



Product Safety Assessment

Bisphenol A

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Names

- CAS No. 80-05-7
- Bisphenol A
- Bisphenol-A
- BPA
- 4,4'-Isopropylidenediphenol
- p,p'-isopropylidenediphenol

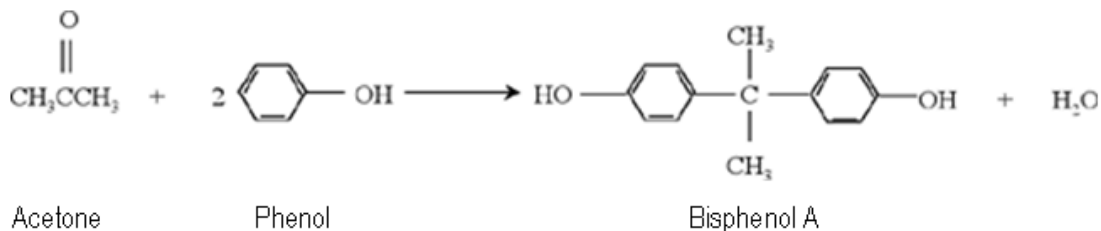
Product Overview

- Bisphenol A (BPA) is an important chemical building block that is used primarily to make polycarbonate (PC) plastic and epoxy resins. PC is a lightweight, high-performance plastic that is used in applications ranging from eyeglass lenses and electronics to safety equipment and food and drink containers. Epoxy resins are most commonly used as protective coatings and adhesives for transportation, marine, civil engineering and metal applications.¹ See [Product Uses](#).
- As sold by Dow, BPA is a white to tan flake or powder. It has a mild odor, but is not volatile. See [Product Description](#).
- Dow does not sell BPA for direct consumer use. Closed systems are used to manufacture BPA, and the polycarbonate and epoxy resins made from BPA, providing little or no opportunity for exposure to it. Workplace exposure could occur during BPA manufacturing operations, or operations that use BPA as a raw material. Workers could be exposed during sampling, testing, packing, maintenance, transport, or other procedures. If a fire occurs where BPA is present, the smoke may contain BPA in addition to its combustion products of varying composition which may be toxic and / or irritating.² See [Exposure Potential](#) and [Physical Hazard Information](#).
- The safety of BPA has been extensively studied for more than four decades. Human exposure to BPA from consumer products made using PC and epoxy resins is extremely small and poses no known risk to human health.³ Despite these results, some debate has occurred about potential health effects from low-dose exposures to BPA. BPA is not known to cause birth defects or adverse effects on reproduction unless the exposure doses are high enough to be toxic to the mother. Direct exposure of the eye or skin to BPA can cause eye and skin irritation or may produce allergic skin reactions when in combination with exposure to ultraviolet radiation from the sun or other sources.⁴ See [Health Information](#).
- BPA is readily biodegradable and its bioconcentration potential is low.⁵ Numerous validated environmental fate studies, combined with the scientific understanding of BPA toxicity, indicate that the current manufacturing and use patterns of BPA pose a low risk to the environment.⁶ See [Environmental Information](#).

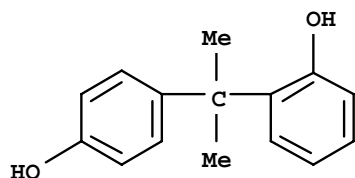
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Manufacture of Product⁷

- **Capacity** – Global production capacity for BPA was 6.6 billion pounds (3.7 million metric tons) in 2003. Dow has a total global BPA capacity of about 770 million pounds (350 thousand metric tons), with production sites in Freeport, Texas; and Stade, Germany.
- **Process** – BPA is made by using an acid catalyst to react acetone with phenol in a continuous, enclosed process under mild conditions of temperature and pressure.



BPA has different isomers (arrangements of the atoms within the molecule). The para, para' (p,p') isomer, which is the desired commercial product, is shown above. This process reaction also produces the ortho, para'-BPA (o,p'-BPA) isomer, shown below, in low levels. The o,p'-BPA impurity is removed by recrystallization. The meta, para'-BPA isomer is not formed in this reaction.



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Product Description^{8,9}

BPA, as produced, is a white to tan flake or powder. It has a mild odor, but is not volatile.

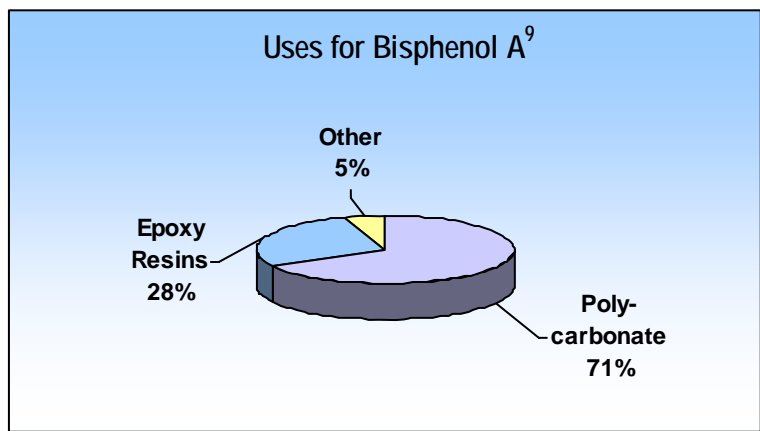
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Product Uses^{10,11}

Almost all of the BPA produced by Dow is consumed at Dow manufacturing sites to make polycarbonate (PC) plastic and epoxy resins. In general, BPA is used to make the following materials:

- **Polycarbonate** – a lightweight, high-performance plastic that is used to make eyeglass lenses, medical equipment, water bottles, digital media (e.g., CDs and DVDs), cell phones, consumer electronics, computers and other business equipment, electrical equipment, household appliances, security shields, construction glazing, automobile headlight lenses, sports safety equipment and reusable food and drink containers
- **Epoxy resins** – versatile resins used for many applications, such as industrial floorings, adhesives, sealants, industrial protective coatings, powder coatings, automotive primers, can coatings and printed circuit boards
- **Other** – specialized, lower volume applications, such as flame retardants, and high performance resins (unsaturated polyester, polysulfone, polyetherimide and polyarylate)

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Exposure Potential^{12,13}

BPA is a raw material used to make polymers that are used to produce consumer products. It is not sold directly for consumer use. Based on the uses for BPA, humans could be exposed through:

- **Workplace exposure** – Exposure can occur either in a BPA manufacturing facility or in the various industrial and manufacturing facilities that use BPA. BPA exposure could also occur during transport. Closed systems are used to manufacture BPA, and the polycarbonate and epoxy resins made from BPA, providing little or no opportunity for exposure to it. However, those working with BPA in manufacturing operations could be exposed during maintenance, sampling, testing, transfer or other procedures. Chemical goggles, gloves and protective equipment should be worn to avoid contact of eyes, skin and clothing with BPA. Each manufacturing, industrial and service facility should have appropriate work process and safety equipment policies in place to limit BPA exposure. Good industrial hygiene practices minimize the risk of exposure. The manufacture of polycarbonate plastic and epoxy resins leaves very low BPA residual levels in the plastic and uncured resins. These residuals are not a significant source of exposure. See [Health Information](#).
- **Consumer exposure to products containing BPA** – Although Dow does not sell BPA for consumer use, consumers come into contact with many products made from BPA. BPA is used to make PC plastic and epoxy coatings, which have many applications in consumer goods. These products could contain trace quantities of residual BPA. If inadequately dried, processed or fabricated, polycarbonate can also hydrolyze or breakdown to form small quantities of BPA. Regulations may exist that govern the allowable quantities of BPA in plastics or epoxy resins. These regulations may vary by city, state, country or geographic region. Information may be found by consulting the relevant [Safety Data Sheet \(SDS\)](#) or [Contact Us](#). See [Health Information](#).
- **Environmental releases** – BPA is not expected to be intentionally released to the environment. In the event of a spill, the focus should be on containing the spill to prevent contamination of soil, surface or ground water. Should BPA reach soil and water nearby, it is moderately toxic to fish on an acute basis; and human and animal contact with contaminated soil should be avoided. Because BPA can form an explosive dust / air mixture, ignition sources should be removed. Consult the relevant [SDS](#) for more information about protective equipment and procedures. See [Environmental](#), [Health](#) and [Physical Hazard Information](#).
- **Large release** – Industrial spills or releases are infrequent and are generally contained. If a large spill does occur, isolate the area. Keep unnecessary and unprotected personnel from entering the area. The material should be captured, collected and re-processed, or disposed of according to federal, state/provincial or local regulations. Emergency personnel should wear proper protective equipment and follow emergency procedures carefully. Under fire conditions, the smoke may contain the original material in addition to combustion products of varying composition which may be toxic and / or irritating. Combustion products may include and are not limited to: phenolic compounds, carbon monoxide and carbon dioxide. Isolate the fire area and deny unnecessary entry (keep people away). Avoid contact with the material and smoke during fire fighting operations. Avoid accumulation of dust. See [Environmental](#), [Health](#) and [Physical Hazard Information](#).

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Health Information¹⁴

If BPA comes into contact with the eye as a result of being handled improperly, it may cause moderate irritation of the eye with corneal injury. Dust may irritate the eyes or membranes of the nose and throat.

Brief skin contact is essentially non-irritating. However, prolonged or repeated contact may cause skin irritation. Skin contact may cause an allergic skin reaction especially when combined with exposure to ultraviolet radiation from the sun or other sources. In Europe, BPA is classified as a

skin sensitizer. Neither short duration nor prolonged skin contact is likely to result in absorption of harmful amounts of BPA.

Small amounts swallowed accidentally or incidentally by handling BPA are not likely to cause injury. Swallowing larger amounts or repeatedly swallowing larger amounts might cause damage to the liver or kidneys.

The evidence from animal studies shows that BPA does not have the potential to be a carcinogen or cause birth defects. BPA is not known to cause birth defects or adverse effects on reproduction unless the doses are high enough to be toxic to the mother. Animals that were repeatedly fed high doses of BPA repeatedly exhibited effects on the liver and kidney.

Questions of Low-Dose Health Effects

In recent years, a hypothesis has been advanced claiming that exposure to extremely low doses of certain substances could cause adverse health effects in humans, including disruption of normal hormonal functions. In science, a hypothesis is a limited statement regarding cause and effect that has not been confirmed through repeated experimental tests. According to this "low-dose hypothesis," health effects might occur at doses far below levels previously determined to be safe using well-established toxicological procedures and principles.¹⁵ BPA is one of the substances included in this low-dose hypothesis.^{16,17}

The health information presented in this product safety assessment is based on a large number of toxicology and environmental studies conducted by industry, government and academia. These studies on BPA, conducted in accordance with validated test methods, do not show a risk of cancer, developmental or endocrine effects.¹⁸ However, the studies cited in the media and internet to support the low-dose hypothesis were not conducted in accordance with validated test methods, which can account for some of the differing results. For instance, the test population may have been so small that differences other than the dosage of BPA may account for the differences in health effects between the exposed and unexposed groups.

Claims of possible effects from low-dose exposure to BPA were first reported in the early 1990s. Since then, many studies have been conducted to determine the validity of the associated claims. National and international groups, as well as industry, have reviewed findings presented in a large number of peer-reviewed, validated toxicological studies.

The weight of evidence from this research does not support the low-dose hypothesis.

- Reviews have been completed by the [European Commission's Scientific Committee on Food \(SCF\)](#), the U.S. Food and Drug Administration, the United Kingdom Food Standards Agency, and the Japanese Ministry of Health, Labor and Welfare. The use of polycarbonate plastics and epoxy resins for food contact applications has been and continues to be recognized as safe by these groups.
- The European Food Safety Authority released its [comprehensive risk assessment](#) on January 29, 2007. As a result of reviewing all of the published literature, it raised the tolerable daily intake (TDI) by a factor of five.¹⁹ The tolerable daily intake is an estimate of the amount of BPA that can be ingested daily over a lifetime without appreciable risk. With human exposure to BPA well below the TDI, the assessment strongly supports the conclusion that BPA is not a risk to human health at the very low levels to which people, including infants and children, might be exposed from use of consumer products.
- The European Commission has completed a comprehensive risk assessment on BPA, which includes a review of evidence for and against low-dose effects ([EU, 2003](#)). The European Commission's Scientific Committee on Toxicity, Ecotoxicity and the Environment ([CSTEE, 2002](#)) independently reviewed the Risk Assessment Report (RAR) and stated: "[A] number of studies using non-standard protocols have reported effects of bisphenol A administration on development using substantially lower doses than the studies performed according to testing guidelines. The RAR critically describes the many weaknesses (lack of repeatability,

problems with experimental design and statistical evaluation, poor reporting) of the low-dose studies. The CSTEE agrees with the conclusion of the RAR that there is no convincing evidence that low doses of bisphenol A have effects on developmental parameters in offspring and remarks that effects observed are not adverse." The CSTEE further remarked, "A number of high quality studies on the reproductive and developmental effects of bisphenol A are already available and do not support low-dose effects."²⁰

- An expert scientific panel convened by the Harvard Center for Risk Analysis concluded that the weight of evidence does not support low-dose effects from BPA. Using a comprehensive and systematic framework for their evaluation, the panel found no consistent affirmative evidence of low-dose effects for any endpoint.^{21,22} This conclusion was reaffirmed by another comprehensive evaluation by an expert panel that included some of the same Harvard panel authors.²³

The combined dietary intake of BPA from PC plastics and epoxy can coatings is estimated to be more than 400 times *lower* than the reference dose considered safe by the U.S. EPA.²⁴ It is estimated that consumers would have to consume more than 500 pounds (227 kilograms) of food and beverages every day of their lives to exceed the BPA reference dose.²⁵

For specific health information, review the relevant [Safety Data Sheet \(SDS\)](#).

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Environmental Information²⁶

Numerous validated environmental fate studies, combined with the scientific understanding of BPA toxicity, indicate that the current manufacturing and use patterns of BPA pose a low risk to the environment.²⁷

BPA is readily biodegradable which means the substance is not expected to be persistent in the environment. Numerous studies have demonstrated short environmental half-lives. Small amounts discharged to wastewater treatment systems are expected to be effectively treated. Numerous studies have shown greater than 90 percent treatment efficiency.

BPA has low potential for bioaccumulation. However, when released to the environment, BPA is moderately toxic to aquatic organisms. In the atmosphere, BPA has a short half-life and atmospheric emissions are low, thus BPA is not considered to be a contributor to low level ozone or green house gas formation.²⁸

For specific environmental information, review the relevant [SDS](#).

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Physical Hazard Information²⁹

BPA is not soluble in water (<0.1%). Spilled BPA flakes or powder may cause a slipping hazard.

BPA may form an explosive dust-air mixture. Under fire conditions, the smoke may contain the original material in addition to combustion products of varying composition which may be toxic and / or irritating. Combustion products may include and are not limited to: phenolic compounds, carbon monoxide and carbon dioxide. Isolate the fire area and deny unnecessary entry (keep people away). Avoid contact with the material and smoke during fire fighting operations. Avoid accumulation of dust.

Additional physical property information for BPA is available on the [SDS](#).

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Regulatory Information

Regulations may exist that govern the manufacture, sale, transportation, use and/or disposal of BPA. These regulations may vary by city, state, country or geographic region. Information may be found by consulting the relevant [Safety Data Sheet \(SDS\)](#) or [Contact Us](#).

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Additional Information

- Safety Data Sheet (<http://www.dow.com/webapps/msds/msdssearch.asp>)
- Contact Us (<http://epoxy.dow.com/epoxy/contact/>)
- [Bisphenol A Global Industry Group](#)
- Our Stolen Future web site – for alternative views (<http://www.ourstolenfuture.org/NewScience/oncompounds/bisphenola/bpauses.htm>)

For more business information about BPA, visit Dow's [Epoxy resins](#) or [Plastics](#) sites.

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References

- ¹ Bisphenol A Global Industry Group, *Bisphenol A Fact Sheet*, June 2003.
- ² *Bisphenol A Safety Data Sheet*, The Dow Chemical Company, No. 414, March 3, 2004, page 3.
- ³ Bisphenol A Global Industry Group, *Bisphenol A Fact Sheet: Human Safety*, July 2007, page 1.
- ⁴ *Bisphenol A Safety Data Sheet*, The Dow Chemical Company, No. 414, March 3, 2004, pages 1-2.
- ⁵ *Bisphenol A Safety Data Sheet*, The Dow Chemical Company, No. 414, March 3, 2004, page 3.
- ⁶ Bisphenol A Global Industry Group, *Bisphenol A Fact Sheet*, October 2002, pages 1 and 4.
- ⁷ *Chemical Economics Handbook (CEH) Product Review Bisphenol A*, SRI Consulting, August, 2004, pages 4, 7 and 18.
- ⁸ *European Union Risk Assessment Report Bisphenol-A*, European Chemicals Bureau, 2003, page 14.
- ⁹ *CEH Product Review Bisphenol A*, SRI Consulting, August, 2004, page 4.
- ¹⁰ *European Union Risk Assessment Report Bisphenol-A*, European Chemicals Bureau, 2003, page 14.
- ¹¹ *CEH Product Review Bisphenol A*, SRI Consulting, August, 2004, page 4.
- ¹² *Bisphenol A Safety Data Sheet*, The Dow Chemical Company, No. 414, March 3, 2004, page 4.
- ¹³ *European Union Risk Assessment Report Bisphenol-A*, European Chemicals Bureau, 2003, pages 115-116.
- ¹⁴ *Bisphenol A Safety Data Sheet*, The Dow Chemical Company, No. 414, March 3, 2004, pages 1-2.
- ¹⁵ Bisphenol A Global Industry Group, *Bisphenol A Human Health & Safety*, date referenced April 7, 2007.
- ¹⁶ Vom Saal, F., Welshons, W., "Large Effects from Small Exposures. II. The Importance of Positive Controls in Low-Dose Research on Bisphenol A," *Environmental Research*, September 1, 2005, page 1.
- ¹⁷ Our Stolen Future web site. (<http://www.ourstolenfuture.org/NewScience/oncompounds/bisphenola/bpauses.htm>)
- ¹⁸ Bisphenol A Global Industry Group, *Bisphenol A Human Health & Safety*, date referenced April 7, 2007.
- ¹⁹ Press Release, "EFSA re-evaluates safety of bisphenol A and sets Tolerable Daily Intake," European Food Safety Authority, January 29, 2007.
- ²⁰ http://europa.eu.int/comm/food/fs/sc/sct/out156_en.pdf

- ²¹ G.M. Gray, J.T. Cohen, G. Cunha, C. Hughes, E.E. McConnell, L. Rhomberg, I.G. Sipes, and D. Mattison, "Weight of the evidence evaluation of low-dose reproductive and developmental effects of bisphenol A", *Human and Ecological Risk Assessment*, Vol. 10, No. 5, 2004, pages 875-921.
- ²² "Weight Of The Evidence Evaluation Of Low-Dose Reproductive And Developmental Effects Of Bisphenol A," Harvard Center for Risk Analysis, Harvard School of Public Health, Boston, Massachusetts, August, 2004.
- ²³ L. Rhomberg, J. Goodman, "An Updated Weight of the Evidence Evaluation of Reproductive and Developmental Effects of Low Doses of Bisphenol A," *Gradient Risk Sciences Bulletin*, Issue 1, June 2006.
- ²⁴ Bisphenol A Global Industry Group, *Bisphenol A Human Health & Safety*, date referenced April 7, 2007.
(<http://www.bisphenol-a.org/human/index.html>)
- ²⁵ Bisphenol A Global Industry Group, *Bisphenol A Fact Sheet: Human Safety*, July 2007, page 2.
- ²⁶ *Bisphenol A Safety Data Sheet*, The Dow Chemical Company, No. 414, March 3, 2004, pages 5-6.
- ²⁷ Bisphenol A Global Industry Group, *Bisphenol A Fact Sheet*, October 2002, pages 1 and 4.
- ²⁸ *European Union Risk Assessment Report Bisphenol-A*, European Chemicals Bureau, 2003.
- ²⁹ *Bisphenol A Safety Data Sheet*, The Dow Chemical Company, No. 414, March 3, 2004, pages 2-3.

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