1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name: PbS core-type quantum dots, oleic acid coated, fluorescence λ_{em} 1400 nm, 10 mg/ml in toluene

Product Number: 747076
Brand: Aldrich

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses: Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company: Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone: +1 800-325-5832
Fax: +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone #: +1-703-527-3887 (CHEMTREC)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Flammable liquids (Category 2), H225
Skin irritation (Category 2), H315
Carcinogenicity (Category 1B), H350
Reproductive toxicity (Category 1A), H360
Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336
Specific target organ toxicity - repeated exposure (Category 2), H373
Aspiration hazard (Category 1), H304
Acute aquatic toxicity (Category 2), H401
Chronic aquatic toxicity (Category 3), H412

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word: Danger

Hazard statement(s)
H225: Highly flammable liquid and vapour.
H304: May be fatal if swallowed and enters airways.
H315: Causes skin irritation.
H336: May cause drowsiness or dizziness.
H350: May cause cancer.
2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.2 Mixtures

Synonyms:
- Fluorescent nanocrystals
- Artificial atoms
- QDs
- CANdot®

Formula: PbS

Hazardous components

<table>
<thead>
<tr>
<th>Component</th>
<th>Classification</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Toluene</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAS-No.</td>
<td>108-88-3</td>
<td>Flam. Liq. 2; Skin Irrit. 2; Repr. 2; STOT SE 3; STOT RE 2; Asp. Tox. 1; Aquatic Acute 2; Aquatic Chronic 1; H325, H304, H315, H336, H361, H373, H401</td>
</tr>
<tr>
<td>EC-No.</td>
<td>203-625-9</td>
<td></td>
</tr>
<tr>
<td>Index-No.</td>
<td>601-021-00-3</td>
<td></td>
</tr>
<tr>
<td>Registration number</td>
<td>01-2119471310-51-XXXX</td>
<td></td>
</tr>
</tbody>
</table>

| **Lead sulphide** |                |                     |
| CAS-No.           | 1314-87-0      | Acute Tox. 4; Repr. 1A; STOT RE 2; Aquatic Acute 1; Aquatic Chronic 1; H302 + H332, |
| EC-No.            | 215-246-6      |                     |
| Index-No.         | 082-001-00-6   |                     |

Precautionary statement(s)

P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and understood.
P210 Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P233 Keep container tightly closed.
P240 Ground/bond container and receiving equipment.
P241 Use explosion-proof electrical/ventilating/lighting/equipment.
P242 Use only non-sparking tools.
P243 Take precautionary measures against static discharge.
P260 Do not breathe dust/fume/gas/mist/vapours/spray.
P264 Wash skin thoroughly after handling.
P270 Use only outdoors or in a well-ventilated area.
P271 Avoid release to the environment.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P301 + P310 IF SWALLOWED: Immediately call a POISON CENTER/doctor.
P303 + P361 + P353 IF ON SKIN (or hair): Take off immediately all contaminated clothing.
P304 + P340 + P312 Rinse skin with water/shower.
P308 + P313 IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor if you feel unwell.
P331 Do NOT induce vomiting.
P332 + P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P370 + P378 In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P403 + P233 Store in a well-ventilated place. Keep container tightly closed.
P403 + P235 Store in a well-ventilated place. Keep cool.
P405 Store locked up.
P501 Dispose of contents/container to an approved waste disposal plant.
4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11.

4.3 Indication of any immediate medical attention and special treatment needed
No data available.

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
No data available.

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up
Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.
For precautions see section 2.2.

7.2 **Conditions for safe storage, including any incompatibilities**
Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Recommended storage temperature 2 - 8 °C


7.3 **Specific end use(s)**
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. **EXPOSURE CONTROLS/PERSONAL PROTECTION**

8.1 **Control parameters**

<table>
<thead>
<tr>
<th>Component</th>
<th>CAS-No.</th>
<th>Value</th>
<th>Control parameters</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
<td>TWA</td>
<td>100 ppm 375 mg/m³</td>
<td>USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STEL</td>
<td>150 ppm 560 mg/m³</td>
<td>USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TWA</td>
<td>200 ppm</td>
<td>USA. Occupational Exposure Limits (OSHA) - Table Z-2</td>
</tr>
<tr>
<td>Remarks</td>
<td>Z37.12-1967</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CEIL</td>
<td></td>
<td>300 ppm</td>
<td>USA. Occupational Exposure Limits (OSHA) - Table Z-2</td>
</tr>
<tr>
<td></td>
<td>Z37.12-1967</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peak</td>
<td></td>
<td>500 ppm</td>
<td>USA. Occupational Exposure Limits (OSHA) - Table Z-2</td>
</tr>
<tr>
<td></td>
<td>Z37.12-1967</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TWA</td>
<td></td>
<td>20 ppm</td>
<td>USA. ACGIH Threshold Limit Values (TLV)</td>
</tr>
<tr>
<td>Visual impairment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female reproductive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pregnancy loss</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015 Adoption</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Substances for which there is a Biological Exposure Index or Indices (see BEI® section)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not classifiable as a human carcinogen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TWA</td>
<td>100 ppm 375 mg/m³</td>
<td></td>
<td>USA. NIOSH Recommended Exposure Limits</td>
<td></td>
</tr>
<tr>
<td>ST</td>
<td>150 ppm 560 mg/m³</td>
<td></td>
<td>USA. NIOSH Recommended Exposure Limits</td>
<td></td>
</tr>
<tr>
<td>Lead sulphide</td>
<td>1314-87-0</td>
<td>TWA</td>
<td>0.050000 mg/m³</td>
<td>USA. ACGIH Threshold Limit Values (TLV)</td>
</tr>
<tr>
<td>Central Nervous System impairment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hematologic effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peripheral Nervous System impairment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Substances for which there is a Biological Exposure Index or Indices (see BEI® section)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confirmed animal carcinogen with unknown relevance to humans varies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TWA</td>
<td>0.050000 mg/m³</td>
<td></td>
<td>USA. NIOSH Recommended Exposure Limits</td>
<td></td>
</tr>
</tbody>
</table>

See Appendix C
If an employee is exposed to lead for more than 8 hours in any work day, the permissible exposure limit, as a time weighted average (TWA) for that day, shall be reduced according to the following formula: Maximum permissible limit (in µg/m³) = 400 ÷ hours worked in the day.

This section applies to all occupational exposure to lead, except as provided in paragraph (a)(2). It does not apply to the construction industry or to agricultural operations covered by 29 CFR part 1928. OSHA specifically regulated carcinogen.

<table>
<thead>
<tr>
<th>PEL</th>
<th>0.050000 mg/m³</th>
<th>OSHA Specifically Regulated Chemicals/Carcinogens</th>
</tr>
</thead>
</table>

**Biological occupational exposure limits**

<table>
<thead>
<tr>
<th>Component</th>
<th>CAS-No.</th>
<th>Parameters</th>
<th>Value</th>
<th>Biological specimen</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
<td>Toluene</td>
<td>0.0200 mg/l</td>
<td>In blood</td>
<td>ACGIH - Biological Exposure Indices (BEI)</td>
</tr>
</tbody>
</table>

Remarks: Prior to last shift of workweek
### 8.2 Exposure controls

**Appropriate engineering controls**
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

**Personal protective equipment**

**Eye/face protection**
Face shield and safety glasses. Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

**Skin protection**
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

**Body Protection**
Complete suit protecting against chemicals. Flame retardant antistatic protective clothing. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 9. PHYSICAL AND CHEMICAL PROPERTIES

#### 9.1 Information on basic physical and chemical properties

<table>
<thead>
<tr>
<th>a) Appearance</th>
<th>Form: liquid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Colour: colourless</td>
</tr>
<tr>
<td>b) Odour</td>
<td>No data available</td>
</tr>
<tr>
<td>c) Odour Threshold</td>
<td>No data available</td>
</tr>
<tr>
<td>d) pH</td>
<td>No data available</td>
</tr>
<tr>
<td>e) Melting point/freezing point</td>
<td>Melting point/range: -93 °C (-135 °F)</td>
</tr>
<tr>
<td>f) Initial boiling point and boiling range</td>
<td>110 °C (230 °F)</td>
</tr>
<tr>
<td>g) Flash point</td>
<td>4 °C (39 °F) - closed cup</td>
</tr>
<tr>
<td>h) Evaporation rate</td>
<td>No data available</td>
</tr>
<tr>
<td>i) Flammability (solid, gas)</td>
<td>No data available</td>
</tr>
<tr>
<td>j) Upper/lower flammability or explosive limits</td>
<td>Upper explosion limit: 7 %(V) Lower explosion limit: 1.2 %(V)</td>
</tr>
<tr>
<td>k) Vapour pressure</td>
<td>29.1 hPa (21.8 mmHg) at 20.0 °C (68.0 °F)</td>
</tr>
</tbody>
</table>
l) Vapour density No data available
m) Relative density 0.865 g/cm³
n) Water solubility No data available
o) Partition coefficient: n-octanol/water No data available
p) Auto-ignition temperature 535.0 °C (995.0 °F)
q) Decomposition temperature No data available
r) Viscosity No data available
s) Explosive properties No data available
t) Oxidizing properties No data available

9.2 Other safety information
No data available

10. STABILITY AND REACTIVITY

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
Vapours may form explosive mixture with air.

10.4 Conditions to avoid
Heat, flames and sparks.

10.5 Incompatible materials
No data available

10.6 Hazardous decomposition products
Other decomposition products - No data available
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Sulphur oxides, Lead oxides
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available
Inhalation: No data available
Dermal: No data available
No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
No data available

Carcinogenicity
IARC: 2A - Group 2A: Probably carcinogenic to humans (Lead sulphide)
2A - Group 2A: Probably carcinogenic to humans (Lead sulphide)

NTP: Reasonably anticipated to be a human carcinogen The reference note has been added by TD based on the background information of the NTP. (Lead sulphide)

OSHA: OSHA specifically regulated carcinogen (Lead sulphide)

**Reproductive toxicity**
No data available
No data available

**Specific target organ toxicity - single exposure**
No data available

**Specific target organ toxicity - repeated exposure**
No data available

**Aspiration hazard**
No data available

**Additional Information**
RTECS: Not available
Lung irritation, chest pain, pulmonary edema, Inhalation studies on toluene have demonstrated the development of inflammatory and ulcerous lesions of the penis, prepuce, and scrotum in animals.

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence (Toluene)
Stomach - Irregularities - Based on Human Evidence (Lead sulphide)

### 12. ECOLOGICAL INFORMATION

12.1 **Toxicity**
No data available

12.2 **Persistence and degradability**
No data available

12.3 **Bioaccumulative potential**
No data available

12.4 **Mobility in soil**
No data available

12.5 **Results of PBT and vPvB assessment**
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 **Other adverse effects**
An environmental hazard cannot be excluded in the event of unprofessional handling or disposal. Toxic to aquatic life.

### 13. DISPOSAL CONSIDERATIONS

13.1 **Waste treatment methods**

**Product**
Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

**Contaminated packaging**
Dispose of as unused product.

### 14. TRANSPORT INFORMATION

**DOT (US)**
UN number: 1294  Class: 3  Packing group: II
Proper shipping name: Toluene, solution
Reportable Quantity (RQ): 833 lbs

Poison Inhalation Hazard: No

**IMDG**
- UN number: 1294
- Class: 3
- Packing group: II
- EMS-No: F-E, S-D
- Proper shipping name: TOLUENE, SOLUTION

**IATA**
- UN number: 1294
- Class: 3
- Packing group: II
- Proper shipping name: Toluene, solution

---

### 15. REGULATORY INFORMATION

**SARA 302 Components**
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**
The following components are subject to reporting levels established by SARA Title III, Section 313:

<table>
<thead>
<tr>
<th>CAS-No.</th>
<th>Revision Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
</tr>
</tbody>
</table>

**SARA 311/312 Hazards**
Fire Hazard, Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

<table>
<thead>
<tr>
<th>CAS-No.</th>
<th>Revision Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
</tr>
<tr>
<td>Lead sulphide</td>
<td>1314-87-0</td>
</tr>
</tbody>
</table>

**Pennsylvania Right To Know Components**

<table>
<thead>
<tr>
<th>CAS-No.</th>
<th>Revision Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
</tr>
<tr>
<td>Lead sulphide</td>
<td>1314-87-0</td>
</tr>
</tbody>
</table>

**New Jersey Right To Know Components**

<table>
<thead>
<tr>
<th>CAS-No.</th>
<th>Revision Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
</tr>
<tr>
<td>Lead sulphide</td>
<td>1314-87-0</td>
</tr>
</tbody>
</table>

**California Prop. 65 Components**

- WARNING! This product contains a chemical known to the State of California to cause cancer.
- Lead sulphide 1314-87-0 2007-09-28

- WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.
  - Toluene 108-88-3 2009-02-01

---

### 16. OTHER INFORMATION

**Full text of H-Statements referred to under sections 2 and 3.**

- Acute Tox. = Acute toxicity
- Aquatic Acute = Acute aquatic toxicity
- Aquatic Chronic = Chronic aquatic toxicity
- Asp. Tox. = Aspiration hazard
- Flam. Liq. = Flammable liquids
- H225 = Highly flammable liquid and vapour.
- H302 + H332 = Harmful if swallowed or if inhaled
H304 May be fatal if swallowed and enters airways.
H315 Causes skin irritation.
H336 May cause drowsiness or dizziness.
H350 May cause cancer.
H360 May damage fertility or the unborn child.
H361 Suspected of damaging fertility or the unborn child.
H373 May cause damage to organs through prolonged or repeated exposure.
H401 Toxic to aquatic life.
H410 Very toxic to aquatic life with long lasting effects.
H412 Harmful to aquatic life with long lasting effects.
Repr. Reproductive toxicity
Skin Irrit. Skin irritation
STOT RE Specific target organ toxicity - repeated exposure
STOT SE Specific target organ toxicity - single exposure

**HMIS Rating**
Health hazard: 2
Chronic Health Hazard: *
Flammability: 3
Physical Hazard 0

**NFPA Rating**
Health hazard: 2
Fire Hazard: 3
Reactivity Hazard: 0

**Further information**
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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide.
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**Preparation Information**
Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 5.7 Revision Date: 09/23/2016 Print Date: 05/10/2017