



U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

ODI RESUME

Investigation: EA 18-002
Prompted by: PE16-017
Date Opened: 04/18/2018
Investigator: Robert Caple
Approver: Stephen Ridella
Subject: Extended Braking Distance

Date Closed: 01/15/2021
Reviewer: Scott Yon

MANUFACTURER & PRODUCT INFORMATION

Manufacturer: Ford Motor Company
Products: MY 2006-2012 Fusion/MKZ & MY 2006-2011 Milan
Population: 600,166

Problem Description: The brake pedal may lose pressure resulting in increased pedal travel and potentially increasing the stopping distance.

FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	873	1,041	1825**
Crashes/Fires:	52	10	62
Injury Incidents:	4	1	5
Number of Injuries:	5	2	7
Fatality Incidents:	0	0	0

** Total eliminates duplicates received by ODI and manufacturer.

ACTION / SUMMARY INFORMATION

Action: This investigation is closed, see NHTSA Safety Recall 19V-904 for further details.

Summary:

On April 18, 2018, the Office of Defects Investigation (ODI) opened Engineering Analysis (EA) 18-002 to investigate reports of braking concerns in model year (MY) 2006-12 Ford Fusion and Lincoln MKZ, and MY 2006-11 Mercury Milan vehicles manufactured with Continental Automotive System's ABS hydraulic control units (HCUs). Complainants report that after an ABS braking event (initiated by slippery or uneven surfaces) the brake pedal moved towards the floor and the vehicle stopping distance increased beyond driver expectations.

Inside the HCU are four hydraulic normally closed (NC) valves with zinc-coated moving armatures that control the flow of brake fluid. Unstable brake fluid can degrade over time, allow the brake fluid to gel, and corrosion to form on the armatures. The high-viscosity gelation and corrosion can cause the armatures to become stuck (open). In some cases, braking returns to normal when the armature(s) subsequently become unstuck. The intermittent condition proves difficult to diagnose with complainants reporting having (non-HCU) repairs conducted only to have the condition return.

During the investigation, 14 HCUs from complaint vehicles were recovered, including seven from reported crashes. NHTSA's Vehicle Research and Test Center (VRTC) disassembled the HCUs, removed the four NC valves in each, and confirmed 22 of the 56 NC valves contained stuck armatures. On seven of the 14 HCUs, both front wheel armatures were stuck, on nine of the 14 HCUs two or three armatures were stuck. And 52 of the 56 NC armatures exhibited corrosion of the zinc coating. Forces required to extract stuck armatures from the valve sleeve were measured to range from 1.1 to 18.0 lbs. VRTC also conducted ABS braking tests on a variety of test surfaces that showed HCU failures cause increases in pedal travel and braking distances. Testing also showed that if the driver was able to apply four times the brake pedal force and two times the brake pedal travel, then high-vehicle decelerations could be achieved, however, single or multiple wheel lockups were also occurring.

Based on Ford's response to ODI's July 20, 2018 information request letter, and complainants' reports to NHTSA, ODI identified a population of vehicles with an elevated level of field failure compared to vehicles produced both before and after. Further evaluation of Ford's response identified that the brake fluid used to produce these vehicles, a specific formulation of a DOT3 fluid provided by CCI Corporation between February 2006 and July 2009, differed from the brake fluid used in other vehicle populations. ODI used the correlation of fluid specification and elevated field failures to identify a vehicle population exhibiting a defect trend. The complaints, crashes and injuries cited above, and the 14 recovered HCUs involve vehicles from this population.

On December 18, 2019, Ford submitted safety recall (19V-904) to remedy HCU failures on the MY 2006-2010 Ford Fusion, Lincoln MKZ, and Mercury Milan vehicles manufactured with the suspect CCI brake fluid formulation. Ford will function test the HCU and replace the DOT 3 brake fluid with an improved DOT 4 brake fluid. If the HCU fails the function test, Ford will install an HCU with a different armature coating (black oxide). HCUs with black oxide coating were fully phased into Ford's new vehicle production by MY 2016; these HCUs do not appear to be experiencing armature corrosion. ODI notes that the non-recalled EA18-002 subject vehicles, which were manufactured with a different specification brake fluid, did not display an elevated level of field failures like the recalled vehicles.

Based on available information, Ford's recall addresses the unreasonable risk to motor safety. Accordingly, the investigation is closed. The ODI reports cited above can be reviewed at [NHTSA.gov](https://www.nhtsa.gov) under the identification (ODI) numbers found in the attached list.

Attachment to EA18-002 Close Resume

List of reference (ODI) numbers cited on the close resume for EA18-002: 10340190, 10392332, 10446512, 10449457, 10455572, 10467597, 10489124, 10514752, 10533506, 10554281, 10559710, 10587183, 10594697, 10606597, 10615775, 10618330, 10629592, 10639014, 10640257, 10641549, 10644354, 10652002, 10653400, 10655357, 10658960, 10659096, 10670396, 10670480, 10672699, 10684046, 10690056, 10690173, 10692468, 10694951, 10704042, 10712615, 10713269, 10721041, 10745073, 10749892, 10760420, 10783662, 10787563, 10787755, 10790504, 10794803, 10806255, 10807281, 10807637, 10807655, 10810060, 10811561, 10818601, 10819862, 10820307, 10822164, 10822948, 10823422, 10824987, 10825433, 10826114, 10836359, 10836561, 10837758, 10837770, 10845863, 10852553, 10854702, 10854765, 10855365, 10860086, 10863054, 10863161, 10863250, 10870186, 10873218, 10873431, 10874967, 10875748, 10875760, 10876335, 10881298, 10882204, 10883508, 10883561, 10884934, 10885025, 10887635, 10888626, 10893019, 10894501, 10897327, 10897356, 10897544, 10899417, 10903135, 10903875, 10905557, 10906293, 10910435, 10915658, 10916749, 10916867, 10917229, 10917606, 10920381, 10920642, 10920650, 10923968, 10924068, 10925296, 10925894, 10926036, 10927112, 10928256, 10928668, 10929495, 10929499, 10934454, 10934590, 10934917, 10935394, 10936078, 10936125, 10936299, 10937599, 10937620, 10937634, 10937635, 10937644, 10937648, 10937660, 10937706, 10937715, 10937736, 10937743, 10937745, 10937748, 10937757, 10937760, 10937764, 10937782, 10937798, 10937812, 10937815, 10937831, 10937832, 10937837, 10937842, 10937851, 10937853, 10937860, 10937862, 10937864, 10937871, 10937876, 10937892, 10937895, 10937919, 10937922, 10937933, 10937941, 10937946, 10937951, 10937959, 10938013, 10938014, 10938015, 10938313, 10938329, 10938341, 10938342, 10938355, 10938358, 10938367, 10938377, 10938394, 10938410, 10938411, 10938439, 10938442, 10938447, 10938448, 10938462, 10938468, 10938469, 10938474, 10938475, 10938483, 10938485, 10938497, 10938514, 10938519, 10938534, 10938538, 10938548, 10938553, 10938568, 10938584, 10938607, 10938615, 10938637, 10938662, 10938669, 10938678, 10938708, 10938774, 10938817, 10938834, 10938846, 10938853, 10938865, 10938882, 10938986, 10938993, 10938998, 10939061, 10939069, 10939117, 10939176, 10939180, 10939214, 10939230, 10939243, 10939267, 10939274, 10939287, 10939456, 10939468, 10939480, 10939484, 10939487, 10939524, 10939609, 10939660, 10939715, 10939718, 10939749, 10939770, 10939779, 10939831, 10939832, 10939853, 10939989, 10940172, 10940182, 10940219, 10940313, 10940326, 10940328, 10940381, 10943692, 10943973, 10943983, 10944011, 10944032, 10944100, 10944114, 10944121, 10944298, 10944338, 10944408, 10944413, 10944489, 10944490, 10944553, 10944976, 10945003, 10945223, 10945291, 10945423, 10945485, 10945827, 10945869, 10946143, 10946155, 10946567, 10946680, 10946848, 10947061, 10947062, 10947103, 10947310, 10947398, 10947446, 10947717, 10947818, 10947887, 10948359, 10948490, 10948525, 10948660, 10949025, 10949034, 10949037, 10949159, 10949252, 10949320, 10949592, 10949624, 10949645, 10949698, 10949872, 10949928, 10950024, 10950117, 10950135, 10950203, 10950300, 10950366, 10950456, 10953920, 10953981, 10954019, 10954039, 10955004, 10955440, 10955499, 10955665, 10956122, 10956421, 10957738, 10958323, 10958326, 10958566, 10958571, 10958746, 10959081, 10959154, 10959481, 10959589, 10959973, 10960332, 10966095, 10966363, 10966376, 10966645, 10967302, 10967409, 10968382, 10968500, 10968590, 10968917, 10968996, 10969005, 10969208, 10969491, 10969627, 10969655, 10969869, 10970531, 10971079, 10971094, 10971738, 10978769, 10978995, 10979447, 10979625, 10980410, 10980868, 10980955, 10980982, 10981513, 10981685, 10983452, 10983776, 10983789, 10983913, 10984166, 10985081, 10985648, 10985982, 10990570, 10990599, 10990668, 10990698, 10990787, 10991069, 10991898, 10992413,

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