

EKIDNA MANUAL

Manual for Testing Cannabis Samples with Ekidna

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Before You Begin

Welcome to Ekidna, a whole new approach to cannabis testing.

This manual contains important safety and operating information on the installation and proper use of the reader and various testing kits. We recommend that you read through the entire manual before you do any testing to understand how to safely operate the system and achieve fast, accurate results.

Important Safety Symbols



Hazard; could result in injury.



Caution; could damage the reader or result in inaccurate results.

DISCLAIMER

Ekidna's products are intended for legal purposes only, to be used in accordance with local laws and regulations.

You warrant that you have received adequate information regarding the goods to ensure their safe use. In no event shall Ekidna be liable for any direct, indirect, punitive, incidental, special consequential damages, to property or life, whatsoever arising out of or connected with the use or misuse of Ekidna's products and/or materials provided by Ekidna, including but not limited to, chemicals, substances, and hazardous materials.

It is your sole responsibility to understand and follow all federal laws and regulations, provincial or state laws and regulations, and/or any other applicable laws, regulations, and guidelines relevant to handling and disposal of all materials, including but not limited to chemicals, substances, and hazardous materials, provided to you by Ekidna. In no event shall Ekidna be liable for any direct, indirect, punitive, incidental, special consequential damages, to property or life, whatsoever arising out of or connected with the handling or disposal of materials supplied by Ekidna, including but not limited to, chemicals, substances, and hazardous materials.

What's in the Box

Components

- Ekidna reader with dust cover
- Test tube holding rack
- USB-C cable
- Vortexer

**Note: If any of these components are missing or damaged upon arrival do not attempt to use the reader. Immediately contact support by using the form on <https://ekidna.ca/support/> or calling us at +1 613-696-5938.*



Reader Device

The Ekidna reader is a high-precision electronic device, housed in a custom-designed reader to facilitate fast and easy testing in most environments. The test kit slot is protected by a dust cover, and it is recommended that the cover be in place at all times when the reader is not in use to protect the electrical connections.




There are two ports on opposite sides of the device. The first is a USB-C slot, for connecting the reader to a computer. The second is a multi-pin LEMO connector port (not required for testing).

The Ekidna device does not require an external power source or batteries. There is a LED light to indicate the status of the device:

- Unlit: reader is not connected to a computer, and not receiving power.
- Blue: reader is connected, but not running a test.
- Red: reader is connected and running a test.
- Green: firmware update being installed.

Cautions

- ⚠ Do not insert anything into the reader besides an Ekidna-approved cap or the dust cover. This could permanently damage the reader.
- ⚠ Do not attempt to force an Ekidna-approved cap into a broken or damaged reader.

-  Do not submerge the reader in liquid.
-  Avoid getting liquids into any of the openings on the reader, including the testing slot, the USB port, or LEMO connector port. If liquid does get onto the connector pins in the testing slot, unplug the reader from your computer, carefully clean it out with a tissue, and allow it to fully dry before attempting to run test kits.
-  Do not connect the reader to anything other than a computer running the approved Ekidna software.

Test Kits





Ekidna test kits are designed to provide fast and accurate results, tailored for specific cannabinoids in defined potency ranges. Please review the information included in this section to ensure you use the correct test kit for your needs.



The Ekidna tests cannot provide any information on other chemicals or potential contaminants, including but not limited to: terpenes, pesticides, or trace heavy metals.

Important Safety Information

Ekidna test kits contain organic solvents and chemicals that may include any of the following: dimethyl sulfoxide, tetrabutylammonium perchlorate, or ferrocene.

These chemicals are considered hazardous, so proper care should be taken to minimize the risks to users. Avoid contact with skin, direct inhalation, or ingestion. Wear appropriate personal protection and safety equipment, including gloves (disposable nitrile or latex) and eye goggles. Please consult this Important Safety Information and all applicable Safety Data Sheets prior to handling any potentially hazardous materials. It is your responsibility to ensure that all chemicals, substances, and materials are handled and disposed of safely and in accordance with all applicable laws, regulations, and guidelines.

-  Do not use the test kit if you see liquid or leaks in the bag.
-  If contact is made with your skin, remove all exposed clothing and immediately wash with plenty of water. If skin irritation appears, consult a medical professional.
-  In case of contact with your eyes, immediately rinse with plenty of water for at least 15 minutes. Seek medical attention.
-  If inhaled, get to fresh air and seek medical attention.

-  If ingested, immediately seek medical attention. Do not induce vomiting.
-  Do not expose test kits to direct heat sources, including but not limited to: hot plates, heat guns, or open flames. The flash point for the solution is 80°C (176°F).

In case of spills, we recommend that users have paper towels nearby. Immediately wipe up the affected areas, and clean with isopropyl alcohol or water.

Test Kit Storage

Test kits should be stored upright in the plastic bags provided until use. They should be stored out of direct sunlight, and between temperatures of 18–25°C. If exposed to temperatures below 18°C for an extended period of time, there is a chance the solution may freeze. If this happens, allow the solutions to thaw to room temperature slowly. **DO NOT EXPOSE TUBES TO DIRECT HEAT SOURCES LIKE A HOT PLATE, HEAT GUN, OR OPEN FLAME.**

Test Kit Disposal

After use, test kits will contain both organic solvents and degraded cannabis materials and should be disposed of according to the federal laws and guidelines previously approved for your company.

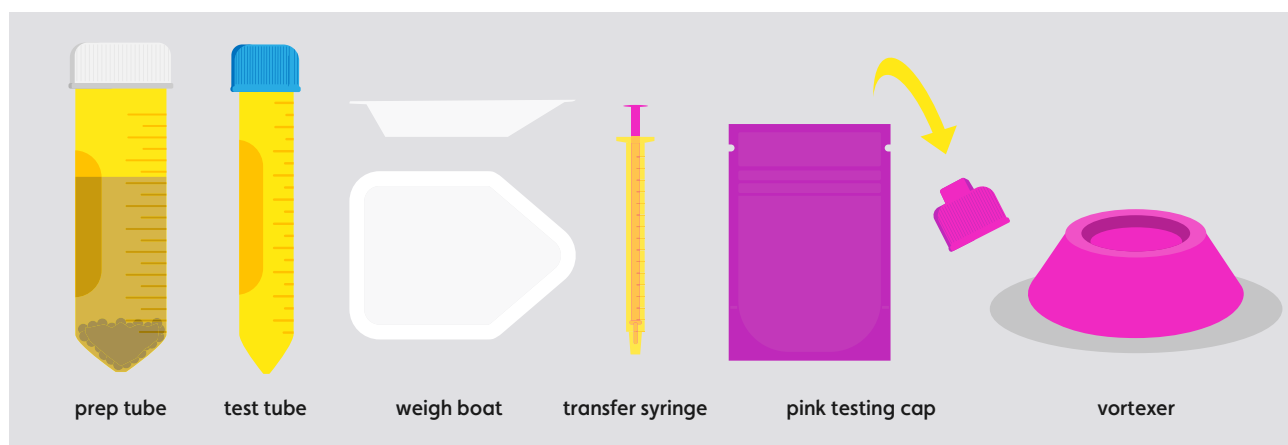
Any remaining test kit solution should be poured out of the test tubes into an appropriate receptacle for organic solvent waste and disposed of following provincial or state guidelines. Use isopropyl alcohol or water to rinse all components (including both tubes and the testing cap) to remove all traces of chemicals and cannabis, and dispose of this rinse in the same receptacle. **DO NOT DISPOSE OF SOLUTIONS INTO BUILDING PLUMBING OR CITY SEWER SYSTEMS.**

Once the organic solvent and cannabis material has been removed and the components have been rinsed and dried, the test kit components can be disposed of in regular solid waste.

Ekidna's products are intended for legal purposes only, to be used in accordance with local laws and regulations. It is your sole responsibility to understand and follow all federal laws and regulations, provincial or state laws and regulations, and/or any other applicable laws, regulations, and guidelines relevant to handling and disposal of all materials, including but not limited to chemicals, substances, and hazardous materials, provided to you by Ekidna. In no event shall Ekidna be liable for any direct, indirect, punitive, incidental, special consequential damages, to property or life, whatsoever arising out of or connected with the handling or disposal of materials supplied by Ekidna, including but not limited to, chemicals, substances, and hazardous materials.

Components

- Prep tube: larger tube (nominal volume of 50 mL), with solution and steel balls
- Testing tube: smaller tube (nominal volume of 15 mL), with solution
- Plastic weigh boat
- Plastic transfer syringe
- Ekidna pink testing cap (containing sensor chip), stored in UV-protected bag (sensor bag)



The following chart provides the parameters for guaranteed accuracy with the Ekidna system. For an overview discussion about accuracy in testing, please [visit https://ekidna.ca/thc-potency-test-kit/accuracy/](https://ekidna.ca/thc-potency-test-kit/accuracy/).

THCa Version: 1; Whole Dry Bud or Ground Dry Bud, Accuracy & Range

THCa Version 1 Test Kit	
Software	V0.3 - V1.9.3
Sample Types	Ground dry flower; whole dry flower
Sample Mass	445 mg (min: 400 mg; max: 490 mg)
Potency Range*	9.70% – 26.0% THCa potency (mass fraction) only
Accuracy†	Within 0% – 10% relative of HPLC measurement
Extraction Time	5 min
Testing Time	~ 4 min

***Note:** this is the potency range at which accurate results are guaranteed on the Ekidna system. Depending on the mass added, it is possible that a result above (maximum of 32.5%) or below (minimum of 7.9%) these ranges could be measured. Such results would still be valid.

†Accuracy: The Ekidna test was validated against a third party HPLC system. With the defined mass and potency ranges listed above, on a data set of 60 replicates from five different cannabis bud samples, our results were found to be consistently within 10% relative change (defined as $\left(\frac{|x_{Ekidna} - x_{HPLC}|}{x_{HPLC}}\right) \cdot 100\%$, where x_{Ekidna} = %THCa measured on the Ekidna reader, and x_{HPLC} = %THCa measured on the HPLC). Mean = 3.3%, Median = 2.8%.

THCa Version: 2; Whole Dry Bud or Ground Dry Bud, Accuracy & Range

THCa Version 2 Test Kit	
Software	V1.9.3 or higher
Sample Types	Ground dry flower; whole dry flower
Sample Mass	445 mg (min: 400 mg; max: 490 mg)
Potency Range*	10.0% – 31.5% THCa potency (mass fraction) only
Accuracy†	Within 0% – 10% relative of HPLC measurement
Extraction Time	5 min
Testing Time	~ 2 min

***Note:** this is the potency range at which accurate results are guaranteed on the Ekidna system. Depending on the mass added, it is possible that a result above (maximum of 38.6%) or below (minimum of 8.2%) these ranges could be measured. Such results would still be valid.

†Accuracy: The Ekidna test was validated against a third party HPLC system. With the defined mass and potency ranges listed above, on a data set of 111 replicates from 10 different cannabis bud samples, our results were found to be consistently within 10% relative change (defined as $\left(\frac{|x_{Ekidna} - x_{HPLC}|}{x_{HPLC}}\right) \cdot 100\%$, where x_{Ekidna} = %THCa measured on the Ekidna reader, and x_{HPLC} = %THCa measured on the HPLC). Mean = 3.4%, Median = 2.7%.

Disclaimer: there can be minor differences in calculated cannabinoid amounts between different HPLC machines in different labs. Therefore it's possible that results obtained on our system will not always fall within the accuracy range described above when compared to every HPLC machine.

Usage

This test is designed for use with THCa/THC dominant bud only. The CBDa/CBD content must be below 1.5%. If the CBDa/CBD content is above this, inaccurate results could be obtained.

Each testing kit is designed to be used ONCE and ONLY ONCE.

Avoid spilling liquid from either test tube. The Ekidna testing kits are carefully designed and fabricated to provide accurate results for each test and rely on precise volumes of solutions. If any solution is spilled, or leaking occurs before or during testing, dispose of the kit following proper disposal procedures and begin the test again with a new kit.

Note: **the test kit was designed for dry cannabis only**, with “dry” meaning within 5% – 15% relative moisture content. Testing bud with moisture levels higher than this could result in incorrect %THCa values.

The Ekidna system reports the potency as-is, without any corrections for moisture.

Additional Required Equipment

Scale

A balance, preferably with an accuracy 1% at 100 mg, is required to perform the Ekidna test. Ekidna sells balances from established suppliers if you require one. A less accurate balance may introduce additional error to results obtained.

Balances should be operated on a flat, vibration-free surface and be properly leveled and calibrated. The balance should be cleaned prior to testing and between samples to ensure accurate values and avoid cross-contamination.

Computer

A computer (laptop or desktop) running Windows 10 is required for running the Ekidna software. A USB port (Type A) is required for connecting the reader to the computer. Ensure the computer power setting for sleep timer is set to a minimum of 10 minutes to avoid the computer from shutting down while a test is running.

External Timer (Optional)

The Ekidna software comes equipped with timers to enable users to achieve the best results through efficient cannabis extraction. Operators can also use their own timers, when testing multiple samples on one reader device. We recommend using a digital lab timer, preferably with an audible alarm, and can provide timers from established supplies if users wish to use one.

Safety Equipment

Operators should wear gloves when handling cannabis samples and Ekidna test solutions. Gloves should be changed frequently to avoid cross-contamination. Eye protection is also strongly recommended.

Operators should wash their hands when finished working with the Ekidna tester.

Optimal Operating Conditions

The Ekidna system should be operated in a clean, dry environment, like a lab, office or climate-controlled warehouse. Optimal ambient temperature for testing is between 19 - 23°C. The device should be operated at least 0.5 m away from any electromagnetic interference-generating devices (power cables, motors, etc.). The balance will require a flat, vibration-free work surface to ensure accurate measurement of mass.

Test Instructions

You will need:

- Laptop with Ekidna software
- Access to 2 AC power plugs
- A scale (see the "Additional Required Equipment - Scale" section above)
- A flat work surface
- Ekidna reader and USB cable (see the "Reader Device" section, above)
- Ekidna test tube holder
- Ekidna test kit (see the "Test Kit" section, above)
- Bud sample (~450 mg)
- Nitrile or latex gloves
- Spatula or scoop (for ground bud only)
- Vortexer

Setting Up

1. Install the Ekidna software on your computer by running the executable file and following all the prompts.
 - ⚠️ Ensure the computer power setting for sleep timer is set to a minimum of 10 minutes to avoid the computer from shutting down while a test is running
2. Connect the Ekidna reader to your computer using the USB cable provided. If you see a blue LED light, that indicates the reader is connected properly and has power. A red LED indicates that the reader is in use.
3. Remove the dust cover from the reader slot and set it aside.
4. Open the Ekidna software and select **Test Run** from the menu. Once connected, the reader will display the device ID number in the lower left corner in green.
5. Fill in all necessary information for your sample on the Sample Information screen.

- a. Type the **User Name** in the field provided. (Required field.)
- b. Enter a name for your sample. We recommended that you make it descriptive enough to be identified at a later date. (Required field.)
- c. In the **Version Type** dropdown, select the test type that matches the code on the test kit label. (Required field.)

NOTE: choosing an incorrect test version will result in erroneous results.

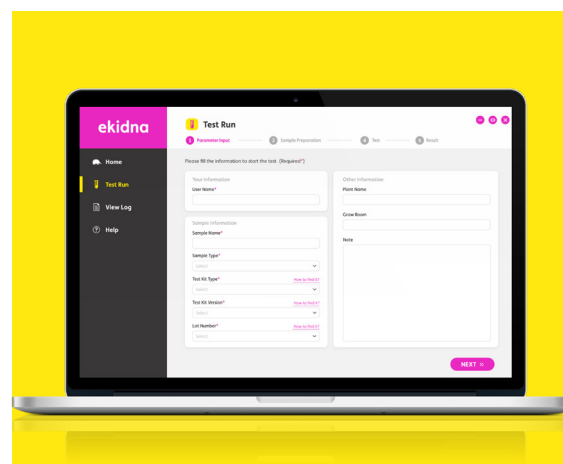
- d. In the **Cannabinoid Type** dropdown, select the cannabis medium to be analyzed. (Required field.)

NOTE: choosing an incorrect cannabinoid type will result in erroneous results. Ensure that both the test kit label and choice in this

- e. **menu match.** Select the correct **Sample Type**. (Required field.)

NOTE: depending on the test kit type, choosing an incorrect option could result in erroneous results.


- f. Enter the **Test Kit Lot Number**, listed on the test kit label, in the provided field.
- g. Enter the **Plant Name** and/or **Grow Room** information in the provided fields.
- h. A **Notes** section is included for any additional details or information you wish to capture for the cannabis sample.
- i. When you've finished entering all the information, click **Next**.



Weighing Sample and Extraction: Whole Dry Bud and Ground Dry Bud

1. Put on your gloves and eye protection and open the test kit bag.
2. Remove the two tubes and put them in the test kit holding rack.
3. Place the plastic weigh boat on the scale. If your scale has an enclosure, make sure all its doors are closed.
 - Check that the scale doesn't need to be calibrated again (if it has been sitting for a long period of time).
4. Press "Tare" on the scale to reset the mass to 0 mg.
 - Note: the value on the scale should be steady at 0 mg. If it fluctuates, try to re-tare until it's stable. If the value does not stabilize, move the balance to an area with less vibrations or air currents and try again.
5. Weigh the amount of cannabis displayed in the application by adding cannabis to the boat.
 - The optimal mass for the test kit selected is provided in the application. The minimum and maximum allowable weights are also displayed. Note: the software will not accept a value outside of this mass range, as it will result in incorrect results.
 - For whole bud: place a small bud of cannabis in the boat. We recommend that large pieces of stem be removed. As it can be challenging with some samples to hit the exact target weight, some minor adjustments may be required. You can try adding smaller pieces of bud (if under target) or by breaking off small amounts (if over target).
 - Caveat: overhandling can sometimes cause inaccurate results.
 - For ground bud: using a spatula or scoop, transfer the loose material into the weigh boat.
6. Wait for the balance to stabilize and enter the exact mass of bud into the software.
 - Results from the Ekidna test will only be accurate if the correct mass is recorded.

7. Open the large prep tube, remove the weigh boat from the balance, and transfer the sample into this tube. **It is essential that all the bud material is transferred into the tube.**

- We recommend that the bud not be handled during the transfer step. For best results, hold the open tube in one hand and the weigh boat in the other. Center the boat over the opening of the tube and carefully tip/pour the bud sample into the tube.
-  The Ekidna test kits contain organic solvents. Avoid contact with skin and eyes.



8. Re-cap the large prep tube. Holding the cap on the prep tube with your thumb, vigorously shake the tube (up and down) for 30 seconds. There is a timer provided in the software for this step.

- Note: the metal balls in the tube will break up the bud into smaller pieces, facilitating extraction. The more the bud is fragmented, the better the extraction, and the more accurate the test results.

9. Place the large tube back into the test tube holding rack and wait 1 minute. There is a timer provided in the software for this step.

10. After 1 minute, remove the prep tube from the holding rack and press the bottom of the tube down on the vortexer to activate it. Vortex for ~ 10 seconds.

- This vortexing step supplements the shaking step, ensuring the plant matter is completely crushed for efficient extraction of cannabinoids.
- We recommend holding the tube perfectly vertical in the vortexer to achieve the most efficient mixing.

11. Place the large tube back into the tube holder and wait AT LEAST 4 minutes for the cannabinoids to extract from the plant. There is a timer provided in the software for this step.

- It is normal to observe a color change and bud particulate floating to the top of the tube, as well as settling to the bottom.
- The optimal extraction time for cannabinoids in the Ekidna test is 5 minutes. Large deviations from this extraction time could result in erroneous results.

Liquid Transfer

1. When the 5 minute extraction time is complete, remove the caps from both the larger prep tube and the smaller testing tube.
2. Unwrap the transfer syringe (included the test kit) and push the plunger all the way to the bottom.
 - **For accurate results it is essential that the plunger be fully depressed.** As it is possible for the plunger to move during shipping, it must be pushed down manually before insertion into the prep tube.
3. Submerge the opening of the transfer syringe below the surface of the liquid in the prep tube, about half-way between the top and bottom of the liquid. Try to avoid excessive agitation of the solution and areas with larger plant pieces.
4. **SLOWLY** pull the plunger all the way to the top of the transfer syringe, until you feel some resistance. The final position of the plunger will be above the 1 mL demarcation.
 - We recommend a slow, consistent pull of the plunger to avoid air bubbles. While a small air gap at the top is normal, if you observe the formation of excessive air bubbles we recommend that you depress the plunger and try again. Air bubbles will cause erroneous results.
 - Do not use excessive force when pulling the plunger up. This could cause the plunger to come out of the syringe.
5. Without touching the plunger, remove the filled syringe from the prep tube and insert it into the testing tube. Depress the plunger to fully empty the contents of the syringe into this tube.
6. Re-cap both tubes.
7. Remove the smaller testing tube out of the rack and give it a quick shake to mix the solutions. Return this tube to the holding rack.
8. Remove the cap on the small testing tube. Open the sensor cap bag, remove the pink sensor cap, and carefully screw it all the way onto the testing tube.
 - Use caution when removing the pink sensor cap from the protective bag. Only handle the pink plastic portion of the cap. **DO NOT TOUCH THE SENSOR.** Excessive handling of the cap could damage the sensor, resulting in erroneous or failed tests.

Testing Guidelines

Running the Test

1. Invert the testing tube (with the pink cap attached), and align the raised ridge on the pink sensor cap with the groove in the reader opening. Push the cap into the reader; when properly inserted the top of the cap will be level with the opening in the reader. Do not use excessive force; if at any point the cap has resistance during insertion, double check that the raised ridge is properly aligned with the groove
2. In the Ekidna software click **Start Test**. The LED indicator light on the reader will turn red while the test is running.
 - Note: do not leave the test tube inverted for an extended period of time. The test should be started IMMEDIATELY after the cap is inserted into the reader. Failure to do so could result in testing errors or erroneous results.
3. At the end of the test a popup window will appear to confirm the test is complete, and the LED indicator light will go back to blue.
4. Click **Next** to view the results.
5. If there is an error message instead of numerical results, refer to the Troubleshooting section and follow the suggested course of action. If there are continuing issues, please contact support by using the form on <https://ekidna.ca/support/> or calling us at +1 613-696-5938. Please note that our support hours are Monday to Friday, 9 AM to 4 PM Eastern time, excluding statutory holidays.

Completion of Testing

1. When the test is complete, remove the testing tube from the reader.
2. After all tests are completed for the day, replace the dust cover on the reader and exit out of the software.
3. Disconnect the reader from the computer and store in a safe and dry location.
4. Dispose of Ekidna test kit materials following the guidelines in the Disposal section of this manual.
 - The cannabis-containing solutions must be disposed of following guidelines for safe disposal of cannabis waste material in organic solvents. The solutions cannot be disposed of in building plumbing or city sewer system.
3. All historical test results can be accessed by clicking the **Log** tab in the Ekidna software. Log files are also stored as CSV files, which can be found by clicking on **View Log** in the Ekidna application.

Useful Tips for Increasing Efficiency During Continuous Testing

If you're running multiple sequential experiments on a single reader, the Weighing Sample and Extraction steps for the subsequent test can be performed while the current test is running.

Note: This will require knowing the minimum/maximum boundaries of the Ekidna test in advance to avoid using an incorrect mass. An external timer will be required. Dedicated lab timers work best, but a computer timer or stopwatch application will also suffice.

1. Start the first test, following regular instructions outlined in the Setting Up, Weighing Sample and Extraction, and Liquid Transfer sections of this manual.
2. After step 2 in Running the Test (selecting **Start Test** on the Ekidna software), the second sample can be prepared.
3. Remove the used test kit prep tube from the holding rack and store in a safe location where it can remain vertical until proper disposal.
4. Open a second test kit bag, remove the prep and test tubes, and place them in the testing rack.
5. Using a permanent marker, label the prep tube with all necessary information that needs to be captured, including sample ID.
 - Alternatively, information can be recorded on a piece of paper.
6. Starting at step 3, follow all the instructions in the Weighing Sample and Extraction steps, with the following substitutions made:
 - Record the mass of bud on the test tube (or piece of paper).
 - Use an external timer for the 30 second shaking, 10 second vortex, and 5 minute extraction steps.
7. Follow the steps 1 – 7 outlined in the Liquid Extraction section.
 - DO NOT ATTACH THE SENSOR CAP UNTIL JUST BEFORE INSERTION INTO THE READER.
8. When the first experiment is complete, remove the used testing tube and set aside in a safe location where it can remain vertical until disposal.
9. Follow the software prompts to return to the **Sample Information** page. Record the information written on the prep tube.
10. Click **Next** and enter the mass of bud added. Click **Skip to Test** to skip the extraction timers.

11. Attach the pink sensor cap securely to the testing tube, invert the tube into the reader, and select **Start Test**. The third sample can now be prepared while this test is running.

Important notes:

- Depending on user efficiency and preference, steps 8 and 9 could be performed before step 7 (liquid transfer step), while the cannabinoids are still being extracted.
- Only screw on the pink sensor cap immediately before running the test in the reader.
- We recommend that **no more than 1 test (per reader) be queued and extracting** while test(s) are running on the reader.

Troubleshooting & Error Codes

Code	Possible Cause	What to Do
201, 202, 203	<ul style="list-style-type: none"> Problems with connection between test kit and reader. Test kit not present. Bad/damaged sensor. Poor or no connection between reader and kit. Impurities in sample. 	<ul style="list-style-type: none"> Confirm proper kit type and version were entered. Confirm cannabis sample is appropriate for kit type. Confirm cap was inserted properly (if not, cap cannot be re-used). Confirm the sensor was not damaged before the start of the test. Check that no debris or liquid in the connection slot (if so, follow instructions for cleaning in the Reader section of this manual). Run a new kit.
301	<ul style="list-style-type: none"> No sample in the kit. Cannabinoid below minimum potency. 	<ul style="list-style-type: none"> Confirm proper kit type and version was entered. Confirm cannabis sample is appropriate for kit type. Confirm sample was added and the workflow was followed correctly. Run a new kit.
303	<ul style="list-style-type: none"> Cannabinoid below minimum potency. 	<ul style="list-style-type: none"> Confirm proper kit type and version were entered. Confirm sample was added and the workflow was followed correctly. Run a new kit with a larger mass that is still within the bounds for that kit version.
304	<ul style="list-style-type: none"> Cannabinoid above maximum potency. 	<ul style="list-style-type: none"> Confirm proper kit type and version were entered. Confirm sample was added and the workflow was followed correctly. Confirm liquid was not spilled during preparation. Run a new kit with a smaller mass that is still within the bounds for that kit version.
Pop up Window: "The port is closed"	<ul style="list-style-type: none"> Reader device has been disconnected from the computer 	<ul style="list-style-type: none"> Check the USB cord connection Make sure the cord is not under stress. If problem occurs frequently replace with a new cord. Confirm computer sleep and hibernate settings are set to a minimum of 10 minutes. If the error occurs during sample information or timers, the sample can still be accurately analyzed. Start an external time with the amount of extraction time remaining. Re-enter the sample information, mass, and select "Skip to Test." Attach the sensor cap at the end of the timer and start the test. Run a new kit.

If problems persist, please contact support by using the form on <https://ekidna.ca/support/> or calling us at +1 613-696-5938. Please note that our support hours are Monday to Friday, 9 AM to 4 PM Eastern time, excluding statutory holidays.

DISCLAIMER

UNLESS SEPARATELY AGREED TO IN A WRITTEN EXPRESS LIMITED WARRANTY ACCOMPANYING YOUR PRODUCT, ALL PRODUCTS PROVIDED BY EKIDNA ARE PROVIDED "AS IS" AND ON AN "AS AVAILABLE" BASIS, WITHOUT WARRANTIES OF ANY KIND FROM EKIDNA, EITHER EXPRESS OR IMPLIED. TO THE FULLEST EXTENT POSSIBLE PURSUANT TO APPLICABLE LAW, EKIDNA DISCLAIMS ALL WARRANTIES EXPRESS, IMPLIED, OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY, SATISFACTORY QUALITY OR WORKMANLIKE EFFORT, FITNESS FOR A PARTICULAR PURPOSE, RELIABILITY OR AVAILABILITY, ACCURACY, QUIET ENJOYMENT, NON INFRINGEMENT OF THIRD PARTY RIGHTS OR OTHER VIOLATION OF RIGHTS. SOME JURISDICTIONS DO NOT ALLOW EXCLUSIONS OR LIMITATIONS OF IMPLIED WARRANTIES, SO THE ABOVE EXCLUSIONS OR LIMITATIONS MAY NOT APPLY TO YOU. NO ADVICE OR INFORMATION, WHETHER ORAL OR WRITTEN, OBTAINED BY YOU FROM EKIDNA OR ITS AFFILIATES SHALL BE DEEMED TO ALTER THIS DISCLAIMER BY EKIDNA OF WARRANTY REGARDING PRODUCTS SUPPLIED BY EKIDNA, OR TO CREATE ANY WARRANTY OF ANY SORT FROM EKIDNA.

YOU EXPRESSLY ACKNOWLEDGE AND AGREE THAT, TO THE EXTENT PERMITTED BY APPLICABLE LAW, USE OF THE EKIDNA PRODUCTS IS AT YOUR SOLE RISK AND THAT THE ENTIRE RISK AS TO SATISFACTORY QUALITY, PERFORMANCE, ACCURACY AND EFFORT IS WITH YOU.

Appendices:

Safety Data Sheets

Ferrocene Safety Data Sheet

Tetra-n-butylammonium perchlorate Safety Data Sheet

Dimethyl sulfoxide Safety Data Sheet

SAFETY DATA SHEET

Creation Date 08-Sep-2014

Revision Date 24-Dec-2021

Revision Number 4

1. Identification

Product Name Ferrocene

Cat No. : AC119140000; AC119140025; AC119140050; AC119141000;
AC119145000

CAS No 102-54-5
Synonyms Dicyclopentadienyliron

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use.

Details of the supplier of the safety data sheet

Company

Fisher Scientific Company
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US**:001-201-796-7100 / **Europe**: +32 14 57 52 99
CHEMTREC Tel. No.**US**:001-800-424-9300 / **Europe**:001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable solids	Category 2
Acute oral toxicity	Category 4

Label Elements

Signal Word

Warning

Hazard Statements

Flammable solid
Harmful if swallowed

**Precautionary Statements****Prevention**

Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting equipment
Wear protective gloves/protective clothing/eye protection/face protection

Ingestion

IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth

Fire

In case of fire: Use CO₂, dry chemical, or foam for extinction

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

Toxic to aquatic life with long lasting effects

3. Composition/Information on Ingredients

Component	CAS No	Weight %
Dicyclopentadienyl iron	102-54-5	98

4. First-aid measures

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get medical attention.
Inhalation	Remove from exposure, lie down. Remove to fresh air. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention. If not breathing, give artificial respiration.
Ingestion	Clean mouth with water. Get medical attention.
Most important symptoms and effects	No information available.
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Water spray. Carbon dioxide (CO ₂). Dry chemical. Chemical foam.
Unsuitable Extinguishing Media	No information available

Flash Point No information available
Method - No information available

Autoignition Temperature Not applicable
Explosion Limits
Upper No data available
Lower No data available
Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical
Flammable. Combustible material.

Hazardous Combustion Products

Carbon monoxide (CO). Carbon dioxide (CO₂).

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health
2

Flammability
2

Instability
0

Physical hazards
N/A

6. Accidental release measures

Personal Precautions Ensure adequate ventilation. Use personal protective equipment as required.
Environmental Precautions Do not flush into surface water or sanitary sewer system.

Methods for Containment and Clean Up Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment. Sweep up and shovel into suitable containers for disposal. Do not let this chemical enter the environment.

7. Handling and storage

Handling Avoid contact with skin and eyes. Do not breathe dust. Do not ingest. If swallowed then seek immediate medical assistance. Use spark-proof tools and explosion-proof equipment. Use only non-sparking tools.

Storage. Keep in a dry, cool and well-ventilated place. Keep container tightly closed. Keep away from heat, sparks and flame. Flammables area. Incompatible Materials. Strong oxidizing agents.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Dicyclopentadienyl iron	TWA: 10 mg/m ³ TWA: 1 mg/m ³	(Vacated) TWA: 10 mg/m ³ (Vacated) TWA: 5 mg/m ³ (Vacated) TWA: 1 mg/m ³ TWA: 15 mg/m ³ TWA: 5 mg/m ³	TWA: 10 mg/m ³ TWA: 5 mg/m ³ TWA: 1 mg/m ³	TWA: 10 mg/m ³ TWA: 1 mg/m ³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists

OSHA - Occupational Safety and Health Administration

NIOSH IDLH: NIOSH - National Institute for Occupational Safety and Health

Engineering Measures Ensure adequate ventilation, especially in confined areas. Use explosion-proof electrical/ventilating/lighting equipment.

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Powder Solid
Appearance	Amber
Odor	Strong
Odor Threshold	No information available
pH	No information available
Melting Point/Range	173 - 176 °C / 343.4 - 348.8 °F
Boiling Point/Range	249 °C / 480.2 °F @ 760 mmHg
Flash Point	No information available
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	Not applicable
Specific Gravity	No information available
Solubility	Slightly soluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	Not applicable
Decomposition Temperature	No information available
Viscosity	Not applicable
Molecular Formula	C ₁₀ H ₁₀ Fe
Molecular Weight	186.04

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions. heat sensitive.
Conditions to Avoid	Keep away from open flames, hot surfaces and sources of ignition. Excess heat. Incompatible products.
Incompatible Materials	Strong oxidizing agents
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO ₂)
Hazardous Polymerization	No information available.
Hazardous Reactions	None under normal processing.

11. Toxicological information**Acute Toxicity**

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Dicyclopentadienyl iron	LD50 = 1320 mg/kg (Rat)	LD50 > 3000 mg/kg (Rat)	Not listed

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS No	IARC	NTP	ACGIH	OSHA	Mexico
Dicyclopentadienyl iron	102-54-5	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects, both acute and delayed No information available

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. The product contains following substances which are hazardous for the environment.

Persistence and Degradability Soluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No

UN1325

Proper Shipping Name

FLAMMABLE SOLIDS, ORGANIC, N.O.S.

Technical Name	(FERROCENE)
Hazard Class	4.1
Packing Group	II
TDG	
UN-No	UN1325
Proper Shipping Name	FLAMMABLE SOLIDS, ORGANIC, N.O.S.
Hazard Class	4.1
Packing Group	II
IATA	
UN-No	UN1325
Proper Shipping Name	FLAMMABLE SOLIDS, ORGANIC, N.O.S.
Hazard Class	4.1
Packing Group	II
IMDG/IMO	
UN-No	UN1325
Proper Shipping Name	FLAMMABLE SOLIDS, ORGANIC, N.O.S.
Hazard Class	4.1
Packing Group	II

15. Regulatory information

United States of America Inventory

Component	CAS No	TSCA	TSCA Inventory notification - Active-Inactive	TSCA - EPA Regulatory Flags
Dicyclopentadienyl iron	102-54-5	X	ACTIVE	-

Legend:

TSCA US EPA (TSCA) - Toxic Substances Control Act, (40 CFR Part 710)

X - Listed

- - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories

Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Japan (ISHL), Australia (AICS), China (IECSC), Korea (KECL).

Component	CAS No	DSL	NDSL	EINECS	PICCS	ENCS	ISHL	AICS	IECSC	KECL
Dicyclopentadienyl iron	102-54-5	X	-	203-039-3	X	X	X	X	X	99-3-1231

KECL - NIER number or KE number (<http://ncis.nier.go.kr/en/main.do>)

U.S. Federal Regulations

SARA 313	Not applicable
SARA 311/312 Hazard Categories	See section 2 for more information
CWA (Clean Water Act)	Not applicable
Clean Air Act	Not applicable
OSHA - Occupational Safety and Health Administration	Not applicable
CERCLA	Not applicable
California Proposition 65	This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Dicyclopentadienyl iron	X	X	X	-	X

U.S. Department of Transportation

Reportable Quantity (RQ): N
 DOT Marine Pollutant N
 DOT Severe Marine Pollutant N

U.S. Department of Homeland Security This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

Authorisation/Restrictions according to EU REACH

Safety, health and environmental regulations/legislation specific for the substance or mixture

Component	CAS No	OECD HPV	Persistent Organic Pollutant	Ozone Depletion Potential	Restriction of Hazardous Substances (RoHS)
Dicyclopentadienyl iron	102-54-5	Not applicable	Not applicable	Not applicable	Not applicable

Component	CAS No	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Major Accident Notification	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Safety Report Requirements	Rotterdam Convention (PIC)	Basel Convention (Hazardous Waste)
Dicyclopentadienyl iron	102-54-5	Not applicable	Not applicable	Not applicable	Not applicable

16. Other information

Prepared By Regulatory Affairs
 Thermo Fisher Scientific
 Email: EMSDS.RA@thermofisher.com

Creation Date 08-Sep-2014
 Revision Date 24-Dec-2021
 Print Date 24-Dec-2021
 Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

Creation Date 22-Mar-2018

Revision Date 05-Jan-2021

Revision Number 2

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product identifier

Product Description:	<u>Tetra-n-butylammonium perchlorate</u>
Cat No. :	43999
Synonyms	1-Butanaminium, N,N,N-Tributyl-, Perchlorate.
CAS-No	1923-70-2
EC-No.	217-655-5
Molecular Formula	C16H36ClNO4
Reach Registration Number	-

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

Recommended Use	Laboratory chemicals.
Uses advised against	No Information available

1.3. Details of the supplier of the safety data sheet

Company	Alfa Aesar Avocado Research Chemicals, Ltd. Shore Road Port of Heysham Industrial Park Heysham, Lancashire LA3 2XY United Kingdom Office Tel: +44 (0) 1524 850506 Office Fax: +44 (0) 1524 850608
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E-mail address	uktech@alfa.com www.alfa.com Product Safety Department
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1.4. Emergency telephone number

Call Carechem 24 at
+44 (0) 1865 407333 (English only);
+44 (0) 1235 239670 (Multi-language)

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

CLP Classification - Regulation (EC) No 1272/2008

Physical hazards

Oxidizing solids

Category 2 (H272)

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Health hazards

Skin Corrosion/Irritation
Serious Eye Damage/Eye Irritation
Specific target organ toxicity - (single exposure)

Category 2 (H315)
Category 2 (H319)
Category 3 (H335)

Environmental hazards

Based on available data, the classification criteria are not met

Full text of Hazard Statements: see section 16

2.2. Label elements



Signal Word

Danger

Hazard Statements

H272 - May intensify fire; oxidizer
H315 - Causes skin irritation
H319 - Causes serious eye irritation
H335 - May cause respiratory irritation

Precautionary Statements

P221 - Take any precaution to avoid mixing with combustibles
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P302 + P352 - IF ON SKIN: Wash with plenty of soap and water
P304 + P340 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
P312 - Call a POISON CENTER or doctor/physician if you feel unwell
P371 + P380 + P375 - In case of major fire and large quantities: Evacuate area. Fight fire remotely due to the risk of explosion

2.3. Other hazards

No information available

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1. Substances

Component	CAS-No	EC-No.	Weight %	CLP Classification - Regulation (EC) No 1272/2008
Tetrabutylammonium perchlorate	1923-70-2	EEC No. 217-655-5	99	Ox. Sol. 2 (H272) STOT SE 3 (H335) Skin Irrit. 2 (H315) Eye Irrit. 2 (H319)

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Reach Registration Number

-

Full text of Hazard Statements: see section 16

SECTION 4: FIRST AID MEASURES

4.1. Description of first aid measures

Eye Contact	Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.
Skin Contact	Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes.
Ingestion	Clean mouth with water and drink afterwards plenty of water.
Inhalation	Remove to fresh air.
Self-Protection of the First Aider	Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination.

4.2. Most important symptoms and effects, both acute and delayed

No information available.

4.3. Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically.

SECTION 5: FIREFIGHTING MEASURES

5.1. Extinguishing media

Suitable Extinguishing Media

Use extinguishing measures that are appropriate to local circumstances and the surrounding environment. Water spray, carbon dioxide (CO₂), dry chemical, alcohol-resistant foam.

Extinguishing media which must not be used for safety reasons

No information available.

5.2. Special hazards arising from the substance or mixture

Oxidizer: Contact with combustible/organic material may cause fire. May ignite combustibles (wood, paper, oil, clothing, etc.).

Hazardous Combustion Products

Carbon monoxide (CO), Carbon dioxide (CO₂), Nitrogen oxides (NO_x), Hydrogen chloride, Ammonia.

5.3. Advice for firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures

Ensure adequate ventilation.

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6.2. Environmental precautions

See Section 12 for additional Ecological Information.

6.3. Methods and material for containment and cleaning up

Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Sweep up and shovel into suitable containers for disposal.

6.4. Reference to other sections

Refer to protective measures listed in Sections 8 and 13.

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for safe handling

Keep away from clothing and other combustible materials.

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice. Keep away from food, drink and animal feeding stuffs. Do not eat, drink or smoke when using this product. Remove and wash contaminated clothing and gloves, including the inside, before re-use. Wash hands before breaks and after work.

7.2. Conditions for safe storage, including any incompatibilities

Store under an inert atmosphere. Protect from moisture. Keep containers tightly closed in a dry, cool and well-ventilated place. Do not store near combustible materials.

Technical Rules for Hazardous Substances (TRGS) 510 Storage Class (LGK)
(Germany)

Class 5.1B

7.3. Specific end use(s)

Use in laboratories

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters

Exposure limits

This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies

Biological limit values

This product, as supplied, does not contain any hazardous materials with biological limits established by the region specific regulatory bodies

Monitoring methods

BS EN 14042:2003 Title Identifier: Workplace atmospheres. Guide for the application and use of procedures for the assessment of exposure to chemical and biological agents.

MDHS14/3 General methods for sampling and gravimetric analysis of respirable and inhalable dust

Derived No Effect Level (DNEL) No information available

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Route of exposure	Acute effects (local)	Acute effects (systemic)	Chronic effects (local)	Chronic effects (systemic)
Oral Dermal Inhalation				

Predicted No Effect Concentration (PNEC) No information available.

8.2. Exposure controls

Engineering Measures

Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation, especially in confined areas.

Wherever possible, engineering control measures such as the isolation or enclosure of the process, the introduction of process or equipment changes to minimise release or contact, and the use of properly designed ventilation systems, should be adopted to control hazardous materials at source

Personal protective equipment

Eye Protection Goggles (European standard - EN 166)

Hand Protection Protective gloves

Glove material	Breakthrough time	Glove thickness	EU standard	Glove comments
Nitrile rubber	> 480 minutes	0.11 mm	EN 374	(minimum requirement)
Neoprene				

Skin and body protection Long sleeved clothing

Inspect gloves before use.

Please observe the instructions regarding permeability and breakthrough time which are provided by the supplier of the gloves.

(Refer to manufacturer/supplier for information)

Ensure gloves are suitable for the task: Chemical compatibility, Dexterity, Operational conditions, User susceptibility, e.g. sensitisation effects, also take into consideration the specific local conditions under which the product is used, such as the danger of cuts, abrasion.

Remove gloves with care avoiding skin contamination.

Respiratory Protection When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.
To protect the wearer, respiratory protective equipment must be the correct fit and be used and maintained properly

Large scale/emergency use Use a NIOSH/MSHA or European Standard EN 136 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced
Recommended Filter type: Particulates filter conforming to EN 143

Small scale/Laboratory use Use a NIOSH/MSHA or European Standard EN 149:2001 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Recommended half mask:- Valve filtering: EN405; or; Half mask: EN140; plus filter, EN 141
When RPE is used a face piece Fit Test should be conducted

Environmental exposure controls No information available.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

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Physical State	Crystalline Solid	
Appearance	White	
Odor	No information available	
Odor Threshold	No data available	
Melting Point/Range	210 - 217 °C / 410 - 422.6 °F	
Softening Point	No data available	
Boiling Point/Range	No information available	
Flammability (liquid)	Not applicable	Solid
Flammability (solid,gas)	No information available	
Explosion Limits	No data available	
Flash Point	No information available	Method - No information available
Autoignition Temperature	No data available	
Decomposition Temperature	No data available	
pH	No information available	
Viscosity	Not applicable	Solid
Water Solubility	Soluble	
Solubility in other solvents	No information available	
Partition Coefficient (n-octanol/water)		
Vapor Pressure	No data available	
Density / Specific Gravity	No data available	
Bulk Density	No data available	
Vapor Density	Not applicable	Solid
Particle characteristics	No data available	

9.2. Other information

Molecular Formula	C16H36ClNO4
Molecular Weight	341.91
Oxidizing Properties	Oxidizer
Evaporation Rate	Not applicable - Solid

SECTION 10: STABILITY AND REACTIVITY

10.1. Reactivity

Yes

10.2. Chemical stability

Oxidizer: Contact with combustible/organic material may cause fire.

10.3. Possibility of hazardous reactions

Hazardous Polymerization	No information available.
Hazardous Reactions	No information available.

10.4. Conditions to avoid

Incompatible products. Excess heat. Combustible material.

10.5. Incompatible materials

Combustible material. Finely powdered metals. Organic materials. Water. Reducing Agent. Strong reducing agents.

10.6. Hazardous decomposition products

Carbon monoxide (CO). Carbon dioxide (CO₂). Nitrogen oxides (NO_x). Hydrogen chloride. Ammonia.

SECTION 11: TOXICOLOGICAL INFORMATION

ALFAA43999

SAFETY DATA SHEET

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11.1. Information on hazard classes as defined in Regulation (EC) No 1272/2008

Product Information

(a) acute toxicity;	
Oral	No data available
Dermal	No data available
Inhalation	No data available
(b) skin corrosion/irritation;	Category 2
(c) serious eye damage/irritation;	Category 2
(d) respiratory or skin sensitization;	
Respiratory	No data available
Skin	No data available
(e) germ cell mutagenicity;	No data available
(f) carcinogenicity;	No data available
	There are no known carcinogenic chemicals in this product
(g) reproductive toxicity;	No data available
(h) STOT-single exposure;	Category 3
Results / Target organs	Respiratory system.
(i) STOT-repeated exposure;	No data available
Target Organs	No information available.
(j) aspiration hazard;	Not applicable
	Solid
Symptoms / effects, both acute and delayed	No information available.

11.2. Information on other hazards

Endocrine Disrupting Properties	Assess endocrine disrupting properties for human health. This product does not contain any known or suspected endocrine disruptors.
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SECTION 12: ECOLOGICAL INFORMATION

12.1. Toxicity

Ecotoxicity effects	Contains no substances known to be hazardous to the environment or that are not degradable in waste water treatment plants.
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12.2. Persistence and degradability

Persistence

Soluble in water, Persistence is unlikely, based on information available.

12.3. Bioaccumulative potential

Bioaccumulation is unlikely

12.4. Mobility in soil

The product is water soluble, and may spread in water systems. Will likely be mobile in the environment due to its water solubility. Highly mobile in soils

12.5. Results of PBT and vPvB assessment

No data available for assessment.

12.6. Endocrine disrupting properties

Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

12.7. Other adverse effects

Persistent Organic Pollutant Ozone Depletion Potential

This product does not contain any known or suspected substance

This product does not contain any known or suspected substance

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Waste from Residues/Unused Products

Waste is classified as hazardous. Dispose of in accordance with the European Directives on waste and hazardous waste. Dispose of in accordance with local regulations.

Contaminated Packaging

Dispose of this container to hazardous or special waste collection point.

European Waste Catalogue (EWC)

According to the European Waste Catalog, Waste Codes are not product specific, but application specific.

Other Information

Waste codes should be assigned by the user based on the application for which the product was used. Do not empty into drains.

SECTION 14: TRANSPORT INFORMATION

IMDG/IMO

14.1. UN number

UN1479

14.2. UN proper shipping name

Oxidizing solid, n.o.s

Technical Shipping Name

Tetrabutylammonium perchlorate

14.3. Transport hazard class(es)

5.1

14.4. Packing group

II

ADR

14.1. UN number

UN1479

14.2. UN proper shipping name

Oxidizing solid, n.o.s

Technical Shipping Name

Tetrabutylammonium perchlorate

14.3. Transport hazard class(es)

5.1

14.4. Packing group

II

IATA

ALFAA43999

SAFETY DATA SHEET

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Revision Date 05-Jan-2021

14.1. UN number UN1479
14.2. UN proper shipping name Oxidizing solid, n.o.s
Technical Shipping Name Tetrabutylammonium perchlorate
14.3. Transport hazard class(es) 5.1
14.4. Packing group II

14.5. Environmental hazards No hazards identified

14.6. Special precautions for user No special precautions required

14.7. Maritime transport in bulk according to IMO instruments Not applicable, packaged goods

SECTION 15: REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

X = listed, Europe (EINECS/ELINCS/NLP), U.S.A. (TSCA), Canada (DSL/NDSL), Philippines (PICCS), China (IECSC), Japan (ENCS), Australia (AICS), Korea (ECL).

Component	EINECS	ELINCS	NLP	TSCA	DSL	NDSL	PICCS	ENCS	IECSC	AICS	KECL
Tetrabutylammonium perchlorate	217-655-5	-		X	X	-	-	-	-	-	-

Regulation (EC) No 649/2012 of the European Parliament and of the Council of 4 July 2012 concerning the export and import of dangerous chemicals
Not applicable

National Regulations

WGK Classification Water endangering class = 3 (self classification)

UK - Take note of Control of Substances Hazardous to Health Regulations (COSHH) 2002 and 2005 Amendment

15.2. Chemical safety assessment

A Chemical Safety Assessment/Report (CSA/CSR) has not been conducted

SECTION 16: OTHER INFORMATION

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

H315 - Causes skin irritation
H319 - Causes serious eye irritation
H335 - May cause respiratory irritation
H272 - May intensify fire; oxidizer

Legend

CAS - Chemical Abstracts Service

EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory

DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

SAFETY DATA SHEET

Tetra-n-butylammonium perchlorate

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PICCS - Philippines Inventory of Chemicals and Chemical Substances
IECSC - Chinese Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances

ENCS - Japanese Existing and New Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

WEL - Workplace Exposure Limit
ACGIH - American Conference of Governmental Industrial Hygienists
DNEL - Derived No Effect Level
RPE - Respiratory Protective Equipment
LC50 - Lethal Concentration 50%
NOEC - No Observed Effect Concentration
PBT - Persistent, Bioaccumulative, Toxic

TWA - Time Weighted Average
IARC - International Agency for Research on Cancer
Predicted No Effect Concentration (PNEC)
LD50 - Lethal Dose 50%
EC50 - Effective Concentration 50%
POW - Partition coefficient Octanol:Water
vPvB - very Persistent, very Bioaccumulative

ADR - European Agreement Concerning the International Carriage of Dangerous Goods by Road
IMO/IMDG - International Maritime Organization/International Maritime Dangerous Goods Code
OECD - Organisation for Economic Co-operation and Development
BCF - Bioconcentration factor

ICAO/IATA - International Civil Aviation Organization/International Air Transport Association
MARPOL - International Convention for the Prevention of Pollution from Ships
ATE - Acute Toxicity Estimate
VOC (volatile organic compound)

Key literature references and sources for data

<https://echa.europa.eu/information-on-chemicals>
Suppliers safety data sheet, Chemadvisor - LOLI, Merck index, RTECS

Training Advice

Chemical hazard awareness training, incorporating labelling, Safety Data Sheets (SDS), Personal Protective Equipment (PPE) and hygiene.

Use of personal protective equipment, covering appropriate selection, compatibility, breakthrough thresholds, care, maintenance, fit and standards.

First aid for chemical exposure, including the use of eye wash and safety showers.

Chemical incident response training.

Prepared By	Health, Safety and Environmental Department
Creation Date	22-Mar-2018
Revision Date	05-Jan-2021
Revision Summary	SDS authoring systems update, replaces ChemGes SDS No. 1923-70-2.

**This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006
COMMISSION REGULATION (EU) 2020/878 amending Annex II to Regulation (EC) No
1907/2006**

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of Safety Data Sheet

SAFETY DATA SHEET

Creation Date 23-Jan-2009

Revision Date 24-Dec-2021

Revision Number 7

1. Identification

Product Name Dimethyl sulfoxide

Cat No. : D139-1; D139-RS19; NC1115865

CAS No 67-68-5
Synonyms Methyl sulfoxide; DMSO

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use.

Details of the supplier of the safety data sheet

Company

Fisher Scientific Company
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) Identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids

Category 4

Label Elements

Signal Word

Warning

Hazard Statements

Combustible liquid

Precautionary Statements

Prevention

Keep away from heat/sparks/open flames/hot surfaces. - No smoking

Fire

In case of fire: Use CO₂, dry chemical, or foam for extinction

Storage

Store in a well-ventilated place. Keep cool

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

None identified

Other hazards

DMSO readily penetrates skin and may carry other dissolved chemicals into the body.

3. Composition/Information on Ingredients

Component	CAS No	Weight %
Dimethyl sulfoxide	67-68-5	>95

4. First-aid measures

General Advice	If symptoms persist, call a physician. Show this safety data sheet to the doctor in attendance.
Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Get medical attention immediately if symptoms occur.
Inhalation	Remove to fresh air. Get medical attention immediately if symptoms occur. If not breathing, give artificial respiration.
Ingestion	Do NOT induce vomiting. Get medical attention.
Most important symptoms and effects	Difficulty in breathing. Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Water spray, carbon dioxide (CO ₂), dry chemical, alcohol-resistant foam. Water mist may be used to cool closed containers.
Unsuitable Extinguishing Media	No information available
Flash Point	87 °C / 188.6 °F
Method -	No information available
Autoignition Temperature	301 °C / 573.8 °F
Explosion Limits	
Upper	42 vol %
Lower	2.6 vol %
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical

Combustible material. Containers may explode when heated. Thermal decomposition can lead to release of irritating gases and

vapors.

Hazardous Combustion Products

Carbon monoxide (CO). Carbon dioxide (CO₂). Sulfur oxides. Sulfides. Formaldehyde.

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health
2 *

Flammability
2

Instability
1

Physical hazards
N/A

6. Accidental release measures

Personal Precautions

Use personal protective equipment as required. Remove all sources of ignition. Take precautionary measures against static discharges. Ensure adequate ventilation.

Environmental Precautions

Should not be released into the environment. Do not flush into surface water or sanitary sewer system. See Section 12 for additional Ecological Information.

Methods for Containment and Clean Up

Remove all sources of ignition. Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling

Wear personal protective equipment/face protection. Ensure adequate ventilation. Keep away from open flames, hot surfaces and sources of ignition. Avoid contact with skin, eyes or clothing. Avoid ingestion and inhalation.

Storage.

Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat, sparks and flame. Incompatible Materials. Strong oxidizing agents. Strong acids. Strong bases. Alkali metals.

8. Exposure controls / personal protection

Exposure Guidelines

This product does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Engineering Measures

Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State
Appearance
Odor

Liquid
Colorless
Odorless

Odor Threshold	No information available
pH	No information available
Melting Point/Range	18.4 °C / 65.1 °F
Boiling Point/Range	189 °C / 372.2 °F
Flash Point	87 °C / 188.6 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	42 vol %
Lower	2.6 vol %
Vapor Pressure	0.55 mbar @ 20°C
Vapor Density	2.7
Specific Gravity	1.100
Solubility	Soluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	301 °C / 573.8 °F
Decomposition Temperature	> 190°C
Viscosity	1.98 mPa.s @ 25°C
Molecular Formula	C2 H6 O S
Molecular Weight	78.13

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Hygroscopic.
Conditions to Avoid	Incompatible products. Excess heat. Exposure to moist air or water. Keep away from open flames, hot surfaces and sources of ignition.
Incompatible Materials	Strong oxidizing agents, Strong acids, Strong bases, Alkali metals
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO ₂), Sulfur oxides, Sulfides, Formaldehyde
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	Thermal decomposition can take place above 189°C / 372°F.

11. Toxicological information

Acute Toxicity

Product Information Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Dimethyl sulfoxide	LD50 = 28300 mg/kg (Rat)	LD50 = 40000 mg/kg (Rat)	LC50 > 5.33 mg/L (Rat) 4 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation	No information available
Sensitization	No information available
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS No	IARC	NTP	ACGIH	OSHA	Mexico
Dimethyl sulfoxide	67-68-5	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects	No information available.
Developmental Effects	No information available.
Teratogenicity	No information available.
STOT - single exposure	None known
STOT - repeated exposure	None known
Aspiration hazard	No information available
Symptoms / effects, both acute and delayed	Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting
Endocrine Disruptor Information	No information available
Other Adverse Effects	The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Contains no substances known to be hazardous to the environment or that are not degradable in waste water treatment plants. Do not empty into drains. .

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Dimethyl sulfoxide	EC50 96h 12350 - 25500 mg/L	40 g/L LC50 96 h 33-37 g/L LC50 96 h	= 16000 mg/L EC50 Pseudomonas putida 16 h = 32 g/L EC50 Tetrahymena pyriformis 24 h = 77 mg/L EC50 Photobacterium phosphoreum 5 min	EC50 24h 7000 mg/L

Persistence and Degradability	Persistence is unlikely
Bioaccumulation/ Accumulation	No information available.
Mobility	. Will likely be mobile in the environment due to its water solubility.

Component	log Pow
Dimethyl sulfoxide	-2.03

13. Disposal considerations

Waste Disposal Methods	Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.
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14. Transport information

DOT	COMBUSTIBLE LIQUID, NOT REGULATED FOR TRANSPORT IN THIS QUANTITY According to 49 CFR §173.150(f)(1), this material should be reclassified as NA1993, Combustible Liquid, NOS if it is shipped in bulk.
UN-No	NA1993
Proper Shipping Name	Combustible liquid, n.o.s.
Packing Group	III
TDG	Not regulated
IATA	Not regulated
IMDG/IMO	Not regulated

15. Regulatory information

United States of America Inventory

Component	CAS No	TSCA	TSCA Inventory notification - Active-Inactive	TSCA - EPA Regulatory Flags
Dimethyl sulfoxide	67-68-5	X	ACTIVE	-

Legend:

TSCA US EPA (TSCA) - Toxic Substances Control Act, (40 CFR Part 710)

X - Listed

- - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories

Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Japan (ISHL), Australia (AICS), China (IECSC), Korea (KECL).

Component	CAS No	DSL	NDSL	EINECS	PICCS	ENCS	ISHL	AICS	IECSC	KECL
Dimethyl sulfoxide	67-68-5	X	-	200-664-3	X	X	X	X	X	KE-32367

KECL - NIER number or KE number (<http://ncis.nier.go.kr/en/main.do>)**U.S. Federal Regulations**

SARA 313 Not applicable

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act) Not applicable

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration Not applicable

CERCLA Not applicable

California Proposition 65 This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Dimethyl sulfoxide	-	X	-	-	-

U.S. Department of Transportation

Reportable Quantity (RQ): N

DOT Marine Pollutant N

DOT Severe Marine Pollutant N

U.S. Department of Homeland Security This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade Slight risk, Grade 1

Authorisation/Restrictions according to EU REACH

Component	REACH (1907/2006) - Annex XIV - Substances Subject to	REACH (1907/2006) - Annex XVII - Restrictions on Certain Dangerous	REACH Regulation (EC 1907/2006) article 59 - Candidate
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	Authorization	Substances	List of Substances of Very High Concern (SVHC)
Dimethyl sulfoxide	-	Use restricted. See item 75. (see link for restriction details)	-

<https://echa.europa.eu/substances-restricted-under-reach>

Safety, health and environmental regulations/legislation specific for the substance or mixture

Component	CAS No	OECD HPV	Persistent Organic Pollutant	Ozone Depletion Potential	Restriction of Hazardous Substances (RoHS)
Dimethyl sulfoxide	67-68-5	Listed	Not applicable	Not applicable	Not applicable

Component	CAS No	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Major Accident Notification	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Safety Report Requirements	Rotterdam Convention (PIC)	Basel Convention (Hazardous Waste)
Dimethyl sulfoxide	67-68-5	Not applicable	Not applicable	Not applicable	Not applicable

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 23-Jan-2009

Revision Date 24-Dec-2021

Print Date 24-Dec-2021

Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

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End of SDS