



SURFACE VEHICLE STANDARD

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Superseding J3107 JUL2020

Vacuum Excavation and Sewer Cleaning Equipment - Safety Requirements

RATIONALE

There is much confusion and many different interpretations within the industry regarding the 3 m distance described in 8.1.1 of the 2020 published SAE J3107. After discussions with industry experts, it was agreed that (1) clarifications are needed and that 4 m is more appropriate for the distance (clarified to be from the ground) being described in this clause, and (2) additional requirements related to the manual contents, as well as markings, should be added.

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1. SCOPE

This SAE Standard provides safety requirements for vacuum excavation and sewer cleaning equipment. This document is not intended to cover equipment addressed by other on-road federal, state, and local regulations. Truck-mounted or trailer-mounted vehicles are required to meet local or regional on-road requirements, as applicable.

1.1 Purpose

The purpose of this document is to provide guidance for design and user information to mitigate hazards associated with the use and maintenance of vacuum excavation equipment and sewer cleaning equipment.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J3106 Vacuum Excavation and Sewer Cleaning Equipment Classification and Nomenclature

2.1.2 ISO Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ISO 2867	Earth-Moving Machinery - Access Systems
ISO 3457	Earth-Moving Machinery - Guards - Definitions and Requirements
ISO 6750-1	Earth-Moving Machinery - Operator's Manual – Part 1: Contents and Format
ISO 10533	Earth-Moving Machinery - Lift-Arm Support Devices
ISO 12508	Earth-Moving Machinery - Operator Station and Maintenance Areas - Bluntness of Edges
ISO 13766-1	Earth-Moving and Building Construction Machinery - Electromagnetic Compatibility (EMC) of Machines with Internal Electrical Power Supply - Part 1: General EMC Requirements Under Typical Electromagnetic Environmental Conditions
ISO 13850	Safety of Machinery - Emergency Stop Function - Principles for Design
ISO 13857	Safety of Machinery - Safety Distances to Prevent Hazard Zones Being Reached by Upper and Lower Limbs
ISO 15817	Earth-Moving Machinery - Safety Requirements for Remote Operator Control Systems
ISO 15818	Earth-Moving Machinery - Lifting and Tying-Down Attachment Points - Performance Requirements

2.1.3 API Publications

Available from API, 1220 L Street, NW, Washington, DC 20005-4070, Tel: 202-682-8000, www.api.org.

API 2219 Safe Operation of Vacuum Trucks in Petroleum Service

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 NASSCO Publications

Available from NASSCO, 1314 Bedford Avenue, Baltimore, MD 21208.

Jetter Code of Practice: A guide for the selection and operation of sewer jetter equipment

2.2.2 WJTA Publications

Available from WaterJet Technology Association, 906 Olive Street - Suite 1200, St. Louis, MO 63101-1448.

Industry Best Practices for the Use of High-Pressure Waterjetting Equipment

Recommended Practices for the Use of Industrial Vacuum Equipment

2.2.3 Association of Equipment Manufacturer Safety Material

Available from Association of Equipment Manufacturers, 6737 West Washington St - Suite 2400, Milwaukee, WI 53214-5650.

Vacuum Excavator Safety Manual

High-Pressure Sewer Cleaner Safety Manual

2.2.4 ASME Publications

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), www.asme.org.

ASME B30.5:2018 Mobile and Locomotive Cranes

3. TERMS AND DEFINITIONS

Terms and definitions applicable to this SAE Standard can be found in SAE J3106 or as noted otherwise.

4. GENERAL

Equipment shall comply with the safety requirements of this standard.

5. ACCESS

5.1 Access systems shall be provided on the equipment for daily/weekly/monthly maintenance points as indicated in the operator's manual, all operational controls, and any relevant access points or locations. The access system shall:

- Minimize probability of a user being inadvertently restrained by devices such as protrusions, controls, steps, or handles catching or holding body appendages or user's wearing apparel.
- Minimize protrusions that could trip or increase severity of injury in case of a fall.
- Provide smooth hand grasp surfaces.
- Minimize probability of user contact with potential hazards such as extreme differentials in hot or cold, moving parts, electrical hazards, and sharp corners.

- Be obvious as to proper usage without special training.
 - Permit and, by proper placement of components, promote achievement of three-point support while ascending or descending the access system when more than 1 m above the ground.
 - Have slip-resistant surfaces (including any device or structural component designed as part of an access system) where the access system is designed for walking, climbing, stepping, or crawling.
- 5.2 When steps, handholds, platforms, guardrails, or walkways are provided, they should meet the dimensional and design requirements in ISO 2867.
- 5.3 For work or routine maintenance areas on the machine that exceed 1.8 m from a lower level, provisions (e.g., tie-off points, guardrail) for a fall protection system shall be provided.

6. OPERATOR'S CONTROLS

- 6.1 A key-locked system or similar protection against unauthorized use shall be provided.
- 6.2 Functions that can result in hazardous operation or motion, as defined by the manufacturer, shall require that an operator is at the controls and there is a means to prevent inadvertent actuation of controls.
- 6.3 Control functions shall be clearly and permanently identified.
- 6.4 Remote control systems shall meet the requirements of ISO 15817.

7. BOOM

- 7.1 Booms shall have a dedicated transport position which prevents unintentional movement.
- 7.2 The intended use of the boom shall be stated in the operator's manual.
- 7.3 If boom is intended for lifting, the lifting capacity shall be indicated in the operator's manual and on the machine.
- 7.4 Booms shall have a means to prevent hazardous unintended movement.

8. PROTECTIVE MEASURES AND DEVICES

8.1 Electrical Hazards

8.1.1 Overhead Power Lines

Equipment with components (such as a boom or debris body) that are higher than or can be raised higher than 4 m (measured from the ground) shall be provided with information and warnings to the user to maintain distance from overhead power lines in accordance with federal, state, and local regulations.

This safety sign shall be visible from the operator's station and on the outside of the equipment warning of electrocution unless proper clearance to overhead power lines is maintained.

8.1.2 Buried Electrical Lines

When equipment is intended to excavate in an area where buried electrical lines may be present, the following requirements apply:

- Instructions shall be provided in the manual to locate buried electrical utilities prior to ground engagement in accordance with federal, state, and local regulations.
- Instructions shall be provided to use and maintain suitable electrically insulated boots and gloves.

- Dig tube, air, and water lance nozzle should be designed to minimize damage to insulation on electrical wires and other underground services.

8.2 Emergency Stop

An easily accessible or remotely controlled means of relieving suction shall be provided at the point of use when the force required to break the suction exceeds 222.5 N.

An emergency stop meeting the requirements of ISO 13850, stop category zero, to rapidly shut down the air, water, and vacuum systems, shall be provided near the operator's controls.

8.3 Moving Parts

8.3.1 General

Guards shall meet the requirements of ISO 3457.

All moving parts that create a hazard shall be designed, positioned, or provided with protection to minimize the risk of crushing, shearing, and cutting. ISO 13857 shall be used to determine safe distances.

8.3.2 Power Take-Off

Power take-off shaft shall be guarded against inadvertent contact.

NOTE: Guards, shape of the surrounding envelopes, or any part of the machine can satisfy this requirement.

8.4 Dumping of the Body

Means shall be provided to avoid loss of control of the body when going over center (for example, counter balance valves).

8.5 Sharp Edges

Sharp edges and acute angles shall be in accordance with ISO 12508 in those areas that can be accessed in normal operations and routine maintenance.

8.6 Hot Surfaces

Thermal guarding shall be considered for preventing contact with hot surfaces ($>74^{\circ}\text{C}$) in the path of access systems and when accessing routine maintenance points according to manufacturer's recommendations. If guarding is not possible, a safety sign shall be used to warn of the thermal hazard.

8.7 Raised Components

Any raised component or load that could pose a hazard of crushing or pinching shall have a load-locking method.

When provided, prop devices shall be designed and tested to ISO 10533.

Hydraulic load-locking devices shall be evaluated for the possibility of a single-mode failure resulting in component falling.

8.8 Doors and Access Panels

A means shall be provided to secure doors or hinged access panels from falling or closing inadvertently and provide instructions for use if hazard will result. These means shall be capable of withstanding a wind speed of 29 km/h.

A means shall be provided to prevent doors and access panels from becoming a hazard during transport. For example, doors should be constructed in a way to close in the direction of travel.

8.9 Jetter Hoses

Guide fin assembly that prevents the nozzle from turning in the pipe shall be provided.

9. VISIBILITY

Visibility aids, such as mirrors or cameras, shall be used on truck mounted vacuum equipment to allow visibility to potentially hazardous areas (for example, rear of equipment during backing, etc.). Refer to local regulations for rear visibility test requirements.

10. LIFTING AND TRANSPORT

10.1 Securement of Tools

Provisions shall be made so that tools, hoses, attachments, and other devices can be securely attached to the equipment during transport. Instructions for securement of tools shall be provided in the operator's manual.

10.2 Skid-Mounted Equipment

Skid-mounted equipment shall be secured to the trailer or truck chassis with appropriately sized devices. Tie down points shall be provided to anchor the equipment during transport and the location of the tie down points shall be identified on the equipment. Instructions for tie down shall be provided in the operator's manual.

10.3 Lifting Requirements

Lifting points shall meet the requirements of ISO 15818. The conditions for lifting (e.g., recommend lifting only when empty) shall be provided.

11. EMC (ELECTROMAGNETIC COMPATIBILITY)

11.1 General

Vacuum excavator equipment and sewer cleaning equipment systems incorporating digital electronics should be tested as a system to ensure that they do not interfere with radio, television, and emergency broadcast services per FCC Part 15 rules.

Vacuum excavator equipment and sewer cleaning equipment systems incorporating digital electronics should be tested to ensure that they are not susceptible to external sources of electromagnetic interference that could induce unexpected hazardous movement or unintended function. The systems should be tested for radiated and conducted RF immunity, and electro-static discharge (ESD) according to ISO 13766-1.

11.2 Digital Devices and Systems

All digital devices and systems (for example, controllers, instrumentation, engine controllers) shall meet the EMC requirements (radiated and conducted emissions) of:

- FCC, for equipment sold in the U.S.
- Industry Canada, for equipment sold in Canada.

11.3 Wireless Devices and Systems

Wireless devices and systems (for example, remote controls, telematics) shall meet the requirements of:

- FCC Wireless Operations in ISM Band, for equipment sold in the U.S.
- ISED RSS 210, for equipment sold in Canada.

12. ELECTRONIC AND ELECTRICAL SYSTEMS

12.1 General

The following requirements shall be met:

- Electrical and electronic components shall be installed in such a way as to avoid damage from exposure to environmental conditions (corresponding to the intended use of the machine) that can cause deterioration.
- Wire insulation shall have flame-retardant properties.
- Lead-through (for example, through frames and bulkheads) shall be protected from abrasion.
- Wires/cables not protected by over-current devices shall not be strapped in direct contact with pipes or hoses containing fuel.
- Components installed exterior to the machine or directly exposed to the environment shall have a minimum degree of protection corresponding to IEC 60529, IP 55.
- The positive battery terminal, alternator, and starter terminals shall have an insulated cover.
- Where an electrical socket is provided, the voltage and current shall be marked.
- Wiring systems should comply with SAE J1614.

12.2 Over-Current Protective Devices

Unless specifically designed to be unfused (for example, starter motor, alternator, pre-heater), the fusing for the electrical equipment shall be as close as practical to the source. The protecting device for the load center (for example, fuse box, relay box) shall be near or adjacent to the battery.

Protection devices should be sized to protect the wire sizes attached to them. If a harness is split (separated into multiple wires), then the protection device shall also be placed immediately after the point of the split, unless protection device rating prior to the split is sufficiently low to protect the wire sizes after the split.

12.3 Batteries

Lead-acid batteries shall be firmly attached in a ventilated space.

13. PRESSURIZED SYSTEMS

13.1 General

Consideration should be given for insulating hand-held tools that may become hot during operation.

Air, hydraulic, vacuum, and water systems shall be equipped with a method to relieve pressure and/or vacuum; i.e., relief valve or frangible disk.

All system components shall be rated to the stated system pressure.

Hoses shall be guarded to meet the requirements of ISO 3457.

13.2 Hydro Excavation Lance

The lance shall have a non-locking, hold-to-run trigger. This trigger shall be guarded to minimize accidental activation.

13.3 Jetting

Appropriate nozzle skid and/or nozzle extension to prevent the hose from turning around in the pipe and instructions for use shall be provided.

Hose guards to protect the sewer hose from sharp edges and damage should be provided (for example, roller sets, hose guide, manhole roller).

A method shall be provided to protect the operator from hazards while jetting due to sewer hose failure (for example, use of PPE, guarding, jobsite control, operator control placement).

Hoses shall be designed to ensure proper connection (for example, size, configuration, color coding).

13.4 Air Excavation System

The air system shall be equipped with excess flow valve, automatic shut-off or other means to prevent out of control hose whip.

Hose ends shall be equipped with a fitting to help prevent unintended disconnect; for example, a Chicago-style fitting.

When a lance is stated to be non-conductive, electrically insulated, or dielectric, a rating shall be provided.

The lance shall have a non-lockable, hold-to-run trigger. This trigger shall be guarded to minimize accidental activation.

13.5 Pressure Off-Loading

A system shall be in place to avoid over pressurization of vacuum system.

The vacuum system shall be designed for the rated pressure.

A safety sign shall be placed on the equipment warning that the system can be pressurized.

A system shall be in place to isolate the vacuum hose from pressurized system.

A manual means shall be provided to safely depressurize the system after a loss of power.

14. HAZARDOUS ENVIRONMENTS

If vacuum system is intended to be used in potentially flammable or combustible situation, the machine shall be designed to meet the requirements in API 2219.

If vacuum system is intended to be used for collecting combustible dust or vapor, a method to dissipate static charge must be provided according to NFPA 77.

15. HAZARDOUS MATERIALS

15.1 If vacuum system is intended to be used to collect and transport hazardous materials on public roadways, the debris body shall meet DOT and Transport Canada requirements.

15.2 Design considerations for collecting hazardous materials shall include:

- Debris body composition.
- Seal/component compatibility.
- Filter compatibility.

15.3 Design considerations to consider for decontamination shall include the ability to:

- Clean and visually inspect all material flow paths.
- Clean or replace all filter media in the debris path.
- Clean and sanitize bio-hazard material.

16. WATER HEATERS

Systems equipped with water heaters shall include:

- A thermostat.
- Flame-out protection.
- Over-temperature protection.
- A device to help ensure minimum water flow (for example, flow switch, pressure switch).

17. INFORMATION FOR USE

17.1 The following information related to equipment specifications shall be provided either in the operator's manual or marked on the equipment. Refer to ISO 6750-1 for additional guidance.

- Maximum vacuum pressure.
- Maximum pressure of offloading system, if equipped.
- Maximum pressure of all water systems.
- Maximum pressure of all air systems.
- Pressure rating of air tools/hydraulic tools.
- Maximum height in transport configuration.
- Instructions on how to determine the maximum operating height of the equipment as configured.
- For skid-mounted equipment, the center of gravity of the skid and payload.
- Specific noise test conditions, if noise information is provided.
- Empty weight or instructions on how to have the equipment weighed.

17.2 The following general information shall be provided in the operator's manual:

- Intended use of the equipment.
- Proper location and content of safety signs.

17.3 The following specific information related to personal protection equipment that may be needed shall be provided by the manufacturer, along with instructions for the user to assess hazards to determine what is required. This equipment can include, but is not limited to:

- Hearing protection.