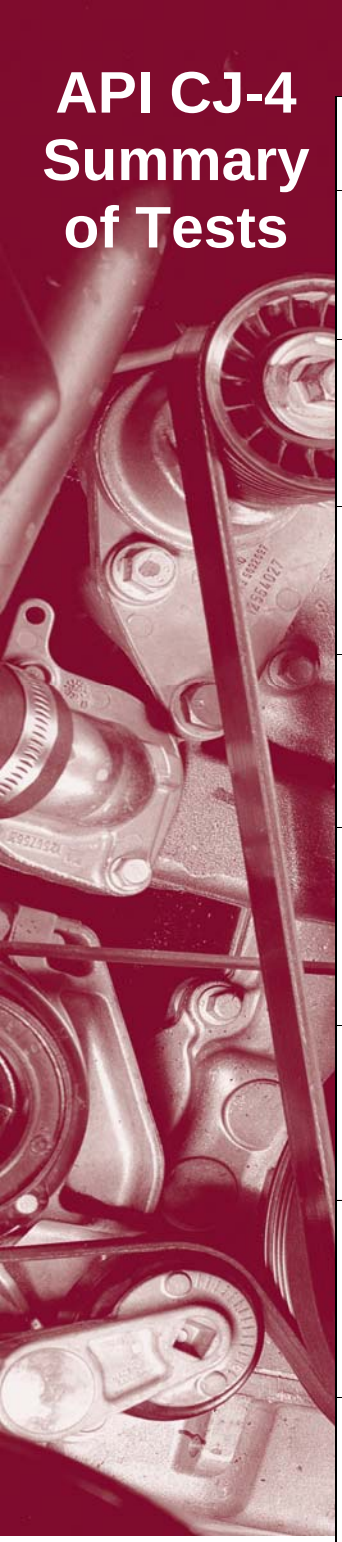
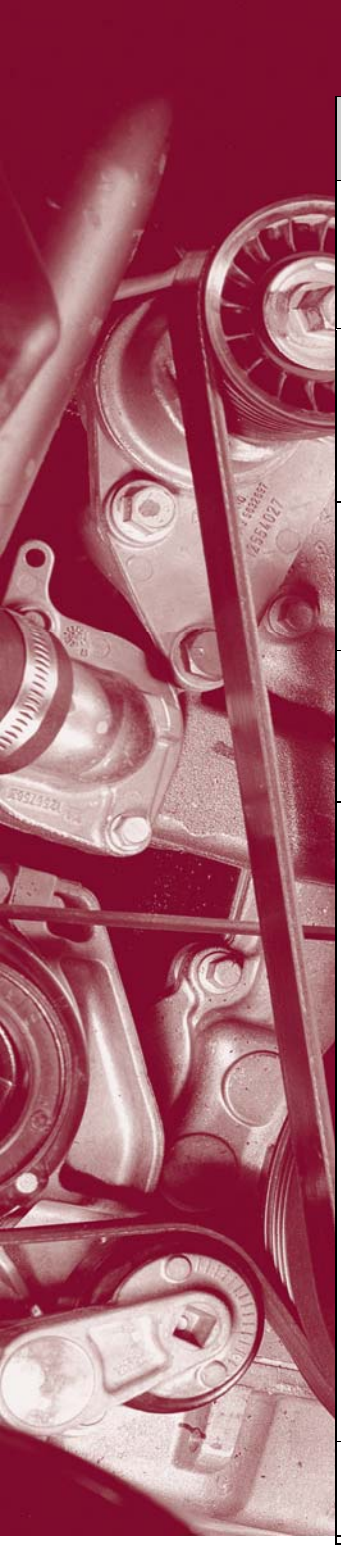
API CJ-4 Summary of Tests



TEST TYPE	PURPOSE	PARAMETER	REQUIREMENT
Caterpillar 1N	Evaluates performance of crankcase lubricants	Piston deposits Ring sticking Piston scuffing Ring scuffing Liner scuffing Oil consumption	Weighted demerits, max 286.2/311.7/323.0 Top groove fill, max 20/23/25 Top land heavy carbon, max 3/4/5 Oil consumption (0-252 hrs) g/kwh, max 0.5 Piston/ring/liner scuffing None Piston ring stick None
Caterpillar C13	Evaluates performance of crankcase lubricants for piston deposits, oil consumption	Liner (1Y-4107) Piston (1Y-4106) Top Ring (1Y-4108) 2nd Ring (1Y-4109) Oil Ring (1Y-4110)	Delta O/C: Max 31, Merit Wt 300, Anchor 25, Min 10 ATLC: Max 35, Merit Wt 300, Anchor 30, Min 15 ATGC: Max 53, Merit Wt 300, Anchor 46, Min 30 R2TCA: Max 33, Merit Wt 100, Anchor 22, Min 5 Merits 1000
Cummins ISB	Evaluates a crankcase lubricant's ability to reduce valve train and cam-shaft lobe wear	Camshaft Mushroom-style slider tappets Crosshead	MTAC: 1 / 2 / 3 ACSW 55: 55 / 59 / 61 ATWL 100: 100 / 108 / 11
Cummins ISM	Evaluates a lubricant's effectiveness at reducing soot-related overhead wear, sludge, oil filter plugging	Injector adjusting screw Sludge Crosshead Top ring wear Oil filter plugging	Parameter: Anchor / Merit Wt / Max / Min XHD: 5.7 / 350 / 7.1 / 4.3 RWL: 100 / 0 / 100 / 0 Ofdp: 13 / 150 / 19 / 7 IAS: 27 / 350 / 49 / 16 Sludge: 9 / 150 / 9.3 / 8.7 Merits 1000
Engine Oil Aeration Test	Determines effectiveness of engine lubricating oils at minimizing air entrainment in large pickups and medium-duty trucks	Oil Evaluation	At 20 hours, the maximum allowable amount of air entrained in the oil is 8% for API CJ-4, CI-4, and CH-4; and 10% for API CF-4.
Mack T11	Evaluates soot handling performance	Oil Filter Plugging	Vis 12 cSts: 6.0 TGA Soot Mins Vis 15 cSts: 6.7 Vis 4 cSts: 3.5 New oil MRV@-20C: 20000 All grades 180-Hr Used MRV: 25000, Yield stress <35 D 4684M
Mack T11A	Evaluates soot handling performance of lubricating oils operating in diesel engines equipped with EGR	Oil samples	180-Hr sample soot: 4.82 / 5.16 / 5.49 New oil MRV@-20C: 20000 All grades 180-Hr Used MRV: 25000, Yield stress <35 D 4684M
Mack T12	Evaluates an oil's ability to minimize cylinder liner, piston ring and bearing wear in engines with EGR	Piston ring wear, cylinder liner wear, lead bearing corrosion, oil consumption, and oxidation	Parameter: Anchor / Merit Wt / Max / Min RWL: 70 / 200 / 105 / 35 LWS: 20 / 250 / 24 / 12 Lead: 25 / 200 / 35 / 10 Lead delta: 10 / 200 / 15 / 0 O/C: 65 / 150 / 85 / 50 Merits 1000
Roller Follower Wear Test	Determines effects of lubricating oils on camshaft roller follower axle wear	Roller follower axles	Average Pin Wear Mils, max. or µm, max.: MTAC Limits 0.30 / 0.33 / 0.36 or 7.6 / 8.4 / 9.1
Sequence IIIF	Measures oil thickening and piston deposits under high-temp conditions	istons inspected for deposits, varnish; cam lobes, lifters measured for wear; oil screen plugging is evaluated	PARAMETER: Viscosity increase PASS LIMIT: 275%
Sequence IIIG	Measures oil thickening and piston deposits under high-temp conditions	Pistons inspected for deposits, varnish; cam lobes and lifters measured for wear; oil screen plugging is evaluated	PARAMETER: Viscosity increase PASS LIMIT: 150%



Chemical and Bench Tests

Foaming	Determines the foaming characteristics of lubricating oils	Foaming volumes	Foaming / Settling Sequence I, max 10 / 0 % Sequence II, max 20 / 0 % Sequence III, max 10 / 0 %
High-Temperature Corrosion	Evaluates diesel engine lubricants to determine tendency to corrode various metals	Four metal coupons	Copper Used oil increase Max 20 ppm Lead Used oil increase Max 120 ppm Copper Strip rating Max 3 ---
High-Temperature High-Shear Viscosity	Covers the laboratory determination of the viscosity of engine oils	Viscosity	Viscosity @ 150 degrees C, minimum 3.5 cP
NOACK Volatility	Examines the evaporation loss of engine oils	The loss in mass of oil is determined	Evap Loss @ 250 Degrees C Vis Grades other than 10W-30, max 13% Evap Loss @ 250 Degrees C 10W-30, max 15%
Seal Compatibility	Evaluates the compatibility of automotive engine oils with four reference elastomers	Effects of test oils on elastomers, measurement of changes in volume, hardness, tensile properties	Nitrile Volume change +5 / -3 Hardness +7 / -5 Tensile strength +10 / -TMC 1006 Elongation +10 / -TMC 1006 Silicone Volume change +TMC 1006 / -3 Hardness +5 / –TMC 1006 Tensile strength +10 / -45 Elongation +20 / -30 Polyacrylate Volume change +5 / -3 Hardness +8 / -5 Tensile strength +18 / -15 Elongation +10 / -35 FKM Volume change +5 / -2 Hardness +7 / -5 Tensile strength +10 / -TMC 1006 Elongation +10 / -TMC 1006 Vamac G Volume change +TMC 1006 / -3 Hardness +5 / -TMC 1006 Tensile strength +10 / -TMC 1006 Elongation +10 / -TMC 1006
Sooted Oil MRV	Measures yield stress and viscosity of engine oils	Viscosity and yield stress	180-Hour sample from Mack T-11 or T-11A Viscosity @ -20C, max 25,000 mPa•s Yield Stress < 35 Pa

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