Received September 18, 2013
S. McHenry

PORSCHE

VIA FEDERAL EXPRESS

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Mr. Jeff L. Quandt, Chief
Vehicle Control Division
Office of Defects Investigation
National Highway Traffic Safety Administration
400 Seventh Street, S.W., Room 5319
Washington, D.C. 20590

September 17, 2013

RE: Preliminary Evaluation (NVS-213 swm / PE13-009)

Dear Mr. Quandt:

This letter and the attached report and enclosure are in response to your letter dated May 9, 2013 to Mr. David Geiger. As agreed with staff we responded to the first eight requests in our letter dated July 26, 2013 and are now responding to the last eight requests. We also included some additional information responsive to Request 2 at the request of staff. In addition, as agreed with staff, we have limited the scope of the subject and peer vehicles to include only those models (911 Turbo, 911 GT2, and 911 GT3) which contain coolant pipes which use an adhesive to secure the pipes to the engine components.

Should you have any additional questions please do not hesitate to contact me at (770) 290-3627.

Sincerely,

Walter J. Lewis, Manager
Regulatory Affairs

Enclosures

2. *State, by model and model year, the number of subject and peer vehicles Porsche has manufactured for sale or lease in the United States and federalized territories for which Porsche sold an extended service plan. Separately, for each vehicle, state the following (if a vehicle had more than one plan, such as a maintenance plan and an extended service repair plan, then list the vehicle separately for each plan that it had):*

   a. *Vehicle identification number (VIN);*
   b. *Make;*
   c. *Model;*
   d. *Model Year;*
   e. *Name of the extended service plan;*
   f. *The mileage at which the extended service plan expires; and*
   g. *The number of months from the warranty start date at which the extended service plan expires.*

   Provide the table in Microsoft 2010, or a compatible format, entitled "EXTENDED SERVICE PLAN DATA." See Enclosure 1, Data Collection Disc, for a pre-formatted table which provides further details regarding this submission.

2. As we stated in our previous letter, please be aware that Porsche did not offer extended service or maintenance plans for the subject or peer vehicles. However, upon further discussion with ODI staff, we were informed that the information sought in this request is information pertaining to Porsche's Certified Pre-Owned Warranty (CPO). This is a warranty offered on used vehicles that have been inspected and certified as qualifying for the used car warranty. The terms of the CPO are 2 years and up to 100,000 miles, whichever comes first. CPO claims are processed by our claims processing system in the same way as for new car warranties, thus any relevant claims that were covered by the CPO warranty will be described in the warranty data submitted in the "WARRANTY_DATA.xlsx" filed in our earlier response. Enclosed is an Excel file "CPO_DATA.xlsx" located in the folder labeled "02" on the enclosed CD which lists the CPO covered vehicles. The number of CPO covered subject and peer vehicles by model and model year is given in the worksheet labeled "OVERVIEW." The individual data for each specific VIN (i.e. engine code, model, platform, model year, etc.) is given in the worksheet labeled "INDIVIDUAL_DATA."

9. *Describe all assessments, analyses, tests, test results, studies, surveys, simulations, investigations, inquiries and/or evaluations (collectively, "actions") that relate to, or may relate to, the alleged defect in the subject and peer vehicles that have been conducted, are being conducted, are planned, or are being planned by, or for, Porsche. For each such action, provide the following information:*

   a. *Action title or identifier;*
   b. *The actual or planned start date;*
   c. *The actual or expected end date;*
   d. Brief summary of the subject and objective of the action;
   e. *Engineering group(s)/supplier(s) responsible for designing and for conducting the action; and*
   f. *A brief summary of the findings and/or conclusions resulting from the action.*

   For each action identified, provide copies of all documents related to the action, regardless of whether the documents are in interim, draft, or final form. Organize the documents chronologically by action.

9. Prior to the current investigation, Porsche conducted an evaluation in August of 2007 to evaluate leaking coolant pipes in the subject vehicles. Based on 15 warranty claims on GT3 and 911 Turbo vehicles for coolant leakage, the Series-Production Quality Team conducted an analysis of coolant pipes from two vehicles from the field (please refer to the file 9-1.pdf located in Folder "09" on the enclosed CD). The title of the action was: Series-production Quality Team, Topic A 472000929 "Coolant connection pipe GT3 leaking" (please refer to the file 9-2.pdf located in Folder "09" on the enclosed CD). The review concluded that the leaks on these two vehicles arose from the bonded joints, and were caused by an inadequate application of adhesive on the pipe connections of these two vehicles. Since not enough adhesive was applied, the bonding gap was not filled sufficiently during production to prevent leaks and ensure the required strength. The supplier began planning for the introduction of quality improvements in the fall of 2007 to replace the manual application of the adhesive, with an automated process, which would ensure a more consistent application of adhesive and conformity with Porsche's supplier specification 996.002.206.70. This process change is described in response to question number 10.

10. Describe all modifications or changes made by, or on behalf of, Porsche in the design, material composition, manufacture, quality control, supply, or installation of the subject components, from initial design and development to date, which relate to, or may relate to, the alleged defect. For each such modification or change, provide the following information:

a. The date or approximate date on which the modification or change was incorporated into vehicle production;
b. A detailed description of the modification or change;
c. The reason(s) for the modification or change;
d. The part number(s) (service and engineering) of the original component;
e. The part number(s) (service and engineering) of the modified component;
f. Whether the original unmodified component was withdrawn from production and/or sale, and if so, when;
g. When the modified component was made available as a service component; and
h. Whether the modified component can be interchanged with earlier production components.

Also, provide the above information for any modification or change that Porsche is aware of which may be incorporated into vehicle production within the next 120 days.

10. On January 25, 2008, Porsche's supplier introduced the use of an automated metering device for application of adhesive on pipe adapters. The automated metering device was introduced to ensure a more uniform and consistent application of adhesive to the joints prior to assembly, and was introduced in response to the 2007 analysis described in our response to Request 9. For a detailed description of the production change notice to the glue application process please refer to the file "10-1.pdf" located in folder "10" on the enclosed CD. For a detailed illustration of the affected components please refer to file "10-2.pdf" located in folder "10" on the enclosed CD.

There are no plans for further modifications or changes.

11. Provide the following information regarding the subject vehicles:

a. Copies of all New Car Limited Warranty & Customer Information booklets;
b. A representative copy of an Owner's Manual for a subject vehicle;
c. Copies of all Porsche owner literature or communications related to advice or warnings when driving on race circuits, sports driving schools or club sports events (such as detailed via the Internet in the Porsche iManuals: How-To Information for Porsche Owners webpages for the subject vehicles; and
d. A summary of advertising or promotion done by Porsche that would indicate to consumers that the subject vehicles are "race track ready," "ready to push the limits" or can be used as-is in performance events (e.g., Sports Driving School, Club Sports Events, etc.) such as is found at www.porsche.com/microsite/911-gt3/usa.aspx?ws=1.

11a. Folder "11" in the enclosed CD contains electronic copies of the warranties for the model year 2001 through 2007 subject vehicles. The following table contains the file names for each of the warranties contained in the folder:

Model Year	File Name	Comment
2001	11-1.pdf 11-2.pdf	Note there were 2 versions of the manual.
2002	11-3.pdf	
2003	11-4.pdf	
2004	11-5.pdf	
2005	11-6.pdf	
2006	11-7.pdf	
2007	11-8.pdf	

Please note we did not include other owner's information (ex. navigation system manual, etc.) as we do not believe it to be responsive to this request.

11b. Also, enclosed is an electronic copy of the 2007 model year 911 GT3 owner's manual (please refer to the file "11-9.pdf" locate in folder "11" on the enclosed CD). We have electronic versions of the owner's manual for most of the other subject vehicles. Please let us know if you wish electronic copies of the manual for other models.

11c. We have manually reviewed all of the hardcopy advertising literature we have in our library for the subject vehicles for any language involving advice or warnings regarding race track use and have found no such information.

11d. In the past, for subject and peer vehicles, Porsche did not advertise or promote the vehicles as in the microsite cited in this request above. The subject microsite referenced is for the 2014 model year 911 GT3 which will be introduced to the U.S. market this fall.

12. *Provide the following information regarding each cooling systems used in the subject and peer vehicles:*

a. *Provide a block diagram of the cooling system showing all major components, the flow paths in each operating mode and each subject component (appropriately named/described and numbered);*
b. *A vehicle diagram showing the location of the cooling system components and each subject component (using numbering from 12.a) relative to other vehicle components (e.g., rear tires, alternator, power steering pump, engine, etc.);*
c. *Coolant capacity;*
d. *Design maximum coolant temperature;*
e. *Provide a table showing coolant temperatures at each of the subject coolant pipe fittings under normal and severe duty driving conditions (i.e., conditions that would produce the highest cooling system temperatures) and the corresponding gauge temperature for each condition; state all conditions/assumptions for each, including ambient temperatures and all operating conditions/duty cycle;*
f. *Describe, and provide photographs of, all system gauges, warning lamps and messages associated with the cooling system, including normal operating range for the gauge and the conditions required for each warning/message; and*
g. *Describe, and provide copies of all reports relating to, all testing performed by Porsche to validate the subject component adhesive bonds both for severe use conditions and long term durability (state all test conditions used for each).*

12a. Folder "12" on the enclosed CD contains block diagrams of the subject and peer vehicles to illustrate the coolant flow through the various systems. The subject connections are labeled in red font and are cross-referenced with the lettering system given in our response to Request 10 where the actual parts are photographed or illustrated (please refer to file "10-2.pdf" in folder 10 on the enclosed CD). The following table lists the file names and describes the subject or peer vehicle block diagram:

File name	Application
12.1.pdf	996 Turbo
12.2.pdf	996 GT3
12.3.pdf	997 GT3-1
12.4.pdf	997 Turbo

On the above block diagrams the symbol "WS1" refers to the water neck component of cylinder 1 – 3 (in German "Wasserstutzen").

Please also note that in front of the left and right side radiators are the air conditioning system's condensers.

12b. Folder "12" also contains various photographs of a 911 GT3 to illustrate the locations of the various vehicle components and systems. The following table contains the file name and a description of the illustration:

File Name	Description
12-5.pdf	X-ray illustration of the GT3 with the engine (where the subject components with glued connections are located indicated by a star) are shown relative to the wheels, alternator, and power steering pump.
12-6.jpeg	Photograph of an engine next to the vehicle to illustrate the relative location of the engine to the rear axle.
12-7.jpeg	Photograph illustrating that the wheelhouses are sealed off from the engine compartment by means of plastic covers.
12-8.jpeg	Photograph of engine from below vehicle.
12-9.pdf	Isoview of front radiators and AC condensers.
12-10.pdf	Illustration of the water neck and similar components located on the engine block (997 generation).
12-11.pdf	Isoview total coolant system (997 generation).
12-12.pdf	Illustration of the water neck and similar components located on the engine block (996 generation).
12-13.pdf	Isoview total coolant system (996 generation).

In addition it has to be noted that the components added to the engine (turbocharger, catalysts, muffler, etc.) basically separate the engine compartment from the road surface (please refer to photograph in file "12-8.pdf") and are at normal operating temperatures extremely hot. Also, note the lower area in front of the transmission/engine unit is covered with aerodynamic shielding.

12c. The total coolant capacities for the subject and peer vehicles are:

Vehicle	Manual Transmission	Automatic Transmission
996 Turbo	28 Liters	29 Liters
996 GT3	28 Liters	N/A
997 Turbo	25 Liters	27 Liters
997 GT3	28 Liters	N/A

12d. For a detailed list of the maximum coolant temperatures under the worst case conditions (race track) at the various connection points, please refer to the file "12-14.xlsx" located in folder "12" on the enclosed CD. The subject connections (A1, A2, B2, etc.) are cross-referenced to those labeled in red font in the block diagrams mentioned in response to Request 12a and also in our response to Request 10 where the actual parts are photographed or illustrated (please refer to file "10-2.pdf").

12e. A detailed table of the maximum pressures under the worst case conditions (race track) at the various connection points is also given in file "12-14.xlsx" located in folder "12" on the enclosed CD.

Folder "12" also contains temperature tables that list the maximum coolant and engine oil temperatures at certain locations under different driving conditions for both the manual and Tiptronic (automatic) transmission versions of the 996 and 997 Turbo, with both standard and upgraded (KIT) engines. The following table contains the file name and a description of the driving conditions contained in the file:

File Name	Driving Conditions
12-15.pdf	50 kph (30 mph) constant speed, Ambient Temperature = 86 °F (30 °C)
12-16.pdf	Race track, Ambient Temperature = 86 °F (30 °C)
12-17.pdf	1) Uphill driving, Ambient Temperature = 86 °F (30 °C) 2) Idle, Ambient Temperature = 109.4 °F (43 °C) 3) Stop-and-Go, Ambient Temperature = 109.4 °F (43 °C)

The relative temperature levels measured at the various fittings under the 50 kph (30 mph) and uphill driving conditions will mirror the pattern shown in the racetrack measurements.

12f. The 2007 911 GT3 owner's manual mentioned in response to Request 11b contains a detailed explanation and illustrations of the coolant system gauges, warning lamp and on-board computer messages involving the state of the vehicle's coolant system (please refer to the file "11-9.pdf" located in folder "11" on the enclosed CD). The following table indicates the locations within the manual where the pertinent information can be found:

Page(s)	**Description**
74-75	Explanation and illustration of the instrument cluster
88	Illustration of the on-board computer
82	Description of coolant temperature gauge and coolant warning lamp
114	Description of on-board computer check coolant level and engine temperature warning
157	Coolant level

12g. Porsche did not conduct specific durability testing of the adhesive bonds used in the coolant pipe fittings. The subject vehicles were tested in accordance with routine Porsche engine and full vehicle durability tests. Additional information on the performance of the adhesives is contained in our response to Request 13b.

13. *Provide the following information regarding the subject components:*

a. *One sample each of a water pump housing with subject pipe fittings assembled (i.e., glued in place) and a pre-assembled water pumps housing and associated pipe fittings (i.e., not glued in place);*
b. *Identify and describe each bonding agent used in the assembly and/or repair of the subject components, by supplier, product name and product serial number and provide the following additional information for each;*
   i) Copies of all Porsche specifications; and
   ii) Copies of all product literature and material data sheets;
c. *Also identify by make, model and model year, any other vehicles of which Porsche is aware that contain the identical coolant pipe connection method (adhesive), whether installed in production or in service, and state the applicable dates of production or service usage;*
d. *State the material compositions of the subject coolant pipes and each of the respective mating housings;*
e. *State the dimensional specifications for each of the subject coolant pipes and each of the respective mating housings; and*
f. *State the thermal expansion coefficients for of the subject coolant pipes and each of the respective mating housings.*

13a. As agreed with staff, we have limited the number of samples requested to only those pertaining to the water neck, the subject of this analysis. The parts are en route to NHTSA under separate cover. The parts being submitted are as follows:

Part Number	Item sent	Condition
997.106.039.72	1	New, assembled
	2	New, unassembled
	3	Field return, damaged
997.106.039.90	4	New, assembled
	5	New, unassembled
996.106.039.73	6	New, assembled
	7	New, unassembled

13b. Supplier: Henkel Loctite Europe, Dusseldorf, Germany
Product: Loctite 638/648

Porsche specifications: Not available.

Loctite specifications: please refer to files "13-1.pdf" and "13-2.pdf" located in folder 13 on the enclosed CD.

13c. Model year 2011-2014 Cayenne (all models)
Model year 2010-2014 Panamera (all models).

13d. Please refer to file 13-3.pdf contained in folder 13 on the enclosed CD for a detailed description of the materials and thermal expansion coefficient for all of the subject fittings. Please note the parts are grouped together by application (A, B, C, etc.) and are cross-referenced with the lettering system given in the detailed illustration of the affected components contained in file "10-2.pdf" in folder 10 of the enclosed CD.

13e. Folder 13 also contains engineering drawings of the various subject fittings. The following table contains the file names and a description of the relevant component.

File name	Component
13-4.pdf	Heat exchanger console
13-5.pdf	Heat exchanger console
13-6.pdf	Pipe fitting
13-7.pdf	Pipe fitting
13-8.pdf	Pipe fitting
13-9.pdf	Pipe fitting
13-10.pdf	Steering pump support
13-11.pdf	Steering pump support
13-12.pdf	Steering pump support
13-13.pdf	Steering pump support
13-14.pdf	Steering pump support
13-15.pdf	Steering pump support
13-16.pdf	Thermostat housing
13-17.pdf	Thermostat housing

13-18.pdf	Thermostat housing
13-19.pdf	Water neck
13-20.pdf	Water neck
13-21.pdf	Water neck
13-22.pdf	Water neck
13-23.pdf	Water neck
13-24.pdf	Water pump housing
13-25.pdf	Water pump housing
13-26.pdf	Water pump housing
13-27.pdf	Water pump housing
13-28.pdf	Water pump housing
13-29.pdf	Water pump housing
13-30.pdf	Water pump housing
13-31.pdf	Water pump housing
13-32.pdf	Water pump housing
13-33.pdf	Water pump housing
13-34.pdf	Water pump housing

13f. Please refer to our attachment referenced in 13d.

14. *Provide the following information regarding the alleged defect:*

a. *The causal or contributory factor(s);*
b. *The failure mechanism(s) and the effects of temperature and age on failure of the adhesive joints;*
c. *Porsche's assessment of which pipe fittings are most likely to fail the earliest in life based on the mechanism and factors identified in 14.a ad 14.b;*
d. *Porsche's assessment of the relatively frequency of actual failures by coolant pipe fitting and all sources of data used for this assessment;*
e. *Copies of all service procedures for repairing loose or separated coolant pipe fittings joined by epoxy or other bonding material;*
f. *State whether Porsche believes all subject coolant pipe fittings should be serviced (i.e., removed and reinstalled) when the first fails or that each fitting should only be repaired after exhibiting signs of failure;*
g. *Describe any survey/testing performed by, or for, Porsche, or of which Porsche is otherwise aware, to assess the condition of adhesive bonds in non-failed pipe fittings in vehicles experiencing a first or second failure of subject coolant pipe fitting, or in any subject or peer vehicles with no evidence of subject component failure;*
h. *For the three pipe fittings with the highest failure likelihoods and/or frequencies (from 14.c and/or 14.d), provide field return samples of failed parts (separated pipe fitting and associated housing); and*
i. *Provide one sample of each kit that has been released, or developed, by Porsche for use in service repairs to the subject component/assembly which relate, or may relate, to the alleged defect in the subject and peer vehicles.*

14a. The causal and contributory factors include:

- Potential overheating of the water neck connection due to racetrack use, contamination of radiators and/or contamination of air-conditioning condensers located in front of the coolant radiator,
- Variation of adhesive bead thickness and distribution within the joint due to manual application of adhesive,
- Potential installation of racing components (exhaust system, engine reprogramming, camshafts, aerodynamic kits, etc.) which increase the operating temperature of the coolant system,
- Too low coolant level, and

- Use of non-OEM approved engine coolants (ex. Water Wetter, Summit Performance Racing Coolant, etc.) with unknown chemical compositions and potential negative effects on the subject adhesive.

14b. The above contributory factors can result in degradation of the adhesive with the gradual development of a partial leak and, over time and repeated high heat cycles, complete failure of the connection. This slow developing failure mechanism is mentioned by many customers' VOQs, which refer to smell, small leaks observed in engine compartment or garage floor, and illumination of coolant level warning lamp.

14c. Porsche identified the water neck coolant pipes used in the various subject vehicles as the most likely to fail from the observed warranty claims and customer complaints. The water neck component is identified by three different part numbers in each of the three subject vehicle models. The following table identifies the part and applications:

Water neck (connections)	**Application**	**Vehicles**	**Spare Part No.**
A (A1, A2)	996 Turbo 996 GT2 996 GT3	MY2001-2005 911 Turbo MY2002-2005 911 GT2 MY2003-2005 911 GT3	996.106.039.73
G (G1, G2 G3)	997 GT2	MY2008-2011 911 GT2	997.106.039.72
K (K1, K2)	997 GT3	MY2007-2011 911 GT3	997.106.039.90

In each of the water necks, there is a single bonded connection point which is by far the most likely to fail (connections A2, G2 and K2). Porsche believes it is this single common connection point that has leaked in the vast majority of warranty claims and complaints. The reason is that the coolant exits the cylinder head at this location and is likely exposed to the highest temperatures and pressures. When the engine is shut off the system coolant temperature peaks and remains hot for some period at this location as a transfer point for heat from the cylinder head to the water neck. Over time, this particular connection has significantly higher heat exposure than other connections of the water neck.

14d. Based on the number of warranty claims for the subject vehicles we calculate a complaint rate of 1.589% up to the present. Considering the average age of the vehicles in subject

group is 9.6 years as of September 10, 2013, and the average age of the vehicle when repaired was 4.2 years, leads us to the conclusion that the failure rate will not increase significantly in the future. For further details please refer to the Excel file in our response to Request No. 16.

14e. Please be aware that Porsche does not recommend repairing any loose or separated fittings involving the subject components. Porsche only recommends that the entire assembly be replaced.

14f. Our instructions to the technicians are to only replace the components that have failed.

14g. Porsche is not aware of any such testing or surveys.

14h. Please refer to our response to 13a.

14i. No such kits are available from Porsche.

15. *State the number of each of the following that Porsche has sold that may be used in the subject and peer vehicles and peer by component name, part number (both service and engineering/production), model and model year of the vehicle in which it is used and month/year of sale (including the cut-off date for sales, if applicable):*

a. *Subject components; and*
b. *Any kits that have been released, or developed, by Porsche for use in service repairs to the subject components.*

For each component part number, provide the supplier's name, address, and appropriate point of contact (name, title, and telephone number). Also identify by make, model and model year, any other vehicles of which Porsche is aware that contain the identical coolant pipe connection method (adhesive), whether installed in production or in service, and state the applicable dates of production or service usage.

15a. File "15-1.pdf" in folder "15" on the enclosed CD contains a table listing the total parts shipment to the U.S. by calendar year for each of the subject parts for the subject and peer vehicles. It is unknown if all of the parts were actually used for repairs of the subject or peer vehicles. The supplier of the relevant components is:

Gusstechnik Schopfheim GmbH & Co. KG
Grienmatt 1
79650 Schopfheim
Mr. Kay Mattern / CEO
Tel.: 011 49 762269740444

15b. Porsche has not developed or released any repair kits.

Please note: as mentioned in our response to Request 13c the 2011-2014 Cayenne and 2010-2014 Panamera use an identical coolant pipe connection method as the subject and peer vehicles.

16. *Furnish Porsche's assessment of the effects of the alleged defect on the handling and stability of: (a) the incident vehicle caused by coolant wetting of one or both rear tires; and (b) oncoming traffic caused by changes in road friction caused by spilled coolant in the subject and peer vehicles, including:*

   a. *Porsche's estimate of the maximum amount of coolant that can leak from each hose fitting;*
   b. *For each fitting, the likelihood of leaked coolant contacting one or both rear tires;*
   c. *The effects of leaked coolant on tire traction in the incident vehicle;*
   d. *The effects of spilled coolant on road safety for oncoming traffic;*
   e. *The risk to motor vehicle safety that it poses;*
   f. *What warnings, if any, the operator and operators of trailing vehicles would have that the alleged defect was occurring or subject component was malfunctioning; and*
   g. *The reports included with this inquiry.*

16. Porsche's analysis has concluded that it would be extremely unlikely for the alleged defect to have any impact on the handling and stability of subject vehicles. There are number of vehicle design features which make it difficult or impossible for coolant to accumulate on the road surface in a quantity that could impair traction, and Porsche has not seen any such cases.

Leakage Location

The water neck on the subject vehicles is located behind the rear axle. When the vehicle is in motion, any liquid that leaks from this location will be drawn aft, away from the front and rear wheels by airflow across the vehicle. In addition, the water neck is located on top of the engine. In order to reach the ground, or the wheels, the coolant would have to pass over various hot components that would quickly evaporate the unpressurized coolant. In fact, some of the hottest components on the vehicle, including the muffler, exhaust pipes, and catalysts are between the leakage location and the ground. In addition, the entire engine compartment is separated from the wheel wells by plastic wheel well liners, which prevent liquids from the engine compartment from getting on the rear wheels.

Leakage Volume

The vast majority of all leaks are slow leaks of very small quantities of coolant, which are identified by owners either due to low coolant warnings or small quantities of fluid found on

the garage floor. These small leaks develop slowly over time, and are associated with very small volumes of fluid. Even if coolant from these leaks could get directly under the rear wheels, which it cannot, there would be no potential for loss of traction due to the lack of volume.

In a very small percentage of cases, the coolant leaks result from sudden and complete disconnection of the water neck pipe connection under severe engine operating conditions, like those experienced during racing or race track driving. These cases are rare, because they are typically preceded by slow leaks, which provide a warning of future failure. These warnings include: the odor from the ethylene glycol coolant, coolant accumulating under the car when parked, or the low coolant warning light. In cases where these early indications are not detected, the degradation of the bonded connection will continue over time and can potentially lead to a complete loss of the pipe bond. Even in these rare cases, a number of vehicle design factors limit the total volume of leakage, and make it extremely unlikely for any impact on vehicle control. First, the plastic retaining clip on the hose connection to the pipe, and the relationship of the pipe to the intake manifold limit the amount of pipe movement, even when there is a complete loss of pipe bonding to the water neck. This was confirmed by bench tests that were conducted in response to this PE to determine the quantity and flow pattern of leaking coolant when the glued connection of the water neck fails completely.

In order to get access to the water neck connection, a 997 GT3 engine was mounted on a test bench with the engine intake system removed. For practical reasons cold water, approximately 0.5 liter, was pressurized to above 2 bar. The cooling line attached to the glued in pipe of the water neck is fixed by means of a plastic clamp and kept in a defined position relative to the engine block and the water neck. This allows the loose pipe to move a few millimeters within the neck and not to completely dislodge. Accordingly, the first test showed a relatively small leak of water as a mist (please refer to the video file "16-1.mp4" located in folder "16" on the enclosed CD).

To simulate the worst case, the plastic clamp was removed before the second test (please refer to the video file "16-2.mp4" located in folder "16" on the enclosed CD). The observed relative movement between the water neck and pipe and its mating hose was still only a few millimeters. A higher rate of coolant mist loss was observed (a few liters per minute). However, this is a theoretical value because under real operating conditions with a leak in the cooling system, the system pressure will drop almost immediately, thus reducing the flow of coolant through the leak.

In addition, the total contents of the coolant system (approximately 28 liters) cannot be lost because of the water pump's location on the engine, which is well above most of the coolant

system fluid. The only coolant available for leakage is the quantity in the over-flow reservoir, and a small additional amount in the engine block above the pump location. Shortly after loss of the bond, the water pump will suck in air instead of coolant, which leads to cavitation in the pump and a loss of pump pressure. The pump will not continue to pump coolant out of the system through the leak once the coolant falls below the pump level. The total amount of fluid available to leak in this situation is approximately 4 to 5 liters. When the pump stops working, the engine will quickly overheat. The fact that we are not aware of any engine overheat damage claims in our warranty records related to coolant pipe leakage supports our assumption that the loss of coolant is never catastrophic.

Finally, the coolant that is lost due to complete loss of the pipe bond turns to steam and is not deposited on the roadway as liquid. Under real world conditions, with the engine running at normal operating temperatures (over 100 ° C) and the coolant pressure at this location (approx. 2 bar), any leaking coolant will immediate expand and evaporate. This phenomenon was observed by many customers who filed a VOQ and report steam coming from the engine compartment.

For all of these reasons, Porsche believes that a loss of traction or control would not be expected for either the subject vehicles or following traffic, in the event of a failure of the subject components.

Conclusion and Summary

Porsche has found no defect related to motor vehicle safety with relation to the pipe fittings at issue in this evaluation.

There are no reports of injuries, fatalities or property damage, nor are police reports available which would support allegations of damage to the driver's car or other vehicles.

In addition to the information provided in this submission which supports our findings, it has to be noted that the cars in question are often used on track for driver education or racing. It is self-evident that conditions on a track are substantially different from public roadways. Drivers on a track operate their vehicles close to the physical limits of the machine and driver with the inherent risk of loss of vehicle control. Drivers, often wearing a helmet, are more distracted than on public roads because the focus and concentration is on performance driving rather than on any warning lamps on the dashboard or observing traffic conditions behind them. This could explain the various VOQs which allege a problem occurred on a track.

Considering the average age of the subject vehicle fleet of 9.6 years, the failure rate of coolant fitting at issue is very small. The technology to connect material, where welding or threaded connectors is difficult or impossible, with adhesives (ex. different material with different heat absorption characteristics) is a common industry practice and proven over many years. Loctite is the leading company for this technology. Besides the sports car models (GT2, GT3 and Turbo), this technology is also used in various applications in pure Porsche racing vehicles (ex. GT3 Supercup). Other applications other than passenger cars included New Holland's harvest combines and street cars built by Koncar Electric Vehicles Incorporated.

Enclosed is Excel file "16-3.xlsx" in folder 16 on the enclosed CD that provides a summary of all the relevant vehicle information. Please note that not all of the VOQs which are contained in the agency "Analysis of VOQs and Porsche Complaints related to PE13-009 as of August 13, 2013" include the vehicle VIN and thus are not mapped into the Excel file.