**NHTSA comMercury Routing Slip**

Printed: 1/30/2013

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**Author:**

WILLIAM ROSENBLUTH
ASA, INC.
12015 CANTER LANE
RESTON, VA 20191
Tel: 703-860-0060 Fax: E-mail: billrosenbluth@asareston.com

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PETITION, Toyota Prius Steering, Upper Intermediate Extension Shaft #2, Manufacturing Defect w/respect to Recall 12V-537 (Lower Intermediate Extension Shaft #1, Manufacturing Defect)

Investigation Reference:

Vehicle: Richwine Subject Vehicle 2005 Toyota Prius
VIN: JTDKB20U95   MfgDt 10/04
Issue: Alleged Steering Malfunction

Dear Sir:;

1. At the request of the owner, George Richwine, on 4Jan13, I flew to Jacksonville FL Naval Air Station (JAX, NAS), and inspected his subject vehicle in the base impound lot. My activities included an inspection of the occupant compartment steering column components [no lift was available to allow for inspection of the lower components] and retrieval of ECM and SRS data. The steering wheel was shown by Mr. Richwine to rotate multiple turns, in both directions, with no resistance. A key part of my inspection was to see if the prior-applied steering Recall [fix for improperly manufactured steering column lower intermediate shaft #1] was still intact or whether a failure of Recall 12V-537 was the cause of the current loss of steering issue.

2. My inspection revealed that the current loss of steering issue was caused by a catastrophic failure of the upper steering intermediate shaft [steering upper intermediate shaft #2]. The upper steering intermediate shaft [steering intermediate shaft #2] was decoupled from the electric-power-assist column output spline. A careful examination of the decoupled components revealed that for an extended period of time, the upper steering intermediate shaft had not been properly installed on the spline output of the power assist
column. This allowed a metallurgical failure [spline wearout] on the interior of the upper steering intermediate shaft #2 which consequently allowed separation of that shaft from the electrical steering power assist column. My examination of that shaft spline showed a long term deterioration of the upper intermediate shaft #2 inside spline as evidenced by metallurgical shards of deteriorated spline metal still residing in the upper intermediate shaft cavity.

3. My full report, attached, documents photographic and mechanical evidence confirming my observations and confirming that the upper steering intermediate shaft had not been properly installed on the spline output of the power assist column. My report also shows, for an exemplar vehicle, a correct upper steering intermediate shaft #2 installation on the power assist column output spline.

4. I know of no intervening repair to the upper steering intermediate shaft between the time of vehicle manufacture and my inspection. The Recall procedure [for the lower intermediate steering shaft #1] specifically instructs technicians to avoid any operations on the upper intermediate shaft #2.

5. Thus, with a reasonable degree of engineering and scientific certainty, my conclusion, drawn from these facts, is that the Richwine subject vehicle steering column linkage was improperly assembled at its original manufacturing point and thus contained a latent manufacturing defect. This manufacturing defect is a complementary, but wholly different, manufacturing defect than is described and illuminated in Recall 12V-537 and the service instructions to remediate that condition.

6. The net instruction from this conclusion is that there was a gap in Toyota quality control - in a mission-critical system [steering column linkage]. Had such a defect manifested itself under highway speed conditions, significant and severe injuries may have ensued to the driver and occupants of the Prius and quite possibly to other vehicles and occupants. Thus, this situation affects public highway traffic safety.

7. Accordingly, I petition NHTSA to open an investigation into defect conditions in upper immediate steering extension shaft #2 conditions in the 2004-09 Prius vehicles manufactured under similar circumstances.

Respectfully submitted,

Bill Rosenbluth

William Rosenbluth
A. Background

Mr. Richwine narrates that:

I was an avid follower of the Toyota Prius hybrid and ordered one as soon as possible. But, living in San Diego (Southern California), there was a lot of demand and I had to wait more than one year to take delivery of a Prius in November 2004 (a 2005 vehicle). Although I loved the vehicle and was excited to be driving one, I experienced three problems that Toyota stated they knew nothing about and the Toyota dealer said they could not replicate:

1) The cruise control would cancel but not re-engage (ironic since the most recent problem was that the cruise wouldn't disengage)

2) The car would drift off course whenever I took my eyes off the road for even a moment (e.g., to tune the radio): over time, I learned that I had to steer the car constantly or it would drift into another lane (apparently this is due to a computer algorithm that attempts to correct for wind and road surface anomalies).

3) The radio reception was poor.

Within the first year, Toyota issued a safety recall for the [steering, lower] intermediate shaft but the dealer discounted the necessity and stated that, even if I never brought the vehicle in for the recall, it wouldn't make any difference (it was an "over-kill" reaction by Toyota). I ignored that advice and scheduled the recall along with an oil and filter change. I don't know how long this should have taken but the car was ready for me within a short time so I question whether or not the safety recall was ever actually conducted.
Here's what happened: I was driving on the Interstate with the cruise control set at 70 mph. Seeing traffic stopped ahead, I applied the brakes for a moment to slow, then released the brake to coast. Much to my surprise, the cruise control was still engaged and the car accelerated. I applied the brakes again, manually turned off the cruise control, then was able to coast. I drove for another half-hour without incident until the following afternoon when I drove again, experiencing a much more serious problem. I had just turned left, and was straightening the wheels (turning the steering wheel back right) [to enter a parking spot] when I heard, and felt, a loud "snap" in the steering wheel, immediately upon which I knew the steering was disconnected and I could no longer steer the car. Very, very fortunately, and only because I was already nearly stopped, I was able to stop the vehicle without incident. However, I immediately recognized that, had this happened in almost any other scenario than being nearly parked, the outcome would have been markedly different. The steering wheel is completely loose, not controlling anything, and all the many steering wheel controls are equally disconnected, including the driver's air bag (SRS), something that I would have needed, but wouldn't have worked, had I crashed into oncoming traffic or an Interstate median. Had I not decided to run a frivolous and unnecessary errand, I would have otherwise been on the Interstate, rushing home for Thanksgiving like many others, but now am merely stranded, in a motel, far from home in Jacksonville, FL, wondering what to do next. My low mileage (just 27,773 mi), seven year old Prius is still parked, undriveable, ... {taken from CAS statement as supplied by Mr. Richwine}.

Mr. Richwine reported his steering problem to NHTSA on 25Nov2011. Exhibit A.1 shows this NHTSA VOQ submission #10437229, dated 25Nov11.

Exhibit A.2 shows the [only known] NHTSA response to Mr. Richwine, dated 19Oct2012.

B. **Subject Vehicle Inspection and Global Opinions**

1. On 4Jan13, I flew to Jacksonville FL Naval Air Station (JAX, NAS), and inspected the subject vehicle in the base impound lot. My activities included an inspection of the occupant compartment steering column components [no lift was available to allow for inspection of the lower components] and retrieval of ECM and SRS data. The steering wheel was shown by Mr. Richwine to rotate multiple turns, in both directions, with no resistance. A key part of my inspection was to see if the prior-applied steering Recall [fix for improperly manufactured steering column lower intermediate shaft #1] was still intact or whether a failure of that Recall was he cause of the current loss of steering issue.

2. My inspection revealed that the current loss of steering issue was caused by a catastrophic failure of the upper steering intermediate shaft [steering upper intermediate shaft #2]. The upper steering intermediate shaft [steering intermediate shaft #2] was decoupled from the electric-power-assist column output spline. A careful examination of the decoupled
components revealed that for an extended period of time, the upper steering intermediate shaft had not been properly installed on the spline output of the power assist column. This allowed a metallurgical failure [spline wearout] on the interior of the upper steering intermediate shaft #2 which consequently allowed separation of that shaft from the electrical steering power assist column. My examination of that shaft spline showed a long term deterioration of the upper intermediate shaft #2 inside spline as evidenced by metallurgical shards of deteriorated spline metal still residing in the upper intermediate shaft cavity.

3. In Section C below I show photographic and mechanical evidence confirming my observations and confirming that the upper steering intermediate shaft had not been properly installed on the spline output of the power assist column. In Section C below I also show, for an exemplar vehicle, a correct upper steering intermediate shaft #2 installation on the power assist column output spline.

4. I know of no intervening repair to the upper steering intermediate shaft between the time of vehicle manufacture and my inspection. The Recall procedure [for the lower intermediate steering shaft #1] specifically instructs technicians to avoid any operations on the upper intermediate shaft #2.

5. Thus, with a reasonable degree of engineering and scientific certainty, my conclusion, drawn from these facts, is that the Richwine subject vehicle steering column linkage was improperly assembled at its original manufacturing point and thus contained a latent manufacturing defect. This manufacturing defect is a complementary, but wholly different, manufacturing defect than is described and illuminated in Recall 12V537 and the service instructions to remediate that condition.

6. The net instruction from this conclusion is that there was a gap in Toyota quality control - in a mission-critical system [steering column linkage]. Had such a defect manifested itself under highway speed conditions, significant and severe injuries may have ensued to the driver and occupants of the Prius and quite possibly to other vehicles and occupants. Thus, this situation affects public highway traffic safety.

7. These facts now suggest that the vehicle manufacturer be tasked to investigate how their manufacturing quality control function missed this steering column linkage assembly defect and how many other similar steering mis-assembly defects exist in the Prius consumer usage world [for vehicles manufactured under similar circumstances].

C. Basis of Subject Vehicle Global Opinions
George Richwine, 05Prius

Data & Analysis, Steering Failure

1. On 4Jan13, I flew to Jacksonville FL Naval Air Station (JAX, NAS), and inspected the subject vehicle (SV) in the base impound lot. My activities included retrieval of ECM and SRS data and an inspection of the occupant compartment steering column components [no lift was available to allow for inspection of the lower components]. On immediate vehicle viewing, the subject vehicle steering wheel was shown by Mr. Richwine to rotate multiple turns, in both directions, with no resistance and no response of the front wheels. I made a video of that demonstration. Exhibit C.1 shows the SV as found. Note the upper intermediate steering shaft #2 seen hanging over brake pedal.

2. My first inspection step was to interrogate the ECM [engine control computer] with OBD2Spy v4.12 and AutoEnginuity V11.0 scanners. The ECM evidenced no DTCs and no Freeze Frame data on either scanner. See Exhibit C.2.

3. Next, the SRS ECU [EDR] was interrogated with AutoEnginuity V11.0 scanner and a Bosch CDR v 8.10. No event data was saved in the EDR. DTCs B1801 [Driver Squib Stage 1 = open] and DTC B1811 [Driver Squib Stage 2 = open] were retrieved from the SRS ECU. These are entirely consistent with the unrestricted steering wheel which clearly ruptured the clockspring [used to connect to driver airbag squib 1 and squib 2]. See Exhibit C.3.

4. The steering column linkage in the subject 2005 Prius consists of two intermediate shafts and an electric power assist top column. Exhibit C.4.1 shows the upper half of the steering column linkage and Exhibit C.4.2 shows the lower half of the steering column linkage.

5. The subject 2005 Prius is subject to recall C0T [NHTSA 12V-537], “Steering Intermediate Extension Shaft May Fail”. This Recall concerns the lower steering intermediate shaft [#1] and the potential for an improper-metallurgy shaft to fail. Exhibit C.5.1 shows the customer notice for Recall 12V-537. Exhibit C.5.2 shows an excerpt of the technician service instructions which depict the lower steering intermediate shaft [#1] in detail.

6. Mr. Richwine thought he had the Toyota steering Recall applied 12Dec2006 by Frank Toyota. Exhibit C.6.1 appears to confirm this steering Recall application. However, in a current service record retrieval by the same dealer, Exhibit C.6.2, the current [Jan 2013] Toyota vehicle database shows that the Steering Recall was not applied.

7. I next confirmed that the SV steering column had lost all integrity [steering wheel free to turn with no restrictions or stops]. This is also recorded on video with Mr. Richwine demonstrating this condition.
8. Inspecting the upper column for possible causes of this, I found that the upper steering intermediate shaft [#2] had separated from the exit spline of the power assist column output. This separation had no observable or known intervening cause such as a collision or abusive usage. The upper steering column intermediate shaft #2 separation is not part of the Toyota Steering Recall 12V-537 or any of its predecessor versions. See Exhibit C.8.

9. Exhibit C.9 shows the upper mating end of the upper end of the upper steering intermediate shaft #2 and the fact that its internal splines are mechanically worn away for approximately 1/4 of the intended mating distance [with the power assist exit spline]. It should be noted that the upper intermediate shaft #2 is actually part of a sliding link, and the malfunction portion was intended by design to have been locked onto the power assist exit spline. This lock function is accomplished by its affixing bolt occupying the machined annulus in the power assist exit spline, as well as 'cinching up' the intermediate shaft #2 internal spline connection [this is a venerable mechanical design, conceptually similar to the manner in which many bicycle pedals are locked onto the bicycle drive gear axle]. There was no deformation of the power assist exit spline indicating a possible drag-over of the locking bolt.

10. Since the locking bolt was found intact in the intermediate shaft, and was no deformation of the power assist exit spline indicating a possible drag-over, the locking bolt could not ever have been properly locked onto the power assist exit spline. Additionally, a careful examination of location of the rust marks on the power assist exit spline show that the upper intermediate shaft #2 was only installed on approximately the first third of the power assist exit spline. Its intended design [based on proper locking bold position would have been for complete coverage of the upper intermediate shaft #2 spline with the power assist exit spline - with the locking/cinching bolt residing in the power assist exit spline annulus. Exhibit C.9 shows the SV bolt and the power assist exit spline annulus.

11. Exhibit C.9 also shows that the worn section of the upper intermediate shaft #2 spline coincides with the approximate [NON-rust mark delineated, covered] portion of the power assist exit spline.

12. The evidence presented above appears compelling, but as a hypothesis, it must be tested against design intent reality. I did that on 8Jan13 using an exemplar 06Prius vehicle.  

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1 To confirm the applicability of my exemplar, I checked the part #s of the OEM upper steering intermediate shaft #2 for both model years. It turns out that Toyota installed a new P/N 45260-47052 on vehicle production after Nov05 and specified that same P/N as superceding the OEM shaft P/N for any replacements on 2005 MY vehicles. Thus the mechanical design for both model years is by definition, identical.
Exhibit C.12 is a photo sequence showing that exemplar vehicle and its upper intermediate steering shaft #2 assembly on the exemplar power assist exit spline annulus. These photos clearly show, with no ambiguity, that a proper installation includes the cinching bolt properly residing in the power assist exit spline annulus.

13. Thus, barring evidence of an intervening cause, the above investigation supports, with a reasonable degree of engineering and scientific certainty, my conclusion that the Richwine subject vehicle was improperly assembled at its original assembly plant and thus contained a manufacturing defect which was not identified or remedied by Toyota Quality Control. This is a complementary, but wholly different, manufacturing defect then that illuminated in Recall 12V-537 [and all prior versions of that Recall].

14. The net instruction from this conclusion is there was an undefendable gap in Toyota quality control - in a mission-critical system [steering column linkage]. Had such a defect manifested itself under highway speed conditions, significant and severe injuries may have ensued to the driver and occupants of the Prius and quite possibly to other vehicles and occupants. Thus, this situation affects public highway traffic safety.

15. These facts now suggest that the vehicle manufacturer be tasked to investigate how their manufacturing quality control function missed this steering column linkage assembly defect and how many other similar steering mis-assembly defects exist in the Prius consumer usage world [for vehicles manufactured under similar circumstances].

Respectfully Submitted

Bill Rosenbluth

William Rosenbluth
Exhibit A.1 George Richwine report of steering problem to NHTSA on 25Nov2011.
Exhibit A.2  NHTSA response to George Richwine, 19Oct12.

From: <Stephen.McHenry@dot.gov>
Subject: Toyota Prius report filed with NHTSA, #10457229
Date: October 18, 2012 6:36:07 PM EDT
To: [redacted]

Mr. Richwine:

My name is Stephen McHenry. I am an Investigator with the National Highway Traffic Safety Administration of the US Department of Transportation. I am interested in the report you filed with us regarding your 2005 Prius steering system problem. Your report and the material you submitted was very detailed, thank you for taking the time to file it with us. What was the final resolution to the problem? Did they fix it by performing a recall or was some other work done? Is there anything else you can tell me would be helpful in understanding the problem you experienced?

Stephen McHenry
Investigator, US D.O.T.
National Highway Traffic Safety Administration
Office of Defects Investigation
MV-213 Room W49-300
1200 New Jersey Ave., SE
Washington D.C. 20590-0001
202.366.4983 or 1.877.355.8368 x-64983
Fax 202.366.1767

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Exhibit C.1 The SV as found.

Note the upper intermediate steering shaft #2 hanging over brake pedal.
Exhibit C.2. Interrogation of ECM [engine control computer] with OBD2Spy v4.12 and AutoEnginuity V11.0 scanners. The ECM evidenced no DTCs and no Freeze Frame data on either scanner.
See Exhibit C.3. The SRS ECU [EDR] was interrogated with AutoEnginuity V11.0 scanner and a Bosch CDR v 8.10. No event data was saved in the EDR. DTCs B1801 [Driver Squib Stage 1 = open] and DTC B1811 [Driver Squib Stage 2 = open] were retrieved from the SRS ECU. These are entirely consistent with the unrestricted steering wheel which clearly ruptured the clockspring [used to connect to driver airbag squib 1 and squib 2].
Exhibit C.4.1 Upper half of the steering column linkage. The steering column linkage in the subject 2005 Prius consists of two intermediate shafts and an electric power assist top column. Note annotated power assist output spline and upper intermediate shaft #2.

2005 Toyota Prius
Fig. 8: Identifying Steering Column Assy Components And Torque Specifications (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Exhibit C.4.1 Upper half of the steering column linkage. The steering column linkage in the subject 2005 Prius consists of two intermediate shafts and an electric power assist top column. Note annotated power assist output spline and upper intermediate shaft #2.

2005 Toyota Prius
Fig. 8: Identifying Steering Column Assy Components And Torque Specifications (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.
Exhibit C.4.2  Lower half of the steering column linkage.  Note annotated lower intermediate shaft #1.

2005 Toyota Prius

Fig. 4: Identifying Steering Gear Assy Components And Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.
Exhibit C.5.1 shows the [interim] customer notice for Recall 12V-537.

2004 to certain 2009 Model Year Prius Vehicles
CST - Steering Intermediate Extension Shaft (Phase 2) and
COH - Hybrid Electric Water Pump
SAFETY RECALL NOTICE (Bulletin Notice)

[VIN]

Dear Toyota Customer:

This notice is being sent to you in accordance with the requirements of the National Traffic and Motor Vehicle Safety Act. Toyota has decided that two defects, which relate to motor vehicle safety, exist in some 2004 to certain 2009 Model Year Prius vehicles.

The purpose of this letter is to explain what the recalls are about and to keep you informed of Toyota's implementation plan. We are currently making preparations to implement the Safety Recall remedies. We will send you another notification when the preparations are complete.

What is the Steering Intermediate Extension Shaft condition?

The steering intermediate extension shaft ("extension shaft") is a component of the steering assembly and connects the steering column to the steering rack. Due to insufficient hardness of the extension shaft supplied by a specific supplier, the splines which connect the extension shaft to the steering gear box could deform if the steering wheel is frequently and forcefully turned to the full-locked position while driving at a slow speed, such as parking in a tight parking space. The splines could eventually wear out over time, which could result in loss of steering ability, increasing the risk of a crash.

What is the Hybrid Electric Water Pump condition?

There is a possibility that the coil wire of the electric motor installed in the Water Pump for the Hybrid System may have been scratched during the coil manufacturing process at the supplier. In this condition, the coil wire may corrode or be scratched at the connector pin and in some cases break. If this occurs, the water pump could stop, leading to the illumination of various warning lights in the instrument panel. There is also the potential that a short circuit can occur between adjacent coil wires, resulting in an open fuse for the electric power supply circuit. If the fuse is open, the hybrid system will stop while the vehicle is being driven, which may increase the risk of a crash.

What should you do?

We appreciate your patience while we prepare the remedy parts. In the meantime, if you experience either condition described above, please contact your local Toyota dealer for diagnosis and appropriate repair. If the problem is related to the issues addressed by these recalls, the repair will be performed at no charge to you.

At this time the remedy for the Steering Intermediate Extension Shaft is available; however to minimize your inconvenience Toyota recommends that you wait until the Hybrid Electric Water Pump remedy is available and have both remedies performed at the same time. In the event you choose to have the Steering Intermediate Extension Shaft remedy performed prior to receiving the remedy notice, you will still need to return to the dealership to have the Hybrid Electric Water Pump replaced when the remedy is available.

If you would like to update your vehicle ownership or contact information, you may do so by registering at www.toyota.com/ownersupdate. You will need your full 11-digit Vehicle Identification Number (VIN) to input the new information.

What if you have other questions?

- Your local Toyota dealer will be more than happy to answer any of your questions and set up an appointment to perform the repair.
- You can find additional information and locate a Toyota dealer in your area by going online and visiting www.toyota.com/recall.
- Additional information is also available by contacting the Toyota Customer Experience Center at 1-866-270-9371 Monday through Friday, 8:00 am to 8:00 pm, or Saturday 7:00 am through 4:00 pm Pacific Time.
Exhibit C.5.2 shows an excerpt of the technician service instructions which depict the lower steering intermediate shaft [#1] in detail.

5. REMOVE THE EXTENSION SHAFT BOLT

NOTE: It may be necessary to turn the wheels to access the bolt.

DO NOT remove or disengage the extension shaft in any way.

6. INSPECT THE EXTENSION SHAFT

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<td>NG Replace the extension shaft and 3 bolts. Proceed to SECTION VII. EXTENSION SHAFT &amp; BOLT REPLACEMENT</td>
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NOTE: The new shaft in the kit (04001-41212) is manufactured with a countersink. DO NOT mix the old and new shaft.
Exhibit C.6.1  Service record showing Richwine SV [lower] steering [intermediate #1] shaft Recall application apparently completed per R/O # 0048063.

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Exhibit C.6.2  Current service record showing Richwine SV [lower] steering [intermediate #1] shaft
Recall application as not completed.

From: Crissy Daley <daley@franktoyota.com>
Subject: Service Repair from Frank Toyota
Date: January 11, 2013 12:25:46 PM EST
To: "richwine_11@gmail.com" <richwine_11@gmail.com>

Hallo Mr. Richwine,

I am sorry to hear about your apartment getting broken in to. I tried to access your vehicle's service history in our records. Unfortunately since the last time you came in was back in 2006 we have purged all of our records. I was able to pull your Prius' National Service History from Toyota. I have attached that. I am sorry that we are not able to provide you with your service records but if there is anything else that I can do please let me know.

Crissy Berrick
Service Support Manager
Frank Toyota
(019) 474-5573 ext. 433
daley@franktoyota.com

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Richwine_05Prius_DataAnalysis_1f_and_13Jan13
Exhibit C.8. Showing the upper steering intermediate shaft [#2] as found separated from the exit spline of the power assist column output. This separation had no observable or known intervening cause such as a collision or abusive usage.
Exhibit C.9 shows the upper mating end of the upper end of the upper steering intermediate shaft #2 and the fact that its internal splines are mechanically worn away for approximately 1/4 of the intended mating distance [with the power assist exit spline]. It should be noted that the upper intermediate shaft #2 is actually part of a sliding link, and the malfunction portion was intended by design to have been locked onto the power assist exit spline. Note metallurgical debris inside spline cavity.
Exhibit 12. A photo sequence showing that exemplar vehicle and its upper intermediate steering shaft #2 assembly on the exemplar power assist exit spline annulus. These photos clearly show, with no ambiguity, that a proper installation includes the cinching bolt properly residing in the power assist exit spline annulus.