SUGGESTIONS FOR THE MIL-PRIME-STANDARD ORGANIZATION

(Informal Report)

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The forthcoming MIL-PRIME-STD and MIL-PRIME-HANDBOOK offer potential for significant improvement in the specification of flying qualities requirements. The MIL-PRIME-STD will give the basic framework for the specification of flying qualities. Suggestions and rationale for detailed requirements will be given in the MIL-PRIME-HANDBOOK.

Each SPO will be able to tailor the flying qualities requirements to the specific needs and objectives of its programs. The new MIL-PRIME-STD/-HANDBOOK should also facilitate keeping the specifications abreast of a rapidly changing Technology. In my opinion, many of the flying qualities specification problems encountered during the AMST (Advanced Medium STOL Transport) program would have been alleviated by the proposed MIL-PRIME-STD/-HANDBOOK concept.

In creating this new MIL-PRIME-STD it would be very desirable, from the airplane designer's viewpoint, to rearrange the flying qualities topics relative to the order in which they now appear in MIL-F-87858. The organization used in MIL-F-87858 follows primarily along the lines of flight phases and the individual parameters used to specify flying qualities. This organization tends to be very difficult for the flight control system designer to use. For example, when designing the pitch axis feel system the designer must compile a list of all requirements related to the pitch axis control forces and displacements. In reviewing MIL-F-87858 he will find that these requirements are scattered through sixteen separate sections of the specification, ranging all the way from section 3.2.2.2.1 to section 3.6.3.1. This type of problem prompted Boeing to evaluate alternate organizational structures when the Design Requirements and Objectives document was written for the YC-14.

The table of contents showing the organization of the YC-14 Design Requirements and Objectives document is given on the following pages. The subjects have been grouped by airplane systems to simplify the control system design tasks. A similar arrangement is recommended for the MIL-PRIME-STD.
3.1 GENERAL REQUIREMENTS AND DEFINITIONS

3.1.1 Operational Philosophy

3.1.1.1 Operational Modes
3.1.1.2 Flight Phase Categories
3.1.1.3 Operating Margins
3.1.1.4 State of the Aircraft

3.1.2 Configurations and Loadings

3.1.3 Flight Envelopes

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3.1.3.3 Permissible Flight Envelopes

3.1.4 Flying Qualities Levels and Application

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3.1.4.2.2 Specific Failure States
3.1.4.2.3 Special Failure States

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3.1.5.3 Discrete Gust Analysis

3.1.6 Flight Control Systems

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3.1.6.3 Basic/Manual Modes and Subsystems
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3.2.1.2 Takeoff
3.2.1.3 Landing

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3.2.1.3.2 Pitch Acceleration
3.2.1.3.3 Maneuver Control Power
3.2.1.3.4 Glide Slope Control

3.2.1.4 Stall-Recovery
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3.2.2.2 Breakout Forces
3.2.2.3 Constant Speed Maneuver Force and Displacement Gradients

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3.2.2.4 Minimum Stick Forces
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3.2.2.5.3 Accelerated Flight
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3.2.2.5.5 Landing
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3.2.3 Stability and Response Characteristics

3.2.3.1 Minimum Damping
3.2.3.2 Pitch Rate Characteristics
3.2.3.3 Pitch Attitude Hold
3.2.3.4 Flight Path Characteristics

3.2.3.4.1 Hands-Off Flight Path Stability
3.2.3.4.2 Hands-On Flight Path Stability
3.2.3.4.3 Pitch Attitude - Flight Path Relationship
3.2.3.4.4 Load Factor Response

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3.4 FLIGHT CONTROL SYSTEMS DESIGN

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3.4.1.2 Powered Control Systems
3.4.1.3 Fail Safety
3.4.1.4 Structural Load Path
3.4.1.5 Dissimilar Load Path
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3.4.2 Primary Flight Control System

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3.2.4 Stalls
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3.2.4.2 Warning Speed for Stalls at 1g Normal to the Flight Path
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3.2.5 Pilot Assist Modes
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3.3.1.3 Crosswind Takeoff and Landing
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3.3.2 Control Forces and Displacement

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3.3.3.1.3 Bank Angle Oscillations
3.3.3.1.4 Roll Rate Oscillations

3.3.3.2 Heading Control
3.3.3.3 Turn Coordination
3.3.3.4 Roll-Sideslip Stability
3.3.3.5 Roll-Sideslip Coupling
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3.3.4 Stalls

3.3.5 Pilot Assist Modes

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3.3.5.4 Category II Landing Approach
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- 3.4.3.2.2 Trim Using Primary Control Surfaces
- 3.4.3.2.3 Series Trim
- 3.4.3.2.4 Effects of Trim System Failures on Primary Controls

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- 3.4.4.1 Design Simplicity
- 3.4.4.2 Engagement
- 3.4.4.3 Override Capability
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3.4.5 Maintainability
- 3.4.5.1 Operational Checkout Provisions
- 3.4.5.2 Malfunction Detection and Fault Isolation Provisions
- 3.4.5.2.1 Built-in Test Equipment
- 3.4.5.2.2 Provisions for Checkout with Portable Test Equipment
- 3.4.5.3 Maintenance Personnel Safety Provisions
Wayne Thor, ASD: Do you currently use MIL-F-8785B as a design handbook?

Answer: No, we do not use MIL-F-8785B as a design handbook. We design a flight control system which we believe will meet the requirements of the spec. Then we evaluate this flight control system against the requirements. We will have to go through the same process with the new MIL-FTMEM-STD. Nothing will have changed in this regard.

We have successfully used the proposed organization for the YC-14 Design Requirements and Objectives (DR&O) document. I have shown a summary of the way the DR&O was organized — a complete table of contents is shown in my paper. We found that all of the requirements contained in MIL-F-8785B can be melded into the proposed organization scheme. The first attempt at a DR&O for the YC-14 was organized much like MIL-F-8785B. This caused significant problems for the designers to use.

Hansel Stegall, NASA JSC: Aren’t you going to have the same problem with your proposed organization as you accuse the spec? Why rewrite the spec to conform to a new organization? Why not add a cross-reference index at the back?

Answer: No, I do not think it would be satisfactory to simply provide a cross index of requirements to relate subsystem design (such as a feel system) to the various sections of the MIL-FTMEM-STD. This would be clumsy. It is not obvious why it is necessary to stick with the same organization as currently in MIL-F-8785B. Some definite improvements are possible.

This request to reorganize the flying qualities requirements is perhaps more significant to Boeing than to some other aerospace companies. Some of our engineers have not spent their entire career working with MIL-F-8785B. It is a definite problem for them to use this spec, since they must spend so much time reading through the various sections to find the ones that apply to their particular design problem(s). This is well illustrated by the pitch feel system where the designer must compile the requirements from 16 major sections of
MIL-F-8785B where design values are given. It should not be necessary to do this sifting and sorting. It leads to an increased probability of oversight and errors in addition to a waste of good engineering manpower. The designer should be able to go to the table of contents in the MIL-PRIME-STD and quickly identify all applicable requirements. This is not possible with the MIL-F-8785B organization.