

Model 44
EFA Scientific Comparator Test Stand



**GAS TURBINE AND JET
ENGINE COMPONENTS**

**Effective Flow Area
Measurement**

Accurately analyzing airflow through jet engine and gas turbine components has been critical in the success of the aerospace industry. CCDI has satisfied manufacturers for nearly 50 years by offering quality airflow test equipment and part testing to GE, CFM, Honeywell, Pratt and Whitney, and others.

**Single-Blower Configuration
Effective Flow Area Measurement**

SOLUTION: TIME PROVEN DESIGN

The CCDI Model 44 is a compact, high-performance Effective Flow Area (EFA) test stand designed for production and laboratory measurement of gas turbine and aerospace components requiring airflow capacities up to **25 square inches EFA**. Utilizing CCDI's latest EFAOne software and standardized-day RPM technology, the Model 44 provides exceptional repeatability while occupying significantly less floor space than larger multi-blower systems. A single Gardner Denver HF-514 blower, a 15 Horsepower Marathon motor driven by a Hitachi speed controller make up the power plant in this compact machine. Lower maintenance cost without a clutch system in two blower systems.

The latest revision introduces Keller 0309 Series transducers (0.05 % FS) and EFAOne, software with standardized-day RPM correction for superior stability.

FEATURES

- Repeatability: $\pm 0.1\%$ *
- Step-by-Step Operator Software option
- Uses Orifice Plates, ASME Nozzles, ASME Arrays
- Choice of NIST Traceable or dimensionally calibrated Orifices
- Current Available in English and French, other languages are possible
- Uses modern Microsoft .NET framework

* Conditions: Orifice plate at conditions of 70 Deg $\pm$ 2 Deg F, 5” WC, less than 15 Sq. In. typical, depends on Model configuration. Call for additional repeatability details.



ASME Calibration Nozzles

1. System Overview

Applications	Gas-turbine and jet-engine vane rings, segment flow tests, bleed ports, and airfoil components
Measurement principle	Differential pressure and density compensated EFA using standardized-day RPM
Automation	Closed-loop flux-vector blower drive with PID control; PC-based EFAOne software (.NET framework)
Repeatability	$\pm 0.10\%$ of reading @ 5 inWC and 70 °F (typical)
Overall ASME NIST Uncertainty	$\pm 0.35\%$ of reading (typical @ 5 inWC, NIST-traceable ASME Array reference)

2. Measurement Ranges

Parameter	Nominal Range	Resolution	Sensor Type / Accuracy
Plenum Pressure	0 – 1.5 PSIG	24-Bit	Keller ± 0.05 % FS
Atmospheric Pressure	16 – 32 In.HgA	24-Bit	Keller ± 0.05 % FS
Temperature (Plenum & Room)	49.6 – 120.3 °F	0.01 °F	2252 Ohm @25C Thermistor ± 0.5 °F
Flow Range (EFA)	0.5 – 25 in ²	0.001 in ²	ASME Array / Orifice Plate Standardization

3. Measurement Performance

The Model 44 operates as a comparator-style EFA system. Parts are measured relative to calibrated orifice plates, ASME nozzles, ASME arrays, or customer master parts. Because the machine is comparator based, short-term repeatability and pressure stability are the primary performance factors.

Comparator Measurement Technology

Unlike absolute flow measurement systems that rely solely on instrument accuracy, the Model 44 measures production parts relative to calibrated airflow standards including ASME nozzle arrays, ASME nozzles, precision orifice plates, or customer master parts. This comparator approach minimizes the influence of long-term sensor calibration while emphasizing repeatability, stability, and correlation to known standards.

The Model 44 uses Keller 0.05% FS pressure transducers with CCDI C2251 24-bit measurement modules. This configuration provides stable high-resolution pressure measurement suitable for repeatable EFA comparison testing.

Typical repeatability: $\pm 0.10\%$ of reading at 5 inWC under stable laboratory conditions.

Attribute	Specification
Repeatability	$\pm 0.10\%$ of reading typical @ 5 inWC
System uncertainty	Configuration dependent; available after uncertainty budget review
Flow range	Up to 25 in ² EFA

* Includes plenum, barometric and temperature terms for active correction.

“Values shown represent best typical conditions at 70 °F, Standard Day, with stabilized blower operation.”

4. ASME Nozzle Array Master

- Eleven calibrated nozzles: 6×5 in², 2×2 in², 1×1 in², 1×0.5 in².
- Additive configuration for flows from 0.5 to ≈ 25 in²
- NIST-traceable five-year calibration interval.
- Serves as corporate EFA transfer standard for satellite test facilities.

5. Software and Data System

EFAOne Software

- Standard-day RPM normalization (auto compensates for baro & temperature changes).
- Workflow interface with step-by-step operator guidance.
- Separate modules for Calibration, Correlation, Testing and Report Generation.
- Data logging with network transfer and built-in QC reports.

- Password-controlled levels (Operator / Supervisor / Engineer / Maintenance).

EFAOne Software Screen Samples:

The screenshot displays the EFAOne software interface. At the top, a menu bar includes 'Test Operator', 'Reports', 'Setup', 'Diagnostics', 'Tools', 'Shutdown', and 'About'. The main area is divided into several sections:

- Calibration/Correlation Tables:**
 - Cal Table: 55-25CM, Slope: 0.003249, Offset: -0.652191
 - Cor Table: 25CM, Slope: 6.451500, Offset: -0.000500
- Pressure and Flow Measurements:**
 - Ref. Pressure In. WC: 5.000
 - Atmospheric Pressure In. HgA: 0.000
 - Reference Blower RPM: 0.0
 - Main Blower RPM: 0.0
 - Plenum Press In. WC: 0.0000
 - Reference Blower Deg F: 0.00
 - Main Blower Deg F: 0.00
- EFA Testing Section:**
 - Buttons: F2 Load Program, F3 Calibration, F4 Master ->, F5 Start ->, F6 ReMaster ->, F7 Finished
 - Part Test Profile Name: Part ID
 - Batch or Job Info: TEST.TST : TEST
- Test Results Table:**

Line	Serial	Customer	Cust. EFA	Cust EFA P-P%	Meas. EFA	EFA P-P%	Std Day RPM
Production Averages							
- Footer:** Zeroing Completed, Ready for next operation

Test Screen

Test Screen Features:

1. Part tests are stored in profiles that reference orifice plates and correlation parts which are shared by other parts.
2. Each step-by-step process is handled by the workflow buttons on the left. As each process is completed the next step highlighted.
3. Results are tabulated on the Test Screen as a batch showing mastering and measurements.
4. Flow test conducted on “Flow Test” Screen, shows averaging, pass/fail status, stores lots of information with every test.

Flow Test Screen:

Flow and Verify Master Part

Part ID: TEST
 Customer:
 Order:
 Serial:
 Job:
 Engine:
 Auxiliary:

Measurements
 Plenum Press In. WC: **0.0000**
 Flow Sq. In.: **0.00000**
 Area Measurement: **0.0000**

Test Status:
☐ Test In Progress Indicator
☐ Press. in Range
☐ Pressure Stable
☐ Temp. Stable
☐ RPM Stable
☐ Ready, counting
 Oil Pressure Ready

Test Type:
 Test Seq #: 0000

Wxx - Warmup test, Rxx = Production Run
 Statistics (Warm-ups not included)
 Min:
 Max:
 Avg: P-P%:

F1 Cancel F4 Start ☒ Close when finished flowing
 F12 Exit

Filename: Filename.dat
 Comments:

PID
☒ PID-Auto -1.0 -0.1 -0.01 -0.001 0.001 0.01 0.1 1.0 VDC: 0.000 Reset
 Show PID Graph

This screen pops up when conducting a flow test. The “Test Status” shows LED-like indicators as each condition reaches proper “steady state” to take final measurement.

Airflow Parameters

Certain screens are limited to users with certain password levels. We have reorganized these parameters sections to make them less overwhelming yet still give you the control that you need.

Airflow Parameter Details

Part Name: TEST Revision: A Profile Comment: N/A
 OEM: Not Defined Last Edited:
 File Name: TEST.TST Save/Exit

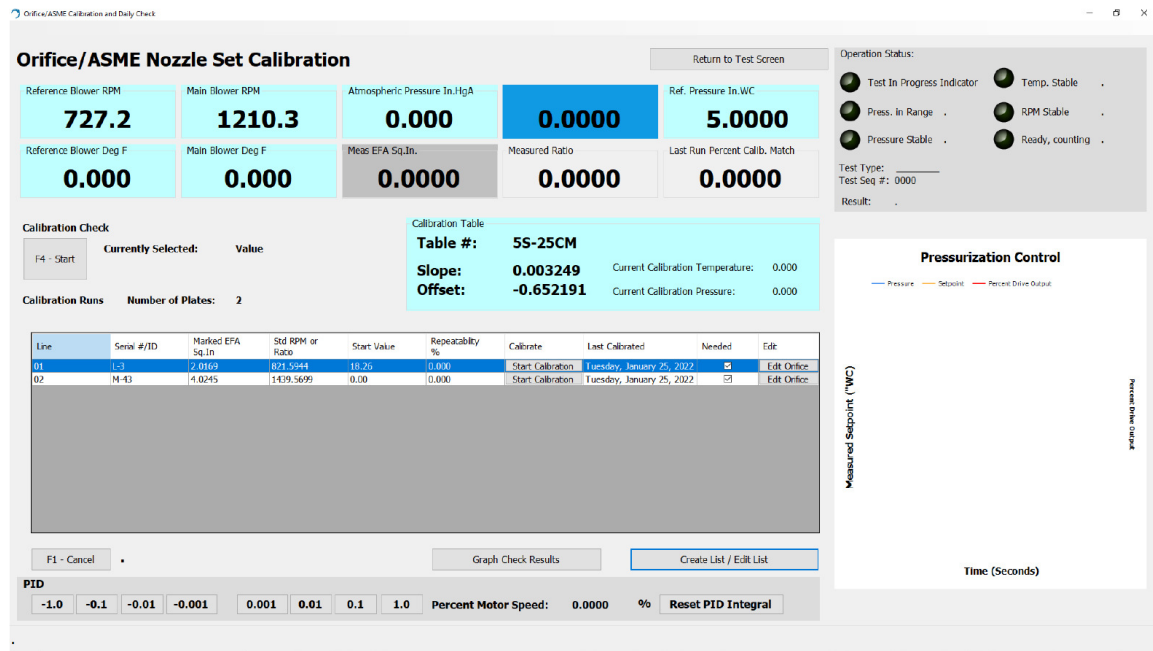
Settings Input Requirements Data Acquisition PID Settings Tables Master Part Requirements Finish Actions

Setpoint: 5.000 Direction: Pressure Number Of Test Runs: 5 Typical Settings
 Minimum Flow: 0.0000 Start Value: 13.65 Number of Warm-up Runs: 1
 Maximum Flow: 0.0000
 Num/Blowers: 1 Pressure Decimal Places: 5
 Template Name: Flow Decimal Place:s 4
 Fixture ID: Final Area Decimal Places: 4
 Data Filename: CALIB.DAT Pressure Units: In. WC
 Area Units:

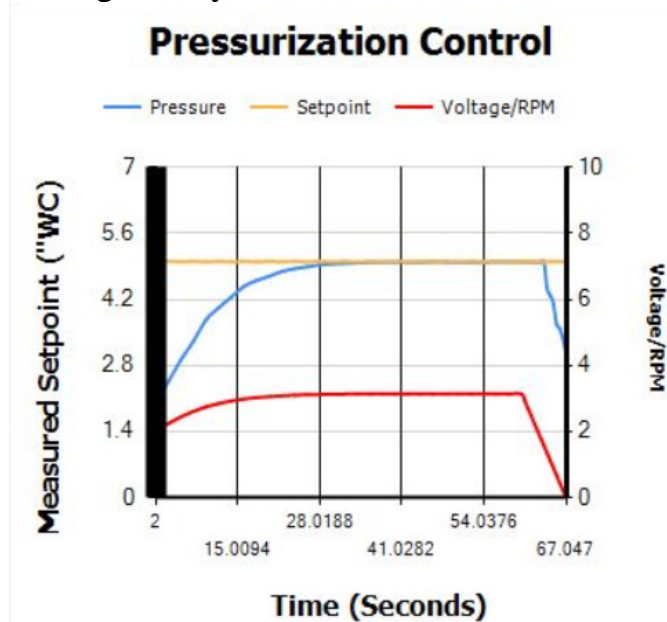
☐ Condense Multi-line flow results into a single Average Flow log entry

Orifice plate calibration.

Flow ranges no longer need to have three orifice plates to define a range. The new EFAONE software does EFA vs Standardized RPM. We call this “Standard Day RPM” because it stores and compares the RPM to values that are correct to a standardized Atmospheric Pressure, Temperature and Humidity. Therefore, it can deal with changes much better than a reference blower can.



During a test you can monitor the motor and PID controls:



We have a report generator that allow selections of part tests and browsing of data.

ERA Print

Selection Criteria Review/Print Old Reports Configure About Exit

MACHSER

Choose from this first:

Selected Files: CALIB.DAT

Choose this second:

Part ID: EFATEST

Choose this last:

Date Order: Blank - 10May18

Report Formatting:

Lt & Rt Margins: 25

Top/Bottom Margins: 25

Font Size: 10

Lines per page: 60

Then pick what you want to print by ticking the select checkboxes:

Select	Test No.	S/N	Avg EFA	Cust EFA	Date	Time	Order	Record ID No.	Comment
☒	1	BLANK	1.69656	1.69656	10May18	11:02:37	Blank	50865485	
☐	1	BLANK	1.70056	1.70056	10May18	11:05:17	Blank	50865490	
☐	1	SWTU-11.61	14.4517	14.4517	10May18	11:23:07	Blank	50865526	
☐	1	SWTU-11.61	14.43774	14.43774	10May18	11:25:59	Blank	50865531	
☐	1	SWTU-11.61	14.43668	14.43668	10May18	11:27:22	Blank	50865534	
☐	1	7M072-15.94	14.94633	14.94633	10May18	11:35:12	Blank	50865550	
☐	1	7M072-15.94	14.94379	14.94379	10May18	11:36:44	Blank	50865553	
☐	1	7M072-15.94	14.94116	14.94116	10May18	11:38:18	Blank	50865556	
☐	1	SWA-11.75	14.4498	14.4498	10May18	11:46:03	Blank	50865572	

Select Matching S/Ns Select All S/Ns Graph Flows Deselect All

Status: N/A

Selected Item(s) Statistics from Serial Number List

Number of Records: xx Minimum Cust Area: xx

Minimum EFA: xx Maximum Cust Area: xx

Maximum EFA: xx Average Cust Area: xx

Average EFA: xx Peak-to-Peak Percent: xx

Print Report Style A Print Report Style B Print Report Style C Cal/Cor Report Style D Print Report Style E

View/Print Graphs

Exit

Selft. Decimal Precision: 3 Print Landscape Save Reports

Result Decimal Precision: 3 Print SignatureLine

Report Generation

We have numerous report formats for test results.

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EFA FLOW REPORT -- A
-----
CCDI Model 88 EFA TEST STAND - SN: 088-01-1234 V5.22

DATAFILE: T53-17.DAT          PRINT DATE: May 08, 2008   TIME: 14:42

PART IDENTIFICATION      TEST PARAMETER      NULL      CUSTOMER AREA CORR
-----
Part ID: T51-17          Part DP: 5.000      S/N      CUST AREA      MEAS EFA
Engine: NIST 3.0 DIA     2nd Ord: 0.0000    LOW      10.000         10.000
Order #: TUE 2:15       1st Ord: 1.0000    MED      20.000         20.000
Op/Date: FWB/24APR07    Const: 0.0000     HI       0.000         0.000

Part      Measured      Measured      Diff.Plenum      Inlet      Motor
Serial No.  Cust Area  EFA(Sq In)  Press. ("H2O)  Temp. (Deg F)  Speed (RPM)
-----
UI87-1      7.017      7.017      4.970      76.71      2366.0
Note: CHECKING PRINTER & COUNTER 1

UI87-2      7.022      7.022      4.990      77.27      2367.7
UI87-2      7.022      7.022      5.000      77.35      2367.6
-----
Average Value = 7.022      7.022
+/- %Peak     = 0.002      0.002 %   Note: CHECKING PRINTER & COUNTER 2

Tested By: _____ Test Date: _____

```

6. System and Facility Requirements

Electrical	380 – 460 VAC 3-phase @ 30A
Compressed Air Input	30 – 100 psig clean dry air
Ambient Range	50 – 100 °F (10 – 38 °C)
Pressure Range	0 – 20 inWC (pressure or vacuum optional)
Cycle Time	< 1.5 min per EFA measurement

7. Mechanical Data

Size (H × W × D)	TBD
Required Clearance	Front 20 ft · Rear 10 ft · Sides 5 ft · Top 3 ft

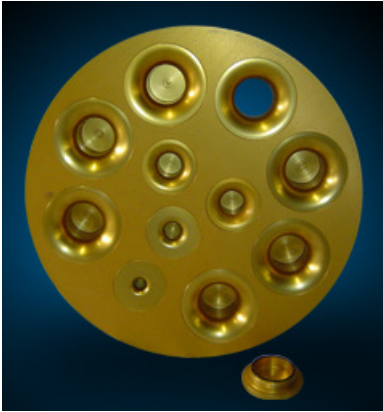
Construction	TBD
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8. Performance Summary

Attribute	Specification
Repeatability (typical)	± 0.10 % of reading @ 5 inWC
Stabilization time	< 30 s to steady-state PID lock
Data outputs	EFA (in ² /cm ² /mm ²), Pressure (inWC), temperature (°F / °C), density (lb/ft ³)
Reports	Test Results, Mastering, Calibration History, Correlation Reports
Warranty	Two years (parts & labor)

9. Certification and Traceability

- Mensor CPT-6100 transducers are calibrated to NIST standards ± 0.01 % FS.
- ASME Array nozzles calibrated via CCDI sonic nozzle transfer standard with ≤ 0.25 % uncertainty.
- Full system uncertainty verified through correlation to ASME Master standard.
- Calibration interval recommended every 12 months (5 years for ASME Array).



ASME Array – 11- Position Model

Document Reference: Model 44 EFA Scientific Comparator Test Stand –
Technical Specification (Rev 2026)

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