GreenScreen® Assessment for [*Substituted Amine Phosphate Mixture (CAS#* 66034-17-1)]

Method Version: GreenScreen® Version 1.2[1]

Verified or Non-Verified[2]: NON-VERIFIED

Introduction[3,4,5]

This GreenScreen assessment is based on the information reported in the corresponding chemical hazard profile in "An Alternatives Assessment for the Flame Retardant Decabromodiphenylether (DecaBDE) Final Report"[3]. Additional information on hazard endpoints beyond what was included in the final report was not sought with the exception of reactivity. Hazard classification information for reactivity was supplemented because it is not included in the DfE report but is needed to apply the GreenScreen Benchmark system.

Hazard classification levels reported in the DfE profiles and in this GreenScreen report may differ due to differences between criteria as defined in the DFE "Alternatives Assessment Criteria for Hazard Evaluation"[4] and the GreenScreen for Safer Chemicals v1.2 methods[5]. Any differences in interpretation are explained and justified in this GreenScreen report.

Non-Verified GreenScreen® Assessment Prepared By:	**Non-Verified GreenScreen® Assessment Quality Control Performed By:**
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Date: February 9, 2014 (expires after 3 years)	Date: March 19, 2014
Licensed Profiler or Certified Practitioner (specify): N/A	

Confirm application of the *Disclosure and Assessment Rules and Best Practice*[6]: (List any deviations)

Chemical Name (CAS #):
Substituted Amine Phosphate Mixture (CAS# 66034-17-1)

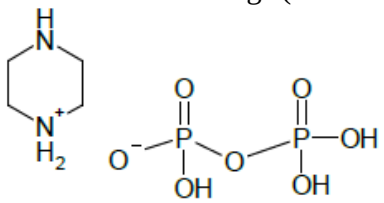
[1] Use GreenScreen® Assessment Procedure (Guidance) V1.2
[2] "NON-VERIFIED" means that Verification Has Not Been Performed on this GreenScreen Assessment
[3] An Alternatives Assessment for the Flame Retardant Decabromodiphenylether (DecaBDE http://www.epa.gov/dfe/pubs/projects/decaBDE/deca-report-complete.pdf. P 4-617
[4] Available at: http://www.epa.gov/dfe/alternatives_assessment_criteria_for_hazard_eval.pdf, accessed 10/2013.
[5] Details available at: http://www.cleanproduction.org/Greenscreen.v1-2.php, accessed 10/2013.
[6] See GreenScreen Guidance V1.2 Section 8

Also Called:
Piperazine pyrophosphate;

Tradenames:
ADK STABILIZER FP-2100J; ADK STABILIZER FP-2200; ADK STABILIZER FP-2200S; ADK STABILIZER FP-2400

Suitable analogs or moieties of chemicals used in this assessment (CAS #'s):
Piperazine (110-85-0); and confidential analogs, piperazine-containing compounds.

Chemical Structure(s):
*Note: Include chemical structure(s) of all suitable analogs (and /or moieties) used in the assessment.



Notes related to production specific attributes[7]:

For Inorganic Chemicals and relevant particulate organics (*if not relevant, list NA*)
Define Properties:
1. Particle size (e.g., silica of respirable size)
2. Structure (e.g., amorphous vs. crystalline)
3. Mobility (e.g., water solubility, volatility)
4. Bioavailability: Not absorbed from the skin, absorption through lung and GI tract. (Estimated by analogy)

For Polymeric Materials: (*delete this section if not a polymeric material*)
Not a polymer

Identify Applications/Functional Uses:
(e.g., Cleaning product, TV casing)
1. Flame Retardant

GreenScreen Benchmark Score and Hazard Summary Table:[8,9,10,11]

[7] Note any composition or hazard attributes of the chemical product relevant to how it is manufactured. For example, certain synthetic pathways or processes result in typical contaminants, by-products or transformation products. Explain any differences between the manufactured chemical product and the GreenScreen assessment of the generic chemical by CAS #.
[8] See Appendix A for a glossary of hazard endpoint acronyms
[9] See Appendix B for alternative GreenScreen Hazard Summary Table (Classification presented by exposure route)
[10] For inorganic chemicals only, see GreenScreen Guidance V1.2 Section 14.4. (Exceptions for Persistence)
[11] For Systemic Toxicity and Neurotoxicity, repeated exposure data are preferred. Lack of single exposure data is not a Data Gap when repeated exposure data are available. In that case, lack of single exposure data may be represented as NA instead of DG. See GreenScreen Guidance V1.2 Section 9.3.

Substituted Amine Phosphate Mixture was assigned a **Benchmark Score of 2** based on moderate Group I human toxicity endpoints (carcinogenicity, mutagenicity, reproductive toxicity, and developmental toxicity); and high persistence along with moderate Group II human toxicity endpoints (multiple). Substituted Amine Phosphate Mixture could score a Benchmark 1 if the data gap for endocrine activity was filled with a high hazard score.

Green Screen Hazard Ratings: [*Substituted Amine Phosphate Mixture*]																	
Group I Human					**Group II and II* Human**								**Ecotox**		**Fate**		**Physical**	
C	**M**	**R**	**D**	**E**	**AT**	**ST**		**N**		**SnS***	**SnR***	**IrS**	**IrE**	**AA**	**CA**	**P**	**B**	**Rx**	**F**
						single	repeated	single	repeated										
M	*M*	*M*	*M*	DG	*M*		*M*		*L*	L	*M*	*L*	*M*	*M*	*L*	*H*	*vL*	*L*	**L**

Note: Hazard levels (Very High (vH), High (H), Moderate (M), Low (L), Very Low (vL)) in *italics* reflect estimated values, authoritative B lists, screening lists, weak analogues, and lower confidence. Hazard levels in **BOLD** font are used with good quality data, authoritative A lists, or strong analogues. Group II Human Health endpoints differ from Group II* Human Health endpoints in that they have four hazard scores (i.e., vH, H, M and L) instead of three (i.e., H, M and L), and are based on single exposures instead of repeated exposures.

Environmental Transformation Products and Ratings[12]:
Identify feasible and relevant environmental transformation products (i.e., dissociation products, transformation products, valence states) and/or moieties of concern[13]

Functional Use	**Life Cycle Stage**	**Trans-formation Pathway**	**Environmental Transformation Products**	**CAS #**	**Feasible and Relevant?**	**GreenScreen List Translator Score or GreenScreen Benchmark Score**
			Pyrophosphoric acid	2466-09-3		LT-U (GreenWERCS)
			Piperazine	110-85-0		LT-U (Pharos)
			glycine	56-40-6		LT-U (Pharos)
			other confidential substances			N/A

Introduction

"This alternative is a mixture. The substituted amine phosphate mixture represents the ADK Stabilizer series of commercial mixtures that are comprised of approximately 50% of piperazine

[12] See GreenScreen Guidance V1.2 Section 13
[13] A moiety is a discrete chemical entity that is a constituent part or component of a substance. A moiety of concern is often the parent substance itself for organic compounds. For inorganic compounds, the moiety of concern is typically a dissociated component of the substance or a transformation product.

pyrophosphate (Diphosphoric acid, compd. with piperazine (1:1), CAS 66034-17-1, MW=264) and a substituted amine phosphate. Piperazine pyrophosphate will dissociate into piperazine and pyrophosphate (diphosphoric acid) anions under environmental conditions and, therefore, the relevant dissociation products piperazine or pyrophosphate was used in each endpoint as appropriate. The same approach was used for the substituted amine phosphate anions. Measured or estimated values for the dissociated components were used to fill assessment data gaps as appropriate."[14]

Hazard Classification Summary Section:

For all hazard endpoints:

- **Search all GreenScreen specified lists. Report relevant results either in each hazard endpoint section or attach to the end of the report.**
- **Always indicate if suitable analogs or models were used.**
- **Attach modeling results (See Appendix C).**
- **Include all references either in each hazard endpoint section or at the end of the report.**

Group I Human Health Effects (Group I Human)

Carcinogenicity (C) Score (H, M or L): *M*
Substituted amine phosphate was assigned a score of MODERATE for Carcinogenicity based on a moderate score within the EPA's DfE alternatives assessment. The moderate designation in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. EPA indicates the score was based on tumor formation in animals which appeared to happen in a mechanical nature under conditions in which bladder calculi were produced. The relevance of this to human cancers is uncertain. While the score was based on test data, the relevance of the results to human carcinogenicity is unclear and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:
MODERATE: The carcinogenicity hazard potential for the substituted amine phosphate mixture is estimated to be moderate based on the substituted amine phosphate component. There is evidence that oral exposure to the substituted amine phosphate component causes carcinogenicity in experimental animals. However, there is no evidence located as to the substituted amine phosphate component's carcinogenicity to humans. Tumor formation in animals appeared to happen in a mechanical nature under conditions in which it produced bladder calculi. No data were located as to the carcinogenic potential of the substituted amine phosphate mixture or salts. IARC classifies the substituted amine phosphate component as Group 3*: not classifiable as to its carcinogenicity to humans.*

Mutagenicity/Genotoxicity (M) Score (H, M or L): *M*
Substituted amine phosphate mixture was assigned a score of MODERATE for Mutagenicity based on a moderate score within the EPA's DfE alternatives assessment. The moderate designation in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. The score was based on *in vitro* and *in vivo* studies for exposures to substituted amine phosphate and

[14] An Alternatives Assessment for the Flame Retardant Decabromodiphenylether (DecaBDE http://www.epa.gov/dfe/pubs/projects/decaBDE/deca-report-complete.pdf. P 4-617

piperazine. The moderate score within EPA's alternatives assessment was based on test data for analogs and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:
MODERATE: Estimated based on positive results for chromosomal aberrations *in vivo* in mice exposed to the substituted amine phosphate component and positive results for gene mutations following *in vitro* exposure to the piperazine component in mouse lymphoma assays. There were also positive results *in vitro* for DNA synthesis-inhibition in Hela S3 cell and genetic toxicity in *Escherichia coli*WP2s in a microscreen assay following exposure to the substituted amine phosphate component. No data were located for the substituted amine phosphate mixture salts regarding the genotoxicity endpoint.

Reproductive Toxicity (R) Score (H, M, or L): *M*
Substituted amine phosphate mixture was assigned a score of MODERATE for Reproductive Toxicity based on a moderate score within the EPA's DfE alternatives assessment. For reproductive toxicity, EPA's DfE uses numerical data quantifying the hazard associated with the 3 different hazard levels, whereas Green-Screen does not base the hazard score on a numerical rating system but bases classifications on listing under GHS, the EU, and NTP. Therefore the conversion of DfE's developmental and reproductive toxicity conclusions to comparable GreenScreen hazard scores is done on a case by case basis. DfE's moderate score was based on reproductive effects occurring in rats after exposures to piperazine dihydrochloride with reproductive NOAEL's of 125 mg/kg/day and LOAEL of 300 mg/kg/day based on decreased litter size. The reproductive effects presented in the DfE report correspond to a GHS reproductive hazard score of 2 and a GreenScreen hazard score of moderate. The score was based on test data for an analogue chemical within EPA's alternatives assessment and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:
MODERATE: Hazard potential for reproductive toxicity of the substituted amine phosphate mixture is estimated to be moderate based on data for the piperazine moiety from piperazine dihydrochloride. Rats exposed to 300 mg/kg/day had decreased litter size in both generations. The NOAEL is identified at 125 mg/kg/day. There is uncertainly if effects could occur at doses between 125 and 250 mg/kg/day (the criteria cutoff dose for a LOW hazard designation is > 250 mg/kg/day. There were no adequate reproductive toxicity data located for the substituted amine phosphate mixture or substituted amine phosphate component of the mixture.

Developmental Toxicity incl. Developmental Neurotoxicity (D) Score (H, M or L): *M*
Substituted amine phosphate mixture was assigned a score of MODERATE for Developmental Toxicity based on a moderate score within the EPA's DfE alternatives assessment. For developmental toxicity EPA's DfE uses numerical data quantifying the hazard associated with the 3 different hazard levels, whereas GreenScreen does not base the hazard score on a numerical rating system but bases classifications on listing under GHS, the EU and NTP. Therefore the conversion of DfE's developmental and reproductive toxicity conclusions to comparable GreenScreen hazard scores is done on a case by case basis. DfE's moderate score was based on developmental effects occurring in rats and rabbits after exposures to substituted amine phosphate component and piperazine respectively. These reported effects correspond to a GHS developmental hazard score of 2 and a GreenScreen hazard score of moderate. The test data however was collected on surrogate chemicals and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:

MODERATE: Hazard potential for developmental toxicity of the substituted amine phosphate mixture is estimated to be moderate based on data for piperazine moiety from piperazine phosphate and professional judgment. There is uncertainty if effects occur at doses between 94 and 250 mg/kg/day because a LOAEL was not identified (the criteria cutoff dose for a LOW hazard designation is >250 mg/kg/day). Embryotoxicity was reported in conjunction with maternal toxicity and were considered to be secondary effects. Data for the substituted amine phosphate component showed no developmental effects in rats exposed during gestation to doses up to 1,060 mg/kg-day. A conservative approach was used since there were no measured values for the substituted amine phosphate mixture.

Endocrine Activity (E) Score (H, M or L): DG
Substituted amine phosphate mixture was assigned a score of DATA GAP for Endocrine Activity based on insufficient data located to describe the effect of the substituted amine phosphate mixture on the endocrine system.

The summary provided within the EPA's alternatives assessment was as follows:
There were insufficient data located to describe the effect of the substituted amine phosphate mixture on the endocrine system. In one study, the substituted amine phosphate component did not exhibit estrogenic activity *in vitro* in a yeast two-hybrid assay.

Group II and II* Human Health Effects (Group II and II* Human)
Note: Group II and Group II endpoints are distinguished in the v 1.2 Benchmark system (the asterisk indicates repeated exposure). For Systemic Toxicity and Neurotoxicity, Group II and II* are considered sub-endpoints. When classifying hazard for Systemic Toxicity/Organ Effects and Neurotoxicity endpoints, repeated exposure results are required and preferred. Lacking repeated exposure results in a data gap. Lacking single exposure data does not result in a data gap when repeated exposure data are present (shade out the cell in the hazard table and make a note). If data are available for both single and repeated exposures, then the more conservative value is used.*

Acute Mammalian Toxicity (AT) Group II Score (vH, H, M or L): *M*
Substituted amine phosphate mixture was assigned a score of MODERATE for Acute Mammalian Toxicity. The acute mammalian toxicity classification in both the EPA's DfE and GreenScreen assessments is based on the same measured endpoints. While the DfE reports a high hazard for inhalation exposure to the piperazine, the weight of evidence based on the presented data indicates an inhalation LD_{50} of >1 mg/L dust. For example, three inhalation studies are presented for rat inhalation of piperazine which have an LD_{50} range of 0.8-5.4 mg/L and an average LD_{50} of 2.77. In addition, two rat 4-hour inhalation studies are presented in the DfE report, one with an LD_{50} = 0.8 mg/L and one with a reported LD_{50} of 2.0 mg/L. Furthermore, the inhalation LD_{50} value for the substituted amine phosphate component is 3.2. The acute mammalian toxicity score was based on test data for analog compounds and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:
HIGH: Using a conservative approach, acute toxicity hazard potential for the substituted amine phosphate mixture is estimated based on toxicity for inhalation exposure to the piperazine moiety in rats. The hazard is estimated to be low for oral and dermal routes of exposure to the substituted amine phosphate and piperazine components of the mixture.

Systemic Toxicity/Organ Effects incl. Immunotoxicity (ST)

(ST-single) Group II Score (single dose: vH, H, M or L):
DfE evaluates Systemic Toxicity based on repeated exposures. Lack of data for Systemic Toxicity based on a single exposure does not constitute a data gap when data for repeated exposures are available.

(ST-repeat) Group II* Score (repeated dose: H, M, L): *M*
Substituted amine phosphate mixture was assigned a score of MODERATE for Systemic Toxicity/Organ Effects based on a moderate score within the DfE report. The score was based on test data from a 90-day oral rat LOAEL of 72 mg/kg/day based on stones and diffuse epithelial hyperplasia in the urinary bladders in male rats. This score is based on test data for the substituted amine phosphate component and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:
MODERATE: Repeated dose effects from the substituted amine phosphate mixture are estimated based on effects following repeated oral exposure to the substituted amine phosphate component in rats. Decreased body weight gain and feed consumption along with stones and diffuse epithelial hyperplasia in the urinary bladder were reported at a dose of 72 mg/kg/day. No data were located for the substituted amine phosphate mixture or salts.

In addition:
There is estimated to be no potential for immunotoxicity of the substituted amine phosphate mixture based on expert judgment. Data located for the substituted amine phosphate component are not sufficient to determine the hazard potential for this endpoint.

Neurotoxicity (N)
(N-single) Group II Score (single dose: vH, H, M or L): DfE evaluates Neurotoxicity based on repeated exposures. Lack of data for Neurotoxicity based on a single exposure does not constitute a data gap when data for repeated exposures are available.

(N-repeat) Group II* Score (repeated dose: H, M, L): *L*
Substituted amine phosphate mixture was assigned a score of LOW for Neurotoxicity based on a low score within the EPA's DfE alternatives assessment. This conclusion within the DfE report was based on expert judgment with no additional information provided and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:
LOW: Neurotoxicity hazard potential of the substituted amine phosphate mixture is estimated to be low based on expert judgment.

Skin Sensitization (SnS) Group II* Score (H, M or L): L
Substituted amine phosphate mixture was assigned a score of LOW for Skin Sensitization. The low designation for skin sensitization in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. The score was based on test data within EPA's alternatives assessment and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:
LOW: Neither the substituted amine phosphate mixture nor the piperazine pyrophosphate component are skin sensitizers.

Respiratory Sensitization (SnR) Group II* Score (H, M or L): *M*
Substituted amine phosphate mixture was assigned a score of MODERATE for Respiratory Sensitization. This conclusion was based on professional judgment on analogy to piperazine-containing compounds and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:
MODERATE: Respiratory sensitization hazard potential for the substituted amine phosphate mixture is estimated to be moderate based on analogy to the piperazine-containing compounds.

Skin Irritation/Corrosivity (IrS) Group II Score (vH, H, M or L): L
Substituted amine phosphate mixture was assigned a score of LOW for Skin Irritation/Corrosivity based on tests results provided within the EPA's DfE alternatives assessment which indicates piperazine is corrosive to rabbit skin with limited additional information. The very low designation for dermal irritation within the Alternatives assessment is equivalent to the low score criteria in the GreenScreen. The score was based on estimation by analogy and components of the parent molecule within the EPA's alternatives assessment and therefore the hazard score is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:
VERY LOW: Based on no indication of dermal irritation for the substituted amine phosphate component and no irritation to mild irritation for the piperazine pyrophosphate component of the substituted amine phosphate mixture

Eye Irritation/Corrosivity (IrE) Group II Score (vH, H, M or L): *M*
Substituted amine phosphate mixture was assigned a score of MODERATE for Eye Irritation based on a moderate classification within the EPA's DfE alternatives assessment. DfE categorization is based on estimation by analogy, reporting of substituted amine phosphate component being slightly irritating to rabbit eyes and piperazine being irritating to rabbit eyes. The score was based on estimation by analogy and components of the parent molecule within the EPA's alternatives assessment and therefore the hazard score is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:
MODERATE: Based on indications of mild to moderate eye irritation in rabbits for both the substituted amine phosphate and piperazine pyrophosphate components of the substituted amine phosphate mixture. In addition, eye irritation hazard due to the substituted amine phosphate mixture is estimated to be Moderate based on data for a confidential analog showing eye irritation in rabbits..

Ecotoxicity (Ecotox)

Acute Aquatic Toxicity (AA) Score (vH, H, M or L): *M*
Substituted amine phosphate mixture was assigned a score of MODERATE for Acute Aquatic Toxicity based on a moderate hazard within the DfE report. The moderate designation for acute aquatic toxicity in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. The score was a based on a piperazine 48-hour LC_{50} of 21mg/L in Daphnia magna. This hazard score is based on a chemical analog and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:

MODERATE: Acute toxicity hazard for the substituted amine phosphate mixture is estimated based on an experimental LC_{50} value of 21 mg/L in *Daphnia magna* for the piperazine moiety of the ionized mixture which represents the most conservative value. Although measured toxicity values for the substituted amine phosphate free base indicate a low hazard designation for this component of the mixture, a conservative approach was used since there are no measured values for the substituted amine phosphate mixture.

Chronic Aquatic Toxicity (CA) Score (vH, H, M or L): *L*
Substituted amine phosphate mixture was assigned a score of LOW for Chronic Aquatic Toxicity. The low designation for chronic aquatic toxicity in both GreenScreen and EPA's Alternatives assessment is based on the same measured endpoints. The score was based on test data all of which showed effects levels at >10mg/L. The score is based on analogs and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:
LOW: The substituted amine phosphate mixture chronic toxicity hazard potential is estimated based on measured chronic toxicity values for the piperazine moiety, on estimated values for piperazine pyrophosphate and on estimated values for the substituted amine phosphate component of the mixture for all three surrogate species.

Environmental Fate (Fate)

Persistence (P) Score (vH, H, M, L, or vL): *H*
Substituted amine phosphate mixture was assigned a score of HIGH for Persistence. The DfE reports a high score for persistence based on both modeling and measured data. Information included in the alternatives assessment indicates the piperazine compound may be readily biodegradable under aerobic conditions. Lower aerobic biodegradation rates have been observed for the substituted amine phosphate dissociation product. Estimated environmental half-lives are 120 and 75 days for the substituted amine phosphate and the piperazine pyrophosphate, respectively. The score was based on both expert judgment and analog chemicals within EPA's alternatives assessment and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:
HIGH: The substituted amine phosphate mixture is estimated to show high persistence in the environment based on experimental data for the dissociation species of the substituted amine phosphate component and piperazine pyrophosphate. Additionally, biodegradation estimates for piperazine pyrophosphate and the substituted amine phosphate component suggest high persistence for these ionic compounds.

Bioaccumulation (B) Score (vH, H, M, L, or vL): *vL*
Substituted amine phosphate mixture was assigned a score of VERY LOW for Bioaccumulation. The low designation for bioaccumulation in EPA's Alternatives assessment is equivalent to a very low score in GreenScreen. The score was based on an estimated measured BCF value and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:
LOW: The substituted amine phosphate mixture is expected to have low potential for bioconcentration and bioaccumulation based on an estimated BCF and BAF values of <100 for the two components of the mixture, piperazine pyrophosphate and substituted amine phosphate.

Physical Hazards (Physical)

Reactivity (Rx) Score (vH, H, M or L): *L*
Substituted amine phosphate mixture was assigned a score of LOW for Reactivity based on professional judgment and supporting information for the two individual components of the product. Because of the lack of concrete data for this endpoint, the score of LOW was italicized.

Substituted amine phosphate mixture is a mixture of pyrophosphate and piperazine. Piperazine is identified as non-reactive in the National Library of Medicine's Hazardous Substances Database which assigns a reactivity of '0' and states '*This degree includes materials that are normally stable, even under fire exposure conditions, and that do not react with water.'* New Jersey has identified that piperazine has a NFPA ranking of '0' indicating 'minimal' reactivity concerns (New Jersey, 2004). Pyrophosphate is identified as '*not explosive*' and '*no oxidizing properties*' in a European Commission's IUCLID dataset.

Based upon professional judgment and the information above, substituted amine phosphate mixture is unlikely to be reactive.

References:
National Library of Medicine's Hazardous Substances Database, available at: http://toxnet.nlm.nih.gov/cgi-bin/sis/search/r?dbs+hsdb:@term+@na+TETRASODIUM%20PYROPHOSPHATE, accessed 12/2013.

New Jersey Department of health and Senior Services, Hazardous Substance Fact Sheet on Piperazine, April 2001, 6 p., accessed 12/2013.

European commission, European Chemicals Bureau, IUCLID Dataset, 02/19/2000, 26 p., available at: http://esis.jrc.ec.europa.eu/doc/IUCLID/data_sheets/7722885.pdf, accessed 12/2013.

Flammability (F) Score (vH, H, M or L): L
Substituted amine phosphate mixture was assigned a score of LOW for Flammability based on a not flammable description within the DfE report. This conclusion was based on professional judgment and is reported in italics.

APPENDIX A: Hazard Benchmark Acronyms (alphabetical order)

(AA) Acute Aquatic Toxicity

(AT) Acute Mammalian Toxicity

(B) Bioaccumulation

(C) Carcinogenicity

(CA) Chronic Aquatic Toxicity

(Cr) Corrosion/ Irritation (Skin/ Eye)

(D) Developmental Toxicity

(E) Endocrine Activity

(F) Flammability

(IrE) Eye Irritation/Corrosivity

(IrS) Skin Irritation/Corrosivity

(M) Mutagenicity and Genotoxicity

(N) Neurotoxicity

(P) Persistence

(R) Reproductive Toxicity

(Rx) Reactivity

(SnS) Sensitization- Skin

(SnR) Sensitization- Respiratory

(ST) Systemic/Organ Toxicity