

# Interoperability of wildfire retardants – Current state of knowledge

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Two long-term retardant products have recently been added to the U.S. Forest Service’s Qualified Product List (QPL)<sup>1</sup>. Anecdotal evidence from field trials suggest that interoperability issues may exist between existing and new retardant products available for use in fixed-wing aircrafts. This InfoNote intends to present the current state of knowledge on this topic.

## Introduction

Perimeter Solutions have been the main manufacturer of QPL-approved retardant products used in fixed-wing aircrafts in recent decades. Current products include Phos-Chek MVP (dry concentrate), Phos-Chek 259 (dry concentrate), Phos-Chek LC-95A (wet concentrate), and Phos-Chek LCE20 (wet concentrate). Recently, Fortress Fire Retardant Systems’ two<sup>1</sup> long-term retardant products – FR-100 (dry concentrate) and FR-200 (wet concentrate) received a ‘Fully Qualified’ status on the QPL (U.S. Forest Service 2022). During the pursuit of a ‘Fully Qualified’ status, anecdotal evidence suggested that two retardant products (LC-95A and FR-100) were unable to be used together due to instances of disruption to normal aircraft operations ([SAFECOM #21-0664](#)) and extensive maintenance and cleaning requirements ([SAFECOM #21-0507](#)). Questions regarding interoperability and corrosion have been brought up and by proxy, extended to other products belonging to the respective manufacturers. This InfoNote aims to collate the current state of

information on the interaction of the two retardant product families (i.e., Phos-Chek vs. Fortress).

## Issue of interoperability

The current issue of interoperability is two-fold – (1) co-mingling, and (2) corrosion of the retardants. These issues arose during the Operational Field Evaluation (OFE) when an aircraft that was using FR-100 reloaded at a different tanker base with LC-95A. The interaction of the two products – i.e., ‘co-mingling’ resulted in a precipitation of thick residue that posed significant maintenance and cleaning challenges. Details and pictorial evidence are presented in *Clark L., et al.* (2021). The co-mingled precipitate resulted in the seizing of actuators, rendering the aircraft inoperable. Further disassembly and inspection of different components such as end cap guide bolts, mount screws, and cylinder shafts suggested incidence of corrosion to varying extents. This issue was found to occur only when the two products interacted and was absent when the products were used in isolation.

## Industry and regulator response

Due to the safety and financial risk involved, a group of airtanker vendors wrote to the U.S. Forest Service Chief wherein the concern of “dynamics of mixing current retardant products with Fortress FR-100” was highlighted, citing potential for corrosion, issues with product consistency, and chemical reactions with unknown byproducts. In response, the U.S. Forest Service updated the QPL with a bolded footnote that reads:

<sup>1</sup> At the time of writing this report, a third Fortress product (FR-105M) has received ‘Conditionally Qualified’ status. This product was not a part of the studies referenced in this document and therefore has been excluded from this InfoNote.

*“CAUTION: When switching between Fortress and Phos-Chek products, rinsing the tank and outside of the airtanker is required. Cross-mixing of these products may increase maintenance time and cleaning.”*

## More questions

The interoperability issue with LC-95A and FR-100 has resulted in more questions on the product families (Phos-Chek vs. Fortress). The following are some of the more prominent questions:

1. Does the comingling issue arise when other Phos-Chek and Fortress products are mixed?
2. What is the underlying cause of the precipitation of solid residue when the products are mixed?
3. If corrosion occurs, under what circumstances does it occur and what is the underlying cause?

## Existing literature

To date, several entities have pursued answering some of these questions. However, given the sensitivity around the subject, little has been publicly disclosed. The current prominent source of information comes from Fortress in the form of a technical report (*McLellan and White, 2022*) in response to the issue of interoperability. The report addresses both comingling and corrosion of the two retardant product families. The following are highlighted findings from the analysis:

### Comingling test results

- Mixing FR-100 and FR-200 with LC95A-Fx should be strictly avoided due to precipitation formation/coagulation
- Mixing FR-100 and FR-200 with MVP-Fx was found to cause no coagulation
- LCE20-Fx and 259-Fx were not tested. MVP-Fx was suggested as a suitable proxy for LCE20-Fx and 259-Fx, based on retardant formulations

### Corrosion test results

- 90-day uniform corrosion studies of comingled products were within QPL’s FS 5100-304d specification. Note, only analogous products were comingled in this test (dry concentrate products tested together and wet concentrate products tested together)
- 10-day uniform corrosion studies tested both analogous and non-analogous products. Corrosion rates were extrapolated to compare data to U.S. Forest Service’s 1-year corrosion data. Results were estimated to be in accordance with FS 5100-304d specification

Further information related to comingling ratios and specific data can be found in the report.

Note: The author has not validated any of the data presented in (*McLellan and White, 2022*).

## Conclusion

Current literature suggests that comingling of FR-100 and FR-200 will result in precipitation/coagulation and must be strictly avoided. Further testing is required to definitively comment on LCE20 and 259 and their associated potential for comingling and corrosion. Current literature also suggests corrosion caused by comingled products are estimated to be within the FS 5100-304d specification. Given the anecdotal evidence of corrosion of some aircraft components in *Clark L., et al. (2021)*, further studies may be required to better understand its cause.

It is expected that further guidance will be provided by the U.S. Forest Service on how to proceed with the interoperability of the two retardant products in the near future.

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## References

U.S. Forest Service. *Long-term retardant for wildland fire management*. 2022. Accessed on December 5, 2022 ([https://www.fs.fed.us/gov/fire/wildfire/documents/2022-0905\\_spl\\_ref.pdf](https://www.fs.fed.us/gov/fire/wildfire/documents/2022-0905_spl_ref.pdf)).

Clark, L., Noordemeer, C., Martin, J., Belozer, Janine., Casavan, Leslie. *Fortress FR-100 retardant - Documentation of aviation safety-related concerns when co-mingling with Phos-Chek LC95* (2021).

McLellan, J., White, M. *Analysis of commingling between magnesium chloride-based and legacy ammonium phosphate-based long-term fire retardants* (2022).

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