# Gate Access Time Study for the Rancho Mirage Fire Department

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CERTIFICATION STATEMENT

I hereby certify this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

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Abstract

The City of Rancho Mirage is largely a walled and gated residential community. Emergency responders access gates on a frequent basis, however, the problem is the Rancho Mirage Fire Department (RMFD) had not determined vehicle access times through community gates.

Emergency responders use a key switch to open the gates. Other devices called secondary access devices may improve emergency response times by opening the community gates automatically. The purpose of the research was to determine access time for emergency vehicles using the current practice and for simulated secondary devices, in order to determine any time difference that would be significant to the RMFD.

Descriptive research was used to answer “What is the time required to access gates with the manual key switch?”; “What is the time required to access gates with a simulated secondary access device?”; “What is the time difference if any, between the two?”

Procedures included attending the third year class at the National Fire Academy; conducting research in the Learning Resource Center and on the Internet. Gate time studies were conducted with three sets of data collected for statistical analysis. Statistical analysis was returned and evaluated. This paper was written with results of the analysis included and discussed.

Results determined it takes 30.4655 seconds for a light vehicle to access gates with a manual key switch. It takes 36.7332 seconds for a fire engine to access gates with a manual key switch. Any vehicle can access the gate with a simulated access device in 15.2797 seconds. There was a statistically significant difference in time of 15.1877 seconds for the light vehicle to

access gates with optical strobe switches and a difference of 21.45345 seconds for the fire engine.

Recommendations included sharing results with department officials, developing a standard for secondary access devices, communicating with stakeholders and elected officials, and recommending use of the devices to other jurisdictions.

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**Gate Access Time Study for the Rancho Mirage Fire Department**

The City of Rancho Mirage is largely a walled and gated residential community, with 85% of the residential dwelling units located within gates. The majority of the RMFD's responses are inside of these communities. The problem is the RMFD has not determined emergency vehicle access times through community gates. The RMFD currently uses the Knox® brand manual key switch required by the California Fire Code, as the primary method to open the gates. Accessing a community’s vehicular gates on an emergency response requires the fire apparatus to stop at the gate, have an emergency responder exit the vehicle, insert and turn a key, and reenter the vehicle before continuing with the response.

Other types of devices may have different access times than those used by the RMFD. Devices such as optical strobe switches and radio operated gate controls are available for use on community gates. These devices allow gates to be activated while a vehicle is in motion, without requiring an emergency responder to stop, exit the vehicle, and activate the key switch manually.

This technology would significantly reduce the number of manual activations currently required by the RMFD. Fire department personnel would no longer need to exit and reenter apparatuses to open gates for the majority of incidents. Gate access times may be reduced from the current manual practice, resulting in an overall reduction in incident response time. Injuries to firefighters may be reduced from slips, trips, or falls from apparatuses. Benefits to the public may result from decreased response times.

The use of such secondary devices is currently not mandatory and some devices are not approved for use by the RMFD. The RMFD has not yet evaluated the benefits of the devices for operational value nor have they assessed the possibility of changing fire codes in the future to make such devices mandatory. As part of this process, the RMFD sought to determine the access time for the current manual process, the access time for secondary access devices, and any time difference between the two. A reduction in emergency response times would be a determining factor for the RMFD to approve the devices.

The purpose of the research is to determine emergency vehicle access times through motorized gates in the city of Rancho Mirage. The study is focused on the time required to access gates with the manual key switch, the time required to access the community with a simulated secondary access device, and a comparison of the times to determine any difference.

Descriptive research was used to answer “What is the time required to access gates with the manual key switch?”; “What is the time required to access gates with a simulated secondary access device?”; “What is the time difference if any, between the two?”

This research may lead the RMFD to determine if secondary access devices are beneficial and should be considered for use in the community. Emergency response times may be reduced and firefighter safety may be improved.

## Background and Significance

The city of Rancho Mirage is an affluent area dominated by walled and gated residential communities. With striking views of the Santa Rosa Mountains, the city offers luxurious desert lifestyles for its wealthy residents. Rancho Mirage is located two hours east of downtown Los Angeles in the Coachella Valley.

Rancho Mirage has both permanent and seasonal residents. Year 2010 figures from the US Census Bureau (United States Census Bureau, 2011, p. 1) list the population of Rancho Mirage at 17,504 permanent residents. The population of the city swells to nearly double during the winter months. Local demographic data (Rancho Mirage.com, 2011, p. 3) illustrates that an additional 13,795 seasonal residents lived in the city during the winter of 2009 and 2010. This figure, according to the census estimates, has increased by 21.6 percent in the last five years.

The city covers an area of 24.77 square miles. Rancho Mirage is part of the larger area known as the Cove Communities (CC), which includes the cities of Palm Desert and Indian Wells. The CC was largely developed in the 1970's and 1980's. The neighborhoods of the CC were conditioned upon California Fire Code standards. Fortunately for residents of the CC, more restrictive local ordinances were also enacted that provided for wider streets, cul-de-sacs, and closer hydrant spacing. Adequate and codified fire department access was constructed during that time. Gate access for emergency responders was obtained through the still current requirement of Knox® access devices.

The majority of the communities in Rancho Mirage are walled and gated. According to the City of Rancho Mirage (City of Rancho Mirage, 2010, p. 1), there are a total of 13,482 dwelling units in the city. Of the 13,482 dwelling units, 11,479 units (85%) are located in these developments. All dwelling units in the city are in one of 126 identified communities. Of these communities, 110 are walled and gated, while 16 are not.

In 2011, Community Risk Reduction research was performed to identify, map, and inspect every gate in the city, as part of this researcher’s Executive Fire Officer Program and job capacity as the Rancho Mirage Fire Marshal. This research identified 190 vehicular access gates in the city. A program for subsequent annual inspection has also been developed for the city’s numerous gates.

There are three types of gates. Thirty-three emergency access gates are manual swinging gates locked with a chain and Knox® padlock. These gates are seldom used, existing strictly for emergency access. Thirteen gates are motorized, staffed gates where around-the-clock security personnel control access to the community. The third, most common type of gate is a motorized, unstaffed gate.

Motorized, unstaffed gates represent 144—or nearly 76%—of the vehicular access gates in the city. Residents operate the gates through a variety of means such as a keypad entry, a garage door-type opener, or a transducer in the windshield. This type of gate is referred to as a horizontal arm swinging gate. The gates are comprised of either one or two sections with a horizontal arm of the gate that swings open when activated. Emergency access to open this type of gate is obtained by a manual key switch. To open the gate, emergency responders must stop the vehicle, exit the cab, operate the key switch, and re-enter the vehicle before continuing to the incident.

In the past, the RMFD has experienced a large number of emergency responses into gated communities. As 33 of the gates are manual key switches used only for emergency response and 13 are staffed with security personnel, assuming equal distribution of calls, approximately 91%

of emergency responses into gated communities require fire department activation of motorized, unstaffed, horizontal arm gates. In 2011, RMFD responders entered communities through these gates hundreds of times.

Utilizing manual switches has been problematic for responders from time to time. Prior to the inspection program implemented by the RMFD, emergency responders encountered inoperable key switches: fine desert sand sometimes causes the locks to not turn, keys have had difficulty coming in or out of the locks, or non-working switches have been encountered that do not open the gate when turned. These failures have caused response delays. For example, responders may have been forced to use an alternate gate or have lost valuable incident response time until the gate was successfully opened.

Presently, the RMFD may still encounter response delays. The gate inspection program is not 100% successful in eliminating inoperable gates. Recent vandalism to Knox® key switches has been found or reported. A vandalized switch would not be located between inspections, so more than one delay from an inoperable switch may occur. Vehicles stack at gates at peak hours. Sometimes five or more vehicles may be waiting at a gate to enter. If the first vehicle is having difficulty accessing the community, all other vehicles including the fire apparatus are stuck waiting. In such a case, an emergency responder would be sent forward on foot with the key to open the gate, allow the private vehicles to proceed, and then continue with the response. Any of these situations increase emergency response times, possibly having an impact on the lives of residents or the safety of firefighters.

In the future, the RMFD would expect more issues with the key switches and possible delays. Knox® box vandalisms appear to be increasing. This may result in a delayed entry. The number of emergency responses is also increasing annually. RMFD responses have increased an average of 99 calls per year from 2006 to 2011 (California Department of Forestry Altaris CAD, 2005). Response times may also begin to rise from increased traffic flow on the streets as the communities grow.

The median age of Rancho Mirage is also increasing. Currently the median age is 62.3 years. Forty-three percent of the population is age 65 or above (Desert Recreation District, 2012, p. 93). As the communities and their populations age, an increased need for rapid access through gated communities to provide medical care will occur. Therefore, access within these communities must be as attainable and expeditious as possible every moment of the day.

With the increase in responses, the risk of injuries to firefighters also increases. According to the *U.S Firefighter Injuries-2010* report published by the National Fire Protection Association (Carter Jr. & Molis, 2011, p. 10), 4,380 firefighter injuries occurred while responding to or returning from an incident. Of these injuries, 2,705, or 61.8%, were strain, sprain, and muscular pain in nature. As RMFD firefighters constantly climb in and out of fire apparatuses on emergency responses to operate a key switch, the risk of injury from slip, trip, fall, strain, or sprain is substantial.

As with any industry, technology has evolved since most of the communities were built. The Knox® key switch system has provided extremely dependable access over the years. With limited exceptions, the devices work extremely well. There are though, products on the market that when used in conjunction with the key switch may decrease the time required to access the gates that do not require firefighters to exit the vehicle while responding. The use of these products may improve access and decrease response times within the CC. The decrease in response time may prevent the loss of life or property. Use of this technology may also reduce the risk of injury to firefighters and other responders.

There are two primary types of products: optical strobe switches and radio controlled devices. Optical switches operate the gate by detecting the traffic-emitting signal from the emergency vehicle's light bar. When it detects the signal, the gate opens. Radio operated devices are programmed with the fire department's radio frequency. When the microphone is depressed within the effective range of the device, the gate is activated. Both of these devices allow the gate to open without having to stop, exit the vehicle, operate the key switch, and reenter the vehicle before continuing with the response.

Part of this researcher's role as the Rancho Mirage Fire Marshal is the responsibility to ensure adequate and codified emergency access for fire department operations. This includes any items that may increase firefighter safety and decrease incident response times. Manufacturers and fire service leaders claim the devices save response time, but no empirical studies were found to substantiate the claims. Time savings would be a very important consideration for the RMFD and parent Riverside County Fire Department in determining whether to standardize the devices. Despite extensive searching, no time studies have been located regarding this subject.

This research may assist in fire department operations, including the immediate establishment of a incident command system (ICS) as needed for routine emergencies or low frequency, high-risk incidents such as an earthquake. By quickly allowing the setup of the ICS system, critical incident information and documentation can be gathered and communicated in an emergency, as outlined in Chapter 1 of the Executive Analysis of Fire Service Operations in Emergency Management course (U.S Department of Homeland Security/U.S Fire Administration/National Fire Academy, 2011).

Rancho Mirage has a large population of persons 65 years and older. This research may reduce the loss of life to persons 65 years and older, one of the operational objectives of the United States Fire Administration (USFA).

The city of Rancho Mirage Fire Department is operated through a series of contracts by a combination of State and County career personnel. The California Department of Forestry and Fire Protection (CALFIRE) contracts with the County of Riverside for municipal fire protection within the county. This agreement, by virtue of the California Public Resources Code, results in CALFIRE operating ninety-six fire stations with 1,150 career personnel in all unincorporated areas of Riverside County. Twenty-one incorporated cities (one of the cities being Rancho Mirage) and one community services district have then contracted with the Riverside County Fire Department (RCOFD) to provide their municipal fire protection. The result is state employees providing municipal fire protection to a large portion of Riverside County, including the city of Rancho Mirage. The RMFD is administered by one Division Chief and three Battalion Chiefs (two field Battalion Chiefs and one Fire Marshal). The Division Chief serves as Chief of the RMFD and reports to the Chief of CALFIRE Riverside Unit/Riverside County Fire Department. The Division Chief interacts daily with the Rancho Mirage City Manager, however no members of the department are employees of the City of Rancho Mirage.

The Rancho Mirage Fire Department suppression staff operates two fire stations, including two fire engines, one shared independent company truck, and one advanced life support ambulance. The 24 twenty-four permanent career staff of the RMFD is composed of state employees of CALFIRE.

The RMFD Fire Marshals staff consists of two personnel. One county employee is assigned as the Fire Safety Specialist (FSS)—an employee who performs plan reviews and inspections throughout the city. The writer of this paper is the Fire Marshal, a state employee of CALFIRE.

## Literature Review

The RMFD encounters gated communities every day. As 85% of the city's dwellings are behinds walls and gates (City of Rancho Mirage, 2010, p. 1), RMFD emergency responders are constantly utilizing the Knox® key switch system to access the communities. Prior research by the RMFD (Brooker, 2011, p. 34) has shown that 144 of the city's 190 gates in the community are unstaffed, horizontal arm, motorized gates.

The California Fire Code (CFC) (California Fire Code, 2010, Chapter 5) requires that security gates across a fire department access road must be approved by the fire chief and require the use of a key box for fire department access. The RCOFD, including Rancho Mirage, has always used the Knox® Company to fulfill this need. Riverside County Ordinance 787.6 (Riverside County Fire Department, 2011, p. 8) has adopted the CFC and added additional requirements to Chapter 5, including the authority of the Fire Chief to require additional fire protection where obstructions of fire access roads occur. Likewise, the city of Rancho Mirage has adopted the CFC, including Chapter 5, as its model fire protection code for the city (California Fire Code, 2011, p. 6).

Although the RMFD is a stand-alone city and has its own codes and ordinances, including adoption of the fire code, the city is part of the integrated, regional, cooperative fire protection program administered by the RCOFD. As a contracted partner in this system, certain issues affecting the entire regional fire protection system must be reviewed and standardized by the RCOFD. This is required to ensure consistency of department-wide operations. Therefore, any standards approved by the RMFD need to be consistent with the RCOFD. The standardization for use of these devices has not yet occurred.

Standard use of radio-operated access devices has not been adopted and these devices are not currently approved to be programmed with RCOFD's frequencies. A communications plan has not been developed for radio-operated products and potential impacts to Emergency Command Center operations have not yet been explored.

Other jurisdictions have faced standardization concerns as well. The applied researcher R.V. Petrillo identified the concern facing his community of Palm Coast, Florida (Petrillo, 2006). In 2006, gated communities were growing rapidly in that area. He conducted surveys of neighboring departments on their standards for emergency access. The result of the surveys was there is no standard for emergency access. Different agencies have different requirements, from key switches to radio, siren, or optical devices. Others use a myriad of keys or access combinations on key-pads. His research identified the need for his department to quickly establish a standard for gated communities. His suggestion was for the use of the Click2Enter® radio device.

The city of Hilton Head, South Carolina identified similar problems. In an August 2005 Fire Chief magazine article, Chief Tom Fieldstead wrote of the concerns emergency responders face with gated communities in that jurisdiction, which is 70% walled and gated. According to Fieldstead (2005), gated communities present his department with major challenges. Gated communities typically have fewer cross-street connections, which require responders to drive further to access points. While designed to ensure security to the residents, gates "slow response times" for emergency responders including fire, police and ambulances. Any delay in some cases according to Fieldstead "can be life threatening." (Fieldstead, 2005)

Fieldstead continues by stating the demand for gated communities is increasing. Fire service leaders must therefore prepare for this by either attempting to eliminate walls and gates from communities or proactively plan for reasonable alternatives. The choice for Hilton Head was to move to an electronic system, which eliminates the need for multiple access systems. According to Fieldstead (2005), “moving to an electronic system allows the department access and reduces response times.” Hilton Head chose a radio gate access system.

Johns Creek, Georgia (City of Johns Creek, Georgia, 2010) voices in on the matter in a 2010 community newsletter article describing its new radio gate access program. Fearing a response delay in one of its 41 gated communities or apartments, the city started retrofitting gates with the Click2Enter® radio system. In the newsletter, both the Johns Creek police and fire chief describe not being able to access communities due to inoperative gate codes. Sometimes gates needed to be forced open to gain access. Johns Creek Police Chief Densmore states that the new system could save lives and that it is unacceptable to have emergency equipment delayed outside of gates because they are unable enter. Johns Creek Fire Chief Joseph Daniels also discusses firefighters having to stop, exit the vehicle, and activate a key switch, which according to Daniels costs response time. Daniels also claims “The new system takes a couple of minutes off the response time. In an emergency, minutes matter.” (City of Johns Creek, Georgia, 2010)

National Fire Codes® published by the National Fire Protection Association (NFPA) are also not specific regarding gate devices. Section 1141 (National Fire Protection Association [NFPA], 2007, Chapter 1141) of the code addresses fire lanes and means of access. According to this code, gates should be set back a minimum of thirty feet from the roadway. The local Authority Having Jurisdiction (AHJ) shall have the authority to require an unlocking feature. The gates shall open inwards and they shall have a means to override normal operations as well as manual overrides in the event of a power outage. The code does not go into further detail or address specific emergency access devices further.

The Door & Access Manufacturers Association (DASMA) (Door & Access Systems Manufacturers Association International [DASMA], 2010) has guidelines for emergency access to vehicular gate systems. Its technical data sheet #378 states that gates should have a powered emergency access system or a manual release as required by the AHJ. It makes no further mention of electronic emergency access devices. The DASMA technical data sheet #378 is as specific and no more than NFPA Section 1141. DASMA claims to be “North America’s leading trade association of manufacturers of garage doors, rolling doors, high performance doors, garage door operators, vehicular gate operators, and access control products.” (DASMA, 2010)

There are also no building, planning, or public works codes at a state, uniform, or national level that address emergency access. The Uniform Building Code, or California Building Code, does not cover vehicular access. There are no standard planning or public works codebooks. Each jurisdiction develops its own as needed by local ordinance.

Although there is no standard for emergency access devices in model codes and many jurisdictions including the RMFD and RCOFD have yet to address the issue, many agencies have addressed gate requirements by mandating the use of specific devices. In a 2007 *Fire Engineering* article, Tom Chronister, Certified Protection Professional, recognized the need for emergency access devices. Chronister (2007) explains that the demand for gated communities is increasing and that having multiple keys, remote controls, or access codes is detrimental. He further states that the demand for gated communities is at a record high and the issue of emergency access is of highest importance. According to Chronister (2007), “unimpeded scene access could be the difference between life and death.” Chronister concluded that “without proper planning, such systems can adversely affect public safety response unless the use of emergency bypass systems on all electronic gates is mandated.” (Chronister, 2007)

There are many jurisdictions however, that have heeded the advice of Chronister and Fieldstead. They have properly planned for gated communities by requiring secondary access device systems. The city of Phoenix, Arizona is one example. The Phoenix Fire Department (PFD) addresses gate requirements in Chapter 7 of the Emergency Access Detail Book (Phoenix Fire Department, n.d., Chapter 7). This department requires, in addition to the Knox® key switch, a dual strobe optical device. According to the standard stated by the PFD, optical preemptive devices are required on all gates. They have chosen the Tomar® strobe switch optical device as mandatory in that jurisdiction.

Beaufort County, Georgia has also standardized access devices in its gate access program. According to their program, “the commitment of Beaufort County is to reduce the response times to all areas of the county including the areas protected by electronic security gates. This has led to the development of a program to insure a standard access control method for all electronically operated security gates.” (Beauford County, n.d.) Beaufort County chose the Click2Enter® radio system as its standard.

California has several jurisdictions that have also developed gate access requirements. The Orange County Fire Authority (OCFA) is one. Guideline B-09, “Fire Master Plans for Commercial & Residential Developments,” outlines the standards for that department, which encompasses 23 jurisdictions. OCFA requires that an approved secondary device be installed in addition to the Knox® key switch. OCFA allows the use of radio or optical devices. OCFA also enforces the requirement of the Irvine Police Department to have Click2Enter® installed on all gates and public buildings in that city.

The Oxnard Fire Department is a department that produced a retroactive code mandating the installation of radio devices on all gates. According to Ordinance 2666 passed in 2004, the city found “there are many electronic and electric access gates in businesses, commercial, and residential portions of the city” and that “emergency personnel have difficulty promptly entering the area closed with such gates when confronted with threats to public health, safety, and welfare.” (Oxnard Fire Department, 2004) The ordinance provided a two-year time-frame for compliance.

The Fairfield, California Fire Department requires radio devices for its jurisdiction, specifically the Click2Enter® product. The requirements are outlined in Standard 95-44 which states, “All electrical vehicular gates shall be provided with access control utilizing a Radio Transceiver…This transceiver will allow emergency vehicles to open the gate from a mobile or portable radio.” (Fairfield, California Fire Department, n.d.)

The significance of these code requirements used by other jurisdictions goes beyond any potential response time savings. According to the *U.S Firefighter Injuries-2010* report published by the National Fire Protection Association (Carter Jr. & Molis, 2011, p. 10), 4,380 firefighter injuries occurred while responding to or returning from an incident. Of these injuries, 2,705, or 61.8%, of the injuries were strain, sprain, and muscular pain in nature. Similarly, according to the Topical Fire Report Series (*Fire-Related* Injuries, 2011) published by the U.S. Fire Administration, 4,880 firefighter injuries were reported to the National Fire Incident Reporting System (NFIRS) while responding to emergencies from 2006 to 2008. Jurisdictions such as the RMFD, which only use the key switch, expose firefighters to slip and fall injuries from apparatuses while responding to emergencies. Secondary devices, as mandated in the referenced codes, drastically reduce that potential.

CALFIRE Policy is clear on the need to identify and reduce the potential for workplace injuries. CALFIRE Handbook 1700 (CALFIRE 1700, 2003) identifies the goals of the

Department's Safety and Injury/Illness Prevention Program. In order to protect the lives and welfare of our personnel, it is the department's goal to identify potential workplace hazards and to eliminate or control them before they result in injuries. All managers and supervisors have a responsibility to reduce the frequency, severity, and monetary costs of injuries. It is also a responsibility to actively support programs designed to reduce injuries in the workplace.

Response times are also very important to the RMFD and RCOFD. The need for efficient and timely operations has been most recently demonstrated in the Riverside County Fire Department Turnout Times Policy (Riverside County Fire Department [RCOFD], 2011). According to the policy, "time objectives are essential to provide proper emergency incident response and delivery of service." (RCOFD, 2011, p. 1) It is important for the RMFD to reach established benchmarks for emergency response times. Time objectives referenced in this policy are outlined in NFPA 1710.

According to NFPA 1710 (NFPA, 2007, Chapter 17), the fire department shall arrive on scene of an EMS incident within four minutes or less 90% of the time. The NFPA 1710 standard for fire responses states that the first apparatus must be on scene within four minutes or less from time of dispatch, and that the total alarm must be on scene within 8 minutes or less. Response time is defined by NFPA 1710 as, "The travel time that begins when units are en route to the emergency incident and ends when units arrive at scene." (NFPA, 2007, Chapter 17) As this is the benchmark by policy for the RMFD, efficiency of emergency response is a major consideration for the department.

Political, public, and media interests regarding response times is also clear. The Los Angeles Fire Department (LAFD) has recently been in the center of controversy regarding its response times. The controversy has been centered around impacts of budget reductions within the LAFD. Media reports claimed that response times suffered because of the budget reductions. One example of such an article is the Daily Breeze article "LAFD's Response Times to Medical Emergencies has Slowed Since Cuts." (Orlov, 2012) Inconsistencies within the department's statistical unit, contrary to the media reports, prompted the Mayor to hire an outside consultant to review response time data of the fire department.

The Orlov article describes the findings of an internal audit by the city controller, in which incident response times to medical emergencies did increase between twelve and twenty seconds following the cuts. The article also cites the concern of the controller regarding the quality of the department's response time data. The controller finds it, "unacceptable that the LAFD has been unable to accurately track its emergency response times." (Orlov, 2012)

According the Los Angeles Times (Welch, Lopez, & Linthicum, 2012) the LAFD only meets the national response standard of one minute for call processing 15% of the time. Time lag in the department's dispatch center results in the failure to reach national call processing time for the vast majority of the incidents. A time analysis of over one million calls showed the department fell notably short of the standard. According to the article, "seconds are critical in emergencies," and the LAFD has not met the standard. (Welch, Lopez, & Linthicum, 2012)

Manufacturers claim that the devices improve important emergency response times. Click2Enter® (Click2Enter, 2012, p. 1) states on its website that it will "Improve emergency response time." Manufacturers of PETEHome, a web-based gate access product, state that "seconds matter, response time is everything… No longer will police, fire or emergency services be delayed for a single second," while attempting to access gates. (PETEHome.com, 2011)

To assist in planning the data collection and analysis for this project, the Creative Research Systems website (Creative Research Systems, 2007) was visited. The website provided general information on sampling, including a sampling size calculator. The website defined sample size, confidence interval, and confidence level. The site stated that most researchers "use the 95% confidence level." (Creative Research Systems, 2007, p. 2) The Statistics-Help-For-Students (Statistics-Help-For-Students, 2008) website was used to assist in correctly presenting the data in proper APA format in this paper.

In summary, Fieldstead and Chronister state very clearly that gated communities are on the rise and that emergency access needs to be a major consideration. Without a detailed plan for this major consideration, responders may likely be delayed by gates. The answer for these two fire chiefs was to require an electronic bypass system for gates.

Many other agencies have taken the advice of Fieldstead and Chronister. Johns Creek, Georgia, fearing a response delay, installed secondary access devices on gates in their jurisdiction. The Phoenix Fire Department, OCFA, and Fairfield Fire Department have mandated the use of secondary devices. Oxnard Fire Department mandated retroactive compliance on existing gates. Numerous other fire departments in California and elsewhere have also mandated secondary devices.

So far, the RMFD has not such measures. The RMFD is in a similar position to Petrillo in Palm Coast, Florida. In reviewing existing standards, Petrillo realized there is no standard. There is no consistency between departments or in model codes. A review of model codes, including the CFC, NFPA Codes, and local ordinances, indicates that these model codes only require emergency access but do not mention secondary devices or other bypass systems. DASMA also does not make recommendations regarding secondary devices. The codes only state that emergency access is required in a manner required by the AHJ. There are also no codes for planning, public works, or building codes addressing emergency access. This information has influenced the research project by determining that the RMFD will have to develop the standard of its choice for secondary devices.

There are many claims of response time savings related to the devices. Chief Daniels states that the devices “take a couple of minutes off the response time.” (City of Johns Creek, Georgia, 2010) Beaufort County mandated the devices to “reduce response time.” (Beauford County, n.d.) Fieldstead said that gates “slow response times.” (Fieldstead, 2005) Chronister stated that unimpeded access can be, “the difference between life and death,” by gates. (Chronister, 2007)

Response times are very important to the RMFD, as demonstrated in the Turnout Times Policy. In developing any standard for the devices, such as Petrillo was interested in completing, response time savings from the devices would be cruicial consideration. No empirical time studies have yet been found to substantiate the claims of Fieldstead, Daniels, and Beaufort County. This research project was influenced by these claims and the lack of empirical validation for them, and sought to gather factual data to quantify any time savings from such devices.

Response times are extremely important to the public, politicians, emergency service providers, and the media, as illustrated by the issues raised in Los Angeles. Accurate response time data is critical. Response times are used as a tool in Los Angeles to measure service delivery in the wake of budgetary reductions. Future budgetary decisions may rest upon response times and the importance of accurate data. Comparison to national standards has also been conducted in Los Angeles. The inability to produce accurate data or reach national response time benchmarks is clearly problematic in that jurisdiction.

This project was also influenced by the number of injuries to firefighters that occur while responding to emergencies. Thousands of injuries occur nationwide due to strain and sprain injuries while responding to emergencies according to Carter, Molis, and NFIRS data. Currently, RMFD responders have to exit the vehicle to activate the key switch every time they access a horizontal arm motorized gate. This type of gate is encountered an estimated 91% of the time in Rancho Mirage. Emergency responders access the gates in this manner hundreds of times each year. CALFIRE Policy requires managers to identify and reduce the potential for workplace injuries to occur. Such secondary devices may prevent injuries to firefighters because emergency responders will no longer, or only rarely, have to activate key switches in the current manner. Reducing the potential for workplace injuries to members of the RMFD would be a tremendous asset. Secondary access devices may do just that.

## Procedures

This research project continues to examine issues related to access gates in Rancho Mirage. Prior research identified the total number of gates and resulted in the development of an annual inspection program. Further work was needed, however, to fully resolve issues related to the gates, including whether secondary access devices should be required. Response time savings due to secondary devices is widely claimed by the fire service and manufacturers, but no data has been located to support the claim. Time savings are important to the RMFD in determining whether to support the application of secondary devices in the community. In order to resolve the time issue, research was conducted as described:

1. In January 2012, this researcher attended the Executive Analysis of Fire Service in Operations and Emergency Management course at the National Fire Academy in Emmitsburg, Maryland. While at the academy, research was conducted in the Learning Resource Center relating to work others had done on this subject. This included a search of the Center's resources for reviews of ARP's, journals, magazines, Internet articles, and code-related materials. Material reviewed for this project were organized and collected for future use and documentation, as cited in this paper.
2. In March 2012, this project was discussed at different times with several individuals including the City Manager, Public Works Director, City Engineer and Fire Safety Specialist. Ideas to accomplish the research were discussed, including the sample size to represent the population of gates, the confidence level for the study, and methods for conducting the time tests. It was also suggested at this time that a paired t-test would likely be the most appropriate way to determine the answers to the research

questions. The Creative Research Systems website was used to determine the confidence level and sample size. A high level of certainty was sought, so a 95% confidence level was chosen, as recommended by the website. Out of the Rancho Mirage's 190 access gates, the population of 144 unstaffed, horizontal arm, motorized gates was known, based on previous research and development of the gate inspection program. Based on the population of 144 and a 95% confidence level, the website determined a sample of 104 access gates was needed. As part general discussions during this time regarding the project, researcher decided to seek assistance from the local community college for statistical analysis of the data.

3. On February 27, 2012, this researcher went to College of the Desert in Palm Desert, California and was referred to Dr. Nicole Tortoris, Associate Professor of Sociology. A meeting with Dr. Tortoris occurred at this time. Dr. Tortoris confirmed that a paired t-test would indeed be the best way to evaluate the data and confirmed the sample size for the required confidence level. Sampling techniques were also discussed and Dr. Tortoris advised she would be happy to perform the data analysis.
4. On February 28, 2012, testing methods were established. The first step was to set up the access corridor. The access corridor is the standard distance that would be used for all testing. A review of city aerial maps and random samples determined that the standard setback of gates is 96 feet from the street. For all gates, a distance of 20 feet on the inside of the gate from the closed position would ensure that the rear of the vehicle would be completely through the gate. A testing distance of 116 feet for each sample was thereby determined for this research. The setback distance of 96 feet was selected to start the time because optical devices must be in line of sight with the

emergency vehicle to be activated. The vehicle would have to start making the turn from the street to towards the gate for the switch to be activated. For each sample, time would begin when the vehicle crossed the 96-foot mark and end when the vehicle crossed 20 feet behind the gate. The RMFD focused on the two primary types of vehicles in the department that access the gates. One is the fire engine and the other is the department’s ambulance. The RMFD has the same type of engine and ambulance in the fleet. The RCOFD standard is the Smeal Type 1 Fire Engine. The vehicle is 26 feet long. The RMFD ambulances are Frazer ambulance modules on Ford F-350 chassis and are 18 feet long. Four sets of data were to be collected. First was the fire engine using the key switch. Actual fire apparatuses would approach a gate and activate the key switch in a manner used by that particular crew. No other direction would be given to the operator other than to respond to and access the gate as if you were responding to an emergency. The second data set was the fire engine with a simulated optical strobe switch. As switches are very infrequently encountered in Rancho Mirage, the only way to conduct the testing is simulation. To simulate the device, a fire department member would be positioned at the key switch and activate the switch when the vehicle crossed the front of the corridor. The gate would open as if preempted by the strobe. The third data set would be the ambulance using the key switch. The fourth set would be the ambulance with the simulated strobe switch. Times would be recorded for each sample by a designated timekeeper.

5. On March 1, 2012, sample testing began. An RMFD fire engine and ambulance were requested to a chosen gated community where the vehicles could easily make continuous loops and return to the starting line. A location was chosen with a 96-foot

setback and a mark was made at 20 feet inside the gate to delineate the 116 foot corridor. The engine was given directions to respond as if on any emergency call and access the gate with the key switch. Time was recorded with a stopwatch by the FSS and this researcher was observing the sample testing. The fire engine proceeded down the street towards the access corridor at normal emergency response speed, made the turn onto the corridor, stopped, keyed the gate open, returned to the vehicle, and proceeded with the response. Time was started when the front bumper crossed and the corridor and ended when the rear bumper crossed the twenty foot mark inside of the gate. After a few samples with both the engine and the ambulance using the key switch, the same process was repeated simulating the strobe switch. The direction was given to the drivers to access the corridor but this time the gate would be opening automatically. The FSS started the time and turned the key switch concurrently when the bumper of the apparatus crossed the corridor. Time was stopped when the rear bumper crossed the 20-foot mark. A few more samples were taken with a different fire engine and operator, as well as with an ambulance and squad at this location using the key switch method. Data was compiled by the researcher.

6. The sample data was then discussed. Operators were debriefed at the testing site by the researcher. A couple of notable items appeared from the preliminary tests and debrief. Operators appeared to quickly recognize the location of the key switch and very rapidly exited the vehicle to activate the switch. The key switch operated extremely smooth with the key inserting and exiting very quickly and the switch working very well. Operators indicated that this does not represent the population of gates. Key switches are not always in the same place. Some are at the key pad, while

others are on the wall at the gate. It often takes time according to the operators, to locate the switch. Secondly, not nearly all of the key switches are as smooth as the sample switch. Keys seize up and some switches are difficult to operate. A major consideration noted by the emergency responders was during the simulate strobe. In each of the samples, regardless of the engine or ambulance, the vehicles did not have to completely stop to access the gates. Access times were very similar. It was also noted that sample testing was interrupted several times by apparatuses having to leave the test for actual emergency responses. Based on these factors, testing was modified.

7. Testing methods were refined. In order to represent the entire population of city gates, a large majority of the gates had to be tested. Firstly, this was needed to address concerns of bias from the operators. Secondly, fire engines and ambulances were no longer requested to do the testing. The apparatuses used for testing from this point forward consisted of the FSS's vehicle and the researcher's Battalion Chief pickup truck. Thirdly, simulated strobe sample sets were combined. Because sample times for both the engine and the ambulance were very similar on simulated strobe tests, this data set would be combined into one set. The name was changed to "Any Vehicle with Strobe" representing any RMFD fleet vehicle. The second data set was changed to "Light Vehicles with Key" to represent the combination of ambulances, squads, and pickups to conduct the testing. Data sets for Fire Engine continued to be named "Fire Engine with Key" but were slightly modified. Since light vehicles used for the remainder of the testing are shorter than the 26-foot fire engine, the stopping line inside of the gate was increased by 7 feet to 27 feet. This accounts for the 7-foot difference between the 19-foot long light vehicles and the 26-foot long fire engine.

Time was stopped when the rear bumper of the light vehicle reached the 27-foot mark, representing the bumper of the engine. With the sampling strategy well-defined, sampling could continue in earnest.

8. All time samples were taken. Over the course of two weeks, all of the time samples were completed. The first data set completed was “Any Vehicle with Strobe.” The FSS and researcher completed the samples by driving to many of the gates in the database. The 116-foot corridor was measured for each gate. The FSS and researcher took turns either driving or activating the key switch and stopwatch function. Data was recorded for each sample until the required 104 samples were completed for that set. The second data set, “Light Vehicle with Key,” was completed in a similar manner. Numerous gates were visited and time samples taken. For this set, either the FSS or researcher would perform the key switch access through the corridor while the other gathered the time with the stopwatch and documented the sample. The third data set “Engine with Key” was gathered in a similar manner as the second, with the exception of the 123-foot corridor versus the 116-foot, in order to represent the difference in length between the fire engine and the vehicle used for the study. The sample location was also increased for this data set. The researcher chose to include similar gates in neighboring Palm Desert to increase the variables in key switch locations and lock operations, as identified by the operators during the sample testing. After completing all samples, the three data sets were entered into an Excel spreadsheet. The data sheets appear as Appendix A in this report.
9. On March 18, 2012, the data sets were submitted via email to Dr. Tortoris for statistical analysis. Dr. Tortoris used the computer program SPSS© to perform the

analysis. On March 20, 2012, the completed analysis was returned via email to the researcher.

10. Results of the analysis were reviewed by the researcher and appear in the results section of this paper. The complete analysis appears as Appendix B in this report.
11. During the period from April to May 2012, this Applied Research Project was written in accordance with the National Fire Academy Applied Research Project Guidelines. The Internet was used in assisting with representing the results of the research in proper APA format. The paper was submitted to the National Fire Academy on June 15, 2012.

Several limitations occurred with this research project. Strobe switches were simulated. There is currently only one strobe switch installed on the entire population of gates in the CC. Having actual strobe switches for this project was not possible. Dozens of different gates were used to obtain the samples. It would not have been possible to have switches installed on all of the gates so the samples could be obtained. The researcher simulated the strobe switch based on previous training with the vendor, and personal knowledge of the devices. The researcher knows that the switches would activate as soon as the vehicle started to turn towards the gate as simulated in the testing. The gate with the switch was not used for the sampling because of its proximity to a main thoroughfare and busy civilian use.

The project was limited by the fixed access distance of 96 feet. Some communities have longer gate setbacks. The strobe or radio device would open the gate at a greater distance than 96 feet for those gates. These are not standard. The most common distance is 96 feet, and was therefore used for this study on every sample.

The fire engines were simulated. The majority of the fire engine key switch samples were obtained in the refined testing method described in number seven above. It was not practical or possible to have a front-line fire engine committed for testing. It was not practical or cost effective to consume the large amount of fuel that would be required if a reserve apparatus had been used. Community relations would not be favorable if fire engines were continuously driving through the access gates during the course of the day. For these reasons, only a portion of the samples were taken with actual fire engines. Different drivers were observed during those samples, and key characteristics, such as the speed of the vehicle and the position of the gate when the vehicle started to move forward, were used to simulate the fire engine key switch data. The additional length of the fire engine compared to the test vehicle was accounted for in the samples.

Driver bias could also be considered a limitation. The majority of the samples were taken by the FSS and the researcher. Sample testing included six drivers in all. It was observed that some crews would have the passenger exit the vehicle to activate the switch; with other crews, the apparatus driver would activate the switch. For all key switch tests conducted by the FSS and researcher, the driver exited the vehicle to activate the switch. Also, a fire engine is higher and may be more difficult to enter and exit compared to the pickup used in the simulation, therefore the conditions of the fire engine driver were not exactly reflected in the simulation.

## Results

Non-parametric tests were performed to determine the time required to access gates for light vehicles and fire engines with the manual key switch. The results to the question "What is the time required to access the gates with the manual key switch?' are shown in Table 1 below:

Table 1

*Light Vehicle and Fire Engine using key switch*

| Vehicle type | M | SD | N |
|---|---|---|---|
| Light Vehicle | 30.4655 | 4.29 | 104 |
| Fire Engine | 36.7332 | 5.3419 | 104 |

The average access time for the light vehicle with key is 30.4655 seconds. The average access time for the engine with key is 36.7332 seconds. The sample size was 104 representing a population of 144 gates.

The light vehicle access time was faster than the fire engine. First, the light vehicles were observed to be notably faster in accelerating after the key switch had been activated. The gates did not have to be all of the way opened before the light vehicle could start rolling towards the gate, thereby improving its access time. Second, the fire engine is longer, slower, and wider than light vehicles. In actual tests using the fire engine, drivers were observed to be much more cautious when approaching an opening gate. They would move forward very slowly while the gates were opening and accelerated only when they were completely open. The fire engine also had to travel a further distance to complete the access corridor because of its length. The research question was answered that the access time for a light vehicle with key is on average is 30.4655 seconds and the access time for the fire engine with key is on average 36.7332 seconds.

Non-Parametric tests were performed to answer the second question of “What is the time required to access the gates with a simulated secondary access device” The results are in Table 2 below:

Table 2

*Any vehicle using simulated strobe device*

| Vehicle type | M | SD | N |
|---|---|---|---|
| Any Fire Department Vehicle | 15.2797 | 1.67910 | 104 |

The average time for any fire department vehicle to access a gate with a simulated strobe device is 15.2797 seconds. This average is based on a sample of 104 from a population of 144 gates.

Data revealed that using a simulated strobe any RMFD vehicle, including the fire engine, ambulance squad, pickup, or inspector vehicle, can access the gate corridor within 15.27 seconds on average. Visible observation determined that regardless of the vehicle type, when the simulated strobe was activated, the gates were approximately halfway open or more when the vehicles reached the gate. In nearly all of the tests, the vehicles maintained a visibly faster rate of speed than the key switch activations. In none of the tests did any of the vehicles have to come to a complete stop before the gates were fully open, allowing the vehicle to proceed. In none of the tests did the vehicle operator have to stop, exit the vehicle, and activate the key switch before accessing the corridor. As indicated by this data, any fire department vehicle can access the gate corridor with a simulated strobe in 15.2797 seconds on average.

The results for the question “What is the time difference if any, between the two?” was determined. A paired samples t-test was used to compare two pairs of data. The first pair was “Light Vehicle with Key” and “Any Vehicle with Strobe.” The second pair compared was “Engine with Key” and “Any Vehicle with Strobe.” The results appear in Tables 3 below:

Table 3

*Paired samples- key switch versus simulated strobe*

| Paired Type | M | SD | N | Sig(2-tailed) | t |
|---|---|---|---|---|---|
| Light vehicle with key<br>Any vehicle with strobe | 15.18577 | 4.89454 | 104 | .000 | 31.640 |
| Any vehicle with strobe<br>Fire engine with key | -21.45345 | 5.04455 | 104 | .000 | -43.370 |

The first paired samples t-test was conducted to compare the light fire department vehicles using the key switch to any fire department vehicle using a simulated strobe device. There was a significant difference in the access times for light vehicles with key (M=30.4655, SD=4.29) and any vehicle with strobe (M=15.2797, SD=1.67910), conditions t(104)=31.640, p=000. These results suggest that use of the strobe has an effect on vehicle access times. Specifically, light vehicle access times are reduced with the use of the strobe. The time difference is 15.18577 seconds on average.

The second paired samples t-test was conducted to compare the fire engine using the key switch to any fire department vehicle using a simulated strobe device. There was a significant difference in the access times for the fire engine with key (M=36.7332, SD=5.34190) and any vehicle with strobe (M=15.2797, SD=1.67910) conditions t(104)=-43.370, p=000. These results suggest that use of the strobe has an effect on vehicle access times. Specifically, fire engine access times are reduced with the use of the strobe. The time difference is 21.45345 seconds on average.

An unexpected finding was also discovered during this research. While not an original research question for this project, a third paired samples t-test determined that there is a significant difference in access time between the light vehicle with key (M=30.4655, SD=4.29) and fire engine with key (M=36.7332, SD=5.34190), conditions t(104)=-8.384, p=000. The data revealed that the light vehicle can access the gate corridor with the key faster than the fire engine. Specifically, the light vehicle can access the gate corridor 6.26768 seconds on average faster than the fire engine using the key switch. The data for this paired samples t-test is shown in table 4:

Table 4

*Paired samples- fire engine versus light vehicle using key switch*

| Paired Type | M | SD | N | Sig(2-tailed) | t |
|---|---|---|---|---|---|
| Light vehicle with key<br>Fire engine with key | -6.26768 | 7.62410 | 104 | .000 | -8.384 |

The light vehicles are smaller and faster than the fire engine. The access corridor is shorter. The passenger-type vehicles allow the driver to more efficiently enter and exit the vehicle. Acceleration was physically observed to be faster than the fire engine. The vehicles were observed to move forward as the gates were opening while the fire engine waited for the gates to be fully opened before proceeding.

## Discussion

This research has determined that secondary access devices will reduce emergency response times through gate corridors in Rancho Mirage. Light vehicles will get through gates in a little over 15 seconds faster than with the manual key switch. Fire engines will get through on average of nearly 21.5 seconds quicker. As the RMFD encounters gates so frequently, this difference in time is a significant benefit.

Response times in Rancho Mirage are very good and the department is fortunate not to be challenged on emergency response times, as the case with the LAFD. It is interesting to this researcher that the audit conducted by the city controller, as described by Orlov, identified response time increases of "twelve to eighteen" seconds. For the LAFD, this is huge. This difference is similar in time savings to the results shown here by this research.

At first glance, 15 or 21 seconds may not appear to be of any particular significance. Heavy traffic, negotiating stop signs, or cars failing to yield to emergency vehicles would certainly add more than 15 to 21 seconds to an emergency response. Cars stacked at a gate or speed bumps inside of a community would further add to the response time. The consideration, however, should focus on the results that the devices save this amount of time. Any time lost on an emergency response call cannot be gained back. These secondary devices ensure that regardless of external conditions, response times through the gates are minimized. Without these devices, the same traffic delays now result in a 30 to 42 second delay in reaching a patient or fire.

The L.A. Times states, "seconds are critical in emergencies." (Orlov, 2012) PETEHome states that "seconds matter." (PETEHome.com, 2011) This writer agrees that seconds are important. They are certainly important in maintaining the "essential time objectives" as outlined in the RCOFD policy regarding turnout times and the response time criteria outlined in NFPA 1710. Unnecessary delays can be “life threatening” according to Fieldstead (2005). Chronister (2007) argued that, “unimpeded scene access could be the difference between life and death.” This researcher believes that both of these gentlemen would argue that seconds do in fact matter.

Many references in this project claimed that response times would be reduced with the use of secondary devices. Manufacturer claims include those from Click2Enter®, stating that the device will, “improve emergency response times.” Fieldstead stated that gates, “slow response times,” and the devices, “reduce response times.” Beaufort County mandated the use of such devices in order to “reduce response times.” Chief Daniels says the use of key switches “costs response time.” This research confirmed that all of these statements are true for Rancho Mirage.

Unstaffed motorized gates slow response times by 15 to 21 seconds on average for the conditions of this testing. This is in agreement with statements made by Fieldstead. Response times are slower without the secondary devices than with them. Daniels’ statement that the key switch “costs response time” is also true. Response time is lost with the key switch compared to the optical strobe. This study agrees with Fieldstead, Click2Enter®, and Beaufort County that the devices do reduce or improve emergency response times through the gate corridor.

This study is however, inconsistent with the statement from Daniels that their new system “takes a couple of minutes off of the response time.” (City of Johns Creek, Georgia, 2010) The device of choice for Johns Creek is the Click2Enter®. This radio device is similar to the simulated strobe used in the sample testing, so for the purpose of this study, Rancho Mirage would not expect much greater time savings with the radio device, if any. A slightly greater savings may occur if the device has a larger range of effectiveness than the optical strobe device.

The statement from Daniels regarding the reduction of response times was further considered. This researcher informally tested the Rancho Mirage gate that featured an actual strobe in place. That particular gate has a much longer setback, and the strobe activates the gate in time for the gate to be completely open for arriving apparatuses. Engines or light vehicles can proceed at a speed as if the gate was not there. Emergency responders who use that gate testify to the time savings by the gate being open. Some individual gates such as this one may even have faster times. Even under these or any other circumstances, however, the time savings in Rancho Mirage would still not be a couple of minutes.

As for the device of choice for Rancho Mirage, radio devices have not yet been approved for use. Being a very large fire service organization encompassing a huge geographic area in Southern California, the parent RCOFD needs to determine if it wants to operationally support the devices. Predominantly gated communities only exist in certain small geographic pockets, such as the Cove Communities. This researcher does not know if the RCOFD wants to support a county-wide radio plan for devices that would only have limited use outside of the CC. The researcher would review the standards for the OCFA and the PFD in determining the device of choice for Rancho Mirage. The optical devices as required by the PFD may be sufficient.

This project took particular interest in the article from Chronister. Chronister had a good understanding of the scope of the emerging gate issues in our communities. He realized in 2007 that the demand for gated communities is high and that unimpeded access is critical to emergency operations. He understood and explained that “without proper planning, such systems can adversely affect public safety.” Chronister also wrote of the importance of “mandating emergency bypass systems.” (Chronister, 2007)

No model code has mandated emergency bypass systems as Chronister suggests. The CFC only states that the AHJ has the authority to require a key box. NFPA 1141 gives general guidelines on setbacks, installation, and that the AHJ has the authority to require unlocking features. There are no other model codes for community development, planning, or public works that address mandating access. The RCOFD has not specifically addressed this issue, but has provided authority for the Fire Chief to require additional fire protections where access issues exist.

The model codes and RCOFD ordinance are in contrast to those jurisdictions that have agreed with Chronister and have actively pursued codes and ordinances that mandate secondary devices. The PFD requires a strobe device. Beaufort, Georgia and Hilton Head, SC both mandate radio devices. California departments including Fairfield, Oxnard, and OCFA mandate secondary devices that are either radio or optical. The OCFA is near Rancho Mirage and of similar community design. The OCFA and PFD codes may be examined more closely by the RCOFD if the recommendation is to explore a department standard.

The main issue is that the RMFD is at the stage where Petrillo was in 2006. Petrillo recognized that “no standardization” for gates existed and that he needed to choose one. His survey exposed that different departments have different requirements and that organizational preferences vary. This researcher has concluded the same finding and interpretation. There is no question that the secondary devices save response time. Likewise, there is no standard in place to address the related problems. The RMFD and RCOFD need to determine which standard they wish for their organization and develop a plan for implementation.

Response times are good in the RMFD. Community relations are extremely favorable. Some communities have already approached the department about the use of such secondary devices. For these reasons, this researcher would not suggest a retroactive ordinance, such as Oxnard, but rather invest in community education for voluntary compliance.

A critical reason for the RMFD to require secondary devices is firefighter safety. Data shows that 91% of responses in gated communities access motorized unstaffed gates. In none of the simulate strobe tests did firefighters have to exit the vehicle while on the emergency response to activate the gate. RMFD emergency responders have a huge and unnecessary exposure to slip, trip and fall injuries during this process.

This researcher was amazed at the reported injuries from both the U.S Firefighter Injuries report and NFIRS data. In 2010, 2,705 injuries were from strain and sprain while responding according to U.S Firefighter Injuries report; 4,880 injuries of this manner were reported to NFIRS between 2006 and 2008. Although the data is not more specific and no information of RMFD injuries in this manner has been located, the potential for such an injury can be severely reduced by the use of secondary access devices. CALFIRE Policy 1700 (2003) supports the findings of this research in that “potential workplace hazards” may be reduced or eliminated before an injury occurs.

In summary regarding this project, this researcher agrees with Chronister (2007) that unimpeded access “could be the difference between life and death.” The results of this research do not prove that a response time savings of 15 to 21 seconds could save a life, but one could assume that it is possible. There are many variables that prevent such a conclusion, however. Dispatch time, turnout time, and response time are those variables identified in NFPA 1710. Patient access time to the 911 system also varies. Too many variables prevent this research from determining specific outcomes. The only outcome that is factual is that RMFD response times will be reduced when accessing motorized vehicular gates equipped with secondary access devices. This research has shown the importance of response times and that response time reductions can occur through gate corridors in Rancho Mirage. Any factors known to increase response time savings should be harnessed. For Rancho Mirage, this means requiring secondary access devices in its jurisdiction.

## Recommendations

As a result of this research the following recommendations are made:

1. The findings of this research should be shared with the Executive Staff of the RCOFD in order to inform departmental direction.
2. The finding of the research and the direction of the RCOFD should then be shared with Rancho Mirage city officials.
3. Standard codes requiring the use of secondary devices should be developed locally for the RMFD and a county ordinance should be developed for the RCOFD. Discussions with officials would determine the code specifics.
4. RMFD officials should work closely with city of Rancho Mirage officials to develop an education program for elected officials, community stakeholders, homeowner associations, and other public service organizations. The program needs to include an explanation of the benefits of the devices and immediate contact information of the FSS for assistance.
5. The RMFD needs to continue with its current gate inspection program, which will ensure all devices are in place and working properly.

For future readers experiencing a large amount of gated communities in their jurisdiction:

1. Secondary access devices should be considered. The type is up for individual consideration.
2. Note the word “secondary.” The *primary* system for the RMFD is the Knox® Key Switch. The CFC requires a key box. *The key switch is always the primary access device and will always be mandatory in the RMFD*

*jurisdiction.* Secondary devices are in addition to the primary key switch. Check all applicable fire codes in your jurisdiction.

3. Be sure to include other public safety organizations in your discussions. A global solution for all agencies may be achieved through one standard. OCFA is a good example.
4. When developing standards for your jurisdiction, review the numerous codes and ordinances currently being used by others. Someone else has likely developed a standard that may work for you.
5. Consider a gate inspection program. This helps ensure fire department access is in place and functioning.

# Appendices

## Appendix A: Gate Time Samples

| Light Vehicles with Key | Engine with Key | Any Vehicle with Strobe |
|---|---|---|
| 27.45 | 27.03 | 13.41 |
| 27.24 | 31.29 | 14.6 |
| 29.75 | 38.49 | 15.02 |
| 26.46 | 37.58 | 12.64 |
| 26.74 | 35.55 | 14.25 |
| 27.45 | 36.18 | 15.5 |
| 24.24 | 35.55 | 14.11 |
| 26.54 | 35.2 | 14.18 |
| 28.4 | 34.43 | 14.39 |
| 28.85 | 32.9 | 15.08 |
| 28.01 | 36.39 | 14.11 |
| 26.61 | 34.5 | 12.71 |
| 30.73 | 34.78 | 13.74 |
| 27.8 | 35.13 | 15.64 |
| 30.17 | 37.02 | 12.43 |
| 26.54 | 35.97 | 13.65 |
| 30.59 | 32.83 | 12.43 |
| 26.82 | 33.25 | 13.2 |
| 30.1 | 34.64 | 15.22 |
| 26.47 | 33.32 | 12.85 |
| 30.17 | 34.92 | 13.48 |
| 27.45 | 33.94 | 12.64 |
| 28.78 | 33.27 | 13.16 |
| 35.48 | 36.95 | 14.32 |
| 31.78 | 30.15 | 18.51 |
| 29.34 | 41.98 | 14.38 |
| 27.73 | 35.34 | 17.88 |
| 36.37 | 35.83 | 16.27 |
| 26.68 | 36.88 | 16.2 |
| 28.85 | 38.77 | 14.95 |
| 26.68 | 41.21 | 16.69 |
| 25 | 47.5 | 17.11 |
| 27.59 | 39.95 | 15.99 |
| 27.87 | 40.3 | 16.06 |
| 26.68 | 40.72 | 16.13 |
| 26.75 | 43.31 | 15.29 |
| 27.38 | 44.63 | 15.57 |

| | | |
|---|---|---|
| 28.78 | 39.6 | 17.11 |
| 27.94 | 43.17 | 14.32 |
| 26.61 | 40.93 | 15.93 |
| 26.12 | 41.9 | 17.04 |
| 31.15 | 40.79 | 15.57 |
| 27.23 | 35.62 | 18.79 |
| 26.12 | 36.25 | 17.46 |
| 23.82 | 44.14 | 17.25 |
| 24.44 | 45.19 | 18.79 |
| 30.38 | 32.02 | 17.18 |
| 23.85 | 37.51 | 16.97 |
| 29.41 | 42.89 | 15.29 |
| 24.38 | 46.59 | 15.69 |
| 32.06 | 48.82 | 16.9 |
| 28.64 | 28.29 | 16.13 |
| 29.4 | 31.99 | 15.29 |
| 24.93 | 38.07 | 16.48 |
| 28.55 | 37.58 | 17.18 |
| 27.73 | 40.09 | 17.49 |
| 26.89 | 36.74 | 15.71 |
| 27.94 | 34.78 | 16.76 |
| 28.08 | 33.39 | 16.83 |
| 26.33 | 45.12 | 17.04 |
| 27.94 | 44.71 | 15.84 |
| 25.49 | 37.09 | 16.34 |
| 26.12 | 43.79 | 16.48 |
| 33.67 | 40.58 | 15.64 |
| 25 | 36.96 | 13.34 |
| 34.43 | 34.85 | 13.48 |
| 28.15 | 26.82 | 14.24 |
| 27.1 | 33.6 | 17.74 |
| 24.83 | 36.67 | 14.25 |
| 29.96 | 39.95 | 15.43 |
| 29.12 | 33.46 | 14.19 |
| 31.36 | 40.79 | 16.34 |
| 33.67 | 37.58 | 12.99 |
| 36.11 | 27.45 | 13.41 |
| 37.09 | 28.78 | 13.24 |
| 35.62 | 36.95 | 13.62 |
| 34.78 | 44.84 | 18.72 |
| 33.87 | 38 | 18.71 |
| 34.23 | 29.44 | 11.31 |
| 33.67 | 39.53 | 15.64 |

| | | |
|---|---|---|
| 33.74 | 23.85 | 16.9 |
| 37.3 | 20.88 | 14.11 |
| 38.84 | 48.4 | 16.55 |
| 38.7 | 38.14 | 15.15 |
| 36.95 | 40.16 | 14.74 |
| 34.99 | 39.04 | 16.06 |
| 35.62 | 39.39 | 15.36 |
| 36.81 | 34.64 | 13.11 |
| 37.72 | 28.99 | 14.25 |
| 36.51 | 29.54 | 15.7 |
| 35.62 | 32.27 | 16.2 |
| 38.35 | 28.84 | 15.57 |
| 36.46 | 30.8 | 14.63 |
| 35.41 | 29.26 | 16.2 |
| 34.85 | 35.41 | 16.69 |
| 35.48 | 40.169 | 16.17 |
| 39.11 | 34.64 | 12.36 |
| 37.72 | 38.84 | 10.96 |
| 31.36 | 35.48 | 14.2 |
| 33.67 | 40.86 | 16.39 |
| 35.62 | 31.22 | 15.02 |
| 34.85 | 34.92 | 15.08 |
| 36.76 | 47.41 | 15.29 |
| 35.44 | 36.11 | 14.46 |

## Appendix B: Statistical Analysis of Data

# Frequencies

**Notes**

| | | |
|---|---|---|
| Output Created | | 20-Mar-2012 10:40:47 |
| Comments | | |
| Input | Data | C:\Users\NTortoris\Desktop\gate.sav |
| | Active Dataset | DataSet1 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 104 |
| Missing Value Handling | Definition of Missing | User-defined missing values are treated as missing. |
| | Cases Used | Statistics are based on all cases with valid data. |
| Syntax | | FREQUENCIES VARIABLES=Key Strobe BigKey /STATISTICS=STDDEV RANGE MEAN MEDIAN MODE /HISTOGRAM NORMAL /ORDER=ANALYSIS. |
| Resources | Processor Time | 00 00:00:02.060 |
| | Elapsed Time | 00 00:00:02.044 |

[DataSet1] C:\Users\NTortoris\Desktop\gate.sav

**Statistics**

| | | Light Vehicle with Key | Light Vehicle with Strobe | Engine Key |
|---|---|---|---|---|
| N | Valid | 104 | 104 | 104 |
| | Missing | 0 | 0 | 0 |
| Mean | | 30.4655 | 15.2797 | 36.7332 |
| Median | | 28.9850 | 15.3950 | 36.5300 |
| Mode | | 33.67[a] | 15.29 | 34.64[a] |
| Std. Deviation | | 4.29002 | 1.67910 | 5.34190 |
| Range | | 15.29 | 7.83 | 27.94 |

a. Multiple modes exist. The smallest value is shown

## Frequency Table

**Light Vehicle with Key**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 23.82 | 1 | 1.0 | 1.0 | 1.0 |
| | 23.85 | 1 | 1.0 | 1.0 | 1.9 |
| | 24.24 | 1 | 1.0 | 1.0 | 2.9 |
| | 24.38 | 1 | 1.0 | 1.0 | 3.8 |
| | 24.44 | 1 | 1.0 | 1.0 | 4.8 |
| | 24.83 | 1 | 1.0 | 1.0 | 5.8 |
| | 24.93 | 1 | 1.0 | 1.0 | 6.7 |
| | 25.00 | 2 | 1.9 | 1.9 | 8.7 |
| | 25.49 | 1 | 1.0 | 1.0 | 9.6 |
| | 26.12 | 3 | 2.9 | 2.9 | 12.5 |
| | 26.33 | 1 | 1.0 | 1.0 | 13.5 |
| | 26.46 | 1 | 1.0 | 1.0 | 14.4 |
| | 26.47 | 1 | 1.0 | 1.0 | 15.4 |

| | | | | |
|---|---|---|---|---|
| 26.54 | 2 | 1.9 | 1.9 | 17.3 |
| 26.61 | 2 | 1.9 | 1.9 | 19.2 |
| 26.68 | 3 | 2.9 | 2.9 | 22.1 |
| 26.74 | 1 | 1.0 | 1.0 | 23.1 |
| 26.75 | 1 | 1.0 | 1.0 | 24.0 |
| 26.82 | 1 | 1.0 | 1.0 | 25.0 |
| 26.89 | 1 | 1.0 | 1.0 | 26.0 |
| 27.10 | 1 | 1.0 | 1.0 | 26.9 |
| 27.23 | 1 | 1.0 | 1.0 | 27.9 |
| 27.24 | 1 | 1.0 | 1.0 | 28.8 |
| 27.38 | 1 | 1.0 | 1.0 | 29.8 |
| 27.45 | 3 | 2.9 | 2.9 | 32.7 |
| 27.59 | 1 | 1.0 | 1.0 | 33.7 |
| 27.73 | 2 | 1.9 | 1.9 | 35.6 |
| 27.80 | 1 | 1.0 | 1.0 | 36.5 |
| 27.87 | 1 | 1.0 | 1.0 | 37.5 |
| 27.94 | 3 | 2.9 | 2.9 | 40.4 |
| 28.01 | 1 | 1.0 | 1.0 | 41.3 |
| 28.08 | 1 | 1.0 | 1.0 | 42.3 |
| 28.15 | 1 | 1.0 | 1.0 | 43.3 |
| 28.40 | 1 | 1.0 | 1.0 | 44.2 |
| 28.55 | 1 | 1.0 | 1.0 | 45.2 |
| 28.64 | 1 | 1.0 | 1.0 | 46.2 |
| 28.78 | 2 | 1.9 | 1.9 | 48.1 |
| 28.85 | 2 | 1.9 | 1.9 | 50.0 |
| 29.12 | 1 | 1.0 | 1.0 | 51.0 |
| 29.34 | 1 | 1.0 | 1.0 | 51.9 |
| 29.40 | 1 | 1.0 | 1.0 | 52.9 |
| 29.41 | 1 | 1.0 | 1.0 | 53.8 |
| 29.75 | 1 | 1.0 | 1.0 | 54.8 |
| 29.96 | 1 | 1.0 | 1.0 | 55.8 |
| 30.10 | 1 | 1.0 | 1.0 | 56.7 |
| 30.17 | 2 | 1.9 | 1.9 | 58.7 |
| 30.38 | 1 | 1.0 | 1.0 | 59.6 |
| 30.59 | 1 | 1.0 | 1.0 | 60.6 |

| | | | | |
|---|---|---|---|---|
| 30.73 | 1 | 1.0 | 1.0 | 61.5 |
| 31.15 | 1 | 1.0 | 1.0 | 62.5 |
| 31.36 | 2 | 1.9 | 1.9 | 64.4 |
| 31.78 | 1 | 1.0 | 1.0 | 65.4 |
| 32.06 | 1 | 1.0 | 1.0 | 66.3 |
| 33.67 | 4 | 3.8 | 3.8 | 70.2 |
| 33.74 | 1 | 1.0 | 1.0 | 71.2 |
| 33.87 | 1 | 1.0 | 1.0 | 72.1 |
| 34.23 | 1 | 1.0 | 1.0 | 73.1 |
| 34.43 | 1 | 1.0 | 1.0 | 74.0 |
| 34.78 | 1 | 1.0 | 1.0 | 75.0 |
| 34.85 | 2 | 1.9 | 1.9 | 76.9 |
| 34.99 | 1 | 1.0 | 1.0 | 77.9 |
| 35.41 | 1 | 1.0 | 1.0 | 78.8 |
| 35.44 | 1 | 1.0 | 1.0 | 79.8 |
| 35.48 | 2 | 1.9 | 1.9 | 81.7 |
| 35.62 | 4 | 3.8 | 3.8 | 85.6 |
| 36.11 | 1 | 1.0 | 1.0 | 86.5 |
| 36.37 | 1 | 1.0 | 1.0 | 87.5 |
| 36.46 | 1 | 1.0 | 1.0 | 88.5 |
| 36.51 | 1 | 1.0 | 1.0 | 89.4 |
| 36.76 | 1 | 1.0 | 1.0 | 90.4 |
| 36.81 | 1 | 1.0 | 1.0 | 91.3 |
| 36.95 | 1 | 1.0 | 1.0 | 92.3 |
| 37.09 | 1 | 1.0 | 1.0 | 93.3 |
| 37.30 | 1 | 1.0 | 1.0 | 94.2 |
| 37.72 | 2 | 1.9 | 1.9 | 96.2 |
| 38.35 | 1 | 1.0 | 1.0 | 97.1 |
| 38.70 | 1 | 1.0 | 1.0 | 98.1 |
| 38.84 | 1 | 1.0 | 1.0 | 99.0 |
| 39.11 | 1 | 1.0 | 1.0 | 100.0 |
| Total | 104 | 100.0 | 100.0 | |

**Light Vehicle with Strobe**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 10.96 | 1 | 1.0 | 1.0 | 1.0 |
| | 11.31 | 1 | 1.0 | 1.0 | 1.9 |
| | 12.36 | 1 | 1.0 | 1.0 | 2.9 |
| | 12.43 | 2 | 1.9 | 1.9 | 4.8 |
| | 12.64 | 2 | 1.9 | 1.9 | 6.7 |
| | 12.71 | 1 | 1.0 | 1.0 | 7.7 |
| | 12.85 | 1 | 1.0 | 1.0 | 8.7 |
| | 12.99 | 1 | 1.0 | 1.0 | 9.6 |
| | 13.11 | 1 | 1.0 | 1.0 | 10.6 |
| | 13.16 | 1 | 1.0 | 1.0 | 11.5 |
| | 13.20 | 1 | 1.0 | 1.0 | 12.5 |
| | 13.24 | 1 | 1.0 | 1.0 | 13.5 |
| | 13.34 | 1 | 1.0 | 1.0 | 14.4 |
| | 13.41 | 2 | 1.9 | 1.9 | 16.3 |
| | 13.48 | 2 | 1.9 | 1.9 | 18.3 |
| | 13.62 | 1 | 1.0 | 1.0 | 19.2 |
| | 13.65 | 1 | 1.0 | 1.0 | 20.2 |
| | 13.74 | 1 | 1.0 | 1.0 | 21.2 |
| | 14.11 | 3 | 2.9 | 2.9 | 24.0 |
| | 14.18 | 1 | 1.0 | 1.0 | 25.0 |
| | 14.19 | 1 | 1.0 | 1.0 | 26.0 |
| | 14.20 | 1 | 1.0 | 1.0 | 26.9 |
| | 14.24 | 1 | 1.0 | 1.0 | 27.9 |
| | 14.25 | 3 | 2.9 | 2.9 | 30.8 |
| | 14.32 | 2 | 1.9 | 1.9 | 32.7 |
| | 14.38 | 1 | 1.0 | 1.0 | 33.7 |
| | 14.39 | 1 | 1.0 | 1.0 | 34.6 |
| | 14.46 | 1 | 1.0 | 1.0 | 35.6 |
| | 14.60 | 1 | 1.0 | 1.0 | 36.5 |
| | 14.63 | 1 | 1.0 | 1.0 | 37.5 |

| | | | | |
|---|---|---|---|---|
| 14.74 | 1 | 1.0 | 1.0 | 38.5 |
| 14.95 | 1 | 1.0 | 1.0 | 39.4 |
| 15.02 | 2 | 1.9 | 1.9 | 41.3 |
| 15.08 | 2 | 1.9 | 1.9 | 43.3 |
| 15.15 | 1 | 1.0 | 1.0 | 44.2 |
| 15.22 | 1 | 1.0 | 1.0 | 45.2 |
| 15.29 | 4 | 3.8 | 3.8 | 49.0 |
| 15.36 | 1 | 1.0 | 1.0 | 50.0 |
| 15.43 | 1 | 1.0 | 1.0 | 51.0 |
| 15.50 | 1 | 1.0 | 1.0 | 51.9 |
| 15.57 | 3 | 2.9 | 2.9 | 54.8 |
| 15.64 | 3 | 2.9 | 2.9 | 57.7 |
| 15.69 | 1 | 1.0 | 1.0 | 58.7 |
| 15.70 | 1 | 1.0 | 1.0 | 59.6 |
| 15.71 | 1 | 1.0 | 1.0 | 60.6 |
| 15.84 | 1 | 1.0 | 1.0 | 61.5 |
| 15.93 | 1 | 1.0 | 1.0 | 62.5 |
| 15.99 | 1 | 1.0 | 1.0 | 63.5 |
| 16.06 | 2 | 1.9 | 1.9 | 65.4 |
| 16.13 | 2 | 1.9 | 1.9 | 67.3 |
| 16.17 | 1 | 1.0 | 1.0 | 68.3 |
| 16.20 | 3 | 2.9 | 2.9 | 71.2 |
| 16.27 | 1 | 1.0 | 1.0 | 72.1 |
| 16.34 | 2 | 1.9 | 1.9 | 74.0 |
| 16.39 | 1 | 1.0 | 1.0 | 75.0 |
| 16.48 | 2 | 1.9 | 1.9 | 76.9 |
| 16.55 | 1 | 1.0 | 1.0 | 77.9 |
| 16.69 | 2 | 1.9 | 1.9 | 79.8 |
| 16.76 | 1 | 1.0 | 1.0 | 80.8 |
| 16.83 | 1 | 1.0 | 1.0 | 81.7 |
| 16.90 | 2 | 1.9 | 1.9 | 83.7 |
| 16.97 | 1 | 1.0 | 1.0 | 84.6 |
| 17.04 | 2 | 1.9 | 1.9 | 86.5 |
| 17.11 | 2 | 1.9 | 1.9 | 88.5 |
| 17.18 | 2 | 1.9 | 1.9 | 90.4 |

| | | | | | |
|---|---|---|---|---|---|
| | 17.25 | 1 | 1.0 | 1.0 | 91.3 |
| | 17.46 | 1 | 1.0 | 1.0 | 92.3 |
| | 17.49 | 1 | 1.0 | 1.0 | 93.3 |
| | 17.74 | 1 | 1.0 | 1.0 | 94.2 |
| | 17.88 | 1 | 1.0 | 1.0 | 95.2 |
| | 18.51 | 1 | 1.0 | 1.0 | 96.2 |
| | 18.71 | 1 | 1.0 | 1.0 | 97.1 |
| | 18.72 | 1 | 1.0 | 1.0 | 98.1 |
| | 18.79 | 2 | 1.9 | 1.9 | 100.0 |
| | Total | 104 | 100.0 | 100.0 | |

**Engine with Key**

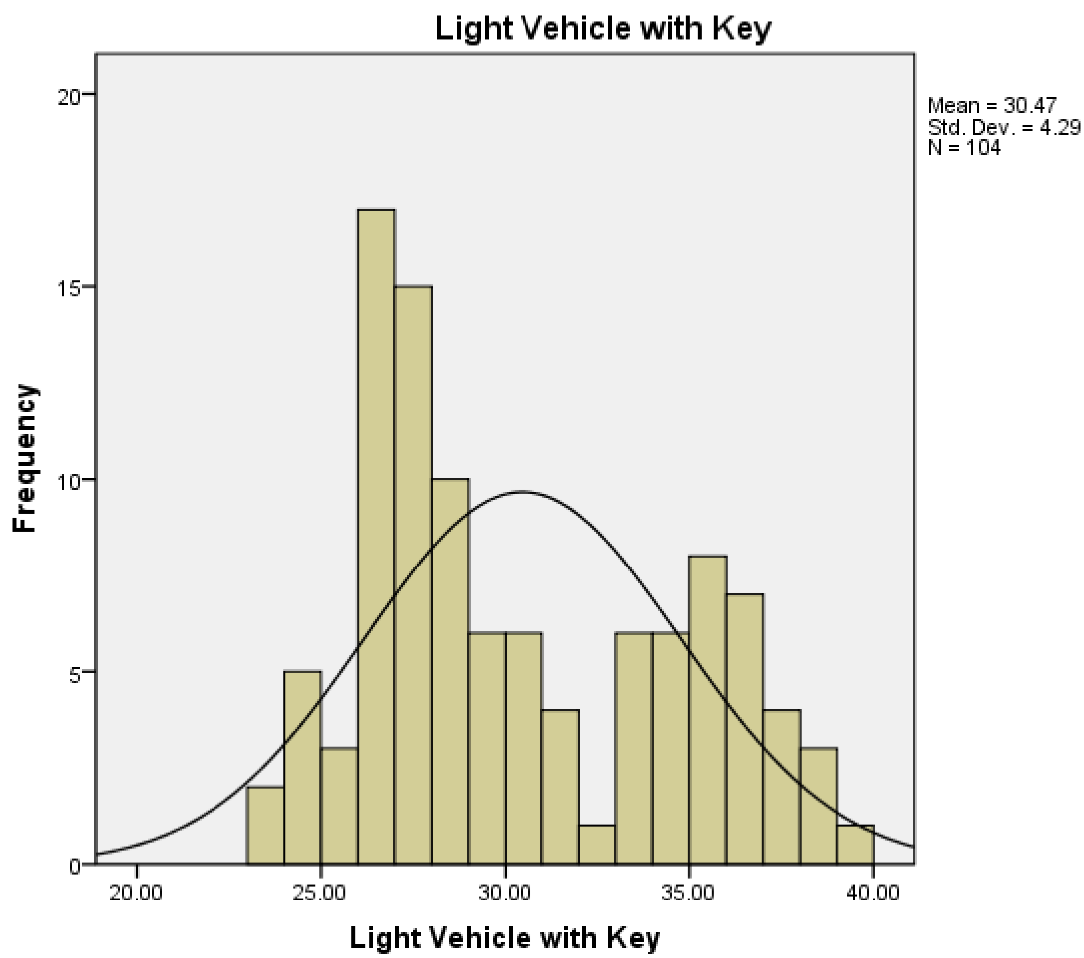
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 20.88 | 1 | 1.0 | 1.0 | 1.0 |
| | 23.85 | 1 | 1.0 | 1.0 | 1.9 |
| | 26.82 | 1 | 1.0 | 1.0 | 2.9 |
| | 27.03 | 1 | 1.0 | 1.0 | 3.8 |
| | 27.45 | 1 | 1.0 | 1.0 | 4.8 |
| | 28.29 | 1 | 1.0 | 1.0 | 5.8 |
| | 28.78 | 1 | 1.0 | 1.0 | 6.7 |
| | 28.84 | 1 | 1.0 | 1.0 | 7.7 |
| | 28.99 | 1 | 1.0 | 1.0 | 8.7 |
| | 29.26 | 1 | 1.0 | 1.0 | 9.6 |
| | 29.44 | 1 | 1.0 | 1.0 | 10.6 |
| | 29.54 | 1 | 1.0 | 1.0 | 11.5 |
| | 30.15 | 1 | 1.0 | 1.0 | 12.5 |
| | 30.80 | 1 | 1.0 | 1.0 | 13.5 |
| | 31.22 | 1 | 1.0 | 1.0 | 14.4 |
| | 31.29 | 1 | 1.0 | 1.0 | 15.4 |
| | 31.99 | 1 | 1.0 | 1.0 | 16.3 |
| | 32.02 | 1 | 1.0 | 1.0 | 17.3 |
| | 32.27 | 1 | 1.0 | 1.0 | 18.3 |
| | 32.83 | 1 | 1.0 | 1.0 | 19.2 |

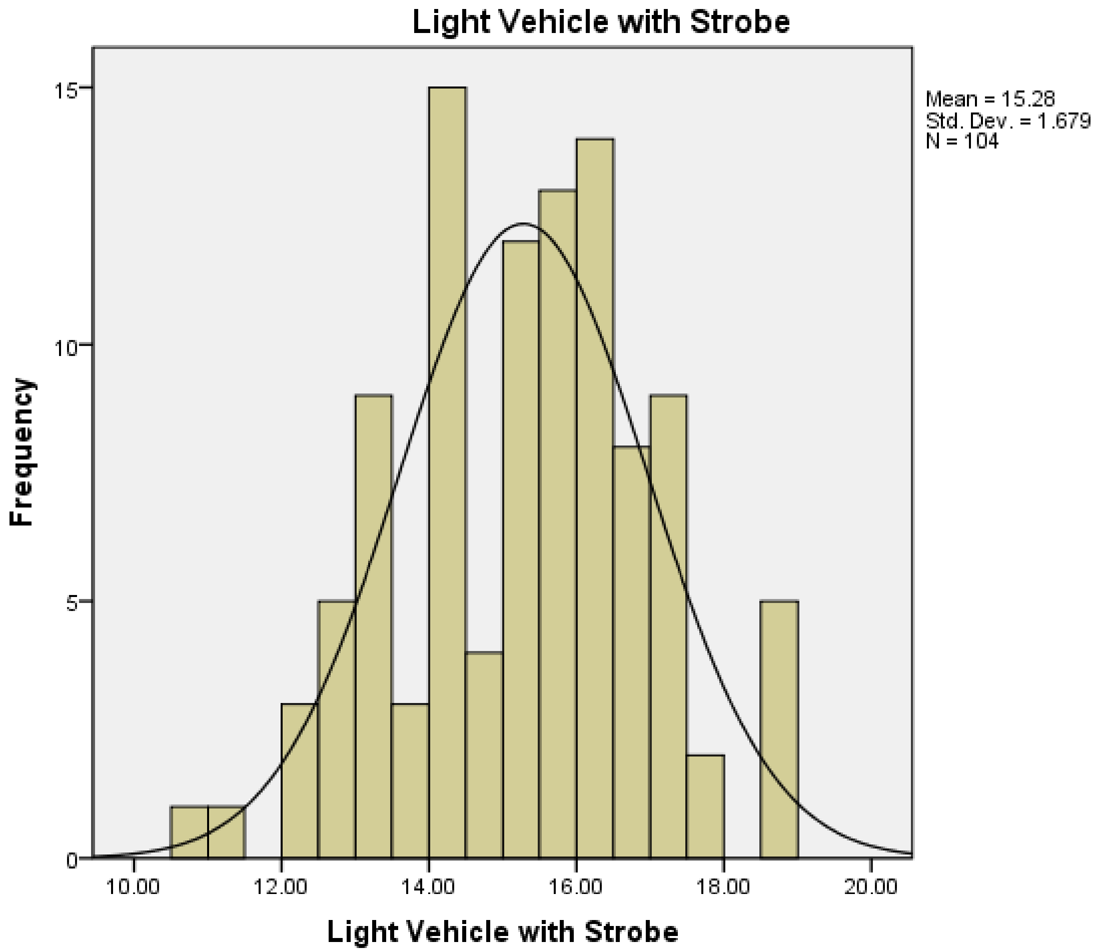
| | | | | |
|---|---|---|---|---|
| 32.90 | 1 | 1.0 | 1.0 | 20.2 |
| 33.25 | 1 | 1.0 | 1.0 | 21.2 |
| 33.27 | 1 | 1.0 | 1.0 | 22.1 |
| 33.32 | 1 | 1.0 | 1.0 | 23.1 |
| 33.39 | 1 | 1.0 | 1.0 | 24.0 |
| 33.46 | 1 | 1.0 | 1.0 | 25.0 |
| 33.60 | 1 | 1.0 | 1.0 | 26.0 |
| 33.94 | 1 | 1.0 | 1.0 | 26.9 |
| 34.43 | 1 | 1.0 | 1.0 | 27.9 |
| 34.50 | 1 | 1.0 | 1.0 | 28.8 |
| 34.64 | 3 | 2.9 | 2.9 | 31.7 |
| 34.78 | 2 | 1.9 | 1.9 | 33.7 |
| 34.85 | 1 | 1.0 | 1.0 | 34.6 |
| 34.92 | 2 | 1.9 | 1.9 | 36.5 |
| 35.13 | 1 | 1.0 | 1.0 | 37.5 |
| 35.20 | 1 | 1.0 | 1.0 | 38.5 |
| 35.34 | 1 | 1.0 | 1.0 | 39.4 |
| 35.41 | 1 | 1.0 | 1.0 | 40.4 |
| 35.48 | 1 | 1.0 | 1.0 | 41.3 |
| 35.55 | 2 | 1.9 | 1.9 | 43.3 |
| 35.62 | 1 | 1.0 | 1.0 | 44.2 |
| 35.83 | 1 | 1.0 | 1.0 | 45.2 |
| 35.97 | 1 | 1.0 | 1.0 | 46.2 |
| 36.11 | 1 | 1.0 | 1.0 | 47.1 |
| 36.18 | 1 | 1.0 | 1.0 | 48.1 |
| 36.25 | 1 | 1.0 | 1.0 | 49.0 |
| 36.39 | 1 | 1.0 | 1.0 | 50.0 |
| 36.67 | 1 | 1.0 | 1.0 | 51.0 |
| 36.74 | 1 | 1.0 | 1.0 | 51.9 |
| 36.88 | 1 | 1.0 | 1.0 | 52.9 |
| 36.95 | 2 | 1.9 | 1.9 | 54.8 |
| 36.96 | 1 | 1.0 | 1.0 | 55.8 |
| 37.02 | 1 | 1.0 | 1.0 | 56.7 |
| 37.09 | 1 | 1.0 | 1.0 | 57.7 |
| 37.51 | 1 | 1.0 | 1.0 | 58.7 |

| | | | | |
|---|---|---|---|---|
| 37.58 | 3 | 2.9 | 2.9 | 61.5 |
| 38.00 | 1 | 1.0 | 1.0 | 62.5 |
| 38.07 | 1 | 1.0 | 1.0 | 63.5 |
| 38.14 | 1 | 1.0 | 1.0 | 64.4 |
| 38.49 | 1 | 1.0 | 1.0 | 65.4 |
| 38.77 | 1 | 1.0 | 1.0 | 66.3 |
| 38.84 | 1 | 1.0 | 1.0 | 67.3 |
| 39.04 | 1 | 1.0 | 1.0 | 68.3 |
| 39.39 | 1 | 1.0 | 1.0 | 69.2 |
| 39.53 | 1 | 1.0 | 1.0 | 70.2 |
| 39.60 | 1 | 1.0 | 1.0 | 71.2 |
| 39.95 | 2 | 1.9 | 1.9 | 73.1 |
| 40.09 | 1 | 1.0 | 1.0 | 74.0 |
| 40.16 | 1 | 1.0 | 1.0 | 75.0 |
| 40.17 | 1 | 1.0 | 1.0 | 76.0 |
| 40.30 | 1 | 1.0 | 1.0 | 76.9 |
| 40.58 | 1 | 1.0 | 1.0 | 77.9 |
| 40.72 | 1 | 1.0 | 1.0 | 78.8 |
| 40.79 | 2 | 1.9 | 1.9 | 80.8 |
| 40.86 | 1 | 1.0 | 1.0 | 81.7 |
| 40.93 | 1 | 1.0 | 1.0 | 82.7 |
| 41.21 | 1 | 1.0 | 1.0 | 83.7 |
| 41.90 | 1 | 1.0 | 1.0 | 84.6 |
| 41.98 | 1 | 1.0 | 1.0 | 85.6 |
| 42.89 | 1 | 1.0 | 1.0 | 86.5 |
| 43.17 | 1 | 1.0 | 1.0 | 87.5 |
| 43.31 | 1 | 1.0 | 1.0 | 88.5 |
| 43.79 | 1 | 1.0 | 1.0 | 89.4 |
| 44.14 | 1 | 1.0 | 1.0 | 90.4 |
| 44.63 | 1 | 1.0 | 1.0 | 91.3 |
| 44.71 | 1 | 1.0 | 1.0 | 92.3 |
| 44.84 | 1 | 1.0 | 1.0 | 93.3 |
| 45.12 | 1 | 1.0 | 1.0 | 94.2 |
| 45.19 | 1 | 1.0 | 1.0 | 95.2 |
| 46.59 | 1 | 1.0 | 1.0 | 96.2 |

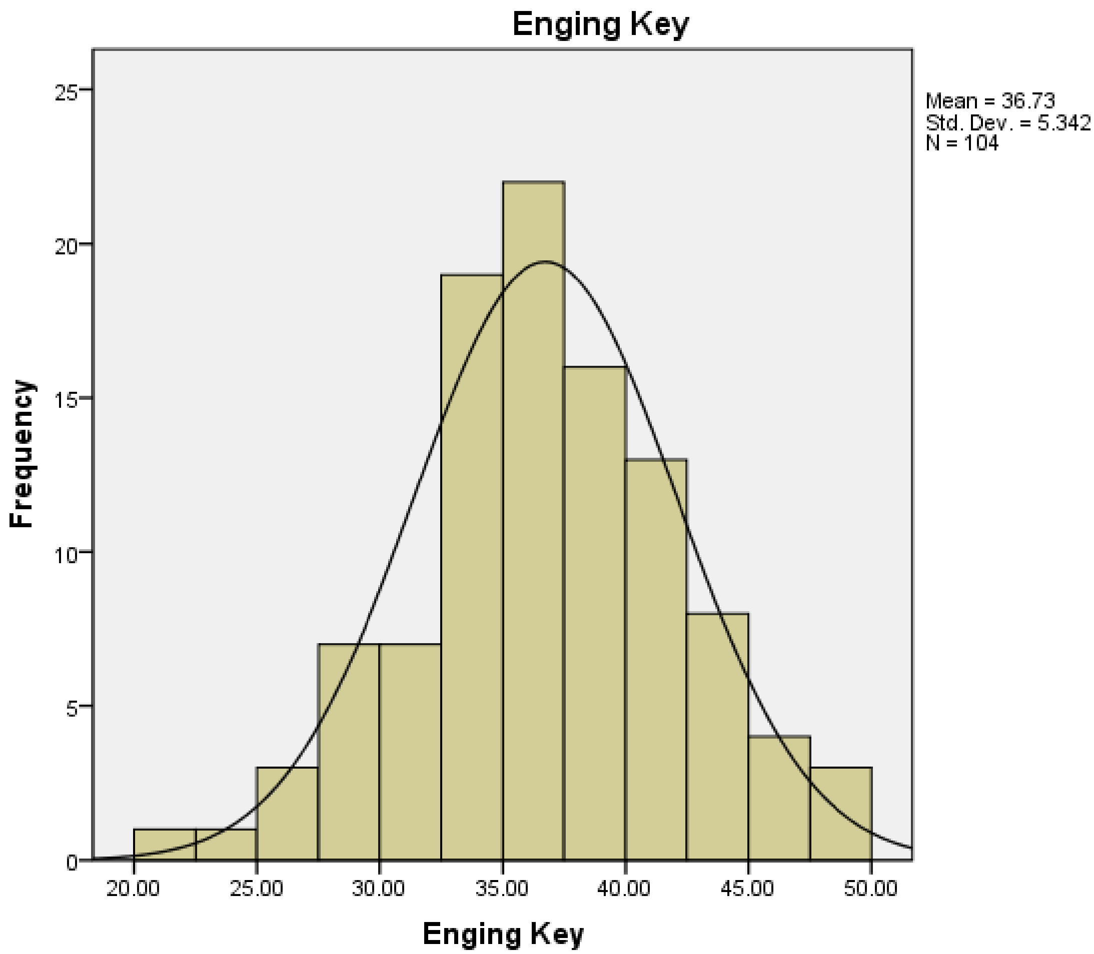
| | | | | |
|---|---|---|---|---|
| 47.41 | 1 | 1.0 | 1.0 | 97.1 |
| 47.50 | 1 | 1.0 | 1.0 | 98.1 |
| 48.40 | 1 | 1.0 | 1.0 | 99.0 |
| 48.82 | 1 | 1.0 | 1.0 | 100.0 |
| Total | 104 | 100.0 | 100.0 | |

## Histogram






Should Read “Any Vehicle with Strobe”




Should read “Engine with Key”

```
T-TEST PAIRS=Key Strobe Key WITH Strobe BigKey BigKey (PAIRED)
  /CRITERIA=CI(.9500)
  /MISSING=ANALYSIS.
```

## T-Test

**Notes**

| | | |
|---|---|---|
| Output Created | | 20-Mar-2012 10:43:12 |
| Comments | | |
| Input | Data | C:\Users\NTortoris\Desktop\gate.sav |
| | Active Dataset | DataSet1 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 104 |
| Missing Value Handling | Definition of Missing | User defined missing values are treated as missing. |
| | Cases Used | Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis. |
| Syntax | | T-TEST PAIRS=Key Strobe Key WITH Strobe BigKey BigKey (PAIRED) /CRITERIA=CI(.9500) /MISSING=ANALYSIS. |
| Resources | Processor Time | 00 00:00:00.015 |
| | Elapsed Time | 00 00:00:00.016 |

```
[DataSet1] C:\Users\NTortoris\Desktop\gate.sav
```

**Paired Samples Statistics**

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | Light Vehicle with Key | 30.4655 | 104 | 4.29002 | .42067 |
| | Any Vehicle with Strobe | 15.2797 | 104 | 1.67910 | .16465 |
| Pair 2 | Any Vehicle with Strobe | 15.2797 | 104 | 1.67910 | .16465 |
| | Engine Key | 36.7332 | 104 | 5.34190 | .52382 |
| Pair 3 | Light Vehicle with Key | 30.4655 | 104 | 4.29002 | .42067 |
| | Engine Key | 36.7332 | 104 | 5.34190 | .52382 |

**Paired Samples Correlations**

| | | N | Correlation | Sig. |
|---|---|---|---|---|
| Pair 1 | Light Vehicle with Key & Light Vehicle with Strobe | 104 | -.190 | .054 |
| Pair 2 | Light Vehicle with Strobe & Engine Key | 104 | .329 | .001 |
| Pair 3 | Light Vehicle with Key & Engine Key | 104 | -.244 | .013 |

**Paired Samples Test**

| | | Paired Differences | | |
|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean |
| Pair 1 | Light Vehicle with Key Any Vehicle with Strobe | 15.18577 | 4.89454 | .47995 |
| Pair 2 | Any Vehicle with Strobe - Engine Key | -21.45345 | 5.04455 | .49466 |
| Pair 3 | Light Vehicle with Key - Engine Key | -6.26768 | 7.62410 | .74760 |

**Paired Samples Test**

| | | Paired Differences: 95% Confidence Interval of the Difference | | |
|---|---|---|---|---|
| | | Lower | Upper | t |
| Pair 1 | Light Vehicle with Key<br>Any Vehicle with Strobe | 14.23390 | 16.13763 | 31.640 |
| Pair 2 | Any Vehicle with Strobe -<br>Engine Key | -22.43449 | -20.47241 | -43.370 |
| Pair 3 | Light Vehicle with Key -<br>Engine with Key | -7.75038 | -4.78499 | -8.384 |

**Paired Samples Test**

| | | df | Sig. (2-tailed) |
|---|---|---|---|
| Pair 1 | Light Vehicle with Key<br>Any Vehicle with Strobe | 103 | .000 |
| Pair 2 | Light Vehicle with Strobe –<br>Engine with Key | 103 | .000 |
| Pair 3 | Light Vehicle with Key -<br>Engine with Key | 103 | .000 |

```
*Nonparametric Tests: Related Samples.
NPTESTS
  /RELATED TEST(Key Strobe BigKey)
  /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE
  /CRITERIA ALPHA=0.05  CILEVEL=95.
```

## Nonparametric Tests

**Notes**

| | | |
|---|---|---|
| Output Created | | 20-Mar-2012 10:44:26 |
| Comments | | |
| Input | Data | C:\Users\NTortoris\Desktop\gate.sav |
| | Active Dataset | DataSet1 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 104 |
| Syntax | | NPTESTS<br>/RELATED TEST(Key Strobe BigKey)<br>/MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE<br>/CRITERIA ALPHA=0.05 CILEVEL=95. |
| Resources | Processor Time | 00 00:00:00.562 |
| | Elapsed Time | 00 00:00:00.937 |

```
[DataSet1] C:\Users\NTortoris\Desktop\gate.sav
```

**Hypothesis Test Summary**

| | Null Hypothesis | Test | Sig. | Decision |
|---|---|---|---|---|
| 1 | The distributions of Light Vehicle with Key, Light Vehicle with Strobe and Enging Key are the same. | Related-Samples Friedman's Two-Way Analysis of Variance by Ranks | .000 | Reject the null hypothesis. |

Asymptotic significances are displayed. The significance level is .05.

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