



Model 88
EFA Scientific Comparator Test Stand
Dimensions : 68" H x 50" W x 75" D
1727mm H x 1270mm W x 1905mm D

GAS TURBINE AND JET ENGINE COMPONENTS

Effective Flow Area Measurement

PRODUCT REQUIREMENTS

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, Garrett, Pratt and Whitney, Solar Turbine, and others.

SOLUTION: TIME PROVEN DESIGN

The Model 88 takes measurements of Barometric Pressure, Air Temperature, and Humidity to reliably measure Effective Flow Area (EFA). Continuous improvement has been made on the technology for over 15 years as the design was refined to optimize performance, making the Model 88 an accurate and stable EFA instrument ideal for area airflow measurements of vane rings and segments.

The latest revision introduces Mensor CPT-6100 transducers (0.01 % FS) and EFAOne software with standardized-day RPM correction for superior stability.

FEATURES

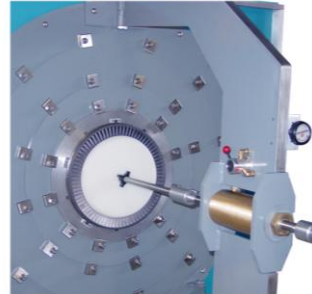
- Repeatability: +/- 0.1%*
- Step-by-Step Operator Software option
- Various configurations such as 88S-20, 88D-30, 88D-40 and others

- 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 +/- 2 Deg F, 5” WC, less than 15 Sq. In. typical, depends on Model configuration. Call for additional repeatability details.



ASME Calibration Nozzles



Front View of Clamp

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	± 0.10 % of reading @ 5 inWC and 70 °F (typical)
Overall Uncertainty	± 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 – 1.0 psig (optional 0 – 0.5 psig for low-flow)	0.0001 psig	Mensor CPT-6100 ± 0.01 % FS
Atmospheric Pressure	8 – 17 psia	0.0001 psia	Mensor CPT-6100 ± 0.01 % FS
Temperature (Plenum & Room)	49.6 – 120.3 °F	0.1 °F	Platinum RTD ± 0.5 °F
Flow Range (EFA)	0.5 – 30 in ² (40 in ² with 40 HP option)	0.001 in ²	ASME Array / Orifice Plate Standardization

3. Measurement Uncertainty (Best Typical Conditions)

Test Pressure	Machine Uncertainty*	Overall Uncertainty (ASME Array Ref)**	Overall Uncertainty (2 Arrays Averaged)
0.5 inWC	± 0.0028 inWC (0.29 %)	± 0.0022 inWC (0.44 %)	± 0.0019 inWC (0.37 %)
1.0 inWC	± 0.0017 inWC (0.17 %)	± 0.0037 inWC (0.37 %)	± 0.0029 inWC (0.29 %)
5.0 inWC	± 0.0052 inWC (0.10 %)	± 0.017 inWC (0.35 %)	± 0.013 inWC (0.26 %)

* Includes plenum, barometric and temperature terms.

** Based on single ASME Array 0.33 % of reading traceability.

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

4. ASME Nozzle Array Master

- Eleven calibrated nozzles: $7 \times 5 \text{ in}^2$, $2 \times 2 \text{ in}^2$, $1 \times 1 \text{ in}^2$, $1 \times 0.5 \text{ in}^2$.
 - Additive configuration for flows from 0.5 to $\approx 30 \text{ in}^2$ (40 in^2 with extended option).
 - NIST-traceable five-year calibration interval.
 - Serves as corporate EFA transfer standard for satellite test facilities.
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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 'EFA Testing' software interface. At the top, there's a menu bar with 'Test Operator', 'Reports', 'Setup', 'Diagnostics', 'Tools', 'Shutdown', and 'About'. Below the menu, the 'CCDI' logo is visible. 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 Readings:**
 - 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:**
 - Part Test Profile Name: Part ID
 - TEST.TST : TEST
 - Buttons: F2 Load Program, F3 Calibration, F4 Master ->, F5 Start ->, F6 ReMaster ->, F7 Finished
- Test Results Table:**

Line	Serial	Customer	Cust. EFA	Cust EFA P-P%	Meas. EFA	EFA P-P%	Std Day RPM
Production Averages							
- Buttons:** F1 Cancel/Erase, Airflow Parameter Details

At the bottom, a status bar reads: '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:
 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

Table:

No.	Area	Flow	Status
W01			
R01			

Buttons: F1 Cancel, F4 Start, F12 Exit

☐ Close when finished flowing

Filename:
 Comments:

PID

☒ PID-Auto VDC:

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

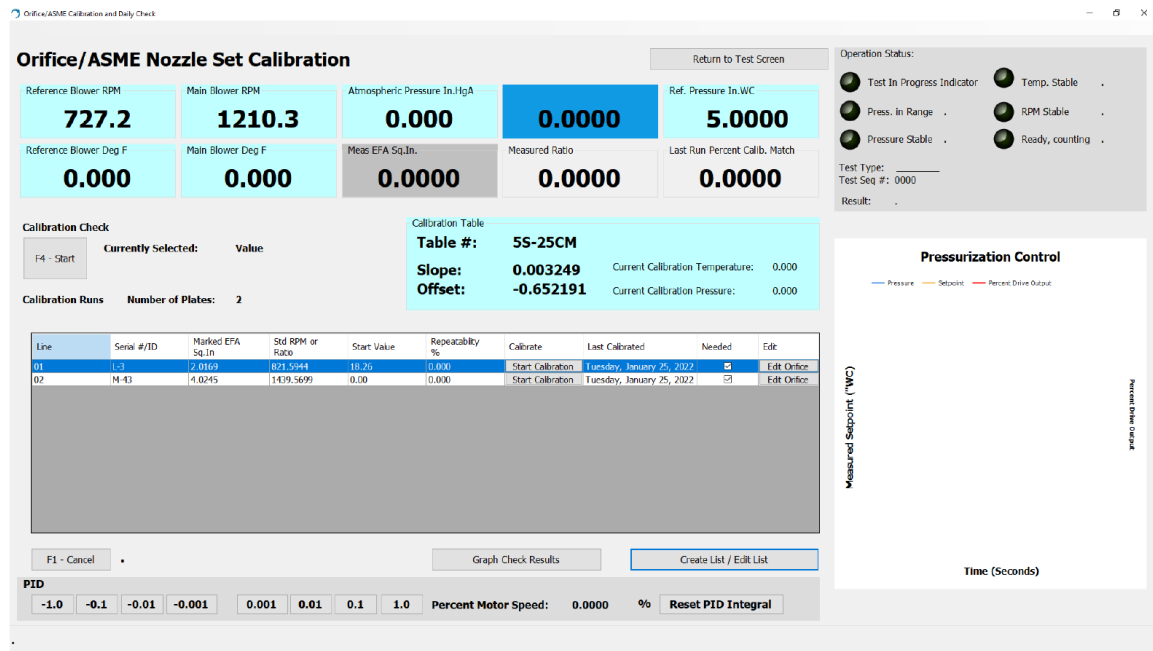
Part Name: Revision: Profile Comment:
 OEM: Last Edited:
 File Name:

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

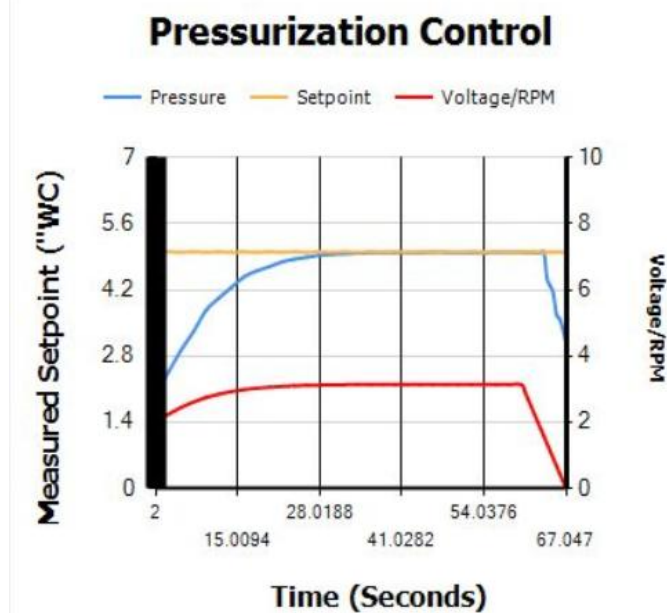
Setpoint: Direction: Number Of Test Runs:
 Minimum Flow: Start Value: Number of Warm-up Runs:
 Maximum Flow:
 Num/Blowers: Pressure Decimal Places:
 Template Name: Flow Decimal Place:s:
 Fixture ID: Final Area Decimal Places:
 Data Filename: Pressure Units:
☐ Condense Multi-line flow results into a single Average Flow log entry Area Units:

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.

EFA Print

Selection Criteria Review/Print Old Reports Configure About Exit

MACHSER

Choose from this first:

Selected File: CALIB.DAT

CALIB.DAT

Choose this second:

Part ID: EFATEST

CALIB2
SWA-PT6
CALIB2
EFATEST

Choose this last:

Date-Order: Blank - 10May18

Blank - 14Feb17
8288919 - 20Feb17
Blank - 10May18
9.9569 - 25Sep21
9.9569#2 - 25Sep21
Blank - 4Oct21
7.0025 - 4Oct21

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 checkbox:

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

Selft. Decimal Precision: 3 Print Landscape ☒ Save Reports

Result Decimal Precision: 3 Print SignatureLine

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
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

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: _____

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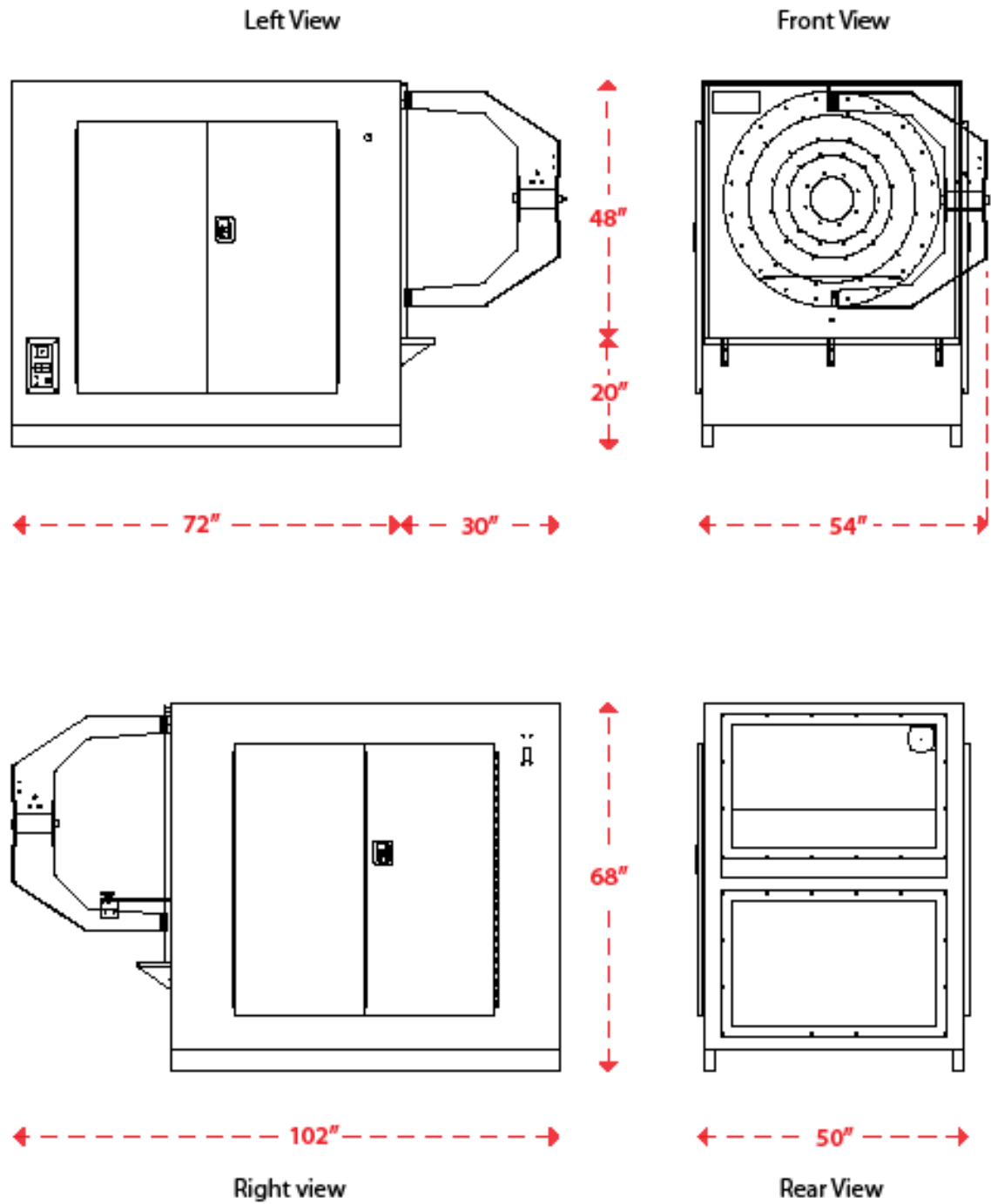
6. System and Facility Requirements

Electrical	380 – 460 VAC 3-phase @ 30–100 A (depending on blower config.)
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 min per EFA measurement

7. Mechanical Data

Size (H × W × D)	68 × 50 × 75 in (1727 × 1270 × 1905 mm)
Required Clearance	Front 20–40 ft · Rear 10–15 ft · Sides 5–8 ft · Top 3 ft
Construction	Welded steel frame, powder-coated panels, vibration-isolated blower mounts





Space Requirement		
	Ideal	Minimum (longer Stabilization Time)
Front(ft.)	40	20
Rear(ft.)	15	10
Sides(ft.)	8 on either side	5 on either side
Top(ft.)	3	3

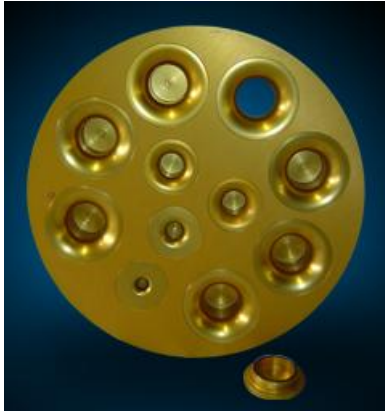
8. Performance Summary

Attribute	Specification
Repeatability (typical)	± 0.10 % of reading @ 5 inWC
Overall system uncertainty	± 0.35 % of reading @ 5 inWC (± 0.26 % if dual array average)
Stabilization time	< 30 s to steady-state PID lock
Data outputs	EFA (in ² /cm ² /mm ²), pressure (psig or 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 88 EFA Scientific Comparator Test Stand – Technical Specification (Rev 2025)

Revision 2025 – Incorporates Mensor CPT-6100 (0.01 % FS) and EFAOne Software Enhancements

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