

LJ20 Exhaust System – Thermal Decoking

(and maybe repair of oil injection system*)

Old Codger New To Old Suzuki Jeeps

The 1972 LJ20 I recently acquired had been stored in a barn but had not been started for over five years. Per the deceased owner's son, the oil injection system had quit when the jeep was pretty new. The oil line to the pump had been disconnected and the gasoline/oil had been premixed in the tank since that time. Several bottles for Pennzoil 30W motor oil were found in the back, all but one empty. One partial bottle of Quicksilver outboard motor oil was also found.

In working toward making it run again, I noticed the end of the little tail pipe was almost completely plugged with coke (carbon) deposits. A closer look at the plug also indicated what appeared to be the outline of a coke embalmed mud-dauber wasp nest. To clean out the coke, both the expansion chamber section and the rear section of the exhaust system were removed and de-coked using the thermal process outlined as follows.

Here are some before and after pictures. I also used the wife's bathroom scales to do a before and after weight-in of the two sections. Together, they weighed over three pounds less after the decoking.

Joint between expansion chamber and rear section



Before



After

End of tail pipe



Before
(had outline of mud dauber's nest)

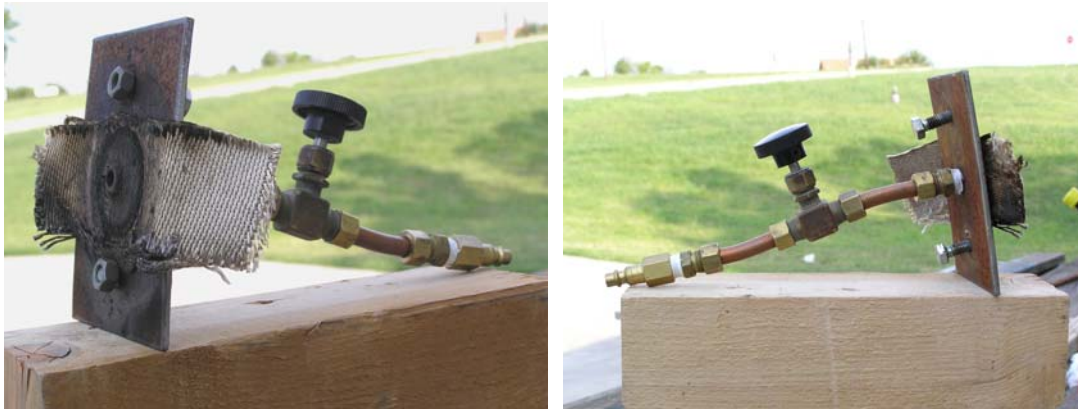


After

The goal was to perform a very, very slow - controlled burn of the carbon contained in the coke deposits. As the coke would be almost 100% carbon, this would result in removing the deposits down to a clean pipe.

Equipment used:

- A. Oxygen/acetylene torch
- B. Air compressor to provide constant source of compressed air.
- C. Homemade adapter with valve for connecting air to exhaust pipe and controlling air flow.
- D. Bolts / wrenches for attaching to adapter to the flange.



Two views of the adapter are shown above. It was made using:

- Small piece of flat steel - 1/8 (minimum) thickness – drilled and tapped for 1/4 inch pipe threads
- 3/8 inch copper tubing, brass fittings and male end of an air hose quick coupler.
- Woven fiberglass high-heat cloth which I had on hand which was used for gasket – (could substitute other high heat material)
- Small valve I had on hand – (would not recommend using the popular quarter-turn ball valve as they are not real sensitive for controlling flow)
- Bolt holes drilled to match those on flange

Principle of operation: The adapter served to seal one of the (flange) ends on a section of pipe. This seal plus the valve allowed for a controlled flow of low volume, compressed air. The carbon in the coke served as the source of fuel for the burn. Controlling the air with the valve provided control of the oxygen to the fuel and thus control of the burn.

Ignition of the coke was accomplished by heating the outside of a small section of the pipe to the red hot stage. This resulted in the coke inside the pipe at that area being heated to a temperature above its auto-ignition temperature. The burn was then started by opening the air valve a small amount thus providing oxygen to the hot coke. The burn was controlled by the amount of air allowed to enter the sealed end of the pipe

1. Precautions taken included:

- A. I was the one accountable for doing this task safely.
- B. MSDS on Pennzoil 30W Motor Oil and Petroleum Coke were read.
(<http://www.pennzoil.com/products/technical/msds.html>)(www.glcarbon.com/pdf/article_GREEN.pdf)
- C. The decoking process must be done with the exhaust system removed from the vehicle and placed in a well ventilated outside area.
- D. Fire – the decoking could not be performed near dry grass or other flammable material.
- E. Explosion – Prior to starting the burn, the adapter was installed on each section and connected to the compressed air which was used to ventilate the section. This was continued for adequate time to help ensure that it did not contain any raw gasoline or gasoline vapors that could result in an explosion
- F. Damage to the exhaust system could result by excess heat caused by:
 - i Allowing too much air in contact with the hot coke.
 - ii Using pure oxygen from the torch in lieu of compressed air.
- G. Smoke resulting from the burning process should not be inhaled.
- H. There is some thought that parts of the exhaust system on the LJ two cycle engines may be insulated with material containing asbestos, thus the air flow through pipes during the burn should not exceed that of normal exhaust flow.
- I. Hot pipes during and after burn could burn the skin.
- J. The smoke from the burn would probably stink very badly. Fortunately my shop is pretty isolated. That and favorable wind direction prevented having a bad case of mad wife and neighbors.

2. Preparing for the burn:

- A. Removed the middle and back sections of the exhaust system. The short pipe making up the front section (between the exhaust manifold and the middle section) was not removed as it contained very little coke.
- B. Removed the copper gaskets between the flanges and set them aside to reuse. The heat generated during the decoking could melt the copper.
- C. Placed the section of pipe to be decoked on jack stands. Old big bellied men like me do this to make things more accessible without bending so much.
- D. Attached the adapter to the flange and connected to the air hose.
- E. Verified that the air valve on the adapter was in the closed position.

3. Starting the burn:

- A. Used the torch to heat a small section of the pipe's exterior nearest to the adapter. Heat was applied to the pipes full circumference but only about an inch of the pipes length.
- B. Heated the area described above until it became red hot full circle and then opened the valve a small amount to start a very slow flow of air through the valve. This ignited the coke inside the pipe.
- C. Made a quick feel of the pipe with bare hand about ten minutes after removing the torch. **Caution: Burn Hazard.**
 - i If it was still hot in the area heated, the coke should be burning inside.
 - ii If it was getting colder the coke was probably not burning resulting in the need to heat it again with the torch.

iii If it was getting hot in a large area, this indicated having too much air and could result in an uncontrolled burn. The air valve would be closed partially. (It could be closed completely and the process started over).

D. Determined the burn rate by touching the pipe every few minutes to determine how fast the heat was traveling down the pipe and by observing how much smoke was coming from the open end of the pipe.

E. Continued monitoring the burn rate until the burn was completed. It took over two hours to do the pipe on the expansion chamber in the picture above.

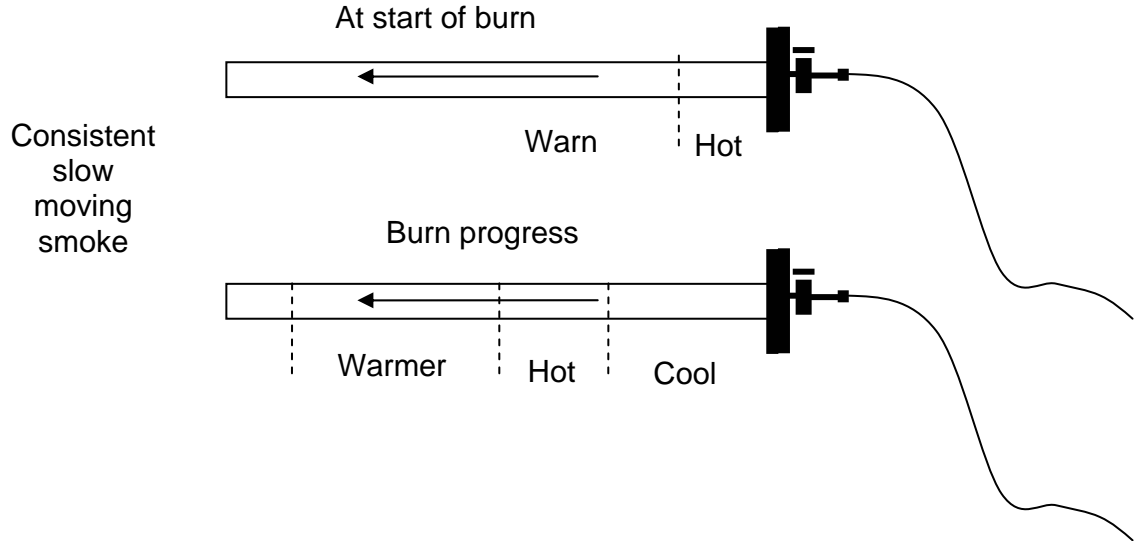
Note: Due to the expansion chamber itself not containing enough coke, one end of the pipe was decoked and then the adapter moved to the other end and another burn started.

Note: Only one burn was needed on the rear section as it contained more coke. I believe this was due to it being a greater distance from the engine which allowed the exhaust to cool and condense and also due to the mud dauber's nest.

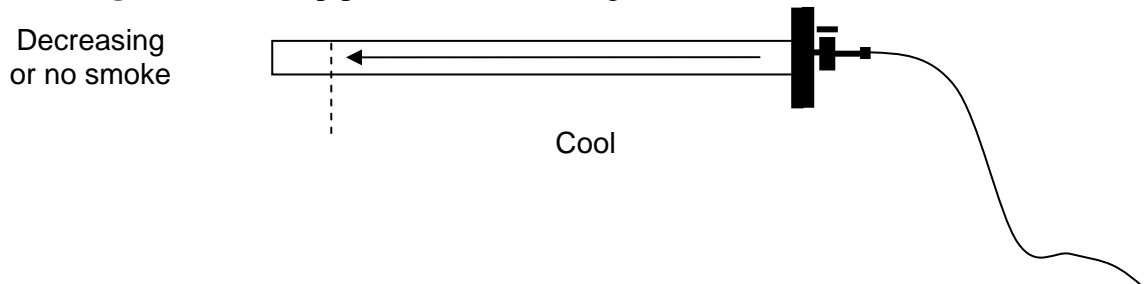
4. **Monitoring the burn:** Ideally, the amount of air entering through the valve would provide enough oxygen to allow a small section of coke to burn full circle inside the pipe but not enough for the coke to burn on down the pipe. (Think of a grass fire in very short grass on a windless day versus one with a twenty mile per hour wind) The goal was to have a complete burn full circle with the hot spot on the pipe moving very slowly and leaving a cool pipe

5. **Sketches and pictures to help explain the process:**

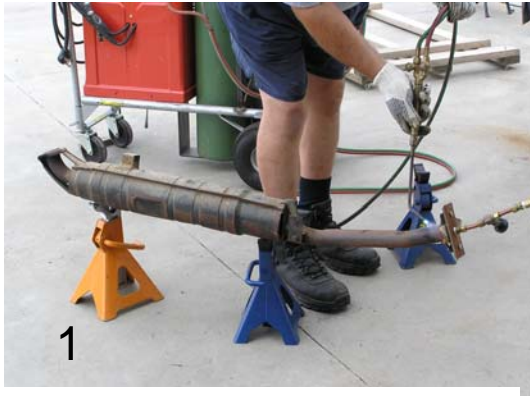
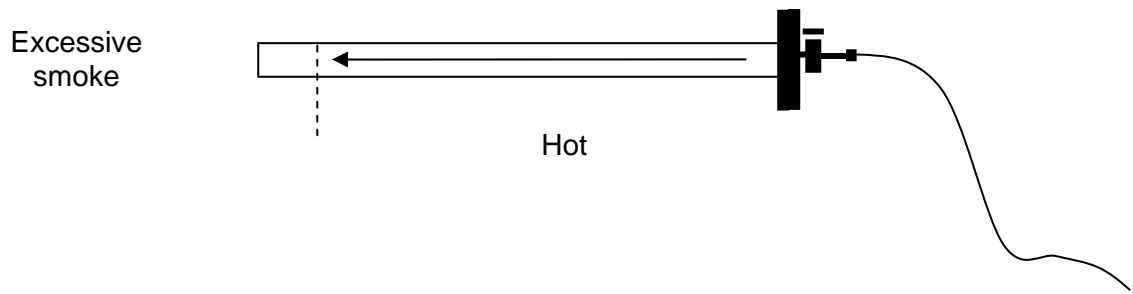
Ideal burn - The hot spot will be started nearest the adapter and then will move slowly down the pipe without applying additional heat. There will be consistent, slow moving smoke exiting the pipes open end.



Fire has gone out – The pipe will be cool throughout and there will be no smoke.



Too fast of burn – A large section of pipe will be hot and a large amount of smoke will be exiting the open end of the pipe.



1 Starting – heat being applied, air valve closed



2 Pipe is hot and about ready for air.
Big belly guy is also ready for air due to changing wind direction.



3 Good burn going
Wind going right direction



4 Remains of mud dauber wasp nest
from end of tail pipe after decoking

Could there be a connection between the mud-dauber's nest in the exhaust and the problem with the automatic oiling system which started years ago?

When I found the wasp nest encased in the coked up exhaust system, I had the following thoughts. .

1. The wasp nest might have started the problem with the oil injection system a long time ago when the jeep was fairly new..
 - A. Maybe it plugged the exhaust system to the point of increasing the pressure in the crankcase to the point that little or no oil was sucked into the engine.
 - B. This would have resulted in the owner not using the oil injection system and starting the premix.
 - C. The original owner was in his sixties when he purchased the LJ20. The jeep saw intermittent use in his farming and ranching operation and also for hunting trips to the Rockies. All at slow speed at which a 30 -1 gas / oil mixture would have been a little heavy thus adding to the plugging of the exhaust system.

Prior to decoking the exhaust, I disassembled the oil pump per the instructions I found on this website. The pump was very clean so I reassembled it.

After the decoking, I cleaned the oil tank and replaced and connected the oil line from tank to pump. After starting the engine, the oil started flowing through the previously empty oil lines.

Now the problem is that two of the lines are sucking in some air which may be due to my disturbing those blasted little rubber-coated washers which I am now blaming on some long deceased mud daubers whose deed could have also contributed to the stress and thus the early death of the original owner thirty years later at age ninety four. Dam those wasp!

Anyway, it was just a thought. Have a good one,

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