

Engineering Standard

SAES-B-068

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Electrical Area Classification

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Saudi Aramco DeskTop Standards

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1 Scope

- 1.1 This Standard shall be used for the electrical classification of areas in which flammable gases or vapors are, or may be, present, in the air in quantities sufficient to produce explosive or ignitable mixtures. Classification of new facilities, or extensions/additions to existing facilities shall be performed using the Class I/Zone/Group method per API RP 505 and, for selected facilities as specified below, NFPA 70.
- 1.2 Where this Standard is supplemented by or is in conflict with specialized requirements for offshore platforms covered in [SAES-B-009](#) and for bulk plants/air fueling operations, in SAES-B-070; those Standards shall govern.
- 1.3 The electrical classification of areas containing combustible dust (Class II) and easily ignitable fibers (Class III) atmospheres per NFPA 70 shall be developed with the concurrence of the Saudi Aramco Chief Fire Prevention Engineer.

2 Conflicts and Deviations

- 2.1 Any conflicts between this Standard and other applicable Saudi Aramco Engineering Standards (SAESs), Saudi Aramco Materials System Specifications (SAMSSs), Saudi Aramco Standard Drawings (SASDs), or industry standards, codes, and forms shall be resolved in writing by the Company or Buyer Representative through the Manager, Loss Prevention Department of Saudi Aramco, Dhahran.
- 2.2 Direct all requests to deviate from the Standard in writing to the Company or Buyer Representative, who shall follow internal company procedure [SAEP-302](#) and forward such requests to the Manager, Loss Prevention Department of Saudi Aramco, Dhahran.

3 References

All referenced Specifications, Standards, Codes, Forms, Drawings, and similar material shall be considered part of this Standard to the extent specified herein and shall be the latest issue (including all revisions, addenda, and supplements) unless stated otherwise.

3.1 Saudi Aramco Standards

Saudi Aramco Engineering Procedure

[SAEP-302](#)

*Instructions for Obtaining a Waiver of a
Mandatory Saudi Aramco Engineering
Requirement*

Saudi Aramco Engineering Standards

<u>SAES-B-009</u>	<i>Fire Protection and Safety Requirement for Offshore Production Facilities</i>
<u>SAES-J-502</u>	<i>Analyzer Shelters</i>
<u>SAES-J-902</u>	<i>Electrical Systems for Instrumentation</i>
<u>SAES-J-903</u>	<i>Intrinsically Safe Systems</i>
<u>SAES-K-002</u>	<i>Air Conditioner Systems For Essential Operating Facilities</i>
<u>SAES-P-100</u>	<i>Basic Power System Design Criteria</i>
<u>SAES-P-103</u>	<i>Direct Currents and UPS Systems</i>
<u>SAES-T-151</u>	<i>Communication DC Power System</i>

3.2 Industry Codes and Standards

American Petroleum Institute

<i>API RP 500</i>	<i>Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1, and Division 2</i>
<i>API RP 505</i>	<i>Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2</i>

National Fire Protection Association

<i>NFPA 30</i>	<i>Flammable and Combustible Liquids Code</i>
<i>NFPA 30A</i>	<i>Automotive and Marine Service Station Code</i>
<i>NFPA 59</i>	<i>Storage and Handling of Liquefied Petroleum Gases at Utility Gas Plants</i>
<i>NFPA 70</i>	<i>National Electrical Code (NEC)</i>
<i>NFPA 325</i>	<i>Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids</i>
<i>NFPA 496</i>	<i>Purged and Pressurized Enclosures for Electrical Equipment</i>

4 Definitions

***An adequately ventilated outdoor location** is any space which is open and free from obstruction to the natural passage of air through it, vertically or horizontally. Such locations may be roofed over and/or closed on one side.

***An adequately ventilated indoor location** is one that meets the conditions noted in API RP 505 Section 6.6 on Ventilation.

A Classified Location is as follows:

A Class I, Zone 0 location is an area that meets one of the following:

- in which ignitable concentrations of flammable gases or vapors are present continuously
- in which ignitable concentrations of flammable gases or vapors are present for long periods of time

A Class I, Zone 1 location is an area that meets one of the following:

- in which ignitable concentrations of flammable gases or vapors are likely to exist under normal operating conditions
- in which ignitable concentrations of flammable gases or vapors may exist frequently because of repair or maintenance operations or because of leakage
- in which equipment is operated or processes are carried on, of such a nature that equipment breakdown or faulty operations could result in the release of ignitable concentrations of flammable gases or vapors and also cause simultaneous failure of electrical equipment in a mode to cause the electrical equipment to become a source of ignition
- that is adjacent to a Class I, Zone 0 location from which ignitable concentrations of vapors could be communicated, unless communication is prevented by adequate positive pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided.

A Class I, Zone 2 location is an area that meets one of the following:

- in which ignitable concentrations of flammable gases or vapors are not likely to occur in normal operation and if they do occur they will exist only for a short period
 - in which volatile flammable liquids, flammable gases, or flammable vapors are handled, processed, or used, but in which the liquids, gases, or vapors normally are confined within closed containers or closed systems from which they can escape, only as a result of accidental rupture or breakdown of the container or
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system, or as the result of the abnormal operation of the equipment with which the liquids or gases are handled, processed, or used.

- in which ignitable concentrations of flammable gases or vapors normally are prevented by positive mechanical ventilation, but which may become hazardous as a result of failure or abnormal operation of the ventilation equipment
- that is adjacent to a Class I, Zone 1 location, from which ignitable concentrations of flammable gases or vapors could be communicated, unless such communication is prevented by adequate positive pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

***Combustible gases and vapors:** gases and vapors that can form flammable or explosive mixtures with air.

***A combustible liquid:** is a liquid that has a flash point greater than 54°C.

***A flammable liquid:** is a liquid that has a flash point equal to or less than 54°C.

***Heavier-than-air gas/vapor:** is a gas/vapor with a density under release conditions that is equal to or greater than 75% of that of air at atmospheric pressure and 15°C.

***Lighter-than-air gas/vapor:** is a gas/vapor with a density under release conditions that is less than 75% of that of air at atmospheric pressure and 15°C.

A nonclassified location: is one which is completely outside Class I, Zone 0, Zone 1 and Zone 2 classified locations.

Also in the "nonclassified location" category are those enclosed spaces, not containing a release source, in Class I, Zone 0, Zone 1, Zone 2 locations, that are pressurized or purged by inert gas or by air taken from nonclassified locations by systems that comply with type "X" or type "Z" purging, respectively, per NFPA 496.

***A volatile liquid:** is defined as any of the following: a flammable liquid, a combustible liquid at a temperature within 8°C of its flashpoint or at a temperature equal to or above its flashpoint.

** indicates the definition is different from the definition used in API RP 505*

5 General Design

5.1 Area Classification Drawings shall be developed for all facilities where flammable liquids, gases, or vapors are produced, processed, stored or handled. This applies to new facilities, or extensions/additions to existing facilities. The classification shall be performed using the Class I/Zone/Group method per the guidelines within API RP 505 and this standard. Extensions/additions to

existing facilities already classified by the "Division" method can be classified by the same method with approval of the Chief Fire Prevention Engineer. For this purpose use API RP 500 and the historical standard SAES-B-068 issued December 1, 1996 in consultation with the Chief Fire Prevention Engineer.

Commentary Note:

If a "Zone" classification is added to an existing facility that was classified by the Class I/Division/Group method, it is highly recommended that the entire facility be re-classified to the "Zone" classification. Refer to Section 7 for guidelines to perform this reclassification. Converting to "Zone" from the "Division" system will maximize the long-term operational benefits and is in the best interests of the entire facility to be converted to a consistent "Zone" classification system.

5.2 Ventilation

Indoor locations shall be designated "adequately ventilated" if the conditions noted in Section 6.6, Ventilation, of API RP 505 are met.

5.3 Mixtures of Gases or Vapors of Different Ignition Temperatures

Where a mixture of gases or vapors is composed of gases/vapors of different ignition temperature, designation of the ignition temperature of the mixture shall be by any one of the following methods:

5.3.1 The ignition temperature of that gas/vapor in the mixture having the lowest individual ignition temperature per NFPA 325.

5.3.2 The ignition temperature of the mixture as determined by a test specified in NFPA 325.

5.3.3 The ignition temperature as determined by calculations that have been reviewed and accepted by the Chief Fire Prevention Engineer, Dhahran.

5.4 Mixtures of Gases of Different Densities

For a gas or mixture of gases composed entirely of lighter-than-air gases, the extent of the classified location shall satisfy the requirements for lighter-than-air vapors.

Where a mixture is composed of lighter-than-air and heavier-than-air gases and the mixture density is less than 75% of the density of air at standard conditions, the extent of the classified area shall satisfy the requirements for lighter-than-air vapors.

Where the mixture has a density equal to or greater than 75% of air at standard conditions, it shall be considered as a heavier-than-air vapor for area classification purposes.

5.5 Mixtures of Gases of Different Groups

Where a mixture contains gases of different Groups per NFPA 70, the area classification shall satisfy the requirements for every Group for which the aggregate volume of gas constitutes 30% or more of the mixture composition.

5.6 Electrical Area Classification Drawings

The development of the electrical classification drawings shall follow the guidelines presented within API RP 505. These drawings shall be produced as part of any project proposal, final design, and as-built issue of drawings for any capital or maintenance project that creates or changes the extent of an electrically classified location. Electrical area classification drawings shall be submitted to the Chief Fire Prevention Engineer (Loss Prevention Department) and the Supervisor, Electrical Unit (Consulting Services) or their representatives for review. The drawings shall, as a minimum, show the following information:

5.6.1 The demarcation of the Zone 0, 1, 2 and unclassified areas, both vertically and horizontally via plan, elevation, and section views.

5.6.2 The minimum ignition temperature of the mixture of gases/vapors creating each classified location.

5.6.3 The type of gas or vapor in each of the classified areas. This shall be presented as the name(s) of the gas/vapor and by the Group IIA, B, or C designations defined within NFPA 70 and API RP 505.

5.7 Typical relationship between Zone classification and the presence of flammable mixtures can be seen in the following rule-of thumb.

Zone	Flammable Mixture Present
0	1000 or more hours/year (10%)
1	10 < hours/year < 1000 (.1% to 10%)
2	1 < hours/year < 10 (.01% to .1%)
unclassified	Less than 1 hour/year (.01%)

Refer to API RP 505 section 6.5.8 for further details.

5.8 For electrical equipment design and installation requirements, refer to [SAES-P-100](#). Instrumentation in hazardous areas shall meet listing/certification requirements specified in [SAES-J-902](#) and [SAES-J-903](#).

6 Extent of Classification Locations

6.1 General Conditions

The distances specified in this section are the minimum distances necessary to delineate the electrically classified location created by a specific release point or piece of equipment.

6.2 General Release Sources

A release source is a point or location from which a flammable gas, vapor or liquid may be released into the atmosphere such that an ignitable gas atmosphere could be formed. Given below are designated release sources. For each source, rules are given for determining the extent of the classified location attributable to it. These directions shall be used in all circumstances unless specific direction is given otherwise in Sections 6.3 or 6.4.

For figures, refer directly to the API RP 505 and NFPA references cited. Where Figure 20, 21 or 22 is referenced in this Standard, the "additional Zone 2 area" is mandatory.

- 6.2.1 For relief valves venting to atmosphere, the classified area shall be determined by:
- a) Figure 20, or Figure 21, when the source is adequately ventilated and the gas/vapor is heavier than air.
 - b) Figure 24, when the source is adequately ventilated and the gas/vapor is lighter than air.
 - c) Figure 22, when the source is inadequately ventilated and the gas/vapor is heavier than air.
 - d) Figure 25, when the source is inadequately ventilated and the gas/vapor is lighter than air.
 - e) The termination of a relief valve discharge, the associated weep hole, and the bonnet vent shall each be a "source".
 - f) A non-flowing pilot on a pilot-operated relief valve shall not be a "source".
- 6.2.2 For packing glands or seals on pumps and compressors the classified area shall be determined by:
- a) Figure 20, Figure 21, when the source is adequately ventilated and the gas/vapor is heavier than air.
 - b) Figure 24, when the source is adequately ventilated and the gas/vapor is lighter than air.
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- c) Figure 22, when the source is inadequately ventilated and the gas/vapor is heavier than air.
 - d) Figure 25, when the source is inadequately ventilated and the gas/vapor is lighter than air.
- 6.2.3 For threaded fittings that are not seal-welded, the classified area shall be determined by:
- a) Figure 20, Figure 21, when the source is adequately ventilated and the gas/vapor is heavier than air.
 - b) Figure 24, when the source is adequately ventilated and the gas/vapor is lighter than air.
 - c) Figure 22, when the source is inadequately ventilated and the gas/vapor is heavier than air.
 - d) Figure 25, when the source is inadequately ventilated and the gas/vapor is lighter than air.
 - e) Adequately ventilated threaded fittings that are not seal-welded shall not be considered release sources when containing fuel gas with a maximum gauge operating pressure of 350 kPa (50 psig).
- 6.2.4 For the atmospheric terminations of sample stations, the classified area shall be determined by:
- a) Figure 20, Figure 21, when the source is adequately ventilated and the gas/vapor is heavier than air.
 - b) Figure 24, when the source is adequately ventilated and the gas/vapor is lighter than air.
 - c) Figure 22, when the source is inadequately ventilated and the gas/vapor is heavier than air.
 - d) Figure 25, when the source is inadequately ventilated and the gas/vapor is lighter than air.
 - e) When sampling frequency is equal to or greater than once a week, the space within 1.5 m of the termination (the "source") shall be classified as Class I, Zone 0 in Figures 20, 21, 24, and 25.
- 6.2.5 For the manways and piping-to-vessel connections on process vessels and the piping-to-equipment connections on process equipment, the classified area shall be determined by:
- a) Figure 22, when the source is inadequately ventilated and the gas/vapor is heavier than air.
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- b) Figure 25, when the source is inadequately ventilated and the gas/vapor is lighter than air.
 - c) When the source in 6.2.7 is adequately ventilated, the Class I, Zone 2 area shall extend for 3 m around it. This is for all gases/vapors, irrespective of whether they are lighter than air or heavier than air.
 - d) Connections on adequately ventilated vessels and equipment containing fuel gas at a maximum gauge operating pressure of 350 kPa (50 psig) shall not be considered release sources.
 - e) Connections on furnaces, fired boilers, fired heaters, incinerators, and other equipment containing open flames shall not be considered release sources. See Note (f) of paragraph 6.2.7.
- 6.2.6 For flanges, fittings, and valve stems, the classified area shall be determined by:
- a) Figure 22, when the source is inadequately ventilated and the gas/vapor is heavier than air.
 - b) Figure 25, when the source is inadequately ventilated and the gas/vapor is lighter than air.
 - c) When the source is adequately ventilated, it shall not create a classified location.
- 6.2.7 For the terminations of vents and drains (this includes vents and drains on all instrumentation impulse lines containing volatile liquids or combustible gas) that have to be opened to the atmosphere as part of normal operation, the classified area shall be determined as follows:
- a) Figure 20 and 21, when the source is adequately ventilated and the gas/vapor is heavier than air.
 - b) Figure 24, when the source is adequately ventilated and the gas/vapor is lighter than air.
 - c) Figure 22, when the source is inadequately ventilated and the gas/vapor is heavier than air.
 - d) Figure 25, when the source is inadequately ventilated and the gas/vapor is lighter than air.
 - e) Vents and drains that are installed solely for hydrotest, steam-out, and maintenance and that are plugged or blinded, shall not be designated as release points.
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- f) Vents and drains to the atmosphere on fired equipment and other equipment having a continuous source of ignition shall be considered a release source, irrespective of Note (e) of Paragraph 6.2.6 of this Standard.

6.3 Special Systems

The areas in the following systems shall be classified with reference to the noted sections from NFPA. Areas classified under the Division classification system should be reclassified as Zone 0, Zone 1 and Zone 2 based on the intent of API RP 505. Where the referenced standard has not been updated to zone classification, use API RP 505 in conjunction with this standard, sound engineering and safety design. Final drawings must be approved by the Chief Fire Prevention Engineer.

- 6.3.1 Aircraft Hangars: NFPA 70, Article 513
- 6.3.2 Bulk Storage Plants and Aircraft Fueling System: NFPA 70, Article 515
- 6.3.3 Commercial Garages Repair and Storage: NFPA 70, Article 511
- 6.3.4 Container and Portable Tank Storage: NFPA 30, Chapter 4
- 6.3.5 Gasoline Dispensing and Service Stations: NFPA 70, Article 514; NFPA 30A, Chapter 6
- 6.3.6 Spray Application, Dipping, and Coating Processes: NFPA 70, Article 516
- 6.3.7 Health Care Facilities: NFPA 70, Article 517
- 6.3.8 Facilities that store or handle of liquefied petroleum gas (LP-Gas): NFPA 59, Chapter 1

6.4 Special Release Sources and Equipment

The extent of the classified area in relation to the following release sources and equipment shall be as stated below. When conflict arises between the specific requirements of this paragraph and those given in paragraph 6.2, the requirements of this paragraph shall take precedence.

- 6.4.1 The interior of analyzer houses shall be classified as Class 1 Zone 1 and group consistent with liquids or gases being handled. Other requirements for specific electrical equipment installed in analyzer shelters are found in [SAES-J-502](#).
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- 6.4.2 Battery rooms that are adequately ventilated according to requirements in [SAES-P-103](#) and [SAES-T-151](#) are nonclassified. For interiors of unventilated battery rooms, electrical area classification shall be Class I, Zone 1, Group IIC. Refer to [SAES-K-002](#) for further requirements.
- 6.4.3 Drainage ditches, swales, and associated remote impounding basins (located in unclassified areas) for process location surface drainage shall create a Class I, Zone 2 location, as follows:
- a) Within ditches and swales.
 - b) The space between grade elevation and 0.6 m above the top of ditches and swales. This shall extend from the centerline of the ditch or swale at this elevation to points 4.5 m from the edges of the ditch or swale.
 - c) Within an impounding basin, up to the top of its dike.
- 6.4.4 Pits, sumps, open trenches, and any other below-grade locations in Class I, Zone 2 locations shall be classified as Class I, Zone 1.
- 6.4.5 Laboratory hoods, ducting, and storage rooms shall be classified as follows:
- a) Enclosed space of fume hood: Class I, Zone 1.
 - b) Exhaust ducting associated: Class I, Zone 1 with fume hoods.
 - c) Vent for exhaust ducting: Per requirements of paragraph 6.2.7 for vents.
 - d) Storage rooms for samples and chemicals: Per requirements of paragraph 6.3.4.
- 6.4.6 Oily water sewer systems shall be classified as follows:
- 6.4.6.1 Class I, Zone 0 locations shall be:
- a) Within manholes.
 - b) Within catch basins.
 - c) Within lift stations and sumps.
 - d) Within all underground piping.
 - e) Within all vents.
 - f) Within .5 m of the termination of vents from the following: manholes, lift stations, sumps, underground piping systems.
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As indicated on API RP 505, Figure 27 for unit separators, pre separators, and separators.

- 6.4.6.2 Class I, Zone 1 within .5 m and 1.5 m from the vents of the following: manholes, lift stations, sumps, underground piping systems.
- 6.4.6.3 Class I, Zone 2 within 1.5 m and 3 m from the vents of the following: manholes, lift stations, sumps, underground piping systems.
- 6.4.7 Sanitary sewer systems shall be classified as follows:
 - 6.4.7.1 Class I, Zone 1
 - a) Inside lift stations.
 - b) Space within 1.5 m of termination of vent from lift stations.
 - 6.4.7.2 Class I, Zone 2
 - a) Space between 1.5 m and 3 m of termination of vents from lift stations.
 - b) 0.6 m from the edge and 0.6 m above the cover of a sanitary sewer lift station.
- 6.4.8 For onshore bulk plant or fuel terminal loading / unloading bays, the general 3-dimensional area within the rack curbs and between grade and the canopy, shall be Class I, Zone 2 for the purposes of installing fixed instrumentation and electrical equipment. Point sources, such as catch basins (see 6.4.6 above), shall be treated separately. Refer to SAES-B-070 for other requirements.
- 6.4.9 Offshore oil and product loading facilities shall be classified in accordance with API RP 505, Figure 19, Marine Terminal Handling Flammable Liquids.

Commentary Note:

A comprehensive location classification for a marine terminal would include classified locations due to other release points present on the loading facility. For example, when water level changes may result in vapors from cargo tank vents, ullage openings or sump vents to collect underneath the berth deck, consideration should be given to classifying underneath the deck as Zone 1. Most ships have elevated venting or high velocity valves which should prevent ship source vapors from being a continuous problem, but each facility should evaluate this

depending on it's service and layout. This requirement and Figure 19 represent classification due only to ship venting, loading arms and hoses. It does not consider other sources of vapors such as slop tank vents, relief valves, or vapor recovery compressors.

- 6.4.10 Single Point Mooring Buoys (SPMB) are classified as Class I, Zone 2 locations to a distance 1.5 m vertically above the highest possible hydrocarbon release source and horizontally to the outer edge of the buoy. The inner chamber of Catenary Anchor Leg Mooring (CALM) type buoys is classified as a Class I, Zone 0 location.
- 6.4.11 Pipeways at grade which are bordered by elevated roads or dike walls, all of height 1 m or greater, on two sides shall create electrically classified locations as follows:
- **Nonclassified:** When the minimum distance between the outer edge of the pipeway and the closer wall is 30 m or greater.
 - **Class I, Zone 2:** When the minimum width between dike walls or roads is 30 m but the minimum distance between the outer edge of the pipeway and the closer wall is less than 30 m.
 - **Class I, Zone 1:** When the minimum width and length is less than 30 m.
- 6.4.12 In tank farm areas, pumps which are located at the edge of a pipeway and which are bordered on the other three sides by dikes or walls of 1 m height or more shall create classified locations as follows:
- Class I, Zone 1: When the linear dimension between opposite walls is less than 30 m.
 - Class I, Zone 2: When the linear dimension between opposite walls is 30 m or greater.
- 6.4.13 The classified area created by dissolved air flotation units and biological oxidation units shall be per API RP 505, Figure 27.
- 6.4.14 Scraper traps shall create a classified area per API RP 505, Figure 49.
- 6.4.15 Release sources and points associated with drilling and oil wells shall be classified per the requirements of the following drawings of API RP 505:
- a) Drilling Rig - Figures 29, 30, 31 and 32
 - b) Mud Tank - Figures 33 and 34
 - c) Vibrating Shale Shaker - Figure 35
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- d) Desander/Desilter - Figures 36 and 37
- e) Flowing Well - Figures 39, 40, 41, 42, 43, 44, 45, 46 and 47

6.4.16 Areas associated with mechanical draft evaporative cooling towers handling process water and serving heat exchangers handling volatile liquids or combustible gas shall be classified per API RP 505, Figure 28.

7 Conversion to Zone from Division

The following guidelines should be used when converting an existing Division/Group classification to a Zone/Group classification.

7.1 Gas Group Reclassification:

- a) Change "Group A" and "Group B" to "Group IIC".
- b) Change "Group C" to "Group IIB".
- c) Change "Group D" to "Group IIA".

7.2 Electrical Area Reclassification:

- a) For Division 1 areas apply API RP 505 and have the electrical area classification drawings approved by the Chief Fire Prevention Engineer.
- b) Change "Division 2" areas to "Zone 2" areas

Commentary Note:

For existing facilities that are not yet reclassified, P&CSD (Instrument Unit Supervisor) and the Chief Fire Prevention Engineer or their representatives shall approve Zone 1 certified instrumentation within an existing Division 1 area. Zone 1 equipment may not be appropriate since Division 1 contains both Zone 1 and Zone 0 conditions. Only listed intrinsically safe equipment shall be installed in Zone 0 conditions per [SAES-J-903](#).

28 May, 2003

Revision Summary
Major revision.