Oil Pressure hose, Cessna 120/140/140A

Borrowed from the Cessna 150

Oil pressure flexible hose for the Cessna 120/140/140A airplanes

In The Beginning:

The original oil pressure line from the engine to the firewall and the firewall to the gauge was made of 1/8 inch copper tubing. Vibration of the engine causes it to be work hardened because of the millions of flexures. Work hardened copper tubing becomes brittle, leading to fracture and failure. Looking for something better, something that would not break from vibration, Cessna adopted a "rubber" hose for the 150 and used it ever since on all the planes. Continental and the gauge makers selected the size two fittings, which are matched to either the 1/8th copper or the size two hose. Continental/Cessna later used size four fittings and hose but those cannot be adapted to use on our engines/planes, so all of this article deals with the size two.

The Better Idea:

The recommended avoidance of failure of the copper tubing on the 120/140's for most of us is to replace the copper tubing and fittings with the same type rubber hose used on the earlier Cessna 150's. For those who insist on keeping their planes the same as when they were issued, but want to keep it safe, the method recommended for them is to periodically replace the copper tube with a new one: Wicks has the tubing, but Spruce no longer does. If you absolutely had to re-use your existing tubing, an alternative is to remove the tube assembly, cut the tube and remove the aluminum AN fittings from the copper tubing and then do the hard part. Anneal the copper tube (heat it to red hot, then plunge it into cool or cold water as rapidly as possible) and then re-install the fittings and re-do the flare (s). This combo is much more difficult and not recommended. One reason is that the correct tool for creating the 37° is important and ranges from $19 for the simplest to nearly $300. Not all flares are the same, with air conditioning and natural gas flares having different angles (one is 35°, close but not the same) which will not mate properly to plane fittings.

150 Hose Part Number:

For those willing to adopt the Cessna 150 hose, the part number was originally S1168-2-15 and is listed and shown in the Cessna 150 parts catalog at figure 30, item 16.

Recently, now February of 2004, a member found that he could not order that part number and that it had been superseded by the part number 359-2D0150 at $49. The 0's are really zeroes, not "oh"s. This part number is for a part fifteen inches long.

Some prefer to have the hose made at approved shops for hoses and give the reason that the hose from Cessna tends to be a little long. There should be at least a couple more inches than the firewall to engine length for wiggling.

The recommendation to change to the 150 hose was made by the FBO doing the annual on my plane about 1987 and after realizing its benefits, I did a few sketches and wrote up the recommendation for the club members. Trying to be thorough and knowing that some would want to make it themselves, I determined the materials to be used and added that information to the article, but that portion was never submitted to the web site. The recommendation was to use the Stratoflex 193 hose. Great stuff, right size, inexpensive, easy to make up an assembly when using a mandrel as recommended....

And then...I got the manual from Stratoflex which included the specifications (the specs are not listed in the catalogs such as Aircraft Spruce) for the 193 hose. I was dismayed to find that I had almost misled the readers by assuming that the hose was acceptable for the use.

In the picture from the manual, you can note that it is good up to only 165° F. How I wish it was 165° C.

I went through all the arguments....."probably will hold up.....the oil in the hose doesn't move...the hose really won't be as hot as the oil" and so on, but reality was the realization that the end of the hose most assuredly would get as hot as the oil, and that can get to 225° F, a long shot from 165° F.

Reluctantly, although it was a "perfect" solution and "might" be safe because there was probably a lot of safety margin in the hose, I could not justify recommending the use of it if it didn't meet the requirements.

It could be used between the firewall and the gauge, but not between the firewall and the engine...except....look again at the spec and note that it is approved for air or vacuum, not oil. A double whammy.

I placed a call to Parker-Hannifin, otherwise known as Stratoflex and got ahold of the engineer and he confirmed that the specs have not been changed on the 193 and then explained that they have never tested above 160, that the hose is meant only for instrument lines, air or vacuum fed, and then he verified that the mil spec on the product was still the same. (Norm Alexander 1-800-C-Parker (Parker-Hannifin/Stratoflex) x 1378)

Member Jim Williams asked why I had not mentioned how to make a hose so I sent the research I had gone through. He had found an approved hose maker called Avcells and they had made a hose like the Cessna unit, using...guess what...the 193 type. To make sure, I suggested that he call Sacramento Sky Ranch to discuss what they used and why. He did.

Jim's input and feedback

"I called Sacramento Sky Ranch as you suggested. I was very impressed with the friendliness and willingness to help that I got from their man. First, I simply asked what hose I needed for the application without giving him any background on how we have our doubts about 193-2. Wouldn't you know, he said the exact same thing as Avcells' man - not only is it an OK choice, but it is the ONLY choice available.

Then I brought up the specs and questioned the suitability due to temperature and fluid-compatibility inadequacies. His answer was that Yes, he was aware that it didn't technically meet the temp, etc. requirements, but since there is no other alternative Cessna and Piper have both used this hose for this application for a long time, and without problems.

He said that if you buy the C-150 hose from Cessna, you will get 193-2 hose. Piper even used it for brake lines on some aircraft. Finally, he said that there really is no other application or use for 193-2 hose other than oil pressure and manifold pressure lines, and that it really isn't used for instrument/vacuum lines in that size at all (I'm not sure if he's right about this). Anyway, his point was that there is no alternative, and that really the only purpose for even manufacturing 193 hose this small is for this purpose.

So, here is my current assessment, subject to your further input. First, I am cheesed-off that there is no safe and acceptable substitute to the dangerous rigid line, nor is there any way to easily convert to larger size #3, which would solve the problem. Second; Cessnas, including many from the factory, have been flying around for many years with 193-2 hoses, and without any problems (if Skyranch is being truthful). So in the end, the only choices I see are to either fly with an non-approved hose which has a good history or replace the original rigid line, whose design has a proven history of cracking, with a new one of the same type. As Charlie Brown once said...AAUUGGHH! If Cessna truly did use 193-2 hose on factory 150s, would that calm your fears any? I guess all this means you must still be flying with a rigid line - am I correct? I really can't decide what to do. Any further advice? "

Jim Williams

My plane has the 150 hose. My decision was easy...years ago, the FBO at annual time said that the 150 hose could be used, so I said: "sure, do it" and have been happy ever since it was done.

Sacramento Sky Ranch has had that good reputation for a long time. The son, John, now runs the operation, having taken over from the parents, and all my interfaces have been with John. I edited his first book on engines. As a result of that interface, I have been given tours through their plant and that included being shown how they made the hoses. The most recent time, they made the six inch long sample hose in

these pictures using the size two type 193 and the fittings that any order would get...and they tested it for flow and pressure. The cleanliness and adherence to the details of the process were impressive. One of the things that rang a bell was their explanation about how one must use mandrels or take the chance of cutting a little flapper which acts like a block under fluid flow which will drive you nuts or...down. Moreover, they use a mandrel they made for the size two, and then pressure and flow test every hose they make.

When the copper tubing was engineered into the planes for the oil lines and the primer lines, there wasn't anything else. Sometimes, we have to remind ourselves that there was a day before Kleenex, and this is another example. In '45, the plane makers had just completed building something on the order of 200,000 planes, all using copper tubing for instrument lines, and.....Neoprene and other artificial rubbers were new, being explored and why change? The "magic" Neoprene tips which solved the fuel leak problem by replacing the stainless steel needle of the Stromberg carburetors was a godsend and occurred in 1943. I doubt that there were any hoses of the material which had reached the makers' hands or been approved by the makers. Consequently, they used the copper tubing, something familiar and troublefree from their viewpoint.

Yes, I agree with using the hose.

193 HOSE Part no.

193-2
193-3
193-4
193-6
193-8
193-10

SPECIFICATIONS: Hose meets or exceeds the requirements of MIL-H-5593

CONSTRUCTION: Tube — Seamless Buna N. Reinforcement..one braid of high tensile fiber cord. Cover....Synthetic rubber.

IDENTIFICATION: LP-Mil H 5593 date of manufacture, manufacturer's code marked on one side of hose. Repeated every twelve inches.

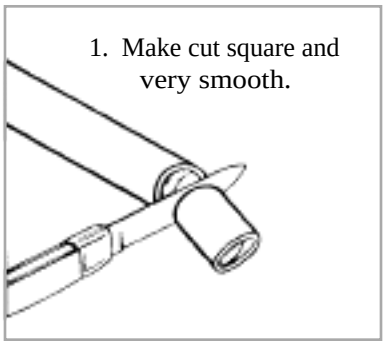
APPLICATION: Low pressure air and vacuum instrument systems. Vacuum service 20" Hg sizes -2 through -6

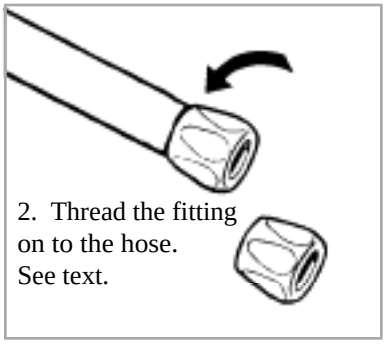
TEMPERATURE RANGE: -65 F to 165 F (-54 C to 74 C)

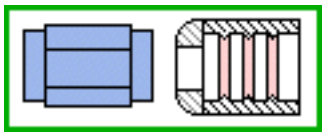
It has a burst strength of 2,000 (yes, thousand) PSI, rated at 300 PSI working pressure and 600 PSI proof pressure.

I subsequently found that there are other things that don't meet "spec", but the FAA acknowledges that will happen and tell the makers of the planes something like this: "you test it and prove it works, even if it does not meet the requirements where used, but the responsibility is yours". And that is exactly what the makers did in the case of the rubber hose versus the copper tube. I have never heard of or read about an oil pressure hose failing, but there must have been some, even if by old, old age by now. It makes sense, just as for the fuel hose, to replace the 150 hose on our planes every few years. Having said that, another member just changed to the new part number for the hose and found that it had been made six years before; there used to be a "rubber age limit" for such things, including O'rings and they found out that the material did not deteriorate like real rubber, so the suggested service limits no longer exist. Still...

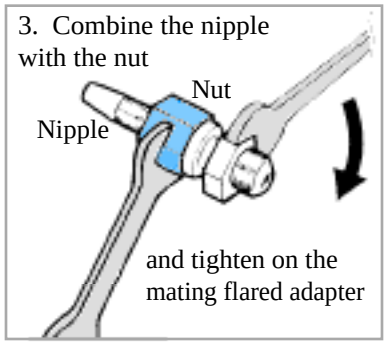
Assembly, The Manufacturer's Instructions Plus Comments:

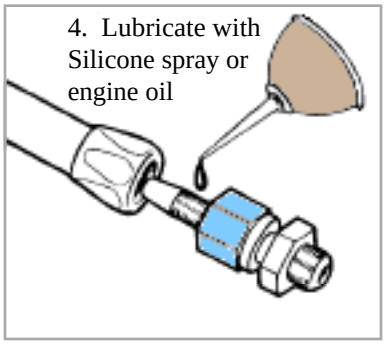






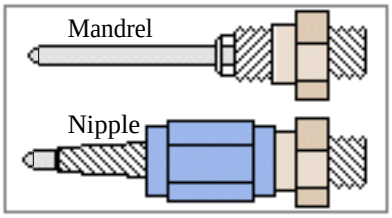
What is not explained in the manufacturer's instructions is the reason to keep the end square when you cut it and why you "thread" the hose into the socket but I will later. The end assembly has been sectioned to show the void inside. You need to hold the socket in a soft-jaw vise just tight enough to allow you to press and rotate the silicone spray-lubricated hose into the socket until the end of the hose bottoms...then, back off a quarter turn. NOTE: THE ARROW IS SHOWING THAT THE DIRECTION OF ROTATION WHILE PRESSING IS COUNTERCLOCKWISE.

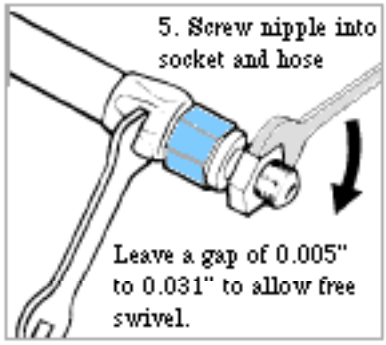




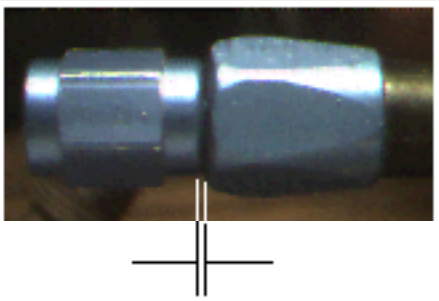
Every manufacturer says to use a mandrel to prevent damage to the inside of the hose as the nipple is screwed in. The end of the nipple is sharp and the inside dimension of the hose tends to be a trifle undersize. The job of the mandrel is to push the interfering rubber out of the way of the sharp end of the nipple so that there is no cut-but-still-hanging-in-there flap of rubber.

Here is the kicker. Although all the manufacturers say to use the mandrel always, NONE make one for the size two hose. You have to make it yourself, best done with the shank end of a 1/8th inch drill or drill blank. From the figure, you can see how that can be done, with the drill blank end butted by the cap or fitting used to hold the nipple tight inside while screwing the nipple into the hose and fitting.

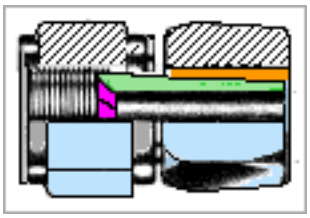




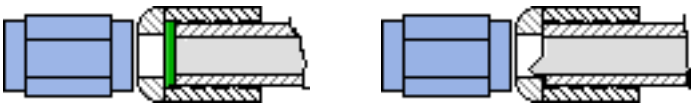
Step 3 shows that there must be a mating part to screw into the nut; they show you using an open end wrench but a vise is really required for more than one assembly effort. Note the use of silicone spray on the nipple, not the oil recommended by the manufacturer but reality is that either can be used. Start the nipple into the opening in the hose..it takes a surprising amount of force to do this start step, and you need to maintain pressure on it when you start to rotate the assembly as shown in the 5 figure. If you are heavy handed in this step and turn the nipple in too far, you will break it, so work up to the gap indicated rather than closing and then hoping to back off and open the gap.



This is where the gap should be measured to ensure between 0.005 and 0.031 clearance so there is no binding when securing the nut to the mating fitting.



The end of the assembly and the fitting at the engine to which it is attached. On the right, the assembly partially sectioned to show the nipple (the nipple in green and the threads to be imagined) threads; the purple accents indicate the tube flare portion of the nipple and the orange is used to indicate the hose since black would lose the detail intended to be shown.



The little green slice at the bottom of the socket void in the left figure shows the gap that should be there when the hose is properly installed; recall that you are to turn the hose in until it stops and then back off a quarter turn. When that is the state of the assembly, you can look in the end and see the hose's inside diameter (ID) is concentric with the hole in the socket. If you do not make the end square and if you do not back off a quarter turn, you can expect to create the worst condition; as shown on the right, there will be a turned-inward section of the hose which could be partially cut off during the next stage of the assembly by the sharp leading edge of the nipple, especially if the recommended mandrel is not used! The flapper so formed has caused lots of grief for others.

Costs:

For the new replacement hose part number 359-2D0150 at $49. The 0's are really zeroes, not "oh"s. From Tom's aircraft in Long Beach CA, the best and most reliable Cessna info outfit I have done business with. Rick there called Cessna to find out the details of the new part.

Yes, it is the size two hose and fittings and so will fit the C-engines and the 0-200 as well.

Length 15 inches.

To make your own:

Hose about $4 per foot, and two fittings at $7.25 to $9.50 each for a total of about $30 with shipping.

Holding fittings and a mandrel.

Wicks copper tube 45 cents per foot
Flaring tools if you replace with copper: $19, for size 1/8th copper tubing only, $82, $127, $143, $396, $486

On the left side of this figure is the AN 823 fitting with the flow-limiting hole in the output end. Most never see the end of this fitting on the engine so they are not aware that there is a flow-reducing opening on the side which attaches to the oil pressure hose. That hole is 0.06" in diameter and one can lose an incredible amount of oil through it when the oil pressure is normal. If you find your fitting does not have the flow-limiting sized hole, ask your mechanic if you can make one (I have not been able to find a source for them) because without the small hole, the flow rate would be several times as much.

Aeroquip 306, not mentioned until now, is the same as the 193 hose, and has similar features; size two, 65° F to 160° F, max operating 300 PSI, Minimum burst 2,000 PSI. Use with type 471 fittings. Prices about the same as for the 193.

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