

Repair of Yanmar Tach-Hour meter, discussion. November 30, 2012

Problem: Hour meter display is erratic, faint or flashing numerals, or no display. Hour counter is still operating but display is unreliable, unreadable or simply out.

Solution: Remove failed/defective silicone rubber LCD substrate passivation where ribbon cable and display integrated circuit are attached to the LCD (Liquid Crystal Display) substrate. This material was introducing spurious conduction paths.

Root cause: Defective silicone rubber applied over the IC, ribbon connection and LCD substrate became conductive or trapped contaminants and/or humidity and disrupted circuit interconnections on the LCD display substrate which includes transparent Indium Tin Oxide conductors and a surface mounted integrated circuit.

Challenge: Access to the trouble area requires careful lifting of the face display which is glued down. I used a razor blade and exacto knife to separate the face plate from the mounting face.

Having lifted this face plate, a wooden tooth pick, chisel shaped, is used to dislodge and remove the failed/defective silicone rubber which crumbled away from the substrate, ribbon cable connection area and integrated circuit. A wooden tooth pick is recommended because it will not scratch the LCD substrate, ribbon cable or IC. The LCD substrate has transparent conductive oxide electrodes made of the transparent conductor Indium Tin Oxide (ITO).

The silicone compound covering this area flaked off and crumbled readily. It must be scraped away from all surfaces to which it was applied. A can of air is helpful to blow the crumbs away. A small stiff brush can also be helpful. Once the majority of the material is removed, a careful going over of the surfaces with a fresh, sharpened chisel flat, wooden toothpick will remove the last bit of residue. This last step is very very important because the defective silicone rubber on the surface of the LCD substrate must be fully removed to eliminate spurious conductive paths.

1. Tach-Hour Meter assembly lifted out of housing showing display ribbon cable and connector.

2. Tach-Hour meter assembly showing display ribbon cable and connector. Note connector collar down in the capture position.

3. Circuit board end of display ribbon cable out of socket. Note socket collar lifted up in the release position. This end of the display cable and its circuit board connector were originally thought to be the source of the problem. After cleaning these connections and application of silicone grease to create a gas tight fitting, the display continued to fail.

4. Silicone grease used on connector end of ribbon cable to create gas tight connection between ribbon connector cable and connector.

5. Thumb holding face plate up to expose ribbon connection area including LCD and IC at the right of the LDC display.

6. Thumb holding face plate up to expose ribbon connection area including LCD and IC at the right of the LDC display. A close-up of this area in the next photo.

7. Close up of LCD substrate area where ribbon cable connects and IC is connected. This entire area had the failed/defective silicone rubber compound applied. Residue is still present on the substrate surface. Not done yet.

8. Reassembled Tach-Hour unit with persistent, bright, well defined numerals in hour display. Tach shows 3000 RPM with 510 Hertz square wave applied to tach input.

Conclusion: I expected the problem to be mechanical via connector corrosion but instead found a failed and defective silicone rubber compound covering conductors on the LCD display substrate. The purpose of this compound is apparently to prevent humidity and contaminants on the LCD substrate and its exposed transparent conductors of Indium Tin Oxide. After removing all of the silicone compound and its residue, the spurious conduction paths were eliminated and the display began to work normally. No damage was discovered or caused in the disassembly. The unit is returned to its original operating condition.

The unit was placed in the freezer for an hour then removed and powered up. No problems were seen with condensing moisture on/in the unit. However this remains a concern since the removed silicone compound was originally applied for a reason.

I tried to measure the conductivity of a crumb of the silicone rubber I removed but was unable to make a reliable contact to the very small crumbs on which I attempted this measurement.