Table 3-5. Deutz Trouble Codes (D2.9L4 Engine)

KWP-Code	SPN	FMI	Blink code	Error Identification
969	624	5	513	SVS lamp; open load.
970	624	12	513	SVS lamp: powerstage over temperature.
971	624	3	513	SVS lamp; short circuit to battery.
972	624	4	513	SVS lamp; short circuit to ground.
973	523612	14	555	Softwarereset CPU SWReset_0.
974	523612	14	555	Softwarereset CPU SWReset_1.
975	523612	14	555	Softwarereset CPU SWReset_2.
976	91	11	226	Plausibility error between APP1 and APP2 or APP1 and idle switch.
978	29	2	126	Plausibility error between sensor and idle switch, Acceleratio Pedal Detection. In case of Hand Throttle with Low Idle Switch, it is the plausibility check between hand throttle and idle switch.
980	523550	12	515	Terminal 50 was operated too long.
981	172	3	226	Air flow temperature sensor; short circuit to battery or open load.
982	172	4	226	Air flow temperature sensor; short circuit to ground.
986	523921	0	714	Burner temperature, temperature above upper shutoff threshold.
989	523921	1	714	Burner temperature, temperature below lower shutoff threshold.
992	105	1	128	Charged Air cooler down stream temperature. Temperature below lower physical threshold.
994	105	3	128	Electrical error charged air temperature. Signal range check high.(SRC).
995	105	4	128	Electrical error charged air temperature. Signal range check low.
996	105	0	233	Charged air cooler temperature. System reaction initiated. High charged air cooler temperature. Warning threshold exceeded.
997	105	0	233	Low charged air cooler temperature. Shut off threshold exceeded.
998	105	11	128	Diagnostic fault check for charged air cooler downstream temperature sensor. No detail informationen!
1007	412	3	682	Electrical error EGR cooler downstream temperature. Signal range check high.
1008	412	4	682	electrical error EGR cooler downstream temperature. Signal range check low.
1011	523960	0	771	Physical range check high for EGR cooler downstream temperature.
1012	523960	1	771	Physical range check low for EGR cooler downstream temperature.
1014	5763	6	594	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8). Signal range check high.
1015	520521	5	594	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); signal range check low.
1016	5763	7	594	Actuator position for EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8) not plausible.
1022	5763	6	594	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); signal range check high.
1023	5763	5	594	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); signal range check low.
1024	5763	3	594	Position sensor error of actuator EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8). Signal range check high.
1025	5763	4	594	Position sensor error actuator EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8). Signal range check low.
1026	4769	2	684	Temperature downstream DOC, plausibility error.

Table 3-5. Deutz Trouble Codes (D2.9L4 Engine)

KWP-Code	SPN	FMI	Blink code	Error Identification
1029	4766	0	684	Temperature downstream DOC, temperature above upper shutoff threshold.
1030	4766	0	684	Temperature downstream DOC, temperature above upper warning threshold.
1034	4769	3	684	Sensor error exhaust gas temperature downstream (DOC); signal range check high.
1035	4769	4	684	Sensor error exhaust gas temperature downstream (DOC); signal range check low.
1036	4768	2	683	Temperature upstream DOC, plausibility error.
1039	4765	0	683	Temperature upstream DOC, temperature above upper shutoff threshold.
1040	4765	0	683	Temperature upstream DOC, temperature above upper warning threshold.
1044	4768	3	683	Electrical error exhaust gas temperature upstream (DOC); signal range check high.
1045	4768	4	683	Electrical error exhaust gas temperature upstream (DOC); signal range check low.
1047	3248	4	685	Sensor error particle filter downstream temperature; signal range check low.
1067	1180	3	556	Sensor error exhaust gas temperature upstream turbine; signal range check high.
1068	1180	4	556	Sensor error exhaust gas temperature upstream turbine; signal range check low.
1069	4360	0	668	Exhaust temperature upstream SCR-Cat, temperature above upper physical threshold.
1070	4360	1	668	Sensed exhaust temperature before SCR-Cat is < physical low limit.
1071	4361	2	668	Signal error for CAN message . No detail informationen!
1072	4361	3	668	Sensor error DEF catalyst exhaust gas temperature upstream; signal range check high.
1073	4361	4	668	Sensor error DEF catalyst exhaust gas temperature upstream; signal range check low.
1074	1761	14	127	DEF tank level; warning threshold exceeded.
1075	3361	6	677	DEF dosing valve; power at the end of injection too high.
1077	3361	3	677	DEF dosing valve; short circuit to battery on low side.
1078	3361	3	677	DEF dosing valve; short circuit to battery or open load on high side.
1079	3361	4	677	Urea dosing valve; short circuit to ground or open load on low side.
1080	3361	4	677	DEF dosing valve; short circuit on high side.
1081	4345	5	674	SCR heater relay DEF returnline sekondary side; open load.
1082	4366	5	762	SCR main relay (secondary side): open load.
1083	4343	5	673	SCR heater relay DEF pressureline secondary side; open load.
1084	4366	5	762	SCR main relay (secondary side); Shortcut to battery.
1085	4366	5	762	SCR main relay (secondary side), heat relay (secondary side), heating elements or heating valve short to ground.
1086	4341	5	675	SCR heater relay DEF supplyline secondary side; open load.
1087	523719	5	672	SCR heater relay DEF supply modul secondary side; open load.
1088	4366	5	671	SCR Tank heating valve secundary side: open load.
1089	4243	11	783	SCR heater; Pressure line heater error and temperature condition to perform an afterrun (Group error diagnosis heater). SCR system heater diagnostic reports error; shut off SCR-system.
1090	4345	5	674	SCR heater relay DEF returnline primary side; open load.
1091	4345	12	674	Over Temperature error . No detail informationen!
1092	4345	3	674	SCR heater DEF returnline; short circuit to battery.
1093	4345	4	674	SCR heater DEF returnline; short circuit to ground.
1094	4343	5	673	SCR heater relay DEF pressureline primary side; open load.

Table 3-5. Deutz Trouble Codes (D2.9L4 Engine)

KWP-Code	SPN	FMI	Blink code	Error Identification
1095	4343	12	673	Over Temperature error No detail informationen!
1096	4343	3	673	SCR heater DEF pressureline; short circuit to battery.
1097	4343	4	673	SCR heater DEF pressureline; short circuit to ground.
1098	523718	5	676	SCR main relay (primary side); open load.
1099	523718	12	676	SCR main relay (primary side); powerstage over temperature.
1100	523718	3	676	SCR main relay (primary side); short circuit to battery.
1101	523718	4	676	SCR main relay (primary side); short circuit to ground.
1102	4341	5	675	SCR heater relay DEF supply line primary side; open load.
1104	4341	3	675	SCR-heater DEF supplyline; short circuit to battery.
1105	4341	4	675	SCR-heater DEF supply line; short circuit to ground.
1106	523719	5	672	SCR heater relay DEF supplymodule primary side; open load.
1107	523719	12	672	Over Temperature error . No detail informationen!
1108	523719	3	672	SCR heater DEF supplymodule; short circuit to battery.
1109	523719	4	672	SCR heater DEF supplymodule; short circuit to ground.
1110	4366	5	671	SCR tank heating valve primary side; open load.
1111	4366	12	671	SCR-heater relay urea tank powerstage output; over temperature.
1112	4366	3	671	SCR Tank heating valve; short circuit to battery.
1113	4366	4	671	SCR Tank heating valve; short circuit to ground.
1117	523632	11	666	Pump motor not available for actuation.
1118	4375	5	666	Urea pump motor; open load.
1120	4375	3	666	Urea pump motor; short circuit to battery.
1121	4375	4	666	Urea pump motor; short circuit to ground.
1122	4334	0	665	Supply module DEF, DEF pressure above upper physical threshold.
1123	4334	1	665	Urea supply module pressure sensor; physical range check low (defect pressure sensor).
1124	4334	0	665	Urea pump pressure sensor; high signal not plausible.
1125	4334	1	665	Urea pump pressure sensor; low signal not plausible.
1126	523632	2	665	Signal error for CAN message. No detail informationen!
1127	523632	3	665	Sensor error urea pump pressure; signal range check high.
1128	523632	4	665	Sensor error urea pump pressure; signal range check low.
1129	4376	5	667	SCR reversal valve; open load.
1130	4376	12	667	SCR reversing valve; over temperature.
1131	4376	3	667	SCR reversal valve; short circuit to battery.
1132	4376	4	667	SCR reversing valve; short circuit to ground.
1135	3031	0	669	DEF tank, DEF temperature in DEF tank is to high.
1136	3031	1	669	DEF tank, DEF temperature below lower physical threshold.
1137	4365	2	669	Tank temperature signal error for CAN message.
1138	4365	3	669	Sensor error urea tank temperature: short circuit to battery.
1139	4365	4	669	Sensor error urea tank temperature; short circuit to ground.
1157	97	12	228	Water in fuel level prefilter; maximum value exceeded.
1158	523946	0	772	Zero fuel calibration injector 1 (in firing order); maximum value exceeded.
1159	523947	0	772	Zero fuel calibration injector 2 (in firing order); maximum value exceeded.

Table 3-5. Deutz Trouble Codes (D2.9L4 Engine)

KWP-Code	SPN	FMI	Blink code	Error Identification
1160	523948	0	772	Zero fuel calibration injector 3 (in firing order); maximum value exceeded.
1161	523949	0	772	Zero fuel calibration injector 4 (in firing order); maximum value exceeded.
1162	523950	0	772	Zero fuel calibration injector 5 (in firing order); maximum value exceeded.
1163	523951	0	772	Zero fuel calibration injector 6 (in firing order); maximum value exceeded.
1164	523946	1	772	Zero fuel calibration injector 1 (in firing order); minimum value exceeded.
1165	523947	1	772	Zero fuel calibration injector 2 (in firing order); minimum value exceeded.
1166	523948	1	772	Zero fuel calibration injector 3 (in firing order); minimum value exceeded.
1167	523949	1	772	Zero fuel calibration injector 4 (in firing order); minimum value exceeded.
1168	523950	1	772	Zero fuel calibration injector 5 (in firing order); minimum value exceeded.
1170	523612	12	555	Internal software error ECU.
1171	175	2	144	Customer oil temperature: signal unplausible.
1173	523973	14	779	SCR Tamper detection; derating timer below limit 1.
1174	523974	14	779	SCR Tamper detection; derating timer below limit 2.
1175	523975	14	175	Urea quality; derating timer below limit 1.
1176	523976	14	175	Urea qulaity; derating timer below limit 2.
1177	523977	14	781	Urea tank level; derating timer below limit 1.
1178	523978	14	781	Urea tank level; derating timer below limit 2.
1180	168	0	318	Physical range check high for battery voltage.
1181	168	1	318	Physical range check low for battery voltage.
1183	172	1	226	Air inlet filter sensor out of physical range check.
1193	1180	0	556	Physical range check high for exhaust gas temperature upstream turbine.
1194	1180	1	556	Physical range check low for exhaust gas temperature upstream turbine.
1219	524018	14	786	HMI engine derate service state. DPF wasn´t regenerated, power reduction phase 1 (manuell regeneration request).
1220	524022	14	786	HMI engine derate stop state. DPF wasn´t regenerated, power reduction phase 2 (manuell regeneration request).
1222	190	14	212	Camshaft- and Crankshaft speed sensor signal not available on CAN.
1223	5763	5	594	Actuator EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); open load.
1224	5763	6	594	Actuator EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); over current.
1226	5763	3	594	EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); short circuit to battery.
1227	5763	3	594	EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); short circuit to battery.
1228	5763	4	594	EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); short circuit to ground.
1229	5763	4	594	EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); short circuit to ground.
1230	5763	6	594	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); Overload by short-circuit.
1231	5763	11	594	Power stage over temperature due to high current.
1232	5763	4	594	actuator AGR valve (2.9;3.6) throttle valve (4.1;6.1;7.8); Voltage below threshold.
1239	523984	3	788	UB7; Short circuit to battery error of actuator relay 6.
1241	523986	4	176	Relais SCR-Heater, Short Circuit to Ground (High side Control side).
1242	523987	4	791	UB6; Short circuit to ground actuator relay 6.
1247	524019	11	862	Burner Control; Air Line - Blocked. Air Pump; air lines blocked.

Table 3-5. Deutz Trouble Codes (D2.9L4 Engine)

KWP-Code	SPN	FMI	Blink code	Error Identification
1248	523910	9	695	Burner Control; Air Pump - CAN Lost. Air Pump; CAN communication lost.
1249	523910	7	695	Air pump; CAN communication interrupted no purge function available.
1250	523910	12	695	Air Pump; internal error.
1252	523910	0	695	Air Pump; operating voltage error.
1254	524014	1	858	Air inlet EPV - pressure too low. Air pressure glow plug flush line; below limit.
1255	524013	7	857	Burner Control; Flame lost max. Burner operation is interrupted too often.
1257	523915	7	853	HCl dosing valve (DV1); blocked open.
1258	524016	11	859	Burner Control; HFM - Electrical Fault. HFM sensor; electrical fault.
1259	524016	2	859	Burner Control; HFM - Plausibilitätsfehler 1. Amount of air is not plausible to pump speed.
1261	523910	6	695	Burner Control Air Pump; over current. Air pump electrically overloaded.
1262	523922	7	854	Burner Control; Shut-off Valve - Blocked closed. Burner Shut Off Valve; blocked closed.
1263	524021	11	864	Burner Control; Fuel line ShutOff downstream - broken. Burner fuel line pipe leak behind Shut Off Valve.
1264	523922	7	855	Burner Shut Off Valve; blocked open.
1282	523993	9	794	
1285	524038	9	824	Timeout error of CAN-Receive-Frame ComMS_Sys1TO (error memory Slave); Master-Slave internal CAN message.
1286	524039	9	825	Timeout error of CAN-Receive-Frame ComMS_Sys2TO (error memory Slave); Master-Slave internal CAN message.
1287	524040	9	826	Timeout error of CAN-Receive-Frame ComMS_Sys3TO (error memory Slave); Master-Slave internal CAN message.
1288	524041	9	827	Timeout error of CAN-Receive-Frame ComMS_Sys4TO (error memory Slave); Master-Slave internal CAN message.
1289	524042	9	828	Timeout error of CAN-Receive-Frame ComMS_Sys5TO (error memory Slave); Master-Slave internal CAN message.
1290	524043	9	829	Timeout error of CAN-Receive-Frame ComMS_Sys6TO (error memory Slave); Master-Slave internal CAN message.
1291	524045	9	831	Master Slave, Error of message counter CAN receive message ComMSMoFOvR; ComMSMoFOvR1CNT.
1292	524046	9	832	Master-Slave CAN; Error Checksum of CAN-Receive Message.
1293	524047	9	833	Master-Slave CAN; Error of message length of CAN receive message ComMSMoFOvR;_ComMSMoFOvR1DLC.
1294	524048	9	834	Timeout error CAN message ComMSMoFOvR1TO error memory Slave.
1299	523788	0	655	Wastegate plauisibility error off CAN transmit message.
1300	523788	0	655	Timeout Error of CAN-Receive-Frame ComTrbChActr; Wastegate.
1302	524024	11	866	Deviation of the exhaust gas temperature setpoint to actual value downstream (DOC) too high.
1324	523995	13	795	Check of missing injector adjustment value programming (IMA) injector 7 (in firing order).

Table 3-5. Deutz Trouble Codes (D2.9L4 Engine)

KWP-Code	SPN	FMI	Blink code	Error Identification
1325	523996	13	796	check of missing injector adjustment value programming (IMA) injector 8 (in firing order).
1326	523997	4	797	Injector cylinder bank 1 slave; short circuit.
1327	523998	4	798	Injector cylinder bank 2 slave; short circuit.
1328	523999	12	799	Injector powerstage output Slave defect.
1329	524000	5	177	Injector 7 (in firing order); interruption of electric connection.
1330	524001	5	178	Injector 8 (in firing order); interruption of electric connection.
1333	524000	3	177	Injector 7 (in firing order); short circuit.
1334	524001	3	178	Injector 8 (in firing order); short circuit.
1337	2797	4	565	Timeout of Short-Circuit Ground Diagnosis Cyl. Bank 0; _IVDiaShCirGndToutBnk_0.
1338	2798	4	566	Timeout of Short-Circuit Ground Diagnosis Cyl. Bank 1; _IVDiaShCirGndToutBnk_1.
1339	2797	4	565	Injector diagnostic; Short circuit to ground cylinder bank 0.
1340	2798	4	566	Injector diagnostic; Short circuit to ground cylinder bank 1.
1341	524035	12	555	Injector diagnostics; time out error in the SPI communication.
1342	524036	12	555	Injector diagnostics Slave; time out error in the SPI communication.
1345	524069	9	896	Timeout Error of CAN-Receive-Frame MSMon_FidFCCTO; Master-Slave CAN communication faulty.
1357	524052	11	836	Error memory Slave reports FID MSMonFC2 (collective error).
1368	524052	11	836	Error memory Slave reports FID MSMonFC3 (collective error).
1378	523919	2	694	Sensor air pump airpressure; plausibility error.
1379	523920	2	716	Sensor exhaust gas back pressure burner; plausibility error.
1380	3253	2	692	Sensor differential pressure (DPF); plausibility error.
1381	164	2	839	Rail pressure safety function is not executed correctly ().
1389	523922	5	715	Burner Shut Off Valve; open load.
1390	523922	12	715	Burner Shut Off Valve; powerstage over temperature.
1392	523922	4	715	Burner Shut Off Valve; short circuit to ground.
1395	523921	2	714	Burner temperature sensor; Plausibility Check for burner temperature sensor. Sensor burner temperature; plausibility error.
1398	1136	0	681	Physical range check high for ECU temperature.
1402	4769	2	684	Sensor exhaust gas temperature OxiCat downstream (normal operation); plausibility error.
1403	4769	2	684	Sensor exhaust gas temperature OxiCat downstream (regeneration); plausibility error.
1411	1188	11	814	Wastegate actuator; internal error.
1412	1188	11	814	Wastegate actuator; EOL calibration not performed correctly.
1413	1188	13	814	Wastegate actuator calibration deviation too large, recalibration required.
1414	1188	2	814	Wastegate; status message from ECU missing.
1415	1188	7	814	Wastegate actuator; blocked.
1417	1188	11	814	Wastegate actuator; over temperature (> 135°C).
1418	1188	11	814	Wastegate actuator; operating voltage error.
1423	5763	0	594	Warning threshold for an internal actuator error exceeded, < 4L EGR.actuator und >4L Air Intake Flap.
1424	5763	1	594	Shut off threshold for an internal actuator error exceeded, < 4L EGR.actuator und >4L Air Intake Flap.
1425	172	0	226	air temperature within air filter box above maximum physical value.

Table 3-5. Deutz Trouble Codes (D2.9L4 Engine)

KWP-Code	SPN	FMI	Blink code	Error Identification
1431	524028	2	815	CAN message PROEGRActr; plausibility error.
1432	524029	2	815	Timeout Error of CAN-Receive-Frame ComEGRActr - exhaust gas recirculation positioner.
1436	524034	5	816	Disc Separator; open load.
1437	524034	12	816	Disc Separator; powerstage over temperature.
1438	524034	3	816	Disc separator; short circuit to battery.
1439	524034	4	816	Disc separator; short circuit to ground.
1440	524030	7	815	EGR actuator; internal error.
1441	524031	13	815	EGR actuator, calibration error.
1442	524032	2	815	EGR actuator; status message "EGRCust" is missing.
1443	524033	7	815	EGR actuator; due to overload in Save Mode.
1455	3711	12	711	Temperature during stand-still main phase too low or too high.
1458	523960	0	771	High exhaust gas temperature EGR cooler downstream; warning threshold exceeded.
1464	0	0	-	
1466	0	0	-	
1467	0	0	-	
1469	0	0	-	
1470	0	0	-	
1471	0	0	-	
1472	0	0	-	
1481	524025	5	845	DPF system; operating voltage error.
1482	524044	9	188	CAN message ComMS_Sys7 not received from slave.
1484	524068	2	895	Master ECU and Slave ECU have been identified as the same types.
1485	524052	11	836	Master ECU and Slave ECU data sets or software are not identical.
1486	523718	5	676	SCR mainrelay; open load (only CV56B).
1488	523718	3	676	SCR mainrelay; short circuit to battery (only CV56B).
1489	523718	4	676	SCR mainrelay; short circuit to ground (only CV56B).
1490	4376	5	667	SCR reverting valve; open load.
1491	4376	12	667	SCR reverting valve; over temperature.
1493	4376	4	667	SCR reverting valve; short circuit to ground.
1505	524057	2	843	Fuel low pressure pump; error pressure build up.
1523	2659	2	822	Exhaust Gas Recirculation AGS Sensor; signal not plausible.
1524	2659	0	822	Exhaust Gas Recirculation AGS Sensor; Sensed exhaust mass value above maximum physical value.
1525	2659	1	822	Exhaust Gas Recirculation AGS Sensor; Sensed exhaust mass value below minimum physical value.
1526	2659	12	822	Exhaust Gas Recirculation AGS Sensor; plausibility error, AGS sensor has not passed the burn off process.
1527	2659	2	822	Exhaust Gas Recirculation AGS Sensor; Temperature of EGR mass not plausible.
1529	524070	2	897	(Upstream NOx-Sensor) Diagnostic Fault Check for invalid upstream NOx value (Sensor self diagnostic DFC set by Deutz-SW). NOx-Sensor before SCR-Cat: Invalid upstream NOx value.
1530	524071	2	898	(Downstream NOx-Sensor) Diagnostic Fault Check for invalid downstream lambda value (Sensor self diagnostic DFC set by Deutz-SW).

Table 3-5. Deutz Trouble Codes (D2.9L4 Engine)

KWP-Code	SPN	FMI	Blink code	Error Identification
1531	524072	2	899	(Upstream NOx-Sensor) Diagnostic Fault Check for invalid upstream lambda value (Sensor self diagnostic DFC set by Deutz-SW).
1532	524073	2	245	(Downstream NOx-Sensor) Diagnostic Fault Check for invalid downstream NOx value (Sensor self diagnostic DFC set by Deutz-SW).
1533	524074	9	246	NOx sensor downstream SCR-CAT, sensor internally open load.
1534	524075	11	247	NOx sensor downstream SCR-CAT, sensor internally short circuit.
1535	524076	9	248	NOx sensor upstream SCR-CAT, sensor internally open line.
1536	524077	11	249	NOx sensor upstream SCR-CAT, sensor internally short circuit.
1537	524078	9	255	NOx sensor downstream SCR-CAT, lambda value above upper physical threshold.
1538	524079	9	256	NOx sensor downstream SCR-CAT, lambda value below lower physical threshold.
1539	524080	9	257	NOx sensor upstream SCR-CAT, lambda value above upper physical threshold.
1540	524081	9	258	NOx sensor upstream SCR-CAT, lambda value below lower physical threshold.
1541	524082	9	259	(Downstream NOx-Sensor) Diagnostic Fault Check for downstream NOx value over maximum limit (DFC set by Deutz-SW).
1542	524083	9	261	NOx-Sensor downstream SCR-CAT, NOx value below minimum value.
1543	524084	9	911	NOx-Sensor upstream SCR-CAT, NOx value above maximum value.
1544	524085	9	912	NOx sensor upstream SCR-CAT, NOx value below lower physical threshold.
1545	524149	2	968	Plausibility error between pressure downstream turbine (PTrbnDs) and ambient air pressure (EnvP).
1555	524063	5	869	SCR heater return line; open load.
1556	524063	5	869	SCR main relay not connected.
1557	524063	5	869	SCR heater pressure line; open load.
1558	524063	3	869	SCR heater main relay; short circuit to battery.
1559	524063	4	869	SCR heater main relay load side (K31) on heating valve (Y31), Short cut to ground.
1560	524063	5	869	SCR relay for suction line not connected.
1561	524063	5	869	SCR heater supply module; open load.
1562	524063	5	869	SCR heater tank; open load.
1565	524065	0	892	Pressure sensor upstream SCR-CAT, pressure above upper physical threshold.
1566	524065	1	892	Pressure sensor upstream SCR-CAT, pressure below lower physical threshold.
1569	524065	3	892	Pressure sensor upstream SCR-CAT; short circuit battery or open load.
1570	524065	4	892	Pressure sensor upstream SCR-CAT; short circuit ground.
1579	524066	3	893	SCR measurement heater output stage; short circuit battery or open load.
1581	524067	0	894	DEF supply module, heater temperature above upper physical threshold.
1582	524067	1	894	DEF supply module, heater temperature below lower physical threshold.
1585	524067	0	894	DEF supply module, temperature above upper physical threshold.
1586	524067	1	894	DEF supply module, temperature below lower physical threshold.
1593	1761	0	129	DEF tank, DEF level above upper physical threshold.
1594	1761	1	129	DEF tank, DEF level below lower physical threshold.
1597	524149	2	968	Pressure downstream turbine, plausibility error.
1598	524065	2	892	Pressure sensor upstream SCR-CAT, plausibility error.
1616	3699	2	818	Passive regeneration of DPF; plausibility error. DPF differential pressure sensor and a further sensor or actuator CRT system defective.

Table 3-5. Deutz Trouble Codes (D2.9L4 Engine)

KWP-Code	SPN	FMI	Blink code	Error Identification
1617	3699	2	818	Passive regeneration of DPF; DOC error. Temperature sensor us. and ds. DOC simultaneously defect.
1619	524087	5	884	Urea Error Lamp; open load.
1620	524087	12	884	Urea Error Lamp; temperatur over limit.
1621	524087	3	884	Urea Error Lamp; short circuit battery.
1622	524087	4	884	Urea Error Lamp; short circuit ground.
1630	524132	2	955	Fuel low pressure upstream fuel low pressure pump not plausible.
1631	524132	0	955	Fuel low pressure upstream fuel low pressure pump, pressure above maximum warning threshold.
1632	524132	0	955	Fuel low pressure upstream fuel low pressure pump, pressure above maximum shut off threshold.
1633	524132	1	955	Fuel low pressure upstream fuel low pressure pump, pressure below minimum shut off threshold.
1634	524132	1	955	Fuel low pressure upstream fuel low pressure pump, pressure below minimum warning threshold.
1635	3699	0	818	Maximum standstill time reached; oil exchange request ignored.
1639	524147	13	966	SCR System, pressure build up not possible.
1646	524063	12	869	DEF supply modul, time for defrosting too long.
1647	524063	12	869	DEF tank, time for defrosting too long.
1654	1761	14	138	Urea Tank Signal to HMI for indicating the Urea Tank-Level (Urea tank volume ratio low threshold 1).
1655	1761	14	138	DEF tank, DEF level below first warning threshold.
1656	1761	14	138	DEF tank, DEF level below second warning threshold.
1658	524096	14	196	Control of the SCR system; If the start stop counter (EPA-Counter) exceeds the threshold. SCRCtl_ctEngStrtStopThresh_C. This counter will increment only once in each driving cycle in case of an SCR error. If the counter reaches the threshold, the DFC will be set to inhibit the engine start. Engine will not be started, because of EPA-Counter.
1659	524114	9	938	Timeout error of CAN-Transmit-Frame A1DOC.
1660	524115	9	939	Timeout error of CAN-Transmit-Frame AT1S.
1661	524116	9	194	Timeout error of CAN-Transmit-Frame SCR2.
1662	524117	9	941	Timeout error of CAN-Transmit-Frame SCR3.
1663	524097	9	921	Timeout error of CAN-Transmit-Frame DPFBrnAirPmpCtl.
1664	524098	9	922	Timeout error of CAN-Transmit-Frame ComDPFBrnPT.
1665	524099	9	923	Timeout error of CAN-Transmit-Frame ComDPFC1.
1666	524100	9	924	Timeout error of CAN-Transmit-Frame ComDPFHisDat.
1667	524101	9	925	Timeout error of CAN-Transmit-Frame ComDPFTstMon.
1668	524105	9	929	Timeout error of CAN-Transmit-Frame ComEGRMsFlw.
1669	524108	9	932	Timeout error of CAN-Transmit-Frame ComEGRTVActr.
1670	524110	9	934	Timeout error of CAN-Transmit-Frame ComETVActrTO.
1671	524112	9	936	Timeout ComIntake Throttle Valve Actr.
1672	524118	9	942	Timeout error of CAN-Receive-Frame ComRxCM1.
1673	524119	9	943	Timeout error of CAN-Receive-Frame ComRxCustSCR3.
1674	524102	9	926	Timeout error of CAN-Receive-Frame ComRxDPFBrnAirPmpCtl.

Table 3-5. Deutz Trouble Codes (D2.9L4 Engine)

KWP-Code	SPN	FMI	Blink code	Error Identification
1675	524103	9	927	Timeout error of CAN-Receive-Frame ComRxDPFBrnAirPmp.
1676	524104	9	928	Timeout error of CAN-Receive-Frame ComRxDPFCtl.
1677	524106	9	195	Timeout error of CAN-Receive-Frame ComRxEGRMsFlw1.
1678	524107	9	931	Timeout error of CAN-Receive-Frame ComRxEGRMsFlw2.
1679	524109	9	933	Timeout error of CAN-Receive-Frame ComRxEGRTVActr.
1680	524111	9	935	Timeout error of CAN-Receive-Frame ComRxETVActr.
1681	524113	9	937	Timeout error of CAN-Receive-Frame ComRxITVActr.
1682	524120	9	944	Timeout error of CAN-Receive-Frame ComRxSCRHtDiag.
1683	524121	9	945	Timeout error of CAN-Receive-Frame ComRxTrbChActr.
1684	524122	9	946	Timeout error of CAN-Receive-Frame ComRxUQSens.
1685	524123	9	947	Timeout error of CAN-Receive-Frame ComSCRHtCtl.
1686	524124	9	948	Timeout error of CAN-Receive-Frame ComTxAT1IMG.
1687	524125	9	949	Timeout error of CAN-Receive-Frame ComTxTrbChActr
1698	524133	2	956	HMI system; set if restore button blocked.
1699	524134	0	957	DPF, ash load exceeds the shutoff threshold.
1700	524134	0	957	DPF, ash load exceeds the warning threshold.
1701	524135	0	958	DPF, soot load exceeds the shutoff threshold.
1702	524135	14	958	DPF, soot load exceeds the service request threshold.
1703	524135	0	958	DPF, soot load exceeds the warning threshold.
1705	524156	9	972	Timeout error of CAN-Receive-Frame ComRxEBC2.
1752	2791	7	415	EGR actuator, actuator blocked.
1753	2791	2	415	EGR actuator, CAN error.
1754	2791	13	415	EGR actuator, EOL calibration error.
1755	2791	12	415	EGR Actuator, internal electrical fault.
1756	2791	13	415	EGR actuator, learning process aborted.
1757	2791	6	415	EGR actuator current is above maximum threshold.
1758	2791	3	415	EGR actuator supply voltage is above the maximum threshold.
1759	2791	4	415	EGR actuator supply voltage is below minimum threshold.
1760	2791	13	415	EGR actuator, learning process out of range.
1761	2791	7	415	EGR actuator, broken spring detected.
1762	2791	16	415	EGR actuator, temperature high.
1763	2791	0	415	EGR actuator, temperature critical high.
1788	1188	7	814	Turbocharger wastegate, mechanical blocking detected.
1789	1188	2	814	Turbocharger wastegate, CAN Error.
1790	1188	13	814	Turbocharger wastegate, EOL calibration error.
1791	1188	12	814	Turbocharger wastegate, internal electrical error.
1792	1188	13	814	Turbocharger wastegate, learning process aborted.
1793	1188	6	814	Turbocharger wastegate, current above maximum threshold.
1794	1188	3	814	Turbocharger wastegate, supply voltage above maximum threshold.
1795	1188	4	814	Turbocharger wastegate, supply voltage below minimum threshold.
1796	1188	13	814	Turbocharger wastegate, learning process out of range.
1797	1188	7	814	Turbocharger wastegate, broken spring detected.
1799	1188	0	814	Turbocharger wastegate, temperature critical high.

Table 3-5. Deutz Trouble Codes (D2.9L4 Engine)

KWP-Code	SPN	FMI	Blink code	Error Identification
1827	524141	7	192	DEF dosing valve, dosing valve blocked.
1857	523612	12	555	Engine starter, plausibility error of starter release condition.
1858	524147	7	966	SCR-System, reverting valve blocked
1859	524175	0	993	SCR-CAT, Nox emissions above maximum threshold.
1860	524074	2	246	NOx-Sensor after SCR-Cat: Nox-Sensor dew point problem or plausibility problem.
1861	524076	2	248	NOx-Sensor before SCR-Cat: Nox-Sensor dew point problem or plausibility problem.
1863	524177	7	995	SCR System, DEF suction line blocked.
1864	524178	7	996	SCR System, DEF pressure out of range.
1865	4360	2	668	Exhaust temperature sensor upstream SCR, plausibility error.
1866	4334	2	665	DEF supply module pressure, plausibility error.
1867	524067	2	894	Supply module heater temperature, plausibility error.
1868	524067	2	894	Supply module temperature, plausibility error.
1869	1761	2	129	DEF tank level, plausibility error.
1870	3031	2	669	Urea tank temperature outside of plausible thresholds.
1874	524152	2	971	Urea Quality Sensor; Timeout CAN message.
1875	524153	2	997	Urea tank level & urea tank temperature via CAN bus, timeout of CAN message.
1880	1761	14	138	DEF tank, DEF level below third warning threshold.
1881	4768	2	683	exhaust gas temperature sensors up- and downstream DOC are physically swapped
1882	524025	14	845	The standstill-regeneration mode time exceeds the long-limit. Vehicle was too long or too often in standstill mode. Make oil change and reset counter.
1883	524025	14	845	The standstill-regeneration mode time exceeds the short-limit. Vehicle was too long or too often within a short time in standstill mode. Make oil change and reset counter.
1889	524189	9	269	Master / Slave Can disturbed.
1891	524190	14	272	Inducement level 1 activ.
1892	524191	14	273	Inducement level 2 activ.
1893	524193	8	275	The standstill-regeneration mode time exceeds the long limit threshold. Vehicle was too long or too often in standstill mode. Change oil and reset counter.
1894	524194	8	276	The standstill-regeneration mode time exceeds the short-limit. Vehicle was too long or too often within a short time in standstill mode. Change oil and reset counter.
1895	3519	12	277	DEF tank temperature, temperature too high
1896	3520	3	278	DEF quality sensor, short circuit to battery or open load
1897	3520	4	278	DEF quality sensor, short circuit to ground
1898	3519	3	277	DEF quality sensor, internal temperature sensor short circuit to battery or open load
1899	3519	4	277	DEF quality sensor, internal temperature sensor short circuit to ground.
1900	524195	14	279	Standstill request due to crystalisation ignored too long.
1901	524196	13	283	Variant handling, address error.
1902	524196	2	283	Variant handling, Synchronisation error.
1904	3520	2	278	DEF quality seonsor, bad DEF quality detected or no DEF measuring possible.
1907	3520	13	278	Urea quality at UQS invalid.
1908	3519	13	277	Temperature at UQS invalid.

Table 3-5. Deutz Trouble Codes (D2.9L4 Engine)

KWP-Code	SPN	FMI	Blink code	Error Identification
1911	3532	3	127	The DEF Level at UQS out of max. physical range.
1912	3532	4	127	Quality at UQS out of min. physical range.
1914	4365	3	669	DEF qualitysensor, tank temperatur; Short circuit to battery or open load.
1915	4365	4	669	DEF qualitysensor, tank temperatur; Short circuit to ground.
1917	3936	14	286	Standstill request ignored too long.
1918	3936	14	286	Standstill time based escalation requests Inducement step 2.
1921	51	5	594	Intake Throttle Flap, H-Bridge, wiring harness broken at connected actuator.
1922	51	6	594	Intake Throttle Flap, H-Bridge, current above maximum threshold.
1924	51	3	594	Intake Throttle Flap, H-Bridge, short circuit to battery (A02).
1925	51	3	594	Intake Throttle Flap, H-Bridge, short circuit to battery (A67).
1926	51	4	594	Intake Throttle Flap, H-Bridge, short circuit to ground (A02).
1927	51	4	594	Intake Throttle Flap, H-Bridge, short circuit to ground (A67).
1931	51	7	594	Intake Throttle Flap, H-Bridge, position of actuator not plausible (deviation from setpoint more than 7%).
1935	51	3	594	Intake Throttle Flap, H-Bridge, short circuit to battery oder broken wiring harness.
1936	51	4	594	Intake Throttle Flap, H-Bridge, short circuit to ground.
1943	524202	11	313	SCR error code in master ECU active.
1944	524203	11	313	DEF tank level failure is in master ECU active.
1945	524204	11	313	SCR afterrun failure is in master ECU active.
1946	524205	11	313	SCR Co2Off failure is in master ECU active.
1947	524206	11	313	SCR disable DEF dosing failure is in master ECU active.
1971	524230	11	315	Inducement HW Failure Slave.
1972	524231	11	315	Inducement SCR Tamp. Slave.
1973	524232	11	315	Inducement DEF Qualitity in Slave ECU.
1980	524239	11	315	SCR regeneration failure is in slave ECU active.
1989	524248	11	315	NOX sensor downstream error in slave ECU.
1990	524249	11	315	DEF dosing valve error in slave ECU.
1992	524251	11	315	DEF pressure problems in slave ECU.
1993	524252	11	315	Reverting valve error in slave ECU.
1994	524253	11	315	DEF back flow line heater error on slave ECU.
1995	524254	11	315	Error NOx-Tailpipe emissions exceeded on Slave ECU.
1996	524255	11	315	DEF suction line heater error on slave ECU.
1997	524256	11	315	DEF supply module heater error on slave ECU.
1998	524257	11	315	Error Exhaust pressure upstream SCR on Slave ECU.
1999	524258	11	315	Error Exhaust temperature upstream SCR on Slave ECU.
2000	524259	11	315	DEF pressure line heater error on slave ECU.
2001	524260	11	315	Error Urea pump temperature on Slave ECU.
2002	524261	11	315	Error DEF heater relais on Slave ECU.
2007	524266	14	287	Announcement triggers the Inducement Level 2.
2008	524267	14	845	Max. launch time for stand still exceeded (60min).
2011	4171	2	668	Dynamic temperatur check of temp before SCR.
2013	524147	13	996	Set together with DFC_SCRCoBldUpLoPres. DFC_SCRCoBldUpLoPresRst is only used for inducement purposes. It ensures that legal inducement is working correctly.

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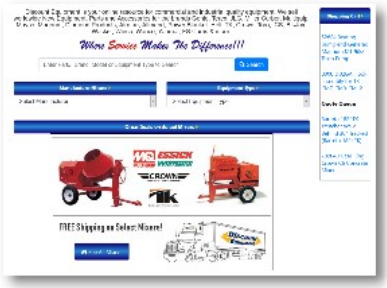

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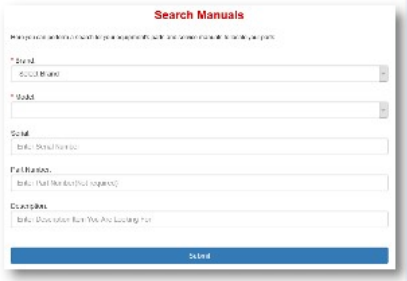

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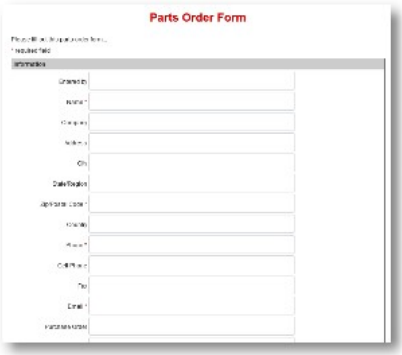

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SECTION 4. BOOM & PLATFORM

4.1 BOOM SYSTEMS

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 disabled. To continue use of the machine the controls must be re-enabled to start the timer system over again. This is done by releasing all functions, then releasing and re-depressing the footswitch.

Platform Load Sensing System (LSS) (If Equipped)

The Platform Load Sensing System consists of four load cells, mounted between the boom and platform support, and a dedicated CAN Bus harness connecting the sensor to the platform console. The operator selects the modes (restricted or un-restricted zones) he wishes to work in using a dual capacity switch on the platform control. The indicators in platform control changes to match the selection.

This system measures the weight in the platform and check if it exceeds the capacity limit according to the mode currently selected.

The LSS weight reading plays no role in determining the dual capacity control actions. But it will set correct trigger value for weight based on dual capacity switch locations. If the load in platform exceeds the trigger value, the platform overload indicator will flash, the platform alarm will sound at the standard JLG duty cycle of 5 seconds on / 2 seconds off, and all platform controls (except emergency descent) will be disabled.

The platform load sensing system is optional for ANSI Export and Japan machines at this moment.

Above Elevation (Above Horizontal) - Drive Speed Cutback System

The above elevation cutout system uses the same angle sensor mounted in the pivot end of the lift cylinder to sense when the boom is raised substantially above horizontal. The articulated jib of the 460SJ 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 sensor 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. The "safe" condition of the machine is when high engine and high speed is allowed (at low boom angles).

Transport Position Interlock System

The transport position interlock system uses the "Transport Position Sensing System" to sense when the boom is out of the transport (nearly stowed) position. The articulated jib of the 460SJ and H460SJ 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" does. 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).

Function Speed Control System

The platform controls for the platform rotation, platform leveling, jib lift, and main boom telescoping are controlled through a common infinitely variable speed control knob. This knob provides a common control signal allowing a smooth ramp up, controlled maximum output speed, and ramp down. Each function has its own personality settings allowing the characteristics of each function to be modified using the standard analyzer. Not all functions will respond the same to the changes in the function speed knob position.

Emergency Decent System

The emergency descent system allows the boom and jib to be lowered in the event of primary power (engine power) loss. This system uses electrically powered solenoid valves and the force of gravity to lower the booms and jib. The following functions are included in this system and will operate normally if the engine is not running and the "auxiliary power" switch has been activated.

- Main Lift Down
- Jib Down
- Fly boom telescope in or out
- Turn table swing

Main Boom Lift End of Stroke Damping

When the lift cylinder is activated to lower or raise the main boom, the UGM monitors the main boom angle through an angle sensor. When the boom is approaching maximum angle and is within 5° of end of stroke, the UGM will slow down the travelling speed of the cylinder to provide end of stroke damping by controlling hydraulic valve flow rate of the lift cylinder. The damping rate can be adjusted by personal settings through JLG hand analyzer.

Jib Lift End of Stroke Damping

The Jib Lift cylinder is constructed in a way that causes the Jib Lift cylinder oil flow to be restricted by an orifice while lowering the jib near the end of stroke at minimum elevation. This flow restriction reduces the speed of this function just before bottoming out the cylinder.

Machine Safety Override (MSSO) (CE Market Only)

The Machine Safety System Override allows the boom and jib to be lowered in the event that a machine safety system is preventing machine operation. This system uses an additional button found on the Ground Panel to allow all boom functions to function from the Ground Station with the engine running. When MSSO is used, an event will be logged in the JLG Control System and will require service access to clear.

Transport Position Sensing System

The transport position sensing system is consisted of a boom angle sensor (this sensor has built-in redundancy to meet safety related regulations) mounted in the pivot end of the lift cylinder, and two boom length proxy switches mounted near the pivot end of the base boom. The system uses these three sensor/switches combination to sense if the boom is in the position associated with high speed travel. The control circuit reads two redundant angular sensor signals from the boom angle sensor.

Above transport angle is recognized when one angular sensor signal from the boom angle sensor reads more than 5° greater than horizontal (with respect to the turntable), and resets to within transport position when both angular sensor signals read less than 3° greater than horizontal (with respect to the turntable).

Transport length is recognized when any one of the two length switches reads more than 24 inch extension of fly boom. During failures of either of the two length switches, the system will sense a disagreement. Then it will assume the boom is extended out past the limit. The position of the articulated jib is not considered.

This system is used to control the following systems:

- Above Elevation (Above Horizontal) - Drive Speed Cutback System
- Drive/Steer – Boom Function Interlock System
- Oscillating Axle lock up System
- Lift cylinder end of stroke electrical damping stop

The transport position sensing system uses the following components:

- Boom angle sensor
- Boom length sensors

BOOM ANGLE SENSOR

The boom angle sensor measures boom position to control drive speed and the oscillating axle. The redundant sensor reading is used as a safety redundancy in case one sensor fails.The boom angle sensor is mounted on the pivot end of the lift cylinder as shown in Figure 4-3., Transport Switches Installation.

In transport:

- The boom angle sensor reads the main boom is less than 3° below horizontal with respect to the turntable
  - **a.** Drive speed and oscillating axle are not affected

Out of transport:

- The boom angle sensor reads the main boom is more than 5° above horizontal with respect to the turntable
  - **a.** Drive speed is cut back and the oscillating axle locks

Dual capacity:

- The boom angle sensor reads more than 51° above horizontal with respect to the turntable

Boom Angle Sensor Circuit

The boom angle sensor circuit uses a redundant reading to ensure the sensor is operating properly and the machine stays within safe operating conditions. With the main boom completely lowered on the rest, activate the lift up function and the sensor will read the following:

Ground Module: Plug J7 Pin 4

- Voltage starts at 4.5 volts when the boom is on the boom rest
- As the boom is raised the voltage decreases to 0.5 volts
- As the boom is lowered the voltage increases to 4.5 volts

Ground Module: Plug J7 Pin 7

- Voltage starts at 0.5 volts when the boom is on the boom rest
- As the boom is raised the voltage increases to 4.5 volts
- As the boom is lowered the voltage decreases to 0.5 volts

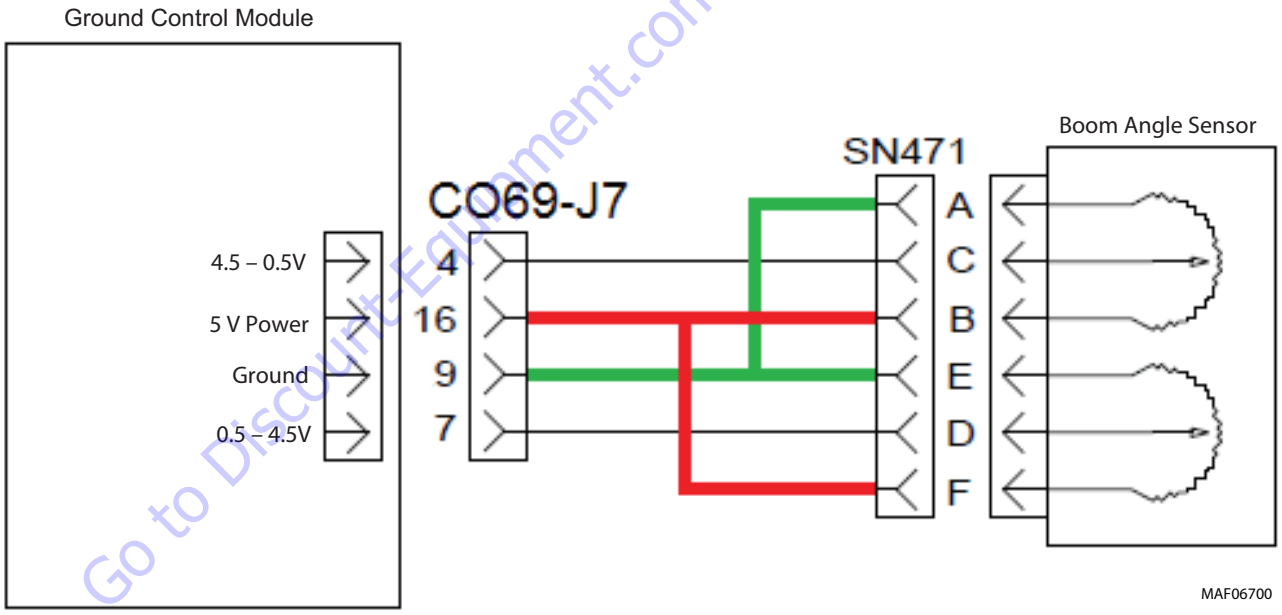


Figure 4-1. Boom Angle Sensor Circuit

BOOM LENGTH SENSORS

The boom length sensors measure boom length to control drive speed and the oscillating axle based on that measurement. The two proximity sensor system is used as a safety redundancy in case one sensor fails. The boom length sensors are mounted on the left side of the base boom, near the pivot end, as shown Figure 4-3., Transport Switches Installation.

In transport:

- Both of the two length switches reads less than 12 in (30.5 cm) of extension of the fly boom
  - **a.** Drive speed and oscillating axle are not affected

Out of transport:

- Both of the two length switches reads more than 12 in (30.5 cm) of extension of the fly boom
  - **a.** Drive speed is cut back and the oscillating axle locks

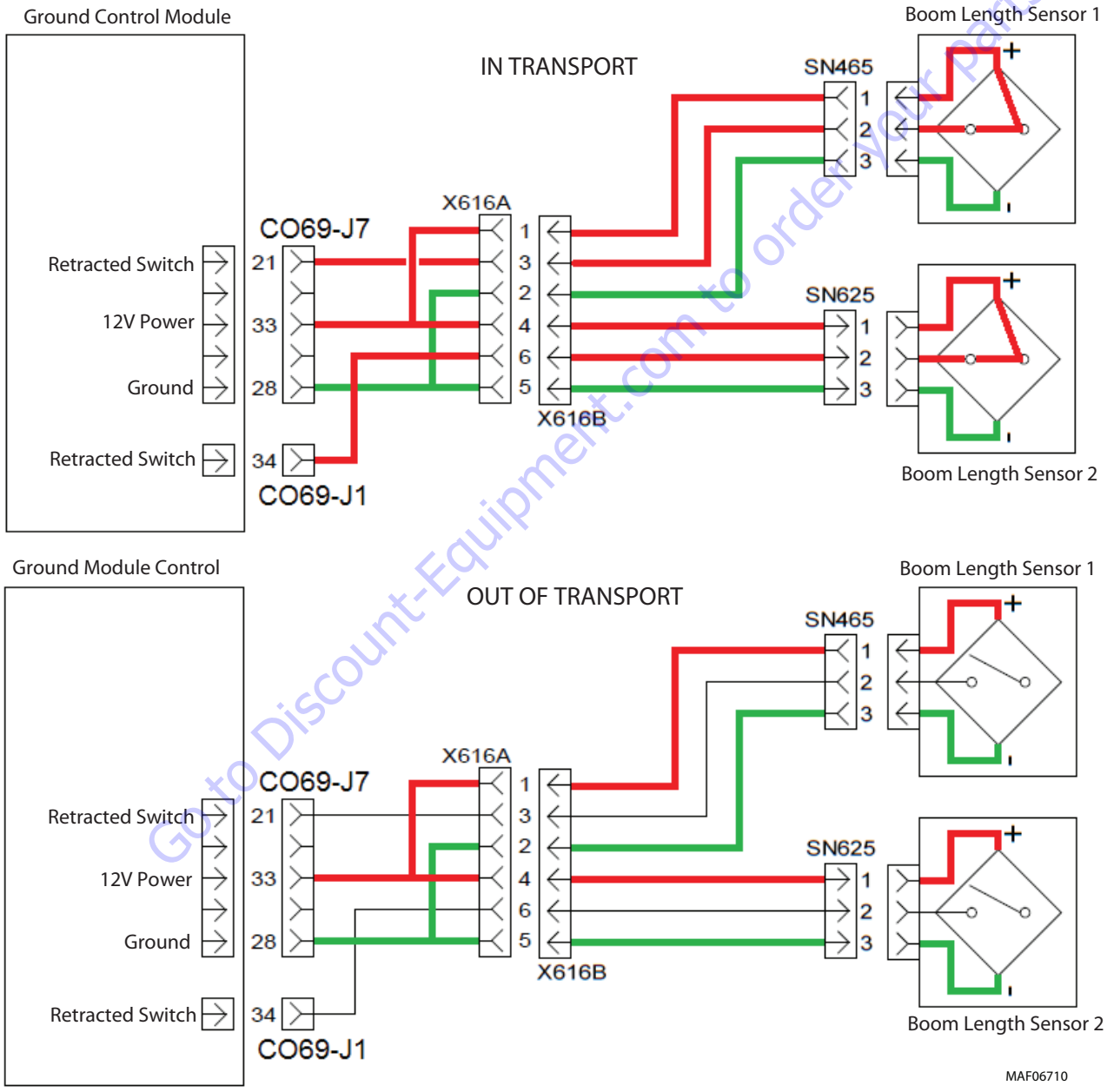


Figure 4-2. Boom Length Sensors Circuit

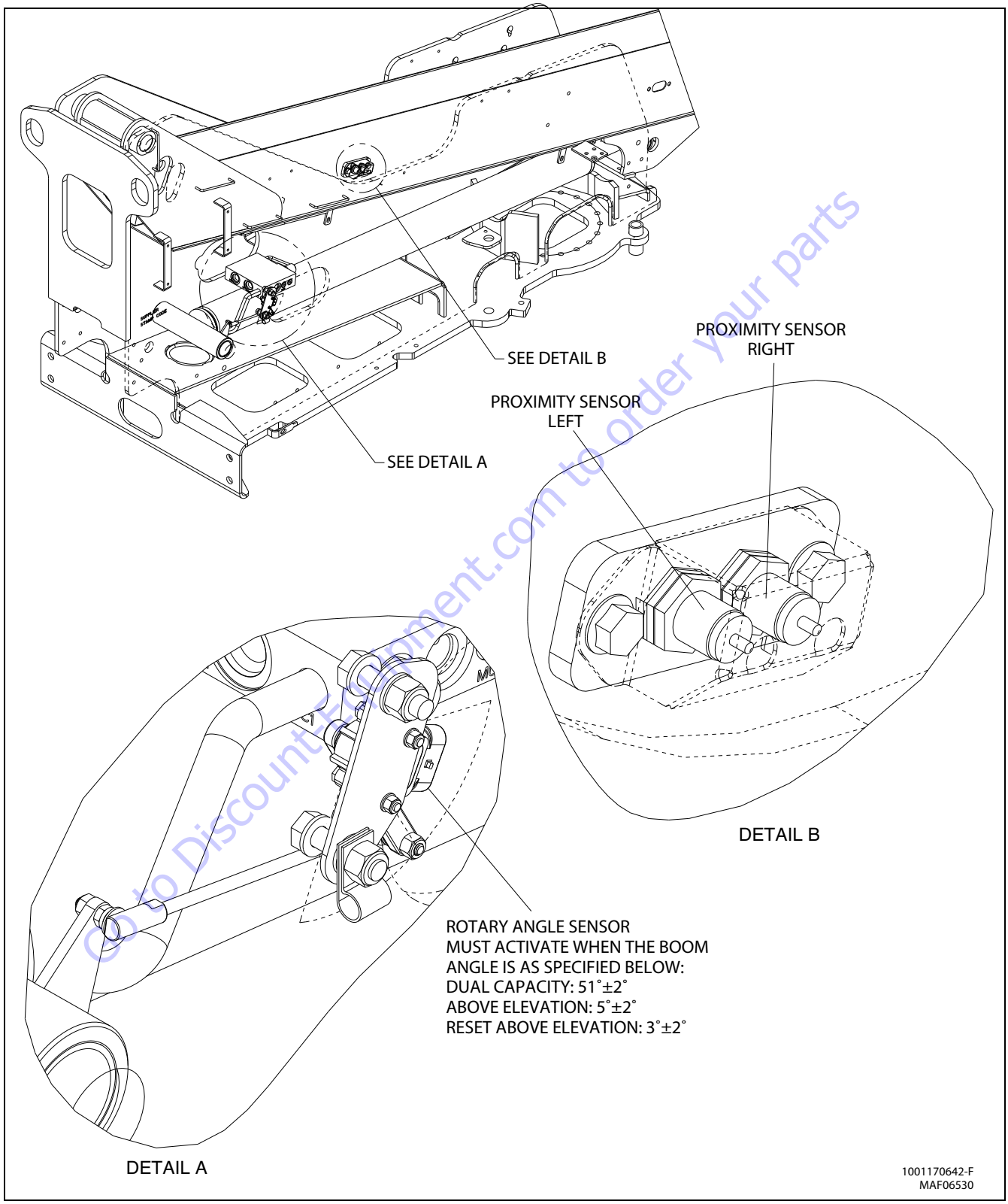


Figure 4-3. Transport Switches Installation

Dual Capacity Selection and Indicator System

The dual capacity selection and indicator system consists of a capacity mode toggle switch in platform control box, a set of fly boom position redundant proximate sensors, and a main boom angle sensor.

The operator selects the mode he wishes to work in (600 lb /270 kg or 1000 lb / 450 kg). The light indicator in the platform control box will change to match the selected mode, unless there is a system DTC that forces the machine into 1000 lb / 450 kg mode.

The system uses the boom length proximity sensors and boom angle sensor to prevent the platform from entering the unrestricted 600 lbs / 270 kg zone if the restricted 1000 lbs / 450 kg mode is selected.

When the dual capacity switch is in the 1000 lb / 450 kg restricted position, the platform will move but stop at the boundaries of the restricted zone. The platform will not be able to enter the unrestricted zone. When the machine control system senses the platform is already on the boundaries of the restricted zone, it only allows the retraction of the fly boom, or lifting up of the main boom since these movements place the platform further away from the unrestricted zone.

If the platform is already inside the restricted zone, and the dual capacity switch is flipped to 1000 lb / 450 kg position at that time, the machine will only allow the fly boom to retract, and will only allow the base boom to lift up, since these actions will bring the platform towards the restricted zone.

When the dual capacity switch is in the 600 lb / 270 kg position, the platform can go anywhere within the whole boundaries.

The above paragraph only applies to the 400SC. The 460SJC are single capacity machines (600 lb / 270 kg).

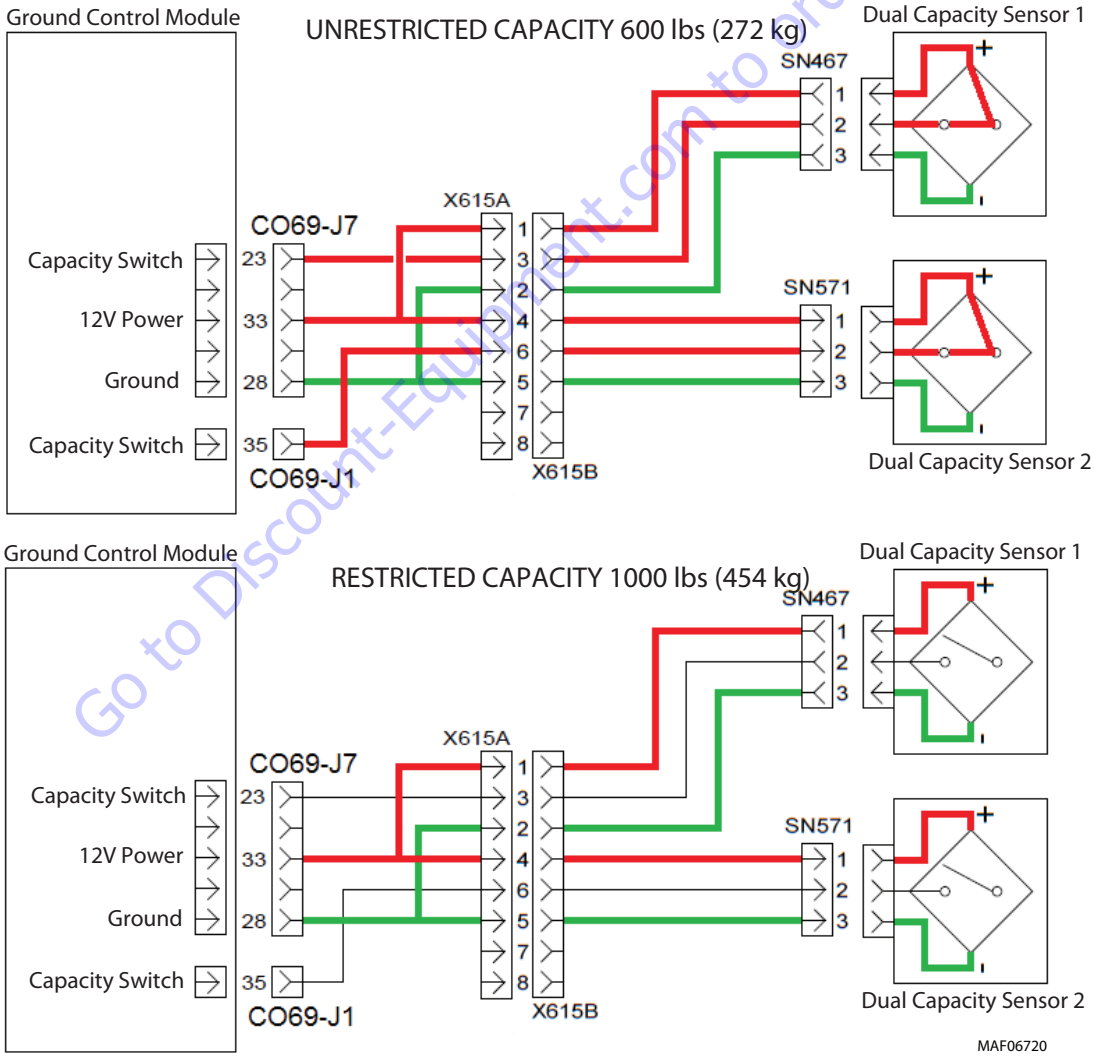


Figure 4-4. Dual Capacity Sensor Circuit

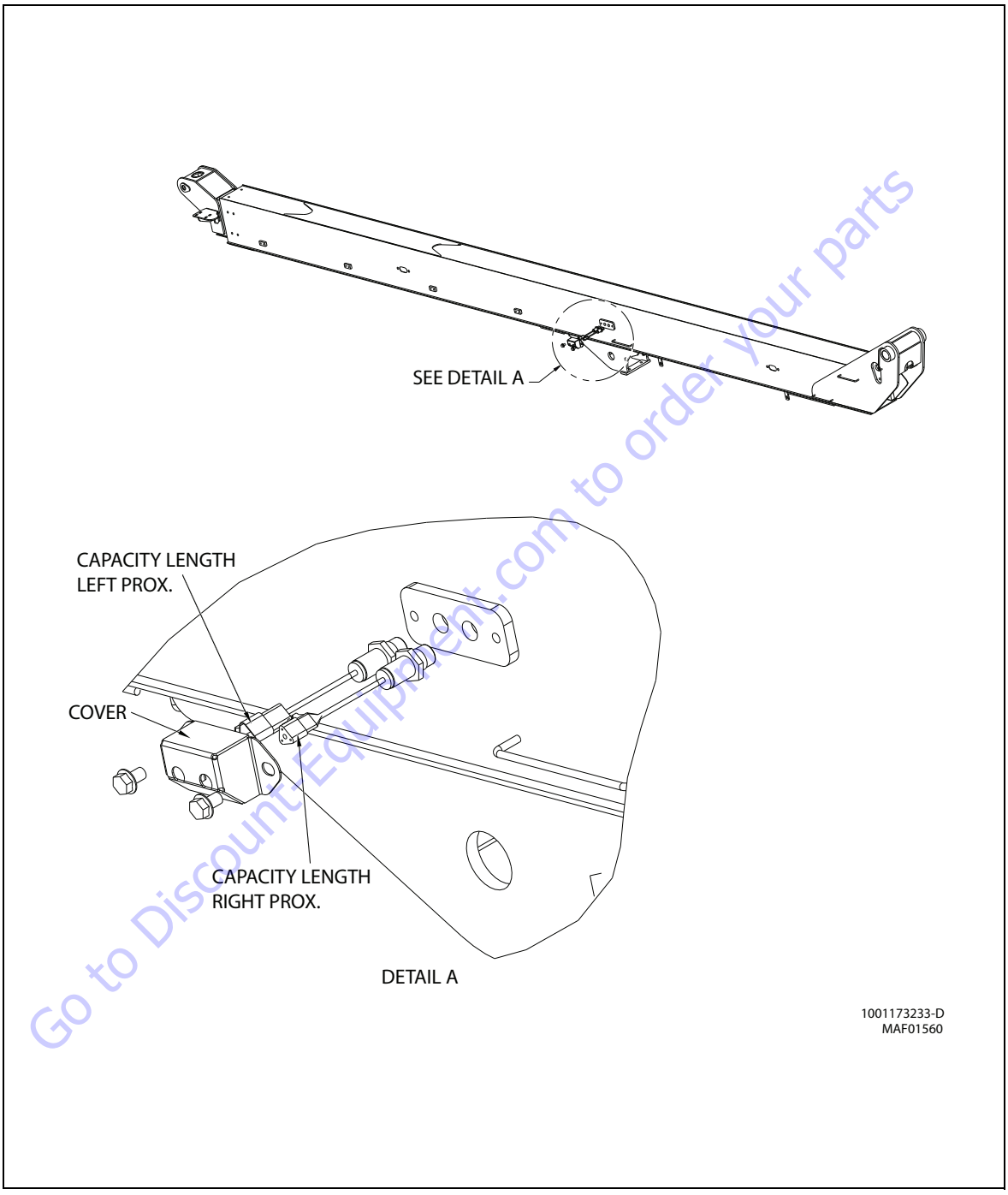


Figure 4-5. Capacity Switch Installation

4.2 PLATFORM

Platform/Support Removal

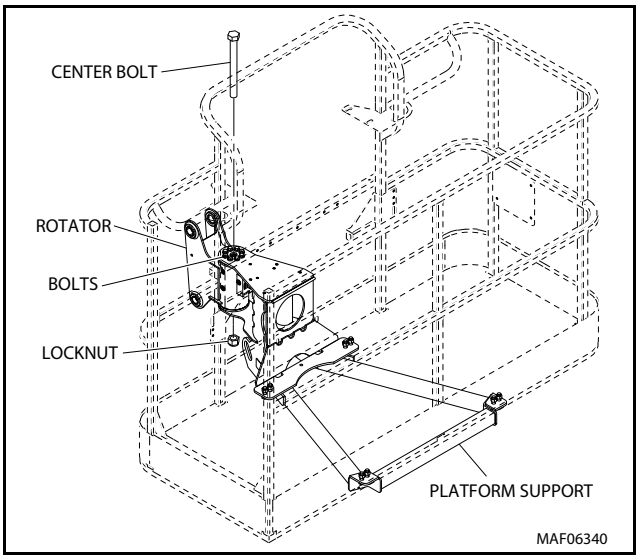
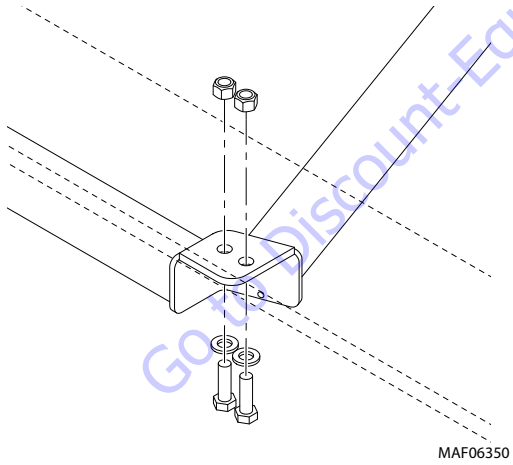


Figure 4-6. Location of Components

1. Disconnect electrical cable from control console.

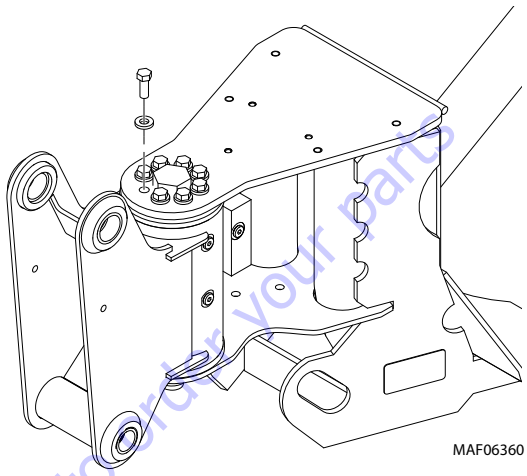
NOTE: *The platform weighs approximately 176 lbs. (80 kg).*

2. Remove the bolts securing the platform to the platform support, then remove the platform.

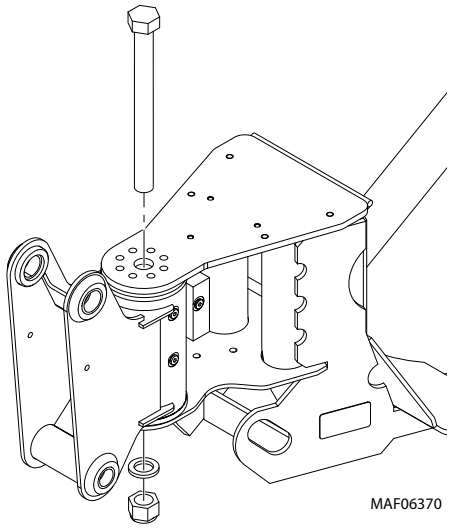


NOTE: *The platform support weighs approximately 132 lbs. (60 kg).*

3. Using a suitable device, support the platform support.
4. Remove the bolts and washers securing the support to the rotator.



5. Using a suitable brass drift and hammer, remove the center bolt and locknut.

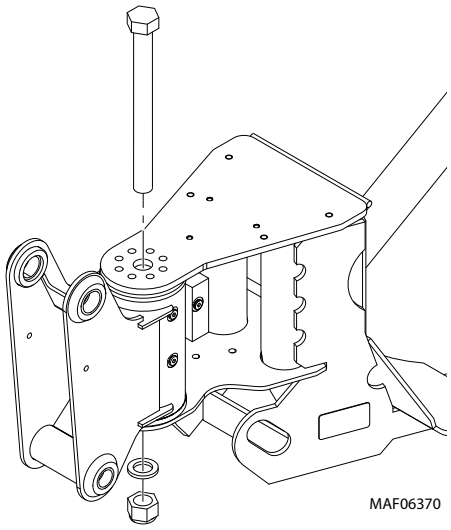


6. Remove the platform support from rotator.

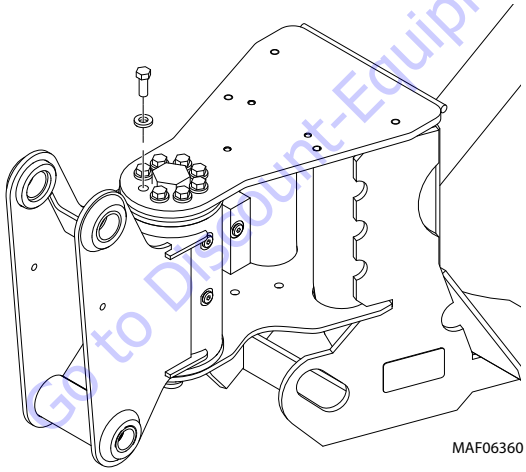
Platform/Support Installation

NOTE: *The platform support weighs approximately 132 lbs. (60 kg).*

1. Using a suitable device, support the platform support and position it on the rotator.
2. Install the rotator center bolt and locknut.


MAF06370

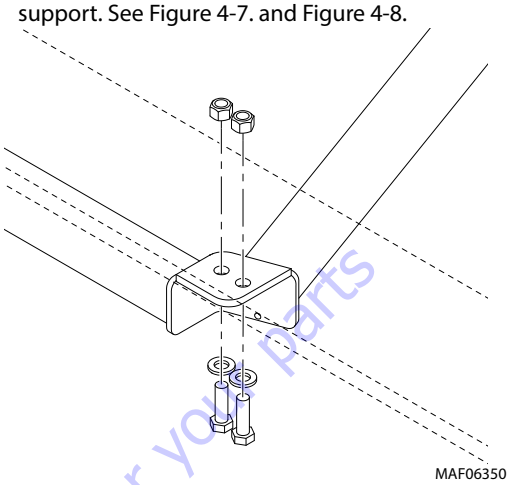
3. Apply JLG Threadlocker P/N 0100011 to the eight bolts securing the support to the rotator and install the bolts.


MAF06360

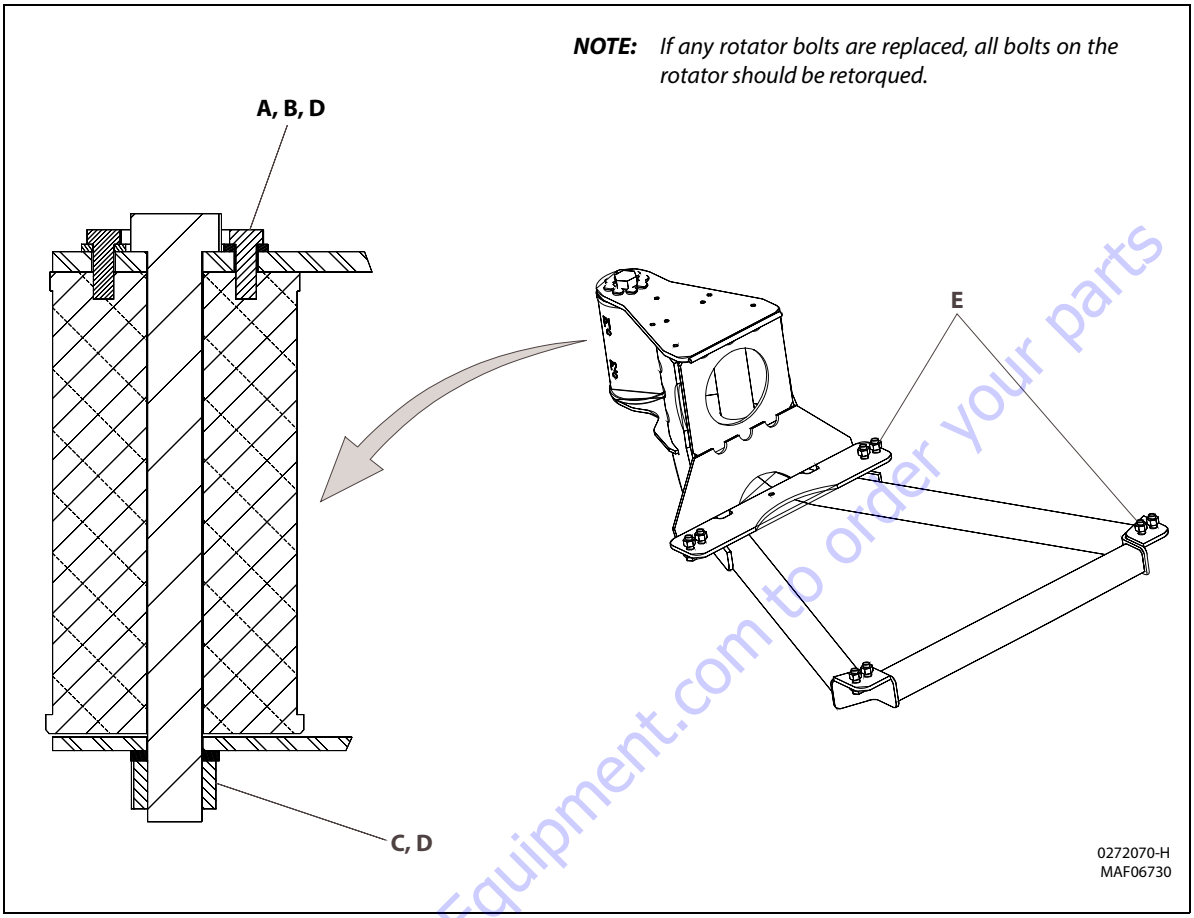
4. Torque the nut on the rotator center bolt and the retaining bolts. See Figure 4-7. and Figure 4-8.

NOTE: *The platform weighs approximately 176 lbs. (80 kg).*

5. Position the platform on the platform support and install the bolts securing the platform to the platform support. See Figure 4-7. and Figure 4-8.

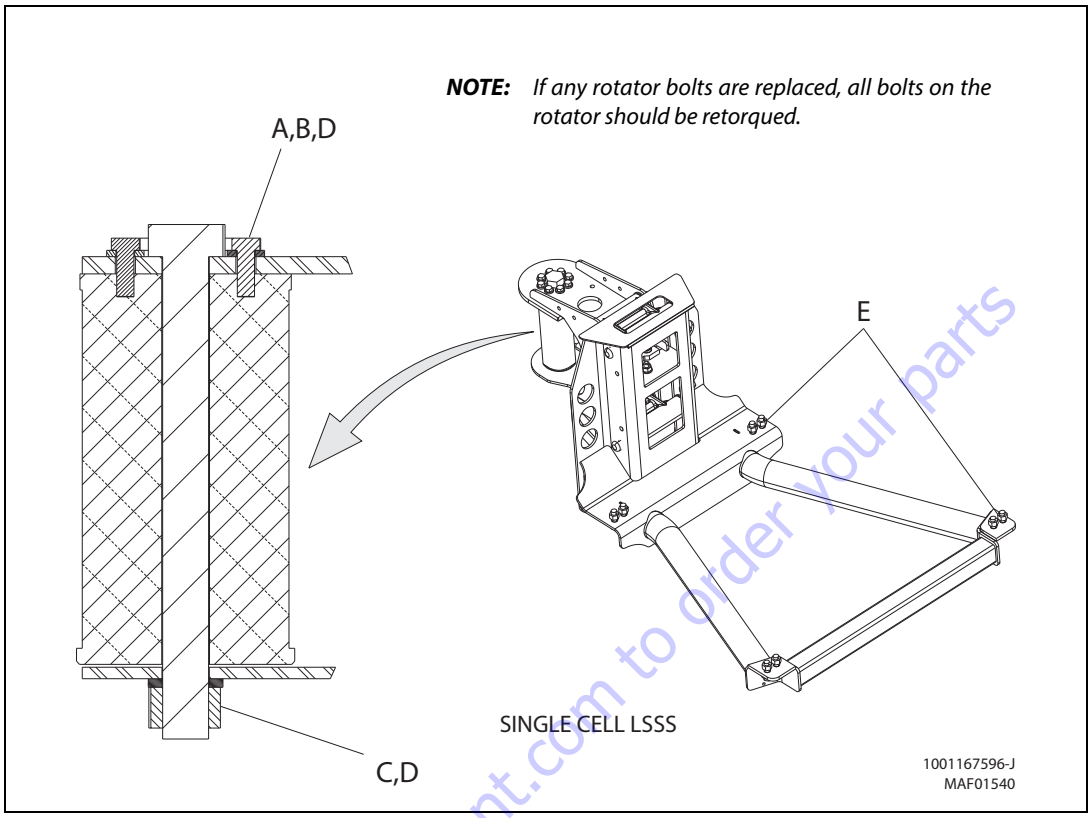

MAF06350

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



A Torque to 40 ft. lbs. (55 Nm)
B JLG Threadlocker P/N 0100011
C Torque to 586 ft. lbs. (795 Nm)
D Check torque every 150 hours of operation
E Torque to 75 ft. lbs. (102 Nm)

Figure 4-7. Platform Support Torque Values (Without LSS)



A Torque to 40 ft. lbs. (55 Nm)
B JLG Threadlocker P/N 0100011
C Torque to 586 ft. lbs. (795 Nm)
D Check torque every 150 hours of operation
E Torque to 65 ft. lbs (88 Nm)

Figure 4-8. Platform Support Torque Values (Single Cell LSS)

4.3 MAIN BOOM POWERTRACK

Removal

1. Disconnect wiring harness connectors located in turntable.

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. Remove hydraulic lines and electrical cables from powertrack.
4. Using suitable lifting equipment, adequately support powertrack weight along entire length.

NOTE: *The powertrack weighs approximately 21 lbs. (9 kg).*

5. Remove bolt #1 securing the push tube on the fly boom section.
6. With powertrack supported and using all applicable safety precautions, remove bolts #2, and #3 securing rail to the carrier tube and push tube. Remove powertrack from boom section.

Installation

1. Using suitable lifting equipment, adequately support the powertrack weight along entire length.

NOTE: *The powertrack weighs approximately 21 lbs. (9 kg).*

2. With powertrack supported and using all applicable safety precautions, align and install bolts #2 and #3 securing rail to the carrier tube and push tube.
3. Install bolts #1 securing the push tube on the fly boom section.
4. Remove tag and reconnect all hydraulic lines and electrical cable to the powertrack.

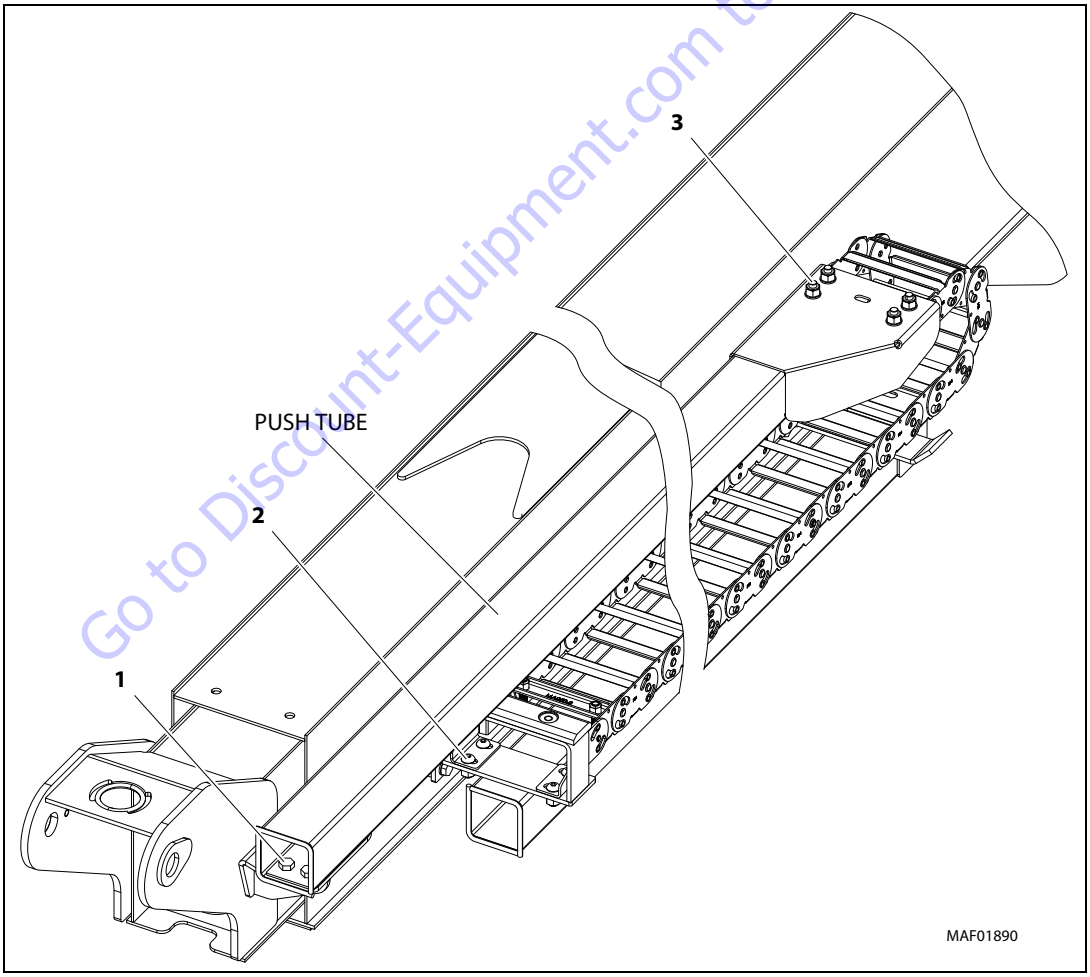


Figure 4-9. Location of Components - Main Boom Powertrack

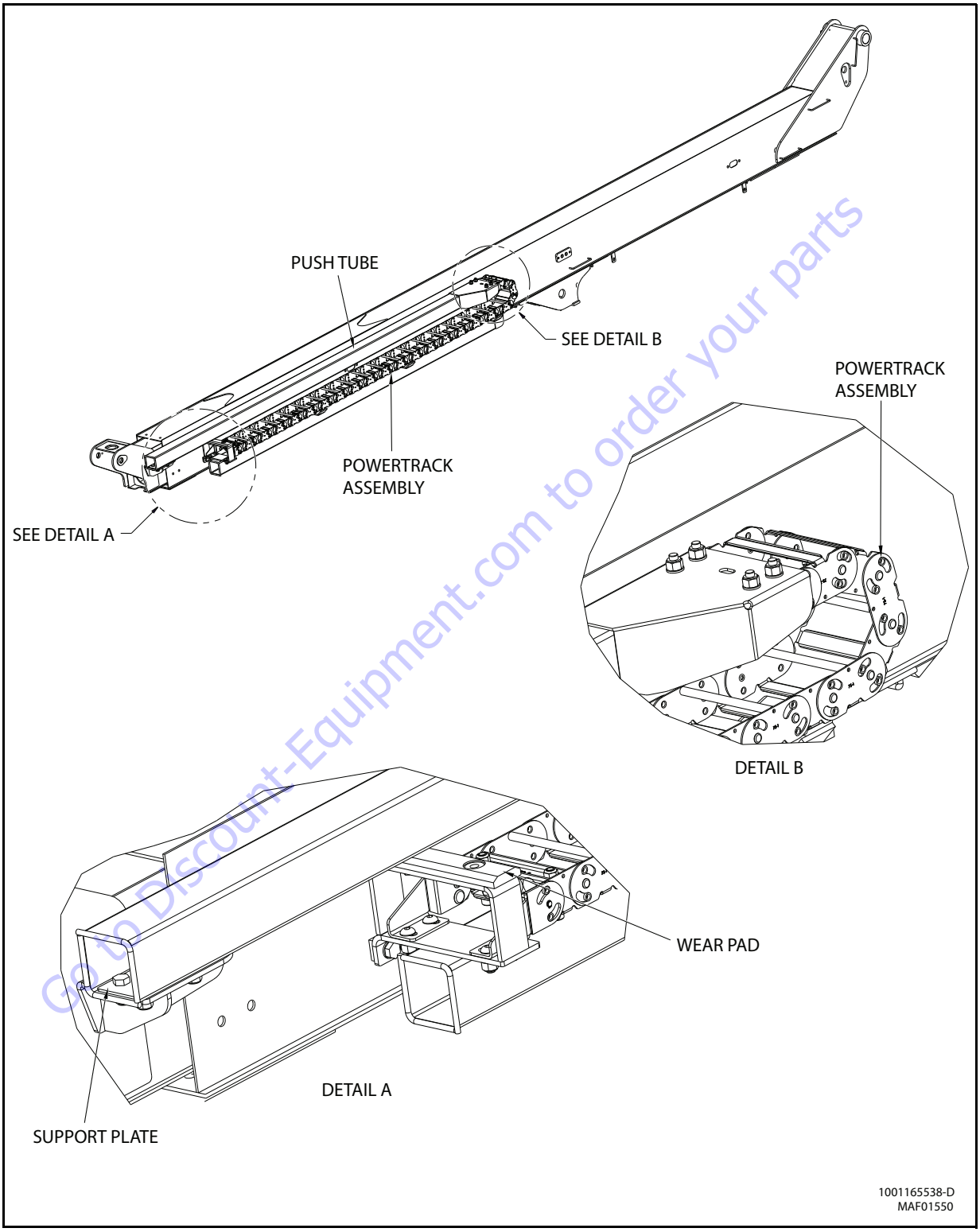


Figure 4-10. Powertrack Installation Main Boom

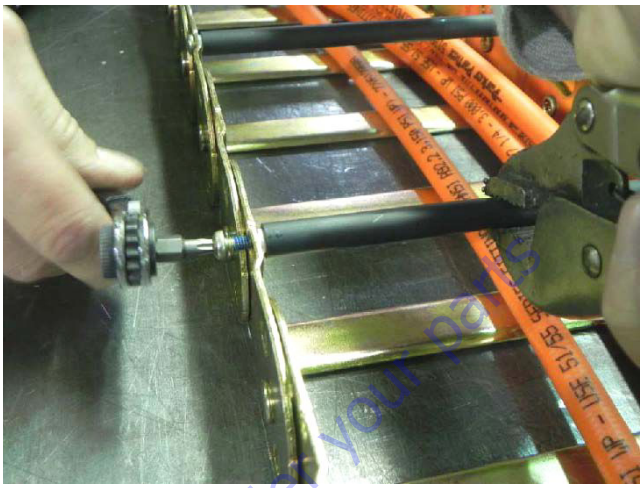
Powertrack Maintenance

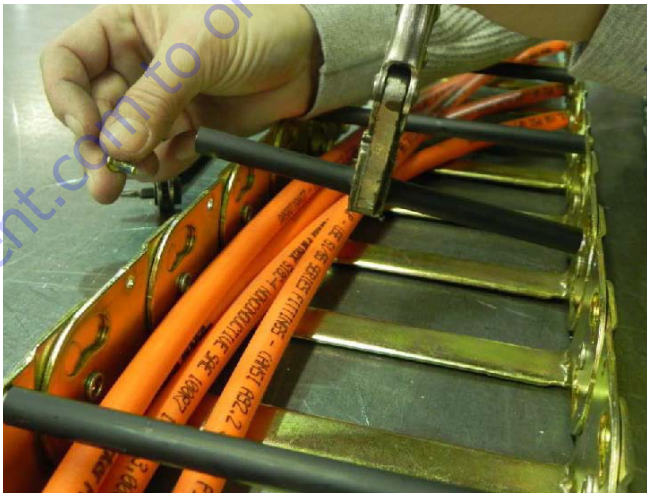
REMOVE LINK

NOTE: *Hoses shown in powertrack are for example only. Actual hose and cable arrangements are different.*

1. Clamp bar and poly roller tightly so they do not spin when removing screw. With a small 1/4 in. ratchet and a T-20 torx bit, remove 8-32 x 0.500 screw from one side.

2. Repeat step 1 and remove screw from other side of track. Remove bar/poly roller from powertrack.

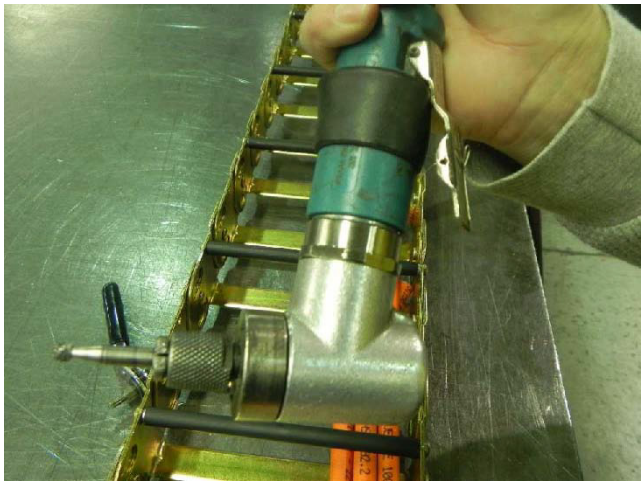




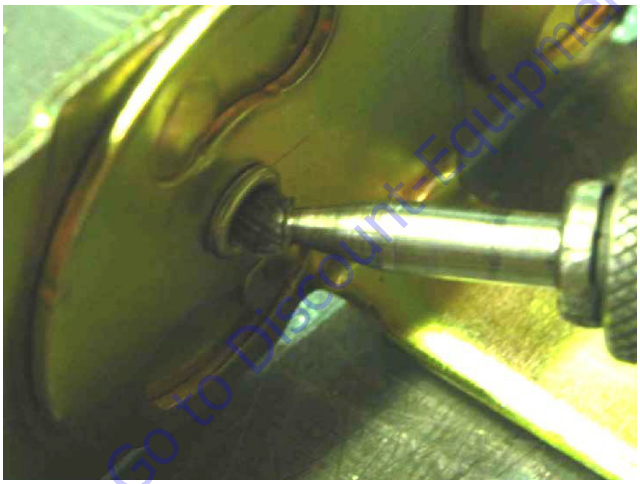
NOTICE

REPOSITION CABLES/HOSES AND KEEP COVERED DURING GRINDING TO PREVENT DAMAGE.

1. To remove a link, rivets holding links together must be removed. Use a right-angle pneumatic die grinder with a 1/4 in. ball double cut bur attachment.

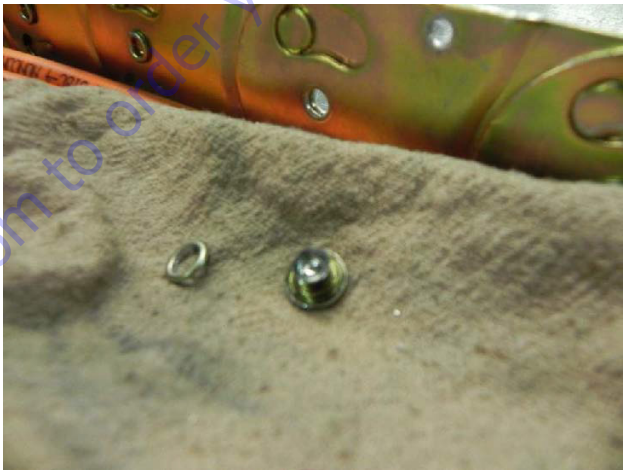


2. Insert tool into rolled over end of rivet. Grind out middle of rivet until rolled over part of rivet falls off. Repeat for all rivets to be removed.

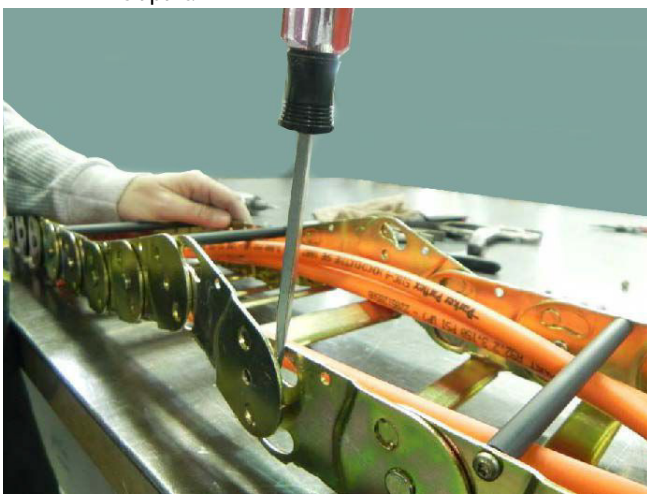


3. After grinding it may be necessary to use a center punch with a hammer to remove rivet.

NOTE: *It may be necessary to loosen fixed end brackets from machine to move track section enough to disconnect links.*



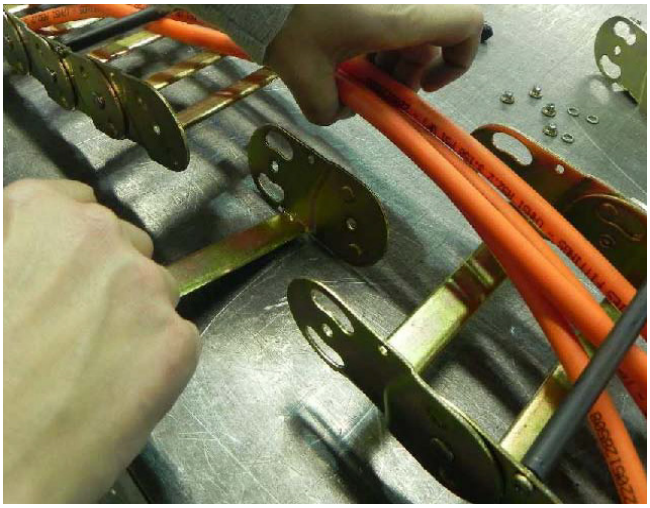
4. Insert flat head screwdriver between links. Twist and pull links apart.



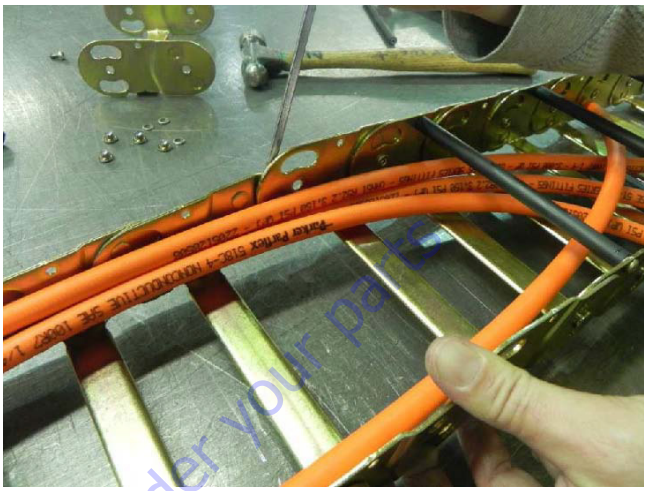
5. Remove link from other section of powertrack using screwdriver.

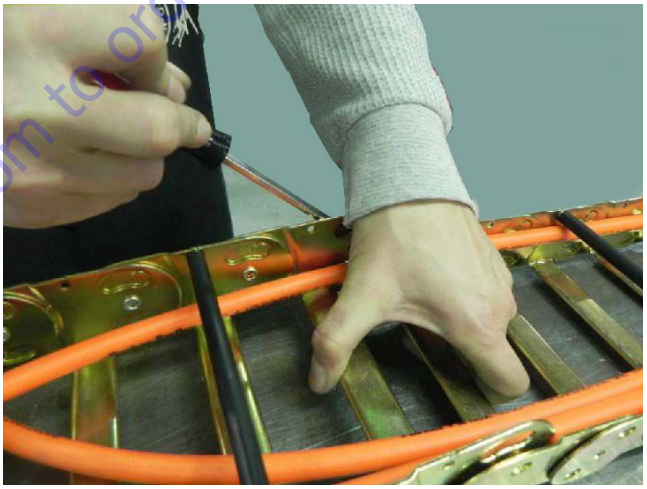
INSTALL NEW LINK

1. Squeeze cut-out end of new link into half-shear (female) end of track section.

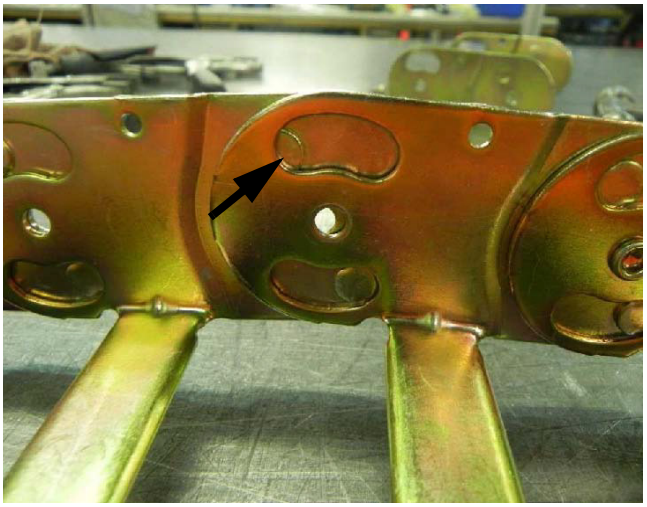


2. Spread half-shear (female) end of new link and slide cut-out end of track section into it. Use a screwdriver if necessary.

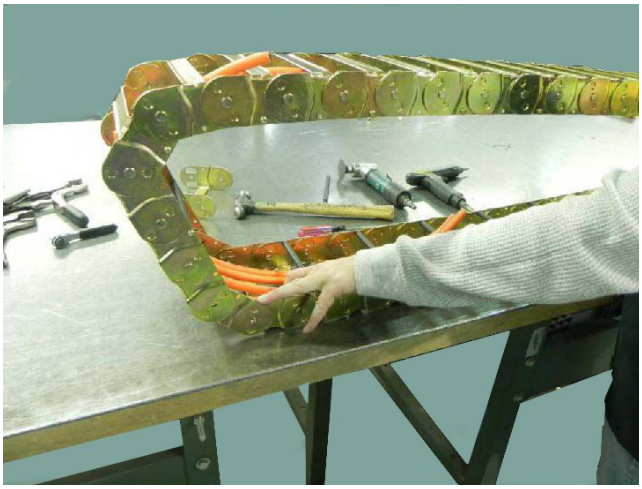


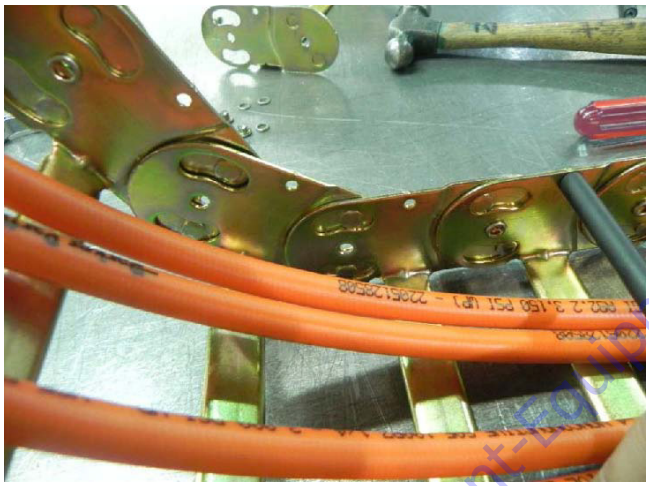


3. After new link is installed round half-shears do not fit properly in cut-outs.

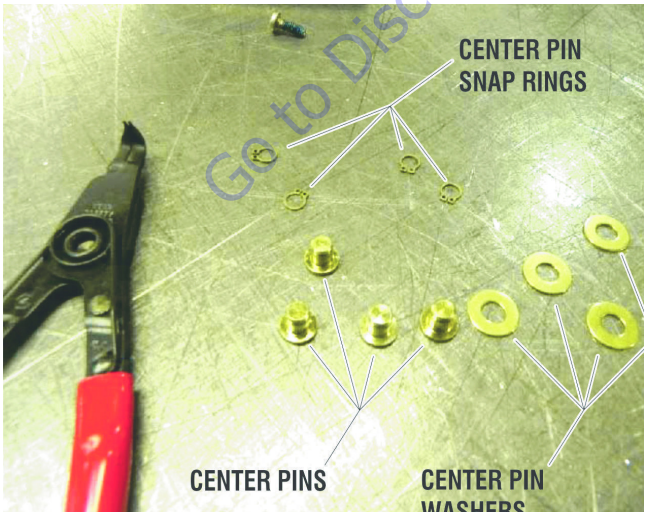


4. Pull moving end over track so new connection is positioned in curve of powertrack. Round half-shears will rotate into cut-outs.



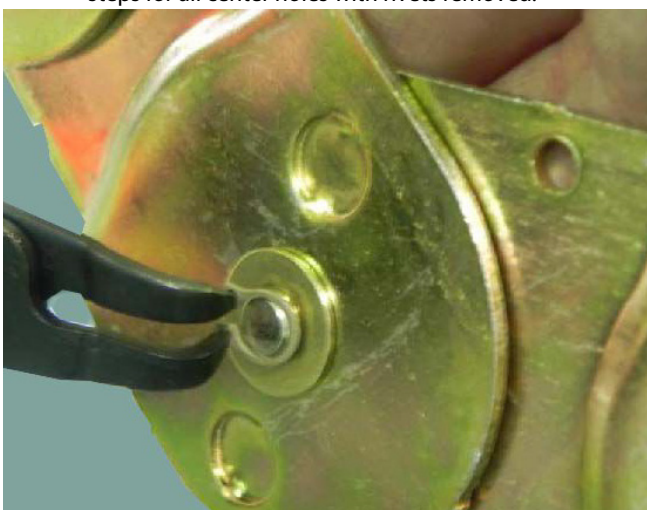


5. Parts shown below connect new link to powertrack.

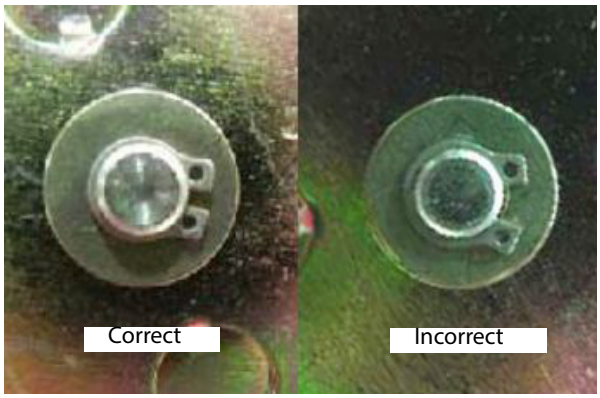


6. Push pin through center hole then slide washer on pin.

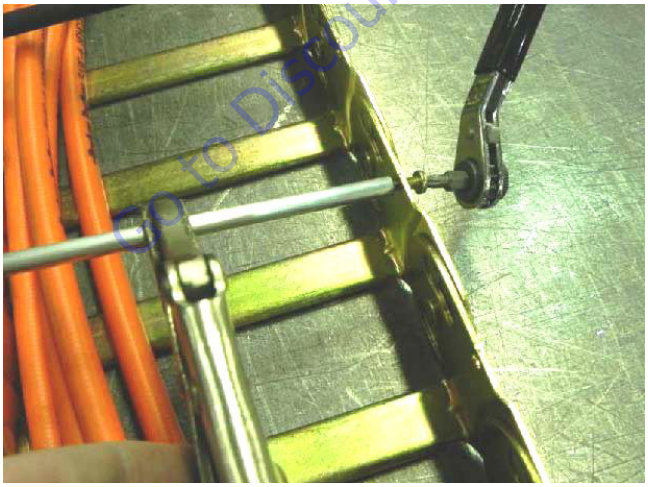
7. Install snap ring in groove on pin. Repeat pin installation steps for all center holes with rivets removed.



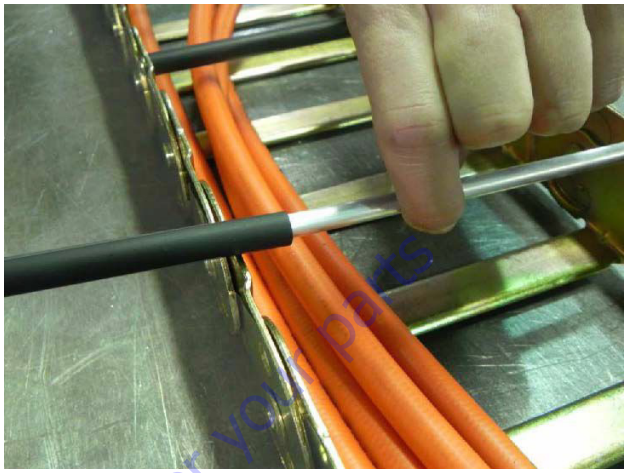
NOTE: *Make sure snap rings are seated in pin groove and closed properly.*



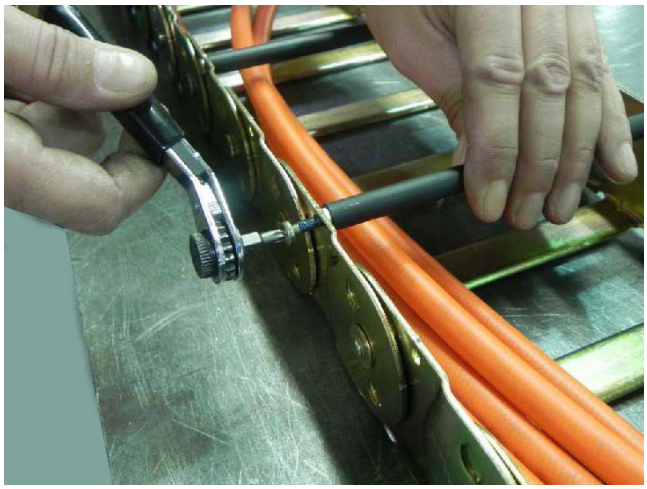
1. Install new 8-32 x 0.500 self-threading torx head screw in end of new aluminum round bar. Torque to 18-20 in. lbs. (2-2.25 Nm).



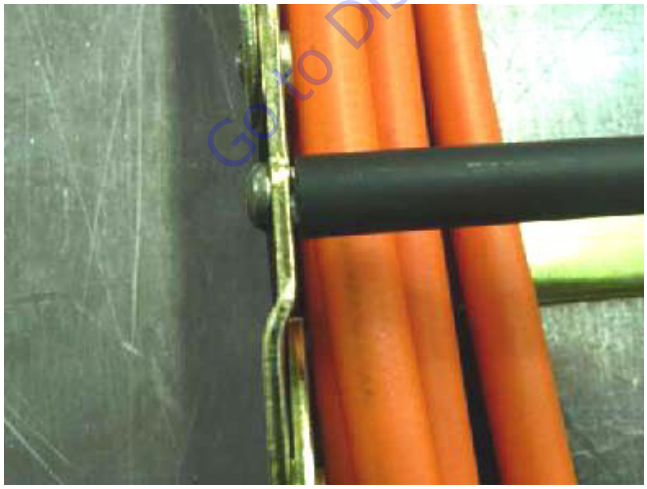
2. Pull up on other end of round bar and slide new poly roller on bar.



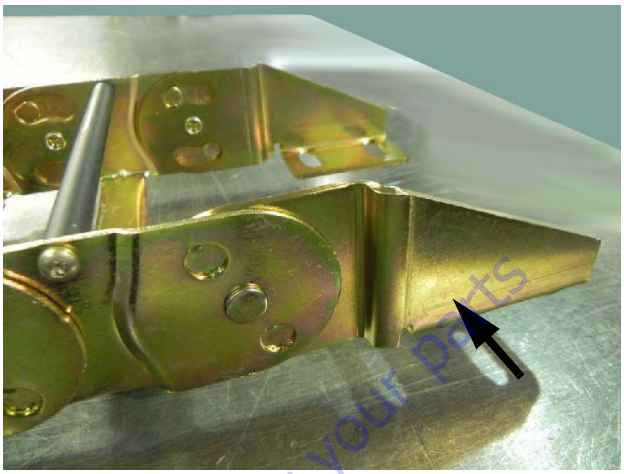
3. Install new 8-32 x 0.500 self threading screw on other side. Torque to 18-20 in. lbs. (2-2.25 Nm).



NOTE: *When tightening screws make sure screw head is seated against link with no space in between link and underside of screw head.*



REPLACE FIXED END BRACKETS



NOTICE

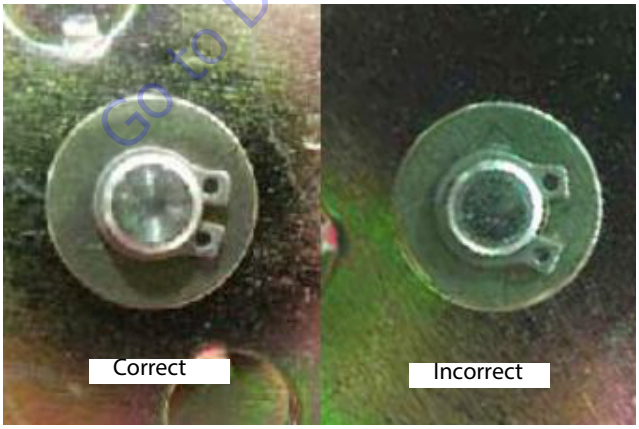
REPOSITION CABLES/HOSES AND KEEP COVERED DURING GRINDING TO PREVENT DAMAGE.

1. Remove rivets as shown in link removal instructions on page 15.

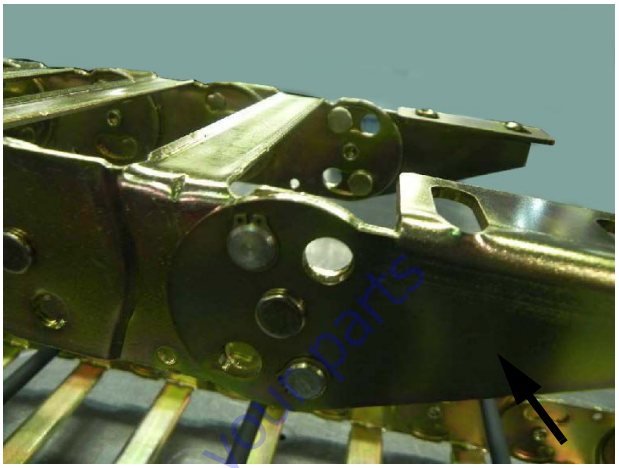
2. Parts used: Bracket Center Pin and Center Pin Snap Ring.

3. Take new bracket and install bracket center pin and snap ring. Repeat on other bracket if replacing it.

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



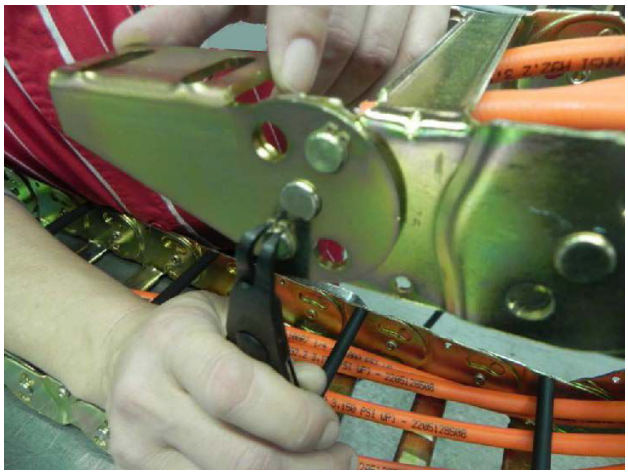
REPLACE MOVING END BRACKETS



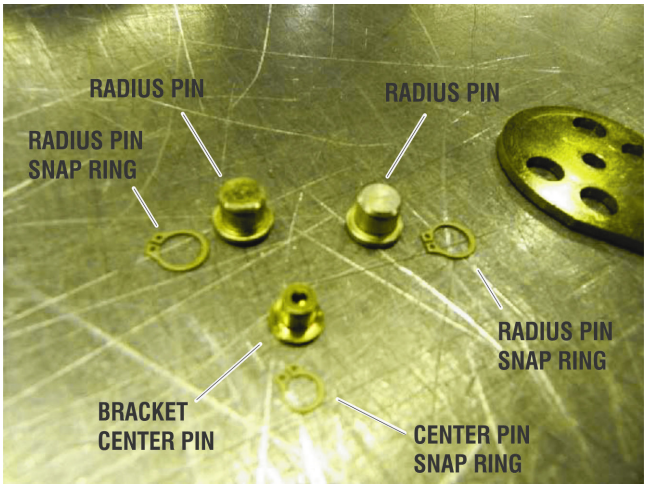
NOTICE

REPOSITION CABLES/HOSES AND KEEP COVERED DURING GRINDING TO PREVENT DAMAGE.

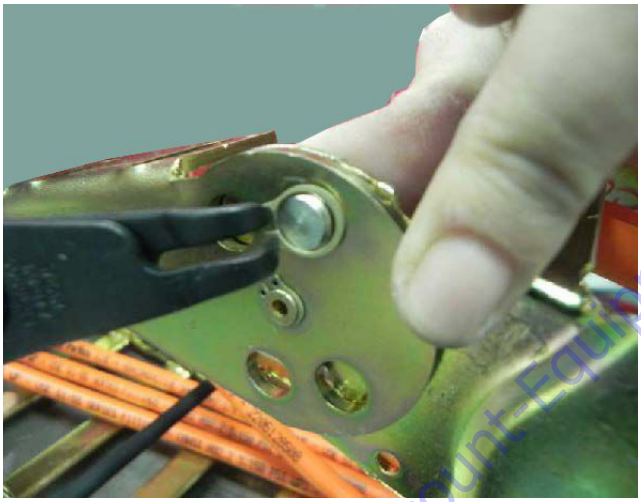
1. Remove existing pins and center rivet. Remove rivet as shown in link removal instructions on page 15. Repeat on other bracket if replacing it.



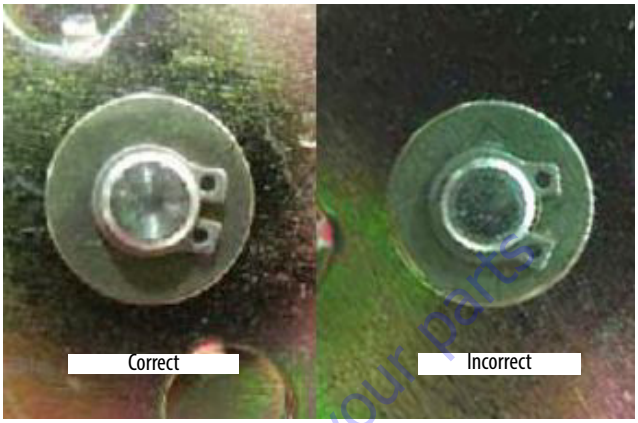
2. Install center pin with snap ring in new bracket.



3. Install radius pins and snap rings in original locations. Repeat with other moving end if replacing it.



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



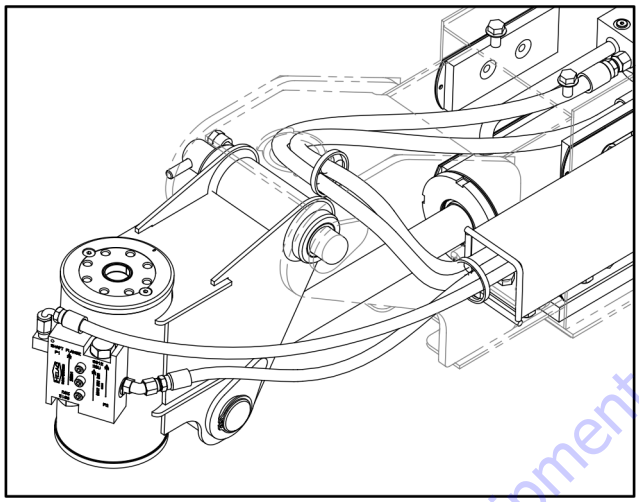
4. Make sure both brackets rotate correctly.

4.4 BOOM MAINTENANCE

Removal - 400SC

Remove platform, platform support, and rotator as an assembly as follows:

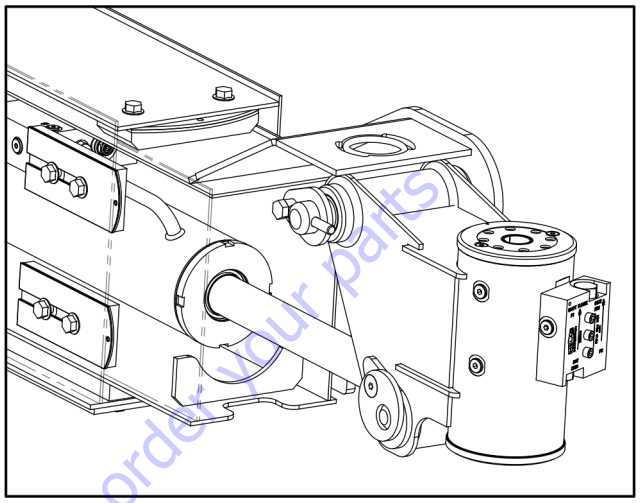
1. Disconnect electrical cable from platform control console.
2. Using an overhead crane or suitable lifting device, use nylon support straps to support the assembly.
3. Tag and disconnect hydraulic hoses running to the rotator and slave cylinder.



NOTE: *The platform, support, and rotator assembly will weigh approximately 150 to 170 kg (330 to 375 lb) depending upon platform configuration. These values DO NOT reflect any optional equipment attached to the platform.*

NOTE: *When removing retaining pin from rod end of the level cylinder, make sure cylinder is properly supported.*

4. Remove the hardware securing pin attaching level cylinder to rotator. Using a suitable brass drift and hammer, remove retaining pin from the rotator and level cylinder
5. Remove bolts and keeper pins that secure retaining pins attaching platform support to the boom. Using a suitable brass drift and hammer, remove retaining pins from the platform support and boom nose.



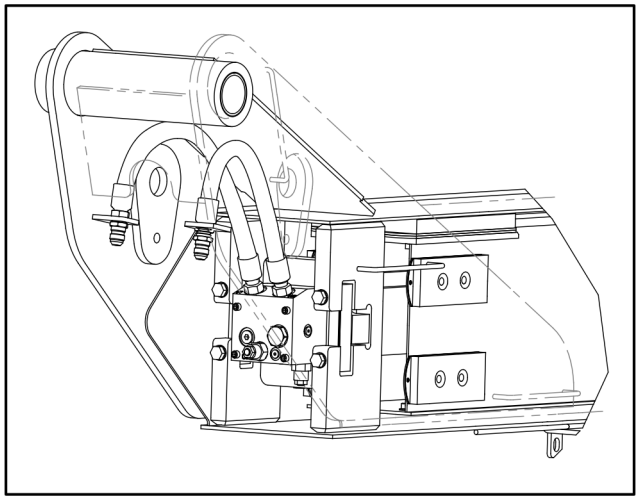
Remove boom from turntable as follows:

1. Disconnect wiring harness from ground control harness connector.

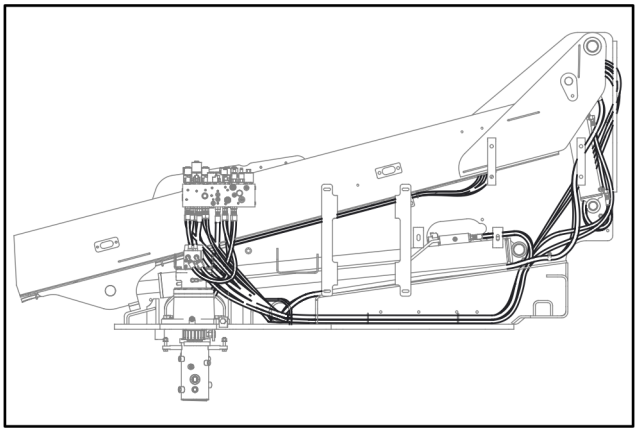
⚠ CAUTION

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 a suitable container to catch escaping hydraulic fluid. Cap all hydraulic lines and ports.



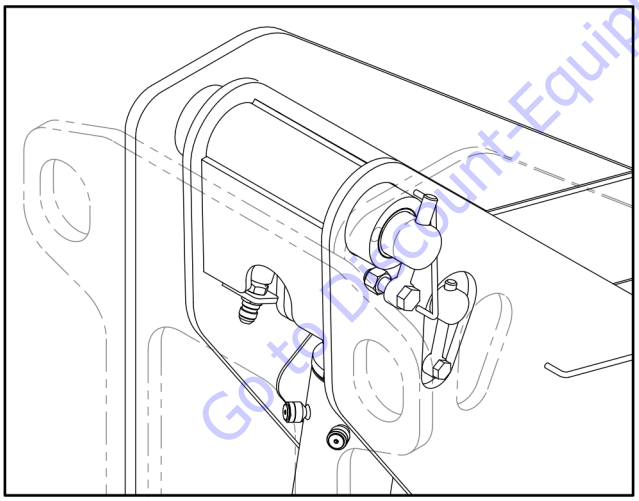
3. Tag and disconnect hydraulic lines from boom to the main control valve. Use a suitable container to catch escaping hydraulic fluid. Cap all hydraulic lines and ports.



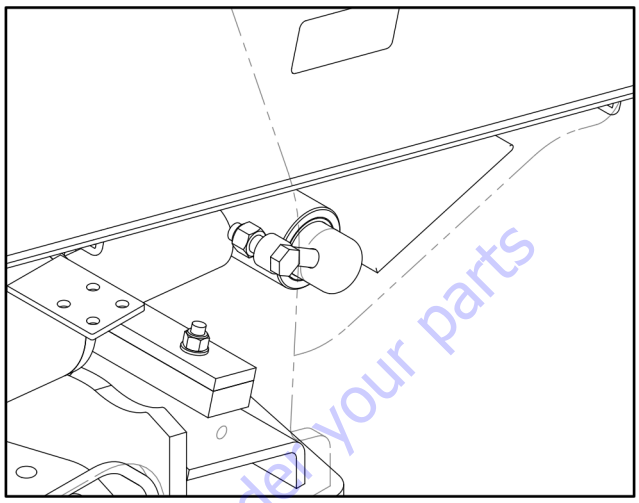
NOTE: *Boom weighs approximately 695 kg (1525 lb). This weight does not include platform or rotator.*

4. Using a suitable lifting device, adequately support boom weight along entire length.

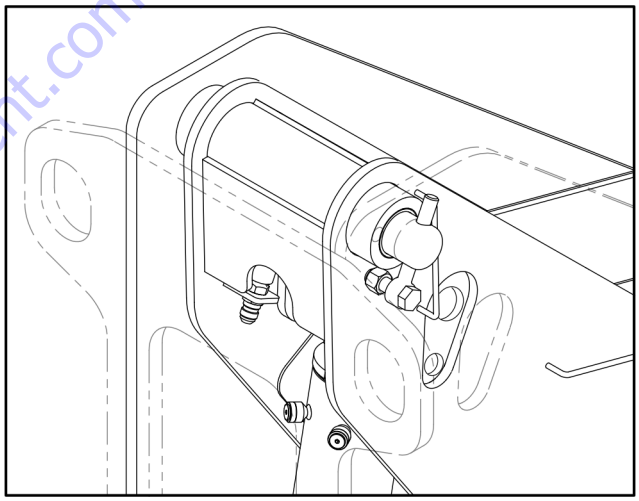
5. Tag and disconnect hydraulic hoses from boom master cylinder. Cap or plug all openings. Remove bolts and keeper pins securing upper master cylinder pivot pin. Remove pivot pin.



6. Ensure lift cylinder is adequately supported. Remove bolts and keeper pins securing lift cylinder pivot pin. Using a suitable brass drift and hammer, remove pivot pin from boom.



7. Remove hardware securing boom pivot pin. Using a suitable brass drift and hammer, remove pin from turntable.



8. Carefully lift boom assembly clear of turntable and lower to ground or suitable supported work surface.

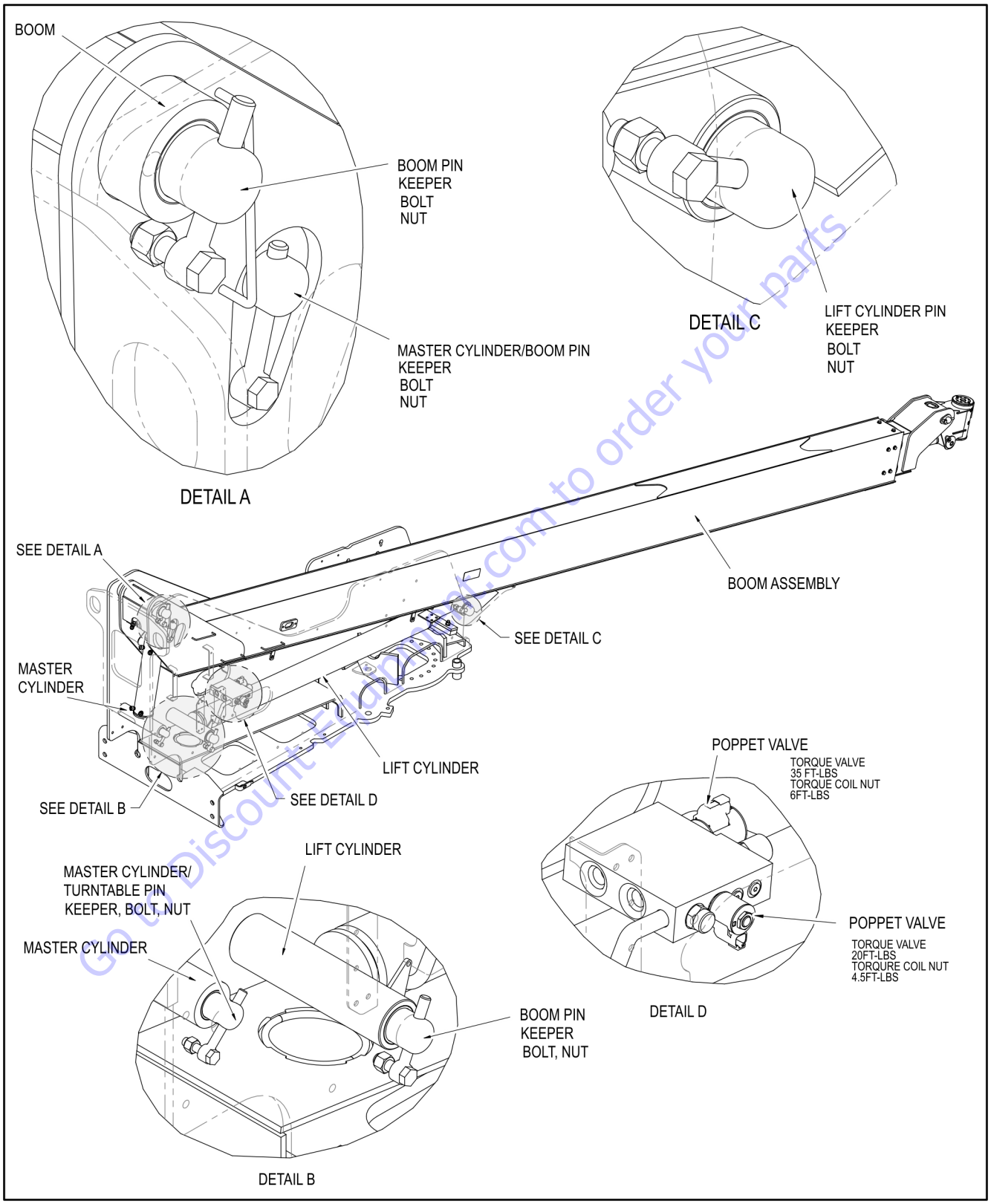


Figure 4-11. Boom Installation - 400SC

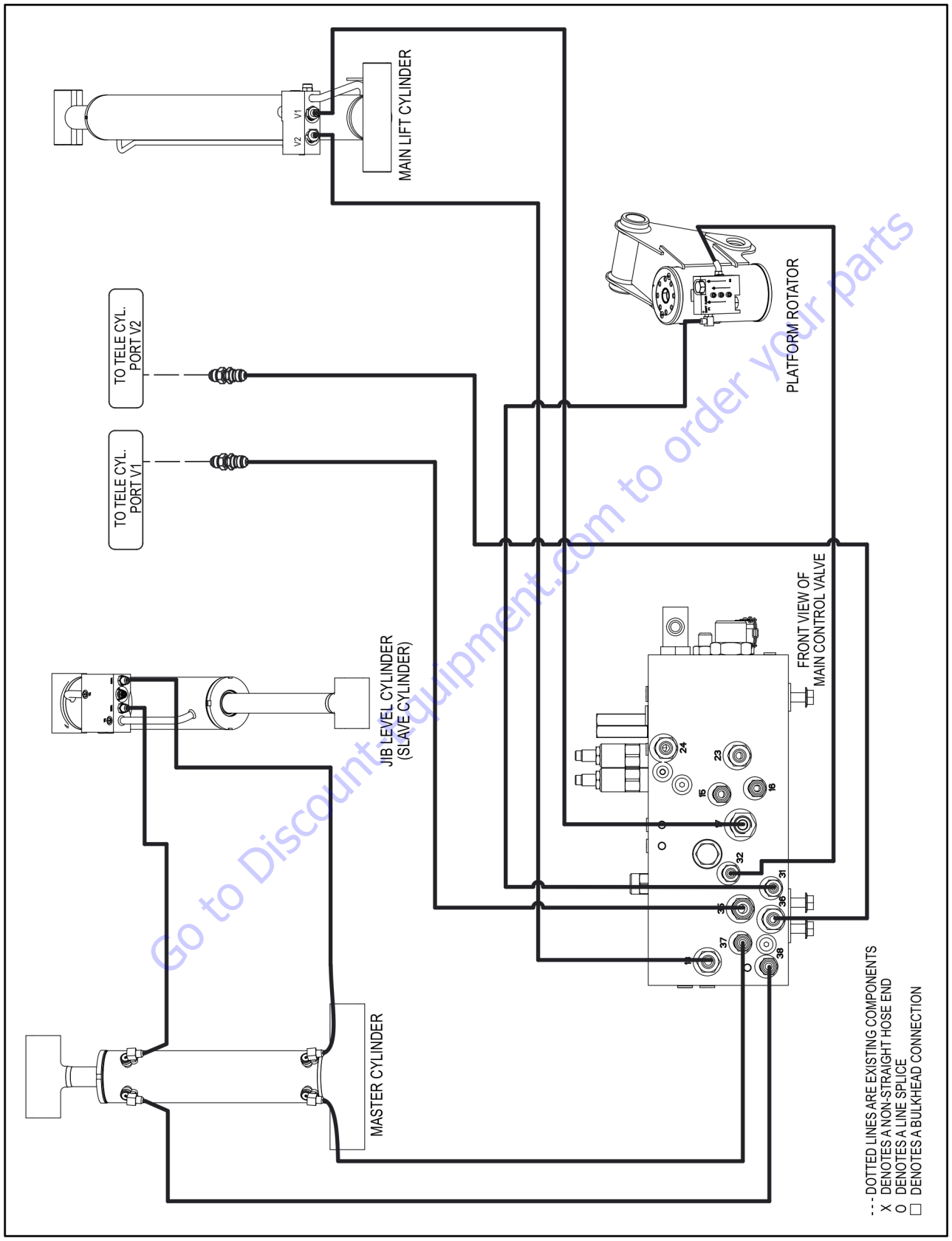


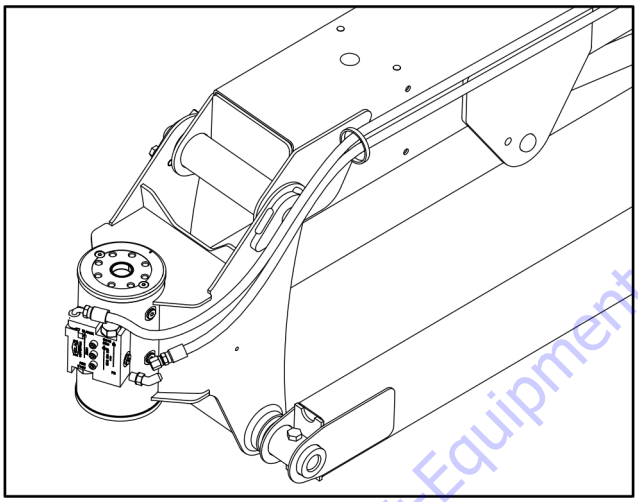
Figure 4-12. Boom Hydraulic System - 400SC

Removal - 460SJC

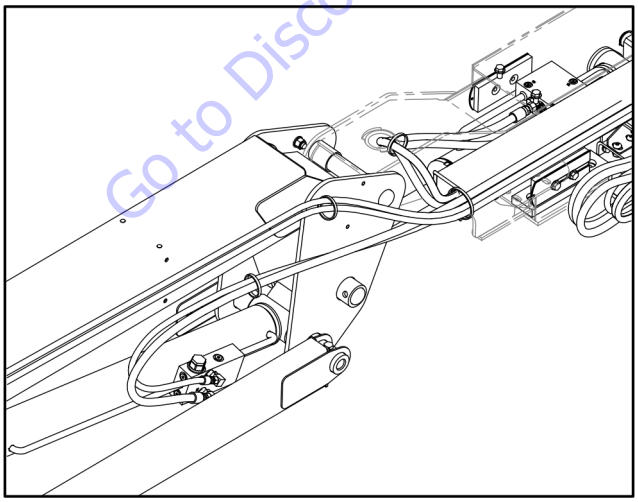
Remove the platform, platform support, rotator and jib as an assembly as follows:

NOTE: *The platform, support, rotator and jib assembly will weigh approximately 650 to 700 lbs. (300 to 320 kg) depending upon platform configuration. These values DO NOT reflect any optional equipment attached to the platform.*

1. Disconnect electrical cables from the platform control console.
2. Using an overhead crane or suitable lifting device, use nylon support straps to support the assembly.
3. Tag and disconnect hydraulic hoses running to the rotator.

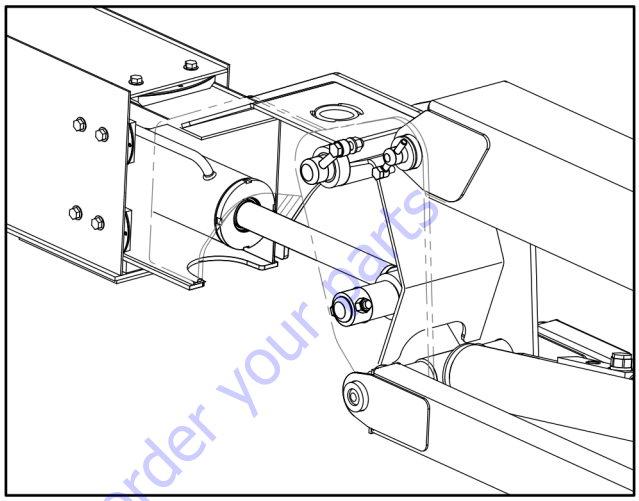


4. Tag and disconnect the hydraulic hoses running to the jib lift cylinder and level cylinder.

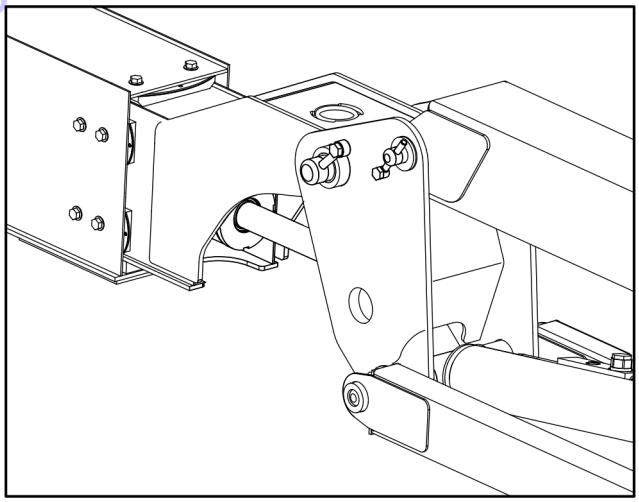


NOTE: *When removing retaining pin from rod end of the level cylinder, make sure cylinder is properly supported.*

5. Remove bolts and keeper pins that secure the retaining pins attaching the slave level cylinder to the jib. Using a suitable brass drift and hammer, remove the retaining pin form the jib.



6. Remove bolts and keeper pins that secure the retaining pin attaching the jib pivot pin to the boom. Using a suitable brass drift and hammer, remove the retaining pin from the jib and boom nose.



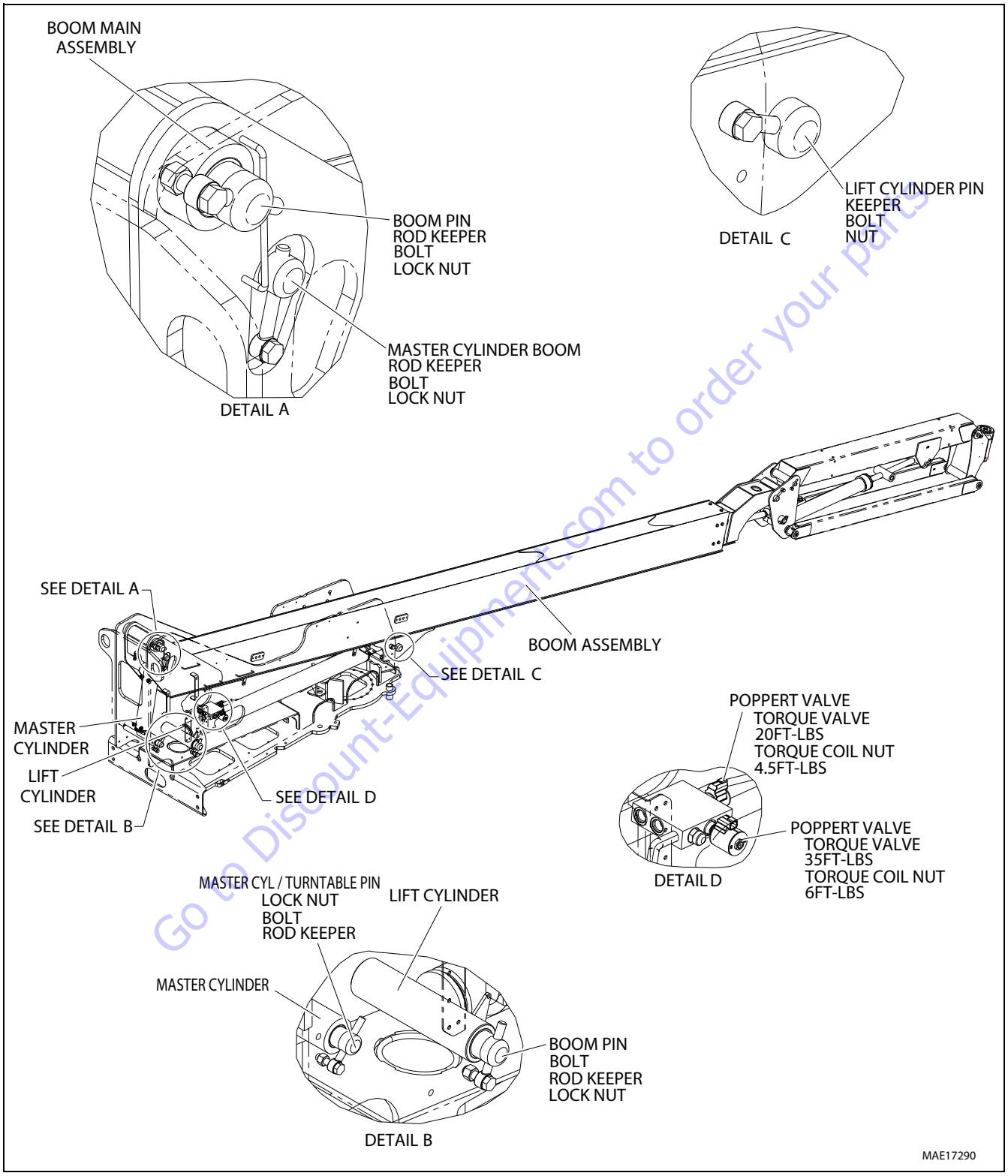


Figure 4-13. Boom Installation - 460SJC

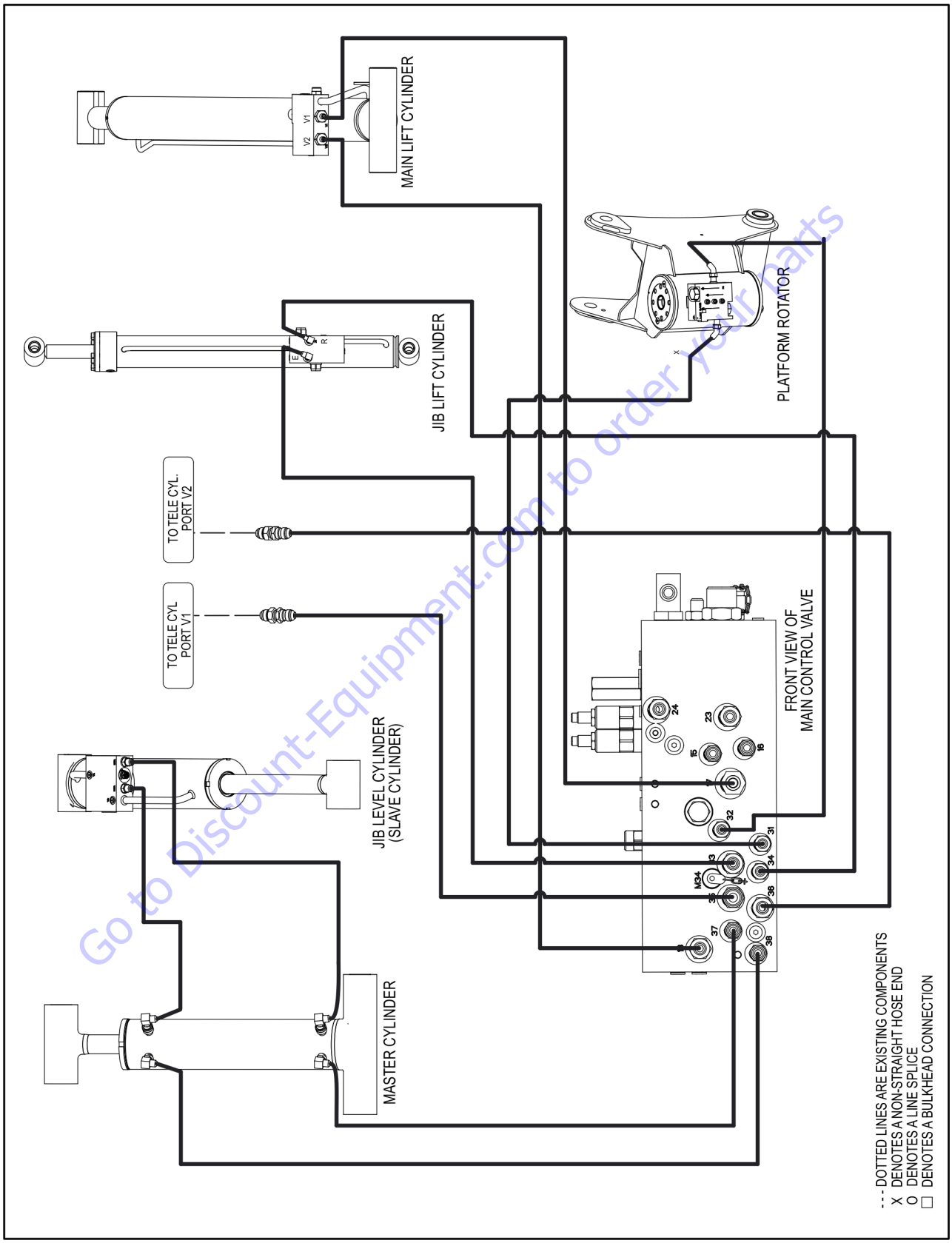


Figure 4-14. Boom Hydraulic System - 460SJC

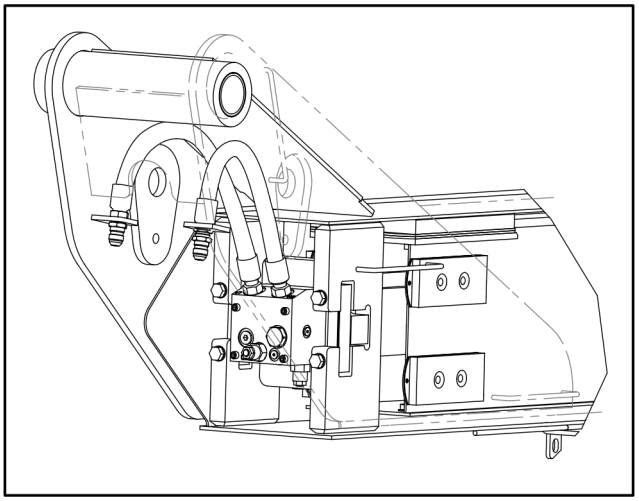
Remove boom from turntable as follows:

1. Disconnect wiring harness from ground control harness connector.

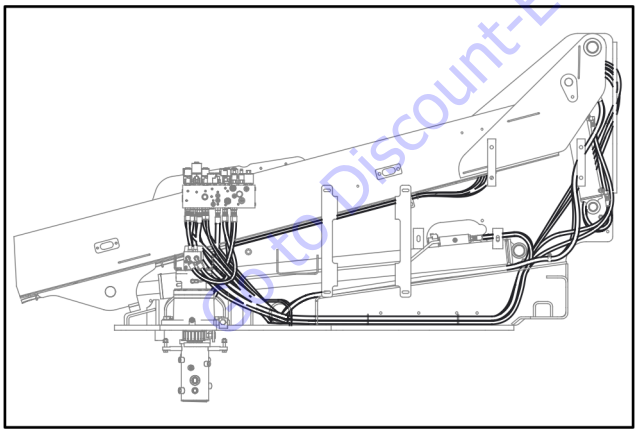
⚠ CAUTION

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 a suitable container to catch escaping hydraulic fluid. Cap all hydraulic lines and ports.



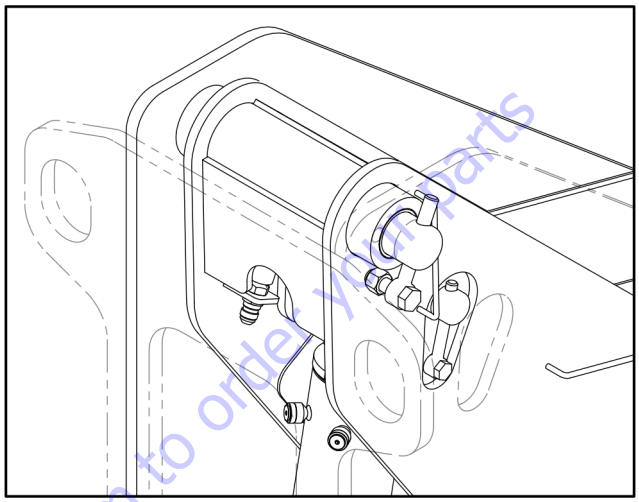
3. Tag and disconnect hydraulic lines from boom to the main control valve. Use a suitable container to catch escaping hydraulic fluid. Cap all hydraulic lines and ports.



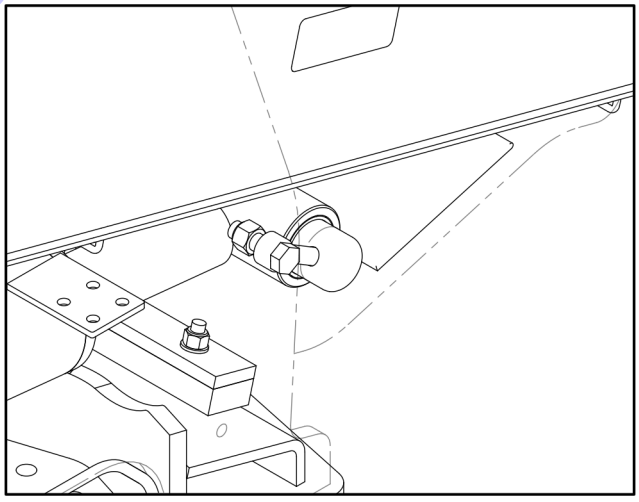
NOTE: *The 460SJC boom weighs approximately 740 kg (1630 lb). This weight does not include platform, rotator or jib.*

4. Using a suitable lifting device, adequately support boom weight along entire length.

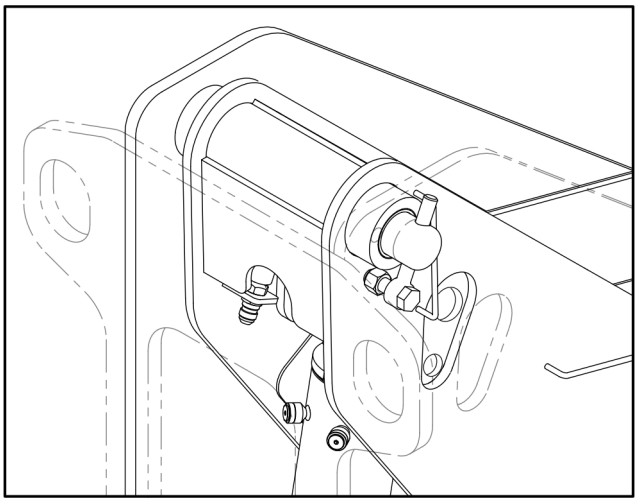
5. Tag and disconnect hydraulic hoses from boom master cylinder. Cap or plug all openings. Remove bolts and keeper pins securing upper master cylinder pivot pin. Remove pivot pin.



6. Ensure lift cylinder is adequately supported. Remove bolts and keeper pins securing lift cylinder pivot pin. Using a suitable brass drift and hammer, remove pivot pin from boom.



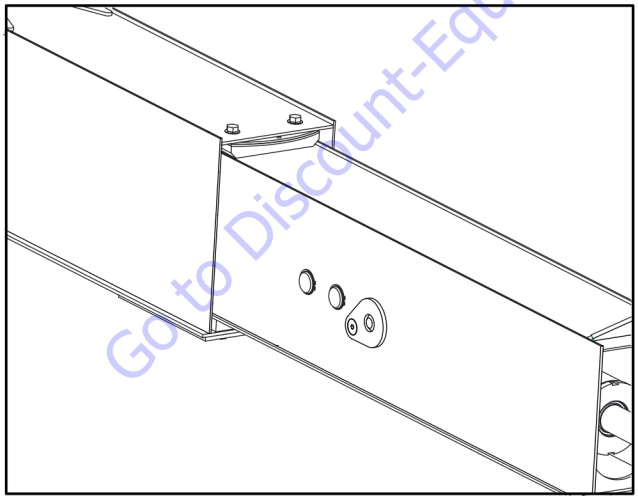
7. Remove hardware securing boom pivot pin. Using a suitable brass drift and hammer, remove pin from turntable.



8. Carefully lift boom assembly clear of turntable and lower to ground or suitable supported work surface.

Disassembly

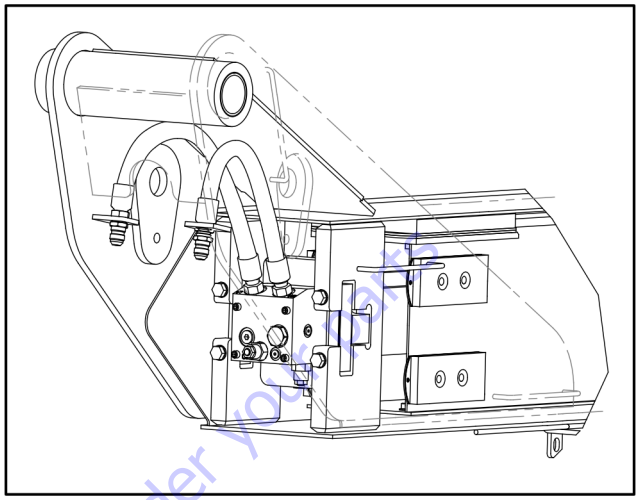
1. Using a portable power source, attach hose to telescope cylinder port block. Using all applicable safety precautions, activate hydraulic system and extend cylinder to gain access to cylinder rod retaining pin. Shut down hydraulic system.



2. Carefully disconnect hydraulic hose from retract port of cylinder. There will be initial weeping of hydraulic fluid which can be caught in a suitable container. After initial discharge, there should be no further leakage from the retract port.

3. Remove hardware securing telescope cylinder to fly boom section. Remove pin from fly.

4. Remove hardware securing telescope cylinder to base boom section.



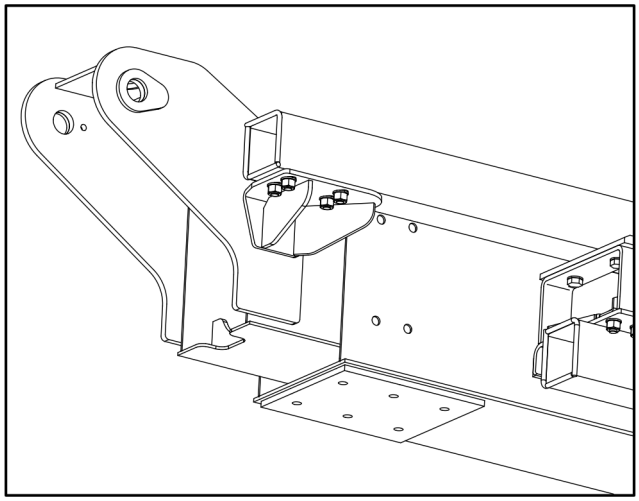
NOTE: *Telescope cylinder weighs approximately 160 kg (350 lb).*

5. Using a suitable lifting device, remove telescope cylinder from boom sections.

6. Tag all hoses and wires from front of fly boom and bottom of base boom for reassembly.

7. Remove hardware securing front wear pads on base boom section. Remove wear pads.

8. Remove hardware securing powertrack to front end of fly boom section.



9. Using a suitable lifting device, remove fly boom from boom section.

NOTE: *Fly boom section weighs approximately 135 kg (300 lb).*

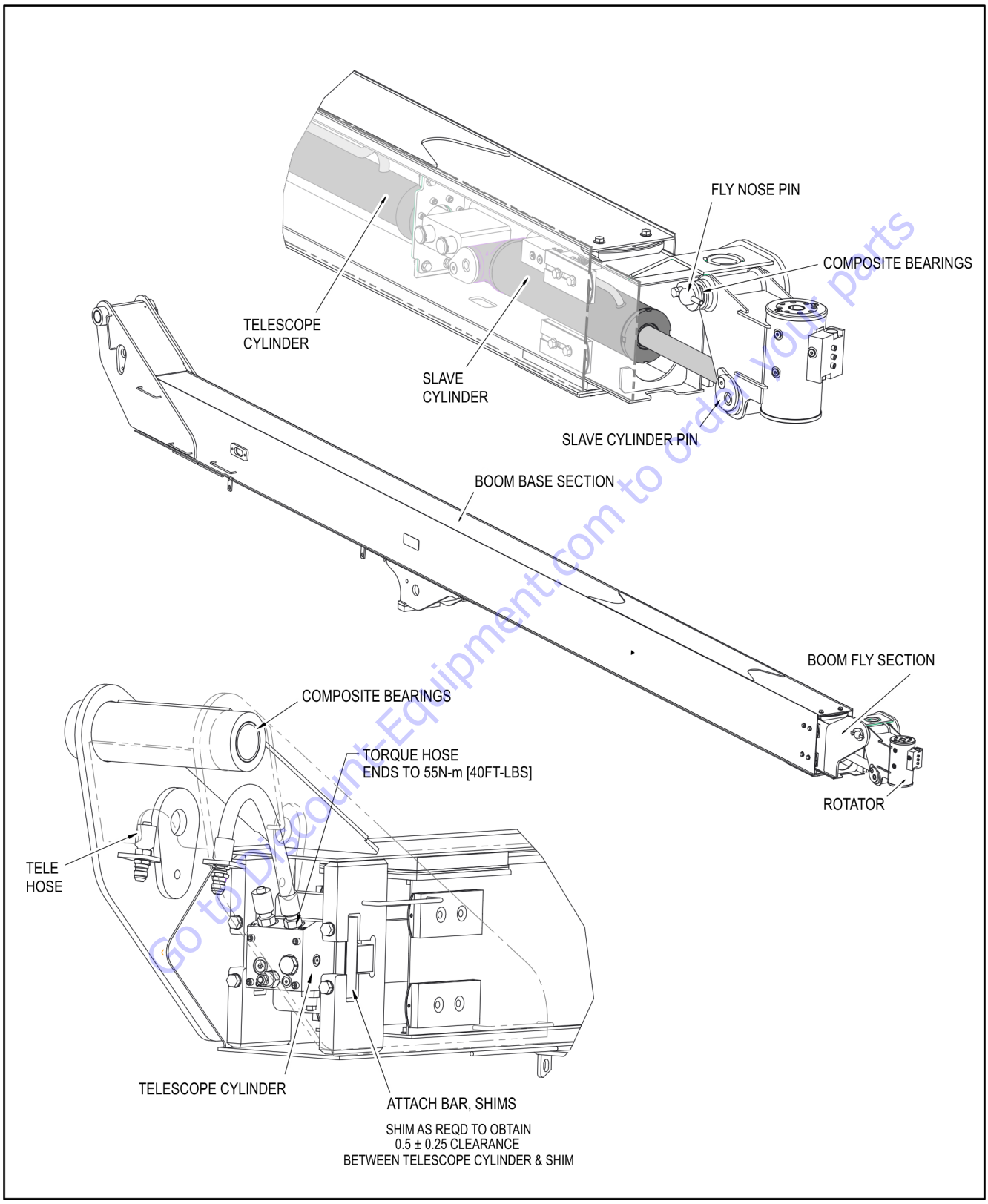
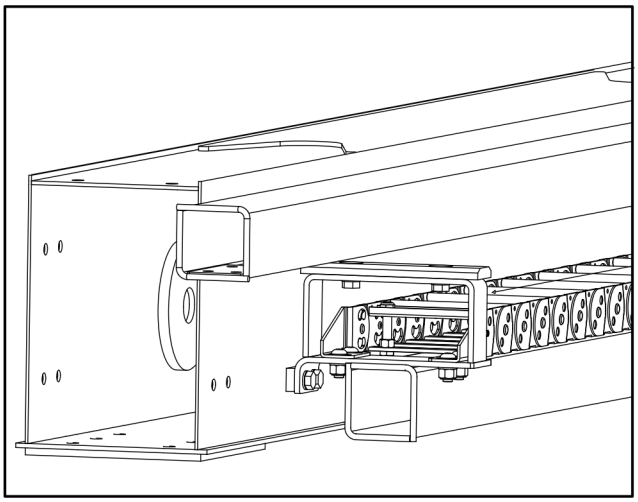


Figure 4-15. Boom Assembly

10. If necessary, remove wear pads from rear of fly boom section.

11. If necessary, remove hydraulic lines and electrical cables from powertrack.

12. If necessary, remove hardware securing powertrack to the base boom section. Remove powertrack.



Inspection

1. Inspect all boom pivot pins for wear, scoring or other damage, and for tapering or ovality. Replace pins as necessary.

2. Inspect lift cylinder pins for wear, scoring or other damage, and for tapering or ovality. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.

3. Inspect telescope cylinder rod attach pin for wear, scoring or other damage. Replace pin as necessary.

4. Inspect inner diameter of boom pivot bushings for scoring, distortion, wear or other damage. Replace bushings as necessary.

5. Inspect wear pads for wear.

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

1. Install power track to the attach point on base boom section. Secure power track with attaching hardware.

2. Install hydraulic lines and electrical cables in power track as tagged during disassembly.

3. Install wear pads to the rear of fly section.

4. Using suitable lifting equipment, slide fly section into the base section until the telescope cylinder attach point aligns with holes in side of base section.

NOTE: *Fly boom section weighs approximately 135 kg (300 lb).*

5. Measure distance between telescope cylinder port block attach point on base boom section and attach point on fly boom section.

6. Connect a suitable auxiliary hydraulic power source to the telescope cylinder port block.

7. Extend telescope cylinder the distance of the two attach points.

8. Secure sling and lifting device at telescope cylinder's approximate center of gravity Lift cylinder to aft end of boom assembly.

NOTE: *Telescope cylinder weighs approximately 160 kg (350 lb).*

9. Slowly slide the telescope cylinder into boom assembly, align rod end with attach point in fly section. Insert pin and secure with retaining ring.

10. Align bolt holes at aft end of base boom section with telescope cylinder port block. Secure telescope cylinder with hardware.

11. Install wear pads at end of base boom section. Using shims, set adjustable wear pads to zero clearance. Adjust pads alternately side to side, so fly boom section is centered in base boom section.

12. Retract boom section fully. Using shims, adjust wear pads at aft end of boom section to zero clearance. Adjust pads alternately side to side, so that fly boom section is centered in base boom section.

13. Disconnect auxiliary power source from telescope cylinder.

Installation

1. Using suitable lifting equipment, position boom assembly on turntable so boom pivot holes in both boom and turntable are aligned.
2. Install boom pivot pin, ensuring location of hole in pivot pin aligns with attach point on upright.
3. Using all applicable safety precautions, operate lifting equipment to position boom lift cylinder so holes in cylinder rod end are aligned with the one in the turntable. Insert cylinder pins.
4. If necessary, gently tap pins into position with a soft headed mallet, ensure attach holes in pins are aligned with attach holes in boom structure. Secure with hardware.
5. Connect all hosing and wiring.
6. Install platform to boom assembly.
7. Connect all hosing and wiring at platform control station.
8. Using all safety precautions, operate machine systems and extend and retract boom for four or five cycles. Check for proper operation.
9. Shut down machine systems and check for leaks.

4.5 JIB - 460SJC

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

Removal

1. For platform and support removal see Section 4.2 - Platform.
2. Position the articulating jib boom level with ground.

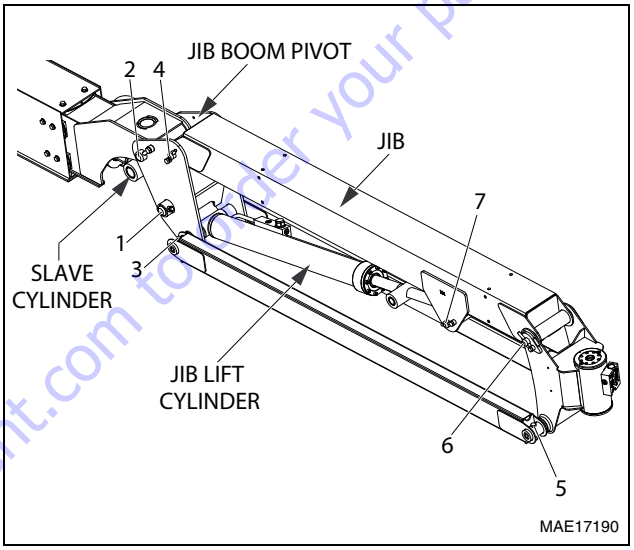
NOTICE

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

3. Tag and disconnect hydraulic lines from level cylinder and lift cylinder. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
4. Remove mounting hardware from slave leveling cylinder pin #1. Using a suitable brass drift and hammer, remove the cylinder pin from jib assembly.
5. Remove mounting hardware from jib assembly 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 fly boom pivot pin for wear, scoring, tapering and ovality, or other damage. Replace pins as necessary.
2. Inspect fly boom pivot attach points for scoring, tapering and ovality, or other damage. Replace pins as necessary.
3. Inspect inner diameter of 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.

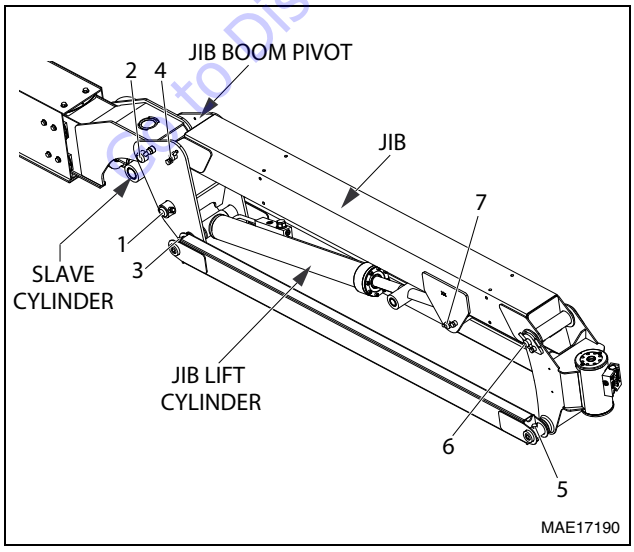
7. Inspect structural units of jib boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.

Assembly

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

Installation

1. Align 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.
2. Align the slave leveling cylinder with attach holes in jib boom pivot weldment. Using a soft head mallet, install slave leveling cylinder pin #1 into articulating jib boom pivot weldment and secure with mounting hardware.



4.6 BOOM CLEANLINESS GUIDELINES

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

1. JLG recommends use of the JLG Hostile Environment Package if available to keep internal portions of a boom cleaner and to help prevent dirt and debris from entering the boom. This package reduces 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 you follow all guidelines for servicing your equipment in accordance with instructions outlined in the JLG Service & Maintenance Manual for your machine. Periodic maintenance and inspection is vital to 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 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 JLG Service & Maintenance Manuals.
4. The first attempt to remove debris from inside the boom must be to utilize pressurized air to blow debris toward the nearest exiting point from the boom. Make sure all debris is removed before operating machine.
5. If pressurized air cannot dislodge 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 all debris is removed, that no “puddling” of water has occurred, and boom internal components are dry prior to operating machine. Make sure you comply with all federal and local laws for disposing wash water and debris.
6. If pressurized air or washing does not remove debris, disassemble boom in accordance to instructions outlined in the JLG Service & Maintenance Manual to remove debris.

4.7 BOOM SHIMMING PROCEDURE

NOTE: *When installing wear pads, wear pad bolt lengths may need to be adjusted as shim thicknesses are adjusted. Bolt lengths should be flush or up to one thread below surface of insert.*

1. Measure and take note of the inside width and inside height of the base boom opening for reference later in this procedure.

2. Install side wear pads on fly boom and shim as required to match the corresponding dimension recorded in Step 1 within +0/-1.2 mm. Divide shims as evenly as possible between sides of the boom. The number of shims installed at position #1 must match position #2, and position #3 must match position #4 as shown below. Take note to how many shims are installed in each position.

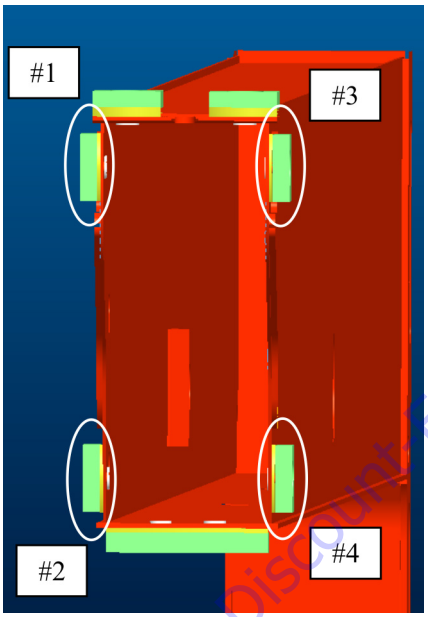


Figure 4-16. Fly Boom Wear Pads

3. Install top wear pads and shims on fly boom.

4. Install bottom wear pads on fly boom and shim as required to obtain the total base boom dimension within +0/-1.2 mm of the corresponding dimension from Step 1.

5. Slide fly boom into base boom, leaving 1 to 2 meters exposed.

6. Install bottom wear pads and shims in end of base boom.

7. Instal side pads and shims in base boom. Distribute shims to each side to match distribution noted in Step 2. Positions #5/6 must match positions #1/2. Positions #7/8 must match positions #3/4 (See Figure 4-16. and Figure 4-17.). Verify no more shims will fit on either side.

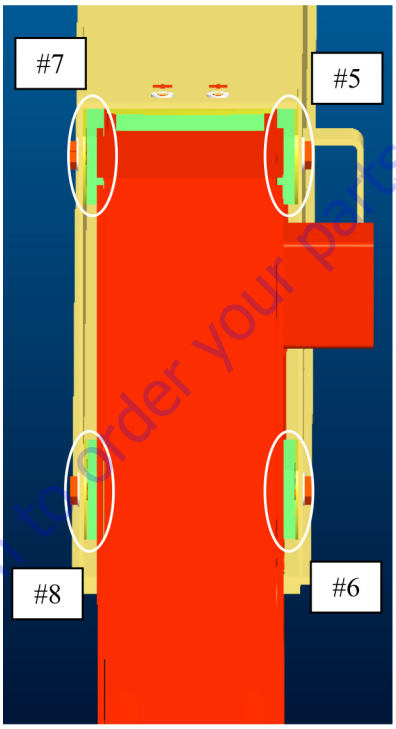


Figure 4-17. Base Boom Wear Pads

NOTE: *Do not use a wedge to install more shims than will fit with use of a pry bar. This may result in boom being shimmed too tight. Pry bars should only be used to finish installing a shim that can be installed by hand more than half of its length.*

8. Install top wear pads and shims in base boom leaving a gap of 0mm to 1.2mm between top of fly boom and inside of base boom.

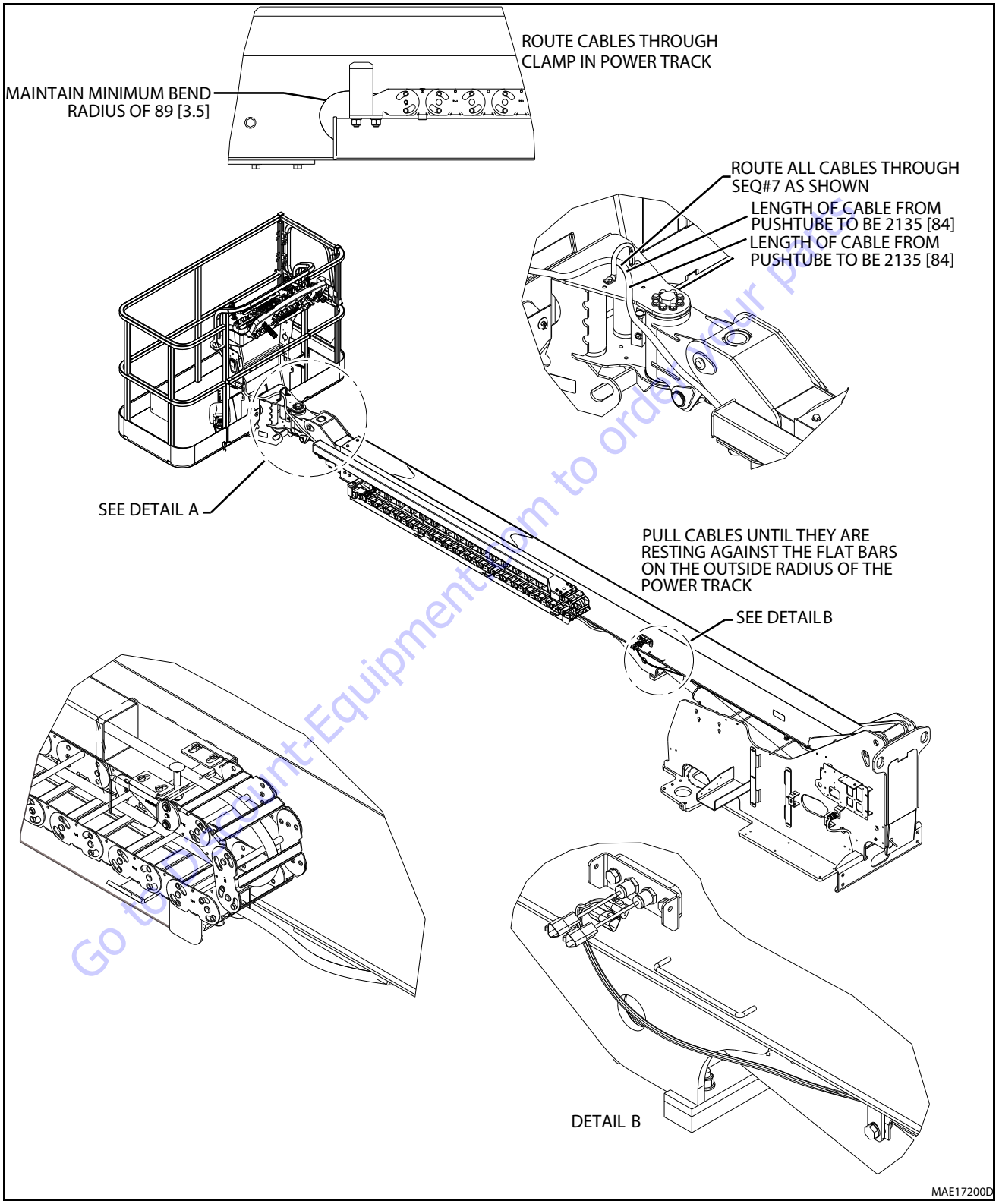


Figure 4-18. Cables and Clamps Installation - 400SC (Sheet 1 of 2)

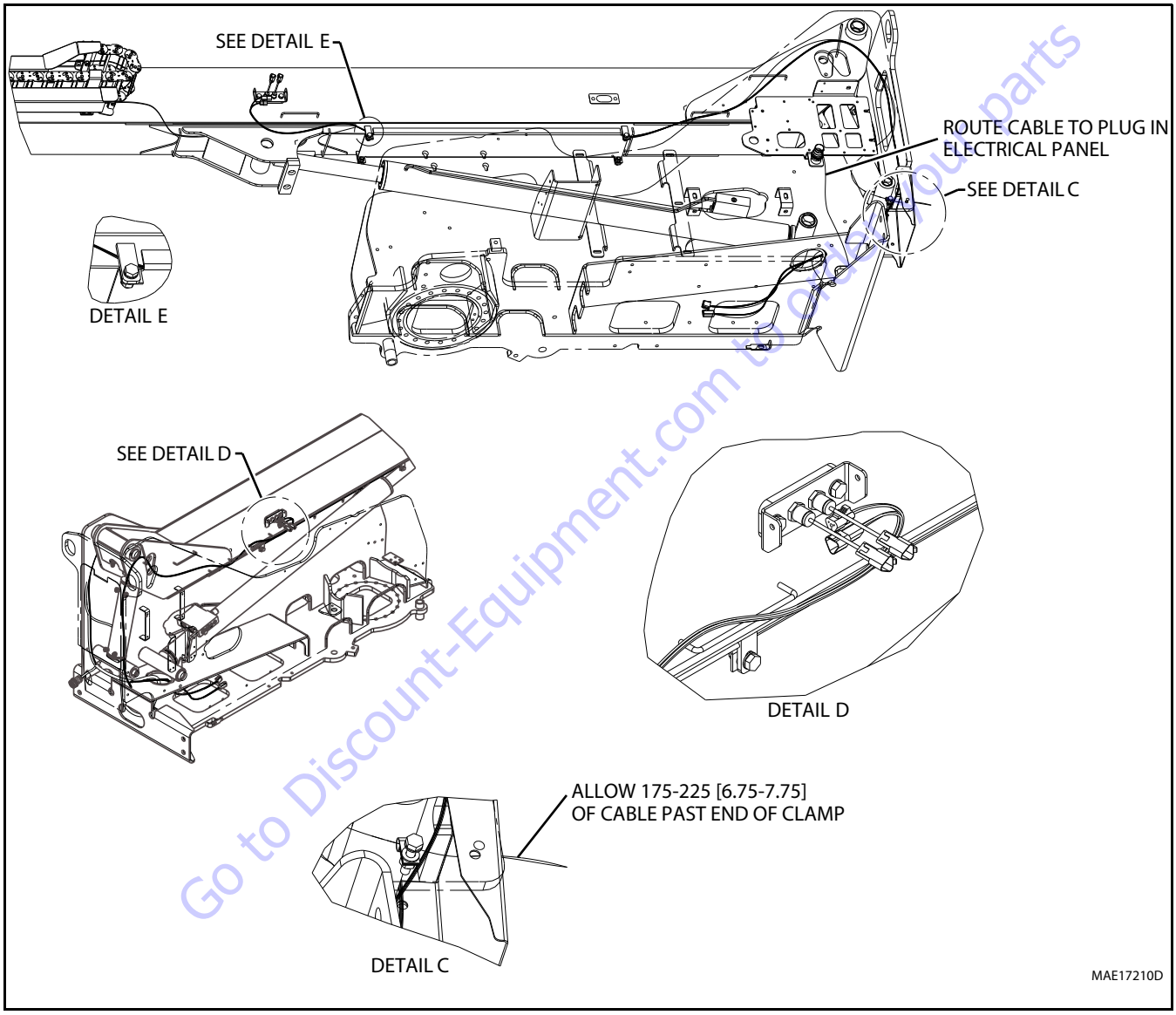


Figure 4-19. Cables and Clamps Installation - 400SC (Sheet 2 of 2)

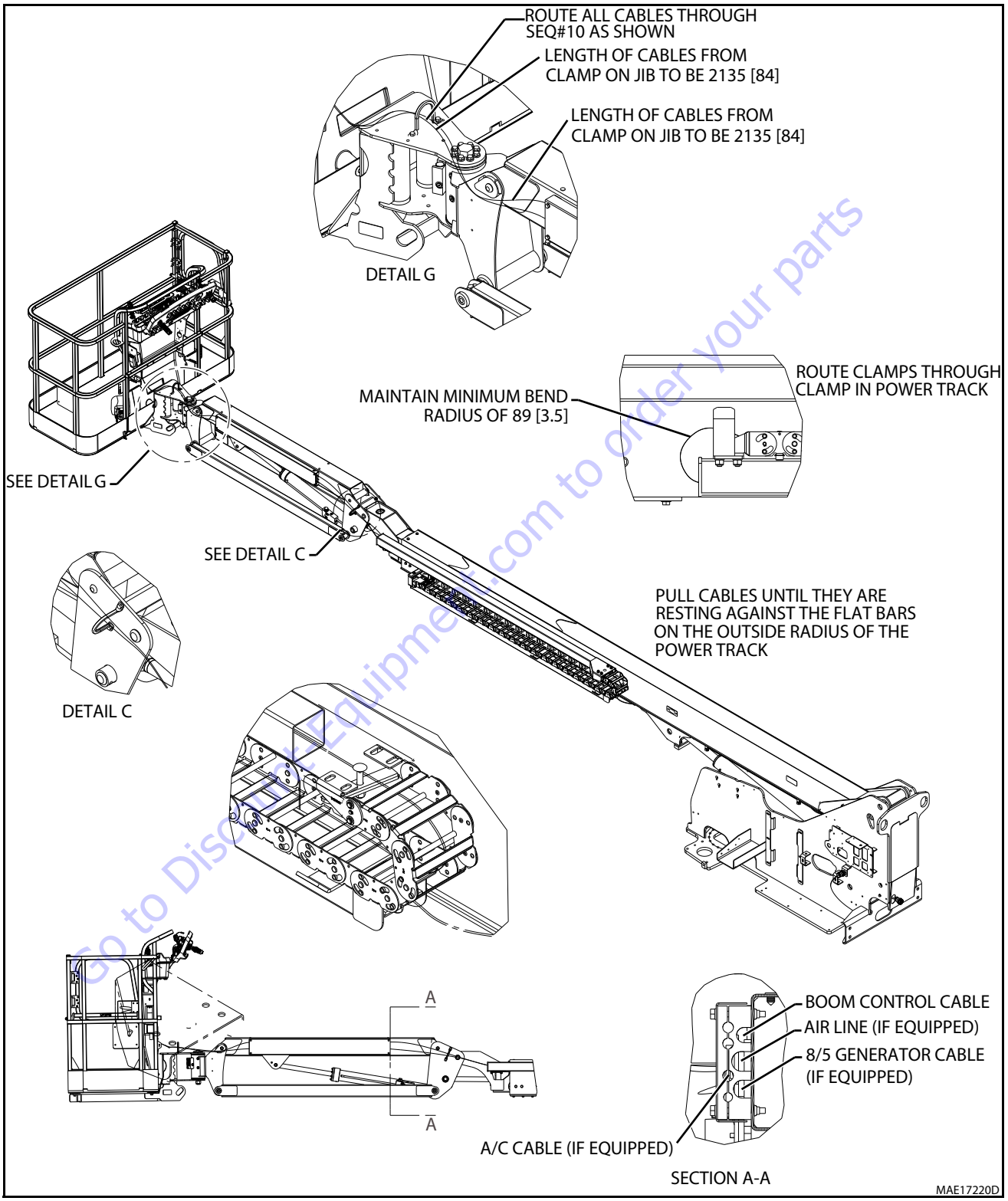


Figure 4-20. Cables and Clamps Installation - 460SJC (Sheet 1 of 2)

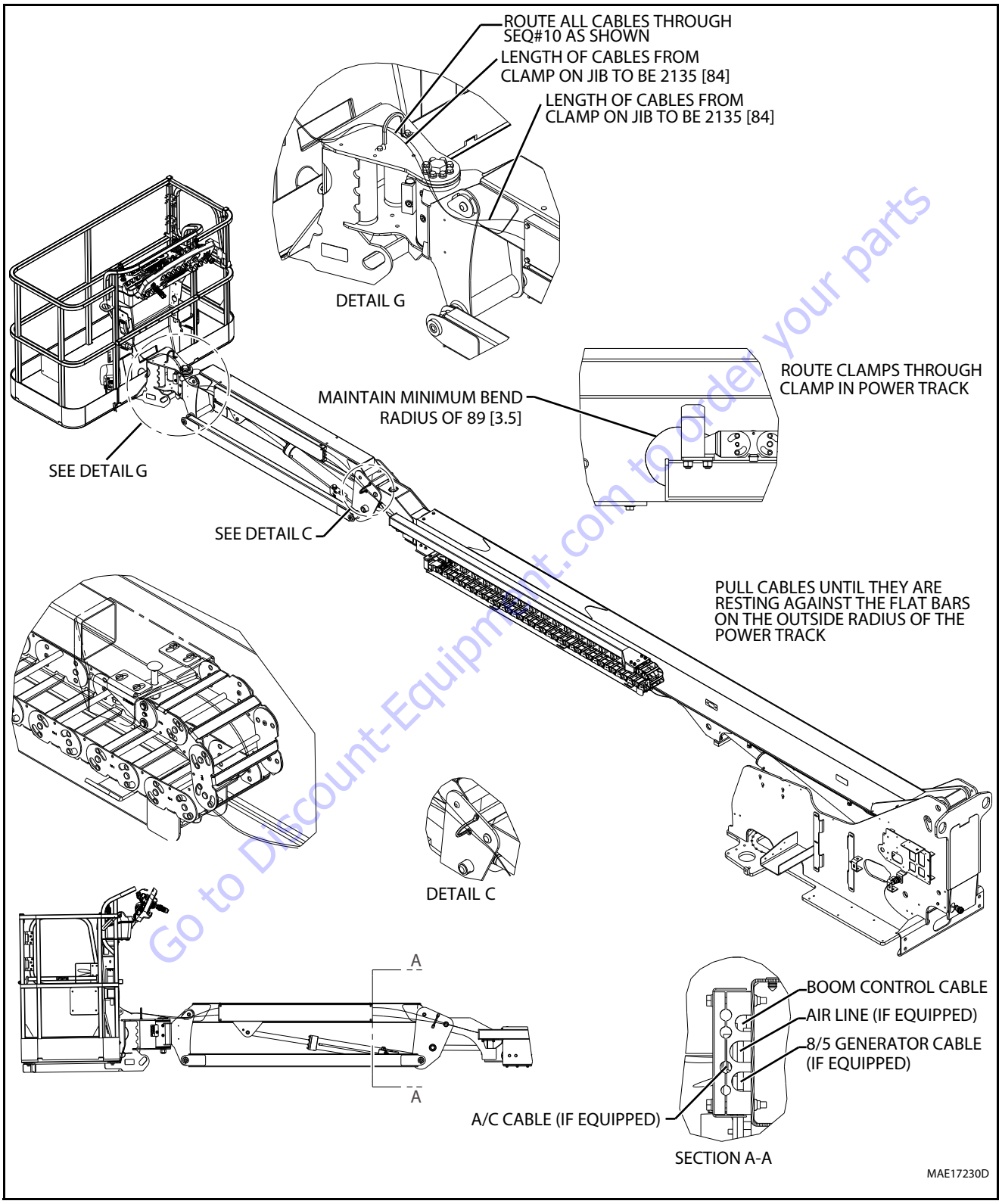


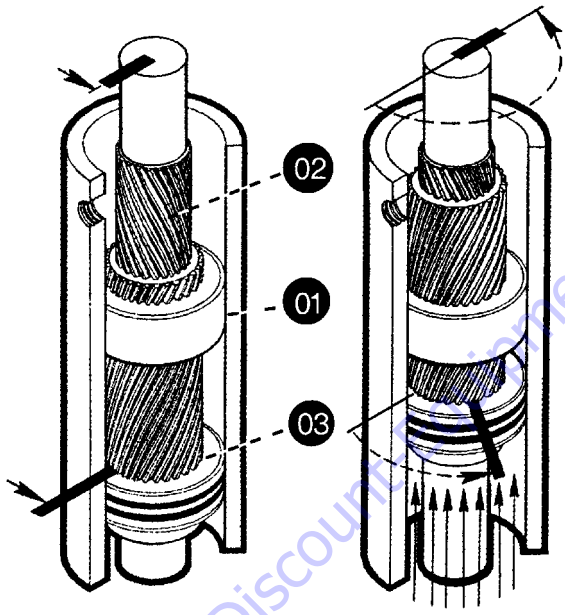
Figure 4-21. Cables and Clamps Installation - 460SJC (Sheet 2 of 2)

4.8 ROTARY ACTUATOR

Theory of Operation

The L20 Series rotary actuator converts linear piston motion to 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 inside diameter of piston. Outside diameter of piston carries a second set of splines, of opposite hand, which engage with matching splines in the housing.

As hydraulic pressure is applied, piston is displaced axially in the housing - similar to a hydraulic cylinder - while splines cause shaft to rotate. When control valve is closed, oil is trapped inside actuator, preventing piston movement and locking shaft in position.



Bars indicate starting positions of piston and shaft. Arrows indicate rotation direction. Housing with integral ring gear remains stationary.

Shaft glands, bearings, and end cap are not shown for clarity.

As fluid pressure is applied, piston is displaced axially while helical gearing causes piston and shaft to rotate simultaneously.

Double helix design compounds rotation: shaft rotation is about twice of piston.

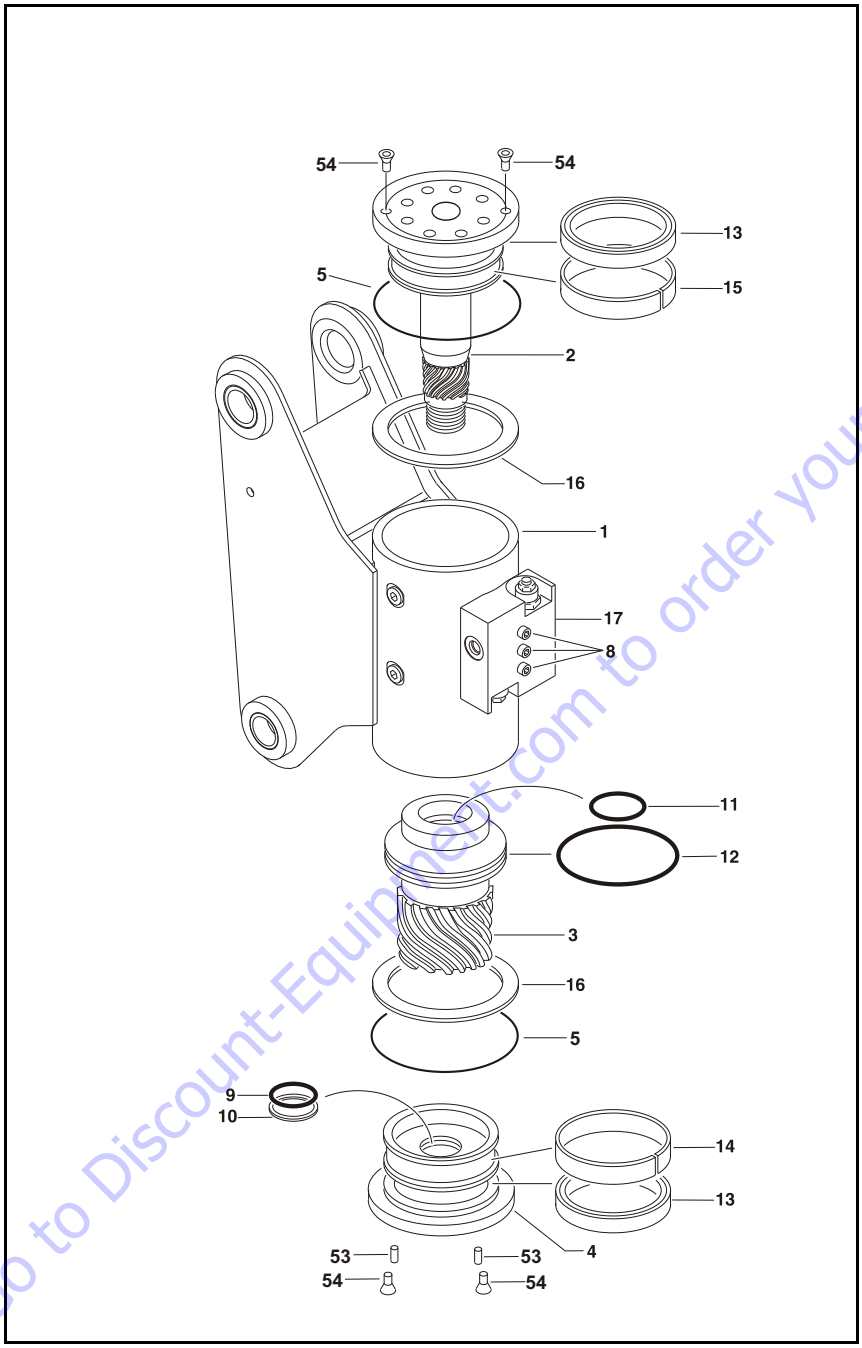
Shaft is supported radially by large upper radial bearing and lower radial bearing. Axially, shaft is separated from housing by upper and lower thrust washers. End cap is adjusted for axial clearance and locked in position by set screws or pins.

Required Tools

Basic tools required for assembly and disassembly of the actuator and their intended functions are as follows:

1. Flashlight - helps examine timing marks, component failure, and overall condition.
2. Felt Marker - match mark 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 - end cap removal 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 a customized flat-head screwdriver. To make this tool, heat flat end with a torch and bend to a slight radius in a vice. Round off sharp edges with a grinder.

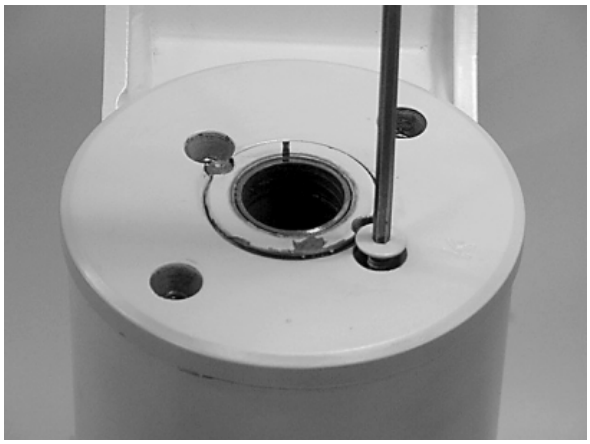


1. Housing
2. Shaft
3. Piston Sleeve
4. End Cap
5. Exclusion Seal
8. Bolt
9. Cap Seal
10. Cap Ring
11. Rod Seal
12. Piston Seal
13. Bearing Packing
14. Cap Bearing
15. Shaft Bearing
16. Thrust Washer
17. Counterbalance Valve
53. Lock Pin
54. Countersunk Screw

Figure 4-22. Rotary Actuator - Exploded View

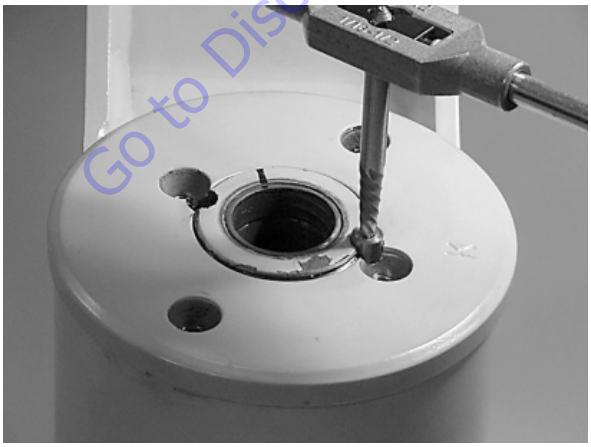
Disassembly

1. Remove capscrews (54) over end cap lock pins (53).



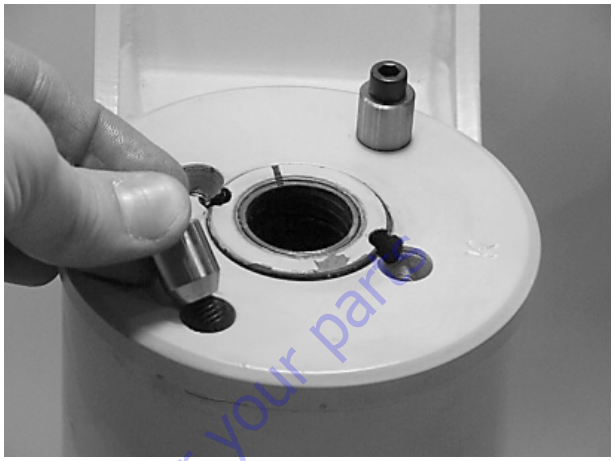
2. Using a 3.18mm (1/8") drill bit, drill hole in center of each lock pin to a depth of approximately 4.76mm (3/16").

3. Remove lock pins using an "Easy Out" (#2 shown).



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

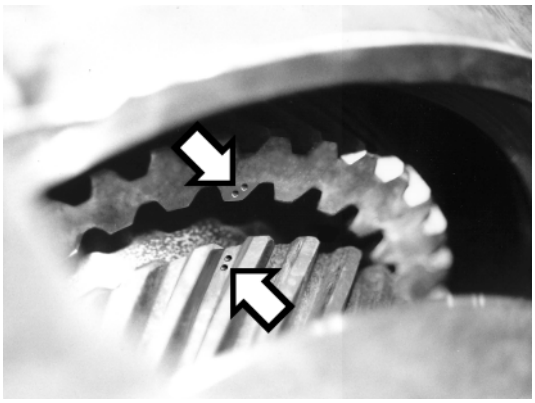
4. Install end cap (4) removal tools provided with Helac seal kit.



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

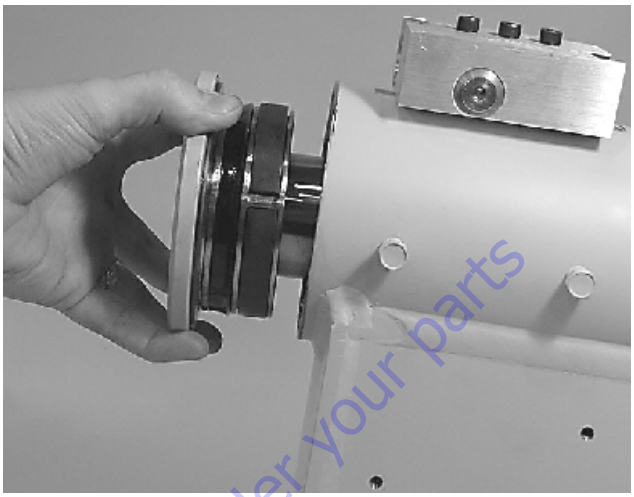
6. Remove end cap (4) and set aside.

7. Actuator has timing marks for proper engagement.



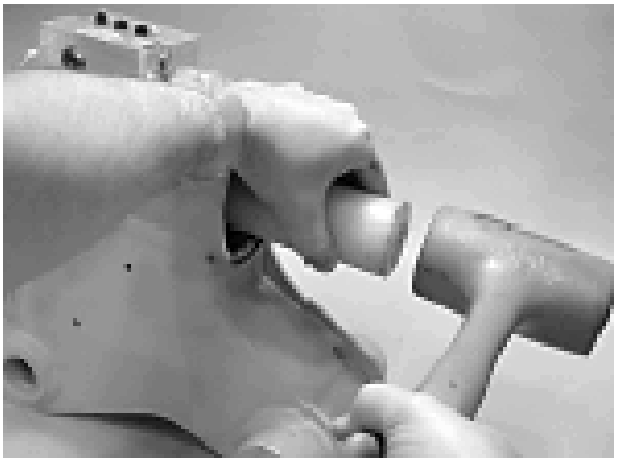
8. Use a felt marker to clearly indicate timing marks between shaft and piston before removing shaft, (2). This simplifies timing during assembly.

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



10. Mark housing (1) ring gear in relation to piston O.D. gear before removing piston sleeve (3). There are timing marks on housing ring gear (1), piston (3), and shaft (2).

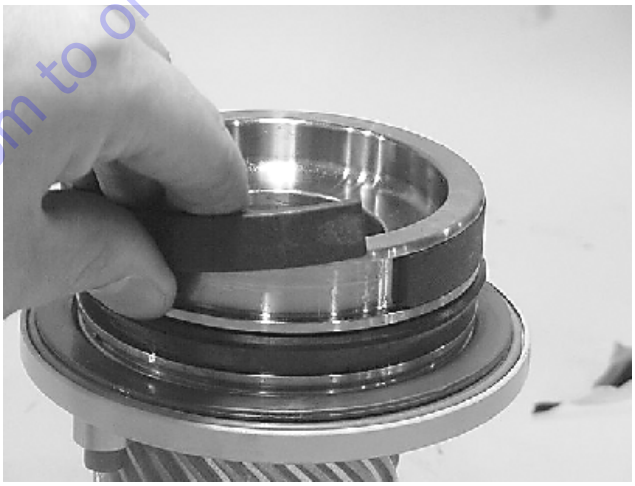
11. Use a rubber mallet and plastic mandrel to prevent damage when removing piston sleeve (3).



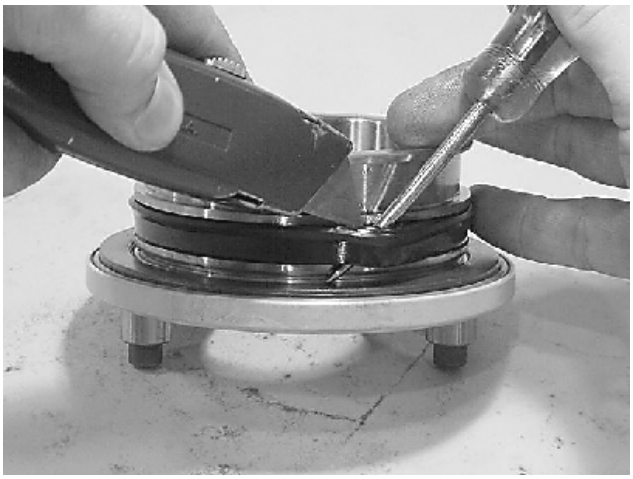
12. Mark piston and housing with a marker where piston gear teeth come out of engagement with housing gear teeth as shown.

13. Remove O-ring (9) and backup ring (10) from end cap (4) and set aside.

14. Remove wear guides (14) from end cap (4) and shaft (2).



15. To remove main pressure seals (13), it is easiest to cut them using a sharp razor blade being careful not to damage the seal groove.



16. Remove thrust washers (16), from end cap (4) and shaft (2).

17. Remove exclusion seal (5) from groove in end cap (4) and shaft (2).

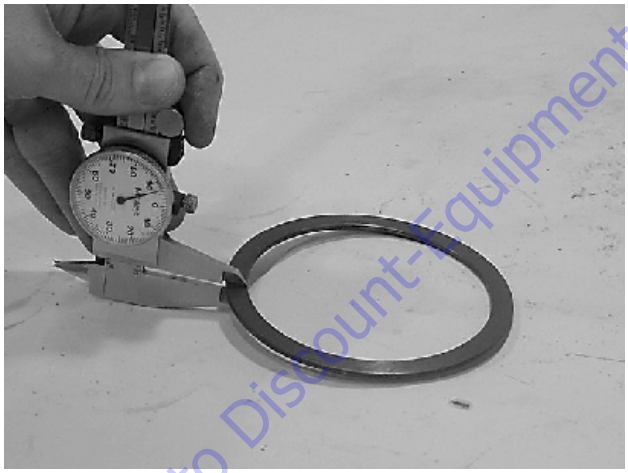
18. Remove piston O.D. seal (12).

19. Remove piston I.D. seal (11).

Inspection

1. Clean parts in a solvent tank and dry with compressed air before inspecting. Inspect seal grooves, bearing grooves, thrust surfaces, rod surface, housing bore, and gear teeth for surface finish abnormalities.

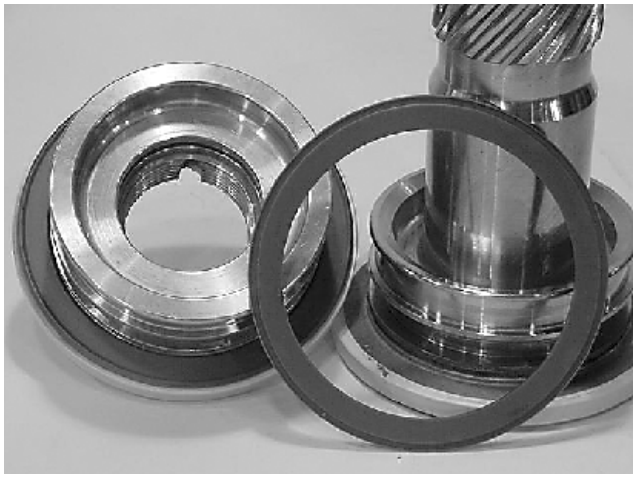
2. Inspect thrust washers (16) for rough or worn edges and surfaces. Measure thickness to make sure it is not less than 2.34 mm (0.092 in).



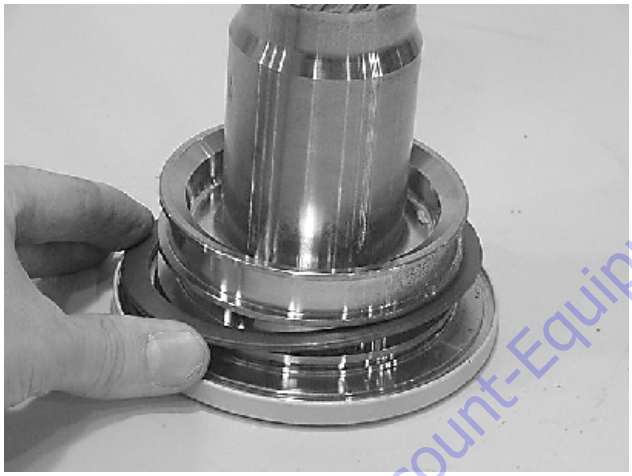
3. Inspect wear guide condition. Measure thickness not less than 3.12 mm (0.123 in).

Assembly

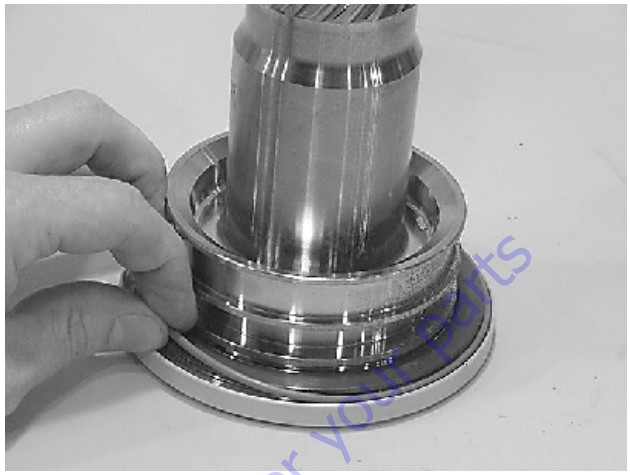
1. Gather all components and tools to one location.



2. Install thrust washer (16) on shaft (2) and end cap (4).



3. Install exclusion seal (5) in groove on shaft (2) and end cap (4) around outside edge of thrust washer (16).



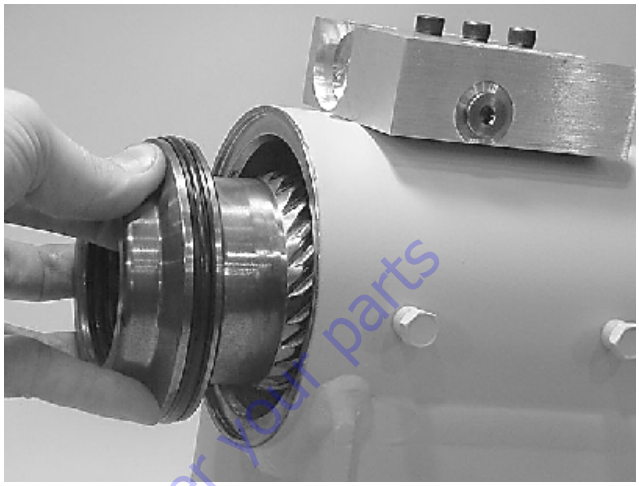
4. Use seal tool in a circular motion to install main pressure seal (13) on shaft (2) and end cap (4).

5. Install wear guide (14) on end cap (4) and shaft (2).

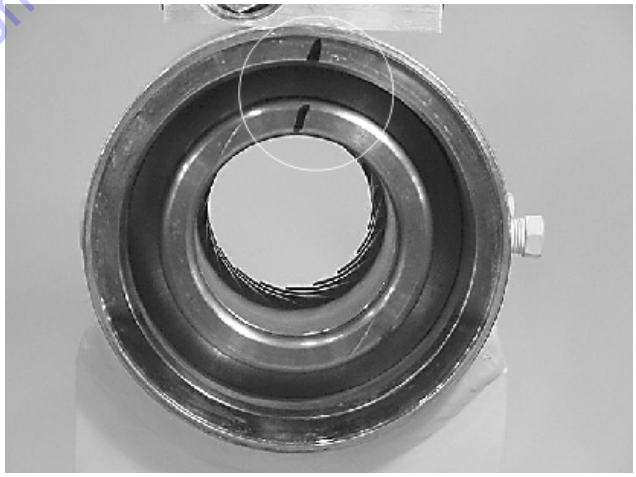
6. Install inner T-seal (11) in piston (3) using a circular motion.
7. Install outer T-seal (12) by stretching it around groove in a circular motion. Each T-seal has 2 back-up rings (see drawing for orientation).

8. Beginning with inner seal (11), insert one end of backup ring in lower groove and feed the rest in using a circular motion. Make sure wedged ends overlap correctly.
9. Repeat for outer seal (12).

10. Insert piston (3) in housing (1) until outer piston seal (12) is touching inside housing bore.

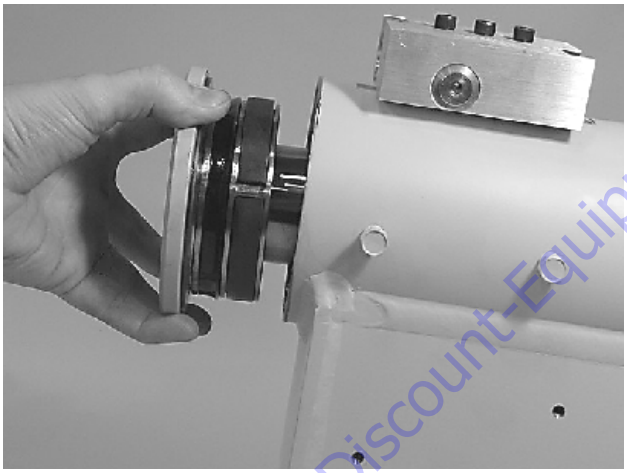


11. Looking from angle shown, rotate piston (3) until marks on piston and housing (1) line up as shown.
12. Using a rubber mallet, tap piston into housing to point where gear teeth meet.

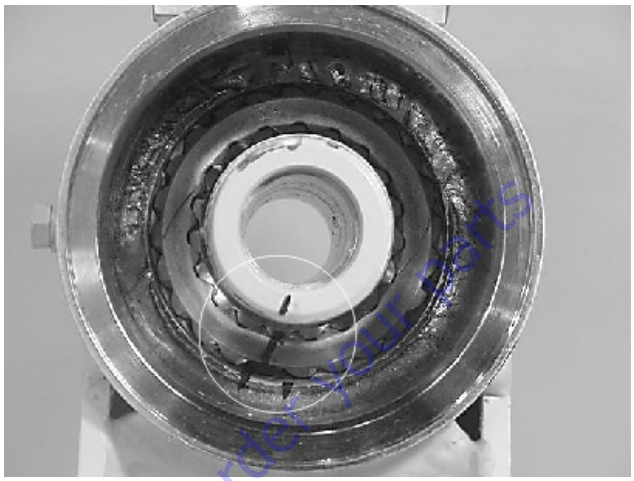


13. Look from opposite end of housing (1) to see if timing marks line up. When they do, tap piston (3) in until gear teeth mesh together. Tap piston into housing until it bottoms out.

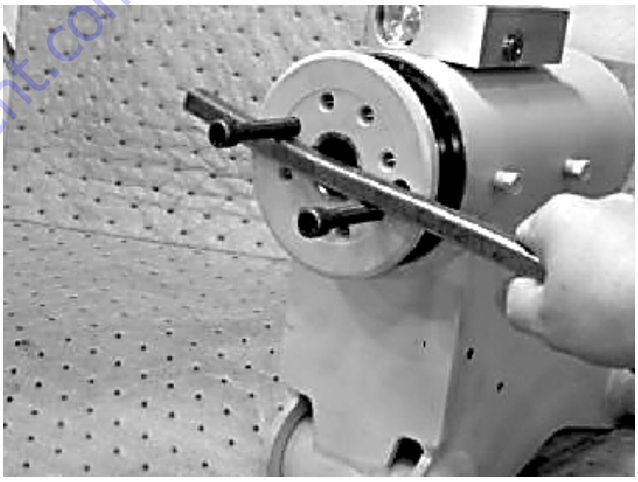
14. Install shaft (2) into piston (3). Do not damage seals. Do not engage piston gear teeth yet.



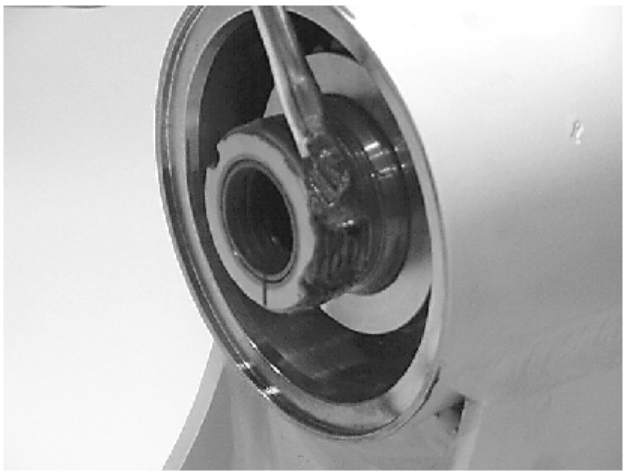
15. Looking from view shown, use existing timing marks to line up gear teeth on shaft (2) with gear teeth on inside of piston (3). Now tap flange end of shaft with a rubber mallet until gear teeth engage.



16. Install 2 bolts in threaded holes in flange. Using a bar, rotate shaft clockwise until wear guides are seated inside housing bore.

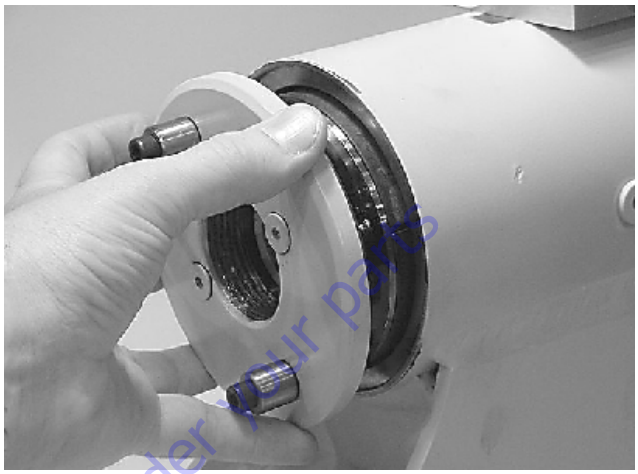


17. Coat threads on end of shaft with anti-seize grease to prevent galling.

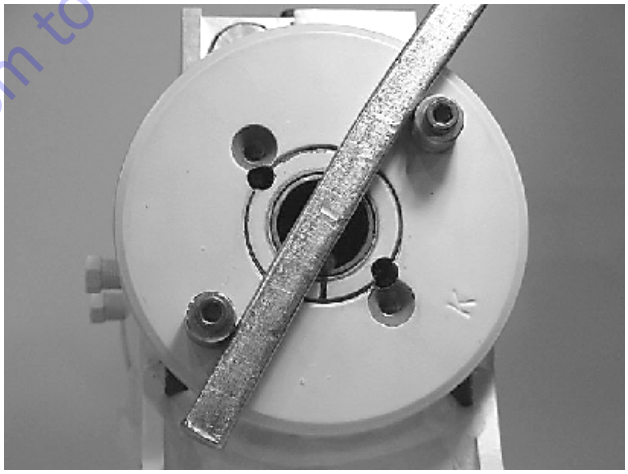


18. Install 0-ring (9) and back-up ring (10) in inner seal groove on end cap (4).

19. Thread end cap (4) on shaft (2) end. Make sure wear guide stays in place on end cap as it is threaded in housing (1).

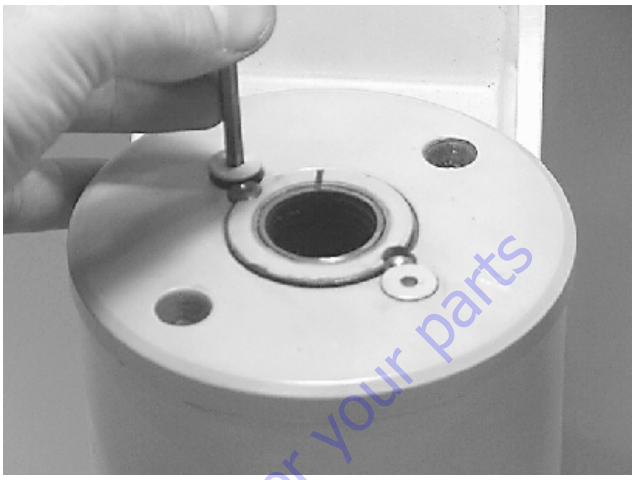


20. Tighten end cap (4) and align holes for lock pins.



21. Place lock pins (53) provided in Helac seal kit in holes with dimple side up. Using a punch, tap lock pins to bottom of hole.

22. Insert set screws (54) over lock pins. Tighten to 2.825 Nm (25 in-lb).



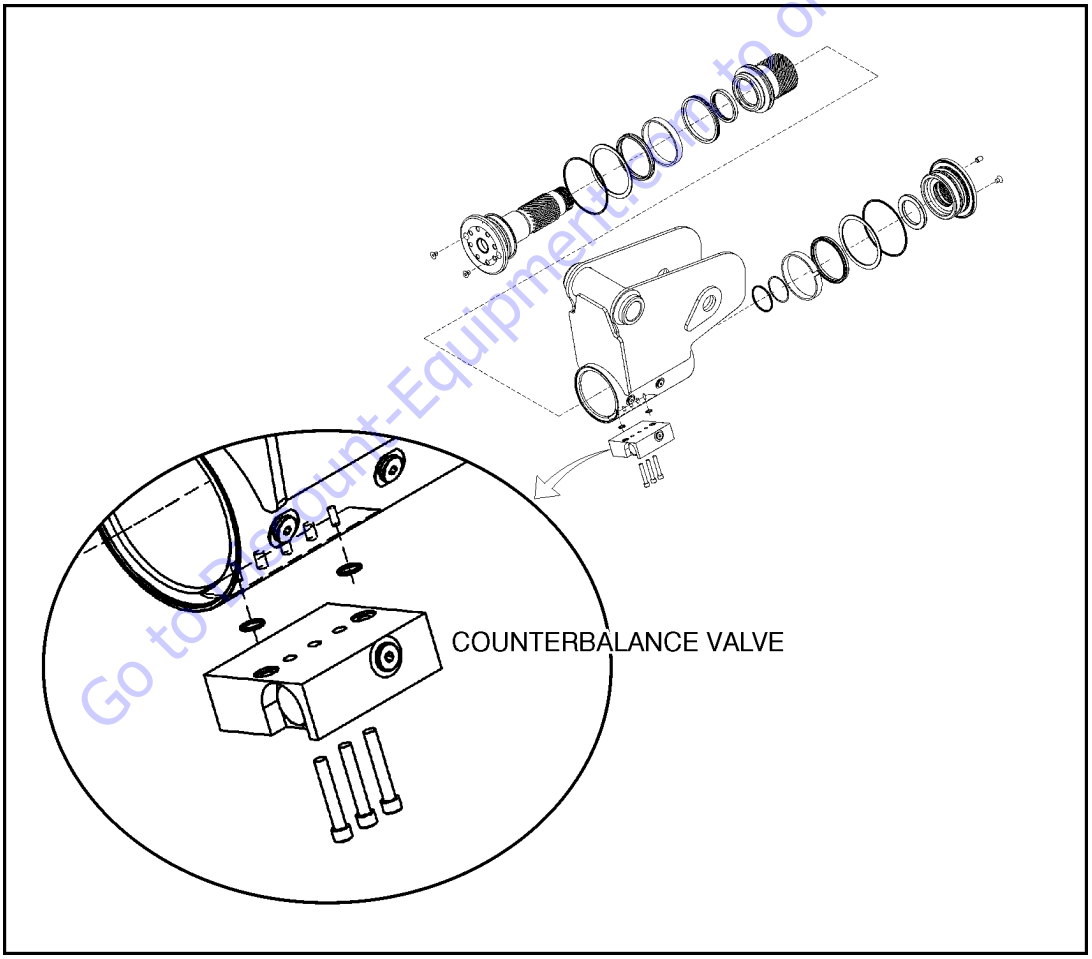


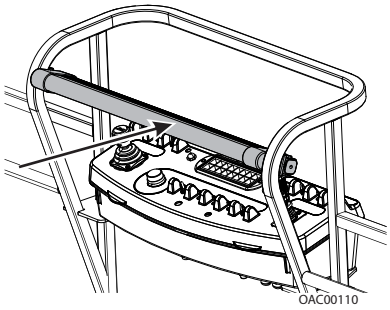
Figure 4-23. Rotator Counterbalance Valve

4.9 SKYGUARD

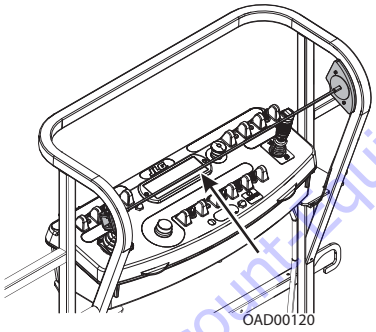
Operation

SkyGuard provides enhanced control panel protection. When the SkyGuard sensor is activated, functions in use at the time of actuation will reverse or cutout. The SkyGuard Function Table provides more details on these functions.

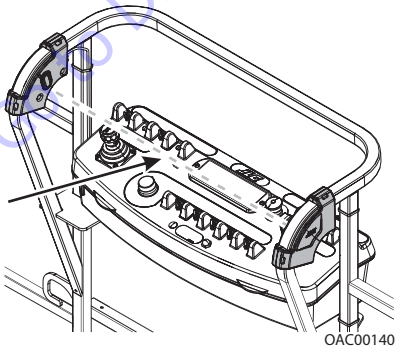
Consult the following illustrations to determine which type of SkyGuard the machine is equipped with. Regardless of the type, SkyGuard function according to the SkyGuard Function Table does not change.



SkyGuard



SkyGuard SkyLine™



SkyGuard SkyEye™

⚠ WARNING

THE MACHINE OPERATOR IS REQUIRED TO PERFORM A DAILY FUNCTION TEST TO ENSURE PROPER OPERATION OF THE SKYGUARD SYSTEM.

Function Test

SKYGUARD ONLY

Perform this function test if **SkyGuard only** is selected in machine setup (refer to Table 6-2).

From the Platform Control Console in an area free from obstructions:

1. Operate the telescope out function, then activate SkyGuard sensor.
2. Once sensor has been activated, ensure telescope out function stops then telescope in function operates for a short duration. Additionally, verify Soft Touch/SkyGuard indicator light flashes and horn sounds. If machine is equipped with SkyGuard beacon, ensure it flashes when sensor activates.
3. With SkyGuard sensor still engaged, press and hold yellow Soft Touch/SkyGuard override button. Operate a function to verify operation can be resumed.
4. Disengage SkyGuard sensor, release controls, and recycle footswitch. Ensure normal operation available.

In Ground Mode:

Operation is allowed regardless of SkyGuard activation.

SOFT TOUCH ONLY

If **Soft Touch only** is selected in machine setup (refer to Table 6-2), machine will treat the Soft Touch/SkyGuard override switch as if it is a Soft Touch switch.

SKYGUARD NOT SELECTED IN MACHINE SETUP

If the SkyGuard system is installed on the machine, but no option is selected in the machine setup (refer to Table 6-2), SkyGuard sensor status will be ignored. No function cutout or reversal will be implemented.

Diagnostics & Troubleshooting

If SkyGuard does not function when the sensor is engaged, first verify the configuration under the
MACHINE SETUP: SKYGUARD OPTION menu using the handheld Analyzer. Ensure the selected configuration matches the actual system installed on the machine. If not, select the correct configuration, then verify operation.

Additionally, use the handheld analyzer to navigate to the DIAGNOSTICS: FEATURES → SKYGUARD INPUTS menu to determine additional SkyGuard fault information.

Engage the SkyGuard sensor and observe the Analyzer to determine if the switch/relay closes.

If the status of the switch/relay remains OPEN while the SkyGuard sensor is actively engaged, it is possible the sensor has failed and should be replaced immediately.

If the status of the switch/relay remains CLOSED while the SkyGuard sensor is actively engaged, a power or ground wire may not be making good contact or may be loose or broken. Additionally, there is a low probability that both relays may have failed.

If the switch/relay status is in disagreement, then one may have failed or is not installed correctly. In this case, the machine will be inoperable.

FAULT CODES

Refer to Table 6-13 for more fault code information

- **0039 -** SkyGuard switch activation fault
- **2563 -** SkyGuard switch disagreement fault

Table 4-1. SkyGuard Function Table

Drive Forward	Drive Reverse	Steer	Swing	Boom Lift Up	Boom Lift Down	Boom Tele Out	Boom Tele In	Jib Lift	Basket Level	Basket Rotate
C	C	C	R	R	R	R	C	C	C	C
R = Indicates Reversal is Activated										
C = Indicates Cutout is Activated										

4.10 PLATFORM ROTATE BLEED PROCEDURE

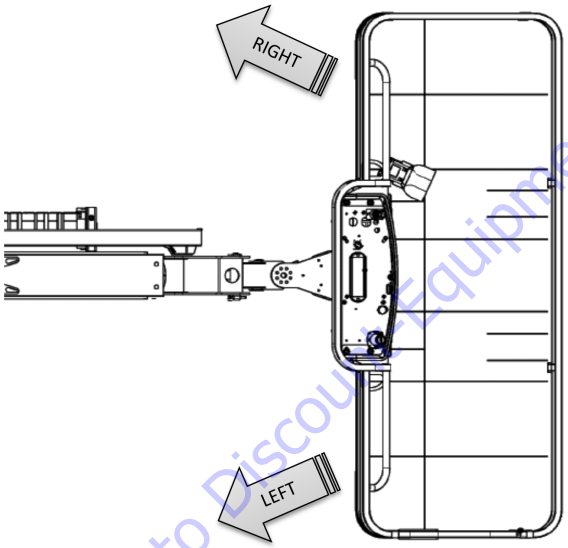
NOTE: *This procedure will have to be performed any time a component is removed or replaced in the platform rotate hydraulic circuit.*

General Notes & Precautions

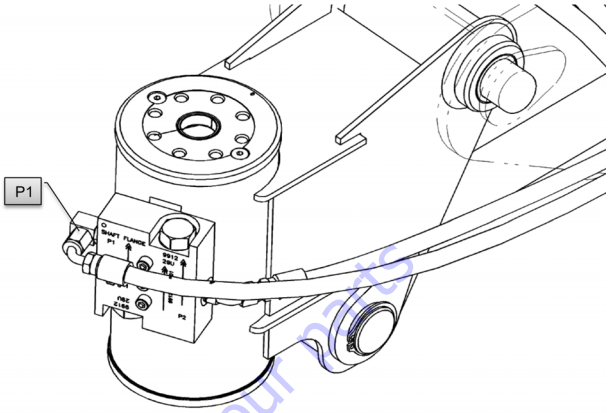
- Wear appropriate eye protection.
- Engine must be turned off when loosening & tightening hydraulic connections.
- Ensure persons and objects are clear of the platform area prior to starting the engine and activating platform rotate function.
- Place appropriate pan and absorbent mats under platform rotator to collect hydraulic fluid.

Procedure

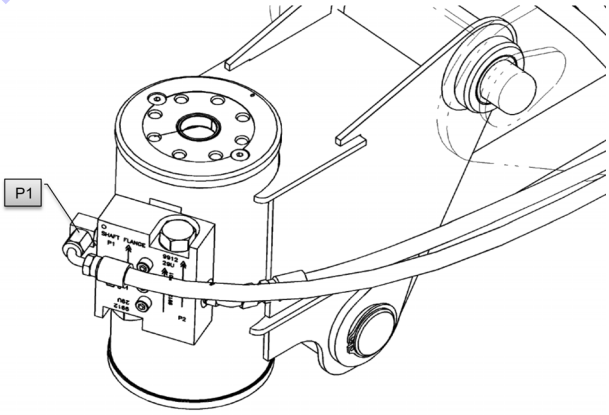
1. Activate platform rotate right until end of stroke and hold for 5 seconds.



2. Activate platform rotate left until end of stroke and hold for 5 seconds.
3. Loosen hydraulic hose end at port P1 of platform rotator 1 turn (use existing paint mark as a reference).



4. Activate platform rotate right for approximately 10 seconds (the platform will rotate slowly).
5. Activate platform rotate left until end of stroke.
6. Repeat steps 4 & 5 until air is removed.
7. Tighten hydraulic hose end at port P1 of platform rotator to 14 ft. lbs. (19 Nm).

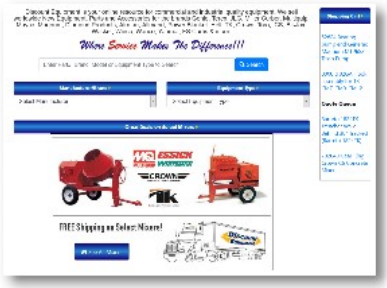


8. Activate platform rotate right until end of stroke and hold for 5 seconds.
9. Loosen hydraulic hose end at port P2 of platform rotator.

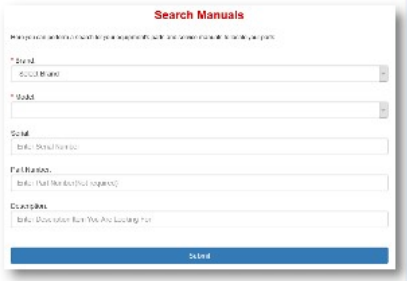
PARTS FINDER

Search Website by Part Number

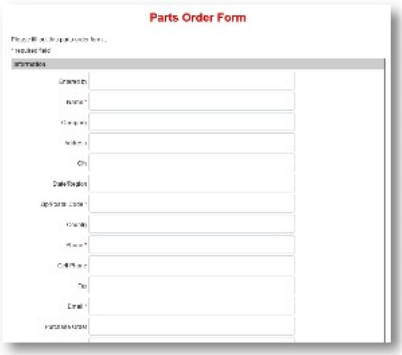
Discount Equipment



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



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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 5. HYDRAULICS AND HYDRAULIC SCHEMATICS

5.1 O-RING LUBRICATION

All fittings with O-rings must be lubricated with hydraulic oil before assembly using one of the following four methods:

- Cup and Brush
- Dip
- Spray

Cup and Brush

Tools needed:

- Small container for hydraulic oil
- Small paint brush

1. Hold fitting in one hand and dip brush into container with other hand. Remove excess hydraulic oil from brush so an even film of oil is applied to O-ring.

2. Hold fitting over hydraulic oil container and brush an even film of oil around entire O-ring in fitting. Make sure O-ring is completely saturated.

3. Turn over fitting and repeat previous step to O-ring on other side of fitting. Make sure entire O-ring is coated with hydraulic oil.

Dip Method

NOTE: *This method works best with Face Seal O-rings, but will work for all O-ring fitting types.*

Tools needed:

- Small leak proof container
- Sponge cut to fit inside container
- Small amount of hydraulic oil to saturate sponge.

1. Place sponge inside container and add hydraulic oil to sponge until fully saturated.
2. Dip fitting into sponge using firm pressure.

NOTE: *After lifting fitting, a small droplet should form and drip from bottom of fitting. This indicates an even coating of oil.*

NOTE: *O-ring boss-type fittings require more pressure to immerse more of fitting into saturated sponge. This also causes more oil to be dispersed from sponge.*

Spray Method

This method requires a pump or trigger spray bottle.

1. Fill spray bottle with hydraulic oil.
2. Hold fitting over a suitable catch can.
3. Spray entire O-ring surface with a medium coat of oil.

Brush-on Method

This method requires a sealed bottle brush.

1. Fill bottle with hydraulic oil.
2. Using slight pressure to body of spray bottle, invert bottle so brush end faces down.
3. Brush an even coat of hydraulic oil on entire O-ring.

5.2 HYDRAULIC CONNECTION ASSEMBLY AND TORQUE SPECIFICATION

Tapered Thread Types

NPTF = national tapered fuel (Dry Seal) per SAE J476/J512

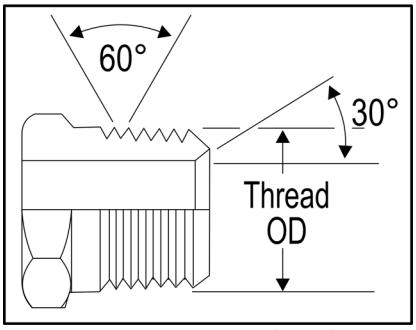


Figure 5-1. NPTF thread

BSPT = British standard pipe tapered per ISO7-1

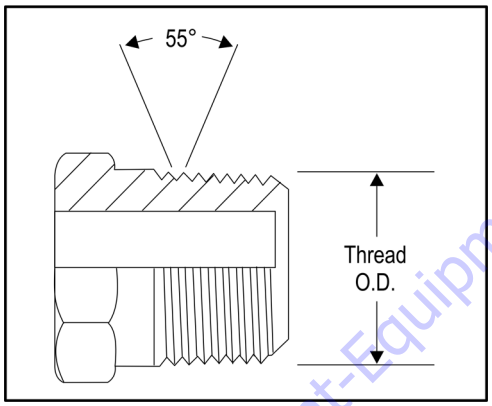


Figure 5-2. BSPT thread

Straight Thread Types, Tube and Hose Connections

JIC = 37° flare per SAE J514

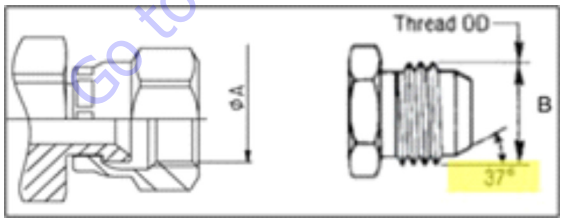


Figure 5-3. JIC Thread

SAE = 45° flare per SAE J512

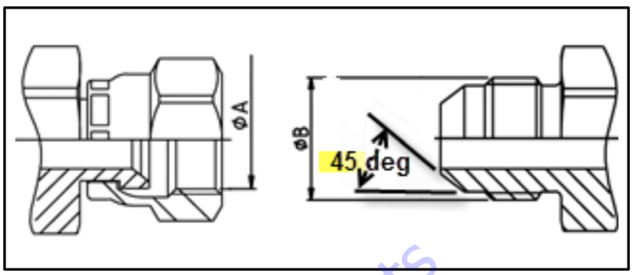


Figure 5-4. SAE Thread

ORFS = o-ring face seal per SAE J1453

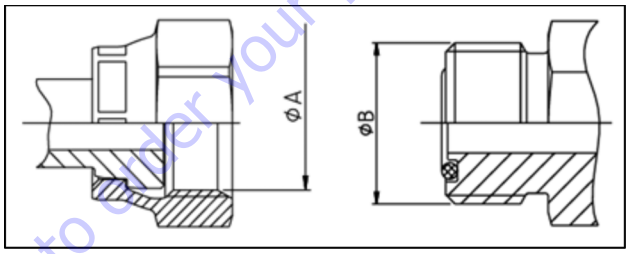


Figure 5-5. ORFS Thread

MBTL = metric flareless bite type fitting, pressure rating L (medium) per ISO 8434, DIN 2353

MBTS = metric flareless bite type fitting, pressure rating S (high) per ISO 8434, DIN 2353

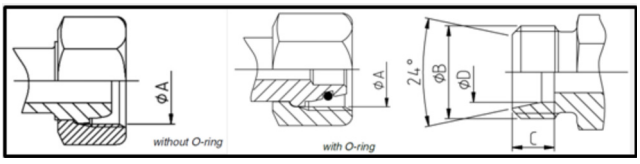


Figure 5-6. MTBL-MBTS Thread

BH = bulkhead connection – JIC, ORFS, MBTL, or MBTS types

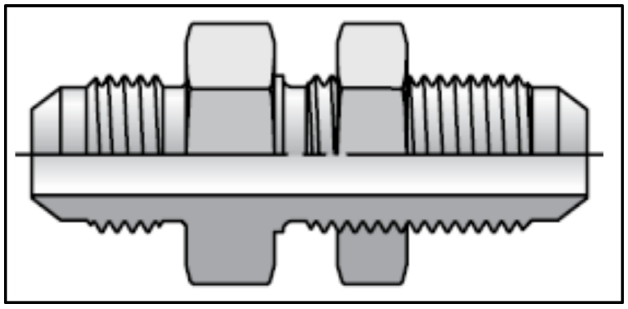
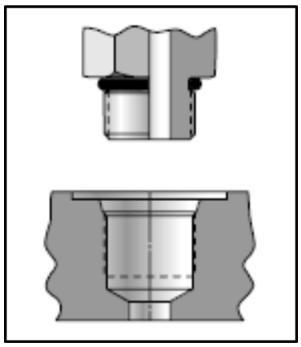


Figure 5-7. Bulkhead Thread

Straight Thread Types, Port Connections

ORB = o-ring boss per SAE J1926, ISO 11926

MPP = metric pipe parallel o-ring boss per SAE J2244, ISO 6149, DIN 3852



MFF = metric flat face port per ISO 9974-1

BSPP = British standard parallel pipe per ISO 1179-1, DIN 3852-2

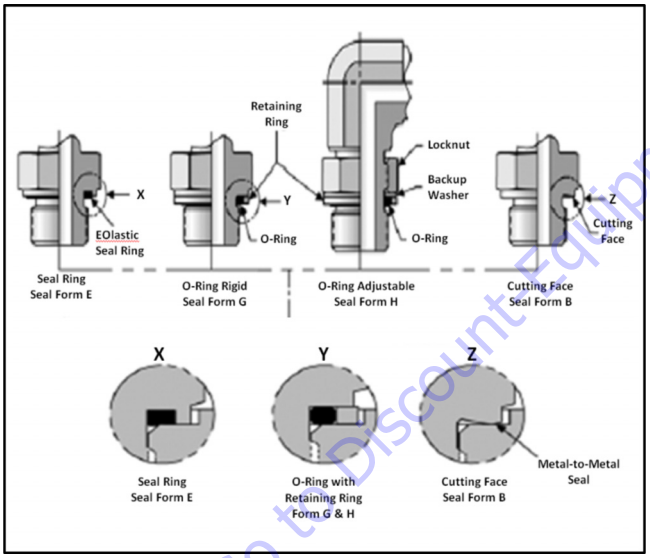


Figure 5-8. MFF-BSPP Thread

Flange Connection Types

FL61 = code 61 flange per SAE J518, ISO 6162

FL62 = code 62 flange per SAE J518, ISO 6162

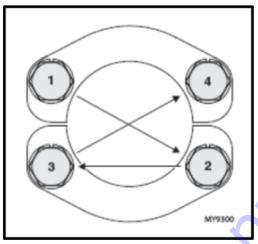


Figure 5-9. ORB-MPP Thread

Tightening Methods

Torque = Application of a twisting force to the applicable connection by use of a precise measurement instrument (i.e. torque wrench).

Finger Tight = The point where the connector will no longer thread onto the mating part when tightened by hand or fingers. Finger Tight is relative to user strength and will have some variance. The average torque applied by this method is 3 ft. lbs. (4 Nm). Also referred to as 'Hand Tight.'

TFFT = Turns From Finger Tight; Application of a preload to a connection by first tightening the connection by hand (fingers) and applying an additional rotation counted by a defined number of turns by use of a tool.

FFWR = Flats From Wrench Resistance; Application of a preload to a connection by tightening to the point of initial wrench resistance and turning the nut a described number of 'flats'. A 'flat' is one side of the hexagonal tube nut and equates to 1/6 of a turn. Also referred to as the 'Flats Method.'

Assembly And Torque Specifications

Prior to selecting the appropriate torque from the tables within this section, it is necessary to properly identify the connector being installed. Refer to the Figures and Tables in this section.

GENERAL TUBE TYPE FITTING ASSEMBLY INSTRUCTIONS

1. Take precautions to ensure that fittings and mating components are not damaged during storage, handling or assembly. Nicks and scratches in sealing surfaces can create a path for leaks which could lead to component contamination and/or failure.
2. When making a connection to tubing, compression or flare, inspect the tube in the area of the fitting attachment to ensure that the tube has not been damaged.
3. The assembly process is one of the leading causes for contamination in air and hydraulic systems. Contamination can prevent proper tightening of fittings and adapters from occurring.
   - **a.** Avoid using dirty or oily rags when handling fittings.
   - **b.** If fittings are disassembled, they should be cleaned and inspected for damage. Replace fittings as necessary before re-installing.
   - **c.** Sealing compounds should be applied where specified; however, care should be taken not to introduce sealant into the system.
   - **d.** Avoid applying sealant to the area of the threads where the sealant will be forced into the system. This is generally the first two threads of a fitting.
   - **e.** Sealant should only be applied to the male threads.
   - **f.** Straight thread fittings do not require sealants. O-rings or washers are provided for sealing.
   - **g.** When replacing or installing an o-ring, care is to be taken while transferring the o-ring over the threads as it may become nicked or torn. When replacing an o-ring on a fitting, the use of a thread protector is recommended.
   - **h.** When installing fittings with o-rings, lubrication shall be used to prevent scuffing or tearing of the o-ring. See o-ring Installation (Replacement) in this section.
4. Take care to identify the material of parts to apply the correct torque values.
   - **a.** Verify the material designation in the table headings.
   - **b.** If specifications are given only for steel fittings and components, the values for alternate materials shall be as follows: Aluminum and Brass- reduce steel values by 35%; Stainless Steel- Use the upper limit for steel.
5. To achieve the specified torque, the torque wrench is to be held perpendicular to the axis of rotation.

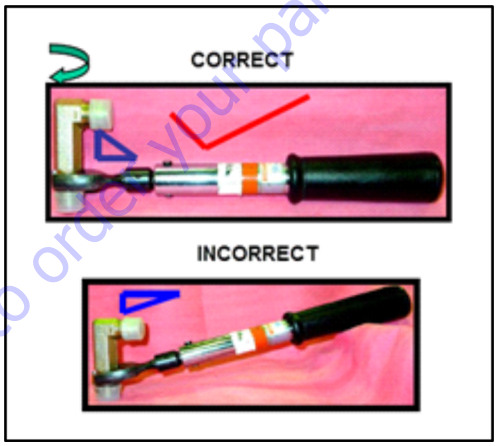


Figure 5-10. Torque Wrench Angle

6. Refer to the appropriate section in this manual for more specific instructions and procedures for each type of fitting connection.

Assembly Instructions for American Standard Pipe Thread Tapered (NPTF) Connections.

1. Inspect components to ensure male and female port threads are free of rust, splits, dirt, foreign matter, or burrs.
2. Apply a suitable thread sealant, such as Loctite 567, to the male pipe threads if not already applied. Ensure the first 1 to 2 threads are uncovered to prevent system contamination.
3. Assemble connection hand tight.
4. Mark fittings, male and female.

⚠ CAUTION

OVER TIGHTENING MAY CAUSE DEFORMATION OF THE PIPE FITTING AND DAMAGE TO THE JOINING FITTING, FLANGE OR COMPONENT MAY OCCUR.

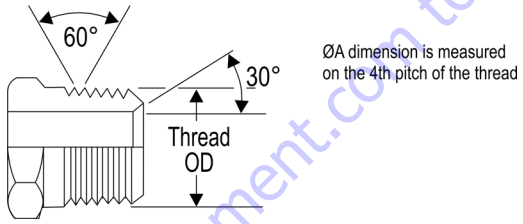
NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGNMENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.

5. Rotate male fitting the number of turns per Table 5-1, NPTF Pipe Thread. See FFWR and TFFT Methods for TFFT procedure requirements.

NOTE: *TFFT values provided in Table 5-1, NPTF Pipe Thread are applicable for the following material configurations:*

- STEEL fittings with STEEL mating components
- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 5-1. NPTF Pipe Thread



TYPE/FITTING IDENTIFICATION					Turns From Finger Tight (TFFT)**
Material	Dash Size	Thread Size	ØA*		
		(UNF)	(in)	(mm)	
STEEL, ALUMINUM, OR BRASS FITTINGS WITH **STEEL, ALUMINUM, OR BRASS** MATING COMPONENTS	2	1/8-27	0.40	10.24	2 to 3
	4	1/4-18	0.54	13.61	2 to 3
	6	3/8-18	0.67	17.05	2 to 3
	8	1/2-14	0.84	21.22	2 to 3
	12	3/4-14	1.05	26.56	2 to 3
	16	1-11 1/2	1.31	33.22	1.5 to 2.5
	20	1 1/4-11 1/2	1.65	41.98	1.5 to 2.5
	24	1 1/2-11 1/2	1.89	48.05	1.5 to 2.5
	32	2-11 1/2	2.37	60.09	1.5 to 2.5

* ØA thread dimension for reference only.

** See FFWR and TFFT Methods subsection for TFFT procedure requirements.

Assembly Instructions for British Standard Pipe Thread Tapered (BSPT) Connections

1. Inspect components to ensure male and female port threads are free of rust, splits, dirt, foreign matter, or burrs.
2. Apply a suitable thread sealant, such as Loctite 567, to the male pipe threads if not already applied. Ensure the first 1 to 2 threads are uncovered to prevent system contamination.
3. Assemble connection hand tight.
4. Mark fittings, male and female.

⚠ CAUTION

OVER TIGHTENING MAY CAUSE DEFORMATION OF THE PIPE FITTING AND DAMAGE TO THE JOINING FITTING, FLANGE OR COMPONENT MAY OCCUR.

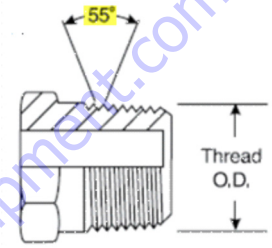
NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGNMENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.

5. Rotate male fitting the number of turns per Table 5-2, BSPT Pipe Thread. See FFWR and TFFT Methods for TFFT procedure requirements.

NOTE: *TFFT values provided in Table 5-2, BSPT Pipe Thread are applicable for the following material configurations:*

- STEEL fittings with STEEL mating components
- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 5-2. BSPT Pipe Thread



TYPE/FITTING IDENTIFICATION					Turns From Finger Tight (TFFT)**
MATERIAL	Dash Size	Thread Size (BSPT)	ØA* (in)	ØA* (mm)	
STEEL, ALUMINUM, OR BRASS FITTINGS WITH **STEEL, ALUMINUM, OR BRASS** MATING COMPONENTS	2	1/8-28	0.38	9.73	2 to 3
	4	1/4-19	0.52	13.16	2 to 3
	6	3/8-19	0.66	16.66	2 to 3
	8	1/2-14	0.83	20.96	2 to 3
	12	3/4-14	1.04	26.44	2 to 3
	16	1-11	1.31	33.25	1.5 to 2.5
	20	1 1/4-11	1.65	41.91	1.5 to 2.5
	24	1 1/2-11	1.88	47.80	1.5 to 2.5
	32	2-11	2.35	59.61	1.5 to 2.5

* ØA thread dimension for reference only.

** See Appendix B for TFFT procedure requirements.

Assembly Instructions for 37° (JIC) Flare Fittings

1. Inspect the flare for obvious visual squareness and concentricity issues with the tube OD. Ensure surface is smooth, free of rust, weld and brazing splatter, splits, dirt, foreign matter, or burrs. If necessary replace fitting or adapter.

⚠ CAUTION

DO NOT FORCE A MISALIGNED OR SHORT HOSE/TUBE INTO ALIGNMENT. IT PUTS UNDESIRABLE STRAIN ONTO THE JOINT EVENTUALLY LEADING TO LEAKAGE.

2. Align tube to fitting and start threads by hand.

⚠ CAUTION

THE TORQUE METHOD SHOULD NOT BE USED ON LUBRICATED OR OILY FITTINGS. NO LUBRICATION OR SEALANT IS REQUIRED. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

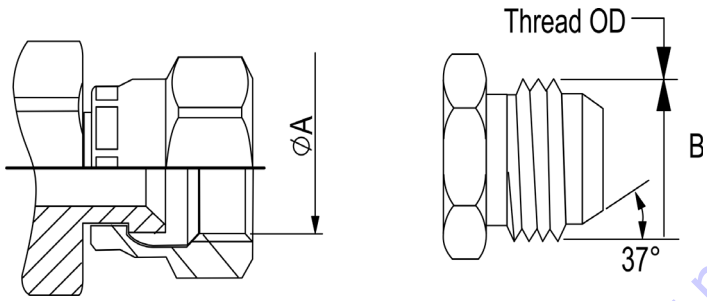
3. Torque assembly to value listed in Table 5-3, 37° Flare (JIC)Thread - Steel or Table 5-4, 37° Flare (JIC)Thread - Aluminum/Brass while using the Double Wrench Method per Double Wrench Method. Refer to FFWR and TFFT Methods for procedure requirements if using the FFWR method.

NOTE: *Torque values provided in Table Table 5-3, 37° Flare (JIC)Thread - Steel and Table 5-4, 37° Flare (JIC)Thread - Aluminum/Brass are segregated based on the material configuration of the connection.*

ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 5-3. 37° Flare (JIC)Thread - Steel

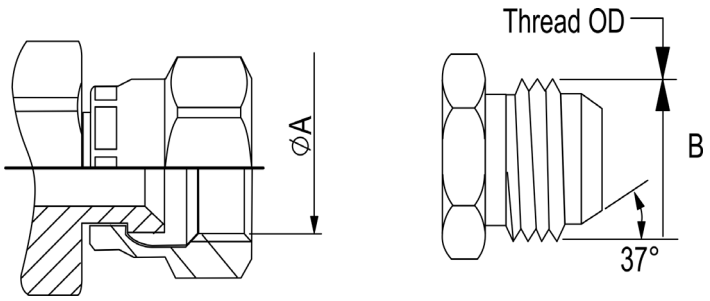


Type/Fitting Identification							Torque						Flats from Wrench Resistance (F.F.W.R)**
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max	
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.28	7.00	0.31	7.75	6	7	7	8	9	10	--
	3	3/8-24	0.34	8.60	0.37	9.50	8	9	10	11	12	14	--
	4	7/16-20	0.39	10.00	0.44	11.10	13	14	14	18	19	19	1-1/2 to 1-3/4
	5	1/2-20	0.46	11.60	0.50	12.70	14	15	15	19	20	21	1 to 1-1/2
	6	9/16-18	0.51	13.00	0.56	14.30	22	23	24	30	31	33	1 to 1-1/2
	8	3/4-16	0.69	17.60	0.75	19.10	42	44	46	57	60	63	1-1/2 to 1-3/4
	10	7/8-14	0.81	20.50	0.87	22.20	60	63	66	81	85	89	1 to 1-1/2
	12	1 1/16-12	0.97	24.60	1.06	27.00	84	88	92	114	120	125	1 to 1-1/2
	14	1 3/16-12	1.11	28.30	1.19	30.10	100	105	110	136	142	149	1 to 1-1/2
	16	1 5/16-12	1.23	31.30	1.31	33.30	118	124	130	160	168	176	3/4 to 1
	20	1 5/8-12	1.54	39.20	1.63	41.30	168	176	185	228	239	251	3/4 to 1
	24	1 7/8-12	1.80	45.60	1.87	47.60	195	205	215	264	278	291	3/4 to 1
	32	2 1/2-12	2.42	61.50	2.50	63.50	265	278	292	359	377	395	3/4 to 1

* ØA and ØB thread dimensions for reference only.

** See Appendix B for FFWR procedure requirements.

Table 5-4. 37° Flare (JIC)Thread - Aluminum/Brass



TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max	
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.28	7.00	0.31	7.75	4	4	5	5	6	7	--
	3	3/8-24	0.34	8.60	0.37	9.50	5	6	7	7	8	9	--
	4	7/16-20	0.39	10.00	0.44	11.10	8	9	9	11	12	13	1-1/2 to 1-3/4
	5	1/2-20	0.46	11.60	0.50	12.70	9	10	10	12	13	14	1 to 1-1/2
	6	9/16-18	0.51	13.00	0.56	14.30	14	15	16	19	20	21	1 to 1-1/2
	8	3/4-16	0.69	17.60	0.75	19.10	27	29	30	37	39	41	1-1/2 to 1-3/4
	10	7/8-14	0.81	20.50	0.87	22.20	39	41	43	53	56	58	1 to 1-1/2
	12	11/16-12	0.97	24.60	1.06	27.00	55	57	60	74	78	81	1 to 1-1/2
	14	13/16-12	1.11	28.30	1.19	30.10	65	68	72	88	93	97	1 to 1-1/2
	16	15/16-12	1.23	31.30	1.31	33.30	77	81	84	104	109	114	3/4 to 1
	20	15/8-12	1.54	39.20	1.63	41.30	109	115	120	148	155	163	3/4 to 1
	24	17/8-12	1.80	45.60	1.87	47.60	127	133	139	172	180	189	3/4 to 1
	32	21/2-12	2.42	61.50	2.50	63.50	172	181	189	234	245	257	3/4 to 1

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for FFWR procedure requirements.

Assembly Instructions for 45° SAE Flare Fittings

1. Inspect the flare for obvious visual squareness and concentricity issues with the tube OD. Ensure surface is smooth, free of rust, weld and brazing splatter, splits, dirt, foreign matter, or burrs. If necessary replace fitting or adapter.

⚠ CAUTION

DO NOT FORCE A MISALIGNED OR SHORT HOSE/TUBE INTO ALIGNMENT. IT PUTS UNDESIRABLE STRAIN ONTO THE JOINT EVENTUALLY LEADING TO LEAKAGE.

2. Align tube to fitting.
3. Tighten fitting by hand until hand tight.

⚠ CAUTION

THE TORQUE METHOD SHOULD NOT BE USED ON LUBRICATED OR OILY FITTINGS. NO LUBRICATION OR SEALANT IS REQUIRED. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

Torque fitting to value listed in Table 5-5, 45° Flare (SAE) - Steel and Table 5-6, 45° Flare (SAE) - Aluminum/Brass while using the Double Wrench Method outlined in this section. Refer to FFWR and TFFT Methods for procedure requirements if using the TFFT method.

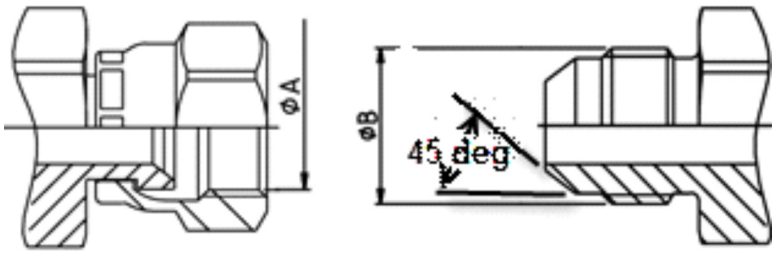
NOTE: *Torque values provided in Table 5-5, 45° Flare (SAE) - Steel and Table 5-6, 45° Flare (SAE) - Aluminum/Brass are segregated based on the material configuration of the connection.*

ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS

mating components.

Table 5-5. 45° Flare (SAE) - Steel

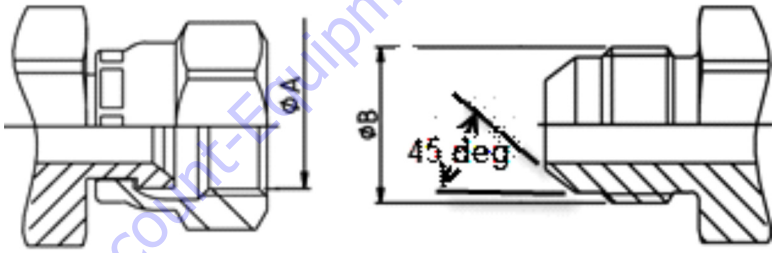


TYPE/FITTING IDENTIFICATION							Torque					
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]		
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	7/16-20	0.39	9.90	0.44	11.10	13	14	14	18	19	19
	6	5/8-18	0.56	14.30	0.63	15.90	22	23	24	30	31	33
	8	3/4-16	0.69	17.50	0.75	19.10	42	44	46	57	60	62
	10	7/8-14	0.81	20.60	0.87	22.20	60	63	66	81	85	89
	12	11/16-14	0.98	25.00	1.06	27.00	84	88	92	114	119	125

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for FFWR procedure requirements.

Table 5-6. 45° Flare (SAE) - Aluminum/Brass



TYPE/FITTING IDENTIFICATION							Torque					
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]		
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	4	7/16-20	0.39	9.90	0.44	11.10	8	9	9	11	12	12
	6	5/8-18	0.56	14.30	0.63	15.90	14	15	15	19	20	20
	8	3/4-16	0.69	17.50	0.75	19.10	27	29	30	37	39	41
	10	7/8-14	0.81	20.60	0.87	22.20	39	41	43	53	56	58
	12	11/16-14	0.98	25.00	1.06	27.00	55	58	61	75	79	83

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for TFFT procedure requirements.

Assembly Instructions for O-ring Face Seal (ORFS) Fittings

1. Ensure proper o-ring is installed. If o-ring is missing install per O-ring Installation (Replacement).
2. Ensure surface is smooth, free of rust, weld and brazing splatter, splits, dirt, foreign matter, or burrs. If necessary replace fitting or adapter.

⚠ CAUTION

CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

3. Pre-lubricate the o-ring with Hydraulic Oil.
4. Place the tube assembly against the fitting body so that the flat face comes in contact with the o-ring. Hand thread the nut onto the fitting body.
5. Torque nut to value listed in Table 5-7, O-ring Face Seal (ORFS) - Steel or Table 5-8, O-ring Face Seal (ORFS) - Aluminum/Brass while using the Double Wrench Method. Refer to FFWR and TFFT Methods for procedure requirements if using the FFWR method.

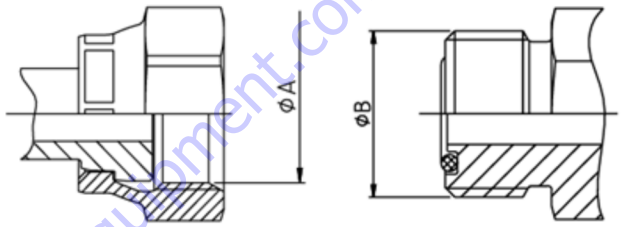
NOTE: *Torque values provided in Table 5-7, O-ring Face Seal (ORFS) - Steel and Table 5-8, O-ring Face Seal (ORFS) - Aluminum/Brass are segregated based on the material configuration of the connection.*

ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or

BRASS mating components

Table 5-7. O-ring Face Seal (ORFS) - Steel

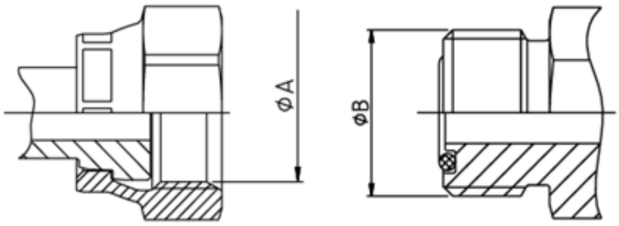


TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**	
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			Tube Nuts	Swivel & Hose Ends
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max		
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	9/16-18	0.51	13.00	0.56	14.20	18	19	20	25	26	27	1/4 to 1/2	1/2 to 3/4
	6	11/16-16	0.63	15.90	0.69	17.50	30	32	33	40	43	45	1/4 to 1/2	1/2 to 3/4
	8	13/16-16	0.75	19.10	0.81	20.60	40	42	44	55	57	60	1/4 to 1/2	1/2 to 3/4
	10	1-14	0.94	23.80	1.00	25.40	60	63	66	81	85	89	1/4 to 1/2	1/2 to 3/4
	12	13/16-12	1.11	28.20	1.19	30.10	85	90	94	115	122	127	1/4 to 1/2	1/2 to 3/4
	16	17/16-12	1.34	34.15	1.44	36.50	110	116	121	149	157	164	1/4 to 1/2	1/2 to 3/4
	20	111/16-12	1.59	40.50	1.69	42.90	150	158	165	203	214	224	1/4 to 1/2	1/2 to 3/4
	24	2-12	1.92	48.80	2.00	50.80	230	242	253	312	328	343	1/4 to 1/2	1/2 to 3/4
	32	21/2-12	2.43	61.67	2.50	63.50	375	394	413	508	534	560	1/4 to 1/2	1/2 to 3/4

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methodsfor FFWR procedure requirements.

Table 5-8. O-ring Face Seal (ORFS) - Aluminum/Brass



TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**	
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			Tube Nuts	Swivel & Hose Ends
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max		
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	4	9/16-18	0.51	13.00	0.56	14.20	12	13	13	16	18	18	1/4 to 1/2	1/2 to 3/4
	6	11/16-16	0.63	15.90	0.69	17.50	20	21	22	27	28	30	1/4 to 1/2	1/2 to 3/4
	8	13/16-16	0.75	19.10	0.81	20.60	26	28	29	35	38	39	1/4 to 1/2	1/2 to 3/4
	10	1-14	0.94	23.80	1.00	25.40	39	41	43	53	56	58	1/4 to 1/2	1/2 to 3/4
	12	13/16-12	1.11	28.20	1.19	30.10	55	58	61	75	79	83	1/4 to 1/2	1/2 to 3/4
	16	17/16-12	1.34	34.15	1.44	36.50	72	76	79	98	103	107	1/4 to 1/2	1/2 to 3/4
	20	111/16-12	1.59	40.50	1.69	42.90	98	103	108	133	140	146	1/4 to 1/2	1/2 to 3/4
	24	2-12	1.92	48.80	2.00	50.80	12	13	13	16	18	18	1/4 to 1/2	1/2 to 3/4
	32	21/2-12	2.43	61.67	2.50	63.50	20	21	22	27	28	30	1/4 to 1/2	1/2 to 3/4

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for FFWR procedure requirements.

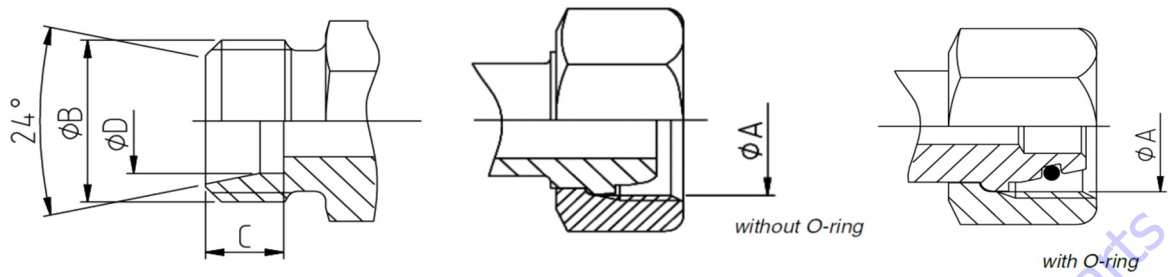
Assembly Instructions for DIN 24° Flare Bite Type Fittings (MBTL and MBTS)

⚠ CAUTION

A NON-SQUARE TUBE END CAN CAUSE IMPROPERLY SEATED FITTINGS AND LEAKAGE.

1. Inspect the components to ensure free of contamination, external damage, rust, splits, dirt, foreign matter, or burrs. Ensure tube end is visibly square. If necessary replace fitting or tube.
2. Lubricate thread and cone of fitting body or hardened pre-assembly tool, as well as the progressive ring and nut threads.
3. Slip nut and progressive ring over tube, assuring that they are in the proper orientation.
4. Push the tube end into the coupling body.
5. Slide collet into position and tighten until finger tight. Mark nut and tube in the finger-tight position. Tighten nut to the number of flats listed in Table 5-9, DIN 24°Cone (MBTL & MBTS) while using the Double Wrench Method. The tube must not turn with the nut.

Table 5-9. DIN 24°Cone (MBTL & MBTS)



TYPE/FITTING IDENTIFICATION								DIN 24° CONE FLARELESS BITE FITTING (With or Without o-ring)						
MATERIAL	TYPE	Tube O.D.	Thread M Size	ØA*	ØB*	C*	ØD*	Torque [Ft-Lb]			Torque [N-m]			Flats from Wrench Resistance (F.F.W.R)**
		(mm)	(Metric)	(mm)	(mm)	(mm)	(mm)	Min	Nom	Max	Min	Nom	Max	
STEEL FITTINGS WITH STEEL MATING COMPONENTS	DIN 24° CONE FLARELESS BITE (MBTL) FITTING	6	M12x1.5	10.50	12.00	7.00	6.20	FFWR is the recommended method of fitting assembly. Torque values are application specific due to variability in the fitting supplier, coating, lubrication, and other physical characteristics of the connection. Refer to the specific procedure in the						1.5 to 1.75
		8	M14x1.5	12.50	14.00	7.00	8.20							1.5 to 1.75
		10	M16x1.5	14.50	16.00	7.00	10.20							1.5 to 1.75
		12	M18x1.5	16.50	18.00	7.00	12.20							1.5 to 1.75
		15	M22x1.5	20.50	22.00	7.00	15.20							1.5 to 1.75
		18	M26x1.5	24.50	26.00	7.50	18.20							1.5 to 1.75
		22	M30x2	27.90	30.00	7.50	22.20							1.5 to 1.75
		28	M36x2	33.90	36.00	7.50	28.20							1.5 to 1.75
		35	M45x2	42.90	45.00	10.50	35.30							1.5 to 1.75
		42	M52x2	49.90	52.00	11.00	42.30							1.5 to 1.75
	TYPE	Tube O.D.	Thread M Size	ØA*	ØB*	C*	ØD*	Torque [Ft-Lb]			Torque [N-m]			Flats from Wrench Resistance (F.F.W.R)**
		(mm)	(Metric)	(mm)	(mm)	(mm)	(mm)	Min	Nom	Max	Min	Nom	Max	
	DIN 24° CONE FLARELESS BITE (MBTS) FITTING	6	M14x1.5	12.50	14.00	7.00	6.20	FFWR is the recommended method of fitting assembly. Torque values are application specific due to variability in the fitting supplier, coating, lubrication, and other physical characteristics of the connection. Refer to the specific procedure in the						1.5 to 1.75
		8	M16x1.5	14.50	16.00	7.00	8.20							1.5 to 1.75
		10	M18x1.5	16.50	18.00	7.50	10.20							1.5 to 1.75
		12	M20x1.5	18.50	20.00	7.50	12.20							1.5 to 1.75
		14	M22x1.5	20.50	22.00	8.00	14.20							1.5 to 1.75
		16	M24x1.5	22.50	24.00	8.50	16.20							1.5 to 1.75
		20	M30x2	27.90	30.00	10.50	20.20							1.5 to 1.75
		25	M36x2	33.90	36.00	12.00	25.20							1.5 to 1.75
		30	M42x2	39.90	42.00	13.50	30.20							1.5 to 1.75
		38	M52x2	49.90	52.00	16.00	38.30							1.5 to 1.75

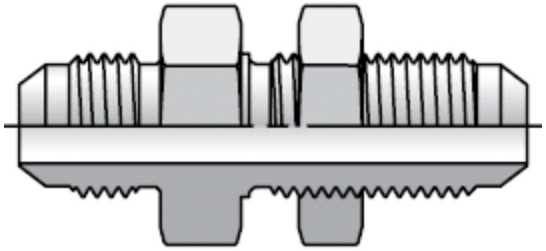
* ØA, ØB, C, & ØD thread dimensions for reference only.

** See Appendix B for FFWR procedure requirements.

Assembly Instructions for Bulkhead (BH) Fittings

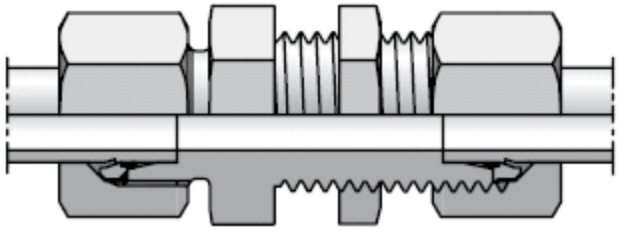
1. Ensure threads and surface are free of rust, weld and brazing splatter, splits, burrs or other foreign material. If necessary replace fitting or adapter.
2. Remove the locknut from the bulkhead assembly.
3. Insert the bulkhead side of the fitting into the panel or bulkhead bracket opening.
4. Hand thread the locknut onto the bulkhead end of the fitting body.
5. Torque nut onto fitting per Table 5-10 and Table 5-11 while using the Double Wrench Method.

Table 5-10. Bulkhead Fittings (BH) - INCH



TYPE/FITTING IDENTIFICATION				FASTENING JAM NUT for Bulkhead Connectors					
MATERIAL	TYPE	Dash Size	Thread Size	Torque					
				[Ft-Lb]			[N-m]		
			(UNF)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS	O-RING FACE SEAL (ORFS) BULKHEAD FITTING	4	9/16-18	15	16	17	20	22	23
		6	11/16-16	25	27	28	34	37	38
		8	13/16-16	55	58	61	75	79	83
		10	1-14	85	90	94	115	122	127
		12	13/16-12	135	142	149	183	193	202
		14	15/16-12	170	179	187	230	243	254
		16	17/16-12	200	210	220	271	285	298
		20	111/16-12	245	258	270	332	350	366
		24	2-12	270	284	297	366	385	403
	TYPE	Dash Size	Thread Size	Torque					
				[Ft-Lb]			[N-m]		
			(UNF)	Min	Nom	Max	Min	Nom	Max
	37° FLARE (JIC) BULKHEAD FITTING	3	3/8-24	8	9	9	11	12	12
		4	7/16-20	13	14	14	18	19	19
		5	1/2-20	20	21	22	27	28	30
		6	9/16-18	25	27	28	34	37	38
		8	3/4-16	50	53	55	68	72	75
		10	7/8-14	85	90	94	115	122	127
		12	11/16-12	135	142	149	183	193	202
		14	13/16-12	170	179	187	230	243	254
		16	15/16-12	200	210	220	271	285	298
		20	15/8-12	245	258	270	332	350	366
		24	17/8-12	270	284	297	366	385	403
		32	21/2-12	310	326	341	420	442	462

Table 5-11. Bulkhead Fittings (BH) - METRIC



TYPE/FITTING IDENTIFICATION				FASTENING JAM NUT for Bulkhead Connectors					
MATERIAL	TYPE	Connecting Tube O.D.	Thread M Size	Torque					
				[Ft-Lb]			[N-m]		
		(mm)	(metric)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS	DIN 24° CONE FLARELESS BITE (MBTL) BULKHEAD FITTING	6	M12x1.5	14	15	16	19	20	22
		8	M14x1.5	17	18	19	23	24	26
		10	M16x1.5	22	23	24	30	31	33
		12	M18x1.5	35	37	39	47	50	53
		15	M22x1.5	44	47	50	60	64	68
		18	M26x1.5	70	75	80	95	102	108
		22	M30x2	115	120	125	156	163	169
		28	M36x2	150	157	164	203	213	222
		35	M45x2	155	162	169	210	220	229
		42	M52x2	220	230	240	298	312	325
	DIN 24° CONE FLARELESS BITE (MBTS) BULKHEAD FITTING	Connecting Tube O.D.	Thread M Size	Torque					
				[Ft-Lb]			[N-m]		
		(mm)	(metric)	Min	Nom	Max	Min	Nom	Max
		6	M14x1.5	17	15	16	23	20	22
		8	M16x1.5	22	18	19	30	24	26
		10	M18x1.5	35	23	24	47	31	33
		12	M20x1.5	40	35	37	54	47	50
		14	M22x1.5	44	47	50	60	64	68
		16	M24x1.5	70	75	80	95	102	108
		20	M30x2	115	120	125	156	163	169
		25	M36x2	150	157	164	203	213	222
		30	M42x2	155	162	169	210	220	229
		38	M52x2	220	230	240	298	312	325

Assembly Instructions for O-ring Boss (ORB) Fittings

1. Inspect components to ensure that male and female port threads are free of rust, splits, dirt, foreign matter, or burrs.
2. Ensure proper o-ring is installed. If o-ring is missing install per O-ring Installation (Replacement).

⚠ CAUTION

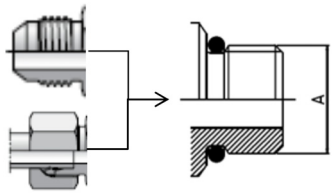
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

3. Pre-lubricate the o-ring with Hydraulic Oil.
4. For Non-Adjustable and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 5-12 through Table 5-17 while using the Double Wrench Method.
   a. The table headings identify the straight thread o-ring port and the type on the other side of the fitting. The torque will be applied to the straight thread o-ring port.
   b. Torque values provided in Table 5-12 through Table 5-17 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

7. Inspect to ensure the o-ring is not pinched and the washer is seated flat on the counterbore of the port.

Table 5-12. O-ring Boss (ORB) - Table 1 of 6



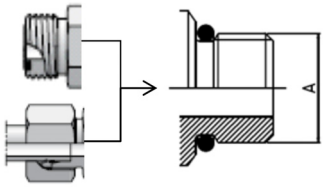
TYPE/FITTING IDENTIFICATION					HEX TYPE PLUGS & STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(85)	(90)	(94)	10	10	11
	3	3/8-24	0.37	9.52	(155)	(163)	(171)	18	18	19
	4	7/16-20	0.44	11.11	22	23	24	29	31	33
	5	1/2-20	0.50	12.70	23	25	26	32	34	35
	6	9/16-18	0.56	14.28	29	31	32	40	42	43
	8	3/4-16	0.75	19.10	52	55	57	70	75	77
	10	7/8-14	0.87	22.22	85	90	94	115	122	127
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
	32	2 1/2-12	2.50	63.50	375	394	413	510	534	560

TYPE/FITTING IDENTIFICATION					HEX TYPE PLUGS & STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(55)	(58)	(61)	6	7	7
	3	3/8-24	0.37	9.52	(101)	(106)	(111)	11	12	13
	4	7/16-20	0.44	11.11	14	15	16	19	20	22
	5	1/2-20	0.50	12.70	15	16	17	20	22	23
	6	9/16-18	0.56	14.28	19	20	21	26	27	28
	8	3/4-16	0.75	19.10	34	36	37	46	49	50
	10	7/8-14	0.87	22.22	55	58	61	75	79	83
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
	32	2 1/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

Table 5-13. O-ring Boss (ORB) - Table 2 of 6

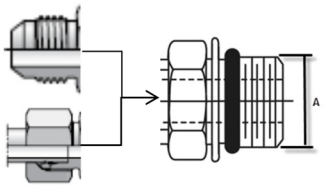


TYPE/FITTING IDENTIFICATION					STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	26	27	28	35	37	38
	5	1/2-20	0.50	12.70	30	32	33	40	43	45
	6	9/16-18	0.56	14.28	35	37	39	46	50	53
	8	3/4-16	0.75	19.10	60	63	66	80	85	89
	10	7/8-14	0.87	22.22	100	105	110	135	142	149
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
	32	2 1/2-12	2.50	63.50	375	394	413	510	534	560
TYPE/FITTING IDENTIFICATION					STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	17	18	18	23	24	24
	5	1/2-20	0.50	12.70	20	21	21	27	28	28
	6	9/16-18	0.56	14.28	23	24	24	31	33	33
	8	3/4-16	0.75	19.10	39	41	43	53	56	58
	10	7/8-14	0.87	22.22	65	69	72	88	94	98
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
	32	2 1/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

Table 5-14. O-ring Boss (ORB) - Table 3 of 6

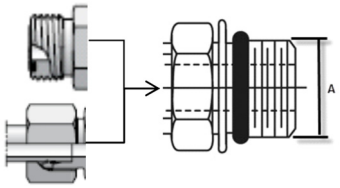


TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(60)	(63)	(66)	7	7	7
	3	3/8-24	0.37	9.52	(100)	(105)	(110)	11	12	12
	4	7/16-20	0.44	11.11	15	16	17	20	22	23
	5	1/2-20	0.50	12.70	21	22	23	28	30	31
	6	9/16-18	0.56	14.28	29	31	32	40	42	43
	8	3/4-16	0.75	19.10	52	55	57	70	75	77
	10	7/8-14	0.87	22.22	85	90	94	115	122	127
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
	32	2 1/2-12	2.50	63.50	375	394	413	510	534	560
TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(39)	(41)	(43)	4	5	5
	3	3/8-24	0.37	9.52	(65)	(69)	(72)	7	8	8
	4	7/16-20	0.44	11.11	10	11	11	14	15	15
	5	1/2-20	0.50	12.70	14	15	15	19	20	20
	6	9/16-18	0.56	14.28	19	20	21	26	27	28
	8	3/4-16	0.75	19.10	34	36	37	46	49	50
	10	7/8-14	0.87	22.22	55	58	61	75	79	83
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
	32	2 1/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

Table 5-15. O-ring Boss (ORB) - Table 4 of 6



TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	15	16	17	20	22	23
	5	1/2-20	0.50	12.70	30	32	33	40	43	45
	6	9/16-18	0.56	14.28	35	37	39	46	50	53
	8	3/4-16	0.75	19.10	60	63	66	80	85	89
	10	7/8-14	0.87	22.22	100	105	110	135	142	149
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
	32	2 1/2-12	2.50	63.50	375	394	413	510	534	560
TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	10	11	11	14	15	15
	5	1/2-20	0.50	12.70	20	21	21	27	28	28
	6	9/16-18	0.56	14.28	23	24	24	31	33	33
	8	3/4-16	0.75	19.10	39	41	43	53	56	58
	10	7/8-14	0.87	22.22	65	69	72	88	94	98
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
	32	2 1/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

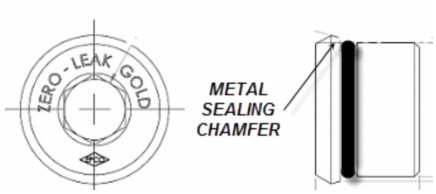
Table 5-16. O-ring Boss (ORB) - Table 5 of 6

TYPE/FITTING IDENTIFICATION					HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(30)	(32)	(33)	3	4	4
	3	3/8-24	0.37	9.52	(55)	(58)	(61)	6	7	7
	4	7/16-20	0.44	11.11	10	11	11	14	15	15
	5	1/2-20	0.50	12.70	14	15	16	19	20	22
	6	9/16-18	0.56	14.28	34	36	38	46	49	52
	8	3/4-16	0.75	19.10	60	63	66	80	85	89
	10	7/8-14	0.87	22.22	100	105	110	135	142	149
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
	32	2 1/2-12	2.50	63.50	375	394	413	510	534	560
TYPE/FITTING IDENTIFICATION					HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(20)	(21)	(21)	2	2	2
	3	3/8-24	0.37	9.52	(36)	(38)	(40)	4	4	5
	4	7/16-20	0.44	11.11	6	7	7	8	9	9
	5	1/2-20	0.50	12.70	9	10	10	12	14	14
	6	9/16-18	0.56	14.28	22	24	25	30	33	34
	8	3/4-16	0.75	19.10	39	41	43	53	56	58
	10	7/8-14	0.87	22.22	65	69	72	88	94	98
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
	32	2 1/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

Table 5-17. O-ring Boss (ORB) - Table 6 of 6



TYPE/FITTING IDENTIFICATION					ZERO LEAK GOLD® HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	2	3	4	3	4	5
	3	3/8-24	0.37	9.52	3	4	5	4	5	7
	4	7/16-20	0.44	11.11	7	8	9	9	11	12
	5	1/2-20	0.50	12.70	9	10	11	12	14	15
	6	9/16-18	0.56	14.28	11	12	13	15	16	18
	8	3/4-16	0.75	19.10	28	30	32	38	41	43
	10	7/8-14	0.87	22.22	46	48	50	62	65	68
	12	1 1/16-12	1.06	27.00	51	54	57	69	73	77
	14	1 3/16-12	1.19	30.10	Fitting size greater than -12 not typically specified on JLG applications. Consult specific service procedure if encountered.					
	16	1 5/16-12	1.31	33.30						
	20	1 5/8-12	1.63	41.30						
	24	1 7/8-12	1.87	47.60						
	32	2 1/2-12	2.50	63.50						

TYPE/FITTING IDENTIFICATION					ZERO LEAK GOLD® HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	2	3	4	3	4	5
	3	3/8-24	0.37	9.52	3	4	5	4	5	7
	4	7/16-20	0.44	11.11	7	8	9	9	11	12
	5	1/2-20	0.50	12.70	9	10	11	12	14	15
	6	9/16-18	0.56	14.28	11	12	13	15	16	18
	8	3/4-16	0.75	19.10	28	30	32	38	41	43
	10	7/8-14	0.87	22.22	46	48	50	62	65	68
	12	1 1/16-12	1.06	27.00	51	54	57	69	73	77
	14	1 3/16-12	1.19	30.10	Fitting size greater than -12 not typically specified on JLG applications. Consult specific service procedure if encountered.					
	16	1 5/16-12	1.31	33.30						
	20	1 5/8-12	1.63	41.30						
	24	1 7/8-12	1.87	47.60						
	32	2 1/2-12	2.50	63.50						

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

Assembly Instructions for Adjustable Port End Metric (MFF) Fittings

1. Inspect components to ensure that male and female threads and surfaces are free of rust, splits, dirt, foreign matter or burrs.
2. If o-ring is not pre-installed, install proper size, taking care not to damage it. See O-ring Installation (Replacement) for instructions.

⚠ CAUTION

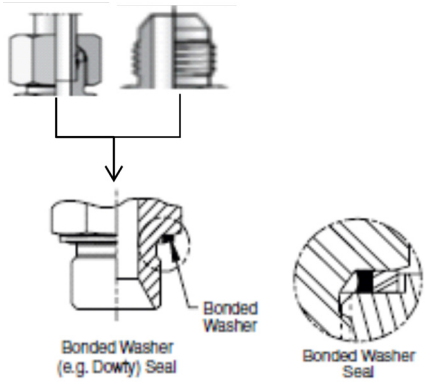
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

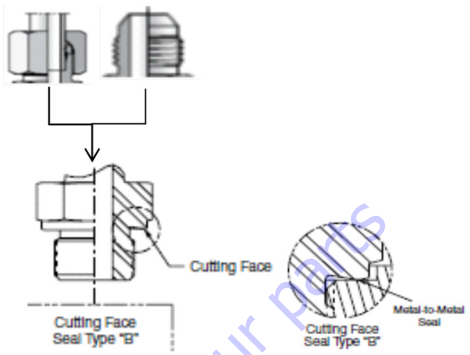
3. Pre-lubricate the o-ring with Hydraulic Oil.
4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 5-18, Table 5-19, Table 5-20, Table 5-21, Table 5-22, or Table 5-23 while using the Double Wrench Method.
   a. The table headings identify the Metric port and the type on the other side of the fitting. The torque will be applied to the Metric port.
   b. Torque values provided in Table 5-18, Table 5-19, Table 5-20, Table 5-21, Table 5-22, and Table 5-23 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

7. Inspect to ensure the o-ring is not pinched and the washer is seated flat on the counterbore of the port.

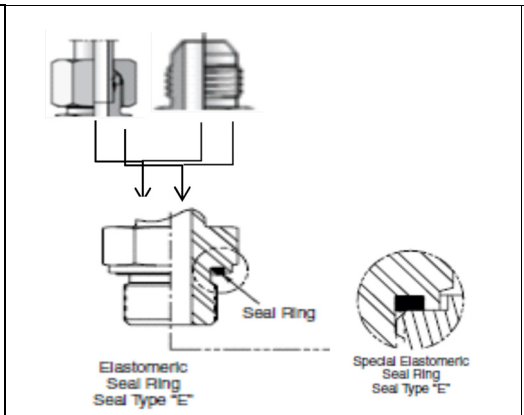
Table 5-18. Metric Flat Face Port (MFF) - L Series - Table 1 of 3

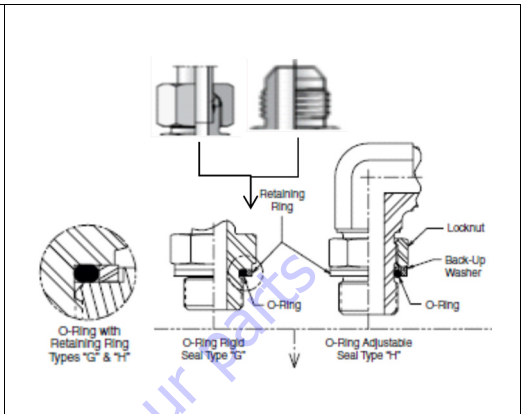




TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	7	8	8	9	11	11	13	14	14	18	19	19
	M12x1.5	8	15	16	17	20	22	23	22	23	24	30	31	33
	M14x1.5	10	26	28	29	35	38	39	33	35	36	45	47	49
	M16x1.5	12	33	35	36	45	47	49	48	51	53	65	69	72
	M18x1.5	15	41	43	45	55	58	61	59	62	65	80	84	88
	M22x1.5	18	48	51	53	65	69	72	103	108	113	140	146	153
	M27x2	22	66	70	73	90	95	99	140	147	154	190	199	209
	M33x2	28	111	117	122	150	159	165	251	264	276	340	358	374
	M42x2	35	177	186	195	240	252	264	369	388	406	500	526	550
	M48x2	42	214	225	235	290	305	319	465	489	512	630	663	694
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	4	5	5	5	7	7	8	9	9	11	12	12
	M12x1.5	8	10	11	11	14	15	15	14	15	16	19	20	22
	M14x1.5	10	17	18	19	23	24	26	21	22	23	28	30	31
	M16x1.5	12	21	22	23	28	30	31	31	33	34	42	45	46
	M18x1.5	15	27	28	29	37	38	39	38	40	42	52	54	57
	M22x1.5	18	31	33	34	42	45	46	67	70	73	91	95	99
	M27x2	22	43	45	47	58	61	64	91	96	100	123	130	136
	M33x2	28	72	76	79	98	103	107	163	171	179	221	232	243
	M42x2	35	115	121	127	156	164	172	240	252	264	325	342	358
	M48x2	42	139	146	153	188	198	207	302	318	332	409	431	450

Table 5-19. Metric Flat Face Port (MFF) - L Series - Table 2 of 3





TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	13	14	14	18	19	19	13	14	15	18	19	20
	M12x1.5	8	18	19	20	25	26	27	18	19	20	25	26	28
	M14x1.5	10	33	35	36	45	47	49	30	31	32	40	42	44
	M16x1.5	12	41	43	45	55	58	61	41	43	45	55	58	61
	M18x1.5	15	52	55	57	70	75	77	52	54	57	70	74	77
	M22x1.5	18	92	97	101	125	132	137	66	70	73	90	95	99
	M27x2	22	133	140	146	180	190	198	133	139	146	180	189	198
	M33x2	28	229	241	252	310	327	342	229	240	252	310	326	341
	M42x2	35	332	349	365	450	473	495	332	348	365	450	473	495
	M48x2	42	398	418	438	540	567	594	398	418	438	540	567	594
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	8	9	9	11	12	12	8	9	9	11	12	12
	M12x1.5	8	12	13	13	16	18	18	12	13	13	16	18	18
	M14x1.5	10	21	22	23	28	30	31	19	20	21	26	27	29
	M16x1.5	12	27	28	29	37	38	39	26	28	29	36	38	39
	M18x1.5	15	34	36	37	46	49	50	34	35	37	46	48	50
	M22x1.5	18	60	63	66	81	85	89	43	45	47	59	61	64
	M27x2	22	86	91	95	117	123	129	86	91	95	117	123	129
	M33x2	28	149	157	164	202	213	222	149	157	164	202	213	222
	M42x2	35	216	227	237	293	308	321	216	227	237	293	308	321
	M48x2	42	259	272	285	351	369	386	259	272	285	351	369	386

Table 5-20. Metric Flat Face Port (MFF) - L Series - Table 3 of 3

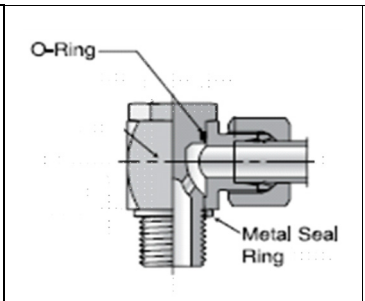
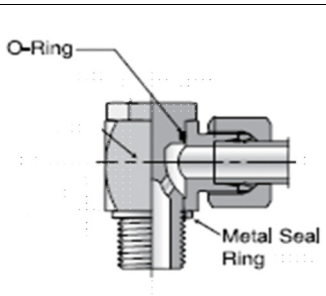
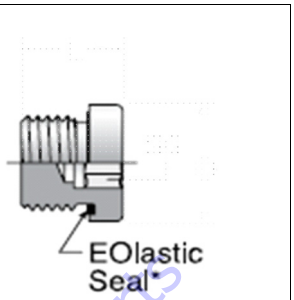
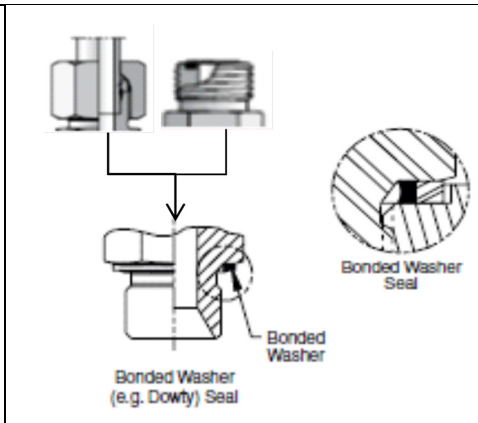
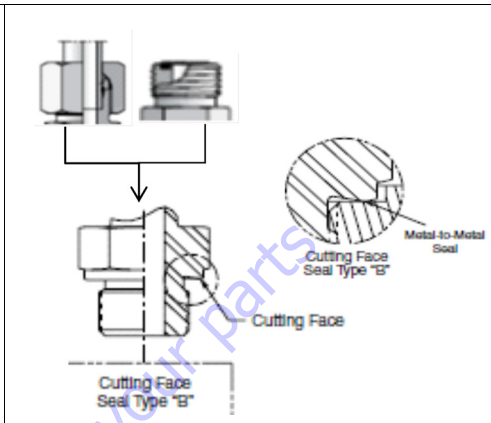
																				
TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with L series DIN (MBTL) opposite end						HIGH PRESSURE BANJO FITTINGS with L series DIN (MBTL) opposite end						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	13	14	14	18	19	19	13	14	14	18	19	19	9	10	10	12	14	14
	M12x1.5	8	26	28	29	35	38	39	33	35	36	45	47	49	18	19	20	25	26	27
	M14x1.5	10	37	39	41	50	53	56	41	43	45	55	58	61	26	28	29	35	38	39
	M16x1.5	12	44	46	48	60	62	65	59	62	65	80	84	88	41	43	45	55	58	61
	M18x1.5	15	59	62	65	80	84	88	74	78	81	100	106	110	48	51	53	65	69	72
	M22x1.5	18	89	94	98	120	127	133	103	108	113	140	146	153	66	70	73	90	95	99
	M27x2	22	96	101	106	130	137	144	236	248	260	320	336	353	100	105	110	135	142	149
	M33x2	28	--	--	--	--	--	--	266	280	293	360	380	397	166	175	183	225	237	248
	M42x2	35	--	--	--	--	--	--	398	418	438	540	567	594	266	280	293	360	380	397
	M48x2	42	--	--	--	--	--	--	516	542	568	700	735	770	266	280	293	360	380	397
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	8	9	9	11	12	12	8	9	9	11	12	12	6	7	7	8	9	9
	M12x1.5	8	17	18	19	23	24	26	21	22	23	28	30	31	12	13	13	16	18	18
	M14x1.5	10	24	26	27	33	35	37	27	28	29	37	38	39	17	18	19	23	24	26
	M16x1.5	12	29	30	31	39	41	42	38	40	42	52	54	57	27	28	29	37	38	39
	M18x1.5	15	38	40	42	52	54	57	48	51	53	65	69	72	31	33	34	42	45	46
	M22x1.5	18	58	61	64	79	83	87	67	70	73	91	95	99	43	45	47	58	61	64
	M27x2	22	62	66	69	84	89	94	153	161	169	207	218	229	65	69	72	88	94	98
	M33x2	28	--	--	--	--	--	--	173	182	190	235	247	258	108	114	119	146	155	161
	M42x2	35	--	--	--	--	--	--	259	272	285	351	369	386	173	182	190	235	247	258
	M48x2	42	--	--	--	--	--	--	335	352	369	454	477	500	173	182	190	235	247	258

Table 5-21. Metric Flat Face Port (MFF) - S Series - Table 1 of 3

TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end						FORM B (CUTTING FACE) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M12x1.5	6	15	16	17	20	22	23	26	28	29	35	38	39
	M14x1.5	8	26	28	29	35	38	39	41	43	45	55	58	61
	M16x1.5	10	33	35	36	45	47	49	52	55	57	70	75	77
	M18x1.5	12	41	43	45	55	58	61	81	85	89	110	115	121
	M20x1.5	14	41	43	45	55	58	61	111	117	122	150	159	165
	M22x1.5	16	48	51	53	65	69	72	125	132	138	170	179	187
	M27x2	20	66	70	73	89	95	99	199	209	219	270	283	297
	M33x2	25	111	117	122	150	159	165	302	317	332	410	430	450
	M42x2	30	177	186	195	240	252	264	398	418	438	540	567	594
	M48x2	38	214	225	235	290	305	319	516	542	568	700	735	770
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M12x1.5	6	10	11	11	14	15	15	17	18	19	23	24	26
	M14x1.5	8	17	18	19	23	24	26	27	28	29	37	38	39
	M16x1.5	10	21	22	23	28	30	31	34	36	37	46	49	50
	M18x1.5	12	27	28	29	37	38	39	53	56	58	72	76	79
	M20x1.5	14	27	28	29	37	38	39	72	76	79	98	103	107
	M22x1.5	16	31	33	34	42	45	46	81	86	90	110	117	122
	M27x2	20	43	45	47	58	61	64	129	136	142	175	184	193
	M33x2	25	72	76	79	98	103	107	196	206	216	266	279	293
	M42x2	30	115	121	127	156	164	172	259	272	285	351	369	386
	M48x2	38	139	146	153	188	198	207	335	352	369	454	477	500

Table 5-22. Metric Flat Face Port (MFF) - S Series - Table 2 of 3

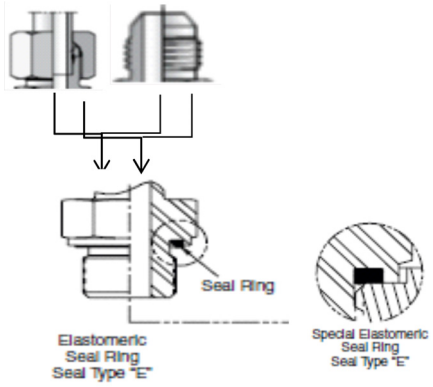
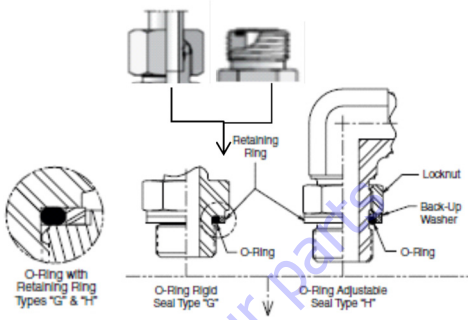
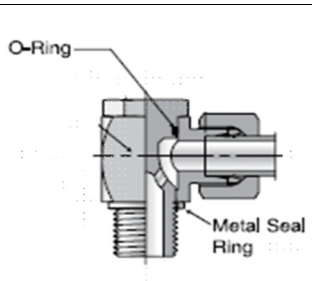
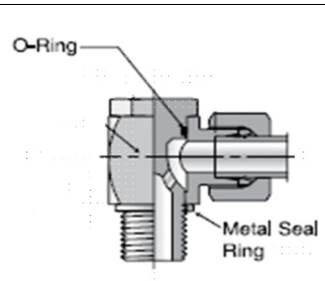
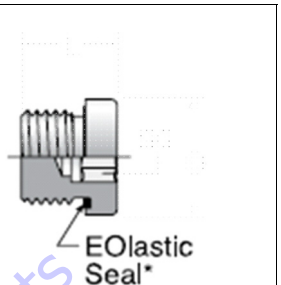
														
TYPE/FITTING IDENTIFICATION			FORM E (EOLASTIC SEALING RING) STUD ENDS AND HEX TYPE PLUGS with (ORFS) or S series DIN (MBTS) opposite end						FORM G/H (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	26	28	29	35	38	39	26	28	29	35	38	39
	M12x1.5	8	33	35	36	45	47	49	41	43	45	55	58	61
	M14x1.5	10	52	55	57	70	75	77	52	55	57	70	75	77
	M16x1.5	12	66	70	73	90	95	99	66	70	73	90	95	99
	M18x1.5	15	92	97	101	125	132	137	92	97	101	125	132	137
	M22x1.5	18	100	105	110	135	142	149	100	105	110	135	142	149
	M27x2	22	133	140	146	180	190	198	133	140	146	180	190	198
	M33x2	28	229	241	252	310	327	342	229	241	252	310	327	342
	M42x2	35	332	349	365	450	473	495	332	349	365	450	473	495
	M48x2	42	398	418	438	540	567	594	398	418	438	540	567	594
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	17	18	19	23	24	26	17	18	19	23	24	26
	M12x1.5	8	21	23	23	29	31	32	27	28	29	37	38	39
	M14x1.5	10	34	36	37	46	49	50	34	36	37	46	49	50
	M16x1.5	12	43	45	47	58	61	64	43	45	47	58	61	64
	M18x1.5	15	60	63	66	81	85	89	60	63	66	81	85	89
	M22x1.5	18	65	69	72	88	94	98	65	69	72	88	94	98
	M27x2	22	86	91	95	117	123	129	86	91	95	117	123	129
	M33x2	28	149	157	164	202	213	222	149	157	164	202	213	222
	M42x2	35	216	227	237	293	308	321	216	227	237	293	308	321
	M48x2	42	259	272	285	351	369	386	259	272	285	351	369	386

Table 5-23. Metric Flat Face Port (MFF) - L Series - Table 3 of 3

																				
TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with S series DIN (MBTS) opposite end						HIGH PRESSURE BANJO FITTINGS with S series DIN (MBTS) opposite end						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS								
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque						Torque								
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]					
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max			
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	26	28	29	35	38	39	33	35	36	45	47	49	--	--	--	--	--	--			
	M12x1.5	8	37	39	41	50	53	56	41	43	45	55	58	61	--	--	--	--	--	--			
	M14x1.5	10	44	46	48	60	62	65	59	62	65	80	84	88	--	--	--	--	--	--			
	M16x1.5	12	59	62	65	80	84	88	74	78	81	100	106	110	--	--	--	--	--	--			
	M18x1.5	15	81	85	89	110	115	121	92	97	101	125	132	137	59	62	65	80	84	88			
	M22x1.5	18	89	94	98	120	127	133	100	105	110	135	142	149	--	--	--	--	--	--			
	M27x2	22	100	105	110	135	142	149	236	248	260	320	336	353	--	--	--	--	--	--			
	M33x2	28	--	--	--	--	--	--	266	280	293	360	380	397	--	--	--	--	--	--			
	M42x2	35	--	--	--	--	--	--	398	418	438	540	567	594	--	--	--	--	--	--			
	M48x2	42	--	--	--	--	--	--	516	542	568	700	735	770	--	--	--	--	--	--			
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque						Torque								
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]					
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max			
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	17	18	19	23	24	26	21	22	23	28	30	31	--	--	--	--	--	--			
	M12x1.5	8	24	26	27	33	35	37	27	28	29	37	38	39	--	--	--	--	--	--			
	M14x1.5	10	29	30	31	39	41	42	38	40	42	52	54	57	--	--	--	--	--	--			
	M16x1.5	12	38	40	42	52	54	57	48	51	53	65	69	72	--	--	--	--	--	--			
	M18x1.5	15	53	56	58	72	76	79	60	63	66	81	85	89	38	40	42	52	54	57			
	M22x1.5	18	58	61	64	79	83	87	65	69	72	88	94	98	--	--	--	--	--	--			
	M27x2	22	65	69	72	88	94	98	153	161	169	207	218	229	--	--	--	--	--	--			
	M33x2	28	--	--	--	--	--	--	173	182	190	235	247	258	--	--	--	--	--	--			
	M42x2	35	--	--	--	--	--	--	259	272	285	351	369	386	--	--	--	--	--	--			
	M48x2	42	--	--	--	--	--	--	335	352	369	454	477	500	--	--	--	--	--	--			

Assembly Instructions for Metric ISO 6149 (MPP) Port Assembly Stud Ends

1. Inspect components to ensure that male and female threads and surfaces are free of rust, splits, dirt, foreign matter or burrs.
2. If o-ring is not pre-installed, install proper size, taking care not to damage it. See O-ring Installation (Replacement) for instructions.

⚠ CAUTION

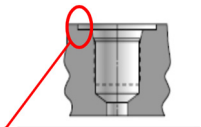
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

3. Pre-lubricate the o-ring with Hydraulic Oil.
4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 5-24 while using the Double Wrench Method.
   a. The table headings identify the Metric port and the type on the other side of the fitting. The torque will be applied to the Metric port.
   b. Torque values provided in Table 5-24 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

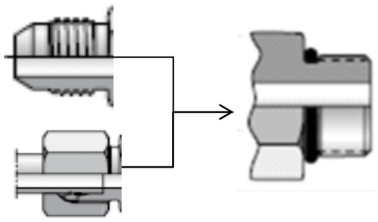
- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

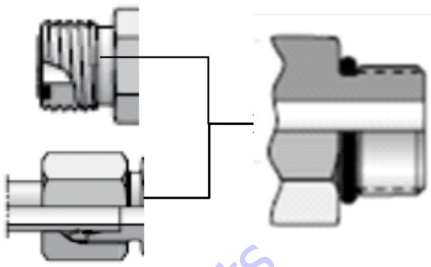
7. Inspect to ensure the o-ring is not pinched and the washer is seated flat on the counterbore of the port.

Table 5-24. Metric Pipe Parallel O-ring Boss (MPP)



Note: Metric O-ring only style (ISO 6149) requires o-ring chamfer in the port, similar to ISO 11926 (SAE ORB),**but is not interchangeable.**





TYPE/FITTING IDENTIFICATION			STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M8x1	4	6	7	7	8	9	9	8	9	9	10	12	12
	M10x1	6	11	12	12	15	16	16	15	16	17	20	22	23
	M12x1.5	8	18	19	20	25	26	27	26	28	29	35	38	39
	M14x1.5	10	26	28	29	35	38	39	33	35	36	45	47	49
	M16x1.5	12	30	32	33	40	43	45	41	43	45	55	58	61
	M18x1.5	15	33	35	36	45	47	49	52	55	57	70	75	77
	M20x1.5	--	--	--	--	--	--	--	59	62	65	80	84	88
	M22x1.5	18	44	46	48	60	62	65	74	78	81	100	106	110
	M27x2	22	74	78	81	100	106	110	125	132	138	170	179	187
	M30x2	--	95	100	105	130	136	142	175	184	193	237	249	262
	M33x2	25	120	126	132	160	171	179	230	242	253	310	328	343
	M38x2	--	135	142	149	183	193	202	235	247	259	319	335	351
	M42x2	30	155	163	171	210	221	232	245	258	270	330	350	366
	M48x2	38	190	200	209	260	271	283	310	326	341	420	442	462
	M60x2	50	230	242	253	315	328	343	370	389	407	500	527	552
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M8x1	4	4	5	5	5	7	7	5	6	6	7	8	8
	M10x1	6	7	8	8	9	11	11	10	11	11	14	15	15
	M12x1.5	8	12	13	13	16	18	18	17	18	19	23	24	26
	M14x1.5	10	17	18	19	23	24	26	21	22	23	28	30	31
	M16x1.5	12	20	21	21	27	28	28	27	28	29	37	38	39
	M18x1.5	15	21	22	23	28	30	31	34	36	37	46	49	50
	M20x1.5	--	--	--	--	--	--	--	30	40	42	41	54	57
	M22x1.5	18	29	30	31	39	41	42	48	51	53	65	69	72
	M27x2	22	48	51	53	65	69	72	81	86	90	110	117	122
	M30x2	--	62	65	68	84	88	92	114	120	125	155	163	169
	M33x2	25	78	82	86	106	111	117	150	157	164	203	213	222
	M38x2	--	88	93	97	119	126	132	153	161	168	207	218	228
	M42x2	30	101	106	111	137	144	150	159	168	176	216	228	239
	M48x2	38	124	130	136	168	176	184	202	212	222	274	287	301
	M60x2	50	150	157	164	203	213	222	241	253	265	327	343	359

Assembly instructions for Adjustable Port End (BSPP) Fittings

1. Inspect components to ensure that male and female threads and surfaces are free of rust, splits, dirt, foreign matter or burrs.
2. If o-ring is not pre-installed, install proper size, taking care not to damage it. See O-ring Installation (Replacement) for instructions.

⚠ CAUTION

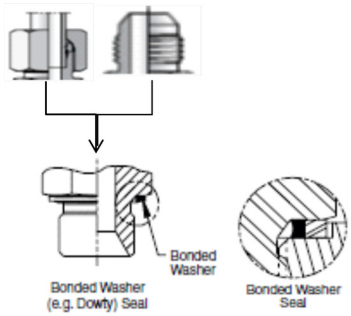
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

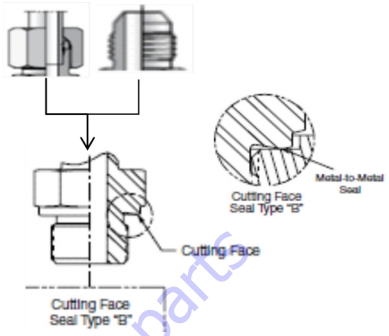
3. Pre-lubricate the o-ring with Hydraulic Oil.
4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 5-25, Table 5-26, Table 5-27, Table 5-28, Table 5-29, or Table 5-30 while using the Double Wrench Method.
   a. The table headings identify the BSPP port and the type on the other side of the fitting. The torque will be applied to the BSPP port.
   b. Torque values provided in Table 5-25, Table 5-26, Table 5-27, Table 5-28, Table 5-29, and Table 5-30 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

7. Inspect to ensure the o-ring is not pinched and the washer is seated flat on the counterbore of the port.

Table 5-25. British Standard Parallel Pipe Port (BSPP) - L Series - Table 1 of 3





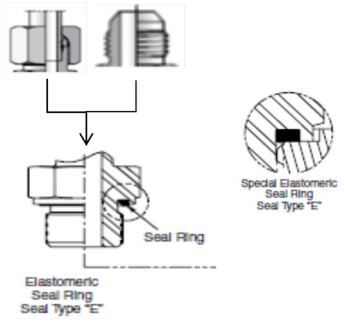
TYPE/FITTING IDENTIFICATION			FORM A**(SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B** (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	7	8	8	9	11	11	13	14	14	18	19	19
	G 1/4A	8	26	28	29	35	38	39	26	28	29	35	38	39
	G 1/4A	10	26	28	29	35	38	39	26	28	29	35	38	39
	G 3/8A	12	33	35	36	45	47	49	52	55	57	70	75	77
	G 1/2A	15	48	51	53	65	69	72	103	108	113	140	146	153
	G 1/2A	18	48	51	53	65	69	72	74	78	81	100	106	110
	G 3/4A	22	66	70	73	90	95	99	133	140	146	180	190	198
	G 1A	28	111	117	122	150	159	165	243	255	267	330	346	362
	G 1-1/4A	35	177	186	195	240	252	264	398	418	438	540	567	594
	G 1-1/2A	42	214	225	235	290	305	319	465	489	512	630	663	694
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	4	5	5	5	7	7	8	9	9	11	12	12
	G 1/4A	8	17	18	19	23	24	26	17	18	19	23	24	26
	G 1/4A	10	17	18	19	23	24	26	17	18	19	23	24	26
	G 3/8A	12	21	22	23	28	30	31	34	36	37	46	49	50
	G 1/2A	15	31	33	34	42	45	46	67	70	73	91	95	99
	G 1/2A	18	31	33	34	42	45	46	48	51	53	65	69	72
	G 3/4A	22	42	45	47	57	61	64	86	91	95	117	123	129
	G 1A	28	72	76	79	98	103	107	158	166	174	214	225	236
	G 1-1/4A	35	115	121	127	156	164	172	259	272	285	351	369	386
	G 1-1/2A	42	139	146	153	188	198	207	302	318	333	409	431	451

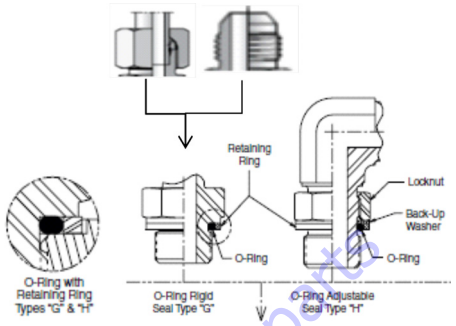
* Typical for JLG Straight Male Stud Fittings

** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings

Table 5-26. British Standard Parallel Pipe Port (BSPP) - L Series - Table 2 of 3





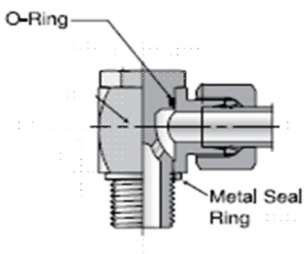
TYPE/FITTING IDENTIFICATION			FORM E* (EOLASTIC SEALING RING) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	13	14	14	18	19	19	13	14	14	18	19	19
	G 1/4A	8	26	28	29	35	38	39	26	28	29	35	38	39
	G 1/4A	10	26	28	29	35	38	39	26	28	29	35	38	39
	G 3/8A	12	52	55	57	70	75	77	52	55	57	70	75	77
	G 1/2A	15	66	70	73	90	95	99	66	70	73	90	95	99
	G 1/2A	18	66	70	73	90	95	99	66	70	73	90	95	99
	G 3/4A	22	133	140	146	180	190	198	133	140	146	180	190	198
	G 1A	28	229	241	252	310	327	342	229	241	252	310	327	342
	G 1-1/4A	35	332	349	365	450	473	495	332	349	365	450	473	495
	G 1-1/2A	42	398	418	438	540	567	594	398	418	438	540	567	594
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	8	9	9	11	12	12	8	9	9	11	12	12
	G 1/4A	8	17	18	19	23	24	26	17	18	19	23	24	26
	G 1/4A	10	17	18	19	23	24	26	17	18	19	23	24	26
	G 3/8A	12	34	36	37	46	49	50	34	36	37	46	49	50
	G 1/2A	15	43	45	47	58	61	64	43	45	47	58	61	64
	G 1/2A	18	43	45	47	58	61	64	43	45	47	58	61	64
	G 3/4A	22	86	91	95	117	123	129	86	91	95	117	123	129
	G 1A	28	149	157	164	202	213	222	149	157	164	202	213	222
	G 1-1/4A	35	216	227	237	293	308	321	216	227	237	293	308	321
	G 1-1/2A	42	259	272	285	351	369	386	259	272	285	351	369	386

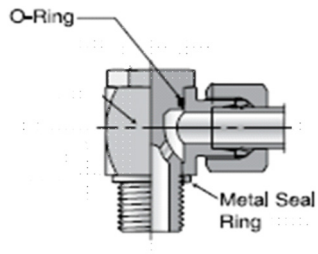
* Typical for JLG Straight Male Stud Fittings

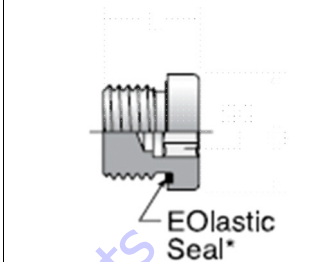
** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings

Table 5-27. British Standard Parallel Pipe Port (BSPP) - L Series - Table 3 of 3







TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with L series DIN (MBTL) opposite end						HIGH PRESSURE BANJO FITTINGS with L series DIN (MBTL) opposite end						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G1/8A	6	13	14	14	18	19	19	13	14	14	18	19	19	10	11	11	13	15	15
	G1/4A	8	30	32	33	40	43	45	33	35	36	45	47	49	22	23	24	30	31	33
	G1/4A	10	30	32	33	40	43	45	33	35	36	45	47	49	22	23	24	30	31	33
	G3/8A	12	48	51	53	65	69	72	52	55	57	70	75	77	44	46	48	60	62	65
	G1/2A	15	66	70	73	90	95	99	89	94	98	120	127	133	59	62	65	80	84	88
	G1/2A	18	66	70	73	90	95	99	89	94	98	120	127	133	59	62	65	80	84	88
	G3/4A	22	92	97	101	125	132	137	170	179	187	230	243	254	103	108	113	140	146	153
	G1A	28	--	--	--	--	--	--	236	248	260	320	336	353	148	156	163	200	212	221
	G1-1/4A	35	--	--	--	--	--	--	398	418	438	540	567	594	295	313.5	332	400	425	450
	G1-1/2A	42	--	--	--	--	--	--	516	542	568	700	735	770	332	349	365	450	473	495
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G1/8A	6	8	9	9	11	12	12	8	9	9	11	12	12	6	7	7	8	9	9
	G1/4A	8	20	21	21	27	28	28	21	22	23	28	30	31	14	15	16	19	20	22
	G1/4A	10	20	21	21	27	28	28	21	22	23	28	30	31	14	15	16	19	20	22
	G3/8A	12	31	33	34	42	45	46	34	36	37	46	49	50	29	30	31	39	41	42
	G1/2A	15	43	45	47	58	61	64	58	61	64	79	83	87	38	40	42	52	54	57
	G1/2A	18	43	45	47	58	61	64	58	61	64	79	83	87	38	40	42	52	54	57
	G3/4A	22	60	63	66	81	85	89	111	117	122	150	159	165	67	70	73	91	95	99
	G1A	28	--	--	--	--	--	--	153	161	169	207	218	229	96	101	106	130	137	144
	G1-1/4A	35	--	--	--	--	--	--	259	272	285	351	369	386	216	227	237	293	308	321
	G1-1/2A	42	--	--	--	--	--	--	335	352	369	454	477	500	216	227	237	293	308	321

* Typical for JLG Straight Male Stud Fittings

** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings

Table 5-28. British Standard Parallel Pipe Port (BSPP) - S Series - Table 1 of 3

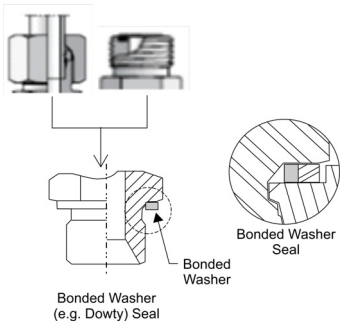
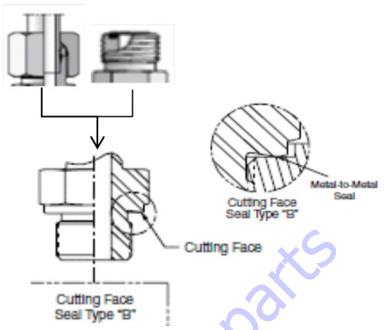
														
TYPE/FITTING IDENTIFICATION			FORM A** (SEALING WASHER) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end						FORM B** (CUTTING FACE) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	26	28	29	35	38	39	41	43	45	55	58	61
	G 1/4A	8	26	28	29	35	38	39	41	43	45	55	58	61
	G 3/8A	10	33	35	36	45	47	49	66	70	73	90	95	99
	G 3/8A	12	33	35	36	45	47	49	66	70	73	90	95	99
	G 1/2A	14	48	51	53	65	69	72	111	117	122	150	159	165
	G 1/2A	16	48	51	53	65	69	72	96	101	106	130	137	144
	G 3/4A	20	66	70	73	90	95	99	199	209	219	270	283	297
	G 1A	25	111	117	122	150	159	165	251	264	276	340	358	374
	G 1-1/4A	30	177	186	195	240	252	264	398	418	438	540	567	594
	G 1-1/2A	38	214	225	235	290	305	319	516	542	568	700	735	770
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	17	18	19	23	24	26	27	28	29	37	38	39
	G 1/4A	8	17	18	19	23	24	26	27	28	29	37	38	39
	G 3/8A	10	21	22	23	28	30	31	43	45	47	58	61	64
	G 3/8A	12	21	22	23	28	30	31	43	45	47	58	61	64
	G 1/2A	14	31	33	34	42	45	46	72	76	79	98	103	107
	G 1/2A	16	31	33	34	42	45	46	62	66	69	84	89	94
	G 3/4A	20	43	45	47	58	61	64	129	136	142	175	184	193
	G 1A	25	72	76	79	98	103	107	163	171	179	221	232	243
	G 1-1/4A	30	115	121	127	156	164	172	259	272	285	351	369	386
	G 1-1/2A	38	139	146	153	188	198	207	335	352	369	454	477	500
* Typical for JLG Straight Male Stud Fittings														
** Non typical for JLG Straight Male Stud Fittings, reference only.														
*** Typical for JLG Adjustable Fittings														

Table 5-29. British Standard Parallel Pipe Port (BSPP) - S Series - Table 2 of 3

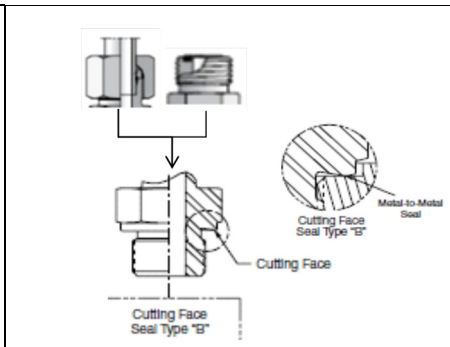
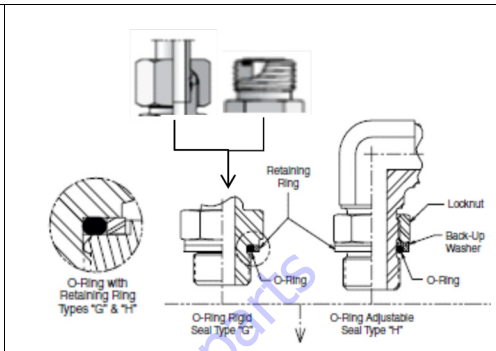
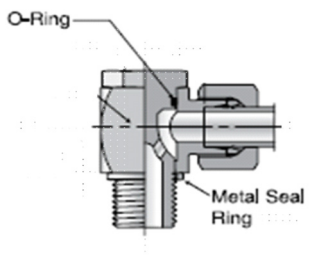
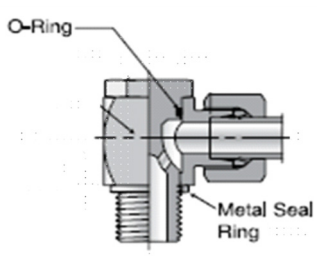
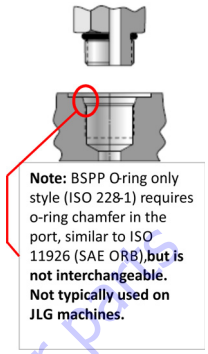
														
TYPE/FITTING IDENTIFICATION			FORM E* (EOLASTIC SEALING RING) STUD ENDS AND HEX TYPE PLUGS with (ORFS) or S series DIN (MBTS) opposite end						FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	41	43	45	55	58	61	26	28	29	35	38	39
	G 1/4A	8	41	43	45	55	58	61	26	28	29	35	38	39
	G 3/8A	10	59	62	65	80	84	88	52	55	57	70	75	77
	G 3/8A	12	59	62	65	80	84	88	52	55	57	70	75	77
	G 1/2A	14	85	90	94	115	122	127	66	70	73	90	95	99
	G 1/2A	16	85	90	94	115	122	127	66	70	73	90	95	99
	G 3/4A	20	133	140	146	180	190	198	133	140	146	180	190	198
	G 1A	25	229	241	252	310	327	342	229	241	252	310	327	342
	G 1-1/4A	30	332	349	365	450	473	495	332	349	365	450	473	495
	G 1-1/2A	38	398	418	438	540	567	594	398	418	438	540	567	594
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	27	28	29	37	38	39	17	18	19	23	24	26
	G 1/4A	8	27	28	29	37	38	39	17	18	19	23	24	26
	G 3/8A	10	38	40	42	52	54	57	34	36	37	46	49	50
	G 3/8A	12	38	40	42	52	54	57	34	36	37	46	49	50
	G 1/2A	14	55	58	61	75	79	83	43	45	47	58	61	64
	G 1/2A	16	55	58	61	75	79	83	43	45	47	58	61	64
	G 3/4A	20	86	91	95	117	123	129	86	91	95	117	123	129
	G 1A	25	149	157	164	202	213	222	149	157	164	202	213	222
	G 1-1/4A	30	216	227	237	293	308	321	216	227	237	293	308	321
	G 1-1/2A	38	259	272	285	351	369	386	259	272	285	351	369	386
* Typical for JLG Straight Male Stud Fittings														
** Non typical for JLG Straight Male Stud Fittings, reference only.														
*** Typical for JLG Adjustable Fittings														

Table 5-30. British Standard Parallel Pipe Port (BSPP) - S Series - Table 3 of 3







TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with S series DIN (MBTS) opposite end						HIGH PRESSURE BANJO FITTINGS with S series DIN (MBTS) opposite end						JIS/BSPP O-RING ONLY					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	30	32	33	40	43	45	33	35	36	45	47	49	Fitting type not typically specified on JLG applications. Refer to the specific procedure in this Service Manual.					
	G 1/4A	8	30	32	33	40	43	45	33	35	36	45	47	49						
	G 3/8A	10	48	51	53	65	69	72	52	55	57	70	75	77						
	G 3/8A	12	48	51	53	65	69	72	52	55	57	70	75	77						
	G 1/2A	14	66	70	73	90	95	99	89	94	98	120	127	133						
	G 1/2A	16	66	70	73	90	95	99	89	94	98	120	127	133						
	G 3/4A	20	92	97	101	125	132	137	170	179	187	230	243	254						
	G 1A	25	--	--	--	--	--	--	236	248	260	320	336	353						
	G 1-1/4A	30	--	--	--	--	--	--	398	418	438	540	567	594						
	G 1-1/2A	38	--	--	--	--	--	--	516	542	568	700	735	770						
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	20	21	21	27	28	28	22	22	23	30	30	31	Fitting type not typically specified on JLG applications. Refer to the specific procedure in this Service Manual.					
	G 1/4A	8	20	21	21	27	28	28	22	22	23	30	30	31						
	G 3/8A	10	31	33	34	42	45	46	34	36	37	46	49	50						
	G 3/8A	12	31	33	34	42	45	46	34	36	37	46	49	50						
	G 1/2A	14	43	45	47	58	61	64	58	61	64	79	83	87						
	G 1/2A	16	43	45	47	58	61	64	58	61	64	79	83	87						
	G 3/4A	20	60	63	66	81	85	89	111	117	122	150	159	165						
	G 1A	25	--	--	--	--	--	--	153	161	169	207	218	229						
	G 1-1/4A	30	--	--	--	--	--	--	259	272	285	351	369	386						
	G 1-1/2A	38	--	--	--	--	--	--	335	352	368	454	477	499						

* Typical for JLG Straight Male Stud Fittings

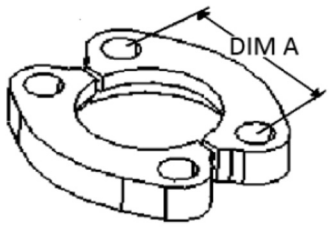
** Non typical for JLG Straight Male Stud Fittings, reference only.

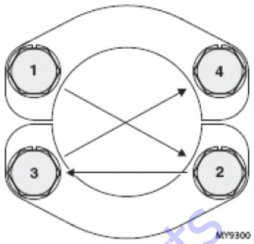
*** Typical for JLG Adjustable Fittings

Assembly Instructions for Flange Connections: (FL61 and FL62)

1. Make sure sealing surfaces are free of rust, splits, scratches, dirt, foreign matter or burrs.
2. Install o-ring as per “O-ring Installation (Replacement)” .
3. Pre-lubricate the o-ring with Hydraulic Oil.
4. Position flange and clamp halves.
5. Place lock washers on bolt and bolt through clamp halves.
6. Tighten all bolts by hand.
7. Torque bolts in diagonal sequence in two or more increments to the torque listed on Table 5-31and Table 5-32.

Table 5-31. Flange Code (FL61 & FL62) -Inch Fasteners

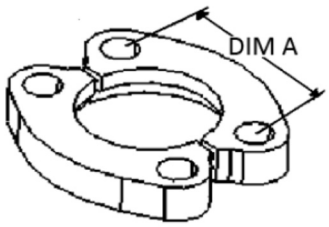


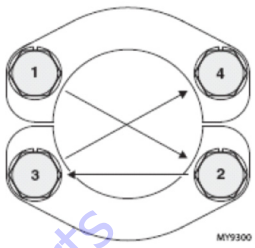


TYPE/FITTING IDENTIFICATION						STEEL 4-BOLT FLANGE SAE J518 (INCH FASTENERS)													
TYPE	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with GRADE 5 Screws						Fastener Torque for Flanges Equipped with GRADE 8 Screws					
							[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
		(in)	(mm)	(in)	(mm)	(UNF)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
CODE 61 SPLIT FLANGE (FL61)	8	0.50	13	1.50	38.10	5/16-18	18	19	19	24	25	26	24	25	26	32	34	35
	12	0.75	19	1.88	47.75	3/8-16	32	33	35	43	45	47	44	46	49	60	63	66
	16	1.00	25	2.06	52.32	3/8-16	32	33	35	43	45	47	44	46	49	60	63	66
	20	1.25	32	2.31	58.67	7/16-14	52	54	57	70	74	77	68	71	75	92	97	101
	24	1.50	38	2.75	69.85	1/2-13	77	81	85	105	110	116	111	116	122	150	158	165
	32	2.00	51	3.06	77.72	1/2-13	77	81	85	105	110	116	111	116	122	150	158	165
	40	2.50	64	3.50	88.90	1/2-13	77	81	85	105	110	116	111	116	122	150	158	165
	48	3.00	76	4.19	106.43	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325
	56	3.50	89	4.75	120.65	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325
	64	4.00	102	5.13	130.30	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325
	80	5.00	127	6.00	152.40	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325
TYPE	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with GRADE 5 Screws						Fastener Torque for Flanges Equipped with GRADE 8 Screws					
							[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
		(in)	(mm)	(in)	(mm)	(UNF)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
CODE 62 SPLIT FLANGE (FL62)	8	0.50	13	1.59	40.39	5/16-18	--	--	--	--	--	--	24	25	26	32	34	35
	12	0.75	19	2.00	50.80	3/8-16	--	--	--	--	--	--	44	46	49	60	63	66
	16	1.00	25	2.25	57.15	7/16-14	--	--	--	--	--	--	68	71	75	92	97	101
	20	1.25	32	2.62	66.55	1/2-13	--	--	--	--	--	--	111	116	122	150	158	165
	20	1.25	32	2.62	66.55	--	--	--	--	--	--	--	--	--	--	--	--	--
	24	1.50	38	3.12	79.25	5/8-11	--	--	--	--	--	--	218	228	239	295	310	325
	32	2.00	51	3.81	96.77	3/4-10	--	--	--	--	--	--	332	348	365	450	473	495

* A dimension for reference only.

Table 5-32. Flange Code (FL61 & FL62) - Metric Fasteners





TYPE/FITTING IDENTIFICATION						STEEL 4-BOLT FLANGE SAE J518 (INCH FASTENERS)													
TYPE	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with CLASS 8.8 Screws						Fastener Torque for Flanges Equipped with CLASS 10.9 Screws					
							[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
		(in)	(mm)	(in)	(mm)	(Metric)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
CODE 61 SPLIT FLANGE (FL61)	8	0.50	13	1.50	38.10	(Metric)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
	12	0.75	19	1.88	47.75	M8x1.25	18	19	19	24	25	26	18	19	19	24	25	26
	16	1.00	25	2.06	52.32	M10x1.5	37	39	41	50	53	55	37	39	41	50	53	55
	20	1.25	32	2.31	58.67	M10x1.5	37	39	41	50	53	55	37	39	41	50	53	55
	24	1.50	38	2.75	69.85	M10x1.5	37	39	41	50	53	55	37	39	41	50	53	55
	32	2.00	51	3.06	77.72	M12x1.75	68	71	75	92	97	101	68	71	75	92	97	101
	40	2.50	64	3.50	88.90	M12x1.75	68	71	75	92	97	101	68	71	75	92	97	101
	48	3.00	76	4.19	106.43	M12x1.75	68	71	75	92	97	101	68	71	75	92	97	101
	56	3.50	89	4.75	120.65	M16x2	155	163	170	210	221	231	155	163	170	210	221	231
	64	4.00	102	5.13	130.30	M16x2	155	163	170	210	221	231	155	163	170	210	221	231
	80	5.00	127	6.00	152.40	M16x2	155	163	170	210	221	231	155	163	170	210	221	231
TYPE	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with CLASS 8.8 Screws						Fastener Torque for Flanges Equipped with CLASS 10.9 Screws					
							[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
		(in)	(mm)	(in)	(mm)	(Metric)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
CODE 62 SPLIT FLANGE (FL62)	8	0.50	13	1.59	40.39	M8x1.25	--	--	--	--	--	--	24	25	26	32	34	35
	12	0.75	19	2.00	50.80	M10x1.5	--	--	--	--	--	--	52	54	57	70	74	77
	16	1.00	25	2.25	57.15	M12x1.75	--	--	--	--	--	--	96	101	105	130	137	143
	20	1.25	32	2.62	66.55	M12x1.75	--	--	--	--	--	--	96	101	105	130	137	143
	20	1.25	32	2.62	66.55	M14x2	--	--	--	--	--	--	133	139	146	180	189	198
	24	1.50	38	3.12	79.25	M16x2	--	--	--	--	--	--	218	228	239	295	310	325
	32	2.00	51	3.81	96.77	M20x2.5	--	--	--	--	--	--	406	426	446	550	578	605

* A dimension for reference only.

Double Wrench Method

To prevent undesired hose or connector rotation, two wrenches must be used; one torque wrench and one backup wrench. If two wrenches are not used, inadvertent component rotation may occur which absorbs torque and causes improper joint load and leads to leaks. For hose connections, the 'layline' printed on the hose is a good indicator of proper hose installation. A twisted lay-line usually indicates the hose is twisted. See Figure 5-11. for double wrench method requirements.

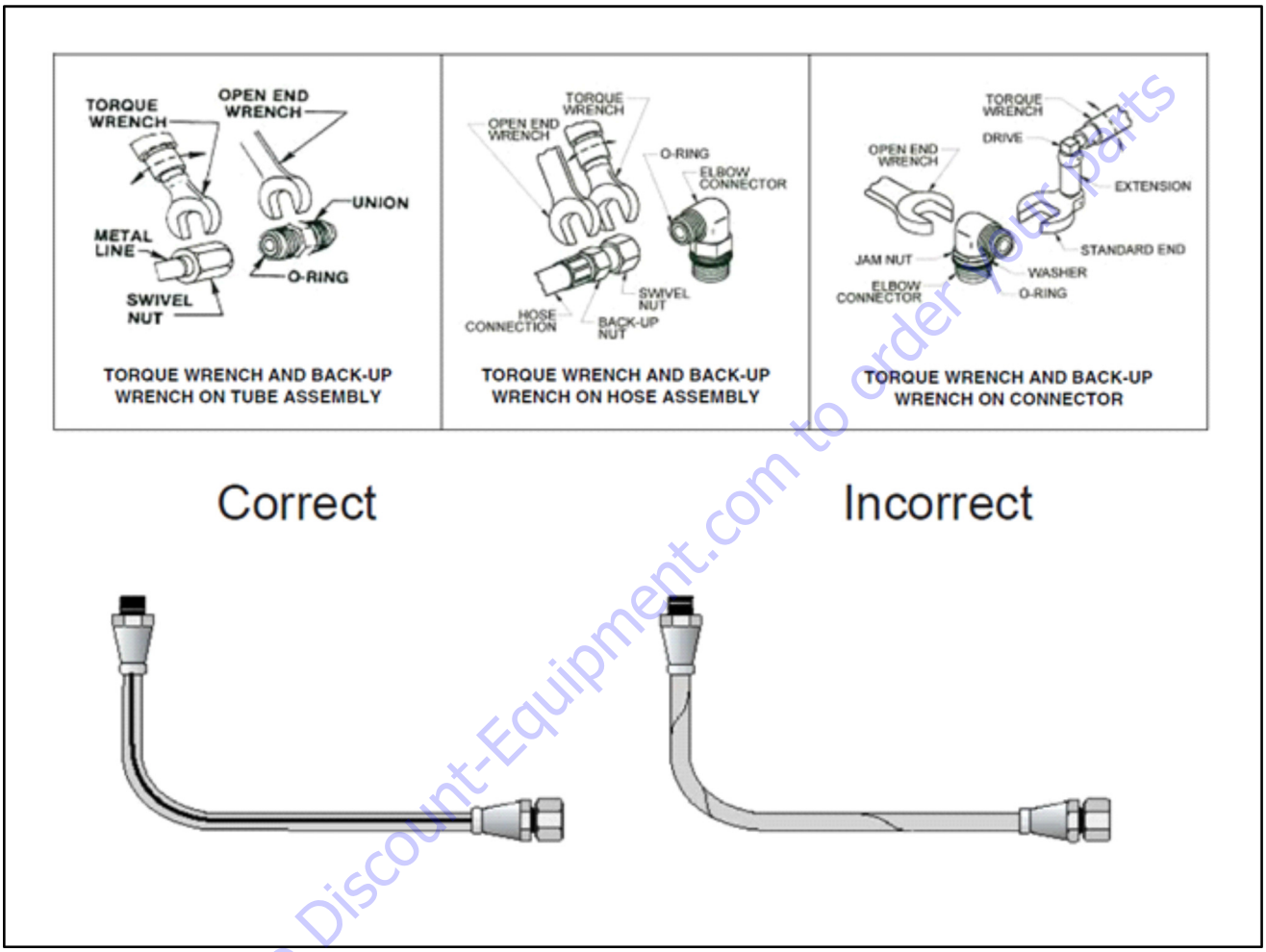


Figure 5-11. Double Wrench Method

FFWR and TFFT Methods

FFWR (FLATS FROM WRENCH RESISTANCE METHOD)

1. Tighten the swivel nut to the mating fitting until no lateral movement of the swivel nut can be detected; finger tight condition.
2. Mark a dot on one of the swivel hex nut flats and another dot in line on the connecting tube adapter. See Figure B.1.
3. Use the double wrench method per Appendix A, turn the swivel nut to tighten as shown in Figure 5-11. The nut is to be rotated clockwise the number of hex flats as defined by the applicable Table in Section 5.0.
4. After the connection has been properly tightened, mark a straight line across the connecting parts, not covering the dots, to indicate the connection has been properly tightened. See Figure 5-12.

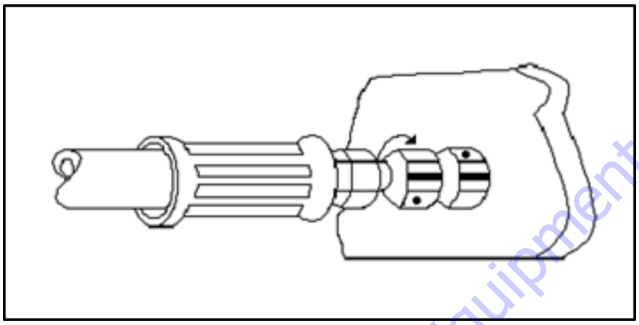


Figure 5-12. FFWR Method

TFFT (TURNS FROM FINGER TIGHT METHOD)

1. Tighten the swivel nut to the mating fitting until no lateral movement of the swivel nut can be detected; finger tight condition.
2. Mark a dot on one of the swivel hex nut flats and another dot in line on the connecting tube adapter.
3. Use the double wrench method per Appendix A, turn the swivel nut to tighten. The nut is to be rotated clockwise the number of turns as defined by the applicable Table in Section 5.0.
4. After the connection has been properly tightened, mark a straight line across the connecting parts, not covering the dots, to indicate the connection has been properly tightened.

Adjustable Stud End Assembly

For Adjustable Stud End Connections; the following assembly steps are to be performed:

1. Lubricate the o-ring with a light coat of hydraulic oil.
2. Position #1 – The o-ring should be located in the groove adjacent to the face of the backup washer. The washer and o-ring should be positioned at the extreme top end of the groove as shown.
3. Position #2 – Position the locknut to just touch the backup washer as shown. The locknut in this position will eliminate potential backup washer damage during the next step.
4. Position #3 – Install the connector into the straight thread box port until the metal backup washer contacts the face of the port as shown.
5. Position #4 – Adjust the connector to the proper position by turning out (counterclockwise) up to a maximum of one turn as shown to provide proper alignment with the mating connector, tube assembly, or hose assembly.
6. Position #5 – Using two wrenches, use the backup wrench to hold the connector in the desired position and then use the torque wrench to tighten the locknut to the appropriate torque.
7. Visually inspect, where possible, the joint to ensure the o-ring is not pinched or bulging out from under the washer and that the backup washer is properly seated flat against the face of the port.

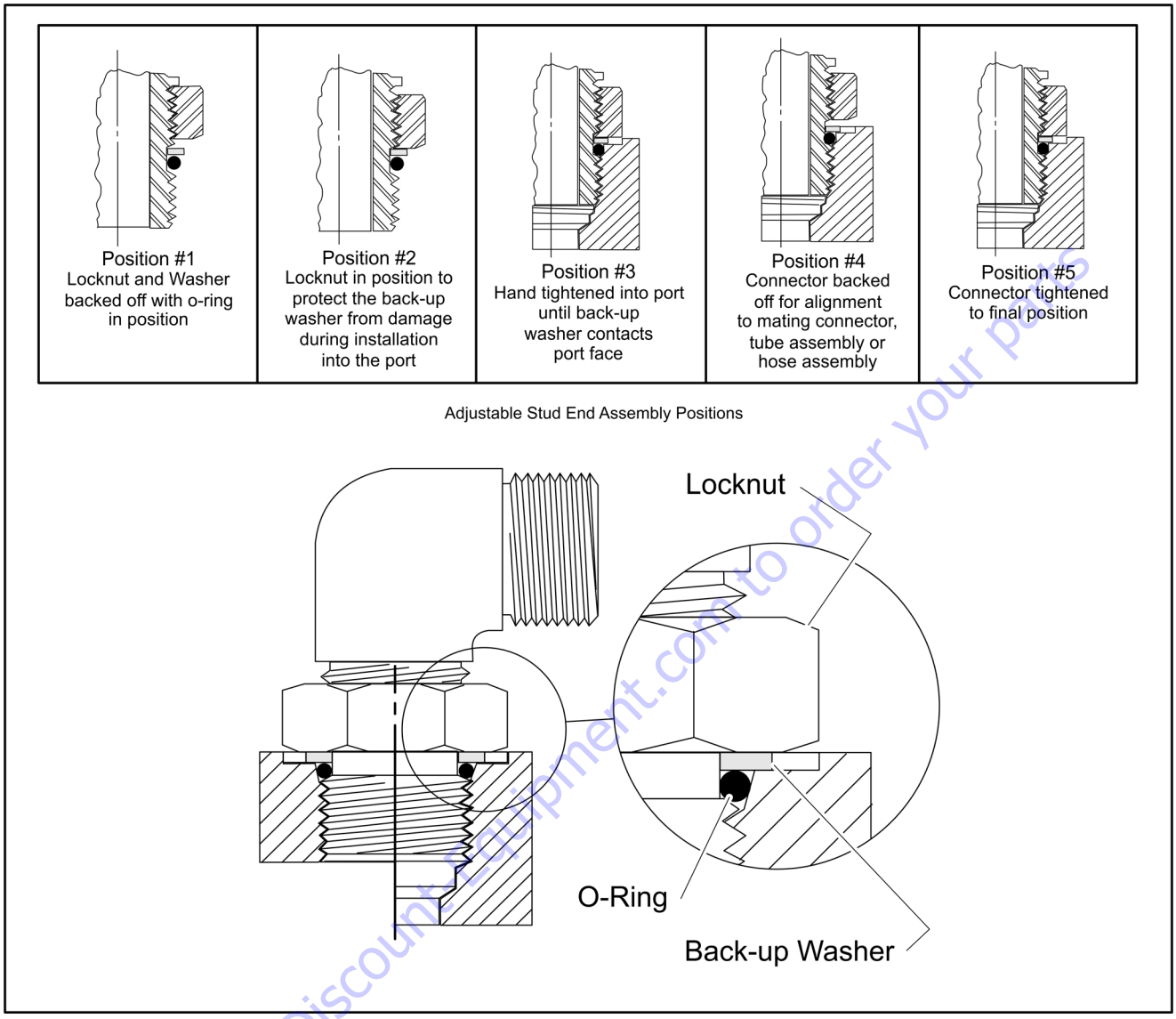


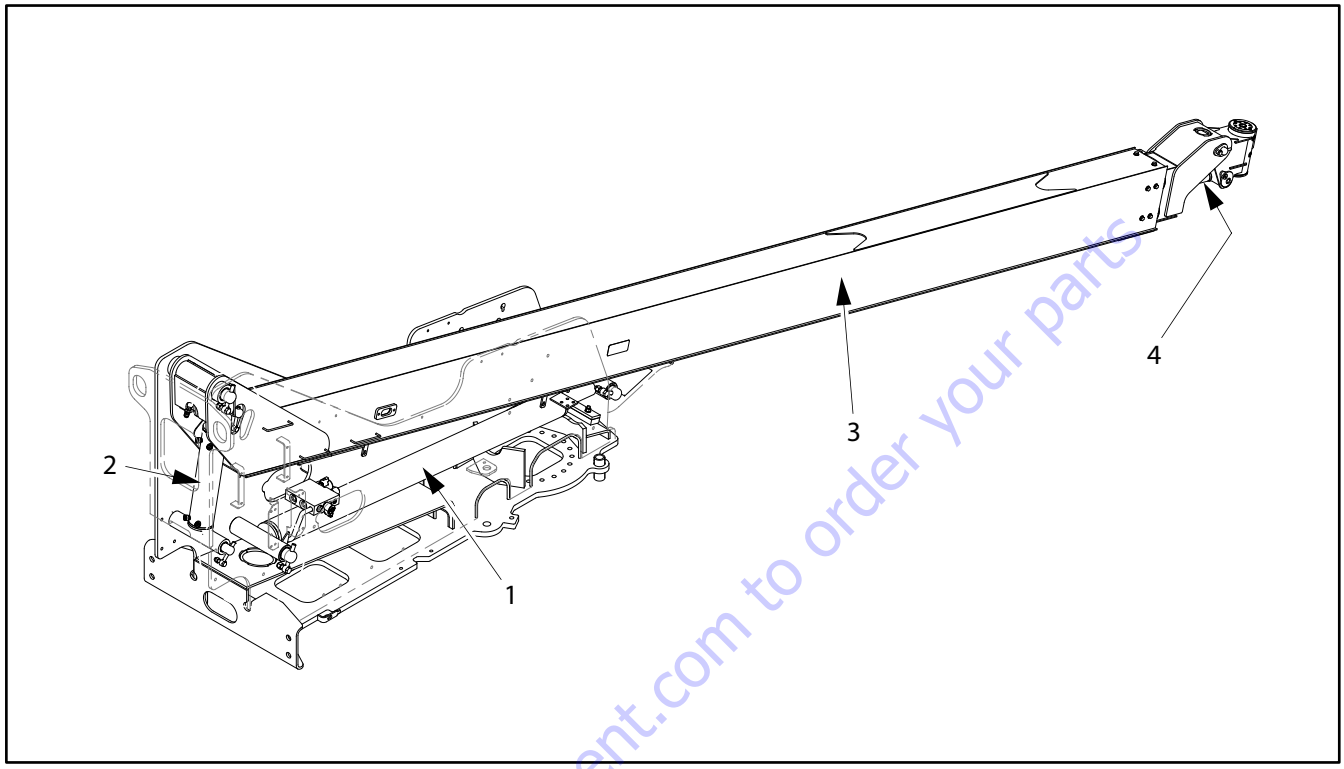
Figure 5-13. Adjustable Stud End Assembly

O-ring Installation (Replacement)

Care must be taken when installing o-rings over threads during replacement or installation. o-rings could become nicked or torn. A damaged o-ring could lead to leakage problems.

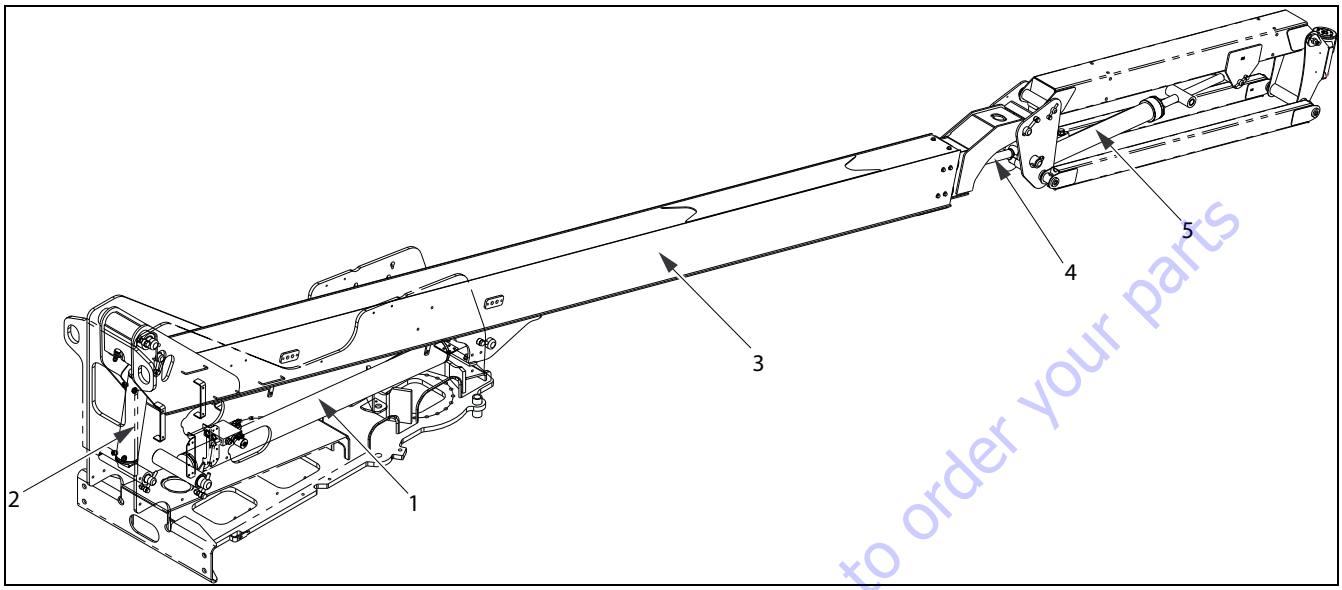
1. Inspect o-ring for tears or nicks. If any are found replace o-ring.
2. Ensure proper o-ring to be installed. Many o-rings look the same but are of different material, different hardness, or are slightly different diameters or widths.
3. Use a thread protector when replacing o-rings on fittings.
4. In ORB; ensure o-ring is properly seated in groove. On straight threads, ensure o-ring is seated all the way past the threads prior to installation.
5. Inspect o-ring for any visible nicks or tears. Replace if found.

5.3 HYDRAULIC CYLINDERS



1. Lift
2. Master
3. Telescope
4. Platform Level

Figure 5-14. Hydraulic Cylinder Locations - 400SC



1. Lift
2. Master
3. Telescope
4. Platform Level
5. Jib

Figure 5-15. Hydraulic Cylinder Locations - 460SJC

Lift Cylinder

Refer to Figure 5-19.

DISASSEMBLY

NOTICE

CONTAMINATION MAY DAMAGE EQUIPMENT. DISASSEMBLE CYLINDER ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to cylinder port block fitting.

⚠ WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate hydraulic power source and extend cylinder. Shut down and disconnect power source. Adequately support cylinder rod, if applicable.
3. Remove cartridge-type counterbalance valve and fittings from cylinder port block. Discard O-rings.
4. Place cylinder barrel in a suitable holding fixture. Tap around outside of cylinder head retainer with a suitable hammer to break thread-locking compound.

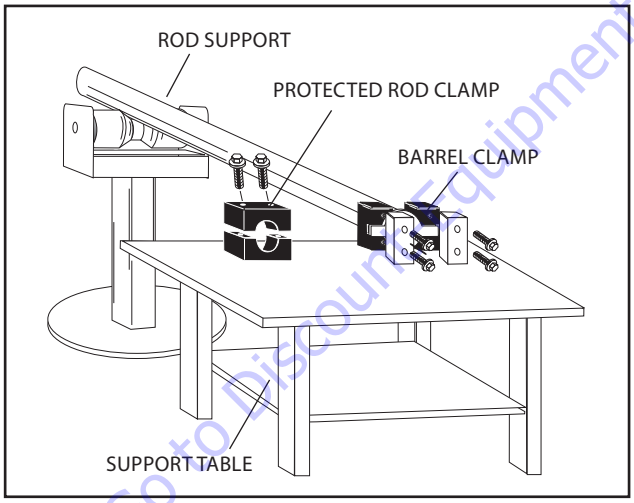


Figure 5-16. Cylinder Barrel Support

5. Remove screw (6) from hydraulic cylinder assembly.
6. Unscrew cylinder head (8) with pin-face spanner wrench.

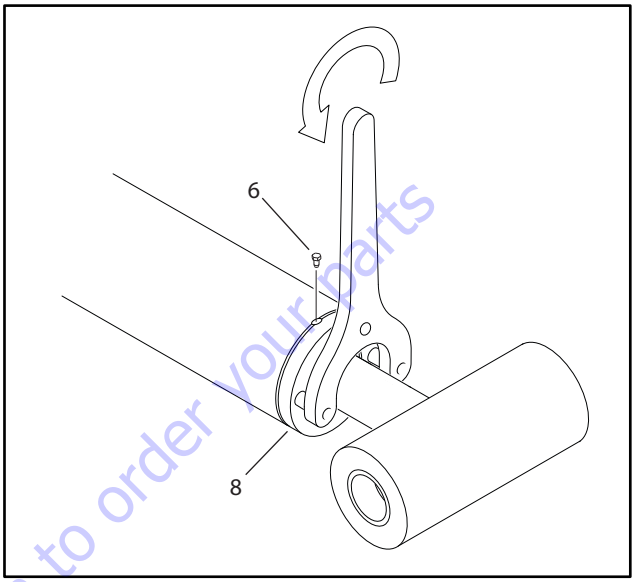


Figure 5-17. Cylinder Head Removal

NOTICE

PULLING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN REMOVING CYLINDER ROD, HEAD, AND PISTON.

7. Clamp barrel securely. Pull rod assembly and cylinder head from barrel.
8. Protect cylinder rod from damage and clamp in a vise or holding fixture as close to piston as possible.

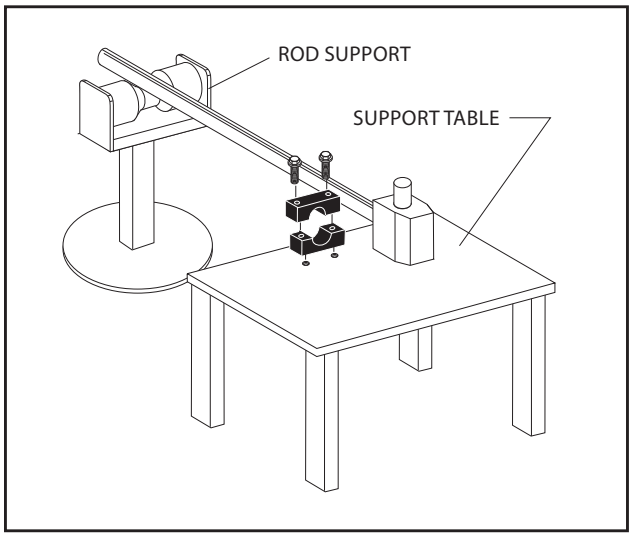
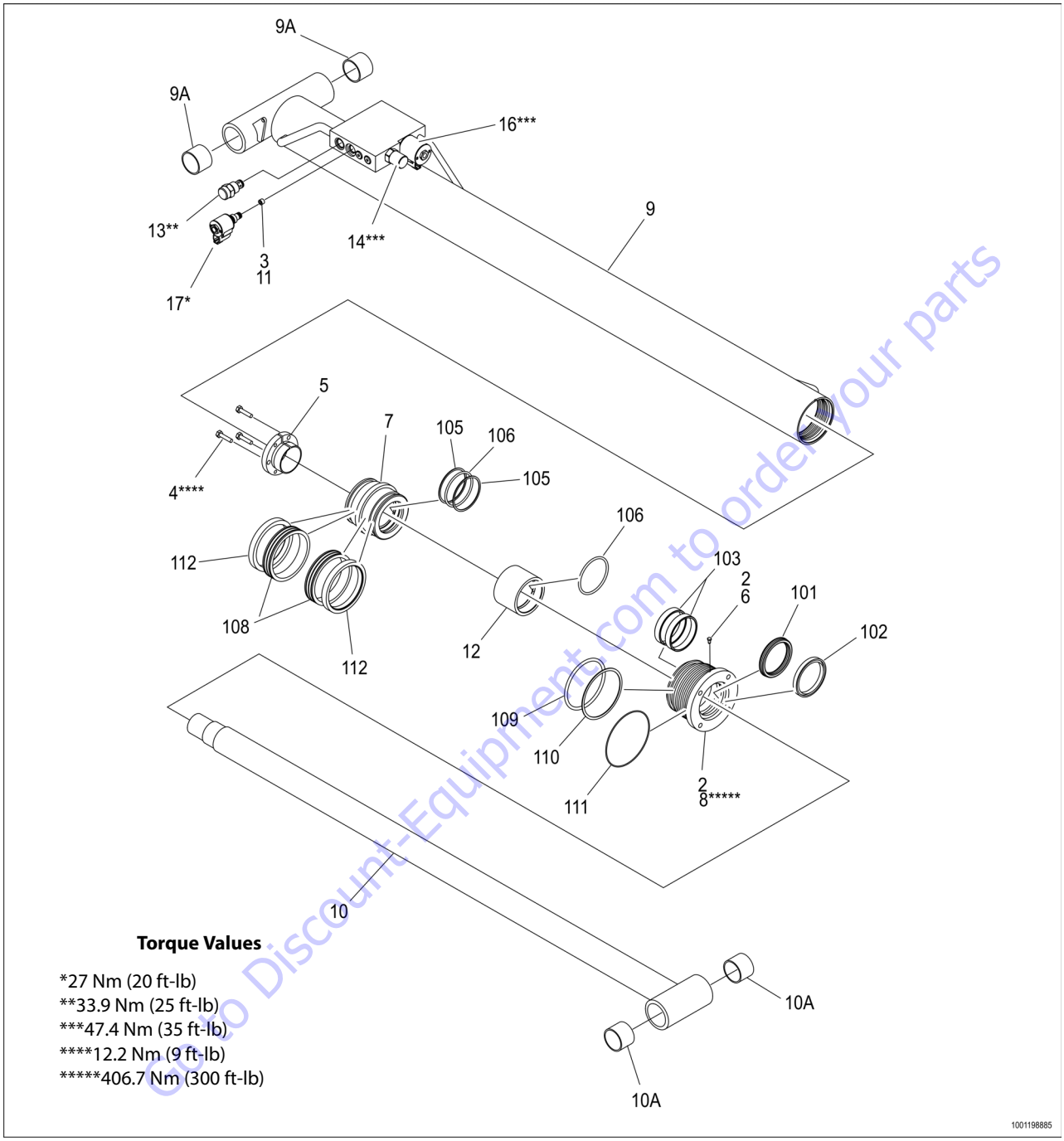


Figure 5-18. Cylinder Rod Support



Torque Values

*27 Nm (20 ft-lb)
**33.9 Nm (25 ft-lb)
***47.4 Nm (35 ft-lb)
****12.2 Nm (9 ft-lb)
*****406.7 Nm (300 ft-lb)

1. Not Used
2. Anti-Seize Lubricant
3. Locking Compound
4. Bolt
5. Bushing
6. Screw
7. Piston
8. Cylinder Head
9. Barrel
9A. Bearing
10. Rod
10A. Bearing
11. Orifice
12. Spacer
13. Thermal Relief
14. Pressure Compensated Valve
15. Not Used
16. Lift Down (Engine Power) Valve
17. Lift Down (Aux Power) Valve
101. Rod Seal
102. Wiper
103. Wear Ring
104. Not Used
105. Back-Up Ring
106. Seal
107. Not Used
108. Seal
109. O-Ring
110. Back-Up Ring
111. O-Ring
112. Lock Ring

Figure 5-19. Lift Cylinder

9. Remove capscrews (4) from tapered bushing (5).
10. Insert capscrews in threaded holes in outer piece of tapered bushing. Progressively tighten cap screw(s) until bushing is loose on piston.
11. Remove tapered bushing. Discard capscrews.
12. Remove piston (7) and spacer (12) from rod (10).

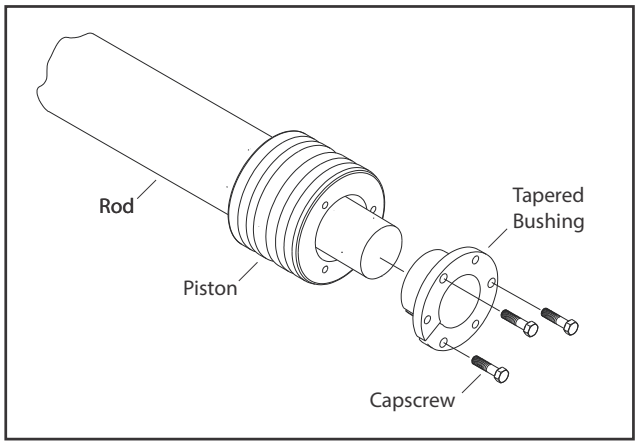


Figure 5-20. Tapered Bushing Removal

NOTICE

REMOVE SEALS USING A BRASS OR PLASTIC PICK ONLY. DO NOT USE A KNIFE, SHARP OBJECT, OR SCREW DRIVER. NOTE SEAL ORIENTATION BEFORE REMOVING FOR PROPER INSTALLATION.

13. Remove and discard two lock rings (112) and seals (108) from outside of piston (7).
14. Remove O-ring (105), seal (106), and O-ring (105) from inside of piston (7).
15. Remove O-ring (106) from spacer (12).

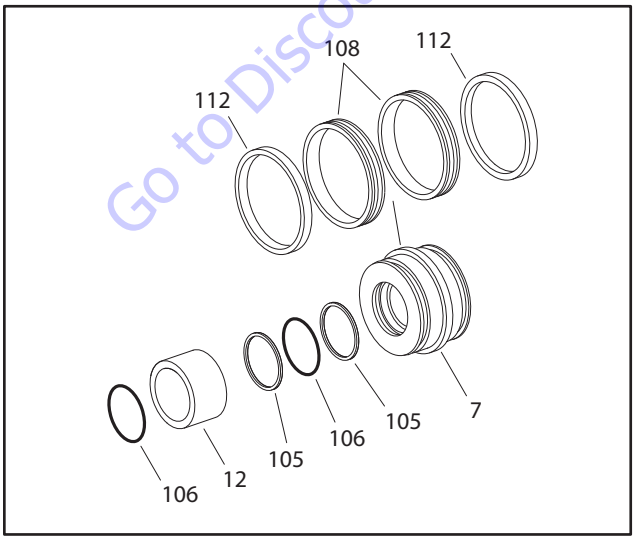


Figure 5-21. Piston and Spacer Disassembly

16. Remove rod from holding fixture.
17. Remove cylinder head assembly (8) from rod (10).
18. Remove and discard O-ring (109), back-up ring (110), and O-ring (111) from cylinder head (8).
19. Remove and discard two wear rings (103), wiper (102), and rod seal (101) from cylinder head (8).

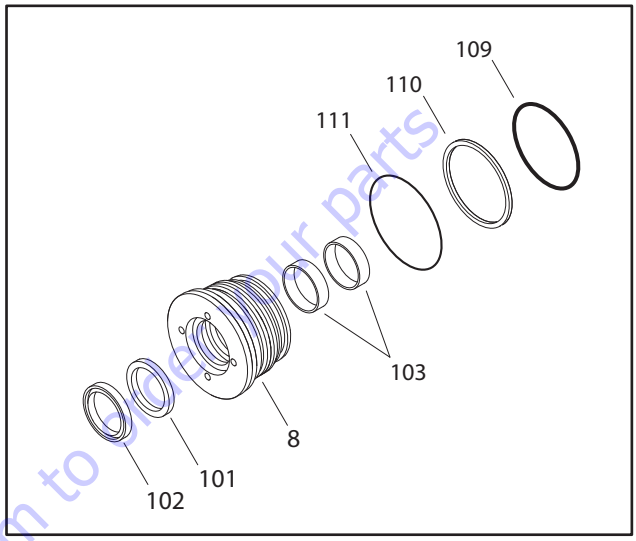


Figure 5-22. Cylinder Head Disassembly

CLEANING AND INSPECTION

1. Clean all parts in approved cleaning solvent.
2. Inspect cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage, scoring and distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and O-ring grooves in piston for burrs and sharp edges. Dress surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and O-ring grooves in head for burrs and sharp edges. Dress surfaces as necessary.

12. Inspect cylinder head outside diameter for scoring or other damage, ovality, and tapering. Replace as needed.
13. Inspect rod and barrel bearings for signs of excessive wear or damage. If worn or damaged, rod/barrel must be replaced.
14. Inspect spacer for burrs and sharp edges. Dress inside diameter as needed.
15. Inspect port block fittings and valves. Replace as needed. Torque valves to specifications shown in Figure 5-19., Lift Cylinder.
16. Inspect oil ports for blockage or presence of dirt or other foreign material. Repair as necessary.

COMPOSITE BUSHING

1. Clean hole (steel bushing) of burrs, dirt etc. for easier bushing installation.
2. Lubricate inside of steel bushing with WD40 before bearing installation.
3. Press composite bushing in steel bushing using an arbor.

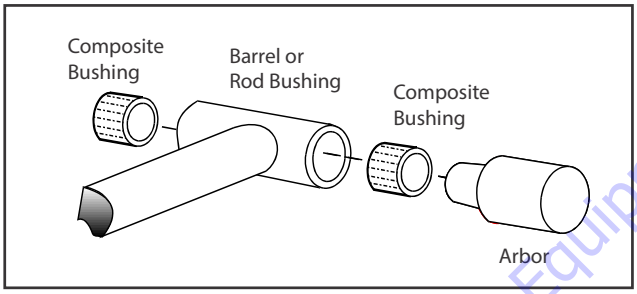


Figure 5-23. Composite Bushing Installation

ASSEMBLY

NOTICE

INCORRECT SEAL INSTALLATION CAN CAUSE CYLINDER LEAKS AND IMPROPER CYLINDER OPERATION. ENSURE ALL PISTON SEALS ARE CORRECTLY INSTALLED. REFER TO CROSS SECTION ILLUSTRATIONS FOR CORRECT SEAL ORIENTATION.

NOTE: *Use correct cylinder seal kit for cylinder assembly. See your JLG Parts Manual.*

Apply a light film of hydraulic oil to all components before assembly.

1. Support rod in holding fixture.
2. Install two wear rings (103), seal (101), and wiper (102) inside cylinder head (8).
3. Install O-ring (111), backup ring (110), and O-ring (109) on cylinder head.
4. Slide cylinder head assembly on rod (10) to rod end. Do not dislodge or damage seals.

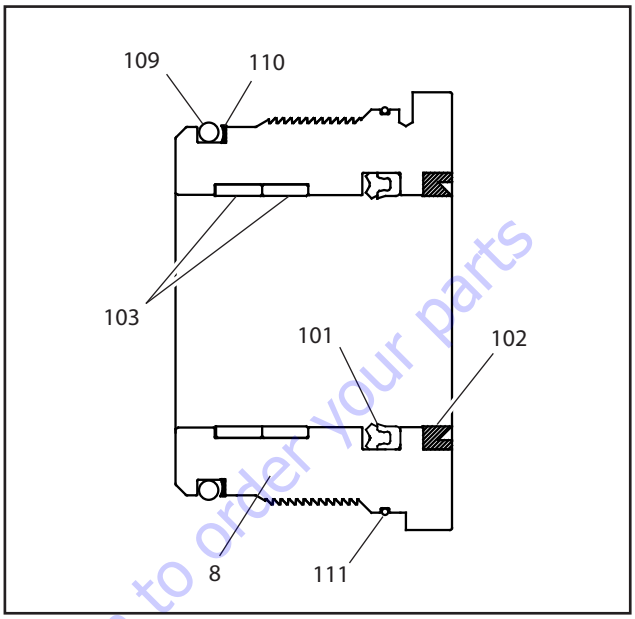


Figure 5-24. Cylinder Head Seal Installation

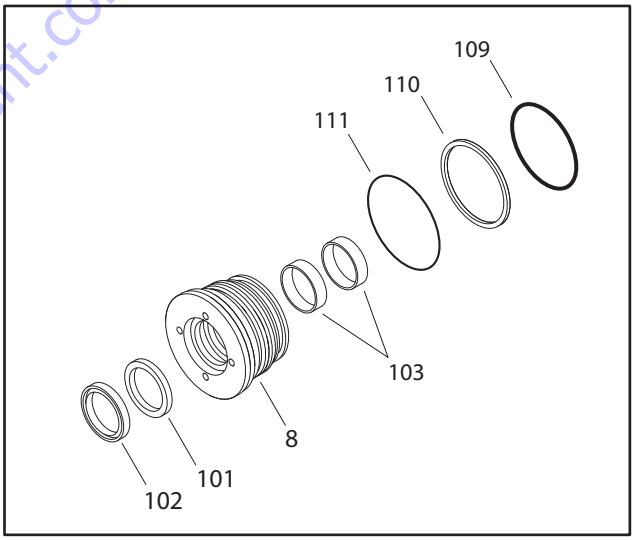


Figure 5-25. Cylinder Head Assembly

5. Install O-ring (106) in spacer (12). Slide spacer on rod (10). Do not dislodge or damage O-ring

6. Install O-ring back-up ring (105), O-ring (106), and back-up ring (105) in piston (7).

7. Install two seals (108) and lock rings (112) on piston.

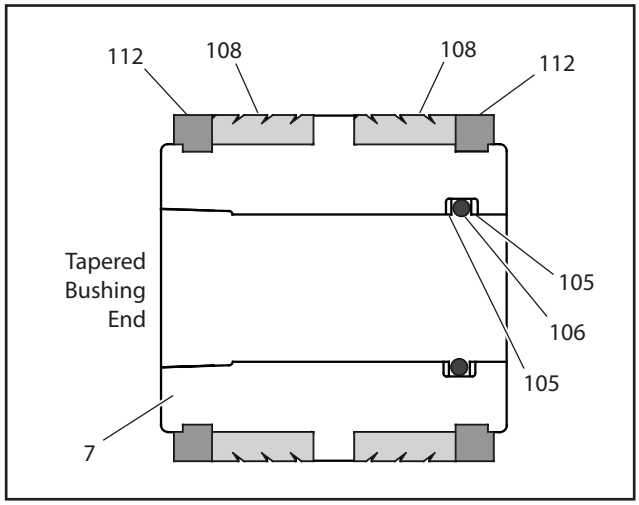


Figure 5-26. Piston and Spacer Seal Installation

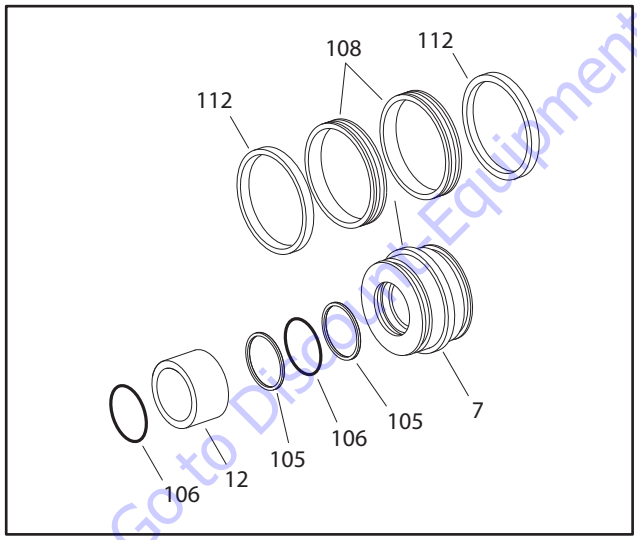


Figure 5-27. Piston and Spacer Assembly

8. Carefully install piston on cylinder rod. Do not damage or dislodge O-ring and back-up rings.

NOTE: *Piston and mating end of rod must be free of oil when installing tapered bushing.*

NOTE: *Apply JLG Medium-Strength (Blue) Thread Locking Compound P/N 010011 or equivalent to new JLG furnished tapered bushing capscrews when rebuilding master, platform, lift, and telescope cylinders.*

9. Insert tapered bushing loosely in the piston. Install JLG capscrews (not vendor capscrews) through drilled holes in the bushing and tapped holes in piston.

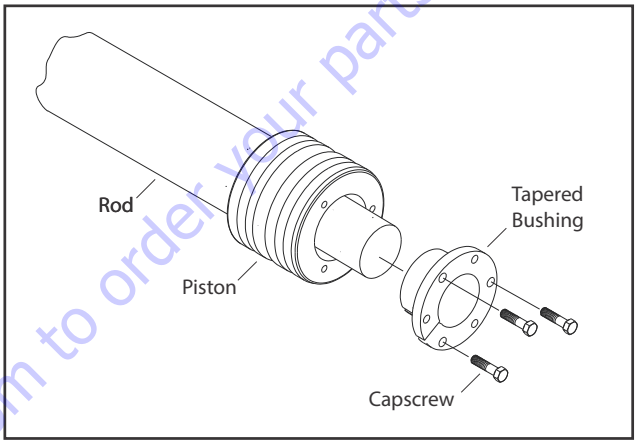


Figure 5-28. Tapered Bushing Installation

10. Tighten capscrews evenly and progressively in rotation to 12.2 Nm (9 ft-lb).

11. Set tapered bushing with a 16-24 oz (454-680 g) hammer and 19 mm (3/4 in) brass drift. Place drift against bushing between capscrews and tap once. Repeat for remaining two spaces between capscrews.

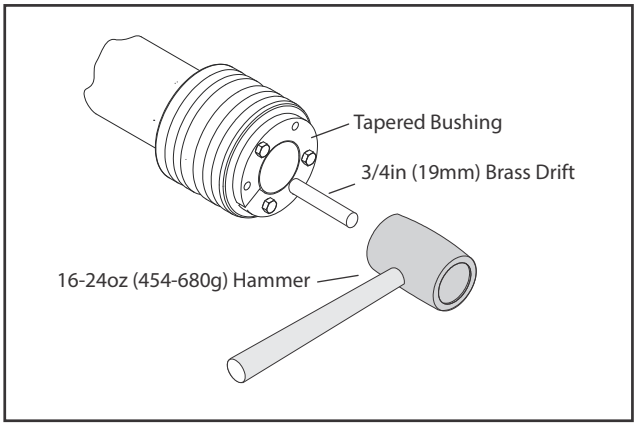


Figure 5-29. Seating Tapered Bushing

12. Re-torque capscrews evenly and progressively in rotation to 12.2 Nm (9 ft-lb).

13. Position cylinder barrel in a suitable holding fixture.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

14. Clamp barrel securely and support rod. Insert piston end into barrel cylinder. Do not damage or dislodge seal.

15. Remove cylinder rod from holding fixture.

16. Place cylinder barrel in suitable holding fixture.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

17. Clamp barrel securely and support rod. Insert piston end into barrel cylinder. Do not damage or dislodge piston O-rings and backup ring.

18. Apply anti-seize to cylinder head (8) threads. Screw in cylinder head. Torque to 406.7 Nm (300 ft-lb). Adjust cylinder head so screw hole is aligned between cylinder head and barrel.

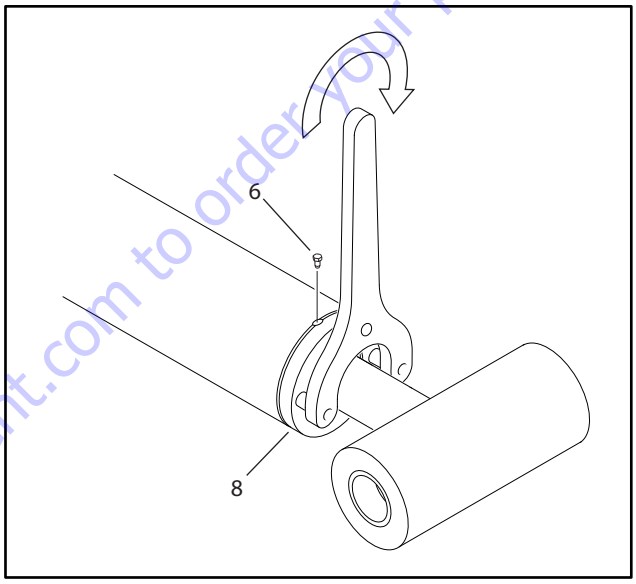


Figure 5-30. Cylinder Head Installation

19. Apply anti-seize to screw (6) and install in hole.

Master Cylinder

Refer to Figure 5-34.

DISASSEMBLY

NOTICE

CONTAMINATION MAY DAMAGE EQUIPMENT. DISASSEMBLE CYLINDER ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to cylinder port block fitting.

⚠ WARNING

DO NOT FULLY EXTEND CYLINDER TO END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate hydraulic power source and extend cylinder. Shut down and disconnect power source. Adequately support cylinder rod, if applicable.
3. If applicable, remove cartridge-type holding valve and fittings from cylinder port block. Discard O-rings.
4. Place cylinder barrel in a suitable holding fixture. Tap around outside of cylinder head end cap with hammer to break thread-locking compound.

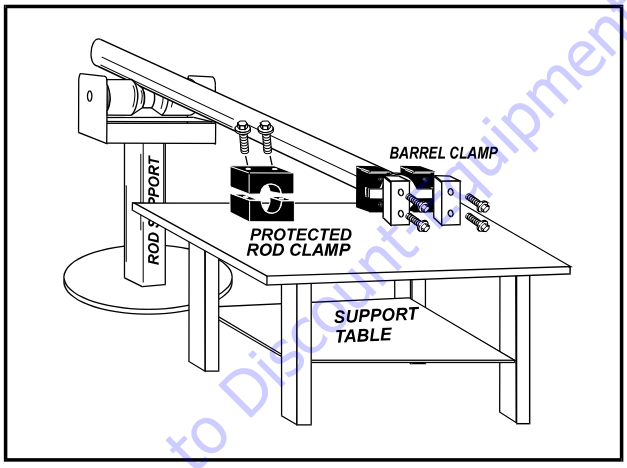


Figure 5-31. Cylinder Barrel Support

5. Unscrew cylinder head with hook spanner wrench.

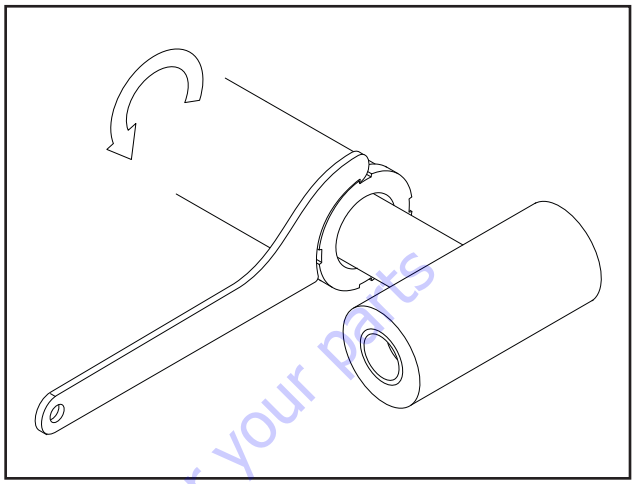


Figure 5-32. Cylinder Head Removal.

NOTICE

PULLING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN REMOVING CYLINDER ROD, HEAD, AND PISTON.

6. Clamp barrel securely. Pull rod assembly from barrel.

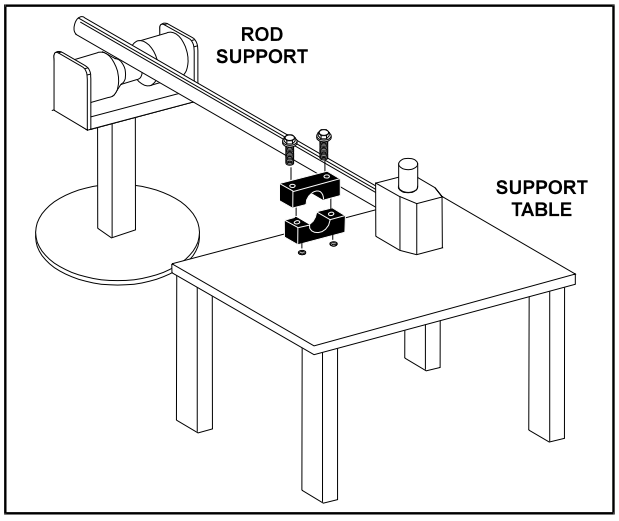
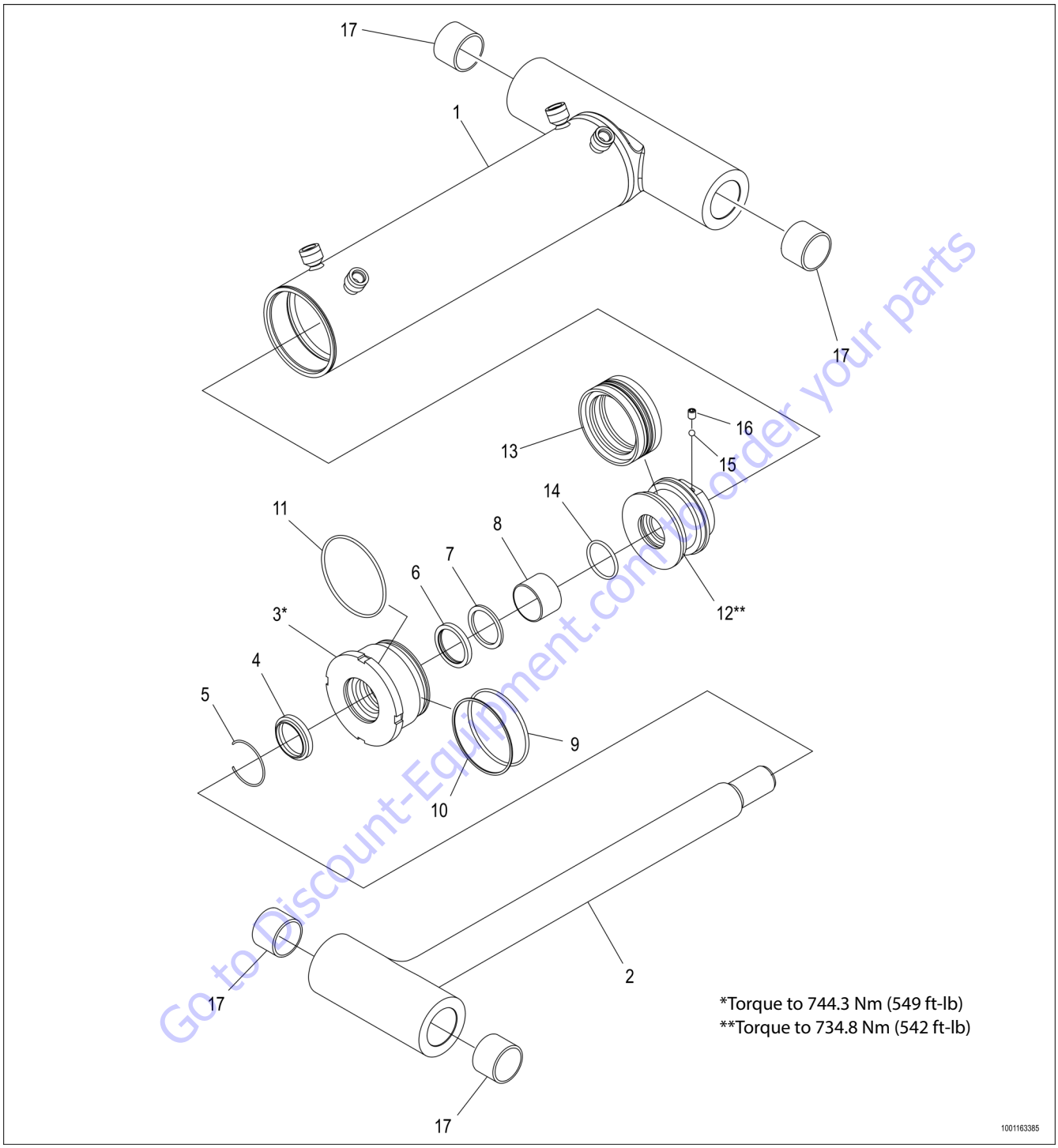


Figure 5-33. Cylinder Rod Support



1. Barrel
2. Rod
3. Cylinder Head
4. Wiper
5. Retaining Ring
6. Back-Up Ring
7. Rod Seal
8. Dry Bearing
9. O-Ring
10. Back-Up Ring
11. O-Ring
12. Piston
13. Seal
14. O-Ring
15. Ball
16. Setscrew
17. Bearing

Figure 5-34. Master Cylinder

8. Loosen setscrew (16) retaining ball (15) in piston (12).
9. Screw piston counter-clockwise and remove from rod.
10. Remove and discard O-ring (14) and seal (13).

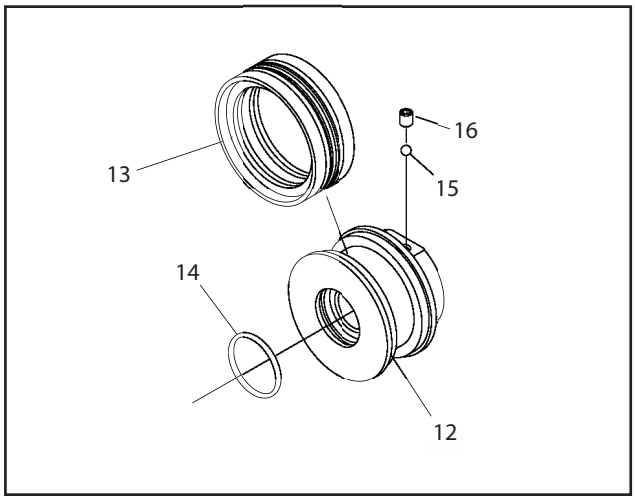


Figure 5-34. Piston Disassembly

11. Remove rod from holding fixture.
12. Remove cylinder head assembly (3) from rod (2).
13. Remove and discard O-ring (9), back-up ring (10), and O-ring (11) from cylinder head.
14. Remove and discard retaining ring (5), wiper (4), dry bearing (8), rod seal (7), and back-up ring (6) from cylinder head (3).

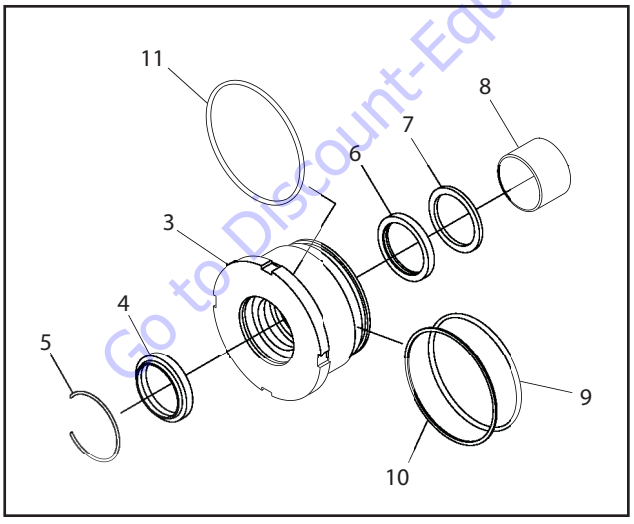


Figure 5-35. Cylinder Head Disassembly

CLEANING AND INSPECTION

1. Clean all parts in approved cleaning solvent.
2. Inspect cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage, scoring and distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and O-ring grooves in piston for burrs and sharp edges. Dress surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and O-ring grooves in head for burrs and sharp edges. Dress surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage, ovality, and tapering. Replace as needed.
13. Inspect rod and barrel bearings for signs of excessive wear or damage. If worn or damaged, rod/barrel must be replaced.
14. Inspect oil ports for blockage or presence of dirt or other foreign material. Repair as necessary.

COMPOSITE BUSHING

1. Clean hole (steel bushing) of burrs, dirt etc. for easier bushing installation.
2. Lubricate inside of steel bushing with WD40 before bearing installation.
3. Press composite bushing in steel bushing using an arbor.

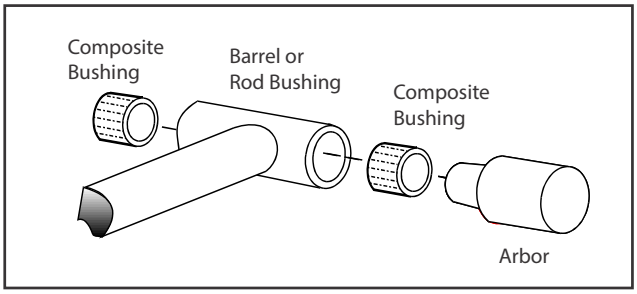


Figure 5-36. Composite Bushing Installation

CYLINDER ASSEMBLY

NOTICE

INCORRECT SEAL INSTALLATION CAN CAUSE CYLINDER LEAKS AND IMPROPER CYLINDER OPERATION. ENSURE ALL PISTON SEALS ARE CORRECTLY INSTALLED. REFER TO CROSS SECTION ILLUSTRATIONS FOR CORRECT SEAL ORIENTATION.

NOTE: *Use correct cylinder seal kit for cylinder assembly. See your JLG Parts Manual.*

Apply a light film of hydraulic oil to all components before assembly.

1. Support rod in holding fixture.
2. Install back-up ring (6), rod seal (7), and dry bearing (8) in cylinder head (3).
3. Install wiper (4) and retaining ring (5) in cylinder head.
4. Install O-ring (11) on cylinder head.
5. Install backup ring (10) and O-ring (9) on cylinder head.
6. Slide cylinder head assembly on rod (2) to rod end. Do not dislodge or damage seals.

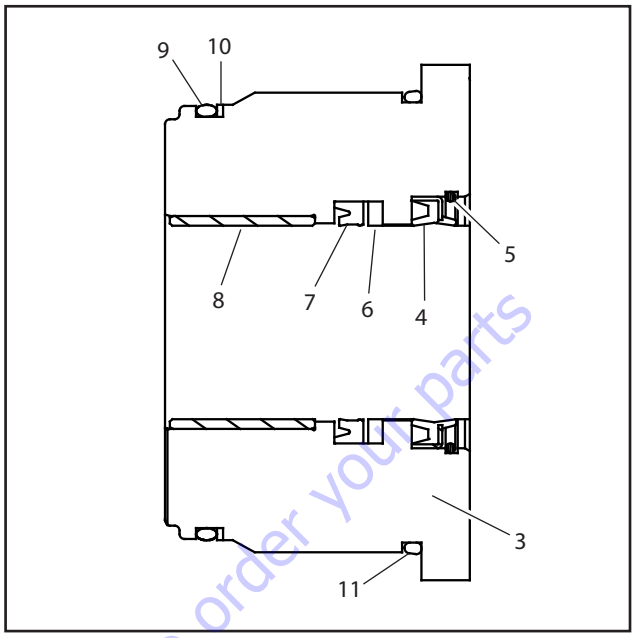


Figure 5-37. Cylinder Head Seal Installation

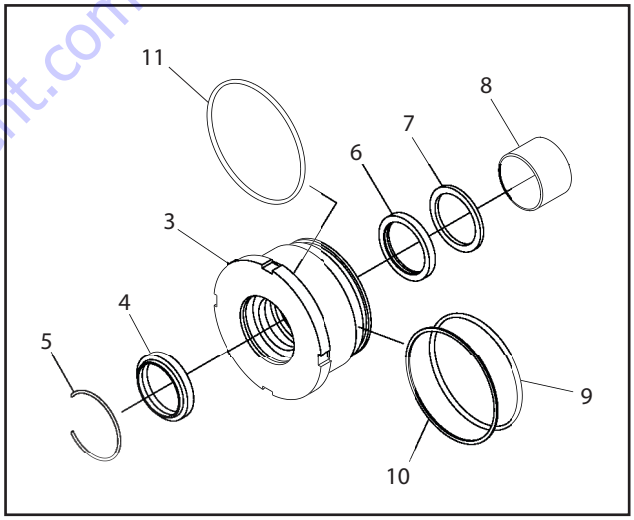


Figure 5-38. Cylinder Head Assembly

7. Install O-ring (14) in piston (12).
8. Install seal (16) on piston.
9. Apply JLG thread locking compound (P/N 0100011) to piston threads. Install piston on rod. Torque to 734.8 Nm (542 ft-lb).
10. Install ball (15) and setscrew (16).

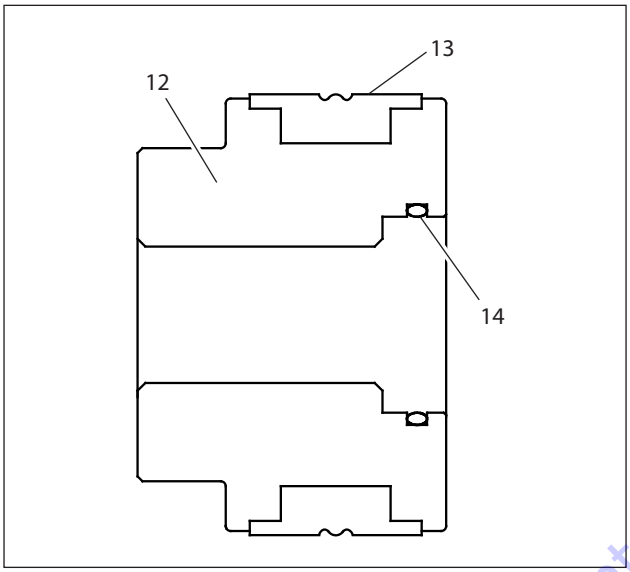


Figure 5-39. Piston Seal Installation

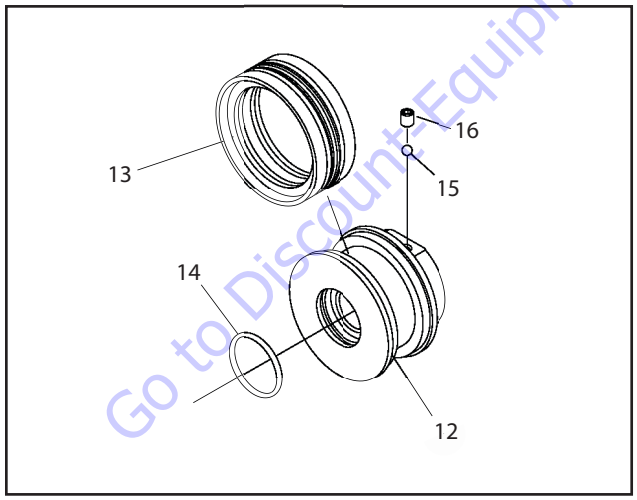


Figure 5-40. Piston Assembly

11. Position cylinder barrel in a suitable holding fixture.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

12. Clamp barrel securely and support rod. Insert piston end into barrel cylinder. Do not damage or dislodge seal.
13. Remove cylinder rod from holding fixture.
14. Place cylinder barrel in suitable holding fixture.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

15. Clamp barrel securely and support rod. Insert piston end into barrel cylinder. Do not damage or dislodge piston O-rings and backup ring.
16. Continue pushing rod into barrel. Screw in cylinder head. Torque to 737 ft-lb (1000 Nm).

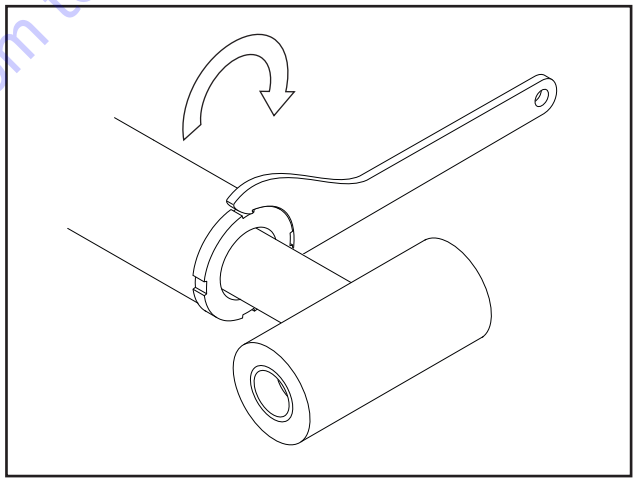


Figure 5-41. Cylinder Head Installation

Telescope Cylinder

Refer to Figure 5-45.

DISASSEMBLY

NOTICE

CONTAMINATION MAY DAMAGE EQUIPMENT. DISASSEMBLE CYLINDER ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to cylinder port block fitting.

⚠ WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate hydraulic power source and extend cylinder. Shut down and disconnect power source. Support cylinder rod as needed.
3. Place cylinder barrel in a suitable holding fixture. Tap around outside of cylinder head retainer with suitable hammer to break thread-locking compound.

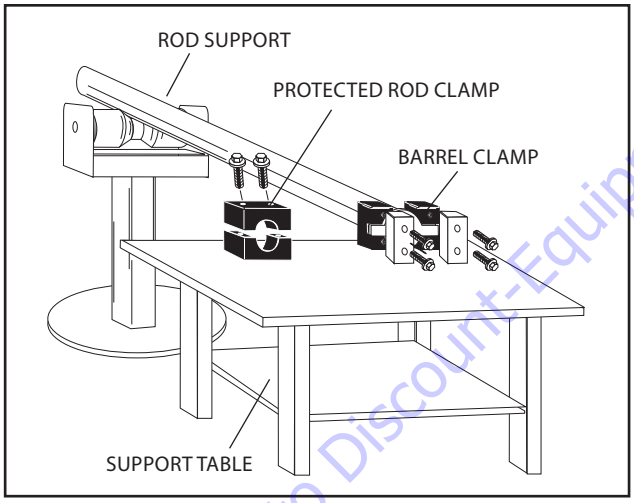


Figure 5-42. Cylinder Barrel Support

NOTE: *Label cartridge valves and locations before removal for easy reassembly.*

4. Remove shuttle valve (14D) and two counterbalance valves (14C, 14E) from valve block (14).
5. Remove four bolts (4) and valve block from barrel (7).
6. Remove two O-rings (111) from valve block.

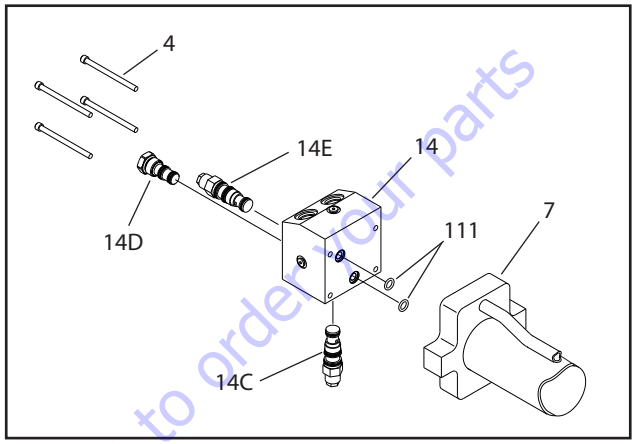


Figure 5-43. Valve Block Disassembly

7. Remove two nuts (19), four washers (20), two bolts (18), and wear pad (13) from two locations on plate (12).
8. Remove eight socket head bolts (6) from plate (12) and cylinder head (11).

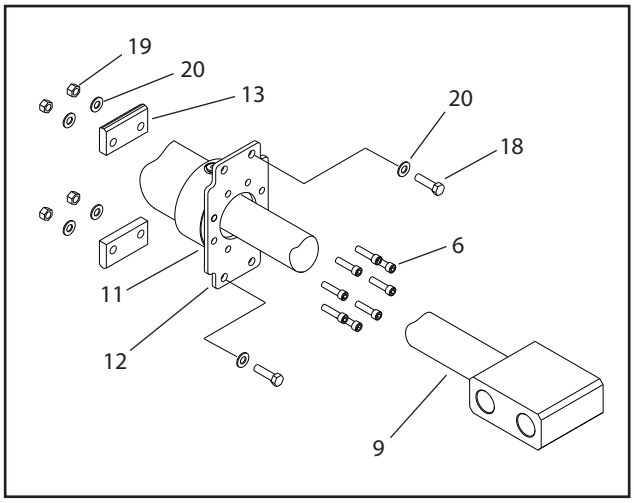
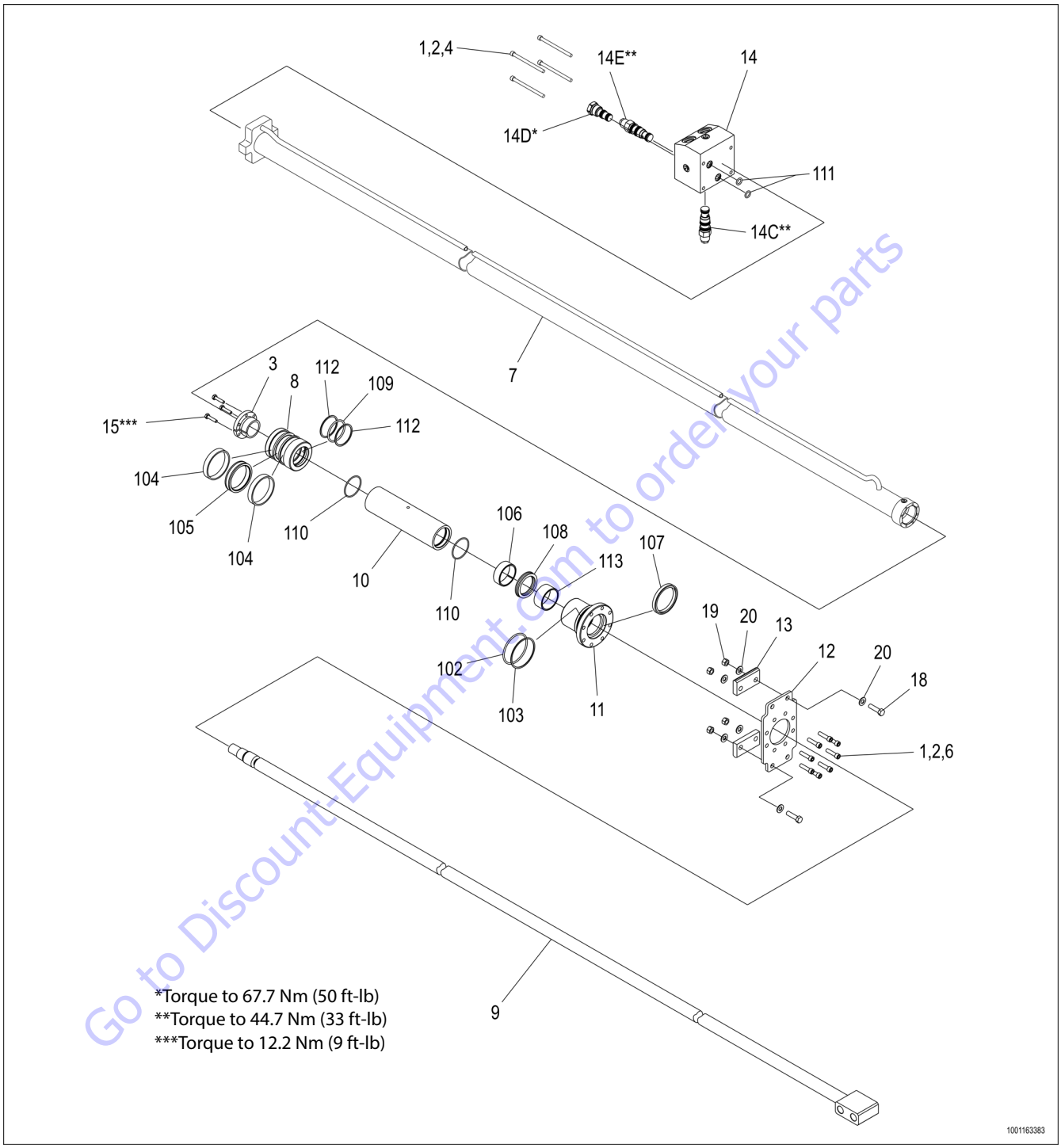


Figure 5-44. Cylinder Head Removal



1.	Locking Compound	7.	Barrel	13.	Wear Pad	16.	Not Used	103. Seal	109. O-Ring
2.	Locking Primer	8.	Piston	14.	Valve Block	17.	Not Used	104. Wear Ring	110. O-Ring
3.	Tapered Bushing	9.	Rod	14C.	Counterbalance Valve	18.	Bolt	105. Seal	111. O-Ring
4.	Socket Head Bolt	10.	Spacer	14D.	Shuttle Valve	19.	Nut	106. Wear Ring	112. Back-up Ring
5.	Not Used	11.	Cylinder Head	14E.	Counterbalance Valve	20.	Washer	107. Wiper	113. Wear Ring
6.	Socket Head Bolt	12.	Plate	15.	Bolt	102.	O-Ring	108. Seal	

Figure 5-45. Telescope Cylinder

NOTICE

PULLING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN REMOVING CYLINDER ROD, HEAD, AND PISTON.

9. Clamp barrel securely. Pull rod from barrel.
10. Using suitable protection, clamp cylinder rod in a vise or similar holding fixture as close to piston as possible.

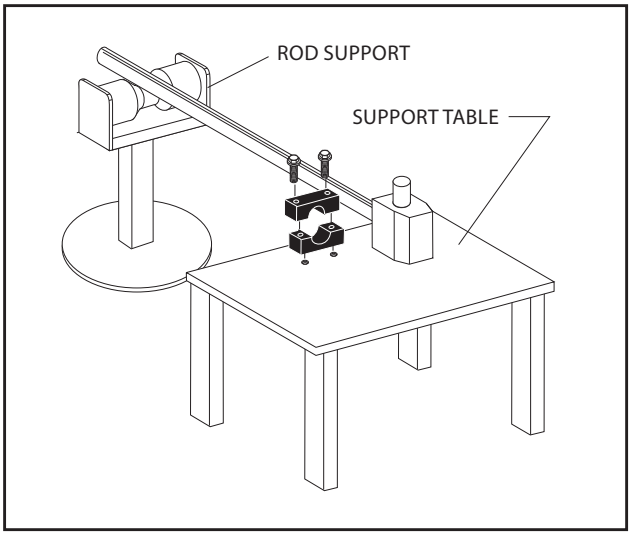


Figure 5-46. Cylinder Rod Support

11. Remove capscrews (15) from tapered bushing (3).
12. Insert capscrews in threaded holes in outer piece of tapered bushing. Progressively tighten cap screw(s) until bushing is loose on piston.
13. Remove tapered bushing. Discard capscrews.
14. Remove piston (8) and spacer (10) from rod (9).

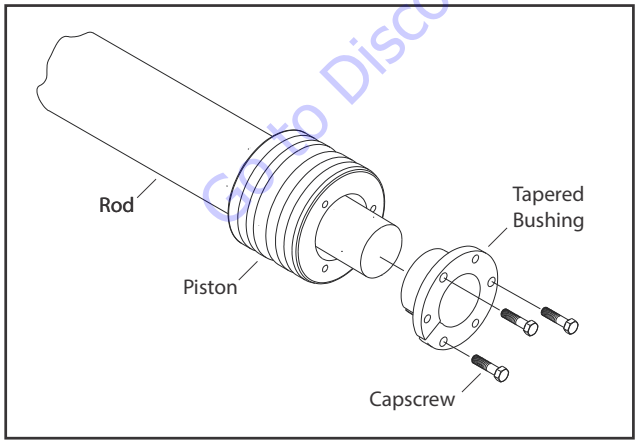


Figure 5-47. Tapered Bushing Removal

NOTICE

REMOVE SEALS USING A BRASS OR PLASTIC PICK ONLY. DO NOT USE A KNIFE, SHARP OBJECT, OR SCREW DRIVER. NOTE SEAL ORIENTATION BEFORE REMOVING FOR PROPER INSTALLATION.

15. Remove spring retaining ring (14) from piston (13) and shaft (15). Screw piston counter-clockwise and remove piston from cylinder rod.
16. Remove and discard piston seal (12) and O-ring (11).

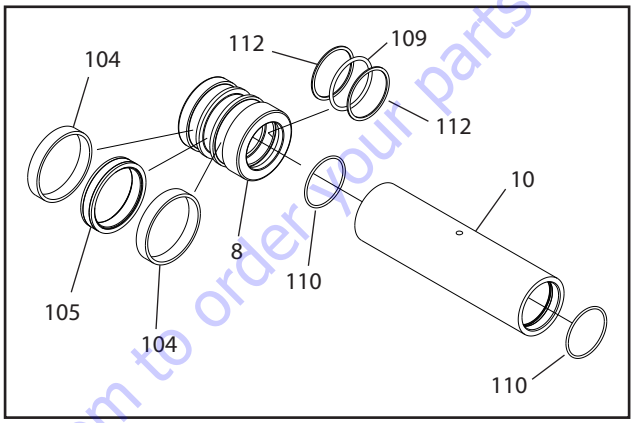


Figure 5-48. Piston and Spacer Disassembly

17. Remove rod from holding fixture.
18. Remove plate (12) and cylinder head (11) from rod (9).
19. Remove and discard O-ring (102) and back-up ring (103) from outside of cylinder head.
20. Remove and discard wear ring (106), seal (108), wear ring (113), and wiper (107) from inside of cylinder head.

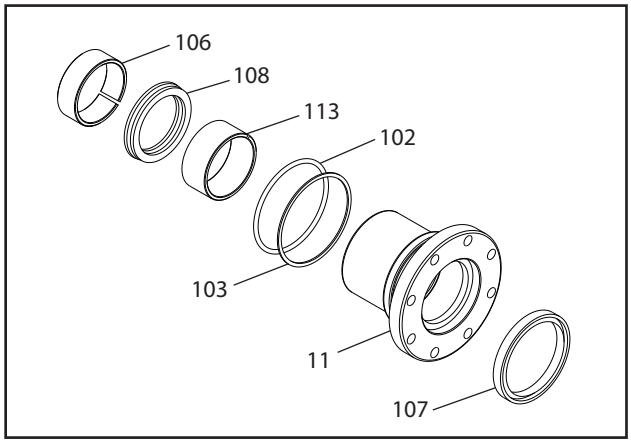


Figure 5-49. Cylinder Head Disassembly

CLEANING AND INSPECTION

1. Clean all parts in approved cleaning solvent.
2. Inspect cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage, scoring and distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and O-ring grooves in piston for burrs and sharp edges. Dress surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and O-ring grooves in head for burrs and sharp edges. Dress surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage, ovality, and tapering. Replace as needed.
13. Inspect rod and barrel bearings for signs of excessive wear or damage. If worn or damaged, rod/barrel must be replaced.
14. Inspect port block fittings and valves. Replace as needed. Torque valves to specifications shown in Figure 5-45., Telescope Cylinder.
15. Inspect oil ports for blockage or presence of dirt or other foreign material. Repair as necessary.

COMPOSITE BUSHING

1. Clean hole (steel bushing) of burrs, dirt etc. for easier bushing installation.
2. Lubricate inside of steel bushing with WD40 before bearing installation.
3. Press composite bushing in steel bushing using an arbor.

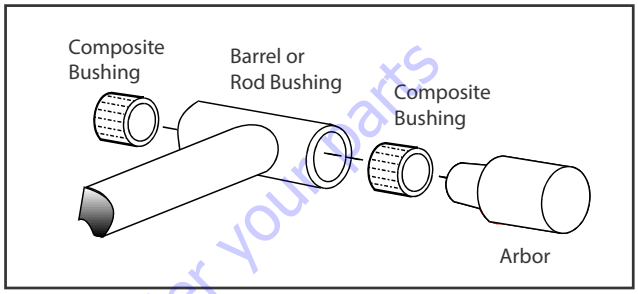


Figure 5-50. Composite Bushing Installation

ASSEMBLY

NOTICE

INCORRECT SEAL INSTALLATION CAN CAUSE CYLINDER LEAKS AND IMPROPER CYLINDER OPERATION. ENSURE ALL PISTON SEALS ARE CORRECTLY INSTALLED. REFER TO CROSS SECTION ILLUSTRATIONS FOR CORRECT SEAL ORIENTATION.

NOTE: *Use correct cylinder seal kit for cylinder assembly. See your JLG Parts Manual.*

Apply a light film of hydraulic oil to all components before assembly.

1. Support rod in holding fixture.
2. Install wear rings (113), seal (108), and wear ring (106), and wiper (107) inside cylinder head (11).
3. Install O-ring (111), backup ring (110), and O-ring (109) on cylinder head.
4. Slide plate (12) on rod (9).
5. Slide cylinder head assembly on rod. Push cylinder head and plate to rod end. Do not dislodge or damage seals.

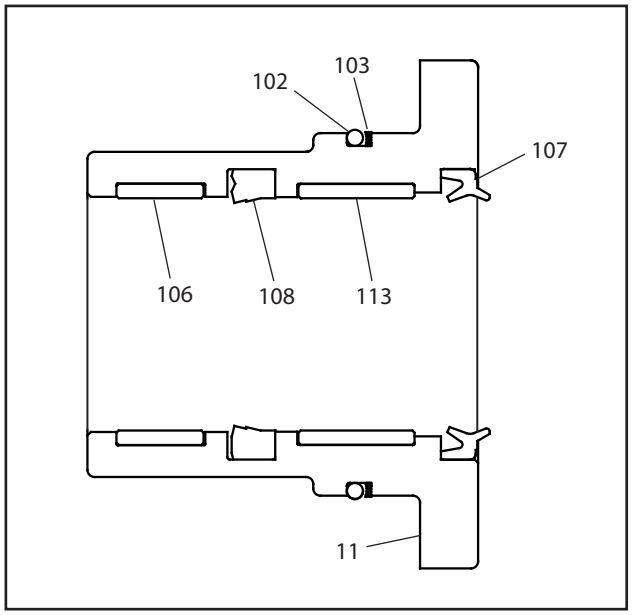


Figure 5-51. Cylinder Head Seal Installation

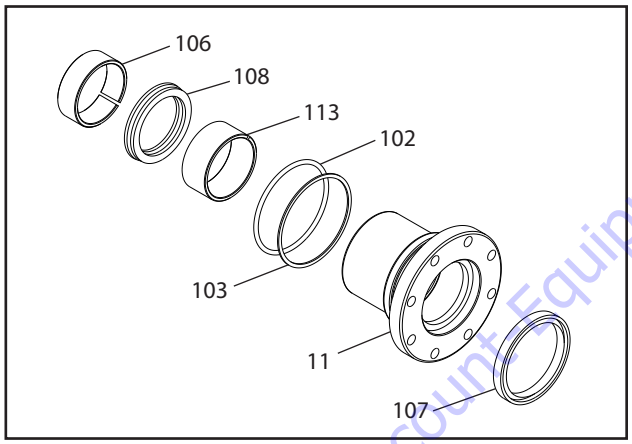


Figure 5-52. Cylinder Head Assembly

6. Install two O-rings (110) in spacer (10). Slide spacer on rod (9). Do not dislodge or damage O-ring
7. Install back-up ring (112), O-ring (109), and back-up ring (112) in piston (8).
8. Install seal (105) and two wear rings (104) on piston.

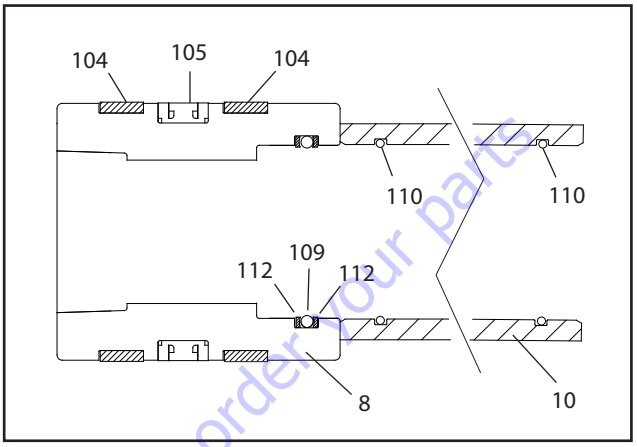


Figure 5-53. Piston and Spacer Seal Installation

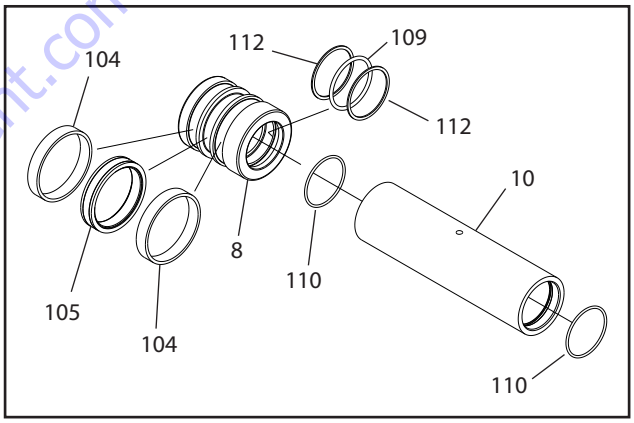


Figure 5-54. Piston and Spacer Assembly

9. Carefully install piston on cylinder rod. Do not damage or dislodge O-ring and back-up rings.

NOTE: *Piston and mating end of rod must be free of oil when installing tapered bushing.*

NOTE: *Apply JLG Medium-Strength (Blue) Thread Locking Compound P/N 010011 or equivalent to new JLG furnished tapered bushing capscrews when rebuilding master, platform, lift, and telescope cylinders.*

10. Insert tapered bushing loosely in the piston. Install JLG capscrews (not vendor capscrews) through drilled holes in the bushing and tapped holes in piston.

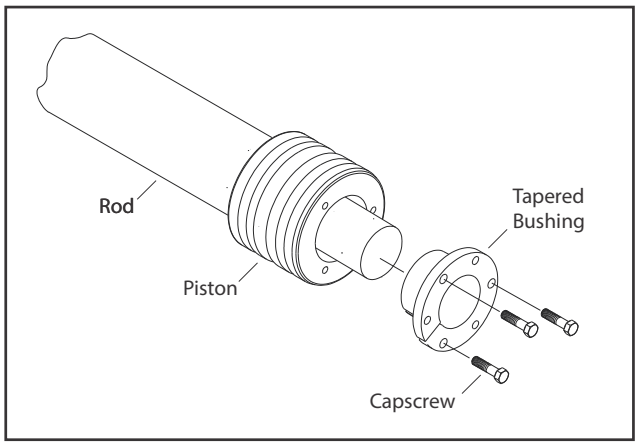


Figure 5-55. Tapered Bushing Installation

11. Tighten capscrews evenly and progressively in rotation to 12.2 Nm (9 ft-lb).

12. Set tapered bushing with a 16-24 oz (454-680 g) hammer and 19 mm (3/4 in) brass drift. Place drift against bushing between capscrews and tap once. Repeat for remaining two spaces between capscrews.

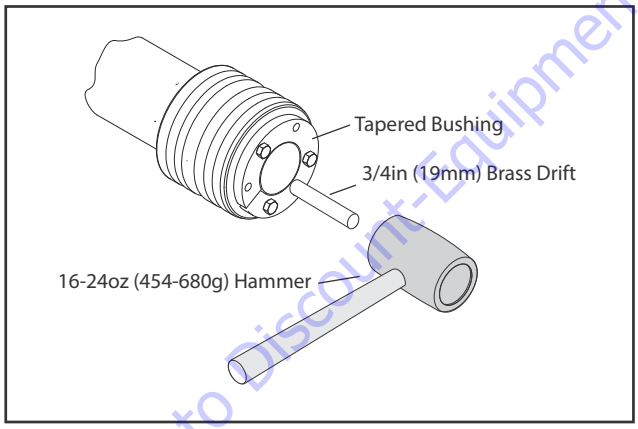


Figure 5-56. Seating Tapered Bushing

13. Re-torque capscrews evenly and progressively in rotation to 12.2 Nm (9 ft-lb).

14. Position cylinder barrel in a suitable holding fixture.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

15. Clamp barrel securely and support rod. Insert piston end into barrel cylinder. Do not damage or dislodge seal.

16. Remove cylinder rod from holding fixture.

17. Place cylinder barrel in suitable holding fixture.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

18. Clamp barrel securely and support rod. Insert piston end into barrel cylinder. Do not damage or dislodge piston O-rings and backup ring.

19. Install cylinder head in barrel. Align Apply locking primer and JLG thread locking compound P/N 0100011 anti-seize to threads of eight socket head bolts (6). Push in cylinder head and align holes to holes in barrel (11).

20. Align plate (12) on cylinder head. Install eight socket head bolts to plate, cylinder head, and barrel.

21. Install wear pads (13) to plate in two places with two bolts (18), four washers (20) and two locknuts (19).

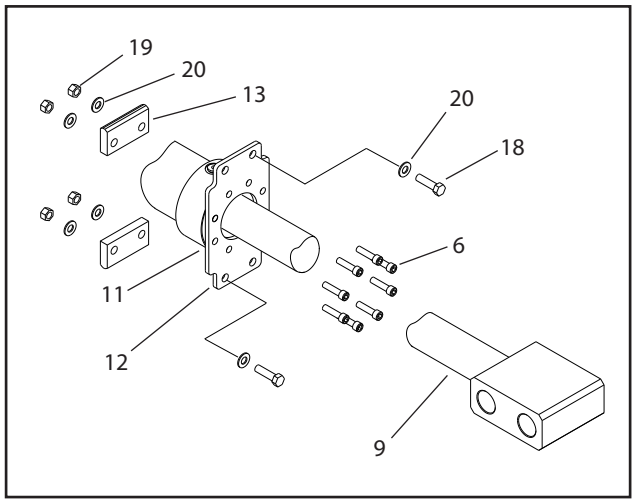


Figure 5-57. Cylinder Head Installation

22. Install two O-rings (111) in valve block (14).

23. Apply locking primer and locking compound (JLG P/N 0100011) to four bolts (4). Install valve block on barrel (7) with bolts.

24. Install shuttle valve (14D) in valve block. Torque to 67.7 Nm (50 ft-lb).

25. Install two counterbalance valves (14C, 14E) in valve block. Torque to 44.7 Nm (33 ft-lb).

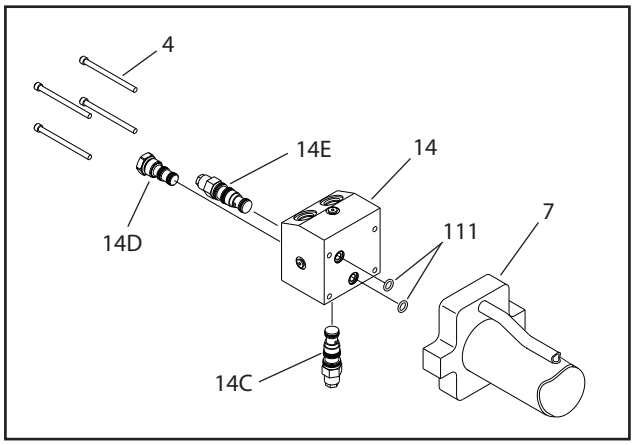


Figure 5-58. Valve Block Assembly

Jib Lift Cylinder (460SJC Only)

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

⚠ WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove the counterbalance holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

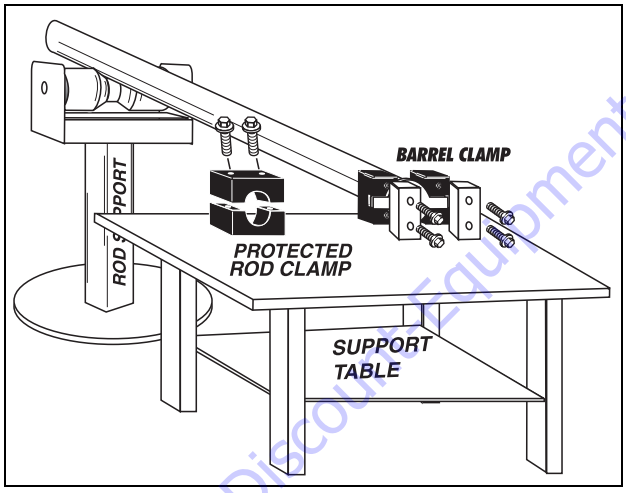


Figure 5-59. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

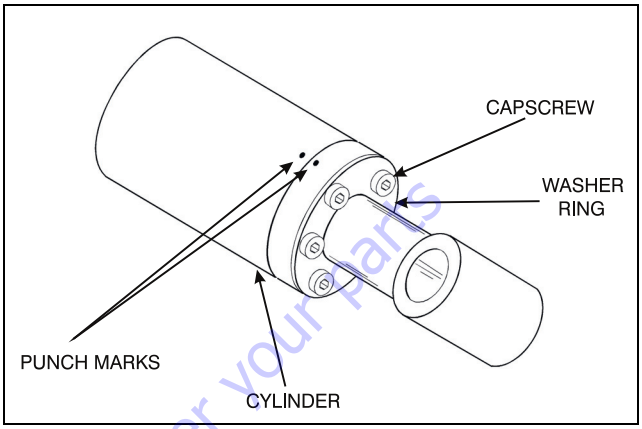


Figure 5-60. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

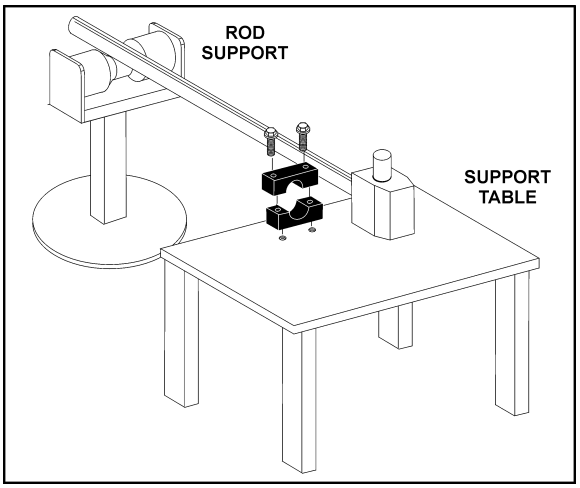
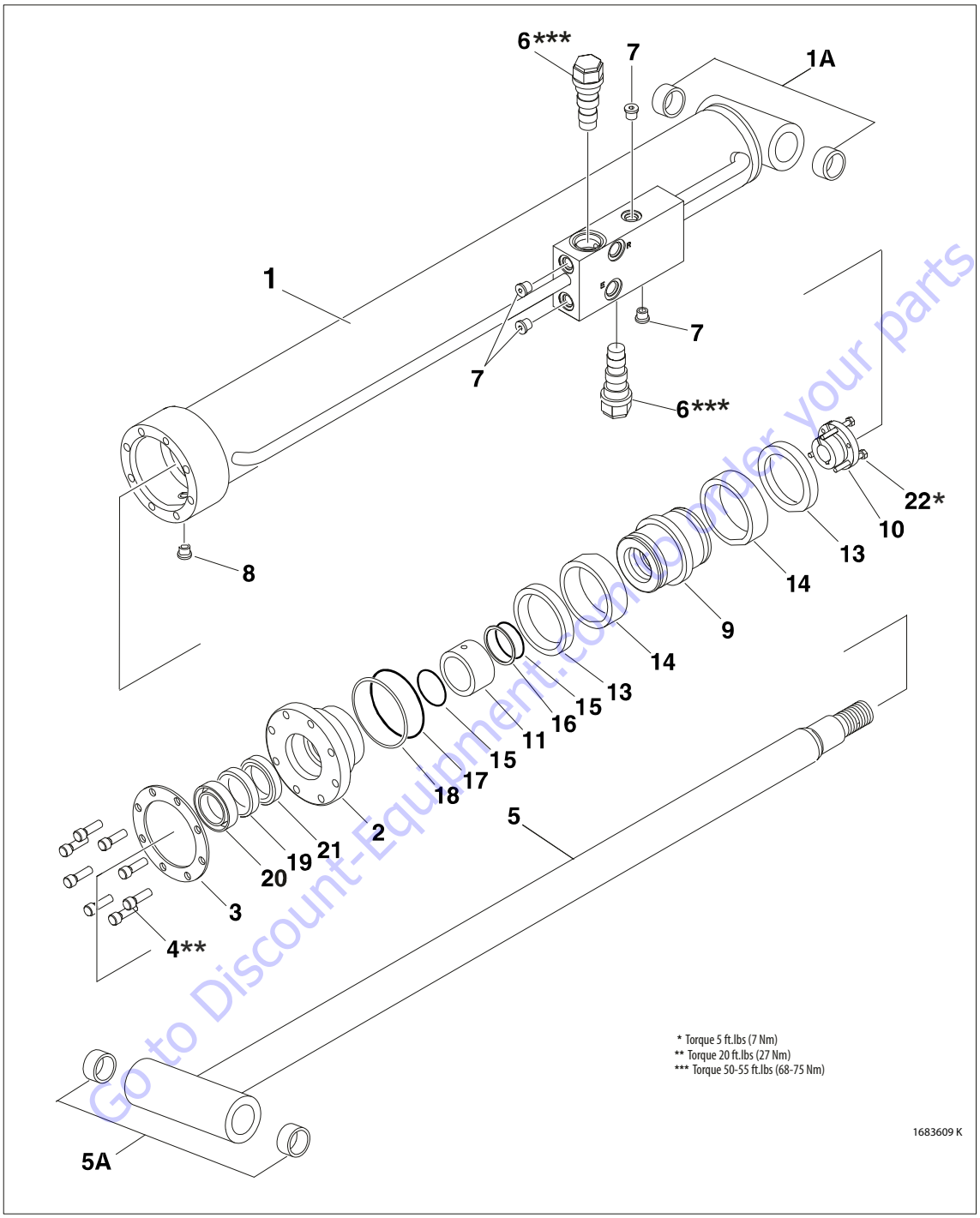


Figure 5-61. Cylinder Rod Support



1. Barrel
1A. Bushing
2. Head
3. Ring Washer
4. Bolt
5. Rod
5A. Bushing
6. Counterbalance Valve
7. O-ring Plug
8. O-ring Plug
9. Piston
10. Tapered Bushing
11. Tube Spacer
12. Setscrew
13. Lock Ring
14. Piston Seal
15. O-ring
16. Backup Ring
17. O-ring
18. Backup Ring
19. Rod Seal
20. Wiper Seal
21. Wear Ring
22. Capscrew

Figure 5-62. Jib Lift Cylinder (460SJC Only)

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
10. Remove the bushing from the piston.

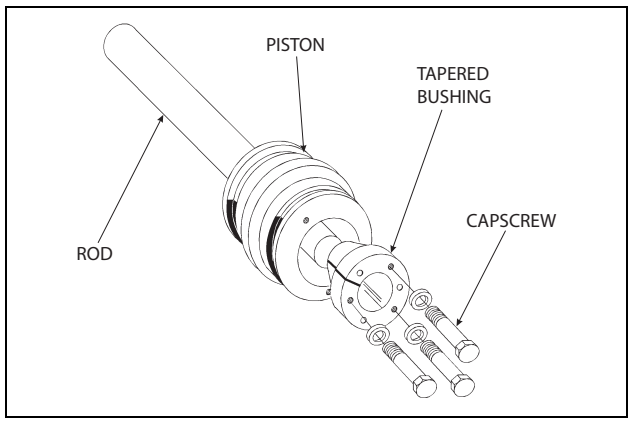


Figure 5-63. Tapered Bushing Removal

11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seal rings, and backup rings.
13. Remove piston spacer, if applicable, from the rod.
14. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, back-up rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

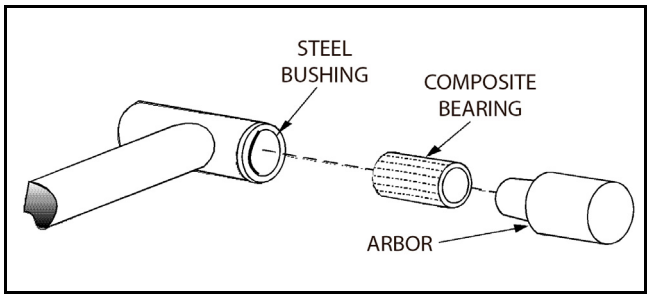


Figure 5-64. Composite Bearing Installation

12. Inspect spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
13. If applicable, inspect port block fittings and holding valve. Replace as necessary.
14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
15. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

NOTE: *Apply a light film of hydraulic oil to all components prior to assembly.*

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

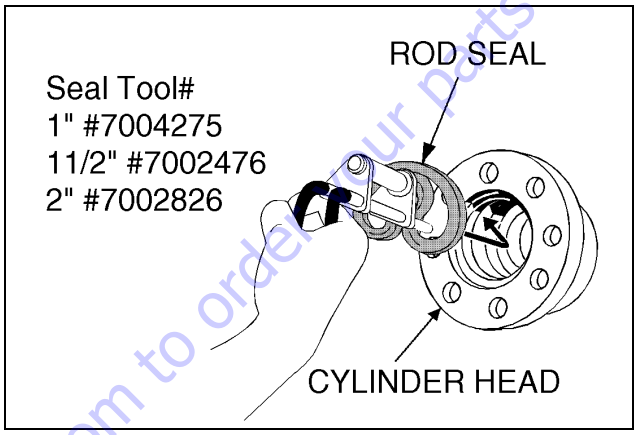


Figure 5-65. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

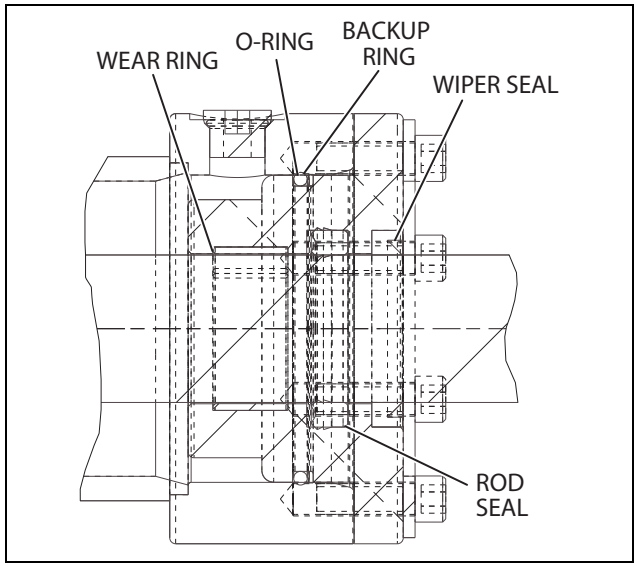


Figure 5-66. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.

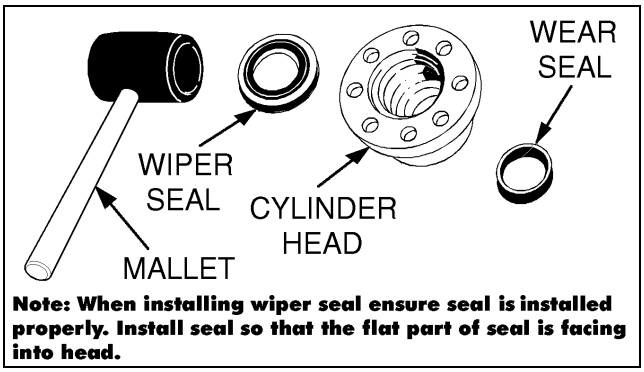


Figure 5-67. Wiper Seal Installation

3. Place a new o-ring and back-up seal in the applicable outside diameter groove of the cylinder head.

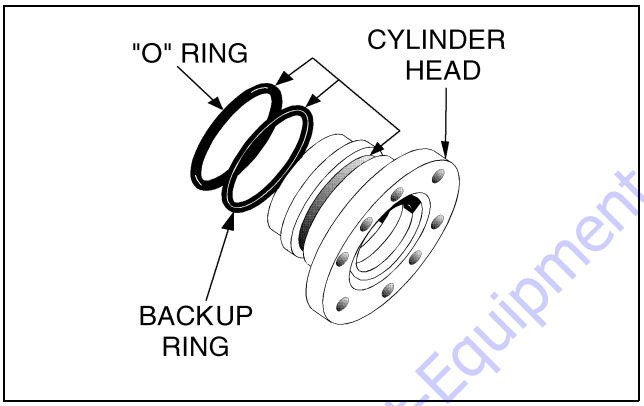


Figure 5-68. Installation of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.
5. Carefully slide the piston spacer on the rod.
6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
7. Place a new o-ring and back-up rings in the inner piston diameter groove.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.
9. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

10. Install the bolts in tapered bushing.
11. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

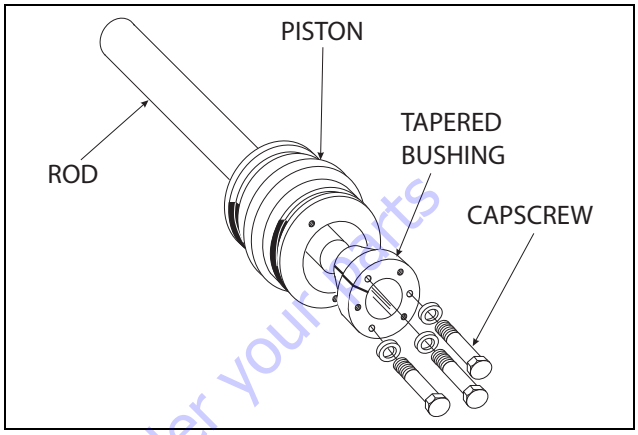


Figure 5-69. Tapered Bushing Installation

12. Tighten the capscrews evenly and progressively in rotation to 5 ft-lb. (7 Nm).
13. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;
    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.
    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

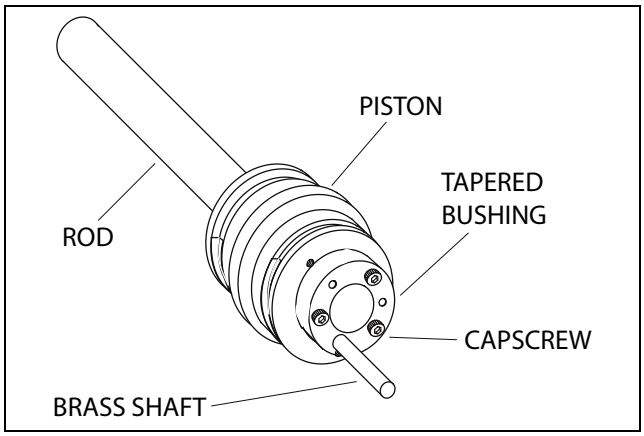


Figure 5-70. Seating the Tapered Bearing

14. Rotate the capscrews evenly and progressively in rotation to 5 ft-lb (7 Nm).

15. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCKK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

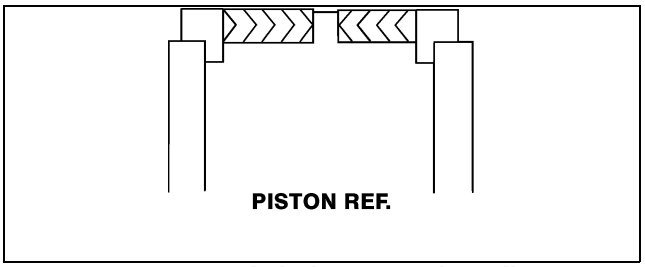


Figure 5-71. Hydrolock Piston Seal Installation

16. Place new hydrolock seal and guidelock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

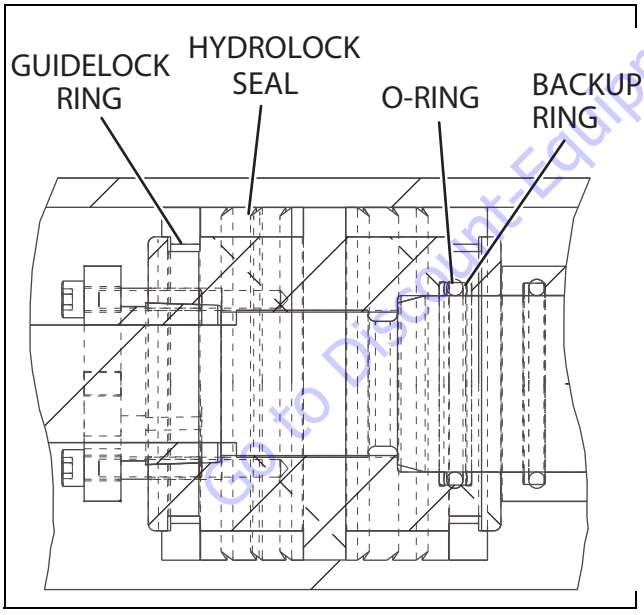


Figure 5-72. Piston Seal Kit Installation

17. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

18. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

19. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

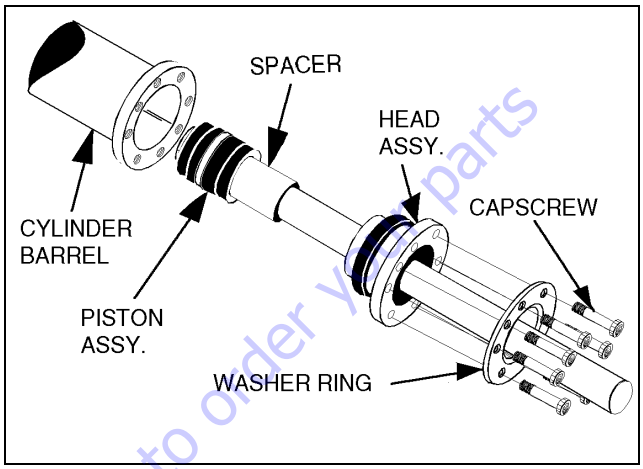


Figure 5-73. Rod Assembly Installation

20. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 20 ft-lb (27 Nm).

21. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.

22. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable. Torque valves to 50-55 ft-lb (68-75 Nm).

Platform Level Cylinder

DISASSEMBLY

Refer to Figure 5-77.

NOTICE

CONTAMINATION MAY DAMAGE EQUIPMENT. DISASSEMBLE CYLINDER ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to cylinder port block fitting.

⚠ WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate hydraulic power source and extend cylinder. Shut down and disconnect power source. Adequately support cylinder rod, if applicable.
3. Remove cartridge-type counterbalance valve and fittings from cylinder port block. Discard O-rings.
4. Place cylinder barrel in a suitable holding fixture. Tap around outside of cylinder head retainer with a suitable hammer to break thread-locking compound.

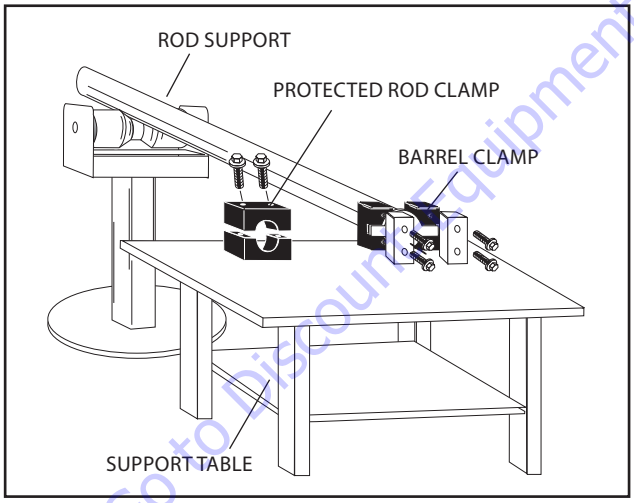


Figure 5-74. Cylinder Barrel Support

5. Unscrew cylinder head with hook spanner.

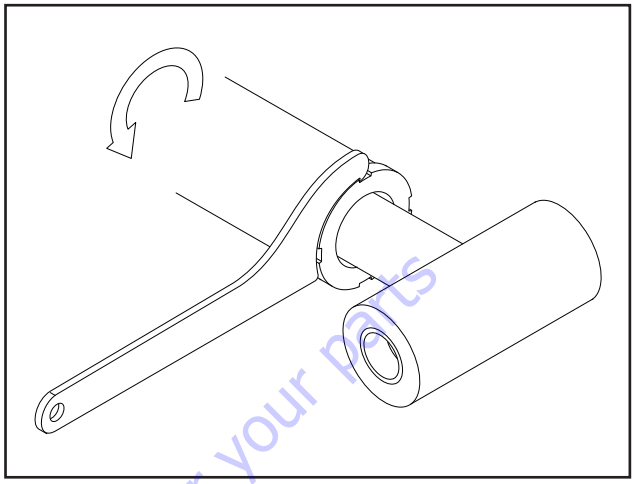


Figure 5-75. Removing Cylinder Head

NOTICE

PULLING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN REMOVING CYLINDER ROD, HEAD, AND PISTON.

6. Clamp barrel securely. Pull rod assembly and cylinder head from barrel.
7. Protect cylinder rod from damage and clamp in a vise or holding fixture as close to piston as possible.

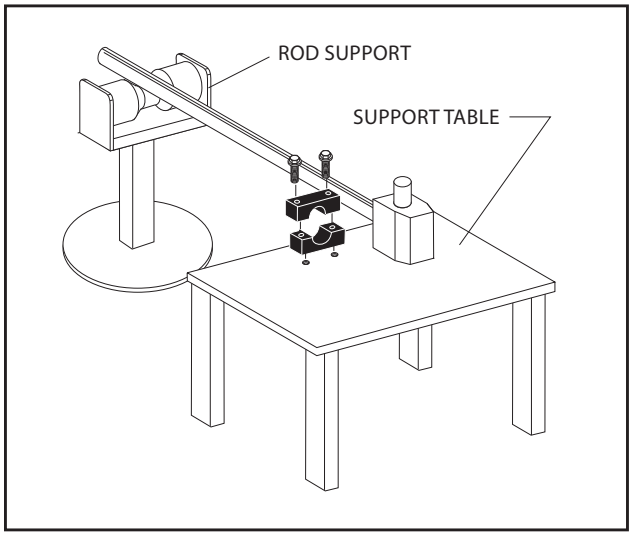
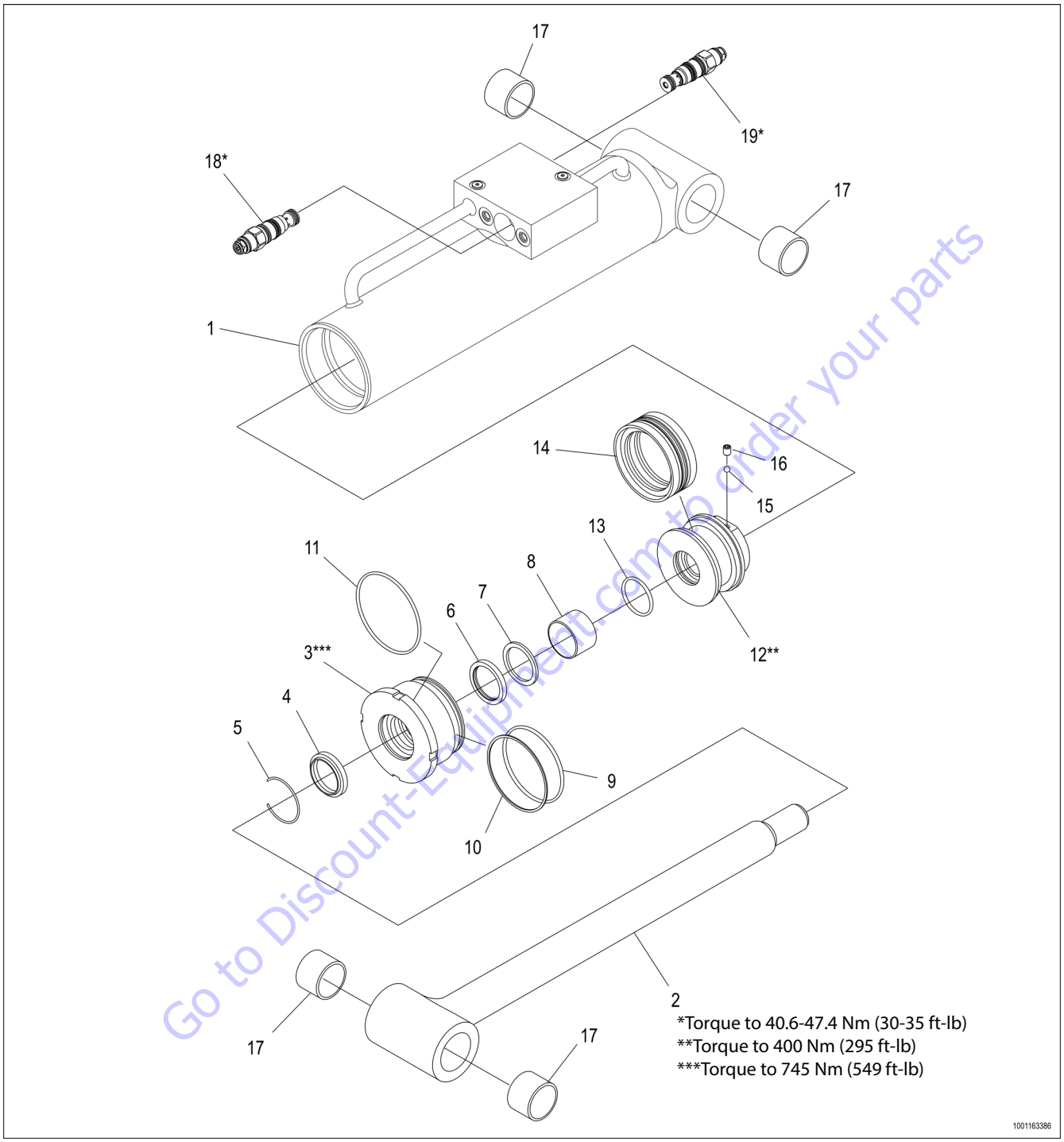


Figure 5-76. Cylinder Rod Support



1. Barrel
2. Rod
3. Head
4. Wiper
5. Retaining Ring
6. Rod Seal
7. Back-up Ring
8. Dry Bearing
9. O-Ring
10. Back-up Ring
11. O-Ring
12. Piston
13. O-Ring
14. Piston Seal
15. Ball
16. Setscrew
17. Bearing
18. Counterbalance Valve
19. Counterbalance Valve

Figure 5-77. Platform Level Cylinder

8. Loosen setscrew (16) retaining ball (15) in piston (12).
9. Screw piston counter-clockwise and remove from rod.
10. Remove and discard O-ring (14) and seal (13).

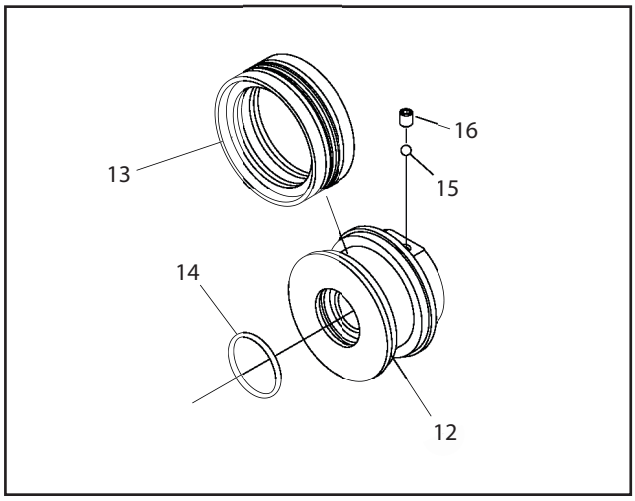


Figure 5-77. Piston Disassembly

11. Remove rod from holding fixture.
12. Remove cylinder head assembly (3) from rod (2).
13. Remove and discard O-ring (9), back-up ring (10), and O-ring (11) from cylinder head.
14. Remove and discard retaining ring (5), wiper (4), dry bearing (8), rod seal (7), and back-up ring (6) from cylinder head (3).

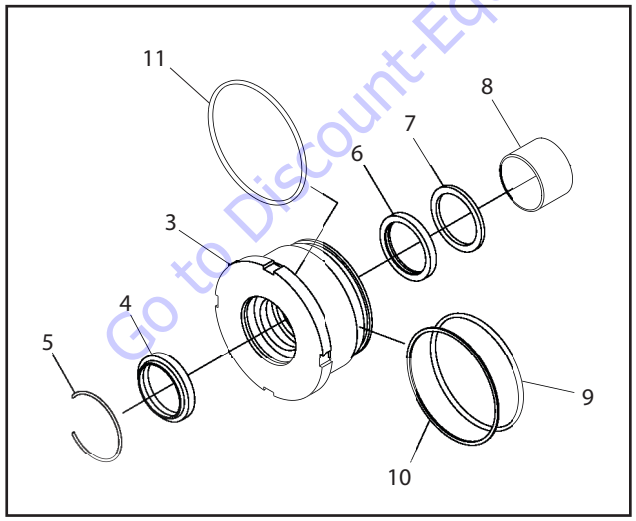


Figure 5-78. Cylinder Head Disassembly

CLEANING AND INSPECTION

1. Clean all parts in approved cleaning solvent.
2. Inspect cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage, scoring and distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and O-ring grooves in piston for burrs and sharp edges. Dress surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and O-ring grooves in head for burrs and sharp edges. Dress surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage, ovality, and tapering. Replace as needed.
13. Inspect rod and barrel bearings for signs of excessive wear or damage. If worn or damaged, rod/barrel must be replaced.
14. Inspect port block fittings and valves. Replace as needed. Torque valves to specifications shown in Figure 5-77., Platform Level Cylinder.
15. Inspect oil ports for blockage or presence of dirt or other foreign material. Repair as necessary.

COMPOSITE BUSHING

1. Clean hole (steel bushing) of burrs, dirt etc. for easier bushing installation.
2. Lubricate inside of steel bushing with WD40 before bearing installation.
3. Press composite bushing in steel bushing using an arbor.

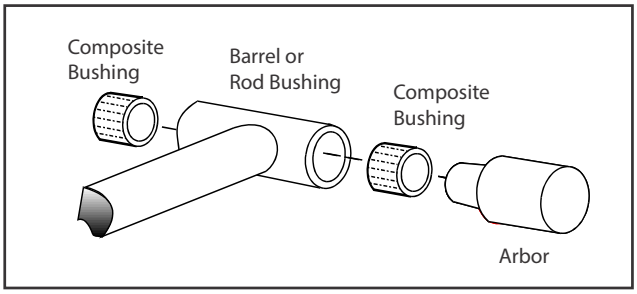


Figure 5-79. Composite Bushing Installation

CYLINDER ASSEMBLY

NOTICE

INCORRECT SEAL INSTALLATION CAN CAUSE CYLINDER LEAKS AND IMPROPER CYLINDER OPERATION. ENSURE ALL PISTON SEALS ARE CORRECTLY INSTALLED. REFER TO CROSS SECTION ILLUSTRATIONS FOR CORRECT SEAL ORIENTATION.

NOTE: *Use correct cylinder seal kit for cylinder assembly. See your JLG Parts Manual.*

Apply a light film of hydraulic oil to all components before assembly.

1. Support rod in holding fixture.
2. Install back-up ring (6), rod seal (7), and dry bearing (8) in cylinder head (3).
3. Install wiper (4) and retaining ring (5) in cylinder head.
4. Install O-ring (11) on cylinder head.
5. Install backup ring (10) and O-ring (9) on cylinder head.
6. Slide cylinder head assembly on rod (2) to rod end. Do not dislodge or damage seals.

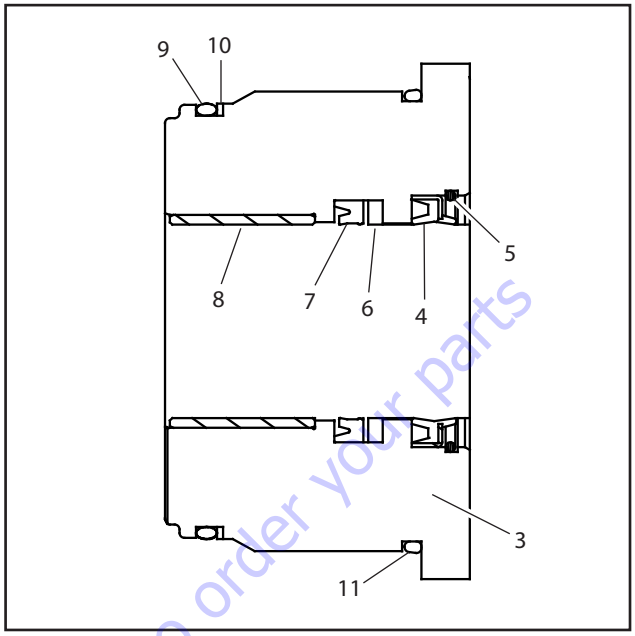


Figure 5-80. Cylinder Head Seal Installation

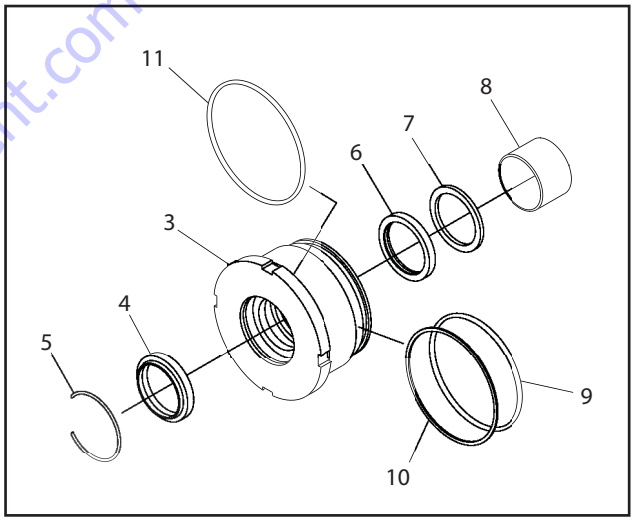


Figure 5-81. Cylinder Head Assembly

7. Install O-ring (14) in piston (12).
8. Install seal (16) on piston.
9. Apply JLG thread locking compound (P/N 0100011) to piston threads. Install piston on rod. Torque to 400 Nm (295 ft-lb).
10. Install ball (15) and setscrew (16).

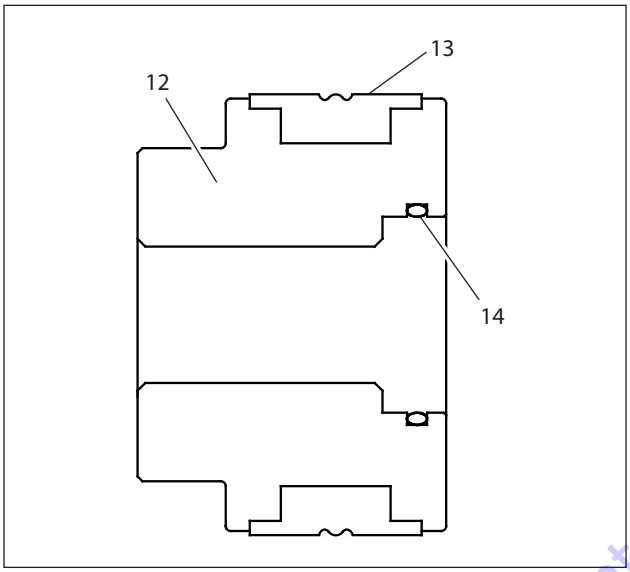


Figure 5-82. Piston Seal Installation

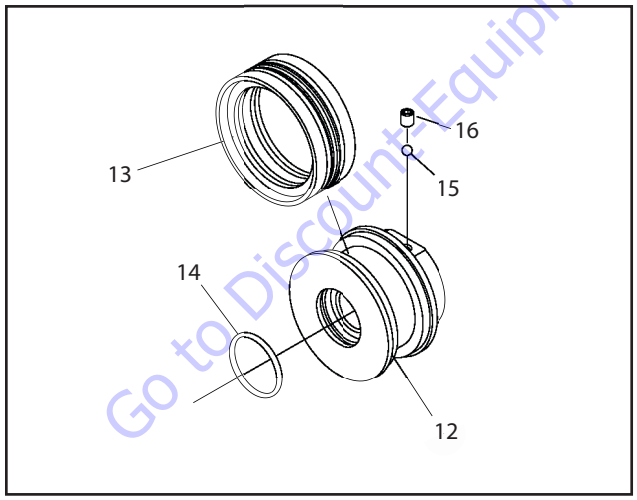


Figure 5-83. Piston Assembly

11. Position cylinder barrel in a suitable holding fixture.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

12. Clamp barrel securely and support rod. Insert piston end into barrel cylinder. Do not damage or dislodge seal.
13. Remove cylinder rod from holding fixture.
14. Place cylinder barrel in suitable holding fixture.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

15. Clamp barrel securely and support rod. Insert piston end into barrel cylinder. Do not damage or dislodge piston O-rings and backup ring.
16. Continue pushing rod into barrel. Screw in cylinder head. Torque to 745 Nm (549 ft-lb).

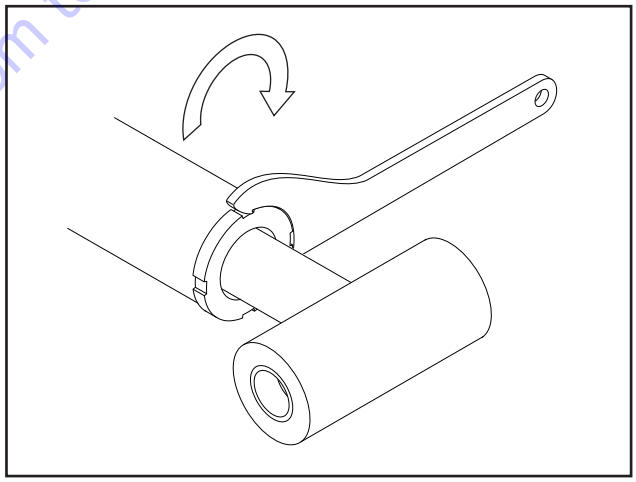


Figure 5-84. Cylinder Head Installation

5.4 HYDRAULIC SYSTEM INSTALLATION

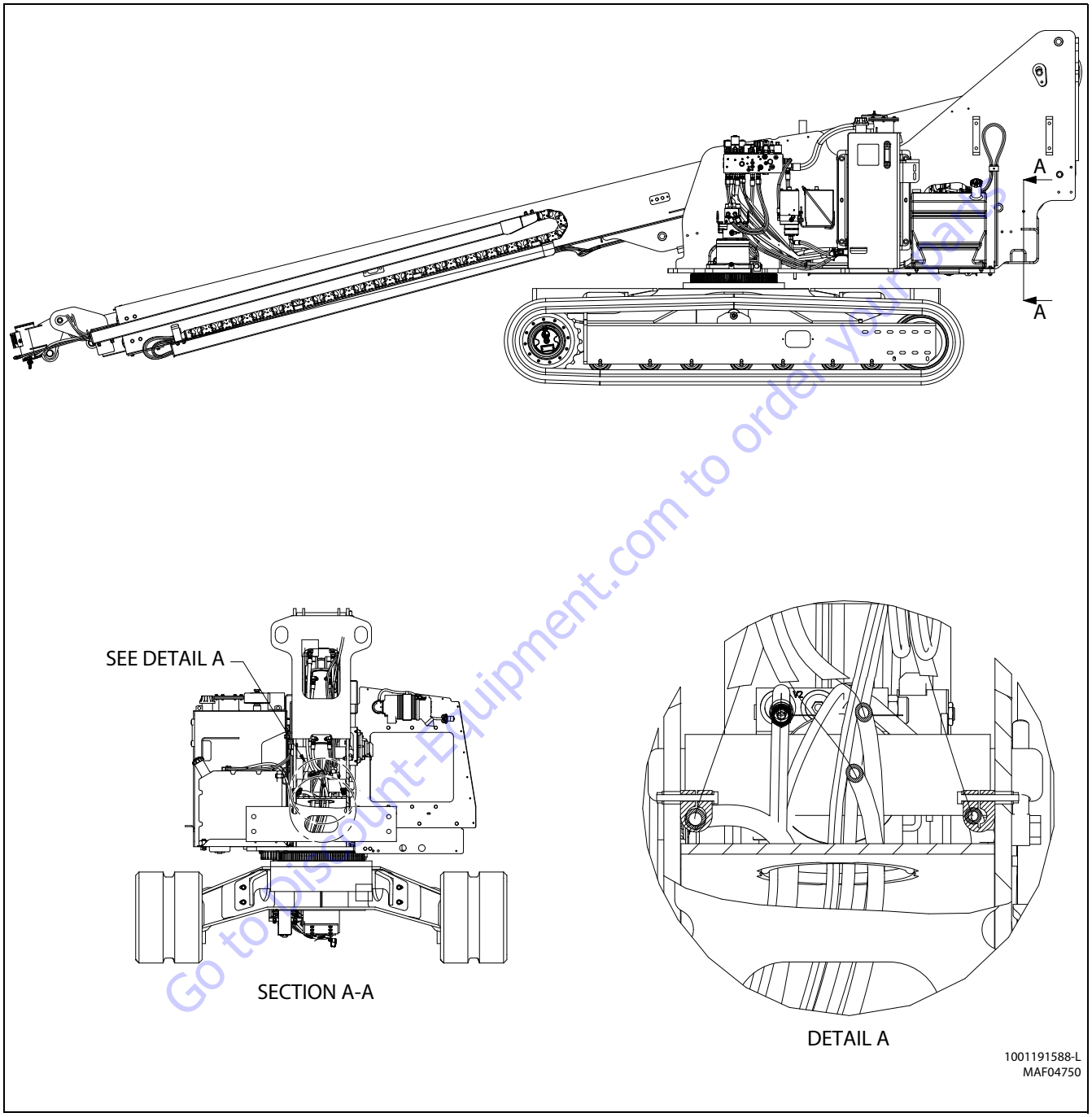


Figure 5-85. Hydraulic System Installation (400SC) - Sheet 1 of 16

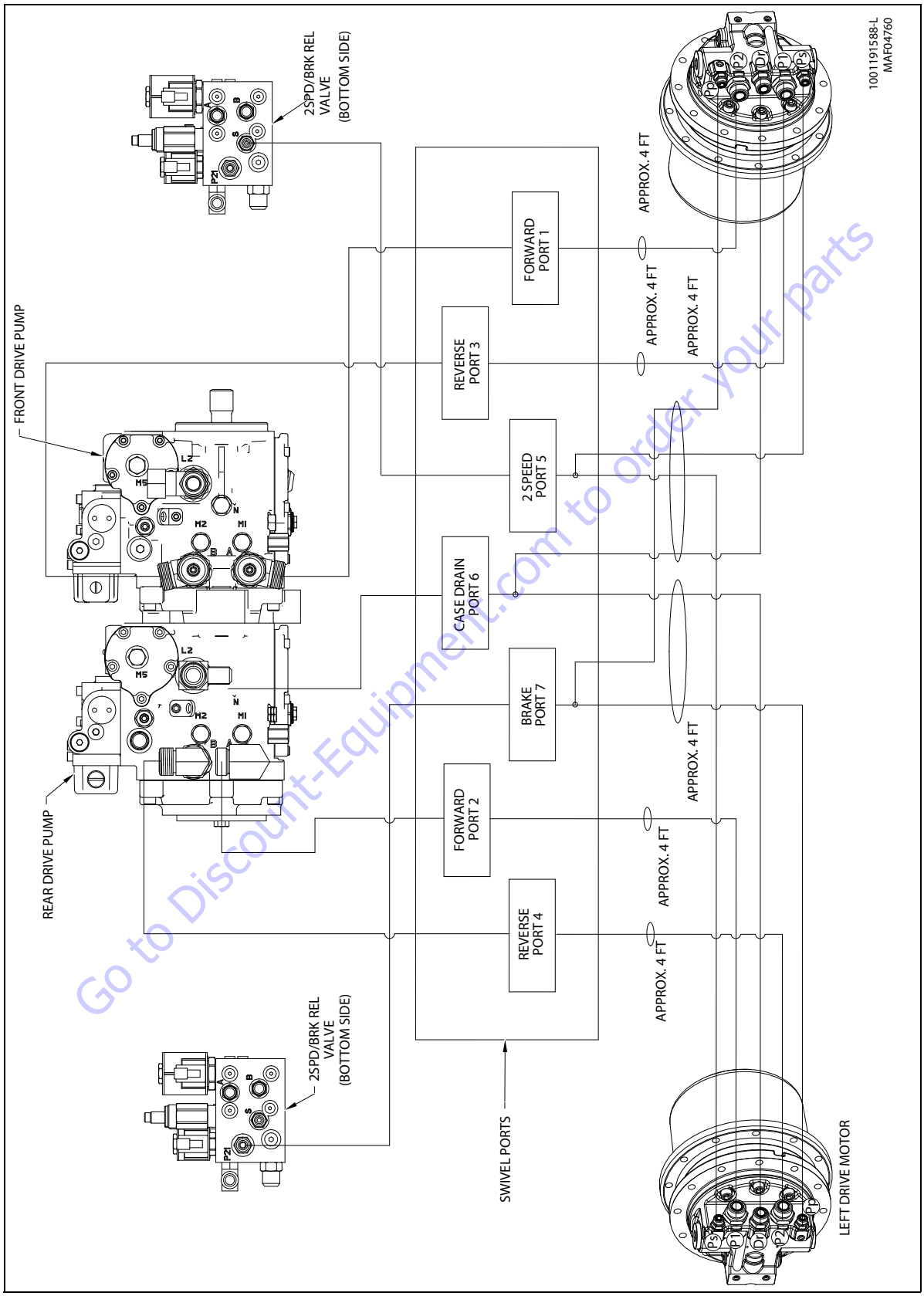


Figure 5-86. Hydraulic System Installation (400SC) - Sheet 2 of 16

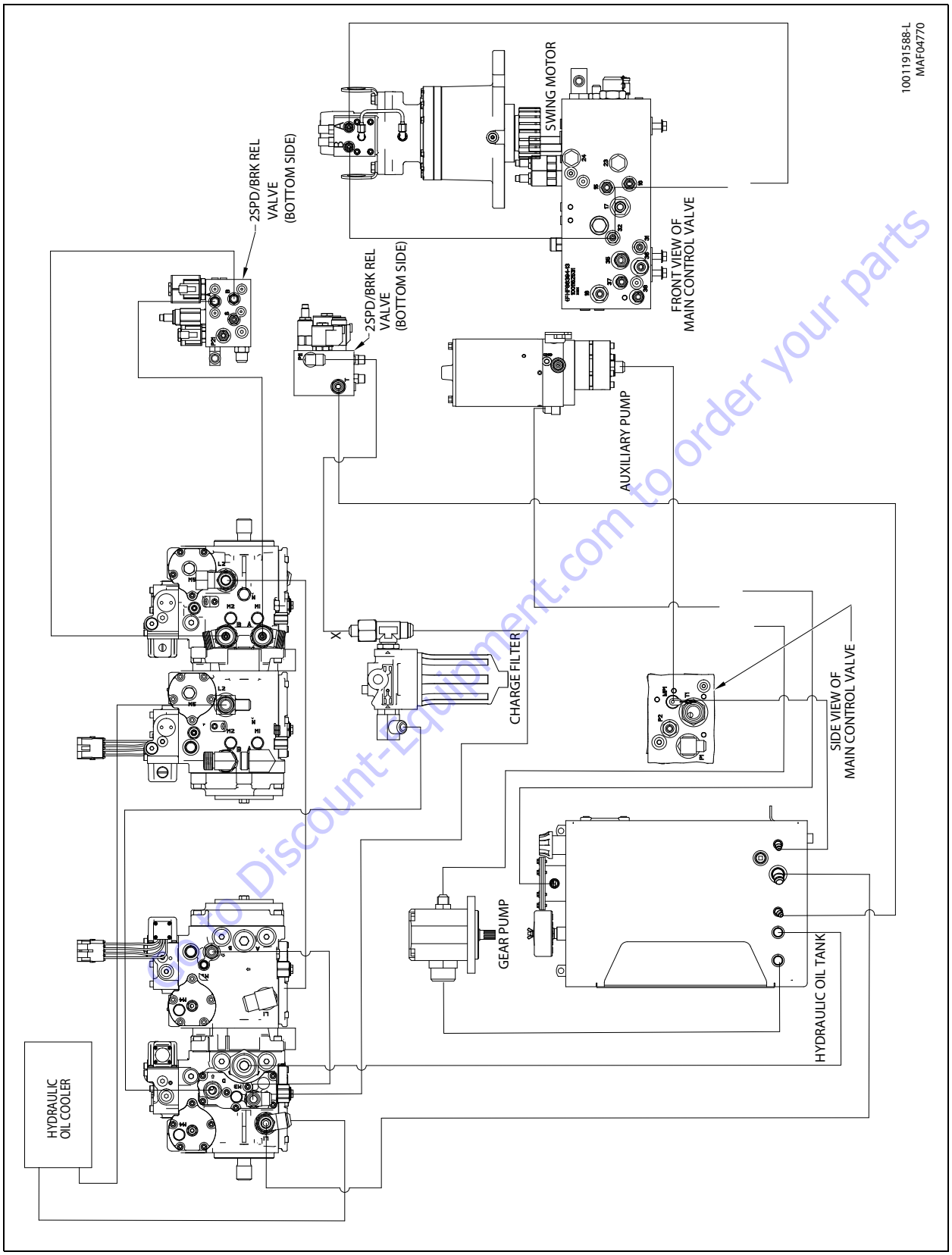


Figure 5-87. Hydraulic System Installation (400SC) - Sheet 3 of 16

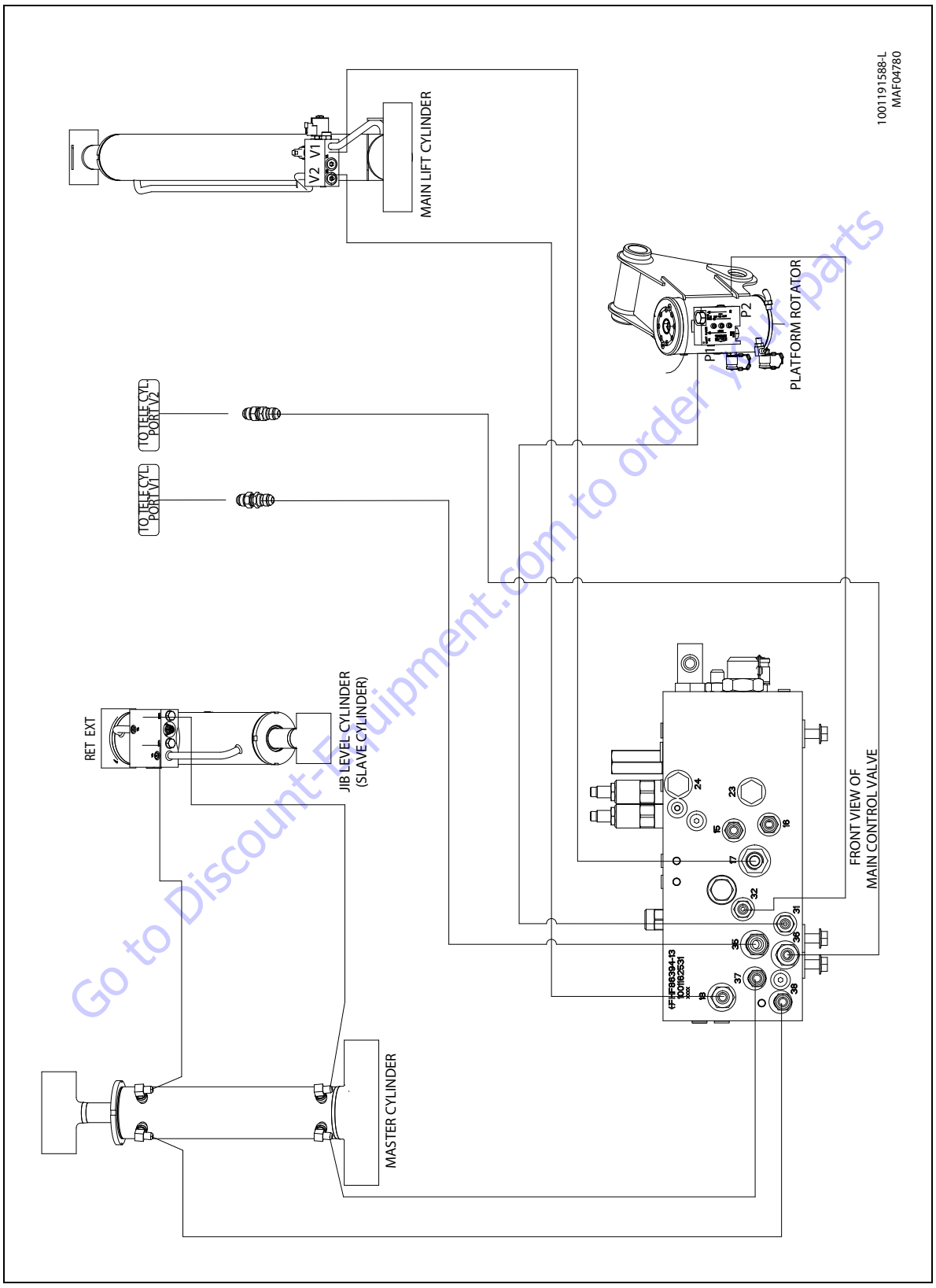


Figure 5-88. Hydraulic System Installation (400SC) - Sheet 4 of 16

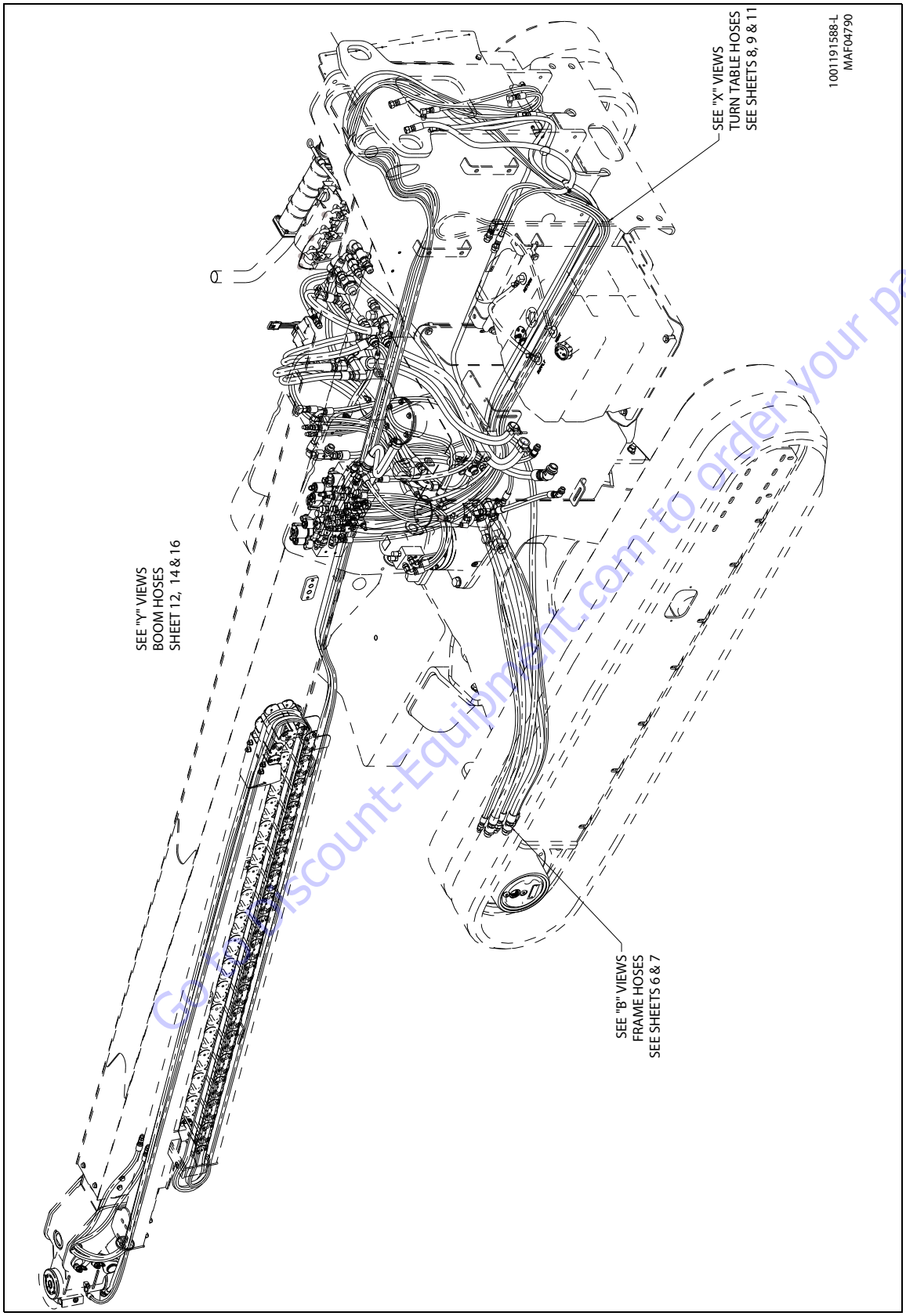


Figure 5-89. Hydraulic System Installation (400SC) - Sheet 5 of 16

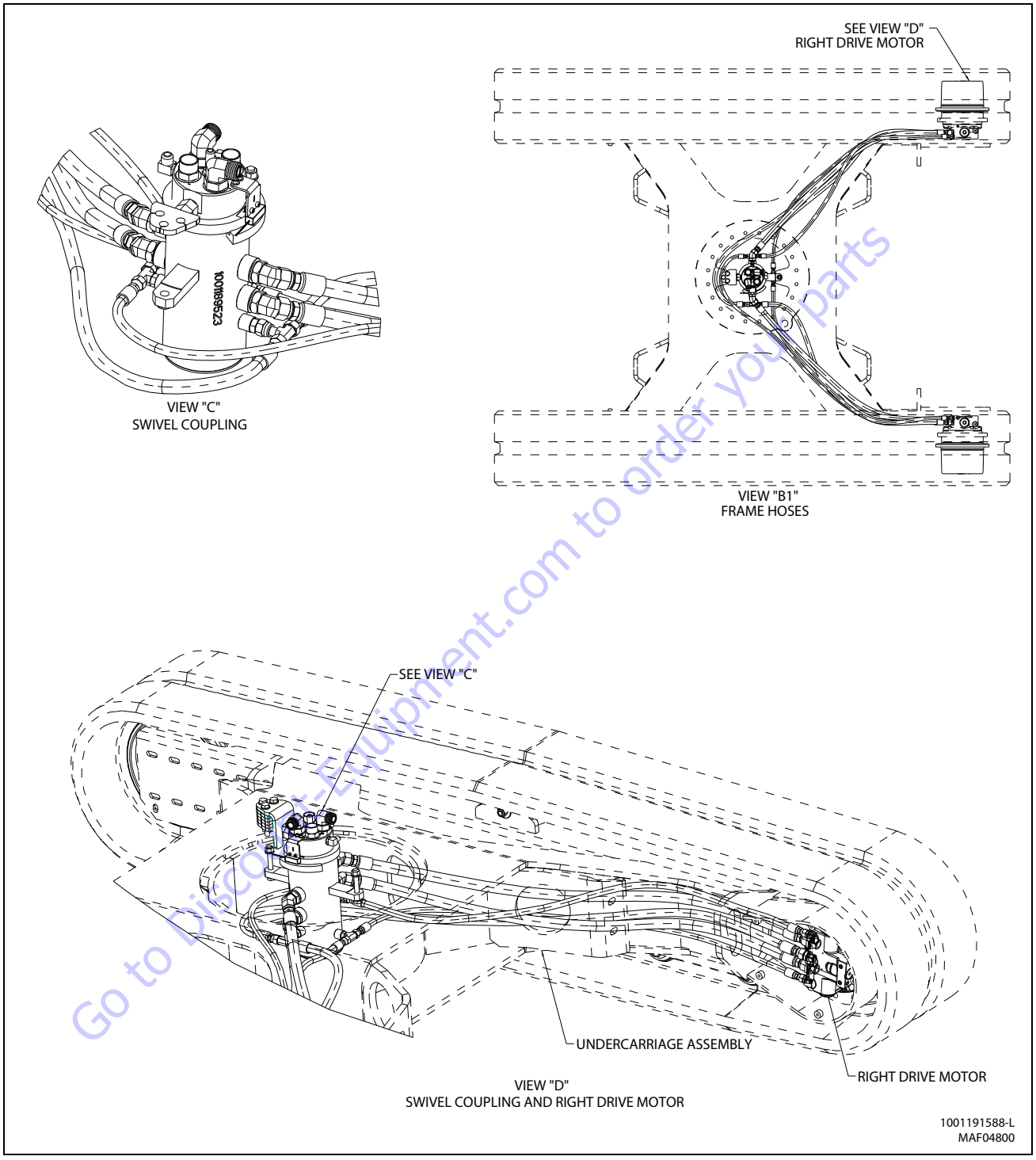


Figure 5-90. Hydraulic System Installation (400SC) - Sheet 6 of 16

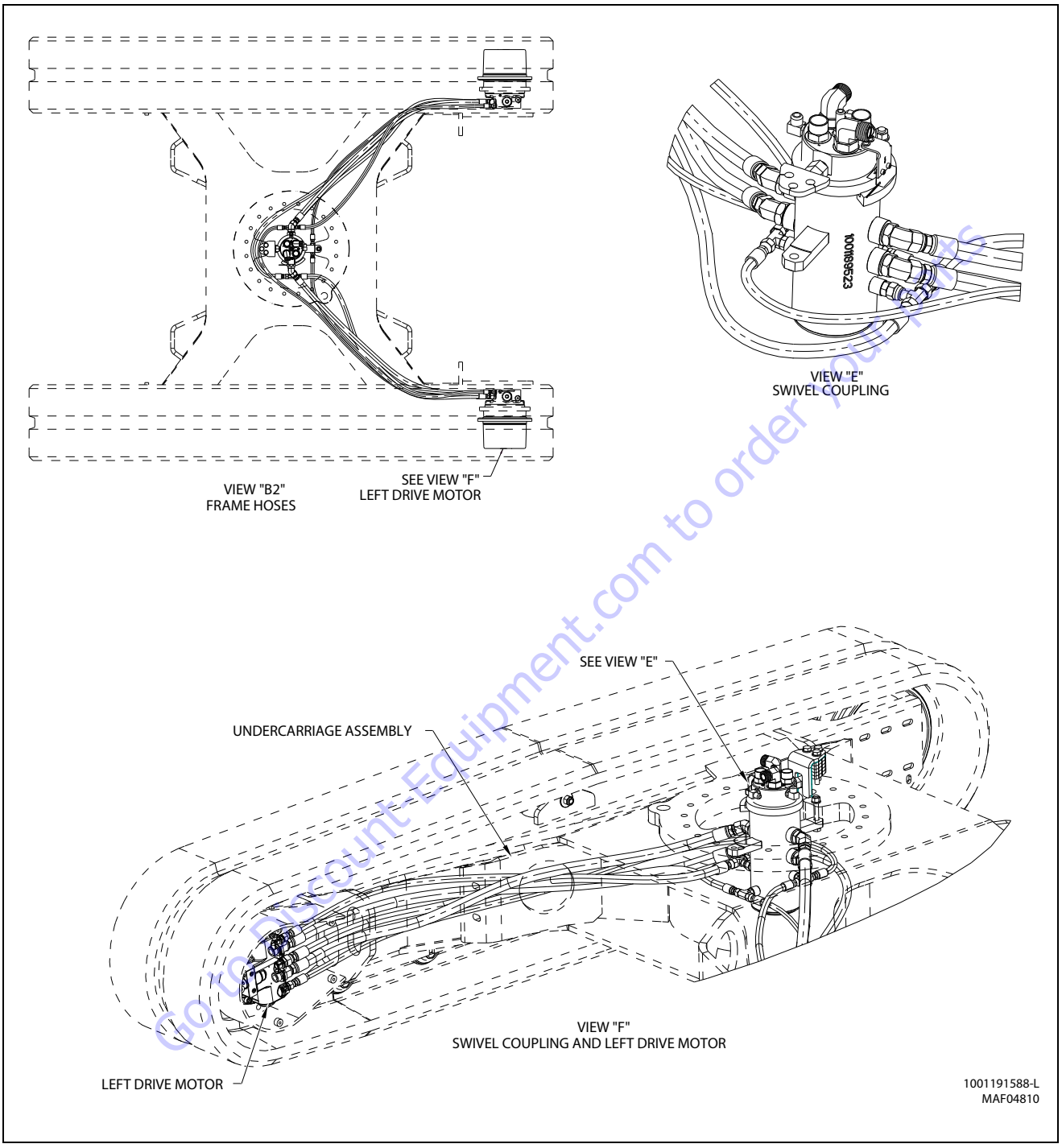


Figure 5-91. Hydraulic System Installation (400SC) - Sheet 7 of 16

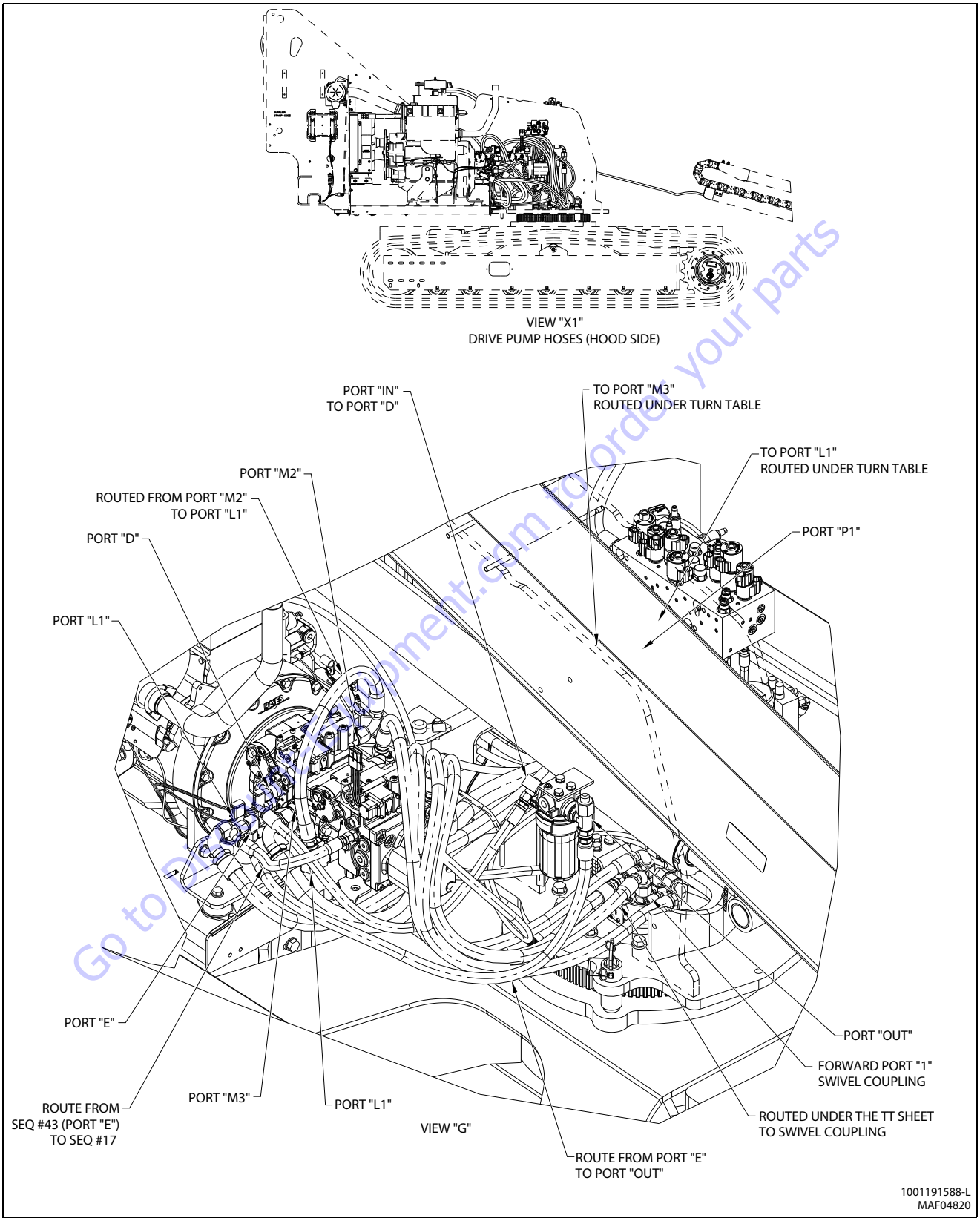


Figure 5-92. Hydraulic System Installation (400SC) - Sheet 8 of 16

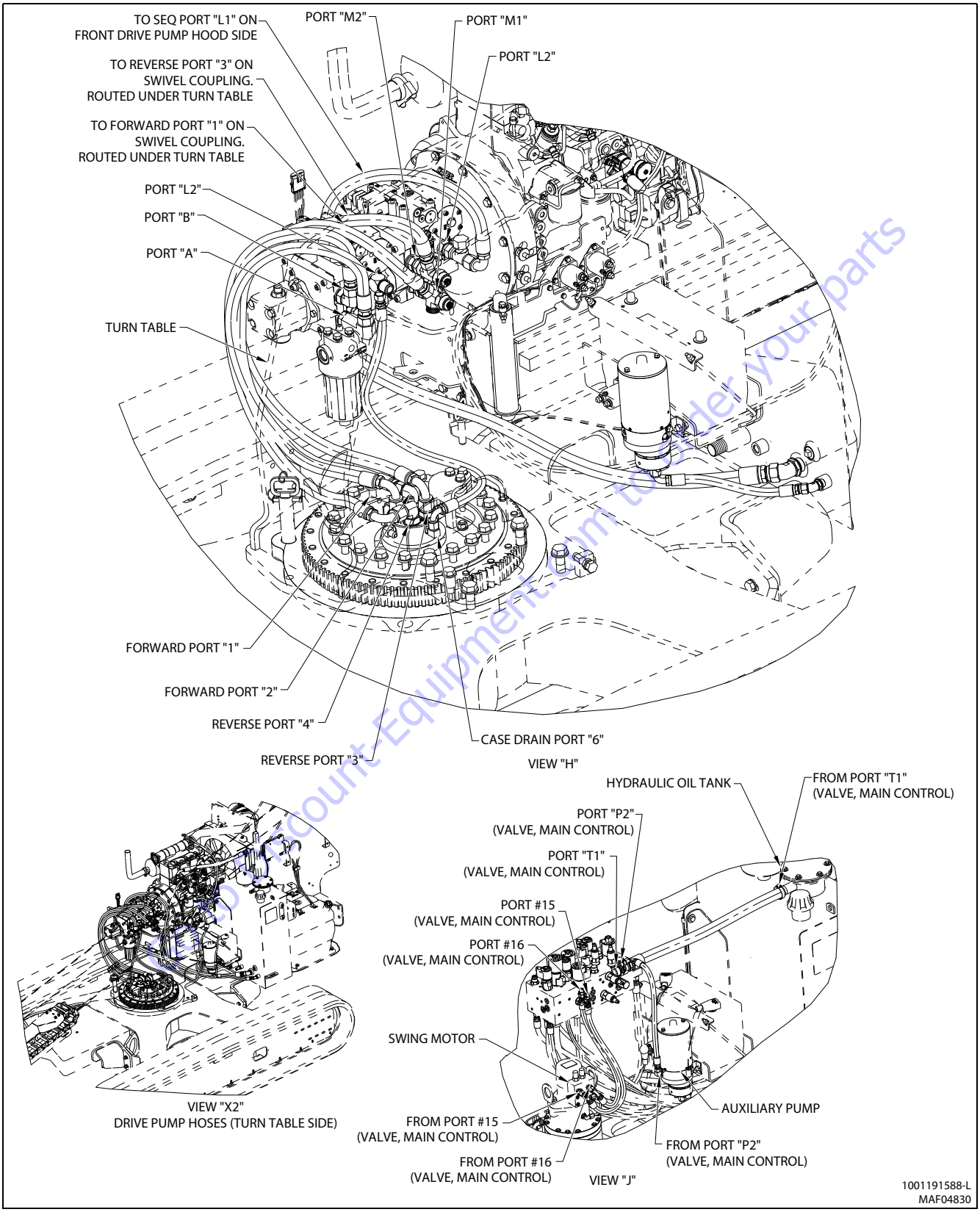


Figure 5-93. Hydraulic System Installation (400SC) - Sheet 9 of 16

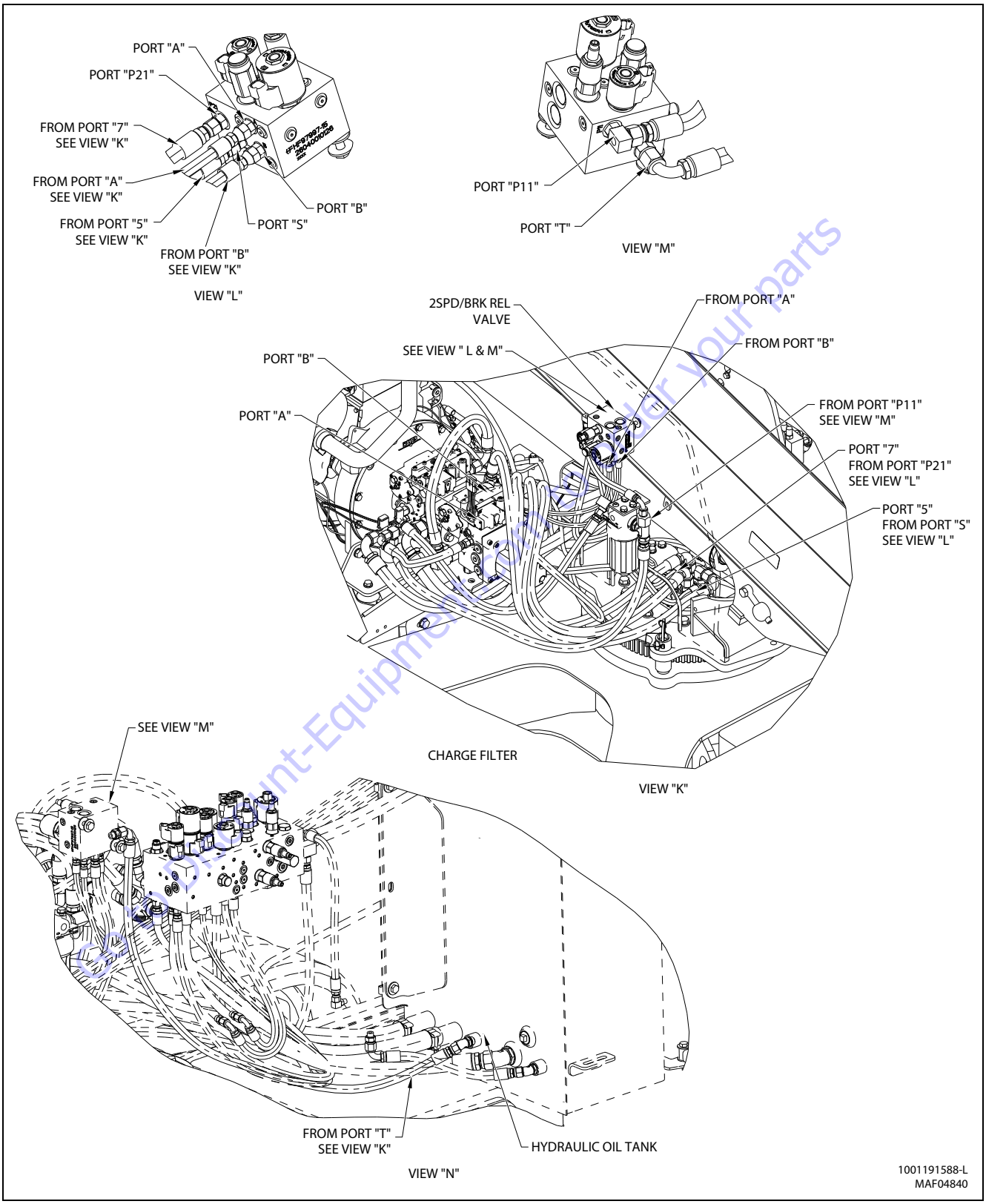


Figure 5-94. Hydraulic System Installation (400SC) - Sheet 10 of 16

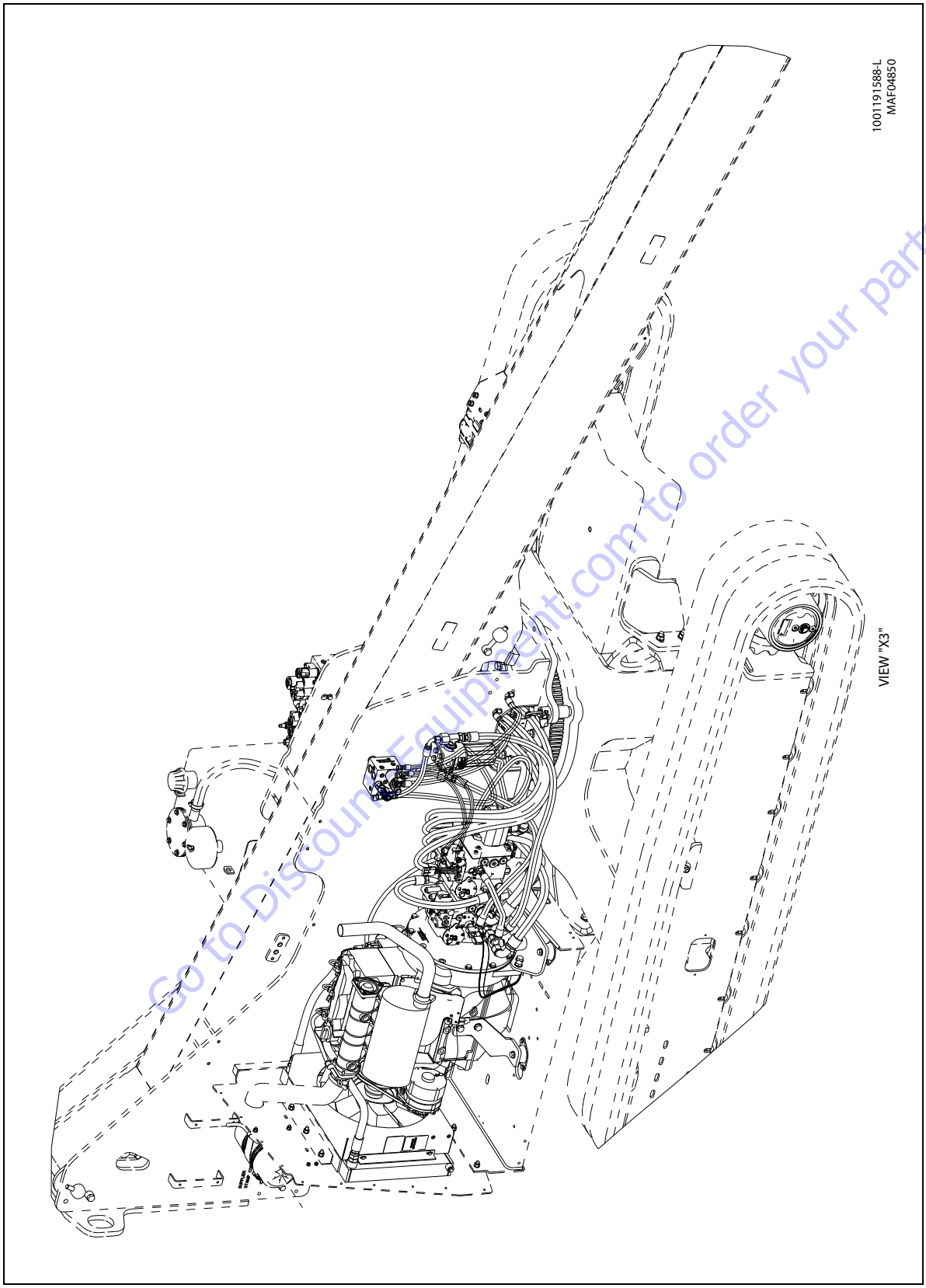


Figure 5-95. Hydraulic System Installation (400SC) - Sheet 11 of 16

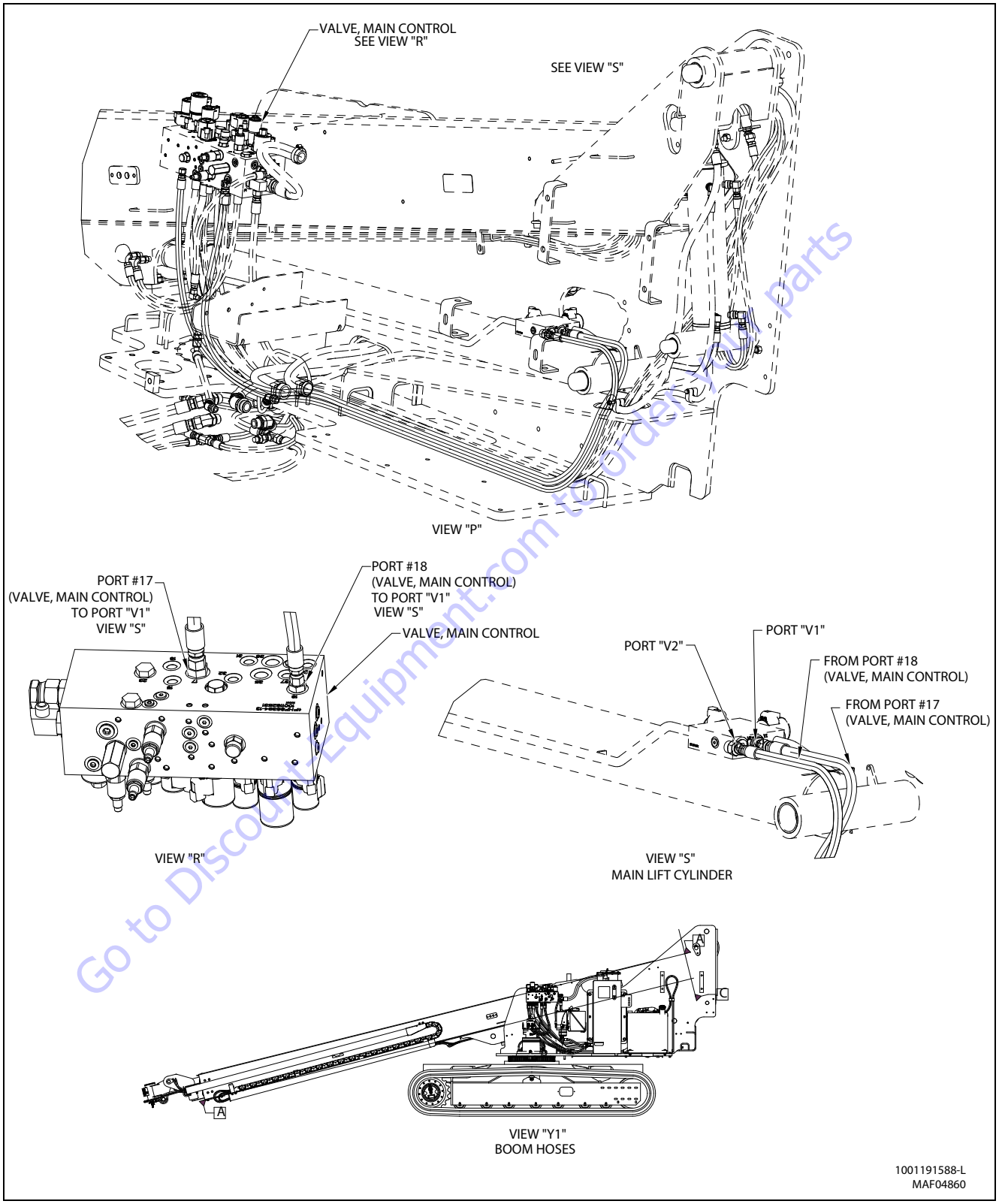


Figure 5-96. Hydraulic System Installation (400SC) - Sheet 12 of 16

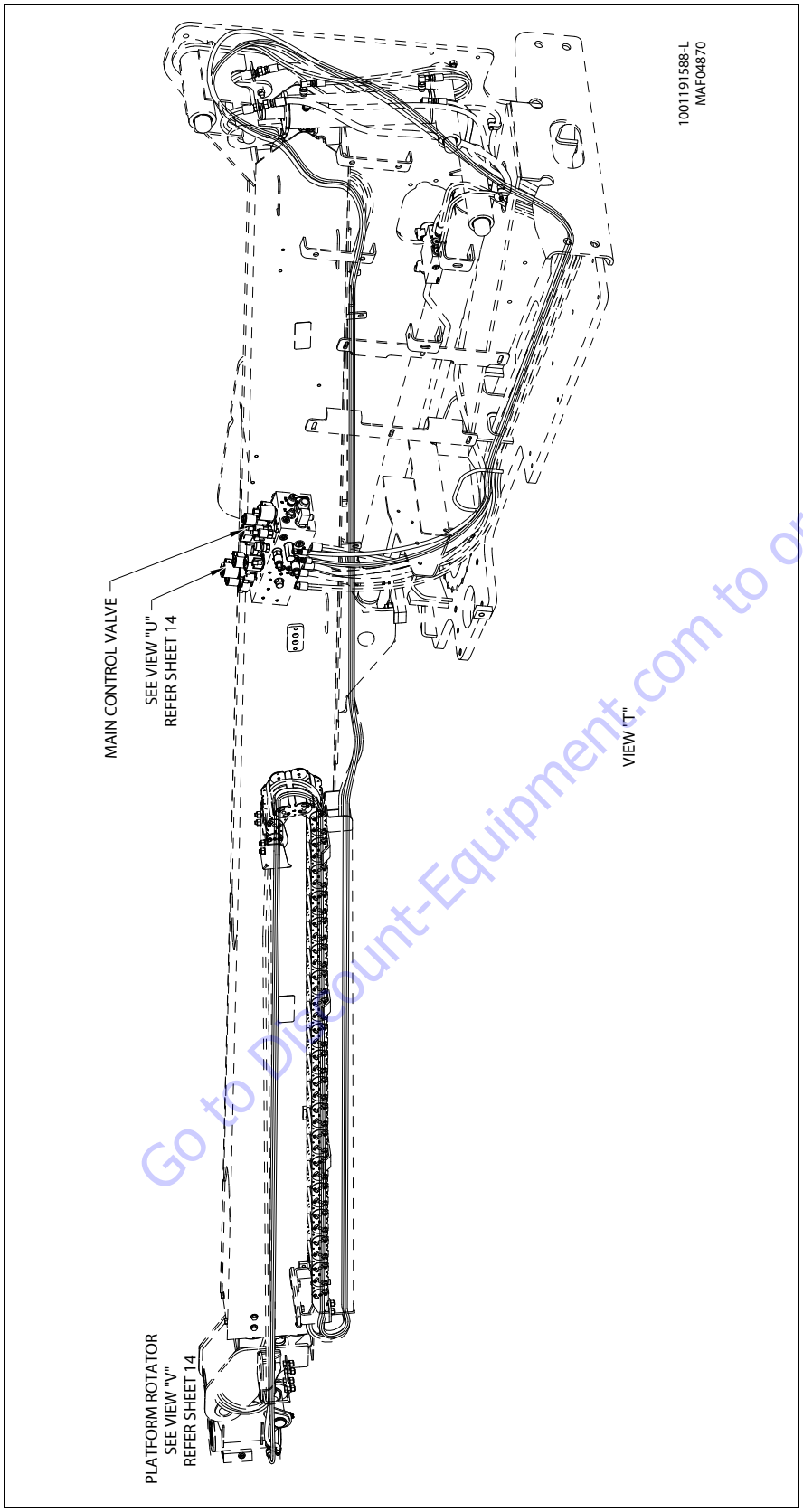


Figure 5-97. Hydraulic System Installation (400SC) - Sheet 13 of 16

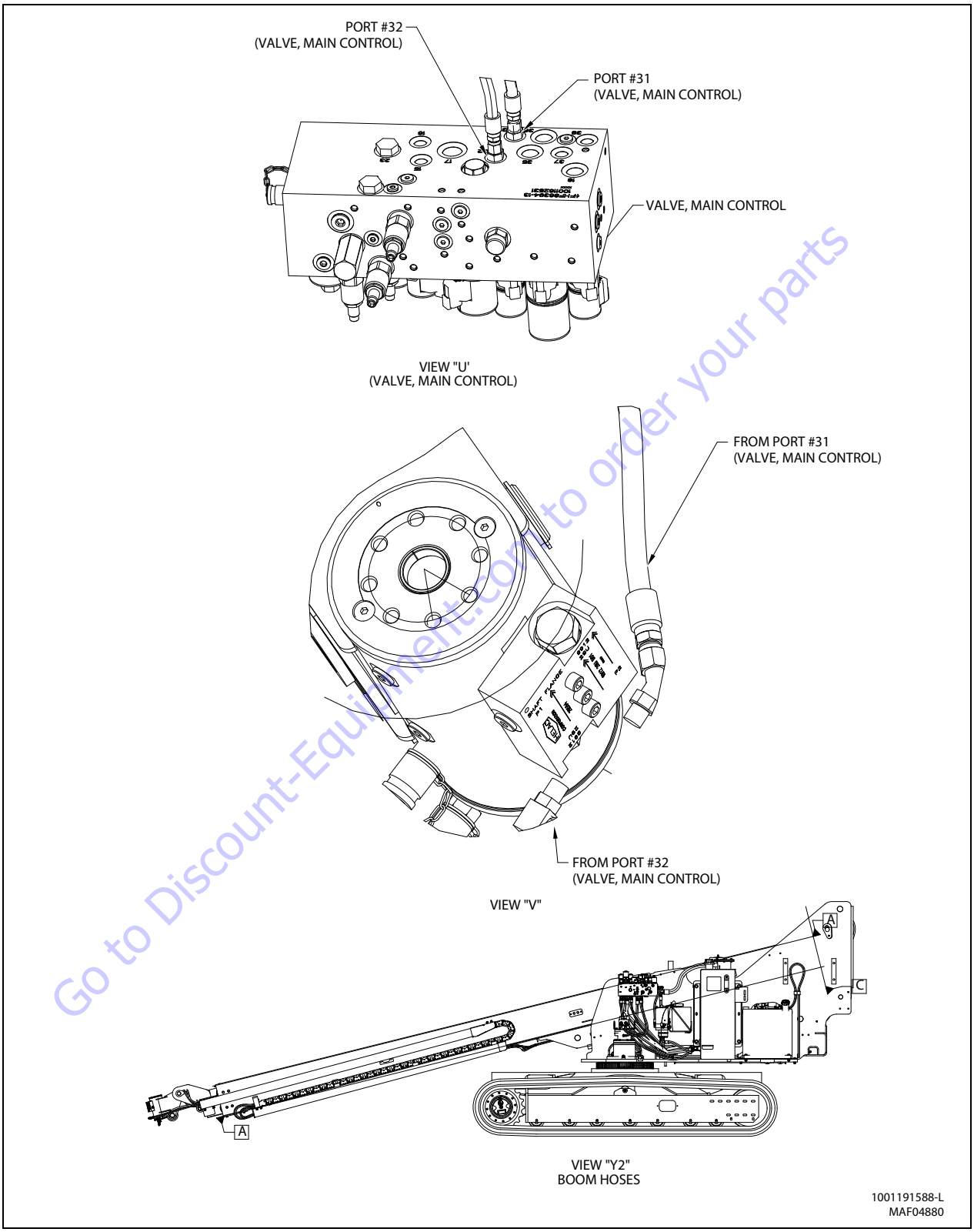


Figure 5-98. Hydraulic System Installation (400SC) - Sheet 14 of 16

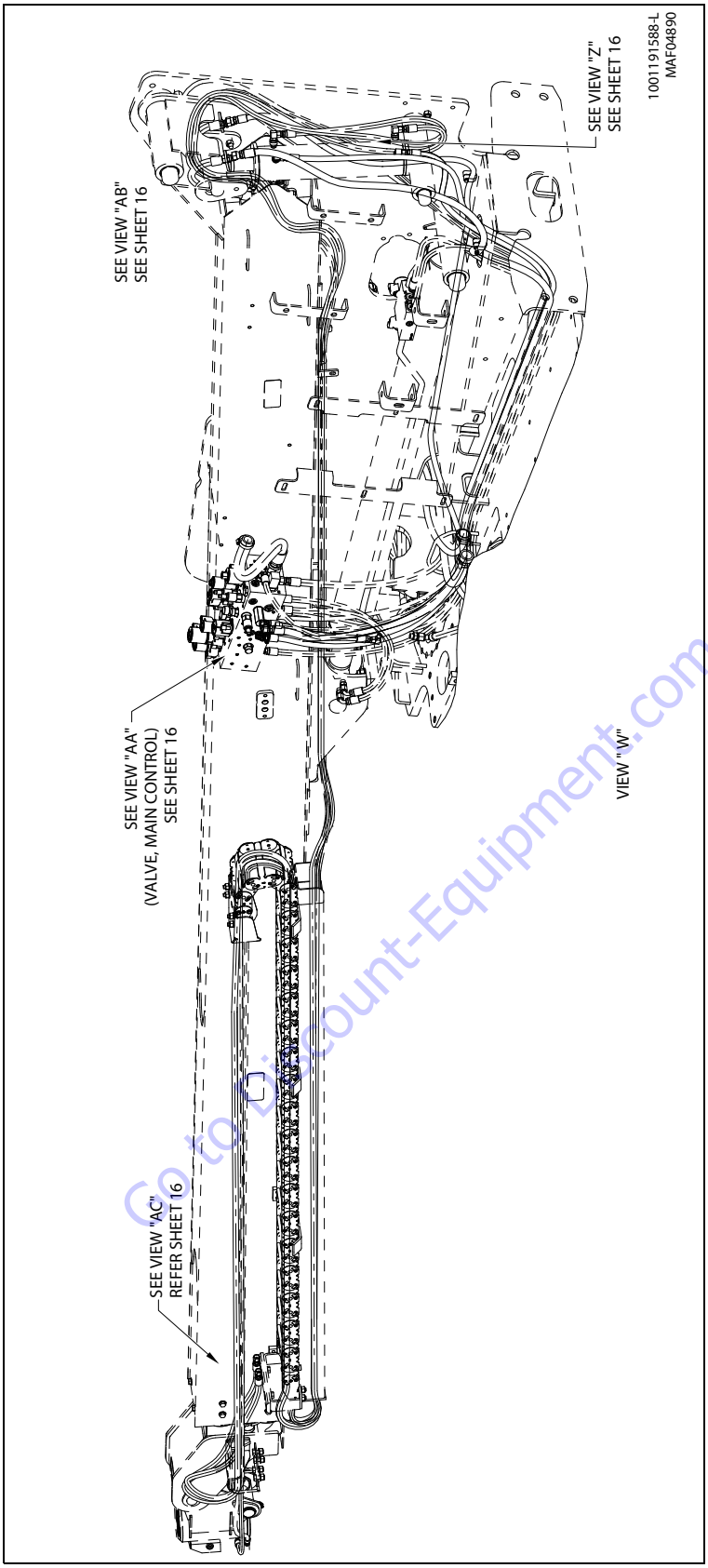


Figure 5-99. Hydraulic System Installation (400SC) - Sheet 15 of 16

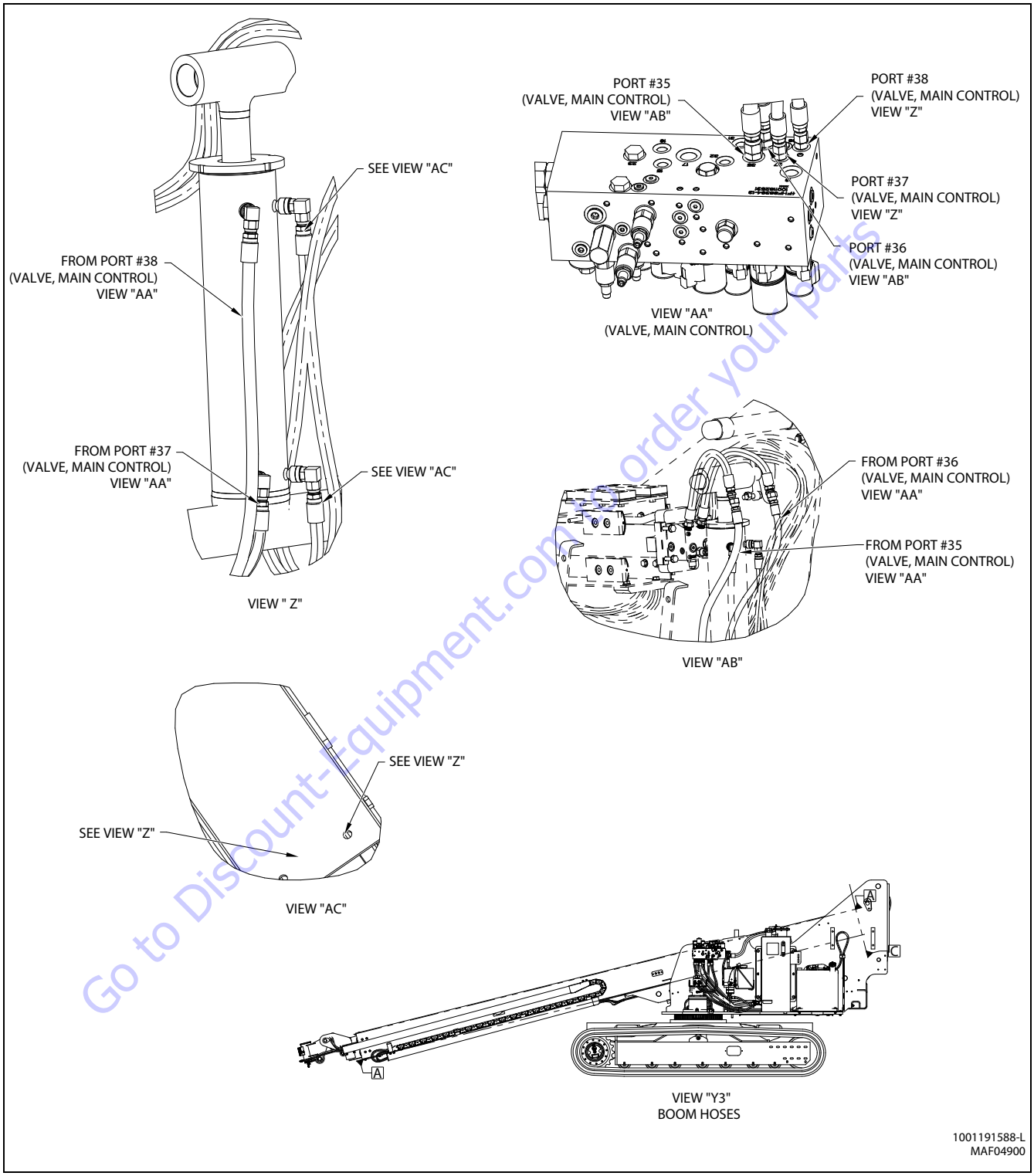


Figure 5-100. Hydraulic System Installation (400SC) - Sheet 16 of 16

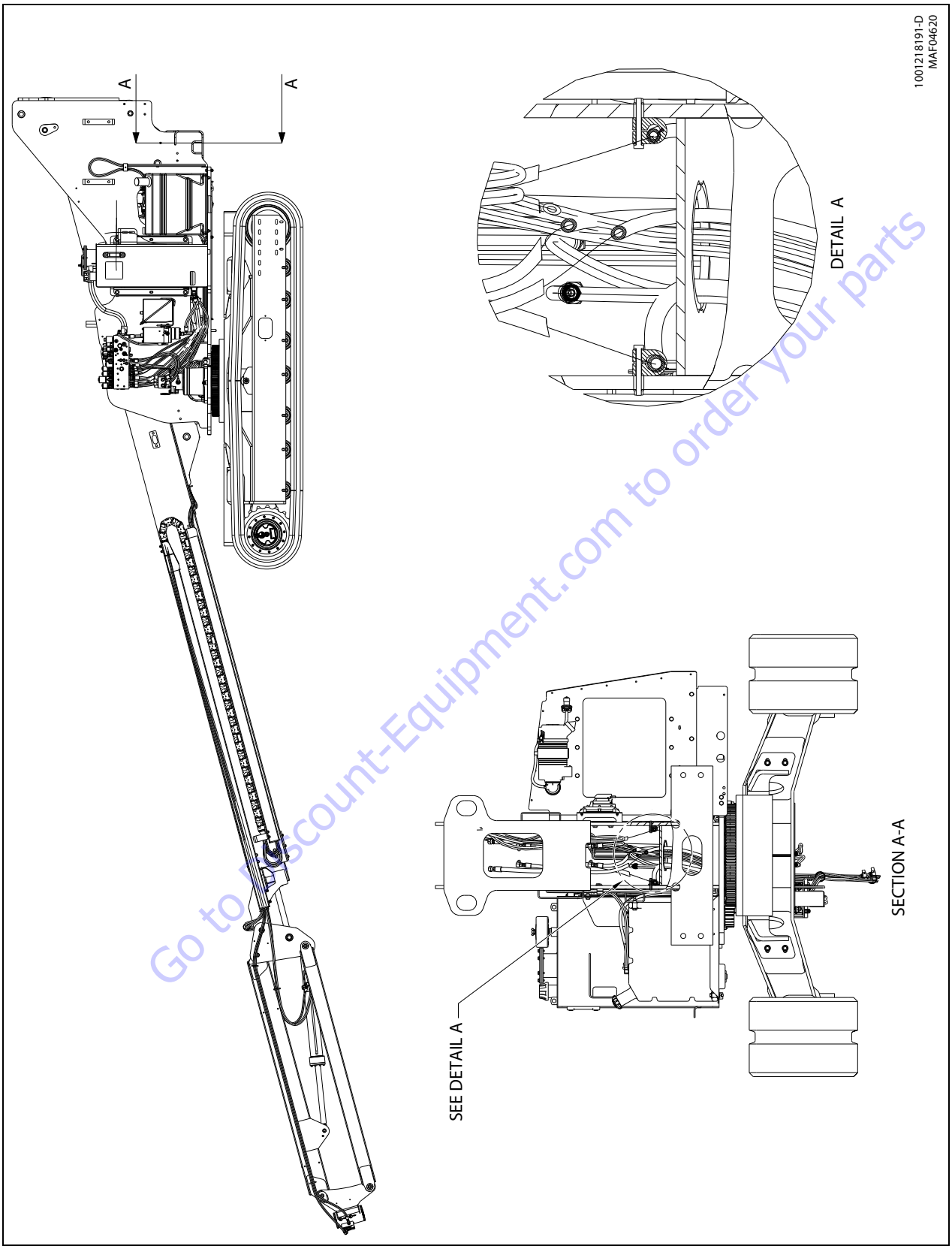


Figure 5-101. Hydraulic System Installation (460SJC) - Sheet 1 of 15

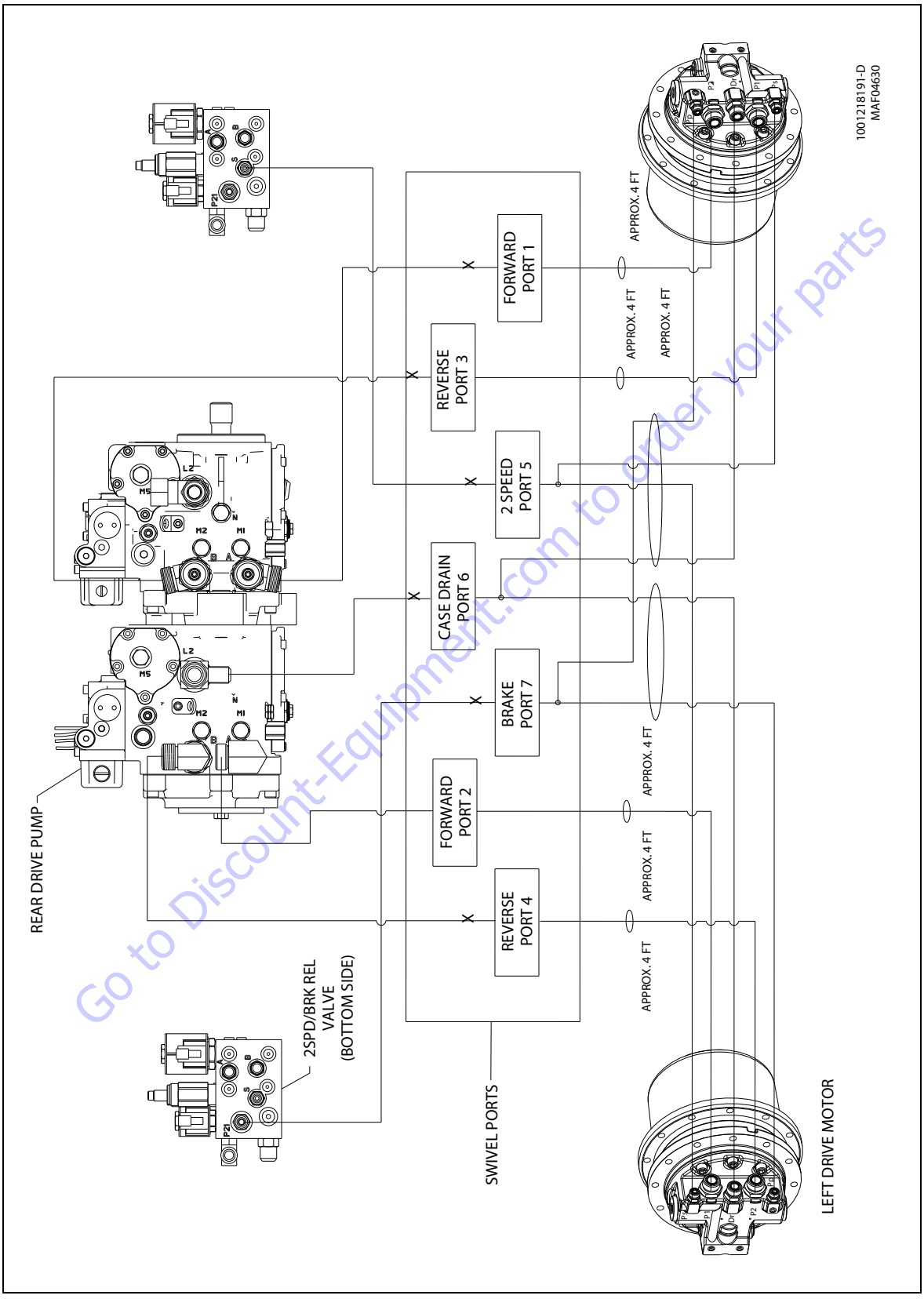


Figure 5-102. Hydraulic System Installation (460SJC) - Sheet 2 of 15

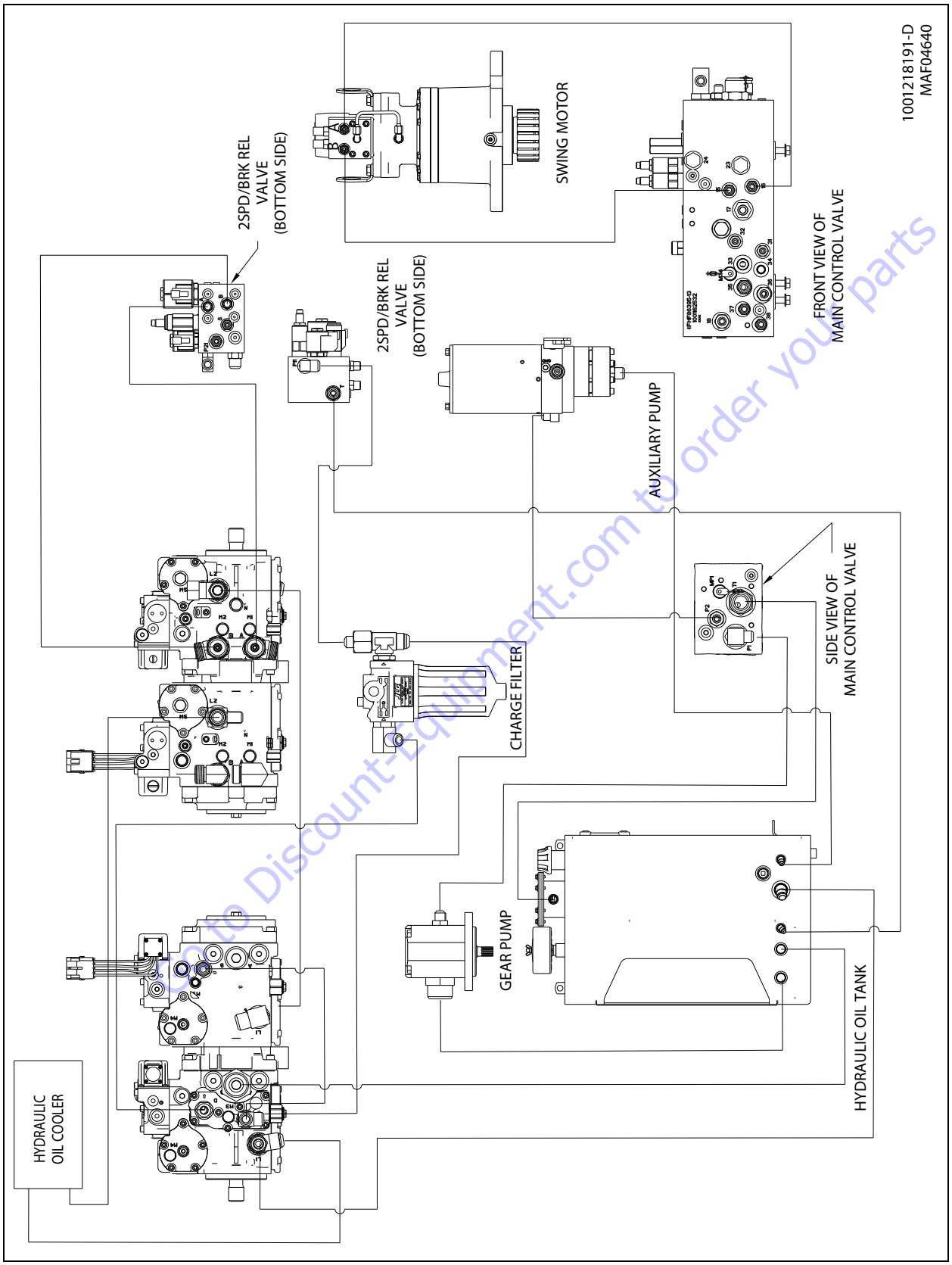


Figure 5-103. Hydraulic System Installation (460SJC) - Sheet 3 of 15

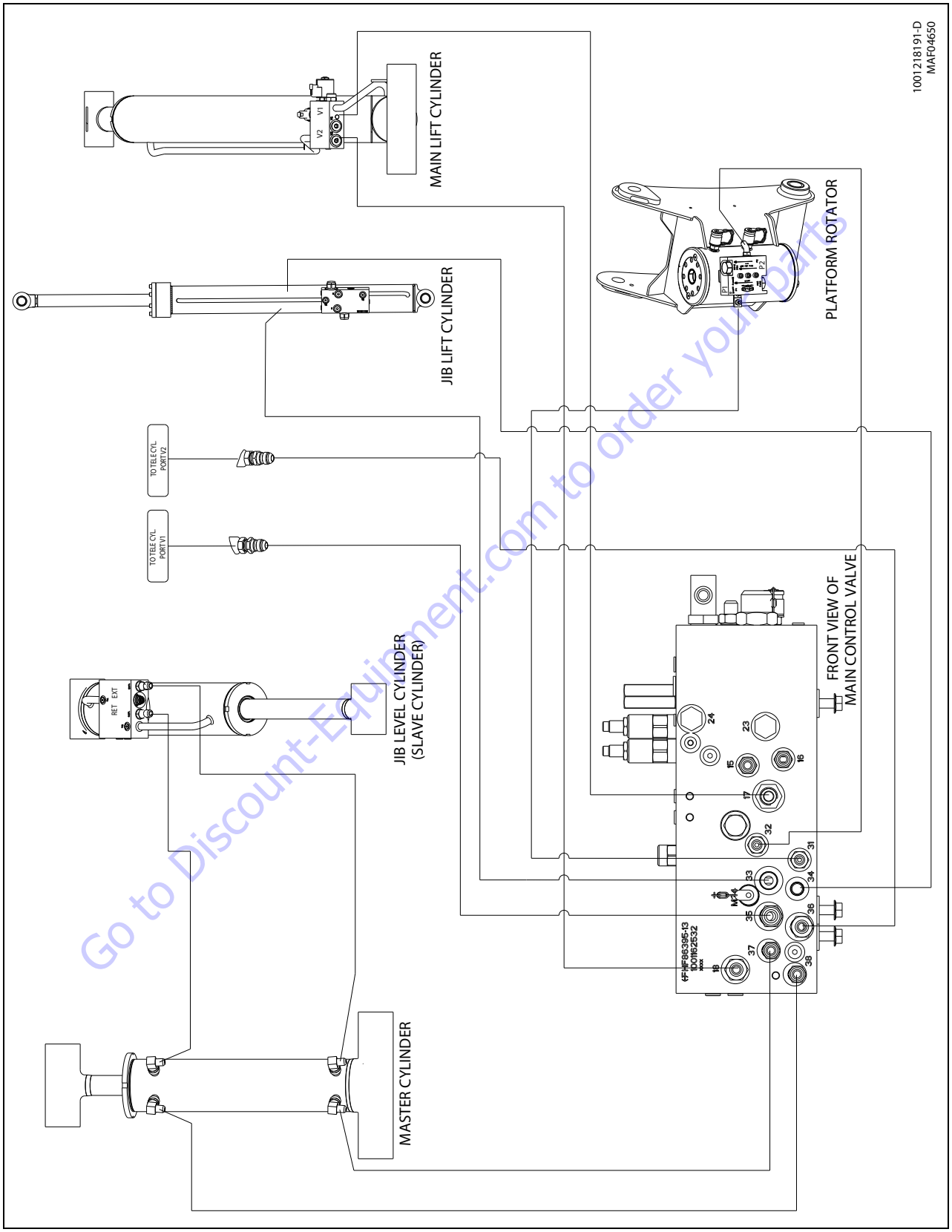


Figure 5-104. Hydraulic System Installation (460SJC) - Sheet 4 of 15

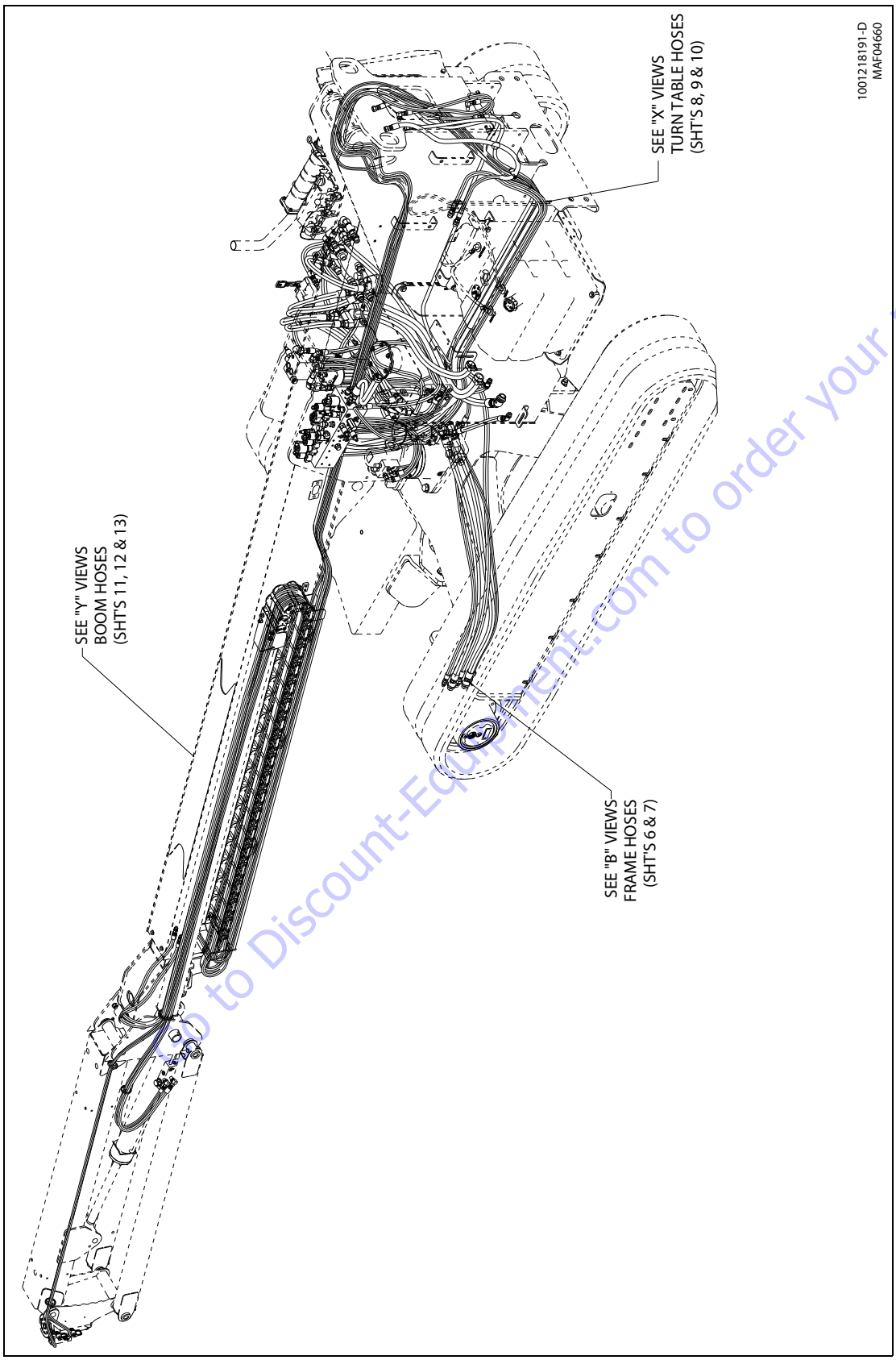


Figure 5-105. Hydraulic System Installation (460SJC) - Sheet 5 of 15

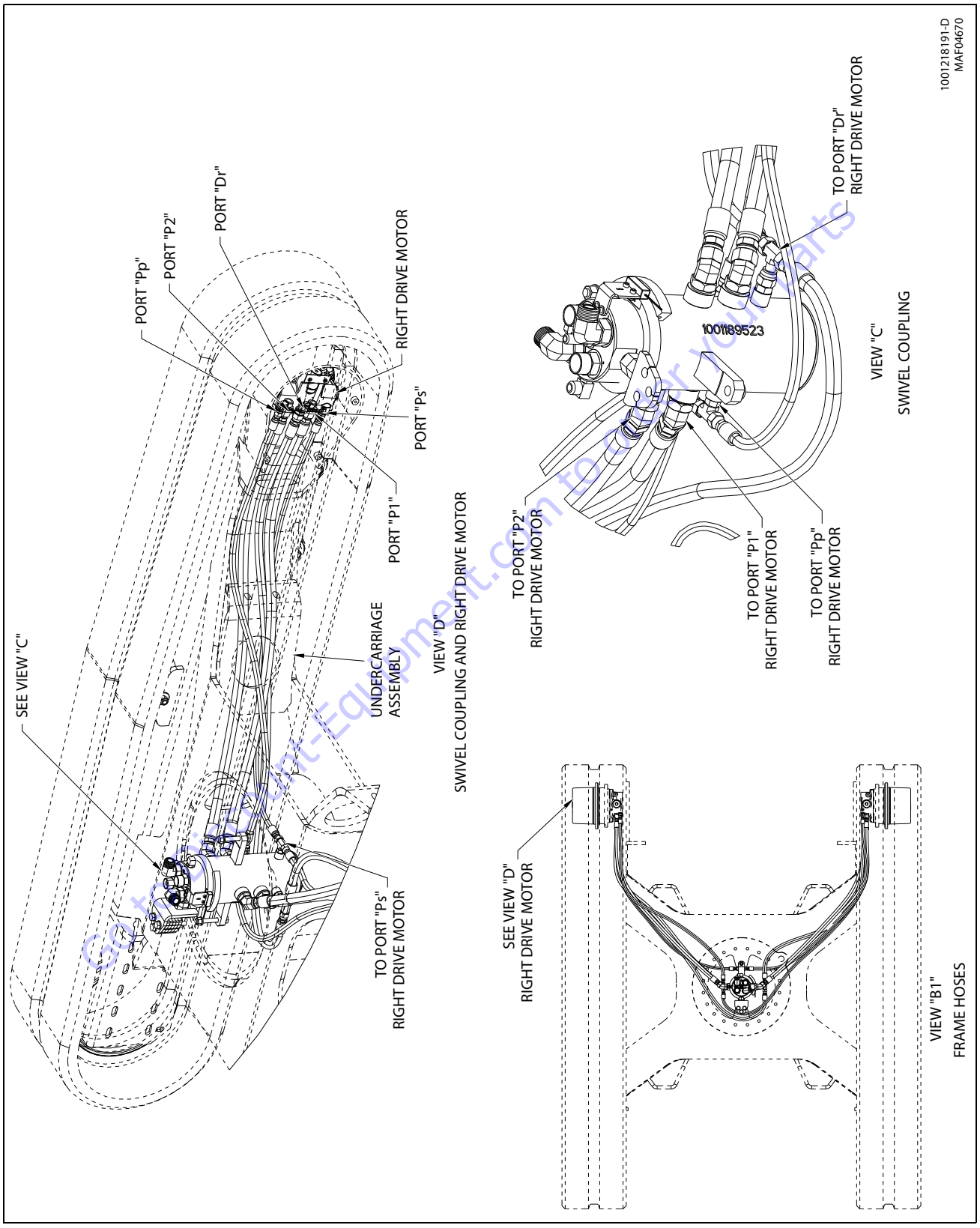


Figure 5-106. Hydraulic System Installation (460SJC) - Sheet 6 of 15

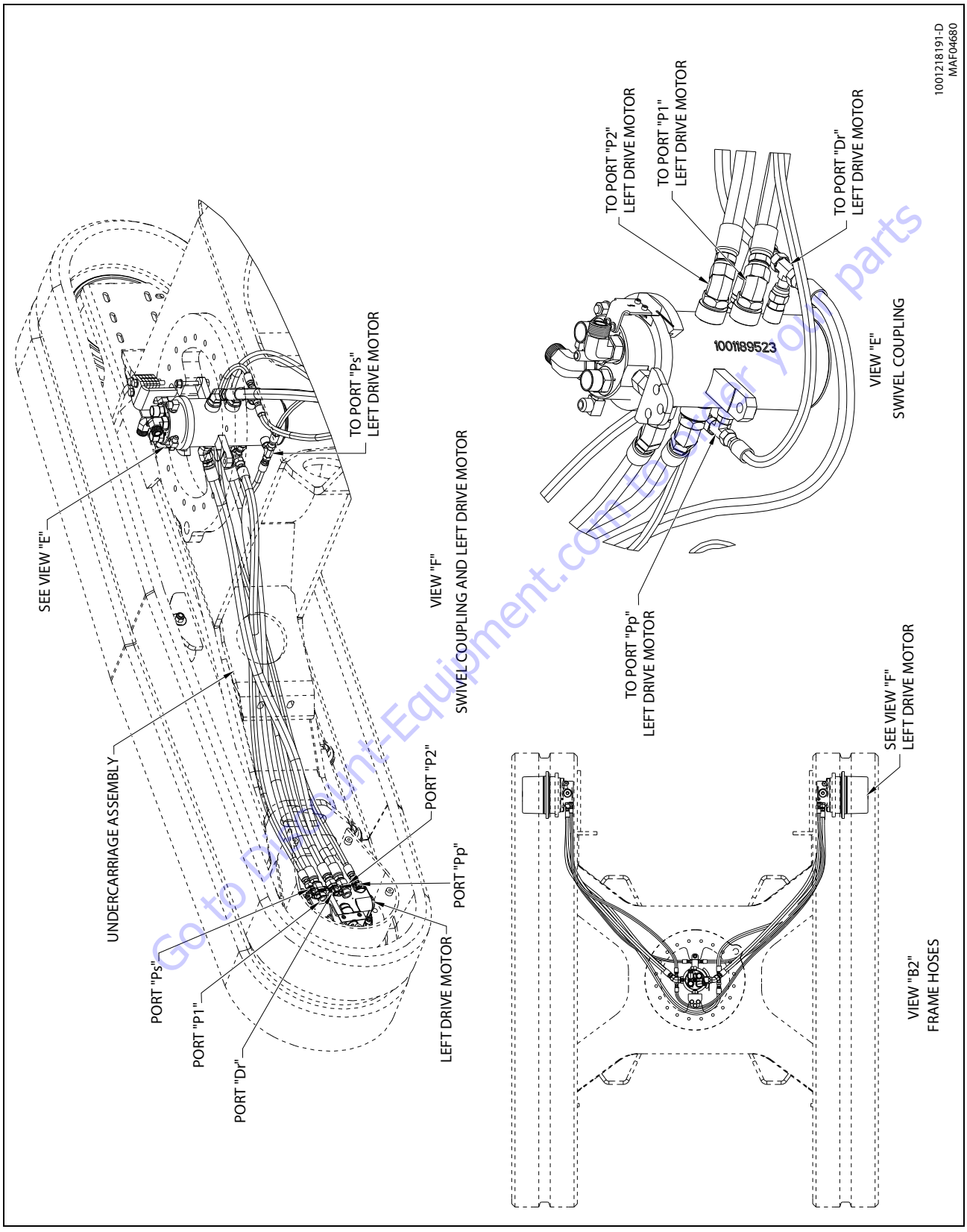


Figure 5-107. Hydraulic System Installation (460SJC) - Sheet 7 of 15

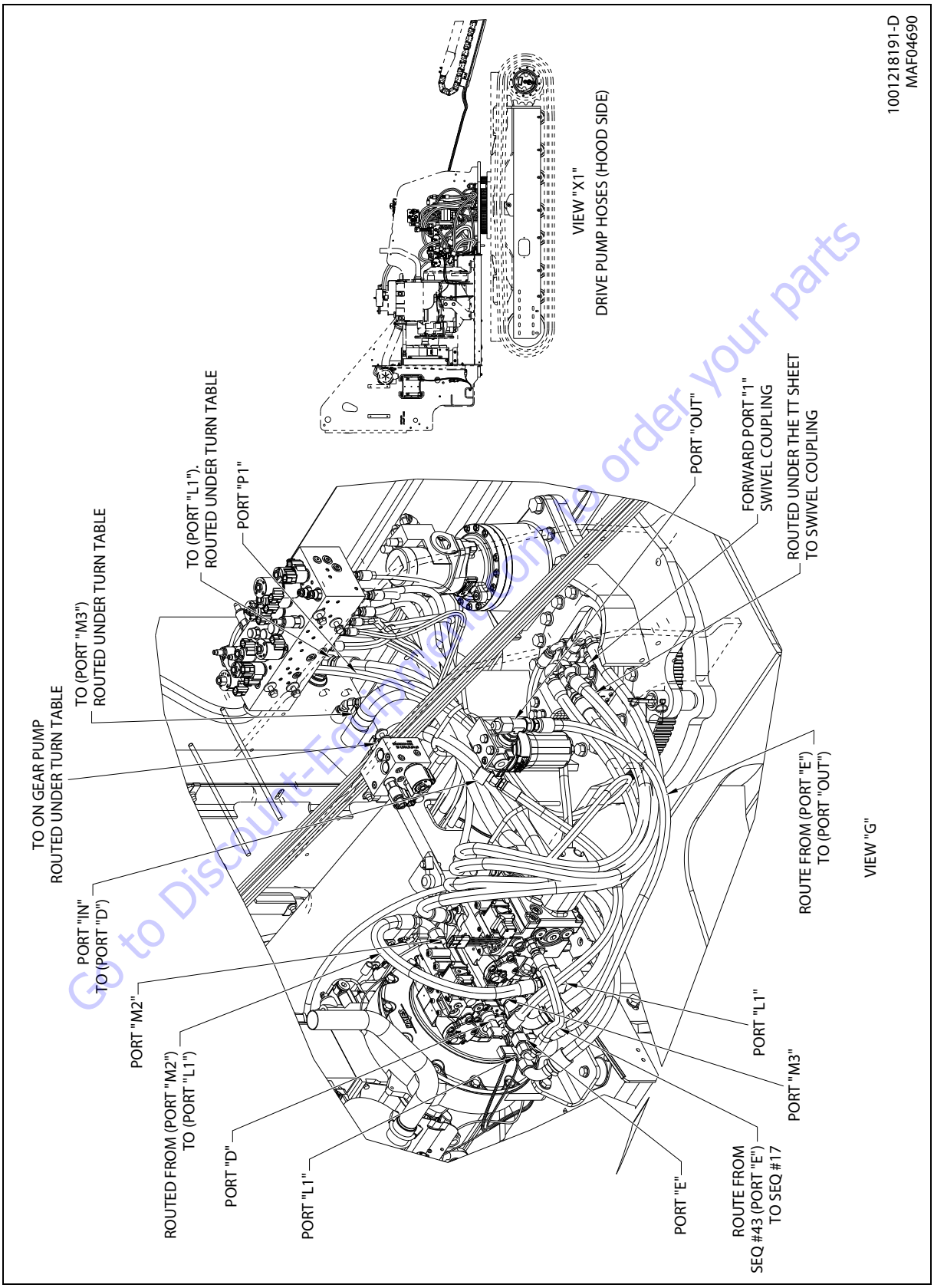


Figure 5-108. Hydraulic System Installation (460SJC) - Sheet 8 of 15