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# Portable Traffic Signals in the Work Zone

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## Introduction

Work zones are a fact of life as our society attempts to maintain and improve our transportation infrastructure. As such, we must also recognize that there are always four elements in tension in the design and execution of a work zone – minimizing the delay and disruption of the traveling public, maintaining the safety of both the public traveling through and the workers within the work zone, containing the costs to the public, and maintaining a margin of profit for the contractor doing the work. Traffic control within the work zone has a direct effect on all of these elements.

There are many types of work zones, and many types of traffic control within work zones – more than this article could adequately address. Using portable traffic signal equipment to minimize delay, increase work zone safety, control costs and improve profitability is the focus of this article. We will also look at the past, present and potential future of portable traffic signals. In this article, portable traffic signals (PTS) are defined as traffic signals and associated control equipment that can be quickly and easily transported and deployed into a work zone. The collective group of these devices makes up a system that is able to control traffic in an orderly, safe manner using standard red/yellow/green traffic signals.

## Common Applications

The single lane road closure is a large part of the portable signal marketplace. These simple systems are designed for fast deployments with simple to use control equipment. This equipment is and should be oriented for a less sophisticated user. Variations exist from state to state, but by and large meet MUTCD requirements and have a mast arm with one RYG signal at the end of the arm and one that is on the side of the upright mast. Common specifications for these systems allow synchronized system operation between trailers by three common means: 1. precision time clocks which are synchronized before deployment, 2. a hardwire connection between trailers, and 3. radio communication between the trailers.

Single lane road closures often involve bridge repair or reconstruction. It is not uncommon for these projects to grow into more complex phasings because of side roads, or private driveways that need to be signalized. Sometimes the signals on these driveways are non-MUTCD compliant, having only 1 traffic signal and having the signal at less than 8 feet. This is allowed because such driveways are private, not public right of ways.

As technology has improved and advanced, portable traffic signals can reproduce most simple to complex traffic phasings, from the single lane road closure to a fully actuated dual ring quad left turn with pedestrian signals utilizing multiple portable mast arms to be used simultaneously for a single approach. The more complex systems that tend to follow existing standards, such as NEMA TS1 or 2070/ATC, give a greater ability to emulate real intersections and work well for intersections being constructed or reconstructed. These systems offer nearly full NEMA TS1 functionality via a menu driven user interface and industry standard conflict monitoring.

## Gaining Perspective

All of today's sophisticated portable traffic signals are possible because of the maturing of DC powered traffic control technology, DC powered LED technology, solar power technology, non-intrusive vehicle detection, and frequency hopping spread spectrum radios. Because of these technologies, the portable traffic signal is now the smart tool for today's work zone traffic control.

OMJC's design goals in our portable signal systems have always been to get emergency and planned work zone traffic control people out of harm's way and reproduce what they do with safe, automated, actuated traffic control equipment, featuring traffic signal industry standard conflict monitoring. In so doing, labor costs can be reduced, traffic delay minimized and tort exposure minimized. And we have equipment that accomplishes these goals. But to show you how good today's portable signals are, we really need to see where they have come from.

In the beginning, portable traffic signals had many difficulties. The signals had to be hardwired to the main control unit because there was no other effective way to build the system. The signals used industry standard incandescent lamps in or-

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der to meet ITE illumination requirements. These lamps consumed much more power than today's LED indications. Thus, the cables were long, heavy and awkward, and must be routed through the work zone in some fashion. Power had to be supplied by diesel generated AC power. The diesel – smelly and noisy - constantly needed fuel, lubrication and attention – no awards for labor reduction or environmental consciousness there. This system was ultimately effective, but not cheap nor easy, nor even very portable, but it did provide for all approaches to be simultaneously monitored by a single, centralized industry standard conflict monitor (CM). These industry standards (whether 170 or NEMA TS1 or a descendent) have enviable safety and tort defense records, thereby minimizing tort exposure.

The first wireless portable signals used distributed quartz redundant timers and low wattage DC tungsten lamps, with a liquid lead acid battery bank powering each unit. While this was easy and portable, it presented problems. Among them, there was no effective means of providing an actuated system – the system had to function as a fixed cycle length system only.

Then there were also early attempts to use a wireless radio connection. This usually involved licensing with the FCC, which is no longer necessary with the frequencies used today. The cables were eliminated, but at a greater cost, and the diesel remained, in spite of the battery banks on board. There was no flexibility – two actuated traffic movements were all you could get.

### The Current Features Offered

The temporary traffic signal market place now offers many quickly deployed tools to help manage work zone traffic. These tools offer the ability to enable the motoring public to experience a minimum of delays in a variety of work zones. Optional equipment even allows an operator within the work zone to operate and or interrupt normal signal operation. Even pilot car control is available.

As mentioned earlier, one element that gives today's portable traffic signal equipment viability is LED signal lighting. All systems today are battery powered because of the low power draw of the LED. This battery-powered equipment offers run times (autonomy) from mere hours to 20-40 days, depending upon the size of the battery bank. Some systems are designed for daily use and need to be recharged manually. With the addition of solar panel charging, many systems are now capable of running pretty much year around – now traffic signals can be green in more than one way! Cloudy days are compensated for by excess sizing of solar and battery systems. Battery lives are sustainable for up to 10 years by choosing quality battery systems. Long battery discharge cycles tend to help prolong battery life. Battery life is also largely affected by the frequency and depth of battery discharges. While liquid lead acid batteries are still the price leaders, the AGM battery (standard on all OMJC PTS) offers the attractive combination of being maintenance and corrosion free, unspillable even in an accident, and having an extremely low resting discharge rate.

The lower power consumption of LEDs also has enabled the industry to expand portable signal capabilities. Today it is not uncommon to see added signal heads for additional traffic phases, and a broader

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range of detection equipment being used. Emergency preemption is also becoming more common.

Today's PTS systems, including OMJC systems, are robust and secure. Most offer significant wind loadings – OMJC's is rated to 80 MPH. Some also offer security for the trailer itself – removable hitches, high security mounting hardware for solar panels, cell phone dialers, and even GPS tracking of the trailers.

The higher end systems, such as OMJC's 2070/ATC based units, often provide integrated dedicated military quality spread spectrum radios (using IP type networking) communicating real time control and monitoring as an integral part of the control equipment design. The more complex high-end controllers provide multiple rings, barriers, I/O mapping, coordination, preemption and overlap functions, including trailing green overlaps, which can greatly improve traffic efficiency in a single lane road closure. You may also find menu driven interface functionality, Ethernet ports, Linux based software, web based user interfaces and computer emulators with download capabilities. They may offer state of the art conflict monitoring that utilizes the new programmable ITS monitor key enabling real time monitoring of each channel's voltages and current draw, plus the other features expected in hardwired systems. These units are as safe, versatile and effective as anything controlling traffic in the USA.

Currently there is a new NEMA TS5 committee in place developing a standard for "Traffic Controllers for Portable Traffic Signal Systems". It will be interesting to see where and what it ends up with. A deficiency in this industry is that, unlike the standards for permanent intersections, most current monitoring systems are proprietary or non-existent.

## Methodologies

Portable signal methodologies do vary. One of the common methodologies is to have the intelligence distributed. This might mean that within each node or portable signal device timing and monitoring is done locally. The timing is sometimes done completely with precision time clock(s) that are redundant of necessity. This system precludes the use of detection or preemption unless a means of communication between trailers is included. Some specifications under this and its variations specify identical control systems for each node. This is contrary to the established standards for permanent traffic signals, where most of the control and monitoring is centralized at a master location. This type of technology may be more difficult to defend against tort claims, as it lacks the pedigree and the testing procedures of the established monitoring standards. Third party automated testers currently handle the testing of monitors within the established standards, which provides a disinterested party to verify the proper functioning of the monitor on a regular basis, which can be critical in the event of a tort claim.

Hardwire connections between portable signals nodes are largely for those users/buyers that aren't confident with radio system qualities. Hardwire doesn't make a lot of sense otherwise. The weakness of hardwire is that it typically requires running the cable across a roadway and often through a construction area. The beauty of radio-connected systems is that they are fast to deploy.

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Radio systems have come a long way from early attempts to use "off the shelf" systems. Now we at OMJC integrate a radio right into the system hardware and software design. Our most recent radio system can be interrogated and modified on the fly. One can view definitive RSSI, response times, and communication error data, enabling real time adjustments that can be made while the system is operational. This qualitative data is very useful for tweaking in a system to ensure stability for long duration deployments, or to compensate for topography that is "pushing" the system, such as mountain areas.

As for current offerings in conflict monitoring, OMJC presently offers a system (our 2070/ATC) that operates with high end real time ITS monitoring and handles it through an integrated spread spectrum radio system that emulates a NEMA TS2 BIU/MMU arrangement, enabling wireless operation between non-connected portable signal trailers. Today we are utilizing equipment much like you would see in the normal traffic signal cabinet, able to monitor hard and soft failures and even current levels on each monitor channel. Modern traffic phasing and deployments go from simple to complex, and modern portable signals such as our 2070/ATC system, with fully actuated eight phase intersection capabilities, are now up to the task.

## Become an Informed Buyer

We would encourage buying agencies to understand what they are buying. The industry is divergent enough that without agencies specifying standards there could be a smorgasbord of types of equipment one could procure. When purchasing portable signals, some basic questions that need to be asked include:

- Who will be using the equipment?
- Who will set up the equipment?
- Who will provide the controller timing?
- What is the frequency that the equipment will be used?
- How long are the durations of typical uses?
- Will the system need to have vehicular or pedestrian detection?
- How complex will the traffic phasing be?
- How much versatility does the owner want?
- Is shading or overcast skies a common occurrence where the equipment will be used, thereby diminishing the effectiveness of solar power?
- How long do you want the system to run on battery power alone?
- Is the application to replace permanent signals during construction?
- What is the capacity of the user to maintain the equipment?
- Do the system nodes also need to be able to function merely as a portable mast arm in the event of an emergency knock-down, with the ability to pass control of the on-board signal lights to an existing signal system?
- What is the size of the footprint available for the equipment to be positioned? Trailer widths vary from 6 to 8 feet.
- What level of training will operators need?
- Are you comfortable that the level of system monitoring offered will give you adequate tort protection?

Buyers need to know that features and quality come with a price. Three big factors that control competitive costs are: overall system power consumption, the features required, and the quality required.

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## Advanced future features

Time the flashing yellow: Much like the new flashing left turn arrow allowed by the MUTCD, we would suggest the use of work zone signals adopt a " flashing yellow ball" signal for allowing traffic to proceed in a single lane road closure, rather than timing the green. Our reasoning: do not give the driver the "right of way" green signal, but rather give him a timed flashing yellow, which means "proceed with caution." This would put the driver in a different position, with a greater degree of personal responsibility, requiring him to drive more cautiously. It would also reduce tort claim exposure.

Increasingly we are seeing the demand for pedestrian signals on portable signals as well. Thus, portable signals will have to adopt a means to provide them.

Future automatic timing: The technology is there for GPS calculations to enable an actuated system to determine its own red clearance timings if the operator can provide the system speeds. This would make good sense for day time flagger replacement use, where the system is set up and taken down each day before and after the work shifts are done with their road repairs.

## Conclusions

What can we conclude after our overview of portable signals in a work zone? First, the technology currently exists to safely and efficiently eliminate flaggers from the work zone. This removes the most exposed individual in a work zone from harm's way, saving lives, moving traffic and reducing costs. This technology is convenient, in that much of it is solar powered and wireless. It is quick to install and remove. We have seen that there are significant differences in how sophisticated and versatile such systems can be, and how complex or simple their programming may be. That is why it is essential to "do your homework" and understand your needs before you specify or choose such a system. You may need a simple system to handle a single lane road closure. Or, you may need the equipment to temporarily replace a complex intersection. Either way, the equipment is available. Ultimately, safety is the primary issue. While a PTS cannot guarantee the compliance of the motorist, it can get the flagger or policeman out of the work zone. If no personnel is in front of the vehicle, the vehicle can't hit him or her. The PTS can and will save lives. This alone recommends their increased use in the work zone.

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B.S. Engineering Technology, Texas A & M, spent three years with John Deere's Product Engineering Center before entering the traffic signal industry. He has been in the traffic signal industry for the past 30 years. He has spent the last 26 years as the President and CEO of OMJC Signal, of which twenty have been dedicated to the development and instigation of Portable Traffic Systems.

Arlen is a proponent of supporting current and future generations through sustainable equipment for roadway infrastructure. He started OMJC Signal 25 years ago with the idea of recycling the ever-growing stockpile of used traffic equipment. This is still an active part of the OMJC company business.

**LYLE STOUT**
B.A., ISU, has accrued 20 years experience with traffic equipment. He is certified for IMSA Level 2 Field. He has been involved in the development of portable traffic signals at OMJC since its onset. He assisted in the development of many products in the Port-a-Mast line. He has been part of the mechanical and electrical component development team, including solar power and traffic control.

Lyle is a long time advocate of renewable energy. He has devoted much of his professional time to realizing its effective use in traffic. His perspectives on wind and specifically solar energy have helped bring OMJC to the cutting-edge of portable traffic signal technology.