

SAFETY DATA SHEET

Preparation Date: 3/1/2019

Revision date 3/1/2019

Revision Number: G1

1. IDENTIFICATION

Product identifier

Product code: A1095
Product Name: ALUMINUM NITRATE, NONAHYDRATE, CRYSTAL, REAGENT, ACS

Other means of identification

Synonyms: Aluminum trinitrate nonahydrate
 Nitric acid, Aluminum salt, nonahydrate
CAS #: 7784-27-2
RTECS # BD1050000
CI#: Not available

Recommended use of the chemical and restrictions on use

Recommended use: Petroleum Production and Refining. Laboratory reagent. Research and Development.
Uses advised against No information available

Supplier: Spectrum Chemical Mfg. Corp
 14422 South San Pedro St.
 Gardena, CA 90248
 (310) 516-8000

Order Online At: <https://www.spectrumchemical.com>
Emergency telephone number Chemtrec 1-800-424-9300
Contact Person: Tom Tyner (USA - West Coast)
Contact Person: Ibad Tirmiz (USA - East Coast)

2. HAZARDS IDENTIFICATION

Classification

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

Considered a dangerous substance or mixture according to the Globally Harmonized System (GHS)

Skin corrosion/irritation	Category 2
Serious eye damage/eye irritation	Category 2A
Oxidizing solids	Category 3

Label elements

Warning

Hazard statements
 Causes skin irritation
 Causes serious eye irritation
 May intensify fire; oxidizer

Product code: A1095

Product name: ALUMINUM NITRATE,
 NONAHYDRATE, CRYSTAL,
 REAGENT, ACS

Page



Hazards not otherwise classified (HNOC)

Not Applicable

Other hazards

May be harmful if swallowed

Precautionary Statements - Prevention

Wash face, hands and any exposed skin thoroughly after handling
Keep away from heat/sparks/open flames/hot surfaces. — No smoking
Keep/Store away from clothing and other combustible materials
Take any precaution to avoid mixing with combustibles
Wear protective gloves

Precautionary Statements - Response

IN CASE OF FIRE: Use water to extinguish. Do not use dry chemicals or foams. CO2 or Halon may provide limited control.

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.

IF ON SKIN: Wash with plenty of water

If skin irritation occurs: Get medical advice/attention

Take off contaminated clothing and wash it before reuse

Precautionary Statements - Disposal

Dispose of contents/container to an approved waste disposal plant

3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS No	Weight-%
Aluminum Nitrate, Nonahydrate	7784-27-2	100

4. FIRST AID MEASURES

First aid measures

General Advice: National Capital Poison Center in the United States can provide assistance if you have a poison emergency and need to talk to a poison specialist. Call 1-800-222-1222.

Skin Contact: Wash off immediately with soap and plenty of water removing all contaminated clothing and shoes. Get medical attention. If skin irritation persists, call a physician.

Eye Contact: Flush eyes with water for 15 minutes. Get medical attention. If symptoms persist, call a physician.

Inhalation: Move to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Ingestion: Do not induce vomiting without medical advice. Never give anything by mouth to an

Product code: A1095

Product name: ALUMINUM NITRATE,
NONAHYDRATE, CRYSTAL,
REAGENT, ACS

Page

unconscious person. Consult a physician if necessary.

Most important symptoms and effects, both acute and delayed

Symptoms

Causes skin irritation
Causes eye irritation
May cause coughing and shortness of breath
Somnolence
It may affect metabolism
Weight loss/gain
May cause methemoglobinemia and cyanosis
May cause digestive (gastrointestinal) tract irritation
May cause nausea and vomiting
Ataxia
Headache
Weakness
May cause drowsiness or dizziness
Convulsions
Fatigue
Irregular heartbeat
Weak, rapid pulse or rapid heart rate (Tachycardia)
Seizures
Coma
Sweating and flushing of skin
Visual disturbances
It may affect the kidneys
It may affect the blood
Central nervous system effects

Indication of any immediate medical attention and special treatment needed

Notes to Physician: Treat symptomatically.

Protection of first-aiders

First-Aid Providers: Avoid exposure to blood or body fluids. Wear gloves and other necessary protective clothing. Dispose of contaminated clothing and equipment as bio-hazardous waste.

5. FIRE-FIGHTING MEASURES

Extinguishing Media

Suitable Extinguishing Media:

Water. CO2 may be of no value in extinguishing fires involving oxidizers and may only provide limited control.

Unsuitable Extinguishing Media:

Dry chemical. Foam. Halons.

Specific hazards arising from the chemical

Hazardous combustion products

If it is involved in a fire the following can be released:
Nitrogen oxides (NOx). Aluminum oxides.

Specific hazards

Oxidizer. Keep away from combustible materials (wood, paper, oil, clothing, etc.). The product is not flammable, but it may cause fire when in contact with other material. Contact with combustible or organic materials may cause fire. Will accelerate burning when involved in a fire. Container explosion may occur under fire conditions or when heated.

Special Protective Actions for Firefighters

Product code: A1095

Product name: ALUMINUM NITRATE,
NONAHYDRATE, CRYSTAL,
REAGENT, ACS

Page

Specific Methods:

No information available

Special Protective Equipment for Firefighters:

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

6. ACCIDENTAL RELEASE MEASURES**Personal precautions, protective equipment and emergency procedures****Personal Precautions:**

Wear personal protective equipment. Avoid contact with skin, eyes and clothing. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Avoid dust formation. Keep combustibles (wood, paper, oil, clothing, etc.) away from spilled material. Remove all sources of ignition.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Prevent entry into waterways, sewers, basements or confined areas. Prevent product from entering drains. Do not let product enter drains.

Methods and material for containment and cleaning up**Methods for containment**

Stop leak if you can do it without risk. Cover with plastic sheet to prevent spreading.

Methods for cleaning up

Sweep up and shovel. Use appropriate tools to put the spilled material in a suitable chemical waste disposal container. Do not use combustible materials such as paper towels, sawdust, clothing, etc. to clean up spill. Clean contaminated surface thoroughly.

7. HANDLING AND STORAGE**Precautions for safe handling****Technical Measures/Precautions:**

Provide sufficient air exchange and/or exhaust in work rooms. Avoid dust formation. Keep away from incompatible materials.

Safe Handling Advice

Wear personal protective equipment. Avoid contact with skin, eyes and clothing. Use only in well-ventilated areas. Do not ingest. Do not breathe dust. When using do not smoke. Keep away from combustible material. Handle in accordance with good industrial hygiene and safety practice.

Conditions for safe storage, including any incompatibilities**Technical Measures/Storage Conditions:**

Keep container tightly closed in a dry and well-ventilated place. Do not store near combustible materials. Store at room temperature in the original container. Store away from incompatible materials. Store in a segregated and approved area.

Incompatible Materials:

Reducing agents
Powdered metals
Organic materials
Combustible materials

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Product code: A1095

Product name: ALUMINUM NITRATE,
NONAHYDRATE, CRYSTAL,
REAGENT, ACS

Page

Control parameters

National occupational exposure limits

United States

Component	CAS No	OSHA	NIOSH	ACGIH	AIHA WEEL
Aluminum Nitrate, Nonahydrate	7784-27-2	None	None	None	None

Canada

Component	CAS No	Canada - Alberta	Canada - British Columbia	Canada - Ontario	Canada - Quebec
Aluminum Nitrate, Nonahydrate	7784-27-2	2 mg/m ³ TWA(as Al)	None	None	2 mg/m ³ TWAEV(as Al)

Australia and Mexico

Component	CAS No	Australia	Mexico
Aluminum Nitrate, Nonahydrate	7784-27-2	None	None

Appropriate engineering controls

Engineering measures to reduce exposure:

Ensure adequate ventilation, especially in confined areas. Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Individual protection measures, such as personal protective equipment

Personal Protective Equipment

Eye protection: Goggles or Safety glasses with side-shields.

Skin and body protection: Chemical resistant protective suit
Gloves
Long sleeved clothing

Respiratory protection: Effective dust mask. or. Wear respirator with dust filter. Be sure to use an approved/certified respirator or equivalent.

Hygiene measures: Avoid contact with skin, eyes and clothing. When using, do not eat, drink or smoke. Wash hands before breaks and immediately after handling the product

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state:

Solid

Appearance:

Crystals.

Color:

White.

Odor:

Odorless.

Taste

No information available.

Formula

Al(NO₃)₃.9H₂O

Product code: A1095

Product name: ALUMINUM NITRATE,
NONAHYDRATE, CRYSTAL,
REAGENT, ACS

Page

Molecular/Formula weight (g/mole): 375.13 g/mol	Flammability (solid, gas) no data available	Flashpoint (°C/°F): No information available
Flash Point Tested according to: Not available	Autoignition Temperature (°C/°F): No information available	Lower Explosion Limit (%): No information available
Upper Explosion Limit (%): No information available	Melting point/range(°C/°F): 73°C/163°F	Decomposition temperature(°C/°F): 135°C/275°F
Boiling point/range(°C/°F): No information available	Bulk density: No information available	Density (g/cm3): No information available
Specific gravity: No information available	pH 2.5-3.5 (5%)	Vapor pressure @ 20°C (kPa): No information available
Evaporation rate: No information available	Vapor density: No information available	VOC content (g/L): No information available
Odor threshold (ppm): No information available	Partition coefficient (n-octanol/water): No information available	Viscosity: No information available
Miscibility: No information available	Solubility: Very soluble in water Very soluble in alcohol Very slightly soluble in Acetone Practically insoluble in Ethyl Acetate Practically insoluble in pyridine	

10. STABILITY AND REACTIVITY

Reactivity

Oxidizer. Reacts with reducing agents, organic material, combustible materials, and powdered metals

Chemical stability

Stability: Stable under recommended storage conditions.

Possibility of Hazardous Reactions: Hazardous polymerization does not occur

Conditions to avoid: Avoid dust formation. Heat. Incompatible materials.

Incompatible Materials: Reducing agents
Powdered metals
Organic materials
Combustible materials

Hazardous decomposition products: Aluminum oxide. Nitrogen oxides (NOx).

Other Information

Corrosivity: No information available

Special Remarks on Corrosivity: No information available

11. TOXICOLOGICAL INFORMATION

Product code: A1095

Product name: ALUMINUM NITRATE,
NONAHYDRATE, CRYSTAL,
REAGENT, ACS

Page

Information on likely routes of exposure

Principal Routes of Exposure:

Ingestion. Inhalation. Skin.

Acute Toxicity

Component Information

Aluminum Nitrate, Nonahydrate	
CAS No	7784-27-2

LD50/oral/rat = 3671 mg/kg Oral LD50 Rat
LD50/oral/mouse = 3980 mg/kg oral LD50 mouse
LD50/dermal/rabbit = No information available
LD50/dermal/rat = No information available
LC50/inhalation/rat = No information available
LC50/inhalation/mouse = No information available
Other LD50 or LC50 information = No information available

Product Information

LD50/oral/rat =
Value - Acute Tox = No information available

LD50/oral/mouse =
Value - Acute Tox Oral = No information available

LD50/dermal/rabbit
Value - Acute Tox = No information available

LD50/dermal/rat
VALUE - Acute Tox Dermal = No information available

LC50/inhalation/rat
VALUE-Vapor = No information available
VALUE-Gas = No information available
VALUE-Dust/Mist = No information available

LC50/Inhalation/mouse
VALUE-Vapor = No information available
VALUE - Gas = No information available
VALUE - Dust/Mist = No information available

Symptoms

Skin Contact: Causes skin irritation. Skin contact may result in redness, pain, inflammation, itching, scaling, and/or blistering.

Eye Contact: Causes eye irritation. Symptoms may include stinging, tearing, redness.

Inhalation May cause respiratory tract irritation. Symptoms may include coughing and shortness of breath.

Ingestion Can cause nausea, vomiting, hypermotility, diarrhea. It produces flushing of the face, mild decrease of blood pressure, rash, ringing in the ears, and nerve

Product code: A1095

Product name: ALUMINUM NITRATE,
NONAHYDRATE, CRYSTAL,
REAGENT, ACS

Page

deafness. May affect behavior/central nervous system (somnolence), respiration(respiratory depression). It may cause anorexia. Inorganic nitrates can be reduced to nitrites in the stomach and can induce Methemoglobinemia, an increase in the level of methemoglobin in the blood, resulting in hypoxia (decreased blood oxygen), difficulty breathing, and cyanosis (a bluish discoloration of the skin and lips due to deficient oxygenation the blood). Other symptoms of Methemoglobinemia may include chocolate brown colored blood, weakness, dizziness, lethargy, vertigo, lightheadedness, fatigue, lethargy, mental impairment, convulsions, syncope, irregular pulse, anorexia, decrease in blood pressure, headache, tingling, flushing, perspiration, circulatory collapse, loss of consciousness, seizures, coma, death. May affect urinary system (kidneys). May affect behavior/central nervous system (somnolence, ataxia). May affect metabolism (weight loss).

Aspiration hazard No information available.

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

Chronic Toxicity This product is also a nitrate, therefore nitrate poisoning can occur. Prolonged or repeated nitrate ingestion may affect the urinary system (kidneys) and also may affect the blood, resulting in methemoglobin formation with attendant cyanosis, anorexia, hyperpnea and later dyspnea and chocolate brown colored blood. The primary toxic effects of nitrates include orthostatic hypotension and methemoglobinemia, Other symptoms include muscular weakness, faintness, dizziness, lightheadedness, fatigue, throbbing headache, mental impairment, incoordination, seizures, and convulsions, bradycardia or tachycardia, dysrhythmias, dyspnea. Prolonged or repeated ingestion of large amounts of nitrates may affect the liver and can cause gastroenteritis, nausea, vomiting, abdominal pain, weight loss. Possible coma and death. Chronic ingestion of aluminum may cause Aluminum Related Bone Disease or aluminum-induced Osteomalacia with fracturing Osteodystrophy, microcytic anemia, weakness, fatigue, visual and auditory hallucinations, memory loss, speech and language impairment (dysarthria, stuttering, stammering, anomia, hypofluency, aphasia and eventually, mutism), epileptic seizures(focal or grand mal), motor disturbance(tremors, myoclonic jerks, ataxia, convulsions, asterixis, motor apraxia, muscle fatigue), and dementia (personality changes, altered mood, depression, diminished alertness, lethargy, 'clouding of the sensorium', intellectual deterioration, obtundation, coma), and altered EEG.

Sensitization: No information available.

Mutagenic Effects: No information available

Carcinogenic effects: Not considered carcinogenic.

Component	CAS No	IARC	ACGIH - Carcinogens	NTP	OSHA HCS - Carcinogens	Australia - Notifiable Carcinogenic Substances	Australia - Prohibited Carcinogenic Substances
Aluminum Nitrate, Nonahydrate	7784-27-2	Not listed	Not listed	Not listed	Not listed	Not listed	Not listed

ACGIH (American Conference of Governmental Industrial Hygienists)

IARC (International Agency for Research on Cancer)

NTP (National Toxicology Program)

OSHA (Occupational Safety and Health Administration of the US Department of Labor)

Reproductive toxicity No data is available

Reproductive Effects: No information available

Developmental Effects: No information available

Teratogenic Effects: No information available

Specific Target Organ Toxicity

STOT - single exposure No information available.

STOT - repeated exposure No information available.

Target Organs: Blood. Kidneys. Liver.

12. ECOLOGICAL INFORMATION

Ecotoxicity

Ecotoxicity effects: No data available.

Persistence and degradability: No information available

Bioaccumulative potential: No information available.

Mobility in soil No information available

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Disposal Methods

Waste from residues / unused products:

Waste must be disposed of in accordance with Federal, State and Local regulation.

Contaminated packaging:

Empty containers should be taken for local recycling, recovery or waste disposal Do not re-use empty containers
Dispose of as unused product.

Component	CAS No	RCRA - F Series Wastes	RCRA - K Series Wastes	RCRA - P Series Wastes	RCRA - U Series Wastes
Aluminum Nitrate, Nonahydrate	7784-27-2	None	None	None	None

14. TRANSPORT INFORMATION

DOT

UN-No: UN1438

Proper Shipping Name: Aluminum nitrate

Hazard Class 5.1

Subsidiary Class No information available

Packing group: III

Emergency Response Guide Number 140

Product code: A1095

Product name: ALUMINUM NITRATE,
NONAHYDRATE, CRYSTAL,
REAGENT, ACS

Page

Marine Pollutant No data available
DOT RQ (lbs): No information available
Special Provisions A1, A29, IB8, IP3, T1, TP33
Symbol(s): No information available
Description: UN1438, Aluminum nitrate, 5.1, III

TDG (Canada)

UN-No: UN1438
Proper Shipping Name: Aluminum nitrate
Hazard Class 5.1
Subsidiary Risk: No information available
Packing Group: III
Marine Pollutant No Information available
Description: UN1438, Aluminum nitrate, 5.1, III

ADR

UN Number UN1438
Proper Shipping Name: Aluminium nitrate
Transport hazard class(es) 5.1
Packing group III
Subsidiary Risk: No information available
Description: UN1438, Aluminium nitrate, 5.1, III

IMDG

UN-No: UN1438
Proper Shipping Name: Aluminum nitrate
Hazard Class: 5.1
Subsidiary Risk: No information available
Packing Group: III
Marine Pollutant No information available
EMS: F-A
Description UN1438, Aluminium nitrate, 5.1, III

RID

UN Number UN1438
Proper Shipping Name: Aluminium nitrate
Transport hazard class(es) 5.1
Subsidiary Risk: No information available
Packing group III
Description: UN1438, Aluminium nitrate, 5.1, III

ICAO (air)

UN-No: UN1438
Proper Shipping Name: Aluminium nitrate
Hazard Class 5.1
Subsidiary Risk: No information available
Packing Group: III
Description: UN1438, Aluminium nitrate, 5.1, III

IATA

UN Number UN1438
Proper Shipping Name: Aluminium nitrate
Transport hazard class(es) 5.1
Subsidiary Risk: No information available
Packing group III
Precautionary Statements - Response 5L

Special Provisions Description:

No information available
UN1438, Aluminium nitrate, 5.1, III

15. REGULATORY INFORMATION

International Inventories

Component	CAS No	U.S. TSCA	KOREA KECL	Philippines (PICCS)	Japan ENCS	China IECSC	Australia AICS	EINECS-No.
Aluminum Nitrate, Nonahydrate	7784-27-2	Exempt from listing on TSCA 8(b) Inventory since it is a hydrate. However the anhydrous form (CAS no. 13473-90-0) is listed as ACTIVE on the TSCA 8(b) Inventory.	Not present	Present	Not present	Present	Present	Not present

U.S. Regulations

Aluminum Nitrate, Nonahydrate

New Jersey RTK Hazardous Substance List: sn 3722 (as nitrate compounds)

New Jersey (EHS) List: SN 3722 500 lb. TPQ (as nitrate compounds)

New Jersey - Discharge Prevention - List of Hazardous Substances: Present (as nitrate compounds, water dissociable)

Minnesota - Hazardous Substance List: Present (as aluminum soluble salts)

California Directors List of Hazardous Substances: Present (as aluminum soluble salts)

California Prop. 65: Safe Drinking Water and Toxic Enforcement Act of 1986.

Chemicals Known to the State of California to Cause Cancer:

This product does not contain a chemical requiring a warning under California Prop. 65. (See table below)

Chemicals Known to the State of California to Cause Reproductive Toxicity:

This product does not contain a chemical requiring a warning under California Prop. 65. (See table below)

Component	CAS No	Carcinogen	Developmental Toxicity	Male Reproductive Toxicity	Female Reproductive Toxicity:
Aluminum Nitrate, Nonahydrate	7784-27-2	Not Listed	Not Listed	Not Listed	Not Listed

CERCLA/SARA

Component	CAS No	CERCLA - Hazardous Substances and their Reportable Quantities	Section 302 Extremely Hazardous Substances and TPQs	Section 302 Extremely Hazardous Substances and RQs	Section 313 - Chemical Category	Section 313 - Reporting de minimis
Aluminum Nitrate, Nonahydrate	7784-27-2	None	None	None	Nitrate compounds, water dissociable	1.0% diminimis concentration

U.S. TSCA

Component	CAS No	TSCA Section 5(a)2 - Chemicals With Significant New Use Rules (SNURS)	TSCA 8(d) -Health and Safety Reporting
Aluminum Nitrate, Nonahydrate	7784-27-2	Not Applicable	Not Applicable

Product code: A1095

Product name: ALUMINUM NITRATE, NONAHYDRATE, CRYSTAL, REAGENT, ACS

Page

Canada

WHMIS 2015 - GHS Classifications

WHMIS 2015 Hazard Classification Information:

Component
Aluminum Nitrate, Nonahydrate
7784-27-2 (100)

WHMIS 2015 Hazard Classification
Oxidizing solids - Category 3: H272 May intensify fire, oxidizer.;
Serious Eye Damage/Eye Irritation - Category 2A: H319 Causes serious eye irritation.

Canada Hazardous Products Regulation This product has been classified according to the hazard criteria of the HPR (Hazardous Products Regulation) and the SDS contains all of the information required by the HPR

DSL/NDSL

Component	CAS No	Canada (DSL)	Canada (NDSL)
Aluminum Nitrate, Nonahydrate	7784-27-2	Not Listed	Not Listed

Component	CAS No	CEPA Schedule I - Toxic Substances
Aluminum Nitrate, Nonahydrate	7784-27-2	Not listed

Component	CAS No	CEPA - 2010 Greenhouse Gases Subject to Mandatory Reporting
Aluminum Nitrate, Nonahydrate	7784-27-2	Not listed

EU Classification

EU GHS - SV - CLP 1272/2008

Component	CAS No	EU GHS - SV - CLP (1272/2008)
Aluminum Nitrate, Nonahydrate	7784-27-2	

EU - CLP (1272/2008)

R-phrase(s)

R 8 - Contact with combustible material may cause fire.
R36/38 - Irritating to eyes and skin

S -phrase(s)

S17 - Keep away from combustible material
S26 - In case of contact with eyes, rinse immediately with plenty of water and seek medical advice
S28 - After contact with skin, wash immediately with plenty of water
S45 - In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible)
S36/37/39 - Wear suitable protective clothing, gloves and eye/face protection

Component	CAS No	Classification	Concentration Limits:	Safety Phrases
Aluminum Nitrate, Nonahydrate	7784-27-2		No information	

The product is classified in accordance with Annex VI to Directive 67/548/EEC

Indication of danger:

O - Oxidising.

Product code: A1095

Product name: ALUMINUM NITRATE,
NONAHYDRATE, CRYSTAL,
REAGENT, ACS

Page

Xi - Irritant

Xi



O



16. OTHER INFORMATION

Preparation Date: 3/1/2019
Revision date 3/1/2019
Prepared by: Sonia Owen

Disclaimer:

All chemicals may pose unknown hazards and should be used with caution. This Safety Data Sheet (SDS) applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this SDS. The physical properties reported in this SDS are obtained from the literature and do not constitute product specifications. Information contained herein does not constitute a warranty, whether expressed or implied, as to the safety, merchantability or fitness of the goods for a particular purpose. Spectrum Chemicals & Laboratory Products, Inc. assumes no responsibility for results obtained or for incidental or consequential damages, including lost profits, arising from the use of these data. No warranty against infringement of any patent, copyright or trademark is made or implied. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this SDS is based on technical data judged to be reliable, Spectrum assumes no responsibility for the completeness or accuracy of the information contained herein.

End of Safety Data Sheet