

# Chemical Essentials Handbook

*Essentials & Storage Guidelines*



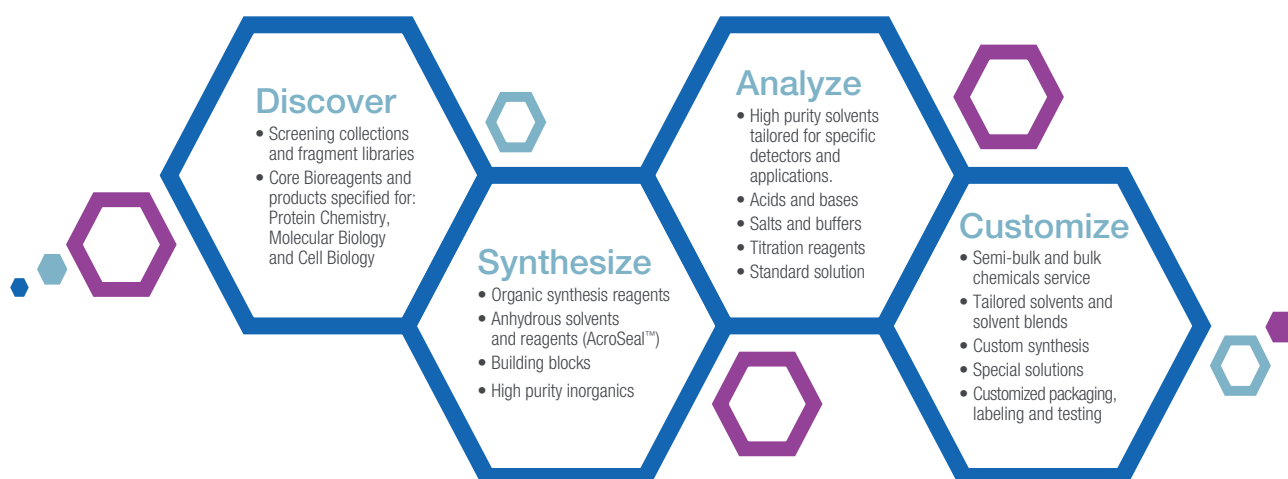
Reliability.  
Purity.  
Certainty.

## Introduction

This handbook includes a selection of essential chemicals for analysis, synthesis, inorganic and life science applications, plus key information on safe storage, handling and packaging to support your chemistry.

Whatever your field of activity: industry, production, quality control, research, analysis or development, our team is available to provide you with the best service and support:

- Chemistry experience and expertise
- Large field sales force with highly experienced specialists to advise and support you
- Huge warehouse space ensures high product availability
- An experienced customer service team dedicated to making your contact with us easy and efficient.



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# Find the perfect chemicals for your discovery, synthesis and analysis

Our portfolio of brands and product grades offer a range of solutions for your chemistry applications.

For	Category/Application	Grades/Product Ranges
<b>Analysis</b> (Pages 4-7)	Liquid Chromatography	Optima UHPLC/MS Optima LC/MS and Certified HPLC-MS UHPLC Gradient Certified Advanced HPLC Gradient Certified HPLC Gradient
	Gas Chromatography	Distol – For Pesticides and Residue analysis GC Headspace
	Elemental Analysis	Optima Grade TraceMetal Grade PrimarPlus Grade
	Molecular Spectroscopy and Micro Analysis	For Spectroscopy IR and For Spectrophometry UV For NMR
	Other Analysis	For Analysis Extra Pure and Specified Laboratory Reagent (SLR) For Electronic Use
	Titration	For Volumetry For pH Metry For Karl Fischer – Aqualine
<b>Research</b> (Pages 10-15)	Organic Synthesis	Building blocks Catalysts Deuterated products Extra dry solvents Functional reagents Organometallics Silica gel
	Inorganic Reagents	High purity inorganics - Puratronic High purity metal products - Premion Precious metal compounds Anhydrous materials - Ultra Dry Rare earth products - Reacton Fuel cells catalysts & compounds High purity materials for photovoltaics Cerion nanoparticles
<b>Discovery</b> (Pages 8-9)	Life Sciences	For Electrophoresis For Peptide Synthesis For Cell Biology For Molecular Biology For Proteomics and Genomics
	Drug Discovery	Heterocyclic building blocks Screening libraries Fragment collections
<b>Production</b> (Pages 16-17)	To support your scale up and production requirements all of our catalogue products are available in bulk and semi-bulk quantities	

# Fisher Chemical

## Find the perfect chemicals for your analytical application

- Rigorous quality assurance and testing procedures throughout the production process ensure the lot-to-lot consistency required for reproducible results
- Fisher Chemical products come in a variety of innovative packaging options designed for safety, environmental protection, convenient handling and storage, and preservation of product integrity
- High-volume solvent delivery systems, available in 10L to 1000L, offer environmentally friendly solvent handling solutions for your applications, enhancing safety and improving productivity within your lab
- For the complete portfolio of Fisher Chemical products and promotions, please visit your local distributor website or [www.acros.com](http://www.acros.com)



Grade	Application	Definition
UHPLC-MS Optima™	UHPLC-MS	Ultra high-purity solvents specifically qualified for <b>UHPLC-MS instrumentation</b> . Specification based on higher ionization efficiency to detect organic contaminants in full scan MS with the absence of an additive. Signal to noise specification greater than ten when measured with 250 ppt Propazine using MS/MS. Filtered at 0.1µm, packaged in borosilicate glass and tightened metal specifications minimizes metal ion adduct formation.
Optima LC-MS	LC-MS	Optima LC-MS grade products meet stringent purity requirements of <b>LC/MS and UHPLC</b> by addressing the need for minimal organic contamination with 0.1µm filtration to make particle free. Evaluated for 17 metal impurities at ppb concentrations for minimal metal mass adduct formation. High ionization efficiency to detect organic contaminants at 50 ppb max (positive) and 300 ppb max (negative) in full scan MS. Screened for UV-absorbing contaminants at every wavelength in the 200 to 400 nm range to afford smooth baselines and to reduce interferences.
LC-MS	LC-MS	Ideal mobile phase for <b>routine LC-MS applications</b> . Guaranteed for low level of trace metals and nonvolatile residue. Low level of absorbance, performance under gradient conditions. Filtered at 0.2µm.
UHPLC Gradient grade	UHPLC-UV	Solvent certified for <b>UHPLC analysis with high UV transmission</b> . Low background noise at 210nm and 254nm. Filtered at 0.1µm for ultra low particulates.
Advanced HPLC Gradient grade	HPLC Gradient grade	<b>Advanced HPLC gradient grade</b> specifically manufactured to guarantee a very low level of gradient baseline drift. Includes lot analysis and absorbance curve on the label. Filtered at 0.2µm.
HPLC Gradient grade	HPLC Gradient grade	<b>HPLC solvents suitable for gradient analysis</b> . Guaranteed for low absorbance/high UV transmission and low concentration of non-volatile impurities. In some instances may be suitable for fluorescence detection. Includes lot analysis and absorbance curve on the label. Filtered at 0.2µm.
HPLC Fluorescence	HPLC with Fluorescence and UV detectors	HPLC solvents suitable for <b>Fluorescence and UV detectors</b> . Guaranteed for low fluorescence between 250nm and 750nm emission & excitation wavelengths.
HPLC Electrochemical	HPLC with Electrochemical and UV detectors	HPLC solvents suitable for <b>Electrochemical and UV detectors</b> . Guaranteed for low electrochemical activity and low UV absorbance/high transmission. Includes lot analysis and absorbance curve on label.
GPC	GPC - Gel Permeation Chromatography	Solvents manufactured for <b>gel permeation chromatography</b> . Filtered to 0.2µm. Low water, residue and colour. Unique chemical range – Actual lot analysis on the pack label.
GC Headspace	GC-HS - Gas Chromatography Headspace	High purity solvents for accurate and reliable analysis of organic volatile impurities (OVIs) by gas chromatography headspace (GC-HS).
Distol	GC - Gas Chromatography	Range of solvents suitable for <b>pesticide and petroleum residue analysis</b> . Guaranteed to meet the ECD, NPD and FID detectors requirement.
Optima Grade	ICP-MS	Highest purity acids, bases and water specifically qualified for <b>Ultra trace elemental analysis by ICP-MS instrument</b> . Ultra-pure quality tested for up to 65 parameters at 1-100 ppt level.
Trace Metal™ Grade	ICP	Trace Metal grade qualified for <b>trace elemental analysis by ICP instrument</b> . Acids & reagents tested for up to 65 parameters at ppb levels.
Primar Plus™ Grade	AAS	Primar Plus grade suitable for <b>trace elemental analysis by AAS instrument</b> . Acids & reagents are tested for up to 40 parameters at 1 to 10 ppb level.
For Analysis	General analytical applications	Certified reagents for analytical applications. Tested for up to 18 guaranteed parameters. Actual lot analysis on the pack label.
For Analysis Conform Eur.Ph.	General analytical applications	Certified reagents for analytical application meeting the Eur.Ph requirement. Tested for up to 18 guaranteed parameters. Actual lot analysis on the pack label.
Specified Laboratory Reagents (SLR)	Laboratory applications	Specified Laboratory Reagents for general laboratory applications. Extra pure grade tested for up to 13 parameters.
Technical	General use	For general use in the laboratory.
Buffers	pH-Metry	Buffer NIST Standard solutions certified for pH measurement. Ready to use, with an accuracy factor of ±0.02 pH at 20°C. Also available as concentrates, packaged in ampules.
Volumetric solution	Volumetry	Standard solutions for volumetric analysis. Accuracy factor up to 0.999 - 1.001 NIST traceability. Ready to use.
Solute	Volumetry	Concentrated standard solutions for volumetric analysis. NIST traceability. Supplied in singles or pack of six sealed ampules.
Aqualine™	Karl Fischer titration	Karl Fischer reagents for the determination of moisture. Volumetric and coulometric reagents and standards. Pyridine free, rapid titration and a stable end-point. Supplied in single packs or in ampules.

The Fisher Chemical product range includes over 4,400 products.  
A selection of our most essential products from this range can be found in the list below.

#### UHPLC-MS Optima™: Ultra-high purity solvents specifically qualified for Mass Spec instrumentation

Product Name	Product code	Merck	Sigma	VWR
Acetonitrile, Optima UHPLC-MS grade <b>New!</b>	A956			
Methanol, Optima UHPLC-MS grade <b>New!</b>	A958			
Water, Optima UHPLC-MS grade <b>New!</b>	W8			

#### LC-MS Optima: High purity solvents specifically qualified to meet the stringent purity requirements of LC-MS

Product Name	Product code	Merck	Sigma	VWR
Acetonitrile, Optima LC-MS grade	A955	100029	14261	
Iso-propanol, Optima LC-MS grade	A461		34965	
Methanol, Optima LC-MS grade	A456	106035	14262	
Water, Optima LC-MS grade	W6		14263	

#### LC-MS: Solvents qualified for routine LC-MS applications

Product Name	Product code	Merck	Sigma	VWR
Acetonitrile, for HPLC-MS	A/0638		34967	83640
Methanol, for HPLC-MS	M/4062		34966 646377	83638
Water, for HPLC-MS	W/0112		39253	83645

#### UHPLC-UV: Solvents qualified for routine UHPLC-UV applications

Product Name	Product code	Merck	Sigma	VWR
Acetonitrile, for UHPLC gradient grade analysis	A/0650	100030		83642
Methanol, for UHPLC gradient grade analysis	M/4070	106007		
Water, for UHPLC gradient grade analysis	W/0120	115333		

#### HPLC Gradient grade: Solvents qualified for routine Gradient grade Liquid chromatography

Product Name	Product code	Merck	Sigma	VWR
Acetonitrile, HPLC for gradient analysis, meets Ph.Eur.	A/0627	100030	34998 34851	20060 83639
Isopropanol, HPLC for gradient analysis	P/7508	101040	650447	
Methanol, HPLC for gradient analysis	M/4058	106007	34885	20864
Water, HPLC for gradient analysis	W/0106	115333	34877 270733	23650

#### HPLC grade: Solvents qualified for routine Liquid chromatography

Product Name	Product code	Merck	Sigma	VWR
Acetonitrile, for HPLC	A/0626	114291	34881	20048
Chloroform, for HPLC, stabilized with amylene	C/4966	102444	34854	83626
Ethyl acetate, for HPLC	E/0906	100868	34858	83621
Heptane, for HPLC, approx. 99% n-Heptane	H/0106	104390	34873	24539
Isohexane, for HPLC, contains <5% n-Hexane	H/0405	104335		83622
Isopropanol, for HPLC	P/7507	101040	34863 439207	20880
Hexanes, for HPLC, 95% n-Hexane approx.	H/0406	104391	34859	24575
Methanol, for HPLC	M/4056	106018	34860	20837
Tetrahydrofuran, for HPLC, unstabilized	T/0706	108101	34865	28559

#### Solvents qualified for Gas chromatography

Product Name	Product code	Merck	Sigma	VWR
Acetone, for residue analysis, Distol	A/0603	100012	34480	83656
Dichloromethane, for residue analysis, Distol, stabilized with amylene	D/1853	106054	34488	83665
Hexanes, for residue analysis, Distol, 95% n-Hexane approx.	H/0403	104371	34484	83661
Methanol, for residue analysis, Distol	M/4053	106011	34485	83967
DMAC, N,N-Dimethylacetamide, GC Headspace <b>New!</b>	D160	100399	44901	
DMF, N,N-Dimethylformamide, GC Headspace <b>New!</b>	D133	100202	51781	
DMSO, Dimethyl Sulfoxide, GC Headspace <b>New!</b>	D139	101900	51779	
NMP, N-Methyl-2-Pyrrolidone, GC Headspace <b>New!</b>	N140		69337	
Water, GC Headspace <b>New!</b>	W10	100577	53463	

## Solvents for Analysis, Certified AR

Product Name	Product code	Merck	Sigma	VWR
Acetone, Certified AR for analysis, meets Ph.Eur.	A/0600	100014	24201 32201	20066
Chloroform, 99.8+%, Certified AR for analysis, stabilized with amylene	C/4960	102445	32211	22709
Cyclohexane, Certified AR for analysis	C/8921	109666	33117	23224
Dichloromethane, Certified AR for analysis, stabilized with amylene	D/1852	106050	24233 32222	25630
Diethyl ether, Certified AR for analysis, stabilized with BHT, meets Ph.Eur.	D/2450	100921	32203	23811
Dimethylformamide, Certified AR for analysis	D/3841	103053	33120	23466
1,4-Dioxane, Certified AR for analysis, stabilized with BHT	D/4550	109671	33147	23540
Ethanol absolute 99.8+%, Certified AR for analysis, meets Ph.Eur., BP, USP	E/0650	100983	32221	20821
Ethyl acetate, Certified AR for analysis	E/0900	109623	33211	23882
n-Heptane, Certified AR for analysis	H/0160	104379	32287	24551
n-Hexane, Certified AR for analysis	H/0421	104367	32293	24577
Hexanes, Certified AR for analysis, 95% n-Hexane approx	H/0355	104374		83992
Isopropanol, Certified AR for analysis	P/7500	109634	24137	20842
Methanol, Certified AR for analysis	M/4000	106009	24229	20847
n-Pentane, Certified AR for analysis	P/1021	107177	76871	26185
Petroleum ether 40-60°C, Certified AR for analysis, n-hexane < 2%	P/1760	101775	32299	23835
Tetrahydrofuran, Certified AR for analysis, stabilized with 0.025% BHT	T/0701	109731	87368	28551
Toluene, Certified AR for analysis	T/2300	108325	32249 89681	28676

## Solvents, SLR, Extra-pure grade

Product Name	Product code	Merck	Sigma	VWR
Acetone, extra pure, SLR	A/0560	822251	179973	20065
Chloroform, 99+%, extra pure, stabilized with amylene, SLR	C/4920	822265	472476	22707
Cyclohexane, extra pure, SLR	C/8920	102832	C100307	23223
Dichloromethane, 99+%, extra pure, stabilized with amylene, SLR	D/1850	822271		23367
Diethyl ether, extra pure, SLR, stabilized with BHT	D/2400	100923	14775	23819
Dimethylformamide, extra pure, SLR	D/3840	103034	D5879	23470
1,4-Dioxane, extra pure, SLR, stabilized with BHT	D/4500	103115	D201863	23532
Ethanol 99%+, absolute, extra pure, SLR	E/0600	107017	24103	20816
Ethyl acetate, extra pure, SLR	E/0850	822277	16371	23880
n-Heptane, extra pure, SLR	H/0155	104365	H2198	24549
n-Hexane, extra pure, SLR	H/0420	104368	15671	24580
Methanol, extra pure, SLR	M/3950	107018	179337 320390	20846
Petroleum ether 40-60°C, extra pure, SLR	P/1440			23826
Toluene, 99+%, extra pure, SLR	T/2200	107019	179965	28675

## Acids &amp; Reagents for Trace Elemental Analysis

Product Name	Product code	Merck	Sigma	VWR
Hydrochloric acid 32-35%, Optima™, for ultra trace elemental analysis	A466	101514	96208	83878
Hydrochloric acid 34-37%, Trace Metal™, for trace metal analysis	A508	100318	84415	83871
Nitric acid 67-69%, Optima, for ultra trace elemental analysis	A467	101518	02650	83879
Nitric acid 67-69%, Trace Metal, for trace metal analysis	A509	100441	84385	83872
Sulfuric acid 93-98%, Optima, for ultra trace elemental analysis	A468	101516	77239	
Sulfuric acid 93-98%, Trace Metal, for trace metal analysis	A510	100714	84716	83875
Water, Optima, for ultra trace elemental analysis	W9	101262	14211	83877

## Acids &amp; Bases for Analysis, Certified AR

Product Name	Product code	Merck	Sigma	VWR
Acetic acid glacial, Certified AR for analysis, meets Ph.Eur., BP, USP	A/0400	100063	27225	20104
Ammonia solution, 35%, Certified AR for analysis, d=0.88	A/3280	105423	05002	21190
Formic acid, 98-100%, Certified AR for analysis	F/1900	100264	33015	20318
Hydrochloric acid, 37%, Certified AR for analysis, d=1.18	H/1200	100317	30721	20252
Nitric acid 68 % d= 1.42, Certified AR, for analysis	N/2300	100452	84380	20425
Potassium hydroxide, Certified AR for analysis, pellets, meets Ph.Eur., BP	P/5640	105029	30603	26668
Sodium hydroxide, Certified AR for analysis, pellets, meets Ph.Eur., BP	S/4920	106469	S5881	28244
Sulfuric acid min 95% d=1.83, Certified AR, for analysis	S/9240	100731	30743	20700

## Salts for analysis &amp; SLR, Extra-pure grade

Product Name	Product code	Merck	Sigma	VWR
Ammonium acetate, Certified AR for analysis	A/3440	101116	32301	21200
Ammonium acetate, extra pure, SLR, crystals	A/3400	101115	A7262	21198
Ammonium chloride, Certified AR, for analysis, meets analytical specification of Ph.Eur., BP	A/3920	101145	31107	21236
Ammonium chloride, 99+%, extra pure, SLR	A/3880		A4514 11209	21235
Calcium chloride dihydrate, Certified AR for analysis, meets Ph.Eur.	C/1500	102382	31307	22317
Potassium carbonate anhydrous, Certified AR, for analysis, meets Ph.Eur.	P/4120	104928	60109	26726
Potassium chloride, Certified AR for analysis	P/4280	104936	31248	26764
Potassium chloride, extra pure, SLR, Eur. Ph.	P/4240		60130	26760
Potassium dihydrogen orthophosphate, Certified AR for analysis	P/4800	104873	P0662	26936
Potassium iodide, Certified AR for analysis	P/5880	105043	30315	26846
Potassium nitrate, Certified AR for analysis, meets analytical specification of Ph.Eur., BP	P/6120	105063	31263	26869
Sodium acetate trihydrate, Certified AR for analysis, crystal	S/2040	106267	32318	27652
Sodium chloride, Certified AR for analysis, meets analytical specification of Ph.Eur.	S/3160	106404	31434	27810
Sodium chloride, extra pure, SLR	S/3120		S9888	27800
Sodium hydrogen carbonate, Certified AR for analysis, meets Ph.Eur.	S/4240	106329	31437	27778
Sodium sulfate anhydrous, Certified AR for analysis, fine powder	S/6650	106649	31481	28114
Sodium sulfate anhydrous, Certified AR for analysis, granular	S/6640	106637	71962	
Sodium sulfate anhydrous, 99+%, extra pure	S/6600	106639	S9627	28111

## Buffer NIST Standard Solutions &amp; Concentrated

Product Name	Product code	Merck	Sigma	VWR
Buffer solution pH 4,00 (phthalate), NIST Standard solution ready to use for pH measurement	J/2820	109435	B5020	32095
Buffer concentrated solution pH 4 (phthalate),	J/2820C	109884	38743	32084
Buffer colour coded solution pH 4,00 (phthalate) Red, NIST Standard solution ready to use	J/2825	109475	33665	32044
Buffer solution pH 7,00 (phosphate), NIST Standard solution ready to use for pH measurement	J/2850	109439	B4770	32096
Buffer concentrated solution pH 7,00 (phosphate), NIST Standard for pH measurement	J/2850C	109887	38746	
Buffer colour coded solution pH 7,00 (phosphate) Yellow, NIST Standard solution ready to use	J/2855	109477	33666	32045
Buffer solution pH 10,00 (borate), NIST Standard solution ready to use for pH measurement	J/2880	109438	B4895	32040
Buffer concentrated solution pH 10 (borate),	J/2880C	109890	38749	
Buffer colour coded solution pH 10,00 (borate) Blue, NIST Standard solution ready to use	J/2885	109400	33668	

## Karl Fischer reagents for titration by Volumetry

Product Name	Product code	Merck	Sigma	VWR
Karl Fischer Aqualine™ Complete 5	K/2000	188005	34805	
Karl Fischer Aqualine complete 5K	K/2250R	188006	34816	
Karl Fischer Aqualine Matrix-K	K/2300R	188008	34817	
Karl Fischer Aqualine Solvent	K/2100	188015	34800	
Karl Fischer Aqualine solvent CM	K/2110	188016	34812	
Karl Fischer Aqualine Titrant 5	K/2200	188010	34801	

## Standard Volumetric solutions

Product Name	Product code	Merck	Sigma	VWR
Ethylenediaminetetraacetic acid disodium salt solution 0,1M (0,2N), ready to use solution	J/3700	108431	34550	28662
Ethylenediaminetetraacetic acid trisodium salt solution 0,1M (0,2N), Standard Concentrate	J/3720C	109992		
Hydrochloric acid solution 1M (1N), NIST Standard solution ready to use, Eur.Ph., USP, BP	J/4320	109057	318949	30024
Hydrochloric acid solution 1M (1N), NIST Standard Concentrate, for Volumetric analysis	J/4320C	109970	38283	32050
Potassium hydroxide solution 1M (1N), NIST Standard solution ready to use, For Volumetric	J/6630	109918	35112	31300
Potassium hydroxide solution 1M (1N), NIST Standard Concentrate, for Volumetric analysis	J/6630C	109107	38073	
Silver nitrate solution 0,1M (0,1N), NIST Standard sol. ready to use, meets Ph.Eur., BP, USP	J/7330	109081	35375	30471
Silver nitrate solution 0,1M (0,1N), NIST Standard Concentrate, for Volumetric analysis	J/7330C	109990	38310	
Sodium hydroxide solution 1M (1N), NIST Standard solution ready to use, meets Ph.Eur., BP	J/7620	109137	319511	31627
Sodium hydroxide solution 1M (1N), NIST Standard Concentrate, for Volumetric analysis	J/7620C	109956	38215	32066
Sodium thiosulfate solution 0,1M (0,1N), NIST Standard solution ready to use	J/7950	109147	35245	31553
Sodium thiosulfate solution 0,1M (0,1N), NIST Standard Concentrate, for Volumetric analysis	J/7950C	109950	38200	32065
Sulfuric acid solution 0,5M (1N), NIST Standard solution ready to use	J/8430	109072	72238	30144
Sulfuric acid solution 0,5M (1N), NIST Standard Concentrate, for Volumetric analysis	J/8430C	109981	38294	32053

The Alfa Aesar brand is known worldwide for a variety of high purity products used in analytical chemistry. Recognized for purity and quality, our products and brands are backed by technical and sales teams dedicated to providing you the best service possible.

Specpure® analytical standards are manufactured for unsurpassed performance in accuracy, purity, and quality. Also available are hundreds of other products, including MS standards, HPLC solvents, analytical graphite products, pH test strips and solutions, indicators, acids and bases and a selection of infrared spectroscopy products.

# Fisher BioReagents

## Find the perfect reagents for your discovery application

Material Grade	Definition
DNA Grade	Designates reagents suitable for use in Molecular Biology applications involving the manipulation of DNA. Tested for specific contaminants such as DNase and protease.
DNA Synthesis	Designates reagents suitable for use with automated DNA synthesis instrumentation.
Electrophoresis	Material used specifically for electrophoresis applications.
Genetic Analysis Grade	Material that is specially prepared for various molecular cloning applications. Tested for specific contaminants such as DNase and RNase.
IEF Grade	Material suitable for use with isoelectric focusing of proteins.
Islet Isolation Grade	Material suitable for isolation of pancreatic islets.
Molecular Biology Grade	Designates reagents suitable for use in Molecular Biology applications. Tested for specific contaminants such as nucleases and bacteria where appropriate.
Molecular Genetics	Reagent chemicals that have been specifically purified and assayed for Molecular Genetics applications.
PCR Grade	Material suitable for use in Polymerase Chain Reaction (PCR).
Peptide Synthesis	Designates reagents suitable for use with protein synthesis instrumentation.
Protein Electrophoresis Grade	Material used specifically for protein electrophoresis applications.
Sequencing	Material designed for use with automated DNA or protein sequencing equipment.
Super Pure	Material with a purity level exceeding the various monograph grades.
Tissue Culture Grade	Materials of superior quality where there are no published standards and that are suitable for use in Tissue Culture applications.
CellPURE™	Biological Buffers, ideal for cell cultivation, isolation of cells, enzyme assays, and other biochemical applications.
JustPURE™	"Good" buffers from Fisher BioReagents with very high purity (assay > 99%) and only trace amounts of metal ions, useful for applications requiring tight control of elemental content.

## Vital Reagents for Life Science

- Designed for a wide range of molecular biology, protein chemistry, cell biology and microbiology applications
- High-purity products that meet stringent industry specifications for critical factors such as purity, water content, levels of contaminants and absence of DNase, RNase and protease activity
- Reagents are prequalified and guaranteed to be suitable for the designated technique

For more product choices and promotions, please visit your local distributor website or [www.acros.com](http://www.acros.com)



**The Fisher BioReagents product range includes approximately 1000 products. A selection of our most essential products from this range can be found in the list below.**

### Core Bioreagents

Product Name	Storage Conditions	Product code	Sigma	Bio-Rad
Bovine serum albumin, fraction V, cold-ethanol precipitated	RT	BP1605	A4503	
Bovine serum albumin, fraction V, heat shock treated, suitable for immunological studies	RT	BP1600	A3294	
Chloroform, molecular biology grade, approx. 0.75% ethanol as a preservative	RT	BP1145	496189	
Dimethyl sulfoxide	RT	BP231	34869	
Ethanol, Molecular Biology Grade	RT	BP2818	E7023	
Chloroform, Approx. 0.75% Ethanol as Preservat	RT	BP120	E5134	
Formamide, molecular biology	4°C	BP227	47671	
Formamide, super pure	4°C	BP228	F9037	
Glycerol, molecular biology	RT	BP229	G7893	
Isopropanol, Molecular Biology Grade	RT	BP2618	I9516	
JustPURE Ethylenediaminetetraacetic Acid Disodium Salt Dihydrate	RT	BP2927	E1644	
Methanol, peroxide-free, sequencing	RT	BP1105	494437	
70% Molecular Biology Ethanol solution <b>New!</b>	RT	BP8201		
96% Molecular Biology Ethanol solution <b>New!</b>	RT	BP8202	E7148	
PBS Tablets	RT	BP2944	P4417	
Phosphate buffered saline, 10X powder concentrate, white granular powder	RT	BP665	P3813	31098
Phosphate buffered saline, 10X solution	RT	BP399	79378	161-0780

## Core Bioreagents Continued

Product Name	Storage Conditions	Product code	Sigma	Bio-Rad
Sodium chloride (dry basis), >99.5%	RT	BP358	31434	
Sodium dodecyl sulfate, white powder, electrophoresis	RT	BP166	L4509	161-0302
Tris base, white crystals or crystalline powder, molecular biology	RT	BP152	93362	161-0716
Tris buffered saline, 10X Solution, pH 7.4, molecular biology	RT	BP2471	T5912	170-6435
Tween 20	RT	BP337	P2287	170-6531
Water, Biotech grade, sterile	RT	BP2485	W3513	
Water, Molecular Biology Grade	RT	BP2819	W4502	
Water, DNA grade	RT	BP2470	W4502	163-2091
Water, for RNA work, DEPC-treated and nuclease-free, molecular biology	RT	BP561	95289	700-7253
Water, nuclease free	RT	BP2484	95284	700-7253

## Protein and Nucleic Acid for Electrophoresis

Product Name	Storage Conditions	Product code	Sigma	Bio-Rad
Agarose, broad separation range for DNA/RNA, genetic analysis grade	RT	BP1356	A9539	161-3101
Agarose, low-EEO/multi-purpose, molecular biology grade	RT	BP160	A6013	161-3102
Dithiothreitol, white crystals or powder, for electrophoresis	4°C	BP172	D9163	161-0611
Ethidium bromide, 1% solution, molecular biology	RT	BP1302	E1510	161-0433
FastrUN™ Tris SDS PAGE Running Buffer, 10X <b>New!</b>	RT	BP881		
HEPES (Fine White Crystals) for Molecular Biology	RT	BP310	54457	
MES, fine white crystals	RT	BP300	M3671	
Methanol, peroxide-free, sequencing	RT	BP1105	494437	
MOPS (Fine White Crystals) for Molecular Biology	RT	BP308	69950	
Phenol, saturated, liquid, pH 6.6/7.9	4°C	BP1750I	P4557	
Proteinase K, from Tritirachium album, DNase and RNase free	-20°C	BP1700	P2308	
Sodium Dodecyl Sulfate (SDS), Micropellets <b>New!</b>	RT	BP8200	74255	
TEMED, Electrophoresis	RT	BP150	T9281	
Tris-acetate-EDTA (TAE) solution 50X, DNase RNase and protease free	RT	BP1332	T4948	161-0743
Tris-Borate-EDTA, 10X solution, electrophoresis	RT	BP1333	93290	161-0733
Triton X-100 for Electrophoresis	RT	BP151	T8532	161-0407
Urea, molecular biology grade, Colorless-to-White Crystals or Crystalline powder	RT	BP169	51461	161-0731

## Cell and Tissue Culture

Product Name	Storage Conditions	Product code	Sigma	Bio-Rad
2XTY Broth, Granulated <b>New!</b>	RT	BP9743		
Agar, Granulated <b>New!</b>	RT	BP9744		
Agar	RT	BP1423	A1296	
Ampicillin Sodium Salt, crystalline powder	4°C	BP1760	A0166	166-0407EDU
CellPURE® PBS 10X, Cell Culture Grade	RT	BP2940	P5493	
D-Sucrose, molecular biology	RT	BP220	S0389	
Glycine, white crystals or crystalline powder	RT	BP381	G8898	161-0718
Isopropyl-β-D-thiogalactopyranoside, dioxane-free	4°C	BP1755	I6758	
Kanamycin Sulfate, white powder	RT	BP906	K1377	
LB Agar, (Lennox L Agar), Granulated <b>New!</b>	RT	BP9745		
LB Agar, Miller	RT	BP9724	L3147	
LB Broth, Miller	RT	BP9723	L3522	
LB Broth, Lennox	RT	BP9722	L7658	
LB Broth, Miller, (Powder)	RT	BP1426	L3522	
Phosphate Buffered Saline, 10X solution	RT	BP399	79378	161-0780
Puromycin Dihydrochloride	RT	BP2956	P7255	
Rapamycin	RT	BP2963	R0395	
SOB Broth (Capsules)	RT	BP9737	H8032	
Tryptone (Granulated)	RT	BP9726	T2559	
Vancomycin	RT	BP2958	V1130	
Water, Microbial Cell Culture Grade	RT	BP2820	W3500	
Yeast Extract	RT	BP1422	Y1625	
Yeast Extract (Granulated)	RT	BP9727	Y1626	

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Pure	Basic specification, suitable for chemical synthesis and general laboratory work.
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Extra dry	Extra dry solvents with water content of 50 ppm or lower at the time of manufacture, filtered over 0.2µm PTFE filter and filled under inert gas.
Extra dry over molecular sieves	Extra dry solvents with water content of 50 ppm or lower at the time of manufacture, filled under inert gas and stored over molecular sieve for enduring shelf life.
For spectroscopy	The solvents show a very low absorption in the UV or IR spectrum and a high purity.
For NMR	Deuterium labeled compounds and solvents for NMR spectroscopy.

The Acros Organics product range includes over 33,000 products. A selection of our most essential products from this range can be found in the list below.

#### Boronic acids

Product Name	CAS Number	Product code	Sigma
Bis(pinacolato)diboron, 98%	73183-34-3	33057	473294
4-Methoxy-3-pyridineboronic acid hydrate, 97%	N/A	37838	
Phenylboronic acid, 98+%, may contain varying amounts of anhydride	98-80-6	13036	78181, P20009
Quinoline-3-boronic acid, 97%	191162-39-7	36773	709522
4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)aniline, 97%	214360-73-3	36638	518751
4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)pyridine, 97%	181219-01-2	36751	578770

#### Catalysts

Product Name	CAS Number	Product code	Sigma
4-Dimethylaminopyridine, 99%	1122-58-3	14827	
Titanium(IV) isopropoxide, 98+%	546-68-9	19470	
<b>Catalysts - metal</b>			
1,1'-Bis(diphenylphosphino)ferrocene-palladium(II)dichloride dichloromethane adduct	95464-05-4	34868	379670
Bis(triphenylphosphine)palladium(II) chloride, 98%	13965-03-2	29925	208671, 15253
Hydrogen hexachloroplatinate(IV) hydrate, ACS reagent	26023-84-7	40501	520896, 206083, P7082
Hydrogen hexachloroplatinate(IV) hydrate, ca. 40% Pt	26023-84-7	19537	81080
Palladium(II) acetate, 47.5% Pd	3375-31-3	19518	205869, 76044, 520764
Platinum(II) acetylacetonate, 98%	15170-57-7	36935	282782, 55944
Platinum(IV) oxide, 83% Pt	1314-15-4	19532	206032, 81090
Potassium hexachloroplatinate(IV), ca. 40% Pt	16921-30-5	19535	206067, 60260, 520861
Rhodium(II) acetate dimer, anhydrous, ca 46% Rh	15956-28-2	26863	209058, 83725
Ruthenium(III) chloride hydrate, 35 - 40% Ru	14898-67-0	19548	463779, 84050, 206229
Tetrakis(triphenylphosphine)palladium(0), 99%	14221-01-3	20238	697265, 87645
Tris(dibenzylideneacetone)dipalladium(0), 97%	51364-51-3	31877	328774
<b>Catalysts - phase transfer</b>			
Hexadecyltrimethylammonium bromide, 99+%	57-09-0	22716	H5882
Tetrabutylammonium hydrogen sulfate, 98%	32503-27-8	16838	86868, 155837

## Catalysts Continued

Product Name	CAS Number	Product code	Sigma
Tetrabutylammonium hydroxide, 1M solution in methanol	2052-49-5	21291	86882, 230189
Tetrabutylammonium hydroxide, 40 wt.% (1.5M) solution in water	2052-49-5	17661	86880, 178780
Tetraheptylammonium bromide, 99%	4368-51-8	21816	87301, T6533
<b>Catalysts - solid supported</b>			
Palladium hydroxide on carbon, powder, unreduced, 20% Pd, moisture ca 60%	12135-22-7	19962	330094
Palladium on activated carbon, 10% Pd, (50% wet with water for safety), unreduced	7440-05-3	42298	205699
Palladium on activated carbon, 10% Pd, unreduced	7440-05-3	19503	205699, 75990
Palladium on activated carbon, unreduced, 5% Pd	7440-05-3	19502	276707, 75992
Palladium on calcium carbonate, poisoned with 3.5% lead, 5% Pd	7440-05-3	19507	205737
Platinum on activated carbon, 10% Pt, ca .50% moisture	7440-06-4	19524	205958, 80983
Platinum on activated carbon, 5% Pt	7440-06-4	19523	205931, 80981
Rhodium on alumina, 5% Rh, powder	7440-16-6	19957	212857, 83720

## Cesium compounds

Product Name	CAS Number	Product code	Sigma
Cesium carbonate, 99.5%, for analysis	534-17-8	19204	562572, 20960, 441902
Cesium chloride, 99+%, for analysis	7647-17-8	18950	562599, 20968, C6914
Cesium fluoride, 99%, for analysis	13400-13-0	18951	198323, 20990

## Chromatography

Product Name	CAS Number	Product code	Sigma
Aluminium oxide, neutral, Brockmann I, for chromatography, 50-200µm, 60A	1344-28-1	36668	06300, 199974, A1522
Florisil™, 60-100 mesh, for column chromatography	1343-88-0	20545	15025, 24278, 46385, 220744
Silica gel, for chromatography, 0.030-0.200 mm, 60 A	7631-86-9	41929	60741, 288616
Silica gel, for chromatography, 0.035-0.070 mm, 60 A	7631-86-9	24036	645524, 12479, 227196
Silica gel, for chromatography, 0.060-0.200 mm, 60 A	7631-86-9	24037	288624
Silica gel, for column chrom., ultra-pure, 40-60µm, 60A	7631-86-9	36005	645524, 60752, 227196
Silica gel, for column chrom., ultra-pure, 60-200µm, 60A	7631-86-9	36006	60738, 288624

## Deuterated solvents

Product Name	CAS Number	Product code	Sigma
Chloroform-d, for NMR, 99.8 atom % D	865-49-6	16625	151823
Chloroform-d, for NMR, 100 atom % D, packaged in 0.75 ml ampoules	865-49-6	32068	444731
Chloroform-d, for NMR, 99.8 atom % D, AcroSeal™	865-49-6	42677	151823
Chloroform-d, for NMR, 99.8 atom % D, stabilized with silver foil	865-49-6	35142	530735
Chloroform-d, for NMR, 99.8+ atom % D, contains 0.03 v/v% TMS	865-49-6	20956	225789
Deuterium oxide, for NMR, 99.8 atom % D	7789-20-0	16630	
Methanol-d4, for NMR, packaged in 0.75 ml ampoules, 99.8 atom % D	811-98-3	32075	441384
Methanol-d4, for NMR, with 0.03% TMS, in 0.75 ml ampoules, 99.8 atom % D	811-98-3	35147	530530
Methyl sulfoxide-d6, for NMR, 99.9 atom % D	2206-27-1	16629	151874
Methyl sulfoxide-d6, for NMR, packaged in 0.75 ml ampoules, 99.9 atom % D	2206-27-1	32077	545880
Methyl sulfoxide-d6, for NMR, with 0.03% TMS, 99.9 atom % D	2206-27-1	35145	296147
Methyl sulfoxide-d6, for NMR, with 0.03% TMS, in 0.75 ml ampoules, 99.9 atom % D	2206-27-1	35254	545880

## Dry solvents

Product Name	CAS Number	Product code	Sigma
Acetonitrile, 99.9+%, Extra Dry, AcroSeal	75-05-8	32681	271004
Isopropanol, 99.8%, Extra Dry, AcroSeal	67-63-0	32696	278475, 59309
Methanol, 99.9%, Extra Dry, AcroSeal	67-56-1	32695	322415
Tetrahydrofuran, 99.85%, Extra Dry, stabilized, AcroSeal	109-99-9	32697	186562, 401757
N,N-Dimethylformamide, 99.8%, Extra Dry, AcroSeal	68-12-2	32687	227056
<b>Dry solvents - Extra Dry over Molecular Sieves</b>			
Dichloromethane, 99.8%, Extra Dry over Molecular Sieve, Stabilized, AcroSeal	75-09-2	34846	04778, 66749
Diethyl ether, 99.5%, Extra Dry over Molecular Sieve, Stabilized, AcroSeal	60-29-7	36433	31685
1,4-Dioxane, 99.5%, Extra Dry over Molecular Sieve, stabilized, AcroSeal	123-91-1	36434	539538, 42510
Methanol, 99.8%, Extra Dry over Molecular Sieve, AcroSeal	67-56-1	36439	65542
N,N-Dimethylformamide, 99.8%, Extra Dry over Molecular Sieve, AcroSeal	68-12-2	34843	40228
Tetrahydrofuran, 99.5%, Extra Dry over Molecular Sieve, Stabilized, AcroSeal	109-99-9	34845	87371

## Drying Agents

Product Name	CAS Number	Product code	Sigma
Calcium chloride, 96%, extra pure, powder, anhydrous	10043-52-4	34961	22313, 06991, 12095, 21074, C4901
Magnesium sulfate, 97%, pure, anhydrous	7487-88-9	41348	203726, 63135, 208094, M7506
Molecular sieves 4A, 8 to 12 mesh	70955-01-0	19727	208604, 334308
Silica gel orange, for drying purposes, non toxic grade, 2-5 mm	1327-36-2	39203	94098
Silica gel, for drying purposes, non-toxic grade, 3-6 mm	7631-86-9	35740	85330, 13767

## Functional reagents

Product Name	CAS Number	Product code	Sigma
Boron trifluoride etherate, approx. 48% BF <sub>3</sub>	109-63-7	17456	
1,1'-Carbonyldiimidazole, 97%	530-62-1	15181	
Diisopropyl azodicarboxylate, 94%	2446-83-5	32756	
1,6-Hexanediamine, 99.5+%	124-09-4	12064	
N,O-Bis(trimethylsilyl)trifluoroacetamide, 98+%	25561-30-2	16800	
Paraformaldehyde, 96%, extra pure	30525-89-4	41678	
Potassium tert-butoxide, 98+%, pure	865-47-4	16888	
Sodium bis(trimethylsilyl)amide, pure, 2M solution in THF, AcroSeal™	1070-89-9	27785	
Sodium cyanoborohydride, 95%	25895-60-7	16855	
Sodium azide, 99%, extra pure	26628-22-8	19038	
<b>Functional reagents - coupling reagents</b>			
Benzyl bromide, 98%	100-39-0	10587	
N,N'-Dicyclohexylcarbodiimide, 99%	538-75-0	11390	
Trifluoromethanesulfonic anhydride, 98+%	358-23-6	17506	
<b>Functional reagents - Grignard reagents</b>			
Isopropylmagnesium chloride - Lithium chloride complex, 1.3M solution in THF, AcroSeal	745038-86-2	38628	656984
Isopropylmagnesium chloride, 2.0M solution in THF, AcroSeal	1068-55-9	21285	230111, 59570
Methylmagnesium bromide, 3M solution in diethyl ether, AcroSeal	75-16-1	18354	189898, 67742
Methylmagnesium chloride, 3M (22 wt.%) solution in THF, AcroSeal	676-58-4	25256	189901, 67743
Vinylmagnesium bromide, 0.7M solution in THF, AcroSeal	1826-67-1	20939	225584, 95008
Vinylmagnesium chloride, 1.9M (16.5 wt.%) solution in THF, AcroSeal	3536-96-7	25259	476552, 95010
<b>Functional reagents - halogenating agents</b>			
Bromine, 99.6%, for analysis	7726-95-6	19666	16040, 277576
Bromine, 99+%, extra pure	7726-95-6	40284	207888
Cyanogen bromide, 97%	506-68-3	11078	16774, C91492
Diethylaminosulfur trifluoride, 95%	38078-09-0	21611	31942, 235253
Diiodomethane, 99+%, stabilized	75-11-6	16983	158429, 66880,
Hydrobromic acid, pure, ca. 48 wt% solution in water	10035-10-6	12317	295418, 268003
Hydrogen bromide, pure, 33 wt% solution in glacial acetic acid	37348-16-6	12318	18735
Iodine, 99.5%, extra pure, resublimed	7553-56-2	19656	03551, 266426
N-Bromosuccinimide, 99%	128-08-5	10745	B81255
N-Iodosuccinimide, 98%	516-12-1	29957	58070, 220051
Oxalyl bromide, 98%	15219-34-8	15089	113034, 75758
Oxalyl chloride, 98%	79-37-8	12961	71241, 320420
Potassium fluoride, 99%, extra pure, anhydrous	7789-23-3	20135	307599, P1179
<b>Functional reagents - organolithiums</b>			
n-Butyllithium, 1.6M solution in hexanes, AcroSeal	109-72-8	18127	186171, 20160
n-Butyllithium, 2.5M solution in hexanes, AcroSeal	109-72-8	21335	230707
tert-Butyllithium, 1.9M solution in pentane, AcroSeal	594-19-4	18128	456721, 20190, 186198
Lithium diisopropylamide, 2M sol. in THF/n-heptane/ethylbenzene, AcroSeal	4111-54-0	26883	361798, 62491
Methylolithium, 1.6 M sol. in diethyl ether (± 5% w/v), AcroSeal	917-54-4	18875	67740, 197343
<b>Functional reagents - reagents in solution</b>			
(Trimethylsilyl)diazomethane, 2M solution in hexanes	18107-18-1	38533	362832, 92738
Ammonia, ca. 7N solution in methanol	7664-41-7	13371	499145
Boron tribromide, 1M solution in methylene chloride	10294-33-4	19890	211222, 15692
Boron trichloride, 1M solution in methylene chloride, AcroSeal	10294-34-5	17668	178934, 15708
Boron trifluoride, 12% (1.5M) in methanol	373-57-9	40276	264121, 15715, B1127
Hydrogen bromide, pure, 33 wt% solution in glacial acetic acid	37348-16-6	12318	18735
Hydrogen chloride, pure, 2N solution in diethyl ether, AcroSeal	7647-01-0	36847	455180
Hydrogen chloride, pure, 5 to 6N solution in 2-propanol	7647-01-0	13370	
Propargyl bromide, 80 wt.% solution in toluene, stabilized	106-96-7	13148	P51001, 81831

## Oxidation reagents

Product Name	CAS Number	Product code	Sigma
3-Chloroperoxybenzoic acid, 70-75%, balance 3-Chlorobenzoic acid and water	937-14-4	25579	273031, 25800
Dess-Martin periodinane, 15 wt.% solution in dichloromethane	87413-09-0	33311	
2,3-Dichloro-5,6-dicyano-1,4-benzoquinone, 98%	84-58-2	11330	D60400, 35680
Hydrogen peroxide, for analysis, 35 wt.% solution in water, stabilized	7722-84-1	20246	95299, 31642
Sodium hypochlorite, 13% active chlorine	7681-52-9	21925	71696, 13440
Sodium periodate, 99%, for analysis	7790-28-5	19838	71860, 30323
Sodium peroxide, 96%	1313-60-6	20770	71880, 223417

## Phosphine ligands

Product Name	CAS Number	Product code	Sigma
(±)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98%	98327-87-8	36864	481084, 17386
9,9-Dimethyl-4,5-bis(diphenylphosphino)xanthene, 98%	161265-03-8	37806	37806
Chlorodicyclohexylphosphine, 97%	16523-54-9	35329	481408
Triphenylphosphine, 99%	603-35-0	14042	93090, T84409
Tris(2-carboxyethyl)phosphine hydrochloride, 98%	51805-45-9	36383	93284, C4706

## Protection and deprotection of functional groups

Product Name	CAS Number	Product code	Sigma
Acetic anhydride, 99+%, pure	108-24-7	14949	110043, 45840, 539996, A6404
Benzoyl chloride, 99%, pure	98-88-4	10575	320153, 12940, 240540
Benzyl chloroformate, 97 wt%, stabilized	501-53-1	15294	23160, 119938
Chlorotrimethylsilane, 98%	75-77-4	11012	C72854, 92361, 386529
2,2-Dimethoxypropane, 98+%	77-76-9	11563	00660, D136808
Di-tert-butyl dicarbonate, 97%	24424-99-5	18977	199133, 34660
Di-tert-butyl dicarbonate, 99%	24424-99-5	19467	361941, 50431, 199133
9-Fluorenylmethyl chloroformate, 98%	28920-43-6	17094	23185, 160512
1,1,1,3,3,3-Hexamethyldisilazane, 98%	999-97-3	12058	379212, 52620, H4875
p-Toluenesulfonyl chloride, 99+%	98-59-9	13903	240877, 89730
Trimethylsilyl trifluoromethanesulfonate, 99%	27607-77-8	20944	91741, 225649

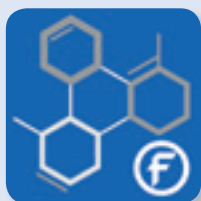
## Reducing Agents

Product Name	CAS Number	Product code	Sigma
Diisobutylaluminium hydride, 1M solution in hexane, AcroSeal™	1191-15-7	18379	
tert-Butylchlorodimethylsilane, 98%	18162-48-6	18393	
Zinc, 98+%, dust (stable acc. to UN classification class 4)	7440-66-6	19834	
Hydrazine hydrate, 100% (Hydrazine, 64%)	10217-52-4	19671	225819
Hydroxylamine hydrochloride, 99+%	5470-11-1	27010	55469, 159417
Iron, 99%, powder, -70 mesh (<212 micron)	7439-89-6	19781	44890
Sodium biphenyl, 20%w/w solution in diethylene glycol diethyl ether, offered as 20 x 15mL	5137-46-2	41942	14446, 277134
Sodium hydride, 60% dispersion in mineral oil, in soluble bags	7646-69-7	18986	199230, 71620
Sodium hydride, 60% dispersion in mineral oil, in soluble bags, in resealable cans	7646-69-7	33214	452912, 71620
Sodium hydrosulfite, ca. 85%, tech.	7775-14-6	16959	71699, 157953
Sodium thiosulfate, 98.5%, extra pure, anhydrous	7772-98-7	20287	72049, 217263, S1648
Triethylsilane, 99%	617-86-7	21292	89706, 230197
Triisopropylsilane, 98%	6485-79-6	21492	233781, 92095
Tri-n-butyltin hydride, 97%	688-73-3	21573	234788, 90915
<b>Reducing Agents - Aluminium hydrides and borohydrides</b>			
Borane-methyl sulfide complex, 94%, AcroSeal	13292-87-0	17706	179825, 15587
Borane-tetrahydrofuran complex, 1M solution in THF, Stabilized, AcroSeal	14044-65-6	17508	176192, 15594
Diisobutylaluminium hydride, 1.2M (20 wt%) solution in toluene, AcroSeal	1191-15-7	20108	82068, 192724
Lithium aluminium hydride, 95%, powder	16853-85-3	19032	199877, 62420, S31502
Sodium borohydride, 98+%, powder	16940-66-2	18930	686018, 71320, 213462
Sodium triacetoxyborohydride, 97%	56553-60-7	29182	316393

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Puratronic®	High purity base metals and salts. Each Puratronic compound has a minimum purity of 99.99% (many exceed 99.999%).
REacton	High purity rare earth metals, alloys and compounds. Recognized as a benchmark for high purity rare earths, the REacton brand encompasses the entire Lanthanide series (excluding promethium) along with scandium and yttrium. REacton rare earths feature extremely low impurity levels. Under the REacton name, we offer a broad range of high purity rare earth materials, including Oxides, Halides, Carbonates, Nitrates, Acetates and more.
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Ultra Dry	A comprehensive line of ultra dry materials. Ultra dry compounds are manufactured under exacting conditions to ensure that oxygen and water impurities are in the parts per million range. Only high purity starting materials are used in the manufacturing process, which results in overall purities of 99.9% to 99.999%. All ultra dry salts are ampouled under argon, and most are available in -10 mesh beads and powder form.

The Alfa Aesar product range includes over 46,000 products.

A selection of our most essential products from this range can be found in the list below.

#### High Purity Inorganics

Product Name	CAS Number	Product Code	Sigma
Aluminum nitrate hydrate, Puratronic®, 99.999% (metals basis excluding Hg)	25838-59-9	010626	
Aluminum oxide, alpha-phase, 99.95% min (metals basis)	1344-28-1	042573	342742
Copper(II) oxide, Puratronic®, 99.995% (metals basis)	1317-38-0	010700	203130
Indium(III) chloride, anhydrous, 99.999% (metals basis)	10025-82-8	011856	429414
Indium(III) sulfide, 99.995% (metals basis)	12030-24-9	044836	308293
Lead(II) iodide, ultra dry, 99.999% (metals basis)	10101-63-0	044314	554359
Sodium chloride, Puratronic®, 99.999% (metals basis)	7647-14-5	010862	204439
Tetraammineplatinum(II) chloride monohydrate, Premion®, 99.995% (metals basis)	13933-33-0	010836	
Titanium(IV) oxide, rutile, 99.5% min (metals basis)	1317-80-2	043047	
Vanadium(IV) sulfate oxide hydrate, 99.9% (metals basis)	123334-20-3	011090	

## Organometallics

Product Name	CAS Number	Product Code	Sigma
Allylzinc bromide, 0.5M in THF, packaged under Argon in resealable ChemSeal bottles		H58012	
4-Cyanobutylzinc bromide, 0.5M in THF, packaged under Argon in resealable ChemSeal bottles	226570-68-9	H58897	497894
Cyclobutylzinc bromide, 0.5M in THF, packaged under Argon in resealable ChemSeal bottles		H58247	
Cyclohexylzinc bromide, 0.5M in THF, packaged under Argon in resealable ChemSeal bottles	7565-57-3	H58852	498033
Cyclopropylzinc bromide, 0.5M in THF, packaged under Argon in resealable ChemSeal bottles	126403-68-7	H58008	680982
3-(Ethoxycarbonyl)propylzinc bromide, 0.5M in THF, packaged under Argon in resealable ChemSeal bottles	131379-39-0	H58023	498491
4-Fluorobenzylzinc chloride, 0.5M in THF, packaged under Argon in resealable ChemSeal bottles	312693-07-5	H58847	498602
Isopropylzinc bromide, 0.5M in THF, packaged under Argon in resealable ChemSeal bottles	77047-87-1	H58536	680966
Phenylzinc bromide, 0.5M in THF, packaged under Argon in resealable ChemSeal bottles	38111-44-3	H58659	524719
2-Pyridylzinc bromide, 0.5M in THF, packaged under Argon in resealable ChemSeal bottles	218777-23-2	H58544	499382

## Precious Metal Compounds and Catalysts

Product Name	CAS Number	Product Code	Sigma
Dihydrogen hexachloroiridate(IV) hydrate, 99% (metals basis), Ir 38-42%	110802-84-1	011031	
Dihydrogen hexachloroplatinate(IV) hydrate, 99.9% (metals basis)	26023-84-7	011051	
Gold(III) acetate, 99.9% (metals basis)	15804-32-7	039742	
Hydrogen tetrachloroaurate(III) hydrate, 99.9% (metals basis), Au 49% min	27988-77-8	012325	
Hydrogen tetrachloroaurate(III) trihydrate, ACS, 99.99% (metals basis), Au 49.0% min	16961-25-4	036400	
Iridium(III) chloride hydrate, 99.8% (metals basis)	14996-61-3	011030	
Palladium(II) chloride, 99.9% (metals basis), Pd 59.0% min	7647-10-1	011034	205885
Palladium(II) nitrate hydrate, 99.8% (metals basis), Pd 39% min	10102-05-3	011035	
Platinum(II) 2,4-pentanedionate, Pt 48.0% min	15170-57-7	010526	282782
Tetrakis(triphenylphosphine)palladium(0), 99.8% (metals basis), Pd 9% min	14221-01-3	010548	

## Pure Elements

Product Name	CAS Number	Product Code	Sigma
Bromine liquid, 99.8%	7726-95-6	000905	
Cesium, 99.98% (metals basis)	7440-46-2	010146	
Gold shot, semi-spherical, 6.35mm (0.25in) & down, Premion r, 99.999% (metals basis)	7440-57-5	040317	
Gold wire, 0.2mm (0.008in) dia, 99.9% (metals basis)	7440-57-5	010195	
Gold wire, 14kt, red, 1.63mm (0.064in) dia, Au 58.3% min		040328	
Platinum gauze, 52 mesh woven from 0.1mm (0.004in) dia wire, 99.9% (metals basis)	7440-06-4	010283	
Platinum slug, 6.35mm (0.25in) dia x 12.7mm (0.50in) length, Premion r, 99.99+% (metals basis)	7440-06-4	013374	
Silver wire, 2.0mm (0.08in) dia, annealed, 99.9% (metals basis)	7440-22-4	011435	
Vanadium foil, 0.127mm (0.005in) thick, 99.8% (metals basis)	7440-62-2	013783	
Zirconium sponge, 0.8-25.4mm (0.03-1.0in), 99.5%, Zr & Hf	7440-67-7	010441	267651

## Solvents

Product Name	CAS Number	Product Code	Sigma
Acetonitrile, HPLC Grade, 99.7+% min	75-05-8	022927	34881
N,N-Dimethylformamide, anhydrous, amine free, 99.9%	68-12-2	043465	15440
Dimethyl sulfoxide, HPLC Grade, 99.9+% min	67-68-5	022914	34869
Ethanol, Alcohol Reagent, anhydrous, denatured, ACS, 94-96%	64-17-5	033361	
Methanol, Semiconductor Grade, 99.9% min	67-56-1	019393	
Methanol, ultrapure, HPLC Grade, 99.8+% min	67-56-1	022909	646377
1-Propanol, ACS, 99.5+% min	71-23-8	043848	402893
2-Propanol, ACS, 99.5% min	67-63-0	036644	673773
Tetrahydrofuran, UV, HPLC Grade, 99.7+% min, unstab.	109-99-9	022904	34865
Water, ultrapure, HPLC Grade	7732-18-5	022934	270733

## Specialized Chemical Services

### We Support Your Chemistry



**Manufacturing**



**Tailored Specifications**



**Mixtures and Blends**



**Customized Packaging**



**Bulk and  
Semi-bulk Chemicals**



**Custom Synthesis**



**Testing Services**



**Reduced waste**



**Sourcing Support**

We enable our customers to optimize their own resources with our secure and validated global supply chain; global sourcing capabilities; and manufacturing, quality control and packaging expertise.

Our Specialized Chemical Services (SCS) team serves customers who require something different:

- Semi-bulk and bulk chemicals
- Tailored solvents and solvent blends
- Custom synthesis and special solutions
- Additional testing services
- Customized packaging and labeling



## Bulk and Semi-bulk Chemicals

The extensive catalogue offering encompasses the Fisher Chemical, Fisher BioReagents, Acros Organics, Alfa Aesar and Maybridge brands. Any product from these brands is available in larger quantities to suit your semi-bulk and bulk requirements.

We can secure and manage the supply of these products using either internal manufacturing or select partners worldwide through our extensive supply-chain network.

Additional testing services can be provided on request.

## Custom Blending Process

We can tailor make solvents to meet your specifications for your application. In addition, our dedicated solvent-mixing facilities are available to produce high-quality blends. Solvents are charged by weight, through a 0.2µm filter, by air-driven pump and/or by nitrogen pressure. Small amounts of solid and liquid additives are added via charge-ports.

We can manufacture aqueous and non-aqueous solutions to match your specification.

## Custom Synthesis

We have been custom manufacturing products for many years with production methods for over 8000 products in our extensive database. Whether you are looking to synthesise complex organic building blocks, ligands and precious metal catalysts, optimise your synthesis or develop a scalable route, we are able to provide the expertise and knowledge to support your project.

Our diverse and flexible custom manufacturing capabilities support our customers' custom synthesis requirements from R&D through to full scale production, with quantities from gram to tonne. Communication with our customers is a key priority for our dedicated UK custom synthesis team, who are on hand to provide bespoke support to customers throughout the development and manufacturing process. Our laboratories operate to ISO 9001 and 14001 accreditations.

## Customized Packaging and Labeling



Our products are available in a wide variety of innovative packaging designed for safety, environmental protection, convenient handling and storage and preservation of product integrity while complying with all relevant regulations.

Custom-packaging is also available or we can fill our chemicals into packaging supplied by you.

Find out how we can help to increase your lab efficiency by providing your chemicals tested, labeled, packaged and delivered to your exact specification. Please visit [www.wesupportyourchemistry.com](http://www.wesupportyourchemistry.com) for more information.

## High Volume Solvents Delivery Systems

### Safety, efficiency and convenience

High-volume solvent delivery systems, available in 10L to 1000L, offer environmentally friendly solvent handling solutions for your applications, enhancing safety and improving productivity within your lab.

### Enhanced solvent safety

High-volume solvent delivery systems incorporate safety features to protect the lab and the environment by offering a combination of mechanical and manual controls to prevent unwanted solvent flow. The bottle-free, closed system eliminates the potential for glass bottle breakage and makes the risk of spills and exposure to vapors negligible.

### Reduce lab-operating costs

Increase lab efficiency by eliminating:

- Repeated solvent testing
- Multiple lots of material
- Bottle rinsing
- Disposal costs

### Environmentally friendly solution

- Reduce the amount of solid waste generated in your laboratory
- Minimize the release of flammable or toxic solvent liquids and vapors
- Eliminate bottle rinsing – empty containers are returned, cleaned and refilled

### For your applications

- High-performance liquid chromatography (HPLC)
- Preparative chromatography and high-volume gas chromatography sample preparation
- Process synthesis and extractions



## Our Labels

### What's on the label



GHS information











Product specific information



LOT analysis

### GHS Pictograms Explained

<p><b>GHS01 Exploding bombs</b> = Explosive, self reactive; heating may cause fire or explosion.</p> 	<p><b>GHS02 Flame</b> = Flammable, chemicals can catch fire easily and burst into flames.</p> 	<p><b>GHS03 Flame over circle</b> = Oxidizing, can react with other materials causing them to burn or explode.</p> 
<p><b>GHS04 Gas cylinder</b> = Gas under pressure: chemical can explode, rocket or harm health if the cylinder is heated, ruptured or leaking.</p> 	<p><b>GHS05 Corrosion</b> = Corrosive: may cause skin corrosion/ burns; eye damage; eat away clothing, working surfaces, and or metals.</p> 	<p><b>GHS06 Skull and crossbones</b> = Toxic: highly poisonous material; can cause immediate and possibly serious health problems.</p> 
<p><b>GHS07 Exclamation mark</b> = Other Hazard irritant (skin and eye), skin sensitizer, acute toxicity, narcotic effects, respiratory track irritant, harmful if swallowed, toxic if inhaled.</p> 	<p><b>GHS08 Health hazard</b> = Specific health hazard including– Carcinogenic; Mutagenic; Toxic for Reproduction: may cause asthma or damage to specific organs of the body.</p> 	

# Chemical Storage/Handling Recommendations

## Chemical Incompatibility

Chemicals should react in the lab, not in the stockroom. The inadvertent mixing of inventory can produce toxic vapor/gas, fire or explosion. Stay safe in the storeroom; adhere to the following prescribed precautions and consult the chemical compatibility tables (below) for caustic combinations. For product specific information, refer to the Material Safety Data Sheet (MSDS) provided with purchase.

## General Guidelines

- Protect eyes and skin: lab safety glasses with side shields, lab coats and closed-toe shoes must be worn for basic personal protection
- Safely space shelves and racks to accommodate the upright removal of the largest chemical container; prevent tipping and dripping with adequate clearance
- Identify and substitute safer chemical alternatives
- Keep hazardous materials away from heat and direct sunlight to prevent the degradation of chemicals and deterioration of storage containers and labels
- Do not store hazardous materials (except cleaners) under sinks
- Avoid chemical stockpiling; procure hazardous materials as needed
- Limit fume hood storage of hazardous materials
- Conduct periodic cleanouts to minimize accumulation of chemicals
- Keep all food (including gum), beverages, tobacco and open cosmetics outside the work area

## Acids and Bases

### Isolate acids:

- From reactive metals, including sodium, potassium and magnesium
- From sodium cyanide, iron sulfide, calcium carbide and other compounds that can react to produce toxic fumes/gases
- Place combustible organic carboxylic acids (i.e., acetic acid) in a flammable storage locker; store inorganic acids in acid storage cabinets
- Store acids and bases in air-tight containers with snug-fitting caps; avoid loose lids or glass stoppers; use vented caps when necessary to prevent over-pressurization
- Keep piranha etch and aqua regia in a fume hood at all times
- Use non-aluminum drip trays for aqueous sodium and potassium hydroxide solutions; isolate nitric acid when utilizing secondary containment
- Safely transfer containers of acid and base solutions using bottle carriers
- Never pour water into acid; slowly add the acid to the water and stir



## Flammable and Combustible Liquids

- The main legislation for storing flammable liquids in Fire Resistant Cabinets in Europe is EN14470 Part 1. There are additional local country standards that exist which you should also be aware of
- The safe storage and handling of chemicals is essential in any volume, but generally you should consider whether the risk of the spread of fire is mitigated by using suitable fire resistant cabinets
- Anyone storing or planning to store highly flammable and/or flammable liquids should pay particular attention to their local legislation



	Acids, Inorganic	Acids, Oxidizing	Acids, Organic	Alkalis (Bases)	Oxidizers	Poisons, Inorganic	Poisons, Organic	Water-Reactives	Organic Solvents
Acids, inorganic			X	X		X	X	X	X
Acids, oxidizing			X	X		X	X	X	X
Acids, organic	X	X		X	X	X	X	X	
Alkalis (bases)	X	X	X				X	X	X
Oxidizers			X				X	X	X
Poisons, inorganic	X	X	X				X	X	X
Poisons, organic	X	X	X	X	X	X			
Water-reactives	X	X	X	X	X	X			
Organic solvents	X	X		X	X	X			

X indicates incompatibility between two chemical product groups. Incompatible products should not be stored in close proximity.

## Chemical Incompatibilities table

Chemical	Store Separately From
Acetic acid	Chromic acid, nitric acid, perchloric acid, peroxides, permanganates and other oxidizers
Acetone	Concentrated nitric and sulfuric acid mixtures, and strong bases
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali metals	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia, anhydrous	Mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenic materials	Any reducing agent
Azides	Acids
Bromine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, turpentine, benzene, finely divided metals
Calcium oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidizing agents
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible materials
Chromic acid and chromium trioxide	Acetic acid, naphthalene, camphor, glycerol, glycerin, turpentine, alcohol, flammable liquids in general
Chlorine	Same as Bromine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids, organic or inorganic
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Hydrocarbons	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Acids
Hydrofluoric acid	Ammonia, aqueous or anhydrous bases and silica
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, flammable liquids
Hydrogen sulfide	Fuming nitric acid, other acids, oxidizing gases, acetylene, ammonia (aqueous or anhydrous), hydrogen
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitrates	Sulfuric acid
Nitric acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals
Nitrites	Acids
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Silver, mercury
Oxygen	Oils, grease, hydrogen; flammable liquids, solids, or gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease and oils
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorus (white)	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate and perchlorate	Sulfuric and other acids, alkali metals, magnesium and calcium
Potassium permanganate	Glycerin, ethylene glycol, benzaldehyde, sulfuric acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric Acid	Potassium chlorate, potassium perchlorate, potassium permanganate (or compounds with similar light metals: sodium, lithium, etc.)
Tellurides	Reducing agents

(From Manufacturing Chemists' Association, *Guide for Safety in the Chemical Laboratory*, pp. 215–217, Van Nostrand)

# Chemical Resistance and Physical Properties of Plastics

## Resin Codes

<b>ECTFE:</b> Ethylene- chlorotrifluoroethylene copolymer	<b>PFA:</b> Perfluoroalkoxy
<b>ETFE:</b> Ethylenetetrafluoroethylene	<b>PMMA:</b> Polymethyl methacrylate
<b>FEP:</b> Fluorinated ethylene propylene	<b>PMP:</b> Polymethylpentene
<b>FLPE:</b> Fluorinated high-density polyethylene	<b>PP:</b> Polypropylene
<b>FLPP:</b> Fluorinated polypropylene	<b>PS:</b> Polystyrene
<b>HDPE:</b> High-density polyethylene	<b>PSF:</b> Polysulfone
<b>LDPE:</b> Low-density polyethylene	<b>PTFE:</b> Polytetrafluoroethylene
<b>NYL:</b> Nylon (polyamide)	<b>PUR:</b> Polyurethane
<b>PPCO:</b> Polypropylene copolymer	<b>PVC:</b> Polyvinyl chloride
<b>PC:</b> Polycarbonate	<b>PVDF:</b> Polyvinylidene fluoride
<b>PETG:</b> Polyethylene terephthalate copolyester	<b>TPE:</b> Thermoplastic elastomer
<b>PK:</b> Polyketone	<b>XLPE:</b> Cross-linked high-density polyethylene

Do not store strong oxidizing agents in plastic labware except if made of FEP, PFA or PTFE. Other plastics will become brittle after prolonged exposure.

Do not place plastic labware directly in a flame or on a hotplate unless specified.

Use these charts as a reference only. They are recommendations, not guarantees, of fitness for particular uses. Test materials under actual conditions before using them for your applications.

## Chemical Resistance Summary

Classes of substances; temperature 68°F (20°C)	ECTFE/ETFE	FEP/PTFE/PFA	FLPE	HDPE/XLPE	LDPE	NYL	PC	PETG	PK	PMMA	PMP	PP/PPCO	PS	PSF	PUR	PVC	PVDF	TPE <sup>‡</sup>
Acids, weak or dilute	E	E	E	E	E	F	E	E	E	G	E	E	E	E	G	E	E	E
Acids <sup>†</sup> , strong or concentrated	G	E	E	E	E	N	N	N	G	N	E	E	F	G	F	E	E	F
Alcohols, aliphatic	E	E	E	E	E	N	G	E	G	N	E	E	E	G	F	E	E	E
Aldehydes	E	E	G	G	G	F	F	N	E	G	G	G	N	F	G	N	E	N
Bases	E	E	F	E	E	F	N	N	G	F	E	E	E	E	N	E	E	E
Esters	E	E	E	G	G	E	N	N	E	N	G	G	N	N	N	N	G	N
Hydrocarbons, aliphatic	E	E	E	G	F	E	F	E	E	G	F	G	N	G	E	E	E	N
Hydrocarbons, aromatic	E	E	E	G	F	E	N	N	E	N	F	F	N	N	N	N	E	N
Hydrocarbons, halogenated	E	E	G	F	N	G	N	N	E	N	N	F	N	N	N	N	N	N
Ketones	G	E	E	G	G	E	N	N	E	N	F	G	N	N	N	N	N	N
Oxidizing agents, strong	F	E	F	F	F	N	N	N	G	N	F	F	N	G	N	G	G	N

<sup>†</sup> For oxidizing acids, see table entry "Oxidizing agents, strong." <sup>‡</sup> TPE gaskets

**E = Excellent resistance**  
No damage after 30 days of constant exposure.

**G = Good resistance**  
Little or no damage after 30 days of constant exposure.

**F = Fair resistance**  
Some effect after 7 days of constant exposure. Depending on the material, the effect may be cracking, crazing, loss of strength or discoloration. Solvents may cause softening, swelling, and permeation losses with PA, PP, PMP, LDPE and HDPE; the solvent effects on these materials are normally reversible.

**N = Not recommended**  
Not recommended for continuous use. Immediate damage may occur. Depending on the material, the effect will be severe cracking, crazing, loss of strength, discoloration, deformation, dissolution or permeation loss.

## Solvent Miscibility

	Acetone	Acetonitrile	Carbon tetrachloride	Chloroform	Cyclohexane	1,2 Dichloroethane	Dichloroethane	Diethyl ether	Dimethylformamide	Dimethylsulfoxide	1,4 Dioxane	Ethanol	Ethyl acetate	Heptane	Hexane	Methanol	Methyl-tert-butyl ether	Pentane	Propan-1-ol	Propan-2-ol	Tetrahydrofuran	Toluene	2, 2, 4, Trimethylpentane	Water	
Acetone																									
Acetonitrile																									
Carbon tetrachloride																									
Chloroform																									
Cyclohexane		●																							
1,2 Dichloroethane																									
Dichloroethane																									
Diethyl ether																									
Dimethylformamide					●																				
Dimethylsulfoxide					●			●																	
1,4 Dioxane																									
Ethanol																									
Ethyl acetate																									
Heptane																									
Hexane		●							●	●															
Methanol		●							●	●															
Methyl-tert-butyl ether					●									●	●										
Pentane		●															●								
Propan-1-ol																									
Propan-2-ol																									
Tetrahydrofuran																									
Toluene																									
2, 2, 4, Trimethylpentane		●							●	●															
Water			●	●	●	●	●	●	●	●			●	●	●		●	●				●	●		

● indicates that solvents are not miscible

# Chemical Resistance of Labware Materials

## How to Use This Chart

### Use This Chart as a General Guide Only.

Test each chemical before storing in labware.

The first letter of each pair represents the resistance rating at 20°C; the second at 50°C.

#### E = Excellent resistance

No damage after 30 days of constant exposure.

#### G = Good resistance

Little or no damage after 30 days of constant exposure.

#### F = Fair resistance

Some effect after 7 days of constant exposure. Depending on the material, the effect may be cracking, crazing, loss of strength or discoloration. Solvents may cause softening, swelling, and permeation losses with PA, PP, PMP, LDPE and HDPE; the solvent effects on these materials are normally reversible.

#### N = Not recommended

Not recommended for continuous use. Immediate damage may occur. Depending on the material, the effect will be severe cracking, crazing, loss of strength, discoloration, deformation, dissolution or permeation loss.

#### Examples

EE = Acetic Acid, 50% - LDPE gives excellent resistance at both 20°C and 50°C.

GF = n-Amyl acetate - PPE/PPCO gives good resistance at 20°C but resistance is reduced to fair at 50°C.

#### Warning!

**Do not store strong oxidizing agents in plastic containers except those made of Teflon™ FEP, PFA or PTFE. Other plastics will become brittle after prolonged exposure.**

CHEMICAL	LDPE	HDPE	PP/PPCO	PMP	FEP/PTFE/ PFA	ECTFE/ ETFE	PC	PVC	PSF	PVDF	PS	NYL	Stainless Steel	Glass	Ceramic
Acetaldehyde	GN	GF	GN	GN	EE	GF	FN	GN	NN	EE	NN	EG	EE	EE	EE
Acetamide, sat.	EE	EE	EE	EE	EE	EE	NN	NN	NN	—	EE	EE	EE	EE	EE
Acetic acid, 5%	EE	EE	EE	EE	EE	EE	EG	EE	EE	EE	EG	FN	EE	EE	EE
Acetic acid, 50%	EE	EE	EE	EE	EE	EG	EG	EG	GG	EE	GG	NN	EE	EE	EE
Acetone	NN	NN	EE	EE	EE	GF	NN	NN	NN	NN	NN	EE	EE	EE	EE
Acetonitrile	EE	EE	FN	FN	EE	EE	NN	NN	NN	EE	NN	EE	EG	EE	EE
Acrylonitrile	EE	EE	FN	FN	EE	EG	NN	NN	NN	GF	NN	EG	EG	EE	EE
Adipic acid	EG	EE	EE	EE	EE	EE	EE	EG	GG	—	EE	EF	EG	EE	EE
Alanine	EE	EE	EE	EE	EE	EE	NN	NN	NN	—	EE	EG	—	—	—
Allyl alcohol	EE	EE	EE	EG	EE	EE	GF	GF	GF	—	GF	NN	EE	EG	EG
Aluminum hydroxide	EG	EE	EG	EG	EE	EE	FN	EG	GG	EE	GG	EE	EE	NN	EE
Aluminum salts	EE	EE	EE	EE	EE	EE	EG	EE	EE	EE	GG	NN	GG	EE	EE
Amino acids	EE	EE	EE	EE	EE	EE	EE	EE	EE	EE	EE	EG	—	—	—
Ammonia	EE	EE	EE	EE	EE	EE	NN	EG	GF	EE	GF	FF	EE	EE	EE
Ammonium acetate, sat.	EE	EE	EE	EE	EE	EE	EE	EE	EE	EE	EE	EE	EG	EE	EE
Ammonium glycolate	EG	EE	EG	EG	EE	EE	GF	EE	GG	EE	EE	GG	—	—	—
Ammonium hydroxide, 5%	EE	EE	EE	EE	EE	EE	FN	EE	GG	EE	EF	GF	EE	EE	EE
Ammonium hydroxide, 30%	EG	EE	EG	EG	EE	EE	NN	EG	GG	EE	GF	FN	EE	EE	EE
Ammonium oxalate	EG	EE	EG	EG	EE	EE	EE	EE	EE	EE	EE	GF	EE	EE	EE
Ammonium salts	EE	EE	EE	EE	EE	EE	EG	EG	EE	EE	GG	NN	EE	EE	EE
n-Amyl acetate	GF	EG	GF	GF	EE	EE	NN	NN	NN	EE	NN	EE	EE	EE	EG
Amyl chloride	NN	FN	NN	NN	EE	EE	NN	NN	NN	EE	NN	EG	EE	EE	EE
Aniline	EG	EG	GF	GF	EE	GN	FN	NN	NN	EF	NN	GF	EG	EE	EE
Benzaldehyde	EG	EE	EG	EG	EE	EF	FN	NN	FF	EE	NN	EG	GG	EE	EE
Benzene	FN	NN	GF	GF	EE	EG	NN	NN	NN	EE	NN	EE	GG	EE	EE
Benzoic acid, sat.	EE	EE	EG	EG	EE	EE	EG	EG	FF	EE	GG	NN	EG	EE	EE
Benzyl acetate	EG	EE	EG	EG	EE	EG	FN	NN	NN	—	NN	EG	GG	EE	EE
Benzyl alcohol	NN	FN	NN	NN	EE	EE	NN	GF	NN	EE	NN	NN	GG	EE	EE
Bromine	NN	FN	NN	NN	EE	EG	FN	GN	NN	EE	NN	NN	EE	EG	GG
Bromobenzene	NN	FN	NN	NN	EE	GN	NN	NN	NN	EE	NN	EG	GG	GG	GG
Bromoform	NN	NN	NN	NN	EE	GF	NN	NN	NN	EE	NN	FF	GG	EE	EE
Butadiene	NN	FN	NN	NN	EE	EE	NN	FN	NN	EE	NN	FF	GG	EE	EE
n-Butyl acetate	GF	EG	GF	GF	EE	EG	NN	NN	NN	EE	NN	EE	GG	EE	EE
n-Butyl alcohol	EE	EE	EE	EG	EE	EE	GF	GF	GF	EE	EG	NN	EE	EE	EE
sec-Butyl alcohol	EG	EE	EG	EG	EE	EE	GF	GG	GF	EE	GG	NN	EE	EE	EE
tert-Butyl alcohol	EG	EE	EG	EG	EE	EE	GF	EG	GF	EE	EE	NN	EE	EE	EE
Butyric acid	NN	FN	NN	NN	EE	EE	FN	GN	GG	EE	NN	FN	GG	EE	EE
Calcium hydroxide, conc.	EE	EE	EE	EE	EE	EE	NN	EE	GG	EE	GG	NN	GG	NN	EE
Calcium hypochlorite, sat.	EE	EE	EE	EG	EE	EE	FN	GF	EE	EE	GF	NN	EE	EE	EE
Carbazole	EE	EE	EE	EE	EE	EE	NN	NN	NN	—	EE	EE	—	—	—
Carbon disulfide	NN	NN	NN	NN	EE	EF	NN	NN	NN	EE	NN	EG	EE	EE	EE
Carbon tetrachloride	FN	GF	GF	NN	EE	EE	NN	GF	NN	EE	NN	EE	GG	EE	EE
Cedarwood oil	NN	FN	NN	NN	EE	EG	GF	FN	FF	EE	NN	EG	—	—	—
Cellose acetate	EG	EE	EG	EG	EE	EG	FN	FN	NN	EG	NN	EE	GG	EE	EE
Chlorine, 10% in air	GN	EF	GN	GN	EE	EE	EG	EE	NN	EE	FN	NN	FF	EE	EE
Chlorine, 10% (moist)	GN	GF	FN	GN	EE	EE	GF	EG	NN	EE	NN	NN	FF	EE	EE
Chloroacetic acid	EE	EE	EG	EG	EE	EE	FN	FN	NN	E-	GN	NN	GG	EE	EE
p-Chloroacetophenone	EE	EE	EE	EE	EE	EE	NN	NN	NN	—	NN	EG	—	—	—
Chloroform	FN	FN	GF	NN	EE	GF	NN	NN	NN	EE	NN	FF	EE	EE	EE
Chromic acid, 10%	EE	EE	EE	EE	EE	EE	GF	EG	NN	EE	EE	NN	GG	EE	EE
Chromic acid, 50%	EE	EE	GF	GF	EE	EE	FN	EF	NN	EG	FF	NN	FF	EE	NN
Cinnamon oil	NN	FN	NN	NN	EE	EG	GF	NN	FF	—	NN	GF	EE	—	—
Citric acid, 10%	EE	EE	EE	EE	EE	EE	EG	GG	EE	EE	EG	NN	GG	EE	EE
Cresol	NN	FN	GF	NN	EE	EG	NN	NN	NN	EE	NN	EE	EE	EE	EE
Cyclohexane	FN	FN	FN	NN	EE	EG	EG	GF	NN	EE	NN	EE	EE	EE	EE
DeCalin	GF	EG	GF	FN	EE	EE	NN	EG	NN	—	NN	EE	—	—	—
o-Dichlorobenzene	FN	FF	FN	FN	EE	EF	NN	NN	NN	EE	NN	EG	GG	EE	EE
p-Dichlorobenzene	FN	GF	GF	GF	EE	EF	NN	NN	NN	EE	NN	EG	GG	EE	EE
Diethyl benzene	NN	FN	NN	NN	EE	EG	FN	NN	NN	—	NN	EE	GG	EE	EE
Diethyl ether	NN	FN	NN	NN	EE	EG	NN	FN	NN	EG	NN	EE	GG	EE	EE
Diethyl ketone	NN	NN	GG	GF	EE	GF	NN	NN	NN	NN	NN	EE	GG	EE	EE
Diethyl malonate	EE	EE	EE	EG	EE	EE	FN	GN	FF	EG	NN	EE	—	—	—
Diethylene glycol	EE	EE	EE	EE	EE	EE	GF	FN	GG	EE	GG	EE	EE	EE	EE
Diethylene glycol ethyl ether	EE	EE	EE	EE	EE	EE	FN	FN	FF	—	NN	EE	EE	EE	EE
Dimethyl formamide	EE	EE	EE	EE	EE	GG	NN	FN	NN	NN	NN	GF	EE	EE	EE
Dimethylsulfoxide	EE	EE	EE	EE	EE	EG	NN	NN	NN	—	EG	EE	EE	EE	EE
1,4-Dioxane	GF	GG	GF	GF	EE	EF	GF	FN	GF	NN	NN	EF	GG	EE	EE
Dipropylene glycol	EE	EE	EE	EE	EE	EE	GF	GF	GF	—	EE	EE	—	—	—
Ether	NN	FN	NN	NN	EE	EG	NN	FN	NN	EG	NN	EE	EE	EE	EE
Ethyl acetate	EE	EE	EE	FN	EE	EE	NN	NN	NN	NN	NN	EE	GG	EE	EE
Ethyl alcohol (absolute)	EG	EE	EG	EG	EE	EE	EG	EG	EG	EE	FN	NN	EE	EE	EE
Ethyl alcohol, 40%	EG	EE	EG	EG	EE	EE	EG	EE	EG	EE	GF	NN	EE	EE	EE
Ethyl benzene	FN	GF	FN	FN	EE	GF	NN	NN	NN	—	NN	EE	GG	—	—
Ethyl benzoate	FF	GG	GF	GF	EE	EG	NN	NN	NN	NN	NN	EE	—	—	—
Ethyl butyrate	GN	GF	GN	FN	EE	EG	NN	NN	NN	NN	NN	EE	EG	—	—
Ethyl chloride, liquid	FN	FF	FN	FN	EE	EE	NN	NN	NN	EE	NN	GF	EE	EE	EE
Ethyl cyanoacetate	EE	EE	EE	EE	EE	EE	FN	FN	FF	NN	GN	GF	—	—	—
Ethyl lactate	EE	EE	EE	EE	EE	EE	FN	FN	FF	NN	FN	EG	—	—	—
Ethylene chloride	GN	GF	FN	NN	EE	EE	NN	NN	NN	EE	NN	EG	GG	EE	EE
Ethylene glycol	EE	EE	EE	EE	EE	EE	GF	EE	EE	EE	EE	EE	GG	EE	EE
Ethylene glycol methyl ether	EE	EE	EE	EE	EE	EE	FN	FN	FF	—	NN	EE	—	—	—
Ethylene oxide	FF	GF	FF	FN	EE	EE	FN	FN	EE	EE	NN	EE	GG	EE	EE
Fluorides	EE	EE	EE	EE	EE	EE	EE	EE	EE	EE	GG	EE	—	—	—
Fluorine	FN	GN	FN	FN	EG	EF	GF	EG	NN	—	NN	NN	EG	EE	—
Formaldehyde, 10%	EE	EE	EE	EG	EE	EE	EG	GF	GF	EE	FN	GF	EE	EE	EE

CHEMICAL	LDPE	HDPE	PP/PPCO	PMP	FEP/PTFE/ PFA	ECTFE/ ETFE	PC	PVC	PSF	PVDF	PS	NYL	Stainless Steel	Glass	Ceramic
Formaldehyde, 40%	EG	EE	EG	EG	EE	EE	EG	GF	GF	EE	NN	GF	EE	EE	EE
Formic acid, 3%	EG	EE	EG	EG	EE	EE	EG	GF	GG	EE	EG	NN	GG	EE	EE
Formic acid, 50%	EG	EE	EG	EG	EE	EE	EG	GF	GG	EE	FF	NN	GG	EE	EE
Formic acid, 98 to 100%	EG	EE	EG	EF	EE	EE	EF	FN	FF	EE	FF	NN	GG	EE	EE
Freon® TF	EG	EG	EG	FN	EE	EG	GF	GF	EG	EE	FN	—	EE	EE	EE
Fuel oil	FN	GF	EG	GF	EE	EE	EG	EE	EG	EE	NN	EE	EE	EE	EE
Gasoline	FN	GG	GF	GF	EE	EE	FF	GN	FF	EE	NN	EE	EE	EE	EE
Glacial acetic acid	EG	EE	EG	EG	EE	EE	NN	EG	FN	EG	NN	NN	EG	EE	EE
Glycerine	EE	EE	EE	EE	EE	EE	EE	EE	EE	EE	EE	EE	EE	EE	EE
n-Heptane	FN	GF	FF	FF	EE	EE	EG	GF	EG	EE	NN	EE	EE	EE	EE
Hexane	NN	GF	GF	FN	EE	EE	FN	GN	EG	EE	NN	EE	EE	EE	EE
Hydrochloric acid, 1 to 5%	EE	EE	EE	EG	EE	EE	EE	EE	EE	EE	EE	NN	NN	EE	EE
Hydrochloric acid, 20%	EE	EE	EE	EG	EE	EE	GF	EG	EE	EE	EE	NN	NN	EE	EE
Hydrochloric acid, 35%	EE	EE	EG	EG	EE	EE	NN	GF	EE	EE	FF	NN	NN	EE	EE
Hydrofluoric acid, 4%	EG	EE	EG	EG	EE	EE	GF	GF	EE	EE	GF	NN	NN	EE	—
Hydrofluoric acid, 48%	EE	EE	EE	EE	EE	EE	NN	GF	FN	EE	NN	NN	NN	NN	NN
Hydrogen peroxide, 3%	EE	EE	EE	EE	EE	EE	EE	EE	EE	EE	EG	NN	GG	EE	EG
Hydrogen peroxide, 30%	EG	EE	EG	EG	EE	EE	EE	EE	EE	EE	EG	NN	GG	EE	EG
Hydrogen peroxide, 90%	EG	EE	EG	EG	EE	EE	EE	EG	EE	E-	EG	NN	GG	EE	EG
Isobutyl alcohol	EE	EE	EE	EG	EE	EE	EG	EG	EG	EE	GG	NN	EE	EE	EE
Isopropyl acetate	GF	EG	GF	GF	EE	EG	NN	NN	NN	—	NN	EE	GG	EE	EE
Isopropyl alcohol	EE	EE	EE	EE	EE	EE	EE	EG	EE	EE	EG	NN	GG	EE	EE
Isopropyl benzene	FN	GF	FN	NN	EE	EG	NN	NN	NN	—	NN	EG	—	—	—
Kerosene	FN	GG	GF	GF	EE	GF	EE	EE	GF	EE	NN	EE	EE	EE	EE
Lactic acid, 3%	EG	EE	EG	EG	EE	EE	EG	GF	EE	EG	GG	NN	GG	EE	EE
Lactic acid, 85%	EE	EE	EG	EG	EE	EG	EG	GF	EE	GF	GG	NN	GG	EE	EE
Methoxyethyl oleate	EG	EE	EG	EG	EE	EE	FN	NN	NN	—	NN	EG	—	—	—
Methyl alcohol	EE	EE	EE	EE	EE	EE	GF	EF	GF	EE	FN	NN	EE	EE	EE
Methyl ethyl ketone	NN	NN	EG	NN	EE	GF	NN	NN	NN	NN	NN	EE	EE	EE	EE
Methyl isobutyl ketone	NN	NN	GF	FF	EE	GF	NN	NN	NN	GN	NN	EE	GG	EE	EE
Methyl propyl ketone	GF	EG	GF	FF	EE	EG	NN	NN	NN	NN	NN	EE	EE	—	—
Methylene chloride	FN	FN	FN	FN	EE	GG	NN	NN	NN	NN	NN	GF	GG	EE	EE
Mineral oil	GN	EE	EE	EG	EE	EE	EG	EG	EE	EE	EE	EE	EE	EE	EE
Nitric acid, 1 to 10%	EE	EE	EE	EE	EE	EE	EE	EG	EF	EE	GN	NN	EE	EE	EE
Nitric acid, 50%	GN	GN	FN	GN	EE	EE	GF	GF	GF	EG	NN	NN	EG	EG	NN
Nitric acid, 70%	FN	GN	NN	GF	EE	EE	NN	FN	NN	GF	NN	NN	GG	EE	NN
Nitrobenzene	NN	FN	NN	NN	EE	EG	NN	NN	NN	EN	NN	FF	GG	EE	EE
n-Octane	EE	EE	EE	EE	EE	EE	GF	FN	GF	EE	NN	EE	EE	EE	EE
Orange oil	FN	GF	GF	FF	EE	EE	FF	FN	FF	EE	NN	GF	EE	EE	EE
Ozone	EG	EE	EG	EE	EE	EE	EG	EG	EE	EE	FF	EG	EG	—	—
Perchloric acid	GN	GN	GN	GN	GF	EG	NN	GN	NN	EE	GF	NN	FF	EE	EE
Perchloroethylene	NN	NN	NN	NN	EE	EE	NN	NN	NN	EE	NN	EE	EG	EE	EE
Phenol, crystals	GN	GF	GN	FG	EE	EE	NN	FN	FF	EE	NN	NN	GG	EE	EE
Phosphoric acid, 1 to 5%	EE	EE	EE	EE	EE	EE	EE	EE	EE	EE	GG	NN	NN	EE	EE
Phosphoric acid, 85%	EE	EE	EG	EG	EE	EE	EE	EE	EE	EE	EG	NN	NN	EE	EE
Pine oil	GN	EG	EG	GF	EE	EG	GF	FN	FF	EE	NN	GF	EE	—	—
Potassium hydroxide, 1%	EE	EE	EE	EE	EE	EE	FN	EE	EE	EE	GG	GF	EG	GF	GF
Potassium hydroxide, conc.	EE	EE	EE	EE	EE	EE	NN	EG	EE	EG	GG	FF	EG	NN	NN
Propane gas	NN	FN	NN	NN	EE	EE	FN	EG	FF	EE	NN	FF	GF	NN	NN
Propylene glycol	EE	EE	EE	EE	EE	EE	GF	FN	GG	—	EE	EE	GG	EE	EE
Propylene oxide	EG	EE	EG	EG	EE	FN	GF	FN	GG	FN	NN	EE	EE	—	—
Resorcinol, sat.	EE	EE	EE	EE	EE	EE	GF	FN	NN	—	GF	NN	—	—	—
Resorcinol, 5%	EE	EE	EE	EE	EE	EF	GF	GN	NN	—	GF	NN	—	—	—
Saicylaldehyde	EG	EE	EG	EG	EE	EN	GF	FN	FF	EG	NN	EG	—	—	—
Saicylic acid, powder	EE	EE	EE	EG	EE	EE	EG	GF	EE	EE	EE	EG	GG	EE	EE
Saicylic acid, sat.	EE	EE	EE	EE	EE	EE	EG	GF	EE	EE	EG	NN	GG	EE	EE
Salt solutions, metallic	EE	EE	EE	EE	EE	EE	EE	EE	EE	EE	GG	FF	EG	—	—
Silver acetate	EE	EE	EE	EE	EE	EE	EG	GG	EE	EE	GG	EF	—	—	—
Silver nitrate	EG	EE	EG	EE	EE	EE	EE	EG	EE	EE	GF	NN	GG	EE	EE
Sodium acetate, sat.	EE	EE	EE	EE	EE	EE	EG	GF	EE	EE	GG	FF	GG	EE	EE
Sodium hydroxide, 1%	EE	EE	EE	EE	EE	EE	FN	EE	EE	EE	GG	EE	GG	GE	GE
Sodium hydroxide, 50% to sat.	GG	EE	EE	EE	EE	EE	NN	NN	EG	EG	EE	GF	GF	NN	NN
Sodium hypochlorite, 15%	EE	EE	GF	EE	EE	EE	GF	EE	EE	EE	EE	NN	NN	EE	EG
Stearic acid, crystals	EE	EE	EE	EE	EE	EE	EG	EG	GG	EE	EG	EF	EG	EE	EE
Sulfuric acid, 1 to 6%	EE	EE	EE	EE	EE	EE	EE	EG	EE	EE	EG	NN	FN	EE	EG
Sulfuric acid, 20%	EE	EE	EG	EG	EE	EE	EG	EG	EE	EE	EG	NN	NN	EE	GG
Sulfuric acid, 60%	EG	EE	EG	EG	EE	EE	GF	EG	EE	EE	GN	NN	NN	EE	NN
Sulfuric acid, 98%	GG	GG	FN	GG	EE	EE	NN	GN	NN	EG	NN	NN	NN	EE	NN
Sulfur dioxide, liq., 46 psi	NN	FN	NN	NN	EE	EG	GN	FN	GG	EE	NN	NN	FN	NN	NN
Sulfur dioxide, wet or dry	EE	EE	EE	EE	EE	EE	EG	EG	GG	GE	FN	NN	FN	EE	EE
Sulfur salts	FN	GF	FN	FN	EE	EG	FN	NN	GG	GF	NN	NN	—	—	—
Tartaric acid	EE	EE	EE	EE	EE	EE	EG	EG	EE	EE	GG	EF	FF	EE	EE
Tetrahydrofuran	FN	GF	GF	FF	EE	GF	NN	NN	NN	FN	NN	EE	EE	EE	EE
Thionyl chloride	NN	NN	NN	NN	EE	EE	NN	NN	NN	—	NN	NN	NN	EE	EE
Toluene	FN	GG	GF	FF	EE	EE	FN	NN	NN	EE	NN	EE	EE	EE	EE
Tributyl citrate	GF	EG	GF	GF	EE	EG	NN	FN	FF	EF	NN	EG	—	—	—
Trichloroethane	NN	FN	NN	NN	EG	NN	NN	NN	NN	—	NN	EE	GG	EE	EE
Trichloroethylene	NN	FN	NN	NN	EE	EG	NN	NN	NN	EE	NN	EE	GG	EE	EE
Triethylene glycol	EE	EE	EE	EE	EE	EE	EG	GF	EE	—	EE	EE	—	—	—
Tripropylene glycol	EE	EE	EE	EE	EE	EE	EG	GF	EE	—	EE	EE	—	—	—
Turpentine	FN	GG	GF	FF	EE	EE	FN	GF	NN	EE	NN	EE	EE	EE	EE
Undecyl alcohol	EF	EG	EG	EG	EE	EG	GF	EF	FF	EE	GG	EE	—	—	—
Urea	EE	EE	EE	EG	EE	EE	NN	GN	FF	EE	EG	EE	GG	EE	EE
Vinylidene chloride	NN	FN	NN	NN	EE	GF	NN	NN	NN	EE	NN	NN	GG	—	—
Xylene	GN	GF	FN	FN	EE	EG	NN	NN	NN	EE	NN	EE	GG	EE	EE
Zinc stearate	EE	EE	EE	EE	EE	EE	EE	EG	EE	EE	EE	EE	EE	EE	EE

## Effects of Chemicals on Labware

Chemicals may affect the weight, strength, color, dimensions, flexibility and surface appearance of labware.

The basic models of interaction that cause these changes are:

- (1) chemical attack on the polymer chain, with resultant reduction in physical properties, including oxidation; reaction of functional groups in or on the chain; and depolymerization;
- (2) physical change, including absorption of solvents, resulting in softening and swelling of the plastic; permeation of solvent through the plastic; or dissolution in a solvent; and
- (3) stress-cracking from the interaction of a "stress-cracking agent" with molded-in or external stresses.

The reactive combination of compounds of two or more classes may cause a synergistic or undesirable chemical effect. Other factors affecting chemical resistance include: temperature, pressure, internal or external stresses (such as centrifugation), and length of exposure to and concentration of the chemical. As temperature increases, resistance to attack decreases.



### Warning!

The plastic resin information in these tables, excluding stainless steel, glass and ceramic, has been provided by Thermo Scientific™ Nalgene™ and is reprinted with their permission. It should be used **ONLY** as a guide for selecting labware for testing.

Test the labware for 72 hours under expected or proposed conditions of use, **BEFORE** putting into service. Test with care to avoid injury or property damage.

Thermo Fisher Scientific does not warrant (neither express nor imply) that the information in these tables is accurate or complete.

## Physical Constants

Name and symbol	Value and units
Velocity of light, $c$	$2.997902 \times 10^{10}$ cm/s
Planck constant, $h$	$6.62377 \times 10^{27}$ erg s/molecule
Avogadro constant, $N$	$6.02380 \times 10^{23}$ molecule/mol
Faraday constant, $F$	96,493.1 C/equivalent
Absolute temperature of ice point, $T(0^\circ\text{C})$	273.15 K
Pressure-volume product for 1 mol of gas at $0^\circ\text{C}$ and zero pressure (PV) $P=0$ ; $T=0^\circ\text{C}$	2271.16 J/mol
Gas constant	
$P=0$	8.31469 J/mol $^\circ$
$R=(PV) T=0^\circ\text{C}$ $T(0^\circ\text{C})$	1.98726 cal/mol $^\circ$
Boltzmann constant	$1.38031 \times 10^{16}$ erg/molecule $^\circ$
$k=R/N$	11.96171 Jcm/mol
Constant relating wave number and energy $Z=Nhc$	2.858917 cal cm/mole
Standard atmosphere, atm	1,013,250 dynes/cm $^2$
Thermochemical calorie	4.1840 J (exact)

## Common Conversion Factors

Parts per Million	Parts per Billion	Percent
10,000 ppm	10,000,000 ppb	1.0%
1,000 ppm	1,000,000 ppb	.1%
100 ppm	100,000 ppb	.01%
10 ppm	10,000 ppb	.001%
1 ppm	1,000 ppb	.0001%
0.1 ppm	100 ppb	.00001%
0.01 ppm	10 ppb	.000001%

## Glossary of Elemental Forms

Below are descriptions of the standard elemental forms as found on [www.alfa.com](http://www.alfa.com) and our literature.

Form	Description
Bar	A rectangular or cylindrical piece of material
Cubes	Uniform sized, cubic shaped pieces of material
Disc	A cylindrical piece of material with a diameter much larger than the thickness
Felt	Compressed, porous, nonwoven fabric
Fiber	A pure monofilament form of solid material having an extremely high length to diameter ratio
Flake	Powder with a flat, irregular shape
Foil	A thin sheet of pure material, 0.025mm-2mm
Gauze	A wire cloth material consisting of wires of a pure material woven into a grid having consistent openings
Granules	Uniform, amorphous pieces of material
Ingot	A cast, usually rectangular piece of material
Lump	A solid piece of amorphous material, larger than a granule
Mossy	Pieces formed by dropping molten metal into water
Needles	Uniform, elongated pieces of material
Pellets	Somewhat regular shaped pieces of material
Pieces	Solid pieces of material, larger than a granule
Plate	A sheet of fabricated pure material >2mm thick
Powder	Solid material with a very small particle size
Ribbon	A thin width of foil, offered in rolls of varying length
Rod	A uniform strand of a pure material having a diameter $\geq 2.0$ mm
Shot	Spherical to semi-spherical pieces of material of varying sizes
Slugs	Short cylindrical pieces of material of varying lengths and diameters
Spheres	Uniform sized, spherical pieces of material
Splatter	Pieces formed by dropping molten metal onto a cooling surface
Sputtering target	A disc of high purity material used as an atomic sputtering source for ion bombardment
Sponge	Pieces with a high surface area resulting from complex surface morphology
Thin foil	A very thin sheet of unsupported pure material 1.1-24.0 micron thick
Tubing	A uniform strand of a pure material having a hollowed core
Turnings	Small concentric shavings machined from a larger form
Ultrathin foil	An extremely thin sheet of pure material, supported or unsupported $\leq 1$ micron thick
Wire	A uniform strand of a pure material having a diameter $\leq 2.0$ mm
Yarn	A parallel collection of a definite number of fiber strands, usually three to several hundred

# Interactive Periodic Table

Use our interactive periodic table to view our complete portfolio of pure elements. Click on chemical symbols to view the full list of products and technical information. Grey tiles indicate products are readily available.

View online [www.alfa.com/pure-elements](http://www.alfa.com/pure-elements)

1																	2
H																	He
3	4											5	6	7	8	9	10
Li	Be											B	C	N	O	F	Ne
11	12											13	14	15	16	17	18
Na	Mg											Al	Si	P	S	Cl	Ar
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
55	56	57-71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs	Ba	La-Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
87	88	89-103	104	105	106	107	108	109	110	111	112	113	114	115	116		
Fr	Ra	Ac-Lr	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv		
			57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
			La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
			89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
			Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

Alfa Aesar

**Element Details**

AI

Atomic Weight:  
26.9815385

Atomic Number:  
13

Element Name:  
Aluminum

ALUMINUM [Al]<sup>3+</sup>

Select a form or compound to view products

**Element Forms**

- Aluminum
- Aluminum foil
- Aluminum plate
- Aluminum sheet
- Aluminum wire
- Aluminum alloy strip

**Alloys**

- Aluminum-graphite
- Aluminum-iron
- Aluminum-nickel
- Aluminum-silicon
- Aluminum-tin
- Aluminum-zinc
- Aluminum-zinc-magnesium

**Aluminum Compounds**

- Aluminum chloride
- Aluminum nitrate
- Aluminum oxide
- Aluminum phosphate
- Aluminum silicate
- Aluminum sulfate

**Element Description**

Pure aluminum is light, malleable, and non-toxic. It is easily formed, machined, or cast. The alloying metal has high thermal conductivity and low electrical resistance. Aluminum is the most abundant metal in the earth's crust. It is also abundant among metals in the earth's crust by weight.

Property Name	Property Value	Property Name	Property Value
Atomic Code	13(26.9815)	First Ionization Energy	738 kcal/mole
CAS #	7429-89-5	Electronegativity	1.61 (Pauling)
Casimir Factor	1.18e-24 cm <sup>3</sup>		
Melting Point	933.47°C	Heat of Fusion @ 25°C	10.71 kJ
Boiling Point	2543°C	Latent Heat of Vaporization @ 25°C	35.0 kJ/m <sup>3</sup>
Density	2.70 g/cm <sup>3</sup>	Electrical Resistivity @ 25°C	2.825 μΩ-cm
Thermal Conductivity @ 25°C	236.9 W/m-K	Crystal Structure	Cubic, FCC

## A – Z index

Product Name	Page no.	Product Name	Page no.
Tris-acetate-EDTA (TAE) solution 50X, DNase RNase and protease free	8	Diisopropyl azodicarboxylate, 94%	11
Acetic acid glacial, Certified AR for analysis, meets Ph.Eur., BP, USP	5	2,2-Dimethoxypropane, 98+%	12
Acetic anhydride, 99+%, pure	12	4-Dimethylaminopyridine, 99%	9
Acetone, Certified AR for analysis, meets Ph.Eur.	4, 5	9,9-Dimethyl-4,5-bis(diphenylphosphino)xanthene, 98%	12
Acetonitrile	4, 10, 15	N,N-Dimethylformamide, anhydrous, amine free, 99.9%	15
Agar	8	Dimethyl sulfoxide	7, 15
Agarose	8	Dimethylformamide	5, 8, 10
Allylzinc bromide, 0.5M in THF, ChemSeal	15	1,4-Dioxane	5, 10
Aluminum nitrate hydrate, Puratronic, 99.999%	14	(±)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98%	12
Aluminum oxide, alpha-phase, 99.95% min	14	1,1'-Bis(diphenylphosphino)ferrocene-palladium(II)dichloride dichloromethane adduct	9
Aluminium oxide, neutral, Brockmann I, for chromatography, 50-200µm, 60A	10	Di-tert-butyl dicarbonate	12
Ammonia solution, 35%, Certified AR for analysis, d=0.88	5	Dithiothreitol, white crystals or powder, for electrophoresis	8
Ammonia, ca. 7N solution in methanol	11	Ethanol	5, 7, 15
Ammonium acetate	6	Ethidium bromide, 1% solution, molecular biology	8
Ammonium chloride	6	3-(Ethoxycarbonyl)propylzinc bromide, 0.5M in THF, ChemSeal	15
Ampicillin Sodium Salt, crystalline powder	8	Ethyl acetate	4, 5
Benzoyl chloride, 99%, pure	12	Ethylenediaminetetraacetic acid disodium salt solution 0,1M	6
Benzyl bromide, 98%	11	Ethylenediaminetetraacetic acid disodium Salt Dihydrate	7
Benzyl chloroformate, 97 wt%, stabilized	12	Florisil, 60-100 mesh, for column chromatography	10
Borane-methyl sulfide complex, 94%, AcroSeal	12	Formamide	7
Borane-tetrahydrofuran complex, 1M solution in THF, Stabilized, AcroSeal	12	Formic acid, 98-100%, Certified AR for analysis	5
Tris-Borate-EDTA, 10X solution, electrophoresis	8	9-Fluorenylmethyl chloroformate, 98%	12
Boron tribromide, 1M solution in methylene chloride	11	4-Fluorobenzylzinc chloride, 0.5M in THF, ChemSeal	15
Boron trichloride, 1M solution in methylene chloride, AcroSeal	11	Glycerol, molecular biology	7
Boron trifluoride etherate, approx. 48% BF3	11	Glycine, white crystals or crystalline powder	8
Boron trifluoride, 12% (1.5M) in methanol	11	Gold(III) acetate, 99.9%	15
Bovine serum albumin, fraction V	7	Gold shot	15
Bromine	11	Gold wire	15
Bromine liquid, 99.8%	15	HEPES (Fine White Crystals) for Molecular Biology	8
N-Bromosuccinimide, 99%	11	HEPES free acid, 99+%, for molecular biology, DNase, Rnase and Protease free	8
Buffer solutions for pH measurement	6	Heptane, for HPLC, approx. 99% n-Heptane	4
tert-Butylchlorodimethylsilane, 98%	12	n-Heptane	5
n-Butyllithium solution	11	n-Hexane	5
tert-Butyllithium, 1.9M solution in pentane, AcroSeal	11	Hexadecyltrimethylammonium bromide, 99+%	10
Tri-n-butyltin hydride, 97%	12	1,1,1,3,3,3-Hexamethyldisilazane, 98%	12
Calcium chloride dihydrate, Certified AR for analysis, meets Ph.Eur.	6	1,6-Hexanediamine, 99.5+%	11
Calcium chloride, 96%, extra pure, powder, anhydrous	10	Hexanes	4, 5
1,1'-Carbonyldiimidazole, 97%	11	Hydrazine hydrate, 100% (Hydrazine, 64%)	12
Tris(2-carboxyethyl)phosphine hydrochloride, 98%	12	Hydrobromic acid, pure, ca. 48 wt% solution in water	11
Cefotaxime sodium salt, 95%	8	Hydrochloric acid	5
CellPURE PBS 10X, Cell Culture Grade	8	Hydrochloric acid solution 1M	6
Cesium, 99.98%	15	Hydrogen bromide, pure, 33 wt% solution in glacial acetic acid	11
Cesium carbonate, 99.5%, for analysis	10	Hydrogen chloride, solution	11
Cesium chloride, 99+%, for analysis	10	Hydrogen hexachloroplatinate(IV) hydrate	9
Cesium fluoride, 99%, for analysis	10	Hydrogen peroxide, for analysis, 35 wt.% solution in water, stabilized	11
Chlorodicyclohexylphosphine, 97%	12	Hydrogen tetrachloroaurate(III) hydrate, 99.9%	15
Chloroform	4, 5, 7	Hydrogen tetrachloroaurate(III) trihydrate, ACS, 99.99%	14/15
Chloroform-d, for NMR	10	Hydroxylamine hydrochloride, 99+%	12
3-Chloroperoxybenzoic acid, 70-75%, balance 3-Chlorobenzoic acid and water	11	Tris(hydroxymethyl)aminomethane, 99.85%, for molecular biology, DNase, RNAse and Protease free	8
Chlorotrimethylsilane, 98%	12	Indium(III) chloride, anhydrous, 99.999%	14
Ciprofloxacin, 98%	8	Indium(III) sulfide, 99.995%	14
Copper(II) oxide, Puratronic, 99.995%	14	Iodine, 99.5%, extra pure, resublimed	11
4-Cyanobutylzinc bromide, 0.5M in THF, ChemSeal	15	N-Iodosuccinimide, 98%	11
Cyanogen bromide, 97%	11	Iron, 99%, powder, -70 mesh (<212 micron)	12
Cyclobutylzinc bromide, 0.5M in THF, ChemSeal	15	Isohexane, for HPLC, contains <5% n-Hexane	4
Cyclohexane	5	Isopropanol	4, 5, 7, 10, 15
Cyclohexylzinc bromide, 0.5M in THF, ChemSeal	15	Isopropyl-8-D-thiogalactopyranoside, dioxane-free	8
Cyclopropylzinc bromide, 0.5M in THF, ChemSeal	15	Isopropylmagnesium chloride - Lithium chloride complex, 1.3M solution in THF, AcroSeal	11
Dess-Martin periodinane, 15 wt.% solution in dichloromethane	11	Isopropylmagnesium chloride, 2.0M solution in THF, AcroSeal	11
Deuterium oxide, for NMR, 99.8 atom % D	10	Isopropylzinc bromide, 0.5M in THF, ChemSeal	15
Tris(dibenzylideneacetone)dipalladium(0), 97%	9	Kanamycin sulfate	8
2,3-Dichloro-5,6-dicyano-1,4-benzoquinone, 98%	11	Kanamycin Sulfate, white powder	8
Dichloromethane	4, 5, 8, 10	Karl Fischer Aqualine	6
N,N'-Dicyclohexylcarbodiimide, 99%	11	LB Agar, Miller	8
Diethyl ether	5, 10	LB Broth, Lennox	8
Diethylaminosulfur trifluoride, 95%	11	LB Broth, Miller	8
Dihydrogen hexachloroplatinate(IV) hydrate, 99.9%	15	Lead(II) iodide, ultra dry, 99.999%	14
Diiodomethane, 99+%, stabilized	11		
Diisobutylaluminium hydride solution	12		

Product Name	Page no.
Lithium aluminium hydride, 95%, powder	12
Lithium diisopropylamide, 2M sol. in THF/n-heptane/ethylbenzene, AcroSeal	11
Magnesium sulfate, 97%, pure, anhydrous	10
MES, fine white crystals	8
Methanol	4, 5, 7, 8, 10, 15
Methanol-d4, for NMR	10
4-Methoxy-3-pyridineboronic acid hydrate, 97%	9
Methyl sulfoxide-d6, for NMR	10
Methylithium, 1.6 M sol. in diethyl ether (± 5% w/v), AcroSeal	11
Methylmagnesium bromide, 3M solution in diethyl ether, AcroSeal	11
Methylmagnesium chloride, 3M (22 wt.%) solution in THF, AcroSeal	11
Molecular sieves 4A, 8 to 12 mesh	10
MOPS (Fine White Crystals) for Molecular Biology	8
Nitric acid	5
Oxalyl bromide, 98%	11
Oxalyl chloride, 98%	11
Palladium hydroxide on carbon, powder, unreduced, 20% Pd, moisture ca 60%	10
Palladium on activated carbon	10
Palladium on calcium carbonate, poisoned with 3.5% lead, 5% Pd	10
Palladium(II) acetate, 47.5% Pd	9
Palladium(II) chloride, 99.9%, Pd 59.0% min	14/15
Palladium(II) nitrate hydrate, 99.8%, Pd 39% min	15
Paraformaldehyde, 96%, extra pure	11
n-Pentane, Certified AR for analysis	5
Petroleum ether 40-60°C	5
Phenol, saturated, liquid, pH 6.6/7.9	8
Phenylboronic acid, 98+%, may contain varying amounts of anhydride	9
Phenylzinc bromide, 0.5M in THF, ChemSeal	15
Phosphate buffered saline, solutions, powdered and tablets	7, 8
Bis(pinacolato)diboron, 98%	9
Platinum on activated carbon	10
Platinum(II) acetylacetonate, 98%	9
Platinum(IV) oxide, 83% Pt	9
Platinum(II) 2,4-pentanedionate, Pt 48.0% min	15
Platinum gauze, 99.9%	15
Platinum slug, 99.99+%	15
Potassium carbonate anhydrous, Certified AR, for analysis, meets Ph.Eur.	6
Potassium chloride	6
Potassium dihydrogen orthophosphate, Certified AR for analysis	6
Potassium fluoride, 99%, extra pure, anhydrous	11
Potassium hexachloroplatinate(IV), ca. 40% Pt	9
Potassium hydroxide solution 1M (1N)	6
Potassium hydroxide, Certified AR for analysis, pellets, meets Ph.Eur., BP	5
Potassium iodide, Certified AR for analysis	6
Potassium nitrate, Certified AR for analysis, meets analytical specification of Ph.Eur., BP	6
Potassium tert-butoxide, 98+%, pure	11
1-Propanol	15
2-Propanol	4, 5, 7, 10, 15
Propargyl bromide, 80 wt.% solution in toluene, stabilized	11
Proteinase K, from Tritirachium album, DNase and RNase free	8
Puromycin Dihydrochloride	8
2-Pyridylzinc bromide, 0.5M in THF, ChemSeal	15
Quinoline-3-boronic acid, 97%	9
Rapamycin	8
Rhodium on alumina, 5% Rh, powder	10
Rhodium(II) acetate dimer, anhydrous, ca 46% Rh	9
Ruthenium(III) chloride hydrate, 35 - 40% Ru	9
Silica gel orange, for drying purposes, non toxic grade, 2-5 mm	10
Silica gel, for chromatography	10
Silica gel, for drying purposes, non-toxic grade, 3-6 mm	10
Silver nitrate solution 0,1M (0,1N)	6
Silver wire, 99.9%	15
SOB Broth (Capsules)	8
Sodium acetate trihydrate, Certified AR for analysis, crystal	6
Sodium azide, 99%, extra pure	11
Sodium biphenyl, 20%w/w solution in diethylene glycol diethyl ether, offered as 20 x 15mL	12
Sodium bis(trimethylsilyl)amide, pure, 2M solution in THF, AcroSeal	11

Product Name	Page no.
Sodium borohydride, 98+%, powder	12
Sodium chloride	6, 8, 14
Sodium cyanoborohydride, 95%	11
Sodium Dodecyl Sulfate (SDS)	8
Sodium hydride, 60% dispersion in mineral oil, in soluble bags	12
Sodium hydrogen carbonate, Certified AR for analysis, meets Ph.Eur.	6
Sodium hydroxide solution 1M (1N)	6
Sodium hydroxide, Certified AR for analysis, pellets, meets Ph.Eur., BP	5
Sodium hydrosulfite, ca. 85%, tech.	12
Sodium hypochlorite, 13% active chlorine	11
Sodium periodate, 99%, for analysis	11
Sodium peroxide, 96%	11
Sodium sulfate anhydrous	6
Sodium thiosulfate solution 0,1M (0,1N)	6
Sodium thiosulfate, 98.5%, extra pure, anhydrous	12
Sodium triacetoxyborohydride, 97%	12
D-Sucrose, molecular biology	8
Sulfuric acid	5
Sulfuric acid solution 0,5M (1N)	6
TEMED, Electrophoresis	8
Tetraammineplatinum(II) chloride monohydrate, 99.995%	14
Tetrabutylammonium hydrogen sulfate, 98%	10
Tetrabutylammonium hydroxide, 1M solution in methanol	10
Tetrabutylammonium hydroxide, 40 wt.% (1.5M) solution in water	10
Tetraheptylammonium bromide, 99%	10
Tetrahydrofuran	4, 5, 8, 10, 15
Tetrakis(triphenylphosphine)palladium(0)	9, 15
4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)aniline, 97%	9
4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)pyridine, 97%	9
Titanium(IV) isopropoxide, 98+%	9
Titanium(IV) oxide, rutile, 99.5% min	14
Toluene	5
p-Toluenesulfonyl chloride, 99+%	12
Triethylsilane, 99%	12
Trifluoromethanesulfonic anhydride, 98+%	11
Triisopropylsilane, 98%	12
(Trimethylsilyl)diazomethane, 2M solution in hexanes	11
N,O-Bis(trimethylsilyl)trifluoroacetamide, 98+%	11
Trimethylsilyl trifluoromethanesulfonate, 99%	12
Triphenylphosphine, 99%	12
Bis(triphenylphosphine)palladium(II) chloride, 98%	9
Tris base, white crystals or crystalline powder, molecular biology	8
Tris buffered saline, 10X Solution, pH 7.4, molecular biology	8
Triton X-100 for Electrophoresis	8
Tryptone (Granulated)	8
Tween 20	8
Urea, molecular biology grade, Colorless-to-White Crystals or Crystalline powder	8
Vancomycin	8
Vanadium foil, 99.8%	15
Vanadium(IV) sulfate oxide hydrate, 99.9%	14
Vancomycin hydrochloride, >900 microgram/mg	8
Vinylmagnesium bromide, 0.7M solution in THF, AcroSeal	11
Vinylmagnesium chloride, 1.9M (16.5 wt.%) solution in THF, AcroSeal	11
Water	4, 5, 8, 15
Yeast Extract	8
Zinc, 98+%, dust (stable acc. to UN classification class 4)	12
Zirconium sponge, 99.5%, Zr & Hf	15

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**key**

Numbers in brackets are mass numbers of the most stable or most common isotope. Atomic weights conform to the Bulletin of the International Union of Pure and Applied Chemistry, volume 56, number 6 1984. Scaled to Ar (C-12) = 12.

**filling of electrons:**

on s level on f level on d level on p level

atomic number  
atomic symbol  
electronegativity  
atomic weight  
electronic structure

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