# IAPMO IGC 426-2026

PUBLIC REVIEW DRAFT

*Industry Standard for*

# On-Ratio Performance Evaluation of Spray Polyurethane Foam (SPF) Draft

# *IAPMO Standard*

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# *Contents*

# *Preface*

This is the first edition of IAPMO IGC 426, *On-Ratio Performance Evaluation of Spray Polyurethane Foam (SPF)*.

This Standard was developed by the IAPMO Standards Review Committee (SRC) in accordance with the policies and procedures regulating IAPMO industry standards development, Policy S-001, Standards Development Process. This Standard was approved as an IAPMO Industry Standard on Month Day year.

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- *(b) relevant section, table, or figure number, as applicable;*
- *(c) wording of the proposed change, tracking the changes between the original and the proposed wording; and*
- *(d) rationale for the change.*

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- *(a) the edition of the standard for which the interpretation is being requested;*
- *(b) the definition of the problem, making reference to the specific section and, when appropriate, an illustrative sketch explaining the question;*
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# IAPMO IGC 426-2026
# On-Ratio Performance Evaluation of Spray Polyurethane Foam (SPF)

## 1 Scope

This standard specifies a test method for evaluating process parameters of spray polyurethane foam (SPF) insulation, including both open-cell and closed-cell types, under controlled variations in component ratio and environmental conditions. The method assesses the effects of mix ratio, ambient temperature, processing temperature, and fluid pressure on the quality of the applied foam. It provides procedures for measuring sprayability, set-back (foam shrinkage), core density, and other physical characteristics, with continuous recording of processing parameters.

### 1.1 Applicability

This test method is applicable to research, quality control, and compliance testing of SPF equipment and materials. The test method may be used to demonstrate that SPF products, when applied within specified parameters, meet on-ratio quality and physical property requirements.

This standard does not address long-term material properties (such as thermal resistance or aging), chemical emissions, fire resistance, or flammability. These topics are covered by other standards (e.g., ASTM C518, ASTM D8445, ASTM E84, ASTM D1622).

### 1.2 Alternative Materials

The requirements of this Standard are not intended to prevent the use of alternative materials or methods of construction provided such alternatives meet the intent and requirements of this Standard.

### 1.3 Terminology

In this Standard,

(a) “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy to comply with the Standard;
(b) “should” is used to express a recommendation, but not a requirement;
(c) “may” is used to express an option or something permissible within the scope of the Standard; and
(d) “can” is used to express a possibility or a capability.

Notes accompanying sections of the Standard do not specify requirements or alternative requirements; their purpose is to separate explanatory or informative material from the text. Notes to tables and figures are considered part of the table or figure and can be written as requirements.

### 1.4 Units of Measurement

SI units are the primary units of record in global commerce. In this Standard, the inch/pound units are shown in parentheses. The values stated in each measurement system are equivalent in application, but each unit system is to be used independently. All references to gallons are to U.S. gallons.

# 2 Reference Publications

This Standard refers to the following publications

**ASTM – American Society of Testing and Materials**
**ASTM C518** – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
**ASTM D1621** – Standard Test Method for Compressive Properties of Rigid Cellular Plastics
**ASTM D1622** – Standard Test Method for Apparent Density of Rigid Cellular Plastics
**ASTM D2126** – Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
**ASTM D8445** – Standard Practice for Measuring Chemical Emissions from Spray Polyurethane Foam (SPF) Insulation Samples in a Large-scale Ventilated Enclosure
**ASTM E29** – Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
**ASTM E84** – Standard Test Method for Surface Burning Characteristics of Building Materials

# 3 Definitions and Abbreviations

## 3.1 Definitions

The following definitions shall apply in this Standard:

**3.1.1 A-side and B-side (components)** – The two liquid chemical components use to produce SPF. The A-side is the isocyanate component (commonly known as a methylene diphenyl diisocyanate (MDI) or polymeric methylene diphenyl diisocyanate (PMDI)). The B-side is the resin blend, which contains polyols, catalysts, blowing agents, flame retardants, surfactants, and other additives. The components are intended to be mixed at equal volumes to achieve the desired chemical reaction.

**3.1.2 Core Density (Apparent Density)** – The mass per unit volume of the foam's core, excluding the surface skin. Core density is typically expressed in pounds per cubic foot (lb/ft$^3$) or kilograms per cubic meter (kg/m$^3$).

**3.1.3 Gear-Driven (Metering System) Proportioner**– An SPF dispensing machine that uses positive-displacement gear pumps for both A and B components, with flow measurements and electronic control to maintain the desired component ratio.

**3.1.4 Mix Ratio (A:B Ratio)** – The proportion of A-side to B-side components by volume as delivered to the mixing chamber of the spray gun.

***Note:*** *Spray polyurethane foam (SPF) is typically formulated for a 1:1 volume ratio (100 parts A to 100 parts B). The ratio may be expressed as A:B (e.g., 1.00:1) or as a percentage deviation from 1:1. An "A-rich" off-ratio indicates excess A-side (ratio > 1:1); a "B-rich" off-ratio indicates excess B-side (ratio < 1:1). For example, a ratio of 1.02:1 represents a 2% A-side rich condition, and 0.98:1 represents a 2% B-side rich condition. Maintaining the mix ratio within a specified tolerance (commonly ±2% of 1:1) is necessary to achieve optimal foam properties.*

*On-Ratio: Mix of 1:1 (100 parts A to 100 parts B).*

*Off-Ratio: Mix of either A-side and/or B-side at a ratio that does not equal 1.*

**3.1.5 Set-back (Foam Shrinkage)** – The reduction in foam thickness that occurs after application during curing and cooling. Set-back is measured as the difference between the initial peak thickness of the foam immediately after expansion and the final thickness after full cure (typically measured after 24 hours at ambient conditions).

**3.1.6 Spray Equipment Terminology** – The following terms are used in this Standard:

- **Dynamic pressure** - The pressure at which the fluids are delivered to the spray gun during application
- **Heated hose** - Hose assemblies that maintain A and B component temperatures up to the spray gun
- **Mix chamber** – The internal part of gun where the components impinge and mix
- **Nozzle or spray tip** – The output orifice that shapes the spray pattern
- **Spray gun** - The device at the end of the hose where A and B components are mixed and dispensed.
- **Transfer pumps** - Pumps that feed chemicals from supply drums to the proportioner

These terms are consistent with standard industry usage in SPF application. For specific equipment definitions, refer to manufacturer documentation.

**3.1.7 Spray Pass / Lift** – A single, continuous application of foam to a substrate, typically producing a defined thickness. In this test method, a spray pass refers to applying foam in one motion to achieve the target thickness. Multiple passes may be used to build up greater thickness, but this method generally evaluates single-pass performance.

**3.1.8 Spray Polyurethane Foam (SPF)** – A cellular plastic foam produced by mixing and reacting an isocyanate component (A-side) with a polyol resin component (B-side), typically at a 1:1 volume ratio. The components are sprayed in place, where they expand and cure to form a thermal insulation material.

**3.1.9 Sprayability** – The qualitative ability of the foam system to be sprayed uniformly and efficiently. Sprayability includes the uniformity of atomization, adhesion to the substrate, stability of the spray pattern, absence of anomalies such as sputtering or frothing, and the rate at which the foam becomes tack-free.

**3.1.10 Substrate** – The surface onto which the foam is sprayed for testing.

## 3.2 Abbreviations

The following abbreviations apply in this Standard:

**CC SPF** – closed-cell SPF
**HFO –** Hydrofluoroolefin (a blowing agent type for CC SPF)
**MDI** – methylene diphenyl diisocyanate (iso component)
**OC SPF** – open-cell SPF
**PMDI** – Polymeric methylene diphenyl diisocyanate (iso component)
**PPE –** Personal Protective Equipment
**SPF –** Spray Polyurethane Foam

# 4 General Requirements

## 4.1 Materials

Spray polyurethane foam (SPF) systems consist of two components, A-side and B-side, which are processed and applied as spray polyurethane foam.

**4.1.1** The A-Side shall be a diisocyanate, which may be either a methylenediphenyl diisocyanate or a polymeric methylenediphenyl diisocyanate.

**4.1.2** The B-Side shall consist of a blend of catalysts, surfactants, polyols, blowing agents, fire retarders, and water.

**4.1.3** Open-cell foam shall have a density ranging from 5.61kg/m3 (0.35lb/ $ft^3$) to 12.81kg/ m3 (0.80lb/ $ft^3$) and shall be characterized by greater than 90% open cell content in accordance with ASTM D1622.

**4.1.4** Closed-cell foam shall have a density ranging from 28.03 kg/$m^3$ (1.75lb/$ft^3$) to 40.05 kg/$m^3$ (2.5 lb/$ft^3$) and shall be characterized by greater than 90% closed cell content in accordance with ASTM D1622.

**4.1.5** Roofing foam shall be closed-cell with a density ranging from 40.05 kg/$m^3$ (2.5lb/ft3) to 64.07 kg/$m^3$ (4.0 lb/ft3) in accordance with ASTM D1622.

**4.1.6** Polyurea shall be an elastomeric composition derived from the reaction of an isocyanate component (which may be an aromatic or aliphatic, monomeric, polymeric, quasi-prepolymer, or prepolymer) and an amine component.

## 4.2 Toxicity

Materials and components specified in Section 4.1 shall be used and installed in accordance with the manufacturer's recommendations and installation practices.

# 5 Testing Requirements

## 5.1 Test Specimen, Test Apparatus, and Procedure

### 5.1.1 Test Specimen

The test specimen shall consist of a rigid panel substrate onto which foam is sprayed. The minimum recommended substrate shall be 1/2-inch (12 mm) thick plywood or oriented strand board (OSB) panels, approximately 0.3 m × 0.3 m (12 in × 12 in) in size. The substrate shall be conditioned to the temperatures set in the test plan prior to foam application.
*Note: If multiple layers of foam are to be sprayed, additional substrate or larger panels may be required.*

### 5.1.2 Test Apparatus

The test apparatus shall consist of:

**Proportioning Apparatus:** The proportioning apparatus shall independently meter and record A-side and B-side flow rates, pressures, and temperatures; shall maintain the specified A:B ratio within ±2% during spraying; and shall provide data logging of these parameters at a minimum frequency of 1 Hz (once per second). The apparatus and hose system shall include heating to maintain component processing temperatures and shall be capable of generating sufficient fluid pressure for SPF application (typically up to 13,790 kPa (2,000 psi)). Alternative apparatus may be used, provided they meet these performance requirements.

**Spray Gun:** A two-component spray gun shall be used that is compatible with the proportioning apparatus and shall provide proper mixing of A-side and B-side components. Air-purge or mechanical-purge types may be used. The mix chamber and spray tip shall be selected to achieve the specified output and a uniform spray pattern. Heated hoses shall maintain component temperature to the point of mixing.

**Substrate Panel:** The test substrate shall be a rigid panel as described in 5.1.1. Alternate substrates may be used if relevant to the application and shall be documented in the test report.

**Environmental Control (if required):** When testing outside normal laboratory conditions, environmental control shall maintain humidity, ambient and substrate temperatures as specified in the test plan. Ventilation shall be adequate to comply with safety requirements while avoiding airflow that disrupts spray application.

**Measurement Instruments:** Calibrated instruments shall be provided to measure ambient temperature, substrate temperature, component temperatures, and line pressures during spraying. Dynamic pressure should be measured proximal to the spray gun during application. Instruments shall have ranges appropriate to the values encountered.

**Foam Property Measurement Tools**: Tools shall include: a calibrated ruler, calipers, or depth gauge for thickness measurement; a laboratory balance for mass; and dimensional measurement aids for volume determination. Additional tools (e.g., straightedge, cutting implements) may be used as needed.

**Data Logging:** The data logging system shall record, at a minimum, time, A-side and B-side pressures, temperatures, flow rates, and the actual A:B ratio during spraying, at ≥1 Hz. Recording of ambient and substrate temperatures and product identification should be included. The system shall permit export of recorded data.

**Calibration**: All instruments (e.g., pressure gauges, thermometers, balance) shall be calibrated per manufacturer instructions prior to testing. Calibration records shall be retained and available for review upon request.

### 5.1.3 Procedure

#### 5.1.3.1 Preparation and Setup:

(a) **Machine Setup:** The proportioning apparatus and chemical supply shall be positioned and configured in accordance with the manufacturer's instructions. The test area shall be ventilated. Component heaters and heated hoses shall be set to the manufacturer's recommended processing temperatures. The apparatus shall be allowed to reach steady-state operating conditions prior to testing.

(b) **Substrate Placement:** The test substrate panel shall be mounted securely in the desired orientation. A vertical orientation is recommended unless otherwise specified. The panel shall be fixed to prevent movement during spraying. Reference points or grids may be marked on the panel as needed. A fresh panel is recommended for each major trial condition.

(c) **Environmental Conditioning:** Ambient and substrate temperatures shall be adjusted and conditioned as required for the test. The ambient and substrate temperatures shall be measured and recorded prior to each trial.

(d) **Review test plan:** Test plan shall be reviewed to determine test conditions and parameters. *Note: See Informative Annex A for a sample test plan.*

#### 5.1.3.2 Trial Execution

(a) **Target Ratio Setting:**
For each trial, the proportioning apparatus shall be set to the A:B ratio specified in the test plan. The ratio setting shall be documented for each trial.

(b) **Set Other Parameters:**
All other test parameters, including fluid pressure and component temperatures, shall be set according to the test plan. Each parameter shall be allowed to reach steady-state before spraying.

(c) **Spraying the Foam:**
A brief test spray shall be performed to ensure proper operation. Foam shall be applied to the substrate in a single, uniform pass to achieve the target thickness. The spray gun shall be held perpendicular to the substrate. The target thickness for each trial shall be consistent with the test plan.

(d) **Data Recording:**
The data logging system shall record all required parameters during spraying (See Section 5.1.2). The operator shall observe and note any anomalies in spray pattern, foam appearance, or equipment operation. Initial foam thickness shall be measured immediately after expansion for reference.

(e) **Stopping Criteria:**
Spraying shall be stopped once the target area is covered. The foam shall not be disturbed immediately after application. If multiple samples are sprayed on one panel, they shall be spaced to prevent interaction.

(f) **After Spraying – Data Marking:**
Each sample shall be clearly identified with trial number, ratio setting, temperature, humidity, and end-use application. Data logging for the trial shall be stopped and saved.

(g) **Allow Foam to Cure:**
The foam shall be allowed to cure undisturbed. Final thickness and other measurements shall be taken after a standard cure time, as specified in the test plan (e.g., 1 hour or 24 hours).

#### 5.1.3.3 Measurements and Evaluations Post-Cure

(a) **Thickness and Set-Back Measurement:**
The thickness of the cured foam shall be measured at the center and at a minimum of four additional points across the sample using a calibrated ruler or depth gauge. If initial thickness was measured, set-back shall be calculated as the difference between initial and final thickness at corresponding points. The average set-back and range shall be reported.

(b) **Qualitative Observation of Foam Quality:**
The cured foam shall be inspected for:
- Color and surface uniformity,
- Cell structure (by cutting a cross-section),
- Adhesion to the substrate, and
- Presence of defects such as cracks, splits, or delamination.

Observations shall be recorded.

(c) **Core Density Determination:**
Core density shall be determined in accordance with ASTM D1622.

(d) **Additional Tests:**
Additional property tests may be performed as specified in the test plan, such as:
- Compression strength (ASTM D1621),
- Reactivity profile (analysis of temperature or pressure changes over time),
- Thermal conductivity (ASTM C518),
- Dimensional stability (ASTM D2126),
- Other property tests requested by the customer.

(e) **Repetition:**
The spraying and measurement process shall be repeated for each condition in the test plan. Duplicate trials are recommended for critical conditions identified in the test plan to ensure repeatability.
*Note: If equipment malfunctions during the spraying process, discard the sample and repeat the trial.*

(f) **Interpreting Machine Logs:**
After all trials, logged data shall be retrieved and reviewed. For each trial, the actual achieved ratio, pressures, and temperatures during spraying shall be determined and correlated with foam results. Any anomalies shall be noted (e.g. equipment sensor goes offline temporarily).

### 5.1.2 Records and Reports

The test report shall include comprehensive documentation of the materials, conditions, procedures, and results. At a minimum, the report shall contain the following:

- **Identification of Foam Product:** Name, manufacturer, product designation (open-cell or closed-cell), lot/batch number (if available), and blowing agent type (if known). Any formulation specifics (e.g., “Winter” or “Summer” formulation) shall be noted.

- **Equipment Used:** Description of the spraying equipment (make and model of proportioner, spray gun type, hose length). Calibration status of measurement devices shall be included.

- **Test Conditions:** Table or listing of environmental and machine settings for each trial, including ambient temperature (and humidity if notable), substrate material and temperature, component temperatures (A & B, set and actual), fluid pressure, and ratio setting. See Table 1 for an example.

- **Procedure Notes:** Any deviations from the prescribed procedure or issues that arose during testing.

- **Results – Quantitative:** For each trial, report:
- Final foam thickness (and initial if measured) and calculated set-back,
- Core density values,
- Any other measured property (e.g., compressive strength if performed),
- Actual achieved ratio from data log.
  *Note: See Table 2 for an example.*

- **Results – Qualitative:** For each trial, report observations on:
- Sprayability,
- Appearance,
- Cell structure,
- Adhesion,
- Odor (if noted)

- **Discussion (optional):** Interpretation of results, including the effect of off-ratio or environmental conditions on foam properties.

- **Conclusion/Compliance Statement:** Statement of whether the foam met the specified criteria under the tested conditions, specified by the test plan.

- **Data Attachments:** Attach or reference raw data logs, plots, or tables as required.

- **Precision and Bias Statement:** Include any known uncertainty or reference to the standard's precision statement.

- **Photographic Documentation (optional):** Photographs of foam samples (surface and cross-section) may be included.

- **Signature/Certification:** The report shall be signed and dated by the responsible testing engineer or laboratory.

- **Appendices:** Supplementary information such as full datasets, calibration certificates, or additional background may be included as appendices.

**5.2.1 Calculations and Data Analysis**

**5.2.2 Mix Ratio and Deviation:**
The actual mix ratio for each trial shall be calculated from logged data, either by integrating flow rates (total volume A vs. B) or using the recorded ratio value. The result shall be expressed as A:B and as percent deviation from nominal.

**5.2.3 Thickness and Set-back:**
For each sample, the average foam thickness after cure shall be calculated. If initial thickness was recorded, set-back shall be calculated for each point and averaged. Set-back may also be reported as a percentage of initial thickness.

**5.2.4 Density:** Core density shall be calculated for each sample in accordance with Section 5.1.3.3(n). If multiple pieces are tested, report the average and range. Percentage difference from nominal or on-ratio density may be calculated.

**5.2.5 Statistical Analysis:** If replicate trials are performed, standard deviation for key metrics (e.g., density, set-back) shall be calculated.

**5.2.6 Other Calculations**: If timed events (e.g., rise time, tack-free time) are recorded, average values may be reported. Comparative metrics may be calculated if multiple formulations or machines are tested.

**5.2.7 Rounding and Significant Figures:** Results shall be reported in accordance with ASTM E29 or an agreed-upon rounding method. Density shall be reported to two decimal places, thickness to the nearest 0.01 in (0.1 mm), and ratio to 0.01 ratio unit (0.1%). Sufficient significant figures shall be maintained to reflect measurement precision.

**Table 1**
**Example Test Conditions**

| Trial | Ratio Setting (A:B) | Ambient Temp (˚C/°F) | A/B Component Temp (˚C/°F) | Fluid Pressure (kPa/psi) | Other Notes |
|---|---|---|---|---|---|
| 1 | 1.00:1 (on-ratio) | 21˚C/70°F | 54/54˚C;130/130°F | 8274kPa/1200psi | Baseline condition |
| 2 | 1.02:1 (2% A-rich) | 21˚C/70°F | 54/54˚C;130/130°F | 8274kPa/1200psi | Slight A excess |
| 3 | 1.13:1 (13% A-rich) | 21˚C/70°F | 54/54˚C;130/130°F | 8274kPa/1200psi | Significant off-ratio |
| 4 | 1.00:1 | 4˚C/40°F | 54/54˚C;130/130°F | 8274kPa/1200psi | Cold ambient |

**Table 2**
**Example of Quantitative Trial Results**
(See Sections 5.2.2)

| Trial | Actual Ratio (A:B) | Avg. Thickness (cm/in) | Set-back (cm/in) | Core Density (kg/m³; lb/ft³) |
|---|---|---|---|---|
| 1 (baseline) | 1.00:1 | 5.08cm/2.00 in | 0.00 (0%) | 32.0kg/m³; 2.0 lb/ft³ |
| 2 (2% A-rich) | 1.01:1 | 4.95cm/1.95 in | 0.05 (2.5%) | 33.6 kg/m³; 2.1 lb/ft³ |
| 3 (13% A-rich) | 1.12:1 | 4.57cm/1.80 in | 0.20 (10%) | 36.8 kg/m³; 2.3 lb/ft³ |

# Informative Annex A

# Sample Test Plan

**A1.1 Objective:** This informative appendix provides a sample test plan for SPF Ratio Trials. This is a sample only and does not contain any real data or references.

# SPF Ratio Trials

*In accordance with IAPMO IGC 426-2026*

*On-Ratio Performance Evaluation of Spray Polyurethane Foam (SPF)*

**1. Manufacturer Information**

| | |
|---|---|
| **Manufacturer Name:** | Spray Foam Company |
| **Address:** | 123 Main Street<br>Anytown, USA 12345 |
| **Contact:** | [To be completed] |

**2. Product Information**

| | |
|---|---|
| **Product Name:** | SPF Closed-Cell Foam |
| **Product Type:** | Closed-Cell SPF (CC SPF) |
| **Nominal Density:** | 32.04 kg/m³ (2.0 lb/ft³) |
| **Lot/Batch Number:** | [To be completed prior to testing] |
| **Blowing Agent:** | [To be completed] |
| **Formulation:** | [Standard / Winter / Summer] |

**3. Test Objective**

This test plan describes the procedures for evaluating the on-ratio performance of SPF Closed-Cell Foam under controlled variations in component mix ratio and ambient temperature conditions. The objective is to assess the effects of mix ratio deviation and environmental conditions on foam quality, sprayability, set-back (shrinkage), and core density in accordance with IAPMO IGC 426.

## 4. Test Equipment

### 4.1 Proportioning Apparatus

| | |
|---|---|
| **Make/Model:** | [To be completed] |
| **Type:** | Gear-Driven Metering System |
| **Data Logging:** | Minimum 1 Hz sampling rate for A/B pressures, temperatures, flow rates, and ratio |
| **Hose Length:** | [To be completed] |

4.2 Spray Gun

| | |
|---|---|
| **Type:** | [Air-purge / Mechanical-purge] |
| **Mix Chamber:** | [To be completed] |
| **Spray Tip/Nozzle:** | [To be completed] |

### 4.3 Test Substrate

| | |
|---|---|
| **Material:** | ½-inch (12 mm) OSB, Plywood, or Gypsum Wallboard |
| **Size:** | 0.3 m × 0.3 m (12 in × 12 in) |
| **Orientation:** | Vertical (unless otherwise specified) |
| **Conditioning:** | Conditioned to test ambient temperature prior to foam application |

### 4.4 Measurement Instruments

All instruments shall be calibrated per manufacturer instructions prior to testing. Calibration records shall be retained.

| Instrument | Purpose | Calibration Status |
|---|---|---|
| Thermometer(s) | Ambient, substrate, component temps | [To be verified] |
| Pressure Gauges | Fluid line pressures | [To be verified] |
| Depth Gauge/Calipers | Foam thickness measurement | [To be verified] |
| Laboratory Balance | Core density determination | [To be verified] |

**5. Test Conditions**

The following test conditions shall be evaluated. Each trial shall use a fresh substrate panel.

| Trial | Ratio Setting (A:B) | Ambient Temp | A/B Component Temp | Fluid Pressure | Notes |
|---|---|---|---|---|---|
| 1 | 1:1 *(on-ratio)* | 21°C / 70°F | 54°C / 54°C 130°F / 130°F | 8,274 kPa 1,200 psi | **Baseline** |
| 2 | 1.02:1 *(2% off-ratio)* | 21°C / 70°F | 54°C / 54°C 130°F / 130°F | 8,274 kPa 1,200 psi | Slight **"A"** excess |
| 3 | 1.13:1 *(13% off-ratio)* | 21°C / 70°F | 54°C / 54°C 130°F / 130°F | 8,274 kPa 1,200 psi | Significantly off-ratio |
| 4 | 1:1 *(on-ratio)* | 4°C / 40°F | 54°C / 54°C 130°F / 130°F | 8,274 kPa 1,200 psi | **Cold ambient** |

**5.1 Application Parameters**

| | |
|---|---|
| **Target Foam Thickness:** | ~5 cm (~2 inches) per pass |
| **Spray Gun Distance:** | [Per manufacturer recommendation] |
| **Spray Passes:** | Single pass |
| **Cure Time (Final Measurements):** | 24 hours at ambient conditions |

**6. Measurements and Evaluations**

**6.1 During Application**

The data logging system shall record the following parameters at ≥1 Hz during spraying:

- A-side and B-side pressures (kPa/psi)
- A-side and B-side temperatures (°C/°F)
- A-side and B-side flow rates (cc/s)
- Actual A:B ratio
- Ambient temperature

**6.2 Post-Cure Measurements**

The following measurements shall be performed after the specified cure time:

| Measurement | Method |
|---|---|
| Thickness | Center and minimum 4 additional points per sample |
| Set-back (Shrinkage) | Difference between initial and final thickness |
| Core Density | Per ASTM D1622 (send to 3rd party accredited lab) |

**6.3 Qualitative Observations**
For each trial, the following shall be documented:

- Sprayability (uniformity of spray, pattern stability)
- Color and surface uniformity
- Cell structure (via cross-section)
- Adhesion to substrate
- Presence of defects (cracks, splits, delamination)

**7. Reference Standards**
- IAPMO IGC 426: On-Ratio Performance Evaluation of Spray Polyurethane Foam (SPF)
- ASTM D1621: Standard Test Method for Compressive Properties of Rigid Cellular Plastics
- ASTM D1622: Standard Test Method for Apparent Density of Rigid Cellular Plastics
- ASTM E29: Standard Practice for Using Significant Digits in Test Data

**8. Approvals**

| Role | Signature / Date | Printed Name |
|---|---|---|
| Prepared By: | | |
| Reviewed By: | | |
| Approved By: | | |

**9. Document Control**

| | |
|---|---|
| **Test Plan Number:** | [To be assigned] |
| **Revision:** | Rev. 0 (Initial Release) |
| **Date:** | [To be completed] |

# Informative Annex B

## B1. Example Test Data

**B1.1 Objective:** This appendix provides an illustrative example of data collected during a series of spray foam trials according to this test method. It demonstrates how the raw data and measured results might be presented. This example is provided for informational purposes only.

**B1.2 Setup:** The example trials were performed on a closed-cell SPF system with nominal 32.04 kg/m³ (2.0lb/ft³) density. The proportioner used was an Akurate Dynamics Delta CPS-HV. Three ratio settings were tested at standard ambient conditions (~21˚C/~70°F): on-ratio (1:1), mildly off-ratio (1.02:1 A-rich), and significantly off-ratio (1.13:1 A-rich). All other conditions (component temperature ~54˚C/~130°F, spray pressure ~8274kPa/~1200 psi, substrate OSB at 54˚C/70°F) were held constant. Each trial sprayed a ~5cm/~2-inch-thick foam layer on a 0.3mx0.3m (12”×12”) panel.

**B1.3 Logged Machine Data Excerpt:** Below is a snapshot from the machine’s log file during the spraying of the 1.13:1 trial (Trial 3). For brevity, only select parameters and time points are shown:

| Time (hh:mm:ss) | A Pressure (kPa/psi) | B Pressure (kPa/psi) | A Flow (cc/s) | B Flow (cc/s) | Ratio % | A Fluid Temp (˚C/°F) | B Fluid Temp (˚C/°F) |
|---|---|---|---|---|---|---|---|
| 15:20:00 | 8274/1200 | 8136/1180 | 650 | 580 | 112% | 54/130 | 54/130 |
| 15:20:01 | 8239/1195 | 8067/1170 | 660 | 590 | 112% | 54/130 | 54/129 |
| 15:20:02 | 8308/1205 | 8170/1185 | 655 | 585 | 112% | 54/130 | 54/130 |
| *…during spray…* | … | … | … | … | … | … | … |
| 15:20:10 | 8205/1190 | 8205/1190 | 640 | 640 | 100% | 54/129 | 54/129 |
| *Spray off* | | | | | | | |

*Explanation:* At the start of Trial 3, the A pump was intentionally sped up to target ~13% higher flow than B. The log shows Ratio % around 112% (meaning A was 12% higher than B) at the beginning of the spray. Near 10 seconds, the operator released the trigger (flows dropped; by 15:20:10 the flow rates equalized as the system pressure equalized with no flow, showing 100% ratio at idle). The temperature remained around setpoint (54˚C/130°F) and pressures were balanced (~8274kPa/~1200 psi). This confirms the machine achieved the intended off-ratio during actual spraying. (In an actual dataset, dozens of lines per second would be logged; here a few are shown for illustration.)

**B1.4 Summary of Results:** Table X1.1 compiles the key outcomes of the three example trials:

**Table X1.1 –** Results of Example SPF Ratio Trials

| Trial | Ratio Setting (A:B) | Actual Ratio (from log) | Foam Appearance & Sprayability | Core Density (lb/ft³;lb/ft³) | Set-back (mm/inches) | Notes |
|---|---|---|---|---|---|---|
| 1 | 1.00:1 (On-ratio) | ~1.00:1 (100%) | Smooth, creamy spray; uniform light-yellow foam. | 32.8; 2.05 | 0.51/0.02 | Baseline – foam met specs. |
| 2 | 1.02:1 (2% A-rich) | ~1.01–1.02:1 (101–102%) | Slightly stiffer spray fan, foam a bit darker. | 33.6; 2.10 | 1.27/0.05 | Very minor differences. |
| 3 | 1.13:1 (13% A-rich) | ~1.12:1 (112%) | Spray was slightly "dry" and sputtery; foam dark, shiny skin. | 36.8; 2.30 | 51/0.20 | Foam brittle; shrank visibly. |

**B1.5 Interpretation:** In this example, Trial 1 produced foam at the expected 32.04 kg/m³ (2.0lb/ft³) density with negligible set-back (essentially no shrinkage). Trial 2 (just 2% high on A) still yielded acceptable foam, slightly higher density 33.6 kg/m³ (2.10lb/ft³) and a barely noticeable 1.27mm (0.05") shrink. The foam was qualitatively very similar to Trial 1, indicating the product can tolerate a slight ratio deviation. Trial 3, however, with a significant 13% excess A, resulted in a 12% higher density and notable 51mm (0.2") thickness loss (about 10% shrinkage from initial ~5cm (~2.0") down to ~4.6cm (~1.8"). The foam in Trial 3 was observed to be harder and more friable (crumbled when cut), consistent with known effects of A-rich off-ratio foam being "hard, friable, and brittle". This data supports the importance of maintaining ratio within a tight range, and it validates that the machine's real-time ratio control and logging correctly identified the off-ratio condition which correlated with the poorer foam outcome.

**B1.6 Photo Documentation:** This section should include photographs of the foam samples, as well as descriptions of the foam sample qualities depicted in the photos. Samples should be labeled with their respective trial numbers. Example descriptions may be as follows:

- Figure X1.1 shows photographs of the foam samples from Trial 1 and Trial 3 for visual comparison. The on-ratio sample (left) is uniform in texture and color, whereas the 13% off-ratio sample (right) shows a darker surface and slight cracks at the edges (highlighted by arrows) due to shrinkage.
- Definition of set-back (shrinkage) measurement, as used in this context
- Visual indistinguishability of on-ratio vs off-ratio foam without measurement (importance of verification)
- Mix ratio tolerance ±2% and effects of off-ratio (hard/brittle vs soft/gummy foam)
- Definition of sprayability in terms of uniform spray, adhesion, setup
- Method for determining core density by cutting sample without skin and measuring mass/volume


**International Association of Plumbing and Mechanical Officials (IAPMO)**

**4755 East Philadelphia Street | Ontario, California, 91761**

**1-800-854-2766 | 1-909-472-4100 | www.IAPMOstandards.org**

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