European Union Aviation Safety Agency

Comment-Response Document (CRD) 2022-05

RELATED A-NPA: 2022-05— RMT.0733

26.2.2023

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1. Summary of the outcome of the consultation

EASA published advance NPA (A-NPA) 2022-05 in May 2022 to present the initial concepts and preliminary draft requirements for landing- and-take-off (LTO) noise and CO_2 emissions of supersonic transport (SST) aeroplanes.

EASA reviewed the comments received and decided to not further develop of European environmental certification requirements (beyond the contents of A-NPA 2022-05) in the near term.

Instead, as described in the European Plan for Aviation Safety (EPAS) 2023-2025, EASA's technical proposals for LTO noise and CO_2 emission requirements for SST aeroplanes are currently fed into the ongoing work of ICAO CAEP working groups to support the development of international environmental standards for SST aeroplanes.

With the aim of ensuring transparency of the process, EASA has decided to publish in the meantime already the comments received during the consultation of A-NPA 2022-05.

EASA retains the option to re-activate RMT.0733 in the future. Should this be the case, the comments received during the present consultation will be further considered for the development of the regulatory material and EASA's feedback in accordance with Art 6(8) of MB Decision 01-2022 will be provided.

Updates on the task will be regularly provided in the future EPAS editions.

2. Individual comments

EASA would like to thank all commenters for their interest in and contribution to this rulemaking activity. Please see below the comments received during the consultation.

(General Comments) -

comment *1* comment by: *AOPA Sweden*

AOPA Sweden
2022-06-05

Comments on NPA 2022-05, Supersonic Transport Aeroplanes

I suppose that none of the airplanes in General Aviation will ever fly in a supersonic speed, at least not in a foreseable future. Hence, we do not have any comments on the proposal other than it is a good idea to regulate the mode of transport in regards to envirenmental purpose.

comment *15* comment by: *LBA*

LBA comment:

LBA supports that technological advances have to be reflected in current requirements. Since it is currently not foreseeable when the ICAO will implement corresponding environmental regulations for supersonic aircraft, we welcome EASA's initiative to develop its own noise and emission regulations for the European member states.

In our opinion, it is a correct approach to adopt the regulations and limits for subsonic aircraft accordingly. However, we consider a trade-off between noise approval and co2 emissions (as proposed in 5. Impact assessment (IA)) to be the wrong approach, because with this measure it is no longer necessary to develop an engine design that is optimal in every respect.

In connection with the planned ban on supersonic flights over the territory of the EU as proposed in NPA 2022-04 (regular update of the SERA regulatory framework), this proposed regulation is an important step to maintain the high level of environmental protection in the EU.

comment *16* comment by: *GdF*

We support the general initial ban of aircraft operating at super- and transonic speeds and the introduction of applicable noise abatement / measurement standards for potential new kinds of aeroplanes.

If EASA decides later on to allow these kinds of operations, we would like to see the necessary rules of the air, liability regulation and infrastructure implemented well beforehand. Experience with military supersonic aircraft has shown that the created noise and necessary planning to ensure separation to subsonic aircraft cannot be overestimated.

comment *18* comment by: *Rolls-Royce plc*

Comment Summary

Applicability

Suggested Resolution

The new rule should be based on high TRL technology. Thus it should have a statement on the applicability in terms of cruise Mach numbers. From RR view, supersonic cruise at Ma<1.8 seems to be a sufficient range of applicability.

comment *32* comment by: *Rolls-Royce plc*

Comment Summary

General Comment on CO2 Standards: We understand EASA were obliged to introduce an initial CO2 rulemaking concept, but this is premature giving the progress on the international CO2 standards rulemaking

Suggested Resolution

Wait for more progress within ICAO on supersonic CO2 standards.

comment *36* comment by: *Rolls-Royce plc*

Comment Summary

Applicability of CO2 standard

Suggested Resolution

General Comment on CO2 Standards: Given the current focus of supersonic aircraft designs it is necessary consider limiting any applicability to planes less than or equal to Mn 1.8. The technical difficulties increase at faster supersonic speeds.

comment *37* comment by: *Rolls-Royce plc*

Comment Summary

General: EASA asks for comments on CO2 standards with regards to whether a speed parameter should be included.

Suggested Resolution

We believe this is a serious consideration for future international work on this subject as the technical difficulty on CO2 increases with increasing speed. It certainly should not be ruled out at this early stage in CO2 metric development.

comment *53* comment by: *Aviation Environment Federation*

We commend EASA on the following points:

- EASA is proposing Ch. 14 limits for supersonic aircraft in order to maintain a level playing field across different aircraft types. We believe that this principle should be applied broadly across applicable environmental standards, not applied only to noise.
- For proposing that the CO_2 metric system is being conserved for supersonic aircraft, and not including speed in the metric, per Option 1 in the proposal. That metric system was developed via a four year, inclusive process that involved a variety of EU stakeholders from government, industry, and academia. The alternative Option 2 (inclusion of noise in the metric) would directly promote higher speed designs with inferior fuel efficiency.
- Likewise, we support the idea of having certification procedures for supersonic aircraft with requirements for both supersonic and subsonic operations.

We take issue with the following aspects of the proposal

- Since the goal of the proposal is to "maintain the current high level of environmental protection in Europe", it is unclear why EASA is not proposing to apply the CAEP/10 subsonic limits to supersonic CO_2. In the proposal, EASA writes that "the CO_2 MVs of supersonic aircraft are expected to be approximately 2–3 times higher than the CO_2 limit for new subsonic aeroplane types."* Since the CO_2 MV is understood to be representative of real-world operations, not requiring supersonic aircraft to meet those limits will lead to emissions many multiples of existing subsonic aircraft.
- The decision to focus only on noise and CO_2, and to ignore other impacts of supersonic emissions, for example NOx/PM and non-CO2.

* NOTE: This is higher than estimated by our colleagues at ICCT: at +52% to +115% exceedance for a MN2.2 aircraft carrying 55 passengers: https://theicct.org/wp-content/uploads/2021/06/Environmental_Supersonic_Aircraft_20180717.pdf.
Since that time, upward revisions of MTOM have likely altered the expected margin of supersonic aircraft to the standard.

Specific comments on noise:

- CAEP is currently undergoing a review of noise standard stringency, with a decision expected in February 2025. We recommend adding a clarification that, when subsonic noise standards are updated at CAEP/13 (2025), those should become applicable to supersonics as well.

Specific comments on CO_2:

- EASA should apply the same CO_2 limits to supersonic aircraft as currently apply for subsonic designs in order to avoid the risk of backsliding on environmental protection
- We propose that all data collected on supersonic CO_2, including RGF, and 1/SAR points, be published in the EASA Emissions Databank. Even if the subsonic CO_2 standard is not applied to supersonic designs, margin/exceedances to the NT limits should be reported in the EASA CO2 databank.
- Moreover, both flight altitude and MN should also be collected since these variables have significant impacts on the non-CO_2 climate impacts of supersonic aircraft (citation: MIT study for NASA).

Specific comments on non-CO_2:

- EASA should consider whether it should develop non-CO2 limits as part of its proposal given the large estimated non-CO2 climate impacts identified in studies.

comment *54* comment by: *Federal Aviation Administration (FAA)*

Attachment #1

Executive Summary

The Federal Aviation Administration (FAA) in general agrees with the following statement from the Executive Summary of the A-NPA 2022-05:

> *The proposed LTO noise limits correspond to the existing limits for subsonic jet aeroplanes, which are contained in Chapter 14 of ICAO Annex 16, Volume I. Pending ongoing work towards establishing an appropriate CO2 limit for SST aeroplanes, provisions for the standardised measurement and reporting of CO2 emissions are proposed as an interim step.*

The FAA has comments and / or clarification questions on specific proposals contained in Sections 4.2 and 4.3 of the A-NPA 2022-05.

The FAA encourages EASA to work with ICAO's Committee on Aviation Environmental Protection (CAEP) to finalize the LTO noise Standards and Recommended Practices (SARPs) within the current CAEP/13 cycle as this will provide needed certainty to the SST manufacturers. The FAA seeks similar cooperative working relationship with EASA under the auspices of CAEP in developing appropriate CO_2 limits for supersonic aeroplanes that are based on technical data and analysis.

Introduction

The FAA appreciates the opportunity to provide our feedback on EASA's Advance Notice of Proposed Amendment (A-NPA) 2022-05 that provides initial concepts for the development of environmental protection requirements for SST aeroplanes.

The FAA also appreciates close working relationship with the EASA and other regulatory bodies and stakeholders at ICAO's Committee on Aviation Environmental

Protection (CAEP) over the previous CAEP cycles aimed at developing environmental standards for civil supersonic aeroplanes.

The FAA concurs with the need to develop internationally uniform environmental standards for civil supersonic aeroplanes. Internationally uniform aviation standards for civil subsonic aeroplanes developed under the auspices of ICAO over the past 60+ years have contributed to significant growth in global trade, travel and communication. The need for such globally uniform environmental standards are all the more important for civil supersonic aeroplanes as a large portion of such fleet is aimed at international travel.

The FAA has reviewed the A-NPA and is pleased to offer the following feedback on the Preliminary draft requirements for LTO noise and CO_2 emission requirements of SST aeroplanes.

comment *66* comment by: *SAE International*

July 21st, 2022

(Comments filed electronically through Comment Response Tool)

Advanced Notice of Proposed Amendment – 2022-5
Environmental protection requirements for supersonic transport aeroplanes

SAE International appreciates the opportunity to comment on EASA's proposed amendment on environmental protection requirements for supersonic transport aeroplanes.

SAE International is the largest non-government mobility standards developing organization in the world. For over 100 years, SAE International has developed aerospace industry voluntary consensus standards to support the aviation community. SAE International's Aerospace Standards repository includes over 8,000 consensus documents and its 180 technical committees are comprised of over 10,000 experts from 56 countries. A well-established framework exists within SAE to develop and revise standards for the wider aviation community.

With supersonic aircraft applications being researched, developed, and tested to varying degrees of maturity SAE has established a Supersonic Aircraft Steering Group (SASG). The activities of this Steering Group are intended to guide the collective effort of the industry, government and otherstakeholders related to supersonic aircraft systems and applications, and help develop industry standards, through the collaboration among industry and government to facilitate uniform certification and regulatory compliance procedures.

Members include Boom Supersonic, Rolls-Royce, Boeing, Gulfstream, Collins Aerospace, Honeywell, Reaction Engines, Hermeus, Exosonic, United Airlines, the United States' Federal Aviation Administration (FAA), the United States' National Aeronautics and Space Administration (NASA), the Brazilian Civil Aviation Authority – Agência Nacional de Aviação Civil (ANAC) and the Japanese Aeronautics and Space

Research Agency – Japan Aeronautics Exploration Administration (JAXA). As a global Group we have invited, and welcome, European participants as well.

The Supersonic Aircraft Steering Group is a strategic group aiming to identify, direct, and coordinate standardization activities necessary to support supersonic aircraft applications at the top-level system, subsystem, and component levels.

The SASG intends to define the standardization landscape necessary to support supersonic aircraft development, certification, and operations and to propose ways forward for developing such standards, where sought, vital and needed. As part of this work there are two particularly relevant SAE technical committees that address exhaust and noise emissions and work closely with ICAO/CAEP:

> The E-31 Aircraft Engine Gas and Particulate Emissions Measurement Committee, which addresses all aspects of aircraft exhaust emissions measurement tools, methods, processes, and equipment. It is responsible for standardizing measurement methods of emissions from aircraft.

> The A-21 Aircraft Noise Measurement Aviation Emission Modeling Committee, which addresses all aspects of aircraft noise measurement processes, testing, modeling, and analyses. The group coordinates aircraft noise measurement efforts with a variety of organizations internationally, such as ICAO, FAA, EASA, and NASA.

Environmental protection issues are of importance to SAE International and our membership. The SASG is supportive of the work being done in ICAO, EASA, FAA and other regulatory forums on noise and emissions. Additionally, several SASG's members are regular participants and members of the ICAO/CAEP WG1. The Group notes the proposed EASA amendment largely follows work that CAEP is currently undertaking and we support global harmonization to set requirements at the ICAO level and avoid a patchwork of regional requirements. SASG appreciates EASA publishing A-NPA 2022-05 and seeking inputs from all SST aviation's stakeholders. We recommend EASA work with ICAO / CAEP to develop CAEP SARP for SST LTO Noise expeditiously.

SAE International and the SASG offers its assistance to provide additional information on aerospace standards and specifications which could support the proposed amendment and help develop new and/or revise existing industry standards to help support the re-introduction of Supersonic commercial flight.

SAE International and the Supersonic Aircraft Steering Group appreciates the opportunity to provide comments on this proposed amendment.

comment *67* comment by: *FOCA Switzerland*

The Federal Office of Civil Aviation (FOCA) in Switzerland thanks EASA for the consultation on this A-NPA 2022-05. Our office supports the proposal contained in this NPA.

comment *71* comment by: *Boeing*

The following response from The Boeing Company has been submitted to EASA via the Comment Response Tool (CRT) in response to EASA NPA-Advance Notice of Proposed Amendment A-NPA 2022-05 – Environmental protection requirements for supersonic transport aeroplanes.

Boeing has a long history with supersonic aircraft, having studied the design and development of a viable commercial supersonic transport off and on beginning in the 1960's and continuing through today. Aviation technology has come a long way since the days of the Concorde, but so have the expectations for the environmental performance of new aircraft. This A-NPA provides a needed and welcome first step toward development of clear environmental standards for modern commercial supersonic aircraft.

First and foremost, Boeing believes that the development of a harmonized international noise standard is critical to achieving a successful reintroduction of commercial supersonic aircraft. Without such a standard in place, a patchwork of differing national and regional standards may hinder or prevent the ability to effectively design, build, and operate these aircraft. We recognize and welcome the EASA proposal as a bridge to fill a gap in the noise standard for modern commercial supersonic aircraft until an internationally agreed upon ICAO CAEP standard has been developed, approved, and published in Annex 16 Volume I. To this end we strongly encourage the European Union and EASA to actively participate in that process to reach consensus on a harmonized rule within the ICAO and CAEP framework. Boeing remains committed to supporting this effort as a member of both the US and international aerospace industry.

comment *75* comment by: *Gulfstream Aerospace Corporation*

Gulfstream welcomes the opportunity to respond to this European Union Aviation Safety Agency (EASA) Advance Notice of Proposed Amendment (A-NPA) on Environmental protection requirements for supersonic transport (SST) aeroplanes. Gulfstream commends EASA for demonstrating leadership with this A-NPA and encourages the continued global harmonization of standards though the International Civil Aviation Organization's Committee on Aviation Environmental Protection (ICAO CAEP).
Gulfstream views the efforts in work within CAEP as a crucial step toward enabling the return of supersonic aircraft and recognizes the collaborative opportunity for EASA to support the CAEP activities through this A-NPA. Finalizing the landing and takeoff (LTO) noise standards within the current CAEP cycle will help reduce the current regulatory uncertainty for the aviation industry.
Gulfstream supports the high-level concepts outlined by the EASA A-NPA and acknowledges that supersonic aircraft need to be designed and operated in an environmentally responsible manner. With specific regard to noise, Gulfstream believes that although supersonic aircraft have different performance capabilities and characteristics as compared to subsonic aircraft, future supersonic aircraft with Variable Noise Reduction Systems (VNRS) can meet Chapter 14 noise limits using takeoff and landing procedures consistent with typical day-to-day operations.
Gulfstream also supports the development of a supersonic transport aeroplane CO_2 metric system. However, Gulfstream believes it is too early to consider a CO_2 limit in advance of a metric system. A new SST CO_2 metric system is expected to differ considerably from the subsonic metric system due to the unique characteristics of

supersonic aeroplanes, requiring additional data and analysis. Specifically, the SST CO_2 metric system should define a new reference geometric factor (RGF) that is suitable for supersonic aeroplanes, new cruise points, and a new limit line that includes Mach number as a correlating parameter. As with LTO noise standards, Gulfstream supports harmonized global rulemaking through CAEP for both the metric development and eventual SST CO_2 limits.

Specific comments are also provided in the applicable sections.

In conclusion, while Gulfstream agrees with the overall principles of this A-NPA, we strongly support prioritizing the development of harmonized global standards and regulatory procedures through the ICAO CAEP. Gulfstream views the EASA development of supersonic transport aeroplane standards as a beneficial certification option should a manufacturer apply for type certification before ICAO finalizes regulatory standards for supersonic aeroplanes.

comment *89* comment by: *DGAC France*

DGAC France would like to thank EASA for this A-NPA and for the good work and progress under RMT.0733.

comment *94* comment by: *AIA*

Attachment #2

The Aerospace Industries Association (AIA) welcomes the opportunity to respond to this European Union Aviation Safety Agency (EASA) Advance Notice of Proposed Amendment (A-NPA) on Environmental protection requirements for supersonic transport aeroplanes. AIA commends EASA for demonstrating leadership with this A-NPA, but AIA prefers global harmonization of standards through the International Civil Aviation Organization's Committee on Aviation Environmental Protection (ICAO CAEP) to enable global manufacturers to produce the next generation of environmentally responsible supersonic aeroplanes. Independent, regional development outside of the CAEP process will cause a lack of global standard harmonization.

As the Executive Summary to the A-NPA acknowledges, a new generation of supersonic transport aeroplanes is being developed with planned introduction in the late 2020's. AIA members view the efforts underway in CAEP as a crucial step toward enabling this return of supersonic aircraft and recognize the collaborative opportunity for EASA to support through this A-NPA. The lack of appropriate landing and takeoff (LTO) noise standards has been a major contributor to regulatory uncertainty for the supersonic industry and, by addressing this through this proposed amendment, EASA is encouraging innovation that could transform how we move, travel, and experience our planet.

AIA supports the high level concepts outlined by the EASA A-NPA. AIA and our members realize that for supersonic aircraft to be successful, they will need to be designed and operated in an environmentally responsible manner. With regards to noise specifically, AIA's view is that, while supersonic aircraft will have very different performance capabilities and characteristics to subsonic aircraft, manufacturers

need to ensure that they utilize the latest technology to minimize landing and take-off noise for communities around airports. AIA member companies have integrated these modern technologies into their future aeroplanes, enabling them to achieve Chapter 14 noise levels using innovative advanced procedures.

We also support development of a supersonic transport aeroplane CO2 metric system, although believe it is premature to consider a CO2 limit ahead of agreeing on a metric system, as was done for the subsonic CO2 standard. This new SST CO2 metric system will differ considerably from the subsonic metric system due to unique characteristics of supersonic aeroplanes and will require more data and analysis. In particular, the metric system should identify a new geometry factor (to replace RGF in the subsonic standard) suitable for supersonic aeroplanes, new cruise points, and include Mach as a correlating parameter. As with a LTO noise standard, AIA supports harmonized global rulemaking through CAEP for both the metric development and eventual SST CO2 limits.

While we agree with the overall principles of the A-NPA, we strongly support prioritizing harmonized global standards and regulatory procedures through the ICAO CAEP. We view the EASA development of supersonic transport aeroplanes standards as a possible certification option should a supersonic aeroplane apply for type certification in advance of ICAO finalizing a supersonic LTO noise standard, as well as providing valuable expertise and data to ICAO CAEP for development of such global standards.
Additionally, AIA encourages EASA to work closely with the ICAO CAEP, country regulatory agencies, research organizations, and the ICCAIA to ensure specific details of the LTO noise SARP are technically feasible, economically reasonable, and align with the noise reducing technologies being developed by industry. Specific recommendations for language changes and areas of further consideration are outlined below.

<u>AIA Comments on Concepts for LTO noise requirements for SST aeroplanes</u>

In section 3.2.4. Noise Certification Reference Procedures, AIA proposes the following :
The definition of V2 should be clearly described as the minimum speed that needs to be maintained up to acceleration altitude, in the event of an engine failure
V2 range should be informed by takeoff speeds required for safe operations and meaningful noise reduction, which is expected to be between V2 + 10 kts to 250 kts. The higher speed included in the N-NPA reflects outdated industry guidance, with several manufacturers now finding lower V2 speeds resulting in greater noise reduction.
Clarification on “The VNRS configuration that produces the highest noise level must be used,” noting that this needs to ensure that it applies to the appropriate reference conditions.
For safety reasons, the VNRS system may need to be deactivated for emergency operation. Therefore, we suggest inclusion of “in normal operations” after “...or if such system can be deactivated by the pilot.”
We suggest the final ‘power cutback’ should be dictated by airworthiness requirements, and no minimum PLR thrust should be specified so long as the use of PLR results in meaningful noise reductions. It should be noted that the ideal PLR thrust varies as a function of numerous parameters, most notably number of

engines. To ensure meaningful noise reductions are achieved for all categories of supersonic aircraft, the reference procedure should not include a limit to 'power cutback.'
AIA members are currently evaluating use of VNRS to reduce approach noise; as such, we encourage updating the approach reference procedures to enable use of VNRS. This would include high lift device configuration changes and potentially throttle setting changes.

In section 3.2.5. Test procedures:
The A-NPA includes language about the VNRS being deactivated before the aircraft reaches a point on the flight track that is relevant for establishing the flyover noise level. We suggest clarification on this language, given the VNRS is not intended to be "activated" or "deactivated;" rather, the VNRS sequence would simply be completed prior to the flyover noise event.
In section 3.2.6. Evaluation methods:
Further clarification and definition should be added to the language on equivalent procedures and use of actual take-offs.

Proposal N-1 comments on LTO noise standard applicability, stating the proposed requirements shall apply to all supersonic aeroplanes capable of sustaining level flight at speeds exceeding a Mach number of 1. Aviation environmental standards are data-driven, which requires any standard to be informed by data. In order to ensure a data-driven LTO standard, the applicability can only include categories of aircraft for which data is provided. The data driven approach ensures standards adhere to the terms of reference; technologically feasible, economically viable, and environmentally beneficial. As such, AIA suggests limiting applicability to the maximum design Mach numbers and maximum takeoff mass of the future aeroplanes proposed by ICCAIA.

comment *100* comment by: *Boom Supersonic*

Attachment #3

TO: EASA

SUBJECT: Comments on "*Environmental protection requirements for supersonic transport aeroplanes*", Docket: EASA A-NPA 2022-05

Submitted electronically via the automated Comment-Response Tool (CRT) on June 25, 2022.

On behalf of Boom Supersonic (hereafter referred to as Boom), I am writing to provide feedback on the European Union Aviation Safety Agency (EASA) Advance Notice of Proposed Amendment (A-NPA) 2022-05, "Environmental protection requirements for supersonic transport aeroplanes." Boom is a member of the Aerospace Industries Association (AIA), and therefore supports the comments submitted by AIA. We are submitting comments separately to reinforce AIA's comments as well as to highlight items of particular interest to Boom.

Boom is redefining commercial air travel by bringing sustainable, supersonic flight to the skies. Boom's commercial airliner, Overture, is designed and committed to industry-leading standards of speed, safety, and sustainability. Overture will be net-zero carbon, capable of flying on 100% sustainable aviation fuels (SAF) at twice the speed of today's fastest passenger jets. The airliner will deliver a quieter experience both for passengers and airport communities: Overture will use the world's first automated noise reduction system on take-off, fly without afterburners, and meet ICAO Chapter 14 / FAA Stage 5 noise levels. Boom is on track to begin production on Overture at its manufacturing facility in Greensboro, North Carolina, in 2024, and begin flying passengers by the end of the decade.

Boom welcomes the opportunity to respond to EASA A-NPA 2022-05 on Environmental protection requirements for supersonic transport aeroplanes. Boom commends EASA for recognizing the need to provide a framework to enable global manufacturers to produce the next generation of environmentally responsible supersonic aeroplanes with this A-NPA. However, we encourage EASA to primarily work through the International Civil Aviation Organization Committee on Aviation Environmental Protection (ICAO/CAEP) to ensure global standards are set.

As the Executive Summary to the A-NPA acknowledges, a new generation of supersonic transport aeroplanes is being developed with planned introduction in the late 2020's. Boom views this A-NPA and the concurrent efforts underway in the ICAO/CAEP as a crucial step toward enabling this return of supersonic aircraft. The lack of appropriate landing and takeoff (LTO) noise standards has been a contributor to regulatory uncertainty for the supersonic industry and, by addressing this through this proposed amendment, EASA is encouraging innovation that could transform how we move, travel and experience our planet.

Boom supports the high level concepts outlined by the EASA A-NPA. Boom recognizes that for supersonic aircraft to be successful, they will need to be designed and operated in an environmentally responsible manner. With regards to noise specifically, Boom's view is that, while supersonic aircraft will have very different performance capabilities and characteristics to subsonic aircraft, manufacturers need to ensure that they utilize the latest technology to minimize landing and take-off noise for communities around airports. Boom has integrated these modern technologies into its airliner, Overture, enabling it to achieve Chapter 14 noise levels using innovative advanced procedures.

We also support development of a supersonic transport aeroplane CO_2 metric system, although believe it is premature to consider a CO_2 limit, as work on a global standard has not commenced. This new SST CO_2 metric system will differ considerably from the subsonic metric system due to unique characteristics of supersonic aeroplanes, and will require more data and analysis. In particular, the metric system should identify a new geometry factor (to replace RGF in the subsonic standard) suitable for supersonic aeroplanes, new cruise points, and include Mach as a correlating parameter. As with a LTO noise standard, Boom supports harmonized global rulemaking for both the metric development and eventual SST CO_2 limits.

While we agree with the overall principles of the A-NPA, we strongly support prioritizing harmonized global standards and regulatory procedures through the ICAO/CAEP. We view the EASA development of supersonic transport aeroplanes

standards as a possible certification option should a supersonic aeroplane apply for type certification in advance of ICAO finalizing a supersonic LTO noise standard, as well as providing valuable expertise and data to ICAO/CAEP for development of such global standards.

Boom encourages EASA to work closely with the ICAO/CAEP, State regulatory agencies, research organizations, and the International Coordinating Council of Aerospace Industries Associations (ICCAIA) to ensure specific details of the LTO noise SARP and new SST CO_2 metric system are technically feasible, economically reasonable, and align with the technologies being developed by industry. Specific recommendations for language changes and areas of further consideration are outlined below.

Boom Comments on Concepts for LTO noise requirements for SST aeroplanes

Boom strongly supports all of the specific recommendations for language changes and areas of further consideration for LTO noise requirements for SST aeroplanes outlined in the AIA comment letter (submitted electronically to EASA via the CRT).

In particular, we wish to reiterate the following considerations:

- V2 range should be informed by takeoff speeds required for safe operations and meaningful noise reduction, which is expected to be between V2 + 10 kts to 250 kts. The higher speed included in the A-NPA reflects outdated industry guidance, with several manufacturers now finding lower V2 speeds resulting in greater noise reduction.
- We suggest the final 'power cutback' should be dictated by airworthiness requirements, and no minimum PLR thrust should be specified so long as the use of PLR results in meaningful noise reductions. It should be noted that the ideal PLR thrust varies as a function of numerous parameters, most notably number of engines. To ensure noise reductions are achieved for all categories of supersonic aircraft, the reference procedure should not include a limit to 'power cutback'.
- We are currently evaluating the use of VNRS to reduce approach noise; as such, we encourage updating the approach reference procedures to allow use of VNRS. This would include high lift device configuration changes and potentially throttle setting changes.

Boom Comments on Concepts for CO_2 emission requirements for SST aeroplanes

In addition to the comments outlined in the AIA letter, Boom would like to emphasize language changes and areas of further consideration for SST CO_2 requirements.

Boom has the following comments on Section 3.3 and 4.3 of the A-NPA:

- In section 3.3.4 EASA states that "no need to modify the RGF definition for SST aeroplanes was identified". The CO2 metric value (MV) system for SSTs should incorporate some measure of speed, either as part of the definition of the metric value, or as a correlating parameter. The cruise Mach number

of SSTs directly determines the achievable fuel efficiency of the aeroplane, and is a measure of productivity of supersonic travel (similar to the way cabin area is treated via the RGF in the subsonic MV). We believe that a CO2 metric system for SSTs should identify a new geometry factor (to replace RGF in the subsonic standard) suitable for supersonic aeroplanes, new cruise test points, and include Mach as a correlating parameter.

- In Section 3.3.5, EASA states that "an advantage of [using the same MV definition as subsonic aircraft certification] is the resulting comparability of CO2 MVs between subsonic and supersonic aeroplane designs". EASA should clarify how it plans to compare subsonic and supersonic metric values, since (a) the current definition of CO2 MV does not consider speed as a measure of productivity of supersonic transport, and (b) the proposed MV approach for supersonics involves additional test points (3 at subsonic reference conditions and 3 at supersonic reference conditions).
- In Section 4.3, item 5.1(a), EASA defines the high gross mass certification point for both supersonic and subsonic certification as "representative for initial cruise conditions". EASA should clarify whether this refers to a single mass for both subsonic and supersonic MVs or separate masses, given that the aircraft mass for supersonic cruise may be lower than that at initial subsonic cruise.
- In Section 4.3, item 6.1(a) the reference conditions are specified as "steady (unaccelerated, straight and level flight". However, supersonic aircraft are typically operated in a cruise-climb manner throughout supersonic cruise to maximize range. This needs to be accounted for when defining measurement conditions.
- In Section 4.3, item 6.1(e) the specifications call for a "fuel lower heating value equal to 43.217 MJ/kg". The proposed language should account for potential use of fuels with higher energy densities (e.g., next-generation SAF).

The A-NPA states that the proposed requirements shall apply to all supersonic aeroplanes capable of sustaining level flight at speeds exceeding a Mach number of 1. Given the necessity for data-driven and technologically feasible environmental standards, Boom suggests limiting applicability to the maximum design Mach numbers and maximum takeoff mass of the project aircraft provided by ICCAIA.
Boom remains fully committed to development of practical environmental protection requirements for supersonic transport aeroplanes. Thank you for your consideration of our comments.

comment *101* comment by: *Exosonic*

GENERAL COMMENTS
Thank you for providing this Advance Notice of Proposed Amendment (A-NPA) 2022-05. Proposed regulatory guidance helps manufacturers develop environmentally compatible vehicles by reducing design target and business case uncertainty and risk. The EASA objective to maintain the current high level of environmental protection in Europe is also supported by Exosonic, Inc. in Europe and worldwide. By operating as quietly as subsonic airplanes that meet Chapter 14 (Chapter 3 – 14 EPNdB cumulative) noise certification limits, new generation supersonic airplanes would be as acceptable to airports as subsonic airplanes. Operating as quiet as

subsonic airplanes is important for countering past experience that supersonic airplanes, like the Concorde (Chapter 3 + 44 EPNdB cumulative), are louder than subsonic airplanes.

However, recent published analyses predict that EASA's planned certification procedure will require supersonic airplanes to be much quieter operationally than Chapter 14 subsonic airplanes, due to the very different performance trends of supersonic airplanes. Despite this stringency application difference, industry and Exosonic are in favor of using subsonic-like procedures and limits initially. We plan to demonstrate, validate, and quantify the quieter supersonic airport-vicinity noise during flight testing and operations. From this quantified operational difference, certification procedure changes will be developed so supersonic and subsonic certified noise levels are similarly proportional to their operational noise. Thereafter, it is intended that subsonic and supersonic noise stringency updates can advance together.

Exosonic and others also want supersonic airplanes with reduced net greenhouse gas (GHG) and global warming emissions. Since supersonic flight requires greater fuel burn, reducing global warming emissions will rely on fuel-efficient design and the use of lower GHG life-cycle synthetic aviation fuel (SAF). We agree with EASA changes to the GHG metric calculation to accommodate the unique characteristics of supersonic airplanes, but offer some recommended changes for their implementation to limit increased supersonic certification cost.

Thank you for accepting these comments from Exosonic, Inc. on your A-NPA 2022-05.

comment *73* comment by: *Civil Aviation Authority the Netherlands*

The Netherlands Civil Aviation Authority has no comments on this Advanced Notice of Proposed Amendment on environmental protection requirements for supersonic transport aeroplanes.

comment *8* comment by: *UECNA*

It is strange that EU citizens (or actually global citizens) are apparently not considered as key stakeholders and were not involved in the preparation of this A-NPA. (ref: page 1, Affected stakeholders; 1.1 second paragraph (page 4)). We think that representatives of citizens affected by aircraft noise should have been involved at the earliest possible moment. UECNA would have been happy to participate in the preparatory meetings as mentioned in 1.1 second paragraph (page 4).
We would appreciate to be invited to and contribute to the workshops and/or technical meetings that are mentioned in the second paragraph of 1.3 (page 5)

1. About this A-NPA p. 4

comment *88* comment by: *Hermeus Corp.*

Attachment #4

Hermeus Corp. appreciates the opportunity to submit comments on the European Union Aviation Safety Agency's initial concepts regarding environmental protection requirements for supersonic transport aeroplanes. Hermeus is a startup developing hypersonic aircraft to radically accelerate air travel. Hypersonic aircraft have the potential to create trillions of dollars of new global economic growth per year, unlocking significant resources that can be utilized to solve the world's greatest problems, such as climate change. Actualizing this world-changing aviation technology requires collaboration between industry, governments, and international organizations. In fact, all these stakeholders are currently engaged in a deliberative process to develop global, uniform standards that are tailored to supersonic aircraft. This process will enable industry to transform transportation and create economic and social opportunities in an environmentally responsible manner.

An international regulatory effort involving all stakeholders is already occurring. As the A-NPA recognizes, the International Civil Aviation Organization's Committee on Aviation Environmental Protection (CAEP) is addressing certification standards for supersonic aircraft. In particular, Working Group 3 is evaluating landing and takeoff engine emissions and the relationships between noise, emissions, fuel burn, and Mach number. The purpose of this work program is to develop effective and globally uniform Standards and Recommended Practices (SARPs). These SARPs will be formulated by 2025. CAEP's schedule for issuing emissions SARPs supports the introduction of commercial supersonic aircraft in the late 2020s.

National and intergovernmental regulatory agencies are expected to adopt CAEP's SARPs to maintain global harmonization of aircraft regulations. This is particularly crucial for the supersonic industry. Supersonic transportation is ideally suited for transcontinental routes. Uniform regulations are thus necessary to ensure efficiency and fair competition. Because EASA is expected to adopt CAEP's SARPs, this rulemaking is duplicative and unnecessary.

As noted above, CAEP is developing its environmental regulations with input from all relevant stakeholders. CAEP receives input from national governments representing every region of the world, including Europe; international organizations, including the European Union; and non-governmental organizations representing industry, transportation system operators, and environmental concerns. CAEP is uniquely positioned to receive comments from all stakeholders to draft uniform standards.

Although EASA has requested feedback for this rulemaking, it has focused on the narrower range of European interests. This is reflected in the information EASA gathered to prepare this A-NPA. While EASA met with European aircraft and engine manufacturers and member states, it has not arranged meetings with non-European industry representatives or states. The supersonic industry is global, as described above. The worldwide CAEP process is best suited to develop globally acceptable, uniform standards.

Another feature of the CAEP process is its reliance on supersonic data. Supersonic aircraft differ from subsonic aircraft in design, operations, and environmental benefits. These fundamental differences compel a unique approach to supersonic regulation. Further, any standards should consider environmental issues holistically and account for all relevant trades. Drafting single-issue regulations would risk foreclosing an integrated approach to environmental protection. In addition, regulations should wait until operational supersonic data is available. If regulations were issued on single topics and based on subsonic aircraft – rather than waiting for supersonic data – they would adversely restrict the development and design of supersonic aircraft. Regulators should be cautious of imposing limits on a nascent industry. Premature regulation could discourage investment, development, and growth of the supersonic industry, which would result in society failing to benefit from this revolution in transportation.

Hermeus appreciates EASA's interest in ensuring that supersonic aircraft operate in an environmentally responsible manner. For the reasons discussed above, Hermeus respectfully requests that EASA defer to CAEP to develop Standards and Recommended Practices for environmental protection. If EASA nevertheless proceeds with this rulemaking, Hermeus requests that landing and take-off noise and emission requirements consider environmental issues holistically and be based solely on supersonic data.

1.3. The next steps p. 5

comment *9* comment by: *UECNA*

- We would appreciate to be invited to and contribute to the workshops and/or technical meetings that are mentioned in the second paragraph of 1.3 (page 5)
-
- · The second paragraph suggests that once ICAO would have developed requirements for SST aeroplanes, these would automatically become applicable in the EU in accordance with Article 9(2) first sentence. This is in our view incorrect as the first sentence refers to a specific amendment level of ICAO Annex 16, and this amendment level does not have requirements for SST's. So, Article 9.2 would have to be amended by the European Commission (as described in article 19.2 of the Basic Regulation) to refer to a later amendment level, and it is not a given that this will happen.

2.1. Why we need to amend the rules - issue/rationale p. 6

comment *3* comment by: *Swedish Transport Agency, Civil Aviation Department (Transportstyrelsen, Luftfartsavdelningen)*

2.1 Why we need to amend the rules/Related safety issues, page 6
It is stated: "*There is no safety recommendation pertinent to the scope of this A-NPA*. Perhaps this statement could be further ellaborated, by saying "*Airworthiness requirements for SST (specified elsewhere) are expected to be fulfilled."*

2. Objective and context of this A-NPA p. 6

comment *102* comment by: *Exosonic*

OBJECTIVE
EASA's proposal states, "Maintain the current high level of environmental protection in Europe."

As a manufacturer, we greatly prefer providing a supersonic product to our customers that maintains the high level of environmental protection afforded by subsonic airplanes. We want to provide our operators with a supersonic airplane that is accepted at airports because it maintains the quiet operations of Chapter 14 compliant subsonic airplanes. Likewise, we want supersonic airplanes that contribute no more to net greenhouse gas (GHG) emissions and global warming than subsonic airplanes, including achieving net zero GHG emissions before the subsonic 2050 goal.

2.3. How we want to achieve it p. 7

comment *14* comment by: *FAA*

Para 2.3

Referenced Text: ...development of ICAO SAPRs

Rationale: Typo

Proposed Resolution: ...development of ICAO SARPs

3.1. General approach p. 8

comment *10* comment by: *UECNA*

We strongly support the idea to ensure that noise certification standards of supersonic aircraft should be designed such that the results for supersonic aircraft can be directly compared with those of subsonic aircraft ("level playing field"). After all, for citizens on the ground it makes no difference whether the noise is generated by a supersonic or subsonic aircraft. As such we agree to the general approach described in the third paragraph of 3.1 and later. However, there are a few essential elements that need to be addressed. We also think that the current level of ambition in the NPA is not high enough.

- o The new generation of supersonic aircraft should be held to higher standards than those for existing subsonic aircraft. It is obvious that noise levels of current subsonic aircraft are problematic in terms of their impact on the health and wellbeing of citizens around the world. Any new

development should bring improvements in this aspect, and else its introduction should not be allowed. There is no place for backsliding in the area of aircraft noise. The mere fact that the aircraft would be capable of supersonic speeds is no justification for increasing the negative impact of aviation which is already at an unacceptable level. Note that Supersonic aircraft will need a large amount of fuel to be carried which reduces the payload of such aircraft. So fewer people are being transported and the amount of noise per passenger is therefore greater.

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- o It is our opinion that SST's should in any case not be noisier than state of the art subsonic aircraft brought to market at the time of introduction of these supersonic aircraft. As such it would not be sufficient to apply CH14 standards, as these are not representative of that technology level. This is obvious from the EASA environmental report 2019 that in figure 2.2 clearly shows that already today subsonic aircraft have, even at their highest weight and maximum thrust settings, margins of more than 10 EPNdB cumulative to Chapter 14. ICAO/CAEP independent experts expect further improvements (reductions) in the noise certification levels. Thus SST's should be required to meet significantly more stringent LTO noise standards then CH14. Note that CH14 was developed 10 years ago and that the noise standards for subsonic aircraft are being reviewed for an increase in stringency at this moment. This is a clear indication that Chapter 14 is not an appropriate standard to be applied to future supersonic aircraft
-
- o The A-NPA also mentions that SST's should be given different reference procedures for noise measurements. This would be acceptable if they would be equally stringent, however the use of higher speeds, and potentially use of VNRS my well lead to an overall decrease in stringency of the requirements. We note that subsonic aircraft, if allowed to use higher take-off speeds or VNRS, would achieve significantly lower certification noise levels. The final measurement results (or the regulatory limit levels) should be adapted to maintain a level playing field between subsonic and supersonic aircraft in terms of their certification levels (and/or margins to the limits).

3.2.4. Noise certification reference procedures p. 10

comment *2* comment by: Commentor

3.2.4 Noise Certification Reference Procedure
(b) Take-off reference procedure with VNRS

In addition to the different speed range described under (a), the following requirements are imposed for the alternative reference procedure for aircraft with VNRS:

(1) The VNRS configuration that produces the highest noise level must be used. It has been discussed that a VNRS for SST aeroplanes may comprise more than one procedure that could be selected operationally on an aerodrome-by-aerodrome

basis. The above requirement addresses the potential implementation of such a concept.

The effect of 3.2.4 (b) (1) will be to encourage aircraft manufacturers to optimize the VNRS for only the certification procedure. This will result in louder operational noise as compared to a system that is programmed to be specific to given airports. To prevent abuse of VNRS (for example favoring lower engine maintenance costs over lower noise) the regulatory bodies should include an operational requirement that the VNRS that minimizes noise for a given airport be used. This clause is hurting no one except the people exposed to aircraft noise.

(2) Any thrust reduction that is initiated by the VNRS (PLR) before the final 'power cutback' point must not result in a thrust lower than 75 % of the maximum available thrust. This condition is intended to prevent the VNRS from bypassing the final 'power cutback point'.

With respect to 3.2.4 (b) (2), why should there be any limitations to the amount of PLR used other than those necessary to satisfy safety requirements such as all-engine and one-engine inoperative climb gradients? Please educate me; what is the issue with "bypassing" the final 'power cutback point'? What exactly do you mean by "bypassing"?

For certain supersonic configurations the 25% PLR limitation will have the effect of dramatically increasing maximum takeoff weight and with it fuel burn and emissions.

EASA should not assume they know what the most effective solution is for satisfying the Chapter 14 noise criteria.

(3) The take-off reference path needs to be calculated by synthesis based on segments of constant aircraft configuration.

With respect to 3.2.4 (b) (3), would you please clarify what you mean by "segments"? Do you have specific segments in mind? Or are these segments to be defined at the discretion of the OEM?
What is the purpose of this clause? Based on the text below, it is not to facilitate a reduction in the number of configurations evaluated for equivalent procedures.

Furthermore, in the absence of any approved (or proposed) equivalent procedures for SST aeroplanes, it is assumed that the noise levels of SST aeroplanes will be established based on actual take-offs – in contrast to the intercept procedures that are common practice as an equivalent procedure for the noise certification of subsonic aeroplane types.

comment *7* comment by: *UECNA*

3.2.4.(b)(2). The NPA refers to a final 'power cutback' point and final 'power cutback point'. It is intended to prevent "the VNRS from bypassing the final 'power cutback point' "f. This 'final power cutback point' concept is not defined in the NPA and we would like to get clarification as what exactly it refers to and what it intends to achieve. We did not see a particular requirement in the proposed reference take-off procedure referring to this.

comment *41* comment by: *UK CAA*

Page No: 11

Paragraph No: 3.2.4(b)

Comment: It is stated that "it is currently not expected that the VNRS of SST aeroplanes would be active during the approach segment" and that "The approach reference procedure for SST aeroplanes in this document is therefore proposed to be identical to the one for subsonic jet aeroplanes". UK CAA supports this for an aircraft without VNRS. However it cannot be excluded that an SST aeroplane will be developed with an active VNRS during the approach segment. With this in mind UK CAA recommends that an approach reference procedure with VNRS be proposed.

Justification: Having an approach reference procedure for an SST aeroplane with VNRS active during the approach segment would facilitate the noise certification of such an aeroplane.

comment *76* comment by: *Gulfstream Aerospace Corporation*

- The definition of V2 should be clearly described as the minimum speed that needs to be maintained up to acceleration altitude, in the event of an engine failure.

comment *77* comment by: *Gulfstream Aerospace Corporation*

The V2 increment range should be informed by takeoff speeds required for safe operations and meaningful noise reduction, which is expected to be between V2 + 10 kts to 250 kts. The higher speed included in the A-NPA reflects outdated industry guidance, with several manufacturers now finding lower V2 speeds resulting in greater noise reduction.

comment *78* comment by: *Gulfstream Aerospace Corporation*

In 3.2.4(b), for takeoff reference procedures, "the VNRS configuration that produces the highest noise level must be used", could be misinterpreted and discourage the Applicant from effectively utilizing VNRS. For simplicity and consistency with the subsonic standards, Gulfstream recommends allowing the Applicant to select the configuration for takeoff (similar to subsonic standards as defined in ICAO Annex 16 Volume I, section 3.6.2(e))

comment *79* comment by: *Gulfstream Aerospace Corporation*

·•For safety reasons, the VNRS system may need to be deactivated for emergency operation. Therefore, we suggest inclusion of "in normal operations" after "...or if such system can be deactivated by the pilot, …".

comment *80* comment by: *Gulfstream Aerospace Corporation*

With regard to the reduced thrust limitations used to determine noise certification takeoff profiles, as with subsonic aircraft certification profiles, limitations should be defined by the airworthiness requirements. This would apply to both PLR and the final “power cutback” used under certification conditions.

comment *81* comment by: *Gulfstream Aerospace Corporation*

Gulfstream defines maximum available thrust to mean the thrust consistent with Sea Level Static thrust used for certification including any lapse associated with altitude and speed. Gulfstream requests clarification on what EASA means by “maximum available thrust” in the context of this A NPA with respect to limitations on PLR.

comment *82* comment by: *Gulfstream Aerospace Corporation*

VNRS may be needed to reduce approach noise; as such, Gulfstream encourages updating the approach reference procedures to enable use of VNRS. Such VNRS to reduce approach noise may include variable geometry features related to the engine.

comment *103* comment by: *Exosonic*

SUPERSONIC NOISE CERTIFICATION SPECIFIC COMMENTS
3.2.4(a) Speeds can want to be as lower. Accommodating lower V2 + speeds should not be a problem.

3.2.4(b)(2) A limitation here above cutback power should not be needed because best performance will be obtained with initially higher power to get more height over the takeoff cutback monitor.

3.2.3. Maximum noise levels p. 10

comment *19* comment by: *Rolls-Royce plc*

3.2.3 page 10 Comment Summary

Development Margin

Proposed text: "Therefore, it is worth mentioning that the latest subsonic jet aeroplane types have a cumulative margin of at least 5 EPNdB against the Chapter-14 limits, which reflects the inherent advantages of subsonic aircraft designs in environmental protection, when compared to supersonic aircraft designs."

Suggested Resolution

Although industrial programme risk management will require sufficient noise margin for nominal prediction to start, any stringency over Chapter 14 will mean emissions and range of the aircraft to be significantly affected.

comment *90* comment by: *DGAC France*

DGAC France - Comment 1:

3.2.3. Maximum noise levers, paragraph 1:
"*The maximum noise levels ('noise limits') for subsonic jet aeroplanes are defined in Chapter 14 of ICAO Annex 16, Volume I, and depend on the MTOM of the aircraft and the number of engines. It is proposed to apply the same noise limits to SST aeroplanes. This way, the current level of environmental protection in Europe would be maintained, and a level playing field between subsonic jet aeroplanes and SST aeroplanes is ensured*"

We strongly support this approach. Preserving the progress made by subsonic aircraft regarding noise is important, thus noise limits corresponding to the current Chapter 14 are desirable.

3.2.5. Test procedures p. 11

comment *20* comment by: *Rolls-Royce plc*

3.2.4.a page 11 Comment Summary

Noise cert. - Take-off reference speed
Proposed text: "A reference speed range of 'at least V2 + 65 km/h (V2 + 35 kt), but not greater than V2 + 102 km/h (V2 + 55 kt)' is therefore proposed (see Section 4.2, Proposal N-5.2). In addition, a maximum allowable speed of 463 km/h (250 kt) is defined."

Suggested Resolution

While an absolute limit of 250 kts is considered reasonable, the speed range provided seems to limit potential of optimisation. Depending on aircraft, reference speed range velocities down to v2+10kts should be considered.

comment *21* comment by: *Rolls-Royce plc*

3.2.4.b.1 page 11 Comment Summary

VNRS - Configurations
Proposed text: "The VNRS configuration that produces the highest noise level must be used."

Suggested Resolution

This statement needs clarification. This is contradictory to subsonic certification, where the applicant can select the configuration for take-off. It may mean no VNRS can be used.

comment *22* comment by: *Rolls-Royce plc*

3.2.4.b.2 page 11 and 4.2.5.3.1.b page 24 Comment Summary

VNRS - max thrust reduction
Proposed text: "Any thrust reduction that is initiated by the VNRS (PLR) before the final 'power cutback' point must not result in a thrust lower than 75 % of the maximum available thrust.

[...] average engine take-off thrust shall be used from the start of take-off to the point where the applicant's VNRS design provides input to the controls of the aeroplane. Any reduction of the thrust through the VNRS design shall not result in a thrust lower than 75 per cent of the maximum available take-of thrust;"

Suggested Resolution

The reference condition for max available thrust needs to be defined: i.e. SLS or before first thrust cut (check with 5.3.1 (f)). It cannot be related to the actual minimum thrust at cutback (p 25, 5.3.1, (d), (i), (ii)) since this depends on the specific aircraft. The limitation of thrust cut should be controlled by safety requirements (OEI conditions--> minimal thrust requirement for the actual aircraft). This would give enough room for noise optimisation.

comment *24* comment by: *Rolls-Royce plc*

3.2.4. page 11 Comment Summary

VNRS - limitation
Proposed text: "It is worth noting that if any pilot action is necessary to activate, or select the use of, an automatically controlled noise reduction system, or if such system can be deactivated by the pilot, that system is not considered a VNRS in the context of this A-NPA."

Suggested Resolution

It is clear, that a regularly de-activation by the pilot is not desired and VNRS must be used for every take-off. However, in case of an emergency, the pilot should be able to override the PLR thrust in order to save the aircraft. The FAA NPRM seems to allow this. Please clarify.

comment *25* comment by: *Rolls-Royce plc*

3.2.4 page 11 Comment Summary

VNRS - Definition
Proposed text: "While the use of VNRS is mostly referred to as a means to optimise noise performance during take-off, such technology could also be considered for the approach. However, based on initial feedback from industry, it is currently not expected that the VNRS of SST aeroplanes would be active during the approach segment."

Suggested Resolution

VNRS will complete before cutback. However, but means of control used within VNRS may still be involved in providing cutback and pilot demanded thrust at cutback and approach conditions. I.e. a variable nozzle for engine operability, may not be in the nominal cruise setting during approach and take-off. Is it correct to assume this is not in conflict with this requirement?

comment *83* comment by: *Gulfstream Aerospace Corporation*

The A-NPA includes language about the VNRS being deactivated before the aircraft reaches a point on the flight track that is relevant for establishing the flyover noise level. While VNRS should not be able to be deactivated during normal operations, it is possible VNRS may still be in process during the flyover condition. Examples may include a configuration change during the Flyover noise event or variable geometry features integral to the engine design. As such, Gulfstream recommends removal of the assumption that the VNRS will be deactivated well before the aircraft reaches a point on the flight track that is relevant for establishing the flyover noise level.

3.2.6. Evaluation methods p. 12

comment *26* comment by: *Rolls-Royce plc*

3.2.5 page 12 Comment Summary

VNRS - Definition
Proposed text: "Such method is not considered to be required for the flyover condition, as it is assumed that the VNRS will be deactivated well before the aircraft reaches a point on the flight track that is relevant for establishing the flyover noise level."

Suggested Resolution

See above: VNRS will complete operation before cutback. However, means of control used within VNRS may still be involved in providing cutback and pilot demanded thrust at cutback and approach conditions.

comment *27* comment by: *Rolls-Royce plc*

3.2.6 (4.2, N-7) page 12 Comment Summary

Noise Certification - equivalent procedures
If take-off noise levels are established with an active VNRS system, the integrated method of adjustment must be used to calculate the EPNL10. The alternative simplified method is limited to aeroplane types that do not change configuration over the flight path. [...] Furthermore, in the absence of any approved (or proposed) equivalent procedures for SST aeroplanes, it is assumed that the noise levels of SST aeroplanes will be established based on actual take-offs – in contrast to the intercept procedures that are common practice as an equivalent procedure for the noise certification of subsonic aeroplane types.

Suggested resolution

RR would prefer use of an equivalent procedure using intercept procedures. There is no technical limitation to do so: The take-off reference path needs to be calculated by synthesis based on segments of constant aircraft configuration, which are achievable with intercept procedures.

comment *42* comment by: *UK CAA*

Page No: 12

Paragraph No: 3.2.6, first bullet

Comment: It is stated that "If take-off noise levels are established with an active VNRS system, the integrated method of adjustment must be used to calculate the EPNL". It is proposed that the simplified method of adjustment may be used for the establishment of the flyover noise levels if VNRS is deactivated well before the aircraft reaches a point on the flight track that is relevant for establishing the flyover noise level.

Justification: The use of the simplified method of adjustment would reduce the complexity of the process to adjust measured noise levels to reference conditions.

comment *43* comment by: *UK CAA*

Page No: 12

Paragraph No: 3.2.6

Comment: It is stated that "in the absence of any approved (or proposed) equivalent procedures for SST aeroplanes it is assumed that the noise levels of SST aeroplanes will be established based on actual take-offs". Intercept procedures should be permitted, when justified and appropriate, noting that in 3.2.5 it is stated that "VNRS will be deactivated well before the aircraft reaches a point on the flight track that is relevant for establishing the flyover noise level."

Justification: The use of intercept procedures would lead to significant reductions in test time and cost.

comment *84* comment by: *Gulfstream Aerospace Corporation*

Further clarification and definition should be added to the language on equivalent procedures and use of actual take-offs. Gulfstream anticipates using flight-path intercept methodology and dynamic noise analysis for Lateral / PLR noise testing, noise database development and the calculation of the noise certification level similar to the equivalent procedures that are permitted for subsonic aircraft noise certification.

comment *85* comment by: *Gulfstream Aerospace Corporation*

•The text in the A-NPA states the lateral full-power reference noise measurement point for jet-powered aeroplanes is defined as “the point on a line parallel to and 450 m from the runway centre line, where the noise level is a maximum during takeoff.” Gulfstream requests clarification on whether the Lateral noise level is evaluated after lift-off or if EASA expects ground roll to be included. By comparison, 14 CFR Part 36 Appendix B36.3 states the Lateral point is defined as “the point on a line parallel to and 1,476 feet (450 m) from the runway centerline, or extended centerline, where the noise level after lift-off is at a maximum during takeoff.”

3.3.2. Reference masses for SAR measurement p. 13

comment *33* comment by: *Rolls-Royce plc*

3.3.2 page 13 Comment Summary

Reference masses for SAR measurement

Suggested Resolution

We agree that choice of Specific Air Range (SAR) is the best parameter to consider in terms of consistency with CO2 standards and as a fuel efficiency metric.
We also agree that use of a subsonic SAR point and supersonic SAR point at the optimum SAR is the best way forward, but the choices of weights are over-complicated.

comment *68* comment by: *Dassault-Aviation*

* § 3.3.2 page 13 : “the reference mass point …CAEP Working Group 3 during the CAEP/12 cycle11”.

Dassault-Aviation fully agree with this assessment. It could also be applicable to some subsonic aircraft with MTOW<120 000 lb.

comment *92* comment by: *DGAC France*

DGAC France - Comment 3:

Section 3.3.2. paragraph 2
"*Different workarounds have been explored using performance models of conceptual SST aeroplanes, and have been discussed with European key manufacturers. The definition of reference gross masses as a function of the MTOM appears challenging in the short term, especially concerning the low gross mass point. More data would be required for further analyses to ensure that a low gross mass point that is defined as a function of the MTOM is representative of end-of-cruise conditions across different SST aeroplane designs. Specifying the reference masses based on maximum zero-fuel mass (MZFM) and MTOM could be an alternative for further assessment.*

However, evaluating such approach requires robust data and more detailed insights into SST aeroplane design considerations."

It seems desirable to explore specifying the reference masses based on maximum zero-fuel mass (MZFM) and MTOM.
Using MTOM percentages to define SAR measurement points is a pragmatic approach, but it may introduce in some cases an unfair treatment of competing aircraft, when they have significantly different fuel mass fractions, or ratio of fuel mass to MTOM. It seems that it could be more relevant to use MZFW, as suggested in the A-NPA.

Let's take a theoretic example of a supersonic aircraft with two variants A and B, the only difference being that variant B uses some part of the rear cabin space to add an extra fuel tank in order to extend range capacity, so that as a result, the fuselage of B has a shorter cabin and a fraction of it is not accessible as it is hosting a fuel tank.
Both aircraft are the same and have the same performance regarding fuel burn, but they don't have the same fuel ratio: the B variant has a higher ratio of Maximum Fuel Mass/MTOM than the A variant.
The A-NPA is based on the high-level idea of measuring 3 points of SAR to get a representative fuel burn indication in cruise phase, by measuring fuel burn at the start of cruise, mid-cruise and at end of cruise.

Measurement of SAR_1: For the measurement of the start of cruise SAR point, SAR_1, we are at a common point of the trajectory of both aircraft A and B. A percentage of the MTOM seems thus suitable to define when to measure SAR_1, because it provides a unique percentage to use, the same for A and B, while the mass of fuel to reach top of climb expressed as a % of MFM(A) or MFM(B) would give two different percentages.

Measurement of SAR_2: to take the average of the gross mass of the aircraft between SAR_1 gross mass and SAR_3 gross mass seems right.

Measurement of SAR_3: using a fixed % of MTOM to define when to measure SAR_3 means that A and B are not at the same point of their trajectory in the case of a take-off with max fuel capacity and at MTOM. It leads to measuring B way sooner during its cruise phase, for SAR_3 but also for SAR_2, than A, so that B is measured before its mid-cruise and before its end cruise. Sooner in the trajectory means B will get a worse SAR value than at the end of its cruise, being heavier at this % of MTOM than at the end of its cruise. This contradicts the principle of measuring at start-mid-end of cruise and introduces an unfair feature with respect to measuring competing aircraft that do not have the same fuel ratio.
At the top of descent point (very end of cruise), the fuel mass left is the fuel needed for Descent plus the fuel for Reserves (D+R). The mass of the aircraft is ZFW+D+R.
A suitable way to define that mass across the aircraft to be regulated is needed. It is likely possible, with the help of relevant data, to express D+R as a function of ZFW. Then the mass of the aircraft at top of descent is a function of ZFW and, to measure S_3 at the end of cruise, some margin of a few percent vs the gross mass of the aircraft at top of descent could be taken. It seems thus possible to define a relevant point representing end of cruise for each aircraft based on its ZFW.
If compatibility or comparability with the subsonic standard has to be ensured, both approaches could exist in parallel, so that information is available with measurement

either only at %s of MTOM or with a % of MTOM at SAR_1 and a % of ZFW at SAR_3. The metric value to be compared to the regulatory limit could be left to the choice of the applicant, offering the possibility for each design to be measured at a similar "end of cruise" point.
Introducing the use of a % of MZFW to define the SAR_3 measurement point would avoid that aircraft that are the same, or similar and competing, with the same level of technology but with different design choices, choices that in the view of a technical standard are equally legitimate, get a different margin to the standard.

3.3. Concepts for CO 2 emission requirements for SST aeroplanes p. 13

comment *95* comment by: *DGAC France*

DSAC France - Comment 5:

Section 3.3, regarding the choice of parameters whose regulatory limit depends on.

The rulemaking activity on supersonic CO2 regulation could explore using Payload and/or Design Range as parameters whose limit depends on, rather than MTOM.
With MTOM being the parameter, structural improvements reducing the aircraft mass are not directly rewarded. The lighter aircraft has more payload, which is better for the environment, or more range for the same payload, thus providing a higher service, but it is not credited for it. Therefore, this specific case is not aligned with the idea that "The margin to the limit can be seen as a fuel-efficiency measure from an aircraft technology/design perspective".
To that point, and trying to start from scratch again, one can note that the service provided by an aircraft is basically the combination of :

- payload,
- range,
- speed.

Whether speed should be valued within a CO2 standard is disputable. One can claim that the primary added value of aviation is to transport people and goods from point A to point B in a safe manner, and in a reasonable time. So whether the actual travel duration, and consequently a 10-20% penalty (turboprops vs regional jets) or a 40-50ish % time savings through supersonic speed, should be included in the service provided can be subjective.
As a matter of fact, speed is not included in the metrics used in the ICAO context to monitor performance: the goal of 2% global fuel efficiency is evaluated through volume of fuel used per revenue tonne kilometre performed, and kilograms of fuel burned per available tonne-kilometre (kg/ATK) to be calculated at the maximum payload maximum range condition was adopted by the Independent Experts (ICAO Doc 9963). These metrics are relative to the payload of aircraft, i.e to the carbon intensity of the provided service in the sense of "what is transported".
The subsonic CO2 standard does also not introduce any different treatment for aircraft with different speeds. It sees speed as a means of adjusting the design of an aircraft to the regulatory limit, reducing its metric value.
Excluding speed from the structure of a SST CO2 standard and leaving the task of dealing with it to the regulatory limit, a "natural" formulation of a CO2 framework

could be to plot a proxy of fuel burn (environmental impact) versus service provided, which can take the form of plotting (1/SAR)avg against two correlating parameters, namely Range and Payload. In this way, the data itself attempt to reflect the real world, and the regulatory limit to be added on top of the plot has to be tweaked in order to yield a relevant technological comparison, with similar margin for similar level of technology.
This would be a way to go towards the objective to increase transparency in the fuel efficiency and CO2 emissions of SST aircraft.
Defining a payload parameter, or alternatively defining an MTOM minus Aircraft Empty Mass parameter, might not be easy and might prove burdensome. This has proven in the past not be obvious, but maybe environmental protection is worth the effort.
Other alternatives could also be explored, for example as described in Green, J.E. & Jupp, J.A. (2016). CAEP/9-agreed certification requirement for the Aeroplane CO2 Emissions Standard: a comment on ICAO Cir 337. The Aeronautical Journal, 120, pp 693-723. doi:10.1017/aer.2016.19.
It could be opposed to such a change in the formulation of a CO2 standard versus the existing subsonic standard that it would hamper the comparability of CO2 MVs between subsonic and supersonic aeroplane designs. One could yet still consider requiring publication of RGF in addition to the previous parameter, so that information allowing comparisons is available.

3.3.3. Reference altitudes and speeds for SAR measurement p. 14

comment *5* comment by: *Swedish Transport Agency, Civil Aviation Department (Transportstyrelsen, Luftfartsavdelningen)*

3.3.3 Reference altitudes and speeds for SAR measurement, page 15
It is stated: "*SAR measurements in supersonic reference conditions are proposed to be performed at combinations of altitude and airspeed selected by the applicant, with the additional condition that the airspeed must be supersonic and within 10 % of the airspeed corresponding to the maximum operating Mach number (MMO) of the aeroplane*."
A question: Where doses the 10% come from?

comment *11* comment by: Commentor

(b) The upcoming new generation of SST aeroplanes is expected to operate at supersonic cruise
speed over sea, but at subsonic cruise speed when flying over land, to avoid unacceptable situations for the public due to sonic booms. Further to avoid unacceptable situation for the public due to sonic booms, buffer zones to sea coasts must be defined.

comment *34* comment by: *Rolls-Royce plc*

3.3.2 page 14 Comment Summary

Reference masses for SAR measurement

Suggested Resolution

A supersonic CO2 standard could be developed with the use of just a mid mission SAR point at supersonic and subsonic conditions at one weight rather than at multiple weights.

comment *91* comment by: *DGAC France*

DGAC France - Comment 2:

Section 3.3.3. paragraph 5:
"*SAR measurements in supersonic reference conditions are proposed to be performed at combinations of altitude and airspeed selected by the applicant, with the additional condition that the airspeed must be supersonic and within 10 % of the airspeed corresponding to the maximum operating Mach number (MMO) of the aeroplane. This way it is ensured that the SAR is measured sufficiently close to the aeroplane's supersonic design Mach number. Within those boundaries, it is assumed that SAR-optimal combinations of altitude and airspeed are likely to be chosen by the applicants, as otherwise the resulting SAR values would be adversely affected.*"

We are very much in favour of this proposal. SST aircraft could operate some fully subsonic flights, for example in the case of SST Business Jets doing a short mission over Europe. It is therefore advisable that their CO2 performance at subsonic speed is monitored. It will also allow comparability with subsonic aircraft where relevant.

3.3.4. Further reference conditions, test procedures, reference geometric factor (RGF) p. 15

comment *104* comment by: *Exosonic*

SUPERSONIC GHG EMISSION CERTIFICATION SPECIFIC COMMENTS
EASA's proposed SAR changes with weight should work well.

Existing RGF calculation is not intended for supersonic airplanes that have their baggage on the main deck to improve their fineness ratio. Could such area be excluded?

The 0.24 power applied to RGF should be slightly increased because smaller supersonic airplanes cannot achieve the fineness, and therefore efficiency, of larger vehicles.

3.3.5. CO 2 metric-value definition p. 16

comment *4* comment by: *Swedish Transport Agency, Civil Aviation Department (Transportstyrelsen, Luftfartsavdelningen)*

3.3.5 CO2 metric-value defintion, page 16

It is stated that Option 2 may simplify the definition of a technologically feasible CO2 limit, and the disavantages are lack of data and disconnection between CO2 MV and fuel efficiency. It could also be clarified that introducing a speed parameter in the metric value could set a precedent for future SARP development for different types of aircraft, that might be to the detriment of environmental benefit. For example: “transport capability” (MTOM) in current ICAO regulation isn´t representative of perceieved noise.

comment *12* comment by: Commentor

Traficom is supporting Option 1.

comment *13* comment by: *FAA*

Paragraph Number
3.3.5. CO2 metric-value definition

Referenced Text Option 1, Option 2

Comment: Both of the recommended options for calculation of the CO2 emission evaluation metric value (MV) should include a reduction factor for mandatory operation with SAF.

Proposed Resolution: Specify an optional reduction factor for those supersonic aircraft that specifiy a mandatory operating limitation for use of CORSIA eligible SAF.

comment *35* comment by: *Rolls-Royce plc*

3.3.5 page 16 Comment Summary

CO2 metric value definition

Suggested Resolution

It is premature to suggest that the Reference Geometric Factor (RGF) used for subsonic CO2 standards is suitable for supersonic aircraft.
EASA needs to wait for work in ICAO on this subject.

comment *72* comment by: *CAA -Norway*

The Norwegian CAA appreciate EASAS efforts with the objective to ensure a high, uniform level of environmental protection in Europe, and the opportunity to comment on this NPA. We welcome these suggested environmental protection requirements for SST airplanes, in the absence of ICAO Standards and SARPs. The proposed noise limits for SST which correspond to ICAO Annex 16, Chapter 14 limits are important to maintain the current level of environmental protection in Europe and to avoid an increase noise exposure around airports. We think it should be further elaborated whether introducing an speed parameter in the metric value can have an impact on future SARP development for all types of airplanes, for

emissions and also perceived noise, and whether it may be environmental beneficial or not.

comment *93* comment by: *DGAC France*

DGAC France - Comment 4:

Section 3.3.5 :
"*The CO2 metric value (MV) is defined as the reciprocal value of the SAR (averaged for the three reference points and measured in units of kg fuel per km range) divided by an RGF with an exponent. The exponent of 0.24 in the denominator of the MV definition is there to balance the effects of aircraft capacity (RGF) against range (MTOM) within the metric system*"

The effect of RGF is questionable. It might be worth exploring what are the benefits for using RGF and if it is appropriate for supersonic aircraft, and if yes, in the metric itself.
To the A-NPA, the RGF represents a proxy for payload capability. What is the expected benefit of having RGF in the metric? What does "balance the effects of aircraft capacity (RGF) against range (MTOM) within the metric system" mean?
With the example of two SST aircraft A and B where the rear part of the fuselage of B is used to host an additional fuel tank, we have a situation where RGF(B) < RGF(A), for example RGF(A)=2*RGF(B).
In the case where reference gross masses are defined as in the current subsonic standard (no use of MZFW), A and B have the same SAR measurements.
Then, applying the subsonic metric value definition, there is a factor 2^(0,24) = 1.18 between A and B's metric value (MV): MV(B) = 1.18*MV(A). This might be an extreme example. For RGF(B)=0.85*RGF(A), MV(B) = 1.04*MV(A), so a 4% difference.
But B and A are the same aircraft, only with a difference in the choice regarding the trade-off between Payload and Range. So that B would have less margin to the regulatory limit than A for no specific reason, unless there is a judgment that Payload should be more rewarded than Range, but such a choice does not seem to be a technical one, so such a judgment should not be a consequence of the formulation of a CO2 standard.
In that sense, beyond its definition, beyond refinement or replacement with another kind of geometrical measurement of the aircraft, the question of using RGF or not could be raised.
Not using RGF might also make sense.
It makes the metric more simple and explainable, being simply a proxy of fuel burn per km. It could be a lever to meet an objective stated in page 17 of the NPA, i.e the objective to increase transparency in the fuel efficiency and CO2 emissions of such aircraft.
From the point of view of climate, which is recording only how much CO2 is emitted, and does not care about the RGF of the aircraft, it seems more relevant. It seems closer to telling some "environmental truth". This seems like a good thing to do with the metric itself, while the regulatory limit could accommodate for tweaking about RGF, or also take into account aircraft speed, in order to warrant as best as possible a fair technology comparison.
From a society point of view, not only how much CO2 is emitted, but how much CO2 is emitted with respect to the service provided is also relevant, that is to provide an

understanding of efficiency in the use of resources. It is not really clear how an RGF^0.24 within the metric itself fulfils that mission, or if there would be some disconnection between CO2 MV of SST aeroplanes and their actual fuel efficiency leading to the same risk of disconnection that is pointed out regarding option 2 with inclusion of speed in the MV definition. See also our comment 5 (#94 in CRT) about the choice of parameters whose limit depends on.
Page 16, it is stated that "An advantage of Option 1 is the resulting comparability of CO2 MVs between subsonic and supersonic aeroplane designs". This could be an argument against not using RGF. But one could also consider that RGF could still be required to be measured, and then published, so that the information to ensure comparability to subsonic CO2 MVs is available.

comment *96* comment by: *DGAC France*

DGAC France - Comment 6

Section 3.3.5, regarding speed in the metric or not.

It is clear that speed has a significant impact on the fuel burn of a SST aircraft.
The subsonic CO2 standard does not introduce any different treatment for aircraft with different speeds. It sees speed as a means of adjusting the design of an aircraft to the regulatory limit, reducing its metric value.
One can claim that the primary added value of aviation is to transport people and goods from point A to point B in a safe manner, and in a reasonable time, while the climate does not care about how fast people and goods were transported, but only about how much CO2 was emitted. In that sense, the ability to travel faster seems to be a choice of comfort on the part of the passenger. It might respond to a niche market, but it is not showing any technological advance versus slower aircraft. Faster does not mean technologically more advanced, or else the Concorde would be more advanced than say an A350. Being only technical, the CO2 metric should reflect CO2 emissions, and not value or penalise the design speed, which is a choice of the manufacturer.
In order to reflect physics, the regulatory limit can accommodate for the consequences from flying faster on fuel burn, managing that similar level of technology get a similar level of margin to the standard, as suggested at the end of option 1.
For these reasons, between option 1 and option 2, we support option 1.

Proposal N-1 Applicability p. 19

comment *44* comment by: *UK CAA*

Page No: 19

Paragraph No: Proposal N-1

Comment: UK CAA supports the application of the EASA requirements to all SST aeroplanes regardless of MTOM and number of engines.

comment *55* comment by: *Federal Aviation Administration (FAA)*

Proposal N-1 Applicability:
In Paragraph 1.1: The applicability requirements are intended for all supersonic jet aeroplanes, including their derived versions, effective per the date of application for a type certificate. – **FAA concurs**

In Paragraph 1.2: Regarding the included provisions for situations that do not require demonstration of (noise) compliance that apply to subsonic airplanes, FAA finds this acceptable due to the temporary nature of the circumstances, as long as airworthiness (safety) is satisfied. – **FAA concurs**

For Rationale: The preliminary draft requirements for LTO noise certification of SST aeroplanes are intended to apply to all supersonic jet aeroplanes, independent of their number of engines, MTOM, or design (maximum operating Mach number) speed (see Section 3.2.1 of this A-NPA). FAA acknowledges the proposed scope is independent of number of engines, maximum takeoff mass (MTOM), and design (Mach number) speed. This is consistent with ICAO WG1 SARP development for supersonic jet aeroplanes. – **FAA concurs**

comment *86* comment by: *Gulfstream Aerospace Corporation*

Proposal N-1 comments on LTO noise standard applicability, stating the proposed requirements shall apply to all supersonic aeroplanes capable of sustaining level flight at speeds exceeding a Mach number of 1. Aviation environmental standards are data-driven, which requires any standard to be informed by data. The data driven approach ensures standards adhere to the terms of reference; technologically feasible, economically viable, and environmentally beneficial. As such, Gulfstream suggests limiting applicability of this initial standard to the maximum design Mach numbers and maximum takeoff mass of the future aeroplanes that have been proposed by ICCAIA. As mentioned in the AIA Industry response to the FAA Supersonic NPRM, this data-driven approach is important for maintaining the integrity of the standard-setting process. Setting noise standards only where there is appropriate data to do so will also ensure that supersonic aircraft are not subject to a 'one-size fits all' approach.

Proposal N-3 Noise measurement points p. 19

comment *45* comment by: *UK CAA*

Page No: 20

Paragraph No: Proposal N-3.1 (a)

Comment: UK CAA supports the definition of the lateral full-power reference noise measurement point being "the point on a line parallel to and 450 m from the runway centre line, where the noise level is a maximum during take-off".

comment *57* comment by: *Federal Aviation Administration (FAA)*

Proposal N-3 Noise measurement points:

For Rationale: Using the same noise measurement points as for subsonic jet aeroplanes allows for a direct comparison of the resulting noise levels (see Section 3.2.2 of this A-NPA) and also supports the consistent relationship with the proposed use of Chapter 14 limits. - **FAA concurs**
FA-A clarification: **In paragraph 3.1 (a), is the term "full-power" for lateral point applicable for the measurement using VNRS procedures since PLR will be at reduced power?**

Proposal N-2 Noise measurements p. 19

comment *56* comment by: *Federal Aviation Administration (FAA)*

Fo Rationale: Using the same noise evaluation measure as for subsonic jet aeroplanes allows for a direct comparison of noise levels between subsonic and supersonic aircraft (see Section 4.2.2 of this A-NPA). **FAA considers that the more important factor is use of the EPNdB noise metric as the noise correlating parameter with MTOM.**

Proposal N-4 Maximum noise levels p. 20

comment *6* comment by: *UECNA*

- · 4.1.2 The proposal is to use the same differentiation in noise limits in flyover for 2, 3 and 4-engined aircraft. We would like to see more justification for this choice. This differentiation is based on average characteristics for subsonic aircraft and is intended to compensate for the fact that in airworthiness minimum climb performance requirements are based on N-1 engine operation. This leads to subsonic two-engine aircraft in general having a better climb performance with all engine functioning than three- or four engine aircraft. Would the same relation hold for supersonic aircraft, which by design need much higher power to mass ratio to allow for supersonic flight? If not, the regulation should cater for these differences and maintain the level playing field in terms of comparability of noise certification levels for subsonic and supersonic aircraft.
-
- · The NPA justifies the use of higher take-off reference speed by referring to "design differences" without specifying why the higher speeds would be justified and what those higher speeds would be. It is noted that higher speeds in general lead to lower noise levels in the EPNdB, all other things being equal. We would propose to maintain the same speeds that are required for subsonic aircraft and use section 5.1.4 to deal with cases where the applicant can show that the design would really need the higher speeds.

comment *28* comment by: *Rolls-Royce plc*

4.2.3.1 N-3 page 20 Comment Summary

Noise Certification - Lateral
Proposed text: "lateral full-power reference noise measurement point for jet-powered aeroplanes:
the point on a line parallel to and 450 m from the runway centre line, where the noise level is a maximum during take-off;"

Suggested Resolution

Does this definition of the lateral point include the ground run? This would limit the ability to use equivalent (intercept) procedures as preferred by RR. As lateral attenuation will reduce noise from low altitudes significantly, it should be a regulatory task to approve and validate a lateral attenuation method to be used by the applicants (similar to atmospheric absorption).

comment *29* comment by: *Rolls-Royce plc*

4.2.3.2.2 N-3 page 20 Comment Summary

Noise Certification - Lateral
Proposed text: "Sufficient lateral test noise measurement points shall be used to demonstrate that the maximum noise level on the appropriate lateral line has been clearly determined."

Suggested Resolution

RR assumes equivalent (intercept) procedures can be used to certify supersonic AC. Theoretically infinitely high number of microphones required to comply with requirement. This is different from subsonic procedures. How practically that would be implemented? RR proposes to establish and validate lateral attenuation method to verify that AC on the runway is not louder than during intercept due to lateral attenuation.

comment *39* comment by: *Umwelt- und Nachbarschaftshaus*

As representative of a multi-stakeholder dialogue, based around Frankfurt airport - including Deutsche Lufthansa, Fraport, Deutsche Flugsicherung and several local and regional political representatives - we very much appreciate the approach of having the same maximum noise limits for sub- and supersonic aeroplanes. There must not be any exemptions/ "lex boom" with regards to noise for supersonic aeroplanes. The noise standards should refer to the respective weight class.

Additionally, if new noise chapters will be implemented in the future, the maximum noise standards for supersonic aeroplanes should be raised accordinly to those of subsonic aeroplanes.

And finally, it should be ensured that no use of afterburner is allowed for supersonic aeroplanes.

comment *46* comment by: *UK CAA*

Page No: 20

Paragraph No: Proposal N-4

Comment: UK CAA supports the proposed maximum noise levels, including the need to have a cumulative margin of not less than 17 EPNdB, and the need to have not less than 1 EPNdB at each of the three measurement points.

comment *58* comment by: *Federal Aviation Administration (FAA)*

Proposal N-4 Maximum Noise Levels:
For Rationale: The noise limits correspond to the noise limits for subsonic jet aeroplanes in Chapter 14 of ICAO Annex 16, Volume I, in order to maintain the current level of environmental protection in Europe, and ensure a level playing field between subsonic and supersonic jet aircraft (see Section 3.2.3 of this A-NPA). - **FAA concurs for global standards.**

FAA questions:
Future SSTs for higher cruise Mach may not be able to achieve Chapter 14 levels and be economically viable. ***Is EASA open for further discussion on this?***
Does EASA foresee changing Chapter 14 requirement for SSTs if a new future subsonic noise regulation is in place to maintain the level playing field?
FAA clarification: **In paragraph 4.1.1, is the term "full-power" for lateral point applicable for the measurement using VNRS procedures since PLR will be at reduced power?**

comment *74* comment by: *- Destinus*

Due to the noisy nature of supersonic and hypersonic aircraft propulsion systems (e.g., Air Turbo Rocket (ATR) engines, rocket engines, etc.), the noise limits set forth in this NPA may be too restrictive. This fact would be aggravated due to the need of using thrust increase systems such as afterburners, usually required in this type of aircraft during the takeoff. Something similar to what happened with the Concorde, where the noise level during takeoff could exceed 110 EPNdB even reaching 125 EPNdB with the afterburner (ref: US Environmental Protection Agency (EPA) 1974 Noise Measurement of Concorde 02 Approach and Takeoff at Dallas – FT.Worth and
Dulles International Airports).

Proposal N-5.1 Noise certification reference procedures - General conditions p. 22

comment *59* comment by: *Federal Aviation Administration (FAA)*

Proposal N-5.1 Noise certification reference procedures —General conditions

The preliminary draft requirements correspond to those for subsonic jet aeroplanes, with the exception of the take-off reference procedures that are specified in Proposals N-5.2 and N-5.3 (see Section 3.2.4 of this A-NPA). – **FAA concurs**.

In Paragraph 5.1.4: It specifies the contingency for flexibility by an authority to allow for departure from Reference procedures because of design constraints. This had not been considered under the ICAO CAEP/11 WG1 activities. ***Can EASA explain their rationale for how much departure from Reference can be accepted?***

In Paragraph 5.1.5: The reference procedures as specified in points 5.2, 5.3, and 5.4 shall be calculated under the following reference atmospheric conditions. ***Is the intent to maintain SAE ARP866 use or move to SAE ARP5534 atmospheric model?***

comment *97* comment by: *Bundesvereinigung gegen Fluglärm e.V.*

In principle it is the logic approach to define for SST the same noise limits as for subsonic planes. But it should be considered that chapter 14 doesn't represent the state of the art; e.g. E190-E2 or A350-941 have a margin of 25-30 dB. New noise limits with significantly reduced limits (at least 5 dB for each measurement point) are overdue. We suggest to define noise limits also for SST which are close to the best subsonic planes.

Proposal N-5.2 Noise certification reference procedures - Take-off reference procedure without VNRS p. 23

comment *47* comment by: *UK CAA*

Page No: 23

Paragraph No: Proposal N-5.2.1 (d)(1)

Comment: UK CAA supports the proposal that the take-off speed shall be "at least V2 + 65 km/h (V2 + 35 kt) but not greater than V2 + 102 km/h (V2 + 55 kt)" and "not greater than 463 km/h (250 kt)".

comment *60* comment by: *Federal Aviation Administration (FAA)*

Proposal N-5.2 Noise certification reference procedures — Take-off reference procedure without VNRS
-From Rationale: The take-off procedure without VNRS corresponds to the take-off procedure for subsonic jet aeroplanes, but with adapted speeds. This procedure is envisaged for SST aeroplanes without VNRS (see Section 3.2.4 of this A-NPA). - **FAA concurs section, except for prescribing a speed range of V2+ 35 to V2+55 kts and the tolerance range of +25 to +35 kts to both ends of speed range, as this may constrain designs. Can EASA share the technical analyses with ICAO WG1 for the prescribed speed range limits and tolerances proposed?** FYI**:** FAA suggests the range of V2+10 to less than 250 kts (currently limited for under 10k ft altitude for subsonic).

Proposal N-5.3 Noise certification reference procedures - Take-off reference procedure with VNRS p. 24

comment *23* comment by: *Rolls-Royce plc*

3.2.4.b.2 (page 11) and 4.2.5.3.1.b (page 24) Comment Summary

VNRS - max thrust reduction
Proposed text: "Any thrust reduction that is initiated by the VNRS (PLR) before the final 'power cutback' point must not result in a thrust lower than 75 % of the maximum available thrust.
[...] average engine take-off thrust shall be used from the start of take-off to the point where the applicant's VNRS design provides input to the controls of the aeroplane. Any reduction of the thrust through the VNRS design shall not result in a thrust lower than 75 per cent of the maximum available take-of thrust;"

Suggested Resolution

The reference condition for max available thrust needs to be defined: i.e. SLS or before first thrust cut (check with 5.3.1 (f)). It cannot be related to the actual minimum thrust at cutback (p 25, 5.3.1, (d), (i), (ii)) since this depends on the specific aircraft. The limitation of thrust cut should be controlled by safety requirements (OEI conditions--> minimal thrust requirement for the actual aircraft). This would give enough room for noise optimisation.

comment *30* comment by: *Rolls-Royce plc*

4.2.5.3.1.a N-5.3 page 24 Comment Summary

Noise cert. - Take-off reference speed
Proposed text: "The take-off reference flight path using VNRS shall be calculated as follows: (a) the most critical (that which produces the highest noise level) configuration shall be used;"

Suggested Resolution

See comment for section 3.2.4.

comment *40* comment by: *Umwelt- und Nachbarschaftshaus*

Allowing the use of VNRS during take-off procedures is ok - BUT ONLY if VNRS is effective in both: the low and more distant areas around the departure routes to protect local residents.

comment *48* comment by: *UK CAA*

Page No: 24

Paragraph No: Proposal N-5.3.1 (a)

Comment: UK CAA supports the proposal that the "the most critical (that which produces the highest noise level) configuration shall be used".

comment *49* comment by: *UK CAA*

Page No: 24

Paragraph No: Proposal N-5.3.1 (b)

Comment: UK CAA supports the proposal that the "Any reduction of the thrust through the VNRS design shall not result in a thrust lower than 75 per cent of the maximum available take-of thrust".

comment *50* comment by: *UK CAA*

Page No: 24

Paragraph No: Proposal N-5.3.1 (b) and N-5.3.1 (d)

Comment: Noting that N-5.3.1 (b) would permit a reduction in thrust to "not lower than 75 per cent of the maximum available take-of thrust" and that N-5.3.1 (d) would permit a further reduction in thrust to maintain "a climb gradient of 4 per cent" or "in the case of multi-engined aeroplanes, level flight with one engine inoperative, whichever thrust is greater" UK CAA proposes that no increase in thrust should be permitted between the first and second thrust reduction.

Justification: Communities under the flight path are known to react badly to noise caused by sudden fluctuations in engine thrust. By restricting any VNRS changes in thrust to reductions only the impact on local communities would be minimised.

Proposed Text: "there shall be no increase in thrust at any time during the reference procedure."

comment *51* comment by: *UK CAA*

Page No: 25

Paragraph No: Proposal N-5.3.1 (g)

Comment: UK CAA supports the proposal that the take-off speed shall be "at least V2 + 65 km/h (V2 + 35 kt) but not greater than V2 + 102 km/h (V2 + 55 kt)" and "not greater than 463 km/h (250 kt)".

comment *61* comment by: *Federal Aviation Administration (FAA)*

Proposal N-5.3 Noise certification reference procedures — Take-off reference procedure with VNRS
For Rationale: the take-off procedure with VNRS is envisaged for SST aeroplanes with VNRS installed (see Section 3.2.4 of this A-NPA). – **FAA concurs with inclusion for a**

take-off procedures with VNRS, except for the proposed limitation of: speed range/tolerance criteria, limited engine thrust criteria and the conflicting requirement for highest noise configuration.

FAA comments:
Can EASA share the technical analyses with ICAO WG1 for the prescribed speed range limits and tolerances proposed?
Can EASA share the technical analyses with ICAO WG1 for limiting PLR to 75% of engine thrust capability? This limitation may not belong in the environmental requirements as it may conflict with approved airworthiness. The minimum thrust is governed by aircraft performance and airworthiness requirements. It is also a constraint to the thrust cutback limits defined in paragraph d). If viable below 75% for airworthiness, why prescribe additional requirements that can inhibit noise reduction design creativity?
Why prescribe the use of the highest noise configuration when VNRS is being designed to reduce the noise? Preferrable to say the certification configuration must be relevant to day to day operations? [Note: The VNRS concept allows for technological applicability of dynamic systems to provide scheduled and repeatable reduction of noise]
FAA seeks more clarity on the profile process described in paragraph 5.3.1.c.
Does EASA recognize and support variable high lift devices as part of VNRS?
For discussion in paragraph 3.2.4 (b)(2), it either assumes or mandates cutback be used. What if the applicant chooses not to utilize cutback?

comment *98* comment by: *Bundesvereinigung gegen Fluglärm e.V.*

The use of VNRS cannot be accepted, if it is possible, that the operator of the plane disabled the system in his workshop. It is not satisfying that the pilot should not get the possibility to disengage the system. Due we expect that the possibility will be given to disable the system during maintenance we suggest to specify a noise measurement without VNRS for every plane. We advise that in many cases we have noise conflicts not only very close to the airport but also in some distance. Reduction of thrust leads to a lower altitude; the effect of the reduced distance between source and receiver is often larger than the effect of the reduced emission.

Proposal N-5.4 Noise certification reference procedures - Approach reference procedure p. 25

comment *31* comment by: *Rolls-Royce plc*

4.2.5.3.1.e N-5.3 page 25 Comment Summary

Cutback definition
Proposed text: "if thrust cutback as defined under d) above is used, the configuration of the aeroplane shall not be changed after thrust cutback;"

Suggested Resolution

See comment on section 3.2.4. To come into supersonic cruise, the aircraft will need to change configuration. In particular a variable nozzle may have to be closed during transition from climb into supersonic cruise. The aircraft operation procedures will be defines such that sufficient altitude is gained for transition to cruise. It can be shown by prediction, that the engine is not going to be noisier than at Cutback during this transition.

comment *52* comment by: *UK CAA*

Page No: 25

Paragraph No: Proposal N-5.4

Comment: UK CAA supports the proposed approach reference procedures for an SST aeroplane without VNRS. However UK CAA recommends that an approach reference procedure with VNRS be proposed.

Justification: We believe it cannot be excluded that an SST aeroplane will be developed with an active VNRS during the approach segment. Having an approach reference procedure for an SST aeroplane with VNRS active during the approach segment would facilitate the noise certification of such an aeroplane.

comment *62* comment by: *Federal Aviation Administration (FAA)*

Proposal N-5.4 Noise certification reference procedures — Approach reference procedure
For Rationale: The approach reference procedure corresponds to the respective procedure for subsonic aeroplanes (see Section 3.2.4 of this A-NPA).- **FAA concurs**
FAA Question: ***Will EASA consider an optional use of VNRS (PLR and / or variable high lift devices) for approach as well?***

Proposal N-6 Test procedures p. 26

comment *17* comment by: *GdF*

SERA.8020 uses the wording and value of plus or minus Mach 0.02 and plus or minus 10 kts. Wouldn't similar values have to be used in 6.5 and 6.6?

comment *63* comment by: *Federal Aviation Administration (FAA)*

Proposal N-6 Test Procedures: The test procedures correspond to those for subsonic aeroplanes, with adapted provisions for the limitations on flight conditions (see Section 3.2.5 of this A-NPA). ***FAA concurs, contingent that these test procedures serve as guidelines until more comprehensive analyses/data are available to verify the applicability for supersonic aircraft.***

Proposal N-7 Appendix p. 27

comment *64* comment by: *Federal Aviation Administration (FAA)*

Proposal N-7 Appendix: The contents of this Appendix are proposed to correspond to the technical contents of Appendix 2 to ICAO Annex 16, Volume I, with the certain exceptions. ***FAA concurs, contingent that these Appendix procedures serve as guidelines until more comprehensive analyses/data are available to verify the applicability for supersonic aircraft***.

Proposal CO 2 -2 Reporting of SAR and RGF p. 28

comment *38* comment by: *Rolls-Royce plc*

4.3.3.1 pages 28/32 Comment Summary

Publication of CO2 metric values

Suggested Resolution

We believe P28 is describing the reporting to EASA of values and not to the public, as page 32 suggests publicising just the CO2 metric values which is the same as that done for subsonic standards.
Could EASA please confirm that only the final metric values will be published not the proprietary data that goes into building up that metric value?

4.3. Preliminary draft requirements for CO 2 emissions of SST aeroplanes p. 28

comment *65* comment by: *Federal Aviation Administration (FAA)*

Proposal CO_2: The FAA supports the concept of exploring the CO_2 emissions metric system, developed within ICAO/CAEP for subsonic aeroplanes in Annex 16 Volume III, for potential use for supersonic aeroplanes. Before any supersonic CO_2 emissions regulations are set in place by EASA, the FAA recommends that the proposed conceptual exploration of the CO_2 emissions metric system require sound incorporation of technical elements unique to supersonic flight. For instance, the FAA supports EASA with investigating the incorporation of cruise design Mach number of the aeroplane, as well as other technical elements such as the use of variable noise reduction systems (VNRS), that may affect the way supersonic aeroplanes consume fuel in the future. These recommendations are proposed with the understanding that there would be some level of coordination between EASA and ICAO CAEP's emissions technical working group for validation and verification in advance of finalizing any future European regulations.

comment *87* comment by: *Gulfstream Aerospace Corporation*

In review of this A-NPA, the CO2 emissions section appears to be earlier in development than the noise section. Gulfstream has provided limited comments on concepts for CO2 emissions requirements for SST aeroplanes below. Gulfstream looks forward to collaborating with EASA on the development of the CO2 emissions standard within ICAO. Specifically:

• Gulfstream believes the existing reference geometric factor (RGF) used for subsonic CO2 emissions is inappropriate as the subsonic RGF does not account for the sensitivity of supersonic aeroplanes to drag and the resulting impact to cabin size and shaping.
• Additional work is required to determine how best to account for the cruise Mach number within the emissions standard, whether through the metric, correlating parameter, or the limit line(s). Supersonic aircraft design varies significantly with changes in cruise Mach number, and fuel burn levels would be expected to change at varying Mach numbers, even with a constant technology level.
• The basic concept for testing at a speed based on MMO instead of the best range may be possible, but additional detail must be defined. Questions that must be considered include but are not limited to:
o At what weights could the aeroplane achieve MMO?
o What altitude would be required for evaluation?
• The proposed process to determine the weight points seems more complex than necessary and could benefit by being simplified.
• Gulfstream encourages EASA to focus on similar "key criteria" to the criteria used for the development of the subsonic standard. Gulfstream believes "Utilization Independence" is an essential criterion to preserve.
• Gulfstream believes the desire to report and record subsonic metric values, while useful for emissions inventories, is not appropriate for a supersonic certification standard.
Gulfstream encourages EASA to prioritise the continuation of the ongoing effort within ICAO to complete a supersonic CO2 certification standard.

Proposal CO 2 -5 Reference aeroplane masses p. 30

comment *69* comment by: *Dassault-Aviation*

* Proposal CO2-5 page 30:

We agree on the content of the proposal of A-NPA for supersonic (noise and CO2), which is globally consistent with our responses to the questionnaires in February 2022
For CO2 aspects, on the key topic of reference masses for SAR determination, we fully agree with the current proposal based on cruise design mass points being defined by applicant but in case of difficulties to precisely define the design mission, alternative solutions based on the certified parameter MZFW (taking into account effects of fuel/MTOW ratio on gross weight points) could be proposed:
a) define the low gross weight M3=C*MZFW (with a value of C between 1.1 and 1.2 to be defined precisely)
b) replace 3 gross weights by a unique gross weight equal to (MTOW+MZFW)/2.

Proposal CO 2 -7 Test procedures p. 31

comment *70* comment by: *Dassault-Aviation*

* Proposal CO2-7 page 31 "Note: …in either ASTM D1655-15…".

The -15 refers to the specification dated 2015. Today we are at -21. We propose to use ASTM D1655-XX to be compliant to the latest version of the specification.

Proposal CO 2 -8 CO 2 emissions evaluation metric values p. 31

comment *99* comment by: *Bundesvereinigung gegen Fluglärm e.V.*

The proposed metric, which is related to MTOM, is not suitable to describe the CO_2 – emissions. We suggest to use a metric, which is related to the maximum payload and the maximum range with maximum payload. An additional factor dependent to the size of the fuselage which privileges smaller aircrafts is not meaningful.