NIST Plastic Composition Analysis Workshop Pre-read

NIST is hosting a virtual workshop on Plastic Composition Analysis Workshop: Identifying reference material, data, and measurement needs September 28-29, 2026, with the goal of bringing together experts to identify critical challenges in plastic composition analysis where reference materials, interlaboratory studies, or documentary standard developments would deliver significant value for U.S. industry. The workshop will be highly interactive with participants engaging in discussions focused on identifying reference material and data needs as well as critical measurement challenges.

This pre-read provides useful background on existing NIST reference materials and data relevant to plastic composition analysis. Additionally, workshop organizers invite participants to reflect on the guiding questions in preparation for the breakout sessions.

Please visit the event page for information about the workshop, including a detailed agenda.

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Reference Materials and Reference Data Background Information

NIST Standard Reference Data: NIST produces the Nation's Standard Reference Data (SRD). These data are assessed by experts and are trustworthy such that people can use the data with confidence and base significant decisions on the data. NIST provides 49 free SRD databases and 41 fee-based SRD databases. SRD must be compliant with rigorous critical evaluation criteria. Learn more.

NIST Reference Materials: NIST supports accurate and compatible measurements by certifying and providing over 1300 Standard Reference Materials® with well-characterized composition or properties, or both. These materials are used to perform instrument calibrations in units as part of overall quality assurance programs, to verify the accuracy of specific measurements, and to support the development of new measurement methods. Learn more.

Reference Material Definitions: For context, some definitions relating to reference materials are given below. Additional definitions and information about reference materials are available here.

- **Reference Material (RM**) - Material, sufficiently homogeneous and stable with respect to one or more specified properties, which has been established to be fit for its intended use in a measurement process.
- **Certified Reference Material (CRM)** - Reference material characterized by a metrologically valid procedure for one or more specified properties, accompanied by a certificate that provides the value of the specified property, its associated uncertainty, and a statement of metrological traceability.
- **NIST Standard Reference Material® (SRM)** - NIST CRMs that deliver values certified by NIST. All SRMs deliver at least one certified property value that is:
    - Metrologically traceable to an internationally recognized higher-order reference system, such as the SI, and
    - Deemed by NIST to be suitable for providing unbiased calibration and/or validation of measurement procedures.
- **NIST Reference Material** – Reference materials that deliver property values for established measurands that are fit for the materials' intended uses, including between-method harmonization, within-method precision assessment, and process stability assessment.
- **NIST Research Grade Test Material (RGTM)** - A material evaluated during the SRM/RM development phase. RGTMs may be distributed in a NIST-sponsored interlaboratory inter-comparison to determine the fit for purpose of the candidate SRM/RM material. It is prepared to be homogeneous and stable but typically has not been quantitatively evaluated for all properties of potential interest.
- **NIST Certified Value** - A value reported on an SRM certificate or certificate of analysis for which NIST has the highest confidence in its accuracy in that all known or suspected sources of bias have been fully investigated or accounted for by NIST. (NIST SP 260-136).
- **NIST Non-Certified Value** - A best estimate of the true value based on currently available information; however, they do not meet NIST's criteria for certification (NIST SP 260-136).

NIST Reference Materials and Data Related to Plastic Composition Analysis

NIST Polymer Reference Material Overview

The tables below provide an overview of current or recent NIST reference materials relevant to plastic composition analysis. Links are provided to the NIST Store where additional information, including certificates of analysis, is available.

Table 1: NIST polymer reference materials developed for molecular weight, molar mass distribution, or melt flow rate determination. A brief perspective gives a history of these SRMs, their status in 2016, and challenges and opportunities to develop new standards to address industrial measurement challenges.

Item	Name	Certified Values	Availability
Reference materials developed for the determination of molecular weight or molar mass distribution			
SRM 705a	Polystyrene (Narrow Molecular Weight Distribution)	M_w, *Intrinsic Viscosity*	Available
SRM 706a	Polystyrene (Broad Molecular Mass Distribution)	M_w	Available
SRM 1475a	Linear Polyethylene (Whole Polymer)	*Melt Flow Rate,* M_n, M_w, M_z, *limiting viscosity, solid density, heat capacity*	Waitlist
SRM 1478	Polystyrene (Narrow Molecular Weight Distribution)	M_w, M_n, *Intrinsic Viscosity*	Available
SRM 1479	Polystyrene (Narrow Molecular Weight Distribution)	M_w	Available
SRM 1482a	Linear Polyethylene Narrow Molecular Mass Distribution (13 600 g/mol)	M_w, M_n, *Intrinsic Viscosity*	Discontinued
SRM 1483a	Linear Polyethylene Narrow Molecular Mass Distribution (32 100 g/mol)	M_w, M_n, *Intrinsic Viscosity*	Discontinued
SRM 1488	Poly(methyl methacrylate) 29 K Narrow Molecular Weight Distribution	M_n, *Limiting Viscosity*	Available
SRM 2885	Polyethylene (Mass-Average Molar Mass [MW] 6 280 g/mol)	M_w, *Intrinsic Viscosity*	Discontinued
SRM 2886	Polyethylene (Mass-Average Molar Mass [MW] 87 000 g/mol)	M_w, *Intrinsic Viscosity*	Discontinued
SRM 2887	Polyethylene (Mass-Average Molar Mass [MW] 196 400 g/mol)	M_w, *Intrinsic Viscosity*	Discontinued
Reference materials developed for the determination of melt flow rate using ASTM D1238-13			
SRM 1473c	Low Density Polyethylene Resin	*Melt Flow Rate*	Available
SRM 1474b	Polyethylene Resin	*Melt Flow Rate*	Available
SRM 1476a	Branched Polyethylene Resin	*Melt Flow Rate*	Available
Reference materials developed for the determination of melt flow rate using ASTM D1238-82			
SRM 1496	Unpigmented Polyethylene Gas Pipe Resin	*Melt Flow Rate, Intrinsic Viscosity*	Available

Table 2: NIST reference materials developed for plastic elemental analysis, determination of phthalate esters in polyvinyl chloride, or textile composition.

Item	Name	Certified Values	Availability
Reference materials developed for elemental analysis of polymers			
SRM 2855	Additive Elements in Polyethylene	*Mass fraction of Na, P, S, Ca, Ti, Cr, Zn*	Waitlist
SRM 2859	Restricted Elements in Polyvinyl Chloride	*Mass fraction of Cd, Ca, Cr, Fe, Rb, Hg, S, Sn*	Waitlist
SRM 2861	Restricted Elements in Polyvinyl Chloride	*Mass fraction of Sb, As, Ba, Cd, Ca, Cr, Fe, Pb, Hg, Se, S, Sn*	Waitlist
Reference materials developed for determining phthalate esters in polyvinyl chloride			
SRM 2860	Phthalates in Polyvinyl Chloride	*Mass fraction of bis(2-ethylhexyl) phthalate and di-n-octyl phthalate*	Waitlist
Test materials intended for textile composition analysis			
RGTM 10279	Textiles for Feedstock Identification	None - currently available as part of an interlaboratory study.	Available

NIST Mass Spectral Data, Tools, and Documentation

The NIST Mass Spectrometry Data Center develops mass spectral data, tools, and documentation They have several efforts ongoing to advance composition analysis of polymers and plastics including:

- **Mass Spectral Libraries:** Expanding the number of plastics-related small molecule compounds in the Electron Ionization Mass Spectral and Tandem Mass Spectral libraries. A recent publication summarized some of these efforts related to plastics.
- **Software Development:** NIST has developed a pyrolysis gas chromatography mass spectrometry (pyGC-MS) software tool for the identification of polymers by pyrolysis breakdown products. Learn more.

NIST Textile Data and Test Materials

NIST has been developing data and reference materials to support analysis of textile composition. These include:

- **Data**: Near Infrared Spectra of Origin-defined and Real-world Textiles (NIR-SORT) is a spectroscopic and materials characterization dataset for known provenance and post-consumer fabrics. The dataset contains data on textile specimens for applications including fiber content classification, systems and software development, and validation of textile sorting systems.
- **Test Materials:** FIBR: Fiber Identification Benchmarking with Research-Grade Test Materials (RGTM 10279) is available for collaboration with NIST to support an interlaboratory study on textile classification.

NIST Per- and Polyfluoroalkyl Substances (PFAS) and Non-Targeted Analysis Resources

Researchers at NIST have been developing reference materials and data resources that can be used to increase confidence in PFAS measurements, including the targeted, quantitative measurement and the non-targeted, qualitative identification of PFAS in different matrices. In addition, there has been emerging

category of techniques, referred to as non-targeted analysis, that intend to detect and identify small molecules in mixtures, such as plastic, using advanced instrumental and data analysis.

- **Reference Materials:** See NIST reference materials with measured amounts of PFAS here. Note none of these have a polymer matrix.
- **Interlaboratory Studies:** NIST has administered interlaboratory studies to understand the method performance for quantifying PFAS in a range of materials, including commercial mixtures. Recently, this work included the evaluation of laboratory performance for the non-targeted analysis of complex mixtures for the identification of PFAS, the report is available here.
- **Database Infrastructure:** The Database Infrastructure for Mass Spectrometry (DIMSpec) project focused on the creation of an open-source toolkit supporting storage and sharing of high-resolution mass spectra with attached sample and methodological metadata. As a demonstration of its utility, the DIMSpec toolkit was used to create a database of curated mass spectra for PFAS generated from various sources. Read more.

Guiding questions for breakout discussions

Workshop organizers invite participants to reflect on the following questions in preparation for the discussion sessions. NIST intends to synthesize the input received into a publicly available workshop report. To encourage open dialogue, input will be collected without attribution. Breakout discussions will be moderated, and participants will have an opportunity to provide feedback verbally and in writing. After the workshop, participants can provide additional comments to capture any input they were unable to provide during the breakout sessions or additional reflections from the workshop.

Plenary Session

- What motivated you to attend this workshop?
- If you currently use NIST reference materials or reference data, which ones do you use and why?
- If you could have one reference material or data set that currently does not exist, what would it be? How would it help advance plastic composition analysis?

Macromolecular Structure

- Which techniques / methods do you use for macromolecular structure characterization (e.g., molar mass and distribution, chemical composition, chain topology)?
- What are key challenges with regards to quantifying macromolecular structure? Consider aspects such as molar mass and distribution, chemical composition, monomer distribution, chain topology, and instrument / method limitations.
- What is most needed to overcome these challenges and limitations? Is there a need for reference materials, additional data such as constants at analytical conditions (dn/dc, Mark-Houwink, A_2), data processing methods, new measurement techniques or other developments?
- If additional reference materials are needed, how would they be used? What certified or reference values are needed (e.g M_w, M_n, Intrinsic viscosity, melt flow rate)? Describe the needed material including polymer type or family, chain architecture, and molecular weight range and distribution - e.g., “linear polyethylene with $M_w > 100{,}000$ g/mol and a polydispersity index < 1.5”.

- Other than reference materials, what else is needed to advance macromolecular characterization? How would it help?

Plastic Blends

- What techniques / methods do you use to quantify plastic blend composition? What are the most significant challenges or limitations to these techniques? Are there specific materials or methods where different laboratories yield conflicting results?
- What are the most significant challenges in composition analysis of polymer blends? Consider accuracy, detection limits, comparability, blend composition (e.g., polymer types, additives, recycled content).
- What is most needed to overcome challenges or limitations for plastic blend analysis? (e.g. reference materials, documentary standards, interlaboratory studies, reference data or other developments)
- If plastic blend reference materials are needed, how they would be used? What certified or reference values are needed? Describe the needed material including composition (polymers type, concentration, additives) and form factor - e.g., "Pellets of recycled HDPE with 5 wt% PP".
- Other than reference materials, what else is needed to advance plastic blend analysis? How would it help?

Textile Composition

- What techniques / methods do you use to analyze the chemical composition of textiles?
- What are challenges / limitations to current textile composition analysis or identification methods? Consider aspects such as accurately identifying components, difficulty separating blended fibers, interferences, or lack of sensitivity for low-percentage components.
- What components (e.g. halogens, specific dye classes, finishes, or legacy additives) most significantly interfere with the accurate quantification of the base polymers in textiles?
- Where is the greatest lack of reproducibility in textile composition analysis? Are there specific materials or methods where different laboratories yield conflicting results?
- Are currently available composition analysis guides/standards adequate? Why or why not?
- What is most needed to overcome challenges or limitations for textile composition analysis? (e.g., reference materials, documentary standards, interlaboratory studies, reference data or other developments)
- Does the NIST **RGTM 10279** and associated guide serve the current need? If so, in what capacity? If not, what specific gaps hinder analysis?
- If additional textile reference materials are needed, what is most urgently needed? Please be as specific as possible about what is needed and why – e.g., "A recycled PET/cotton blend spiked with known levels of brominated flame retardants for instrument calibration".
- Is there a need for expanded reference data sets (e.g., similar to NIST NIR-SORT)? If so, what specific properties, measurements, materials (e.g., fibers, blends, degradation state) are missing and how would these data sets improve your accuracy or throughput?

Halogen Determination in Plastics

- What established or emerging techniques / methods do you use to analyze halogens in plastics? What are the most significant challenges or limitations to these techniques? These can include technical measurement or logistical (e.g., high cost or limited training) challenges.
- What halogenated species or combinations are of the greatest importance to analyze in plastics and, briefly, why? What concentrations are necessary to analyze for most purposes? Specify if the specific halogens, total organic halogens, or total halogen (organic and inorganic) concentration is needed.
- What is most needed to overcome challenges or limitations for plastics halogen analysis? (e.g., reference materials, documentary standards, interlaboratory studies, reference data or other developments).
- If additional reference materials are needed, how they would be used? What certified or reference values are needed? Describe the needed material including type of matrix, halogen species, concentration, and form factor, e.g., "50 ppm total organic fluorine in polyvinyl chloride pellets".
- Is there a need for additional reference data, such as GC-MS or LC-MS, for halogenated compounds? What compounds and what data is most important to have?

Metals Analysis in Plastics

- What established or emerging techniques / methods do you use to analyze metals in plastics? What are the most significant challenges or limitations to these techniques / methods?
- What metals and mass fraction ranges are of the greatest importance to analyze in plastics? Why?
- What is most needed to overcome challenges or limitations for plastics metals analysis? (e.g., reference materials, documentary standards, interlaboratory studies, reference data or other developments)
- What reference materials are currently used for the analysis of metals in plastics? Are they sufficient? If not, why not?
- If additional reference materials are needed, how would they used? What certified or reference values are needed? Describe the needed material including type of matrix, metal species, concentration, and form factor, e.g., "100 ppm total arsenic in PET film".
- Other than reference materials, what else is needed to advance analysis of metals in plastics? How would it help?
- What are upcoming measurement challenges for metals in plastics analysis that you see coming in the future?

Additives, Non-intentionally Added Substances (NIAS), and Non-targeted Analysis

- What type of techniques / methods do you use to understand the broad scope of chemicals in polymers? (e.g., LC-HRMS, GC-MS, NMR, FTIR, Raman)
- What motivates the analysis of additives and NIAS in plastics? Is it manufacturing needs or regulatory requirements (e.g., applicable regulatory statutes or laws)?

- How does industry use non-targeted analysis for plastics? Is it performed in-house or by contract analytical laboratories? Is it hypothesis generating or hypothesis driven?
- What support is needed most for industry laboratories to implement these advanced analysis techniques? (e.g., reference materials or data, documentary standards, interlaboratory studies, new techniques, more training, or other developments)
- Are there plastics-related compounds such as degradation products, additives, or chemicals of concern that currently lack reference data? Comment on class, type, or source of compound, type of data is needed (e.g., LC-MS mass spectra, FTIR spectra), and why it is important.
- How is information made available about chemicals of concern (e.g., unintended presence in products, impact on manufacturing processes, toxicity in commercial products, or regulatory issues)?
- What challenges of additives and/or NIAS measurements are most important to you or your industry? (e.g., identification of unknowns, quantitation of compounds without analytical standards, in-line identification, standardized instrumentation or workflow, increased confidence in identification results, or challenges related to specific compounds or classes of compounds)
- What is the relative importance of quantitation versus identification to your work? Do you require multiple different measurements to confirm an identification?

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Abbreviations and Definitions

A_2	Second Viral Coefficient
CRM	Certified Reference Material
DIMSpec	Database Infrastructure for Mass Spectrometry
dn/dc	Refractive Index Increment
FIBR	Fiber Identification Benchmarking with Research-Grade Test Materials (RGTM 10279)
FTIR	Fourier Transform Infrared Spectroscopy
GC-MS	Gas Chromatography-Mass Spectrometry
HDPE	High Density Polyethylene
LC-HRMS	Liquid Chromatography-High-Resolution Mass Spectrometry
LC-MS	Liquid Chromatography-Mass Spectrometry
M_n	Number Average Molecular Weight
M_w	Weight Average Molecular Weight
M_z	Z-average Molecular Weight
NIAS	Non-intentionally Added Substances
NIR-SORT	Near Infrared Spectra of Origin-defined and Real-world Textiles
NIST	National Institute of Standards and Technology
NMR	Nuclear Magnetic Resonance
NTA	Non-targeted Analysis
PET	Polyethylene terephthalate
PFAS	Per- and Polyfluoroalkyl Substances
PP	Polypropylene
pyGC-MS	Pyrolysis Gas Chromatography Mass Spectrometry
RGTM	NIST Research Grade Test Material
RM	Reference Material
SRD	Standard Reference Data
SRM	NIST Standard Reference Material®