Exemption No. 10613

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98057-3356

In the matter of the petition of **Gulfstream Aerospace LP** for an exemption from §§ 25.901(b)(1)(i), 25.901(b)(2), 25.903(d)(2), 25.939(a), 25.1301(a),(c)&(d), 25.1309(c), 25.1322, and 25.1549(a) of Title 14, Code of Federal Regulations	**Regulatory Docket No.FAA-2012-0553**

GRANT OF EXEMPTION

On June 28, 2012, Mr. Charly Gaber, Gulfstream Aerospace LP (GALP), P.O. Box 1036, Airport City 70100, Israel, petitioned for a partial, time-limited exemption from certain engine-installation, operational-limitation, and engine-indication provisions of Title 14, Code of Federal Regulations (14 CFR) as they apply to the level of wing anti-ice bleed supply provided to the airplane from the engines, a level that exceeds the engine-installation manual limits for Honeywell AS907 engines installed on GALP Model G280 airplanes.

The petitioner requests relief from the following regulations:

Section 25.901(b)(1) & (2) as amended by Amendments 25-1 through 25-46:

(b) For each powerplant—
(1) The installation must comply with—
(i) The installation instructions provided under § 33.5 of this chapter
(2) The components of the installation must be constructed, arranged, and installed so as to ensure their continued safe operation between normal inspections or overhauls

Section 25.903(d)(2) as amended by Amendments 25-1 through 25-100:

(d) *Turbine engine installations.* For turbine engine installations—
(2) The powerplant systems associated with engine control devices, systems, and instrumentation, must be designed to give reasonable assurance that those engine

operating limitations that adversely affect turbine rotor structural integrity will not be exceeded in service

Section 25.939(a) as amended by Amendments 25-1 through 25-40:

(a) Turbine engine operating characteristics must be investigated in flight to determine that no adverse characteristics (such as stall, surge, or flameout) are present, to a hazardous degree, during normal and emergency operation within the range of operation limitations of the airplane and of the engine.

Section 25.1301(a), (c) & (d) as codified, February 1, 1965:

Each item of installed equipment must:
(a) Be of a kind and design appropriate to its intended function;
(c) Be installed according to limitations specified for that equipment; and
(d) Function properly when installed.

Section 25.1309(c) as amended by Amendments 25-1 through 25-41:

(c) Warning information must be provided to alert the crew to unsafe system operating conditions, and to enable them to take appropriate corrective action. Systems, controls, and associated monitoring and warning means must be designed to minimize crew errors which could create additional hazards

Section 25.1322 as amended by Amendments 25-1 through 25-38:

Warning, caution, and advisory lights.
If warning, caution, or advisory lights are installed in the cockpit, they must, unless otherwise approved by the Administrator, be—

(a) Red, for warning lights (lights indicating a hazard which may require immediate corrective action);
(b) Amber, for caution lights (lights indicating the possible need for future corrective action);
(c) Green for safe operation lights; and
(d) Any other color, including white, for lights not described in paragraphs (a) through (c) of this section, provided the color differs sufficiently from the colors prescribed in paragraphs (a) through (c) of this section to avoid possible confusion.

Section 25.1549(a) as amended by Amendments 25-1 through 25-40:

For each required powerplant and auxiliary power unit instrument, as appropriate to the type of instrument—

(a) Each maximum and, if applicable, minimum safe operating limit must be marked with a red radial or a red line

The petitioner supports its request with the following information:

This section quotes the relevant information from the petitioner's request, with minor edits for clarity. The complete petition is available at the Department of Transportation's Federal Docket Management System, on the Internet at http://regulations.gov, in docket no. FAA-2012-0553.

> There is an extremely remote risk that an ITT [inter-turbine temperature] exceedance warning message might occur during the initial wing warm-up phase of WAI System operation under certain conditions. Engine bleed demands during this phase and the current FADEC [full-authority digital engine control] ITT limits may lead to an indication of engine ITT exceedance to the flight crew. However, the engine is actually certified to a higher value (955°C continuous, 970°C maximum for 20 seconds) than the flight deck exceedance indication as-generated by the current FADEC version (928°C). The engine may therefore continue to safely operate without any adverse affect to the engine or continued safe flight of the aircraft.
>
> For such an actual exceedance all of the following conditions, events and related crew actions would have to occur:
>
> - Field elevation greater than 8,000 feet
> - Icing conditions would have to be present (less than 10°C / visible moisture)
> - Pilot would have to fail to recognize potential for icing conditions and not activate the system prior to take-off or initiation of approach procedures
> - Co-pilot would have to overlook the pilot's failure to activate WAI System despite defined procedures
> - Crew then recognizes the error and activates the WAI System while at take-off or go-around power
>
> Due to the current configuration of engine FADEC and WAI System control software as reviewed with FAA and intended for Type Certification, it has proven impractical to demonstrate full compliance through aircraft or other system limitations or by system level changes with the above-listed rules in a timely manner. GALP therefore respectfully requests that this time-limited exemption be granted without delay to support the timely issuance of a Type Certificate for the Gulfstream G280. This would permit the reasonable development of mitigating improvements in WAI System control and engine FADEC software within a workable time-frame.
>
> Type Certification of the Gulfstream G280 to include Flight Into Known Icing (FIKI) is vital to the product. Restricting the operational envelope in this manner, or in any form

that otherwise restricts airplane performance is commercially unviable for GALP and its customers and would be very detrimental to the marketability of this aircraft.

This exemption would be time-limited to two (2) years to allow improvements presently in development to be completed and implemented into the G280 fleet. Improvements now in-work include optimized aircraft and engine control system and indication software designed to preclude the possibility of an engine ITT exceedance indication during certain high-bleed demand operating conditions.

Fleet operational experience demonstrates that the high-usage rate for a Gulfstream Mid-Cabin airplane is about 600 hours per year, and that a more typical usage rate is approximately 400 hours per year. Given the limited time-frame for the requested exemption and considering the operational window for the airplanes that would be delivered within a 2 year time-frame, the risk of an ITT exceedance is reduced due to the engines only having a partially deteriorated condition and thereby would have more margin to an ITT limit than a fully deteriorated engine as used in the margin analysis. The limited number of airplanes that will be delivered within the two-year period of the requested exemption represents a negligible addition to overall fleet risk.

Supportive Information:

GALP, with assistance from the engine manufacturer, has established that tolerance against the risk of the described exceedance occurring is related to engine ‘margin’, e.g. a newly-delivered engine has greater ITT temperature margins than an ‘end of life’ engine. Airplanes delivered within the requested 2 year window will have new engines and should accumulate no more than approximately one-eighth of their useful margin-life during that time-span at the average-to-highest airplane usage rates. This mitigates any exposure to the condition, should AFM procedures not be followed, as these margins help offset the likelihood of a high-bleed rate condition driving such an occurrence.

Current aircraft ITT engine limits are below the certified engine ITT limits by as much as 27 degrees. Even if a momentary engine ITT exceedance is seen during the brief period of time while the wing anti ice system heats up the wing, the engine is certified to a higher value than the airframe exceedance indication as stated above (955°C continuous / 970°C maximum for 20 seconds vs. 928°C in the current FADEC SW), and will continue to safely operate without any affect to the engine or continued safe flight of the aircraft.

GALP’s assessment of the possibility of an actual operational ITT exceedance event during foreseeable flight conditions has also shown the likelihood of such an actual ITT exceedance occurring during foreseeable fleet operations to be extremely remote. Therefore the risk of an actual exceedance occurring during an indication error event is mitigated. The limited number of airplanes that will be delivered within the two-year period of the requested exemption represents a negligible addition to overall fleet risk.

Normal operational procedures provide ample means by which the crew may avoid the operational issue of an ITT exceedance indication. The condition of this exemption will be also be appropriately stressed during pilot type rating and training activities in the Gulfstream G280 so as to ensure crew awareness of the extremely remote potential for an exceedance warning.

GALP will design, certify and incorporate into Gulfstream G280 production line and existing fleet, a series of modifications required to demonstrate compliance with the requirements of the above listed rules within the time permitted by this exemption, if granted.

Issue of Public Interest

Denial of this petition for exemption would result in the delay in Type Certification and delivery of the Gulfstream G280. While these airplanes are not manufactured in the U.S., a significant portion of the airplane, including the wings, engines, avionics, and interiors are manufactured by U.S. suppliers. Denial of this exemption would result in the loss of revenue for the U.S. suppliers and have an adverse impact on the U.S. balance of trade, both of which are contrary to the public interest.

Granting this exemption would permit the efficient transport of employees, corporate executives and important clientele in an efficient and safe environment. Due to the high demand for these corporate aircraft, it is imperative that the petitioner is granted the regulatory relief requested. Failure to achieve this goal will result in delivery delays and the potential for significant loss of income, in both domestic and foreign trade for the United States and the petitioner. Therefore the stabilizing effect that the manufacture and support of corporate aircraft has on the job market and balance of trade for the United States is significant and definitely in the public interest.

Type Certification without FIKI is not a commercially viable option due to the operational needs of the corporate aircraft market. Similarly, airplane performance restrictions are not a commercially viable option and would be highly punitive to GALP's ability to compete in the marketplace, at best.

Adequate time is needed to develop the appropriate mitigations and system features to address this concern. This will involve software modifications to the engine FADEC and WAI System control which require a long lead-time to assure proper functionality and software compliance. System changes are required to critical engine and aircraft control systems which must be carefully done to not introduce additional or unexpected hazards to these controls.

GALP is responding in a timely fashion to this issue which, as stated above, only became known during recent FAA FSB [Flight Standardization Board] activities. This is a crucial time in the development and certification of the Gulfstream G280. A delay in granting

this exemption would be detrimental to GALP by delaying the Type Certification and delivery of the product..

Effect of the Exemption on Safety

The overall potential of an ITT exceedance indication is very limited given the number of foreseeable conditions that must be present. Analysis of foreseeable fleet operations, the attending risks of an occurrence / icing event and related operational actions, Airplane Flight Manual (AFM) procedures (including prohibition against operation in WAI System auto-mode) and reliability of the associated components and systems have shown that an acceptable level of safety is assured.

In addition to appropriate procedures, clear placarded information will be present in the cockpit to prohibit operation of the WAI System in auto-mode. When the WAI System is switched off, system probability failures that could cause Uncommanded activation of WAI are extremely improbable and are not caused by a single failure.

To further mitigate any risk of an event that might occur from unforeseen rapid engine deterioration in-service, it is also proposed that an interim power assurance check be performed at “A check” at 500 hours, or “C check” at 12 months, whichever comes first. This is to ensure that appropriate ITT margins are maintained in-service.

The MMEL [master minimum-equipment list] will prohibit single bleed source dispatch or other dispatch configuration limitations which are fundamental to the exemption being requested.

Federal Register publication

A summary of this petition was published in the *Federal Register* on August 13, 2012. The FAA received no relevant comments.

The FAA’s Analysis

The Gulfstream Aerospace LP (GALP) petition acknowledges that the Model G280 type design currently proposed for certification will not fully comply with a number of applicable 14 CFR part 25 regulations due primarily to the adverse impacts of the level of wing anti-ice bleed supply provided to the airplane from the engines, a level that exceeds the engine-installation manual limits for the Honeywell AS907 engines during initial wing anti-icing “warm-up” operation. These impacts are exacerbated by the fact that the current engine ITT “maximum safe operating limit,” as presented at the airplane level, is considerably lower than that actually approved for the engine.

Because the level of wing anti-ice bleed supply provided to the airplane from the engines exceeds the engine-installation manual limits, the airplane does not comply with § 25.901(b)(1).

However, as stated in a letter in the docket from the responsible engine-certification office, “This minor HP overbleed condition is acceptable, with no limitations, for the proposed two-year exemption period.”

As the petitioner notes, the airplane will have limited operational exposure to the noncompliant type design to be approved under this partial, time-limited exemption. A rough estimate of the total operating time of airplanes delivered in this configuration, during the time period covered by this exemption, would be on the order of 20,000 hours.

The petitioner will be required, by the conditions for granting this partial, time-limited exemption, to substantiate that:

- When the Wing Anti-Ice (WAI) System is switched off, system failures that could cause uncommanded activation of WAI are extremely improbable and are not caused by a single failure. A detailed system description and system-safety analysis (SSA) providing verification of these facts will be required.
- Acceptable means are provided to effectively prohibit operation with the WAI in “Auto” (automatic) mode.
- Flight crew procedures and training minimize the potential for and consequences of any potential ITT exceedance related to this granting.
- Engine ITT margins, under any operating and environmental conditions approved for the airplane, will be sufficient throughout the period of the exemption to provide an acceptable assurance that:
    - exceeding the indicated redline limit under non-failure conditions is “extremely remote” as stated by the petitioner (Note: The intention here is not to mandate the use of numerical-probability assessment methods unless such are required to support the finding);
    - in any foreseeable engine-out/single-bleed-source configuration, the engine supplying all the WAI bleed will still be capable of providing:
        - at least maximum continuous thrust up to a safe operating altitude without exceeding the indicated redline limit; and
        - full takeoff/go-around thrust without exceeding the actual engine “maximum safe operating limit”; and
    - in any foreseeable dual-source configuration:
        - at least one engine will be capable of providing at least maximum continuous thrust without exceeding the indicated redline limit; and
        - both engines will be capable of full takeoff/go-around thrust without exceeding the actual engine “maximum safe operating limit.”

This partial, time-limited exemption allows non-compliances which, if allowed to persist, would represent a lower level of safety than intended by the regulations. This is why the FAA intends to require that all Model G280 airplanes be brought into full compliance as soon as practicable. Nevertheless, the fact that the additional per-flight-hour risks associated with these non-

compliances are low allows development of a well-considered recovery program to ensure that the solution does not introduce a problem worse than the one we are trying to solve, and that this recovery program is clearly in the public interest.

In consideration of the above, the FAA concludes that granting this partial time-limited exemption should not adversely affect safety.

If the FAA were to deny this petition, that would substantially delay delivery of these aircraft and put considerable schedule pressure on the development and certification of those engine and airplane-design changes necessary to bring the G280 type design into compliance. This would not only have the obvious adverse economic and logistical impacts noted by the petitioner, but also inherently increase the risk of undiscovered development errors in the required design changes. Malfunctions of those critical systems, which could be impacted by this re-design, could have a more adverse impact on safety than could foregoing the re-design. Consequently, the FAA considers it crucial to allow ample time for proper development and validation of critical design changes.

In consideration of the above, and with the finding above that granting this exemption should not adversely affect safety, the FAA concludes that granting this partial, time-limited exemption is in the public interest.

The FAA's decision

In consideration of the foregoing, I find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. 40113 and 44701, delegated to me by the Administrator, Gulfstream Aerospace LP (GALP) is granted a partial time limited exemption from §§ 25.901(b)(1)(i), 25.901(b)(2), 25.903(d)(2), 25.939(a), 25.1301(a), (c), & (d), 25.1309(c), 25.1322, and 25.1549(a) as they apply to the level of wing anti-ice bleed supply provided to the airplane from the engines, a level that exceeds the engine-installation manual limits for Honeywell AS907 engines installed on GALP Model G280 airplanes. This partial, time-limited exemption is subject to the following conditions and limitations:

1. For type certification by means of this exemption, GALP must substantiate that:
    a. When the Wing Anti-Ice (WAI) System is switched off, system failures that could cause uncommanded activation of WAI are extremely improbable and are not caused by a single failure. A detailed system description and SSA providing verification of these facts will be required;
    b. Acceptable means are provided to effectively prohibit operation with the WAI in "Auto" (automatic) mode;
    c. Flight crew procedures and training minimize the potential for and consequences of any potential ITT exceedance related to this granting; and

d. Engine ITT margins, under any operating and environmental conditions approved for the airplane, will be sufficient throughout the period of the exemption to provide an acceptable assurance that:

   i) exceeding the indicated redline limit under non-failure conditions is “extremely remote” as stated by the petitioner (Note: The intention here is not to mandate the use of numerical-probability assessment methods unless such are required to support the finding);
   ii) in any foreseeable engine-out/single-bleed-source configuration, the engine supplying all the WAI bleed will still be capable of providing:
      (1) at least maximum continuous thrust up to a safe operating altitude without exceeding the indicated redline limit; and
      (2) full takeoff/go-around thrust without exceeding the actual engine “maximum safe operating limit”; and
   iii) in any foreseeable dual-source configuration:
      (1) at least one engine will be capable of providing at least maximum continuous thrust without exceeding the indicated redline limit; and
      (2) both engines will be capable of full takeoff/go-around thrust without exceeding the actual engine “maximum safe operating limit.”

2. The “Airworthiness Limitation” section of the “Instructions for Continued Airworthiness” for any airplane certificated under this exemption will state that these airplanes cannot be operated after September 30, 2014, unless the FAA-approved service information approved in accordance with limitation 4 (below) is incorporated.

3. On or before January 10, 2014, GALP shall obtain FAA type-certification approval of an amendment to the GALP Model G280 type design, an amendment that eliminates any noncompliant design features approved by means of this exemption.

4. On or before March 28, 2014, GALP will develop, validate, and submit, for FAA approval, all service information necessary to incorporate the design changes required by limitation 3 (above).

5. Airplanes for which application for airworthiness certificate is made after September 30, 2014, must incorporate any design changes required by limitation 3 (above).

6. The FAA will not issue original airworthiness approvals for GALP Model G280 airplanes after September 30, 2014, unless GALP has shown full compliance with the provisions of this exemption by that date.

The granting of this exemption does not relieve any regulatory obligation to identify and correct unsafe conditions.

Issued in Renton, Washington, on August 28, 2012.

/s/ Ali Bahrami

Ali Bahrami
Manager, Transport Airplane Directorate
Aircraft Certification Service