Model A Shocks

History of Development

Frenchman Maurice Houdaille (Hoo Dye) invented the Model A Ford Double Acting Shock Absorber. He began experimenting in 1902 seeking a suitable shock-absorbing device, first trying friction and quickly moving to hydraulic principles.

MAURICE HOUDAILLE - 1880-1953

In 1905 he produced his first oscillating instrument with a single paddle. The tremendous shock absorbing pressures caused excessive wear and he invented the double or balanced wing shaft first patented in Europe in 1907. The balanced wing shaft operates with working pressure on both sides eliminating thrust.

The next major addition was the concentric replenishing reservoir, which feeds fluid to the working chambers and prevents leakage by eliminating the need for packing against high pressures.

Houdaille then added vents to eliminate gasses generated by the heat developed in absorbing shock - the

Houdaille Hydraulic Double Acting Shock Absorber was patented in 1914 in both Europe and the United States.

In the U.S., the first Houdailles were first seen on imported high-end European automobiles. American manufactures wanted similar devices. Mr. Paul V. Clodia, a European automobile importer, traveled to France and returned to New York with the manufacturing and selling rights for the Houdaille Shock Absorber. The first ones "made in U.S.A." were produced in 1915 and used on Cummingham and Mercer cars. In Europe, the shocks were adopted to the French 75 field artillery piece used in WWI. The shocks were not produced in the U.S. during the WWI (1917 & 1918) due to material shortages.

At the end of WWI, Mr. A.B. Shultz, an automotive engineer from Buffalo, New York assumed Clodia's contract and started production in 1919. Mr. Shultz's company was first known as the Houde Engineering Corporation, which later became the Houdaille-Hershey Corporation (1928). Houdaille-Hershey controlled the Oakes Lock Corporation, the Hershey Lock Corporation, and the Detroit Tire Carrier Company.

By 1923, Houdaille shocks became standard equipment on the Lincoln followed by Pierce-Arrow in 1925 and then

Jordan and Sterns-Knight. The riding comfort provided by the Houdaille shock absorber became an industry standard on fine automobiles.

The Model A Ford

Ford made the Houdaille standard equipment on the Model A in October 1927 making it the first generally available automobile with shock absorbers.

The Houdaille shock is made to very exacting standards and tightly machined to withstand the daily pressures of driving over poorly surfaced roads. They used the best materials and manufacturing processes available at the time.

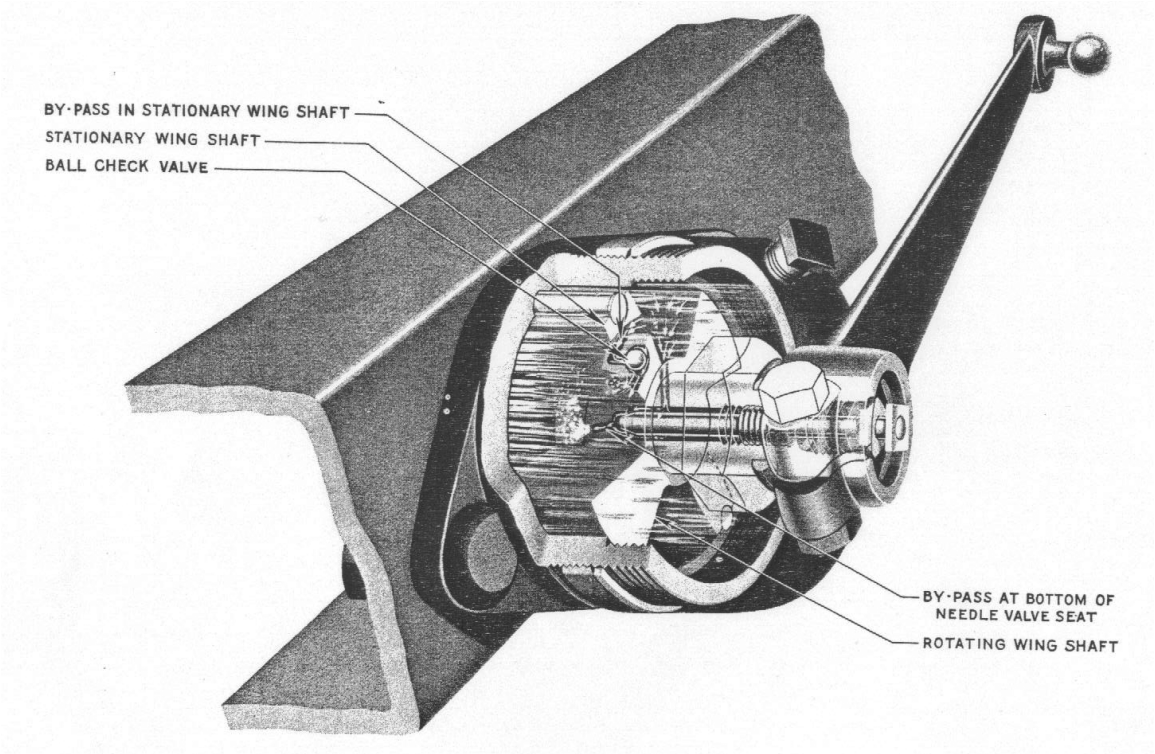
Four different companies manufactured shocks for the Model A. They were:

- Houdaille Engineer Corp. – stamped “HOUDE. ENG. CORP. BUFFALO, N.Y.” with or without “H. E. Co.”.
- Ford Motor Company, Green Island – stamped “Ford” on the base of each shock and on the face of the cover.
- National Acme Company – stamped “NA” on each cover.
- Spicer Manufacturing Company – stamped “S” on

each cover.

The shafts of the right front and left rear shocks were notched for the shock arm bolt on the left side (viewing the shock body face on). The covers or mounting ears of the bases were usually marked “CW” for clockwise rotation. The left front and right rear shocks were similarly marked (”AC”) and notched for anti-clockwise rotation.

The Model A shock serves three purposes on the car, first and most significantly the shock retards movement of the front and rear springs on recoil and on the rebound, second shocks control the side-to-side lean of the car going around curves, and finally they provide an additional attachment of the frame to the axle components.



Operation

When the car drives over a bump in the road, the resistance of the fluid in the shock softens the recoil of the springs. The upward movement of the shock arm causes the winged shaft to rotate. Internally the fluid is forced from one compartment to another through small by-pass ports in the stationary wings and around the bottom of the needle valve seat.

On the spring rebound, the shock arm moves downward under greater resistance since the pressure on the ball closes the by-pass ports and all fluid is forced through the ports on the rotating shaft. The rate of flow is controlled by the needle valve.

Ideally the shock action is 40% resistance on the upward movement of the shock arm and 60% resistance on the downward movement.

As the rotating shaft operates the constant movement generates gasses from the heat and agitation. The two bleed-valves or vents in the inner chamber cover, one on each side of the shock body expel these gases along with fluid into the concentric (low pressure) reservoir. A single by-pass valve in the cover allows fluid to flow into the inner chamber when the shock is at rest. This one-way valve allows the reservoir to be relatively low pressure when operating while the inner chamber is very high pressure.

Rebuilding the Shock

Model A shocks may be rebuilt, even after 80 plus years of use and abuse. However, they must be in very good condition to begin as the time to disassemble, clean, and repair is significant and materials are fairly expensive. In my experience, only about 30% of original shocks can be successfully rebuilt. There are a number of good after market manufactures of replacement shocks that look and function like the originals. These are good choices for the “driver” car. Rebuilding is for blue ribbon judging or for personal satisfaction.

Before starting to rebuild a shock absorber carefully study the exploded drawings and read the Model A Service bulletin for February 1931. This provides a good overview of the operation of the shock absorber and detail on how to take it apart and reassemble. *The Restorer* has also featured a number of great articles that should be read prior to tearing apart a shock.

Rebuilding begins with a hands on and visual inspection. If the rotating wing shaft is loose or off center the shock probably cannot be rebuilt. Remove the filler plug and see what comes out. If nothing or only hardened shock fluid which looks like dirty rocks come out you may have a problem. Check the square head of the rotating shaft, if it is rounded over because the shock arm was not kept tight it cannot be rebuilt. Broken ears on the shock case or a cracked cover are also beyond repair. In the best case the shock you plan to rebuild has come off a car, retains a little fluid and the rotating wing shaft can be moved slightly.

M&S Hydraulics, a company specializing in antique Ford shock absorbers production and rebuilding, uses the following criteria to determine if a shock can be rebuilt.

1. The shaft can be turned, and it is not loose and does not wobble from side to side. About 10% of shocks are like this. All can be rebuilt.
2. The shaft is loose and wobbles from side to side, even the slightest amount. These shocks are worn out and cannot be rebuilt.
3. The shaft is frozen and crooked. Look for an uneven circular clearance between the shaft and the stamped cover. Worn out and cannot be rebuilt.
4. The shaft is frozen but straight. All these must be disassembled to determine if they can be rebuilt. This category will constitute about 40% of the total. About half of these can be rebuilt.

Brush off the dirt and grease so you can handle the shock, no need to clean it. Remove the filler plug and place the shock(s) flat down on a bed of charcoal in your BBQ. Fill the reservoir with lighter fluid, add a little more charcoal and then cover with lighter fluid. Carefully start the fire and allow the shock(s) to cook for several hours. The heat melts and consumes the old seals; burns up any residual fluid and the different coefficients of expansion of the metals will help break them apart.

Occasionally, the filler plug will not come out easily and

may be stripped. This cover requires re-tapping with a 3/8 by 27 N.P.T and if the inner threads are damaged, it cannot be rebuilt.

After the shocks are cool, clean the outsides with a fine wire brush. Then mount the shock in an appropriate fixture held by a solid vice attached to a workbench that is bolted to the floor. The forces involved in working with shocks are considerable and success demands a solid fixture to handle the work.

It is important to keep all the parts from each shock together, so if working with multiple shock absorbers have the same number of containers. I use small paint buckets from the local hardware store, but a three pound coffee can works just as well. I also tag each bucket with the shock type “AC” or “CW”, its type from the judging standards, and owner or vehicle. Parts are not interchangeable between AC and CW shocks as the rotations are different. It is possible to interchange parts within a group provided the internal design is the same. Generally, you keep the parts together and either rebuild the shock as it was assembled or discard it if it cannot be rebuilt.

Disassembly

Using a strap wrench remove the cover by rotating in counter clockwise (unscrew it). I have seen too many shock covers damaged by a chain type wrench or even worse bent out of round with a big pipe wrench. The cover may spin off easily or be very difficult requiring a fair amount of force. You may need to tap the cover with a brass hammer to free it. If it does not move after several attempts heat can be applied. The combination of tapping, heat, and the strap wrench will eventually meet with success. I also have a "special" tool made for very difficult covers (see photograph). Brush the threads around the locking ring; provide the threads a little lubrication with penetrating oil, then remove the locking ring. Since the O-ring seal between the cover and locking ring was burned away there is no need to try to back off the locking ring prior to removing the cover. Sometimes the locking ring will hang up due to dirt, in which case back it off, clean the threads and then remove.

You can now attempt to remove the needle valve. The upper nut (square, hex, or pointer) must be rotated along with the packing nut. Screwing out the packing nut alone will break the upper nut and screwing out the upper nut alone will eventually cause it to bind and potentially break. If the

valve does not come loose with minimal pressure leave it alone, it can be removed later.

Now place the shock absorber onto your fixture. Next carefully mark the position of the inner chamber cover relative to the case. I use a chisel and a small hammer placing a line-like mark. Others use a center punch on both surfaces. The critical item is to mark the position so the inner cover must be correctly bottomed on reassembly. This is so the vents will line up properly and for the replenishing valve alignment.

With the shock bolted securely to your fixture and the fixture solidly held by a vice use a ¾" drive, 1 9/16th impact socket 3 inches in length to remove the inner cover. A good air impact wrench makes this easier. A ¾" T-handle and a 4' long cheater bar can also be use to "break" loose the inner chamber. If using a bar remember it requires considerable force to break the cover lose. The original K.R. Wilson tool used by Ford dealers was approximately 5 feet in length. When the inner cover "breaks" loose a few degrees of arc it often does so with a loud "pop", don't worry, you didn't hurt anything. You can now remove the wrench and spin the inner cover off by hand. While I have only disassembled a couple of hundred shocks, they have all spun off by hand

after using the wrench for a few degrees of arc. If there is a small ball bearing on top of one or both of the stationary wings pick them out and place them in your bucket. Inspect the bottom of the inner chamber cover. It should be a flat smooth surface with a machined appearance. If badly pitted it cannot be rebuilt.

Now remove the needle valve if not previously accomplished. Examine the valve for pitting or excessive wear. If the valve is pitted, it will need to be replaced. Penetrating oil and a little heat can help in the removal of very stubborn valves.

Next remove the rotating winged shaft and inspect. You may discover the inner chamber filled with solidified shock fluid that makes removal with you fingers difficult. Attach an adjustable wrench to the square portion of the shaft and rotate it back and forth slightly. This should be sufficient to allow its removal – no force is necessary. Inspect the shaft, if pitted or worn it cannot be rebuilt. Inspect the area about an inch from the top of the shaft where the wing shaft seal rides. If this area is not smooth and straight the shaft cannot be rebuilt economically.

Drain all material from the shock body. You may need a dental pick to help remove built up material. Be careful

you do not pry out the lead “caulking” at the corners of the stationary wings. The caulk keeps the stationary wings from moving. The body should have a machined surface inside without pitting. A small amount of pitting in the center under the rotating shaft is acceptable, but elsewhere it means the body cannot be rebuilt.

If all parts look good, it is time for a good cleaning with a wire brush. A cup brush on a drill works well for the inside cover and a wheel works well for almost everything else. Clean the treads on the body and the locking ring. You will notice the locking ring has a beveled side for holding the O-ring seal in place, clean this well. The inside of the shock body requires a small wire brush and dental picks. A Dermel or similar rotary tool works well on the inside.

Next remove the two vents in the inner chamber cover. Some of the covers have four vents and others have two. The vents are driven out from the top surface downward using a small drift. The vents are staked on the top and occasionally on the bottom as well – the staking is done since they are under great pressure. Ford replaced the vents when rebuilding shocks; however they can be cleaned and reused easily. Inspect and lightly clean the vent. You will note a <u>single</u> v-shaped grove in the vent. Clean this with

a small triangular file, you do not need to cut it deeply, just clean it. The vents are reinstalled with the v-shaped grove facing outward – away from the rotating shaft. They are driven in from the bottom and staked with a small punch or chisel. The staking should be in the center and parallel with the outer edge so the vent in not accidentally closed.

The by-pass valve in the inner cover must be cleaned using a combination of a dental pick and compressed air. The two by-pass valves on the stationary wings are cleaned in the same way. If you have the by-pass valve or valves on top of the stationary wings the seat and port should be cleaned – pipe cleaners, steel wool, and denatured alcohol work well.

Clean the rotating wing shaft using pipe cleaners and alcohol for the ports. Clean the inside with a bore brush available from your local sporting goods store. Carefully trace the threads for the jam nut – this should be done by hand only so as not to damage the second set of threads below, which are for the needle valve itself. Ford traced both sets of thread, however the inner threads are 3/8 -20 which is a non-standard thread. The tap requires a special order and is not necessary if you did a good job with the bore brush and alcohol.

There are usually two by-pass valves on the stationary wings of the shock body. These are cleaned with a dental pick, alcohol, and compressed air. You should “feel” the ball moving and air should pass freely one way. On some models the by-pass valve is located on top of the stationary wing and it can be cleaned with a pipe cleaner or fine steel wool, a dental pick, alcohol, and compressed air. If necessary the ball can be removed by working out the pin that holds it in place. The valve can then be cleaned and a new ball of the correct size inserted. The balls come with shock rebuild kits from the suppliers. When putting in a new ball tap it lightly with a small hammer to seat it. A new pin can be made from a paper clip and it is inserted back in the hole and trimmed off.

All parts of the shock should now be clean and ready for a final wash using denatured alcohol and then blow them dry with compressed air.

Assembly

Place your fixture horizontal in your vice and attach the shock body. Apply a small amount of fine oil to the threads of the locking ring and spin it on the body. Pay particular attention to the alignment so the angled edge is facing up to secure the O-ring seal. Bring the locking ring all the way to

the bottom of the shock body. Place the 0-ring seal over the body and all the way down to the locking ring.

Apply a few drops of shock absorber fluid to the inside of the body and to the rotating wing shaft for lubrication and place the shaft into the body. Pay particular attention to the groove in the square head of the shaft and insert correctly for either AC or CW depending on which shock body your are reassembling. [See diagram]

Take the needle valve either the original if acceptable or one of the aftermarket ones and apply graphite-impregnated string between the jam nut and the washer. This is similar to packing a water pump. Apply enough to fill the area to the size of the jam nut. Now, insert the valve into the winged shaft turning both the valve adjusting nut and jam nut together. The adjusting nut can bottom out first and then using a ½" wrench tighten the jam nut firmly. Back out the adjusting nut approximately 3/8th of a turn.

Locate the wing shaft equal distance between the stationary wings and then fill all four compartments with shock fluid just short of the top of the wings. This is necessary to preload the shock and saves a lot of time filling and refilling the reservoir. Place the inner cover over the wing shaft and tighten with your fingers. It should secure

almost to your mark. The ¾" drive 1 9/16th socket and impact wrench or T-handle are necessary to bottom out the cover. Turn until your marks align. This requires a fair amount of torque, but not nearly as much as needed to remove the cover.

Slide the wing shaft seal over the shaft and down to its pocket on the inner chamber cover. Lightly coat the inside threads of the reservoir cover with gasket shellac (Indianhead by Permatex) and turn it down until it comes in contact with the wing shaft seal. You can now turn it by hand until firmly tight. The filler plug opening should be approximately 20-40 degrees from the shock body ear and up. It faces left on the AC shock and right on the CW shock – see diagram.

Move the O-ring seal up onto the reservoir and then turn the locking ring up tightly by hand. Use a spanner wrench and tighten the locking ring as solidly against the reservoir.

Reposition the fixture to the vertical position and fill the reservoir with shock fluid to approximately ¼" below the opening. Put the filler plug into the reservoir and tighten firmly.

Using an adjustable wrench you can now "test" the

action of your rebuild shock. It should move freely both up and down with less resistance on the upward stroke. Adjust the needle valve as necessary. The factory setting was open ¼ turn for the front shock and 3/8 turn for the rear. Given the conditions of modern roads either of these adjustments should be adequate. After rotating the shock back and forth several times recheck the level of the reservoir and replenish as necessary.

Clean the outside surface of the shock with denatured alcohol and hang it with the filler plug down. Leave it in this position for a few days to see if there are any leaks. If no leaks develop the shock is ready for priming, painting, and then installation.

Installation on the Car

Install the shocks on your Model A using an “AC” on the left front and right rear positions and a “CW” on the right front and left rear. Secure the shocks with the special mounting bolts with a 7/8" diameter “D” shaped head. The bolts were unfinished and the net was unfinished until mid-1930 and painted black thereafter. The lock washers werel unfinished. The flat end of the “D” fits securely against the shock body. The earliest (1927) shocks used to hex head bolts but this is very rare. The shocks need to be firmly

mounted to the frame.

Shock Arms

Install the shock arm using the 3/8” –24 X 1-7/8 bolt, castellated nut and cotter pin. The arm should be securely mounted to the rotating wing shaft with no play. There were a number of different shock arms used throughout production and the judging standards should be consulted to determine which is correct for your car. The arms should not be twisted and the ball should not be excessively worn or out of round.

Shock Links

Attach the shock link using either the original style or the later “dog bone” type. Use new rubber covers over the arm and axle balls on the “dog bone” type links. Original links require more maintenance, but are essential for blue ribbon judging and authentic restoration.

The original style link should be disassembled, cleaned, and inspected. If the holes where the arms go in are badly out of round, find a new link. File off and smooth any bur or sharp edges from wear.

The bushings that ride against the hardened ball on the perches and shock arms are covered in brass with a groove in them for lubrication. This groove must clean and the

brass in good condition to use them. Place a bushing into the link body with a little grease on it.

If you need to change the grease fitting check the inside carefully after installing the fitting on the tube. The modern replacements (even those that duplicate the originals) are slightly longer and often protrude into the tube body to the point where they interfere with free movement of bushings. If necessary remove and file down the grease fitting so it is flush with the inside of the tube.

Initial In-Service Inspection

Check your newly rebuilt shocks frequently for the first 500 miles and adjust them for driving comfort. If the reservoirs are kept full, all bolts on the shock and arms are tight, and the links tight and properly lubricated your Model A should ride smoothly and provide good passenger comfort.

Service and Maintenance

Fluid: Do not use oil, kerosene or hydraulic jack fluid in Houdaille type shock absorbers. Use only shock absorber fluid, which contains a small amount of alcohol (10%) to prevent freezing and a rust inhibitor. The shock fluid is 90% glycerine and all ports, valve, and passageways of the Houdailles were design for this level of resistance (viscosity).

Oil will solidify in the winter or reduce resistance and will not mix with the glycerine in the shock.

Fluid Level: The level of the fluid in the shocks should be approximately 1/4 inch below the opening. Check this level frequently or about every 1,000 miles.

Attaching Bolts: The shock body must be firmly attached to the body and the shock arm firmly attached to the shock. These bolts should be checked along with fluid level to ensure they are tight and to prevent damage. Make inspection of the shock absorber arm clamp bolt a regular part of your maintenance inspection every 500 miles.

Links: Original style tube links must be lubricated regularly, every 500 miles, through the grease fittings. Using your grease gun lubricate until grease can be seen at the edge of the rubber seals. Dog bone style links do not require lubrication, however the rubber should be checked every 5,000 miles and replaced if necessary. All links must be kept tight.