

PROTECTING SENSORS IN WELD CELLS

The Fastest Way to Dramatically Increase Weld Cell Productivity

White Paper

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Improving sensor survivability in weld cells is one of the easiest and fastest ways to reduce unplanned downtime and lower cost. This white paper will show how this can be done.

See how you can:

- Convert mean time between planned maintenance from days to months – or longer
- Decrease unplanned downtime maintenance hours
- Vastly increase overall weld cell productivity and profitability
- Significantly decrease weld cell maintenance cost

“Exposed sensors in welding cells are simply failure prone. They’re associated with high material consumption and they are the cause of both planned and unplanned down time. It’s the way it is. We work around the issues, have sensor change out down to a few minutes, and have even installed a couple of industrial vending machines so availability is instantaneous. We’ve simply accepted it and live in this paradigm.”

—Weld Cell Manager

When it comes to sensors, cables, and connectors in weld cells, weld cell management people are so used to the high cost of constant replacement, downtime, and lost productivity that they begin to think it’s natural that weld cells are just that way. Sensors are constantly damaged by loading impact. Slag, weld debris, and heat ruin not only the sensors, but their associated connectivity.

It gets to the point that most people involved with weld cells start thinking there’s not much you can do about the wastage but put in a vending machine or some kind of sensor dispensing system close at hand – as if having replacement parts nearby is a viable process improvement.

It’s Time to Break the High Sensor Wastage Weld Cell Paradigm

“It’s common to work with customers who consume between \$8K to \$70K per month in sensors and related connectivity products (\$96K to \$840K per year). It’s also common to have customers call and say, ‘I need the absolute best, rock-bottom price you have for these four or five sensor types, our high runners. The person with the best price gets the business. If I can’t fix the problem, I’ll keep cost to the absolute lowest level I can and keep change out to the absolute minimum amount of time. This is the best that can be expected to increase weld cell productivity.’”

—Sensor Sales Engineer

It’s time to dispel the myth that maintaining weld cells equals high costs, constant replacement, and frequent maintenance episodes.

The reason that many weld cells have such high sensor replacement costs is that the sensors used may not match the application, and/or they are incorrectly placed in the cell, insufficiently protected from heat, slag, and impact. And it doesn’t end there. Often connectivity is supplied using the wrong cable jacketing material. Sensor mounts are often of the wrong design for weld cell service or they are manufactured from the wrong materials such as lightweight plastics that are vulnerable to weld hostilities.

Premature Sensor Failure in Weld Cells

Problem: Heat and Slag

High ambient temperatures and weld debris, also known as weld slag, weld berries, or weld BB's, attack sensor enclosures, faces, connections, and flimsy plastic mounting brackets.



Solutions:

1. Choose the Right Sensor

Choose the right sensor for the right application in every cell location, taking into account the type of welding being accomplished. Sensors are rated devices and are application-specific. MIG, TIG, laser, and resistance welding all have their own unique set of characteristics. Not every cell location can accept the same sensor type.

- Coated sensors provide a thermal barrier and resist weld debris, slag accumulation, and to a degree, resist impact on the sensor face.
- Steel faced sensors tend to be more robust and resist impact. Try to use only flush (shielded) type sensors in weld cells. They can be surrounded or encapsulated in metal and there's less potential risk to shearing off the exposed coil as with tubular non-flush types. Sensors with one piece gun drilled stainless steel housings stand up to major incidental impacts. Some have long range characteristics which, combined with PTFE coatings, give them long term survivability in tough weld cell applications, and their price/performance ratio is the best in the market.



This sensor has a slag resistant coating that dramatically increases its life.

2. Protect Your Sensors and Connectivity

Apply a total heat and slag solution to your sensors, cabling, and connectors.

An application-specific coating applied to the face of a proximity sensor repels weld slag accumulation and protects it from damage even in the most severe welding environments. Start with a high durability TPE cable, and then cover the cable, sensor, and its protective products with silicone tubing and weld wrap. This system guards the cable and secures the jacket in its proper location while sealing remaining connectivity components against harsh, hot weld spray.

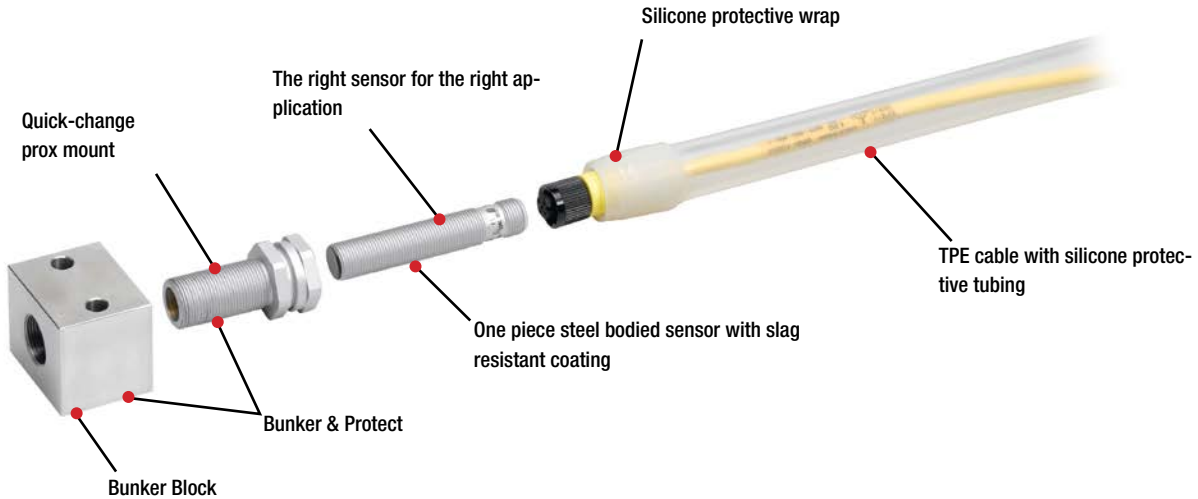
Silicone wrap is a self-bonding, non-adhesive silicone tape that once applied like tape on a hockey stick, will protect the sensor and connector from slag and heat just as well as silicone jacketing. Once applied, the wrap bonds to itself, becoming a solid barrier to heat and slag, protecting anything it is applied to.

PVC jacket material on connectors should never be used in a weld environment. PVC burns through quickly and can become extremely brittle in a short period of time. PUR styles (polyurethane) offer a better degree of nick resistance, flex characteristics, and resistance to welding debris, but a new generation of TPE (thermoplastic elastomer) takes the positive aspects of PUR to a higher degree of performance. Most weld cell users have learned to further encapsulate their connectors with opaque, medical grade silicone that resists weld slag and weld berries and significantly prevents cable burn through. Newer materials such as woven ceramic fibers are currently being investigated.



Now that these sensors and their connectivity are correctly protected, they should last for months—not just days.

While TPE cables have outperformed other cable materials such as PVC and PUR, there are additional steps that can be taken to protect connector cables. Tubular silicone jacketing, cut to length and applied to the cables back from the connector will protect the cabling from ambient temperatures of up to 500° F as well as prevent slag build up on the cabling.



Problem: Parts Loading Impact

Parts to be joined, or completed components that are loaded and unloaded either manually or by robot, are often dropped on exposed and vulnerable sensors, physically destroying the sensor or the entire sensing system. If an inductive proximity sensor located on a clamp is hit by metal to be joined, usually through loading impact, extensive sensor damage and premature failure may result.

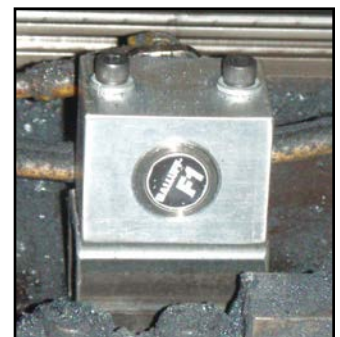


Loading impact can destroy unprotected sensors

Solution:

Bunker and Protect! Mechanical protection is central to the integration of any sensor in hostile manufacturing environments. Mechanical accessories provide a means of rapid change out and unparalleled deep thermal protection, act as a heat sink, guard against the heaviest of direct impact and weld debris, and ensure continuous sensor function.

The greater the protection, the longer the sensor life. Using a bunker block in conjunction with a quick-change prox mount protects the sensor body and face from debilitating physical damage. Prox mounts and bunker blocks are made of machined aluminum or steel and can be PTFE coated. PTFE coating significantly prolongs sensor life by providing a thermal barrier to protect against heat. It also retards build up of weld slag spatter and spray, and eases removal of surrounding deposits of weld debris during scheduled maintenance periods.



Virtually any sensor can be protected by a Bunker Block.

Problem: Sensor/Cable Connection Failure

Sensor/cable connections are a major point of failure. Connectors need to be designed to withstand the hostile weld cell environment. If a sensor cable's connection has too much stress from slag build up or if it has the wrong angle, tension and pressure on the connection will cause premature failure. Heat, slag accumulation, and flexing of the cable cause connectors to break at the most vulnerable location.

Most sensor types are generally hard-wired to M12 DC Micro or M8 Nano-style connectors. One of the largest problems with sensors in weld cells revolves around the issue of cable/connector burn through.



Slag built up slowly on this cable until the weight pulled the connection apart.



Unprotected sensor/cable connections can cause expensive unplanned downtime.

Solution:

Use only the highest grade of cost-effective connectors available. TPE exhibits excellent chemical, lubricant, flex, heat, nick, coolant, and pinch resistance. There are several models that can function with every sensor found in the typical weld facility, facilitating standardization and transparency in the organization. Follow proper cable exit geometry to avoid creating stress on the cable/sensor connection, especially in the presence of heat and other weld hostilities.

Once again, seal your entire sensor/connector/mounting system with new generation self-fusing, self-bonding silicone wrap that's rated to 500° F. It is clear so LED's can be observed, it guards connections against fine weld spray, and it eliminates the need for hose clamps (which attract weld berries) and vulnerable zip ties for attachment.



Prox sensor correctly protected against impact



Problem: Inadequate Mounting Brackets

Plastic mounting brackets deteriorate rapidly in welding environments. This contributes to false sensing, no sensing, or increased vulnerability of the sensor itself. Moreover, with these brackets, sensor bodies are usually not encapsulated, exposing them to high heat, weld debris spray, and impact.

Solution:

Don't use plastic mounts in the weld cell environment. Instead use bunkered aluminum or steel mounting solutions. Bunkering protects the sensors from impact, and heat. Then, once the sensor and the bunker is protected with silicone wrap, slag build up will be drastically impeded, increasing the intervals between maintenance as well as decreasing downtime during maintenance.



Problem: Incorrectly Applied Photoelectric Sensors

Photoelectric sensors require attention to perform well in welding environments. Plastic-body photoelectric sensors must be protected from parts loading impact. In addition, just as with a pair of glasses, if the optical lens becomes excessively occluded, photoelectric sensors cannot perform their function.

Solution:

Choose only robust photoelectric sensors with heat and mar-resistant lenses. Choose devices with high excess gain properties that can sense through dense weld smoke and debris. Use lens blow-off shields or air knives to create a positive air pressure in front of the sensor, lengthening the time it takes to fog over and reduce frequent maintenance wipe downs. Bunker all photoelectric sensors as you would any inductive proximity type. Avoid fiber optics. Both glass and plastic fiber optic bundles are frequently broken in welding cells. One speck of debris and the fiber lens is usually rendered useless.

Vending Machines: Detours on the Road to Productivity

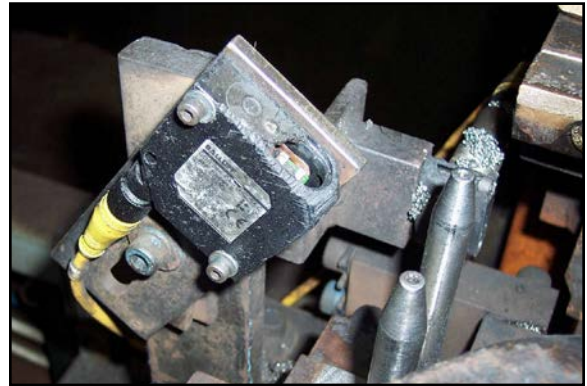
Vending and other dispensing solutions may offer increased convenience, but they do nothing to lower operational costs – in fact they tend to do the opposite. Vending machines make it easier to sacrifice sensors to a replacement process that actually may be out of control, with little tracking of sensors as to where, why, and how often they are being installed. Before even more dispensing machines are installed, get to the root cause analysis of failure and fix the problems first. Worry about supply-chain management after sensor wastage problems have been fixed.

Streamline your storeroom/crib MRO inventory. After you've gotten your arms around sensor-related problems, consolidate the number and types of sensors in stores/electrical cribs, weed out what you don't need or will never use again. How many electrical cribs carry totally obsolete sensors and connectors? How many times has the wrong device been installed causing another down time issue? Eliminate redundant sensors. Your sensor manufacturer will help you through this process.

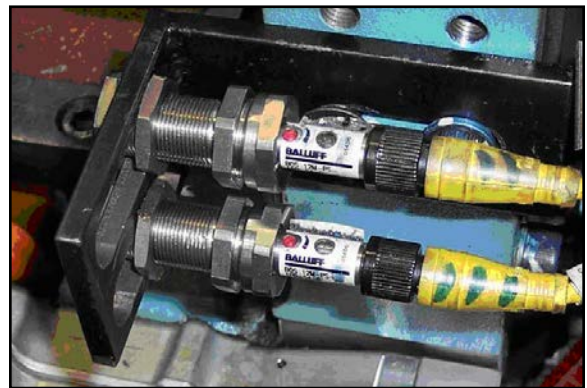
How to Get Started Towards a More Efficient Weld Cell Production Process

Arrange for a thorough weld cell audit. If you're experiencing what you believe to be heavy consumption of sensors used in your day-to-day welding process, or you believe maintenance time is out of the ordinary, an audit of each individual sensor in every weld cell location may be warranted. In almost every instance, you will dramatically increase production, reduce machine down time, reduce material and maintenance costs, and increase profitability by integration of even a few of these recommended weld cell improvement methods.

Understand through a documented weld cell audit, how every sensor in every location on the plant floor is performing, where recurrent problems occur and why, and where maintenance people are constantly replacing sensors. Get a handle on the problems and regain control of your processes. Remember, the definition of insanity is doing the same thing over and over again and expecting a different result. Get buy-in and support for a sensor improvement/upgrade program from plant management down through the entire organization. It's got to become embraced by the organization. A little pain (change) and a little cost-effective upgrade expense on the front end will pay massive dividends down the road. And it will allow maintenance personnel to do other, more important things.



This unprotected photoelectric sensor has been destroyed by weld slag and heat.



Photoelectrics in a quick-change mount dramatically increase their life

Let's Examine Our Process

A comprehensive weld audit will provide weld cell management with a complete review of weld cell sensor use. That means how well sensors are working, how well they are protected, and a means to lower sensor consumption and associated costs while significantly raising overall weld cell productivity. Here's just one example of what happened when we did this for a large Tier One automotive supplier.

- From January 1 to April 27, 2007, their most problematic cell experienced 117 minutes of sensor-related downtime in that four month period.
- Five different types of M18 proximity sensors were mounted in simple L brackets at various points in the weld cell. These sensors were exposed to a large helping of slag, weld debris, and heat in the MIG weld process.
- Unlighted connectors supplied through vending machines were experiencing extensive burn through.

The bottom line was that the downtime on this machine was assigned a value of \$422 per minute times 117 minutes of sensor related downtime, which annualizes out to \$148,000.

Following an audit, all existing sensors and connectors were removed and replaced with two appropriate application-specific sensors. The sensors were installed in heavy Bunker Blocks with rapid-change out ready prox mounts or PTFE-coated prox mounts. Original unlighted sensor connectors were replaced with visible lighted TPE versions, facilitating status and power sensor checks, all covered with medical grade silicone weld resistant jacketing and sealed with silicone wrap. Once this was accomplished, the cell had a significantly upgraded sensor system protected from the weld environment by the latest in heat and slag protective technology.

After more than six months of evaluation, here's what was reported:

- Zero true sensor failures due to slag, heat, or impact.
- One sensor was damaged when a heavy component was dropped on it, but replacement downtime was not charged as a "Sensor Failure".
- No maintenance interruptions due to weld cell hostilities or standard operational conditions were experienced.

The Bottom Line:

Excluding cost of material for retrofit, this once problematic cell is now at a run rate to produce an overall per annum net savings of \$137,000, allowing maintenance personnel to be more productive. This reduces stress on the organization and reduces dependency on a vending machine to supply high consumption components that shouldn't be highly consumed devices in the first place!

Once you've got your sensor problems straightened out, your cribs will be current and organized. Resolve to never get into this situation again. On your next weld cell order, be certain that you meet with your most able sensor manufacturer representative. Review sensor designs with that individual. Let him make suggestions and recommendations. Gather his input as to what he thinks needs to go in each sensor location. Involve your own most able maintenance personnel and gather their input as well. After all, these are the people who live with the issues each day. Spend a little extra money on the front end for the best bunkering and protection, rapid change-out mounts, application-specific sensors, and connectivity systems you can find. Write the specification not only for the brand, but for the type of system that goes into the cell design, sensor location by individual location. Your weld cell OEM should be more than willing to accommodate your request for what you decide is best to ensure sensor longevity in your new cell.

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