PLANT PROBLEMS... put your know-how to work

Question No. 1: Why Is Diesel Piston Worn?

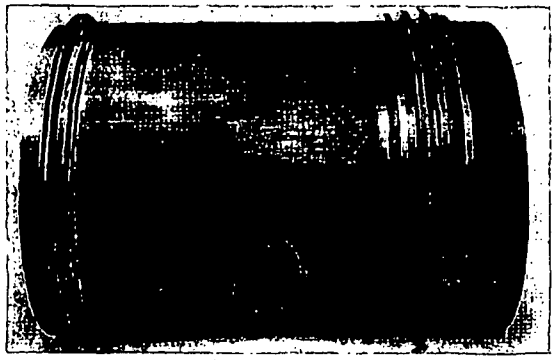
HERE ARE THE FACTS: One piston of our 4-cycle 8-cyl 1000-hp diesel is worn oval about 0.015 in. on the thrust side, and the rings are worn the same way. Liner shows normal wear with no scoring.

Recently we put in a new piston and ran for three hours. Then the wrist pin got hot and the piston scored the liner.

Checking the engine we found outside lubricator supplying oil to pistons was working right when scoring occurred. We now get a noise from this cylinder that sounds like a piston slap. Since engine is only 11 months old and oil pistons are correct size, what is causing our trouble?

Why did piston wear oval in such a short time? What's best way to repair piston and liner? How can we avoid trouble in this engine?—*BB, March Power*

Here Are the Answers



THESE PHOTOS show piston scoring from abnormal thrust, caused by engine overload, and fatigued crown resulting from continued overload.

An unbalanced and overloaded cylinder leads to abnormal thrust pressure on piston. This may overload wrist pin and bushing, or distort connecting rod. More heat must be rejected to cooling water when engine is overloaded. Higher heat load may break down oil film. Lack of good lubrication can lead to seizure and scoring.

Good corrections include: (1) Hone or rebore liner. If maximum bore limitations are exceeded, renew liner. (2) Clean the piston; renew if under minimum diameter or if distorted. Remember, using a liner with maximum bore and a piston with minimum diameter may produce too large a clearance.

(3) Check rod alignment and straighten or renew if necessary. (4) Refit or renew wrist and pin bushing. (5) Renew piston rings. (6) Check connecting rod bearings, adjusting as needed. (7) Clean cylinder cooling-water passages. (8) Reassemble engine and take cold compression readings on cylinders.

(9) Run engine at no load, checking compression and exhaust. (10) Reset fuel racks. Run engine under load while adjusting fuel system to give equal exhaust temperatures in each cylinder.

Excessive skirt clearance causes piston slap, but a similar sound may come from too early injection of fuel. To isolate and eliminate fuel noise, shut off supply to cylinder in question while engine is running. If noise stops, retime fuel pump.

CARL J SARNE *Havertown, Pa.*

CRANKSHAFT BEARINGS aren't at fault because *BB* reports no trouble with them. Wrist pin is at fault. Its clearance may be less than manufacturer recommends. This will cause overheating.

Rebore liner and fit an oversize piston. Same wrist pin may be used, but check to see that pin ends fit piston and bearings with right clearances.

A J BREUGELMANS *New York, N. Y.*

CHECK CRANKSHAFT alignment. We had similar trouble in a 5-cylinder engine. There was 0.005-in. distortion at No. 4 crank. Piston and rings in this cylinder wore as *BB* describes. Refitting the main bearings and lowering outboard bearing stopped wear in No. 4, but then it showed up in No. 5.

BB's trouble is from misalignment. Best cure is to align engine as carefully as possible. Repair a worn cylinder by reboring to a larger size and fitting an oversize piston. Or build up liner surface with porous chrome to standard size, and use a new piston.

A M DAMEROW *Elk River, Minn.*

CONNECTING-ROD bearing is fitted too low on one side. This pulls rod foot down, causing excessive side thrust on piston. Insert a shim of right thickness to align rod foot correctly. Check clearance of the bearing after fitting shim.

F A BUTLER *Dallas, Texas*

...elp the other guy cure his headaches

TYLER HICKS, *Associate Editor*

...WAYS CHECK piston for roundness ...er-driving in a wrist pin. When a ...on is out of round it wears more ...idly. A few hearty whacks with a ...d hammer usually cures this trouble ...ur plant.

...wrist-pin clearance and connect-...rod side play are normal, pin heat-...results from lack of lubrication. ...eck oil bore in rod, holes in wrist pin ...d crankbox.. You may find a rag or ...me lint in crankbox oil hole.

...J F TILLIER *Mexico City, Mex.*

MISALIGNMENT between piston and ...er is causing *BB's* trouble, not faulty ...brication. Oval wear of piston thrust ...e shows that misalignment is the cul-...t. Check liner for wear in fore and ...t direction of engine.

...Scoring shortly after new piston was ...talled could not be blamed on the ...ston if its dimensions were correct and ...er was in good condition.

...Check piston-pin clearance to see it agrees with manufacturer's recommendation. It should be free of score marks. Also, check rod for straightness. If liner isn't worn excessively, you can be certain connecting rod and its bearings are at right angles with crankshaft. Consult engine manufacturer for best repair methods when you expect to do a large job on your diesel engine.

HENRY GREINER *Anoka, Minn.*

LARGE LINER BORE and small piston allow piston to wobble in cylinder. Small bore with a large piston causes overheating, scoring and possible seizing. Piston that has too much clearance wears oval, and causes liner to wear oval in a shorter time than normally expected.

When fitting rings to out-of-round cylinders, be sure they are fitted to the largest diameter of cylinder to prevent ring binding, distortion, overheating, etc.

Renew the liner, instead of reboring it. Fit new piston.

JOHN GEIST *Brooklyn, N. Y.*

HOT WRIST PIN suggests it may be fitted too tightly. This could cause unequal wear in cylinder. Be sure wrist-pin ends fit piston and bearing properly. Wrongly fitted wrist pin can run hot, seize, and force piston sides out against liner, scoring it. Check pin carefully.

PETE TELLER *Chicago, Ill.*

SLIGHTLY BENT connecting rod causes this trouble. Bent rod throws an unbalanced load on wrist-pin bearing; oil distribution is poor. Rod causes piston to slap cylinder wall on dead center.

A heavy fuel charge in this cylinder during cold starting might cause connecting rod to bend, especially if start is sudden and engine has a large flywheel. Cylinder relief valves, if fitted to engine, should pop when fuel charge is excessive.

Since a good job is important I'd call in the manufacturer's engineer to get the best advice possible.

ART BELTON *Montreal, Can.*

Question No. 2: Is This Stack the Right Size?

HERE ARE THE FACTS: The steel stack for our new ...iler is to be 50 in. dia, 150 ft high above boiler-room ...or. Boiler is rated at 20,000 lb per hr, 125 psig, 353 F. ...ed temperature is 212 F, gas leaves boiler at 585 F. ...ere is no heat recovery. CO_2 leaving furnace is 14%, ...aving boiler 13.5%.

...Losses expected are: dry gas 12.5%, H_2 and moisture in ...pulverized-coal fuel 4.8, moisture in air 0.30, unburned ...mbustible 1.5, radiation 1.2, unaccounted for 1.5%.

Guaranteed boiler efficiency is 78.4%; average draft loss through boiler is 0.60 in. H_2O; required draft at entrance to first pass 0.15 in. H_2O; furnace draft needed at minimum rating 0.05 in. H_2O.

Proximate fuel analysis is: moisture 2.88%, volatile 36.0, carbon 52.36, ash 8.76%.

I don't think stack size recommended is right. What's best way to check stack size? Is size recommended correct?—*GK, March Power*

Here Are the Answers

STACK HEIGHT, DIAMETER depend on (1) amount of fuel to be burned (2) ...el type (3) gas temperature (4) type ...rate (5) design of boiler and breeching (6) flue arrangement (7) plant ...climate, and (8) atmospheric air temp.

Amount of fuel that will be burned ...determines flue-gas quantity. Gas temperature and plant altitude fix gas volume. You must know these factors to ...nd stack diameter.

Amount of fuel and its properties, ...together with grate type and boiler design (number of passes, turns, etc) ...determine draft intensity required. Gas ...and atmospheric air temperatures are ...needed to find thermal head available.

Though *GK's* data are incomplete, ...I've computed stack size, using several ...reasonable assumptions. I'm assuming ...boiler is stoker fired because pulverized ...fuel is generally not considered economical for outputs of less than 50,000 lb of steam per hr. Also, with pulverized-fuel firing, air heaters generally supply hot air for heating and transporting the fuel. *GK* mentions no heat recovery, another reason for assuming stoker firing.

From the proximate analysis, computations show his fuel has a heating value of 14,910 Btu per lb on a moisture-and-ash-free basis. On the original basis it is 13,100 Btu per lb.

Boiler heat balance is in table, left.

Boiler Heat Balance

	%	Btu/lb fuel
Input	100	13,100
Output	78.4	10,250
Energy losses:		
Dry flue gas	12.5	1635
H_2 and H_2O in fuel	4.8	628
H_2O in air	0.3	39
Unburned combustible	1.5	195
Radiation	1.2	157
Unaccounted	1.5	196

At an output of 20,000 lb of steam per hr, quantity of fuel burned when boiler runs at guaranteed efficiency of 78.4% is 1970 lb per hr. Theoretical amount of air needed for firing this fuel with a heating value of 13,100 Btu per lb, is found by calculation to be 10 lb of air per lb of fuel. Therefore, total amount of air theoretically needed is 19,700 lb per hr.

From the dry gas loss expected, 12.5%, we can compute weight of dry gas per lb of fuel as 13.5 lb. Total dry flue gas from combustion is (1970) (13.5) — 26,600 lb per hr. Using the dry flue gas quantity and theoretical air for combustion, excess air is 35%.

Dry gas leaving boiler includes all