NAFC
National Aerial Firefighting Centre

OPS-001
Firebombing Delivery Systems

Standard

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1 Background

Firefighting aircraft are required to be equipped with a delivery system approved for that aircraft type. NAFC Members approve each individual combination of aircraft type and delivery system through ARENA or during a tender evaluation.

Requirements of any contract take precedence over this Standard. Any exceptions to this Standard will be made at the absolute discretion of NAFC or a Member.

2 Approval Criteria

Firebombing delivery systems must be designed, fitted, and operated, in accordance with legislation.

Compliance with all requirements listed here will not necessarily result in approval. Approval of a delivery system by the United States Interagency Airtanker Board (IAB) may not result in approval in Australia.

Contractors may be required to provide certification from an independent authority of the maximum physical volume of water that may be carried in the delivery system. The aircraft must be reasonably capable of carrying this volume.

2.1 All Delivery Systems

Delivery systems must:

a) not compromise the airworthiness or controllability of the aircraft
b) enable the aircraft to operate safely
c) be capable of delivering water, foam, retardant, and water enhancing polymer gel solutions where approved for the aircraft type
d) be clean and free of chemicals, except those approved by Members
e) not require use of excessive personal strength or unusual aircraft attitudes to deliver the load
f) be robust, reliable, and as simple to maintain as possible
g) report event data to AFAMS in accordance with *NAFC Standard OPS-014 Tracking, Event Reporting, and Messaging*
h) be designed with redundant capability (such as manual drop) in case of primary delivery systems failure, where possible
i) minimise weight and drag
j) minimise leakage
    - Acceptable leakage losses are:

Aircraft / System Type	Full load, static test, 60 minutes	Full load, firebombing, 20 minutes
Fixed Wing Tank	<2 litres lost	<5 Litres lost
Rotary Wing Tank	<2 litres lost	<5 litres lost
Rotary Wing Bucket	<20 litres lost	<50 litres lost

k) achieve flow rates during testing with a full load of water of:

Aircraft / System	Minimum acceptable flow rate
Fixed Wing Tank	1,000 litres per second
Rotary Wing Tank	500 litres per second
Rotary Wing Bucket	500 litres per second

Flow rate is measured from the time the door starts to open to the time the substantive load has left the tank.

l) be capable of producing a standard drop (as defined below). Dispersal characteristics of water, various fire suppressant solutions, and retardant slurries are different.

A standard drop:

i. is conducted:

Parameter	Value
Drop door or valve	fully open or maximum setting
Aircraft height - Rotary wing	75 feet AGL
Aircraft height - Fixed wing	75 feet AGL or minimum safe height
Aircraft speed - Rotary wing	40 knots
Aircraft speed - Fixed wing	minimum safe drop speed
Terrain	flat
Conditions	ISA at sea level, nil wind.

ii. has the concentration of retardant or suppressant on the ground of:

Type	Minimum concentration
Retardant	0.81 litres / square metre
Suppressant	0.2 litres / square metre

iii. with a pattern (effective zone) that is:

- reasonably rectangular
- has no “striping” or gaps in coverage
- with a width variation no greater than + or - 20% along its length (e.g. a 15 metre wide pattern would have no areas narrower than 12 metres or wider than 18 metres)

- a distribution of retardant or suppressant that is as even as practicable, ideally with no greater variance than 20%
- a width of:

Aircraft / System	Effective zone width
Fixed Wing Tank	between 15 metres and 20 metres
Rotary Wing Tank	between 10 metres and 15 metres
Rotary Wing Bucket	n/a

For restricted loads, a reduction in width of effective pattern may be allowable to no less than 10 metres wide.

- for fixed wing aircraft - not less than 40 metres in length for a full load

iv. has little retardant or suppressant (ideally no more than 15%) outside the effective zone as possible

If over 500 litres capacity, delivery systems must also:

- be fitted with a suppressant chemical concentrate (e.g. foam and water enhancing polymer gels) reservoir and injection system that:
  - can inject a measured pre-set amount of concentrated chemical into the firebombing tank or bucket with an accuracy of plus or minus 5% of volume. (i.e. if set to inject 20 litres, the actual injection of concentrate is between 19.0 and 21.0 litres)
  - minimises the manual handling of heavy containers for on-board reservoir filling. A pilot-activated stand-alone electric pump drawing concentrate from containers on the ground is preferred. The fill point should be in view of the pilot.
  - can be operated by the pilot with a single-action button or switch
  - incorporates a means to mix the concentrate in the tank or bucket (e.g. a distribution manifold) without excessive foaming
  - includes suppressant concentrate reservoir with minimum capacity of:

Aircraft / Delivery system type	Minimum capacity as % of maximum water load
Fixed Wing - ground reloading	1.2%
Fixed Wing - self filling (scooping)	6%
Rotary Wing - with tank	5%
Rotary Wing - with bucket	6%

If over 1,200 litres capacity, delivery systems must also:

- have multi-drop / split load capability
- be operated by electrical, pneumatic, or hydraulic means (unless approved by the Member) that enable advance determination of the drop amount.

Aircraft Type	Minimum number of splits
Fixed Wing with tank < 3000 litres	at least two parts
Fixed Wing with tank > 3000 litres	at least four parts
Rotary Wing Type 2 and 3	at least two parts
Rotary Wing Type 1	at least four parts

Compartmentalisation may be an acceptable alternative to splitting loads if each compartment is capable of carrying:

Aircraft Type	Minimum volume per compartment
Fixed Wing Tank	1000 litres
Rotary Wing Tank	500 litres

2.2 Tank Delivery Systems

Unless approved by the Member, tanks must:

- be capable of restricted flow. If not continuously variable, at least four options should be available.
- have doors that operate quickly ("snap operation"), especially with split loads.
- have doors that close fully in flight when the tank is empty
- have effective venting without restriction, pulsing, or striping effects caused by negative pressure. Venting must prevent leakage.
- enable the pilot to determine in advance flow rate or coverage level
- activate the dump with a single-action button or switch, mounted on the control column, throttle quadrant, or cyclic.

2.3 Fixed-Wing Aircraft

Fixed wing aircraft tanks must:

- produce an adequate ground distribution of retardant
- be ground-filled without restriction through at least one external 80mm (“3 inch”) diameter “Camlock” male fitting. For Single Engine Air Tankers (SEAT) this fitting must be located on the left-hand side of the aircraft behind the wing, and have an integral stop valve with “on” and “off” positions clearly marked
- not contain plumbing, fittings, fixtures or other systems that measure less than 75mm internal diameter. SEAT must carry an approved adaptor fitting to reduce external filler port from the 80mm male “Camlock” to 50mm (“2 inch”) male “Camlock”.

2.4 Rotary-Wing Aircraft

With delivery system fitted, the aircraft must be capable of:

- achieving adequate ground distribution of retardant where possible
- a minimum cruising True Air Speed with the delivery system fitted:

Aircraft / System Type	Minimum TAS
Rotary Wing with tank empty tank, snorkel in filling position	100 knots
Rotary Wing with bucket full bucket on 30 meter long-line	80 knots

Tanked systems must be capable of being ground-filled without restriction through an external 80mm (“3 inch”) “Camlock” male fitting located in a safe position on the side of the aircraft.

Unless exempted by the Member, Rotary Wing aircraft with tank or bottom fill buckets must have hover fill systems that:

- can use with fresh or brackish water without restriction. (Some contracts may require self-filling with salt water without impediment.)
- can fill from a suitable dip tank
- fill to full in ISA conditions at Mean Sea Level in under 70 seconds
- operate without undue restriction on pump duty cycles. Hover-fill pumps must be capable of providing 20 complete fills per hour of operation without restriction.
- have filtering to prevent clogging or ingestion of items that may damage the pump or components.

Unless exempted by the Member, buckets:

- must be able to reduce the load carried without affecting bucket operation or quality of drop (e.g. by capacity reduction or partial load).
- with greater than 1,200 litres capacity must:
  - have the suppressant concentrate reservoir on-board the aircraft
  - deliver suppressant concentrate to the bucket via a suitable hose with a breakaway connection
  - may be required in come contracts to be able to bottom fill through the dump valve by pumps and/or flapper valves.