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F-108 TURNAROUND CAPABILITIES

The F-108 air vehicle is currently being designed to fly at least two successive long-range missions with a fifteen minute turnaround in between under any climatic conditions that permits normal servicing of the aircraft. If no special procedures other than normal ground servicing and normal mission profiles are flown, a limitation on a third mission develops from the overheating of the tires and, if they have not been expended, the GAR-9 missiles. Since under operational conditions it may be desirable to fly more than two successive missions and still maintain short turnaround times, an examination has been made of these limitations and the procedures that can be followed to circumvent them.

A problem with missile overheating occurs only if the missiles have not been expended in the course of two successive flights. Since the further heating that will occur during the supersonic portion of the third flight will cause them to exceed their temperature limits, some extra measure must be taken prior to the third mission. One possibility is to unload the heated missiles and reload the aircraft with new missiles, which would increase the time required for the second turnaround on the order of six minutes. The missiles can also be cooled in flight by opening the missile bay door at any time the aircraft is subsonic. For example, if the missile bay door were open for ten minutes during the let down after the second mission, the missiles would be cool enough to begin the third mission without further action.

The temperature limits on the tires are 250° F. for actual use and 270° F. for storage in the wheel wells. These limits are not exceeded during two successive design long-range missions with only a fifteen minute turnaround, but they would be exceeded should a third mission be attempted without some action to reduce the temperature of the tires.

An examination of the time-temperature profile of the tires during a typical mission-turnaround cycle reveals that the greatest heating takes place during take-off, and the greatest cooling occurs during the period when the gear is extended prior to landing. Some increase in temperature occurs during supersonic flight, but insulation in the wheel well keeps the rate of heating low compared to heating due to tire flexing on take-off. Flying missions of less than maximum range does not change the picture appreciably since the decrease in heating due to less supersonic flight is just about balanced by the extra heating during landing roll (due to the heavier weight at touchdown and hence greater tire flexing). Cooling by radiation and natural convection while the aircraft is on the ground is very slow, and would necessitate turnaround times of excessive length (something on the order of one hour after the second mission before a third take-off can be safely executed).

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Of the several possible ways around this limitation, the most practical appears to be to simply spray the tires and gear with a fine spray of water during the turnaround period. Spray nozzles are generally available at most bases and this simple expedient should provide the necessary cooling medium to allow the F-108 to fly continuous short turnaround missions when required. There are several design features of the F-108 which appear to make this scheme practical even though it might not be practical for contemporary aircraft. First, it is planned that deceleration during landing will be accomplished by thrust reverser action and that brakes will be used primarily for taxi and for back-up during emergency landings. Therefore, during normal landings, it is not anticipated that the brakes will heat up to a level (as they might if full brakes were used for deceleration during landing) where damage would be sustained by spraying them with a fine spray of water during turnaround. Secondly, the F-108 wheels are being designed to remove the hazard to ground personnel from blowouts and wheel failures. This is accomplished by designing into the wheel small plugs of metal with melting points such that if excessive temperatures begin to develop in the tires, they will melt and release the tire pressure before the blowout danger level has been reached. (The melting point of these plugs is well above that that could be reached during normal tire flexing in take-off and landing and consequently will not cause the tires to go flat during normal operations. They are designed to guard against the much higher temperatures that can result from the heat stored in overheated brakes draining into the tire casings and causing failure.)

This procedure of spraying the tire and gear would not be recommended as a standard operation but would be used only on those occasions when a third or subsequent mission is required without time for normal air cooling on the ground. It is objectionable because its continuous practice might cause excessive corrosion of the metallic parts and because, if the brakes have been used excessively and are very hot, brake damage might possibly result. It does appear reasonable, however, for occasional use.

Whether or not the tires cool enough for safe take-off can be determined simply by touching them. When they are cool enough to allow touching for a few seconds, they are cool enough for take-off. In addition, a warning indication is given to the pilot any time the brakes are heated enough to present a danger to the tires. Excessive use of the brakes during a landing would thus be indicated if it would endanger a subsequent flight. Or, a malfunctioning or dragging brake during take-off would be indicated to the pilot so he can slow down, extend his landing gear, and aerodynamically cool the gear and brakes.

A second possible solution involves varying the landing procedures so as to provide more time with the landing gear extended and cooled by air blast, which provides very rapid cooling. The landing gear may be lowered below Mach 0.6 and indicated air speeds of less than 300 knots. This condition is satisfied at approximately 15,000 feet when a normal descent is made. Under normal procedures about three minutes of gear down time is available, and the two mission limitation is based on that figure. By extending the landing gear for six minutes prior to each landing, three short turnaround missions may be safely flown and by extending the landing gear for approximately eight to nine minutes prior to each landing or fifteen minutes prior to every other landing a continuous series of short turnaround missions may be flown.

Finally, there is the possibility of using high temperature tires in the F-108. It is presently thought that the occasion for more than two short turnaround missions in succession will occur infrequently and therefore the spraying procedure first outlined is the most practical solution. Should, however, this situation be anticipated by the Air Force to occur more frequently than is presently envisioned, the use of high temperature tires may be preferable. The F-108 gear is designed to operate with high temperature tires. These tires, which incidentally are being planned for the B-70, will have a critical upper limit somewhere in the range of 350° to 500° F. If high temperature tires are used with the presently insulated wheel wells, five or more consecutive design long-range missions may be flown.