Xylidines: Human health tier II assessment

13 February 2015

Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
Benzenamine, 2,3-dimethyl-	87-59-2
Benzenamine, 2,6-dimethyl-	87-62-7
Benzenamine, 3,4-dimethyl-	95-64-7
Benzenamine, 2,4-dimethyl-	95-68-1
Benzenamine, 2,5-dimethyl-	95-78-3
Benzenamine, 3,5-dimethyl-	108-69-0

Preface

This assessment was carried out by staff of the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) using the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework.

The IMAP framework addresses the human health and environmental impacts of previously unassessed industrial chemicals listed on the Australian Inventory of Chemical Substances (the Inventory).

The framework was developed with significant input from stakeholders and provides a more rapid, flexible and transparent approach for the assessment of chemicals listed on the Inventory.

Stage One of the implementation of this framework, which lasted four years from 1 July 2012, examined 3000 chemicals meeting characteristics identified by stakeholders as needing priority assessment. This included chemicals for which NICNAS already held exposure information, chemicals identified as a concern or for which regulatory action had been taken overseas, and chemicals detected in international studies analysing chemicals present in babies' umbilical cord blood.

Stage Two of IMAP began in July 2016. We are continuing to assess chemicals on the Inventory, including chemicals identified as a concern for which action has been taken overseas and chemicals that can be rapidly identified and assessed by using Stage One information. We are also continuing to publish information for chemicals on the Inventory that pose a low risk to human health or the environment or both. This work provides efficiencies and enables us to identify higher risk chemicals requiring assessment.

The IMAP framework is a science and risk-based model designed to align the assessment effort with the human health and environmental impacts of chemicals. It has three tiers of assessment, with the assessment effort increasing with each tier. The Tier I assessment is a high throughput approach using tabulated electronic data. The Tier II assessment is an evaluation of risk on a substance-by-substance or chemical category-by-category basis. Tier III assessments are conducted to address specific concerns that could not be resolved during the Tier II assessment.

These assessments are carried out by staff employed by the Australian Government Department of Health and the Australian Government Department of the Environment and Energy. The human health and environment risk assessments are conducted and published separately, using information available at the time, and may be undertaken at different tiers.

This chemical or group of chemicals are being assessed at Tier II because the Tier I assessment indicated that it needed further investigation.

For more detail on this program please visit:**www.nicnas.gov.au**

Disclaimer

ACRONYMS & ABBREVIATIONS

Grouping Rationale

The chemicals in this group are the six isomers of xylidine. The chemicals are:

- benzenamine, 2,3-dimethyl- (2,3-DMA) (CAS number 87-59-2);
- benzenamine, 2,4-dimethyl- (2,4-DMA) (CAS number 95-68-1);
- benzenamine, 2,5-dimethyl- (2,5-DMA) (CAS number 95-78-3);
- benzenamine, 2,6-dimethyl- (2,6-DMA) (CAS number 87-62-7);
- benzenamine, 3,4-dimethyl- (3,4-DMA) (CAS number 95-64-7); and
- benzenamine, 3,5-dimethyl- (3,5-DMA) (CAS number 108-69-0).

A number of considerations justify the inclusion of these chemicals into a group including the:

- functional group structural similarity including two methyl and one amino group attached directly to the benzene ring;
- similarity of the physico-chemical properties including melting points, boiling points, water solubility, log Kow, dissociation constants in water; and
- similarity in the toxicologically relevant human health effects, where available, including acute toxicity, repeated dose toxicity, and genotoxicity.

Import, Manufacture and Use

Australian

No specific Australian use, import, or manufacturing information has been identified.

International

The following international uses have been identified through:

- the European Union (EU) Registration, Evaluation and Authorisation of Chemicals (REACH) dossiers;
- the Organisation for Economic Cooperation and Development Screening information data set International Assessment Report (OECD SIAR);
- Galleria Chemica;
- the Substances and Preparations in the Nordic countries (SPIN) database;
- the OECD High Production Volume chemical program (HPV);
- the United States (US) Environmental Protection Agency's Aggregated Computer Toxicology Resource (ACToR); and
- the US National Library of Medicine's Hazardous Substances Data Bank (HSDB).

Xylidines have reported site-limited uses as intermediates for producing dyes, pigments, photographic chemicals, antioxidants, synthetic resins, and fragrances.

They also have excluded uses as intermediates in producing pharmaceuticals and pesticides.

Restrictions

Australian

No known restrictions have been identified.

International

The chemicals 2,4-, 2,5-, 2,6-DMA are listed on the EU Cosmetics Regulation 1223/2009 Annex II—List of substances prohibited in cosmetic products (Galleria Chemica)

Existing Worker Health and Safety Controls

Hazard Classification

The chemical 2,6-DMA is classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia):

- Xn; R20/21/22 Harmful by inhalation, in contact with skin, if swallowed
- Xi; R37/38 Irritating to respiratory system, and skin
- R40 Limited evidence of a carcinogenic effect

Exposure Standards

Australian

No specific exposure standards are available.

International

The following exposure standards are identified for 2,3-, 2,4-, 2,5-, 2,6-, 3,4-, 3,5-DMA (Galleria Chemica).

An exposure limit of 5–10 mg/m^3 (1–2 ppm) time weighted average (TWA) and 50 mg/m^3 (10 ppm) short-term exposure limit (STEL)/MAK/occupational exposure limit (OEL) in different countries such as the USA (Alaska, Hawaii), Canada (Yukon), Norway and Switzerland.

Health Hazard Information

Toxicokinetics

The chemical 2,6-DMA is readily absorbed orally and distributed throughout the body in rats. Studies indicate that after administration of a single oral dose of [14C]-2,6-DMA, the highest levels of radioactivity were found in the urine, and also recovered in the blood and tissues, especially red blood cells and liver. Upon repeated dosing, greater levels of radioactivity were present in the blood and other tissues, suggesting that 2,6-DMA or its metabolites bind to blood and/or tissue components (OECD, 2012). Methaemoglobin formation was seen in repeated dose studies (see **Repeat oral dose toxicity**). Other studies indicated that, along with the parent compound, the metabolites 4-hydroxy-2,6-dimethylaniline (4-HDMA) and a trace level of N,2,6-trimethylaniline were also excreted in the urine of rats (OECD, 2012).

Studies in rats for 2,4-DMA showed that the parent compound and the metabolite N-acetyl-4-amino-3-methylbenzoic acid (AAMBA) and a trace level of N-2,4-trimethylaniline were excreted in the urine (OECD, 2012).

The metabolism of xylidines occurs via N-acetylation or N-hyroxylation, oxidation of a methyl group, and direct hydroxylation of the aromatic ring (EU, 2009). However, the toxicologically significant metabolites are generated after N-hydroxylation of the amine group. Subsequent Phase 2 metabolism can result in nitrenium ion formation, which can bind to nucelophiles including DNA and form protein adducts. An investigation on DNA adduct formation of 2,6- and 3,5-dimethylaniline metabolites in vivo in male C57BL/6 mice revealed bladder and liver cells had quantifiable DNA adduct levels (OECD, 2012). Furthermore, in human patients receiving lidocaine (also known as xylocaine or lignocaine) treatment, where 2,6-DMA is a known metabolite, 2,6-DMA-haemoglobin adduct levels are elevated (Bryant, 1994).

Acute Toxicity

Oral

The chemical 2,6-DMA is classified with the risk phrase ‘Harmful if swallowed’ (Xn; R22) in the HSIS (Safe Work Australia). The available data (median lethal dose—LD50—300–2000 mg/kg bw (OECD TG 423)) support this classification (OECD, 2012; REACH d). Reported signs of toxicity include changes in motor activity, a severe decrease in locomotor activity, adopting a prone position, abnormal gait, hypotonia, deep respiration, lethargy and cyanosis.

The chemical 2,4-DMA has moderate acute toxicity based on results from animal tests (OECD Test Guideline (TG) 401) following oral exposure with an LD50 of 1259 mg/kg bw in male rats (OECD, 2012).

Dermal

The chemical 2,6-DMA is classified with the risk phrase ‘Harmful in contact with skin’ (Xn; R21) in the HSIS (Safe Work Australia).

No data are available to determine if the classfication should be amended.

Inhalation

The chemical 2,6-DMA is classified with the risk phrase ‘Harmful by inhalation’ (Xn; R20) in the HSIS (Safe Work Australia). The available data support this classification.

In a study conducted in accordance with OECD TG 403, the LC50 for 2,4-DMA was reported to be 1.53 mg/L in air. Reported signs of toxicity included lung congestion, bladder distension and liver pallor, and an increase in body weight gain (REACHa).

In a study for 2,6-DMA conducted similarly to OECD TG 403, reported signs of toxicity included salivation, apathy, closed eyes and slight secretion from the nose. Effects were reversible within one day. There was no significant findings at necropsy. (REACH d).

Observation in humans

Methaemoglobinaemia has been observed in humans who had been treated with the

local anaesthetic lidocaine from which 2,6-DMA is produced by a cleavage reaction (EU, 2009).

Corrosion / Irritation

Corrosivity

No data are available.

Respiratory Irritation

The chemical 2,6 DMA is classified as hazardous with the risk phrase 'Irritating to respiratory system' (Xi; R37) in the HSIS (Safe Work Australia).

There is insufficient evidence to determine if the current classfication should be amended.

Skin Irritation

The chemical 2,6-DMA is classified as hazardous with the risk phrase 'Irritating to skin' (Xi; R38) in the HSIS (Safe Work Australia). The available data support this classification.

In a study according to OECD TG 404, 2,6-DMA produced slight to clearly recognisable erythema and slight to severe oedema following a four-hour occlusive application on intact rabbit skin. All animals showed scale formation, and two animals showed necrosis with severe to very severe redness of the skin (OECD, 2012).

The chemical 2,4-DMA is slightly irritating to skin in animal studies (REACH a). The chemical 3,5-DMA produced no skin irritation in New Zealand White rabbits in a semi occlusive application of 0.5mL of the test substance in studies that were performed in accordance with OECD TG 404 (REACH f).

Eye Irritation

The chemicals were reported to slightly irritate the eyes when tested according to OECD TG 405.

The average scores for 2,4 DMA (undiluted) for the cornea, iris/conjunctivae (redness) and conjunctivae (chemosis) were given as 1.1, 1.2, 1.6 and 1.3, respectively. The effects were reversible within seven days after application (REACH a). The average scores for 2,6 DMA (undiluted) for the cornea, iris/conjunctivae (redness) and conjunctivae (chemosis) were given as 1, 0.44, 2 and 1, respectively. The effects were reversible within eight days after application (REACH d).

There is insufficient evidence to support recommending the chemicals within this group to be classified.

Observation in humans

No data are available.

Sensitisation

Respiratory Sensitisation

No data are available.

Skin Sensitisation

The chemicals 2,4 DMA and 2,6 DMA were not found to induce dermal sensitisation when tested according to OECD TG 429 (REACH a; REACH d). The other members of the group are not expected to induce skin sensitisation (OECD, 2012).

Observation in humans

No data are available.

Repeated Dose Toxicity

Oral

For 2,6-DMA, a combined repeated dose toxicity study with a reproduction/developmental toxicity screening test was conducted according to OECD TG 422. Haematological changes included a significant increase in methaemoglobin in the high-dose males and females, as well as an increase in mean corpuscular volume (MCV) and reticulocytes. A decrease in red blood cell count (RBC), haemoglobin and mean corpuscular haemoglobin concentration (MCHC) in high-dose males was also reported. A significant increase in methaemoglobin was also seen in high-dose females. The no observed adverse effect level (NOAEL) reported for males and females was 10 mg/kg bw/day based on the effects on the kidneys (an increase in relative weight, hyaline droplets of the proximal tubular epithelium and necrosis of the renal papilla); and liver (an increase in relative weight and hepatocellular centrilobular hypertrophy) (OECD, 2012).

In several 28-day studies conducted in accordance with OECD TG 407 for 2,3-, 2,4-, 2,5-, 3,4-, and 3,5-DMA, the reported NOAELs was 2–12 mg/kg bw/day. Values were based on commonly reported effects across most chemicals in the group, including decreased body weight gain, an increase in target organ weights and effects on the organs including the kidneys (renal tubular epithelial hyaline droplets, discolouration of papillae and an increase in relative weight), liver (centrilobular hypertrophy of hepatocytes, an increase in relative weight) and spleen (haemosiderin deposits), as well as haematological changes (an increase in methaemoglobin and reticulocyte count; and a decrease in red blood cell count and haemoglobin) (OECD, 2012).

For all members of the group, the adverse effects on the blood were consistently observed, with increased methaemoglobin resulting in haemolysis. At doses ≥ 50 mg/kg bw/day of 2,3-, 2,5-, 2,6-, 3,4-, and 3,5-DMA and 10 mg/kg bw/day of 2,4-DMA, reduced haemoglobin, erythrocyte concentration and cyanosis were seen in exposed animals. Haemosiderin deposition in other target organs including the liver, kidneys and spleen were observed. Effects in the kidneys included papillary necrosis, dilated renal tubules and/or hyaline droplets, as well as a relative weight increase. Hepatic toxicity was evidenced by increased relative and/or absolute weights of the liver and hypertrophy of the centrilobular hepatocytes (OECD, 2012).

Dermal

No data are available.

Inhalation

In a 28-day repeated dose inhalation toxicity study conducted in accordance with OECD TG 412, the no observed adverse effect concentration (NOAEC) for 2,4-DMA was reported to be 0.033 mg/L air, based on decreased body weight gain, and increased organ weight (the liver and kidneys) (REACH a).

Genotoxicity

Based on the weight of evidence from the available in vitro and in vivo genotoxicity studies, the chemicals are considered to be genotoxic. Although there is a lack of data for individual members of the group, the similarity across all isomers is seen in the repeated dose studies. Haemolysis and methaemoglobinaemia are markers of metabolic transformation that lead to genotoxic outcomes and are seen for all isomers.

In vitro

Although consistent results have not been observed, positive results were reported in several in vitro assays for most of the chemicals in the group (OECD, 2012; REACH a; REACH b; REACH c; REACH d; REACH e; REACH f) including:

- a bacterial reverse mutation assay of *Salmonella typhimurium* (OECD TG 471) with metabolic activation for the chemicals 2,3- and 2,4-DMA in the TA100 strain and for 2,6-DMA in the TA100 and TA1535 strains;
- a bacterial reverse mutation assay of *S. typhimurium* strains (guideline not specified) with and without metabolic activation for 2,3-, 2,4-, 2,5-, and 3,4-DMA;
- a chromosomal aberration (OECD TG 473) study with and without metabolic activation for 2,3-, 2,4-, and 3,5-DMA;
- a sister chromatid exchange assay in Chinese hamster lung cells for the chemicals 2,3-, 2,4-, 2,6-, and 3,5-DMA and in Chinese hamster ovary (CHO) cells for 2,6-DMA; and
- a cell transformation assay in BALB/c-3T3 for 2,6-DMA.

In vivo

Gene mutation assays with Muta mice showed positive results for the chemicals 2,5-DMA and 2,6-DMA, with an increased gene mutation frequency in the nasal tissue, and additional mutations in the bone marrow on exposure to 2,5-DMA. In the same study, 3,5-DMA gave a negative result.

Results were negative in micronucleus assays for all members of the category in bone marrow and for the chemicals 2,5-, 2,6-, and 3,5-DMA in peripheral blood.

In single cell gel electrophoresis (SCG) comet assays, all members of the category induced DNA damage in the lungs, kidneys and liver; and for the chemicals 3,4- and 3,5-DMA in bone marrow.

The available data across all members of the group support the classification for mutagenicity.

Carcinogenicity

The chemical 2,6-DMA is classified as hazardous—Category 3 carcinogenic substance—with the risk phrase ‘Limited evidence of carcinogenic effect’ in the HSIS (Safe Work Australia). The available data support this classification.

In a two-year carcinogenicity study conducted similarly to OECD TG 453, male and female Charles River CD rats were administered 0, 100, 300, 1000, 3000 ppm (equivalent to 0, 15, 50, 150 mg/kg bw/day) (IUCLID, 2012) of 2,6-DMA in their diet. Increased incidences of carcinomas of the nasal cavity and of the papillary adenomas were observed at the highest dose in both sexes. In addition, a rare tumour of the nasal cavity, rhabdomyosarcoma, was also seen in both sexes. Increased incidences of adenocarcinomas were seen in high-dose males and sarcoma was present in a high-dose female (REACH d).

The carcinogenicity of 2,4- and 2,5-DMA was investigated in a study of male Charles River CD rats and male and female HaM/ICR mice which were administered the chemicals at a low dose (half the maximum tolerated level) and the maximum tolerated dose (doses not specified). An increased incidence of pulmonary tumours on exposure to 2,4-DMA was seen in female mice at the high dose only. Exposure to 2,5-DMA led to an increase in subcutaneous fibromas and fibrosarcoma in male rats and vascular tumours in male mice at all doses (OECD, 2012).

An autoradiography study in female Sprague Dawley (SD) rats showed the chemical 2,6-DMA metabolites bound in tissues in the nasal olfactory mucosa and the mucosa of the upper alimentary and respiratory tracts. The carcinogenic effect of 2,6-DMA in these tissues in rats was correlated with the capacity to bioactivate the compound in vivo (Tyden, 2004).

While data on carcinogenicity are lacking for the other members of the group, the uniform observation of metabolite pathways leading to methaemoglobinaemia (which is related to the formation of carcinogenic metabolites) and the consistent genotoxicity results, the other isomers should also be treated as potential carcinogens.

Reproductive and Developmental Toxicity

Based on the limited information, the chemicals do not show specific reproductive or developmental toxicity.

Data are available for 2,6-DMA. In a study according to OECD TG 422, a decrease in the number of implantations was observed, secondary to maternal toxicity (OECD, 2012).

Risk Characterisation

Critical Health Effects

The critical health effects for risk characterisation include systemic acute effects (skin and respiratory system irritation) and long-term effects (carcinogenicity and mutagenicity). The chemicals can also cause toxic effects in the organs (kidney, liver, and blood) resulting from repeated oral or inhalation exposure.

Public Risk Characterisation

Given that the main use of the chemical is as an intermediate to manufacture other chemicals, it is unlikely that the public will be exposed to the chemical. It is expected that the chemical will not be present in final consumer products. Hence, the public risk from these chemicals is not considered to be unreasonable.

However, the public could be exposed to the chemical as an impurity in, or through release of the chemical from dyes manufactured using the chemical, including by:

- dermal contact with the chemical from prolonged exposure to articles of clothing and leather goods containing the dye; and
- oral exposure by young children sucking the materials (packaging, paper) and crayons containing pigments and the textiles containing the dye.

The risk to the public from these routes of exposure will be considered in subsequent IMAP assessments of the relevant dye and pigment chemicals

Occupational Risk Characterisation

Given the critical health effects (mutagenicity, carcinogenicty, respiratory sensitisation and acute toxicity), the chemical could pose an unreasonable risk to workers unless adequate control measures to minimise exposure to the chemical are implemented. Based on the available data, the hazard classification in HSIS is considered appropriate.

NICNAS Recommendation

The chemicals are recommended for amendment to the classification for worker health and safety. The chemical is also recommended for a Tier III assessment as part of the assessment of 'Azo dyes that Cleave to Aromatic Amines of Potential Toxicological Concern' (NICNAS).

Regulatory Control

Public Health

For use in textile dyes, further regulatory controls for public health may be determined as part of a Tier III assessment for 'Azo dyes that Cleave to Aromatic Amines of Potential Toxicological Concern' (NICNAS).

Work Health and Safety

The chemicals are recommended for classification and labelling under the current approved criteria and adopted GHS as below. This assessment does not consider classification of physical and environmental hazards.

The chemical 2,6-DMA is currently classified for the hazards shown in * below.

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Acute Toxicity	Harmful if swallowed (Xn; R22)* Harmful in contact with skin (Xn; R21)* Harmful by inhalation (Xn; R20)*	Harmful if swallowed - Cat. 4 (H302) Harmful in contact with skin - Cat. 4 (H312) Harmful if inhaled - Cat. 4 (H332)
Irritation / Corrosivity	Irritating to skin (Xi; R38)* Irritating to respiratory system (Xi; R37)*	Causes skin irritation - Cat. 2 (H315) May cause respiratory irritation - Specific target organ tox, single exp Cat. 3 (H335)
Genotoxicity	Muta. Cat 3 - Possible risk of irreversible effects (Xn; R68)	Suspected of causing genetic defects - Cat. 2 (H341)
Carcinogenicity	Carc. Cat 3 - Limited evidence of a carcinogenic effect (Xn; R40)*	Suspected of causing cancer - Cat. 2 (H351)

[a] Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(2004)].

[b] Globally Harmonized System of Classification and Labelling of Chemicals (GHS) United Nations, 2009. Third Edition.

[*] Existing Hazard Classification. No change recommended to this classification

Advice for industry

Control measures

Control measures to minimise the risk from oral, dermal and inhalation exposure to the chemicals should be implemented in accordance with the hierarchy of controls. Approaches to minimise risk include substitution, isolation and engineering controls. Measures required to eliminate, or minimise risk arising from storing, handling and using a hazardous chemical depend on the physical form and the manner in which the chemicals are used. Examples of control measures which could minimise the risk include, but are not limited to:

- using closed systems or isolating operations;
- using local exhaust ventilation to prevent the chemicals from entering the breathing zone of any worker;
- health monitoring for any worker who is at risk of exposure to the chemicals, if valid techniques are available to monitor the effect on the worker's health;
- air monitoring to ensure control measures in place are working effectively and continue to do so;
- minimising manual processes and work tasks through automating processes;
- work procedures that minimise splashes and spills;
- regularly cleaning equipment and work areas; and
- using protective equipment that is designed, constructed, and operated to ensure that the worker does not come into contact with the chemicals.

Guidance on managing risks from hazardous chemicals are provided in the *Managing risks of hazardous chemicals in the workplace—Code of practice* available on the Safe Work Australia website.

Personal protective equipment should not solely be relied upon to control risk and should only be used when all other reasonably practicable control measures do not eliminate or sufficiently minimise risk. Guidance in selecting personal protective equipment can be

obtained from Australian, Australian/New Zealand or other approved standards.

Obligations under workplace health and safety legislation

Information in this report should be taken into account to help meet obligations under workplace health and safety legislation as adopted by the relevant state or territory. This includes, but is not limited to:

- ensuring that hazardous chemicals are correctly classified and labelled;
- ensuring that (material) safety data sheets ((M)SDS) containing accurate information about the hazards (relating to both health hazards and physicochemical (physical) hazards) of the chemicals are prepared; and
- managing risks arising from storing, handling and using a hazardous chemical.

Your work health and safety regulator should be contacted for information on the work health and safety laws in your jurisdiction.

Information on how to prepare an (M)SDS and how to label containers of hazardous chemicals are provided in relevant codes of practice such as the *Preparation of safety data sheets for hazardous chemicals—Code of practice* and *Labelling of workplace hazardous chemicals—Code of practice*, respectively. These codes of practice are available from the Safe Work Australia website.

A review of the physical hazards of these chemicals has not been undertaken as part of this assessment.

References

OECD (2012). SIDS Initial Assessment Profile (SIAP) on Xylidines. Accessed at **http://webnet.oecd.org/hpv/ui/SIDS_Details.aspx?id=2ea4d2a6-ba18-42ba-be99-bde33838c425**

Bruschweiler BJ, Kung S, Burgi D, Muralt L, Nyfeler E (2014). Identification of non-regulated aromatic amines of toxicological concern which can be cleaved from azo dyes used in clothing textiles. Regulatory Toxicology and Pharmacology. 69 pp. 263–272

Bryant, M.S et al (1994). 2,6-Dimethylaniline—hemoglobin adducts from lidocaine in humans. Carcinogenesis, 15 (10), 2287-2290

European Commission (EC) (2009). Recommendation from the Scientific Committee on Occupational Exposure Limits for 2,6-dimethylaniline (o-xylidine). Accessed January 2015 at **file://central.health/dfsuserenv/Users/User_19/copele/Downloads/sum%20146%20new%20template%20WEB%20ready%20(3).pdf**

European Commission (EU). IUCLID datasheet (2012) on 2,6 Dimethylaniline (87-62-7). Accessed January 2015 at **http://webnet.oecd.org/HPV/UI/SIDS_Details.aspx?id=d4433fd4-6765-4244-8de9-c6fab5beb978**

Galleria Chemica. Accessed December 2014 at **http://jr.chemwatch.net/galleria/**.

Hazardous Substances Data Bank (HSDB). National Library of Medicine. Accessed on December 2014 at **http://toxnet.nlm.nih.gov**.

National Industrial Chemicals Notification and Assessment Scheme (NICNASa). Tier II human health assessment for Azo dyes that cleave to aromatic amines of potential toxicological concern. Australian Government Department of Health. Accessed February 2015 at **http://www.nicnas.gov.au**

REACH Dossier (REACH). 2,3-xylidine (CAS No. 87-59-2). Accessed December 2014 at **http://echa.europa.eu/information-on-chemicals**

REACH Dossier (REACH). 2,4-xylidine (CAS No. 95-68-1). Accessed December 2014 at **http://echa.europa.eu/information-on-chemicals**

REACH Dossier (REACH). 2,5-xylidine (CAS No. 95-78-3). Accessed December 2014 at **http://echa.europa.eu/information-on-chemicals**

REACH Dossier (REACH). 2,6-xylidine (CAS No. 87-62-7). Accessed December 2014 at **http://echa.europa.eu/information-on-chemicals**

REACH Dossier (REACH). 3,4-xylidine (CAS No. 95-64-7). Accessed December 2014 at **http://echa.europa.eu/information-on-chemicals**

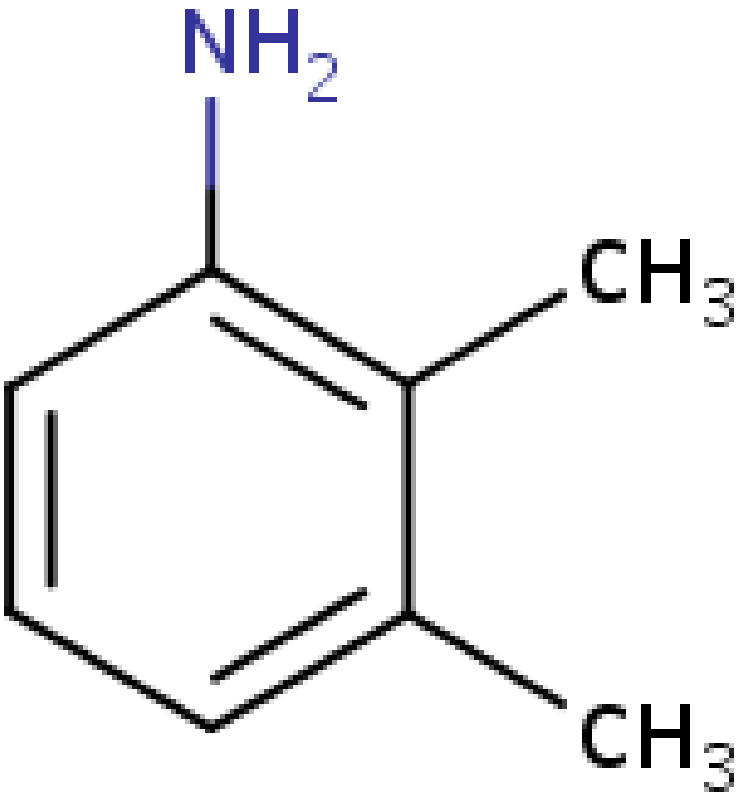
REACH Dossier (REACH). 3,5-xylidine (CAS No. 108-69-0). Accessed December 2014 at **http://echa.europa.eu/information-on-chemicals**

Safe Work Australia (SWA). Hazardous Substances Information system (HSIS). Accessed December 2014 at **http://hsis.safeworkaustralia.gov.au/HazardousSubstance**.

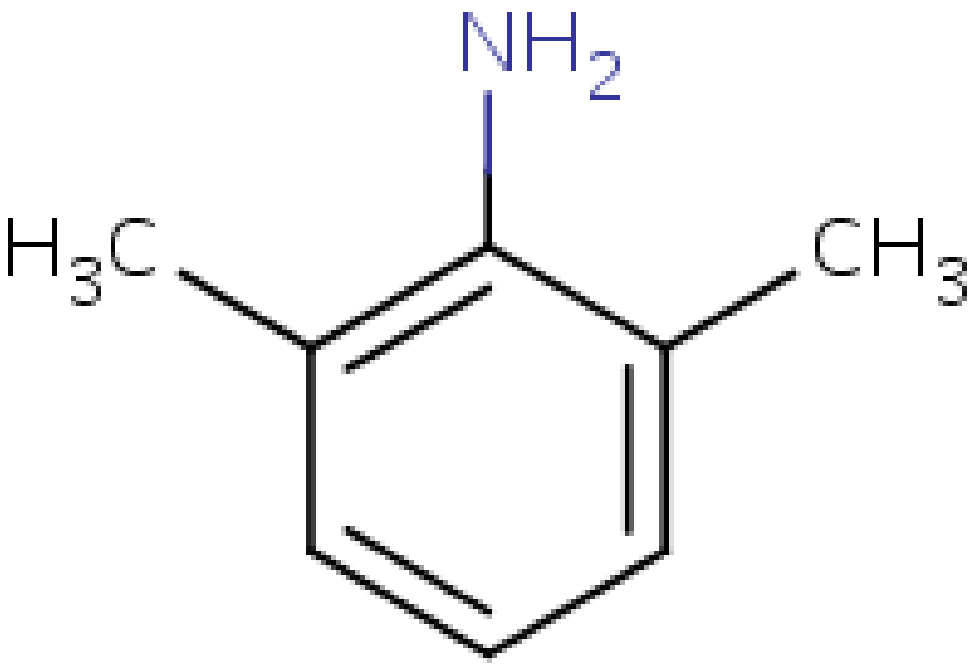
Tyden, E. et al (2004). Metabolic Activation of 2,6-Xylidine in the Nasal Olfactory Mucosa and the Mucosa of the Upper Alimentary and Respiratory Tracts in Rats. Toxicological Sciences, 81 (2), 263-272

Last Update 13 February 2015

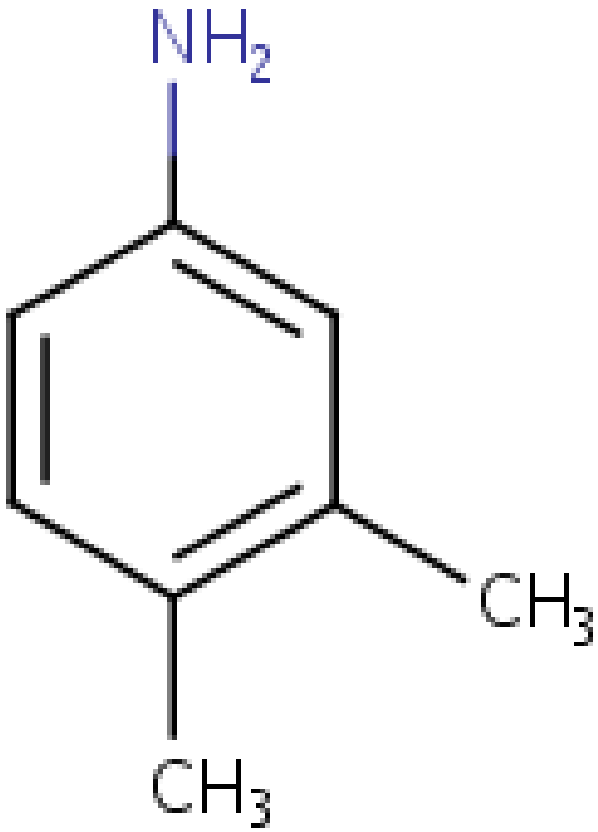
Chemical Identities

Chemical Name in the Inventory and Synonyms	**Benzenamine, 2,3-dimethyl-** aniline, 2,3-dimethyl- 2,3-xylidine 2,3-dimethylaniline 2,3-dimethylbenzenamine 2,3-xylylamine
CAS Number	87-59-2
Structural Formula	
Molecular Formula	C8H11N
Molecular Weight	121.18

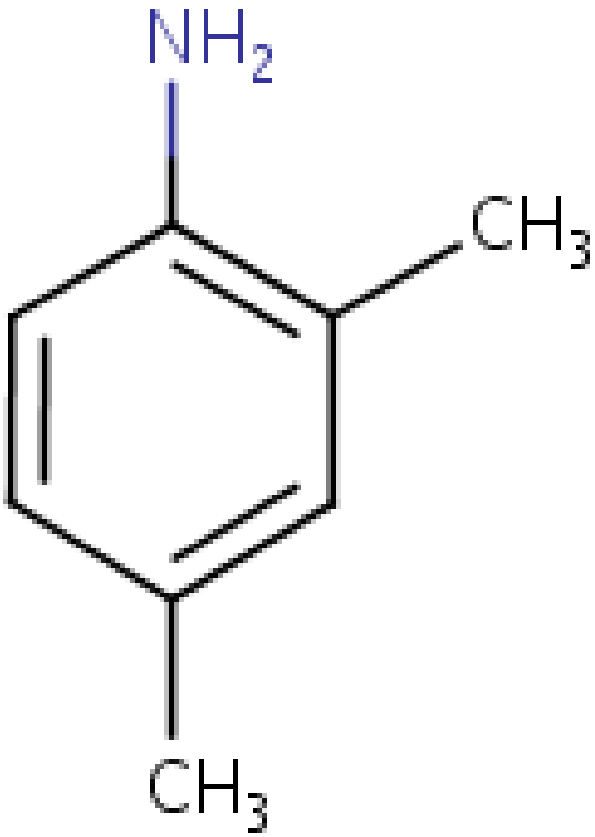
Chemical Name in the Inventory and Synonyms	**Benzenamine, 2,6-dimethyl-** aniline, 2,6-dimethyl- 2,6 xylidine

	2,6-dimethylaniline 2,6-dimethylbenzenamine 2,6-xylylamine
CAS Number	87-62-7
Structural Formula	
Molecular Formula	C8H11N
Molecular Weight	121.18

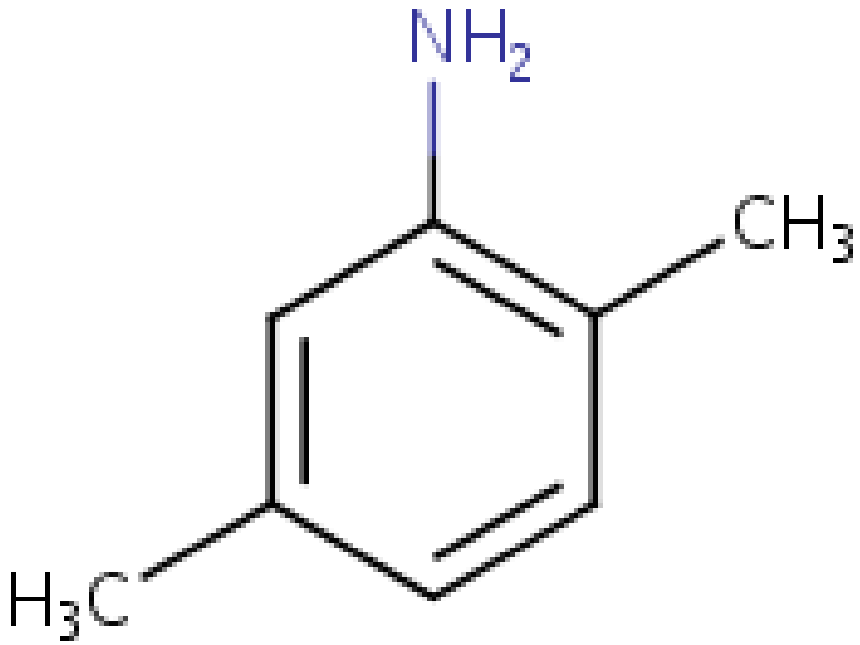
Chemical Name in the Inventory and Synonyms	**Benzenamine, 3,4-dimethyl-** 3,4-dimethylaniline 3,4-xylidine aniline, 3,4-dimethyl- 3,4-xylylamine 3,4-dimethylbenzenamine
CAS Number	95-64-7
Structural Formula	

	
Molecular Formula	C8H11N
Molecular Weight	121.18

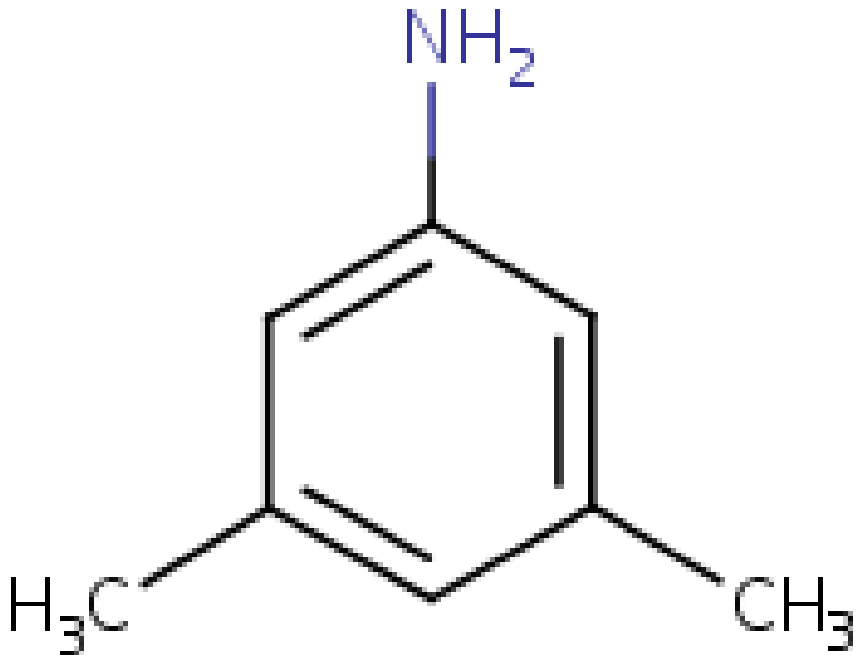
Chemical Name in the Inventory and Synonyms	**Benzenamine, 2,4-dimethyl-** aniline, 2,4-dimethyl- 2,4-xylidine 2,4-dimethylaniline 2,4-dimethylbenzenamine 2,4-xylylamine
CAS Number	95-68-1
Structural Formula	

	
Molecular Formula	C8H11N
Molecular Weight	121.18

Chemical Name in the Inventory and Synonyms	**Benzenamine, 2,5-dimethyl-** aniline, 2,5-dimethyl- 2,5-xylidine 2,5-dimethylaniline 2,5-dimethylbenzenamine 2,5-xylylamine
CAS Number	95-78-3
Structural Formula	

	
Molecular Formula	C8H11N
Molecular Weight	121.18

Chemical Name in the Inventory and Synonyms	**Benzenamine, 3,5-dimethyl-** aniline, 3,5-dimethyl- 3,5-xylidine 3,5-dimethylaniline 3,5-dimethylbenzenamine 3,5-xylylamine
CAS Number	108-69-0
Structural Formula	

	
Molecular Formula	C8H11N
Molecular Weight	121.18

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