

UNION PACIFIC RAILROAD COMPANY

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Memo _____

MCH _____

Portland April 29 1948

Correction of conditions contributing to production of excessive smoke by oil burning 3900 Class locomotives.

On investigating the matter it was found that certain locomotives were ~~found to be at fault~~ in attempting to maintain full boiler pressure the fire was forced and much smoke was produced.

Locomotive 3921 was considered the poorest steamer in the assignment and was reported tight for steam numerous times over a period of several months. A trip to Portland to settle was made to determine the major cause of poor steaming. The appearance of the fire was red and smoky showing the presence of air and steam leaks in the front end. The fire did not fill the back corners of the firebox and no combination of atomizer pressure or

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damper adjustments would force the fire back to the corners. This condition was the result of improper air distribution in the firepan.

On arrival at Portland the locomotive 3981 was held for a hydrostatic test. When test was applied it was found that the throttle gland was leaking badly an auxiliary steam pipe was leaking at the superheater header the exhaust stand joint had one small leak and two units were leaking. These steam leaks in the front end were sufficient to make the locomotive tight for steam. Because of the poor performance of the locomotive the exhaust nozzles were checked for size and found to be $2\frac{3}{4}$ " diameter giving a total area of 47.5 sq. in., the standard exhaust nozzle size being 3" ^{diam.} with a total area of 56.6 sq. in. An inspection of the stacks showed the front stack extension to be $1\frac{1}{2}$ in diameter.

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smaller than the stack choke. From the appearance of the back stack, it ~~thinks~~ ^{was} covered on the back third of the circumference by a thin coating of carbon, the exhaust steam and gases ~~was~~ not properly filling the stack. A check of several other 13900 class stacks showed the same condition on all back stacks. It

This condition is probably caused by the impingement of the flue gases against the exhaust steam jets of the back nozzle ~~which~~ ^{which} the jets forward away from the back side of the stack and preventing the scrubbing action which is noticeable on a stack which is properly filled.

After repairing the steam leaks and applying standard 3" diameter exhaust nozzle tips a partial back plate was applied. The plate extended the width of the table plate and from

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three inches above the bottom edge of the stack extension to the table plate. In other words it is equivalent to the center section of the old back plate with the part above the stack extension cut out and used only to support the plate between ~~stack extension~~ and table plate. The firepan air openings were modified by applying removable strips to the side air chutes, which allowed the adjustment of the opening from $4\frac{1}{2}'' \times 31\frac{1}{2}''$ to $8'' \times 31\frac{1}{2}''$. More air was admitted under the burner by cutting away the lower part of the burner support casting and the large pan front sheet. The opening $5\frac{1}{2}'' \times 9\frac{1}{2}''$ was fitted with a sliding plate so that the air opening could be adjusted to suit requirements.

Before the locomotive was placed in service the front stack was fitted with a stack extension of the correct size, a new front end door gasket was applied

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The old burner was checked and found to be the old type with the small orifice. The atomizer opening was badly steam cut and ~~broken~~ too deep. A new wide mouth burner was applied with atomizer opening .030" deep.

The front stack was fitted with an extension of the correct size and the front end checked for air leaks. On the first trip Portland to Seattle and return with locomotive 3981 on trains 457 and 458 adjustments were made on the fireman's air openings. Leaving Portland the openings on the side air chutes were $4\frac{1}{2}" \times 3\frac{1}{2}"$ and under the burner $5" \times 9\frac{1}{2}"$. The locomotive steamed, but not as free as desired and the fire flashed at the door excessively. At Tacoma the opening under the burner was reduced approximately $10\frac{1}{2}" \times 9"$ inches which was sufficient to reduce the door flash but

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still forced the flames to the back corners. On arrival Seattle some carbon had formed on the flash wall so the side air openings were increased to $5\frac{1}{2} \times 3\frac{1}{2}$.

On the return trip the locomotive steamed free and full boiler pressure could be maintained at all times with only a slight haze of smoke at the stacks. The firebox was apparently filled under all operating conditions and performance was considered satisfactory. On arrival Albinas a small amount of carbon had formed on flash wall but was considered of no consequence.

Several more trips were made with locomotive 3981 on trains 457 and 458 and steaming qualities and performance were good under a wide range of operating conditions from very light operation to very heavy operation. Back pressures ranged up to 20 PSI. Some blower was necessary to

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maintain full boiler pressure and hold the water up below 4 PSI back pressure but this is considered about average.

Some firemen had some difficulty in maintaining full boiler pressure without excessive smoke but when instructed as to the proper method of firing were able to perform satisfactorily.

Locomotive 3981 has now been working about two weeks since the final adjustments on air openings and burner, and performance has been satisfactory. There have been no reports of locomotive being tight for steam. A final check was made April 30 on a round trip Portland to Seattle. The locomotive steams free and any excessive smoke made with this locomotive in its present condition is the responsibility of the engine crew.

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Locomotive 3975 was also a chronic hard steaming locomotive so it was decided to modify the firepan air openings as was done on locomotive 3981. It

The existing side air openings were 13" x 28 $\frac{1}{4}$ " and the burner was the old type with small orifice ^{and} with an atomizer opening .037" too deep

The ^{side} air openings were reduced to 6" x 28 $\frac{1}{4}$ ", more air was admitted under the burner, the opening being made adjustable with a sliding plate, and a new burner with a .038" atomizer opening was applied. A partial back plate was also

A round trip Portland to Seattle was made and the air opening under the burner adjusted to give satisfactory results. After the proper air opening under the burner had been determined the locomotive burned a good bright fire filled the back corners and steamed free.

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No further trouble has been experienced with this locomotive so far as steaming is concerned. The first trip was made April 24 and crews have reported that the locomotive steams free and can be fired with a clear stack.

~~It was at this time~~ decided to modify the burner air opening on locomotive 3976. This locomotive has been a free steaming locomotive but the fire did not fill the back corners. At times the side sheets were visible as well as the brick work.

The air opening at the burner was modified as shown on flanked point of dwg 623(A 26910) attached. A trip was made on this locomotive in freight service and it was found that the fire was opening up and filling the firebox completely. The locomotive steamed very freely.

No change was made in the side air openings as the locomotive was a free steamer.

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An inspection of the stacks of locomotives 3975 and 3981 after a number of trips with the partial back plate, showed that there was a definite improvement in the scrubbing action of the exhaust jets on the back portion of the back stack. Observations were also made of light smoke from the stacks and the density was uniform in front and back stacks. Smoke from double stack locomotives without back plates is generally more dense at the back stack. This would indicate that a partial back plate is desirable to ~~improve the~~ efficiency of the double stack arrangement.

The ~~advised~~ air opening under the burner is desirable as it effectively forces the fire into the back corner of the firebox. It also permits directing the burner lower on the flash wall and helps prevent formation of carbon

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on the bottom and sides of the
firepan.

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