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TRC0206

An Evaluation and Comparizon of the IRISystems Infrared Inspections System and The Raytheon NightSight ProtectIR 4000B Thermal Imaging System in Detecting Inoperative Brakes on Commercial Vehicles in Arkansas

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An Evaluation and Comparison of the IRISystems Infrared Inspection System and the Raytheon NightSight ProtectIR 4000B Thermal Imaging System in Detecting Inoperative Brakes on Commercial Vehicles in Arkansas.

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16. Abstract

This project was performed by the Research Section of the Arkansas State Highway and Transportation Department in conjunction with the Arkansas Highway Police. Standard inspection procedures accomplish the goal of removing unsafe commercial vehicles from the public highway system. However, this study has shown that this goal can be accomplished more efficiently and remove more of the unsafe commercial vehicles from the public highway system. The cumulative effect of being able to screen more commercial vehicles with this new infrared scanning technology as compared to the standard inspection procedures will cause an increase in the safety of commercial vehicles for two reasons: (1) the deterrence effect of carrier operators knowing that their vehicles can be scanned for failed brakes will cause these operators to make sure there brakes are working, and (2) the chances of not being inspected will be dramatically reduced through the utilization of this technology.

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We extend our thanks to all the Highway Police across the state of Arkansas that performed the inspections on the commercial vehicles being called out for inspection after screening by the infrared imaging cameras and many thanks to Reggie Smith for taking the time to assemble the Raytheon system.

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An Evaluation and Comparison of the IRISystems Infrared Inspection System and the Raytheon NightSight ProtectIR 4000B Thermal Imaging System in Detecting Inoperative Brakes on Commercial Vehicles in Arkansas.

1.0 Introduction

The increase in commercial trucking along interstate highways in conjunction with the limited number of Highway Police available has led to the need for more efficient means of enforcing commercial vehicle standards. Currently, commercial vehicle inspections are performed based on a random selection in combination with the experience of the inspection officer and fleet maintenance records.

The utilization of new technologies employed in different applications in order to improve existing processes or techniques is found in several areas of industry. Specifically, the use of thermal imaging evolving from military use to scanning commercial vehicles for failed brakes is just one example.

The handicap of the limited number of Highway Police charged with the inspection of a growing number of commercial vehicles on our highway can be overcome with the incorporation of thermal imaging into the screening process of commercial vehicles. This technology has proven to be an efficient screening method for detecting malfunctioning braking systems on commercial vehicles (Christiaen 21).

However, there are several different types of thermal imaging cameras. These different types of cameras differ in price, resolution, and other characteristics relating to zoom, focus, and panning abilities.

2.0 Purpose and Scope

The focus of this study will be to evaluate two different types of thermal imaging systems and compare the relative effectiveness of each in screening brakes of commercial vehicles.

2.1 Purpose

The purpose of this study was to compare the infrared inspection system (IRIS) manufacture by IRISystems, Inc. and the Raytheon NightSight ProtectIR 4000B Thermal Imaging System. Both systems were installed in separate vans and viewed and controlled from inside the van by an operator.

2.2 Scope

The IRIS was leased for a period of three months beginning in September 2001 and ending the last day of October 2001. A work program that consisted of every Tuesday and Wednesday of each week was scheduled with the Highway Police in order to evaluate the effectiveness of the thermal imaging systems. The IRIS was utilized in the field for a total of 24 days.

The work schedule allowed for the evaluation of various locations throughout the state of Arkansas that included the following: Westbound I-40 Mayflower Weigh Strip, Eastbound I-40 Alma Weigh Station, Dumas-McGhee area, Eastbound and Westbound I-40 Hope Weigh Stations, Northbound Bridgeport Weigh Station, Eastbound Lonoke Weigh Strip, I-540 Springdale Weigh Station, and Northbound I-55 Weigh Station.

The Raytheon NightSight ProtectIR 4000B Thermal Imaging System (RNP) was not operational until mid-September. However, this system was still utilized for 14 of the 24 scheduled work days in a side-by-side comparison with the IRIS.

3.0 Background

A thermal imaging camera is a detector of infrared energy coupled with a lens that gives a visual representation of thermal energy emitted by all objects with a temperature above absolute zero (0 degrees Kelvin). Basically, an infrared camera allows the human eye to seat heat. Figure one illustrates the relationship between visible light and infrared light. Thermal imagers translate the energy transmitted in the infrared wavelength into

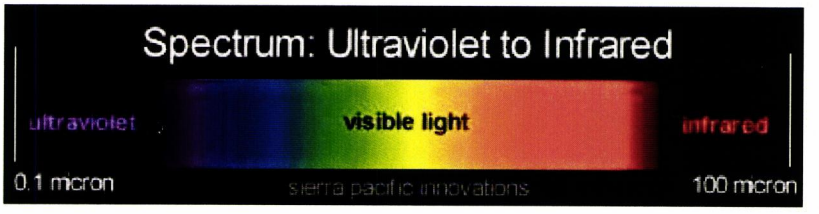


Figure 1 Ultraviolet to Infrared Spectrum

data that can be processed into visible light. This visible light is then displayed on a monitor for viewing. All objects above 0 degrees Kelvin emit thermal infrared energy so thermal imagers can passively see all objects regardless of ambient light. Hotter objects emit more infrared energy than colder objects and this contrast between objects that differ in temperature can be viewed on the monitor.

For purposes of this study, the infrared camera was being used to detect failed brakes on commercial vehicles. Brakes work by brake pads contacting the brake drum in order to slow down the vehicle. This contact of the brake pad with the brake drum creates heat due to friction. This heat can be viewed on the infrared monitor. By viewing the brake drums with the infrared camera, it could be quickly ascertained whether the brake is functioning properly. Properly functioning brakes produces heat when the brakes are applied.

The commercial vehicles are being inspected at weigh stations or inspection stations and the trucks must apply their brakes when entering the inspection stations.

These slower speeds are optimal for a thorough screening of all brakes on a commercial vehicle.

4.0 Materials and Methods

The Research Section of the Planning and Research Division of Arkansas State Highway and Transportation Department (AHTD) conducted this research project in conjunction with the Arkansas Highway Police Department. An IRISystem from IRISystems, Inc. was leased for a period of three months. Another infrared inspection system was constructed in order to compare the two systems. This second system consisted of an infrared camera purchased from Raytheon, Inc. The Raytheon camera was mounted to an AHTD van along with a monitor and VCR installed inside the van.

4.1 Materials

This comparison study consisted of two separate infrared camera systems. Figure 2 below illustrated both of these systems. The IRISystem is on the right and the

Figure 2 Picture of IRISystem and Raytheon System

Raytheon system is on the left. The IRISystem was leased for a three-month period from IRISystems, Inc. Research personnel constructed the other system. The basic components of both of these systems consisted of the following: (1) an infrared camera, (2) a monitor, (3) a VCR, and (4) a vehicle. The IRISystem had several extra features that will be discussed in the next section. Table 1 below compares the cost of both of the

systems. The dollar figure in parenthesis for the Raytheon system does not include the cost of van or the VCR. These two items were not bought on this project. The cost estimates of these two items (the VCR and van) and are listed here for comparison

Table 1 Cost Comparison

	Raytheon System	IRISystem
Infrared Camera	$9423.00	N/A
Window Tinting	$336.00	N/A
Inverter	$198.00	N/A
Monitor	$661.00	N/A
VCR	$150.00	N/A
Van	$30,000	N/A
Total	$40,768 ($10,618)*	$296,000

*Cost excluding VCR and Van

purposes only. The VCR was borrowed from another project and the van was a departmental van from the Research Section. This cost comparison disregards the cost of labor required to assemble the Raytheon system. As illustrated, there is a substantial difference between the prices of the two systems. However, the IRISystem has more components than the Raytheon system. For example, the IRISystem had not only an infrared camera but also a color camera along with a high quality printer and an extra VCR. The details of each of these systems will be discussed individually in the following sections.

4.1.1 IRISystem

First, a general description of the IRISystem will be discussed and then each of the basic components of the IRISystem will be discussed. The IRISystem consisted of both a color camera and an infrared camera. Inside the van, two monitors were mounted side-by-side in order to view both the infrared video and the color video. Both of these cameras were connected to separate VCR's for recording. There was also a control panel assembled that served two functions: (1) it allowed for ease of operating both of the VCR's and (2) it allowed the operator to mark the tape after observing a failed brake in order to be able to quickly return to that section of the tape. Figure 3 shown below illustrates the IRISystem. The infrared ball turret camera mounted on the roof near the rear of the vehicle can be seen.

Figure 3 Picture of IRISystem

Another important characteristic of the van is the tinted windows. The tinted windows minimized the glare from sunlight while viewing the monitors. The tinted windows also helped keep the temperature inside the van from rising during the heat of the day.

The layout of the components on the inside of the van was very well planned and constructed. It allowed for ease of controlling the system will all the necessary controls at arms reach. Figure 4 below shows the layout of the inside of the van.

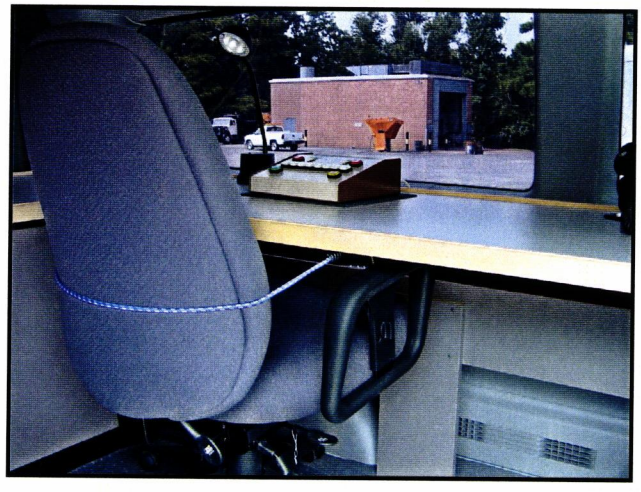


Figure 4 Inside Layout of IRIS Van

The picture above shows the control panel on top of the desk that was built to control the dual VCR's. This control panel also allowed the operator to mark the tape in order to quickly locate that exact location on the tape for review at a later time. Figure 5 below shows the layout of the dual monitors and dual VCR setup.

Figure 5 Dual Monitors and Dual VCR's

This configuration allowed the operator easy access to all controls. The dual VCR configuration allows the operator to quickly return to both a color image and a thermal

image. These images can then be printed out on the attached printer. Figure 6 shows the color printer. The black control box on top of the printer controls the image that the printer will print. The color image or the thermal image can be printed. This printer is an exceptionally high quality printer that prints developed film quality images.

Figure 6 Color Printer with Camera Selection Device

The next picture shown in figure 7 illustrates the hand control that controls the motion of the ball turret camera. The hand control consists of several push buttons, scroll

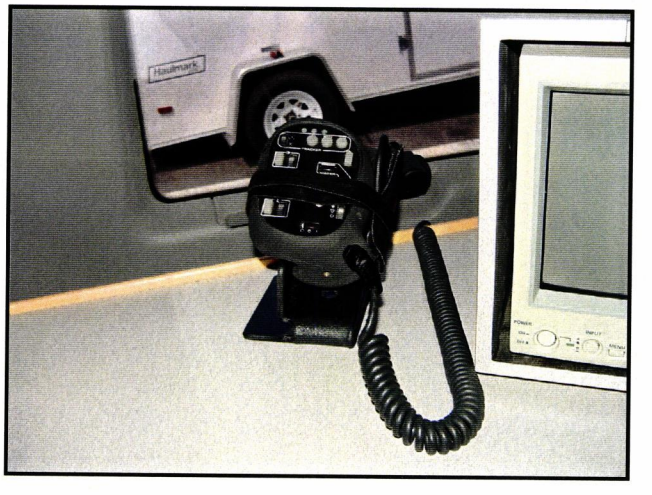


Figure 7 Hand Control for IRISystem

buttons, a camera selection button, and a hat top thumb control to control the movement of the camera. The operator can control the focus, zoom, contrast, polarity and panning

speed with this hand control. The module is ergonomically designed for comfort and for extended hours of use. Figure 8 shows the ball turret camera.

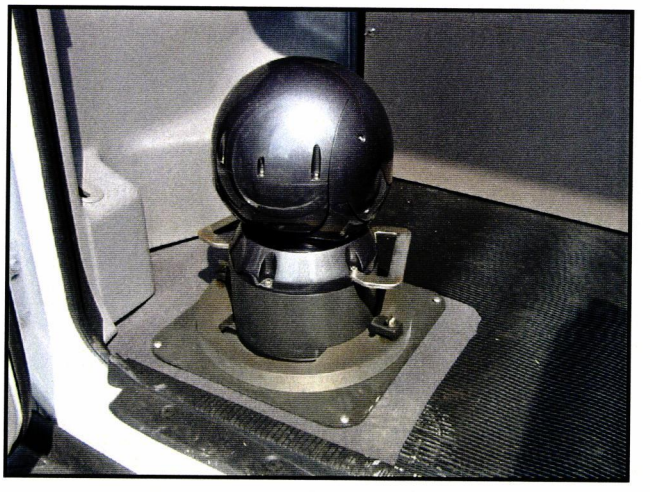


Figure 8 Ball Turret Camera

The ball turret camera can be conveniently stored in the rear of the van. This protects the camera from theft and the elements of the weather while not in use. During use the ball turret camera is transferred to a mount on the roof of the van near the rear of the vehicle. The mount on top of the van is identical to the mount shown here on the inside floor of the van. Figure 9 below illustrates the camera mounted on the roof of the van.

Figure 9 Ball Turret Camera Mounted on Roof

The large circular lens near the bottom of the ball turret is part of the infrared camera. The smaller lens of the color camera is located above the infrared camera lens. The cable attached to the camera can easily be removed to allow the camera to be dismounted from the roof of the van and stored for travel.

The Raytheon has a similar setup to the IRISystem. The next section will detail the layout of the Raytheon system.

4.1.2 Raytheon NightSight ProtectIR 4000B

The basic components of the Raytheon system consisted of vehicle rooftop mounted infrared camera, a monitor, and a VCR. This system was mounted on a Research Section vehicle. Figure 10 below shows a close up of the Raytheon camera.

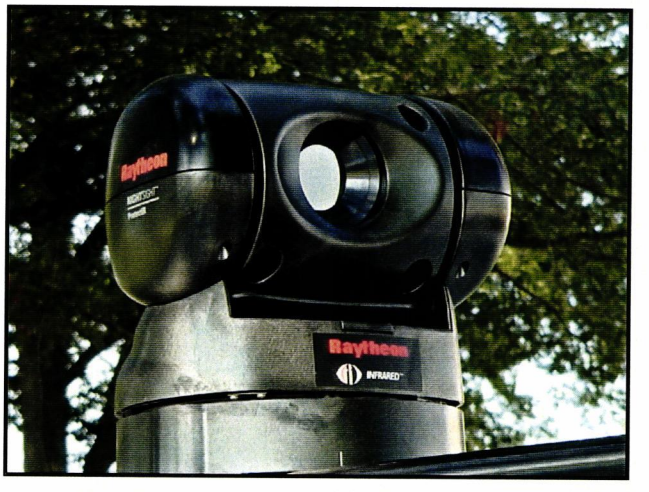


Figure 10 Raytheon Infrared Camera

This camera is permanently mounted to the roof of the van. The camera is not removed for storage like the IRISystem. The Raytheon camera rolls down and faces towards the rear of the vehicle when not in operation.

Figure 11 below shows the IRISystem after final assembly. Another difference between the two camera systems is the time required for the infrared image to appear on the monitor. The Raytheon takes a maximum of 60 seconds to produce an image on the

Figure 11 Raytheon System

monitor. The IRISystem requires a minimum of approximately ten minutes to produce an infrared image. Another difference between the systems can be seen in the type of hand control. Figure 12 below shows the Raytheon hand control. This hand control does not

Figure 12 Raytheon Camera Control

have a zoom, a focus, a camera selection button, or a contrast adjustment on it like the IRISystem hand control. The Raytheon camera system has automatic focus and contrast built into the camera. This hand control allowed for only one panning speed, whereas, the IRISystem control was pressure sensitive allowing the panning speed to increase or decrease based on the amount of pressure applied to the control.

The next picture shown in Figure 13 shows the assembly of the Raytheon system on the inside of the van. A small center console was built to house the inverter and the control box for the camera. The monitor was mounted on top of the console for easy viewing. The video cable coming from the camera was connected through the attached VCR for recording the video. This monitor was twice as big as the monitors used in the IRISystem. The bigger monitor was able to produce a larger viewing image.

Figure 13 Raytheon Assembly

4.2 Methods

The primary method for evaluating and comparing these two systems consisted of setting up the two systems side by side at a weigh station or an inspection station. Several of these types of areas are located next to the highways throughout the state of Arkansas. A number of these locations were tested with respect to suitability for accommodating the camera systems based on the geographic layout of the site and the availability of a line of sight that allowed for maximum viewing time of commercial vehicles that passed by the camera systems. Some of the locations evaluated were to

small that prevented the camera systems from being far enough away from the flow of traffic to be highly effective. The optimal situation found during the study allowed for a distance of approximately 100 yards away from the flow of traffic and at least a 150 degree line of sight measured by panning the camera from the left to the right horizontally. This optimal positioning allowed the outside brake drums of a passing vehicle to be viewed at an angle and then the inside brake drums could be viewed as the vehicle passed directly in front of the camera position. Furthermore, there had to be enough distance between the camera position and an officer placed down stream in the traffic flow to be radioed about which vehicles to pull over for inspection. An officer from inside the van would radio another officer identifying the vehicle to be pulled over for inspection.

Figure 14 Officers in IRISystem

Figure 15 Officer Down Stream of Traffic Flow

Figure 14 illustrates officers inside the IRISystem viewing the infrared images looking for failed braking system. Figure 15 shows an officer down stream in the traffic flow listening for vehicles over the radio to be identified for inspection. The down stream officer would either waive vehicle by or would signal the vehicle to pull over for inspection.

The next section will present results of the comparison study.

5.0 Presentation of Results

The intended purpose of this study was to evaluate the effectiveness of the IRISystem and the Raytheon system as it relates to commercial brake screening. The results presented in this and the following sections were based solely on IRIS Inspections. These inspections were performed August 1, 2001 through October 31, 2001. Results are broken down into two categories IRIS Inspections and Standard Inspections. IRIS Inspections were performed every Tuesday and Wednesday of the above mentioned time period. Table 2 shows an overall summary of data collected.

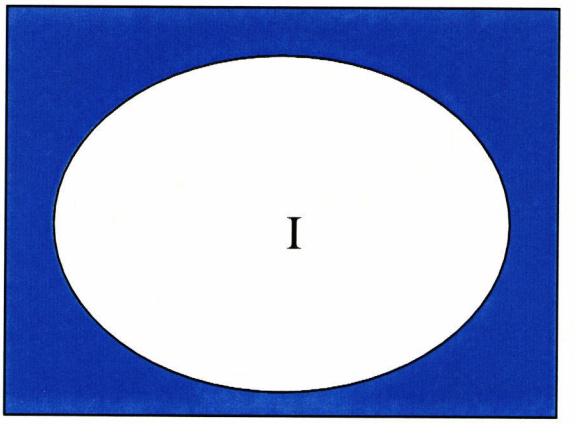
Overall	
Number of Inspections	426
IRIS Inspections	228
Standard Inspections	198
Number of Violations	706
IRIS Violations	460
Standard Violations	245
Brake Related Violations	254
IRIS Inspections	211
Standard Inspections	43
Driver Related Violations	135
IRIS Inspections	42
Standard Inspections	93
Other Violations	316
IRIS Inspections	207
Standard Inspections	109

Table 2 Summary of Data

5.1 Inspection Domains

It is important to note how standard inspections were retrieved. IRIS inspections were done anywhere from time ranges of 8:45 a.m. to 3:00 p.m. The period of standard inspections is directly dependent on the period of IRIS inspections. An example of this is if the IRISystem inspected vehicles from 9:00 am to 12:00 pm on Tuesday and

Wednesday of a particular week, standard inspections were retrieved from 9:00 am to 12:00 pm of that particular week with the exclusion of those two days. Retrieving standard inspections in this manner allows the comparison of inspections with the IRIS versus inspections without the IRIS over similar time periods. Figure 16 illustrates the domain of data collected.



$$S = \{x \in I \cup I' \mid I \cap I' = \varnothing\}$$

Where I = IRIS Inspections, I' = Standard Inspections, and x = Inspection

Figure 16 Inspection Domain

5.2 Inspections Performed by District

The following districts/visit values included in this study are: District 1: Hempstead County, AR – 1 visit, District 1 (South): Hwy 65, Pine Bluff, AR– 2 visits, District 2: Mayflower, AR – 3 visits, District 4: Hope, AR – 2 visits, and District 5: Crittenden County – 2 visits. Figure 17 shows a visual picture of the location of each district and a breakdown of IRIS and Standard Inspections.

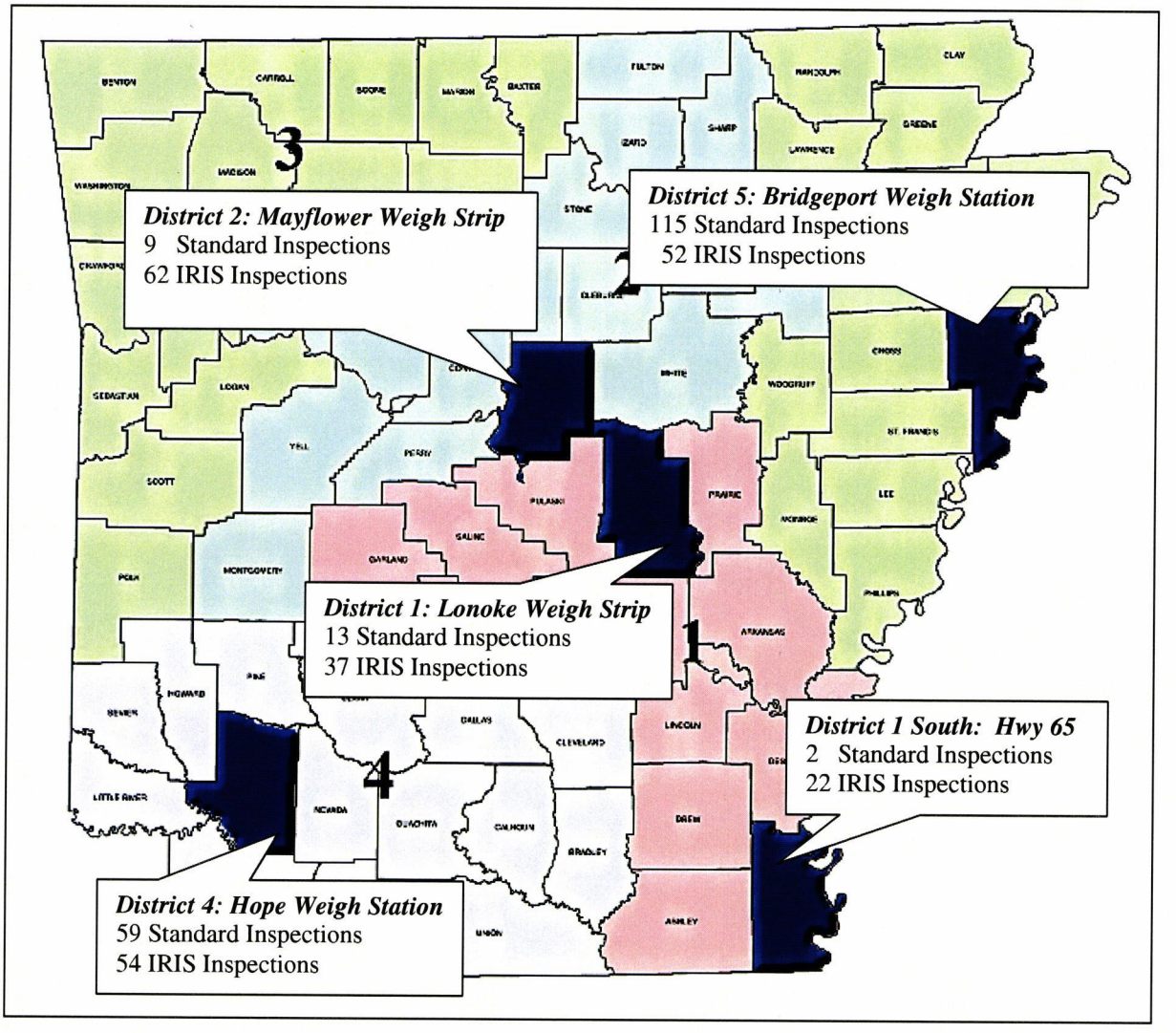


Figure 17 Inspections By District

5.3 Violations

5.3.1 Description of Violations

Violations were broken down into three categories: Brake Related, Driver Related, or Other Violations. A violation is considered to be a Brake Related Violation if any word in the violation description contains "brake", "wheel", "tire", "rim", or "axle". A couple of examples of a Brake Related Violation are "Brake connections with leaks/constrictions", "Tire-front tread depth less than 2/32 inch", and "Wheel/rim cracked or broken". The letter 'D' in the violation information section of an Inspection Report

denotes a Driver Related Violation. Some examples of Driver Related Violations are "Driver failing to retain last 7 days logs", "Driver's record of duty not current", and "Local Laws Speeding". A violation is broken down into the category "Other Violations" if it could not be categorized into the Driver or Brake Related Violation Category. An example of violations categorized into the Other Violations category is "Emergency warning devices not as required".

5.3.2 Violations Found

So that the account of violations would be accurate, all inspections were retrieved from the SafetyNet Database. SafetyNet is a database maintained by Arkansas Highway Police to keep track of inspection violations in Arkansas. Figure 18 shows a bar chart on the violations that were found during this study.

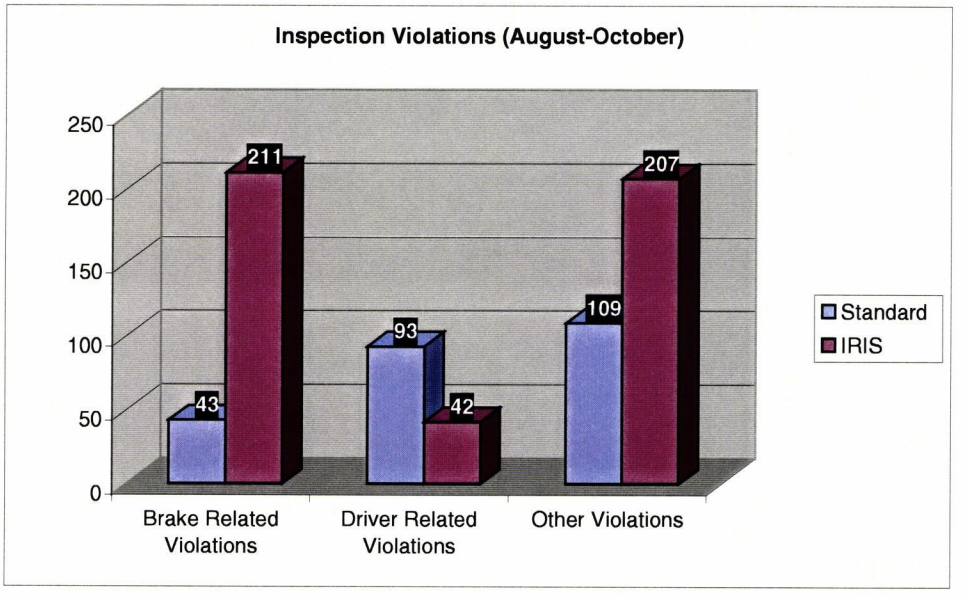


Figure 18 Summary of Violations

5.4 Inspection Efficiency

The effectiveness of IRIS Inspections was obtained by taking the number of trucks resulting in at least one violation and dividing it by the number of inspections completed. The efficiency rating of each district and an overall efficiency is listed in Table 3. Inspection efficiency is further discussed in section 6.0 Discussion of Results.

	Standard	IRIS
District 1	92.31% (12/13)	62.16% (23/37)
District 1 (South)	0.00% (0/2)	72.73% (16/22)
District 2	100.00% (9/9)	79.03% (49/62)
District 4	45.76% (27/59)	63.64% (35/55)
District 5	80.00% (92/115)	86.54% (45/52)
Overall	70.71% (140/198)	73.68% (168/228)

Table 3 IRIS Inspection Efficiency

5.5 Brake Efficiency

The focus of this study was to evaluate and determine the relative effectiveness of the IRIS and Raytheon van in detecting inoperative brakes. Brake efficiency was retrieved by taking the number of trucks with at least one violation and dividing it by the number of inspections performed. The following table shows a breakdown by county of the efficiency of spotting faulty brakes.

	Standard	IRIS
District 1	15.38%	45.95%
District 1(South)	0.00%	59.09%
District 2	22.22%	61.29%
District 4	10.17%	50.91%
District 5	20.87%	75.00%
Overall	17.17%	59.21%

Table 4 Brake Inspection Efficiency

6.0 Discussion of Results

The data presented in this paper helps understand the inspection efficiency of both Standard and IRIS Inspections. There are several factors that possibly could have influenced the efficiency of inspections performed with IRIS. These factors include the discrepancies between individual operators, the efficiency related to Brake Related Violations, and the number of violations with and without IRIS.

Due to the set-up and organization of the operation, there was a new IRIS operator performing inspections each week. This meant that the operator had to familiarize himself/herself with how the IRIS operated. If operators were given more time to train and learn the idiosyncrancies of the infrared system, there would be a dramatic difference in the efficiency over time. Each operator would learn his or her own method of identifying inoperative brakes.

The efficiency as it relates to Brake Related Violations shows us that IRIS based inspections are more efficient at spotting cold brakes. Since the sample sizes in some cases are not comparable, comparisons of Standard Efficiency to IRIS Efficiency should be avoided. They should be looked at individually. Referring back to Table 3 on page 19, the change in brake efficiency as it relates to a specific district is not substantial when taking into account the sample size.

A crucial part of this data is the number of IRIS violations and the number of Standard violations. Table 2 on page 15 shows that the number of violations with IRIS is considerable larger than those performed without IRIS. Standard Inspections are more than likely carried out based upon either the appearance of the truck or the behavior of the driver. This is evident due to the fact that there are more driver and other violations

than brake violations. This data shows that the IRIS method is superior to the current method of screening trucks.

Although Standard Inspections are netting violations (supra page 19), Standard Inspections do not get the trucks in the worse condition off the road as the IRIS does. The Arkansas Highway Police can definitely improve there screening procedures by incorporating the IRISystem into inspection operations.

7.0 Conclusions

Standard inspection procedures accomplish the goal of removing unsafe commercial vehicles from the public highway system. However, this study has shown that this goal can be accomplished more efficiently and remove more of the unsafe commercial vehicles from the public highway system. The cumulative effect of being able to screen more commercial vehicles with this new infrared scanning technology as compared to the standard inspection procedures will cause an increase in the safety of commercial vehicles for two reasons: (1) the deterrence effect of carrier operators knowing that their vehicles can be scanned for failed brakes will cause these operators to make sure there brakes are working, and (2) the chances of not being inspected will be dramatically reduced through the utilization of this technology. Furthermore, this study has proven that the utilization of this technology will allow the limited personnel of the AHP to effectively screen the increasing population of commercial vehicle traffic in the future.

8.0 Recommendations

From the results of this study, the following recommendations have been reached. The use of infrared technology as a screening tool for the AHP in their inspection duties is essential. The IRISystem has proven to be an effective system and a recommendation for purchase of this system is recognized for the following reasons: (1) the IRISystem is designed and tailored for law enforcement agencies, and (2) the extra capabilities such as the color printer, color camera, and dual VCR setup facilitates evidentiary needs of law enforcement agencies.

As for the Raytheon system used for detecting failed brakes, this system proved to be useful in spotting failed brakes. However, it is not recommended that anymore of these systems be purchased without further study. The Raytheon system simply did not compare to the IRISystem with regard to the following aspects: (1) the setup did not have a comfortable workstation for extended hours of use by AHP personnel, and (2) the system was not designed to meet the evidentiary needs of the AHP. However, this system, because of its effectiveness in spotting bad brakes, may be a low cost alternative to for screening commercial vehicles at selected weigh stations by permanently mounting this camera at a weigh station. A conclusive statement about the use of this camera in this type of application cannot be made without further study.

9.0 Bibliography

Christiaen, Anne-Claire and Steve J. Shaffer, *Evaluation of Infrared Brake Screening Technology: Final Report*, U.S. Department of Transportation, Report No.: DOT-MC-01-007, December 2000.

10.0 Appendix

10.1 Scripts of News Articles

10.1.1 Texarkana Gazette

Stopping a problem

System takes guesswork out of determining which trucks have faulty brakes

By ANTHONY DAVIS of the Gazette Staff

Between 6,000 and 8,000 trucks pass the Guernsey Weigh Station between Texarkana and Hope on Interstate 30 each day.

Determining which ones could brake safely is usually hit-and-miss for the Arkansas Highway Police charged with enforcing local, state and federal motor carrier regulations and laws.

On Tuesday, the odds favored the AHP as tractor-trailer and commercial rigs unknowingly drove past an infrared, heat-sensitive camera that identifies "cold brakes."

"Braking is the major problem we are having with commercial vehicles as far as accidents and problem areas. This is one thing that's going to help us to catch the violators," District 4 AHP Commander Gary East said. "But we don't just wait for a violator to come up. We pull in a certain number a day just to check them. Depending on the day of the week, we normally have two to three officers on each side, but I have some other officers here to help out because of the IRIS (Infrared Imaging System) van."

Manning the van, parked near the weigh station, are two representatives of the Arkansas Highway Department and a highway police officer. Unlike the Texas Department of Public Safety, which has an enforcement arm called the License and Weight Service, Arkansas has the AHP administratively assigned to the highway department.

Chris Corbitt, a civil engineer with AHD, is assisting police with the IRIS program on a trial basis to evaluate its effectiveness in the field. The imaging system identifies the presence of heat in the passing truck's brake pads and drums. It is 98 percent accurate in detecting faulty brakes, Corbitt said. False readings of cold brakes are sometimes attributable to trucks that have been driven for only a short distance or have been parked and cooled down naturally.

The nearly $300,000 imaging system is being leased for three months, which is about to come to an end. It has been used all over the state to positive reviews from officers.

"This is a joint effort between our research department and the highway police," Corbitt said. "We heard about it after a four-state study involving Kentucky, Tennessee, North Carolina and Virginia. It's absolutely effective. Previously the way to do this was to

randomly inspect when the officer had a gut feeling about the truck. This tool allows us to pull out trucks that they know are unsafe because of the infrared imaging."

Trucks that register concern for the highway police are pulled over into the lot for a thorough inspection.

"They are considered out-of-service until the problem is corrected," East said. "That's the biggest problem with the trucking industry is the bad brakes, and we are just looking for new technology that will help us spot the violator."

The tip-off to trouble provided by IRIS sometimes leads to additional violations. East produced one report on an inspection that resulted not only in identifying which specific brake systems were not functioning, but also resulted in stop-lamp violations, leaking brake connections and no brake warning device.

The department's time with IRIS is about to expire, but District 4 Highway Police officers give this system high marks.

RETURN to Arkansas Section / Thursday, September 27, 2001

Heat sensor used to spot bad brakes

NOEL E. OMAN
ARKANSAS DEMOCRAT-GAZETTE

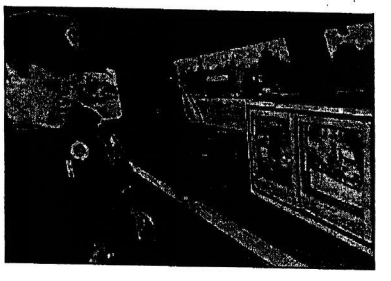
LONOKE -- Apache helicopters helped make the world safe during the Persian Gulf War.

A decade later, a key piece of the attack helicopter's equipment is making U.S. roads safer by identifying potentially dangerous trucks.

During the war the forward-looking infrared system was mounted on the chin of one of the world's most advanced machines of war.

Now it's mounted atop a nondescript white van.

Then the system served as the helicopter pilot's eyes for potential battle targets, using heat to distinguish objects.



Arkansas Democrat-Gazette/STEVE KEESEE

Arkansas Highway Police Cpl. Ross H. Batson sits in a van equipped with an infrared system to check truck brakes at an inspection station west of Lonoke on Wednesday. When the system's camera focuses on good brakes, a bright glow appears on the screen on the left.

Now it acts as the eyes for law enforcement officers intent on spotting defective brakes on big trucks -- the most common safety violation in trucking and a factor most recently in the May 31 bus crash that left three Mountainburg students dead and eight others injured.

Officers believe the equipment is every bit as good on the road as it was on the battlefield. That's especially evident when officers recall how they found defective brakes until now: inspecting randomly selected trucks.

"That's hit or miss," said Cpl. Ross Baston, a field training officer for the Arkansas Highway Police, an arm of the state Highway and Transportation Department. "Now every truck we pull over, we know there's something wrong."

The highway police demonstrated the device Wednesday morning at an inspection station on Interstate 40 just west of Lonoke.

It's part of a three-month test of a system valued at $300,000, 80 percent of which the federal government would cover.

A long line of trucks slowed down and entered the station. The vast majority exited without stopping for a complete inspection as their brakes passed the test.

But in the first couple of hours, Baston said the infrared system spotted more than a dozen trucks with potentially defective brakes. A day earlier the system spotted 22 in two hours.

When the infrared system detected such brakes, Baston and other officers in the van parked near the inspection station entrance ramp radioed officers up the line to pull the trucks over.

"We're not wasting our time or the driver's time," Baston said. "It's a more effective use of time."

As the trucks rolled by the ball-mounted camera, an infrared image of the truck appeared on one of two monitors in the van. Chris Corbitt, a civil engineer with the Highway Department, worked a hand-held device much like a video-game controller to zoom in close to the truck or adjust the contrast of the image on the screen.

A white glow on the inside of each wheel meant the brakes were working. Working brakes generate friction, friction generates heat, and heat shows up white on infrared images. If the brakes weren't operating properly, the wheel area would be black, or cold.

Corbitt and the officers trained in using the device don't stop every truck with cold brakes. Some have brakes that barely register, which can be an indication the truck has just begun its journey or it doesn't have a load.

But when one or two cold brakes show up on a semi with several hot ones, officers know to pull over the truck for a closer inspection.

A full inspection takes one officer 45 minutes to an hour to complete. With a team of nine officers, 40 randomly selected trucks could be inspected in a four-hour period.

And while it is uncertain whether every truck inspected will have defective brakes, it is certain that defective brakes are the most common defect on big rigs, according to government figures.

Last year, highway police performed 7,761 "Level One" inspections, in which officers crawl underneath trucks and commercial buses to check the brakes. They took 1,474, or 19 percent, of those trucks off the road until brake repairs were made.

Nationally, 873,000 "Level One" inspections were performed and 242,182 trucks, or 27 percent, were taken off the road until brake repairs were made, according to the Federal Motor Carrier Safety Administration.

Bad brakes are something investigators are studying closely in the Mountainburg crash. The tractor-trailer rig that hit the school bus had mechanical problems on all 10 of its brakes, said David Rayburn, a National Transportation Safety Board investigator. Seven of the brakes, he added, had violations serious enough to have the truck taken off the road.

Truckers welcome the infrared system.

"It's a good service," said Jerry Wright of West Memphis, who had just finished -- "believe it or not," he added -- hauling a load of brake shoes from West Memphis to Little Rock, when the infrared device detected a defective brake on his rig. "They found an air leak I didn't know about.

"Something else could've happened and it could've been because of

faulty brakes, God forbid. I look at it as they helped me and maybe even saved someone's life."

This article was published on Thursday, September 27, 2001

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Highway Police Using Infrared System To Check Brakes

By Tim Taylor

Donrey Little Rock Bureau

LONOKE -- The Arkansas Highway Police are looking at I.R.I.S. (Infra Red Inspection System) as a way to reduce the number of commercial vehicles with faulty brakes on the state's highways.

A recent example of the danger of flawed brakes was the May 31 collision of a tractor-trailer rig with a school bus in Mountainburg that resulted in the death of three students. The accident occurred after the truck went through a stop sign and smashed into to the rear of the bus; an investigation revealed that defective brakes on the truck caused the crash.

"Had that vehicle been screened (by I.R.I.S.), judging from the results we've seen so far, the system would have more than likely picked up the faulty brakes," said Highway Police Chief Ronnie Burks, who said brake problems are the leading source of violations among commercial trucks in the state.

The Highway Police is leasing I.R.I.S. from the Canadian firm that developed the system, also used by the U.S. Army in its Apache helicopters. A video camera mounted atop a van at an inspection site shoots infrared images of each truck as it rolls past, relaying the footage to a monitor within the van. Inspectors view the images as each truck passes, looking for the presence of heat in the truck's brake drums. Heat from the drums indicates that the brakes are functioning correctly; an inconsistency or darkness in the color of the drums alerts the inspector to a possible malfunction and leads to a manual brake inspection.

I.R.I.S. has been leased for three months as part of a research project being conducted by the police and the Arkansas Highway and Transportation Department, according to AHTD's Chris Corbitt, principal investigator on the project. In a three-hour period, police inspectors monitored some 400 trucks at an Interstate 540 weigh station Tuesday, said Corbitt. Twenty-two underwent manual inspections, he said, with almost a dozen put out of service because of brake problems.

Burks reasons that a system like I.R.I.S., which costs $300,000, would benefit the trucking industry as well as the police by eliminating the need for indiscriminate brake inspections. "It's going to take the randomness out of it and allow us to be able to target the ones with bad brakes," he said.

The results of the research project, which will conclude in October, will determine whether the Highway Police would purchase an I.R.I.S., said Burks.

I.R.I.S. inspections have already taken place at sites in McGehee, West

[illegible] inspections have already taken place at sites in McGehee, West Memphis, Hope and Fort Smith; Highway Police inspectors will conduct an inspection in Springdale Oct. 16-17.

New Tool To Catch Bad Brakes

Iris Camera

New Tool To Catch Bad Brakes

Story by Mike Hellgren Posted 9/26/01 5:38:39 PM

Central Arkansas, where Interstates 30 and 40 connect, is a Mecca for truck traffic. Many of the big rigs weigh more than 80,000 pounds, and one of the biggest dangers to you: bad brakes.

But there's new technology that spots them more quickly and effectively than ever before. It's called 'Iris'. The trucks that travel the roads give off heat from friction when they brake. The iris infrared camera can spot that.

In just two days at one weigh station, they've already caught more than 30 bad big rigs.

As trucks parade through a weigh station near Lonoke, they're being watched--by a heat-sensing camera. When the camera doesn't detect brake heat from friction, highway police Corporal Ross Batson calls for an inspection.

Batson says "you don't catch them all. You can't catch them all." But he's doing well. "Eight pulled over so far; we've been doing it for a two hour period."

Highway police took Maron Jernigan's truck out of service. "I thought things were working because I had a heavy load on--sweet potatoes out of Mississippi.

That's what I'm hauling."

Batson tells KARK News 4 "besides driver error, brake problems in a truck are one of the leading factors in a wreck."

Right now, there is only one Iris truck in Arkansas. The cost: $300,000. But if the experiment pays off, it could be one of your best safety tools when one of these 80,000 pound behemoths is bearing down behind you.

Highway police officers say the infrared Iris camera has an accuracy rate of between 98 and 100 percent.

Watch KARK News 4 for more on this story!

10.2 Raytheon Camera Specifications

PRODUCT SPECIFICATIONS

ProtectIR 4000B | Thermal Imaging Solutions

NIGHTSIGHT PROTECTIR

NIGHTSIGHT 4000B TAKES YOU BEYOND THE LIMITATIONS OF YOUR EYE SIGHT:

The NightSight ProtectIR 4000B is the next Thermal Imaging Solution offered by Raytheon for the law enforcement, security and surveillance markets. As the successor to Raytheon's Series 200, the 4000B combines an infrared video camera with a pan and tilt positioning platform. The camera and positioning platform are operated via a cabled joystick controller, allowing the operator to point the camera as needed. The infrared video image is displayed on any TV monitor that may be supplied by Raytheon or its customers, with pan position feedback displayed in the video signal. The system is internally and externally designed to withstand the rigors of mobile and land-based outdoor environments. The base unit architecture is designed to allow future optional feature upgrades such as video recording capability and programmed scans.

ProtectIR 4000B Camera

SEE THE UNSEEN

Raytheon

INFRARED

Specifications and design subject to change without notice.

SEE THE UNSEEN

RAYTHEON COMMERCIAL INFRARED

PRODUCT SPECIFICATIONS

ProtectIR 4000B | Thermal Imaging Solutions

NIGHTSIGHT PROTECTIR

OPTICS:

Optics	f/1.0
Depth of Field	7.6 meters to infinity (25 ft. to infinity)
Field of View	12° x 9°

VIDEO:

Contrast/Brightness Control	Automatic
Infrared Polarity	White-Hot
Video Output	NTSC

PHYSICAL:

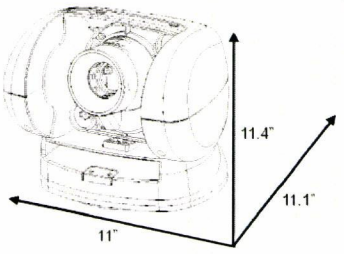
Pan/Tilt Camera Dimensions	W-280mm, H-290mm, D-282mm (W-11", H -11.4", D-11.1")
Pan/Tilt Camera Weight	4.5 kg (10 lbs)

PERFORMANCE:

Cold Start to IR video image	60 seconds (typical)
Detector Range	Detects a person up to 450 meters (1500 ft.)
Image Resolution	160 X 120 pixels
Operating Voltage	9.5 to 16 Vdc (12 Vdc nominal)
Pan Function	Joystick controlled 360° continuous
Tilt Function	Joystick controlled, -20°/+180° from horizontal
Operating Interfaces (from Joystick)	ON/OFF, Pan/Tilt Control
Pan Position Feedback	Graphic Indication on Monitor
Operating Temperature	-40° to 55° C (-40° to 131° F)

OPTIONAL EQUIPMENT:

Roof Bar Assembly	
Dimensions	H-82.5mm, D-228mm, (H-3.25", D-9" W-adjustable to vehicle)
Weight	5 kg. (11 lbs.)



SEE THE UNSEEN

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10.3 IRISystem Camera Specifications

Ultra7500™

APPLICATIONS

- Law Enforcement
- EMS
- Search & Rescue
- Environmental Monitoring

HIGH PERFORMANCE COMPACT LAW ENFORCEMENT FLIR

FLIR's new Ultra 7500 meets the multi-role mission requirements of today's busy law enforcement organization. The lightweight, dual sensing gimbal with laser illuminator option is designed to provide 24 hour a day, higher altitude, long-range search and surveillance from airborne platforms. The ultimate force multiplier, Ultra 7500 improves law enforcement air to ground teamwork and allows aviation units to cover large patrol sectors by reducing response times.

MULTI-SENSING = MULTI-TASKING

The Ultra 7500 sets the standard in airborne imaging. Its triple payload capability features a 320 x 240 pixel InSb IR imager and low-light TV camera. The optional Class IIIb long-range laser illuminator can pinpoint and illuminate a specific target, creating better air-to-ground unit cooperation and extending the range of night vision equipment.

COMPACT, LIGHT AND STABLE

The Ultra 7500 is the most compact and lightweight airborne imager on the market. At just 9 inches and weighing approximately 26 pounds, the fully sealed gimbal is designed to minimize drag and provide more ground clearance. The system's compact size translates into increased aircraft useful loads and fuel savings for longer flight times and reduced operational costs. Advanced stabilization produces clear, detailed images.

ENHANCED OPTICAL PERFORMANCE

The new low-light TV camera with 18X optical zoom delivers outstanding daylight imagery and greatly enhances operations during the dusk and dawn hours. The IR optics feature a continuous zoom, allowing the operator to customize the Field Of View (FOV) as the tactical situation requires. Zoom in or out without losing sight of the target. The IR and TV auto focus ensures that the displayed image is always clear.

EASY OPERATION

The Ultra 7500's state-of-the-art Autotracker enhances operations by tracking targets automatically. The system keeps designated targets or scenes within the FOV without the need for constant operator input, reducing operator workload and stress while improving overall mission performance.

New on-screen graphics use recognizable icons which increase the operator's situational awareness and promote better and more rapid in-flight decision making. The hand controller features color-coding and backlighting. The system's direct access functionality eliminates the need to search through menus for customized operation.

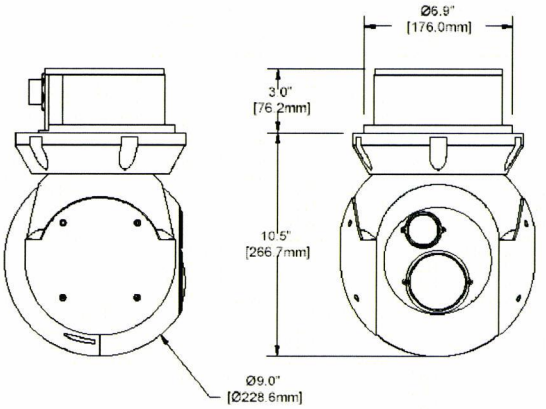
BACKED BY THE FLIR NAME

FLIR is the world's leading supplier of advanced infrared imaging systems for military, government and law enforcement applications. FLIR's global network of service and training centers assures customers the experience, resources, and commitment they demand.

FLIR SYSTEMS

AIRBORNE SYSTEMS
www.flir.com/u75

SYSTEM SPECIFICATIONS	
Turret Size	9.0" dia. x 13.5" h (22.9 x 34.3 cm)
Turret Weight	26 lbs. (11.8 kg)
Field of Regard	360° continuous in Azimuth and Elevation
Slew Rates	0° to 50° both axes
Stabilization	Fiber optic gyro stabilization
THERMAL IMAGER	
Sensor	320 x 240 InSb FPA 3-5µm
Fields of View	22° - 2.2° horizontal, 10:1 continuous zoom
Calibration	Internal Nonuniformity Correction (NUC)
DAYLIGHT IMAGER	
Pixel Arrangement	811H x 608V (NTSC) 795H x 596V (PAL)
Resolution	450 Television Lines
Telescope	18:1 continuous zoom, 4X electronic zoom
Fields of View	0.7° (e-zoom) to 47° horizontal continuous zoom
CCD Sensitivity	0.2 lux @ f/1.4 w/out filter, 3 lux @ f/1.4 w/filter
ELECTRONIC CONTROL UNIT	
Size	9.85" x 5.50" x 8.00" (24.21 x 10 x 20.32 cm)
Weight	9.1 lbs (4.13 kg)
Power Requirements	18VDC to 32VDC input
Max Current Requirements	15 amps
Communications	RS 232/422
Video Output	Four
OPTIONS	
ARINC interface, RS-232 serial GPS interface, Radar interface, SLASS interface, laser pointer or laser illuminator and IR & CCD optical extenders.	



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