Capillary Action - Sucking up fluids where they don't belong

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Tim has been getting a lot of calls about coolant, rainwater and other fluids travelling to places they don't belong. Here he gives some advice on capillary action and a few case studies that have resulted in faults due to fluids being in all the wrong places!

Capillary action is a strange thing that can help water, and other liquids, defy gravity. Given the right conditions, such as a small gap between two surfaces or cloth-like material to act as a wick, the liquid can travel upwards and into a small enclosed area. Capillary action can also allow fluid to travel up the length of a wiring loom. Once in the enclosed area, it is likely to stay and can eventually cause problems.

Capillary action can make diagnosing the source of the contamination hard to understand, as the liquid can defy gravity and travel on some very unusual and lengthy routes to it's final destination.

Case Study 1: BMW Mini Cooper with multiple fault issues

This vehicle was running in limp home mode when we were asked to diagnose multiple faults codes. The original scan revealed faults in various components within the engine management system.

The coolant temperature sensor was the first code in the list, along with Long Term Fuel Trim and Mixture Regulation. Lambda sensor signal errors also came up several times in the list.

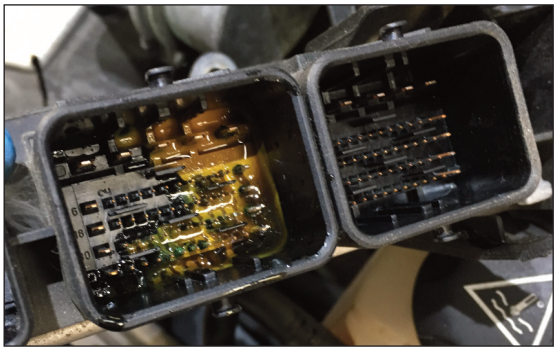
The test plan revealed signal errors on the coolant temperature sensor and the lambda sensor. The lambda sensor was checked on serial data, but seemed to be unresponsive. Additionally, the coolant data was very erratic.

When disconnecting the coolant sensor for resistance testing, it was discovered that coolant was leaking into the connector plug, an obvious mechanical failure of the sensor.

The Lambda sensor was inspected, and no fault found with the component, so the ECM was unplugged, to circuit test the wiring to the lambda sensor. This is when we found coolant had wicked up the loom from the coolant temperature sensor and contaminated multiple terminals in one ECM multiplug.

Cleaning the contamination, drying the ECM connector and replacing the coolant temperature sensor, and opening up the loom and drying the affected cables, cured all the issues.

The coolant sensor on this Mini had failed and was leaking



The leaked coolant wicked up to the ECM and was causing multiple problems

> " Capillary action can make diagnosing the source of the contamination hard to understand "

Case Study 2: 2010 Citroen C3 with multiple fault issues

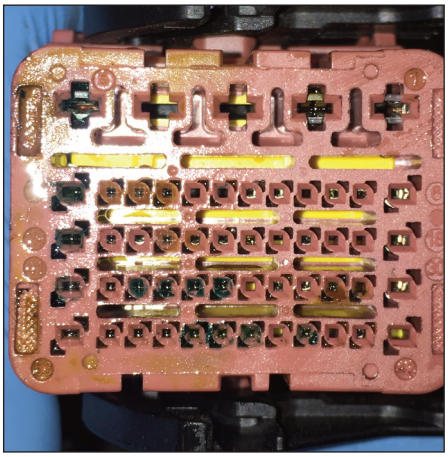
This vehicle had various codes for coolant temp signal errors, cam sensor signal errors, mixture regulation faults and would not rev above 1200 rpm.

To speed up testing, the ECM was the best place to scope all the circuits involved. As we disconnected the multiplugs, it was found to have coolant in one of the ECM connectors. We disconnected the coolant sensor on the vehicle to find the exact same issue with coolant leaking from the sensor and wicking up the loom into the ECM and contaminating multiple circuits.

Both vehicles where fitted with the same engine group, with the coolant sensors in the same location, indicating a common failure point on both engines.

It is a common and often seen problem where liquids are drawn up the loom by a capillary action into control units. Some recent examples seen by the helpline are:

- A Ford Mondeo 2005 model with water contaminated Central electronics module.
- Water from a leaking rear light cluster had wicked all the way from the rear of the vehicle travelling up the loom to the passenger side dash and causing multiple failures.
- On a Mercedes C200 Kompressor, oil from the cam sensors wicked up the loom and filled the ECM with engine oil
- A Vauxhall Corsa C leaked engine oil from the oil pressure switch that wicked up and into the ECM' This caused multiple system errors.



Fluid wicking up a wiring loom caused damage within this connector

Coolant had wicked up a wiring loom and caused this damage at the ECM