UNITED STATES DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

In re:

EA15-001
Air Bag Inflator Rupture

GENERAL MOTORS LLC'S PETITION FOR INCONSEQUENTIALITY AND REQUEST FOR DEFERRAL OF DETERMINATION REGARDING CERTAIN GMT900 VEHICLES EQUIPPED WITH TAKATA "SPI YP" AND "PSPI-L YD" PASSENGER INFLATORS SUBJECT TO JANUARY 2017 TAKATA EQUIPMENT DIR FILINGS

General Motors LLC ("**GM**") hereby petitions the National Highway Traffic Safety Administration ("**NHTSA**") under 49 U.S.C. §§ 30118(d), 30120(h) and 49 C.F.R. part 556 with respect to the Takata "SPI YP" and "PSPI-L YD" model front-passenger airbag inflators installed as original equipment in the GM vehicles covered by Takata's equipment defect information reports ("**DIRs**") filed on January 3, 2017, and requests that NHTSA provide GM until August 31, 2017 to complete its engineering analysis and inflator-aging studies before making a determination on this Petition. In support of this request, GM relies on the engineering testing and analysis summarized below, as well as the information that GM has provided to the Agency during periodic briefings on the status of its investigation and in connection with its November 15, 2016 Petition for Inconsequentiality, as more specifically described below.

I. Introduction

As required by the Amendment to November 3, 2015 Consent Order between NHTSA and TK Holdings Inc. (the "**Amendment**"), Takata filed several equipment DIRs in May 2016 that covered, among other inflators, SPI[1] and PSPI-L[2] model airbag inflators without chemical drying agents not yet under recall that Takata sold to multiple OEMs.[3] These DIRs included the "SPI YP" and "PSPI-L YD" model front-passenger airbag inflators (the "**May DIR GMT900 Inflators**") not yet under recall that were installed as original equipment in the following GMT900[4] vehicles (collectively, the "**May DIR GMT900 Vehicles**"):

(i) 2007-2011 model year GMT900 vehicles that had ever been registered in the region defined by NHTSA as Zone A; and

(ii) 2007-2008 model year GMT900 vehicles that had ever been registered in the region defined by NHTSA as Zone B.

Takata filed the May 2016 equipment DIRs without any evidence of any incidents, whether in the field or in ballistic testing, of rupture in a SPI YP and PSPI-L YD model inflator, which utilize GM-specific designs and are contained in unique vehicle environments.

Following Takata's May DIR filings, after consultations with NHTSA, GM filed two DIRs on May 27, 2016 (updated as of June 13, 2016) that covered the May DIR GMT900 Vehicles. GM's DIRs provide, in part, that "[a]fter reviewing the available information, data, and analysis, GM believes that the vehicles it manufactured with these inflators do not contain a present defect which poses an unreasonable risk to motor vehicle safety," but that GM would conduct a recall of

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[1] SPI means "Smokeless Passenger Inflator."

[2] PSPI means "Programmable Smokeless Passenger Inflator."

[3] NHTSA required Takata to take this action because NHTSA determined that these Takata inflators may contain a latent defect—propellant degradation caused by long-term exposure to humidity and temperature cycling—that can cause the inflator to rupture during deployment.

[4] The GMT900 is a specific vehicle platform that forms the structural foundation for a variety of GM trucks and sport utility vehicles, including the Chevrolet Silverado 1500, GMC Sierra 1500, Chevrolet Silverado 2500/3500, GMC Sierra 2500/3500, Chevrolet Tahoe, Chevrolet Suburban, Chevrolet Avalanche, GMC Yukon, GMC Yukon XL, Cadillac Escalade, Cadillac Escalade ESV, and Cadillac Escalade EXT.

these vehicles "unless GM is able to prove to NHTSA's satisfaction that the inflators in its vehicles do not pose an unreasonable risk to safety."

On November 15, 2016, GM filed its Petition for Inconsequentiality and Request for Deferral of Determination Regarding Certain GMT900 Vehicles Equipped with Takata "SPI YP" and "PSPI-L YD" Passenger Inflators under 49 U.S.C. §§ 30118(d), 30120(h) and 49 C.F.R. part 556 (the "**First Petition**"). In the First Petition, GM argued that the equipment defect determined to exist by Takata in the May DIR GMT900 Inflators is inconsequential as it relates to motor vehicle safety in the May DIR GMT900 Vehicles. First Petition at 1. GM further requested that NHTSA defer a decision on the First Petition until August 31, 2017, which would permit GM to complete its testing and engineering analysis on the long-term safety of SPI YP and PSPI-L YD inflators in GMT900 vehicles. *Id.* at 3-4.

In support of its request for deferral, GM argued that the inflators in the May DIR GMT900 Vehicles are currently performing as designed, and would likely continue to perform as designed for a number of years, as evidenced by available field data, ballistic testing of field and aged parts, and stress-strength interference analysis. *Id.* at 13-17. GM further argued that, because GM's engineers and suppliers have been working on redesigned replacement inflators to be ready in the event that the inflators in the May DIR GMT900 Vehicles must be replaced, granting GM's deferral would not delay GM's efforts to engineer and validate replacement inflators as an available remedy for the May DIR GMT900 Vehicles, should that remedy ultimately be required. *Id.* at 17-18. On November 28, 2016, NHTSA granted GM's deferral request. *See* General Motors LLC, Receipt of Petition for Inconsequentiality and Decision Granting Request To File Out of Time and Request for Deferral of Determination, 81 Fed. Reg. 85681 (Nov. 28, 2016).

GM now requests similar treatment for the Takata SPI YP and PSPI-L YD inflators covered by the latest round of Takata equipment DIRs, which Takata filed on January 3, 2017 (the "**January DIR GMT900 Inflators**"). These inflators were installed as original equipment in the following GMT900 Vehicles (the "**January DIR GMT900 Vehicles**"):

GM Zone A Population	**GM Zone B Population**	**GM Zone C Population**
2012 GMT900 vehicles	2009 GMT900 vehicles	2007 – 2008 GMT900 vehicles

The facts and arguments contained in the First Petition, which remain largely unchanged since GM's November filing, support the deferral requested in this Petition with greater force. Compared to the May DIR GMT900 Inflators, the January DIR GMT900 Inflators are: (i) in newer vehicles, in the case of the Zone A and Zone B populations; or (ii) located in the lowest risk Zone C region (none of the May DIR GMT900 Vehicles were in Zone C). The January DIR GMT900 Inflators have therefore been exposed to significantly less humidity and temperature cycling than the May DIR GMT900 Inflators, and are in lower Priority Groups under the recently issued Third Amendment to the Coordinated Remedy Order. Granting GM's requested deferral is consistent with and supported by NHTSA's findings of fact in its decision on GM's First Petition; will provide GM and Orbital ATK sufficient time to complete the long-term GMT900 inflator aging study; and will allow the Agency to render a single decision on both GM petitions in light of the results of that study. Deferring a determination, moreover, will not delay GM's remedy program, if required, as the earliest Sufficient Supply & Remedy Launch Deadline for any of the vehicles covered by this Petition is December 31, 2017.

II. Background

A. GM's investigation and transparency with NHTSA with respect to its investigation

In November 2014, GM began proactively investigating Takata inflators in GMT900 vehicles. GM began this investigation in light of the Takata inflator recalls conducted by other automakers. Although Honda had experienced inflator ruptures in its vehicles and initiated limited recalls relating to Takata inflators before 2014,[5] recalls relating to Takata inflators in high-humidity regions began expanding in the latter half of 2014 to nine other OEMs, including GM (for GM-badged vehicles that were not manufactured by GM, the Pontiac Vibe (Toyota Matrix) and the Saab 9-2X (Subaru Impreza) vehicles).

Whether viewed in the context of voluntary OEM product-safety investigations generally or with respect to the Takata recalls specifically, GM's investigation—now two years in length—is extraordinary in its scope, duration, and scientific rigor. To GM's knowledge, no other OEM has expended more engineering resources to the task of understanding the root causes of inflator rupture or to estimating the long-term performance of the different Takata airbag inflator variants used in their vehicles.

In the process of this unique investigation, GM has provided NHTSA personnel with consistent, detailed information regarding GM's investigation. Since November 2014, and in addition to attending industry-wide technical meetings as part of the OEM Independent Testing Coalition, GM has been in regular communication with NHTSA regarding the status of its own investigation, updated NHTSA on new analysis and field data, responded to NHTSA inquiries,

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[5] In June 2014, GM conducted a safety recall (NHTSA Recall 14V-372) relating to front driver Takata airbag inflators in certain 2013–2014 model year Chevrolet Cruze vehicles. However, this recall related to a Takata manufacturing issue (incorrectly installed baffles) and was not humidity-related.

and regularly provided in-person technical briefings to NHTSA engineers and lawyers. A listing of the various meetings and discussions follows.

- November 25, 2014. GM shares its preliminary, internal investigation plan for GMT900 vehicles with NHTSA, including GM's proposal to seek GMT900 passenger airbag inflators proactively from the field to understand the effect of the environment (vehicle and external) and humidity on these Takata inflators over time.

- January 23, 2015. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation. GM's initial presentations to NHTSA in the beginning of 2015 include, among other things, GM's preliminary analyses of Takata's CT scan measurements of propellant wafers in SPI/PSPI-L inflators returned from the field.

- February 13, 2015. GM conducts a telephonic conference with NHTSA to brief NHTSA on GM's Takata investigation and testing plans.

- March 25, 2015. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation. GM's presentation includes, among other things, GM's initial analysis of data supplied by Takata and other OEMs on the performance of Takata inflators in other vehicles, which indicates marked differences between the observed propellant degradation in SPI/PSPI-L inflators recovered from GMT900 vehicles (as measured by CT scanning) and the observed propellant degradation in inflators recovered from other vehicles.

- May 14, 2015. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation.

- May 22, 2015. GM conducts a telephonic conference with NHTSA staff to review the status of GM's investigation.

- July 23, 2015. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation.

- August 27, 2015. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation.

- September 14, 2015. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation.

- October 15, 2015. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation.

- November 19, 2015. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation.

- November 24, 2015. GM conducts a telephonic conference to provide the November 19th briefing to certain NHTSA personnel that were unable to attend the in-person meeting on November 19.

- December 17, 2015. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation, including Orbital ATK ("**Orbital**") testing and analysis and information on recent field part returns.

- January 7, 2016. GM conducts a telephonic conference to update NHTSA on the Orbital testing plan.

- January 21, 2016. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation.

- February 18, 2016. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation.

- March 17, 2016. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation.

- April 6, 2016. GM conducts a telephonic conference to update NHTSA on data generated by returned field parts from GMT900 vehicles.

- April 14, 2016. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation.

- April 26, 2016. GM conducts a telephonic conference to update NHTSA on the status of GM's investigation.

- May 10, 2016. GM meets with NHTSA in NHTSA's Washington, D.C. office and provide a comprehensive technical briefing on the status of GM's investigation. GM's presentation included, among other things, the results from Takata's CT scanning and ballistic testing on inflators returned from GMT900 vehicles in Zone A regions, which indicated that the inflators were performing safely and as designed.

- May 12, 2016. GM conducts a telephonic conference to update NHTSA on the status of GM's investigation.

- May 18, 2016. GM conducts a telephonic conference to solicit feedback from NHTSA on the testing discussed during the May 10 technical briefing.

- June 16, 2016. Following the filing of GM's Preliminary DIRs on May 27, 2016 (see below), GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation.

- July 28, 2016. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of Orbital's short-term testing and GM's inflator aging study.

- August 16, 2016. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of Orbital's short-term testing and GM's inflator aging study.

- September 1, 2016. GM meets with NHTSA in NHTSA's Washington, D.C. office to provide a detailed technical briefing to ODI on GM's investigation and the initial results of Orbital's short-term testing. GM's investigation includes updated CT scanning and ballistic testing results, along with the results of GM's recently completed inflator aging study. This meeting also provides NHTSA with an overview of GM's petition for deferral, which is filed on September 2.

- September 13, 2016. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation.

- October 4, 2016. GM conducts a telephonic conference to update NHTSA on the status of GM's investigation.

- October 13, 2016. GM meets with NHTSA in NHTSA's Washington, D.C. office to update NHTSA on the status of GM's investigation.

- November 1, 2016. GM meets with NHTSA in GM's Detroit office to update NHTSA on the status of GM's investigation.

- December 6, 2016. GM meets with NHTSA in GM's Detroit office to update NHTSA on the status of GM's investigation.

Going forward, moreover, GM will continue to provide monthly updates to NHTSA regarding the status of its investigation, as required by the terms of the November 25, 2016 order granting the deferral request in GM's First Petition. *See* General Motors LLC, Receipt of Petition for Inconsequentiality and Decision Granting Request To File Out of Time and Request for Deferral of Determination, 81 Fed. Reg. 85681 (Nov. 28, 2016).

B. GM's January 2017 DIRs

On January 10, 2017, following Takata's filing of its January DIRs under the Amendment, GM filed two DIRs covering the January DIR GMT900 Vehicles. As it stated in its earlier May 2016 filings, GM's January 2017 DIRs state that:

> After reviewing the available information, data, and analysis, GM believes that the vehicles it manufactured with these inflators do not contain a present defect which poses an unreasonable risk to motor vehicle safety. Given that GM has not determined that a safety

> defect exists, GM is filing this Preliminary DIR in light of NHTSA's Amended Consent Order directing that, "[t]he filing of DIRs by Takata will trigger the vehicle manufacturers' obligations to file DIRs," the Coordinated Remedy Order. (See CRO ¶ 46), and NHTSA regulations. See 49 C.F.R. Part 573. We are not aware of any cases of inflator ruptures in any passenger airbag inflators in our vehicles worldwide.
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> Contemporaneously with the filing of this DIR, GM is filing with NHTSA a Petition for Inconsequentiality and Request for Deferral of Determination with respect to the subject vehicles. GM will conduct a recall of its airbag inflators covered by the January 2017 Takata DIRs in the event that GM is unable to prove to NHTSA's satisfaction that the inflators in its vehicles do not pose an unreasonable risk to safety and NHTSA denies GM's Petition for Inconsequentiality and Request for Deferral of Determination.

As stated in GM's January 2017 DIRs, GM has not determined that a defect that poses an unreasonable risk to safety exists in the January DIR GMT900 Vehicles. Nothing in this Petition or in the act of filing this Petition is an admission, implied or otherwise, that such a safety defect exists.

III. Discussion

A. Basis for Petition (49 U.S.C. § 30118(d) and § 30120(h); 49 C.F.R. Part 556.4(b)(5))

To petition for an exemption under sections 30118(d) and 30120(h) of the Safety Act, NHTSA's regulations require the manufacturer to file a DIR pursuant to 49 C.F.R. part 573. 49 C.F.R. § 556.4(c). If the manufacturer has not itself made a determination that a defect exists, this DIR does "not constitute a concession by the manufacturer of, nor will it be considered relevant to, the existence of a defect related to motor vehicle safety or a nonconformity." *Id.*

GM has not determined that a defect that poses an unreasonable risk to safety exists in the January DIR GMT900 Vehicles, and this Petition does not constitute a concession by GM of the existence of a defect in the January DIR GMT900 Vehicles, as permitted by 49 C.F.R. § 556.4(c). GM continues to study the performance of these inflators in the field and GM is continuing its engineering analysis of the specific and unique factors that influence inflator performance in GMT900 Vehicles. GM's analysis currently shows that even the oldest of these vehicles will continue to perform as designed for years into the future, even in the highest heat and humidity regions of Zone A. When its engineering analysis and inflator aging studies are completed in August of 2017, moreover, GM will be able to submit a fulsome record to NHTSA showing how the specific characteristics of these vehicles, along with the unique nature of the SPI YP and PSPI-L YD variants, affect the long term service life of the inflators after exposure to conditions of high absolute humidity.

As in the case of defect determinations under the Safety Act generally, the particular application and use of the defective component is relevant to—and, in this case, determinative of—whether the component poses a safety risk within a certain population of vehicles. As the D.C. Circuit held in the landmark case defining OEM obligations under the Safety Act, "[i]t is possible that the same component may contain a defect in performance relating to motor vehicle safety in one class of vehicle or use but not in another." *United States v. General Motors Corporation*, 518 U.S. 420, 439 n.88 (D.C. Cir. 1975) ("*Wheels*"); *see also Ctr. For Auto Safety, Inc. v. NHTSA*, 342 F. Supp. 2d 1, 14 (D.D.C. 2004), *aff'd sub nom.*, 452 F.3d 798 (D.C. Cir. 2006) ("[U]sage is clearly relevant to a determination of whether a vehicle contains a safety-related defect."). Consistent with the *Wheels* case, as discussed more fully below, the SPI "YP" and PSPI-L "YD" variants that GM used in the GMT900 platform are not used by any other original equipment manufacturer and have unique design features, which, together with the unique in-vehicle environment in the GMT900 vehicles, positively influences the performance of these inflators in the field over time compared to other inflator and vehicle variants.

B. Blomquist Expert Report and vehicle-specific differences

The Amendment was accompanied by an expert report prepared by Dr. Harold R. Blomquist (the "**Blomquist Report**"). Citing to three separate expert reports prepared by Fraunhofer Gesellschaft (retained by Takata), Exponent (retained by Honda), and Orbital ATK (retained by the OEM Independent Testing Coalition, of which GM is a member), the Blomquist Report concludes that the cause of ruptures in Takata PSAN inflators is inflator-propellant damage caused by long-term moisture intrusion and temperature cycling. Blomquist Report ¶ 17.

While the root cause of rupture is widely accepted, the "exposure time needed to sufficiently degrade the propellant to the point that an inflator poses an unreasonable risk to occupant safety" is not completely understood. *See id.* at ¶¶ 30-31. In his report, Dr. Blomquist expressly noted that "vehicle platform differences" could impact the rate of propellant degradation from vehicle to vehicle. *Id.* at ¶ 30 (stating that "further research is needed to validate" whether Exponent's "model inputs . . . correctly simulate real world performance degradation").

These vehicle platform differences, Dr. Blomquist explained, were potentially significant variables. Additional testing could "demonstrate that inflators in certain vehicle platforms, models, or configurations take a longer time to present an increased [rupture] risk . . . ." *Id.* at ¶ 30 n.12; *see also id.* at ¶ 18(a) (stating that "vehicle platform . . . can affect in-vehicle temperature and humidity near the inflator"); Amendment at ¶ 6 (stating that Takata's "own testing and analysis" supports the conclusion that manufacturing variations, vehicle make/model, and the specific type of inflator at issue "considerably" impact the "potential for propellant degradation and the expected rate of degradation").

C. GM's study and investigation of Takata inflators in GMT900 vehicles

During its investigation, GM has extensively analyzed the ballistic performance of the SPI YP and PSPI-L YD variants that GM used in the GMT900 platform, which—crucially—have a

GM-specific design and are contained in a unique vehicle environment. Although other OEMs used Takata SPI and PSPI-L model inflators, Takata produced several different variants of these models, each with different design characteristics. The SPI YP and PSPI-L YD variants that GM used in the GMT900 platform are not used by any other original equipment manufacturer and have multiple unique design advantages, including greater vent-area-to-propellant-mass ratios, steel (as opposed to aluminum) end caps, and thinner propellant wafers, which influence burn rates and internal ballistic dynamics.

The physical environment in GMT900 vehicles, moreover, better protects the front-passenger inflator from the extreme temperature cycling that can cause inflator rupture. GMT900 vehicles, which are light trucks and SUVs, have larger interior volumes than smaller passenger cars, and are equipped with solar-absorbing windshields and side glass, all of which significantly reduce interior vehicle temperatures. GM believes, given its present understanding, that these inflator-design and vehicle-environment factors help explain why, as discussed more fully below, inflators recovered from the GMT900 vehicles continue to perform as designed in the field and have not ruptured in ballistic testing, even after significant real-world and laboratory exposure to temperature cycling and humidity.

To supplement its internal analysis, GM has retained Orbital to conduct a long-term aging study that will estimate the service-life expectancy of GMT900 inflators. Orbital needs until approximately August 2017 to complete this study. As more fully described below, the current results of this investigation support the conclusion that the inflators in the January DIR GMT900 Vehicles are currently performing as designed in the field, and that even the Zone A vehicles in the field will continue to perform as designed for at least the next 8.5 years, even after exposure to some of the highest heat and highest humidity environments found in Zone A. This is five years longer than the oldest Zone A May DIR GMT900 Vehicles subject to the First Petition. GM believes this estimate of 8.5 years will only grow as GM's inflator aging studies continue and inflators continue to be conditioned and tested to show their performance over extended periods of time.

D. Field data and GM's internal testing and analysis demonstrates that the Takata SPI YP and PSPI-L YD variants in GMT900 vehicles are currently performing as designed.

1. An estimated 55,000 Takata passenger airbag inflators have deployed in GMT900 vehicles without a single reported rupture

As part of its Safety and Field Investigations process, GM actively monitors vehicle-performance data for evidence of potential safety issues, including incidents of inflator rupture. This dataset includes customer complaints, GM Technical Assistance Center logs, warranty claims, legal claims, field investigations, and NHTSA VOQs. Although these sources do not track airbag deployments in the field, it is possible to estimate field deployments using accident rate and severity information published by NHTSA (NASS). Using this method, GM estimates that over 55,000 PSPI-L and SPI inflators have deployed in GMT900 vehicles since model year 2007, the first model year that GMT900 vehicles utilized these inflators. GM is not aware of a single confirmed rupture report involving a Takata SPI YP or PSPI-L YD inflator in a GMT900 vehicle.

2. GM has analyzed and safely deployed approximately 1,600 Takata SPI YP and PSPI-L YD inflators from the oldest affected GMT900 vehicle population in the highest-risk region

The results from GM's ballistic testing is consistent with the field data. Since November 2014, GM has sent PSPI-L YD and SPI YP inflators from GMT900 vehicles in the field to Takata for ballistic testing and analysis. To date, Takata has ballistic tested 1624 such inflators, and all deployed safely and as designed; none of the inflators ruptured or demonstrated elevated deployment pressure or other signs of abnormal deployment.[6] And these tests are just the beginning. GM will be testing and deploying more inflators going forward as part of its test plans, both internally and with Orbital.

These deployed inflators included a significant number of GMT900 inflators that, according to the Blomquist Report, are at the highest risk of rupture. *See* Blomquist Report ¶ 17. The vast majority of these inflators—1169 PSPI-L YD and 392 SPI YP inflators—came from Zone A GMT900 vehicles recovered from 2007-2008 model year vehicles, which are the oldest population of GMT900 vehicles in the field with Takata passenger airbag inflators.

3. GM artificially aged and ballistic tested Takata SPI YP and PSPI-L YD inflators from the oldest GMT900 vehicle population in the highest-risk region—and all deployed normally

In addition to ballistic tests of unaltered field parts, GM has also conducted ballistic tests on laboratory aged parts to study the future performance of GMT900 SPI YP and PSPI-L YD inflators after additional aging in Zone A states. To conduct these tests, GM artificially aged 12 inflators—6 SPI YP and 6 PSPI-L YD—recovered from 2007-2008 model year GMT900 vehicles in Florida. These inflators had an average of 7.7 years (for the SPI inflators) and 7.8 years (for the PSPI-L inflators) of field exposure.

To further age the parts, GM subjected the 12 returned field parts to continuous temperature cycling in a temperature/humidity chamber. To simulate the temperatures inside a GMT900 vehicle in a Zone A state, GM left a GMT900 vehicle outside in Miami, Florida—facing south, exposed to direct sunlight, during the hottest part of the year—and collected temperature and humidity measurements from sensors placed directly on the inflator housing inside. GM replicated

[6] On information and belief, Takata has provided NHTSA with the data associated with these ballistic tests. For this reason, GM has not submitted this data with its Petition. GM can provide this data on request.

the temperature and humidity conditions that GM observed inside the Miami test vehicle in the temperature/humidity chamber, and continuously exposed the test parts to these conditions on four-hour cycles for 58 straight days. GM estimates that this cycling added the equivalent of seven additional years of Zone A temperature and humidity exposure to the test parts.

GM then sent the parts to Takata for analysis and ballistic testing. Despite having significant real-world temperature and humidity exposure and an additional 7 years of simulated Zone A aging from the temperature/humidity chamber, these inflators did not rupture during testing, or even demonstrate elevated deployment pressure or other signs of abnormal deployment. The results from these tests are attached as **Exhibit A**.

Based on these studies, GM believes that the January DIR GMT900 Vehicles in Zone A will continue to perform as designed for at least 14.5 years of exposure in the field. Given that the oldest of the January DIR GMT900 Vehicles in Zone A would be approximately six years old at present, GM believes even these oldest vehicles would continue to be safe for at least another 8.5 years, even assuming that these vehicles were exposed to some of the highest heat and highest humidity environments found in Zone A. The January DIR GMT900 Vehicles in Zone B and C, although comparatively older than the Zone A vehicles, have not been exposed to these temperature and humidity conditions, and can be expected to perform safely for much longer.

Further, GM's tests have not ceased. GM continues to age inflators and GM will continue to test and deploy inflators, both with the help of Orbital, and separately.

4. Stress-strength interference analysis suggests that the propellant in older GMT900 inflators from Zone A has not degraded to a sufficient degree to create a rupture risk

In addition to the ballistic testing described above, Takata has CT scanned 1578 PSPI-L and SPI inflators recovered from 2007-2008 model year GMT900 vehicles to measure the outside diameter of the inflator's propellant wafers—a key correlate of propellant degradation. *See*

Blomquist Report ¶ 18.b (stating that propellant degradation leads to density changes that "manifes[t] as increased diameter"). Like the inflators collected for purposes of ballistic testing, almost all of these inflators—1516—were collected from GMT900 vehicles in the Zone A region. Again, this will continue and this sample size will only grow larger. To estimate risk of rupture in these vehicles, GM engineers used an analysis technique called stress-strength interference. In this context, stress-strength interference involves plotting two curves on a graph: (i) the normal distribution of wafer diameters from scanned field inflators (the "**Field Parts Curve**"); and (ii) the normal distribution of wafer diameters in inflators that have ruptured, or energetically deployed, during ballistic testing (the "**Energetic Deployment Curve**"). If these curves overlap, the amount of overlap represents the probability of rupture in a particular group of inflators.

GM's stress-strength interference analysis is attached as **Exhibit B** and **Exhibit C.** Exhibit B contains the model for PSPI-L inflators recovered from 2007-2008 model year GMT900 vehicles in Zone A. Exhibit C contains the model for SPI inflators recovered from 2007-2008 model year GMT900 vehicles in Zone A. Because no inflators from GMT900 vehicles have ruptured, there is no understood Energetic Deployment Curve for GMT900 inflators; in the absence of such data, GM created the Energetic Deployment Curves in its analysis using data from ballistic tests conducted by Takata on inflators recovered from other vehicles that have experienced ruptures during testing.[7] GM believes that this approach is, if anything, conservative, particularly as applied to the January DIR GMT900 Inflators, which have been exposed to less environmental humidity and temperature cycling than the parts GM used to create the Field Parts Curves. Additionally, GM has presented evidence to NHTSA that the SPI YP and PSPI-L YD inflators in

[7] Takata provided these measurements to GM with the identifying names of other OEMs removed. On information and belief, Takata has already provided NHTSA with these CT scan measurements. For this reason, GM has not submitted this data with its Petition. GM can provide this data on request.

the GMT900 have design advantages that that will make these unique variants more resistant to rupture compared to other inflators based on ballistic testing, ballistic modeling, and propellant-wafer density measurements performed by Orbital (further analysis on this issue is ongoing). Once this testing is complete, the Energetic Deployment Curves in the attached charts could shift to the right, indicating additional reduction in overall rupture risk.

IV. Request for relief

GM requests that, before making a determination on this Petition, NHTSA provide GM until August 31, 2017 to complete its engineering analysis and inflator aging studies. Given that GM's analysis demonstrates that the inflators in Zone A January DIR GMT900 Vehicles will continue to perform as designed for at least another 8.5 years even in high heat and high absolute humidity environments, this request for additional time is reasonable and well-supported by the engineering analysis to date. It is also logically consistent with NHTSA's deferral decision on GM's First Petition, and would permit NHTSA to reach a single determination on both Petitions in September 2017, after Orbital has completed its long-term aging study.

Providing GM this additional time, moreover, will not delay GM's efforts to engineer and validate replacement inflators as an available remedy for the GMT900 vehicles, should that remedy ultimately be required. As NHTSA is aware, GM's engineers and GM's suppliers have been working on re-designed replacement inflators to be ready in the event that the inflators in these vehicles must be replaced. GM's current belief is that a validated engineering solution should be ready by June 30, 2017 (barring unforeseen setbacks).

As noted above, GM's investigation is ongoing. GM has retained Orbital to study and evaluate the specific SPI YP and PSPI-L YD variants that GM used in the GMT900 vehicles, and to test the effect of different inflator design variables—wafer thickness, vent area, moisture dynamics, and others—in the GMT900 platform's unique thermal environment. Attached as

Exhibit D are Statements of Work agreed upon between GM and Orbital that describe, in detail, the work Orbital has been contracted to perform for GM. Orbital has been conducting this study since May 2016, and expects to complete this study in August 2017. To date, GM believes that Orbital's work has not demonstrated that an unreasonable risk to safety exists in any GMT900 vehicles. To the contrary, GM believes that Orbital's results, which have been shared with NHTSA in the various meetings described in Section II.A above, support the contention that the January DIR GMT900 Vehicles do not pose an unreasonable risk to safety at this time and will not pose an unreasonable risk, if at all, for at least 8.5 years for the vehicles in the highest heat and humidity regions of Zone A. To be clear, GM is committed to continuing the Orbital study and to sharing the results of GM's internal analysis and Orbital's study with NHTSA going forward. GM plans to continue its monthly updates with NHTSA during this process. Once the engineering analysis and inflator aging studies are complete, GM intends to supplement and amend this Petition to provide a full record upon which NHTSA can make its determination. However, at present, GM is simply asking for more time.

V. Conclusion

Based on current field and ballistic-testing data and the analyses described herein, which indicate that the January DIR GMT900 Inflators are currently performing as designed, GM requests that NHTSA exempt GM from the notification and remedy requirements of the Safety Act with respect to GM's January 2017 DIRs until at least August 31, 2017. It is GM's belief that once its engineering analysis and inflator aging studies are complete, GM will be able to supplement and amend this Petition and the First Petition, providing a full record of its investigation and have the data available to make a determination on the GMT900 vehicles covered by these petitions. However, at this time, GM is only requesting that NHTSA grant GM until August 31, 2017 to complete this analysis and submit the results to NHTSA.

GM believes the available field data and engineering analysis supports a threshold showing that the January DIR GMT900 Inflators are currently performing as designed in the field and that a deferral of a ruling on this Petition until August 31, 2017, as with the First Petition, does not pose an unreasonable risk to safety. More specifically, the field reports, ballistic testing, and stress-strength modeling along with GM's consistent and timely updates to NHTSA on the investigation as it proceeds support the request for deferral. Further, because GM's engineers and GM's suppliers have been working on redesigned replacement inflators to be ready in the event that the inflators in these vehicles must be replaced, providing GM this additional time will not delay GM's efforts to engineer and validate replacement inflators as an available remedy for the January DIR GMT900 Vehicles, should that remedy ultimately be required.

Respectfully submitted,

GENERAL MOTORS LLC

Jeffrey M. Boyer
Vice President, Global Vehicle Safety

Exhibit List

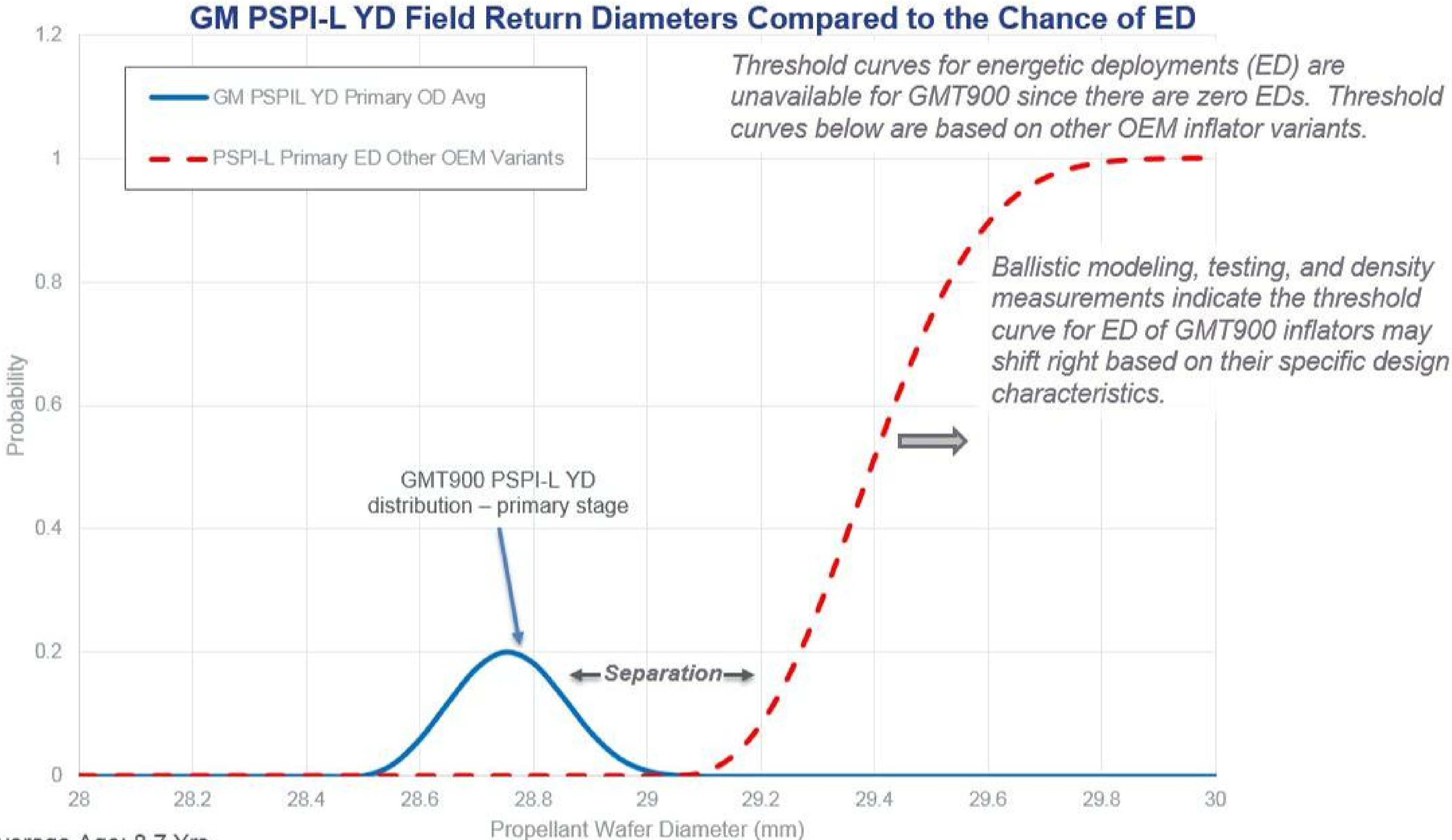
Exhibit A:	Ballistic test data – Laboratory aged field parts
Exhibit B:	Stress-strength interference analysis for PSPI-L inflators installed in 2007-2008 GMT900 vehicles (Updated)
Exhibit C:	Stress-strength interference analysis for SPI inflators installed in 2007-2008 GMT900 vehicles (Updated)
Exhibit D:	Orbital ATK SOWs

EXHIBIT A

Exhibit A submitted separately in native format

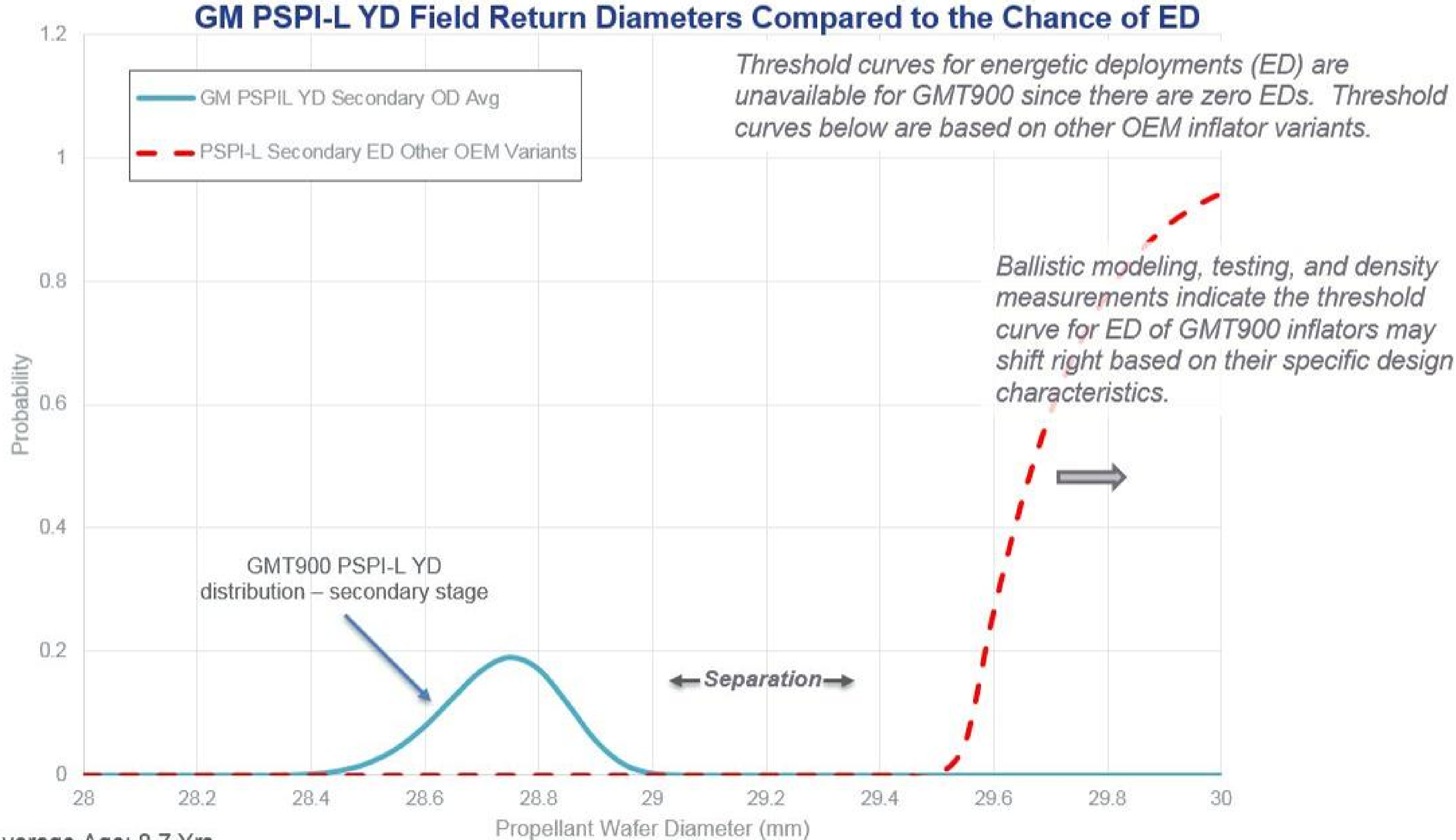
EXHIBIT B

GMT900 PAB INFLATORS – CURRENT FIELD PERFORMANCE



Average Age: 8.7 Yrs

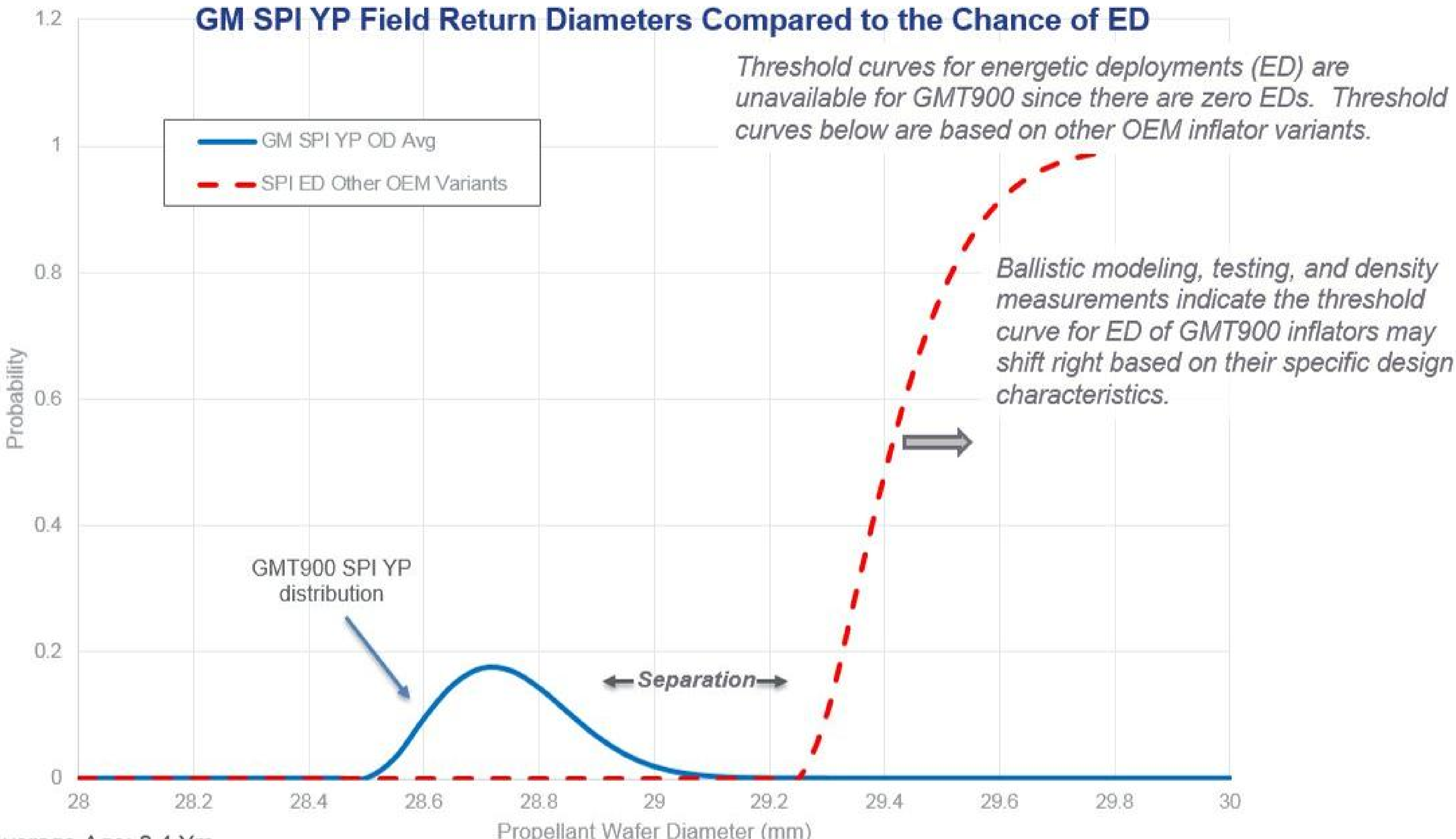
GMT900 PAB INFLATORS – CURRENT FIELD PERFORMANCE



Average Age: 8.7 Yrs

EXHIBIT C

GMT900 PAB INFLATORS – CURRENT FIELD PERFORMANCE



Average Age: 8.4 Yrs

EXHIBIT D

STATEMENT OF WORK	Passenger Airbag Testing

AUTHOR:	[redacted]	BUYER:	[redacted]
PHONE:	[redacted]	PHONE:	[redacted]
DEPARTMENT:	Internal Investigations	UPDATE DATE:	**6/15/16**
SUBMIT DATE:	6/8/16	PURCHASE ORDER #:	**<purchase order issued to supplier for development work>**
REVIEWED FOR EXPORT COMPLIANCE BY:	[redacted]	EXPORT COMPLIANCE CLASSIFICATION:	**EAR99**

PROJECT TITLE:

Passenger Airbag Testing & Analysis for GMT900 Field Returns

PURPOSE:

Review of GM High Absolute Humidity (HAH) passenger airbag field returns for indications of elevated risk on the oldest parts GM has in the field.

TASKS AND RESPONSIBILITIES:

RASIC Roles & Responsibilities

LEGEND: **G**= General Motors Engineering **R**= Responsible, **A**= Approval
S= Supplier **S**= Support, **I**= Inform, **C**= Consult

WHAT \ ROLES	R	A	S	I	C
Test Plan & DOE Matrix	S	G			
Program Management	S		G		G
Acquire Inflators	G				
Testing & Analysis	S			S	G
Final Test Report & Data	S			G	

DELIVERABLES:

Deliverable	Req'd By Date	Submit To GM
Program Plan	With Quote	Buyer
Bill of Materials	With Quote	Buyer
DOE Matrix	With Quote	Buyer
Report Out Meetings	Every Week	[redacted]
Final Report	8/15/2016	

PROJECT TIMING:

Overall Timing: 6-8 weeks

TECHNICAL SPECIFICATION:

Definition:

1. Scanning Electron Microscope (SEM) per LTP-3320-1496
2. Closed Bomb (Burn Rate) per LTP-1026
3. Crush Strength per LTP-0599
4. Inflator Types: SPI-YP (GMT900 HD), PSPI-L YD (GMT900 LD)
   a. Inflators acquired by GM though field returns and virgin inflators direct from production
5. Inflator Types: PSPI-L FD and SPI AJ
   a. Field returns and virgin inflators located at Orbital ATK.

Project Scope:

<u>Testing</u>

A DOE will be created to test the performance of new baseline and aged field returned inflators. The DOE will contain inflators selected by age, location and wafer size.

1. **Heavy Weight Inflator Testing**
   a. Between 10-40 of each type of inflator to be tested (PSPI-L YD & PSPI-L FD)
   b. The selected inflators will be dissected and disassembled according to the DOE parameters.
   c. The heavyweight test fixtures for PSPI-L (existing) will be used for obtaining ballistic data and combustion pressures for all the DOE tests.
2. **Leak Rate Testing**
   a. Approximately 6 of each type of inflator (3 virgin and 3 field) to be tested
      i. PSPI-L YD and SPI YP
      ii. PSPI-L FD and SPI AJ
   b. Inflators will be placed into moisture barrier bags containing D2O and sealed. The inflators will be temperature cycled between 20C and 50, 60 & 70C for several days. Gas samples will be extracted from the inflators and measured for D2O content by GCMS. A relative leak rate will be determined for each inflator.
   c. A transducer will be mounted on each inflator to measure the internal pressure. The inflators will be temperature cycled between 20C and 50, 60 & 70C and held. The pressure will increase due to the temperature change and the decay will be monitored. A relative leak rate will be determined for each inflator.
3. **Moisture Dynamics**
   a. **Glass Jar Ambient Temperature Moisture Competition:** Moisture levels in 2004 in the presence 3110 as a function of 2004/3110 weight ratio and total water content in the system will be assessed. Known weights of water will be added to pre-dried 2004 and 3110 into separate pre-weighed vials. The vials will be uncapped and placed into a sealed jar or Parr bomb and allowed to equilibrate. Each vial will be weighed to determine the moisture content. Data will provide plausible total inflator moisture levels in inflator systems where 2004 is desiccated by AI-cup 3110, closure 3110 or 3110 from both sources. Tests will be designed to mimic mean or high percentile moisture levels reported in the MEAF for 3110.
   b. **High Temperature Moisture Competition:** Enhance resolution of the “X curve” in a sealed system: determine if loss of 3110 desiccant capacity relative to 2004 is abrupt or gradual as a function of increasing temperature. Known weights of water will be added to pre-dried 2004 and 3110 into separate pre-weighed vials. The vials will be uncapped and placed into a Parr bomb and allowed to equilibrate at the target temperature. The Parr bomb will be cooled to room temperature and the vials will be weighed to determine the amount of moisture in each constituent. Emphasis will be to gather multiple readings for selected water levels in the temperature range between 40-70°C.
   c. **Moisture Pump Simulation:** Utilizing the best data available for equilibrium levels of moisture between head space, 3110 and 2004, rates of moisture accumulation or loss within an inflator as a function of leak rate and diurnal cycling at specified sets of hot/cold

temperatures and external absolute humidity will be estimated. Model outputs will be used in selecting moisture levels to be added to inflators for controlled environmental aging.

4. Wafer Dissection and Testing

a. Test propellants from selected inflators based on age, location and wafer size. The tests will be used as an aid in differentiating GM inflator aging from other OEM inflator aging characteristics. Tests to be conducted include:
   i. Karl Fisher moisture on 2004 wafers (Polytron)
   ii. Gravimetric moisture on 3110 tablets
   iii. SEM of 2004 wafer surfaces
   iv. Envelope density of 2004 wafers and 3110 tablets (Geopyc)
   v. Closed Bomb (Burn Rate)
   vi. Crush Strength

5. O-ring Aging

a. Test O-rings from selected inflators based on age, location and wafer size. The tests will be used as an aid in differentiating GM inflator aging from other OEM inflator aging characteristics. Tests to be conducted include:
   i. Shore A
   ii. Photo microscopy
   iii. THF extraction weight loss

<u>Modeling and Analysis</u>

1. Inflator Design Comparisons

a. Complete a part-by-part comparison of PSPI-L FD to PSPI-L JD to PSPI-L YD and SPI – AA/AJ to SPI- DH to SPI – YP (build on Inflator design comparisons done during the ITC Root Cause investigation.)
b. Identify design similarities, differences and determine if these differences can affect leak rate, pressure capability, operating pressure, and sensitivity to operating pressure changes.
c. Compare design differences to failure rate differences to the MEAF.
d. Summarize and document information.

2. Platform Comparisons

a. Take OEM platform data on Temperature and humidity for diurnal cycles.
   i. Platforms will include Corolla, Vibe, Sentra, and GM LT.
b. Compare this data to failure rate differences in the MEAF, and to OATK Leak rate and Moisture Dynamic testing.
c. Summarize and document information.

3. MEAF Review

a. Obtain and upload latest version of the MEAF.
b. Identify failure rate differences by Inflator type/prefix and platform. Identify other differences that could also affect failure rate.
   i. Compare Corolla HAH failure rates to other types/prefixes/platforms.
   ii. Compare groupings of like-inflators based on similar design characteristics, and like-platforms based on similar temperature/humidity profiles.
   iii. Identify threshold diameter based on type/prefix and platform (not all PSPI-L have the same threshold diameter).
   iv. Relate inflator design differences and platform differences to threshold diameter differences.
c. Summarize and document information.

4. Ballistic Modeling

a. Develop ballistic models for PSPI-L YD, SPI-YP, SPI-AJ/AA, and SPI-DH.
b. Anchor to ballistic and quench test data from Takata and OATK.
c. Exercise models to determine differences in peak pressure, available propellant after peak pressure, and sensitivity to runaway pressure given an anomaly.
d. Compare model differences to failure rate differences in the MEAF.
e. Summarize and document information.

GM	**STATEMENT OF WORK**	**Takata Airbag Inflator Durability Testing**

AUTHOR:	[redacted]	BUYER:	[redacted]
PHONE:	[redacted]	PHONE:	[redacted]
DEPARTMENT:	Internal Investigations	UPDATE DATE:	**4/15/16**
SUBMIT DATE:	2/2/16	PURCHASE ORDER #:	**<purchase order issued to supplier for development work>**
REVIEWED FOR EXPORT COMPLIANCE BY:	[redacted]	EXPORT COMPLIANCE CLASSIFICATION:	**EAR99**

PROJECT TITLE:

Takata Airbag Inflator Durability Testing

PURPOSE:

Determine how temperature and thermal cycling (long term exposure to high absolute humidity conditions) of inflators affects ballistic deployment.

TASKS AND RESPONSIBILITIES:

RASIC Roles & Responsibilities

LEGEND: **G**= General Motors Engineering **S**= Supplier

R= Responsible, **A**= Approval **S**= Support, **I**= Inform, **C**= Consult

WHAT \ ROLES	R	A	S	I	C
Test Plan & Aging Matrix	S	G			
Program Management	S		G		G
Acquire Inflators	G				
Testing & Analysis	S			S	G
Final Test Report & Data	S			G	

DELIVERABLES:

Deliverable	Req'd By Date	Submit To GM
Program Plan	With Quote	Buyer
Bill of Materials	With Quote	Buyer
Aging Matrix	With Quote	Buyer
Status Update	Every Week	[redacted]
Report Out Meetings	Every Month	Schedule Meeting
Live Dissection Analysis Rpt s	Every 1.5 Months	[redacted]
Ballistic Tank Test Data	Every 3 Months	[redacted]
Final Report	7/1/2017	[redacted]

PROJECT TIMING:

Overall Timing: 16 Months (GM reserves the right to cease the testing at any time, for any reason, and will only be responsible for work completed as of the date the project was discontinued.)

- Inflator Build: 2 months
- Moisture Equilibrium Study: 1 month (in parallel with Thermal Aging Study)
- Thermal Cycle Aging Study: 10 months
  - 280 Cycles (5 Years) – Jul 2016
  - 560 Cycles (10 Years) – Sep 2016
  - 840 Cycles (15 Years) – Oct 2016
  - 1120 Cycles (20 Years) – Nov 2016
  - 1400 Cycles (25 Years) – Jan 2017
  - 1680 Cycles (30 Years) – March 2017
- Testing and analysis on final samples, report preparation: 4 months

TECHNICAL SPECIFICATION:

Definition:

1. SAE/USCAR 24-2 (April 2013) – Inflator Technical Requirements and Validation
2. CT Scan of inflator - Volumax Cat Scan Specifications
3. Live Dissection
   a. Weigh and measure outer diameter and inner diameter on all 2004 wafers
   b. Weigh and measure height and outer diameter on all 3110 and 2004 tablets (5 each)
   c. Measure Moisture Content
      i. 3110 tablets in closures: SPI, PSPI-L primary and secondary
      ii. One wafer: SPI, PSPI-L primary and secondary
   d. Crush Strength per LTP-0599
      i. Four wafers from SPI
      ii. Three wafers from PSPI-L primary and one from secondary
   e. Scanning Electron Microscope (SEM) per LTP-3320-1496
   f. Closed Bomb (Burn Rate) per LTP-1026
4. Post Aging Analysis
   a. CT Scan of inflator per Volumax Cat Scan Specifications
   b. Ballistic Tank Test at 23°C per SAE J2238 Airbag Inflator Ballistic Tank Test Procedure
      i. Pressure time curve from each chamber
      ii. Inspect inflators for structural anomalies
5. Inflator Types: SPI-YP (GMT900 HD), PSPI-L YD (GMT900 LD) and PSPI-L FD (Pontiac Vibe)
   a. Inflators to be acquired from Takata

Project Scope:

1. Inflator Build

- Total Moisture Content – add water to achieve the targeted total moisture content accounting for the latent moisture in the as built condition.
- Percentages use the weight of main propellant mass convention.
- Proposed total moisture content
  - Baseline – As Built
  - Mid – 0.15% primary chamber, 0.45% secondary chamber
    - Primary to compare to highest moisture from GMT900 parts (0.12%)
  - High – 0.30% primary chamber, 0.70% secondary chamber
    - Primary to compare to 95%ile moisture from returned competitor parts (0.24%)
- Confirmation - Measure the amount of moisture in the 2004 and 3110 propellant in inflators for each moisture level as built (Baseline, Mid and High).

2. Moisture Equilibrium Study

- Determine minimum cycle times (ambient to hot and hot to ambient) to bring inflators to an equilibrium condition for 3 different temperature cycles on the PSPI-L YD inflator:
    - Target hot temperatures:
        - 50°C (max inflator temp in regions outside HAH area)
        - 60°C (max inflator temp observed in GMT900 in HAH area)
        - 70°C (max inflator temp of some competitor vehicles in HAH area)
    - Target ambient temperature: 23°C

3. Thermal Cycle Aging Study

- Time Zero CT Scan on inflators – 5 for each inflator type and condition (45 inflators).
- Maintain Control Samples for each inflator type at 23°C and 70°C for each moisture level while the rest of the inflators undergo the various temperature cycles.
    - 3 Initial Live Dissection
    - 5 Initial Ballistic Tank Tests

    - 3 Final Live Dissection for each 23°C and 70°C
    - 5 Final Ballistic Tank Tests 23°C and 70°C
- Conduct accelerated aging on each inflator type at 3 specified moisture levels (Baseline, Mid and High) to 1680 cycles (approximately 30 years) or whenever GM decides to halt aging process.
    - Control the humidity inside the thermal cycling chamber to a mutually agreed upon level during cycling.
    - Start with a 4 hour cycle time (2 hours at hot, 2 hours at ambient)
    - Reduce cycle time following the outcome of the moisture equilibrium study if necessary.
    - If results of moisture equilibrium study indicate a cycle time longer than four hours, consult GM for determination whether project should continue.
- Complete the following analysis at each interval for each inflator type at the 50°C and 60°C temperature cycles for the baseline moisture level:
    - 280 cycles (5 years)
        - 1 live dissection
    - 560 cycles (10 years)
        - 1 live dissection and 2 post aging analysis
    - 840 cycles (15 years)
        - 1 live dissection
    - 1120 cycles (20 years)
        - 1 live dissection and 2 post aging analysis
    - 1400 cycles (25 years)
        - 1 live dissection
    - 1680 cycles (30 years)
        - 1 live dissection and 2 post aging analysis
- Complete the following analysis at each interval for each inflator type at each temperature cycle for the mid and high moisture levels and for the baseline moisture level at the 70°C temperature cycle:
    - 280 cycles (5 years)
        - 1 live dissection
    - 560 cycles (10 years)
        - 1 live dissection and 7 post aging analysis
    - 840 cycles (15 years)
        - 1 live dissection
    - 1120 cycles (20 years)
        - 1 live dissection and 7 post aging analysis
    - 1400 cycles (25 years)
        - 1 live dissection
    - 1680 cycles (30 years)
        - 1 live dissection and 7 post aging analysis

Inflator Matrix:

	PSPI-L FD			PSPI-L YD			SPI YP			
	As Built	0.12%	0.24%	As Built	0.12%	0.24%	As Built	0.12%	0.24%	Total
Control Samples @ 23°C	16	16	16	16	16	16	16	16	16	144
Control Samples @ 70°C	8	8	8	8	8	8	8	8	8	72
Moisture Equilibrium	0	0	0	12	12	12	0	0	0	36
Thermal Cycle Aging @ 50°C	12	27	27	12	27	27	12	27	27	198
Thermal Cycle Aging @ 60°C	12	27	27	12	27	27	12	27	27	198
Thermal Cycle Aging @ 70°C	27	27	27	27	27	27	27	27	27	243
Total	75	105	105	87	117	117	75	105	105	891