UNCLASSIFIED

<table>
<thead>
<tr>
<th>AD NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD856935</td>
</tr>
</tbody>
</table>

LIMITATION CHANGES

TO:
Approved for public release; distribution is unlimited.

FROM:
Distribution authorized to U.S. Gov't. agencies and their contractors; Administrative/Operational Use; 09 JUL 1956. Other requests shall be referred to Air Force Aero Propulision Lab., Wright-Patterson AFB, OH 45433.

AUTHORITY
AFAPL ltr 3 Jan 1974

THIS PAGE IS UNCLASSIFIED
In accordance with instructions from Hq AFSC (SCG), the holdings of the former ASNPD Library are being offered to the Defense Documentation Center (DDC). DDC has indicated an interest in subject document. Request return of report with information as indicated below by........

FLOYD H. MASON, Lt Colonel, USAF  
Director of Engineering Standards  
Subject Report

1st Ind

TO: ASNPD

1. ASNPD is (not) authorized to release subject report to DDC. Please underline one.

2. Number of applicable AFR 310-2 distribution statement ........ (If none, please check ☐. If addition or change of statement occurs, please mark it on the report.)

Michael Lehman  
Senior Editor  
Executive Officer
HAMILTON-STANDARD MODEL JFC12 CONTROL METEERING CHARACTERISTICS

Mr. JG G. Barrett
Power Plant Laboratory

9 July 1956

Project No. 3031-40142

Wright Air Development Center
Air Research and Development Command
United States Air Force
Wright-Patterson Air Force Base, Ohio
When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Copies of AEDC Technical Reports and Technical Notes should not be returned to the Wright Air Development Center unless return is required by security considerations, contractual obligations, or notice on a specific document.
HAMILTON-STANDARD MODEL JFC12 CONTROL METERING CHARACTERISTICS

A. PURPOSE:

1. To obtain typical acceleration, deceleration and governing control characteristics of the Model JFC12 Fuel Control over a range of engine operating conditions and fuel density.

B. FACTUAL DATA:

2. The Model JFC12 control is a hydromechanical design produced by Hamilton-Standard for the model J57 engine. This control has as inputs the high pressure compressor turbine assembly rotating speed \( N_2 \), burner pressure \( P_b \), and power lever angular position. It controls fuel flow through by-passing the excess output from a fixed displacement. Continuous hydromechanical computing establishes metering valve area. A constant metering head is held across the metering valve. Principal control provisions are described briefly as follows:

a. For engine acceleration a ratio of fuel flow rate to burner pressure \( \dot{m}_f/P_b \) is held. Compressor inlet temperature trim \( T_2 \) reduces the ratio at certain conditions in order to skirt compressor surge.

b. The deceleration provision is likewise a \( \dot{m}_f/P_b \) ratio except where this would yield a fuel flow less than fixed minimum flow which is obtained on a minimum metering valve stop.

c. Speed governing is of the proportional type. Steady state \( N_2 \) is controlled by the intersection of the control generated curve and the engine fuel flow requirement. Inlet temperature bias \( T_2 \) lowers the controlled \( N_2 \) as \( T_2 \) is reduced (to prevent \( N_1 \) from overspeed).

3. Hamilton-Standard Model JFC12, Part No. 95625, Serial No. 1572, was set-up in the Engine Accessories Laboratory for this test. The test was conducted on Meriam Test Stand Model No. D20399. The tests were conducted during the period of 3 - 10 May 1956. Two fuels were provided in order to have a range of specific gravity. These fuels were (a) MIL-F-7824H, specific gravity 0.785 at 80°F and (b) J15 with a specific gravity of 0.783 at 80°F.
4. The test results obtained are given in the attached curves. Significant notes on these curves are as follows:

a. Reference: Figure 1. A plot of the full throttle acceleration, governing and minimum flow with the two fuels at burner pressures of 5.0, 12.5 and 20.0 psia is shown. The curves represent typical very high altitude performance. The reduction of $\frac{V_F}{P_B}$ to avoid compressor surge during acceleration is clearly shown.

b. Reference: Figure 2. A plot of idle throttle position metering for the conditions of overspeed, governing, and underspeed with the two fuels and range of burner pressures is given.

c. Reference: Figure 3. The plot of full throttle metering at inlet temperatures ($T_2$) of 72°F and -34°F is shown. The governor is seen to re-set by 200 control shaft RPM with this range of temperatures. The control exhibits approximately 20 RPM hysteresis as noted in the increasing vs. decreasing run. The curve also shows the surge notch which progressively comes into effect as $T_2$ is reduced.

d. Reference: Figure h. This curve illustrates the increase in fuel flow as burner pressure is increased. The full curve is given for $P_B$ of 150 psia and $T_2$ of 72°F, a condition approximating ground level performance.

The above curves may be used by interpolation to define specific control performance within the range of test conditions.

5. The fuel density effect on metering was determined to approximate the square root of the specific gravity ratio. Metered flow increased an average of 1.2% for a specific gravity increase from 0.765 to 0.783.

C. CONCLUSIONS:

6. Typical accelerating, decelerating and governing curves of the JFC12 control were determined covering a range of altitude conditions ($P_F$), power lever angle, inlet temperature and fuel density.

D. RECOMMENDATIONS:


COORDINATION:  
R. E. HOFFMAN, Chief  ENGINE ACCELERATION BRANCH

PREPARED BY:  
JAMES G. HARRETT, SCLFG-2

9 July 1956  
WADC TN 56-295
This report has been reviewed and is approved.

FOR THE COMMANDER:

DISTRIBUTION:
WCLR-4 (1 cy)
WC/PC-2 (2 cys)
WCOSI-3 (1 cy)
WCOSI-4 (1 cy)

9 July 1956
WADC TN 56-295
FULL THROTTLE METERING CHARACTERISTIC

Model JFC12 Control (Ham. Std.) Part No. 95625, Ser. No. 1572

Test Conditions: Power Lever Angle 105°, T₁ = -83°F, Fuel Temp. = 77°F, Total Flow 10,000 lb/hr, Burner Pressure and Fuel as noted.

FIGURE 1

<table>
<thead>
<tr>
<th>Burner Pressure</th>
<th>Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.0 psia</td>
<td>7024A</td>
</tr>
<tr>
<td>20.0</td>
<td>JP5</td>
</tr>
<tr>
<td>12.5</td>
<td>7024A</td>
</tr>
<tr>
<td>12.5</td>
<td>JP5</td>
</tr>
<tr>
<td>5.0</td>
<td>7024A</td>
</tr>
<tr>
<td>5.0</td>
<td>JP5</td>
</tr>
</tbody>
</table>
IDLE METERING CHARACTERISTIC

Model J7C12 Control (Ham. Std.) Part No. 9362, Ser. No. 1572

    =77°F, Total Flow 10,000 lb/hr, Burner Pressure and Fuel as noted.

20.0 psia  7024A
20.0     JP5
12.5     7024A
12.5     JP5
5.0      7024A
5.0      JP5

FIGURE 2

N_2, RPM/100

3 May 1956
INLET AIR TEMPERATURE EFFECT AT FULL THROTTLE

Model JPS12 Control (Ham, Std.) Part No. 95625, Ser. No. 1572

Test Conditions:
- Power Lever Angle 105°, Fuel Temp. 27°F,
- Total Flow 10,000 lb/hr., Burner Pressure
12.5 psia., JP5 Fuel Inlet Temp (T2) as noted.

\[ T_2 = 72°F, N_2 \text{ Increase} \]
\[ T_2 = 72°F, N_2 \text{ Decrease} \]
\[ T_2 = -83°F, N_2 \text{ Increase} \]
BURNER PRESSURE AT FULL THROTTLE

Model JPC12 Control (Ham. Std.) Part No. 95625, Ser. No. 1572


150 psia Burner Pressure
125 psia Burner Pressure
70 psia Burner Pressure
35 psia Burner Pressure