THE GLIDING FEDERATION OF AUSTRALIA INC.

GFA AN 175
(ISSUE 3)

AIRWORTHINESS ADVICE NOTICE.

SUBJECT: **ENGINE COMPARTMENT FIRE CONTAINMENT AND RETARDATION.**

TYPES AFFECTED: All self launching and power assisted sailplanes, fitted with 2 stroke, 4 stroke, rotary and jet engines. This includes Experimental and Light Sports Aircraft.

REFERENCES: GFA Airworthiness Directive AD 687 (as amended)
GFA Engineering Order MB18-12-1 (as amended)

BACKGROUND: This AN outlines aspects and considerations for the containment and the retardation of engine compartment fires, endeavouring to provide sufficient time for appropriate pilot action to be taken.

Issue 2 of AD 687 moves GFA Engineering Order MB18-12-1 to AN 175 Issue 3. The attached Engineering Order **is advisory despite the use of the word 'mandatory'**, but is highly recommended and should be considered.

(1) A BRIEF HISTORY:

Over the past 3 decades, in Australia and worldwide, there have been numerous powered sailplane fires both in flight and on the ground. In addition, many instances have been found of potential fire hazards in the form of fuel leaks, oil leaks and deficient exhaust systems. Instances found of fires starting, then self-extinguishing. Adding to the mix are some powered sailplane types that may not fully meet the fire protection standards set by OSTIV, LSFM, JAR, and CS when originally certified. The following extracts from accident reports highlight the need for adequate fire containment and retardation. This also emphasizes the need for engine and systems maintenance to be of the highest possible standard. The GFA powered sailplane fleet is aging and that contributes to the potential for fire.

(1-1) GERMANY 2018 This Stemme suffered an in-flight fire in the circuit, managing to land on the aerodrome before the fire rendered the sailplane uncontrollable.

The fire started in the engine bay and eventually spread to the rear fuselage burning it through, collapsing the structure after landing. If that had occurred while negotiating a landing, all or part rudder and elevator control would have been lost.

ISSUED:

CHIEF TECHNICAL OFFICER

For and on behalf of:

THE GLIDING FEDERATION OF AUSTRALIA Inc.

In this case the fire had not spread forward, into the cockpit area before landing.

The crew were unharmed, having sufficient time to land and exit the sailplane. A similar occurrence with a Stemme in Australia in 2006 was unfortunately fatal to 2.

(1-2) AUSTRALIA 2018 This ASH25E is seen in flight with fire coming from the wheel bay and the rear end of the engine compartment. It is probable, but not proven, that the rear fuselage burnt through, causing loss of control, prior to ground impact. Fatal to one.

(1-3) AUSTRALIA 2014 This Ximango suffered an engine oil leak, resulting in an engine compartment fire which was able to spread to the fuselage and cockpit. The pilot was fortunate to ditch into a lake suffering minor injuries.

An extract from the accident report:

"Shutting down the engine had no appreciable effect on the fire, which by now had started to breach the cowling on the upper right rear where the oil tank inspection hatch is located."

Had the fire been better retarded and contained in the engine compartment the pilot may have had more time and less drama to resolve the situation. The fire also badly burnt the underside of the fuselage back to well behind the wing root.

This photo of the burnt engine compartment shows the extent of the damage. The Rotax 912 engine coolant hoses totally burnt, but the fire-resistant sleeving over the fuel hoses stopped them burning.

With some of the aluminium parts in the engine compartment melted the temperatures would have exceeded 700 C.

The full details of this accident are available on the GFA website: Operations: Occurrences 2014.

(2) FIRE PROTECTION STANDARDS

When a new powered sailplane type is certified it must meet the requirements of "Design Standards." Currently, that is the EASA publication: **"Easy Access Rules for Sailplanes and Powered Sailplanes (CS-22) (Amendment 2)."** Historically, the GFA fleet has been certified since the sixties under a range of standards, OSTIV, BCAR, LFSM, JAR-22 and CS-22, ALL of which have detailed almost identical fire prevention, containment and retardation requirements, reflecting decades of experience. The following extracts from, CS-22, show what has been in place since 1969, detailed in all Powered Sailplane Airworthiness Design Standards, issued over that period.

CS 22.1193 Cowling and nacelle

(c) Cowling must be at least fire-resistant.

(d) Each part behind an opening in the engine compartment cowling must be at least fire-resistant for a distance of at least 600 mm aft of the opening.

(e) Each part of the cowling subjected to high temperatures due to its nearness to exhaust system ports or exhaust gas impingement, must be fireproof.

CS 22.1191 Firewalls.

(b) The firewall or shroud must be constructed so that no hazardous quantity of liquid, gas or flame can pass from the engine compartment to other parts of the sailplane.

(c) The firewall and shroud must be fireproof and protected against corrosion. (See AMC 22.1191 (c))

NOTE: Under 1093 C for 15 minutes conditions, an exposed section of a firewall will glow red hot, causing ignition to anything flammable, attached to, or within 25 mm of the rear face, on the cockpit side.

NOTE:

Fireproof means	……	1093 C for 15 minutes exposure.
Fire Resistant means	…...	1093 C for 5 minutes exposure
Melting point of Duralumin	…...	670 C
Reference:	……	FAA AC20-135

(3) ENGINE INSTALLATIONS OF CONCERN

There are a wide variety of engine installations, these are some examples:

TYPE A: Engine fully extended. The engine bay can be saturated with oil and fuel over time. Fire retarding paint is needed over all internal surfaces, including the insides of the access doors. Possible penetration of fire into the rear boom should also be considered. Small jet engines are known to spit fuel unburnt and burning, during failed starts, which can be a major fire hazard.

TYPE B: A fully buried engine.

History shows that this installation will be subject to more fuel, oil and radiator fluid saturation over time and more likely to have a fire event. Full internal coverage is needed, including the inside of the access doors. Cleaning the soaked internal structure can be extremely difficult.

Possible penetration of fire into the inside of the fuselage rear boom should also be considered.

TYPE C: **Touring Motor Glider (fiberglass).** A fire in this compartment is an immediate threat to the cabin occupants from both heat and noxious fumes, which will be exacerbated if raw FRP and internal upholstery become ignited. The engine cowls must be internally treated to stop the cowls igniting. The firewall must be fireproof and the external surface of the fuselage immediately behind the cowl flap exit should be coated to prevent ignition by flames exiting through the cooling exit duct. The underside of the fuselages of these types of powered sailplanes are notorious for being left with uncleaned layers of oil and dirt.

TYPE D: Motorfalke / RF4 / RF5 / Ask 14 and similar types. (Fabric covered fuselages)

This family of powered sailplanes are fabric covered timber and tube steel structures. The area indicated by yellow arrows behind the bottom cowl cooling air outlet is fabric covered, including the wheel fairing.

All of that fabric area can become fuel, and oil saturated and exhaust damaged making it highly flammable.

The fabric covered areas marked by the red arrows are vulnerable to fire spreading from the cowls. The standard of: *"600 mm rear of cowl openings"* for the application of fire retardant paint should be followed here and is one of the ORIGINAL configurations prompting the standard.

(4) FIRE RETARDING PAINT DEFECTS

Fire retarding paint is intended to shelter and protect flammable material preventing its ignition. However, if the paint flakes off or is damaged, then the protection is removed, and fire can progress.

STEMME COWL DETERIORATION.

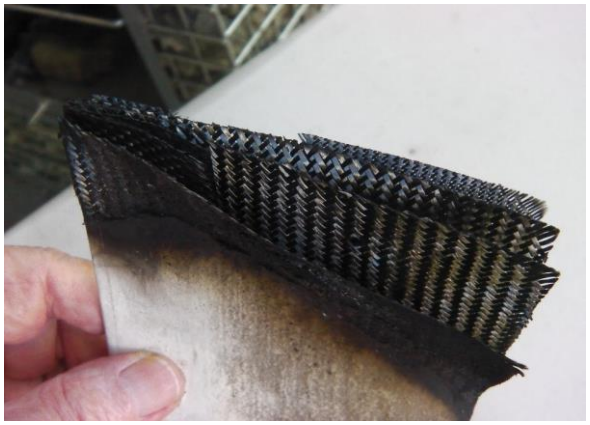
This is an example of deteriorated paint, which would be ineffective in the event of a fire:

This photo shows a Stemme engine cowl with peeling fire retarding paint, leaving the composite structure exposed to flame should a fire occur. The fire would spread behind the fire retarding paint to burn the structure. This typical deterioration can be found on the cowls and in rear fuselage compartments of all sailplane types.

NOTE: The only way this problem can be rectified is to remove the flaking paint **completely** and re-paint with an **approved intumescent paint** product. “Repairing” by overcoating the flaking paint will not ensure protection. The new Intumescent paint must be securely attached to the surface it is protecting.

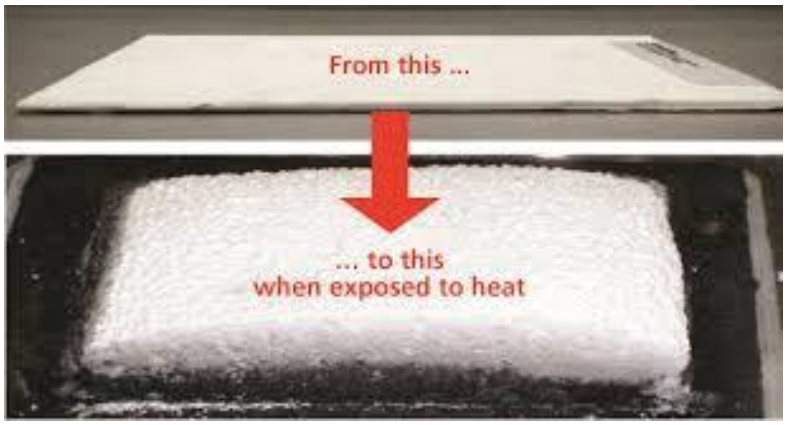
(5) BURNT EPOXY / GLASS COMPOSITE

This photo shows how our composites burn. The Epoxy resin is totally burned out, leaving the glass fabric (or carbon) intact. The structure has no strength and no stiffness. The paint under the thumb is original “Fire Resistant,” applied by the German manufacturer. The fire has worked itself behind the paint to burn the resin.



(6) INTUMESCENT PAINT

A PAINT COVER WHICH, WHEN HEATED, EXPANDS UP TO 50 TIMES ITS OWN THICKNESS, THEREBY SHELTERING THE MATERIAL IT IS COVERING, FROM HEAT AND COMBUSTION, UP TO 1093 C FOR EXPOSURE TIMES EXCEEDING 15 MINUTES.



POLICY:

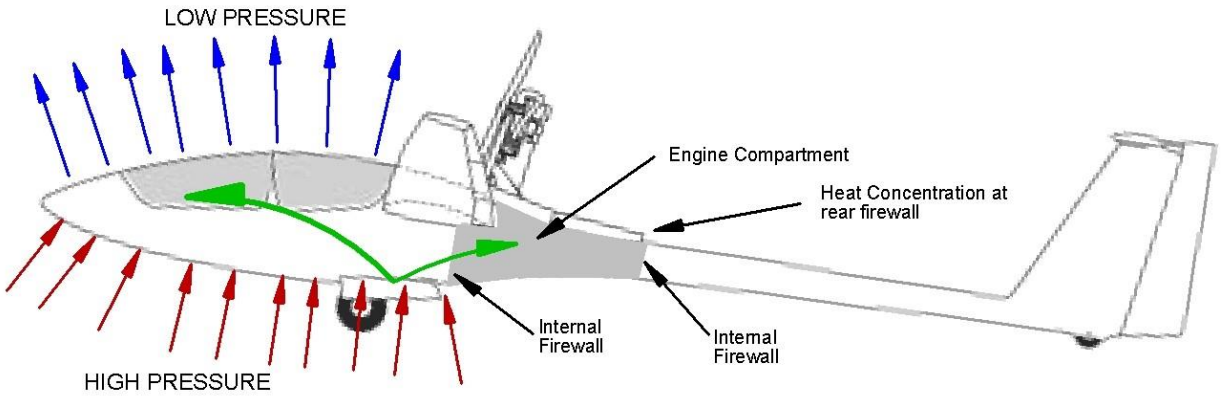
There are numerous brands of Intumescent paint on the Australian market with strong emphasis now on it being used for fire protection under bush fire conditions.

Intumescent products approved by GFA for powered sailplane application are the result of consultation with manufacturers and the product having a history of aviation use.

(7) CONSIDERING AIRFLOW

Aircraft fly simply because they create low pressure above and high pressure below the aircraft. The differential in pressures not only creates airflow around the outside of the sailplane but can induce quite strange airflows INSIDE the sailplane.

(7-1) TYPICAL REAR ENGINE

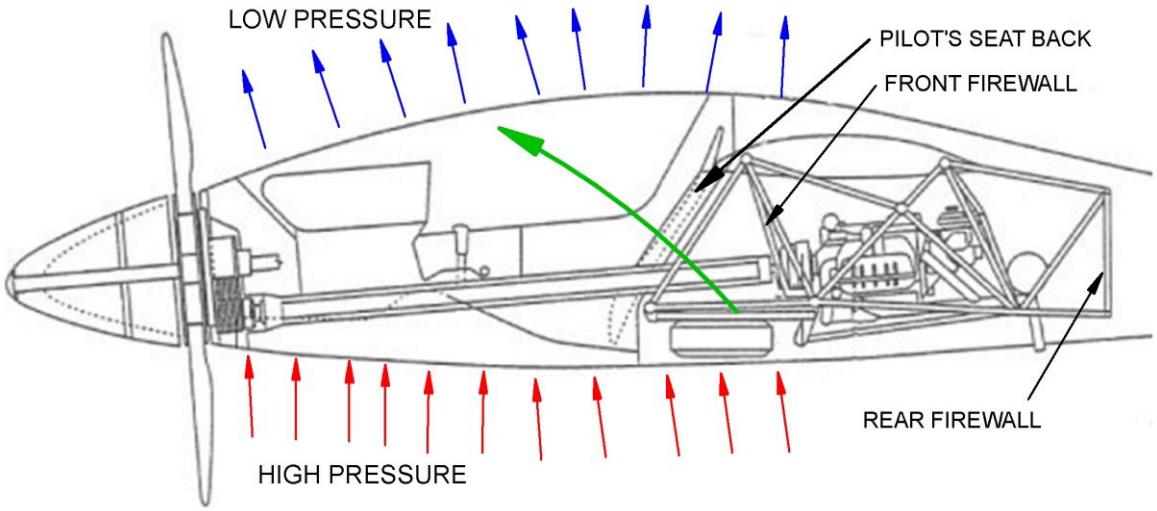


This diagram shows an ASH 25E in roughly a thermalling attituted.

(1) The high pressure air under the fuselage will tend to be drawn towards the cockpit by the low presssure along the top of the canopy.
(2) There is low pressure over the engine compartment tending to also draw air from the high pressure area.
(3) The front firewall stops air flow into the engine compartment.
(4) IF the front firewall is not fitted or is not sealed, the movement of air will create a "blow Torch" affect on any fire in the engine compartment.

(7-1) STEMME AIRFLOW

The Stemme fuel system is entirely located in the undercarriage bay ahead of the engine. Any fuel leak has the potential of spreading rearwards into the engine compartment resulting in fire. The pressure differential induces airflow from the undercarriage bay **forward into** the cockpit taking with it any fumes, smoke, even fire, should it occur in the undercarriage bay.



(8) PILOT REMEDIAL ACTION

When a pilot becomes aware of an engine fire, in front or behind, the first series of actions that must be taken are to stop feeding the fire with fuel and air and close off any possible entry of smoke or fumes into the cockpit. Fumes from burning FRP are very potent and quickly debilitating.

"In Case of Engine Fire" instructions found in most Powered Sailplane flight manuals are to be adapted into a placard and installed in the cockpit in full view of the pilot/s. This is an example taken from the Dimona H36 flight manual:

ENGINE FIRE DURING FLIGHT

Throttle -	FULL POWER
Fuel Valve -	OFF
Cabin Heat -	PUSH
Cabin air -	PUSH
Ignition -	OFF when engine Stops

Slipping the aircraft can keep smoke and flames from the cockpit

Where there are no manufacturer's instructions, a placard can be modelled like this example.

Where Cowl Flaps are fitted, they should be **CLOSED** to contain the fire and reduce airflow through the engine compartment.

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ENGINEERING ORDER ….. MB18-12-1 Issue 1

(Prepared in accordance with GFA DAPM issue 5)

GFA PROJECT No 2018-9

SUBJECT:	Application of Fire Retardant Intumescent Paint.
APPLICABLE TO:	All self launch and sustainer powered sailplanes, including Experimental. Not applicable to electric drive and Light Sports Aircraft.
PREPARED FOR	Gliding Federation of Australia Inc**.**

All work performed under this engineering order is to be done in accordance with good aeronautical practice and where necessary comply with the GFA Inc. Manual of Standard Procedures Part 3 (current issue) and all of that document's subsidiary publications and references. Persons carrying out this work program must be appropriately authorized by the GFA Inc. On completion of the modification a hard copy or electronic copy of the approved Engineering Order is to be lodged with the sailplane's maintenance records.

(1) GENERAL

This Engineering Order supports GFA Airworthiness Directive AD 687 by outlining and authorizing the application to and maintenance of, **Intumescent Fire Retardant Paint** (**IFRP**) in powered sailplane engine compartments and surrounding external structure where piston, rotary and jet engines are housed. The purpose is to slow down a developing fire's rate of progression by shielding flammable, exposed structure, providing the flight crew with more **time** to react to the emergency. GFA AD 687 details **Mandatory** requirements, however, this Engineering Order also has recommended procedures which the Registered Operator should seriously consider. Please refer to engine compartment, fire discussion material in GFA AN 175, to appreciate the importance of fire containment and retardation.

1-1 REFERENCES

Appendix A	Ff88 data and application instructions.
Appendix B	Treatment of firewalls**.**
Appendix C	Requirements for specific powered sailplane types.
Appendix D	Cockpit placarding.
Appendix E	Miscellaneous Information
CS-22	Specifies fire protection requirements.
GFA AN 175	Discussion material.
GFA AD 278	Re-finishing inspections.

(2) APPROVED PAINT PRODUCTS

2-1 **Firefree 88** Originally formulated by the Boeing Aircraft Company for aviation use, now manufactured by Firefree Coatings Inc. USA.
For supply initially contact: Mike Burns **mike38burns@gmail.com**

Ff88 must be handled, stored and applied in accordance with the maker's requirements as detailed in Appendix A.

2-2 Other Intumescent paint products may be added to this EO as experience is gained.

2-3 The original fire retarding paint used by the powered sailplane manufacturer or their approved alternative, is automatically accepted, but must be applied in accordance with its manufacturer's approved application instructions.

(3) REPLACING DETERIORATED FIRE RESISTANT PAINT

The aim is to comply with CS-22 and previous Design Requirements:

CS 22.1193 Cowling and nacelle

(c) Cowling must be at least fire-resistant.

(d) Each part behind an opening in the engine compartment cowling must be at least fire-resistant for a distance of at least 600 mm aft of the opening.

(e) Each part of the cowling subjected to high temperatures due to its nearness to exhaust system ports or exhaust gas impingement, must be fireproof.

The following instructions are for GRP, CRP and Duralumin front engine cowls, rear fuselage located engine bay linings and external airframe surfaces, that have been found to have deteriorated, flaking or missing protective paint coverage.

The following instructions (3-1 to 3-5) apply irrespective of the type of Intumescent Fire Retarding Paint to be applied.

3-1 INSPECTION

The structure to be re-finished must be inspected for prior radiated heat damage. It may be necessary to repair the damage after cleaning and before re-coating. In most cases that will be a GRP or CRP repair following the sailplane manufacturer's or GFA repair procedures. The inside surfaces of some engine cowls are fitted with shielding material indicating that radiated heat hot spots are developed by the proximity of exhaust systems. That shielding is to be removed and retained where practical for re-installation after re-finishing. Ref: Appendix E. Exhaust systems must be inspected for lagging condition, if found unserviceable, it must be renewed.

3-2 CLEANING

It is essential to de-grease thoroughly before any other action is taken to prevent contaminates being forced into the surfaces. Where prior soaking of the structure with petrol, oil, diesel, jet A1 or coolant has taken place, removal may be extremely difficult.

3-3 SURFACE PREPARATION

All of the original protective paint is to be removed.

The full effectiveness of a new paint cover will only be realized if it is securely adhered to the surface it is expected to protect. Historically, some production paints were found to be water soluble. Care must be taken not to damage the underlying structure. A final surface roughness equivalent to 60/80 grit paper will assist the **IFRP** to lock onto the GRP and CRP surfaces. For aluminium alloy surfaces, cleaning is to be followed by the application of a Zinc Phosphate etching primer to give the **IFRP** grip.

3-4 APPLICATION

The paint manufacturer's and the sailplane manufacturer's application instructions must be complied with, requiring the Registered Operator to source that information.

3-5 RE-FINISHING INSPECTION

Where full removal of the original finish is required, a second inspection in accordance with GFA AD 278 (as amended) is required to verify structural integrity before the new paint is applied.

(4) APPLICATION OF Ff88 FIRE RETARDANT PAINT

4-1 APPLICATION

All of the surface preparations, detailed in Section (3) apply to Ff88. The Ff88 manufacturer's instructions shown in Appendix A must be followed where applicable**.**

4-2 DRY FILM THICKNESS

For effective protection, a finished dry film thickness of 1.00 mm must be created. That is a wet thickness of 1.5 mm. Use of a wet thickness gauge, easily made by the operator, is recommended. In most cases, this will require 2 to 3 coats to be applied. Using 1.5 mm multiplied by the area to be finished in square mm and dividing by 1,000,000, provide the approx. volume of Ff88 needed in litres.

4-3 CURING.

Being water based, Ff88 will cure slowly. Touch dry will take up to 6 hours, full hardness taking up to 14 days depending on the ambient conditions. (Ref Appendix A)

4-4 OVER COATING

Internally applied Ff88 need not be over coated, but over coating will stop long term oil and fuel contamination. On external surfaces, a covering will stop degradation from exposure to hot air, exhaust gas, moisture, oil and fuel. Good quality Acrylic paint is recommended by the Ff88 manufacturer.

4-5 REPAIRING Ff88

Where Ff88 becomes damaged, (NOT flaking or lifting) it can be repaired by extremely thorough cleaning, then sanding the area with 100 grit paper, not Silicone. Applying enough layers to bring it back to its correct thickness. Observe the drying and cure times in (3-6).

(5) POST RE-FINISHING EVALUATION

Intumescent properties will be activated when the surface temperature passes 350F (177C). Where there is proximity to exhaust systems that temperature may be exceeded during ground running or full power climbs at the best rate of climb speed. High ambient temperatures may also have an influence. After curing, powered sailplanes with forward mounted engines or rear buried engines should be ground run-up to engine temperature limits, and the cowls and engine compartments inspected for heat radiation effects. If signs of excess heat radiation are found, then either exhaust pipe lagging may be needed or heat reflective, fire resistant, material installed in the affected areas. (Ref: Appendix E). The use of stick on recording temperature labels is recommended. (Ref: Appendix E)

(6) EXTERNAL AIRFRAME PROTECTION

Reference: ***CS 22.1193:*** *(d) Each part behind an opening in the engine compartment cowling must be at least fire-resistant for a distance of at least 600 mm aft of the opening.*

This photo shows a typical engine cooling air outlet on the bottom engine cowl. These can be either adjustable cowl flaps or fixed outlets.

To protect the bottom of the fuselage from ignition, **IFRP** is to be applied to the surface aft of cowl outlets for at least 600 mm aft and 100 mm wider than the outlet opening, each side, to cover the contingency of Side Slipping as part of pilot emergency procedures. (Ref: Appendix D and Appendix B (D))

6-1 SURFACE PREPARATION

The underside fuselage, aft of the cowl outlet may be heavily contaminated with oil requiring significant cleaning. The original finish need not be removed back to the structural surface if it is gelcoat and there are no signs of flaking or peeling. However, a paint finish may not provide grip making full removal necessary. A surface finish equivalent to 60/80 grit paper is needed to secure the **IFRP**.

The implementation details in Sections (3) and (4) apply, particularly Item 3-5.

(7) WEIGHT and BALANCE

Normally, there will be a small weight loss or gain created by the finish removal and replacement. Weighing engine cowls before and after and weighing Fire Blankets before installation, will assist a person holding a GFA Weight and Balance Authority, to make an assessment and provide a log book entry with new cockpit load limitation placards if required.

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(8) LOG BOOK ENTRY

On completion of the re-finishing and satisfactory evaluation, a log book entry is to be made by a person authorized by The Gliding Federation of Australia Inc confirming full, or partial compliance with this Engineering Order. The **Batch Number** of Ff88, if used, must be included in the log book entry.

(9) DESIGN APPROVAL

DESIGN APPROVAL

Engineering Order MB18-12-1 (issue 1 pages 1 to 10) is Design Approved

Pursuant to CASAR 22.437

Signed:…….M. P. Burns..... M P Burns ARN 524173 Date: 8/3/2019…..

APPENDIX A Ff88 Manufacturer's Instructions.

These Instructions are for Industrial and Construction applications, to be read in conjunction with Section 4 of this Engineering Order, which has precedent for Powered Sailplane application.

FIREFREE 88®

Firefree 88®, a premium quality, water based, nontoxic, intumescent fire resistant coating

APPLICATIONS INSTRUCTIONS

FIREFREE 88®

FF88® coating is a water based product, it is important to take into account the Firefree 88 coating is not a standard decorative paint, but a specialized intumescent fire resistant protective coating.

SURFACE PREPARATION

All surfaces to be coated must be clean, cured, firm, dry and free of dust, dirt, oil, wax, grease, mildew, loose flaking paint, efflorescence or any other contamination or condition that would adversely affect the performance of the coating. Etch or prime (with a latex primer or fast dry oil base primer/sealer) glossy, glazed or dense surfaces. Always prime oil based finish coatings with an oil based fast dry primer/sealer. Fill holes and surface irregularities with a suitable patching compound to match surface profile. Spot prime all patched areas with appropriate primer. Metal surfaces must be free of rust.

MOISTURE

Measure the moisture content of surfaces using a moisture meter. Do not apply material unless the moisture content is below the following maximums: Concrete 15%, Wood 17%. Do not commence work until all such defects have been corrected.

TEMPERATURE

Do not apply FF88® if air temperature is below 50°F (10°C). Air circulation is important. If the coating is applied below 50°F, it may take the coating longer to be fully dried and consequently will interfere with the curing between coats In addition, it could cause the intumescent coating to sag.

HUMIDITY

We don't recommend applying the coating if relative humidity exceeds 75%. In humid conditions it may take 4 to 6 hours to dry. MAKE SURE THAT PAINT IS COMPLETELY DRY BEFORE APPLYING THE NEXT COAT. If the paint runs let it tack then use a brush or roller to feather it out. If you need to sand FF88® use 100 grit sandpaper.

PERSONAL PROTECTION

Use personal protective clothing, including safety glasses to prevent any particles of paint from entering the eyes. Protective gloves are recommended for prolonged contact exposure. Respiratory protection is not required; however, make sure plenty of ventilation is allowed when sanding or spraying. Protective half mask can be used when painting to prevent breathing paint dust, particles from entering the lungs.

RECOMMENDED EQUIPMENT

Application Method: S-Spray, B-Brush, R-Roller, DO NOT THIN FIREFREE 88. If you need to strain FF88® only use a gauze the size used in fly screen doors.

SPRAY-AIRLESS: Capable of a pressure range of 780 to 3300 psi

TIP: .017 to .023 heavy duty 4" to 12" fan width recommended.
Reduction: Do not thin. Firefree 88 can be stirred with a paint wood-paddle (this is the similar procedure like paint). Apply at can consistency. Use of airless sprayer is recommended (use of a dedicated spray line is required)

ROLLER: Use a 1-1/4" (20-25mm) nap synthetic cover for heavy application (or others depending on finish). A short nap roller can be used but this may result in a slight textured finish.

BRUSH: For brush application, a nylon/fully loaded brush should be used. A laying on technique will reduce the brush marking.

WET FILM THICKNESS (WFT)

Always use a wet mil film gauge to measure each wet coat application. Each coat application can be built up to different levels of wet mil thicknesses using multiple passes of coating with an airless spray gun, brush or roller. To use the gauge, insert the teeth into the wet basecoat. The last tooth to be coated indicates the thickness achieved. It is important to ensure that the wet film applied is of sufficient thickness to give the required dry film thickness.

DRY FILM THICKNESS (DFT)

The dry film thickness to be applied will be recommended by Firefree and will vary upon:

- the assembly make up
- the material/substrate being coated; and
- the fire rating being required.

The dry film thickness recommended by Firefree needs to be precisely complied with for adequate performance, thus during application, the wet film thickness should be checked using a wet film thickness gauge.

The ratio of wet film thickness to dry film thickness is 1.5. Thus for every 1 mil of dry film thickness, 1.5 mils of wet thickness should be applied. The final dry film thickness should also be verified per inspection below.

CURING

This process takes full effect when the coat (s) reached proper hardness. For example, oil paint takes 7-10 days to fully cure; whereas, water based products could take up to a 14 days period to reach optimum hardness. This means that every coat will have a drying time and a curing time.

COVERAGE

The recommended dry film thickness will determine the coverage rate. There is no set coverage rate that applies to all assemblies. The coating is made up of 67% solids and thus, on average, the ratio of wet thickness to dry thickness is 1.5 to 1. Any consideration for quantity and waste or overspray is the sole responsibility of the end user. Waste factor will depend on the method of application (brush, roll or spray), job site conditions and other factors and should be based on the applicators experience

MAINTENANCE

Surfaces which have been coated with FF88® should be protected from abuse and abrasion. Damaged surfaces should be repaired and FF88® should be reapplied to the original specified dry film thickness to maintain specific rating.

CLEAN UP & SAFETY

Wash brushes, rollers, spray guns & pumps and other painting tools in COLD clean water promptly after painting. Clean and remove any dried product (in the U.S. we suggest "Goof Off"). Use all products completely or dispose of properly. Local disposal requirements vary; consult your sanitation department or state-designated agency for more information on disposal options.

Use only with adequate ventilation. Do not breathe spray mist or sanding dust. Avoid contact with eyes and prolonged or repeated contact with skin. Wear eye protection and or gloves during application or sanding. A dust/particulate respirator approved by NIOSH should be worn when sanding or spraying. Close container after each use. First Aid: If you experience difficulty breathing, leave the area to obtain fresh air. In Case of Spill: Absorb with inert material and dispose of as specified under "CLEANUP".

STORAGE & TEMPERATURE

FF88® cannot be exposed to freezing temperatures. It is important to maintain storage temperatures above the freezing point. FF88® should be stored at recommended temperatures between 50º F to 85ºF (10ºc to 29ºc).
Expected shelf life: (2) years from the date of manufacture (DOM). Product must be kept at recommended storage conditions and in original unopened containers.

ABOUT THE COMPANY

FIREFREE Coatings, Inc is a privately owned company based in California. FF88® has been tested and listed by FaM Approvals; a division of FM Global, classified by Underwriters Laboratories and accepted by NY Material and Equipment Acceptance (MEA) Division. Firefree Coatings Inc tests its products at accredited third party IAS www.iasonline.org fire testing laboratories.
Address: 580 Irwin St., Suite 1, San Rafael, CA 94901
Toll Free: 888-990-3388 • 415-459-6488 • fax 415-459-6055
www.firefree.com

APPENDIX B Treatment of Firewalls.

The aim is to comply with CS22 and previous Design Requirements.

CS 22.1191 Firewalls.

(b) The firewall or shroud must be constructed so that no hazardous quantity of liquid, gas or flame can pass from the engine compartment to other parts of the sailplane.

(c) The firewall and shroud must be fireproof and protected against corrosion. (See AMC 22.1191 (c))

NOTE: Under 1093 C for 5 or 15 minute conditions, an exposed section of a firewall will glow red hot, causing ignition to anything attached to, or adjacent to, the rear face, on the cockpit side.

FIREWALL CONFIGURATIONS

(A) **A normal front engine firewall** with nothing attached to it on the cockpit side. This does not need the application of **IFRP** to the front face.

(B) **A front engine firewall with upholstery** attached on the cockpit side. This needs **IFRP** to be applied to the front face or the upholstery removed. If it is deemed necessary to have sound or heat insulation on the cockpit side of the firewall, the use of a 1000C rated Fire Blanket under the insulation is acceptable. The insulation or upholstery itself should be treated with a fire-retardant spray. (Ref: Appendix E-3)

(C) **A front engine firewall fitted up against an non fire retarded, FRP structural bulkhead** on the cockpit side, must have **IFRP** applied to the front face to prevent ignition of the FRP.

IMPLEMENTATION

1. The implementation details in Sections (3) and (4) fully apply.
2. The front engine firewall will be made of mild steel or stainless steel. Steel type must be determined to allow a suitable etching compound to be applied before application of **IFRP**.
3. **For mild steel**. After careful cleaning and mild abrasion, a good quality steel metal primer will provide a base for the **IFRP**.

4 **For stainless steel**. After careful cleaning, the application of a galvanized metal-etching primer, specifically for stainless steel must be used. No other type of primer will promote adequate adhesion and a base for the **IFRP**.

(D) **A firewall at the front and back of a rear, buried, or pop up, engine compartment,**

The front wall and rear wall of these compartments are classified as a **Firewall**. They must be Fireproof and sealed around the edges with heat resistant putty to stop fire and fumes moving into either the forward fuselage or the rear fuselage boom. If not made from mild or stainless steel they must be coated on the engine side with **IFRP**.

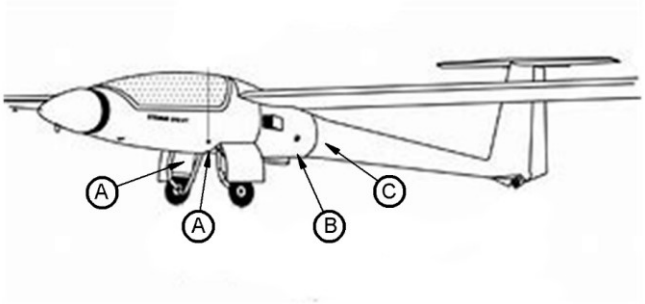
The area behind the engine compartment shown by the **black arrow** must be considered for **IFRP** coverage as discussed in Section (6)

APPENDIX C Specific Powered Sailplane Types

The powered sailplane types detailed in this appendix require specific treatment.

C-1 STEMME series.

History shows that the Stemme series has several potential "fire fronts" making the need for more widespread use of Intumescent paint to protect the cockpit and rear fuselage boom.



RECOMMENDED

(A) The entire undercarriage bay, including the inside of the undercarriage doors to be coated, with particular attention to the front wall isolating the cockpit. The front face of the firewall need not be coated.

(B) Consideration should be given to extending Intumescent coating into the rear fuselage boom.

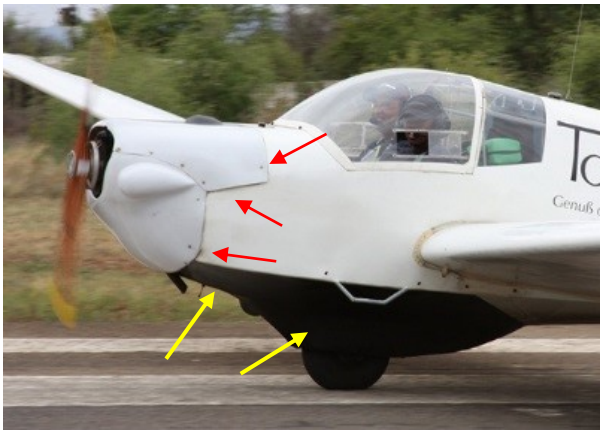
MANDATORY:

(C) All of the inside surfaces of the engine compartment cowling to be coated, including cowl flaps. The external, bottom fuselage surface, aft of the cowl flap exit opening, to be coated for at least 600 mm aft and 100 mm wider than the cowl flap each side.

IMPLEMENTATION

The implementation details in Section (3), fully apply.

C-2 MOTORFALKE / RF4 / RF5 / Ask 14 and similar series. (Fabric covered fuselages)



This family of powered sailplanes are fabric covered timber and tube steel structures. The area behind the bottom cowl cooling air outlet is fabric covered, including the wheel fairing. All of that fabric area can become fuel, oil and exhaust saturated making it highly flammable.

IFRP should be applied at least back to the centerline of the wheel and span sideways to each bottom longeron.

The fabric covered areas marked by the red arrows are vulnerable to fire spreading from the cowls. The standard of: "*600 mm rear of cowl openings*" for the application of fire retardant paint should be followed here and is one of the ORIGINAL configurations that prompted that standard.

The implementation details in Sections (3) and (4) fully apply.

C-3 IS28M2 / Vivat (Powered sailplanes with Alclad fuselage structures)

The underside of the fuselage immediately aft of the engine cowl flap is sheet Alclad which is not Fire Retardant, needing Intumescent paint coverage for protection.

C-4 POWERED SAILPLANES WITH PYLON MOUNTED ENGINES.

The engine is capable of dripping fuel and oil onto the fuselage structure at the base of the pylon. The inside of any engine cowling can be contaminated. This could be ignited. Each installation needs to be evaluated and if the application of Ff88 or other approved Intumescent paint can be applied to offset an event, then action should be taken.

APPENDIX D Placarding

"In Case of Engine Fire" instructions found in most Powered Sailplane flight manuals are to be adapted into a placard and installed in the cockpit in full view of the pilot/s. This is an example taken from the Dimona H36 flight manual:

ENGINE FIRE DURING FLIGHT

Throttle -	FULL POWER
Fuel Valve -	OFF
Cabin Heat -	PUSH
Cabin air -	PUSH
Ignition -	OFF when engine Stops

Slipping the aircraft can keep smoke and flames from the cockpit

Where there are no manufacturer's instructions, a placard can be modelled like this example.

Where Cowl Flaps are fitted, they should be **CLOSED** to contain the fire and reduce airflow through the engine compartment.

APPENDIX E Miscellaneous Information

E-1 Temperature Stick on Measuring Strips.

RS Components Stock No. **779-9776**

These strips are available from a range of suppliers. They can be stuck onto heat exposed areas and monitored over time to indicate if the radiated heat gets into the range selected, through a wide range of operating conditions.

E-2 Heat Resistant Sealing Compound.

3M™ Fire Barrier Silicone Sealant 2000

This product is sold for aviation use being used around firewalls to stop heat and fume penetration. Being Intumescent it offers the best protection.

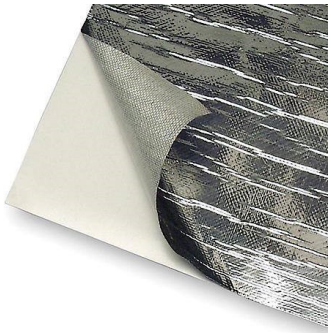
The data sheet must be sourced by the person using the product to ensure its application is in accordance with the manufacture's requirements.

E-3 1000 C Fire Blanket

Industrial welding blankets with a continuous rating of 1000C or higher can be used between a mild or stainless steel firewall and internal cockpit insulation or upholstery.

"Weld Guard" W740165 from BOC is an example.

E-4 Heat Reflective Tape.



To protect small, local areas of engine compartments subject to excessive radiated heat, reflective tape may be applied just large enough to cover the affected area.

"Reflect-A-Cool" and "Reflect-A-Gold" are typical examples of good quality automotive performance products.

Being "stick on," the area must be clinically clean for reliable adhesion.