(NAVY) NAVAIR 17-15-50.4
(ARMY) TM 38-301-4
(AIR FORCE) T.O. 33-1-37-4
(COAST GUARD) CGTO 33-1-37-4

15 July 2020
Change 1 – 1 July 2022

TECHNICAL MANUAL

JOINT OIL ANALYSIS PROGRAM MANUAL

VOLUME 4

LABORATORY ANALYTICAL METHODOLOGY AND EQUIPMENT CRITERIA (NON-AERONAUTICAL)

This manual supersedes NAVAIR 17-15-50.4 dated 15 July 2020.
The latest change information, change 1 dated 1 July 2022, has been incorporated in this issue and makes this a complete manual.

This manual incorporates IRAC 003.

This manual is incomplete without NAVAIR-17-15-50.1, NAVAIR-17-15-50.2 and NAVAIR-17-15-50.3

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NUMERICAL INDEX OF EFFECTIVE WORK PACKAGES/PAGES

List of Current Changes

Change #	*Date*		*Change #*	*Date*
Original 0	15 July 2020		Change 1	1 July 2022
				Incorp IRAC 003

Only those work packages/pages assigned to the manual are listed in this index. Dispose of the superseded issues of the technical manuals. Superseded classified technical information shall be destroyed in accordance with applicable regulations. The portion of text affected in a changed or revised work package is indicated by change bars in the outer righthand margin.

Total number of pages in Volume 4 of this manual is 594.

Note: the HMWS WP for this manual is located in Volume 2

15 July 2020
Change 1 – 1 July 2022

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
010 00	COMPONENT: CATERPILLAR 3306 (ENGINE)	1 thru 2	0	0
011 00	COMPONENT: CATERPILLAR 11614457 (ENGINE)	1 thru 2	1	0
012 00	COMPONENT: CATERPILLAR D333/C/T (ENGINE)	1 thru 4	1	0
013 00	COMPONENT: CATERPILLAR D343T/A (ENGINE)	1 thru 4	1	0
014 00	COMPONENT: CATERPILLAR D198ER (ENGINE)	1 thru 2	1	0
015 00	COMPONENT: CATERPILLAR D298/D298ERX37 (ENGINE)	1 thru 2	1	0
016 00	COMPONENT: CATERPILLAR D397 (ENGINE)	1 thru 2	1	0
017 00	COMPONENT: CATERPILLAR D17000 (ENGINE)	1 thru 2	1	0
018 00	COMPONENT: CONTINENTAL AVDS 1790-2A/2C/2D/ (ENGINE)	1 thru 4	1	0
019 00	COMPONENT: CONTINENTAL AVDS 1790-2DR (ENGINE)	1 thru 2	1	0
020 00	COMPONENT: CONTINENTAL AVDS1790-8CR (ENGINE)	1 thru 4	1	0
021 00	COMPONENT: CONTINENTAL LD/LDS/LDT 465-1/-2 (ENGINE)	1 thru 4	0	0
022 00	COMPONENT: CONTINENTAL LDS-427-2 (ENGINE)	1 thru 2	1	0
023 00	COMPONENT: CUMMINS HBI-600 (ENGINE)	1 thru 2	1	0
024 00	COMPONENT: CUMMINS JN6 (ENGINE)	1 thru 2	1	0
025 00	COMPONENT: CUMMINS LI-600 (ENGINE)	1 thru 2	1	0
026 00	COMPONENT: CUMMINS NHBIS-600 (ENGINE)	1 thru 2	1	0
027 00	COMPONENT: CUMMINS NHC 250 (ENGINE)	1 thru 6	1	0
028 00	COMPONENT: CUMMINS NTC 290 (ENGINE)	1 thru 4	1	0
029 00	COMPONENT: CUMMINS NTA/NTC 400 (ENGINE)	1 thru 4	1	0

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
030 00	COMPONENT: CUMMINS V8-265 (ENGINE)	1 thru 2	1	0
031 00	COMPONENT: CUMMINS V8-300 (ENGINE)	1 thru 2	1	0
032 00	COMPONENT: CUMMINS VT-400 (ENGINE)	1 thru 2	1	0
033 00	COMPONENT: CUMMINS VTA-903 (ENGINE)	1 thru 4	1	0
034 00	COMPONENT: DETROIT DIESEL ALLISON 190 (ENGINE)	1 thru 2	1	0
035 00	COMPONENT: DETROIT DIESEL ALLISON 3-53 (ENGINE)	1 thru 2	0	0
036 00	COMPONENT: DETROIT DIESEL ALLISON 3080 (ENGINE)	1 thru 2	1	0
037 00	COMPONENT: DETROIT DIESEL ALLISON 4-53/N (ENGINE)	1 thru 2	1	0
038 00	COMPONENT: DETROIT DIESEL ALLISON 4057C (ENGINE)	1 thru 2	1	0
039 00	COMPONENT: DETROIT DIESEL ALLISON 6V53/T (ENGINE)	1 thru 4	1	0
040 00	COMPONENT: DETROIT DIESEL ALLISON 8V53T (ENGINE)	1 thru 2	1	0
041 00	COMPONENT: DETROIT DIESEL ALLISON 8V71T (ENGINE)	1 thru 4	1	0
042 00	COMPONENT: DETROIT DIESEL ALLISON 8V92T (ENGINE)	1 thru 6	1	0
043 00	COMPONENT: DETROIT DIESEL ALLISON 12V71T (ENGINE)	1 thru 2	0	0
044 00	COMPONENT: ELECTRO MOTIVE DIVISION 8-567B (ENGINE)	1 thru 2	1	0
045 00	COMPONENT: ELECTRO MOTIVE DIVISION 16-645E/E6 (ENGINE)	1 thru 2	1	0
046 00	COMPONENT: FAIRBANKS MORSE 38D-81/8 (ENGINE)	1 thru 2	1	0
047 00	COMPONENT: INTERNATIONAL HARVESTER DT-466B (ENGINE)	1 thru 2	1	0
048 00	COMPONENT: JOHN DEERE 6059T-DW-04 5.9 LITER (ENGINE)	1 thru 2	0	0
049 00	COMPONENT: LYCOMING AGT 1500 TURBINE (ENGINE)	1 thru 2	0	0

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
050 00	COMPONENT: MACK ENDT-673 (ENGINE)	1 thru 2	1	0
051 00	COMPONENT: MAN D-2840 (ENGINE)	1 thru 2	1	0
052 00	COMPONENT: MERCEDES BENZ OM617952 (ENGINE)	1 thru 2	1	0
053 00	COMPONENT: C-180 (ENGINE)	1 thru 2	1	0
054 00	COMPONENT: GTCP 85127	1 thru 2	1	0
055 00	COMPONENT: SD802 (ENGINE)	1 thru 2	1	0
056 00	COMPONENT: CATERPILLAR D5/3T 3394 (TRANSMISSION)	1 thru 2	1	0
057 00	COMPONENT: CATERPILLAR POWERSHIFT 4R219 (TRANSMISSION)	1 thru 2	1	0
058 00	COMPONENT: CATERPILLAR 5R3855 (TRANSMISSION)	1 thru 2	1	0
059 00	COMPONENT: CATERPILLAR D7155 (TRANSMISSION)	1 thru 2	0	0
060 00	COMPONENT: CLARK 4000 (TRANSMISSION)	1 thru 2	1	0
061 00	COMPONENT: DETROIT DIESEL ALLISON 3331-1 (TRANSMISSION)	1 thru 2	1	0
062 00	COMPONENT: DETROIT DIESEL ALLISON CD 850 6A (TRANSMISSION)	1 thru 4	1	0
063 00	COMPONENT: DETROIT DIESEL ALLISON CLBT 750 (TRANSMISSION)	1 thru 2	1	0
064 00	COMPONENT: DETROIT DIESEL ALLISON CRT 3531-1 (TRANSMISSION)	1 thru 2	1	0
065 00	COMPONENT: DETROIT DIESEL ALLISON G 411-2A (TRANSMISSION)	1 thru 2	0	0
066 00	COMPONENT: DETROIT DIESEL ALLISON HT 740D (TRANSMISSION)	1 thru 2	1	0
067 00	COMPONENT: DETROIT DIESEL ALLISON HT 750CRD (TRANSMISSION)	1 thru 2	0	0
068 00	COMPONENT: DETROIT DIESEL ALLISON HT 754CRD (TRANSMISSION)	1 thru 2	1	0
069 00	COMPONENT: DETROIT DIESEL ALLISON MT 654CR (TRANSMISSION)	1 thru 4	0	0

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
070 00	COMPONENT: DETROIT DIESEL ALLISON THM-3L80 (TRANSMISSION)	1 thru 2	0	0
071 00	COMPONENT: DETROIT DIESEL ALLISON TT2421-1 (TRANSMISSION)	1 thru 2	1	0
072 00	COMPONENT: DETROIT DIESEL ALLISON TX100-1 (TRANSMISSION)	1 thru 4	1	0
073 00	COMPONENT: DETROIT DIESEL ALLISON X1100-3B (TRANSMISSION)	1 thru 4	1	0
074 00	COMPONENT: DETROIT DIESEL ALLISON XT1410-4 (TRANSMISSION)	1 thru 2	0	0
075 00	COMPONENT: DETROIT DIESEL ALLISON XT1410-5A TRANSMISSION)	1 thru 4	1	0
076 00	COMPONENT: DETROIT DIESEL ALLISON G 250-1A (TRANSMISSION)	1 thru 2	1	0
077 00	COMPONENT: GENERAL ELECTRIC HMPT-500 (TRANSMISSION)	1 thru 4	0	0
078 00	COMPONENT: INTERNATIONAL HARVESTER S-700 (TRANSMISSION)	1 thru 2	1	0
079 00	COMPONENT: MAN ZF4S-15GP (TRANSMISSION)	1 thru 2	1	0
080 00	COMPONENT: MERCEDES BENZ WF4A018 (TRANSMISSION)	1 thru 2	1	0
081 00	COMPONENT: REINTJES VWS2232 (MARINE GEARBOX)	1 thru 2	1	0
082 00	COMPONENT: TWIN DISC 8FLW1307 (TRANSMISSION)	1 thru 2	1	0
083 00	COMPONENT: 3S7094 (TRANSMISSION)	1 thru 2	1	0
084 00	COMPONENT: 5R6192 (TRANSMISSION)	1 thru 2	1	0
085 00	COMPONENT: 7G4851 (TRANSMISSION)	1 thru 2	1	0
086 00	COMPONENT: 8S3543 (TRANSMISSION)	1 thru 2	1	0
087 00	COMPONENT: C-51-2012 (TRANSMISSION)	1 thru 2	1	0
088 00	COMPONENT: HS 400-3 (TRANSMISSION)	1 thru 2	1	0
089 00	COMPONENT: M1070 TRANSMISSION	1 thru 2	1	0

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
090 00	COMPONENT: M1074 TRANSMISSION	1 thru 2	1	0
091 00	COMPONENT: M1075 TRANSMISSION	1 thru 2	0	0
092 00	COMPONENT: THM-400/THM-4L80E TRANSMISSION WEAR METAL BASELINES	1 thru 2	0	0
093 00	COMPONENT: TX200-6 (TRANSMISSION)	1 thru 2	1	0
094 00	COMPONENT: ZED F MODEL WG-120 (TRANSMISSION)	1 thru 2	0	0
095 00	COMPONENT: M1000 HYDRAULIC SYSTEM	1 thru 2	1	0
096 00	COMPONENT: M1070 HYDRAULIC SYSTEM	1 thru 2	1	0
097 00	COMPONENT: M1074 HYDRAULIC SYSTEM	1 thru 2	1	0
098 00	COMPONENT: M1075 HYDRAULIC SYSTEM	1 thru 2	0	0
099 00	COMPONENT: M88A2 HERCULES MAIN HYDRAULIC SYSTEM	1 thru 2	0	0
100 00	COMPONENT: M911 HYDRAULIC SYSTEM	1 thru 2	1	0
101 00	NAVY (SHIPS) PHYSICAL PROPERTY TEST LIMITS BY TYPE OIL AND USE	1 thru 4	1	1
101 01	LUBRICANT: MIL-PRF-2104 (15W-40) DIESEL LUBE OIL APPLICABLE SYSTEMS: DIESEL ENGINES, SURFACE SHIP AND SUBMARINE	1 thru 2	0	0
101 02	LUBRICANT: MIL-PRF-9000 DIESEL LUBE OIL (MS 9250) APPLICABLE SYSTEMS: DIESEL ENGINES, SURFACE SHIP, CARRIERS, AND SUBMARINES	1 thru 2	0	1
101 03	LUBRICANT: MOBIL DELVAC 1640 DIESEL LUBE OIL APPLICABLE SYSTEMS: DIESEL ENGINES AND REDUCTION GEARS, SURFACE SHIPS	1 thru 4	1	1
101 04	LUBRICANT: MIL-PRF-5606 HYDRAULIC FLUID APPLICABLE SYSTEMS: HYDRAULIC SYSTEMS	1 thru 2	1	0
101 05	LUBRICANT: MIL-DTL-17111 HYDRAULIC FLUID APPLICABLE SYSTEMS: POWER TRANSMISSION HYDRAULIC SYSTEMS	1 thru 2	1	0

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
101 06	LUBRICANT: MIL-PRF-17331 STEAM TURBINE LUBE OIL (2190) APPLICABLE SYSTEMS: CONTROLLABLE PITCH PROPELLER (CPP) / CONTROLLABLE REVERSIBLE PITCH PROPELLER (CRP) SURFACE SHIP	1 thru 4	1	1
101 07	LUBRICANT: MIL-PRF-17331 STEAM TURBINE LUBE OIL (2190 TEP) AS HYDRAULIC FLUID OR MIL-DTL-32353 HYDRAULIC & LUBRICATING OIL, SYNTHETIC HYDROCARBON BASE (2190-S) AS HYDRAULIC FLUID APPLICABLE SYSTEMS: SUBMARINES (SSN, SSBN, SSGN, MTS) HYDRAULIC SYSTEMS INTERNAL TO THE PRESSURE HULL	1 thru 2	1	1
101 08	LUBRICANT: MIL-PRF-17331 STEAM TURBINE LUBE OIL (2190 TEP) APPLICABLE SYSTEMS: SURFACE SHIP AND SUBMARINE LUBE OIL SYSTEMS (E.G. LPAC, HPAC, CRANES)	1 thru 2	0	1
101 09	LUBRICANT: MIL-PRF-17331 STEAM TURBINE LUBE OIL (2190 TEP) APPLICABLE SYSTEMS: SURFACE SHIP LUBE SYSTEMS (E.G. MAIN REDUCTION GEARS (MRG), LCS-1 AFT LINE SHAFT BEARING LUBE OIL SYSTEM)	1 thru 4	1	1
101 10	LUBRICANT: MIL-PRF-17331 STEAM TURBINE LUBE OIL (2190 TEP) APPLICABLE SYSTEMS: SUBMARINE PROPULSION AND LOW PRESSURE BLOWER	1 thru 2	1	0
101 11	LUBRICANT: MIL-PRF-32353 SYNTHETIC STEAM TURBINE LUBE OIL (2190-S) APPLICABLE SYSTEMS: SURFACE SHIP AND SUBMARINE LUBE OIL SYSTEMS	1 thru 2	1	1
101 12	LUBRICANT: MIL-PRF-17672 HYDRAULIC FLUID (2075TH/2110TH/2135TH) APPLICABLE SYSTEMS: SURFACE SHIP HYDRAULIC SYSTEMS (E.G. SIDEPORT CARGO CRANES, DAVITS, BALLAST CONTROL HYDRAULIC POWER UNIT, INTERCEPTOR, LHRS)	1 thru 2	0	1
101 13	LUBRICANT: MIL-PRF-17672 HYDRAULIC FLUID (2075TH, 2110TH, 2135TH) APPLICABLE SYSTEMS: IN-SERVICE SUBMARINES (SSN, SSBN, SSGN) HYDRAULIC SYSTEMS EXTERNAL TO THE PRESSURE HULL AND HYDRAULIC COMPENSATING SYSTEMS	1 thru 2	1	1

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
101 14	LUBRICANT: MIL-PRF-17672 HYDRAULIC FLUID (2075TH) APPLICABLE SYSTEMS: RAST SYSTEM HYDRAULIC POWER UNIT (WHPU) RESERVOIR, ROPE ACCUMULATOR, LINES A AND G	1 thru 2	1	0
101 15	LUBRICANT: MIL-PRF-17672 HYDRAULIC FLUID (2075TH) APPLICABLE SYSTEMS: SUBMARINE DSRV/DSS	1 thru 2	1	0
101 16	LUBRICANT: MIL-PRF-17672 HYDRAULIC FLUID (2110TH) APPLICABLE SYSTEMS: LCS-1 CLASS ROLLS ROYCE WATERJET HYDRAULIC POWER UNIT	1 thru 2	1	1
101 17	LUBRICANT: MIL-PRF-17672 HYDRAULIC FLUID (2110TH) APPLICABLE SYSTEMS: LCS-2 CLASS WARTSILLA WATERJET HYDRAULIC POWER UNIT (HPU)	1 thru 2	1	1
101 18	LUBRICANT: MIL-PRF-17672 HYDRAULIC FLUID (2110TH) APPLICABLE SYSTEMS: STEERING GEAR, SURFACE SHIP	1 thru 2	0	1
101 19	LUBRICANT: MIL-PRF-17672 HYDRAULIC FLUID (2110TH) APPLICABLE SYSTEMS: LCS-2 SMARTPAC HYDRAULIC POWER UNIT AND BOWTHRUSTER AUXILLARY POWER UNIT	1 thru 2	1	1
101 20	LUBRICANT: MIL-PRF-17672 HYDRAULIC FLUID (2135TH) APPLICABLE SYSTEMS: STEERING GEAR, SURFACE SHIP	1 thru 2	0	1
101 21	LUBRICANT: MIL-PRF-17672 HYDRAULIC FLUID (2135TH) APPLICABLE SYSTEMS: ANCHORS, SURFACE SHIP	1 thru 2	1	0
101 22	LUBRICANT: MIL-PRF-17672 HYDRAULIC FLUID (2135TH) APPLICABLE SYSTEMS: LCS-1 AND LCS-3 ONLY LUBE OIL POWERPACK (PP)	1 thru 2	1	0
101 23	LUBRICANT: MIL-H-19457 HYDRAULIC FLUID (HFR-1) APPLICABLE SYSTEMS: SHIPBOARD HYDRAULIC SYSTEMS	1 thru 2	1	0
101 24	LUBRICANT: MIL-H-22072 HYDRAULIC FLUID (HFC) APPLICABLE SYSTEMS: SHIPBOARD HYDRAULIC SYSTEMS	1 thru 2	1	0
101 25	LUBRICANT: MIL-PRF-83282 HYDRAULIC FLUID APPLICABLE SYSTEMS: RAST SYSTEM RAPID SECURING DEVICE (RSD), PATROL CRAFT STEERING GEAR	1 thru 2	1	0
101 26	LUBRICANT: PR 1192 HYDRAULIC FLUID APPLICABLE SYSTEMS: SUBMARINES SSN, SSBN, SSGN, NR-1, NKTV EXTERNAL HYDRAULIC SYSTEMS (WHEN AUTHORIZED)	1 thru 2	1	0
101 27	LUBRICANT: MIL-PRF-23699 C/I (CORROSION INHIBITED) GAS TURBINE LUBE OIL APPLICABLE SYSTEMS: GAS TURBINE ENGINES AND GENERATORS	1 thru 2	0	1

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
101 28	LUBRICANT: MIL-PRF-23699 HTS (HIGH TEMPERATURE STABILITY) GAS TURBINE LUBE OIL APPLICABLE SYSTEMS: GAS TURBINE ENGINES AND GENERATORS	1 thru 2	0	1
101 29	LUBRICANT: POE SYNTHETIC OIL APPLICABLE SYSTEMS: SUBMARINE R134A AC/REFRIGERATION PLANTS	1 thru 2	1	0
101 30	LUBRICANT: POE SYNTHETIC OIL APPLICABLE SYSTEMS: SURFACE SHIP R134A AC/REFRIGERATION PLANTS	1 thru 2	0	0
101 31	LUBRICANT: POE SYNTHETIC OIL APPLICABLE SYSTEMS: SURFACE SHIP R236A AC/REFRIGERATION PLANTS	1 thru 2	1	0
101 32	LUBRICANT: VV-L-825 REFRIGERANT COMPRESSOR OIL APPLICABLE SYSTEMS: R-114 A/C REFRIGERATION PLANTS MS RCO-2 SURFACE SHIP AND SUBMARINE	1 thru 2	1	0
101 33	LUBRICANT: SAE J2360 (MIL-PRF-2105) (80W-90) GEAR OIL APPLICABLE SYSTEMS: SHIPBOARD GEAR SYSTEMS (E.G. ANCHORS)	1 thru 2	1	1
101 34	LUBRICANT: SAE J2360 GEAR OIL (85W-140) APPLICABLE SYSTEMS: SHIPBOARD GEAR SYSTEMS	1 thru 2	1	1
101 35	LUBRICANT: MOBILFLUID 424 LUBE OIL APPLICABLE SYSTEMS: SHIPBOARD HYDRAULIC SYSTEMS	1 thru 2	1	1
101 36	LUBRICANT: MIL-PRF-23699 C/I (CORROSION INHIBITED) LUBE OIL APPLICABLE SYSTEMS: LCAC PROPULSION SYSTEMS AND HYDRAULIC SYSTEMS	1 thru 2	0	1
101 37	LUBRICANT: MIL-PRF-9000 DIESEL LUBE OIL (MS 9250) APPLICABLE SYSTEMS: PROPULSION AND PROPELLER SYSTEMS	1 thru 4	1	1
101 38	LUBRICANT: MIL-DTL-17111 HYDRAULIC FLUID APPLICABLE SYSTEMS: MOD 2 AND MOD 4 UPPER AND LOWER ACCUMULATOR SYSTEMS	1 thru 2	0	1
101 39	LUBRICANT: MIL-PRF-23699 C/I (CORROSION INHIBITED) LUBE OIL APPLICABLE SYSTEMS: LCAC PROPULSION SYSTEMS AND HYDRAULIC SYSTEMS	1 thru 2	1	1
101 40	LUBRICANT: MIL-PRF-23699 C/I (CORROSION INHIBITED) GAS TURBINE LUBE OIL APPLICABLE SYSTEMS: GAS TURBINE ENGINES	1 thru 2	0	1

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
101 41	LUBRICANT: MOBIL SHC GEAR 3200 APPLICABLE SYSTEMS: SHIPBOARD GEAR SYSTEMS	1 thru 2	0	1
101 42	LUBRICANT: MOBILGEAR 600XP 68 APPLICABLE SYSTEMS: LCS-2 CLASS GAS TURBINE AND MAIN DIESEL PROPULSION ENGINE MAIN THRUST BEARING	1 thru 2	0	1
102 00	COMPONENT: GE-LM2500 GAS TURBINE SYSTEM/USE: MAIN PROPULSION SYSTEM	1 thru 2	1	0
103 00	COMPONENT: ALLISON 501K GAS TURBINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
104 00	COMPONENT: ALCO 12 251-C DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
105 00	COMPONENT: ALCO 16 251-C DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
106 00	COMPONENT: CATERPILLAR 16 D399 DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
107 00	COMPONENT: CUMMINS VT12-0875MPH/LH1X2 DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
108 00	COMPONENT: CUMMINS VT12-875MRH/LH DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
109 00	COMPONENT: DETROIT DIESEL (GM) 12005; 12006 DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
110 00	COMPONENT: DETROIT DIESEL (GM) 12VA6217 DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
111 00	COMPONENT: DETROIT DIESEL (GM) 6-71; 12007M DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
112 00	COMPONENT: DETROIT DIESEL (GM) 6V53N DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
113 00	COMPONENT: ELECTRO MOTIVE (GM) 12-268A DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
114 00	COMPONENT: ELECTRO MOTIVE (GM) 16-248 DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
115 00	COMPONENT: ELECTRO MOTIVE (GM) 12-278 DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
116 00	COMPONENT: ELECTRO (GM) 8-278ANN DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
117 00	COMPONENT: ELECTRO (GM) 8-498NN DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
118 00	COMPONENT: ELECTRO (GM) 16-645E5LLRRLR DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
119 00	COMPONENT: FM (COLT) 10-38D8 1/8 DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
120 00	COMPONENT: FM (COLT) 10-38NTD8 1/8 DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
121 00	COMPONENT: FM (COLT) 12-38ND8 1/8 DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
122 00	COMPONENT: FM (COLT) 8-38ND8 1/8 DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
123 00	COMPONENT: GM 16-645E2 DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
124 00	COMPONENT: GM 8V-71T DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
125 00	COMPONENT: PACKARD ID-1700-T3/T4 DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
126 00	COMPONENT: RUSTON PAXMAN 12-YCLM DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
127 00	COMPONENT: WAUKESHA L1616DSIN/TO DIESEL ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	0
128 00	COMPONENT: ALCO 8-251E DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
129 00	COMPONENT: CATERPILLAR 6-D-353 DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
130 00	COMPONENT: CATERPILLAR D353 DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
131 00	COMPONENT: CUMMINS 6-NH220GPG84 DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
132 00	COMPONENT: CUMMINS 6-NH220PG92 DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
133 00	COMPONENT: GM CUMMINS 6-NT400GCM DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
134 00	COMPONENT: DETROIT DIESEL (GM) 16V-149 TI DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
135 00	COMPONENT: DETROIT DIESEL (GM) 16-7163-7200 DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
136 00	COMPONENT: DETROIT DIESEL (GM) 16V-71 DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
137 00	COMPONENT: DETROIT DIESEL (GM) 3-71-3151 DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
138 00	COMPONENT: DETROIT DIESEL (GM) 6-6151ENOD671RC DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
139 00	COMPONENT: ELECTRO MOTIVE (GM) 3-268A DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
140 00	COMPONENT: ELECTRIC MOTIVE (GM) 8-268A DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
141 00	COMPONENT: ELECTRO MOTIVE (GM) 8-56CR DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
142 00	COMPONENT: ELECTRO MOTIVE (GM) 12-645E2LL DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
143 00	COMPONENT: FM (COLT) 8-38D8 1/8 DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
144 00	COMPONENT: GM 8-268 DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
145 00	COMPONENT: GM 4-71 DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
146 00	COMPONENT: HERCULES 6-DWXD DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
147 00	COMPONENT: RUSTON PAXMAN 8-RPHCZ DIESEL ENGINE SYSTEM/USE: SHIPS SERVICE GENERATOR	1 thru 2	1	0
148 00	COMPONENT: ALCO 16-251B16 DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
149 00	COMPONENT: ALCO 8-251-E DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
150 00	COMPONENT: CUMMINS 6-NH220BI DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
151 00	COMPONENT: DETROIT DIESEL (GM) 71637/300016V71/LC DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
152 00	COMPONENT: DETROIT DIESEL (GM) 6-71RC7 DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
153 00	COMPONENT: ELECTRO MOTIVE (GM) 3-268A DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
154 00	COMPONENT: FM (COLT) 10-38F5 1/4 DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
155 00	COMPONENT: FM (COLT) 6-38F5 1/4 DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
156 00	COMPONENT: FM (COLT) 6-38ND8 1/8 DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
157 00	COMPONENT: FM (COLT) 7-38F5 1/4 DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
158 00	COMPONENT: FM (COLT) 8-38D8 1/8 HISHOCK DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
159 00	COMPONENT: GM 6-71 DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
160 00	COMPONENT: GM 12V71RC DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
161 00	COMPONENT: GM 16-645E5 DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	1
162 00	COMPONENT: HERCULES 6-DFXD DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
163 00	COMPONENT: SUPERIOR GDB8 DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
164 00	COMPONENT: FARRELL GEARS SYSTEM/USE: REDUCTION GEARS	1 thru 2	1	0
165 00	COMPONENT: G.E. GEARS SYSTEM/USE: REDUCTION GEARS	1 thru 2	1	0
166 00	COMPONENT: WESTERN GEAR GEARS SYSTEM/USE: REDUCTION GEARS	1 thru 2	1	0
167 00	COMPONENT: WESTINGHOUSE GEARS SYSTEM/USE: REDUCTION GEARS	1 thru 2	1	0
168 00	COMPONENT: WESTERN GEAR 1100 GEARS SYSTEM/USE: TRANSMISSION	1 thru 2	1	0

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
169 00	COMPONENT: SAC FOR DETROIT DIESEL (GM) 16V-149 TI AIR COMPRESSOR SYSTEM/USE: STARTING	1 thru 2	1	0
170 00	COMPONENT: INGERSOLL RAND AIR COMPRESSOR SYSTEM/USE: HIGH PRESSURE	1 thru 2	1	0
171 00	COMPONENT: WORTHINGTON AIR COMPRESSOR SYSTEM/USE: HIGH PRESSURE	1 thru 2	1	0
172 00	COMPONENT: INGERSOLL RAND NS100NL AIR COMPRESSOR SYSTEM/USE: INTERMEDIATE AND LOW PRESSURE	1 thru 2	1	0
173 00	COMPONENT: R12 AIR CONDITIONING COMPRESSOR SYSTEM/USE: CHILLED WATER	1 thru 2	1	0
174 00	COMPONENT: R11 AIR CONDITIONING COMPRESSOR SYSTEM/USE: CHILLED WATER	1 thru 2	1	0
175 00	COMPONENT: R114 AIR CONDITIONING COMPRESSOR SYSTEM/USE: CHILLED WATER	1 thru 2	1	0
176 00	COMPONENT: R12 REFRIGERATION SYSTEMS SYSTEM/USE: DIRECT EXPANSION	1 thru 2	1	0
177 00	COMPONENT: SPRING BEARINGS SYSTEM/USE: LINE SHAFT	1 thru 2	1	0
178 00	COMPONENT: HARDY TYNES AIR SUPPLY SYSTEM SYSTEM/USE: FORCED DRAFT BLOWER	1 thru 2	1	0
179 00	COMPONENT: WESTINGHOUSE AIR SUPPLY SYSTEM SYSTEM/USE: FORCED DRAFT BLOWER	1 thru 2	1	0
180 00	COMPONENT: MIL-PRF-9000 (MS9250) FLUID SYSTEM/USE: ANCHOR WINDLASS ENGINE (TO BE PROVIDED)	1 thru 2	1	0
181 00	COMPONENT: MIL-PRF-17672 (2110TH) FLUID SYSTEM/USE: ANCHOR WINDLASS HYDRAULIC SYSTEM (TO BE PROVIDED)	1 thru 2	1	0
182 00	COMPONENT: MIL-PRF-17672 (2135TH) FLUID SYSTEM/USE: ANCHOR WINDLASS ENGINE (TO BE PROVIDED)	1 thru 2	1	0
183 00	COMPONENT: MIL-PRF-17672 (2075/2110, 2135) FLUID SYSTEM/USE: BALLAST HYDRAULIC SYSTEM (TO BE PROVIDED)	1 thru 2	1	0
184 00	COMPONENT: MIL-PRF-17672 FLUID SYSTEM/USE: CAPSTAN HYDRAULIC SYSTEM (TO BE PROVIDED)	1 thru 2	1	0

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
185 00	COMPONENT: MIL-PRF-17672 (2135TH) FLUID SYSTEM/USE: CENTRAL HYDRAULICS (TO BE PROVIDED)	1 thru 2	1	0
186 00	COMPONENT: MIL-PRF-17331 (2190 TEP) FLUID SYSTEM/USE: CPP/CRP HYDRAULICS (TO BE PROVIDED)	1 thru 2	1	0
187 00	COMPONENT: MIL-PRF-9000 (MS 9250) FLUID SYSTEM/USE: CPP/CRP HYDRAULICS (TO BE PROVIDED)	1 thru 2	1	0
188 00	COMPONENT: MIL-PRF-17672 (2135TH) FLUID SYSTEM/USE: CRANE HYDRAULICS (TO BE PROVIDED)	1 thru 2	1	0
189 00	COMPONENT: MIL-DTL-17111 FLUID SYSTEM/USE: CRANE HYDRAULICS (TO BE PROVIDED)	1 thru 2	1	0
190 00	COMPONENT: MIL-PRF-17672 (2135TH) FLUID SYSTEM/USE: ELEVATOR HYDRAULICS (TO BE PROVIDED)	1 thru 2	1	0
191 00	COMPONENT: MIL-PRF-19457 FLUID SYSTEM/USE: ELEVATOR HYDRAULICS (TO BE PROVIDED)	1 thru 2	1	0
192 00	COMPONENT: MIL-PRF-17672 (2135TH) FLUID SYSTEM/USE: STEERING GEAR HYDRAULICS (TO BE PROVIDED)	1 thru 2	1	0
193 00	COMPONENT: MIL-PRF-17672 (2110TH) FLUID SYSTEM/USE: STERN GATE HYDRAULICS (TO BE PROVIDED)	1 thru 2	1	0
194 00	COMPONENT: ROLLS ROYCE MARINE MT7 SYSTEM/USE: MAIN PROPULSION/LIFT SYSTEMS	1 thru 2	1	1
195 00	COMPONENT: LYCOMING VERICOR (ALLIED SIGNAL) T40B / ETF40B GAS TURINE ENGINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	1
196 00	COMPONENT: MTU 8V 396 DIESEL ENGINE SYSTEM/USE: SHIP SERVICE DIESEL GENERATOR	1 thru 2	1	0
197 00	COMPONENT: ROLLS ROYCE MT30 GAS TURBINE SYSTEM/USE: MAIN PROPULSION	1 thru 2	1	1
198 00	COMPONENT: FM 8 CYLINDER-38ND 8-1/8 OP OR FM 12 CYLINDER-38ND 8-1/8 OP DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
199 00	COMPONENT: CATERPILLAR 3512B DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
200 00	COMPONENT: CATERPILLAR 3512B DIESEL GENERATOR SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	0
201 00	COMPONENT: BOW/STERN RAMP HYDRAULICS SYSTEM/USE: LCAC HYDRAULIC SYSTEMS	1 thru 2	0	1
202 00	COMPONENT: T-62T-40-7 AUXILIARY POWER UNIT SYSTEM/USE: LCAC PROPULSION SYSTEMS	1 thru 2	0	1

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
203 00	COMPONENT: REDUCTION GEAR SYSTEM/USE: LCAC PROPULSION SYSTEMS	1 thru 2	0	1
204 00	COMPONENT: CONTROLLABLE PITCH PROPELLOR SYSTEM/USE: LCAC PROPULSION SYSTEMS	1 thru 2	0	1
205 00	COMPONENT: SCAVANGE FAN HYDRAULICS SYSTEM/USE: LCAC HYDRAULIC SYSTEMS	1 thru 2	0	1
206 00	COMPONENT: BOW THRUSTER HYDRAULICS SYSTEM/USE: LCAC PROPULSION SYSTEMS	1 thru 2	0	1
207 00	COMPONENT: 12V AND 16V PA6B DIESEL ENGINE SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	0	1
208 00	COMPONENT: DIESEL LUBRICATING OIL STORAGE TANK SYSTEM/USE: EMERGENCY GENERATOR	1 thru 2	1	1
209 00	COMPONENT: PH-47C AUXILIARY POWER UNIT SYSTEM/USE: LCAC100 PROPULSION SYSTEMS	1 thru 2	1	1

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(NAVY) NAVAIR 17-15-50.4
(ARMY) TM 38-301-4
(AIR FORCE) T.O. 33-1-37-4
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LIST OF TECHNICAL PUBLICATIONS DEFICIENCY REPORTS INCORPORATED

None.

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INTRODUCTION

1. Purpose. Volume 4 presents the methodology for evaluating the test results obtained using spectrometric wear metal measurement and various chemical and physical property tests on oil samples collected from non-aeronautical equipment. The methodology enables an evaluator to identify wear metals present in the sample and their probable sources, to judge equipment condition, and to make recommendations, which influence maintenance and operational decisions. Following these recommendations can enhance safety and equipment reliability and contribute to more effective and economic maintenance practices. Test procedures are contained in Volume 2.

2. Applicability. The provisions of this manual apply to all activities of the Departments of the Army, Navy, and the Air Force participating in the Joint Analysis Program (JOAP) and analyzing non-aeronautical samples. They also apply to the laboratories operating under contract or mutual assistance agreements therewith.

3. Manual Change Procedures. Detailed procedures for manual changes are contained in Volume 1.

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NON-AERONAUTICAL EQUIPMENT ANALYTICAL METHODOLOGY

Table of Contents

1. General.

   a. Each moving part in a machine has a normal rate of wear. As machine components wear, microscopic metallic wear particles are generated. Some microscopic particles are small enough to pass through a filter and remain suspended in the lubricating oil. When a machine is operating normally and operated under normal conditions, the concentration of these wear particles will be fairly consistent at the end of each oil change period. However, differences in load and working environment will affect the rate of wear of the machine components, as will various internal oil system problems and component friction changes. When abnormal wear takes place in the equipment, the concentration of one or more elements will increase significantly. Therefore, the concentration of wear particles will not always be the same and the evaluator must interpret the results of oil sample analysis to determine the reason for the changes detected and the possible effects of these changes on the equipment.

   b. The JOAP non-aeronautical analytical methodology encompasses the interpretation of used oil sample analysis results, assessment of equipment and oil condition based on analysis results, diagnosis of the probable sources of wear metals and contaminants, and the issuance of accurate and effective equipment maintenance and operational recommendations to the operating activity. The methodology uses wear metal evaluation criteria tables by type equipment and individual equipment diagrams as well as subjective evaluation of a series of laboratory tests. Specific guidelines such as wear metal evaluation criteria tables which can be used for evaluating oil analysis test results for specific components and types of equipment are presented in WP 004 and higher in this volume (JOAP Manual Volume 4).

      (1) The wear metal evaluation criteria tables provide the wear metal range and trend values which relate the oil sample wear metal concentration to the expected condition of the equipment or oil condition. These Work Packages may also contain supplemental technical information to assist the evaluator in identifying the most probable sources of wear metal. For some equipment, the criteria have not been determined but will be added when available. Data provided in these tables are intended for use as guidelines by evaluators, not as strict go/no-go criteria. The guidelines were statistically derived using analysis of samples from operating equipment from various geography locations. Absolute values that will indicate specific impending component failures may actually be somewhat above or below the concentration levels shown. Therefore, the evaluator must apply subjective

judgment, experience, and knowledge of the particular component from which a sample is taken to determine evaluation recommendations.

(2) The individual equipment diagrams present wear metals source information keyed to location by the use of equipment cutaway schematics. The cutaway or cross sectional figures for the equipment provide detailed breakout information of metallic elements present in the equipment. In some instances, the figures identify elements that will not be detected by the spectrometer. These elements are shown for evaluator information only, with the possibility that they may be detected by other laboratory methods

NOTE

WP 002 01, which is found at the end of this work package, contains a table linking Navy components/equipment to the specific work packages in Volume 4 where the applicable evaluation criteria or limits are posted.

2. Wear Metal Sources.

a. Internal combustion engines are subject to contamination from external sources such as sand and dirt, as well as internal sources, such as blow-by combustion contaminants and wear metals from various oil-wetted moving parts, which are deposited in the oil system in varying degrees, depending upon the equipment condition.

b. Transmissions are difficult to evaluate and may be relatively easily contaminated with dirt, sand, and water. Transmissions may reveal high increases in debris (both metals and nonmetals) without detrimental wear of the oil-wetted working components. Therefore, the evaluator should be familiar with the transmissions being evaluated and also with any factors that might cause extreme or sudden increases in transmission oil contamination.

c. The specific metals that may normally be found in diesel engines and transmissions of non-aeronautical equipment used by the military services are discussed below:

(1) Iron (Fe). Iron is one of the most common wear metals found in oil samples. Iron may be generated from the wear of cylinder walls, shafts, gears, rolling element bearings, splines, and numerous other engine or transmission parts. Iron may also be the result of machining chips or debris left in the equipment oil system during manufacture or overhaul. Iron may also be present as a result of rust in some equipment.

(2) Silver (Ag). Silver is used as plating on some oil seals and bushings and may also be found in small amounts in some sleeve bushings. Silver is also used as overlay on some bearings such as gas turbine journal bearings and wrist pin bearings on locomotive engines.

(3) Aluminum (Al). Aluminum may be found in the oil systems of engines and transmissions because of the wear of pistons, washers, shims, some oil pumps, torque convectors, housings or cases, etc. It may also be the result of machining chips or debris left in the equipment oil system during manufacture or overhaul.

(4) Chromium (Cr). Chromium in the oil system may result from the wear of numerous oil-wetted parts that are alloyed or plated with chromium. The most common occurrence will probably result from wear of chromium plated piston rings.

(5) Copper (Cu). Copper is found in connecting rod and main bearings, many bushings, thrust washers and piston pin bearings. Also, many transmission and brake plates contain sintered bronze, which is very high in copper content.

(6) Silicon (Si). Although not a metallic element, silicon is commonly present in many oil systems and may be detected by spectrometric testing. The main source of silicon in engines (silica) is from external sources through the air induction system, which may admit significant amounts of dirt or sand if not maintained properly. Silicon may also be introduced in the form of dirt or sand during maintenance if proper maintenance practices are not observed. Aluminum and cast iron parts used in both engines and transmissions have significant amount of silicon. Some seals and gaskets, as well as antifoaming agents in oils, also contain silicon and/or silicone.

(7) Tin (Sn). Tin is used to plate some engine pistons and may also be present in connecting rod and main bearings, many bushings, thrust washers and piston pin bearings.

(8) Sodium (Na). Sodium is commonly present in many oil systems and may be detected by spectrometric testing. Sodium in the oil may result from seawater contamination. If seawater is present, a 0.05% water result will have a sodium concentration of approximately 5ppm and a 0.20% water result will have a sodium concentration of approximately 20ppm.

(9) Nickel (Ni). Nickel is used for plating and as an alloying element in many oil-wetted components. Some cast irons and stainless steels contain significant amounts of nickel.

(10) Lead (Pb). Lead is used for plating and may be found in significant amounts in connecting rod and main bearings, bushings, thrust washers and piston pin bearings. Lead may also be found in transmission clutch and brake friction plates.

(11) Molybdenum (Mo). Molybdenum is used as an alloying element in many oil-wetted engine and transmission components. Molybdenum is also used as a coating on the top, second, and third compression rings in the Continental AVDS 1790 engines and on the top ring of the Caterpillar 3208 engines.

(12) Magnesium (Mg). Magnesium is used as an alloying element in some oil-wetted components but is not employed extensively for non-aeronautical vehicles where weight is a less significant factor.

3. Lubricant and Hydraulic Fluid Information.

a. Specifications. Military specifications for lubricants and hydraulic fluids are frequently published in a format which includes sections describing the intended use of the oil/fluid, referenced documents, lubricant/fluid property requirements, level of performance, quality assurance provisions, test procedures for determination of properties, packaging and marking instructions, and qualification procedures. A specific military agency is responsible for the qualification of oils/fluids to each specification. The agency determines, from in-house or commercial laboratory evaluation data that products submitted for qualification meet all specification requirements. Periodically, an updated qualified products lists (QPL) is published for each specification giving the government designation (if any) for the lubricant, the manufacturer's designation for the lubricant/fluid, a test or qualification reference number/fluid, and the manufacturer's name and address.

b. Military and NATO Symbols. Lubricating engine and gear oils and hydraulic fluids are generally identified by military symbols and, in some instances, NATO Code Number designations. To provide a ready

reference for specification products, Table 1 lists military lubricant and hydraulic fluid specifications with their respective grade and military and NATO designations.

c. Within the confines of this discussion, a lubricant serves the following functions.

(1) Provides a film to reduce friction between rolling and sliding hardware components, i.e., roller and ball bearings and races, sleeve bearings and shaft surfaces, piston rings and cylinder liners, etc. Adequate lubricant film strength under extreme pressures and temperatures assures minimum metal-to-metal scuffing, scoring, and reduced overall wear.

(2) Provides a medium to transfer heat caused by friction from critical working surfaces.

(3) Acts as a flushing liquid to carry away wear particles and other foreign material.

(4) Contains additives which:

(a) Suspend combustion blow-by products and debris in the oil.

(b) Provide a sealing medium in piston engines.

(c) Maintain the cleanliness of critical component surfaces.

(d) Chemically react with power-system produced contaminates to neutralize their adverse effects.

d. Additives.

(1) Additives are normally classified as detergents, dispersants, oxidation inhibitors, corrosion inhibitors, anti-wear agents, pour point depressants, or anti-foam agents.

TABLE 1. Military Lubricant and Hydraulic Fluid Symbols and NATO Code Numbers

Product	Specification	Grade	Symbols	
			Military *	NATO
Hydraulic fluid, petroleum base, aircraft, missile, and ordinance	MIL-PRF-5606	----	OHA	H-515
Hydraulic fluid, petroleum base, preservation and operation	MIL- PRF-6083	----	OHT	C-635
Hydraulic fluid, fire resistant, non-neurotoxic	MIL-H-19457	----	----	H-580
Hydraulic fluid, catapult	MIL-H-22072	----	----	H-579
Hydraulic fluid, rust inhibited, fire resistant, synthetic hydrocarbon base	MIL-PRF-46170 (Type I-ground) (Type II- aerospace test stands)	----	FRH	H-544
Lubricating oil, internal combustion engine, tactical service	MIL-PRF-2104	10W 30 40 SCPL 15W/40	OE/HDO-10 OE/HDO-30 OE/HDO-40 OE/HDO-SCPL OE/HDO-15/40	0-237 0-238 ---- 0-1230
Lubricating oil, gear, multi-purpose	MIL-PRF-2105	75W 80W/90 80/140	GO-75 GO-80/90 GO-85-140	0-186 0-226 0-228
Lubricating oil, aircraft turbine engines, synthetic base	MIL-PRF-7808	3	----	0-148
		4		O-163
Lubricating oil, shipboard internal combustion engine, high out-put diesel	MIL-PRF-9000	----	9250	0-278
Lubricating oil, steam turbine and gear, moderate service	MIL-PRF-17331	----	2190 TEP	0-250
Hydraulic fluid petroleum, inhibited	MIL-PRF-17672	----	2075TH 2110TH 2135TH	---- H-573 ----
Lubricating oil, internal combustion engine, preservative and break-in	MIL-PRF-21260	10(Type I) 30(Type I) 50(Type 1)	PE-10-1 PE-30-1 PE-50-2	C-640 C-642 C-644

TABLE 1. Military Lubricant and Hydraulic Fluid Symbols and NATO Code Numbers – (Continued)

Product	Specification	Grade	Symbols	
			Military *	NATO
Lubricating oil, aircraft turbine engine, synthetic base	MIL-PRF-23699	STD	----	0-156
		C/I		O-152
		HTS		O-154
		EE		O-167
Lubricating Oil, Internal Combustion Engine, Synthetic Base, Combat/Tactical Service	MIL-PRF-32626	SMPL-TYPE 1	OE/HDO SMPL-1	
Lubricating oil, Automotive Engine, API Service SM for Military Administrative Service	SAE-J2362	10W	----	----
		30	----	----
		5W/30	----	----
		10W/30	----	----
		15W/40	----	----
Lubricating oil, internal combustion engine arctic	MIL-PRF-46167	5W/20	OEA-30	0-183
Hydraulic fluid, fire resistant, synthetic hydrocarbon base, aircraft	MIL-PRF-83282	----	----	H-537
Lubricating oil, refrigerant compressor, uninhibited	FED SPEC	----	RC0-2	O-282
	VVL-825		RC0-4	O-290

NOTE:

* FRH: fire resistant hydraulic
GO: gear oil
OEA: oil, engine arctic
OE/HDO: oil, engine/heavy duty operation
OHA: oil, hydraulic aircraft
OHT: oil, hydraulic testing
PE: preservative, engine
RCO: refrigerant, compressor oil
TEP: turbine extreme pressure
TH: turbine hydraulic
SMPL synthetic multipurpose powertrain lubricant

NOTE

Commercially available automotive oil additives (after market additives) should not be used as supplements for military or commercial specification oils since the additives may be incompatible and may result in a partial or complete loss of vital oil characteristics. Problems such as increased pour points, foaming

tendencies, bearing wear, engine corrosion, and piston ring deposits have been identified with additive misapplications, which have resulted in equipment malfunction and damage.

(2) Each type of lubricant is formulated to meet a specific function and set of operating conditions. The quality of the lubricant base stock and the intended application will dictate the need for a particular additive type. Table 2 lists the various types of additives, which may be used, corresponding chemical compound types and those chemical elements detectable by spectrometric analysis. Since numerous chemical compounds may be used within each additive class, only general descriptions of additive compositions can be given. In many cases, determination of the presence or absence of a specific additive can only be made through chemical analysis. This is especially true if the additive is an organic compound and contains no unique chemical elements other than the more common elements of carbon, hydrogen, oxygen, and nitrogen.

NOTE

Lubricant manufactures frequently use additives, which may be misinterpreted as wear metals during spectrometric analysis. An example of this is the use of copper as an anti-oxidant.

TABLE 2. Lubricant Additives

Additive Type	Chemical Type	Elements Detectable by Spectrometric Analysis
Antioxidant	Organic Metallo-organic	None Zn, Cu
Detergent	Metallo-organic	B, Ba, Mg, Na
Dispersant	Organic	None
Load-carrying	Organic	None
	Metallo-organic	Zn
Corrosion inhibitor	Organic	None
	Metallo-organic	Zn
VI improver	Organic	None
Anti-foam	Organic-silicone	Si
Pour point depressant	Organic	None

4. Lubricant Degradation.

a. Causes. Three basic factors control lubricant degradation: service time, operating temperature, and contamination. Time and temperature are directly related. The useful life of a lubricant is extended when equipment is operated at moderate operating temperatures and it is reduced when equipment is operated at severe operating temperatures such as sustained engine operation at high loads or continuous operation with high-sulfur fuel.

b. Effects. Breakdown of a formulated lubricant may be associated with oxidative deterioration of the base stock or depletion or modification of a particular additive. Oxidative deterioration results in the formation of acids, which promote corrosion and organic products. These products increase the viscosity of the oil. The effect of a significant increase in viscosity is a reduction in the pumpability of the lubricant and the amount of lubricant flow through delivery jets and ports. This reduces the lubricant's ability to reduce friction, transfer heat, flush contaminants, and maintain component cleanliness. Products resulting from oxidative deterioration may also promote the formation of deposits, which can interfere with the operation of mechanical components and plug oil filters and jets. Additive depletion results in the reduction or loss of the lubricant property which the additive was intended to provide such as detergency, dispersany, and lubricating ability.

c. Contamination. Lubricant contamination may occur as a consequence of faulty maintenance practices, poor handling techniques with new replacement oil, system-ingested contaminants, or system-generated contaminants.

(1) System Ingested. In internal combustion engines, the main ingested contamination is dirt and/or sand, which causes abrasive wear of mechanical components. The introduction of such contamination is usually caused by a malfunction in the engine air induction system (damaged air filter, air hoses, etc.). This type of contamination will normally be detected as high silicon during spectrometric analysis of system oil samples.

(2) System Generated. Several types of system-generated contaminants may occur. Examples include antifreeze fluid, water, unburned fuel, soot, and various products of combustion (blow-by products), which enter the lubricant crankcase through the piston ring area. Wear metals may also be considered a special type of system-generated contaminant. The presence (or absence) of wear metals is an indication of the integrity and condition of the oil-wetted mechanical system. If wear particles of appreciable size are generated, damage to mating surfaces such as gears and bearings may occur.

(3) Contaminant Types. Table 3 lists the various types of lubricant contaminants, which may be found, the significance of the contamination and the corresponding analytical methods for contaminant detection.

TABLE 3. Lubricant Contaminants

Contaminant Type	Significance	Analytical Method
Wear metals	System wear	Spectrometer
Coolant	Emulsifies oil, impairs lubrication, destroys dispersant additives	Crackle test; blotter spot; spectrometer for Na, B, FTIR
Free water	Corrosion, emulsifies oil, impairs lubrication	Crackle test; blotter spot; spectrometer for Na with Marine equipment, visual inspection, FTIR
Fuel	Lowers oil viscosity	Viscosity; Alkalinity Test
Dirt, sand	Causes abrasive wear	Spectrometer for Si, Al; blotter spot; visual inspection
Blow-by products, soot	Increases viscosity, forms sludge	Viscosity; blotter spot, FTIR
Reactive compounds	Corrosion, viscosity increase	Viscosity; Alkalinity Test
Rust	Internal corrosion	Spectrometer for Fe

5. Equipment Analysis Guidance.

   a. The following paragraphs provide general information on the types of oil analysis tests to be conducted on non-aeronautical fluid samples as well as guidance on how to interpret the results. Table 4 is a summary of this information. Army Oil Analysis Program laboratories follow the testing and evaluation procedures established by OASIS (Oil Analysis Standard Interservice System) which are analogous to Table 4 and these guidelines with a few minor exceptions.

   b. Engines. As a minimum, all engine samples are typically evaluated by four screening test procedures: spectrometric analysis, viscosity, blotter spot test and test for water. If the results obtained for any screening test are outside the evaluation guidelines, the laboratory evaluator shall consider the nature and degree of the failing result and schedule additional testing as required. See Table 4 for testing requirements. See Volume 4, WP 101 00 through 184 00 for Navy Ship requirements. A recommendation for maintenance action should not be made until a resample has been requested to verify the suspected situation.

      (1) Spectrometric values which exceed guidelines listed on applicable criteria tables should be evaluated to determine whether a critical situation exists and the appropriate laboratory recommendation should be assigned. For example, a verification sample that confirms excessive wear metal concentrations is considered a critical situation and warrants a recommendation for maintenance action. But an increasing wear trend on a routine sample is not considered a critical situation; it warrants a recommendation for resampling.

NOTE

A request for a sample of the new oil from stock is desirable whenever an increase in an element is suspected to be the result of additives from an oil addition.

Spectrometric results should also be evaluated for foreign contamination such as ingested dirt, evidenced by high silicon or aluminum, or engine coolant leakage, evidence by increases in sodium and boron. Additive levels may be shown by spectrometric data for elements such as zinc, boron, magnesium, or sodium.

      (2) Viscosity guidelines for MIL-L-2104 are typically based on results obtained using the Nametre viscometer. Viscosity results below minimum guidelines indicate the sample should be tested for fuel dilution. Viscosity results above maximum guidelines indicate the sample should be tested for total contaminants by blotter test and for water by crackle or Karl Fischer. Alkalinity should also be checked because low alkalinity means acids are being produced which are depleting the alkaline additives in the oil. These acids can form products which increase the viscosity. Viscosities for oils other than MIL-L-2104 should be evaluated by comparing the viscosity of the used oil sample to the viscosity of a sample of the new oil.

TABLE 4. Non-Aeronautical Equipment Lubricant Sample Analysis Guide
(Navy / Marine Corps Only)

The sequence of the following tests is provided as a guide, not as mandatory requirements for the services oil analysis programs.

I. ENGINES.

A. Spectrometric.

1. Pass - Go to I.B.
2. Fail - See wear metal guidelines for specific equipment.
   a. Critical - Resample to verify.
      (1) Wear Metals – abnormal or high range.
      (2) Oil contamination by dirt or dust - Si increase.
   b. Noncritical - Resample to verify, then change oil.
      (1) Oil contamination by dirt or dust - Si increase.
      (2) Additive depletion - Zn, Mg, or Cu decrease.
      (3) Coolant problem - B or Na increase by 20 PPM or more.

B. Viscosity.

1. Pass - Go to I.C.
2. Fail - See viscosity guidelines.
   a. Low - Fuel dilution or wrong oil. Verify by flashpoint test and change oil. If repeat problem, make maintenance recommendation for fuel dilution.
   b. High - Soot, sludge, water or wrong oil. Verify by blotter and water tests and change oil.

C. Blotter.

1. Pass - Go to I.D. or I.E.
2. Fail - See blotter test instructions in Volume II, work package 012 00.
   a. Contaminated oil - Soot or water is present. Verify by water (crackle or KF) test and change oil.
   b. Additive depletion - Spot has poor dispersancy. Verify by spectrometric Analysis (large decrease in Zn, Mg, or Cu) and change oil.

D. Crackle Test for Water.

1. Pass - Go to I.E. if quantitative degree of water content required (optional).

TABLE 4. Non-Aeronautical Equipment Lubricant Sample Analysis Guide (Continued)

2. Fail - See crackle test instructions in Volume 2, work package 008 00.
    a. Free water - Change oil.
    b. Coolant leak - Verify by spectrometric (B or Na increase by 20 PPM or more) and change oil.
    c. Dissolved water - Verify by KF test and consult guidelines.

E. Karl Fischer Test for Water.
1. Pass.
2. Fail - See guidelines, Volume II, work package 009 00.

F. Fourier Transform Infrared (FT-IR) Spectrometric Analysis Results.
1. Pass.
2. Fail - See FT-IR method number guidelines and analysis test warnings.
    a. Contaminated oil - Soot or water present.
    b. Water exceeds guidelines - change oil and service or replace filter.
    c. Fuel or coolant exceeds guidelines recommending corrective action. If fault is corrected, then perform oil change and service or replace filter.
    d. Additive depletion or lubricant degradation change oil and service or replace filter.

II. TRANSMISSIONS.

A. Spectrometric.
1. Pass - Go to II.B.
2. Fail - See wear metal guidelines for specific equipment.
    a. Critical - Resample to verify.
        (1) Wear metals - abnormal to high range.
        (2) Oil contamination by dirt or dust - Si increase.
    b. Noncritical - Resample to verify, then change oil.
        (1) Oil contamination by dirt or dust - Si increase.
        (2) Additive depletion - Zn, Mg, or Cu decrease.

TABLE 4. Non-Aeronautical Equipment Lubricant Sample Analysis Guide (Continued)

(3) Water or moisture condensation - Na increase.

B. Viscosity.

1. Pass - Go to II.C.
2. Fail - See viscosity guidelines.
   a. Low - Wrong oil, change oil.
   b. High - Sludge, water or wrong oil. Verify by water test and change oil.

C. Water Test - Crackle or Karl Fischer.

1. Pass.
2. Fail - See guidelines, Volume II, work package 008 00.

D. Fourier Transform Infrared (FT-IR) Spectrometric Analysis Results.

1. Pass.
2. Fail - water, oxidation, Ethylene Glycol, Anti-wear Region 1, Anti-wear Region 2 and Water Readings. Change oil and service or replace filter.

III. HYDRAULIC SYSTEMS.

The following tests are approved methods of testing hydraulic fluid condition and may be directed by services as required. These tests may be performed singly or in combination as required. (Army laboratories shall use spectrometric, viscosity, and water testing as a minimum.)

A. Spectrometric.

B. Viscosity.

C. Water testing, Crackle or Karl Fischer Method.

D. Electronic Particulate Count.

E. Colorimetric Patch Testing.

F. Fourier Transform Infrared (FT-IR) Spectrometric Analysis Results.

1. Pass.
2. Fail - Change oil and service or replace filter.

(3) Blotter spot test results reflect the presence or absence of total contaminants, dispersancy additives, and coolant in the oil. Evidence of solids and coolant contamination can be confirmed by reviewing spectrometric results for silicon (for dirt) and sodium and boron (for coolant). The presence of either solids or coolant contamination or the absence of dispersant additives warrants a recommendation to change oil.

(4) Crackle tests result indicate the presence or absence of water. If the test is positive, the blotter spot test should be reviewed for dispersancy because the presence of either free water or coolant will reduce the dispersancy. Review of spectrometric data described above will indicate if the positive test result is caused by coolant.

(5) FT-IR spectrometer tests transmission servicing oils for additive depletion and the presence of contaminants such as soot, fuel, water, coolant (Ethylene Glycol), oxidation, oil additives, or incorrect oil addition. The presence of contaminants or additive depletion warrants a lab recommendation to change oil and service or replace the component filter. If the presence or fuel or coolant is confirmed by a resample, then the AOAP laboratory will issue a DA Form 3254-R, Oil Analysis Recommendation and Feedback, for corrective action.

c. Transmissions. Transmission samples should be evaluated by the screening tests of spectrometric analysis, viscosity, and water determination.

(1) Spectrometric results that exceed criteria shall be evaluated by the screening tests of spectrometric analysis, viscosity, and water determination.

(2) Viscosity values which fail guidelines, either high or low, shall be cause for a laboratory recommendation to change oil.

(3) A crackle test indication of water in the oil shall be cause for a laboratory recommendation to change oil.

(4) FT-IR spectrometer test for presence of contaminants or absence and additives in components servicing oil the following applies. When established guidelines are exceeded, the recommendation will be to change oil and service/replace filter.

d. Hydraulic System. Samples shall be evaluated by spectrometric analysis, viscosity, water testing, electronic particulate count, or colormetric patch testing. (Army samples shall have spectrometric, viscosity, water, and FT-IR testing as a minimum.) Laboratory recommendations for hydraulic systems shall be limited to normal or to change fluid.

6. Evaluation Procedure. The following procedure shall be used when evaluating sample results:

a. Determine the range for each critical wear metal concentration in the sample result from the appropriate equipment wear metal evaluation criteria table in JOAP Volume 4, WP 004 00 and higher.

Wear metals considered significant, and for which oil analysis monitoring is required for the particular equipment, are those for which numerical criteria are provided in the applicable equipment criteria table.

b. Review the technical information section included on each criteria table for additional information to be used in the evaluation process.

c. Compare the wear metal concentration levels of the current sample with the levels of the previous sample to determine whether changes are occurring which indicate developing or impending equipment problems. Analysis readings will normally vary between samples and are generally related to equipment operating time since oil change.

TABLE 5. Viscosity Guidelines for MIL-L-9000 and MIL-L-2104 Oils at 100 °F

ALLOWABLE USE LIMITS AT 100 °F		
Oil Specification	**Centistokes (cSt)**	
	Min	**Max**
MIL-L-9000	90	200
MIL-L-2104:		
Grade 10	58	154
Grade 30	73	192
Grade 50	160	430
Grade 15W4	69	144

d. Determine the wear metal trend between the last sample and the current sample and compare with the trend limit listed in the criteria table. Most abnormal trends are usually readily apparent. The trends in the table are based on the wear metal between samples will not be exactly the specified hours; therefore, a conversion must be made for approximate trend value comparison purposes. A trend comparison can be made by dividing the wear metal increases between samples by the operating hours between samples and then multiplying the results by 10. Trend values for the specified sample intervals are calculated as follows:

$[(A-B)/(C-D)]X10 =$ trend value for 10 hours

A = PPM this sample

B= PPM last sample

C = operating hours this sample

D = operating hours last sample

NOTE

The formula shown above for calculating trends is a quick way to determine the trend values. However, trend values calculated using this formula for samples taken very frequently may be much less accurate or reliable than trend values calculated for samples taken less frequently. This possibility of error is caused by the spectrometer allowable tolerances and also by the possibility of a variance in the rate of wear metal production over a period of time. The calculated trend values will be helpful information for the evaluation process, but if samples taken more frequently than at 10 hour intervals are being evaluated,

the calculated trend values are not considered accurate for use as equipment acceptable/not acceptable criteria.

e. Wear metal concentrations exceeding the guidelines but with normal trends may, in some cases, be acceptable, although samples may be required more frequently to minimize the possibility of missing an impending failure.

f. Trend values included in the evaluation criteria tables, are, as previously stated, intended as guidelines for the evaluator, since there are many other factors that must be evaluated to determine actual equipment condition and whether subsequent laboratory recommendations to the customer are required. Generally speaking, trends encountered will fall into one of the following categories:

(1) Level (little or no change): considered normal.

(2) Slightly to moderately increasing or decreasing within trend limits: Usually indicative of problems. A sudden increase may indicate the start of an equipment problem, while a sudden decrease may indicate defective sampling procedures, oil addition/change without documentation, or sample identification problems. Investigation for causes or requests for verification samples and/or decreased sampling interval may be appropriate.

(3) Sharply increasing or decreasing within trend limits: Usually indicative of problems. A sudden increase may indicate the start of an equipment problem, while a sudden decrease may indicate defective sampling procedures, oil addition/change without documentation, or sample identification problems. Investigation for causes or requests for verification samples and/or decreased sampling interval may be appropriate.

(4) Erratic increases and decreases of trend level: This usually indicates a problem in sampling procedure, oil addition or change without documentation, sample identification, etc. This should trigger a request to review activity sampling procedures and submit a verification sample.

(5) Increases exceeding trend limits: Generally indicative of equipment problems. Consult comment sections and equipment history. This will normally result in resample request and/or a maintenance action recommendation.

NOTE

The above categories are subjective since no definitive increase/decrease point value within the trend limits may be arbitrarily assigned. Severity of increase or decreases must be determined by each evaluator after considering all factors involved. The above listing is not considered complete but is provided to show that trend variances, while still within limits, should be monitored to detect impending problems prior to development, whether action recommendations to operating activities are required or not.

g. Determine the appropriate recommendation to be made to the operating activity. Laboratory recommendation codes applicable to non-aeronautical equipment are contained in JOAP Volume 1, WP 005 00. The majority of sample results will be normal, with the appropriate recommendation Code A. In most cases, this recommendation may be determined without extensive reference to the tables or charts.

However, applicable tables and charts for the equipment being monitored should be consulted for any special guidance information.

h. If a recommendation for maintenance action is indicated, the comments sections and equipment diagrams should be reviewed. These may provide additional maintenance information concerning likely problem areas that may warrant inclusion in the laboratory recommendation/maintenance advisory notification to the operating activity.

i. The above procedure can serve as a step-by-step operational guide for evaluator personnel with limited experience, while retaining considerable flexibility for use by an experienced evaluator who can readily take into account the many factors which influence evaluations and recommendations. The judgment of the evaluator is an important part of the evaluation process. Judgment and experience shall not be subordinated by numerical data when reasonable doubt exists in the validity of the recommendation indicated by the numerical data.

NAVY SHIP COMPONENT/EQUIPMENT AND FLUID LIMITS WORK PACKAGES CROSS REFERENCE TABLE

This work package provides a cross reference table to assist Navy laboratory operators in finding the appropriate Volume 4 work packages to be used in the evaluation of oil samples. Navy laboratory operators should use the Standard Lab Recommendation Codes found in Volume 1 WP 005 00 Tables 2 and 3.

Hull Class	Component/Equipment	E/CSN	FluidType	Fluid Limits WP	Equipment Limits WP
CG-47	Anchor Gearbox	ANCHGE	80W-90	WP 101 33	Under Development
CG-47	Anchor Hydraulic Power Unit	ANCHHY	MIL-PRF-17672 2110	WP 101 21	Under Development
CG-47	Controllable Pitch Propeller	CPP or CRP	MIL-PRF-17331	WP 101 06	Under Development
CG-47	Davit Hydraulic Power Unit	DAVIT	MIL-PRF-17672 2110	WP 101 12	Under Development
CG-47	Hydraulic Valve Control Station	HVCS	MIL-PRF-17672 2110	WP 101 12	Under Development
CG-47	Lathe	LATHE	MIL-PRF-17331	WP 101 08	Under Development
CG-47	LM 2500 Gas Turbine Engine	GTE or GTM	MIL-PRF-23699 (C/I)	WP 101 27	WP 102 00
CG-47	Main Reduction Gear	MRG	MIL-PRF-17331	WP 101 09	Under Development
CG-47	MK 45 Gun Mount	GUNMT	MIL-F-17111	WP 101 38	Under Development
CG-47	OK-410 TACTAS Winch	TACTAS	MIL-F-17111	WP 101 05	Under Development
CG-47	Rapid Securing Device	RSD	MIL-H-83282	WP 101 25	Under Development
CG-47	Rapid Securing Device (RSD) Rope Accumulator	RSDROPEACC	MIL-H-83282	WP 101 25	Under Development
CG-47	RAST WHPU	RASTWHPU	MIL-PRF-17672 2075	WP 101 14	Under Development
CG-47	RR 501-K17 Gas Turbine Generator	GTG	MIL-PRF-23699 (C/I)	WP 101 27	WP 103 00
CG-47	RR 501-K17 Gas Turbine Reduction Gear	GRG	MIL-PRF-17331	WP 101 08	Under Development
CG-47	Steering HPU Shut Off Valve	HYDSTRSHUTVALVE	MIL-PRF-17672 2135	WP 101 20	Under Development
CG-47	Steering HPU Tank Drain	HYDSTRTANKDRAIN	MIL-PRF-17672 2135	WP 101 20	Under Development

Hull Class	Component/Equipment	E/CSN	FluidType	Fluid Limits WP	Equipment Limits WP
CG-47	Torpedo Strikedown Lift	STRKDL	MIL-F-17111	WP 101 05	Under Development
CVN-68	Davit Hydraulic Power Unit	DAVIT	MIL-PRF-17672 2110	WP 101 12	Under Development
CVN-68	GM Electro Motive 16-645E5N LI Diesel Engine	EDG	MIL-PRF-9000	WP 101 02	WP 161 00
CVN-78	Davit Hydraulic Power Unit	DAVIT	MIL-PRF-17672 2110	WP 101 12	Under Development
CVN-78	12V and 16V PA6B Diesel Engine	EDG	MIL-PRF-9000	WP 101 02	WP 207 00
DDG-1000	Propulsion Motor End Bearing	PMENDBEAR	MIL-PRF-9000	WP 101 02	Under Development
DDG-1000	Caterpillar C18 Emergency Diesel Generator	EDG	MIL-PRF-2104 15W40	WP 101 01	Under Development
DDG-1000	MT 30 Gas Turbine Engine	GTE or GTM	MIL-PRF-23699 HTS	WP 101 28	WP 197 00
DDG-1000	MT 5 Gas Turbine Generator	GTG or GTE	MIL-PRF-23699 HTS	WP 101 28	WP 197 00
DDG-1000	MT 5 Gas Turbine Reduction Gear	GRG	MIL-PRF-23699 HTS	WP 101 28	WP 197 00
DDG-1000	Steering Gear Intermediate Speed Reducer	ISR	85W-140	WP 101 34	Under Development
DDG-1000	Steering Gear Low Speed Gear Case	LSGC	Mobil SHC Gear 3200	WP 101 41	Under Development
DDG-1000	Turning Gear	TURNGEAR	MIL-PRF-17331	WP 101 08	Under Development
DDG-51	Anchor Gearbox	ANCHGE	80W-90	WP 101 33	Under Development
DDG-51	Anchor Hydraulic Power Unit	ANCHHY	MIL-PRF-17672 2135	WP 101 21	Under Development
DDG-51	Controllable Pitch Propeller	CPP or CRP	MIL-PRF-17331	WP 101 06	Under Development
DDG-51	Davit Hydraulic Power Unit	DAVIT	MIL-PRF-17672 2110	WP 101 12	Under Development
DDG-51	Hydraulic Valve Control Station	HVCS	MIL-PRF-17672 2135	WP 101 12	Under Development
DDG-51	LM 2500 Gas Turbine Engine	GTE or GTM	MIL-PRF-23699 (C/I)	WP 101 27	WP 102 00
DDG-51	Main Reduction Gear	MRG	MIL-PRF-17331	WP 101 09	Under Development
DDG-51	MK 45 Gun Mount	GUNMT	MIL-F-17111	WP 101 38	Under Development

Hull Class	Component/Equipment	E/CSN	FluidType	Fluid Limits WP	Equipment Limits WP
DDG-51	OK-410 TACTAS Winch	TACTAS	MIL-F-17111	WP 101 05	Under Development
DDG-51	OK-410 Winch Handling and Storage Group	TACTASWINCH	MIL-F-17111	WP 101 05	Under Development
DDG-51	Rapid Securing Device	RSD	MIL-H-83282	WP 101 25	Under Development
DDG-51	Rapid Securing Device (RSD) Rope Accumulator	RSDROPEACC	MIL-H-83282	WP 101 25	Under Development
DDG-51	RAST WHPU	RASTWHPU	MIL-PRF-17672 2075	WP 101 14	Under Development
DDG-51	RR 501-K34 Gas Turbine Generator	GTG	MIL-PRF-23699 (C/I)	WP 101 27	WP 103 00
DDG-51	RR 501-K34 Gas Turbine Reduction Gear	GRG	MIL-PRF-23699 (C/I)	WP 101 27	WP 103 00
DDG-51	Steering Hydraulic Case Drain	HYDSTRCASEDRAIN	MIL-PRF-17672 2135	WP 101 20	Under Development
DDG-51	Steering Hydraulic Servo Valve	HYDSTRSERVO	MIL-PRF-17672 2135	WP 101 20	Under Development
LCAC-02	Prop Bearing	BPROP	MIL-PRF-23699 C/I	WP 101 36	WP 201 00
LCAC-02	Prop/Rudder	RPROP	MIL-PRF-23699 C/I	WP 101 36	WP 201 00
LCAC-02	Auxiliary Power Unit	APU or GTM	MIL-PRF-23699 C/I	WP 101 27	WP 202 00
LCAC-02	Bow Ramp	BOWRAMP	MIL-PRF-23699 C/I	WP 101 36	WP 201 00
LCAC-02	Bow Thruster	BOWTHR	MIL-PRF-23699 C/I	WP 101 36	WP 206 00
LCAC-02	Gas Turbine Engine	GTE or GTM	MIL-PRF-23699 C/I	WP 101 27	WP 195 00
LCAC-02	Lube Oil Tank	LOTANK	MIL-PRF-23699 C/I	WP 101 36	Under Development
LCAC-02	Scavenge Fan	SCAVFAN	MIL-PRF-23699 C/I	WP 101 36	WP 205 00
LCAC-02	Stern Ramp	STERNRAMP	MIL-PRF-23699 C/I	WP 101 36	WP 201 00
LCAC-02	Propeller Lube Oil	CPP or CRP	MIL-PRF-23699 C/I	WP 101 36	WP 204 00
LCAC-02	Reduction Gear	MRG	MIL-PRF-23699 C/I	WP 101 36	WP 203 00
LCAC-100	Gas Turbine Engines	GTE	MIL-PRF-23699 C/I	WP 101 40	WP 194 00

Hull Class	Component/Equipment	E/CSN	FluidType	Fluid Limits WP	Equipment Limits WP
LCAC-100	Reduction Gear / Lube Oil Sump	GRBX	MIL-PRF-23699 C/I	WP 101 36	WP 203 00
LCAC-100	Propeller Lube Oil	BPROP	MIL-PRF-23699 C/I	WP 101 36	Under Development
LCAC-100	Propeller Pitch Control Module	PPCM	MIL-PRF-23699 C/I	WP 101 36	Under Development
LCAC-100	Hydraulic System	HYDSYS	MIL-PRF-23699 C/I	WP 101 36	Under Development
LCAC-100	Auxiliary Power Unit	APU	MIL-PRF-23699 C/I	WP 101 40	WP 209 00
LCC-19	Colt Emergency Diesel Generator	EDG	MIL-PRF-2104 15W40	WP 101 01	Under Development
LCC-19	Steering Hydraulic Power Unit	HYDSTR	MIL-PRF-17672 2135	WP 101 20	Under Development
LCS-1	Anchor Hydraulic Power Unit	ANCHHY	MIL-PRF-17672 2075	WP 101 21	Under Development
LCS-1	Interceptor Hydraulic Power Unit	INTERCEPTOR	MIL-PRF-17672 2110	WP 101 12	Under Development
LCS-1	Launch Recovery Handling and Stowage System LRHS	LRHS	MIL-PRF-17672 2075	WP 101 12	Under Development
LCS-1	MK 110 Gun Mount	GUNMT	MIL-F-17111	WP 101 38	Under Development
LCS-1	MT 30 Gas Turbine Engine	GTE or GTM	MIL-PRF-23699 HTS	WP 101 28	WP 197 00
LCS-1	Rolls Royce Kamewa Waterjet	WJHPU	MIL-PRF-17672 2110	WP 101 16	Under Development
LCS-1	Rolls Royce Waterjet Power Pack	WJPP	MIL-PRF-17672 2135	WP 101 22	Under Development
LCS-1	Sideport Door Hydraulic Power Unit	SIDEPORTHPU	MIL-PRF-17672 2075	WP 101 12	Under Development
LCS-2	Bow Thruster Hydraulic Power Unit	BOWTHRUSTHPU	MIL-PRF-17672 2110	WP 101 19	Under Development
LCS-2	LM 2500 Gas Turbine Engine	GTE or GTM	MIL-PRF-23699 HTS	WP 101 27	WP 102 00
LCS-2	LM 2500 GTE Hydraulic Start Unit	GTHSU	MIL-PRF-17672 2110	WP 101 12	Under Development
LCS-2	MK 110 Gun Mount	GUNMT	MIL-F-17111	WP 101 38	Under Development
LCS-2	SmartPac Hydraulic Power Unit	SMTHPU	MIL-PRF-17672 2110	WP 101 19	Under Development
LCS-2	Wartsilla Waterjet	WJHPU	MIL-PRF-17672 2110	WP 101 17	Under Development

Hull Class	Component/Equipment	E/CSN	FluidType	Fluid Limits WP	Equipment Limits WP
LCS-2	GT Main Thrust Bearing	MTBGT	MobilGear 600XP 68	WP 101 42	Under Development
LCS-2	MPDE Main Thrust Bearing	MTBMPDE	MobilGear 600XP 68	WP 101 42	Under Development
LHA-6	Aircraft Elevator	ACELEV	MIL-PRF-19457	WP 101 23	Under Development
LHA-6	Anchor Gearbox	ANCHGE	80W-90	WP 101 33	Under Development
LHA-6	Anchor Hydraulic Power Unit	ANCHHY	MIL-PRF-17672 2135	WP 101 21	Under Development
LHA-6	Controllable Pitch Propeller	CPP or CRP	MIL-PRF-17331	WP 101 06	Under Development
LHA-6	Hydraulic Valve Control Station	HVCS	MIL-PRF-17672 2135	WP 101 12	Under Development
LHA-6	JLG Man-Lift Engine	JLGENG	MIL-PRF-2104 15W40	WP 101 01	Under Development
LHA-6	JLG Man-Lift Hydraulic	JLGHYD	Mobilfluid 424	WP 101 35	Under Development
LHA-6	LM 2500+ Gas Turbine Engine	GTE or GTM	MIL-PRF-23699 (C/I)	WP 101 27	WP 102 00
LHA-6	Main Reduction Gear	MRG	MIL-PRF-17331	WP 101 09	Under Development
LHA-6	RAS Winch	RASWINCH	80W-90	WP 101 33	Under Development
LHA-6	Sideport Cargo Crane	CCRANE	MIL-PRF-17672 2135	WP 101 12	Under Development
LHA-6	Steering HPU Case Return	HYDSTRCASEDRAIN	MIL-PRF-17672 2135	WP 101 20	Under Development
LHA-6	Steering HPU Gage Valve	HYDSTRGAGE	MIL-PRF-17672 2135	WP 101 20	Under Development
LHD-1	ALCO 16-251C Emergency Diesel Generator	EDG	MIL-PRF-9000	WP 101 02	WP 105 00
LHD-1 / LHD-8	Aircraft Elevator	ACELEV	MIL-PRF-19457	WP 101 23	Under Development
LHD-1 / LHD-8	Anchor Gearbox	ANCHGE	80W-90	WP 101 33	Under Development
LHD-1 / LHD-8	Anchor Hydraulic Power Unit	ANCHHY	MIL-PRF-17672 2135	WP 101 21	Under Development
LHD-1 / LHD-8	Central Hydraulic Power Unit	CHPU	MIL-PRF-17672 2110	WP 101 12	Under Development
LHD-1 / LHD-8	Sideport Cargo Crane	CCRANE	MIL-PRF-17672 2135	WP 101 12	Under Development

Hull Class	Component/Equipment	E/CSN	FluidType	Fluid Limits WP	Equipment Limits WP
LHD-1 / LHD-8	Controllable Pitch Propeller	CPP or CRP	MIL-PRF-17331	WP 101 06	Under Development
LHD-1 / LHD-8	Hydraulic Valve Control Station	HVCS	MIL-PRF-17672 2135	WP 101 12	Under Development
LHD-1 / LHD-8	JLG Man-Lift Engine	JLGENG	MIL-PRF-2104 15W40	WP 101 01	Under Development
LHD-1 / LHD-8	JLG Man-Lift Hydraulic	JLGHYD	Mobilfluid 424	WP 101 35	Under Development
LHD-1 / LHD-8	Main Reduction Gear	MRG	MIL-PRF-17331	WP 101 09	Under Development
LHD-1 / LHD-8	Refueling at Sea (RAS) Winch	RASWINCH	80W-90	WP 101 33	Under Development
LHD-1 / LHD-8	Steering HPU Case Return	HYDSTRCASEDRAIN	MIL-PRF-17672 2135	WP 101 20	Under Development
LHD-1 / LHD-8	Steering HPU Gage Valve	HYDSTRGAGE	MIL-PRF-17672 2135	WP 101 20	Under Development
LHD-1 / LHD-8	Stern Gate Hydraulic	STERNGATE	MIL-PRF-17672 2110	WP 101 12	Under Development
LHD-8	Lathe	LATHE	MIL-PRF-17331	WP 101 08	Under Development
LHD-8	LM 2500+ Gas Turbine Engine	GTE or GTM	MIL-PRF-23699 (C/I)	WP 101 27	WP 102 00
LPD-17	Anchor Gearbox	ANCHGE	80W-90	WP 101 33	Under Development
LPD-17	Anchor Hydraulic Power Unit	ANCHHY	MIL-PRF-17672 2135	WP 101 21	Under Development
LPD-17	Ballast Hydraulic Power Unit	BALLHY	MIL-PRF-17672 2110	WP 101 12	Under Development
LPD-17	Cargo Elevator	CWELEV	MIL-PRF-17672 2135	WP 101 12	Under Development
LPD-17	Cargo Elevator Speed Reducer	CWELEVGE	80W-90	WP 101 33	Under Development
LPD-17	Central Hydraulic Power Unit	CHPU	MIL-PRF-17672 2135	WP 101 12	Under Development
LPD-17	Controllable Pitch Propeller	CPP or CRP	MIL-PRF-17331	WP 101 06	Under Development
LPD-17	Flight Deck Ramp Door Hydraulic Power Unit	FDRDHPU	MIL-PRF-17672 2110	WP 101 12	Under Development
LPD-17	Hydraulic Test Stand	HTS	MIL-PRF-17331	WP 101 08	Under Development
LPD-17	JLG Man-Lift Engine	JLGENG	MIL-PRF-2104 15W40	WP 101 01	Under Development

Hull Class	Component/Equipment	E/CSN	FluidType	Fluid Limits WP	Equipment Limits WP
LPD-17	JLG Man-Lift Hydraulic	JLGHYD	Mobilfluid 424	WP 101 35	Under Development
LPD-17	Knuckle Boom Crane	BOOMCRANE	MIL-PRF-17672 2135	WP 101 12	Under Development
LPD-17	Lathe	LATHE	MIL-PRF-17331	WP 101 08	Under Development
LPD-17	Main Reduction Gear	MRG	MIL-PRF-17331	WP 101 09	Under Development
LPD-17	Steering HPU Pump Casing	HYDSTRPUMP	MIL-PRF-17672 2135	WP 101 20	Under Development
LPD-17	Steering HPU RAM Assembly	HYDSTRRAM	MIL-PRF-17672 2135	WP 101 20	Under Development
LPD-17	Steering HPU Service Tank	HYDSTRTANK	MIL-PRF-17672 2135	WP 101 20	Under Development
LPD-17	Stern Gate Hydraulic	STERNGATE	MIL-PRF-17672 2110	WP 101 12	Under Development
LPD-17	Well Deck Bridge Crane	WDBCRANE	MIL-PRF-6086	WP 101 39	Under Development
LPD-26AF	Well Deck Bridge Crane	WDBCRANE	80W-90	WP 101 33	Under Development
LSD-41/49	Anchor Gearbox	ANCHGE	80W-90	WP 101 33	Under Development
LSD-41/49	Anchor Hydraulic Power Unit	ANCHHY	MIL-PRF-17672 2135	WP 101 21	Under Development
LSD-41/49	Ballast Hydraulic Power Unit	BALLHY	MIL-PRF-17672 2110	WP 101 12	Under Development
LSD-41/49	Bridge Crane	BCRANE	80W-90	WP 101 33	Under Development
LSD-41/49	Controllable Pitch Propeller	CPP or CRP	MIL-PRF-17331	WP 101 06	Under Development
LSD-41/49	Hydraulic Valve Control Station	HVCS	MIL-PRF-17672 2135	WP 101 12	Under Development
LSD-41/49	JLG Man-Lift Engine	JLGENG	MIL-PRF-2104 15W40	WP 101 01	Under Development
LSD-41/49	JLG Man-Lift Hydraulic	JLGHYD	Mobilfluid 424	WP 101 35	Under Development
LSD-41/49	Main Reduction Gear	MRG	MIL-PRF-17331	WP 101 09	Under Development
LSD-41/49	Steering HPU Pump Casing	HYDSTRPUMP	MIL-PRF-17672 2135	WP 101 20	Under Development
LSD-41/49	Steering HPU Service Tank	HYDSTRTANK	MIL-PRF-17672 2135	WP 101 20	Under Development

Hull Class	Component/Equipment	E/CSN	FluidType	Fluid Limits WP	Equipment Limits WP
LSD-41/49	Stern Gate Hydraulic	STERNGATE	MIL-PRF-17672 2110	WP 101 12	Under Development
MCM-1	Anchor Gearbox	ANCHGE	80W-90	WP 101 33	Under Development
MCM-1	Controllable Pitch Propeller	CPP or CRP	MIL-PRF-9000	WP 101 37	Under Development
MCM-1	Hydraulic Power Unit 30	HPU	MIL-PRF-17672 2110	WP 101 12	Under Development
MCM-1	Hydraulic Power Unit 75	HPU	MIL-PRF-17672 2110	WP 101 12	Under Development
MCM-1	Hydraulic Valve Control Station	HVCS	MIL-PRF-17672 2135	WP 101 12	Under Development
MCM-1	Main Reduction Gear	MRG	MIL-PRF-9000	WP 101 37	Under Development
MCM-1	Minesweeping Magnetic Cable Reel	MAGCABLE	80W-90	WP 101 33	Under Development
MCM-1	Minesweeping Winch Mechanical	MECHWINCH	80W-90	WP 101 33	Under Development
MCM-1	Minesweeping Winch Mag Reel	MAGWINCH	80W-90	WP 101 33	Under Development
MCM-1	Steering HPU Gage Valve	HYDSTRGAGE	MIL-PRF-17672 2110	WP 101 18	Under Development
MCM-1	Steering HPU Pump Casing	HYDSTRPUMP	MIL-PRF-17672 2110	WP 101 18	Under Development
MCM-1	Stern Crane Hoist Winch	HWSCRANE	80W-90	WP 101 33	Under Development
MCM-1	Stern Crane Slew Drive	SLCRANE	80W-90	WP 101 33	Under Development
PC-1	Anchor Gearbox	ANCHGE	80W-90	WP 101 33	Under Development
PC-1	Fin Stabilizer	FINSTAB	MIL-H-83282	WP 101 25	Under Development
PC-1	Gate Hydraulic Power Unit	GATEHPU or CCRS	MIL-PRF-17672 2135	WP 101 12	Under Development
PC-1	Steering Hydraulic Power Unit	HYDSTR	MIL-H-83282	WP 101 25	Under Development

COMPONENT:	**ALLIS-CHALMERS 3500 ENGINE**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
AC3500	645M	EFLA
AC3500	AN/MJQ-12 A	VELA
AC3500	MEP-006A	VECA
AC3500	MEP-105A	VEDA
AC3500	PU650B/G	VEMA
AC3500	PU699A/M	VFBA
AC3500	PU700A/M	VFCA
AC3500	PU707A/M	VLMA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-200	0-1	0-30	0-21	0-65	0-56	0-10		0-83		
Marginal Range	201-246		31-37	22-26	66-80	57-69	11-13		84-103		
High Range	247-307	2	38-47	27-32	81-100	70-86	14-16		104-128		
Abnormal	308+	3+	48+	33+	101+	87+	17+		129+		
Abnormal Trend (PPM Increase in 10 Hrs)	61	2	9	6	20	17	4		26		

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COMPONENT:	**AMERICAN 244F ENGINE**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
AMER 244F	**LOCO120T**	**XCPA**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-63		0-12	0-25	0-46	0-29			0-37		
Marginal Range	64-77		13-15	26-31	47-56	30-36			38-45		
High Range	78-97		16-18	32-39	57-70	37-45			46-56		
Abnormal	98+		19+	40+	71+	46+			57+		
Abnormal Trend (PPM Increase in 10 Hrs)	19		4	8	14	9			11		

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COMPONENT:	HMMWV 6.2 LITER ENGINE

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
6.2 L DIESEL	M1025	BBFA
6.2 L DIESEL	M1025A1	BBFB
6.2 L DIESEL	M1026	BBGA
6.2 L DIESEL	M1026A1	BBGB
6.2 L DIESEL	M1035	BBLA
6.2 L DIESEL	M1036	BBHA
6.2 L DIESEL	M1037	BBKA
6.2 L DIESEL	M1038	BBEA
6.2 L DIESEL	M1038A1	BBEB
6.2 L DIESEL	M1042	TCTA
6.2 L DIESEL	M1043	BBJA
6.2 L DIESEL	M1044	BBNA
6.2 L DIESEL	M1046	TCSA
6.2 L DIESEL	M1069	AKZA
6.2 L DIESEL	M1097	BBMA
6.2 L DIESEL	M1097A1	BBUA
6.2 L DIESEL	M1109	B6AA
6.2 L DIESEL	M1121	B6HA
6.2 L DIESEL	M966	BBCA
6.2 L DIESEL	M966A1	BBCB
6.2 L DIESEL	M996	BBBA
6.2 L DIESEL	M996A1	BBBB
6.2 L DIESEL	M997	BBAA

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
6.2 L DIESEL	M997A1	BBAB
6.2 L DIESEL	M998	BBDA
6.2 L DIESEL	M998A1	BBDB
6.2 L DIESEL	SECM	SECM

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES.**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

These interim wear metal guidelines are based on the manufacturer's used lubrication oil chemical analysis. The Oil Analysis Standard Inter-service System (OASIS) software will be modified to reflect actual wear metal parameters.

Wear Metal/Coolant Elements		Limits (PPM)	Footnotes
Aluminum	(Al)	50	-
Boron	(B)	20	A,B
Chromium	(Cr)	45	-
Copper	(Cu)	400 (150)	A,B,D,E
Iron	(Fe)	500	A
Lead	(Pb)	115	A
Molybdenum	(Mo)	40	A,B
Silicon	(Si)	90	A,B,C
Sodium	(Na)	50	A,B
Tin	(Sn)	90	-

NOTES:

A. Values allowed over the component lubrication oils' baseline.
B. The elements may be present in servicing lubrication oil or coolant additive packages.
C. This value can be higher on a new engine or engine recently serviced due to silicone form-in-place gaskets being utilized.
D. Engine(s) used in application where extended idling is required may incur copper readings levels of 600 PPM or higher.
E. Lower value readings for 1985 year model engines because of revised rocker arm design.

COMPONENT:	**CASE 504BD/A-504BDT (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CASE-504BD	MW24C	EFQA
CASE-A504BDT	MW24C	EFQB

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES.**

Table 1 - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-202		0-30	0-18	0-73	0-81	0-11		0-51		
Marginal Range	203-248		31-37	19-22	74-89	82-100	12-14		52-64		
High Range	249-311		38-46	23-28	91-112	101-124	15-17		65-80		
Abnormal											
Abnormal Trend (PPM Increase in 10 Hrs)	62		9	6	22	25	4		16		

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COMPONENT:	**CATERPILLAR 3208 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CAT-3208	613BWDNS	EVGA
CAT-3208	613BWDS	EVFA
CAT-3208	613BSNS	EHZA
CAT-3208	613BSNSI	EJLA
CAT-3208	613BSS	EH2A
CAT-3208	613BSSI	EJKA
CAT-3208	K300	EXBA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	30-150		0-10	0-3	0-20	0-20			0-25	0-20	
Marginal Range	151-230		11-15	4-12	21-27	21-35			26-40	21-27	
High Range	231-300		16-45	13-20	28-35	36-50			41-75	28-35	
Abnormal	301		46+	21+	36+	51+			76+	36+	
Abnormal Trend (PPM Increase in 10 Hrs)	60		9	4	7	10			15	7	

TECHNICAL INFORMATION

A faulty air induction system is normally the major source of silicon in engine oil. Antifoaming agents in engine oil normally contain silicon which will give 3 to 7 PPM in new oil. Silicone coatings may also be used in oil-wetted engine parts. Aluminum and cast iron parts in the engine can have significant amounts of silicon in their composition.

Molybdenum (Mo) levels can be employed to determine the condition of the top (fire) ring. Molybdenum may be

present as a dry lubricant or as an additive in some greases, requiring evaluator interpretation.

The engine is liquid-cooled; therefore, ethylene glycol may be present in the engine oil, indicating coolant contamination.

Lead (Pb) is normally generated at relatively high levels during the break-in period of the engine, and then remains fairly constant except for heavy loading, marginal lubrication, or excessive dirt. Increased lead can be the first symptom of bearing distress.

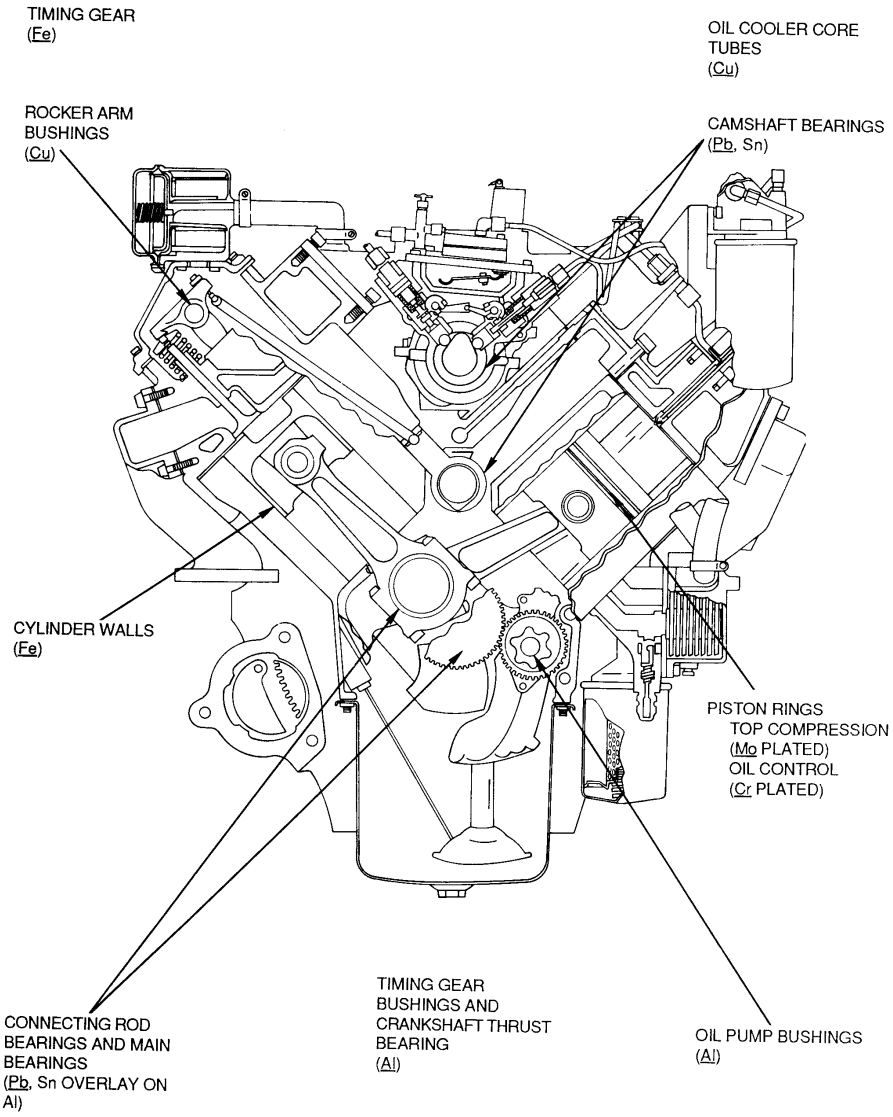

FIGURE 1. Caterpillar 3208

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COMPONENT:	**CATERPILLAR 3304 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CAT-3304	950BNS	EFWA
CAT-3304	950BNSCE	EGEA
CAT-3304	950BS	EFVA
CAT-3304	950BSCE	EGFA
CAT-3304	CAT-130GNS	EHNA
CAT-3304	CAT-130GNSE	TAAA
CAT-3304	CAT-130GS	EHPA
CAT-3304	CAT-130GSCE	TABA
CAT-3304DIT	CAT-130G	EHFA
CAT-3304DIT	CAT-130GNSC	EJJA
CAT-3304NA	LT	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-91		0-11	0-5	0-60	0-22	0-11		0-25		
Marginal Range	92-112		12-14	6	61-73	23-27	12-13		26-31		
High Range	113-140		15-17	7	74-92	28-34	14-16		32-38		
Abnormal	141+		18+	8+	93+	35+	17+		39+		
Abnormal Trend (PPM Increase in 10 Hrs)	66		4	2	18	7	4		8		

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COMPONENT:	CATERPILLAR 3306 (ENGINE)

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CAT-3306	140H	EHAB
CAT-3306	CAT-D5	EAPA
CAT-3306	CAT-D5A	EANA
CAT-3306	CAT-D5B	TEKA
CAT-3306	CAT-D7F	EA2A
CAT-3306	CAT-D7G	TELA
CAT-3306	CAT-D7H	TELB
CAT-3306	CAT-D7R	TEMA
CAT-3306	D5BNS	EBAA
CAT-3306	D5BS	EBBA
CAT-3306	D5BS1	TFBA
CAT-3306B	CAT-814F	E5DA
CAT-3306B	CAT-815F	E5EA
CAT-3306TA	LG TUG	XAG8
CAT-3306TA	LT	Not Assigned

TECHNICAL AUTHORITY:	ARMY
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-154	0-1	0-24	0-29	0-58	0-26	0-11		0-34		
Marginal Range	155-189		25-29	30-36	59-72	27-32	12-14		35-42		
High Range	190-236	2	30-36	37-44	73-90	33-40	15-18		43-52		
Abnormal	237+	3+	37+	45+	91+	41+	19+		53+		
Abnormal Trend (PPM Increase in 10 Hrs)	47	2	7	9	18	8	4		10		

COMPONENT:	**CATERPILLAR 11614457 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	M520	N/A
N/A	M553	N/A
N/A	M559	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**ENGINE NO LONGER IN USE. WP RETAINED FOR HISTORICAL REFERENCE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-137	0-2	0-26	0-12	0-54	0-28			0-36		
Marginal Range	138-169		27-32	13-14	55-66	29-35			37-44		
High Range	170-211	2	33-40	15-18	67-83	36-44			45-55		
Abnormal	212+	3+	41+	19+	84+	45+			56+		
Abnormal Trend (PPM Increase in 10 Hrs)	42	2	8	4	17	9			11		

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COMPONENT:	**CATERPILLAR D333/C/T (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CAT-D333	CAT-12	EBKA
CAT-D333	CAT-120ROPS	EHKA
CAT-D333CT	MEP-007A	VCGA
CAT-D333CT	MEP-106A	VCHA
CAT-D333CT	MEP-116A	TVBA
CAT-D333CT	PU495A/G	VCLA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-60		0-8	0-3	0-13	0-15			0-25		
Marginal Range	61-90		9-15	4-7	14-21	16-23			26-40		
High Range	91-120		16-18	8-12	22-28	24-30			41-75		
Abnormal	121+		19+	13+	29+	31+			76+		
Abnormal Trend (PPM Increase in 10 Hrs)	24		4	3	5	6			15		

TECHNICAL INFORMATION

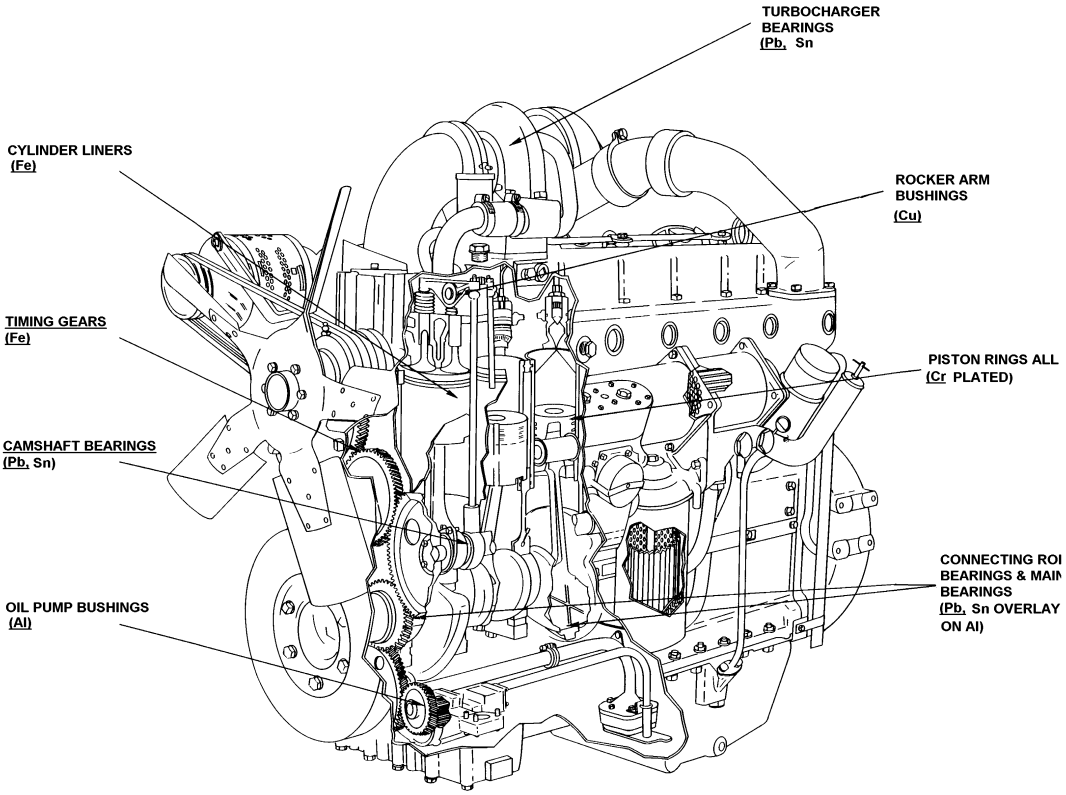
A faulty air induction system is normally the major source of silicon in engine oil. Antifoaming agents in engine oil normally contain silicone in engine oil. Antifoaming agents in engine oil normally contain silicone which will give 3 to 7 PPM in new oil. Silicone coatings may also be used in oil-wetted engine parts. Aluminum and cast iron parts in the engine can have significant amounts of silicon in their composition.

If the engine is in operation only occasionally, it may show a significant increase in iron (Fe) wear particles during operation caused by rust of components. Operation during cold and warm periods of the year makes a difference in the concentration of wear particles. When it is cold, the copper values become higher due to an increase of water in the oil caused by condensation. In cold weather there may also be an increase of iron, chromium, lead,

and aluminum wear particles caused by increased wear from starting the engine.

The engine is liquid-cooled; therefore, ethylene glycol may be present in the engine oil, indicating coolant contamination.

Lead (Pb) is normally generated at relatively high levels during the break-in period of the engine, and then remains fairly constant except for heavy loading, marginal lubrication, or excessive dirt. Increased lead can be the first symptom of bearing distress.



TIMING GEAR

BUSHINGS AND

CRANKSHAFT THRUST

BEARING

(Al)

OIL COOLER CORE

TUBES

(Cu)

FIGURE 1. Caterpillar D333C

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COMPONENT:	**CATERPILLAR D343T/A (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CAT-D343TA	AN/MJQ-11A	VENA
CAT-D343TA	MEP-009A	VEGA
CAT-D343TA	MEP-009B	TVCA
CAT-D343TA	MEP-108A	VEVA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-40		0-9	0-2	0-15	0-15			5-25		
Marginal Range	41-65		10-15	3-6	16-25	16-23			26-40		
High Range	66-90		16-18	7-10	26-50	24-30			76+		
Abnormal	91+		19+	11+	51+	31+			76+		
Abnormal Trend (PPM Increase in 10 Hrs)	18		4	3	10	6			15		

TECHNICAL INFORMATION

A faulty air induction system is normally the major source of silicon in the engine oil. Antifoaming agents in engine oil normally contain silicone which will give 3 to 7 PPM in new oil. Silicone coatings may also be used in oil-wetted engine parts. Aluminum and cast iron parts in the engine can have significant amounts of silicon in their composition.

If the engine is in operation only occasionally, it may show a significant increase in iron (Fe) wear particles during operation caused by rust of components. Operation during cold and warm periods of the year makes a difference in the concentration of wear particles. When it is cold, the copper values become higher due to an increase of water in the oil caused by condensation. In cold weather there may also be an increase of iron, chromium, lead,

and aluminum wear particles caused by increased wear from starting the engine.

The engine is liquid-cooled; therefore, ethylene glycol may be present in the engine oil, indicating coolant contamination.

Lead (Pb) is normally generated at relatively high levels during the break-in period of the engine, and then remains fairly constant except for heavy loading, marginal lubrication, or excessive dirt. Increase lead can be the first symptom of bearing distress.

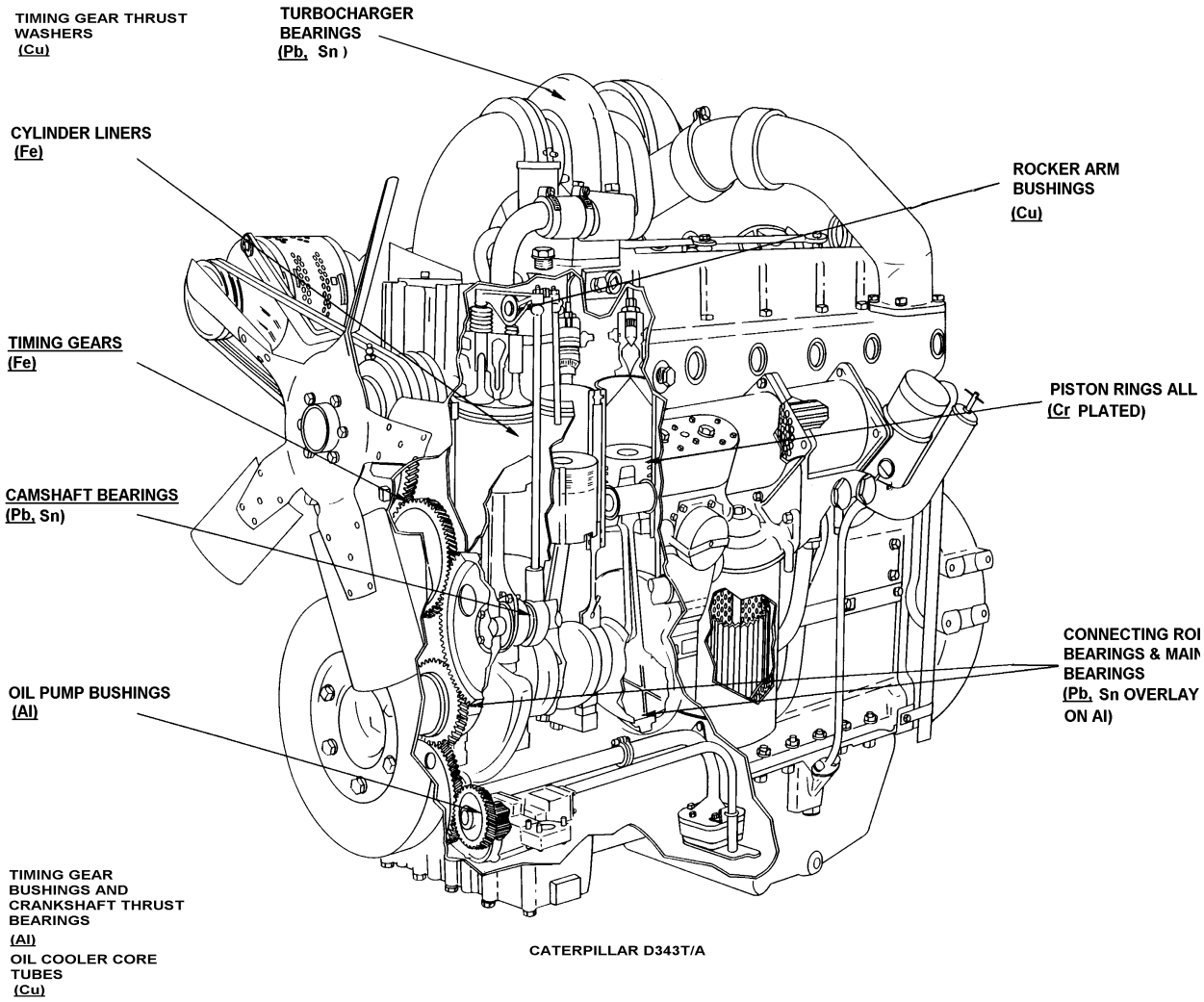

FIGURE 1. Caterpillar D343T/A

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COMPONENT:	**CATERPILLAR D198ER (ENGINE**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
D198ERX51	AN/MJQ-15	VLOA
D198ERX51	AN/MJQ-18	VLAA
D198ERX51	MEP-003A	VCDB
D198ERX51	MEP-004A	VCDA
D198ERX51	MEP-103A	VCEA
D198ERX51	MEP-113A	VLFA
D198ERX51	PU405A/M	VCNA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-113		0-20	0-16	0-26	0-26					
Marginal Range	114-139		21-25	17-19	27-32	27-32					
High Range	140-174		26-29	20-24	33-39	33-39					
Abnormal	175+		30+	25+	40+	40+					
Abnormal Trend (PPM Increase in 10 Hrs)											

TECHNICAL INFORMATION

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COMPONENT:	**CATERPILLAR D298/D298ERX37 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
D298ERX37	AN/MJQ-10A	VCOA
D298ERX37	MEP-005A	VCCA
D298ERX37	MEP-104A	VCFA
D298ERX37	MEP-114A	VLGA
D298ERX37	PU406B/M	VCMA
D298ERX37	PU760M	VLNA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-116		0-10	0-16	0-30	0-23					
Marginal Range	117-143		11-12	17-19	31-37	24-38					
High Range	144-179		13-14	20-24	38-44	29-34					
Abnormal	180+		15+	25+	45+	35+					
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**CATERPILLAR D397 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CAT-D397	LOCO60T	XCSA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-40		0-7	0-6	0-73	0-17			0-32		
Marginal Range	41-49		8-9	7-8	74-89	18-20			33-39		
High Range	50-62		10-11	9-10	90-112	21-25			40-49		
Abnormal	63+		12+	11+	113+	26+			50+		
Abnormal Trend (PPM Increase in 10 Hrs)	12		3	3	22	5			10		

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COMPONENT:	**CATERPILLAR D17000 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CAT-D17000	LOCO44T	XCLB

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-148		0-11	0-5	0-54	0-31	0-4		0-44		
Marginal Range	149-182		12-14	6-7	55-67	32-38			45-54		
High Range	183-228		15-17	8	68-83	39-47	5		55-68		
Abnormal	229+		18+	9+	84+	48+	6+		69+		
Abnormal Trend (PPM Increase in 10 Hrs)	46		4	2	17	9	2		14		

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COMPONENT:	**CONTINENTAL AVDS 1790-2A/2C/2D/ (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
AVDS17902	M60	6ACA
AVDS17902DR	M88A1	6AHA
1790-2A	M48A5	ABCB
1790-2C	M60A3	ABBA
1790-2CA	M60A1	MAEA
1790-2CA	M60A1AVLB	ARCB
1790-2DA	M48A5	ABCD
1790-2DA	M48A5AVLB	AREA
1790-2DA	M60A1AVLB	ARCB

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-99	0-6	0-43	0-10	0-50	0-60	0-8	0-6	0-30	0-14	
Marginal Range	100-145	7-9	44-63	11-14	51-65	61-85	9-12	7-8	31-42	15-20	
High Range	146-185	10-11	64-82	15-18	66-85	86-110	13-15	9-10	43-55	21-26	
Abnormal	186+	12+	83+	19+	86+	111+	16+	11+	56+	27+	
Abnormal Trend (PPM Increase in 10 Hrs)	37	3	16	4	17	22	4	3	11	5	

TECHNICAL INFORMATION

The AVDS 1790-2A engines in the field are being modified to AVDS 1790-2D. AVDS-1790-2C/2D/2/DR engines are classified as Reliability Improvement Selected Equipment (RISE) versions of the engine. The RISE engines retain 10 gallons less residual oil after oil drain than the unmodified engines.

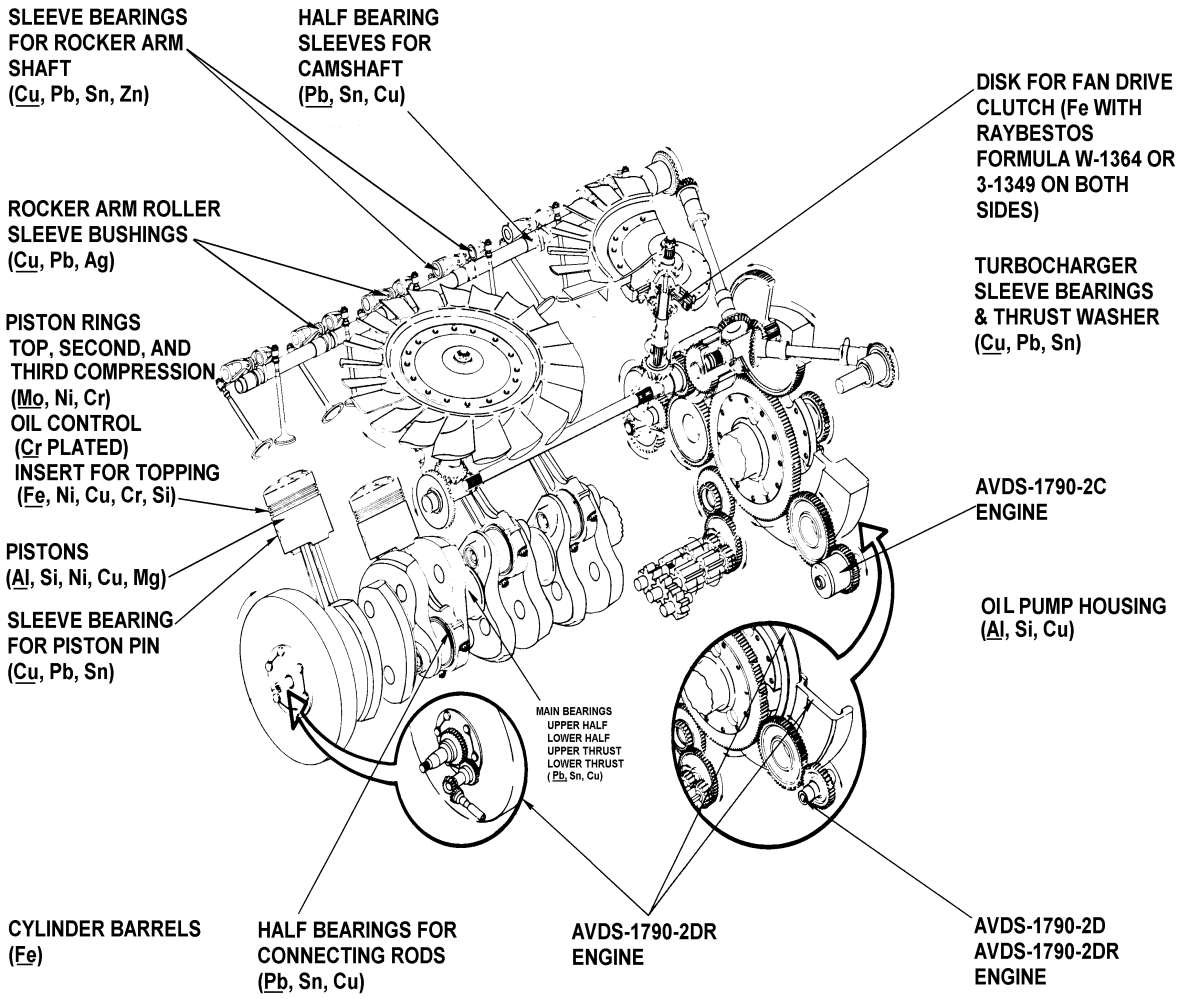
A faulty air induction system is the major source of silicon in engine oil. Silicone coatings may also be used in oil-wetted engine parts. Aluminum and cast iron parts in the engine can have significant amounts (up to 13.5%) of silicon in their composition.

When the rear main seal in an AVDS 1790 engine attached to a CD 850-6A transmission wears excessively or ceases to function properly, there will be cross-contamination of the engine and transmission lubricants. This, in general, will be indicated by increasing or high copper (Cu) and lead (Pb) in the engine oil samples and, simultaneously, increasing or high molybdenum (Mo) in the transmission oil samples.

The engine is air-cooled; therefore, no liquid coolant contamination problems should be experienced.

Aluminum and iron particles from both wear and machining are commonly found in the oil pan.

Aluminum-Silicon (Al-Si)	Piston wear or piston and cylinder wall wear. Could also be derived from machining chips left in engine.
Iron (Fe)	Wear of cylinder walls. Wear of numerous other engines parts. Also from machining chips left in engine.
Chromium (Cr)	Oil control rings are surfaced plated with chromium.
Molybdenum (Mo)	Face of the compression rings are surface plated with molybdenum.
Lead-Tin-Copper (Pb-Sn-Cu)	Crankshaft bearings, both connecting rods, and mains.
Iron-Chromium-Nickel (Fe-Cr-Ni)	Oil ring expander spring or fan drive clutch ball.
Silver (Ag)	Trace metals in rocker arm roller sleeve bearings.



CONTINENTAL AVDS 1790-2A/2C/2D

FIGURE 1. Continental AVDS 1790-2A/2C/2D

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COMPONENT:	**CONTINENTAL AVDS 1790-2DR (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
1790-2DR	**M88A1**	**AQAA**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-103	0-7	0-20	0-10	0-28	0-41	0-6	0-3	0-22	0-3	
Marginal Range	104-127	8-9	21-24	11-12	29-34	42-51	7-8	4	23-28	4	
High Range	128-158	10-12	25-40	13-15	35-66	52-90	9-11	5-6	29-40	5	
Abnormal	159+	13+	41+	16+	67+	91+	12+	7+	41+	6+	
Abnormal Trend (PPM Increase in 10 Hrs)	14	2	3	2	4	10	2	2	4	2	

TECHNICAL INFORMATION

The AVDS 1790-2DR is equipped with a power take-off unit employed in hoisting and towing various vehicles of equipment.

A faulty air induction system is the major source of silicon in engine oil. Aluminum and cast iron parts in the engine can have significant amounts (up to 13.5 percent) of silicon in their composition.

When the rear main seal in an AVDS 1790 engine attached to a XT 1410-2A transmission wears excessively or ceases to function properly, there will be cross-contamination of the engine and transmission lubricants. This, in general will be indicated by increasing or high copper (Cu) and lead (Pb) in the engine oil samples and, simultaneously, increasing or high molybdenum (Mo) in the transmission oil samples.

The engine is air-cooled; therefore, no liquid coolant contamination problems should be experienced.

Aluminum and iron particles from both wear and machining are commonly found in the oil pan.

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COMPONENT:	**CONTINENTAL AVDS1790-8CR (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
1790-8CR	**M88A2**	**AQAB**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni
Normal Range	0-103	0-7	0-20	0-10	0-28	041	0-6	0-3
Marginal Range	104-127	8-9	21-24	11-12	29-34	42-51	7-8	4
High Range	128-158	10-12	25-40	13-15	35-66	52-90	9-11	5-6
Abnormal	158+	13+	41+	16+	67+	91+	12+	7+
Abnormal Trend (PPM Increase in 10 Hrs)	14	2	3	2	4	10	2	2

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS (Continued)

	Pb	Mo	Mg	Ti	Na	Zn	B
Normal Range	0-22	0-103	0-99	0	0-13	0-496	0-87
Marginal Range	23-28	104-127	100-122	*	14-16	497-610	88-107
High Range	29-40	128-158	123-152	1	17-19	611-763	108-134
Abnormal	41+	159+	153+	2+	20+	764+	135+
Abnormal Trend (PPM Increase in 10 Hrs)	4	32	30	1	4	153	27

TECHNICAL INFORMATION

The AVDS 1790-8CR is equipped with a power take-off driveshaft employed to power the HH88A2 Hercules' vehicle hydraulic system.

A faulty air induction system is one of the major sources of silicon (Si) in engine oil. Silicone coatings may also be used in oil-wetted engine parts. Aluminum and cast iron parts in the engine can have significant amounts of silicon in their composition.

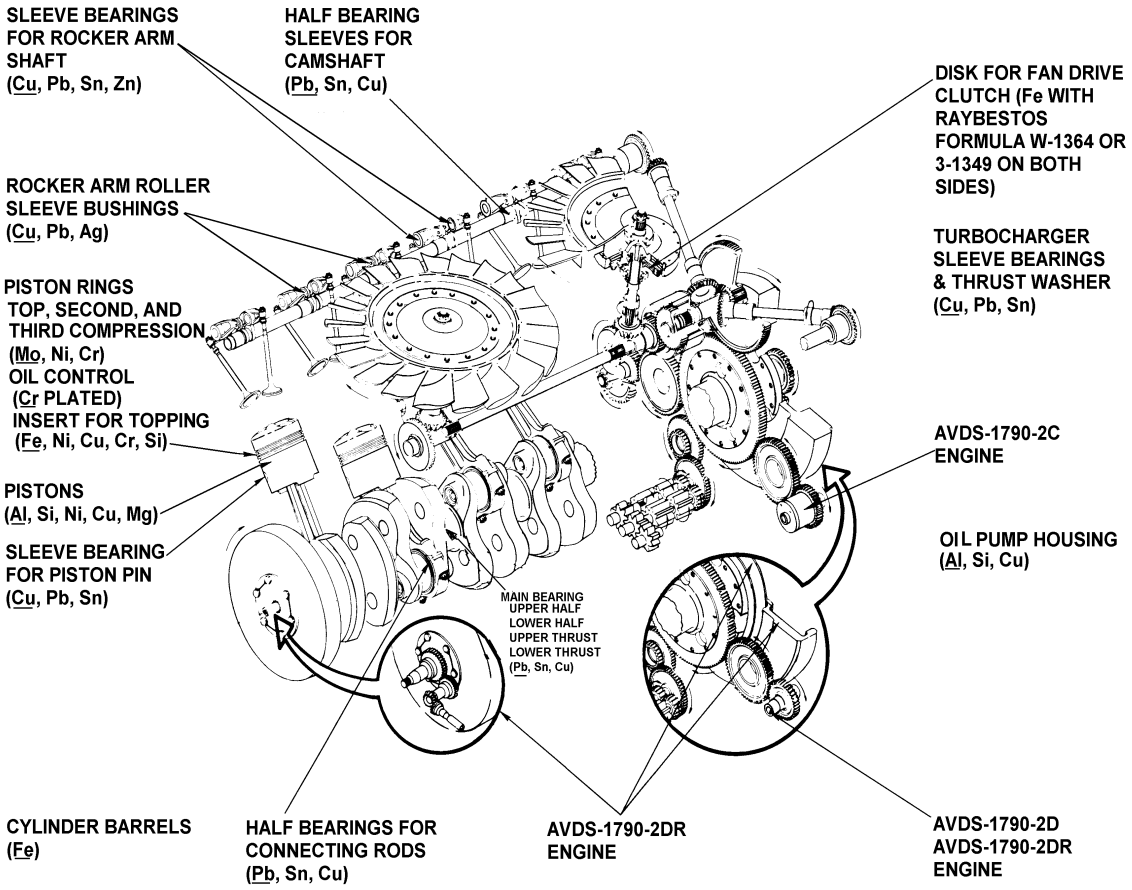
The cylinder walls are impregnated with a ceramic material consisting of chromium (Cr), magnesium (Mg) and silicon (Si). Significant increases in Cr, Mg, or Si wear material particles during operation may be an early symptom of cylinder wall distress.

When the rear main seal in an AVDS 1790-8CR engine (attached to the XT1410-5A transmission) wears excessively or ceases to function properly, there will be cross-contamination of the engine and transmission lubricants. In general, this will be indicated by increasing or high copper (Cu) and lead (Pb) in the wear metal analysis readings of the engine oil samples and, simultaneously, increasing or high molybdenum (Mo) in the wear metal analysis readings of the transmission oil samples.

The AVDS 1790-8CR engine is air-cooled; therefore, evidence of ethylene glycol or other liquid coolants should not be found in oil sample analysis data.

Aluminum and iron particles from both wear and machining are commonly found in the oil pan.

Operation in cold and warm ambient environment conditions can affect the concentration of wear particles in oil sample analysis data. During cold ambient operations, Cu readings may increase due to increased water contamination from condensation. Additionally, cold ambient engine starting wear may increase for Fe, Cr, Pb and Al wear particle concentrations.



CONTINENTAL AVDS 1790- 2DR

FIGURE 1. Continental AVDS1790-2DR

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COMPONENT:	CONTINENTAL LD/LDS/LDT 465-1/-2 (ENGINE)

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
LDS-465-1	M291A2	TBCA
LDS-465-1	M51A2	BQEA
LDT-465-1D	M109A1	BLSB
LDT-465-1D	M109A2	BM3C
LDT-465-1D	M109A3	BMJD
LDT-465-1D	M291A1	BRPE
LDT-465-1D	M292A1	BGMC
LDT-465-1D	M292A2	BGLC
LDT-465-1D	M292A4	TBDC
LDT-465-1D	M292A5	BGNC
LDT-465-1D	M34A2	TBEC
LDT-465-1D	M35A2	BMAC
LDT-465-1D	M35A2C	BMRC
LDT-465-1D	M36A2	BMCC
LDT-465-1D	M49A1C	BMXC
LDT-465-1D	M49A2C	BMEC

TECHNICAL AUTHORITY:	ARMY
STATUS:	COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-214	0-5	064	0-30	0-51	0-65			0-98		
Marginal Range	215-263	6	65-78	31-36	52-63	66-80			99-121		
High Range	264-329	7-8	79-98	37-45	64-79	81-100			122-151		
Abnormal	330+	9+	99+	46+	80+	101+			152+		
Abnormal Trend (PPM Increase in 10 Hrs)	15	2	4	3	4	4			6		

TECHNICAL INFORMATION

A faulty air induction system is normally the major source of silicon in engine oil. Antifoaming agents in engine oil normally contain silicone which will give 3 to 7 PPM in new oil. Silicone coatings may also be used in oil-wetted engine parts. Aluminum and cast iron parts in the engine can have significant amounts (up to 10.5 percent) of silicon in their composition.

The engine is liquid-cooled; therefore, ethylene glycol may be present in the engine oil, indicating coolant contamination.

Piston rings, cylinder sleeves, and pistons normally show the most significant wear during operation. There is normally some wear of the rocker arm bearings which would produce trace amounts of silver (Ag).

Iron particles from both wear and machining are commonly found in the oil pan.

Chromium (Cr)	Oil control rings are surface plated with chromium.
Tin (Sn)	Plating on pistons.
Tin-Iron (Sn-Fe)	Engine pistons and cylinder wall wear.
Iron (Fe)	Wear of cylinder walls. Wear of numerous other engine parts. Also may be from machining chips left in engine.
Nickel-Chromium-Cobalt (Ni-Cr-Co)	Exhaust valves.
Cobalt-Chromium-Tungsten	Intake valve seat.
Silver (Ag)	Trace metal in rocker-arm bearings.

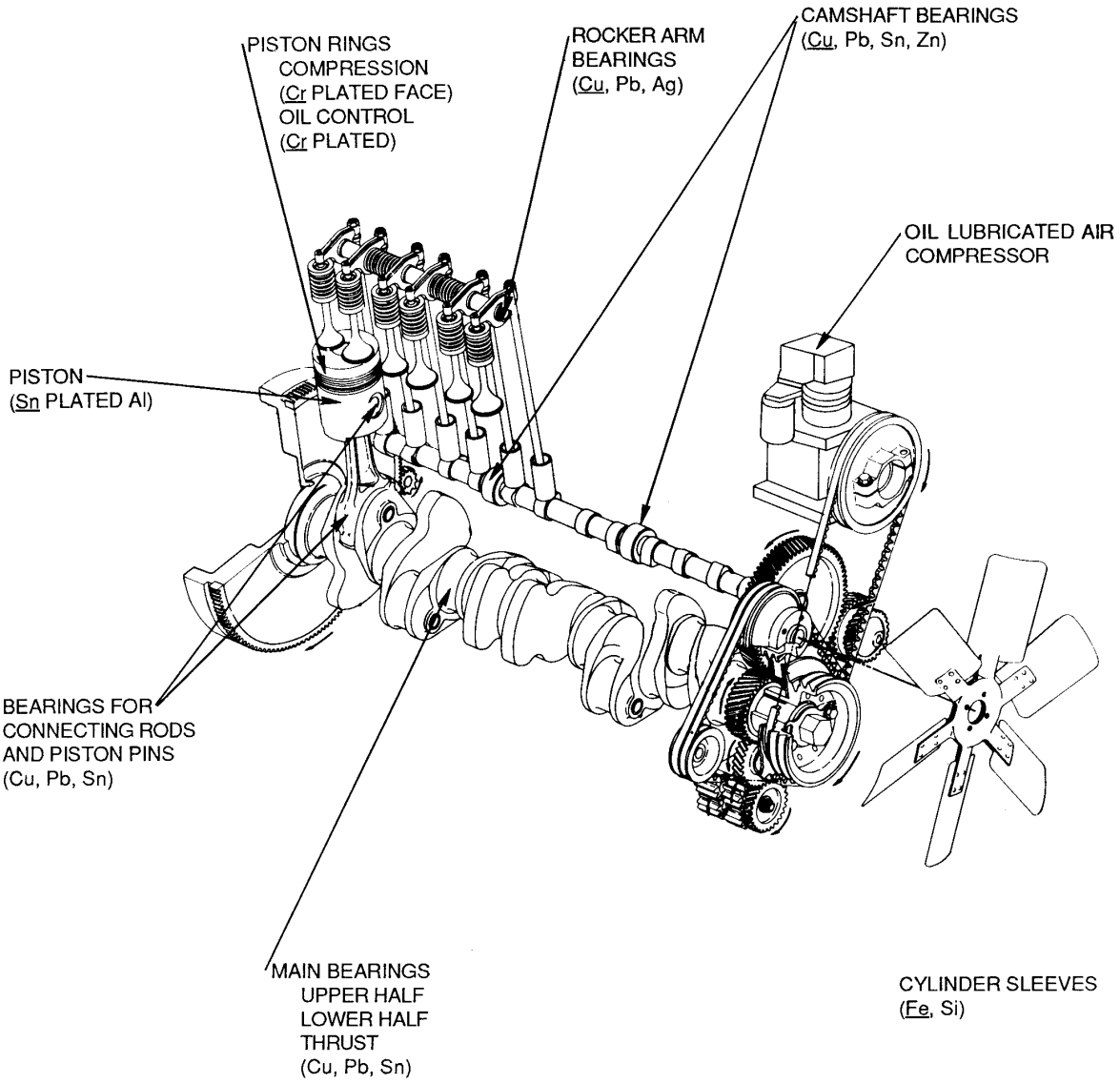

FIGURE 1. Continental LD/LDS/LDT 465

COMPONENT:	**CONTINENTAL LDS-427-2 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-123		0-30	0-20	0-72	0-31	0-25		0-85		
Marginal Range	124-151		31-37	21-25	73-88	32-38	29-31		86-104		
High Range	152-189		38-46	26-31	89-110	39-48	32-38		105-130		
Abnormal	190+		47+	32+	111+	49+	39+		131+		
Abnormal Trend (PPM Increase in 10 Hrs)	12		3	2	3	3	3		6		

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COMPONENT:	**CUMMINS HBI-600 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
HBI-600	LOCO25T	XDFA
HBI-600	LOCO45T	XCWA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-155		0-15	0-30	0-97	0-32			0-47		
Marginal Range	156-191		16-19	31-37	98-120	33-39			48-57		
High Range	192-238		20-23	38-46	120-150	40-49			58-72		
Abnormal	239+		24+	47+	151+	50+			73+		
Abnormal Trend (PPM Increase in 10 Hrs)	48		4	9	30	10			14		

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COMPONENT:	**CUMMINS JN6 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-123		0-32	0-23	0-97	0-30					
Marginal Range	124-151		33-39	24-28	98-119	31-37					
High Range	152-189		40-49	29-34	120-149	38-44					
Abnormal	190+		50+	35+	150+	45+					
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**CUMMINS LI-600 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
LI-600	**LOCO80T**	**XCVA**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-68		0-3	0-3	0-79	0-32	0-6		0-33		
Marginal Range	69-83		4	4	80-97	33-39	7		34-41		
High Range	84-104		5	5	98-121	40-49	8-9		42-51		
Abnormal	105+		6+	6+	122+	50+	10+		52+		
Abnormal Trend (PPM Increase in 10 Hrs)	21		2	2	24	10	3		10		

TECHNICAL INFORMATION

AVERAGE:	Fe=29	Mg=469	Sn=2
	Ag=1	Na=55	Ti=1
	Al=1	Ni=1	B=73
	Cr=1	Pb=11	Mo=1
	Cu=32	Si=9	Zn=715

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COMPONENT:	**CUMMINS NHBIS-600 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
NHBIS-600	**LOCO80T-470**	**XCMA**
NHBIS-600	**LOCO80T-550**	**XCNA**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-50		0-7	0-7	0-153	0-17			0-45		
Marginal Range	51-62		8-9	8	154-188	18-21			45-56		
High Range	63-78		10-11	9-10	189-235	22-26			57-70		
Abnormal	79+		12+	11+	236+	27+			71+		
Abnormal Trend (PPM Increase in 10 Hrs)	16		3	3	47	5			14		

TECHNICAL INFORMATION

AVERAGE:	Fe=21	Mg=444	Sn=1
	Ag=1	Na=23	Ti=1
	Al=2	Ni=1	B=42
	Cr=2	Pb=10	Mo=151
	Cu=39	Si=6	Zn=716

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COMPONENT:	CUMMINS NHC 250 (ENGINE))

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
NHC-250	M809	TBNA
NHC-250	M809A1	TBPA
NHC-250	M810	TBQA
NHC-250	M811	BRNA
NHC-250	M811A1	TBRA
NHC-250	M811A2	TBSA
NHC-250	M812	TBTA
NHC-250	M812A1	TBUA
NHC-250	M813	BSBA
NHC-250	M813A1	BSDA
NHC-250	M814	BSKA
NHC-250	M815	BSEA
NHC-250	M816	BSQA
NHC-250	M817	BSRA
NHC-250	M818	BSHA
NHC-250	M819	BSLA
NHC-250	M820	BSMA
NHC-250	M820A1	TBVA
NHC-250	M820A2	BSNA
NHC-250	M821	BSPA
NHC-250	M923	BRYA
NHC-250	M923A1	BSSA
NHC-250	M924	BRXA

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
NHC-250	M924A1	BSUA
NHC-250	M925	BRTA
NHC-250	M925A1	BSTA
NHC-250	M926	BRWA
NHC-250	M926A1	BSVA
NHC-250	M927	BRVA
NHC-250	M927A1	BSWA
NHC-250	M928	BRUA
NHC-250	M928A1	TCHA
NHC-250	M929	BTHA
NHC-250	M929A1	BSYA
NHC-250	M930	BTGA
NHC-250	M930A1	BSZA
NHC-250	M931	BTEA
NHC-250	M931A1	BS2A
NHC-250	M932	BTDA
NHC-250	M932A1	BS3A
NHC-250	M934	BTBA
NHC-250	M934A1	BS4A
NHC-250	M934A2	EL4A
NHC-250	M936	BTFA
NHC-250	M936A1	BS6A
NHC-250	M939	BRSA
NHC-250	M940	TBXA

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
NHC-250	M941	TBYA
NHC-250	M942	TBZA
NHC-250	M943	TCAA
NHC-250	M944	TCBA
NHC-250	M945	TCCA

TECHNICAL AUTHORITY:	ARMY
STATUS:	COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-189		0-24	0-27	0-31	0-48			0-73		
Marginal Range	190-233		25-29	28-34	32-39	49-60			74-90		
High Range	234-291		30-36	35-42	40-48	61-74			91-112		
Abnormal	292+		37+	43+	49+	75+			113+		
Abnormal Trend (PPM Increase in 10 Hrs)	13		3	3	3	4			5		

TECHNICAL INFORMATION

A faulty air induction system is normally the major source of silicon in engine oil. Antifoaming agents in engine oil normally contain silicone which will give 3 to 7 PPM in new oil. Silicone coatings may also be used in oil-wetted engine parts. Aluminum and cast iron parts in the engine can have significant amounts of silicone in their composition.

Piston rings and cylinder liners normally show the most significant wear during operation.

The engine is liquid-cooled; therefore, ethylene glycol present in the engine oil would indicate a leak in the coolant system.

Aluminum-Silicon (Al-Si)	Piston wear or piston and cylinder wall wear.
Chromium (Cr)	Oil control rings and first compression ring are chromium plated.
Chromium-Iron (Cr-Fe)	Ring and Cylinder liner wear.
Iron (Fe)	Wear of cylinder walls. Wear of numerous other engine parts. Also from machining chips left in the engine.

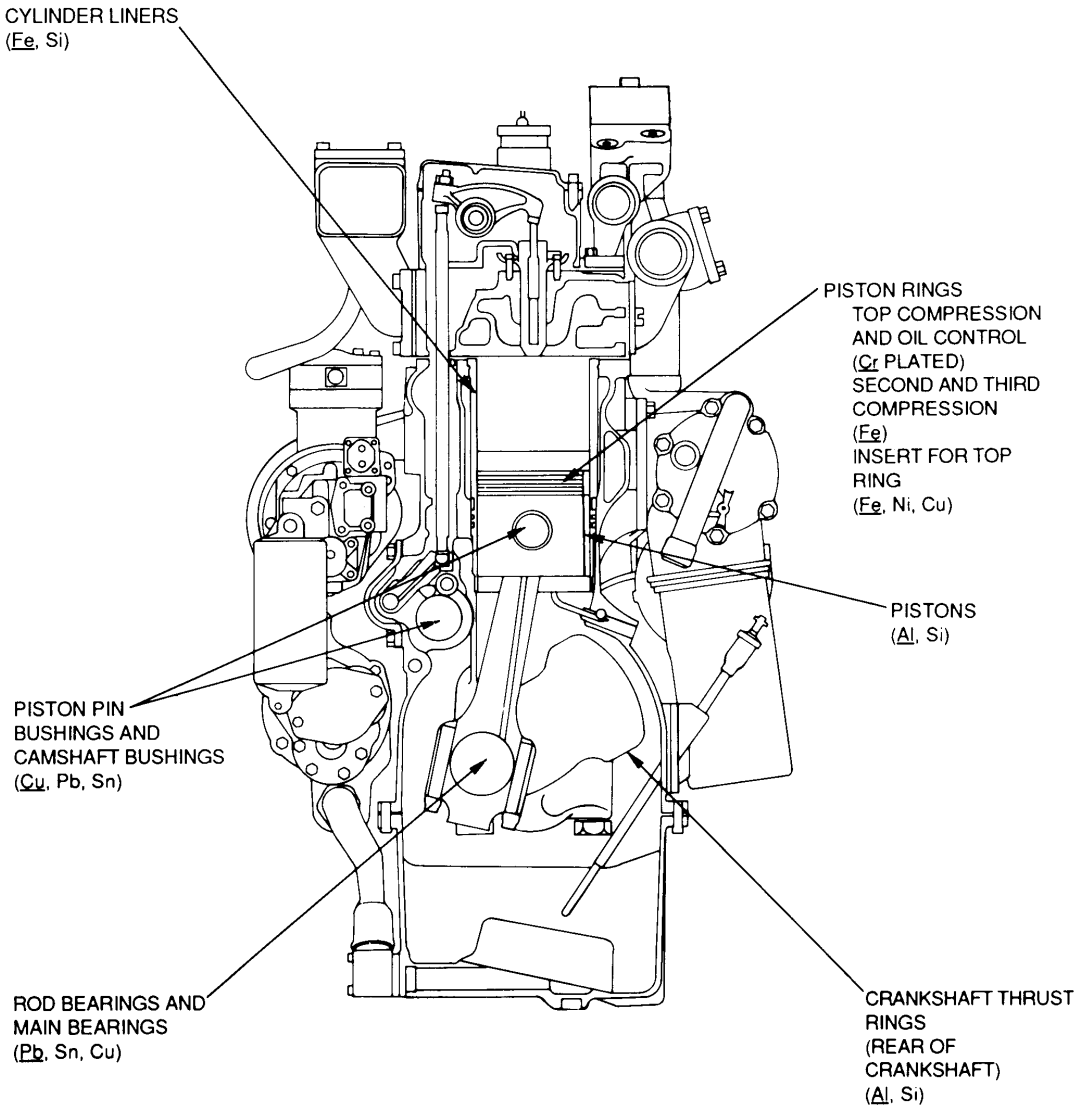

FIGURE 1. Cummins NHC 250

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COMPONENT:	**CUMMINS NTC 290 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
NTC-290	F5070	EZYA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-107		0-19	0-13	0-92	0-42	0-4	0-2	0-38	0-12	
Marginal Range	108-130		20-24	14-16	93-114	43-51	5	3	39-47	13-14	
High Range	131-164		25-30	17-19	115-142	52-64	6	4	48-58	15-18	
Abnormal	165+		31+	20+	143+	65+	7+	5+	59+	19+	
Abnormal Trend (PPM Increase in 10 Hrs)	11		2	2	6	4	2	2	3	2	

TECHNICAL INFORMATION

A faulty air induction system is normally the major source of silicon in engine oil. Antifoaming agents in engine oil normally contain silicone which will give 3 to 7 PPM in new oil. Silicone coatings may also be used in oil-wetted engine parts. Aluminum and cast iron parts in the engine can have significant amounts of silicon in their composition.

Piston rings and cylinder liners normally show the most significant wear during operation.

The engine is liquid-cooled; therefore, ethylene glycol present in the engine oil would indicate a leak in the coolant system.

Wear of end-thrust washers in turbocharger will permit rubbing of the turbocharger hot wheel against the turbocharger housing. This in turn will produce chromium, iron, nickel, and copper in the engine oil.

Aluminum-Silicon (Al-Si)	Piston wear or piston and cylinder wall wear. Crankshaft thrust bearing.
Chromium (Cr)	Oil control rings and first compression ring are chromium plated.
Chromium-Iron (Cr-Fe)	Ring and Cylinder liner wear.
Iron (Fe)	Wear of cylinder walls. Wear of numerous other engine parts. Also from machining chips left in the engine.

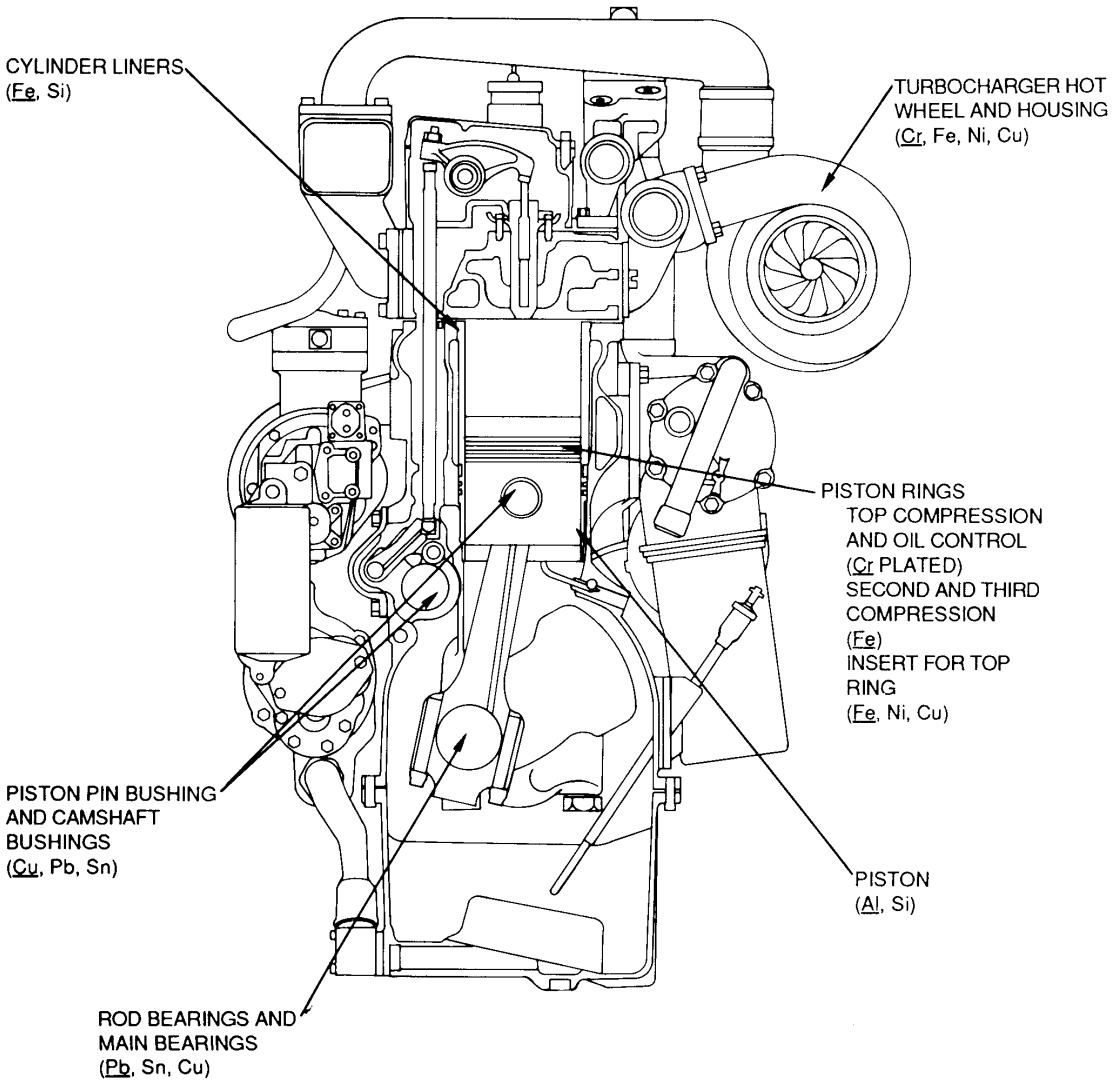

FIGURE 1. Cummins NTC 290

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COMPONENT:	**CUMMINS NTA/NTC 400 (ENGINE))**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
NTC-400	M915	B4AA
NTC-400	M915A1	B4BA
NTC-400	M915A4	B4MA
NTC-400	M916	B4CA
NTC-400	M917	EZZA
NTC-400	M918	EXCA
NTC-400	M919	EXDA
NTC-400	M920	B4DA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-57		0-15	0-9	0-62	0-31			0-35		
Marginal Range	58-70		16-18	10-11	63-76	32-38			36-43		
High Range	71-88		19-22	12-13	77-95	39-47			44-54		
Abnormal	89+		23+	14+	96+	48+			55+		
Abnormal Trend (PPM Increase in 10 Hrs)	4		2	2	4	3			3		

TECHNICAL INFORMATION

A faulty air induction system is normally the major source of silicon in engine oil. Antifoaming agents in engine oil normally contain silicone which will give 3 to 7 PPM in new oil. Silicone coatings may also be used in oil-wetted engine parts. Aluminum and cast iron parts in the engine can have significant amounts of silicon in their composition.

Piston rings and cylinder liners normally show the most significant wear during operation.

The engine is liquid-cooled; therefore, ethylene glycol present in the engine oil would indicate a leak in the coolant system.

Wear of end-thrust washers in turbocharger will permit rubbing of the turbocharger hot wheel against the turbocharging housing. This in turn will produce chromium, iron, nickel, and copper in the engine oil.

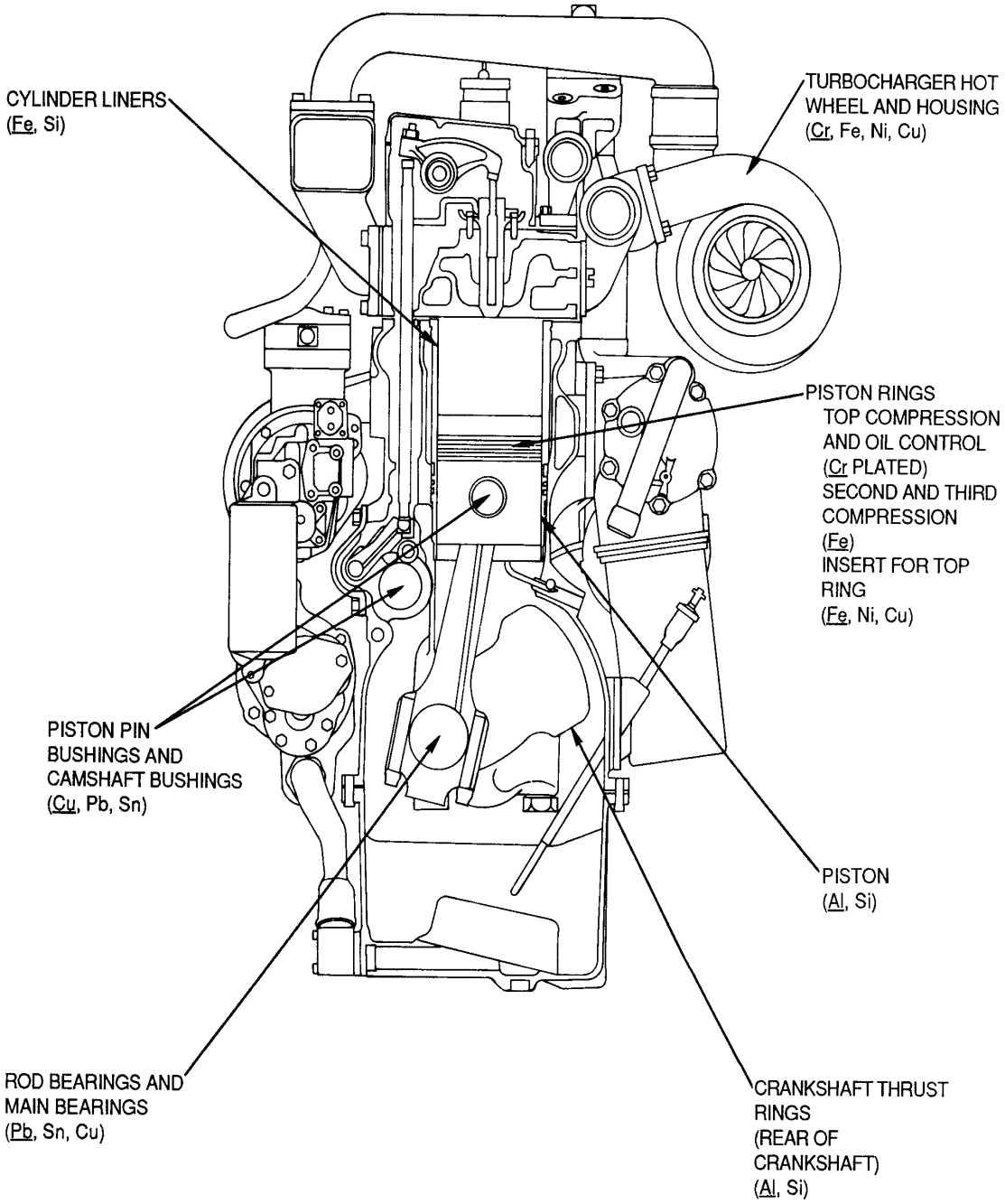

FIGURE 1. Cummins NTC 400

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COMPONENT:	**CUMMINS V8-265 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-173		0-19	0-25	0-157	0-101	0-164	0-221	0-69		
Marginal Range	174-213		20-23	26-31	158-194	102-124	165-202	222-272	70-85		
High Range	214-266		24-28	32-39	195-242	125-155	203-253	273-340	86-107		
Abnormal	267+		29+	40+	243+	1569+	254+	341+	108+		
Abnormal Trend (PPM Increase in 10 Hrs)	53		6	8	48	31	51	68	21		

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COMPONENT:	**CUMMINS V8-300 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-139		0-19	0-30	0-85	0-56	0-205	0-279	0-88		
Marginal Range	140-171		20-24	31-37	86-105	57-69	206-252	280-343	89-108		
High Range	172-213		25-30	38-46	106-131	70-86	253-315	344-429	109-135		
Abnormal	214+		31+	47+	132+	87+	316+	430+	136+		
Abnormal Trend (PPM Increase in 10 Hrs)	43		6	9	26	17	63	86	27		

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COMPONENT:	**CUMMINS VT-400 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
LVTC-7A1	**USARMY-LVTC-7A1-VT-400**	**TWPA**
LVTP-7A1	**USARMY-LVTP-7A1-VT-400**	**TWSA**
LVTR-7A1	**USARMY-LVTR-7A1-VT-400**	**TWUA**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-134	0-1	0-21	0-64	0-270	0-40	0-4		0-28	0-26	
Marginal Range	135-165		22-26	65-79	271-332	41-50	5		29-35	27-32	
High Range	166-206	2	27-33	80-99	333-415	51-62	6-7		36-43	33-40	
Abnormal	207+	3+	34+	100+	416+	63+	8+		44+	41+	
Abnormal Trend (PPM Increase in 10 Hrs)	41	2	7	20	83	12	2		9	8	

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COMPONENT:	CUMMINS VTA-903 (ENGINE)

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
VTA-903T	M2	APAA
VTA-903T	M270	N/A
VTA-903T	M270A1	6BDZ
VTA-903T	M2A1	ALEA
VTA-903T	M2A2	TARA
VTA-903T	M2A3	N/A
VTA-903T	M3	APBA
VTA-903T	M3A1	ALFA
VTA-903T	M3A2	TASA
VTA-903T	M3A3	N/A
VTA-903T	M4	APCB
VTA-903T	M7	AP7A
VTA-903T	M7 ODS-SA	AP9A
VTA-903T	M7A2	AP8A
VTA-903T	M993	TANA
VTA-903T600	M270	QBU1
VTA-903T600	M2A2	TARB
VTA-903T600	M2A2ODS	APEA
VTA-903T600	M2A2ODS-E	AFRA
VTA-903T600	M2A3	N/A
VTA-903T600	M3A2ODS	APFA
VTA-903T600	M3A3	APH1

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
VTA-903T600	M6	AP6A
VTA-903T600	9125TC	QP6A
VTA-903T600	LVTR-7A1	N/A
VTA-903T600	M2	N/A
VTA-903T600	M3	N/A
VTA-903T600	M32ORT	N/A
VTA-903T600	M9	N/A
VTA-903T600	M993	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-87		0-17	0-30	0-23	0-32	0-3		0-22		
Marginal Range	88-112		18-23	31-41	24-28	33-40	4-5		23-27		
High Range	113-140		24-28	45-52	29-36	41-49	6-7		28-33		
Abnormal	141+		29+	53+	37+	50+	8+		34+		
Abnormal Trend (PPM Increase in 10 Hrs)	13		3	7	8	6	2		2		

TECHNICAL INFORMATION

A faulty air induction system is normally the major source of silicon in the engine oil. Antifoaming agents in engine oil normally contain silicone which will give 3 to 7 PPM in new oil. Silicone coatings may also be used in oil-wetted engine parts. Aluminum and cast iron parts in the engine can have significant amounts of silicon in their composition.

Piston rings and cylinder liners normally show the most significant wear during operation.

The engine is liquid-cooled; therefore, ethylene glycol present in the engine oil would indicate a leak in the coolant system.

Valve-guide wear will normally not show up in the engine oil because it, along with guide lubricating oil, will be exhausted during operation of the engine.

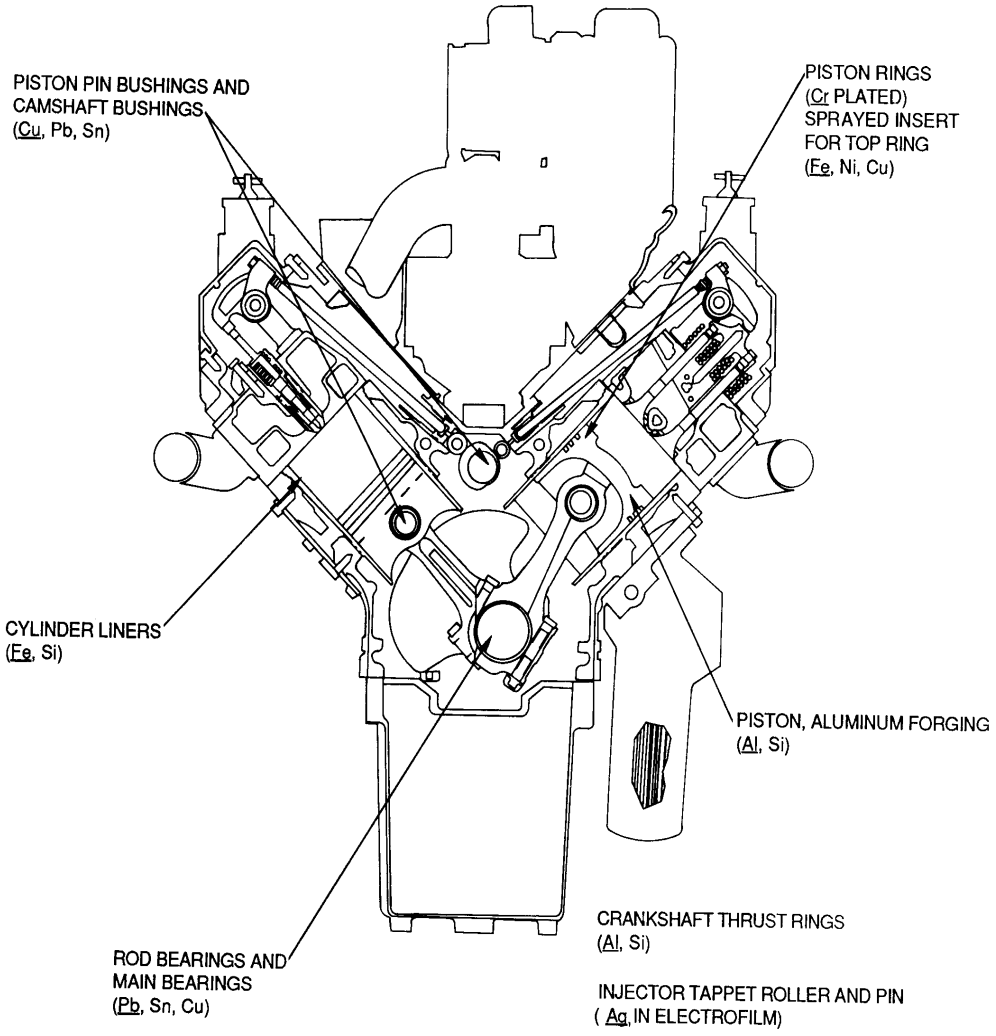

FIGURE 1. Cummins VTA-903

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COMPONENT:	**DETROIT DIESEL ALLISON 190 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
IHD190	**TRK MAINT 6X6 M876**	**BHAA**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-192		0-39	0-23	0-36	0-44	0-20	0-3	0-69	0-4	
Marginal Range	193-237		40-48	24-29	37-45	45-54	21-25	4	70-85	5	
High Range	238-296		49-90	30-36	46-56	55-68	26-31	5	86-107	6	
Abnormal	297+		61+	37+	57+	69+	32+	6+	108+	7+	
Abnormal Trend (PPM Increase in 10 Hrs)	22		3	2	3	4	2	2	6	2	

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COMPONENT:	**DETROIT DIESEL ALLISON 3-53 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DD353	BSF-400	EXEA
DD353	270-9	EUSA
DD353	C350B	TEHA
DD353	C350B-D	TEWA
DD353	C530A	EURA
DD353	H446	EKTA
DD353	SP848	EUUA
DD353	US90CCD1	ZHCA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-212	0-10	0-27	0-22	0-36	0-74	0-32	0-8	0-41	0-6	
Marginal Range	231-261	11-12	28-33	23-27	37-44	75-92	33-39	9-10	42-51	7-8	
High Range	262-327	13-15	34-42	28-34	45-55	93-115	40-49	11-13	52-63	9-10	
Abnormal	328+	16+	43+	35+	56+	116+	50+	14+	64+	11+	
Abnormal Trend (PPM Increase in 10 Hrs)	15	2	3	3	3	5	3	2	4	2	

TECHNICAL INFORMATION

A faulty air induction system is normally a significant source of silicon in engine oil. Antifoaming agents in engine oil normally contain silicone which will give 3 to 7 PPM in new oil. Silicone is used in "Print-O-Seal" cylinder head gaskets and crankshaft seals for this engine which will normally show 20 to 30 PPM silicon in the oil. Aluminum and cast iron parts in the engine have significant amounts of silicon in their composition.

Significant wear can be expected on the piston skirts and cylinder liners for this engine.

The engine is liquid-cooled; therefore, ethylene glycol present in the engine oil would indicate a leak in the coolant system.

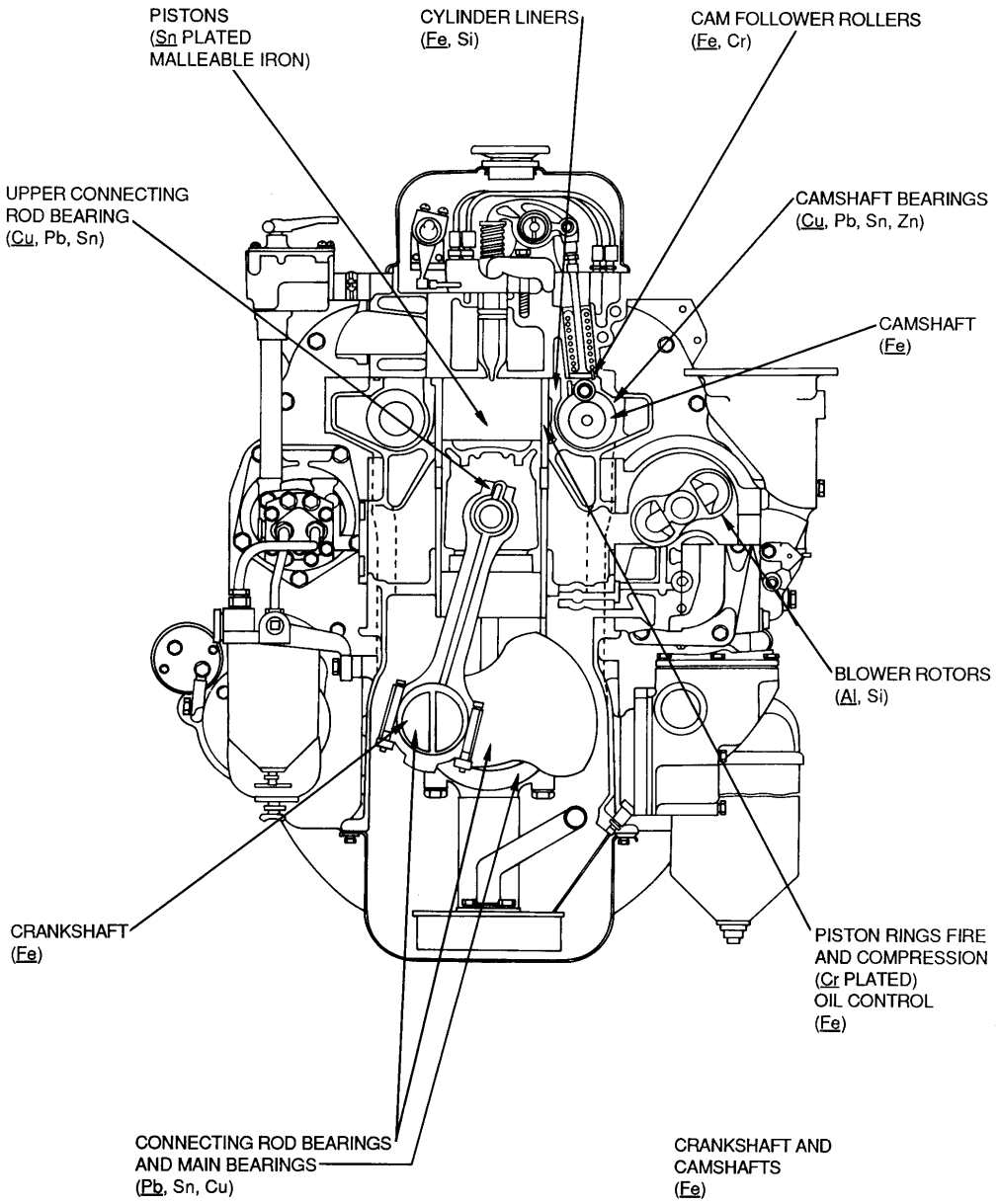

FIGURE 1. Detroit Diesel Allison 3-53

COMPONENT:	**DETROIT DIESEL ALLISON 3080 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DD3080	**LOCO10T**	**TXAA**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-100		0-5	0-10	0-26	0-11			0-20		
Marginal Range	101-123		6-7	11-12	27-31	12-14			21-25		
High Range	124-153		8	13-15	32-39	15-17			26-31		
Abnormal	154+		9+	16+	40+	18+			32+		
Abnormal Trend (PPM Increase in 10 Hrs)	31		2	4	8	4			6		

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COMPONENT:	**DETROIT DIESEL ALLISON 453N (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DD453N	ARTFT6	DJCF
DD453N	MLT6	DJJA
DD453N	MLT6-2	DJBF
DD453N	MLT6CH	DJLA
DD453	250RPV	DWLA
DD453	RS28	EVPA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-164		0-13	0-16	0-30	0-34					
Marginal Range	165-203		14-16	17-19	31-37	35-43					
High Range	204-254		17-19	20-24	38-44	44-54					
Abnormal	255+		20+	25+	45+	55+					
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**DETROIT DIESEL ALLISON 4057C (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	**N/A**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-270		0-20	0-52	0-54	0-77	0-31		0-47		
Marginal Range	271-332		21-25	53-64	55-66	78-95	32-39		48-57		
High Range	333-415		26-31	65-80	67-83	96-118	40-48		58-72		
Abnormal	416+		32+	81+	84+	119+	49+		73+		
Abnormal Trend (PPM Increase in 10 Hrs)	83		6	16	17	24	10		14		

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COMPONENT:	DETROIT DIESEL ALLISON 6V53/T (ENGINE)

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DD6V53	1500M	TVAA
DD6V53	M1059	AESA
DD6V53	M1064	AE4A
DD6V53	M1068	AE5A
DD6V53	M106A1	AEFA
DD6V53	M106A2	AERA
DD6V53	M113A2	AENA
DD6V53	M113A3	AEYB
DD6V53	M548	AEGA
DD6V53	M548A1	AEUA
DD6V53	M551A1	ALBB
DD6V53	M577A2	AEQA
DD6V53	M878	BTAA
DD6V53	M901	AEMA
DD6V53	M901A1	AEVA
DD6V53	M981	AETA
DD6V53	RTL10	DJHA
DD6V53	RTL10-1	DJDF
DD6V53N	MT250	ELAA
DD6V53N	RMS-250	TVRA
DD6V53T	M1059A3	AFAA
DD6V53T	M1064A3	AE8B
DD6V53T	M1068A3	N/A

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DD6V53T	M113A3	AEYA
DD6V53T	M113A3/OSV-MBT	AUKB
DD6V53T	M113A3BMP-2	AEZA
DD6V53T	M113A3MBT	AUKA
DD6V53T	M548A3	AEUB
DD6V53T	M551 OPFOR	ALDA
DD6V53T	M551A1	ALBA
DD6V53T	M577A3	N/A
DD6V53T	M58	AE8B
DD6V53T	M878A1	BTLA
DD6V53T	M981A1	TAQA
DD6V53T	M981A3	TAQB

TECHNICAL AUTHORITY:	ARMY
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-90	0-2	0-6	0-5	0-21	0-25	0-25		0-25	0-5	
Marginal Range	91-120	3	7-8	6-7	22-31	26-34	26-37		26-35	6-7	
High Range	121-150	3-4	9-10	8-9	32-41	35-45	38-49		36-45	8-9	
Abnormal	151+	5+	11+	10+	42+	46+	50+		46+	10+	
Abnormal Trend (PPM Increase in 10 Hrs)	30	2	3	3	8	9	10		9	3	

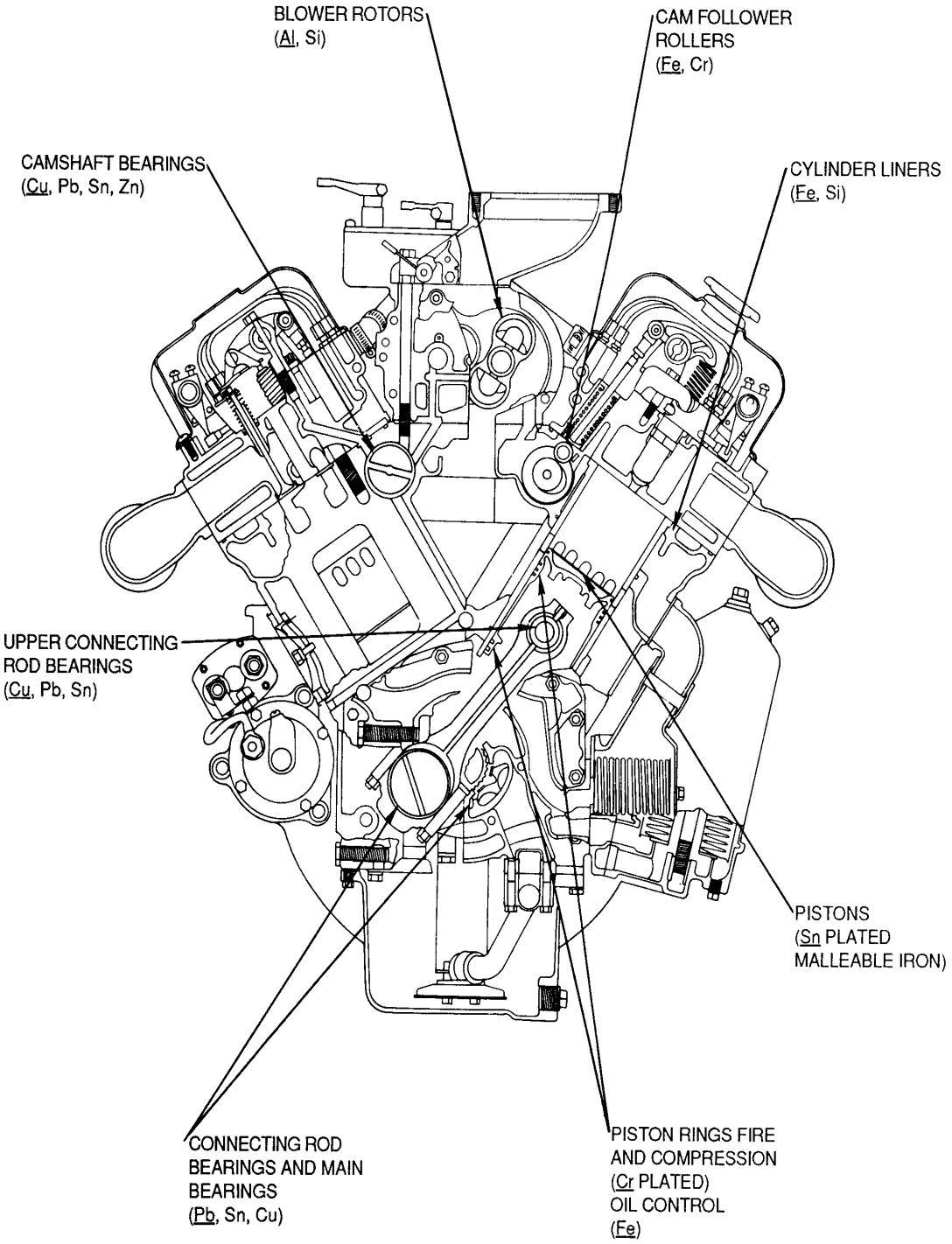

FIGURE 1. Detroit Diesel Allison 6V53/T

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COMPONENT:	**DETROIT DIESEL ALLISON 8V53T (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-100	0-3	0-30	0-10	0-30	0-30	0-30	0-3	0-30	0-3	
Marginal Range	101-150	4-5	31-50	11-20	31-50	31-50	31-50	4-5	31-50	4-5	
High Range	151-200	6-10	51-60	21-30	51-70	51-70	51-70	6-10	51-70	6-10	
Abnormal	201+	11+	61+	31+	71+	71+	71+	11+	71+	7+	
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**DETROIT DIESEL ALLISON 8V71T (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DD8V71T	M109A3	BFVA
DD8V71T	M109A4	3E8A
DD8V71T	M109A5	3E7A
DD8V71T	M109A6	N/A
DD8V71T	M578	3LAA
DD8V71T	M992A2	AKA1
DD8V71T	XM1050	XFVL
DD8V71TLHR	M109A6	3FC1
DD8V71TLHR	M992A2	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-123	0-6	0-18	0-22	0-47	0-40	0-43		0-27	0-2	
Marginal Range	124-170	7	19-27	23-33	48-67	41-55	44-62		28-38	3-4	
High Range	171-215	8-10	28-36	34-44	68-88	56-75	63-81		39-49	5-6	
Abnormal	216+	11+	37+	45+	89+	76+	82+		50+	7+	
Abnormal Trend (PPM Increase in 10 Hrs)	43	3	7	9	17	15	16		10	2	

TECHNICAL INFORMATION

A faulty air induction system is normally a significant source of silicon in engine oil. Antifoaming agents in engine oil normally contain silicone which will give 3 to 7 PPM in new oil. Silicone is used in "Print-O-Seal" cylinder head gaskets and crankshaft seals for this engine which will normally show 20 to 30 PPM silicon in the oil. Aluminum and cast iron parts in the engine can have significant amounts (up to 10 percent) of silicon in their composition.

Significant wear can be expected on the piston skirts and cylinder liners for this engine.

The engine is liquid-cooled; therefore, ethylene glycol present in the engine oil would indicate a leak in the coolant system.

Chromium (Cr)	Oil control rings and first compression ring are chrome plated.
Tin (Sn)	Plating on pistons.
Iron (Fe)	Wear of cylinder walls. Wear of numerous other engine parts. Also from machining chips left in engine.
Lead-Tin-Copper (Pb-Sn-Cu)	Crankshaft bearings, both connecting rods, and mains. Wear of many bushings, bearings, and thrust washers.
Copper-Lead-Tin-Zinc (Cu-Pb-Sn-Zn)	Wear of many bushings.
Aluminum-Silicon-Cadmium (Al-Si-Cd)	Upper connecting rod bearing shell and No. 7 main bearing washers.

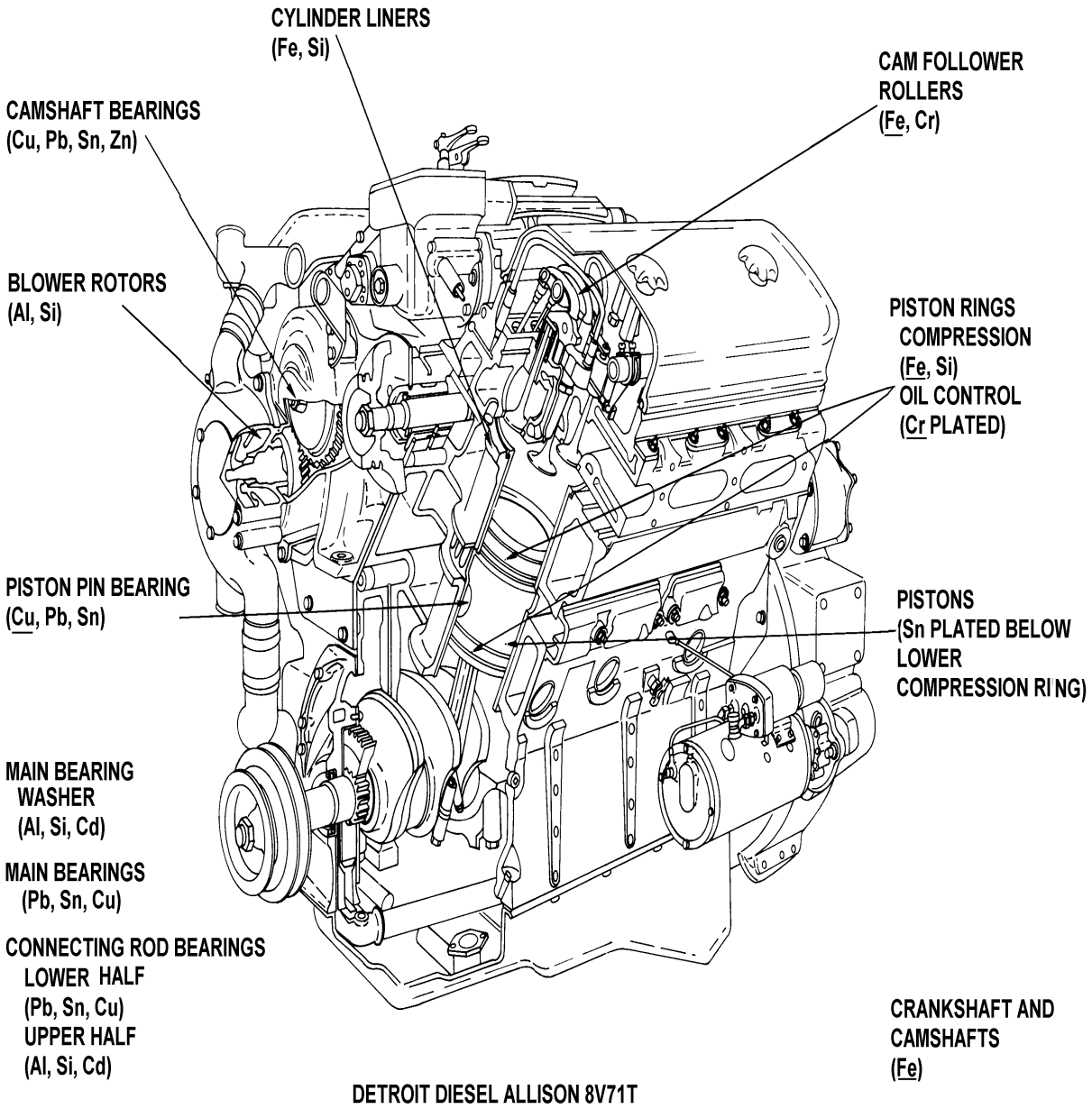

FIGURE 1. Detroit Diesel Allison 8V71T

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COMPONENT:	DETROIT DIESEL ALLISON 8V92T (ENGINE)

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DD8V92TA	CF-1	XJ31
DD8V92TA	M1070	B5CA
DD8V92TA	M1074	B4GA
DD8V92TA	M1075	N/A
DD8V92TA	M1120	B5EA
DD8V92TA	M1120A2	B3PA
DD8V92TA	M1120A2R1	B3QA
DD8V92TA	M1142	EAMA
DD8V92TA	M1158	EAMB
DD8V92TA	M1975	EZ4A
DD8V92TA	M1977	DV4A
DD8V92TA	M1977A2 WOW	EW2A
DD8V92TA	M1977A2 WW	DV4B
DD8V92TA	M1977A2R1 WOW	DV4F
DD8V92TA	M1977A2R1 WW	DV4E
DD8V92TA	M977	B2GA
DD8V92TA	M977A2 WOW	B2PA
DD8V92TA	M977A2 WW	B2MA
DD8V92TA	M977A2R1 WOW	B2QA
DD8V92TA	M977A2R1 WW	B2NA
DD8V92TA	M978	B2HA
DD8V92TA	M978A2 WOW	B2TA

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DD8V92TA	M978A2 WW	B2RA
DD8V92TA	M978A2R1 WOW	B2UA
DD8V92TA	M978A2R1 WW	B2SA
DD8V92TA	M983	B2AA
DD8V92TA	M983A2	B2VA
DD8V92TA	M983A2R1	B2WA
DD8V92TA	M984	B2BA
DD8V92TA	M984A1	TCDA
DD8V92TA	M984A2	B2XA
DD8V92TA	M984A2R1	B2YA
DD8V92TA	M985	B2JA
DD8V92TA	M985A2 WOW	B3KA
DD8V92TA	M985A2 WW	B2ZA
DD8V92TA	M985A2R1 WOW	B3LA
DD8V92TA	M985A2R1 WW	B3JA
DD8V92TA	M985E1	TCJA
DD8V92TA	M985E1A2	B3MA
DD8V92TA	M985E1A2R1	B3NA
DD8V92TA	CF-1	XJ31
DD8V92TA	M1070	B5CA
DD8V92TA	M1074	B4GA
DD8V92TA	M1075	N/A
DD8V92TA	M1120	B5EA
DD8V92TA	M1120A2	B3PA

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DD8V92TA	M1120A2R1	B3QA
DD8V92TA	M1142	EAMA
DD8V92TA	M1158	EAMB
DD8V92TA	M1975	EZ4A
DD8V92TA	M1977	DV4A
DD8V92TA	M1977A2 WOW	EW2A
DD8V92TA	M1977A2 WW	DV4B
DD8V92TA	M1977A2R1 WOW	DV4F
DD8V92TA	M1977A2R1 WW	DV4E
DD8V92TA	M977	B2GA
DD8V92TA	M977A2 WOW	B2PA
DD8V92TA	M977A2 WW	B2MA
DD8V92TA	M977A2R1 WOW	B2QA
DD8V92TA	M977A2R1 WW	B2NA
DD8V92TA	M978	B2HA
DD8V92TA	M978A2 WOW	B2TA
DD8V92TA	M978A2 WW	B2RA
DD8V92TA	M978A2R1 WOW	B2UA
DD8V92TA	M978A2R1 WW	B2SA
DD8V92TA	M983	B2AA
DD8V92TA	M983A2	B2VA
DD8V92TA	M983A2R1	B2WA
DD8V92TA	M984	B2BA
DD8V92TA	M984A1	TCDA

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DD8V92TA	M984A2	B2XA
DD8V92TA	M984A2R1	B2YA
DD8V92TA	M985	B2JA
DD8V92TA	M985A2 WOW	B3KA
DD8V92TA	M985A2 WW	B2ZA
DD8V92TA	M985A2R1 WOW	B3LA
DD8V92TA	M985A2R1 WW	B3JA
DD8V92TA	M985E1	TCJA
DD8V92TA	M985E1A2	B3MA
DD8V92TA	M985E1A2R1	B3NA

TECHNICAL AUTHORITY:	ARMY
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-201		0-16	0-25	0-70	0-67	0-54	0-6	0-53	0-13	
Marginal Range	202-247		17-19	26-31	71-86	68-83	55-66	7-8	54-65	14-17	
High Range	248-309		20-24	32-38	87-107	84-104	67-83	9-10	66-82	18-21	
Abnormal	310+		25+	39+	108+	105+	84+	11+	83+	22+	
Abnormal Trend (PPM Increase in 10 Hrs)	25		2	3	5	4	4	2	4	2	

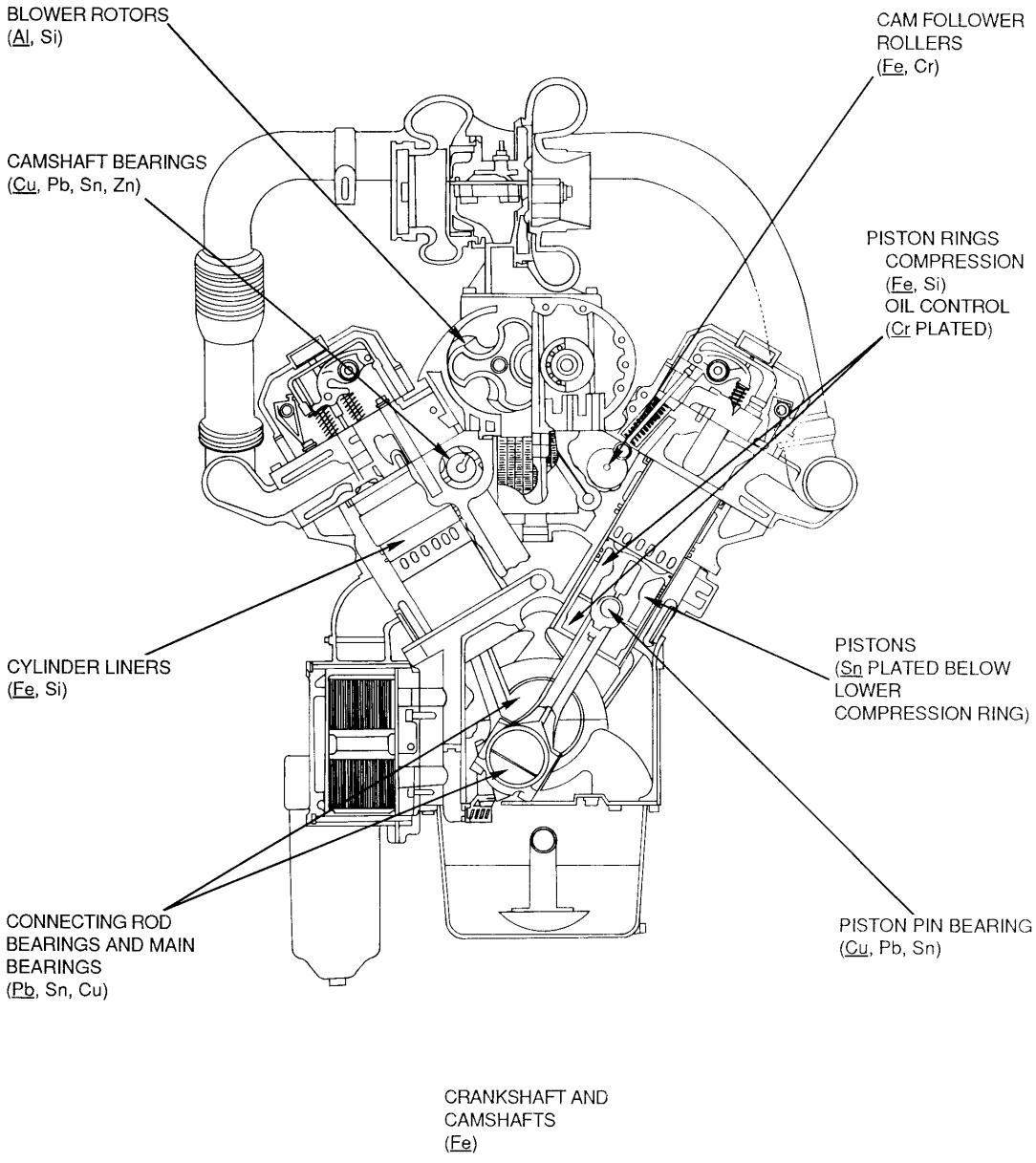

FIGURE 1. Detroit Diesel Allison 8V92T

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COMPONENT:	**DETROIT DIESEL ALLISON 12V71T (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DD12V71T	LCM8	WAEB

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-135	0-6	0-27	0-12	0-30	0-45	0-45	0-3	0-60	0-3	
Marginal Range	136-166	7	28-33	13-14	31-37	46-55	46-55	4	61-73	4	
High Range	167-207	8-9	34-42	15-18	38-46	56-69	56-69	5	74-92	5	
Abnormal	208+	10+	43+	19+	47+	70+	70+	6+	93+	6+	
Abnormal Trend (PPM Increase in 10 Hrs)	18	2	2	2	3	3	4	2	4	2	

TECHNICAL INFORMATION

A faulty air induction system is normally a significant source of silicon in engine oil. Antifoaming agents in engine normally contain silicone which will give 3 to 7 PPM in new oil. Silicone is used in "Print-O-Seal" cylinder head gaskets and crankshaft seals for engine which normally show 20 to 30 PPM silicone in the oil. Aluminum and cast iron parts in the engine can have significant amounts (up to 10 percent) of silicon in their composition.

Significant wear can be expected on the piston skirts and cylinder liners for this engine.

The engine is liquid-cooled; therefore, ethylene glycol present in the engine oil would indicate a leak in the coolant system.

Chromium (Cr)	Oil control piston ring faces are chrome plated.
Tin (Sn)	Plating on pistons.
Iron (Fe)	Wear of cylinder walls. Wear of numerous other engine parts. Also from machining chips left in engine.
Lead-Tin-Copper (Pb-Sn-Cu)	Crankshaft bearings, both mains and connecting rods. Wear of piston rings and crankshaft thrust washer.

Copper-Lead-Tin-Zinc (Cu-Pb-Sn-Zn)	Wear of many bushings.
Aluminum-Silicon-Cadmium (Al-Si-Cd)	Upper connecting rod bearing shell and No. 7 main bearing washer.

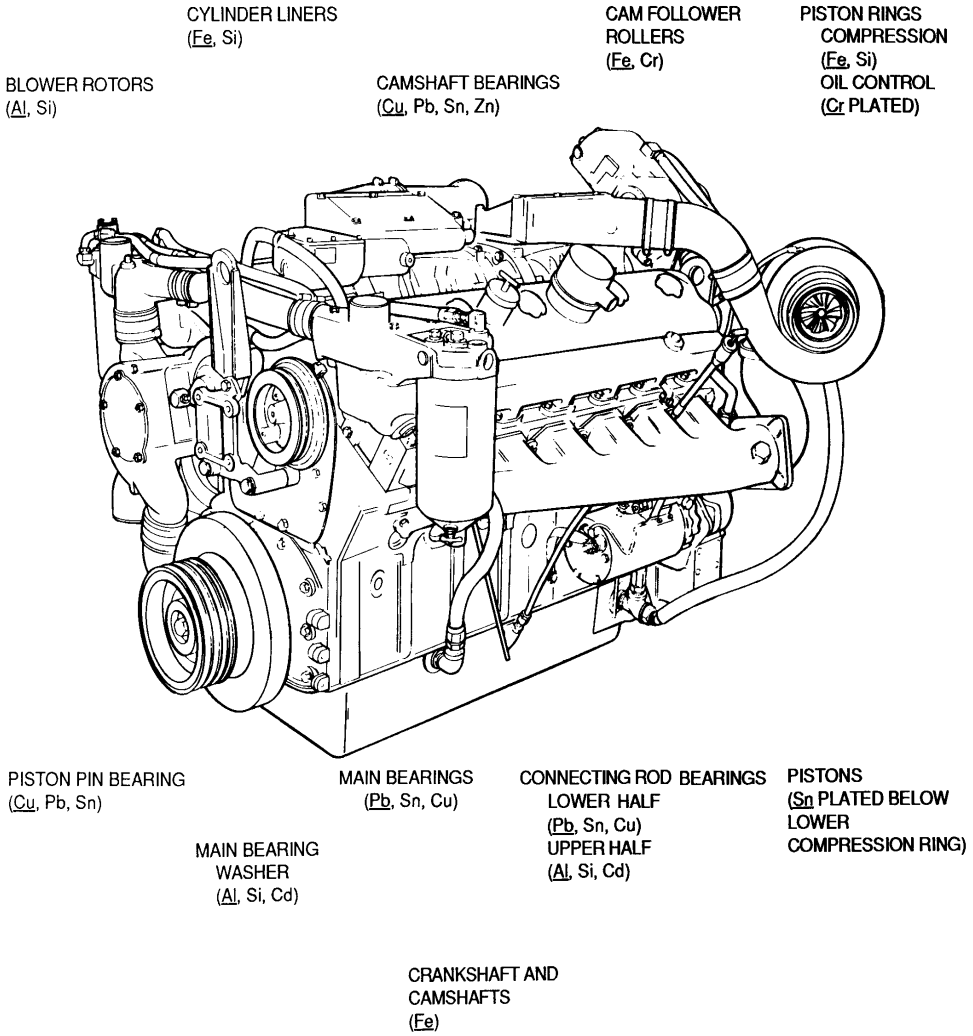

FIGURE 1. Detroit Diesel Allison 12V71T

COMPONENT:	**ELECTRO MOTIVE DIVISION 8-567B (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
EMD8-567B	LOCO100T	XCIA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-42	0-38	0-3		0-128	0-14	0-4		0-38		
Marginal Range	43-52	39-47	4		129-158	15-18	5-6		39-47		
High Range	53-65	48-58	5		159-197	19-22	7		48-58		
Abnormal	66+	59+	6+		198+	23+	8+		59+		
Abnormal Trend (PPM Increase in 10 Hrs)	13	12	2		39	4	2		12		

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COMPONENT:	**ELECTRO MOTIVE DIVISION 16-645E/E6 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
EMD16-645E	LOCO120T	XCQA
EMD16-645E6	LSV	WAXA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN-USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Pb	Sn	Ni	Si	Mo	Mg
Normal Range	1-20	0	1-9	1-20	1-19	1-10	1-9	1-3	1-15		
Marginal Range	21-25	1	10-12	21-25	20-35	11-15	10-12	4-5	16-17		
High Range	16-30	2	13-14	26-30	36-50	16-20	13-14	6	18-20		
Abnormal	31+	3+	15+	31+	51+	21+	15+	7+	21+		
Abnormal Trend (PPM Increase in 10 Hrs)											

TECHNICAL INFORMATION

Sodium (Na)	Evaluation is required when sodium increases 35-50 PPM above new oil. Greater than 50 PPM over the Na concentration in new oil is considered normal.
Zinc (Zn)	Zinc concentrations of 1-10 PPM are acceptable. Greater than 10 PPM is considered abnormal.

NOTE

All LSVs and LOCO GP-10/11s have chrome, rather than steel, liners.

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COMPONENT:	**FAIRBANKS MORSE 38D-81/8 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
38D-81/8	LOCO120T	TXDA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-102		0-9	0-10	0-31	0-17			0-19		
Marginal Range	103-126		10-11	11-13	32-38	18-21			20-23		
High Range	127-157		12-14	14-16	39-47	22-26			24-29		
Abnormal	158+		15+	17+	48+	27+			30+		
Abnormal Trend (PPM Increase in 10 Hrs)	31		3	4	9	5			5		

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COMPONENT:	**INTERNATIONAL HARVESTER DT-466B (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
IHCDT-466B	**M10A**	**DJUA**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-182		0-18	0-29	0-243	0-47	0-10		0-55		
Marginal Range	183-224		19-23	30-35	244-300	48-58	11-12		56-68		
High Range	225-280		24-28	36-44	301-374	59-72	13-15		69-85		
Abnormal	281+		29+	45+	375+	73+	16+		86+		
Abnormal Trend (PPM Increase in 10 Hrs)	56		6	9	75	14	4		17		

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COMPONENT:	**JOHN DEERE 6059T-DW-04 5.9 LITER (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
JD6059T	AN/MJQ-41	VICC
JD6059T	MEP-806A	VG7A
JD6059T	MEP-816A	VN6A
JD6059T	PU805	VLND
JD6059T	PU806	VLNE
JD6059TDW04	544E	TDBA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Pb	Sn	Na	Mo	Mg
Normal Range	0-60		0-1	0-1	0-10	0-1	0-10				
Marginal Range	61-75		2-10	2-4	11-25	2-15	11-25				
High Range	76-150		11-20	5-8	26-40	16-21	26-40				
Abnormal	151+		21+	9+	41+	22+	41+				
Abnormal Trend (PPM Increase in 10 Hrs)											

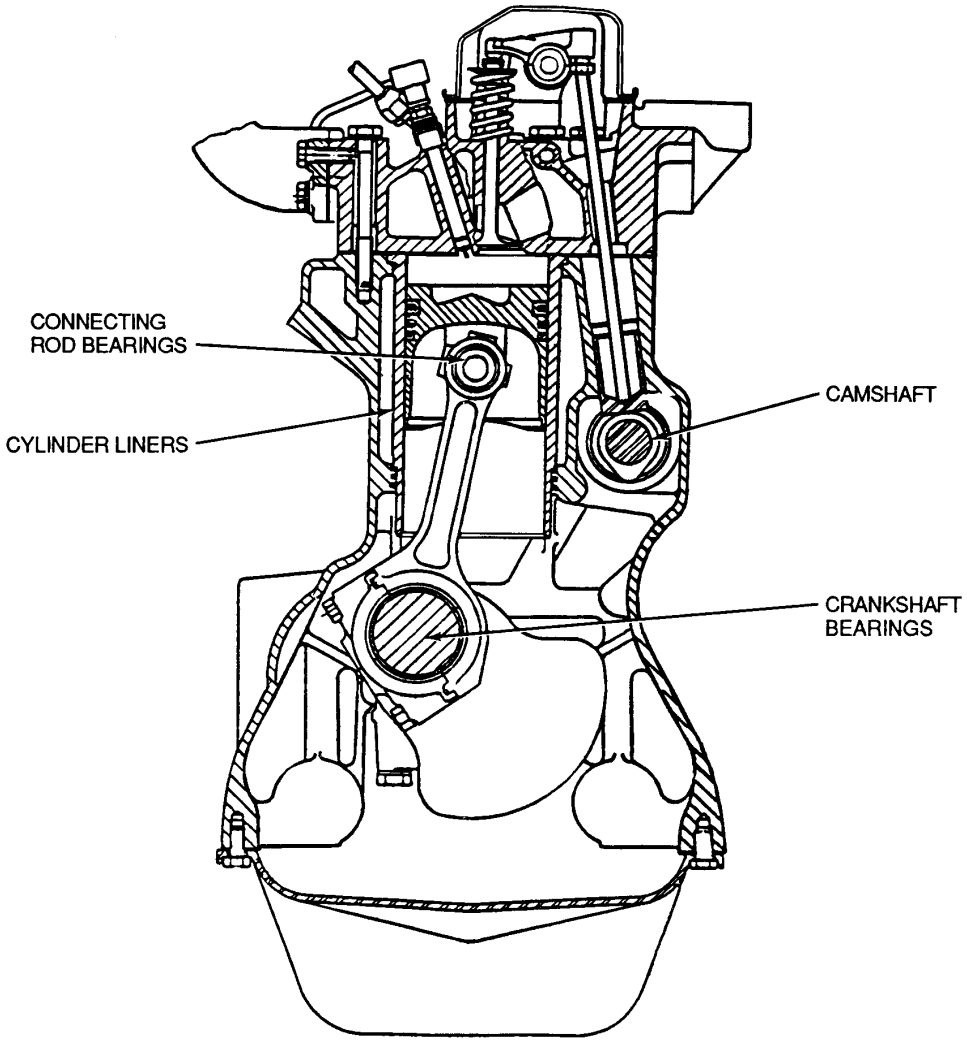

FIGURE 1. John Deere 6059T-DW-04 5.9 Liter Engine - Sectional View

COMPONENT:	**LYCOMING AGT 1500 TURBINE (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
AGT-1500	M1	AAAA
AGT-1500	M104	ARDA
AGT-1500	M1A1	AABA
AGT-1500	M1A2	TAUA
AGT-1500	M1-IP	AACA
AGT-1500	PANTHER MINE CLR	AABB
AGT-1500	XM1150 ABV	ABVA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Ti	Ni	Pb	Mo	Zn
Normal Range	0-14	0-3	0-3	0-1	0-3	0-32	0-2	0-1	0-3	04	0-13
Marginal Range	15-16	4	4	2	4	33-38	3	2	4	5	14-16
High Range	17-20	5	5	3	5	39-50	4	3	5	6-7	17-19
Abnormal	21+	6+	6+	4+	6+	51+	5+	4+	6+	8+	20+
Abnormal Trend (PPM Increase in 10 Hrs)	4	2	2	2	2	10	2	2	2	2	4

TECHNICAL INFORMATION

Engine oil is employed for cooling alternator.

Engine oil-wetted splines are used in accessory and reduction gearboxes (AGB and RGB).

Low levels (13 PPM) of zinc (Zn) may indicate use of galvanized containers for handling engine oil. This is harmless.

Over 75 PPM Zn with calcium (Ca), magnesium (Mg), or barium (Ba) present indicates transmission oil mixed

with engine oil. Up to 10 percent transmission oil in engine oil can be tolerated indefinitely.

External sources should be considered first when attempting to explain Zn levels.

Iron (Fe) is by far the most important wear metal to monitor.

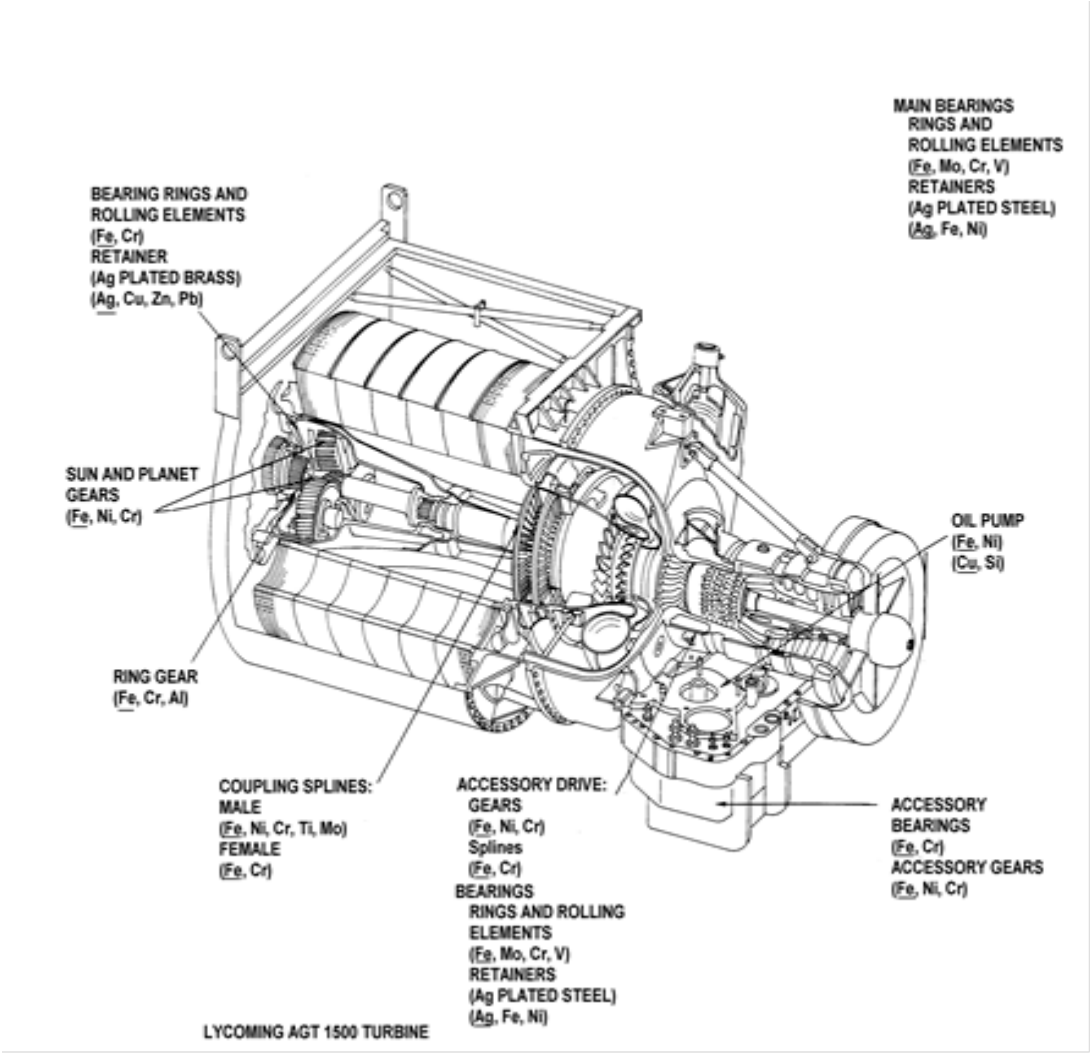

FIGURE 1. John Deere 6059T-DW-04 5.9 Liter Engine - Sectional View

COMPONENT:	**MACK ENDT-673 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ENDT-673	W15A	TEVA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-220		0-27	0-23	0-57	0-43	0-13	0-4	0-77	0-25	
Marginal Range	221-271		28-33	24-28	58-70	44-53	14-15	5	78-94	26-31	
High Range	272-339		34-41	29-35	71-88	54-67	16-19	6	95-118	32-39	
Abnormal	340+		42+	36+	89+	68+	20+	7+	119+	40+	
Abnormal Trend (PPM Increase in 10 Hrs)	15		3	3	4	4	2	2	7	3	

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COMPONENT:	**MAN D-2840 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	**N/A**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-129	0-1	0-14	0-36	0-30	0-15	0-9		0-54		
Marginal Range	130-159		15-18	37-45	31-37	16-18	10-11		55-67		
High Range	160-198	2	19-22	46-56	38-46	19-23	12-14		68-83		
Abnormal	199+	3+	23+	57+	47+	24+	15+		84+		
Abnormal Trend (PPM Increase in 10 Hrs)	40	2	4	11	9	4	3		17		

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COMPONENT:	**MERCEDES BENZ OM617952 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
OM617952	**M973**	**BXAA**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-243		0-25	0-17	0-84	0-45			0-17	0-25	
Marginal Range	244-300		26-30	18-21	85-103	46-55			18-21	26-30	
High Range	301-375		31-38	22-27	104-129	56-69			22-26	31-38	
Abnormal	376+		39+	28+	130+	70+			27+	39+	
Abnormal Trend (PPM Increase in 10 Hrs)	75		8	5	26	14			5	8	

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COMPONENT:	**C-180 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
C-180	3000M	DJ8A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-104		0-10	0-10	0-86	0-20			0-67		
Marginal Range	105-127		11-13	11-12	87-106	21-24			68-83		
High Range	128-159		14-16	13-15	107-132	25-31			84-104		
Abnormal	160+		17+	16+	133+	32+			105+		
Abnormal Trend (PPM Increase in 10 Hrs)	32		4	4	26	6			21		

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COMPONENT:	**GTCP 85127**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
GTCP85-127	APP-1	VAFC
GTCP85-127	JHTWX1096	TVUA
GTCP85-127	LPU-71	VAFB
GTCP85-127	LPU-71W	VAAA
GTCP85-127	PPU85-4	VAAB
GTCP85-127	PPU85-5	VAFA

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	9		2	2	3	4	6		7		
Marginal Range	0-30		0-4	0-5	0-8	0-13	0-19		0-22		
High Range	30-37		5	6-7	9-10	14-16	20-24		23-27		
Abnormal	38-46		6	8	11-13	17-20	25-29		28-34		
Abnormal Trend (PPM Increase in 10 Hrs)	47+		7+	9+	14+	21+	30+		35+		

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COMPONENT:	**SD802 (ENGINE)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-250		0-52	0-26	0-151	0-128	0-12		0-41		
Marginal Range	251-308		53-64	27-32	152-185	129-157	13-15		42-50		
High Range	309-385		65-80	33-41	186-232	158-196	16-19		51-63		
Abnormal	386+		81+	42+	233+	197+	20+		64+		
Abnormal Trend (PPM Increase in 10 Hrs)	77		16	8	46	39	4		13		

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COMPONENT:	**CATERPILLAR D5/3T 3394 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
D5/3T3394	CAT-D5B	TEKJ
D5/3T3394	D5BNS	EBAG
D5/3T3394	D5BS	EBBG
D5/3T3394	D5BS1	TFBH

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-224	0-1	0-6	0-4	0-223	0-75	0-4		0-91		
Marginal Range	225-276		7	5	224-274	76-92	5		92-112		
High Range	277-345		8-9	6-7	275-343	93-115	6		113-140		
Abnormal	346+	2+	10+	8+	344+	116+	7+		141+		
Abnormal Trend (PPM Increase in 10 Hrs)	69	2	3	2	69	23	2		28		

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COMPONENT:	**CATERPILLAR POWERSHIFT 4R219 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-74		0-8		0-130	0-38	0-3		0-51		
Marginal Range	75-92		9-10		131-160	39-47	4		52-62		
High Range	93-114		11-13		161-200	48-59	5		63-78		
Abnormal	115+		14+		201+	60+	6+		79+		
Abnormal Trend (PPM Increase in 10 Hrs)	7		2		12	3	3		4		

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COMPONENT:	**CATERPILLAR 5R3855 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CAT-5R3855	DV43	DJNG

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-54		0-9		0-241	0-63			0-40		
Marginal Range	55-67		10-11		242-297	64-77			41-50		
High Range	68-83		12-14		298-371	78-97			51-62		
Abnormal	84+		15+		372+	98+			63+		
Abnormal Trend (PPM Increase in 10 Hrs)	17		3		74	19			12		

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COMPONENT:	**CATERPILLAR D7155 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CAT-D7155	M915	B4AG
CAT-D7155	M916	B4CG
CAT-D7155	M917	EZZG
CAT-D7155	M918	EXCG
CAT-D7155	M919	EXDG
CAT-D7155	M920	B4DG

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	20-100		5-15	0-2	0-3	5-15					
Marginal Range	101-200		16-30	3-6	4-7	16-30					
High Range	201-300		31-45	7-10	8-10	31-50					
Abnormal	301+		46+	11+	11+	51+					
Abnormal Trend (PPM Increase in 10 Hrs)	60		9	3	3	10					

TECHNICAL INFORMATION

Silicone additives may be used for antifoaming agents in the lubricating oil, thus new oil normally gives a reading of 3 to 7 PPM silicon. Springs used in clutches for the transmission may have silicone coatings. This will result in high silicon readings on new or rebuilt equipment. Also, the transmission will normally show high iron readings during the break-in period.

The transmission is air-cooled; therefore, there should be no ethylene glycol contamination problems.

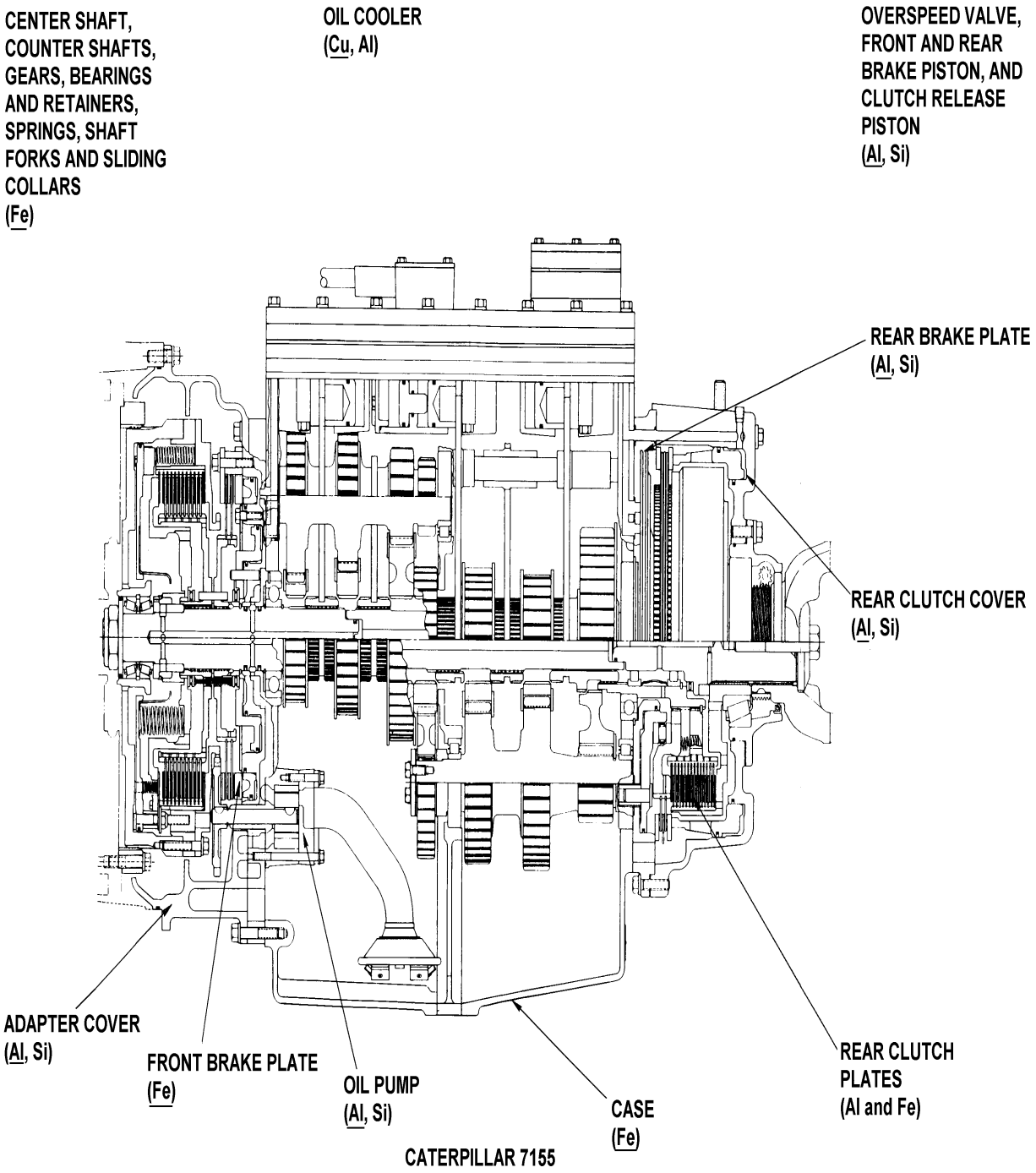

FIGURE 1 - Caterpillar 7155 Transmission

COMPONENT:	**CLARK 4000 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CLK4000	175B	EFBG

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-149	0-2	0-43	0-8	0-364	0-90	0-9		0-16		
Marginal Range	150-183	3	44-53	9-10	365-448	91-110	1-11		17-20		
High Range	184-229		54-66	11-12	449-560	111-138	12-14		21-25		
Abnormal	230+	4+	67+	13+	561+	139+	15+		26+		
Abnormal Trend (PPM Increase in 10 Hrs)	46	2	13	3	112	28	3		5		

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COMPONENT:	**DETROIT DIESEL ALLISON 3331-1 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ALS-3331-1	ARTFT6	DJCG
ALS-3331-1	MLT6	DJJG
ALS-3331-1	MLT6CH	DJLG

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-94		0-17		0-236	0-35	0-16		0-231		
Marginal Range	95-116		18-21		237-291	36-44	17-19		232-284		
High Range	117-154		22-27		292-363	45-55	20-24		285-355		
Abnormal	155+		28+		364+	56+	25+		356+		
Abnormal Trend (PPM Increase in 10 Hrs)	29		5		73	11	4		71		

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COMPONENT:	DETROIT DIESEL ALLISON CD 850 6A (TRANSMISSION)

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CD850-6A	M48A5	6RDE
CD850-6A	M48A5AVLB	AREG
CD850-6A	M60	6RDF
CD850-6A	M60A1	MAEG
CD850-6A	M60A1AVLB	ARCG
CD850-6A	M60A3	ABBG
CD850-6A1	M48A5AVLB	AREH
CD850-6A1	M60	6REB
CD850-6A1	M60A1AVLB	ARCH
CD850-6A1	M60A3	ABBH

TECHNICAL AUTHORITY:	ARMY
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-150	0-15	0-13	0-5	0-180	0-28	0-13		0-100		
Marginal Range	151-205	16-22	14-18	6-7	181-255	29-36	14-18		101-140		
High Range	206-260	23-30	19-25	8-9	256-325	37-45	19-25		141-175		
Abnormal	261+	31+	26+	10+	326+	46+	26+		176+		
Abnormal Trend (PPM Increase in 10 Hrs)	52	6	5	3	65	9	5		35		

TECHNICAL INFORMATION

When silver (Ag) and iron (Fe) are increasing excessively and at approximately the same rate, the silver-plated bushings (Part No. 7539858) in the steer differential pinion are wearing excessively. When silver (Ag) only is rapidly increasing, the silver-plated seal ring (Part No. 8352004) in the main oil pump may be wearing excessively, and the pump pressure should be monitored closely.

Some of the brake and clutch plates in the transmission are sintered bronze. When the iron and copper in the transmission are increasing at approximately the same rate, the plates may need adjustment, but are probably in good condition. On the other hand, if the iron wear rate exceeds the copper wear rate, the plates are probably worn excessively, and the transmission may fail. This is because the plates are worn through and the iron is coming from the backing plates. In a new transmission, the copper may run as high as 300 PPM with a much lower iron count until the transmission has worn-in and the fluid has been changed.

When the rear main oil seal in the AVDS 1790 engine wears excessively or ceases to function properly, there will be cross-contamination of the engine and transmission (CD-850-6A) lubricants. This, in general, will be indicated by increasing or high molybdenum (Mo) in the transmission oil samples and high copper and lead in the engine oil samples.

Transmission is air-cooled; therefore, no liquid-coolant contamination problems.

Wear of bushings is normally minimal.

Aluminum-Silicon (Al-Si)	Turbine converter, and first stator wear. Could also be derived from machining chips left in transmission. Aluminum particles are commonly found in pan.
Silicon (Si)	Aluminum and cast iron parts have significant amounts of silicon in their composition.
Silver (Ag)	Silver-plated oil seals and silver-plated planetary gear bushings.
Copper (Cu)	Brake and clutch plates contribute significant amounts of copper, especially in new or newly rebuilt transmission.
Copper-Lead-Tin (Cu-Pb-Sn)	Bushings.
Copper-Lead-Tin-Zinc (Cu-Pb-Sn-Zn)	Thrust washers.
Iron (Fe)	Wear of numerous transmission parts. Also machining chips left in transmission.

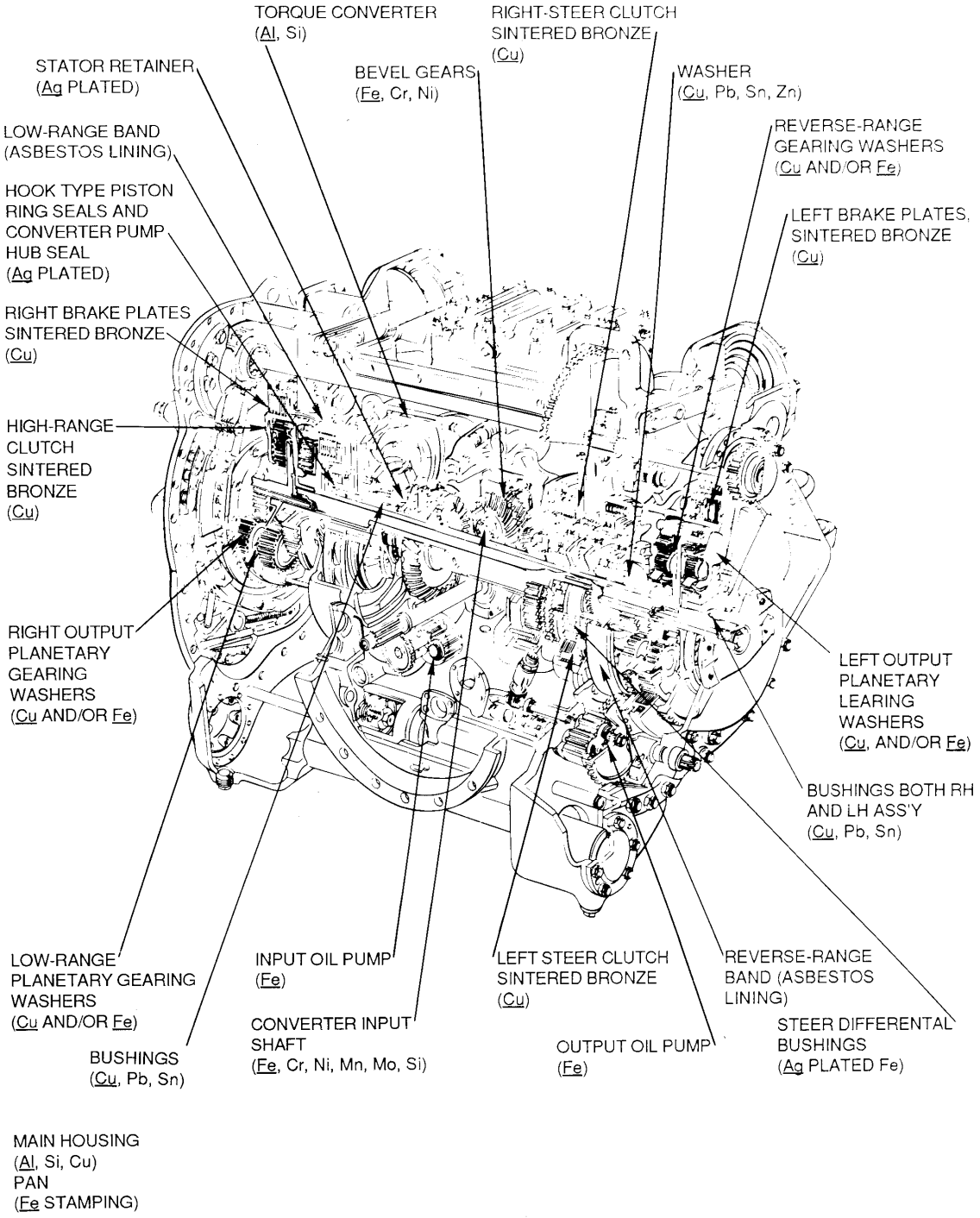

FIGURE 1. Detroit Diesel Allison CD 850-6A

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COMPONENT:	**DETROIT DIESEL ALLISON CLBT 750 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-106	0-11	0-19	0-3	0-198	0-58	0-6	0-5	0-19		
Marginal Range	107-131	12-14	20-24	4	199-244	59-72	7-8	6	20-24		
High Range	132-163	15-17	25-29	5	245-304	73-89	9-10	7-8	25-30		
Abnormal	164+	18+	30+	6+	305+	90+	11+	9+	31+		
Abnormal Trend (PPM Increase in 10 Hrs)	10	2	2	2	18	4	2	2	2		

TECHNICAL INFORMATION

Silicon additives may be used as antifoaming agents in the lubricating oil, thus new oil normally gives a reading of 3-7PPM silicon.

Aluminum particles are commonly found in the transmission pan. Aluminum and cast iron parts have significant amounts of silicon in their composition.

Transmission is liquid-cooled; therefore, ethylene glycol may be present in the oil. If significant amounts of ethylene glycol are found, it is suggested that appropriate action be taken because the clutches and seals may be affected accordingly.

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COMPONENT:	**DETROIT DIESEL ALLISON CRT 3531-1 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CRT-3531-1	RTL10	DJHG
CRT-3531-1	RTL10-1	DJDG

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-117		0-16	0-4		0-51	0-12		0-318		
Marginal Range	118-145		17-20	5		52-63	13-15		319-391		
High Range	146-181		21-24	6-7		64-79	16-19		392-489		
Abnormal	182+		25+	8+		80+	20+		490+		
Abnormal Trend (PPM Increase in 10 Hrs)	36		4	2		1+6	4		98		

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COMPONENT:	**DETROIT DIESEL ALLISON G 411-2A (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
G411-2A	XM1050	XSCN

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-212	0-24	0-20	0-15	0-208	0-55	0-17	0-13	0-124	0-4	
Marginal Range	213-261	25-30	21-24	16-18	209-256	56-68	18-21	14-16	125-152	5	
High Range	262-326	31-37	25-31	19-23	257-320	69-85	22-26	17-20	153-190	6	
Abnormal	327+	38+	32+	24+	321+	86+	27+	21+	191+	7+	
Abnormal Trend (PPM Increase in 10 Hrs)	16	3	2	2	23	4	2	2	11	2	

TECHNICAL INFORMATION

The brake and clutch plates in the transmission are sintered bronze. When the iron and copper in the transmission are increasing at approximately the same rate, the plates may need adjustment, but are probably in good condition. On the other hand, if the iron wear rate exceeds the copper wear rate, the plates are probably worn excessively, and the transmission may fail.

When aluminum or aluminum and iron are increasing excessively, wear is occurring in the transmission torque converter.

Increasing silver or silver and iron may be the result of wear of the plated hook-type seals.

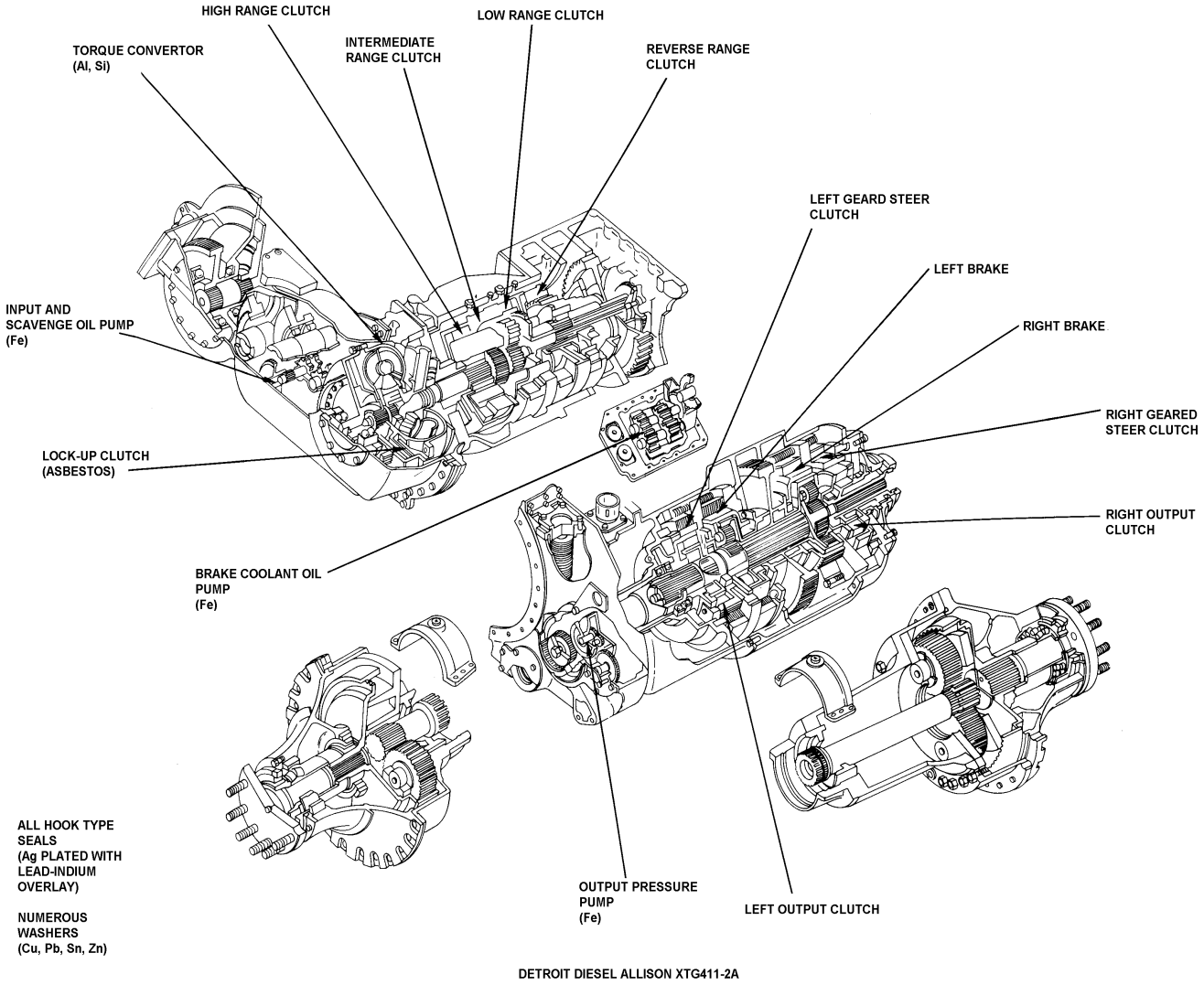

FIGURE 1. Detroit Diesel Allison XTG411-2A

COMPONENT:	**DETROIT DIESEL ALLISON HT 740D (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DDA-HT740D	M977	B2GG
DDA-HT740D	M978	B2HG
DDA-HT740D	M983	B2AG
DDA-HT740D	M984	H2BG
DDA-HT740D	M984A1	TCDG
DDA-HT740D	M985	B2JG
DDA-HT740D	M985E1	TCJG

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-119	0-3	0-13	0-3	0-310	0-25	0-13		0-21		
Marginal Range	120-147		14-16	4	311-381	26-31	14-17		22-26		
High Range	148-184	4	17-20	5	382-476	32-39	18-21		27-33		
Abnormal	185+	5+	21+	6+	477+	40+	22+		34+		
Abnormal Trend (PPM Increase in 10 Hrs)	37	2	4	2	95	8	4		7		

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COMPONENT:	**DETROIT DIESEL ALLISON HT 750CRD (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
HT750CRD	F5070	EZYH
HT750DRD	2500L	TCWG

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-100	0-11	0-21	0-4	0-202	0-47	0-10	0-5	0-66	0-8	
Marginal Range	101-123	12-14	22-26	5	203-249	48-58	11-13	6	67-82	9	
High Range	124-153	15-17	27-33	6	250-311	59-73	14-16	7-8	83-102	10-12	
Abnormal	154+	18+	34+	7+	312+	74+	17+	9+	103+	13+	
Abnormal Trend (PPM Increase in 10 Hrs)	9	2	2	2	24	4	2	2	3	2	

TECHNICAL INFORMATION

Silicon additives may be used as antifoaming agents in the lubricating oil, thus new oil normally gives a reading of 3 to 7 PPM silicon.

Aluminum particles are commonly found in the transmission pan. Aluminum and cast iron parts have significant amounts of silicon in their composition.

Transmission is liquid-cooled; therefore, ethylene glycol may be present in the oil. If significant amounts of ethylene glycol are found, it is suggested that appropriate action be taken because the clutches and seals may be affected accordingly.

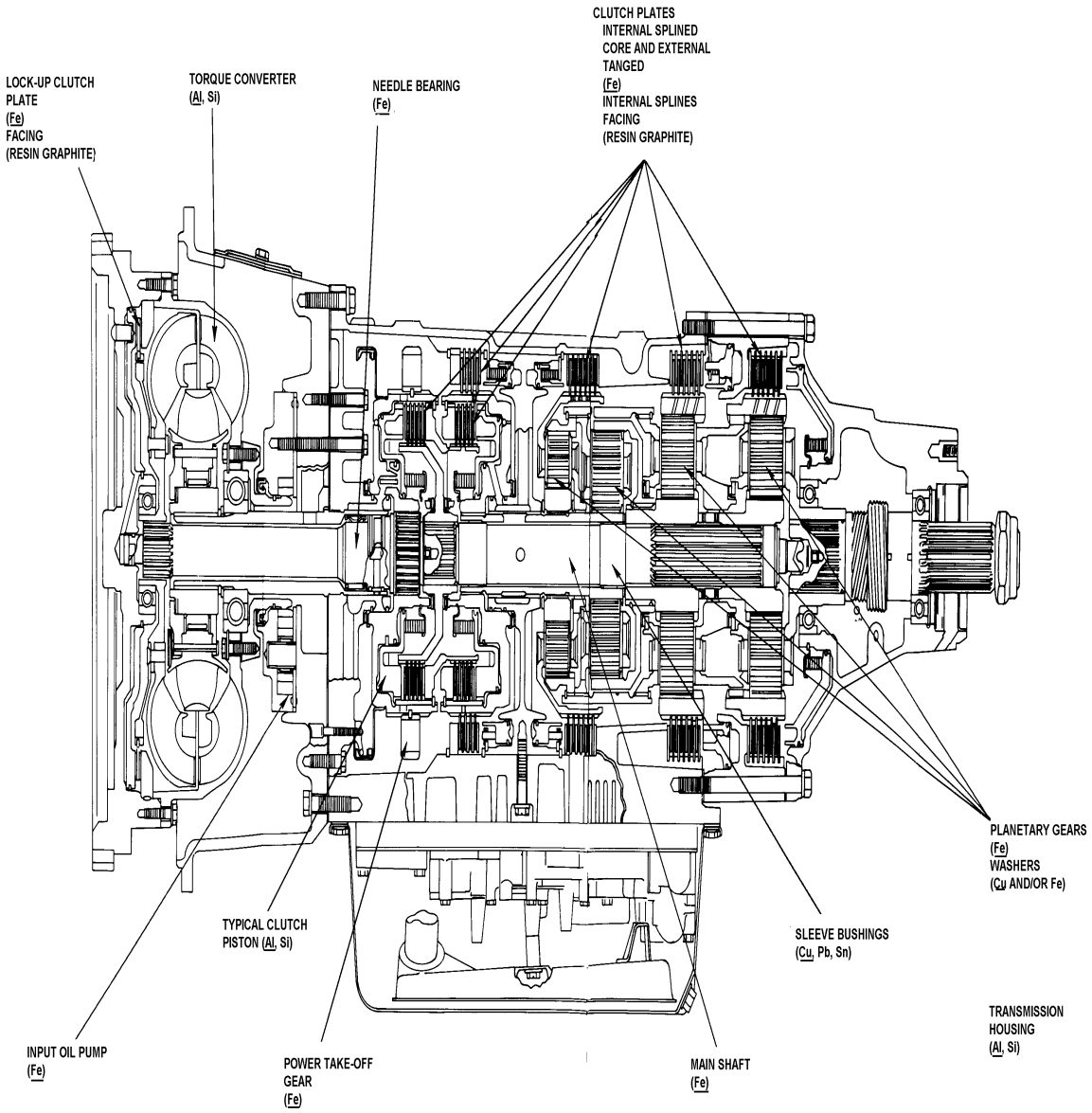

FIGURE 1. Detroit Diesel Allison HT 750CRD (Transmission)

COMPONENT:	**DETROIT DIESEL ALLISON HT 754CRD (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
HT754CRD	**M915A1**	**B4BG**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-90		0-9		0-470	0-12			0-59		
Marginal Range	91-111		10-11		471-578	13-15			60-73		
High Range	112-138		12-13		579-723	16-19			74-92		
Abnormal	139+		14+		724+	20+			93+		
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	DETROIT DIESEL ALLISON MT 654CR (TRANSMISSION)

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
MT654	M923	BRYG
MT654	M923A1	BSSG
MT654	M923A2	BS7G
MT654	M924	BRXG
MT654	M924A1	BSUG
MT654	M925	BRTG
MT654	M925A1	BSTG
MT654	M925A2	BS8G
MT654	M926	BRWG
MT654	M926A1	BSVG
MT654	M927	BRVG
MT654	M927A1	BSWG
MT654	M927A2	BS9G
MT654	M928	BRUG
MT654	M928A1	TCHG
MT654	M928A2	BTMG
MT654	M929	BTHG
MT654	M929A1	BSYG
MT654	M929A2	BTNG
MT654	M930	BTGG
MT654	M930A1	BSZG
MT654	M930A2	BTOG

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
MT654	M931	BTEG
MT654	M931A1	BS2G
MT654	M931A2	BTPG
MT654	M932	BTDG
MT654	M932A1	BS3G
MT654	M932A2	BTQG
MT654	M934	BTBG
MT654	M934A1	BS4G
MT654	M934A2	BTRG
MT654	M936	BTFG
MT654	M936A1	BS6G
MT654	M936A2	BTTG
MT654	M939	BRSG
MT654	M939A2	BRSH
MT654	M940	TBXG
MT654	M941	TBYG
MT654	M942	TBZG
MT654	M943	TCAG
MT654	M944	TCBG
MT654	M945	TCCG

TECHNICAL AUTHORITY:	ARMY
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-146	0-6	0-15	0-4	0-500	0-21	0-6		0-23		
Marginal Range	147-180	7	16-19	5	501-625	22-26	7-8		24-28		
High Range	181-225	8-9	20-23	6-7	626-780	27-33	9-10		29-35		
Abnormal	226+	10+	24+	8+	781+	34+	11+		36+		
Abnormal Trend (PPM Increase in 10 Hrs)	45	3	4	2	160	7	3		7		

TECHNICAL INFORMATION

*The manufacturer states normal break-in is 5000mi/200hr/12mo, whichever is longest. During this time, an increase in Cu alone is not cause for concern. No action should be taken except to change oil when Cu reached 900 PPM. If Cu and another wear metal element increase simultaneously, detrimental wear may be occurring and routine evaluation techniques apply.

Silicon additives may be used as antifoaming agents in the lubricating oil, thus new oil normally gives a reading of 3 to 7 PPM silicon.

Aluminum particles are commonly found in the transmission pan. Aluminum and cast iron parts have significant amounts of silicon in their composition.

Transmission is liquid-cooled; therefore, ethylene glycol may be present in the oil. If significant amounts of ethylene glycol are found, it is suggested that appropriate action be taken because the clutches and seals may be affected accordingly.

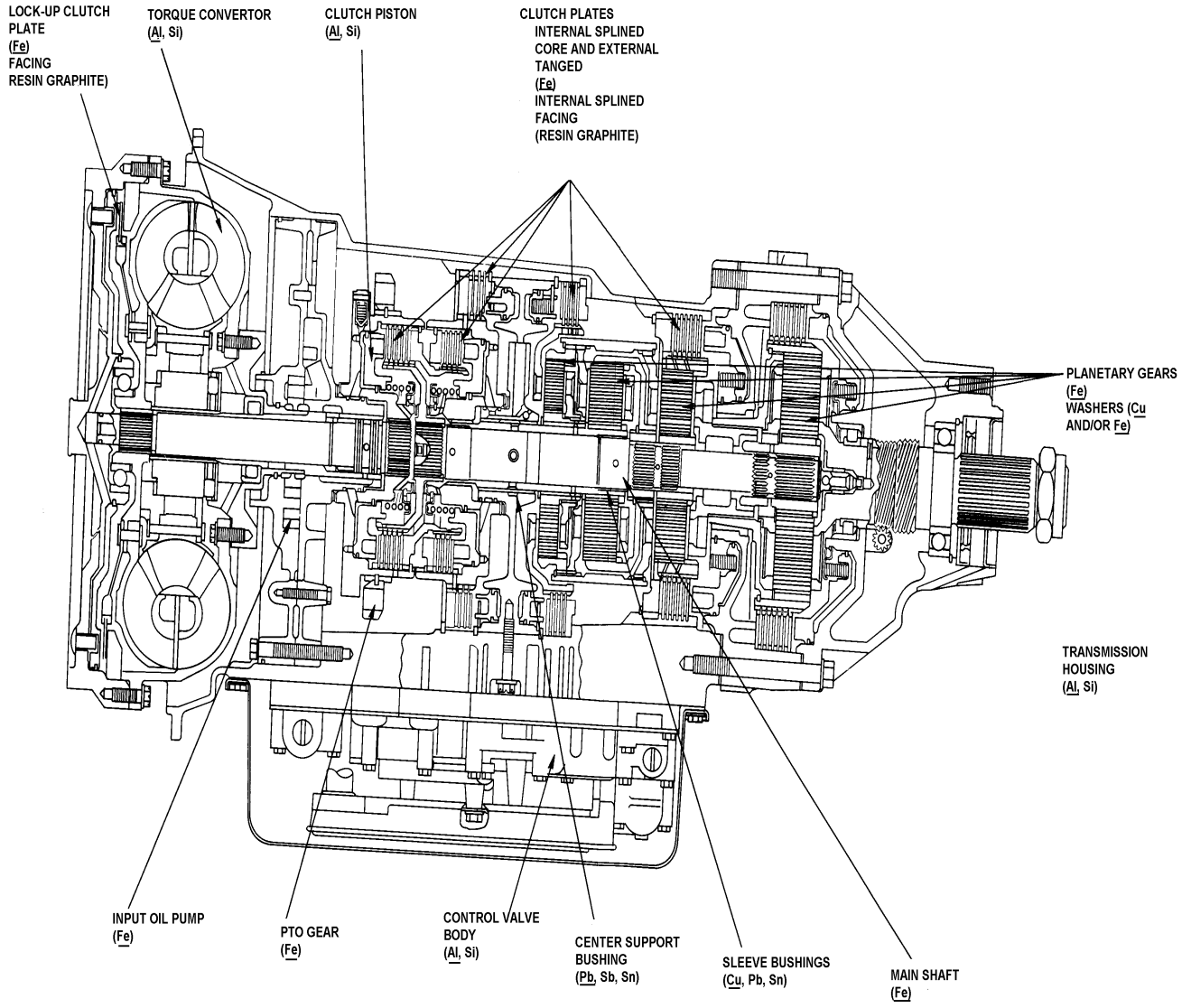

FIGURE 1. Detroit Diesel Allison MT 654CR

COMPONENT:	DETROIT DIESEL ALLISON THM-3L80 (TRANSMISSION)

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
THM-3L80	M1025	BBFG
THM-3L80	M1025A1	BBFH
THM-3L80	M1026	BBGG
THM-3L80	M1026A1	BBGH
THM-3L80	M1035	BBLG
THM-3L80	M1036	BBHG
THM-3L80	M1037	BBKG
THM-3L80	M1038	BBEG
THM-3L80	M1038A1	BBEH
THM-3L80	M1042	TCTG
THM-3L80	M1043	BBJG
THM-3L80	M1044	BBNG
THM-3L80	M1046	TCSG
THM-3L80	M1069	AKZG
THM-3L80	M1097	BBMG
THM-3L80	M1097A1	BBUG
THM-3L80	M1109	B6AG
THM-3L80	M966	BBCG
THM-3L80	M966A1	BBCH
THM-3L80	M996	BBBG
THM-3L80	M996A1	BBBH
THM-3L80	M997	BBAG

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
THM-3L80	M997A1	BBAH
THM-3L80	M998	BBDG
THM-3L80	M998A1	BBDH
THM-3L80	SECM	SECO

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS WEAR METAL BASELINES

These interim wear metal guidelines are based on the manufacturer's used lubrication oil chemical analysis. The Oil Analysis Standard Interservice System (OASIS) software will be modified to reflect actual wear metal parameters.

Wear Metal/Coolant Elements	Normal Limits (PPM)	Upper Limits (PPM)
Aluminum (Al)	2 to 25	50 to 75
Boron (B)	10 to 100	200 (See Notes)
Copper (Cu)	20 to 150	300 to 400
Iron (Fe)	10 to 100	200
Lead (Pb)	5 to 50	150 or higher
Magnesium (Mg)	0	-
Molybdenum (Mo)	0	-
Silicon (Si)	2 to 25	50
Sodium (Na)	Less than 25	-
Zinc (Zn)	600 to 900	

NOTE

High readings of B, Mg, Mo, and Zn are usually indications of component's lubrication additive packages. If after establishing a base from obtaining a sample of the servicing oil, increases in the above mentioned elements are an indication of coolant/water contamination. If the component's oil sample is discolored, then recommend the transmission oil be changed.

COMPONENT:	**DETROIT DIESEL ALLISON TT2421-1 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
TT2421-1	**MW24C**	**EFQG**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-73		0-16		0-99	0-41	0-50	0-110	0-108		
Marginal Range	90		17-20		100-122	42-51	51-61	111-135	109-132		
High Range	112		21-25		123-153	52-63	62-76	136-169	133-166		
Abnormal	113+		26+		154+	64+	77+	170+	167+		
Abnormal Trend (PPM Increase in 10 Hrs)	22		5		31	13	15	34	33		

TECHNICAL INFORMATION

Silver (Ag)	May be seen, but is not considered significant by the item manager.

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COMPONENT:	DETROIT DIESEL ALLISON TX100-1 (TRANSMISSION)

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
TX-100	M1068	AE5G
TX-100-1	M1059	AESG
TX-100-1	M1064	AE4G
TX-100-1	M106A1	AEFG
TX-100-1	M106A2	AERG
TX-100-1	M113A2	AENG
TX-100-1	M113A3	AEYH
TX-100-1	M548	AEGG
TX-100-1	M548A1	AEUG
TX-100-1	M577A2	AEQG
TX-100-1	M901A1	AEVG
TX-100-1	M981	AETG
TX-100-1	M981A1	TAQG

TECHNICAL AUTHORITY:	ARMY
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-112	0-8	0-23	0-3	0-222	0-18	0-10	0-2	0-293	0-3	
Marginal Range	113-138	9-10	24-28		223-273	19-22	11-12		294-360		
High Range	139-173	11-12	29-35	4	274-342	23-27	13-16	3	361-451	4	
Abnormal	174+	13+	36+	5+	343+	28+	17+	4+	452+	5+	
Abnormal Trend (PPM Increase in 10 Hrs)	34	3	7	2	68	5	4	2	90	2	

TECHNICAL INFORMATION

Silicon additives may be used as antifoaming agents in the lubricating oil, thus new oil normally gives a reading of 3 to 7 PPM silicon.

Aluminum particles are commonly found in the transmission pan. Aluminum and cast iron parts have significant amounts of silicon in their composition.

Oil contamination is usually "operator-induced."

Transmission is liquid-cooled; therefore, ethylene glycol may be present in the oil. If significant amounts of ethylene glycol are found, it is suggest that appropriate action be taken because the clutches and seals may be affected accordingly.

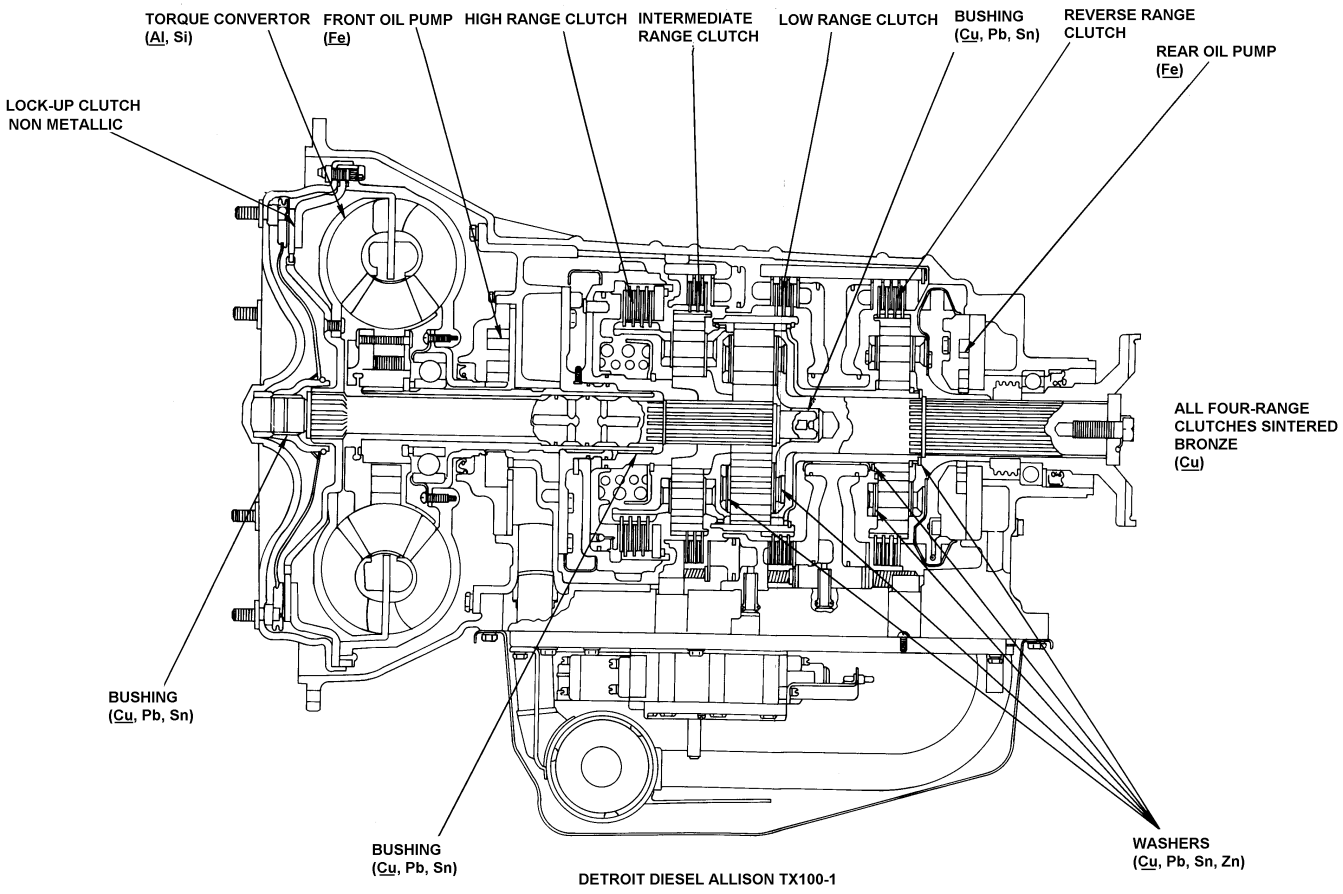

FIGURE 1. Detroit Diesel Allison TX100-1

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COMPONENT:	**DETROIT DIESEL ALLISON X1100-3B(TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
X1100-3B	M1	AAAG
X1100-3B	M104	ARDG
X1100-3B	M1A1	AABG
X1100-3B	M1A2	TAUG
X1100-3B	M1-IP	AACG
X1100-3B	PANTHER MINE CLR	AABH
X1100-3B	XM1150 ABV	ABVH

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-147		0-171	0-7	0-653	0-27	0-32	0-6	0-227		
Marginal Range											
High Range	471-676		172-300	8-12	654-903	28-34	33-51	7-10	228-325		
Abnormal	677+		301+	13+	904+	35+	52+	11+	326+		
Abnormal Trend (PPM Increase in 10 Hrs)	63		50	3	78	6	10	3	65		

TECHNICAL INFORMATION

The brake and clutch plates in the transmission are sintered bronze. When the iron and copper in the transmission are increasing at approximately the same rate, the plates may need adjustment, but are probably worn excessively, and the transmission may fail. This is because the plates are worn through and the iron is coming from the backing plates.

The transmission is air-cooled; therefore, there should be no ethylene glycol contamination problems.

Probable sources of wear metals:

Fe - Steel gears
Ag - Hydrostatic cylinder cups
Al - Torque converter, oil pump, and main housing bearing
Cr and Mo - Steel alloys (usually <4 PPM)

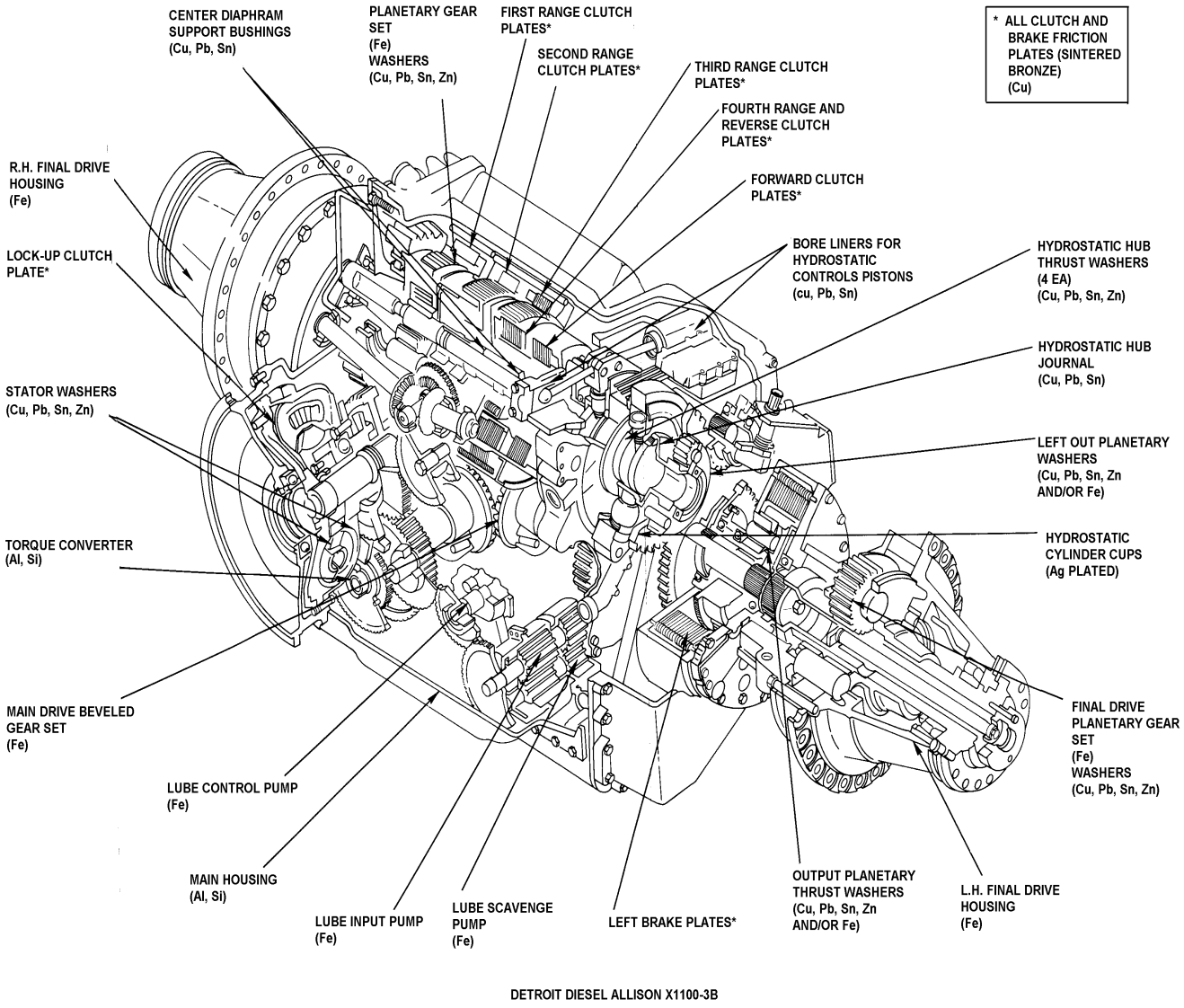

FIGURE 1. Detroit Diesel Allison X1100-3B

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COMPONENT:	**DETROIT DIESEL ALLISON XT1410-4 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
XT-1410-4	**M88A1**	**AQAG**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-266	0-49	0-18	0-7	0-659	0-19	0-32	0-6	0-184	0-9	
Marginal Range	267-328	50-60	19-22	8-9	660-812	20-24	33-40	7	185-226	10-11	
High Range	329-410	61-75	23-28	10-11	813-900	25-29	41-50	8-9	227-283	12-14	
Abnormal	411+	76+	29+	12+	901+	30+	51+	10+	284+	15+	
Abnormal Trend (PPM Increase in 10 Hrs)	82	15	5	3	203	6	10	3	54	4	

TECHNICAL INFORMATION

Increasing copper (Cu) usually indicates wear of clutch and brake plates. Rapid initial wear is normally experienced during "break-in" of new transmissions or newly installed clutch and brake plates. The clutch plates are in transmission center section assembly. Brake plates are in both the R.H. and L.H. output reduction (final drive) assemblies. These three assemblies have a common oil system; therefore, an oil analysis alone will not indicate where excessive wear has occurred. This can only be determined by careful observation and analysis of transmission and/or vehicle performance symptoms or inspections. For this same reason, whenever a failure has generated debris, the system including coolers, oil lines, transmission center section and both R.H. and L.H. output reduction assemblies must be thoroughly flushed or disassembled for cleaning.

When aluminum (Al) or aluminum and iron (Fe) are increasing excessively, wear is occurring in the transmission torque converter.

When silver (Ag) or silver and iron are increasing excessively, wear is probably occurring in the steer flywheel drive gear bushing or the thrust washers in the low, intermediate, reverse or output carriers. This may also indicate wear of the retainer progresses, aluminum may also increase. Increasing silver or silver and iron may also be the result of wear of the plated hook-type seal rings in the converter high clutch areas.

The transmission is air-cooled; therefore, there should be no liquid-coolant contamination problems.

COMPONENT:	**DETROIT DIESEL ALLISON XT1410-5A (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
XT-1410-5A	M88A2	AQAH

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni
Normal Range	0-266	0-49	0-18	0-7	0-659	0-19	0-32	0-6
Marginal Range	267-328	50-60	19-22	8-9	660-812	20-24	33-40	7
High Range	329-410	61-75	23-28	10-11	813-1014	25-29	41-50	8-9
Abnormal	411+	76+	29+	12+	1015+	30+	51+	10+
Abnormal Trend (PPM Increase in 10 Hrs)	82	15	5	3	203	6	10	3

NOTE:

* Value is low or unchanged from previous value listed for the same element.

Table 1 - JOAP ATOMIC EMISSION ROTRODE LIMITS (CONTINUED)

	Pb	Mo	Mg	Ti	Na	Zn	B
Normal Range	0-184	0-9	0-226	0	0-27	0-746	0-2
Marginal Range	185-226	10-11	227-279	*	28-33	747-918	3
High Range	227-283	12-14	280-348	1	34-42	919-1147	4
Abnormal	284+	15+	349+	2+	43+	1148+	5+
Abnormal Trend (PPM Increase in 10 Hrs)	56	4	69	1	8	229	2

TECHNICAL INFORMATION

The XT1410-5A transmission does not use engine oil MIL-L-2104; it uses Caterpillar Transmission/Drive Train oil meeting Caterpillar specification TO-4 (Cat TDTO, TO-4). This oil is specially formulated for transmissions and provides improved control of friction with the clutch, steering and brake plates. The most apparent benefit of using the Cat TDTO, TO-4 oil is the improved steering response.

Increasing copper (Cu) usually indicates wear of clutch, steering and brake plates. Rapid increases in Cu are normally experienced during initial break-in of new clutch, steering and brake plates in new or rebuilt transmissions and output reduction (final drive) assemblies.

The transmission center section assembly and the two output reduction (final drive) assemblies share a common oil system with continuous oil exchange. Therefore, an oil analysis alone cannot indicate which of the three assemblies is encountering excessive wear. This can only be determined by careful observation and analysis of transmission and/or vehicle performance symptoms or inspections. For this reason, whenever a failure has generated debris, the system, including oil coolers, oil lines, transmission center section and both right and left hand output reduction (final drive) assemblies must be thoroughly flushed or disassembled for cleaning.

When aluminum (Al) or aluminum and iron (Fe) are increasing excessively, wear is occurring in the transmission torque converter.

When silver (Ag) or silver and iron (Fe) are increasing excessively, wear is probably occurring in the steer flywheel drive gear bushing (in units prior to S/N BMY0282) or the thrust washers in the low, intermediate, reverse or output carriers. This may also indicate wear of the converter stator retainer washer. As wear of the retainer progresses, aluminum may also increase. Increasing silver or silver and iron may also be the result of wear of the silver-plated hook-type seal rings in the converter high clutch area.

The transmission oil is air-cooled. There should be no liquid coolant contamination problems.

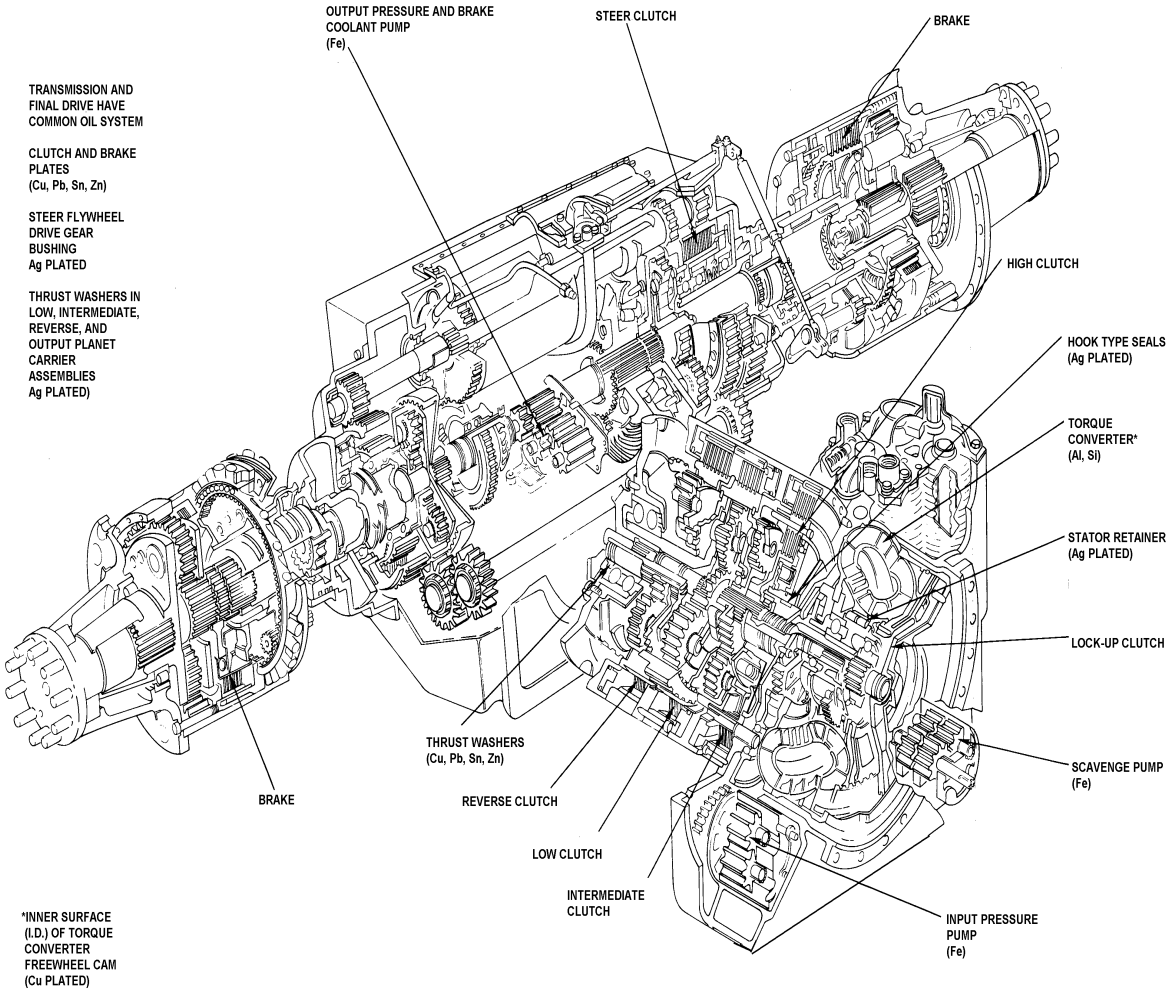

FIGURE 1. Detroit Diesel Allison XT1410-5A

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COMPONENT:	**DETROIT DIESEL ALLISON G 250-1A (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
G250-1A	M551 OPFOR	ALDG
G250-1A	M551A1	ALBG

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-122	0-20	0-27	0-11	0-194	0-52	0-23		0-103	0-9	
Marginal Range	123-151	21-25	28-33	12-13	195-238	53-64	24-28		104-127	10-11	
High Range	152-188	26-31	34-41	14-16	239-298	65-81	29-35		128-158	12-14	
Abnormal	189+	32+	42+	17+	299+	82+	36+		159+	15+	
Abnormal Trend (PPM Increase in 10 Hrs)	13	3	3	2	23	4	3		9	2	

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COMPONENT:	GENERAL ELECTRIC HMPT 500 (TRANSMISSION)

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
HMPT-500	M2	APAG
HMPT-500	M2A1	ALEG
HMPT-500	M2A2	TARG
HMPT-500	M2A3	N/A
HMPT-500	M3	APBG
HMPT-500	M3A1	ALFG
HMPT-500	M3A2	TASG
HMPT-500	M3A3	N/A
HMPT-500	M7A3 BFIST	BSTG
HMPT-500	M993	TANG
HMPT-500-3	M2	APAH
HMPT-500-3	M2A1	ALEH
HMPT-500-3	M2A2	TARH
HMPT-500-3	M3	APBH
HMPT-500-3	M3A1	ALFH
HMPT-500-3	M3A2	TASH
HMPT-500-3	M7	AP7G
HMPT-500-3	M993	TANH
HMPT-500-3E	M2	APAJ
HMPT-500-3E	M2A1	ALEJ
HMPT-500-3E	M2A2	TARJ
HMPT-500-3E	M3	APBJ
HMPT-500-3E	M3A1	ALFJ

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
HMPT-500-3E	M3A2	TASJ
HMPT-500-3E	M4	APCG
HMPT-500-3E	M993	TANJ
HMPT-500-3EC	M270	N/A
HMPT-500-3EC	M270A1	6BDV
HMPT-500-3EC	M6	AP6G
HMPT-500-3ECB	M2A2	TARL
HMPT-500-3ECB	M2A3	N/A
HMPT-500-3ECB	M3A3	N/A
HMPT-500-3ECB	M7 ODS-SA	AP9G
HMPT-500-3ECB	M7A2	AP8G
HMPT-500-3TE	M2A2	TARK
HMPT-500-3TE	M3A2	TASK
HMPT-500-B	M2	APAK
HMPT-500-B	M2A1	ALEK
HMPT-500-B	M3	APBK
HMPT-500-B	M3A1	ALFK
HMPT-500-B	M993	TANK
HMPT-500-ECB	M2A2ODS	APEG
HMPT-500-ECB	M2A2ODS-E	AFRG
HMPT-500-ECB	M3A2ODS	APFG

TECHNICAL AUTHORITY:	ARMY
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-186	0-8	0-45	0-5	0-276	0-124			0-52		
Marginal Range	187-229	9-10	46-55	6	277-339	125-153			53-64		
High Range	230-286	11-12	56-69	7	340-424	154-191			65-80		
Abnormal	287+	13+	70+	8+	425+	192+			81+		
Abnormal Trend (PPM Increase in 10 Hrs)	20	2	3	2	28	13			4		

TECHNICAL INFORMATION

This is 500-hp hydromechanical power transmission (HMPT) with fully automatic shifting, three forward and one reverse speed ranges.

It is liquid-cooled, but the transmission pressure is normally higher than the liquid-coolant pressure, therefore transmission oil would normally contaminate the coolant in the event of a common leak between the two.

Transmission has a tow pump to provide push- or pull-start capability for the vehicle engine.

Power take-off (PTO) could present wear and oil contamination problems.

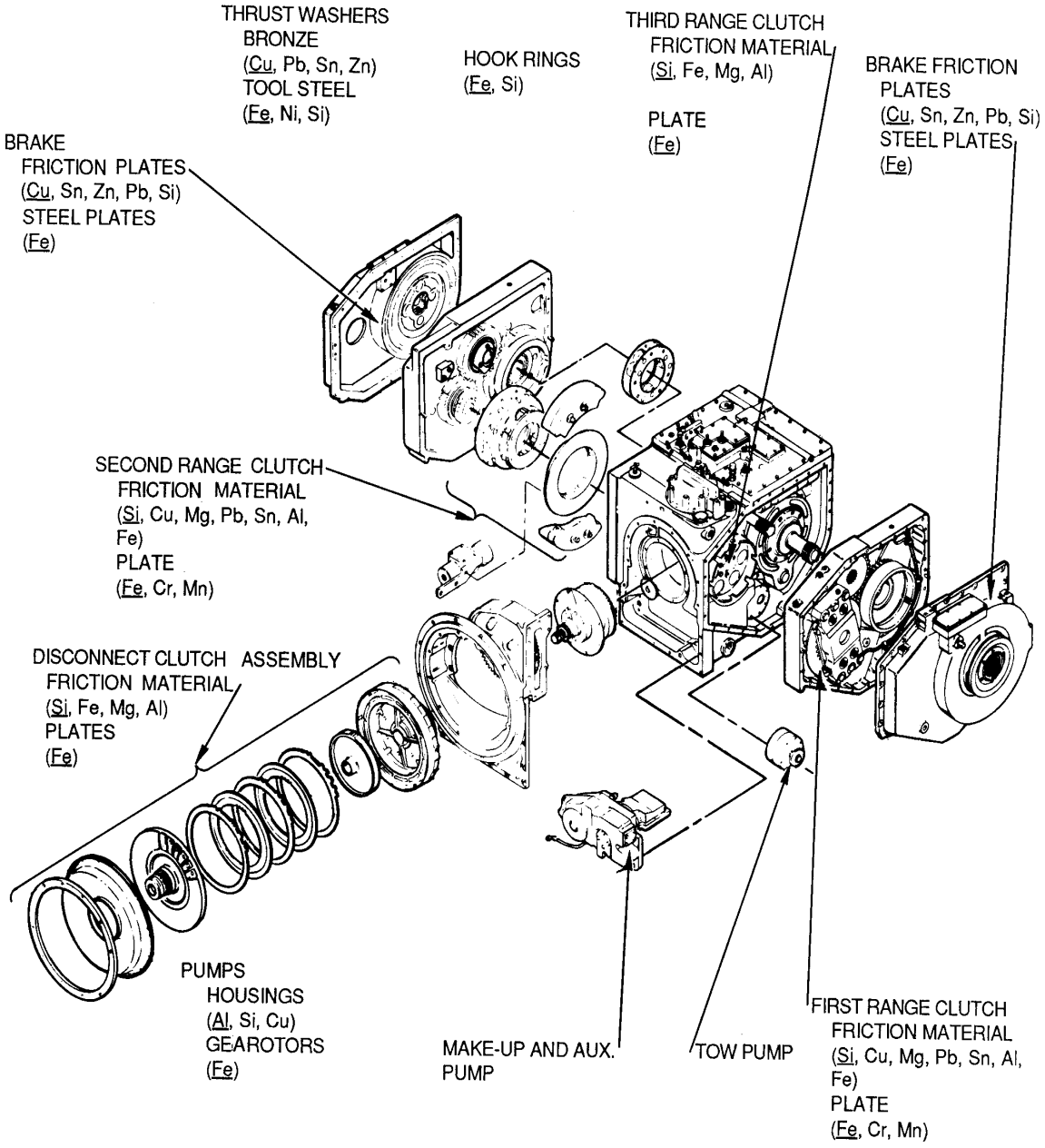

FIGURE 1. General Electric HMPT-500

COMPONENT:	**INTERNATIONAL HARVESTER S-700 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
IHCS-700	**M10A**	**DJUG**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-60	0-4	0-14	0-5		0-89	0-5		0-47		
Marginal Range	61-74	5	15-17	6		90-109	6		48-58		
High Range	75-93	6	18-21	7		110-136	7-8		59-73		
Abnormal	94+	7+	22+	8+		137+	9+		74+		
Abnormal Trend (PPM Increase in 10 Hrs)	19	2	4	2		27	2		15		

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COMPONENT:	**MAN ZF4S-15GP (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-54	0-1	0-7	0-6	0-22	0-26	0-5		0-79		
Marginal Range	55-66		8-9	7	23-27	27-32	6		80-97		
High Range	67-83		10-11	8	28-34	33-40	7-8		98-122		
Abnormal	84+	2+	12+	9+	35+	41+	9+		123+		
Abnormal Trend (PPM Increase in 10 Hrs)	17	2	3	2	7	8	2		24		

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COMPONENT:	**MERCEDES BENZ WF4A018 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
W4A-018	**M973**	**BXAG**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-105		0-19		0-346	0-59	0-10		0-17		
Marginal Range	106-130		20-23		347-426	60-72	11-12		18-21		
High Range	131-162		24-29		427-532	73-90	13-15		22-26		
Abnormal	163+		30+		533+	91+	16+		27+		
Abnormal Trend (PPM Increase in 10 Hrs)	32		6		106+	18	4		5		

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COMPONENT:	**REINTJES VWS2232 (MARINE GEARBOX)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-200				0-25				0-150		
Marginal Range	201-300				251-400				151-250		
High Range	301-500				401-700				251-400		
Abnormal	500+				700+				400+		
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**TWIN DISC 8FLW1307 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-96	0-44	0-10	0-5	0-404	0-77	0-7		0-124		
Marginal Range	97-118	45-54	11-12	6	405-497	78-94	8-9		125-153		
High Range	119-147	55-68	13-15	7	498-622	95-118	10-11		154-191		
Abnormal	148+	69+	16+	8+	623+	119+	12+		192+		
Abnormal Trend (PPM Increase in 10 Hrs)	29	14	4	2	124	24	3		38		

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COMPONENT:	**3S7094 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
3S7094	CAT-D5	EAPG
3S7094	CAT-D5A	EANG
3S7094	CAT-D5B	TEKG

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-318		0-15		0-439	0-89	0-9		0-349		
Marginal Range	319-391		16-18		440-541	90-110	10-11		350-429		
High Range	392-489		19-26		542-676	111-137	12-14		430-536		
Abnormal	490+		24+		677+	138+	15+		537+		
Abnormal Trend (PPM Increase in 10 Hrs)	98		4		135	27	3		107		

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COMPONENT:	**5R6192 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
5R6192	CAT-130G	EHFG
5R6192	CAT-130GNS	EHNG
5R6192	CAT-130GNSC	EJJG
5R6192	CAT-130GNSE	TAAG
5R6192	CAT-130GS	EHPG
5R6192	CAT-130GSCE	TABG

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-154		0-15		0-202	0-69			0-14		
Marginal Range	155-189		16-19		203-248	70-86			15-17		
High Range	190-236		20-24		249-310	87-107			18-21		
Abnormal	237+		25+		311+	108+			22+		
Abnormal Trend (PPM Increase in 10 Hrs)	47		4		62	21			4		

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COMPONENT:	**7G4851 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
7G4851	950BNS	EFWG
7G4851	950BNSCE	EGEG
7G4851	950BS	EFVG
7G4851	950BSCE	EGFG

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-160		0-14	0-4	0-167	0-38	0-6		0-21		
Marginal Range	161-197		15-17	5	168-205	39-47	7		22-25		
High Range	198-247		18-22	6	206-256	48-59	8-9		26-32		
Abnormal	248+		23+	7+	257+	60+	10+		33+		
Abnormal Trend (PPM Increase in 10 Hrs)	49		4	2	51	12	3		6		

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COMPONENT:	**8S3543 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
8S3543	613BSNS	EHZG
8S3543	613BSNSI	EJLG
8S3543	613BSS	EH2G
8S3543	613BSSI	EJKG
8S3543	613BWDNS	EVGG
8S3543	613BWDS	EVFG

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-54		0-15		0-65	0-23	0-4		0-33		
Marginal Range	55-66		16-18		66-80	24-28	5		34-40		
High Range	67-83		19-23		81-101	29-35	6-7		41-50		
Abnormal	84+		24+		102+	36+	8+		51+		
Abnormal Trend (PPM Increase in 10 Hrs)	17		4		20	7	2		10		

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COMPONENT:	**C-51-2012 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-105	0-18	0-13	0-18		0-41	0-12		0-330		
Marginal Range	106-130	19-22	14-17	19-22		42-50	13-15		331-406		
High Range	131-162	23-28	18-21	23-27		51-63	16-19		407-508		
Abnormal	163+	29+	22+	28+		64+	20+		509+		
Abnormal Trend (PPM Increase in 10 Hrs)	32	6	4	5		13	4		102		

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COMPONENT:	**HS 400-3 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
HS400-3	LT	N/A
HS400-3	LVTC-7A1	TWPG
HS400-3	LVTP-7A1	TWSG
HS400-3	LVTR-7A1	TWUG

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-100	0-5	0-15	0-5	0-200	0-30			0-200		
Marginal Range	101-150	6-7	16-20	6-7	201-250	31-40			201-250		
High Range	151-200		21-30		251-300	41-50			251-300		
Abnormal	201+	8+	31+	8+	301+	51+			301+		
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**M1070 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cu	Na	Pb	Si	Sn
Normal Range	0-60	0-3	0-22	0-311	0-11	0-172	0-10	0-9
Marginal Range	61-85	4-5	23-28	312-383	12-13	173-212	11-18	10-15
High Range	85-100	6-7	29-35	384-478	14-16	213-265	19-26	16-20
Abnormal	101+	8+	36+	479+	17+	266+	27+	21+
Trend	18	3	7	96	4	53	5	4

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COMPONENT:	**M1074 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cu	Na	Pb	Si	Sn
Normal Range	0-60	0-3	0-15	0-311	0-10	0-172	0-10	0-9
Marginal Range	61-85	4-5	16-18	312-382	11-13	173-212	11-18	10-15
High Range	85-100	6-7	19-23	383-478	14-16	213-265	19-26	16-20
Abnormal	101+	8+	24+	479+	17+	266+	27+	21+
Trend	18	3	4	96	4	53	5	4

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COMPONENT:	**M1075 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cu	Na	Pb	Si	Sn
Normal Range	0-60	0-3	0-16	0-337	0-11	0-172	0-10	0-9
Marginal Range	61-85	4-5	17-20	338-415	12-13	173-212	11-18	10-15
High Range	85-100	6-7	21-25	416-519	14-16	213-265	19-26	16-20
Abnormal	101+	8+	26+	520+	18+	266+	27+	21+
Trend	18	3	4	104	4	53	5	4

TECHNICAL INFORMATION

NOTES

The prevalent metal/elemental components in these transmissions are comprised of Aluminum (Al), Iron (Fe), Copper (Cu), Tin (Sn) and Lead (Pb). Typical contamination elements are Silicon (Si) from dirt and additive, and Sodium (Na) representing salt from the dirt. MIL-PRF-2104 products are used in the transmissions.

The Titanium (Ti), Chromium (Cr), and Nickel (Ni), are not considered adequate for use as wear metals since there are no components with those elements in any concentration that should be monitored. Therefore, it is recommended that these elements should not be monitored under AOAP for the M1070, M1074, and M1075 transmissions.

Zinc (Zn), Molybdenum (Mo), Boron (B), and Magnesium (Mg) are typical additives found in products under MIL-PRF-2104. Mg can also be found in some metallic alloys. However, when the Mg is an additive it can be found in concentrations as high as 600 PPM. Therefore, Mg is not a good indicator of

wear since there is no way to determine how much is from the additives and how much is from wear. Unlike Zn, not all lubricant products contain B, Mg, or Mo. B and Mo, like Mg, are not recommended for use as elements to be used for condition since they are not wear elements nor a typical value can be determined for oil condition. The element Zn is an exclusive result of additives. The range of values for Zn in oil is 1000-1300 PPM. This range is a normal range for Zn. Values lower than 900 PPM should be considered suspicious since it would be a result of a non-MIL-PRF-2104 product.

COMPONENT:	THM-400/THM-4L80E TRANSMISSION WEAR METAL BASELINES

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
THM-4L80E	M1025	HCFH
THM-4L80E	M1025A2	BCFG
THM-4L80E	M1035A2	BCLG
THM-4L80E	M1043A2	BCJG
THM-4L80E	M1097	TCDE
THM-4L80E	M1097A1	TBUG
THM-4L80E	M1097A2	BCMG
THM-4L80E	M1097R1	DCMF
THM-4L80E	M1113	B6BG
THM-4L80E	M1114	B6CG
THM-4L80E	M1121	B6HG
THM-4L80E	M1123	B6GG
THM-4L80E	M1151	B6DG
THM-4L80E	M1151A1	B6EG
THM-4L80E	M1152	B6FG
THM-4L80E	M1152A1	B6JG
THM-4L80E	M1165	B6KG
THM-4L80E	M1165A1	B6LG
THM-4L80E	M1167	T6LH
THM-4L80E	M707	3RHG
THM-4L80E	M997A2	BCAG
THM-4L80E	M998A2	BCDG

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
THM-4L80E	SECM	SECP
THM-4L80E	SECMA2	SEC3

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE WEAR METAL/COOLANT LIMITS

These interim wear metal guidelines are based on the manufacturer's used lubrication oil chemical analysis. The Oil Analysis Standard Interservice System (OASIS) software will be modified to reflect actual wear metal parameters.

	Al	B	Cu	Fe	Pb	Mg	Mo	Si	Na	Zn
Normal	2-25	10-100	20-150	10-100	5-50	0	0	2-25	<25	600-900
Upper Limits	50-75	200*	300-400	200	150+			50		

* See Note.

NOTE

High readings of B, Mg, Mo, and Zn are usually indications of component's lubrication additive packages. If after establishing a base from obtaining a sample of the servicing oil, increases in the above mentioned elements are an indication of coolant/water contamination. If the component's oil sample is discolored, then recommend the transmission oil be changed.

COMPONENT:	**TX20-6 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE WEAR METAL/COOLANT LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-208	0-23	0-9	0-4		0-41			0-73		
Marginal Range	209-225	24-29	10-11	5		42-50			74-90		
High Range	256-319	30-36	12-14	6		51-63			91-112		
Abnormal	320+	37+	15+	7+		64+			113+		
Abnormal Trend (PPM Increase in 10 Hrs)	64	7	3	2		13			22		

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COMPONENT:	**ZED F MODEL WG-120 (TRANSMISSION)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE WEAR METAL/COOLANT LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Normal Range	0-60				0-25						
Marginal Range	61-75				26-50						
High Range	76-150				51-150	40					
Abnormal	151+				151+						
Abnormal Trend (PPM Increase in 10 Hrs)											

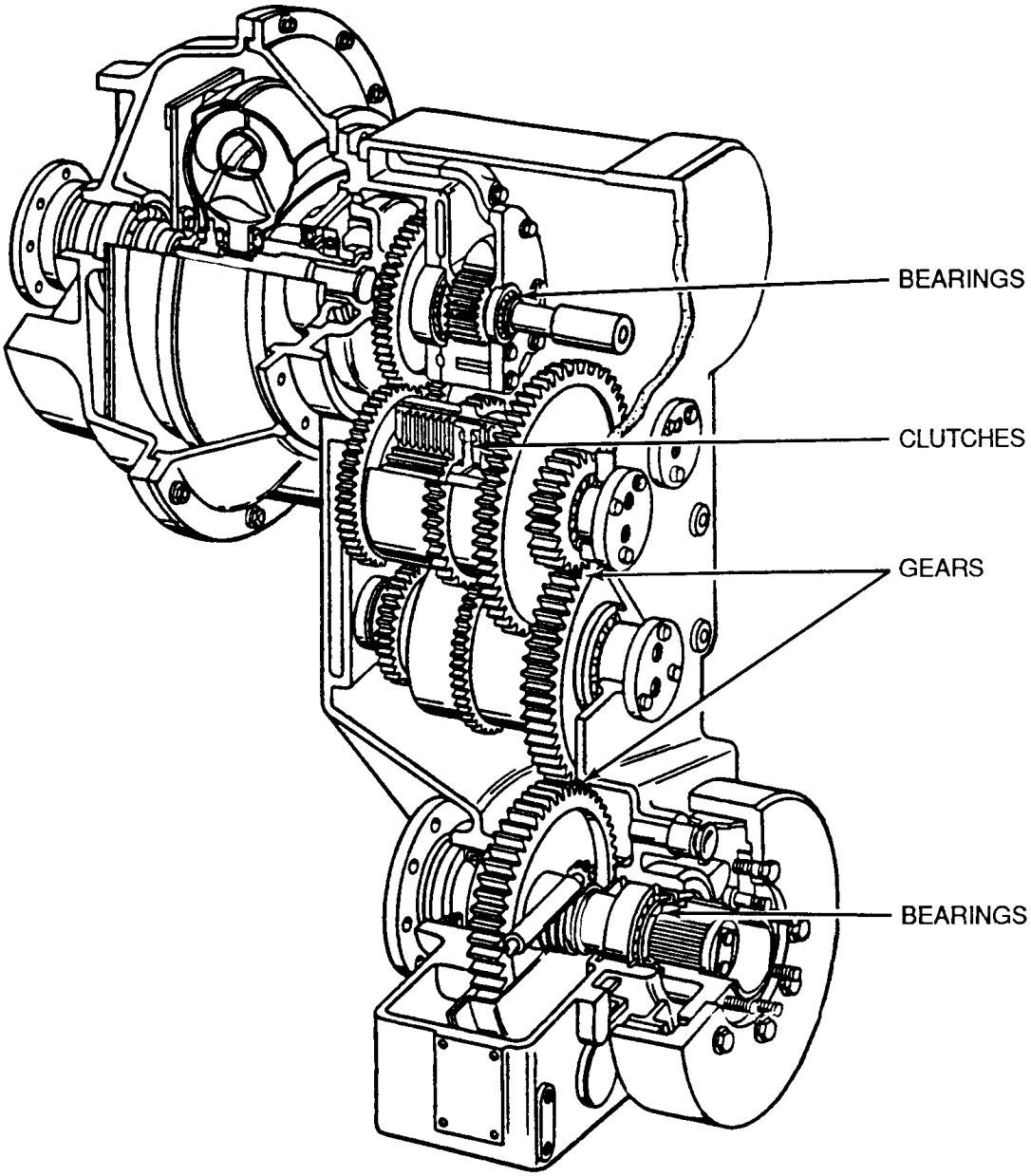

FIGURE 1. ZED F Model WG-120 Transmission - Sectional View

COMPONENT:	**M1000 HYDRAULIC SYSTEM**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
H1-M1000	**M1000**	**CXUN**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE WEAR METAL/COOLANT LIMITS

	Fe	Al	Cu	Mg	Na	Si
Trend	4	7	0-11	0-32	0-15	0-11
Normal	0-13	0-14	12-13	33-39	16-18	12-14
Marginal	14-18	15-20	14-17	40-49	19-23	15-17
High	19-29	20-25	18+	50+	24+	18+
Abnormal	30+	26+	4	10	4	4

TECHNICAL INFORMATION

NOTE

This system requires the use of a hydraulic fluid instead of a product under MIL-PRF-2104.

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COMPONENT:	**M1070 HYDRAULIC SYSTEM**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
H1-M1070	**M1070**	**B5CM**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE WEAR METAL/COOLANT LIMITS

	Fe	Al	Cu	Pb	Na	Si
Trend	4	7	9	2	4	6
Normal	0-13	0-14	0-30	0-4	0-14	0-18
Marginal	14-18	15-20	31-37	5	15-17	19-22
High	19-29	20-25	38-47	6	18-21	23-28
Abnormal	30+	26+	48+	7+	22+	29+

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COMPONENT:	**M1074 HYDRAULIC SYSTEM**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
H1-M1074	**M1074**	**B4GM**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE WEAR METAL/COOLANT LIMITS

	Fe	Al	Cu	Pb	Na	Si
Trend	4	7	38	42	4	6
Normal	0-13	0-14	0-123	0-135	0-16	0-18
Marginal	14-18	15-20	124-152	136-166	17-19	19-22
High	19-29	20-25	153-190	167-208	20-24	23-28
Abnormal	30+	26+	191+	209+	25+	29+

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COMPONENT:	**M1075 HYDRAULIC SYSTEM**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
H1-M1075	**M1075**	**N/A**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE WEAR METAL/COOLANT LIMITS

	Fe	Al	Cu	Pb	Na	Si
Trend	4	7	32	27	4	6
Normal	0-13	0-14	0-104	0-89	0-15	0-18
Marginal	14-18	15-20	105-128	90-110	16-18	19-22
High	19-29	20-25	129-160	111-137	19-23	23-28
Abnormal	30+	26+	161+	138+	24+	29+

TECHNICAL INFORMATION

NOTES

General information on the metallurgy of the hydraulic system indicates the metals found in hydraulic systems are Iron (Fe), Aluminum (Al), Magnesium (Mg), and Copper (Cu).

MIL-PRF-2104 fluid is used for all listed components except for the M1000, which requires a hydraulic fluid.

Additives found in products under MIL-PRF-2104 can contain the following elements: Zn, Mg, Mo, Si, Ca, and B (Ca is not currently included in the AOAP and is only mentioned as reference). The concentrations can vary depending on the technology used. Only the element Zn is found all the time at concentrations between 1000-1300 PPM. Si is found between 5-20 PPM. The other elements can range from 0-600 PPM.

The following elements are not recommended to be monitored/used to determine

condition of the system: Ag, Cr, Ni, Sn, Ti, Pb, B, Mo, and Zn are either not part of the metallurgy of the system (at least in any significance) or the oil contributions would overshadow any wear limits making monitoring worthless. The problem with elements that are in the oil is that they can change in concentration from 0 to the maximum range indicated above and therefore significantly affect AOAP limits.

COMPONENT:	**M88A2 HERCULES MAIN HYDRAULIC SYSTEM**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
H1-M88A2	**M88A2**	**AQAM**

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni
Normal Range	0-3	0	0-1	0-1	0-1	0-16	0-5	0-1
Marginal Range	4-5	*	2	2	2	17-20	6	*
High Range	6	1	3	3	3	21-25	7-8	2
Abnormal	7+	2+	4+	4+	4+	26+	9+	3+
Abnormal Trend (PPM Increase in 10 Hrs)	2	*	2	2	2	5	2	1

Table 1 - JOAP ATOMIC EMISSION ROTRODE LIMITS (Continued)

	Pb	Mo	Mg	Ti	Na	Zn	B
Normal Range	0-1	0-2	0-7	0-1	0-10	0-52	0-2
Marginal Range	2	*	8-15	*	11-12	53-64	3
High Range	3-4	3	16-25	2	13-15	65-80	4
Abnormal	5+	4+	26+	3+	16+	81+	5+
Abnormal Trend (PPM Increase in 10 Hrs)	2	2	4	2	4	16	2

TECHNICAL INFORMATION

Increasing silicon (Si) usually indicates contamination of the servicing component oil system. A drain and flush of the hydraulic system, including replacement of both the return circuit filter and the charge circuit filter, will reduce abnormal silicon analysis readings.

The presence of iron (Fe) or iron and water (H_2O) is probably rust occurring as a result of condensation or internal

oil pump and/or component wear; such as cooler, quick disconnect valves, cross overlines, etc., since this is a closed operating system. Components would include the cooler, quick disconnect valves, cross-over lines, etc. Analysis readings of 1,000 parts per million (PPM) or more of water in a hydraulic oil sample usually warrant a recommendation to change oil and service or replace the filter. The FT-IR test for the presence of water in EP additive fluids is observed as a baseline rise or offset, but does not show the evidence of Tyndal-particulate or colloidal scattering.

COMPONENT:	**M911 HYDRAULIC SYSTEM**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	**ARMY**
STATUS:	**COMPONENT NO LONGER IN SERVICE. WORK PACKAGE RETAINED FOR REFERENCE PURPOSES**

Table 1 - JOAP ATOMIC EMISSION ROTRODE WEAR METAL/COOLANT LIMITS

	Fe	Al	Pb	Na	Si	Cu
Trend	4	7	0-20	6	6	13
Normal	0-13	0-14	21-25	0-29	0-18	0-44
Marginal	14-18	15-20	26-31	30-36	19-22	45-54
High	19-29	20-25	32+	37-45	23-28	55-67
Abnormal	30+	26+	6	46+	29+	68+

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NAVY (SHIPS) PHYSICAL PROPERTY TEST LIMITS BY TYPE OIL AND USE

This work package is composed of a series of tables for each type of oil used by ship equipment. The test limits for the oils are based upon the type of oil in use as well as the specific type of equipment in which it is being used.

1. Purpose. The purpose of this work package is to establish the test limits for specific Navy Ships Lubricating Oils when used in the listed applications.

2. Applicability. The provisions of this work package apply to all Navy Oil Analysis Program Laboratories.

3. References: The following references should be consulted for additional guidance on the testing and evaluation of in-service ships lubricants and hydraulic fluids:

   a. Naval Ships Technical Manual (NSTM) Chapter 262, Lubricating Oils, Greases, Specialty Lubricants, and Lubrication Systems

   b. Naval Ships Technical Manual (NSTM) Chapter 556, Hydraulic Equipment (Power Transmission And Control)

   c. Naval Ships Technical Manual (NSTM) Chapter 562, Naval Surface Ships Steering Systems

   d. MIP 5161/9R3-80, MRC 7CRW

   e. Naval Ships Technical Manual (NSTM) Chapter 516, Refrigeration Systems

4. Work Package Structure. This Work Package is divided into forty-two sections.

WP 101 01 - MIL-PRF-2104 (15W-40) Diesel Lube Oil, Surface ship and Submarine

WP 101 02 - MIL-PRF-9000 Diesel Lube Oil (MS-9250) Diesel.Engines, Surface Ships, Carriers, and Submarines

WP 101 03 - MOBIL DELVAC 1640 Diesel Lube Oil, Surface Ship Engines and Reduction Gears

WP 101 04 - MIL-PRF-5606 Hydraulic Fluid, Hydraulic Systems

WP 101 05 - MIL-DTL-17111 Hydraulic Fluid, Hydraulic Systems

WP 101 06 - MIL-PRF-17331 Steam Turbine Lube Oil (2190TEP) Controllable-Pitch-Propeller (CPP)/ Controllable Reversible Pitch Propeller (CRP), Surface Ship

WP 101 07 - MIL-PRF-17331 Steam Turbine Lube Oil (2190 TEP) as Hydraulic Fluid or MIL-DTL-32353 Hydraulic & Lubricating Oil, Synthetic Hydrocarbon Base (2190-S) as Hydraulic Fluid Submarines (SSN, SSBN, SSGN, MTS) Hydraulic Systems Internal to the Pressure Hull

WP 101 08 - MIL-PRF-17331 Steam Turbine Lube Oil (2190 TEP), Surface Ships and Submarine Lube Systems (e.g. LPAC, HPAC, Cranes)

WP 101 09 - MIL-PRF-17331 Steam Turbine Lube Oil (2190 TEP), Surface Ship Lube Systems (MRG, LCS1 AFT Line Shaft Bearing LO System)

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LUBRICANT:	**MIL-PRF-2104 (15W-40) DIESEL LUBE OIL**
APPLICABLE SYSTEMS:	**DIESEL ENGINES, SURFACE SHIP AND SUBMARINE**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
CRANE	ALL	2A05
EDG	DDG1000 Class	EF01
EDG	SSN-774 Class	EH50
MPE or MPDE	MCM-1 Class	MR0F or MR0G
SSG or SSDG	LCC-19 Class	SH13
SSG or SSDG	MCM-1 Class	SR00

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS[1]

	Limits [2]
Spectrometric Test Required	Refer to applicable JOAP Manual Vol 4 Work Pack by T/M/S

TABLE 2. Water Content[1]

Test Details	Limits [2]	Recommendation [3]
Water (Crackle) Or	Pass/Fail	Determine source and repair. Purify or change oil
Water ASTM D 6304 (Karl Fisher)	2000 PPM Maximum	

TABLE 3. Viscosity[1]

Test Details	Limits [2]	Recommendation [3]
Viscosity (cSt) at 104 °F/40°C	<85 Unacceptable	Immediately determine source of fuel leak and change oil prior to running.
	85 to 144 Acceptable	None
	>144 Unacceptable	Change oil at next scheduled opportunity.

TABLE 4. Fuel Dilution[1]

Test Details	Limits [2]	Recommendation [3]
Fuel Dilution, %	0.0 to <2.0 Acceptable	None
	2.0 to <3.5 Marginal	Determine cause and repair.
	3.5 to <5.0 Warning	Determine cause, repair, change oil.
	≥5.0 Unacceptable	Immediately determine cause, repair, and change oil prior to running.

Notes: [1] See Reference a for additional guidance.

[2] These limits do not apply to surface ships in the Diesel Readiness System (DRS) program. Report DRS results with no recommendation

[3] Resample if results may not be indicative of actual system condition.

LUBRICANT:	MIL-PRF-9000 DIESEL LUBE OIL (MS 9250)
APPLICABLE SYSTEMS:	DIESEL ENGINES, SURFACE SHIP, CARRIERS, AND SUBMARINE

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
CRANE	ALL	2A03
MISC	ALL	5A02
TBCHARGE	ALL	7001
N/A	ALL	AA02
ACOMP	ALL	AA02
EDG	LHD-1 Class	EI13
EDG	SSN 688 Class	ET53
EDG	SSBN/SSGN 726 Class	ET03
EDG	SSN-21 Class	ET13
EDG	CVN-68 Class	EE08
EDG	CVN-78 Class	N/A
GEARS	ALL	J005
PUMP	ALL	P003
TANK	ALL	T001
PMENDBEAR	DDG-1000 Class	B001

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

Test	Limits
Spectrometric Required	Refer to tables in JOAP Manual Vol IV by T/M/S

TABLE 2. Water Content [1]

Test Details	Limits [2]	Recommendation [3]
Water (Crackle) Or	Pass/Fail	Determine source and repair. Purify or change oil.
Water by ASTM D 6304	Pass 2000 PPM Maximum	

TABLE 3. Viscosity [1]

Test Details	Limits [2]	Recommendation [3]
Viscosity (cSt) at 104 °F/40°C	<90 Unacceptable	Determine cause, repair and change oil.
	90 to 200 Acceptable	None
	>200 Unacceptable	Determine cause, repair and change oil

TABLE 4. Fuel Dilution [1,4]

Test Details	Limits [2]	Recommendation [3]
Fuel Dilution, %	0.0 to <2.0 Acceptable	None
	2.0 to <3.5 Marginal	Determine Cause and repair,
	3.5 to <5.0 Warning	Determine cause, repair and change oil.
	≥5.0 Unacceptable	Immediately determine cause, repair, and change oil prior to running.

Notes:
1. See Reference a for additional guidance.
2. These limits do not apply to surface ships in the Diesel Readiness System (DRS) program. Report DRS results with no recommendation
3. Resample if results may not be indicative of actual system condition.
4. Applies to engine samples only.

LUBRICANT:	**MOBIL DELVAC 1640 DIESEL LUBE OIL**
APPLICABLE SYSTEMS:	**DIESEL ENGINES AND REDUCTION GEARS, SURFACE SHIPS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
MDE or MPDE	LCS-1 Class	ML01
MDE or MPDE	LCS-2 Class	ML02
RG	LCS-2 Class	RL2Y
SSG or SSDG	LCS-1 Class	SH1L
SSG or SSDG	LCS-2 Class	SH2L

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

Test	Limits
Spectrometric Required	Refer to tables in JOAP Manual Vol IV by T/M/S

TABLE 2. Water Content *[1]*

Test Details	Limits *[2]*	Recommendation *[3]*
Water by ASTM D 6304[5]	Pass 2000 PPM Maximum	Determine source and repair, purify or change oil.
Water by ASTM D 6304[4]	0 – 0.19%	Acceptable
	0.20 – 0.40%	Purify. Isolate source and repair.
	> 0.40%	Repair before operating. Change oil.

TABLE 3. Viscosity [1]

Test Details	Limits [2]	Recommendation [3]
Viscosity (cSt) at 104 °F/40°C [5]	<90 Unacceptable	Determine cause, repair and change oil.
	90 to 200 Acceptable	None
	>200 Unacceptable	Determine cause, repair and change oil.
Viscosity (cSt) at 104 °F/40°C [4]	< 98 Unacceptable	Secure equipment. Repair fuel source prior to operation, change oil after repairs.
	98 to 107	Troubleshoot and repair fuel source. TYCOM DFS required to operate. Change oil after repairs.
	108 to 117	Troubleshoot and plan to repair fuel source. Oil change not required.
	118 to 165 Acceptable	None
	> 165 Unacceptable	Change Oil.

TABLE 4. Fuel Dilution [1,4]

Test Details	Limits [2]	Recommendation [3]
Fuel Dilution, %	0.0 to <2.0 Acceptable	None
	2.0 to <3.5 Marginal	Determine Cause and repair,
	3.5 to <5.0 Warning	Determine cause, repair and change oil.
	≥5.0 Unacceptable	Immediately determine cause, repair, and change oil prior to running.

TABLE 5. Particle Count[5]

Test Details	Limits		Recommendation[2]
Particle Count (Electronic)	NAS 1638 Class 11 Ranges included:		Replace system filters. Filter oil or replace oil.
	Size	**Max**	
	5-15	512,000	
	15-25	91,200	
	25-50	16,200	
	50-100	2,880	
	100+	512	

TABLE 6. Total Acid Number [5]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	3.5 Maximum	Change Oil

Notes:
[1] See Reference a for additional guidance.
[2] These limits do not apply to surface ships in the Diesel Readiness System (DRS) program. Report DRS results with no recommendation
[3] Resample if results may not be indicative of actual system condition.
[4] Applies to engine samples only.
[5] Applies to reduction gear samples only.

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LUBRICANT:	**MIL-PRF-5606 HYDRAULIC FLUID**
APPLICABLE SYSTEMS:	**HYDRAULIC SYSTEMS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
N/A	ALL	N/A

TABLE 1. Water Content[1]

Test Details	Limits	Recommendation[2]
ASTM D 6304 (Karl Fisher)	500 PPM Maximum	Filter or Change oil.

TABLE 2. Particle Count[1]

Test Details	Limits		Recommendation[2]
Particle Count (Electronic)	NAS 1638 Class 9 Ranges included:		Replace system filters. Filter oil or replace oil.
	Size	**Max**	
	15-25	22,800	
	25-50	4,050	
	50-100	720	
	100+	128	

Notes: [1] See Reference a for additional information and guidance.
[2] Resample if results may not be indicative of actual system condition.

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LUBRICANT:	**MIL-DTL-17111 HYDRAULIC FLUID (POWER TRANSMISSION)**
APPLICABLE SYSTEMS:	**HYDRAULIC SYSTEMS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
WINCH	ALL	W004

TABLE 1. Water Content

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM Maximum	Filter or Change oil.

TABLE 2. Particle Count

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 9 Ranges included:		Replace system filters. Filter oil or replace oil.
	Size	**Max**	
	15-25	22,800	
	25-50	4,050	
	50-100	720	
	100+	128	

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LUBRICANT:	**MIL-PRF-17331 STEAM TURBINE LUBE OIL (2190)**
APPLICABLE SYSTEMS:	**CONTROLLABLE PITCH PROPELLER (CPP) / CONTROLLABLE REVERSIBLE PITCH PROPELLER (CRP) SURFACE SHIP**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
CPP or CRP	CG-47 Class	C80M
CPP or CRP	CG-68 Class	C8AM
CPP or CRP	DDG-51 Class	CF1M
CPP or CRP	LHA-6 Class	CI0M
CPP or CRP	LHD-1 Class	CI1M
CPP or CRP	LHD-8 Class	CI2M
CPP or CRP	LPD-17 Class	CJ0M
CPP or CRP	LSD-41 Class	CN0M
CPP or CRP	LSD-49 Class	CP0M
CPP or CRP	MISC	CH5M

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

Test	Limits *
Spectrometric Required	Refer to tables in JOAP Manual Vol IV by T/M/S

TABLE 2. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM Maximum	Purify or Change oil.

TABLE 3. Viscosity [1]

Test Details	Limits	Recommendation
Viscosity, (cSt) at 104ºF/40ºC	<70 Unacceptable	Determine cause, repair, and change oil
	70 to 73 Unacceptable	Notify
	74 to 97 Acceptable	None
	>97 Unacceptable	Determine cause, repair, and change oil

TABLE 4. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0.50 Maximum	Change oil

TABLE 5. Particle Count [1]

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 8 Ranges included:		Purify or filter the oil
	Size	Max	
	5-15	64,000	
	15-25	11,400	
	25-50	2,025	
	50-100	360	
	100+	64	

Notes: [1] See Reference a for additional information and guidance.

TABLE 6. Flashpoint [1,2]

Test Details	Limits	Recommendation
Continuous Closed Cup Flashpoint, °F	400°F or greater	Satisfactory: No action required.
	370-399°F	Minor Degradation: Equipment may continue to be used during resolution/confirmation of the results. Notification to TYCOM, Chain of Command, and NSWCPD Lubricants ISEA is required and submit samples at the earliest opportunity. The NSWCPD Lubricants ISEA will begin to closely monitor the oil properties and inform TYCOM of results and/or actions that need to be taken.
	370°F or less	Degraded Oil: Immediately notify Chain of Command, TYCOM, and NSWCPD Lubricants ISEA. Submit samples at earliest opportunity. Perform flash points daily in order to continue to use affected equipment. Record the daily tests, and forward findings to TYCOM and NSWCPD Lubricants ISEA. If flash points indicate a declining trend (from earlier tests) use of the affected equipment shall be discontinued and any ignition source secured. TYCOM and NSWCPD Lubricants and Equipment ISEAs shall be notified for further guidance.

Notes: [1] See Reference a for additional information and guidance.
[2] Only applicable to ship classes with electric heaters on CPP Systems (CG-47 Class, DDG-51 Class, LHD-8 Class, LHA-6 Class, LPD-17 Class, LSD-41 Class, LSD-49 Class)

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LUBRICANT:	**MIL-PRF-17331 STEAM TURBINE LUBE OIL (2190 TEP) AS HYDRAULIC FLUID OR MIL-DTL-32353 HYDRAULIC & LUBRICATING OIL, SYNTHETIC HYDROCARBON BASE (2190-S) AS HYDRAULIC FLUID**
APPLICABLE SYSTEMS:	**SUBMARINES (SSN, SSBN, SSGN, MTS) HYDRAULIC SYSTEMS INTERNAL TO THE PRESSURE HULL**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
HYD	**SSN-688 Class**	**3A06**
HYD	**SSN-774 Class**	**3A06**
HYD	**SSBN/SSGN 726 Class**	**3A06**
HYD	**SSN-21 Class**	**3A06**

TABLE 1. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM Maximum	Perform spectrometric testing if water is above 500 PPM to determine salt or fresh water contamination. Filter or change oil.

TABLE 2. Particle Count [1]

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 9 Ranges included:		Replace system filters. Filter oil (See NSTM 556 for additional information and guidance.)
	Size	Max	
	15-25	22,800	
	25-50	4,050	
	50-100	720	
	100+	128	

Notes: [1] See Reference b for additional information and guidance.

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LUBRICANT:	**MIL-PRF-17331 STEAM TURBINE LUBE OIL (2190 TEP)**
APPLICABLE SYSTEMS:	**SURFACE SHIP AND SUBMARINE LUBE OIL SYSTEMS (e.g. LPAC, HPAC, CRANES)**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
GRG	CG-47 Class	H80Y
MISC	ALL	5A01
BLOWER	ALL	6A0Y
ACOMP	ALL	AA01
HPAC	ALL	AA01
MPAC	ALL	AA01
LPAC	ALL	AA01
BEARING	ALL	B001
GEAR	ALL	J001
PUMP	ALL	P001
TANK	ALL	T002

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

Test	Limits *
Spectrometric Required	Refer to tables in JOAP Manual Vol IV by T/M/S

TABLE 2. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM Maximum	Change or renovate oil

TABLE 3. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0.50 Maximum	Change Oil

TABLE 4. Viscosity [1]

Test Details	Limits	Recommendation
Viscosity (cSt) at 104°F/40°C	<70 Unacceptable	Determine cause, repair, and change oil.
	70 to 73 Unacceptable	Notify
	74 to 97	None
	>97 Unacceptable	Determine cause, repair, and change oil.

Notes: [1] See Reference a for additional information and guidance.

LUBRICANT:	**MIL-PRF-17331 STEAM TURBINE LUBE OIL (2190 TEP)**
APPLICABLE SYSTEMS:	**SURFACE SHIP LUBE SYSTEMS (E.G. MAIN REDUCTION GEARS (MRG), LCS-1 AFT LINE SHAFT BEARING LUBE OIL SYSTEM)**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
MRG	CG-47 Class	R80Y
MRG	DDG-51 Class	RF1Y
MRG	LCC-19 Class	RH1Y
MRG	LCS-1 Class	RL1Y
MRG	LHD-1 Class	RI1Y
MRG	LHD-8 Class	RI2Y
MRG	LHA-6 Class	RI0Y
MRG	LPD-17 Class	RJ1Y
MRG	LSD-41 Class	RN0Y
MRG	LSD-49 Class	RP0Y
MRG	ALL	R50Y
LOPOWERPACK/AFT-LSB-LOSYSTEM 1	LCS-1 Class	5A01

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

Test	Limits *
Spectrometric Required	Refer to tables in JOAP Manual Vol IV by T/M/S

TABLE 2. Water Content [2]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM Maximum	Change or renovate oil

TABLE 3. Total Acid Number [2]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0.50 Maximum	Change Oil

TABLE 4. Viscosity [2]

Test Details	Limits	Recommendation
Viscosity (cSt) at 104°F/40°C	<74 Unacceptable	Determine cause, repair, and change oil.
	74 to 97 Acceptable	None
	>97 Unacceptable	Determine cause, repair, and change oil

TABLE 5. Particle Count [2,3]

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 10 Ranges included:		Replace system filters. Filter oil.
	Size	Max	
	25-50	8,100	
	50-100	1,440	
	100+	256	

TABLE 6. Particle Count [2,]

Test Details	Limits	Recommendation
Particle Count (Electronic) ISO 4406 (4 µm, 6 µm, 14 µm); Code, Max	-/15/13	Purify oil

TABLE 7. Flashpoint [2 5,]

Test Details	Limits	Recommendation
Continuously Closed Cup Flashpoint, °F	400°F or greater	Satisfactory: No action required.
	399°F or less	Degraded Oil: Immediately notify Chain of Command, TYCOM, and NSWCPD Lubricants ISEA. Submit samples at earliest opportunity. Perform flash points daily in order to continue to use affected equipment. Record the daily tests, and forward findings to TYCOM and NSWCPD Lubricants ISEA. If flash points indicate a declining trend (from earlier tests) use of the affected equipment shall be discontinued and any ignition source secured. TYCOM and NSWCPD Lubricants and Equipment ISEAs shall be notified for further guidance.

Notes:
1. LOPOWERPACK applies to LCS-1,3 and AFT-LSB-LOSYSTEM applies to LCS-5AF
2. See Reference a for additional information and guidance
3. Applies to reduction gear samples only.
4. Applies to LCS-5AF AFT LSB LO System samples only.
5. Only applicable to ship classes with electric heaters on MRG Systems (CG-47 Class, DDG-51 Class, LCS-1 Class, LHD-8 Class, LHA-6 Class, LPD-17 Class, LSD-41 Class, LSD-49 Class)

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LUBRICANT:	**MIL-PRF-17331 STEAM TURBINE LUBE OIL (2190 TEP)**
APPLICABLE SYSTEMS:	**SUBMARINE PROPULSION AND LOW PRESSURE BLOWER**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
N/A	N/A	N/A

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

Test	Limits *
Spectrometric Required	Refer to tables in JOAP Manual Vol IV by T/M/S

TABLE 2. Water Content

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM Maximum	Change or purify oil.

TABLE 3. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0.50 Maximum	Change oil.

TABLE 4. Viscosity [1]

Test Details	Limits			Recommendation
		Min	Max	
Viscosity (cSt) at 104°F/40°C	Gears	74	97	Acceptable
	Other Systems *	70	73	Notify
		74	97	Acceptable

Notes: [1] See Reference a for additional information and guidance.

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LUBRICANT:	**MIL-PRF-32353 SYNTHETIC STEAM TURBINE LUBE OIL (2190-S)**
APPLICABLE SYSTEMS:	**SURFACE SHIP AND SUBMARINE LUBE OIL SYSTEMS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
ALL	ALL	5A06

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

Test	Limits *
Spectrometric Required	Refer to tables in JOAP Manual Vol IV by T/M/S

TABLE 2. Water Content

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM Maximum	Change or purify oil.

TABLE 3. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0.50 Maximum	Change oil.

TABLE 4. Viscosity [1]

Test Details	Limits			Recommendation
Viscosity (cSt) at 104°F/40°C		Min	Max	
	Gears	74	97	Acceptable
	Other Systems	70	73	Notify
		74	97	Acceptable

Notes: [1] See Reference a for additional information and guidance.

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LUBRICANT:	**MIL-PRF-17672 HYDRAULIC FLUID (2075TH/2110TH/2135TH)**
APPLICABLE SYSTEMS:	**SURFACE SHIP HYDRAULIC SYSTEMS (e.g. SIDEPORT CARGO CRANES, DAVITS, BALLAST CONTROL HYDRAULIC POWER UNIT, INTERCEPTOR, LHRS)**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
CRANE	ALL	2A02
CRANE	ALL	2A06
JLG	ALL	2A06
HPU	ALL	3A03
INTERCEPTOR	LCS-1 Class	3A03
BALLHY	ALL	3A03
HPU	ALL	3A04
HVCS	ALL	3A04
MISC	ALL	5A04
ACOMP	ALL	AA04
GEAR	ALL	J004
CWELEV	LPD-17 Class	LK01
DAVIT	ALL	Q002
DAVIT	ALL	Q003
TANK	ALL	T004
WINCH	ALL	W001

TABLE 1. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM (0.05%) Maximum	Purify or Change oil.

TABLE 2. Particle Count [1, 2]

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 8 Ranges included:		Filter or Change oil.
	Size	Max	
	5-15	64,000	
	15-25	11,400	
	25-50	2,025	
	50-100	360	
	100+	64	

TABLE 3. Particle Count [1, 3]

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 10 Ranges included:		Filter or Change oil.
	Size	Max	
	5-15	256,000	
	15-25	45,600	
	25-50	8,100	
	50-100	1,440	
	100+	256	

Notes: 1 See Reference b for additional information and guidance.
2. Applies to all samples EXCEPT MCM-1 class HPU.
3. Applies to ONLY MCM-1 class HPU samples.

LUBRICANT:	**MIL-PRF-17672 HYDRAULIC FLUID (2075TH, 2110TH, 2135TH)**
APPLICABLE SYSTEMS:	**IN-SERVICE SUBMARINES (SSN, SSBN, SSGN) HYDRAULIC SYSTEMS EXTERNAL TO THE PRESSURE HULL AND HYDRAULIC COMPENSATING SYSTEMS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
HYD	**SSN-688 Class**	**3A02**
HYD	**SSN-774 Class**	**3A02**
HYD	**SSBN/SSGN 726 Class**	**3A02**
HYD	**SSN-21 Class**	**3A02**

TABLE 1. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM Maximum	Perform spectrometric testing if water is above 500 PPM to determine salt or fresh water contamination. Filter or Change oil.

TABLE 2. Particle Count [1]

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 10 Ranges included:		Replace system filters. Filter oil.
	Size	Max	
	15-25	45,600	
	25-50	8,100	
	50-100	1,440	
	100+	256	

Notes: [1] See Reference b for additional information and guidance.

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LUBRICANT:	**MIL-PRF-17672 HYDRAULIC FLUID (2075TH)**
APPLICABLE SYSTEMS:	**RAST SYSTEM HYDRAULIC POWER UNIT (WHPU) RESERVOIR, ROPE ACCUMULATOR, LINES A AND G**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
WHPU Reservoir	**ALL**	**W001**
WHPU Rope Accumulator	**ALL**	**W001**
WHPU Line A	**ALL**	**W001**
WHPU Line G	**ALL**	**W001**

TABLE 1. Water Content [1]

Test Details	Limits	Recommendation	Reference
Water ASTM D 6304 (Karl Fisher)	500 PPM Maximum	Filter or Change oil.	

TABLE 2. Particle Count [1]

Test Details	Limits		Recommendation	Reference
Particle Count (Electronic)	NAS 1638 Class 10 Ranges included:		Replace system filters. Filter oil or change oil.	
	Size	Max		
	15-25	45,600		
	25-50	8,100		
	50-100	1,440		
	100+	256		

Notes: [1] See Reference b for additional information and guidance.

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LUBRICANT:	**MIL-PRF-17672 HYDRAULIC FLUID (2075TH)**
APPLICABLE SYSTEMS:	**SUBMARINE DSRV/DSS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
N/A	N/A	N/A

TABLE 1. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM Maximum	Filter or Change oil.

TABLE 2. Particle Count [1]

Test Details	Limits		Recommendation
Particle Count (Electronic) Operating limits, not for overhaul	NAS 1638 Class 10 Ranges included:		Replace system filters. Filter oil.
	Size	Max	
	5-15	256,000	
	15-25	45,600	
	25-50	8,100	
	50-100	1,440	
	100+	256	

Notes: [1] See Reference b for additional information and guidance.

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LUBRICANT:	**MIL-PRF-17672 HYDRAULIC FLUID (2110TH)** [1]
APPLICABLE SYSTEMS:	**LCS-1 CLASS ROLLS ROYCE WATERJET HYDRAULIC POWER UNIT**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
RR WATERJET HPU	**LCS-1 Class**	**WJ01**

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

Test	Limits *
Spectrometric Required	Refer to tables in JOAP Manual Vol IV by T/M/S

TABLE 2. Water Content [2]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	< 500 PPM Maximum	Acceptable
	500 to 2000 PPM	Perform spectrometric testing if water is above 500 PPM to determine salt or fresh water contamination. Filter or Change oil.
	> 2000 PPM	Change oil. Change filters. Submit 2K for RMC tech assist as significant damage may have occurred.

TABLE 3. Particle Count [1]

Test Details	Limits	Recommendation
Particle Count (Electronic) ISO 4406 ((4 µm, 6 µm, 14 µm), Code, Max	-/15/12	Change Filters
	-/16/13	Purify and change filters. Submit 2K for RMC technical assistance during purification.
	-/18/15	Do not operate. Submit 2K for RMC technical assistance as significant damage may have occurred.

Notes: [1] Mobil DTE 10 Excel 46 and Mobil DTE 25 are considered acceptable alternatives to MIL-PRF-17672 2110TH for the systems listed in this work package and the same limits apply.

[2.] See Reference b for additional information and guidance.

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LUBRICANT:	**MIL-PRF-17672 HYDRAULIC FLUID (2110TH)** [1.]
APPLICABLE SYSTEMS:	**LCS-2 CLASS WARTSILLA WATERJET HYDRAULIC POWER UNIT (HPU)**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
Waterjet Hydraulic Power Unit (HPU)	**LCS-2 Class**	**WJO2**

TABLE 1. Water Content [2]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	< 500 PPM Maximum	Acceptable
	500 to 1000 PPM	Perform spectrometric testing if water is above 500 PPM to determine salt or fresh water contamination. Filter or Change oil.
	> 1000 PPM	Change oil. Change filters. Submit 2K for RMC tech assist as significant damage may have occurred.

TABLE 2. Particle Count [2]

Test Details	Limits	Recommendation
Particle Count (Electronic) ISO 4406 ((4 µm, 6 µm, 14 µm), Code, Max	-/16/13	Change Filters
	-/17/14	Purify and change filters. Submit 2K for RMC technical assistance during purification.
	-/18/15	Do not operate. Submit 2K for RMC technical assistance as significant damage may have occurred.

Notes: [1] Mobil DTE 10 Excel 46 and Mobil DTE 25 are considered acceptable alternatives to MIL-PRF-17672 2110TH for the systems listed in this work package and the same limits apply

[2.] See Reference b for additional information and guidance.

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LUBRICANT:	**MIL-PRF-17672 HYDRAULIC FLUID (2110TH)**
APPLICABLE SYSTEMS:	**STEERING GEAR, SURFACE SHIP**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
HVSC	CG-47 Class	3A03
HPU	LCS-1 Class	3A03
HPU	LCS-2 Class	3A03
HYDSTRGAGE	MCM-1 Class	3A04
HYDSTRPUMP	MCM-1 Class	3A04

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

Test	Limits *
Spectrometric Required	Report Only

TABLE 2. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM Maximum	Filter or Change oil.

TABLE 3. Viscosity [1]

Test Details	Limits		Recommendation
Viscosity, (cSt) at 104ºF/40ºC	Min	Max	
	41	51	Change oil.

TABLE 4. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0.4 Maximum	Change oil

TABLE 5. Particle Count [1]

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 8 Ranges included:		Replace system filters. Filter oil.
	Size	Max	
	5-15	64,000	
	15-25	11,400	
	25-50	2,025	
	50-100	360	
	100+	64	

Notes: [1] See Reference c for additional information and guidance

LUBRICANT:	**MIL-PRF-17672 HYDRAULIC FLUID (2110TH) [1]**
APPLICABLE SYSTEMS:	**LCS-2 SMARTPAC HYDRAULIC POWER UNIT AND BOWTHRUSTER AUXILLARY POWER UNIT**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
SMTHPU	LCS-2 Class	3A03
BOWTHRAPU	LCS-2 Class	3A03

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

Test	Limits *
Spectrometric Required	Report Only

TABLE 2. Water Content [2]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM (0.05%) Maximum	Filter or Change oil.

TABLE 3. Particle Count [2, 3]

Test Details	Limits	Recommendation
Particle Count (Electronic) ISO 4406 ((4 µm, 6 µm, 14 µm), Code, Max	-/16/13	Replace system filters. Filter oil.
	-/19/16	Replace system filters. Submit 2K for RMC technical assistance to identify root cause and to perform oil filtration.

Notes: [1] Mobil DTE 10 Excel 46 and Mobil DTE 25 are considered acceptable alternatives to MIL-PRF-17672 2110TH for the systems listed in this work package and the same limits apply

[2.] See Reference c for additional information and guidance

[3] The limit for new oil in this system is ISO -/14/11 Maximum

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LUBRICANT:	**MIL-PRF-17672 HYDRAULIC FLUID (2135TH)**
APPLICABLE SYSTEMS:	**STEERING GEAR, SURFACE SHIP**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
HPU	CG-47 Class	3A04
HPU	DDG-51 Class	3A04
HPU	LHA-6 Class	3A04
HPU	LHD-1 Class	3A04
HPU	LHD-8 Class	3A04
HPU	LPD-17 Class	3A04
HPU	LSD-41/49 Class	3A04

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

Test	Limits *
Spectrometric Required	Report Only

TABLE 2. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM (0.05%) Maximum.	Filter or Change oil.

TABLE 3. Viscosity [1]

Test Details	Limits		Recommendation
Viscosity, (cSt) at 104ºF/40ºC	Min	Max	
	55	75	Change oil.

TABLE 4. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0.40 Maximum	Change oil

TABLE 5. Particle Count [1]

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 8 Ranges included:		Replace system filters. Filter oil.
	Size	Max	
	5-15	64,000	
	15-25	11,400	
	25-50	2,025	
	50-100	360	
	100+	64	

Notes: [1] See Reference c for additional information and guidance.

LUBRICANT:	**MIL-PRF-17672 HYDRAULIC FLUID (2135TH)**
APPLICABLE SYSTEMS:	**ANCHORS, SURFACE SHIP**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
ANCHHY	ALL	1A01

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

Test	Limits
Spectrometric Required	Report Only

TABLE 2. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM Maximum.	Filter or Change oil.

TABLE 3. Particle Count [1]

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 8 Ranges included:		Replace system filters. Filter oil.
	Size	Max	
	15-25	11,400	
	25-50	2,025	
	50-100	360	
	100+	64	

Notes: [1] See Reference c for additional information and guidance.

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LUBRICANT:	**MIL-PRF-17672 HYDRAULIC FLUID (2135TH)**
APPLICABLE SYSTEMS:	**LCS-1 and LCS-3 Only LUBE OIL POWERPACK (PP)**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
LOPP	LCS-1 and LCS-3	3A04

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

Test	Limits
Spectrometric Required	Report Only

TABLE 2. Viscosity

Test Details	Limits		Recommendation
Viscosity (cSt) at 104ºF/40ºC	Min	Max	Change Oil
	61	75	

TABLE 3. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM Maximum	Filter or Change oil.

TABLE 4. Particle Count [1]

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 10 Ranges included:		Replace system filters. Filter oil.
	Size	Max	
	5-15	256,000	
	15-25	45,600	
	25-50	8,100	
	50-100	1,440	
	100+	256	

Notes: [1] See Reference c for additional information and guidance.

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LUBRICANT:	**MIL-H-19457 HYDRAULIC FLUID (HFR-1)**
APPLICABLE SYSTEMS:	**SHIPBOARD HYDRAULIC SYSTEMS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
ACELEV	LHD-1 Class	LI0S
ACELEV	LHD-8 Class	LI0S

TABLE 1. Water Content

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	3000 PPM Maximum	Filter or Change oil.

TABLE 2. Total Acid Number

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0.3 Maximum	Change oil

TABLE 3. Particle Count

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 12 Ranges included:		Replace system filters. Filter oil or replace oil.
	Size	Max	
	15-25	182,400	
	25-50	32,400	
	50-100	5,760	
	100+	1,024	

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LUBRICANT:	**MIL-H-22072 HYDRAULIC FLUID (HFC)**
APPLICABLE SYSTEMS:	**SHIPBOARD HYDRAULIC SYSTEMS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
ALL	ALL	N/A

TABLE 1. Viscosity

Test Details	Limits		Recommendation
Viscosity (cSt) at 104ºF/40ºC	Min	Max	Change Oil
	41	51	

TABLE 2. Particle Count

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 9 Ranges included:		Replace system filters. Filter oil or replace oil.
	Size	Max	
	15-25	22,800	
	25-50	4,050	
	50-100	720	
	100+	128	

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LUBRICANT:	**MIL-PRF-83282 HYDRAULIC FLUID**
APPLICABLE SYSTEMS:	**RAST SYSTEM RAPID SECURING DEVICE (RSD), PATROL CRAFT STEERING GEAR**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
RSD	**ALL**	**W005**
HPU	**PC Class**	**N/A**

TABLE 1. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM Maximum	Filter or Change oil.

TABLE 2. Particle Count [1]

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 10 Ranges included:		Replace system filters. Filter oil.
	Size	Max	
	5-15	256,000	
	15-25	45,600	
	25-50	8,100	
	50-100	1,440	
	100+	256	

Notes: [1] See Reference c for additional information and guidance.

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LUBRICANT:	**PR 1192 HYDRAULIC FLUID**
APPLICABLE SYSTEMS:	**SUBMARINES SSN, SSBN, SSGN, NR-1, NKTV EXTERNAL HYDRAULIC SYSTEMS (WHEN AUTHORIZED)**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
N/A	N/A	N/A

TABLE 1. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	1000 PPM Maximum	Perform spectrometric testing if water is above 500 PPM to determine salt or fresh water contamination. Filter or Change oil.

TABLE 2. Particle Count [1]

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 10 Ranges included:		Replace system filters. Filter oil.
	Size	Max	
	15-25	45,600	
	25-50	8,100	
	50-100	1,440	
	100+	256	

Notes: [1] See Reference b for additional information and guidance.

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LUBRICANT:	**MIL-PRF-23699 C/I (CORROSION INHIBITED) GAS TURBINE LUBE OIL**
APPLICABLE SYSTEMS:	**GAS TURBINE ENGINES AND GENERATORS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
GTE	CG-47 Class	G80O
GTE	DDG-51 Class	GF1M
GTE	LCAC	GH0Q
APU	LCAC	GH0R
GTE	LCS-2 Class	GJ2M
GTE	LHA-6 Class	GK1M
GTE	LHD-8 Class	GL1M
GTG	CG-47 Class	H80Z
GTG	DDG-51 Class	HF1Z
GRG	DDG-51 Class	RF1Z
TANK	ALL	T003

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Limits
Spectrometric Test Required	Refer to applicable JOAP Manual Vol 4 Work Package by T/M/S

TABLE 2. Viscosity [1]

Test Details	Limits		Recommendation
Viscosity (cSt) at 104°F/40°C	Min	Max	Change oil if outside limit range, wrong oil suspected.
	23	35	

TABLE 3. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0 to 1.5 Acceptable	None
	>1.5 to 2.0 Alerted	Oil is SAT, but shall be sampled at half of normal periodicity.
	>2.0 Unacceptable	Change Oil

TABLE 4. Water Content

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	*Report Only* (No Requirement)	

TABLE 5. Particle Count

Test Details	Limits	Recommendation
Particle Count (Electronic)	*Report Only* (No Requirement)	

Notes: [1] See Reference a for additional guidance.

LUBRICANT:	**MIL-PRF-23699 HTS (HIGH TEMPERATURE STABILITY) GAS TURBINE LUBE OIL**
APPLICABLE SYSTEMS:	**GAS TURBINE ENGINES AND GENERATORS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
GTE	DDG 1000 Class	GF2M
GTE	LCS-1 Class	GJ1M
GTG	DDG 1000 Class	HF3Y
GRG	DDG 1000 Class	HF3Y

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Limits [2]
Spectrometric Test Required	Refer to applicable JOAP Manual Vol 4 Work Pack by T/M/S

TABLE 2. Viscosity [1]

Test Details	Limits		Recommendation
Viscosity (cSt) at 104°F/40°C	Min	Max	Change oil if outside limit range, wrong oil suspected.
	23	45	

TABLE 3. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0 to 1.0 Acceptable	None
	>1.0 Unacceptable	Change Oil.

TABLE 4. Water Content

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	1000 PPM Maximum	Change Oil

TABLE 5. Particle Count

Test Details	Limits	Recommendation
Particle Count (Electronic)	*Report Only* (No Requirement)	

Notes: [1] See Reference a for additional guidance.

LUBRICANT:	**POE SYNTHETIC OIL**
APPLICABLE SYSTEMS:	**SUBMARINE R134A AC/REFRIGERATION PLANTS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
REFER	SSM-688 Class	4001
REFER	SSBN/SSGN 726 Class	4001
REFER	SSN-21 Class	4001
AC	SSN-774 Class	4001

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS[1]

	Limits [2]
Spectrometric Test Required	Refer to applicable JOAP Manual Vol 4 Work Pack by T/M/S

TABLE 2. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	200 PPM Maximum	Change oil.

TABLE 3. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0.30 Maximum	Change oil.

Notes: [1] See Reference d for additional guidance.

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LUBRICANT:	**POE SYNTHETIC OIL**
APPLICABLE SYSTEMS:	**SURFACE SHIP R134A AC/REFRIGERATION PLANTS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
HFC-134a	**ALL**	**4001**
HFC-134a	**ALL**	**4005**
HFC-134a	**ALL**	**4006**
HFC-134a	**ALL**	**4007**

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Limits
Spectrometric Test Required	Refer to applicable JOAP Manual Vol 4 Work Pack by T/M/S

TABLE 2. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	100 PPM Maximum	Change oil.

TABLE 3. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0.10 Maximum	Change oil.

Notes: [1] See Reference e for additional guidance.

TABLE 4. Viscosity [1]

Test Details	Limits		Recommendation
Viscosity (cSt) at 104°F/40°C (ISO 32 Oil)	Min	Max	Change oil.
	30	34	
Viscosity (cSt) at 104°F/40°C (ISO 68 Oil)	Min	Max	Change oil.
	64	72	
Viscosity (cSt) at 104°F/40°C (ISO 120 Oil)	Min	Max	Change oil.
	114	126	
Viscosity (cSt) at 104°F/40°C (ISO 170 Oil)	Min	Max	Change oil.
	161	179	

Notes: [1] See OEM Recommendation for additional information and guidance.

LUBRICANT:	**POE SYNTHETIC OIL**
APPLICABLE SYSTEMS:	**SURFACE SHIP R236A AC/REFRIGERATION PLANTS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
AC or REFER	**ALL**	**4004**

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Limits
Spectrometric Test Required	Refer to applicable JOAP Manual Vol 4 Work Pack by T/M/S

TABLE 2. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	300 PPM Maximum	Change oil.

TABLE 3. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0.30 Maximum	Change oil.

Notes: [1] See Reference e for additional guidance.

TABLE 4. Viscosity [1]

Test Details	Limits		Recommendation
Viscosity (cSt) at 104°F/40°C (ISO 46 Oil)	Min	Max	Change oil.
	43	49	

Notes: [1] See OEM Recommendation for additional information and guidance.

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LUBRICANT:	**VV-L-825 REFRIGERANT COMPRESSOR OIL**
APPLICABLE SYSTEMS:	**R-114 A/C REFRIGERATION PLANTS MS RCO-2 SURFACE SHIP AND SUBMARINE**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
AC	ALL	4002

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Limits
Spectrometric Test Required	Refer to applicable JOAP Manual Vol 4 Work Pack by T/M/S

TABLE 2. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	100 PPM Maximum	Change Oil

TABLE 3. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	(Surface Ships) 0.10 Maximum (Submarines) 0.07 Maximum	Change Oil

Notes: [1] See Reference e for additional information and guidance.

TABLE 4. Viscosity [1]

Test Details	Limits		Recommendation
Viscosity (cSt) at 104°F/40°C (Surface Ships)	Min	Max	Change oil.
	58	79	

Notes: [1] See OEM Recommendation for additional information and guidance.

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LUBRICANT:	**SAE J2360 (MIL-PRF-2105) (80W-90) GEAR OIL**
APPLICABLE SYSTEMS:	**SHIPBOARD GEAR SYSTEMS (e.g. ANCHORS)**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
ANCHGE	ALL	1A02
CRANE	ALL	2A01
MISC	ALL	5A05
GEAR	ALL	J002
WINCH	ALL	W002

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Limits
Spectrometric Test Required	Refer to applicable JOAP Manual Vol 4 Work Pack by T/M/S

TABLE 2. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	3000 PPM (0.30%) Maximum	Determine source and repair. Remove water or change oil

TABLE 3. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	3.50 Maximum	Change oil.

TABLE 4. Viscosity [1]

Test Details	Limits		Recommendation
Viscosity (cSt) at 104°F/40°C	Min	Max	Change oil.
	120	170	

Notes: [1] See OEM Recommendation for additional information and guidance.

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LUBRICANT:	**SAE J2360 GEAR OIL (85W-140)**
APPLICATIONS:	**SHIPBOARD GEAR SYSTEMS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
Intermediate Speed Reducer (ISR)	DDG-1000 Class	N/A

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Limits
Spectrometric Test Required	Refer to applicable JOAP Manual Vol 4 Work Pack by T/M/S

TABLE 2. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	3000 PPM Maximum	Determine source and repair. Remove water or change oil

TABLE 3. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	3.10 Maximum	Change oil.

TABLE 4. Viscosity [1]

Test Details	Limits		Recommendation
Viscosity (cSt) at 104°F/40°C	Min	Max	Change oil.
	300	390	

TABLE 5. Particle Count [1]

Test Details	Limits	Recommendation
Particle Count (Electronic) ISO 4406 ((4 µm, 6 µm, 14 µm), Code, Max	-/20/16	Change oil.

Notes: [1] See OEM Recommendation for additional information and guidance.

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LUBRICANT:	**MOBILFLUID 424 LUBE OIL**
APPLICABLE SYSTEMS:	**SHIPBOARD HYDRAULIC SYSTEMS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
JLG-HYD	LHA-6 Class	N/A
JLG-HYD	LHD-8 Class	N/A
JLG-HYD	LPD-17 Class	N/A
JLG-HYD	LSD-41 Class	N/A
JLG-HYD	LSD-49 Class	N/A

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Limits
Spectrometric Test Required	Refer to applicable JOAP Manual Vol 4 Work Pack by T/M/S

TABLE 2. Water Content [1]

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	2000 PPM (0.20%) Maximum	Determine source and repair. Remove water or change oil

TABLE 3. Viscosity [1]

Test Details	Limits		Recommendation
Viscosity (cSt) at 104°F/40°C	Min	Max	Change oil.
	30	87.6	

Notes: [1] See OEM Recommendation for additional information and guidance.

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LUBRICANT:	**MIL-PRF-23699 C/I (CORROSION INHIBITED) LUBE OIL**
APPLICABLE SYSTEMS:	**LCAC PROPULSION SYSTEMS AND HYDRAULIC SYSTEMS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
MRG	LCAC	RH0Z
CPP	LCAC	CH0N
SCAVFAN	LCAC	IOOI
BOWTHR	LCAC	VOOI
RPROP	LCAC	5A03
BPROP	LCAC	5A03
BOWRAMP	LCAC	5A03
STERNRAMP	LCAC	5A03
LOTANK	LCAC	T003

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Limits
Spectrometric Test Required	Refer to applicable JOAP Manual Vol 4 Work Pack by T/M/S

TABLE 2. Viscosity [1]

Test Details	Limits		Recommendation
Viscosity (cSt) at 104°F/40°C	Min	Max	Change oil if outside limit range, wrong oil suspected.
	23	35	

TABLE 3. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0 to 1.5 Acceptable	None
	>1.5 Unacceptable	Change Oil.

TABLE 4. Water Content

Test Details	Limits	Recommendation
Water ASTM D 6304 (Karl Fisher)	2000 PPM (0.20%) Maximum	Purify or Change oil.

TABLE 5. Particle Count

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 8 Ranges included:		Filter or Change oil.
	Size	Max	
	5-15	64,000	
	15-25	11,400	
	25-50	2,025	
	50-100	360	
	100+	64	

Notes: [1] See Reference a for additional information guidance.

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LUBRICANT:	**MIL-PRF-9000 DIESEL LUBE OIL (MS 9250)**
APPLICABLE SYSTEMS:	**PROPULSION AND PROPELLER SYSTEMS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
CPP	MCM-1 Class	CR0M
MRG	MCM-1 Class	RR0W

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Limits
Spectrometric Test Required	Refer to applicable JOAP Manual Vol 4 Work Pack by T/M/S

TABLE 2. Water Content *1*

Test Details	Limits*2*	Recommendatio *3*
Water (Crackle)	Pass/Fail	Recommend change filters and/or operate through polisher to remove/reduce water contamination.
Water ASTM D 6304 (Karl Fisher)	2000 PPM (0.20%) Maximum	

TABLE 3. Viscosity *1*

Test Details	Limits*2*	Recommendation*3*
Viscosity (cSt) at 104°F/40°C	<90 Unacceptable	Determine cause, repair, and change oil.
	90 to 200 Acceptable	None
	>200 Unacceptable	Determine cause, repair, and change oil.

TABLE 4. Total Acid Number [1, 4, 5]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	3.5 Maximum	Change oil.

TABLE 5. Particle Count [1, 4]

Test Details	Limits		Recommendation [2]
Particle Count (Electronic)	NAS 1638 Class 10 Ranges included:		Operate through polisher to remove particle contamination.
	Size	Max	
	25-50	8,100	
	50-100	1,440	
	100+	256	

TABLE 6. Particle Count [1, 5]

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638 Class 8 Ranges included:		Recommend change filters and operate through polisher to remove particle contamination.
	Size	Max	
	5-15	64,000	
	15-25	11,400	
	25-50	2,025	
	50-100	360	
	100+	64	

TABLE 7. Flashpoint [1, 4]

Test Details	Limits	Recommendation
Continuous Closed Cup Flashpoint, °F	400°F or greater	Satisfactory: No action required.
	399°F or less	Degraded Oil: Immediately notify Chain of Command, TYCOM, and NSWCPD Lubricants ISEA. Submit samples at earliest opportunity. Perform flash points daily in order to continue to use affected equipment. Record the daily tests, and forward findings to TYCOM and NSWCPD Lubricants ISEA. If flash points indicate a declining trend (from earlier tests) use of the affected equipment shall be discontinued and any ignition source secured. TYCOM and NSWCPD Lubricants and Equipment ISEAs shall be notified for further guidance.

TABLE 8. Flashpoint [1,5]

Test Details	Limits	Recommendation
Continuous Closed Cup Flashpoint, °F	400°F or greater	Satisfactory: No action required.
	370-399°F	Minor Degradation: Equipment may continue to be used during resolution/confirmation of the results. Notification to TYCOM, Chain of Command, and NSWCPD Lubricants ISEA is required and submit samples at the earliest opportunity. The NSWCPD Lubricants ISEA will begin to closely monitor the oil properties and inform TYCOM of results and/or actions that need to be taken.
	Less than 370°F	Degraded Oil: Immediately notify Chain of Command, TYCOM, and NSWCPD Lubricants ISEA. Submit samples at earliest opportunity. Perform flash points daily in order to continue to use affected equipment. Record the daily tests, and forward findings to TYCOM and NSWCPD Lubricants ISEA. If flash points indicate a declining trend (from earlier tests) use of the affected equipment shall be discontinued and any ignition source secured. TYCOM and NSWCPD Lubricants and Equipment ISEAs shall be notified for further guidance

Notes:
1. See Reference a for additional information guidance.
2. These limits do not apply to surface ships in the Diesel Readiness System (DRS) program. Report DRS results with no recommendation
3. Resample if results may not be indicative of actual system condition.
4. Applies to reduction gear samples only.
5. Applies to controllable pitch propeller samples only.

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LUBRICANT:	**MIL-DTL-17111 HYDRAULIC FLUID**
APPLICABLE SYSTEMS:	**MOD 2 AND MOD 4 UPPER AND LOWER ACCUMULATOR SYSTEMS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
GUNMT	ALL	U001

TABLE 1. Viscosity

Test Details	Limits[2]	Recommendation[3]
Viscosity (cSt) at 104°F/40°C	23.0 Minimum	Change oil.

TABLE 2. Total Acid Number

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0.5 Maximum	Change oil.

TABLE 3. Total Water Content

Test Details	Limits[2]	Recommendation
Water (Crackle)	Pass/Fail	Filter or Change oil.
Water ASTM D 6304 (Karl Fisher)	200 PPM (0.02%) Maximum	

TABLE 4. Particle Count

Test Details	Limits		Recommendation
Particle Count (Electronic)	NAS 1638		Replace system filters. Filter oil or replace oil.
	Size	Max	
	5-15	123,300	
	15-25	22,000	
	25-50	3,900	
	50-100	685	
	100+	64	

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LUBRICANT:	**MIL-PRF-6086 GEAR OIL**
APPLICABLE SYSTEMS:	**SHIPBOARD GEAR SYSTEMS (WELL DECK BRIDGE CRANE)**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
WDBCRANE	LPD-17	N/A

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Limits
Spectrometric Test Required	Report Only.

TABLE 2. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	2.0 Maximum	Change Oil.

TABLE 3. Viscosity [1]

Test Details	Limits		Recommendation
Viscosity (cSt) at 104°F/40°C	Min	Max	Change oil.
	21	36	

Notes: [1] See OEM Recommendation for additional information and guidance.

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LUBRICANT:	**MIL-PRF-23699 C/I (CORROSION INHIBITED) GAS TURBINE LUBE OIL**
APPLICABLE SYSTEMS:	**GAS TURBINE ENGINES**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
GTM	LCAC-100 Class	N/A

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Limits
Spectrometric Test Required	Refer to applicable JOAP Manual Vol 4 Work Package by T/M/S.

TABLE 2. Viscosity [1]

Test Details	Limits		Recommendation
Viscosity (cSt) at 104°F/40°C	Min	Max	Change oil.
	21	36	

TABLE 3. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	0 to 1.0 Acceptable	None
	>1.0 Unacceptable	Change oil.

TABLE 4. Total Water Content

Test Details	Limits[2]	Recommendation
Water ASTM D 6304 (Karl Fisher)	*Report Only* (No Requirement)	

TABLE 5. Particle Count

Test Details	Limits[2]	Recommendation
Particle Count (Electronic)	*Report Only* (No Requirement)	

Notes: [1] See Reference a for additional guidance.

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LUBRICANT:	**MOBIL SHC GEAR 3200**
APPLICABLE SYSTEMS:	**SHIPBOARD GEAR SYSTEMS**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
Low Speed Gear Case (LSGC)	DDG-1000 Class	N/A

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Limits
Spectrometric Test Required	Refer to applicable JOAP Manual Vol 4 Work Package by T/M/S.

TABLE 2. Water Content [1]

Test Details	Limits[2]	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM Maximum	Determine source and repair. Remove water or change oil

TABLE 3. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	*Report Only* (No Requirement)	

TABLE 4. Viscosity [1]

Test Details	Limits		Recommendation
Viscosity (cSt) at 104°F/40°C	Min	Max	Change oil.
	2750	3650	

TABLE 5. Particle Count [1]

Test Details	Limits	Recommendation
Particle Count (Electronic) ISO 4406 (4 µm, 6 µm, 14 µm), Code, Max	-/20/16	Change oil.

Notes: [1] See OEM Recommendation for additional information and guidance.

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LUBRICANT:	**MOBILGEAR 600XP 68**
APPLICABLE SYSTEMS:	**LCS-2 CLASS GAS TURBINE AND MAIN DIESEL PROPULSION ENGINE MAIN THRUST BEARING**

EQUIPMENT	HULL	TYPE EQUIPMENT CODE
GT Main Thrust Bearing (MTBGT)	LCS-2 Class	N/A
MPDE Main Thrust Bearing (MTBMPDE)	LCS-2 Class	N/A

TABLE 1. - JOAP ATOMIC EMISSION ROTRODE LIMITS

	Limits
Spectrometric Test Required	Refer to applicable JOAP Manual Vol 4 Work Package by T/M/S.

TABLE 2. Water Content [1]

Test Details	Limits[2]	Recommendation
Water ASTM D 6304 (Karl Fisher)	500 PPM (0.05%) Maximum	Determine source and repair. Remove water or change oil

TABLE 3. Total Acid Number [1]

Test Details	Limits	Recommendation
Total Acid Number, mg KOH/g	*Report Only* (No Requirement)	

TABLE 4. Viscosity [1]

Test Details	Limits		Recommendation
Viscosity (cSt) at 104°F/40°C	Min	Max	Change oil.
	61	75	

TABLE 5. Particle Count [1]

Test Details	Limits	Recommendation
Particle Count (Electronic) ISO 4406 (4 µm, 6 µm, 14 µm), Code, Max	-/16/13	Change Filters.
	-/17/14	Purify and change filters. Submit 2K for RMC technical assistance during purification.
	-/18/15	Do not operate. Submit 2K for RMC technical assistance as significant damage may have occurred.

Notes: [1] See OEM Recommendation for additional information and guidance.

COMPONENT:	**GE-LM2500 GAS TURBINE**
SYSTEM/USE:	**MAIN PROPULSION SYSTEM**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
LM2500	**CG 47 CLASS**	**G80O**
LM2500	**DDG 51 CLASS**	**GF1M**
LM2500	**LCS-2 CLASS**	**GJ2M**
LM2500+	**LHA-6 CLASS**	**GK1M**
LM2500+	**LHD-8 CLASS**	**GL1M**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-2				0-4	0-22				0-11
Marginal Range	3-5				5-9	23-52				12-29
High Range	6-10				10-14	53-64				30-40
Abnormal	11+				15+	65+				41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**ALLISON 501K**
SYSTEM/USE:	**SHIPS SERVICE GAS TURBINE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
501-K17	**CG 47 CLASS**	**H80Z**
501-K34	**DD 51 CLASS**	**HF1Z**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-2				0-4					
Marginal Range	3-5				5-9					
High Range	6-10				10-14					
Abnormal	11+				15+					
Abnormal Trend (PPM Increase in 10 Hrs)										

Average Concentration Other Elements:

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COMPONENT:	**ALCO 12 251-C DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ALCO 12 251-C	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-17		0-4	0-4	0-11	0-22	0-11		0-2	0-11
Marginal Range	18-34		5-9	5-9	12-29	23-52	12-29		3-5	12-29
High Range	35-48		10-14	10-14	30-40	53-64	30-40		6-10	30-40
Abnormal	49+		15+	15+	41+	65+	41+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**ALCO 16 251-C DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ALCO 16 251-C	**LHD-1 Class**	**EI13**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-22		0-5	0-7	0-19	0-22	0-7		0-2	0-11
Marginal Range	23-52		6-13	8-15	20-42	23-52	8-15		3-5	12-29
High Range	53-64		14-20	16-25	43-55	53-64	16-25		6-10	30-40
Abnormal	65+		21+	26+	56+	65+	26+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**CATERPILLAR 16 X399 DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CATERPILLAR 16 X399	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-29		0-7	0-4	0-29	0-22	0-7		0-2	0-11
Marginal Range	30-59		8-15	5-9	30-59	23-52	8-15		3-5	12-29
High Range	60-80		16-25	10-14	60-80	53-64	16-25		6-10	30-40
Abnormal	81+		26+	15+	81+	65+	26+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

Average Concentration Other Elements:

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COMPONENT:	**CUMMINS VT12-0875MPH/LH1X2 DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CUMMINS VT12-0875MPH/LH1X2	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-11		0-2	0-4	0-17	0-22	0-5		0-2	0-11
Marginal Range	12-29		3-5	5-9	18-34	23-52	6-13		3-5	12-29
High Range	30-40		6-10	10-14	35-48	53-64	14-20		6-10	30-40
Abnormal	41+		11+	15+	49+	65+	21+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**CUMMINS VT12-0875MPH/LH DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CUMMINS VT12-0875MPH/LH	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-17		0-2	0-4	0-11	0-22	0-14		0-2	0-11
Marginal Range	18-34		3-5	5-9	12-29	23-52	15-30		3-5	12-29
High Range	35-48		6-10	10-14	30-40	53-64	31-45		6-10	30-40
Abnormal	49+		11+	15+	41+	65+	46+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**DETROIT DIESEL (GM) 12005; 12006 DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DETROIT DIESEL (GM) 12005; 12006	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-99		0-7	0-5	0-7	0-22	0-11			0-11
Marginal Range	100-144		8-15	6-13	8-15	23-52	12-29			12-29
High Range	145-170		16-25	14-20	16-25	53-64	30-40			30-40
Abnormal	171+		26+	21+	26+	65+	41+			41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**DETROIT DIESEL (GM) 12VA6217 DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DETROIT DIESEL (GM) 12VA6217	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-64		0-5		0-7	0-22				0-11
Marginal Range	65-109		6-13		8-15	23-52				12-29
High Range	110-135		14-20		16-25	53-64				30-40
Abnormal	136+		21+		26+	65+				41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**DETROIT DIESEL (GM) 6-71; 12007M DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DETROIT DIESEL (GM) 6-71; 12007M	WLB 297 Class	SWA1
DETROIT DIESEL (GM) 6-71; 12007M	WLM 540 Class	SW81
DETROIT DIESEL (GM) 6-71; 12007M	WLIC 298 Clas	EW51
DETROIT DIESEL (GM) 6-71; 12007M	WLIC 75301 Class	EWB1

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-94		0-5	0-5	0-19	0-22	0-17			0-11
Marginal Range	95-139		6-13	6-13	20-42	23-52	18-34			12-29
High Range	140-165		14-20	14-20	43-55	53-64	35-48			30-40
Abnormal	166+		21+	21+	56+	65+	49+			41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**DETROIT DIESEL (GM) 6V53N DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DETROIT DIESEL (GM) 6V53N	CG-47 Class	O8A1

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-17				0-7	0-22				0-11
Marginal Range	18-34				8-15	23-52				12-29
High Range	35-48				16-25	53-65				30-40
Abnormal	49+				26+	66+				41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**ELECTRO MOTIVE (GM) 12-268A DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ELECTRO MOTIVE (GM) 12-268A	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-19		0-2	0-9	0-26	0-22	0-14		0-2	0-11
Marginal Range	20-42		3-5	10-24	27-55	23-52	15-30		3-5	12-29
High Range	43-55		6-10	25-30	56-72	53-64	31-45		6-10	30-40
Abnormal	56+		11+	31+	73+	65+	46+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**ELECTRO MOTIVE (GM) 16-248 DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
GM ELECTRO MOTIVE (EMD) 16-248	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-19		0-2	0-4	0-17	0-22	0-11		0-2	0-11
Marginal Range	20-42		3-5	5-9	18-34	23-52	12-29		3-5	12-29
High Range	43-55		6-10	10-14	35-48	53-64	30-40		6-10	30-40
Abnormal	56+		11+	15+	49+	65+	41+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**ELECTRO MOTIVE (GM) 12-278 DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
GM ELECTRO MOTIVE (EMD) 12-278	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-24		0-5		0-14	0-22	0-11			0-11
Marginal Range	25-54		6-13		15-30	23-52	12-29			12-29
High Range	55-68		14-20		31-45	53-64	30-40			30-40
Abnormal	69+		21+		46+	65+	41+			41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**ELECTRO MOTIVE (GM) 8-278ANN DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ELECTRO MOTIVE (GM) 8-278ANN	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-9		0-2	0-14	0-22	0-22	0-11		0-2	0-11
Marginal Range	10-24		3-5	15-30	23-52	23-52	12-29		3-5	12-29
High Range	25-30		6-10	31-45	53-64	53-64	30-40		6-10	30-40
Abnormal	31+		11+	46+	65+	65+	41+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**ELECTRO MOTIVE (GM) 8-498NN DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ELECTRO MOTIVE (GM) 8-498NN	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-26	0-4	0-4	0-4	0-24	0-22	0-9		0-2	0-11
Marginal Range	27-55	5-9	5-9	5-9	25-54	23-52	10-24		3-5	12-29
High Range	56-72	10-14	10-14	10-14	55-68	53-64	25-30		6-10	30-40
Abnormal	73+	15+	15+	15+	69+	65+	31+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**ELECTRO MOTIVE (GM) 16-645E5LLRRLR DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
GM ELECTRO MOTIVE (EMD) 16-645E5LLRRLR	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-22		0-2	0-2	0-24	0-22	0-7		0-2	0-11
Marginal Range	23-52		3-5	3-5	25-54	23-52	8-15		3-5	12-29
High Range	53-64		6-10	6-10	55-68	53-64	16-25		6-10	30-40
Abnormal	65+		11+	11+	69+	65+	26+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**FM (COLT) 10-38D8 1/8 DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
FM (COLT) 10-38D8 1/8	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-26		0-5	0-4	0-9	0-22	0-11		0-4	0-11
Marginal Range	27-55		6-13	5-9	10-24	23-52	12-29		5-9	12-29
High Range	56-72		14-20	10-14	25-30	53-64	30-40		10-14	30-40
Abnormal	73+		21+	15+	31+	65+	41+		15+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**FM (COLT) 10-38NTD8 1/8 DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
FM (COLT) 10-38NTD8 1/8	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-14		0-4	0-7	0-9	0-22	0-11		0-2	0-11
Marginal Range	15-30		5-9	8-15	10-24	23-52	12-29		3-5	12-29
High Range	31-45		10-14	16-25	25-30	53-64	30-40		6-10	30-40
Abnormal	46+		15+	26+	31+	65+	41+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**FM (COLT) 12-38ND8 1/8 DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
FM (COLT) 10-38D8 1/8	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-19		0-7	0-9	0-9	0-22	0-11		0-2	0-11
Marginal Range	20-42		8-15	10-24	10-24	23-52	12-29		3-5	12-29
High Range	43-55		16-25	25-30	25-30	53-64	30-40		6-10	30-40
Abnormal	56+		26+	31+	31+	65+	41+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**FM (COLT) 8-38ND8 1/8 DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
FM (COLT) 8-38ND8 1/8	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-19		0-4	0-17	0-22	0-22	0-11		0-2	0-11
Marginal Range	20-42		5-9	18-34	23-52	23-52	12-29		3-5	12-29
High Range	43-55		10-14	35-48	53-64	53-64	30-40		6-10	30-40
Abnormal	56+		15+	49+	65+	65+	41+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**GM ELECTRO MOTIVE (EMD) 16-645E2 DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
GM ELECTRO MOTIVE (EMD) 16-645E2	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-14	0-2	0-14	0-4	0-17	0-22	0-11	0-2	0-2	0-11
Marginal Range	15-30	3-5	15-30	5-9	18-34	23-52	12-29	3-5	3-5	12-29
High Range	31-45	6-10	16-45	10-14	35-48	53-64	30-40	6-10	6-10	30-40
Abnormal	46+	11+	46+	15+	49+	65+	41+	11+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**DETROIT DIESEL (GM) 8V-71T DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DETROIT DIESEL (GM) 8V-71T	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-94		0-5	0-5	0-17	0-22	0-17	0-17		0-11
Marginal Range	95-139		6-13	6-13	18-34	23-52	18-34	18-34		12-29
High Range	140-165		14-20	14-20	35-48	53-64	35-48	35-48		30-40
Abnormal	166+		21+	21+	49+	65+	49+	49+		41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**PACKARD ID-1700-T3/T4 DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
PACKARD ID-1700-T3/T4	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-17		0-7	0-4	0-14	0-22	0-7		0-2	0-11
Marginal Range	18-34		8-15	5-9	15-30	23-52	8-15		3-5	12-29
High Range	35-48		16-25	10-14	31-45	53-64	16-25		6-10	30-40
Abnormal	49+		26+	15+	46+	65+	26+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**RUSTON PAXMAN 12-YCLM DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
RUSTON PAXMAN 12-YCLM	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-36		0-14	0-4	0-17	0-22	0-9	0-2		0-11
Marginal Range	37-69		15-30	5-9	18-34	23-52	10-24	3-5		12-29
High Range	70-92		31-45	10-14	35-48	53-64	25-30	6-10		30-40
Abnormal	93+		46+	15+	49+	65+	31+	11+		41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**WAUKESHA L1616DSIN/TO DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
WAUKESHA L1616DSIN/TO	**MCM Class**	**MR0G**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-19		0-11	0-7	0-19	0-22	0-9		0-2	0-11
Marginal Range	20-42		12-29	8-15	20-42	23-52	10-24		3-5	12-29
High Range	43-55		30-40	16-25	43-55	53-64	25-30		6-10	30-40
Abnormal	56+		41+	26+	56+	65+	31+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**ALCO 8-251E DIESEL ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ALCO 8-251E	**WAGB 10 Class**	**SU00**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-17		0-5	0-7	0-11	0-22	0-9		0-2	0-11
Marginal Range	18-34		6-13	8-15	12-29	23-52	10-24		3-5	12-29
High Range	35-48		14-20	16-25	30-40	53-64	25-30		6-10	30-40
Abnormal	49+		21+	26+	41+	65+	31+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**CATERPILLAR 6-D-353 DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CATERPILLAR 6-D-353	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-26		0-11	0-7	0-11	0-22	0-11		0-2	0-11
Marginal Range	27-55		12-29	8-15	12-29	23-52	12-29		3-5	12-29
High Range	56-72		30-40	16-25	30-40	53-64	30-40		6-10	30-40
Abnormal	73+		41+	26+	41+	65+	41+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**CATERPILLAR D353 DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CATERPILLAR D353	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-34	0-2	0-9	0-4	0-22	0-22	0-11	0-2	0-2	0-11
Marginal Range	35-65	3-5	10-24	5-9	23-52	23-52	12-29	3-5	3-5	12-29
High Range	66-85	6-10	25-30	10-14	53-64	53-64	30-40	6-10	6-10	30-40
Abnormal	86+	11+	31+	15+	65+	65+	41+	11+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**CUMMINS 6-NH220GPG84 DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CUMMINS 6-NH220GPG84	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-36		0-9	0-4	0-14	0-22	0-14		0-2	0-11
Marginal Range	37-69		10-24	5-9	15-30	23-52	15-30		3-5	12-29
High Range	70-92		25-30	10-14	31-45	53-64	31-45		6-10	30-40
Abnormal	93+		31+	15+	46+	65+	46+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**CUMMINS 6-NH220PG92 DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CUMMINS 6-NH220PG92	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-17		0-4	0-4	0-7	0-22	0-11		0-2	0-11
Marginal Range	18-34		5-9	5-9	8-15	23-52	12-29		3-5	12-29
High Range	35-48		10-14	10-14	16-25	53-64	30-40		6-10	
Abnormal	49+		15+	15+	26+	65+	41+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**CUMMINS 6-NT400GCM DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CUMMINS 6-NT400GCM	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-24		0-4	0-5	0-7	0-22	0-17		0-2	0-11
Marginal Range	25-54		5-9	6-13	8-15	23-52	18-34		3-5	12-29
High Range	55-68		10-14	14-20	16-25	53-64	35-48		6-10	30-40
Abnormal	69+		15+	21+	26+	65+	49+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**DETROIT DIESEL (GM) 16V-149 TI DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DETROIT DIESEL (GM) 16V-149 TI	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-17		0-4	0-4	0-9	0-22	0-4	0-2		0-11
Marginal Range	18-34		5-9	5-9	10-24	23-52	5-9	3-5		12-29
High Range	35-48		10-14	10-14	25-30	53-64	10-14	6-10		30-40
Abnormal	49+		15+	15+	31+	65+	15+	11+		41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**DETROIT DIESEL (GM) 16-7163-7200 DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DETROIT DIESEL (GM) 16-7163-7200	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-19		0-2	0-4	0-14	0-22	0-11		0-2	0-11
Marginal Range	20-42		3-5	5-9	15-30	23-52	12-29		3-5	12-29
High Range	43-55		6-10	10-14	31-45	53-64	30-40		6-10	30-40
Abnormal	56+		11+	15+	46+	65+	41+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**DETROIT DIESEL (GM) 16V-71 DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DETROIT DIESEL (GM) 16V-71	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-29	0-2	0-9	0-4	0-9	0-22	0-5	0-2	0-2	0-11
Marginal Range	30-59	3-5	10-24	5-9	10-24	23-52	6-13	3-5	3-5	12-29
High Range	60-80	6-10	25-30	10-14	25-30	53-64	14-20	6-10	4-10	30-40
Abnormal	81+	11+	31+	15+	31+	65+	21+	11+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**DETROIT DIESEL (GM) 3-71-3151 DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DETROIT DIESEL (GM) 3-71-3151	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-26		0-5	0-11	0-17	0-22	0-17			0-11
Marginal Range	27-55		6-13	12-29	18-34	23-52	18-34			12-29
High Range	56-72		14-20	30-40	35-48	53-64	35-48			30-40
Abnormal	73+		21+	41+	49+	65+	49+			41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**DETROIT DIESEL (GM) 6-6151ENOD671RC DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DETROIT DIESEL (GM) 6-6151ENOD671RC	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-24		0-2	0-11	0-9	0-22	0-17	0-5	0-2	0-11
Marginal Range	25-54		3-5	12-29	10-24	23-52	18-34	6-13	3-5	12-29
High Range	55-68		6-10	30-40	25-30	53-64	35-48	14-20	6-10	30-40
Abnormal	69+		11+	41+	31+	65+	49+	21+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**GM ELECTRO MOTIVE (EMD) 3-268A DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
GM ELECTRO MOTIVE (EMD) 3-268A	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-22		0-2	0-17	0-14	0-22	0-22		0-2	0-11
Marginal Range	23-52		3-5	18-34	15-30	23-52	23-52		3-5	12-29
High Range	53-64		6-10	35-48	31-45	53-64	53-64		6-10	30-40
Abnormal	65+		11+	49+	46+	65+	65+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**GM ELECTRIC MOTIVE (EMD) 8-268A DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
GM ELECTRIC MOTIVE (EMD) 8-268A	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-29		0-2	0-19	0-14	0-22	0-9		0-2	0-11
Marginal Range	30-59		3-5	20-42	15-30	23-52	10-24		3-5	12-29
High Range	60-80		6-10	43-55	31-45	53-64	25-30		6-10	30-40
Abnormal	81+		11+	56+	46+	65+	31+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**GM ELECTRO MOTIVE (EMD) 8-56CR DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
GM ELECTRO MOTIVE (EMD) 8-56CR	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-7	0-2	0-2	0-4	0-9	0-22	0-11		0-2	0-11
Marginal Range	8-15	3-5	3-5	5-9	10-24	23-52	12-29		3-5	12-29
High Range	16-25	6-10	6-10	10-14	25-30	53-64	30-40		6-10	30-40
Abnormal	26+	11+	11+	15+	31+	65+	41+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**GM ELECTRO MOTIVE (EMD) 12-645E2LL DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
GM ELECTRO MOTIVE (EMD) 12-645E2LL	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-17	0-2	0-2	0-5	0-17	0-22	0-7		0-2	0-11
Marginal Range	18-34	3-5	3-5	6-03	18-34	23-52	8-15		3-5	12-29
High Range	35-48	6-10	6-10	14-20	35-48	53-64	16-25		6-10	30-40
Abnormal	49+	11+	11+	21+	49+	65+	26+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**FM (COLT) 8-38D8 1/8 DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
FM (COLT) 8-38D8 1/8	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si	
Normal Range	0-17		0-4	0-7	0-9	0-22	0-11		0-2	0-11	
Marginal Range	18-34		5-9	8-15	10-24	23-52	12-29		3-5	12-29	
High Range	35-48		10-14	16-25	25-30	53-64	30-40		6-10	30-40	
Abnormal	49+		15+	26+	31+	65+	41+		11+	41+	
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**GM ELECTRO MOTIVE (EMD) 8-268 DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
GM ELECTRO MOTIVE (EMD) 8-268	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si	
Normal Range	0-34		0-9	0-24	0-24	0-22	0-17			0-11	
Marginal Range	35-65		10-24	25-54	25-54	23-52	18-34			12-29	
High Range	66-85		25-30	55-68	55-68	53-64	35-48			30-40	
Abnormal	86+		31+	69+	69+	65+	49+			41+	
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**DETROIT DIESEL (GM) 4-71 DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DETROIT DIESEL (GM) 4-71	**WLIC 800 Class**	**SW71**
DETROIT DIESEL (GM) 4-71	**WLR 311 Class**	**SW91**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si	
Normal Range	0-69		0-9		0-14	0-22	0-19			0-11	
Marginal Range	70-114		10-24		15-30	23-52	20-42			12-29	
High Range	115-140		25-30		31-45	53-64	43-55			30-40	
Abnormal	141+		31+		46+	65+	56+			41+	
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**HERCULES 6-DWXD DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
HERCULES 6-DWXD	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si	
Normal Range	0-34		0-5	0-4	0-14	0-22	0-11		0-2	0-11	
Marginal Range	35-65		6-13	5-9	15-30	23-52	12-29		3-5	12-29	
High Range	66-85		14-20	10-14	31-45	53-64	30-40		6-10	30-40	
Abnormal	86+		21+	15+	46+	65+	41+		11+	41+	
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**RUSTON PAXMAN 8-RPHCZ DIESEL ENGINE**
SYSTEM/USE:	**SHIPS SERVICE GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
RUSTON PAXMAN 8-RPHCZ	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si	
Normal Range	0-26		0-17	0-2	0-7	0-22	0-7	0-2		0-11	
Marginal Range	27-55		18-34	3-5	8-15	23-52	8-15	3-5		12-29	
High Range	56-72		35-48	6-10	16-25	53-64	16-25	6-10		30-40	
Abnormal	73+		49+	11+	26+	65+	26+	11+		41+	
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**ALCO 16-251B16 DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ALCO 16-251B16	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si	
Normal Range	0-14	0-2	0-7	0-4	0-7	0-22	0-7		0-2	0-11	
Marginal Range	15-30	3-5	8-15	5-9	8-15	23-52	8-15		3-5	12-29	
High Range	31-45	6-10	16-25	10-14	16-25	53-64	16-25		6-10	30-40	
Abnormal	46+	11+	26+	15+	26+	65+	26+		11+	41+	
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**ALCO 8-251-E DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ALCO 8-251-E	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-17		0-5	0-5	0-11	0-22	0-11			0-11
Marginal Range	8-34		6-13	6-13	12-29	23-52	12-29			12-29
High Range	35-48		14-20	14-20	30-40	53-64	30-40			30-40
Abnormal	49+		21+	21+	41+	65+	41+			41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**CUMMINS 6-NH220BI DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CUMMINS 6-NH220BI	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-24		0-9	0-7	0-14	0-22	0-11			0-11
Marginal Range	25-54		10-24	8-15	15-30	23-52	12-29			12-29
High Range	55-68		25-30	16-25	31-45	53-64	30-40			30-40
Abnormal	69+		31+	26+	46+	65+	41+			41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**DETROIT DIESEL (GM) 71637/300016V71/LC DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DETROIT DIESEL (GM) 71637/300016V71/LC	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-29	0-2	0-9	0-4	0-9	0-22	0-5	0-2	0-2	0-11
Marginal Range	30-59	3-5	10-24	5-9	10-24	23-52	6-13	3-5	3-5	12-29
High Range	60-80	6-10	25-30	10-14	25-30	53-64	14-20	6-10	6-10	30-40
Abnormal	81+	11+	31+	15+	31+	65+	21+	11+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**DETROIT DIESEL (GM) 6-71RC7 DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DETROIT DIESEL (GM) 6-71RC7	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-24		0-2	0-4	0-9	0-22	0-14	0-2	0-2	0-11
Marginal Range	25-54		3-5	5-9	10-24	23-52	15-30	3-5	3-5	12-29
High Range	55-68		6-10	10-14	25-30	53-64	31-45	6-10	6-10	30-40
Abnormal	69+		11+	15+	31+	65+	46+	11+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**GM ELECTRO MOTIVE (EMD) 3-268A DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ELECTRO MOTIVE (GM) 3-268A	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-26		0-4	0-9	0-26	0-22	0-24		0-2	0-11
Marginal Range	27-55		5-9	10-24	27-55	23-52	25-54		3-5	12-29
High Range	56-72		10-14	25-30	56-72	53-64	55-68		6-10	30-40
Abnormal	73+		15+	31+	73+	65+	69+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**FM (COLT) 10-38F5 ¼ DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
FM (COLT) 10-38F5 1/4	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-29		0-4	0-4	0-7	0-22	0-7		0-2	0-11
Marginal Range	30-59		5-9	5-9	8-15	23-52	8-15		3-5	12-29
High Range	60-80		10-14	10-14	16-25	53-64	16-25		6-10	30-40
Abnormal	81+		15+	15+	26+	65+	26+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**FM (COLT) 6-38F5 1/4 DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
FM (COLT) 6-38F5 1/4	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-17		0-2	0-4	0-14	0-22	0-7	0-2	0-2	0-11
Marginal Range	18-34		3-5	5-9	15-30	23-52	8-15	3-5	3-5	2-29
High Range	35-48		6-10	10-14	31-45	53-64	16-25	6-10	6-10	30-40
Abnormal	49+		11+	15+	46+	65+	26+	11+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**FM (COLT) 6-38ND8 1/8 DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
FM (COLT) 6-38ND8 1/8	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-17		0-11	0-11	0-7	0-22	0-7		0-2	0-11
Marginal Range	18-34		12-29	12-29	8-15	23-52	8-15		3-5	12-29
High Range	35-48		30-40	30-40	16-25	53-64	16-25		6-10	30-40
Abnormal	49+		41+	41+	26+	65+	26+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**FM (COLT) 7-38F5 1/4 DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
FM (COLT) 7-38F5 1/4	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si	
Normal Range	0-17		0-2	0-4	0-14	0-22	0-9		0-2	0-11	
Marginal Range	18-34		3-5	5-9	15-30	23-52	10-24		3-5	12-29	
High Range	35-48		6-10	10-14	31-45	53-64	25-30		6-10	30-40	
Abnormal	49+		11+	15+	46+	65+	31+		11+	41+	
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**FM (COLT) 8-38D8 1/8 HISHOCK DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
FM (COLT) 8-38D8 1/8 HISHOCK	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-17		0-4	0-22	0-7	0-22	0-11		0-2	0-11
Marginal Range	18-34		5-9	23-52	8-15	23-52	12-29		3-5	12-29
High Range	35-48		10-14	53-64	16-25	53-64	30-40		6-10	30-40
Abnormal	49+		15+	65+	26+	65+	41+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**DETROIT DIESEL (GM) 6-71 DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DETROIT DIESEL (GM) 6-71	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-24		0-2	0-4	0-9	0-22	0-14		0-2	0-11
Marginal Range	25-54		3-5	5-9	10-24	23-52	15-30		3-5	12-29
High Range	55-68		6-10	10-14	25-30	53-64	31-45		6-10	30-40
Abnormal	69+		11+	15+	31+	65+	46+		11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**DETROIT DIESEL (GM) 12V71RC DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
DETROIT DIESEL (GM) 12V71RC	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-26		0-11		0-7	0-22	0-11			0-11
Marginal Range	27-55		12-29		8-15	23-52	12-29			12-29
High Range	56-72		30-40		16-25	53-64	30-40			30-40
Abnormal	73+		41+		26+	65+	41+			41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**GM ELECTRO MOTIVE (EMD) 16-645E5N LL DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
GM ELECTRO MOTIVE (EMD) 16-645E5	CVN 68 Class	EE08

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Na	Pb	Sn	Ni	Si	B	Zn
Normal Range	0-9	0	0-2	0	0-25	0-12	0-3	0-1	0-3	0-8	0-2	
Marginal Range	10-12	1	3	1-2	26-63	13-27	4-5			9-11	3-5	
High Range	>12	>1	>3	>2	>63	>27	>5	>1	>3	>11	>5	>1799
Abnormal												
Abnormal Trend (PPM Increase in 10 Hrs)	>1803		>625	>131	>2862	>1981	>625			>1610	>301	

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COMPONENT:	**HERCULES 6-DFXD DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
HERCULES 6-DFXD	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-49		0-9	0-4	0-26	0-22	0-17	0-2	0-2	0-11
Marginal Range	50-89		10-24	5-9	27-55	23-52	18-34	3-5	3-5	12-29
High Range	90-112		25-30	10-14	56-72	53-64	35-48	6-10	6-10	30-40
Abnormal	113+		13+	15+	73+	65+	49+	11+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**SUPERIOR GDB8 DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
SUPERIOR GDB8	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-69		0-17		0-34	0-22	0-26			0-11
Marginal Range	70-114		18-34		35-65	23-52	27-55			12-29
High Range	115-140		35-48		66-85	53-64	56-72			30-40
Abnormal	141+		49+		86+	65+	73			41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**FARREL GEAR**
SYSTEM/USE:	**REDUCTION GEARS**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
FARREL	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-9	0-2	0-2	0-2	0-14	0-22	0-7	0-2	0-2	0-11
Marginal Range	10-24	3-5	3-5	3-5	15-30	23-52	8-15	3-5	3-5	12-29
High Range	25-30	6-10	6-10	6-10	31-45	53-64	16-25	6-10	6-10	30-40
Abnormal	31+	11+	11+	11+	46+	65+	226+	11+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**G.E. GEAR**
SYSTEM/USE:	**REDUCTION GEARS**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
GEARS	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-11	0-2	0-2	0-2	0-17	0-22	0-11	0-2	0-2	0-11
Marginal Range	12-29	3-5	3-5	3-5	18-34	23-52	12-29	3-5	3-5	12-29
High Range	30-40	6-10	6-10	6-10	35-48	53-64	30-40	6-10	6-10	30-40
Abnormal	41+	11+	11+	11+	49+	65+	41+	11+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**WESTERN GEAR**
SYSTEM/USE:	**REDUCTION GEARS**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
WESTERN	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-14	0-2	0-2	0-2	0-9	0-22	0-11	0-2	0-2	0-11
Marginal Range	15-30	3-5	3-5	3-5	10-24	23-52	12-29	3-5	3-5	12-29
High Range	31-45	6-10	6-10	6-10	25-30	53-64	30-40	6-10	6-10	30-40
Abnormal	46+	11+	11+	11+	31+	65+	41+	11+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**WESTINGHOUSE GEAR**
SYSTEM/USE:	**REDUCTION GEARS**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
WESTINGHOUSE	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-7	0-2	0-4	0-2	0-22	0-22	0-11	0-2	0-2	0-11
Marginal Range	8-15	3-5	5-9	3-5	23-52	23-52	12-29	3-5	3-5	12-29
High Range	16-25	6-10	10-14	6-10	53-64	53-64	30-40	6-10	6-10	30-40
Abnormal	26+	11+	15+	11+	65+	65+	41+	11+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**WESTERN GEAR 1100**
SYSTEM/USE:	**REDUCTION GEARS**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
WESTERN GEAR 1100	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-44		0-5		0-26	0-22				0-11
Marginal Range	45-82		6-13		27-55	23-52				12-29
High Range	83-105		14-20		56-72	53-64				30-40
Abnormal	106+		21+		73+	65+				41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**SAC FOR DETROIT DIESEL (GM) 16V-149 TI AIR COMPRESSOR**
SYSTEM/USE:	**STARTING**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
SAC FOR DETROIT DIESEL (GM) 16V-149 TI	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-9			0-5						0-5
Marginal Range	10-24			6-13						6-13
High Range	25-30			14-20						14-20
Abnormal	31+			21+						21+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**INGERSOLL RAND AIR COMPRESSOR**
SYSTEM/USE:	**HIGH PRESSURE**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
INGERSOLL RAND AIR COMPRESSOR	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si	Ti
Normal Range	0-4		0-2	0-2	0-11	0-2	0-54	0-2	0-2	0-2	0-2
Marginal Range	5-9		3-5	3-5	12-29	3-5	55-94	3-5	3-5	3-5	3-5
High Range	10-14		6-10	6-10	30-40	6-10	95-118	6-10	6-10	6-10	6-10
Abnormal	15+		11+	11+	41+	11+	119+	11+	11+	11+	11+
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**WORTHINGTON AIR COMPRESSOR**
SYSTEM/USE:	**HIGH PRESSURE**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
WORTHINGTON AIR COMPRESSOR	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si	Ti
Normal Range	0-24	0-2	0-2	0-2	0-9	0-2	0-4	0-4	0-2	0-2	0-2
Marginal Range	25-54	3-5	3-5	3-5	10-24	3-5	5-9	5-9	3-5	3-5	3-5
High Range	55-68	6-10	6-10	6-10	25-30	6-10	10-14	10-14	6-10	6-10	6-10
Abnormal	69+	11+	11+	11+	31+	11+	15+	15+	11+	11+	11+
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**INGERSOLL RAND NS100NL AIR COMPRESSOR**
SYSTEM/USE:	**INTERMEDIATE AND LOW PRESSURE**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
INGERSOLL RAND NS100NL	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-2	0-2	0-2	0-2	0-7	0-22	0-14	0-2	0-2	0-11
Marginal Range	3-5	3-5	3-5	3-5	8-15	23-52	15-30	3-5	3-5	12-29
High Range	6-10	6-10	6-10	6-10	16-25	53-64	31-45	6-10	6-10	30-40
Abnormal	11+	11+	11+	11+	26+	65+	46+	11+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**R12 AIR CONDITIONING COMPRESSOR SYSTEM**
SYSTEM/USE:	**CHILLED WATER**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
R12 AIR CONDITIONING COMPRESSOR	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range						0-22				0-11
Marginal Range						23-52				12-29
High Range						53-64				30-40
Abnormal						65+				41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**R11 AIR CONDITIONING COMPRESSOR SYSTEM**
SYSTEM/USE:	**CHILLED WATER**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
R11 AIR CONDITIONING COMPRESSOR	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si	Ti
Normal Range	0-654	0-2	0-11	0-2	0-654	0-5	0-2	0-4	0-26	0-2	0-2
Marginal Range	655-699	3-5	12-29	3-5	655-699	6-13	3-5	5-9	27-55	3-5	3-5
High Range	700-725	6-10	30-40	6-10	700-725	14-20	6-10	10-14	56-72	6-10	6-10
Abnormal	726+	11+	41+	11+	726+	21+	11+	15+	73+	11+	11+
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**R114 AIR CONDITIONING COMPRESSOR**
SYSTEM/USE:	**CHILLED WATER**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
R114 AIR CONDITIONING COMPRESSOR FLUID	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si	Ti
Normal Range	0-2		0-2	0-2	0-9	0-2	0-2	0-2	0-2	0-2	0-2
Marginal Range	3-5		3-5	3-5	10-24	3-5	3-5	3-5	3-5	3-5	3-5
High Range	6-10		6-10	6-10	25-30	6-10	6-10	6-10	6-10	6-10	6-10
Abnormal	11+		11+	11+	31+	11+	11+	11+	11+	11+	11+
Abnormal Trend (PPM Increase in 10 Hrs)											

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COMPONENT:	**R12 REFRIGERATION SYSTEMS**
SYSTEM/USE:	**DIRECT EXPANSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
R12 REFRIGERATION	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-11		0-2	0-2	0-17	0-22	0-2	0-7	0-2	0-11
Marginal Range	12-29		3-5	3-5	18-34	23-52	3-5	8-15	3-5	12-29
High Range	30-40		6-10	6-10	35-48	53-64	6-10	16-25	6-10	30-40
Abnormal	41+		11+	11+	49+	65+	11+	26+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**SPRING BEARING**
SYSTEM/USE:	**LINE SHAFT**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
SPRING BEARING	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range						0-22				0-11
Marginal Range						23-52				12-29
High Range						53-64				30-40
Abnormal						65+				41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**HARDY TYNES AIR SUPPLY SYSTEM**
SYSTEM/USE:	**FORCED DRAFT BLOWER**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
HARDY TYNES AIR SUPPLY	ALL	NA

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-2	0-2	0-2	0-2	0-5	0-22	0-11	0-2	0-2	0-11
Marginal Range	3-5	3-5	3-5	3-5	6-13	23-52	12-29	3-5	3-5	12-29
High Range	6-10	6-10	6-10	6-10	14-20	53-64	30-40	6-10	6-10	30-40
Abnormal	11+	11+	11+	11+	21+	65+	41+	11+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**WESTINGHOUSE AIR SUPPLY SYSTEM**
SYSTEM/USE:	**FORCED DRAFT BLOWER**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
WESTINGHOUSE AIR SUPPLY	**ALL**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-7	0-2	0-2	0-2	0-5	0-22	0-11	0-2	0-2	0-11
Marginal Range	8-15	3-5	3-5	3-5	6-13	23-52	12-29	3-5	3-5	12-29
High Range	16-25	6-10	6-10	6-10	14-20	53-64	30-40	6-10	6-10	30-40
Abnormal	26+	11+	11+	11+	21+	65+	41+	11+	11+	41+
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**MIL-PRF-9000 (MS9250) ANCHOR WINDLASS ENGINE FLUID**
SYSTEM/USE:	**ANCHOR WINDLASS**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ANCHOR WINDLASS ENGINE	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Range											
Normal Range											
Marginal Range											
High Range											
Abnormal											
Abnormal Trend (PPM Increase in 10hrs)											

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COMPONENT:	**MIL-PRF-17672 (2110TH) ANCHOR WINDLASS HYDRAULIC FLUID**
SYSTEM/USE:	**ANCHOR WINDLASS**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ANCHOR WINDLASS HYDRAULIC	ALL	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Range											
Normal Range											
Marginal Range											
High Range											
Abnormal											
Abnormal Trend (PPM Increase in 10hrs)											

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COMPONENT:	MIL-PRF-17672 (2135TH) ANCHOR WINDLASS ENGINE FLUID
SYSTEM/USE:	ANCHOR WINDLASS

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ANCHGE	ALL	N/A

TECHNICAL AUTHORITY:	NAVAL SEA SYSTEMS COMMAND
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Range											
Normal Range											
Marginal Range											
High Range											
Abnormal											
Abnormal Trend (PPM Increase in 10hrs)											

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COMPONENT:	MIL-PRF-17672 (2075/2110, 2135) BALLAST SYSTEM HYDRAULIC FLUID
SYSTEM/USE:	BALLAST SYSTEM

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
BALLHY	ALL	N/A

TECHNICAL AUTHORITY:	NAVAL SEA SYSTEMS COMMAND
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Range											
Normal Range											
Marginal Range											
High Range											
Abnormal											
Abnormal Trend (PPM Increase in 10hrs)											

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COMPONENT:	MIL-PRF-17672 CAPSTAN HYDRAULIC SYSTEM FLUID
SYSTEM/USE:	CAPSTAN HYDRAULIC SYSTEM

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
N/A	N/A	N/A

TECHNICAL AUTHORITY:	NAVAL SEA SYSTEMS COMMAND
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Range											
Normal Range											
Marginal Range											
High Range											
Abnormal											
Abnormal Trend (PPM Increase in 10hrs)											

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COMPONENT:	MIL-PRF-17672 CENTRAL HYDRAULICS SYSTEM FLUID
SYSTEM/USE:	CENTRAL HYDRAULICS

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
HVCS	ALL	N/A

TECHNICAL AUTHORITY:	NAVAL SEA SYSTEMS COMMAND
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Range											
Normal Range											
Marginal Range											
High Range											
Abnormal											
Abnormal Trend (PPM Increase in 10hrs)											

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COMPONENT:	MIL-PRF-17331 (2190 TEP) CPP/CRP HYPDRAULICS FLUID
SYSTEM/USE:	CONTROLABLE PITCH PROPELLER

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CPP or CRP	CG-47 Class	C80M
CPP or CRP	CG-68 Class	C8AM
CPP or CRP	DDG-51 Class	CF1M
CPP or CRP	LHA-6 Class	CI0M
CPP or CRP	LHD-1 Class	CI1M
CPP or CRP	LHD-8 Class	CI2M
CPP or CRP	LPD-17 Class	CJ0M
CPP or CRP	LSD-41 Class	CN0M
CPP or CRP	LSD-49 Class	CP0M

TECHNICAL AUTHORITY:	NAVAL SEA SYSTEMS COMMAND
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Range											
Normal Range											
Marginal Range											
High Range											
Abnormal											
Abnormal Trend (PPM Increase in 10hrs)											

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COMPONENT:	MIL-PRF-9000 (MS9250) CONTROLLABLE PITCH PROPELLER HYDRAULIC FLUID
SYSTEM/USE:	CPP/CRP HYDRAULICS

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CPP	MDM-1 Class	CR0M

TECHNICAL AUTHORITY:	NAVAL SEA SYSTEMS COMMAND
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Range											
Normal Range											
Marginal Range											
High Range											
Abnormal											
Abnormal Trend (PPM Increase in 10hrs)											

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COMPONENT:	MIL-PRF-17672 (2135TH) CRANE HYDRAULIC FLUID
SYSTEM/USE:	HYRDRAULIC SYSTEM

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CRANE	ALL	N/A

TECHNICAL AUTHORITY:	NAVAL SEA SYSTEMS COMMAND
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Range											
Normal Range											
Marginal Range											
High Range											
Abnormal											
Abnormal Trend (PPM Increase in 10hrs)											

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COMPONENT:	MIL-PRF-17111 CRANE HYDRAULIC SYSTEM FLUID
SYSTEM/USE:	HYDRAULIC SYSTEM

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CRANE	ALL	N/A

TECHNICAL AUTHORITY:	NAVAL SEA SYSTEMS COMMAND
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Range											
Normal Range											
Marginal Range											
High Range											
Abnormal											
Abnormal Trend (PPM Increase in 10hrs)											

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COMPONENT:	MIL-PRF-17672 (2135TH) ELEVATOR HYDRAULIC SYSTEM FLUID
SYSTEM/USE:	ELEVATOR HYDRAULIC SYSTEM

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ELEV	ALL	N/A

TECHNICAL AUTHORITY:	NAVAL SEA SYSTEMS COMMAND
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Range											
Normal Range											
Marginal Range											
High Range											
Abnormal											
Abnormal Trend (PPM Increase in 10hrs)											

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COMPONENT:	MIL-PRF-19457 ELEVATOR HYDRAULIC SYTEM FLUID
SYSTEM/USE:	ELEVATOR HYDRAULIC SYSTEM

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
ELEV	ALL	N/A

TECHNICAL AUTHORITY:	NAVAL SEA SYSTEMS COMMAND
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Range											
Normal Range											
Marginal Range											
High Range											
Abnormal											
Abnormal Trend (PPM Increase in 10hrs)											

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COMPONENT:	MIL-PRF-17672 (2135TH) STEERING GEAR HYDRAULIC SYSTEM FLUID
SYSTEM/USE:	STEERING GEAR HYDRAULICS

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
HYDSTR	ALL	N/A

TECHNICAL AUTHORITY:	NAVAL SEA SYSTEMS COMMAND
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Range											
Normal Range											
Marginal Range											
High Range											
Abnormal											
Abnormal Trend (PPM Increase in 10hrs)											

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COMPONENT:	MIL-PRF-17672 (2110TH) STERN GATE HYDRAULIC SYSTEM FLUID
SYSTEM/USE:	STERN GATE HYDRAULIC SYSTEM

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
STERN GATE	ALL	N/A

TECHNICAL AUTHORITY:	NAVAL SEA SYSTEMS COMMAND
STATUS:	IN USE

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Si	Sn	Ni	Pb	Mo	Mg
Range											
Normal Range											
Marginal Range											
High Range											
Abnormal											
Abnormal Trend (PPM Increase in 10hrs)											

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COMPONENT:	**ROLLS ROYCE MARINE MT7**
SYSTEM/USE:	**MAIN PROPULSION/LIFT SYSTEMS**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
MT7	LCAC-100 Class	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Na	Ni	Pb	Si
Normal Range	0-2	0-2	0-2	0-2	0-2	0-2		0-2	0-2	0-10
Marginal Range										9-10
High Range										
Abnormal										
Abnormal Trend (PPM Increase in 10 Hrs)										

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS (Continued)

	Sn	Ti	B	Mo	Zn	Ba	P	Ca	Cd	K
Normal Range	0-3	0-2		0-2	0-2					
Marginal Range	4									
High Range										
Abnormal	≥5	≥3		≥3	≥3					
Abnormal Trend (PPM Increase in 10 Hrs)										

Recommendation:

Drain, flush reservoir, replace lube filter, re-service with lube oil, resume sampling schedule.Submit sample for a new baseline.

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COMPONENT:	**LYCOMING VERICOR (ALLIED SIGNAL) T40B / ETF40B GAS TURINE ENGINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
TF40B	**LCAC**	**GH0Q**
ETF40B	**LCAC**	**GH0Q**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Na	Ni	Pb	Si
Normal Range	0-14	0-3	0-3	0-1	0-3	0-3		0-1	0-3	0-32
Marginal Range	15-16		4	2	4	4		2	4	33-38
High Range	17-19	4	5	3	5-9	5		3	5	39-50
Abnormal	≥20	≥5	≥6	≥4	>10	≥6		≥4	≥6	≥51
Abnormal Trend (PPM Increase in 10 Hrs)	4	2	2	2	2	2		2	2	10

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS (Continued)

	Sn	Ti	B	Mo	Zn	Ba	P	Ca	Cd	K
Normal Range	0-14	0-2		0-4	0-13					
Marginal Range	15-16	3		5	14-16					
High Range	17-20	4		6-7	17-19					
Abnormal	≥21	≥5		≥8	≥20					
Abnormal Trend (PPM Increase in 10 Hrs)	5	2		2	4					

Recommendation:

Drain, flush reservoir, replace lube filter, re-service with lube oil, resume sampling schedule. Submit sample for a new baseline.

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COMPONENT:	**MTU 8V 396 DIESEL ENGINE**
SYSTEM/USE:	**SHIP SERVICE DIESEL GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
MTU 8V 396	**LCS-2 Class**	**SH2L**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-44		0-4		0-14		0-2	0-1		0-9
Marginal Range										
High Range	45-64		5-9		15-29		3-4	2-4		10-29
Abnormal	> 65		> 10		> 29		> 5	> 5		> 30
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**ROLLS ROYCE MT30 GAS TURBINE**
SYSTEM/USE:	**MAIN PROPULSION**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
MT-30	DDG 1000 Class	GF2M
MT-30	LCS-1 Class	GJ1M

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Pb	Sn	Ni	Si
Normal Range	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-4	0-2	0-10
Marginal Range										
High Range										
Abnormal										
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**FM 8 CYLINDER-38ND 8-1/8 OP OR FM 12 CYLINDER-38ND 8-1/8 OP DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
FM 8 cylinder-38ND 8-1/8 OP or FM 12 cylinder-38ND 8-1/8 OP	**SSN 688 Class SSBN/SSGN 726 Class SSN 21 Class**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Na	Ni	Pb	Si
Normal Range	0-11	0-1	0-3	0-5	0-5	3-48	0-19	0-1	0-2	0-12
Marginal Range	12-18			6-11	6-16		20-49			
High Range										
Abnormal	>18	>1	>3	>11	>16	<3;>48	>49	>1	>2	>12
Abnormal Trend (PPM % Increase Compared to Previous Sample)	>64		>64	>64	>74		>99			>74

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS (Continued)

	Sn	Ti	B	Mo	Zn	Ba	P	Ca	Cd	K
Normal Range	0-1	0-1	0-7	0-1	101-1799	0-1	300-1299	3001-6499	0-1	0-1
Marginal Range										2-4
High Range										
Abnormal	>1	>1	>7	>1	<101; >1799	>1	<301; >1299	<3001 ; >6499	>1	>4
Abnormal Trend (PPM % Increase Compared to Previous Sample)			>64							

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COMPONENT:	**CATERPILLAR 3512B DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CATERPILLAR 3512B	**SSN 774 Class**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Na	Ni	Pb	Si
Normal Range	0-20	0-1	0-3	0-3	0-10		0-17	0-2	0-3	0-5
Marginal Range	21-30	2	4-5	4-5	11-30		18-72	3	4-5	6-10
High Range	31-40	3	6-7	6-7	31-40		73-127	4-5	6-7	11-15
Abnormal	>40	>3	>7	>7	>40		>127	>5	>7	>16

** Cu up to 500 ppm is acceptable within 1000 hours of work being performed on the cooling piping.

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS (Continued)

	Sn	Ti	B	Mo	Zn	Ba	P	Ca	Cd	K
Normal Range	0-1	0-1	0-3			0-4			0-4	0-4
Marginal Range	1	2	4-6			5-30			5-30	5-30
High Range	2	3	7-9							
Abnormal	>3	>3	>9			>30			>30	>30

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COMPONENT:	**CATERPILLAR 3512B DIESEL GENERATOR**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CATERPILLAR 3512B	SSN 774 Class	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu**	Mg	Na	Ni	Pb	Si
Normal Range	0-20		0-3	0-3	0-10		0-5	0-2	0-3	0-4
Marginal Range	21-30		4-5	4-5	11-30		6-10	3	4-5	5-7
High Range	31-33		6	6	31-40		11-15	4-5	6	7-9
Abnormal	>34		>6	>6	>40		>15	>5	>6	>9

** Cu up to 500 ppm is acceptable within 1000 hours of work being performed on the cooling piping.

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS (Continued)

	Sn	Ti	B	Mo	Zn	Ba	P	Ca	Cd	K
Normal Range	0-2									
Marginal Range	3-4									
High Range	5									
Abnormal	>5									

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NOTE

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COMPONENT:	**BOW/STERN RAMP HYDRAULICS**
SYSTEM/USE:	**LCAC HYDRAULIC SYSTEMS**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
STERNRAMP	LCAC	5A03
BOWRAMP	LCAC	5A03
BPROP	LCAC	5A03
RPROP	LCAC	5A03

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Na	Ni	Pb	Si
Normal Range	0-14		0-3				0-3			0-14
Marginal Range	15-16		4				4			15-16
High Range	17-20		5				5			17-20
Abnormal	≥21		≥6				≥6			≥21
Abnormal Trend (PPM Increase in 10 Hrs)	4		2				2			5

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS (Continued)

	Sn	**Ti**	**B**	**Mo**	**Zn**	Ba	**P**	**Ca**	**Cd**	**K**
Normal Range	0-14	0-2			0-13					
Marginal Range	15-16	3			14-16					
High Range	17-20	4			17-19					
Abnormal	≥21	≥5			≥20					
Abnormal Trend (PPM Increase in 10 Hrs)	5	2			4					

Recommendation (for Propeller Lube Oil):

Drain, flush reservoir, replace lube filter, re-service with lube oil, resume sampling schedule. Submit sample for a new baseline.

Recommendation (for Ramp Lube Oil):

Resample and validate results. If results are confirmed, consult local maintenance for further guidance.

NOTE

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COMPONENT:	**T-62T-40-7 AUXILIARY POWER UNIT**
SYSTEM/USE:	**LCAC PROPULSION SYSTEMS**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
APU	LCAC	GH0R

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Na	Ni	Pb	Si
Normal Range	0-6	0-3	0-3	0-2	0-2	0-2		0-1		0-30
Marginal Range	7	4	4	3	3	3		2		31-37
High Range	8-9	5	5	4	4	4		3		38-44
Abnormal	≥10	≥6	≥6	≥5	≥5	≥5		≥4		≥45
Abnormal Trend (PPM Increase in 10 Hrs)	3	2	2	2	2	2		2		9

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS (Continued)

	Sn	Ti	B	Mo	Zn	Ba	P	Ca	Cd	K
Normal Range	0-14			0-2						
Marginal Range	15-16			3						
High Range	17-20			4						
Abnormal	≥21		≥10	≥5	≥10					
Abnormal Trend (PPM Increase in 10 Hrs)	5			2						

Recommendation:

Drain, flush reservoir, replace lube filter, re-service with lube oil, resume sampling schedule. Submit sample for a new baseline.

NOTE

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COMPONENT:	**REDUCTION GEAR**
SYSTEM/USE:	**LCAC PROPULSION SYSTEMS**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
MRG	LCAC	RH0Z

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Na	Ni	Pb	Si
Normal Range	0-14	0-3	0-3	0-1	0-3	0-3	0-3	0-1	0-3	0-14
Marginal Range	15-16	4	4	2	4	4	4	2	4	15-16
High Range	17-20	5	5	3	5	5	5	3	5	17-20
Abnormal	≥21	≥6	≥6	≥4	≥6	≥6	≥6	≥4	≥6	≥21
Abnormal Trend (PPM Increase in 10 Hrs)	4	2	2	2	2	2	2	2	2	5

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS (Continued)

	Sn	Ti	B	Mo	Zn	Ba	P	Ca	Cd	K
Normal Range	0-14	0-2			0-13					
Marginal Range	15-16	3			14-16					
High Range	17-20	4			17-19					
Abnormal	≥21	≥5	≥10		≥20					
Abnormal Trend (PPM Increase in 10 Hrs)	5	2			4					

Recommendation:

Resample and validate results. If results are confirmed, consult local maintenance for further guidance.

NOTE

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COMPONENT:	**CONTROLLABLE PITCH PROPELLOR**
SYSTEM/USE:	**LCAC PROPULSION SYSTEMS**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
CPP	LCAC	CH0N

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Na	Ni	Pb	Si
Normal Range	0-14	0-3	0-3	0-1	0-3		0-3	0-1	0-3	0-14
Marginal Range	15-16	4	4	2	4		4	2	4	15-16
High Range	17-20	5	5	3	5		5	3	5	17-20
Abnormal	>21	>6	>6	>4	>6		>6	>4	>6	>21
Abnormal Trend (PPM Increase in 10 Hrs)	4	2	2	2	2		2	2	2	5

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS (Continued)

	Sn	Ti	B	Mo	Zn	Ba	P	Ca	Cd	K
Normal Range	0-14	0-2			0-13					
Marginal Range	15-16	3			14-16					
High Range	17-20	4			17-19					
Abnormal	>21	>5			>20					
Abnormal Trend (PPM Increase in 10 Hrs)	5	2			4					

Recommendation (for Propeller Lube Oil):

Drain, flush reservoir, replace lube filter, re-service with lube oil, resume sampling schedule. Submit sample for a new baseline.

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COMPONENT:	**SCAVANGE FAN HYDRAULICS**
SYSTEM/USE:	**LCAC HYDRAULIC SYSTEMS**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
SCAVFAN	LCAC	IOOI

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Na	Ni	Pb	Si
Normal Range	0-14		0-3				0-3			0-14
Marginal Range	15-16		4				4			15-16
High Range	17-20		5				5			17-20
Abnormal	>21		>6				>6			>21
Abnormal Trend (PPM Increase in 10 Hrs)	4		2				2			5

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS (Continued)

	Sn	Ti	B	Mo	Zn	Ba	P	Ca	Cd	K
Normal Range	0-14	0-2			0-13					
Marginal Range	15-16	3			14-16					
High Range	17-20	4			17-19					
Abnormal	>21	>5			>20					
Abnormal Trend (PPM Increase in 10 Hrs)	5	2			4					

Recommendation:

Resample and validate results. If results are confirmed, consult local maintenance for further guidance

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COMPONENT:	**BOW THRUSTER HYDRAULICS**
SYSTEM/USE:	**LCAC PROPULSION SYSTEMS**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
BOWTHR	LCAC	VOOI

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Na	Ni	Pb	Si
Normal Range	0-14		0-3				0-3			0-14
Marginal Range	15-16		4				4			15-16
High Range	17-20		5				5			17-20
Abnormal	>21		>6				>6			>21
Abnormal Trend (PPM Increase in 10 Hrs)	4		2				2			5

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS (Continued)

	Sn	Ti	B	Mo	Zn	Ba	P	Ca	Cd	K
Normal Range	0-14	0-2			0-13					
Marginal Range	15-16	3			14-16					
High Range	17-20	4			17-19					
Abnormal	>21	>5			>20					
Abnormal Trend (PPM Increase in 10 Hrs)	5	2			4					

Recommendation:

Resample and validate results. If results are confirmed, consult local maintenance for further guidance.

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COMPONENT:	**12V AND 16V PA6B DIESEL ENGINE**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
12V and 16V PA6B	CVN-78 Class	N/A

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Na	Ni	Pb	Si
Normal Range	0-16	0	0-4	0-1	0-6	31-319	0-17	0-1	0-1	0-16
Marginal Range	17-26		5-6		7-10		18-24		2	17-21
High Range	>26	>0	>6	>1	>10	<31 >319	>24	>1	>2	>21
Abnormal										
Abnormal Trend (PPM Increase in 10 Hrs)										

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS (Continued)

	Sn	**Ti**	**B**	**Mo**	**Zn**	Ba	**P**	**Ca**	**Cd**	**K**
Normal Range	0	0-6	0-2	689-1479	0	621-1139	2801-6599	0-1	0-2	
Marginal Range		7-15	3-13		1			2	3-7	
High Range	>0	>15	>13	<689 >1479	>1	<621 >1139	<2801 >6599	>2	>7	
Abnormal										
Abnormal Trend (PPM Increase in 10 Hrs)										

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COMPONENT:	**DIESEL LUBRICATING OIL STORAGE TANK**
SYSTEM/USE:	**EMERGENCY GENERATOR**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
STORAGE TANK	**SSN 688 Class SSBN/SSGN 726 Class SSN 21 Class**	**N/A**

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Na	Ni	Pb	Si
Normal Range	0-6	0-1	0-3	0-1	0-5	13-48	0-14	0-1	0-2	0-12
Marginal Range										
High Range										
Abnormal	>6	>1	>3	>1	>5	<13; >48	>14	>1	>2	>12

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS (Continued)

	Sn	Ti	B	Mo	Zn	Ba	P	Ca	Cd	K
Normal Range	0-1	0-1	0-7	0-1	401-1799	0-1	801-1599	4001-6299	0-1	0-2
Marginal Range										
High Range										
Abnormal	>1	>1	>7	>1	<401; >1799	>1	<801; >1599	<4001; >6299	>1	>2

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COMPONENT:	**PH-47C AUXILIARY POWER UNIT**
SYSTEM/USE:	**LCAC100 PROPULSION SYSTEMS**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	END ITEM	JOAP TYPE EQUIPMENT CODE
APU	LCAC100	GH0T

TECHNICAL AUTHORITY:	**NAVAL SEA SYSTEMS COMMAND**
STATUS:	**IN USE**

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Na	Ni	Pb	Si
Normal Range	0-6	0-3	0-3	0-2	0-2	0-2		0-1		0-30
Marginal Range	7	4	4	3	3	3		2		31-37
High Range	8-9	5	5	4	4	4		3		38-44
Abnormal	>10	>6	>6	>5	>5	>5		>4		>45

Table 1 - JOAP ATOMIC EMISSION ROTRODE UPPER LIMITS (Continued)

	Sn	Ti	B	Mo	Zn	Ba	P	Ca	Cd	K
Normal Range	0-14			0-2						
Marginal Range	15-16			3						
High Range	17-20			4						
Abnormal	>21			>5	>10					

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