

## Technical Report Documentation Page

1. Report No. FHWA-AZ-04-559(1)	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle <b>SPR 559 - New, Improved, Comprehensive, and Automated Driver's License Test and Vision Screening System</b>		5. Report Date May 2005	
		6. Performing Organization Code	
7. Authors Sandy H. Straus		8. Performing Organization Report No.	
9. Performing Organization Name and Address  <b>ESRA Consulting Corporation 1650 South Dixie Highway, 3<sup>rd</sup> Floor Boca Raton, Florida 33432 (561) 361-0004 <a href="http://www.esracorp.com">http://www.esracorp.com</a></b>		10. Work Unit No.	
		11. Contract or Grant No. SPR-PL-1-(61) 559	
12. Sponsoring Agency Name and Address  <b>ARIZONA DEPARTMENT OF TRANSPORTATION 206 S. 17TH AVENUE PHOENIX, ARIZONA 85007</b>  Project Manager: John Semmens		13. Type of Report and Period Covered	
		14. Sponsoring Agency Code	
15. Supplementary Notes Prepared in cooperation with the U.S. Department of Transportation, Federal Highway Administration			
16. Abstract This one-of-a-kind comprehensive study highlights the importance of automated testing techniques and the significance of vision screening measures other than standard visual acuity testing for assessing all drivers and, in particular, at-risk drivers and older drivers. Non-automated tests tend to be subjective, time-consuming, costly, and heavily reliant on the experience of the examiner. Due to the high collision, injury, and fatality rates of all drivers in the State of Arizona, and the disproportionate number of at-fault older drivers and collision risks in the States of Arizona and Florida, new and automated screening methodologies and vision standards are now needed to promote road safety, predict visual impairment, and evaluate possible restriction or confiscation of driver's licenses. This study demonstrates that environmental factors and manner of collisions increase in collision involvement for drivers between ages 50 to 59 years in both Arizona and Florida. Drivers age 80 to 89 years in both states are most likely at-fault in collisions compared to all other age cohorts. These results are consistent among drivers cited for collision involvement due to visual defects. Our findings, which span an 11- year period from 1991 to 2001, not only apply to Arizona and Florida, two states with some of the largest proportions of older individuals in the United States, but, as our global survey of motor vehicle bureau directors or their representatives of the United States, Commonwealth of Puerto Rico, United Kingdom, Canada, New Zealand, and Australia illustrate, any state, country, province, territory, commonwealth, or nation with an increasing number of older drivers. A pilot study, to follow, ultimately allows for the implementation of effective strategies for screening of visual impairment and eye disease in all Arizona drivers. Snellen acuity, the most widely used vision testing measure, accounts for less than 0.1 percent of the visual field and fails to quantify contrast sensitivity and color vision (Fink and Sadun, 2004), two of several visual parameters needed for safe driving. It is recommended that at-risk and older drivers in Arizona are tested for vision through a newly designed system of measures provided by two automated tests (to test vision condition and function) and one driving simulator (to assess eye status). Hence we integrate it into a larger system and provide additional recommendations as these relate to motor vehicle operation skills and cognition. These automated systems and methodologies may ultimately serve as a prototype of transportation license testing improvements for all other states, countries, and agencies (e.g., aviation, rail, maritime, commercial vehicles, etc.) to follow. Such techniques may also reduce the incidence of fraudulent schemes and issuances of driver's licenses, commercial driver's licenses, and hazardous materials transportation licenses.			
17. Key Words older driver, at-risk driver, driver's license test, UFOV, RAIR, Relative Accident Involvement Ratio, probabilistic risk assessment, visual acuity, driving simulator, vision test, dementia, Alzheimer's Disease, Parkinson's Disease, Macular Degeneration, Arizona, Florida, ESRA Dynamic Vision Assessment for Transportation, license renewal, automated testing, vision screening system, ESRA DVAT, ESRA VAPT, ESRA Vision Assessment Procedure for Transportation, simulator sickness, flashback effect, aftereffect, cybersickness, ESRA DAT, driver license test procedure, transportation license test		18. Distribution Statement Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia, 22161	
19. Security Classification  Unclassified		23. Registrant's Seal	
20. Security Classification  Unclassified		21. No. of Pages  438	22. Price

**The ESRA DAT™ System is developed by:**

ESRA Consulting Corporation  
ESRA DAT™ Sales Division  
1650 South Dixie Highway, Third Floor  
Boca Raton, Florida 33432  
USA

Telephone: (561) 361-0004  
Arizona Fax: (520) 844-8555  
e-mail: [dat@esracorp.com](mailto:dat@esracorp.com)  
web: <http://www.esracorp.com>



I dedicate this report to the memory of Max, my grandfather, a pedestrian statistic. May this report serve as a testament to his legacy. He is sorely missed.

*This one is for you, Papa.*

**SI\* (MODERN METRIC) CONVERSION FACTORS**

APPROXIMATE CONVERSIONS TO SI UNITS					APPROXIMATE CONVERSIONS FROM SI UNITS				
Symbol	When You Know	Multiply By	To Find	Symbol	Symbol	When You Know	Multiply By	To Find	Symbol
<b><u>LENGTH</u></b>					<b><u>LENGTH</u></b>				
in	inches	25.4	millimeters	mm	mm	millimeters	0.039	inches	in
ft	feet	0.305	meters	m	m	meters	3.28	feet	ft
yd	yards	0.914	meters	m	m	meters	1.09	yards	yd
mi	miles	1.61	kilometers	km	km	kilometers	0.621	miles	mi
<b><u>AREA</u></b>					<b><u>AREA</u></b>				
in <sup>2</sup>	square inches	645.2	square millimeters	mm <sup>2</sup>	mm <sup>2</sup>	Square millimeters	0.0016	square inches	in <sup>2</sup>
ft <sup>2</sup>	square feet	0.093	square meters	m <sup>2</sup>	m <sup>2</sup>	Square meters	10.764	square feet	ft <sup>2</sup>
yd <sup>2</sup>	square yards	0.836	square meters	m <sup>2</sup>	m <sup>2</sup>	Square meters	1.195	square yards	yd <sup>2</sup>
ac	acres	0.405	hectares	ha	ha	hectares	2.47	acres	ac
mi <sup>2</sup>	square miles	2.59	square kilometers	km <sup>2</sup>	km <sup>2</sup>	Square kilometers	0.386	square miles	mi <sup>2</sup>
<b><u>VOLUME</u></b>					<b><u>VOLUME</u></b>				
fl oz	fluid ounces	29.57	milliliters	mL	mL	milliliters	0.034	fluid ounces	fl oz
gal	gallons	3.785	liters	L	L	liters	0.264	gallons	gal
ft <sup>3</sup>	cubic feet	0.028	cubic meters	m <sup>3</sup>	m <sup>3</sup>	Cubic meters	35.315	cubic feet	ft <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.765	cubic meters	m <sup>3</sup>	m <sup>3</sup>	Cubic meters	1.308	cubic yards	yd <sup>3</sup>
NOTE: Volumes greater than 1000L shall be shown in m <sup>3</sup> .									
<b><u>MASS</u></b>					<b><u>MASS</u></b>				
oz	ounces	28.35	grams	g	g	grams	0.035	ounces	oz
lb	pounds	0.454	kilograms	kg	kg	kilograms	2.205	pounds	lb
T	short tons (2000lb)	0.907	megagrams (or "metric ton")	mg (or "t")	Mg	megagrams (or "metric ton")	1.102	short tons (2000lb)	T
<b><u>TEMPERATURE (exact)</u></b>					<b><u>TEMPERATURE (exact)</u></b>				
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celsius temperature	°C	°C	Celsius temperature	1.8C + 32	Fahrenheit temperature	°F
<b><u>ILLUMINATION</u></b>					<b><u>ILLUMINATION</u></b>				
fc	foot candles	10.76	lux	lx	lx	lux	0.0929	foot-candles	fc
fl	foot-Lamberts	3.426	candela/m <sup>2</sup>	cd/m <sup>2</sup>	cd/m <sup>2</sup>	candela/m <sup>2</sup>	0.2919	foot-Lamberts	fl
<b><u>FORCE AND PRESSURE OR STRESS</u></b>					<b><u>FORCE AND PRESSURE OR STRESS</u></b>				
lbf	poundforce	4.45	newtons	N	N	newtons	0.225	poundforce	lbf
lbf/in <sup>2</sup>	poundforce per square inch	6.89	kilopascals	kPa	kPa	kilopascals	0.145	poundforce per square inch	lbf/in <sup>2</sup>