

(R) PERSONNEL PROTECTION FOR GENERAL PURPOSE INDUSTRIAL MACHINES

Foreword—This Reaffirmed Document has been changed only to reflect the new SAE Technical Standards Board Format.

1. Scope and Purpose—This SAE Standard is intended to be used as a guide for manufacturers and users of general purpose industrial machines to provide a reasonable degree of protection for personnel during normal operation and servicing. This document excludes skid steers which are covered by SAE J1388. Avoidance of accidents also depends upon the care exercised by such persons (see SAE J153). Inclusion of this standard in state, federal, or any laws or regulations where flexibility of revision is lacking is discouraged.

2. References

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

- SAE J38 AUG91—Lift Arm Support Device for Loaders
- SAE J99 MAR86—Lighting and Marking of Industrial Equipment on Highways
- SAE J115 JAN87—Safety Signs
- SAE J153 MAY87—Operator Precautions
- SAE J185 JUN88—Access Systems for Off-Road Machines
- SAE J208 AUG86—Safety for Agricultural Tractors
- SAE J297 JUN85—Operator Controls on Industrial Equipment
- SAE J386 JUN85—Operator Restraint Systems for Off-Road Work Machines
- SAE J674 NOV90—Safety Glazing Materials — Motor Vehicles
- SAE J717 FEB87—Auxiliary Power Take-Off Drives for Agricultural Tractors
- SAE J721 MAY87—Operating Requirements for Tractors and Power Take-Off Driven Implements
- SAE J725 MAR91—Mounting Brackets and Socket for Warning Lamp and Slow-Moving Vehicle (SMV) Identification Emblem
- SAE J920 SEP85—Technical Publications for Off-Road Work Machines
- SAE J943 JUN88—Slow-Moving Vehicle Identification Emblem
- SAE J1026 APR90—Braking Performance—In Service Crawler Tractors and Crawler Loaders
- SAE J1029 MAR86—Lighting and Marking of Construction and Industrial Machinery
- SAE J1042 FEB86—Operator Protection for General Purpose Industrial Machines
- SAE J1116 JUN86—Categories of Off-Road Self-Propelled Work Machines
- SAE J1170 JUN91—Rear Power Take-Off for Agricultural Tractors

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

QUESTIONS REGARDING THIS DOCUMENT: (412) 772-8512 FAX: (412) 776-0243
TO PLACE A DOCUMENT ORDER; (412) 776-4970 FAX: (412) 776-0790
SAE WEB ADDRESS <http://www.sae.org>

SAE J98 Revised NOV92

SAE J1362 JUN92—Symbols for Controls, Indicators, and Tell-Tales for Off-Road, Self-Propelled Work Machines

SAE J1388 JUN85—Personnel Protection—Skid Steer Loaders

SAE J1473 OCT90—Braking Performance—Rubber-Tired Earthmoving Machines

2.1.2 ANSI—AVAILABLE FROM ANSI, 11 WEST 42ND STREET, NEW YORK, NY 10036-8002

ANSI/SAE Z26.1—Safety Code for Safety Glazing Materials for Glazing, Motor Vehicles Operating on Land Highways

2.1.3 ASAE PUBLICATIONS—Available from ASAE, 2950 Niles Road, St. Joseph, MI 49085-9659.

ASAE S318.2—Safety Chain for Towed Equipment

ASAE S318.10—Safety for Agricultural Equipment

2.1.4 ECE PUBLICATION—Available from Economic Commission for Europe, Palais des Nations 1211 Geneve 10, Switzerland.

ECE Regulation #43—Uniform Provisions Concerning the Approval of Safety Glazing and Glazing Materials for Installation on Power Driven Vehicles and Their Trailers

2.1.5 ISO PUBLICATION—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 6405-2—Common symbols

3. Definitions

3.1 **General Purpose Industrial Machines**—Are defined as that class of tractors and associated equipment used in the operations such as landscaping, construction services, loading, digging, grounds keeping, and highway maintenance (see SAE J1116).

3.2 **Propelling Machines**—Are tractors or self-propelled units.

3.3 **Towed, Semi-mounted, And Mounted Equipment**—Are equipment used in conjunction with propelling machines as defined in 3.2.

3.4 **A Highway**—Is the entire width between the boundary lines of every way publicly maintained when any part thereof is open to the use of the public for purposes of vehicular travel. (Uniform Vehicle Code published by National Committee on Uniform Traffic Laws and Ordinances.)

3.5 **Acute Entry Angle**—Is the mesh point of gears or the run-on point where a belt or chain contacts a sheave, sprocket, or idler.

3.6 **A "Guard" Or "Shield"**—Is a barrier which is intended to prevent inadvertent contact with a potential hazard during operation.

3.7 **Guarded By Location**—A hazard is guarded by location when it is guarded by other parts or components of the machine that are not themselves guards, or when the hazard is beyond the safety distance.

4. Labels, Safety Signs, and Instructions

- 4.1 Safety signs shall be displayed to warn the operator and others of potential hazards during normal operations and servicing.
- 4.2 Safety signs shall conform to SAE J115.
- 4.3 Controls whose functions are not obvious should be identified. If symbols are used, they shall be in accordance with SAE J1362 or ISO 6405-2.

4.4 Operation, Service, and Maintenance Instructions

- 4.4.1 General operator instructions and field maintenance procedures shall be provided by manuals and/or machine signs. Manuals should have SAE J153 and SAE J920 as a guideline.

The manual shall also advise that: In addition to the design and configuration of equipment, hazard control and accident prevention are dependent upon the awareness, concern, and prudence and requires suitable training of personnel involved in the operation, transport, maintenance, and storage of equipment.

- 4.4.2 Written hazard avoidance instructions shall include identification of the need for personal protective equipment such as, but not limited to, protection for the eyes, ears, feet, hands, and head.
- 4.4.3 Stored energy devices can release energy in an uncontrolled and hazardous manner if not disconnected and/or disassembled following proper procedures. Signs identifying the potential hazard and its proper corrective action shall be provided on or near the device and/or to reference such procedures in the operator's manual. Examples of stored energy devices are spring loaded mechanisms, pressurized fluid systems, and hydraulic accumulators.
- 4.4.4 HYDRAULIC HAZARDS (IF APPLICABLE)—The operator's service and maintenance manuals shall contain:
 - a. A warning that hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin, and can cause serious injury and possibly death if proper medical treatment by a physician familiar with this type of injury is not received immediately.
 - b. Information cautioning to keep body and hands away from pin holes or nozzles which eject hydraulic fluid under high pressure and to use paper or cardboard and NOT HANDS to search for leaks.
 - c. Information cautioning the operator to make sure all hydraulic fluid connections are tight and all hydraulic hoses are in good condition before applying pressure to the system.
 - d. Information explaining how to minimize the hazard during the relieving of all pressure or force in each system before disconnecting the lines or performing work on the system.

5. Service

- 5.1 Servicing or adjusting shall be done with the engine stopped except where specific instructions to perform certain operations with the engine running are provided with the equipment.
- 5.2 Access shall be provided to the areas requiring regular servicing, adjusting, or inspecting.

6. Operator Controls

- 6.1 Location and movement of operator controls shall be in accordance with SAE J297.

SAE J98 Revised NOV92

6.2 Controls should be identified. If symbols are used, they shall be in accordance with SAE J1362.

6.3 Foot pedals shall be of adequate size, spacing, and appropriate configuration, and shall have either slip-resistant surfaces or other means of minimizing the possibility of operator's feet slipping off the pedals.

6.4 Hand controls shall be of appropriate configuration and size to permit an adequate grasp and hand clearance.

7. **Operating and Servicing Positions**

7.1 All propelling machines and equipment shall be equipped with access systems in accordance with SAE J185.

7.2 If the mounting step(s), ladder(s), or handhold(s) of the propelling machine are made inaccessible by installation of mounted equipment, similar facilities for steps and handholds shall be provided on the equipment.

7.3 A slip-resistant means shall be provided on the operator's platform to minimize the possibility of slipping.

7.4 Glazing material, such as glass or plastic used in cabs, shall be of a type and quality that minimizes the risk of injury due to fragmentation when fractured in accordance with SAE J674, except that:

7.4.1 Windshields may conform to tempered safety glass, Item 2 of ANSI Z26.1 (see draft latest issue).

7.4.2 Windshields may include zone toughened glass conforming to ECE Regulation Number 43 (see draft latest issue).

7.4.3 Curved and flat glazing material larger than 1.4 m² (15.1 ft²) for windshields and for side and rear windows of propelling machines may deviate from 7.4.1 requirements in that, when broken, what appears to be the 10 largest particles shall weigh no more than the equivalent weight of 64.5 cm² (10 in²) of the sample.

7.5 If the operation of the equipment or machine requires a second person on either the propelling machine or the equipment, a suitable position shall be provided which conforms to Section 7. Instructions shall discourage any other person from riding on either the equipment or the propelling machine.

7.6 All sharp edges and corners at the operator's station and entry way shall be appropriately treated to minimize potential hazard to the operator.

8. **Power Take-Off**—The power take-off (PTO) and power take-off drive lines shall conform to the provisions of SAE J1170, SAE J721, and the PTO section of SAE J208. Auxiliary power take-offs shall conform to SAE J717. Non-standard auxiliary drives intended to power only selected implements or attachments should be so identified.

9. **Tractor Rollover Protection**

9.1 Rollover Protective Structure (ROPS) and Falling Object Protective Structure (FOPS) shall be provided and conform to SAE J1042.

9.2 Batteries, fuel tanks, oil reservoirs, and coolant systems should be constructed, located, or sealed per guidelines in SAE J1042.

10. Shields or Guards

- 10.1 Traction Elements**—All propelling machines shall be provided with fenders or guards to minimize the possibility of the operator, when in the normal position within the operator's station, contacting moving traction elements, unless the propelling machine is fitted with equipment or other means of accomplishing this purpose.
- 10.2 Engine Components**—Provisions shall be made to minimize the possibility of personal contact with rotating components when the engine is running.
- 10.3 Heat Protection**—A guard or shield shall be provided to minimize inadvertent contact with surfaces hot enough to cause personal injury during normal operation or servicing.
- 10.4 Power Drives on Propelling Machines and Equipment**—The acute entry angles of exposed gears, belts, and chain drives and idlers shall be covered by shields, rods, mesh, or other portions of the machine to minimize the possibility of inadvertent contact.
- 10.5** Constant running drives, or drives that rotate when the engine is running with all clutches disengaged, shall have the outside face of pulleys, sheaves, sprockets, and gears, plus the sides at acute entry angles covered by a shield.
- 10.6** Rotating shafts and projections, such as exposed bolts, keys, or set screws on sprockets, sheaves or pulleys, shall be shielded unless guarded by location.
- 10.7** Ground drives shall be shielded in accordance with 10.4 and 10.6 if personnel are exposed to them while the drives are in motion.
- 10.8** Functional components, such as cutterbars, flail rotors, mixing augers, conveying augers, rotary tillers, and similar units which must be exposed for proper function shall be shielded to a degree consistent with the intended function of the component.
- 10.9** Access doors and shields, which present the risk of injury from functional components when not in place, shall not be readily detachable from the machine.
- 10.10** Access doors and shields for functional components which continue to rotate after the power is disengaged and present the risk of injury shall have a suitable safety sign provided in the immediate area.
- 10.11** Shields shall be free from sharp corners and projections.
- 11. Raised Components**—A means shall be provided to protect against inadvertent dropping of lifted components on propelling machines or equipment which must be in raised position for normal servicing or adjusting. (For front-end loaders, see SAE J38.)

12. Travel on Highways

- 12.1** Lighting and markings of propelling machines and equipment shall conform to SAE J99.
- 12.1.1** The operator's manual for the unit shall instruct the user to operate the flashing warning light whenever the propelling machine is on a highway except where such use is prohibited by law.

SAE J98 Revised NOV92

- 12.2 Hitch pins and other hitching devices shall be provided with a retainer to prevent accidental unhitching.
- 12.3 Components that are retracted to decrease transport width shall have a means for securing during transport.
- 12.4 Provisions shall be made for the use of safety chains on equipment which is towed behind motor vehicles on highways (see ASAE S338.2).
- 12.5 Slow moving vehicle identification emblem and mounting shall conform to SAE J943 and SAE J725.
13. **Braking and Parking Requirements**—Braking systems shall comply with SAE J1026 for crawler machines. Performance of brake systems for in-service wheeled machines shall comply with SAE J1473.
14. **Fire Protection**
- 14.1 Shields shall be provided for the engine manifolds, muffler, and exhaust pipe when necessary to prevent contact with flammable material normally associated with a given operation.
- 14.2 Sediment bowls used on gasoline engines shall be fire resistant.
- 14.3 Fuel tanks for gasoline engines shall have the air expansion volume vented. Leakage from the tank or vent should not occur at the manufacturers' maximum recommended machine operating angles.
15. Operator restraint system shall be per SAE J386 and SAE J1042, requirements for industrial machines.
16. **Lighting**—Lighting and marking of off-road machines shall conform to SAE J1029.
17. **Notes**
- 17.1 **Key Words**—Personnel protection, general purpose industrial machines, safety signs, labels, operator controls, power take-off, ROPS, FOPS, shields, guards, brakes, fire protection, lights
- 17.2 **Marginal Indicia**—The change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE SAE OFF-ROAD MACHINERY TECHNICAL COMMITTEE
SC25—GENERAL PURPOSE TRACTORS (INDUSTRIAL)