Small Worm-Style Hose Clamp Failures in Automotive Applications

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Worm-style hose clamps need to be made from high-quality material, torqued to manufacturers' specifications and regularly inspected for leakage.

What is typically done with a leak at a small worm-style (worm gear) hose clamp? Just keep tightening it until the leak stops! **Figure 1** is the anatomy of the small worm-style hose clamp. The over-torqueing of small worm-style hose clamps can lead to serious problems. Proper torque is around 10 to 15 in-lb, but rarely does anyone actually use a torque wrench to apply the clamp.

Fig. 1 — anatomy of the small worm-style hose clamp.

This is usually done by feel, but if the hose material starts to extrude through the grooves in the hose clamp, this is probably too much torque, as illustrated in **Figure 2**. Apparently in this case, a leaking fuel hose was over tightened, which stopped the leak temporarily. The leak redeveloped later on, causing a fire that destroyed the vehicle.

Fig. 2 — Over-torqueing can cause the hose material to extrude through the grooves in the hose clamp.

Figure 3 shows a slightly different cause of a fuel leak, which occurred at a hose clamp, and which also resulted in the loss of the vehicle. Apparently, there had been a leak in the metal fuel tube and the leaking area of the tube was removed with a saw. This resulted in an irregular surface as shown in the photo.

Fig. 3 — Irregular surface resulting from where a leaking area in a metal fuel tube was removed with a saw.

A rubber hose along with a small worm-style hose clamp were substituted. Additionally, it should be noted here that polymer hoses can only accommodate a certain amount of distortion of a round tube and may leak eventually, driven by environmental conditions such as vibration and high temperature. Because of the distorted shape of the metal fuel tube, the hose clamp became over-tightened in an attempt to eliminate leakage, as can be seen by the extruded polymer through the gear groves.

In yet another case, as shown in **Figure 4**, the fuel hose slipped off the metal fuel tube, resulting in a fuel related fire in the vehicle.

This situation resulted from insufficient clamp torque and the positioning of the worm-style clamp. It appears that the clamp may have only partially engaged the fuel tube, significantly reducing the clamping force.

Figure 5 illustrates another case of a polymer hose, which has been substituted for a part of a metal fuel tube. This leakage is most likely a result of the polymer not being able to handle the high temperatures in the engine compartment. The fuel tube should have been replaced and not repaired with a polymer hose and a worm-style hose clamp. This is a misapplication.

Worm-style clamps may not provide the clamping force

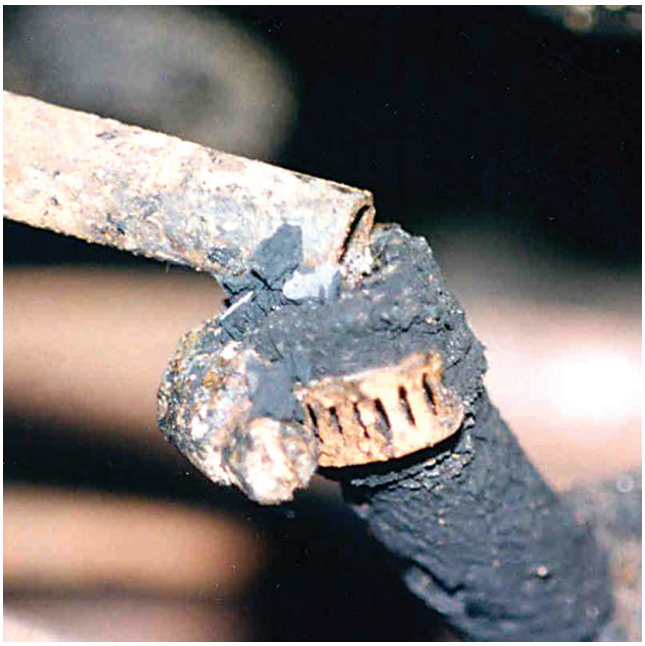

Fig. 4 — Fuel hose slipped off the metal fuel tube, resulting in a fuel related fire.

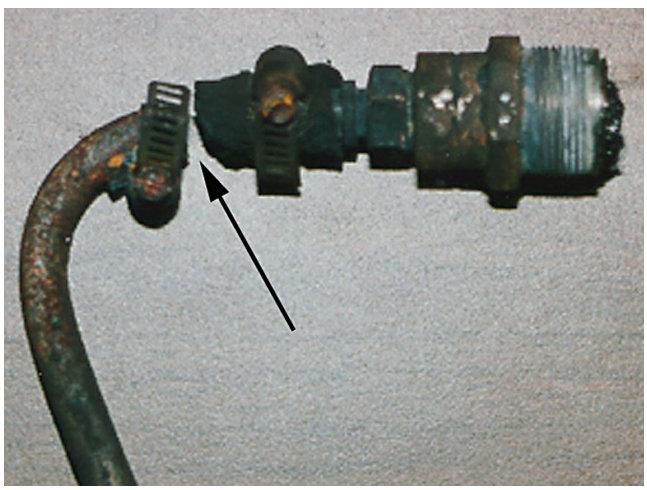

Fig. 5 — Polymer substituted for part of a metal fuel tube not able to handle high temperatures in the engine compartment.

needed for some applications subjected to high pressures. And over-tightening is a constant problem with this type of clamp.

Also, the pressure distribution circumferentially around the band is often uneven with this type of a design, which can eventually result in leakage.

Corrosion can be a problem with low-quality clamp material, which can also cause future failure. It is advisable to select clamps constructed of high quality material, regularly inspect for leakage and follow the manufacturer's recommendation for tightening torques.

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***Dr. Charles C. Roberts** has been providing professional engineering services from the north-central Illinois, USA, area and the surrounding states since 1979, with **C. Roberts Consulting Engineers, Inc.** But the company has long been involved in engineering design and analysis and providing expert advice for his clients. Dr. Charles C. Roberts has a diverse engineering career, starting with **Alden Hydraulic Laboratories** in the mid-1960s, where he designed and analyzed hydraulic systems and performed hydraulic modeling. From Alden Hydraulic Laboratories, he transferred his knowledge to **Jamesbury Corporation** and then the **Yuma Proving Grounds**. At the Yuma Proving Grounds, Dr. Roberts gained insight into not only automotive engineering and motor vehicle testing, but also accident reconstruction, human factors engineering, vehicle thermal analysis, failure analysis and environmental testing. After Yuma, Dr. Roberts moved to **Bell Laboratories** where he was involved in the physical design of electronic switching equipment and computers, and also delving into building environmental systems and structural analysis. Finally, prior to starting his own consulting firm, Dr. Charles C. Roberts worked for **Packer Engineering**, assisting clients in a number of areas including accident reconstruction, failure analysis, metallurgical engineering, biomechanics analysis, aircraft accident analysis, turbine rotor reliability analysis, computerized structural analysis, heat transfer analysis, safety engineering, infrared thermography, metallurgical engineering and engineering design. Dr. Roberts continues those efforts with C. Roberts Consulting Engineers, Inc.*
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