



Introduction

Matheson is an industry leader advancing proprietary internal cylinder treatments that ensure mixture stability and purity. Our Research and Development team continues to explore new ground with continued advancements for internal cylinder treatment. Whether for aluminum or steel cylinders, special preparation and inerting of the cylinder wall are essential to maintaining component combinations and concentrations.

ULTRA-LINE®

Matheson's ULTRA-LINE® series of processes minimizes cylinder wall reactions to impurities, particulate generation, metallic generation and enhances the overall product stability. This is particularly critical in corrosive and low concentration mixtures.

MicroShield™

In response to the growing amount of more sensitive analytical instruments, Matheson developed our MicroShield™ series of cylinder treatments. Internal cylinder walls, although smooth to the naked eye, have many active sites, which can house impurities and react with mixture minor components. These active sites can have adverse effects on low ppm and ppb mixtures.

UniBlend® and UniTherm®

Matheson UniBlend® batches have unique preparation capabilities that result in identical component concentrations in entire batches - and we have done this in 2 to 10 component gas mixtures. The best evidence is our UniTherm® identical natural gas mixtures of 10 components. Matheson is the first to achieve NIST NTRM approval of a natural gas mixture.

Matheson Mixture Grades

Tighter operating controls have been placed on many industries to optimize production, conform to more stringent environmental and personal safety regulations and adopt higher levels of system automation. All of these factors influence the need for tighter calibration standard specifications used for process stream monitoring, impurity analysis and control, environmental compliance, health and safety monitoring, and basic research and development. The table on the following pages represents Matheson's existing calibration gas mixture capabilities. The grade availability for each individual component may vary depending on its reactivity, stability, certification capabilities and traceability.

Matheson Reference Grade

Matheson Reference Grade has the highest standard pedigree having all minor components directly traceable to NIST Standard Reference Materials (SRM):

- Direct laboratory certification against NIST SRM and /or NTRM.
- Gravimetric blending using high purity raw materials.
- Dual certification where the laboratory concentrations must agree with the gravimetric concentrations better than 1% relative.
- Guaranteed 1% certification accuracy for the shelflife of the gas mixture.
- This is a reference standard for the most demanding of applications.

MaxiTherm™ Natural Gas Standards

- Each cylinder is produced using high resolution gravimetric scales plus research grade hydrocarbons to provide 1 BTU uncertainty in each cylinder.
- Matheson uses the only NIST NTRM for natural gas mixtures for laboratory certification of all minor components.
- Certification accuracies for minor components begin with Methane at < 0.07% relative precision at the 95% confidence level.
- Dual certification of the BTU content using laboratory and gravimetric BTU values demonstrates BTU uncertainty of 1 BTU at the 95% confidence level.
- Each cylinder has a certificate of analysis with full traceability to NIST and natural gas industry documentation; the BTU and customer specified calculated values, and the dual validation of 1 BTU uncertainty.
- Natural Gas industry software applying customer specified conditions are used to calculate BTU values.

UniTherm™ Natural Gas Batches

- UniTherm™ uses batch blending technology to produce homogeneous batches of natural gas calibration standards with < 0.7 BTU variation between cylinders.
- UniTherm™ technology has been used to produce 20 NIST NTRM, which were statistically identical cylinders.
- UniTherm™ batches can be certified as MaxiTherm™, or receive batch certification.

Primary Grade

- Primary grade is the traditional specialty gas high resolution gravimetric mixture with certification accuracy of either 1% relative, or 0.02% absolute: whichever is less.
- Primary grade minor components will usually be those without gas NIST SRM, plus there may be multicomponent mixtures combined with NIST SRM gas traceable minor components.
- Primary grade mixture gravimetric concentrations have some minor components dual certified by laboratory analysis to validate the 1% certification accuracy.
- If components allow, mixtures may be either gas or liquid.
- Each cylinder has a certificate of analysis complete with NIST traceability, shelf-lives, and certified concentrations.



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Certified Plus Grade

- The Certified Plus grade has minor component certification accuracy of $\pm 2\%$ relative for all minor components.
- The blend tolerance may be about twice that of primary standard grade mixtures.
- Reactive gas mixtures that are certified titrimetrically fit this grade. Examples are HCl, ammonia, and chlorine – among others.
- Minor components have single certification by either of laboratory analysis or gravimetric concentration. All multicomponent mixtures will have some components laboratory certified.
- Each cylinder has a certificate of analysis complete with NIST traceability, shelf-lives, and certified concentrations.

Certified Grade

- Certified grade minor components have certification accuracy of $\pm 2\%$ relative when concentration is 50 ppm or higher, and 5% less than 50 ppm.
- The blend tolerance for minor components may be double that of Certified Plus grade, and four times that of Primary grade.
- Minor components have single certification by either of laboratory analysis or gravimetric concentration. All multicomponent mixtures will have some components laboratory certified.
- Certified grade is often used for multicomponent sulfur containing minor components, liquid mixtures, and multicomponent hydrocarbon mixtures with minor components having low ppm to per cent concentrations.
- Each cylinder has a certificate of analysis complete with NIST traceability, shelf-lives, and certified concentrations.

Gravimetric Grade

- Gravimetric grade has all minor components certified by the weighed values only.
- Both the blend tolerance and certification accuracy are 2% relative for all minor components.
- The Gravimetric grade is used for ideally behaving minor components in high ppm to percent concentrations.
- Each cylinder has a certificate of analysis complete with NIST traceability, shelf-lives, and certified concentrations.

EPA Protocol Grade

- EPA Protocol certified standards meet or exceed gas standards specified in U.S. regulations 40CFR60 and 40CFR75 for environmental compliance.
- The laboratory analysis applies U.S. EPA document "EPA Traceability for Assay and Certification of Gaseous Calibration Standards," September, 1997.
- All minor components are laboratory certified using an NIST SRM or NTRM.
- All minor components 10 ppm or higher have 1% certification accuracy using interference free analysis methods.
- EPA Protocols of Nitric Oxide available as low as 1 ppm.
- Each cylinder has a certificate of analysis exceeding the content specified in the U.S. EPA traceability document.
- Only aluminum cylinders are used.

Cal-MAT™ 1 Grade

- Cal-MAT™ 1 mixtures are intended to exceed the daily calibration requirements of continuous emissions monitors as specified in 40CFR60.
- Cal-MAT™ 1 minor components are directly NIST SRM traceable minor components with 1% certification accuracy, but they do not have to be certified using the U.S. EPA Protocol procedure.
- Certified concentrations are from laboratory analysis only, and one analysis is standard.
- Blend tolerances are as stringent as the Primary grade.
- Each cylinder has a certificate of analysis complete with NIST traceability, shelf-lives, and certified concentrations.

Cal-MAT™ 2 Grade

- Cal-MAT™ 2 mixtures are intended to meet the daily calibration requirements of continuous emissions monitors as specified in 40CFR60.
- Minor component certification accuracies are 2% relative, and the blend tolerance may be about five times that of the Cal-MAT™ 1.
- Minor components may be directly NIST SRM gas traceable, or may include environmental pollutants such as HCl and ammonia that are certified titrimetrically.
- Each cylinder has a certificate of analysis complete with NIST traceability, shelf-lives, and certified concentrations.

Custom Grade

- Custom grade is required for those gas and liquid mixtures that do not fit neatly into established mixture grades' blend tolerance or certification accuracy.
- Multicomponent mixtures often have minor components at ppm and percent concentrations that require different certification accuracies.
- Each cylinder has a certificate of analysis complete with NIST traceability, shelf-lives, and certified concentrations.

Unanalyzed Grade

- The Unanalyzed grade is used when the minor component accuracy does not have to be less than 10%.
- Unanalyzed grade gas and liquid mixtures may be used as reactants in processes, or as test mixtures.

UniBlend®

- UniBlends® are homogeneous batches of gas mixtures in cylinders.
- UniBlend® batch sizes may exceed 50 cylinders.
- UniBlends® will have gravimetric traceability, plus they may have dual certification from laboratory analysis as well.
- All mixture grades except EPA Protocol grade may be done as a UniBlend®.
- Laboratory certifications can be done as every cylinder to batch certification.
- Certificates of analysis are available for all cylinders, or individual cylinders.



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Matheson Mixture Grades

Mixture Grade	Blend Technique	Blend Tolerance		Certification Accuracy	Certification	NIST Traceability
Matheson Reference Standard	Gravimetric	5% - 50%	±1%	1%	Dual	SRM, NTRM, NMI, Weight
		500ppm - 5%	±2%			
		1ppm ≤ 500ppm	±5%			
Primary Standard	Gravimetric	5% - 50%	±1%	1% or 0.02% absolute	Single or Dual	Weight or Traceable Lab Standards
		500ppm - 5%	±2%			
		1ppm ≤ 500ppm	±5%			
Certified Plus Standard	Gravimetric or Partial Pressure	5% - 50%	±2%	2%	Single	Weight, Traceable Lab Standards or Titrimetrics
		500ppm - 5%	±5%			
		1ppm ≤ 500ppm	±10%			
Certified Standard	Gravimetric or Partial Pressure	10% - 50%	±5%	50ppm - 50% ±2% 1ppm - 50ppm ±5%	Single	Weight, Traceable Lab Standards or Titrimetrics
		50ppm - <10%	±10%			
		1 - 50ppm	±20%			
Gravimetric Standard	Gravimetric	2%		2%	Single	Weight
Unanalyzed Standard	Gravimetric or Partial Pressure	10%		None	None	None
Custom Standard	Gravimetric	Varies with component and concentration		Varies	Single	Varies