



# High purity metalorganics (HPMO)

**Nouryon**

# High purity metalorganics

We are Nouryon, your partner in essential chemistry for a sustainable future

We are a global specialty chemicals leader. Industries worldwide rely on our essential chemistry in the manufacture of everyday products such as paper, plastics, building materials, food, pharmaceuticals, and personal care items. Building on our nearly 400-year history, the dedication of our 10,000 employees, and our shared commitment to business growth, strong financial performance, safety, sustainability, and innovation, we have established a world-class business and built strong partnerships with our customers. We operate in over 80 countries around the world and we supply customers around the world with ingredients for the manufacture of life's essentials. Specialty chemicals are used in, among others, paints, detergents, foods, plastics, cosmetics, construction, pulp and paper, pharmaceuticals, electronics, agriculture and for plastics.

## A long history

We have a long history in metal alkyls, starting with large scale production of aluminum alkyls in 1959. Today we are one of the leading global producers of these products with a broad range of metal organics based on aluminum, zinc, magnesium, gallium, indium and boron, which are supplied to the polymer, pharmaceutical and semiconductor industry.

## MO-sources

Nouryon high purity metalorganics division was created in 2000 in order to better serve the semiconductor industry.

This allows us to focus on the specific needs of this market while leveraging our global distribution and service networks, manufacturing scale and expertise, global R&D, and expertise in safe handling of metalorganics. As such, we excel in safety, quality, consistency and innovation.

We focus on the production of high purity MOsources based on indium, gallium, aluminum, zinc and magnesium. These products have >99.999% purity and are sold in electropolished stainless steel bubblers to the semiconductor industry. We have grown over the past decade to become one of the leading suppliers of these chemicals. Our products are used in a huge range of industrial and consumer products. These include LED lighting, solar cells, lasers and many other electronic devices.

## World-scale production and backward integration

Our La Porte, Texas manufacturing site was the first to produce trimethyl gallium in 1971, and has since then been expanded significantly to produce a wide range of MO-sources in dedicated production equipment. Owing to our vast knowledge of the safe and efficient production of metalorganics for the polymer industry, we produce our high purity MO-sources at relatively large scale, ensuring high purity and excellent product consistency.

We also operate a world-scale trimethyl aluminum (TMAI) plant, making us the only high purity metalorganics producer fully back-integrated into this important raw material. We use leading edge transfilling techniques that ensure the repeatable and consistent delivery of the highest purity metalorganics in every cylinder that we supply.

Our La Porte site is an OSHA VPP Star site, and is ISO 9001 and 14001 certified, recognizing strict compliance with environmental regulations and adherence to state-of-the-art quality systems.

Our products are distributed globally using regional transfilling and/or warehousing distribution centers, ensuring close proximity to our customers.

## Innovation

We are committed to support the continued steep growth of the industries we serve by supplying the growing volumes of MO-sources required, building on the advantages of integration in our overall large-scale metalorganics production environment.

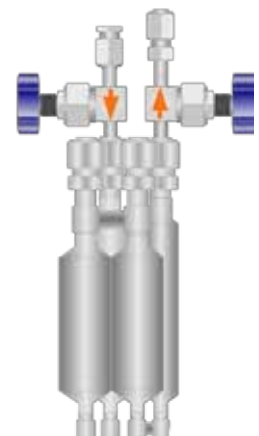
Our bench mark bubbler designs provide enhanced and stable delivery of our products. Meeting the growing volume demands we offer various larger bubbler types, including support to central delivery systems building on our experience in the supply of bulk high purity metalorganics to the solar cell industry.



### Our products

Our range of products to the compound semiconductor and Si-semiconductor industry includes ultra-high purity gallium-, indium-, aluminum-, magnesium- and zinc-based MO-sources.

Element	Chemical name	Acronym
Aluminum	Trimethylaluminum	TMAI
	Low Ox – Trimethylaluminum	TMAI LO
	Triethylaluminum	TEAL
Gallium	Trimethylgallium	TMGa
	Triethylgallium	TEGa
Indium	Trimethylindium	TMIIn
Magnesium	Bis(cyclopentadienyl)magnesium	Cp2Mg
Zinc	Dimethylzinc	DMZn
	Diethylzinc	DEZn



### Cylinder and equipment offerings

Nouryon metalorganic cylinders are designed and manufactured to the highest standards in industrial semiconductor manufacturing technologies:

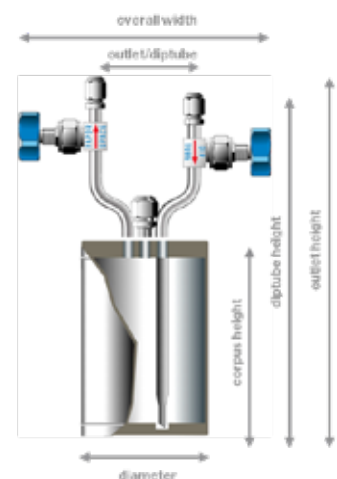
- Semiconductor industry compatible cleaning, regeneration and handling
- Interior surface is electro-polished
- Constant and consistent wall thickness which leads to defined thermal transfer
- Optional purging valve configurations

For delivery of TMIIn we have developed the Hiperquad bubblers, which offer the following benefits:

- Unique stability of the TMIIn flow-rate and MO-concentration during the entire lifetime of the bubbler
- Complete utilization of the TMIIn source up to 98%

### Dimensions

Type	Max. width (mm)	Max. depth (mm)	Fitting height (mm)	Fill height (mm)	Fill weight TMIIn (gr)
Hiperquad 350	89	87	300	152	350
Hiperquad 850	130	120	330	195	850



### Heat exchangers and innovative thermostats

Enabling customers to minimize downtime, we also offer convenient custom-designed heat-exchangers that can be connected to traditional water baths, for several of our larger fill size bubblers.

## Our cylinders

A variety of cylinder sizes with a range of volumes is available.

The tables below provide a selection of cylinder dimensions and typical fill weight data for liquid MO-sources. More cylinder styles and sizes as well as other valve configurations are available on request.

### Cylinder volumes and dimensions

Cylinder	Gross volume <sup>1</sup> (ml)	Corpus height (mm)	Diameter (mm)	Diptube height (mm)	Outlet height (mm)	Diptube outlet (mm)	Overall width (mm)
150 ml	150	108	51	235	248	83	219
400 ml	350	108	76	235	248	83	219
600 ml	540	164	76	291	303	83	219
1000 ml	980	168	102	295	308	83	219
3000 ml	2590	191	152	318	331	83	219
3800 ml	3800	195	168	335	348	83	219
8000 ml (8 L)	6400	400	168	514	527	83	220
20000 ml (20 L)	18250	403	273	511	524	83	319

### Standard fill weights (gram)<sup>2</sup>

Cylinder	TMGa	TEGa	TMin	TMAI	DMZn	DEZn	Cp2Mg
150 ml	150	150	100	100	150	150	50
400 ml	350	350	250	230	400	400	100
600 ml	600	550	400	380	700	600	-
1000 ml	1000	1000	-	730	1100	1000	-
3000 ml	2900	2700	-	1900	3500	3000	-
3800 ml	3800	3600	-	2500	4700	4000	-
8000 ml (8 L)	7200	6600	-	4700	-	-	-
20000 ml (20 L)	20000	19000	-	-	-	-	-

<sup>1</sup> Gross volume is defined as the maximum filling volume, 90% of total cylinder volume.

<sup>2</sup> Fill weights based on maximum fill volume; smaller fill weights are available on request.



# Your safety is our priority

Nouryon's success in safely handling Metal Organics (MO) is due to our long-term commitment to safety. Knowledge of proper handling techniques, carefully designed facilities and thorough training of personnel can overcome the hazards. Personnel who understand and pay proper attention will be able to handle metal organics confidently and safely.



## Safety and handling

Our MO-sources like TMAI, TMGa and TMIn ignites upon exposure to air and reacts violently with water. They must be handled under a dry, inert atmosphere, e.g. nitrogen or argon. TMAI may undergo exothermic decomposition with evolution of flammable gas if heated above 120°C (248°F). The decomposition may become self-accelerating and UNCONTROLLABLE and may result in an explosion. Water must be scrupulously removed from process equipment prior to putting it into metal alkyls service. Failure to do so may result in an explosion. MO-sources causes severe burns to the skin and eyes. It is imperative that proper personal protective equipment be worn when handling MO's.

## Storage

MO sources are stable when stored under a dry, inert atmosphere and away from heat. MO's may undergo violent exothermic decomposition with flammable gas evolution if stored at too high temperatures. Metal alkyls should, in general, be kept 6-12°C above their melting point. For example, in case of solidified TMAI (melting point 15°C) place the container for at least 16 hours in a temperature controlled room at 25-35°C until the product is completely liquified.

## Safety services

Nouryon is recognized as a global leader in metal alkyl safety. We always place safety as our top priority. Sharing our experience in safety is one of the most important resources we offer. Through our safety programs we can provide expert advice on the handling of these materials including:

- classroom review of safety and handling of metal alkyls
- consultation of metal alkyl facility design
- demonstrations on the safe use, handling and control of metal alkyls
- demonstrations on the safe connecting and disconnecting of cylinders
- on-site assistance and advice regarding procedures



# Contact us

Your global Nouryon HPMO team is here to serve you. For more information, please contact your sales manager or regional Nouryon sales office.

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### Additional information

Product Data Sheets (PDS) and Safety Data Sheets (SDS) are available at [nouryon.com](http://nouryon.com)

On request we also provide specific publications on subjects such as the safe use and storage of metal alkyls, facilities design and maintenance, and unloading procedures.



We create ingredients for the manufacture of life's essentials. You'll find our products all around you, in things like food, buildings, and everyday items like your children's toys. Sustainability is at heart of everything we do, and we rank #1 in the Dow Jones Sustainability Index. To keep devising sustainable, innovative solutions for the problems posed by everyday life, we want to work with the very best people and partners - like you. For more information please visit [nouryon.com](http://nouryon.com)

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