

MATERIAL SAFETY DATA SHEET

SECTION 1: Product and Company Identification

Orbital Technologies Corporation
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Product Name: JSC Mars-1A Martian Regolith Simulant
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SECTION 2: Hazards Identification

Overview: JSC Mars-1A is a palagonitic tephra (volcanic ash altered at low temperatures). The material is mined from a cinder quarry and sieved to either a <1 mm fraction or <5 mm fraction. No milling or crushing has been completed on this material. Grain size distribution analysis conducted in 2007 has shown that it contains no particles <13 micron, which minimizes dust exposure concerns.

Caution: Excessive inhalation over long period may cause irritation to eyes and respiratory tract.

HAZARD	RATING (0-4)
Health	1 (Slight hazard)
Reactivity	0 (No hazard)
Flammability	0 (No hazard)
Exposure	1 (Slight hazard)
Storage	0 (No hazard)

Potential Health Effects:

Inhalation: May cause irritation to the respiratory tract if inhaled.
Skin Contact: No adverse effects expected.
Eye Contact: May cause irritation.
Chronic Exposure: No studies have been conducted on long-term effects.
Pre-existing conditions: Persons with impaired respiratory function may be aggravated by excessive inhalation over long periods.

See SECTION 11: Toxicological Information.

Potential Environmental Effects: None identified.

SECTION 3: Composition Information

JSC Mars-1A is dominated by amorphous palagonite. The only phases detected by x-ray diffraction are plagioclase feldspar and minor magnetite. Iron Mossbauer spectroscopy also detected traces of hematite, olivine, pyroxene and/or glass.

For chemical composition the normal convention for data presentation uses oxide formulae from an assumed oxidation state for each element (with the exception of Fe) and oxygen is calculated by stoichiometry. For example, silicon is analyzed as an element but presented as SiO₂. ***It is important to understand that these are representations of the chemistry and do not represent actual phases or minerals in the simulant.***

Major Element Composition	CAS #	% by Wt.
Silicon Dioxide (SiO ₂)	14808-60-7	34.5-44
Titanium Dioxide (TiO ₂)	13463-67-7	3-4
Aluminum Oxide (Al ₂ O ₃)	1344-28-1	18.5-23.5
Ferric Oxide (Fe ₂ O ₃)	1309-37-1	9-12
Iron Oxide (FeO)	1332-37-2	2.5-3.5
Magnesium Oxide (MgO)	1309-48-4	2.5-3.5
Calcium Oxide (CaO)	1305-78-8	5-6
Sodium Oxide (Na ₂ O)	1313-59-3	2-2.5
Potassium Oxide (K ₂ O)	12136-45-7	0.5-0.6
Manganese Oxide (MnO)	1344-43-0	0.2-0.3
Diphosphorus Pentoxide (P ₂ O ₅)	1314-56-3	0.7-0.9

SECTION 4: First Aid Measures

Inhalation: Move to fresh air. Get medical attention if symptoms occur.

Skin Contact: Wash exposed area with soap and water.

Eye Contact: Immediately flush eyes with water for 15 minutes. Get medical attention if irritation persists.

SECTION 5: Fire Fighting Measures

Fire: Not a fire hazard.

Explosion: No information found.

Fire extinguishing: Use any means suitable for extinguishing surrounding fire.

SECTION 6: Accidental Release Measures

Personal Precautions: Use personal protection recommended in Section 8.

Methods for Containment: No special instructions necessary.

Methods for Clean-Up: For spills, pick up and place in a suitable container for reclamation or disposal, using a method that minimizes creating airborne material.

SECTION 7: Handling and Storage

Handling: Use precaution when handling to minimize release of the material to the environment. Observe all warnings and precautions listed for this product.

Storage: Keep container closed when not in use and store in a cool, dry, ventilated area. Containers of the material may require caution when empty since they retain product residues.

SECTION 8: Exposure Controls/Personal Protection

Airborne Exposure Limits: No ACGIH TLV exposure limits have been determined for JSC Mars-1A, therefore a cautious approach would be to maintain exposure limits for nuisance dust as defined by OSHA (15 mg/m³) or ACGIH (10 mg/m³). JSC Mars-1A does not contain particles lower than 13 micron however.

Ventilation: No ventilation equipment is necessary, however a cautious approach for long term exposure would be use of a NIOSH/MSHA approved dust respirator.

Skin Protection: Wear protective gloves as a precaution.

Eye Protection: Use safety goggles as a precaution.

SECTION 9: Physical and Chemical Properties

Appearance: JSC Mars-1A <1 mm simulant is a red material similar to sand.
JSC Mars-1A <5 mm simulant is a red material similar to a sand and gravel mix.

Odor: None to slightly organic soil smell

Bulk Specific Gravity: 0.8 g/cm³

pH: No information

Magnetic Properties: JSC Mars-1A contains a highly magnetic component.

Approximately 25 wt.% of the material can be lifted with a strong magnet.

SECTION 10: Stability and Reactivity

Stability: Stable under ordinary conditions of use and storage.

Conditions to Avoid: None

Incompatible Materials: No information found

Hazardous Decomposition Products: No information found

SECTION 11: Toxicological Information

General Comments: Inhalation of dust may irritate nose, throat and lungs. Eye contact with solids may produce irritation. Use NIOSH nuisance dust masks or respirators and eye protection to avoid long term exposure to simulant if applicable during use.

SECTION 12: Ecological Information

No impact to the environment is expected if released.

SECTION 13: Disposal Considerations

Containers of the material may require caution when empty since they retain product residues..

SECTION 14: Transport Information

JSC Mars-1A ships as a Class 50 freight.

SECTION 15: Regulatory Information

Not regulated.

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