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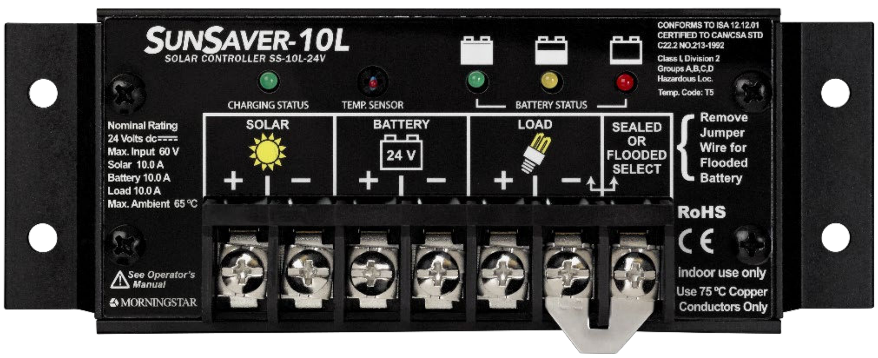
Understanding Class 1 and Division 2—a primer



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As counter-intuitive as it might sound, the fossil-fuel industry—particularly oil and gas—depends on the renewable energy industry for many aspects of extraction, production and transportation.

By nature, pumping and mining operations are often very removed from any access to the electrical grid, and using generators is often prohibitively expensive and impractical based on maintenance and fueling requirements. At the well, renewables increasingly are called upon to power injection pumps, lighting equipment, and monitoring devices. Along the pipeline, renewables are often the only means of providing cathodic protection to prevent corrosion and ensure pipeline integrity. Across the board, renewable energy provides cost-effective, dependable electricity for mission-critical communications, data acquisition, metering, site security, and much more.

For this reason, both oil & gas and mining operators have been significant customers for off-grid photo-voltaic (PV) solar electric solutions. Working with some of the leading operators, the question often comes up as to what exactly does the Hazardous Locations (Class 1, Division 2 Groups A-D) Classification actually mean—and why should operators look for it when specifying off-grid solar-powered components and systems? This Primer answers those questions and provides a quick, high-level overview of the Classification Standards.

Hazard protection: a two-way street

Along with protecting electrical devices *from* their surrounding environment, protection in this case also refers to protecting the *environment* from the devices themselves, in situations where an unprotected electrical device might have the potential to spark an explosion or cause a fire.

Specifically, protecting electrical equipment in hazardous locations (such as the one pictured below) dictates special considerations to make sure that both the electronics and their enclosures are designed to operate in such a way that is ignition and explosion proof. Toward that end, the United States' National Electrical Code (NEC) Division and Canadian Standards Association (CSA) have established hazardous locations classification systems and define hazardous locations by class and division. Industrial solar electrification systems that operate in hazardous locations in and around the U.S. or Canada, such as those present in many oil and gas operations, must be explosion proof and their electrical specifications must comply with this classification system.

In other parts of the world, areas containing potentially explosive atmospheres are dealt with using a "Zone System" classification scheme. Zones are based predominantly on the International Electro-technical Commission (IEC) and the European Committee for Electro-technical Standardization (CENELEC) standards. The most significant difference in the "Zone System" is that the level of hazard probability is divided into three Zones as opposed to two Divisions, as with the NEC and CSA standards.

The following chart provides an executive summary of global Hazardous Location Classification basics:

Hazardous Materials	Class / Division System	Zone System (1)
Gasses or Vapors (1)	Class 1, Division 1	Zone 0, Zone 1
	Class 1, Division 2	**Zone 2**
Combustible Dusts (2)	Class 2, Division 1	Zone 20, Zone 21
	Class 2, Division 2	Zone 22
Fibers or Flyings	Class 3, Division 1	No Equivalent
	Class 3, Division 2	

(1) *The United States & Canada have adopted Zones for Gasses and Vapors.*
(2) *Zones for Dust are not yet developed for North America.*

For the purposes of this brief, the North American Class 1, Division 2 classification system alone is being highlighted, along with the reason why charge controllers used in these stand-alone solar powered industrial electrical systems must be correctly certified. In the context of a solar electric system, the charge controller is usually the electrically-active component that's both "heart and brains" of the outfit, controlling the PV/solar-generated electricity flowing from the modules into batteries for storage as well as the DC output to power connected loads, ensuring both system operation and battery health. This means having the correct certification is critical at the charge controller level.

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The breakdown of those certifications is as follows:

A **Class** includes the industrial environment where potentially flammable or explosive gases/vapors, liquids or fibers/dusts may be present:

Class 1	Locations are made hazardous by the presence of flammable gases, liquids or vapors.
Class 2	Locations are described as hazardous because of the presence of combustible dusts.
Class 3	Locations contain easily ignitable fibers or flyings.

A **Division** refers to ignitable concentrations of flammable materials that may be present:

Division 1	Designates an environment where ignitable concentrations of flammable gases, liquids, vapors or dusts can exist some of the time, or all of the time, under normal operating conditions or where easily ignitable fibers and flyings are manufactured, handled or used.
Division 2	An environment where ignitable concentrations are not likely to exist under normal operating conditions or where Class 3 materials are stored or handled.

A **Group** provides a further definition of hazardous classes. Combustible materials are grouped by their relevant physical properties. In fact, the Class 1 classification is divided into four alphabetized Groups, determined by the specific gas or vapor involved: Groups A thru D (these groups include, but are not limited to):

Group A	Acetylene
Group B	Hydrogen
Group C	Ethylene and Carbon Monoxide
Group D	Propane, Gasoline, Naphtha, Benzene, Butane, Ethyl Alcohol, Acetone and Methane

Some typical Class 1/Division 2 applications suitable for using off-grid PV/solar electric systems include (but are certainly not limited to):

- Supervisory Control and Data Acquisition (SCADA)
- Remote telemetry
- Gas-well injection pumps
- Cathodic Protection (CP) systems for pipeline corrosion resistance
- Gas-flow meters
- Security systems including video monitoring
- Communication hubs (wellhead and pipeline monitoring)
- Off-shore platforms
- Remote Terminal Unit (RTU) communications
- Central Station monitoring

- LED lighting fixtures for night-time operations
- HMI (Human Machine Interface) sensors

Morningstar is the world-leading supplier of solar charge controllers and now inverters to the oil and gas industry, with some four million units installed around the world, many in fault-intolerant, remote applications. Most important for oil and gas operators, Morningstar SunSaver™ and SunKeeper™ controllers undergo rigorous testing to earn all critical and applicable safety certifications, including but not limited to:

1. Hazardous Locations: Class 1, Div. 2 Groups A-D
2. ANSI/ISA-12.12.01-2007 (USA)
3. CSA C22.2 No. 213-M1987 (CANADA; reaffirmed 2004)

Not only does this make them ideal for the oil and gas industry, but Class I, Division 2 certified controllers have been proven to reduce the overall cost and time of installation and provide superior return on investment, since they do not require an additional explosion-proof (purged and pressurized) enclosure.

In fact Morningstar's SunSaver and SunKeeper controllers are specifically engineered and built to thrive in oil and gas installations. With very advanced thermal design—a Morningstar hallmark—their internal circuitry's operating temperature is much lower than the auto-ignition temperature of most flammable gases and vapors. They are also thoroughly sealed and designed to operate at lower temperatures without the use of relays or requiring cooling fans as do most charge controllers, thus eliminating the risk of high temperature arching and sparking. Moreover, each product version has been certified and reaffirmed.

An industry standard for oil and gas operations, SunSaver specifications include:

- Manufactured in a certified ISO 9001 facility
- Available in 6A, 10A or 20A at 12Vdc or 24Vdc versions.
- Environmentally-optimized for high reliability and increased battery life

- Hazardous Location rating - Class 1, Div. 2 Groups A-D
- Sealed, fanless design for higher efficiency, increased safety and longer life
- CE, RoHS and REACH compliant
- UL 1604/ANSI/ISA 12.12.01-2000 (USA)
- and CSA C22.2 No. 213-M1987 (Reaffirmed 2004) (CANADA) Listed
- UL 1741 (with terminal cover) listed*
- FCC Title 47 (CFR), Part 15 Subpart B for Class B Device

* Wire terminal cover included with every SunSaver.

The SunKeeper is a small, single-panel controller ideal for lower-powered solar electric systems. Its specifications include:

- Manufactured in a certified ISO 9001 facility
- Available in 6A & 12A at 12Vdc versions
- Environmentally-optimized, high-temperature rated
- Hazardous locations rating - Class 1, Div. 2 Groups A-D
- CE, RoHS and REACH compliant
- UL 1604/ANSI/ISA 12.12.01-2000 and CSA C22.2 No. 213-M1987 Listed

Both the SunSaver and SunKeeper solar charge controllers are the ideal building-block for a range of solar electric systems that can provide electricity for many facets of oil and gas extraction, production and transportation. To learn more about how to specify and select a system, check out Morningstar's website at www.morningstarcorp.com

Morningstar's in-house sales engineering team will be glad to connect you with resources to provide you with the most effective solar solution for your application. Contact them at sales@morningstarcorp.com

For more information about specific hazardous locations and their suitable ratings, visit the OSHA website: www.osha.gov/doc/outreachtraining/htmlfiles/hazloc.html

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