

SCREENING-LEVEL HAZARD CHARACTERIZATION Triphenylboron Category

Sponsored Chemicals

Triphenylborane

CASRN 960-71-4

Triphenylboron with sodium hydroxide

CASRN 12113-07-4

The High Production Volume (HPV) Challenge Program¹ was conceived as a voluntary initiative aimed at developing and making publicly available screening-level health and environmental effects information on chemicals manufactured in or imported into the United States in quantities greater than one million pounds per year. In the Challenge Program, producers and importers of HPV chemicals voluntarily sponsored chemicals; sponsorship entailed the identification and initial assessment of the adequacy of existing toxicity data/information, conducting new testing if adequate data did not exist, and making both new and existing data and information available to the public. Each complete data submission contains data on 18 internationally agreed to “SIDS” (Screening Information Data Set^{1,2}) endpoints that are screening-level indicators of potential hazards (toxicity) for humans or the environment.

The Environmental Protection Agency’s Office of Pollution Prevention and Toxics (OPPT) is evaluating the data submitted in the HPV Challenge Program on approximately 1400 sponsored chemicals by developing hazard characterizations (HCs). These HCs consist of an evaluation of the quality and completeness of the data set provided in the Challenge Program submissions. They are not intended to be definitive statements regarding the possibility of unreasonable risk of injury to health or the environment.

The evaluation is performed according to established EPA guidance^{2,3} and is based primarily on hazard data provided by sponsors; however, in preparing the hazard characterization, EPA considered its own comments and public comments on the original submission as well as the sponsor’s responses to comments and revisions made to the submission. In order to determine whether any new hazard information was developed since the time of the HPV submission, a search of the following databases was made from one year prior to the date of the HPV Challenge submission to the present: (ChemID to locate available data sources including Medline/PubMed, Toxline, HSDB, IRIS, NTP, ATSDR, IARC, EXTOXNET, EPA SRS, etc.), STN/CAS online databases (Registry file for locators, ChemAbs for toxicology data, RTECS, Merck, etc.) and Science Direct. OPPT’s focus on these specific sources is based on their being of high quality, highly relevant to hazard characterization, and publicly available.

¹ U.S. EPA. High Production Volume (HPV) Challenge Program; <http://www.epa.gov/chemrtk/index.htm>.

² U.S. EPA. HPV Challenge Program – Information Sources; <http://www.epa.gov/chemrtk/pubs/general/guidocs.htm>.

³ U.S. EPA. Risk Assessment Guidelines; <http://cfpub.epa.gov/ncea/raf/rafguid.cfm>.

OPPT does not develop HCs for those HPV chemicals which have already been assessed internationally through the HPV program of the Organization for Economic Cooperation and Development (OECD) and for which Screening Initial Data Set (SIDS) Initial Assessment Reports (SIAR) and SIDS Initial Assessment Profiles (SIAP) are available. These documents are presented in an international forum that involves review and endorsement by governmental authorities around the world. OPPT is an active participant in these meetings and accepts these documents as reliable screening-level hazard assessments.

These hazard characterizations are technical documents intended to inform subsequent decisions and actions by OPPT. Accordingly, the documents are not written with the goal of informing the general public. However, they do provide a vehicle for public access to a concise assessment of the raw technical data on HPV chemicals and provide information previously not readily available to the public.

<p>Chemical Abstract Service Registry Number (CASRN)</p>	<p><u>Sponsored Chemicals</u></p> <p>CASRN 960-71-4</p> <p>CASRN 12113-07-4</p>
<p>Chemical Abstract Index Name</p>	<p><u>Sponsored Chemicals</u></p> <p>Borane, triphenyl –</p> <p>Borate (1-), hydroxyphenyl-, sodium(T4) –</p>
<p>Structural Formula</p>	<p>See Section 1</p>
<p style="text-align: center;">Summary</p> <p>The category chemicals are solids that are expected to have low to high water solubility and negligible to low vapor pressure. The members of this category are unstable in water and are expected to have low persistence (P1) and low bioaccumulation potential (B1); however, the persistence and bioaccumulation potential of the hydrolysis products are unknown.</p> <p>The acute oral toxicity of the category chemicals to rats is moderate and the acute inhalation toxicity of CASRN 960-71-4 to rats is high. The category chemicals are corrosive to rabbit skin and severely irritating to rabbit eyes. CASRN 960-71-4 is not a dermal sensitizer in guinea pigs. The category chemicals did not induce gene mutations when tested <i>in vitro</i>. The potential health hazard of the category chemicals for systemic toxicity following repeated-dose exposures, and for reproductive and developmental toxicity and chromosomal aberrations could not be determined because of data gaps.</p> <p>The acute hazard of CASRN 960-71-4 to aquatic invertebrates (48-h EC50) is 0.002 mg/L. No toxicity data are available on fish and aquatic plants for the chemicals in this category.</p> <p>Ready biodegradation, hydrolysis, acute toxicity to fish and aquatic plants endpoints; repeated-dose/reproductive/developmental toxicity and chromosomal aberrations test data were identified as data gaps under the HPV Challenge Program.</p>	

The sponsor, E.I. du Pont de Nemours and Company submitted a Test Plan and Robust Summaries to EPA for the Triphenylboron category on November 21, 2003. EPA posted the submission on the ChemRTK HPV Challenge website on February 19, 2004, (<http://www.epa.gov/chemrtk/pubs/summaries/triphnlb/c14976tc.htm>). EPA comments on the original submission were posted to the website on June 23, 2004. Public comments were also received and posted to the website. The sponsor has not provided revised/updated robust summaries reflecting testing proposed in their original test plan.

Category Justification

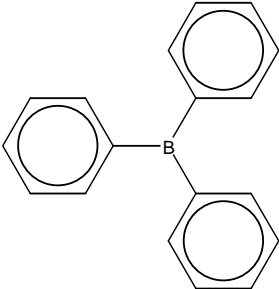
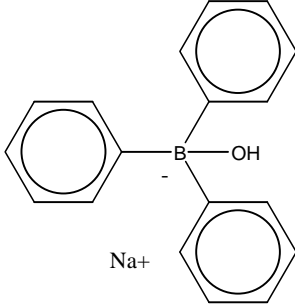
The triphenylboron category is composed of triphenylborane (TPB), CASRN 960-71-4, and its hydroxide adduct triphenylboron compound with sodium hydroxide (TBP-NaOH), CASRN 12113-07-4. TBP is a monofunctional Lewis acid which is provided as the sodium hydroxide adduct for shipping purposes. TPB-NaOH is produced as a ~ 8 – 10 % aqueous solution with free sodium hydroxide and is hence, strongly alkaline; however, at pH < 7 TBP-NaOH will dissociate into TPB and NaOH at pH < 7. The grouping of these two chemicals in one category is therefore supported by the fact that TBP-NaOH will become TBP at or near neutral pH.

1 Chemical Identity

1.1 Identification and Purity

The following description is taken from the 2003 Test Plan and Robust Summaries:

The triphenylboron category is composed of triphenylborane (TPB), CASRN 960-71-4, and triphenylboron compound with sodium hydroxide (TPB-NaOH), CASRN 12113-07-4. TPB is a monofunctional Lewis acid. Test substance purity, when noted in the Robust Summaries, ranged in most cases between 90% - 100%. The chemical structures of the triphenylboron category chemicals are depicted in Table 1.

Table 1: Triphenylboron Category Sponsored Chemical Structures		
Sponsored Chemicals		
Chemical Name	CASRN	Structure
Triphenylborane	960-71-4	
Triphenylboron with sodium hydroxide	12113-07-4	

1.2 Physical-Chemical Properties

Triphenylborons are solids with low to high water solubility and negligible to low vapor pressure. The physical-chemical properties of the triphenylboron category are summarized in Table 2.

Property	Triphenylborane	Triphenylboron with sodium hydroxide
CASRN	960-71-4	12113-07-4
Molecular Weight	241.8	281.8
Physical State	White crystalline solid	Solid
Melting Point	136°C (measured)	>300°C (measured) (decomposes)
Boiling Point	347°C (measured) (decomposes with heat, stable below 380°C)	>300°C (decomposes)
Vapor Pressure	1.19×10^{-5} mm Hg at 25°C (estimated) ²	8.5×10^{-18} mm Hg at 25°C (estimated) ²
Water Solubility	0.09895 mg/L at 25°C (estimated) ²	8-10% at 25°C (as prepared)
Dissociation Constant (pK _a)	No data	Dissociates to triphenylborane and sodium hydroxide at pH <7
Henry's Law Constant	3.8×10^{-5} atm-m ³ /mole (estimated) ²	1.1×10^{-18} atm-m ³ /mole (estimated) ²
Log K _{ow}	5.52 (estimated) ²	4.37 (estimated) ²

¹E.I. Du Pont de Nemours & Company, Inc. December 31, 2003. Robust Summary and Test Plan for Triphenylboron category. <http://www.epa.gov/chemrtk/pubs/summaries/triphnlb/c14976tc.htm>.

²Estimated values for these endpoints are not likely to be accurate because triphenylborons rapidly hydrolyze.

2 General Information on Exposure

2.1 Production Volume and Use Pattern

The two category chemicals had an aggregated production volume in the United States of 2 to 20 million pounds during calendar year 2005.

Information on uses in the IUR submissions was claimed confidential. The HPV submission for the category chemicals states that the chemicals are not currently sold for commercial applications. However, potential applications of the chemicals include olefin polymerization, agrichemicals, metal scavenging, and in consumer products, e.g., fuel additives and flame retardants.

2.2 Environmental Exposure and Fate

No quantitative information is available on releases of the chemicals in this category to the environment.

The environmental fate properties are provided in Table 3. Triphenylborane (CASRN 960-71-4) is reported to be unstable in water and hydrolyzes to form mixtures of phenylboric oxide and phenylboronic acid (Brown and Dodson, 1957). The hydroxytriphenylborate sodium salt is prepared as an 8-10% aqueous solution from triphenylborane by reaction with sodium hydroxide and water. At near neutral pH, the hydroxytriphenylborate sodium salt dissociates with the loss of the hydroxide anion and results in the formation of triphenylborane, which subsequently reacts with water to form the hydrolysis products phenylboric oxide and phenylboronic acid. Thus, triphenylborane and hydroxytriphenylborate sodium salt are expected to have low persistence (P1), while the persistence of the hydrolysis products are unknown. Since triphenylborane and hydroxytriphenylborate sodium salt are unstable in water, the bioaccumulation potential is expected to be low (B1), while the bioaccumulation of the hydrolysis products are unknown.

Since members of the triphenylboron category rapidly hydrolyze, it was not possible to estimate their soil mobility, volatilization, rate of atmospheric photooxidation, or fugacity. In addition, the estimates provided for water solubility, Henry's Law Constant, Log Kow, and bioaccumulation potential are not likely to be accurate.

Measured biodegradation and hydrolysis data were not submitted; therefore these parameters were identified as data gaps under the HPV Challenge Program.

Property	Triphenylborane	Triphenylboron with sodium hydroxide
CASRN	960-71-4	12113-07-4
Photodegradation Half-life	No data ²	No data ²
Hydrolysis Half-life	Hydrolyzes rapidly ³	Dissociates to triphenylborane and sodium hydroxide at pH < 7
Biodegradation	No data ²	No data ²
Bioconcentration	No data ²	No data ²
Log K _{oc}	No data ²	No data ²
Fugacity (Level III Model)	No data ²	No data ²
Persistence ⁵	P1	P1
Bioaccumulation ⁵	B1	B1

¹E.I. Du Pont de Nemours & Company, Inc. December 31, 2003. Robust Summary and Test Plan for Triphenylboron category. <http://www.epa.gov/chemrtk/pubs/summaries/triphnlb/c14976tc.htm>.

²No estimated endpoints are provided because triphenylborons hydrolyze.

³Brown HC and Dodson VH. 1957. J. Am. Chem. Soc. 79:2302-2306

⁴Federal Register. 1999. Category for Persistent, Bioaccumulative, and Toxic New Chemical Substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

3 Human Health Hazard

A summary of health effects data submitted for SIDS endpoints is provided in Table 4. The table also indicates where data for tested category members are read-across (RA) to untested members of the category.

Acute Oral Toxicity

Triphenylborane (CASRN 960-71-4)

(1) Male ChR-CD rats (10/dose) were administered single doses of triphenylborane (> 90%) in corn oil via gavage at 150, 180, 225 or 250 mg/kg-bw and observed for 14 days. Mortalities were 0/10, 5/10, 8/10 and 8/10 at 150, 180, 225 and 250 mg/kg-bw, respectively. All mortality occurred 1-3 days after dosing.

LD₅₀ = 196 mg/kg-bw

(2) Male ChR-CD rats (1/dose) were administered single doses of triphenylborane (10% active ingredient) in corn oil via gavage at 450, 670, 1000, 1500, 2250, 5000, 7500 or 11,000 mg/kg-bw (approximately 45, 67, 100, 150, 225, 500, 750 or 1100 when adjusted to active ingredient

concentration) and observed for 14 days. Mortality occurred within two days at doses 225 mg/kg-bw and higher.

LD₅₀ = 225 mg/kg-bw (active ingredient concentration)

Triphenylboron compound with sodium hydroxide (CASRN 12113-07-4)

(1) Male ChR-CD rats (1/dose) were administered single doses of triphenylboron compound with sodium hydroxide as an aqueous solution via gavage at 26, 40, 60, 90, 130, 200, 300, 450, 670 and 2250 mg/kg-bw and observed for 14. Mortality was observed from 10 minutes to 1 day at and above 200 mg/kg-bw.

LD₅₀ = 200 mg/kg-bw

(2) Male ChR-CD rats (4/dose) were administered single doses of triphenylboron compound with sodium hydroxide (9% wt in water) via gavage at 200, 1000, 1250 and 1500 mg/kg-bw and observed for 14 days. Mortalities were 0/10, 2/10, 6/10 and 7/10 at 200, 1000, 1250 and 1500 mg/kg-bw respectively. Mortalities occurred within 1-2 days after dosing, with the exception of 1 rat at 1000 mg/kg-bw, which was found dead after 13 days. The test substance was reported as 9% wt in water; however, it is unclear if this represents 9% triphenylboron or 9% of triphenylboron-NaOH which is typically produced as a ~ 8 – 10 % aqueous solution with free sodium hydroxide. The higher LD₅₀ reported in this study, as compared to the study above and those for triphenylboron suggest a 9% solution of the 8-10% TBP-NaOH solution was used.

LD₅₀ = 1236 mg/kg-bw

Acute Inhalation Toxicity

Triphenylborane (CASRN 960-71-4)

Male ChR-CD rats (6/dose) were exposed head-only to triphenylborane at 0.004, 0.050, 0.073 and 0.474 mg/L for 4 hours and observed for 14 days. Mortality was 0/6, 0/6, 1/6, and 4/6 at 0.004, 0.050, 0.073, and 0.474 mg/L respectively.

LC₅₀ = 0.073 mg/L

Repeated-Dose Toxicity

Triphenylborane (CASRN 960-71-4)

No data were submitted. Sponsor proposed testing.

Triphenylboron compound with sodium hydroxide (CASRN 12113-07-4)

No data were submitted.

Reproductive toxicity

Triphenylborane (CASRN 960-71-4)

No data were submitted. Sponsor proposed testing.

Triphenylboron compound with sodium hydroxide (CASRN 12113-07-4)

No data were submitted.

Developmental Toxicity

Triphenylborane (CASRN 960-71-4)

No data were submitted. Sponsor proposed testing.

Triphenylboron compound with sodium hydroxide (CASRN 12113-07-4)

No data were submitted.

Genetic Toxicity – Gene Mutation

In vitro

Triphenylborane (CASRN 960-71-4)

Salmonella typhimurium strains TA98, TA100, TA1535, TA1537 and TA1538 were tested at 0, 0.8, 1.6, 2.4, 3.2 and 4.0 µg/plate with triphenylborane in the presence and absence of metabolic activation. The test substance was extremely toxic to the tester strains. No increases in mutation frequency were reported at any concentration tested, with or without metabolic activation.

Triphenylborane was not mutagenic in this assay.

Triphenylboron compound with sodium hydroxide (CASRN 12113-07-4)

(1) *S. typhimurium* strains TA98, TA100, TA1535, TA1537 and TA1538 were tested with triphenylboron compound with sodium hydroxide at concentrations of 0, 25, 50, 100, 250 and 500 µg/plate in the presence of metabolic activation and 0, 10, 20, 30, 50 and 100 µg/plate in the absence of metabolic activation. Positive and negative (solvent) controls were included for each assay. No increases in mutation frequency were reported at any concentration tested, with or without metabolic activation.

Triphenylboron compound with sodium hydroxide was not mutagenic in this assay.

(2) Chinese Hamster Ovary (CHO) cells were tested with triphenylboron compound with sodium hydroxide at concentrations ranging from 17.7 – 88.6 µM in the absence of metabolic activation for 18 h or to concentrations ranging from 35.4 – 283.6 µM in the presence of metabolic activation for 5 hours. All assays involved solvent control and positive controls. Toxicity was observed at higher concentrations, but no further details were provided. No increases in mutation frequency were reported at any concentration tested, with or without metabolic activity.

Triphenylboron compound with sodium hydroxide was not mutagenic in this assay.

Genetic Toxicity – Chromosomal Aberrations

Triphenylborane (CASRN 960-71-4)

No data were submitted. Sponsor proposed testing.

Triphenylboron compound with sodium hydroxide (CASRN 12113-07-4)

No data were submitted.

Additional Information

Eye Irritation

Triphenylborane (CASRN 960-71-4)

In two separate tests, albino rabbits (2/sex not specified) were instilled with undiluted and 20% solution in 3-pentenenitrile. The test eye of 1 rabbit in each test was rinsed with water after 20 seconds, and the test eye of the other rabbit remained unwashed. The test substance was a severe eye irritant in both tests.

Triphenylborane was severely irritating to rabbit eyes in this study.

Triphenylboron compound with sodium hydroxide (CASRN 12113-07-4)

Albino rabbits (2/sex not specified) were instilled with 1/10th mL of undiluted triphenylboron compound with sodium hydroxide in the right conjunctival sac. The treated eye of one animal was washed after 20 seconds with tap water for 1 minute and the treated eye of the other animal was left unwashed. The cornea, iris and conjunctiva were observed at 1 and 4 hours and at 1, 2, 3, 7 and 14 days. Triphenylboron compound with sodium hydroxide produced progressive, generalized moderate but penetrating corneal opacity, moderate iritis and severe conjunctivitis with necrosis of the outer lids which progressed to deep injury after 2 days and a distorted cornea after 14 days. At 17 days the cornea showed signs of outward distortion with the lower half hardened. Both the washed and unwashed eyes showed the same symptoms.

Triphenylboron compound with sodium hydroxide was corrosive to rabbit eyes in this study.

Skin Irritation

Triphenylborane (CASRN 960-71-4)

Albino rabbits (6, sex not stated) were administered undiluted triphenylborane dermally on clipped backs under occluded conditions for 4 hours and assessed at 24 and 48 hours after exposure. The test substance produced skin corrosion in 6 of 6 animals.

Triphenylborane was corrosive to rabbit skin in this study.

Triphenylboron compound with sodium hydroxide (CASRN 12113-07-4)

Albino rabbits (6/male) were treated with 0.5 mL of undiluted triphenylboron compound with sodium hydroxide on their hairless intact skin under occluded conditions. Patches were removed after 24 hours and reactions observed at 24 and 48 hours. Necrosis with severe to moderate edema was observed in all the rabbits at 24 hours.

Triphenylboron compound with sodium hydroxide was corrosive to rabbit skin in this study.

Skin Sensitization

Triphenylborane (CASRN 960-71-4)

Albino guinea pigs (10 males) were administered triphenylborane as 1% slurry via a series of 4 sacral intradermal injections. Following a two week rest period, the animals were challenged by applying 0.05 ml of 10% and 1% slurry to shaved intact skin. Ten previously unexposed guinea pigs received similar application during the challenge. Mild irritation was observed from the 10% slurry and no irritation was observed from the 1% slurry. No sensitization was observed at challenge.

Triphenylborane was not a dermal sensitizer in guinea pig in this study.

Conclusion: The acute oral toxicity of the triphenylboron category members to rats is moderate and the acute inhalation toxicity of triphenylborane to rats is high. The triphenylboron category members are corrosive to rabbit skin and severely irritating/corrosive to rabbit eyes. Triphenylborane is not a dermal sensitizer in guinea pigs. The triphenylboron category members did not induce gene mutations when tested *in vitro*. The potential health hazard of the triphenylboron category members for systemic toxicity following repeated-dose exposures, and for reproductive and developmental toxicity and chromosomal aberrations could not be determined because of data gaps.

Table 4. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program: Summary of Human Health Data		
Endpoints	Triphenylborane (960-71-4)	Triphenylboron compound with sodium hydroxide (12113-07-4)
Acute Oral Toxicity LD₅₀ (mg/kg-bw)	196	200
Acute Inhalation Toxicity LC₅₀ (mg/L)	0.073	—
Repeated-Dose Toxicity NOAEL/LOAEL (mg/kg- bw/day)	— Testing proposed	—
Reproductive Toxicity NOAEL/LOAEL (mg/kg- bw/day)	— Testing proposed	—
Developmental Toxicity NOAEL/LOAEL (mg/kg- bw/day)	— Testing proposed	—
Genetic Toxicity – Gene Mutation <i>In vitro</i>	Negative	Negative
Genetic Toxicity – Chromosomal Aberrations	— Testing proposed	—
Other Information – Eye Irritation	Severely irritating	Corrosive
Skin Irritation	Corrosive	Corrosive
Skin Sensitization	Negative	—*

— indicates endpoint was not addressed for this chemical; * indicates endpoint is not included in the base data set under the HPV Challenge Program.

4 Hazards to the Environment

A summary of aquatic toxicity data submitted for SIDS endpoints is provided in Table 5. The table also indicates where data for tested category members are read across (RA) to untested members of the category.

Acute Toxicity to Fish

Triphenylborane (CASRN 960-71-4)

No data were submitted. This endpoint remains a data gap under the HPV Challenge Program.

Triphenylboron compound with sodium hydroxide (CASRN 12113-07-4)

No data were submitted. This endpoint remains a data gap under the HPV Challenge Program.

Acute Toxicity to Aquatic Invertebrates

Triphenylborane (CASRN 960-71-4)

Daphnia magna were exposed to triphenylborane at nominal concentrations of 0, 0.00001, 0.0001, 0.001, 0.01, 0.1 and 1 mg/L under static conditions for 48 hours. No additional information on study methods or results was provided.

48-h EC₅₀ = 0.002 mg/L

Triphenylboron compound with sodium hydroxide (CASRN 12113-07-4)

No data were submitted. This endpoint remains a data gap under the HPV Challenge Program.

Toxicity to Aquatic Plants

Triphenylborane (CASRN 960-71-4)

No data were submitted. This endpoint remains a data gap under the HPV Challenge Program.

Triphenylboron compound with sodium hydroxide (CASRN 12113-07-4)

No data were submitted. This endpoint remains a data gap under the HPV Challenge Program.

Conclusion: The acute hazard of CASRN 960-71-4 to aquatic invertebrates (48-h EC₅₀) is 0.002 mg/L. No toxicity data are available on fish and aquatic plants for the chemicals in this category. The fish and aquatic plants endpoints remain as data gaps under the HPV Challenge Program.

Table 5. Summary Table of the Screening Information Data Set as Submitted under the U.S. HPV Challenge Program: Summary of Environmental Effects – Aquatic Toxicity Data		
Endpoints	Triphenylborane (960-71-4)	Triphenylboron compound with sodium hydroxide (12113-07-4)
Acute Toxicity to Fish 96 h-LC₅₀	No data	No data
Aquatic Invertebrates 48-h EC₅₀ (mg/L)	0.002	No data (RA) 0.002
Toxicity to Aquatic Plants 96-h EC₅₀ (mg/L)	No data	No data

(RA) = Read Across

5 References

Brown, H.C.; Dodson, V.H. Studies in stereochemistry. XXII. The preparation and reactions of trimesitylborane. Evidence for the nonl-localized nature of the odd electron in triarylborane radical ions and related free radicals. *J. Am. Chem. Soc.* 1957, 79, 2302-2306.