CIVIL AVIATION AUTHORITY PAKISTAN
FLIGHT STANDARDS DIRECTORATE

This Information Bulletin, adopted by Flight Standards Directorate aims to keep members of Pakistani Civil Aviation community updated on latest items of common interest and developments within the aviation industry. It is anticipated that, the bulk of material would be of relevance to AOC, Training, Standards and helpful to the Safety Managers who implement their policies.

The Bulletin is designed to serve the objective of Flight Standards Directorate that is "To improve upon Safety Standards".

INFORMATION BULLETIN

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LOW VISIBILITY - MIST AND FOG

Description

Mist and Fog are the terms used to describe low visibility caused by water droplets suspended in the air. Mist is a term used to describe visibility of greater than 1000m while Fog is the term used when visibility is less than 1000m.

Fog is effectively surface cloud and has a significant impact on the conduct of flying operations particularly landing and take-off.

There are many different types of fog defined according to how they are formed;

Radiation Fog

On a cloudless night, especially within a high pressure system, the land surface loses heat to the atmosphere by radiation and cools. Moist air in contact with cooling surface also cools and when the temperature falls below the dew point for that air, fog forms. This type of fog is known as radiation fog.

Formation of Radiation Fog

Initially it may be mist that forms and then thicker fog as the temperature drops and more water vapour condenses into water droplets in the air. Air does not conduct heat very well so in still air conditions fog may not form at all and a layer of dew or frost will form on the surface instead. However, if there is a light wind of around 5 knots, then this will mix the air in contact with the surface and the layer of fog will be thicker. With stronger winds, the fog may lift to form layers of stratus.

Dispersal of Radiation Fog

As the sun rises, and the surface temperature increases, then the air in contact with the surface will warm and the fog will gradually disperse. The fog may rise to form a low layer of stratus.

If the fog is particularly thick, then it may prevent the sun from heating the surface and the fog will not clear. This situation is common in the autumn in northern Europe when some airfields may be affected by fog for many days.

Anticipating Radiation Fog

The three conditions for radiation fog are:

- *clear skies,*
- *moist air, and*
- *a light wind.*

Advection Fog

Advection fog occurs when a warm, moist, air mass flows across a colder surface. The air mass is cooled from below by the colder surface and, if the temperature of the air mass is reduced to the dew point, then fog forms.

Formation of Advection Fog

Advection Fog is common in Spring over western Europe when warm moist air flows in from the Atlantic over the cold land mass.

Advection Fog can also occur when warm maritime air passes over cold water, such as a current flowing south from Arctic waters or cold water welling up from the deep ocean.

In the Arctic, particularly in northern Canada, where there are wide expanses of water and numerous islands with small airstrips, advection fog is a major hazard to aviation. Visibility can change from unlimited to zero in a very short space of time because of a slight change in the wind bringing moist warmer maritime air across the colder landmass. The fog can clear and the visibility can improve just as rapidly as it declined, if the wind direction changes again to blow the air from the land towards the sea. Such conditions can be difficult to forecast.

Frontal Fog and Hill Fog

Frontal fog occurs in two ways:

- *When, during the passage of a front, cloud extends down to the surface. This is especially the case over higher ground and may also be termed hill fog.*
- *When the air in contact with the surface becomes saturated by evaporation from the rain that has fallen. These conditions may occur in the cold air ahead of a warm front.*

Steam Fog

Steam Fog occurs when very cold air flows across relatively warm water. Water vapour evaporating from the surface of the water rapidly cools below its dew point, as it is mixed with and cooled by the cold air, and condenses to form fog.

Formation of Steam Fog

Steam Fog, also known as Steaming Fog, Evaporation Fog, Frost Smoke or Arctic Sea Smoke, occurs when evapouration takes place into cold air lying over warmer water. It is usually quite shallow. This phenomenon is mainly a feature of higher latitudes especially in winter.

It is named by analogy with the condensed vapour or steam which appears above water which is heated. Invisible vapour is given off from the water but is almost immediately recondensed as it comes into contact with the colder air. The air has to be much colder than the water so that convection currents develop. Formation also requires that there is:

- *A marked surface temperature inversion in the air before it moves over the sea or inland water bodies so as to preclude the lapse rate becoming unstable through a deep layer*

- *A low air temperature, typically 0 degrees Celsius or below, so that a comparatively small amount of moisture can produce supersaturation, otherwise the heating process will outweigh the tendency towards saturation.*

Because of these requirements, this type of fog is usually only formed over water surfaces near to a source of cold air, such as frozen ground or ice sheets in Polar Regions. One classic occurrence is following the sudden break up of sea ice to expose relatively warm water.

In the steep sided fjords along parts of the Icelandic and Norwegian Coasts and similar environments elsewhere, steam fog may reach a depth of 500 feet or more and drift over adjacent land areas. Whilst relatively rare in temperate latitudes, cold air which collects in and then drifts down large river valleys and out over a relatively warm sea surface, in very light wind conditions, can occasionally lead to the formation of smaller and much shallower areas of this type of fog in winter.

In a more ephemeral context but by exactly the same process, many people will have seen the steaming of tarred road surfaces or bitumen roofs in sunshine after rain.

Effects

- *Low visibility. Low visibility in fog clearly affects flying operations.*

Airport operations in Fog

Reduced visibility because of fog may result in restrictions on movements at an airport, reduced capacity (because of procedural increased separation between aircraft take-offs and landings in order to maintain safety), and may lead to the closure of the airport.

Solutions

Radiation Fog

- *When conditions for radiation fog exist, it is a good idea to examine the pattern of weather over the preceding days to see if fog has occurred and at what time of the day and at what temperature.*

- *Monitoring the temperature and dew point at an airport can help controllers and pilots alike to predict the onset of radiation fog and plan operations accordingly.*

- *if conducting local flying operations, such as flying training, beware getting airborne when there is a early afternoon lifting of fog while conditions for radiation fog still exist - you could find yourself spending the night somewhere else!*

- *If planning to fly to an aerodrome where conditions for radiation fog exist,*
    - *time your planned arrival for about an hour after local noon when maximum solar heating takes place.*
    - *Expect delays and carry additional contingency fuel.*

Frontal Fog

- *Flying at low level, i.e. below safety altitude, in conditions of frontal fog and low cloud can quickly become extemely hazardous if visual flight rules cannot be maintained. Attempting to fly between layers of Stratus, so-called "letter boxing", can result in impact with terrain CFIT if forward visibility and Situational Awareness is lost.*

Advection Fog

- *In circumstances where advection fog can quickly make an aerodrome unusable, particularly in the high Arctic, pilots are wise to carry sufficient contingency fuel to be able to keep a number of potential diversion airfields available as options in the event that the destination weather deteriorates unexpectedly."Always keep another card up your sleeve"*

Airport Operations

- *Crews and controllers should exercise additional caution during low visibility operations - loss of situational awareness is a major contributary factor in Runway Incursion events.*

- *Airports should ensure that collaborative decision making arrangements to maximise airport capacity involve met service providers.*

- *Flight crews should anticipate longer taxying times in low visibility operations and carry additional fuel accordingly.*

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