Inspections and Tests of Engine-Coolant Radiators with Integrated ATF-Temperature-Stabilizing Cylinders from 2005-10 Nissan Light Trucks

Four Nissan radiators were procured, inspected and tested by the Defects Analysis Group at the Vehicle Research and Test Center (VRTC), East Liberty, Ohio, in response to a request to support the Office of Defects Investigation (ODI) on Defect Petition DP12-004. This defect petition was requested by the North Carolina Consumers Council, Inc. (NCCCI). The ODI opening resume[1] listed 512 Vehicle Owner's Questionnaire (VOQs) complaints between late 2005 and early 2012. The ODI and NCCCI complaints allege repeated unexpected slow acceleration, various transmission malfunctions, and other safety concerns due to the engine coolant mixing with the automatic transmission fluid (ATF).

BACKGROUND

Two of the four radiators were procured from a salvage yard and were designated as SY1 and SY2. These salvage yard radiators were used to develop the procedures for inspecting and testing the coolant side of the complete radiator, opening the radiator to expose the internal ATF temperature stabilizing cylinder, and for inspecting and testing the ATF temperature-stabilizing concentric-walled cylinder after removal from the radiator.

The other two radiators were procured from vehicle owners who had filed VOQs with the ODI. The first vehicle was a 2005 Nissan Frontier pickup truck (designated as NF1) and associated with VOQ 10422384. The Vehicle Identification Number (VIN) was 1N6AD07W95C******. The www.safercar.gov complaint on NF1 is shown in the Appendix as Figure 1, was one of 13 owners from Ohio who filed VOQs. Ten of the Ohio complainants were contacted by email, two were contacted by phone, and one was not reachable. Twelve of these owners responded to the list of VRTC questions. The second vehicle was a 2005 Nissan Pathfinder SUV (designated as NP1) and associated with VOQ 10415028. The VIN was 5N1AR18WX5C******. The www.saftercar.gov complaint on NP1 is shown in Figure 2, was from West Virginia, and was located from an expanded search of the VOQs from the states surrounding Ohio. This new area contained 52 owners reporting the problem to ODI, of which 45 were contacted by email and 16 responded. These two owners were the only owners who responded to the VRTC emails and telephone calls, had reportedly experienced the problem, currently owned the vehicle, and still had the original radiator installed in the vehicle.

COLLECTION OF COMPLAINT-VEHICLE RADIATORS

The list of VRTC questions and the email reply of the Ohio owner of NF1 are shown in Figures 3 and 4. Notes from a follow up conversation on July 10th are shown in Figure 5. On July 25th, the owner was met at his local Nissan dealership, and the vehicle was inspected in the parking lot of the dealership. The vehicle and the inspection sheet are shown in Figures 6 and 7, respectively, and the vehicle appeared to be in good condition with 94,278 miles on the odometer. The coolant was low in the radiator, and the ATF could not be checked because the

[1] http://www-odi.nhtsa.dot.gov/acms/cs/jaxrs/download/doc/UCM422685/INOA-DP12004-9949.PDF

dipstick cap was unexpectedly secured in place with a hex-headed screw. The owner again discussed his situation, as listed in the notes in Figure 8, and he said the transmission would operate normally after a restart of the vehicle, even when driving on the freeway, unless he idled as at a stop sign or red traffic light, or after being in motion if he shifted the transmission to Reverse then to Drive. Then the transmission would not shift normally, a malfunction-indicator lamp (MIL) would illuminate on the instrument cluster, the transmission would delay shifting, and the transmission seemed to slip so that the engine speed was higher than normal but the vehicle speed was lower than normal. The owner had the ATF changed 11 months and 2,847 miles ago. All repair orders collected are shown in Figures 9 through 11. The owner reported that the vehicle was no longer his daily commuting vehicle and was saved for trips where he needed the utility of the pickup truck. The drivability of the vehicle was observed and videotaped[2] in operation by the owner and a transcript of that discussion is shown in Figure 12. He discussed the potential risks of someone operating a vehicle in this condition but had not experienced an actual risk-to-safety incident. He was concerned about the repair cost that was estimated to be $4,500 to $7,500.

The vehicle was then brought into the Nissan dealership. The radiator fluids were collected by the service technician, at the locations shown in Figure 13, early and late in the release of the contained fluids to capture possible sediment as well as any floating contamination. The fluids were later photographed with normal lighting, as shown in Figure 14, and with lighting from below, as shown in Figure 15. The technician advised that he had seen this problem with mixed fluids in the past, and that the fluids from this vehicle appeared to be normal. The removal of the radiator was observed, and it appeared to be in good condition, as shown in Figure 16. The radiator was retrieved and brought to VRTC. Since this radiator did not appear to have the cross contamination between the two fluids, the search for a failed radiator continued.

The VOQ complainants contact list was widened to states surrounding Ohio. The initial email reply of the West Virginia owner of NP1 is shown in Figures 17 and 18. On August 28th, the owner was met at his local Nissan dealership, and the vehicle appeared to be in good condition with 126,495 miles on the odometer. The 2005 Nissan Pathfinder SUV had been reported to be not drivable and was to be towed to the dealership for the radiator replacement. At the dealership, the owner discussed his situation, as listed in the notes in Figure 19. The owner reported that he had not been driving the vehicle for approximately one year, but he had driven it to the dealership that day and did not want any additional wear and tear on the transmission. He also said that he had replaced the engine coolant and the ATF approximately 12 months and 40 miles ago. He described the transmission slipping, jerking, the tires making chirping noises, and lack of acceleration when needed, such as pulling out onto a highway. He discussed the potential of being hit by another vehicle due to the lack of acceleration when pulling out into traffic, but he had not experienced an actual risk-to-safety incident. He was concerned about the repair cost that was estimated at $6,000.

The vehicle was brought into the repair bay by the service technician, and then the vehicle was photographed, as shown in Figure 20. The vehicle was also inspected while it was on the hoist. The inspection sheet is shown in Figure 21 and the repair order is shown in Figure 22. The coolant was at a normal level in the radiator. During the fluid collection, shown in Figure 23,

[2] H:\DanPearse\DP12-004-Nissan-ATF_in_Coolant\Nissan Frontier Field Test 25 July 2012- Reduced.wmv

the technician noted that the engine coolant and ATF did not look normal. The fluid sampling included fluid that was released early and late in the draining procedure. The fluids were shown previously in Figures 14 and 15. This technician also advised that he had seen this problem with mixed fluids in the past. The service manager reported that they find mixed fluids in a vehicle being serviced once or twice per month. The removal of the radiator was observed, and it externally appeared to be in good condition, as shown in Figure 24.

INSPECTIONS AND TESTS OF THE SALVAGE-YARD RADIATORS AT VRTC

The coolant side of each radiator was sealed with a stock Nissan non-venting radiator cap, a hose at the lower outlet (capped by clamping it onto a VRTC-made aluminum disk), and a hose at the upper inlet. This hose was fitted with an adapter to inject compressed shop air and measure the internal pressure to the engine coolant side of the radiator. Adjacent to the pressure transducer was a shutoff valve to hold the applied pressure, allowing pressure losses over time to be monitored. The entire radiator was then submerged in a 110-gallon tank and observed for bubbles that would indicate the source of a leak. During this test, the ports to the ATF cylinder were open to the water in the tub and, after the cylinder filled with tank water, were monitored for bubbles indicating a crossover leak. This test loaded the ATF cylinder with external pressure (compressive forces on the concentric walled tube), as the engine coolant was expected to have more pressure than the ATF. The test set up is shown in Figures 25 to 27.

The SY1 salvage radiator tested was found to have an external leak on the coolant side at a gash in the liquid-to-air cooling fins. While this imperfection had been noted before the test, it did not look like the damage included the fluid tubes between the upper and lower plastic-end caps of the radiator. The submersion test revealed the damage was more substantial. This damage may have occurred during the shipping of the radiator from the salvage yard.

The SY2 radiator was tested next. This radiator held the injected pressure at 20 psi without bubbles, indicating no external or internal crossover leak in this unit. Then the shutoff valve was actuated, and the trapped applied pressure held steady over a weekend.

Next, the lower plastic-end cap was removed from the radiator cores by bending the 134 metal tabs outward releasing the crimp seal. The ATF double-walled cylinder was then exposed (but still in the plastic-end cap) and examined visually, as shown in Figure 28. The SY1 ATF cylinder was removed from the plastic-end cap by cutting the cap around each ATF cylinder port, as shown in Figure 29. This removal method did not disturb the retaining nuts that held the ATF cylinder in position in the radiator lower cap. There was a concern that removal of the retaining nuts could change the as-received condition (crack or other damage) of the area around the ATF ports. The SY2 ATF cylinder was tested while still in the lower plastic-end cap.

The test-equipment hose fittings were modified to pressurize the ATF cylinders outside of the radiators and submerged in the tank. Both salvage-yard ATF cylinders held the initial pressure and the trapped pressure for at least four hours. No bubbles were observed. These ATF cylinders did not appear to have any leaks, as shown in Figure 30. This test loaded the ATF cylinder with expansive forces on the concentric walled tube, simulating a higher ATF pressure than engine coolant pressure.

The salvage-yard radiators were examined for corrosion. One theory, proposed by the service writer/technician at a field visit, was that the radiators were being damaged due to lack of maintenance. The anti-corrosives in the coolant are depleted over time, and if the coolant is not changed, corrosion of the radiator components could result. Inside both salvage-yard units, there were light flaky deposits on the interior of the lower end cap and similarly colored powdered deposits on the ATF cylinder, as shown in Figures 31 to 33. There was also corrosion on both salvage-yard radiators along the crimp tabs and O-ring seal between the coolant core and the lower plastic-end cap, as shown in Figures 34 and 35. No leaks were observed at these locations in the submersion tank.

INSPECTIONS AND TESTS OF COMPLAINT-VEHICLE RADIATORS AT VRTC

The complaint radiators were inspected and disassembled one-step-at-a-time, and they were pressure tested between each component removal to insure that the disassembly of the radiator did not affect the ATF cylinder.

The complaint radiator retrieved from NF1 was sealed, pressurized, and submerged in the water tank. The radiator held the initial 20-psi pressure and the trapped pressure for four hours. No bubbles were observed externally nor from the ATF cylinder ports. This result was expected since the fluids collected from this vehicle did not appear to have been compromised.

The radiator retrieved from NP1 was sealed, pressurized, and submerged in the water tank. The radiator bubbled slowly but steadily from the open ATF ports. Two bubbles, one large and one small, were emitted approximately every 10 seconds from one ATF port, as shown in Figure 36. These bubbles indicated a crossover leak between the two fluid systems. The 20-psi pressure was trapped in the radiator by closing the valve, and the pressure dropped slowly to 12 psi over four hours. At the end of the four-hour period, it was also noticed that the radiator core had started to leak air externally along the lower plastic-end cap in the middle with a steady stream of very small bubbles.

Next, the lower plastic-end caps were removed from both complaint radiator cores. The internal ATF cylinders were examined and are shown in Figures 37 to 40. The complaint radiator retrieved from NF1 had light deposits inside the plastic-end cap and on the cylinder similar to the salvage yard units. There was light corrosion at one corner of the radiator core, as shown in Figure 41. The radiator retrieved from NP1 did not have those deposits, but it did have significant corrosion along the middle section of the radiator core where the slow leak developed late in the four-hour pressure hold test, as shown in Figures 42 to 44.

The ATF cylinders of the radiators from the complaint vehicles were then pressure tested while still in the lower plastic-end cap and submerged in the tank. The ATF cylinder from NF1 held the 20-psi pressure, as shown in Figure 45. Then the valve was turned to seal the pressure in the cylinder, and it held steady for four hours. No further pressure tests were conducted on this unit.

The ATF cylinder from NP1 was pressure tested while still installed in the lower plastic-end cap, and it leaked from both ends near the ATF ports, as shown in Figure 46, with only 1-psi of

pressure. Upon a closer look, it was noted that both ends were leaking from an area just inboard of the ports near the point where the mounting disk of the port met the cylinder, as shown in Figure 47. The lower end plastic-cap was then cut away by hand with a hacksaw to avoid loading the port area by unscrewing the mounting nuts, as had previously been discussed with the salvage yard unit. The ATF cylinder was again submerged, and there was more visibility in the area of the leak. The right and left sides had identical leak points immediately inboard of the port mounting disks, as shown in Figures 48 and 49. The remaining plastic section of the lower-end cap was then clamped in a vise (to avoid loading the port mounting disks at the attachment points to the ATF cylinder) and the original mounting nuts removed. Both sides had significant corrosion debris under the exterior mounting nuts, as shown in Figure 50. The ATF cylinder was again submerged to inspect the leak points. The trail of bubbles was clearly from the inner contact point of the inlet and outlet port disks and the cylinder, as shown in Figures 51 and 52. The ATF cylinder was pressurized to 20 psi, and the shutoff valve was actuated. The ATF cylinder leaked to 0-psi pressure in 11 seconds. This expansive-force-pressure test leaked at a much higher rate than the previous compressive-force-pressure test conducted with the entire radiator.

MICROSCOPIC INSPECTION OF THE ATF CYLINDERS AT THE ATF PORTS

The NP1 ATF cylinder was dried, and the left port area was observed under the stereo microscope. The tube was lightly pressurized, and small milky bubbles appeared at the intersection of the left port disk and the cylinder, as shown at a magnification of 5X in Figure 53. Then a slight vacuum was applied to the cylinder to remove the liquid from the area of interest, as shown at 15X in Figure 54, revealing a fracture in the thin-walled cylinder. A closer view of this area, at 25X, showed additional radial cracks in the cylinder surface emanating away from the central tear, as shown in Figure 55. This fracture appeared to be the result of normal hoop stress on the cylinder in an area that was restrained by the port disk that resulted in a stress concentration and a fatigue fracture. Next, the right port area was examined, as shown in Figure 56 at a magnification of 3X, and the cylinder wall appeared to be intact. The fracture became apparent under a magnification of 10X, as shown in Figure 57. A close-up of the area is shown at a magnification of 50X in Figure 58, and the thin cylinder wall was again separated along the line of the filler alloy of the weld.

Outboard of each ATF mounting-port disk is a similar interface between the disk and the cylinder. No leaks were observed in these areas. The cylinder is not pressurized in this area due to the location of the end cap for the double-walled cylinder, as shown in Figure 59. The overall cylinder was again inspected for signs of other abuse. The salvage-yard radiators had bent ATF inlet/outlet ports from removal or shipping damage. This deformation could stress the disk/cylinder area. The ATF inlet/outlet tubes on the complaint cylinders showed no signs of abuse. The installation nuts holding the ATF cylinder to the lower plastic-end cap did not appear to have been over torqued, and the fractures did not seem to have a torsional feature.

The NF1 ATF cylinder was inspected with the stereomicroscope in the area of the failure of the NP1 ATF cylinder. It was observed to have a wider attachment weld-filler alloy area and cracks along the same surface on both ends, as shown in Figures 60 to 63. The two salvage-yard ATF cylinders were inspected at each end, and it was found that three of the four ends also had

cracks in the same area of concern, as shown in Figures 64 to 71. However, these units did not leak at these points in the submersion tests.

The ATF cylinder SY1 was cut open to observe the inner construction of the temperature stabilization cylinder and to see the underside of the port disk in the area of the cracks. The interior was found to be filled with fins, as shown in Figures 72 and 73. It was not possible to remove the interior fins without disturbing the cylinder wall area to study the area under the port disk.

In summary, four radiators were inspected and tested. Two were from salvage yards and were used to develop the procedures for testing and inspecting the other two radiators, which were from complaint vehicles. The owners of the two complaint radiators were interviewed and their concerns were financial based and that this failure could put someone in danger, but they had no specific safety-risk event to report. The radiator from one complaint vehicle was found to be in good condition, and the owner's transmission problems were not related to the radiator or fluid cross contamination of engine coolant and ATF. The second radiator from a complaint vehicle was found to have crossover contamination. When the radiator was pressurized and submerged, bubbles were emitted from the ATF ports. After removing the ATF temperature stabilization tube and pressurizing the tube, bubbles were emitted from near the discs at the mounting points of the ATF ports. When examined under a microscope, cracks and fractures were observed at the lead points. The other three nonleaking ATF cylinders were inspected under the microscope and found that five of the six ATF port areas were cracked similarly to the leaking unit.

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APPENDIX

List of Abbreviations

50X	**microscope magnification - ratio of apparent size being 50 times the true size**
ATF	**automatic transmission fluid**
DP	**defect petition**
NCCCI	**North Carolina Consumers Council, Inc.**
MIL	**malfunction indicator lamp**
NF1	**Nissan Frontier pickup truck #1**
NHTSA	**National Highway Traffic Safety Administration**
NP1	**Nissan Pathfinder SUV #1**
ODI	**Office of Defects Investigation**
SUV	**sport utility vehicle**
SY1	**salvage-yard radiator #1**
SY2	**salvage-yard radiator #2**
USDOT	**United States Department of Transportation**
VIN	**vehicle identification number**
VOQ	**vehicle owner's questionnaire from ODI**
VRTC	**Vehicle Research and Test Center**

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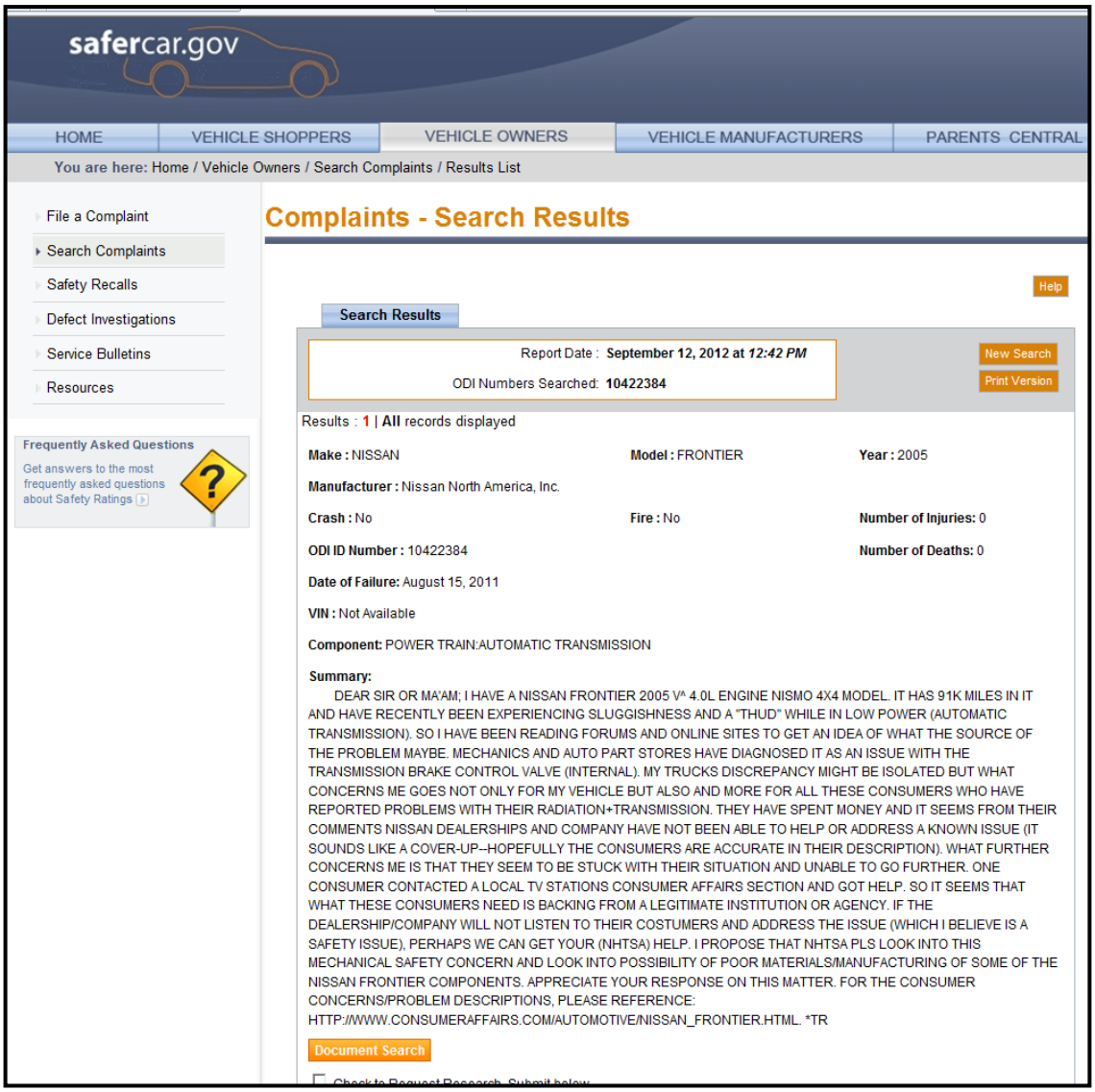
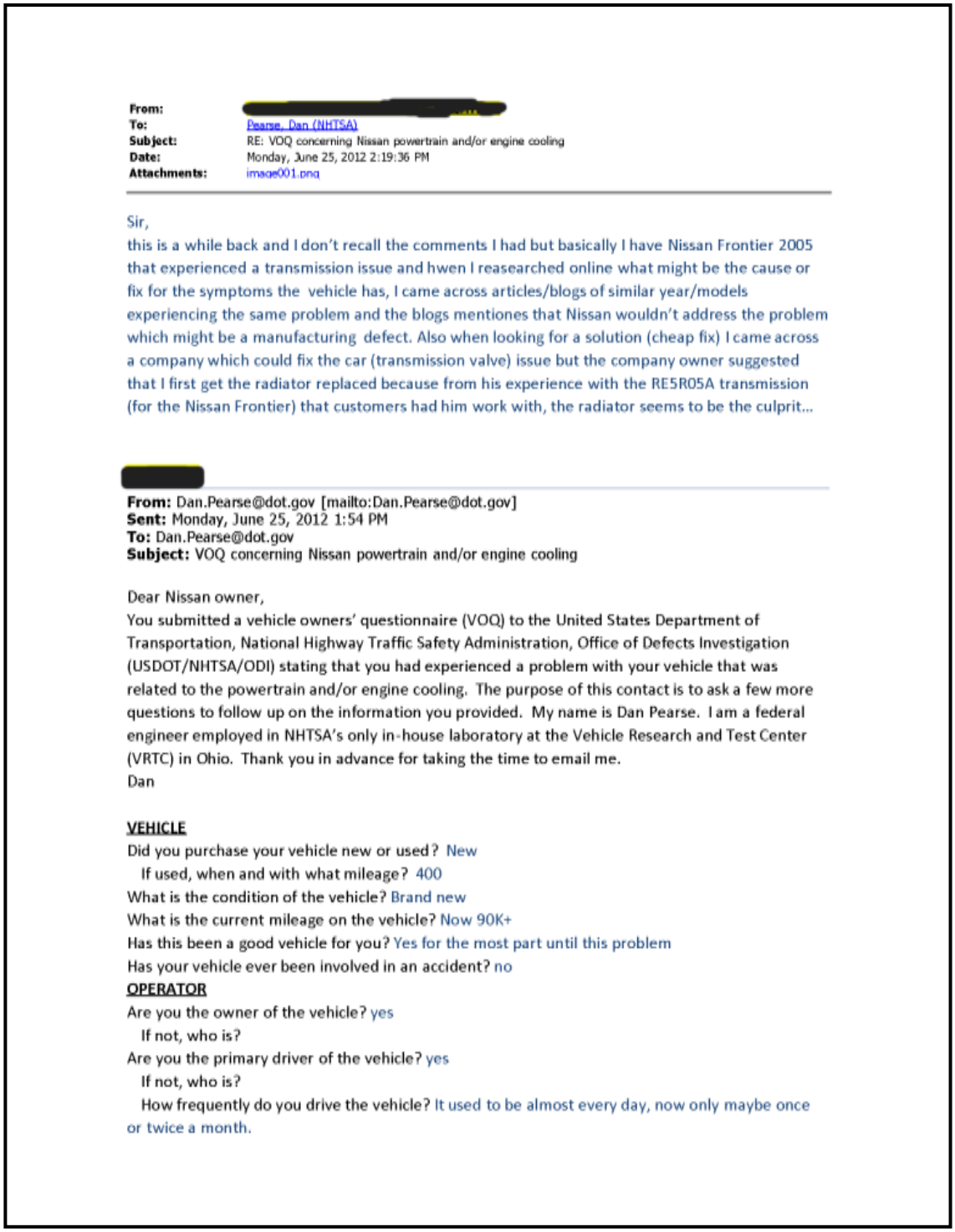


Figure 1 – VOQ 10422384 from www.safercar.gov with the Owner's Description of his Complaint on Vehicle NF1

Figure 2 – VOQ 10415028 from www.safercar.gov with the Owner's Description of his Complaint on Vehicle NP1



From: [redacted]
To: Pearse, Dan (NHTSA)
Subject: RE: VOQ concerning Nissan powertrain and/or engine cooling
Date: Monday, June 25, 2012 2:19:36 PM
Attachments: image001.png

Sir,
this is a while back and I don't recall the comments I had but basically I have Nissan Frontier 2005 that experienced a transmission issue and hwen I reasearched online what might be the cause or fix for the symptoms the vehicle has, I came across articles/blogs of similar year/models experiencing the same problem and the blogs mentiones that Nissan wouldn't address the problem which might be a manufacturing defect. Also when looking for a solution (cheap fix) I came across a company which could fix the car (transmission valve) issue but the company owner suggested that I first get the radiator replaced because from his experience with the RE5R05A transmission (for the Nissan Frontier) that customers had him work with, the radiator seems to be the culprit...

[redacted]

From: Dan.Pearse@dot.gov [mailto:Dan.Pearse@dot.gov]
Sent: Monday, June 25, 2012 1:54 PM
To: Dan.Pearse@dot.gov
Subject: VOQ concerning Nissan powertrain and/or engine cooling

Dear Nissan owner,
You submitted a vehicle owners' questionnaire (VOQ) to the United States Department of Transportation, National Highway Traffic Safety Administration, Office of Defects Investigation (USDOT/NHTSA/ODI) stating that you had experienced a problem with your vehicle that was related to the powertrain and/or engine cooling. The purpose of this contact is to ask a few more questions to follow up on the information you provided. My name is Dan Pearse. I am a federal engineer employed in NHTSA's only in-house laboratory at the Vehicle Research and Test Center (VRTC) in Ohio. Thank you in advance for taking the time to email me.
Dan

VEHICLE
Did you purchase your vehicle new or used? New
If used, when and with what mileage? 400
What is the condition of the vehicle? Brand new
What is the current mileage on the vehicle? Now 90K+
Has this been a good vehicle for you? Yes for the most part until this problem
Has your vehicle ever been involved in an accident? no
OPERATOR
Are you the owner of the vehicle? yes
If not, who is?
Are you the primary driver of the vehicle? yes
If not, who is?
How frequently do you drive the vehicle? It used to be almost every day, now only maybe once or twice a month.

Figure 3 – Email Survey from Owner of NF1 – Page 1

Were you driving the vehicle at the time of the reported incident? yes

If not, who was?

PRIOR TO THE INCIDENT

Had you experienced any problems with the drivability of the vehicle prior to the incident? no

When did the previous problems appear? Almost a year and a half ago I think...

How frequently did these problems appear? Every time driven.

What did you experience? A thud in the gearshift when starting to accelerate, computer code issues with the Brake Control Solenoid.. yet the transmission fluid I guess is what one describes as "frothy" with bubbles In it???—which could be an indication of coolant that leaked into the transmission system....

DURING THE REPORTED INCIDENT

Please describe what happened during the reported incident. normal

What were the roadway type and conditions? Regular residence road

What were the surrounding traffic conditions? Neighborhood, city

CURRENT CONDITION OF THE VEHICLE

Has the vehicle radiator been replaced or repaired? No--

Has the vehicle transmission been replaced or repaired? No

Does your vehicle still exhibit the concern you identified in your VOQ? yes

OTHER

Do you have anything that you wish to add? Due to the symptom the mileage has really gone down observably—this is probably due to wasted gas when vehicle is accelerating. Basically, once the "thud" sound happen, it is hard for the vehicle to get started moving (while in 1st or 2nd gear—automatic trasnmission). Have to step on the gas more—as if the transmission fails to engage immediately (almost slipping) and it doesn't' seem to shift in the highest gear instantly unlike before when the vehicle was new, didn't have this problem.

When I took it to the transmission place, they estimated a $4500 to $7500(if transmission is ot be replaced) to fix and/or open up transmission. Probably more if the radiator system need to be fixed.. Researching the website I found blogs of owners who have removed their Valve body and installed spring, bearing kits and/or sent their transmission valve bodies to a companies that upgrade them to Racing Spec which would hopefully replace the failed components—Control valve...but of course if the cooling system will leak coolant again, then the problem will resurface an or the coolant will cause other transmission issues...?

I suspect that the coolant system might be leaking internally because of the transmission fluid I removed (as a sample) and that the coolant fluid reservoir seem to run low faster... but of course this is something I have to verify..

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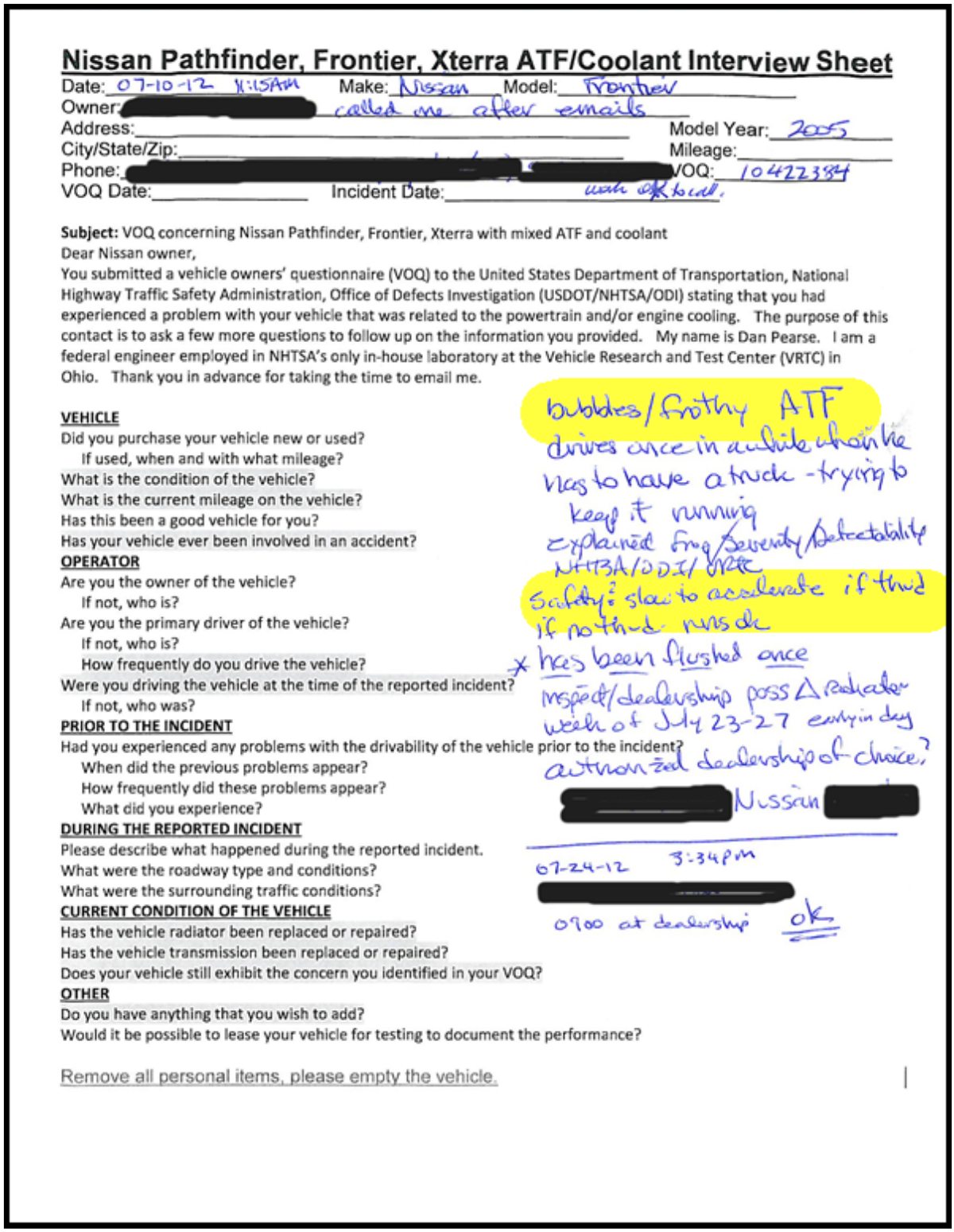
Dan.Pearse@nhtsa.dot.gov 937-666-4511

Figure 4 – Email Survey from Owner of Vehicle NF1 – Page 2



Nissan Pathfinder, Frontier, Xterra ATF/Coolant Interview Sheet

Date: 07-10-12 11:15AM Make: Nissan Model: Frontier
Owner: [redacted] called me after emails
Address: Model Year: 2005
City/State/Zip: Mileage:
Phone: [redacted] VOQ: 10422384
VOQ Date: Incident Date: unk & told.

Subject: VOQ concerning Nissan Pathfinder, Frontier, Xterra with mixed ATF and coolant
Dear Nissan owner,
You submitted a vehicle owners' questionnaire (VOQ) to the United States Department of Transportation, National Highway Traffic Safety Administration, Office of Defects Investigation (USDOT/NHTSA/ODI) stating that you had experienced a problem with your vehicle that was related to the powertrain and/or engine cooling. The purpose of this contact is to ask a few more questions to follow up on the information you provided. My name is Dan Pearse. I am a federal engineer employed in NHTSA's only in-house laboratory at the Vehicle Research and Test Center (VRTC) in Ohio. Thank you in advance for taking the time to email me.

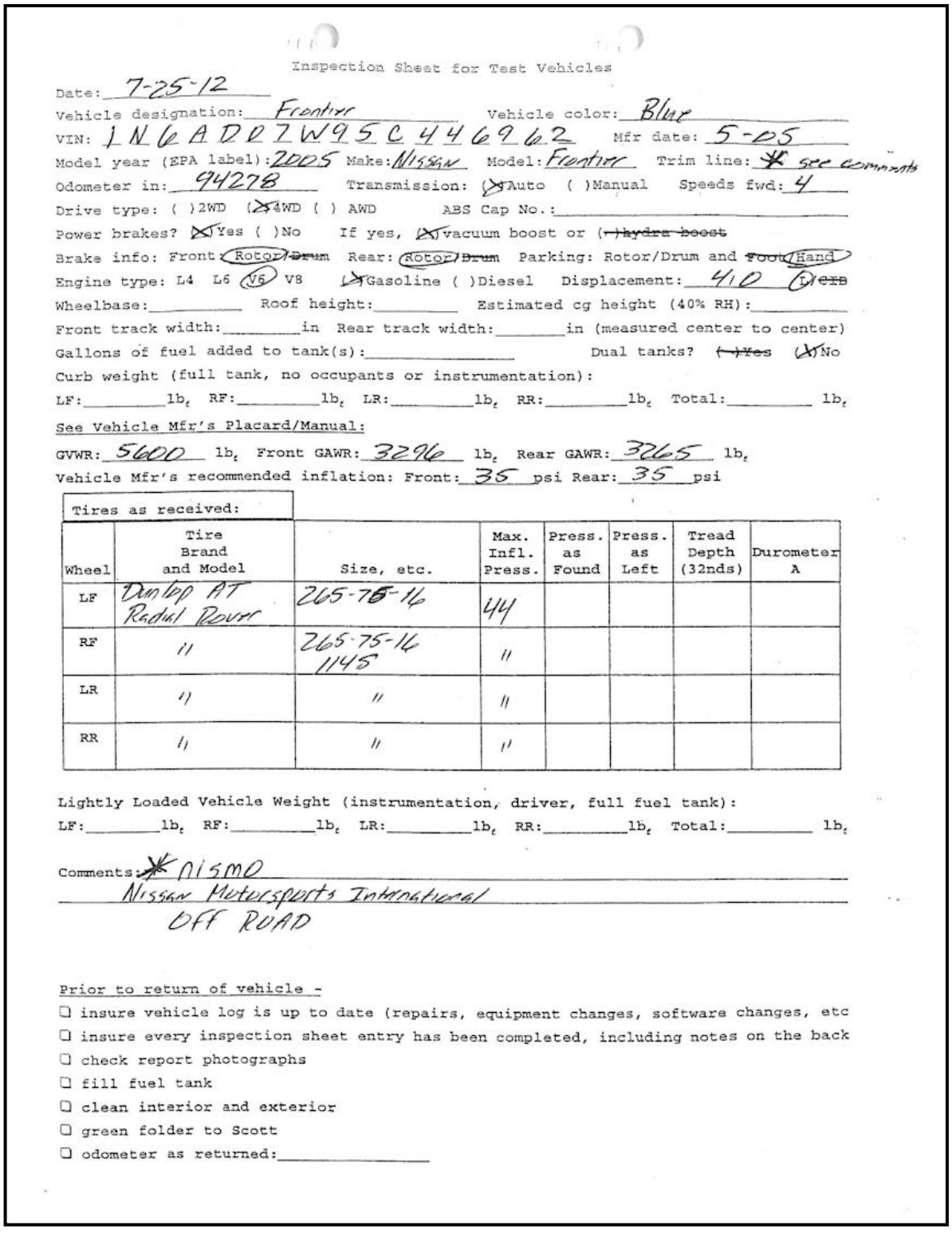
VEHICLE
Did you purchase your vehicle new or used?
If used, when and with what mileage?
What is the condition of the vehicle?
What is the current mileage on the vehicle?
Has this been a good vehicle for you?
Has your vehicle ever been involved in an accident?
OPERATOR
Are you the owner of the vehicle?
If not, who is?
Are you the primary driver of the vehicle?
If not, who is?
How frequently do you drive the vehicle?
Were you driving the vehicle at the time of the reported incident?
If not, who was?
PRIOR TO THE INCIDENT
Had you experienced any problems with the drivability of the vehicle prior to the incident?
When did the previous problems appear?
How frequently did these problems appear?
What did you experience?
DURING THE REPORTED INCIDENT
Please describe what happened during the reported incident.
What were the roadway type and conditions?
What were the surrounding traffic conditions?
CURRENT CONDITION OF THE VEHICLE
Has the vehicle radiator been replaced or repaired?
Has the vehicle transmission been replaced or repaired?
Does your vehicle still exhibit the concern you identified in your VOQ?
OTHER
Do you have anything that you wish to add?
Would it be possible to lease your vehicle for testing to document the performance?

Remove all personal items, please empty the vehicle.

bubbles/frothy ATF
drives once in awhile then he has to have a truck - trying to keep it running
explained frq/Severity/Detectability NHTSA/ODI/ VRTC
Safety? slow to accelerate if thru if not thru runs ok
* has been flushed once
insp@/dealership poss Δ radiator week of July 23-27 early in day
authorized dealership of choice?
[redacted] Nissan [redacted]
07-24-12 3:34pm
[redacted]
0900 at dealership ok

Figure 5 – Phone Notes from Conversation with Owner of Vehicle NF1

Figure 6 – Vehicle NF1 During Inspection at the Dealership Prior to Service



Inspection Sheet for Test Vehicles

Date: 7-25-12

Vehicle designation: Frontier Vehicle color: Blue

VIN: 1N6ADD7W95C446962 Mfr date: 5-05

Model year (EPA label): 2005 Make: Nissan Model: Frontier Trim line: * see comments

Odometer in: 94278 Transmission: (X) Auto ( ) Manual Speeds fwd: 4

Drive type: ( ) 2WD (X) 4WD ( ) AWD ABS Cap No.:

Power brakes? (X) Yes ( ) No If yes, (X) vacuum boost or ( ) ~~hydra-boost~~

Brake info: Front: (Rotor) ~~Drum~~ Rear: (Rotor) ~~Drum~~ Parking: Rotor/Drum and ~~Foot~~ (Hand)

Engine type: L4 L6 (V6) V8 (X) Gasoline ( ) Diesel Displacement: 4.0 (L) ~~cid~~

Wheelbase: Roof height: Estimated cg height (40% RH):

Front track width: in Rear track width: in (measured center to center)

Gallons of fuel added to tank(s): Dual tanks? ~~( ) Yes~~ (X) No

Curb weight (full tank, no occupants or instrumentation):

LF: lb, RF: lb, LR: lb, RR: lb, Total: lb,

See Vehicle Mfr's Placard/Manual:

GVWR: 5600 lb, Front GAWR: 3296 lb, Rear GAWR: 3265 lb,

Vehicle Mfr's recommended inflation: Front: 35 psi Rear: 35 psi

Tires as received:

Wheel	Tire Brand and Model	Size, etc.	Max. Infl. Press.	Press. as Found	Press. as Left	Tread Depth (32nds)	Durometer A
LF	Dunlop AT Radial Rover	265-75-16	44				
RF	"	265-75-16 1145	"				
LR	"	"	"				
RR	"	"	"				

Lightly Loaded Vehicle Weight (instrumentation, driver, full fuel tank):

LF: lb, RF: lb, LR: lb, RR: lb, Total: lb,

Comments: * NISMO
Nissan Motorsports International
OFF ROAD

Prior to return of vehicle -

- ☐ insure vehicle log is up to date (repairs, equipment changes, software changes, etc
- ☐ insure every inspection sheet entry has been completed, including notes on the back
- ☐ check report photographs
- ☐ fill fuel tank
- ☐ clean interior and exterior
- ☐ green folder to Scott
- ☐ odometer as returned:

Figure 7 – Inspection Sheet from Vehicle NF1

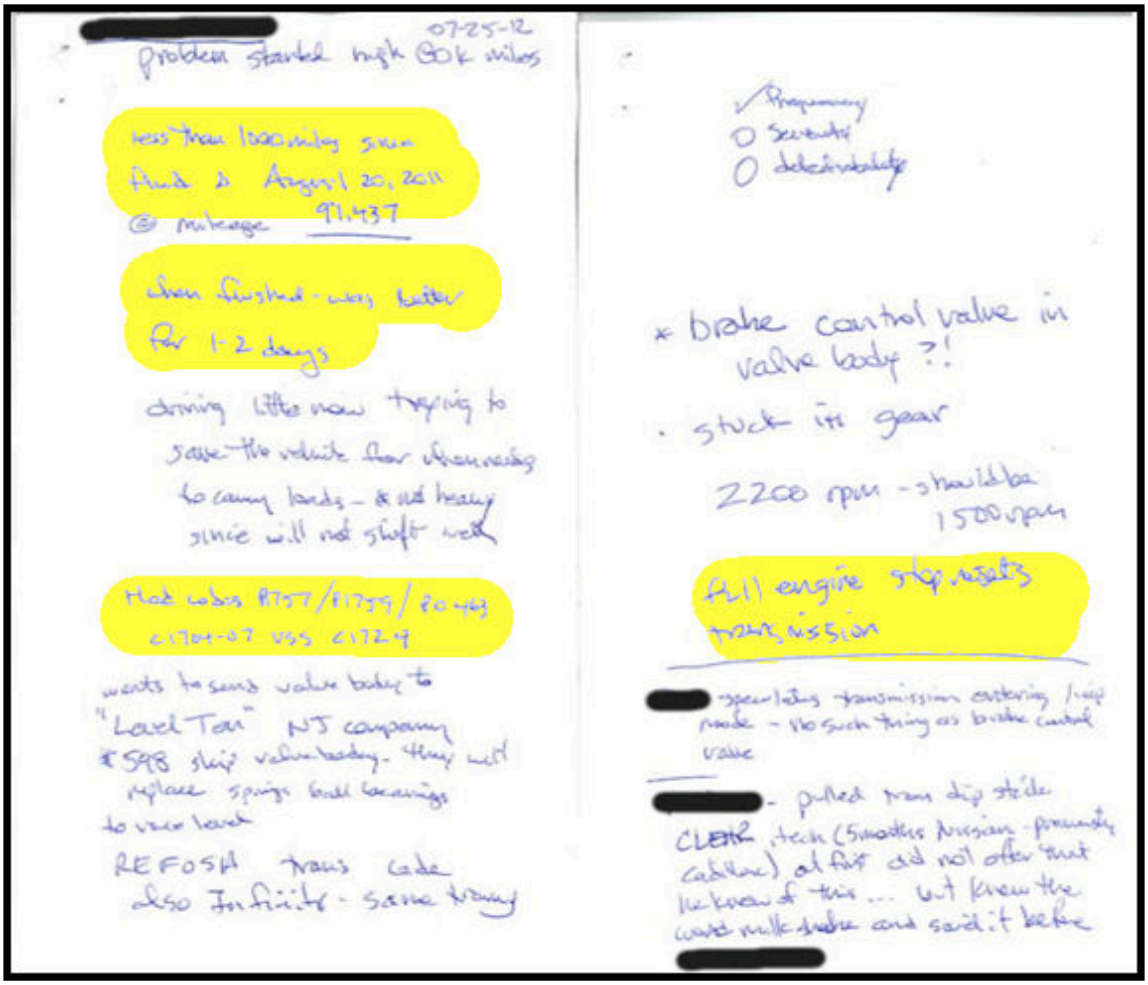
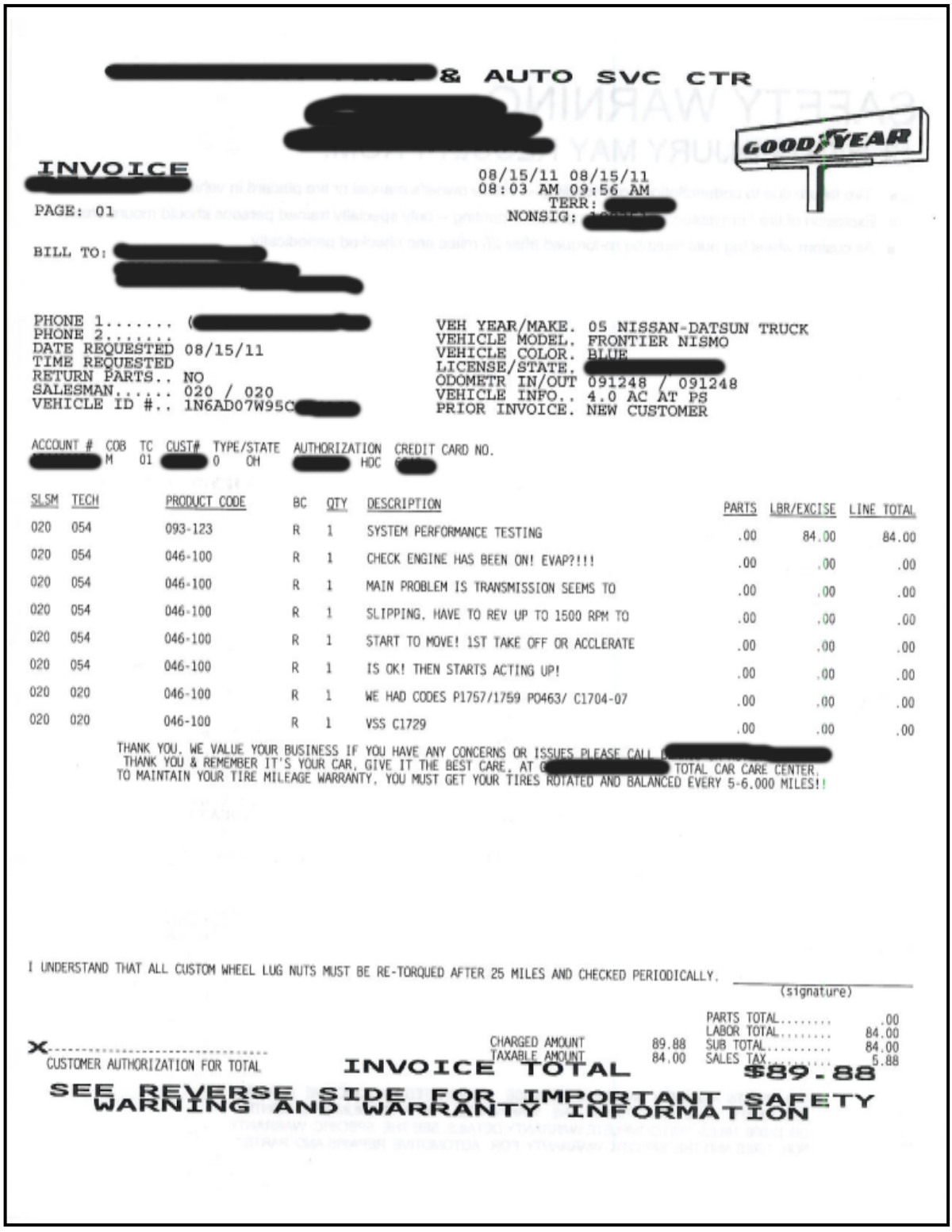


Figure 8 – Interview Notes at the Dealership with the Owner of Vehicle NF1



[redacted] & AUTO SVC CTR

[redacted]

GOODYEAR

INVOICE [redacted]

08/15/11 08/15/11
08:03 AM 09:56 AM
TERR: [redacted]
NONSIG: [redacted]

PAGE: 01

BILL TO: [redacted]

PHONE 1..... ([redacted]
PHONE 2.....
DATE REQUESTED 08/15/11
TIME REQUESTED
RETURN PARTS.. NO
SALESMAN..... 020 / 020
VEHICLE ID #.. 1N6AD07W95C[redacted]

VEH YEAR/MAKE. 05 NISSAN-DATSUN TRUCK
VEHICLE MODEL. FRONTIER NISMO
VEHICLE COLOR. BLUE
LICENSE/STATE. [redacted]
ODOMETR IN/OUT 091248 / 091248
VEHICLE INFO.. 4.0 AC AT PS
PRIOR INVOICE. NEW CUSTOMER

ACCOUNT #	COB	TC	CUST#	TYPE/STATE	AUTHORIZATION	CREDIT CARD NO.
[redacted]	M	01	[redacted]	0 OH	[redacted]	HDC [redacted]

SLSM	TECH	PRODUCT CODE	BC	QTY	DESCRIPTION	PARTS	LBR/EXCISE	LINE TOTAL
020	054	093-123	R	1	SYSTEM PERFORMANCE TESTING	.00	84.00	84.00
020	054	046-100	R	1	CHECK ENGINE HAS BEEN ON! EVAP?!!!	.00	.00	.00
020	054	046-100	R	1	MAIN PROBLEM IS TRANSMISSION SEEMS TO	.00	.00	.00
020	054	046-100	R	1	SLIPPING. HAVE TO REV UP TO 1500 RPM TO	.00	.00	.00
020	054	046-100	R	1	START TO MOVE! 1ST TAKE OFF OR ACCLERATE	.00	.00	.00
020	054	046-100	R	1	IS OK! THEN STARTS ACTING UP!	.00	.00	.00
020	020	046-100	R	1	WE HAD CODES P1757/1759 P0463/ C1704-07	.00	.00	.00
020	020	046-100	R	1	VSS C1729	.00	.00	.00

THANK YOU. WE VALUE YOUR BUSINESS IF YOU HAVE ANY CONCERNS OR ISSUES PLEASE CALL [redacted]
THANK YOU & REMEMBER IT'S YOUR CAR, GIVE IT THE BEST CARE. AT [redacted] TOTAL CAR CARE CENTER.
TO MAINTAIN YOUR TIRE MILEAGE WARRANTY, YOU MUST GET YOUR TIRES ROTATED AND BALANCED EVERY 5-6,000 MILES!!

I UNDERSTAND THAT ALL CUSTOM WHEEL LUG NUTS MUST BE RE-TORQUED AFTER 25 MILES AND CHECKED PERIODICALLY. _____ (signature)

X----------
CUSTOMER AUTHORIZATION FOR TOTAL

CHARGED AMOUNT 89.88
TAXABLE AMOUNT 84.00

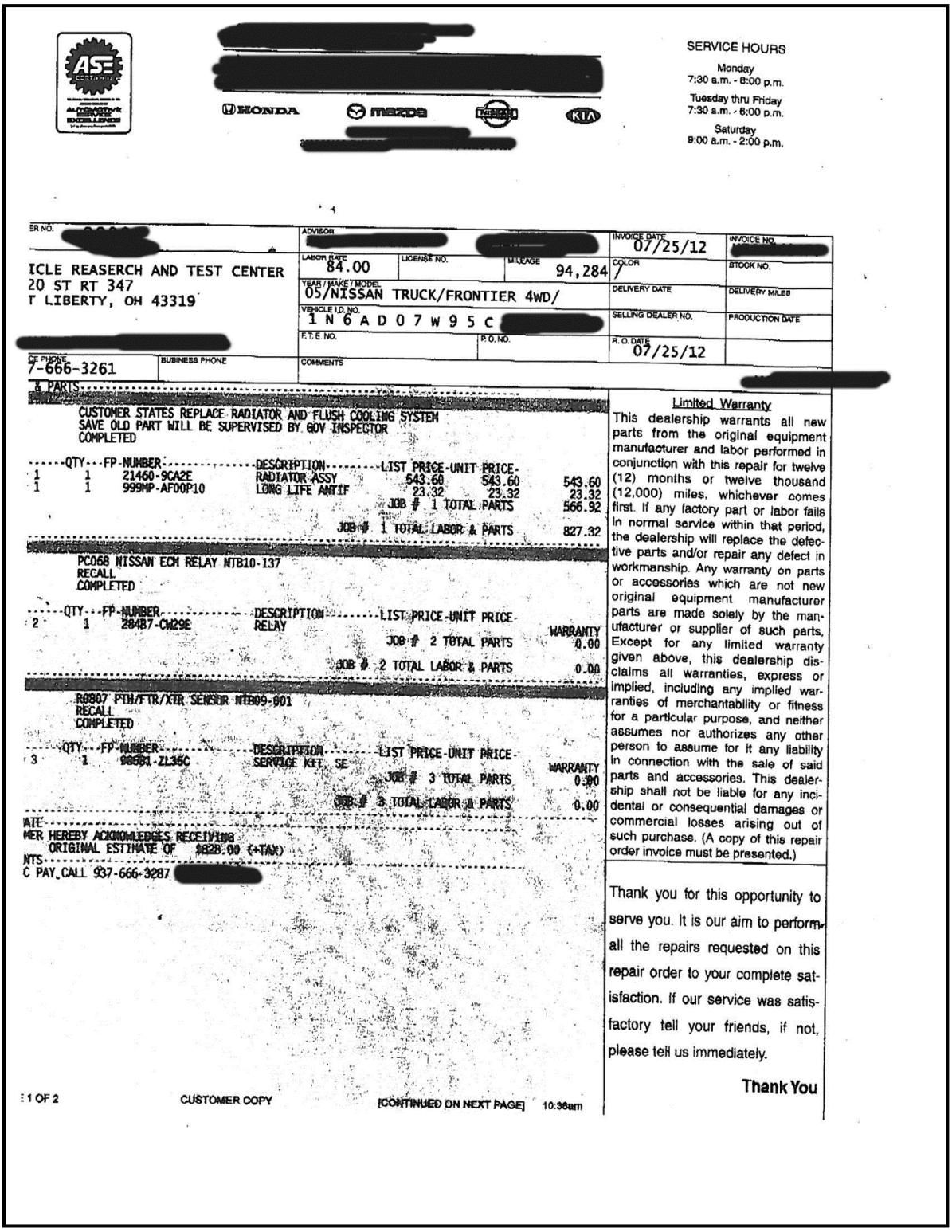
PARTS TOTAL..... .00
LABOR TOTAL..... 84.00
SUB TOTAL..... 84.00
SALES TAX..... 5.88

INVOICE TOTAL $89.88

SEE REVERSE SIDE FOR IMPORTANT SAFETY WARNING AND WARRANTY INFORMATION

Figure 9 – Previous Repair Order from the Owner of NF1 Page 1

Figure 10 – Previous Repair Order from the Owner of NF1 Page 2



SERVICE HOURS
Monday
7:30 a.m. - 8:00 p.m.
Tuesday thru Friday
7:30 a.m. - 6:00 p.m.
Saturday
8:00 a.m. - 2:00 p.m.

HONDA mazda NISSAN KIA

ICLE REASERCH AND TEST CENTER
20 ST RT 347
T LIBERTY, OH 43319

7-666-3261

ADVISOR | INVOICE DATE 07/25/12 | INVOICE NO.
LABOR RATE 84.00 | LICENSE NO. | MILEAGE 94,284 | COLOR | STOCK NO.
YEAR/MAKE/MODEL 05/NISSAN TRUCK/FRONTIER 4WD/ | DELIVERY DATE | DELIVERY MILES
VEHICLE I.D. NO. 1N6AD07W95C | SELLING DEALER NO. | PRODUCTION DATE
F.T.E. NO. | P.O. NO. | R.O. DATE 07/25/12
OF PHONE | BUSINESS PHONE | COMMENTS

& PARTS

CUSTOMER STATES REPLACE RADIATOR AND FLUSH COOLING SYSTEM
SAVE OLD PART WILL BE SUPERVISED BY GOV INSPECTOR
COMPLETED

QTY	FP	NUMBER	DESCRIPTION	LIST PRICE	UNIT PRICE	
1	1	21460-9CA2E	RADIATOR ASSY	543.60	543.60	543.60
1	1	999MP-AF00P10	LONG LIFE ANTIF	23.32	23.32	23.32
				JOB # 1 TOTAL PARTS		566.92
				JOB # 1 TOTAL LABOR & PARTS		827.32

PC068 NISSAN ECM RELAY NTB10-137
RECALL
COMPLETED

QTY	FP	NUMBER	DESCRIPTION	LIST PRICE	UNIT PRICE	
2	1	284B7-CM29E	RELAY			WARRANTY
				JOB # 2 TOTAL PARTS		0.00
				JOB # 2 TOTAL LABOR & PARTS		0.00

R0807 PTH/FTR/XTR SENSOR NTB09-001
RECALL
COMPLETED

QTY	FP	NUMBER	DESCRIPTION	LIST PRICE	UNIT PRICE	
3	1	98581-ZL35C	SERVICE KIT, SE			WARRANTY
				JOB # 3 TOTAL PARTS		0.00
				JOB # 3 TOTAL LABOR & PARTS		0.00

ATE
MER HEREBY ACKNOWLEDGES RECEIVING
ORIGINAL ESTIMATE OF $828.00 (+TAX)
NTS
C PAY CALL 937-666-3287

Limited Warranty

This dealership warrants all new parts from the original equipment manufacturer and labor performed in conjunction with this repair for twelve (12) months or twelve thousand (12,000) miles, whichever comes first. If any factory part or labor fails in normal service within that period, the dealership will replace the defective parts and/or repair any defect in workmanship. Any warranty on parts or accessories which are not new original equipment manufacturer parts are made solely by the manufacturer or supplier of such parts. Except for any limited warranty given above, this dealership disclaims all warranties, express or implied, including any implied warranties of merchantability or fitness for a particular purpose, and neither assumes nor authorizes any other person to assume for it any liability in connection with the sale of said parts and accessories. This dealership shall not be liable for any incidental or consequential damages or commercial losses arising out of such purchase. (A copy of this repair order invoice must be presented.)

Thank you for this opportunity to serve you. It is our aim to perform all the repairs requested on this repair order to your complete satisfaction. If our service was satisfactory tell your friends, if not, please tell us immediately.

Thank You

1 OF 2 CUSTOMER COPY [CONTINUED ON NEXT PAGE] 10:36am

Figure 11 – Repair Order from the Replacement of the Radiator on NF1

Transcript of video while riding with owner who filed VOQ 1042384

Driver:	It is only normal on the first go, before you stop. And, only when you do not reverse.
Passenger:	OK.
Driver:	So I'm going to try it. I'm going to do it again.
Passenger:	Yes.
Driver:	It's probably going to work.
Driver:	Now if you put it in drive without…without reversing right. It will move. See?
Passenger:	OK.
Driver:	It may be 1000 rpm but…
Passenger:	And lets see what it does on the acceleration on our way back.
Driver:	Once I stop, that's when the problem happens.
Passenger:	It's going to happen right now again?
Driver:	Yeah, if…if I stop at a stop sign or if we hear a thud….if I reverse I will hear the thud very pronounced
Passenger:	Don't reverse.
Driver:	Don't reverse. See right now. It is fine. Maybe a couple of stops, or a stop after [it will act up again].
Passenger:	So it sounds and feels different?
Driver:	Right. See, see you feel that acceleration…you see the (points to tachometer)…you feel the gear change?
Passenger:	Yes.
Driver	And there's no struggling…there's a little bit of struggling but not a whole lot.
Time Brake in Video	
Driver:	There it is struggling again.
Passenger:	Yes.
Driver:	It's up to 2,000 and I'm stepping where I would normally be at 40 miles per hour. I doesn't get up there until…you know a few seconds later. It's still accelerating.
Driver:	At this rate I should be going 50 for how I was stepping on the gas.
Driver:	And once you get going…get going, but sometimes…somehow it doesn't get up to a higher gear. I can go up to 65…70 and it will go up to 3,000 rpm and above it just doesn't shift into the highest gear. Because I think that normally if I go about 80 the next…the last gear kicks in. And…
Passenger:	Uh-huh.
Driver:	It's at 70 and 80, should kick in then. But if I step on the gas and accelerate such as I did there, it seems to just rev up instead of [go]. When this first happens… but if that does not happen then or it doesn't get stuck on stop…its fine. But if I get stuck on a stop sign…If I stop once, it's gonna have the symptoms. If I don't stop once, if I just keep going without having reversed, its fine. You know but, I have to stop somewhere normally. So if we're go to go on the freeway…from a stop, and just starting it right off at the entrance, it wouldn't have a problem.

Figure 12 – Transcript of Discussion from the Video While Riding with the Owner in NF1

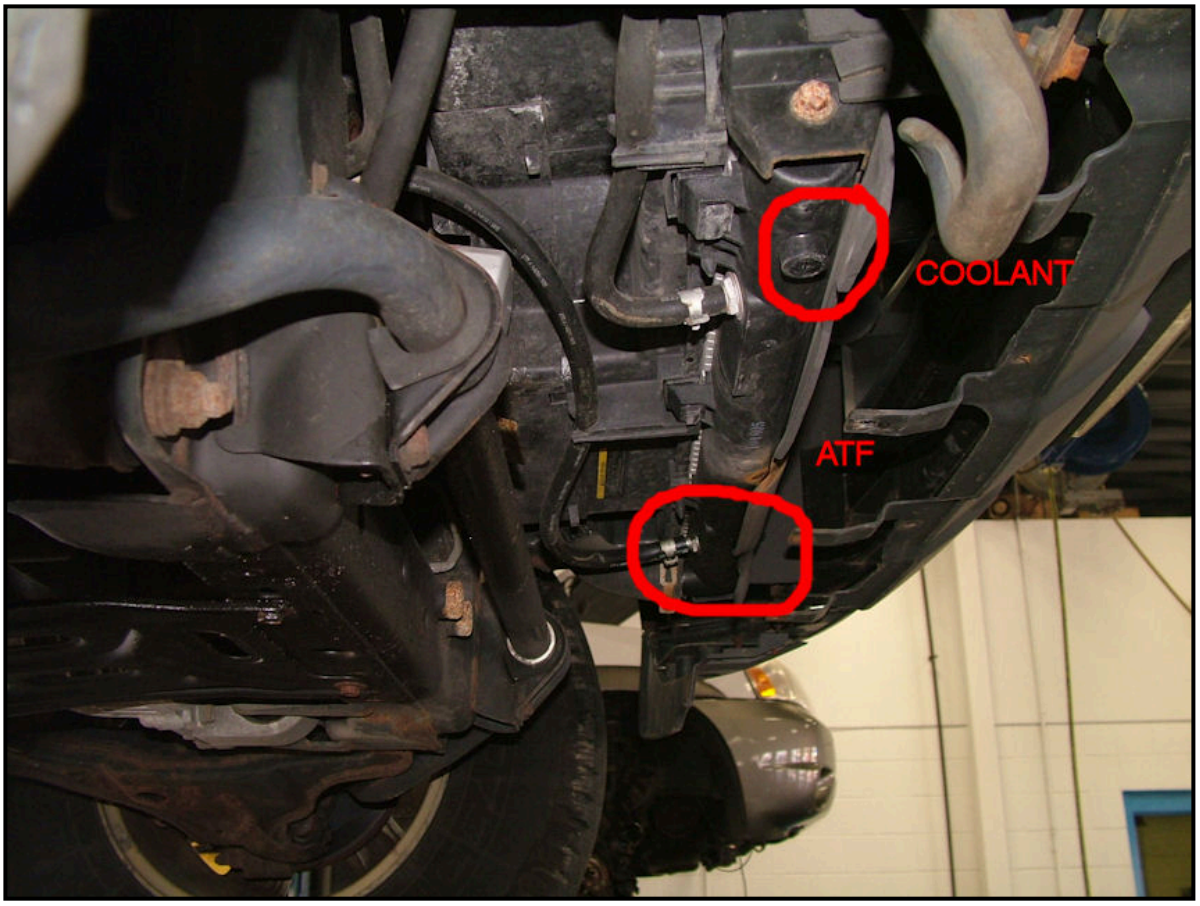


Figure 13 – Drain Points for Fluid Collections from NF1

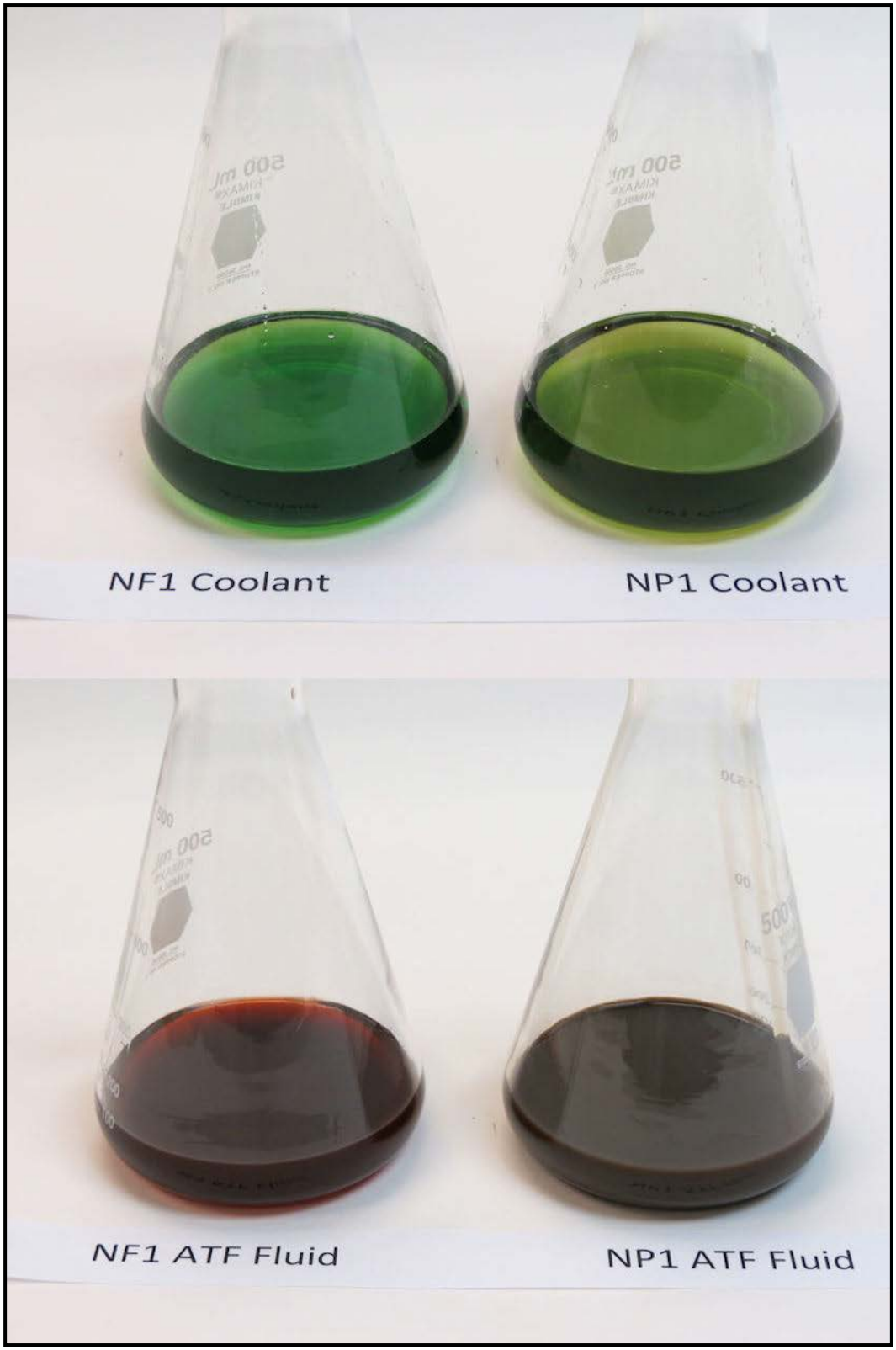


Figure 14 – Engine Coolant and ATF Samples from NF1 and NP1

[The fluids from NF1 were Deemed Normal, While Fluids from NP1 were Considered Abnormal]

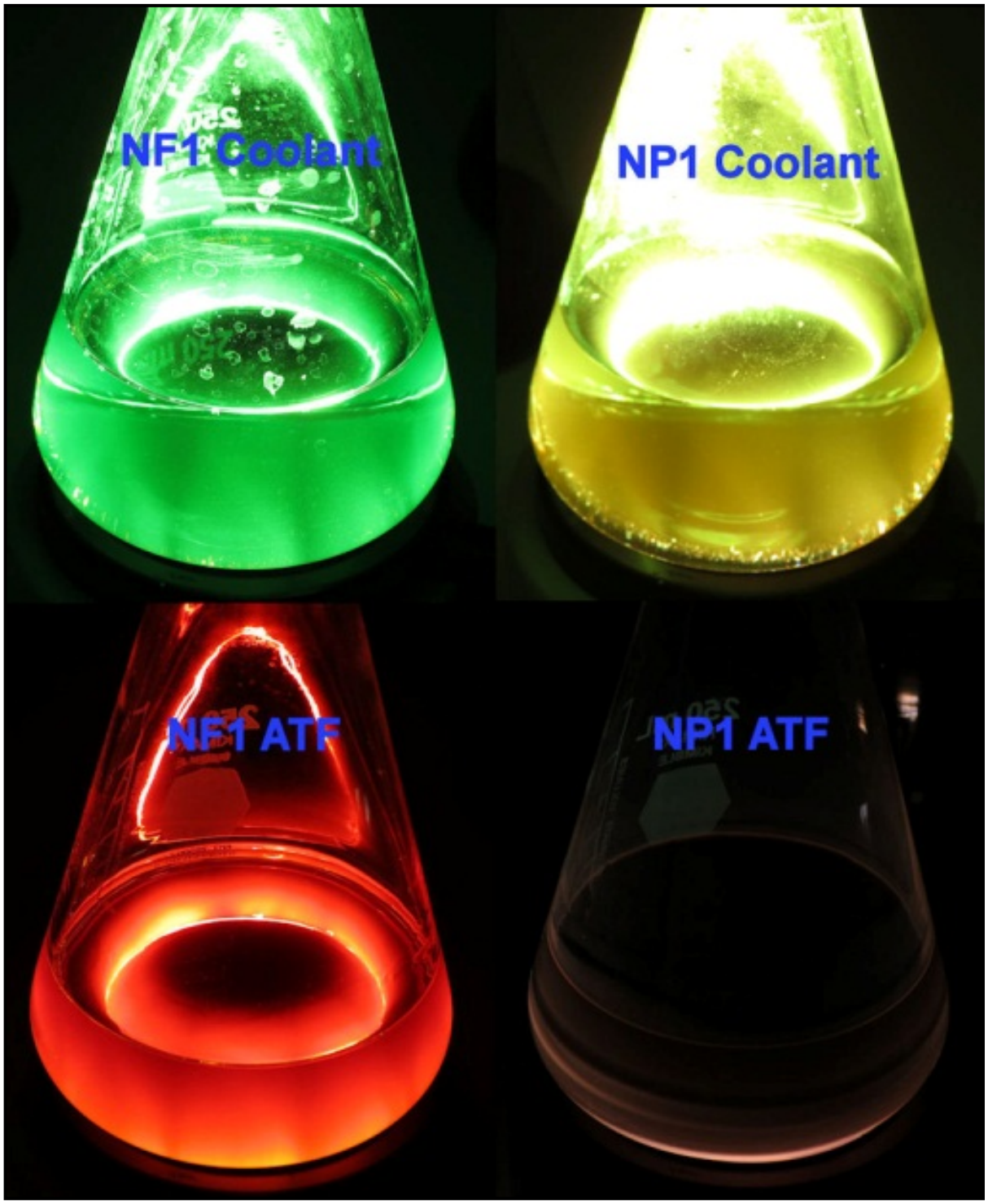


Figure 15 – Engine Coolant and ATF Samples from NF1 and NP1 with Lighting from Below to Show the Differences in Colors

[The fluids from NF1 were Deemed Normal, While Fluids from NP1 were Considered Abnormal]

Figure 16 – The Radiator after Removal from NF1

From: [redacted]
To: Pearse, Dan (NHTSA)
Subject: RE: VOQ concerning Nissan powertrain and/or engine cooling
Date: Wednesday, August 01, 2012 3:38:51 PM
Attachments: image001.png

From: Dan.Pearse@dot.gov [mailto:Dan.Pearse@dot.gov]
Sent: Wednesday, August 01, 2012 3:32 PM
To: Dan.Pearse@dot.gov
Subject: VOQ concerning Nissan powertrain and/or engine cooling

Dear Nissan owner,
You submitted a vehicle owners' questionnaire (VOQ) to the United States Department of Transportation, National Highway Traffic Safety Administration, Office of Defects Investigation (USDOT/NHTSA/ODI) stating that you had experienced a problem with your vehicle that was related to the powertrain and/or engine cooling. The purpose of this contact is to ask a few more questions to follow up on the information you provided. My name is Dan Pearse. I am a federal engineer employed in NHTSA's only in-house laboratory at the Vehicle Research and Test Center (VRTC) in Ohio. Thank you in advance for taking the time to email me.
Dan

VEHICLE
Did you purchase your vehicle new or used? used
If used, when and with what mileage? 30000
What is the current condition of the vehicle? Broke down
What is the current mileage on the vehicle? 110000
Has this been a good vehicle for you? yes
Has your vehicle ever been involved in an accident? no
OPERATOR
Are you the owner of the vehicle? yes
If not, who is?
Are you the primary driver of the vehicle? yes
If not, who is?
How frequently do you drive the vehicle? Never, its broke down
Were you driving the vehicle at the time of the reported incident? yes
If not, who was?
PRIOR TO THE INCIDENT
Had you experienced any problems with the drivability of the vehicle prior to the incident?
When did the previous problems appear?
How frequently did these problems appear?
What did you experience?
DURING THE REPORTED INCIDENT
Please describe what happened during the reported incident.
What were the roadway type and conditions at the time of the incident?
What were the surrounding traffic conditions at the time of the incident?

Figure 17 – Email Survey from Owner of NP1 – Page 1

CURRENT CONDITION OF THE VEHICLE

Does your vehicle have the original radiator? yes
Does your vehicle have the original transmission? yes
Has the vehicle transmission had any repairs performed on it? no
Have you had your automatic transmission fluid flushed? yes
Does your vehicle still exhibit the concern you identified in your VOQ? Yes, still broke down

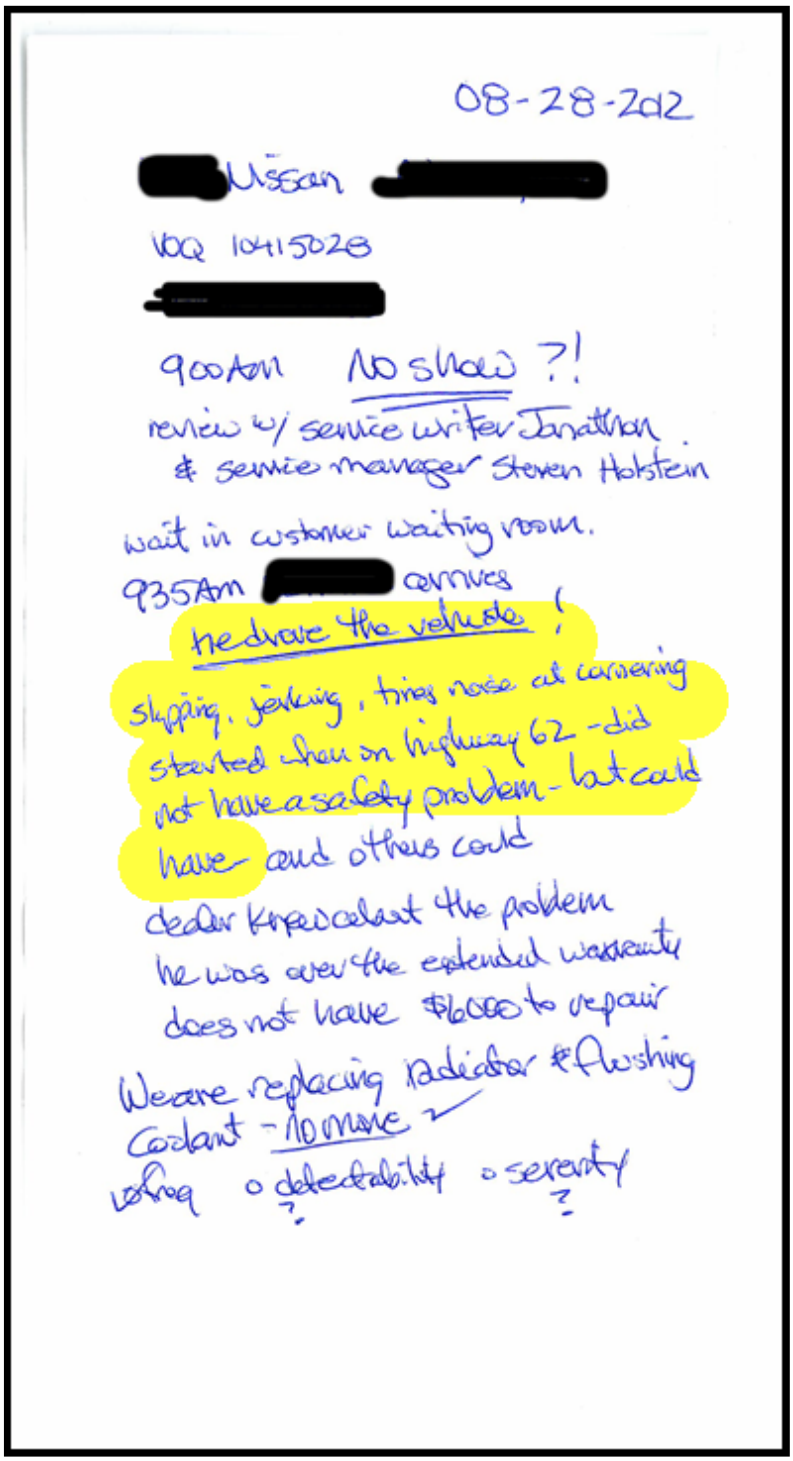
OTHER

Do you have anything that you wish to add? Nissan raised the warranty from 60,000 to 80,000 miles but did not inform owners of the problem with the radiator cooler, if so I could have replaced it with an after market one, and my transmission would still work today, fortunately I was not in an accident, but it just locked up and stopped working I took it to a Nissan dealer and they said with the 2005, 2006 pathfinders that this happens all the time, I wish they would have told the owners, I got a nice car, that wont run because of a avoidable problem and I don't have the 6,000 dollars they want to put a new transmission and new cooler in.

Dan Pearse
Federal Vehicle Safety Engineer
United States Department of Transportation
National Highway Traffic Safety Administration
Vehicle Research & Test Center - Defects Analysis Group
Dan.Pearse@nhtsa.dot.gov 937-666-4511

Report Vehicle Safety Defects!
www.safercar.gov
www.safertruck.gov

Figure 18 – Email Survey from Owner of NP1 – Page 2



08-28-2012

[redacted] Nissan [redacted]

VOQ 10415028

[redacted]

900Am No show ?!

review w/ service writer Jonathan & service manager Steven Holstein

wait in customer waiting room.

935Am [redacted] arrives

he drove the vehicle (

slipping, jerking, tires noise at cornering started when on highway 62 - did not have a safety problem - but could have - and others could

dealer knew about the problem

he was over the extended warranty

does not have $6000 to repair

We are replacing radiator & flushing

Coolant - no more ✓

Voltage ○ detectability ○ severity

?

?

Figure 19 – Interview Notes at the Dealership with the Owner of Vehicle NP1

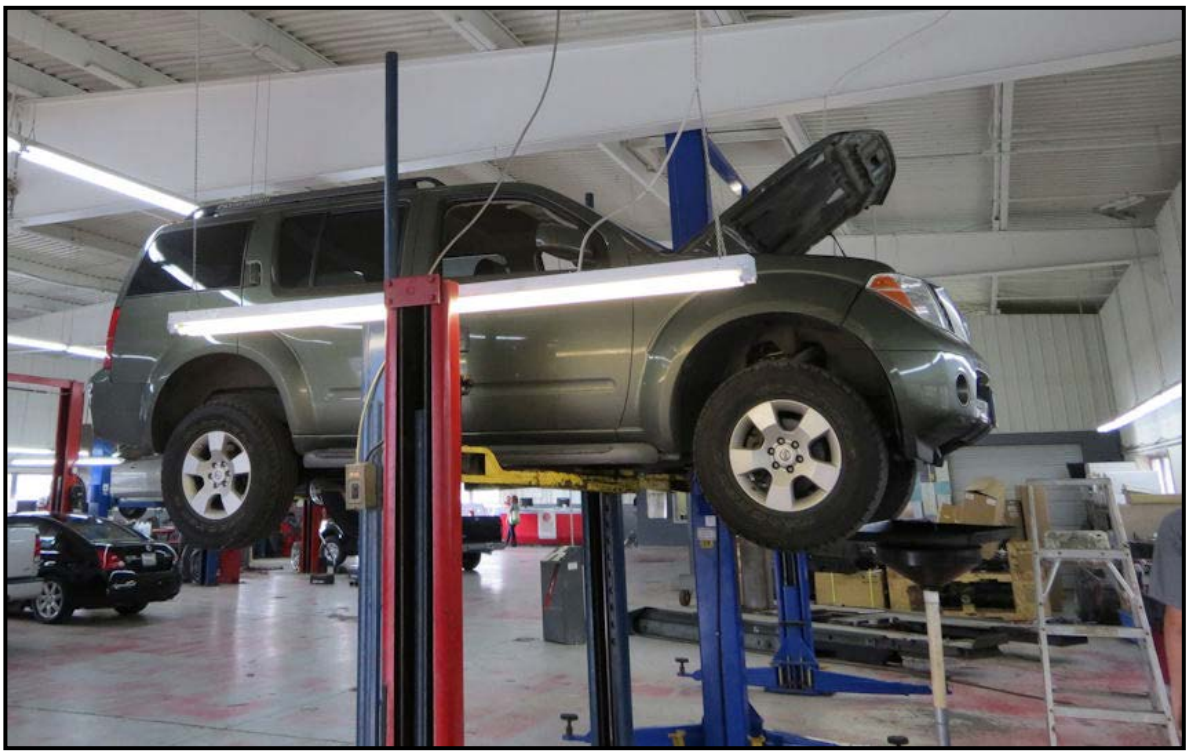
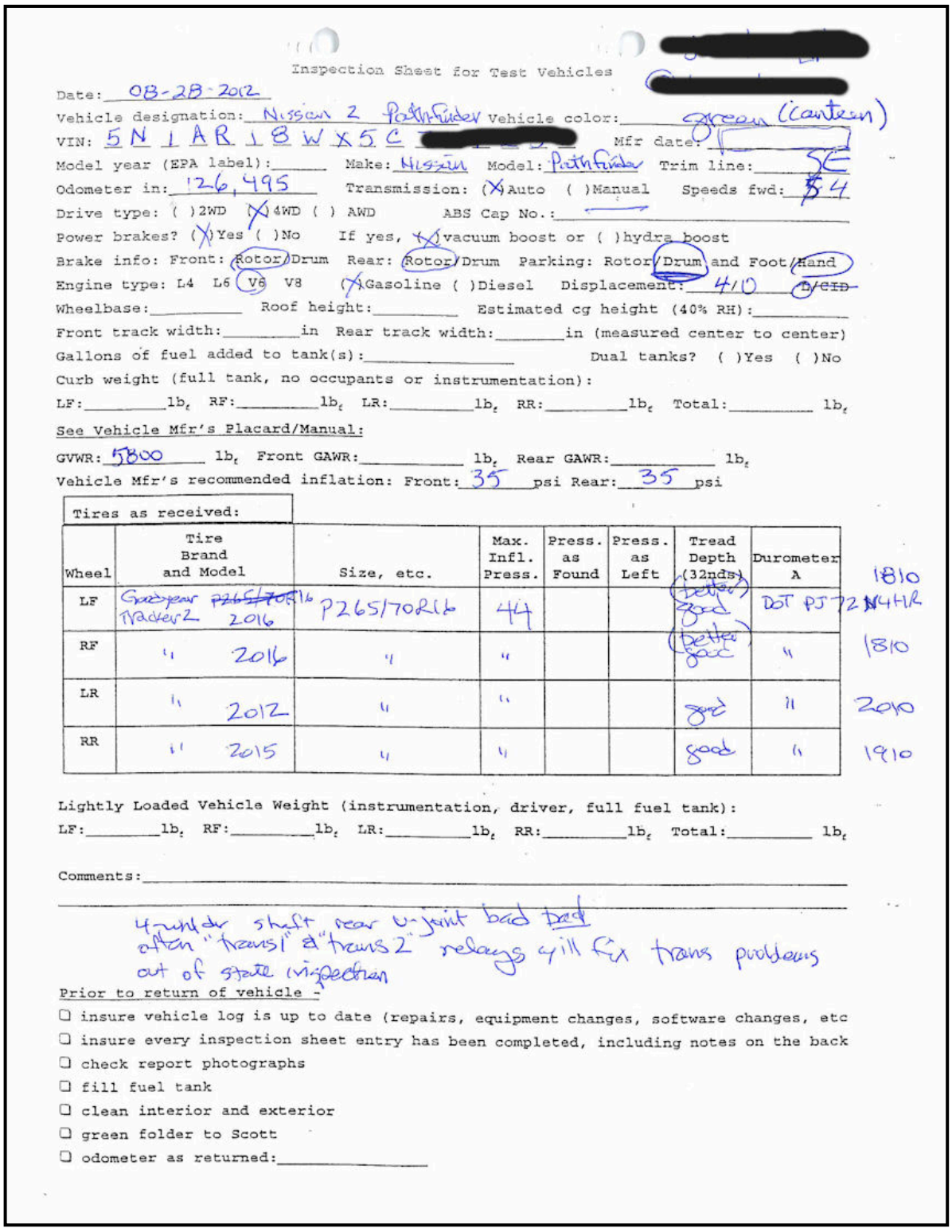


Figure 20 – Vehicle NP1 During Inspection at the Dealership Prior to Service



Inspection Sheet for Test Vehicles

Date: 08-28-2012

Vehicle designation: Nissan 2 Pathfinder Vehicle color: green (canteen)

VIN: 5N1AR18WX5C [redacted] Mfr date: [redacted]

Model year (EPA label): _____ Make: Nissan Model: Pathfinder Trim line: SE

Odometer in: 126,495 Transmission: (X) Auto ( ) Manual Speeds fwd: 5 4

Drive type: ( ) 2WD (X) 4WD ( ) AWD ABS Cap No.: _____

Power brakes? (X) Yes ( ) No If yes, (X) vacuum boost or ( ) hydra boost

Brake info: Front: Rotor/Drum Rear: Rotor/Drum Parking: Rotor/Drum and Foot/Hand

Engine type: L4 L6 V6 V8 (X) Gasoline ( ) Diesel Displacement: 4.0 ~~L/CID~~

Wheelbase: _____ Roof height: _____ Estimated cg height (40% RH): _____

Front track width: _____ in Rear track width: _____ in (measured center to center)

Gallons of fuel added to tank(s): _____ Dual tanks? ( ) Yes ( ) No

Curb weight (full tank, no occupants or instrumentation):

LF: _____ lb, RF: _____ lb, LR: _____ lb, RR: _____ lb, Total: _____ lb,

See Vehicle Mfr's Placard/Manual:

GVWR: 5800 lb, Front GAWR: _____ lb, Rear GAWR: _____ lb,

Vehicle Mfr's recommended inflation: Front: 35 psi Rear: 35 psi

Tires as received:

Wheel	Tire Brand and Model	Size, etc.	Max. Infl. Press.	Press. as Found	Press. as Left	Tread Depth (32nds)	Durometer A	
LF	Goodyear ~~P265/70R16~~ Tracker 2 2016	P265/70R16	44			(better) good	DOT PJ 72 N4HR	1810
RF	" 2016	"	"			(better) good	"	1810
LR	" 2012	"	"			good	"	2010
RR	" 2015	"	"			good	"	1910

Lightly Loaded Vehicle Weight (instrumentation, driver, full fuel tank):

LF: _____ lb, RF: _____ lb, LR: _____ lb, RR: _____ lb, Total: _____ lb,

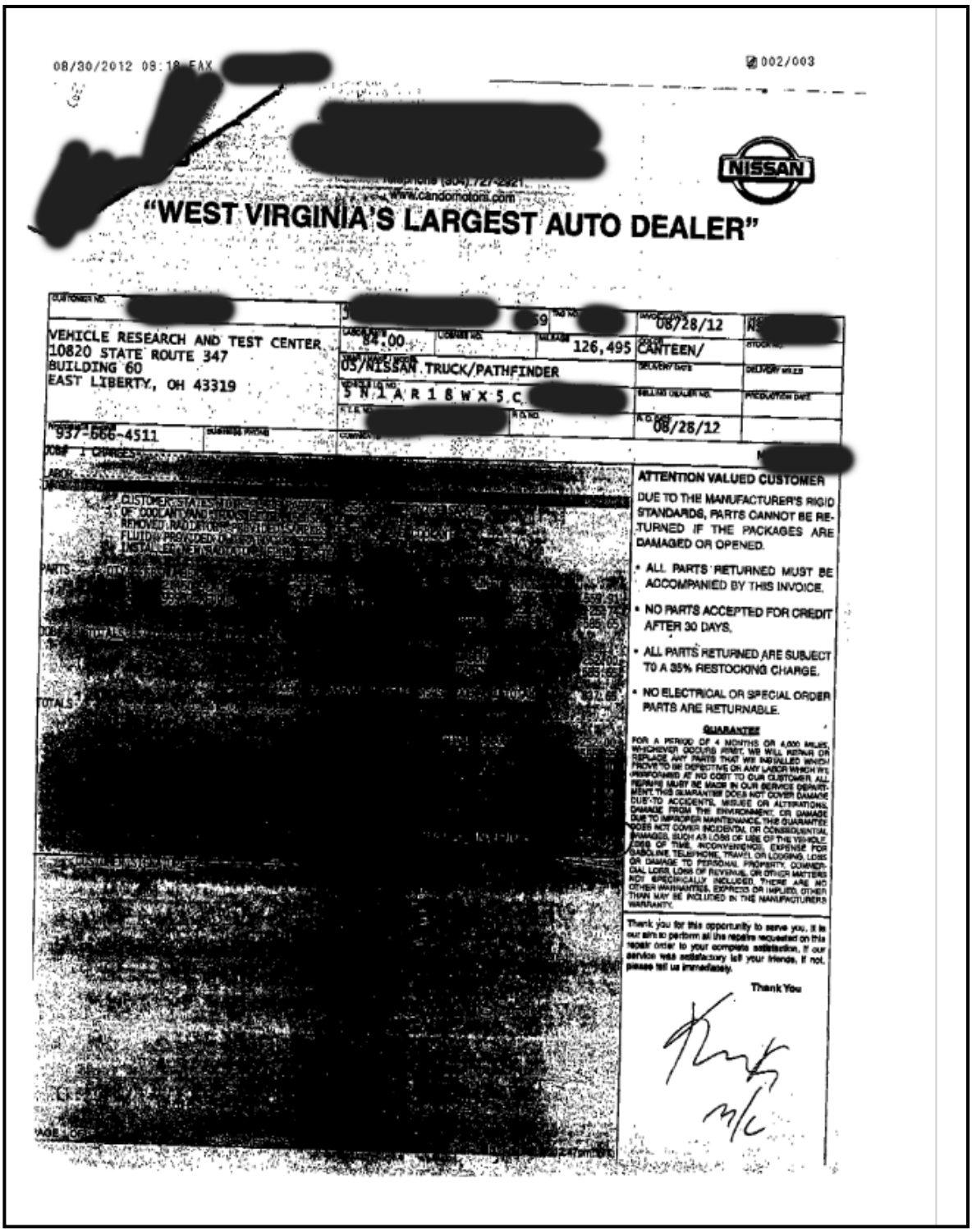
Comments: _____

4-wheeler shaft rear U-joint bad bad often "trans1" & "trans2" relays will fix trans problems out of state inspection

Prior to return of vehicle -

- ❑ insure vehicle log is up to date (repairs, equipment changes, software changes, etc
- ❑ insure every inspection sheet entry has been completed, including notes on the back
- ❑ check report photographs
- ❑ fill fuel tank
- ❑ clean interior and exterior
- ❑ green folder to Scott
- ❑ odometer as returned: _____

Figure 21 – Inspection of Vehicle NP1 (VOQ 10422384)



08/30/2012 08:18 FAX [redacted] 002/003

[redacted]

www.candornotors.com

"WEST VIRGINIA'S LARGEST AUTO DEALER"

VEHICLE RESEARCH AND TEST CENTER
10820 STATE ROUTE 347
BUILDING 60
EAST LIBERTY, OH 43319

937-666-4511

84.00

126,495

05/NISSAN TRUCK/PATHFINDER

5N1AR18WX5C[redacted]

08/28/12

08/28/12

CANTEEN/

ATTENTION VALUED CUSTOMER

DUE TO THE MANUFACTURER'S RIGID STANDARDS, PARTS CANNOT BE RETURNED IF THE PACKAGES ARE DAMAGED OR OPENED.

- ALL PARTS RETURNED MUST BE ACCOMPANIED BY THIS INVOICE.
- NO PARTS ACCEPTED FOR CREDIT AFTER 30 DAYS.
- ALL PARTS RETURNED ARE SUBJECT TO A 35% RESTOCKING CHARGE.
- NO ELECTRICAL OR SPECIAL ORDER PARTS ARE RETURNABLE.

GUARANTEE

FOR A PERIOD OF 4 MONTHS OR 4,000 MILES, WHICHEVER OCCURS FIRST, WE WILL REPAIR OR REPLACE ANY PARTS THAT WE INSTALLED WHICH PROVE TO BE DEFECTIVE OR ANY LABOR WHICH WE PERFORMED AT NO COST TO OUR CUSTOMER. ALL REPAIRS MUST BE MADE IN OUR SERVICE DEPARTMENT. THIS GUARANTEE DOES NOT COVER DAMAGE DUE TO ACCIDENTS, MISUSE OR ALTERATIONS, DAMAGE FROM THE ENVIRONMENT, OR DAMAGE DUE TO IMPROPER MAINTENANCE. THIS GUARANTEE DOES NOT COVER INCIDENTAL OR CONSEQUENTIAL DAMAGES, SUCH AS LOSS OF USE OF THE VEHICLE, LOSS OF TIME, INCONVENIENCE, EXPENSE FOR GASOLINE, TELEPHONE, TRAVEL OR LODGING, LOSS OR DAMAGE TO PERSONAL PROPERTY, COMMERCIAL LOSS, LOSS OF REVENUE, OR OTHER MATTERS NOT SPECIFICALLY INCLUDED. THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OTHER THAN MAY BE INCLUDED IN THE MANUFACTURERS WARRANTY.

Thank you for this opportunity to serve you. It is our aim to perform all the repairs requested on this repair order to your complete satisfaction. If our service was satisfactory tell your friends. If not, please tell us immediately.

Thank You

m/c

Figure 22 – Repair Order from the Replacement of the Radiator on NP1

Figure 23 – Fluid Collections from NP1

Figure 24 – The Radiator after Removal from NP1

Figure 25 – Submersion Tank for Leak Testing a Pressurized Radiator or Subcomponent

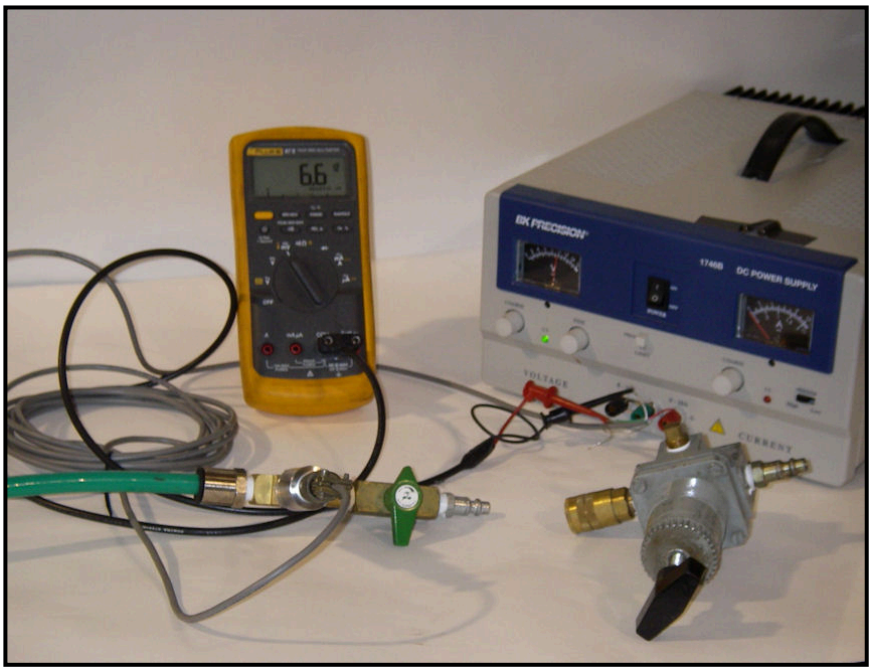


Figure 26 – Pressurization Test Equipment for Leak Testing Radiators and Subcomponents

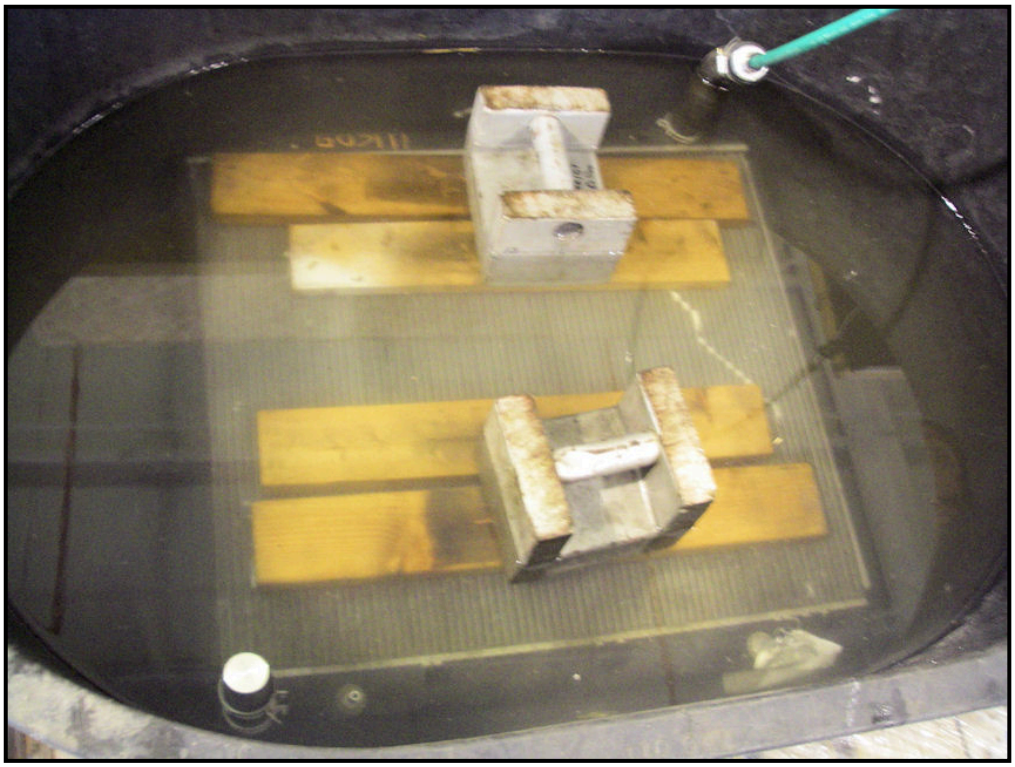


Figure 27 – Test Radiator Submerged in Tank to Test for Crossover Leaks Between the Engine Coolant and the Internal ATF Cylinder

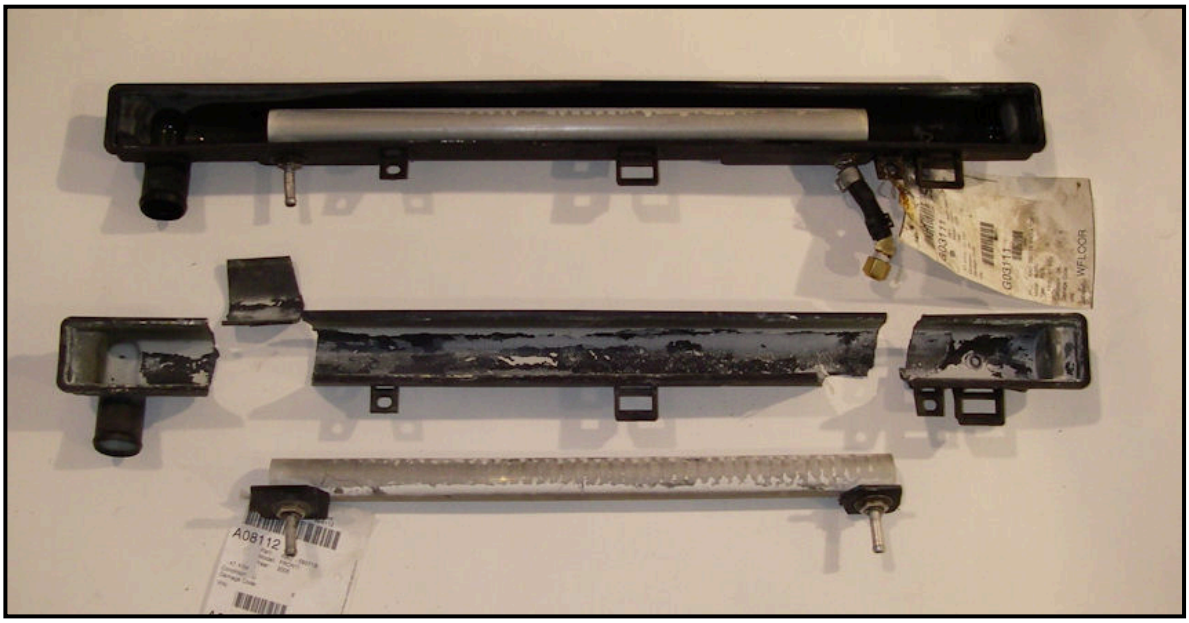


Figure 28 - Two Salvage-Yard Units after the Lower End Cap was Removed

[The SY1 ATF cylinder was removed from the lower plastic-end cap without turning the retaining nuts.]

Figure 29 – The ATF Cylinder SY1 was Removed from the Lower Radiator End Cap without Turning the Mounting Nuts to not Disturb the As Received Condition

Figure 30 – The Salvage Yard ATF Cylinders were Pressurized and Submerged During a Leak Test – No Bubbles

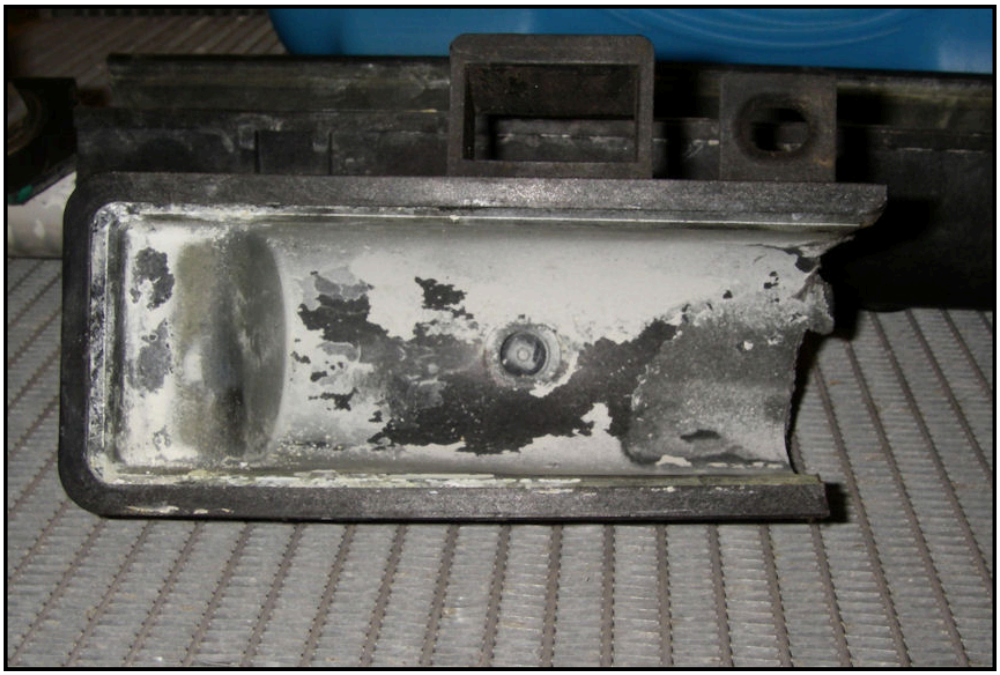


Figure 31 – Radiator SY1 Lower End Cap with Powdery Deposits

Figure 32 – Radiator ATF Cylinder SY1 with Powdery Deposits

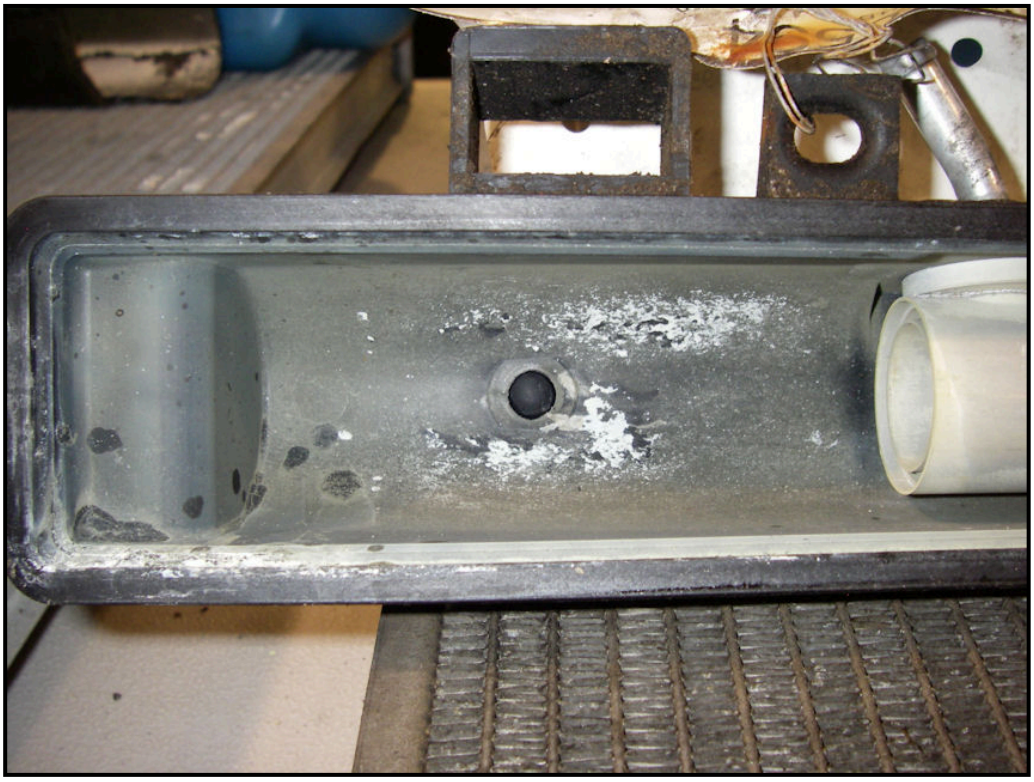


Figure 33 – Radiator SY2 Lower End Cap with White Flaky Deposits

Figure 34 – Radiator SY1 with Corrosion on the Radiator Core at the Lower End Cap Attachment O-Ring

Figure 35 – Radiator SY2 with Corrosion on the Radiator Core at the Lower End Cap Attachment O-Ring

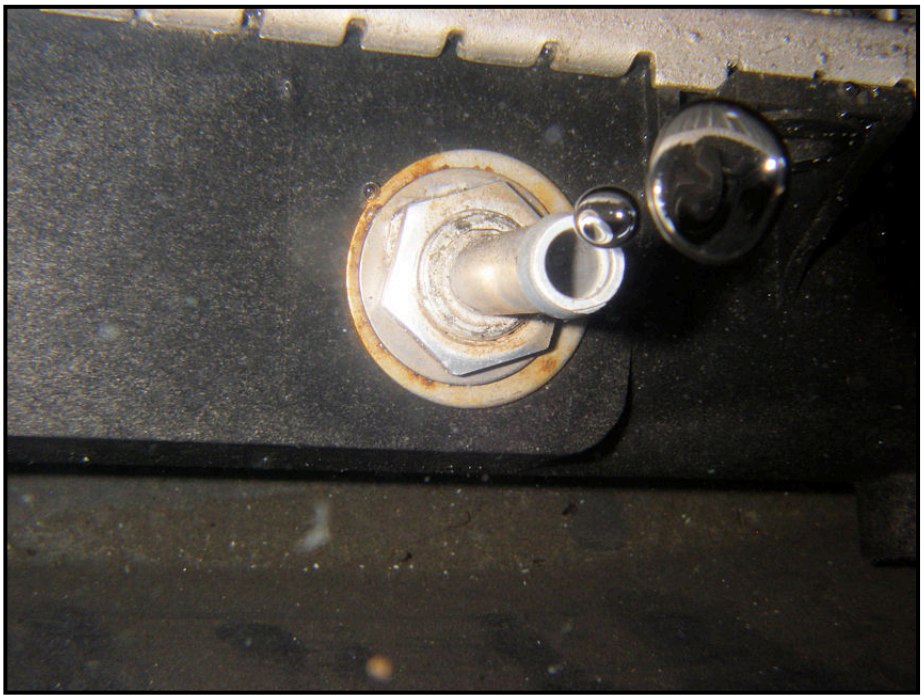


Figure 36 – Complete Radiator NP1 Submerged with Crossover Leak from the ATF Cylinder Port

Figure 37 – Lower End Cap Removed from Radiator NF1 with Left Side White Powdery Deposits

Figure 38 - Lower End Cap Removed from Radiator NF1 with Right Side White Flaky Deposits

Figure 39 - Lower End Cap Removed from Radiator NP1 with Left Side Showing No Deposits

Figure 40 - Lower End Cap Removed from Radiator NP1 with Right Side Showing Light Deposits

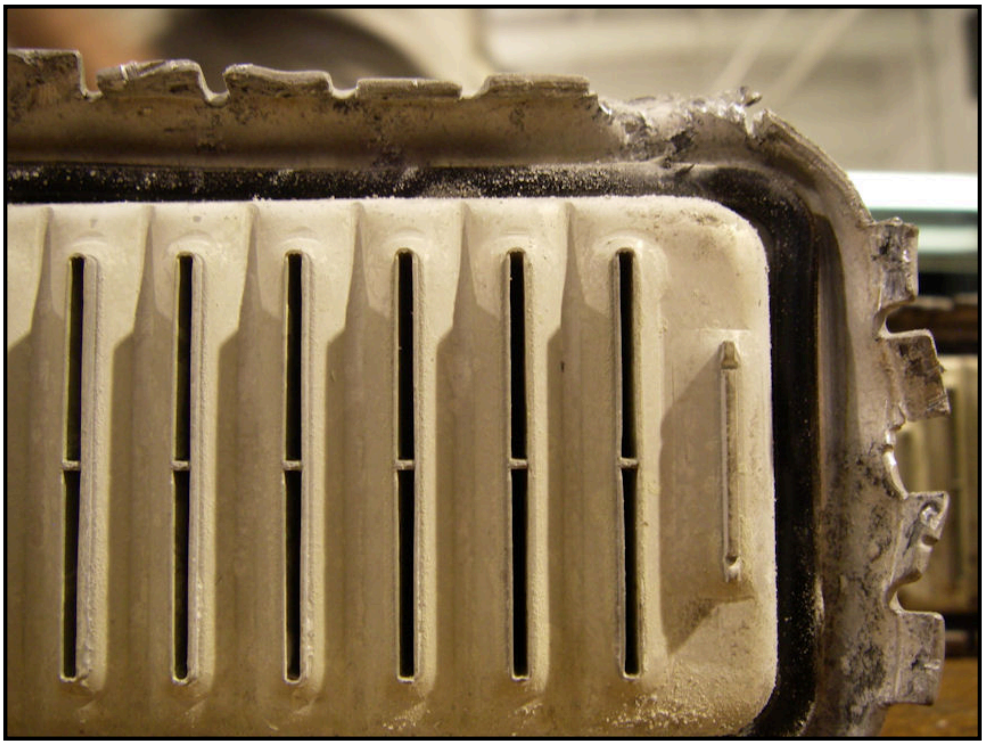


Figure 41 - Radiator NF1 with Corrosion on the Radiator Core at the Lower End Cap Attachment O-Ring

Figure 42 - Radiator NP1 with Corrosion on the Radiator Core Along the Middle at the Lower End Cap Attachment O-Ring

Figure 43 – Close-up of Radiator NP1 with Corrosion on the Radiator Core Along the Middle at the Lower End Cap Attachment O-Ring

Figure 44 – Close-up of the Lower End Cap of Radiator NP1 with Corrosion Deposits at Interface to the Radiator Core

Figure 45 – The Submerged ATF Cylinder NF1 After Removal from the Radiator During the Cylinder Leak Test – No Bubbles

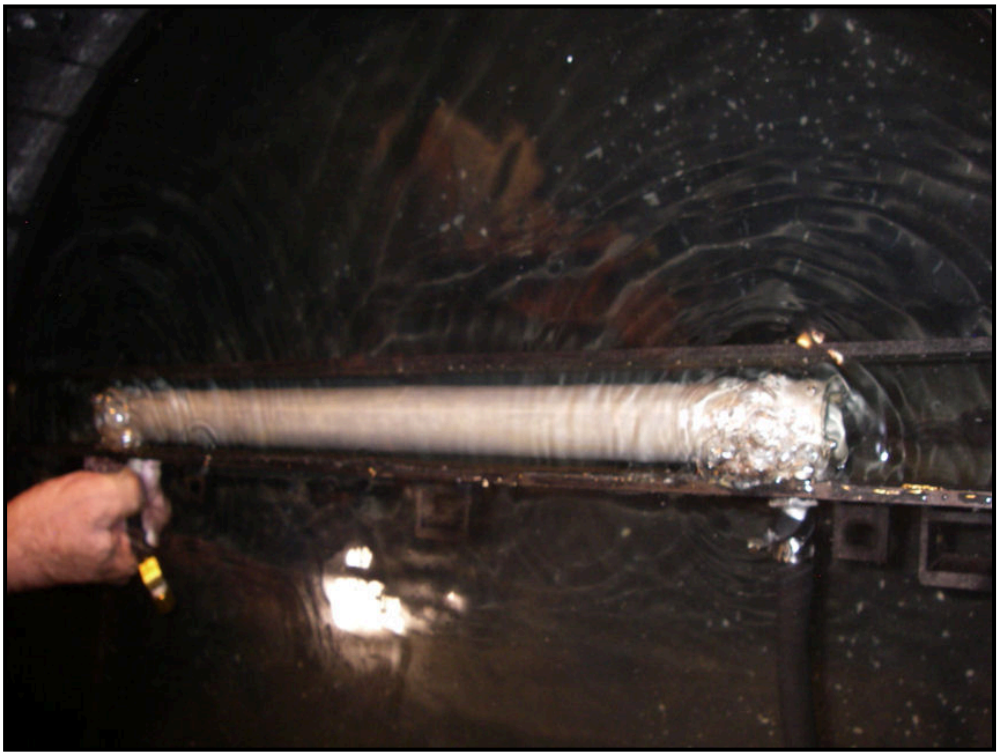


Figure 46 – The Submerged ATF Cylinder NP1 Inside the Lower End Cap was Found to Leak Near Both ATF Ports

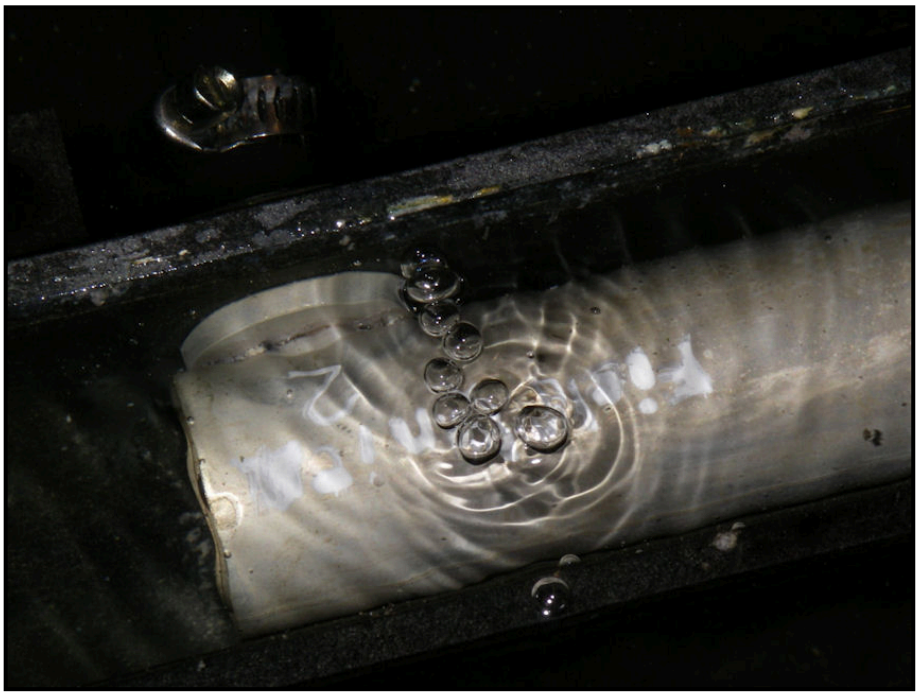


Figure 47 – Close-up of The Submerged ATF Cylinder NP1 Inside the Lower End Cap Showing the Leak Near the Right ATF Port

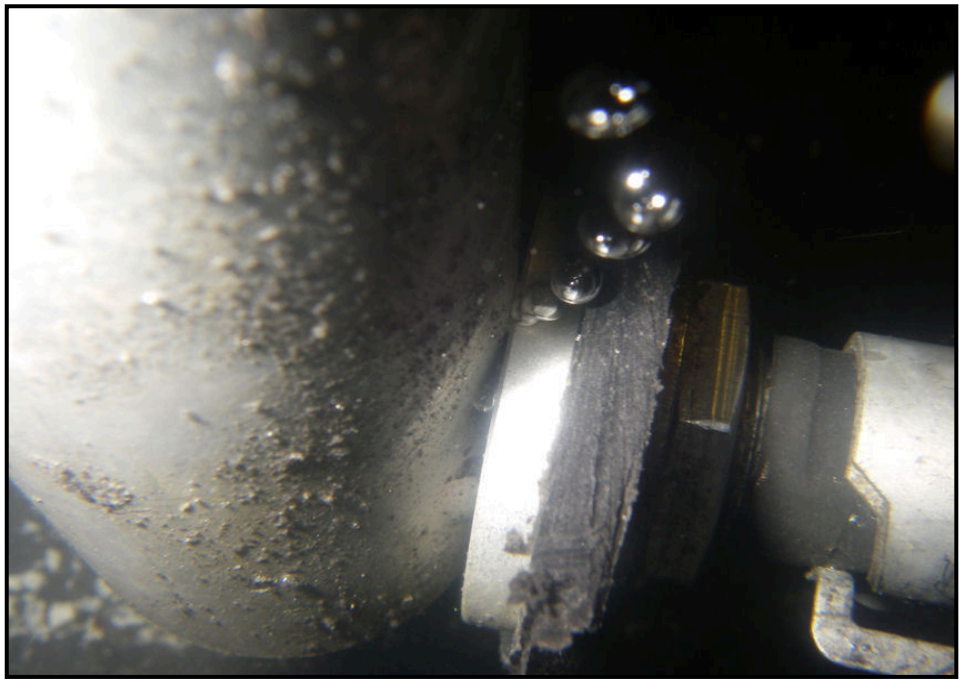


Figure 48 – The Submerged ATF Cylinder NP1 After Cutting Away the Lower End Cap without Removing the Nuts Showing the Leak at Left ATF Port

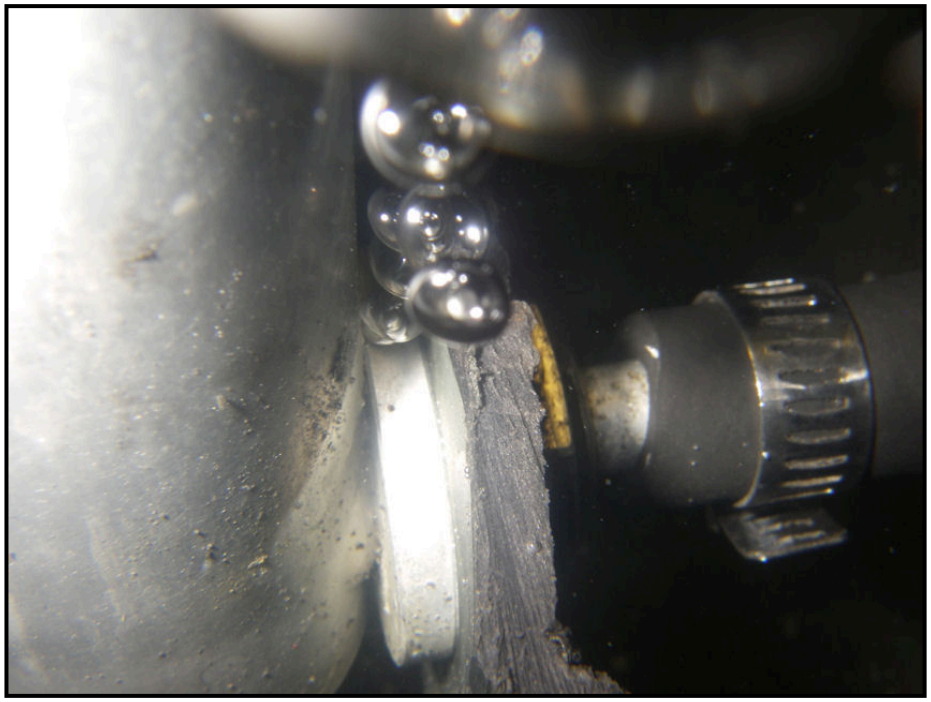


Figure 49 – The Submerged ATF Cylinder NP1 After Cutting Away the Lower End Cap without Removing the Nuts Showing the Leak at Right ATF Port

Figure 50 – The ATF Cylinder NP1 After Removing the Retaining Nuts Showing the Corrosion that was Present at Both ATF Ports

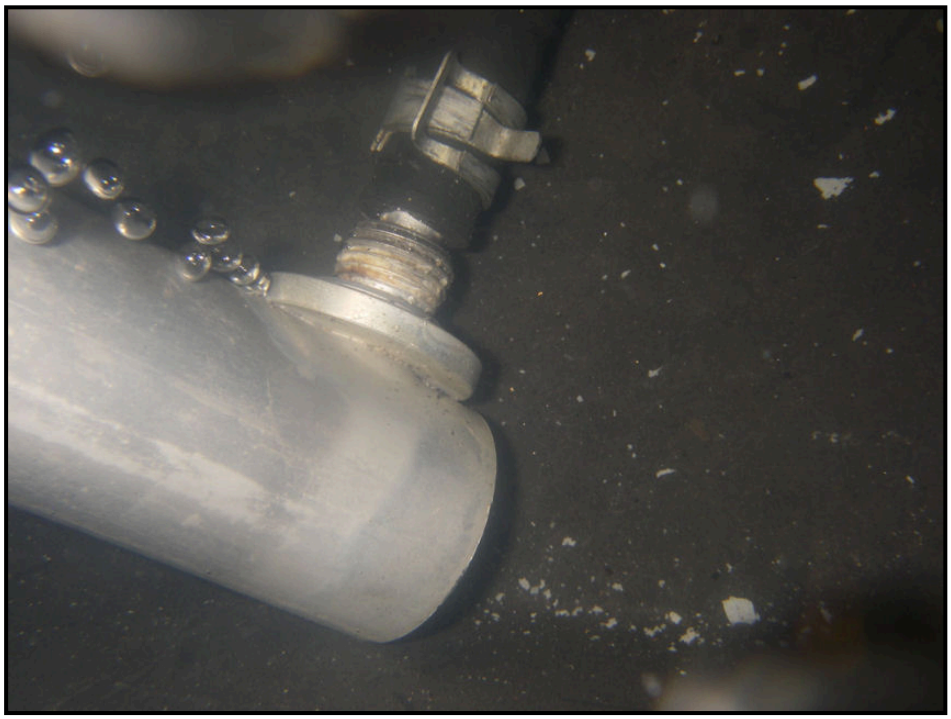


Figure 51 – The Submerged ATF Cylinder NP1 After Complete Removal from the Lower End Cap Showing the Leak at Left ATF Port

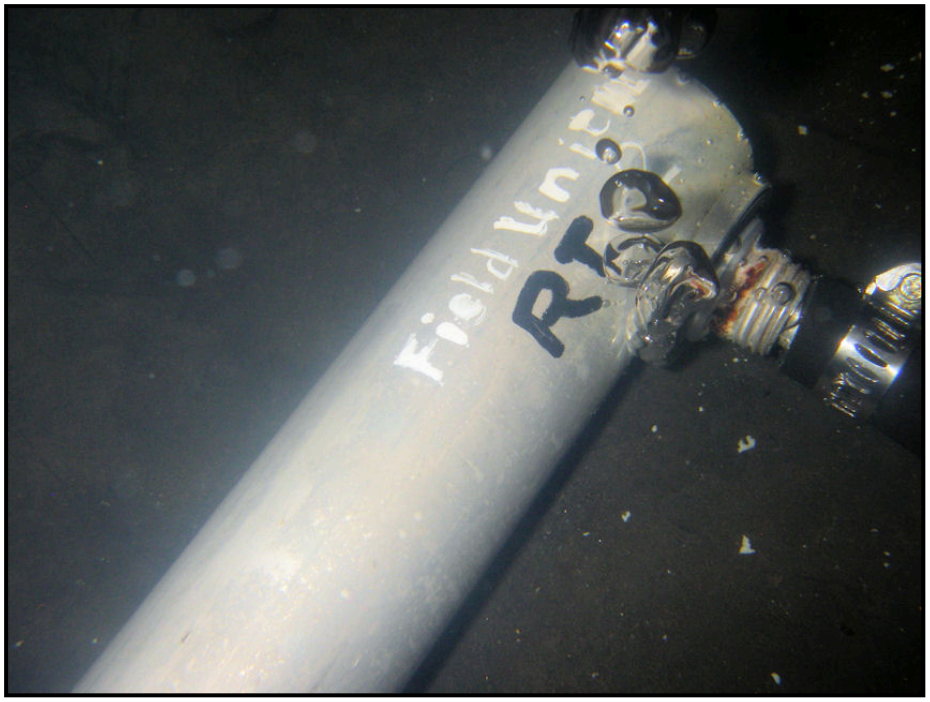


Figure 52 – The Submerged ATF Cylinder NP1 After Complete Removal from the Lower End Cap Showing the Leak at Right ATF Port

Figure 53 – The ATF Cylinder NP1 Under the Stereo Microscope at Magnification 5X with Slight Pressurization Showing the Leak Point Near the Left ATF Port

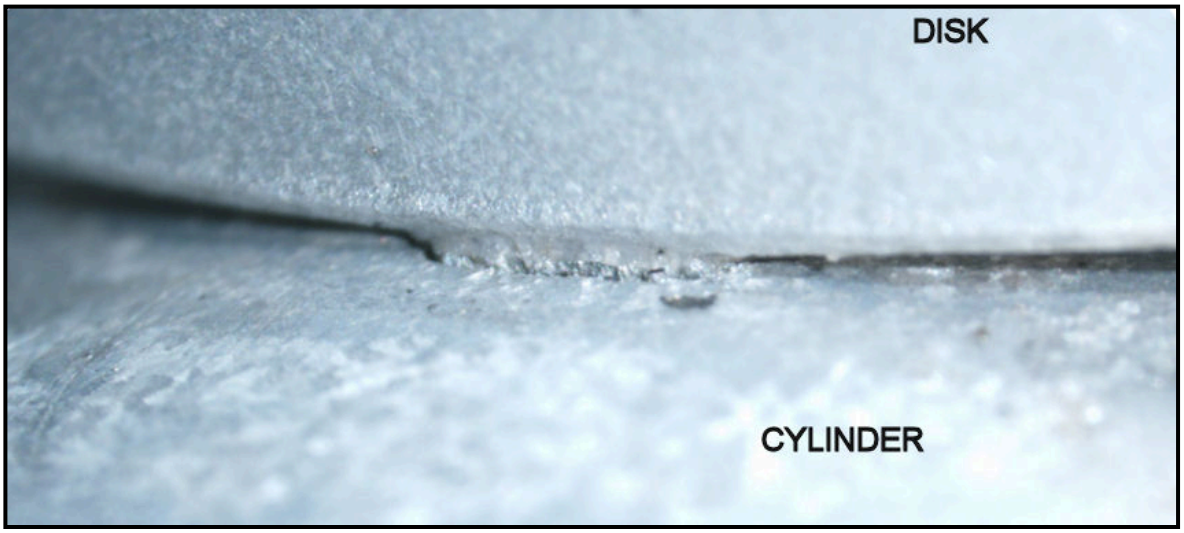


Figure 54 – The ATF Cylinder NP1 at 15X Showing a Fracture in the Thin-Walled Tube at the Disk of Left ATF Port

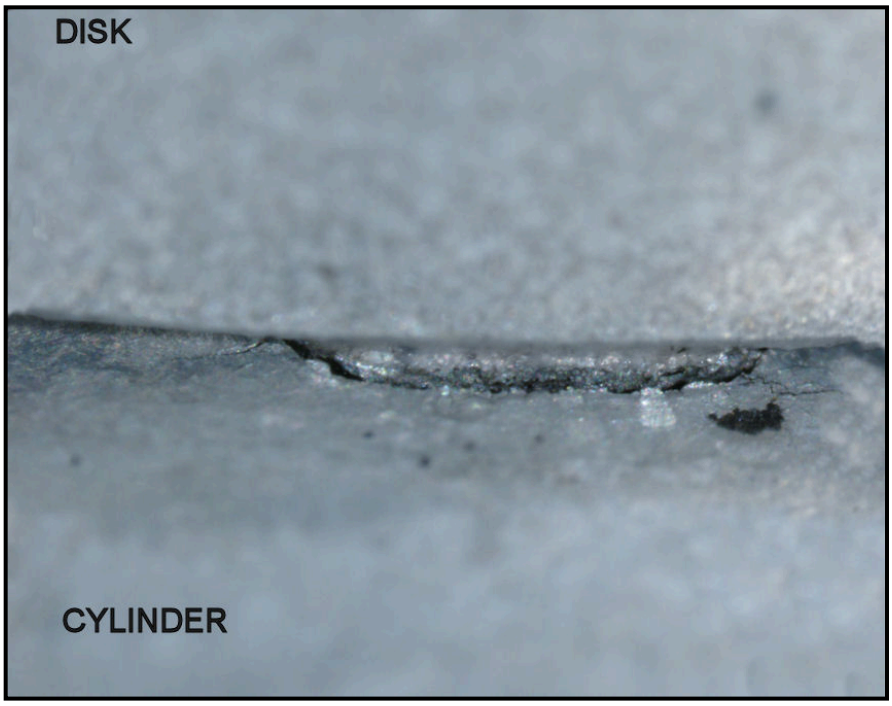


Figure 55 – The ATF Cylinder NP1 at 25X Showing a Fracture in the Thin-Walled Tube at the Disk of Left ATF Port

Figure 56 – The ATF Cylinder NP1 at 3X Showing Area of Leak at the Disk of Right ATF Port

Figure 57 – The ATF Cylinder NP1 at 10X Showing a Fracture in the Thin-Walled Tube at the Disk of Right ATF Port

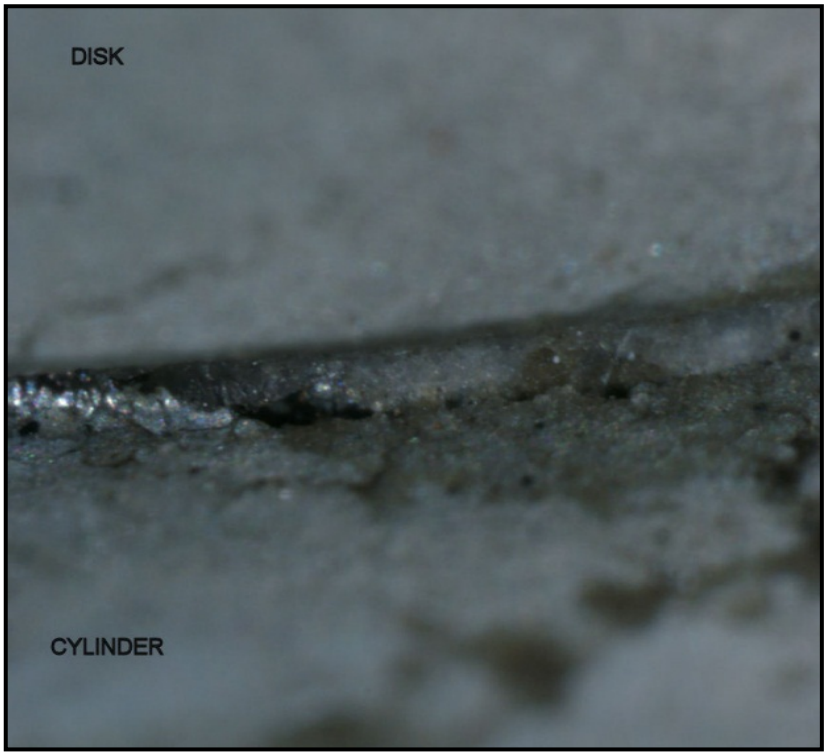


Figure 58 – A Close-up Showing the Fracture in the ATF Cylinder NP1 at 50X at the Disk of Right ATF Port

Figure 59 – Showing the Outboard Side of the ATF Port on the ATF Cylinder Where No Leaks were Observed

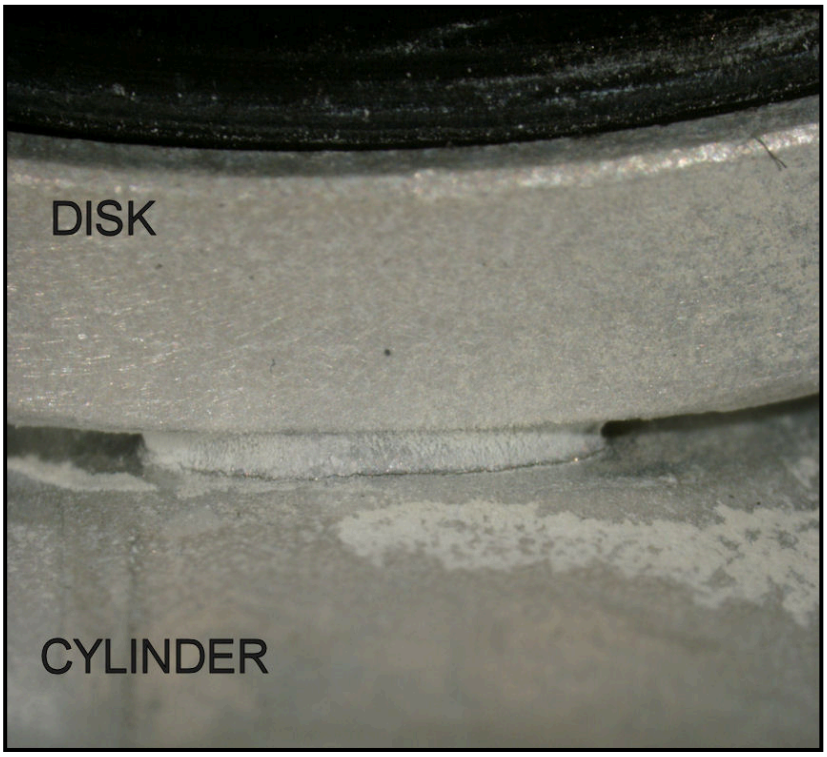


Figure 60 – The ATF Cylinder NF1 at 10X Showing a Wider Weld and a Crack at the Disk of Left ATF Port but No Leak was Observed

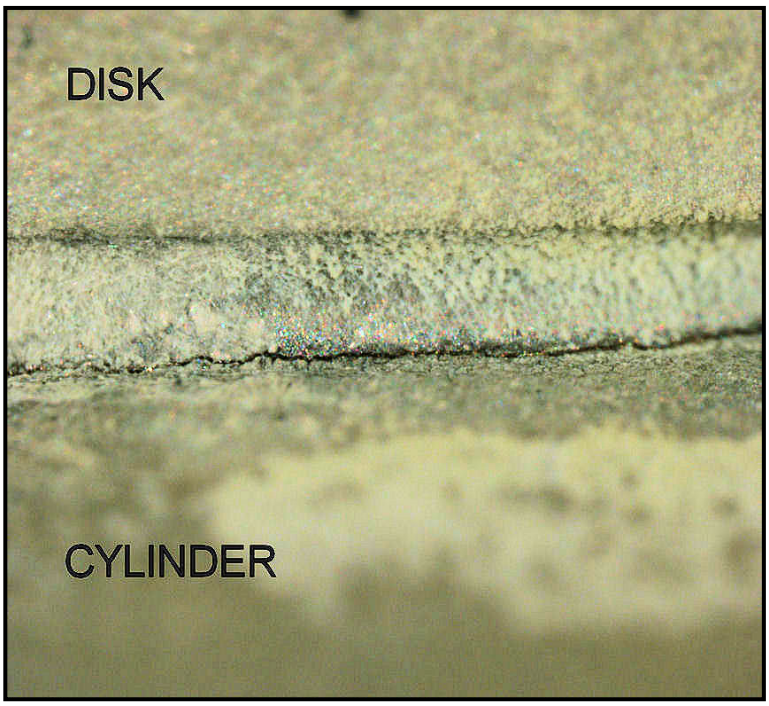


Figure 61 – The ATF Cylinder NF1 at 30X Showing a Crack at the Disk of Left ATF Port but No Leak was Observed

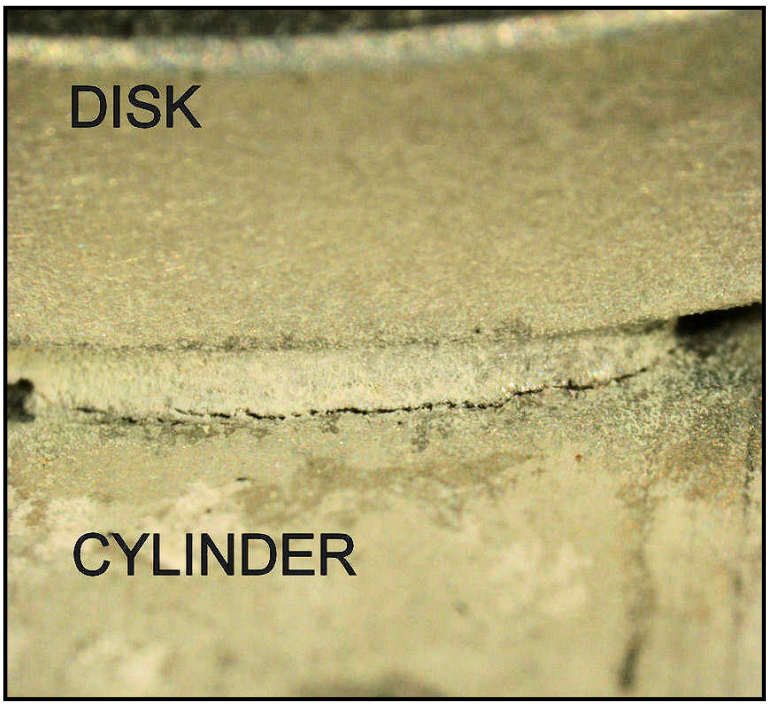


Figure 62 – The ATF Cylinder NF1 at 15X Showing a Crack at the Disk of Right ATF Port but No Leak was Observed

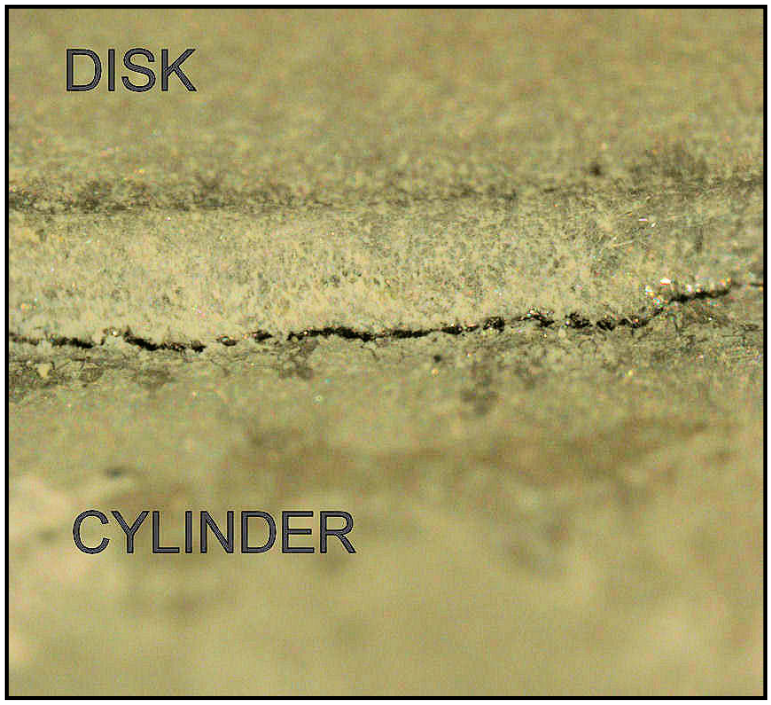


Figure 63 – The ATF Cylinder NF1 at 30X Showing a Crack at the Disk of Right ATF Port but No Leak was Observed

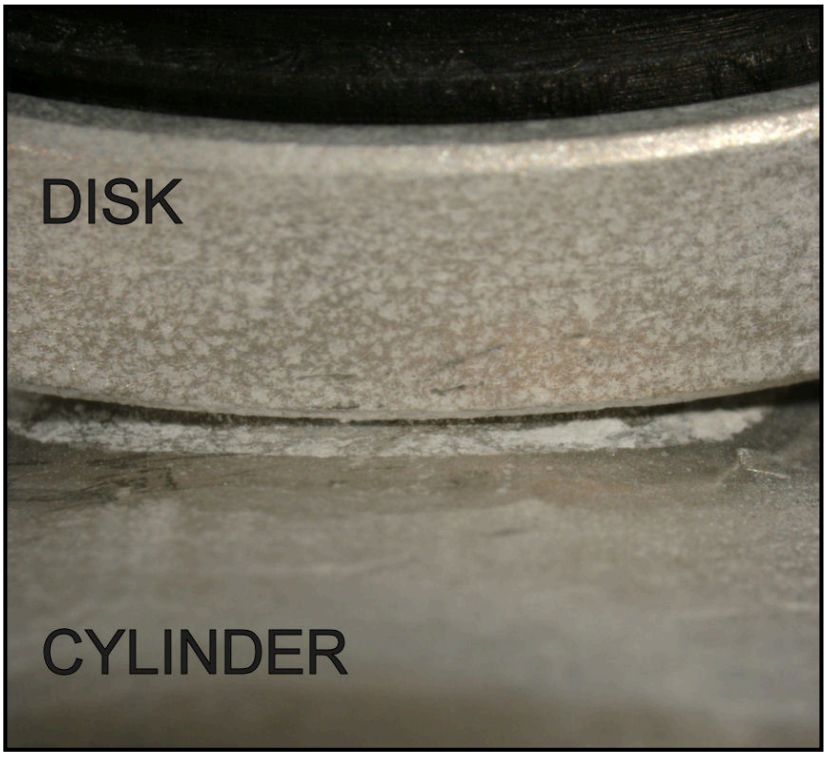


Figure 64 – The ATF Cylinder SY#1, Which Did Not Leak, at 10X Showing No Crack at the Disk of Left ATF Port

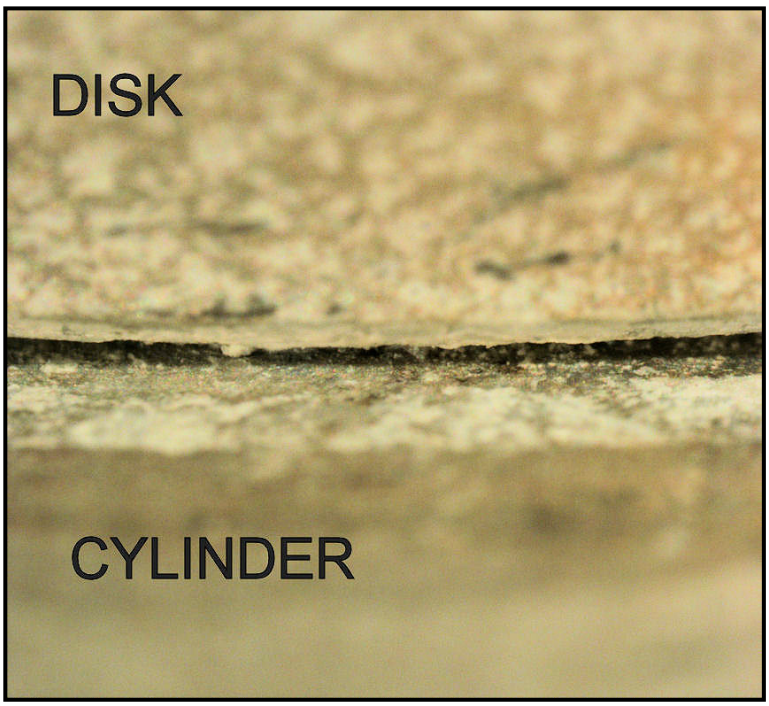


Figure 65 – The ATF Cylinder SY#1, Which Did Not Leak, at 30X Showing No Crack at the Disk of Left ATF Port – After Cleaning with Reagent and a Nylon Brush

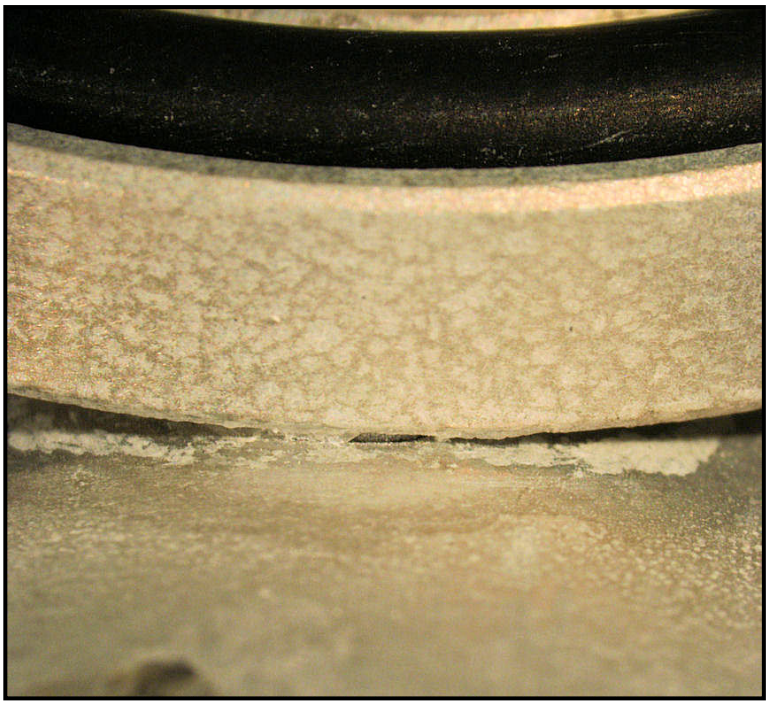


Figure 66 – The ATF Cylinder SY#1, Which Did Not Leak, at 10X after Cleaning at the Disk of Right ATF Port

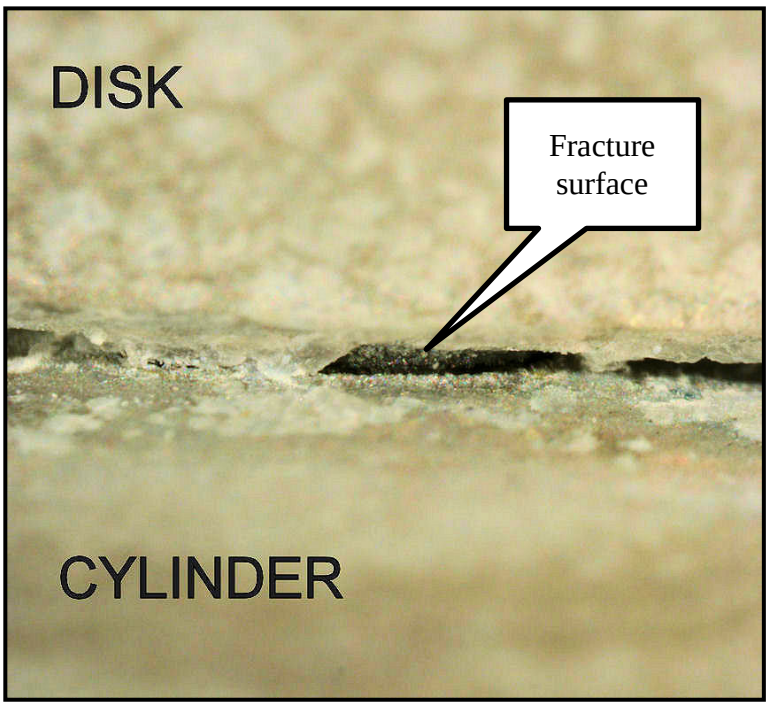


Figure 67 – ATF Cylinder SY#1 at 30X After Cleaning Showing a Fracture In the Cylinder Under the Disk of Right ATF Port, but No Leak was Observed

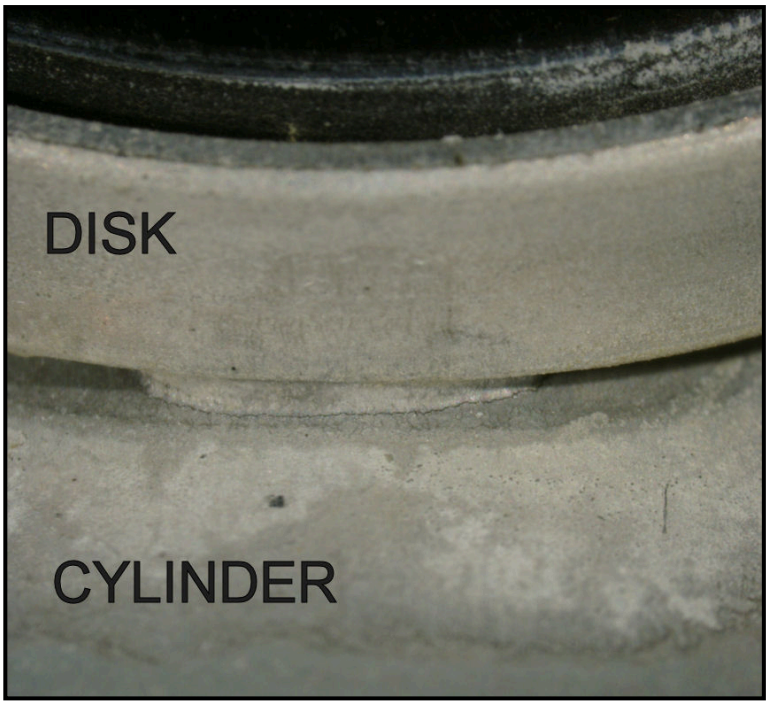


Figure 68 – The ATF Cylinder SY#2 at 10X at the Disk of Left ATF Port, but No Leak was Observed

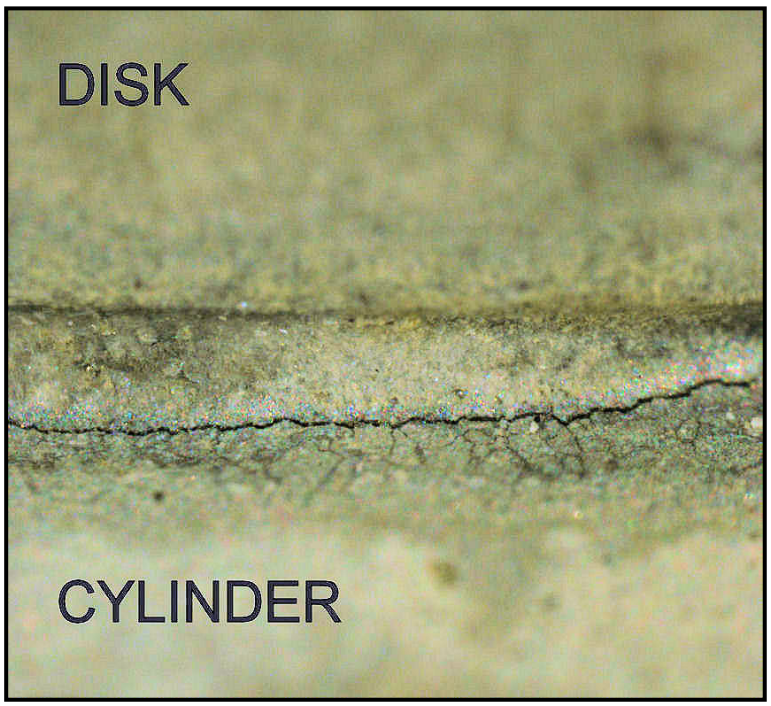


Figure 69 – The ATF Cylinder SY#2 at 35X Showing a Crack in the Weld at the Disk of Left ATF Port, but No Leak was Observed

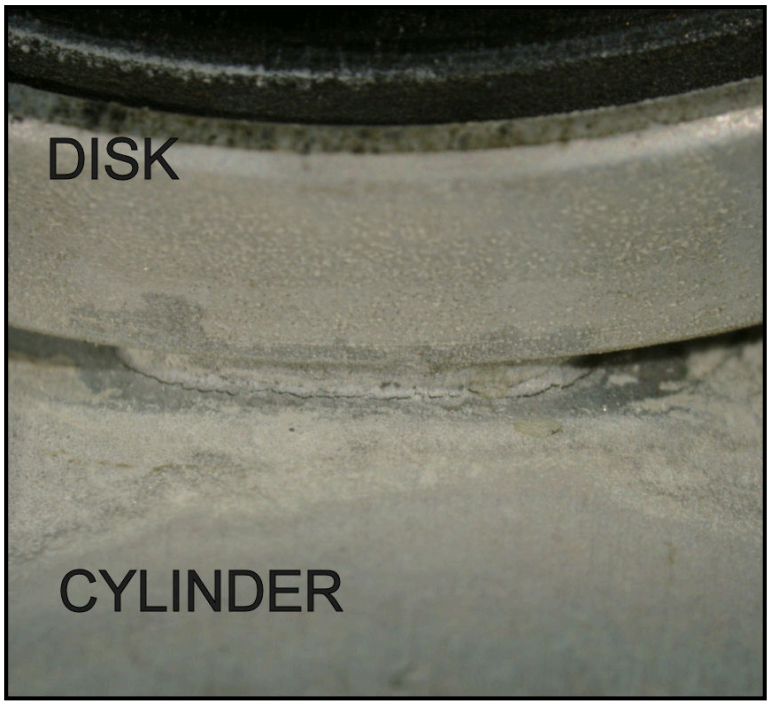


Figure 70 – The ATF Cylinder SY#2 at 10X at the Disk of the Right ATF Port, but No Leak was Observed

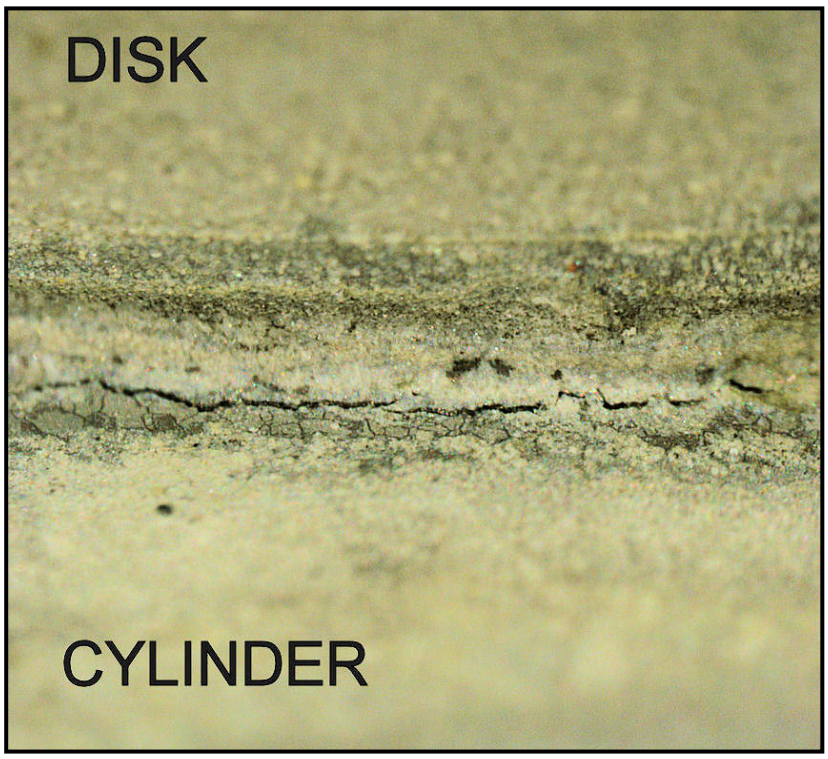


Figure 71 – The ATF Cylinder SY#2 at 30X Showing a Crack in the Weld at the Disk of Right ATF Port, but No Leak was Observed

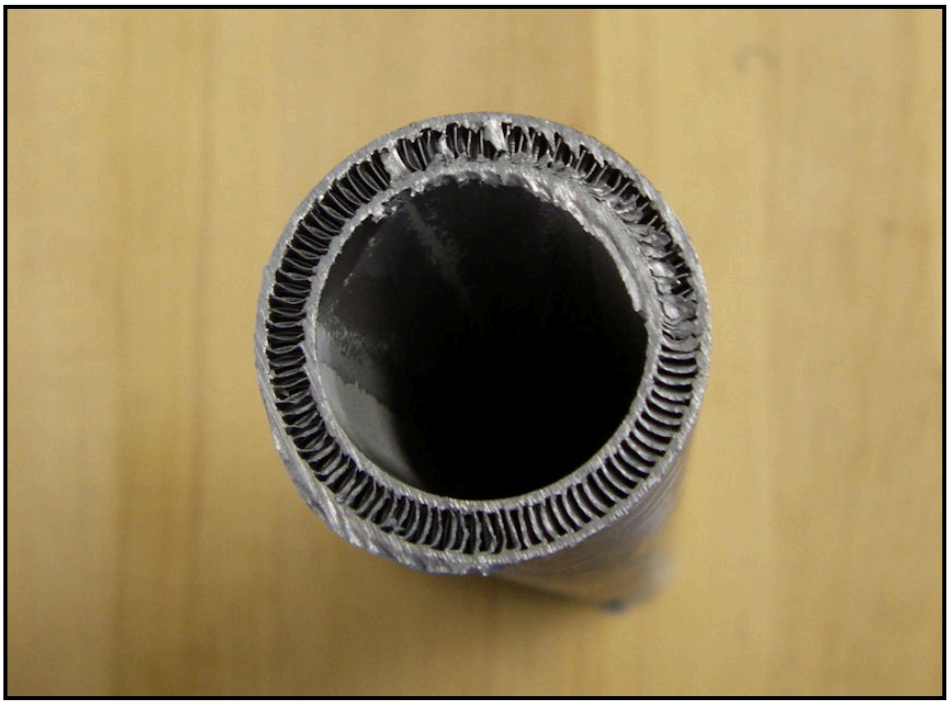


Figure 72 – The ATF Cylinder SY#1 was Cross-sectioned to View the Interior

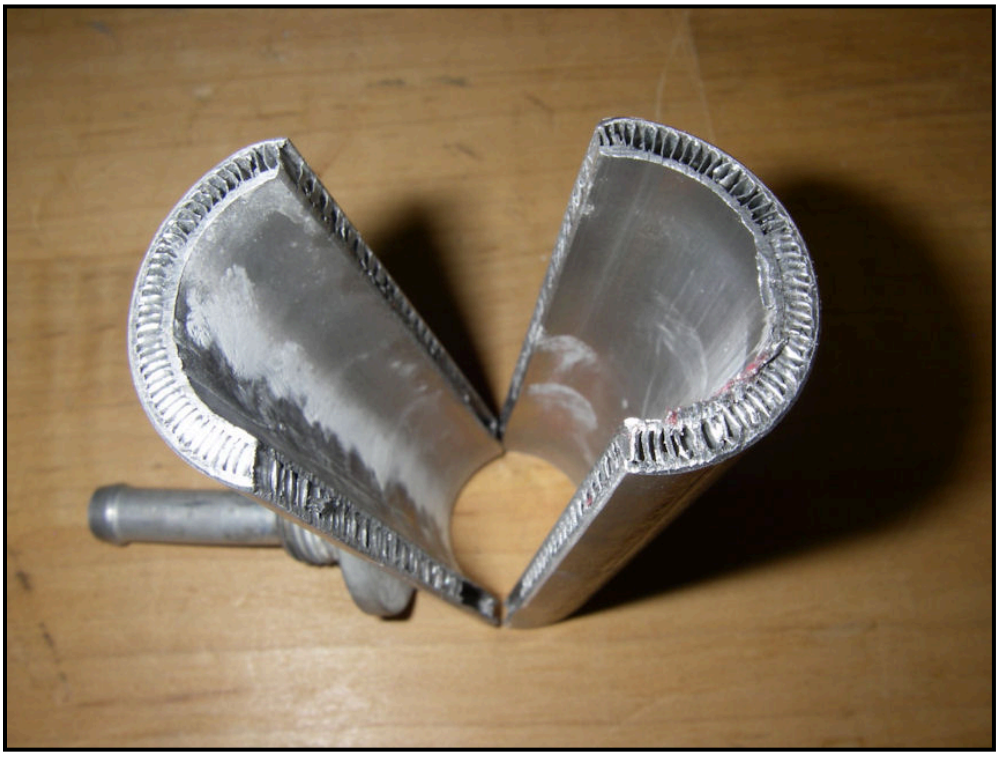


Figure 73 – The ATF Cylinder SY#1 was Then Cut Longitudinally to Further Expose the Interior Design