SURFACE VEHICLE INFORMATION REPORT

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Fire Prevention on Forestry Machinery

RATIONALE

J1212 has been reaffirmed to comply with the SAE five-year review policy.

FOREWORD

This document is an Information Report.

Forestry machinery operates in an organic material environment that commonly contains large quantities of combustible fuel in the form of wood dust, chips, and debris. In addition, elements of the machine such as fuel, hydraulic oil, tires, paint and plastics are ignitable. Forestry machinery is normally powered by an internal combustion engine and utilizes moving machinery components and electrical devices that are potential ignition sources. The machines are operated and maintained by people who have diverse knowledge, skills, policies, practices and awareness about fire prevention and safety. This combination of factors gives rise to a fire hazard level in the forestry industry that is generally acknowledged to be high. Some of these factors are influenced by design, manufacturing, service, maintenance, operation, training and job site management.

This document provides fire prevention information useful for the forestry machinery manufacturer and for the forestry machine user. Not all information applies to all machines. Adherence to the methods and recommendations of this report is not a guarantee of fire prevention.

Relationship of SAE Standard to ISO Standard: ISO 11850, “Machinery for forestry—Self-propelled machinery—Safety requirements” contains a section on fire safety.

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Tel: +1 724-776-4970 (outside USA)
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1. SCOPE

This document applies to off-road forestry work machines defined in SAE J1116 or ISO 6814.

1.1 Purpose

This document identifies major relevant factors and advises on actions that can be considered in minimizing the risk of fire on a forestry machine. This document is intended as a guide and is subject to change to keep pace with experience and technical advances.

2. REFERENCES

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version 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 724-776-4970 (outside USA), www.sae.org.

SAE J30 Fuel and Oil Hoses

SAE J115 Safety Signs

SAE J153 Operator Precautions

SAE J517 Hydraulic Hose

SAE J930 Storage Batteries for Off-Road Work Machines

SAE J1116 Categories of Off-Road Self-Propelled Work Machines

SAE J1942 Hose and Hose Assemblies for Marine Applications

SAE J1942/1 Qualified Hoses for Marine Applications

2.1.2 ISO Publications

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 3600:1996 Tractors, machinery for agriculture and forestry, powered lawn and garden equipment—Operator's manuals—Content and presentation

ISO 3795:1989 Road vehicles, and tractors and machinery for agriculture and forestry—Determination of burning behaviour of interior materials

ISO 6814:2000 Machinery for forestry—Mobile and self-propelled machinery—Terms, definitions and classifications

ISO 9244:1995 Earth-moving machinery—Safety signs and hazard pictorials—General principles

ISO 11684:1995 Tractors, machinery for agriculture and forestry, powered lawn and garden equipment—Safety signs and hazard pictorials—General principles

ISO 11850:2003 Machinery for forestry—Self-propelled machinery—Safety requirements

ISO 21507:2005 Earth-moving machinery—Performance requirements for non-metallic fuel tanks

2.1.3 NFPA Publications

Available from National Fire Protection Agency, 1 Batterymarch Park, Quincy, MA 02169-7471, Tel: 617-770-3000, www.nfpa.org.

NFPA 10 Standard for Portable Fire Extinguishers, 2002 Edition

2.1.4 UL Publications

Available from Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096, Tel: 847-272-8800, www.ul.com.

UL 711 Rating and Fire Testing of Fire Extinguishers, seventh edition, 2004

3. DEFINITIONS

3.1 Fire Fuel

Material that can burn readily, usually organic debris such as wood particles or liquids such as oil or solids such as rubber or plastics.

3.2 Fire Risk Area

A fire fuel, oxygen and an ignition source in immediate proximity to each other.

3.3 Hydraulic Fluid

The ignitable form of the liquid used for hydraulic systems. *(certain provisions of this document do not apply to non-flammable hydraulic fluid)*

3.4 Ignition Source

An object providing sufficient heat energy to ignite a fire fuel.

3.5 Wiring

Electrical conductors, including electrical wires, harnesses, cables and other related components such as connectors and inline fuses.

4. MACHINERY DESIGN

4.1 Risk Analysis

A fire risk analysis can be used to identify hazards and evaluate fire risks as part of the design process. Consideration of the fire risk is part of the product development process in which design decisions often balance conflicting objectives such as regulatory constraints, size and space limits, productivity targets and performance capabilities.

A low risk design avoids creation of hazards. Protective features can be used to reduce the risk if a hazard is unavoidable in the design. Warnings can supplement protective features and are generally necessary if protective features cannot be provided.

A fire risk analysis can be one of many tools for making design decisions. The analysis may be a part of the working process of the designer or it may be a formalized exercise using a pre-defined set of procedures.

4.2 Ignition Sources

Heat energy transfers from an ignition source to a suitable fire fuel material to ignite a fire. If the ignition source is identified and controlled, the risk of a fire can be reduced. Common ignition sources found on machines are hot surfaces, hot particles, and electrical current.

a. Isolation or shielding of the exhaust component surfaces of an engine can reduce the possibility of direct contact with ignitable debris or fluids.

b. Shields on brake components can reduce the accumulation of ignitable material around the brake pads and surfaces. Improper shielding may trap or collect combustible materials creating a risk.

c. Machine adjustment ranges, component wear, and debris accumulations are factors that can lead to friction heating by moving parts. Identification and access for maintenance of exposed moving parts can reduce the risk level.

d. Forestry machines with internal combustion engines are generally required by regulation, e.g. U.S. Code of Federal Regulations 1910.266(f)(6), to have an exhaust spark arresting capability. Application guidance for spark arresting devices, including full flow non-bypass turbochargers, is found in the U.S. National Wildfire Coordinating Group's Spark Arrester Guide NFES 1363.

e. A circuit over-load or short can overheat wiring or electrical devices and can cause ignition of a fire fuel. Electrical arcing can ignite fire fuels or gases. Circuit breakers or fuses provide over-current protection. Wiring restraints prevent insulation wear or damage. Guarding or shielding can reduce the risk level if electrical wiring is routed through a fire risk area.

f. Identification and easy access enables regular inspection and maintenance of battery and alternator cables. Battery cable end covers prevent accidental short circuits and arcing. Physical protection, restraints and short routing lengths can reduce the risk level of cables that do not have over-current protection.

g. A battery disconnect switch will de-energize the electrical system of a machine and prevent electrical hazards when the machine is not operating. Easy access to a clearly identified battery disconnect switch promotes regular use. Over-current protection can be used for wiring that must not be interrupted by a battery disconnect switch.

4.3 Fire Fuel Materials

Fire fuel materials can be ignited by an ignition source in the presence of oxygen. The risk of a fire is reduced by keeping fire fuel materials separated from an ignition source or oxygen.

a. Enclosures, shields and air circulation patterns limit the entry and accumulation of forestry debris around an engine. Minimizing the number and size of openings on an engine cover reduces the amount of debris material that can drop down onto the engine unless other provisions are made to avoid debris accumulation.

b. Accumulation of fire fuel material on the machine can be reduced by avoiding pockets and ledges, including those created by hose routings, brackets, shields and other components. Debris accumulations in the machine under-guarding and in areas where saturation of debris with leaking fuel and oil can occur can be hazardous. Providing easy service access to material accumulation areas promotes effective and regular cleaning.

c. Direct engine air intake pre-cleaner debris discharge away from engine hot surfaces or any other ignition sources.

d. SAE J930 provides installation guidance for batteries to reduce hazards associated with the accumulation of ignitable gases or vapors.

e. A higher flash point engine fuel can reduce the level of fire risk.

f. Fuel line routing to avoid fuel spillage in the event of a fuel line rupture or leak can reduce the fire hazard.

g. Qualified fuel hose systems that are capable of withstanding a 2.5 minute fire test are listed in SAE J1942 and SAE J1942/1.

h. A fuel or oil system that does not leak during machine operation or does not leak into a fire risk area if the machine is overturned and comes to rest on either side or upside down on a horizontal surface for an extended time period can reduce the level of fire risk.

i. Use of combustion resistant materials for hoses, tanks and other ignitable fluid containers can reduce the level of fire risk. ISO 21507 provides flammability requirements for non-metallic fuel tanks. SAE J30 and SAE J517 provide material specifications for fuel and hydraulic hoses.

j. Steel tube is an alternative for hoses that must be routed through a fire risk area such as near hot engine components.

k. A shield or cover that is not simultaneously a trap for debris can be used to contain or deflect an unexpected fluid spray or leak from fluid lines located in a fire risk area.

l. Selecting and positioning of fuel and hydraulic components to minimize leakage or spillage during normal servicing, including fueling, can reduce the level of fire risk.

m. The use of flame retardant material in the operator station can reduce the level of risk of operator injury in the event of a fire. A maximum burning rate of 4 inches / minute or 100 mm / minute is given in ISO 11850 for the burning rate when tested according to ISO 3795.

4.4 Fire Safety

a. Provide fire-prevention information and instructions to the machine owner and operator as required by ISO 3600 and ISO 11850 (part 5.1). Include considerations from Section 5 of this document as appropriate for the particular machine.

b. Provide instructions about general cleaning of debris and other combustible material from the machine including considerations from Section 5 of this document as appropriate for the particular machine.

c. Information labels or safety warning labels can be used to provide fire safety information from Section 5 of this document. SAE J115, ISO 9244, ISO 11684-1 and ISO 11684-2 provide guidance about labeling to identify, prevent and/or avoid hazards.

d. Consider the risk of operator injury in a fire event during operator egress design.

e. NFPA 10 or equivalent regulations require fitting one or more portable hand extinguishers. Mount the extinguisher(s) in a low fire risk area and select extinguisher(s) with a capacity rating appropriate for the size and type of machine, but not less than a 2A-10BC rating as defined in UL 711. Placement of one extinguisher in a position easily accessible from the operator's station enables rapid response. Other local regulations may apply. Regulatory requirements such as NFPA 10 may not be sufficient for some machines.

f. Placing identified fire extinguisher deployment (access) holes adjacent to fire risk areas that are not otherwise accessible aids fire suppression efforts. Multiple access hole locations can encourage dispersion of the extinguishing agent throughout the enclosed volume. Consider ergonomics in the placement of access holes. Access holes within reach from the ground offer advantages.

g. One or more clearly identifiable emergency shutdown switches on stationary or remote controlled machines, accessible from the ground and away from fire risk areas, may aid a rapid shutdown response.

5. MACHINE OPERATION AND MAINTENANCE

Effective prevention of fire in forestry machines requires that machine owners, operators and maintenance personnel understand the fire hazards of the particular operation, act in accordance with safe procedures, know how to operate fire safety devices and understand how fire hazard risks can change with the environmental conditions.

In order to help develop this knowledge and understanding, this section contains fire safety information that could be included in the machine's operation manual, on machine labels, in training materials and with other safety related communications.

5.1 Training

The machine owner, operation manager or similar authority assigns personnel to tasks and provides or verifies the training to do the tasks safely and in a manner that minimizes fire hazards. This responsibility could include a fire hazard analysis for the particular operation, fire prevention training and fire suppression training. Compliance with all local and governmental regulations that pertain to fire prevention is necessary.

a. Describe the purpose, use and maintenance of the fire prevention and fire suppression components of the machine. These components are not a substitute for diligent fire prevention efforts.