU activates a system reaction	Overspeed monitoring during ORC (Override conditions) if engine speed was over 2900rpm	check powertrain settings regarding overspeed
190	14	1222	2-1-2	Camshaft- and Crankshaft speed sensor signal not available on CAN or defect.	Sensors for engine speed are defect.	Threshold for error detection is an internal ECU threshold. Check wiring, check cabels and repair or replace if necessary.
411	0	791	693	delta pressure across venturi in EGR line above physical high limit	sensed value of venturi difference pressure > high limit	Threshold for error detection is an internal ECU threshold. EGR-Valve blocked open EGR-Valve actuator defect EGR-cooler defect (check for coolant water) Reed Valve defect Intake throttle blocked in closed position => Check intake throttle Exhaust pressure too high => Check Exhaust pressure Check Nox-sensor upstream SCR catalyst dp venturi sensor defect
411	1	792	693	delta pressure across venturi in EGR line below physical low limit	sensed value of venturi difference pressure < low limit	Threshold for error detection is an internal ECU threshold. Check correct mounting of difference pressure sensor at venturi tube Exchange difference pressure sensor broken
411	3	795	693	The sensed raw voltage Air_uRawPEGRDeltaP is above the maximum threshold.	EGR Delta pressure Sensor defect	Check cabling, if charge EGR Delta pressure sensor is not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
411	4	381	693	Range check cannot be done or interrupted.	EGR or wiring defect	Check wiring harness and connected EGR.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
411	4	796	693	The sensed raw voltage value Air_uRawPEGRDeltaP is above the minimum threshold.	EGR Delta pressure Sensor defect	Check cabling. If charge EGR Delta pressure sensor is not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
411	11	793	693	DFC is stored in EEPROM and status kept until check is allowed to be carried out again DFC can be reset by service routine 216	deviation between desired O2 concentration in intake air manifold and the real O2-concentration within intake air manifold > limit	Threshold for error detection is an internal ECU threshold. EGR-Valve mechanically blocked open or closed EGR-pipe blocked with metall plate instead sealing downstream EGR-Valve EGR-Valve actuator defect EGR-cooler defect (check for coolant water) Reed Valve defect Intake throttle blocked in closed position => Check intake throttle Exhaust pressure too high => Check Exhaust pressure Check Nox-sensor upstream SCR catalyst dp venturi sensor defect
412	3	1007	682	EGR downstream temperature sensor: the voltage of sensor measured by ECU is out of the target range.	Short circuit to battery. sensor voltage > limit	Check wiring harness to TEGR-sensor. Exchange TEGR-sensor.
412	4	1008	682	EGR downstream temperature sensor: the voltage of sensor measured by ECU is out of the target range.	Short circuit to ground or open load. sensor voltage < limit	Check wiring harness to TEGR-sensor. Exchange TEGR-sensor.
630	12	376	281	Internal hardware monitoring: the ECU finds an error during the access to its EEPROM memory or works with an alternative value	Section could not be erased	Threshold for error detection is an internal ECU threshold. There is no healing possible for the error. In the every new initialization phase, the debounce level is set to zero. If not programmed, EEPROM is defect --> ECU is defect, reprogramm ECU and if necessary replace it.
630	12	377	281	Internal hardware monitoring: the ECU finds an error during the access to its EEPROM memory or works with an alternative value	Minimum 3 blocks could not be readed, EEPROM has Checksum Error	There is no healing possible for the error. In the every new initialization phase, the debounce level is set to zero. If not programmed, EEPROM is defect -->ECU is defect, reprogramm ECU and if necessary replace it
630	12	378	281	Internal hardware monitoring: the ECU finds an error during the access to it's EEPROM memory or works with an alternative value	Block could not be written for minimum 3 times	Threshold for error detection is an internal ECU threshold. If not programmed, EEPROM is defect --> ECU is defect, reprogramm ECU and if necessary replace it.
639	14	84	271	CAN bus 0: the ECU is not allowed to send messages, because the status "BusOff" is detected.	CAN BusOff error; CAN 0 (Customer CAN)	Threshold for error detection is an internal ECU threshold. BusOff bit for CAN A node is set. Check wiring of CAN bus and if necessary repair it, check connection cable and if necessary repair or replace it, check resistance in CAN lines (120 Ohm)

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
651	3	580	154	Injector cyl. 1: the current drop measured by ECU is above the target range	Suspected Components: injector cylinder 1 wiring harness, cable break or short circuit, sensor defective, connection cable damaged	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it. Use SerDia Injector test for diagnosis.
651	5	568	154	Injector cyl. 1: interruption of electrical connection	Interruption of electronic connection Injector cyl. 1	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.
652	3	581	155	Injector cyl. 2: the current drop measured by ECU is above the target range	Suspected Components: injector cylinder 2 wiring harness, cable break or short circuit, sensor defective, connection cable damaged	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it. Use SerDia Injector test for diagnosis.
652	5	569	155	Injector cyl. 2: interruption of electrical connection	Interruption of electronic connection Injector cyl. 2	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.
653	3	582	156	Injector cyl. 3: the current drop measured by ECU is above the target range	Suspected Components: injector cylinder 3 wiring harness, cable break or short circuit, sensor defective, connection cable damaged	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it. Use SerDia Injector test for diagnosis.
653	5	570	156	Injector cyl. 3: interruption of electrical connection	Interruption of electronic connection Injector cyl. 3	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.
654	3	583	161	Injector cyl. 4: the current drop measured by ECU is above the target range	Suspected Components: injector cylinder 4 wiring harness, cable break or short circuit, sensor defective, connection cable	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it. Use SerDia Injector test for diagnosis.
654	5	571	161	Injector cyl. 4: interruption of electrical connection	Interruption of electronic connection Injector cyl. 4	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.
655	3	584	162	Injector cyl. 5: the current drop measured by ECU is above the target range	Suspected Components: injector cylinder 5 wiring harness, cable break or short circuit, sensor defective, connection cable	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it. Use SerDia Injector test for diagnosis.
655	5	572	162	Injector cyl. 5: interruption of electrical connection	Interruption of electronic connection Injector cyl. 5	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.
656	3	585	163	Injector cyl. 6: the current drop measured by ECU is above the target range	Suspected Components: injector cylinder 6 wiring harness, cable break or short circuit, sensor defective, connection cable	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it. Use SerDia Injector test for diagnosis.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
656	5	573	163	Injector cyl. 6: interruption of electrical connection	Interruption of electronic connection Injector cyl. 6	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.
676	11	543	263	Cold start aid relay error.	Relay defect or wire harness problem	Threshold for error detection is an internal ECU threshold. check wire harness, replace relay
676	11	544	263	Cold start aid relay open load	Relay or wire harness	Threshold for error detection is an internal threshold. check wire harness, replace relay
677	3	956	512	Start relay (high side power stage): the current drop measured by ECU is above the target range.	Short cut HighSide-output to battery.	Threshold for error detection is an internal ECU threshold. Check cabling and start relay and if necessary replace it, check connection cable and if necessary repair or replace it.
677	3	960	512	Start relay (low side power stage): the current drain measured by ECU is above the target range.	Shortcut LowSide-Output to battery.	Threshold for error detection is an internal ECU threshold. Check cabling and start relay and if necessary replace it, check connection cable and if necessary repair or replace it.
677	4	957	512	Start relay (high side power stage): the current drain measured by ECU is above the target range.	Shortcut HighSide-output to ground.	Threshold for error detection is an internal ECU threshold. Check cabling and start relay and if necessary replace it, check connection cable and if necessary repair or replace it.
677	4	961	512	Start relay (low side power stage): the current drop measured by ECU is above the target range.	Shortcut LowSide-Output to ground.	Threshold for error detection is an internal ECU threshold. Check cabling and start relay and if necessary replace it, check connection cable of terminal 50 and if necessary repair or replace it.
677	5	958	512	Start relay (low side power stage): the current drop measured by ECU is above the target range	Open circuit/disconnection LowSide-Output.	Threshold for error detection is an internal ECU threshold. Check cabling and start relay and if necessary replace it, check connection cable and if necessary repair or replace it.
677	12	959	512	Start relay (low side power stage): the current drop measured by ECU is above the target range.	Temperature over limit.	Threshold for error detection is an internal ECU threshold. Check cabling and start relay and if necessary replace it, check connection cable and if necessary repair or replace it.
691	8	928	928	Supply module heater: PWM time periode out of valid range.	PWM signal for temperature readout from supply module to the control unit is out of range. Supply modul defect, fault in the wiring.	The Time period of the received PWM signal SCR_tiSMPerPwm is within the specified range of150ms to 250ms Supply module check and replace if necessary. Check the wiring.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
729	3	549	263	wiring to the intake air heater device is faulty.	Intake Air Heater Device: overload, short-circuit	Threshold for error detection is an internal ECU threshold. Electrical error, Check wiring to the intake air heater device.
729	4	551	263	wiring to the air intake heater is faulty	Relay (for cold start aid) cable break or short to ground:	Threshold for error detection is an internal ECU threshold. Electrical error, check wiring to the air intake heater.
729	5	545	263	The cold start aid relay is according to wiring faulty.	Relay defect or wire harness problem	Threshold for error detection is an internal ECU threshold. Electrical error, check wires
729	12	547	263	The cold start aid relay is overheated, which causes this error	High temperature around the cold start relay.	Check the functionality of relay and replace it if needed. Check the temperature around the cold start relay during worst case operation.
898	9	305	118	Timeout Error of CAN-Receive-Frame TSC1TE - active	Timeout Error (Missing CAN Bus message)	Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range.
1079	13	946	282	Internal hardware monitoring: the ECU detects a deviation of the target range of the power supply voltage of sensor output 1.	Suspected components EDC17cv52 Pin A19: DEF press / Exh.PressBeforeTurb (P3) / Air Pump Press /BrnFuelPressAfterDV2 Pin K19: Fan Speed Sensor Pin A21: LDF6T / OilPress / LowFuelPress Pin A17: Rail Pressure Sensor Suspected components EDC17cv54 Pin A21: CAM speed Pin K44: Delta Press Venturi / Poti EGR or Inlet Throttle Pin A24: LDF6T / OilPress / LowFuelPressPin K43: Reserve 5V Sensor Supply Pin A09: second footpedal Suspected components EDC17cv56 Pin A21: Cam speed Pin K44: DEF press / Air FilterDiffPress Pin A24: LDF6T / OilPress / LowFuelPress Pin K43: second footpedal Pin A09: Delta Press Venturi	Check cabling of external components, check working voltage and if necessary correct it, check connection cable and if necessary repair or replace it, if error is not removable, change ECU.
1080	13	947	282	Internal hardware monitoring: the ECU detects a deviation of the target range of the power supply voltage of sensor output 2.	Suspected components EDC17cv52 Pin K16: second footpedal Pin A20: Exh.PressAfterTurb/DPFDiffPress/ BrnDV1Press/HCIPressDV1DV2 Suspected components EDC17cv54 Pin K45: DPF Diff Press / Exh. Press After Turb / Fan Speed Sensor Pin A46: first footpedal Suspected components EDC17cv56 Pin A22: Fan Speed Sensor Pin K45: Position EGR or Intake throttle flap Pin K46: First footpedal	Check cabling of external components, check working voltage and if necessary correct it, check connection cable and if necessary repair or replace it, if error is not removable, change ECU.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
1109	2	121	341	Request of engine shut off: the operator ignores the engine shut off request within an allowed period.	Engine Shut Off demand has been ignored by the user	Depending on error requested a shut off.
1136	0	1398	681	ECU internal temperature; temperature measured by ECU is out of the target range	Short-Circuit in ECU, ECU heated by hot air	Close warm air circuits, replace ECU
1231	14	85	271	CAN bus 1: the ECU is not allowed to send messages, because the status "BusOff" is detected Warning, no diagnostic with SERDIA2010 possible	CAN BusOff error; CAN 1 (Diagnostic CAN)	Threshold for error detection is an internal ECU threshold. BusOff bit for CAN B node is set. Check wiring of CAN bus and if necessary repair it, check connection cable and if necessary repair or replace it, check resistance in CAN lines (120 Ohm)
1235	14	86	271	CAN bus 2: the ECU is not allowed to send messages, because the status "BusOff" is detected. Warning, depends on engine, EAT.	CAN BusOff error; CAN 2 (Engine CAN)	Threshold for error detection is an internal ECU threshold. BusOff bit for CAN C node is set. Check wiring of CAN bus and if necessary repair it, check connection cable and if necessary repair or replace it, check resistance in CAN lines (120 Ohm)
1237	2	747	145	Override switch switch: the ECU receives a permanent signal.	Switch is blocked, taster locked, connection cable damaged plausibility error "override switch > 250ms pressed".	If the Block Button is pressed shorter than the Maximum Plausible pressing Time. Check cabling, if sensor is not working, check switch and if necessary replace it, check connection cable and if necessary repair or replace it.
1761	0	1593	129	The urea tank level sensor detects a value higher than the maximum allowed threshold	Suspected components: Urea Quality Sensor defect mechanical defect at the float gauge	Check level sensor and float gauge
1761	1	1594	129	The DEF tank level sensor detects a value lower than the minimum allowed threshold	Suspected components: Urea Quality Sensor defect mechanical defect at the float gauge	Check level sensor and float gauge
1761	14	1655	138	The urea tank volume ratio is below the threshold of <5%	actual urea tank level SCRUTnk_rVol_mp [%] is below applicable threshold 5%	Check urea level => if empty, then fill in urea Check DEF level sensor. If there is urea in the tank, then move the floater of the level sensor. The floater must be free. If you lift the sensor body, then SCRUTnk_rVol_mp must change. Exchange DEF level sensor, if no change of value or it's implausible.
1761	14	1656	138	The urea tank volume ratio is below the threshold of <2.5%	actual urea tank level SCRUTnk_rVol_mp [%] is below 2.5%	Check urea level => if empty, then fill in urea Check DEF level sensor. If there is urea in the tank, then move the floater of the level sensor. The floater must be free. If you lift the sensor body, then SCRUTnk_rVol_mp must change. Exchange DEF level sensor, if no change of value or it's implausible.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
1761	14	1880	138	The DEF tank level is below the threshold.	actual DEF tank level SCRUTnk_rVol_mp [%] is below the threshold	Check DEF level => if empty, refill Check DEF level sensor. If there is urea in the tank loose the sensor and move it. The floater must be free and move if you lift the sensor body. SCRUTnk_rVol_mp must change. Compare SCRUTnk_rVol_mp to: 1 = SCR_rawUTnkLvl 2 = SCR_rAdapUtnkLvl 3 = SCRUTnk_rActTnkVol *SCRUTnk_facVolPer_mp In case of malfunction, exchange DEF level sensor.
2791	0	1763	415	Internal actuator temperature is above threshold.	Overheating of EGR actuator during operation.	Let EGR actuator cool down and check heat accumulation during worst case operation.
2791	2	1753	415	corrupted CAN communication with actuator.	CAN bus error or faulty EGR actuator.	Threshold for error detection is an internal ECU threshold. Check other CAN bus components. If no message is sent, fix the wiring. If o.k. exchange EGR actuaror.
2791	3	1758	415	Overvoltage at EGR actuator.	High voltage from the battery	Check battery voltage.
2791	4	1759	415	Undervoltage at EGR actuator.	Low voltage from the battery.	Check battery voltage.
2791	6	1757	415	Overcurrent to EGR actuator.	High voltage from battery. EGR actuator is blocked or moving very hard.	Check battery voltage. Check if EGR is blocked or not running smoothly. If everything is o.k. change EGR actuator.
2791	7	1752	415	EGR actuator is mechanically blocked.	EGR actuator faulty or blocked.	Threshold for error detection is an internal ECU threshold. Check the EGR actuator and EGR valve to mechanical blockage / clean. Check for free movement of the valve. If it'S blocked, then exchange the EGR valve.
2791	7	1761	415	EGR actuator spring broken.	mechanical damage of spring due to overstress.	Threshold for error detection is an internal ECU threshold. Exchange EGR actuator.
2791	12	1755	415	Internal electrical fault of EGR actuator.	Internal damage of EGR actuator due to high temperature or electrical wiring issue.	Threshold for error detection is an internal ECU threshold. Exchange EGR actuator.
2791	13	1754	415	EGR actuator can not learn stop positions. Possibly only second failure if other EGRTV failures occure.	Error detection during the learning process.	Threshold for error detection is an internal ECU threshold. Start Serdia Usecase to reset EGR actuator. Check EGR valve and mounting situation. If o.k. change EGR actuator.
2791	13	1756	415	EGR actuator can not learn stop positions because procedure was interrupted.	Interruption of learning process due to mechanical damage.	Threshold for error detection is an internal ECU threshold. Start Serdia Usecase to reset EGR actuator.
2791	13	1760	415	Stop positions of EGR valve not o.k.	Mechanical damage of EGR actuator. EGR valve is blocked or moving very hard.	Threshold for error detection is an internal ECU threshold. Start Serdia Usecase to reset EGR actuator.
2791	16	1762	415	Internal actuator temperature above threshold.	overheating of EGR actuator	Let EGR actuator cool down, check heat accumulation during worst case operation.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
2797	4	1337	565	Injector diagnosis: Timeout of Injetor detection cylinder bank 0	Short-Circuit to ground on component wiring	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Note: affected injector has to be evaluated according to firing order
2797	4	1339	565	Injector test: Short cut to ground on cylinder bank 0	Short-Circuit to ground on component wiring	Check wiring, component, ECU Note: affected injector has to be evaluated according to firing order
2798	4	1338	566	Injector diagnosis: Timeout of Injetor detection cylinder bank 1	Short-Circuit to ground on component wiring	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Note: affected injector has to be evaluated according to firing order
2798	4	1340	566	Injector test: Short cut to ground on cylinder bank 1	Short-Circuit to ground on component wiring	Check wiring, component, ECU Note: affected injector has to be evaluated according to firing order
3031	0	1135	669	The urea tank temperature sensor detects a value above the maximum allowed threshold	Sensed urea tank temperature > physical range high limit	Case "CANBUS sensor": Check urea tank temperature: really hot? Check CANBus-message of DEF sensor urea tank temperature Com_dRxSCR2Byt2 Compare it to Com_dRxSCR1Byt1 (urea temperature at quality sensor) identical? Tank heater permantly on? Check wiring of DEF-quality sensor Case "analog DEF T & Level sensor": Check urea tank temperature: really hot? Check urea tank temperature SCR_tSensUTnkT Compare urea tank temperature to EnvT_t or to SCR_tSMT (the urea temperature inside the supply module) identical? Tank heater permantly on? Check wiring of analog DEF T & Level sensor
3031	1	1136	669	The urea tank temperature sensor detects a value lower than the minimum allowed threshold.	sensed urea tank temperature < physical range low limit	Case "CANBUS sensor": Check ambient temperature EnvT_t => About -40 °C? If yes Error could be plausible Check CANBus-message of DEF sensor urea tank temperature Com_dRxSCR2Byt2 Compare it to Com_dRxSCR1Byt1 (urea temperature at quality sensor) identical? Check wiring of DEF-quality sensor Check quality sensor Case "analog DEF T & Level sensor": Check urea tank temperature: really that cold? Check ambient temperature EnvT_t => About -40 °C? If yes Error could be plausible Check urea tank temperature SCR_tSensUTnkT Check wiring of analog DEF T & Level sensor Check analog DEF T & Level sensor
3224	2	129	596	DLC Error of CAN-Receive-Frame AT1IG1Vol NOX Sensor (SCR-system upstream cat; DPF-system downstream cat); length of frame incorrect	Not Used	Threshold for error detection is an internal ECU threshold. Check Nox-Sensor and the wiring from CAN-BUS.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
3224	9	130	597	Timeout Error of CAN-Receive-Frame AT1IG1Vol; NOX sensor (SCR-system upstream cat; DPF-system downstream cat)	Failure of the CAN Bus message	NOX sensor and sensor connection check
3234	2	138	114	DLC Error of CAN-Receive-Frame AT1O1Vol NOX Sensor (SCR-system downstream cat; DPF-system downstream cat); length of frame incorrect	Failure of the CAN Bus message	NOX downstream sensor and sensor connection check
3234	9	139	117	Timeout Error of CAN-Receive-Frame AT1OG1Vol; NOX sensor (SCR-system downstream cat; DPF-system downstream cat)	Failure of the CAN Bus message	NOX downstream sensor and sensor connection check
3361	3	1077	677	Urea dosing valve (low side power stage): the current drain measured by ECU is above the target range	Fault in the wiring	Threshold for error detection is an internal ECU threshold See substitute function Check the wiring
3361	3	1078	677	Urea dosing valve (high side power stage): the current drain measured by ECU is above the target range	Fault in the wiring	Threshold for error detection is an internal ECU threshold Check the wiring
3361	4	1079	677	Urea dosing valve (low side power stage): the current drain measured by ECU is above the target range	Fault in the wiring	Check the wiring
3361	4	1080	677	Urea dosing valve (high side power stage): the current drain measured by ECU is above the target range	Fault in the wiring	Threshold for error detection is an internal ECU threshold Check the wiring
3361	6	1075	677	Urea dosing valve: the current measured value by ECU at the end of the injection is too high	Fault in the wiriing Defect urea dosing injection valve	Check wiring Check the urea dosing injection valve
3519	3	1898	277	The integrated diagnostic of the temperature sensor of the Urea Quality Sensor recognized a short circuit to battery. The UQS Sensor is an combined sensor of tank temperature, filling grade and DEF quality and it is also an CAN sensor --> no PIN	Wrong diagnostic of the short circuits logic inside the temperature sensor of the UQS CAN Communication corrupted	Check the wiring to the suction unit in the DEF tank. Check the CAN bus communication of the suction unit. In case the communication is corrupt, exchange the suction unit.
3519	4	1899	277	The integrated diagnostic of the temperature sensor of the Urea Quality Sensor recognized a short circuit to ground	DEF quality sensor in the suction unit of the DEF tank is defect CAN Communication corrupted	Check the wiring to the suction unit of the DEF tank. Check the CAN bus communication from the suction unit. In case the signal is corrupt, exchange the suction unit in the DEF tank.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
3519	12	1895	277	The integrated temperature sensor of the Urea Quality Sensor measures higher temperature than threshold	Temperature sensor inside the UQS defect. CAN Communication corrupted. Overheating of the DEF tank due to malfunction of the heating valve. Flow direction is of coolant is wrong due to mixed up the hoses routed to the heating valve. Overheating of the DEF tank due to heat transfer from neighbor parts.	Check the temperature sensor signal for plausibility. In case of improper signal, exchange the suction unit in the tank. Check CAN bus communication for proper signal. In case of improper signal, exchange the suction unit in the tank. Check the function of heating valve and routing of the hoses. The coolant flow through the heating valve must be observed according to the shown arrow. In case all actions above are OK, check the real temperature in the DEF tank during worst case condition and improve the installation of the DEF tank.
3519	13	1908	277	Temperature at UQS out of range the specified thresholds; invalid quality of the temperature	Suspected Components Tank heater DEF sensor	Check temperature system and/or DEF quality sensor
3520	2	1904	2-7-8	Measured DEF Quality from UQS is too low. Quality value received from UQS is < 22 % for a certain time and a certain number or for measuring conditions not observed for a certain time.	Suspected components: Urea quality sensor defect Wrong installation (measuring air) Urea level sensor defect Non urea filled in tank CANBUS problems Evaluation conditions for new quality check not fulfilled after one previous mal detection	Check that there is liquid urea of known quality in the tank first Check urea tank level. Add urea until level is at least 10 cm above sensor. Ensure that urea is not frozen / sufficient urea is liquid Check Sensor: Are urea tank temperature and level displayed? Changes the level if you refill urea? Check electrical connection Check CANBus New quality detection is carried out if urea refill is detected or if an quality evaluation was triggered and was not finished successfully: To provoke a quality measurement: refill urea, at least 10 % of tank volume Wait until quality evaluation was carried out, can take up to 30 minutes => check value. It should be about 33 % Exchange quality sensor
3520	3	1896	278	The integrated diagnostic of the Urea Quality Sensor recognized a short circuit to battery	wiring harness of UQS corrupted CAN Communication corrupted	Threshold for error detection is an internal ECU threshold. Check the wiring harness from the ECU to the suction unit of the DEF tank Check the CAN bus communication. If the signal is corrupt, then exchange the suction unit.
3520	4	1897	278	The integrated diagnostic of the Urea Quality Sensor recognized a short circuit to ground.	wiring harness to the suction unit in the DEF tank is corrupted CAN Communication corrupted	Threshold for error detection is an internal ECU threshold. Check the wiring to the suction unit in the DEF tank. Check the CAN bus communication. In case the communication is corrupt, exchange the suction unit in the DEF tank.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
3520	13	1907	278	Urea quality at UQS out of range the specified thresholds; invalid quality of the urea qualiy	Suspected components DEF quality sensor DEF	Check DEF quality and/or DEF quality sensor
3532	3	1911	127	The urea quality value from the sensor is greater than the maximum physical range threshold Comment: tank temperature is measured by the UQS sensor	Suspected Components: UQS defect	Check DEF quality and/or sensor.
3532	4	1912	127	The urea quality value from the sensor is lower than the minimum physical range threshold.	Suspected Components: UQS defect	Check DEF quality and/or Sensor.
3711	12	1455	711	Temperature Phy_tPfWgh, the weighted DPF temperature < Threshold 1 Temperature Phy_tPfWgh, the weighted DPF temperature > Threshold 2 towards the end of the stand-still main phase.	temperature Phy_tPfWgh, the weighted DPF temperature, is below or above the target temperature towards the end of the stand-still main phase.	Check temperature upstream DOC Exh_tSensOxiCatUs within Stand-still: > 450 °C? If not: => Check air path of engine: EGR-Valve, Intake-Throttle, Turbocharger and Piping each for leakage and correct function Check temperature difference across DOC by Exh_tSensOxiCatDs - Exh_tSensOxiCatUs within Stand-still: < 100°C? If not: Check exhaust pipe downstream turbo charger for oil? check injectors: is an injector got stuck? Too many hydrocarbons in exhaust? White smoke (at hot EAT system, not at cold start)? Check air path of engine: EGR-Valve, Intake-Throttle, Turbocharger and Piping each for leakage and correct function Check exhaust gas temperature sensors within EAT-system: T upstream DOCC, T downstream DOC & T upstream SCR catalyst all three of them can influence Phy_tPfWgh
3936	14	1917	2-8-6	Standstill escalation by time. In case the standstill request will not be released within 50 h by the driver this fault code will be set.	Stand-still request ignored by the operator. Display / stand-still request lamp broken.	Perform Stand-still. If soot load level of DPF has increased too high already call service to perform stand-still. In case the DPF soot load level remove DPF => Exchange DPF.
4334	0	1122	665	The absolute pressure value of the urea pump is greater than an applicable maximal filtered pressure threshold	Suspected Components: Urea pump defect Supply module pressure sensor defect Pump contains dirty parts	Check the urea pump Check the supply module pressur sensor Clean the urea pump (filter)
4334	1	1123	665	Urea supply module pressure sensor: The absolute pressure value of the urea pump is less than an applicable minimal filtered pressure threshold	Check the urea pump Check the supply module pressur sensor Clean the urea pump (filter)	Check the urea pump Check the supply module pressur sensor Clean the urea pump (filter)

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
4334	2	1866	665	absolute difference of sensed urea pump pressure (SCR_pAbsSensUPmpP) and ambient pressure (EnvP_p) > limit abs(UPmpP_pDiffPmpEnv_mp) > UPmpP_pDiffPmpEnv_C (250 hPa)	absolute difference of sensed urea pump pressure (SCR_pAbsSensUPmpP) and ambient pressure (EnvP_p) > limit abs(UPmpP_pDiffPmpEnv_mp) > UPmpP_pDiffPmpEnv_C	Check environment pressure sensor (EnvP_p) => plausible value? Engine shut-off and immediately re-started? => Shut-off again. Wait until afterun of ECU has finished, re-Start engine Back-flow line free? Does the urea pump pressure show values < 1000 hPa in SCR state emptying (64)? Check revision valve => Does the urea pump pressure show values < 1000 hPa in SCR state emptying (64)? => exchange supply module Supply module pressure sensor defect => exchange supply module
4341	3	1104	675	Urea heater supply line: the current drain measured by ECU is above the target range	electrical error	Threshold for error detection is an internal ECU threshold Check wire harness Check supply line
4341	4	1105	675	Urea heater supply line: the current drain measured by ECU is above the target range	electrical error	Threshold for error detection is an internal ECU threshold Check wire harness Check supply line
4341	5	1102	675	Urea heater supply line: the current drain measured by ECU is above the target range	electrical error	Threshold for error detection is an internal ECU threshold Check wire harness Check supply line
4343	3	1096	673	Urea pressure line heater: the current drain measured by ECU is above the target range	shortcut to battery If this error detected during the heating phase is a result error: KWP 1089 broken heating element in pressure line	Threshold for error detection is an internal ECU threshold Check wiring Check heating element
4343	4	1097	673	Urea pressure line heater: the current drain measured by ECU is above the target range	Shortcut to ground If this error detected during the heating phase is a result error: KWP 1089 Short cut to ground or broken wiring, broken heating element in pressure line	Threshold for error detection is an internal ECU threshold Check wiring Check heating element
4343	5	1094	673	Urea pressure line heater: the current drain measured by ECU is above the target range	Open load If this error detected during the heating phase is a result error: KWP 1089 Broken wiring, broken heating element in pressure line	Threshold for error detection is an internal ECU threshold Check wiring Check heating element
4345	3	1092	674	Urea backflow line heater: the current drain measured by ECU is above the target range	Shortcut to battery If this error detected during the heating phase is a result error: KWP 1089 Short cut to battery or broken wiring, broken heating element in backflow line	Threshold for error detection is an internal ECU threshold Check wiring Check heating element
4345	4	1093	674	Urea backflow line heater: the current drain measured by ECU is above the target range	Shortcut to ground If this error detected during the heating phase is a result error: KWP 1089 Short cut to ground or broken wiring, broken heating element in backflow line	Threshold for error detection is an internal ECU threshold Check wiring Check heating element

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
4345	5	1090	674	Urea backflow line heater: the current drain measured by ECU is above the target range	Open load If this error detected during the heating phase is a result error: KWP 1089 Broken wiring, broken heating element in back-flow line	Threshold for error detection is an internal ECU threshold Check wiring Check heating element
4360	0	1069	668	The filtered urea cat upstream temperature is greater than an applicable maximum temperature threshold	Sensed temperature upstream SCR > physical high limit	Check temperature difference across DOC (Exh_tOxiCatDs-Exh_TOxiCatUs) at higher engine load => high difference > 100 K? If yes, the engine emitts too many Hydrocarbons => check injectors: is an injector got stuck? => Check EGR Valve If difference normal the exhaust out of the engie itself is too hot: => Check air path of engine: EGR-Valve, Intake-Throttle, Turbocharger and Piping each for leakage and correct function If that error was set while stand-still operation the error source could be exothermal soot burn off in DPF (which should not happen) => Dismount DPF and check it visually exchange temperature sensor upstream SCR
4360	1	1070	668	The filtered temperature before urea cat is less than an applicable minimum temperature threshold	Sensed temperature upstream SCR catalyst < than physical low limit	Cold start and ambient temperature < Threshold? Missdetection? Check wiring harness to UCatUsT-sensor Exchange UCatUsT-sensor
4360	2	1865	668	Error at static plausibility check: absolut temperature difference of sensed temperature upstream SCR catalyst and ambient temperature > as static plausibility limit at engine cold start (engine was off for at least 8 h), temperature upstream of SCR catalyst is expected to be identical to ambient temperature => see enable conditions for details. Error at dynamic plausibility check: temperature difference of sensed temperature upstream SCR catalyst and ambient temperature < as dynamic plausibility limit dynamic check is blocked if static plausibility check is already faulty => Temperature upstream SCR catalyst must be by 40°C higher than ambient temperature if engine runs and a certain delay time has expired.	Error at static plausibility check: absolut temperature difference of sensed temperature upstream SCR catalyst and ambient temperature > as static plausibility limit at engine cold start (engine was off for at least 8 h), temperature upstream of SCR catalyst is expected to be identical to ambient temperature => see enable conditions for details. Error at dynamic plausibility check: temperature difference of sensed temperature upstream SCR catalyst and ambient temperature < as dynamic plausibility limit dynamic check is blocked if static plausibility check is already faulty => Temperature upstream SCR catalyst must be by 40°C higher than ambient temperature if engine runs and a certain delay time has expired.	Check whether temperature sensor upstream of SCR catalyst is physically mounted within exhaust pipe If cold start condition can be made sure (engine was off for at least 8 h) compare values of EnvT_t, EngDa_tEng, Exh_TOxiCatUs, Exh_tOxiCatDs and SCR_tSensUCatUsT at ignition on, without starting the engine. All identical? Compare values of Exh_TOxiCatUs, Exh_tOxiCatDs and SCR_tSensUCatUsT after 15 min in constant operation point: show all similar values (30 K tolerance width). Are ambient temperature and (EnvT_t), cooling water temperature (EngDa_tEng) plausible? Sensor coated with urea crystalls? Dismount urea injector and inspect temperature sensor upstream SCR catalyst visually Check wiring of sensor Replace sensor
4361	3	1072	668	Urea catalyst upstream temperature sensor: the voltage of sensor measured by ECU is out of the target range	Voltage of temperature sensor upstream SCR catalyst > maximum limit Short circuit to battery	Check sensor Check wiring Replace UCatUsT-sensor
4361	4	1073	668	Urea catalyst upstream temperature sensor: the voltage of sensor measured by ECU is out of the target range	Voltage of temperature sensor upstream SCR catalyst < minimum limit Short circuit to ground	Check sensor Check wiring Replace UCatUsT-sensor

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
4365	2	1137	6-6-9	Signal error in case of Urea tank temperature trnasmitted via CAN-signal Com_tUTnkT.	CAN message is not send properly.	Check sensor connector Check CANbus
4365	3	1138	6-6-9	Urea tank temperature sensor: he current drain measured by ECU is above the target range.	Shortcut or open load.	Threshold for error detection is an internal ECU threshold. The Sensed raw voltage value SCR_uRawUTnkT is below SCR_SRCUTnkT.uMax_C. Check wiring.
4365	3	1914	669	Internal error of DEF quality sensor.	Suspected componentes: DEF quality sensor Wiring harness	Check wiring harness and DEF qualitysensor
4365	4	1139	6-6-9	Urea tank temperature sensor: he current drain measured by ECU is above the target range.	Shortcut or open load.	Threshold for error detection is an internal ECU threshold. The sensed raw voltage value SCR_uRawUTnkT is above SCR_SRCUTnkT.uMin_C. Check wiring.
4365	4	1915	6-6-9	Internal error of DEF quality sensor.	Suspected componentes: DEF quality sensor Wiring harness	Check wiring harness and DEF qualitysensor
4366	3	1112	671	Urea tank heating valve: the current drain measured by ECU is above the target range	Shortcut to battery If this error detected during the heating phase is a result error: KWP 1089 Broken wiring Urea tank heating valve defect	Threshold for error detection is an internal ECU threshold Check wiring Check urea tank heating valve
4366	4	1113	671	Urea tank heating valve: the current drain measured by ECU is above the target range	Shortcut to ground If this error detected during the heating phase is a result error: KWP 1089 Broken wiring Urea tank heating valve defect	Threshold for error detection is an internal ECU threshold Check wiring Check urea tank heating valve
4366	5	1110	671	Urea tank heating valve: the current drain measured by ECU is above the target range	Open load If this error detected during the heating phase is a result error: KWP 1089 Broken wiring Urea tank heating valve defect	Threshold for error detection is an internal ECU threshold Check wiring Check urea tank heating valve
4375	3	1120	666	Urea supply module pump: the current drain measured by ECU is above the target range	Shortcut to battery If this error detected during the heating phase is a result error: KWP 1089 Broken wiring Pump in urea supply module defect	Threshold for error detection is an internal ECU threshold The hardware detects absence of any short circuit to battery on the PWM output power stage for the urea pump module actuator Check wiring Check pump in the urea supply module
4375	4	1121	666	Urea supply module pump: the current drain measured by ECU is above the target range	Shortcut to ground If this error detected during the heating phase is a result error: KWP 1089 Broken wiring Pump in urea supply module defect	Threshold for error detection is an internal ECU threshold The hardware detects a short circuit to ground error on the PWM output power stage for the UreaPump Module Motor Actuator. The error is updated by setting bit 1 of measuring point UPmp-Mot_stPrevTstRslt_mp Check wiring Check pump in the urea supply module

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
4375	5	1118	666	Urea supply module pump: the ECU can not measure any reaction during pump control	Open load Broken wiring Pump in urea supply module defect	Threshold for error detection is an internal ECU threshold The hardware detects the presence of load on the PWM output power stage for the urea pump module actuator. Check wiring Check pump in the urea supply module
4376	3	1131	667	Urea supply module reversal valve: the current drain measured by ECU is above the target range	Shortcut to battery Fault in the wiring Reversal valve in the urea supply module defect	Threshold for error detection is an internal ECU threshold Check wiring Check urea supply modul
4376	4	1132	667	Urea supply module reversal valve: the current drain measured by ECU is above the target range	Shortcut to ground Fault in the wiring Reversal valve in the urea supply module defect	Threshold for error detection is an internal ECU threshold Check wiring Check urea supply modul
4376	5	1129	667	Urea supply module reversal valve: the current drain measured by ECU is above the target range	Open load Fault in the wiring Reversal valve in the urea supply module defect	Threshold for error detection is an internal ECU threshold Check wiring Check urea supply modul
4765	0	1039	683	The exhaust temperature value from the sensor befor DOC is above an applicable upper shutoff threshold TOxiCatUs_tShOffThresHiAds_C = Threshold 1 in Normal and Heatmodes (TOxiCatUs_tShOffThresHiRgn_C = Threshold 2 in stand-still)	sensed temperature upstream DOC > shut-off limit	Check air path of engine: EGR-Valve, Intake-Throttle, Check Turbocharger and Piping each for leakage and correct function Check injectors: is an injector got stuck? Exchange temperature sensor upstream DOC
4765	0	1040	683	The exhaust temperature value from the sensor befor DOC is above an applicable upper warning threshold TOxiCatUs_tWarnThresHi_C = Threshold	Sensed temperature upstream DOC > warning limit	Check air path of engine: EGR-Valve, Intake-Throttle, Turbocharger and Piping each for leakage and correct function Check injectors: is an injector got stuck? Exchange temperature sensor upstream DOC

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
4768	2	1036	683	Static plausibility check: The exhaust temperature value from the sensor before DOC, the exhaust temperature value from the sensor after DOC, the temperature value from the sensor before SCR-Cat, the environment temperature and the coolant engine temperature their ratios to each other exceed their related thresholds. Dynamic plausibility check with environment temperature sensor value: The exhaust temperature value from the sensor before DOC is lower than an applicable environment temperature threshold	Static plausibility check: The exhaust temperature value from the sensor before DOC, the exhaust temperature value from the sensor after DOC, the temperature value from the sensor before SCR-Cat, the environment temperature and the coolant engine temperature their ratios to each other exceed their related thresholds. (difference between temperature after DOC and temperature before DOC > Threshold 1 difference between temperature befor DOC and before SCR > Threshold 2 difference between temperature after DOC and before SCR < Threshold 3 difference between temperature after DOC and ambinet temperature < Threshold 4 differnece between temperatur ambient temperature and engine temperature < Threshold 5) Dynamic plausibility check with environment temperature sensor value: The exhaust temperature value from the sensor before DOC is lower than an applicable environment temperature threshold (< environmental temperature + Threshold 6)	Check ambient temperature => value plausible? upstream DOC sensor mounted within exhaust line? T upstream DOC sensor physically mounted in correct position upstream DOC? (not upstream SCR or downstream DOC?) Check T upstream DOC sensor Check other T-sensors within EAT-system (Exh_tOxiCatDs & UCatUsT_tFlt_mp show plausible values? No errors on them?
4768	2	1881	683	At engine cold start conditions the sensed exhaust gas temperature downstream DOC (Exh_tSensTOxiCatDs) has exceeded the sum of ambient temperature (EnvT_t) + offset (40°C) earlier than the sensed exhaust gas temperature upstream of DOC (Exh_tSensTOxiCatUs). The check is only performed once each ignition cycle and only if the start is judged a cold start. Error status is frozen for that ignition cycle. No healing possible.	Difference temperature of exhaust gas temperature downstream DOC and fixed ambient temperature at ignition on exceeds a certain limit earlier than the difference temperature of exhaust gas temperature upstream DOC and fixed ambient temperature at ignition on.	Check whether all exhaust gas temperature sensors within the EAT system are mounted properly: Within the exhaust line and at correct positions. Check the position of the sensor upstream SCR which might be physically mounted in the wrong position. If cold start condition can be made sure (engine was off for at least 8 h) compare values of EnvT_t, EngDa_tEng, Exh_TOxiCatUs, Exh_tOxiCatDs and SCR_tSensUCatUsT at ignition on, without starting the engine. All identical? Then the sensors itself are okay. Check exhaust piping for leakage. Check wiring of sensors Replace sensors Check DOC => physicallly intact?
4768	3	1044	683	Oxidation catalyst upstream temperature sensor: the voltage of sensor measured by ECU is out of the target range	The sensed raw voltage value Exh_uRawTOxiCatUs is above Exh_SRCTOxiCatUs.uMax_C Shortcut to battery	Check wiring harness to temperature sensor upstream DOC Exchange temperature sensor upstream DOC
4768	4	1045	683	Oxidation catalyst upstream temperature sensor: the voltage of sensor measured by ECU is out of the target range	The sensed raw voltage value Exh_uRawTOxiCatUs is below Exh_SRCTOxiCatUs.uMin_C Shortcut to ground	Check wiring harness to temperature sensor upstream DOC Exchange temperature sensor upstream DOC

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
5763	3	1024	594	Actuator of the external EGR valve: the ECU detects a short circuit to battery or open load.	Short cut to battery or open loop.	Check cabling, actuator defect, check actuator and if necessary replace it, check connection cable and if necessary repair or replace it.
5763	3	1226	594	Actuator EGR-valve: short cut to battery is detected	Short-Circuit to battery on component wiring	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Check repair with SerDia 2010 use case
5763	3	1227	594	Actuator EGR-valve: short cut to battery on ECU pin is detected	Short-Circuit to battery on component wiring	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Check repair with SerDia 2010 use case
5763	4	1025	594	Actuator of the external EGR valve: the ECU detects a short circuit to ground.	Short cut to ground	Check cabling, actuator defect, check actuator and if necessary replace it, check connection cable and if necessary repair or replace it.
5763	4	1228	594	Actuator EGR-valve: short cut to ground on ECU pin is detected	Short-Circuit to ground on component wiring	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Check repair with SerDia 2010 use case
5763	4	1229	594	Actuator EGR-valve: short cut to battery on ECU pin is detected	Short-Circuit to ground on component	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Check repair with SerDia 2010 use case
5763	4	1232	5-9-4	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); Voltage below threshold 3.6) Drosselklappe (4.1;6.1;7.8); Voltage below threshold;	Monitoring for CY146 Under Voltage.	Threshold for error detection is an internal ECU threshold. Check wiring, component
5763	5	1023	5-9-4	Actuator error EGR-Valve; signal range check low, measured current is below target	Short circuit to ground.	Check wiring, check cabels and repair or replace if necessary, check actuator with SERDIA 2010 test for EGR and if necessary replace it.
5763	6	1014	594	Actuator error EGR-Valve. Signal range check high.	Short cut to batterie.	Check wiring and repair or replace if necessary, check actuator with SERDIA test for EGR and if necessary replace it.
5763	6	1022	5-9-4	Actuator error EGR-Valve; signal range check high, measured current by ECU is over target	Short circuit to battery or open circuit.	Check cabling, actuator defect, check actuator and if necessary replace it, check connection cable and if necessary repair or replace it.
5763	6	1223	594	Actuator EGR-Valve: Open load on ECU output is detected	Open circuit on component wiring	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Check repair with SerDia 2010 use case
5763	6	1224	594	Actuator EGR-valve: too high curent is going into the actuator. Output is switched off	Overload on component wiring	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Check repair with SerDia 2010 use case

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
5763	6	1230	5-9-4	Actuator error EGR-valve; Overload by short-circuit	Short Circuit over Load	Threshold for error detection is an internal ECU threshold. Check wiring, component
5763	7	1016	594	Actuator position for EGR valve is not plausible, internal error, angular misalignement of the flap.	Position error of throttle flap (deviation > 7%).	Threshold for error detection is an internal ECU threshold. Threshold for error detection, deviation from setpoint > 7%. Troubleshooting with SERDIA 2010 Use Case "EGR Diagnostic".
5763	11	1231	5-9-4	Power stage overtemperature due to high current.	Temperature dependent Over Current	Threshold for error detection is an internal ECU threshold. Check wiring, component
520521	5	1015	594	Actuator error EGR-Valve. Signal range check low.	Short cut to ground.	Check wiring and repair or replace if necessary, check actuator with SERDIA test for EGR and if necessary replace it.
523009	9	825	253	The pressure relief valve (PRV) has reached the number of allowed activations.	Rail pressure has exceeded the trigger threshold of the pressure limiting valve.	Replace pressure relief valve (PRV) and reset fault with Serdia.
523009	10	833	2-5-3	The pressure relief valve (PRV) has reached the allowed opening time.	Rail pressure has exceeded the trigger threshold of the pressure limiting valve.	Replace pressure relief valve (PRV) and reset fault with Serdia.
523212	9	171	3-3-3	Timeout Error of CAN-Receive-Frame ComEngPrt; Engine Protection	Timeout Error (Missing CAN Bus message)	Check wiring harness and customer devices
523240	9	179	527	Timeout CAN-message FunModCtl; Function Mode Control	Timeout Error (Missing CAN Bus message)	Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range.
523350	4	565	151	Injector cylinder bank 1: the current drop measured by ECU is above the target range	Short circuit injection bank 1 (all injectors of this bank can be affected)	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.
523352	4	566	152	Injector cylinder bank 2: the current drop measured by ECU is above the target range	Short circuit injection bank 2 (all injectors of this bank can be affected)	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.
523354	12	567	153	Internal hardware monitoring: the ECU detects an error of its injector high current output. Chip of CY33x defect power stage components	Defective powerstage in ECU	Threshold for error detection is an internal ECU threshold. If error is not removable, change ECU.
523450	4	839	1-4-3	Diagnostic fault check for min error of COM message.	The sensed raw value is less than the threshold.	Check cabling, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
523470	2	826	146	The pressure relief valve (PRV) has been opened due to excessive pressure.	Rail pressure has exceeded the trigger threshold of the pressure limiting valve.	Threshold for error detection is an internal ECU threshold. Reset the fault and at reappearance check injection system.
523470	2	827	146	The pressure relief valve (PRV) has been opened due to excessive pressure.	Rail pressure has exceeded the trigger threshold of the pressure limiting valve.	Threshold for error detection is an internal ECU threshold. Reset the fault and at reappearance check injection system.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
523470	7	876	146	Rail pressure is out of the expected average range.	Rail pressure is out of the expected average range. PRV can not be opened.	(A) Check railpressure relief valve and replace if necessary. (B) Check high pressure pumps, pressure relief valve and metering unit. (C) Change components if necessary
523470	11	831	146	Rail pressure relief valve can not be opened due to the railpressure.	Railpressure out of tolerance range (PRV can not be opened by a pressure peak in this operating point)	Threshold for error detection is an internal ECU threshold. Check railpressure, check rail pressure sensor for plausibility, check FCU.
523470	11	832	146	Rail pressure is out of the expected average range. The PRV can not be opened at this operating point with a pressure shock.	Averaged rail pressure is outside the expected tolerance range.	Threshold for error detection is an internal ECU threshold. Check PRV and replace if necessary.
523470	12	828	146	Rail pressure relief valve: is open. Shutoff conditions.	Shut Off after PRV Open	Threshold for error detection is an internal ECU threshold. Check PRV opening counter and if necessary replace PRV, check rail-pressure sensor for plausibility and if necessary replace it, check FCU and if necessary replace it.
523470	12	829	146	Rail pressure relief valve is open. Warning conditions.	Warning PRV open	Threshold for error detection is an internal ECU threshold. Check PRV opening counter and if necessary replace PRV, check rail-pressure sensor for plausibility and if necessary replace it, check FCU and if necessary replace it.
523470	14	830	146	Rail pressure relief valve is open. (PRV)	Open PRV	Threshold for error detection is an internal ECU threshold. Only after ECU reset. Check PRV opening counter and if necessary replace it, check rail-pressure sensor for plausibility and if necessary replace it, check FCU and if necessary replace it.
523550	12	980	515	Terminal 50 was operated for more than 2 minutes. This may happen due to short to battery or wrong usage of Terminal 50. Starter control is disabled until this error is healed.	Startinformation to Starter (T50-switch) erratic/defect.	Threshold for error detection is an internal ECU threshold. Check cabling, if sensor not working, check start switch and if necessary replace it, check connection cable and if necessary repair or replace it.
523601	13	948	282	Internal hardware monitoring: the ECU detects a deviation of the target range of the power supply voltage of sensor output 3.	Suspected components EDC17cv52 Pin A18: DeltaPressVenturi / Position intake throttle flap Pin K20: First footpedal Pin K21: Air FilterDiffPress Suspected components EDC17cv54 and cv56 Pin A07: Rail pressure	Check cabling of external components, check working voltage and if necessary correct it, check connection cable and if necessary repair or replace it, if error is not removable, change ECU.
523612	3	644	555	supply voltage too high	not used	Threshold for error detection is an internal ECU threshold.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
523612	4	646	555	supply voltage too low	not used	Threshold for error detection is an internal ECU threshold.
523612	12	387	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Injector shut off demand for the ICO coordinator System responses: not	Threshold for error detection is an internal ECU threshold. Caution ! Sequence error, check error memory for other errors.
523612	12	612	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory.	Plausibility check failed (MoCADC_uNTP_mp is higher than MoCADC_uNTPMax_C).	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	613	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Analysis of test voltage (Value is out of the target -> ECU internal error)	Threshold for error detection is an internal ECU threshold. Check wiring, check connected sensors actuators. If error is still present, exchange ECU.
523612	12	614	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Analysis of the ratiometric correction (Value is out of the target -> ECU internal error)	Threshold for error detection is an internal ECU threshold. Check wiring, check connected sensors actuators. If error is still present, exchange ECU.
523612	12	615	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error report due to an error in the plausbility of Function Coordination(FC) and Monitoring Modul(MM)(ECU internal error)	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	616	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error report due to an interrupted SPI communication (ECU internal error)	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	617	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	multiple error in complete ROM-test during postdrive detected (ECU internal error)	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	618	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Too less bytes received by monitoring memory from CPU as response (ECU internal error). Loss of synchronization sending bytes to the monitoring memory from CPU	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	619	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Suspected components: Injector ECU wiring harness/connector	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	620	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error trying to set MM Response time (ECU internal error)	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	621	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error detected in the internal ECU communication, Too many SPI errors during MoCSOP execution	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
523612	12	623	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error in the check of the shut-off path test of the under voltage detection (ECU internal error). Diagnostic fault check to report the error in undervoltage monitoring	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	624	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error in the check of the shut-off path of the monitoring module (ECU internal error).	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	625	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Time out error trying to set or cancelling the alarm task (ECU internal error). Failure setting the alarm task period	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	627	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error in time monitoring of the shut-off path test (ECU internal error). Diagnostic fault check to report the timeout in the shut off path test	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	628	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error in the check of the shut-off path test of the over voltage detection (ECU internal error). Diagnostic fault check to report the error in overvoltage monitoring	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	629	555	The two voltage values (ADC_VAL1, ADC_VAL2), detected by the accelerator pedal, are not plausible to each other.	Defect pedal or wiring	Threshold for error detection is an internal ECU threshold. Check Pedal, repair or exchange the Pedal. Check wiring. If error is still present, exchange ECU.
523612	12	630	555	Impermissible offset between the engine speed of level 2 and level 1	Calculated engine speed in level 1/2 implausible (-> ECU internal error).	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	631	555	Diagnostic fault check to report the plausibility error between level 1 energizing time and level 2 information	Implausible injection energizing time for either PiIx or MI1 or PoIx.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	632	555	Error in the plausibility of the start of energising angles	Implausible start of energising of either PiIx or MI1 or PoIx.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	633	555	Error in the plausibility of the energising times of the zero fuel quantity calibration	The energising times of the zero fuel quantity calibration ZFC is out of the target. (-> ECU internal error)	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	634	555	Error in the plausibility of PoI2 efficiency.	Error in the plausibility of PoI2 efficiency.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	635	555	Error in the PoI2 shut-off.	Error in the PoI2 shut-off.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	636	555	Error in the plausibility of PoI3 efficiency.	Error in the plausibility of PoI3 efficiency.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
523612	12	637	555	Engine speed: the engine speed calculated by ECU is above the target range; the ECU activates a system reaction	Error in the plausibility of current energising time with maximum permitted energising time. Diagnostic fault check to report the error due to Over Run	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	638	555	Error in the plausibility of the wave correction parts	Error in the plausibility of the wave correction parts	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	639	555	Plausibility error of the Rail pressure sensor	In case the gradient of rail pressure is larger than the max threshold or lesser than the min threshold. Rail metering unit defect. Leakge in the Rail System.	Threshold for error detection is an internal ECU threshold. Check metering unit or cable. Check Rail pressure. Check the Rail System of leakage.
523612	12	640	555	Error in the torque comparison between permissible engine torque and current actual torque	Error in the torque comparison between the permissible inner engine torque and the current plausible actual torque.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	641	555	Diagnosis of curr path limitation forced by ECU monitoring level 2	The torque comparison is not plausible with the torque monitoring.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	642	555	Diagnosis of lead path limitation forced by ECU monitoring level 2	The setpoint path of the air system is limited by the limitation torque of the functional control unit monitoring.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	643	555	Diagnosis of set path limitation forced by ECU monitoring level 2.	If the quantity setpoint is exceeds the limit of the torque function.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
523612	12	714	555	Error report "WDA wire is active" due to a defect query/response communication	Error detection by monitoring module	Threshold for error detection is an internal ECU threshold. Software reset.
523612	12	715	555	Error report "ABE wire is active" due to undervoltage detection	The reason is that a slow dropping of the vehicle electrical system voltage (defective autobattery) should not lead the ECU OCWDA's diagnose to enter an error in the fault memory due to an undervoltage recognition.	Threshold for error detection is an internal ECU threshold. Software reset.
523612	12	716	555	Error report "ABE wire is active" due to overvoltage detection	If the ABE/WDA powerstage shut-off is active due to an overvoltage detection.	Threshold for error detection is an internal ECU threshold. software reset.
523612	12	717	555	Error report "ABE/WDA active" due to an unknown reason	The reason is that a slow dropping of the vehicle electrical system voltage (defective autobattery) should not lead the ECU OCWDA's diagnose to enter an error in the fault memory due to an undervoltage recognition.	Threshold for error detection is an internal ECU threshold. Software reset.
523612	12	1170	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error during positive test (ECU internal error). Diagnostic fault check to report that the positive test failed	Threshold for error detection is an internal ECU threshold. Reflash ECU. If error is still activ replace ECU.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
523612	12	1857	555	Fault in the monitoring during the engine start. Start requested in level 1, but not released in level 2 which leads to no fuel injection.	wiring is not according DEUTZ requirements engine start conditions are not observed low battery voltage during start malfunction of starter	Threshold for error detection is an internal ECU threshold. check other active errors and fix them. check all needed engine start conditions, e.g. neutral switch. check the engine speed during starting of the engine. If it's too low, then check the battery voltage and then check the starter for malfunction.
523612	14	973	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory.	Visibility of Softwareresets in DSM	Threshold for error detection is an internal ECU threshold.
523612	14	974	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory.	Visibility of Softwareresets in DSM	Threshold for error detection is an internal ECU threshold.
523612	14	975	555	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Visibility of SoftwareResets in DSM	Threshold for error detection is an internal ECU threshold. If possible the software update has to be done. Replace the ECU.
523613	0	856	134	Rail pressure: the fuel pressure in rail calculated by ECU is below the target range which is dependant on the engine speed.	Pressure governor deviation exceeds the limiting value based on the engine speed.	Threshold for error detection is an internal ECU threshold. (A) Check for leakage (B) Check fuel-primary pressure (C) Change components, check sensor and if necessary replace it, check fuel system and if necessary repair it
523613	0	857	134	Rail pressure: the fuel pressure in rail calculated by ECU is below the target range which is dependant on the engine speed.	maximum positive deviation of rail pressure exceeded concerning set flow of fuel.	Threshold for error detection is an internal ECU threshold. (A) Check for leakage (B) Check fuel-primary pressure (C) Change components, check sensor and if necessary replace it, check fuel system and if necessary repair it
523613	0	858	134	Rail pressure: the fuel pressure in rail calculated by ECU is above the target range which is dependant on the engine speed.	leakage is detected based on fuel quantity balance.	Threshold for error detection is an internal ECU threshold. (A) Check backflow pressure (B) Check Injector function with SerDia (C) Change components (metering unit, injector) if necessary
523613	0	859	134	Rail pressure: the fuel pressure in rail calculated by ECU is above the target range which is dependant on the engine speed.	Maximum negative rail pressure deviation with metering unit on lower limit is exceeded.	Threshold for error detection is an internal ECU threshold. (A) Check backflow pressure (B) Check Injector function with SerDia (C) Change components (metering unit, injector) if necessary
523613	0	862	134	Rail pressure: the fuel pressure in rail calculated by ECU is above the target range.	Rail pressure exceeds the limiting value.	(A) Check backflow pressure (B) Check pressure relief valve and metering unit. (C) Change components if necessary

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
523613	1	861	134	Rail pressure: the fuel pressure in rail calculated by ECU is below the target range which is dependant on the engine speed.	Rail pressure falls below the limiting value based on the engine speed.	Threshold for error detection is an internal ECU threshold. (A) Check backflow pressure (B) Check Injector function with SerDia (C) Change components (metering unit, injector) if necessary
523613	2	864	134	Rail pressure metering unit, Setpoint of metering unit in overrun mode not plausible.	Pressure pump delivery quantity in overrun exceeds the threshold based on the pressure.	Threshold for detection is an internal ECU threshold. (A) Check backflow pressure (B) Check pressure relief valve and metering unit. (C) Change components if necessary
523615	3	594	135	Fuel metering unit: the current drain measured by ECU is above the target range	short circuit to battery high side	Threshold for error detection is an internal ECU threshold. Check wiring harness and metering unit if necessary repair/replace it.
523615	3	596	135	Fuel metering unit: the current drain measured by ECU is above the target range	short circuit to battery low side	Threshold for error detection is an internal ECU threshold. Check wiring harness and metering unit if necessary repair/replace it.
523615	4	595	135	Fuel metering unit: the current drain measured by ECU is above the target range	short circuit to ground high side	Threshold for error detection is an internal ECU threshold. Check wiring harness and metering unit if necessary repair/replace it.
523615	4	597	135	Fuel metering unit: the current drain measured by ECU is above the target range	short circuit to ground low side	Threshold for error detection is an internal ECU threshold. Check wiring harness and metering unit if necessary repair/replace it.
523615	5	592	135	Detecting an open load fault in the metering unit	wiring harness defective, cable break	Threshold for error detection is an internal ECU threshold. Check wiring harness and metering unit if necessary repair/replace it.
523615	12	593	135	powerstage of metering unit is overheated	over temperature	Threshold for error detection is an internal ECU threshold. Check functionality of metering unit and replace it if needed. Check temperature of metering unit and improve the installation in case of overheating.
523632	3	1127	665	Urea supply module pressure sensor: the current drain measured by ECU is above the target range	Shortcut to battery Broken wiring Pressure sensor in urea supply module defect	Check wiring Check pressure sensor in urea supply module
523632	4	1128	665	Urea supply module pressure sensor: the current drain measured by ECU is above the target range The sensed raw voltage value SCR_uRawUPmpP is above SCR_SRCUPmpP.uMin_C	Shortcut to ground Broken wiring Pressure sensor in urea supply module defect	Check wiring Check pressure sensor in urea supply module
523632	11	1117	666	Urea supply module pump: the current drain measured by ECU is above the target range	When the pump motor does not switch to pump actuation mode after temperature measurement has been carried out.	Threshold for error is an internal ECU threshold

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
523698	11	122	591	Shut off request from supervisory monitoring function	Engine Shut Off due to supervisory function	Threshold for error detection is an internal ECU threshold. Check error memory for additional errorcode to find root cause. Depending on additional error follow the documented "Take action for repair".
523718	3	1100	676	Urea heater relay: the current drain measured by ECU is above the target range	Shortcut to battery If this error detected during the heating phase it is a result error: KWP 1089 Broken wiring, broken relay	Threshold for error detection is an internal ECU threshold Check wiring Check SCR main relay
523718	4	1101	676	Urea heater relay: the current drain measured by ECU is above the target range	Shortcut to ground If this error detected during the heating phase it is a result error: KWP 1089 Broken wiring, broken relay	Threshold for error detection is an internal ECU threshold Check wiring Check SCR main relay
523718	5	1098	676	Urea heater relay: the current drain measured by ECU is above the target range	Open load If this error detected during the heating phase it is a result error: KWP 1089 Broken wiring broken relay	Threshold for error detection is an internal ECU threshold Test SCR main relay Check cabling, if necessary replace relay.
523719	4	1109	672	Urea supply module heater: the current drain measured by ECU is above the target range	Shortcut to ground If this error detected during the heating phase it is a result error: KWP 1089 Broken wiring Heating element in supply module defect	Threshold for error detection is an internal ECU threshold Check wiring Check cabling, if necessary replace supply module
523719	5	1106	672	Urea supply module heater: the current drain measured by ECU is above the target range	Open load If this error detected during the heating phase is a result error: KWP 1089 Broken wiring Heating element in supply module defect	Threshold for error detection is an internal ECU threshold Check wiring Check cabling, if necessary replace supply module
523720	8	925	148	Supply module heater: Duration of switch on is too long.	uty cycle for temperature readout from supply module heater to the control unit is out of range; Supply modul defect, fault in the wiring.	When the received supply module heater temperature duty cycle SCR_rSMT is out of the failurerange (SCR_rSMFailMax_C < SCR_rSMHtrT < SCR_rSMFailMin_C) Supply module check and replace if necessary. Check the wiring.
523720	8	926	148	Supply module heater: Dutycycle timing over error threshold.	Duty cycle for temperature readout from supply module heater to the control unit is not valid. Supply modul defect, fault in the wiring.	When the received supply module heater duty cycle SCR_rSMHtrT is in the valid range (SCR_r- Supply module check and replace if necessary. Check the wiring.
523721	8	930	689	Supply module heater: Dutycycle timing over error threshold.	Duty cycle for temperature readout from supply module to the control unit is out of range. Supply modul defect, fault in the wiring.	Supply module check and replace if necessary. Check the wiring.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
523721	8	931	689	Supply module heater: Dutycycle timing out of valid range.	Duty cycle for temperature readout from supply module to the control unit is not valid. Supply modul defect, fault in the wiring.	When the received supply module duty cycle SCR_rSMT is in the valid range (SCR_rSMTVld-Min_C <= SCR_rSMT <= SCR_rSMTVldMax_C), OR in the failure range (SCR_rSMFailMin_C <=SCR_rSMT <= SCR_rSMFailMax_C) Supply module check and replace if necessary. Check wiring.
523721	11	927	689	Supply module heater: temperature measurement not available.	Duty cycle for temperature readout from supply module heater to the control unit is not available. Supply modul defect, fault in the wiring.	Threshold for detection is an internal ECU threshold. No erasing in the current driving cycle. Supply module check and replace if necessary. Check the wiring.
523722	8	929	691	Supply module heater: Faulty PWM signal from supply module.	PWM Signal for temperature readout from supply module to the control unit is not valid. Supply modul defect, fault in the wiring.	Threshold for error detection is an internal ECU threshold. When valid Sync followed by temperature information signal is received AND valid sync and temperaturesignal for both information is received one after the other. Supply module check and replace if necessary. Check the wiring.
523776	9	291	119	Timeout Error of CAN-Receive-Frame TSC1TE - active	Timeout Error (Missing CAN Bus message)	Threshold for error detection is an internal ECU threshold. Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range.
523777	9	292	119	Message TSC1-TE has been missing (passive)	Passive timeout Error (Missing CAN Bus message)	Check CAN Bus cabling (Bus scheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range, check actuator
523895	13	559	1-5-8	Missing or wrong injector adjustment value programming (IMA) injector 1 (in firing order).	Missing or wrong injector adjustment value for cyl. 1.	Threshold for error detection is an internal ECU threshold. Check correct injector adjustment value (IMA). Use SERDIA UseCase to check it.
523896	13	560	1-5-8	Missing or wrong injector adjustment value programming (IMA) injector 2 (in firing order).	Missing or wrong injector adjustment value for cyl. 2	Threshold for error detection is an internal ECU threshold. check dataset and flash correct injector adjustement value (IMA). Use SERDIA UseCase to check it.
523897	13	561	1-5-8	Missing or wrong injector adjustment value programming (IMA) injector 3 (in firing order).	Missing or wrong parametrisation of injector adjustment cyl. 3.	Threshold for error detection is an internal ECU threshold. Check correct injector adjustment value (IMA).
523898	13	562	1-5-8	Missing or wrong injector adjustment value programming (IMA) injector 4 (in firing order).	Missing or wrong injector adjustment value for cyl. 4.	Threshold for error detection is an internal ECU threshold. Check correct injector adjustment value (IMA).
523899	13	563	1-5-8	Missing or wrong injector adjustment value programming (IMA) injector 5 (in firing order).	Missing or wrong injector adjustment value for cyl. 5.	Threshold for error detection is an internal ECU threshold. Check correct injector adjustment value (IMA).

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
523900	13	564	1-5-8	Missing or wrong injector adjustment value programming (IMA) injector 6 (in firing order).	Missing or wrong injector adjustment value for cyl. 6.	Threshold for error detection is an internal ECU threshold. Check correct injector adjustment value (IMA).
523912	4	73	7-2-2	@ engines < 4l: Throttle valve error, Open Load or Short cut to Battery, blocked valve or wrong control signal for valve. @ engines with Burner T4i: Pressure Sensor error after valve (DV2), lower limit reached	The sensed raw voltage value is below the minimum threshold.	The sensed raw voltage value DPM_uRawBrnDVDsP is above the minimum threshold DPM_SRCBrnDVDsP.uMin_C @ CRT < 4l: check throttle valve @ engines with Burner T4i: check back-pressure valve
523924	4	42	167	Overload at Pins O_V_RH2x: A01, K74, K91. Components on A01, K74, K91 cannot be activated. Internal ECU power stage switched off.	Suspected components: 1- Pin K91: Clutch switch, Brake switch, Engine brake demand, Regeneration activation, Parking brake, Gearbox N, Fan control 1 2- Pin K74: Boost air cooler bypass or electrical fuel pump relay, Fan control 2/fuel valve for flame star	Threshold for error detection is an internal ECU threshold. Check wiring harness and connected loads on pins A01, K74, K91 and/or reflash ECU. If error is still present, exchange ECU.
523925	3	38	731	Short circuit to battery error of actuator relay 2. Components on Pin A88, K57 cannot be activated. Internal ECU power stage switched off.	Suspected Components: 1- Lamps K57: Warn Ash Charge, Diagnostic, Warn Coolant Temp/Level, Warn Oil, Warn Boost Air, Warn Air Filter, Warn Water in Fuel, SCR, Regeneration, Engine Running. 2- Relay Preheat A88 3- Exhaust Flap A88	Check wiring harness and connected loads on pins A88, K57.
523925	4	43	731	Short circuit to ground actuator relais 3 Overload at Pins O_V_RH3x: A88, K57	Suspected components: 1- Pin A88: Preheat relay, Exhaust flap 2- Pin K 57: - control lamps: - OBD, preheat lamp, warning temp., warning oil, maintenance lamp, regeneration indicator, alternator management, engine running, diagnostic	Threshold for error detection is an internal ECU threshold. Check wiring harness and connected loads on pinsA88, K57. If error is still present, exchange ECU.
523926	4	44	732	Short circuit to ground aktuator relais 4. Overload at Pins O_V_PCV: A90	Suspected components: Fan, Wiring harness	Threshold for error detection is an internal ECU threshold. Check wiring harness and connected loads on pin A90. If error is still present, exchange ECU.
523927	3	40	733	Short circuit to battery error of actuator relay 2. Components on Pin A04, A05 cannot be activated. Internal ECU power stage switched off.	Suspected Components: 1- Urea Pump A04 2- SCR Heater A05	Check wiring harness and connected loads on pins A04, A05.
523935	12	168	763	Timeout Error of CAN-Transmit-Frame EEC3VOL1; Engine send messages	Fault is detected if a TimeOut of the EEC3VOL1 frame has occured.	Check wiring harness and customer nodes
523936	12	169	764	Timeout Error of CAN-Transmit-Frame EEC3VOL2; Engine send messages	Timeout Error (Missing CAN Bus message)	Check wiring harness and customer nodes

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
523938	9	133	766	Timeout Error (BAM to packet) for CAN-Receive-Frame AT1IGCVol1 information; factors & Sensorcalibration for NOX Sensor (SCR-system upstream cat; DPF-system downstream cat)	Failure of the CAN Bus message	NOX sensor and sensor connection check
523939	9	134	766	Broadcast Announce Message of the calibration message of the upstream catalytic NOx sensor has failed. Timeout Error (BAM to BAM) for CAN-Receive-Frame AT1IGCVol1 information. factors & Sensorcalibration for NOX Sensor (SCR-system upstream cat, DPF-system downstream cat).	Defective Nox sensor, faulty parameterization	NOX sensor and sensor connection check
523940	9	135	766	Timeout Error (PCK2PCK) for CAN-Receive-Frame AT1IGCVol1 information; factors & Sensorcalibration for NOX Sensor (SCR-system upstream cat; DPF-system downstream cat)	Failure of the CAN Bus message	NOX sensor and sensor connection check
523941	9	140	767	Timeout Error (BAM to packet) for CAN-Receive-Frame AT1OGCVol2 information; factors & Sensorcalibration for NOX Sensor (SCR-system downstream cat; DPF-system downstream cat)	Timeout Error (Missing CAN Bus message)	NOX downstream sensor and sensor connection check
523942	9	141	767	Timeout Error (BAM to BAM) for CAN-Receive-Frame AT1OGCVol2 information, Calibration message 1 of the after catalyst NOx sensor has failed. Factors & Sensorcalibration for NOX Sensor (SCR-system downstream cat, DPF-system downstream cat)	Defective Nox sensor, faulty parameterization.	NOX downstream sensor and sensor connection check.
523943	9	142	767	Timeout Error (PCK2PCK) for CAN-Receive-Frame AT1OGCVol2 information; factors & Sensorcalibration for NOX Sensor (SCR-system downstream cat; DPF-system downstream cat)	The fault is detected when a timeout error in packet 2 of NOxSenVol2Rx frame occurs.	NOX downstream sensor and sensor connection check
523960	0	1011	771	Physical range check high for EGR cooler downstream temperature.	Sensed temperature downstream EGR-cooler > limit.	EGR-Valve blocked open EGR-Valve actuator defect EGR-cooler defect (check for coolant water) Reed Valve defect Intake throttle blocked in closed position Exhaust pressure too high Check Nox-sensor upstream SCR catalyst dp venturi sensor defect
523960	1	1012	771	Physical range check low for EGR cooler downstream temperature.	sensor voltage > lower limit	EGR-Valve blocked open EGR-Valve actuator defect EGR-cooler defect (check for coolant water) Reed Valve defect Intake throttle blocked in closed position Exhaust pressure too high Check Nox-sensor upstream SCR catalyst dp venturi sensor defect

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
523982	0	360	737	Powerstage diagnosis disabled; Indicating that battery voltage is not high.	Powerstage diagnostic can be deactivated due to too high battery voltage.	Check wiring, check alternator, check cables and repair or replace if necessary.
523982	1	361	737	Powerstage diagnosis disabled; Indicating that battery voltage is not low.	Powerstage diagnostic can be deactivated due to too low battery voltage.	Check wiring, check alternator, check cables and repair or replace if necessary.
523984	3	1239	788	Actuator relay 5: the voltage measured by ECU is out of the target range	Short-Circuit to battery to component	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU
523986	4	1241	176	Actuator relay 4: the voltage measured by ECU is out of the target range	Short-Circuit to ground to component	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU
523987	4	1242	791	Actuator relay 5: the voltage measured by ECU is out of the target range	Short-Circuit to ground to component	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU
524050	11	1434	8-3-6	CAN; not used	not used	not used
524051	11	1435	8-3-7	CAN; not used	not used	not used
524057	2	1505	8-4-3	Low fuel pressure: the low fuel pressure calculated by ECU is underneath the target range; the ECU activates a system reaction	Fuel pressure below warning threshold	Threshold for error detection is an internal ECU threshold. Check low fuel pressure system (fuel feed pump, relay , fuse, wiring, sensor) and if necessary repair or replace it.
524063	3	1558	869	SCR heater mainrelay; short circuit to battery Threshold 1 < SCRHtr_rUHtrMeasRatio_mp < Threshold 2	Short-Circuit to battery on wiring to component	Check wiring, component
524063	4	1559	869	Connection between heating valve (Y31) on the control unit Pin A:92 and Load side SCR heater main relay (K31) is a short cut to ground. Threshold 1 < SCRHtr_rUHtrMeasRatio_mp < Threshold 2	Faulty wiring, faulty heater relay (K27-K31), defective heating valve (Y31), broken element in heating.	Disconnect plug from heating valve (Y31) and reset fault. If fault is still present you have to look in the wiring of Y31 to the control unit Pin A:92. If error is no longer present, you have to check the wiring of Y31 via relay K31 and possibly the heating cables and relay (K27-K30).
524063	5	1555	869	Urea backflow line heater: broken wiring detected Threshold 1 < SCRHtr_rUHtrMeasRatio_mp < Threshold 2	Open Load on wiring to component	Check wiring, component
524063	5	1556	869	Urea main relay: broken wiring detected Threshold 1 < SCRHtr_rUHtrMeasRatio_mp < Threshold 2	relay defect relay not connected wiring harness broken problems with supply voltage	Check wiring, component
524063	5	1557	869	Urea pressure line heater: broken wiring detected Threshold 1 < SCRHtr_rUHtrMeasRatio_mp < Threshold 2	Open load on wiring to component	Check wiring, component
524063	5	1560	869	SCR relay for suction line not connected Threshold 1 < SCRHtr_rUHtrMeasRatio_mp < Threshold 2	relay defect relay not connected wiring harness broken problems with supply voltage	Check wiring, component

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
524063	5	1561	869	Open load on wiring to component Threshold 1 < SCRHtr_rUHtrMeasRatio_mp < Threshold 2	Open load on wiring to component	Check wiring, component
524063	5	1562	869	SCR heater tank; open load	Open load on wiring to component	Check wiring, component
524063	12	1646	869	SCR supply module temperature is not reaching a threshold before a calibratable time is exceeded. Corresponding to the environmental Temperature a specific defrosting time is given. After starting the defrosting a clock counter is starting. Does the counter reach the given defrosting time limit, an error will be detected. Is the temperature reached in time the clock counter will be reset Example: by using the calibrated temperature/time curve --> environmental temperature 0°C --> defrosting time limit 6000s --> if the clock counter reaches 6000s the error will be detected	Suspected components: Enviroment temperature sensor defect SCR supply module temperature sensor defect SCR supply module electrical heater defect	Check Environment temperature sensor SCR supply module temperature sensor SCR supply module electrical heater
524065	0	1565	892	The relativ pressure value of the exhaust gas from the urea cat upstream sensor is greater than an applicable maximum pressure threshold	sensed presure upstream SCR catalyst > physical high range limit f(exhaust volume flow) UCatUsP_pRelFlt_mp > UCatUsP_pMax_mp	Check for crystallisation in exhaust line upstream SCR and dwnstream of urea injector Check correct connection from exhaust line to pressure sensor upstream SCR catalyst: syphons?, water in tube?, water in sensor? Check that exhaust pipe outlet is free (downstream SCR catalyst) Check wiring of pressure sensor upstream SCR catalyst Check pressure sensor upstream SCR catalyst: sensor has no connection to vehicle body? => Ensure that sensor is free Does sensor oscillate heavely at engine low idle / high idle? => try to supress the oscillating Exchange pressure sensor upstream SCR catalyst Check calculated exhaust volume flow of engine within EDC: SCR_dvolSCRUs pausible? If not: Check T sensor upstream SCR catalyst, check complete engine air path: EGR-Valve, Intake throttle, turbocharger, piping for leakage and function Check SCR catalyst: Broken? Exchange SCR-Catalyst

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
524065	1	1566	892	The relativ pressure value of the exhaust gas from the urea cat upstream sensor is less than an applicable minimum pressure threshold	sensed presure upstream SCR catalyst > physical high range limit f(exhaust volume flow) UCatUsP_pRelFlt_mp < UCatUsP_pMin_mp	Check correct connection from exhaust line to pressure sensor upstream SCR catalyst: leakage? Check electric connector: 4h pin open / new connector type used? pressure exchange from inside electrical connector with the environemt possible Check exhaust line: any leakages upstream of SCR catalyst? Check wiring of pressure sensor upstream SCR catalyst Exchange pressure sensor upstream SCR catalyst Check calculated exhaust volume flow of engine within EDC: SCR_dvolSCRUs pausible? If not: Check T sensor upstream SCR catalyst, check complete engine air path: EGR-Valve, Intake throttle, turbocharger, piping for leakage and function Check SCR catalyst: Broken? Exchange SCR-Catalyst
524065	2	1598	892	Comparison of urea cat upstream exhaust gas- and environment pressure, the difference should not exceed a certain limit abs(UCatUsP_pDiffEnvCat_mp) > Threshold	absolut value of difference between sensed pressure upstream SCR catalyst and environmental pressure > limit abs(UCatUsP_pDiffEnvCat_mp) > Threshold	Check electric connector: 4h pin open / new connector type used? pressure exchange from inside electrical connector with the environemt possible? water in sensor? sensor frozen? Check wiring of pressure sensor upstream SCR catalyst Exchange pressure sensor upstream SCR catalyst Check intake manifold pressure sensor (Air_pCACDs) Check ambient pressure sensor (EnvP_p)
524065	3	1569	892	voltage of pressure sensor upstream SCR > voltage high limit	voltage of pressure sensor upstream SCR > voltage high limit	Check wiring of pressure sensor upstream SCR catalyst Check pressure sensor upstream SCR catalyst Exchange pressure sensor upstream SCR catalyst
524065	4	1570	892	voltage of pressure sensor upstream SCR < voltage low limit	voltage of pressure sensor upstream SCR < voltage low limit	Check wiring of pressure sensor upstream SCR catalyst. Check pressure sensor upstream SCR catalyst. Exchange pressure sensor upstream SCR catalyst

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
524067	0	1581	894	Filtered urea supply module heater temperature value is above an applicable maximum heater temperature threshold of the supply module The temperature is read out via the PWM signal of the urea pump. That is only possible in status init of the SCR-system short after ignition was switched on. When that state is left the sensed temperature value is frozen.	sensed temperature of supply module heater > physical high range limit	Compare SCR_tSMT with SCR_tSMHtrT. Both show the same value? Check urea tank temperature (SCR_tAdapUTnkT). Very hot (> 70°C), urea tank heater permanet on? Does the pump never stop working? Check wiring to supply module Compare SCR_tSMT with SCR_tSMHtrT. Both show different values or urea tank temperature (SCR_tAdapUTnkT) is cold: exchange urea pump unit Supply module heater temperature sensor defect Supply module heater defect Supply module defect
524067	0	1585	894	Filtered urea supply module temperature value (SCR_tSMT) is above an applicable maximum temperature threshold of the supply module The temperature is read out via the PWM signal of the urea pump. That is only possible in status init of the SCR-system short after ignition was switched on. When that state is left the sensed temperature value is frozen.	sensed temperature of urea within supply module > physical high range limit	Compare SCR_tSMT with SCR_tSMHtrT. Both show the same value? Check urea tank temperature (SCR_tAdapUTnkT). Very hot (> 70°C), ure tank heater permanet on? Does the pump never stop working? Check wiring to supply module Compare SCR_tSMT with SCR_tSMHtrT. Both show different values or urea tank temperature (SCR_tAdapUTnkT) is cold: exchange urea pump unit Supply module temperature sensor defect Supply module heater defect Supply module defect
524067	1	1582	894	Filtered urea supply module heater temperature value is below an applicable minimum heater temperature threshold of the supply module The temperature is read out via the PWM signal of the urea pump. That is only possible in status init of the SCR-system short after ignition was switched on. When that state is left the sensed temperature value is frozen.	sensed temperature of supply module heater < threshold	Check ambient temperature EnvT_t < Threshold? Compare SCR_tSMT with SCR_tSMHtrT Check wiring with regard to supply modul heater exchange urea pump unit Supply module heater temperature sensor defect Supply module defect
524067	1	1586	894	Filtered urea supply module temperature (SCR_tSMT) value is below an applicable minimum temperature threshold of the supply module The temperature is read out via the PWM signal of the urea pump. That is only possible in status init of the SCR-system short after ignition was switched on. When that state is left the sensed temperature value is frozen.	sensed temperature of urea within supply module < physical low range limit	Check ambient temperature EnvT_t < threshold? Compare SCR_tSMT with SCR_tSMHtrT Check wiring with regard to supply modul heater exchange urea pump unit Supply module temperature sensor defect Supply module defect

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
524067	2	1867	894	absolute diference of sensed temperature of supply module heater temperature and ambient temperature UPmpT_tDiffPmpHtrAmb_mp > threshold	absolute diference of sensed temperature of supply module heater temperature and ambient temperature UPmpT_tDiffPmpHtrAmb_mp > threshold	Compare SCR_tSMT with SCR_tSMHtrT, EnvT_t and CEngTds_t and SCR_tAdapUTnkT => All identical? If not: Has the machine been brought from cold environment into a warm one or vice versa without engine running, e.g. at workshop? Environment temperature sensor defect Coolant temperature sensor defect Supply module temperature sensor defect Problem at Supply module unit (broken?) => exchange supply module
524067	2	1868	894	absolute diference of sensed temperature of supply module temperature and ambient temperature > threshold	absolute diference of sensed temperature of supply module temperature and ambient temperature UPmpT_tDiffPmpAmb_mp > threshold	Compare SCR_tSMT with SCR_tSMHtrT, EnvT_t and CEngTds_t and SCR_tAdapUTnkT => All identical? If not: Has the machine been brought from cold environment into a warm one or vice versa without engine running, e.g. at workshop? Environment temperature sensor defect Coolant temperature sensor defect Supply module temperature sensor defect Problem at Supply module unit (broken?) => exchange supply module
524074	9	1533	246	Open load sensor internally at NOx-sensor downstream SCR	Open load sensor internally at NOx-sensor downstream SCR	Threshold for error detection is an internal ECU threshold. Check NOx-Sensor downstream SCR catalyst: water inside? Shake out sensor after dismounting. => If water inside, replace sensor. Check mounting position of sensor and judge it regarding condense water formation / agglomeration. Check wiring harness Exchange sensor
524075	11	1534	247	Short circuit sensor internally at NOx-sensor downstream SCR	Short circuit sensor internally at NOx-sensor downstream SCR	Threshold for error detection is an internal ECU threshold. Check NOx-Sensor downstream SCR catalyst: water inside? Shake out sensor after dismounting. => If water inside, replace sensor. Check mounting position of sensor and judge it regarding condense water formation / agglomeration? Rearrange if critical and possible Check wiring harness Exchange sensor

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
524076	9	1535	248	Open line sensor internally at NOx-sensor downstream SCR NOx Sensors are CAN Sensors --> no HW Pin on the ECU	Open line sensor internally at NOx-sensor downstream SCR	Threshold for error detection is an internal ECU threshold. Check NOx-Sensor upstream SCR catalyst: water inside? Shake out sensor after dismounting. => If water inside, replace sensor. Check mounting position of sensor and judge it regarding condense water formation / agglomeration. Check wiring harness Exchange sensor
524077	11	1536	249	Short circuit sensor internally at NOx-sensor downstream SCR NOx Sensors are CAN Sensors --> no HW Pin on the ECU	Short circuit sensor internally at NOx-sensor downstream SCR	Threshold for error detection is an internal ECU threshold. Check NOx-Sensor upstream SCR catalyst: water inside? Shake out sensor after dismounting. => If water inside, replace sensor. Check mounting position of sensor and judge it regarding condense water formation / agglomeration. Check wiring harness Exchange sensor
524078	9	1537	255	Lambda value of NOx-Sensor downstream SCR is out of range. When the filtered Lambda concentration value at the sensor (ComRxSCR_rFltLamDs_mp) is greater than the physical range check max. lambda threshold	sensed lambda value of Nox-sensor downstream SCR catalyst is > physical high limit ComRxSCR_rCanLamDs_mp > threshold	Check whether NOx-sensor downstream SCR catalyst is physically mounted within the exhaust line Check Lambda values of NOx-sensor downstream SCR catalystat at idle conditions, ComRxSCR_rCanLamDs_mp > threshold? Compare to ComRxSCR_rCanLamUs_mp. Values must be almost identical Check CANBus of NOx-sensor downstream SCR catalyst Check NOx-sensor downstream SCR catalyst wiring Check NOx-sensor downstream SCR catalyst itself Replace NOx-sensor downstream SCR catalyst

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
524079	9	1538	256	sensed lambda value of NOx-sensor downstream SCR catalyst is < physical low limit ComRxSCR_rCanLamDs_mp < threshold	sensed lambda value of NOx-sensor downstream SCR catalyst is < physical low limit ComRxSCR_rCanLamDs_mp < threshold	Compare to ComRxSCR_rCanLamUs_mp. ComRxSCR_rCanLamDs_mp must be almost identical! If almost identical, Check air path of engine: EGR-Valve, Intake-Throttle, Turbocharger and Piping each for leakage and correct function Check injection system of engine. Injector stuck? if sensed lambda upstream SCR higher (ComRxSCR_rCanLamUs_mp) : Diesel in Urea-tank? Check CANBus of NOx-sensor downstream SCR catalyst Check NOx-sensor downstream SCR catalyst wiring Check NOx-sensor downstream SCR catalyst itself Replace NOx-sensor downstream SCR catalyst
524080	9	1539	257	sensed lambda value of Nox-sensor upstream SCR catalyst is > physical high limit ComRxSCR_rCanLamUs_mp > Threshold	sensed lambda value of Nox-sensor upstream SCR catalyst is > physical high limit ComRxSCR_rCanLamUs_mp > Threshold	Check whether NOx-sensor upstream SCR catalyst is physically mounted within the exhaust line Check Lambda values of NOx-sensor upstream SCR catalystat at idle conditions, ComRxSCR_rCanLamUs_mp < Threshold? Compare to ComRxSCR_rCanLamDs_mp. Must be almost identical Check CANBus of NOx-sensor upstream SCR catalyst Check NOx-sensor upstream SCR catalyst wiring Check NOx-sensor upstream SCR catalyst itself Replace NOx-sensor upstream SCR catalyst
524081	9	1540	258	sensed lambda value of Nox-sensor upstream SCR catalyst is < physical low limit ComRxSCR_rCanLamUs_mp < Threshold	sensed lambda value of Nox-sensor upstream SCR catalyst is < physical low limit ComRxSCR_rCanLamUs_mp < Threshold	Check air path of engine: EGR-Valve, Intake-Throttle, Turbocharger and Piping each for leakage and correct function Check injection system of engine. Injector stuck? Check CANBus of NOx-sensor upstream SCR catalyst Check NOx-sensor upstream SCR catalyst wiring Check NOx-sensor upstream SCR catalyst itself Replace NOx-sensor upstream SCR catalyst
524083	9	1542	261	sensed NOx-value of NOx-sensor downstream SCR catalyst < Threshold	sensed Nox-value of Nox-sensor downstream SCR catalyst < physical low limit	Check CANBus of NOx-sensor downstream SCR catalyst Check NOx-sensor downstream SCR catalyst wiring Check NOx-sensor downstream SCR catalyst itself Replace NOx-sensor downstream SCR catalyst

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
524085	9	1544	912	sensed Nox-value of Nox-sensor upstream SCR catalyst < Threshold	sensed Nox-value of Nox-sensor upstream SCR catalyst < physical low limit	Check CANBus of NOx-sensor upstream SCR catalyst Check NOx-sensor upstream SCR catalyst wiring Check NOx-sensor upstream SCR catalyst itself Replace NOx-sensor upstream SCR catalyst
524100	9	1666	924	Timeout error of CAN-Transmit-Frame Com-DPFHisDat.	Open load on CANBUS wiring.	Check wiring, component.
524104	9	1676	928	Timeout error of CAN-Receive-Frame Com-RxDPFCtl. CM1 Module Customer Recieve Message.	Time out of Check CANBUS EAT Control Receive Message, PGN65348. The message is not received.	Threshold for error detection is an internal ECU threshold. Check CANBUS EAT Control Receive Message, PGN65348. CM1 Module Customer Recieve Message.
524118	9	1672	9-4-2	Timeout error of CAN-Receive-Frame ComRxCM1	If the frame CM1 message is not transmitted successfully	Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range.
524121	9	1683	9-4-5	Timeout error of CAN-Receive-Frame Com-RxTrbChActr	Timeout Error (Missing CAN Bus message)	Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range.
524125	9	1687	9-4-9	Timeout error of CAN-Receive-Frame Com-TxTrbChActr	Timeout Error (Missing CAN Bus message)	Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range.
524141	7	1827	192	DEF dosing valve is blocked with crystalized urea or other deposits.	While SCR system is starting up and fter urea pressure reaches 10000 hPa, the DEF dosing module is tested. Expectation is that urea pressure drops below 1500 hPa if injector works properly. The test is repeated up to 3 times before an error is set. SCRSysPresMon_stPresDropDet_mp = 0 while SCRCo_stStatus_mp = 16. Suspected component: wiring harness DEF dosing valve The error is stored into the EEPROM of the ECU and status at ECU shut down is regained at ignition on.	Check electrical connection of urea injector: - wiring harness - connector Conduct SERDIA use-case "injection test". If it is faulty: - remove urea injector from exhaust line: - check for crystallisation direct on injector nozzle / plate - rinse it thoroughly in water - remount urea injector and conduct SERDIA use-case "injection test" If the error is still active, then exchange urea injector.
524141	7	1858	192	DEF dosing valve is blocked with crystalized urea or other deposits.	While SCR system is starting up and fter urea pressure reaches 10000 hPa, the DEF dosing module is tested. Expectation is that urea pressure drops below 1500 hPa if injector works properly. The test is repeated up to 3 times before an error is set. SCRSysPresMon_stPresDropDet_mp = 0 while SCRCo_stStatus_mp = 16. Suspected component: wiring harness DEF dosing valve The error is stored into the EEPROM of the ECU and status at ECU shut down is regained at ignition on.	Check electrical connection of urea injector: - wiring harness - connector Conduct SERDIA use-case "injection test". If it is faulty: - remove urea injector from exhaust line: - check for crystallisation direct on injector nozzle / plate - rinse it thoroughly in water - remount urea injector and conduct SERDIA use-case "injection test" If the error is still active, then exchange urea injector.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
524147	13	1639	966	No proper urea pressure level could be build up within the SCR system state "Fill Lines" => SCRCo_stStatus_mp = 1 within some miuntes	This error shows up, if no proper urea pressure level could be build up within the SCR system state "Fill Lines" => SCRCo_stStatus_mp = 1 within some minutes Once the urea pump pressure has exceeded the threshold the error is declared as okay. Suspected components: Suction line blocked PWM Powerstage has a defect and a default value which leads not to a rising pressure Pump Pressure sensor defect pump filter contains dirty parts reverting valve continously open	Make sure that frozen lines, pump or tank can be excluded! Check whether there is urea in the urea tank Check urea lines: All lines connected? The right lines connected to the correct places? Suction line blocked? No leakage? Not also urea to the outside but also air into the lines, especially in the suction line! Perform service routine "pressure test": Does the urea pump work? => check wiring harness & PWM signal for pump Does the urea pressure rise? DFC already healed? If all unsuccessful so far: Check urea pressure sensor: At ignition on and SCR system state = 0 ("Init check"), SCR_pAbsAdapUPmpP shall be identical to EnvP_p. Fulfilled: Sensor okay! Check reverting valve => see DFC_SCRCoRevVlvBlk Check pump filter: dirt inside? Suspected components: Urea pump broken Reverting valve continously open Urea suction line, backflow line broken or connection swapped PWM Powerstage has a defect Pump Pressure sensor broken
524152	2	1874	971	CAN message is not received for a definite time => error is set. As soon as the message is received the error heals.	CAN message is not received for a definite time => error is set. As soon as the message is received the error heals.	Check eletrical connection oif urea quality sensor Check engine CAN bus Check urea quality sensor itself Exchange urea quality sensor
524153	2	1875	997	CAN message is not reseived for a definite time => error is set. As soon as the message is received the error heals.	CAN message is not reseived for a definite time => error is set. As soon as the message is received the error heals.	Check eletrical connection of suction unit sensor (combined sensor with tank level and tank temperature) Check engine CAN bus Check level sensor itself Exchange suction unit
524156	9	1705	972	Timeout error of CAN-Receive-Frame ComRxEBC2 from wheel speed sensor.	Timeout Error (Missing CAN Bus message) Defect on wheel speed sensor.	Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range. Replace the wheel speed sensor.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
524177	7	1863	995	The error shows up, if no proper urea presure could be build up within the SCR system state "Fill Lines" => SCRCo_stStatus_mp = 1.	This error shows up, if no proper urea presure could be build up within the SCR system state "Fill Lines" => SCRCo_stStatus_mp = 1. 3 cases can lead to the error: Case A: increasing pressure is detected within 15s the check has passed => no error Case B: The pressure threshold was not reached within the 60s but case A was not positiv. Case C: The minimum pressure of 3000 hPa was not reached within the 60s.	Make sure that DEF lines, pump and tank are not frozen. Check for DEF level in the tank. Check DEF lines: Are all DEF lines connected? Is the suction line blocked? Is ther any leakage? Not only urea to the outside but also air into the lines, especially in the suction line! Perform SERDIA usecase "pressure test": Does the DEF pump work? => check wiring harness & PWM signal for pump. Does the urea pressure increase? All errors are already healed? If still unsuccessful so far: Check urea pressure sensor: At ignition on and SCR system state = 0 ("Init check"), SCR_pAbsAdapUPmpP shall be identical to EnvP_p. Fulfilled: Sensor okay! Check DEF pump filter: Is any dirt inside? Suspected components: Suction line PWM Powerstage has a defect and a default value which leads not to a rising pressure DEF pump pressure sensor defect DEF pump filter contains dirty parts

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
524178	7	1864	996	The urea pump is not able to control the urea pressure between 9bar and 11 bar.	The urea pump controller is not able to control the urea pressure between 9bar and 11 bar due to malfunction in the SCR system. Suspected components: - DEF pump broken - Reverting valve continously open - Urea suction line, backflow line broken or connection swapped - PWM Powerstage has a defect - Pump Pressure sensor broken	Make sure that DEF lines, pump and tank are not frozen. Check for DEF level in the tank Check DEF lines: All lines connected? The right lines connected to the correct places? Suction line blocked? Is there any leakage? Not also urea to the outside but also air into the lines, especially in the suction line! Perform SERDIA usecase "pressure test": Does the DEF pump work properly? => check wiring harness & PWM signal for pump Does the DEF pressure rise? Is the error healed? If still unsuccessful so far: - Check DEF pressure sensor: At ignition on and SCR system state = 0 ("Init check"), SCR_pAbsAdapUPmpP shall be identical to EnvP_p. Fulfilled: Sensor okay! - Check reverting valve - Check DEF pump filter: dirt inside? Suspected components: DEF pump broken Reverting valve continously open DEF suction line, backflow line broken or connection swapped PWM Powerstage has a defect DEF pump pressure sensor broken
524190	14	1891	272	Not enough urea in tank or low urea quality or hardware tampering failure is detected or hardware failure is detected	Low DEF tank level Low DEF quality Hardware Tampering is active Hardware Failure is active	Check DEF level in tank. If there is no DEF, refill up to volume above the warning threshold. Check the DEF quality in the tank. If wrong fluid is filled, refill with proper DEF. Check other errors based on hardware malfunctions.
524191	14	1892	273	A low DEF tank level or a low DEF quality is detected or hardware tampering(system components are pinched off) or hardware failures as shortcut to battery, shortcut to ground etc. are detected.	Low DEF tank level Low DEF quality Hardware Tampering is active Hardware Failure is active	Threshold for error detection is an internal ECU threshold. Check the DEF level in tank. If there is no DEF, refill up above the warning level. Check DEF quality filled in the tank. Check other errors based on hardware tampering or failure.

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
524193	8	1893	275	The total time in standstill-regeneration mode exceeds the long-limit threshold within last 500h total engine run time. The error is activated if the engine runs to many times in Standstill regeneartion.	Stand-still mode is very often aborted by the operator. Stand-still mode does not reach required temperature level and regeneration level is therefore reached after a short time again	Read out stand-still statistics => see service manual: Stand-still operation finished or often interrupted by driver / engine shut-off? => Run stand-still and instruct operator Stand-still operation required often by soot load => Check dp DPF pressure sensor Stand-still mode does not reach required temperature level: Check engine air path: Intake Trottle, EGR-Valve and turbocharger okay? Any leakage in engine air intake sytem or exhaust gas system? Check temperature sensors within exhaust system: upstream DOC, downstream DOC If soot load level of DPf allow it: Perform Stand-still and check reached temperature level upstream and downstream DOC: T upstream DOC in the range of 480-550°C? Downstream DOC after 25 min stand-still main phase 590°C are reached? Temerature traces are steady and even? Temperature downstream DOC higher than upstream DOC but difference does not exceed 100 K? Very small difference (< 10 K after 25 min stand-still main phase, 590 °C downstream DOC are not reached) => exchange DOC Very big difference (>100 K after 25 min stand-still main phase, 590 °C downstream DOC exceeded) => check injection system of engine & engine air path

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
524194	8	1894	276	The total time in standstill-regeneration mode exceeds the long-limit threshold: 2,5h stand-still operation within 50h total motor run time. The error is activated if the engine runs to much time in short Standstill regeneartion.	Stand-still mode is aborted / interrupted too often by the operator Stand-still is required too often due to miscalculation in the soot model Stand-still mode does not reache temperature level and regeneration level is therefore reached after a short time again.	Read out stand-still statistics => see service manual: Stand-still operation finished or often interrupted by driver / engine shut-off? => Run stand-still and instruct operator Stand-still operation required often by soot load => Check dp DPF pressure sensor Stand-still mode does not reach required temperature level: Check engine air path: Intake Trottle, EGR-Valve and turbocharger okay? Any leakage in engine air intake sytem or exhaust gas system? Check temperature sensors within exhaust system: upstream DOC, downstream DOC If soot load level of DPF allows it: Perform Stand-still and check reached temperature level upstream and downstream DOC: T upstream DOC in the range of 480-550°C? Downstream DOC after 25 min stand-still main phase 590°C are reached? Temerature traces are steady and even? Temperature downstream DOC higher than upstream DOC but difference does not exceed 100 K? Very small difference (< 10 K after 25 min stand-still main phase, 590 °C downstream DOC are not reached) => exchange DOC Very big difference (>100 K after 25 min stand-still main phase, 590 °C downstream DOC exceeded) => check injection system of engine & engine air path

Table 3-13. Engine Fault Codes

SPN	FMI	Deutz Code	Blink Code	Description	Possible Cause	Action
524195	14	1900	279	The standstill request of detected crystallization is ignored for more than 5h(>300min) This will be activated if there is a standstill request activated by Crystalisation Monitoring.	Back pressure upstream SCR catalyst has reached a level which indicates crystallisation inside of exhaust line. The error detection depends on the sensed pressure upstream of the SCR catalyst and the calculated exhaust volume flow through the mixer pipe. In case of error is set, but no crystallisation can be found in the mixing pipe, a possible reason can be the defect sensors: - exhaust pressure & temperature upstream of the SCR catalyst, - the ambient pressure - the exhaust mass flow => Check air path system at the engine.	Dismount urea injector from exhaust line and inspect visually the injector and the exhaust line for urea crystallisation upstream of SCR catalyst: If crystallisation can be clearly seen, then stand-still must be processed. Has the engine been operated in low load for longer time? If yes, then it could be the reaoson for crystallisation. Does the NOx-Sensors work properly? Compare ComRxSCR_rNOxUs to ComRxSCR_rNOxDs, when ComRxSCR_stNOxRdyUs = 1 & ComRxSCR_stNOxRdyDs = 1 (Warm engine and EAT-system, SCRT_tCatAvrgExhGs_mp > 250°C, SCR_stStatus = "Dosing" = 8): sensed NOx upstream of SCR catalyst must be higher than downstream of SCR catalyst. Go to idle and wait until SCR system enters status "stand-by" (no dosing), SCRT_tCatAvrgExhGs_mp < 225°C: ComRxSCR_rNOxUs = ComRxSCR_rNOxDs Clean urea injector: rinse it thourougly under water Check EGR-Path: difference pressure sensor at venturi tube, EGR cooler, EGR-Valve, Reed-Valve, Intake throttle regarding function and leakage. Does the EGR-cooler leak water in the exhaust? Check air path for leakage Check turbocharger No crystallisation can be seen in the mixing pipe: Check exhaust pressure sensor upstream of SCR catalyst (SCR_pSensUCatUsP): tube, water in sensor? Check environmental pressure sensor (EnvP_p): plausible? Check exhaust temperature sensor upstream of SCR-catalyst (SCR_tSensUCatUsT): plausible compared to Exh_tOxiCatUs & Exh_tOxiCatDs e.g. when engine has idled for 20 minutes? => Run stand-still to remove crystallisation and to reset the DFC
5232719	3	1108	672	Urea supply module heater: the current drain measured by ECU is above the target range	Short circuit to battery If this error detected during the heating phase it is a result error:KWP 1089 Broken wiring Heating element in supply module defect	Threshold for error detection is an internal ECU threshold Check wiring Check cabling, if necessary replace supply module

3.22 GM ENGINE GENERAL MAINTENANCE

Maintenance of the Drive Belt

The serpentine drive belt utilizes a spring loaded tensioner which keeps the belt properly adjusted. The drive belt is an integral part of the cooling and charging systems and should be inspected frequently.

When inspecting the belts check for:

- Cracks or breaks
- Chunking of the belt
- Splits
- Material hanging from the belt
- Glazing and hardening
- Damaged or improperly aligned pulleys
- Improperly performing tensioner

Check the belt tensioner by pressing down on the midway point of the longest stretch between pulleys. The belt should not depress beyond 1/2 inch (13mm). If the depression is more than allowable adjust the tension.

NOTICE

THE ENGINE MANUFACTURER DOES NOT RECOMMEND THE USE OF "BELT DRESSING" OR "ANTI SLIPPING AGENTS" ON THE DRIVE BELT.

Engine Electrical System Maintenance

The engine electrical system incorporates computers and microprocessors to control the engine ignition, fuel control, and emissions. Due to the sensitivity of the computers to good electrical connections periodic inspection of the electrical wiring is necessary. When inspecting the electrical system use the following:

- Check and clean the battery terminal connections and insure the connections are tight
- Check the battery for any cracks or damage to the case
- Check the Positive and Negative battery cables for any corrosion build up, rubbing or chafing, check connection on the chassis to insure they are tight
- Check the entire engine wire harness for rubbing chafing, cuts or damaged connections, repair if necessary
- Check all wire harness connectors to insure they are fully seated and locked
- Check ignition coil and spark plug cables for hardening, cracking, chafing, separation, split boot covers and proper fit
- Replace spark plugs at the proper intervals as prescribed in the engine manufacturer's manual
- Check to make sure all electrical components are fitted securely
- Check the ground and platform control stations to insure all warning indicator lights are functioning

Checking/Filling Engine Oil Level

NOTICE

AN OVERFILLED CRANKCASE (OIL LEVEL OVER THE SPECIFIED FULL MARK) CAN CAUSE AN OIL LEAK, A FLUCTUATION OR DROP IN THE OIL PRESSURE, AND ROCKER ARM "CLATTER" IN THE ENGINE.

NOTICE

CARE MUST BE TAKEN WHEN CHECKING THE ENGINE OIL LEVEL. OIL LEVEL MUST BE MAINTAINED BETWEEN THE "ADD" MARK AND "FULL" MARK ON THE DIPSTICK.

To ensure that you are not getting a false reading, make sure the following steps are taken to before check the oil level.

1. Stop the engine if in use.
2. Allow sufficient time (approximately 5 minutes) for the oil to drain back into the oil pan.
3. Remove the dipstick. Wipe with a clean cloth or paper towel and reinstall. Push the dipstick all the way into the dipstick tube.
4. Remove the dipstick and note the oil level.
5. Oil level must be between the "FULL" and "ADD" marks.

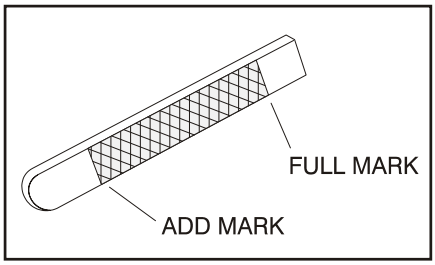


Figure 3-95. Engine Oil Dip Stick

6. If the oil level is below the "ADD" mark, proceed to Step 7 and 8 and reinstall the dipstick into the dipstick tube.
7. Remove the oil filter cap from the valve rocker arm cover.
8. Add the required amount of oil to bring the level up to but not over "FULL" mark on the dipstick.
9. Reinstall the oil fill cap to the valve rocker cover and wipe away any excess oil.

Changing The Engine Oil

NOTICE

WHEN CHANGING THE OIL, ALWAYS CHANGE THE OIL FILTER. CHANGE OIL WHEN THE ENGINE IS WARM FROM OPERATION AS THE OILS WILL FLOW FREELY AND CARRY AWAY MORE IMPURITIES.

To change the oil use the following steps:

1. Start the engine and run until it reaches normal operating temperature.
2. Stop the engine.
3. Remove the drain plug and allow the oil to drain.
4. Remove and discard the oil filter and its sealing ring.
5. Coat the sealing ring on the filter with clean engine oil and wipe the sealing surface on the filter mounting surface to remove any dust, dirt and debris. Tighten the filter securely (follow the filter manufacturers instructions). Do not over tighten.
6. Check the sealing ring on drain plug for any damage, replace if necessary, wipe the plug with a clean rag, and wipe the sealing surface on the pan and reinstall the pan plug. Do not over tighten.
7. Fill the crankcase with oil.
8. Start the engine and check for oil leaks.
9. Stop the engine and check the oil level to insure the oil level is at "FULL".
10. Dispose of the oil and filter in a safe manner.

Coolant Fill Procedure - Dual Fuel Engine

NOTICE

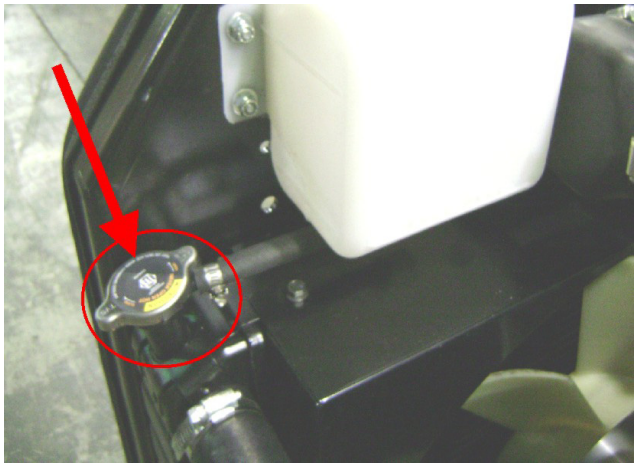
DAMAGE TO THE ENGINE COULD OCCUR IF NOT PROPERLY FILLED WITH COOLANT. LPG FUELED ENGINES ARE MOST PRONE TO CREATING AN AIR LOCK DURING A COOLANT FILL OPERATION DUE TO THE ELECTRONIC PRESSURE REGULATOR (EPR) BEING THE HIGHEST POINT IN THE COOLING SYSTEM. AN EPR THAT APPEARS TO HAVE FROST FORMING ON IT IS A SIGN THAT THE ENGINE COOLING SYSTEM CONTAINS AIR. THE APPEARANCE AND TEMPERATURE OF THE EPR SHOULD BE MONITORED DURING THE COOLANT FILL OPERATION. A WARM EPR IS AN INDICATION THAT THE COOLING SYSTEM IS PROPERLY FILLED AND FUNCTIONING.

⚠ CAUTION

MAKE SURE ENGINE IS COOL BEFORE PERFORMING ANY MAINTENANCE WORK.

1. Loosen the worm gear clamp on the coolant line running into the EPR as shown below and remove the hose from the EPR. Place a rag under the hose to prevent coolant from running onto the engine/machine.

2. Remove the radiator cap. Fill the radiator with coolant until coolant starts to appear from the previously removed hose at the EPR. Reinstall the hose back onto the EPR and continue to fill radiator with coolant.



3. With the radiator cap still removed, start the engine and run until the thermostat opens. The thermostat opens at 170° F (77° C), which can be checked using the JLG handheld analyzer.

NOTICE

WHILE ENGINE IS RUNNING, AIR AND/OR STEAM MAY BE PRESENT COMING FROM THE RADIATOR. THIS IS NORMAL.

4. After running the engine for 5 minutes after it has reached operating temperature, shut the engine off and continue to step 5.

⚠ CAUTION

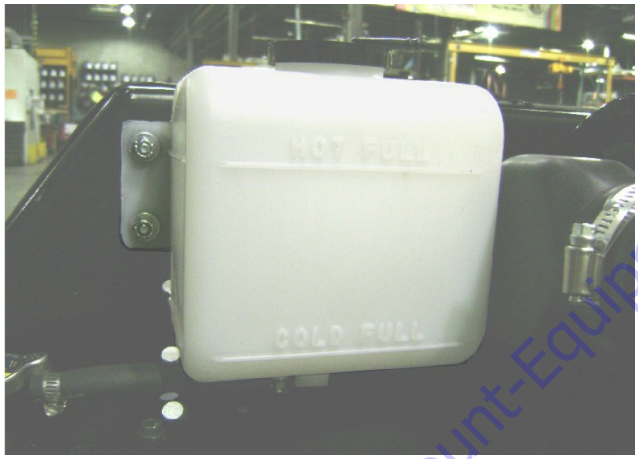
WITH THE ENGINE RUNNING OR WHEN SHUTTING OFF THE ENGINE, SOME HEATED COOLANT MAY SPILL OUT DUE TO AIR "BURPING" OUT OF THE SYSTEM WITH THE RADIATOR CAP OFF.

5. Next, verify that the 2 coolant hoses on the EPR are warm. If they are not warm repeat step 3 and 4, otherwise continue to step 6.

NOTICE

A PROPERLY PURGED COOLING SYSTEM WILL YIELD A WARM UPPER RADIATOR HOSE AND A WARM EPR HOSE. IF THE UPPER RADIATOR HOSE AND/OR EPR HOSE ARE NOT WARM TO THE TOUCH AFTER THE ENGINE HAS RUN FOR 5-8 MINUTES AFTER REACHING OPERATING TEMPERATURE, THE SYSTEM MAY STILL CONTAIN AIR. IT MAY BE NECESSARY TO REPEAT THE ABOVE STEPS.

6. Fill radiator with coolant as needed and install the radiator cap. Next, remove the cap off the coolant recovery bottle and fill just below the HOT FULL line and reinstall the caps.



3.23 GM ENGINE DUAL FUEL SYSTEM

NOTE: *+20° F (-6.6° C) is the low temperature limit for LP gas, for both starting and operation. This applies to all LP gas powered engines.*

The Dual Fuel system allows the operator to operate the vehicle on either gasoline or LPG by positioning a selector switch in the operator's platform. When the operator places the selector switch in the gasoline mode the gasoline fuel pump is energized. While in the gasoline mode the LPG fuel lock-off is isolated and will not energize. In addition the gasoline injector circuit is enabled and injector pulses are provided to each injector and the ECM calibration for gasoline is also enabled. When the operator selects the LPG mode the Low Pressure LPG lock-off is energized and fuel from the LPG tank flows to the Electronic Pressure Regulator (EPR). The EPR receives an electronic signal to position the secondary lever for the start or run positions and when the engine begins to crank the mixer air valve will rise and fuel will begin flowing to engine. During this mode the gasoline fuel pump is isolated and will not be activated. The primary components of the gasoline dual fuel system are the gasoline tank, electric fuel pump and filter, fuel supply line, injector rail and injectors and the fuel pressure regulator. The primary components of the LPG dual fuel system are the LPG fuel tank, in-fuel filter, LPG Low Pressure lock-off, Electronic Pressure Regulator (EPR) and the fuel mixer module. The LPG fuel system operates at pressures which range from 14.0 inches (355.60 mm) of water column up to 312 psi (21.5 BAR).

Components which are shared by both systems include the Electronic Throttle Control and the ECM. The ECM contains a dual calibration; one controls the gasoline fuel system during gasoline operation and one controls the LPG fuel system during LPG operation.

Fuel Filter

Propane fuel like all other motor fuels is subject to contamination from outside sources. Refueling of the equipment's tank and removal of the tank from the equipment can inadvertently introduce dirt and other foreign matter into the fuel system. It is therefore necessary to filter the fuel prior to entering the fuel system components downstream of the tank. An inline fuel filter has been installed in the fuel system to remove the dirt and foreign matter from the fuel. The inline filter is replaceable as a unit only. Maintenance of the filter is critical to proper operation of the fuel system and should be replaced as Section 1. In severe operating condition more frequent replacement of the filter may be necessary.

Electric Lock Off

The Electric Lock Off device is an integrated assembly. When energized the solenoid opens the valve and allows the Propane fuel to flow through the device. The valve opens during cranking and run cycles of the engine. The lock off supply voltage is controlled by the engine control module (ECM).

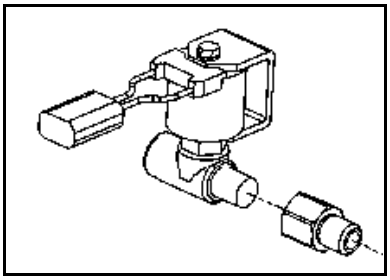
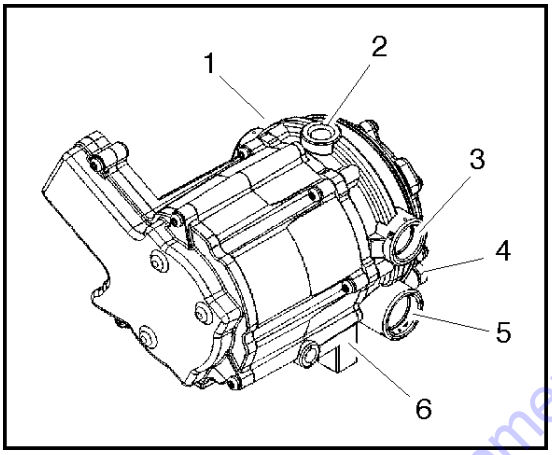


Figure 3-96. Electric Fuel Lock Off

EPR Assembly

The EPR assembly is a combination Low Pressure Regulator and a Voice Coil Assembly. The Voice coil is an electronic actuator which is controlled by an internal microprocessor. The microprocessor provides output data to the ECM and receives input data over a CAN BUS connection. The internal microprocessor receives electrical signals from the Fuel Pressure Sensor FPS and the Fuel Temperature Pressure FTP and communicates the data to the ECM. The ECM uses the FPS and FTP data to calculate the location of the secondary lever in the LPR and sends that data back to the EPR via the CAN BUS. The internal microprocessor in the EPR will then output a signal, which causes the voice coil to move and position the secondary lever to the correct location.



1. Pressure Regulator Section
2. Fuel Inlet
3. Coolant Passage
4. Primary Test Port
5. Secondary Test Port
6. Voice Coil Section

Figure 3-97. EPR Assembly

Low Pressure Regulator (LPR)

The LPR is a combination vaporizer, pressure regulating device. The LPR is a negative pressure, two stage regulator that is normally closed when the engine is not running. When the engine is cranking or running, a partial vacuum is created in the fuel line which connects the regulator to the mixer. This partial vacuum opens the regulator permitting fuel to flow to the mixer.

Propane fuel enters the primary port of the LPR and passes through the primary jet and into the primary/ exchanger chamber. As the propane passes through the heat exchanger the fuel expands and creates pressure inside the chamber. The pressure rises as the fuel expands when the pressure rises above 1.5 psi (10.34 kpa), sufficient pressure is exerted on the primary diaphragm to cause the diaphragm plate to pivot and press against the primary valve pin thus closing off the flow of fuel. This action causes the flow of fuel into the regulator to be regulated.

When the engine is cranking, sufficient vacuum will be introduced into the secondary chamber from the mixer drawing the secondary diaphragm down onto the spring loaded lever and opening the secondary valve allowing vaporized fuel to pass to the mixer. This mechanical action in conjunction with the EPR reactions causes the downward action on the secondary lever causing it to open wider allowing more fuel to flow to the mixer.

⚠ WARNING

THE VOICE COIL SECTION OF THE EPR ASSEMBLY IS AN EMISSIONS CONTROL DEVICE AND CANNOT BE REBUILT. IF THE COIL ASSEMBLY FAILS TO OPERATE PROPERLY, REPLACE IT WITH AN OEM REPLACEMENT PART ONLY.

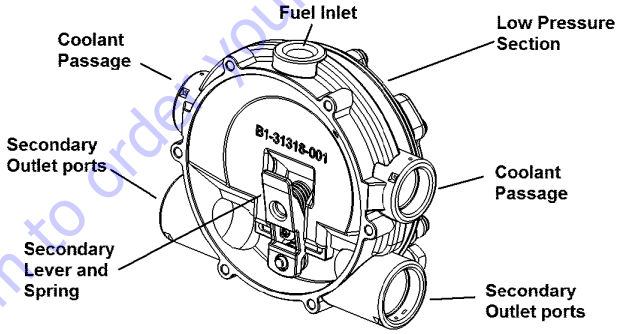


Figure 3-98. Low Pressure Regulators

Air Fuel Mixer

The air valve mixer is an air-fuel metering device and is completely self-contained. The mixer is an air valve design, utilizing a relatively constant pressure drop to draw fuel into the mixer from cranking to full load. The mixer is mounted in the air stream ahead of the throttle control device.

When the engine begins to crank, it draws in air with the air valve covering the inlet, negative pressure begins to build. This negative pressure signal is communicated to the top of the air valve chamber through 4 vacuum ports in the air valve assembly. A pressure/force imbalance begins to build across the air valve diaphragm between the air valve vacuum chamber and the atmospheric pressure below the diaphragm. The air valve vacuum spring is calibrated to generate from 4.0 inches (101.6 mm) of water column at start to as high as 14.0 inches (355.60 mm) of water column at full throttle. The vacuum being created is referred to as Air Valve Vacuum (AVV). As the air valve vacuum reaches 4.0 inches (101.6mm) of water column, the air valve begins to lift against the air valve spring. The amount of AVV generated is a direct result of the throttle position. At low engine speed the air valve vacuum is low and the air valve position is low thus creating a small venturi for the fuel to flow. As the engine speed increase the AVV increases and the air valve is lifted higher thus creating a much larger venturi. This air valve vacuum is communicated from the mixer venture to the LPR secondary chamber via the low pressure fuel supply hose. As the AVV increases in the secondary chamber the secondary diaphragm is drawn further down forcing the secondary valve lever to open wider.

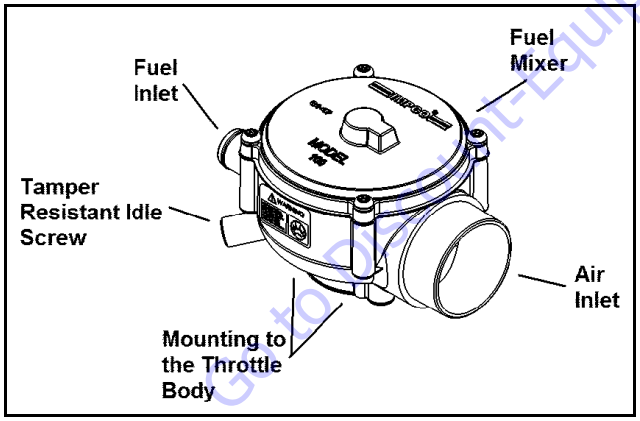


Figure 3-99. Air Fuel Mixer

Electronic Throttle Control (ETC)

Engine speed and load control is maintained by an ETC device. Speed and load control are determined by the ECM. Defaults programmed into the ECM software and throttle position sensors allow the ECM to maintain safe operating control over the engine. The Electronic Throttle Control device or "throttle body assembly" is connected to the intake manifold of the engine. The electronic throttle control device utilizes an electric motor connected to the throttle shaft. When the engine is running electrical signals are sent from the equipment controls to the engine ECM when the operator depresses an equipment function switch. The ECM then sends an electrical signal to the motor on the electronic throttle control to increase or decrease the angle of the throttle blade thus increasing or decreasing the air/fuel flow to the engine.

The electronic throttle control device also incorporates two internal Throttle Position Sensors (TPS) which provide output signals to the ECM as to the location of the throttle shaft and blade. The TPS information is used by the ECM to correct speed and load control as well as emission control.

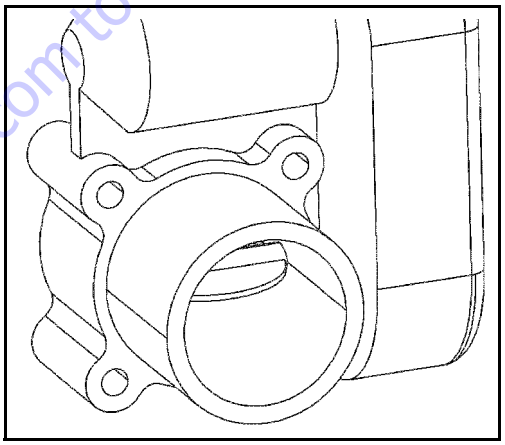


Figure 3-100. ETC throttle control device

Engine Control Module

To obtain maximum effect from the catalyst and accurate control of the air fuel ratio the emission certified engine is equipped with an onboard computer or Engine Control Unit (ECM). The ECM is a 32 bit controller which receives input data from sensors fitted to the engine and fuel system and then outputs various signals to control engine operation.

One specific function of the controller is to maintain "closed loop fuel control". Closed loop fuel control is accomplished when the exhaust gas oxygen sensor (HEGO) mounted in the exhaust system sends a voltage signal to the controller. The controller then calculates any correction that may need to be made to the air fuel ratio. The controller then outputs signals to the EPR to correct the amount of fuel being supplied to the mixer. At the same time the ECM may correct the throttle blade position to correct speed and load of the engine.

The controller also performs diagnostic functions on the fuel system and notifies the operator of malfunctions by turning on a Malfunction Indicator Light (MIL) mounted in the Ground Control Station and the Platform Control Station. Malfunctions in the system are identified by a Diagnostic Code number. In addition to notifying the operator of the malfunction in the system the controller also stores the information about the malfunction in its memory.

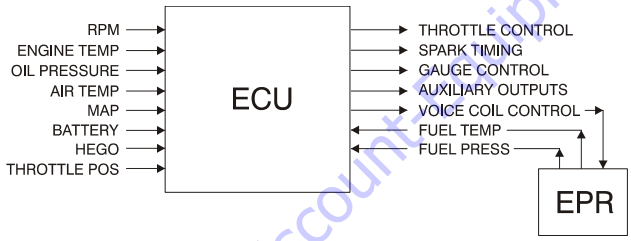


Figure 3-101. LPG Engine Control Unit (ECM)

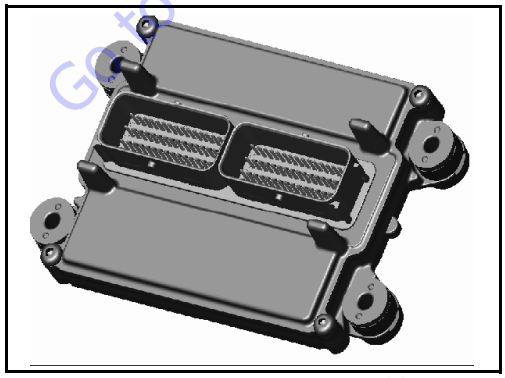


Figure 3-102. ECM Assembly

Heated Exhaust Gas Oxygen Sensor

There are two Heated Exhaust Gas Oxygen Sensors (HEGO). The first HEGO is mounted in the exhaust system downstream of the engine. It is used to measure the amount of oxygen present in the exhaust stream and communicate that to the ECM via an electrical signal. The amount of oxygen present in the exhaust stream indicates whether the fuel/air ratio is too rich or too lean. If the HEGO sensor signal indicates that the exhaust stream is too rich the ECM will decrease or lean the fuel mixture during engine operation, if the mixture is too lean the ECM will richen the mixture. The ECM continuously monitors the HEGO sensor output. If a rich or lean condition is present for an extended period of time, and the ECM cannot correct the condition, the ECM will set a diagnostic code and turn on the MIL light in control box.

The second HEGO is mounted in the exhaust system after the muffler. It measures the amount of oxygen in the exhaust system after the catalyst treatment has been completed in the muffler. If the ECM detects that the catalytic action in the muffler is not sufficient and fuel correction cannot correct the malfunction the MIL light is illuminated in the control box and a DTC code will stored in the computer.

NOTICE

THE HEATED EXHAUST GAS OXYGEN SENSOR IS AN EMISSION CONTROL DEVICE. IF THE HEGO FAILS TO OPERATE, REPLACE IT WITH AN OEM REPLACEMENT PART. THE HEGO SENSOR IS SENSITIVE TO SILICONE OR SILICONE BASED PRODUCTS AND CAN BECOME CONTAMINATED. AVOID USING SILICONE SEALERS OR HOSES TREATED WITH SILICONE LUBRICANTS IN THE AIR STREAM OR FUEL LINES.

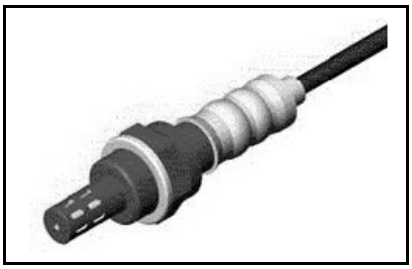


Figure 3-103. Heated Exhaust Gas Oxygen Sensor (HEGO)

Gasoline Multi Point Fuel Injection System (MPFI)

The primary components of the Gasoline Multi Point Fuel Injection (MPFI) fuel system are the fuel tank, electric fuel pump, fuel pressure and temperature sensor manifold, fuel filter and fuel rail.

Gasoline Fuel Pump

The Gasoline is stored as a liquid in the fuel tank and in drawn into the fuel system by an electric fuel pump. The fuel pump will receive a signal from the ECM to prime the fuel system for approximately 2 seconds prior to start. Priming of the fuel system provides for a quicker start, when the engine begins to crank.

Gasoline Pressure And Temperature Sensor Manifold

This engine is equipped with a fuel injector rail that does not have a pressure regulator or a return circuit to the fuel tank. Fuel pressure for this engine is regulated by the engine's ECM. The ECM receive fuel pressure and temperature feedback from the gasoline fuel sensor manifold and uses this information to control the ground side of the fuel pump. Fuel pressure is regulated by the ECM pulse width modulating (PWM) the fuel pump. The fuel pressure and temperature sensor manifold has a return or "bleed" circuit that connects back to the fuel tank. This circuit is used to bleed off any vapor that develops in the line and return a small amount of fuel to the tank. The fuel comes from the fuel tank and passes through the fuel pump. Fuel exits the fuel pump, passes through the filter and then enters the fuel pressure and temperature manifold assembly. Fuel flows through the feed circuit and is delivered to the fuel injector rail. Fuel that enters the bleed circuits through they bypass valve in the manifold is returned to the fuel tank.

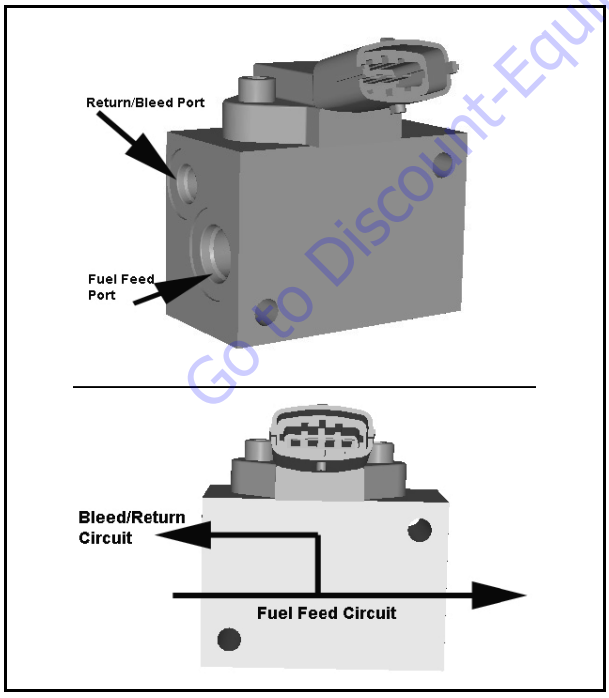


Figure 3-104. Gasoline Fuel Pressure and Temperature Manifold Assembly

Fuel Filter

After the fuel is drawn into the fuel pump, the fuel flows through the gasoline fuel filter. The fuel filter will trap small particles as the fuel passes through the filter to remove debris and prevents the fuel pressure and temperature manifold and fuel injectors from becoming damaged. Maintenance of the fuel filter is required as indicated in Section 1.

Fuel Injector Rail

Fuel flows from the fuel pressure and temperature manifold assembly to the fuel rails where the fuel is delivered to the fuel injectors. The fuel rail also contains a Schrader valve which is utilized to test the regulated pressure of the fuel system.

Fuel Injector

The fuel supply is maintained on the top of the injector from the injector rail. The injector is fed a "pulse" signal through the wire harness which causes the injector to open. During regular operating conditions the ECM controls the opening and duration of opening of the injector. During lower RPM operation the injector signals or "pulses" are less frequent then when the engine is operating at higher RPMs. The engine has been calibrated to deliver the precise amount of fuel for optimum performance and emission control.

3.24 GM ENGINE FUEL SYSTEM REPAIR

Propane Fuel System Pressure Relief

⚠ CAUTION

THE PROPANE FUEL SYSTEM OPERATES AT PRESSURES UP TO 312 PSI (21.5 BAR). TO MINIMIZE THE RISK OF FIRE AND PERSONAL INJURY, RELIEVE THE PROPANE FUEL SYSTEM PRESSURE (WHERE APPLICABLE) BEFORE SERVICING THE PROPANE FUEL SYSTEM COMPONENTS.

To relieve propane fuel system pressure:

1. Close the manual shut-off valve on the propane fuel tank.
2. Start and run the vehicle until the engine stalls.
3. Turn the ignition switch OFF.

NOTICE

RESIDUAL VAPOR PRESSURE WILL BE PRESENT IN THE FUEL SYSTEM. ENSURE THE WORK AREA IS WELL VENTILATED BEFORE DISCONNECTING ANY FUEL LINE.

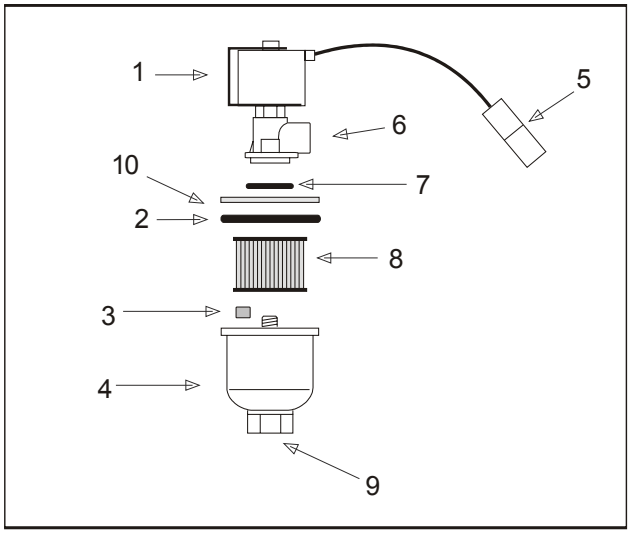
Propane Fuel System Leak Test

⚠ CAUTION

NEVER USE AN OPEN FLAME OF ANY TYPE TO CHECK FOR PROPANE FUEL SYSTEM LEAKS.

Always inspect the propane fuel system for leaks after performing service. Check for leaks at the fittings of the serviced or replaced component. Use a commercially available liquid leak detector or an electronic leak detector. When using both methods, use the electronic leak detector first to avoid contamination by the liquid leak detector.

Propane Fuel Filter Replacement



1. Electric Lock Off Solenoid
2. Housing Seal
3. Filter Magnet
4. Filter Housing
5. Electrical Connector
6. Fuel Outlet
7. O-ring
8. Filter
9. Fuel Inlet
10. Ring

Figure 3-105. Filter Lock Assembly

REMOVAL

1. Relieve the propane fuel system pressure. Refer to Propane Fuel System Pressure Relief.
2. Disconnect the negative battery cable.
3. Slowly loosen the Filter housing and remove it.
4. Pull the filter housing from the Electric lock off assembly.
5. Remove the filter from the housing.
6. Locate Filter magnet and remove it.
7. Remove and discard the housing seal.
8. If equipped, remove and discard the retaining bolt seal.
9. Remove and discard mounting plate to lock off O-ring seal.

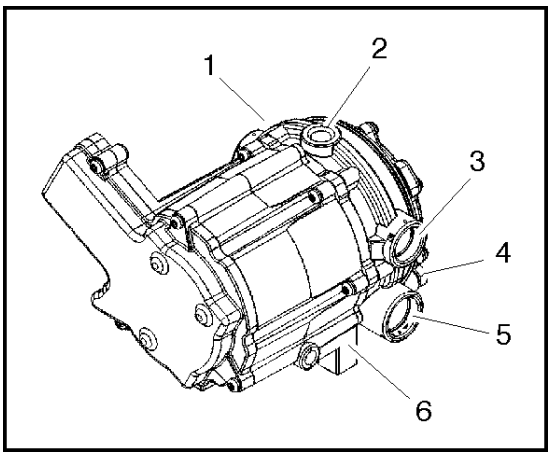
INSTALLATION

NOTICE

BE SURE TO REINSTALL THE FILTER MAGNET INTO THE HOUSING BEFORE INSTALLING NEW SEAL

1. Install the mounting plate to lock off O-ring seal.
2. If equipped, install the retaining bolt seal.
3. Install the housing seal.
4. Drop the magnet into the bottom of the filter housing.
5. Install the filter into the housing.
6. If equipped, install the retaining bolt into the filter housing.
7. Install the filter up to the bottom of the electric lock off.
8. Tighten the filter bowl retainer to 106 in lbs (12 Nm).
9. Open manual shut-off valve. Start the vehicle and leak check the propane fuel system at each serviced fitting. Refer to Propane Fuel System Leak Test.

Electronic Pressure Regulator (EPR) Assembly Replacement



1. Pressure Regulator Section
2. Fuel Inlet
3. Coolant Passage
4. Primary Test Port
5. Secondary Test Port
6. Voice Coil Section

Figure 3-106. EPR Assembly

The EPR assembly is a made up of two separate components. The Voice Coil Section is not serviceable and can only be replaced as an assembly. The pressure regulator section is serviceable and will be detailed in this section.

REMOVAL

1. Relieve the propane fuel system pressure. Refer to Propane Fuel System Pressure Relief.
2. Disconnect the negative battery cable.
3. Slowly remove the fuel inlet fitting at the Electric Lock Off.

NOTE: *Residual vapor pressure will be present in the fuel system.*

4. Disconnect the electrical connector to the Electric Lock off.
5. Remove the Electric Lock Off from the regulator.
6. Remove the lock pin from the vapor fitting on the regulator housing and remove the fitting and hose and retain the pin.
7. Remove the lock pin from the pressure sensor on the regulator housing and remove the Sensor and retain the pin.
8. Using a clamp pliers pinch off the hoses on the coolant lines to the regulator.
9. Remove the lock pin from both the water fittings on the regulator housing and remove the fittings and hoses and retain the pin.
10. Disconnect the EPR electrical connector.
11. Remove the (3) three nuts from the EPR isolators and the EPR mounting bracket.
12. Remove the EPR from the bracket.
13. Remove the (3) three mounting isolators.

INSTALLATION

NOTICE

DO NOT USE TEFLON TAPE ON ANY FUEL FITTING. USE A LIQUID PIPE THREAD SEALANT WHEN INSTALLING FITTINGS.

CHECK ALL THE O-RINGS ON THE VAPOR AND WATER FITTINGS FOR ANY DAMAGE REPLACE IF NECESSARY.

LUBE ALL THE O-RINGS WITH AN O-RING LUBE BEFORE INSTALLING.

1. Install the three (3) rubber isolators to the bottom of the EPR
2. Install the EPR assembly to the bracket and tighten the retaining nuts.

NOTE: *Do not over tighten the isolators and cause a separation of the isolators.*

3. Install the fuel temperature sensor into the regulator opening and lock in place with the locking pin, connect the electrical connector.
4. Insert the fuel vapor line and fitting into the regulator port and lock in place with the locking pin.
5. Install both the water hoses and fittings into the regulator and lock in place with the locking pin remove the clamp pliers from the hoses.
6. Install the electric lock off into the regulator inlet and tighten into proper location, connect the electrical connector.
7. Connect the fuel supply line and tighten until fully seated.
8. Connect the EPR electrical connector.
9. Open the manual valve.

10. Start the vehicle and leak check the propane fuel system at each serviced fitting Refer to Propane Fuel System Leak Test.

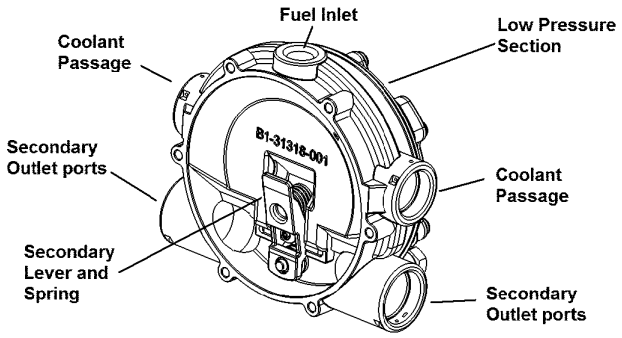


Figure 3-107. Pressure Regulator Section

PRESSURE REGULATOR SECTION REMOVAL

1. Remove the EPR refer to EPR Removal Procedure.
2. Remove the six (6) regulator to voice coil screws using the special tool and separate the regulator from the actuator.

NOTICE

DO NOT REMOVE THE SECONDARY DIAPHRAGM RETAINING PLATE AND DIAPHRAGM THIS WILL VOID THE WARRANTY OF THE ACTUATOR SECTION.

PRESSURE REGULATOR SECTION INSTALLATION

1. Install the regulator to the actuator section using the six (6) retaining screws and tighten 70 in lbs (8 Nm).
2. Install the EPR refer to EPR Installation.

Temperature Manifold Absolute Pressure (TMAP) Sensor

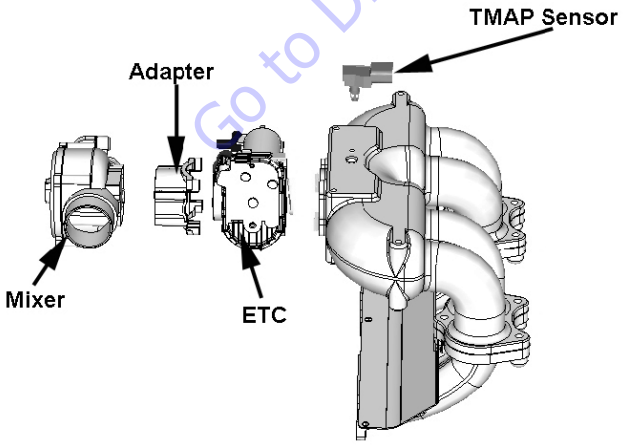


Figure 3-108. (TMAP) Sensor & Electronic Throttle Control (ETC)

REMOVAL

1. Disconnect the TMAP electrical connector.
2. Remove the two retaining bolts.
3. Remove the TMAP.

INSTALLATION

NOTE: *Apply a small amount of O-ring lubricant before installation.*

1. Install in the TMAP.
2. Tighten retaining bolts to 62 lb-in (7 Nm).

Start the vehicle and check for proper operation.

Electronic Throttle Control Replacement

See Figure 3-108.

REMOVAL

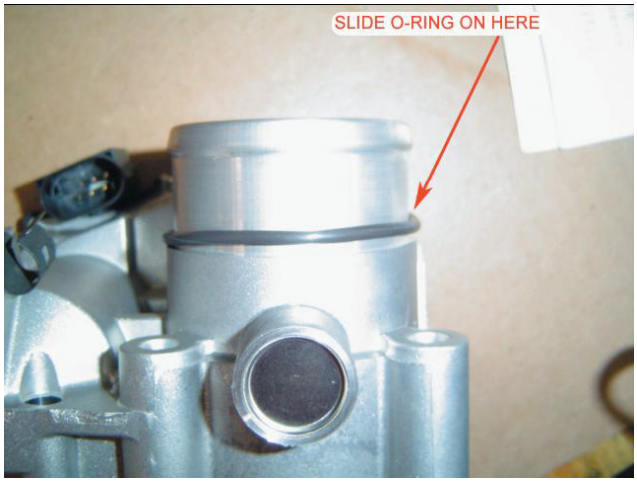
1. Disconnect the negative battery cable.
2. Remove the air intake duct.
3. Release the hose clamp on the vapor fuel line and remove the vapor hose.
4. Disconnect the TMAP electrical connector.
5. Disconnect the electronic throttle control connector.
6. Remove the manifold to throttle body adapter bolts and remove the throttle body mixer assembly.
7. Pull the throttle body assembly from the adapter.
8. Remove electronic throttle control device.
9. Remove the O-rings gasket and discard.

INSTALLATION

NOTICE

LIGHTLY LUBRICATE BOTH THROTTLE CONTROL DEVICE TO ADAPTER O-RINGS.

1. Install the O-ring on throttle body. Press it down to the bottom of the surface.



2. Install the two quad seals. Install one seal at a time to insure the seal does not roll. The seal must sit flat on the throttle body.

3. Attach mixer and throttle body together. The two parts do not bolt together; they will be secured when you mount it on the intake. Notice the orientation of the air inlet and throttle body cover.

4. Place gasket on intake manifold and attach mixer/throttle assembly to manifold.

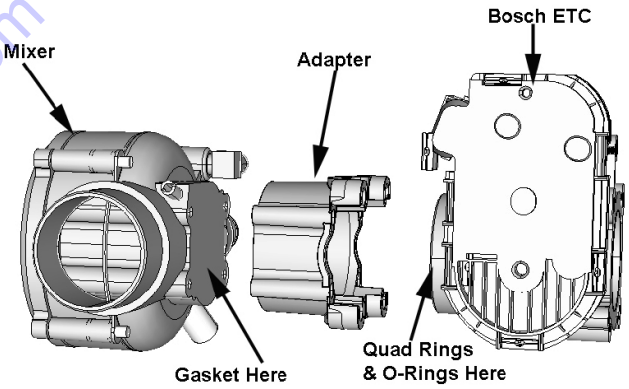


Figure 3-109. Mixer Assembly

Mixer Replacement

See Figure 3-109.

REMOVAL

1. Remove the Throttle control device Refer to Electronic Throttle Body Replacement.
2. Remove the four (4) bolts to the throttle control device to mixer adapter bolts.
3. Remove and discard the mixer to adapter gasket.

INSTALLATION

NOTICE

COVER THROTTLE BODY ADAPTER OPENING TO PREVENT DEBRIS FROM ENTERING ENGINE UNTIL REASSEMBLY.

1. Install Mixer to adapter gasket onto the mixer.
2. Install the mixer to the throttle control device to mixer adapter and secure with the 4 retaining screws. Tighten 80 lb-in (9 Nm).
3. Install Throttle body. Refer to Electronic Throttle Control Device Replacement.
4. Start the engine and leak check all fittings and connections.

Coolant Hose Replacement

REMOVAL

1. Drain the coolant.
2. Using hose clamp pliers, disconnect both hose clamps on each hose.
3. Remove the hose from each of the fittings.

INSTALLATION

NOTE: *Use hose material and lengths specified by JLG.*

1. Install the hose clamps to each hose and set the clamp back on each hose to make installation easier.
2. Fit the hose to the fittings.
3. Secure by positioning each of the clamps.

Vapor Hose Replacement

REMOVAL

1. Using hose clamp pliers disconnect both hose clamps.
2. Remove the vapor hose from each fitting.

INSTALLATION

NOTICE

THE VAPOR SUPPLY HOSE IS SPECIFICALLY DESIGNED, DO NOT USE HOSE MATERIAL OR LENGTH OTHER THAN JLG SPECIFIED PARTS.

1. Install hose clamps and set back on each hose.
2. Reinstall the vapor hose to each fitting.
3. Reset clamps.
4. Start engine and check for leaks.

Engine Control Module Replacement

REMOVAL

1. Disconnect Negative battery cable.
2. Remove controller from mounting bracket.
3. Push connector lock back to unlock connector.
4. Unplug controller and remove.

INSTALLATION

NOTICE

THE CONTROLLER IS CALIBRATED FOR EACH ENGINE VERIFY YOU HAVE THE CORRECT CONTROLLER

1. Plug connector into controller.
2. Push lock into place.
3. Mount controller into mounting bracket.
4. Reconnect the battery cable.
5. Start engine.
6. Check for any DTC codes and clear.
7. Verify engine is in closed loop and no warning lights are illuminated.

Heated Exhaust Gas Oxygen Sensor Replacement

REMOVAL

1. Disconnect Negative battery cable.
2. Disconnect the O2 sensor electrical connector.
3. Using an O2 Sensor socket, remove the O2 Sensor and discard.

INSTALLATION

NOTICE

BEFORE INSTALL THE O2 SENSOR LUBRICATE THREADS WITH ANTI-SEIZE COMPOUND GM P/N 5613695 OR EQUIVALENT. AVOID GETTING COMPOUND ON THE SENSOR TIP.

1. Install O2 sensor. Tighten to 30 ft.lb. (41 Nm).
2. Start engine.
3. Check for any DTC codes and clear.
4. Verify engine is in closed loop and no warning lights are illuminated.

3.25 GM ENGINE LPG FUEL SYSTEM DIAGNOSIS

Fuel System Description

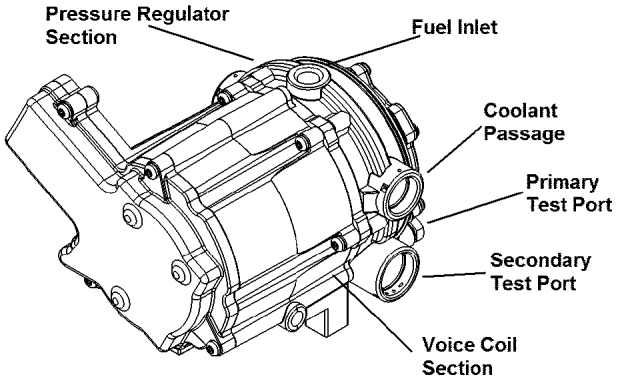


Figure 3-110. EPR Assembly

To maintain fuel and emission control on the LPG fuel system the Engine Control Units (ECM) relies on numerous engine sensor and output data from the Electronic Pressure Regulator (EPR). The ECM will then determine the target fuel calibration and command the EPR to reposition the voice coil to the proper position which, subsequently reposition the secondary lever in the pressure regulator to maintain proper control. The EPR and ECM will continue to communicate back and forth during normal operation.

In the event that the EPR fails to communicate or the Communications Area Network (CAN) cable fails to transmit data the regulator will operate in an open loop configuration. As the air valve vacuum in the mixer venturi is communicated to the secondary chamber of the regulator the secondary diaphragm will be drawn in a downwards motion. This downward motion will cause the secondary lever to open thus allowing more fuel to enter the mixer.

In the (LPR) the fuel is vaporized and the pressure reduced in two stages. The first stage reduces the pressure to approximately 1.0 to 3.0 psi (6.8 to 20.6 kPa). The second stage reduces the pressure to approximately negative 1.5" of water column.

The fuel is then drawn from the secondary chamber of the LPR by the vacuum generated by air flowing through the mixer. This vacuum signal is also used to generate lift for the mixer air valve. This vacuum signal is most commonly referred to as air valve vacuum. In the mixer, the fuel mixes with the air entering the engine. This air/ fuel mixture is then drawn into the engine for combustion.

Diagnostic Aids

This procedure is intended to diagnose a vehicle operating on LPG. If the vehicle will not continue to run on LPG, refer to Hard Start for preliminary checks. Before proceeding with this procedure, verify that the vehicle has a sufficient quantity of fuel and that liquid fuel is being delivered to the LPR. Also, ensure that the manual shut off valve on the LPG tank is fully opened and that the excess flow valve has not been activated.

Tools Required:

- 7/16 Open end wrench (for test port plugs)
- DVOM (GM J 39200, Fluke 88 or equivalent).
- 12 volt test light

Diagnostic Scan Tool

- Diagnostic Display tool.

Pressure Gauges

- IMPCO ITK-2 Test kit
- Water Column Gauge / Manometer (GM 7333-6 or equivalent).
- 0-10 PSI Gauge

Test Description

The numbers below refer to step numbers on the diagnostic table.

5. This step determines if the LPR requires replacement

6. This step determines if the problems are in the mechanical side of the Pressure Regulator or the Electronic Voice Coil

10. This step determines if the Mixer requires replacement

14. This step determines if the Lock Off requires replacement

17. This step determines if the Fuel Filter requires replacement.

Table 3-14. LPG Fuel System Diagnosis

STEP	ACTION	VALUE(S)	YES	NO
1	Were you referred to this procedure by a DTC diagnostic chart?	--	Go to Step 3	Go to Step 2
2	Perform the On Board Diagnostic (OBD) System Check. Are any DTCs present in the ECM?	--	Go to the applicable DTC Table	Go to Step 3
3	Verify that the LPG fuel tank has a minimum of 1/4 tank of fuel, that the manual valve is open and the tank quick connect is fully engaged Does the vehicle have fuel?	--	Go to Step 4	--
4	1. Connect a water column gauge or a manometer to the secondary test port of the low pressure regulator (LPR). 2. Start the engine and allow it to reach operating temperature. Does the engine start and run?	--	Go to Step 5	Go to Step 8
5	With the engine idling, observe the pressure reading for the LPR secondary pressure. Does the fuel pressure fluctuate rhythmically OUTSIDE the specified range?	-1.0" to -2.0" w.c	Go to Step 25	Go to Step 6
6	1. Disconnect the EPR electrical connectors. NOTE: This action will cause a DTC to be set by the ECM 2. With the engine idling observe the pressure reading on the secondary test port. Is the fuel pressure WITHIN the specified range?	-1.0" to -2.0" w.c	Go to Fuel Control System Diagnosis	Go to Step 7
7	1. Inspect the air intake stream between the mixer assembly and the throttle body for leaks. 2. Inspect the fuel hose connection between the LPR and mixer assembly for damage or leakage. 3. Inspect any vacuum hoses for leaks Was a problem found and corrected?	--	Go to Step 26	Go to Step 22
8	1. Connect a water column gauge or a manometer to the secondary test port of the low pressure regulator (LPR). 2. Crank the engine and observe the pressure reading for the LPR secondary pressure. Does the fuel pressure indicate a vacuum is present?	--	Go to Step 12	Go to Step 9
9	1. Remove Air induction hose to the mixer 2. Observe the air valve for movement while the engine is cranking. Note: Movement of the air valve will be minimal at cranking speeds. Does the air valve move when the engine is cranked?	--	Go to Step 11	Go to Step 10
10	1. Inspect the air intake stream to the mixer assembly and the throttle body for vacuum leaks. 2. Inspect the vacuum hoses from the mixer for proper connection and condition. Was a problem found and repaired?	--	Go to Step 26	Go to Step 24
11	Inspect the fuel hose connection between the LPR and the mixer assembly for damage or leakage. Was a problem found and repaired?	--	Go to Step 26	Go to Step 12
12	1. Connect a 0-10 psi gauge to the primary test port of the low pressure regulator (LPR). 2. Crank the engine and observe the pressure reading for the LPR primary pressure. Is the fuel pressure ABOVE the specified value?	1-3 PSI	Go to Step 22	Go to Step 13
13	1. Turn OFF the ignition. 2. Disconnect the LPL connector. 3. Install a test light between the pins of the LPL connector. 4. Crank the engine. The test light should illuminate. Does the test light illuminate?	--	Go to Step 14	Go to Step 16
14	Using a DVOM, check the resistance of the low pressure lock-off (LPL). Is the resistance within the specified range?	12W - 16W	Go to Step 15	Go to Step 23

Table 3-14. LPG Fuel System Diagnosis

STEP	ACTION	VALUE(S)	YES	NO
15	1. Turn the ignition OFF. 2. Close the manual shut-off valve on the LPG tank. CAUTION: When disconnecting LPG fuel lines, liquid LPG may be present. Perform this step in a well ventilated area. 3. Loosen the fuel inlet hose fitting at the inlet of the LPL. Was fuel present when the fitting was loosened?	--	Go to Step 23	Go to Step 17
16	1. Turn OFF the ignition. 2. Connect the test light to chassis ground and probe pin A of the LPL connector. 3. Crank the engine. The test light should illuminate. Does the test light illuminate?	--	Go to Step 20	Go to Step 21
17	1. Remove the LPG fuel filter / LPL. 2. Remove the filter from the LPL. 3. Empty the contents of the inlet side of the LPG fuel filter onto a clean surface. 4. Inspect the contents of the LPG fuel filter for an excessive amount of foreign material or water. If necessary, locate and repair the source of contamination. 5. Verify the LPG fuel filter is not restricted or plugged. Was a problem found?	--	Go to Step 19	Go to Step 18
18	The fuel supply system or hoses are plugged or restricted, locate and repair the problem. Is the action complete?	--	Go to Step 26	--
19	Replace the fuel filter. Refer to Fuel Filter Replacement. Is the action complete?	--	Go to Step 26	--
20	Repair the open in the lock-off ground circuit. Is the action complete?	--	Go to Step 26	--
21	Repair the open in the lock-off power circuit. Is the action complete?	--	Go to Step 26	--
22	Replace the low pressure regulator (LPR). Refer to Low Pressure Regulator Replacement. Is the action complete?	--	Go to Step 26	--
23	Replace the lock-off. Refer to Lock-off Replacement. Is the action complete?	--	Go to Step 26	--
24	Replace the mixer assembly. Refer to Fuel Mixer Replacement. Is the action complete?	--	Go to Step 26	--
25	The fuel supply system is operating normally, if a failure of the control solenoids is suspected. Refer to Fuel Control System Diagnosis. 1. Install the test plug in the LPR secondary chamber. 2. If you were sent to this routine by another diagnostic chart, return to the previous diagnostic procedure. Is the action complete?	--	System OK	--
26	1. Disconnect all test equipment 2. Install the primary and secondary test port plugs. 3. Start the engine. 4. Using SNOOP or equivalent, leak check the test port plugs. Is the action complete?	--	System OK	--

Table 3-15. Symptom Diagnosis

Checks	Action
Important Preliminary Checks	
Before Using This Section	Before using this section, you should have performed On Board Diagnostic Check and determined that: 1. The Control Module and MIL (Malfunction Indicator Lamp) are operating correctly. 2. There are no Diagnostic Trouble Codes (DTCs) stored, or a DTC exists but without a MIL. Several of the following symptom procedures call for a careful visual and physical check. The visual and physical checks are very important. The checks can lead to correcting a problem without further checks that may save valuable time.
LPG Fuel System Check	1. Verify the customer complaint. 2. Locate the correct symptom table. 3. Check the items indicated under that symptom. 4. Operate the vehicle under the conditions the symptom occurs. Verify HEGO switching between lean and rich. **IMPORTANT! Normal HEGO switching indicates the LPG fuel system is in closed loop and operating correctly at that time.**
Visual and Physical Checks	[2] Check all ECM system fuses and circuit breakers. [2] Check the ECM ground for being clean, tight and in its proper location. [2] Check the vacuum hoses for splits, kinks and proper connections. [2] Check thoroughly for any type of leak or restriction. [2] Check for air leaks at all the mounting areas of the intake manifold sealing surfaces. [2] Check for proper installation of the mixer module assembly. [2] Check for air leaks at the mixer assembly. [2] Check the ignition wires for the following conditions: - Cracking - Hardness - Proper routing - Carbon tracking [2] Check the wiring for the following items: - Proper connections, pinches or cuts. [2] The following symptom tables contain groups of possible causes for each symptom. The order of these procedures is not important. If the scan tool readings do not indicate the problems, then proceed in a logical order, easiest to check or most likely to cause first.
Intermittent	
DEFINITION: The problem may or may not turn ON the Malfunction Indicator Lamp (MIL) or store a Diagnostic Trouble Code (DTC).	
Preliminary Checks	[2] Refer to Important Preliminary Checks. [2] Do not use the DTC tables. If a fault is an intermittent, the use of the DTC tables may result in the replacement of good parts.
Faulty Electrical Connections or Wiring	[2] Faulty electrical connections or wiring can cause most intermittent problems. [2] Check the suspected circuit for the following conditions: - Faulty fuse or circuit breaker - Connectors poorly mated - Terminals not fully seated in the connector (backed out) - Terminals not properly formed or damaged - Terminal to wires poorly connected - Terminal tension insufficient. [2] Carefully remove all the connector terminals in the problem circuit in order to ensure the proper contact tension. If necessary, replace all the connector terminals in the problem circuit in order to ensure the proper contact tension. [2] Checking for poor terminal to wire connections requires removing the terminal from the connector body.
Operational Test	If a visual and physical check does not locate the cause of the problem, drive the vehicle with a scan tool. When the problem occurs, an abnormal voltage or scan reading indicates the problem may be in that circuit.

Table 3-15. Symptom Diagnosis

Checks	Action
Intermittent Malfunction Indicator Lamp (MIL)	The following components can cause intermittent MIL and no DTC(s): [2] A defective relay, Control Module driven solenoid, or a switch that can cause electrical system interference. Normally, the problem will occur when the faulty component is operating. [2] The improper installation of electrical devices, such as lights, 2-way radios, electric motors, etc. [2] The ignition secondary voltage shorted to a ground. [2] The Malfunction Indicator Lamp (MIL) circuit or the Diagnostic Test Terminal intermittently shorted to ground. [2] The Control Module grounds.
Loss of DTC Memory	To check for the loss of the DTC Memory: 1. Disconnect the TMAP sensor. 2. Idle the engine until the Malfunction Indicator Lamp illuminates. The ECM should store a TMAP DTC. The TMAP DTC should remain in the memory when the ignition is turned OFF. If the TMAP DTC does not store and remain, the ECM is faulty
Additional Checks	
No Start	
DEFINITION: The engine cranks OK, but does not start.	
Preliminary Checks	Refer to Important Preliminary Checks.
Control Module Checks	If a scan tool is available: [2] Check for proper communication with both the ECM [2] Check the fuse in the ECM battery power circuit. Refer to Engine Controls Schematics. [2] Check battery power, ignition power and ground circuits to the ECM. Refer to Engine Control Schematics. Verify voltage and/or continuity for each circuit.
Sensor Checks	[2] Check the TMAP sensor. [2] Check the Magnetic pickup sensor (RPM).
Fuel System Checks	**Important:** A closed LPG manual fuel shut off valve will create a no start condition. [2] Check for air intake system leakage between the mixer and the throttle body. [2] Verify proper operation of the low pressure lock-off solenoids. [2] Check the fuel system pressures. Refer to the LPG Fuel System Diagnosis. [2] Check for proper mixer air valve operation.
Ignition System Checks	Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. [2] Check for the proper ignition voltage output with J 26792 or the equivalent. [2] Verify that the spark plugs are correct for use with LPG (R42LTS) [2] Check the spark plugs for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits [2] Check for bare or shorted ignition wires. [2] Check for loose ignition coil connections at the coil.
Engine Mechanical Checks	**Important:** The LPG Fuel system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than the gasoline fuel supply system. [2] Check for the following: - Vacuum leaks - Improper valve timing - Low compression - Bent pushrods - Worn rocker arms - Broken or weak valve springs - Worn camshaft lobes.

Table 3-15. Symptom Diagnosis

Checks	Action
Exhaust System Checks	[2] Check the exhaust system for a possible restriction: - Inspect the exhaust system for damaged or collapsed pipes - Inspect the muffler for signs of heat distress or for possible internal failure. [2] Check for possible plugged catalytic converter. Refer to Restricted Exhaust System Diagnosis
Hard Start	
DEFINITION: The engine cranks OK, but does not start for a long time. The engine does eventually run, or may start but immediately dies.	
Preliminary Checks	[2] Refer to Important Preliminary Checks. [2] Make sure the vehicle's operator is using the correct starting procedure.
Sensor Checks	[2] Check the Engine Coolant Temperature sensor with the scan tool. Compare the engine coolant temperature with the ambient air temperature on a cold engine. IF the coolant temperature reading is more than 5 degrees greater or less than the ambient air temperature on a cold engine, check for high resistance in the coolant sensor circuit. Refer to DTC 111 [2] Check the Crankshaft Position (CKP) sensor. [2] Check the Throttle position (TPS) sensor.
Fuel System Checks	Important: A closed LPG manual fuel shut off valve will create an extended crank OR no start condition. [2] Verify the excess flow valve in the LPG manual shut-off valve is not tripped. [2] Check mixer module assembly for proper installation and leakage. [2] Verify proper operation of the low pressure lock-off solenoids. [2] Verify proper operation of the EPR [2] Check for air intake system leakage between the mixer and the throttle body. [2] Check the fuel system pressures. Refer to the Fuel System Diagnosis.
Ignition System Checks	Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. [2] Check for the proper ignition voltage output with J 26792 or the equivalent. [2] Verify that the spark plugs are correct for use with LPG (R42LTS) [2] Check the spark plugs for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits [2] Check for bare or shorted ignition wires. [2] Check for moisture in the distributor cap if applicable. [2] Check for loose ignition coil connections. **Important:** 1. If the engine starts but then immediately stalls, Check the Crankshaft Position (CKP). 2. Check for improper gap, debris or faulty connections.
Engine Mechanical Checks	Important: The LPG Fuel system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than the gasoline fuel supply system. [2] Check for the following: - Vacuum leaks - Improper valve timing - Low compression - Bent pushrods - Worn rocker arms - Broken or weak valve springs - Worn camshaft lobes. [2] Check the intake and exhaust manifolds for casting flash.
Exhaust System Checks	[2] Check the exhaust system for a possible restriction: - Inspect the exhaust system for damaged or collapsed pipes - Inspect the muffler for signs of heat distress or for possible internal failure. [2] Check for possible plugged catalytic converter. Refer to Restricted Exhaust System Diagnosis or Exhaust System in the GM Base Engine Service Manual

Table 3-15. Symptom Diagnosis

Checks	Action
Additional Checks	[2]
Cuts Out, Misses	
DEFINITION: A surging or jerking that follows engine speed, usually more pronounced as the engine load increases which is not normally felt above 1500 RPM. The exhaust has a steady spitting sound at idle, low speed, or hard acceleration for the fuel starvation that can cause the engine to cut-out.	
Preliminary Checks	[2] Refer to Important Preliminary Checks.
Ignition System Checks	[2] Start the engine. [2] Wet down the secondary ignition system with water from a spray bottle, and look/listen for arcing or misfiring as you apply water. [2] Check for proper ignition output voltage with spark tester J 26792. [2] Check for a cylinder misfire. [2] Verify that the spark plugs are correct for use with LPG (R42LTS) [2] Remove the spark plugs in these cylinders and check for the following conditions: [2] Insulation cracks [2] Wear [2] Improper gap [2] Burned electrodes [2] Heavy deposits [2] Visually/Physically inspect the secondary ignition for the following: [2] Ignition wires for arcing, cross-firing and proper routing [2] Ignition coils for cracks or carbon tracking
Engine Mechanical Checks	[2] Perform a cylinder compression check. [2] Check the engine for the following: - Improper valve timing - Bent pushrods - Worn rocker arms - Worn camshaft lobes. - Broken or weak valve springs. [2] Check the intake and exhaust manifold passages for casting flash.
Fuel System Checks	[2] Check the fuel system - plugged fuel filter, low fuel pressure, etc. Refer to LPG Fuel System Diagnosis. [2] Check the condition of the wiring to the low pressure lock-off solenoid.
Additional Check	Check for Electromagnetic Interference (EMI). [2] EMI on the reference circuit can cause a missing condition. [2] Monitoring the engine RPM with a scan tool can detect an EMI. [2] A sudden increase in the RPM with little change in the actual engine RPM, indicates EMI is present. [2] If the problem exists, check the routing of the secondary wires and the ground circuit.
Hesitation, Sag, Stumble	
DEFINITION: The vehicle has a momentary lack of response when depressing the accelerator. The condition can occur at any vehicle speed. The condition may cause the engine to stall if it's severe enough.	
Preliminary Checks	Refer to Important Preliminary Checks.
Fuel System Checks	[2] Check the fuel pressure. Refer to LPG Fuel System Diagnosis. [2] Check for low fuel pressure during a moderate or full throttle acceleration. If the fuel pressure drops below specification, there is possibly a faulty low pressure regulator or a restriction in the fuel system. [2] Check the Manifold Absolute Pressure (MAP) sensor response and accuracy. [2] Check LPL electrical connection [2] Check the mixer air valve for sticking or binding. [2] Check the mixer module assembly for proper installation and leakage. [2] Check the EPR electrical connections.

Table 3-15. Symptom Diagnosis

Checks	Action
Ignition System Checks	Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. If a problem is reported on LPG and not gasoline, do not discount the possibility of a LPG only ignition system failure and test the system accordingly. [2] Check for the proper ignition voltage output with J 26792 or the equivalent. [2] Verify that the spark plugs are correct for use with LPG (R42LTS) [2] Check for faulty spark plug wires [2] Check for fouled spark plugs.
Additional Check	[2] Check for manifold vacuum or air induction system leaks [2] Check the generator output voltage.
Backfire	
DEFINITION: The fuel ignites in the intake manifold, or in the exhaust system, making a loud popping noise.	
Preliminary Check	[2] Refer to Important Preliminary Checks.
Ignition System Checks	**Important! LPG, being a gaseous fuel, requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. The ignition system must be maintained in peak condition to prevent backfire.** [2] Check for the proper ignition coil output voltage using the spark tester J26792 or the equivalent. [2] Check the spark plug wires by connecting an ohmmeter to the ends of each wire in question. If the meter reads over 30,000 ohms, replace the wires. [2] Check the connection at each ignition coil. [2] Check for deteriorated spark plug wire insulation. [2] Check the spark plugs. The correct spark plugs for LPG are (R42LTS) [2] Remove the plugs and inspect them for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits
Engine Mechanical Check	Important! The LPG Fuel system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than a gasoline fuel supply system. [2] Check the engine for the following: - Improper valve timing - Engine compression - Manifold vacuum leaks - Intake manifold gaskets - Sticking or leaking valves - Exhaust system leakage [2] Check the intake and exhaust system for casting flash or other restrictions.
Fuel System Checks	[2] Perform a fuel system diagnosis. Refer to LPG Fuel System Diagnosis.
Lack of Power, Sluggishness, or Sponginess	
DEFINITION: The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary Checks	[2] Refer to Important Preliminary Checks. [2] Refer to the LPG Fuel system OBD System Check [2] Compare the customer's vehicle with a similar unit. Make sure the customer has an actual problem. Do not compare the power output of the vehicle operating on LPG to a vehicle operating on gasoline as the fuels do have different drive feel characteristics [2] Remove the air filter and check for dirt or restriction. [2] Check the vehicle transmission Refer to the OEM transmission diagnostics.

Table 3-15. Symptom Diagnosis

Checks	Action
Fuel System Checks	[2] Check for a restricted fuel filter, contaminated fuel, or improper fuel pressure. Refer to LPG Fuel System Diagnosis. [2] Check for the proper ignition output voltage with the spark tester J 26792 or the equivalent. [2] Check for proper installation of the mixer module assembly. [2] Check all air inlet ducts for condition and proper installation. [2] Check for fuel leaks between the LPR and the mixer. [2] Verify that the LPG tank manual shut-off valve is fully open. [2] Verify that liquid fuel (not vapor) is being delivered to the LPR.
Sensor Checks	[2] Check the Heated Exhaust Gas Oxygen Sensor (HEGO) for contamination and performance. Check for proper operation of the MAP sensor. [2] Check for proper operation of the TPS sensor.
Exhaust System Checks	[2] Check the exhaust system for a possible restriction: - Inspect the exhaust system for damaged or collapsed pipes - Inspect the muffler for signs of heat distress or for possible internal failure. - Check for possible plugged catalytic converter.
Engine Mechanical Check	Check the engine for the following: [2] Engine compression [2] Valve timing [2] Improper or worn camshaft. Refer to Engine Mechanical in the Service Manual.
Additional Check	[2] Check the ECM grounds for being clean, tight, and in their proper locations. [2] Check the generator output voltage. [2] If all procedures have been completed and no malfunction has been found, review and inspect the following items: [2] Visually and physically, inspect all electrical connections within the suspected circuit and/or systems. [2] Check the scan tool data.
Poor Fuel Economy	
DEFINITION: Fuel economy, as measured by refueling records, is noticeably lower than expected. Also, the economy is noticeably lower than it was on this vehicle at one time, as previously shown by an by refueling records.	
Preliminary Checks	[2] Refer to Important Preliminary Checks. [2] Check the air cleaner element (filter) for dirt or being plugged. [2] Visually (Physically) check the vacuum hoses for splits, kinks, and proper connections. [2] Check the operators driving habits for the following items: - Is there excessive idling or stop and go driving? - Are the tires at the correct air pressure? - Are excessively heavy loads being carried? - Is their often rapid acceleration? [2] Suggest to the owner to fill the fuel tank and to recheck the fuel economy. [2] Suggest that a different operator use the equipment and record the results.
Fuel System Checks	[2] Check the LPR fuel pressure. Refer to LPG Fuel System Diagnosis. [2] Check the fuel system for leakage.
Sensor Checks	[2] Check the Temperature Manifold Absolute Pressure (TMAP) sensor.
Ignition System Checks	[2] Verify that the spark plugs are correct for use with LPG (R42LTS) [2] Check the spark plugs. Remove the plugs and inspect them for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits [2] Check the ignition wires for the following items: - Cracking - Hardness - Proper connections
Cooling System Checks	[2] Check the engine thermostat for always being open or for the wrong heat range

Table 3-15. Symptom Diagnosis

Checks	Action
Additional Check	[2] Check the transmission shift pattern. Refer to the OEM Transmission Controls section the Service Manual. [2] Check for dragging brakes.
Rough, Unstable, or Incorrect Idle, Stalling	
DEFINITION: The engine runs unevenly at idle. If severe enough, the engine or vehicle may shake. The engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.	
Preliminary Check	Refer to Important Preliminary Checks.
Sensor Checks	[2] Check for silicon contamination from fuel or improperly used sealant. The sensor will have a white powdery coating. The sensor will result in a high but false signal voltage (rich exhaust indication). The ECM will reduce the amount of fuel delivered to the engine causing a severe drive-ability problem. [2] Check the Heated Exhaust Gas Oxygen Sensor (HEGO) performance: [2] Check the Temperature Manifold Absolute Pressure (TMAP) sensor response and accuracy.
Fuel System Checks	[2] Check for rich or lean symptom that causes the condition. Drive the vehicle at the speed of the complaint. Monitoring the oxygen sensors will help identify the problem. [2] Check for a sticking mixer air valve. [2] Verify proper operation of the EPR. [2] Perform a cylinder compression test. Refer to Engine Mechanical in the Service Manual. [2] Check the LPR fuel pressure. Refer to the LPG Fuel System Diagnosis. [2] Check mixer module assembly for proper installation and connection.
Ignition System Checks	[2] Check for the proper ignition output voltage using the spark tester J26792 or the equivalent. [2] Verify that the spark plugs are correct for use with LPG (R42LTS) [2] Check the spark plugs. Remove the plugs and inspect them for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Blistered insulators - Heavy deposits [2] Check the spark plug wires by connecting an ohmmeter to the ends of each wire in question. If the meter reads over 30,000 ohms, replace the wires.
Additional Checks	**Important:** The LPG Fuel system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than the gasoline fuel supply system. [2] Check for vacuum leaks. Vacuum leaks can cause a higher than normal idle and low throttle angle control command. [2] Check the ECM grounds for being clean, tight, and in their proper locations. [2] Check the battery cables and ground straps. They should be clean and secure. Erratic voltage may cause all sensor readings to be skewed resulting in poor idle quality.
Engine Mechanical Check	[2] Check the engine for the following: - Broken motor mounts - Improper valve timing - Low compression - Bent pushrods - Worn rocker arms - Broken or weak valve springs - Worn camshaft lobes
Surges/Chuggles	
DEFINITION: The engine has a power variation under a steady throttle or cruise. The vehicle feels as if it speeds up and slows down with no change in the accelerator pedal.	
Preliminary Checks	Refer to Important Preliminary Checks.
Sensor Checks	[2] Check Heated Exhaust Gas Oxygen Sensor (HEGO) performance.

Table 3-15. Symptom Diagnosis

Checks	Action
Fuel System Checks	[2] Check for Rich or Lean symptom that causes the condition. Drive the vehicle at the speed of the complaint. Monitoring the oxygen sensors will help identify the problem. [2] Check the fuel pressure while the condition exists. Refer to LPG Fuel System Diagnosis. [2] Verify proper fuel control solenoid operation. [2] Verify that the LPG manual shut-off valve is fully open. [2] Check the in-line fuel filter for restrictions.
Ignition System Checks	[2] Check for the proper ignition output voltage using the spark tester J26792 or the equivalent. [2] Verify that the spark plugs are correct for use with LPG (R42LTS) [2] Check the spark plugs. Remove the plugs and inspect them for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits - Check the Crankshaft Position (CKP) sensor.
Additional Check	[2] Check the ECM grounds for being clean, tight, and in their proper locations. [2] Check the generator output voltage. [2] Check the vacuum hoses for kinks or leaks. [2] Check Transmission

Table 3-16. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
0	3	1561	AUX analog Pull-Down 2 high voltage
0	3	1561	AUX analog Pull-Down 3 high voltage
0	4	1561	AUX analog Pull-Down 2 low voltage
0	4	1561	AUX analog Pull-Down 3 low voltage
0	31	1621	RS-485 Rx inactive
0	31	1622	RS-485 Rx noise
0	31	1623	RS-485 Rx bad packet format
0	31	1624	RS-485 remote shutdown request
0	31	Undefined DTC	Index 10297
0	31	Undefined DTC	Index 10298
0	31	Undefined DTC	Index 10299
29	0	2116	FPP2 higher than IVS
29	1	2140	FPP2 lower than IVS
29	3	2128	FPP2 voltage high
29	4	2127	FPP2 voltage low
51	0	221	TPS1-2 higher than expected
51	1	121	TPS1-2 lower than expected
51	3	123	TPS1 voltage high
51	4	122	TPS1 voltage low
51	7	2112	Unable to reach higher TPS
51	7	2111	Unable to reach lower TPS
51	31	2135	TPS1/2 simultaneous voltages out-of-ran
84	1	502	Roadspeed input loss of signal
91	0	2115	FPP1 higher than IVS
91	1	2139	FPP1 lower than IVS
91	2	1630	J1939 ETC message receipt loss
91	3	2122	FPP1 voltage high
91	4	2123	FPP1 voltage low
91	9	1651	J1939 ETC message receipt loss while in
91	16	2126	FPP1-2 higher than expected
91	18	2121	FPP1-2 lower than expected
91	31	1121	FPP1/2 simultaneous voltages out-of-ran
94	0	88	Fuel pressure higher than expected
94	1	87	Fuel pressure lower than expected
94	3	92	FP high voltage
94	4	91	FP low voltage
100	0	521	Oil pressure sender high pressure
100	1	524	Oil pressure low
100	1	524	Oil pressure sender low pressure
100	3	523	Oil pressure sender high voltage
100	4	522	Oil pressure sender low voltage
100	18	520	Oil pressure sender low pressure stage 1

Table 3-16. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
105	0	127	IAT higher than expected stage 2
105	3	113	IAT voltage high
105	4	112	IAT voltage low
105	15	111	IAT higher than expected stage 1
106	4	107	MAP voltage low
106	16	108	MAP pressure high
108	0	2229	BP pressure high
108	1	129	BP pressure low
110	0	1522	CHT higher than expected stage 2
110	0	217	ECT higher than expected stage 2
110	3	118	ECT voltage high
110	4	117	ECT voltage low
110	15	116	ECT higher than expected stage 1
110	16	1521	CHT higher than expected stage 1
168	15	563	Vbat voltage high
168	17	562	Vbat voltage low
173	0	2428	VEGT temperature high
174	3	183	FT high voltage
174	4	182	FT low voltage
441	0	1417	EMWT1 higher than expected stage 2
441	3	1411	EMWT1 voltage high
441	4	1413	EMWT1 voltage low
441	15	1415	EMWT1 higher than expected stage 1
442	0	1418	EMWT2 higher than expected stage 2
442	3	1412	EMWT2 voltage high
442	4	1414	EMWT2 voltage low
442	15	1416	EMWT2 higher than expected stage 1
443	0	1425	ERWT1 higher than expected stage 2
443	3	1419	ERWT1 voltage high
443	4	1421	ERWT1 voltage low
443	15	1423	ERWT1 higher than expected stage 1
444	0	1426	ERWT2 higher than expected stage 2
444	3	1420	ERWT2 voltage high
444	4	1422	ERWT2 voltage low
444	15	1424	ERWT2 higher than expected stage 1
515	0	1112	RPM above spark rev limit level
515	15	219	RPM higher than max allowed govern speed
515	16	1111	RPM above fuel rev limit leve
558	5	2130	IVS stuck at-idle, FPP1/2 match
558	6	2131	IVS stuck off-idle, FPP1/2 match
628	13	601	Microprocessor failure - FLASH
629	31	606	Microprocessor failure - COP
629	31	1612	Microprocessor failure - RTI 1

Table 3-16. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
629	31	1613	Microprocessor failure - RTI 2
629	31	1614	Microprocessor failure - RTI 3
629	31	1615	Microprocessor failure - A/D
629	31	1616	Microprocessor failure - Interrupt
630	12	604	Microprocessor failure - RAM
636	2	336	CRANK input signal noise
636	4	337	Crank signal loss
636	8	16	Crank and/or cam could not synchronize du
639	9	1629	J1939 TSC1 message receipt loss
639	12	1626	CAN-J1939 Tx fault
639	12	1627	CAN-J1939 Rx fault
639	13	1628	J1939 CAN address / engine-number co
645	3	2619	Tach output short to power
645	4	2618	Tach output ground short
651	5	261	Injector 1 open or short to ground
651	6	262	Injector 1 coil shorted
652	5	264	Injector 2 open or short to ground
652	6	265	Injector 2 coil shorted
653	5	267	Injector 3 open or short to ground
653	6	268	Injector 3 coil shorted
654	5	270	Injector 4 open or short to ground
654	6	271	Injector 4 coil shorted
655	5	273	Injector 5 open or short to ground
655	6	274	Injector 5 coil shorted
656	5	276	Injector 6 open or short to ground
656	6	277	Injector 6 coil shorted
657	5	279	Injector 7 open or short to ground
657	6	280	Injector 7 coil shorted
658	5	282	Injector 8 open or short to ground
658	6	283	Injector 8 coil shorted
659	5	285	Injector 9 open or short to ground
659	6	286	Injector 9 coil shorted
660	5	288	Injector 10 open or short to ground
660	6	289	Injector 10 coil shorted
697	5	1631	PWM1-Gauge1 open / ground short
697	6	1632	PWM1-Gauge1 short to power
698	5	1633	PWM2-Gauge2 open / ground short
698	6	1634	PWM2-Gauge2 short to power
699	5	1635	PWM3-Gauge3 open / ground short
699	6	1636	PWM3-Gauge3 short to power
700	5	1637	PWM4 open / ground short
700	6	1638	PWM4 short to power
713	3	1547	AUX analog Pull-Up/Down 4 high voltage

Table 3-16. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
713	4	1548	AUX analog Pull-Up/Down 4 low voltage
723	2	341	CAM input signal noise
723	4	342	Loss of CAM input signal
724	10	134	EGO1 open / lazy
731	2	326	Knock1 excessive or erratic signa
731	4	327	Knock1 sensor open or not present
920	3	1643	Buzzer control short to power
920	4	1641	Buzzer control ground short
920	5	1642	Buzzer open
925	**3**	**1662**	**PWM6 short to power**
925	5	1661	PWM6 open / ground short
926	2	1664	PWM7 short to power
926	5	1663	PWM7 open / ground short
1079	3	643	Sensor supply voltage 1 high
1079	4	642	Sensor supply voltage 1 low
1079	31	1611	Sensor supply voltage 1 and 2 out-of-range
1080	3	653	Sensor supply voltage 2 high
1080	4	652	Sensor supply voltage 2 low
1127	3	238	TIP high voltage
1127	4	237	TIP low voltage
1192	3	1131	WGP voltage high
1192	4	1132	WGP voltage low
1213	3	1645	MIL control short to power
1213	4	1644	MIL control ground short
1213	5	650	MIL open
1239	7	359	Fuel run-out longer than expected
1268	5	2300	Spark coil 1 primary open or short to ground
1268	6	2301	Spark coil 1 primary shorted
1269	5	2303	Spark coil 2 primary open or short to ground
1269	6	2304	Spark coil 2 primary shorted
1270	5	2306	Spark coil 3 primary open or short to ground
1270	6	2307	Spark coil 3 primary shorted
1271	5	2309	Spark coil 4 primary open or short to ground
1271	6	2310	Spark coil 4 primary shorted
1272	5	2312	Spark coil 5 primary open or short to ground
1272	6	2313	Spark coil 5 primary shorted
1273	5	2315	Spark coil 6 primary open or short to ground
1273	6	2316	Spark coil 6 primary shorted
1274	5	2318	Spark coil 7 primary open or short to ground
1274	6	2319	Spark coil 7 primary shorted
1275	5	2321	Spark coil 8 primary open or short to ground
1275	6	2322	Spark coil 8 primary shorted
1276	5	2324	Spark coil 9 primary open or short to ground

Table 3-16. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
1276	6	2325	Spark coil 9 primary shorted
1277	5	2327	Spark coil 10 primary open or short to ground
1277	6	2328	Spark coil 10 primary shorted
1321	3	617	Start relay coil short to power
1321	4	616	Start relay ground short
1321	5	615	Start relay coil open
1323	11	1311	Cylinder 1 misfire detected
1323	31	301	Cylinder 1 emissions/catalyst damaging misfire
1324	11	1312	Cylinder 2 misfire detected
1324	31	302	Cylinder 2 emissions/catalyst damaging misfire
1325	11	1313	Cylinder 3 misfire detected
1325	31	303	Cylinder 3 emissions/catalyst damaging misfire
1326	11	1314	Cylinder 4 misfire detected
1326	31	304	Cylinder 4 emissions/catalyst damaging misfire
1327	11	1315	Cylinder 5 misfire detected
1327	31	305	Cylinder 5 emissions/catalyst damaging misfire
1328	11	1316	Cylinder 6 misfire detected
1328	31	306	Cylinder 6 emissions/catalyst damaging misfire
1329	11	1317	Cylinder 7 misfire detected
1329	31	307	Cylinder 7 emissions/catalyst damaging misfire
1330	11	1318	Cylinder 8 misfire detected
1330	31	308	Cylinder 8 emissions/catalyst damaging misfire
1347	5	628	Fuel-pump high-side open or short to group
1347	6	629	Fuel-pump high-side short to power
1348	3	629	Fuel pump relay coil short to power
1348	4	628	Fuel pump relay control ground short
1348	5	627	Fuel pump relay coil open
1384	31	1625	J1939 shutdown request
1485	3	687	Power relay coil short to power
1485	4	686	Power relay ground short
1485	5	685	Power relay coil open
1692	0	234	Boost control overboost failure
1692	1	299	Boost control underboost failure
1692	2	236	TIP active
2646	3	1666	PWM8 short to power
2646	5	1665	PWM8 open / ground short
2647	3	1670	PWM9 short to power
2647	5	1669	PWM9 open / ground short
3056	3	8906	UEGO return voltage shorted high
3056	4	8907	UEGO return voltage shorted low
3217	3	8910	UEGO sense cell voltage high
3217	4	8911	UEGO sense cell voltage low
3218	3	8908	UEGO pump voltage shorted high

Table 3-16. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
3218	4	8909	UEGO pump voltage shorted low
3221	3	8904	UEGO cal resistor voltage high
3221	4	8905	UEGO cal resistor voltage low
3221	31	8901	UEGO microprocessor internal fault
3222	0	8916	UEGO sense cell impedance high
3222	3	8902	UEGO heater supply high voltage
3222	4	8903	UEGO heater supply low voltage
3222	10	8914	UEGO sense cell slow to warm up
3225	0	8917	UEGO pump cell impedance high
3225	1	8918	UEGO pump cell impedance low
3225	3	8912	UEGO pump voltage at high drive limit
3225	4	8913	UEGO pump voltage at low drive limit
3225	10	8915	UEGO pump cell slow to warm up
520200	0	171	Adaptive-learn gasoline bank1 high
520200	1	172	Adaptive-learn gasoline bank1 low
520201	0	174	Adaptive-learn gasoline bank2 high
520201	1	175	Adaptive-learn gasoline bank2 low
520202	0	1161	Adaptive-learn LPG high
520202	1	1162	Adaptive-learn LPG low
520203	0	1163	Adaptive-learn NG high
520203	1	1164	Adaptive-learn NG low
520204	0	1155	Closed-loop gasoline bank1 high
520204	1	1156	Closed-loop gasoline bank1 low
520205	0	1157	Closed-loop gasoline bank2 high
520205	1	1158	Closed-loop gasoline bank2 low
520206	0	1151	Closed-loop LPG high
520206	1	1152	Closed-loop LPG low
520207	0	1153	Closed-loop NG high
520207	1	1154	Closed-loop NG low
520208	10	154	EGO2 open / lazy
520209	10	140	EGO3 open / lazy
520210	10	160	EGO4 open / lazy
520211	10	420	Catalyst inactive on gasoline (Bank 1)
520212	10	430	Catalyst inactive on gasoline (Bank 2)
520213	10	1165	Catalyst inactive on LPG
520214	10	1166	Catalyst inactive on NG
520215	3	1515	AUX analog Pull-Down 1 high voltage
520215	4	1516	AUX analog Pull-Down 1 low voltage
520216	3	1511	AUX analog Pull-Up 1 high voltage
520216	4	1512	AUX analog Pull-Up 1 low voltage
520217	3	1513	AUX analog Pull-Up 2 high voltage
520217	4	1514	AUX analog Pull-Up 2 low voltage
520218	3	1517	AUX analog Pull-Up 3 high voltage

Table 3-16. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
520218	4	1518	AUX analog Pull-Up 3 low voltage
520219	3	1541	AUX analog Pull-Up/Down 1 high voltage
520219	4	1542	AUX analog Pull-Up/Down 1 low voltage
520220	3	1543	AUX analog Pull-Up/Down 2 high voltage
520220	4	1544	AUX analog Pull-Up/Down 2 low voltage
520221	3	1545	AUX analog Pull-Up/Down 3 high voltage
520221	4	1546	AUX analog Pull-Up/Down 3 low voltage
520222	3	1551	AUX digital 1 high voltage
520222	4	1552	AUX digital 1 low voltage
520223	3	1553	AUX digital 2 high voltage
520223	4	1554	AUX digital 2 low voltage
520224	3	1555	AUX digital 3 high voltage
520224	3	1555	Water Intrusion Detection
520224	4	1556	AUX digital 3 low voltage
520226	3	916	Shift actuator feedback out-of-range
520226	7	919	Shift unable to reach desired gear
520226	31	920	Shift actuator or drive circuit failed
520230	5	1639	PWM5 open / ground short
520230	6	1640	PWM5 short to power
520240	3	188	Gaseous fuel temperature sender high voltage
520240	4	187	Gaseous fuel temperature sender low volt
520241	2	331	Knock2 excessive or erratic signal
520241	4	332	Knock2 sensor open or not present
520250	31	2120	FPP1 invalid voltage and FPP2 disagree
520250	31	2125	FPP2 invalid voltage and FPP1 disagree
520250	31	1122	FPP1/2 do not match each other or IVS
520251	3	223	TPS2 voltage high
520251	4	222	TPS2 voltage low
520252	5	509	IAC coil open/short
520252	6	508	IAC ground short
520260	0	1171	MegaJector delivery pressure higher than
520260	1	1172	MegaJector delivery pressure lower than
520260	3	1174	MegaJector voltage supply high
520260	4	1175	MegaJector voltage supply low
520260	12	1176	MegaJector internal actuator fault detection
520260	12	1177	MegaJector internal circuitry fault detection
520260	12	1178	MegaJector internal comm fault detection
520260	31	1173	MegaJector comm lost
520270	31	1531	Gov1/2/3 interlock failure
520401	0	1182	Fuel impurity level high
520800	7	11	Intake cam / distributor position error
520801	7	24	Exhaust cam position error
520803	31	1183	MegaJector autozero / lockoff failure

3.26 FORD ENGINE

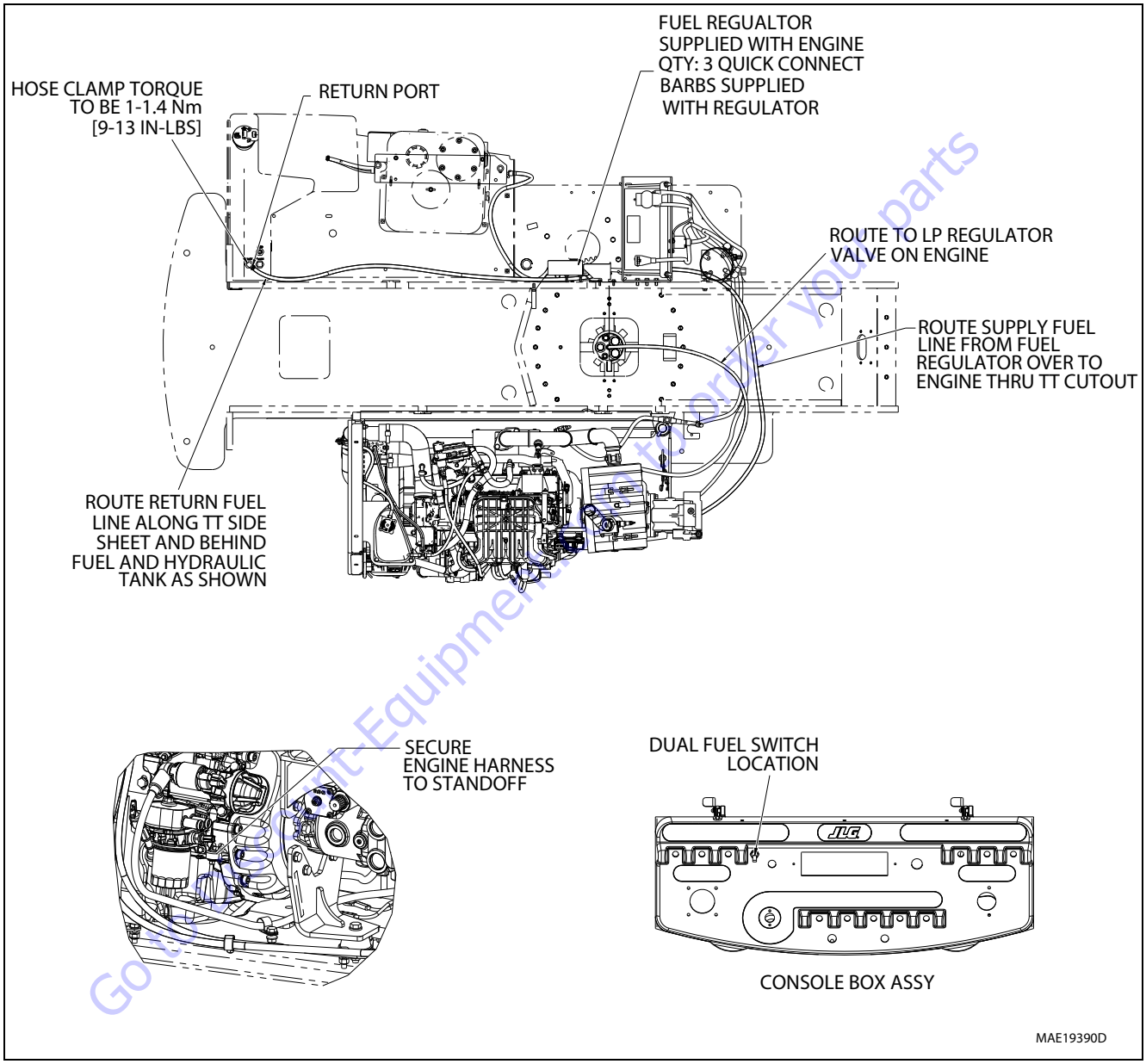


Figure 3-111. Ford Engine Installation - Sheet 1 of 4

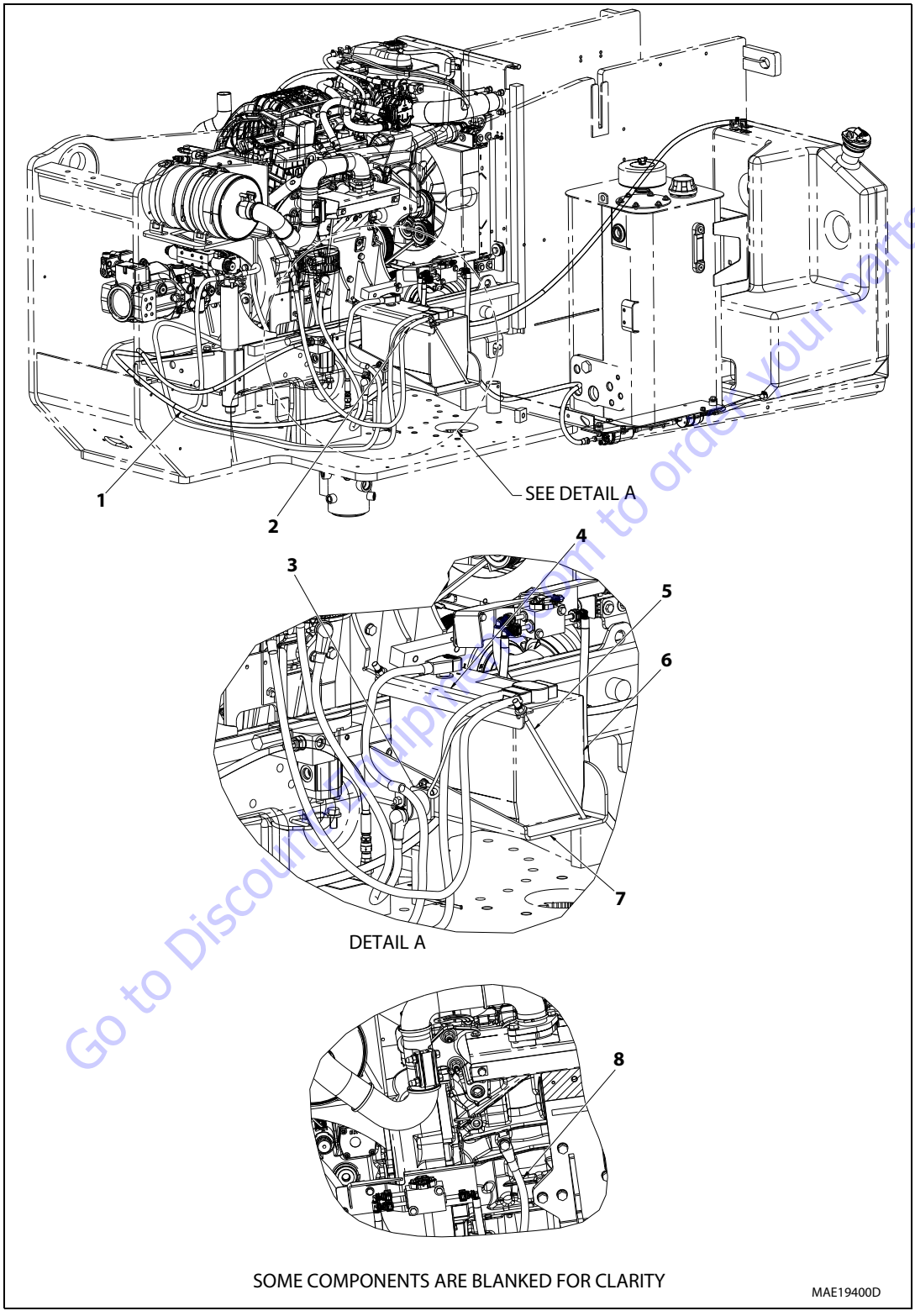


Figure 3-112. Ford Engine Installation - Sheet 2 of 4

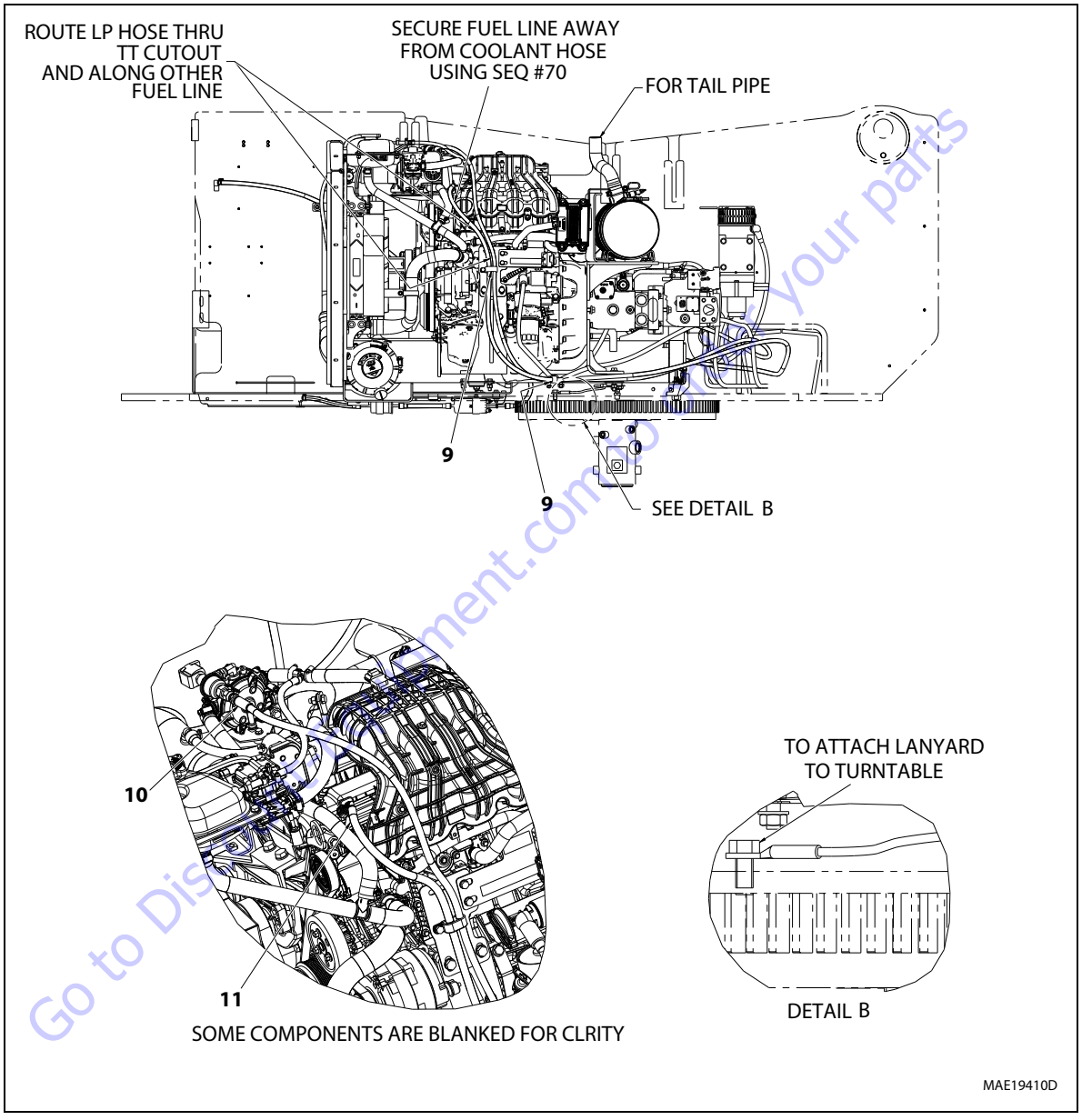
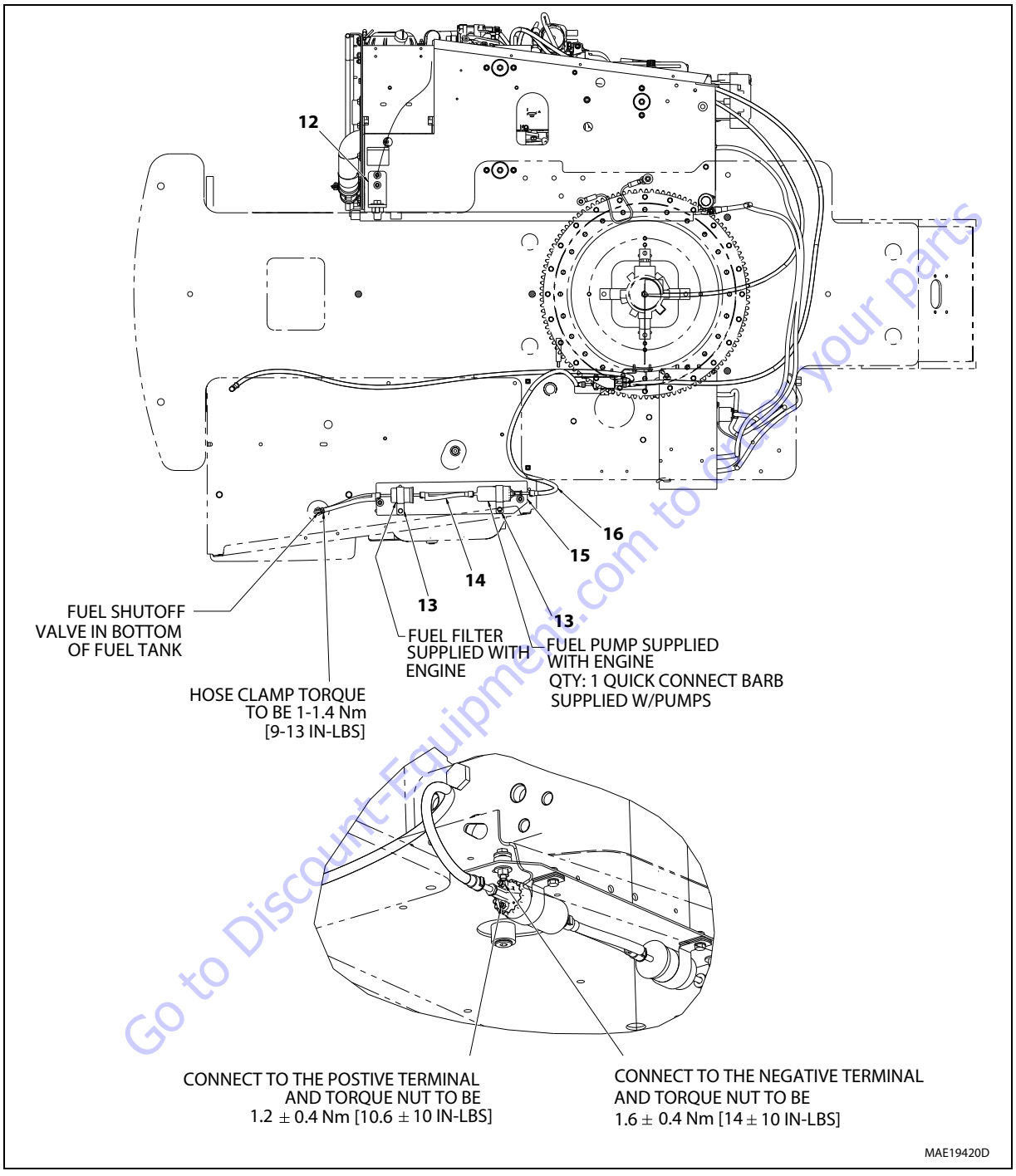


Figure 3-113. Ford Engine Installation - Sheet 3 of 4



1. High Pressure Fuel Hose
2. Battery Cable Kit
3. Solenoid Assembly Relay
4. Battery Hold Down Bracket
5. J-Bolt
6. Battery
7. Battery Bracket
8. Battery Cable Kit
9. Clamp
10. LP Gas Hose
11. High Pressure Fuel Hose
12. Engine Tray Mount
13. P-Clamp
14. High Pressure Fuel Hose
15. Fuel Pump Filter Bracket
16. High Pressure Fuel Hose

Figure 3-114. Ford Engine Installation - Sheet 4 of 4

Table 3-17. Fault Code Cross Reference List (Ford Engine)

Original DTC Number	Fault Name	Corresponding DTC (Current)
11	Intake cam / distributor position	11
24	Exhaust cam position	24
111	CL high LPG	1151
112	EGO open/lazy pre-cat 1	134
113	EGO open/lazy pre-cat 2/post-cat 1	154
114	EGO open/lazy post-cat 1	140
115	EGO open/lazy post-cat 2	160
121	CL high gasoline bank1	1155
122	CL low gasoline bank1	1156
124	CL low LPG	1152
125	CL high NG	1153
126	CL low NG	1154
131	CL high gasoline bank2	1157
132	CL low gasoline bank2	1158
133	Gasoline cat monitor	420
134	LPG cat monitor	1165
135	NG cat monitor	1166
136	Gasoline cat monitor	430
141	AL high gasoline bank1	171
142	AL low gasoline bank1	172
143	AL high LPG	1161
144	AL low LPG	1162
145	AL high NG	1163
146	AL low NG	1164
147	AL high gasoline bank2	174
148	AL low gasoline bank2	175
161	Battery Voltage High	563
162	Battery Voltage Low	562
163	AUX analog PD1 high	1515
164	AUX analog PD1 low	1516
165	AUX analog PU3 high	1517
166	AUX analog PU3 low	1518
167	AUX analog PUD1 high	1541
168	AUX analog PUD1 low	1542
171	AUX analog PUD2 high	1543
172	AUX analog PUD2 low	1544
173	AUX analog PUD3 high	1545
174	AUX analog PUD3 low	1546
181	AUX DIG1 high	1551
182	AUX DIG1 low	1552
183	AUX DIG2 high	1553
184	AUX DIG2 low	1554

Table 3-17. Fault Code Cross Reference List (Ford Engine)

Original DTC Number	Fault Name	Corresponding DTC (Current)
185	AUX DIG3 high	1555
186	AUX DIG3 low	1556
211	IAT high voltage	113
212	IAT low voltage	112
213	IAT higher than expected 1	111
214	IAT higher than expected 2	127
215	Oil pressure low	524
221	ECT/CHT High Voltage	118
222	ECT/CHT Low Voltage	117
223	CHT higher than expected 1	1521
224	CHT higher than expected 2	1522
225	ECT higher than expected 1	116
226	ECT higher than expected 2	217
231	MAP High Pressure	108
232	MAP Low Voltage	107
234	BP high pressure	2229
235	BP low pressure	129
242	Crank sync noise	336
243	Never crank synced at start	16
244	Cam loss	342
245	Cam sync noise	341
246	Crank loss	337
253	Knock 1 sensor Open	327
254	Knock 1 Excessive Signal	326
255	Knock 2 sensor Open	332
256	Knock 2 Excessive Signal	331
261	FP high voltage	92
262	FP low voltage	91
271	FT Gasoline High Voltage	183
272	FT Gasoline Low Voltage	182
273	FT Gaseaous fuel high voltage	188
274	FT Gaseaous fuel low voltage	187
281	TIP High Voltage	238
282	TIP Low Voltage	237
283	TIP Active	236
301	Emissions/catalyst damaging misfire	301
302	Emissions/catalyst damaging misfire	302
303	Emissions/catalyst damaging misfire	303
304	Emissions/catalyst damaging misfire	304
305	Emissions/catalyst damaging misfire	305
306	Emissions/catalyst damaging misfire	306
307	Emissions/catalyst damaging misfire	307

Table 3-17. Fault Code Cross Reference List (Ford Engine)

Original DTC Number	Fault Name	Corresponding DTC (Current)
308	Emissions/catalyst damaging misfire	308
311	Injector Loop Open or Low-side short to Ground	261
312	Injector Coil Shorted	262
313	Injector Loop Open or Low-side short to Ground	264
314	Injector Coil Shorted	265
315	Injector Loop Open or Low-side short to Ground	267
316	Injector Coil Shorted	268
321	Injector Loop Open or Low-side short to Ground	270
322	Injector Coil Shorted	271
323	Injector Loop Open or Low-side short to Ground	273
324	Injector Coil Shorted	274
325	Injector Loop Open or Low-side short to Ground	276
326	Injector Coil Shorted	277
331	Injector Loop Open or Low-side short to Ground	279
332	Injector Coil Shorted	280
333	Injector Loop Open or Low-side short to Ground	282
334	Injector Coil Shorted	283
335	Injector Loop Open or Low-side short to Ground	285
336	Injector Coil Shorted	286
341	Injector Loop Open or Low-side short to Ground	288
342	Injector Coil Shorted	289
351	FPump motor loop open or high-side shorted to ground	628
352	FPump motor high-side shorted to power	629
353	Megajector delivery pressure higher than expected	1171
354	Megajector delivery pressure lower than expected	1172
355	Megajector comm lost	1173
359	Fuel run-out longer than expected	1181
361	Megajector voltage supply high	1174
362	Megajector voltage supply low	1175
363	Megajector internal actuator fault detection	1176
364	Megajector internal circuitry fault detection	1177
365	Megajector internal comm fault detection	1178
411	Primary Loop Open or Low-side Short to Ground	2300
412	Primary Coil Shorted	2301
413	Primary Loop Open or Low-side Short to Ground	2303
414	Primary Coil Shorted	2304
415	Primary Loop Open or Low-side Short to Ground	2306
416	Primary Coil Shorted	2307
421	Primary Loop Open or Low-side Short to Ground	2309
422	Primary Coil Shorted	2310
423	Primary Loop Open or Low-side Short to Ground	2312
424	Primary Coil Shorted	2313

Table 3-17. Fault Code Cross Reference List (Ford Engine)

Original DTC Number	Fault Name	Corresponding DTC (Current)
425	Primary Loop Open or Low-side Short to Ground	2315
426	Primary Coil Shorted	2316
431	Primary Loop Open or Low-side Short to Ground	2318
432	Primary Coil Shorted	2319
433	Primary Loop Open or Low-side Short to Ground	2321
434	Primary Coil Shorted	2322
435	Primary Loop Open or Low-side Short to Ground	2324
436	Primary Coil Shorted	2325
441	Primary Loop Open or Low-side Short to Ground	2327
442	Primary Coil Shorted	2328
511	FPP1 high voltage	2122
512	FPP1 low voltage	2123
513	FPP1 higher than IVS limit	2115
514	FPP1 lower than IVS limit	2139
515	FPP1 higher than FPP2	2126
516	FPP1 lower than FPP2	2121
517	IVS stuck at-idle, FPP1/2 match	2130
518	IVS stuck off-idle, FPP1/2 match	2131
521	FPP2 high voltage	2128
522	FPP2 low voltage	2127
523	FPP2 higher than IVS limit	2116
524	FPP2 lower than IVS limit	2140
525	FPP1/2 simultaneous voltages out of range	1121
526	FPP1 invalid voltage and FPP2 disagrees with IVS	2120
527	FPP2 invalid voltage and FPP1 disagrees with IVS	2125
528	FPP1/2 do not match each other or the IVS	1122
531	TPS1 high voltage	123
532	TPS1 low voltage	122
533	TPS2 high voltage	223
532	TPS2 low voltage	222
535	TPS1 higher than TPS2	221
536	TPS1 lower than TPS2	121
537	Unable to reach higher TPS	2112
538	Unable to reach lower TPS	2111
539	TPS1/2 simultaneous voltages out of range	2135
541	AUX analog PU1 high	1511
542	AUX analog PU1 low	1512
543	AUX analog PU2 high	1513
544	AUX analog PU2 low	1514
545	IVS/Brake/Trans-Park interlock failure	1531
551	Max govern speed override	219
552	Fuel rev limit	1111

Table 3-17. Fault Code Cross Reference List (Ford Engine)

Original DTC Number	Fault Name	Corresponding DTC (Current)
553	Spark rev limit	1112
611	COP failure	606
612	Invalid interrupt	1616
613	A/D loss	1615
614	RTI 1 loss	1612
615	Flash checksum invalid	601
616	RAM failure	604
631	5VE1 low voltage	642
632	5VE1 high voltage	643
633	5VE2 high voltage	653
634	5VE2 low voltage	652
635	5VE 1/2 simultaneous out-of-range	1611
641	Rx Inactive	1621
642	Rx Noise	1622
643	Invalid Packet Format	1623
644	Shutdown Request	1624/1625
646	CAN Tx failure	1626
647	CAN Rx failure	1627
648	CAN addresss conflict failure	1628
655	RTI 2 loss	1613
656	RTI 3 loss	1614
711	Relay Control ground short	686
712	Relay Coil Open	685
713	Relay coil short to power	687
714	Fpump relay control ground short	628
715	Fpump relay coil open	627
716	Fpump relay coil short to power	629
721	Start relay control ground short	616
722	Start relay coil open	615
723	Start relay coil short to power	617
724	Buzzer control ground short	1641
725	Buzzer open	1642
726	Buzzer control short to power	1643
731	PWM1-Gauge1 open / ground short	1631
732	PWM1-Gauge1 short to power	1632
733	PWM2-Gauge2 open /ground short	1633
734	PWM2-Gauge2 short to power	1634
735	PWM3-Gauge3 open / ground short	1635
736	PWM3-Gauge3 short to power	1636
741	PWM4 open / ground short	1637
742	PWM4 short to power	1638
743	PWM5 open / ground short	1639

Table 3-17. Fault Code Cross Reference List (Ford Engine)

Original DTC Number	Fault Name	Corresponding DTC (Current)
744	PWM5 short to power	1640
761	MIL control ground short	1644
762	MIL open	650
763	MIL control short to power	1645
771	Tach output ground short	2618
772	Tach output short to power	2619
1182	Fuel impurity level high	1182
1183	Megajector autozero / lockoff failed	1183
1311	Misfire detected	1311
1312	Misfire detected	1312
1313	Misfire detected	1313
1314	Misfire detected	1314
1315	Misfire detected	1315
1316	Misfire detected	1316
1317	Misfire detected	1317
1318	Misfire detected	1318
1547	AUX analog PUD4 high	1547
1548	AUX analog PUD4 low	1548
1561	AUX analog PD2 high	1561
1562	AUX analog PD2 low	1562
1563	AUX analog PD3 high	1563
1564	AUX analog PD3 low	1564
1629	J1939 TSC1 message receipt lost	1629
1630	J1939 ETC message receipt lost	1630
1661	PWM6 open / ground short	1661
1662	PWM6 short to power	1662
1663	PWM7 open / ground short	1663
1664	PWM7 short to power	1664
1665	PWM8 open / ground short	1665
1666	PWM8 short to power	1666
1669	PWM9 open / ground short	1669
1670	PWM9 short to power	1670

Table 3-18. CAN to DTC Cross Reference (Ford Engine)

SPN	FMI	DTC	DTC and Description
0	31	1531	Gov1/2/3 interlock failure
0	31	1621	RS-485 Rx inactive
0	31	1622	RS-485 Rx noise
0	31	1623	RS-485 Rx bad packet format
0	31	1624	RS-485 remote shutdown request
29	0	2116	FPP2 higher than IVS
29	1	2140	FPP2 lower than IVS
29	3	2128	FPP2 voltage high
29	4	2127	FPP2 voltage low
51	0	221	TPS1-2 higher than expected
51	1	121	TPS1-2 lower than expected
51	3	123	TPS1 voltage high
51	4	122	TPS1 voltage low
51	7	2111	Unable to reach lower TPS
51	7	2112	Unable to reach higher TPS
51	31	2135	TPS1/2 simultaneous voltages out-of-range
84	8	502	Roadspeed input loss of signal
91	0	2115	FPP1 higher than IVS
91	1	2139	FPP1 lower than IVS
91	3	2122	FPP1 voltage high
91	4	2123	FPP1 voltage low
91	9	1651	J1939 ETC message receipt loss while in-gear
91	16	2126	FPP1-2 higher than expected
91	18	2121	FPP1-2 lower than expected
91	19	1630	J1939 ETC message receipt loss
91	31	1121	FPP1/2 simultaneous voltages out-of-range (redundancy lost)
94	3	92	FP high voltage
94	4	91	FP low voltage
100	0	521	Oil pressure sender high pressure
100	1	524	Oil pressure low
100	1	524	Oil pressure sender low pressure
100	3	523	Oil pressure sender high voltage
100	4	522	Oil pressure sender low voltage
102	0	234	Boost control overboost failure
102	1	299	Boost control underboost failure
102	2	236	TIP active
102	3	238	TIP high voltage
102	4	237	TIP low voltage
105	0	127	IAT higher than expected stage 2
105	3	113	IAT voltage high
105	4	112	IAT voltage low
105	15	111	IAT higher than expected stage 1

Table 3-18. CAN to DTC Cross Reference (Ford Engine)

SPN	FMI	DTC	DTC and Description
106	4	107	MAP voltage low
106	16	108	MAP pressure high
108	0	2229	BP pressure high
108	1	129	BP pressure low
110	0	217	ECT higher than expected stage 2
110	0	1522	CHT higher than expected stage 2
110	3	118	ECT voltage high
110	4	117	ECT voltage low
110	15	116	ECT higher than expected stage 1
110	16	1521	CHT higher than expected stage 1
168	15	563	Vbat voltage high
168	17	562	Vbat voltage low
173	0	2428	EGT temperature high
174	3	183	FT high voltage
174	4	182	FT low voltage
441	0	1417	EMWT1 higher than expected stage 2
441	3	1411	EMWT1 voltage high
441	4	1413	EMWT1 voltage low
441	15	1415	EMWT1 higher than expected stage 1
442	0	1418	EMWT2 higher than expected stage 2
442	3	1412	EMWT2 voltage high
442	4	1414	EMWT2 voltage low
442	15	1416	EMWT2 higher than expected stage 1
515	0	1112	RPM above spark rev limit level
515	15	219	RPM higher than max allowed govern speed
515	16	1111	RPM above fuel rev limit level
558	5	2130	IVS stuck at-idle, FPP1/2 match
558	6	2131	IVS stuck off-idle, FPP1/2 match
628	13	601	Microprocessor failure - FLASH
629	31	606	Microprocessor failure - COP
629	31	1612	Microprocessor failure - RTI 1
629	31	1613	Microprocessor failure - RTI 2
629	31	1614	Microprocessor failure - RTI 3
629	31	1615	Microprocessor failure - A/D
629	31	1616	Microprocessor failure - Interrupt
630	12	604	Microprocessor failure - RAM
632	31	359	Fuel run-out longer than expected
636	2	336	CRANK input signal noise
636	4	337	Crank signal loss
636	8	16	Crank and/or cam could not synchronize during start
639	12	1626	CAN-J1939 Tx fault
639	12	1627	CAN-J1939 Rx fault
639	13	1628	J1939 CAN address / engine-number conflict

Table 3-18. CAN to DTC Cross Reference (Ford Engine)

SPN	FMI	DTC	DTC and Description
645	3	2619	Tach output short to power
645	4	2618	Tach output ground short
651	5	261	Injector 1 open or short to ground
651	6	262	Injector 1 coil shorted
652	5	264	Injector 2 open or short to ground
652	6	265	Injector 2 coil shorted
653	5	267	Injector 3 open or short to ground
653	6	268	Injector 3 coil shorted
654	5	270	Injector 4 open or short to ground
654	6	271	Injector 4 coil shorted
655	5	273	Injector 5 open or short to ground
655	6	274	Injector 5 coil shorted
656	5	276	Injector 6 open or short to ground
656	6	277	Injector 6 coil shorted
657	5	279	Injector 7 open or short to ground
657	6	280	Injector 7 coil shorted
658	5	282	Injector 8 open or short to ground
658	6	283	Injector 8 coil shorted
659	5	285	Injector 9 open or short to ground
659	6	286	Injector 9 coil shorted
660	5	288	Injector 10 open or short to ground
660	6	289	Injector 10 coil shorted
695	9	1629	J1939 TSC1 message receipt loss
697	3	1632	PWM1-Gauge1 short to power
697	5	1631	PWM1-Gauge1 open / ground short
698	3	1634	PWM2-Gauge2 short to power
698	5	1633	PWM2-Gauge2 open / ground short
699	3	1636	PWM3-Gauge3 short to power
699	5	1635	PWM3-Gauge3 open / ground short
700	3	1638	PWM4 short to power
700	5	1637	PWM4 open / ground short
701	3	1511	AUX analog Pull-Up 1 high voltage
701	4	1512	AUX analog Pull-Up 1 low voltage
702	3	1513	AUX analog Pull-Up 2 high voltage
702	4	1514	AUX analog Pull-Up 2 low voltage
703	3	1517	AUX analog Pull-Up 3 high voltage
703	4	1518	AUX analog Pull-Up 3 low voltage
704	3	1541	AUX analog Pull-Up/Down 1 high voltage
704	4	1542	AUX analog Pull-Up/Down 1 low voltage
705	3	1543	AUX analog Pull-Up/Down 2 high voltage
705	4	1544	AUX analog Pull-Up/Down 2 low voltage
706	3	1545	AUX analog Pull-Up/Down 3 high voltage
706	4	1546	AUX analog Pull-Up/Down 3 low voltage

Table 3-18. CAN to DTC Cross Reference (Ford Engine)

SPN	FMI	DTC	DTC and Description
707	3	1551	AUX digital 1 high voltage
707	4	1552	AUX digital 1 low voltage
708	3	1553	AUX digital 2 high voltage
708	4	1554	AUX digital 2 low voltage
709	3	1555	AUX digital 3 high voltage
709	4	1556	AUX digital 3 low voltage
710	3	1515	AUX analog Pull-Down 1 high voltage
710	4	1516	AUX analog Pull-Down 1 low voltage
711	3	1561	AUX analog Pull-Down 2 high voltage
711	4	1561	AUX analog Pull-Down 2 low voltage
712	3	1561	AUX analog Pull-Down 3 high voltage
712	4	1561	AUX analog Pull-Down 3 low voltage
713	3	1547	AUX analog Pull-Up/Down 4 high voltage
713	4	1548	AUX analog Pull-Up/Down 4 low voltage
723	2	341	CAM input signal noise
723	4	342	Loss of CAM input signal
731	2	326	Knock1 excessive or erratic signal
731	4	327	Knock1 sensor open or not present
920	3	1643	Buzzer control short to power
920	4	1641	Buzzer control ground short
920	5	1642	Buzzer open
924	3	1640	PWM5 short to power
924	5	1639	PWM5 open / ground short
925	3	1662	PWM6 short to power
925	5	1661	PWM6 open / ground short
926	3	1664	PWM7 short to power
926	5	1663	PWM7 open / ground short
1079	3	643	Sensor supply voltage 1 high
1079	4	642	Sensor supply voltage 1 low
1079	31	1611	Sensor supply voltage 1 and 2 out-of-range
1080	3	653	Sensor supply voltage 2 high
1080	4	652	Sensor supply voltage 2 low
1110	31	1625	J1939 shutdown request
1192	3	1131	WGP voltage high
1192	4	1132	WGP voltage low
1213	3	1645	MIL control short to power
1213	4	1644	MIL control ground short
1213	5	650	MIL open
1268	5	2300	Spark coil 1 primary open or short to ground
1268	6	2301	Spark coil 1 primary shorted
1269	5	2303	Spark coil 2 primary open or short to ground
1269	6	2304	Spark coil 2 primary shorted
1270	5	2306	Spark coil 3 primary open or short to ground

Table 3-18. CAN to DTC Cross Reference (Ford Engine)

SPN	FMI	DTC	DTC and Description
1270	6	2307	Spark coil 3 primary shorted
1271	5	2309	Spark coil 4 primary open or short to ground
1271	6	2310	Spark coil 4 primary shorted
1272	5	2312	Spark coil 5 primary open or short to ground
1272	6	2313	Spark coil 5 primary shorted
1273	5	2315	Spark coil 6 primary open or short to ground
1273	6	2316	Spark coil 6 primary shorted
1274	5	2318	Spark coil 7 primary open or short to ground
1274	6	2319	Spark coil 7 primary shorted
1275	5	2321	Spark coil 8 primary open or short to ground
1275	6	2322	Spark coil 8 primary shorted
1276	5	2324	Spark coil 9 primary open or short to ground
1276	6	2325	Spark coil 9 primary shorted
1277	5	2327	Spark coil 10 primary open or short to ground
1277	6	2328	Spark coil 10 primary shorted
1321	3	617	Start relay coil short to power
1321	4	616	Start relay ground short
1321	5	615	Start relay coil open
1323	11	1311	Cylinder 1 misfire detected
1323	31	301	Cylinder 1 emissions/catalyst damaging misfire
1324	11	1312	Cylinder 2 misfire detected
1324	31	302	Cylinder 2 emissions/catalyst damaging misfire
1325	11	1313	Cylinder 3 misfire detected
1325	31	303	Cylinder 3 emissions/catalyst damaging misfire
1326	11	1314	Cylinder 4 misfire detected
1326	31	304	Cylinder 4 emissions/catalyst damaging misfire
1327	11	1315	Cylinder 5 misfire detected
1327	31	305	Cylinder 5 emissions/catalyst damaging misfire
1328	11	1316	Cylinder 6 misfire detected
1328	31	306	Cylinder 6 emissions/catalyst damaging misfire
1329	11	1317	Cylinder 7 misfire detected
1329	31	307	Cylinder 7 emissions/catalyst damaging misfire
1330	11	1318	Cylinder 8 misfire detected
1330	31	308	Cylinder 8 emissions/catalyst damaging misfire
1347	5	628	Fuel-pump high-side open or short to ground
1347	6	629	Fuel-pump high-side short to power
1348	3	629	Fuel pump relay coil short to power
1348	4	628	Fuel pump relay control ground short
1348	5	627	Fuel pump relay coil open
1385	0	1425	ERWT1 higher than expected stage 2
1385	3	1419	ERWT1 voltage high
1385	4	1421	ERWT1 voltage low
1385	15	1423	ERWT1 higher than expected stage 1

Table 3-18. CAN to DTC Cross Reference (Ford Engine)

SPN	FMI	DTC	DTC and Description
1386	0	1426	ERWT2 higher than expected stage 2
1386	3	1420	ERWT2 voltage high
1386	4	1422	ERWT2 voltage low
1386	15	1424	ERWT2 higher than expected stage 1
1485	3	687	Power relay coil short to power
1485	4	686	Power relay ground short
1485	5	685	Power relay coil open
2646	3	1666	PWM8 short to power
2646	5	1665	PWM8 open / ground short
2647	3	1670	PWM9 short to power
2647	5	1669	PWM9 open / ground short
3050	11	420	Catalyst inactive on gasoline (Bank 1)
3050	11	1165	Catalyst inactive on LPG
3050	11	1166	Catalyst inactive on NG
3051	11	430	Catalyst inactive on gasoline (Bank 2)
3056	3	8906	UEGO return voltage shorted high
3056	4	8907	UEGO return voltage shorted low
3217	3	8910	UEGO sense cell voltage high
3217	4	8911	UEGO sense cell voltage low
3217	5	134	EGO1 open / lazy
3218	3	8908	UEGO pump voltage shorted high
3218	4	8909	UEGO pump voltage shorted low
3221	3	8904	UEGO cal resistor voltage high
3221	4	8905	UEGO cal resistor voltage low
3221	31	8901	UEGO microprocessor internal fault
3222	0	8916	UEGO sense cell impedance high
3222	3	8902	UEGO heater supply high voltage
3222	4	8903	UEGO heater supply low voltage
3222	10	8914	UEGO sense cell slow to warm up
3225	0	8917	UEGO pump cell impedance high
3225	1	8918	UEGO pump cell impedance low
3225	3	8912	UEGO pump voltage at high drive limit
3225	4	8913	UEGO pump voltage at low drive limit
3225	10	8915	UEGO pump cell slow to warm up
3227	5	154	EGO2 open / lazy
3256	5	140	EGO3 open / lazy
3266	5	160	EGO4 open / lazy
3468	3	188	Gaseous fuel temperature sender high voltage
3468	4	187	Gaseous fuel temperature sender low voltage
3673	3	223	TPS2 voltage high
3673	4	222	TPS2 voltage low
4236	0	1151	Closed-loop LPG high
4236	0	1153	Closed-loop NG high

Table 3-18. CAN to DTC Cross Reference (Ford Engine)

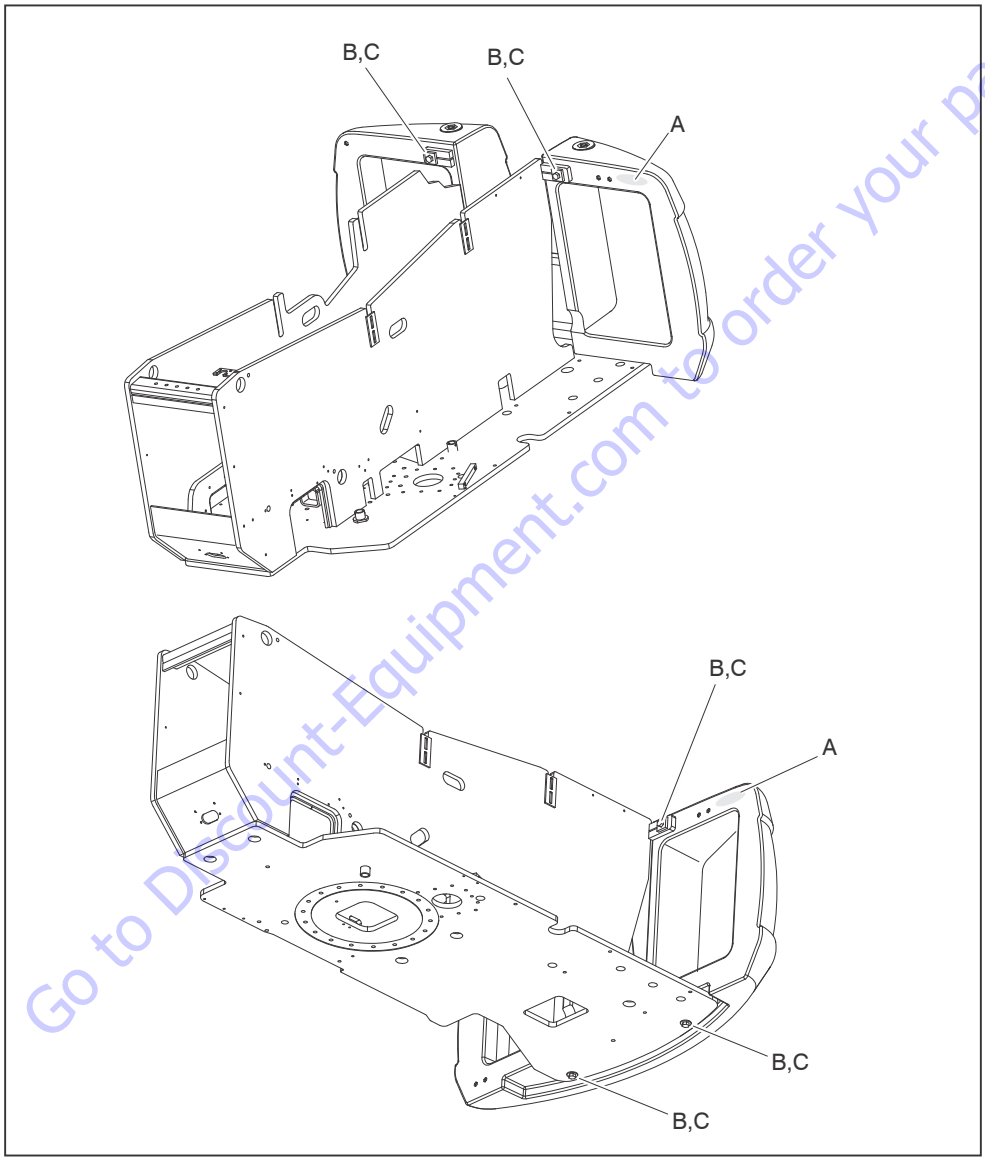
SPN	FMI	DTC	DTC and Description
4236	0	1155	Closed-loop gasoline bank1 high
4236	1	1152	Closed-loop LPG low
4236	1	1154	Closed-loop NG low
4236	1	1156	Closed-loop gasoline bank1 low
4237	0	171	Adaptive-learn gasoline bank1 high
4237	0	1161	Adaptive-learn LPG high
4237	0	1163	Adaptive-learn NG high
4237	1	172	Adaptive-learn gasoline bank1 low
4237	1	1162	Adaptive-learn LPG low
4237	1	1164	Adaptive-learn NG low
4238	0	1157	Closed-loop gasoline bank2 high
4238	1	1158	Closed-loop gasoline bank2 low
4239	0	174	Adaptive-learn gasoline bank2 high
4239	1	175	Adaptive-learn gasoline bank2 low
520197	2	331	Knock2 excessive or erratic signal
520197	4	332	Knock2 sensor open or not present
520199	11	1122	FPP1/2 do not match each other or IVS (redundancy lost)
520199	11	2120	FPP1 invalid voltage and FPP2 disagrees with IVS (redundancy lost)
520199	11	2125	FPP1/2 do not match each other or IVS (redundancy lost)
520201	5	509	IAC coil open/short
520201	6	508	IAC ground short
520260	0	1171	MegaJector delivery pressure higher than expected
520260	1	1172	MegaJector delivery pressure lower than expected
520260	3	1174	MegaJector voltage supply high
520260	4	1175	MegaJector voltage supply low
520260	12	1176	MegaJector internal actuator fault detection
520260	12	1177	MegaJector internal circuitry fault detection
520260	12	1178	MegaJector internal comm fault detection
520260	31	1173	MegaJector comm lost
520401	0	1182	Fuel impurity level high

3.27 COUNTERWEIGHT

Both the 800A and the 800AJ share the same tail and frame counterweights regardless of market. However, there is a difference in frame counterweights depending on the equipped tires and wheel drive options. Pneumatic tire machines require more frame counterweight than is required with foam filled tires and 2 wheel drive machines require more counterweight than 4 wheel drives.

Machines originally equipped with foam filled tires cannot be converted to pneumatic tires and 4 wheel drives cannot be converted to 2 wheel drives without adding counterweight. No counterweight difference is required between the narrow and wide pneumatic tire options. Similarly, no counterweight difference is required between the narrow and wide foam filled tires.

If the counterweight has been removed, ensure the retaining bolts are torqued to the proper value as shown inFigure 3-115.



A. Actual Weight Stamping

B. Apply JLG Threadlocker P/N 0100011 to Bolt Threads and to Threads in Counterweight.

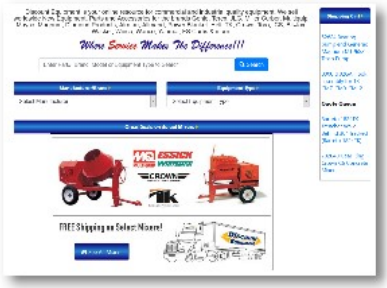
C. Torque to 285 ft. lbs. (386 Nm). Typical Four Places.

Figure 3-115. Counterweight

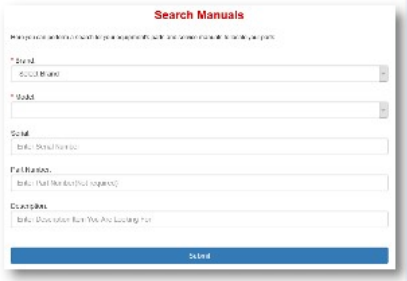
PARTS FINDER

Search Website by Part Number

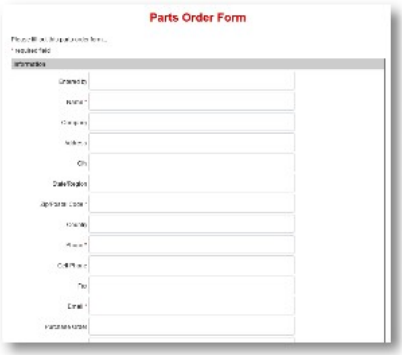
Discount Equipment



Search Manual Library For Parts Manual & Lookup Part Numbers – Purchase or Request Quote



Can't Find Part or Manual? Request Help by Manufacturer, Model & Description



Discount-Equipment.com is your online resource for quality parts & equipment.
Florida: 561-964-4949 Outside Florida TOLL FREE: 877-690-3101

Need parts?

Click on this link: http://www.discount-equipment.com/category/5443-parts/ and choose one of the options to help get the right parts and equipment you are looking for. Please have the machine model and serial number available in order to help us get you the correct parts. If you don't find the part on the website or on once of the online manuals, please fill out the request form and one of our experienced staff members will get back to you with a quote for the right part that your machine needs.

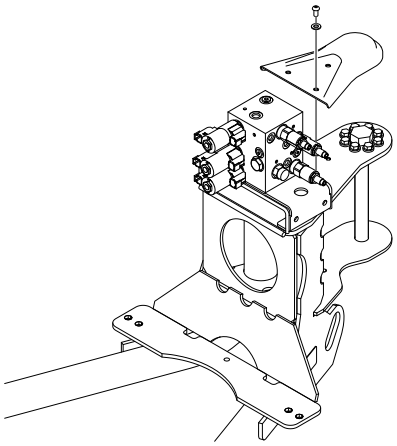
We sell worldwide for the brands: Genie, Terex, JLG, MultiQuip, Mikasa, Essick, Whiteman, Mayco, Toro Stone, Diamond Products, Generac Magnum, Airman, Haulotte, Barreto, Power Blanket, Nifty Lift, Atlas Copco, Chicago Pneumatic, Allmand, Miller Curber, Skyjack, Lull, Skytrak, Tsurumi, Husquvarna Target, , Stow, Wacker, Sakai, Mi-T- M, Sullair, Basic, Dynapac, MBW, Weber, Bartell, Bennar Newman, Haulotte, Ditch Runner, Menegotti, Morrison, Contec, Buddy, Crown, Edco, Wyco, Bomag, Laymor, Barreto, EZ Trench, Bil-Jax, F.S. Curtis, Gehl Pavers, Heli, Honda, ICS/PowerGrit, IHI, Partner, Imer, Clipper, MMD, Koshin, Rice, CH&E, General Equipment, ,AMida, Coleman, NAC, Gradall, Square Shooter, Kent, Stanley, Tamco, Toku, Hatz, Kohler, Robin, Wisconsin, Northrock, Oztec, Toker TK, Rol-Air, Small Line, Wanco, Yanmar

SECTION 4. BOOM & PLATFORM

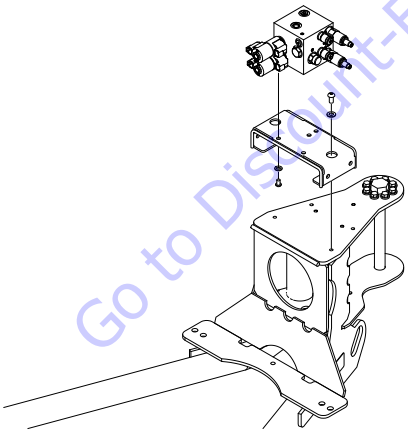
4.1 PLATFORM

Platform Valve Removal

1. Tag and disconnect the hydraulic lines from the platform control valve. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
2. Remove hardware securing cover from the platform support. Remove cover.

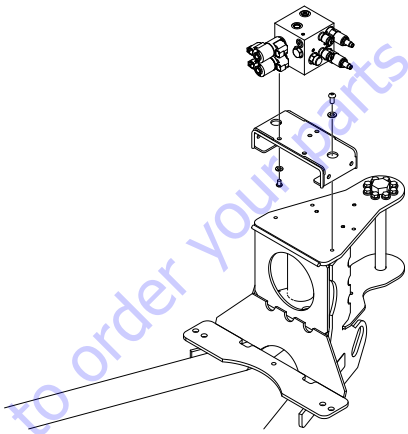


3. Remove hardware securing the mounting bracket to the platform support. Take out the mounting bracket along with platform control valve.
4. Remove hardware securing the platform control valve to the mounting bracket. Remove platform control valve.

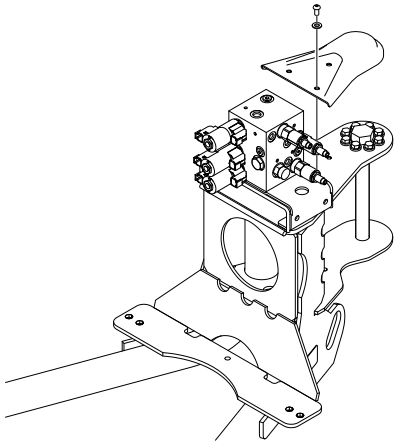


Platform Valve Installation

1. Install platform control valve onto the mounting bracket and secure using hardware.
2. Install the mounting bracket onto the platform support and secure using hardware.



3. Install cover onto the platform support securing the hardware.



4. Remove tag and reconnect the hydraulic lines to the platform control valve.

Support Removal

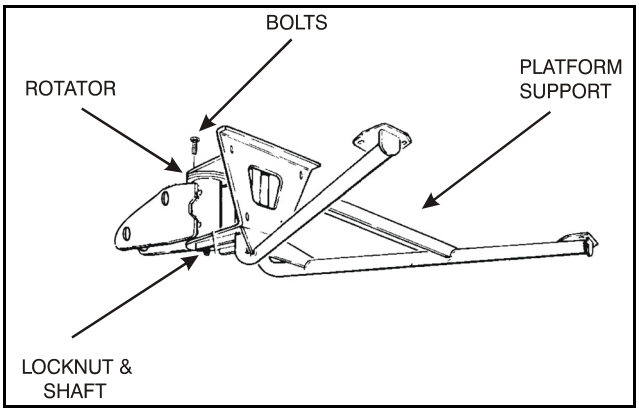
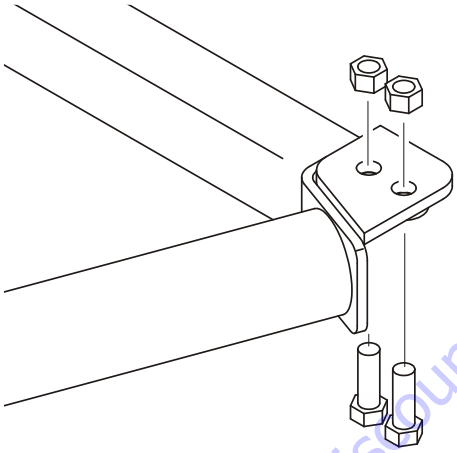


Figure 4-1. Location of Components Platform Support

1. Disconnect electrical cables from control console.
2. Remove the bolts securing the platform to the platform support, then remove the platform.

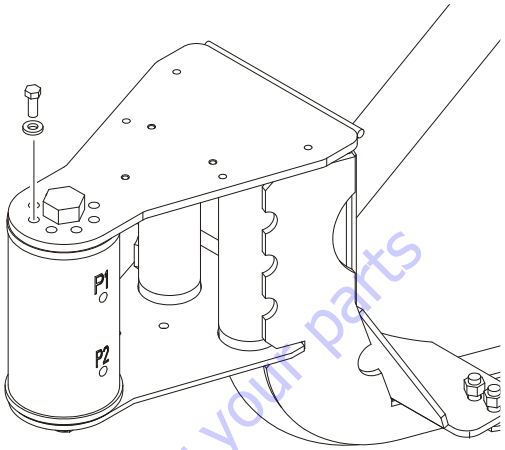
NOTE: *The Platform Weighs approximately 220 lbs (100 kg).*



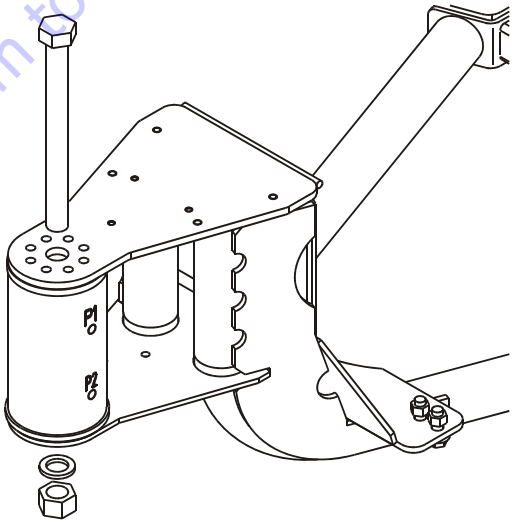
3. Using a suitable device, support the platform support.

NOTE: *The platform support weighs approximately 77 lbs. (35 kg).*

4. Remove the bolts and locknuts securing the support to the rotator.



5. Using a suitable brass drift and hammer, remove the rotator shaft, then remove the support from the rotator.

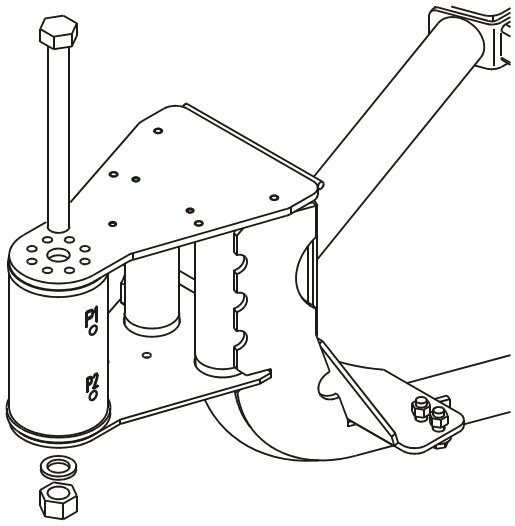


Support Installation

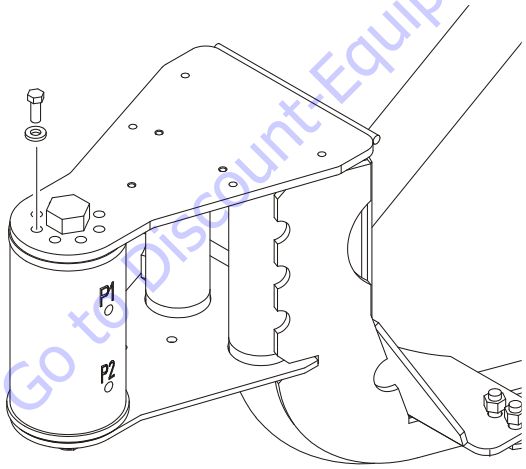
1. Using a suitable device, support the platform support and position it on the rotator.

NOTE: *The platform support weighs approximately 77 lbs. (35 kg).*

2. Install the rotator center bolt.

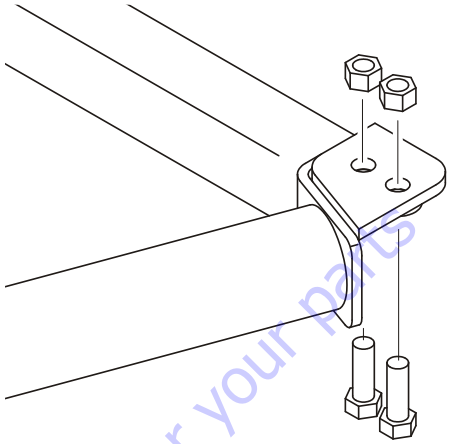


3. Apply JLG Threadlocker P/N 0100011 to the eight bolts and locknuts securing the support to the rotator and install the bolts and locknuts.

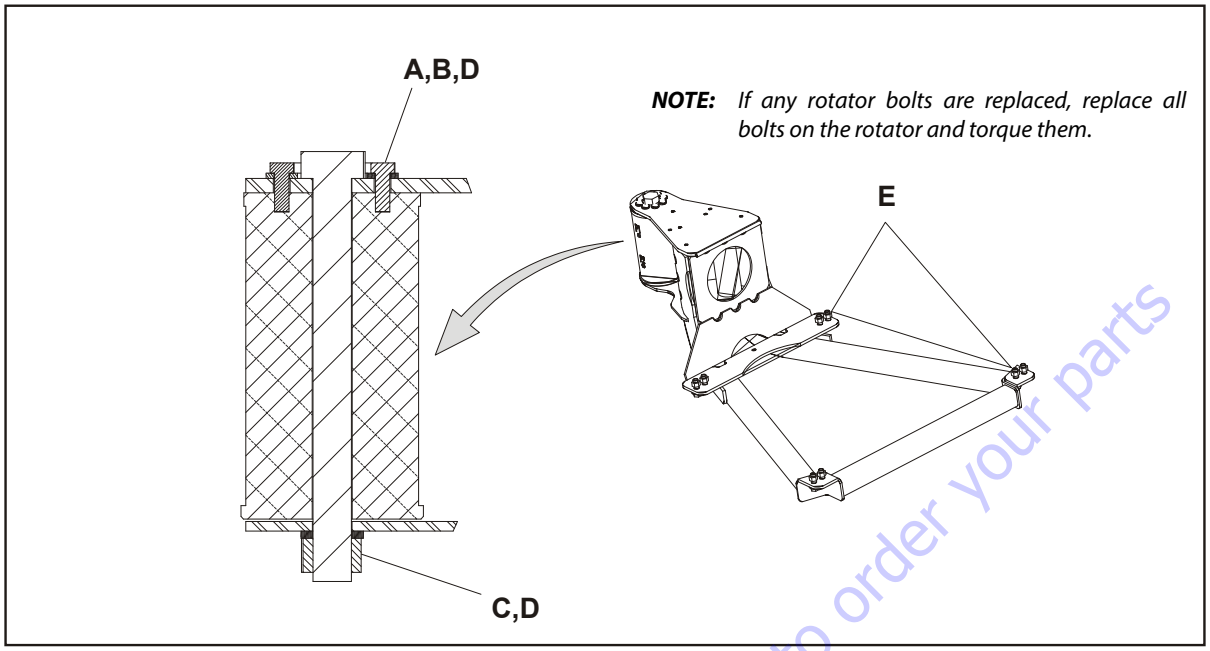


4. Torque the nut on the rotator center bolt to 480 ft. lbs. (651 Nm). Torque the retaining bolts to 40 ft. lbs. (55 Nm).

5. Position the platform on the platform support and install the bolts securing the platform to the platform support. Torque the bolts to 75 ft. lbs. (102 Nm).



6. Connect the electrical cables to the platform control console.



A	Torque to 40 ft.lbs. (55 Nm)
B	JLG Thread locker (#0100011)
C	Torque to 480 ft. lbs. (650 Nm)
D	Check torque every 150 hours of operation
E	Torque to 75 ft. lbs. (102 Nm)

Figure 4-2. Platform Support Torque Values

4.2 ROTATOR AND PLATFORM (SLAVE) CYLINDER

Removal

1. Tag and disconnect hydraulic lines to rotator. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
2. Supporting the rotator, remove hardware from pin #1. Using a suitable brass drift and hammer remove pin #1 from the fly boom.
3. Remove the hardware from pin #2. Using a suitable brass drift and hammer, remove pin #2 from the fly boom and remove the rotator.
4. Telescope the fly section out approximately 20 inches (50 cm) to gain access to the platform (slave) leveling cylinder. (800 AJ only)
5. Supporting the platform (slave) cylinder, remove the hardware from pin #3. Using a suitable brass drift and hammer remove pin #3 from the fly boom.
6. Tag and disconnect hydraulic lines to the platform (slave) leveling cylinder. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports. Remove the platform (slave) cylinder.

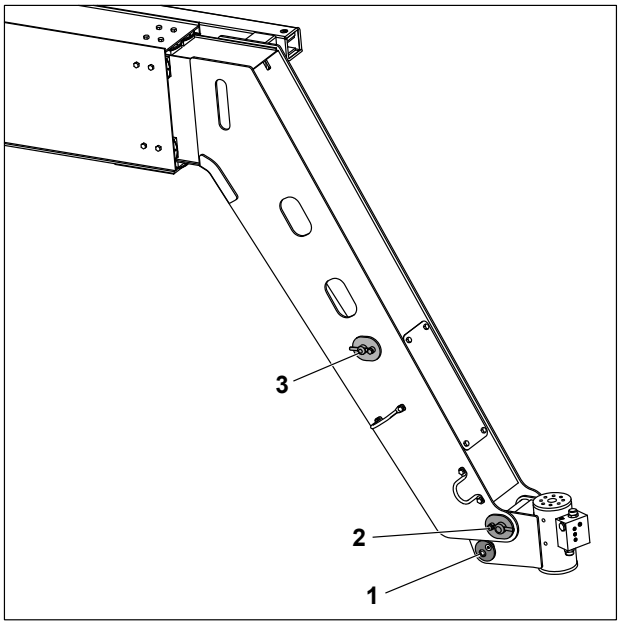


Figure 4-3. Reassembly of Components-Rotator and Leveling Cylinder

4.3 BOOM SYSTEM

Switch Systems

The Capacity Indicator, Transport Position Interlock, and Above Elevation Systems use normally closed electrical switches with "positive opening" contacts.

Capacity Indicator System (800A only)

The capacity indicator system uses a main boom length switch and a main boom angle switch to activate the 500 lbs. (230 kg) or the 1000 lbs. (450 kg) lights in the platform display panel. This is an indicator system only. The operator is responsible to maintain the safe working envelope indicated by the system for the load in the platform. As described in the Positive Opening Switch System, the "safe" condition of the machine is when 500 lbs. (230 kg) is allowed to be unrestricted (at low boom angles and extended boom lengths).

Above Elevation (Above Horizontal) Cutout System

The above elevation cutout system uses a main boom angle switch and a tower boom angle switch to sense when the boom is raised substantially above horizontal. The articulated jib of the 800AJ may be in any position. When "above elevation", the drive motors are automatically restricted to their maximum displacement position (slow speed). Additionally when used in conjunction with the "tilt indicator system", the elevation switches will cause an alarm to sound and automatically put the machine in the creep speed mode. With the exception of the speed cutback, this is a warning system only. The machine will continue to function. The operator is responsible to prevent the machine from attaining an unstable position. As described in the Positive Opening Switch System, the "safe" condition of the machine is when high engine and high speed is allowed (at low boom angles).

Transport Position Interlock System (CE only)

The transport position interlock system uses the "above elevation cutout system" switches with the addition of a main boom telescope switch to sense when the boom is out of the transport (nearly stowed) position. The articulated jib of the 800AJ may be in any position All controls are simultaneously functional when the booms are within the transport position as on the standard machine. When the booms are outside of the transport position, the control functions are interlocked to prevent simultaneous operation of any boom function with drive/steer. The first function set to be operated in this mode, becomes the master function set. In other words, while operating drive/steer functions the boom functions are inoperable. Likewise, while operating boom functions drive/steer functions are inoperable. In addition to being an interlock, this system also disallows high speed operation while the booms are beyond the transport position. While in this position, the machine will respond in the same way as described in the Above Elevation Cutout System. As described in the Positive Opening Switch System, the "safe" condition of the machine is when the use of multiple function operation is allowed (at low boom angles and short boom lengths).

Platform Control Enable System

The platform controls make use of a time dependent enable circuit to limit the time availability of "live" or enabled controls. When the footswitch is depressed, the controls are enabled and the operator has 7 seconds to operate any control. The controls will remain enabled as long as the operator continues to use any function and will remain enabled 7 seconds after the last function has been used. While the controls are "live" the enabled light will be illuminated in the platform display panel. When the time limit has been reached, the enabled light will turn off and the controls will be "dead" or disabled. To continue use of the machine the controls must be re-enabled to start the timer system over again. This is done be cycling the footswitch by releasing and redepressed the footswitch.

Function Speed Control System

The platform controls for the rotate, tower lift, tower telescope, jib lift, and main telescope functions are controlled through a common infinitely variable speed control knob. This knob feeds a common valve driver control circuit allowing a smooth ramp up and controlled maximum output speed. No ramp down is provided. These functions are controlled through common settings in which compromises must be made from function to function due to differences in flow and pressure. Not all functions will respond the same to the changes in the function speed knob position.

Platform

The standard platform utilizes a hinged swing gate for ease of entry and 3/4" expanded metal floor mesh. The optional drop bar gate platform utilizes 1/2" expanded metal floor mesh.

Main Lift End Stroke Dampening System

The main boom lift cylinder is constructed in a way that causes the lift cylinder oil flow to be restricted by an orifice while raising the boom within 5 degrees of maximum elevation. This restriction slows the boom lift speed while raising the boom. The oil flow is not restricted while lowering the boom and therefor the speed is not altered.

QuikStick Lift System

The main boom lift cylinder is pinned between the main boom and the nose of the tower fly boom. This causes an interdependency between the tower and main boom. The main boom changes angle when the tower is raised or lowered. In addition, the maximum angle achieved by the main boom is dependent on the position of the tower boom. When the tower boom is stowed, the main boom's maximum angle is 25 degrees. When the tower boom is fully raised, the main boom's maximum angle is 70 degrees. The main boom can be also be raised or lowered independent of the tower boom within the limits of the boom rests and main boom lift cylinder stroke to a minimum angle of -35 degrees. This allows the platform to reach the ground at any position of the tower boom.

Tower Boom Sequence Valve System

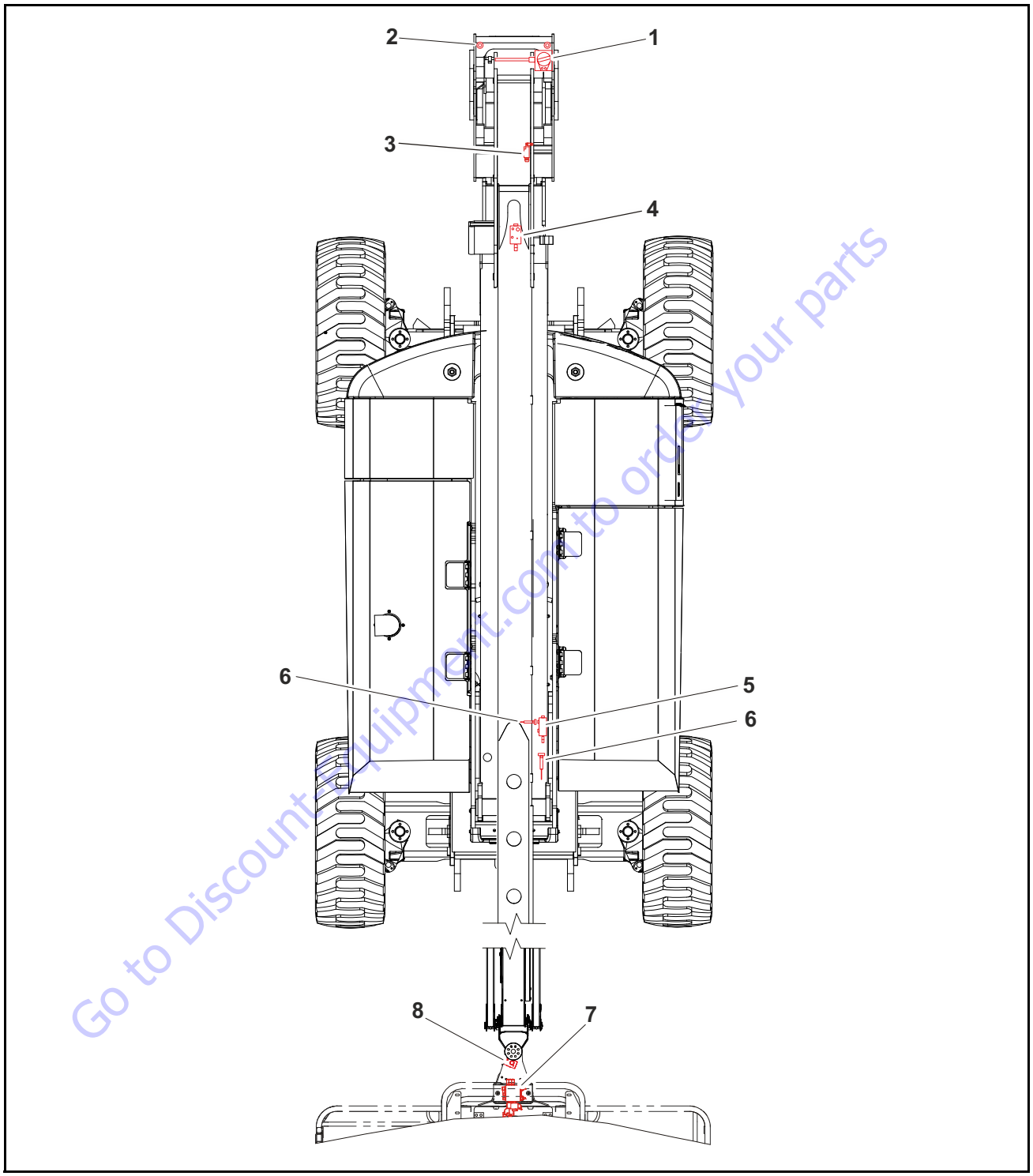
The two section tower boom uses two hydraulic lockout valves to prevent the boom from being telescoped until the boom is fully raised and to prevent the tower boom from being lowered until it is fully retracted. Until the valve mounted in the turntable is actuated by the cam on the tower lift cylinder barrel (at max tower angle), the tower telescope oil flow is blocked preventing the tower from telescoping out. Similarly, until the valve mounted on the tower fly boom is actuated by the tower base boom, the tower lift cylinder oil flow is blocked preventing the tower from lifting down. This is an automatic system.

Upright Level Override System

As the tower boom is raised the upright is leveled by a master-slave cylinder arrangement between the tower lift cylinder and the upright level cylinder. The upright can become out of level in two directions, towards the platform or away from the platform. If the upright is out of level towards the platform, it will automatically correct itself when the tower is lowered by dumping oil from the upright level cylinder over a relief valve mounted in the upright until the tower lift cylinder reaches the end of its stroke. If the upright is out of level away from the platform, the tower lift cylinder is fully retracted with stroke remaining in the upright level cylinder. To correct this condition a re-leveling valve (with a red pull knob) allows the tower to be raised (from ground control) without extending the upright level cylinder. The upright will then correct itself when the tower is lowered to the stowed position.

Ground Control Keyswitch System

The ground control keyswitch is used for selecting the active control of the machine between the platform or ground control stations and as another shut off switch for machine power. On the standard keyswitch, the key is removable only in the off position. This allows the ground control station to have ultimate priority over the platform control.



1. UMS Sensor
2. Main Boom Angle Switch
3. Tower Boom Angle Switch
4. Tower Telescope Plunger Valve
5. Tower Lift Plunger Valve
6. Proximity Switch
7. Rotator Valve
8. Platform Control Valve

Figure 4-4. Boom Component Location

4.4 MAIN BOOM POWERTRACK

Removal

1. Disconnect wiring harness connectors located in tower upright.

NOTICE

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID ENTRY OF CONTAMINANTS INTO SYSTEM.

2. Tag and disconnect hydraulic lines from connectors at boom assembly. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
3. Disconnect dual capacity indicator limit switch from side of boom section. (800A only)
4. Remove hydraulic lines and electrical cables from Powertrack.
5. Using suitable lifting equipment, adequately support Powertrack weight along entire length.
6. Remove bolt #1 securing the push tube on the fly boom section.

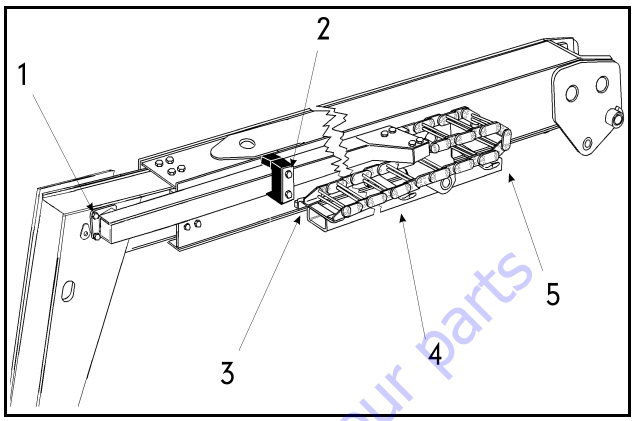


Figure 4-5. Main Boom Powertrack Components

7. Remove bolt #2 securing the push tube on the mid boom section.
8. With Powertrack supported and using all applicable safety precautions, remove bolts #3, #4 and #5 securing rail to the base boom section. Remove Powertrack from boom section.

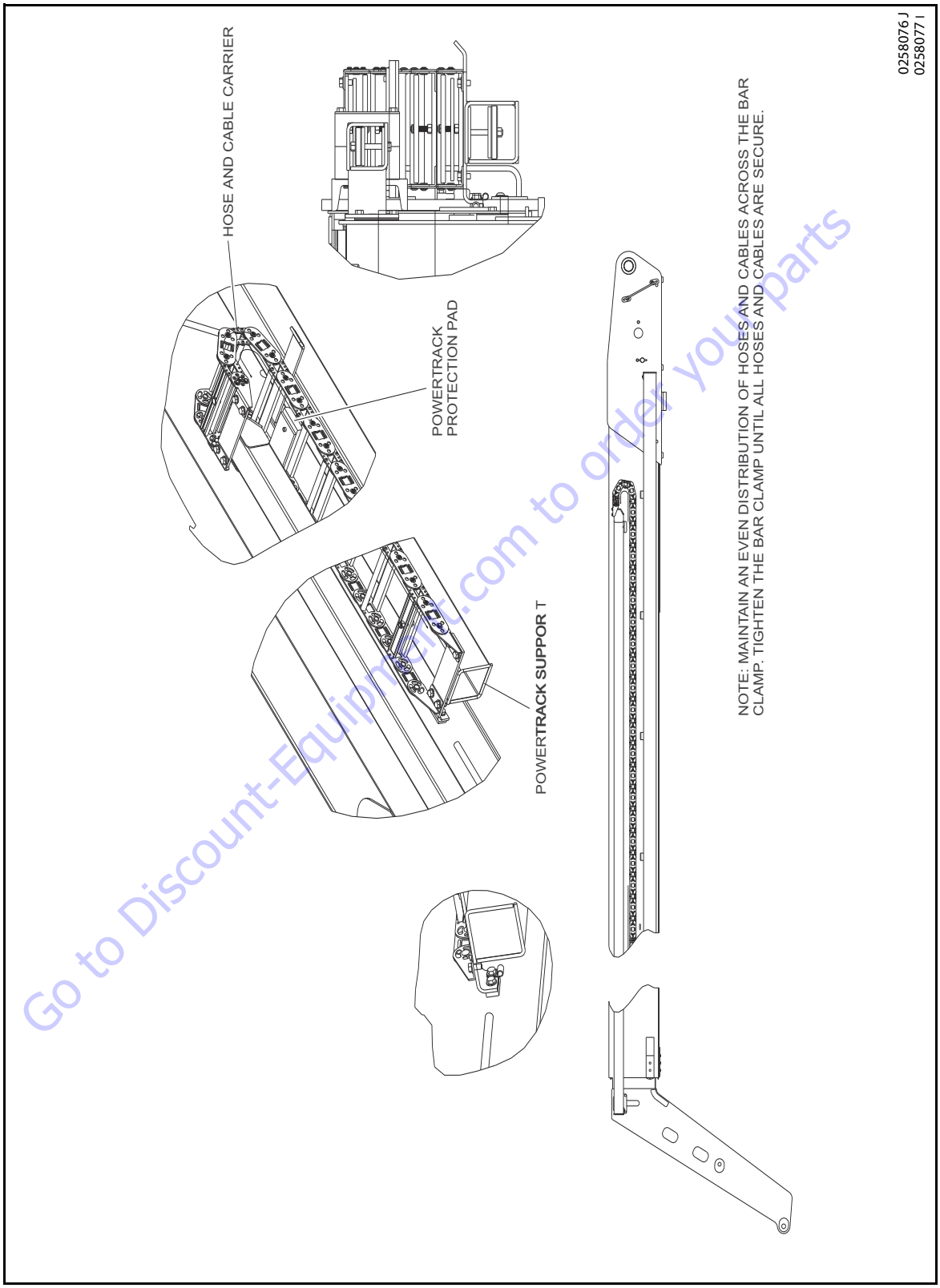
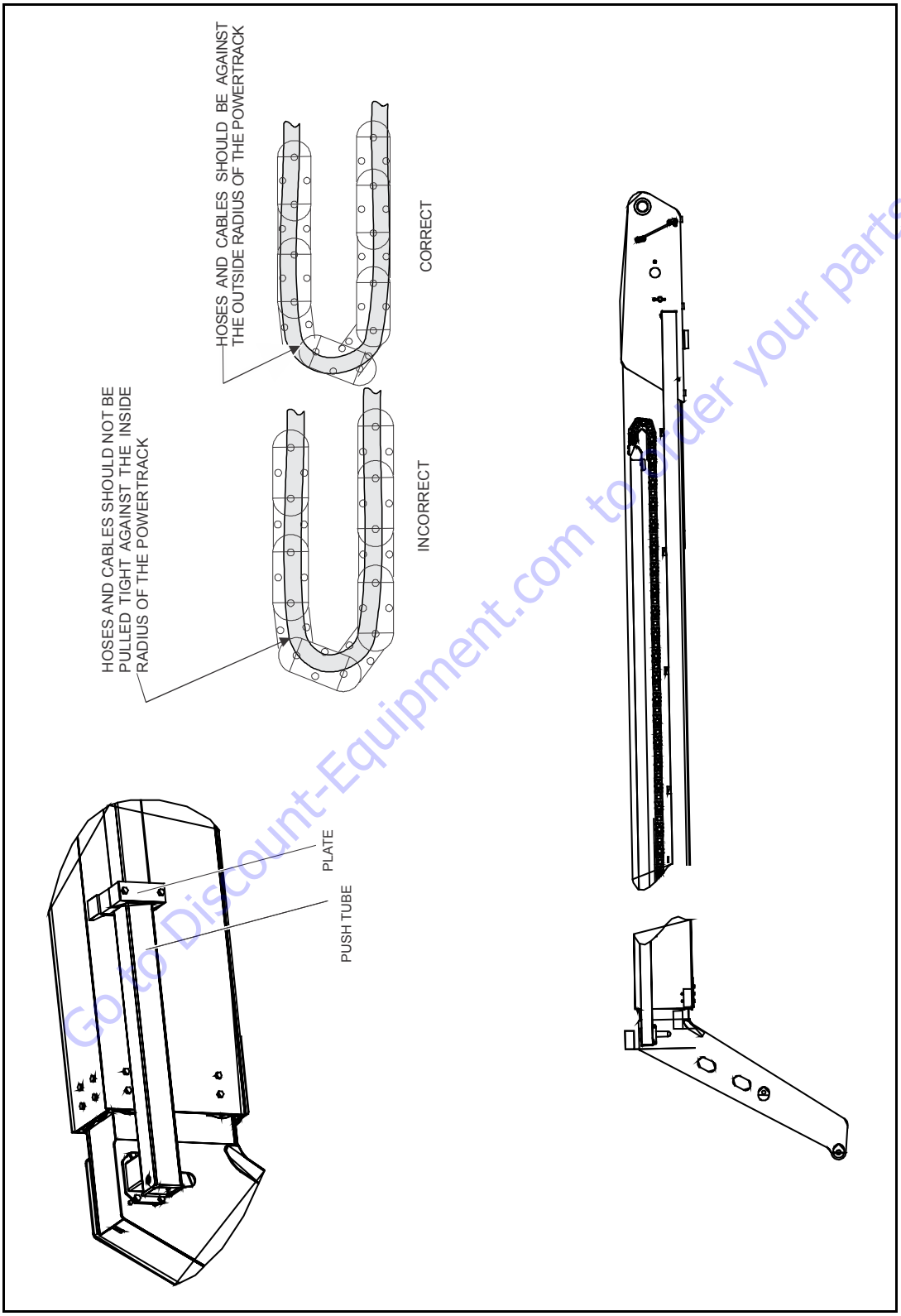


Figure 4-6. Powertrack Installation Main Boom (Sheet 1 of 2)



0258076 J
0258077 I

Figure 4-7. Powertrack Installation Main Boom (Sheet 2 of 2)

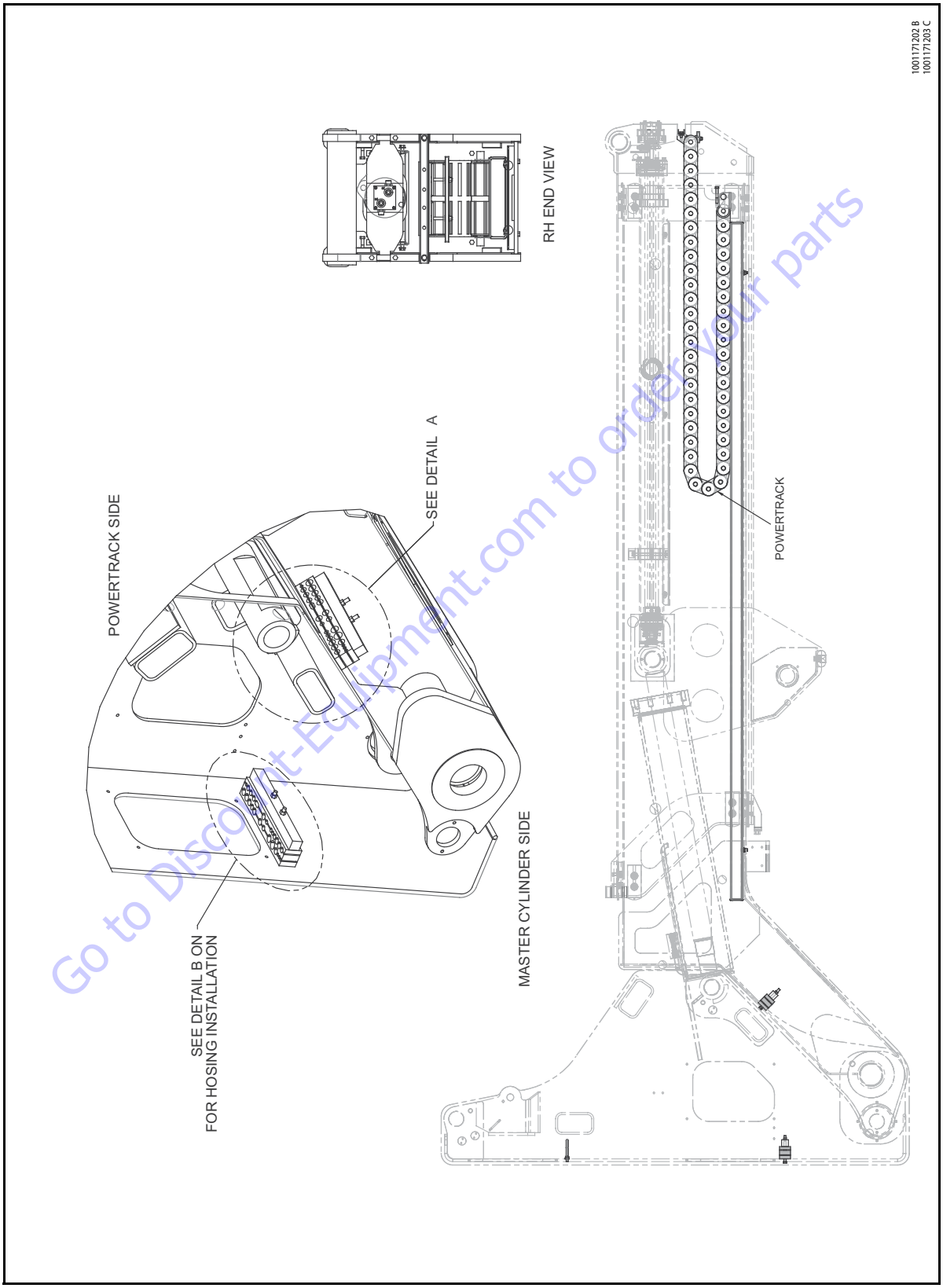


Figure 4-8. Powertrack Installation Tower Boom (Sheet 1 of 3)

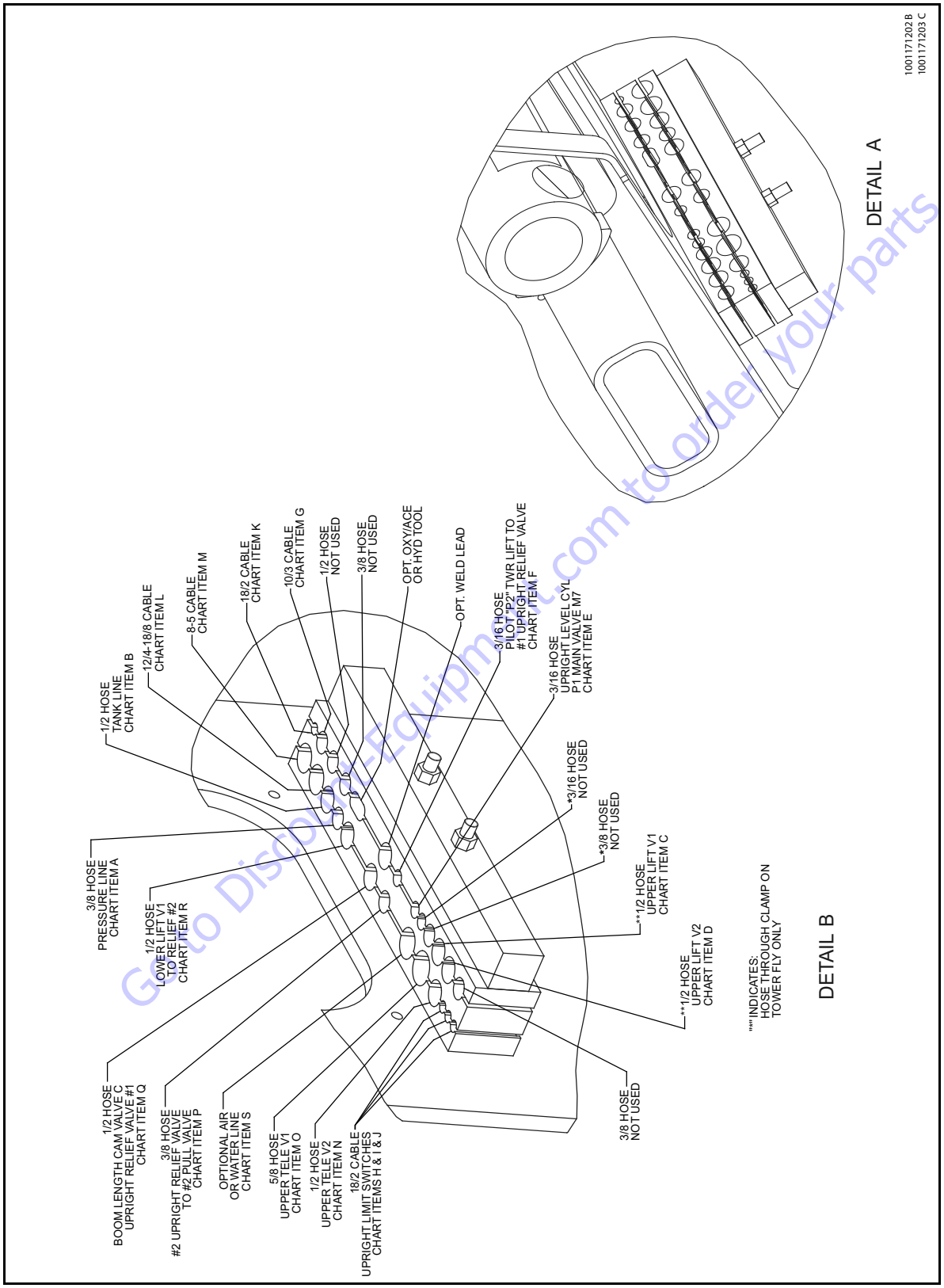
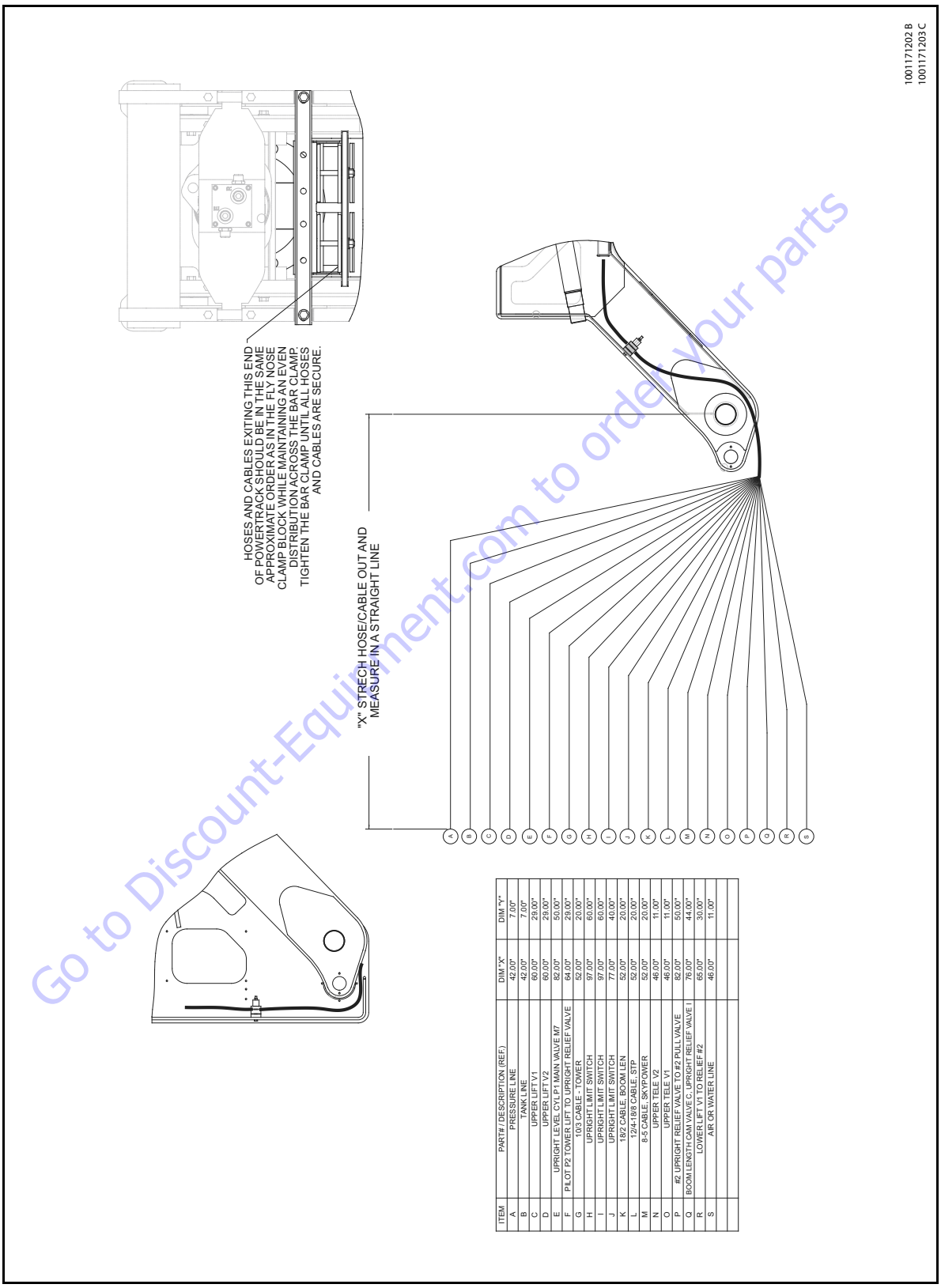


Figure 4-9. Powertrack Installation Tower Boom (Sheet 2 of 3)



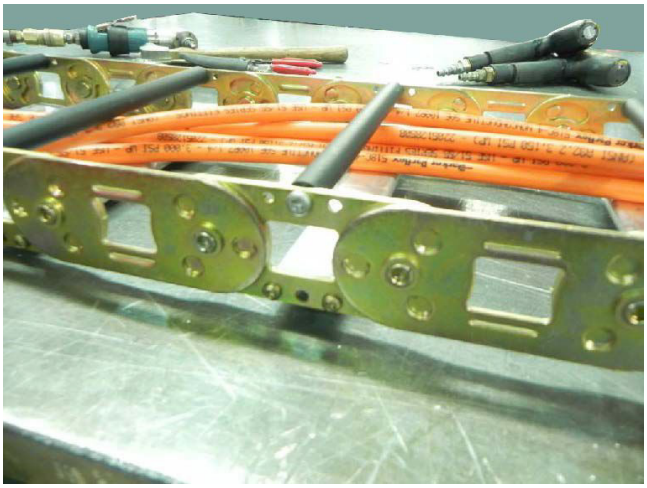
ITEM	PART# / DESCRIPTION (REF.)	DIM "X"	DIM "Y"
A	PRESSURE LINE	42.00"	7.00"
B	TANK LINE	42.00"	7.00"
C	UPPER LIFT V1	90.00"	29.00"
D	UPPER LIFT V2	90.00"	29.00"
E	UPRIGHT LEVEL CYL P1 MAIN VALVE M7	82.00"	50.00"
F	PILOT P2 TOWER LIFT TO UPRIGHT RELIEF VALVE	64.00"	29.00"
G	10/3 CABLE - TOWER	52.00"	20.00"
H	UPRIGHT LIMIT SWITCH	97.00"	60.00"
I	UPRIGHT LIMIT SWITCH	97.00"	60.00"
J	UPRIGHT LIMIT SWITCH	77.00"	40.00"
K	18/2 CABLE, BOOM LEN	52.00"	20.00"
L	12/4-18/8 CABLE, STP	52.00"	20.00"
M	8-5 CABLE, SKYPOWER	52.00"	20.00"
N	UPPER TELE V2	46.00"	11.00"
O	UPPER TELE V1	46.00"	11.00"
P	#2 UPRIGHT RELIEF VALVE TO #2 PULL VALVE	82.00"	50.00"
Q	BOOM LENGTH CAM VALVE C, UPRIGHT RELIEF VALVE	76.00"	44.00"
R	LOWER LIFT V1 TO RELIEF #2	65.00"	30.00"
S	AIR OR WATER LINE	46.00"	11.00"

Figure 4-10. Powertrack Installation Tower Boom (Sheet 3 of 3)

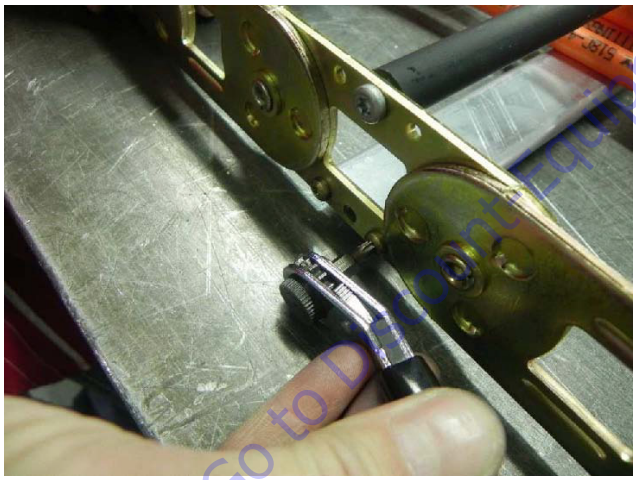
4.5 POWERTRACK MAINTENANCE

Flat Bar Removal

NOTE: *Hoses shown in the Powertrack are for example only. Actual hose and cable arrangements will be different.*

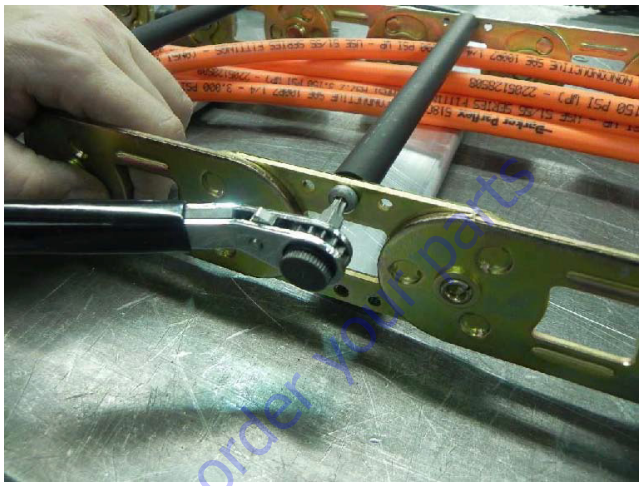


1. Use a small ¼" ratchet and a T-20 Torx bit. Remove the 8-32 x 0.500 screws from both sides. (If the track also has a flat bar on the inside of the track instead of round bar/poly, perform the same step to remove it.)

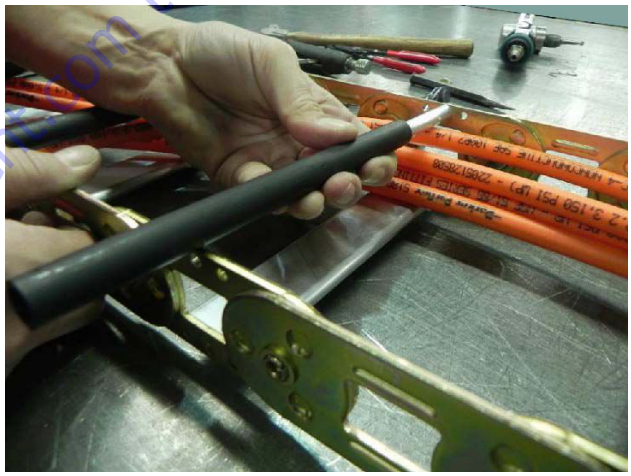


Round Bar/Poly Bar Removal

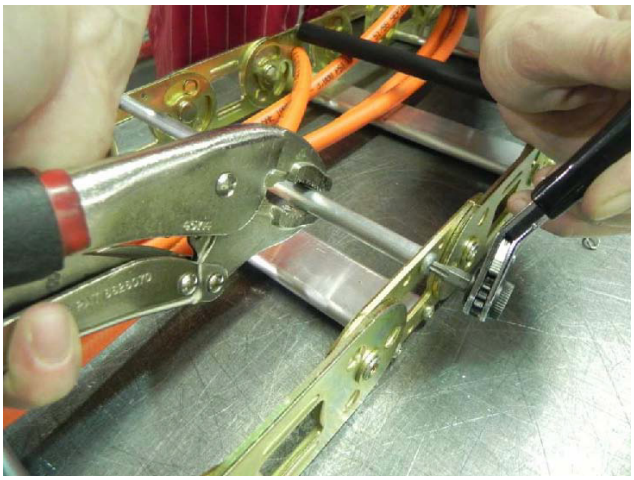
1. Use a small ¼" ratchet with a T-25 Torx bit. Remove the 10-24 x 0.812 screw. (If the bar spins then grip the bar and poly tightly with a vise-grip).

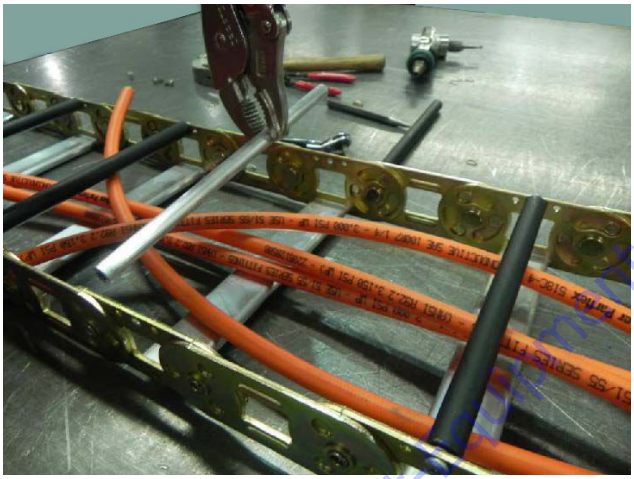


2. Lift up one end of the bar and slide the poly roller off.



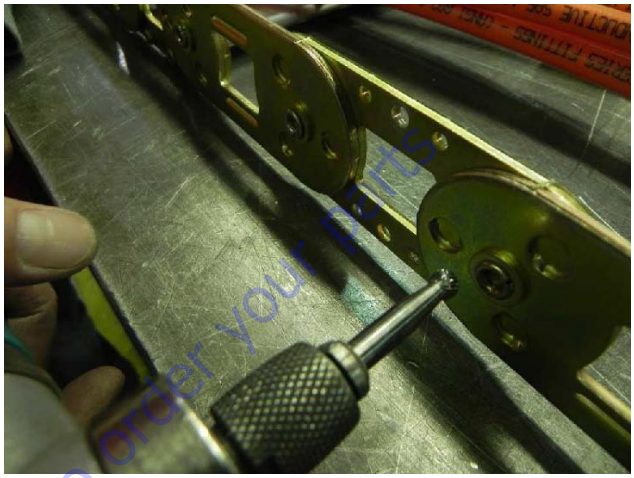
3. While gripping the bar tightly, remove the other 10-24 x 0.812 screw.



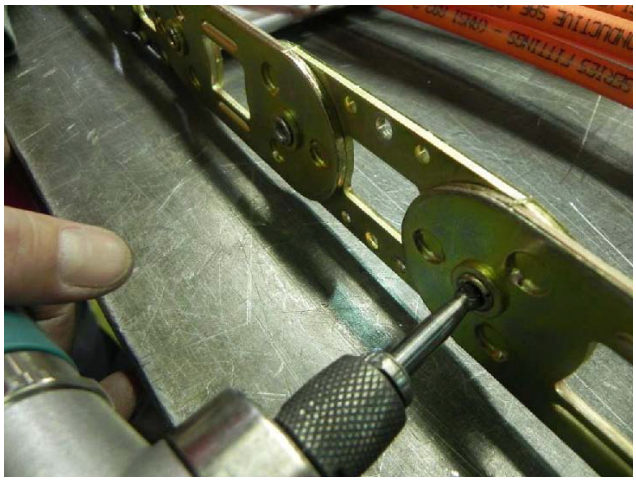


Removing and Installing Links

1. To remove the links, the rivets holding the links together must be removed. The following will show one way this can be done. Use a right angle die grinder with a ¼" ball double cut bur.

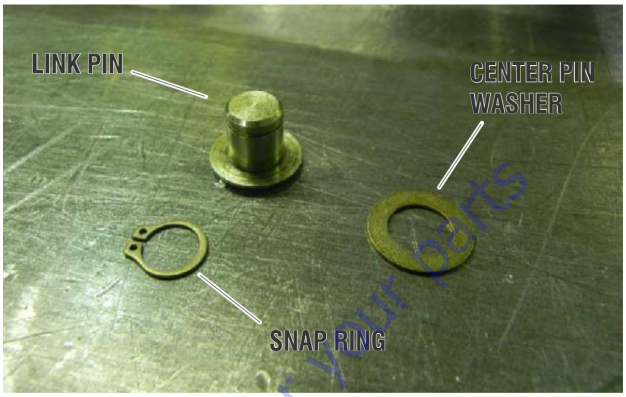


2. Insert the tool into the rolled over end of the rivet as shown. Grind out the middle of the rivet until the rolled over part of the rivet falls off. Repeat this step for all rivets that must be removed.

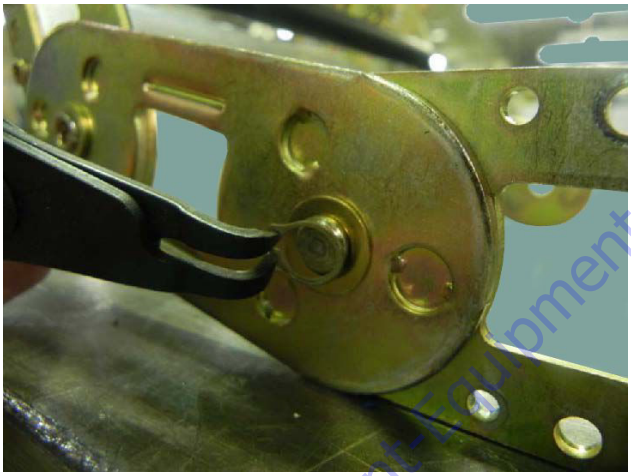


3. After grinding, it is sometimes necessary to use a center punch to punch out the rivet from the link.

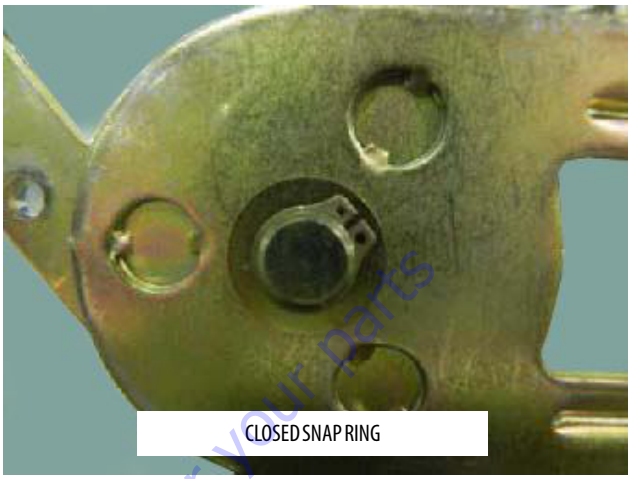
4. To install new links, extend the main moving end over the lower part of the track so the new connection point is in the curved part of the track. This will allow the round half-shears to be rotated in a way they will fit into the peanut-shaped cut-outs.



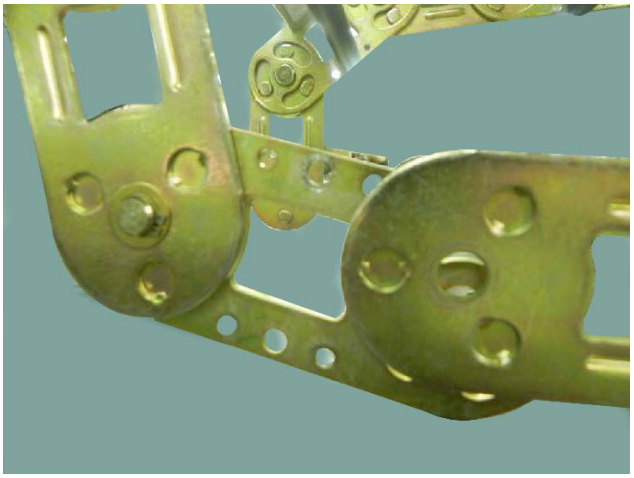
5. Install the pin into the center hole, then slide the washer over the pin. Install the snap ring into the groove in the pin.

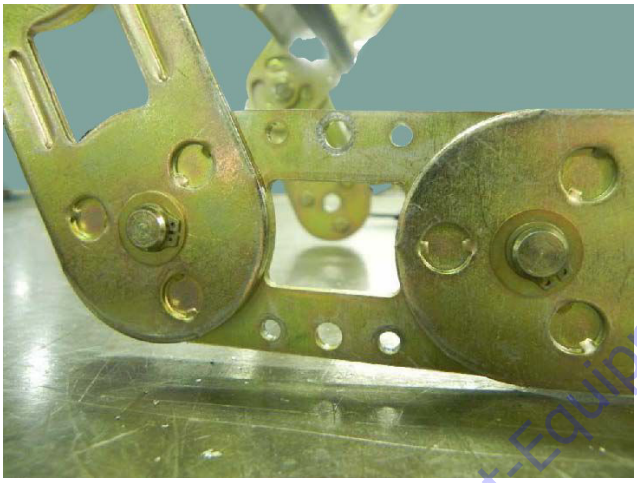


NOTE: *When installing snap rings make sure they are seated in the pin groove and closed properly.*



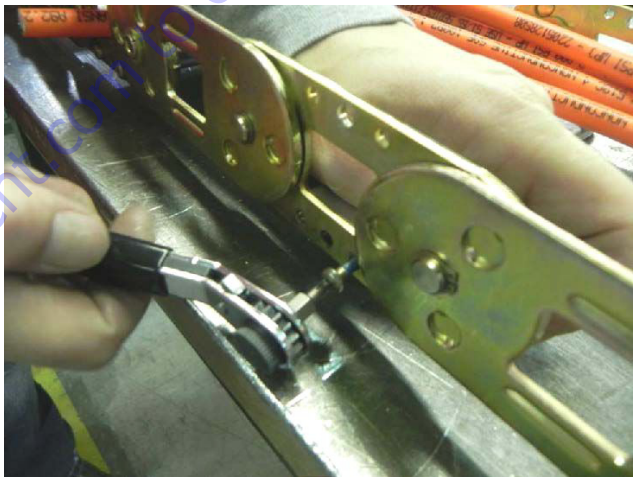
6. Install more pins, washers, and snap rings into all the links where a rivet was removed.





Installing a New Flat Bar

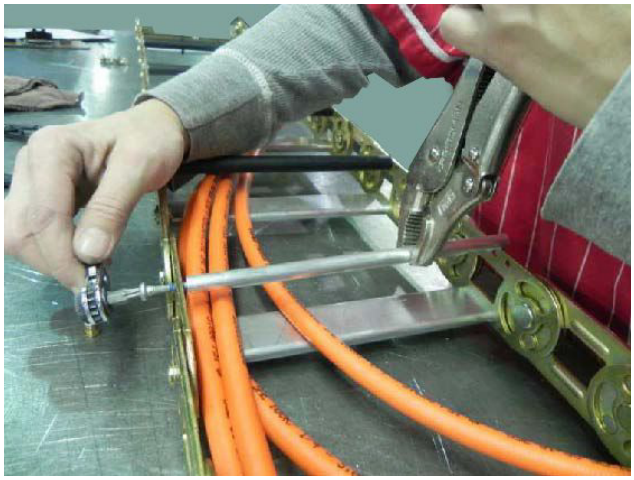
1. While holding the flat bar, install new 8-32 x 0.500 self threading torx screws into both holes on each side of track.



NOTE: *Maximum tightening torque for the 8-32 screw is 18-20 in-lbs (2-2.2 Nm).*

Installing a New Round Bar/Poly Roller

1. While tightly holding the round bar, install the new 10-24 x 0.812 self threading torx screw. Next lift up the other end and slide a new poly roller on. Install another 10-24 x 0.812 screw on the other side.



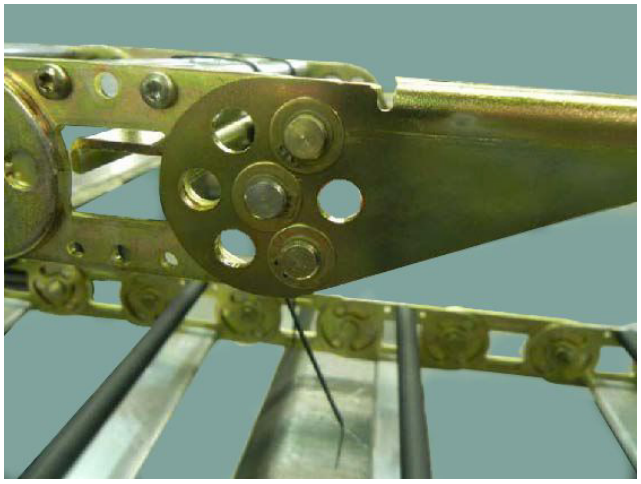
NOTE: *Maximum tightening torque for the 10-24 screw is 45-50 in-lbs (5-5.6 Nm).*

Replacing a Fixed End Bracket

1. Remove the bracket by removing the center pin, washer, and snap ring. Install a new bracket then reinstall the pin, washer, and new snap ring. After installing the new bracket make sure that it rotates correctly.

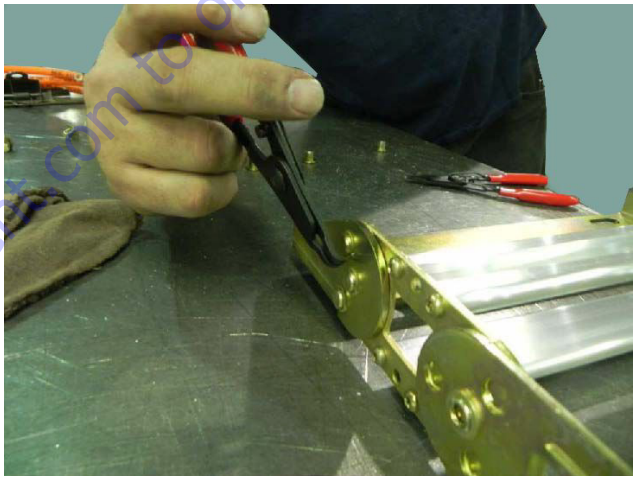
Replacing a Moving End Bracket

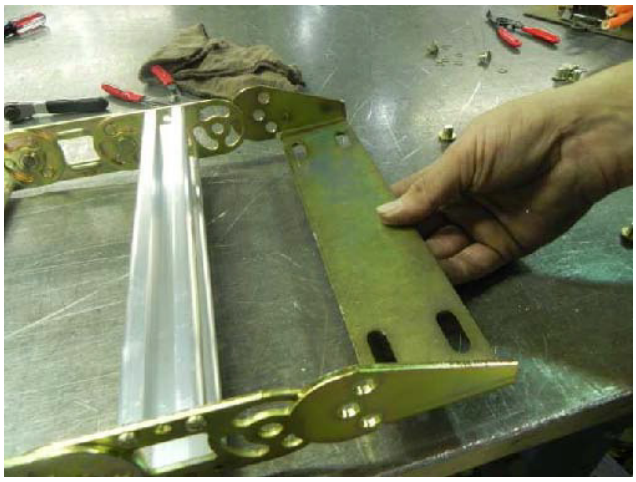
1. Remove bracket by removing all pins, washers, and snap rings. Replace with a new bracket and reinstall the pins, washers, and new snap rings. After installing a new bracket make sure that it rotates correctly.



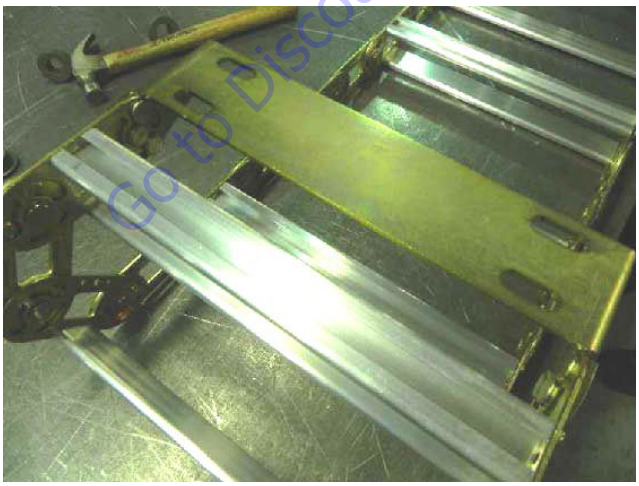
Replacing a One Piece Bracket

1. Remove all pins, washers, and snap rings and slide the bracket off of the links.





2. To install a new bracket, slide the bracket over the links and reinstall the pins, washers, and new snap rings. After installing the new bracket make sure that it rotates correctly.



4.6 BOOM CLEANLINESS GUIDELINES

The following are guidelines for internal boom cleanliness for machines that are used in excessively dirty environments.

1. JLG recommends the use of the JLG Hostile Environment Package if available to keep the internal portions of a boom cleaner and to help prevent dirt and debris from entering the boom. This package reduces the amount of contamination which can enter the boom but does not eliminate the need for more frequent inspections and maintenance when used in these types of environments.
2. JLG recommends that you follow all guidelines for servicing your equipment in accordance with the instructions outlined in the JLG Service & Maintenance Manual for your machine. Periodic maintenance and inspection is vital to the proper operation of the machine. The frequency of service and maintenance must be increased as environment, severity and frequency of usage requires.
3. Debris and foreign matter inside of the boom can cause premature failure of components and should be removed. Methods to remove debris should always be done using all applicable safety precautions outlined in the JLG Service & Maintenance Manuals.
4. The first attempt to remove debris from inside the boom must be to utilize pressurized air to blow the debris toward the nearest exiting point from the boom. Make sure that all debris is removed before operating the machine.
5. If pressurized air cannot dislodge the debris, then water with mild solvents applied via a pressure washer can be used. Again the method is to wash the debris toward the nearest exiting point from the boom. Make sure that all debris is removed, that no “puddling” of water has occurred, and that the boom internal components are dry prior to operating the machine. Make sure you comply with all federal and local laws for disposing of the wash water and debris.
6. If neither pressurized air nor washing of the boom dislodges and removes the debris, then disassemble the boom in accordance to the instructions outlined in the JLG Service & Maintenance Manual to remove the debris.

4.7 MAIN BOOM ASSEMBLY

Removal

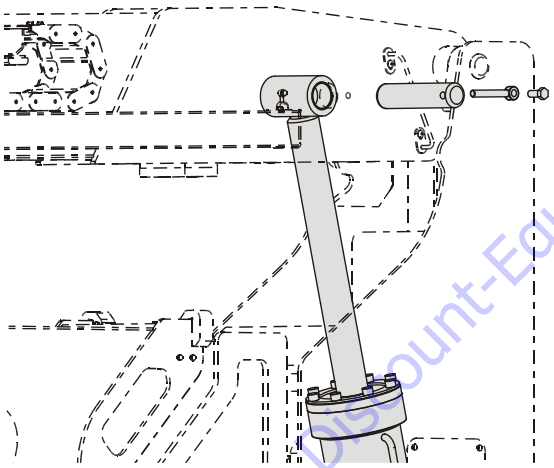
1. Using a suitable lifting equipment, adequately support boom assembly weight along entire length.

NOTICE

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID ENTRY OF CONTAMINANTS INTO SYSTEM.

2. Tag and disconnect hydraulic lines from telescope cylinder. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.

3. Using a suitable brass drift and hammer, remove hardware securing the main boom lift cylinder rod end pin to the base boom section. Remove the main boom lift cylinder pin from base boom. Retract the main boom lift cylinder by using the auxiliary power switch.



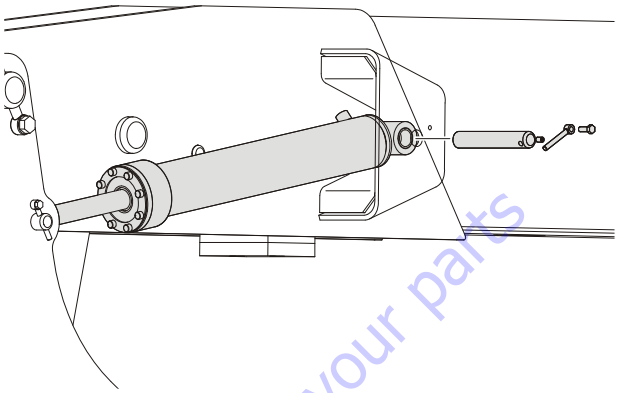
4. Remove the Master Cylinder as follows:

   a. Using an adequate supporting device, support the master cylinder so it doesn't fall when the retaining pins are removed.

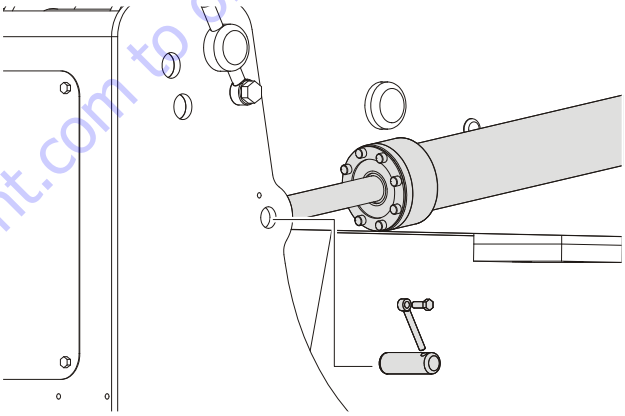
NOTE: *The master cylinder weighs approximately 58.5 lbs. (26.5 kg).*

   b. Tag and disconnect hydraulic lines from Master Cylinder. Use a suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.

   c. Remove the bolt and keeper pin securing the master cylinder barrel end pin to the base boom section. Next, install a 3/8-16 UNC threaded lifting eye into the threaded hole of the pin and pull pin out.

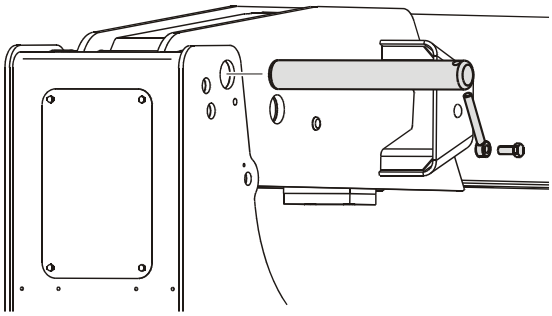


   d. Remove the bolt and keeper pin securing the master cylinder rod end pin to the upright. Remove the pin.



NOTE: *When installing the master cylinder rod end pin, insert the keeper hardware pin to prevent the pin from inserting too far.*

5. Remove the bolt and keeper pin securing the boom pivot pin to the upright. Using a suitable brass drift and hammer, remove the pivot pin from upright.



6. Using all applicable safety precautions, carefully lift boom assembly clear of upright and lower to ground or suitably supported work surface.

NOTE: *The main boom alone weighs approximately 2226 lbs. (1010 kg). Including the platform (slave) cylinder, rotator, and platform support the assembly weighs approximately 3185 lbs. (1445 kg).*

Disassembly

1. Remove hardware securing telescope cylinder to back end of the base boom section.
2. Remove hardware which secures the wear pads to the base boom section; remove the wear pads from the top, sides and bottom of the base boom section.
3. Using overhead crane or suitable lifting device, remove fly boom assembly from base section.
4. Remove hardware from the telescope cylinder pin. Using a suitable brass drift and hammer remove the cylinder pin from fly boom section.
5. Pull the telescope cylinder partially from aft end of the fly boom section; secure the cylinder with a suitable sling and lifting device at approximately the center of gravity.
6. Carefully remove the telescope cylinder and place telescope cylinder on a suitable trestle.

NOTE: *The Main Boom Telescope Cylinder can be removed without disassembling the main boom by disconnecting hydraulic lines, top attaching pin of main boom lift cylinder and telescope cylinders as directed above, and pulling out the telescope cylinder from the rear, thru the access plate opening of the upright.*

7. Remove hardware which secures the wear pads to the aft end of fly boom section; remove the wear pads from the top, sides and bottom of the fly boom section.

Inspection

NOTE: *When inspecting pins and bearings, refer to Section 2, Pins and Composite Bearing Repair Guidelines.*

1. Inspect main boom pivot pin for wear, scoring, tapering and ovality, or other damage. Replace pins as necessary.
2. Inspect telescope cylinder attach point for scoring, tapering and ovality. Replace pins as necessary.
3. Inspect main boom lift cylinder attach pin for wear, scoring, tapering and ovality, or other damage. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.
4. Inspect inner diameter of boom pivot bearing for scoring, distortion, wear, or other damage. Replace bearing as necessary.
5. Inspect all wear pads for excessive wear, or other damage.
6. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.
7. Inspect structural units of boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.

Assembly

NOTE: *When installing fly section wear pads, install same number and thickness of shims as were removed during disassembly.*

1. Measure inside dimensions of the base section to determine the number of shims required for proper fit.
2. Install side, top and bottom wear pads to the aft end of fly section; shim evenly to the measurements of the inside of base boom section.

NOTICE

WHEN ASSEMBLING BOOM SECTIONS, ENSURE THAT THE BOOM SLIDING TRAJECTORIES HAVE BEEN CLEARED OF CHAINS, TOOLS, AND OTHER OBSTRUCTIONS.

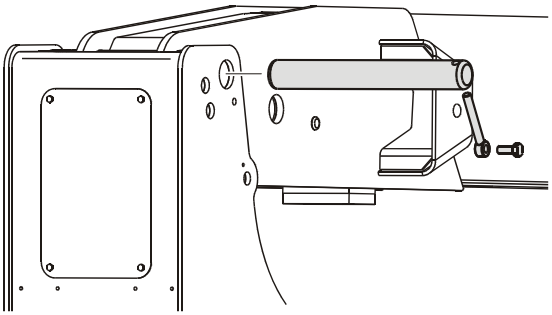
3. Secure the sling and lifting device at the telescope cylinder's approximate center of gravity, and lift the cylinder to the aft end of the fly boom section.
4. Slide telescope cylinder into the aft end of fly boom section. Align attachment holes in fly boom section with hole in rod end of telescope cylinder.
5. Install telescope cylinder pin and secure with mounting hardware.
6. Secure the sling and lifting device at the fly boom assembly approximate center of gravity.
7. Slide fly boom assembly into the base boom section. Shim boom, if necessary, for a total of 1/32 inch (metric equivalent) clearance.
8. Install wear pads into the forward position of the base boom section. Shim boom, if necessary, for a total of 1/32 inch (metric equivalent) clearance.
9. Align the cylinder with the slots at aft end of base boom section, then secure cylinder with mounting hardware.

Installation

1. Using all applicable safety precautions, carefully lift boom assembly to align the pivot holes in the boom with those of the upright.

NOTE: *The main boom alone weighs approximately 2226 lbs. (1010 kg). Including the platform (slave) cylinder, rotator, and platform support the assembly weighs approximately 3185 lbs. (1445 kg).*

2. Using a suitable brass drift and hammer, install the pivot pin into the upright. Install the bolt and keeper pin securing the boom pivot pin to the upright.

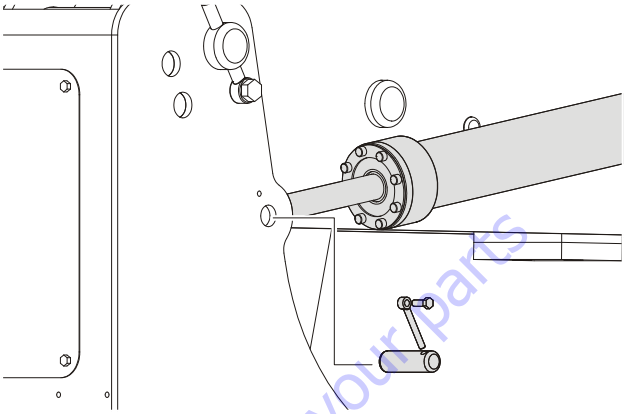


3. Install the Master Cylinder as follows:

   a. Using an adequate supporting device, align the master cylinder with the mounting holes on the boom and upright.

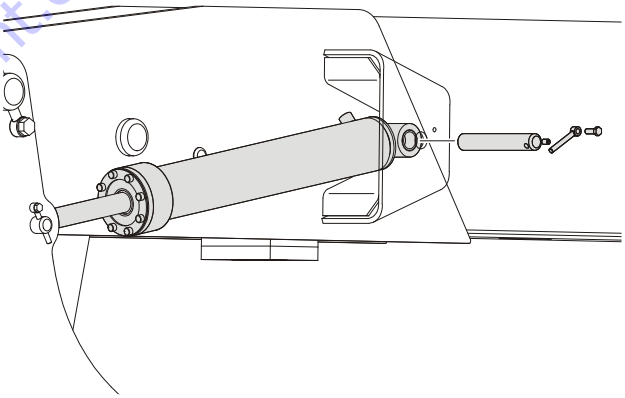
NOTE: *The master cylinder weighs approximately 58.5 lbs. (26.5 kg).*

   b. Install the master cylinder rod end pin. Install the bolt and keeper pin securing the master cylinder rod end pin to the upright.



NOTE: *When installing the master cylinder rod end pin, insert the keeper hardware pin to prevent the pin from inserting too far.*

   c. Install the barrel end retaining pin. Install the bolt and keeper pin securing the master cylinder barrel end pin to the base boom section.



   d. Connect hydraulic lines to the master cylinder as tagged during removal.

4.8 UPRIGHT

Removal

NOTICE

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID ENTRY OF CONTAMINANTS INTO SYSTEM.

1. Remove the main boom assembly. Refer to Section 4.7, Main Boom Assembly.
2. Tag and disconnect hydraulic lines to the main boom lift cylinder. Use a suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.
3. Remove mounting hardware from main boom lift Cylinder barrel end. Using a suitable brass drift and hammer, remove pin #1 from Upright and remove Main Boom Lift Cylinder.

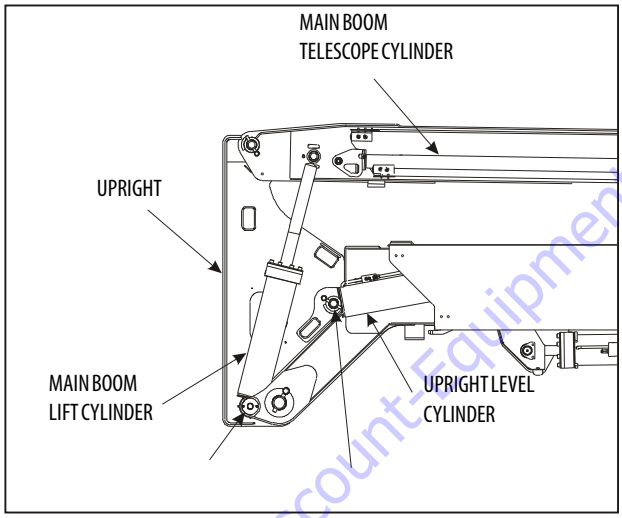


Figure 4-11. Location of Components - Upright

4. Disconnect wiring harness to horizontal limit switch.
5. Disconnect the Upright Level Cylinder as follows:
   a. Using a suitable lifting device, support the Upright.
   b. Remove mounting hardware securing hose bracket in upright, and remove the hose bracket.
   c. Remove mounting hardware securing the upright level cylinder to the upright. Using a suitable brass drift and hammer, remove pin #3 from upright and disconnect the upright level cylinder from the upright.
6. Remove mounting hardware from the Upright Pivot Pin using a suitable brass drift and hammer. Remove pin # 4 from tower boom assembly and remove the upright from the machine.

NOTE: *Steps 7 thru 10 are only necessary if the upright level cylinder is to be removed.*

7. With upright removed, override tower telescope limit switch and extend the tower boom to gain access to the upright level cylinder rod end attach pin.
8. Tag and disconnect hydraulic lines to the upright lift cylinder. Use a suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.
9. Using an overhead crane or suitable lifting device, support the upright lift cylinder, remove mounting hardware from the barrel end of the upright lift cylinder and remove the pin.
10. Carefully remove the upright lift cylinder and place on a suitable work surface.

Installation

NOTE: *Steps 1 thru 4 are only necessary if the upright level cylinder is to be removed.*

1. Using a suitable lifting device, carefully install the upright lift cylinder into place in the tower boom.
2. Install the pin and mounting hardware at the barrel end of the upright lift cylinder.
3. Connect the hydraulic lines to the upright lift cylinder as tagged during removal.
4. Override the tower telescope limit switch and retract the tower boom.
5. Using an adequate lifting device, install the upright into position. Install pin # 4 into the tower boom assembly and secure it in place with the mounting hardware.
6. Connect the Upright Level Cylinder as follows:
   a. Align the holes in the cylinder and upright for pin #3, and install the pin into the upright and connect the upright level cylinder to the upright. Install the mounting hardware securing the pin.
   b. Install the hose bracket and secure in place with the mounting hardware.
7. Connect the wiring harness to horizontal limit switch.
8. Align the holes in the main boom lift cylinder and upright for pin #1 and install the pin. Secure the pin in place with the mounting hardware.
9. Connect the hydraulic lines to the main boom lift cylinder as tagged during removal.
10. Install the main boom. Refer to Section 4.7, Main Boom Assembly.

4.9 TOWER BOOM ASSEMBLY

Removal

NOTICE

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID ENTRY OF CONTAMINANTS INTO SYSTEM.

1. Remove the main boom assembly. Refer to Section 4.7, Main Boom Assembly.
2. Using an overhead crane or suitable lifting device, support the entire Tower Boom Assembly and separately support the tower lift cylinder.
3. Remove mounting hardware from tower lift cylinder rod end. with a brass drift and hammer, remove the tower Lift cylinder Pin disconnecting the tower lift cylinder.
4. Remove mounting hardware from the tower boom pivot pin. Using a suitable brass drift and hammer, remove pin #2 from turntable assembly.
5. Using all applicable safety precautions, carefully lift the Tower Boom Assembly clear of turntable and lower to ground or a suitable supported work surface.
6. Remove mounting hardware from the upright leveling cylinder rod end. with a brass drift and hammer, remove the pin, disconnecting the upright cylinder. Remove with suitable lifting device.

NOTE: *Using a suitable lifting device, support the upright.*

7. Remove the Tower Fly as follows:
   - **a.** Mark all hoses and wiring harnesses at bracket on rear end of tower base boom for future assembly. Remove hoses and wiring from tower boom Powertrack.
   - **b.** Remove mounting hardware that secures the Powertrack to tower base boom and remove the Powertrack.
   - **c.** Remove mounting hardware from tower boom telescope cylinder barrel and rod end.
   - **d.** Slide the telescope cylinder out of the base boom, support with an overhead crane or suitable lifting device.
   - **e.** Remove mounting hardware that secures the wear pads to the front of tower base boom section; Remove the wear pads from the top sides and bottom of the tower base boom.
   - **f.** Using an overhead crane or suitable lifting device, remove the fly section.

Inspection

NOTE: *Refer to Section 2, Pins and Composite Bearing Repair Guidelines.*

1. Inspect tower boom pivot pin for wear scoring, tapering, and ovality, or other damage. Replace pins as necessary.
2. Inspect tower boom pivot attach points for scoring, tapering, and ovality, or other damage. Replace pins as necessary.

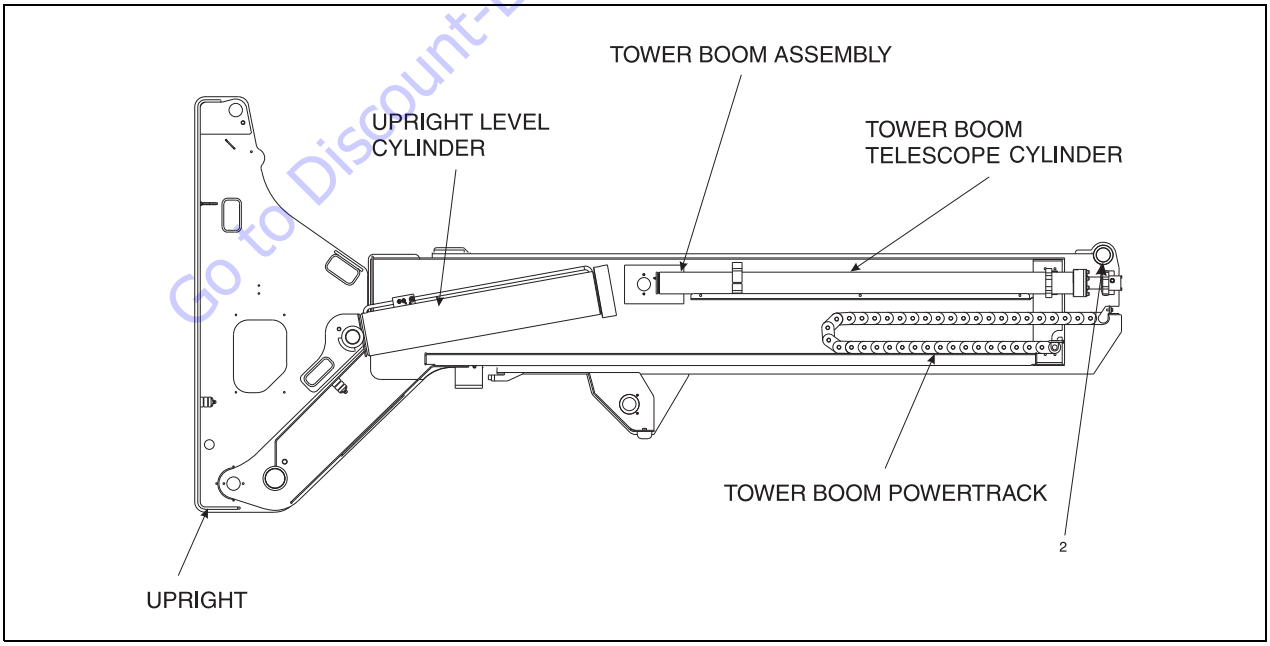


Figure 4-12. Location of Components - Tower Boom Powertrack

3. Inspect inner diameter of tower boom pivot bearings for scoring, distortion, wear, or other damage.
4. Inspect lift cylinder attach pin for wear, scoring, tapering, and ovality, or other damage. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.
5. Inspect inner diameter of upright attach point bearings for scoring, distortion, wear, or other damage. Replace bearing as necessary.
6. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.
7. Inspect structural units of tower boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.
8. Inspect Powertrack for damage such as cracking, wear, or other damage. Replace links or assembly, as necessary.

Assembly

NOTE: *When installing fly section wear pads, install same number and thickness of shims as were removed during disassembly.*

1. Measure inside dimensions of the tower base section to determine the number of shims required for proper fit.
2. Install side, top, bottom wear pads to the aft end of tower fly section; shim evenly to the measurements of the inside of the base boom section.

NOTICE

WHEN ASSEMBLING TOWER BOOM SECTIONS, ENSURE THAT THE BOOM SLIDING TRAJECTORIES HAVE BEEN CLEARED OF CHAINS, TOOLS, AND OTHER OBSTRUCTIONS.

3. Align upright leveling cylinder with attach holes in tower fly boom. Using a soft head mallet, install the cylinder pin into tower fly boom and secure with mounting hardware.
4. Secure the sling and lifting device at the tower fly boom assembly's approximate center of gravity.
5. Slide tower fly boom assembly into the tower base boom section, for a total of 1/32 inch (metric equivalent) clearance.
6. Install wear pads into the forward position of the tower base boom section. Shim boom, if necessary, for a total of 1/32 inch (metric equivalent) clearance.
7. Align the telescope cylinder with the slots at the aft end of tower base boom section, then secure cylinder with mounting hardware.
8. Attach internal Powertrack to tower base boom at bottom only and extended out of boom that the Powertrack links are opened at top.
9. Attach hoses and wiring harnesses at front end of base boom and route thru the Powertrack. Secure hoses and wiring harnesses with hose brackets.
10. Roll the Powertrack back into the base boom section and attach loose end of the Powertrack to the inside top of the fly boom section.

Installation

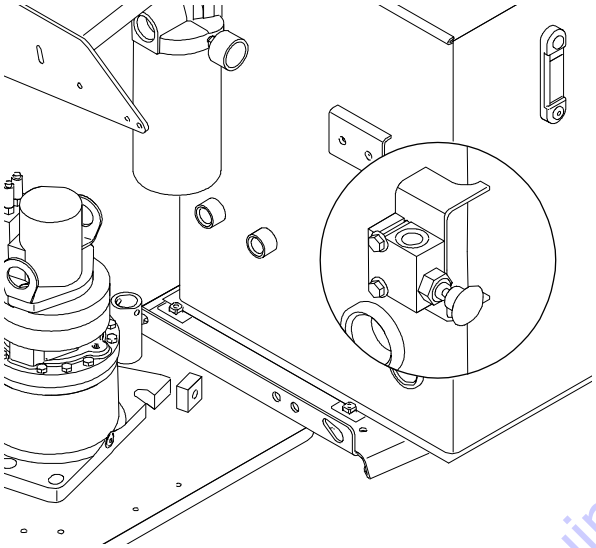
1. Using a suitable lifting device, position boom assembly on turntable so that the pivot holes in both boom and turntable are aligned.
2. Install boom pivot pin, ensuring that location of hole in pin is aligned with attach point on turntable.
3. If necessary, gently tap pin into position with soft headed mallet. Secure pin mounting hardware.
4. Connect all wiring connectors to the correct connectors.
5. Connect all hydraulic lines of boom assembly.
6. Using all applicable safety precautions, operate lifting device in order to position boom lift cylinder so that holes in the cylinder rod end and boom structure are aligned. Insert the lift cylinder pin, ensuring that location of hole in pin is aligned with attach point on boom.
7. Using all applicable safety precautions, operate from the lower controls and raise and extend boom fully, noting the performance of the extension cycle.
8. Retract and lower boom, noting the performance of the retraction cycle.

Tower Out of Sync

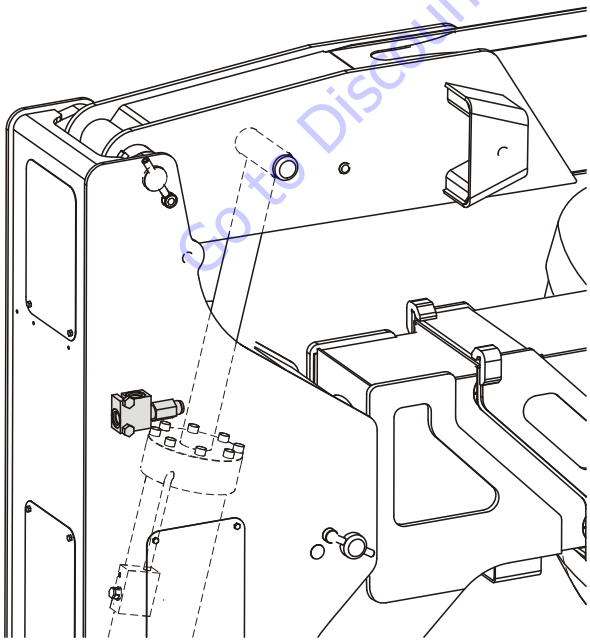
Tower is out of sync backwards, upright leaning toward the platform.

When towering down the upright cylinder bottoms out before the lower lift. Problems that could cause this are:

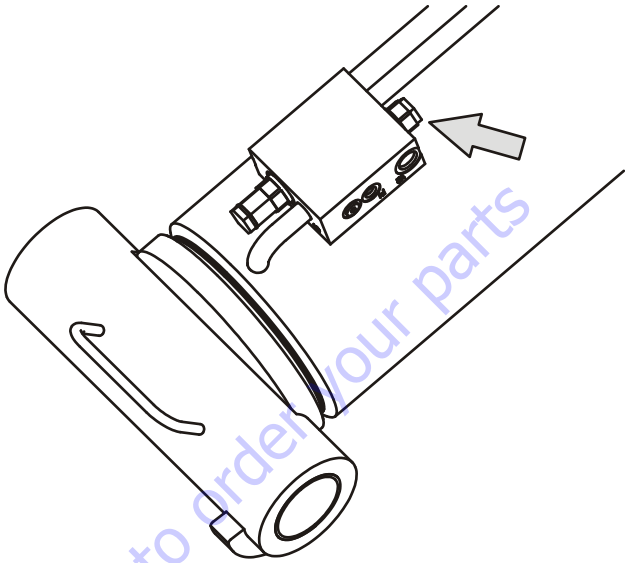
1. The releveling valve (red knob on the oil tank P/N: 4640866), this is a poppet valve that could be leaking fluid out of the closed loop. Manually opening the valve and flushing it can eliminate any contaminate on the seat. The seat could also be damaged, so replacing the cartridge might be necessary.



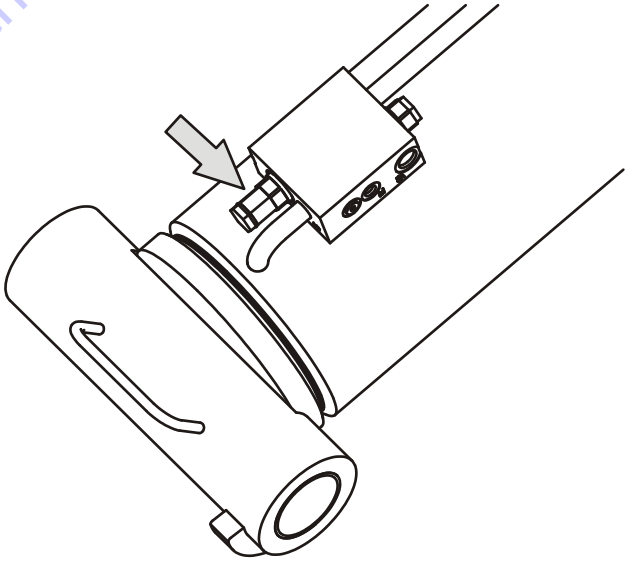
2. A relief valve is located in the upright. This relief valve could be leaking backwards out of the loop. Replace the cartridge. They are pre-set.



3. The counter/balance valve in the piston end of the upright level cylinder. There could be a leak path from the valve port to the pilot port.
   Replace the counter/balance valve.



4. The counter/balance valve in the rod end of the lower lift cylinder. There could be a leak path from the valve port to the pilot port. Replace the counter/balance valve.

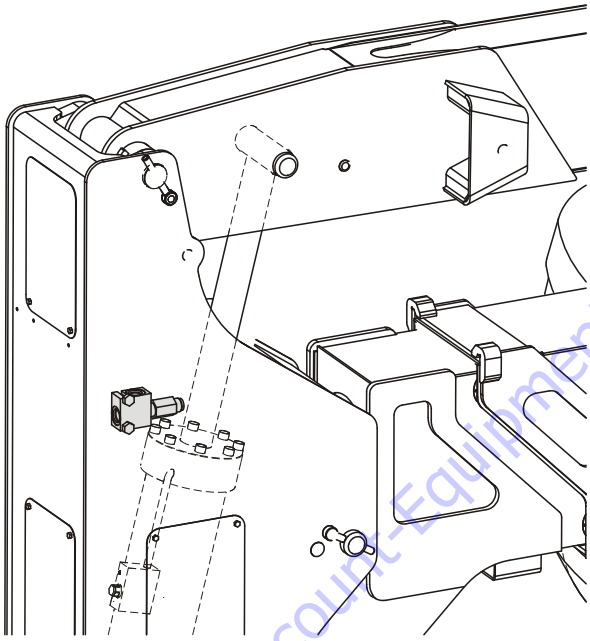


5. The packing on either the upright or lower cylinder can cause this. Do cylinder tests to determine if either cylinder needs new packing.

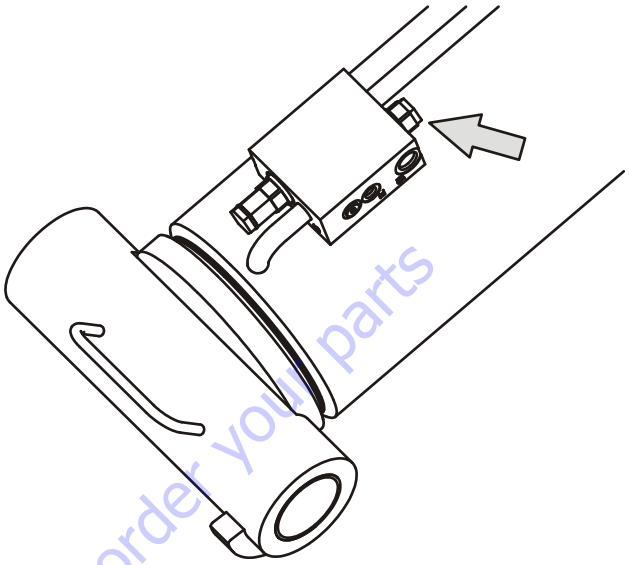
Tower is out of sync forwards, upright leaning toward the steer axle.

When towering down, the lower lift cylinder bottoms out before the upright level cylinder. This is caused by too much oil between the two cylinders. Problems that could cause this are:

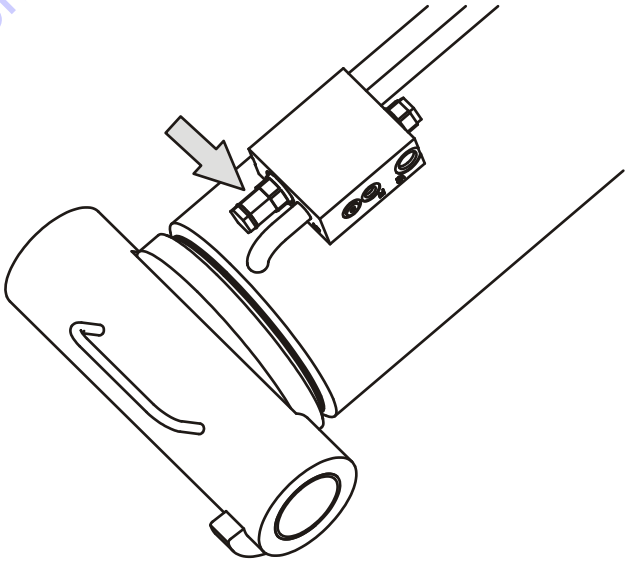
1. The relief valve located in the upright (P/N: 4640929). If this valve is set too low or has contaminate in it causing it to leak prematurely, when lifting down oil can pass through it causing the volume to grow between the cylinders. Flush the valve out and reinstall it, or replace the cartridge. The cartridge pressure is pre-set so no adjustment can be made.



2. The counterbalance valve in the piston end of the upright level cylinder. There could be a leak path from the pilot port to the valve port. Replace the counterbalance valve.



3. The counterbalance valve in the rod end of the lower lift cylinder. There could be a leak path from the pilot port to the valve port. Replace the counterbalance valve.



4. The packing on the lower lift cylinder can cause this. Do a cylinder test to check this out. Refer to Section 2.4, Cylinder Drift Test.

4.10 UPRIGHT MONITORING SYSTEM

The UMS provides a visual and audible warning to the operator when the limits of the upright assembly alignment have been reached. In addition, the UMS will not allow the tower boom to be lowered when the upright assembly is misaligned in a direction oriented away from the work platform.

Re-Synchronizing Upright

A pull type control valve allows the operator to adjust the upright level cylinder if the upright is not 90° (vertical) relative to the chassis (Refer to Figure 4-13.). This valve is located in the tank compartment area.

Perform the following steps with the aid of an assistant:

1. Turn the key switch to the ground control position.
2. Start the engine.
3. Pull and hold the red relevel knob located next to the main control valve. Refer to Figure 4-13.
4. Raise the tower boom 6 feet (1.8 m).
5. Release the red relevel knob.
6. Lower the tower boom fully and continue to hold down the switch to Tower Down for an additional 20 seconds.
7. Repeat steps 3 thru 6 as necessary until the upright is 90° (vertical) relative to the chassis.

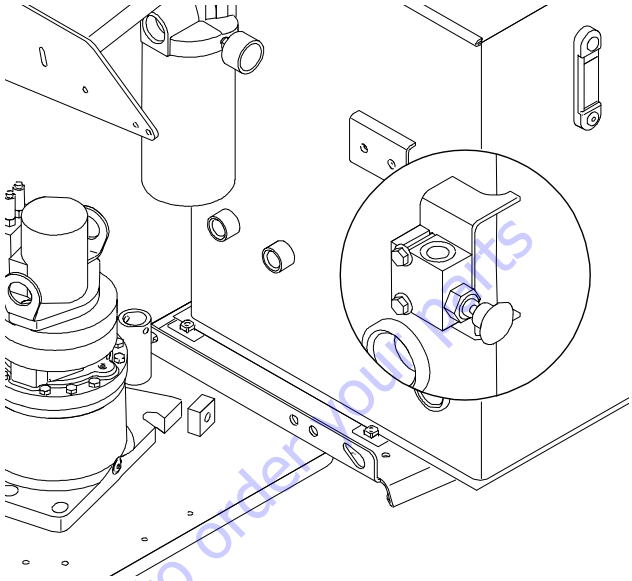


Figure 4-13. Releveling Valve

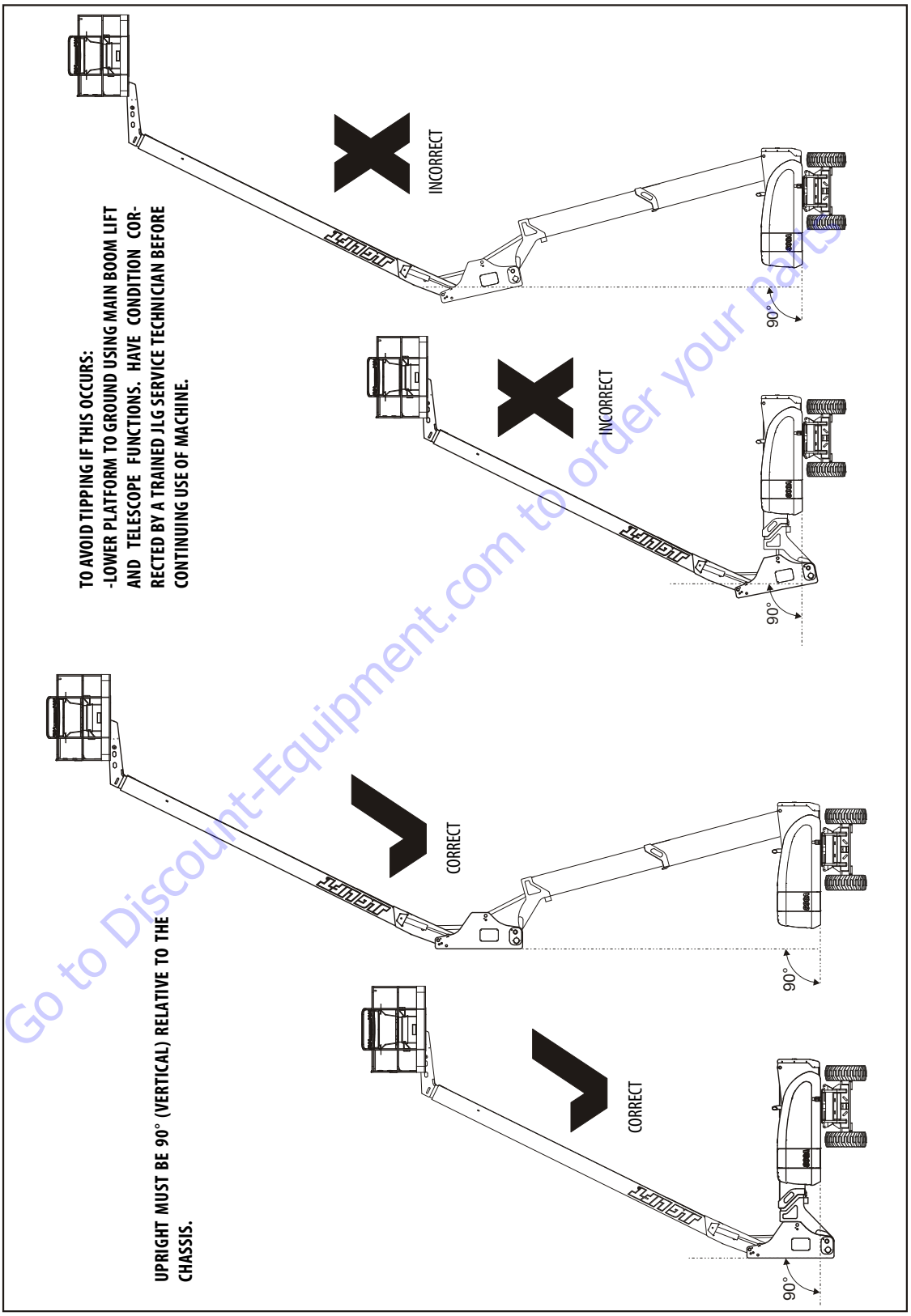


Figure 4-14. Boom Upright Positioning

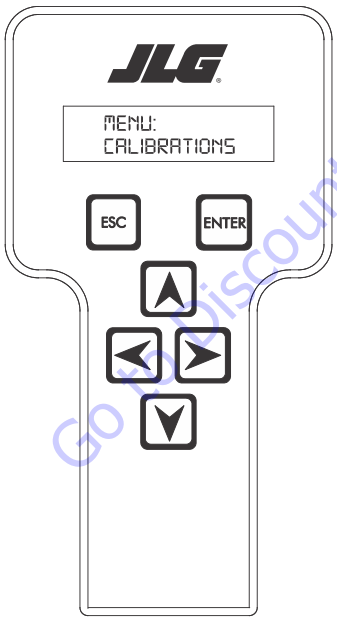
Calibration

1. Connect the JLG Hand-held analyzer to the original analyzer connection in the ground box.

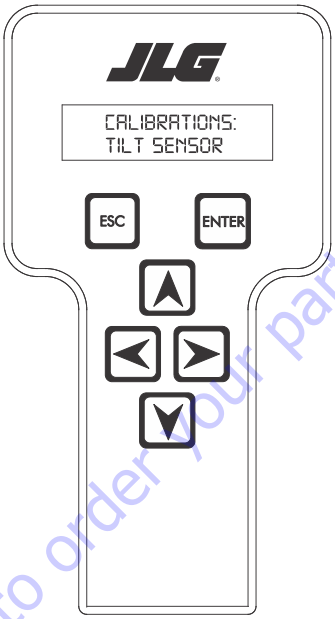
NOTICE

DO NOT CONNECT TO THE ANALYZER CONNECTION PORT INSTALLED WITH THE UPRIGHT MONITORING SYSTEM MODULE.

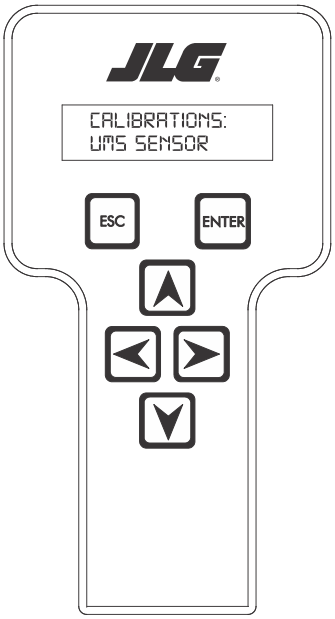
2. Pull out the emergency stop button at the ground control station and start the engine from the ground controls.
3. To calibrate the Upright Monitoring System through the hand-held analyzer, you must be in access level 1. To advance to access level 1, scroll to the ACCESS LEVEL menu and press "ENTER" ENTER. Using the arrows on the keypad, enter the password "33271" and press "ENTER" ENTER.
4. Calibrate the upright monitoring system sensor by the following procedure:
   a. In access level 1, scroll through the menu items until "CALIBRATIONS" is displayed on the second line of the analyzer screen. The screen will display the following:



   b. After pressing 'ENTER" one of the following screens will be displayed:



Or

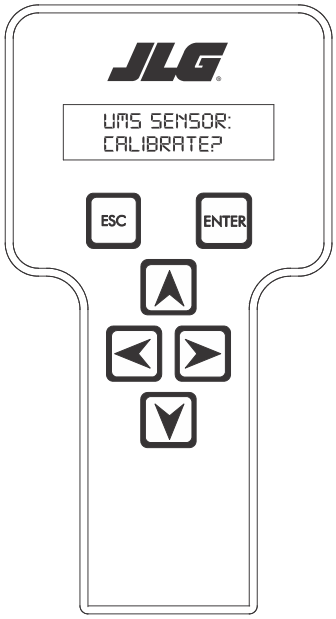


   c. Scroll left to right through the above menu items until "UMS SENSOR" sub menu appears on the bottom line of the analyzer display. Press the "ENTER" ENTER key.

NOTICE

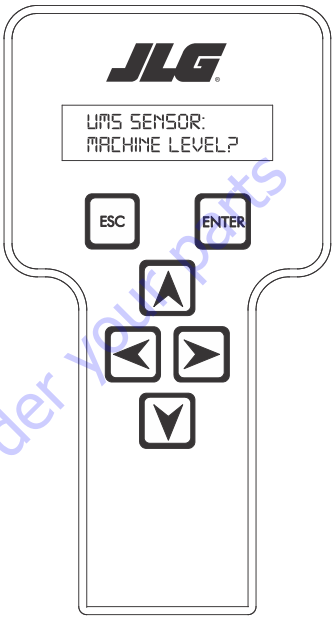
IT IS NOT NECESSARY TO CALIBRATE THE TILT SENSOR IN THE GROUND CONTROL MODULE AT THIS TIME. HOWEVER, WHEN THE TILT SENSOR IN THE GROUND CONTROL MODULE IS RECALIBRATED, THE UPRIGHT MONITORING SYSTEM TILT SENSOR MUST BE RECALIBRATED AS WELL.

d. After selecting "UMS SENSOR", the following screen will appear:



NOTE: *By pressing the left or right arrow keys in this screen, you may view the output of the sensor.*

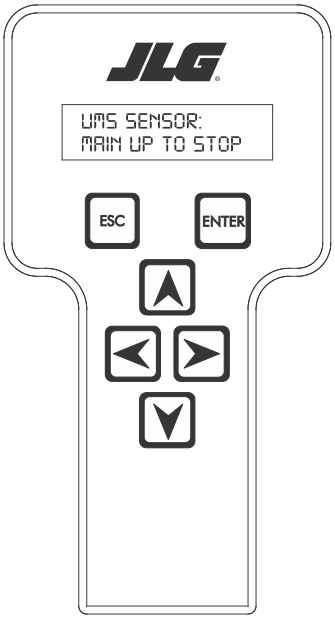
e. Press "ENTER" ENTER and the next screen will display the following, asking if the machine is on a level surface:



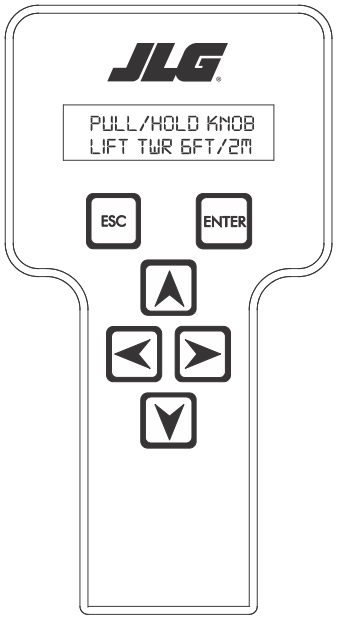
NOTICE

THE MACHINE MUST BE LEVEL FOR PROPER CALIBRATION.

f. Verify the machine is level and press "ENTER" ENTER. The screen will display the following, asking you to fully elevate the main boom:



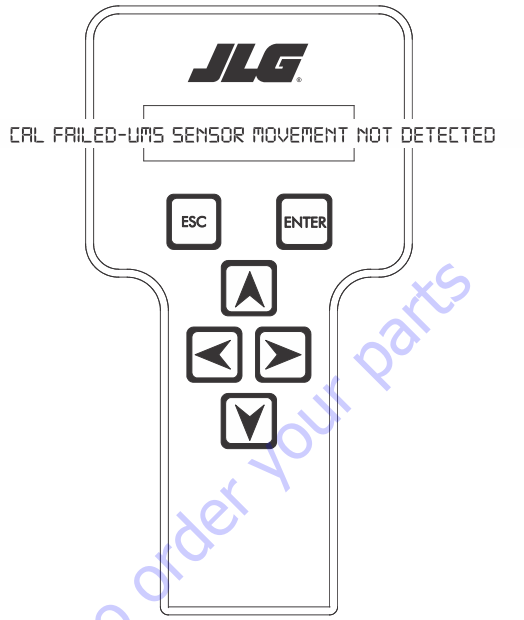
g. After the main boom has been fully elevated, press "ENTER" (ENTER). The analyzer will display the following:



NOTE: *By pressing the left or right arrows in this screen, you may view the output of each sensor.*

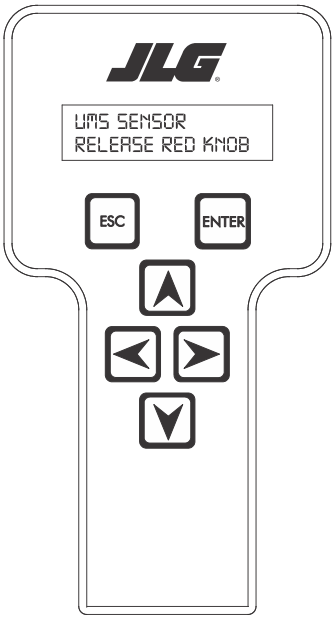
h. With the aid of an assistant, pull and hold the red re-leveling knob on the hydraulic tank while lifting the tower boom. Raise the tower boom six (6) feet or two (2) meters. After elevating the tower the required distance, press "ENTER" (ENTER).

If the upright monitoring system did not detect adequate sensor activity, the screen will display:

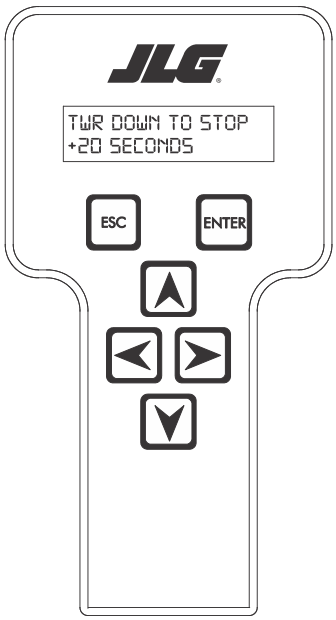


Should you get the above message, verify that the sensor is installed correctly and verify the sensor connection to the sensor harness is secure. Also, ensure the red knob is held fully open for the required time.

If the calibration is executing properly, you shall see the following display:

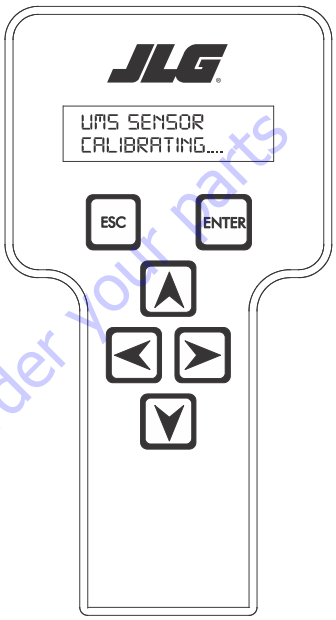


i. When viewing the above display, press "ENTER" (ENTER). The screen will display the following:

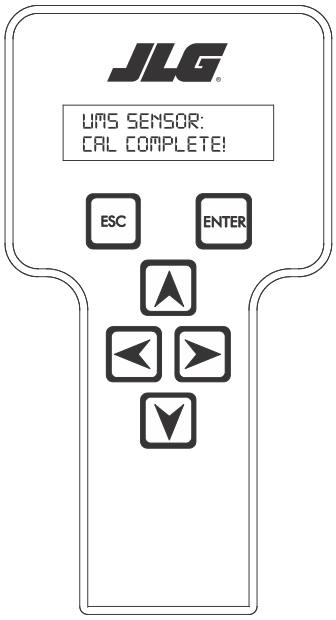


j. Lower the tower boom onto the boom stop. Continue to hold the tower boom down function for at least twenty (20) seconds **WITHOUT RELEASING THE FUNCTION SWITCH**. The calibration must recognize continuous activation of the tower down function switch for the required time.

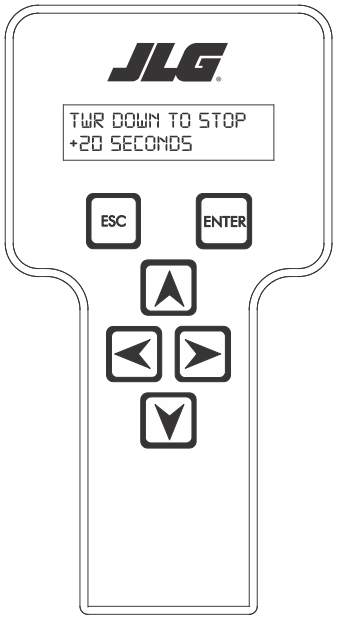
After the required activation time has passed, release the function switch and press "ENTER" (ENTER). The analyzer will display the following message:



If the calibration has been completed successfully, the screen will automatically change to:



If the calibration has not been completed successfully, the display will automatically change to:



Repeat step j until the calibration time requirement has been satisfied.

⚠ WARNING

DO NOT RAISE THE TOWER BOOM AGAIN DURING CALIBRATION.

k. To correctly complete the calibration process, fully retract and fully lower the main boom. Once the machine is in the stowed position, turn off the machine and disconnect the analyzer.

Calibration Faults

CAL Failed-Chassis Not Level

In the event the turntable tilt switch input is logic low indicating that the machine is not level the UMS calibration screens shall display this fault.

CAL Failed-UMS Sensor Raw Output Out Of Range

The control system shall display a fault in the event the raw sensor output is greater then ±5° for the UMS sensor.

CAL Failed-Turntable Sensor Raw Output Out Of Range

The control system shall display a fault in the event the raw sensor output is greater then ±5° for the turntable sensor.

CAL Failed-Calibration Disrupted

If calibration is disrupted, the control system shall display this fault.

CAL Failed- UMS Sensor Movement Not Detected

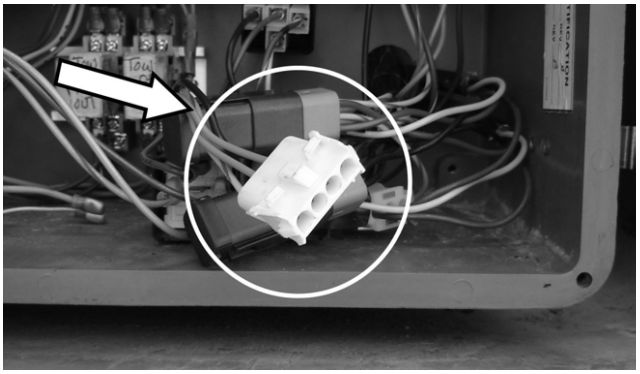
The UMS angle has not detected the required amount of movement during calibration.

Function Check

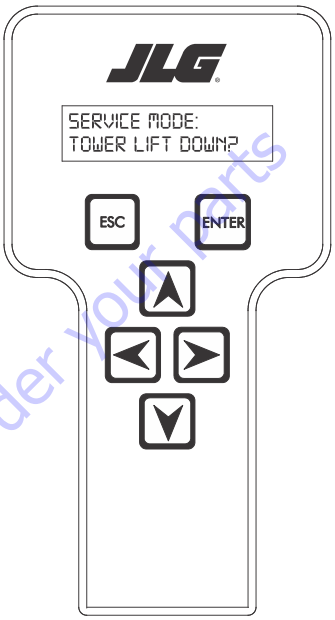
NOTICE

ON ADE EQUIPPED MACHINES, DO NOT CONNECT TO THE ANALYZER CONNECTION PORT INSTALLED WITH THE UPRIGHT MONITORING SYSTEM MODULE.

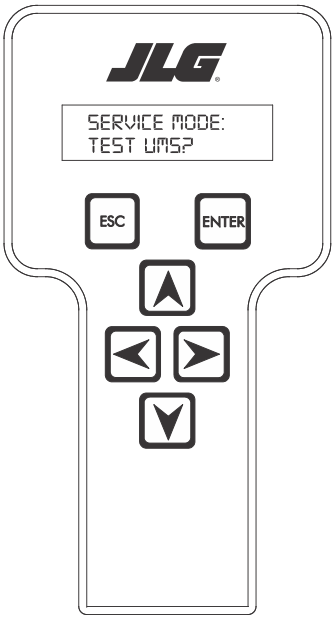
1. Connect the hand-held analyzer at the ground control station using the four-pin connector.



2. Pull out the emergency stop button at the ground control station and turn the key switch to ground controls. Start the engine.
3. Advance to access level 1 by scrolling to the ACCESS LEVEL menu and press "ENTER" (ENTER). Using the arrows on the keypad, enter the password "33271" and press "ENTER" (ENTER).
4. Scroll through the top level menu until SERVICE MODE appears. Press "ENTER" (ENTER) to select this menu item. After pressing "ENTER" one of the following screens will be displayed:

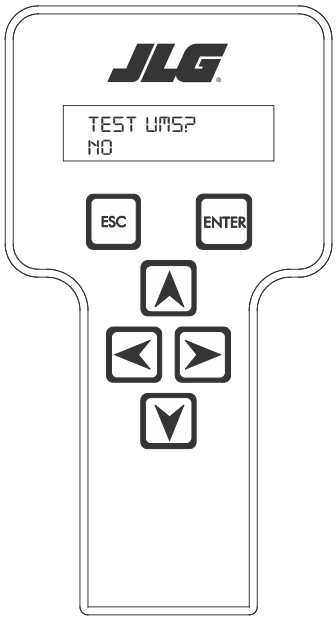


Or

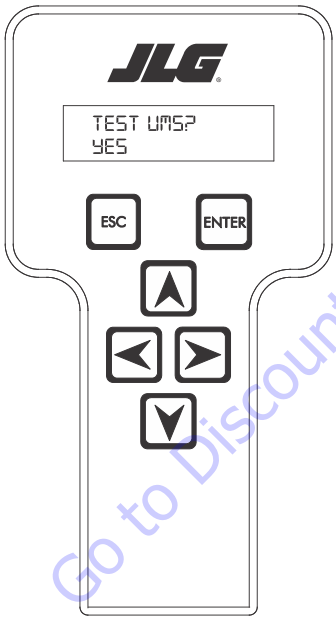


5. Scroll left to right through the above menu items until "TEST UMS?" sub menu appears on the bottom line of the analyzer display. Press the "ENTER" (ENTER) key.

6. The controller will now display the following:



or, by pressing the up and down arrow keys:



7. When the "YES" message is displayed, press the "ENTER" ENTER key to automatically perform a function test. Upon the function test, the system will activate the Upright Monitoring System, warning lights, and alarm. Verify that the alarm sounds, the boom malfunction indicator lights (platform and ground) are illuminated.

8. From the ground controls, raise the tower boom several feet. Verify that the tower boom will not lower.

9. To end the system test, press the Emergency Stop Switch (EMS) at the ground controls. Upon loss of power (pressing the EMS) to the system, the upright monitoring system will reset and all functionality will be restored to the machine.

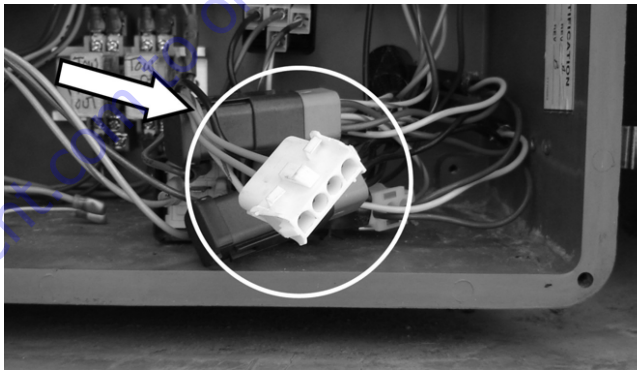
Service Mode/Tower Boom Retrieval

The UMS software incorporates a service mode to temporarily disengage the UMS and allow a tower lift down operation when the UMS has detected a backward stability concern.

NOTICE

ON ADE EQUIPPED MACHINES, DO NOT CONNECT TO THE ANALYZER CONNECTION PORT INSTALLED WITH THE UPRIGHT MONITORING SYSTEM MODULE.

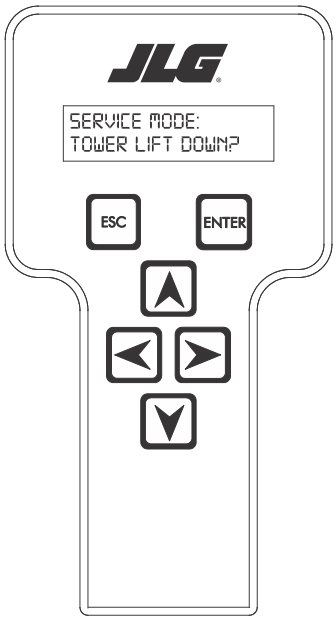
1. Connect the hand-held analyzer at the ground control station using the four-pin connector.



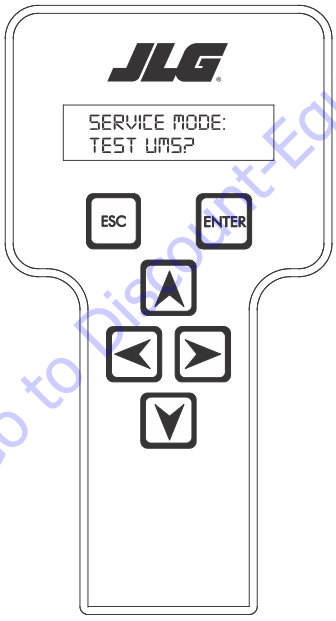
2. Pull out the emergency stop button at the ground control station and turn the key switch to ground controls. Start the engine.

3. Advance to access level 1 by scrolling to the ACCESS LEVEL menu and press "ENTER" ENTER. Using the arrows on the keypad, enter the password "33271" and press "ENTER" ENTER.

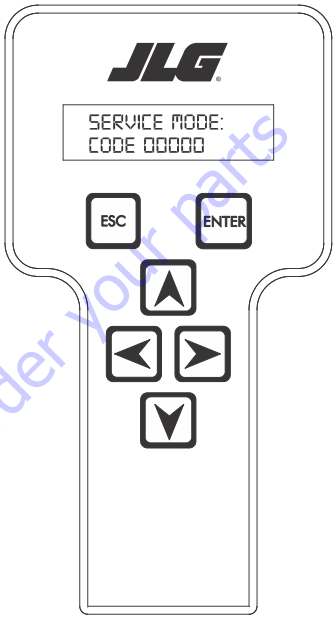
4. Scroll through the top level menu until SERVICE MODE appears. Press "ENTER" (ENTER) to select this menu item. After pressing "ENTER" one of the following screens will be displayed:



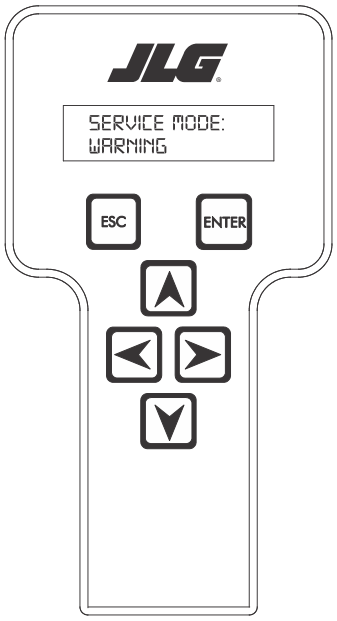
Or



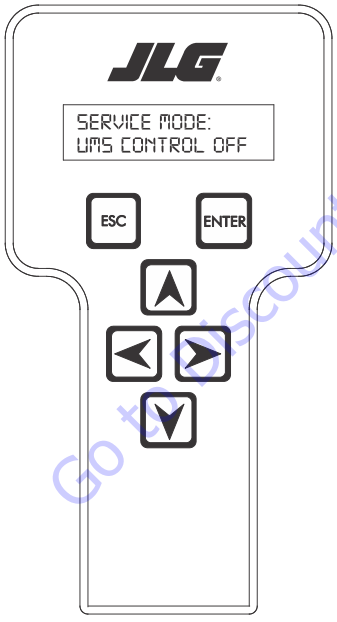
5. Scroll left to right through the above menu items until "TOWER LIFT DOWN?" sub menu appears on the bottom line of the analyzer display. Press the "ENTER" (ENTER) key.
6. The controller will now display the following:



7. Enter the service code "**81075**" and press the "ENTER" ENTER key. The controller display will now display the following,

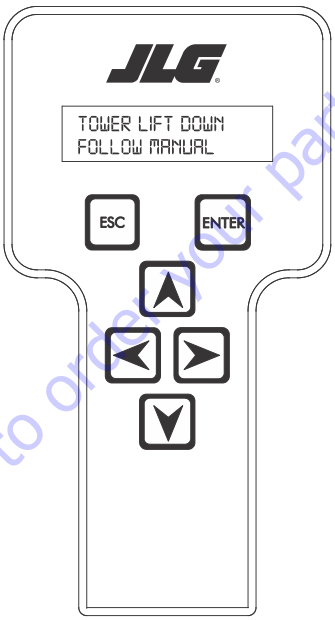


followed by:



The flashing and scrolling messages will repeat until the "ENTER" ENTER key is pressed.

8. When the "ENTER" ENTER key is pressed, the UMS will be disabled and the display will read:



9. Before using tower lift down adhere to the following:

- Make sure the main boom is fully retracted.
- Make sure the tower boom is fully retracted.
- Slowly lower the tower boom.

10. When the platform has been safely lowered to the ground, exit the service mode by pressing the Emergency Stop Switch (EMS) at the ground controls. Upon loss of power (pressing the EMS) to the system, the upright monitoring system will reset and all functionality will be restored to the machine.

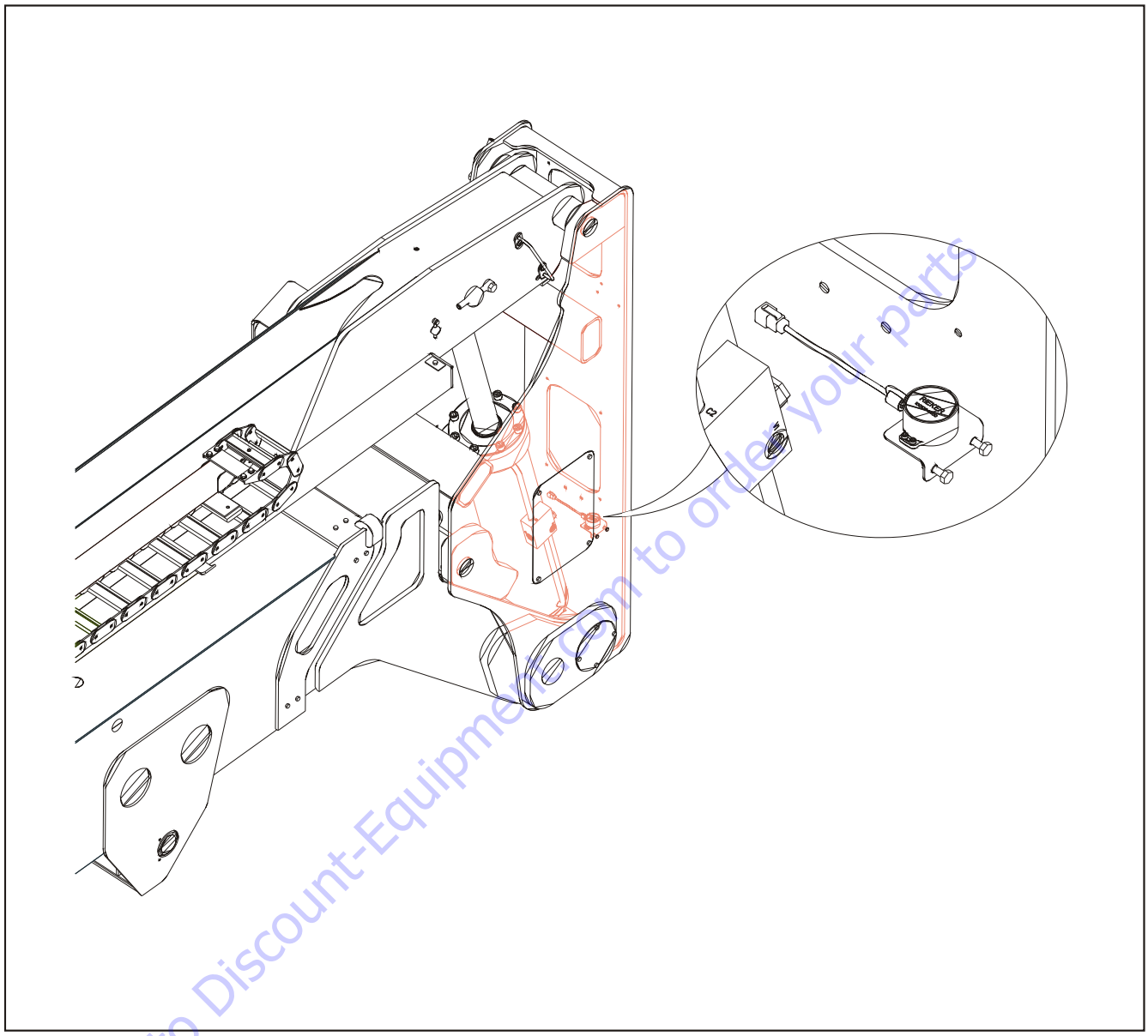


Figure 4-15. UMS Sensor Location

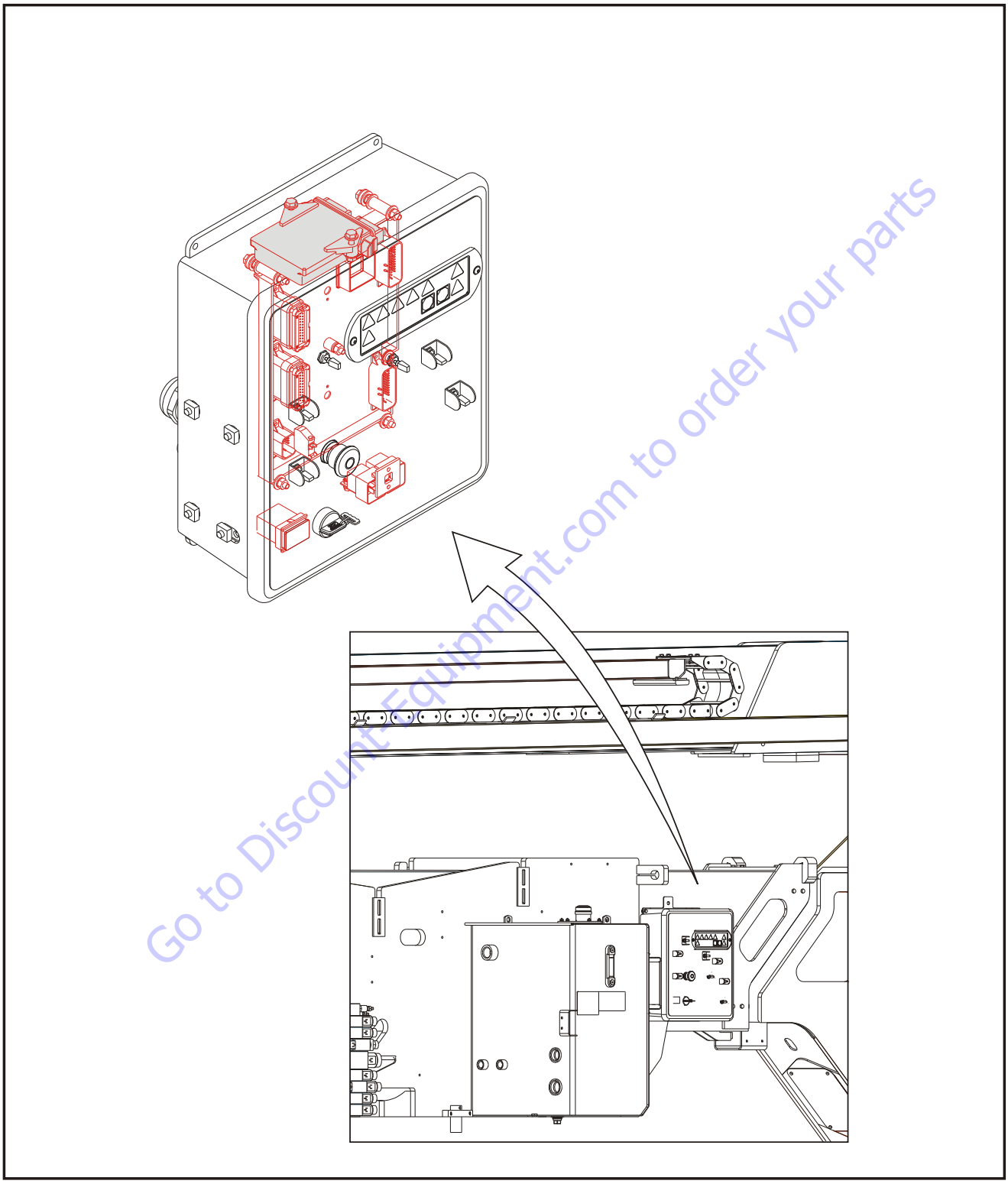


Figure 4-16. UMS Module Location

J1		J2	
1	IGN POWER (7-33V)	1	+5V ANALOG EXCITATION
2	GROUND	2	ANALOG INPUT 0
3	DIGITAL INPUT 0	3	ANALOG GROUND
4	DIGITAL INPUT 1	4	+5V ANALOG EXCITATION
5	DIGITAL INPUT 2	5	ANALOG INPUT 1
6	DIGITAL INPUT 3	6	ANALOG GROUND
7	DIGITAL OUTPUT 0 (PWM, IF)	7	ANALOG INPUT 2
8	DIGITAL OUTPUT 1 (PWM, IF)	8	ANALOG INPUT 3 (NOT POPULATED)
9	DIGITAL OUTPUT 2 (PWM, IF)	9	CANBUS HIGH
10	DIGITAL OUTPUT 3 (PWM, IF)	10	CANBUS LOW
11	DIGITAL OUTPUT 4 (PWM)	11	ANALYZER TRANSMIT
12	DIGITAL OUTPUT 5 (PWM)	12	ANALYZER RECEIVE

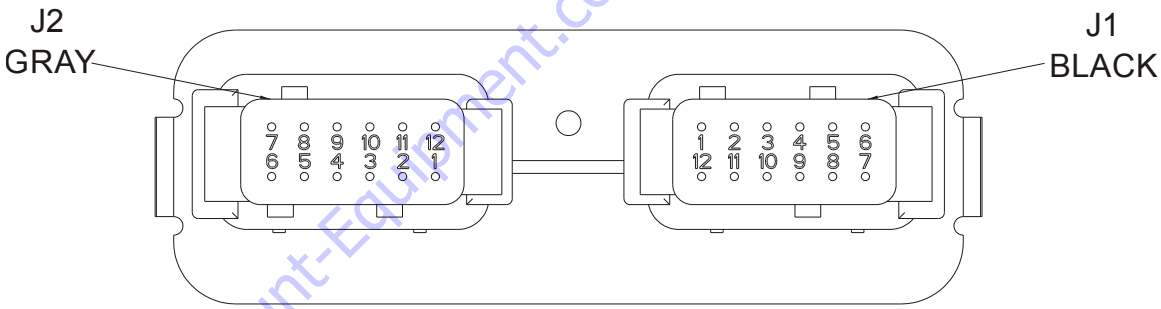


Figure 4-17. UMS Module Pin Identification

4.11 UMS TROUBLESHOOTING AND FAULT MESSAGES

Backward Stability Concern Message

2/5 UMS SENSOR BACKWARD LIMIT REACHED

When the upright angle relative to the turntable is higher than +2.5° (away from the work platform), tower lift down will be disallowed immediately. Tower Lift Down will be re-allowed when the upright angle relative to the turntable is less than 2.0°. If Tower Lift Down is disabled for more than 1.5 seconds, the ground boom malfunction indicator lamp, upright tilted lamp and platform alarm will light/sound continually and a fault shall be raised. These conditions will be latched along with Tower Lift Down until the upright angle is less than 2.0° for 2 seconds and the Tower Lift Down command is returned to neutral.

Solution:

- Inspect sensor mounting.
- Verify sensor calibration on level pad.
- Follow the corrective action listed on decal 1702265 located near the red knob of the machine.
- Inspect machine hydraulics. Refer to Holding Valve Checks in Section 5 - Hydraulics.

Forward Stability Concern Message

2/5 UMS SENSOR FORWARD LIMIT REACHED

When the upright angle relative to the turntable is less than –4.0° for longer than 1.5 seconds, the ground control boom malfunction indicator lamp, the platform malfunction indicator lamp, and platform alarm will light/sound continually and a fault will be raised. The light/alarm signal will stop only when the upright angle reaches values greater than –3.0° for 2 seconds.

Solution:

- Inspect sensor mounting.
- Verify sensor calibration on level pad.
- Tower lift down.
- Inspect machine hydraulics. Refer to Holding Valve Checks in Section 5 - Hydraulics.

Auto Detection Input Low Message

2/5 AUTO DETECTION INPUT LOW

If the UMS detects a valid ground module software version but digital input 2 is not tied high the UMS module shall report a fault.

Solution:

- Inspect wire harness, there should be 12 volts going into pin J1-5 (black connector) of UMS module.

UMS Sensor Communications lost

6/6 UMS SENSOR COMMUNICATIONS LOST

If the UMS detects a valid ground module software version but digital input 2 is not tied high the UMS module shall report a fault.

Solution:

- Inspect wire harness; CANbus communications are on pins J2-9 & J2-10 (gray connector) of the UMS module.
- Using access level 1 of the UMS module, under “DIAGNOSTICS” CAN, EX/SEC and TX/SEC should be values greater than 0. Also “BUS OFF:” and “BUS ERR:” should be 0 and “PASSIVE:” should be a low value.

Out of Usable Range Message

8/1 UMS SENSOR OUT OF USABLE RANGE

When both the Chassis tilt sensor and the UMS sensor read greater than 10° in the same direction the UMS will be disengaged until the condition no longer exists and a fault shall be raised.

Solution:

- Verify the message clears when operating the machine on grade less than 10°.
- Inspect sensor mounting.
- Verify sensor calibration on level pad.

UMS Sensor Not Calibrated Message

8/1 UMS SENSOR NOT CALIBRATED

If the control system detects a sensor out of range condition or a not calibrated fault with the UMS angle sensor, the control system shall report a fault and disable Tower Lift Down and activate the ground boom malfunction indicator lamp, upright tilted lamp and platform alarm continually

If the control system detects that the UMS angle sensor has not been calibrated, the ground boom malfunction lamp will flash at a 3 Hz rate until the system is calibrated or disabled.

Solution:

- Calibrate sensor.

UMS Sensor Faulted Message

8/1 UMS SENSOR FAULTED

If the system detects that the UMS sensor frequency outside the 100Hz +/- 5Hz range or the duty cycle is outside 50% +/- 21% range the control system shall report a fault.

Solution:

- Inspect wire harness going to the sensor and UMS module.
- Inspect sensor mounting.
- Replace sensor.

Incompatible Software Detected Message

9/9 INCOMPATIBLE SOFTWARE DETECTED

If the control system detects that the ground module software is incompatible with the UMS module, the UMS module shall report a fault and disable the footswitch signal to the ground module.

Solution:

- Update ground module software.

Calibration Faults

CAL FAILED-CHASSIS NOT LEVEL

The control system shall display a fault in the event the raw sensor output is greater than ±5° for the chassis sensor.

CAL FAILED-UMS SENSOR RAW OUTPUT OUT OF RANGE

The control system shall display a fault in the event the raw sensor output is greater then ±5° for the UMS sensor.

CAL FAILED-CALIBRATION DISRUPTED

If calibration is disrupted, the control system shall display this fault.

CAL FAILED- UMS SENSOR MOVEMENT NOT DETECTED

The UMS angle has not detected the required amount of movement during calibration.

4.12 ARTICULATING JIB

NOTE: *Pin numbers listed in the following procedures are referenced in Figure 4-18., Location of Components-Articulating Jib.*

NOTE: *Using a suitable lifting device, support the jib.*

Removal

1. For platform/support removal see platform/support removal diagram. (See Section 4.1, Platform).
2. Position the articulating jib boom level with the ground.
3. Remove mounting hardware from platform (slave) cylinder pin #1. Using a suitable brass drift and hammer, remove the cylinder pin from articulating jib boom.
4. Remove mounting hardware from articulating jib boom pivot pin #2. Using a suitable brass drift and hammer, remove the pivot pin from boom assembly.

Disassembly

1. Remove mounting hardware from articulating jib boom pivot pins #3 and #4. Using a suitable brass drift and hammer, remove the pins from articulating jib boom pivot weldment.
2. Remove mounting hardware from rotator support pins #5 and #6. Using a suitable brass drift and hammer, remove the pins from rotator support.
3. Remove mounting hardware from lift cylinder pin #7. Using a suitable brass drift and hammer, remove the cylinder pin from articulating jib boom.

Inspection

NOTE: *When inspecting pins and bearings Refer to Section 2.5, Pins and Composite Bearing Repair Guidelines.*

1. Inspect articulating fly boom pivot pin for wear, scoring, tapering and ovality, or other damage. Replace pins as necessary.
2. Inspect articulating fly boom pivot attach points for scoring, tapering and ovality, or other damage. Replace pins as necessary.
3. Inspect inner diameter of articulating fly boom pivot bearings for scoring, distortion, wear, or other damage. Replace bearings as necessary.
4. Inspect lift cylinder attach pin for wear, scoring, tapering and ovality, or other damage. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.
5. Inspect inner diameter of rotator attach point bearings for scoring, distortion, wear, or other damage.
6. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.

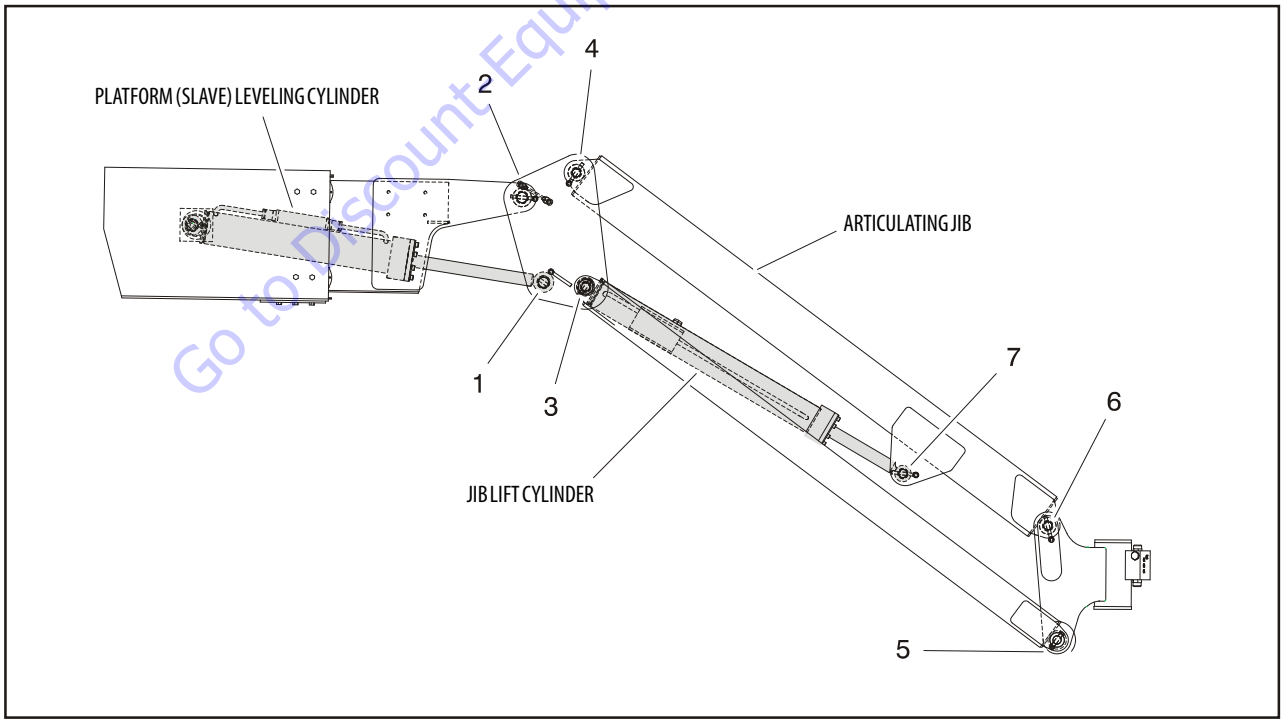


Figure 4-18. Location of Components-Articulating Jib

7. Inspect structural units of articulating jib boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.

Assembly

1. Align lift cylinder with attach holes in articulating jib boom. Using a soft head mallet, install cylinder pin #7 into articulating jib boom and secure with mounting hardware.
2. Align rotator support with attach hole in articulating jib boom. Using a soft head mallet, install rotator support pin #6 into articulating jib boom and secure with mounting hardware.
3. Align bottom tubes with attach holes in rotator support. Using a soft head mallet, install rotator support pin #5 into articulating jib boom and secure with mounting hardware.
4. Align articulating jib boom with attach hole in articulating jib boom pivot weldment. Using a soft head mallet, install rotator support pin #4 into articulating jib boom and secure with mounting hardware.
5. Align bottom tubes with attach holes in articulating jib boom pivot weldment. Using a soft head mallet, install rotator support pin #3 into articulating jib boom pivot weldment and secure with mounting hardware.
6. Align articulating jib boom pivot weldment with attach holes in fly boom assembly. Using a soft head mallet, install pivot pin #2 into fly boom assembly and secure with mounting hardware.
7. Align the platform (slave) leveling cylinder with attach holes in articulating jib boom pivot weldment. Using a soft head mallet, install platform (slave) leveling cylinder pin #1 into articulating jib boom pivot weldment and secure with mounting hardware.

4.13 SEQUENCE FOR HOSE REPLACEMENT IN THE TOWER BOOM

1. Remove the tower boom front cover bolts, exposing the Powertrack.
2. Remove bolts to disconnect the top bar of the Powertrack
3. Pull the Powertrack out of base boom. (as far as hoses will allow)
4. At left side rear of upright, remove access cover plate (4) bolts. (others if necessary)
5. Remove access cover plate, (4) bolts, from bottom front of fly boom.
6. Cut cable ties that attach hose to be replaced.
7. Disconnect hose that is to be replaced, and cap the male fitting.
8. Attach the new hose to the end of the hose to be replaced.
9. Pull these lines thru the upright and out the bottom, then feed back into the fly boom.
10. At the Powertrack, in front of the tower boom, open the Powertrack links to expose the hose to be replaced.
11. Pull hose to be replaced, attached to the new hose, thru the fly boom and thru the Powertrack links.
12. Disconnect new hose from the replaced hose and connect to fitting where the damaged hose was connected.
13. Roll Powertrack back into base, and attach the top bar of the Powertrack (2) bolts to the inside top of the fly boom section.
14. Check for leaks and hardware tightened securely.
15. Replace access cover plates and front cover.

4.14 LIMIT SWITCHES ADJUSTMENT

Main Boom Horizontal Limit Switch

1. Place machine on level surface.
2. Raise main boom 5 to 10 degrees above horizontal. limit switch should activate before this point.
3. Lower main boom until limit switch resets. This should be 1 degree above to 4 degrees below horizontal. (See Figure 4-22. for adjustments)

NOTE: *Angle indicator should be placed approx. 2 ft. from the main boom pivot pin and the attach point on the main boom. Tower angle switch must be reset before main boom angle switch can be activated.*

Tower Boom Horizontal Limit Switch

1. Place machine on level surface.
2. Raise Tower Boom 8 to 13 degrees above horizontal. The tower angle limit switch should activate at this point.
3. Lower the tower boom until the limit switch resets. This should be 2 to 7 degrees below where the switch was activated. (See Figure 4-19. and Figure 4-20. for adjustments).

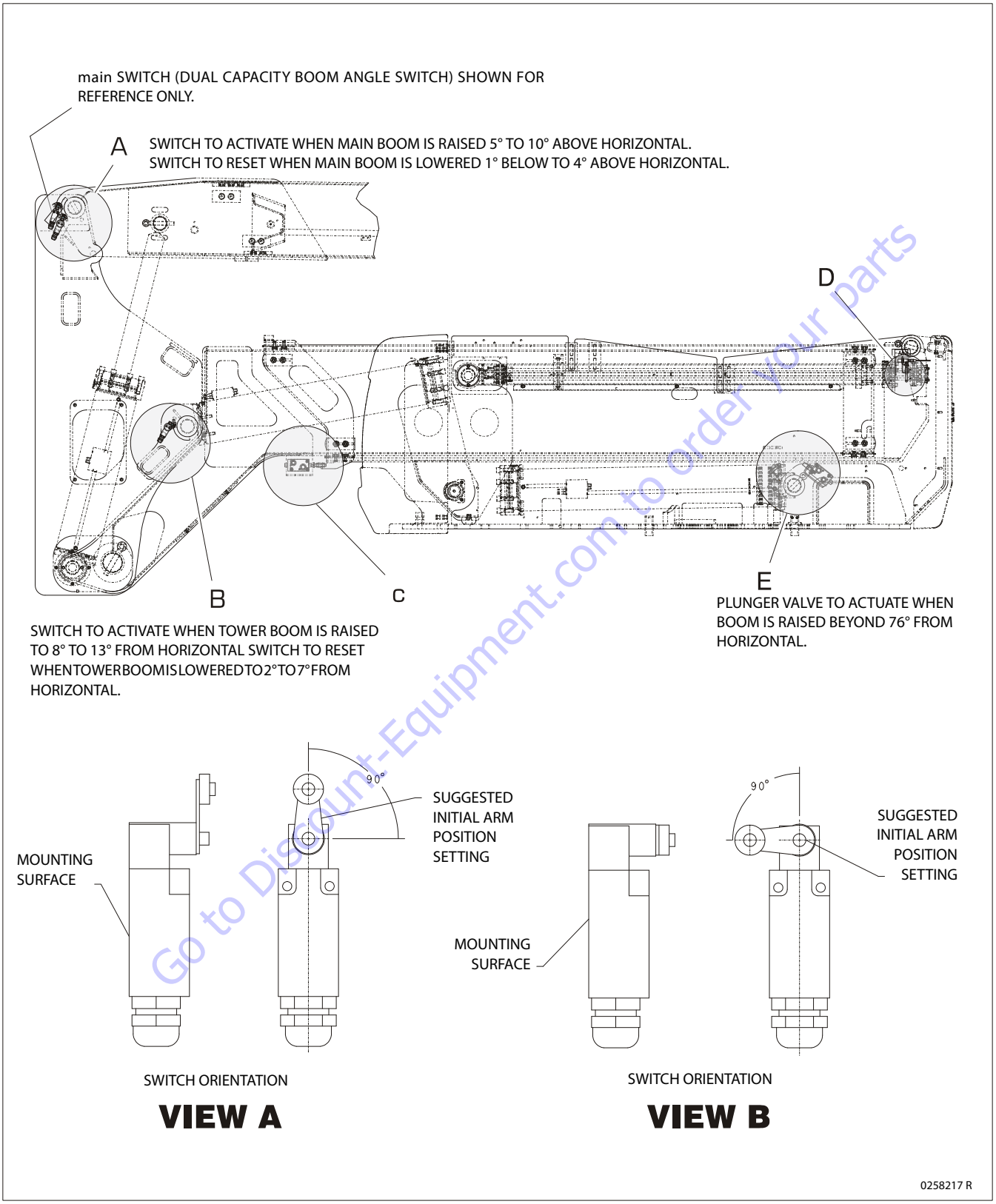
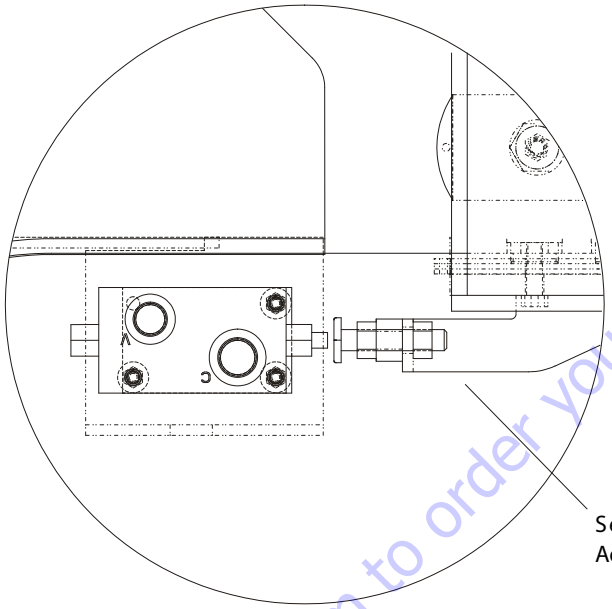


Figure 4-19. Boom Valve and Limit Switches Location (Sheet 1 of 3)

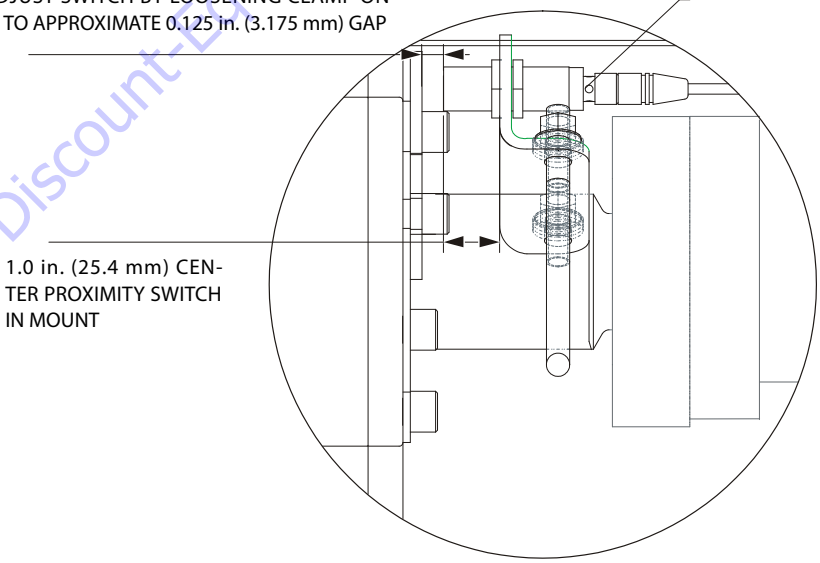


See Section 4.15, Boom Valve Adjustment

VIEW C

ADJUST GAP TO WITHIN 0.20 in. (5 mm) (PREFERRED GAP 0.125 in. (3.175 mm) WHEN LOWER BOOM IS FULLY RETRACTED AND AFTER VALVE IS ADJUSTED ADJUST SWITCH BY LOOSENING CLAMP ON TELE ROD AND SLIDING TO APPROXIMATE 0.125 in. (3.175 mm) GAP

LEDS WILL LIGHT WHEN POWER IS ON AND TARGET IS WITHIN SENSING DISTANCE



1.0 in. (25.4 mm) CENTER PROXIMITY SWITCH IN MOUNT

0258217 R

VIEW D

Figure 4-20. Boom Valve and Limit Switches Location (Sheet 2 of 3)

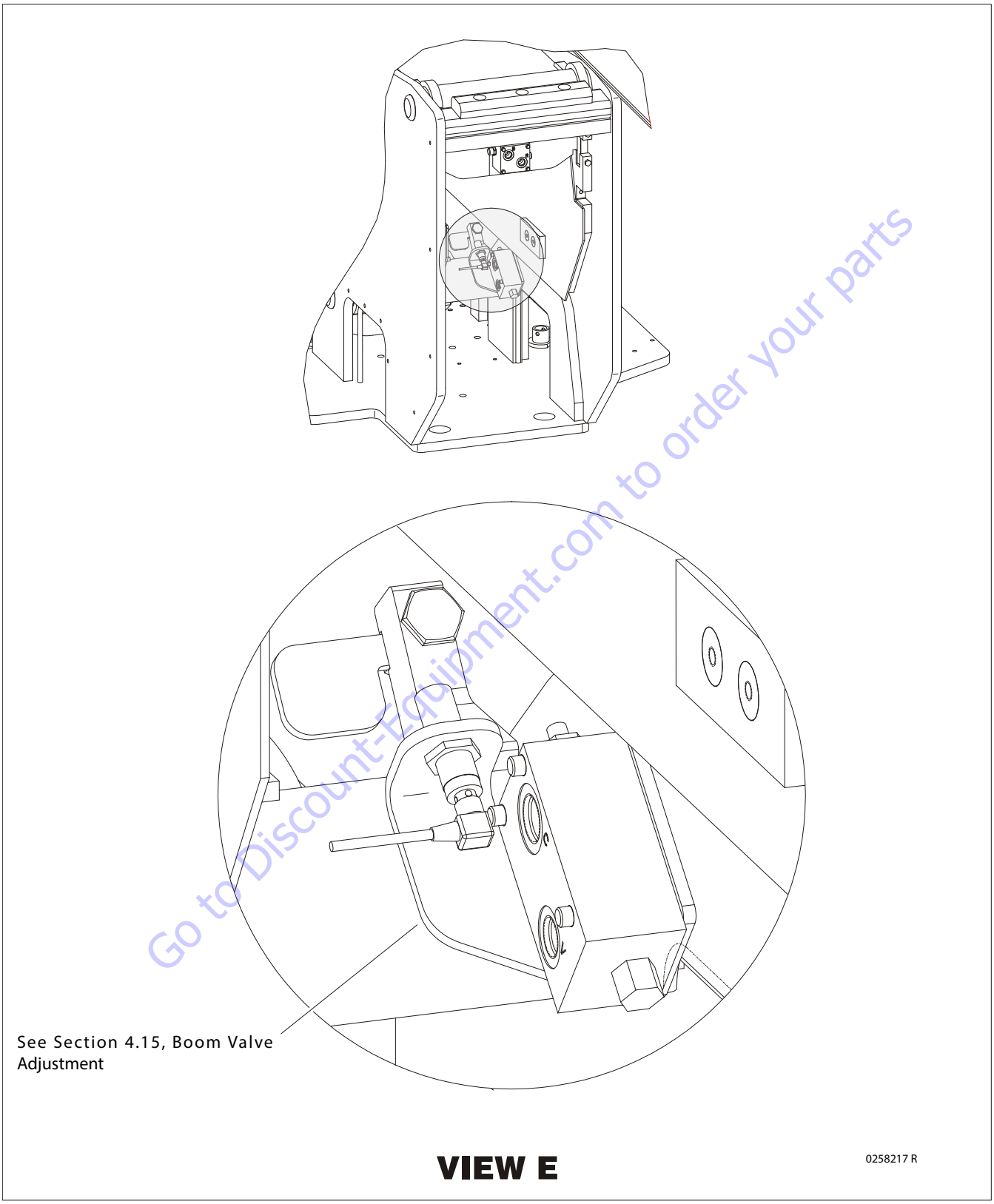


Figure 4-21. Boom Valve and Limit Switches Location (Sheet 3 of 3)

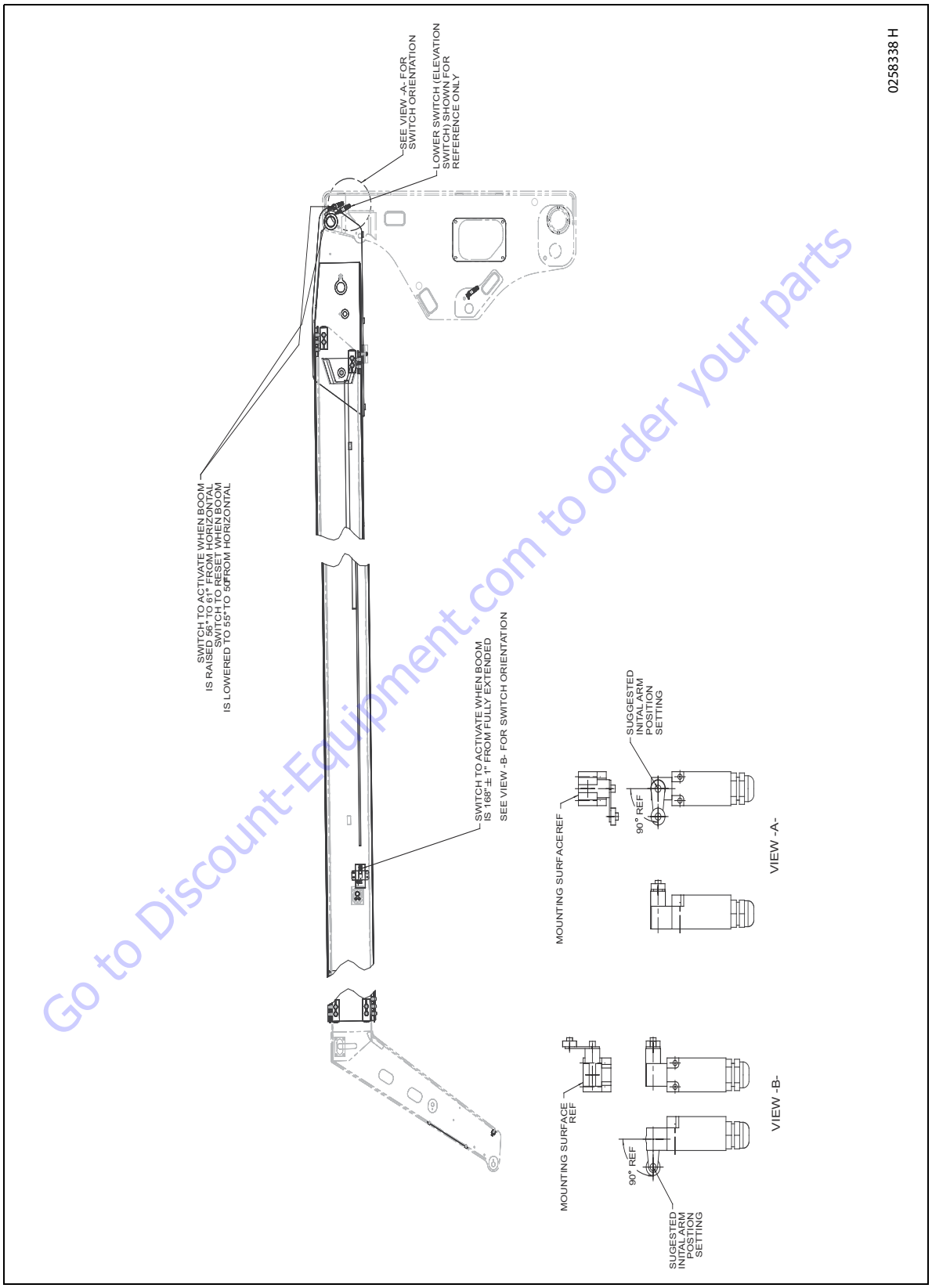


Figure 4-22. Dual Capacity Switches Installation (800 Only if equipped)

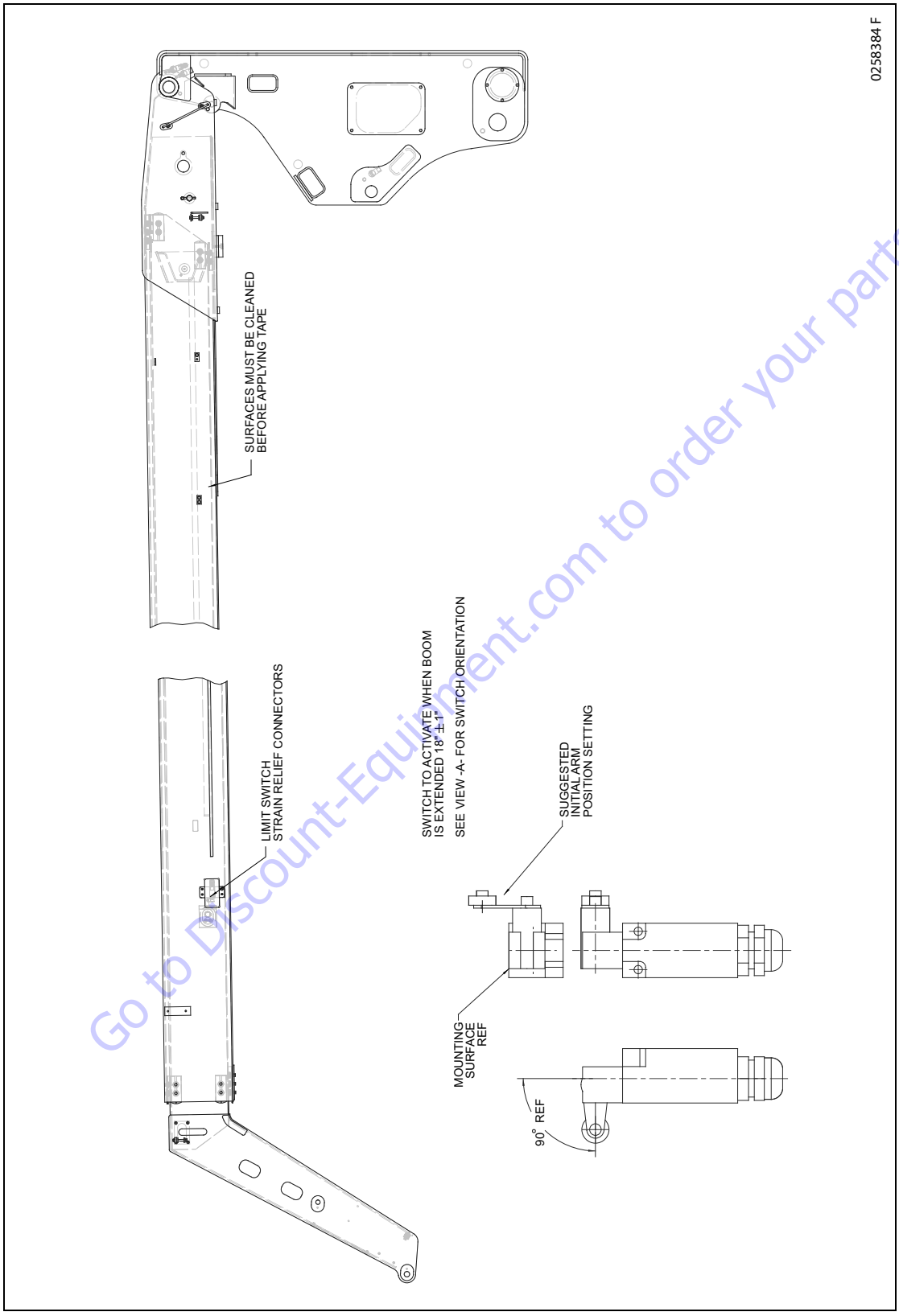


Figure 4-23. Transportation Switch Installation (CE only)

Dual Capacity Angle Limit Switch (800A only)

NOTE: *The boom position and location of the Main Boom Dual Capacity Switch requires a working surface 20 ft. (6m) high to safely check and adjust the switch.*

1. Place machine on level surface.
2. From platform control, with less than 500 lbs. (227 kg) in platform, raise tower boom to maximum angle. Extend main boom until the capacity indicator lights change from 1000 lbs. (454 kg) to 500 lbs. (227 kg).
3. With main boom length in this position, raise the main boom until the indicator lights change back to the 1000 lbs. (454 kg) indicator.
4. The Dual Capacity Limit Switch, located at the telescope cylinder of the Main Boom, Figure 4-22., will activate the 1000 lb. light when the main boom is at 56 to 61 degrees.

NOTE: *Place angle indicator on main base boom at least 2 ft. (0.6m) from pivot pin.*

5. Lower main boom until 500 lb. light comes on. The boom angle at this point should be 50 to 55 degrees.

NOTE: *If limit switch settings need to be changed, you will need to recheck that the 500 lb. light comes on at 50 degrees to 55 degrees when lifting down.*

6. Raise, extend, retract, and lower main boom. Check for smooth operation.

Main Boom Length Switch (800A only)

1. Lift main boom to approximately horizontal.
2. Telescope boom out until 500 lb. light comes on (may need to use auxiliary power to position boom correctly).
3. Mark the wear pad location on the main fly boom.
4. Telescope the main boom to full extension.
5. Measure from the mark on the fly boom to the wear pad. The dimension should be 167" to 169".
6. Lower the tower boom until limit switch resets. This should be 2 to 7 degrees below where the switch

4.15 BOOM VALVE ADJUSTMENT

1. Adjust the screws so the plunger on the valves has 0.250 in. (6.35 mm) travel remaining when the lower boom is fully raised and retracted.
2. After the valves are adjusted, adjust the proximity switches to within 0.20 in. (5 mm) of their target. The LED's on the proximity switches will light when the power is on and the switch is within 0.20 in. (5 mm) of the target. There is a proximity switch to back up both valves.

NOTE: *The cam valve under the boom requires the tower boom to be completely lowered and the cam valve mounted on T/T requires the tower boom to be fully elevated prior to adjustment.*

Tower Boom

1. Shim up wear pads until 1/32 inch (0.8 mm) clearance to adjacent surface.
2. When adjusting wear pads, removing or adding shims, bolt length must also be changed.
   - **a.** When adding shims, longer bolts must be used to ensure proper thread engagement in insert.
   - **b.** When shims are removed, shorter bolts must be used so bolt does not protrude from insert and come into contact with boom surface.

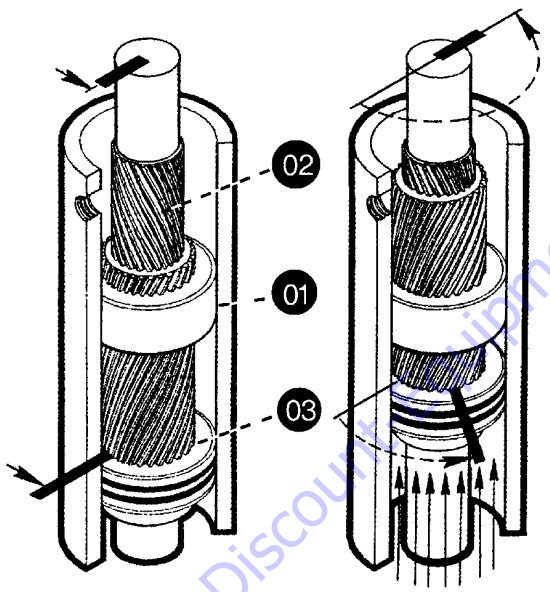
Main Boom

1. Shim up wear pads to within 1/32 inch (0.8 mm) clearance between wear pad and adjacent surface.
2. Adjusting wear pads, removing or adding shims, bolt length must also be changed.
   - **a.** When adding shims, longer bolts must be used to ensure proper thread engagement in insert.
   - **b.** When shims are removed, shorter bolts must be used so bolt does not protrude from insert and Sheaves and wire rope must be replaced as sets.

4.16 ROTATOR ASSEMBLY

Theory of Operation

The L20 Series rotary actuator is a simple mechanism that uses the sliding spline operating concept to convert linear piston motion into powerful shaft rotation. Each actuator is composed of a housing with integrated gear teeth (01) and only two moving parts: the central shaft with integrated bearing tube and mounting flange (02), and the annular piston sleeve (03). Helical spline teeth machined on the shaft engage matching splines on the in- side diameter of the piston. The outside diameter of the piston carries a second set of splines, of opposite hand, which engage with matching splines in the housing. As hydraulic pressure is applied, the piston is displaced axially within the housing - similar to the operation of a hydraulic cylinder - while the splines cause the shaft to rotate. When the control valve is closed, oil is trapped inside the actuator, preventing piston movement and locking the shaft in position.



Bars indicate starting positions of piston and shaft. Arrows indicate direction they will rotate. The housing with integral ring gear remains stationary.

As fluid pressure is applied, the piston is displaced axially while the helical gearing causes the piston and shaft to rotate simultaneously. The double helix design compounds rotation: shaft rotation is about twice that of the piston.

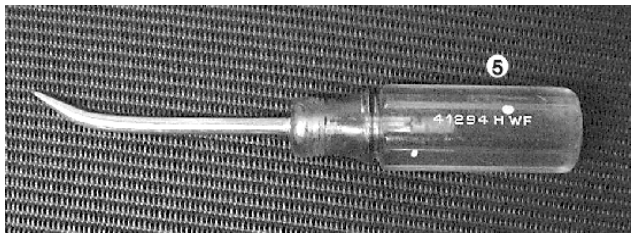
The shaft is supported radially by the large main radial bearing and the lower radial bearing. Axially, the shaft is separated from the housing by the main and lower thrust washers. The end cap is adjusted for axial clearance and locked in position by set screws or pins.

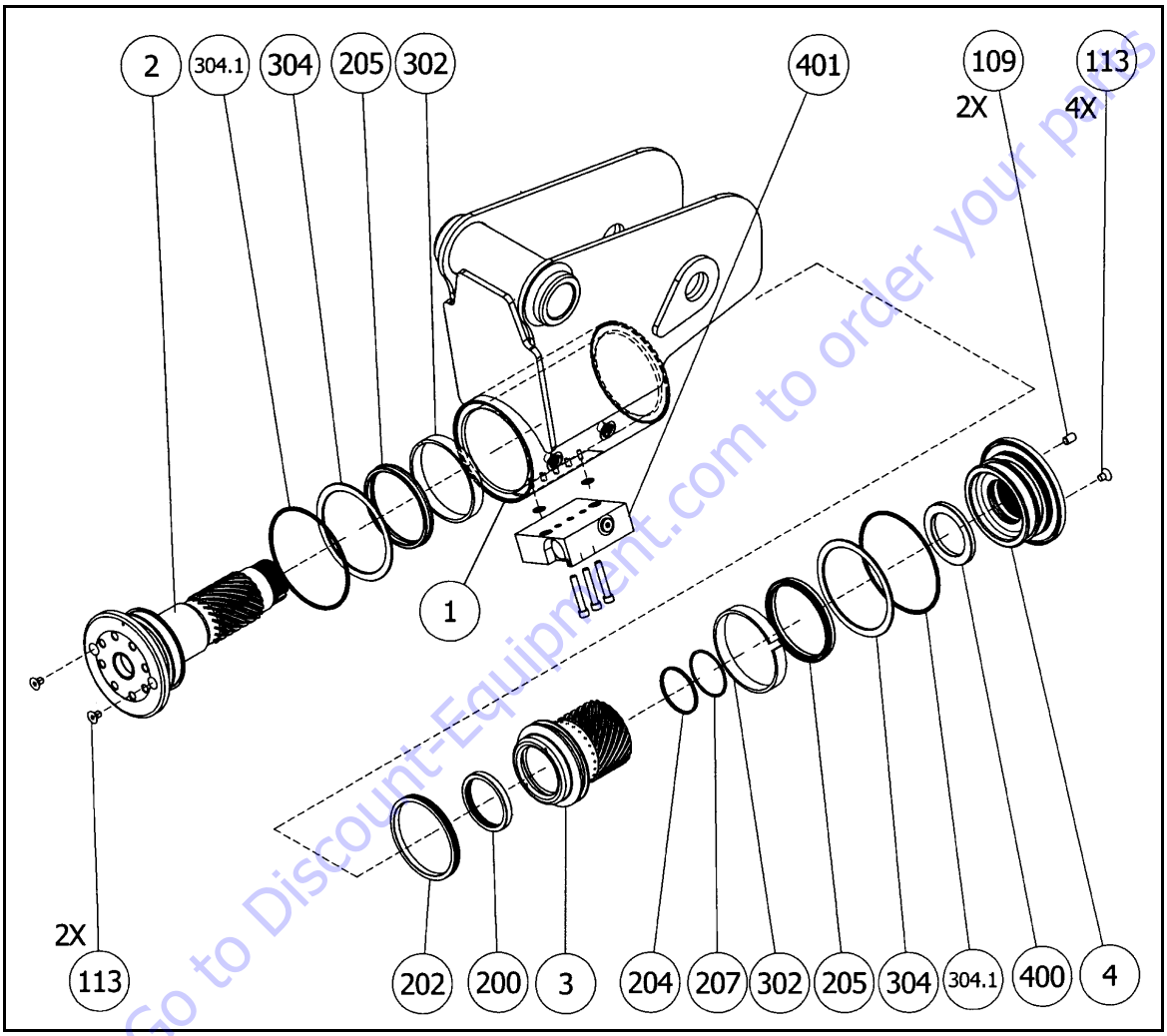
Required Tools

Upon assembly and disassembly of the actuator there are basic tools required. The tools and their intended functions are as follows:

1. Flashlight - helps examine timing marks, component failure and overall condition.
2. Felt Marker - match mark the timing marks and outline troubled areas.
3. Allen wrench - removal of port plugs and set screws.
4. Box knife - removal of seals.
5. Seal tool - assembly and disassembly of seals and wear guides.
6. Pry bar - removal of end cap and manual rotation of shaft.
7. Rubber mallet- removal and installation of shaft and piston sleeve assembly.
8. Nylon drift - installation of piston sleeve
9. End cap dowel pins - removal and installation of end cap (sold with Helac seal kit).

The seal tool is merely a customized standard flat head screwdriver. To make this tool you will need to heat the flat end with a torch. Secure the heated end of the screwdriver in a vice and physically bend the heated end to a slight radius. Once the radius is achieved round off all sharp edges of the heated end by using a grinder. There may be some slight modifications for your own personal preference.





PARTS
1. Housing
2. Shaft
3. Piston Sleeve
4. End Cap

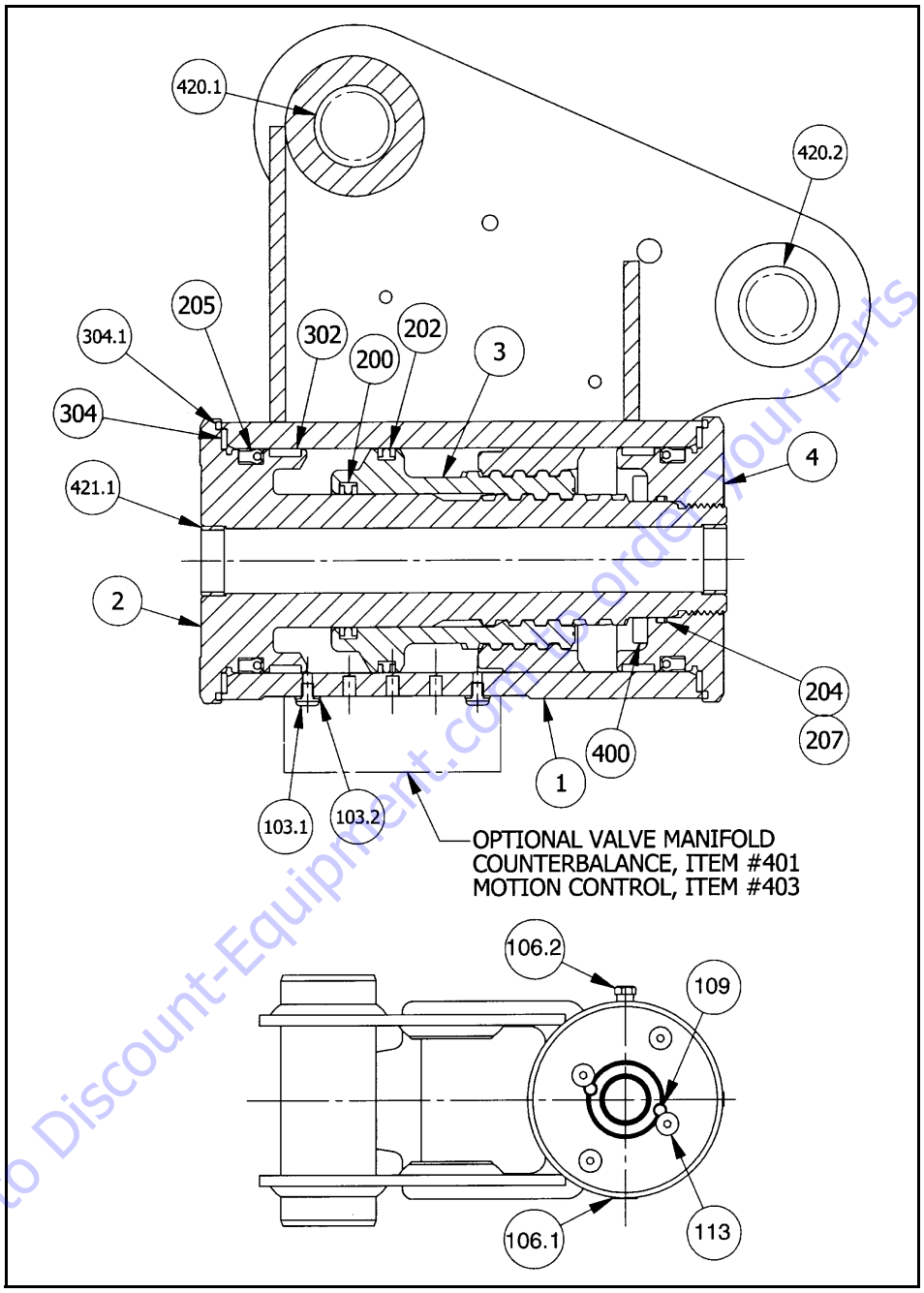
HARDWARE
103.1. Screw
103.2. Washer
106.1. Port Plug
106.2. Port Plug
109. Lock Pin
113. Capscrew

SEALS
200. T-Seal
202. T-Seal
204. O-ring
205. Cup Seal
207. Backup Ring
304.1. Wiper Seal

BEARINGS
302. Wear Guide
304. Thrust Washer

ACCESSORIES
400. Stop Tube
420.1 Bushing
420.2 Bushing
421.1 Bushing

Figure 4-24. Rotator - Exploded View



PARTS	HARDWARE	SEALS	BEARINGS	ACCESSORIES
1. Housing	103.1. Screw	200. T-Seal	302. Wear Guide	400. Stop Tube
2. Shaft	103.2. Washer	202. T-Seal	304. Thrust Washer	420.1 Bushing
3. Piston Sleeve	106.1. Port Plug	204. O-ring		420.2 Bushing
4. End Cap	106.2. Port Plug	205. Cup Seal		421.1 Bushing
	109. Lock Pin	207. Backup Ring		
	113. Capscrew	304.1. Wiper Seal		

Figure 4-25. Rotator- Assembly Drawing

Disassembly

⚠ CAUTION

SECURE PRODUCT TO SLOTTED TABLE OR VISE.

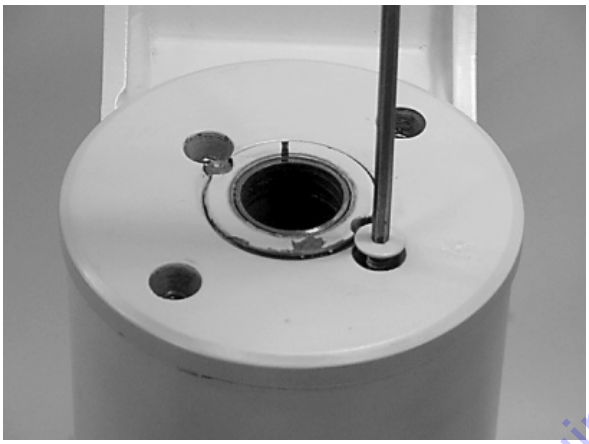
⚠ CAUTION

CONTENTS UNDER PRESSURE. WEAR APPROVED EYE PROTECTION. USE CAUTION WHEN REMOVING PORT PLUGS AND FITTINGS.

NOTICE

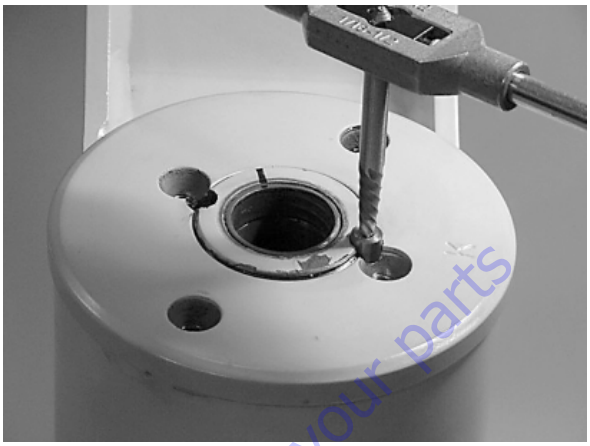
MAKE SURE WORK AREA IS CLEAN.

1. Remove the cap screws (113) over end cap lock pins (109).



2. Using a 1/8" (3.18mm) drill bit, drill a hole in the center of each lock pin to a depth of approximately 3/16" (4.76mm).

3. Remove the lock pins using an "Easy Out" (a size #2 is shown).



If the pin will not come out with the "Easy Out", use 5/16" drill bit to a depth of 1/2" (12.7mm) to drill out the entire pin.

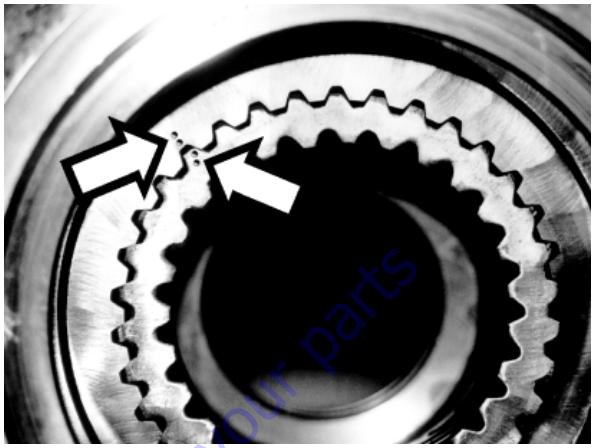
4. Install the end cap (4) removal tools provided with the Helac seal kit.

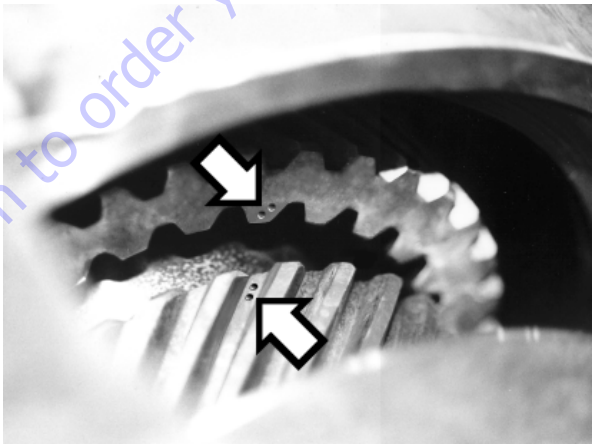
5. Using a metal bar, or similar tool, unscrew the end cap (4) by turning it counter clockwise.

6. Remove the end cap (4) and set aside for later inspection.

7. Remove the stop tube if equipped. The stop tube is an available option to limit the rotation of the actuator.

8. Every actuator has timing marks for proper engagement.





9. Prior to removing the shaft, (2), use a felt marker to clearly indicate the timing marks between shaft and piston. This will greatly simplify timing during assembly.

10. Remove the shaft (2). It may be necessary to strike the threaded end of the shaft with a rubber mallet.

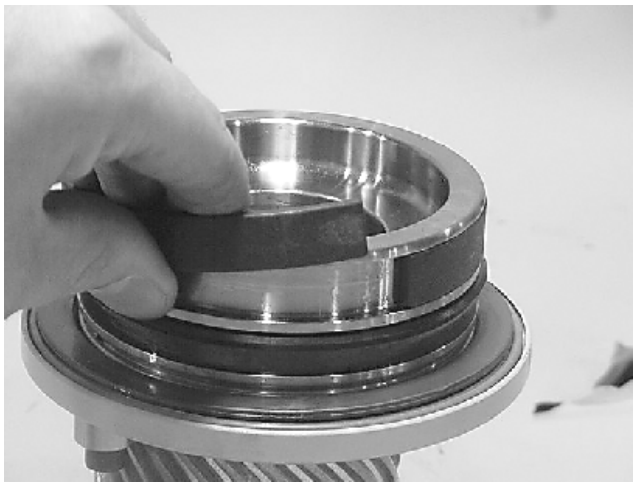
11. Before removing the piston (3), mark the housing (1) ring gear in relation to the piston O.D. gear. There should now be timing marks on the housing (1) ring gear, the piston (3) and the shaft (2).

12. To remove the piston (3) use a rubber mallet and a plastic mandrel so the piston is not damaged.

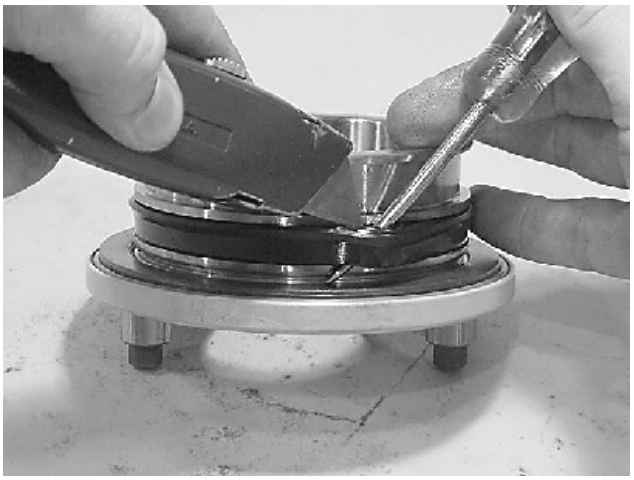
13. At the point when the piston gear teeth come out of engagement with the housing gear teeth, mark the piston and housing with a marker as shown.

14. Remove the o-ring (204) and backup ring (207) from end cap (4) and set aside for inspection.

15. Remove the wear guides (302) from the end cap (4) and shaft (2).



16. To remove the main pressure seals (205), it is easiest to cut them using a sharp razor blade being careful not to damage the seal groove.



17. Remove the thrust washers (304), from the end cap (4) and shaft (2).

18. Remove the wiper seal (304.1) from its groove in the end cap (4) and shaft (2).

19. Remove the piston O.D. seal (202) from the piston.

20. Remove the piston I.D. seal (200). You may now proceed to the inspection process.

Inspection

NOTICE

SMALL OR MINOR SURFACE SCRATCHES CAN BE CAREFULLY POLISHED.

1. Clean all parts in a solvent tank and dry with compressed air prior to inspecting. Carefully inspect all critical areas for any surface finish abnormalities: Seal grooves, bearing grooves, thrust surfaces, rod surface, housing bore and gear teeth.

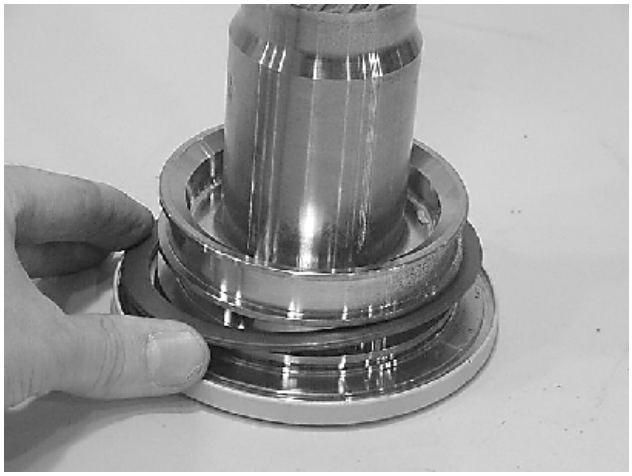
2. Inspect the thrust washers (304) for rough or worn edges and surfaces. Measure it's thickness to make sure it is within specifications (Not less than 0.092" or 2.34 mm).

3. Inspect the wear guide condition and measure thickness (not less than 0.123" or 3.12 mm).

Assembly

1. Gather all the components and tools into one location prior to re-assembly. Use the cut away drawing to reference the seal orientations.

2. Install the thrust washer (304) onto shaft (2) and end cap (4).



3. Install the wiper seal (304.1/green 0-ring) into the groove on the shaft (2) and end cap (4) around the outside edge of the thrust washer (304).

4. Using a seal tool install the main pressure seal (205) onto shaft (2) and end cap (4). Use the seal tool in a circular motion.

5. Install the wear guide (302) on the end cap (4) and shaft (2).

6. Install the O-ring (204) and back-up ring (207) into the inner seal groove on the end cap (4).

7. Install the inner T-seal (200) into the piston (3) using a circular motion.

   Install the outer T-seal (202) by stretching it around the groove in a circular motion.

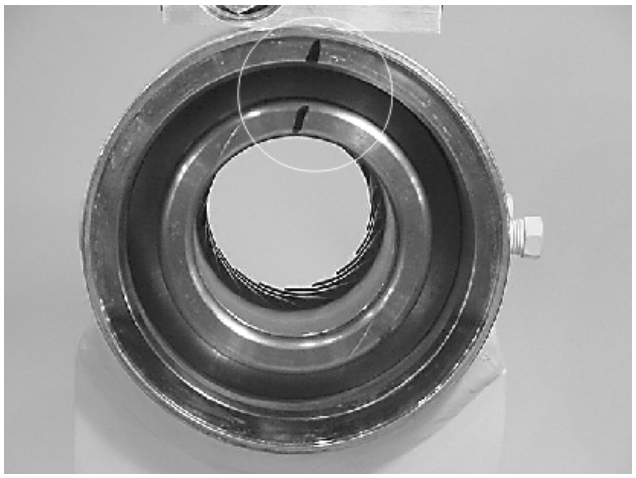
   Each T-seal has 2 back-up rings (see drawing for orientation).

   Beginning with the inner seal (200) insert one end of b/u ring in the lower groove and feed the rest in using a circular motion. Make sure the wedged ends overlap correctly.

   Repeat this step for the outer seal (202).

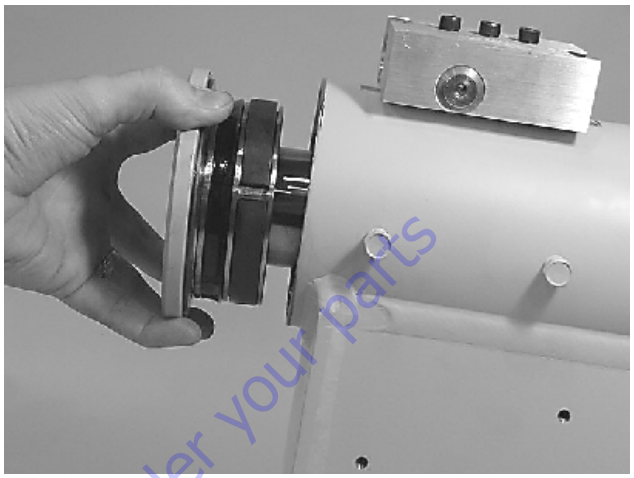
8. Insert the piston (3) into the housing (1) as shown, until the outer piston seal (202) is touching inside the housing bore.

9. Looking from the angle shown, rotate the piston (3) until the marks you put on the piston and the housing (1) during disassembly line up as shown. Using a rubber mallet, tap the piston into the housing up to the point where the gear teeth meet.



10. Looking from the opposite end of the housing (1) you can see if your timing marks are lining up. When they do, tap the piston (3) in until the gear teeth mesh together. Tap the piston into the housing the rest of the way until it bottoms out.

11. Install the shaft (2) into the piston (3). Be careful not to damage the seals. Do not engage the piston gear teeth yet.



12. Looking from the view shown, use the existing timing marks to line up the gear teeth on the shaft (2) with the gear teeth on the inside of the piston (3). Now tap the flange end of the shaft with a rubber mallet until the gear teeth engage.