



Yellow Signal Light Physics, Red-Light Cameras and Engineering Malpractice

ASCE NC Eastern Branch, Feb 15, 2024

Brian Ceccarelli, PE

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It is good to
Question your Assumptions



Syracuse, New York: Milton Ave and Tompkins St, Tipperary Hill³





$$Y = t_p + \frac{v}{2(a + Gg)}$$

Y = yellow change interval

t_p = perception reaction time of the 50th percentile passenger car driver for stopping in an emergency (as if a cow wandered onto the road)

v = approach speed (always 23 mph for left-turning vehicles regardless of speed limit)

a = stopping deceleration for 90th percentile passenger car drivers in an emergency situation

G = grade of road (uphill or downhill)



prior to
March 2020

$$Y = t_p + \frac{v}{2(a + Gg)}$$

Y = yellow change interval

t_p = perception reaction time of the 50th percentile passenger car driver for comfortable stopping (stopping for an expected event)

v = approach speed

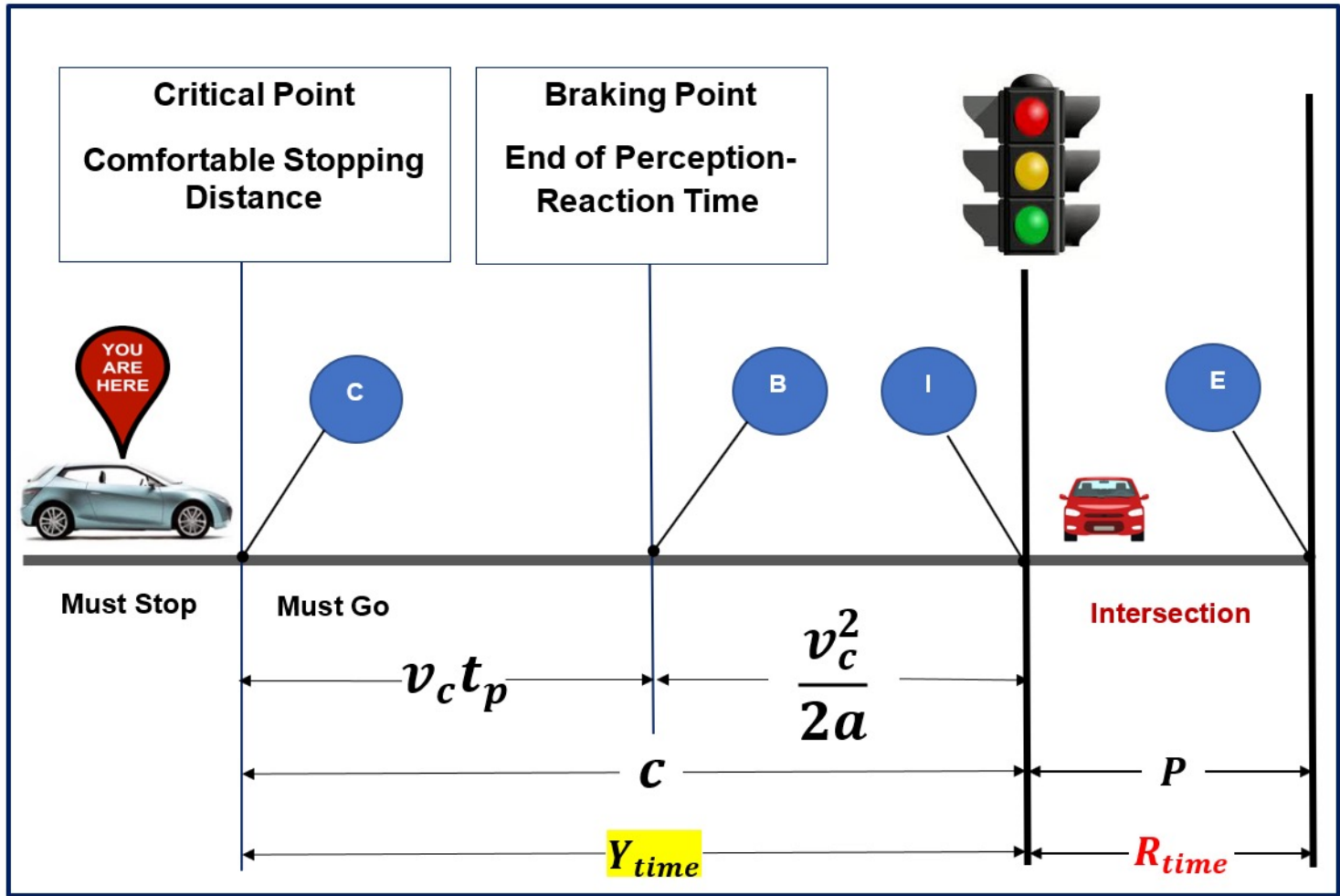
a = comfortable stopping deceleration for 50th percentile passenger car

G = grade of road (uphill or downhill)



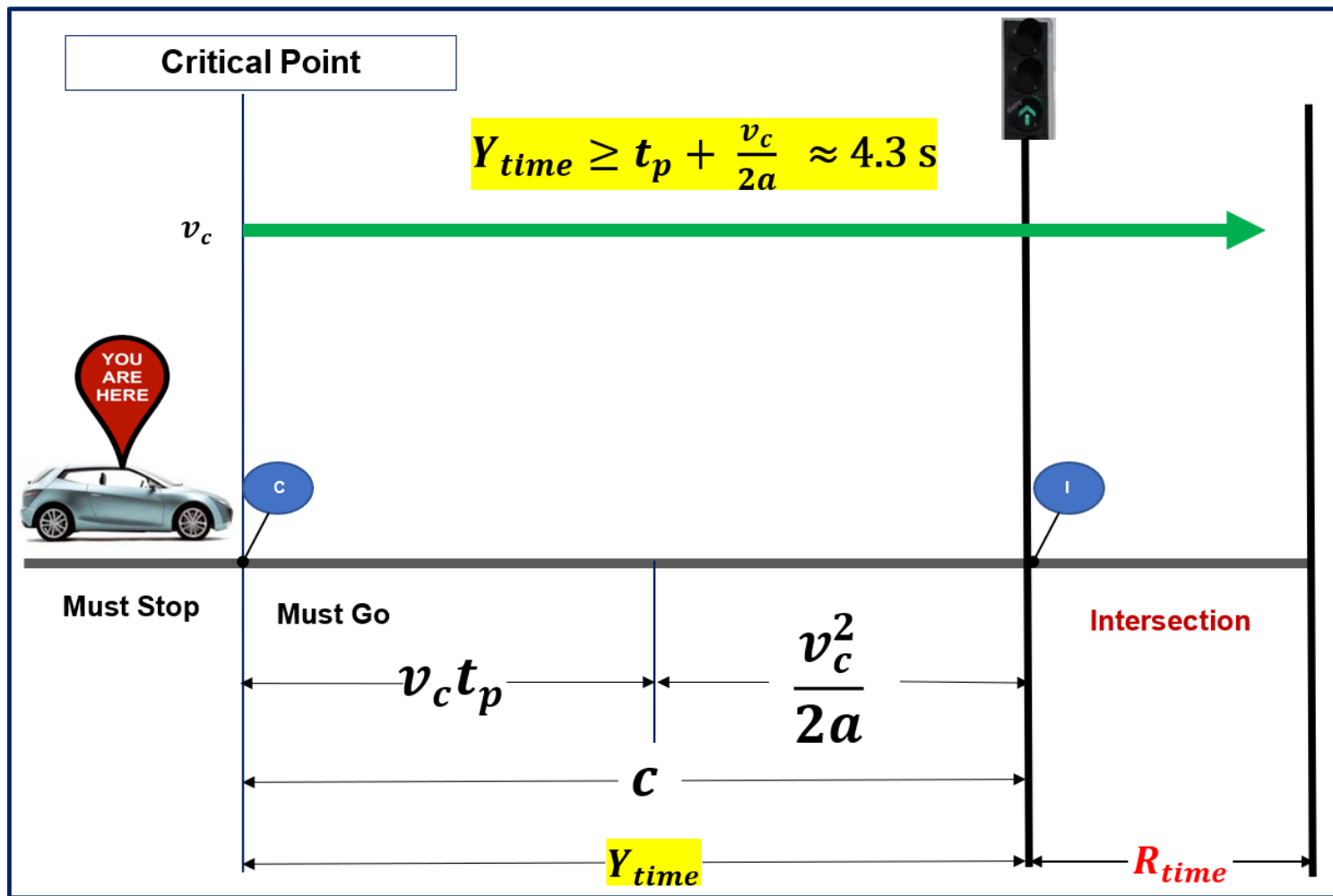








Driver Approaches and Continues at Constant Speed Velocity Profile





MARCH 2020

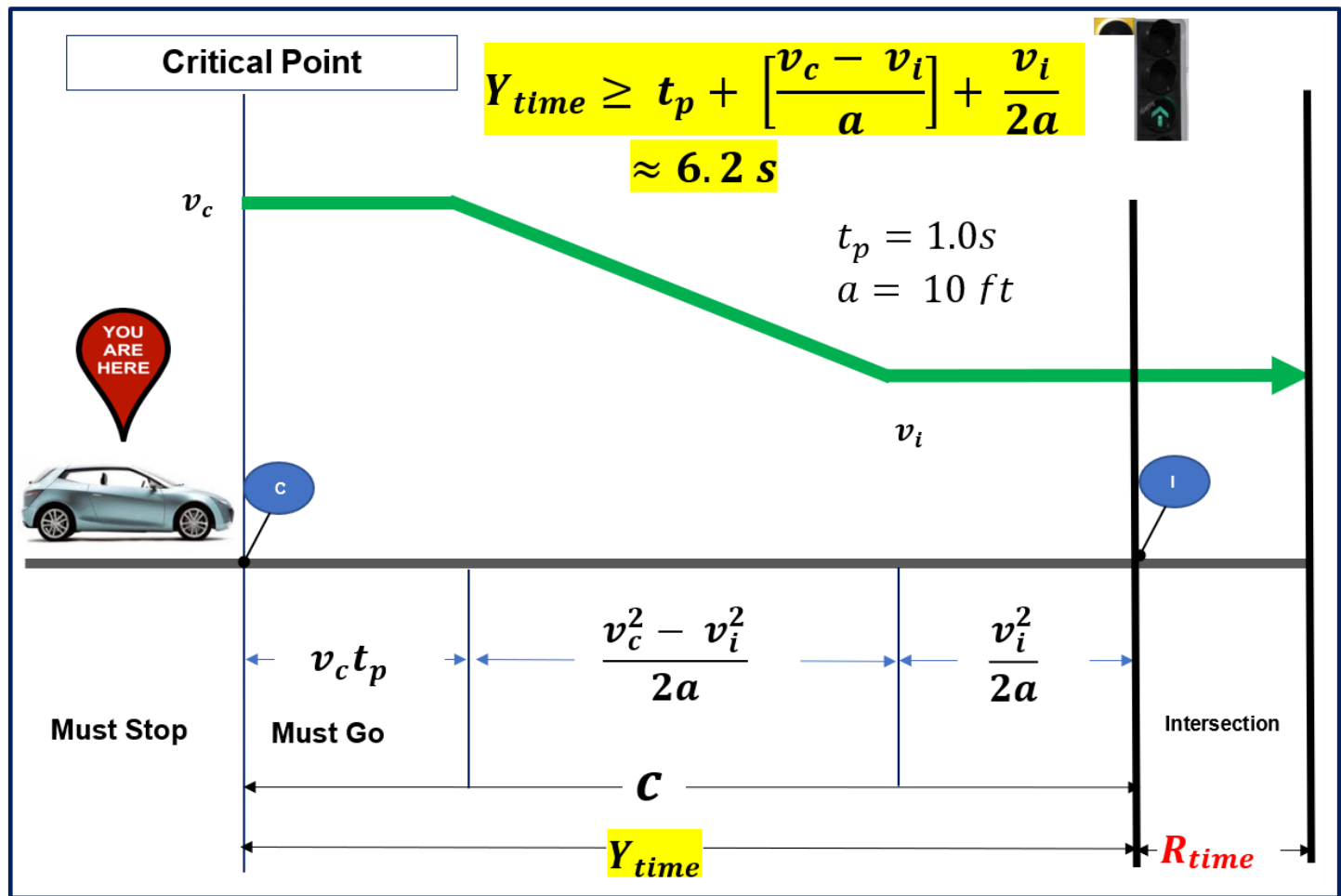
Guidelines for Determining Traffic Signal Change and Clearance Intervals

A Recommended Practice
of the Institute of
Transportation Engineers





New ITE Practice Includes Left-Turning Drivers
Velocity Profile - Måts Jarlström



$$Y = t_p + \frac{v_0 - v_e}{a + G} + \frac{v_e}{2(a + Gg)}$$

Y = yellow change interval

t_p = perception reaction time of the 50th percentile passenger car driver for comfortable stopping (stopping for an expected event)

v_0 = approach speed (the faster of speed limit or 85th percentile speed)

v_e = speed vehicle enters intersection

a = comfortable stopping deceleration for 50th percentile passenger car

G = grade of road (uphill or downhill)



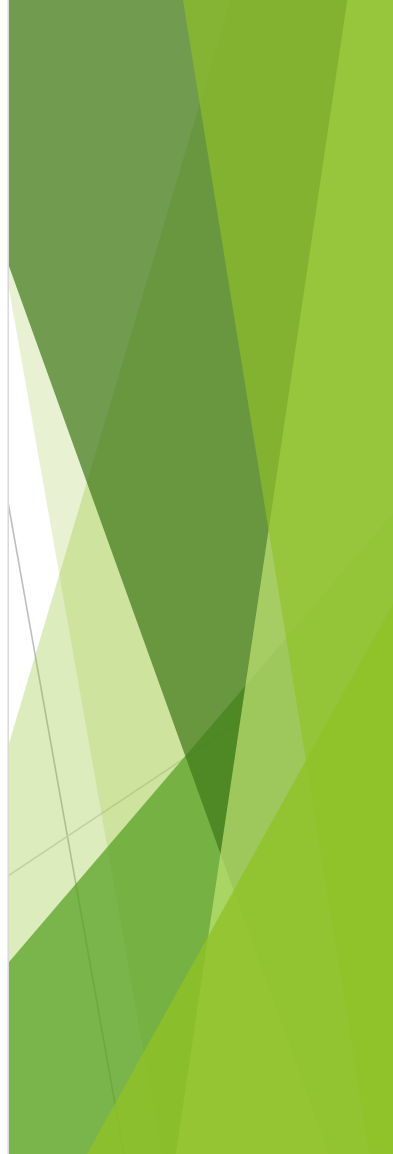
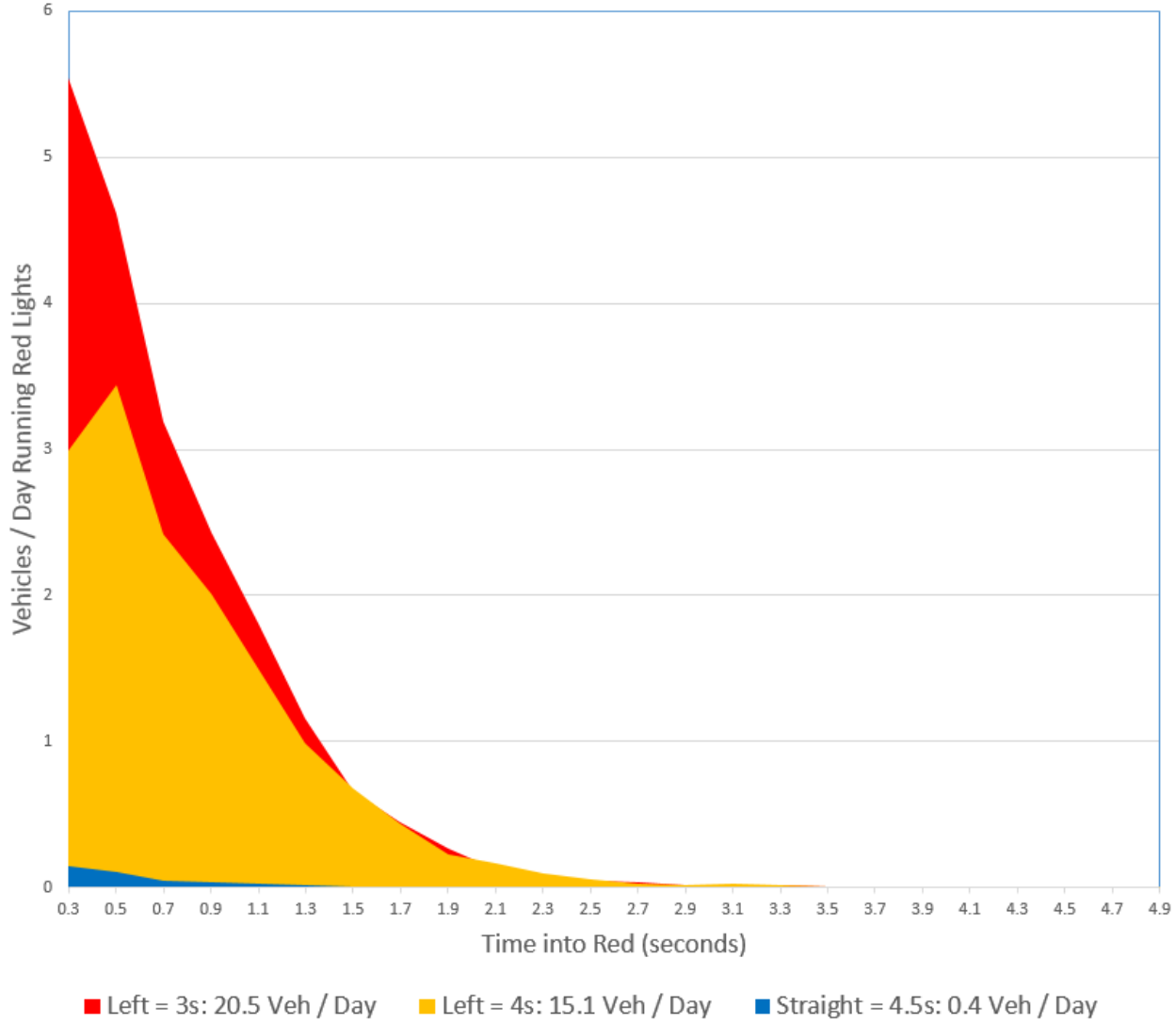
King Canute said, “I command the tides to halt.”

“Let all men know how empty and worthless is the power of kings, for there is none worthy of the name, but He whom heaven, earth and sea obey by eternal laws.” He then hung his gold crown on a crucifix, and never wore it again to the honor of God the almighty King.





Walnut (SB) at Meeting Place. Comparing Lefts and Straights





SafeLight Raleigh

SafeLight Raleigh
P.O. Box 28448
Raleigh, NC 27611-8448



Mail Date: 09/20/2012

Citation Number: S1202488477
Vehicle Tag: NZY4491 NC

Name & Address of Registered Owner

JOHN BRUCE BAIRD
5737 BEARGRASS LN
RALEIGH, NC 276165765

Total Due by: 10/20/2012	\$50
Total Due After: 10/20/2012	\$100
Amount Enclosed	\$

Detach and return this portion with your payment.

Write the citation number and license plate number on your check or money order.

SafeLight Raleigh

NOTICE OF CITATION

You can view full color versions of the violation images at:
<http://www.public.cite-web.com>

Mail Date: 09/20/2012

Citation Number: S1202488477
Pin Number: 265882708

Total Due	\$50
Due Date	10/20/2012

Violation Location: Capital @ New Hope Church - NB
Violation Date: 09/11/2012
Violation Time: 5:57 PM

Photo 1

On 09/11/2012 at 5:57 PM your vehicle license plate NZY4491 NC was photographed (images shown below) driving through an intersection in which the traffic signal was red, in violation of Raleigh City Code, Section 11-2135. At the time of the violation, your vehicle was traveling at 48 MPH. No points will be assessed against your driving record or insurance as a result of this violation. See the violation data below the plate image for more information on this violation.

If payment in full is not received by the due date listed above, a late penalty of \$50.00 will be added to the total amount due.

Plate



Photo 2



Lane: 4	Vehicle Speed: 48
Delay: 0.3	Interval: 0.55
Photo 1, red seconds: 1.87	Photo 2, red seconds: 2.43
Photo 1, yellow seconds: 4.30	Photo 2, yellow seconds: 4.30





Paul Stam, Esq.
North Carolina



Dave Raimondo,
Esq.
New York



- Greenville, NC
- Fayetteville, NC
- Wilmington, NC
- Suffolk County, NY



Funding Issues

NC

Constitution IX, Section 7

- ... clear proceeds of all penalties and forfeitures ... shall remain in the several counties and shall be faithfully appropriated and used exclusively for maintaining the public schools.

NC

GS 115-437

- Clear proceeds must be at least 90% of the gross penal fines.

NY

VAT Title 7, Article 24 Sec 1111b

- Maximum liability to vehicle owner is \$50.



Engineering Malpractice Issues

NC

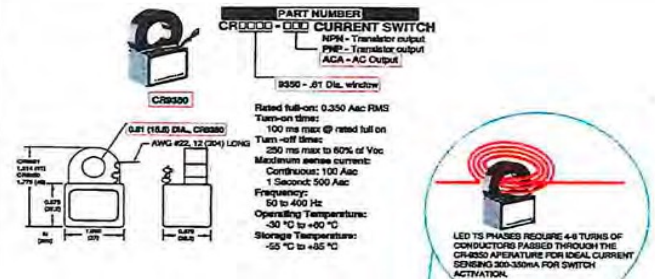
89C-3(6)

- A practice of engineering...is an application of the mathematical and physical sciences.
- 23 CFR 655 -> MUTCD 4D.26(03) as a **standard**, require the yellow change interval to be determine by engineering practices.

NC

89C-23

- NCBELS rules red-light camera installation plans are engineering works.
- NCBELS rules that American Traffic Solutions is practicing engineering without a license.
- NCBELS rules Robert Rennebaum rubberstamped Greenville plans. NCBELS suspends Rennebaum's license.



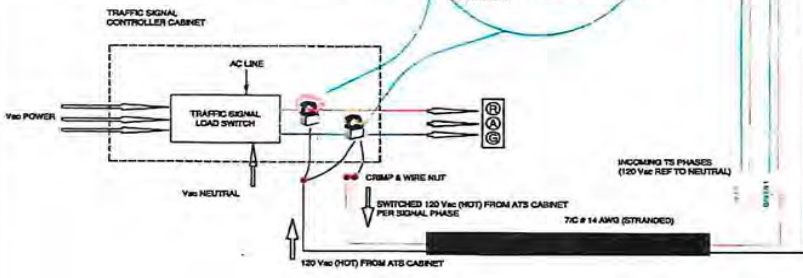
PART NUMBER
CR9350 - CURRENT SWITCH

NP4 - Transistor output
 PNP - Transistor output
 ACA - AC Output

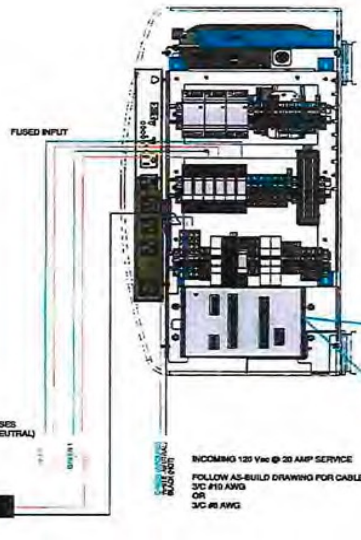
0.050 - .01 Dia. window

CR9350

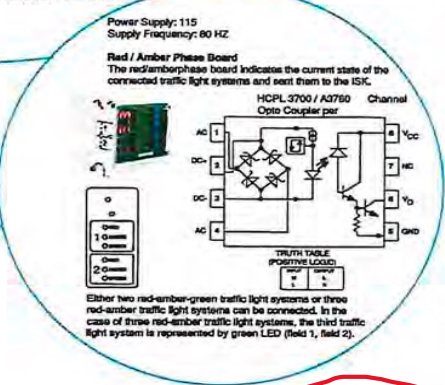
Rated full-on: 0.350 Aac RMS
 Turn-on time: 100 ms max @ rated full on
 Turn-off time: 250 ms max to 60% of Vcc
 Maximum sense current: Continuous: 100 Aac
 1 Second: 500 Aac
 Frequency: 50 to 400 Hz
 Operating Temperature: -30 °C to +60 °C
 Storage Temperature: -55 °C to +85 °C



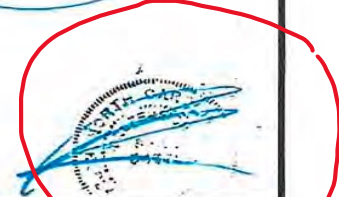
DETAIL "B"
PHASE INPUT WITH ISOLATION DETAIL
 CR-9350: 120 Vac SWITCHED



NOTE: INTERNAL OPO-ISOLATION AS REQUIRED PER PHASE CHANNEL



DETAIL "A"
RED AND AMBER PHASE CONNECTION DETAIL

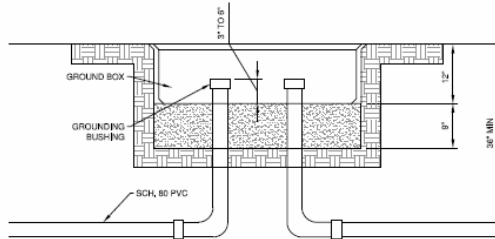


<p>1180 N. ALMA SCHOOL ROAD MESA, AZ 85201 USA TEL: (480) 443-7000 FAX: (480) 907-0801 WWW.ATSCOL.COM</p>	PHASE DETECTION DETAIL E. FIRE TOWER RD AT E. ARLINGTON BLVD / COUNTY HOME RD GREENVILLE, NC			DESIGNED BY: AT5 DATE: 10-28-14 APPROVED BY: APPROVAL DATE:	JOB NUMBER 1487 SITE NO. 200A_GEST10	SHEET NUMBER 4 OF 11 SHEETS
	RED LIGHT PHOTO ENFORCEMENT PROGRAM	REV. BY DATE REVISION 01 3009 7-14-17 PER CITY / DOT COMMENTS 02 3009 7-28-17 PER CITY / DOT COMMENTS	REV. BY DATE REVISION	DESIGNED BY: AT5 DATE: 10-28-14 APPROVED BY: APPROVAL DATE:	JOB NUMBER 1487 SITE NO. 200A_GEST10	SHEET NUMBER 4 OF 11 SHEETS

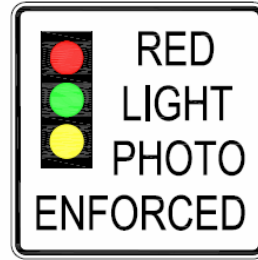


GENERAL & CONSTRUCTION NOTES

- SEPARATE RIGHT-OF-WAY PERMITS ARE REQUIRED FOR WORK WITHIN PUBLIC AGENCY RIGHT-OF-WAY. CONTRACTOR SHALL BE RESPONSIBLE FOR SUBMITTING APPLICATION PERMITS & FEES, AND COMPLY WITH ALL PUBLIC REQUIREMENTS.
- UTILITY LOCATIONS SHOWN ON PLANS ARE APPROXIMATE BASED ON AVAILABLE INFORMATION. CONTRACTOR SHALL BE RESPONSIBLE TO CONTACT DESIGNATED AGENCY TO LOCATE ALL UNDERGROUND UTILITIES 48 HOURS PRIOR TO COMMENCEMENT OF CONSTRUCTION.
- CONTRACTOR SHALL BE RESPONSIBLE TO APPLY AND OBTAIN AN APPROVED TRAFFIC CONTROL PLAN IN ACCORDANCE WITH MUTCD AND LOCAL STANDARDS AS REQUIRED.
- CONTRACTOR SHALL BE RESPONSIBLE TO RESTORE ALL DISTURBED AREAS TO ORIGINAL CONDITION TO AGENCY SATISFACTION AT NO ADDITIONAL COMPENSATION.
- CONTRACTOR SHALL TERMINATE ALL POWER CIRCUITS INTO ATS CABINET.
- INSTALL IN-LINE 30 AMP FUSE INSIDE HAND HOLE ON ATS CAMERA POLES.
- INSTALL FOUNDATION POLE AND GROUNDING WIRE FOR ATS EQUIPMENT. SEE LOCATIONS IN DRAWINGS AND POLE FOUNDATION DETAIL.
- INSTALL PULL-JUNCTION BOX OF THE REQUIRED SIZE AND TYPE PER LOCAL AGENCY STANDARDS.
- SCHEDULE 80 PVC CONDUIT TO BE BORED UNDER ROADWAY - 36" COVER MINIMUM. SEE SIZES AND LOCATION IN DRAWINGS.
- CONTRACTOR SHALL CALL NCDOT AND CITY TRAFFIC SIGNAL SUPERVISOR AT LEAST 72 HOURS IN ADVANCE TO COORDINATE THE POWER DROP INTO THE AGENCIES METER PEDESTAL.
- THE CONTRACTOR SHALL HAVE A LEVEL II (MSA CERTIFIED TECHNICIAN/ ELECTRICIAN ON-SITE AT ALL TIMES DURING CONSTRUCTION. CONDUCTOR SPLICES AND TERMINATIONS SHALL BE MADE BY A QUALIFIED JOURNEYMAN ELECTRICIAN WHO HAS SUCCESSFULLY COMPLETED A RECOGNIZED FOUR (4) YEAR APPRENTICESHIP PROGRAM UNDER THE DIRECT SUPERVISION OF A JOURNEYMAN ELECTRICIAN.
- TERMINATE RED & YELLOW PHASE WIRES TO AGENCIES RED & YELLOW PHASE CONDUCTORS IN THE NEAREST TRAFFIC CONTROLLER CABINET. SEE CONDUCTOR RED & YELLOW PHASE CONNECTION DETAIL. CONTRACTOR SHALL CONTACT NCDOT AND THE CITY TRAFFIC SIGNAL SUPERVISOR AND CITY POLICE DEPARTMENT FOR ON-SITE ASSISTANCE WITH RED & YELLOW PHASE ISOLATION CONNECTION. ALLOW 24 HOURS ADVANCE NOTICE BEFORE CONNECTION.
- WILMINGTON SHALL PROVIDE AND INSTALL "PHOTO ENFORCED" SIGN (S) IN ACCORDANCE WITH MUTCD, AND AS PER NORTH CAROLINA CONSTRUCTION & TRAFFIC STANDARD DETAILS.
- CONTRACTOR SHALL TRIM EXISTING TREES TO IMPROVE LINE OF SIGHT NEEDED. CONTRACTOR SHALL NOTIFY THE AGENCIES AND OBTAIN APPROVAL PRIOR TO TRIMMING.
- AT LOCATIONS WHERE EXISTING ENFORCEMENT EQUIPMENT MAY EXIST, CONTRACTOR SHALL COORDINATE WITH THE OWNER AND ATS PROJECT MANAGER FOR REMOVAL & SALVAGE.
- CONTRACTOR SHALL COORDINATE WITH NCDOT AND CITY TRAFFIC SIGNAL SUPERVISOR AND LAW ENFORCEMENT TO HAVE AN OFFICER PRESENT WHEN TRAFFIC SIGNAL POWER IS TURNED OFF FOR CONNECTION TO POWER PEDESTAL.
- CONNECT POLE TO SOLID BARE BOND GROUND & GROUNDING ROD (OR COIL 25' OF NO. 6 BARE COPPER) IN POLE FOUNDATION & TO SYSTEM GROUND BONDED BACK TO ATS CABINET.
- CONTRACTOR SHALL PLACE THE POLES / FOUNDATIONS IN A LOCATION TO MAINTAIN A 5' CLEAR SPACE FROM THE OVERHEAD POWER LINES.
- CONTRACTOR TO LABEL EACH END OF ALL CABLE RUNS.
- CONTRACTOR TO INSTALL AND LEAVE IN PLACE NYLON DRAW STRING IN ALL CONDUIT RUNS.



**DETAIL "A"
TYPICAL JUNCTION BOX DETAIL**

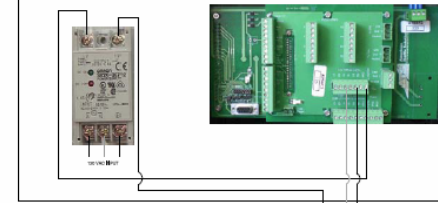


**DETAIL "B"
PROPOSED SIGN TO BE INSTALLED BY WILMINGTON**

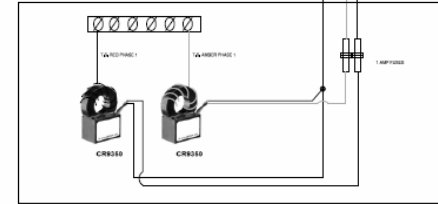
ATS PANEL SCHEDULE

MANUFACTURE - SQUARE OR EQUAL		12 CIRCUIT, 100 AMP RATING				SINGLE PHASE, 120/240V									
22 KAC		70 MAIN BREAKER				LOCATION - METER PEDESTAL									
LOAD	CONDUIT	WIRE	TRIP	1P/2P	VOLTS	DESCRIPTION	CKT	CKT	DESCRIPTION	VOLTS	1P/2P	TRIP	WIRE	CONDUIT	LOAD
			30A	2P		SURGE ARRESTOR	1	2	EXISTING RLC	120	1P	30A	#10	2"	2135
						SPACE	3	4	SPACE						
						SPACE	5	6	RLC	120	1P	30A	#10	2"	2135
						SPACE	7	8	SPACE						
						SPACE	9	10	SPACE						
						SPACE	11	12	SPACE						
TOTAL LOAD: 2135 WATTS								TOTAL AMPS: 30 AMPS (PER RLC)							

ATS CABINET



T.S. CABINET



CR MAGNETICS; MODEL NUMBER CR 9350-ACA-035
THESE MODULES ARE CURRENT SWITCHES THAT ARE 100% NON INVASIVE. THEY ARE CONFIGURED NORMALLY OPEN AND ENABLED WHEN THE PHASE CURRENT PASSED THROUGH THE OPENING IS AT OR EXCEEDS 350 MILLI AMPS.

WHEN THE MODULE IS ACTIVATED, +12VDC IS PASSED BACK TO THE PHASE INPUTS OF THE ATS UNIT.

FROM THE RLC POLE, RUN 3 CONDUCTORS TO THE TRAFFIC CONTROLLER CABINET.

- 1) +12 VDC
- 2) RED PHASE INPUT
- 3) AMBER PHASE INPUT
- 4) 1 AMP IN-LINE FUSES

**DETAIL "C"
CR 9350 MAGNETIC MODULE WIRING DETAIL**



1150 N. ALMA SCHOOL RD
MESA, AZ 85201 USA
TEL: (480) 438-7000 FAX: (480) 937-4204
WWW.ATSOL.COM

ATS STANDARD DETAILS
US 76 / DAWSON ST AT 3RD ST
WILMINGTON, NC

NO.	BY	DATE	REVISION	NO.	BY	DATE	REVISION

1ST SUBMITTAL
DESIGNED BY: JB
DATE: 11/09/15
APPROVED BY:
APPROVAL DATE:

JOB NUMBER
1259
SITE ID(S)
WB17

SHEET NUMBER
3
OF 5 SHEETS



GENERAL CONSTRUCTION NOTES:

INSTALLATION AND CONSTRUCTION SHALL CONFORM TO THE STATE DEPARTMENT OF TRANSPORTATION STANDARDS SPECIFICATIONS SECTIONS APPLICABLE AND STANDARD PLANS DATED AND EFFECTIVE FOR THE CURRENT YEAR AND ANY SPECIAL MUNICIPALITY CODE PROVISIONS.

PHASING DIAGRAM

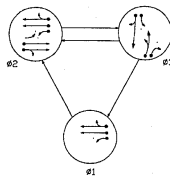
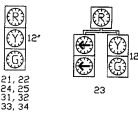


TABLE OF OPERATION table with columns for SIGNAL FACE and PHASE (L, A, R, G, Y).

SIGNAL FACE I.D.

Denotes L.E.D.



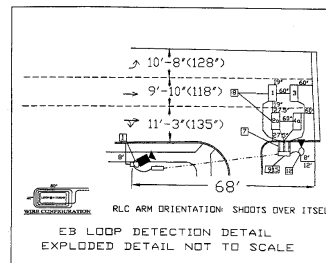
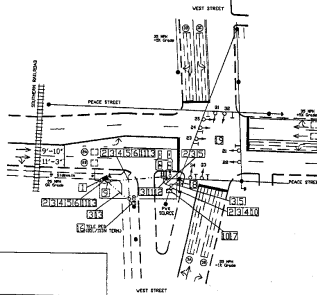
PROJECT REFERENCE NO. SHEET NO. 3 Phase Fully Actuated (Raleigh City Signal System)

LEGEND

- VIDEO DETECTION CAMERA
RLC POLE ASSEMBLY
AUXILIARY FLASH ASSEMBLY
NO. 5 PULLBOX
POWER PEDESTAL

PHASING DIAGRAM DETECTION LEGEND

- PULSE DETECTION
DETECTED MOVEMENT
UNDETECTED MOVEMENT (OVERLAP)
UNDETECTED MOVEMENT
PEDESTRIAN MOVEMENT



CONSTRUCTION LEGEND

- 1. AGE TO PROVIDE POLE CAMERA UNIT...
2. INSTALL 2" PVC CONDUIT PER CITY SPECIFICATIONS...
3. CONNECT A WIRE CONDUIT TO CONTROLLER...
4. INSTALL 1/2" CONDUIT # 14 SHIELDED CABLE FOR 120 VAC...
5. INSTALL 1/2" CONDUIT # 14 SHIELDED CABLE FOR 120 VAC...
6. INSTALL 1/2" CONDUIT # 14 SHIELDED CABLE WITH 120V WIRE...
7. INSTALL LEAD WIRE OUT TO PULL BOX...
8. INSTALL 4" LOOP DETECTOR AREA 24" x 12" IN WAVE CARLING...
9. INSTALL NEW PULL BOX...
10. INSTALL 1/2" INCH FUSE HOLDERS RATED AT 20 AMPS FOR PHASE...
11. INSTALL 1/2" INCH FUSE HOLDERS RATED AT 20 AMPS FOR PHASE...
12. INSTALL 1/2" INCH FUSE HOLDERS RATED AT 20 AMPS FOR PHASE...
13. INSTALL 1/2" INCH FUSE HOLDERS RATED AT 20 AMPS FOR PHASE...
14. SUB CONTRACTOR SHALL BE RESPONSIBLE FOR SUPPLYING AND INSTALLING...
15. PULSE & CYCLE LOOP DETECTOR LEAD INS TO RLC CABLES...
16. TELEPHONE ISM TERMINATIONS...
17. INSTALL POWER PEDESTAL TO NOT SPECIFICATION POWER...
18. INSTALL ON 800V MAGNETIC ARRESTOR AT STREET CORNER...
19. UPGRADE ALL SIGNAL HEADS TO L.E.D. INDICATING

- TRAFFIC SIGNAL HEAD
MODIFIED SIGNAL HEAD
SIGN
PEDESTRIAN SIGNAL HEAD WITH PUSH BUTTON & SIGN
SIGNAL POLE WITH SLIDING GUY
INDUCTIVE LOOP DETECTOR CONTROLLER & CABINET
JUNCTION BOX
2-IN UNDERGROUND CONDUIT
RIGHT OF WAY WITH MARKER
DIRECTIONAL ARROW
POVEMENT MARKING ARROW
LEFT ARROW 'ONLY' SIGN (R3-5L)
RIGHT ARROW 'ONLY' SIGN (R3-5R)
NO TURN ON RED SIGN (R3-11)

TIMING CHART table with columns for PHASE, MINIMUM GREEN, PASSAGE GAP, YELLOW CHANGE INT., MAX. I., MAX. R., and RETAIL POSITION.

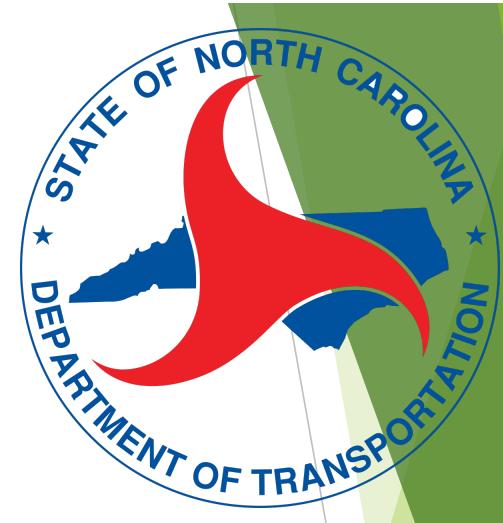
LOOP & DETECTOR UNIT INSTALLATION CHART table with columns for LOOP NO., SIZE (FT), TURNS, DETECTOR UNITS, and PHASE.

AGS STATE AND LOCAL SOLUTION PUBLIC SAFETY SOLUTIONS

Signal Upgrade Proposed in the Offices of...



Form with fields for DIVISION, FILE NO., REVIEWED BY, DATE, and other project details.



Jefferson Griffin



Deanne Mazzochi



Kevin Lacy



“The problem wasn’t that the board disagreed with Ceccarelli - We aren’t rejecting what he said at all”, Ritter said - but that it was outside the board’s authority.

“We went to the USDOT with this. They said, ‘This is the formula we tell every engineer in the United States to use.’ Ritter said. “So if the engineer is applying the formula that is the industry standard, as they were taught, then that is not a violation.

“If Ceccarelli’s claim -that math misapplied by engineers causes unduly short yellow lights, leading directly to traffic accidents, injuries and deaths - was proven unequivocally true, then NCBELS would not act.”



Yellow Signal Light Physics, Red-Light Cameras and Engineering Malpractice

ASCE NC Eastern Branch, Feb 15, 2024

Brian Ceccarelli, PE

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