# Flight Tests of a Ministick Controller in an F/A-18 Airplane

**Pilots' opinions were generally favorable.**

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In March of 1999, five pilots performed flight tests to evaluate the handling qualities of an F/A-18 research airplane equipped with a small-displacement center stick (ministick) controller that had been developed for the JAS 39 Gripen airplane (a fighter/attack/reconnaissance airplane used by the Swedish air force). For these tests, the ministick was installed in the aft cockpit (see figure) and production support flight control computers (PSFCCs) were used as interfaces between the controller hardware and the standard F/A-18 flight-control laws.

The **Ministick** is shown here installed in the aft cockpit of the F/A-18 airplane.

The primary objective of the flight tests was to assess any changes in handling qualities of the F/A-18 airplane attributable to the mechanical characteristics of the ministick. The secondary objective was to demonstrate the capability of the PSFCCs to support flight-test experiments.

The ministick, together with an associated demodulator box, generated single-channel pitch and roll stick commands in the form of DC signals, which were fed to analog input terminals of the PSFCCs. Software was developed to effect cross-channel data links, error detection of signals, and scaling of commands. The signals were scaled to be similar to the maximum inputs generated by the standard F/A-18 control stick. Because the experiment was to assess the effects of the mechanical characteristics of a small-displacement, center-mounted control stick, the original deadbands and stick shaping were used.

The five pilots performed five test flights. General comments and ratings of handling qualities were collected. The tests included the following maneuvers: doublets, frequency sweeps, bank attitude captures, pitch attitude captures, echelon formation flight, column formation flight, gross acquisition, and fine tracking. The echelon formation flight comprised three phases: gentle maneuvering, vertical captures, and more aggressive maneuvers. The column formation flight also comprised three phases: gentle maneuvers, more aggressive maneuvers, and lateral captures.

Cooper-Harper ratings are summarized in the table. The pilots consistently noted that the stick was very sensitive in roll, with some tendency to ratcheting. This tendency could be mitigated by modifying the stick shaping and deadband. The general pilots' comments on the ministick were favorable. The pilots noted that it was extremely easy to generate full-amplitude inputs. At the time of reporting the information for this article, analysis of data was nearing completion and technical reports to document the flight test, compare results with handling-qualities criteria, and describe the process of testing and operating the PSFCCs were in preparation.

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| Pilot | A | B | C | D | E |
|---|---|---|---|---|---|
| Echelon Formation Phase 1 | 4 | 3 | 2 | 3 | 3 |
| Echelon Formation Phase 2 | 4 | 5 | 3 | 2 | 4 |
| Echelon Formation Phase 3 | 4 to 7 | 5 | 4 | 4 | 5 |
| Column Formation Phase 1 | 4 | 3 | 2 | 4 | 4 |
| Column Formation Phase 2 | 3 | 3 | 2 | 4 | 5 |
| Column Formation Phase 3 | 3 to 4 | 5 | 5 | 4 | 4 |
| Gross Acquisition | n/a | 6 to 7 | 2 | 2 | 4 |
| Longitudinal Fine Tracking | n/a | 3 | 2 | 2 | 3 |
| Lateral Fine Tracking | n/a | 4 | 2 | 3 | 6 |

**Handling Qualities** are summarized here on the Cooper-Harper scale (named after the authors of a 1986 paper on ratings of handling qualities by pilots).