



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

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SERVICE REPORT FOR UPPER BLOCK REPLACEMENT
ENTERPRISE DGRS-46 ENGINE SERIAL NUMBER 82004-3063
UNIT 2
EAST BAY MUNICIPAL UTILITIES DISTRICT
OAKLAND, CALIFORNIA

INTRODUCTION

Provided is the onsite field service report (the mechanical disassembly and reassembly of the engine) for the Upper Block Replacement on Enterprise DGRS-46 Engine serial number 82004-3063 (Unit 2), Power Generation Station (PGS), East Bay Municipal Utility District (EBMUD), Oakland, California. The onsite field service report provides an accounting of daily activities, component dimensions as measured, and problems encountered in reassembly. The report has been segmented into assemblies to provide clearances and measurements. The segmented reports includes as found reports and measurements and final reassembly measurements reports in methods used in engine component and overhaul.

SYNOPSIS

Overhaul and replacement of the upper block on Enterprise DGRS-46 Engine serial number 82004-3063 (Unit 2), Power Generation Station (PGS), East Bay Municipal Utility District (EBMUD) was initially scheduled for 24 days. The Upper block was replaced in 7 days (Start 6 Sep18 block back on 15Sep18). The upper block was torqued down main bearings replaced piston rods installed and cylinder heads set in 8 days (27Sep18). Problems encountered in reassembly were: damaged gear train; poor fitment of the exhaust; bent crankshaft; misaligned fuel rack; soft foot on turbocharger platform. Each problem was unplanned requiring additional time to resolve. Change orders and the requisitioning of parts and funding delayed scheduling of work to make each progressive reassembly a process of discovery of new problems.

1. Replacing the gear train revealed the crankshaft was bent.
2. Installing the fuel rack found the rack was bound and misaligned to the upper block.

Disassembly of the engine found the gear train damaged requiring replacement. Funding of the gears delayed work until March 2019. Installation of the gears found the crankshaft was bent at the gear train end, requiring disassembly of the engine and disconnecting the generator again to remove the crankshaft (basically starting over). Additional nonscheduled work included removing the generator for cleaning and testing, providing assistance on other engines to replace cylinder head studs.

The engine was finished on 23 August 2019 and started for mechanical integrity testing. Loaded testing and start up repairs and assistance was accomplished by 3 September 2019. Problems encountered on start up included water pump gear replacement (gear mesh did not match), water leaks in cylinder heads, unanticipated crankcase pressure (expected 1- 1 ½ inch vacuum had ½ to ¾ inch vacuum). The engine was tested to meet contractual requirements of 2300 kw dual fuel and met emissions testing standards.



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SCOPE

Replace upper block: Remove upper block, turbocharger, turbocharger support platform, cylinder heads, connecting rods and pistons, rear cover, fuel rack, flywheel, generator rotor and stator, exciter, gearcase. Replace; exhaust manifold, camshaft gear, idler gear, crankshaft gear, accessory drive gear carrier, oil pump gear carrier, water pump drive gear, pistons, cylinder heads, main bearings, connecting rod bearings, camshaft bearings, fuel pumps, fuel injectors. Realign; crankshaft, turbocharger support platform, gear train, generator rotor and outboard bearing, generator stator, generator exciter, flywheel, exhaust manifold, fuel rack. Reassemble unit and return to service.

CHRONOLOGY

5 September 2018

Badge in processing. Site orientation. Tools in Tracey, California. Begin job using EBMUD engine room tooling. Remove air intake horns, tripleheader (oil, fuel, injector fuel oil return piping)), fuel injectors, fuel injector lines, air start valves, pilot fuel injection lines and pilot fuel ignitor cells, subcovers, cylinder heads, fuel injection pumps. Measure crankshaft deflection. Clean carbon from upper liners, tap piston bolt hoes for lifting bracket. Remove crankcase vent pipe.

6 September 2018

Tools in Hayward, California. Remove fuel gas piping, air start header piping. Loosen connecting rod bolts. Remove connecting rods, separate pistons from connecting rods, set connecting rods and pistons on pallets. Remove ABB turbocharger, set on pallet. Remove exhaust and set outside. Remove turbocharger support bracket. Remove governor from top of gearcase.

7 September 2018

Remove water header to block. Remove oil pump, water pump, overspeed governor and fuel pump from gear case. Remove oil and water piping from front of engine. Remove butterfly valve, lower plenum and charge air cooler. Remove; bolts from gearcase leaving dowels, camshaft outboard bearing cover, idler gear outboard bearing cover. Remove fuel pump rack, fuel pump bases from top of engine. Remove crankcase vent fan. Remove gearcase.

8 September 2018

Remove catwalk and upper plenum set outside. Remove camshaft covers and measure camshaft #1 fuel pump lift at 21° BTC (.197 in to confirm lift). Check air start timing at 10° BTC #1. Tag and remove camshaft lubrication tubing. Remove Ambac pump. Remove start air supply filter. Begin loosening studs on old block to fit lifting bracket. Attempt to loosen through bolts on old block, break 3 ½ in socket (drive is 1 in should be 1 ½ in drive).

10 September 2018

Measure gear lash on gear train. Loosen through bolts on block. Find left rear through bolt nut broken. Remove block through bolts and set on pallets. Strap parts on pallets for shipping.

11 September 2018



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Remove cylinder head studs for block lifting brackets. Remove camshaft tappets and guides. Remove camshaft. One cylinder head stud stuck (broken threads) cannot rotate lifting bracket for fit. Remove upper block. Remove starting air distributor adapter plate, main oil header and camshaft oil header from old block. Transfer camshaft oil header to new upper block.

12 September 2018

Remove conduit from exhaust manifold support brackets. Loosen main bearing caps, measurement on crankshaft thrust .006 (specification .022-.040). Transfer idler gear stub shaft to new block, have to redrill cotter pin holes in bolts for stub shaft. Transfer oil and gear teeth spitter tubing to front of block. Attempt fitting thrust bearings in lower half of crankshaft, .006 thrust. Measure thrust face at .614-.619 work down with sandpaper to .614-.615.

13 September 2018

Fit thrust bearings in engine measure .040 thrust. Set camshaft in upper block to measure runout against the start air distributor mounting plate. Measure new main bearings. Replace #1, #2, #3, #4 #7, #8, #9 main bearings. Install air start tubing lines from air start distributor to cylinder heads.

14 September 2018

Torque main bearing caps, measure main bearing clearance and crankshaft deflection. Clean bedplate. Measure new camshaft bearings and install in block with camshaft caps on. Check camshaft gear hub runout (.001) (parallel to the front of the block for idler gear alignment). Set idler gear to align to camshaft gear (set idler gear shim and thrust on idler gear stubshaft. Begin cleaning parts for reassembly: thru bolts, upper rear cover. Install intake and exhaust and fuel tappets and guides and torque to 200 ftlb, wire tie bolts on tappets housings,

15 September 2018

Dress lower block thru bolt holes. Mount idler gear to check gear lash and thrust. Find idler gear lash is .021to .023 (specification .008-.012) test gear hardness with Rockwell harness files, find hardness is about 40 HRC (specification 59-65 HRC). Remove idler gear and change idler gear stubshaft mounting bolts so the nuts and cotter pins are exposed on the gearcase side to adjust the stubshaft for a different idler gear. Move upper block to base and set on dowels, find .010 misalignment on the base. Raise upper block and find the rear left exhaust side dowel is bent. Replace both bedplate dowels and remove the upper block to bedplate 'o' ring seal and set bedplate to find good alignment. Reinstall the upper block to base 'o' ring seal and set the upper block on the lower base. Clean paint from base areas and measure front end upper block to base seams using a straight edge (no light between the straight edge and the blocks) Clean fuel pump bases. Set lock tabs on camshaft bearing caps. Clean parts. Clean up area.

17 September 2018

Change cylinder head stud on cylinder #4 on Unit #3. Reinstall cylinder head. Restart engine Unit #3 shutdown and change gas metering valve to cylinder head. Begin putting in main bearing lube oil lines on block.

18 September 2018



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Clean and put on block water header inlet pipe. Put in main bearing cotter pins, pick up new thru bolts (from Horspool and Romine (OEM)). Put in thru bolts, (felt gaskets arrive) Begin torque thru bolts. Begin putting in cylinder head studs. Clean parts for reassembly (remove gaskets).

19 September 2018

Remove lower rear cover, clean cover and remove gasket from block. Put in cylinder head studs and torque to 100 ftlb. Set thru bolt height and torque. Clean and paint catwalk for installation. Clean parts (crankcase side covers). Put turbo support bracket up (need to measure level).

20 September 2018

Clean and paint charge air cooler, upper plenum, piping. Measure planar and level alignment of turbocharger support bracket.

21 September 2018

Clean and paint crankcase covers, camshaft galley covers. Measure piston ring end gap, connecting rod bearing thickness.

22 September 2018

Measure piston pins (all good). Clean liners (oil and luberide film coat). Assemble pistons and rods and set on top of engine. Measure piston ring side gap.

24 September 2018

Put in pistons. Measure gas valve opening on 4 cylinder heads. Remove subcover and broken upper stud on #6 cylinder head on Unit 1. Find stud broken below block surface. Wait on welding piece to stud for removal.

25 September 2018

Put on rear cover. Clean cylinder heads for installation. Measure gas valve opening on 2 cylinder heads. Put in tappets and guides. Confirm flywheel pointer at TDC.

26 September 2018

Weld piece to broken stud #6 cylinder head Unit #1. Replace broken stud on cylinder #6 Unit 1. Reinstall cylinder head, restart unit1. Finish installing rear cover Unit 2. Measure camshaft bearing clearances. Disassemble cylinder head with bent intake valve. Review reason for bent valves on cylinder head (possibly shipping handling error).

27 September 2018

Set 5 cylinder heads on engine to get off floor for protection. Put crankcase covers on engine block for protection. Put away tooling, and clean work area. Leave site.

28 September 2018

Travel Oakland to Long Beach California.

30 October 2018



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Return to install exhaust, turbocharger support bracket, turbocharger, replacement connecting rod bolts. Install turbocharger support bracket, find lateral deviation of approximately .025 off engine lateral plane, .007 off engine linear plane. Set turbocharger to measure fit between turbocharger and exhaust manifold. Cannot set exhaust manifold, length is 4 ½ inches too long (old exhaust manifold 138 inches long, this manifold 142 ½ inches long) and strikes turbocharger support bracket. Replace #4 left side (intake side) main bearing stud anti-rotation pin in bottom of stud. Connecting rod bolts replaced and torqued.

27 November 2018

Off load cylinder head and fuel rack to EBMUD. Go get exhaust manifold from vendor. Set and shim exhaust manifold and find exhaust to cylinder head bolt pattern is wrong. Measure space from end of exhaust manifold to turbocharger turbine inlet flange

28 November 2018

Build and install fuel rack. Put cotter pins in connecting rod bolts.

29 November 2018

Align cylinder head exhaust side with straight edge, torque 5 cylinder heads. Put in air start valves.

7 January 2019

Disassemble and begin removing generator rotor and stator for cleaning and inspection.

8 January 2019

Finish disassembly of generator rotor, stator, exciter and exciter housing and ship to vendor for cleaning and inspection.

4 March 2019

Return to site for gear train replacement. Tools arrive 1330. Remove camshaft gear. Clean gears. Find idler gear hub too large for gear. Job to remove crankshaft gear using EBMUD torch cancelled by EBMUD.

5 March 2019

Unpack subcovers and assemble. Finish clean and assemble camshaft gear. Fit exhaust shims and alignment of exhaust elbows. Wait on tools to remove gears (arrive 1000). Remove camshaft gear and reset on camshaft to check blue pattern on camshaft taper. Set up to remove crankshaft gear using EBMUD torch. Job cancelled by EBMUD.

6 March 2019

Install camshaft gear and torque on shaft to 1800 ftlb. CMD welder arrives set up tooling for gear removal. New idler hub arrives with CMD welder and is assembled to idler gear. Gearlash requires removal of stubshaft. (Idler gear stubshaft was mounted to existing dowels on replacement upper block.) Remove stubshaft to remove stubshaft dowels. Begin tap holes in dowels to remove dowels.



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7 March 2019

Finish removing stubshaft dowels and remove stubshaft. CMD welder onsite with CMD torch and propane heater. Issue Hot work permit. Heat and remove crankshaft drive gear. Heat new crankshaft gear on oil and install on crankshaft. Reinstall stubshaft.

8 March 2019

Assemble new idler gear and set on stubshaft. Set idler gear backlash. Rotate camshaft and crankshaft and set cam timing to .197 lift at 21° BTC on #1 fuel camshaft lobe rotating in direction of rotation (clockwise facing rear of engine). Matchmark idler gear to camshaft gear and idler gear to crankshaft drive gear.

9 March 2019

Install fuel rack and rough align fuel pump arms. Install cylinder head intake elbows, cylinder head fuel and air start hear piping. Measure subcover rocker arm clearance find dowels are wrong size (need to replace dowels) Check gearlash and move stubshaft 4 times. Check gearlash in 4 places all acceptable (.008-.012) (witness by EBMUD). Remove idler gear and begin drilling for dowels to set gearlash.

11 March 2019

Check gear teeth blue pattern, find idler to crankshaft gear is 80-90%, camshaft to idler is 10% in some places. Gear teeth surface absorb too much Prussian blue to make full rotation of idler to camshaft gear. Remove camshaft gear to check for key interference. Blue pattern check (5Mar2019) on camshaft taper fit to camshaft hub had 2 spots at low pressure side of key with approximately 80% contact on taper fit. Install #1 fuel pump to load camshaft to idler (gearlash at all points is positive contact from blue pattern). Replace camshaft key with old key and remove .003 from old key. Reassemble camshaft hub on shaft and tighten while checking blue pattern. Blue both sides of camshaft gear for contact, acceptable blue pattern greater than 80%.

12 March 2019

Install subcovers on cylinder heads. Check gear lash against loaded camshaft find the gear lash dropped from .008 to .002 loosen stubshaft to reset gearlash. Reset gearlash using feeler gauges in bottom and camshaft side of idler gear. Find gearlash is moving stubshaft bolts are not tight enough to carry loaded camshaft on idler gear.

13 March 2019

Reverse stubshaft bolting to allow bolt tightening from inside crankcase. Fit grade 8 washers inside crankcase in bolt spotface opening in casting to allow more fastener nut surface for torque. Reset gearlash using feeler gauges in bottom and camshaft side of idler gear. Run gear lash measurements (90° intervals for mechanical center on idler gear) 4 times to compare measurements to see if the stubshaft is moving. Remove idler gear to torque stubshaft bolts.

14 March 2019

Torque stubshaft bolts and turn crankshaft to fit cotter pins. Reset idler on stubshaft and set to timing marks. Recheck gearlash find gear to idler hub runout moved. Measure idler gear runout while rolling engine (runout is .004 max, but displaces .007 gearlash to 0 gearlash). Measure



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gearlash in 12 places to find runout deviation area and try to move hub in gear to recenter gear and hub. Remove idler and disassemble auxiliary gear and hub to measure hub O.D. runout. Set replacement auxiliary gear on stubshaft, find replacement gear is too long for stubshaft. Prepare for repairs to EBMUD auxiliary drive gear hub. (proposed cut hub concentric and metal spray or modify replacement hub to fit the auxiliary drive gear stubshaft. Receive generator rotor, stator and pedestal bearing, set on cribbing. Set up generator pieces for installation (check rigging).

15 March 2019

Install generator rotor, stator, pedestal bearing in place. Set stator and pedestal (outboard bearing) bearing dowels to set generator. Pull rotor into flywheel and put in temporary bolts and 2 pieces of all thread. Work preparing 1 more temporary bolt from old fitted flywheel bolts. Take EBMUD auxiliary gear hub and replacement auxiliary drive gear hub to machine shop to determine repair of hub. Vendor machine shop cut hub and fit bushing in hub.

16 March 2019

Finish preparing (cutting O.D.) of temporary flywheel bolt and set in rotor to flywheel to crankshaft hub connection at machine shop. Align rotor to flywheel to crankshaft hub bolts using straight edge, find heavy damage to 4 of 6 rotor bolt holes from missed drilling/reaming in the past. Torque 2 temporary bolts to 3000 ftlb. Ream 4 bolt holes to same tolerances and fit old bolts (uncut) through bolt holes to determine at least .002 over old bolt O.D. Leave 2 bolts full torque to hold bolt hole position for replacement bolts.

18 March 2019

Continue reaming flywheel bolts (previous holes are stepped and galded. Go to vendor to fit bushing in idler gear hub. Finish bushing cut to center space in idler gear hub at machine shop. (space needed for oil drain hole in hub).

19 March 2019

Pick up reworked idler gear and hub. Set idler gear on stub shaft and find same tight spot but less. Tight spot measures .004 previous reading 0. Rotate hub and find more space at other location. Remove gear and hub, rotate gear on hub to find same tight spot area. Check reworked gear and hub for runout. Check crankshaft gear for runout find .018 runout. Recheck crankshaft for runout (.015). Remove gear and hub and set on floor. Continue work on flywheel and rotor bolt holes, remeasure with different people to confirm measurements. Measure flywheel bolt holes (1.880-1.881).

20 March 2019

Set indicators on crankshaft and measure runout, find .017 runout at end of crankshaft and .010 runout at #1 main bearing shoulder (Measurements are witnessed by Abe Fortes (EBMUD)). Attend EBMUD progress meeting and report findings. Provide as found report from 5-28 September 2019. Begin putting on camshaft tappet housing tubing. Clean up and put away tooling for return to Long Beach.

21 March 2019

Travel Oakland to Long Beach California.



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2 April 2019

Return to site with Goltens Miami Florida representative Ivo Sisic to assess crankshaft damage and possible solutions (repair in place or remove crankshaft and recondition and grind all crankpins and main journal surfaces). Remove #1 piston and rod assembly, #1, #2, #3 main bearing caps. Remove top and bottom main bearings on #1 main journals. Measure runout on #1, #2, #3 main journals (#1-.029: #2-.005: #3-.001). Find main journal surface and #1 crankpin surface unacceptable, #1 main journal- grooves due to debris, #1 crankpin surface waviness due to wear from operation (high oil pressure crossing the bearing surface). #1 connecting rod upper bearing damaged due to surface waviness. Meet with EBMUD project managers and recommend removing crankshaft and sending to Goltens Miami for reconditioning. Measure foundation soft foot (no excessive soft foot, .003 at #2 from front of engine exhaust side). Remove cylinder heads, intake air horns.

3 April 2019

Remove exhaust manifold and store outside by IR compressors (under roof). Remove 3 pistons separate and store in boxes inside engine room. Remove turbocharger and turbocharger support bracket store in engine room on pallets. Prepare rigging to ship block, move old upper block to door for truck on 4 April 2019.

4 April 2019

Load old upper block on truck for shipping to Long Beach CMD. Remove 3 pistons and store in boxes in engine room. Remove main bearing cotter pins. Loosen main caps with upper block in place.

5 April 2019

Remove tie bolts, catwalk and upper plenum. Pack removed parts into crates and pallets and move to make room in engine room. Clean up tools and work area

8 April 2019

Remove catwalk over stator. Move rotor back and secure flywheel to crankshaft. Set rigging on upper block and remove base to upper block 7/8 bolts. Leave rotor suspended over the stator on crane with crane deactivated. Clean up tooling and work area.

9 April 2019

Remove upper block and set on 4X4 wooden cribbing on floor. Dahl arrives and takes rotor cradle, spreader beam and cribbing, leave plastic sheet under rotor in stator. Remove 8 counterweights and 14 counterweight studs, find the counterweight stud nut roll pins are against the tighten side of the castellation meaning the roll pins were installed on the stud and the stud tightened into the stud pocket together.

10 April 2019

Remove 4 counterweights and 10 counterweights studs. Remove flywheel and store inside between unit 1 and 2 on floor on cribbing. Remove main caps, cover crankpins with rags and polyvinyl sheet. Begin tool inventory for departure.



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11 April 2019

Die penetrant inspection of counterweight studs. Cover main bearing cap studs with pvc pipe for crankshaft lift. Go buy die penetrant. (Oakland airport area). Remove bolts and dowels from outboard bearing support for removal to set spacing for work and measurements on bedplate. Begin evaluation to move rotor back for bedplate and crankshaft main bore inspection.

12 April 2019

Begin spraying LPS2 preservative on upper block, pistons, for delay in assembly while crankshaft is being repaired. Remove crankshaft from engine and store on floor. Make gaskets for removed oil piping on upper block. Pack out tooling and clean area.

22 April 2019

Travel Long Beach to Oakland, California.

23 April 2019

Return to site. Move crankshaft shipping crate into engine room. Remove wrap from crankpins and main journals and take pictures for shipping. Rewrap journals oily rags and vinyl wrap. Shipping truck arrives (Penway Express MC 981855-C US DOT 2513262 VIN # J419850) a day early for pick up. Put crankshaft in crate and space main journal saddles at #3, #4 #7. #8, add 4X4 wooden bracing. Make practice lift and add more 4X4 wooden bracing.

24 April 2019

Add more 4X4 wooden bracing to crankshaft shipping crate. Make practice lift for crate strength. Put lid on crankshaft shipping crate and put on truck for shipment to Miami, FL. Clean base for die penetrant inspection.

25 April 2019

Spray die penetrant on base saddles and milled surfaces to carry upper block. Take pictures of die penetrant inspection of base. Clean base of die penetrant. Set main bearing caps on plywood for die penetrant inspection. Clean main bearing caps and spray with die penetrant and take pictures of main bearing caps. Clean die penetrant from main bearing caps and set main bearing caps on base. Clean main bearing cap stud nuts and washers, find 2 nuts thread damaged. Stone bottom of main bearing stud nuts for galling to washers. Run main bearing stud nuts to check damaged threads on studs. Replace air regulator on Hytorc.

26 April 2019

Torque main bearing caps to 2150 ftlb. (4 steps 500 ftlb, 1000 ftlb, 1500 ftlb, 2150 ftlb.). Measure main bearing bores for concentricity (nominal I.D. 14.250 in). Clean and die penetrant inspection of counterweights bottom to crankshaft. Measure plane of engine base surface using K& E level (.010 drop from #9 to #7 main bearing at intake exhaust side of engine base (did not standardize plane of measurement)).

29 April 2019

Remove lower half of engine base rear cover. Reorganize tooling.



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30 April 2019

Goltens arrives on site and provides laser alignment inspection of main bearing bores and engine base flatness. After inspection, spray engine base with WD-40. Goltens inspection finds .0075 main bearing bore deviation (misalignment from #1 to #9 main bearing bore). Goltens planar alignment inspection finds .003 deviation at #7 exhaust side by tie bolt hole.

1 May 2019

Travel Oakland to Long Beach, Ca.

9 June 2019

Travel Long Beach to Oakland, Ca. (8)

10 June 2019

Arrive on site, off load tooling (hytorc, combination wrenches, slings, hand tools). Report to Maintenance (Abe) and EBMUD inspector (Joe). Loosen (detorque) main caps and set nuts in bucket for safe storage. Remove main bearing caps and set on pallets inside engine building. Remove; #3 main bearing studs retaining (anti rotation) pins; #4 main bearing studs retaining pins; #5 main bearing intake side stud retaining pin; #6 main bearing intake side retaining pin, #7 main bearing retaining studs, #8 & 9 (combination retaining pin) main bearing exhaust stud retaining pin. Pins are bent into and 's' turn requiring straightening and alternatively driving out of the studs using a porta power and 4# to 6# hammer and drift to remove from main bearing studs (averaging 2 hr per pin). Pins are bent with porta power, driven to one side, cut with cut off wheel, driven out one side, cut with cut off wheel, driven to free one main bearing stud, remove one main bearing stud and drive the remaining pin piece from the stud. Replacement main bearing stud retaining pins from September 2018 failed on initial tightening of main bearings in September 2018, all 4 replacement main bearing stud retaining pins were replaced with new (material 4140 steel) check main journal runout for flatness-g (Replacement studs in September 2018; #4 intake side main bearing studs, #5 intake side main bearing studs, #6 intake side main bearing studs.) Put away tooling for departure, told to leave site due to general alarm for fire in Power Generations Station. (Departure 1818).

11 June 2019

Receive crankshaft (0800) assist driver in moving truck front end into engine room. Move upper block to one side of engine room, move CMD toolboxes outside of building. Unload crankshaft from truck in engine room. Assist driver in backing out of engine room and driving over outside fuel tanks to leave Power Generation Station (PGS) (1030). Remove crankshaft crate top and inspect crankshaft. Remove crankshaft from crate and set on plywood on floor. Move upper block back to area it was prior to off loading crankshaft. Clean preservative from crankshaft. Measure main bearing journals. Clean engine base and run nuts over studs to clean threads. Set rubber wrap over crankshaft journals and put away tooling. Leave site (1830).

12 June 2019

Polish scratches in crankshaft main journals made by O.D. micrometer when crankshaft main journals were measured on 11Jun19. Set in lower main bearings, remove #6 lower main bearing



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for flaw in overlay (electroplate spot loose in center of main bearing). Finish crankshaft inspection, remove plugs from main journals and remove plugs protecting counterweight stud holes and protecting crankshaft oil passage swaged plugs. Set crankshaft in lower main bearing shells and set crankshaft thrust by lifting crankshaft to lift the weight and push the crankshaft and the main thrust bearings into position (thrust .022). Cut PVC pipe used for main bearing cap stud protectors to hold lower main bearing shells in place to check main journal runout for straightness. Remove PVC protectors and put in main bearings and main bearing caps.

13 June 2019

Torque main bearing caps, measure main bearing clearance, measure crankshaft deflection crankshaft runout on water pump drive gear shaft. Put cotter pins in main bearing nuts except #3 main bearing (to have top main bearing replaced). Spray WD-40 on engine base, exposed crankshaft, crankpins and exposed gears. Cover crankpins with rubber wrap and lay plastic tarp over engine base and crankshaft to cover exposed areas. Put away tools and demobilize.

14 June 2019

Travel Oakland to Long Beach, Ca.

25 June 2019

Travel Long Beach to Oakland, Ca.

26 June 2019

Return to site. Receive counterweight studs at front gate EBMUD. Inspect, measure new bearing and replace #3 main bearing. Torque counterweight studs to 1000 ftlb. Install counterweights and torque to 1000 ftlb. Put counterweight stud roll pins in. Cut bearing main cap stud nut bracket (back up key welded to main bearing cap stud nut to hold stud for tightening) to allow for free crankshaft and counterweight rotation. Check engine base expansion plugs for signs of leaks and loose nuts in flywheel side core plugs. Fill edges and top of expansion plugs on front of engine JB Weld 2 part liquid metal epoxy. Clean flywheel for mounting set up crankshaft to put on flywheel. Clean area and put away tools.

27 June 2019

Lift and set flywheel on crankshaft hub, center bolt holes using hole spacers and tighten flywheel to crankshaft hub using temporary bolts. Reassemble generator rotor outboard bearing support and tighten to 600 ftlb. Reassemble generator outboard and torque bearing to 50 ftlb, measure rotor shaft center at .010 on top. Reassemble generator outboard bearing housing and torque upper housing to 216 ftlb. Lift flywheel side of rotor and pull into flywheel using 2 old removed flywheel bolts, tighten to 3000 ftlb. Check engine bedplate for flatness and burrs using a straight edge. Measure crankshaft crankpin O.D. Confirm rotor to flywheel to crankshaft coupling bolt hole diameter at 1.881- 1.882 in. (old holes 1.875 in). Reassemble generator exciter and exciter mount bracket. (1816 departure)

28 June 2019

Set upper exciter assembly in place and torque bolts to 250 ftlb. Finish clean up ream on 4 flywheel bolts holes and measure bolt holes for fit, (Open up holes to differing sizes, 3 at 1.884,



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1 at 1.890 to 1.884 (taper) (new flywheel bolts 1.900)). Remove #8, #9 main bearing caps to move flywheel side thrust bearing due to loss of clearance during crankshaft assembly to flywheel. Move crankshaft with porta power jack to move #9 lower main bearing (found .005 between lower main bearing thrust flange and engine bedplate side). (disassembly thrust measurement was .026, reassembly thrust .028, reassembly thrust .026, measured before today move .015, after move .025, specification: .022-.040). Rig upper block set on porta power to lower on to bedplate dowels. Put Loctite 518 between bedplate and upper block at 'o' ring seal area. Lower upper block on bedplate and set on dowels. Lift upper block and replace front dowel after seeing a scrape on the top of the dowel pin. Pull front of engine to align front cover gasket seal area. Set upper block down on new front dowel and remove rigging. Clean area and put away tooling. (1907 departure).

29 June 2019

Bring upper block thru bolts from basement. Clean block thru bolts. Put in lower 7/8 bolts between upper block and bedplate. Measurements of upper block to engine bedplate front find .003 and .004 horizontal planar misalignment at the block and bedplate split line. Work on moving upper block .003 and .004 in, put porta power in bedplate to upper block to push upper block and lock in place using block lower bolts. Correct horizontal misalignment to .001. Ream 1 flywheel bolt hole to 1.887 from a taper of 1.890 rotor side to 1.884 engine side. Set block thru bolts in engine with felts and locks and set bolt heights. Torque lower block bolts to 325 ftlb. Torque engine thru bolts with PT-7: intermediate 2800 ftlb (38 psi new calibration 1psi/73ftlb); gearset end 3350 ftlb (46 psi new calibration 1 psi/73ftlb); flywheel end 3900 ftlb (53 psi new calibration 1 psi/73ftlb).

1 July 2019

Finish torque engine upper block thru bolts (done in steps working from center outwards). Put on fuel pump bases and torque to 120 ftlb. Work on flywheel bolt holes (1 out of round from a misdrilled hole leaving 2 centers on the rotor side). Put on engine barring jack. Clean idler gear and mount on stubshaft. Measure idler to camshaft gear and idler gear to crankshaft gear gearlash. (.008 -.012 average at mechanical center (4 points on the idler gear 3 times around to measure differing places on the camshaft and idler crankshaft gears). Install camshaft tappet housing oil supply tubing. Clean and prep catwalk for installation. Check camshaft timing (.197 in at 21°BTDC (engine side plate has 25°BTDC) (need to confirm timing for clean burn conversion timing) (25°BTC for low BTU fuel?). Install missing cylinder head studs from cylinders 2 and 5. Cylinder head studs were removed for upper block lifting plates.

2 July 2019

Check camshaft fuel timing (off by .006 in lift at 21°BTC). Install catwalk with 4X4 supports. Gather pistons and rods and set into assemblies. Check #1 intake timing need more precise surface to measure from to determine cam lobe lift at #1 TDC (.544). Clean liners, piston and rods, check conrod bearings for size and damage before use. Measure new #1 connecting rod bearing. Find impact point on #4 crankpin, polish with rubberized abrasive (determine this to be directional and probably old screwdriver mark to remove bearing held by oil) Set #1, #2, #3, #4, #5, #6 piston and rod assemblies in engine. Clean area and put away tooling. (1850 departure)



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3 July 2019

Reset height on #1 exhaust side thru bolt. Torque connecting rod bolts to 875 ftlb in 3 steps and put in cotter pins. Measure connecting rod bearing clearance. . Set camshaft timing based on #1 intake valve lift (.544 ±.015). Remove idler gear and set timing to move slotted bolts to center of adjustment slot. Check timing on cylinder 1-6 intake and exhaust camshaft lobes (roll once through TDC to go from minor base circle to opening or closing ramp on camshaft lobe. (Intake lift .544 on opening ramp at TDC, exhaust .833 on closing ramp at TDC.) Install turbocharger and turbocharger support bracket. Set exhaust onto support brackets on engine and bolt into place wait for cylinder heads. Clean area and put up tooling (Departure 1845).

5 July 2019

Put on 6 cylinder heads and torque to 3600 ftlb in 3 steps. Set alignment on exhaust to turbocharger, find adapter is ½ inch too long (may need to collapse compensator between adapter and turbocharger turbine inlet) (need electrical connection for welding machine). Confirm flywheel pointer to #1 TDC. Recheck #1 exhaust camshaft lobe timing (.994 (specification .883 ±.015). Confirm #1 fuel timing (.196 (specification .197 @21° BTDC) @21° BTDC). Receive welding machine and safety supplies and miscellaneous tooling from CMD Long Beach, Ca. Tighten camshaft hub to camshaft gear and put in cotter pins. Begin drilling camshaft gear to hub to fit bolts in gear. Clean up area and put up tooling. (Departure 1845)

6 July 2019

Set timing and drill stubshaft for timing (need more drill sizes to reach reaming size). Drill and tap subcovers for air start supply line clamps. Clean air start valve and fuel injector pockets. Measure crankshaft deflection. Recheck #1 connecting rod thrust at .045 find #1 connecting rod is 6.954 wide at crankpin radius point and #6 connecting rod (thrust .021) is 6.990 wide at crankpin radius). Work on fitting exhaust to turbocharger turbine inlet adapter (open up bolt holes to match gaskets). Put on front engine tubing. (departure 1845)

8 July 2019

Continue drilling stubshaft for .750 dowels. Put in 1 dowell on stubshaft. Install 6 subcovers and torque to 150 ftlb. Check torque on rocker arm shafts, torque to 365 ftlb. Go buy welding ground and spare bolts to fix exhaust adapter to turbocharger turbine inlet. Continue work on exhaust adapter plate, fill welding on adapter piece. Have 3 flywheel bolts cut to 1.8865 – 1.887. Buy styrofoam containers for freezing flywheel bolts. Clean area and put away tooling. (departure 1845)

9 July 2019

Finish dowelling idler gear stubshaft. Drill, ream and set one 5/8 fitted bolt (+.002 under hole (hole .625, bolt .622-623)). Buy welding rod and more welding tooling. Put up fuel rack, clean set pilot fuel injection tubing. Clean up weld on exhaust adapter and set into place for weld tack between turbo and exhaust. Clean area and put up tooling. (departure 1840)

10 July 2019



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Finish drilling 5/8 dowel hole in camshaft gear, find fitted bolt is .005 under need to get shoulder bolt and fit. Remove intake rocker arms to set camshaft timing lift at #1 fuel. Clean up idler and camshaft gear, set camshaft to .197 lift at 21° BTC #1 cylinder. Put on idler gear and rotate camshaft to confirm lift at #1 cylinder. Rotate crankshaft to check gearlash, rotate 4 times and check every 6 inches on idler gear (gearlash .008-.011 (specification .008-.012). Tack weld exhaust to turbo charger adapter piece and remove exhaust from engine and set on 2 rolling carts for shipment to exhaust fabricator. Put intake rocker arms back on in subcovers and torque stanchion bolts to 365 ftlb. Put on oil pump gear carrier for fit and check gearlash. Remove oil pump gear carrier to open second bolt hole from the top to move gear carrier for gearlash.

11 July 2019

Open 2nd to top bolt hole oil pump gear to set gearlash (.008- .014 by 420 group drawing) on oil pump gear carrier. Set oil pump gear carrier to .009 gearlash and tighten to 200 ftlb. Rotate engine to measure gearlash at 4 points (mechanical center for rotation of the idler gear (5 rotations of oil pump gear). Go pick up rental truck and take exhaust to exhaust fabricator. Drill oil pump gear carrier and set ½ X 2 ½ inch dowel through the oil pump gear carrier housing into the front of the engine. Confirm oil pump gear carrier gearlash at .009. Weld nut to accessory drive gear carrier dowel to remove front of engine. Set accessory drive on front of engine to check gearlash. Clean area and put up tooling. (departure 1845)

12 July 2019

Weld stud to dowel and pull dowel from front of engine. (dowels were frozen in instead of fit with reams to size). Set accessory drive gear carrier to .009 gearlash and begin drilling holes from .625 to .750 to fit new dowels. Go get exhaust with adapter welded in place. Put up exhaust for fit. Return truck to rental yard. Pick up tooling for dowels. Clean front cover parts and make gaskets. Remove exhaust access cover and remove gasket for pattern and replace tubing to exhaust access cover from exhaust water jacket. Clean up area and put up tooling. (departure 1845)

13 July 2019

Go get liquid N₂ to put in flywheel bolts. Get 1 bolt in. First attempt bolt stick due to too tight a bolt. Remove first bolt with no damage to bolt or hole. Remove .001-.0015 from bolt get bolt in. Stick 1 bolt and gald bolt and hole, damage analysis is grit in chamfer between flywheel and rotor. Damage to bolt is entering. (Need to find way to clean this area). 2nd bolt damage makes bolt unusable. Measure fuel cam lift on all fuel pump bases (3 times to determine cam lobe wear or timing slip). Remove exhaust and set on floor for hot work on (removal of steel to make room for thermal blanket on exhaust adapter piece. Begin alignment of camshaft stub shaft support for camshaft front cover outboard bearing support (.015 runout, not finished). Clean up area and put up tooling.

15 July 2019

Cut a piece from turbo corner bracket to allow installation of thermal insulation blanket. Weld flange to exhaust water inlet and set exhaust back into place for fit. Check #1 fuel timing and find .005-.007 deviation (.003 from gearlash). Remove intake rocker arms and idler gear and rotate camshaft to .197 lift at 21°BTC #1 cylinder. Reinstall idler gear and find .006 deviation



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in fitted bolt holes in camshaft gear to hub. Loosen slotted bolts and rotate camshaft to proper lift and tighten slotted bolts in pattern to reduce rotation of camshaft in tightening bolts to 60 ftlb (specification 60 ftlb for all 6 bolts- 4 slotted - 2 fitted). Drill new 5/8 hole and ream with taper ream to match fitted bolts to hole size (.622-.625). Set crankcase vent line on floor and cut in half to support the pipe from two existing supports. Take 2 flywheel bolts to Diamond to cut O.D. to fit +.0015 - +.002 over flywheel bolt holes. Pick up flywheel bolts and Liquid N₂. Freeze and install 2 flywheel bolts. (departure 1845)

16 July 2019

Remove 2 old flywheel bolts used to hold rotor, flywheel and crankshaft in place for reaming. Torque 2 flywheel bolts to 3000 ftlb. Go get exhaust bolts to attach exhaust to cylinder heads. Ream camshaft gear fitted bolts, indicate .004 side play on fitted bolts. Send 2 bolts to Diamond to get cut for 1.891 and 1.878. Go get bolts and liquid nitrogen. Freeze bolts and put in flywheel. Torque 2 flywheel bolts 3000 ftlb. Finish welding flanges to crankcase vent pipe. Clean area and put up tooling. (Departure 1845)

17 July 2019

Install turbocharger exhaust outlet. Go pick up reamers for accessory drive gear carrier for extra length around the carrier cage for 3/4 dowels. Begin making gaskets for air start mount plate. Install exhaust thermocouple conduit on exhaust side of engine. Install turbocharger exhaust outlet expansion joint (compensator). Install crankcase vent pipe half to building vent piping. Install vent piping support brackets on exhaust brackets. Remove, clean engine base oil drain to sump and replace gaskets and rubber boot to drain piping. Go get 5/8 and 3/4 reamers for fitted bolts in camshaft gear. Go get hydraulic oil for porta powers and 1 bolt for turbocharger exhaust outlet. Weld flange to block water header outlet to exhaust water jacket. Clean area and put up tooling. (departure 1845)

18 July 2019

Fit and tighten crankcase vent pipe and put in pipe dampener supports. Put up water outlet on top of exhaust and find pipe is off center. Fit water outlet pipe and draw up extended flat bar supports. Weld and fit water jacket outlet pipe to exhaust water inlet pipe. Go to get flat bar and brakleen. Work on straightening fitted bolt holes in camshaft gear to correct timing. Put in last flywheel bolt and torque to 3000 ftlb. Clean area and put up tooling (departure 1830)

19 July 2019

Measure camshaft lift at 21° BTC at .197 lift at #1 cylinder fuel. Fit water jacket outlet to exhaust water inlet. Fit tubing to exhaust access cover at rear of engine. Drill and dowel accessory drive gear to front to engine. Drill and dowel fitted 3/4 shoulder bolts into camshaft, measure camshaft lift at .196 for #1 fuel. Center air start distributor adapter plate to air start block cover and replace dowels. Find air start distributor cover adapter dowels are .001 too small (.498 manufacture tolerance), remove dowels and look for .499 dowels. Make gasket for exhaust rear access cover and assemble cover onto exhaust.

20 July 2019



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Remove fitted $\frac{3}{4}$ bolt in camshaft gear and drill hole for cotter pin. Begin camshaft outboard adapter support shaft alignment. Find .010 runout in adapter support shaft fitting. Measure camshaft and find .005 deviation in adapter shaft register on camshaft hub. Remove adapter support shaft and reduce radius of register on one side, no effect. Remove adapter shaft and check for parallel in mounting face and end of adapter shaft (find .004 deviation off parallel). Polish end of crankshaft and fit water pump gear, put in bolts and torque to 120 ftlb and put in tie wire. Clean off front cover, put new gasket on block and set front cover. Put in top and bottom dowels and tighten front cover. Clean area and put away tooling (Departure 1840)

22 July 2019

(Work on short list). Finish torque outboard bearing support (generator) and housing support bolts to 831 ftlb. Finish torque upper block to base $\frac{7}{8}$ bolts in corners between flywheel and base (325 ftlb). Measure generator air gap. Measure camshaft timing at 21°BTC #1 cylinder fuel (.196 lift). Time in fuel pumps, shimmed at 21°BTC. Put up exhaust adapter expansion joint (compensator) (need 18 bolts for both sides 2 inch and 2 $\frac{1}{2}$ in length). Put on rear cover and center on crankshaft. Fit idler subshaft support on front cover. Drilled holes on intake side of engine for wire loom clips. Clean up area, put away tooling. (departure 1850).

23 July 2019

Put tubing on front of engine connected to tubing junction to panel. Put on fuel injection return tubing. Put on 2 center camshaft covers. Center and put on idler gear subshaft cover (check gearlash to confirm no movement on idler subshaft). Remove oil pump adapter plate and dowels and center (down .030). Take camshaft support shaft to machine shop and check dimensions (cut .002 from I.D. of support shaft mount to camshaft register (measure camshaft register at 6.998- 6.996). Put on: fuel injection lines, air start piping, fuel gas piping. Go get bolts for exhaust adapter expansion joint.

24 July 2019

Center and set new dowels for oil pump adapter plate to gearcase. Remove water pump adapter plate and reset centerline for water pump using gearlash (set to .004-.008, specification .004-.006 (water pump gear runout .003)). Water pump gearlash was set using water pump drive gear as measured rotating piece (4 points for mechanical center on the drive gear in lieu of 4 points of mechanical center on the water pump gear.). Install fuel piping and triple header on cylinder heads. Install air intake horns on cylinder heads. Finish putting in bolts on exhaust adapter to turbo. Clean area, put up tooling.

25 July 2019

Drill and put in dowels on water pump adapter plate. Put on cylinder head covers. Make gasket for accessory drive adapter plate, cannot fit fuel pump plate. Alignment of accessory drive gear is $\frac{3}{4}$ inch too low on the gearcase. Measure exciter air gap find .100 difference at lower left pole. Disassemble fuel pump from adapter plate and fit on gearcase. Work on making a template for new adapter plate layup. Set water outlet piping and strap using exhaust outlet piping as reference. Cut exhaust outlet piping to fit outlet pipe. Clean area and put up tooling.

26 July 2019



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Loosen fuel rack brackets to free up fuel rack. Remove fuel gas pipe on fuel rack brackets, loosen air start piping. Move fuel rack back and forth to free up bushings. Remove front cover fuel rack support bracket. Measure camshaft adapter shaft runout (+.006 was .008). Connect water piping outlet from top of engine. Put on water piping to water pump. Take fuel pump accessory drive plate to machine shop for duplication and modification. Take camshaft stubshaft to machine and remove .004 from I.D. of register fit to camshaft(I.D. 7.005 register 6.998). Clean area put up tools.

27 July 2019

Put on oil pump piping. Center and fit camshaft adapter shaft, put on camshaft outboard bearing cover, center and drill (.leave .001 on bottom and center in bearing.) Put on and center air start distributor mounting plate (.003 runout) Replace engine driven fuel pump with one from Long Beach.

29 July 2019

Center camshaft gear adapter shaft to gearcase bearing (.0025 on top and side to center: total .005 horizontal .004 vertical) (cannot accurately measure using feeler gauge, only bottom and 2 sides, measure and use stethoscope for parts touching) Put up camshaft galley covers and ambac pump drive. Put up charge air cooler and lower plenum. Loosen fuel rack and oil bushings to find tight spot. Moving fuel rack to find tight spot for .002 clearance in bushings.

Recommended moves: Gearcase rack angle support remove .100 and check for perpendicular base measures .630 and .602 across bottom linear to rack pipe.: #1 no bushing : #2 .010 shim from block.: #3 no bushing: #4 lift pipe .010: #5 shim .030 from block.: #6 .015 shim from block (all for now). Clean area and put up tooling.

30 July 2019

Cut and fit dowels for camshaft outboard support cover. Drill and ream front camshaft outboard support bearing cover. Measure gear lash (final for gear replacement). Put on crankcase vacuum blower. Connect start air piping to start air valve. Put on shutdown butterfly valve. Disassemble clean and prepare turbocharger compressor outlet pipe for installation. Work on fuel rack; remove #6 fuel rack pipe bracket to make shim pattern.

31 July 2019

Find fuel rack shim point from the block (#2 .040; #4 0; #6 .080). Put on turbocharger compressor outlet piping and stairs to catwalk. Continue to put on control tubing. Find and repair main bearing thermocouple wells. Go get accessory drive gear cover plate and set in place for fit. Drop off gearcase fuel rack support bearing bracket to remove .050. Connect water and oil outlet piping from engine.

1 August 2019

Set fuel rack pin stop and governor control arm and #1 cylinder fuel stop. Set air start distributor. Go get fuel rack gearcase bearing support for fit (Need to remove more). Put on accessory drive cover blank and make center pattern for new cover. Work on fuel rack alignment (looseness) (add .010 to #4 bracket). Prepare ambac pump for installation. Put in main bearing thermocouple wells (set .040 prelaod).



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2 August 2019

Take fuel rack gearcase bearing support, accessory drive blank plate, fuel pump, old mount plate to vendor machine shop. Attempt to set ambac pump timing to 28° BTC find too loose a chain, remove chain and compare to new chain (new chain longer by 1 link). Go buy a longer adjusting bolt for chain tensioner. Remove ambac pump and camshaft covers to remove camshaft mounted sprocket and hub. Find matched camshaft mounted sprocket hub and sprocket and install on camshaft set to .913 from camshaft lobe (drawing calls for .844). Measure sprocket and hub at 4.235 (drawing calls for 4.207). Rotate camshaft to check for gap in hub pieces on camshaft. Need to determine parallel in camshaft mounted sprocket and pump mounted sprocket on installation. Work on fuel rack alignment.

3 August 2019

Ambac pump: Cut and install new chain, tension chain to ¼ -3/16 in slack on top and bottom runs. Check sprocket alignment with straight edge, pump mounted sprocket and hub sprocket on camshaft. New chain length same as old, cannot determine why the old chain had slack. Check sprocket alignment with straight edge (.0015 deviation). Set ambac pump and rotate engine to 28°BTC #6 cylinder. Check ambac timing on all 6 cylinders and trace tubing to pilot fuel injectors on cylinder heads. Work on fuel rack alignment, tighten rack to #5 add .004 to top #4 bracket. Set linkage to fuel pumps.

5 August 2019

Remove .040 from exhaust side and .045 from intake side of generator pedestal bearing to correct crankshaft deflection (+.005 on bottom to -.001 on bottom and sides). Measure crankshaft deflection #5 and #6. #5 +.001, #6 -.001; check rotor find .410 on bottom .450 on top or 10% difference to the top. Measure exciter air gap .090 bottom .165 on top. Move exciter .010 to exhaust side gain .010 to exhaust side. Remove shim from exhaust side to roll circle. Work fuel rack alignment need to cut more from gearcase bearing bracket.. Go get accessory drive cover and fuel pump. Remove spring from under exhaust to turbocharger adapter. Move exciter to exhaust side find bolt bound.

6 August 2019

Work on exciter open bolt holes set to center and align linear and lateral. Fit accessory drive fuel pump on gear case. Go get gearcase fuel rack support. Put on braided flex line from water header to exhaust. Begin putting water in engine stopped due to leak at water pump, no bleed off tubing attached. Put on fuel pump inlet fuel fittings. Begin setting air start piping back on cylinder heads. Clean area put up tooling. Measure exciter air gap to find tight spots using feeler gauge on both sides of exciter.

7 August 2019

Center fuel pump drive coupling to accessory drive coupling and drill and dowel accessory drive plate for fuel pump to gearcase. Work on air start piping; remove air start piping to replace dresser type coupling seals, no appropriate rubber seals in stock. Work on fuel rack alignment, find fuel rack sticking, remove all connections, release rack support brackets, rack thrust collars. Remove all previous temporary shims on fuel rack brackets (used to find binding areas). Shift



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fuel rack limiting cap from #2 fuel pump to #1 fuel pump, find air start piping sitting on fuel rack. Reattach fuel rack brackets, reinsert temporary shims, set fuel rack gearcase support. Put water in engine no leaks after 4 hours. Put tubing on engine. Clean area put up tooling. Remove all shims from fuel rack brackets to redirect fuel rack leading from #2 cylinder head bracket (bushing type for fuel rack only). Measure fuel rack rod to cylinder head bracket milled area using I.D. micrometer to find difference between brackets to redirect fuel rack rod from #2 cylinder head to front cover rack support (find #6- 3.198 from rod to block; #4 no accessible space to measure on block; #2 – 3.235 from rod to block). Tighten all brackets and add .040 to #6 fuel rack bracket; fuel rack loosened. Set accessory drive coupling distance to fuel p8mp drive coupling.

8 August 2019

Work on fuel rack; Make .040 shim for #6 fuel rack bracket. Work on setting front cover fuel rack support. Set fuel linkage return springs. Release thrust collars to move fuel rack rod, find fuel pump linkage misaligned, release #6 fuel pump linkage; rack loosened with no added shim or movement of front cover fuel rack support. Set air start timing to 5° BTDC #1 cylinder. Finish assembly of air start distributor. Measure exciter air gap using one point on rotor winding to poles on exciter housing. Drill and dowel exciter. Clean area and put up tools.

9 August 2019

Set governor control arm and install on fuel rack to set linear distance to fuel pump linkages. Use vacuum cleaner to remove debris from bottom of generator stator and put on generator stator and exciter covers. Remove .005 from #6 fuel rack bracket for alignment. Remove center exhaust support as sample for building new exhaust. Take exhaust support, old Unit 2 idler gear hub, 6 air start valve pistons and caps to CMD Long Beach, Ca. Clean area and put up tools.

10 August 2019

Replace rod ends on governor control arm and install. Set #1 fuel on rack to 0 mm and use same fuel linkage to set remaining 5 fuel pump linkages to fuel rack. Set Zero adjusting screw on all fuel pump linkages to approximately .100 in. Set temporary 3/8 dowels in gearcase fuel rack support (need removable dowels with threaded end) Replace timing window gasket and screws on 6 fuel pumps. Replace fuel pump to base retainer nuts with nylock nuts and torque to 80 ftlb. Remove and reinstall #4, #5, #6 exhaust pipe plugs with high temp neverseize. Clean area. Gather instruments, enough slings to remove Enterprise main bearings (2- 3ft endless loop; 2- 6ft endless loop; 2- 8ft endless loop) (one 3 ft slign to lift enterprise main bearings; one set SAE combination wrenches (7/16 – 1 ¼), one set SAE ½ inch drive socket set (7/16- 1 ¼) , one set 3/8 drive SAE socket set (3/8 – ¾)and take to CMD Long Beach, Ca. Juan Reyes and Genero Panteleon travel Oakland to Long Beach, Ca

11 August 2019

Alan Henrickson travel Oakland to Long Beach, Ca.

21 August 2019

Return to site. Put on air start supply header (replace 6 couplings dresser style). Put on: air start vent tubing to atmosphere on front intake side of engine; fuel gas inlet pressure signal line to



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panel on front of engine; air start vent line on rear intake side or engine to lower plenum; barring jack lock signal to solenoid on air start valve supply line. Work on fitting #3 cylinder head intake horn to upper plenum. Put temporary sock filters and main bearing tubing lines on inside engine. Put temporary sock filters :on camshaft oil supply lines; idler shaft oil supply line, gearcase oil manifold supply line. Plug off oil supply lines to: cylinder head rocker arms, turbocharger, water pump, fuel pump, cam outboard support bearing.

22 August 2019

Put on fuel gas valve and control tubing. Add tubing clamps to lower plenum line to panel and to air start vent line on rear intake side of engine. Work on #3 air intake horn. Put lower turbocharger sheet metal covers on. Put tubing clamp on 3/8 oil pressure signal line to turbocharger to panel. Put on exhaust blankets. Put on temperature and pressure gauges on water and oil pipe headers. Start oil flush at 1300. Remove and change temporary sock filters at 1830 to flush all night. Reset cylinder head valves. Clean area put up tooling.

23 August 2019

Unit start up. Remove socks and put on main bearing tubing, idler gear tubing, gearcase oil spitter tubing, water pump tubing, oil signal to panel tubing, rocker arm tubing, turbocharger oil supply line. Put crankcase doors and gaskets on. Witness oil flow on main bearings and connecting rods, rocker arms. Correct oil pressure tubing to panel. Find water leak from exhaust water jacket drain line (customer wants telltale line). Mechanical integrity run: 15 minute unloaded idle run. Pull crankcase doors and check main and connecting rod bearing temperatures and piston temperatures. Put crankcase doors back on and restart. 1 hour partial load (500 kw) shutdown after 40 minutes for low turbocharger oil pressure (possibly missing oil drain orifice plate). Engine load deviation to 750kw for 10 minutes, (maybe 20% load) start requirement. Clean area and put up tools.

24 August 2019

Shut down Unit #3. Remove turbocharger drain line from Units #2 and #3 to check for orifice plate in drain lines. No orifice plate was found in either turbocharger drain line. Clean drain line flanges and put back on turbochargers on unit #2, #3. Unit #2, remove #3 air intake horn and replace lower gasket to upper plenum and reseal air intake horn. Unit #2 install fuel injection line plastic clamps on fuel injection lines from the fuel injection pumps to 6 fuel injectors to dampen harmonics on lines. Unit #2, tighten 1 inch fuel tubing on fuel pump on gearcase. Restart Unit #3.

26 August 2019

Remove oil inlet pipe on unit #1 and #2 turbochargers find orifice reducer plate held by circlip in both turbochargers. Requested by EBMUD to remove orifice plate from unit #2 turbocharger inlet to compare with orifice plate in #1 turbocharger. Measure unit #1 turbocharger orifice plate hole in place using drill bit ends. Reassemble oil inlet supply pipe on Unit #1 turbocharger and restart unit. Requested by EBMUD to drill out unit #2 orifice plate to .375 and reinstall in unit #2 turbocharger oil inlet and reassemble to oil supply line. Unit #2 start up to 500kw; turbocharger oil pressure 45 psi, oil temperature 136° F. Run 500kw 1hr pull doors, check bearings and crankcase. Restart to 750 kw run 1 hr take firing pressures. Raise load to 1000 kw



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for 1 hr, take firing pressures. Raise load to 1630 kw take firing pressure run 2 hr. Run 2 hr 2160 kw, take firing pressures. Shut down 1900 take web deflection and crankcase inspection. Put doors on crankcase. Clean area put up tooling.

27 August 2019

Replace #5 fuel injection pump. Replace gasket on #4 air intake horn. Replace fuel injection line to injector on #1, #3 cylinder heads. Replace fuel piping with high pressure hose on engine driven fuel pump. Run engine to 1600 kw on diesel and switch to dual fuel. Begin to balance fuel gas valves to cylinders. Shutdown to correct deflection following 2160 kw loaded run on 26 August 2019. Raise pedestal bearing .015 and raise exciter .009. Measure crankshaft deflection after raising pedestal bearing; correction on #6 crankpin -.003 to +.002. Measure exciter air gap both statically and using a designated spot on the exciter winding to exciter poles, tight spot at .050. Put covers on exciter and doors on crankcase. Clean area and put up tooling.

28 August 2019

Unit start up, dual fuel run to 1700 kw for balance of gas admission valves, take firing pressures. run at 2150 kw dual fuel for 1 hr take firing pressures. Shutdown for high crankcase pressure due to water leak in engine. Remove vent fan drain line to find water in drain and blowing from engine. Pull exhaust side doors, remove cylinder head valve covers, roll engine on air, find water leak on #3 cylinder ignitor cell. Drain engine of coolant and replace spiral wound (flexitallic) gasket seal from bottom of ignitor to cylinder. Put valve covers back on cylinder heads, put doors back on crankcase, refill engine with water. Restart engine to run at 1500 kw dual fuel, while watching crankcase vacuum pressure.

29 August 2019

Continue dual fuel run at 2160 kw from 0100 28 August 2019. Crankcase pressure still high (-.2 in or +.1 in H₂O). Repair concrete anchor bolt footing to flywheel guard. Shutdown to find reason for crankcase pressure. Tighten all camshaft covers with torque wrench to 50 ftlb. Tighten gearcase inspection covers to 50 ftlb with torque wrench. Put two ¼ inch screws in holes at rear exhaust side of upper block. Restart engine to 1600 kw no change in crankcase pressure. Shutdown engine remove vent fan coupling and check vent fan rotation (ok), blow down engine find water leak at #3 cylinder, replace #3 ignitor cell and fill with water, leak continues. Replace #3 ignitor again, leak continues. Make leak down tester and pressure test #3 cylinder head, pressure to 80 psi, leak down to 20 psi (20 seconds) and hold. Find cylinder head kit for VSI cylinder heads. Clean area put up tooling.

30 August 2019

Remove #3 cylinder head and die penetrant check fire deck and cylinder liner. Replace #3 cylinder head after measuring gas valve setting on intake valves. Remove manometer tubing plate and put a tubing elbow inside. Replace turbocharger drain line. Set up additional manometer to verify existing manometer (both read the same). Remove vent fan exhaust coupling to vent pipe for startup. Wrap exhaust crankcase BICERA relief doors for vacuum leaks. Remove intake valves from cylinder heads and perform leak down test on cylinder heads (#1-32 sec; #2 - 72 sec; #3 -20 sec; #4 -36 sec; #5 - 58 sec; #6 - 55 sec). Restart engine, load to 2100 diesel, (-.8 in crankcase pressure), switch to dual fuel 2160 kw (-.5 in crankcase pressure).



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Remove wrap from exhaust side BICERA relief doors (Pressure increase .1 in). Reconnect crankcase vent coupling to vent pipe (no change). Put up tools. Engine to run all night at 2100 kw dual fuel (start 1830).

31 August 2019

Replace cylinder #3 pilot fuel injector, and cylinder #3 fuel injection line. Engine shutdown at 2030 30 August 2019 due leak on pilot fuel injector return brazed line. (Engine ran 2 hours without leak; was run at 2100 kw diesel and then switched to dual fuel at 1600 kw) Peak firing pressures taken 30 August 2019 at 2000 with no notice of pilot fuel injector leak running dual fuel at 2160 kw. Leak was noted on top of fuel pump from adapted fuel injection line (double wall injector line with return nut at the pump base end for marine applications (fire code for marine applications). Fuel leak down intake side of engine was noted around 2030 on 30 August 2019 and decision was made to shutdown in case there were more problems than the fuel leak. Leak on #2 cylinder intake horn shutdown at 1530 for repair and replace #1 cylinder kiene valve. Replaced kiene valve on #1 cylinder head. Remove cylinder #2 intake air horn replace gaskets and reinstall. Restart unit and load to 2100 kw dual fuel.

2 September 2019

HOLIDAY

3 September 2019

Run unit at 2100 kw for 3 hr. Run unit at 2300kw for 1 hr take firing pressures, shutdown and take hot crankshaft deflection, crankcase inspection and geartrain inspection. Remove #4 cylinder head intake air horn, replace gaskets to fix air leak. Continue to look for cause of crankcase vacuum pressure being higher than other units Put covers back on crankcase and sort tooling for departure.

4 September 2019

Return to blow down engine to check for water leaks. Find #4 cylinder blowing water. Remove #4 cylinder fuel injector and find water on top of piston. Dress water pump drive gear teeth. Replace #4 ignitor cell and fill engine with water. Remove all main fuel injectors to watch for water in cylinder over a 2 week period. Pack out enough tooling to replace an Enterprise DRS-46 main bearing. Pack tooling and lock gang boxes. Anticipated return 2 weeks to replace #4 cylinder head and replace gear on water pump.

12 September 2019

Return to site. Remove water pump and load on CMD truck for delivery to CMD shop in Long Beach, Ca. Cover gearcase hole and water pump inlet and outlet pipes. Deliver water pump to CMD shop in Long Beach, Ca.

16 September 2019

Return to site. Deliver water pump to PGS EBMUD. Clean water pump piping for gaskets. Install water pump check gear lash and find linear gear contact is off .060. Measure water pump adapter plates and find Unit #2 water pump adapter plate is .050 thinner than water pump adapter plates on Units #1 and #3. Remove water pump from gearcase and make a thicker gasket to give



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linear alignment for gear teeth mesh on water pump drive gear and water pump gear. Reinstall water pump and measure gear lash. Put water pump piping on and measure gear lash. Begin filling engine with water and find water pump seal leaking. Drain water from engine and remove water pump water seal and reseal. Reassemble water pump and refill engine with water (no leaks). Gearlash measurements go from .008 to .006 after connecting water pump piping indicating slight pipe strain most likely in the water inlet piping. Install 6 fuel injectors and fuel injection lines and check jet cells torque (42 ftlb) (no loose jet cells found). Put up tooling and depart.

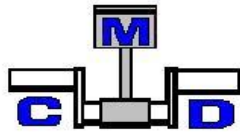
4 November 2019

EBMUD reported #3 main bearing failure with high temperature shutdown (230°F) at 1000.

6 November 2019

Genero, Juan travel to Oakland, Ca. See Addendum reports for main bearing replacement.

END OF CHRONOLOGY SECTION



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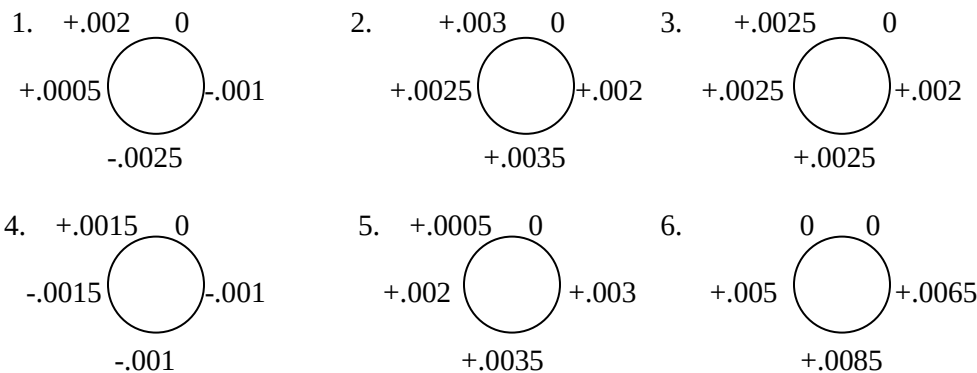
SERVICE REPORT (UNIT 2) AS FOUND

Customer:	East Bay MUD	Date:	9/5/2018
Plant Name:	Power Generation Station	Location:	Oakland, CA
Engine Make:	Delaval Enterprise	Purchase Order №:	BDR-018117-AX
Model:	DGSR-46-CB	CMD Job №:	EBMUD18-002
Serial №:	82004-3063	Service Representative	Alan, Hendrickson
Running Hours:	Not Available	Change Order №:	Contract
Work Description:	Overhaul/inspection/block changeout (As found)		
Attention:	Daniel Eng, Project Engineer		

On 5 to 26 September 2018 Enterprise DGRS-46 engine serial number 84002-3063 (Unit 2), East Bay Municipal Utilities District, Power Generation Station, Oakland, California was disassembled for replacement of the upper block. Predication for the upper block replacement was excessive wear on the cylinder head and liner counterbore surfaces of the old upper block. As found reports were restricted to crankshaft deflection, main bearing thickness, gear train measurements, and failed components (broken block to base thru bolt, milling of turbocharger support bracket, corrosion of main fuel injector pump rack in bushing area).

AS FOUND

Crankshaft deflection measurements (5 September 2018)



Camshaft timing

8 September 2018.

#1 fuel at 21° BTC measured .197 in. camshaft lobe lift.

As found gear lash inspection.

Specification. Camshaft gear to idler gear, .008-.012, idler gear to crankshaft .008-.012, oil pump gear to idler gear .004-.006; accessory drive gear to idler gear; .004-.006)

(Oil pump removed at measurement for upper block removal 38 teeth.)

(Accessory drive gear 13 teeth, idler gear 98 teeth or 6:1 rpm ratio)

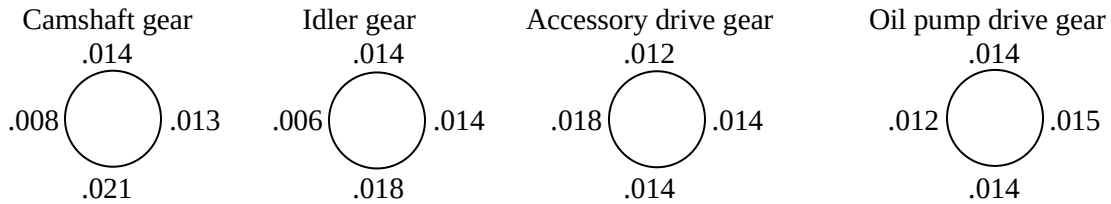
Provided is the disassembly as found measurements on the engine on 7 -8 September 2018.



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Thrust measurements specification for gears.

(Specifications; Camshaft. .004-.007, Idler gear. .004-.007, Accessory drive gear. .003-.012, Oil pump drive gear. .008-.014)

As found thrust measurement for gears.

Camshaft. .006

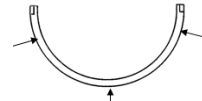
Idler gear. .010

Accessory drive gear. .020

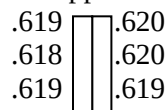
Oil pump drive gear. .018

Main bearing thickness measurements.

AS FOUND (old removed main bearings)



#1 Upper



Notation on bearing

P-03-310-03-OH

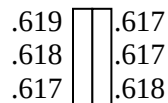
02/01

P6142 01180401

Vendor/Manufacture

Powerhouse Diesel

Lower



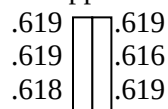
P-03-310-03-OH

02/04

P6142 01180401

Powerhouse Diesel

#2 Upper



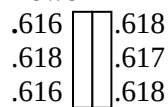
P-03-310-03-OH

02/04

P6142 01180401

Powerhouse Diesel

Lower



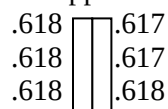
P-03-310-03-OH

02/01

P6142 01180401

Powerhouse Diesel

#3 Upper



P-03-310-03-OH

011359

02-24-09 50

Powerhouse Diesel

Lower



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.617
.617
.618

P-03-310-03-OH
011359
02-24-09 39

Powerhouse Diesel

#4 Upper

.617
.618
.618

P-03-310-03-OH
0011359
02-24-09 21

Powerhouse Diesel

Lower

.618
.617
.617

P-03-310-03-OH
0011359
02-24-09 28

Powerhouse Diesel

#5 Upper

.616
.617
.618

P-03-310-03-OH
0011359
02-24-09 30

Powerhouse Diesel

Lower

.616
.616
.617

P-03-310-03-OH
011359
02-24-09 38

Powerhouse Diesel

#6 Upper

.618
.618
.618

P-030310-03-OH
011359
02-24-09 52

Powerhouse Diesel

Lower

.617
.617
.618

P-03-310-03-OH
011359
02-14-09 47

Powerhouse Diesel

#7 Upper

.618
.619
.618

P-03-310-03-OH
0011359
02-24-09 45

Powerhouse Diesel

Lower

.619
.616
.617

P-03-310-03-OH
0011359
02-24-09 27

Powerhouse Diesel

#8 Upper

.619
.620
.620

Powerhouse Diesel

Lower

Thrust flange





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.619 thrust flange
.620
.620

.611 .618
.617

#9 Upper

.618 .617
.618 .618
.619 .618

Powerhouse Diesel

Thrust flange

Lower

.621 thrust flange
.621
.622

.613 .616
.614

Provided are main bearing pictures removed from the engine

#1 Main bearing wear on upper and lower edge due to debris from damaged water pump drive gear



#2 Main bearing sign of heat on upper and lower shell edge.



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#3 Main bearing loading on lower shell. No debris transfer to upper shell.



#4 Main bearing showing overlay fatigue on lower shell.





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#5 Main bearing loading and overlay fatigue on lower shell



#6 Main bearing overlay fatigue lower shell (normal wear pattern for service life)





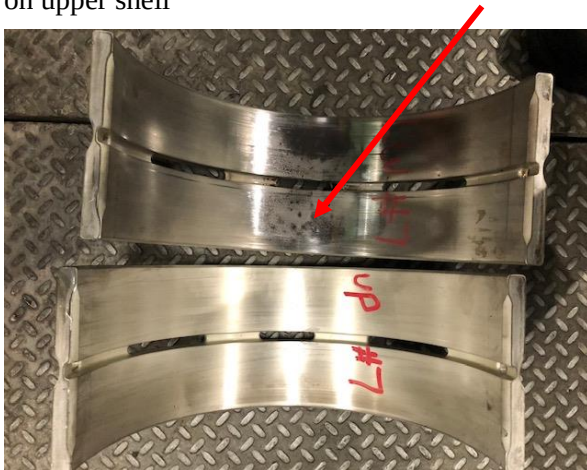
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#7 Main bearing loading and overlay fatigue lower shell (normal wear pattern for service life). No wear on upper shell



#8 Main bearing. Normal wear pattern for service life. No wear on upper shell





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#9 Main bearing. Normal wear pattern for service life. No wear on upper shell. Good alignment to lower shell.



Broken block to base thru bolt.

The flywheel exhaust side block to base thru bolt was found broken at the nut during removal of the upper block. Both the intake and the exhaust side thru bolts at the flywheel end were replaced as a precaution of possible high stresses on the intake side thru bolt following prolonged operation.

Turbocharger support bracket

Turbocharger support bracket was found to have a rise in the middle of the bracket leaving the turbocharger support feet at an angle (leaving soft foot in the turbocharger). Planar measurements of the support bracket were .060 in/ft. and .050 in/ft. sloping upward toward the engine block.

On 20 September 2018 the Turbocharger support bracket planar and level alignment was measured on Enterprise DGRS-46 engine serial number 84002-3063 (Unit 2), East Bay Municipal Utilities District (EBMUD), Power Generation Station, Oakland, California. A review of the turbocharger support bracket was done on 20 September 2018 using a Starrett series 98 12 inch machinist level. Planar deviation found the front center (outboard from the engine block) had a gradual rise of .050 from the exhaust side measured from the mounting bolt hole to approximate center of the bracket and a rise of .060 on the camshaft side of the engine block from the mounting bolt hole to approximate center of the bracket.. The inboard side of the bracket had a rise of .015 on the exhaust of the engine block measured from the mounting bolt hole to the approximate center of the bracket and a rise of .035 camshaft side of the engine block measured from the mounting bolt hole to the approximate center of the bracket. Level alignment found the plane of the mounting bolt holes was off level .015/ft on the exhaust of the engine block and .005/ft on the camshaft side of the engine block. Turbochargers sit flat and level. Turbochargers are preassembled on leveled skids and bedplates with the turbocharger support platform parallel to the bedplate. Common US made turbochargers have a small mounting area to limit the strain on the casing. ABB turbocharger uses 4 support feet to enable a larger casing for a stronger frame. The 4 support feet have to sit flat and level in the plane they are cut in. The misalignment in the existing support bracket will necessarily cause soft foot in the 4 support feet. Shimming of the turbo will put the support feet in plane but will not prevent soft foot (bending of the support feet).



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Outboard exhaust side level out of range measured using feeler gauge .055.



Starrett 98 series 12 inch machinist level bubble out of range center bracket upward to exhaust engine side



Fuel injector pump rack.

Corrosion beneath the #1 bushing coming from the governor control arm was found during cleaning of the fuel injector pump rack. The corrosion was deemed sufficient to account for reported erratic running on load changes in operation. (the corrosion would allow for angled linear motion of the rack in the bushing (excessive wear) instead of radial circular motion of the rack pulling the fuel pumps at intervals).

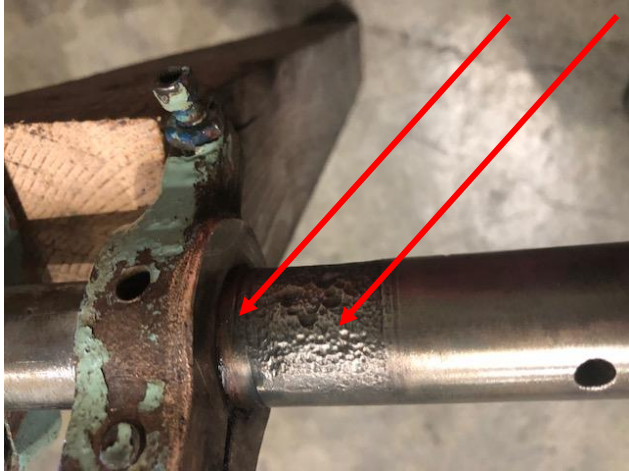
Excessive corrosion wear on both the bushing and rack for control arm support from the governor.



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On September 7, 2018 an inspection of the idler gear was provided on Enterprise DGRS-46 engine serial number 84002-3063 (Unit 2), East Bay Municipal Utilities District, Power Generation Station, Oakland, California. The idler gear had a gear wear pattern corresponding to the oil pump drive gear and marginally out of specification gear backlash (.018 (specification .012 -.014)). Idler gear thrust measurements were also slightly excessive (.010 (specification .004 -.007) (A remnant of thin bronze shim was found on removing the idler from the idler stubshaft.) Hardness test on the gear faces of all the affected gears found the idler gear had 40 HRC with the crankshaft gear, camshaft gear, accessory drive gear, and oil pump drive gear having 55 HRC hardness. Determination to replace all gears in the gear train was based on Enterprise SIM 99 recommending replacing gears as a set by one manufacturer.

Provided is the disassembly as found measurements on the engine on 7 - 8 September 2018.

Camshaft gear	Idler gear	Accessory drive gear	Oil pump drive gear
.014	.014	.012	.014
.008	.006	.018	.012
.013	.014	.014	.015
.021	.018	.014	.014

Thrust measurements for gears

(Specification. Camshaft. .004-.007, Idler gear, .004-.007, Accessory drive gear, .003-.012, Oil pump drive gear, .008-.014)

As Found

Camshaft: .006

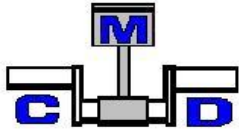
Idler gear: .010

Accessory drive gear: .020

Oil pump drive gear: .018

Note:

Replacing all gears could require some disassembly of existing assembly; possibly removing camshaft if centering and drilling are necessary. Allow 2 weeks + due to availability of additional tooling if needed (reamers for fitted bolts and re-doweling of idler stubshaft).



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Idler Gear Damage



Water Pump Drive Gear Damage



Crankshaft Gear Metal Particles





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ACCESSORY DRIVE GEAR CARRIER INSPECTION IN SHOP

On 5 November 2018 inspection and discovery of excessive heat and seized gear on the shaft on the accessory drive gear was found on Enterprise DRS-46 engine serial number 82004-3063, Unit 2, Power Generation Station, East Bay Municipal Utility District, Oakland, California. The accessory drive gear was removed as part of a gear train replacement following review of damage to the idler gear. Review of the damage to the accessory drive gear found the shaft and bushings were seized and turned together in the gear carrier housing. Disassembly of the gear and carrier found the bushings had seized to the gear sides possibly attributed to the failure of the water pump gear (water pump gear hardened face failed as a granular grit). Fine scratches are found on the faces of both bushings (should be smooth after years of operating in lubrication). The gear and shaft are pinned together and turn independent of the bushings which have an inference fit in the gear carrier (shaft turns in the bushings). Oil is supplied to the gear carrier via ¼ inch tubing from a small manifold at the top right side (facing the front of the engine) and fed into the shaft to bushing clearance (.001-.003 in) via internal drillings to a groove around the bushing to gear carrier housing fit and into a port to the shaft.

SCOPE

Replace the accessory drive gear, bushings and hardware in the accessory drive gear carrier.

CHRONOLOGY

5 November 2018

Begin disassembly of accessory drive gear carrier. Place gear carrier and seized shaft and gear in hydraulic press to remove accessory drive gear and shaft.

5 November 2018

Disassemble accessory drive gear and carrier.

Findings.

Provided are pictures with evidence of excessive heat at the gear shaft and bushings.



Bushing and gear with coked oil (oil cokes at 260° F) on gear carrier housing.



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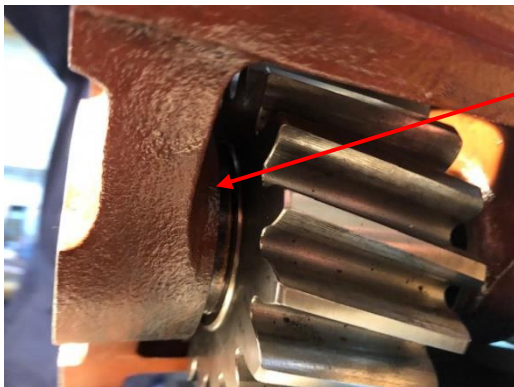
Coked oil and blued surface (carbon precipitate at surface) of gear due to heat.
Flared bushing surface due to heat at contact point with the gear



Flared end of front bushing at contact area with gear side.



Blued steel from heat at contact point with bushing.



Coked oil on rear bushing of gear carrier.



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Rear bushing coked oil.



Rear side of gear blue steel and heat pitting (seized area).



Front bushing melted metal at gear side contact

Both bushings have fine cuts from debris. (Should be smooth from years of lubricated operation)



Scratch from disassembly

Blue steel from heat



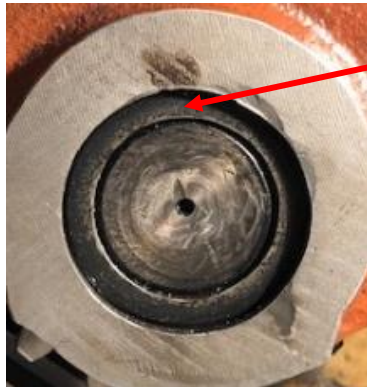
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Bushing and shaft seized together with coked oil between the shaft and bushing.



Coked oil (heat) on bronze bushing and steel shaft

September 25, 2018

During overhaul we found one recondition cylinder head was dropped. The drop bent one cylinder head inlet valve and broke one inlet valve guide.

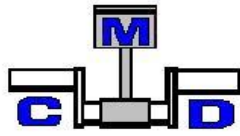
October 3, 2018

Found broken locking pin in bottom of main bearing studs.

Thru bolt was found broken at nut on top of block during removal of thru bolt 10Sep2018. Replaced thru bolt on block installation 18Sep2018

Submittal: Concentricity measurements of engine base main bearing bores. I.D. measurements made at 5 places on both the flywheel side and the engine front side of the main bearing bore.

Engine Base Inspection.



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Engine Base Inspection consisted of measuring: main bearing bore concentricity; main bearing bore alignment (wire line); and engine base top surface plane (flatness) and damage.

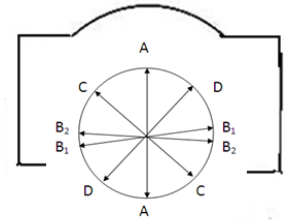
26 April 2019 (1000 to 1300)

Main bearing bore concentricity measurements.

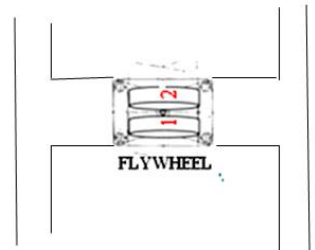
(14.250 nominal)

#1 Flywheel side of bearing bore Engine front side of bearing bore
A WAITING ON MAIN BEARING CAP NUTS FOR REASSEMBLY

B₁
B₂
C
D



#2	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.250	14.251
B ₁	14.249	14.249
B ₂	14.249	14.2495
C	14.250	14.250
D	14.250	14.250

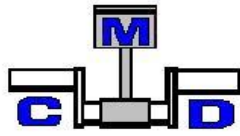


#3	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.2505	14.251
B ₁	14.2505	14.251
B ₂	14.249	14.249
C	14.2505	14.250
D	14.251	14.251

#4	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.252	14.251
B ₁	14.250	14.250
B ₂	14.250	14.250
C	14.251	14.2505
D	14.2505	14.2505

#5	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.250	14.251
B ₁	14.2515	14.2515
B ₂	14.250	14.251
C	14.250	14.2507
D	14.250	14.2507

#6	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.252	14.2525



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B ₁	14.251	14.251
B ₂	14.249	14.250
C	14.252	14.251
D	14.251	14.2515

#7	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.252	14.252
B ₁	14.2515	14.252
B ₂	14.250	14.250
C	14.252	14.252
D	14.251	14.2505

#8	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.2515	14.2515
B ₁	14.2515	14.252
B ₂	14.250	14.250
C	14.252	14.252
D	14.251	14.2505

#9	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.2515	14.2515
B ₁	14.251	14.251
B ₂	14.2515	14.2515
C	14.2515	14.251
D	14.2515	14.251

MEASUREMENTS AS LEFT

ENGINE CRANKSHAFT INSPECTION

Crankshaft thrust. .024

Main Bearing clearance.

(Specification .007- .011)

Main bearing #3 and #6 were .013 reflecting a less bearing shell thickness of .616-.617 on new main bearing shells.

1. .010
2. .010
3. .013
4. .010
5. .010
6. .013
7. .010
8. .010
9. .010

Connecting rod bearing clearance.

1. .011
2. .010



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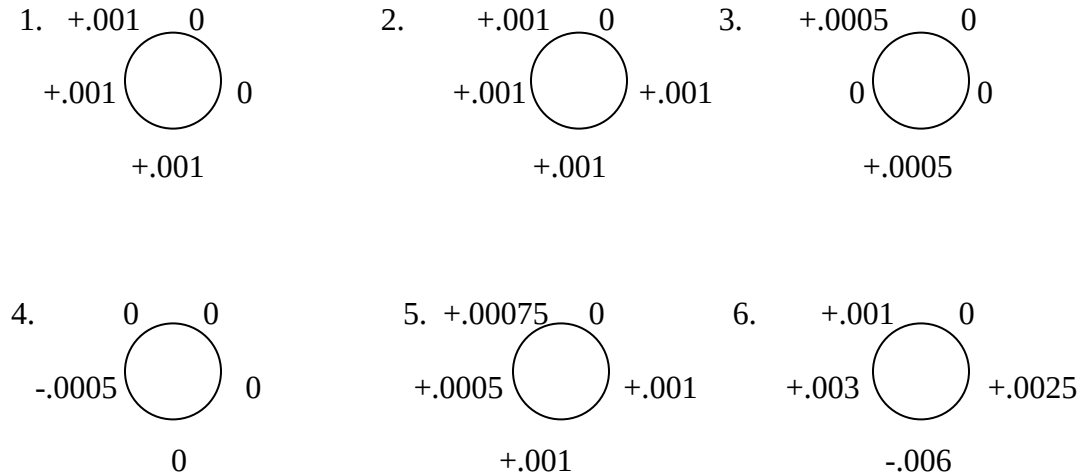
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3. .009
4. .009
5. .010
6. .008

Connecting rod thrust.

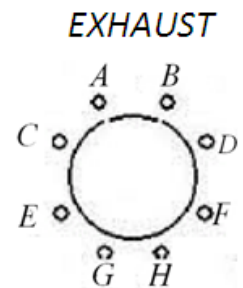
1. .045
2. .019
3. .018
4. .018
5. .017
6. .021

Crankshaft deflection measurements (14 September 2018)

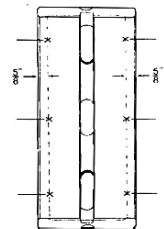
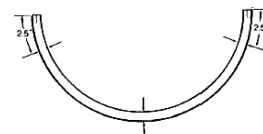


Cylinder liner protrusion measurements.

	A	B	C	D	E	F	G	H
#1	.013	.012	.015	.011	.014	.012	.014	.013
#2	.004	.002	.006	.002	.005	.002	.004	.002
#3	.010	.010	.010	.010	.010	.006	.011	.009
#4	.014	.014	.014	.015	.016	.015	.015	.015
#5	.012	.008	.013	.011	.012	.012	.013	.014
#6	.005	.005	.005	.005	.006	.007	.008	.009



Measure with a ball micrometer at all points marked "X". Avoid crush relief area at end of shell.



Main bearing thickness measurements.

NEW BEARINGS

#1 Upper	
.619	.619
.618	.618

Notation on bearing
None

Vendor/Manufacturer
Odessa Babbitt Bearing



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.618 .618

Lower

.618 .618
.618 .619
.618 .618

None

Odessa Babbitt Bearing

#2 Upper

.618 .618
.618 .618
.618 .618

None

Odessa Babbitt Bearing

Lower

.618 .618
.618 .619
.618 .618

None

Odessa Babbitt Bearing

#3 Upper

.619 .619
.620 .620
.620 .620

31019 07/11

Odessa Babbitt Bearing

Lower

.618 .618
.618 .618
.618 .618

None

Odessa Babbitt Bearing

#4 Upper

.619 .619
.618 .618
.618 .618

None

Odessa Babbitt Bearing

Lower

.618 .620
.618 .619
.618 .618

None

Odessa Babbitt Bearing

#5 Upper

.619 .619
.618 .619
.619 .618

None

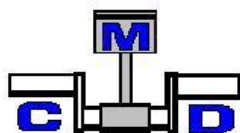
Odessa Babbitt Bearing

Lower

.618 .618
.618 .619

None

Odessa Babbitt Bearing



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.618 .619

#6 Upper

.617 .619
.617 .618
.619 .619

None

Odessa Babbitt Bearing

Lower

.618 .618
.618 .619
.618 .618

None

Odessa Babbitt Bearing

#7 Upper

.619 .619
.618 .619
.618 .618

None

Odessa Babbitt Bearing

Lower

.618 .618
.618 .618
.618 .619

None

Odessa Babbitt Bearing

#8 Upper

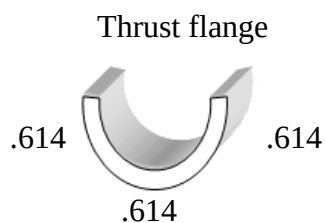
.619 .619
.620 .620
.620 .619

None

Odessa Babbitt Bearing

Lower

.619 thrust flange
.620
.620



Odessa Babbitt Bearing

#9 Upper

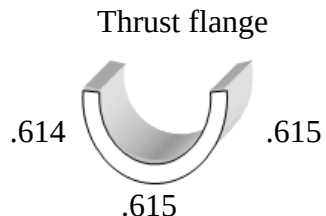
.619 .619
.620 .620
.620 .619

None

Odessa Babbitt Bearing

Lower

.619 thrust flange
.620
.620



Odessa Babbitt Bearing

Crankpin O.D. measurements.



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#1 A B
1. 10.998 10.997
2. 10.998 10.998

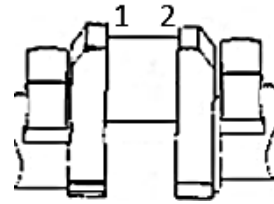
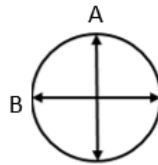
#2
1. 11.000 11.000
2. 11.000 11.000

#3
1. 11.000 11.000
2. 11.000 11.000

#4.
1. 11.001 11.000
2. 11.000 10.997

#5
1. 11.000 11.000
2. 11.000 11.000

#6
1. 10.998 10.997
2. 11.000 10.998

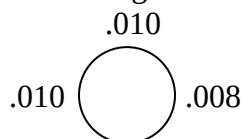


GEAR TRAIN REPLACEMENT

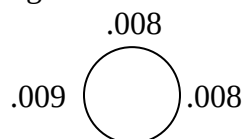
Gear train replacement was determined on 15 September 2018. The idler gear had pitting and was found to have a Rockwell hardness of 40 HRC (specification 59-65 HRC) . Removal of the accessory drive carrier gear for rebuild found the gear had seized due to misalignment on the gearcase. A changeorder purchase was requested and purchasing was authorized in December 2018. Efforts to set gearlash in March 2019 found the crankshaft bent .019 at the water pump drive end of the crankshaft. The bent crankshaft was found during measurements to determine the runout of the idler gear (2 piece idler gear and camshaft gears has space for assembling pieces).

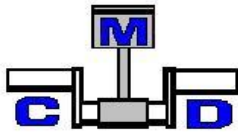
Geartrain replacement 4-17 March 2019
(.008-.012)

Camshaft gear to idler gear



Idler gear to crankshaft gear





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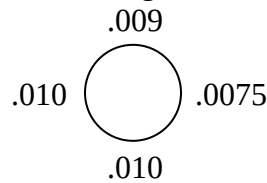
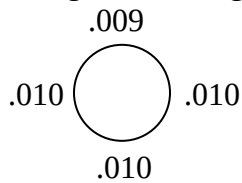
.009

.008

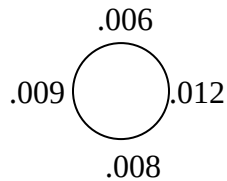
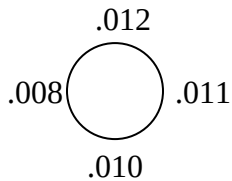
13 March 2019

After reversing stubshaft mounting bolts and making hardened washers for the fastener nuts to assure torque.

Camshaft gear to idler gear Idler gear to crankshaft gear



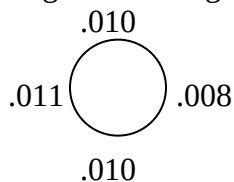
Gearlash confirmation



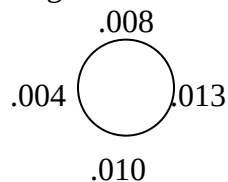
14 March 2019

Cotter pins in, idler rotated to timing marks.

Camshaft gear to idler gear



Idler gear to crankshaft gear.

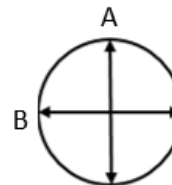


Idler stubshaft

A	B
1. 3.995	3.995
2. 3.995	3.995
3. 3.995	3.995

Idler bushing

A	B
1. 3.999	3.998
2. 3.999	3.999
3. 3.999	3.999





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IDLER GEAR INSPECTION MEASUREMENTS

Idler gear has a reduced diameter (step) at the bottom to fit the idler gear

Idler gear upper I.D.

- A. 21.499
- B. 21.500
- C. 21.500
- D. 21.4995

Idler gear lower I.D.

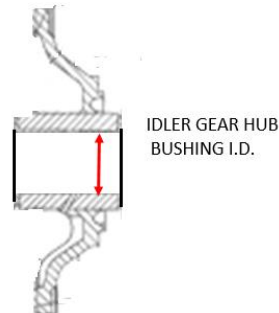
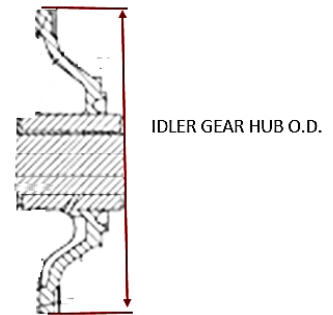
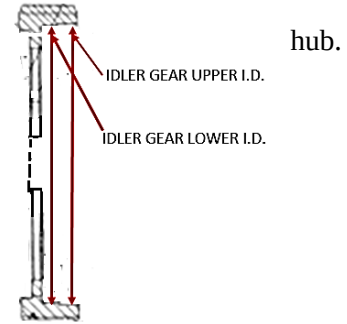
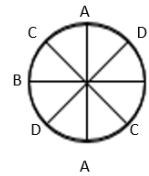
- A. 21.250
- B. 21.2495
- C. 21.2495
- D. 21.250

IDLER GEAR HUB O.D. MEASUREMENTS

- A. 21.247
- B. 21.247
- C. 21.247
- D. 21.247

IDLER GEAR HUB BUSHING I.D. MEASUREMENTS

- A. 3.9965
- B. 3.9965
- C. 3.9965
- D. 3.9965



17 March 2019

Unable to repeat gearlash measurements from idler gear to crankshaft gear using 10 points of measurements.

BENT CRANKSHAFT (see Bent Crankshaft section)

BENT CRANKSHAFT

On 19-20 March 2019 runout measurements on the crankshaft found .019 deviation total indicated runout (TIR) using dial indicators (Starrett .001 in gradation). The TIR deviation indicates a bend at the end of the crankshaft of .009 from centerline. TIR taken at #1 main bearing journal measured .010 in indicating a bend of .005 from centerline at the crankshaft gear shoulder. Measurements taken at disassembly 05 September 2018 of the upper block, main bearing replacement, piston and rod assembly installation, and rear cover did not indicate a bent crankshaft. Deflection readings for #1 crankpin were +.0025 on bottom and +.0005 on top both within specifications. Reassembly crankshaft deflection measurements on 14 September 2018 at #1 crankpin were +.001 on top and +.001 on bottom. Main bearing clearance for #1 and #2 main bearings were .010 and .010 respectively (specification .008-.014).

CRANKSHAFT RUNOUT INSPECTION PREDICATION

19-20 March 2019 dial indicated crankshaft runout was measured at 4 places from the main bearing to the end of the crankshaft. The crankshaft protrudes from the front of the engine and carries the crankshaft gear driving the idler gear which drives; the accessory drive gear (fuel and governor shutdown); the oil



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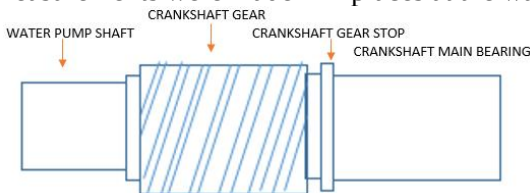
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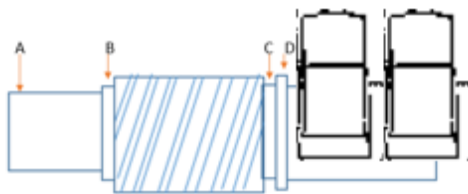
pump drive gear; and the camshaft gear. Gear train replacement is based on gear backlash which sets the distance of the gear teeth spacing. Initial gear backlash (gearlash) measurements on 9 March 2019 were within specification based on a 4 point mechanical center measurement. Loading the camshaft to get more accurate measurements on 11 and 12 March 2019 required moving the stubshaft to get acceptable gearlash. The stubshaft was moved on 13 March 2019, tightened into place and a pilot hole for dowelling was begun. The addition of #1 fuel pump changed gearlash and the bolt configuration was changed to follow the drawing allowing a tighter stubshaft. (Disassembly found the stubshaft mounting bolts reversed to make tightening and fitting the cotter pins from outside the crankcase.) The bolts were reinstalled and tightened from inside the crankcase with hardened (grade 8) washers added as spacers to fit the nuts in the milled spot face relief on the inside of the crankcase wall. The stubshaft bolts were torqued to 300 ftlb and cotter pins fitted on 14 March 2019. A final gearlash in 10 places was made and a tight spot with no gearlash was found. Indicated runout on the interior of the idler gear found .005 runout to determine parallel of the idler to the engine front was done. The idler gear was removed and the hub rotated with the same result. Attempts to center the idler hub in the idler gear did not work. The idler gear and hub were taken to a mutually agreed machine shop (Diamond Tool, Alameda) where the hub O.D. was found to be .007 off center from the hub bushing centerline. (There was a previous rework of knurling on the edge of the hub O.D. (possibly to provide a greater surface)). A decision to cut down a substitute hub to fit was made and the hub was cut to have .002 center fit in the gear. The hub was returned on 19 March 2019 and found to have a tight spot of .004 gear lash (other spots on the camshaft were .012 preventing .004 movement). An indicated runout on crankshaft found a total indicated runout of .017 at the end of the crankshaft and .0105 at the main bearing. A .006 feel gauge could be partially inserted under #1 main bearing.

Provided are the results of the dial indicated crankshaft runout.

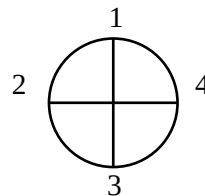
Measurements were made in 2 places at the water pump shaft end and 2 places at the crankshaft gears stop.



The dial indicators were positioned as shown A, B, C, D.



	A	B	C	D
1.	0	0	0	0
2.	.0055	.0055	.0015	.003
3.	.017	.016	.0095	.0105
4.	.004	.0055	.0035	.002



Pictures of indicated positions.



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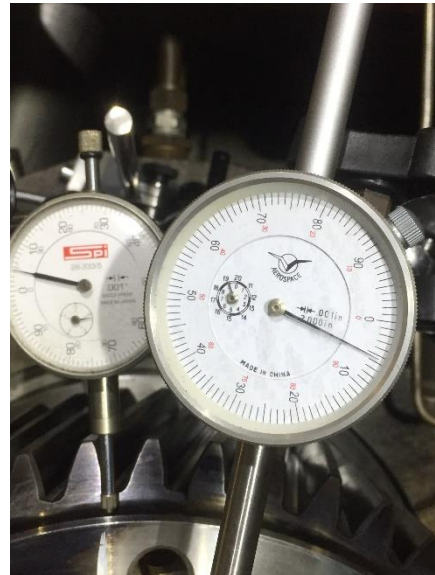
A, B, C, D position 1. All indicators reading 0 C, D Position 2 Indicators reading .0015 and .0035



A, B position 3 indicators reading .017 and .016



A, B position 4, indicators reading .055 and .004





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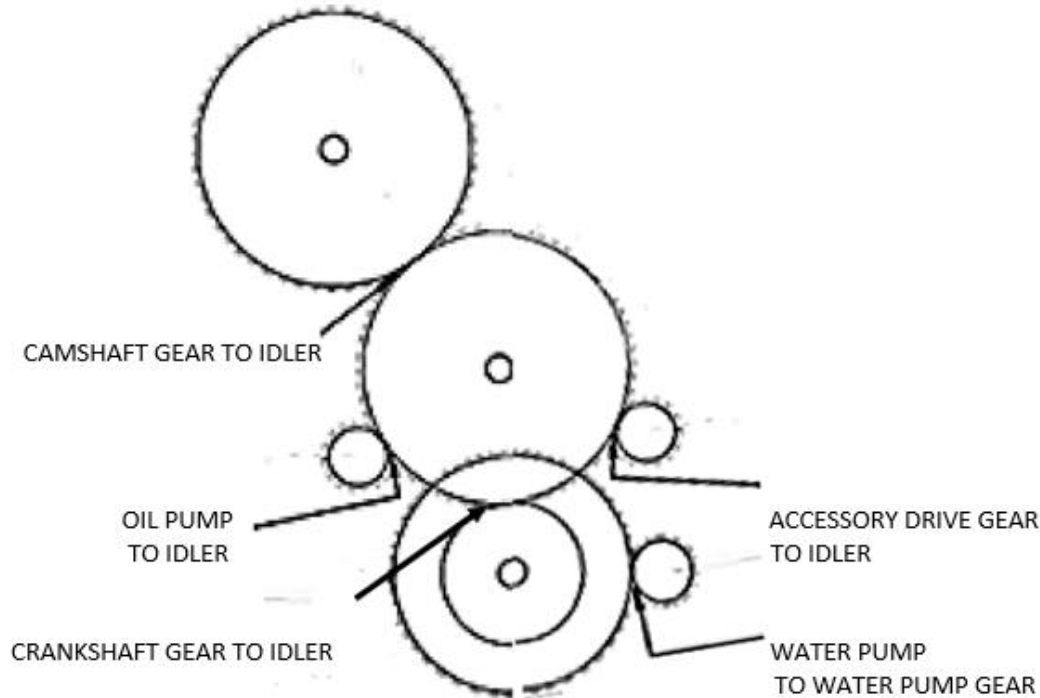
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GEARCASE REASSEMBLY MEASUREMENTS

9-12 July 2019

(Gearcase (front cover) installed 20 July 2019.



Gearlash specifications:

Camshaft to idler: .008-.012

Oil pump to idler: .008-.012

Idler to crankshaft: .008-.012

Water pump to water pump gear: .004-.006

(8 points of measurement is 2 rotations of the gear against the idler gear or 4 crankshaft gear against the idler gear)

Camshaft to idler gear lash.

1. .009
2. .012
3. .009
4. .008
5. .008
6. .009
7. .010
8. .008

Idler gear to crankshaft gearlash.

1. .012
2. .009
3. .009



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4. .009
5. .011
6. .010
7. .012
8. .010

Oil pump gear to idler gearlash.

1. .009
2. .010
3. .009
4. .009
5. .009
6. .009
7. .009
8. .009

26 July 2019 Mounting of oil pump.

1. .011
2. .011
3. .010
4. .015
5. .011
6. .013
7. .011
8. .011

Accessory drive gear to idler gearlash

1. .009
2. .010
3. .009
4. .009

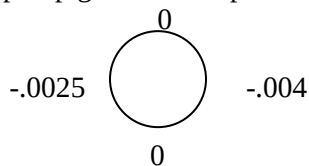
Camshaft gear thrust: .008

Idler gear thrust. .005

Oil pump gear thrust. .006

Accessory gear thrust. .004

Oil pump gear carrier spline to oil pump adapter plate. (centerline measurement)



Water pump gear to water pump drive gear gearlash.

(Specification. 004-.006)

1. .006
2. .005
3. .004
4. .007



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5. .006
6. .007
7. .005

Mounting of water pump gearlash (26 July 2019) (connecting of water pump piping)

1. .008
2. .006
3. .004
4. .004
5. .004
6. .007
7. .006
8. .004

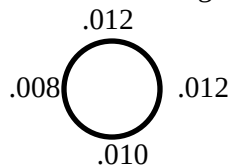
Replace water pump gear and install on gearcase. (16 September 2019)

1. .005
2. .006
3. .006
4. .007
5. .008
6. .006
7. .004
8. .008
9. .007
10. .011
11. .009
12. .007

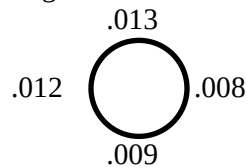
30 July 2019

Measured gearlash after dowelling and assembly of pumps and piping.

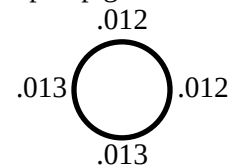
Camshaft to idler gear



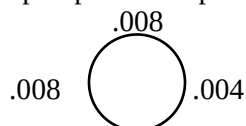
Idler gear to crankshaft gear



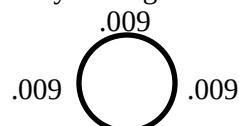
Oil pump gear to idler gear



Water pump to water pump drive gear



Accessory drive gear to idler gear

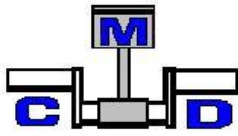


.006

.010



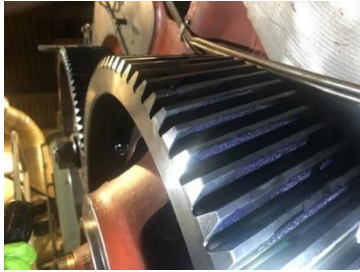
Camshaft to idler gear teeth blue pattern



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Idler gear teeth blue pattern



Oil pump gear teeth blue pattern



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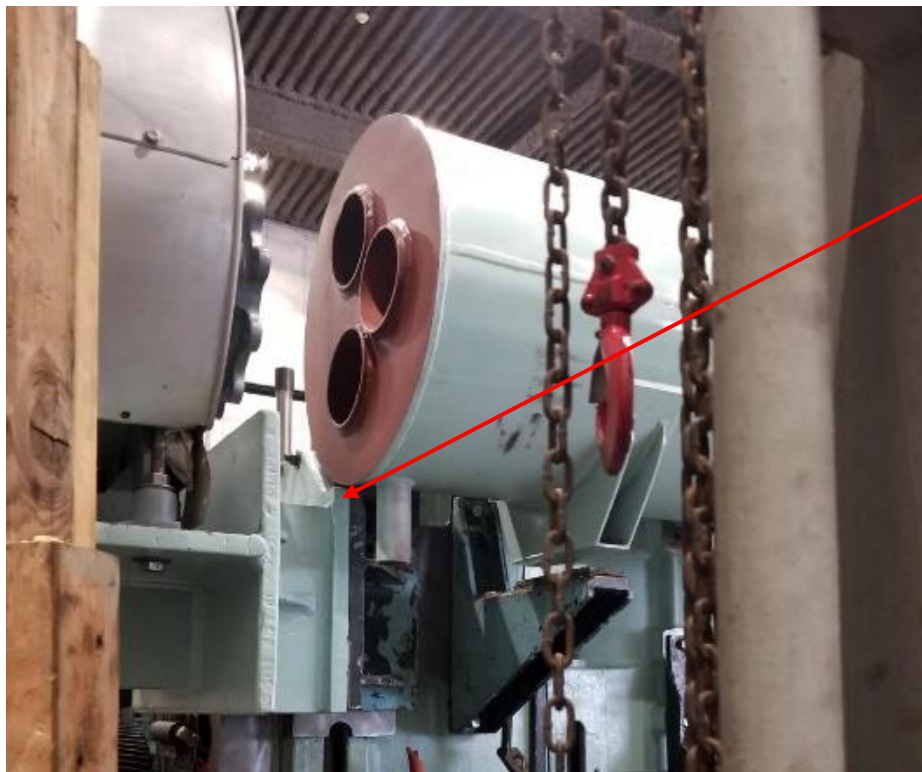
EXHAUST MANIFOLD INSTALLATION

30 October 2018

Failure of initial fitment of exhaust manifold to engine was excessive length of exhaust manifold at #1 cylinder. Exhaust manifold measured 142 ½ inches compared with old manifold measured length of 138 inches. The new exhaust manifold was taken to a certified exhaust fabricator and modified to fit and shimmed into place and aligned to cylinder heads on 27 November 2018.

PREDICATION

Initial exchange of the exhaust manifold began with the replacement of the Enterprise OEM supplied C-17 turbocharger. An ABB turbocharger was installed to align with existing turbocharger exhaust outlet piping. The ABB turbocharger had a distance from the end of the exhaust to the turbocharger turbine inlet of 16 inches. The C-17 turbocharger inlet piping was 24 inches. Accommodating the mounting base of the ABB turbocharger required reconfiguring the turbocharger support bracket by making it wider and shorter, leaving the ABB turbocharger with 12-16 inches to the exhaust manifold outlet pipes. The existing Enterprise DRS-46 exhaust manifold has 6 cylinders configured into 3 outlet pipes in a cavity shrouded in a 2 in X 138 inch water jacket. The reconfigured turbocharger support bracket utilized the same corner bracket as the C-17 turbocharger. The original C-17 turbocharger support bracket was 8 inches wide and 48 inches long.



Reconfigured ABB
turbocharger support
bracket



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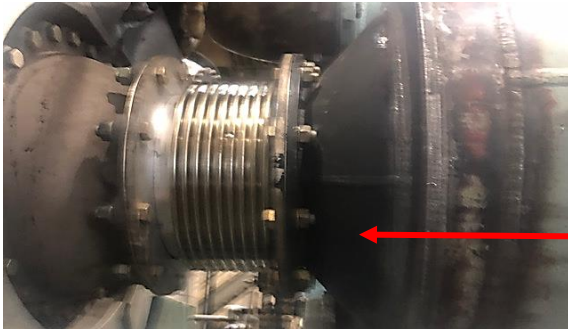
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It was reported by EBMUD the old exhaust manifold adapter piece from the manifold pipes to the turbocharger (after reconfiguring the to the ABB turbocharger support bracket) was leaking hot exhaust gas. Disassembly and removal of the exhaust manifold on 19 September 2018 found the exhaust seal rings were not installed allowing the exhaust gas to leak.

Discrepancies in the exhaust fitment to the turbocharger support bracket were based on EBMUD contractual requirements of OEM replacement specifications. EBMUD had replaced the OEM Enterprise Delaval C-17 turbocharger with an ABB turbocharger without providing detailed plans or drawings of the ABB turbocharger adaptations. CMD built an exhaust manifold based on Enterprise drawings which did not fit the modified ABB turbocharger support bracket and area.

Discrepancies in the exhaust fitment centered on alignment of the exhaust flange to cylinder head bolt holes and offset of the mounting straps for the water outlet pipe on top of the exhaust. The exhaust flange bolt holes on cylinder heads 1-6 were opened to fit the cylinder head bolt pattern. Additional double locking nord lock lockwashers were installed on each grade 8 bolt. The offset mounting straps were corrected using an additional steel strap bolted to the existing welded strap on the exhaust manifold and aligned to fit the cylinder head outlet rubber elbow and the outlet pipe to the cooler. Finished installation of exhaust manifold and welded transition

piece to compensator to ABB turbocharger is provided.



← Welded transition piece to compensator to ABB turbocharger.



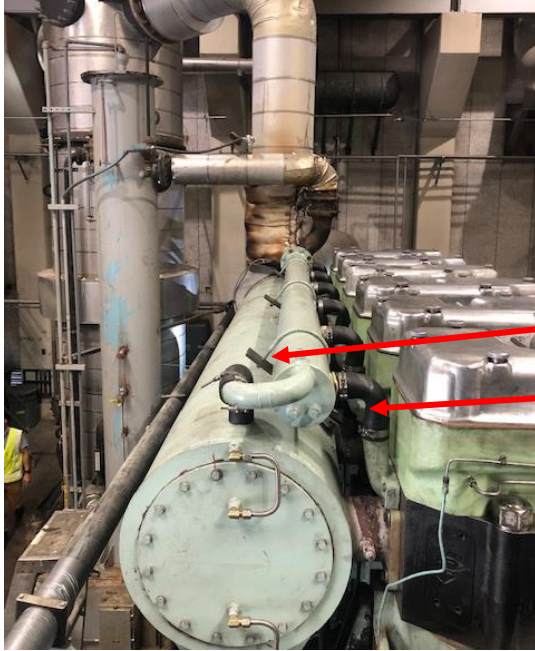
← Water supply flex pipe using flange fittings on both ends from upper block water inlet header to exhaust water jacket inlet.



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Final installation of exhaust manifold on engine

Outlet water pipe and offset strap to outlet pipe.

Cylinder head rubber water outlet elbows



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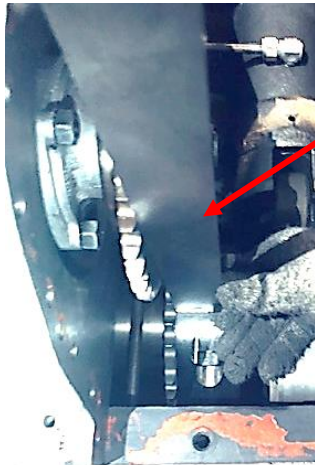
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AMBAC Pump Timing

Clean Burn diesel fuel injection pump timing.

Ambac pump timing was set 2-3 August 2019. Fuel timing was set flowing fuel through the Ambac fuel injection pump to stop or valve closing at 28°BTDC on #1 cylinder. All cylinders were checked for timing using fuel stopping on the closing ramp for the Ambac fuel injection pump. All 6 cylinders stopped fuel flow at 28°BTC. On 2 August 2019 EBMUD requested the camshaft drive sprocket, hub and chain be replaced. The drive sprocket and hub were replaced on 2 August 2019 and the chain was replaced after removing 1 link on 3 August 2019.

Alignment between the Ambac pump sprocket and the camshaft drive sprocket was done using a straight edge.



Straight edge on Ambac pump sprocket and camshaft drive sprocket



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TURBOCHARGER INSTALLATION

Turbocharger overhaul was contractually required by EBMUD to be done by ABB. Mounting and installation was provided by CMD.

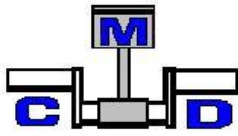
The turbocharger support bracket had an as found curved surface for the turbocharger mounting points resulting in all 4 turbocharger mounting feet being soft (the mounting bolts were all double nutted to prevent looseness). A review of the turbocharger support bracket was done on 20 September 2018 using a Starrett series 98 12 inch machinist level. Planar deviation found the front center (outboard from the engine block) had a gradual rise of .050 from the exhaust side measured from the turbocharger mounting bolt hole to approximate center of the bracket and a rise of .060 on the camshaft side of the engine block from the turbocharger mounting bolt hole to approximate center of the bracket. The inboard side of the bracket had a rise of .015 on the exhaust of the engine block measured from the turbocharger mounting bolt hole to the approximate center of the bracket and a rise of .035 camshaft side of the engine block measured from the mounting bolt hole to the approximate center of the bracket. Level alignment found the plane of the mounting bolt holes was off level .015/ft on the exhaust of the engine block and .005/ft on the camshaft side of the engine block. The turbocharger platform was milled flat and remounted to the existing dowel holes.

Unit start up on 23 August 2019 found the turbocharger oil supply pressure was running at 23 psi at 661 kw. The starting turbocharger was 33 psi with no load. 24 August 2019 disassembly of the turbocharger drain line was performed on units #2 and #3 to locate an orifice to raise turbocharger oil supply pressure. 26 August 2019 oil supply inlet piping was removed from units #2 and #3 to compare the inlet oil supply orifice size. The inlet oil supply orifice was removed from unit #2 and opened to .375 in.



Turbocharger inlet oil supply piping

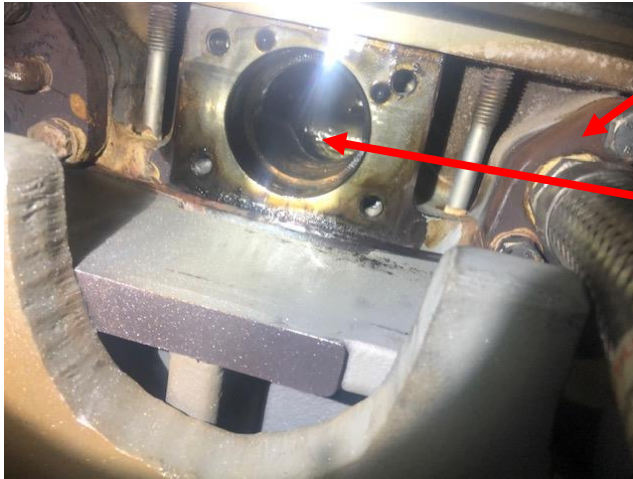
Turbocharger oil drain line



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Turbocharger oil supply line (orifice is in turbocharger casing)

Turbocharger drain unrestricted



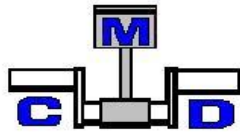
Turbocharger inlet orifice



Turbocharger inlet supply line unrestricted.



Turbocharger drain lines from Units #2 and #3 unrestricted.



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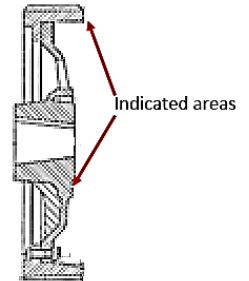
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CAMSHAFT INSPECTION AND REINSTALLATION.

Camshaft installation inspection.

Camshaft straightness (linear deviation) was determined by camshaft bearing clearance and dial indicated runout on the front of the camshaft gear hub parallel to the front of the block. Camshaft indicated runout on the face of the hub measured .001. The measurement was to determine deviation in parallel of the camshaft gear and the idler gear. Dial indicated runout was measured on the face of both the idler gear and the camshaft gear hub face. The indicated runout on the face of both gears would also indicate the straightness of the idler gear stubshaft.



Camshaft timing.

Camshaft timing was initiated 2 July 2019 after setting fuel timing to .197 at 21°BTC (diesel setting). Deviations in camshaft fuel timing resulting from clean burn injection system and nonstandard fuel BTU from digester gas questioned the diesel (21°BTC at .197 lift) and manufacturer setting fuel injection at 25°BTC (determined by fuel pump markings). Camshaft intake and exhaust lobes were found to be 02-350-4-0X (exhaust) and 02-350-08-A1 (intake). Using the lift for intake and exhaust lobes is 02-350-4-0X (exhaust) (.8833 lift on closing ramp at TDC) and 02-350-08-A1 (intake) (.5437 lift on opening ramp at TDC, it was found #1 fuel lobe timing was .196 @21°BTC. Provided are camshaft lobe lift measurements.

Specification:

Intake: .5437 ± .015 on opening ramp

Exhaust: .8833 ± .015 on closing ramp

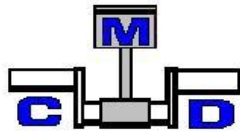
Fuel: set pump to 21°BTC

MEASURED			DEVIATION			
	INTAKE	EXHAUST	FUEL	INTAKE	EXHAUST	FUEL
#1	.548	.896	.196 @ 21°BTDC	+.004	+.013	-.001
#2	.530	.896		-.013	+.013	
#3	.543	.893		0	+.010	
#4	.544	.907		0	+.024	
#5	.547	.893		+.003	+.010	
#6	.537	.894		-.006	+.011	

DEVIATION EXCEEDING ±.015 TOLERANCE

	INTAKE	EXHAUST	FUEL
#1	0	0	0
#2	0	0	
#3	0	0	
#4	0	+.009	
#5	0	0	
#6	0	0	

Camshaft thrust. .008



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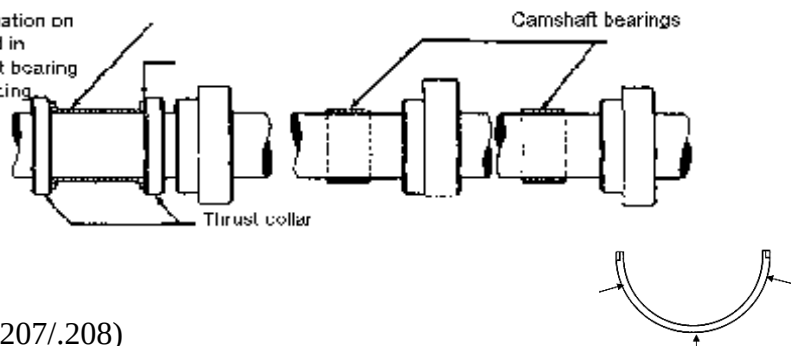
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Camshaft bearing clearance.

1. .004
2. .005
3. .005
4. .005
5. .005
6. .005
7. .005

Camshaft bearing thickness measurements.

For purposes of recording information on this form, bearings are numbered in sequence, starting with the thrust bearing at the gearcase end and proceeding towards the flywheel end.



(Specification thickness. .207/.208)

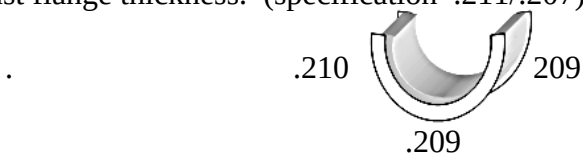
#1. Upper

.208	.2075
.208	.208
.208	.208

Notation on bearing
P 03-350-01-OD
P4627 07-19-02
12 071204

Vendor/Manufacture
Powerhouse Diesel

Thrust flange thickness. (specification .211/.207)



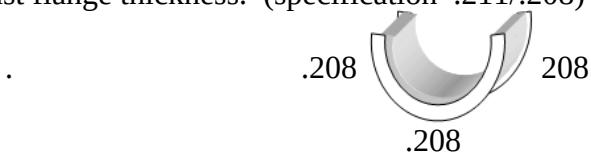
Lower

.207	.208
.207	.208
.207	.209

P 03-350-01-OD
P4627 07-19-02
16 071204

Powerhouse Diesel

Thrust flange thickness. (specification .211/.208)



#2 Upper (Thickness specification .208/.207)

.207	.207
.207	.207

31206 11-10



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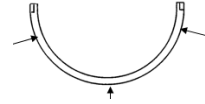
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.207 .207

Lower

.207 .207
.207 .2074
.207 .207

31206 11-10



#3 Upper

.207 .207
.207 .207
.207 .207

31206 11-10

Lower

.207 .2075
.207 .207
.207 .2075

31206 11-10

#4 Upper

.207 .207
.207 .2074
.207 .207

31206 11-10

Lower

.208 .208
.208 .208
.208 .208

31206 11-10

#5 Upper

.207 .2073
.207 .208
.207 .208

31206 11-10

Lower

.207 .207
.207 .207
.207 .207

31206 11-10

#6 Upper

.207 .207
.207 .2075
.207 .2074

31206 11-10



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Lower

.207		.207
.207		.207
.207		.207

31206 11-10

#7 Upper

.208		.207
.208		.207
.207		.208

31206 11-10

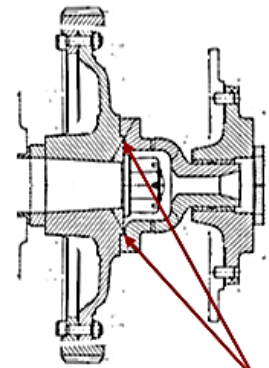
Lower

.207		.2075
.207		.2075
.207		.2075

31206 11-10

Camshaft outboard support shaft. (25-27 July 2019)

The end of the camshaft has an adapter to a gearcase outboard support bearing to carry the weight of the camshaft gear and hub. Indexing the gear adapter to the gearcase bearing is done using a register fit (spigot fit) from the adapter interior end to the face of the camshaft hub. The camshaft gear adapter has to have a runout less than the available clearance in the gearcase bearing. The adapter shaft O.D. is 3.000 in and the I.D. of the gearcase bearing is 3.004 in. The fit of the adapter to the register cut on the face of the camshaft hub is 7.000 I.D. in the interior of the adapter hub and 6.998 O.D. on the camshaft hub register cut. Attempted runout measurements found .010 runout on the adapter shaft. The adapter shaft was machined to 7.005 I.D. to center the runout of the adapter to the camshaft hub. Measurement of the adapter runout was taken using the gearcase as the reference (Mag base indicator mounted on the gearcase to reference the camshaft to the gearcase for the gearcase bearing.). Initial camshaft gear hub runout measurement (.001) was made 14 September 2018. Final camshaft gear runout (0) was made 29 July 2019 and confirmed using a .001 feeler gauge.



CAMSHAFT GEAR HUB REGISTER FIT
TO CAMSHAFT GEAR ADAPTER I.D.

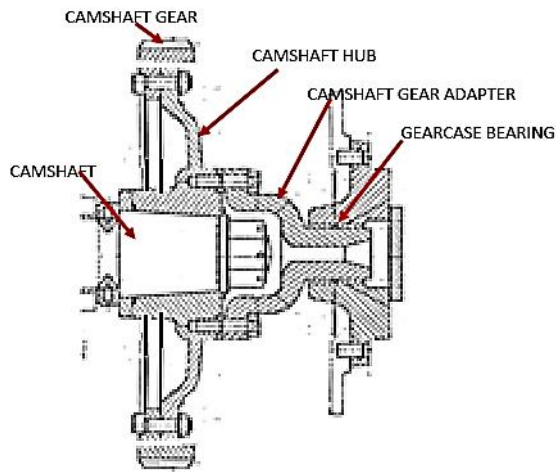


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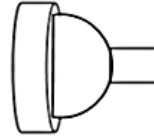
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Below is the assembly



CAMSHAFT GEAR ADAPTER TO
GEARCASE SUPPORT BEARING



Camshaft gear register fit O.D.

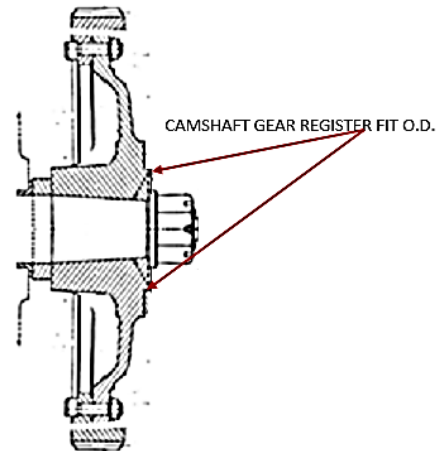
Vertical: 6.998

Horizontal: 6.997

Camshaft gear adapter interior I.D.

Vertical: 7.005

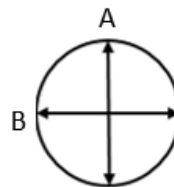
Horizontal 7.005



Camshaft gear adapter shaft O.D.

Vertical: 3.000

Horizontal: 2.999

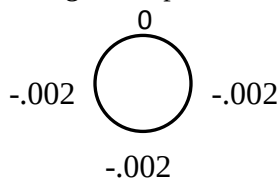


Gearcase bearing I.D.

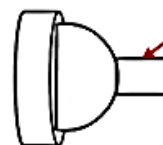
Vertical: 3.004

Horizontal: 3.0035

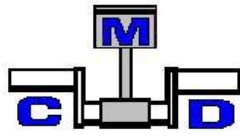
Camshaft gear adapter shaft runout measurement



CAMSHAFT GEAR ADAPTER TO
GEARCASE SUPPORT BEARING



Camshaft adapter shaft was centered in the gearcase bearing using dial indicators to center .002 to a side.



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CYLINDER HEADS

Cylinder head gas valve setting measurement.

Cylinder head gas admission valves are incorporated into the 2 intake valve stems. The stems are wider and have 2 gas seal rings on the wider portion and fit into a ported extension in the valve guide. Off engine valve springs are removed, a 2 inch travel dial indicator set on the valve face and the valve stem is Valve setting is 1.210 fully open on the gas ports.

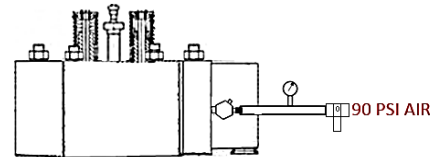
Valve position is facing the air intake.

	Right	Left
Cylinder head B06420	1.213	1.213
B08429	1.215	1.217
038	1.209	1.215 replaced B06362 30Aug19 for water leak.
E07023	1.213	1.213
B06423	1.209	1.206

Cylinder head leak down test. (30 August 2019)

Cylinder head leak down test consists of putting air pressure in the cylinder with the piston at TDC with the valves closed (firing stroke). Air is fed into the cylinder through the kiene valve using an adapter (or remove the kiene valve and use ½ in pipe) and valve connected to an air source (plant air, air hose) with the ability to close the valve and isolate the pressure in the cylinder head. This leak down test was provided in response to positive crankcase pressure running at 2100 kw dual fuel (28 -29August 2019)

Cylinder	Pressure	Time to bleed to 0 psi
1	86 psi	31 seconds
2	82 psi	72 seconds
3	75 psi	15 seconds (replaced B06362 30Aug19 for water leak)
4	84 psi	36 seconds
5	86 psi	56 seconds
6	82 psi	55 seconds

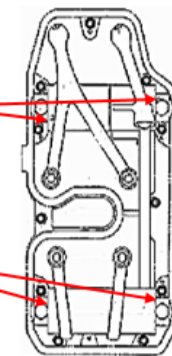


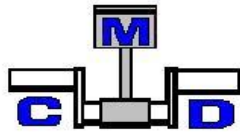
Cylinder head subcover rocker arm end clearance. (5 March 2019)

	Intake	Exhaust
1.	.012	.008
2.	.011	.008
3.	.013	.010
4.	.014	.009
5.	.014	.008
6.	.015	.009

INTAKE ROCKER ARM
END CLEARANCE

EXHAUST ROCKER ARM
END CLEARANCE





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CONNECTING RODS

Connecting rod data and cylinder designation.

Connecting rod data tracks replaced connecting rods and provides reconditioning dates.

(Connecting rod #1 has 2 dates; 9-13-82 is production date, 4-22-18 is reconditioning date. HT is heat treating number; PA - rough casting part number; FF1 – rod number in engine and match mark for cap to rod side.(can't put cap on backwards). Connecting rod #5 is a replacement.

Cylinder #1

	M
P.D.F.	HT 211184
PC. 539	PA 6762
WT. 671 LBS	9-13-82
	17070184
	4-22-18

FF1
FF1

Cylinder #2

	M
P.D.F.	HT 211184
PC. 49	PA 6762
WT. 672 LBS	9-13-82
FF2	
FF2	

Cylinder #3

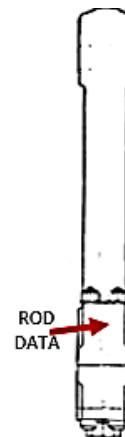
	M
P.D.F.	HT 211184
PC. 469	PA 6762
WT. 672 LBS	9-13-82
FF3	
FF3	

Cylinder #4

	MG
P.D.F.	HT211184
PC. 481	PA 6762
WT. 675 LBS	9-24-82
FF4	
FF4	

Cylinder #5

P.D.F.	HT211184
PC. 488	PA 6762
WT. 670	1-13-83





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7
7

Cylinder #6

P.D.F. HT 211184

PC. 530 PA 6762

WT. 675 LBS 9-24-82

FF6 57

FF6 57

Connecting rod dimensions.

Connecting rod crankpin bore I.D. measurements

(1 and 2 measurements are flywheel and gearcase sides of connecting rod)

#1	A	B ₁	B ₂	C	D
1.	12.249	12.248	12.249	12.249	12.249
2.	12.250	12.248	12.248	12.248	12.250

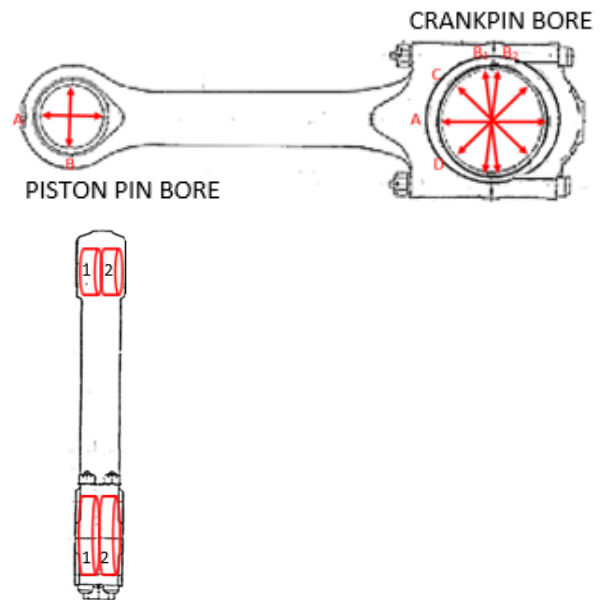
#2	A	B ₁	B ₂	C	D
1.	12.247	12.247	12.249	12.249	12.247
2.	12.247	12.247	12.249	12.249	12.247

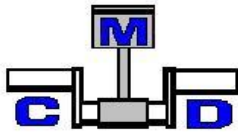
#3	A	B ₁	B ₂	C	D
1.	12.247	12.247	12.249	12.249	12.247
2.	12.247	12.247	12.249	12.249	12.247

#4	A	B ₁	B ₂	C	D
1.	12.247	12.247	12.248	12.249	12.247
2.	12.248	12.248	12.250	12.250	12.248

#5	A	B ₁	B ₂	C	D
1.	12.248	12.249	12.250	12.249	12.248
2.	12.249	12.249	12.249	12.250	12.248

#6	A	B ₁	B ₂	C	D
1.	12.248	12.249	12.248	12.249	12.248
2.	12.249	12.248	12.249	12.250	12.248





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Connecting rod piston pin bore I.D. measurements.

(1 and 2 measurements are flywheel and gearcase sides of connecting rod)

#1 A B
1. 6.762 6.761
2. 6.760 6.760

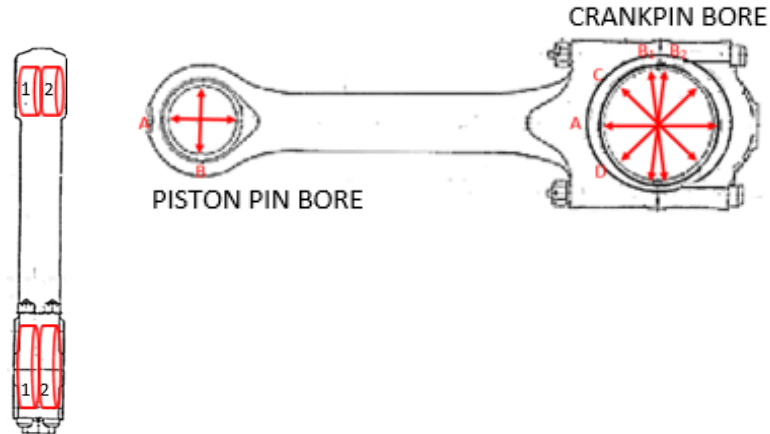
#2 A B
1. 6.764 6.763
2. 6.761 6.761

#3 A B
1. 6.763 6.763
2. 6.761 6.761

#4 A B
1. 6.761 6.761
2. 6.760 6.760

#5 A B
1. 6.761 6.761
2. 6.760 6.760

#6 A B
1. 6.762 6.762
2. 6.761 6.761

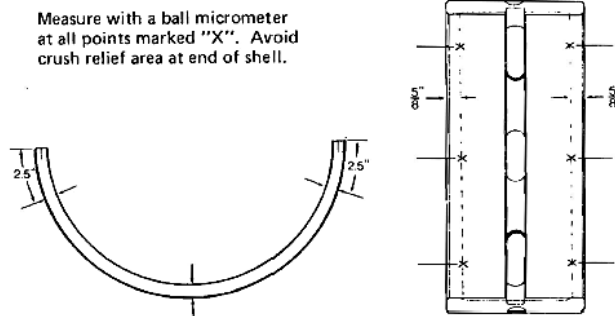


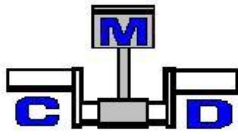
Connecting rod bearing thickness measurements.

Specification: .618/.619

#1
Upper
.619 .619
.619 .619
.618 .618
Lower
.619 .618
.619 .619
.618 .618

#2
Upper
.6185 .6185
.6185 .6185
.6185 .6185





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Lower

.618	□	.618
.6185	□	.618
.6185	□	.619

#3

Upper

.618	□	.6185
.618	□	.618
.618	□	.6185

Lower

.618	□	.618
.618	□	.618
.618	□	.6185

#4

Upper

.618	□	.618
.618	□	.6185
.618	□	.618

Lower

.618	□	.618
.619	□	.618
.618	□	.619

#5

Upper

.618	□	.618
.619	□	.618
.618	□	.619

Lower

.618	□	.618
.618	□	.618
.619	□	.618

#6

Upper

.618	□	.618
.618	□	.618
.618	□	.618

Lower

.619	□	.619
.619	□	.618
.619	□	.619



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CYLINDER LINER I.D. Measurements. (6 September 2018) (Specification 17.000)

#1

	A	B
1.	17.000	17.000
2.	17.000	17.000

#2

	A	B
1.	17.000	17.000
2.	17.000	17.000

#3

	A	B
1.	17.001	17.001
2.	17.001	17.001

#4

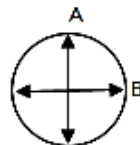
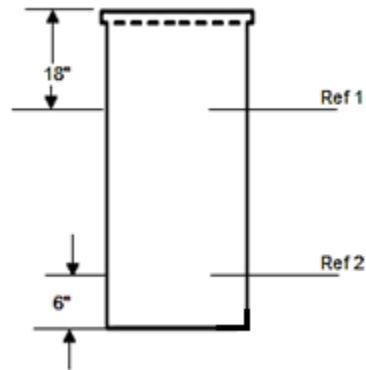
	A	B
1.	17.000	17.000
2.	17.000	17.000

#5

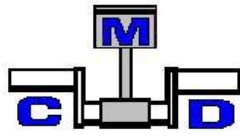
	A	B
1.	17.000	17.000
2.	17.000	17.000

#6

	A	B
1.	17.000	17.000
2.	17.000	17.000



A - Inboard (Exhaust side)
 B - Flywheel end



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

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PISTON MEASUREMENTS

Piston O.D. Measurements (Specification 16.975)

#1

	A	B	C	D
1.	16.980	16.980	16.980	16.979
2.	16.982	16.982	16.981	16.982

#2

	A	B	C	D
1.	16.978	16.978	16.978	16.979
2.	16.980	16.980	16.981	16.980

#3

	A	B	C	D
1.	16.979	16.979	16.979	16.979
2.	16.977	16.977	16.977	16.977

#4

	A	B	C	D
1.	16.979	16.979	16.979	16.979
2.	16.979	16.979	16.979	16.979

#5

	A	B	C	D
1.	16.979	16.979	16.979	16.979
2.	16.981	16.981	16.981	16.981

#6

	A	B	C	D
1.	16.976	16.976	16.976	16.976
2.	16.976	16.976	16.976	16.976

Piston pin bore I.D. measurements.

#1	A	B
1.	6.750	6.750
2.	6.7495	6.7495

#2	A	B
1.	6.7495	6.7495
2.	6.7495	6.7495

#3	A	B
1.	6.749	6.749

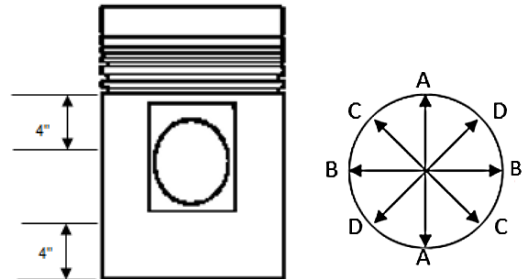
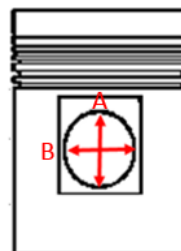
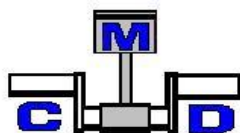


Fig. A. Side View





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2. 6.7495 6.7495

#4 A B
1. 6.750 6.750
2. 6.749 6.749

#5 A B
1. 6.749 6.749
2. 6.749 6.749

#6 A B
1. 6.7495 6.7495
2. 6.749 6.749

Piston crown O.D. measurements

#1 A B
16.878 16.879

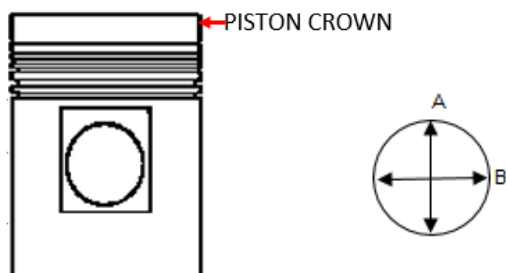
#2 A B
16.876 16.875

#3 A B
16.879 16.8795

#4 A B
16.879 16.880

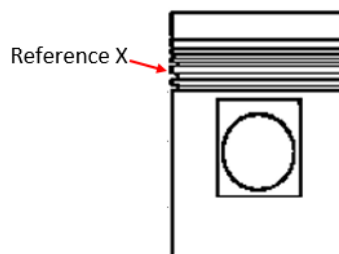
#5 A B
16.879 16.879

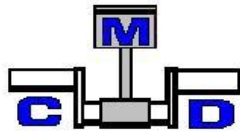
#6 A B
16.879 16.880



Piston to skirt reference 'X' (spot face) measurement.

#1. .007
#2. .005
#3. .007
#4. .006
#5. .006
#6. .007





CALIFORNIA MARINE DIESEL, INC.

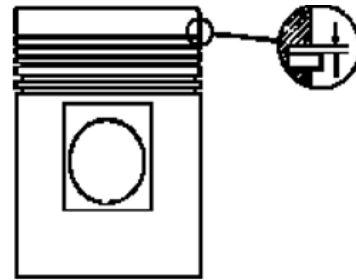
1501 WEST 15TH STREET
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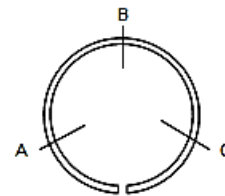
Piston ring clearances

Side clearance End clearance

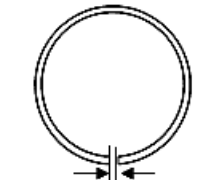
#1	A	B	C	D	
Ring 1	.009	.009	.009	.009	.072
Ring 2	.008	.008	.008	.008	.081
Ring 3	.006	.007	.007	.007	.073
Ring 4	.005	.004	.005	.005	.036
Ring 5	.004	.004	.005	.005	.036



#2					
Ring 1	.007	.008	.007	.006	.075
Ring 2	.005	.006	.006	.005	.082
Ring 3	.006	.006	.006	.006	.065
Ring 4	.004	.003	.004	.006	.036
Ring 5	.003	.003	.004	.006	.038



Location for taking side clearance



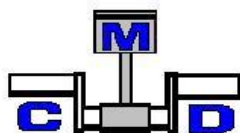
Measurement ring end gap with ring in cylinder liner bore

#3					
Ring 1	.006	.008	.007	.007	.073
Ring 2	.006	.006	.006	.006	.078
Ring 3	.005	.006	.006	.005	.058
Ring 4	.005	.006	.004	.004	.037
Ring 5	.003	.004	.004	.004	.037

#4					
Ring 1	.008	.008	.008	.008	.078
Ring 2	.006	.006	.006	.006	.077
Ring 3	.006	.006	.006	.006	.050
Ring 4	.003	.003	.004	.003	.037
Ring 5	.003	.003	.004	.003	.040

#5					
Ring 1	.007	.006	.007	.007	.065
Ring 2	.005	.005	.005	.006	.080
Ring 3	.005	.005	.006	.005	.075
Ring 4	.003	.003	.005	.003	.040
Ring 5	.003	.003	.003	.003	.040

#6					
Ring 1	.008	.008	.008	.009	.080
Ring 2	.007	.007	.007	.007	.083
Ring 3	.005	.007	.007	.006	.060
Ring 4	.003	.003	.003	.003	.042
Ring 5	.003	.003	.003	.003	.037



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1501 WEST 15TH STREET

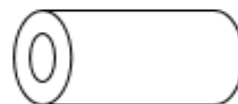
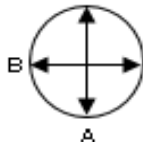
LONG BEACH, CA 90813

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Piston pin O.D. measurement

(Specification: 6.7455 – 6.750)

#1	A	B
1.	6.746	6.746
2.	6.747	6.746
3.	6.746	6.746



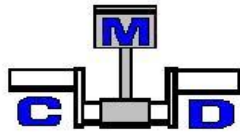
#2		
1.	6.746	6.746
2.	6.746	6.746
3.	6.746	6.7455

#3		
1.	6.747	6.746
2.	6.747	6.746
3.	6.746	6.746

#4		
1.	6.746	6.746
2.	6.746	6.746
3.	6.746	6.746

#5		
1.	6.746	6.746
2.	6.746	6.746
3.	6.746	6.745

#6		
1.	6.746	6.746
2.	6.746	6.746
3.	6.746	6.746



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
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ENGINE BASE INSPECTION

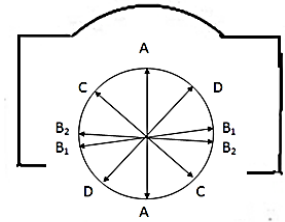
Engine Base Inspection consisted of measuring: main bearing bore concentricity; main bearing bore alignment (wire line); and engine base top surface plane (flatness) and damage.

26 April 2019 (1000 to 1300)

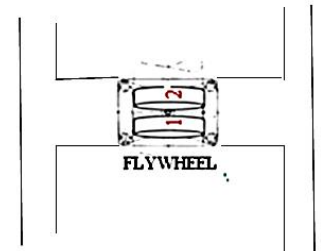
Main bearing bore concentricity measurements.

(14.250 nominal)

#1	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.250	14.250
B ₁	14.249	14.249
B ₂	14.249	14.249
C	14.251	14.251
D	14.250	14.250



#2	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.250	14.251
B ₁	14.249	14.249
B ₂	14.249	14.2495
C	14.250	14.250
D	14.250	14.250

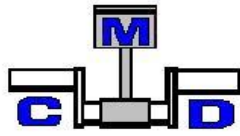


#3	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.2505	14.251
B ₁	14.2505	14.251
B ₂	14.249	14.249
C	14.2505	14.250
D	14.251	14.251

#4	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.252	14.251
B ₁	14.250	14.250
B ₂	14.250	14.250
C	14.251	14.2505
D	14.2505	14.2505

#5	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.250	14.251
B ₁	14.2515	14.2515
B ₂	14.250	14.251
C	14.250	14.2507
D	14.250	14.2507

#6	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.252	14.2525
B ₁	14.251	14.251
B ₂	14.249	14.250
C	14.252	14.251
D	14.251	14.2515



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#7	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.252	14.252
B ₁	14.2515	14.252
B ₂	14.250	14.250
C	14.252	14.252
D	14.251	14.2505

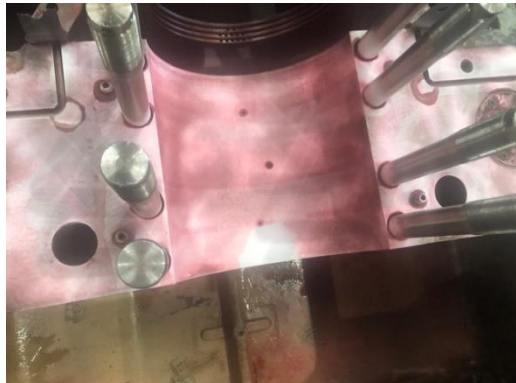
#8	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.2515	14.2515
B ₁	14.2515	14.252
B ₂	14.250	14.250
C	14.252	14.252
D	14.251	14.2505

#9	Flywheel side of bearing bore	Engine front side of bearing bore
A	14.2515	14.2515
B ₁	14.251	14.251
B ₂	14.2515	14.2515
C	14.2515	14.251
D	14.2515	14.251

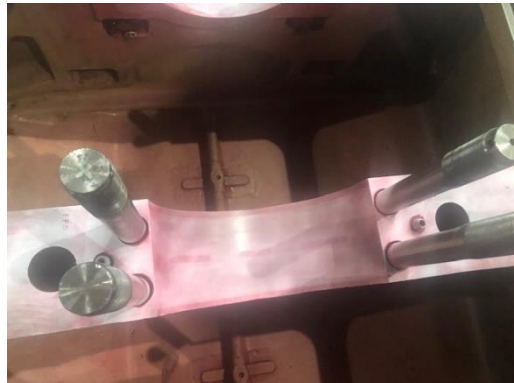
Engine base Inspection.

Engine base inspection was provided by Goltens (Miami, FL) consisting of laser planar alignment and measurement of main bearing bores. Initial determination was the planar alignment (flatness) of the base (bedplate was within tolerance. Laser measurements found a maximum deviation of .003 on the outer wall at #7 with .002 at #6 inner near the main bearing cap (the tie bolt hole). Die penetrant inspection of the main bearing caps and main bearing bore (saddle) was made with no notable discrepancies found (no cracks or surface chips).

#8 and #9

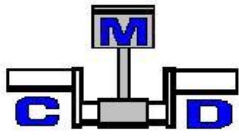


#6



#5

#7



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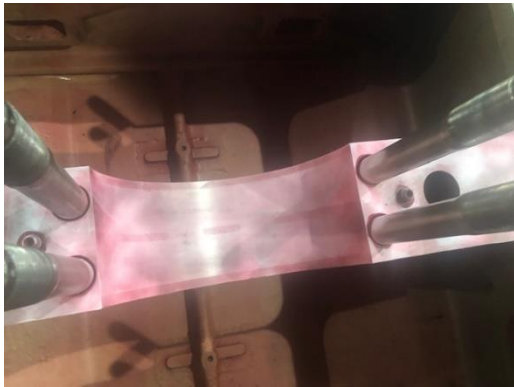
PHONE: (562) 491-5665 • FAX: (562) 491-7505



3



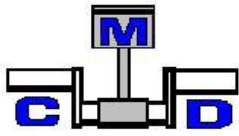
#1 and #2



#4



Main bearing caps



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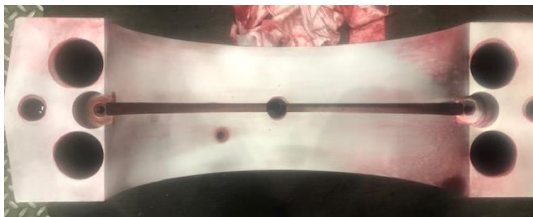
#1



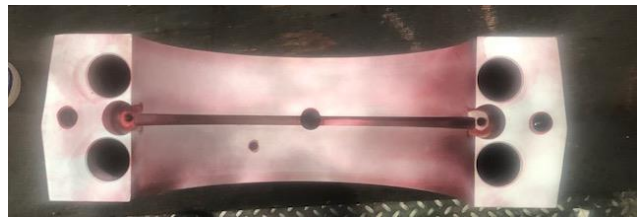
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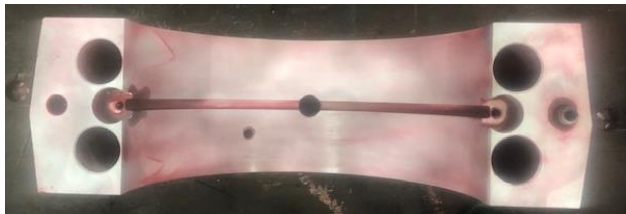
#3



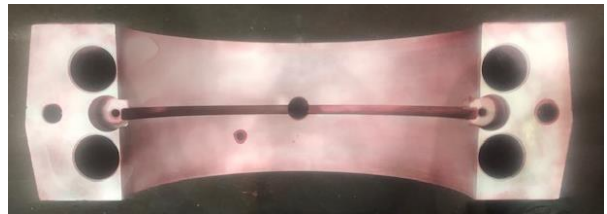
#4



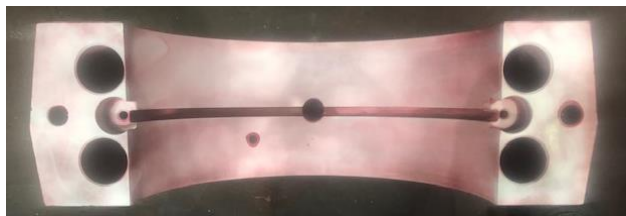
#5



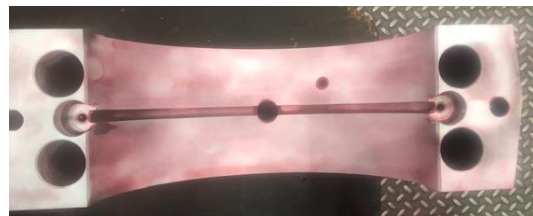
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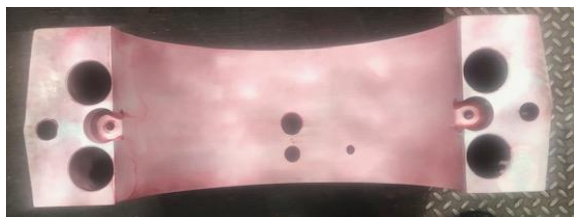
#7



#8



#9





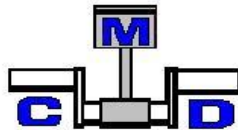
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Fretting was found on the outside of the 'o'ring seal area on the bed plate. Areas were checked with a straight edge and machinist level.





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	Goltens Service Company Inc 101025 USA Today Way Miramar, Florida 33025 +1.305.576.4410	Goltens Houston 7214 Clinton Drive Houston, Texas 77020 +1.713.487.4900	Doc No: GSM-WF-30-11	Doc Title: Foundation Flatness Report	Rev. No.: 0
--	---	---	--------------------------------	---	-----------------------

VSL / Customer:	CALIFORNIA MARINE DIESEL	Work Order No:	RSO 282-30	Executed By:	STEPHAN MILANOVICH
Make: ENTERPRISE	Type: DGSR-46	Serial Number:	82004-3063	Date:	4/30/19

BLOCK

		FWD X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	AFT X13	FLYWHEEL
RIGHT BANK	OUTBOARD														
	INBOARD														
LEFT BANK	INBOARD														
	OUTBOARD														
DISTANCE FROM AFT (mm)															

BED PLATE

		FWD X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	AFT X13	FLYWHEEL
RIGHT BANK	OUTBOARD	0	-03	-06	-09	-08	-04	0							
	INBOARD														
LEFT BANK	INBOARD														
	OUTBOARD	0	0	-05	-07	-06	-03	0							
DISTANCE FROM AFT (mm)															

REMARKS

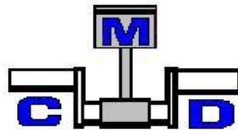
X1=0
 X2=600MM FROM X1 THE LEFT AND THE RIGHT SIDE OF THE ENGINE IS DETERMINED BY LOOKING AT THE ENGINE FROM THE GENERATOR
 X3=1200MM FROM X1 SIDE.
 X4=1800MM FROM X1
 X5=2400MM FROM X1
 X6=3000MM FROM X1 *Straightness Measurements were taken in a line straight down block mating surface.
 X7=3600MM FROM X1

Tool: Easy Lsaser receiver using D22 flatness laser	S/N: 21278	Date Cal.: 7/1/17
Tool:	S/N:	Date Cal.:

Uncontrolled after Printing

Attn: Check for latest revision at G Drive before use

GSMWF3011\TM\REV0\10JUL18



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	Goltens Service Company Inc 101025 USA Today Way Miramar, Florida 33025 +1.305.576.4410	Goltens Houston 7214 Clinton Drive Houston, Texas 77020 +1.713.487.4900	Doc No: GSM-WF-30-04	Doc Title: Main Journal Pocket Calibration Report	Rev. No.: 3
--	---	---	-------------------------	---	----------------

VSL / Customer:	CALIFORNIA MARINE DIESEL	Work Order No:	RSO 282-30	Executed By:	STEPHAN MILANOVICH
Make:	ENTERPRISE	Type:	DGSR-46	Serial Number:	82004-3063
				Date:	4/30/19

No. of Cylinders:
 Counted From ☒ Free End ☐ Fly Wheel

Bearing Shell: ☐ IN ☒ OUT

Units: 1/100 mm

	Pocket	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	
Straightness	V-V	0	0	-.02	-.01	.01	-.03	-.04	-.01	0	
	H-H	0	.01	.02	.06	.01	.07	.04	.01	0	
Center Circle	Pocket	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	
	V-V	0	1	1	2	2	0	-1	1	0	
	H-H	0	-3	-3	-1	2	5	7	4	0	

Tool: Easy Laser Bore alignment Laser	S/N: 29956	Date Cal.: July 2017
---------------------------------------	------------	----------------------

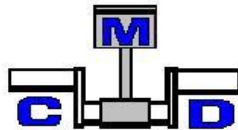
Pocket	No1		No2		No3		No4		No5		No6		No7		No8		No9	
POS	FWD	AFT	FWD	AFT	FWD	AFT	FWD	AFT	FWD	AFT	FWD	AFT	FWD	AFT	FWD	AFT	FWD	AFT
A	14.250	14.249	14.250	14.250	14.2515	14.2505	14.251	14.252	14.2515	14.2505	14.2525	14.252	14.252	14.252	14.2515	14.2515	14.252	14.2515
T	14.251	14.251	14.250	14.249	14.2505	14.250	14.2495	14.249	14.2515	14.251	14.2505	14.2505	14.252	14.2515	14.2525	14.252	14.2515	14.2505
C	14.248	14.248	14.250	14.249	14.2495	14.249	14.2505	14.2495	14.2505	14.250	14.250	14.249	14.249	14.2495	14.2495	14.250	14.2505	14.2505

Tool:	S/N:	Date Cal.:
-------	------	------------

Remarks

-The main bearing pocket bore size was measured in inches

-The laser alignment checks were done in metric units----- all measurements in 1/100ths of a mm.



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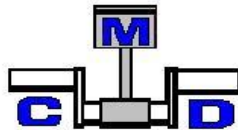
PHONE: (562) 491-5665 • FAX: (562) 491-7505

		Goltens Service Company Inc 10125 USA Today Way Miramar, Florida 33025 +1.305.576.4410		Goltens Houston 7214 Clinton Drive Houston, Texas 77020 +1.713.487.4900		Doc. No: GSM-WF-30-25		Doc. Title: Main Journal Calibration Report		Rev. No.: 0	
VSL / Customer:		DELAVAL ENTERPRISE		Work Order No:		RSO286-30		Executed By:		JOAO RAMIREZ	
Make:		Enterprise		Type:				Serial Number:		Date:	
Counted From: ☐ ← FLYWHEEL / FREE END → ☒											
Nominal OD:		330.20		Before Machining		☐		After Machining		☐	
				Before Polishing		☐		After Polishing		☐	
MJ: 1	1	2	3	4	5	MJ: 2	1	2	3	4	5
A	330.18	330.18	330.18	330.18	330.17	A	330.17	330.17	330.17	330.17	330.17
B	330.18	330.18	330.18	330.18	330.18	B	330.18	330.17	330.17	330.17	330.17
C	330.18	330.18	330.17	330.17	330.18	C	330.18	330.18	330.17	330.17	330.17
D	330.18	330.18	330.17	330.18	330.18	D	330.17	330.17	330.17	330.17	330.17
MJ: 3	1	2	3	4	5	MJ: 4	1	2	3	4	5
A	330.18	330.18	330.18	330.18	330.17	A	330.17	330.17	330.17	330.17	330.17
B	330.18	330.18	330.18	330.17	330.18	B	330.17	330.17	330.17	330.17	330.18
C	330.18	330.18	330.17	330.18	330.18	C	330.17	330.17	330.18	330.18	330.18
D	330.17	330.17	330.18	330.18	330.18	D	330.18	330.17	330.17	330.17	330.17
Remarks											
all main journals were polished by machine and were impossible to remove all watermarks from the surface only through the polishing.											
Tool:		mitutoyo 325-350mm		S/N:		62000219		Date Cal.:		9/12/18	
Tool:				S/N:				Date Cal.:			
Tool:				S/N:				Date Cal.:			

Uncontrolled after Printing

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GSMWF3025/TM/REV0/10JUL18



CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813

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		Goltens Service Company Inc 10125 USA Today Way Miramar, Florida 33025 +1.305.576.4410		Goltens Houston 7214 Clinton Drive Houston, Texas 77020 +1.713.487.4900		Doc. No: GSM-WF-30-25		Doc. Title: Main Journal Calibration Report		Rev. No.: 0	
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VSL / Customer:		DELAVAL ENTERPRISE		Work Order No:		RSO286-40		Executed By:		JOAO RAMIREZ	
Make:		Type:		Serial Number:		Date:					

Counted From: ☐ ← FLYWHEEL / FREE END → ☒

Nominal OD:		330.20		Before Machining		After Machining		Before Polishing		After Polishing	
-------------	--	--------	--	------------------	--	-----------------	--	------------------	--	-----------------	--

MJ: 5	1	2	3	4	5
A	330.17	330.17	330.17	330.17	330.17
B	330.18	330.18	330.17	330.17	330.17
C	330.17	330.17	330.17	330.18	330.18
D	330.18	330.17	330.17	330.17	330.17

MJ: 6	1	2	3	4	5
A	330.18	330.18	330.17	330.18	330.18
B	330.18	330.18	330.18	330.18	330.18
C	330.18	330.17	330.18	330.18	330.18
D	330.18	330.18	330.18	330.18	330.18

MJ: 7	1	2	3	4	5
A	330.17	330.17	330.17	330.16	330.16
B	330.17	330.17	330.16	330.17	330.17
C	330.17	330.17	330.17	330.17	330.17
D	330.17	330.17	330.17	330.17	330.17

MJ: 8	1	2	3	4	5
A	330.18	330.17	330.17	330.17	330.17
B	330.17	330.17	330.17	330.17	330.17
C	330.18	330.17	330.17	330.17	330.17
D	330.17	330.16	330.17	330.17	330.17

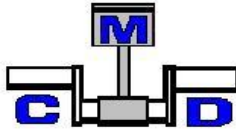
Remarks

all main journals were polished by machine and were impossible to remove all watermarks from the surface only through the polishing.

Tool: mitutoyo 325-350mm		S/N: 62000219		Date Cal.: 9/12/18	
Tool:		S/N:		Date Cal.:	
Tool:		S/N:		Date Cal.:	

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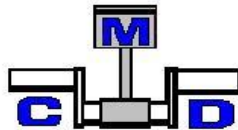
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		Goltens Service Company Inc 10125 USA Today Way Miramar, Florida 33025 +1.305.576.4410		Goltens Houston 7214 Clinton Drive Houston, Texas 77020 +1.713.487.4900		Doc. No: GSM-WF-30-26		Doc. Title: Crankpin Calibration Report		Rev. No.: 0	
VSL / Customer:		DELAVAL ENTERPRISE		Work Order No:		RSO286-30		Executed By:		JOAO RAMIREZ	
Make:		Type:		Serial Number:				Date:		6/4/19	
Counted From: ☐ ← FLYWHEEL / FREE END → ☒											
Nominal OD:		279.44MM		Before Machining		☐		After Machining		☐	
Nominal Web (Z):				Before Polishing		☐		After Polishing		☒	
CP: 1	1	2	3	4	5	CP: 2	1	2	3	4	5
A	279.41	279.41	279.41	279.41	279.42	A	279.38	279.38	279.38	279.38	279.38
B	279.41	279.42	279.41	279.41	279.41	B	279.38	279.38	279.39	279.38	279.38
C	279.41	279.41	279.42	279.42	279.41	C	279.38	279.37	279.38	279.38	279.38
D	279.41	279.41	279.41	279.41	279.41	D	279.38	279.38	279.38	279.38	279.38
CP: 3	1	2	3	4	5	CP: 4	1	2	3	4	5
A	279.38	279.38	279.38	279.38	279.39	A	279.39	279.38	279.38	279.38	279.38
B	279.38	279.38	279.38	279.39	279.38	B	279.38	279.38	279.38	279.37	279.38
C	279.38	279.38	279.38	279.38	279.37	C	279.38	279.38	279.38	279.38	279.38
D	279.37	279.38	279.38	279.37	279.38	D	279.37	279.37	279.38	279.38	279.38
Remarks											
all crank pin journals were polished by machine and were impossible to remove all watermarks from the surface only through the polishing.											
Tool:	mitutoyo 275-300mm			S/N:	1 1010			Date Cal.:	9/12/18		
Tool:				S/N:				Date Cal.:			
Tool:				S/N:				Date Cal.:			

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Goltens Service Company Inc 10125 USA Today Way Miramar, Florida 33025 +1.305.576.4410		Goltens Houston 7214 Clinton Drive Houston, Texas 77020 +1.713.487.4900		Doc. No: GSM-WF-30-26		Doc. Title: Crankpin Calibration Report		Rev. No.: 0	
VSL / Customer:		DELAVAL ENTERPRISE		Work Order No:		RSO286-30		Executed By:	
Make:		Type:		Serial Number:		Date:		6/4/19	

Counted From: ☐ ← FLYWHEEL / FREE END → ☒

Nominal OD:	279.44	Before Machining	☐	After Machining	☐	Before Polishing	☐	After Polishing	☒
Nominal Web (Z)									

CP: 5	1	2	3	4	5
A	279.38	279.39	279.38	279.38	279.38
B	279.38	279.38	279.38	279.38	279.38
C	279.38	279.38	279.37	279.38	279.38
D	279.38	279.38	279.38	279.38	279.38

CP: 6	1	2	3	4	5
A	279.39	279.39	279.39	270.39	279.38
B	279.38	279.39	279.39	279.39	279.39
C	279.39	279.39	279.39	279.39	279.38
D	279.39	279.38	279.38	279.38	279.38

CP:	1	2	3	4	5
A					
B					
C					
D					

CP:	1	2	3	4	5
A					
B					
C					
D					

Remarks

all crank pin journals were polished by machine and were impossible to remove all watermarks from the surface only through the polishing.

Tool:	mitutoyo 275-300mm	S/N:	1 1010	Date Cal.:	9/12/18
Tool:		S/N:		Date Cal.:	
Tool:		S/N:		Date Cal.:	

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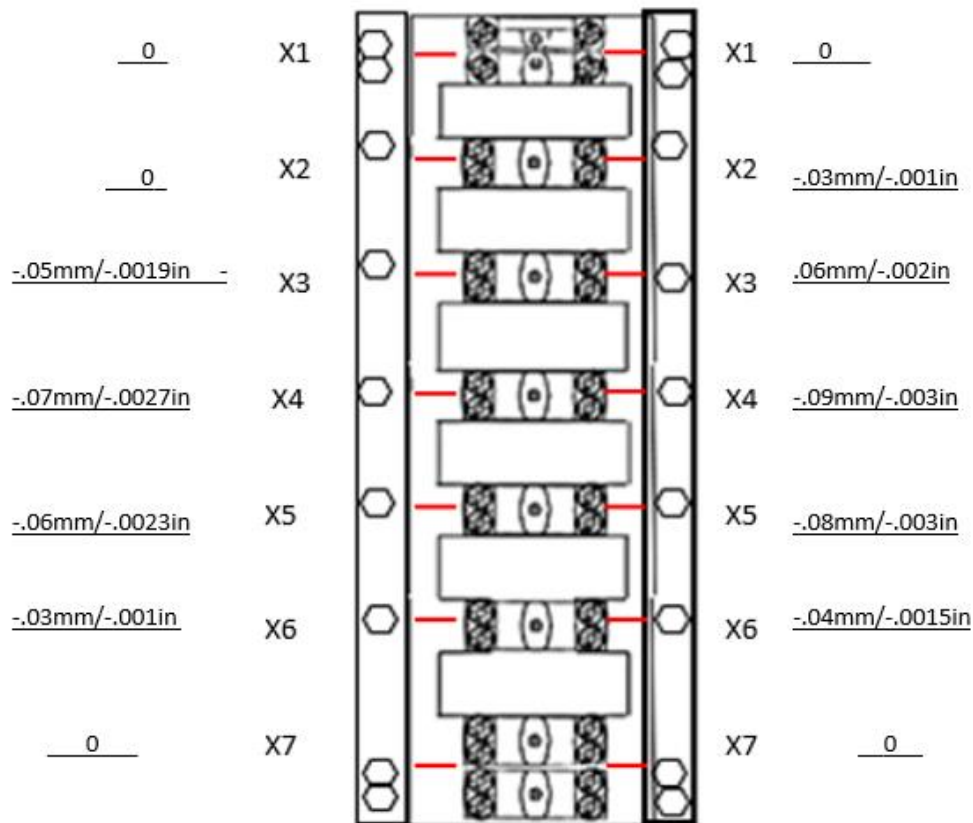
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GOLTENS ENGINE BASE FLATNESS MEASUREMENTS.

Engine base measurements were provided using an East Lssr receiver using D22 flatness laser.

Measuring distance intervals were placed at 600 mm (23.62 in) ½ inch toward center of the main bearing bores over the corresponding foundation bolt. Measurements were made centerline to the main bearings on left and right sides of the base. Measurements were taken following the soft foot inspection of 2 April 2019.



Positions X1 and X7 are the locations of the laser and receiver, measurements are 0 for each end.

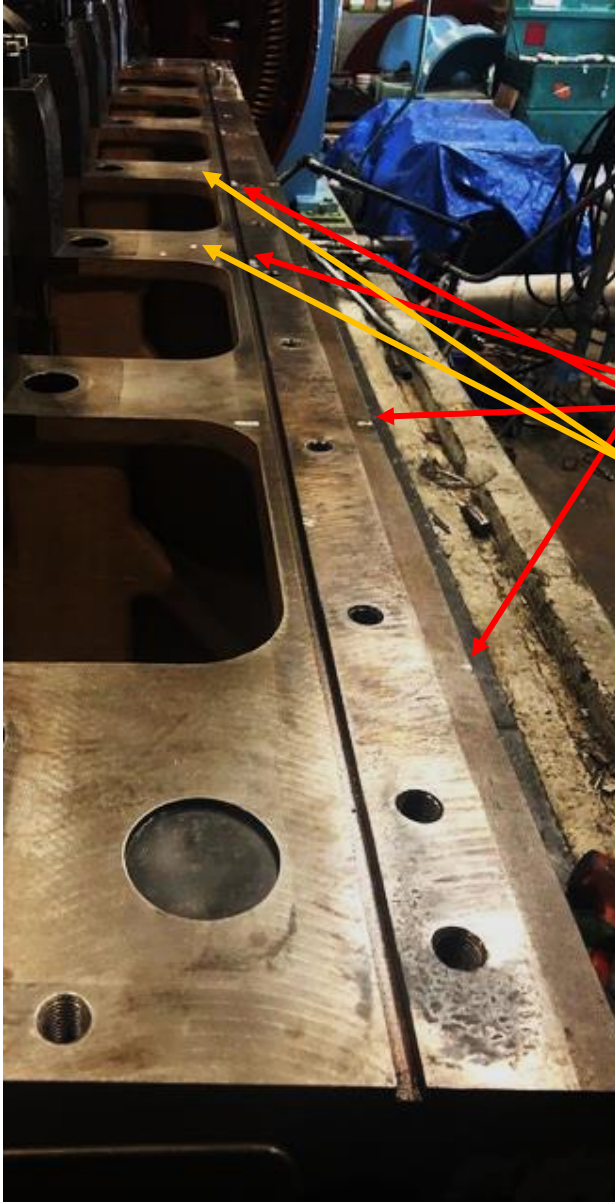


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LEFT BANK INTERVAL POINTS 600 mm (23.62 in)



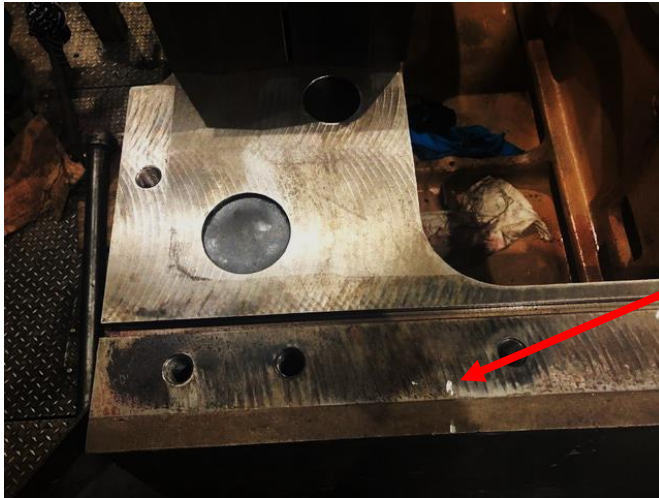
Engine base left bank interval reference points (paint marker points) at 600 mm (23.62 in) intervals from front of base. Flatness measurements set interval points is provided at centerline of the main bearings.



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Left bank #1 and #2 main bearing
initial point set over foundation bolt and centered
on #1 crankpin (crankshaft is out) for 24 in
cylinder center.

RIGHT BANK INTERVAL POINTS 600mm (23.622 in)



Engine base right bank interval points
(paint marker points) at 600 mm (23.622 in) set center line to main
bearings.

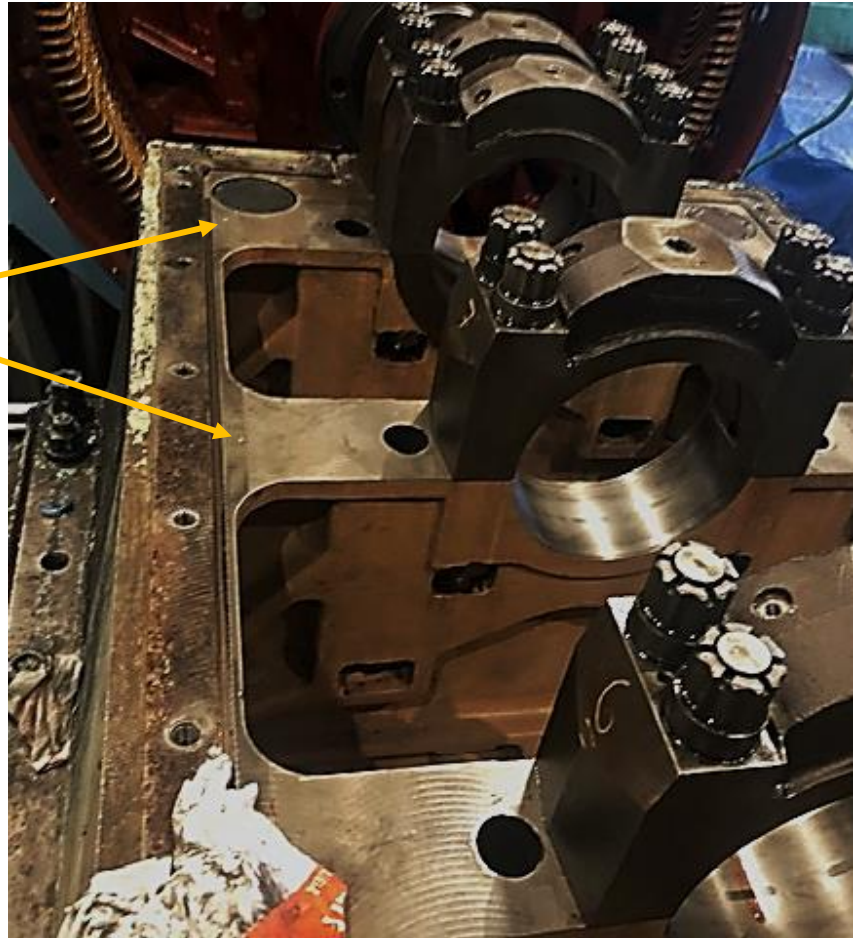


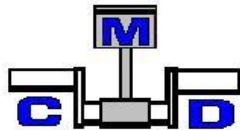
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Right bank rear interval points
(paint marker points) 600 mm
(23.62 in) set centerline to
main bearings.





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GOLTENS ENGINE BASE INSPECTION

Provided are the Goltens Miami Engine Base Inspection Report

.01 mm=.000394 in (Measurements are flatness deviations.) (- (minus) is below laser line plane)

Main bearing location

Right Bank (viewed from flywheel end)

#1 & #2 0
 #3 -.03mm = -.0011 in
 #4 -.06mm = -.0023 in
 #5 -.09mm = -.0035 in
 #6 -.08mm = -.0031 in
 #7 -.04mm = -.0015 in
 #8 & #9 0

Left Bank (viewed from flywheel end)

#1 & #2 0
 #3 0
 #4 -.05mm = -.0019 in
 #5 -.07mm = -.0027 in
 #6 -.06mm = -.0023 in
 #7 -.03mm = -.0011 in
 #8 & #9 0

		BED PLATE													FLYWHEEL
		FWD X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	AFT X13	
RIGHT BANK	OUTBOARD	0	-.03	-.06	-.09	-.08	-.04	0							
	INBOARD														
LEFT BANK	INBOARD														
	OUTBOARD	0	0	-.05	-.07	-.06	-.03	0							
DISTANCE FROM AFT (mm)														0	

REMARKS

X1=0
 X2=600MM FROM X1 THE LEFT AND THE RIGHT SIDE OF THE ENGINE IS DETERMINED BY LOOKING AT THE ENGINE FROM THE GENERATOR
 X3=1200MM FROM X1 SIDE.
 X4=1800MM FROM X1
 X5=2400MM FROM X1
 X6=3000MM FROM X1 *Straightness Measurements were taken in a line straight down block mating surface.
 X7=3600MM FROM X1

Tool: Easy Lsser receiver using D22 flatness laser	S/N: 21278	Date Cal.: 7/1/17
Tool:	S/N:	Date Cal.:

Goltens Laser alignment Check of main bearing bores. (measured from free end (oil pump side))
 (Main bearing caps tightened to 2150 ftlb)



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Laser Alignment Check											
Straightness	Pocket	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	
	V-V	0	0	-.02	-.01	.01	-.03	-.04	-.01	0	
	H-H	0	.01	.02	.06	.01	.07	.04	.01	0	
Center Circle	Pocket	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	
	V-V	0	1	1	2	2	0	-1	1	0	
	H-H	0	-3	-3	-1	2	5	7	4	0	
Tool: Easy Laser Bore alignment Laser				S/N: 29956				Date Cal.: July 2017			

.01 mm = .000394 in

Straightness (deviation of cap and bore from edge to edge using #1 and #9 as base line (0))

Main bearing cap location

	Vertical	Horizontal
#1	0	0
#2	0	.01mm = .0004 in
#3	-.02mm = .0007 in	.02mm = .0007 in
#4	-.01mm = .0004 in	.06mm = .0023in
#5	.01mm = .0004 in	.01mm = .0004 in
#6	-.03mm = .0011 in	.07mm = .0027 in
#7	-.04mm = .0015 in	.04mm = .0015 in
#8	-.01mm = .0004 in	.01mm = .0004 in
#9	0	0

Centerline of circle (measured center of bore from end to end using #1 and #9 and baseline (0))

Main bearing cap location

	Vertical	Horizontal
#1	0	0
#2	.01mm = .0004 in	-.03mm = -.0011 in
#3	.01mm = .0004 in	-.03mm = -.0011 in
#4	.02mm = .0007 in	-.01mm = -.0004in
#5	.02mm = .0007 in	.02mm = .0007 in
#6	0	.05mm = .0019 in
#7	-.01mm = -.0004 in	.07mm = .0027 in
#8	.01mm = .0004 in	.04mm = .0015 in
#9	0	0

Goltens main bearing bore I.D. measurements.

(Measurements are from free end (oil pump end). (Measurements are inch)

Main Bearing Pocket Bore Size																				
Pocket		No1																		
POS	FWD	AFT	FWD	AFT	FWD	AFT	FWD	AFT	FWD	AFT	FWD	AFT	FWD	AFT	FWD	AFT	FWD	AFT		
A	14.250	14.249	14.250	14.250	14.2515	14.2505	14.251	14.252	14.2515	14.2505	14.2525	14.252	14.252	14.2515	14.2515	14.252	14.2515			
T	14.251	14.251	14.250	14.249	14.2505	14.250	14.2495	14.249	14.2515	14.251	14.2505	14.2505	14.252	14.2515	14.2525	14.252	14.2515	14.2505		
C	14.248	14.248	14.250	14.249	14.2495	14.249	14.2505	14.2495	14.2505	14.250	14.250	14.249	14.249	14.2495	14.2495	14.250	14.2505	14.2505		
Tool:						S/N:										Date Cal.:				

T- Vertical

A - Intake diagonal

C - Exhaust diagonal



Main bearing position

#1

Forward	Aft
A 14.250	14.249



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T 14.251	14.251
C 14.248	14.248

#2

	Forward	Aft
A 14.250		14.240
T 14.250		14.249
C 14.250		14.249

#3

	Forward	Aft
A 14.2515		14.2505
T 14.2505		14.250
C 14.2495		14.249

#4

	Forward	Aft
A 14.251		14.252
T 14.2495		14.249
C 14.2505		14.2495

#5

	Forward	Aft
A 14.2515		14.2505
T 14.2515		14.251
C 14.2505		14.250

#6

	Forward	Aft
A 14.2525		14.252
T 14.2505		14.2505
C 14.250		14.249

#7

	Forward	Aft
A 14.252		14.252
T 14.252		14.2515
C 14.249		14.2495

#8

	Forward	Aft
A 14.2515		14.2515
T 14.2525		14.252
C 14.2495		14.250

#9

	Forward	Aft
A 14.252		14.2515
T 14.2515		14.2505
C 14.2505		14.2505



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GOLTENS CRANKSHAFT MEASUREMENTS.

Main journals (measured from free end (oil pump end))

Counted From: ☐ ← FLYWHEEL / FREE END → ☒	
Nominal OD: 330.20	Before Machining ☐ After Machining ☐ Before Polishing ☐ After Polishing ☐

MJ: 1	1	2	3	4	5
A	330.18	330.18	330.18	330.18	330.17
B	330.18	330.18	330.18	330.18	330.18
C	330.18	330.18	330.17	330.17	330.18
D	330.18	330.18	330.17	330.18	330.18

MJ: 2	1	2	3	4	5
A	330.17	330.17	330.17	330.17	330.17
B	330.18	330.17	330.17	330.17	330.17
C	330.18	330.18	330.17	330.17	330.17
D	330.17	330.17	330.17	330.17	330.17

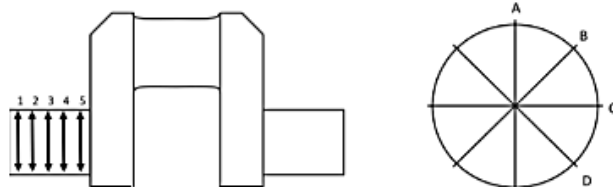
MJ: 3	1	2	3	4	5
A	330.18	330.18	330.18	330.18	330.17
B	330.18	330.18	330.18	330.17	330.18
C	330.18	330.18	330.17	330.18	330.18
D	330.17	330.17	330.18	330.18	330.18

MJ: 4	1	2	3	4	5
A	330.17	330.17	330.17	330.17	330.17
B	330.17	330.17	330.17	330.17	330.18
C	330.17	330.17	330.18	330.18	330.18
D	330.18	330.17	330.17	330.17	330.17

Remarks

all main journals were polished by machine and were impossible to remove all watermarks from the surface only through the polishing.

1 mm = 0.0393 in 330.20mm = 13.000 in
Main journal position 1- 4 (1 – 5 counting small main bearings #1 and #2 as #1 main journal)



#1 & #2

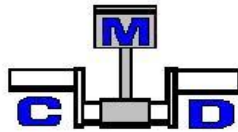
	A	B		
C			D	
1.	330.18mm =12.999 in	330.18mm =12.999 in	330.18mm =12.999 in	330.18mm =12.999 in
2.	330.18mm =12.999 in	330.18mm =12.999 in	330.18mm =12.999 in	330.18mm =12.999 in
3.	330.18mm =12.999 in	330.18mm =12.999 in	330.17mm =12.998 in	330.17mm =12.998 in
4.	330.18mm =12.999 in	330.18mm =12.999 in	330.17mm =12.998 in	330.18mm =12.999 in
5.	330.17mm =12.998 in	330.18mm =12.999 in	330.18mm =12.999 in	330.18mm =12.999 in

#3

	A	B	C	D
1.	330.17mm =12.998 in	330.18mm =12.999 in	330.18mm =12.999 in	330.17mm =12.998 in
2.	330.17mm =12.998 in	330.17mm =12.998 in	330.18mm =12.999 in	330.17mm =12.998 in
3.	330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in
4.	330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in
5.	330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in

#4

	A	B	C	D
1.	330.18mm =12.999 in	330.18mm =12.999 in	330.18mm =12.999 in	330.17mm =12.998 in
2.	330.18mm =12.999 in	330.18mm =12.999 in	330.18mm =12.999 in	330.17mm =12.998 in



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3. 330.18mm =12.999 in 330.18mm =12.999 in 330.17mm =12.998 in 330.18mm =12.999 in
4. 330.18mm =12.999 in 330.17mm =12.998 in 330.18mm =12.999 in 330.18mm =12.999 in
5. 330.17mm =12.998 in 330.18mm =12.999 in 330.18mm =12.999 in 330.18mm =12.999 in

#5

- | | A | B | C | D |
|----|---------------------|---------------------|---------------------|---------------------|
| 1. | 330.17mm =12.998 in | 330.17mm =12.998 in | 330.17mm =12.998 in | 330.18mm =12.999 in |
| 2. | 330.17mm =12.998 in | 330.17mm =12.998 in | 330.17mm =12.998 in | 330.17mm =12.998 in |
| 3. | 330.17mm =12.998 in | 330.17mm =12.998 in | 330.18mm =12.999 in | 330.17mm =12.998 in |
| 4. | 330.17mm =12.998 in | 330.17mm =12.998 in | 330.18mm =12.999 in | 330.17mm =12.998 in |
| 5. | 330.17mm =12.998 in | 330.18mm =12.999 in | 330.18mm =12.999 in | 330.17mm =12.998 in |

Counted From: ☐ ← FLYWHEEL / FREE END → ☒

Nominal OD: 330.20	Before Machining ☐	After Machining ☐	Before Polishing ☐	After Polishing ☐
---------------------------	---	--	---	--

MJ: 5	1	2	3	4	5
A	330.17	330.17	330.17	330.17	330.17
B	330.18	330.18	330.17	330.17	330.17
C	330.17	330.17	330.17	330.18	330.18
D	330.18	330.17	330.17	330.17	330.17

MJ: 6	1	2	3	4	5
A	330.18	330.18	330.17	330.18	330.18
B	330.18	330.18	330.18	330.18	330.18
C	330.18	330.17	330.18	330.18	330.18
D	330.18	330.18	330.18	330.18	330.18

MJ: 7	1	2	3	4	5
A	330.17	330.17	330.17	330.16	330.16
B	330.17	330.17	330.16	330.17	330.17
C	330.17	330.17	330.17	330.17	330.17
D	330.17	330.17	330.17	330.17	330.17

MJ: 8	1	2	3	4	5
A	330.18	330.17	330.17	330.17	330.17
B	330.17	330.17	330.17	330.17	330.17
C	330.18	330.17	330.17	330.17	330.17
D	330.17	330.16	330.17	330.17	330.17

Remarks

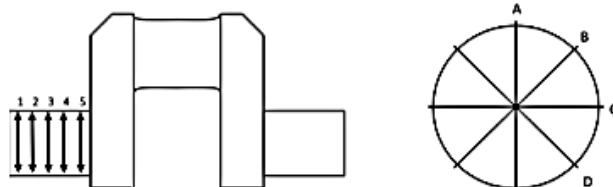
all main journals were polished by machine and were impossible to remove all watermarks from the surface only through the polishing.

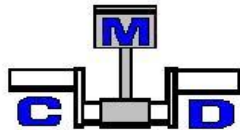
1mm = .0393 in 330.20mm = 13.000 in

Main journal position 5 – 8 (6 – 9 using intermediate size bearings).

#6

- | | A | B | C | D |
|----|---------------------|---------------------|---------------------|---------------------|
| 1. | 330.17mm =12.998 in | 330.18mm =12.999 in | 330.17mm =12.998 in | 330.18mm =12.999 in |
| 2. | 330.17mm =12.998 in | 330.18mm =12.999 in | 330.17mm =12.998 in | 330.17mm =12.998 in |
| 3. | 330.17mm =12.998 in | 330.17mm =12.998 in | 330.17mm =12.998 in | 330.17mm =12.998 in |
| 4. | 330.17mm =12.998 in | 330.17mm =12.998 in | 330.18mm =12.999 in | 330.17mm =12.998 in |
| 5. | 330.17mm =12.998 in | 330.17mm =12.998 in | 330.18mm =12.999 in | 330.17mm =12.998 in |





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#7

A	B	C	D
1. 330.18mm =12.999 in	330.18mm =12.999 in	330.18mm =12.999 in	330.18mm =12.999 in
2. 330.18mm =12.998 in	330.17mm =12.998 in	330.18mm =12.999 in	330.18mm =12.999 in
3. 330.18mm =12.999 in	330.18mm =12.999 in	330.18mm =12.999 in	330.18mm =12.999 in
4. 330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in
5. 330.18mm =12.999 in	330.18mm =12.999 in	330.18mm =12.999 in	330.18mm =12.999 in

#8

A	B	C	D
1. 330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in
2. 330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in
3. 330.17mm =12.998 in	330.16mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in
4. 330.16mm =12.998 in	330.17mm =12.998 in	330.17mm =12.997 in	330.17mm =12.998 in
5. 330.16mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in

#9

A	B	C	D
1. 330.18mm =12.999 in	330.17mm =12.998 in	330.18mm =12.999 in	330.17mm =12.998 in
2. 330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in	330.16mm =12.998 in
3. 330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in
4. 330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in
5. 330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in	330.17mm =12.998 in

Goltens crankpin measurements.

Nominal OD:	279.44MM	Before Machining	☐	After Machining	☐	Before Polishing	☐	After Polishing	☒
Nominal Web (Z):									

CP: 1	1	2	3	4	5
A	279.41	279.41	279.41	279.41	279.42
B	279.41	279.42	279.41	279.41	279.41
C	279.41	279.41	279.42	279.42	279.41
D	279.41	279.41	279.41	279.41	279.41

CP: 2	1	2	3	4	5
A	279.38	279.38	279.38	279.38	279.38
B	279.38	279.38	279.39	279.38	279.38
C	279.38	279.37	279.38	279.38	279.38
D	279.38	279.38	279.38	279.38	279.38

CP: 3	1	2	3	4	5
A	279.38	279.38	279.38	279.38	279.39
B	279.38	279.38	279.38	279.39	279.38
C	279.38	279.38	279.38	279.38	279.37
D	279.37	279.38	279.38	279.37	279.38

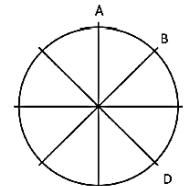
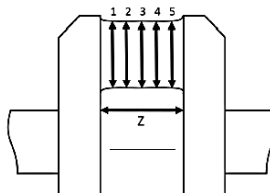
CP: 4	1	2	3	4	5
A	279.39	279.38	279.38	279.38	279.38
B	279.38	279.38	279.38	279.37	279.38
C	279.38	279.38	279.38	279.38	279.38
D	279.37	279.37	279.38	279.38	279.38

Remarks

all crank pin journals were polished by machine and were impossible to remove all watermarks from the surface only through the polishing.

1 mm = .0393 in 279.44 mm = 11.001 in
Measurements are from free end (oil pump side)

Crankpin position 1 - 4





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#1

A	B	C	D
1. 279.41mm =11.000 in	279.41mm =11.000 in	279.41mm =11.000 in	279.41mm =11.000 in
2. 279.41mm =11.000 in	279.42mm =11.001 in	279.41mm =11.000 in	279.41mm =11.000 in
3. 279.41mm =11.000 in	279.41mm =11.000 in	279.42mm =11.001 in	279.41mm =11.000 in
4. 279.41mm =11.000 in	279.41mm =11.000 in	279.42mm =11.001 in	279.41mm =11.000 in
5. 279.42mm =11.001 in	279.41mm =11.000 in	279.41mm =11.000 in	279.41mm =11.000 in

#2

A	B	C	D
1. 279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in
2. 279.38mm =10.999 in	279.38mm =10.999 in	279.37mm =10.998 in	279.38mm =10.999 in
3. 279.38mm =10.999 in	279.39mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in
4. 279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in
5. 279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in

#3

A	B	C	D
1. 279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in	279.37mm =10.998 in
2. 279.38mm =10.999 in	279.38mm =10.999 in	279.37mm =10.998 in	279.38mm =10.999 in
3. 279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in
4. 279.38mm =10.999 in	279.39mm =10.999 in	279.38mm =10.999 in	279.37mm =10.998 in
5. 279.39mm =10.999 in	279.38mm =10.999 in	279.37mm =10.998 in	279.38mm =10.999 in

#4

A	B	C	D
1. 279.39mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in	279.37mm =10.998 in
2. 279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in	279.37mm =10.998 in
3. 279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in
4. 279.38mm =10.999 in	279.37mm =10.998 in	279.38mm =10.999 in	279.38mm =10.999 in
5. 279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in



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Counted From: ☐ ← FLYWHEEL / FREE END → ☒

Nominal OD:	279.44	Before Machining	☐	After Machining	☐	Before Polishing	☐	After Polishing	☒
Nominal Web (Z):									

CP: 5	1	2	3	4	5
A	279.38	279.39	279.38	279.38	279.38
B	279.38	279.38	279.38	279.38	279.38
C	279.38	279.38	279.37	279.38	279.38
D	279.38	279.38	279.38	279.38	279.38

CP: 6	1	2	3	4	5
A	279.39	279.39	279.39	270.39	279.38
B	279.38	279.39	279.39	279.39	279.39
C	279.39	279.39	279.39	279.39	279.38
D	279.39	279.38	279.38	279.38	279.38

CP:	1	2	3	4	5
A					
B					
C					
D					

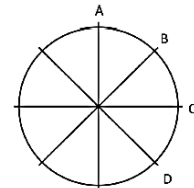
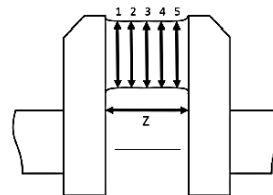
CP:	1	2	3	4	5
A					
B					
C					
D					

Remarks

all crank pin journals were polished by machine and were impossible to remove all watermarks from the surface only through the polishing.

1 mm = .0393 in 279.44 mm = 11.001 in
Measurements are from free end (oil pump side)

Crankpin position 5 - 6



#5

	A	B	C	D
1.	279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in
2.	279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in
3.	279.38mm =10.999 in	279.38mm =10.999 in	279.37mm =10.998 in	279.38mm =10.999 in
4.	279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in
5.	279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in

#6

	A	B	C	D
1.	279.39mm =10.999 in	279.38mm =10.999 in	279.39mm =10.999 in	279.39mm =10.999 in
2.	279.39mm =10.999 in	279.39mm =10.999 in	279.39mm =10.999 in	279.38mm =10.999 in
3.	279.39mm =10.999 in	279.39mm =10.999 in	279.39mm =10.999 in	279.38mm =10.999 in
4.	279.39mm =10.999 in	279.39mm =10.999 in	279.39mm =10.999 in	279.38mm =10.999 in
5.	279.38mm =10.999 in	279.39mm =10.999 in	279.38mm =10.999 in	279.38mm =10.999 in



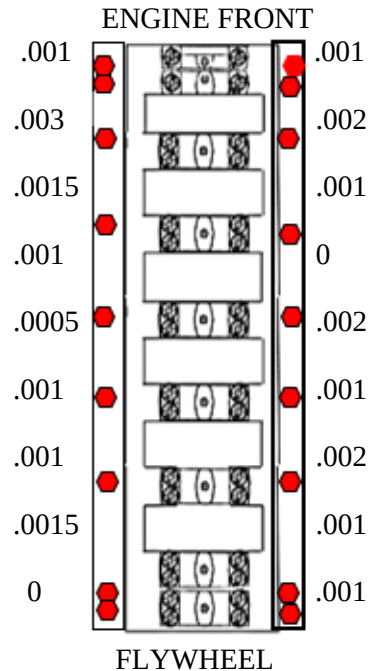
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BASE FOUNDATION SOFT FOOT INSPECTION (2 April 2019)

Foundation Soft Foot inspection is a measurement of the tightness of the base foundation bolt by loosening the foundation bolt (or nut) and measuring looseness with a dial indicator. The looseness will indicate misalignment of the base to upper block and crankshaft (a twist in the base or a planar deviation). (Smallest shim available is .002, no corrections can be made at or below .002)





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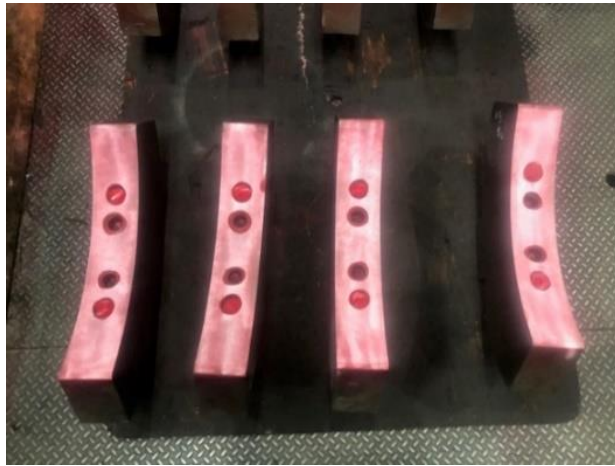
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COUNTERWEIGHT DIE PENETRANT INSPECTION

Counterweights and counterweight were removed 9-10 April 2019 to prepare the crankshaft for shipping and repair.

Die Penetrant NDT (SPOTCHECK SKC-S Aerosol (cleaner); SPOTCHECK SKL-SP2 Aerosol (penetrant); SPOTCHECK SKD-S2 Aerosol (developer). Die penetrant inspection did not find any cracks or fretting on the counterweights bases to crankshaft web shoulder. (2 counterweights per crankpin throw)





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FLYWHEEL BOLTS

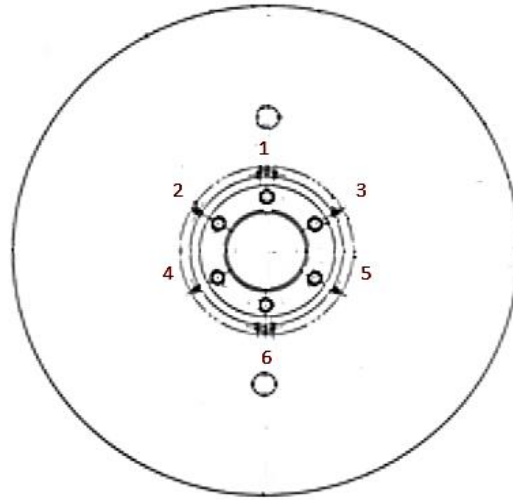
Flywheel bolt holes were opened on average .005 and cut twice; once for each time the flywheel was removed.

Bolt hole size after reaming

1. 1.877
2. 1.887
3. 1.883
4. 1.887
5. 1.884
6. 1.875

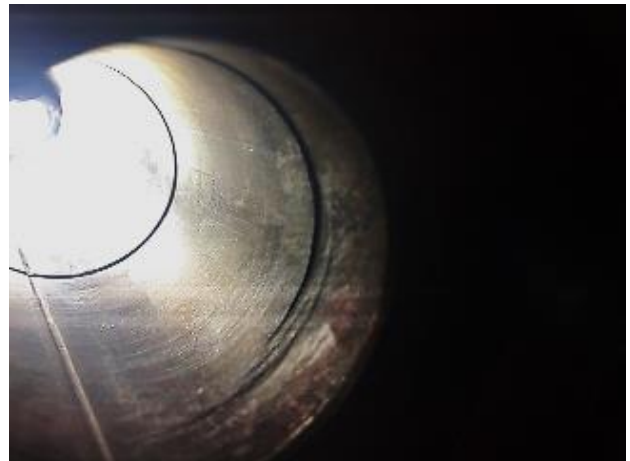
Bolt O.D. size to fit hole

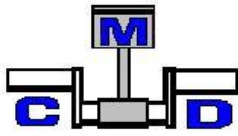
1. 1.879
2. 1.889
3. 1.885
4. 1.887
5. 1.886
6. 1.875



Old removed bolts measured 1.875 for all bolts removed.

Old bolt holes measured 1.875 except for 3 holes with steps and gouges.





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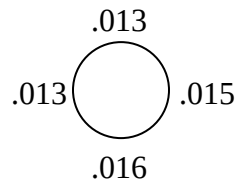
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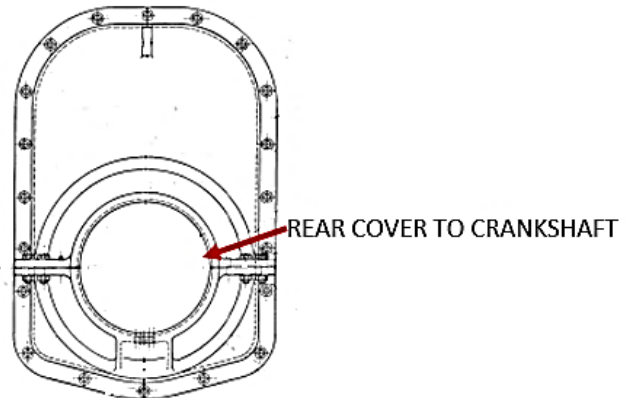
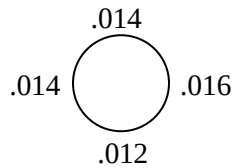
REAR COVER TO CRANKSHAFT CLEARANCE MEASUREMENTS.

Rear cover to crankshaft measurements are provided to ensure the centering of the rear cover on the crankshaft.

Rear cover to crankshaft clearance measurements. (25Sep18)



(22Jul19) Center on crankshaft (.012-.015)





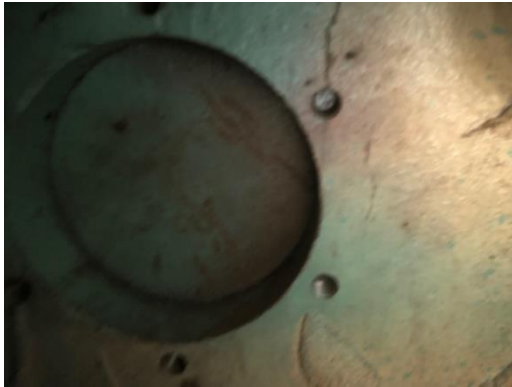
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ENGINE BEDPLATE CORE PLUG AND EXPANSION PLUG INSPECTION.

Engine bedplate core plugs (97607) (Assy drwg 03-305-04) and expansion plugs (CB-005-078) (Assy drwg 03-305-04) are located in the four corners of the bedplate as access for clean out and expansion areas during the casting process. The plugs are usually situated in a large mass and are finished to round holes at the finish of the engine milling. The core plugs and expansion plugs are inaccessible after the upper block has been installed. Expansion plugs are pressed or frozen into the front of the engine and core plugs are held in place on a gasket (97608) (Assy drwg 03-305-04) with 3/8 Allen capscrews in the rear (flywheel side) of the engine. The expansion plugs in the front of the engine are additionally sealed using a sealant.



Right bank (intake side) flywheel side core plug viewed from bottom of bedplate through access holes, no signs of oil leak.



Left bank (exhaust side) flywheel side core plug viewed from bottom of bedplate through access holes, no signs of oil leak.



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Right bank (intake side) front of engine expansion plug with overspray black paint and oil leak seen from bottom of bedplate through access holes.



Left bank (exhaust side) expansion plug engine front with paint overspray and some signs of oil leak, viewed from bottom of bedplate through access holes.



Right bank (intake side) engine front expansion plug with top filled with metal epoxy (JB Weld) to stop possible oil leaks.



Left bank (exhaust side) engine front expansion plug with top filled with metal epoxy (JB Weld) to stop possible oil leaks.



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FUEL RACK INSTALLATION AND ALIGNMENT

Fuel rack was initially put on 1 November 2019 and removed 19 March 2019 to remove crankshaft. Final installation was 16 July 2019. Work to fix tight operation started 26 July 2019. Initial attempts to loosen the fuel rack rod centered on disconnecting all brackets, thrust collars and fuel pump linkages until the fuel rack rod loosened then reconnecting until the a tight spot was found. Shimming the brackets away from the block surface indicated the fuel rack rod brackets were not the same thickness to the block. Shimming the brackets found: #2 bracket- .040; #4 no shim; #6- .080 shim. The gearcase fuel rack support could not be fit without difficulty and was cut three times for a total .275 removed (initial support base measured .630 - .639 thickness on the bottom base).

7 August 2019

The fuel rack was found to be stuck and all connections and collars were disconnected to find the tight spot. During disconnection of the fuel pump linkage it was found the air start piping was partially laying on the fuel rack rod at #2 bracket. Realignment of the fuel rack rod was done with emphasis on angling into #2 bracket to the gearcase support bracket to keep the fuel rack rod parallel to the limits of the block top.

8 August 2019

Using #6 and #2 as 2 points of a line, an ID micrometer measurement of the distance from bracket fuel rack rod to the bracket block mount base (milled area) found #6 – 3.198 and #2- 3.235; #4 had no available block surface to measure. The addition of a .040 shim at #6 bracket loosened the fuel rack to the gearcase support. Measured the bracket block surface to the fuel rack rod using a set of sliding parallels. The bracket to fuel rack rod space was remeasured; #2- 3.235; #4- 3.236; #6- 2.239 (with .040 shim added).

8 August 2019

Connected all brackets, fuel linkages and set thrust collars and gearcase support.

9 August 2019

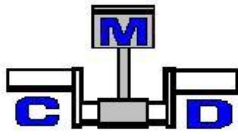
Removed .005 from #6 bracket.

10 August 2019

Set the fuel rack to 0 mm on all pumps with approximately .100 on the adjusting screw of the fuel pump linkage stop at each fuel pump.

METHODOLOGY FOR MEASURING SPACE BETWEEN FUEL RACK ROD AND BLOCK

The fuel rack rod support consists of 6 brackets and an angled support at the gearcase. 3 of the brackets carry the fuel rack rod only and have bushings. The remaining 3 brackets carry the air and gas piping and have no bushings with an approximate clearance .100 to a side for the fuel rack rod. Final assembly of the cylinder heads and fuel pumps found the fuel rack was binding and difficult to move at the governor control arm. Following several attempts to eliminate binding in the fuel rack rod bracket connections to the upper block it was determined the brackets were not the same thickness. Measuring the differences between was done by using a set of sliding parallels then measuring the sliding parallels. Measurements can also be done using a set of dividers that can be set.



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Set of sliding parallels



Measuring sliding parallels



Set of dividers





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CHANGE ORDER #20 (Crankshaft installation following refurbishment by Goltens Miami.)

Change order 20 included disassembly of the engine following Goltens crankshaft assessment. The engine had been assembled to include upper block installation and alignment, piston installation, main bearing installation and measurements, cylinder heads installation, generator rotor bolt holes reaming, exhaust installation and alignment, turbocharger installation, and camshaft installation. For the purposes of this section Change order 20 is restricted to crankshaft installation in the base and required measurements on the crankshaft including main bearing and connecting rod bearing clearances and crankshaft deflections to include unit start up. Change 20 order would encompass the disassembly of the engine and consequent reassembly to the point of completion where the disassembly began.

9-13 June 2019

9 June 2019

Detorque and remove main bearing caps from engine base. Replace bent and broken main bearing stud retaining pins.

10 June 2019

Receive and unload crankshaft from Goltens Miami. Run nuts over main bearing stud threads, clean crankcase. Remove crankshaft from crate, set on engine room floor. Clean preservative from crankshaft and measure main journals O.D. Inspect crankshaft oil passages for foreign material and blemishes to crankshaft finish (finish is nondirectional)

11 June 2019

Polish scratches left from micrometer anvil on crankshaft main journal surfaces. Recheck crankshaft oil passages for foreign material and blockages. Measure dial indicated runout on all main bearing journals with no caps in place (.001 TIR measured)

12 June 2019

Place lower main bearings in engine base. Set crankshaft in lower main bearings and measure crankshaft thrust. Set main bearing caps on base. Remove and dress #9 lower main bearing to fit main bearing cap.

13 June 2019

Torque main bearing caps; measure main bearing clearances and crankshaft deflection. Measure dial indicated runout on water pump drive shaft (.0015 TIR measured). Spray crankshaft with WD-40, wrap crankpins in rubber wrap, cover crankshaft and engine base with plastic tarp.

Crankshaft thrust. .024

(Specification. .022-.040)

Main bearing clearances.

13 June 2019

1. .010
2. .010
3. .010
4. .013
5. .011
6. .012
7. .013



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8. .012

9. .011

Connecting rod bearing clearance.

2 July 2019

1. .012

2. .009

3. .008

4. .008

5. .009

6. .009

Connecting rod thrust.

5 July 2019

1. .045 (EBMUD replacement connecting rod from 2009)

2. .019

3. .018

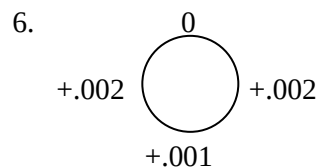
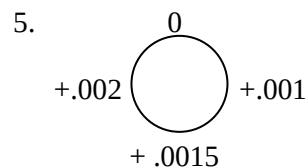
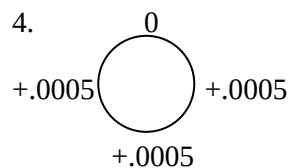
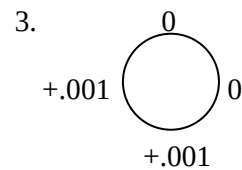
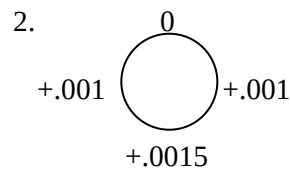
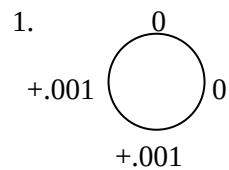
4. .018

5. .017

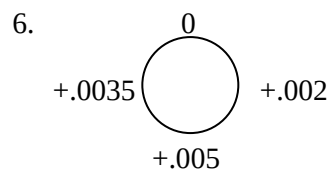
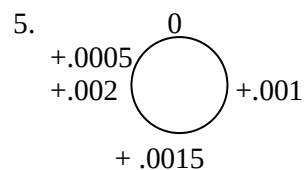
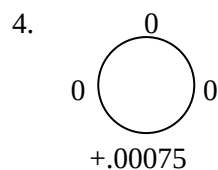
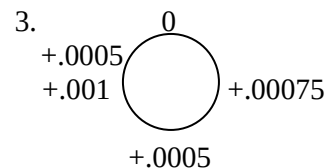
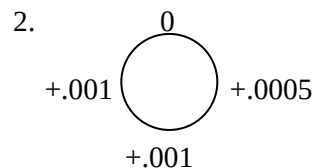
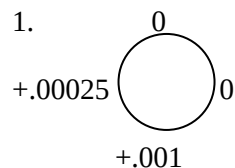
6. .021

Crankshaft deflection. 13 June 2019

(less counterweights, less upper block)



Crankshaft deflection. 28 June 2019 (flywheel, rotor connected, outboard bearing reassembled)





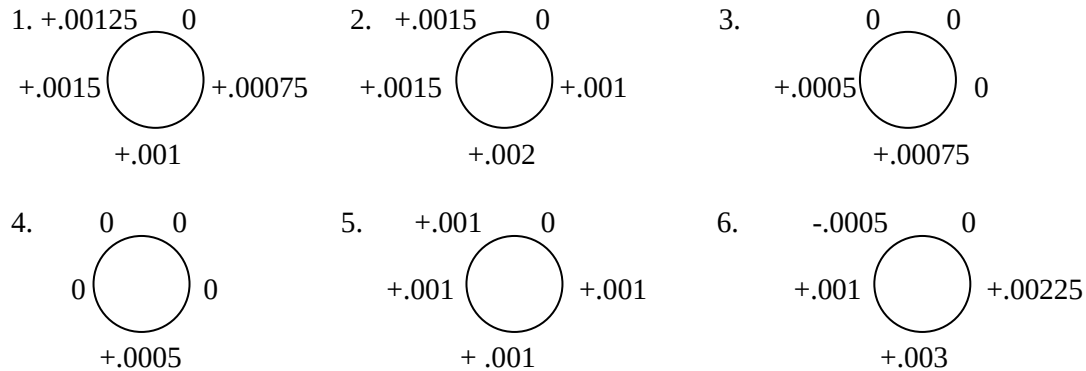
CALIFORNIA MARINE DIESEL, INC.

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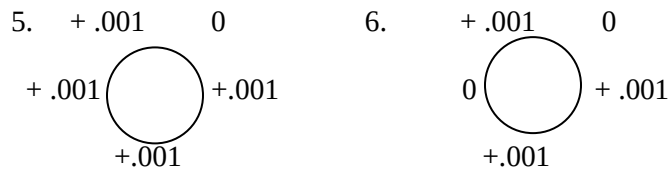
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NOTE: #6 journal indicates a correction of approximately .024 lower on the rotor outboard bearing.

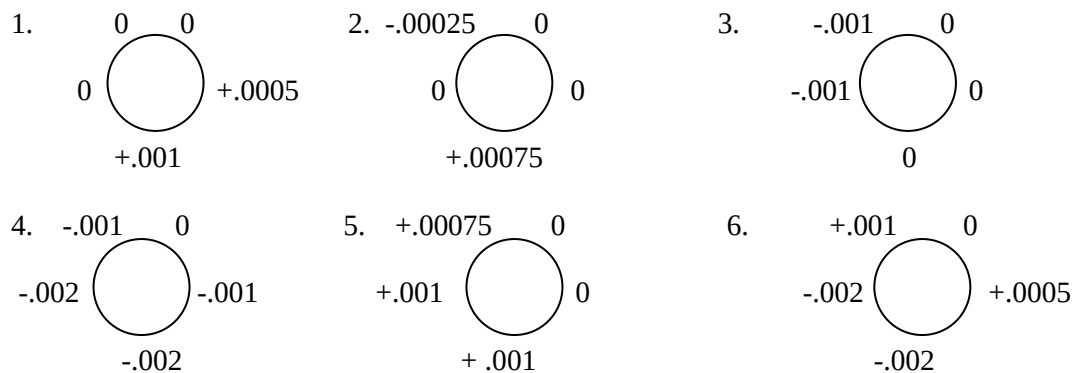
Crankshaft deflection 6 July 2019 (Upper block on, connecting rods in and torqued, cylinder heads on and torqued.)



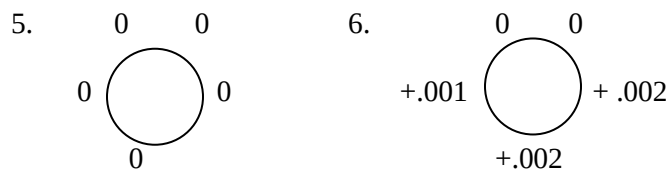
Crankshaft deflection 8 August 2019 correction for generator air gap.



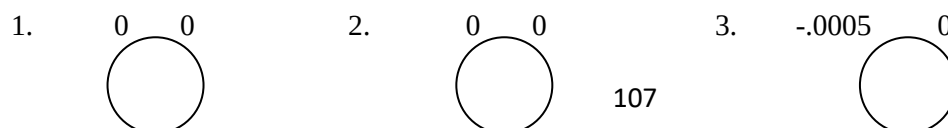
Crankshaft deflection 26 August following 2 hr 2160 kw run.

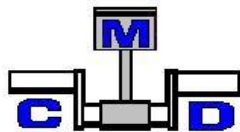


27 August 2019 (Correction for deflection)



Crankshaft deflection 3 September 2019 (following 1 hr run at 2300 kw)





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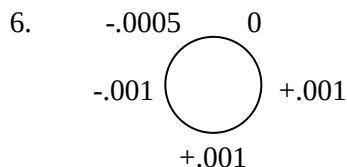
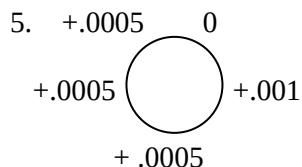
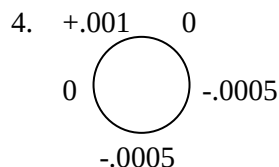
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0 +.0005 +.00025 0 -.0005 0

+0.001

+0.001

-.0005



Crankshaft main journal O.D. measurements

11 June 2019

#1

	A	B	C	D
1.	12.998	12.998	12.998	12.998
2.	12.998	12.998	12.998	12.997

#2

	A	B	C	D
1.	12.997	12.998	12.998	12.997
2.	12.998	12.999	12.998	12.997

#3

	A	B	C	D
1.	12.997	12.998	12.999	12.998
2.	12.997	12.997	12.998	12.997

#4

	A	B	C	D
1.	12.997	12.997	12.998	12.997
2.	12.998	12.997	12.998	12.997

#5

	A	B	C	D
1.	12.998	12.999	12.998	12.998
2.	12.997	12.998	12.998	12.997

#6

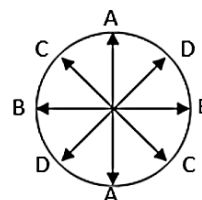
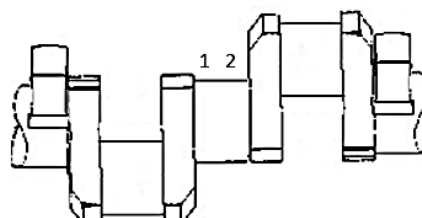
	A	B	C	D
1.	12.998	12.997	12.998	12.998
2.	12.997	12.997	12.998	12.998

#7

	A	B	C	D
1.	12.997	12.997	12.997	12.998
2.	12.998	12.997	12.997	12.997

#8

	A	B	C	D
1.	12.997	12.997	12.998	12.998





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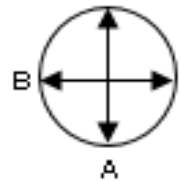
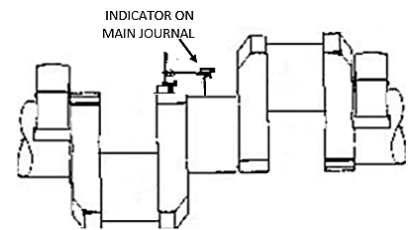
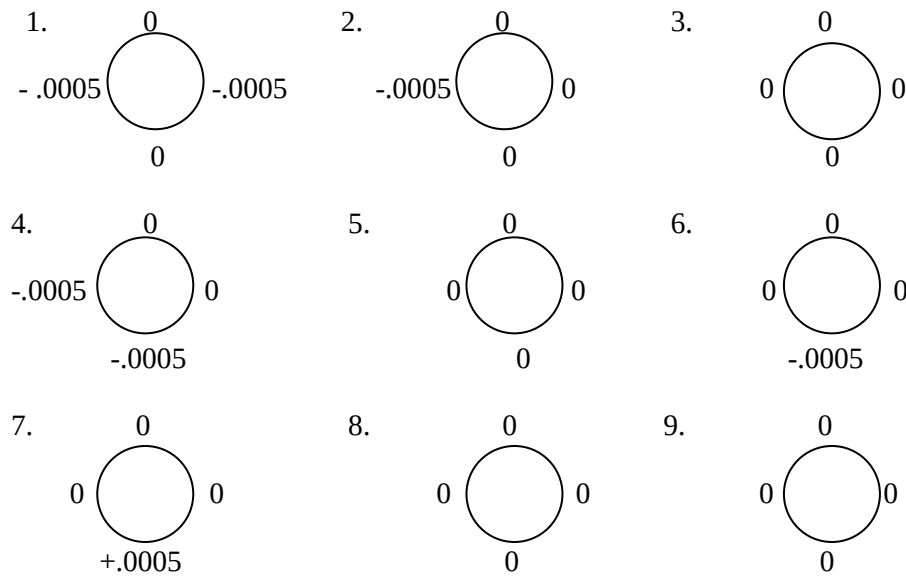
2. 12.997 12.9965 12.998 12.998

#9

	A	B	C	D
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2.	12.998	12.998	12.998	12.998

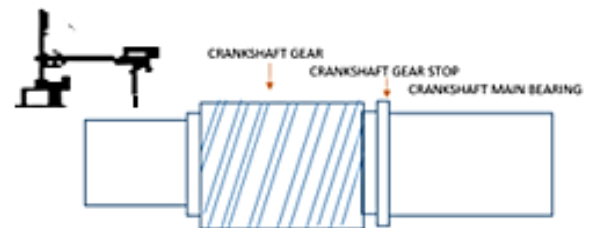
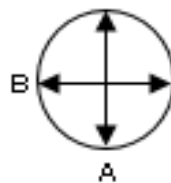
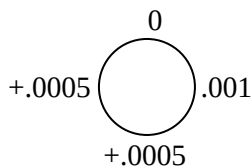
Crankshaft main journals dial indicated runout measurement.

12 June 2019



Dial indicated runout of water pump drive gear shaft.

13 June 2019

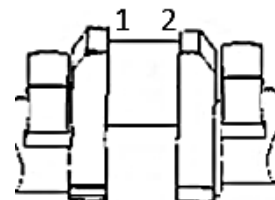


Crankpin O.D. measurements.

27 June 2019

#1	A	B	C	D
1.	10.998	10.998	10.997	10.997
2.	10.997	10.997	10.997	10.997

#2	A	B	C	D
1.	10.997	10.997	10.997	10.9965





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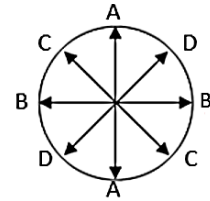
2. 10.998 10.997 10.997 10.9965

#3 A B C D
1. 10.998 10.997 10.999 10.9975
2. 10.997 10.997 10.997 10.997

#4. A B C D
1. 10.997 10.996 10.997 10.996
2. 10.997 10.996 10.9965 10.998

#5 A B C D
1. 10.998 10.997 10.996 10.997
2. 10.997 10.997 10.996 10.997

#6 A B C D
1. 10.998 10.999 10.998 10.998
2. 10.999 10.998 10.999 10.997





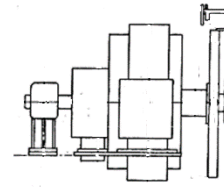
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GENERATOR AIR GAP.

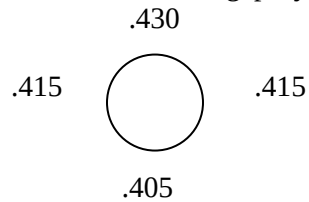
Generator rotor, stator and exciter were removed for cleaning and inspection on 7 January 2019 and reassembled on 15 March 2019. The rotor was disconnected and set in the stator on 10 April 2019 when the upper block was removed to remove the crankshaft for straightening. Provided are final rotor to stator air gap and exciter to exciter housing air gap measurements.



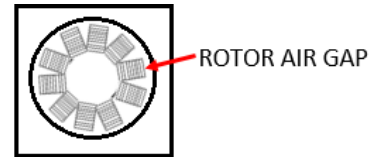
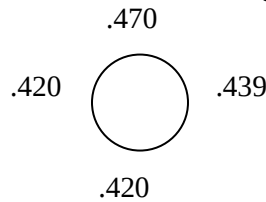
1 August 2019

Rotor to stator air gap measured using one designated pole to 4 designated winding points to measure air gap at mechanical center.

Rotor to stator air gap flywheel side

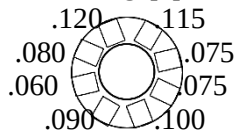


Rotor to stator air gap outboard bearing side

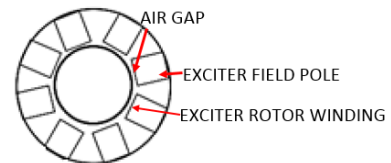
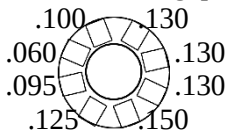


Exciter air gap measured statically to move exciter housing to mechanical center.

Exciter air gap pedestal side

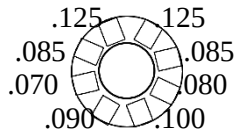


Exciter air gap to stator

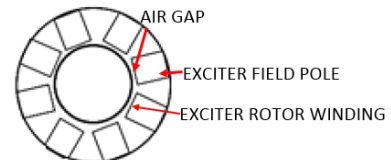
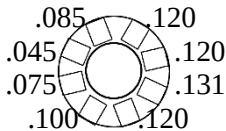


Exciter air gap measured using one designated rotor winding point to all field poles to set and measure air gap mechanical center

Exciter air gap pedestal side



Exciter air gap to stator

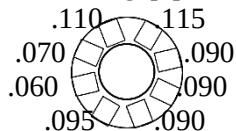


27 August 2019

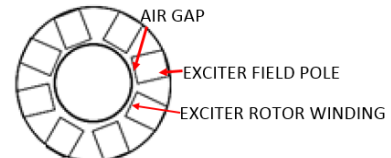
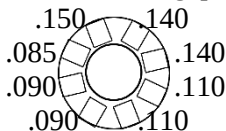
Raised generator pedestal bearing .015 to correct for -.003 deflection on #6 crankpin. Raised exciter .008 to compensate for raise in pedestal bearing.

Exciter air gap measured statically to move exciter housing to mechanical center.

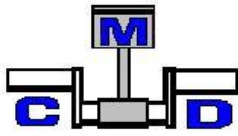
Exciter air gap pedestal side



Exciter air gap to stator



Exciter air gap measured using one designated rotor winding point to all field poles to set and measure air gap mechanical center

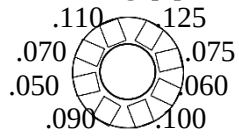


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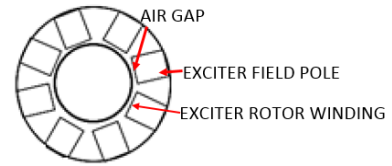
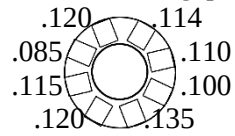
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Exciter air gap pedestal side



Exciter air gap to stator





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START UP PROCEDURES

ENTERPRISE DGSR-46 ENGINE SERIAL NUMBER 82004-3063

UNIT 2

EAST BAY MUNICIPAL UTILITY DISTRICT

OAKLAND, CALIFORNIA

UNIT START UP

UNIT START UP CONSISTS OF PRESTART UP CHECKS, MECHANICAL INTEGRITY CHECKS. UNIT RUN IN.

PRE START UP.

ENGINE

ENGINE IS ASSEMBLED ALL ASSEMBLY MEASUREMENTS AND TORQUES ARE RECORDED AND VERIFIED ACCORDING TO SPECIFICATIONS.

CRANK CASE COVERS HAVE BEEN REMOVED.

1. FINAL INTERNAL VISUAL INSPECTION CRANKCASE HAVE BEEN MADE AND ALL DEBRIS AND FOREIGN OBJECTS REMOVED.

WATER

2. FILL ENGINE WITH WATER TO PROPER LEVEL INDICATED IN WATER CYLINDER (LEG) ACCORDING TO SIGHT GLASS
3. VISUAL INSPECTION OF CRANKCASE INTERNAL FOR WATER LEAKS. AREAS OF POSSIBLE WATER LEAKAGE IS IN BOTTOM OR CYLINDER LINERS. WATER LEAKING FROM THE INSIDE OF CYLINDER LINERS CAN BE EITHER CYLINDER HEAD LEAKS OR THE LINERS. WATER COMING FROM BETWEEN THE LINER AND THE BOTTOM OF THE BLOCK ARE DUE TO LINER SEAL ('O' RING) LEAKS.
4. VISUAL INSPECTION OF WATER COMING FROM UNDER THE CYLINDER HEADS AS INDICATED BY WATER DRIPPING DOWN SIDES OF UPPER BLOCK. ADDITIONALLY WATER LEAKS FROM EXHAUST SIDE FROM EITHER THE WATER OUTLET FROM THE CYLINDER HEAD WATER OUTLET CONNECTION OR THE WATER PIPING RUBBER FITTINGS. WATER MAY ALSO APPEAR TO BE COMING FROM UNDER CYLINDER HEAD NUTS.

ENGINE LUBRICATION

- A. OIL SUPPLY LINES TO MAIN BEARING LINES, CAMSHAFT BEARING LINES, GEARCASE OIL SUPPLY LINES ARE TO BE CONNECTED TO THE MAIN LUBE OIL HEADER AND LEFT DISCONNECTED FROM THE MAIN BEARINGS AND CAMSHAFT LINES AND GEARCASE MANIFOLD, IDLER GEAR SUPPLY.



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1. LINES INCLUDE

TURBO LUBE OIL SUPPLY TO BE PLUGGED AT UNION TO TURBO
MAIN BEARING LINE TO BE LEFT OFF CENTER OF MAIN BEARING OPENING WITH
SOCK FILTER SECURED WITH PLASTIC TIE WRAP.

CAMSHAFT BEARING LINES TO ATTACHED TO MAIN LUBE OIL HEADER TIED OUT OF
CONN ROD ROTATION AND HAVE THE OPEN END AT THE CAMSHAFT COVERED
WITH FILTER SOCK SECURED WITH PLASTIC TIE WRAP.

IDLER GEAR LINE ATTACJED TO MAIN LUBE OIL HEADER AND HAVE THE OPEN END
COVERED WITH SOCK FILTER AND SECURED WITH PLASTIC TIE WRAP

- B. TEMPORARY SOCK FILTERS ARE TO BE ATTACHED TO THEM AND HAVE OIL PUMPED
THROUGH THE SOCKS UNTIL THE SOCKS ARE FOUND TO HAVE NO DEBRIS IN THEM ON
REMOVAL AND INSPECTION.
- C. WHEN OIL LINES ARE DEEMED CLEAN FROM THE TEMPERORARY SOCK FILTERS,
CONNECT THE OIL SUPPLY LINES TO THE MAIN BEARINGS, GEARCASE OIL MANIFOLD,
IDLER GEAR AND CAMSHAFT CROSSOVER SUPPLY LINES. RECONNECT TURBO LUBE OIL
SUPPLY LINE AND CYLINDER HEAD SUPPLY LINE. OIL WILL BE PUMPED THROUGH THE
ENGINE.
- D. WITNESS PRELUBE.
 - 1. VISUALLY CHECK THAT OIL IS FLOWING FROM MAIN BEARINGS, CONNECTING ROD
SIDES, FROM PISTONS DOWN CONNECTING RODS. REMOVE GEARCASE INSPECTION
COVERS AND CONFIRM OIL FROM IDLER GEAR, OIL PUMP GEAR, ACCESSORY DRIVE
GEAR AND FROM BACK OF WATER PUMP AT GEAR INSIDE OF GEARCASE. REMOVE
CYLINDER HEAD COVERS AND CHECK FOR OIL FLOW.
 - 2. ROTATE ENGINE A MINUMUM OF 2 TIMES AND CHECK EACH CONNECTING ROD
AND MAIN BEARING FOR INTERRUPTION OF OIL FLOW. CHECK GEARCASE FOR
FLOW DURING ROATATION.

FUEL OIL

- 1. FUEL OIL TO THE FUEL PUMPS AND FUEL OIL PIPING IS PRESSURIZED AT ENGINE DRIVEN
FUEL PUMP MOUNTED ON THE FRONT COVER OF THE ENGINE OR FROM AN AUXILIARY
OFF MOUNTED ELECTRICALLY DRIVEN FUEL PUMP. ENGINE ROTATION ON START UP
WILL PRESSURIZE THE FUEL PIPING AND LINES TO THE FUEL INJECTION PUMPS AND
INJECTORS. VISUAL INSPECTION OF FUEL PIPING, FUEL INJECTION PUMPS AND FUEL
INJECTORS WILL BE THE PRESTART INSPECTION.

AIR SUPPLY



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1. AIR SUPPLY TO THE ENGINE START AIR AND CONTROLS IS CHECKED BY USING PRESSURING LINES AND USING INSPECTION FLUIDS (SNOOP, SOAP AND WATER). AIR PRESSURE IS CHECKED AND VERIFIED AT GAUGES INSTALLED IN THE CONTROL TUBING AND PIPING.
2. AIR START MANUAL VALVE IS TO BE TESTED AS BLOWDOWN FOR OPERATION.
3. CYLINDER HEAD AIR START VALVES ARE TO BE CHECKED FOR LEAKS FROM AIR START DISTRIBUTOR AT THE TIME OF INSTALLATION OF THE AIR START DISTRIBUTOR. AIR START VALVES ARE TO BE TESTED (STROKED) JUST PRIOR TO INSTALLATION EACH TIME THEY ARE REMOVED.
4. UNIT SHUTDOWN RACK STOP SHOULD BE TESTED FOR SHUTDOWN SIGNALS AND FULL FUEL RACK SHUTDOWN. FUEL RACK SHOULD BE PUSHED TO 0 (ZERO) ON ALL FUEL PUMPS.

GENERATOR

PRESTART

WATER

1. COOLING WATER IS SUPPLIED TO THE GENERATOR ENCLOSURE BY RADIATORS ON THE TOP AND BOTH SIDES OF THE GENERATOR. VISUAL INSPECTION OF THE SIDES AND PIPING CONNECTIONS TO THE BOTTOM INLET AND TOP OUTLET FOR WATER LEAKS.

OIL

1. THE GENERATOR ROTOR IS SUPPORTED BY THE FLYWHEEL COUPLING AND OUTBOARD BEARING. THE OUTBOARD BEARING IS LUBRICATED BY OIL SUMP IN THE OUTBOARD BEARING HOUSING. A CIRCULAR SIGHT GLASS LOCATED ON THE BACK OF THE OUTBOARD BEARING HOUSING HAS TO BE VISUALLY CHECKED FOR OIL LEVEL PRIOR TO START.

ELECTRICAL CHECKS (MEGGER, HIGH POT, ETC.) ARE TO BE MADE AT FINISH OF ASSEMBLY PRIOR TO START TO ASSURE NO DAMAGE HAS OCCURRED DURING ASSEMBLY OR TRANSPORT.

UNIT START UP.

ALL CRANKCASE COVERS ARE INSTALLED AND BOLTS (COVERS FOR CONNECTING RODS MAY BE TIGHTENED USING 4 OR 6 BOLTS) TO HOLD THE COVERS ON FOR UNIT START UP ARE IN PLACE. ABSORBENT PADS ARE PLACED AROUND THE COVERS BOTTOM EDGE TO MITIGATE LEAKING OIL FROM NUTS, USING ALL BOLTS TO HOLD COVERS ON.

ENGINE ROTATION



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ENGINE SHOULD BE ROTATED USING THE BARRING JACK TO DETERMINE IF ANY NOISES FROM THE CRANKCASE OR GENERATOR ARE HEARD PRIOR TO START.

1. OPEN CYLINDER HEAD PRESSURE TEST VALVES (KIENE VALVES). BLOW THE ENGINE DOWN AND CHECK FOR FLUIDS BEING BLOWN FROM CYLINDER HEADS.
2. GOVERNOR FUEL RACK OPERATION SHOULD BE CHECKED DURING ENGINE ROTATION. GOVERNOR CONTROL ARM SHOULD BE CHECKED FOR RANGE OF MOVEMENT (GOES FROM 0 TO FULL RACK AND BACK.)
3. CLOSE CYLINDER HEAD PRESSURE TEST VALVES (KIENE VALVES)
4. ENGINE SPEED STARTING SPEED (40 RPM PERMISSIVE) SHOULD BE CONFIRMED FOR GENERATOR OVERSPEED.

UNIT START UP.

1. MECHANICAL INTEGRITY

MAKE SURE AREA AROUND THE ENGINE IS CLEAR OF TOOLING AND DEBRIS. FLOOR SHOULD BE CLEAN TO IDENTIFY OIL OR WATER LEAKS.

- A. 5 MINUTE RUN.

1A LISTEN FOR ANY ABNORMAL NOISES IN THE CRANKCASE OR AROUND THE ENGINE.

RUN AT 450 RPM FOR MECHANICAL INTEGRITY

2A. REMOVE CRANKCASE DOORS AND CHECK MAIN BEARINGS, CONNECTING RODS, GEARCASE GEARS, CAMSHAFT FROM LOWER DOORS FOR ANY SIGN OF DEBRIS. USING A TEMP GUN RECORD ALL MAIN AND CON ROD BEARING, GEARCASE GEARS, TEMPERATURES AND OIL SUMP TEMPS. VISUAL INSPECTION OF CRANKCASE FOR AND ABNORMAL SIGNS , DEBRIS, FLAKING, OR HEAT.

- 3A. CORRECT ANY DEFICIFENCIES OR ABNORMALITIES FOUND.

- B. 10 MINUTE RUN

1B. LISTEN FOR ANY ABNORMAL NOISES IN THE CRANKCASRE TURBO OR AT THE CYLINDER HEADS. CHECK OUTBOARD BEARING FOR TEMPERATURE DEVIATIONS OR NOISES. CHECK ROTOR AND STATOR FOR ANY NOISES IN THE AREA. LOOK FOR ANY LOOSE PARTS OR WIRES.

2B. REMOVE CRANKCASE DOORS AND CHECK MAIN BEARINGS, CONNECTING RODS, GEARCASE GEARS, CAMSHAFT FROM LOWER DOORS FOR ANY SIGN OF DEBRIS. USING A TEMP GUN RECORD ALL MAIN AND CON ROD BEARING, GEARS, TEMPERATURES AND OIL SUMP TEMPS. VISUAL INSPECTION OF CRANKCASE FOR AND ABNORMAL SIGNS , DEBRIS, FLAKING, OR HEAT.



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3B. CORRECT ANY DEFICIFENCIES OR ABNORMALITIES FOUND.

C. 20 MINUTE RUN 450 RPM

1C. LISTEN FOR ANY ABNORMAL NOISES IN THE CRANKCASE OR AROUND THE ENGINE, CYLINDER HEADS, GEARCASE, GENERATOR

2C. REMOVE CRANKCASE DOORS AND CHECK MAIN BEARINGS, CONNECTING RODS, GEARCASE GEARS, CAMSHAFT FROM LOWER DOORS FOR ANY SIGN OF DEBRIS. USING A HAND THERMOMETER (TEMP GUN) RECORD ALL MAIN AND CON ROD BEARING, GEARS, TEMPERATURES AND OIL SUMP TEMPS. VISUAL INSPECTION OF CRANKCASE FOR AND ABNORMAL SIGNS, DEBRIS, FLAKING, OR HEAT.

3C. CORRECT ANY DEFICIFENCIES OR ABNORMALITIES FOUND.

2. LOADED RUN

450 RPM 500 KW

30 MINUTES AT 500 KW. MONITOR CONTROL PANEL SENSORS, ANY GAUGES PRESENT. LISTEN FOR ANY ABNORMAL NOISES CHECK FOR LEAKS FROM ANY PART OF THE ENGINE OR UNDER THE ENGINE

1000 KW 450 RPM FOR 1 HR FOR A TOTAL RUN OF 2 HR

MONITOR CONTROL PANEL SENSORS, ANY GAUGES PRESENT. LISTEN FOR ANY ABNORMAL NOISES CHECK FOR LEAKS FROM ANY PART OF THE ENGINE OR UNDER THE ENGINE.

SHUTDOWN FOR INTERNAL INSPECTION.

1. REMOVE CRANKCASE DOORS AND CHECK MAIN BEARINGS, CONNECTING RODS, GEARCASE GEARS, CAMSHAFT FROM LOWER DOORS FOR ANY SIGN OF DEBRIS USING A TEMP GUN RECORD ALL MAIN AND CON ROD BEARING, GEARS, TEMPERATURES AND OIL SUMP TEMPS. VISUAL INSPECTION OF CRANKCASE FOR AND ABNORMAL SIGNS, DEBRIS, FLAKING, OR HEAT. REMOVE CYLINDER HEAD COVERS AND INSPECT.

2. MEASURE CRANKSHAFT DEFLECTION AS REFERENCE POINT.

3. PUT COVERS BACK ON ENGINE AND PREPARE FOR RESTART

1500 KW 450M RPM FOR 1HR **2100 KW** 450 RPM FOR 1 HR **2300 KW** IF POSSIBLE FOR LOADING. 1C. LISTEN FOR ANY ABNORMAL NOISES IN THE CRANKCASE OR AROUND THE ENGINE, CYLINDER HEADS, GEARCASE, GENERATOR



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1. REMOVE CRANKCASE DOORS AND CHECK MAIN BEARINGS, CONNECTING RODS, GEARCASE GEARS, CAMSHAFT FROM LOWER DOORS FOR ANY SIGN OF DEBRIS. USING A TEMP GUN RECORD ALL MAIN AND CON ROD BEARING, GEARS, TEMPERATURES AND OIL SUMP TEMPS. VISUAL INSPECTION OF CRANKCASE FOR AND ABNORMAL SIGNS, DEBRIS, FLAKING, OR HEAT. REMOVE CYLINDER HEAD COVERS AND INSPCET FOR ANY ABNORMALITIES.

2. CORRECT ANY DEFICIFENCIES OR ABNORMALITIES FOUND.

RUN ENGINE TO 2300KW FOR 2HR.

1. LISTEN FOR ANY ABNORMAL NOISES IN THE CRANKCASE OR AROUND THE ENGINE, CYLINDER HEADS, GEARCASE, GENERATOR

2. REMOVE CRANKCASE DOORS AND CHECK MAIN BEARINGS, CONNECTING RODS, GEARCASE GEARS, CAMSHAFT FROM LOWER DOORS FOR ANY SIGN OF DEBRIS. USING A TEMP GUN RECORD ALL MAIN AND CON ROD BEARING, GEARS, TEMPERATURES AND OIL SUMP TEMPS. VISUAL INSPECTION OF CRANKCASE FOR AND ABNORMAL SIGNS, DEBRIS, FLAKING, OR HEAT. REMOVE CYLINDER HEAD COVERS AND INSPECT.

3. CORRECT ANY DEFICIFENCIES OR ABNORMALITIES FOUND.

4. MEASURE CRANKSHAFT DEFLECTION.



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LIST OF UNIT START UP DOCUMENTS

UNIT 2

POWER GENERATION STATION

EAST BAY MUNICIPAL UTILITIES DISTRICT
OAKLAND, CALIFORNIA

START UP PROCEDURES

ENTERPRISE DGRS-46 ENGINE SERIAL NUMBER 82004-3603

UNIT 2 EAST BAY MUNICIPAL UTILITIES DISTRICT, OAKLAND, CALIFORNIA

UNIT START UP

EBMUD 26AUG19 Diesel Enterprise R-4 Performance Data Sheets



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START UP PROCEDURES

ENTERPRISE DGSR-46 ENGINE SERIAL NUMBER 82004-3063

UNIT 2

EAST BAY MUNICIPAL UTILITY DISTRICT

OAKLAND, CALIFORNIA

UNIT START UP

UNIT START UP CONSISTS OF PRESTART UP CHECKS, MECHANICAL INTEGRITY CHECKS. UNIT RUN IN.

PRE START UP.

ENGINE

ENGINE IS ASSEMBLED ALL ASSEMBLY MEASUREMENTS AND TORQUES ARE RECORDED AND VERIFIED ACCORDING TO SPECIFICATIONS.

CRANK CASE COVERS HAVE BEEN REMOVED.

5. FINAL INTERNAL VISUAL INSPECTION CRANKCASE HAVE BEEN MADE AND ALL DEBRIS AND FOREIGN OBJECTS REMOVED.

WATER

6. FILL ENGINE WITH WATER TO PROPER LEVEL INDICATED IN WATER CYLINDER (LEG) ACCORDING TO SIGHT GLASS
7. VISUAL INSPECTION OF CRANKCASE INTERNAL FOR WATER LEAKS. AREAS OF POSSIBLE WATER LEAKAGE IS IN BOTTOM OR CYLINDER LINERS. WATER LEAKING FROM THE INSIDE OF CYLINDER LINERS CAN BE EITHER CYLINDER HEAD LEAKS OR THE LINERS. WATER COMING FROM BETWEEN THE LINER AND THE BOTTOM OF THE BLOCK ARE DUE TO LINER SEAL ('O' RING) LEAKS.
8. VISUAL INSPECTION OF WATER COMING FROM UNDER THE CYLINDER HEADS AS INDICATED BY WATER DRIPPING DOWN SIDES OF UPPER BLOCK. ADDITIONALLY WATER LEAKS FROM EXHAUST SIDE FROM EITHER THE WATER OUTLET FROM THE CYLINDER HEAD WATER OUTLET CONNECTION OR THE WATER PIPING RUBBER FITTINGS. WATER MAY ALSO APPEAR TO BE COMING FROM UNDER CYLINDER HEAD NUTS.

ENGINE LUBRICATION

- E. OIL SUPPLY LINES TO MAIN BEARING LINES, CAMSHAFT BEARING LINES, GEARCASE OIL SUPPLY LINES ARE TO BE CONNECTED TO THE MAIN LUBE OIL HEADER AND LEFT DISCONNECTED FROM THE MAIN BEARINGS AND CAMSHAFT LINES AND GEARCASE MANIFOLD, IDLER GEAR SUPPLY.



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2. LINES INCLUDE

TURBO LUBE OIL SUPPLY TO BE PLUGGED AT UNION TO TURBO
MAIN BEARING LINE TO BE LEFT OFF CENTER OF MAIN BEARING OPENING WITH
SOCK FILTER SECURED WITH PLASTIC TIE WRAP.

CAMSHAFT BEARING LINES TO ATTACHED TO MAIN LUBE OIL HEADER TIED OUT OF
CONN ROD ROTATION AND HAVE THE OPEN END AT THE CAMSHAFT COVERED
WITH FILTER SOCK SECURED WITH PLASTIC TIE WRAP.

IDLER GEAR LINE ATTACJED TO MAIN LUBE OIL HEADER AND HAVE THE OPEN END
COVERED WITH SOCK FILTER AND SECURED WITH PLASTIC TIE WRAP

- F. TEMPORARY SOCK FILTERS ARE TO BE ATTACHED TO THEM AND HAVE OIL PUMPED
THROUGH THE SOCKS UNTIL THE SOCKS ARE FOUND TO HAVE NO DEBRIS IN THEM ON
REMOVAL AND INSPECTION.
 - G. WHEN OIL LINES ARE DEEMED CLEAN FROM THE TEMPERORARY SOCK FILTERS,
CONNECT THE OIL SUPPLY LINES TO THE MAIN BEARINGS, GEARCASE OIL MANIFOLD,
IDLER GEAR AND CAMSHAFT CROSSOVER SUPPLY LINES. RECONNECT TURBO LUBE OIL
SUPPLY LINE AND CYLINDER HEAD SUPPLY LINE. OIL WILL BE PUMPED THROUGH THE
ENGINE.
 - H. WITNESS PRELUBE.
- 3. VISUALLY CHECK THAT OIL IS FLOWING FROM MAIN BEARINGS, CONNECTING ROD
SIDES, FROM PISTONS DOWN CONNECTING RODS. REMOVE GEARCASE INSPECTION
COVERS AND CONFIRM OIL FROM IDLER GEAR, OIL PUMP GEAR, ACCESSORY DRIVE
GEAR AND FROM BACK OF WATER PUMP AT GEAR INSIDE OF GEARCASE. REMOVE
CYLINDER HEAD COVERS AND CHECK FOR OIL FLOW.
 - 4. ROTATE ENGINE A MINUMUM OF 2 TIMES AND CHECK EACH CONNECTING ROD
AND MAIN BEARING FOR INTERRUPTION OF OIL FLOW. CHECK GEARCASE FOR
FLOW DURING ROATATION.

FUEL OIL

- 2. FUEL OIL TO THE FUEL PUMPS AND FUEL OIL PIPING IS PRESSURIZED AT ENGINE DRIVEN
FUEL PUMP MOUNTED ON THE FRONT COVER OF THE ENGINE OR FROM AN AUXILIARY
OFF MOUNTED ELECTRICALLY DRIVEN FUEL PUMP. ENGINE ROTATION ON START UP
WILL PRESSURIZE THE FUEL PIPING AND LINES TO THE FUEL INJECTION PUMPS AND
INJECTORS. VISUAL INSPECTION OF FUEL PIPING, FUEL INJECTION PUMPS AND FUEL
INJECTORS WILL BE THE PRESTART INSPECTION.

AIR SUPPLY



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5. AIR SUPPLY TO THE ENGINE START AIR AND CONTROLS IS CHECKED BY USING PRESSURING LINES AND USING INSPECTION FLUIDS (SNOOP, SOAP AND WATER). AIR PRESSURE IS CHECKED AND VERIFIED AT GAUGES INSTALLED IN THE CONTROL TUBING AND PIPING.
6. AIR START MANUAL VALVE IS TO BE TESTED AS BLOWDOWN FOR OPERATION.
7. CYLINDER HEAD AIR START VALVES ARE TO BE CHECKED FOR LEAKS FROM AIR START DISTRIBUTOR AT THE TIME OF INSTALLATION OF THE AIR START DISTRIBUTOR. AIR START VALVES ARE TO BE TESTED (STROKED) JUST PRIOR TO INSTALLATION EACH TIME THEY ARE REMOVED.
8. UNIT SHUTDOWN RACK STOP SHOULD BE TESTED FOR SHUTDOWN SIGNALS AND FULL FUEL RACK SHUTDOWN. FUEL RACK SHOULD BE PUSHED TO 0 (ZERO) ON ALL FUEL PUMPS.

GENERATOR

PRESTART

WATER

2. COOLING WATER IS SUPPLIED TO THE GENERATOR ENCLOSURE BY RADIATORS ON THE TOP AND BOTH SIDES OF THE GENERATOR. VISUAL INSPECTION OF THE SIDES AND PIPING CONNECTIONS TO THE BOTTOM INLET AND TOP OUTLET FOR WATER LEAKS.

OIL

2. THE GENERATOR ROTOR IS SUPPORTED BY THE FLYWHEEL COUPLING AND OUTBOARD BEARING. THE OUTBOARD BEARING IS LUBRICATED BY OIL SUMP IN THE OUTBOARD BEARING HOUSING. A CIRCULAR SIGHT GLASS LOCATED ON THE BACK OF THE OUTBOARD BEARING HOUSING HAS TO BE VISUALLY CHECKED FOR OIL LEVEL PRIOR TO START.

ELECTRICAL CHECKS (MEGGER, HIGH POT, ETC.) ARE TO BE MADE AT FINISH OF ASSEMBLY PRIOR TO START TO ASSURE NO DAMAGE HAS OCCURRED DURING ASSEMBLY OR TRANSPORT.

UNIT START UP.

ALL CRANKCASE COVERS ARE INSTALLED AND BOLTS (COVERS FOR CONNECTING RODS MAY BE TIGHTENED USING 4 OR 6 BOLTS) TO HOLD THE COVERS ON FOR UNIT START UP ARE IN PLACE. ABSORBENT PADS ARE PLACED AROUND THE COVERS BOTTOM EDGE TO MITIGATE LEAKING OIL FROM NUTS, USING ALL BOLTS TO HOLD COVERS ON.

ENGINE ROTATION



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ENGINE SHOULD BE ROTATED USING THE BARRING JACK TO DETERMINE IF ANY NOISES FROM THE CRANKCASE OR GENERATOR ARE HEARD PRIOR TO START.

5. OPEN CYLINDER HEAD PRESSURE TEST VALVES (KIENE VALVES). BLOW THE ENGINE DOWN AND CHECK FOR FLUIDS BEING BLOWN FROM CYLINDER HEADS.
6. GOVERNOR FUEL RACK OPERATION SHOULD BE CHECKED DURING ENGINE ROTATION. GOVERNOR CONTROL ARM SHOULD BE CHECKED FOR RANGE OF MOVEMENT (GOES FROM 0 TO FULL RACK AND BACK.)
7. CLOSE CYLINDER HEAD PRESSURE TEST VALVES (KIENE VALVES)
8. ENGINE SPEED STARTING SPEED (40 RPM PERMISSIVE) SHOULD BE CONFIRMED FOR GENERATOR OVERSPEED.

UNIT START UP.

3. MECHANICAL INTEGRITY

MAKE SURE AREA AROUND THE ENGINE IS CLEAR OF TOOLING AND DEBRIS. FLOOR SHOULD BE CLEAN TO IDENTIFY OIL OR WATER LEAKS.

D. 5 MINUTE RUN.

1A LISTEN FOR ANY ABNORMAL NOISES IN THE CRANKCASE OR AROUND THE ENGINE.

RUN AT 450 RPM FOR MECHANICAL INTEGRITY

2A. REMOVE CRANKCASE DOORS AND CHECK MAIN BEARINGS, CONNECTING RODS, GEARCASE GEARS, CAMSHAFT FROM LOWER DOORS FOR ANY SIGN OF DEBRIS. USING A TEMP GUN RECORD ALL MAIN AND CON ROD BEARING, GEARCASE GEARS, TEMPERATURES AND OIL SUMP TEMPS. VISUAL INSPECTION OF CRANKCASE FOR AND ABNORMAL SIGNS , DEBRIS, FLAKING, OR HEAT.

3A. CORRECT ANY DEFICIFENCIES OR ABNORMALITIES FOUND.

E. 10 MINUTE RUN

1B. LISTEN FOR ANY ABNORMAL NOISES IN THE CRANKCASRE TURBO OR AT THE CYLINDER HEADS. CHECK OUTBOARD BEARING FOR TEMPERATURE DEVIATIONS OR NOISES. CHECK ROTOR AND STATOR FOR ANY NOISES IN THE AREA. LOOK FOR ANY LOOSE PARTS OR WIRES.

2B. REMOVE CRANKCASE DOORS AND CHECK MAIN BEARINGS, CONNECTING RODS, GEARCASE GEARS, CAMSHAFT FROM LOWER DOORS FOR ANY SIGN OF DEBRIS. USING A TEMP GUN RECORD ALL MAIN AND CON ROD BEARING, GEARS, TEMPERATURES AND OIL SUMP TEMPS. VISUAL INSPECTION OF CRANKCASE FOR AND ABNORMAL SIGNS , DEBRIS, FLAKING, OR HEAT.



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3B. CORRECT ANY DEFICIFENCIES OR ABNORMALITIES FOUND.

F. 20 MINUTE RUN 450 RPM

1C. LISTEN FOR ANY ABNORMAL NOISES IN THE CRANKCASE OR AROUND THE ENGINE, CYLINDER HEADS, GEARCASE, GENERATOR

2C. REMOVE CRANKCASE DOORS AND CHECK MAIN BEARINGS, CONNECTING RODS, GEARCASE GEARS, CAMSHAFT FROM LOWER DOORS FOR ANY SIGN OF DEBRIS. USING A HAND THERMOMETER (TEMP GUN) RECORD ALL MAIN AND CON ROD BEARING, GEARS, TEMPERATURES AND OIL SUMP TEMPS. VISUAL INSPECTION OF CRANKCASE FOR AND ABNORMAL SIGNS, DEBRIS, FLAKING, OR HEAT.

3C. CORRECT ANY DEFICIFENCIES OR ABNORMALITIES FOUND.

4. LOADED RUN

450 RPM 500 KW

30 MINUTES AT 500 KW. MONITOR CONTROL PANEL SENSORS, ANY GAUGES PRESENT. LISTEN FOR ANY ABNORMAL NOISES CHECK FOR LEAKS FROM ANY PART OF THE ENGINE OR UNDER THE ENGINE

1000 KW 450 RPM FOR 1 HR FOR A TOTAL RUN OF 2 HR

MONITOR CONTROL PANEL SENSORS, ANY GAUGES PRESENT. LISTEN FOR ANY ABNORMAL NOISES CHECK FOR LEAKS FROM ANY PART OF THE ENGINE OR UNDER THE ENGINE.

SHUTDOWN FOR INTERNAL INSPECTION.

1. REMOVE CRANKCASE DOORS AND CHECK MAIN BEARINGS, CONNECTING RODS, GEARCASE GEARS, CAMSHAFT FROM LOWER DOORS FOR ANY SIGN OF DEBRIS USING A TEMP GUN RECORD ALL MAIN AND CON ROD BEARING, GEARS, TEMPERATURES AND OIL SUMP TEMPS. VISUAL INSPECTION OF CRANKCASE FOR AND ABNORMAL SIGNS, DEBRIS, FLAKING, OR HEAT. REMOVE CYLINDER HEAD COVERS AND INSPECT.

2. MEASURE CRANKSHAFT DEFLECTION AS REFERENCE POINT.

3. PUT COVERS BACK ON ENGINE AND PREPARE FOR RESTART

1500 KW 450M RPM FOR 1HR **2100 KW** 450 RPM FOR 1 HR **2300 KW** IF POSSIBLE FOR LOADING. 1C. LISTEN FOR ANY ABNORMAL NOISES IN THE CRANKCASE OR AROUND THE ENGINE, CYLINDER HEADS, GEARCASE, GENERATOR



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2. CORRECT ANY DEFICIFENCIES OR ABNORMALITIES FOUND.

RUN ENGINE TO 2300KW FOR 2HR.

1. LISTEN FOR ANY ABNORMAL NOISES IN THE CRANKCASE OR AROUND THE ENGINE, CYLINDER HEADS, GEARCASE, GENERATOR

2. REMOVE CRANKCASE DOORS AND CHECK MAIN BEARINGS, CONNECTING RODS, GEARCASE GEARS, CAMSHAFT FROM LOWER DOORS FOR ANY SIGN OF DEBRIS. USING A TEMP GUN RECORD ALL MAIN AND CON ROD BEARING, GEARS, TEMPERATURES AND OIL SUMP TEMPS. VISUAL INSPECTION OF CRANKCASE FOR AND ABNORMAL SIGNS, DEBRIS, FLAKING, OR HEAT. REMOVE CYLINDER HEAD COVERS AND INSPECT.

3. CORRECT ANY DEFICIFENCIES OR ABNORMALITIES FOUND.

4. MEASURE CRANKSHAFT DEFLECTION.



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EAST BAY MUNICIPAL UTILITIES DISTRICT UNIT 2

UNIT START UP

23 August 2019

Unit start commenced at approximately 1430 with a mechanical integrity run of 15 minutes unloaded at idle. An air leak on the bottom of #3 air intake horn was found and a fuel leak was found on #2 fuel injection line at the fuel injection pump. Crankcase doors and gearcase covers were removed and temperatures measured using a handheld thermometer (temp gun). A visual inspection of the crankcase and gearcase found no sign of damage or debris indicating no failure was present or in process. Restart of engine loaded to 750 kw for 10 minutes and then reduced to 500 kw for stepped loading to 2150 kw (conventional loading (easier to keep track of load deviations)). 500 kw loaded run was shutdown due to low turbocharger oil pressure. 500 kw loaded run was scheduled for 1 hr.

24 August 2019

Remove turbocharger drain lines from Unit #2 and #3 to find a reported missing orifice plate to reduce oil flow drain and raise oil pressure in the turbocharger. No orifice plates were found in either turbocharger drain line. The drain lines were put back on to Units #2 and #3 and #3 restarted. #3 air intake horn was removed and resealed on Unit #2. Fuel injection line clamps were installed on the 6 fuel injection lines to the fuel injectors on Unit #2. Provided are pictures of the turbocharger drain lines from Units #2 and #3.

#3 TURBOCHARGER DRAIN



#2 TURBOCHARGER DRAIN



Units #2 and #3 turbocharger drain line pipes.



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26 August 2019

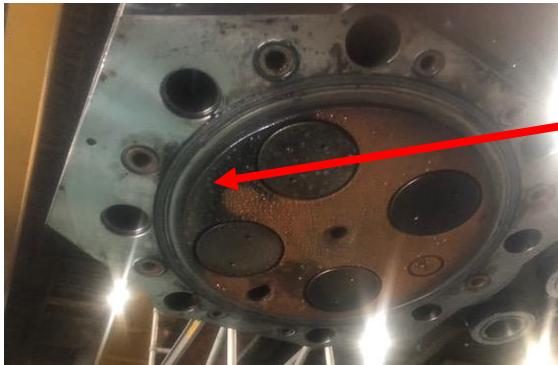
Remove turbocharger inlet supply lines on Units #2 and #3 to access inlet orifice. Compare sizes of inlet orifices and remove and open unit #2 orifice to .375 in. Reinstall inlet oil supply orifice on unit #2 and supply lines to units #2 and #3.



Unit 2 inlet oil supply orifice.

30 August 2019

Replace #3 cylinder head for water leak found on blow down while searching for cause of crankcase pressure deviation. (expected crankcase pressure – 1 in crankcase pressure -.3 in at all loads). #3 cylinder head jet cell replaced twice before replacing cylinder head.



Water leak at exhaust



Oily water on valve stem



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#3 cylinder upper bore die penetrant inspection with piston still in bore. (no sign of crack or leaks)

31 August 2019

Shutdown to replace #3 cylinder main fuel injector line and #3 pilot fuel injector.

Leak on #2 cylinder head intake horn shutdown at 1530 for repair and replace #1 cylinder head kiene valve. Replaced kiene valve on #1 cylinder head. Remove cylinder #2 intake air horn replace gaskets and reinstall. Restart unit and load to 2100 kw dual fuel.

3 September 2019

Run unit at 2100 kw for 3 hr. Run unit at 2300kw for 1 hr take firing pressures, shutdown and take hot crankshaft deflection, crankcase inspection and geartrain inspection. Remove #4 cylinder head intake air horn, replace gaskets to fix air leak. Continue to look for cause of crankcase vacuum pressure being higher than other units Put covers back on crankcase (-.5 in crankcase pressure after replacing #3 cylinder head)



Crankcase vacuum at 2300 kw dual fuel.

4 September 2019

Return to blow down engine to check for water leaks. Find #4 cylinder blowing water. Remove #4 cylinder main fuel injector and find water on top of piston. Dress water pump drive gear teeth. Replace #4 ignitor cell and fill engine with water. Remove all main fuel injectors to watch for water in cylinder over a 2 week period.



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Provided are observed running conditions.

23 August 2019 1615

Speed. 450 rpm

Load. None

Crankcase pressure.

Air manifold temperature. 92°

Air manifold pressure. .8 in H_g

Fuel oil pressure. 33 psi

Oil temperature In. 136° F Out 139° F

Oil pressure In. 59 psi

Turbocharger oil pressure. 33 psi

Turbocharger speed. 5500 rpm.

Oil level in sump. 35 in

Jacket water pressure. psi

Jacket water temperature in. 144 ° F Out. 144° F

Engine vibration. .005 in/sec (5ml)

Main bearing temperatures.

1. 147° F

2. 143° F

3. 145° F

4. 133° F

5. 152° F

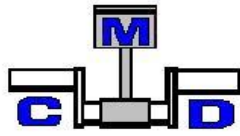
6. 142° F

7. 139° F

8. 140° F

9. 141° F

Pedestal bearing. 78° F



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Exhaust temperatures.

1. 291° F
2. 305° F
3. 298° F
4. 321° F
5. 301° F
6. 305° F

Post turbo exhaust. 462° F

Fuel rack position.

1. 9 mm
2. 10 mm
3. 10 mm
4. 10 mm
5. 10 mm
6. 10 mm

Observed temperature measurement using hand held thermometer inside crankcase following shutdown.

MAIN BEARINGS

1. 145° F
2. 146° F
3. 144° F
4. 145° F
5. 147° F
6. 146° F
7. 148° F
8. 143° F
9. 145° F

CONNECTING RODS

- 137° F
- 136° F
- 144° F
- 141° F
- 135° F
- 140° F

PISTONS

- 156° F
- 154° F
- 156° F
- 155° F
- 156° F
- 156° F

23 August 2019 1645

Speed. 450 rpm

Load. 661 kw

Crankcase pressure.

Air manifold temperature. 94°

Air manifold pressure. 2.83 in Hg

Fuel oil pressure. 31 psi

Oil temperature In. 152° F Out 161° F

Oil pressure In. 59 psi

Turbocharger oil pressure. 23 psi

Turbocharger speed. 8400 rpm.

Oil level in sump. 35 in

Jacket water pressure. psi

Jacket water temperature in. 172 ° F Out. 174° F

Engine vibration. .005 in/sec

Main bearing temperatures.

1. 163° F



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2. 161° F
3. 162° F
4. 161° F
5. 167° F
6. 160° F
7. 158° F
8. 158° F
9. 159° F

Outboard bearing. 78° F

Exhaust temperatures.

1. 587° F
2. 621° F
3. 626° F
4. 630° F
5. 620° F
6. 605° F

Post turbo exhaust. 553 ° F

Fuel rack position

1. 14 mm
2. 15mm
3. 15 mm
4. 15 mm
5. 15mm
6. 15 mm

23 August 2019

Speed. 450 rpm 1650-1705

Load. 750 kw

Crankcase pressure.

Air manifold temperature. 95°

Air manifold pressure. 2.9 in Hg

Fuel oil pressure. 33 psi

Oil temperature In. 158° F Out 161° F

Oil pressure In. 59 psi

Turbocharger oil pressure. 23 psi

Turbocharger speed. 9800 rpm.

Oil level in sump. 35 in

Jacket water pressure. psi

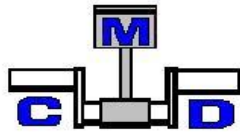
Jacket water temperature in. 172 ° F Out. 174° F

Engine vibration. .005 in/sec

Pedestal bearing. 78° F

Exhaust temperatures.

1. 567° F
2. 643° F



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3. 590° F
 4. 599° F
 5. 589° F
 6. 575° F
- Post turbo exhaust. 549° F
Generator. .9 PF

26 August 2019 (0914-1030)

Speed. 450 rpm

Load. 500 kw

Crankcase pressure. NA

Air manifold temperature. 96° F

Air manifold pressure. 2.47 in Hg

Fuel oil pressure. 32 psi

Oil temperature In. 138° F Out 140° F

Oil pressure In. 60 psi

Turbocharger oil pressure. 42 psi

Turbocharger speed. 8000 rpm.

Oil level in sump. 35 in

Jacket water pressure. 10 psi (gauge)

Jacket water temperature in. 158 ° F Out. 158° F

Engine vibration. .005 in/sec (5ml)

Main bearing temperatures.

1. 145° F
2. 142° F
3. 144° F
4. 143° F
5. 150° F
6. 141° F
7. 141° F
8. 138° F
9. 140° F

Pedestal bearing. 35°C

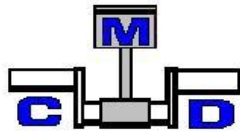
Exhaust temperatures.

1. 547° F
2. 575° F
3. 574° F
4. 573° F
5. 585° F
6. 575° F

Post turbo exhaust. 546° F

Fuel rack position.

1. 14 mm
2. 15 mm
3. 15 mm



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4. 15 mm

5. 15 mm

6. 15 mm

Generator

.89 PF

Voltage 4164 kw

Winding temperatures

W1 33° C

W2 32° C

W3 33° C

W4 33° C

W5 32° C

W6 33° C

Pedestal bearing temperature. 35° C

Observed temperature measurement using hand held thermometer inside crankcase following shutdown.

MAIN BEARINGS

CONNECTING RODS

PISTONS

1. 175° F

162° F

184° F

2. 176° F

164° F

184° F

3. 180° F

178° F

186° F

4. 187° F

177° F

188° F

5. 184° F

179° F

187°

6. 184° F

162° F

179° F

7 178° F

8 166° F

9 166° F

26 August 2019 (1100-1210)

Speed. 450 rpm

Load. 732 kw

Crankcase pressure. -.3 in (manometer)

Air manifold temperature. 99° F

Air manifold pressure. 5.26 in Hg

Air flow: 2736 SCFM

Fuel oil pressure. 30 psi

Oil temperature In. 166° F Out 170° F

Oil pressure In. 53 psi

Turbocharger oil pressure. 33 psi

Turbocharger speed. rpm.

Oil level in sump. 35 in

Jacket water pressure. 9 psi (gauge)

Jacket water temperature in. 172 ° F Out. 174° F

Engine vibration. .005 in/sec (5ml)

Charge air cooler temperature; 102° F

Main bearing temperatures.



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1. 176° F
2. 174° F
3. 175° F
4. 175° F
5. 179° F
6. 173° F
7. 171° F
8. 172° F
9. 172° F

Pedestal bearing. 44°C

Exhaust temperatures.

1. 636° F
2. 669° F
3. 660° F
4. 674° F
5. 670° F
6. 665° F

Post turbo exhaust. ° F

Fuel rack position.

1. 18 mm
2. 19 mm
3. 19 mm
4. 19 mm
5. 19 mm
6. 19 mm

Cylinder firing pressures

1. 610 psi
2. 620 psi
3. 620 psi
4. 620 psi
5. 580 psi
6. 610 psi

Generator

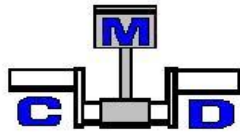
.92 PF

Voltage 4210 kw

Winding temperatures

- W1 39° C
W2 38° C
W3 39° C
W4 39° C
W5 38° C
W6 38° C

Pedestal bearing temperature. 44° C



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26 August 2019 (1100-1210)

Speed. 450 rpm

Load. 1035 kw

Crankcase pressure. -.3 in (manometer)

Air manifold temperature. 95° F

Air manifold pressure. 9.7 in Hg

Air flow: 3266 SCFM

Fuel oil pressure. 29 psi

Oil temperature In. 166° F Out 172° F

Oil pressure In. 52 psi

Turbocharger oil pressure. 33 psi

Turbocharger speed. 12900 rpm.

Oil level in sump. 35 in

Jacket water pressure. 9 psi (gauge)

Jacket water temperature in. 172 ° F Out. 175° F

Engine vibration. .006 in/sec (6ml)

Charge air cooler temperature; 103° F

Main bearing temperatures.

1. 177° F

2. 176° F

3. 176° F

4. 176° F

5. 179°F

6. 174° F

7. 173° F

8. 173° F

9. 174° F

Pedestal bearing. 51°C

Exhaust temperatures.

1. 707° F

2. 739° F

3. 724° F

4. 723° F

5. 712° F

6. 707° F

Post turbo exhaust. 721° F

Fuel rack position.

1. 21 mm

2. 22 mm

3. 22 mm

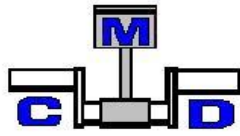
4. 22 mm

5. 22 mm

6. 22 mm

Cylinder firing pressures

1. 720 psi



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2. 700 psi
3. 720 psi
4. 720psi
5. 700 psi
6. 720 psi

Generator

.91 PF

Voltage 4232 kw

Winding temperatures

W1 44° C

W2 44° C

W3 44° C

W4 45° C

W5 43° C

W6 44° C

Pedestal bearing temperature. 51° C

26 August 2019 (1400-1600)

Speed. 450 rpm

Load. 1600 kw

Crankcase pressure. -.3 in (manometer)

Air manifold temperature. 95° F

Air manifold pressure. 20.95 in Hg

Air flow: 4703 SCFM

Fuel oil pressure. 26 psi

Oil temperature In. 167° F Out 178° F

Oil pressure In. 52 psi

Turbocharger oil pressure. 31 psi

Turbocharger speed. 17300 rpm.

Oil level in sump. 35 in

Jacket water pressure. 9 psi (gauge)

Jacket water temperature in. 173 ° F Out. 176° F

Engine vibration. .006 in/sec (6ml)

Charge air cooler temperature; 105° F

Main bearing temperatures.

1. 178° F

2. 177° F

3. 177° F

4. 176° F

5. 178°F

6. 175° F

7. 174° F

8. 174° F

9. 174° F

Pedestal bearing. 55°C



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Exhaust temperatures.

1. 712° F
2. 728° F
3. 715° F
4. 722° F
5. 723° F
6. 717° F

Post turbo exhaust. 752° F

Fuel rack position.

1. 25 mm
2. 26 mm
3. 26 mm
4. 26 mm
5. 26 mm
6. 26 mm

Cylinder firing pressures

1. 940 psi
2. 940 psi
3. 920 psi
4. 930 psi
5. 940 psi
6. 940 psi

Generator

.91 PF

Voltage 4255 kw

Winding temperatures

- W1 50° C
W2 49° C
W3 50° C
W4 50° C
W5 49° C
W6 49° C

Pedestal bearing temperature. 53° C

26 August 2019

Speed. 450 rpm

Load. 2160 kw

Crankcase pressure. -.3 in (manometer)

Air manifold temperature. 97° F

Air manifold pressure. 37.39 in Hg

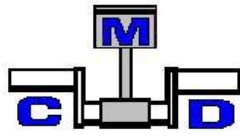
Air flow: 3266 SCFM

Fuel oil pressure. 24 psi

Oil temperature In. 163° F Out 179° F

Oil pressure In. 52 psi

Turbocharger oil pressure. 31 psi



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Turbocharger speed. 21600 rpm.

Oil level in sump. 35 in

Jacket water pressure. 9 psi (gauge)

Jacket water temperature in. 171 ° F Out. 173° F

Engine vibration. .007 in/sec (7ml)

Charge air cooler temperature; 96° F

Main bearing temperatures.

1. 177° F

2. 176° F

3. 176° F

4. 174° F

5. 175°F

6. 174° F

7. 173° F

8. 173° F

9. 173° F

Pedestal bearing. 51°C

Exhaust temperatures.

1. 724° F

2. 717° F

3. 707° F

4. 712° F

5. 738° F

6. 723° F

Post turbo exhaust. 723° F

Fuel rack position.

1. 31 mm

2. 32 mm

3. 32 mm

4. 32 mm

5. 32 mm

6. 32 mm

Cylinder firing pressures

1. 1240 psi

2. 1240 psi

3. 1220 psi

4. 1200 psi

5. 1200 psi

6. 1200 psi

Generator

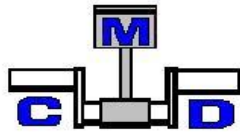
.93 PF

Voltage 4269 kw

Winding temperatures

W1 54° C

W2 53° C



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W3 53° C

W4 54° C

W5 52° C

W6 53° C

Pedestal bearing temperature. 55° C

Observed temperature measurement using hand held thermometer inside crankcase following shutdown.

MAIN BEARINGS

CONNECTING RODS

PISTONS

1. 145° F

152° F

154° F

2. 147° F

154° F

156° F

3. 154° F

146° F

158° F

4. 156° F

147° F

168° F

5. 156° F

157° F

160°

6. 166° F

153° F

161° F

7 156° F

8 154° F

9 147° F

27 August 2019

Dual Fuel

Speed. 450 rpm

Load. 1700 kw

Crankcase pressure. -.3 in (manometer)

Air manifold temperature. 95° F

Air manifold pressure. 29.14 in Hg

Air flow: 4609 SCFM

Fuel oil pressure. 33 psi

Fuel regulator gas pressure. 55 psi

Fuel header gas pressure. 36 psi

Oil temperature In. 166° F Out 177° F

Oil pressure In. 58 psi

Turbocharger oil pressure. 27 psi

Turbocharger speed. 17300 rpm.

Oil level in sump. 35 in

Jacket water pressure. 9 psi (gauge)

Jacket water temperature in. 172 ° F Out. 177° F

Engine vibration. .007 in/sec (7ml)

Charge air cooler temperature; 104° F

Main bearing temperatures.

1. 176° F

2. 175° F

3. 175° F

4. 174° F

5. 176° F

6. 174° F



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7. 172° F

8. 172° F

9. 173° F

Pedestal bearing. 47°C

Exhaust temperatures.

1. 776° F

2. 859° F

3. 809° F

4. 794° F

5. 790° F

6. 825° F

Post turbo exhaust. 863° F

Fuel rack position.

1. 0 mm

2. 0 mm

3. 0 mm

4. 0 mm

5. 0 mm

6. 0 mm

Cylinder firing pressures

1. 800 psi

2. 820 psi

3. 880 psi

4. 840 psi

5. 860 psi

6. 840 psi

Generator

.91 PF

Voltage 4290 kw

Winding temperatures

W1 49° C

W2 49° C

W3 50° C

W4 48° C

W5 49° C

W6 48° C

Pedestal bearing temperature. 47° C

28 August 2019

Dual Fuel

Speed. 450 rpm

Load. 2150 kw

Crankcase pressure. -.3 in (manometer)

Air manifold temperature. 95° F

Air manifold pressure. 29.23 in Hg



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Air flow: 6030 SCFM
Fuel oil pressure. 33 psi
Fuel regulator gas pressure. 55 psi
Fuel header gas pressure. 38.9 psi
Oil temperature In. 166° F Out 174° F
Oil pressure In. 51 psi
Turbocharger oil pressure. 27 psi
Turbocharger speed. 20000 rpm.
Oil level in sump. 35 in
Jacket water pressure. 9 psi (gauge)
Jacket water temperature in. 172 ° F Out. 174° F
Engine vibration. .007 in/sec (7ml)
Charge air cooler temperature; 104° F
Main bearing temperatures.
1. 176° F
2. 174° F
3. 174° F
4. 173° F
5. 174°F
6. 173° F
7. 171° F
8. 172° F
9. 174° F
Pedestal bearing. 44°C
Exhaust temperatures.
1. 806° F
2. 839° F
3. 820° F
4. 818° F
5. 811° F
6. 823° F
Post turbo exhaust. 854° F
Fuel rack position.
1. 0 mm
2. 0 mm
3. 0 mm
4. 0 mm
5. 0 mm
6. 0 mm
Cylinder firing pressures
1. 980 psi
2. 980 psi
3. 1020 psi
4. 980 psi
5. 1000 psi



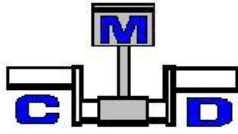
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6. 980 psi
Generator
.92 PF
Voltage 4290 kw
Winding temperatures
W1 50° C
W2 49° C
W3 49° C
W4 49° C
W5 49° C
W6 48° C

30 August 2019
Dual Fuel
Speed. 450 rpm
Load. 2160 kw
Crankcase pressure. -.4 in (manometer)
Air manifold temperature. 95° F
Air manifold pressure. 28.87 in Hg
Air flow: 5914 SCFM
Fuel oil pressure. 33 psi
Fuel regulator gas pressure. 55 psi
Fuel header gas pressure. 38.9 psi
Oil temperature In. 166° F Out 175° F
Oil pressure In. 51 psi
Turbocharger oil pressure. 27 psi
Turbocharger speed. 20000 rpm.
Oil level in sump. 35 in
Jacket water pressure. 9 psi (gauge)
Jacket water temperature in. 172 ° F Out. 177° F
Engine vibration. .007 in/sec (7ml)
Charge air cooler temperature; 104° F
Main bearing temperatures.
1. 176° F
2. 176° F
3. 175° F
4. 175° F
5. 174° F
6. 174° F
7. 172° F
8. 172° F
9. 174° F
Pedestal bearing. 47°C
Exhaust temperatures.
1. 826° F



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2. 850° F
3. 859° F
4. 830° F
5. 834° F
6. 833° F

Post turbo exhaust. 872° F

Fuel rack position.

1. 0 mm
2. 0 mm
3. 0 mm
4. 0 mm
5. 0 mm
6. 0 mm

Cylinder firing pressures

1. 940 psi
2. 940 psi
3. 900 psi
4. 940 psi
5. 900 psi
6. 940 psi

Generator

.91 PF

Voltage 4257 kw

Winding temperatures

- W1 55° C
W2 54° C
W3 55° C
W4 55° C
W5 54° C
W6 55° C

31 August 2019

Dual Fuel

Speed. 450 rpm

Load. 2218 kw

Crankcase pressure. -.4 in (manometer)

Air manifold temperature. 95° F

Air manifold pressure. 29.65 in Hg

Air flow: 6089 SCFM

Fuel oil pressure. 33 psi

Fuel regulator gas pressure. 55 psi

Fuel header gas pressure. 39 psi

Oil temperature In. 166° F Out 177° F

Oil pressure In. 51 psi

Turbocharger oil pressure. 28 psi



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Turbocharger speed. 20000 rpm.

Oil level in sump. 35 in

Jacket water pressure. 9 psi (gauge)

Jacket water temperature in. 173 ° F Out. 178° F

Engine vibration. .010 in/sec (10 ml)

Charge air cooler temperature; 103° F

Main bearing temperatures.

1. 177° F

2. 175° F

3. 176° F

4. 174° F

5. 175°F

6. 174° F

7. 173° F

8. 173° F

9. 174° F

Pedestal bearing. 53°C

Exhaust temperatures.

1. 810° F

2. 847° F

3. 836° F

4. 831° F

5. 826° F

6. 826° F

Post turbo exhaust. 873° F

Fuel rack position.

1. 0 mm

2. 0 mm

3. 0 mm

4. 0 mm

5. 0 mm

6. 0 mm

Cylinder firing pressures

1. 980 psi

2. 1000 psi

3. 1040 psi

4. 1000 psi

5. 980 psi

6. 980 psi

Generator

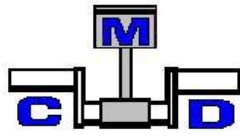
.90 PF

Voltage 4205 kw

59.96 Hz

Winding temperatures

W1 57° C



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W2 56° C
W3 57° C
W4 55° C
W5 55° C
W6 55° C

3 September 2019

Dual Fuel

Speed. 450 rpm

Load. 2378 kw

Crankcase pressure. -.4 in (manometer)

Air manifold temperature. 96° F

Air manifold pressure. 31.81 in Hg

Air flow: 6330 SCFM

Fuel oil pressure. 33 psi

Fuel regulator gas pressure. 55 psi

Fuel header gas pressure. 44 psi

Oil temperature In. 166° F Out 178° F

Oil pressure In. 49 psi

Turbocharger oil pressure. 26 psi

Turbocharger speed. 20700 rpm.

Oil level in sump. 35 in

Jacket water pressure. 9 psi (gauge)

Jacket water temperature in. 173 ° F Out. 178° F

Engine vibration. .010 in/sec (10 ml)

Charge air cooler temperature; 104° F

Main bearing temperatures.

1. 176° F

2. 176° F

3. 176° F

4. 174° F

5. 175° F

6. 174° F

7. 173° F

8. 173° F

9. 174° F

Pedestal bearing. 60°C

Exhaust temperatures.

1. 845° F

2. 846° F

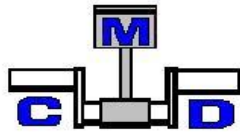
3. 863° F

4. 844° F

5. 850° F

6. 840° F

Post turbo exhaust. 888° F



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Fuel rack position.

1. 0 mm
2. 0 mm
3. 0 mm
4. 0 mm
5. 0 mm
6. 0 mm

Cylinder firing pressures

1. 940 psi
2. 1000 psi
3. 1000 psi
4. 1000 psi
5. 980 psi
6. 1020 psi

Generator

.92 PF

Voltage 4153 kw

60 Hz

Winding temperatures

- W1 58° C
W2 57° C
W3 57° C
W4 58° C
W5 57° C
W6 57° C

Observed temperature measurement using hand held thermometer inside crankcase following shutdown.

MAIN BEARINGS

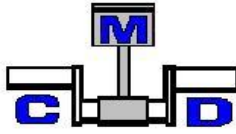
1. 162° F
2. 163° F
3. 164° F
4. 167° F
5. 168° F
6. 165° F
- 7 167° F
- 8 165° F
- 9 164° F

CONNECTING RODS

- 161° F
- 166° F
- 162° F
- 167° F
- 165° F
- 161° F

PISTONS

- 166° F
- 167° F
- 169° F
- 170° F
- 170°
- 169° F



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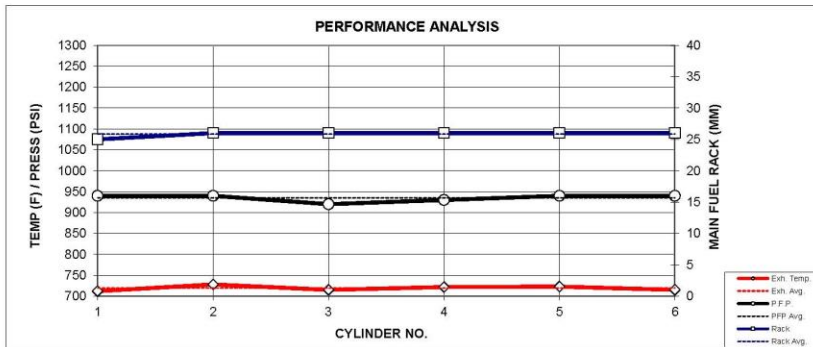
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PERFORMANCE DATA (75% LOAD) 2 HOUR

CUSTOMER	EBMUD	ENGINE S/N	82004-3063	MODEL	DGSR-46-CB	PRESSURES	TEMPERATURES
LOG NO.	N/A	DATE	8/26/2019	TIME	0:00	AIR MFD. 20.9 " HG	AIR MFD. 95 F
FUEL MODE	DIESEL	LOAD (KW)	1612	BMEP	137.5	ENG L.O. 52 PSI	L.O. IN 167 F
						TURBO L.O. 31 PSI	L.O. OUT 178 F
						F.O. MFD 26 PSI	J.W. IN 173 F
						F.G. HDR 26 PSI	J.W. OUT 176 F
						C.C. VAC. -0.3 " H2O	I.C. H2O OUT 105 F
							EXH. STACK 752 F
							M.B. F.F. 178 F
							M.B. F.R. 177 F
							M.B. 1 177 F
							M.B. 2 176 F
							M.B. 3 178 F
							M.B. 4 175 F
							M.B. 5 174 F
							M.B. F.R. 174 F
							M.B. R.R. 174 F



CONNECTING ROD TEMPERATURE: 1 2 3 4 5 6

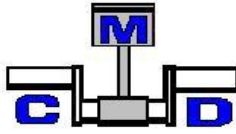
NOTES:

BORE	17	IN
STROKE	21	IN
RPM	450	RPM
KW	2150	KW
BHP	2980	BHP
BMEP	183.4	PSI
TIMING-PRI	23	"BTDC
TIMING-SEC	28	"BTDC

GENERATOR RATING

OUTPUT	KVA
PWR FACTOR	0.91 COS PHI
PHASES	
AMPS	A
VOLTS	4255 V

TURBOCHARGER RATING	
MAKE	
TYPE	
MAX SPEED	RPM
MAX TEMP.	F



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PERFORMANCE DATA (50% LOAD) 2 HOUR

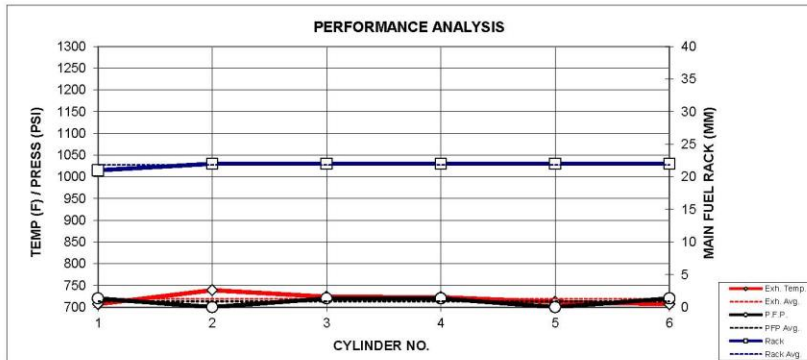
CUSTOMER EBMUD ENGINE S/N 82004-3063 MODEL DGSR-46-CB
LOG NO. N/A DATE 8/26/2019 TIME _____
FUEL MODE DIESEL LOAD (KW) 1075 BMEP 91.7

PRESSURES
AIR MFD. 9.7 " HG
ENG L.O. 52 PSI
TURBO L.O. 33 PSI
F.O. MFD. 29 PSI
F.G. HDR. _____ PSI
C.C. VAC. -0.3 " H2O

TEMPERATURES
AIR MFD. 95 F
L.O. IN 166 F
L.O. OUT 172 F
J.W. IN 172 F
J.W. OUT 175 F
I.C. H2O OUT 103 F
EXH. STACK 721 F
M.B. F.F. 177 F
M.B. F.R. 176 F
M.B. 1 176 F
M.B. 2 176 F
M.B. 3 179 F
M.B. 4 174 F
M.B. 5 173 F
M.B. F.R. 173 F
M.B. R.R. 173 F

Cylinder No.	Exh. Temp.	Exh. Avg.	P.F.P.	PFP Avg.	Rack	Rack Avg.
1	707	719	720	713	21	22
2	739	719	700	713	22	22
3	724	719	720	713	22	22
4	723	719	720	713	22	22
5	712	719	700	713	22	22
6	707	719	720	713	22	22

MISCELLANEOUS
GAS RATIO N/A % GAS
AIR DUMP _____ % OPEN
TURBO RPM 12900 RPM
ENG VIB. N/A MIL P-P
TURBO VIB. N/A MIL P-P

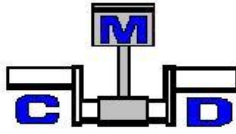


NOTES:

RATING
BORE 17 IN
STROKE 21 IN
RPM 450 RPM
KW 2150 KW
BHP 2980 BHP
BMEP 183.4 PSI
TIMING-PRI 23 °BTDC
TIMING-SEC 28 °BTDC

GENERATOR RATING
OUTPUT 0.92 KVA
PWR FACTOR _____ COS PHI
PHASES _____ A
AMPS _____ A
VOLTS 4232 V

TURBOCHARGER RATING
MAKE _____
TYPE _____
MAX SPEED _____ RPM
MAX TEMP. _____ F



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

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PERFORMANCE DATA (35% LOAD) 1 HOUR

CUSTOMER EBMUD ENGINE S/N 82004-3063 MODEL DGSR-46-CB
LOG NO. N/A DATE 8/26/2019 TIME 0:00
FUEL MODE DIESEL LOAD (KW) 735 BMEP 62.7

Cylinder No.	Exh. Temp.	Exh. Avg.	P.F.P.	PFP Avg.	Rack	Rack Avg.
1	636	662	610	610	18	19
2	669	662	620	610	19	19
3	660	662	620	610	19	19
4	674	662	620	610	19	19
5	670	662	580	610	19	19
6	665	662	610	610	19	19

PRESSURES
AIR MFD. 5.26 " HG
ENG L.O. 53 PSI
TURBO L.O. PSI
F.O. MFD PSI
F.G. HDR PSI
C.C. VAC. " H2O

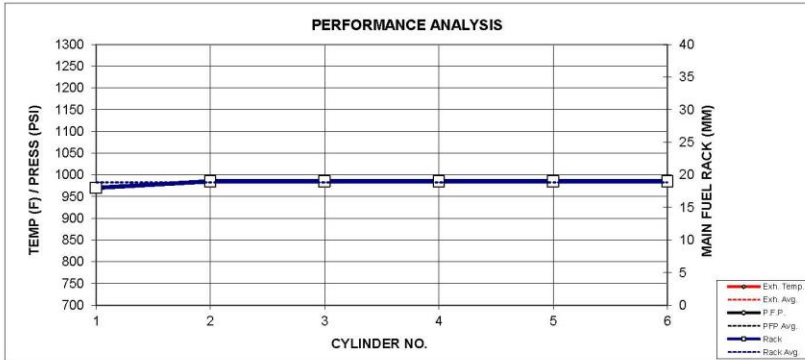
MISCELLANEOUS
GAS RATIO N/A % GAS
AIR DUMP % OPEN
TURBO RPM RPM
ENG VIB. N/A MIL P-P
TURBO VIB. N/A MIL P-P

TEMPERATURES
AIR MFD. 99 F
L.O. IN 166 F
L.O. OUT 170 F
J.W. IN 172 F
J.W. OUT 174 F
I.C. H2O OUT 102 F
EXH. STACK F
M.B. F.F. 176 F
M.B. F.R. 174 F
M.B. 1 175 F
M.B. 2 175 F
M.B. 3 179 F
M.B. 4 173 F
M.B. 5 171 F
M.B. F.R. 172 F
M.B. R.R. 172 F

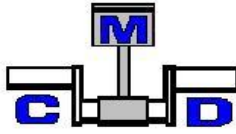
RATING
BORE 17 IN
STROKE 21 IN
RPM 450 RPM
KW 2150 KW
BHP 2980 BHP
BMEP 183.4 PSI
TIMING-PRI 23 °BTDC
TIMING-SEC 28 °BTDC

GENERATOR RATING
OUTPUT 735 KVA
PWR FACTOR 0.92 COS PHI
PHASES
AMPS A
VOLTS 4210 V

TURBOCHARGER RATING
MAKE
TYPE
MAX SPEED RPM
MAX TEMP. F



NOTES:



CALIFORNIA MARINE DIESEL, INC.

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PERFORMANCE DATA (20% LOAD - 537 KW) 1 HOUR TOTAL RH:172,928

CUSTOMER	EBMUD	ENGINE S/N	82004-3063	MODEL	DGSR-46-CB	PRESSURES	TEMPERATURES
LOG NO.	N/A	DATE	8/23/2019	TIME	4.42	AIR MFD. 2.47 " HG	AIR MFD. 95 F
FUEL MODE	DIESEL	LOAD (KW)	500	BMEP	42.7	ENG L.O. 60 PSI	L.O. IN 138 F
						TURBO L.O. 42 PSI	L.O. OUT 140 F
						F.O. MFD 32 PSI	J.W. IN 158 F
						F.G. HDR PSI	J.W. OUT 158 F
						C.C. VAC. " H2O	I.C. H2O OUT 84 F
							EXH. STACK 546 F
							M.B. F.F. 145 F
							M.B. F.R. 142 F
							M.B. 1 144 F
							M.B. 2 143 F
							M.B. 3 150 F
							M.B. 4 141 F
							M.B. 5 141 F
							M.B. F.R. 138 F
							M.B. R.R. 140 F

Cylinder No.	Exh. Temp.	Exh. Avg.	P.F.P.	PFP Avg.	Rack	Rack Avg.
1	547	572	0	0	14	15
2	575	572	0	0	15	15
3	574	572	0	0	15	15
4	575	572	0	0	15	15
5	585	572	0	0	15	15

MISCELLANEOUS	
GAS RATIO	N/A % GAS
AIR DUMP	% OPEN
TURBO RPM	8000 RPM
ENG VIB.	N/A MIL P-P

PERFORMANCE ANALYSIS

TEMP (F) / PRESS (PSI)

MAIN FUEL RACK (MM)

CYLINDER NO.

Legend: Exh. Temp. (red line), Exh. Avg. (red line), P.F.P. (black line), PFP Avg. (black line), Rack (blue line), Rack Avg. (blue line)

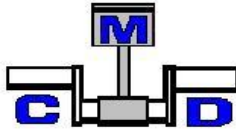
CON ROD	1	2	3	4	5	6
TEMP	162	164	178	177	179	162

NOTES:

RATING	
BORE	17 IN
STROKE	21 IN
RPM	450 RPM
KW	2150 KW
BHP	2980 BHP
BMEP	183.4 PSI
TIMING-PRI	23 °BTDC
TIMING-SEC	28 °BTDC

GENERATOR RATING	
OUTPUT	KVA
PWR FACTOR	0.89 COS PHI
PHASES	A
AMPS	
VOLTS	4164 V

TURBOCHARGER RATING	
MAKE	
TYPE	
MAX SPEED	RPM
MAX TEMP.	F



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PERFORMANCE DATA (NO LOAD) 15 MINUTES

CUSTOMER	EBMUD	ENGINE S/N	82004-3063	MODEL	DGSR-46-CB
LOG NO.	N/A	DATE	8/23/2019	TIME	15:50
FUEL MODE	DIESEL	LOAD (KW)	0	BMEP	0.0

Cylinder No.	Exh. Temp.	Exh. Avg.	P.F.P.	PFP Avg.	Rack	Rack Avg.
1		0	0	0	0	0
2		0	0	0	0	0
3		0	0	0	0	0
4		0	0	0	0	0
5		0	0	0	0	0
6		0	0	0	0	0

PRESSURES	
AIR MFD.	" HG
ENG L.O.	PSI
TURBO L.O.	PSI
F.O. MFD.	PSI
F.G. HDR.	PSI
C.C. VAC.	" H2O

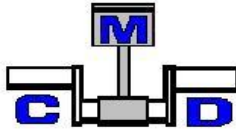
TEMPERATURES	
AIR MFD.	F
L.O. IN	F
L.O. OUT	F
J.W. IN	F
J.W. OUT	F
I.C. H2O OUT	F
EXH. STACK	F
M.B. F.F.	F
M.B. F.R.	F
M.B. 1	F
M.B. 2	F
M.B. 3	F
M.B. 4	F
M.B. 5	F
M.B. F.R.	F
M.B. R.R.	F

MISCELLANEOUS	
GAS RATIO	N/A % GAS
AIR DUMP	% OPEN
TURBO RPM	RPM
ENG VIB.	N/A MIL P-P
TURBO VIB.	N/A MIL P-P

PERFORMANCE ANALYSIS

CONNECTING ROD TEMPERATURE: 1 2 3 4 5 6

NOTES:



CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813

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PERFORMANCE DATA

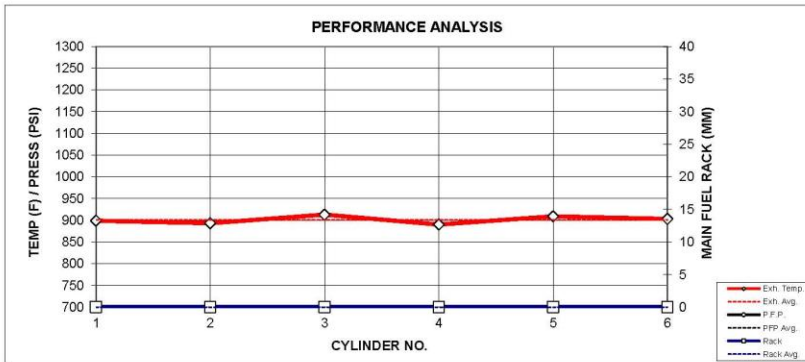
CUSTOMER EBMUD ENGINE S/N 82004-3063 MODEL DGSR-46-CB
LOG NO. N/A DATE 8/27/2019 TIME 18:30
FUEL MODE CLEANBURN LOAD (KW) 2150 BMEP 183.4

PRESSURES
AIR MFD. 32.35 " HG
ENG L.O. 46 PSI
TURBO L.O. 29 PSI
F.O. MFD. 42 PSI
F.G. HDR. 53.4 PSI
C.C. VAC. N/A " H2O

TEMPERATURES
AIR MFD. 95 F
L.O. IN 161 F
L.O. OUT 166 F
J.W. IN 171 F
J.W. OUT 179 F
I.C. H2O OUT 102 F
EXH. STACK 845 F
M.B. F.F. 165 F
M.B. F.R. 165 F
M.B. 1 164 F
M.B. 2 165 F
M.B. 3 166 F
M.B. 4 165 F
M.B. 5 164 F
M.B. F.R. 166 F
M.B. R.R. 168 F

Cylinder No.	Exh. Temp.	Exh. Avg.	P.F.P.	PFP Avg.	Rack	Rack Avg.
1	899	901	0	0	0	0
2	893	901	0	0	0	0
3	913	901	0	0	0	0
4	890	901	0	0	0	0
5	909	901	0	0	0	0
6	903	901	0	0	0	0

MISCELLANEOUS
GAS RATIO 100 % GAS
AIR DUMP 30 % OPEN
TURBO RPM 20000 RPM
ENG VIB. N/A MIL P-P
TURBO VIB. N/A MIL P-P



NOTES:

RATING
BORE 17 IN
STROKE 21 IN
RPM 450 RPM
KW 2150 KW
BHP 2980 BHP
BMEP 183.4 PSI
TIMING-PRI 23 °BTDC
TIMING-SEC 28 °BTDC

GENERATOR RATING
OUTPUT KVA
PWR FACTOR COS PHI
PHASES
AMPS A
VOLTS V

TURBOCHARGER RATING
MAKE
TYPE
MAX SPEED RPM
MAX TEMP. F

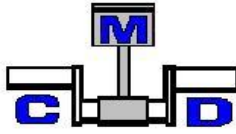


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CRANKSHAFT DEFLECTION POST OVERHAUL																																														
Installation: EBMUD	Engine Type: ENTERPRISE DSR-46CB	Work Order:	Job No:	Date: August 26, 2019																																										
Running Hours:	Place: OAKLAND, CA	Engine No. UNIT 2	Serial Number: 82004-3063-3063																																											
Operating side Rear side As seen from flywheel end Thrust Clearance: <u>0.022</u> " Temperature: <u>154.00</u> F <i>All readings in 1/1000 inch</i> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr style="background-color: #f2f2f2;"> <th>CYL No.</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>6</th> </tr> </thead> <tbody> <tr style="background-color: #f2f2f2;"> <td>A</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>B</td> <td>+ .0005</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>+ .0005</td> </tr> <tr style="background-color: #f2f2f2;"> <td>C</td> <td>+ .001</td> <td>+ .00075</td> <td>0</td> <td>- .001</td> <td>+ .001</td> <td>- .002</td> </tr> <tr> <td>D</td> <td>0</td> <td>0</td> <td>- .001</td> <td>- .002</td> <td>+ .001</td> <td>- .002</td> </tr> <tr style="background-color: #f2f2f2;"> <td>E</td> <td>0</td> <td>- .00025</td> <td>- .001</td> <td>- .001</td> <td>+ .00075</td> <td>+ .001</td> </tr> </tbody> </table> Remarks:					CYL No.	1	2	3	4	5	6	A	0	0	0	0	0	0	B	+ .0005	0	0	0	0	+ .0005	C	+ .001	+ .00075	0	- .001	+ .001	- .002	D	0	0	- .001	- .002	+ .001	- .002	E	0	- .00025	- .001	- .001	+ .00075	+ .001
CYL No.	1	2	3	4	5	6																																								
A	0	0	0	0	0	0																																								
B	+ .0005	0	0	0	0	+ .0005																																								
C	+ .001	+ .00075	0	- .001	+ .001	- .002																																								
D	0	0	- .001	- .002	+ .001	- .002																																								
E	0	- .00025	- .001	- .001	+ .00075	+ .001																																								



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LONG BEACH, CA 90813

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PERFORMANCE DATA (100% LOAD) 2 HOUR

CUSTOMER	EBMUD	ENGINE S/N	82004-3063	MODEL	DGSR-46-CB
LOG NO.	N/A	DATE	8/26/2019	TIME	1700-1900
FUEL MODE	DIESEL	LOAD (KW)	2160	BMEP	184.3

Cylinder No.	Exh. Temp.	Exh. Avg.	P.F.P.	PFP Avg.	Rack	Rack Avg.
1	724	720	1240	1217	31	32
2	717	720	1240	1217	32	32
3	707	720	1220	1217	32	32
4	712	720	1200	1217	32	32
5	738	720	1200	1217	32	32
6	723	720	1200	1217	32	32

PRESSURES	
AIR MFD.	37.39 " HG
ENG L.O.	52 PSI
TURBO L.O.	31 PSI
F.O. MFD	24 PSI
F.G. HDR	PSI
C.C. VAC.	-0.3 " H2O

TEMPERATURES	
AIR MFD.	97 F
L.O. IN	163 F
L.O. OUT	179 F
J.W. IN	171 F
J.W. OUT	173 F
I.C. H2O OUT	96 F
EXH. STACK	723 F
M.B. F.F.	177 F
M.B. F.R.	176 F
M.B. 1	176 F
M.B. 2	174 F
M.B. 3	175 F
M.B. 4	174 F
M.B. 5	173 F
M.B. F.R.	173 F
M.B. R.R.	173 F

MISCELLANEOUS	
GAS RATIO	N/A % GAS
AIR DUMP	% OPEN
TURBO RPM	21600 RPM
ENG VIB.	N/A MIL P-P
TURBO VIB.	N/A MIL P-P

CONNECTING ROD TEMPERATURE:	1	2	3	4	5	6
	152	154	146	147	157	153

NOTES:



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TABLE OF EBMUD SIGNED TORQUE VERIFICATION SHEETS

SIGNED TORQUE VERIFICATION SHEET CONNECTING RODS

SIGNED TORQUE VERIFICATION SHEET COUNTERWEIGHTS

SIGNED TORQUE VERIFICATION SHEET FLYWHEEL BOLTS

SIGNED TORQUE VERIFICATION SHEET FOUNDATION BOLTS

SIGNED TORQUE VERIFICATION SHEET FUEL PUMP BASES, FUEL PUMPS, FUEL INJECTORS

SIGNED TORQUE VERIFICATION SHEET GENERATOR

SIGNED TORQUE VERIFICATION SHEET MAIN BEARING CAPS

SIGNED TORQUE VERIFICATION SHEET SUBCOVERS

SIGNED TORQUE VERIFICATION SHEET THRU BOLTS

SIGNED TORQUE VERIFICATION SHEET UPPER BLOCK TO BASE BOLTS

SIGNED TORQUE VERIFICATION SHEET CAMSHAFT GEAR HUB ADAPTER SUPPORT

SIGNED TORQUE VERIFICATION SHEET CAMSHAFT TAPPET HOUSING BOLTS, CAMSHAFT BEARING CAPS

SIGNED TORQUE VERIFICATION SHEET CYLINDER HEADS



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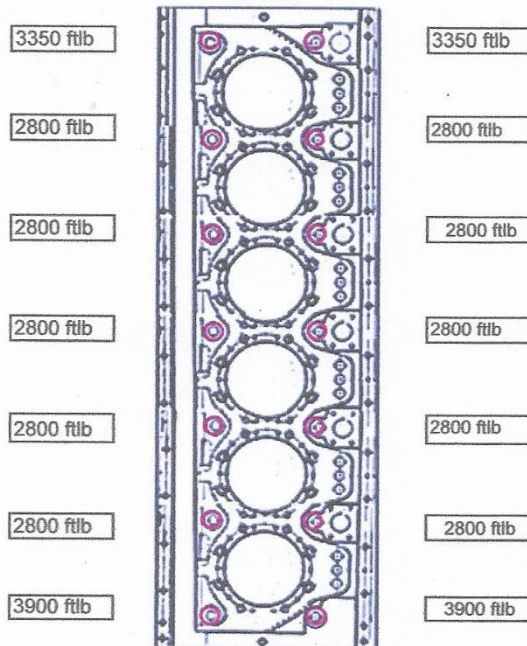


CALIFORNIA MARINE DIESEL INC.

TORQUE VERIFICATION SHEET UPPER BLOCK THRU BOLTS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		July 2, 2019
References		Data Recorded By
		JUAN REYES
Memo		
Upper block thru bolts run from the top of the upper block to the lower engine base. Torque on the upper block thru bolts are 2 front bolts 3350 ftlb; intermediate 2800 ftlb; 2 flywheel bolts 3900 ftlb. Thru bolts were torqued using Mountz NORBAR PT-7 pneumatic torque multiplier serial number 1841/16999. Torque engine thru bolts with PT-7: intermediate 2800 ftlb (38 psi new calibration 1psi/73ftlb); gearset end 3350 ftlb (46 psi new calibration 1 psi/73ftlb); flywheel end 3900 ftlb (53 psi new calibration 1 psi/73ftlb).		

Bolts are tightened from the center outward and crsiccrossed across the engine left to right.

ENGINE FRONT

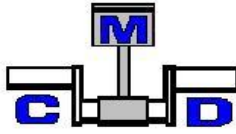


FLYWHEEL

NOTE: Found exhaust side thru bolt broken at top nut 10 September 2019. Set replacement upper block 15 Septemebr 2019. Removed upper block 4 April 2019 after discovering bent crankshaft at water pump drive shaft to #1 main bearing. New thru bolt made by Horsepool and Romine (San Leandro, Ca) to replace broken thru bolt.

SIGNATURE

Alan Romine



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LONG BEACH, CA 90813

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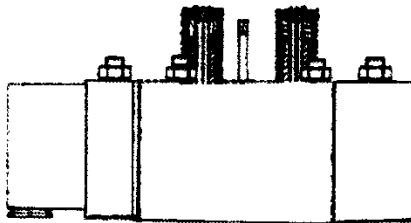
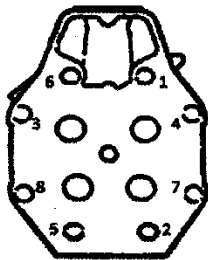
CALIFORNIA MARINE DIESEL

SIGNED TORQUE VERIFICATION SHEET CYLINDER HEADS

EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		July 5, 2019
References		Date Recorded By
		GENERO PANTELEON/ JUAN REYES
Memo		
Cylinder head nuts: 3600 ftlb using Mountz PT 7 : pneumatic torque multiplier serial number 1841-16999: 1200 ftlb = 16 psi; 2400 ftlb = 32 psi; 3600 ftlb = 49 psi		

Subcovers bolt torque: 3600 ftlb 3 steps:

TORQUE PATTERN



CYLINDER #	Initial
1	5-Jul-19 CRH
2	5-Jul-19 CRH
3	5-Jul-19 CRH
4	5-Jul-19 CRH
5	5-Jul-19 CRH
6	5-Jul-19 CRH

Mountz PT7 pneumatic torque multiplier serial number 1841-16999 was used for torque. The rated torque differs for each Pt-7 based on calibration. The following are the rated and calibrated pressures for torque of 3600 ftlb.: Step 1. 600 ftlb with torque wrench to seat head.; Step 2. 16 psi with Mountz Pt-7 torque multiplier.; Step 3. 32 psi with Mountz PT-7 torque multiplier.; Step 4. 49 psi with Mountz Pt-7 torque multiplier. (EBMUD Pt-7 was rated at 15 psi; 30 psi and 41 psi.)

SIGNED

Genero Pantaleon



CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813

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CALIFORNIA MARINE DIESEL INC.

TORQUE VERIFICATION SHEET MAIN BEARING CAPS

Customer		Engine Location	
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA	
Engine Model	Serial No.	Customer Designation	
DSRG-46	82004-3063	UNIT 2	
Total Engine Hours	Hours Since Last Inspection	Date This Inspection	
		13JUN19 26JUN19	
References		Data Recorded By	
		GENERO PANTELEON	
Memo			
Main bearings are tightened in 4 steps (500 ftlb; 1000 ftlb; 1500ftlb; 2150 ftlb final). Main bearing nuts are tightened to 2150ftlb torque using Hytorc hydraulic driven wrench model HY-3XLT serial No FE6594 1 inch drive. 500 ftlb - 1600 psi; 1000 ftlb 3200 psi; 1500 ftlb - 4800 psi; 2150 ftlb- 6600psi			

Main Bearing nut torque: 2150 ftlb. 4 steps: 500 ftlb 1000ftlb; 1500 ftlb; 2150 ftlb diagonally tightened.

		ENGINE FRONT				500 FTLB 1000 FTLB 1500 FTLB 2150 FTLB				Initial
Main Bearing	1					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	JR
	2					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	
Torque pattern	3					26-Jun-19	26-Jun-19	26-Jun-19	26-Jun-19	JR
	4					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	JR
	5					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	JR
	6					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	JR
	7					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	JR
	8					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	JR
	9					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	

NOTE: Main bearings were removed and crankshaft sent out for reconditioning to Goltens Miami, FL. Crankshaft had .019 bend on water pump drive shaft and water spots (lead oxide) stains on the main journals and crankpins. #3 main journal was replaced on 26 Jun3 2019 after finding bearing overlay coming off at the 7 o'clock position.

SIGNED

Alan Hernandez



CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813

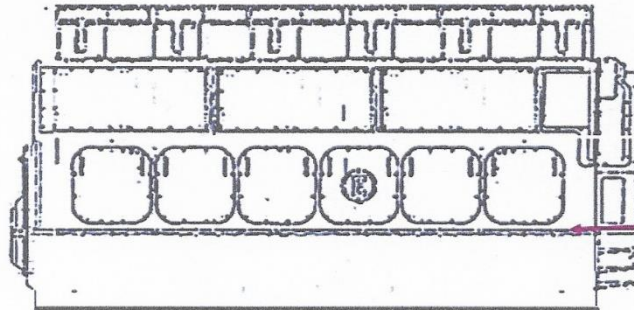
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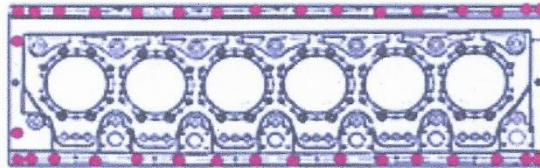
TORQUE VERIFICATION SHEET CYLINDER BLOCK FOOT TO BASE BOLTS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		6/29/2019, 7/22/2019
References		Data Recorded By
		ALAN HENRICKSON
Memo		
Cylinder block foot to base bolts are torqued to 325 ftlb crisscrossing from the center outward in both directions. Tightening was done using a Williams 200 ftlb- 600 ftlb click type torque wrench Model WSC-600 serial number 1018. 3/4 inch drive hystorc used on flywheel side bolts to torque to 325 ftlb using HY-1XLT serial number 007-2589; 325 ftlb - 2400 psi.		

Bolts are tightened to 325 ftlb from the center outward and crisscrossed across the engine from intake to exhaust.



CYLINDER BLOCK FOOT TO BASE
BOLTS 16 EACH SIDE 2 ON
FLYWHEEL SIDE

FLYWHEEL



GEARCASE

--

SIGNATURE

Alan Henrickson



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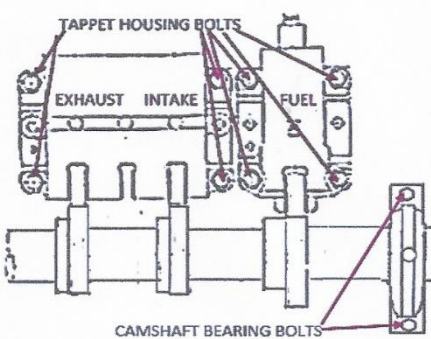
CALIFORNIA MARINE DIESEL INC.

TORQUE VERIFICATION SHEET CAMSHAFT TAPPET HOUSING BOLTS, CAMSHAFT BEARING CAPS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 14, 2018
References		Data Recorded By
		ALAN HENRICKSON / DAVID FIERO
Memo		
Camshaft bearing cap bolts and tappet housing bolts tighten to 200 ftlb torque using a PROTO 250 ftlb click type torque wrench serial number DSH45721 then wire tied in pairs. Camshaft bearing caps are held in place after tighten to torque by lock tabs.		

Camshaft tappet housing bolts torque (air and fuel): 200 ftlb

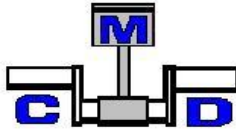
Camshaft bearing cap bolts torque: 200 ftlb

CYLINDER#	AIR	FUEL	BEARINGS	Initial
1	200 ftlb	200 ftlb	200 ftlb	ARH
2	200 ftlb	200 ftlb	200 ftlb	ARH
3	200 ftlb	200 ftlb	200 ftlb	ARH
4	200 ftlb	200 ftlb	200 ftlb	ARH
5	200 ftlb	200 ftlb	200 ftlb	ARH
6	200 ftlb	200 ftlb	200 ftlb	ARH
7			200ftlb	ARH



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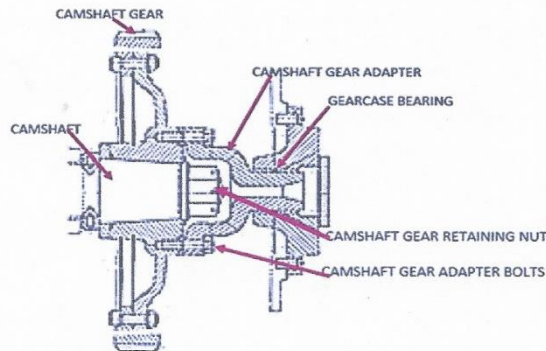
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TORQUE VERIFICATION SHEET CAMSHAFT GEAR HUB CAMSHAFT ADAPTER SUPPORT		
Customer EAST BAY MUNICIPAL UTILITIES DISTRICT		Engine Location OAKLAND, CA
Engine Model DSRG-46	Serial No. 82004-3063	Customer Designation UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection 6 March 2019, 27 July 2019
References		Data Recorded By ALAN HENRICKSON / DAVID FIERO
Memo Camshaft hub gear retaining nut tighten to 1800 ftlb torque using Hytorc hydraulic driven wrench model HY-3XLT serial No FE6594 1 inch drive 1800 ftlb - 5600 psi then rotate to insert cotter pin. Camshaft adapter support bolts are tightened to 60 ftlb using a PROTO 250 ftlb click type torque wrench serial number DSH45721 and then held with lock tabs.		

Camshaft gear hub retaining nut torque: 1800 ftlb.
Camshaft adapter support torque: 60 ftlb



Camshaft gear hub retaining nut torque to 1800 ftlb
Camshaft adapter support bolts torque to 60 ftlb

ARV
DFW

--

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TORQUE VERIFICATION SHEET SUBCOVERS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		5 July 2019, 10 July 2019
References		Data Recorded By
		GENERO PANTELEON/ ALAN HENRICKSON
Memo		
Subcovers were tightened to 120 ftlb using a PROTO 250 ftlb click type 1/2 inch drive torque wrench serial number DSH45721. Rocker arms were tightened to 365 ftlb torque using a Williams 600 ftlb 3/4 drive click type torque wrench Model WSC-600 serial number 1018.		

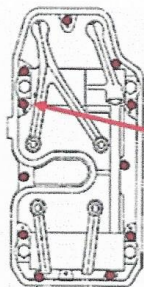
Subcover bolt torque: 120 ftlb

Rocker arm stanchion bolt torque: 365 ftlb

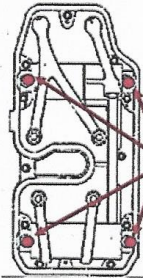
TORQUE PATTERN:

Subcovers: Crisscross or star

Rocker arms: Pul down rocker arms evenly go back and forth on same rocker arm.



SUBCOVER BOLTS



ROCKER ARM STANCHION BOLTS

CYLINDER #	Initial
1	10-Jul-19 5-Jul-19 <i>GRH</i>
2	10-Jul-19 5-Jul-19 <i>GRH</i>
3	10-Jul-19 5-Jul-19 <i>GRH</i>
4	10-Jul-19 5-Jul-19 <i>GRH</i>
5	10-Jul-19 5-Jul-19 <i>GRH</i>
6	5-Jul-19 5-Jul-19 <i>GRH</i>

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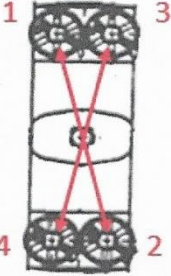
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TORQUE VERIFICATION SHEET MAIN BEARING CAPS		
Customer EAST BAY MUNICIPAL UTILITIES DISTRICT		Engine Location OAKLAND, CA
Engine Model DSRG-46	Serial No. 82004-3063	Customer Designation UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection 13JUN19 26JUN19
References		Data Recorded By GENERO PANTELEON/ ALAN HENRICKSON
Memo Main bearings are tightened in 4 steps (500 ftlb; 1000 ftlb; 1500ftlb; 2150 ftlb final). Main bearing nuts are tightened to 2150ftlb torque using Hylor hydraulic driven wrench model HY-3XLT serial No FE6594 1 inch drive. 500 ftlb - 1600 psi; 1000 ftlb 3200 psi; 1500 ftlb - 4800 psi; 2150 ftlb- 6600psi		

Main Bearing nut torque: 2150 ftlb. 4 steps: 500 ftlb 1000ftlb; 1500 ftlb; 2150 ftlb diagonally tightened.

ENGINE FRONT		500 FTLB	1000 FTLB	1500 FTLB	2150 FTLB	Initial
Main Bearing Torque pattern 	1	13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	ARH
	2	13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	ARH
	3	26-Jun-19	26-Jun-19	26-Jun-19	26-Jun-19	ARH
	4	13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	ARH
	5	13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	ARH
	6	13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	ARH
	7	13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	ARH
	8	13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	ARH
	9	13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	ARH

NOTE: Main bearings were removed and crankshaft sent out for reconditioning to Goltens Miami, FL. Crankshaft had .019 bend on water pump drive shaft and water spots (lead oxide) stains on the main journals and crankpins. #3 main journal was replaced on 26 Jun3 2019 after finding bearing overlay coming off at the 7 o'clock position.

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TORQUE VERIFICATION SHEET MAIN BEARING CAPS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		13JUN19 26JUN19
References		Data Recorded By
		GENERO PANTELEON
Memo		
Main bearings-(4 steps 500 ftlb; 1000 ftlb; 1500ftlb; 1850 ftlb final).		

Main Bearing nut torque: 1850 ftlb. 4 steps: 500 ftlb 1000ftlb; 1500 ftlb; 1850 ftlb diagonally tightened.

		ENGINE FRONT				500 FTLB 1000 FTLB 1500 FTLB 1850 FTLB				Initial
Main Bearing	1					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	GP
	2					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	GP
Torque pattern	3					26-Jun-19	26-Jun-19	26-Jun-19	26-Jun-19	GP
	4					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	GP
	5					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	GP
	6					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	GP
	7					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	GP
	8					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	GP
	9					13-Jun-19	13-Jun-19	13-Jun-19	13-Jun-19	GP

NOTE: Main bearings were removed and crankshaft sent out for reconditioning to Goltens Miami, FL. Crankshaft had .019 bend on water pump drive shaft and water spots (lead oxide) stains on the main journals and crankpins. #3 main journal was replaced on 26 Jun3 2019 after finding bearing overlay coming off at the 7 o'clock position.

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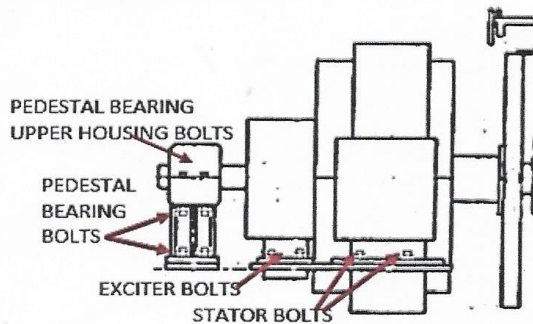
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TORQUE VERIFICATION SHEET GENERATOR STATOR, EXCITER, BEARING		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		27 June 2019, 5-6 August 2019
References		Data Recorded By
		GENERO PANTELEON/ ALAN HENRICKSON
Memo		
Pedestal bearing upper and lower foundation bolts were tightened to 831ftlb torque using a using Hytorc hydraulic wrench model HY-3XLT serial No FE6594 1 inch drive. 831 ftlb - 2600 psi. Stator foundation bolts were tightened to		

Pedestal foundation support 1 1/2 inch bolts torque to 831 ftlb
Pedestal bearing liner 1/2-13 bolts torque to 50 ftlb
Pedestal bearing upper housing 1-8 bolts torque to 216 ftlb.
Stator foundation 1 1/4 bolts torque to 475 ftlb
Exciter bolts torque to 170 ftlb.



Pedestal bearing liner bolts
27-Jun-19 *CPH*

Pedestal bearing upper housing bolts
27-Jun-19 *CPH*

Pedestal bearing bolts
6-Aug-19 *CPH*

Exciter bolts
6-Aug-19 *CPH*

Stator bolts
6-Aug-19 *CPH*

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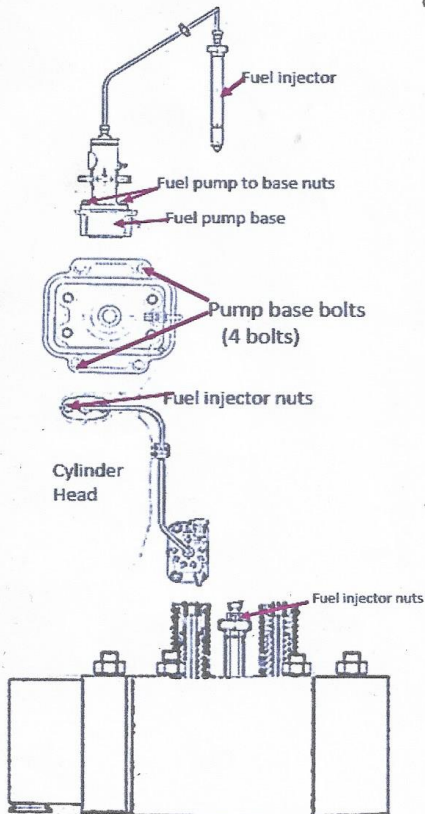
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TORQUE VERIFICATION SHEET FUEL INJECTION PUMP BASES, FUEL PUMP, FUEL INJECTORS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		22-23 July 2019
References		Data Recorded By
		GENERO PANTELEON /JUAN REYES
Memo		
Fuel pump base bolts tighten to 120 ftlb torque. Fuel pump and fuel injectors tighten to 80 ftlb torque. Torque was done using a PROTO 250 ftlb 1/2 inch drive click type torque wrench serial number DSH45721.		

Fuel pump bases torque: 120 ftlb

Fuel pump torque: 80 ftlb

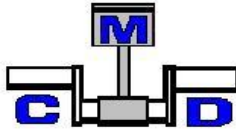
Fuel injectors torque: 80 ftlb



CYLINDER#	Pump base	fuel pump	injector	Initial
1	120 ftlb	80 ftlb	80 ftlb	JR
2	120 ftlb	80 ftlb	80 ftlb	JR
3	120 ftlb	80 ftlb	80 ftlb	JR
4	120 ftlb	80 ftlb	80 ftlb	JR
5	120 ftlb	80 ftlb	80 ftlb	JR
6	120 ftlb	80 ftlb	80 ftlb	JR

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[Signature] / *[Signature]*



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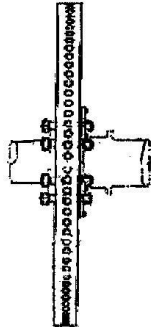
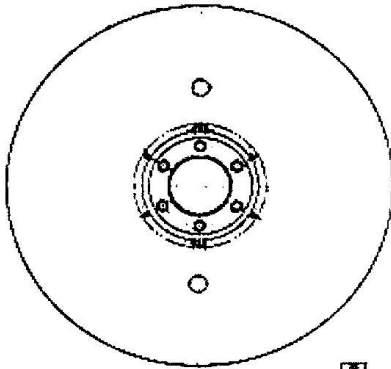


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TORQUE VERIFICATION SHEET FLYWHEEL BOLTS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		July 16, 2019
References		Data Recorded By
		GENERO PANTELEON/ JUAN REYES
Memo		
Flywheel bolts are tightened to 3000ftlb torque using Hytorc hydraulic driven wrench model HY-3XLT serial No FE6594 1 inch drive. 1000 ftlb - 3200 psi; 2000 ftlb - 6400 psi; 3000 ftlb - 9400 psi		

Flywheel bolts torque; 3000 ftlb 3 steps: 1000 ftlb 2000 ftlb 3000 ftlb

TORQUE PATTERN



	1000 ftlb	2000 ftlb	3000 ftlb	Initial
1	16-Jul-19	16-Jul-19	16-Jul-19	JR
2	16-Jul-19	16-Jul-19	16-Jul-19	JR
3	16-Jul-19	16-Jul-19	16-Jul-19	JR
4	16-Jul-19	16-Jul-19	16-Jul-19	JR
5	16-Jul-19	16-Jul-19	16-Jul-19	JR
6	16-Jul-19	16-Jul-19	16-Jul-19	JR

NOTE: 50/50 mixture graphite and oil on flywheel bolts.

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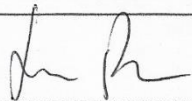
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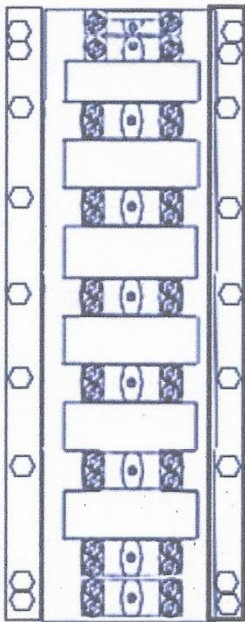


CALIFORNIA MARINE DIESEL INC.

TORQUE VERIFICATION SHEET FOUNDATION BOLTS		
Customer EAST BAY MUNICIPAL UTILITIES DISTRICT		Engine Location OAKLAND, CA
Engine Model DSRG-46	Serial No. 82004-3063	Customer Designation UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection April 2, 2019
References		Data Recorded By JUAN REYES
Memo Foundation bolts are checked for soft foot (looseness). Set a dial indicator on the engine base and loosen the bolt. Add shim under the engine base if necessary. Tighten the foundation bolt to 1400 ftlb torque using Hytorc hydraulic driven wrench model HY-3XLT serial No FE6594 1 inch drive. 735 ftlb - 2400psi		

Each bolt is tightened separately to 735 ftlb.

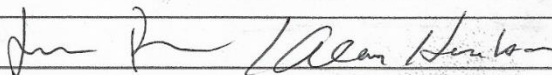
ENGINE FRONT

.001		.001
.003		.002
.0015		.001
.001		0
.0005		.001
.001		.002
.001		.001
.0015		
0		.001

FLYWHEEL

NOTE: Soft foot measured 2 Apr2019 due to bent water pump drive shaft on crankshaft. .002 soft foot found at #3 exhaust side foundation bolt. No action taken due to limits of shim thickness at .002

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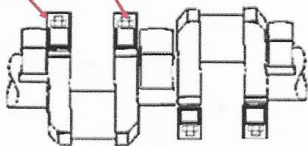
TORQUE VERIFICATION SHEET COUNTERWEIGHTS

Customer		Engine Location	
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA	
Engine Model	Serial No.	Customer Designation	
DSRG-46	82004-3063	UNIT 2	
Total Engine Hours	Hours Since Last Inspection	Date This Inspection	
		June 26, 2019	
References		Data Recorded By	
		GENERO PANTELEON/ JUAN REYES	
Memo			
Counterweight studs (24) and nuts (24) were tightened to 1000 ftlb torque using a Hytorc hydraulically driven 1 inch drive wrench model HY-3XLT serial No FE6594 1 inch drive. 1000 ftlb - 3200 psi.			

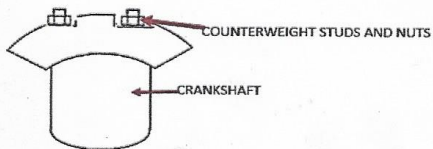
Counterweight studs torque: 1000 ftlb

Counterweight nuts torque: 1000 ftlb

COUNTERWEIGHT STUDS AND NUTS



CYLINDER#	GEARCASE	FLYWHEEL	Initial
1	26-Jun-19	26-Jun-19	JR
2	26-Jun-19	26-Jun-19	JR
3	26-Jun-19	26-Jun-19	JR
4	26-Jun-19	26-Jun-19	JR
5	26-Jun-19	26-Jun-19	JR
6	16-Jun-19	26-Jun-19	JR



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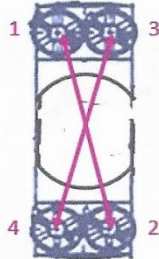
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TORQUE VERIFICATION SHEET CONNECTING RODS		
Customer EAST BAY MUNICIPAL UTILITIES DISTRICT		Engine Location OAKLAND, CA
Engine Model DSRG-46	Serial No. 82004-3063	Customer Designation UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection July 2, 2019
References		Data Recorded By GENERO PANTELEON/ JUAN REYES
Memo #1 connecting rod is reconditioned in 2018. #5 connecting rod was replaced on 15 Sep2018. Connecting rod bolts are tightened to 875ftlb torque using Hytorc hydraulic driven wrench model HY-3XLT serial No FE6594 1 inch drive. 875 ftlb- 2800 psi		

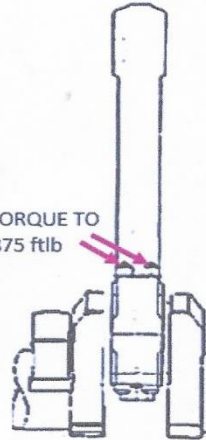
Connecting rod torque: 875 ftlb, 3 steps; 300 ftlb 600 ftlb 875 ftlb

0

Torque pattern



TORQUE TO
875 ftlb



1

300 ftlb	600 ftlb	875 ftlb	Initial
2-Jul-19	2-Jul-19	2-Jul-19	JR

2

2-Jul-19	2-Jul-19	2-Jul-19	JR
----------	----------	----------	----

3

2-Jul-19	2-Jul-19	2-Jul-19	JR
----------	----------	----------	----

4

2-Jul-19	2-Jul-19	2-Jul-19	JR
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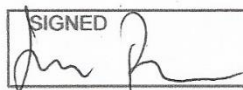
5

2-Jul-19	2-Jul-19	2-Jul-19	JR
----------	----------	----------	----

6

2-Jul-19	2-Jul-19	2-Jul-19	JR
----------	----------	----------	----

NOTE: 1. #5 Connecting rod was replaced due to .057 out of round in the crankpin bore. The replacement connecting rod is designated as 7 at the rod to cap split line for assembly alignment. 2. #1 Connecting rod was reconditioned in 2009 following connecting rod bearing failure. Side thrust on #1 connecting rod is .045 (expected side thrust is .011-.022).

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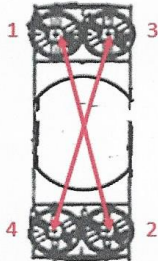
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TORQUE VERIFICATION SHEET CONNECTING RODS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		July 2, 2019
References		Data Recorded By
		GENERO PANTELEON/ JUAN REYES
Memo		
#1 connecting rod is reconditioned in 2018. #5 connecting rod was replaced on 15 Sep2018. Connecting rod bolts are tightened to 875ftlb torque using Hytorc hydraulic driven wrench model HY-3XLT serial No FE6594 1 inch drive. 875 ftlb- 2800 psi		

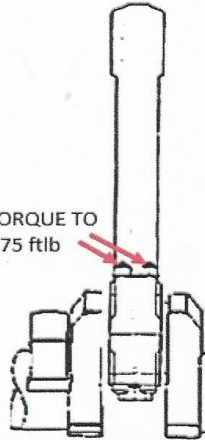
Connecting rod torque: 875 ftlb, 3 steps; 300 ftlb 600 ftlb 875 ftlb

0

Torque pattern



TORQUE TO
875 ftlb



1

300 ftlb	600 ftlb	875 ftlb	Initial
2-Jul-19	2-Jul-19	2-Jul-19	JR

2

2-Jul-19	2-Jul-19	2-Jul-19	JR
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3

2-Jul-19	2-Jul-19	2-Jul-19	JR
----------	----------	----------	----

4

2-Jul-19	2-Jul-19	2-Jul-19	JR
----------	----------	----------	----

5

2-Jul-19	2-Jul-19	2-Jul-19	JR
----------	----------	----------	----

6

2-Jul-19	2-Jul-19	2-Jul-19	JR
----------	----------	----------	----

NOTE: 1. #5 Connecting rod was replaced due to .057 out of round in the crankpin bore. The replacement connecting rod is designated as 7 at the rod to cap split line for assembly alignment. 2. #1 Connecting rod was reconditioned in 2009 following connecting rod bearing failure. Side thrust on #1 connecting rod is .045 (expected side thrust is .011-.022).

SIGNED



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

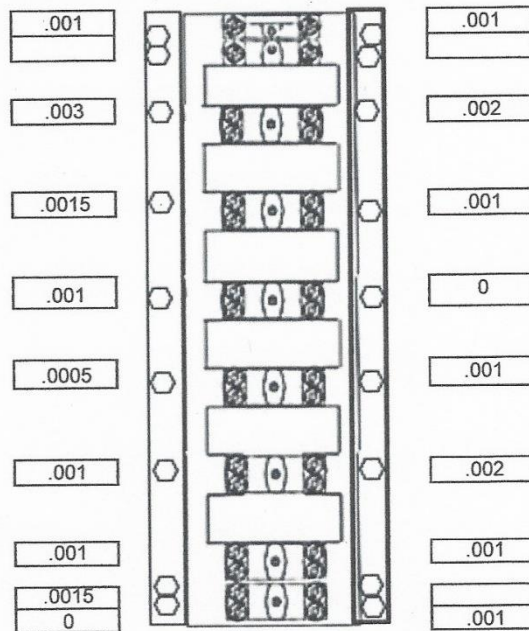


CALIFORNIA MARINE DIESEL INC.

TORQUE VERIFICATION SHEET FOUNDATION BOLTS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		April 2, 2019
References		Data Recorded By
		JUAN REYES
Memo		
Foundation bolts are checked for soft foot (looseness). Set a dial indicator on the engine base and loosen the bolt. Add shim under the engine base if necessary. Tighten the foundation bolt to 1400 ftlb		

Each bolt is tightened separately to 1400 ftlb.

ENGINE FRONT



FLYWHEEL

NOTE: Soft foot measured 2 Apr 2019 due to bent water pump drive shaft on crankshaft. .002 soft foot found at #3 exhaust side foundation bolt. No action taken due to limits of shim thickness at .002

SIGNATURE



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

LIST OF TOOL CALIBRATION CERTIFICATES

MOUNTZ NORBAR PT7 TORQUE MULTIPLIER serial number 1841/16999

HYTORC HY-3XLT Serial number FE6594

HYTORC HY-1XLT Serial number E5001

HYTORC HY-1XLT Serial number CG1692

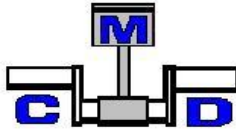
HYTORC Pressure Gauge: Serial number *0015179511

HYTORC Pressure Gauge: Serial number *0087180201

WILLIAMS TORQUE WRENCH Model WSC-600, Serial number 1018

PROTO TORQUE WRENCH 600 ftlb Serial number 9606310005

PROTO TORQUE WRENCH 250 ftlb Serial number DSH47251



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



Calibration Certificate

Certificate No. 496325

Mountz Cal ID: 23477



Calibration Performed By:

MOUNTZ ALABAMA
19051 UNDERWOOD RD.
FOLEY, AL 36535
251-943-4125

Issued To:

CALIFORNIA MARINE DIESEL
1501 W. 15TH ST
LONG BEACH, CA 90813
Sales Order Number: SO193114

Equipment Tested:

Description: NORBAR PT7 TORQUE MULTIPLIER
PNEUMATIC

Serial Number: 1841/16999

Model Number: PT7

Range: 1300 - 4500

Unit of Measure: lbf.ft

Accuracy: 5% REPEATABILITY

Cal. Date: 6/17/2019

Cal. Interval: 12 MONTHS

Cal. Due Date: 6/17/2020

Arrival Condition: MEETS MFG SPEC

Service Performed: CAL TO MFG SPEC

Temp. / RH%: 70 F / 38

Calibration Result: PASS

Uncertainty: 0.89%

Procedure: 3WI-7.1-006

Calibration Notes:

Measurement Data:

Seq.	Reference	Description	Nominal	Tolerance -	Tolerance +	As Found	As Left
1	20 psi	CW 30% Reading 1	1300.00	1235.00	1365.00	1313.06	1313.06
2	20 psi	CW 30% Reading 2	1300.00	1235.00	1365.00	1312.69	1312.69
3	20 psi	CW 30% Reading 3	1300.00	1235.00	1365.00	1339.74	1339.74
4	37 psi	CW 60% Reading 1	2700.00	2565.00	2835.00	2797.33	2797.33
5	37 psi	CW 60% Reading 2	2700.00	2565.00	2835.00	2789.06	2789.06
6	37 psi	CW 60% Reading 3	2700.00	2565.00	2835.00	2783.69	2783.69
7	60 psi	CW 100% Reading 1	4500.00	4275.00	4725.00	4495.57	4495.57
8	60 psi	CW 100% Reading 2	4500.00	4275.00	4725.00	4484.67	4484.67
9	60 psi	CW 100% Reading 3	4500.00	4275.00	4725.00	4478.38	4478.38

Standards Used:

Description	I.D.	Range	Units	Accuracy	Cal. Due	Traceability #
MOUNTZ BMX5000F TORQUE TRANSDUCER FIXED	17917	500 - 5000	lbf.ft	0.5%	1/23/2020	681/281224-11 656414

Work Performed By:

T. HOLLEY
TECHNICIAN

Calibrations are performed using standards traceable to NIST. Our calibration system complies with ANSI/NCSL Z540-1 and ISO17025. This information applies only to the instrument identified above and may not be reproduced, except in full, without prior written consent. Reported uncertainties are expressed as expanded values at approximately the 95% confidence level using a coverage factor of K=2. There is no implied warranty that instrument will maintain its specified tolerances during the calibration interval due to possible drift, environment or other factors beyond our control.

Reviewed By:

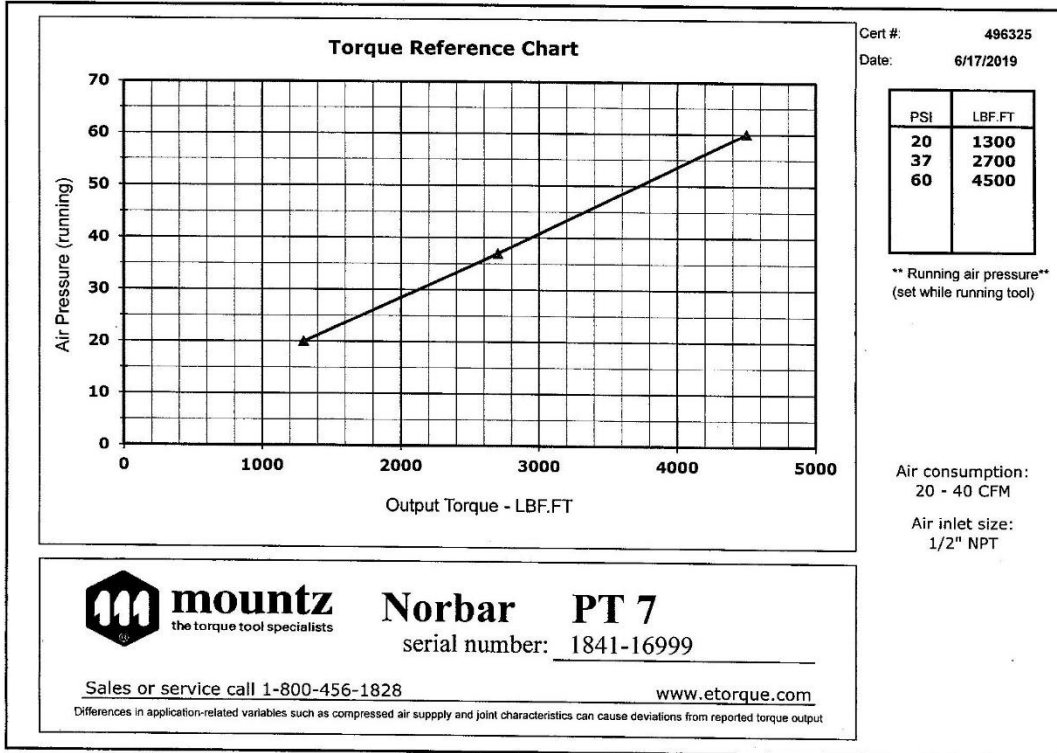
S. HANDS
CALIBRATION QC

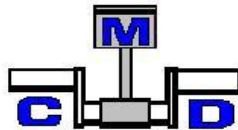


CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



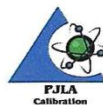


CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

HYTORC[®]
WIND, LLC



HYTORC WIND LLC
2010 E. FRANCIS STREET
ONTARIO, CA. 91710
Phone: 562-908-2100

Certificate of Calibration

Customer: CAL-MARINE DIESEL - 1501 WES' Manufacturer: PROTO
P.O.#: Model No:
Work Order #: 007-2589 Range: 50 - 250 lbf.ft
Units: lbf.ft

Certificate No.: 39-190417132310
Serial #: DSH45721
Temperature: 75°F
Relative Humidity: 48%

STANDARDS & PROCEDURES USED IN CALIBRATION

Calibration Procedure: Hand Torque Instrument Calibration Procedure #328 Version 2.0.

Equipment used:

Torque Specialties TORQUE MASTER Calibration System., Transducer Model TSD 20011 s/n 5617, with TSD6500-2 s/n 20613 Instrument, NIST Traceability #: 161640,
Calibrated: 05/30/18, Due Date: 05/30/2019, Accuracy: within $\pm 0.50\%$ Indicated Value

As Received Results/As Left Results

<u>Clockwise Measurements:</u>		Tolerance	Reading	%	Reading	%	Reading	%
20% of Max.	50.00	+/-4%	50.00	0.00	48.00	-4.00	50.00	0.0
60% of Max.	150.00	+/-4%	148.00	-1.33	150.00	0.00	152.00	1.3
100% of Max.	250.00	+/-4%	254.00	1.60	252.00	0.80	248.00	-0.8

Values in italics are close to spec. limits (for information only)

Visual & Other Examination: PASS

Final Calibration Status: PASS

Calibration Frequency: 1 Year

Calibration Due Date: 4/17/2020

Calibrated By: *Mason Francis*
Mason Francis
Date Calibrated: 4/17/2019

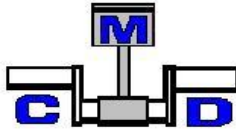
Approved By: *Jim Phillips*
Lab Manager

Clockwise only Calibration performed per ASME B107.300-2010 for Type II Class A Style 2 Design A Torque Instrument.

Calibrations are in accordance with requirements of ISO/IEC 17025:2005. Calibration results were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). Expanded uncertainties expressed at approximately 95% confidence levels using a coverage factor $K=2$ was accounted for in making compliance/non compliance decision with specification, and are available upon request within 30 days of calibration date. Results are valid only to the above item calibrated at the time of test. This certificate shall not be reproduced except in full without the written permission of HYTORC WIND LLC

DATE WRENCH PUT IN SERVICE: _____

V#:1.6 07/07/2015



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

HYTORC WEST COAST
2010 E. FRANCIS ST.
ONTARIO, CA. 91761
(562) 908-2100

HYTORC

EQUIPMENT REPAIR

QUOTE #: 007 - 2589	DATE : 4/17/2019
CUSTOMER:	TECHNICIAN: MASON FRANCIS
ACCOUNT #: CALIFORNIA001	WARRANTY?
INDUSTRY: SHIPYARDS	DATE OF PURCHASE
SHIP TO:	NEW ACCOUNT? YES
CAL-MARINE DIESEL - 1501 WEST 15TH STREET, LONG BEACH, CA. 90813	SUBMIT PAYMENT AND ISSUE ALL PO'S TO HYTORC, DIVISION UNEX CORPORATION 333 ROUTE 17 NORTH MAHWAH NJ 07430
BILL TO:	REPAIR PICTURES:
CALIFORNIA MARINE DIESEL INC 1490 CASPIAN AVE. LONG BEACH, CA. 90813	
CONTACT: ASTREA PRESLEY	CALIBRATION INTERVAL:
PHONE: (562) 491-5665	VAN ID#: VAN-007-CAL
E-MAIL: ASTREAP@CALMARINEDIESEL.COM	P.O.# :
SIGNATURE:	

CALIBRATION NOTES:
REPAIR COMMENTS:

ESTIMATE:		\$1,850.45	<i>(Estimate does not include Sales Tax or Freight charges)</i>	
QTY	PART #	DESCRIPTION	UNIT PRICE	EXTENDED
		XLT-3 SN: FE6594		
		TOOL HAD STRIPED OUT SWIVEL, REPLACED, TESTED AND CALIBRATED		
1	XLT-003	3-50XLT / 4-14XLT UNISW ASSY	\$220.50	\$220.50
1	CAL-TOOL	XLT-3 SN: FE6594	\$250.00	\$250.00
	ITEM DETAIL	XLT-1 SN: E5001	\$0.00	\$0.00
		REPLACED M/F COUPLERS TEST & CALIBRATE		
1	090156-1	10K PSI 1/8 FEMALE COUPLER	\$30.20	\$30.20
1	090155-1/8	10K PSI MALE COUPLER 1/8 NIPPLE	\$25.50	\$25.50
1	CAL-TOOL	XLT-1 SN: E5001	\$250.00	\$250.00
	ITEM DETAIL	XLT-1 SN: CG1692	\$0.00	\$0.00
		SWIVEL CRACKED, REPLACED SWIVEL, TESTED AND CALIBRATED		
1	XLT-001	UNISWIVEL ASSY, .5XLT, 1XLT & 2XLT	\$220.50	\$220.50
1	CAL-TOOL	XLT-1 SN: CG1692	\$250.00	\$250.00
	ITEM DETAIL	HYTORC-AIR SN: 706163	\$0.00	\$0.00
	REPAIR DETAIL	REPAIRED HOSE SET, CHECK FOR LEAKS UP TO 10k PSI CALIBRATED GAUGE	\$0.00	\$0.00
2	090156	10K Psi Female Coupler 1/4" Nipple (251797)	\$28.75	\$57.50
1	080055	4" 10K PSI BOTTOM MOUNT GAUGE (PRE CALIBRATED)	\$135.00	\$135.00
1	CAL-GAUGE	SN: 0015170511	\$0.00	\$0.00
	ITEM DETAIL	HYTORC-AIR SN: 2207278365	\$0.00	\$0.00
	REPAIR DETAIL	REPAIRED HOSE SET, CHECK FOR LEAKS UP TO 10k PSI CALIBRATED GAUGE, ALSO INSTALLED NEW GAUGE WITH COUPLERS	\$0.00	\$0.00
3	090156	10K Psi Female Coupler 1/4" Nipple (251797)	\$28.75	\$86.25
1	CAL-GAUGE	SN: 0087180201	\$125.00	\$125.00
2	SERVICE LABOR	ONSITE REPAIRS AND CALIBRATIONS	\$100.00	\$200.00



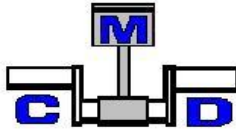
CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

HYTORC WEST COAST
2010 E. FRANCIS ST.
ONTARIO, CA. 91761
(562) 908-2100

1	CAL-MW008	1/2" PROTO SN: DSH45721	\$70.15		\$70.15
1	CAL-MW012	3/4" KD TOOLS SN: 9606310005	\$86.25		\$86.25
1	CAL-MW012	3/4" WILLIAMS SN: 1018	\$86.25		\$86.25



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

HYTORC WEST COAST
2010 E. FRANCIS ST.
ONTARIO, CA. 91761
(562) 908-2100

HYTORC

EQUIPMENT REPAIR

QUOTE #: 007 - 2589	DATE : 4/17/2019
CUSTOMER:	TECHNICIAN: MASON FRANCIS
ACCOUNT #: CALIFORNIA001	WARRANTY?
INDUSTRY: SHIPYARDS	DATE OF PURCHASE
SHIP TO:	NEW ACCOUNT? YES
CAL-MARINE DIESEL - 1501 WEST 15TH STREET, LONG BEACH, CA. 90813	SUBMIT PAYMENT AND ISSUE ALL PO'S TO HYTORC, DIVISION UNEX CORPORATION 333 ROUTE 17 NORTH MAHWAH NJ 07430
BILL TO:	REPAIR PICTURES:
CALIFORNIA MARINE DIESEL INC 1490 CASPIAN AVE. LONG BEACH, CA. 90813	
CONTACT: ASTREA PRESLEY	CALIBRATION INTERVAL:
PHONE: (562) 491-5665	VAN ID#: VAN-007-CAL
E-MAIL: ASTREAP@CALMARINEDIESEL.COM	P.O.# :

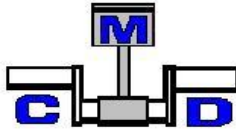
SIGNATURE:

CALIBRATION NOTES:

REPAIR COMMENTS:

ESTIMATE: \$2,093.10 (Estimate does not include Sales Tax or Freight charges)

QTY	PART #	DESCRIPTION	UNIT PRICE	EXTENDED
		XLT-3 SN: FE6594		
		TOOL HAD STRIPED OUT SWIVEL, REPLACED, TESTED AND CALIBRATED		
1	XLT-003	3-50XLT / 4-14XLCT UNISW ASSY	\$220.50	\$220.50
1	CAL-TOOL	XLT-3 SN: FE6594	\$250.00	\$250.00
	ITEM DETAIL	XLT-1 SN: E5001	\$0.00	\$0.00
		REPLACED M/F COUPLERS TEST & CALIBRATE		
1	090156-1	10K PSI 1/8 FEMALE COUPLER	\$30.20	\$30.20
1	090155-1/8	10K PSI MALE COUPLER 1/8 NIPPLE	\$25.50	\$25.50
1	CAL-TOOL	XLT-1 SN: E5001	\$250.00	\$250.00
	ITEM DETAIL	XLT-1 SN: CG1692	\$0.00	\$0.00
		SWIVEL CRACKED, REPLACED SWIVEL, TESTED AND CALIBRATED		
1	XLT-001	UNISWIVEL ASSY, .5XLT, 1XLT & 2XLCT	\$220.50	\$220.50
1	CAL-TOOL	XLT-1 SN: CG1692	\$250.00	\$250.00
	ITEM DETAIL	HYTORC-AIR SN: 706163	\$0.00	\$0.00
	REPAIR DETAIL	REPAIRED HOSE SET, CHECK FOR LEAKS UP TO 10k PSI CALIBRATED GAUGE	\$0.00	\$0.00
2	090156	10K Psi Female Coupler 1/4" Nipple (251797)	\$28.75	\$57.50
1	080055	4" 10K PSI BOTTOM MOUNT GAUGE (PRE CALIBRATED)	\$135.00	\$135.00
1	CAL-GAUGE	SN: 0015170511	\$0.00	\$0.00
	ITEM DETAIL	HYTORC-AIR SN: 2207278365	\$0.00	\$0.00
	REPAIR DETAIL	REPAIRED HOSE SET, CHECK FOR LEAKS UP TO 10k PSI CALIBRATED GAUGE, ALSO INSTALLED NEW GAUGE WITH COUPLERS	\$0.00	\$0.00
3	090156	10K Psi Female Coupler 1/4" Nipple (251797)	\$28.75	\$86.25
1	CAL-GAUGE	SN: 0087180201	\$125.00	\$125.00
2	SERVICE LABOR	ONSITE REPAIRS AND CALIBRATIONS	\$100.00	\$200.00



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



CERTIFICATE OF CALIBRATION

Date: 04/17/2019

Certificate No. 39-190417124242

GAUGE INFORMATION

Gauge Manufacturer/Model No.: HYTORC
Serial No. *0087180201

Pressure Gauge Range 0 - 10000 psi
Accuracy: 100 % of reading

CUSTOMER INFORMATION

Customer: CAL-MARINE DIESEL - 1501 WEST 15TH STREET, LONG BEACH, CA. 90813

W.O./S.O.#: 007-2589

STANDARDS & PROCEDURES USED IN CALIBRATION

Torque Specialties Pressure Transducer, TSD10KPT, sn89958 with TSD6500-2 sn 20613 Instrument, 0 to 10000 psi capacity. Accuracy: 0.25% IV, NIST Traceability Ref# 165545. Calibrated: 05/30/2018, Due: 05/2019. Calibrations performed at 75 °F, Relative Humidity 42 %; Pressure Gauge Calibration Procedure #303, Version 1.3.

CALIBRATION RESULTS

(Increasing Pressure)

GAUGE PRESSURE, psi	TOLERANCES (+/-) psi	AS FOUND/ AS LEFT psi		
1,000	1,000	987		
2,000	2,000	1,966		
3,000	3,000	2,972		
4,000	4,000	4,000		
5,000	5,000	5,014		
6,000	6,000	6,015		
7,000	7,000	7,017		
8,000	8,000	8,003		
9,000	9,000	9,023		
10,000	10,000	10,031		

Calibration Status: Pass

Calibration Frequency: 1 Year

Calibration Due Date: 4/17/2020

Calibrated By: *Mason Francis*
Mason Francis

Approved By: *James Phillips*
Lab Manager

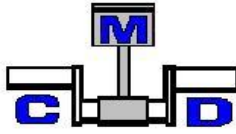
Calibrations are in accordance with requirements of ISO/IEC 17025:2005. Calibration results were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). Expanded uncertainties expressed at approximately 95% confidence levels using a coverage factor K=2 was accounted for in making compliance/non compliance decision with specification, and are available upon request within 30 days of calibration date. Results are valid only to the above item calibrated at the time of test. This certificate shall not be reproduced except in full without the written permission of HYTORC WIND LLC.

DATE PRESSURE GAUGE PUT IN SERVICE: _____

v#2.2 06/02/2017

Page 1 of 1





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1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

HYTORC[®]
WIND, LLC



HYTORC WIND LLC
2010 E. FRANCIS STREET
ONTARIO, CA. 91710
Phone: 562-908-2100

Certificate of Calibration

Customer: CAL-MARINE DIESEL - 1501 WES' Manufacturer: WILLIAMS
P.O.#: Model No: WSC-600
Work Order #: 007-2589 Range: 120 - 600 lbf.ft
Units: lbf.ft

Certificate No.: 39-19041713844
Serial #: 1018
Temperature: 75°F
Relative Humidity: 48%

STANDARDS & PROCEDURES USED IN CALIBRATION

Calibration Procedure: Hand Torque Instrument Calibration Procedure #328 Version 2.0.

Equipment used:

Torque Specialties TORQUE MASTER Calibration System, Transducer Model TSD 20011 s/n 5617, with TSD6500-2 s/n 20613 Instrument, NIST Traceability #: 161640,
Calibrated: 05/30/18, Due Date: 05/30/2019, Accuracy: within $\pm 0.50\%$ Indicated Value

As Received Results/As Left Results

Clockwise Measurements:			Tolerance	Reading	%	Reading	%	Reading	%
20% of Max.	120.00		+/-4%	122.00	1.67	124.00	3.33	124.00	3.3
60% of Max.	360.00		+/-4%	370.00	2.78	368.00	2.22	370.00	2.8
100% of Max.	600.00		+/-4%	622.00	3.67	618.00	3.00	622.00	3.7

Visual & Other Examination: PASS

Final Calibration Status: PASS

Calibration Frequency: 1 Year

Calibration Due Date: 4/17/2020

Calibrated By: *Mason Francis*
Mason Francis
Date Calibrated: 4/17/2019

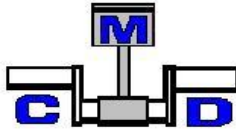
Approved By: *Jim Phillips*
Lab Manager

Clockwise only Calibration performed per ASME B107.300-2010 for Type II Class A Style 2 Design A Torque Instrument.

Calibrations are in accordance with requirements of ISO/IEC 17025:2005. Calibration results were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). Expanded uncertainties expressed at approximately 95% confidence levels using a coverage factor K=2 was accounted for in making compliance/non compliance decision with specification, and are available upon request within 30 days of calibration date. Results are valid only to the above item calibrated at the time of test. This certificate shall not be reproduced except in full without the written permission of HYTORC WIND LLC

DATE WRENCH PUT IN SERVICE: _____

VH:1.6 07/07/2015



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



PJLA Accreditation #66167

CERTIFICATE OF CALIBRATION

Date: 04/17/2019

Certificate No. 39-190417124603

GAUGE INFORMATION

Gauge Manufacturer/Model No.: HYTORC
Serial No. *0015170511

Pressure Gauge Range 0 - 10000 psi
Accuracy: 100 % of reading

CUSTOMER INFORMATION

Customer: CAL-MARINE DIESEL - 1501 WEST 15TH STREET, LONG BEACH, CA. 90813

W.O./S.O.#: 007-2589

STANDARDS & PROCEDURES USED IN CALIBRATION

Torque Specialties Pressure Transducer, TSD10KPT, sn89958 with TSD6500-2 sn 20613 Instrument, 0 to 10000 psi capacity. Accuracy: 0.25% IV, NIST Traceability Ref# 165545. Calibrated: 05/30/2018, Due: 05/2019. Calibrations performed at 75 °F, Relative Humidity 42 %; Pressure Gauge Calibration Procedure #303, Version 1.3.

CALIBRATION RESULTS

(Increasing Pressure)

GAUGE PRESSURE, psi	TOLERANCES (+/-) psi	AS FOUND psi	AS LEFT psi	
1,000	1,000	1,011	1,011	
2,000	2,000	2,015	2,015	
3,000	3,000	3,021	3,021	
4,000	4,000	4,019	4,019	
5,000	5,000	5,025	5,025	
6,000	6,000	6,027	6,027	
7,000	7,000	7,031	7,031	
8,000	8,000	8,022	8,022	
9,000	9,000	9,018	9,018	
10,000	10,000	10,034	10,034	

Calibration Status: Pass

Calibration Frequency: 1 Year

Calibration Due Date: 4/17/2020

Calibrated By: *Mason Francis*
Mason Francis

Approved By: *James Phillips*
Lab Manager

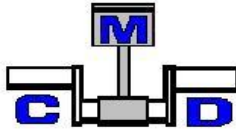
Calibrations are in accordance with requirements of ISO/IEC 17025:2005. Calibration results were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). Expanded uncertainties expressed at approximately 95% confidence levels using a coverage factor K=2 was accounted for in making compliance/non compliance decision with specification, and are available upon request within 30 days of calibration date. Results are valid only to the above item calibrated at the time of test. This certificate shall not be reproduced except in full without the written permission of HYTORC WIND LLC.

DATE PRESSURE GAUGE PUT IN SERVICE: _____

v#2.2 08/02/2017

Page 1 of 1





CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



PJLA Accreditation #66167

CERTIFICATE OF CALIBRATION

HYTORC WIND LLC

2010 E. Francis St.

Ontario, Ca. 91761

Phone: 1-562-908-2100

P.O.#:

S.O.#: 007-2589

SERIAL# CG1692

CUSTOMER CAL-MARINE DIESEL - 1501 WEST 15TH STREET, LONG BEACH, CA.
90813

TOOL MODEL HY-1XLT

STATED ACCURACY: +/- 3% OF HYTORC STANDARD PRESSURE/TORQUE CONVERSION CHART

TORQUE RANGE 200 TO 1340 Lb.ft.

PRESSURE RANGE: 1500 TO 10000 psi

PROCEDURE & METHOD USED

Hydraulic Torque Wrench was calibrated on "Torque Master" Automated Hydraulic Torque Wrench Calibration System in accordance with Hydraulic Torque Tool Calibration Procedure #319 version 2.0.

CALIBRATION EQUIPMENT USED

Torque Specialties TORQUE MASTER Automated Hydraulic Calibration System.

[X] TSD20011, s/n 5617, 0 to 20000 ft.lb Torque Cell with TSD6500-2 s/n 20613 Instrument, NIST Traceability Reference # 165546, Calibration Date: 05/30/2018, Calibration Due Date: 05/2019, Accuracy within $\pm 0.75\%$ Indicated Value.

[X] TSD10KPT, s/n 89958, 0 to 10000 psi Pressure Transducer with TSD6500-2 s/n 20613 Instrument, NIST Traceability Reference # 165545, Calibration Date: 05/30/2018, Calibration Due Date: 05/2019, Accuracy within $\pm 0.25\%$ Indicated Value.

Calibrations performed at 72°F, Relative Humidity 49%.

PRESSURE	HYTORC STANDARD	AS FOUND/ AS LEFT		MIN	MAX
psi	Lb.ft.	Lb.ft.		Lb.ft.	Lb.ft.
1500	200	204		194	206
2000	270	270		262	278
3000	405	408		393	417
4000	535	544		519	551
5000	670	686		650	690
6000	805	816		781	829
7000	940	952		912	968
8000	1075	1088		1043	1107
9000	1205	1228		1169	1241
10000	1340	1370		1300	1380

AS FOUND/ AS LEFT TOOL HY-1XLT SERIAL # CG1692 IS WITHIN STANDARDS OF ACCURACY.

CALIBRATED BY: *Mason Francis*

APPROVED BY: *James Phillips*

Certificate#: 39-190417113933

Calibration Interval: 1 Year

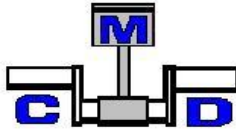
Calibration Due Date: 04/17/2020

Lab Manager

CALIBRATION DATE: 4/17/2019

DATE TOOL PUT IN SERVICE: _____

Calibrations are in accordance with requirements of ISO/IEC 17025:2005. Calibration results were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). Expanded uncertainties expressed at approximately 95% confidence levels using a coverage factor K=2 was accounted for in making compliance/non compliance decision with specification, and are available upon request within 30 days of calibration date. Results are valid only to the above item calibrated at the time of test. This certificate shall not be reproduced except in full without the written permission of HYTORC WIND LLC.



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



PJLA Accreditation #68167

CERTIFICATE OF CALIBRATION

HYTORC WIND LLC
2010 E. Francis St.
Ontario, Ca. 91761
Phone: 1-562-908-2100

CUSTOMER CAL-MARINE DIESEL - 1501 WEST 15TH STREET, LONG BEACH, CA.
90813

P.O.#:
S.O.#: 007-2589

SERIAL# E5001

TOOL MODEL HY-1XLT

STATED ACCURACY: +/- 3% OF HYTORC STANDARD PRESSURE/TORQUE CONVERSION CHART

TORQUE RANGE 200 TO 1340 Lb.ft.

PRESSURE RANGE: 1500 TO 10000 psi

PROCEDURE & METHOD USED

Hydraulic Torque Wrench was calibrated on "Torque Master" Automated Hydraulic Torque Wrench Calibration System in accordance with Hydraulic Torque Tool Calibration Procedure #319 version 2.0.

CALIBRATION EQUIPMENT USED

Torque Specialties TORQUE MASTER Automated Hydraulic Calibration System.

[X] TSD20011, s/n 5617, 0 to 20000 ft.lb Torque Cell with TSD6500-2 s/n 20613 Instrument, NIST Traceability Reference # 165546, Calibration Date: 05/30/2018, Calibration Due Date: 05/2019, Accuracy within $\pm 0.75\%$ Indicated Value.

[X] TSD10KPT, s/n 89958, 0 to 10000 psi Pressure Transducer with TSD6500-2 s/n 20613 Instrument, NIST Traceability Reference # 165545, Calibration Date: 05/30/2018, Calibration Due Date: 05/2019, Accuracy within $\pm 0.25\%$ Indicated Value.

Calibrations performed at 72°F, Relative Humidity 49%.

PRESSURE	HYTORC STANDARD	AS FOUND/ AS LEFT		MIN	MAX
psi	Lb.ft.	Lb.ft.		Lb.ft.	Lb.ft.
1500	200	200		194	206
2000	270	266		262	278
3000	405	402		393	417
4000	535	526		519	551
5000	670	656		650	690
6000	805	788		781	829
7000	940	920		912	968
8000	1075	1064		1043	1107
9000	1205	1178		1169	1241
10000	1340	1302		1300	1380

AS FOUND/ AS LEFT TOOL HY-1XLT SERIAL # E5001 IS WITHIN STANDARDS OF ACCURACY.

CALIBRATED BY: Mason Francis

APPROVED BY: James Phillips

Certificate#: 39-190417113420

Calibration Interval: 1 Year

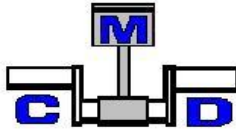
Calibration Due Date: 04/17/2020

Lab Manager

CALIBRATION DATE: 4/17/2019

DATE TOOL PUT IN SERVICE: _____

Calibrations are in accordance with requirements of ISO/IEC 17025:2005. Calibration results were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). Expanded uncertainties expressed at approximately 95% confidence levels using a coverage factor K=2 was accounted for in making compliance/non compliance decision with specification, and are available upon request within 30 days of calibration date. Results are valid only to the above item calibrated at the time of test. This certificate shall not be reproduced except in full without the written permission of HYTORC WIND LLC.



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



PJLA Accreditation #66167

CERTIFICATE OF CALIBRATION

HYTORC WIND LLC

2010 E. Francis St.

Ontario, Ca. 91761

Phone: 1-562-908-2100

P.O.#:

S.O.#: 007-2589

SERIAL# FE6594

CUSTOMER CAL-MARINE DIESEL - 1501 WEST 15TH STREET, LONG BEACH, CA.
90813

TOOL MODEL HY-3XLT

STATED ACCURACY: +/- 3% OF HYTORC STANDARD PRESSURE/TORQUE CONVERSION CHART

TORQUE RANGE 480 TO 3230 Lb.ft.

PRESSURE RANGE: 1500 TO 10000 psi

PROCEDURE & METHOD USED

Hydraulic Torque Wrench was calibrated on "Torque Master" Automated Hydraulic Torque Wrench Calibration System in accordance with Hydraulic Torque Tool Calibration Procedure #319 version 2.0.

CALIBRATION EQUIPMENT USED

Torque Specialties TORQUE MASTER Automated Hydraulic Calibration System.

[X] TSD20011, s/n 5617, 0 to 20000 ft.lb Torque Cell with TSD6500-2 s/n 20613 Instrument, NIST Traceability Reference # 165546, Calibration Date: 05/30/2018, Calibration Due Date: 05/2019, Accuracy within $\pm 0.75\%$ Indicated Value.

[X] TSD10KPT, s/n 89958, 0 to 10000 psi Pressure Transducer with TSD6500-2 s/n 20613 Instrument, NIST Traceability Reference # 165545, Calibration Date: 05/30/2018, Calibration Due Date: 05/2019, Accuracy within $\pm 0.25\%$ Indicated Value.

Calibrations performed at 72°F, Relative Humidity 49%.

PRESSURE	HYTORC STANDARD	AS FOUND/ AS LEFT		MIN	MAX
psi	Lb.ft.	Lb.ft.		Lb.ft.	Lb.ft.
1500	480	472		466	494
2000	640	644		621	659
3000	960	938		931	989
4000	1280	1260		1242	1318
5000	1610	1570		1562	1658
6000	1930	1894		1872	1988
7000	2250	2202		2183	2318
8000	2580	2516		2503	2657
9000	2910	2846		2823	2997
10000	3230	3156		3133	3327

AS FOUND/ AS LEFT TOOL HY-3XLT SERIAL # FE6594 IS WITHIN STANDARDS OF ACCURACY.

CALIBRATED BY: Mason Francis

APPROVED BY: James Phillips

Certificate#: 39-190417112136

Calibration Interval: 1 Year

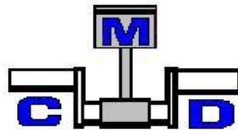
Calibration Due Date: 04/17/2020

Lab Manager

CALIBRATION DATE: 4/17/2019

DATE TOOL PUT IN SERVICE: _____

Calibrations are in accordance with requirements of ISO/IEC 17025:2005. Calibration results were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). Expanded uncertainties expressed at approximately 95% confidence levels using a coverage factor K=2 was accounted for in making compliance/non compliance decision with specification, and are available upon request within 30 days of calibration date. Results are valid only to the above item calibrated at the time of test. This certificate shall not be reproduced except in full without the written permission of HYTORC WIND LLC.



CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

HYTORC[®]
WIND, LLC



HYTORC WIND LLC
2010 E. FRANCIS STREET
ONTARIO, CA. 91710
Phone: 562-908-2100

Certificate of Calibration

Customer: CAL-MARINE DIESEL - 1501 WES' Manufacturer: KD TOOLS
P.O.#: Model No:
Work Order #: 007-2589 Range: 120 - 600 lbf.ft
Units: lbf.ft

Certificate No.: 39-190417131813
Serial #: 9606310005
Temperature: 75°F
Relative Humidity: 48%

STANDARDS & PROCEDURES USED IN CALIBRATION

Calibration Procedure: Hand Torque Instrument Calibration Procedure #328 Version 2.0.

Equipment used:

Torque Specialties TORQUE MASTER Calibration System., Transducer Model TSD 20011 s/n 5617, with TSD6500-2 s/n 20613 Instrument, NIST Traceability #: 161640,
Calibrated: 05/30/18, Due Date: 05/30/2019, Accuracy: within $\pm 0.50\%$ Indicated Value

As Received Results/As Left Results

Clockwise Measurements:			Tolerance	Reading	%	Reading	%	Reading	%
20% of Max.	120.00		+/-4%	120.00	0.00	118.00	-1.67	122.00	1.7
60% of Max.	360.00		+/-4%	366.00	1.67	368.00	2.22	354.00	-1.7
100% of Max.	600.00		+/-4%	606.00	1.00	612.00	2.00	620.00	3.3

Visual & Other Examination: PASS

Final Calibration Status: PASS

Calibration Frequency: 1 Year

Calibration Due Date: 4/17/2020

Calibrated By: *Mason Francis*
Mason Francis
Date Calibrated: 4/17/2019

Approved By: *Jim Phillips*
Lab Manager

Clockwise only Calibration performed per ASME B107.300-2010 for Type II Class A Style 2 Design A Torque Instrument.

Calibrations are in accordance with requirements of ISO/IEC 17025:2005. Calibration results were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). Expanded uncertainties expressed at approximately 95% confidence levels using a coverage factor $K=2$ was accounted for in making compliance/non compliance decision with specification, and are available upon request within 30 days of calibration date. Results are valid only to the above item calibrated at the time of test. This certificate shall not be reproduced except in full without the written permission of HYTORC WIND LLC

DATE WRENCH PUT IN SERVICE: _____

V#:1.6 07/07/2015



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

EBMUD UNIT 2 LIST OF INSPECTION SHEETS

MAIN AND CONNECTING ROD BEARING INSPECTION

CONNECTING ROD/ IN LINE 1-6

CONNECTING ROD BEARING SHELL 1-6

CRANKPIN/ CONNECTING ROD JOURNAL INSPECTION FORM 1-6

CYLINDER LINERS 1-6

LINER PROTRUSION MEASUREMENTS 1-6

PISTON – two piece 1-6

PISTON RINGS 1-6

MAIN JOURNAL INDICATED RUN OUT INSPECTION FORM

MAIN JOURNAL INSPECTION FORM 1-6

MAIN BEARING SHELL 1-6

CRANKSHAFT – Web Deflection and Thrust clearance dtd 5Sep18

CRANKSHAFT – Web Deflection and Thrust clearance dtd 14Sep18

CRANKSHAFT – Web Deflection and Thrust clearance dtd 12Jun19

CRANKSHAFT – Web Deflection and Thrust clearance dtd 28jun19

CRANKSHAFT – Web Deflection and Thrust clearance dtd 8Aug19

CRANKSHAFT – Web Deflection and Thrust clearance dtd 26Aug19

CRANKSHAFT – Web Deflection and Thrust clearance dtd 26Aug19

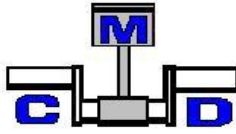
CRANKSHAFT – Web Deflection and Thrust clearance dtd 3Sep19

CAM AND TAPPET ASSEMBLIES

GEARSET – Inline Engine

ROCKER ARM SHAFT TO BUSHING AND THRUST CLEARANCE

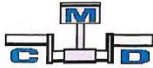
GENERATOR AIR GAP MEASUREMENTS



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

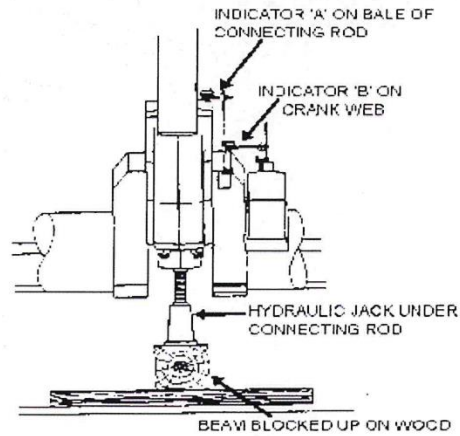
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

MAIN BEARING AND CONNECTING ROD BEARING INSPECTION

CUSTOMER EBMUD LOCATION OAKLAND CA
EQUIPMENT DRSG-46 SERIAL 82004-3603
T TYPE ENTERPRISE ENGINE MODEL 82004-3603



MAIN BEARING CLEARANCE

1	0.010
2	0.010
3	0.010
4	0.013
5	0.011
6	0.012
7	0.013
8	0.012
9	0.011

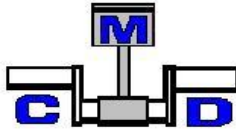
CONNECTING ROD BEARING CLEARANCE

1	0.012	CON ROD	0.045
2	0.009	THRUST	0.019
3	0.008		0.018
4	0.008		0.018
5	0.009		0.107
6	0.009		0.021

NOTE: #1 connecting rod reconditioned by EBMUD with reconditioning certification 17070184 for 4-23-18 from original date of 9-13-82. Rod side clearance is .045 reconditioning had .202 less than

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CRANKSHAFT THRUST 0.024



CALIFORNIA MARINE DIESEL, INC.

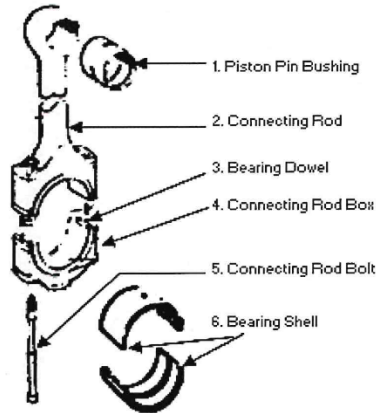
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC.

CONNECTING ROD / INLINE		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTREPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2019
References		Data Recorded By
		John Burnam
Memo		CYLINDER NO
		1



Piston Pin Bushing

Measure inside diameter of piston pin bushing with micrometer in vertical (A-A) and horizontal (B-B) planes, 90 degrees apart. Measure both ends, two inches from end of bushing

Step 1	Piston Pin Bushing I.D.	
	A-A	B-B
Gearcase End	6.762	6.761
Flywheel End	6.760	6.760

Connecting Rod Bearing Bore

Reassemble connecting rod box to connecting rod to measure for out-of-round conditions at connecting rod bearing bore. Do not install bearings. Torque nuts to full torque value as shown in instruction manual. Measure bearing bore inside diameter at both ends, one inch from outer edges. Measure in vertical A-A and horizontal B-B planes. Measure one-quarter inch in opposite sides of split line.

Step 2	Connecting Rod Bearing Bore I.D.	
	A-A	B-B
Gearcase End	12.249	12.248
Flywheel End	12.250	12.248

Non-Destructive Tests

Perform non-destructive test such as dye check on connecting rod box and all fasteners. Record results below.

Step 3
Die Penetrant NDT (SPOTCHECK SKC-S Aerosol (cleaner); SPOTCHECK SKL-SP2 Aerosol (penetrant); SPOTCHECK SKD-S2 Aerosol (developer) used on connecting rod pin bore, connecting rod crankpin bore (connecting rod box), connecting rod bolts (fasteners)

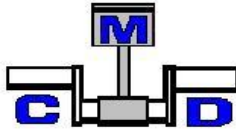
Bolt Torque

Record disassembly (breakaway) and assembly torque for connecting rod bolts. Torque bolts in cross pattern in 20% lifts until final torque is reached. Refer to instruction manual for correct torque values.

Step 4	Connecting Rod Bolt Nut Torque (ft-lbs)			
	1	2	3	4
Disassembly				
Assembly				



wn 2004



CALIFORNIA MARINE DIESEL, INC.

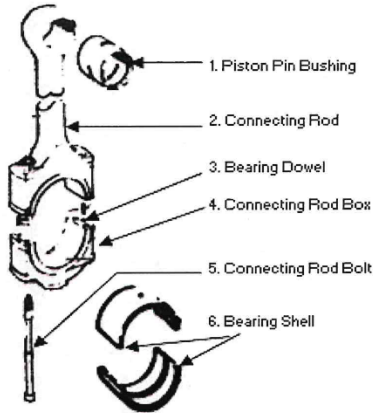
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC.

CONNECTING ROD / INLINE		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTREPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2019
References		Data Recorded By
		John Burnam
Memo		CYLINDER NO
		2



Piston Pin Bushing

Measure inside diameter of piston pin bushing with micrometer in vertical (A-A) and horizontal (B-B) planes, 90 degrees apart. Measure both ends, two inches from end of bushing

Step 1	Piston Pin Bushing I.D.	
	A-A	B-B
Gearcase End	6.764	6.763
Flywheel End	6.761	6.761

Connecting Rod Bearing Bore

Reassemble connecting rod box to connecting rod to measure for out-of-round conditions at connecting rod bearing bore. Do not install bearings. Torque nuts to full torque value as shown in instruction manual. Measure bearing bore inside diameter at both ends, one inch from outer edges. Measure in vertical A-A and horizontal B-B planes. Measure one-quarter inch in opposite sides of split line.

Step 2	Connecting Rod Bearing Bore I.D.	
	A-A	B-B
Gearcase End	12.247	12.247
Flywheel End	12.247	12.247

Non-Destructive Tests

Perform non-destructive test such as dye check on connecting rod box and all fasteners. Record results below.

Step 3	
Die Penetrant NDT (SPOTCHECK SKC-S Aerosol (cleaner); SPOTCHECK SKL-SP2 Aerosol (penetrant); SPOTCHECK SKD-S2 Aerosol (developer) used on connecting rod pin bore, connecting rod crankpin bore (connecting rod box), connecting rod bolts (fasteners)	

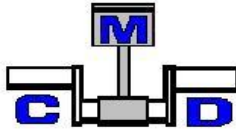
Bolt Torque

Record disassembly (breakaway) and assembly torque for connecting rod bolts. Torque bolts in cross pattern in 20% lifts until final torque is reached. Refer to instruction manual for correct torque values.

Step 4	Connecting Rod Bolt Nut Torque (ft-lbs)			
	1	2	3	4
Disassembly				
Assembly				



wn 2004



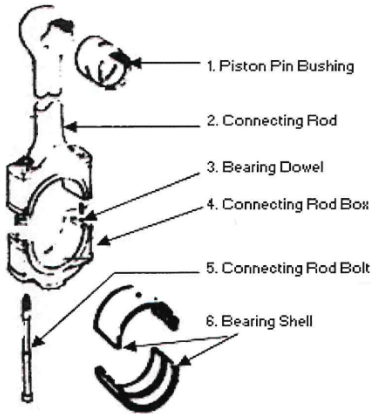
CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC.

CONNECTING ROD / INLINE		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTREPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2019
References		Data Recorded By
		John Burnam
Memo		CYLINDER NO
		3



Piston Pin Bushing

Measure inside diameter of piston pin bushing with micrometer in vertical (A-A) and horizontal (B-B) planes, 90 degrees apart. Measure both ends, two inches from end of bushing

Step 1	Piston Pin Bushing I.D.	
	A-A	B-B
Gearcase End	6.763	6.763
Flywheel End	6.761	6.761

Connecting Rod Bearing Bore

Reassemble connecting rod box to connecting rod to measure for out-of-round conditions at connecting rod bearing bore. Do not install bearings. Torque nuts to full torque value as shown in instruction manual. Measure bearing bore inside diameter at both ends, one inch from outer edges. Measure in vertical A-A and horizontal B-B planes. Measure one-quarter inch in opposite sides of split line.

Step 2	Connecting Rod Bearing Bore I.D.	
	A-A	B-B
Gearcase End	12.247	12.249
Flywheel End	12.247	12.249

Non-Destructive Tests

Perform non-destructive test such as dye check on connecting rod box and all fasteners. Record results below.

Step 3
Die Penetrant NDT (SPOTCHECK SKC-S Aerosol (cleaner); SPOTCHECK SKL-SP2 Aerosol (penetrant); SPOTCHECK SKD-S2 Aerosol (developer) used on connecting rod pin bore, connecting rod crankpin bore (connecting rod box), connecting rod bolts (fasteners)

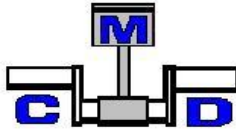


Bolt Torque

Record disassembly (breakaway) and assembly torque for connecting rod bolts. Torque bolts in cross pattern in 20% lifts until final torque is reached. Refer to instruction manual for correct torque values.

Step 4	Connecting Rod Bolt Nut Torque (ft-lbs)			
	1	2	3	4
Disassembly				
Assembly				

wn 2004



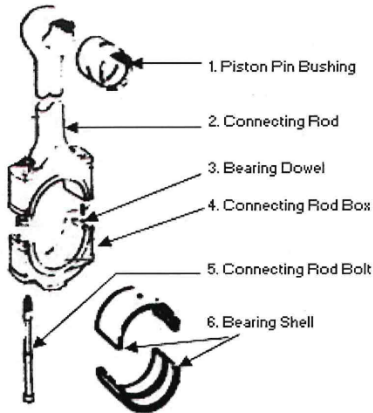
CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC.

CONNECTING ROD / INLINE		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTREPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2019
References		Data Recorded By
		John Burnam
Memo		CYLINDER NO
		4



Piston Pin Bushing

Measure inside diameter of piston pin bushing with micrometer in vertical (A-A) and horizontal (B-B) planes, 90 degrees apart. Measure both ends, two inches from end of bushing

Step 1	Piston Pin Bushing I.D.	
	A-A	B-B
Gearcase End	6.761	6.761
Flywheel End	6.760	6.760

Connecting Rod Bearing Bore

Reassemble connecting rod box to connecting rod to measure for out-of-round conditions at connecting rod bearing bore. Do not install bearings. Torque nuts to full torque value as shown in instruction manual. Measure bearing bore inside diameter at both ends, one inch from outer edges. Measure in vertical A-A and horizontal B-B planes. Measure one-quarter inch in opposite sides of split line.

Step 2	Connecting Rod Bearing Bore I.D.	
	A-A	B-B
Gearcase End	12.247	12.249
Flywheel End	12.248	12.250

Non-Destructive Tests

Perform non-destructive test such as dye check on connecting rod box and all fasteners. Record results below.

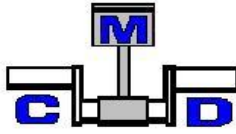
Step 3	
Die Penetrant NDT (SPOTCHECK SKC-S Aerosol (cleaner); SPOTCHECK SKL-SP2 Aerosol (penetrant); SPOTCHECK SKD-S2 Aerosol (developer) used on connecting rod pin bore, connecting rod crankpin bore (connecting rod box), connecting rod bolts (fasteners)	

Bolt Torque

Record disassembly (breakaway) and assembly torque for connecting rod bolts. Torque bolts in cross pattern in 20% lifts until final torque is reached. Refer to instruction manual for correct torque values.

Step 4	Connecting Rod Bolt Nut Torque (ft-lbs)			
	1	2	3	4
Disassembly				
Assembly				

wn 2004



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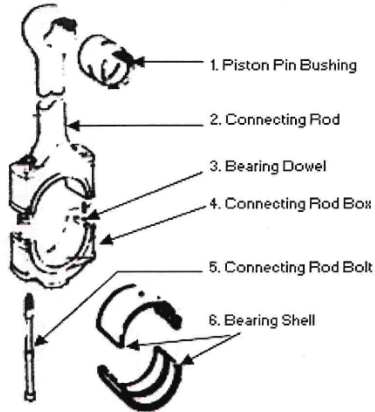
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC.

CONNECTING ROD / INLINE		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTREPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2019
References		Data Recorded By
		John Burnam
Memo		CYLINDER NO
		5



Piston Pin Bushing

Measure inside diameter of piston pin bushing with micrometer in vertical (A-A) and horizontal (B-B) planes, 90 degrees apart. Measure both ends, two inches from end of bushing

Step 1	Piston Pin Bushing I.D.	
	A-A	B-B
Gearcase End	6.761	6.761
Flywheel End	6.760	6.760

Connecting Rod Bearing Bore

Reassemble connecting rod box to connecting rod to measure for out-of-round conditions at connecting rod bearing bore. Do not install bearings. Torque nuts to full torque value as shown in instruction manual. Measure bearing bore inside diameter at both ends, one inch from outer edges. Measure in vertical A-A and horizontal B-B planes. Measure one-quarter inch in opposite sides of split line.

Step 2	Connecting Rod Bearing Bore I.D.	
	A-A	B-B
Gearcase End	12.248	12.249
Flywheel End	12.249	12.250

Non-Destructive Tests

Perform non-destructive test such as dye check on connecting rod box and all fasteners. Record results below.

Step 3
Die Penetrant NDT (SPOTCHECK SKC-S Aerosol (cleaner); SPOTCHECK SKL-SP2 Aerosol (penetrant); SPOTCHECK SKD-S2 Aerosol (developer) used on connecting rod pin bore, connecting rod crankpin bore (connecting rod box), connecting rod bolts (fasteners)

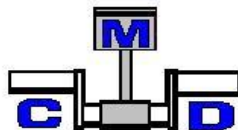


Bolt Torque

Record disassembly (breakaway) and assembly torque for connecting rod bolts. Torque bolts in cross pattern in 20% lifts until final torque is reached. Refer to instruction manual for correct torque values.

Step 4	Connecting Rod Bolt Nut Torque (ft-lbs)			
	1	2	3	4
Disassembly				
Assembly				

wn 2004



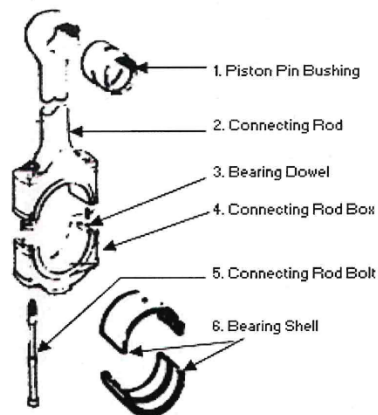
CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC.

CONNECTING ROD / INLINE		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTREPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2019
References		Data Recorded By
		John Burnam
Memo		CYLINDER NO
		6



Piston Pin Bushing

Measure inside diameter of piston pin bushing with micrometer in vertical (A-A) and horizontal (B-B) planes, 90 degrees apart. Measure both ends, two inches from end of bushing

Step 1	Piston Pin Bushing I.D.	
	A-A	B-B
Gearcase End	6.762	6.762
Flywheel End	6.761	6.761

Connecting Rod Bearing Bore

Reassemble connecting rod box to connecting rod to measure for out-of-round conditions at connecting rod bearing bore. Do not install bearings. Torque nuts to full torque value as shown in instruction manual. Measure bearing bore inside diameter at both ends, one inch from outer edges. Measure in vertical A-A and horizontal B-B planes. Measure one-quarter inch in opposite sides of split line.

Step 2	Connecting Rod Bearing Bore I.D.	
	A-A	B-B
Gearcase End	12.249	12.248
Flywheel End	12.248	12.248

Non-Destructive Tests

Perform non-destructive test such as dye check on connecting rod box and all fasteners. Record results below.

Step 3
Die Penetrant NDT (SPOTCHECK SKC-S Aerosol (cleaner); SPOTCHECK SKL-SP2 Aerosol (penetrant); SPOTCHECK SKD-S2 Aerosol (developer) used on connecting rod pin bore, connecting rod crankpin bore (connecting rod box), connecting rod bolts (fasteners)

Bolt Torque

Record disassembly (breakaway) and assembly torque for connecting rod bolts. Torque bolts in cross pattern in 20% lifts until final torque is reached. Refer to instruction manual for correct torque values.

Step 4	Connecting Rod Bolt Nut Torque (ft-lbs)			
	1	2	3	4
Disassembly				
Assembly				



wn 2004



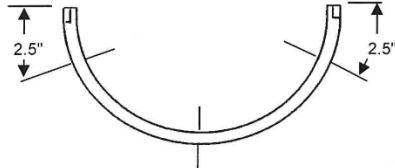
CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813
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CALIFORNIA MARINE DIESEL INC.

CONNECTING ROD BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2019
References		Data Recorded By
		ALAN HENRICKSON
Bearing Shell Position		1



Record manufacturer's data as it appears on bearing shell

Upper Shell

--

Lower Shell

--

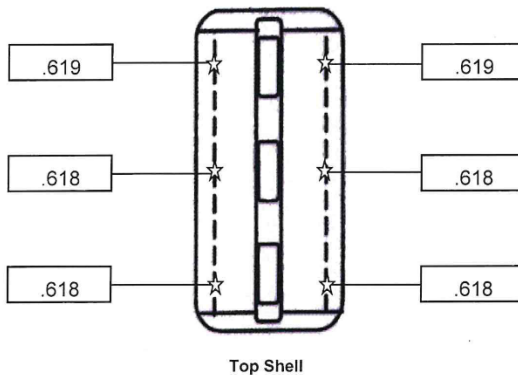
Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

Note any abnormalities and sketch as necessary

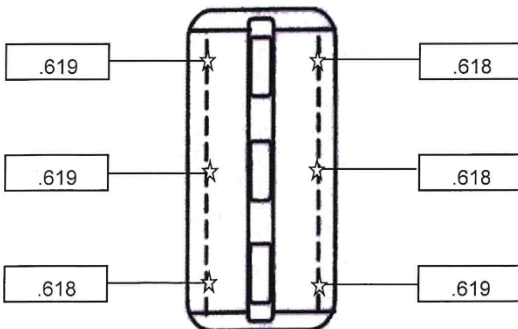
--

Perform non-destructive dye check on all surfaces. Note results below.

Results or Remarks



Top Shell



Bottom Shell

New Bearing ?

Re-used Bearing ?



CALIFORNIA MARINE DIESEL, INC.

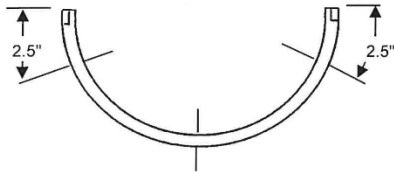
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC.

CONNECTING ROD BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2019
References		Data Recorded By
		ALAN HENRICKSON
Bearing Shell Position		1



Record manufacturer's data as it appears on bearing shell

Upper Shell

--

Lower Shell

--

Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

Note any abnormalities and sketch as necessary

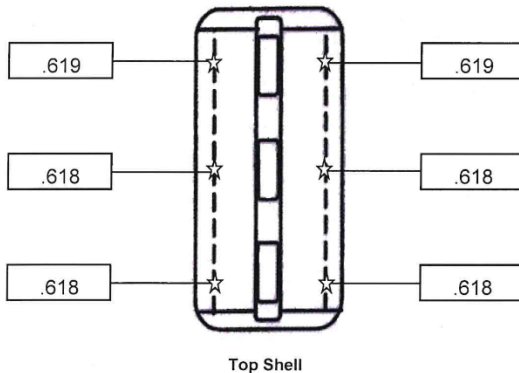
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Perform non-destructive dye check on all surfaces. Note results below.

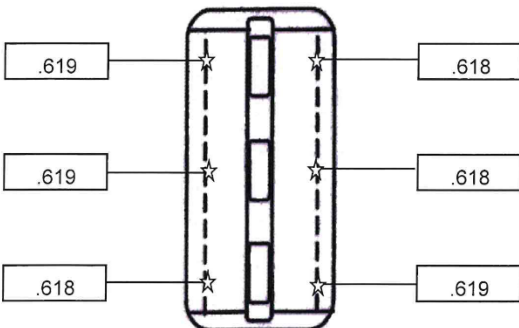
Results or Remarks

New Bearing ?

Re-used Bearing ?



Top Shell



Bottom Shell



CALIFORNIA MARINE DIESEL, INC.

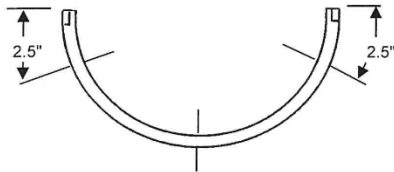
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC.

CONNECTING ROD BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2019
References		Data Recorded By
		ALAN HENRICKSON
Bearing Shell Position		2



Record manufacturer's data as it appears on bearing shell

Upper Shell

--

Lower Shell

--

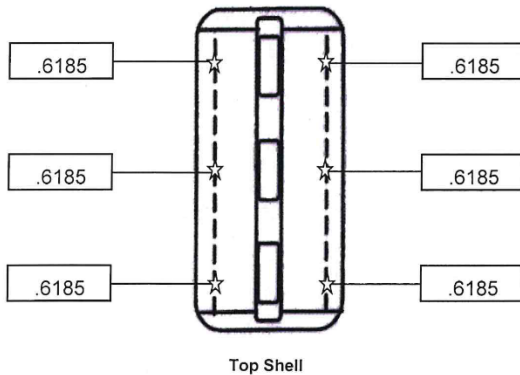
Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

Note any abnormalities and sketch as necessary

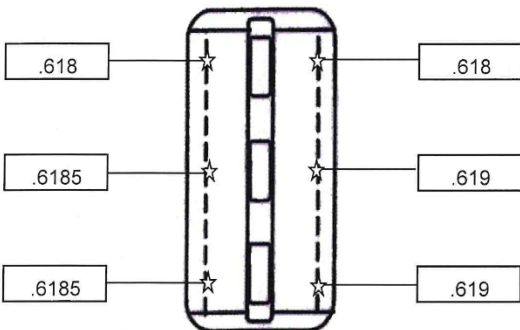
--

Perform non-destructive dye check on all surfaces. Note results below.

Results or Remarks



Top Shell



Bottom Shell

New Bearing ?

X

Re-used Bearing ?

--



CALIFORNIA MARINE DIESEL, INC.

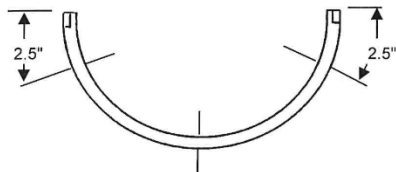
1501 WEST 15TH STREET
LONG BEACH, CA 90813

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CALIFORNIA MARINE DIESEL INC.

CONNECTING ROD BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2019
References		Data Recorded By
		ALAN HENRICKSON
Bearing Shell Position		3



Record manufacturer's data as it appears on bearing shell

Upper Shell

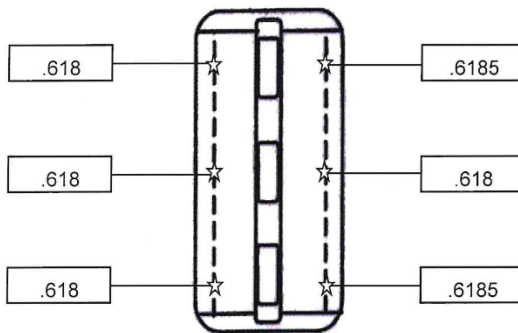
Lower Shell

Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

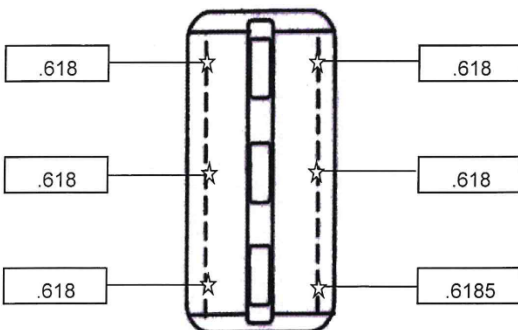
Note any abnormalities and sketch as necessary

Perform non-destructive dye check on all surfaces. Note results below.

Results or Remarks



Top Shell



Bottom Shell

New Bearing ?

Re-used Bearing ?

X



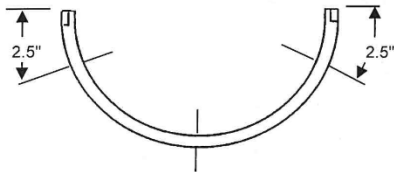
CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC.

CONNECTING ROD BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2019
References		Data Recorded By
		ALAN HENRICKSON
Bearing Shell Position		4



Record manufacturer's data as it appears on bearing shell

Upper Shell

--

Lower Shell

--

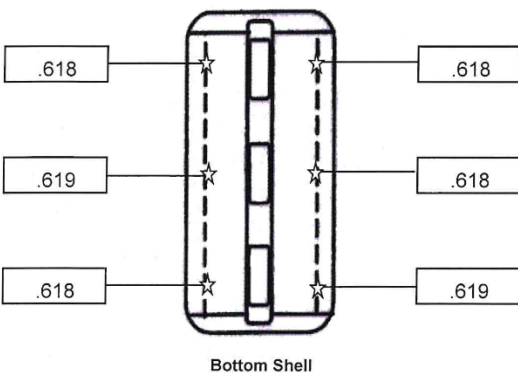
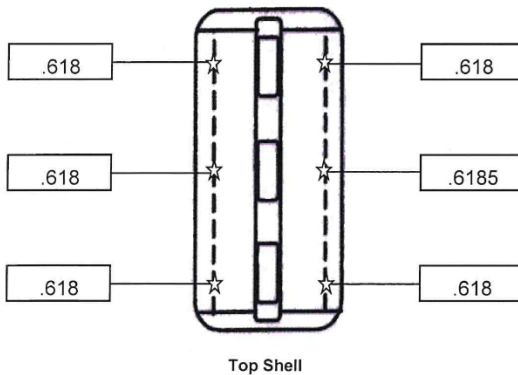
Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

Note any abnormalities and sketch as necessary

--

Perform non-destructive dye check on all surfaces. Note results below.

Results or Remarks



New Bearing ?

X

Re-used Bearing ?

--



CALIFORNIA MARINE DIESEL, INC.

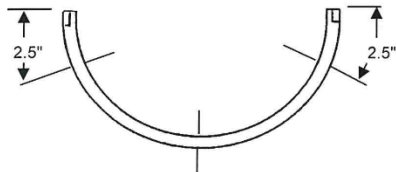
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC.

CONNECTING ROD BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2019
References		Data Recorded By
		ALAN HENRICKSON
Bearing Shell Position		5



Record manufacturer's data as it appears on bearing shell

Upper Shell

--

Lower Shell

--

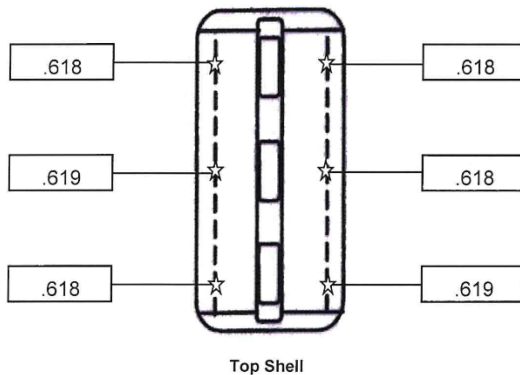
Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

Note any abnormalities and sketch as necessary

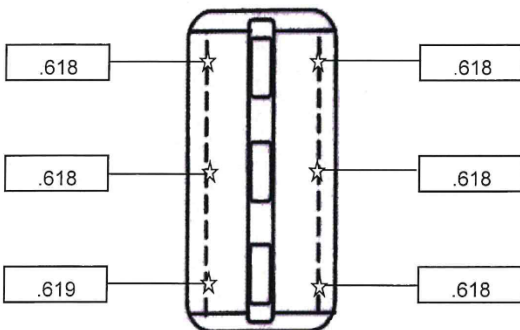
--

Perform non-destructive dye check on all surfaces. Note results below.

Results or Remarks



Top Shell



Bottom Shell

New Bearing ?

X

Re-used Bearing ?

--



CALIFORNIA MARINE DIESEL, INC.

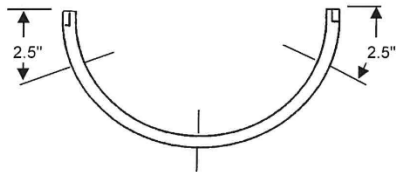
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC.

CONNECTING ROD BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2019
References		Data Recorded By
		ALAN HENRICKSON
Bearing Shell Position		6



Record manufacturer's data as it appears on bearing shell

Upper Shell

--

Lower Shell

--

Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

Note any abnormalities and sketch as necessary

--

Perform non-destructive dye check on all surfaces. Note results below.

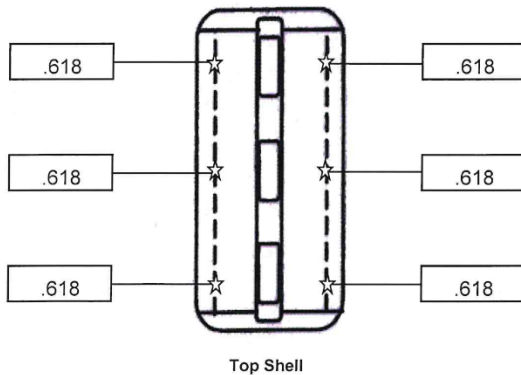
Results or Remarks

New Bearing ?

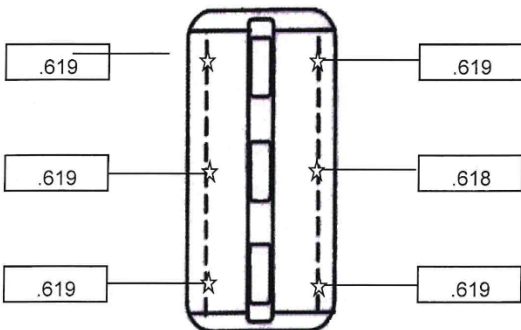
X

Re-used Bearing ?

--



Top Shell



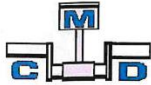
Bottom Shell



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1501 WEST 15TH STREET
LONG BEACH, CA 90813

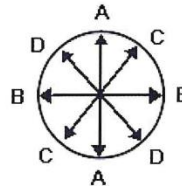
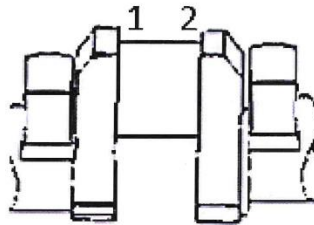
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

CRANKPIN/ CONNECTING ROD JOURNAL INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 27-Jun-19
Inspection performed by ALAN HENRICKSON



Measure 2 inches from fillet vertically, horizontally and twice diagonally, A-A, B-B, C-C, D-D

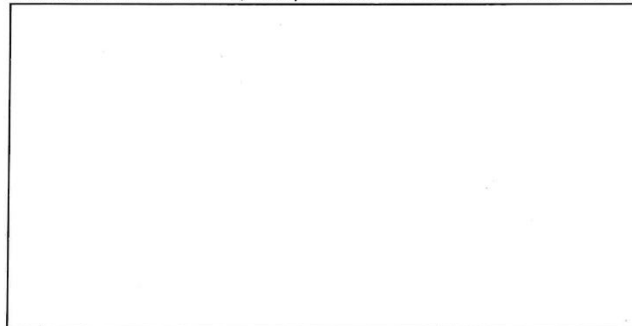
Dimension Specification. 11.000 in

CONNECTING ROD JOURNAL # 1

	A	B	C	D
1	10.998	10.998	10.997	10.997
2	10.997	10.998	10.997	10.997

Note any scratches, impact points, or loss of finish:

Enterprise crankshaft finish is rms 16; Cooper Bessemer crankshaft finish is rms 25





CALIFORNIA MARINE DIESEL, INC.

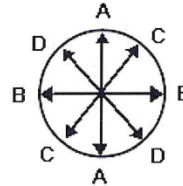
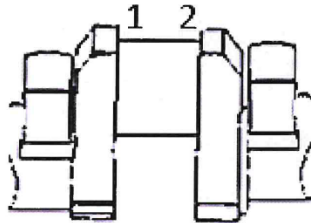
1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

CRANKPIN/ CONNECTING ROD JOURNAL INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 27-Jun-19
Inspection performed by ALAN HENRICKSON



Measure 2 inches from fillet vertically, horizontally and twice diagonally, A-A, B-B, C-C, D-D

Dimension Specification. 11.000 in

CONNECTING ROD JOURNAL # 2

	A	B	C	D
1	10.997	10.997	10.997	10.9965
2	10.998	10.997	10.997	10.9965

Note any scratches, impact points, or loss of finish:

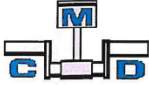
Enterprise crankshaft finish is rms 16; Cooper Bessemer crankshaft finish is rms 25





CALIFORNIA MARINE DIESEL, INC.

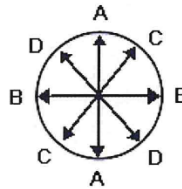
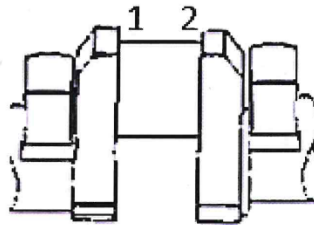
1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

CRANKPIN/ CONNECTING ROD JOURNAL INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 27-Jun-19
Inspection performed by ALAN HENRICKSON



Measure 2 inches from fillet vertically, horizontally and twice diagonally, A-A, B-B, C-C, D-D

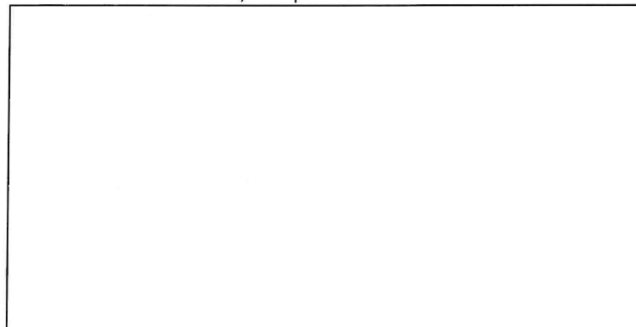
Dimension Specification. 11.000 in

CONNECTING ROD JOURNAL # 3

	A	B	C	D
1	10.998	10.997	10.999	10.9975
2	10.997	10.997	10.997	10.997

Note any scratches, impact points, or loss of finish:

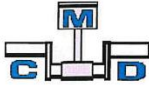
Enterprise crankshaft finish is rms 16; Cooper Bessemer crankshaft finish is rms 25





CALIFORNIA MARINE DIESEL, INC.

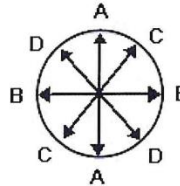
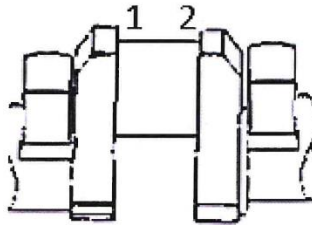
1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

CRANKPIN/ CONNECTING ROD JOURNAL INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 27-Jun-19
Inspection performed by ALAN HENRICKSON



Measure 2 inches from fillet vertically, horizontally and twice diagonally, A-A, B-B, C-C, D-D

Dimension Specification. 11.000 in

CONNECTING ROD JOURNAL # 4

	A	B	C	D
1	10.997	10.997	10.997	10.996
2	10.997	10.997	10.9965	10.998

Note any scratches, impact points, or loss of finish:

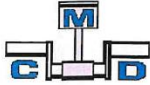
Enterprise crankshaft finish is rms 16; Cooper Bessemer crankshaft finish is rms 25





CALIFORNIA MARINE DIESEL, INC.

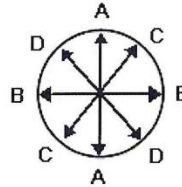
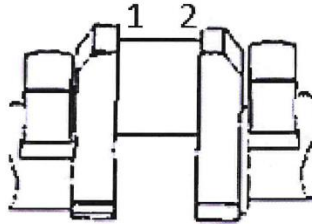
1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

CRANKPIN/ CONNECTING ROD JOURNAL INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 27-Jun-19
Inspection performed by ALAN HENRICKSON



Measure 2 inches from fillet vertically, horizontally and twice diagonally, A-A, B-B, C-C, D-D

Dimension Specification. 11.000 in

CONNECTING ROD JOURNAL # 5

	A	B	C	D
1	10.998	10.997	10.996	10.997
2	10.997	10.997	10.996	10.997

Note any scratches, impact points, or loss of finish:

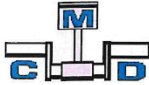
Enterprise crankshaft finish is rms 16; Cooper Bessemer crankshaft finish is rms 25



CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813

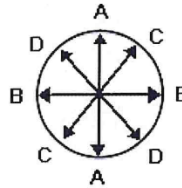
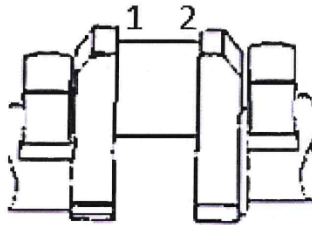
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

CRANKPIN/ CONNECTING ROD JOURNAL INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 27-Jun-19
Inspection performed by ALAN HENRICKSON



Measure 2 inches from fillet vertically, horizontally and twice diagonally, A-A, B-B, C-C, D-D

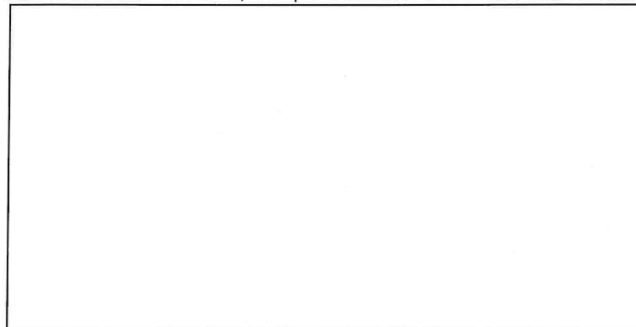
Dimension Specification. 11.000 in

CONNECTING ROD JOURNAL # 6

	A	B	C	D
1	10.998	10.999	10.998	10.998
2	10.999	10.998	10.999	10.997

Note any scratches, impact points, or loss of finish:

Enterprise crankshaft finish is rms 16; Cooper Bessemer crankshaft finish is rms 25





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CALIFORNIA MARINE DIESEL INC

CYLINDER LINERS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGSR-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 6, 2018
References		Data Recorded By
		Alan Henrickson
Memo		Cylinder No. / Bank
		1

Exhaust Side



Intake Side

Indicate blemishes on interior surface of cylinder liner as seen from above



Normal crosshatch



Scratches - Long narrow grooves usually caused by foreign material. Crosshatch pattern runs through.



Scuffing - Caused by piston and/or rings. Can start below oil rings and run up through upper ring travel area. Crosshatch pattern can not be seen.

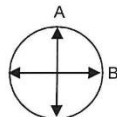
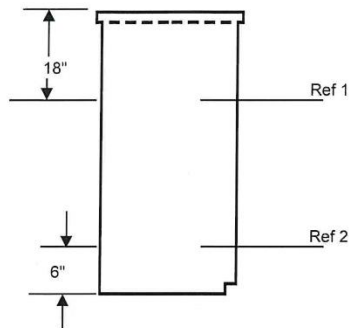


Bright spot - Bearing through crosshatch. Can appear anywhere. Probable cause: heavy bearing by buildup above top ring land.

1. Establish reference measurement and record. If piston is out of liner, or liner is removed from block, use Preferred Reference Position. If piston is installed in liner use Alternative reference position. Take two readings 90 degrees apart.

2. Take readings at position 1 and record

3. Take readings at position 2 and record



A - Inboard (Exhaust side)
B - Flywheel end

	Before Honing		After Honing	
	A	B	A	B
Ref.				
1			17.000	17.000
2			17.000	17.000

Remarks

NEW LINER
LINERS ARE LUBRIDED

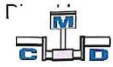
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CALIFORNIA MARINE DIESEL INC

CYLINDER LINERS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGSR-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 6, 2018
References		Data Recorded By
		Alan Henrickson
Memo		Cylinder No. / Bank
		2

Exhaust Side



Intake Side

Indicate blemishes on interior surface of cylinder liner as seen from above



Normal crosshatch



Scratches - Long narrow grooves usually caused by foreign material. Crosshatch pattern runs through.



Scuffing - Caused by piston and/or rings. Can start below oil rings and run up through upper ring travel area. Crosshatch pattern can not be seen.

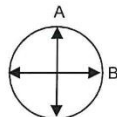
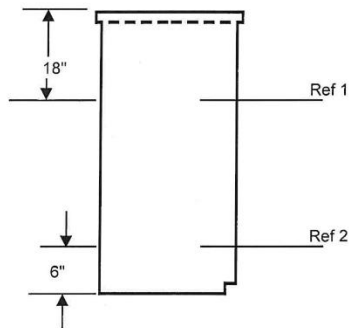


Bright spot - Bearing through crosshatch. Can appear anywhere. Probable cause: heavy bearing by buildup above top ring land.

1. Establish reference measurement and record. If piston is out of liner, or liner is removed from block, use Preferred Reference Position. If piston is installed in liner use Alternative reference position. Take two readings 90 degrees apart.

2. Take readings at position 1 and record

3. Take readings at position 2 and record



A - Inboard (Exhaust side)
B - Flywheel end

	Before Honing		After Honing	
	A	B	A	B
Ref.				
1			17.000	17.000
2			17.000	17.000

Remarks

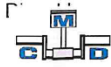
NEW LINER
LINERS ARE LUBRIDED

wn 2004



CALIFORNIA MARINE DIESEL, INC.

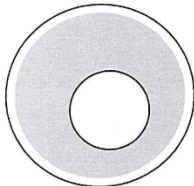
1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC

CYLINDER LINERS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGSR-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 6, 2018
References		Data Recorded By
		Alan Henrikson
Memo		Cylinder No. / Bank
		3

Exhaust Side



Intake Side

Indicate blemishes on interior surface of cylinder liner as seen from above



Normal crosshatch



Scratches - Long narrow grooves usually caused by foreign material. Crosshatch pattern runs through.



Scuffing - Caused by piston and/or rings. Can start below oil rings and run up through upper ring travel area. Crosshatch pattern can not be seen.

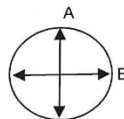
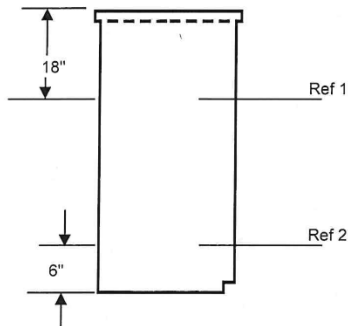


Bright spot - Bearing through crosshatch. Can appear anywhere. Probable cause: heavy bearing by buildup above top ring land.

1. Establish reference measurement and record. If piston is out of liner, or liner is removed from block, use Preferred Reference Position. If piston is installed in liner use Alternative reference position. Take two readings 90 degrees apart.

2. Take readings at position 1 and record

3. Take readings at position 2 and record



A - Inboard (Exhaust side)
B - Flywheel end

	Before Honing		After Honing	
	A	B	A	B
Ref.				
1			17.001	17.001
2			17.001	17.001

Remarks

NEW LINER
LINERS ARE LUBRIDED

wn 2004



CALIFORNIA MARINE DIESEL, INC.

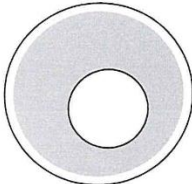
1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC

CYLINDER LINERS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGSR-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 6, 2018
References		Data Recorded By
		Alan Henrickson
Memo		Cylinder No. / Bank
		4

Exhaust Side



Intake Side

Indicate blemishes on interior surface of cylinder liner as seen from above



Normal crosshatch



Scratches - Long narrow grooves usually caused by foreign material. Crosshatch pattern runs through.



Scuffing - Caused by piston and/or rings. Can start below oil rings and run up through upper ring travel area. Crosshatch pattern can not be seen.

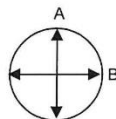
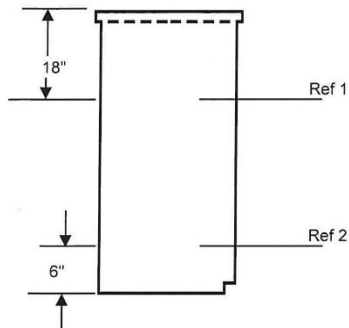


Bright spot - Bearing through crosshatch. Can appear anywhere. Probable cause: heavy bearing by buildup above top ring land.

1. Establish reference measurement and record. If piston is out of liner, or liner is removed from block, use Preferred Reference Position. If piston is installed in liner use Alternative reference position. Take two readings 90 degrees apart.

2. Take readings at position 1 and record

3. Take readings at position 2 and record



A - Inboard (Exhaust side)
B - Flywheel end

	Before Honing		After Honing	
	A	B	A	B
Ref.				
1			17.000	17.000
2			17.000	17.000

Remarks

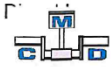
NEW LINER
LINERS ARE LUBRIDED

wn 2004



CALIFORNIA MARINE DIESEL, INC.

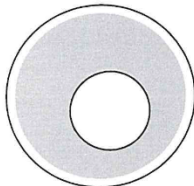
1501 WEST 15TH STREET
LONG BEACH, CA 90813
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CALIFORNIA MARINE DIESEL INC

CYLINDER LINERS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGSR-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 6, 2018
References		Data Recorded By
		Alan Henrikson
Memo		Cylinder No. / Bank
		5

Exhaust Side



Intake Side

Indicate blemishes on interior surface of cylinder liner as seen from above



Normal crosshatch



Scratches - Long narrow grooves usually caused by foreign material. Crosshatch pattern runs through.



Scuffing - Caused by piston and/or rings. Can start below oil rings and run up through upper ring travel area. Crosshatch pattern can not be seen.

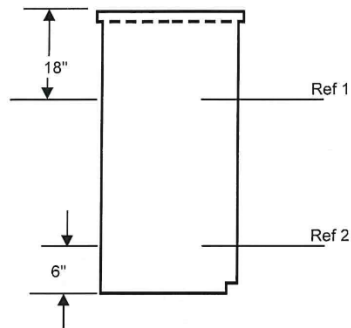


Bright spot - Bearing through crosshatch. Can appear anywhere. Probable cause: heavy bearing by buildup above top ring land.

1. Establish reference measurement and record. If piston is out of liner, or liner is removed from block, use Preferred Reference Position. If piston is installed in liner use Alternative reference position. Take two readings 90 degrees apart.

2. Take readings at position 1 and record

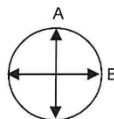
3. Take readings at position 2 and record



	Before Honing		After Honing	
	A	B	A	B
Ref.				
1			17.000	17.000
2			17.000	17.000

Remarks

NEW LINER
LINERS ARE LUBRIDED



A - Inboard (Exhaust side)
B - Flywheel end

wn 2004



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CALIFORNIA MARINE DIESEL INC

CYLINDER LINERS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGSR-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 6, 2018
References		Data Recorded By
		Alan Henrickson
Memo		Cylinder No. / Bank
		6

Exhaust Side



Intake Side

Indicate blemishes on interior surface of cylinder liner as seen from above



Normal crosshatch



Scratches - Long narrow grooves usually caused by foreign material. Crosshatch pattern runs through.



Scuffing - Caused by piston and/or rings. Can start below oil rings and run up through upper ring travel area. Crosshatch pattern can not be seen.

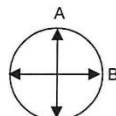
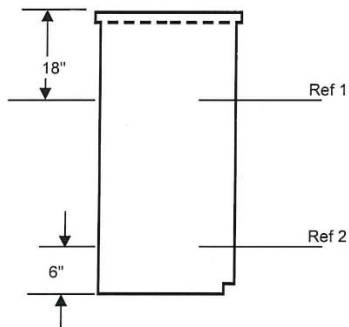


Bright spot - Bearing through crosshatch. Can appear anywhere. Probable cause: heavy bearing by buildup above top ring land.

1. Establish reference measurement and record. If piston is out of liner, or liner is removed from block, use Preferred Reference Position. If piston is installed in liner use Alternative reference position. Take two readings 90 degrees apart.

2. Take readings at position 1 and record

3. Take readings at position 2 and record



A - Inboard (Exhaust side)
B - Flywheel end

	Before Honing		After Honing	
	A	B	A	B
Ref.				
1			17.000	17.000
2			17.000	17.000

Remarks

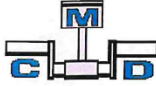
NEW LINER
LINERS ARE LUBRIDED

wn 2004



CALIFORNIA MARINE DIESEL, INC.

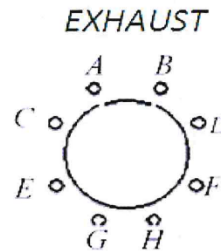
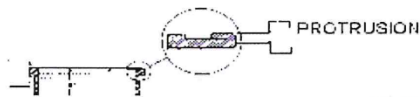
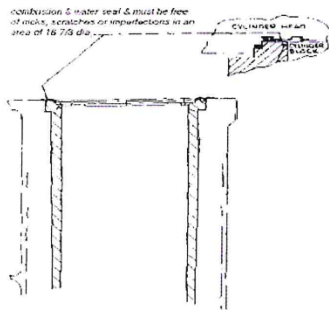
1501 WEST 15TH STREET
LONG BEACH, CA 90813
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CALIFORNIA MARINE DIESEL

LINER PROTRUSION MEASUREMENTS

Customer	EAST BAY MUNICIPAL UTILITIES DISTRICT			Location	OAKLAND, CALIFORNIA
Model	ENTERPRISE DGSR-46			Serial Number	82004-3063
Customer Designation	UNIT 2	Date	20-Sep-18	Inspector	Alan Henrickson
				cylinder number	1



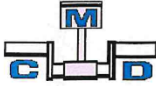
Measurements using depth micrometer are taken at 8 points near each cylinder head stud. Measurements are taken at the edge of the cylinder liner to the engine block adjacent to the liner top.

A	.013
B	.012
C	.015
D	.011
E	.014
F	.012
G	.014
H	.013



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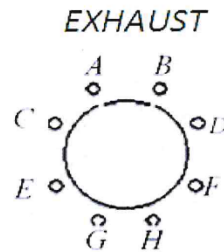
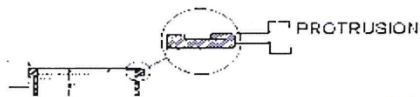
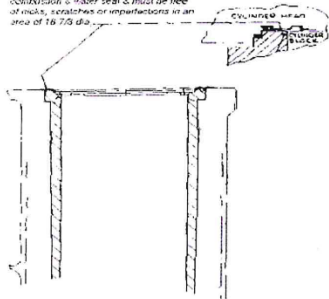


CALIFORNIA MARINE DIESEL

LINER PROTRUSION MEASUREMENTS

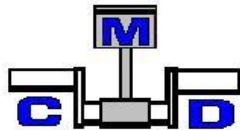
Customer	EAST BAY MUNICIPLA UTILITIES DISTRICT			Location	OAKLAND, CALIFORNIA
Model	ENTERPRISE DGRS-46			Serial Number	82004-3063
Customer Designation	UNIT 2	Date	20-Sep-18	Inspector	ALAN HENRICKSON
				cylinder number	2

compression & water seal & must be free of nicks, scratches or imperfections in an area of 16-7/8 dia.



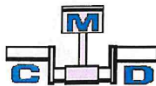
Measurements using depth micrometer are taken at 8 points near each cylinder head stud. Measurements are taken at the edge of the cylinder liner to the engine block adjacent to the liner top.

A	.004
B	.002
C	.006
D	.002
E	.005
F	.002
G	.004
H	.002



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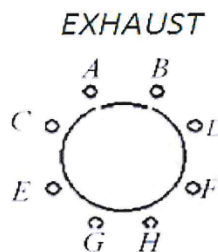
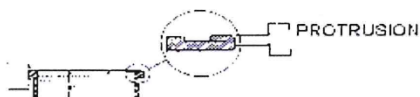
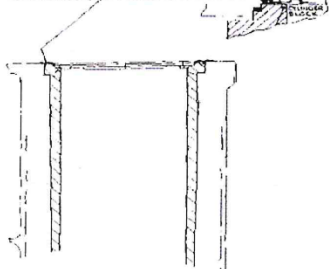


CALIFORNIA MARINE DIESEL

LINER PROTRUSION MEASUREMENTS

Customer	EAST BAY MUNICIPAL UTILITIES DISTRICT			Location	OAKLAND, CALIFORNIA
Model	ENTERPRISE DGRS-46			Serial Number	82004-3063
Customer Designation	UNIT 2	Date	20-Sep-18	Inspector	ALAN HENRICKSON
				cylinder number	3

combustion & water seal & must be free of nicks, scratches or imperfections in an area of 16.75 dia.



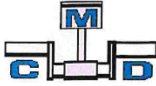
Measurements using depth micrometer are taken at 8 points near each cylinder head stud. Measurements are taken at the edge of the cylinder liner to the engine block adjacent to the liner top.

A	.010
B	.010
C	.010
D	.010
E	.010
F	.006
G	.011
H	.009



CALIFORNIA MARINE DIESEL, INC.

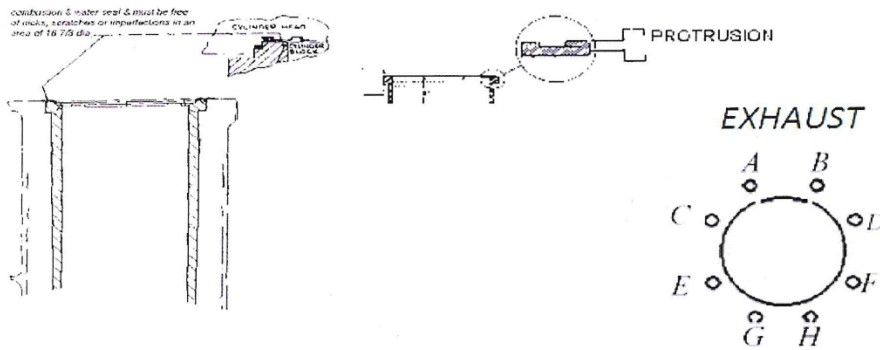
1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

LINER PROTRUSION MEASUREMENTS

Customer	EAST BAY MUNICIPAL UTILITIES DISTRICT			Location	OAKLAND, CALIFORNIA
Model	ENTERPRISE DGRS-46			Serial Number	82004-3063
Customer Designation	UNIT 2	Date	20-Sep-18	Inspector	Alan Henrickson
				cylinder number	4



Measurements using depth micrometer are taken at 8 points near each cylinder head stud. Measurements are taken at the edge of the cylinder liner to the engine block adjacent to the liner top.

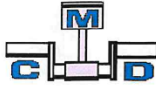
A	.014
B	.014
C	0.014
D	.015
E	.016
F	.015
G	.015
H	.015



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

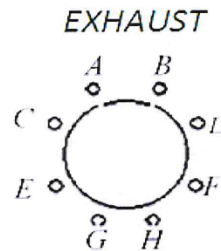
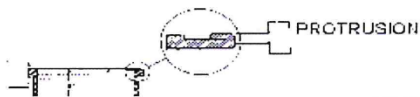
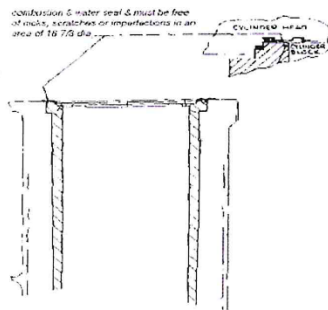
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

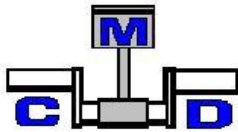
LINER PROTRUSION MEASUREMENTS

Customer	EAST BAY MUNICIPAL UTILITIES DISTRICT			Location	OAKLAND, CALIFORNIA
Model	ENTERPRISE DGRS-46			Serial Number	82004-3063
Customer Designation	UNIT 2	Date	20-Sep-18	Inspector	Alan Henrickson
				cylinder number	5



Measurements using depth micrometer are taken at 8 points near each cylinder head stud. Measurements are taken at the edge of the cylinder liner to the engine block adjacent to the liner top.

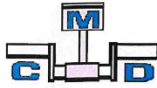
A	.012
B	.008
C	.013
D	.011
E	.012
F	.012
G	.013
H	.014



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LONG BEACH, CA 90813

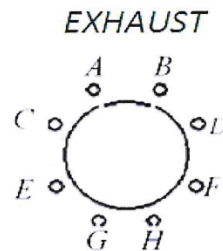
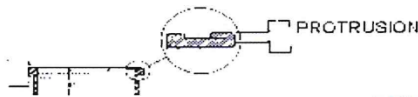
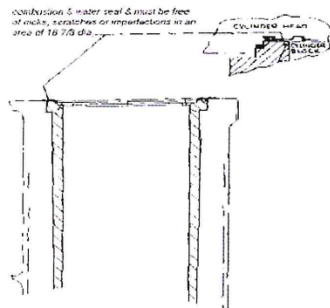
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CALIFORNIA MARINE DIESEL

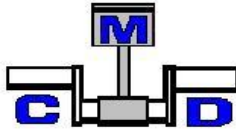
LINER PROTRUSION MEASUREMENTS

Customer	EAST BAY MUNICIPAL UTILITIES DISTRICT			Location	OAKLAND, CALIFORNIA
Model	ENTERPRISE DGSR-46			Serial Number	82004-3063
Customer Designation	UNIT 2	Date	20-Sep-18	Inspector	Alan Henrickson
				cylinder number	6



Measurements using depth micrometer are taken at 8 points near each cylinder head stud. Measurements are taken at the edge of the cylinder liner to the engine block adjacent to the liner top.

A	.005
B	.005
C	.005
D	.005
E	.006
F	.007
G	.008
H	.009



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PISTON - Two Piece		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 2, 2019
References		Data Recorded By
Memo		Cylinder No./ Bank
		1

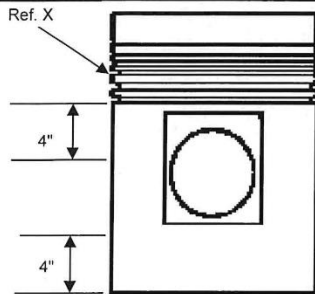


Fig. A Side View

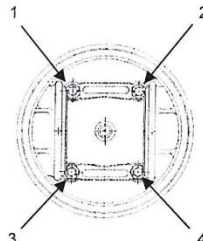


Fig. B Bottom View

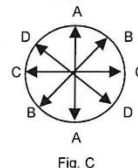


Fig. C

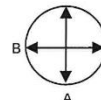


Fig. D

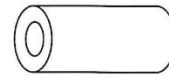


Fig. E Piston Pin

1. Measure skirt outside diameter and record dimensions below. Measure at two locations, 4 inches below bottom ring groove and 4 inches above bottom of skirt (see Fig. A). Measure four positions (A-A, B-B, C-C, D-D) in each location (see Fig. C).

Position	A-A	B-B	C-C	D-D
Upper	16.980	16.980	16.980	16.979
Lower	16.982	16.982	16.981	16.982

2. Measure piston pin outside diameter at two locations 2 inches from each end (Fig. E). Measure two positions (A-A, B-B) in each location (Fig. D).

Position	A-A	B-B
Forward	6.746	6.746
Rear	6.746	6.746

3. Crown to Skirt Clearance (Fig. A Ref. X)

.007

4. Measure piston pin bore in piston in two positions (A-A, B-B) in each end of bore (Fig. D).

Position	A-A	B-B
Forward	6.750	6.750
Rear	6.7495	6.7495

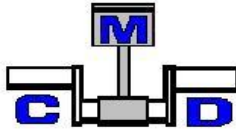
5. Record disassembly (breakaway) torque and assembly torque of piston crown stud nuts (see Fig. B).

Position	1	2	3	4
Disassemble				
Assemble				

6. Note condition of "O" Ring, piston pin plug and general condition of piston

PISTONS RECEIVED ASSEMBLED

wn 2004



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CALIFORNIA MARINE DIESEL INC.

PISTON - Two Piece		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 2, 2019
References		Data Recorded By
Memo		Cylinder No./ Bank
		2

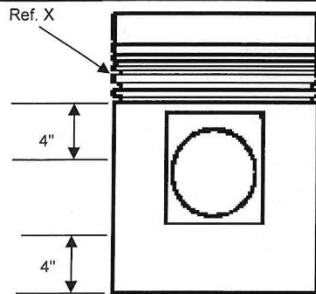


Fig. A Side View

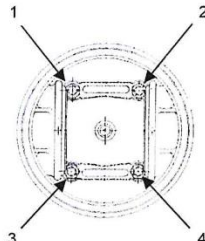


Fig. B Bottom View

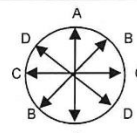


Fig. C

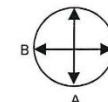


Fig. D

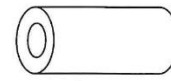


Fig. E Piston Pin

1. Measure skirt outside diameter and record dimensions below. Measure at two locations, 4 inches below bottom ring groove and 4 inches above bottom of skirt (see Fig. A). Measure four positions (A-A, B-B, C-C, D-D) in each location (see Fig. C).

Position	A-A	B-B	C-C	D-D
Upper	16.978	16.978	16.978	16.979
Lower	16.980	16.980	16.981	16.980

2. Measure piston pin outside diameter at two locations 2 inches from each end (Fig. E). Measure two positions (A-A, B-B) in each location (Fig. D).

Position	A-A	B-B
Forward	6.746	6.746
Rear	6.746	6.746

3. Crown to Skirt Clearance (Fig. A Ref. X)

.005

4. Measure piston pin bore in piston in two positions (A-A, B-B) in each end of bore (Fig. D).

Position	A-A	B-B
Forward	6.7495	6.7495
Rear	6.7495	6.7495

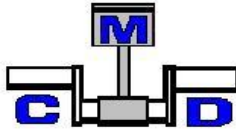
5. Record disassembly (breakaway) torque and assembly torque of piston crown stud nuts (see Fig. B).

Position	1	2	3	4
Disassemble				
Assemble				

6. Note condition of "O" Ring, piston pin plug and general condition of piston

PISTONS RECEIVED ASSEMBLED

wn 2004



CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813

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CALIFORNIA MARINE DIESEL INC.

PISTON - Two Piece		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 2, 2019
References		Data Recorded By
Memo		Cylinder No. / Bank
		3

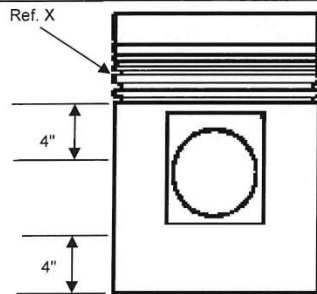


Fig. A Side View

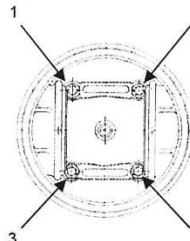


Fig. B Bottom View

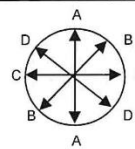


Fig. C

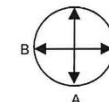


Fig. D

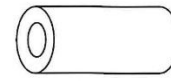


Fig. E Piston Pin

1. Measure skirt outside diameter and record dimensions below. Measure at two locations, 4 inches below bottom ring groove and 4 inches above bottom of skirt (see Fig. A). Measure four positions (A-A, B-B, C-C, D-D) in each location (see Fig. C).

Position	A-A	B-B	C-C	D-D
Upper	16.979	16.979	16.979	16.979
Lower	16.977	16.977	16.977	16.977

2. Measure piston pin outside diameter at two locations 2 inches from each end (Fig. E). Measure two positions (A-A, B-B) in each location (Fig. D).

Position	A-A	B-B
Forward	6.746	6.746
Rear	6.746	6.746

3. Crown to Skirt Clearance (Fig. A Ref. X)

.007

4. Measure piston pin bore in piston in two positions (A-A, B-B) in each end of bore (Fig. D).

Position	A-A	B-B
Forward	6.749	6.749
Rear	6.7495	6.7495

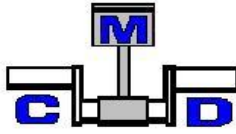
5. Record disassembly (breakaway) torque and assembly torque of piston crown stud nuts (see Fig. B).

Position	1	2	3	4
Disassemble				
Assemble				

6. Note condition of "O" Ring, piston pin plug and general condition of piston

PISTONS RECEIVED ASSEMBLED.

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CALIFORNIA MARINE DIESEL INC.

PISTON - Two Piece		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 2, 2019
References		Data Recorded By
Memo		Cylinder No./ Bank
		4

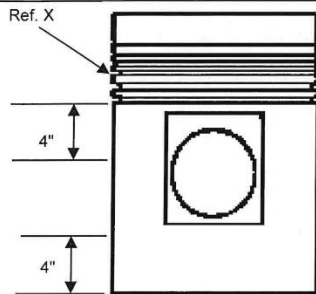


Fig. A Side View

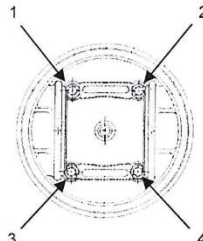


Fig. B Bottom View

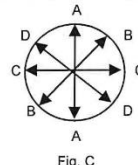


Fig. C

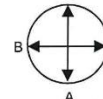


Fig. D

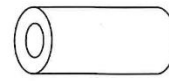


Fig. E Piston Pin

1. Measure skirt outside diameter and record dimensions below. Measure at two locations, 4 inches below bottom ring groove and 4 inches above bottom of skirt (see Fig. A). Measure four positions (A-A, B-B, C-C, D-D) in each location (see Fig. C).

Position	A-A	B-B	C-C	D-D
Upper	16.979	16.979	16.979	16.979
Lower	16.979	16.979	16.979	16.979

2. Measure piston pin outside diameter at two locations 2 inches from each end (Fig. E). Measure two positions (A-A, B-B) in each location (Fig. D).

Position	A-A	B-B
Forward	6.746	6.746
Rear	6.746	6.746

3. Crown to Skirt Clearance (Fig. A Ref. X)

.006

4. Measure piston pin bore in piston in two positions (A-A, B-B) in each end of bore (Fig. D).

Position	A-A	B-B
Forward	6.750	6.750
Rear	6.749	6.749

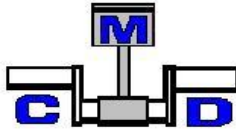
5. Record disassembly (breakaway) torque and assembly torque of piston crown stud nuts (see Fig. B).

Position	1	2	3	4
Disassemble				
Assemble				

6. Note condition of "O" Ring, piston pin plug and general condition of piston

PISTONS RECEIVED ASSEMBLED.

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LONG BEACH, CA 90813

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CALIFORNIA MARINE DIESEL INC.

PISTON - Two Piece		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 2, 2019
References		Data Recorded By
Memo		Cylinder No./ Bank
		5

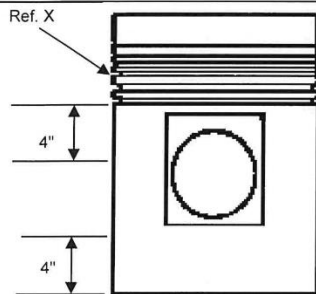


Fig. A Side View

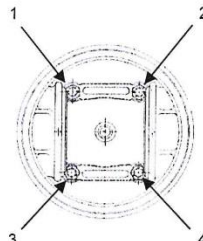


Fig. B Bottom View

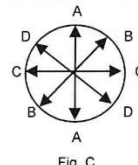


Fig. C

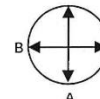


Fig. D

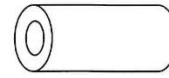


Fig. E Piston Pin

1. Measure skirt outside diameter and record dimensions below. Measure at two locations, 4 inches below bottom ring groove and 4 inches above bottom of skirt (see Fig. A). Measure four positions (A-A, B-B, C-C, D-D) in each location (see Fig. C).

Position	A-A	B-B	C-C	D-D
Upper	16.979	16.979	16.979	16.979
Lower	16.981	16.981	16.981	16.981

2. Measure piston pin outside diameter at two locations 2 inches from each end (Fig. E). Measure two positions (A-A, B-B) in each location (Fig. D).

Position	A-A	B-B
Forward	6.746	6.746
Rear	6.746	6.746

3. Crown to Skirt Clearance (Fig. A Ref. X)

.006

4. Measure piston pin bore in piston in two positions (A-A, B-B) in each end of bore (Fig. D).

Position	A-A	B-B
Forward	6.749	6.749
Rear	6.749	6.749

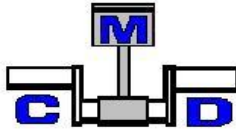
5. Record disassembly (breakaway) torque and assembly torque of piston crown stud nuts (see Fig. B).

Position	1	2	3	4
Disassemble				
Assemble				

6. Note condition of "O" Ring, piston pin plug and general condition of piston

PISTONS RECEIVED ASSEMBLED.

wn 2004



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CALIFORNIA MARINE DIESEL INC.

PISTON - Two Piece		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DSRG-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 2, 2019
References		Data Recorded By
Memo		Cylinder No./ Bank
		6

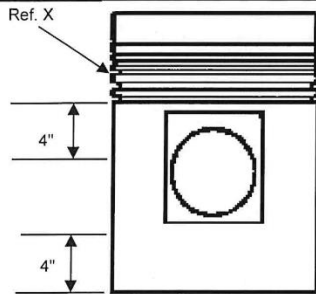


Fig. A Side View

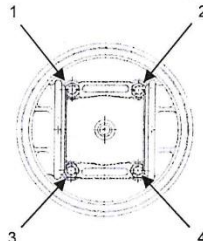


Fig. B Bottom View

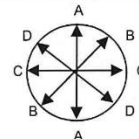


Fig. C

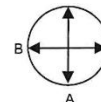


Fig. D

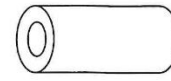


Fig. E Piston Pin

1. Measure skirt outside diameter and record dimensions below. Measure at two locations, 4 inches below bottom ring groove and 4 inches above bottom of skirt (see Fig. A). Measure four positions (A-A, B-B, C-C, D-D) in each location (see Fig. C).

Position	A-A	B-B	C-C	D-D
Upper	16.976	16.976	16.976	16.976
Lower	16.976	16.976	16.976	16.976

2. Measure piston pin outside diameter at two locations 2 inches from each end (Fig. E). Measure two positions (A-A, B-B) in each location (Fig. D).

Position	A-A	B-B
Forward	6.746	6.746
Rear	6.746	6.746

3. Crown to Skirt Clearance (Fig. A Ref. X)

.007

4. Measure piston pin bore in piston in two positions (A-A, B-B) in each end of bore (Fig. D).

Position	A-A	B-B
Forward	6.749	6.749
Rear	6.7495	6.7495

5. Record disassembly (breakaway) torque and assembly torque of piston crown stud nuts (see Fig. B).

Position	1	2	3	4
Disassemble				
Assemble				

6. Note condition of "O" Ring, piston pin plug and general condition of piston

PISTONS RECEIVED ASSEMBLED.

wn 2004



CALIFORNIA MARINE DIESEL, INC.

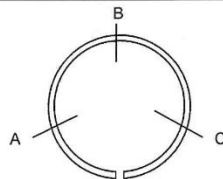
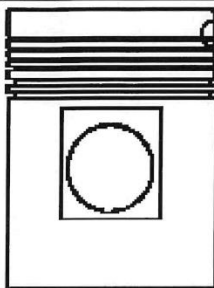
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC.

PISTON RINGS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTREPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		21-22 September 19
References		Data Recorded By
		ALAN HENRICKSON
Memo		Cylinder No. / Bank
		1



Location for taking side clearance



Measurement ring end gap with ring in cylinder liner bore

1. Measure piston ring side clearance in groove with feeler gauge. Measure each ring in three locations, 120 degrees apart.
2. Remove rings from piston for cleaning and measurement. Re-used rings must be marked and re-installed in the order in which they were removed. Record gap and percent ring face contact.
3. If new rings are installed, note reasons in "Remarks" below
4. If new rings are installed, record end gap and side clearance.

Ring	Old (Removed) Rings					New (Replacement) Rings			
	Side clearance			End Gap	% Face Contact	Side clearance			End Gap
	A	B	C			A	B	C	
Compression						.009	.009	.009	.072
Compression									
Intermediate						.008	.008	.008	.081
Intermediate						.006	.007	.007	.073
Oil Control						.005	.004	.005	.036
Oil Control						.004	.005	.005	.036

Remarks



CALIFORNIA MARINE DIESEL, INC.

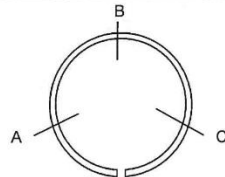
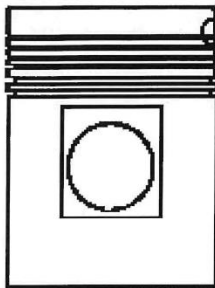
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC.

PISTON RINGS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTRERPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		21-22 September 19
References		Data Recorded By
		ALAN HENRICKSON
Memo		Cylinder No./ Bank
		2



Location for taking side clearance



Measurement ring end gap with ring in cylinder liner bore

1. Measure piston ring side clearance in groove with feeler gauge. Measure each ring in three locations, 120 degrees apart.
2. Remove rings from piston for cleaning and measurement. Re-used rings must be marked and re-installed in the order in which they were removed. Record gap and percent ring face contact.
3. If new rings are installed, note reasons in "Remarks" below
4. If new rings are installed, record end gap and side clearance.

Ring	Old (Removed) Rings					New (Replacement) Rings			
	Side clearance			End Gap	% Face Contact	Side clearance			End Gap
	A	B	C			A	B	C	
Compression						.006	.007	.008	.075
Compression									
Intermediate						.006	.006	.005	.082
Intermediate						.006	.006	.006	.065
Oil Control						.003	.004	.006	.036
Oil Control						.004	.003	.006	.038

Remarks



CALIFORNIA MARINE DIESEL, INC.

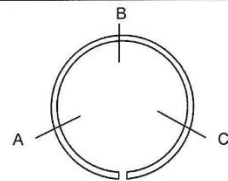
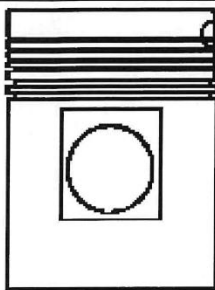
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL INC.

PISTON RINGS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTREPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		21-22 September 19
References		Data Recorded By
		ALAN HENRICKSON
Memo		Cylinder No./ Bank
		3



Location for taking side clearance



Measurement ring end gap with ring in cylinder liner bore

1. Measure piston ring side clearance in groove with feeler gauge. Measure each ring in three locations, 120 degrees apart.
2. Remove rings from piston for cleaning and measurement. Re-used rings must be marked and re-installed in the order in which they were removed. Record gap and percent ring face contact.
3. If new rings are installed, note reasons in "Remarks" below
4. If new rings are installed, record end gap and side clearance.

Ring	Old (Removed) Rings					New (Replacement) Rings			
	Side clearance			End Gap	% Face Contact	Side clearance			End Gap
	A	B	C			A	B	C	
Compression						.006	.007	.008	.073
Compression									
Intermediate						.006	.006	.006	.078
Intermediate						.006	.005	.006	.058
Oil Control						.005	.004	.006	.037
Oil Control						.004	.003	.004	.037

Remarks



CALIFORNIA MARINE DIESEL, INC.

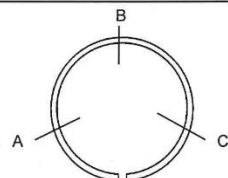
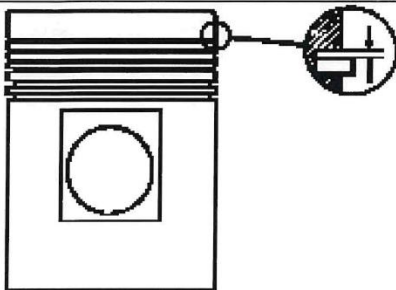
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

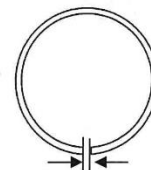


CALIFORNIA MARINE DIESEL INC.

PISTON RINGS			
Customer		Engine Location	
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA	
Engine Model	Serial No.	Customer Designation	
ENTREPRISE DGRS-46	82004-3063	UNIT 2	
Total Engine Hours	Hours Since Last Inspection	Date This Inspection	
		21-22 September 19	
References		Data Recorded By	
		ALAN HENRICKSON	
Memo		Cylinder No./ Bank	
		4	



Location for taking side clearance



Measurement ring end gap with ring in cylinder liner bore

1. Measure piston ring side clearance in groove with feeler gauge. Measure each ring in three locations, 120 degrees apart.
2. Remove rings from piston for cleaning and measurement. Re-used rings must be marked and re-installed in the order in which they were removed. Record gap and percent ring face contact.
3. If new rings are installed, note reasons in "Remarks" below
4. If new rings are installed, record end gap and side clearance.

Ring	Old (Removed) Rings				New (Replacement) Rings			
	Side clearance			End Gap	Side clearance			End Gap
	A	B	C		A	B	C	
Compression					.008	.008	.008	.078
Compression								
Intermediate					.006	.006	.006	.077
Intermediate					.006	.006	.006	.050
Oil Control					.003	.004	.003	.037
Oil Control					.004	.003	.004	.040

Remarks



CALIFORNIA MARINE DIESEL, INC.

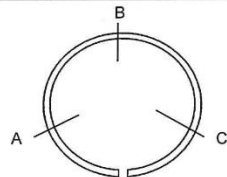
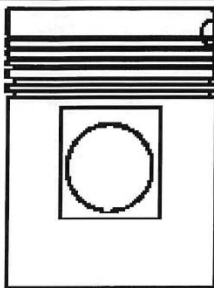
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

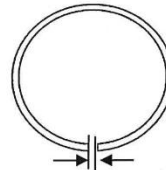


CALIFORNIA MARINE DIESEL INC.

PISTON RINGS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTREPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		21-22 September 19
References		Data Recorded By
		ALAN HENRICKSON
Memo		Cylinder No. / Bank
		5



Location for taking side clearance



Measurement ring end gap with ring in cylinder liner bore

1. Measure piston ring side clearance in groove with feeler gauge. Measure each ring in three locations, 120 degrees apart.
2. Remove rings from piston for cleaning and measurement. Re-used rings must be marked and re-installed in the order in which they were removed. Record gap and percent ring face contact.
3. If new rings are installed, note reasons in "Remarks" below
4. If new rings are installed, record end gap and side clearance.

Ring	Old (Removed) Rings				New (Replacement) Rings			
	Side clearance			End Gap	Side clearance			End Gap
	A	B	C		A	B	C	
Compression					.007	.007	.006	.065
Compression								
Intermediate					.005	.005	.006	.080
Intermediate					.005	.005	.006	.075
Oil Control					.003	.005	.003	.040
Oil Control					.003	.003	.003	.040

Remarks



CALIFORNIA MARINE DIESEL, INC.

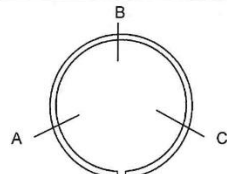
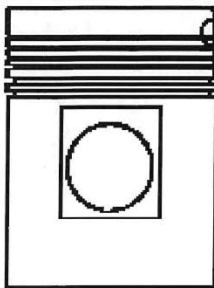
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

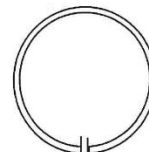


CALIFORNIA MARINE DIESEL INC.

PISTON RINGS		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTRERPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		21-22 September 19
References		Data Recorded By
		ALAN HENRICKSON
Memo		Cylinder No. / Bank
		6



Location for taking side clearance



Measurement ring end gap with ring in cylinder liner bore

1. Measure piston ring side clearance in groove with feeler gauge. Measure each ring in three locations, 120 degrees apart.
2. Remove rings from piston for cleaning and measurement. Re-used rings must be marked and re-installed in the order in which they were removed. Record gap and percent ring face contact.
3. If new rings are installed, note reasons in "Remarks" below
4. If new rings are installed, record end gap and side clearance.

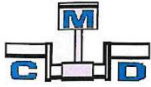
Ring	Old (Removed) Rings				New (Replacement) Rings			
	Side clearance			End Gap	Side clearance			End Gap
	A	B	C		A	B	C	
Compression					.008	.008	.009	.080
Compression								
Intermediate					.007	.007	.007	.083
Intermediate					.005	.006	.007	.060
Oil Control					.003	.003	.003	.042
Oil Control					.003	.003	.003	.037

Remarks



CALIFORNIA MARINE DIESEL, INC.

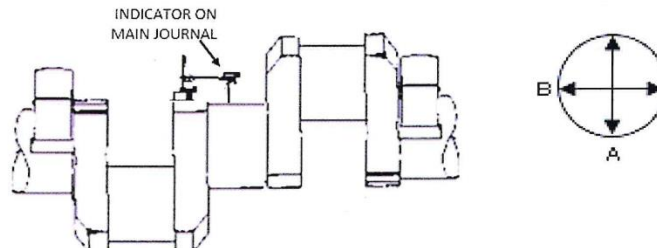
1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

MAIN JOURNAL INDICATED RUNOUT INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 9-Jun-19
Inspection performed by ALAN HENRICKSON



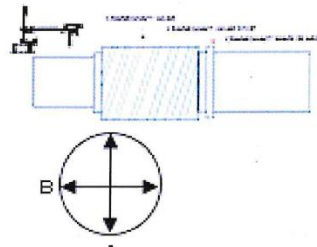
Indicated runout measured on each main journal for 1 revolution of the crankshaft to determine straightness of crankshaft.

MAIN JOURNAL # 1-9

	A	B	C	D
1	0	-.0005	0	-.0005
2	0	0	-.0005	0
3	0	0	0	0
4	0	0	-.0005	-.0005
5	0	0	0	0
6	0	0	0	-.0005
7	0	0	+.0005	0
8	0	0	0	0
9	0	0	0	0

WQATER PUMP DRIVE SHAFT

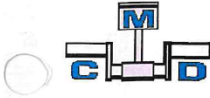
0	+.001	+.0005	+.0005
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CALIFORNIA MARINE DIESEL, INC.

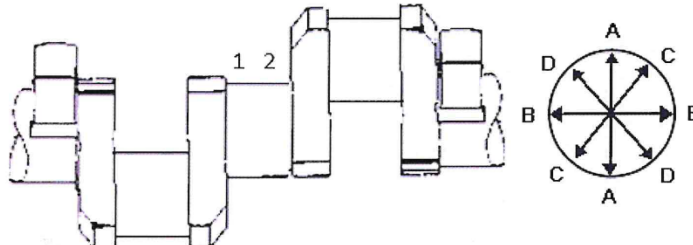
1501 WEST 15TH STREET
LONG BEACH, CA 90813
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CALIFORNIA MARINE DIESEL

MAIN JOURNAL INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 9-Jun-19
Inspection performed by ALAN HENRICKSON



Measure 2 inches from fillet vertically, horizontally and twice diagonally, A-A, B-B, C-C, D-D

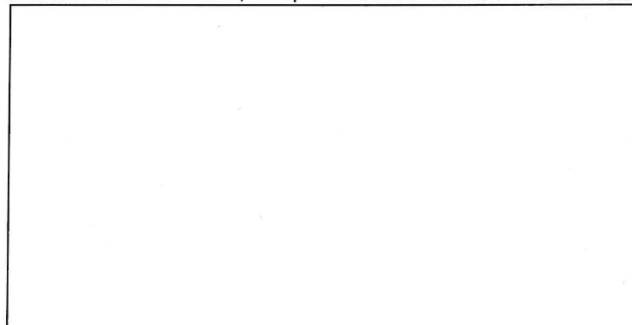
Dimension Specification 13.000

MAIN JOURNAL # 1

	A	B	C	D
1	12.998	12.998	12.998	12.998
2	12.998	12.998	12.998	12.997

Note any scratches, impact points, or loss of finish:

Enterprise crankshaft finish is rms 16; Cooper Bessemer crankshaft finish is rms 25

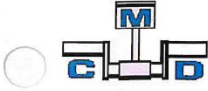




CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

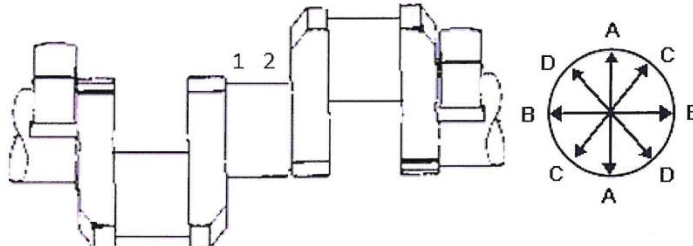
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

MAIN JOURNAL INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 9-Jun-19
Inspection performed by ALAN HENRICKSON



Measure 2 inches from fillet vertically, horizontally and twice diagonally, A-A, B-B, C-C, D-D

Dimension Specification 13.000

MAIN JOURNAL # 4

	A	B	C	D
1	12.997	12.997	12.998	12.9987
2	12.998	12.997	12.998	12.997

Note any scratches, impact points, or loss of finish:

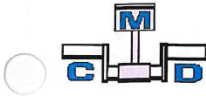
Enterprise crankshaft finish is rms 16; Cooper Bessemer crankshaft finish is rms 25





CALIFORNIA MARINE DIESEL, INC.

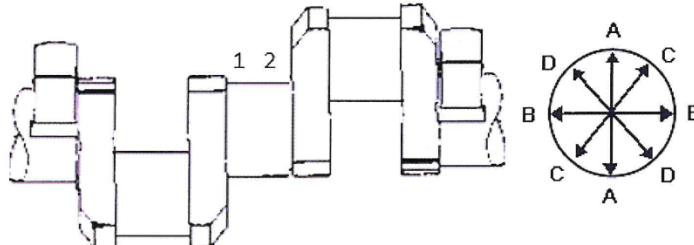
1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

MAIN JOURNAL INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 9-Jun-19
Inspection performed by ALAN HENRICKSON



Measure 2 inches from fillet vertically, horizontally and twice diagonally, A-A, B-B, C-C, D-D

Dimension Specification 13.000

MAIN JOURNAL # 5

	A	B	C	D
1	12.998	12.999	12.998	12.997
2	12.997	12.998	12.998	12.997

Note any scratches, impact points, or loss of finish:

Enterprise crankshaft finish is rms 16; Cooper Bessemer crankshaft finish is rms 25

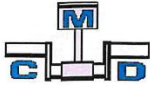




CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

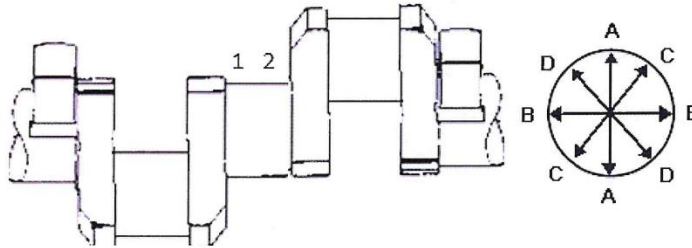
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

MAIN JOURNAL INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 9-Jun-19
Inspection performed by ALAN HENRICKSON



Measure 2 inches from fillet vertically, horizontally and twice diagonally, A-A, B-B, C-C, D-D

Dimension Specification 13.000

MAIN JOURNAL # 6

	A	B	C	D
1	12.998	12.997	12.998	12.998
2	12.997	12.997	12.998	12.998

Note any scratches, impact points, or loss of finish:

Enterprise crankshaft finish is rms 16; Cooper Bessemer crankshaft finish is rms 25





CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

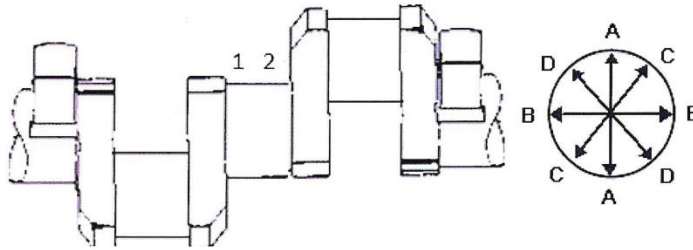
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

MAIN JOURNAL INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 9-Jun-19
Inspection performed by ALAN HENRICKSON



Measure 2 inches from fillet vertically, horizontally and twice diagonally, A-A, B-B, C-C, D-D

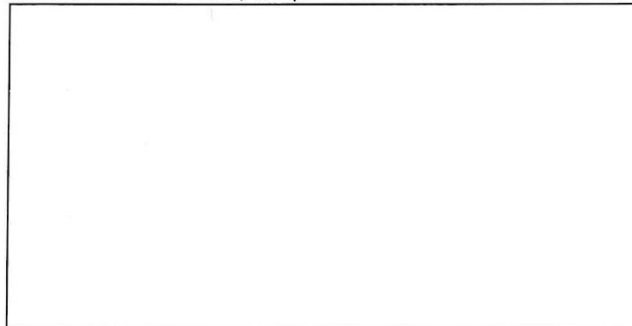
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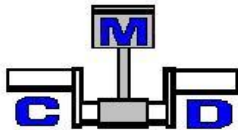
MAIN JOURNAL # 7

	A	B	C	D
1	12.997	12.997	12.997	12.998
2	12.998	12.997	12.997	12.997

Note any scratches, impact points, or loss of finish:

Enterprise crankshaft finish is rms 16; Cooper Bessemer crankshaft finish is rms 25





CALIFORNIA MARINE DIESEL, INC.

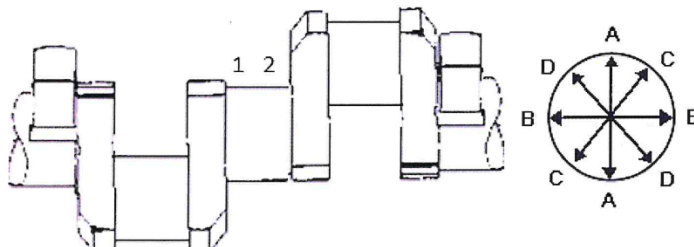
1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

MAIN JOURNAL INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 9-Jun-19
Inspection performed by ALAN HENRICKSON



Measure 2 inches from fillet vertically, horizontally and twice diagonally, A-A, B-B, C-C, D-D

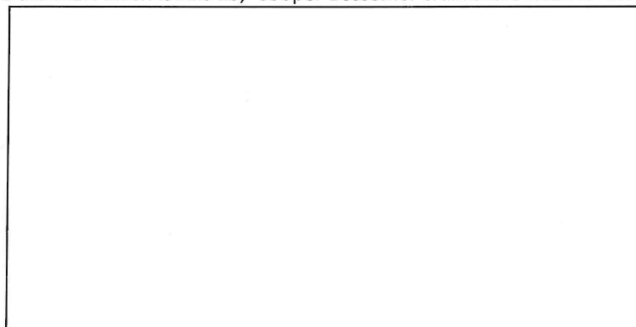
Dimension Specification 13.000

MAIN JOURNAL # 8

	A	B	C	D
1	12.997	12.997	12.998	12.998
2	12.997	12.9965	12.998	12.998

Note any scratches, impact points, or loss of finish:

Enterprise crankshaft finish is rms 16; Cooper Bessemer crankshaft finish is rms 25





CALIFORNIA MARINE DIESEL, INC.

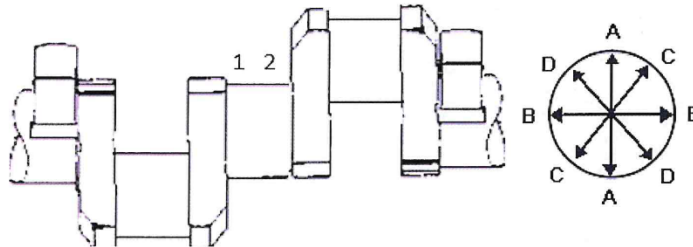
1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

MAIN JOURNAL INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 9-Jun-19
Inspection performed by ALAN HENRICKSON



Measure 2 inches from fillet vertically, horizontally and twice diagonally, A-A, B-B, C-C, D-D

Dimension Specification 13.000

MAIN JOURNAL # 9

	A	B	C	D
1	12.997	12.997	12.998	12.998
2	12.998	12.998	12.998	12.998

Note any scratches, impact points, or loss of finish:

Enterprise crankshaft finish is rms 16; Cooper Bessemer crankshaft finish is rms 25

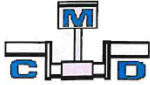




CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

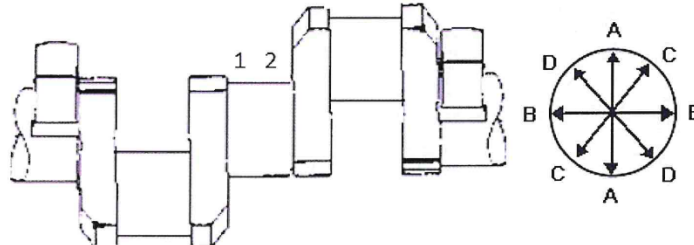
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

MAIN JOURNAL INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 9-Jun-19
Inspection performed by ALAN HENRICKSON



Measure 2 inches from fillet vertically, horizontally and twice diagonally, A-A, B-B, C-C, D-D

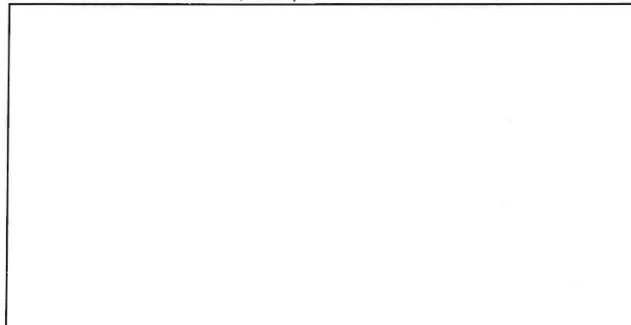
Dimension Specification 13.000

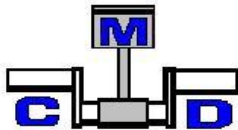
MAIN JOURNAL # 2

	A	B	C	D
1	12.997	12.998	12.998	12.997
2	12.998	12.998	12.998	12.997

Note any scratches, impact points, or loss of finish:

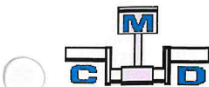
Enterprise crankshaft finish is rms 16; Cooper Bessemer crankshaft finish is rms 25





CALIFORNIA MARINE DIESEL, INC.

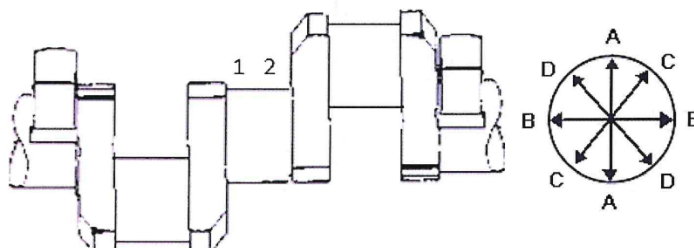
1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

MAIN JOURNAL INSPECTION FORM

CUSTOMER EBMUD LOCATION OAKLAND, CA
EQUIPMENT TYPE ENTERPRISE DSRG-46 FRAME SERIAL NUMBER 82004-3063 DATE 9-Jun-19
Inspection performed by ALAN HENRICKSON



Measure 2 inches from fillet vertically, horizontally and twice diagonally, A-A, B-B, C-C, D-D

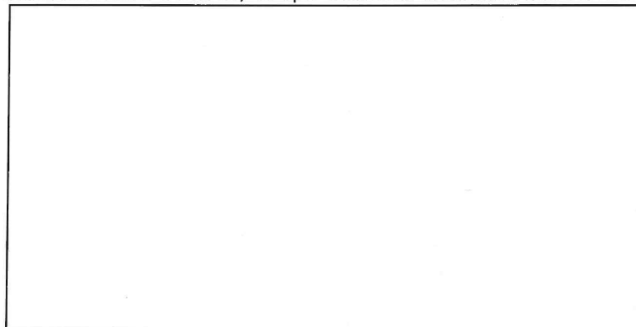
Dimension Specification 13.000

MAIN JOURNAL # 3

	A	B	C	D
1	12.997	12.998	12.999	12.998
2	12.997	12.997	12.998	12.997

Note any scratches, impact points, or loss of finish:

Enterprise crankshaft finish is rms 16; Cooper Bessemer crankshaft finish is rms 25

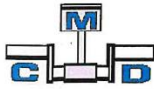




CALIFORNIA MARINE DIESEL, INC.

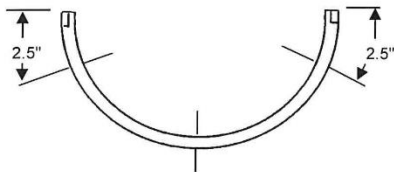
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

MAIN BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DGSR-46	82004-3063	
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2018
References		Data Recorded By
NEW MAIN BEARING SHELL		Alan Henrickson
Bearing Shell Position		1



Record manufacturer's data as it appears on bearing shell

Upper Shell

--

Lower Shell

--

Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

Note any abnormalities and sketch as necessary

--

Perform non-destructive dye check on all surfaces. Note results below.

Results or Remarks

Bearing made by Odessa Babbitt Bearing

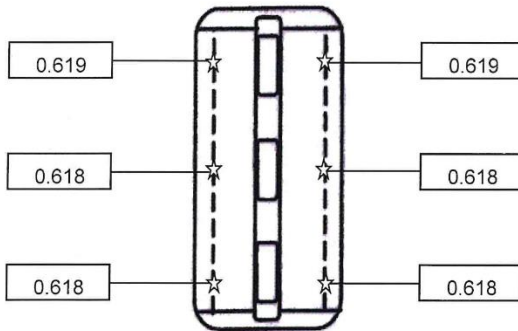
--

New Bearing ?

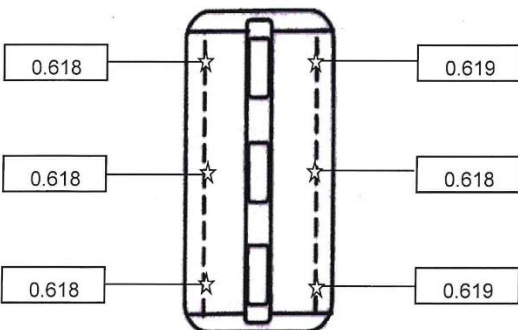
Re-used Bearing ?

X

wn 2004



Top Shell



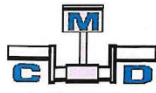
Bottom Shell



CALIFORNIA MARINE DIESEL, INC.

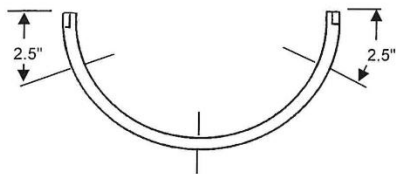
1501 WEST 15TH STREET
LONG BEACH, CA 90813

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CALIFORNIA MARINE DIESEL

MAIN BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DGSR-46	82004-3063	
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2018
References		Data Recorded By
NEW MAIN BEARING SHELL		Alan Henrickson
Bearing Shell Position		2



Record manufacturer's data as it appears on bearing shell

Upper Shell

Lower Shell

Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

Note any abnormalities and sketch as necessary

Perform non-destructive dye check on all surfaces. Note results below.

Results or Remarks

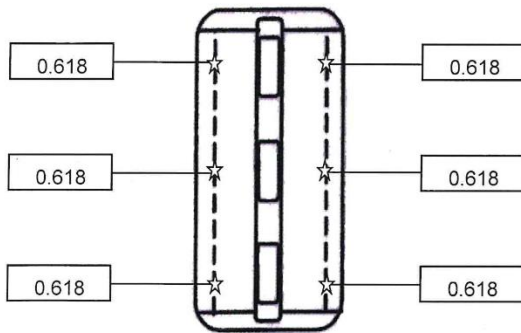
Bearing made by Odessa Babbitt Bearing

New Bearing ?

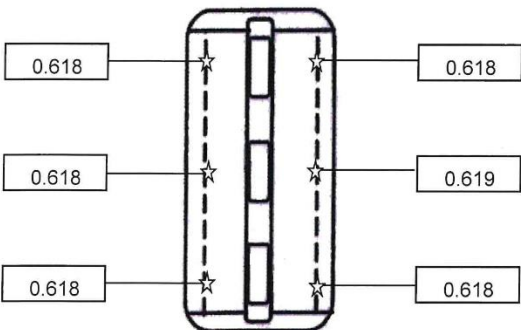
Re-used Bearing ?

X

wn 2004



Top Shell



Bottom Shell



CALIFORNIA MARINE DIESEL, INC.

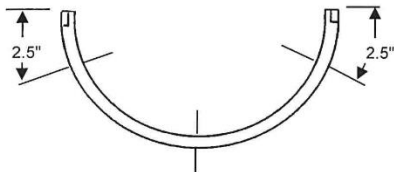
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CALIFORNIA MARINE DIESEL

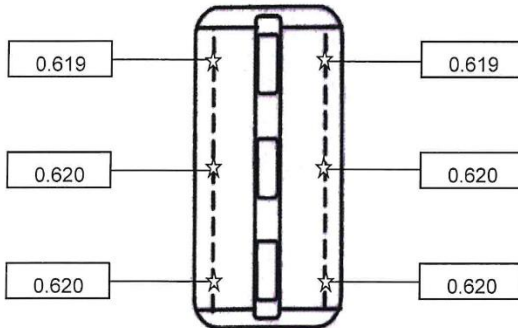
MAIN BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DGSR-46	82004-3063	
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		June 26, 2019
References		Data Recorded By
NEW MAIN BEARING SHELL		Alan Henrickson
Bearing Shell Position		3



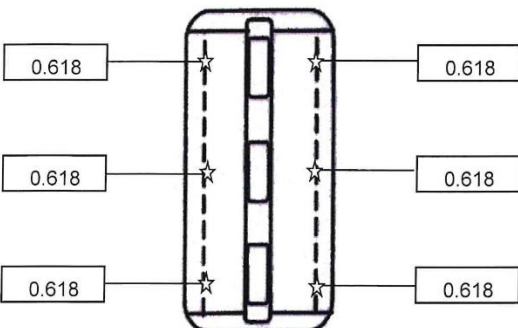
Record manufacturer's data as it appears on bearing shell

Upper Shell 31019
11-Jul

Lower Shell 31019
11-Jul



Top Shell



Bottom Shell

Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

Note any abnormalities and sketch as necessary

Perform non-destructive dye check on all surfaces. Note results below.

Results or Remarks

Bearing made by Odessa Babbitt Bearing

New Bearing ?
Re-used Bearing ?

X

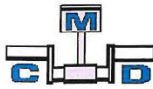
wn 2004



CALIFORNIA MARINE DIESEL, INC.

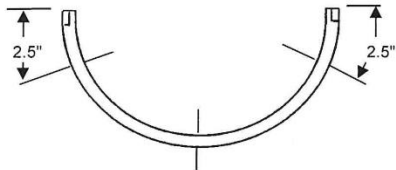
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LONG BEACH, CA 90813

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CALIFORNIA MARINE DIESEL

MAIN BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DGSR-46	82004-3063	
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2018
References		Data Recorded By
NEW MAIN BEARING SHELL		Alan Henrickson
Bearing Shell Position		4



Record manufacturer's data as it appears on bearing shell

Upper Shell

--

Lower Shell

--

Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

Note any abnormalities and sketch as necessary

--

Perform non-destructive dye check on all surfaces. Note results below.

Results or Remarks

Bearing made by Odessa Babbitt Bearing

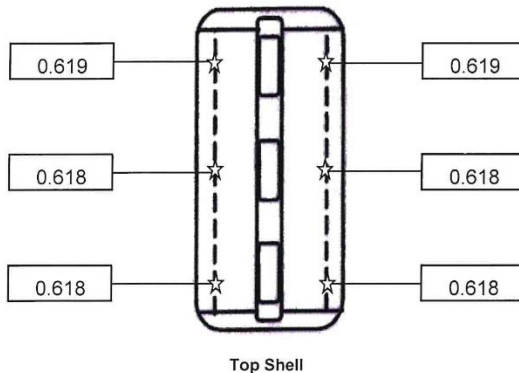
--

New Bearing ?

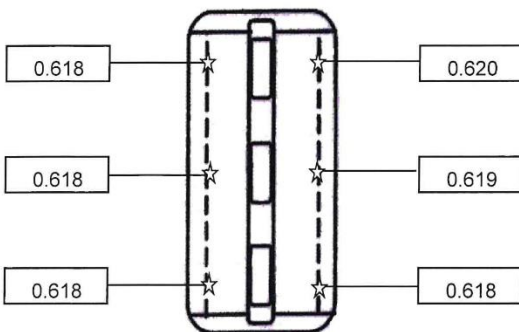
Re-used Bearing ?

X

wn 2004



Top Shell



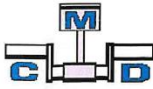
Bottom Shell



CALIFORNIA MARINE DIESEL, INC.

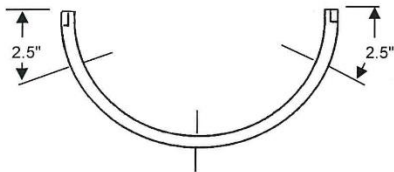
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

MAIN BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DGSR-46	82004-3063	
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2018
References		Data Recorded By
NEW MAIN BEARING SHELL		Alan Henrickson
Bearing Shell Position		5



Record manufacturer's data as it appears on bearing shell

Upper Shell

Lower Shell

Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

Note any abnormalities and sketch as necessary

Perform non-destructive dye check on all surfaces. Note results below.

Results or Remarks

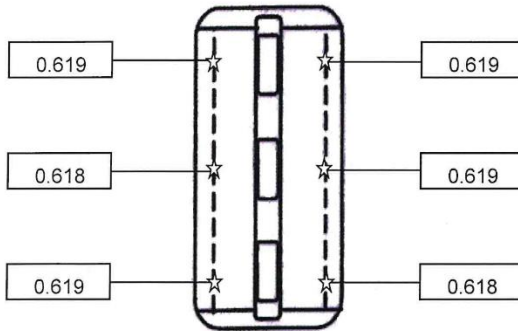
Bearing made by Odessa Babbitt Bearing

New Bearing ?

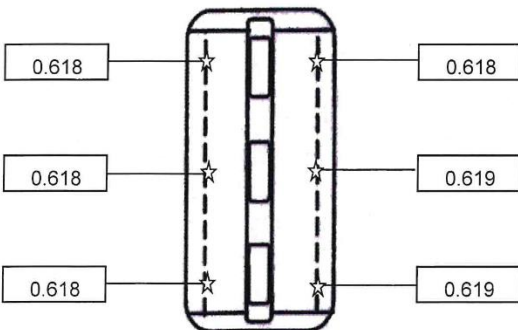
Re-used Bearing ?

X

wn 2004



Top Shell



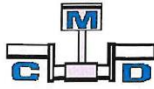
Bottom Shell



CALIFORNIA MARINE DIESEL, INC.

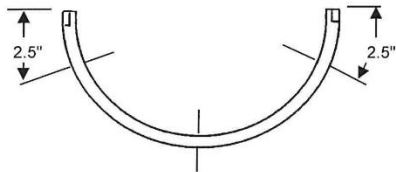
1501 WEST 15TH STREET
LONG BEACH, CA 90813

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CALIFORNIA MARINE DIESEL

MAIN BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DGSR-46	82004-3063	
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2018
References		Data Recorded By
NEW MAIN BEARING SHELL		Alan Henrickson
Bearing Shell Position		6



Record manufacturer's data as it appears on bearing shell

Upper Shell

Lower Shell

Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

Note any abnormalities and sketch as necessary

Perform non-destructive dye check on all surfaces. Note results below.

Results or Remarks

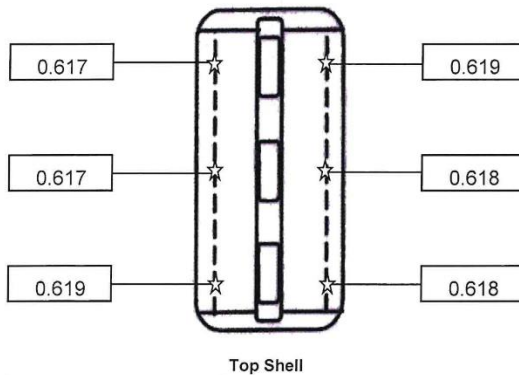
Bearing made by Odessa Babbitt Bearing

New Bearing ?

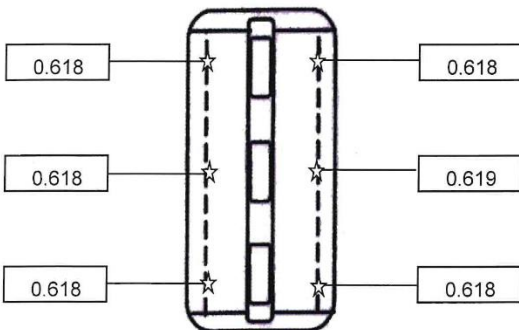
Re-used Bearing ?

X

wn 2004



Top Shell



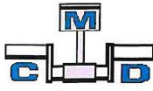
Bottom Shell



CALIFORNIA MARINE DIESEL, INC.

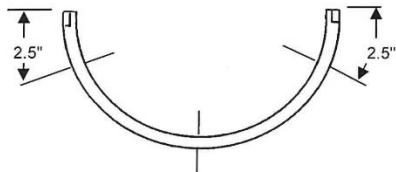
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

MAIN BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DGSR-46	82004-3063	
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2018
References		Data Recorded By
NEW MAIN BEARING SHELL		Alan Henrickson
Bearing Shell Position		7



Record manufacturer's data as it appears on bearing shell
Upper Shell

Lower Shell

Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

Note any abnormalities and sketch as necessary

Perform non-destructive dye check on all surfaces.
Note results below.

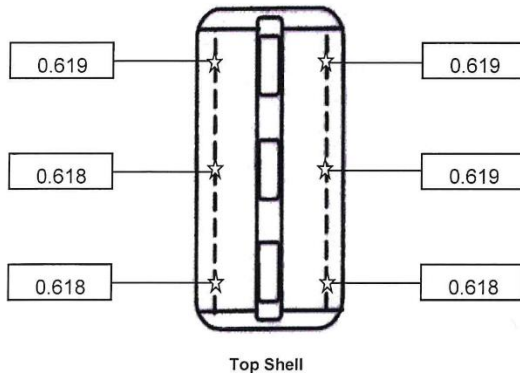
Results or Remarks

Bearing made by Odessa Babbitt Bearing

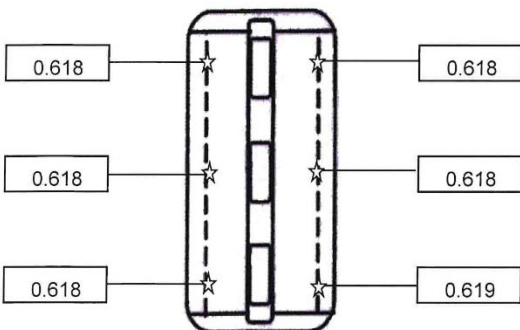
New Bearing ?
Re-used Bearing ?

X

wn 2004



Top Shell



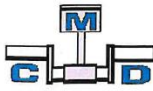
Bottom Shell



CALIFORNIA MARINE DIESEL, INC.

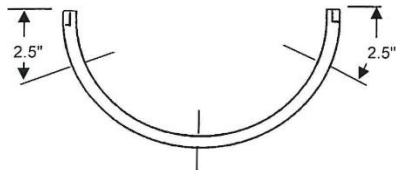
1501 WEST 15TH STREET
LONG BEACH, CA 90813

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CALIFORNIA MARINE DIESEL

MAIN BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGSR-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2018
References		Data Recorded By
NEW THRUST BEARING SHELL		Alan Henrickson
Bearing Shell Position		8



Record manufacturer's data as it appears on bearing shell

Upper Shell

--

Lower Shell

--

Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

Note any abnormalities and sketch as necessary

--

Perform non-destructive dye check on all surfaces. Note results below.

Results or Remarks

AS FOUND REMOVED BEARINGS

Bearing made by Odessa Babbit Bearing

Bearing his 1 piece thrust face as part of lower bearing shell

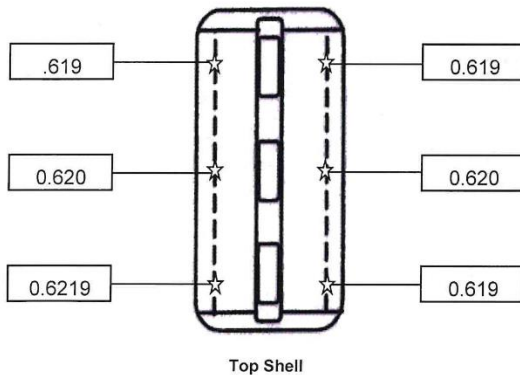


New Bearing ?

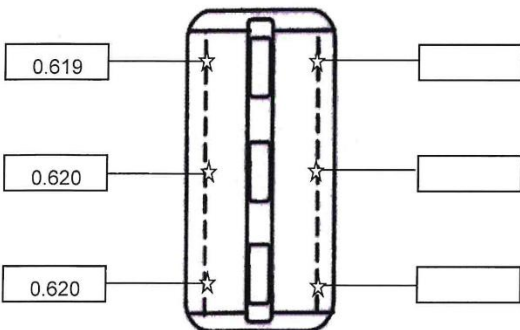
Re-used Bearing ?

X

wn 2004



Top Shell

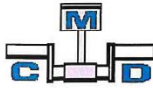


Bottom Shell



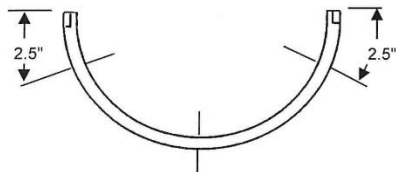
CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

MAIN BEARING SHELL		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DGSR-46	82004-3063	
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 13, 2018
References		Data Recorded By
NEW THRUST BEARING SHELL		Alan Henrickson
Bearing Shell Position		9



Record manufacturer's data as it appears on bearing shell

Upper Shell

Lower Shell

Measure each bearing in six positions (marked "x" on drawings). Use ball micrometer.

Note any abnormalities and sketch as necessary

Perform non-destructive dye check on all surfaces. Note results below.

Results or Remarks

Bearing made by Odessa Babbit Bearing

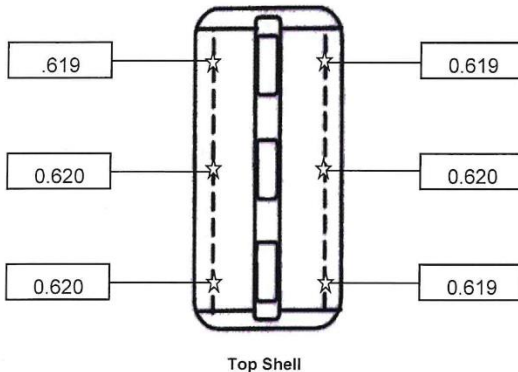
Bearing his 1 piece thrust face as part of lower bearing shell



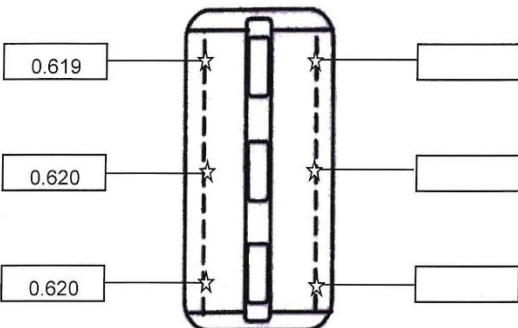
New Bearing ?
Re-used Bearing ?

X

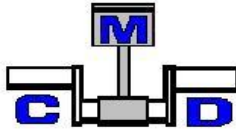
wn 2004



Top Shell



Bottom Shell



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LONG BEACH, CA 90813

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CALIFORNIA MARINE DIESEL INC.

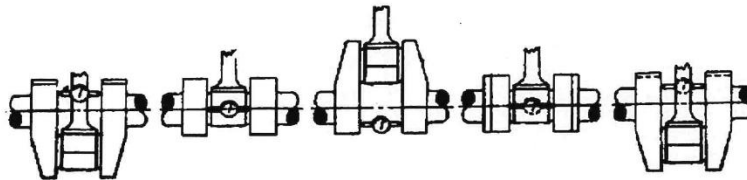
Crankshaft - Web Deflection and Thrust Clearance		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 5, 2018
References		Data Recorded By
		ALAN HENRICKSON

Deflection and thrust clearance checks made after the unit is in service should be made while the engine is hot, i.e., within 4 hours after the unit has been shut down. Record the temperature of the oil in the engine sump tank or engine base.

When an engine where the connecting shaft is solidly coupled to the flywheel is grouted on a concrete foundation, the desired deflection at crank position No.3 is zero to plus (+) 1 mil (one thousandth) in all cranks except the crank adjacent to the flywheel which should be minus (-) 1/2 mil. This distortion allows for thermal distortion of the concrete foundation. When an engine mounted on a steel foundation, i.e., marine installations, appropriate compensations for thermal distortions of the foundation will be based on the locations and temperatures of the fuel and lubricating oil tanks adjacent to the engine foundation.

If the deflection in any crank in an engine in service exceeds 3 mils, corrective action must be taken. Also, if the total deflection value in any two adjacent cranks exceed 3 mils, corrective action must be taken. Example, a +2 in any crank with a -2 in the next adjacent crank adds up to a total of 4 mils deflection between these adjacent cranks. The exception to the above will be engines that have a flexible coupling between the flywheel and the connecting shaft. These engines may have in excess of 3 mils deflection at position No.3 in the crank adjacent to the flywheel. In engines with solidly coupled shafting, excessive deflection at positions No. 2, 3 or 4 in the crank adjacent to the external shafting usually indicates misalignment between the connecting shaft and the engine crankshaft.

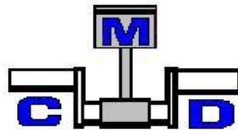
Set the deflection gauge at zero at position No.1 and turn the crankshaft in the direction of normal rotation.



Position 1 Position 2 Position 3 Position 4 Position 5

Record readings in mils, i.e., 1 1/4 rather than .00125 inches.

Sump Temperature	70F			Thrust Clearance:		.006		
Position	Cylinder Number Starting At The Gearcase End							
	1	2	3	4	5	6	7	8
	0	0	0	0	0	0		
	-1	+2	+2	-1	+3	+6 1/2		
	-2 1/2	+3 1/2	+2 1/2	-1 1/2	+3 1/2	+8 1/2		
	+ 1/2	+ 2 1/2	+2 1/2	-1 1/2	+2	+5		
	+2	+3	+2 1/2	+1 1/2	+1/2	0		



CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813

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CALIFORNIA MARINE DIESEL INC.

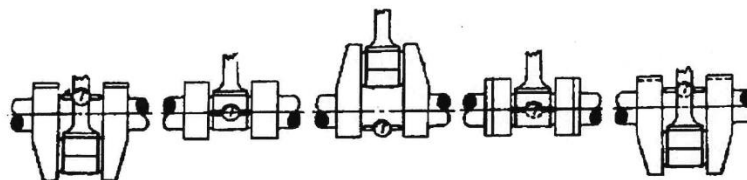
Crankshaft - Web Deflection and Thrust Clearance		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 14, 2018
References		Data Recorded By
		ALAN HENRICKSON

Deflection and thrust clearance checks made after the unit is in service should be made while the engine is hot, i.e., within 4 hours after the unit has been shut down. Record the temperature of the oil in the engine sump tank or engine base.

When an engine where the connecting shaft is solidly coupled to the flywheel is grouted on a concrete foundation, the desired deflection at crank position No.3 is zero to plus (+) 1 mil (one thousandth) in all cranks except the crank adjacent to the flywheel which should be minus (-) 1/2 mil. This distortion allows for thermal distortion of the concrete foundation. When an engine mounted on a steel foundation, i.e., marine installations, appropriate compensations for thermal distortions of the foundation will be based on the locations and temperatures of the fuel and lubricating oil tanks adjacent to the engine foundation.

If the deflection in any crank in an engine in service exceeds 3 mils, corrective action must be taken. Also, if the total deflection value in any two adjacent cranks exceed 3 mils, corrective action must be taken. Example, a +2 in any crank with a -2 in the next adjacent crank adds up to a total of 4 mils deflection between these adjacent cranks. The exception to the above will be engines that have a flexible coupling between the flywheel and the connecting shaft. These engines may have in excess of 3 mils deflection at position No.3 in the crank adjacent to the flywheel. In engines with solidly coupled shafting, excessive deflection at positions No. 2, 3 or 4 in the crank adjacent to the external shafting usually indicates misalignment between the connecting shaft and the engine crankshaft.

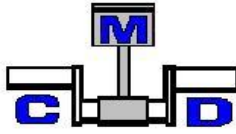
Set the deflection gauge at zero at position No.1 and turn the crankshaft in the direction of normal rotation.



Position 1 Position 2 Position 3 Position 4 Position 5

Record readings in mils, i.e., 1 1/4 rather than .00125 inches.

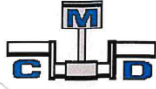
Record readings in mils, i.e., 1/16 rather than .00125 inches.									
Sump Temperature		70F			Thrust Clearance:		.024		
Position		Cylinder Number Starting At The Gearcase End							
		1	2	3	4	5	6	7	8
		0	0	0	0	0	0		
		+1	+1	0	0	+1	+2 1/2		
		+1	+1	0	0	+1	- 6		
		+1	+1	+ 1/2	- 1/2	+ 1/2	+3		
		+1	+1	0	0	+ 3/4	+1		



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Crankshaft - Web Deflection and Thrust Clearance

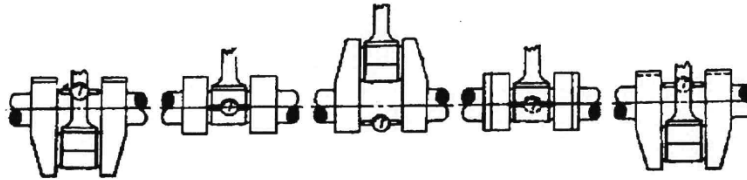
Customer		Engine Location	
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA	
Engine Model	Serial No.	Customer Designation	
DGSR-46	82004-3063	UNIT 2	
Total Engine Hours	Hours Since Last Inspection	Date This Inspection	
		12-Jun-19	
References		Data Recorded By	
DEFLECTION MADE WITH UPPER BLOCK REMOVED NO FLYWHEEL		Alan Hanrickson/12JUN19	

Deflection and thrust clearance checks made after the unit is in service should be made while the engine is hot, i.e., within 4 hours after the unit has been shut down. Record the temperature of the oil in the engine sump tank or engine base.

When an engine where the connecting shaft is solidly coupled to the flywheel is grouted on a concrete foundation, the desired deflection at crank position No.3 is zero to plus (+) 1 mil (one thousandth) in all cranks except the crank adjacent to the flywheel which should be minus (-) 1/2 mil. This distortion allows for thermal distortion of the concrete foundation. When an engine mounted on a steel foundation, i.e., marine installations, appropriate compensations for thermal distortions of the foundation will be based on the locations and temperatures of the fuel and lubricating oil tanks adjacent to the engine foundation.

If the deflection in any crank in an engine in service exceeds 3 mils, corrective action must be taken. Also, if the total deflection value in any two adjacent cranks exceed 3 mils, corrective action must be taken. Example, a +2 in any crank with a -2 in the next adjacent crank adds up to a total of 4 mils deflection between these adjacent cranks. The exception to the above will be engines that have a flexible coupling between the flywheel and the connecting shaft. These engines may have in excess of 3 mils deflection at position No.3 in the crank adjacent to the flywheel. In engines with solidly coupled shafting, excessive deflection at positions No. 2, 3 or 4 in the crank adjacent to the external shafting usually indicates misalignment between the connecting shaft and the engine crankshaft.

Set the deflection gauge at zero at position No.1 and turn the crankshaft in the direction of normal rotation.



Position 1

Position 2

Position 3

Position 4

Position 5

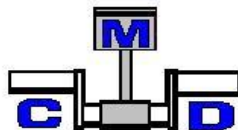
Record readings in mils, i.e., 1 1/4 rather than .00125 inches.

Sump Temperature

Thrust Clearance

Position	Cylinder Number Starting At The Gearcase End							
	1	2	3	4	5	6	7	8
	0	0	0	0	0	0		
	0	+1	0	+ 1/2	+1	+2		
	+1	+ 1 1/2	+1	+ 1/2	+ 1 1/2	+1		
	+1	+ 1	+ 1	+1/2	+ 2	+2		
	0	0	0	0	0	0		

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CALIFORNIA MARINE DIESEL

Crankshaft - Web Deflection and Thrust Clearance

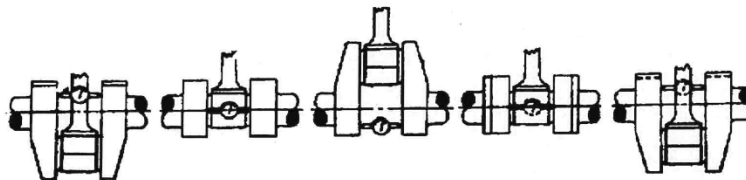
Customer		Engine Location
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
DGSR-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
References		Data Recorded By
DEFLECTION MADE WITH UPPER BLOCK REMOVED FLYWHEEL AND ROTOR CONNECTED		Alan Hanrickson/28JUN19

Deflection and thrust clearance checks made after the unit is in service should be made while the engine is hot, i.e., within 4 hours after the unit has been shut down. Record the temperature of the oil in the engine sump tank or engine base.

When an engine where the connecting shaft is solidly coupled to the flywheel is grouted on a concrete foundation, the desired deflection at crank position No.3 is zero to plus (+) 1 mil (one thousandth) in all cranks except the crank adjacent to the flywheel which should be minus (-) 1/2 mil. This distortion allows for thermal distortion of the concrete foundation. When an engine mounted on a steel foundation, i.e., marine installations, appropriate compensations for thermal distortions of the foundation will be based on the locations and temperatures of the fuel and lubricating oil tanks adjacent to the engine foundation.

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Set the deflection gauge at zero at position No.1 and turn the crankshaft in the direction of normal rotation.



Position 1

Position 2

Position 3

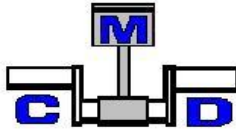
Position 4

Position 5

Record readings in mils, i.e., 1 1/4 rather than .00125 inches.

Sump Temperature		Thrust Clearance							
Position	Cylinder Number Starting At The Gearcase End								
	1	2	3	4	5	6	7	8	
	0	0	0	0	0	0			
	0	+ 1/2	+ 3/4	0	+1	+2			
	+ 1	+ 1	+ 1/2	+ 3/4	+ 1 1/2	+5			
	+ 1/4	+1	+1	0	+2	+3 1/2			
	0	0	0	0	+ 1/2	0			

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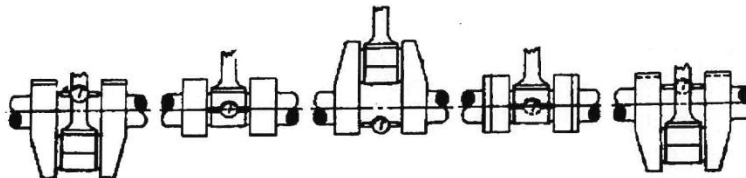
Crankshaft - Web Deflection and Thrust Clearance		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		August 8, 2019
References		Data Recorded By
		ALAN HENRICKSON

Deflection and thrust clearance checks made after the unit is in service should be made while the engine is hot, i.e., within 4 hours after the unit has been shut down. Record the temperature of the oil in the engine sump tank or engine base.

When an engine where the connecting shaft is solidly coupled to the flywheel is grouted on a concrete foundation, the desired deflection at crank position No.3 is zero to plus (+) 1 mil (one thousandth) in all cranks except the crank adjacent to the flywheel which should be minus (-) 1/2 mil. This distortion allows for thermal distortion of the concrete foundation. When an engine mounted on a steel foundation, i.e., marine installations, appropriate compensations for thermal distortions of the foundation will be based on the locations and temperatures of the fuel and lubricating oil tanks adjacent to the engine foundation.

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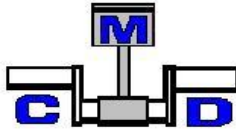
Set the deflection gauge at zero at position No.1 and turn the crankshaft in the direction of normal rotation.



Position 1 Position 2 Position 3 Position 4 Position 5

Record readings in mils, i.e., 1 1/4 rather than .00125 inches.

Record readings in mm/s, i.e., 1/4 rather than .0625 inches.									
Sump Temperature		70F			Thrust Clearance:		.022		
Position		Cylinder Number Starting At The Gearcase End							
		1	2	3	4	5	6	7	8
		0	0	0	0	0	0		
		+ 3/4	+ 1	0	0	+1	+1		
		+1	+ 2	+3/4	+1/2	+1	+1		
		+1 1/2	+1 1/2	+1/2	0	+1	0		
		+1 1/4	+1 1/2	0	0	+1	+1		



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CALIFORNIA MARINE DIESEL

Crankshaft - Web Deflection and Thrust Clearance

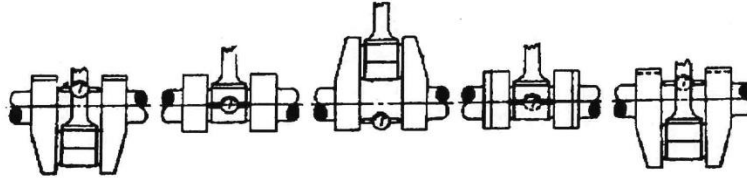
Customer		Engine Location	
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA	
Engine Model	Serial No.	Customer Designation	
DGSR-46	82004-3063	UNIT 2	
Total Engine Hours	Hours Since Last Inspection	Date This Inspection	
		26-Aug-19	
References		Data Recorded By	
DEFLECTION MADE FOLLOWING 2160 KW RUN FOR 2 HR		Alan Hanrickson/6JUL19	

Deflection and thrust clearance checks made after the unit is in service should be made while the engine is hot, i.e., within 4 hours after the unit has been shut down. Record the temperature of the oil in the engine sump tank or engine base.

When an engine where the connecting shaft is solidly coupled to the flywheel is grouted on a concrete foundation, the desired deflection at crank position No.3 is zero to plus (+) 1 mil (one thousandth) in all cranks except the crank adjacent to the flywheel which should be minus (-) 1/2 mil. This distortion allows for thermal distortion of the concrete foundation. When an engine mounted on a steel foundation, i.e., marine installations, appropriate compensations for thermal distortions of the foundation will be based on the locations and temperatures of the fuel and lubricating oil tanks adjacent to the engine foundation.

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Set the deflection gauge at zero at position No.1 and turn the crankshaft in the direction of normal rotation.



Position 1

Position 2

Position 3

Position 4

Position 5

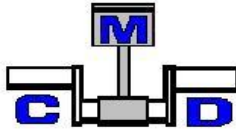
Record readings in mils, i.e., 1 1/4 rather than .00125 inches.

Sump Temperature

Thrust Clearance

Position	Cylinder Number Starting At The Gearcase End							
	1	2	3	4	5	6	7	8
	0	0	0	0	0	0		
	+	0	0	0	+ 1	+ 2 1/4		
	+ 1	3/4	+ 3/4	+ 1/2	+ 1	+ 3		
	0	+ 1 1/2	+ 1/2	0	+ 1	+ 1		
	0	+ 1 1/2	0	0	+ 1	- 1/2		

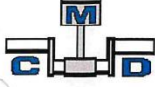
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CALIFORNIA MARINE DIESEL

Crankshaft - Web Deflection and Thrust Clearance

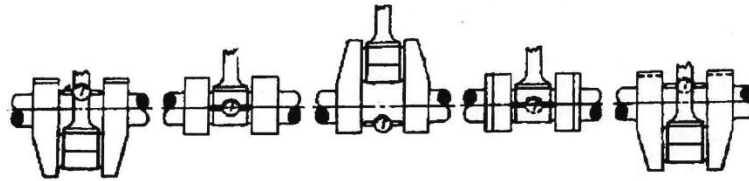
Customer		Engine Location	
EAST BAY MUNICIPAL UTILITY DISTRICT		OAKLAND, CA	
Engine Model	Serial No.	Customer Designation	
DGSR-46	82004-3063	UNIT 2	
Total Engine Hours	Hours Since Last Inspection	Date This Inspection	
		26-Aug-19	
References		Data Recorded By	
DEFLECTION MADE FOLLOWING 2160 KW RUN FOR 2 HR		Alan Hanrickson/6JUL19	

Deflection and thrust clearance checks made after the unit is in service should be made while the engine is hot, i.e., within 4 hours after the unit has been shut down. Record the temperature of the oil in the engine sump tank or engine base.

When an engine where the connecting shaft is solidly coupled to the flywheel is grouted on a concrete foundation, the desired deflection at crank position No.3 is zero to plus (+) 1 mil (one thousandth) in all cranks except the crank adjacent to the flywheel which should be minus (-) 1/2 mil. This distortion allows for thermal distortion of the concrete foundation. When an engine mounted on a steel foundation, i.e., marine installations, appropriate compensations for thermal distortions of the foundation will be based on the locations and temperatures of the fuel and lubricating oil tanks adjacent to the engine foundation.

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Set the deflection gauge at zero at position No.1 and turn the crankshaft in the direction of normal rotation.



Position 1

Position 2

Position 3

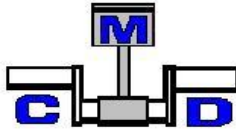
Position 4

Position 5

Record readings in mils, i.e., 1 1/4 rather than .00125 inches.

Sump Temperature		Thrust Clearance						
Position		Cylinder Number Starting At The Gearcase End						
		1	2	3	4	5	6	7
		0	0	0	0	0	0	
		+ 1/2	0	0	- 1	0	+ 1/2	
		+ 1	+ 3/4	0	-2	+1	- 2	
		0	0	- 1	-2	+1	- 2	
		0	+ 1/4	-1	-1	+ 3/4	+1	

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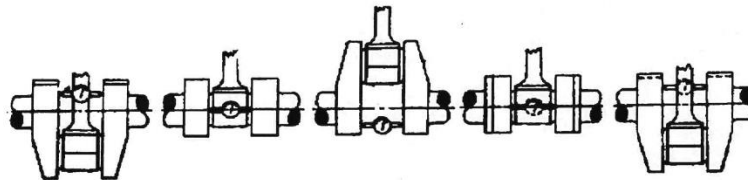
Crankshaft - Web Deflection and Thrust Clearance		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 3, 2019
References		Data Recorded By
2300 KW RUN FOR 1 HR		ALAN HENRICKSON

Deflection and thrust clearance checks made after the unit is in service should be made while the engine is hot, i.e., within 4 hours after the unit has been shut down. Record the temperature of the oil in the engine sump tank or engine base.

When an engine where the connecting shaft is solidly coupled to the flywheel is grouted on a concrete foundation, the desired deflection at crank position No.3 is zero to plus (+) 1 mil (one thousandth) in all cranks except the crank adjacent to the flywheel which should be minus (-) 1/2 mil. This distortion allows for thermal distortion of the concrete foundation. When an engine mounted on a steel foundation, i.e., marine installations, appropriate compensations for thermal distortions of the foundation will be based on the locations and temperatures of the fuel and lubricating oil tanks adjacent to the engine foundation.

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Set the deflection gauge at zero at position No.1 and turn the crankshaft in the direction of normal rotation.



Position 1 Position 2 Position 3 Position 4 Position 5

Record readings in mils, i.e., 1 1/4 rather than .00125 inches.

Sump Temperature	159° F			Thrust Clearance:		.022		
Position	Cylinder Number Starting At The Gearcase End							
	1	2	3	4	5	6	7	8
	0	0	0	0	0	0		
	+ 1/2	0	0	- 1/2	+1	+1		
	+1	+1	- 1/2	- 1/2	+ 1/2	+1		
	0	+ 1/4	- 1/2	0	+ 1/2	- 1		
	0	0	- 1/2	+ 1	+ 1/2	- 1/2		



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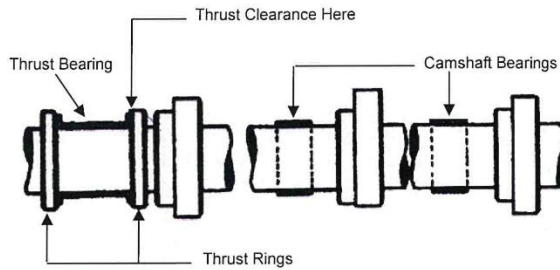
PHONE: (562) 491-5665 • FAX: (562) 491-7505



California Marine Diesel Inc.

CAMSHAFT BEARING SHELLS		
Customer		Engine Location
EBMUD		OAKLAND, CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 14, 2018
References		Data Recorded By
		ALAN HENRICKSON
Memo		Camshaft Designation

For purposes of recording information on this form, bearings are numbered in sequence, starting with the thrust bearing at the gearcase end and proceeding towards the flywheel end.



THRUST CLEARANCE

Move camshaft all the way aft with a bar then measure thrust with feeler gauge between camshaft thrust collar and thrust bearing

Thrust Clearance: .008

BEARING CLEARANCE / THICKNESS

Measure bearing shell to camshaft clearance with feeler gauge, or bearing shell thickness with a micrometer. Indicate method used and record in appropriate spaces below.

☐ BEARING - TO - CAMSHAFT CLEARANCE - Feeler Gauge

1	2	3	4	5	6	7	8	9	10
.004	.005	.005	.005	.005	.005	.005			

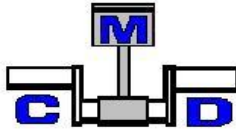
☐ BEARING SHELL THICKNESS - Micrometer (Record upper and lower shell in appropriate box)

1	2	3	4	5	6	7	8	9	10
.208	.207	.207	.207	.208	.207	.208			
.209	.207	.207	.208	.207	.207	.207			

Remarks

Indicate runout on face of camshaft gear hub referenced to front of block. .001

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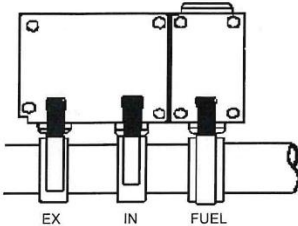
1501 WEST 15TH STREET
LONG BEACH, CA 90813

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CALIFORNIA MARINE DIESEL INC.

CAM & TAPPET ASSEMBLIES		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OKALAND, CA
Engine Model	Serial No	Customer Designation
DGRS-46	82004-3063	UNIT 2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		September 14, 2018
References		Data Recorded By
		ALAN HENRICKSON



Inspection Remarks

Camshaft and bearings installed with upper block sitting on the floor.
Tappets and rollers are new. Tappets and rollers are lube rided.

CAM LOBE CONDITION (Number 1 cylinder at gearcase end)

1R			2R			3R			4R			5R			6R			7R			8R		
E	I	F	E	I	F	E	I	F	E	I	F	E	I	F	E	I	F	E	I	F	E	I	F
X	N	UEL	X	N	UEL	X	N	UEL	X	N	UEL	X	N	UEL	X	N	UEL	X	N	UEL	X	N	UEL
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
1L			2L			3L			4L			5L			6L			7L			8L		

Code: X = Intact C = Chipped K = Cracked O = Other (Indicate in "Inspection Remarks" above)

TAPPET ROLLER CONDITION (Number 1 cylinder at gearcase end)

1R			2R			3R			4R			5R			6R			7R			8R		
E	I	F	E	I	F	E	I	F	E	I	F	E	I	F	E	I	F	E	I	F	E	I	F
X	N	UEL	X	N	UEL	X	N	UEL	X	N	UEL	X	N	UEL	X	N	UEL	X	N	UEL	X	N	UEL
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
1L			2L			3L			4L			5L			6L			7L			8L		

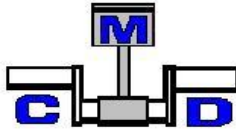
Code: X = Intact C = Chipped K = Cracked O = Other (Indicate in "Inspection Remarks" above)

TAPPET ROLLER PIN CONDITION (As indicated using a dial indicator)

1R			2R			3R			4R			5R			6R			7R			8R		
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
E	I	F	E	I	F	E	I	F	E	I	F	E	I	F	E	I	F	E	I	F	E	I	F
X	N	UEL	X	N	UEL	X	N	UEL	X	N	UEL	X	N	UEL	X	N	UEL	X	N	UEL	X	N	UEL
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
1L			2L			3L			4L			5L			6L			7L			8L		

Code: Record measurements in thousandths of an inch, i.e., write 0.004 as 4, 0.0025 as 25 etc.

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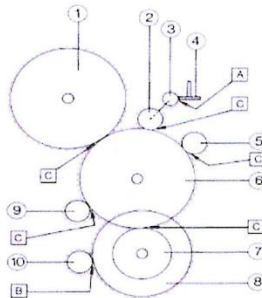


CALIFORNIA MARINE DIESEL INC.

GEARSET - Inline Engine		
Customer		Engine Location
EAST BAY MUNICIPAL UTILITIES DISTRICT		OAKLAND CA
Engine Model	Serial No.	Customer Designation
ENTERPRISE DGRS-46	82004-3063	UNIT2
Total Engine Hours	Hours Since Last Inspection	Date This Inspection
		July 9, 2019
References		Data Recorded By
		ALAN HENRICKSOIN

Nominal Backlash	
Position	Inches
A	0.006 / 0.010
B	0.004 / 0.006
C	0.008 / 0.012

The maximum backlash is 0.006" above nominal backlash.



- 1 Camshaft Gear
- 2 Tachometer Drive Gear
- 3 Governor Drive Gear
- 4 Governor Driven Gear
- 5 Accessory Drive Gear
- 6 Idler Gear
- 7 Crankshaft Gear
- 8 Crank To Pump Gear
- 9 L.O. Pump Gear Carrier Gear
- 10 Water Pump Gear

Unload valve train by loosening rocker arms by lifting fuel tappets and inserting pins through tappet housings to hold them off the fuel cams. Mark each gear in four positions, 90 degrees apart (3,6,9,10 o'clock - see illustration)

Select gear pair to be measured (see table below). Mount a magnetic base dial indicator with its stem resting on the side of the gear listed in the "Rotated" column. Rotate gear to remove all slack. Zero indicator, then rotate in opposite direction to remove all slack. Record backlash in the appropriate space below.

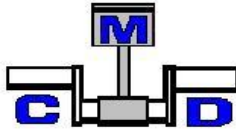
Rotate gear to the next three positions, record backlash in each position. Measure backlash in four positions in each gear pair listed on table.

Inspect lubricating oil spray lines. Insure good spray pattern is obtained at all gear meshes.

Gear Train				Measured Position			
Item	Description	Pos.	GPL	12 O'Clock	3 O'Clock	6 O'Clock	9 O'Clock
1	Camshaft Gear	C	350	.009	.012	.009	.008
2	Tachometer Drive Gear	C	402				
3	Governor Drive Gear	A	402				
4	Governor Driven Gear	A	402				
5	Accessory Drive Gear	C	410	.009	.010	.009	.009
6	Idler Gear	C	355	.012	.009	.009	.009
7	Crankshaft Gear	C	310	.012	.009	.009	.009
8	Crank To Pump Gear	C	355				
9	L.O. Pump Gear Carrier Gear	C	420	.011	.011	.010	.015
10	Water Pump Gear	B	425	.008	.006	.004	.004

Remarks

Oil pump gear and water pump gear are lube ridged and will wear in over time.



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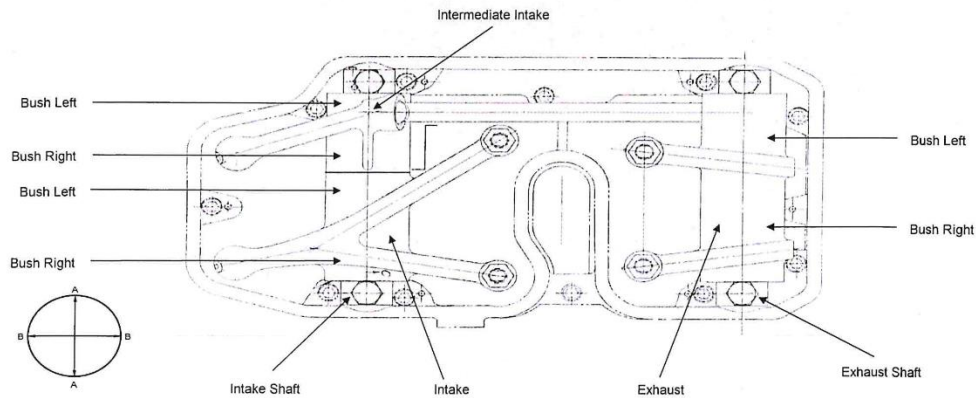
1501 WEST 15TH STREET
LONG BEACH, CA 90813

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CALIFORNIA MARINE DIESEL INC.

Rocker Arm Shaft to Bushing & Thrust Clearance					
Customer			Engine Location		
EAST BAY MUNICIPAL UTILITIES DISTRICT			OAKLAND, CA		
Engine Model		Serial No.	Customer Designation		
ENTERPRISE DGRS-46		82004-3063	UNIT 2		
Total Engine Hours		Hours Since Last Inspection	Date This Inspection		
			March 14, 2019		
References		Engine No.	Data Recorded By		
			ALAN HENRICKSON		



Bushing Diameter

Cylinder No.	1		2		3		4		5		6	
Bushing L / R	L	R	L	R	L	R	L	R	L	R	L	R
Exhaust A - A												
Exhaust B - B												
Intake A - A												
Intake B - B												
Intermediate A - A												
Intermediate B - B												

Shaft Diameter

Cylinder No.	1		2		3		4		5		6	
Shaft L / R	L	R	L	R	L	R	L	R	L	R	L	R
Exhaust A - A												
Exhaust B - B												
Intake A - A												
Intake B - B												
Intermediate A - A												
Intermediate B - B												

Clearance Bushing to Shaft

Cylinder No.	1		2		3		4		5		6	
Clearance L / R	L	R	L	R	L	R	L	R	L	R	L	R
Exhaust Clearance												
Intake Clearance												
Intermediate Clearance												

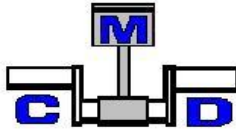
Rocker Arm Assembly to Subcover End Clearance

Exhaust	.012	.011	.013	.010	.014	.015
Intake	.008	.008	.010	.009	.008	.009

SPECIFICATIONS

Rocker Arm Bushing to Shaft
Intake Rocker Arm Assy. To Sub Cover (end clearance)
Exhaust Rocker Arm Assy. To Sub Cover (end clearance)

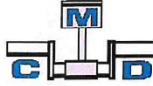
Clearance When New		Replace When Over	
Inches	Millimeters	Inches	Millimeters
.003/.0045	.076/.114	0.010	0.254
.010/.025	.254/.635	0.045	1.143
.005/.015	.127/.381	0.030	0.762



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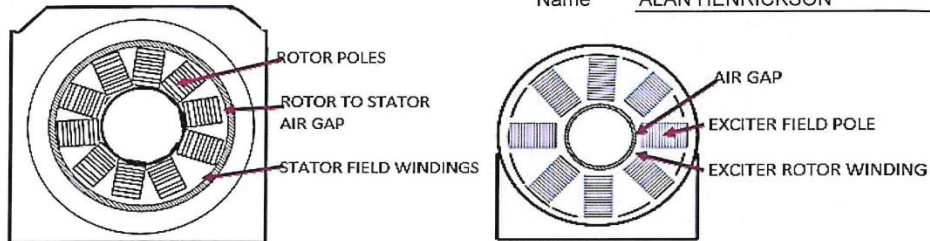
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CALIFORNIA MARINE DIESEL

GENERATOR AIR GAP MEASUREMENTS

CUSTOMER	EAST BAY MUNICIPAL UTILITIES DISTRICT	LOCATION	OAKLAND, CALIFORNIA
EQUIPMENT		SERIAL	
T TYPE	ENTERPRISE ENGINE MODEL DGRS-46	NUMBER	82004-3063
MOTOR		SERIAL	
TYPE	GENERAL ELECTRIC MODEL 5ATI940757D1	NUMBER	8431038
		DATE	27-Aug-19
		Name	ALAN HENRICKSON



Alignment measurements are made at four places vertically and horizontally on both sides between the rotor and the stator in the Air Gap using one rotor pole and selected places on the field windings. The Air Gap should be equally spaced vertically and horizontally. Motor specifications will vary for rotor lift during operation requiring more Air Gap space on top of the rotor to stator.

STATOR AIR GAP MEASUREMENTS

FLYWHEEL SIDE		EXCITER SIDE	
1	.430	1	.439
2	.415	2	.420
3	.405	3	.429
4	.415	4	.420

Geometry of the exciter is opposite of the rotor and stator. The poles are fixed and field winding is mounted to the rotor shaft. Alignment of the exciter rotating windings to the fixed poles is done by measuring air gap between the windings and poles on both sides of the exciter. Exciter air gap should be equally spaced vertically and horizontally. Measurements are made using a fixed point on the windings and measuring to the center of each fixed pole.

EXCITER AIR GAP MEASUREMENTS

STATOR SIDE		PEDESTAL BEARING SIDE	
1	.114	1	.125
2	.110	2	.075
3	.100	3	.060
4	.135	4	.100
5	.120	5	.090
6	.115	6	.050
7	.085	7	.070
8	.120	8	.110

SIGNED _____



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LIST OF ADDENDUM REPORTS

EBMUD Report of Water Pump Replacement dtd 12-17 September 2019

EBMUD Report of #4 Main Bearing Failure dtd 4-15 November 2019



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REPORT OF WATER PUMP REPLACEMENT
ENTERPRISE DGRS-46 ENGINE SERIAL NUMBER 82004-3063
UNIT 2
EAST BAY MUNICIPAL UTILITIES DISTRICT
POWER GENERATION STATION
OAKLAND, CALIFORNIA

On 12 to 17 September 2019 the jacket water pump was replaced on Enterprise DGRS-46 engine serial number 82004-3063 (Unit 2), East Bay Municipal Utilities District, Power Generation Station, Oakland, California. Predication for replacing the jacket water pump was to replace a mismatched water pump gear. The jacket water pump mismatched gear was found on Unit Start up on 23 August 2019 during an inspection following initial start up. The water pump drive gear was dressed in place 4 September 2019 following unit shutdown for water leaks from cylinder #4. On 12 September 2019, the water pump was removed from Unit 2, the water piping covered and the water pump returned to California Martine Diesel, Long Beach, California shop to replace the water pump gear. On 16 September 2019 the jacket water pump was reinstalled on the engine after making a thicker gasket to allow for water pump drive gear to water pump gear alignment. The water pump water seal was found leaking when the engine was filled with water, the seal was reseated in the water pump, and the jacket water pump reinstalled with no further leaks. Water pump gear lash was measured within specification (.004- .006) (measurements of .006 to .008 indicate water pump gear bushing clearances (.002-.004) and water pump drive gear runout on the crankshaft (.002-.003). Fuel injectors were removed by CMD for EBMUD to check for additional cylinder head water leaks on 4 September 2019 and reinstalled in the engine as part of the cylinder head water leak diagnosis.

SCOPE

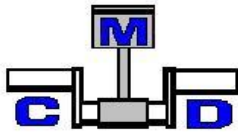
Remove jacket water pump from engine and replace water pump gear. Reinstall on engine.

CHRONOLOGY

12 September

Travel Long Beach to Oakland, California. Return to site. Remove water pump and load on CMD truck for delivery to CMD shop in Long Beach, Ca. Cover gearcase hole and water pump inlet and outlet pipes. Deliver water pump to CMD shop in Long Beach, Ca. Travel Oakland to Long Beach, California.

16 September 2019 Return to site. Deliver water pump to PGS EBMUD. Clean water pump piping for gaskets. Install water pump, check gear lash and find linear gear contact is off .060. Measure water pump adapter plates and find Unit #2 water pump adapter plate is .050 thinner than water pump adapter plates on Units #1 and #3. Remove water pump from gearcase and make a thicker gasket to give linear alignment for gear teeth mesh on water pump drive gear and water pump gear. Reinstall water pump and measure gear lash. Put water pump piping on and measure gear lash. Begin filling engine with water and find water pump seal leaking. Drain water from engine and remove water pump water seal and reseal seal. Reassemble water pump



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and refill engine with water (no leaks). Gearlash measurements go from .008 to .006 after connecting water pump piping indicating slight pipe strain most likely in the water inlet piping.

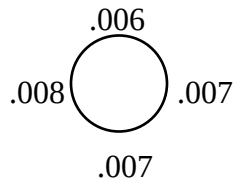
Install 6 fuel injectors and fuel injection lines and check jet cells torque (42 ftlb) (no loose jet cells found).

17 September 2019

TRAVEL OAKLAND TO LONG BEACH, CA

Measurements.

Water pump gear to water pump driven gear gearlash.





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REPORT OF #4 MAIN BEARING FAILURE

ENTERPRISE DGRS-46 ENGINE SERIAL NUMBER 82004-3063

UNIT 2

EAST BAY MUNICIPAL UTILITIES DISTRICT

OAKLAND, CALIFORNIA

On 4 -15 November 2019 #4 main bearing, #4 connecting rod bearing, #4 cylinder head, #4 piston rings wer replaced on #4 cylinder on Enterprise DGRS-46 engine serial number 82004-3063, (Unit 2), East Bay Municipal Utilities District, Oakland, California. The main bearing, connecting rod bearing, cylinder head, and piston rings were replaced on #4 cylinder due to the failure of #4 main bearing. Cylinder head and piston rings were replaced due to a leaking #4 cylinder head. #4 main bearing failed during transfer from diesel to dual fuel at 1600 kw on 4 November 2019 following 40 minutes of operation. The main bearing thermocouple recorded 230° F. #4 cylinder was scheduled for replacement due to a water leak in the cylinder head dating from 28 August 2019. Water damage to the liner was a layer of rust.

SCOPE

Replace #4 main bearing, connecting rod bearing, cylinder head, and piston rings and return unit to service. Run unit to provide break in period .

CHRONOLOGY

6 November 2019

(personnel: Genero Panteleon, Juan Reyes)

Travel Long Beach to Oakland, Ca.

7 November 2019

(personnel: Genero Panteleon, Juan Reyes)

Remove cylinder head, connecting rod and main bearing. Polish connecting rod journal, main bearing journal. Separate piston and connecting rod. Clean area and parts.

8 November 2019

(personnel: Alan Henrickson) 8 hr

Travel Oakland, Ca to Long Beach, Ca

13 November 2019

(personnel: Alan Henrickson)

Clean liner and measure I. D. Clean piston and measure piston ring grooves. Inspect connecting rod, piston, piston pin for visible damage. Receive cylinder head from CMD, Long Beach. Travel Long beach to Oakland, Ca (personnel: Juan Reyes, Jimmy Gong 8 hr)

14 November 2019

(personnel: Alan Henrickson, Jimmy Gong, Juan Reyes) 14 hr

Lift #3, #5 main bearing cap and examine for visible damage or debris in upper main bearing or main journal. . Have Joe (EBMUD inspector) and Abe Fortes (EBMUD PGS) witness condition of main journals and upper bearings Measure liner I.D., connecting rod piston pin bushing I.D., piston pin O.D., replacement main bearing and connecting rod bearing shell thickness and flatness. Measure piston ring



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end gap. Measure piston pin boss I.D. Set and torque #3 and #5 main bearing caps to 2150 ftlb. Set new replacement main bearing shells in #4 crankshaft journal and torque to 2150 ftlb.

1. Meeting with EBMUD (Daniel Eng EBMUD Project manager) on main bearings to be used for replacement of #4 main bearing. Daniel Eng does not want liability of warranty using EBMUD spare bearings by CMD and asks CMD to assume liability for EBMUD spare main bearings as supplied by CMD. Daniel Eng also states cylinder heads are responsibility of CMD even though EBMUD purchased, stored and supplied cylinder heads to project without requesting or funding CMD to review or hydro test EBMUD cylinder heads. Cylinder head leaks were found 28 August 2019.
2. Request for #4 main temperature data trend unavailable. If failure was immediate then indicated bearing failure. If gradual then possibly loading or surface overlay failure (lubrication).

15 November 2019 (12 hr)

(personnel: Alan Henrickson, Juan Reyes, Jimmy Gong)

Put cotter pins in main bearing studs. Measure crankshaft deflection, #2, #3, #4, #5. Measure #4 connecting rod crankpin bore. Assemble and install #5 connecting rod and torque to 879 ftlb. Measure connecting rod bearing clearance at .004. Review removed connecting rod bearing and clearance data and find the bearing shell thickness cannot exceed .618 for minimum .008 bearing clearance. Inform Abe Fortes of problem, clean area and depart.

16 November 2019 (8 hr)

Travel Oakland to Long Beach, Ca

Measurements.

Main bearing clearance.

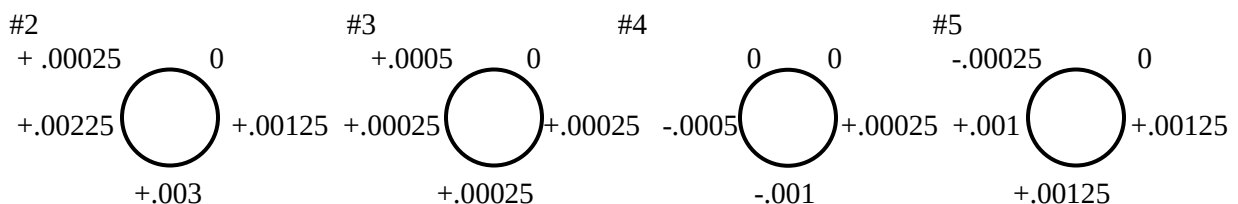
#2. .010

#3. .012

#4. .012

#5. .012

Crankshaft deflection for removed main bearings.



Main bearing thickness measurements.

#4 Upper

.619

.619

.619

.618

.618

Lower

.619

.619

.619

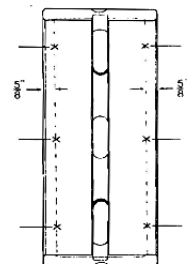
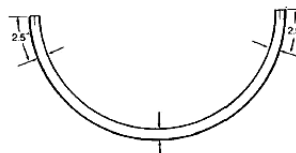
.619

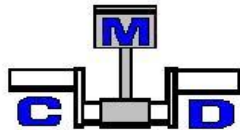
PO # 0011414

12-21-11

PO # 0014190

Measure with a ball micrometer at all points marked "X". Avoid crush relief area at end of shell.





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7-20-12

.618 .618
.618 .618

Connecting rod bearing thickness measurements.

#4 Upper

.620 .620
.620 .620
.620 .620

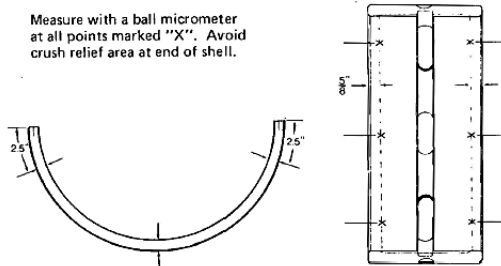
87098 RBH 27 STD
09-17

Lower

.620 .620
.620 .620
.620 .620

87098 RBH 27 STD
09-17

Measure with a ball micrometer
at all points marked "X". Avoid
crush relief area at end of shell.



Piston measurements.

Piston ring groove width measurements

1	.257	.257	.257	.256
2	.257	.257	.256	.257
3	.256	.257	.257	.257
4	.496	.497	.497	.497
5	.498	.497	.498	.498

Piston ring groove depth measurements.

1.	.570	.570	.569	.568
2.	.569	.569	.571	.568
3.	.572	.567	.574	.568
4.	.632	.631	.631	.631
5.	.664	.664	.668	.667

Piston pin O.D. measurements.

	A	B
1.	6.749	6.749
2.	6.750	6.749

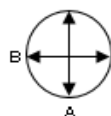


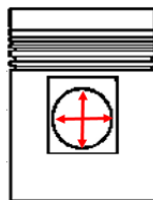
Fig. D



Fig. E Piston Pin

Piston pin boss I.D. measurements.

	A	B
1.	6.752	6.752
2.	6.752	6.752



Connecting rod piston pin bushing I.D. measurements.



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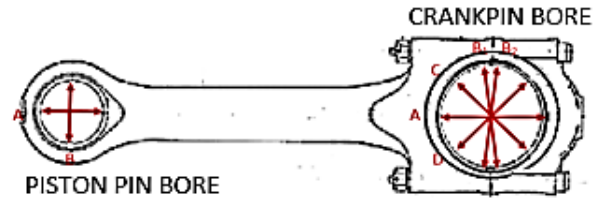
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	A	B
1.	6.762	6.762
2.	6.762	6.762

Connecting rod crankpin bore I.D. measurements

	A	B ₁	B ₂	C	D
1.	12.247	12.250	12.250	12.247	12.248
2.	12.248	12.250	12.251	12.248	12.248

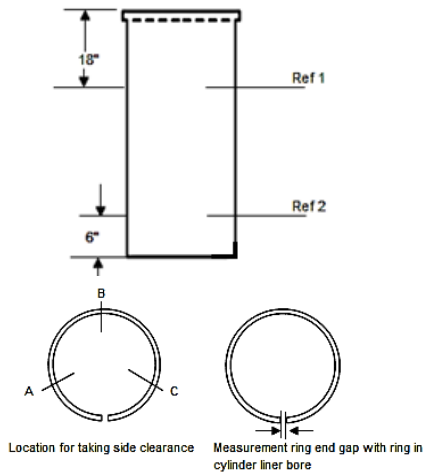


Liner I.D. measurements

	A	B
1.	17.003	17.003
2.	17.004	17.003
3.	17.003	17.003

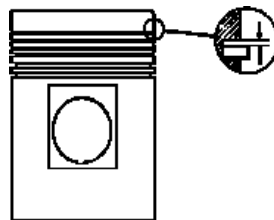
Piston ring end clearance.

- .067
- .087
- .087
- .034
- .033

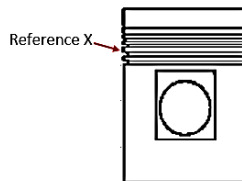


Piston ring side clearance

	A	B	C	D
1.	.008	.008	.008	.008
2.	.006	.006	.006	.006
3.	.005	.005	.005	.005
4.	.003	.003	.003	.003
5.	.003	.003	.003	.003



Piston crown to skirt measurement.
.008





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REPORT OF USED LINER SURVEY

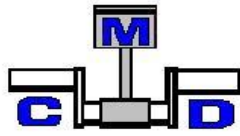
ENTERPRISE DGRS-46 ENGINE LINER PT NO. 03-315-02-OE
EAST BAY MUNICIPAL UTILITIES DISTRICT
POWER GENERATION STATION
OAKLAND, CALIFORNIA

On 16-19 December 2019 a survey of the used liners removed from Enterprise DGRS-48 engine serial number 82004-3063 (Unit 2) was provided. Liner inspection consisted of removing the liners from the removed upper block, cleaning the liners, die penetration inspection of the; counterbore flange to liner body radius and 'o' ring land and grooves areas; measuring the O.D. of the counterbore flange, upper milled fit below the counterbore, 'o' ring lands; I. D measurements of the liner bores. Liner condition reflected the service of the liners; upper combustion area had pitting from the piston compression ring stop to the top of the liner (excepting liners #3 and #5) (this is expected) and ring cuts into the liner bore on liners #2 and #5. The ring cuts on liners #2 and #5 result from prolonged stationary position of the crankshaft with the pistons #2 and #5 being at bottom of stroke. Liner #2 ring cut into the liner bore is at the compression ring resulting from water on the ring to liner. #2 liner ring cut is a partial arc suggesting this resulted from a cylinder head leak or possibly the water was trapped by carbon on the ring. #5 liner ring cuts are circumferential indicating the leak result from a cylinder head water leak. Reusing the liners centers on the amount of material to be removed to either establish a straight surface for the entire liner or leaving the combustion area pitted. Liners #2 and #5 are not recommended for reconditioning due to the lower bore cuts. The remaining liners #1, #3, #4, #6 can possibly be milled or honed back to acceptable standards. Dimensionally #2 liner measured 17.012 I.D. across the intake and exhaust with 17.003 at the bottom (no wear), leaving a .009 taper. The taper can be expected to increase.

The ring cuts at the bottom of #2 and #5 liners result from water line or crevice corrosion where the metal fails in layers due to close proximity of the rings to liner material. The presence of water displaces the oil and a current between differing metals causes a reaction of intermediate metal oxide (rust) reducing the surfaces of the metal with the largest potential surface (greater area) failing first.

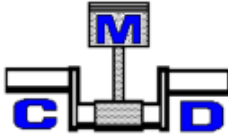
Attachments:

1. Inspection Report; Cylinder Liner Dimensions
2. (Pictures) 1 Upper, 1 Lower, 2 Upper, 2 Lower, 3 Upper, 3 Lower, 4 Upper, 4 Lower, 5 Upper, 5 Lower, 6 Upper, 6 Lower



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Part Number	03-315-03-AA
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Inspection Report

Cylinder Liner Dimensions

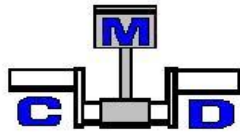
EBMUD 16DEC19 INSPECTION

CYL. #	A FLANGE LINER (New)		A FLANGE LINER (New)	
	A-A	B-B	C-C	D-D

1	19.500	19.498	19.500	19.500
2	19.500	19.498	19.495	19.498
3	19.496	19.497	19.496	19.496
4	19.499	19.497	19.495	19.498
5	19.500	19.498	19.500	19.498
6	19.500	19.499	19.500	19.500

CYL. #	B FLANGE HEIGHT LINER (New)		B FLANGE HEIGHT LINER (New)	
	A-A	B-B	C-C	D-D

1	1.504	1.504	1.504	1.504
2	1.505	1.505	1.505	1.505
3	1.505	1.505	1.505	1.504
4	1.505	1.505	1.505	1.505
5	1.505	1.505	1.505	1.505
6	1.505	1.505	1.505	1.505



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	C BODY FIT LINER (New)		C BODY FIT LINER (New)	
CYL. #	A-A	B-B	C-C	D-D

1	18.995	18.993	18.993	18.996
2	18.993	19.000	18.998	18.998
3	18.995	18.996	18.994	18.994
4	18.994	18.995	18.998	18.993
5	18.997	18.999	18.998	18.997
6	18.994	18.996	18.995	18.994

	D O-RING LAND LINER (New)		D O-RING LAND LINER (New)	
CYL. #	A-A		B-B	

1	18.978	18.980	18.978	18.980
2	18.979	18.979	18.979	18.979
3	18.979	18.980	18.980	18.980
4	18.979	18.980	18.979	18.980
5	18.976	18.979	18.978	18.977
6	18.980	18.977	18.978	18.978



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CYLINDER LINER									
Installation: EBMUD UNIT 2		Engine Type: DGRS-46		Work Order:		Job №:		Date: December 17, 2019	
Running Hours:		Place: EBMUD		LINE SURVEY FOR REUSE OF OLD LINERS 03-315-02-OE					

Measured:

☐ Mounted

☒ Free

NOMINAL CROSSHATCH

SCRATCHES — Long narrow grooves usually caused by foreign material. Crosshatch pattern runs through.

SCUFFING — Caused by piston and/or rings. Can start below oil ring and run up through upper compression ring travel area. Cross-hatch pattern cannot be seen.

BRIGHT SPOT — Bearing through crosshatch. Can appear anywhere. Probable cause: Heavy bearing caused by buildup above top ring land.

Nominal diameter = 17.001" - 17.003" (Inches)

Wear limit = 17.020"

Out of Round = 0.005"

Total Taper = 0.010" (.001" max in any one inch)

Cyl. No.	I				II				III				IV				Condition
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
1	17.006	17.006	17.007	17.003	17.006	17.003	17.003	17.005	17.006	17.005	17.003	17.003	17.003	17.003	17.003	17.003	W, S, SC
2	17.012	17.006	17.006	17.010	17.008	17.003	17.003	17.007	17.008	17.003	17.003	17.005	17.003	17.003	17.003	17.003	W, S, SC
3	17.006	17.006	17.006	17.005	17.005	17.005	17.005	17.006	17.006	17.005	17.005	17.005	17.004	17.004	17.004	17.004	W, S, SC
4	17.008	17.005	17.008	17.003	17.007	17.005	17.007	17.004	17.004	17.004	17.004	17.005	17.004	17.005	17.004	17.005	W, S, SC
5	17.009	17.008	17.007	17.007	17.005	17.004	17.005	17.003	17.007	17.005	17.006	17.006	17.004	17.003	17.003	17.004	W, S, SC
6	17.005	17.006	17.003	17.007	17.005	17.006	17.003	17.005	17.005	17.007	17.006	17.006	17.004	17.005	17.004	17.004	W, S, SC

Condition: X = Good condition W = Worn S = Scratches SC = Scuffing BS = Bright Spot

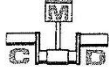
SCRATCHES AND CUTS INTO LINER AT BOTTOM FROM RINGS, WATER STAINS, SCORING ACROSS LINER



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

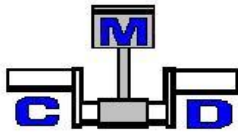


UNIT 2 CYLINDER LINER #6 LOWER BORE

CALIFORNIA MARINE DIESEL



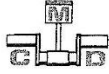
WATER STAINS



CALIFORNIA MARINE DIESEL, INC.

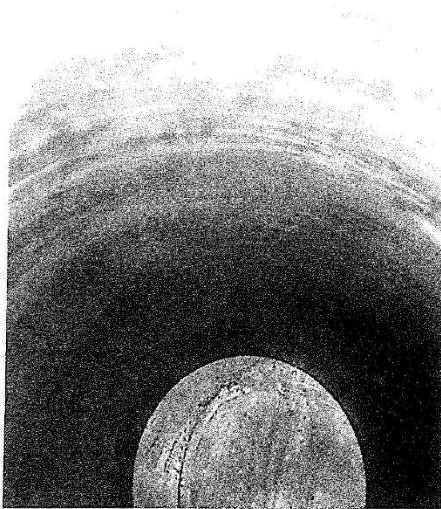
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

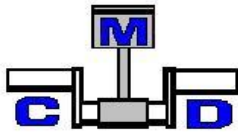


UNIT 2 CYLINDER LINER #6 UPPER BORE

CALIFORNIA MARINE DIESEL



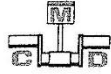
MINIMAL WEAR FOR SERVICE TIME



CALIFORNIA MARINE DIESEL, INC.

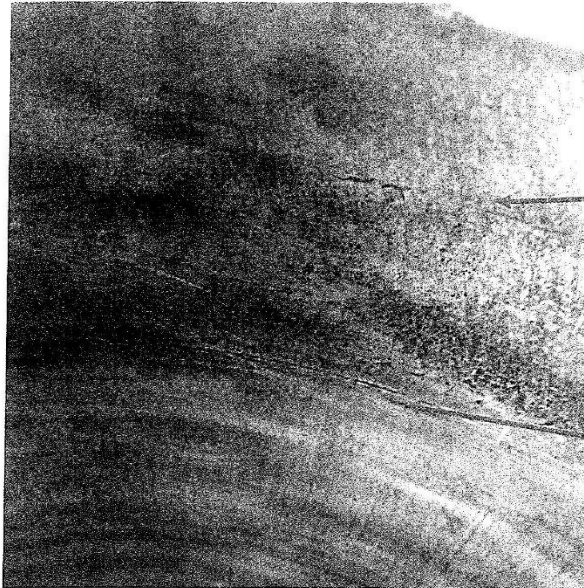
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



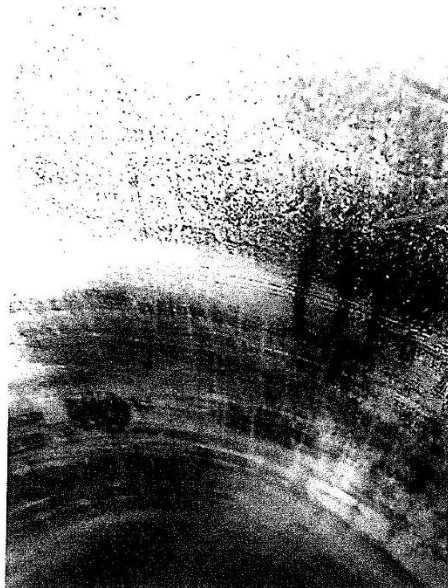
UNIT 2 CYLINDER LINER #6 UPPER BORE

CALIFORNIA MARINE DIESEL



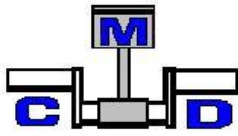
COMBUSTION AREA

MINIMAL RING STOP NO
TRANSITION



COMBUSTION AREA

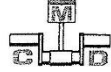
RING STOP CUT



CALIFORNIA MARINE DIESEL, INC.

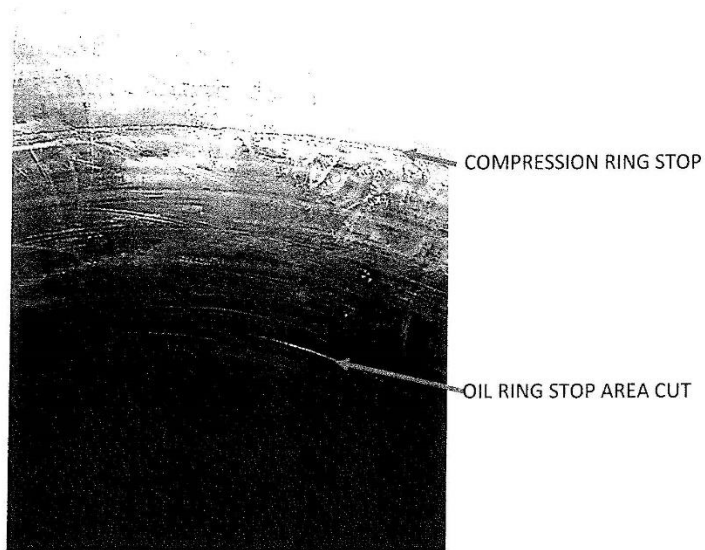
1501 WEST 15TH STREET
LONG BEACH, CA 90813

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UNIT 2 CYLINDER LINER #5 LOWER

CALIFORNIA MARINE DIESEL

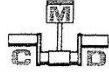




CALIFORNIA MARINE DIESEL, INC.

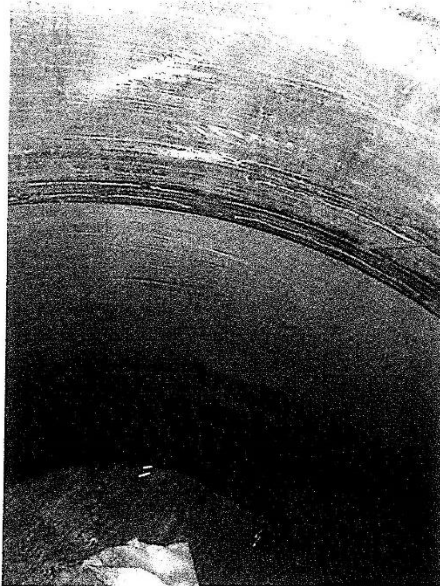
1501 WEST 15TH STREET
LONG BEACH, CA 90813

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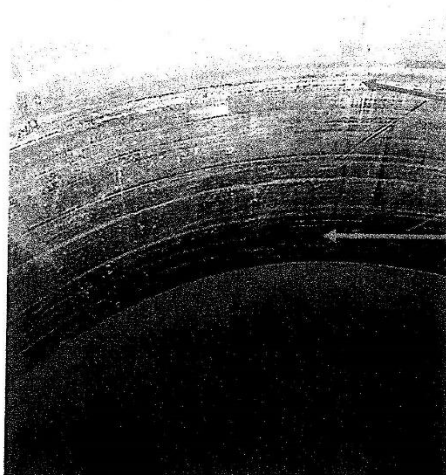
UNIT 2 CYLINDER LINER #5 LOWER

CALIFORNIA MARINE DIESEL



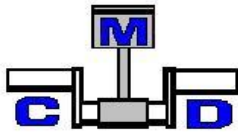
RING STOP CUT

DEATIL OF LOWER RING REVERSAL AND STOP AREA



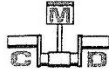
COMPRESSION RING

OIL RING



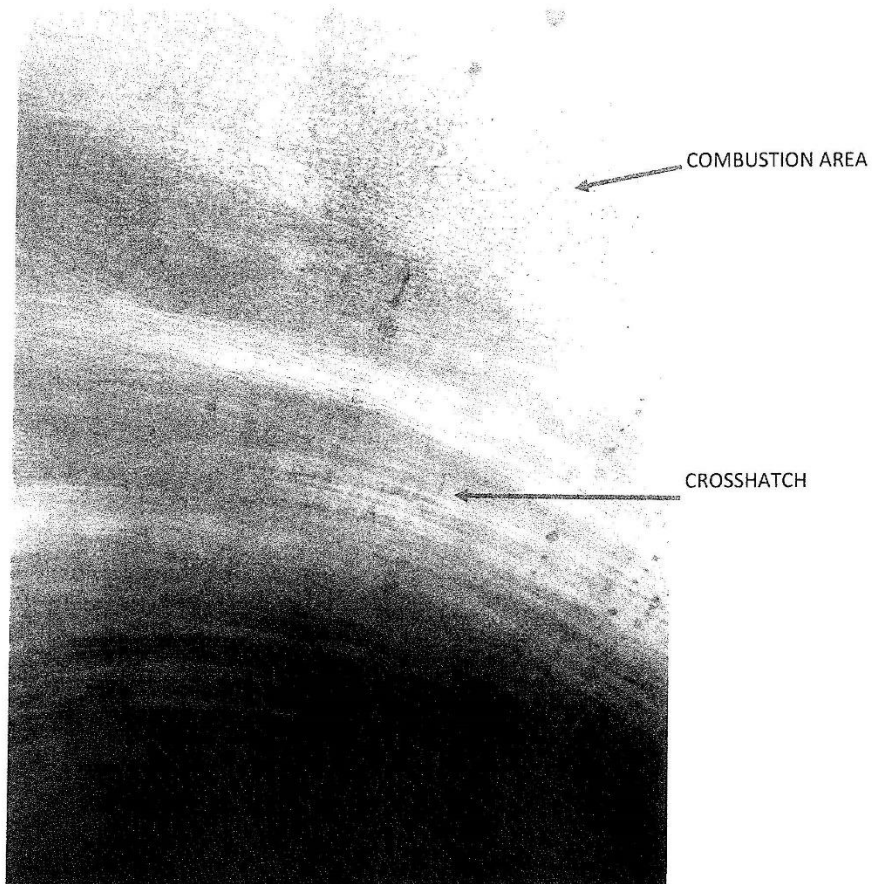
CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505



UNIT 2 CYLINDER LINER #5 UPPER BORE

CALIFORNIA MARINE DIESEL

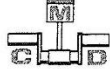




CALIFORNIA MARINE DIESEL, INC.

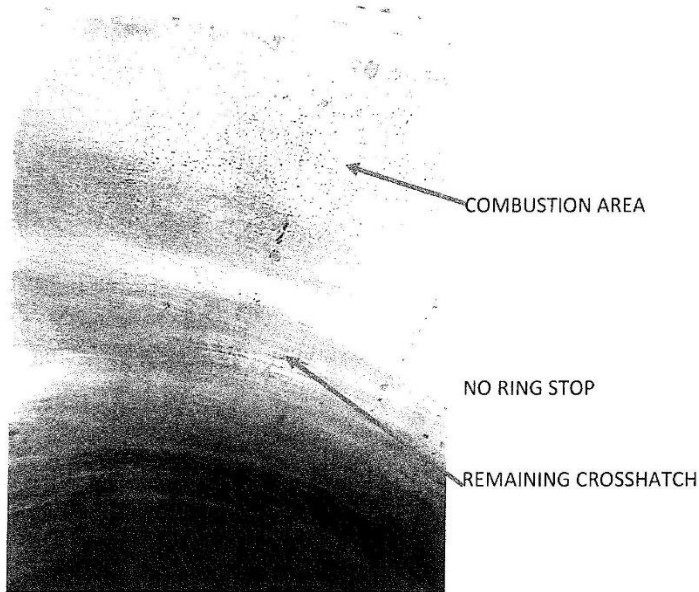
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

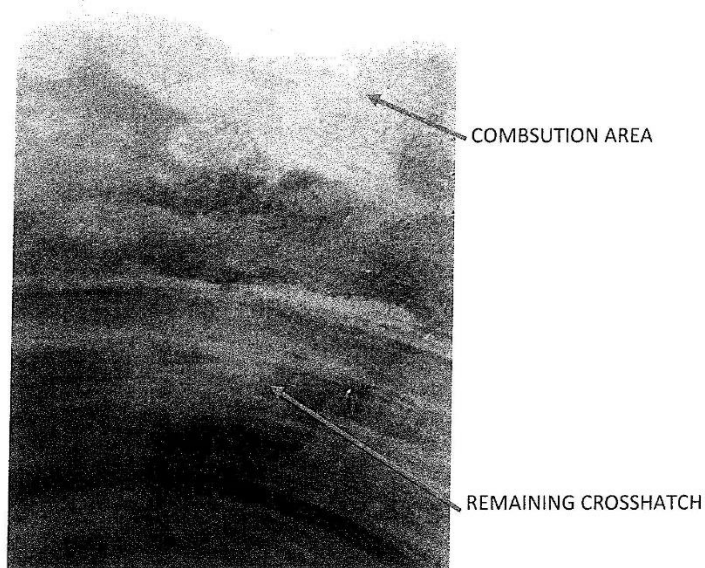


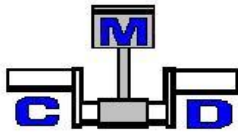
UNIT 2 CYLINDER LINER #5 UPPER BORE

CALIFORNIA MARINE DIESEL



DETAIL OF UPPER LINER NO RING STOP AREA NO TRANSITION TO COMBUSTION AREA (GOOD AREA)

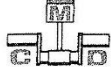




CALIFORNIA MARINE DIESEL, INC.

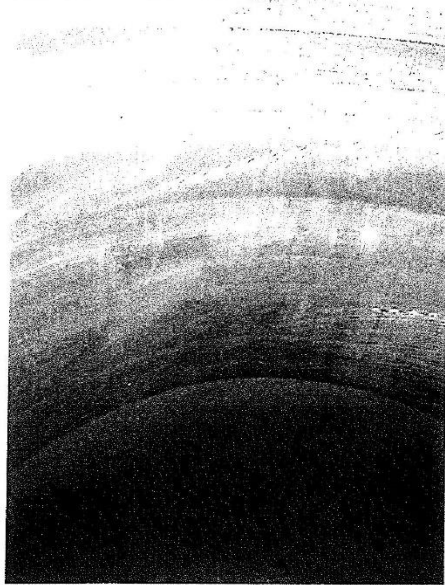
1501 WEST 15TH STREET
LONG BEACH, CA 90813

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UNIT 2 CYLINDER #4 LOWER BORE

CALIFORNIA MARINE DIESEL

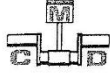




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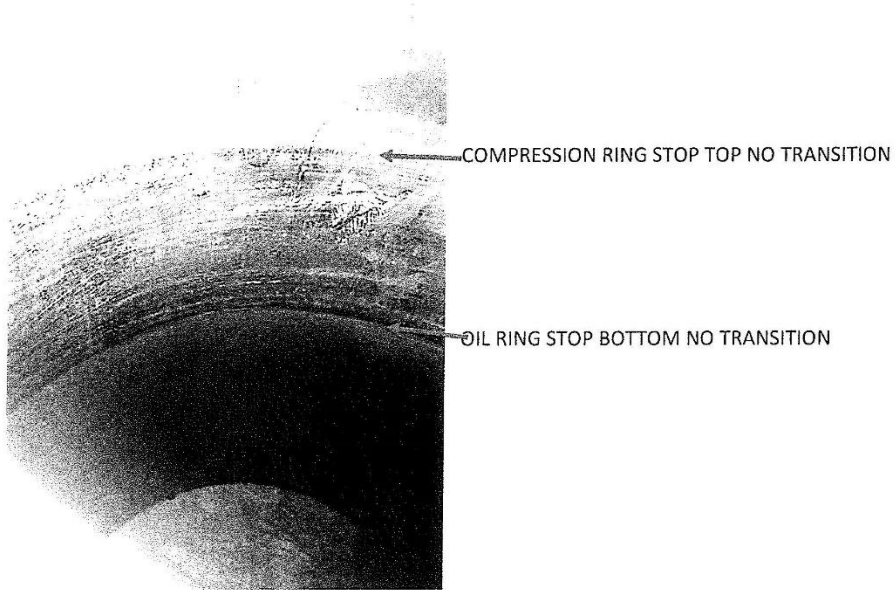
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

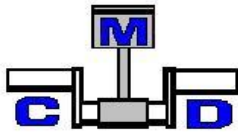


UNIT 2 CYLINDER #4 LOWER BORE

CALIFORNIA MARINE DIESEL



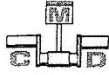
MORE DETAIL OF BOTTOM RING AREA



CALIFORNIA MARINE DIESEL, INC.

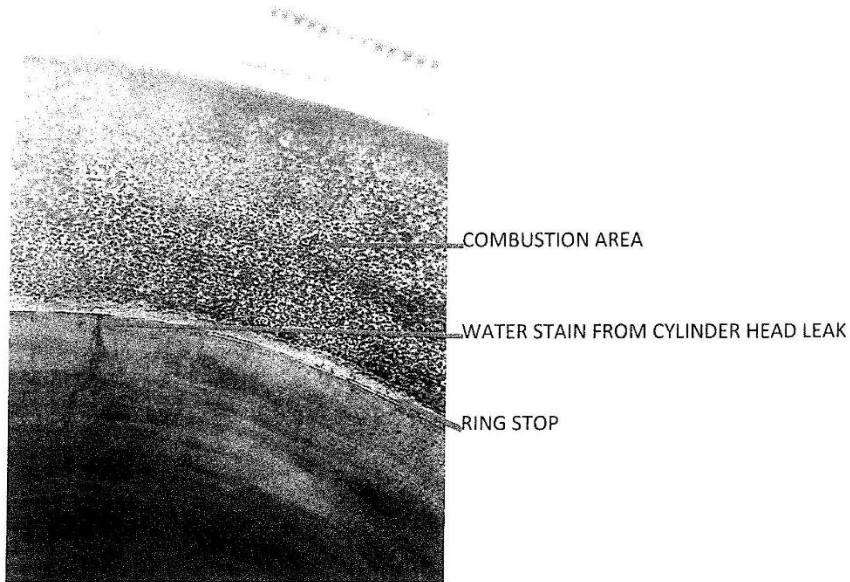
1501 WEST 15TH STREET
LONG BEACH, CA 90813

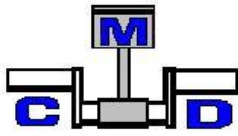
PHONE: (562) 491-5665 • FAX: (562) 491-7505



UNIT 2 CYLINDER #4 UPPER BORE

CALIFORNIA MARINE DIESEL





CALIFORNIA MARINE DIESEL, INC.

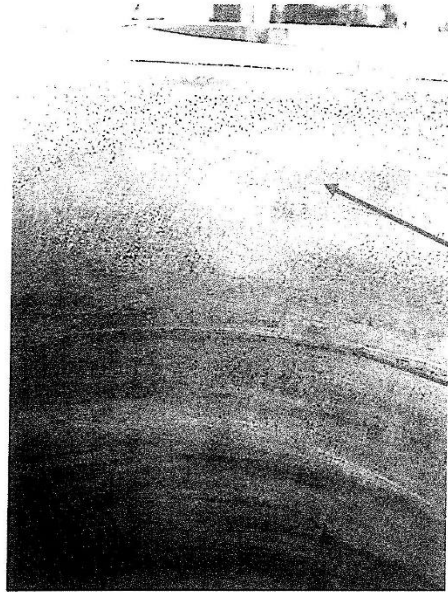
1501 WEST 15TH STREET
LONG BEACH, CA 90813

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UNIT 2 CYLINDER #4 UPPER BORE

CALIFORNIA MARINE DIESEL



COMBUSTION AREA

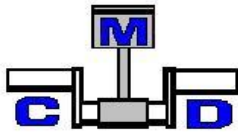
RING STOP NO TRANSITION



COMBUSTION AREA

WATER STAIN FROM CYLINDER HEAD LEAK

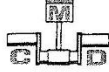
RING STOP



CALIFORNIA MARINE DIESEL, INC.

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UNIT 2 CYLINDER LINER #3 LOWER BORE

CALIFORNIA MARINE DIESEL



WATER STAINS

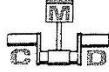
REMAINING CROSSHATCH



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



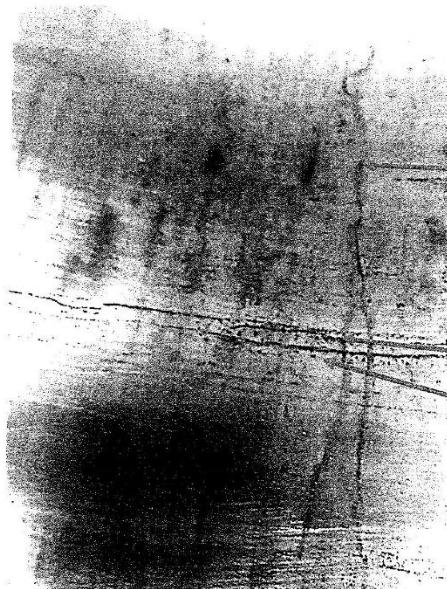
UNIT 2 CYLINDER LINER #3 LOWER BORE

CALIFORNIA MARINE DIESEL



WATER STAINS

REMAINING CROSSHATCH



WATER STAINS

RING STOP (BOTTOM OF STROKE REVERSAL) CUT

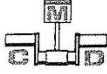
PITTING DAMAGE FROM WATER



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1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



UNIT 2 CYLINDER #4 LOWER BORE

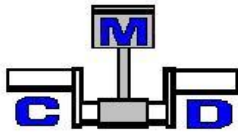
CALIFORNIA MARINE DIESEL



← COMPRESSION RING STOP TOP NO TRANSITION

← OIL RING STOP BOTTOM NO TRANSITION

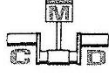
MORE DETAIL OF BOTTOM RING AREA



CALIFORNIA MARINE DIESEL, INC.

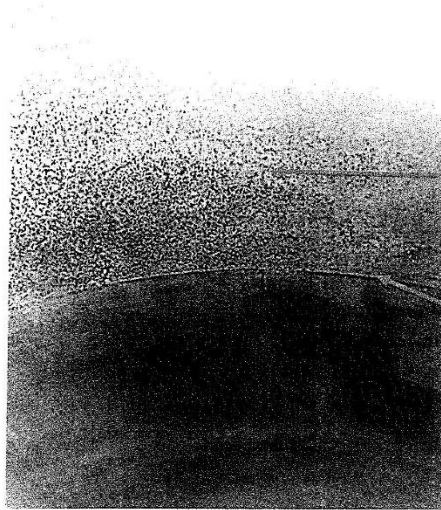
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



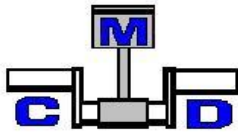
UNIT 2 CYLINDER #3 UPPER BORE

CALIFORNIA MARINE DIESEL



COMBUSTION AREA

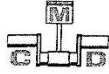
RING STOP AREA



CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813

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UNIT 2 CYLINDER #3 UPPER BORE

CALIFORNIA MARINE DIESEL



COMBUSTION AREA

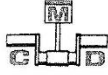
RING STOP AREA NO TRANSITION IN SURFACE



CALIFORNIA MARINE DIESEL, INC.

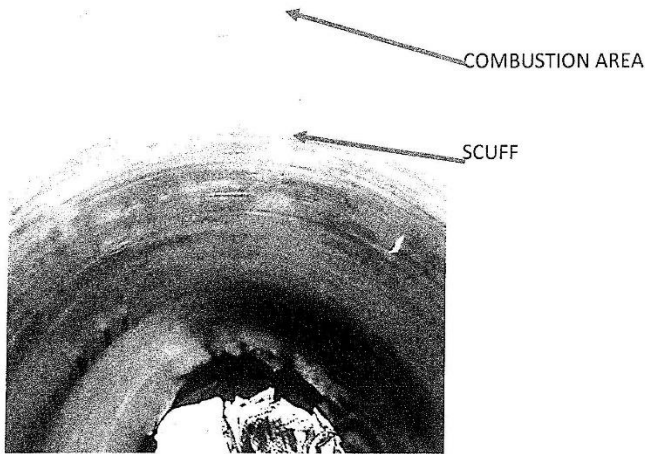
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LONG BEACH, CA 90813

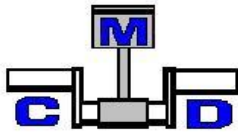
PHONE: (562) 491-5665 • FAX: (562) 491-7505



UNIT 2 CYLINDER #3 UPPER BORE

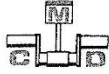
CALIFORNIA MARINE DIESEL





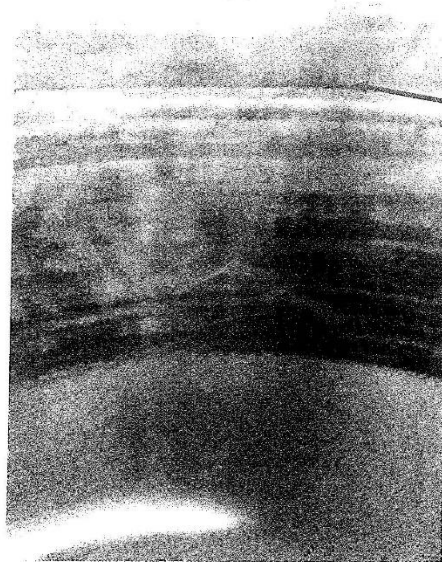
CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505

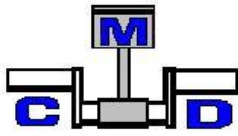


UNIT 2 CYLINDER LINER #2 LOWER BORE

CALIFORNIA MARINE DIESEL



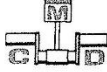
RING STOP CUT



CALIFORNIA MARINE DIESEL, INC.

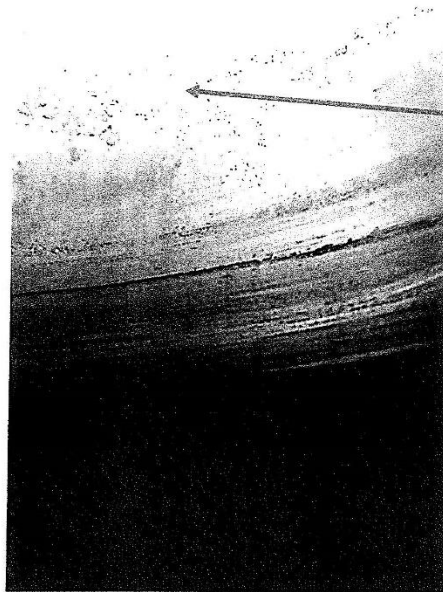
1501 WEST 15TH STREET
LONG BEACH, CA 90813

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UNIT 2 CYLINDER LINER #2 LOWER BORE

CALIFORNIA MARINE DIESEL



PITTING DAMAGE FROM WATER

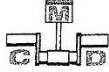
RING STOP CUT



CALIFORNIA MARINE DIESEL, INC.

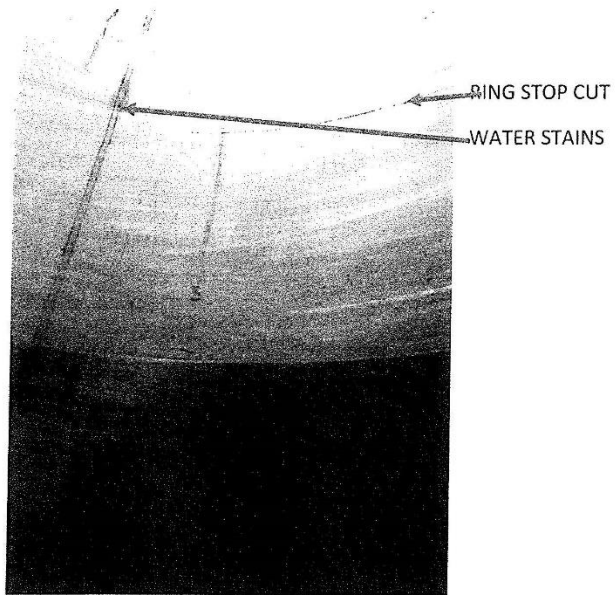
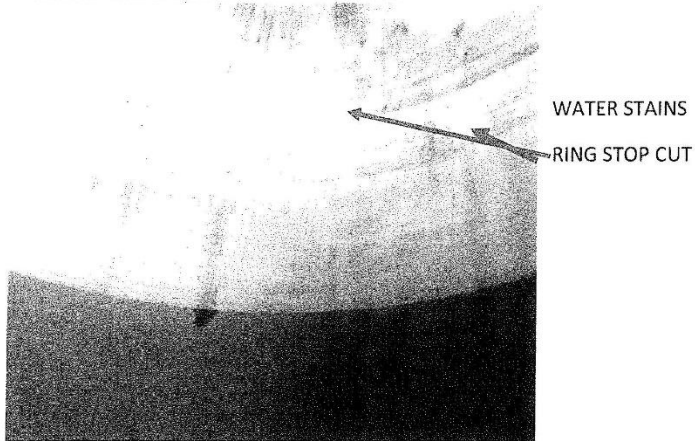
1501 WEST 15TH STREET
LONG BEACH, CA 90813

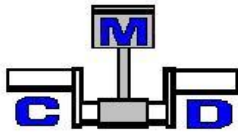
PHONE: (562) 491-5665 • FAX: (562) 491-7505



UNIT 2 CYLINDER LINER #2 LOWER BORE

CALIFORNIA MARINE DIESEL

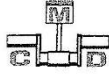




CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813

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UNIT 2 CYLINDER LINER #2 UPPER BORE

CALIFORNIA MARINE DIESEL



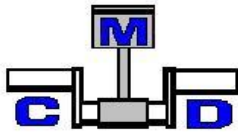
COMBUSTION AREA

RING STOP AREA



COMBUSTION AREA

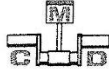
RING STOP AREA



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

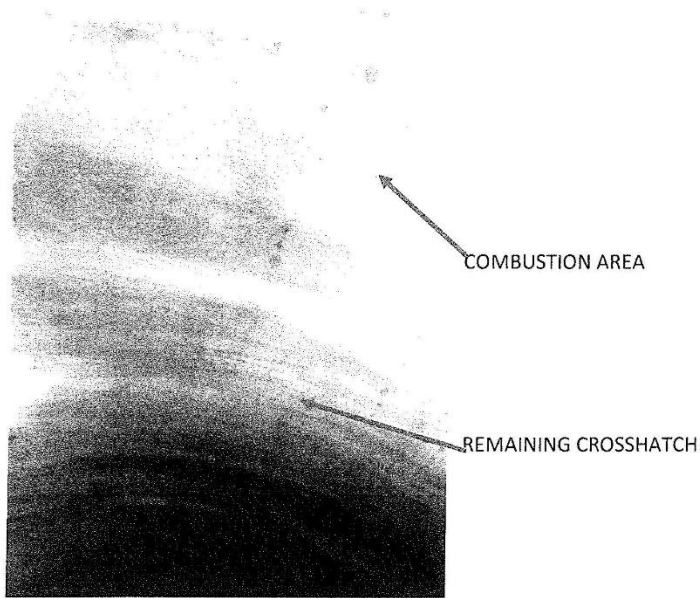
PHONE: (562) 491-5665 • FAX: (562) 491-7505



CALIFORNIA MARINE DIESEL

UNIT 2 CYLINDER LINER #2 UPPER BORE

NO RING STOP TO COMBUSTION AREA

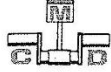




CALIFORNIA MARINE DIESEL, INC.

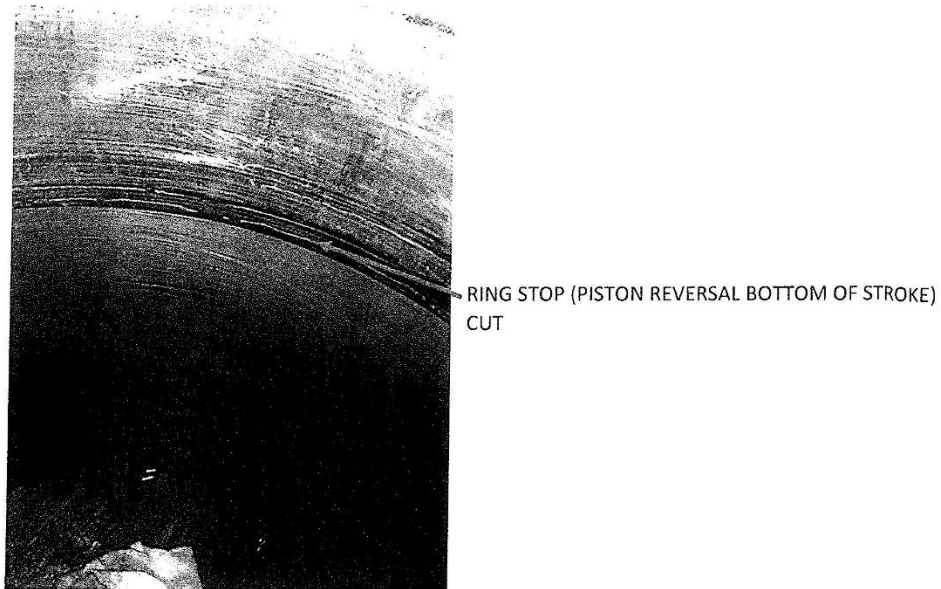
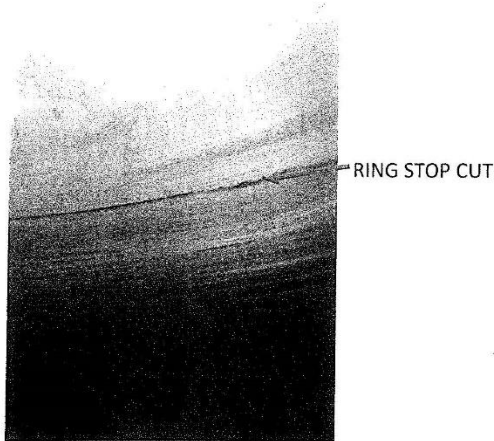
1501 WEST 15TH STREET
LONG BEACH, CA 90813

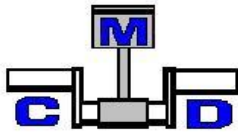
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UNIT 2 CYLINDER LINER #1 LOWER BORE

CALIFORNIA MARINE DIESEL

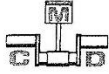




CALIFORNIA MARINE DIESEL, INC.

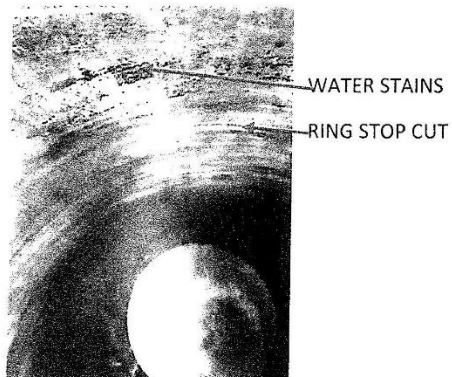
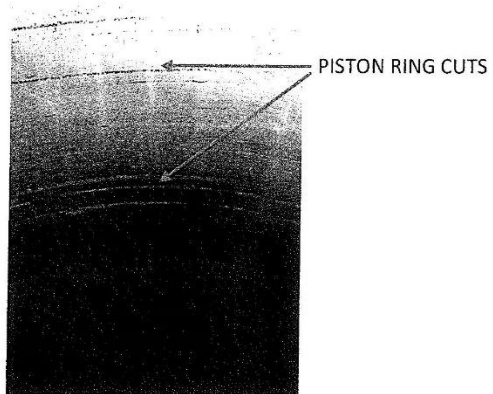
1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



UNIT 2 CYLINDER LINER #1 LOWER BORE

CALIFORNIA MARINE DIESEL

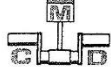




CALIFORNIA MARINE DIESEL, INC.

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UNIT 2 CYLINDER LINER #1 UPPER BORE

CALIFORNIA MARINE DIESEL



COMBUSTION AREA

RING STOP

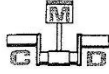
SOME REMAINING CROSSHATCH



CALIFORNIA MARINE DIESEL, INC.

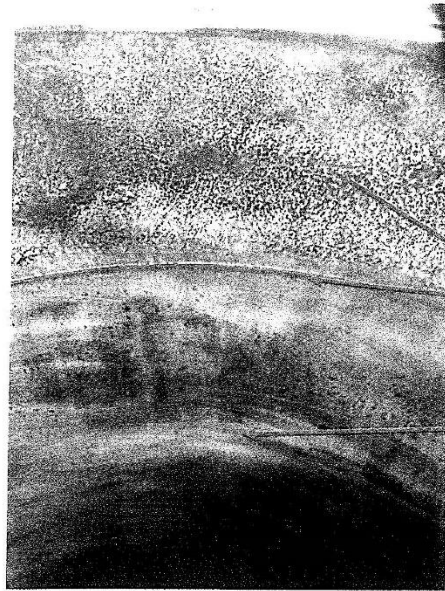
1501 WEST 15TH STREET
LONG BEACH, CA 90813

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UNIT 2 CYLINDER LINER #1 UPPER BORE

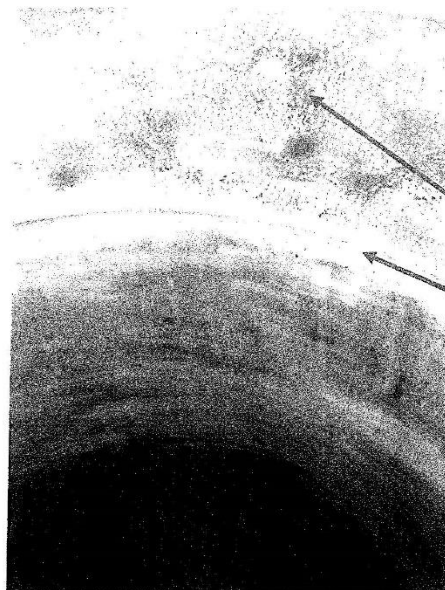
CALIFORNIA MARINE DIESEL



COMBUSTION AREA

RING STOP (PISTON TOP OF STROKE REVERSAL)

SCORING DUE TO HEAT



COMBUSTION AREA

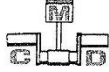
RING STOP AREA



CALIFORNIA MARINE DIESEL, INC.

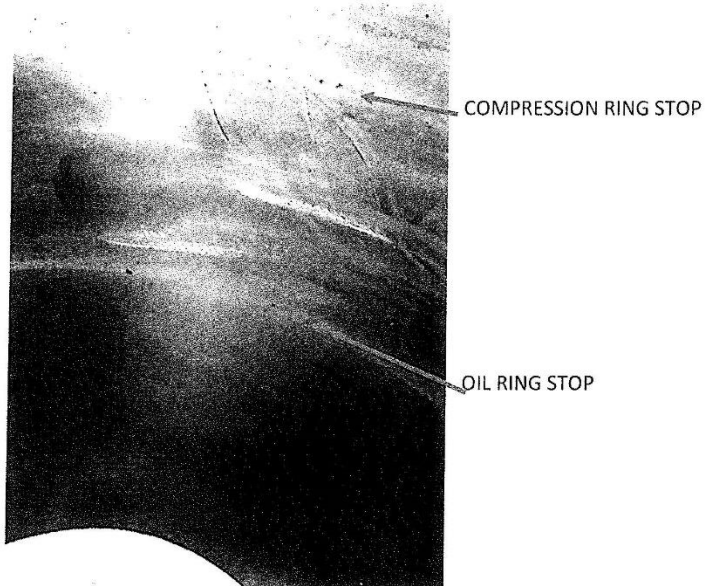
1501 WEST 15TH STREET
LONG BEACH, CA 90813

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UNIT 2 CYLINDER LINER #6 LOWER BORE

CALIFORNIA MARINE DIESEL

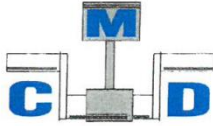


LOWER BORE SHOWS LITTLE WEAR



CALIFORNIA MARINE DIESEL, INC.

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CALIFORNIA MARINE DIESEL, INC.

1501 West 15th Street
Long Beach, CA 90813-1206
Phone: (562) 491-5665 Fax: (562) 491 7505

EAST BAY M.U.D. POWER GENERATION STATION: ENGINE #2 WARRANTY

Unless otherwise specifically stated, engine #2 furnished under East Bay M.U.D. **PO# BRD-08117-AX** is subject to the following warranty: California Marine Diesel, Inc. (hereinafter called Company) warrants that the subject, engine #2, shall be of the kind and quality described in the Company's specifications, and no other warranty or guaranty except of title is made or shall be implied. If any new or overhauled part of said engine thus supplied by the Company fails because of defective workmanship or material within one year or 8,000 hours of operation, whichever comes first, from the successful startup and/or emissions testing date of **10/01/2019** (provided said equipment was properly maintained at Purchaser's facility in accordance with the Company's maintenance and operation requirements, and provided such equipment has been used for the purpose and in the manner intended during the one year or 8,000 hour period shall disclose to its satisfaction that such parts are defective), under said conditions the Company shall replace or repair such defective items using labor and replacement parts at the Company's expense, F.O.B. dock at its warehouse in Long Beach, California.

The Company will not be liable for repairs or alterations unless the same are made with its written consent or approval. The Company reserves its right to routinely examine the equipment stored and/or operated at the Purchaser's facility to verify that the equipment is being stored, operated and maintained in accordance with the Company's storage and maintenance requirements. The Company will not be liable for damages or delays caused by such defective material or workmanship on the part of the Purchaser. It is agreed that the Company's liability under all guaranties or warranties, either express or implied, is expressly limited to the replacing of the Company's supplied parts failing through defective workmanship or material within the times and in the manner aforesaid. Parts claimed to be defective are to be returned to the Company at its option, transport prepaid.

The Company makes no guaranties or warranties whatsoever in respect to products other than that manufactured/re-manufactured by the Company as they are sold under regular warranties of the respective manufacturers. All warranties and guaranties as to efficiency and capacity are based upon shop tests when operating under specified conditions, but do not apply to any condition varying from the foregoing unless expressly agreed upon per the contract with written consent by the Company. The liability of the Company (except as to life) arising out of the supplying of said machinery or equipment or its use, whether on warranties or otherwise, shall not in any case exceed the cost of correcting defects in the machinery or equipment as herein provided, and upon the expiration of said warranty, as herein provided, all such liability shall terminate. The use of material, machinery or equipment manufactured by entities other than the Company, without the express written consent or approval by the Company, shall immediately void all warranties and guaranties granted herein.

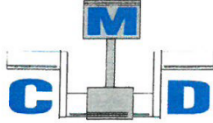
Signed: Denys Ammann – Vice President
California Marine Diesel, Inc.

Signed: Daniel Eng - P.E.
East Bay M.U.D. Wastewater Project and Construction Management



CALIFORNIA MARINE DIESEL, INC.

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CALIFORNIA MARINE DIESEL, INC.

1501 West 15th Street
Long Beach, CA 90813-1206
Phone: (562) 491-5665 Fax: (562) 491 7505

Certificate of Project Completion

Customer Name: East Bay Municipal Utilities District

Job Description / site location: Power Generation Station – Engine #2, Overhaul
2020 Wake Avenue, Oakland, CA 94607

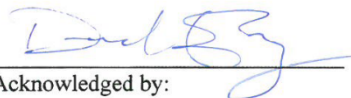
Reference / PO or contract: BDR-08117-AX

Job order number: EBMUD18-002

Completion date: 10/01/2019

The following signature constitutes only the acceptance of the completion of the work described in the applicable order and the release of related personnel from performance on this project.

Nothing contained herein signifies a waiver of any rights of contractual obligations of either party related to warranty claims, indemnification or otherwise, but is intended to simply release the work as "completed" for documentation purposes.


Acknowledged by:

DANIEL ENG
Printed name

10/1/19
Date

ASSOCIATE CIVIL ENGINEER, CONSTRUCTION MANAGER
Title


CMD Representative:

Denys Ammann
Printed name

10/1/2019
Date

Vice President
Title



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505



dahl~beck electric

2775 Goodrick Avenue ♦ Richmond ♦ CA 94801-1109

Phone: (510) 237-2325 ♦ Fax: (510) 237-0608

Email: sales@dahlbeckelectric.com ♦ Website: www.dahlbeckelectric.com

QA REPORTS

California Marine Diesel, Inc ~ EBMUD

Attn: Denys Ammann

Date: February 15, 2019

PES Generator #2 (2153 KW)

Serial #: 8431038

PO #: CMD19-1004

Job # RJ19-0543





CALIFORNIA MARINE DIESEL, INC.

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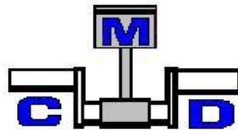
dahlbeck electric

2775 Goodrick Avenue ~ Richmond, CA 94801
Phone (510) 237-2325 ~ Fax (510) 237-0608

As Found Motor Repair Report

Customer: California Marine Diesel, Inc.
Customer P.O. No.: CMD19-1004
Equipment Description: PES Generator # 2 (2153 KW)
Job No. RJ19-0543

Manufacturer	<u>GE</u>	Horse Power	<u>2153 KW</u>
Model No.	<u>5AT19407570</u>	Frame	<u>9407</u>
Serial No.	<u>8431038</u>	Current	<u></u>
Voltage	<u>4160</u>	RPM	<u>450</u>
☐ Overhaul	☐ Rewind	☒ Customer Specification No.	<u>Open & Advise</u>



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
 LONG BEACH, CA 90813
 PHONE: (562) 491-5665 • FAX: (562) 491-7505

Equipment Test Report Customer: California Marine and Diesel, Inc

Equipment Information			
Motor ID	8431038	Operating Volts	4160
Equipment Tag	2153kw PES Gen.no 2	RPM	450
Location	DB	Power	2153 kW
Manufacturer	GE	AC/DC	AC

Test Information	
Test Date/Time: 1/17/2019 - 13:01:09	
Winding Temp: 14 °C	
Job #	RJ19-0543
Test Description	Surge and Hipot Stator
Test Stage	As Found
Operator	Zk
Test Equipment #	Electrom # 0
PP ID#	

Off-line Test Data			
Winding Resistance @20 °C			
Lead 1-2 Ohms			0.055
Lead 2-3 Ohms			0.055
Lead 1-3 Ohms			0.055
Max Delta R (%)			0.0
	Volts	μAmps	MOhms@40 °C
Meg. Test	250	99.85	0
	Volts	μAmps	
Hipot	505	243.11	

Pass/Fail Results	
Surge	PASS
MegOhm	FAIL
Hipot	FAIL
Hipot Step Test	
Ohms Balance	PASS
Off-line Equip. Rating	MARGINAL



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Equipment Test Report

AC Off-line Surge - Summary

Recommended Voltage: 1000

Voltage Reached:

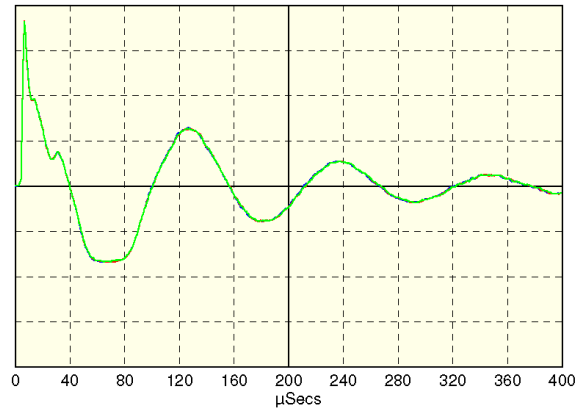
992 / 992 / 982

Wave Difference L1-L2: 1.9%

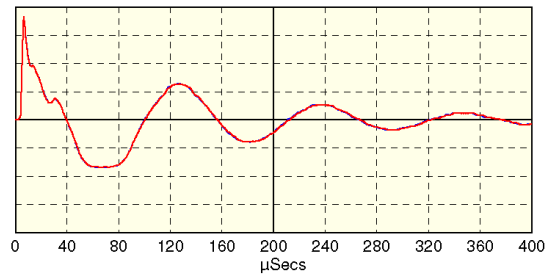
Wave Difference L2-L3: 1.1%

Wave Difference L3-L1: 2.1%

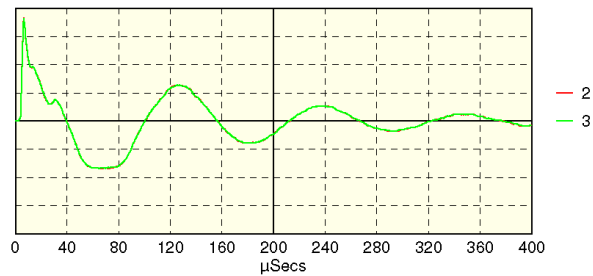
Surge Result: **PASS**



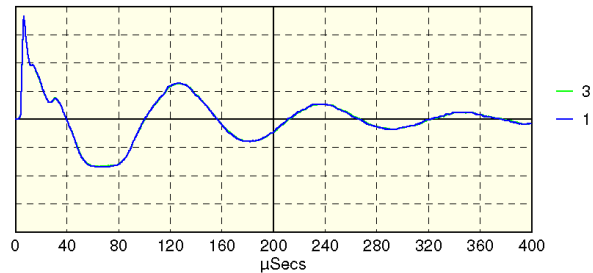
Lead 1-2

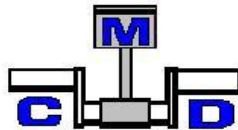


Lead 2-3



Lead 3-1





CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
 LONG BEACH, CA 90813
 PHONE: (562) 491-5665 • FAX: (562) 491-7505

Equipment Test Report Customer: California Marine and Diesel, Inc

Equipment Information			
Motor ID	8431038	Operating Volts	4160
Equipment Tag	2153kw PES Gen.no 2	RPM	450
Location	DB	Power	2153 kW
Manufacturer	GE	AC/DC	AC

Test Information	
Test Date/Time: 1/17/2019 - 13:24:08	
Winding Temp: 14 °C	
Job #	RJ19-0543
Test Description	Surge and Hipot Main Rotor
Test Stage	As Found
Operator	Zk
Test Equipment #	Electrom # 0
PP ID#	

Off-line Test Data			
Winding Resistance @20 °C			
Lead 1-2 Ohms			0.382
Lead 2-3 Ohms			
Lead 1-3 Ohms			
Max Delta R (%)			
	Volts	μAmps	MOhms@40 °C
Meg. Test	0	0.79	
	Volts	μAmps	
Hipot	0	0.00	

Pass/Fail Results	
Surge	PASS
MegOhm	FAIL
Hipot	PASS
Hipot Step Test	
Ohms Balance	PASS
Off-line Equip. Rating	FAIL



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

Equipment Test Report

AC Off-line Surge - Summary

Recommended Voltage: 600

Voltage Reached:

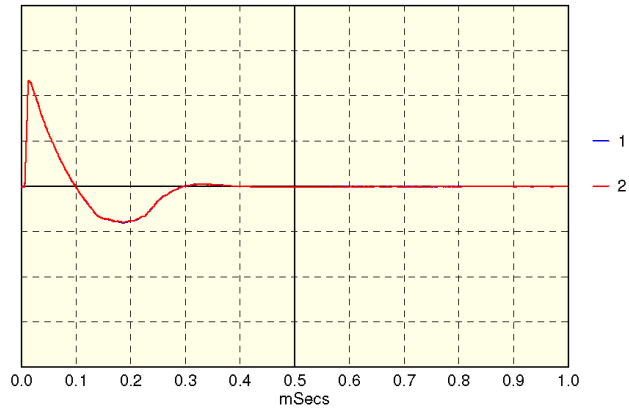
590 / 587 / 0

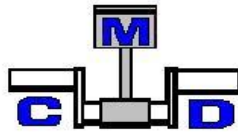
Wave Difference L1-L2: 0.7%

Wave Difference L2-L3: 0%

Wave Difference L3-L1: 0%

Surge Result: **PASS**





CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505

Equipment Test Report Customer: California Marine and Diesel, Inc

Equipment Information			
Motor ID	8431038	Operating Volts	4160
Equipment Tag	2153kw PES Gen.no 2	RPM	450
Location	DB	Power	2153 kW
Manufacturer	GE	AC/DC	AC

Test Information	
Test Date/Time: 1/17/2019 - 13:31:07	
Winding Temp: 14 °C	
Job #	RJ19-0543
Test Description	Surge and hipot Exciter Rotor
Test Stage	As Found
Operator	Zk
Test Equipment #	Electrom # 0
PP ID#	

Off-line Test Data			
Winding Resistance @20 °C			
Lead 1-2 Ohms			0.016
Lead 2-3 Ohms			0.016
Lead 1-3 Ohms			0.016
Max Delta R (%)			0.0
	Volts	μAmps	MOhms@40 °C
Meg. Test	0	0.01	
	Volts	μAmps	
Hipot	0	0.01	

Pass/Fail Results	
Surge	PASS
MegOhm	FAIL
Hipot	FAIL
Hipot Step Test	
Ohms Balance	PASS
Off-line Equip. Rating	FAIL



CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813

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Equipment Test Report

AC Off-line Surge - Summary

Recommended Voltage: 600

Voltage Reached:

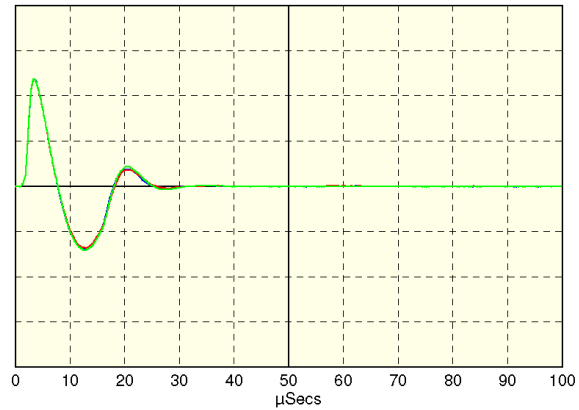
599 / 595 / 599

Wave Difference L1-L2: 3.2%

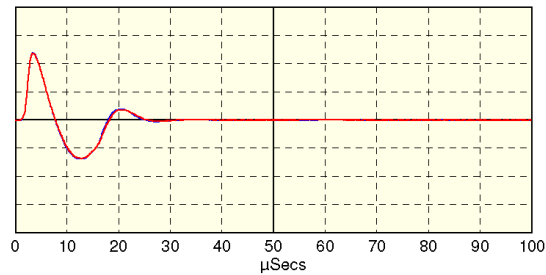
Wave Difference L2-L3: 3.7%

Wave Difference L3-L1: 2.9%

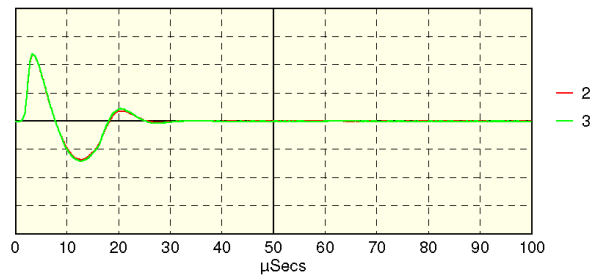
Surge Result: **PASS**



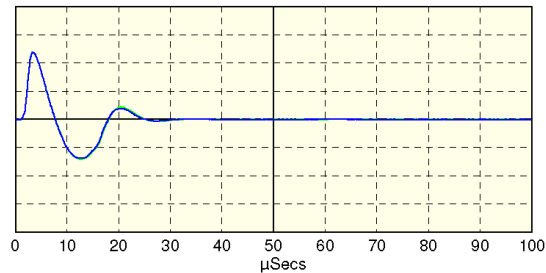
Lead 1-2

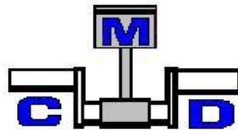


Lead 2-3



Lead 3-1





CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813
PHONE: (562) 491-5665 • FAX: (562) 491-7505

Equipment Test Report Customer: California Marine and Diesel, Inc

Equipment Information			
Motor ID	8431038	Operating Volts	4160
Equipment Tag	2153kw PES Gen.no 2	RPM	450
Location	DB	Power	2153 kW
Manufacturer	GE	AC/DC	AC

Test Information	
Test Date/Time: 1/17/2019 - 14:35:22	
Winding Temp: 14 °C	
Job #	RJ19-0543
Test Description	Surge and Hipot Exciter Field
Test Stage	As Found
Operator	Zk
Test Equipment #	Electrom # 0
PP ID#	

Off-line Test Data			
Winding Resistance @20 °C			
Lead 1-2 Ohms	16.630		
Lead 2-3 Ohms			
Lead 1-3 Ohms			
Max Delta R (%)			
	Volts	μAmps	MOhms@40 °C
Meg. Test	0	0.00	
	Volts	μAmps	
Hipot	0	0.02	

Pass/Fail Results	
Surge	PASS
MegOhm	FAIL
Hipot	FAIL
Hipot Step Test	
Ohms Balance	PASS
Off-line Equip. Rating	FAIL



CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813

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Equipment Test Report

AC Off-line Surge - Summary

Recommended Voltage: 600

Voltage Reached:

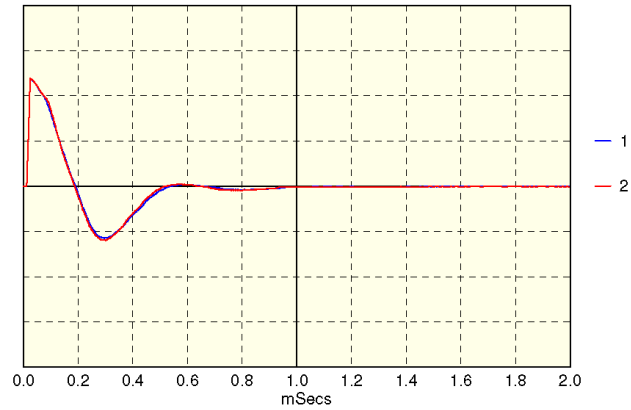
597 / 597 / 0

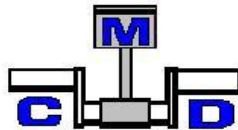
Wave Difference L1-L2: 4.3%

Wave Difference L2-L3: 0%

Wave Difference L3-L1: 0%

Surge Result: **PASS**





CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813
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Equipment Test Report Customer: California Marine and Diesel, Inc

Equipment Information			
Motor ID	8431038	Operating Volts	4160
Equipment Tag	2153kw PES Gen.no 2	RPM	450
Location	DB	Power	2153 kW
Manufacturer	GE	AC/DC	AC

Test Information	
Test Date/Time: 2/11/2019 - 14:00:02	
Winding Temp: 15 °C	
Job #	RJ19-0543
Test Description	SURGE AND HIPOT STATOR
Test Stage	After Clean and Bake
Operator	SW
Test Equipment #	Electrom # 0
PP ID#	

Off-line Test Data			
Winding Resistance @20 °C			
Lead 1-2 Ohms			0.055
Lead 2-3 Ohms			0.055
Lead 1-3 Ohms			0.055
Max Delta R (%)			0.0
	Volts	μAmps	MOhms@40 °C
Meg. Test	1035	0.28	653
	Volts	μAmps	
Hipot	9310	3.23	

Pass/Fail Results	
Surge	PASS
MegOhm	PASS
Hipot	PASS
Hipot Step Test	
Ohms Balance	PASS
Off-line Equip. Rating	PASS



CALIFORNIA MARINE DIESEL, INC.

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LONG BEACH, CA 90813

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Equipment Test Report

AC Off-line Surge - Summary

Recommended Voltage: 9320

Voltage Reached:

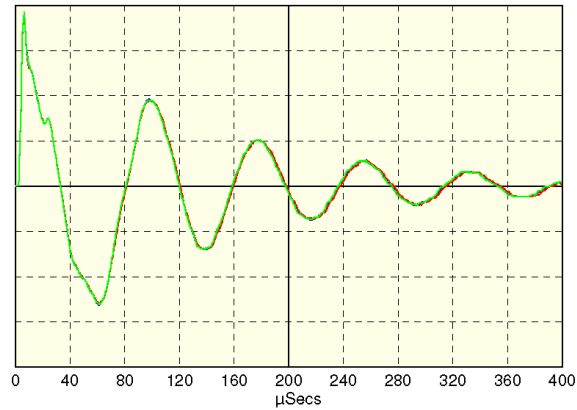
9263 / 9263 / 9263

Wave Difference L1-L2: 3.3%

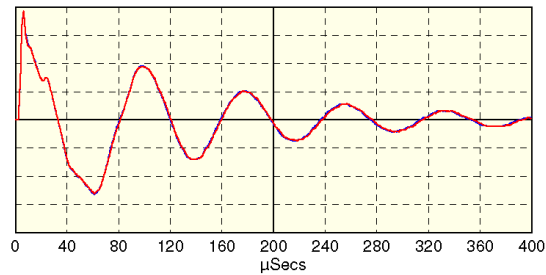
Wave Difference L2-L3: 4.7%

Wave Difference L3-L1: 1.9%

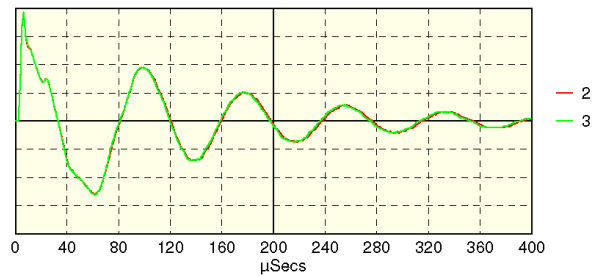
Surge Result: **PASS**



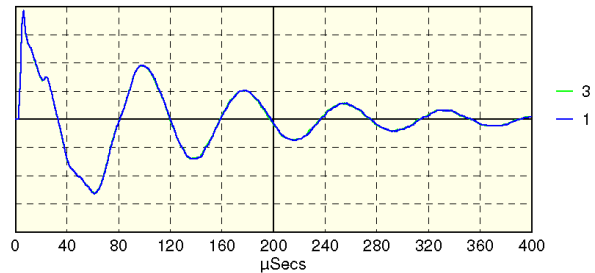
Lead 1-2

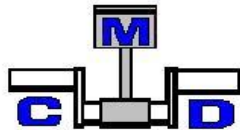


Lead 2-3



Lead 3-1





CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET

LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

Equipment Test Report

Customer: California Marine and Diesel, Inc

Equipment Information			
Motor ID	8431038	Operating Volts	4160
Equipment Tag	2153kw PES Gen.no 2	RPM	450
Location	DB	Power	2153 kW
Manufacturer	GE	AC/DC	AC

Test Information	
Test Date/Time: 2/11/2019 - 13:30:52	
Winding Temp: 11 °C	
Job #	RJ19-0543
Test Description	Surge and hipot Exciter Rotor
Test Stage	After Clean and Bake
Operator	SW
Test Equipment #	Electrom # 0
PP ID#	

Off-line Test Data			
Winding Resistance @20 °C			
Lead 1-2 Ohms			0.016
Lead 2-3 Ohms			0.016
Lead 1-3 Ohms			0.016
Max Delta R (%)			0.0
	Volts	µAmps	MOhms@40 °C
Meg. Test	520	0.33	211
	Volts	µAmps	
Hipot	1315	1.01	

Pass/Fail Results	
Surge	PASS
MegOhm	PASS
Hipot	PASS
Hipot Step Test	
Ohms Balance	PASS
Off-line Equip. Rating	PASS



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

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Equipment Test Report

AC Off-line Surge - Summary

Recommended Voltage: 1500

Voltage Reached:

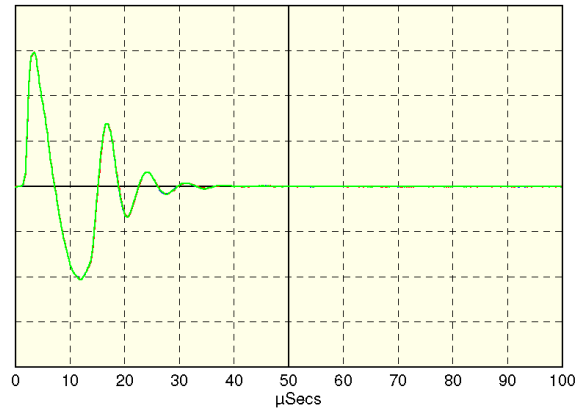
1499 / 1499 / 1499

Wave Difference L1-L2: 1.5%

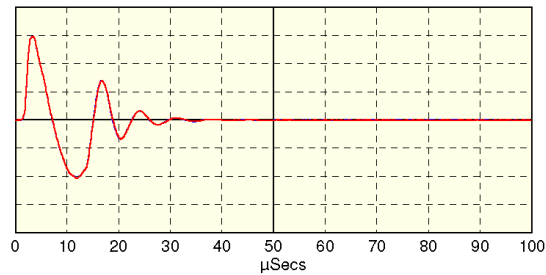
Wave Difference L2-L3: 1.6%

Wave Difference L3-L1: 0.8%

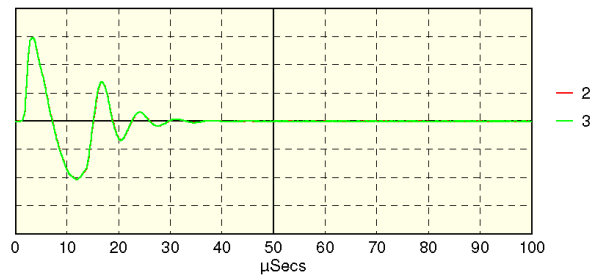
Surge Result: **PASS**



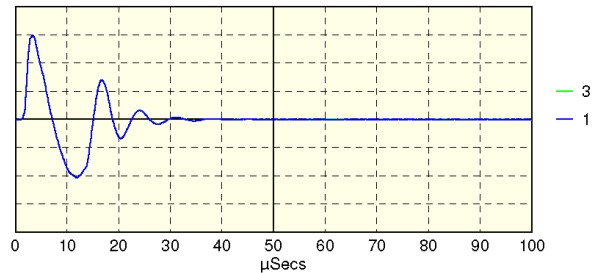
Lead 1-2

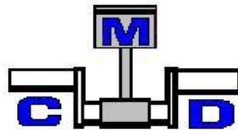


Lead 2-3



Lead 3-1





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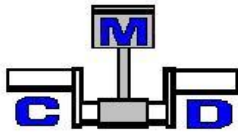
Equipment Test Report Customer: California Marine and Diesel, Inc

Equipment Information			
Motor ID	8431038	Operating Volts	4160
Equipment Tag	2153kw PES Gen.no 2	RPM	450
Location	DB	Power	2153 kW
Manufacturer	GE	AC/DC	AC

Test Information	
Test Date/Time: 2/11/2019 - 13:30:52	
Winding Temp: 11 °C	
Job #	RJ19-0543
Test Description	Surge and hipot Exciter Rotor
Test Stage	After Clean and Bake
Operator	SW
Test Equipment #	Electrom # 0
PP ID#	

Off-line Test Data			
Winding Resistance @20 °C			
Lead 1-2 Ohms			0.016
Lead 2-3 Ohms			0.016
Lead 1-3 Ohms			0.016
Max Delta R (%)			0.0
	Volts	µAmps	MOhms@40 °C
Meg. Test	520	0.33	211
	Volts	µAmps	
Hipot	1315	1.01	

Pass/Fail Results	
Surge	PASS
MegOhm	PASS
Hipot	PASS
Hipot Step Test	
Ohms Balance	PASS
Off-line Equip. Rating	PASS



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Equipment Test Report

AC Off-line Surge - Summary

Recommended Voltage: 1500

Voltage Reached:

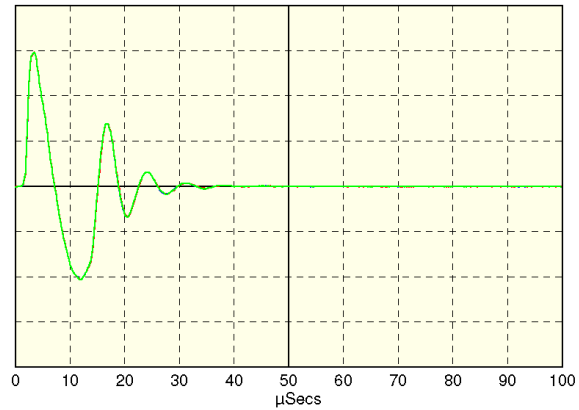
1499 / 1499 / 1499

Wave Difference L1-L2: 1.5%

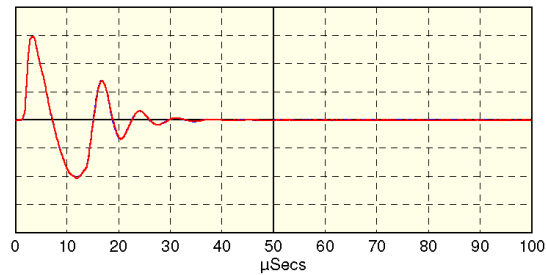
Wave Difference L2-L3: 1.6%

Wave Difference L3-L1: 0.8%

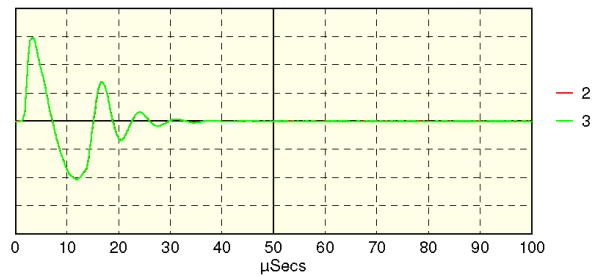
Surge Result: **PASS**



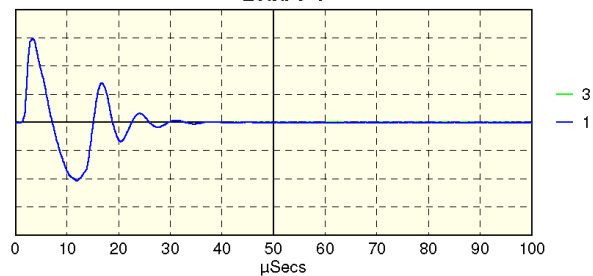
Lead 1-2



Lead 2-3



Lead 3-1





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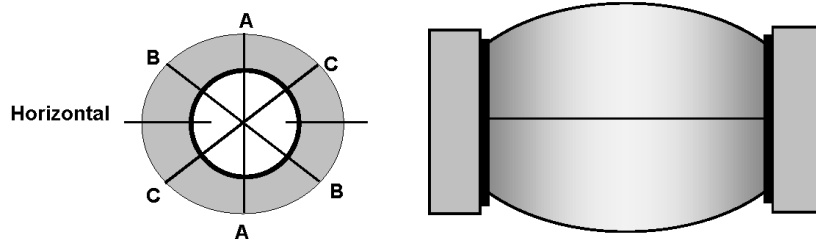
dahlbeck electric
2775 Goodrick Avenue ~ Richmond, CA 94801
(510) 237-2325 ~ Fax (510) 237-0608

As Found OPE Sleeve Bearing Report

Customer: California Marina Diesel, Inc. Date: 1/30/2019

Job No. RJ19-0543 Equipment ID: Generator # 2

Equipment Desc.: PES Generator #2 (2153 kw)



BEARINGS							
	INBOARD				OUTBOARD		
	Journal O.D.	Bearing I.D.	Clearance		Journal O.D.	Bearing I.D.	Clearance
A	8.0000	8.0121	0.0121	A	8.0000	8.0130	0.0130
B	8.0000	8.0124	0.0124	B	7.9998	8.0110	0.0112
C	8.0000	8.0129	0.0129	C	8.0000	8.0134	0.0134
	Bearing O.D.	Housing I.D.	Interference		Bearing O.D.	Housing I.D.	Interference
A	Self Aligning			A	Self Aligning		
B				B			
C				C			

Comments: _____

SEALS							
IB	INBOARD SEAL			IB	OUTBOARD SEAL		
	Journal O.D	Seal I.D.	Clearance		Journal O.D	Seal I.D.	Clearance
	A	N/A			A	N/A	
	B				B		
	C				C		

Comments: _____

Inspected By: Jeff Gaffett Date: 1/30/2019

As Found Condition



CALIFORNIA MARINE DIESEL, INC.

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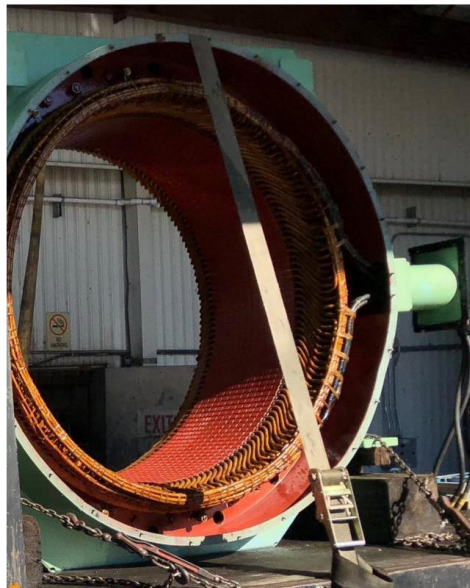
Dahl-Beck Electric Co. 2775 Goodrick Avenue, Richmond, Ca. 94801

Phone (510) 237-2325 Fax (510) 237-0608

Job #: RJ19-0543 – California Marine Diesel, Inc.~ EBMUD – PES Generator #2 (2153 kw)



As Found ~ Stator



Stator after Steam Clean



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Phone (510) 237-2325 Fax (510) 237-0608

Job #: RJ19-0543 – California Marine Diesel, Inc.~ EBMUD – PES Generator #2 (2153 kw)



As Found ~ Rotor



As Found ~ Exciter



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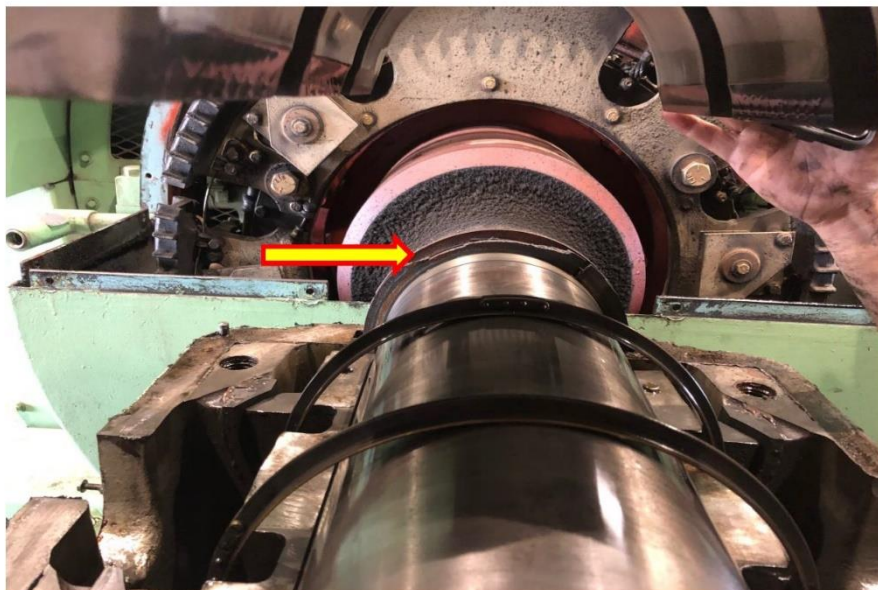
Dahl-Beck Electric Co. 2775 Goodrick Avenue, Richmond, Ca. 94801

Phone (510) 237-2325 Fax (510) 237-0608

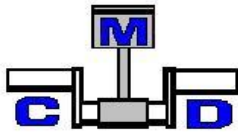
Job #: RJ19-0543 – California Marine Diesel, Inc.~ EBMUD – PES Generator #2 (2153 kw)



As Found ~ Field Frame



As Found ~ Journal / IB Fiber Seal



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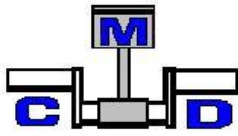
Job #: RJ19-0543 – California Marine Diesel, Inc.~ EBMUD – PES Generator #2 (2153 kw)



As Found ~ OPE Bearing Housing



As Found ~ OPE Housing



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Phone (510) 237-2325 Fax (510) 237-0608

Job #: RJ19-0543 – California Marine Diesel, Inc.~ EBMUD – PES Generator #2 (2153 kw)



As Found ~ Covers



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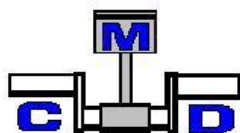


Inspection Report

on P. ST. EBMUD for EAST BAY MUNICIPAL UTILITIES DISTRICT

Wednesday, October 17, 2018





CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
LONG BEACH, CA 90813

PHONE: (562) 491-5665 • FAX: (562) 491-7505

Inspection Overview

Customer

Name	EAST BAY MUNICIPAL UTILITIES DISTRICT
Installation	P. ST. EBMUD

Your ABB Contact

Oscar Padilla
+1 310 518 8500
turbo@us.abb.com

Service Job

Place of Job	ABB Los Angeles Service station
Date of Job	2018-09-17
Engine Running Hours	Unavailable

Customer Reference

ABB Reference	4440088
Service Job ID	2082074-01

Executing Service Station

Los Angeles - WGT
Los Angeles Area Service Center
90745 - Carson
USA

Equipment

Turbocharger Type	TPL65-A10
Serial No.	
Customer Designation	

Engine

Engine Builder
Engine Type
Engine Fuel

Remarks

Cartridge has been removed from complete turbocharger at ABB workshop.
Cartridge was dismantled down to components level.
All parts were cleaned and inspected according to ABB instruction.
Compressor wheel was found with heavy carbon deposits on the vanes. Post cleaning condition was found in good. Ok to be reused after balancing.
Turbine shaft was found in general condition with heavy scaling on turbine blades. Blade tips were observed with minor rubbing marks. Ok to be reused after cleaning and balancing.
Radial bearings were found in general condition and ok to be reused at this time upon condition.
Axial bearing and auxiliary bearing were found in fair condition and ok to be reused.



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Foreign material pieces have been being stocked on axial surface of floating disk and minor scoring are being presented on adjacent surface of trust bearing as well. Replacement recommend to be taken place at this time in point to prevent further damages on both bearing components. Bearing casing was found in damaged condition with heavy ware marks on axial clamping surfaces (adjacent surface of G.O.C and sealing cover clamping surface). Replacement must be taken place at this time in point to prevent hood failure. Hood clamping has been found in loose condition meantime dismantling. Heavy fretting marks were observed on axial clamping surface. Ware limits and clamping pressure has been measured over limits values. Replacement must be taken place to prevent hood failure. Sealing cover has been found in damaged condition with heavy ware on axial clamping surface and circumferential cam recess. Worn out places were measured over limits values. replacement need to be taken place. Other components were evaluated in general condition and ok to be reused at this service.



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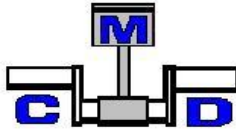
PHONE: (562) 491-5665 • FAX: (562) 491-7505

Assessment Overview

Compressor Components	Condition	Recommendation	Remarks
25000 / Compressor Wheel	Fair	Reuse	Found in fair condition with heavy carbon deposits on the vanes. Ok to be reused after cleaning and balancing.
Bearing Components	Condition	Recommendation	Remarks
32001 / Thrust Bearing	Fair	Replace	Condition found: Scored Found with minor scoring on axial surface. Ok to be reused upon condition.
32101 / Radial Bearing CE	Fair	Reuse	Found in fair condition and ok to be reused upon condition.
32102 / Radial Bearing TE	Fair	Reuse	Found in fair condition and ok to be reused upon condition.
32104 / Auxiliary Bearing	Fair	Replace	Ok to be reused.
32105 / Floating Disc	Fair	Replace	Foreign material pieces have been being stocked on axial surface and minor scoring are being presented on adjacent surface of trust bearing as well. Floating disk recommend to be replaced at this time to prevent further damages.
32106 / Axial Bearing	Fair	Replace	Found in fair condition and ok to be reused upon condition.
32107 / Bearing Bush - TPL	Fair	Reuse	Ok to be reused.
42001 / Bearing Casing	Damaged	Replace	Condition found: Scaled, Eroded

2082074-01 on
Page 4 of 24

ABB

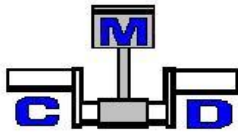


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42002 / Hood	Damaged	Replace	Bearing casing was found in damaged condition with heavy ware marks on axial clamping surfaces (adjacent surface of G.O.C and sealing cover clamping surface). Replacement must be taken place at this time in point to prevent hood failure.
42015 / Sealing Cover	Damaged	Replace	Condition found: Deformed Hood clamping has been found in loose condition meantime dismantling. Heavy fretting marks were observed on axial clamping surface. Ware limits and clamping pressure has been measured over limits values. Replacement must be taken place to prevent hood failure.
			Sealing cover has been found in damaged condition with heavy ware on axial clamping surface and circumferential cam recess. Worn out places were measured over limits values. replacement need to be taken place.
Turbine Components			
Turbine Components	Condition	Recommendation	Remarks
21000 / Shaft	Fair	Reuse	Found in fair condition and ok to be reused at this time.
21007 / Damping Wire	Fair	Reuse	Ok to be reused.
21010 / Labyrinth Sleeve	Fair	Reuse	OK to be reused.
29000 / Turbine Blade	Fair	Reuse	Condition found: Rubbed Found with heavy scaling on blades. blades tip have minor rubbing marks. Ok to be reused upon condition.



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43001 / Partition Wall

Fair

Reuse

Condition found: Good
Ok to be reused.



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21000 / Shaft

Assessment

Condition

Fair

Recommendation

Reuse

Remarks

Found in fair condition and ok to be reused at this time.



Fig. 1: Pre cleaning.



Fig. 2: Post cleaning.

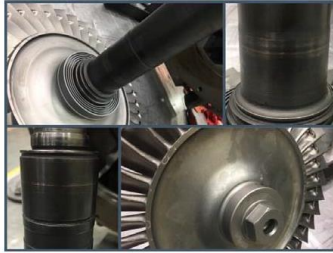


Fig. 3: Post cleaning.



Fig. 4: Pre cleaning.



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21010 / Labyrinth Sleeve

Assessment

Condition

Fair

Recommendation

Reuse

Remarks

OK to be reused.



Fig. 1: Post cleaning.



Fig. 2: Post cleaning.



Fig. 3: Pre cleaning.



Fig. 4: Pre cleaning.



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25000 / Compressor Wheel

Assessment

Condition

Fair

Recommendation

Reuse

Remarks

Found in fair condition with heavy carbon deposits on the vanes. Ok to be reused after cleaning and balancing.



Fig. 1: Post cleaning.



Fig. 2: Post cleaning.



Fig. 3: Pre cleaning.



Fig. 4: Pre cleaning.



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29000 / Turbine Blade

Assessment

Condition

Fair

- Rubbed

Recommendation

Reuse

Remarks

Found with heavy scaling on blades. blades tip have minor rubbing marks. Ok to be reused upon condition.



Fig. 1: Post cleaning.



Fig. 2: Post cleaning.



Fig. 3: Pre cleaning.



Fig. 4: Pre cleaning.



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32001 / Thrust Bearing

Assessment

Condition

Fair

- Scored

Recommendation

Replace

Remarks

Found with minor scoring on axial surface. Ok to be reused upon condition.



Fig. 1: Pre cleaning.



Fig. 2: Post cleaning.



Fig. 3: Post cleaning.



Fig. 4: Pre cleaning.



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32101 / Radial Bearing CE

Assessment

Condition

Fair

Recommendation

Reuse

Remarks

Found in fair condition and ok to be reused upon condition.



Fig. 1: Pre cleaning.



Fig. 2: Post cleaning.



Fig. 3: Pre cleaning.



Fig. 4: Post cleaning.



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32102 / Radial Bearing TE

Assessment

Condition

Fair

Recommendation

Reuse

Remarks

Found in fair condition and ok to be reused upon condition.



Fig. 1: Post cleaning.



Fig. 2: Pre cleaning.

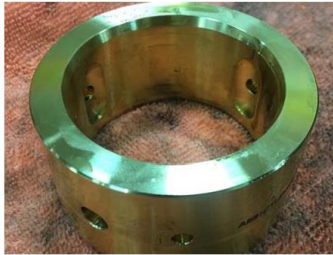


Fig. 3: Pre cleaning.



Fig. 4: Post cleaning.



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32104 / Auxiliary Bearing

Assessment

Condition

Fair

Recommendation

Replace

Remarks

Ok to be reused.



Fig. 1: Post cleaning.



Fig. 2: Post cleaning.



Fig. 3: Pre cleaning.



Fig. 4: Pre cleaning.



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32105 / Floating Disc

Assessment

Condition

Fair

Recommendation

Replace

Remarks

Foreign material pieces have been being stocked on axial surface and minor scoring are being presented on adjacent surface of trust bearing as well. Floating disk recommend to be replaced at this time to prevent further damages.

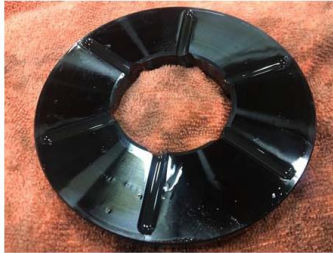


Fig. 1: Pre cleaning.



Fig. 2: Post cleaning.

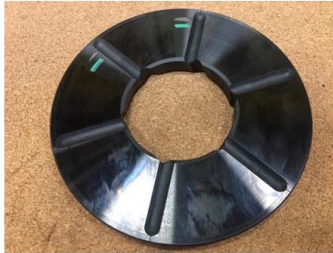
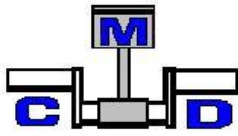


Fig. 3: Post cleaning with foreign material pieces.



Fig. 4: Pre cleaning.



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32106 / Axial Bearing

Assessment

Condition

Fair

Recommendation

Reuse

Remarks

Found in fair condition and ok to be reused upon condition.

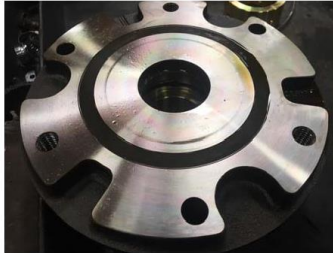


Fig. 1: Pre cleaning.



Fig. 2: Pre cleaning.



Fig. 3: Post cleaning.



Fig. 4: Post cleaning.



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32107 / Bearing Bush - TPL

Assessment

Condition

Fair

Recommendation

Reuse

Remarks

Ok to be reused.



Fig. 1: Pre cleaning.



Fig. 2: Post cleaning.



Fig. 3: Post cleaning.



Fig. 4: Pre cleaning.



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42001 / Bearing Casing

Assessment

Condition

Damaged

- Scaled
- Eroded

Recommendation

Replace

Remarks

Bearing casing was found in damaged condition with heavy wear marks on axial clamping surfaces (adjacent surface of G.O.C and sealing cover clamping surface). Replacement must be taken place at this time in point to prevent hood failure.



Fig. 1: Pre cleaning.



Fig. 2: Worn out sealing cover clamping area.



Fig. 3: Pre cleaning.



Fig. 4: Worn out hood clamping area.



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42002 / Hood

Assessment

Condition

Damaged

- Deformed

Recommendation

Replace

Remarks

Hood clamping has been found in loose condition meantime dismantling. Heavy fretting marks were observed on axial clamping surface. Wear limits and clamping pressure has been measured over limits values. Replacement must be taken place to prevent hood failure.



Fig. 1: Pre cleaning.



Fig. 2: Pre cleaning.

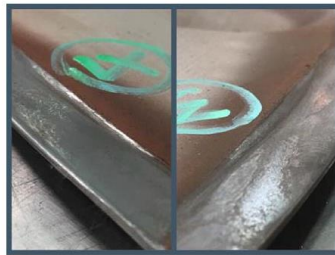


Fig. 3: Heavy fretting on clamping area.



Fig. 4: Flatten clamping G.o.c clamping area.



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42015 / Sealing Cover

Assessment

Condition

Damaged

Recommendation

Replace

Remarks

Sealing cover has been found in damaged condition with heavy wear on axial clamping surface and circumferential cam recess. Worn out places were measured over limits values. replacement need to be taken place.



Fig. 1: Worn out cam recess.



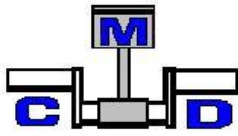
Fig. 2: Pre cleaning.



Fig. 3: Pre cleaning.



Fig. 4: Damaged axial and circumferential cam recess.



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43001 / Partition Wall

Assessment

Condition

Fair

- Good

Recommendation

Reuse

Remarks

Ok to be reused.



Fig. 1: Pre cleaning.



Fig. 2: Pre cleaning.



Fig. 3: Post cleaning.



Fig. 4: Post cleaning.



CALIFORNIA MARINE DIESEL, INC.

1501 WEST 15TH STREET
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Summary

Recommended Parts	Quantity	Remarks
97070 / Spare Parts Set 1 Compressor and Turbine Cleaning	1	
97075 / Spare Parts Set 2 Bearing Check	1	
97084 / Spare Parts Set 3A Bearing Change Axial	1	
42015 / Sealing Cover	1	
42002 / Hood	1	
42001 / BEARING CASING WITH BLIND	1	

Recommended Service Packages
