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| **Chemical** | **Sources of exposure** | **Important properties** | **Injury produced** | **Dangerous exposure level under 15 min  (PPM)** |
| Acetaldehyde | Plastics, synthetic rubber industry, combustion products | High vapor pressure; high water solubility | Upper airway injury; rarely causes delayed pulmonary edema |  |
| Acetic acid, organic  acids | Chemical industry, electronics, combustion products | Water soluble | Ocular and upper airway injury |  |
| Acid anhydrides | Chemicals, paints, and plastics  industries; components of epoxy resins | Water soluble, highly reactive, may cause allergic sensitization | Ocular, upper airway injury, bronchospasm; pulmonary hemorrhage after massive exposure |  |
| Acrolein | Plastics, textiles, pharmaceutical manufacturing, combustion products | High vapur pressure, intermediate water solubility, extremely irritating | Diffuse airway and parenchymal injury |  |
| Ammonia | Fertilizers, animal feeds, chemicals, and pharmaceuticals manufacturing | Alkaline gas, very high water solubility | Primarily ocular and upper airway burn; massive exposure may cause bronchiectasis | 500 |
| Antimony trichloride, antimony penta-chloride | Alloys, organic catalysts | Poorly soluble, injury likely due to halide ion | Pneumonitis, non-cardiogenic pulmonary oedema |  |
| Beryllium | Alloys (with copper), ceramics; electronics, aerospace and nuclear reactor equipment | Irritant metal, also acts as an antigen to promote a long-term granulomatous response | Acute upper airway injury, tracheobronchitis, chemical pneumonitis | 25 μg/m**3** |
| Boranes (diborane) | Aircraft fuel, fungicide manufacturing | Water soluble gas | Upper airway injury, pneumonitis with massive exposure |  |
| Hydrogen bromide | Petroleum refining |  | Upper airway injury, pneumonitis with massive exposure |  |
| Methyl bromide | Refrigeration, produce fumigation | Moderately soluble gas | Upper and lower airway injury, pneumonitis, CNS depression and seizures |  |
| Cadmium | Alloys with Zn and Pb, electroplating, batteries, insecticides | Acute and chronic respiratory effects | Tracheobronchitis, pulmonary oedema (often delayed onset over 24–48 hours); chronic low level exposure leads to inflammatory changes and emphysema | 100 |
| Calcium oxide, calcium hydroxide | Lime, photography, tanning, insecticides | Moderately caustic, very high doses required for toxicity | Upper and lower airway inflammation, pneumonitis |  |
| Chlorine | Bleaching, formation of chlorinated compounds, household cleaners | Intermediate water solubilty | Upper and lower airway inflammation, pneumonitis and non-cardiogenic pulmonary oedema | 5–10 |
| Chloroacetophenone | Crowd control agent, “tear gas” | Irritant qualities are used to incapacitate; alkylating agent | Ocular and upper airway inflammation, lower airway and parenchymal injury with masssive exposure | 1–10 |
| *o*-Chlorobenzomalo- nitrile | Crowd control agent, “tear gas” | Irritant qualities are used to incapacitate | Ocular and upper airway inflammation, lower airway injury with massive exposure |  |
| Chloromethyl ethers | Solvents, used in manufacture of other organic compounds |  | Upper and lower airway irritation, also a respiratory tract carcinogen |  |
| Chloropicrin | Chemical manufacturing, fumigant component | Former First World War gas | Upper and lower airway inflammation | 15 |
| Chromic acid (Cr(IV)) | Welding, plating | Water soluble irritant, allergic sensitizer | Nasal inflammation and ulceration, rhinitis, pneumonitis with massive exposure |  |
| Cobalt | High temperature alloys, permanent magnets, hard metal tools (with tungsten carbide) | Non-specific irritant, also allergic sensitizer | Acute bronchospasm and/or pneumonitis; chronic exposure can cause lung fibrosis |  |
| Formaldehyde | Manufacture of foam insulation, plywood, textiles, paper, fertilizers, resins; embalming agents; combustion products | Highly water soluble, rapidly metabolized; primarily acts via sensory nerve stimulation; sensitization reported | Ocular and upper airway irritation; bronchospasm in severe exposure; contact dermatitis in sensitized persons | 3 |
| Hydrochloric acid | Metal refining, rubber manufacturing, organic compound manufacture, photographic materials | Highly water soluble | Ocular and upper airway inflammation, lower airway inflammation only with massive exposure | 100 |
| Hydrofluoric acid | Chemical catalyst, pesticides, bleaching, welding, etching | Highly water soluble, powerful and rapid oxidant, lowers serum calcium in massive exposure | Ocular and upper airway inflammation, tracheobronchitis and pneumonitis with massive exposure | 20 |
| Isocyanates | Polyurethane production; paints; herbicide and insecticide products; laminating, furniture, enamelling, resin work | Low molecular weight organic compounds, irritants, cause sensitization in susceptible persons | Ocular, upper and lower inflammation; asthma, hypersensitivity pneumonitis in sensitized persons | 0.1 |
| Lithium hydride | Alloys, ceramics, electronics, chemical catalysts | Low solubility, highly reactive | Pneumonitis, non-cardiogenic pulmonary oedema |  |
| Mercury | Electrolysis, ore and amalgam extraction, electronics manufacture | No respiratory symptoms with low level, chronic exposure | Ocular and respiratory tract inflammation, pneumonitis, CNS, kidney and systemic effects | 1.1 mg/m**3** |
| Nickel carbonyl | Nickel refining, electroplating, chemical reagents | Potent toxin | Lower respiratory irritation, pneumonitis, delayed systemic toxic effects | 8 μg/m**3** |
| Nitrogen dioxide | Silos after new grain storage, fertilizer making, arc welding, combustion products | Low water solubility, brown gas at high concentration | Ocular and upper airway inflammation, non-cardiogenic pulmonary oedema, delayed onset bronchiolitis | 50 |
| Nitrogen mustards; sulphur mustards | Military gases | Causes severe injury, vesicant properties | Ocular, upper and lower airway inflammation, pneumonitis | 20mg/m**3** (N)  1 mg/m**3** (S) |
| Osmium tetroxide | Copper refining, alloy with iridium, catalyst for steroid synthesis and ammonia formation | Metallic osmium is inert, tetraoxide forms when heated in air | Severe ocular and upper airway irritation; transient renal damage | 1 mg/m**3** |
| Ozone | Arc welding, copy machines, paper bleaching | Sweet smelling gas, moderate water solubility | Upper and lower airway inflammation; asthmatics more susceptible | 1 |
| Phosgene | Pesticide and other chemical manufacture, arc welding, paint removal | Poorly water soluble, does not irritate airways in low doses | Upper airway inflammation and pneumonitis; delayed pulmonary oedema in low doses | 2 |
| Phosphoric sulphides | Production of insecticides, ignition compounds, matches |  | Ocular and upper airway inflammation |  |
| Phosphoric chlorides | Manufacture of chlorinated organic compounds, dyes, gasoline additives | Form phosphoric acid and hydrochloric acid on contact with mucosal surfaces | Ocular and upper airway inflammation | 10 mg/m**3** |
| Selenium dioxide | Copper or nickel smelting, heating of selenium alloys | Strong vessicant, forms selenious acid (H**2**SeO**3**) on mucosal surfaces | Ocular and upper airway inflammation, pulmonary oedema in massive exposure |  |
| Hydrogen selenide | Copper refining, sulphuric acid production | Water soluble; exposure to selenium compounds gives rise to garlic odour breath | Ocular and upper airway inflammation, delayed pulmonary oedema |  |
| Styrene | Manufacture of polystyrene and resins, polymers | Highly irritating | Ocular, upper and lower airway inflammation, neurological impairments | 600 |
| Sulphur dioxide | Petroleum refining, pulp mills, refrigeration plants, manufacturing of sodium sulphite | Highly water soluble gas | Upper airway inflammation, bronchoconstriction, pneumonitis on massive exposure | 100 |
| Titanium tetrachloride | Dyes, pigments, sky writing | Chloride ions form HCl on mucosa | Upper airway injury |  |
| Uranium hexafluoride | Metal coat removers, floor sealants, spray paints | Toxicity likely from chloride ions | Upper and lower airway injury, bronchospasm, pneumonitis |  |
| Vanadium pentoxide | Cleaning oil tanks, metallurgy |  | Ocular, upper and lower airway symptoms | 70 |
| Zinc chloride | Smoke grenades, artillery | More severe than zinc oxide exposure | Upper and lower airway irritation, fever, delayed onset pneumonitis | 200 |
| Zirconium tetrachloride | Pigments, catalysts | Chloride ion toxicity | Upper and lower airway irritation, pneumonitis |  |
| Monday, 28 February 2011 21:23  Diseases Caused by Respiratory Irritants and Toxic Chemicals  Written by [Ryon, David L.S.](http://iloencyclopaedia.org/part-i-47946/respiratory-system/itemlist/users/3883-ryondavidls) [Rom, William N.](http://iloencyclopaedia.org/part-i-47946/respiratory-system/itemlist/users/3841-romwilliamn) |  |  |  |  |