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December 15, 2017

Heidi King
Deputy Administrator
National Highway Traffic Safety Administration
1200 New Jersey Avenue, SE, West Building
Washington, DC 20590

RE: Docket No. NHTSA–2017–0093; Notice 1

Dear Deputy Administrator King:

The following is a response to NHTSA's request for comments on Ford's petition for relief from its notification and remedy obligations under the National Traffic and Motor Vehicle Safety Act of 1966 to recall Ford vehicles equipped with Takata calcium-sulfate desiccated PSDI–5 driver-side airbag inflators.

We concur with the agency's decision to deny Ford's request for a delayed decision on its petition, based on an ambitious plan to test thousands of inflators. In addition, we would urge you to similarly deny Ford recall relief. This crisis is now entering its ninth year because various manufacturers sought to limit their recall liabilities rather than protect the public from a deadly defect. The agency should not prolong it further by granting Ford's petition.

Inflators with Calcium Sulfate are Hazardous

On July 10, 2017, Takata recalled 2.7 million PSDI-5 driver air bag inflators containing phase-stabilized ammonium nitrate (PSAN) as a generant and calcium sulfate as a desiccant that were produced 2005-2012, and used in the United States as original equipment in frontal driver airbag modules.[1]

Calcium sulfate is used extensively as a commercial desiccant in laboratory use, valued for its chemically stability, as well as its resistance to disintegration and corrosion, nontoxicity, and ability to maintain its adsorbed water in higher ambient temperatures.[2] However, like other

[1] Takata; Recall No. 17E034; Part 573 Defect Notice; July 10, 2017
[2] Desiccant Chart Comparisons; Sorbent Systems; https://www.sorbentsystems.com/desiccants_charts.html; Accessed December 11, 2017

aspects of the design and manufacture of Takata airbag inflators, it does not provide absolute protection against eventual failures: "The low cost of calcium sulfate must be weighed against its equally low adsorptive capacity: it adsorbs only up to 10% of its weight in water vapor. Calcium sulfate also has regeneration characteristics that tend to limit its useful life."[3] Other desiccants, such as molecular sieves and silica gel are often considered more effective at absorbing moisture.[4]

Takata's accompanying chronology in its Part 573 Notice of Defect and Noncompliance describes a field recovery program conducted with Nissan and Ford at NHTSA's request between March 2016 and June 2017, to gather inflators and subject them to a variety of tests. These included live dissections, chemical and dimensional propellant analysis and ballistic testing. Takata reported to the agency that the field-returned inflators had zero ruptures in ballistic test deployments, but that "*some within the population analyzed show a pattern of propellant density reduction over time that is understood to predict a future risk of inflator rupture*." It also allowed that "inflator design and vehicle environment differences between the Nissan and Ford inflators/vehicles *may* influence their aging characteristics." (Emphasis added.)

Nonetheless, Takata determined, "out of an abundance of caution," to recall its first-generation PSDI-5 PSAN driver air bag inflators containing calcium sulfate. In notifying NHTSA of a defect and announcing a recall, Takata acknowledged that these inflators represent an unacceptable risk.

Ford, however, is willing to gamble with the safety of its own customers. It asserts in its petition that it should be excluded from the recall population because about 360 live dissections of Ford vehicle inflators demonstrated "consistent inflator output performance — specifically, measurements of ignition tablet discoloration, generate density, and moisture content of certain inflator constituents did not indicate a reduction-in-density trend." Ford also argued that the Ford vehicle environment was less likely to cause propellant deterioration because there were ''fewer potential moisture sources," due to the presence of only two, foil-wrapped auto-ignition tablets, compared to three unwrapped tablets in other vehicles, divider disk foil tape, and EPDM generate cushion material that "reduces generate movement over time, maintains generate integrity, and leads to consistent and predictable burn rates."

Ford offers no definitive proof that the defective PSDI-5 PSAN driver airbag inflators containing calcium sulfate would operate safely in its vehicles, only speculation. Moreover, at the same time Ford expresses certainty that these inflators would not pose a threat, it asks for more time to conduct further testing. If Ford is still researching the answers to this technical issue, how can it draw any conclusion that would justify its petition to deem the inflators an inconsequential risk to safety?

[3] Desiccant Chart Comparisons; Sorbent Systems; https://www.sorbentsystems.com/desiccants_charts.html; Accessed December 11, 2017

[4] Desiccant Chart Comparisons; Sorbent Systems; https://www.sorbentsystems.com/desiccants_charts.html; Accessed December 11, 2017

Moreover, technical experts that served as consultants to NHTSA and Takata agreed that many factors could lead to an inflator rupture – with moisture intrusion of lesser importance than temperature cycling.

For example, the Exponent report, "Investigation of Takata Inflator Ruptures," emphasizes the role of thermal cycling in failure scenarios: "However, even in hot and dry environments like Arizona, the large daily temperature cycles in the absence of significant moisture ingress can also cause propellant degradation over a prolonged period. High moisture content alone in the absence of temperature cycling will not increase degradation."[5]

Exponent researchers also assert that "Degradation can occur in absence of other factors like degraded or altered booster material."[6] This undercuts Ford's contention that its auto-ignition material supplies sufficient protection to prevent a failure. Likewise, "parameters such as booster-to-main-chamber communication and initial moisture content in the booster material do not significantly affect the calculated moisture flux,"[7] which also indicates that the foil barrier Ford cites as significant protection is insufficient to prevent rupture.

It is true that in its report, written with help from consultant Fraunhofer ICT, Takata acknowledged that variances among vehicle types are determinants in whether or how significantly an airbag inflator will deteriorate due to temperature cycling, stating:

> One of the key observations in the analysis of the field return data is that there exists a strong dependence on outcome based on the vehicle in which the inflator was installed. Limited vehicles studies conducted by Takata show variation in inflator surface temperatures between different vehicle types and models, given identical environmental exposure conditions. This temperature variation appears to have some correlation with different field performance of those models, as shown in Figure 19 below. This is not to say that the vehicle is the cause of the issue- only that the vehicle type may influence the rate that the inflator degrades.[8]

However, contrary to Ford's assertion that variances in its vehicles and inflators mean all of its inflators are safe, Takata emphasized that there are too many variables to claim that one vehicle model is safer than another:

> In addition to the temperature differences measured at the inflator given identical environmental exposures, variations in the day-to-day usage of vehicles can also affect inflator temperature. This variability makes it impossible to quantify precisely the moisture and temperature factors needed for degradation, since the actual decade-long environment for any particular vehicle cannot be determined.[9]

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[5] Investigation of Takata Inflator Ruptures; Pg. 9; Exponent; Subbaiah V. Malladi,; July 2016
[6] Investigation of Takata Inflator Ruptures; Pg. 13; Exponent; Subbaiah V. Malladi; July 2016
[7] Investigation of Takata Inflator Ruptures; Pg. 23; Exponent; Subbaiah V. Malladi; July 2016
[8] Technical Report on the Current Status of the Takata Root Cause Evaluation Effort; Pg. 18; Takata; July 22, 2016
[9] Technical Report on the Current Status of the Takata Root Cause Evaluation Effort; Pg. 20; Takata; July 22, 2016

These variables, which Ford neither controls nor mentions in making its claims of inconsequentiality, make it impossible for Ford to deliver any assurances that the defective airbag inflators installed in its vehicles will not rupture, given time and the right circumstances.

Regardless of the Desiccant, PSAN is Too Volatile

NHTSA, Takata and independent researchers agree: PSAN is a volatile chemical that must be used with extraordinary precision and care, or it is likely to over-pressurize, especially when exposed to temperature cycling and moisture. Thus, the underlying root cause of the ruptures is Takata's use of PSAN as a propellant, affirmed by a series of Takata patents filed over two decades.

In a 1995 patent for a process for preparing azide-free gas generate composition, Takata [which often filed patents under its Research and Development arm, Automotive Systems Laboratory, Inc.] noted that if ammonium nitrate is cycled at temperatures below or above 32 degrees Celsius, its crystals will expand, cracking the gas generant:

> "This is totally unacceptable in a gas generant used in air bag inflators because the burning characteristics would be altered in such that the inflator would not operate properly or might even blow up because of the excess pressure generated."[10]

In a 2003 patent filing for phase-stabilized ammonium nitrate, Takata noted that:

> "Unfortunately, the incorporation and use of ammonium nitrate in pyrotechnic gas generant formulations has generally been subject to certain difficulties or limitations. For example, ammonium nitrate-containing pyrotechnic gas generant formulations have commonly been subject to one or more of the following shortcomings: low burn rates, burn rates exhibiting a high sensitivity to pressure, as well as to phase or other changes in crystalline structure such as may be associated with volumetric expansion . . . As will be appreciated, such changes of form or structure may result in physical degradation of such gas generant formulation forms such as when such gas generant formulation has been shaped or formed into tablets, wafers or other selected shape or form. . . . Unless checked, such changes in ammonium nitrate structure may result in such performance variations in the gas generant materials incorporating such ammonium nitrate as to render such gas generant materials unacceptable for typical inflatable restraint system applications."[11]

They reiterated this concern in 2006:

> "One concern with PSAN-containing propellants as well is that they exhibit significant aggressive behavior with regard to ballistic properties, particularly with respect to USCAR Thermal Shock conditioning when ballistically tested at elevated temperatures (the industry standard is about 85 C).

[10] U.S. Patent No. 5,531,941, Process for Preparing Azide-Free Gas Generant Composition, July 2, 1996
[11] U.S. Patent No. 6,872,265 B2, Phase-Stabilized Ammonium Nitrate, Mar. 29, 2005

> It is also required that airbag inflators be subjected to environmental conditioning, such as high temperature heat aging, thermal aging, thermal cycling, thermal shock, humidity cycling, and so forth. These extreme tests can cause many problems, ranging from failure to inflate the airbag to over-pressurization of the inflator leading to rupture. It is therefore desirable to have a gas generant and inflator system that performs the same regardless of conditioning. The present invention provides a solution to many of these possibilities.
>
> Moisture or volatile contaminants can be introduced to gas generating systems in many ways. A few examples include: improperly processed gas generants that contain excess moisture; moisture introduced to the system via humidity during assembly; moisture introduced to the system during environmental conditioning such as high humidity cycling or salt spray; moisture introduced to the system via decomposition of materials within the system such as auto-ignition materials, seals, gaskets, greases, and other gas generator constituents."[12]

In 2013, after another round of passenger inflator recalls, Takata engineers proposed a new gas generant compound, noting that:

> "During temperature cycling inside of an inflator, tablets or wafers of gas generating compositions containing phase-stabilized ammonium nitrate or PSAN (e.g. PSAN containing about 85 to 90 weight percent ammonium nitrate coprecipitated with about 10-15 weight percent of a potassium salt such as potassium nitrate), may lose density especially in the presence of moisture or humidity. It is believed that in some circumstances, the density loss may lead to less predictable performance criteria."[13]

Researchers at Pennsylvania State University's High Pressure Combustion Laboratory analyzed Takata's PSAN propellant between 2011 and 2014, at the request of Takata and Honda. Over protests from Takata, the researchers concluded that PSAN is susceptible to dynamic burning, meaning when the propellant is exposed to sudden pressure increases, it may burn at a much faster rate and at higher temperatures than expected, leading to over-pressurization.[14] The researchers believed this dynamic burning effect contributed to the ruptures and published their conclusions in 2012, warning that "the effect of dynamic burning behavior of the propellant needs to be accounted for when designing or analyzing systems that subject the PSAN propellant to high pressurization rates."[15] With or without countermeasures to prevent moisture intrusion, PSAN itself is too volatile – even when the wafers maintain their density.

And, Ford cannot ensure the continued stability of Takata airbag inflators that were manufactured under poor processes and controls. There is ample evidence that Takata has been plagued by systemic manufacturing and quality control problems. Since 2001, when a Unibody passenger inflator ruptured in a Honda vehicle because the welds did not hold the filter together

[12] U.S. Patent No. 20070084532 A1, Gas Generant, Oct. 2, 2006
[13] U.S. Patent No. 20140150935 A1, Self-healing Additive Technology, Dec. 2, 2013
[14] Rpt. of TK Holdings Inc. Pursuant to Paragraph 33.a of Nov. 3, 2015 Consent Order, at 52-53
[15] Jonathan T. Essel et al., Transient Burning Behavior of Phase-Stabilized Ammonium Nitrate Based Airbag Propellant, 11 Int'l J. of Energetic Materials & Chemical Propulsion 473 (2012)

(prompting recall 02V080), the public record shows that Takata identified numerous problems not specifically related to its use of PSAN: too much propellant ("overpack"),[16] tape seal leaks,[17] low compaction force,[18] use of reprocessed propellant,[19]no automatic-reject function or auto-reject function shut off,[20] poor traceability,[21] cracked igniter assemblies,[22] damaged booster tubes and cups,[23]missing propellant wafers or springs,[24] low compaction load (not enough propellant fed into the press),[25] and propellant being left out at the plant.[26]

These manufacturing problems are exacerbated by defects in the inflator designs – developed by Takata and approved by the OEMs – which contribute to moisture intrusion. A report by consultant Orbital ATK specifies that the inflators were designed with multiple leak paths that allowed for moisture intrusion over time. Fraunhofer ICT concluded moisture could enter the inflators through the o-ring, igniters, and foil burst shims. The wafers themselves were also faulty: Fraunhofer found that the shape and size of the batwing wafers enabled them to absorb moisture gradually but retain it for a long time, allowing moisture build-up through multiple temperature cycles.[27]

Fraunhofer concluded that "in the absence of manufacturing problems, HAH and high temperature cycles are necessary, but not necessarily sufficient, to cause inflator ruptures."[28] Admittedly, Fraunhofer did find that passenger inflator "outcomes vary significantly between [vehicle makes] and vehicle models, even with common inflators" because the vehicle designs allow varying degrees of moisture intrusion.[29] However, neither Takata nor Ford can ensure that its inflators made between 2005 and 2012 are not compromised by any one of the many manufacturing defects that cause ruptures. Twenty deaths worldwide and more than 200 injuries – many of which occurred in inflators that had not yet been recalled when they ruptured – have demonstrated that.

Ford Remains a Holdout

As other manufacturers have acknowledged to their customers the dangers of defective Takata airbag inflators and have begun to move more actively to recall these components, Ford continues to demonstrate its apathy. First, Ford is the only other manufacturer to have tallied an airbag inflator rupture fatality**,** besides Honda. And yet, as the agency itself noted, Ford has not exhibited any sense of urgency in resolving this issue:

[16] Rpt. of TK Holdings Inc. Pursuant to Paragraph 33.a of Nov. 3, 2015 Consent Order, at 25
[17] Rpt. of TK Holdings Inc. Pursuant to Paragraph 33.a of Nov. 3, 2015 Consent Order, at 29
[18] Rpt. of TK Holdings Inc. Pursuant to Paragraph 33.a of Nov. 3, 2015 Consent Order, at 39
[19] Rpt. of TK Holdings Inc. Pursuant to Paragraph 33.a of Nov. 3, 2015 Consent Order, at 39
[20] Rpt. of TK Holdings Inc. Pursuant to Paragraph 33.a of Nov. 3, 2015 Consent Order, at 41
[21] Rpt. of TK Holdings Inc. Pursuant to Paragraph 33.a of Nov. 3, 2015 Consent Order, at 46
[22] Rpt. of TK Holdings Inc. Pursuant to Paragraph 33.a of Nov. 3, 2015 Consent Order, at 58
[23] Rpt. of TK Holdings Inc. Pursuant to Paragraph 33.a of Nov. 3, 2015 Consent Order, at 58
[24] Rpt. of TK Holdings Inc. Pursuant to Paragraph 33.a of Nov. 3, 2015 Consent Order, at 60
[25] Rpt. of TK Holdings Inc. Pursuant to Paragraph 33.a of Nov. 3, 2015 Consent Order, at 62
[26] Rpt. of TK Holdings Inc. Pursuant to Paragraph 33.a of Nov. 3, 2015 Consent Order, at 66
[27] Rpt. of TK Holdings Inc. Pursuant to Paragraph 33.a of Nov. 3, 2015 Consent Order, at 70-71
[28] Rpt. of TK Holdings Inc. Pursuant to Paragraph 33.a of Nov. 3, 2015 Consent Order, at 76
[29] Rpt. of TK Holdings Inc. Pursuant to Paragraph 33.a of Nov. 3, 2015 Consent Order, at 76-77

> "NHTSA requested Ford's assistance in evaluating Takata calcium-sulfate desiccated PSDI–5 driver-side airbag inflators in February 2016, and over seventeen months later only about 400 covered Ford inflators have been tested. Further, while the covered Ford inflators were original equipment in six vehicle models (Ranger, Fusion, MKZ, Milan, Edge, and MKX), all approximately 400 inflators harvested in Ford's field-recovery program were from the same vehicle model (the Ranger). Moreover, the number of inflators tested under Ford's program was less than half the number tested under Nissan's program, and about *seven percent* of the approximately 6,000 inflators Ford now proposes to test in only about *seven months.*"[30]

In fact, Nissan inflators were included in this PSDI-5 recall, and they recalled them without complaint.

Second, Ford continues to install the same non-desiccated Takata inflators that are the subject of the massive recalls in what NHTSA has dubbed "like-for-like" inflators – which very few other manufacturers are using. In the three years since NHTSA first ordered manufacturers to treat this defect as an urgent public safety issue, almost all manufacturers have procured either desiccated inflators or inflators from other suppliers. Ford sought extensions, telling the agency that three years was not enough for it to find a safe alternative in sufficient numbers to meet the demand.[31] Owners of these vehicles will have to go into the shop again in early 2020 for another replacement, which could lead to reduced completion rates because owners are frustrated or feel the interim remedy is safe enough.

Finally, Ford is still telling its customers that the inflators are safe. On its webpage entitled, "Frequently Asked Questions regarding Takata Airbag Inflator Recalls," Ford responds to a query about whether vehicles with recalled Takata airbags are safe to drive, thus:

> "Based on currently available technical data, Ford Motor Company understands that the vehicles involved in the recent Takata recall are safe to drive while you are waiting for replacement parts. You should have the repair completed as soon as possible after you are notified that parts are available."[32]

This is in stark contrast to Honda's consumer messages. On its Airbag Inflator Recall Center webpage, the manufacturer states: "This safety defect can KILL or seriously injure you or your passengers," and notes: "Urgent Action Required."[33] Honda now has launched extensive print, digital, radio and social media advertising campaigns to inform customers of the importance of having their airbags replaced. In addition, the company conducts door-to-door targeting of owners of Hondas with unrepaired "Alpha" inflators (in certain 2001–2003 Honda and Acura models that have a rupture rate of as high as 50 percent). "Teams of Honda representatives

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[30] Docket No. NHTSA–2017–0093; Notice 1;
[31] Fifth Amendment to the November 23, 2015 Coordinated Remedy; EA 15-001; November 9, 2017
[32] Frequently Asked Questions Regarding Takata Airbag Inflator Recalls; https://owner.ford.com/tools/account/maintenance/recalls/frequently-asked-questions-regarding-takata-airbag-inflator-recalls.html; Accessed December 12, 2017
[33] Airbag Inflator Recall Center; http://hondaairbaginfo.com/; Accessed December 12, 2017

physically knock on owners' doors to assist them with scheduling recall repairs," with the goal of capturing 100 percent of the Alpha inflators.[34] Why isn't Ford acting with the same urgency?

Recall Delays Cost Lives

Ford's past attempts to limit its recall responsibilities resulted in one of the 20 Takata inflator rupture deaths tallied worldwide to date. On December 22, 2015, Joel Knight, 52, of Kershaw County South Carolina, was fatally injured in an otherwise survivable and moderate crash when a defective airbag ruptured in his 2006 Ford Ranger. Knight's vehicle struck a cow that wandered into the road; the airbag inflator exploded during deployment, causing a piece of metal shrapnel to pierce his neck and spine. Knight's death was unwarranted and preventable – this defective Takata airbag inflator type, the Smokeless Driver Inflator or SDI, had already been recalled in 2014 in at least 61 other countries by Honda and Toyota. Those recalls were initiated following ruptures that took the life of at least one other driver – a pregnant woman in Malaysia.

On June 19, 2014, Ford issued its first Takata-related campaign – a voluntary field service action – covering the 2004 Ranger (passenger-only); 2005-2007 Mustang (driver only); and 2005-2006 GT (passenger and driver). Ford issued it at the request of NHTSA "to support an inflator inspection and testing initiative in four high humidity areas."[35] This parts collection campaign involved only vehicles registered or originally sold in Florida, Hawaii, Puerto Rico, and the U.S. Virgin Islands. (The Ranger models included vehicles built between Aug.1, 2003 and July 31, 2004.)

Ford's report to NHTSA made clear that it had "not made a determination that a defect exists in the population of Ford vehicles the Agency has identified" and said it would initiate the action to be responsive to the agency's request.

A little more than a month later, on July 27, 2014, a pregnant woman in Malaysia died when the driver airbag inflator in her 2003 Honda City vehicle ruptured during a crash. The inflator in this vehicle was the same SDI inflator used in Joel Knight's 2006 Ford Ranger.

Following that incident, NHTSA requested that Ford replace driver side airbag inflators in Ranger vehicles. On November 3, 2014, Ford amended its regional field service action campaign to also replace the driver side frontal air bag inflators in the 2004-2005 Ford Ranger vehicles.[36] The action was still limited to Florida, Hawaii, Puerto Rico, and the U.S. Virgin Islands, despite other manufacturers expanding the affected regions, and still, inexplicably, did not include the 2006 Ranger.

Ford noted that it did not have replacement parts for the driver inflators in the Ranger and said it would inform owners as soon as they were available. In December 2014, Ford changed its parts collection campaign for *passenger inflators* into regional Recall 14V787, adding Guam, Saipan,

[34] Airbag Inflator Recall Center; Takata Airbag Inflator Recall Fact Sheet; Http://Hondaairbaginfo.Com/Takata-Airbag-Inflator-Recall-Fact-Sheet/; Accessed December 12, 2017
[35] Ford, Recall No. 14V343, Field Service Action Notice, June 19, 2004
[36] Ford, Recall No. 14V343, Amended Field Service Action Report, Nov. 3, 2014

American Samoa, and parts of Alabama, Mississippi, Louisiana, Texas, and Georgia, which were not included in its regional campaigns for driver side inflators.[37]

On February 12, 2015, Ford turned this parts collection campaign for driver inflators, into a regional recall, still limited to two states and two U.S. territories. This time, Ford stated that:

> "Upon deployment of the driver side and/or passenger side front air bag, excessive internal pressure may cause the inflator to rupture…In the event of a crash necessitating deployment of one of the affected frontal air bags, the inflator could rupture with metal fragments striking and potentially seriously injuring the vehicle occupants."[38]

In May 2015, Ford converted its regional recall for passenger inflators into a nationwide recall after Takata issued a recall requesting such an action.[39] However, importantly, Ford never converted its recall of SDI inflators from the limited regional recall into a nationwide recall, nor did it recall the 2006 Ranger with the same SDI.

Knight's death was partly the impetus for a Takata airbag inflator recall of about 5 million vehicles, which would have included the 2006 Ford Ranger. The family of Joel Knight has publicly stated his death would have been prevented if Ford had launched a timely recall.

We agree.

In Conclusion

NHTSA should deny Ford's petition. The safety risks of Takata airbag inflators with PSAN and calcium-sulfate based desiccant are no longer in question. NHTSA, scientists, and Takata itself have determined: PSAN-based propellant is volatile and dangerous, especially when used in inflators that are poorly designed and built.

Not only are Ford's arguments to be relieved of its recall responsibilities offered without supporting evidence, they fail to adequately address the known fundamental failure mechanisms. The purported protections against moisture intrusion that Ford described do not address the more salient factor in ruptures – thermal cycling, which varies among vehicles' daily usage and the environment in which they operate. Ford cannot guarantee their safety. The last decade has shown that when in doubt about the safety of a Takata airbag, err on the side of caution.

In the meantime, Ford has failed to adequately warn its customers about the dangers of these airbags, and has been slow to investigate how Takata airbag inflators operate in its vehicles and find replacement components.

[37] Ford, Recall No. 14V787, Part 573 Defect Notice, Dec. 10, 2014
[38] Ford, Recall No. 14V343, Part 573 Defect Notice, Feb. 12, 2015
[39] Ford, Recall No. 15V322, Part 573 Defect Notice, May 27, 2015

Rather than asking for extensions and writing petitions, perhaps Ford might better spend its time working to improve its recall completion rate, which, according to the latest post on the agency website, was less than 50 percent.[40]

Sincerely,

Sean E. Kane

[40]Recall Spotlight; Takata Airbags; Completion Rates https://www.nhtsa.gov/recall-spotlight/takata-air-bags#takata-air-bags-completion-rates; Accessed December 12, 2017