



Features and Benefits Overview

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Background

Rigging equipment, including heavy lift slings are frequently subjected to unknown forces. Many factors cause unknowns, such as miscalculated load weights due to missing documentation or an overload situation because a lift starts with the load inadvertently still connected. No matter how careful planning is, rigging equipment overload can result from a multitude of variables. These can include improper training, human error, environmental conditions such as wind gusts, shock loading, center of gravity shift and equipment failure, to name a few. Because of this uncertainty, over 40 workers die each year in the United States in crane-related incidents, a number that has remained constant for the last decade. This does not include other deaths and injuries from countless suspended loads encountered in industrial environments around the world. The Slingmax® Smart Sling can help prevent heavy lifting-related injuries and deaths.

What is a Smart Sling?

Smart Slings are continuously monitored Twin-Path® roundslings that wirelessly alert users when a sling is overloaded. Each Smart Sling has an embedded sensor that watches internal fiber condition for signs of failure. If a threshold condition is detected, Smart Slings will send a signal to a nearby base station. The Smart Sling application displays Smart Sling status and can push alerts to anyone off-site via text message and email. Up to 50 Smart Slings can be monitored at once with a single base station, enabling an entire jobsite to be connected, 24 hours a day, 7 days a week. Whether you're on the ground or off-site, you can rest assured that Smart Slings are keeping you informed and safe.



Figure 1. Smart Slings in use

Smart Sling Benefits

Reliability

Smart Sling employs a simple, yet robust mechanical actuation system for overload detection. This system is an improvement over proven technologies such as the Check-Fast® Inspection System which has been in use since 2006 on over 500,000 Twin-Path slings worldwide. Smart Sling has been both lab and field tested in a variety of applications.

When a Smart Sling is overloaded, a link in the system physically breaks and triggers an overload state. This Smart Sling will now constantly transmit its overloaded status to a paired base station.

The mechanical system at the core of the Smart Sling system has several advantages:

- Smart Slings can be visually inspected for overload by an authorized manufacturer. This condition is physically unambiguous.
- Smart Sling's overload mechanism is not affected by sampling error. Most digital devices can only capture data during fixed intervals (sampling rate). Critical information can be lost by undersampling and events such as overload can be almost instantaneous.
- Smart Slings are tuned to the specific sling and will trigger when overloaded regardless of hitch configuration or sling angle. There is no guesswork or calculating or tracking involved on the user end.
- Connection and hardware issues outside of Smart Sling do not prevent a sling from detecting an overload. Alerts are always visible locally and will transmit offsite when connection is reestablished.

Smart Slings can be returned to an authorized manufacturer for inspection in the event of an overload. If the sling is determined to be in good condition, your Smart Sling can be reset at this facility and placed back into service.

On-site Monitoring

A lift does not have to overload the crane, or even most of the rigging, to result in a compromised sling. If a shorter sling is used than required, or if a sling becomes snagged or hung up, it is possible only that sling will be overloaded while the rest of the lift is a success. At a conventional jobsite, that sling would go back into a box to be used by the next rigger. At a Smart Sling connected jobsite, that sling would send a signal to the Smart Sling system alerting the user that there is an issue. If the user ignores the warning, the next time the system starts and connects to the sling, the overload warning again will be displayed, giving the next user an opportunity to remove the sling from service for inspection and repair.

Off-site Monitoring

Current overload/damage indicators are designed with on-site monitoring in mind. A user must be in physical proximity to the sling to visually inspect it. Other wireless systems deployed for load cells allow remote monitoring, but only within the same general area by someone who is on the jobsite. The Smart Sling system includes text message and email alerts that can be sent to any personnel located anywhere in the world. This gives safety managers, supervisors, etc. an insight into how rigging is being used in the field. When a Smart Sling is overloaded, that information is quickly shared with all interested parties. This avoids a situation where a rigger knows the sling was overloaded but seeks to avoid supervisor scrutiny.

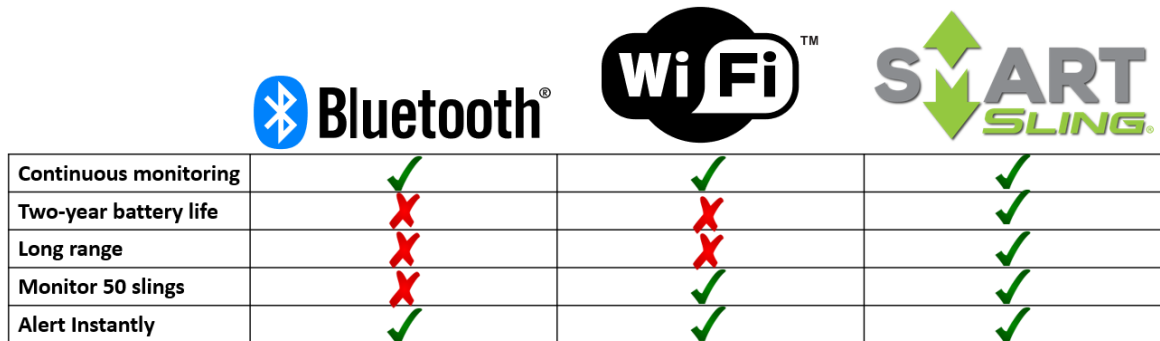
Smart Sling Wireless Protocol

Smart Sling improves on traditional inspection aids by:

- Increasing visibility regardless of lighting, weather, or distance
- Providing real-time feedback on sling condition
- Providing accountability and traceability via alerts and history log

Smart Sling embedded technology is designed to be in constant use, requiring no user input to operate. Smart Sling uses a proprietary radio frequency (RF) protocol developed specifically for use in rigging and lifting, operating at 915 MHz. The protocol frequency and features make communication more resilient at long ranges and in environments where obstructions or interference from other wireless devices are a concern.

Figure 2 shows the extended capability and functionality achieved by designing for the application over typical, off-the-shelf solutions.






	 Bluetooth [®]	 WiFi [™]	 SMART SLING [™]
Continuous monitoring	✓	✓	✓
Two-year battery life	✗	✗	✓
Long range	✗	✗	✓
Monitor 50 slings	✗	✓	✓
Alert Instantly	✓	✓	✓

Figure 2. Comparison of the Smart Sling protocol with typical wireless solutions

The Smart Sling wireless protocol allows Smart Sling technology to benefit from the convenience that all wireless devices offer, while prioritizing functionality such as multi-device support, excellent battery life and long range in actual typical use. Other solutions may require picking and choosing how many slings to monitor at once, managing battery life, and often see underwhelming performance in real world applications.

Positive Feedback







The Smart Sling protocol has numerous features built-in to ensure reliability and robustness as a continuous monitoring device. One of the more obvious features is a required positive feedback status. The Smart Sling system does not assume a sling is in working condition unless it receives a signal from a sling that confirms it.

Each sling checks in with a status signal to a paired base station every 30 seconds, in addition to a maximum 2 second interval in the event of a serious event such as an overload.

This gives the end user a simple and clear **GO** or **NO-GO** status to monitor which captures real time feedback directly transmitted from the slings. There is no need to decipher or interpret data during a lift – Smart Sling does the heavy lifting and gives you the green light to proceed.

Technical Capabilities

Capabilities include:

-  Two year, always on battery life. There is no need to turn Smart Slings off or charge overnight. Battery life may vary in extreme temperature conditions. Non-rechargeable lithium batteries give Smart Sling high performance in tough environments.
-  Rated operating temperature of -40°F to 120°F. Smart Sling may operate at higher temperatures with limited battery life.
-  Smart Slings are waterproof (IP67 rating – submersible to 1 meter (3.3 feet) depth of water). If a Smart Sling is unable to transmit an alert because of signal attenuation due to immersion in water, it will generate upon reestablishment of connection. The Smart Sling base station is splash proof (IP44 rating – entry from water splashing in any direction and tools greater than 1 millimeter (0.04 inches)).
-  Smart Sling components were designed for Twin-Path and share many of its resistances including many acids, alkalis, oils, ultraviolet light and saltwater (See Appendix).
-  Smart Sling electronics are encased in a tough, protective housing (PC/ABS) that can withstand drops of more than 15 feet, crushing of more than 1,000 lbf and the bare electronics can survive impact accelerations of 10g.
-  Smart Sling has a typical range of 150-300 meters (500-1000 feet). Range is highly dependent on the application environment. The Smart Sling protocol is specifically designed for industrial environments, where most wireless technology struggles to perform.

Smart Sling Usage

Smart Slings are health monitoring devices, which are in constant communication and always watching for an alert condition (see schematic in Figure 2). These alerts include overload, low battery life and drops in connectivity. Smart Sling is easy to use in the field. All Smart Slings arrive ready to use with your base station via a simple pairing procedure. Your base station can monitor up to 50 slings simultaneously on a given site, and its placement is up to the user. The Smart Sling base station connects via USB to a laptop which runs the Smart Sling software for site management. The Smart Sling application can be monitored locally or via web-app from any device (*my.smartsling.com*).

The software is simple and intuitive and can monitor everything in range locally without the need for an external connection. Managing inventory, adding or removing slings, and user management is easy. If internet access is available, Smart Sling software can use this to send notifications to any recipients globally via email or text message. All alerts, local and remote, are date and time stamped and include information about the overload including site and sling specific information. Smart Slings are uniquely identified by their serial number, model number, capacity and length, and a user can add custom names and notes for more effective sling management.

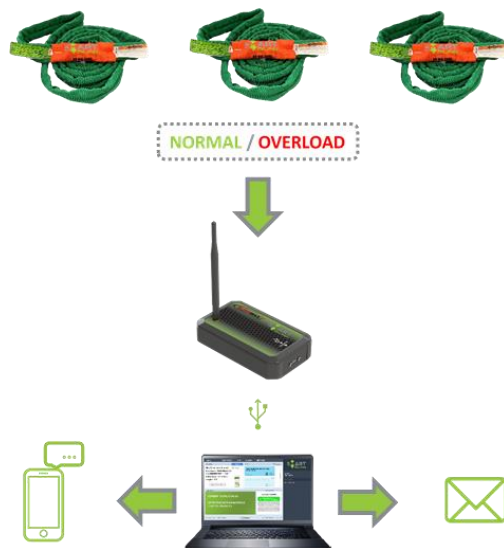


Figure 3. Smart Slings communicate with a nearby base station, which conveys this information via USB connection to the Smart Sling application. The application can send alerts globally via text and email

Multiple Base Stations

Multiple Smart Sling bases can be used on a jobsite to extend the range of slings in use, which is useful in applications where range or interference from the environment is a concern. Your Smart Slings will automatically check in with the nearest available base station, and switch between them if a sling exceeds the range of one but enters the range of another. The Smart Sling application remains simple and easy to use, letting the wireless protocol direct and manage slings in the background.

Smart Sling Availability

The Smart Sling electronics are packaged in a low-profile enclosure designed specifically to tuck between the two load paths of a Twin-Path sling. The enclosure is lightweight and indiscernible, especially on larger sized slings.

Smart Sling is available on any catalog size Twin-Path sling, regardless of length when greater than 5 feet. It is not possible to retrofit an existing Twin-Path sling with Smart Sling technology.

Maintenance

Smart Sling is designed for use in the field and does not require special use and care. Smart Slings share considerations Twin-Path slings do, including rigging away from the tag area (see below).

While the sling overload sensor is rugged, do not apply force to the region indicated by the orange band and “**NO RIG ZONE**” lettering (shown in Figure 3). Physical damage in this region may result in erratic behavior from the Smart Sling and/or reduced performance. Using the **NO RIG ZONE** on any bearing surface is never recommended. All bearing points should be at least 9 inches away from the center of the orange band of the sling on either side (total of 18 inches of clearance).



Figure 4. Smart Sling "NO RIG ZONE"

Smart Sling was designed to mirror the Twin-Path sling regarding durability, weight, ease of use, and repairability. It is recommended that an authorized Smart Sling manufacturer inspect the sling overload sensor yearly and replace the batteries to ensure no lapse in service. Additionally, inspect and evaluate components and field effects on the Smart Sling for guaranteed performance.

About Slingmax

Slingmax Rigging Solutions is recognized worldwide for local service, quality and innovative solutions for the heavy lift and material handling market. The Slingmax organization consists of 38 independent companies, each exclusively licensed, trained and certified to manufacture, repair and test Slingmax products. Strategically located in 12 countries, our 45 full-service manufacturing locations guarantee the same quality service and quick turnaround times our valued customers have come to depend on.

Slingmax currently holds over 50-patents and 100 trademarks worldwide, which include Check-Fast inspection and Rifled Cover Technology. We are best known for our Twin-Path roundsling, but we have numerous other patented rigging solutions including machinery, rigging hardware and electronic warning indicators for roundslings, to name a few.

Appendix

Table 1. Selected Chemical Compatibilities for Smart Sling Components

Chemical	Performance	Affected Area(s)
Organic Substances/Solvents		
Acetone	Poor	All
Benzene	Poor	All
Gasoline	Fair – Good	Seals
Ethyl Alcohol	Good – Very Good	None
Phenol	Very Poor – Good	Enclosure, Seals, Connectors
Chloroform	Poor	All
Carbon Tetrachloride	Poor	All
Methyl Alcohol	Good	All
Gases		
Chlorine	Poor – Fair	Enclosure, Seals
Hydrogen Sulfide	Poor – Good	Enclosure, Seals
Sulfur Dioxide	Poor	Enclosure
Acids		
Hydrochloric Acid	Fair – Good	Enclosure
Sulfuric Acid	Poor	Seals, Connectors
Tartaric Acid	Good – Very Good	All
Acetic Acid	Fair – Very Good	Enclosure, Seals
Nitric Acid	Very Poor – Good	Seals, Connectors
Ammonia Solution	Poor	Enclosure
Calcium Hydroxide	Poor – Good	Enclosure
Potassium Hydroxide	Poor	Enclosure
Sodium Hydroxide	Poor – Fair	Enclosure
Generally Recommended or Adequate		
Organic/Inorganic Acids		
Alkalis		
Oils (Lubricating, Machine, Motor, Diesel, Silicone)		
Ultraviolet Light		
Water (Hot/Cold)		

Slingmax recommends establishing a maintenance schedule that includes frequent replacement of degraded components, such as O-rings, to achieve satisfactory performance in harsh applications. Contact Slingmax engineering for more information.

