AETE 2014-024 (FTr 2)

8 Feb 2015

PROJECT ESTIMATE – AETE 2014-024 CF188
UPDATED TAKEOFF ABORT AND LANDING
CHARTS

References: A. C-12-188-NFM/MB-003, CF-18AM/BM Hornet Aircraft Operating Instructions (ECP-583), Change 1 – Rev 3 – 2013-12-13
B. Flight Safety Hazard Report 136966, 15 Jan 2009 (RDIMS AEPM# 1407922)
C. DTAES Technical Note 75-13-14, Expansion of CF188 Landing and Takeoff Charts for Snow Covered Runways, 16 September 2014 (RDIMS AEPM#1480960)
D. DND Flight Information Publication GPH204A Flight Planning and Procedures (Article 804, Table 1)
E. A-GA-005-000/AG-002, AFTEC Directive, 5 August 2008
F. 10081-1 (SO Ftr Sys) Request for Estimate Updated Takeoff Abort and Landing Charts.
G. 4 Wing Flying and Range Orders

## INTRODUCTION

### BACKGROUND

1. The range of runway conditions that the CF188 encounters on a regular basis varies from dry to wet to snow-covered. Although aircraft takeoff and landing performance charts are available for dry and wet runways, CF188 pilots are not provided with aircraft performance documentation that accounts for the effect of Canadian Runway Friction Index (CRFI) values associated with snow covered runways. The Aircraft Operating Instructions (AOI) at reference A includes takeoff abort and landing data for "dry" runways or for "wet" runways only. A flight safety hazard report (reference B) was raised to address this deficiency in the CF-188 AOI takeoff abort charts (reference A, Figures 4-4-5 & 4-4-6). Although the reference B hazard report only addressed takeoff abort speeds, CRFI impacts both takeoff and landing performance considerably. Therefore, the deficiency described by the hazard report is also pertinent to the CF188 AOI landing distance chart (reference A, Figure 4-10-2).

2. In order to address the deficiencies identified above, Bombardier Aerospace Engineering Services (BAES) was tasked to generate new takeoff abort and landing charts for a CRFI value of 0.35 so that they could be incorporated into the CF188 AOI. The intent was to provide takeoff

and landing performance data for a CRFI roughly equivalent to snow-covered runways. BAES conducted the analysis and presented it to Director of Technical Airworthiness Engineering Services (DTAES) for review. Based on the DTAES review, documented at reference C, flight testing is required to spot-check the new takeoff abort and landing charts generated by BAES prior to incorporating them into the CF188 AOI.

AIM

3. The aim of this project is to support incorporation of the BAES generated CRFI 0.35 takeoff abort and landing charts into the CF188 AOI.

OBJECTIVES

4. The aim of this project will be met through the following objectives:

a. Measure distance and ground speed data for both landings and aborted takeoffs in adverse runway conditions;

b. Verify the accuracy of the BAES computer generated CRFI 0.35 CF188 charts for Landing Distance, Maximum Abort Speed with MIL Thrust and Maximum Abort Speed with MAX Thrust; and

c. Confirm the applicability of the CRFI recommended landing distances chart presented in reference D (GPH204A) to CF188 operations for CRFI values as low as 0.35.

Note: The underlined action-words used to define the objectives of this project were determined IAW reference E.

SCOPE

5. The following factors amplify the objectives and define the scope of this project:

a. Although the DTAES Technical Note at reference C discusses MIN GO performance, and although BAES did construct an amended MIN GO chart for inclusion in the AOIs, the RFE at reference F did not request validation of MIN GO performance. MIN GO testing on reduced CRFI runways would likely be considerably more complex than landing or takeoff abort testing. In accordance with the RFE at reference F, MIN GO testing will not be conducted by this test program; and,

b. Although the BAES analysis and modelling utilized a clean configuration CF188, flight testing will consider different aircraft store configurations. Notably, the QRA configuration (or equivalent) will be the planned end-point.

LIMITATIONS TO SCOPE

6. The following limitations apply to this project:

a. Testing will be conducted on runways that have a length greater than the projected accelerate-stop distance for the aircraft configuration, CRFI, and other appropriate factors associated with a particular test point. Since testing will take place at Cold Lake, a maximum real runway length of 12,000 feet will be available. The simulated runway length will have to be shorter than that. As such, certain combinations of weight, runway length and configuration may not be testable for safety reasons. The feasibility of test points, as viewed from the perspective of their safe execution, will be assessed by the AETE technical and safety review board processes. For the purposes of this estimate, it is important to note that certain combinations of heavy gross weights and high abort speeds associated with long runways may not be reasonably testable;

CONSTRAINTS

7. The following constraints apply to this project:

a. In accordance with reference F, normal CF188 operations are permitted on runways with CRFI values as low as 0.35. Test points at CRFIs below 0.35 will only be at the discretion of the Flight Test Authority (FTA), as authorized during AETE's SRB planning processes;

b. Testing will be contingent on having dedicated access to a Runway Arrestor Gear (RAG) cable, a Mobile Arrestor Gear (MAG) cable or, in certain cases, both. Testing will be contingent on the availability of these assets; and,

c. Contrary to the project's RFE (reference F), it is unlikely that data will be acquired on an "opportunity" basis by simply recording landing data from normal operating sorties. Due to a range of factors (required gross weights, the risk of hot brakes, cross wind limits, etc.), designated test sorties in support of this project will be planned.

TEST CONCEPT

8. Phase I: Landing distance

a. Approximately 2 sorties will be used to validate the new landing distance performance charts for normal landings conducted on 0.35 CRFI runways;

b. Approximately 5 sorties will be used to confirm the applicability of the CRFI recommended landing distance chart presented in reference D (GPH204A) to CF188 operations. In accordance with the test objectives, these test points may be conducted at CRFI values as low as 0.35. At least three of these sorties will be conducted at CRFIs greater than 0.35 (reference D publishes data for CRFI values from 0.18 to 0.6). Although there may be considerable delay in acquiring data for CRFIs of 0.4 or 0.35 (due to the requirement to wait for a suitable naturally occurring runway) initial sorties may be flown well within the presently-permitted flight envelope of the aircraft, at CRFIs as high as 0.5 to 0.8, to simply compare actual landing distance to that predicted by reference D. These sorties may be

flown in spring or summer weather conditions if wet runways associated with CRFIs of less than 0.8 are available;

c. All landings will be flown in accordance with a precise technique, the details of which will be test planned on the basis of AOI and How To Fly (HTF) documentation from the CF188 operational community;

d. Distance and groundspeed data for all landings will be measured by different means, including the CF188 bus recorder available at AETE; and

e. At least two different test pilots will be used in order to control for any subtle differences in pilot technique.

9. Phase II: Accelerate-Stop

a. Approximately 6 sorties will be used to validate the takeoff abort performance charts for takeoff aborts conducted on runways at, or near to, a CRFI of 0.35;

b. Abort testing will require accelerate-stop profiles (as opposed to simply adding takeoff distance to landing distance);

c. Takeoff aborts will be flown in accordance with a precise technique, the details of which will be test planned on the basis of AOI and How To Fly (HTF) documentation from the CF188 operational community;

d. Distance and groundspeed data for all takeoff rolls and aborts will be measured by different means, including the CF188 bus recorder available at AETE; and

e. At least two different test pilots will be used in order to control for any subtle differences in pilot technique.

DATA REQUIREMENTS

10. Flight Test Instrumentation (FTI) will include the following:

a. Bus recording for engine parameters, aircraft mass, position, and velocity;

b. ACMI (via AIS pods installed on both wingtips) for a secondary source of position and velocity, if required;

c. Access to a cockpit compatible differential GPS is desirable;

d. Cockpit Video Recording System (CVRS) tapes for all test sorties, with audio; and

e. Real-time video recording of the aircraft (from a position adjacent to the runway) is desirable.

## SUPPORT REQUIREMENTS

### TIME AND SPACE

11. Test execution will take place at 4 Wing Cold Lake throughout 2015 with the following provisions:

a. As necessary, other locations may be chosen to assist with reducing the timeline of testing provided appropriate field length and arrestor cable facilities are available. This option, if pursued, would require an additional AETE Safety Review Board to confirm the suitability of the chosen airfield; and

b. Provided the appropriate conditions are available, up to one sortie per day could be executed. However, the unpredictable nature of weather and CRFI makes planning for CRFI test events tenuous at best, and so it is impossible to schedule test sorties in advance. Certain sorties will likely have to be postponed until November 2015 for the necessary conditions to be available.

### INTERNAL SUPPORT

12. Fighter Evaluation (Ftr Eval). Ftr Eval will provide two Qualified Test Pilots (QTP) and one Flight Test Engineer (FTE) to execute the test program.

13. Operations (Ops). AETE Ops will schedule a CF188 aircraft (B model preferred) that is configured with a bus recorder, as well as qualified test pilots, to facilitate the testing.

14. Experimental Aircraft Maintenance Engineering (XAMEO). XAMEO will provide a serviceable single or two seat CF188 aircraft with bus recorder installed.

15. Data Acquisition and Processing Services (DAPS).

a. Bus recorder, download and initial analysis and data reduction;

b. Deliver data to DTAES for final analysis. MOAC Data will be processed to determine the total ground roll distance associated with the landings or takeoff aborts (period of time during which the pilot is trying to stop the aircraft). Bus data will be stripped prior to sending it to DTAES so as to provide only the required (and unclassified) parameters; and,

c. Generate data acquisition plan to meet the requirements of this test plan (paragraph 10a).

### EXTERNAL SUPPORT

16. 1 Canadian Air Division (1 Cdn Air Div). 1 Cdn Air Div is required to provide the following:

a. 20 hours of YFR to accomplish all phases of testing;

b. A tasking to 4 Wing to support the project, as necessary, by:

(1) providing RAG and MAG equipment along with necessary personnel to set up and maintain the RAG/MAG to meet the test schedule; and

(2) providing emergency and fire crews to assist with cable engagements and potential emergency scenarios associated with runway aborts (hot brakes, etc.).

17. Project Sponsor. Temporary duty is not expected to be incurred by the project.

ESTIMATED COST

18. No AETE costs are foreseen beyond normal operating costs.

19. No civilian overtime costs are foreseen.

RISK MANAGEMENT

20. The estimated project risk levels are presented in Figure 2.

| Risk | Risk Level | Details |
|---|---|---|
| Safety | Unmitigated high, mitigated to medium. | The final safety risk level will be assigned during the AETE Safety Review Board (SRB). The unmitigated risk level is predicted to be high at this stage due to the potential for hot brakes, blown tires or runway excursions. The mitigated risk level is predicted to be ALOS based on the following considerations:<br>a. Testing, both of landing performance and takeoff abort performance, is not expected to occur outside of what is presently approved for normal operations on the CF-188;<br>b. Accelerate stop testing will take place on runways longer than required to safely stop the aircraft;<br>c. Arrester Gear cables will be used to assure the aircraft has a stopping option;<br>d. Asymmetric loadings will only be considered if confidence in the performance of symmetric loadings has been achieved; and,<br>e. Test points will be flown with minimal cross winds (limits to be assigned prior to the SRB). |
| Technical | Low | All testing techniques and procedures are familiar to AETE. |
| Environmental | Low | No environmental concerns are foreseen. |
| Schedule | Medium | Without any specific mechanism in place to generate the desired runway conditions (i.e. water-spray system to create controlled CRFI states), all low-CRFI testing must be done on an ad-hoc basis at the mercy of local conditions and 4 Wing operational requirements. This could lead to considerable delays, especially if testing is not completed prior to Spring. |
| Financial | Low | No financial concerns are foreseen. |

Figure 2. Risk Description

PROJECT MANAGEMENT

MILESTONES

21. The milestones and duration for this project are estimated in the table in Figure 3. Overall, up to 365 working days may be required to complete this project.

| Milestone | Dependency and Duration (working days) |
|---|---|
| Project Tasking | Estimate + 5 |
| Planning Phase – includes instrumentation design, development and installation. | Tasking + 15 |
| Airworthiness Review Board (ARB) | N/A |
| Technical Review Board (TRB) | Tasking + 20 |
| Safety Review Board (SRB) | Tasking + 25 |
| Execution Phase | 16 Mar 15 to 15 Dec 15 |
| Report Phase – includes data processing and analysis. | Depends on availability of appropriate runway conditions. Possibly as late as February 2016. |
| Report Release | Depends on availability of appropriate runway conditions. Possibly as late as March 2016. |
| Closure Phase | Report Release + 30 |
| Total Duration | Approximately 1 year. |

Figure 3. Estimated Project Milestones and Duration

COORDINATION

22. The following AETE personnel may be contacted for coordination (refer to DWAN for further contact details):

a. Maj J.P Kutryk, OiC FTr Eval; and,

b. Maj J. Furlong, PCO.

PROJECT DELIVERABLES

23. A final report consisting of an executive summary of the test program results with all pertinent conclusions and recommendations within 30 working days of test completion; and,

24. A disposition of T&E final report recommendations shall be included with the report.

Annexes:

Annex A Data Requirements Annex

Annex A to Estimate
AETE 2014-024 (FTr 2)
30 January 2015

ANNEX A – DATA REQUIREMENTS ANNEX

This annex should be maintained as a separate file. See “Data Requirements Annex Template” for guidance.