WRITTEN COMMENTS OF THE
MANUFACTURERS OF EMISSION CONTROLS ASSOCIATION
ON THE CHINA MINISTRY OF ENVIRONMENTAL PROTECTION'S PROPOSED
STAGE 6 EMISSIONS STANDARDS FOR LIGHT-DUTY VEHICLES

June 13, 2016

The Manufacturers of Emission Controls Association (MECA) is pleased to provide comments in support of the China Ministry of Environmental Protection's Stage 6 proposed standards for evaporative and exhaust emissions from light-duty vehicles, including OBD requirements. MECA thanks MEP for their leadership in developing a holistic set of requirements that recognize the limitations of the European regulatory structure and incorporates elements of the more stringent, fuel neutral standards that have evolved over the past 40 years in North America. Furthermore, we recognize MEP for its vision in retaining the technology forcing particle number (PN) standard as part of the proposal in 2020. This will insure that the best available technology is used on both gasoline and diesel vehicles that will require advanced fuel injection and/or wall flow particulate filter technology. We commend the MEP for recognizing the emission benefits of incorporating US style evaporative and On-Board Refueling Vapor Recovery (ORVR) as well as more stringent OBD requirements which will benefit the overall air quality in China. MECA has compared the essential provisions of the European and U.S. light-duty vehicle regulatory framework in a table that can be found on our website at: http://www.meca.org/regulation/mobile-source-regulatory-comparison.

Finalizing these standards for new light-duty vehicles will provide significant economic, climate change and health benefits for the citizens of China. These proposed emission standards build on the extensive experience and success with advanced three-way catalysts, diesel particulate filters (DPFs), and selective catalytic reduction (SCR) technology that spans more than 15 years in the major vehicle markets of the United States, Canada, Europe, and Japan. DPFs and SCR technologies have been used on millions of diesel vehicles to deliver cost-effective, durable reductions of diesel PM and NOx emissions consistent with China MEP's proposed January 1, 2020 compliance date.

The proposed standards are based on an assimilation of tailpipe performance limits, evaporative emission requirements, in-use compliance requirements and OBD thresholds based on experience from the North American and European programs that have been implemented since 2004. MECA commends the MEP for putting policies in place to make 10 ppm sulfur fuel available in advance of this proposal to facilitate and streamline the adoption of the best available emission control technologies into new vehicles that will need to comply with these proposed standards. Our industry supports the emphasis on fuel neutral standards for gasoline and diesel vehicles to enhance the stringency beyond Euro 6c emission limits, the inclusion of stringent evaporative emission requirements based on US experience for over 15 years including ORVR technology, and setting tighter OBD requirements like those developed in the U.S. MECA believes that this proposal represents a solid framework for a balanced, enforceable and comprehensive set of emission standards to achieve significant emission reductions from light-duty vehicles in China. Several areas warrant some additional scrutiny and consideration as

MEP finalizes these light-duty standards. We will highlight a few of these areas for further consideration in our detailed comments below.

MECA is a non-profit association of the world's leading manufacturers of emission control technology for mobile sources. Our members have over 40 years of experience and a proven track record in developing and manufacturing emission control technology for a wide variety of on-road and off-road vehicles and equipment, including extensive experience in developing exhaust and evaporative emission controls for gasoline and diesel light-duty vehicles as well as heavy-duty engines in all world markets. Our industry has played an important role in the emissions success story associated with light and heavy-duty vehicles in North America, and has continually supported efforts to develop innovative, technology-forcing, emissions programs to deal with unique air quality problems such as those in China.

The majority of MECA's comments address the exhaust and evaporative emission provisions detailed in the China MEP's draft proposal that was released on May 13, 2016. MECA believes that achieving the proposed China 6 exhaust and evaporative emission standards and expected emission reductions are technically feasible. This fact is clearly demonstrated by the more than two million SULEV and PZEV compliant light-duty vehicles that have been sold in North America since these near-zero emission, gasoline vehicles were first introduced more than ten years ago. Hundreds of thousands of Euro 6 vehicles deploying similar technologies have also been sold in Europe since September 2015. The technology base of advanced three-way catalysts, high cell density substrates, thermal management strategies, secondary air injection systems, advanced carbon canisters and advanced low fuel permeation materials that have been commercialized for gasoline vehicle applications in North America can provide a compliance pathway for China 6. MECA has provided an overview of the types of emission control technologies that are being deployed in North America and Europe to meet the tightest emission standards for light-duty vehicles in our whitepaper that can be found here: http://www.meca.org/resources/LEV_III-Tier_3_white_paper_0215_rev.pdf from our website www.meca.org >> Resources>>Reports. A recent SAE paper (SAE paper no. 2011-01-0301) demonstrates how advanced three-way catalysts utilizing high cell density substrates can be combined to achieve 32 to 48 mg/km, exhaust emission levels on a four-cylinder, light-duty gasoline vehicle over the FTP75 test cycle.

MECA agrees with MEPs decision to propose tighter particle emission standards for light-duty vehicles. Although a tighter PM standard may require advanced injection systems and/or filters on some GDI engines today, we support MEP's decision to include the European Commission's particle number emission standard for light-duty vehicles powered by gasoline direct injection (GDI) engines as a part of the first phase (6a) light-duty emission standards in 2020. This PN standard was set at 6 X 10^{11} particles/km in Europe starting in 2017, measured using the European PMP particle measurement protocol. The technologies necessary to meet this standard will be well demonstrated in commercial applications by 2020. This level of particle number emissions has been estimated to be approximately equivalent to 0.3 mg/km on a mass basis in MECA's ultrafine particle report and represents the most stringent requirement for particle emissions in the world (http://www.meca.org/resources/MECA_UFP_Executive_Summary_-Mandarin-.pdf). A portion of this report has been translated to Mandarin. This European particle number limit will cause

auto manufacturers to introduce the cleanest, best available control technologies such as advanced fuel injection systems and/or gasoline particulate filters to comply with the European Euro 6c GDI particle number limit.

Auto manufacturers are already working to bring forward early introductions of these cleaner Euro 6c-compliant gasoline engines to the European market in the coming 12 to 18 months. One manufacturer has already commercialized a vehicle that has both advanced injectors and an uncatalyzed GPF. Most recently a European OEM has publicly announced their commitment of bringing GPFs across their European fleet to comply with the Euro 6 PN standard and Europe's RDE requirements: http://www.greencarcongress.com/2016/05/20160527-mb.html. Nearly all auto manufacturers that sell into the European market, are working with MECA members on potential applications of particulate filters on gasoline direct injection vehicles. Gasoline particulate filters (GPFs) are based on the same, wall-flow ceramic filters that have been successfully applied on millions of diesel vehicles and engines in Europe and North America for more than 10 years. The performance and application of these GPFs has been highlighted in a number of recent technical publications (e.g., SAE paper nos. 2010-01-0365, 2011-01-0814, and 2013-01-0836; SAE paper no. 2013-01-0527 authored by Environment Canada and MECA). Like diesel particulate filters, gasoline particulate filters are capable of reducing particle emissions by more than 85% over a wide range of particle sizes, including high capture efficiencies for ultra-fine particles. The application of a GPF on a four-cylinder gasoline direct injection vehicle is expected to cost approximately $100-120 (see ICCT's GPF cost estimate available here: www.theicct.org/estimated-cost-gasoline-particulate-filters), making this emission control technology a cost-effective solution for reducing particulate emissions from future gasoline vehicles. When these filters are properly designed, the impact of a GPF installation on the backpressure and fuel-efficiency of the vehicle has been shown to be minimal. A recent paper (SAE 2016-01-0941) evaluated the durability of a GPF over 150,000 miles and reported that the slight backpressure increase associated with a lifetime of ash in the filter had no measurable impact on fuel economy.

MECA supports China MEP's inclusion of tighter evaporative emission requirements for light-duty vehicles in their proposal. These tighter standards will require the use of advanced evaporative emission technologies such as: advanced carbon canisters, onboard refueling vapor recovery (ORVR) and low permeation materials that have been used in the U.S. to meet U.S. Tier 2 and future Tier 3 evaporative emission requirements for light-duty and medium-duty gasoline or flex-fuel vehicles for over 15 years. These technologies are discussed in the MECA report: "Evaporative Emission Control Technologies for Light-Duty Gasoline Vehicles" (available on MECA's website, www.meca.org, under Resources >> Reports). A detailed discussion in support of tighter evaporative standards, including ORVR, for the Chinese light-duty vehicle fleet can be found on MECA's website here: http://www.meca.org/resources/November_2014_ORVR_Report_-_2-17-15_FINALv4_for_MECA.pdf. MECA has provided detailed comments specifically addressing the proposed evaporative requirements in the China Stage 6 proposal and attached these as Appendix 1 at the end of our comments.

With vehicles equipped with DPF+SCR systems, the importance of proper engine maintenance cannot be overemphasized for the durability and long term performance of the vehicle and emission control system. Regular maintenance becomes critical once a DPF+SCR system is installed because the presence of smoke in the exhaust can no longer be used as an indicator of engine operation problems. High smoke opacity could be a sign of excessive oil consumption or a bad fuel injector, both of which result in high engine-out PM that may lead to plugging of the filter. Once a DPF is installed in the exhaust system, it will capture the PM and mask any signs of high smoke. Since 2010, the California Air Resources Board has initiated an effort to inspect emission controls on light-duty diesel vehicles as part of its biennial Smog Check program to ensure that diesel vehicles are operating properly and that no one has tampered with the emission controls (http://www.arb.ca.gov/msprog/truckstop/quickguide/quickguide78.htm). The program includes a download of the OBD information, as well as a visual smoke check and visual confirmation that the emission control devices are present on the vehicle as installed by the OEM. Similarly, Switzerland has begun using portable PN measurement devices to ensure that DPFs are operating properly in-use and meeting the certified particle number requirements. We encourage the MEP to follow these developments and consider including PN measurements as part of future inspection and maintenance program regulations.

MECA applauds the MEP for including more stringent OBD requirements beyond Euro 6 as part of the proposed China 6 light-duty vehicle standards. In particular, MECA believes that this proposal has struck a reasonable balance with the introduction of criteria pollutant and PM efficiency diagnostic requirements under China 6a. We urge the MEP to consider future strengthening of the OBD requirements to be consistent with the U.S. based OBD monitors and threshold limits in the second phase of the standards (6b) that begin in 2023. These full OBD requirements are an important element of a strong in-use compliance program. In a recent report, the ICCT compared the U.S. and European OBD programs and rated more highly the U.S. style OBD requirements as being more comprehensive than the European requirements (http://www.theicct.org/sites/default/files/publications/LDV%20OBD%20China%20White%20Paper%20vFinal.pdf). Furthermore, OBD provides another important check on the performance of key emissions-related components and ensures that the emission benefits of clean emission control technologies are delivered over the full regulated, useful life of the engine. As MEP finalizes their proposed standards for heavy-duty engines and vehicles as part of a future China VI regulation, we believe that it is extremely important for China to have a consistent OBD system design for both light-duty and heavy-duty engines and vehicles. This is especially true with respect to monitors and their malfunction criteria. This will facilitate development of OBD systems for manufacturer and compliance enforcement by local and national authorities.

MECA provides the following general comments on specific provisions within the proposal for consideration by MEP staff.

- The foundation of any emission control program lies in its ability to be enforced to ensure emission benefits over the full operating life of the vehicle. MECA urges MEP to consider the use of additional test cycles as part of the in-use compliance program in addition to the WLTC to ensure that OEM's calibrate their engines over a broad range of operating conditions experienced in the real world. The use of multiple test cycles for compliance

testing has been demonstrated in the U.S. as a manageable strategy that has been largely effective to ensure that vehicles are not just calibrated to a single test cycle.

- The U.S. program includes in-use testing over a variety of conditions and comprehensive OBD requirements. We support MEP's use of RDE as an in-use compliance tool; however, due to the limited experience of using RDE as a compliance tool, even in Europe, MEP should consider a U.S. style multiple cycle approach of confirming calibration durability in a laboratory setting as experience is developed with the RDE procedure under China 6a. A more complete RDE could be phased-in under China 6b. Furthermore, RDE testing should be considered as a valuable compliance tool as part of MEP's Conformity of Production testing (COP). We believe that cold start emissions are a significant contributor to the total emissions of the vehicle and are particularly relevant for air quality in urban environments. The European Commission intends to include cold-start emissions as part of updates to their RDE procedure later this year. We encourage MEP to include these latest updates in China 6 once they are finalized.
- We believe that the proposed conformity factor of 2.1 for RDE testing starting in 2023 is too generous. Based on experience in the US with in-use compliance PEMS testing of heavy-duty vehicles, we believe a CF of 1.5 is reasonable and is already being demonstrated under the not-to-exceed (NTE) requirements in the U.S. and Europe. A recent demonstration program by our sister association in Europe, AECC, on a light-duty application with baseline engine NOx emissions of 3.4 above the Euro 6 limit was able to demonstrate the benefit of careful engine calibration to achieve a CF below 1.5 with no additional emission control technology (11th Integer Emission Conference, June 18, 2015 and the 2015 Vienna Motor Symposium). Furthermore, the CF in the EU will be 2.1 in 2017 (for new type approvals) and 2019 (all new vehicles), and it will drop to 1.5 in Europe in 2020 (for new type approvals) and 2021 (all new vehicles). Thus, CF levels significantly below 2.1 will already be implemented and proven in Europe several years ahead of the 2023 China 6b implementation date.
- The agency should consider requiring the measurement and reporting of unregulated pollutants such as; CH_4, NH_3, formaldehyde and other air toxics to establish a database for potential future regulation. It would also be beneficial to initiate measurement and reporting requirements for greenhouse gases as part of RDE and certification to establish a good database for future GHG and fuel economy legislation.
- In addition to ensuring the availability of clean, low sulfur fuels, MEP should ensure a stringent lubricating oil standard for gasoline and diesel engines equipped with advanced emission controls such as DPFs and GPFs. Advanced low ash content lubricating oils with less volatile additive packages may be necessary to meet the 150,000 km durability requirements in this proposal. Clear labeling requirements and a phase-out of incompatible lubricants should also be implemented to prevent misapplication in newer technology vehicles equipped with advanced emission controls.

In conclusion, MECA thanks the China MEP for bringing forward this proposal for reducing emissions from light-duty vehicles. Once finalized, these regulations will provide the citizens of China with significant economic, air quality and climate change benefits. MECA encourages the MEP to finalize these regulations as soon as possible in 2016 and to ensure that urea reductant is made available across the country for these new, more stringent emission regulations. MECA members stand ready to work with their customers to deliver the needed

emission control technologies that will allow future new passenger cars and light-duty vehicles to comply with the proposed China 6 emission standards. We ask for the agency's help in ensuring that the emission reductions expected under this proposal are realized by implementing a robust inspection, in-use compliance and enforcement program as authorized to MEP and the provincial EPBs by the 2015 version of the China Clean Air Act.

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Appendix 1: MECA Comments to the Proposed China Stage 6 Evaporative Emissions Requirements

Section A.4.2.10.2.6.18 "the canister purge flow rate and total volume when conducting F.5.8.1.5" should be revised to "the canister purge flow rate and total volume when conducting F.5.9."

Section A.4.2.10.26.19 "the canister purge flow rate and total volume when conducting 1.5.7.1 or 1.5.7.5.5" should be revised to "the canister purge flow rate and total volume when conducting 1.5.7.1 and 1.5.7.5.3 and 1.5.7.5.4."

Section A.4.2.10.2.6.9.10 There is no test procedure described or referenced to measure GWC g/100 ml.

Section 3.29 The definition of "defeat device" of 3.29 is not consistent with F.3.1.3. We recommend keeping the text of F.3.1.3

Section 6. We recommend the main paragraph of section 6 be amended to also state that the type approval vehicle representing the evaporative emissions family should be the "worst case" within the family, including the minimum ratio of canister capacity, per HJT 390, to the total tank ullage volume, when the tank is filled to 40% and other design elements that could affect control.

Section F.1.1.5 Is the BWC measurement per HJT 390?

Section Figure F.1a For clarification, the descriptive text to the right of the "Preconditioning Drive" box, the term "OVC" could be replaced by "Non-NIRCO OVC" to remain consistent with the terminology of section F.5.4.1.

Section F.4.8 The canister BWC, measured per HJT 390, should be reported so as to provide a reference point for F.7

Section F.5.1.8 This provision seems out of place and may be more applicable in F.5.5

Section F.5.6 We recommend adding clarification to the header stating "(refer to section F.5.7 on instructions for NIRCO vehicles)", because technically as written, NIRCO vehicles would undergo two canister preconditioning to critical point steps if the procedures were followed literally.

Section F.5.7.4.1 The reference to F.5.7.5.2 does not appear applicable for the Drain and 95% Fill. It seems referring to F.5.7.3 would be more appropriate.

Section F.5.9.1 Last sentence should read "Prior to the elevated temperature drive, the HEV's battery condition should meet the Table F.1 requirements."

Section F.5.10.3 states to set the SHED temperature to 38C. Section F.5.10.5 is inconsistent with F.5.10.2, because it states to raise the SHED temperature to 33C. Should F.5.10.5 read to raise the SHED temperature to 38C to remain consistent with F.5.10.3?