PILOT PROJECT

PIEZO-ELECTRIC
AUTOMATIC VEHICLE CLASSIFICATION
SYSTEM

OREGON DEPARTMENT OF TRANSPORTATION WITH
CASTLE ROCK CONSULTANTS FOR A
SHRP LONG TERM PAVEMENT PERFORMANCE SITE

by

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INTRODUCTION:

Oregon has 12 sites that are part of the SHRP LTPP program. Part of the data gathering on these sites involves vehicle weight and classification. This pilot project was to show SHRP how to specify, procure and install equipment that would provide the necessary data to characterize the sites for the LTPP program.

Castle Rock Consultants (CRC) were to provide specifications and technical aid on this project. After the project was completed CRC produced a paper for SHRP titled "Piezo-Electric Based Automatic Vehicle Classifier Pilot Project," December 1989. The purpose of this report is to complement the CRC report and discuss the project from Oregon's perspective.

This project, an installation in asphalt concrete, is the first of two pilot projects planned by Oregon. The second pilot project, in Portland Cement Concrete, will be installed in the spring of 1990.

SPECIFICATIONS:

The generic specifications supplied by CRC for Oregon's use were modified to produce a procurement specification that directly addressed this project. The CRC specification covered Automatic Vehicle Classification (AVC) and Weigh In Motion (WIM) as well as materials and installation. The specifications for this project (Appendix 1) covered only materials for use on an AVC site.

The installation requirements in the CRC specification were the general guidelines used for the state-forces installation. Specifications for installation on future projects will be based on what is learned on the pilot projects and be written by Oregon.

THE SITE:

This site, on I-84, Eastbound, at MP 75.95, is near an ATR site located MP 75.93. The intent was to combine the ATR and AVC equipment in a single housing. This permits sharing of utilities and simplifies data collection and comparison.

The negative feature associated with the site was the roadway ruts which were sufficiently deep to cause problems with sensor installation. Since there were no other nearby sites in any better condition, a 100 foot section of the roadway was repaired. The repair consisted of grinding out a 2 inches deep, 12 feet wide slot and filling it with new asphalt concrete.

During the roadway repair, a concrete pad was poured for the instrument cabinet foundation. The instrument cabinet, a re-fitted signal cabinet, was installed and the electricity brought in. Also, all underground conduit was placed so everything would be ready when the piezo-electric sensor was installed.

EPOXY FOR SENSOR INSTALLATION:

Previous experience with sensor installation showed that the epoxy used for sensor installation could be improved. The general properties required were:

- The exotherm of the epoxy needed to be relatively low so no sensor damage would occur. Also, it is not desirable to have steam generated from the moisture inherent to open graded asphalt concrete.
- The epoxy should be moisture insensitive.
- Asphalt concrete is a flexible material, so the epoxy should be flexible enough to move with the asphaltic concrete.
- The epoxy should be thixotropic. (3.5% Cabosil was added to the epoxy for body. This resulted in a material that was a little too stiff. For future work use 2.5%.)

Since installation took place in November, two hardeners (Part B), for cool and cold temperature conditions, were on hand. The prevailing weather conditions dictated selection of the hardener.

Packaging is important. One gallon of Part A was in a two gallon container. One quart containers of Part B, the amount required to catalyze one gallon of part A, were in separate containers. The extra space in the Part A container left room for easy mixing and extra volume for Ottawa sand. Addition of Ottawa sand offers extended control of the exotherm.

Material conforming to the above requirements is now available as RP - 12 from Revalon Systems, San Jose, California.

SENSORS:

The original specifications called for 12 foot, class 2, cable sensors. This type of sensor is adequate for AVC but not suitable for WIM. While the project was underway, film sensor technology became available. Two - six foot film sensors were obtained so film and cable technology will be evaluated on a side by side basis. The films are grade 1 devices so the site can be used for AVC and/or WIM.

FIELD INSTALLATION:

MARKING OUT

The sensors must be parallel and perpendicular to traffic. Typical spacing of the sensors, in a two sensor configuration, is eight feet. A simplified layout procedure is a follows:

1. Measure an eight foot length along the edge of the pavement, parallel to the traffic. Mark the end points.
2. From each endpoint swing a six foot arc nearly perpendicular to the eight foot base.
3. Swing a ten foot arc, from each end of the base, that intersects the opposite six foot arc.

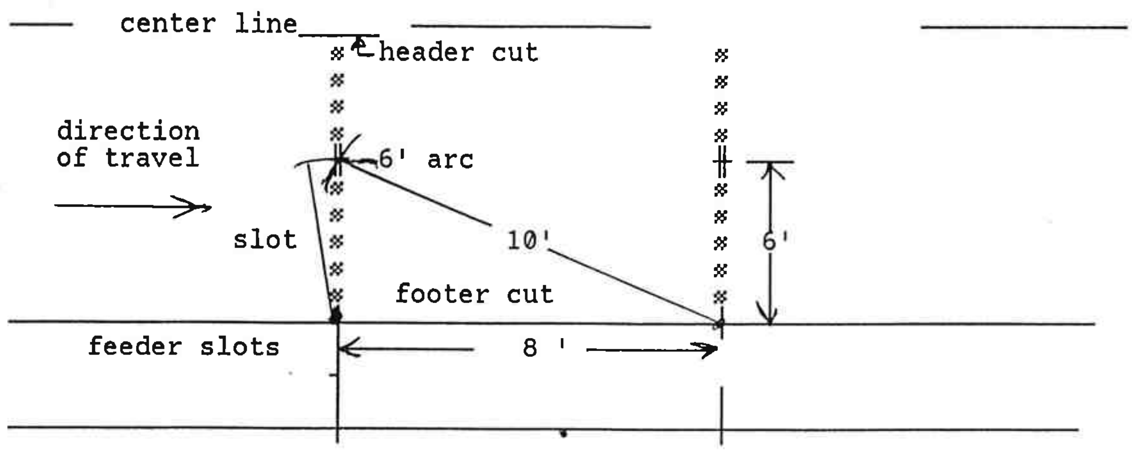
The endpoints and the arc intersections satisfy the parallel and perpendicular requirements for the sensors. Finish the layout using these points as references. (see Figure 1)

SLOT PREPARATION

It was difficult to maintain on-line cuts. This was due in part to the saw's wheels transition from the shoulder area to the roadway area. Also, the operator cannot see the position of the blade since the saw is a center mount design. Some re-cutting was required.

Re-cutting means that extra epoxy is needed to fill the voids between the sensors and pavement. This results in wasted materials and areas where the exotherm[1] is significantly higher than in other areas.

A "header" and "footer" cut about 1/2 inch from the ends of the sensors will save material and give better control of the exotherm.



Slot Cutting Layout
Figure 1

A cutting guide for the saw should be developed to eliminate re-cutting. Part of the design for the guide could include a method of elevating one side of the saw. The slot could be cut slightly wedge-shaped with a wider bottom. This would give the finished installation much greater resistance to pull-out or pop-out.

SENSOR INSTALLATION

During the slot preparation the epoxy was kept in a vehicle that had the heater set to maintain an interior temperature of about 90° F. The epoxy, at the time of mixing, was approximately 80° F. This is the ideal mixing and placement temperature for epoxies.

1 The exotherm generated when an epoxy sets is a function of the total reacting mass. Detrimentally high temperatures may occur in large mass areas.

The metal holders that suspend the sensors in the slots were 1/8 inch by 1 inch steel bar stock about 6 inches long. The holders were wired perpendicular to the sensors and then weighted so the sensors would conform to the roadway surface. Reusable holders with much more weight would be desirable. Also, the means of fastening the sensors to the holder needs improvement.

Before placement of the epoxy, the slots were heated and dried with propane heaters. In spite of the heat, one of the slots had free standing water.

The first step in placing the epoxy is to "butter" the slots with neat catalyzed resin. The free water in the wet slot was absorbed with paper towels, a marginally effective procedure. Blowing out the slot with dry compressed air immediately ahead of the buttering process may be more effective.

The epoxy used to place the first sensor had a higher than desirable exotherm. For the rest of the sensors, Ottawa sand was added to the epoxy to reduce the exotherm. (about two thirds the bulk volume of sand to one volume of the neat epoxy).

A test slot could be used to determine the need for Ottawa sand.

After the epoxy had hardened, a small grinder was used to make the surface of the epoxy match the roadway. For future operations two large style grinders, with spare discs, should be available.

VEHICLE CLASSIFICATION:

Part of CRC's responsibility was to determine the accuracy of the classifier. This was done by taking a visual classification of ~ 1000 vehicles and comparing the results with the classifier. The results were well below the specification requirement of 90% (61% & 68%). Examination of the Oregon algorithms and the raw data showed that the problems were due to the Oregon supplied algorithms. Analysis of the raw data resulted in several changes to the algorithms. The new algorithm table is in Appendix 2. The new table will be tested by comparing the results from the classifier with manual classification from video tape. This is scheduled for the spring of 1990.

SAMPLING:

Analysis of the raw data identified a problem inherent to AVC and WIM. The volume of data gets so large, so fast, it becomes overwhelming. Examination of the data identified a technique to reduce the volume of data without significant loss of information. A method of reducing the volume by about 85% is in Appendix 3.

WIM:

The major purpose for collecting WIM data is for calculating ESAL values. WIM data has a larger standard deviation than static data. This results in overestimated ESAL values. This problem was investigated and the basis for a solution is in Appendix 4.

APPENDIX 1

SPECIFICATIONS FOR AVC EQUIPMENT

1. General Requirements

1.1 These specifications cover the supply of piezo-electric automatic vehicle classification (AVC) systems. The terms "AVC," "equipment," and "systems" mean piezo-electric cable or piezo-electric film AVC systems, including all sensors, electronics, interconnections and software.

1.2 The operation of systems supplied under this specification shall be compatible with the requirements of the Strategic Highway Research Program (SHRP).

1.3 Three (3) sets of operator's manuals for each AVC unit shall be submitted with the equipment.

1.4 One (1) maintenance manual shall accompany each unit when delivered. Maintenance manuals shall include schematics, circuit diagrams, parts lists, parts price list, parts lists with cross-reference of all components by manufacturers, and instructions suitable for state technicians to perform services and repairs.

1.5 All software used with the AVC systems shall be clearly documented and provided at no additional cost. Software shall include source code. A software manual, including documentation, shall be provided for each AVC system.

1.6 Any proposed software licensing agreements required by the equipment supplier shall be submitted as part of the bid.

1.7 Acceptance testing of the equipment will be for a minimum of thirty (30) consecutive days of continuous operation.

1.8 If the equipment does not operate according to the specifications during the acceptance testing period, the State will have the option of returning the equipment at vendor's cost.

1.9 The vendor shall provide training for State personnel in operation, maintenance, trouble-shooting, and repairs for the equipment. The bid shall include the vendor's proposed training schedule.

2. Configuration

2.1 The proposed system will be of the type shown in figure 1.

3. Operating Environment

3.1 The system shall operate in through traffic lanes of interstate and principal highways covering the full range of traffic volumes and truck percentages.

3.2 The piezo sensors shall operate within specification when installed in asphalt concrete, segmented portland cement concrete, and continuously reinforced portland cement concrete pavements. Bidders shall supply independent verification of this fact.

3.3 The electronics shall meet specifications from a temperature of 0 to +160 degrees Fahrenheit, and up to 95 percent relative humidity. The systems shall be capable of withstanding temperatures in the range -40 to +160 Fahrenheit without permanent damage or deterioration.

4. Durability

4.1 The piezo sensors shall have an operating life of at lease one (1) year. Failure during that period will require replacement at the vendor's expense.

4.2 The electronics sub-system shall have an operating life of at least two (2) years. Failure during that period will require replacement at the vendor's expense.

5. In-Pavement Sensors

5.1 Piezo cables shall be manufactured by Thermocoax, or approved equal. The cables shall be mounted in accordance with the guidelines in Federal Highway Administration demonstration project FHWA-DP-88-76-006. Other piezo-based technology sensors will be considered. Other mountings may be considered, where the vendor can provide independent evidence of satisfactory operation.

5.2 Active cable length shall be 11'6" in 12' lanes.

5.3 Feeder cables shall be without joints.

5.4 Piezo cable mountings shall be permanently installed, flush with the pavement surface, using epoxy adhesive (Hermetite or similar) along the entire length of each sensor.

6. Data Input and Processing

6.1 The vehicle classification system shall be capable of monitoring signals from two piezo sensors per lane.

6.2 Charge amplifiers, with sealed connectors, shall be provided with time constants between 2 and 4 seconds.

6.3 The signal processing algorithm shall be certified to operate in accordance with a flow-chart supplied by the manufacturer. The flow chart shall indicate and quantify how noise suppression and axle detection is accomplished.

6.4 The vehicle classifier algorithm shall classify in accordance with 19 vehicle classifications used in Oregon's weigh-in-motion systems (see table 1). Additionally, the algorithm should be flexible and provide output in accordance with FHWA Scheme F (look-up table appended as table 2).

6.5 Provision shall be made for on-site input of all system operating parameters including data processing and system software.

6.6 Diagnostic checks of system operation and performance shall include, as a minimum, checks for low battery power, axle sensor failure, telemetry errors, and condition of module data.

7. Data Storage and Output

7.1 All data output shall be ASCII and RS232-C compatible. External data transmission rates shall include 300/1200 baud. Protocols and handshaking shall be provided for communication to external printers, terminals and IBM-compatible microcomputers. Output shall have "xon/xoff" type protocol.

7.2 An RS232-C port shall be provided for data output at the AVC site.

7.3 Individual vehicle data shall include vehicle number, time, lane, speed, class and axle spacings.

7.4 In the continuous mode of operation, individual vehicle data shall be stored in memory or output in real time.

7.5 In the selection mode, individual vehicle data shall be output or stored in memory for all trucks and buses, or for any selected vehicle class.

7.6 Data storage capacity shall be provided for at least 64K characters.

8. Data Retrieval System

8.1 Provision shall be made for portable data retrieval from the site. Take away memory, portable memory modules, downloading to a dedicated retrieval unit, downloading to a portable microcomputer, or a similar system shall be clearly defined and demonstrated by the manufacturer.

8.2 Whatever data retrieval system is utilized, the eventual data output shall be as specified in Section 7 above.

9. Power and Telemetry

9.1 The system shall be designed for low power consumption and continuous operation. It shall be capable of operating on 110-120 VAC, batteries and a solar panel. Where 110-120 VAC commercial power is utilized, battery back-up shall be provided for 48 hours of continuous operation during supply failures, brown-outs or other supply fluctuations.

9.2 Systems shall include a telemetry sub-system able to receive and transmit data via an auto-answer modem. Provision shall be made for error trapping and re-transmission of data.

9.3 All of the system input parameters shall be capable of being monitored and re-set via the telemetry sub-system.

10. Equipment Cabinet

10.1 Equipment will be housed in an unheated, uncooled, and unsealed roadside cabinet containing power mains, telephone connection, and other electronic equipment. The manufacturer shall provide a case and rack system for the equipment, capable of excluding dust and moisture and preventing accidental damage to components during routine maintenance.

11. Design Requirements

11.1 All electric components shall be of solid state design with high noise immunity utilizing low power, CMOS technology. Logic and data storage components shall be mounted on replaceable plug-in circuit boards. All components shall be firmly mounted and housed so that they will not be damaged by jolts and vibrations encountered in transportation and use. Electronic components shall be fully protected against overloads, power surges and transients.

11.2 Service and delivery of spare parts shall be assured.

12. Performance

12.1 The system shall be capable of a classification accuracy of 90 percent or greater, to allow for compensation or canceling between vehicle categories. This level of accuracy shall be achieved for all vehicle categories contained with the Oregon WIM system, considered either individually or in any combination, provided that the total number of vehicles surveyed in the group exceeds 100 during the period of the accuracy survey.

13. Delivery

13.1 All equipment and software shall be delivered by June 30, 1989.

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APPENDIX 2: VEHICLE CLASSIFICATION ALGORITHMS

LOOKUP TABLE FOR AVC
REVISED FEBRUARY 1990
OREGON 19 BIN

- **ESAL Equations**
- **L - Axle Load in KIPS**
- **Single = 1.239×10^{-5} $L^{3.905}$**
- **Dual = 1.623×10^{-6} $L^{3.865}$**
- **Tridem = 4.827×10^{-7} $L^{3.860}$**

All measurements are in feet.

Tandem axle spacing is up to and including 8 feet.
Tridem axle spacing is up to and including 12 feet.

Description	Class	Axles	Algorithm
Light Vehicles (Cars, Vans, Pickups)	1	2	(A1 - A2)<=12
Light Vehicles with Trailers	2	3 4	(A1 - A2)<=12, 8<(A2 - A3)<=18 (A1 - A2)<=12, (A2 - A3)>8, (A3 - A4)<8
Single Unit	3	2	12<(A1 - A2)<=20
Buses	4	2	(A1 - A2)>20
Single Unit	5	3	7<(A1 - A2)<=20, (A2 - A3)<=8
Combinations (2-S1)	6	3	Not Classed Elsewhere
Buses	7	3	(A1 - A2)>20, (A2 - A3)<=8
Combinations (2-S2, 2-2, 3-S1)	8	4	Not Classed Elsewhere
3-S1 Combination	9	4	(A1 - A2)>7, (A2 - A3)<=8, (A3 - A4)>6
Single Unit	10	4	(A1 - A2)>7, (A2 - A3) + (A3 - A4)<=12
3-S2 Semi	11	5	(A2 - A3)<=8, (A4 - A5)<10.5
2-S1-2 Twins	12	5	(A2 - A3)>=8, (A3 - A4)<=15, (A4 - A5)>8
Combinations	13	5	Not Classified Elsewhere
3-S1-2 Combination	14	6	(A2 - A3)<=8, (A3 - A4)>15, (A4 - A5)>15, (A5 - A6)>15
Combination	15	6	Not Classed Elsewhere
2-S1-2-2 Triples	16	7	(A2 - A3)>8, (A3 - A4)<=15, (A4 - A5)>8, (A5 - A6)<=15, (A6 - A7)>8
Combinations	17	7	Not Classed Elsewhere
Combinations	18	8	All
Combinations	19	9+	All

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APPENDIX 3

OREGON'S PROPOSED SAMPLING PLAN FOR AVC AND WIM SITES

One of the major problems in capturing axle weight data is the sheer number of records that must be dealt with. For example, a one week axle sampling at a site with an ADT of 10,000 results in 70,000 records that must be stored, handled and sorted. Table I, from the 1987 Traffic Volume Tables, is a recap of traffic trends at permanent recorder stations on the interstate system. If these sites were studied seasonally with WIM equipment capturing a weeks data on each site, the volume of data is staggering.

The purpose of this proposal is to show how the volume of data may be significantly reduced without loss of information.

Table I

ATR DATA ON OREGON INTERSTATE

VEHICLES % HEAVY	VEHICLES % LIGHT	ADT	LOCATION
45.5	54.5	5100	I-84, .5 mi S of Union-Baker county line
17.7	82.3	48700	I-5, .6 mi S of Baldoc Rest Area
14.5	85.8	48700	I-205, 1.3 mi E of I-5
28.3	71.7	14700	I-5, 4.9 mi N of Oakland junction
37.0	63.0	6900	I-84, 1.0 mi W of Oregon 74
21.9	78.1	21500	I-5, 2.0 mi W of Gold Hill
34.0	66.0	11600	I-5, 3.1 mi S of Ashland
18.3	81.7	22900	I-5, 3.2 mi N of Ashland
16.9	83.1	31400	I-5, S approach of Medford viaduct
66.1	33.9	14800	I-5, 5.7 mi N of Grants Pass
28.7	71.3	24200	I-5, 19 mi N of Eugene
31.6	68.4	9800	I-84, 0.8 mi W of Oregon-Idaho state line
46.0	54.0	5300	I-84, 1.5 mi S Baker Malheur County Line
25.3	74.7	18000	I-84, W end of Sandy River Bridge
8.2	91.8	91000	I-5, Interstate Bridge N of Portland
6.9	93.1	75300	I-405, Southerly Junction of I-5
8.8	91.2	101500	I-5, Terwilliger Blvd., Portland
9.9	90.1	103500	I-5, Ainsworth St., Portland
8.4	91.6	65100	I-205, at Government Island
5.2	94.8	99900	I-5, Marquam Bridge
10.0	90.0	78400	I-405, W Fremont Bridge Interchange
27.4	72.6	9400	I-84, 4.2 mi W of Pendelton
26.0	74.0	12500	I-84, 6.3 mi W of The Dalles

In terms of Oregon's 19 bin classification system, class 1 vehicles have 2 axles with a maximum spacing of 12 feet. In the sample under study, this class had a mean GVW of approximately 4000 pounds and 1 standard deviation (σ) of approximately 2000 pounds. At least 98% of the vehicles in the light vehicle category from the above table fall into class 1.

Note 1: The lower the ADT the higher the percentage of light three axle combinations. The observed range is a high of 5.5% - 3 axle vehicles in a low ADT area (on the interstate) to nil in the very high ADT areas.

Axle weight samples using WIM equipment would typically be used for one week each season to define the characteristics of the traffic at various sites. If data was collected for each vehicle, for the sites listed in the above table, there would be approximately 6.5 million records collected quarterly.

The problem becomes:

> how can sampling be done to minimize the number of records collected and still maintain the integrity of the information?

The Chapter on "Hypothesis Testing and Interval Estimation" in the text "Statistics for the Social Sciences", by William L. Hays, Published by Holt, Reinhart and Winston, 1973, has a section that applies to the stated problem.

The section "Sample Size and the Accuracy of Estimation of the Mean" provides a solution as follows. If the sample mean is to lie within $.1\sigma$ of the true mean, at a probability of .99, then:

$$\text{prob.}(|M - \mu| \leq .1\sigma) = .99$$

Assuming that the sampling distribution is nearly normal, the 99% confidence interval should have the limits

$$M - .1\sigma$$

and

$$M + .1\sigma$$

This is the same as

$$.1\sigma = 2.58\sigma_M$$

so that

$$.1\sigma = 2.58 \frac{\sigma}{\sqrt{N}}$$

solving for N

$$N = 665.6$$

Thus, if 666 independent observations are made, the probability that the estimate is wrong by more than $.1\sigma$ is only 1 in 100. Note that the number of observations is independent of the standard deviation.

This sampling criteria can be applied to the light vehicle class and is best demonstrated by example.

The first example, with an ADT of 10,000 and 70,000 total records, would be treated as follows.

> Determine the percentage of light vehicles (use 85% for the example).
>
> Divide 70,000x0.85 by 666, which is 90.
>
> Count the light vehicles and discard all but the counts that are divisible by 90.
>
> This will result in a sample with very nearly 666 records, representing the light vehicle class, with a mean that is +/- 200 pounds of the true mean 99 times out of 100.
>
> The final sample will contain all the heavy vehicle records, (10,500) plus the light vehicle sample (666) for a total of 11,166.

The data collection requirements have been reduced by (70,000 - 11,166) 58,834 records or 84%.

When the ESAL contribution of this class of vehicle is considered, this is much more in line with the effort expended for the information gained.

APPENDIX 4

EQUATING WIM AND STATIC WEIGHING DATA

by H. M. (Marty) Laylor, 3/19/90

Given:

1) The N axle weights, y_i, i = 1 to N, in kips from a WIM site.

2) The standard deviation, σ_s, of the static weights from a static weighing site.

Definition:

The mean of the static weights, $\bar{X}$, is the same as the mean of the WIM weights, $\bar{Y}$.

Calculations:

Determine the mean, $\bar{Y}$, and standard deviation, σy, from the WIM axle weight data.

Calculate a "scatter coefficient" S, $S = \sigma_s/\sigma_y$.

Calculate an "intermediate" set, I, $I_i = S \times y_i$, i = 1 to N.

Determine the mean, $\bar{I}$, and standard deviation, σ_i, for the intermediate set. Note that $\sigma_i = \sigma_s$.

Correct the mean of the intermediate set by adding $(\bar{X} - \bar{I})$ to each member of the intermediate set to get the corrected weights y_c, eg:

$$y_{ci} = I_i + (\bar{X} - \bar{I}),\ I = 1 \text{ to } N$$

These corrected weights will yeild the same ΣESAL as if the weights were static.

STATIC AXLE WEIGHT	ESAL	WIM AXLE WEIGHT	ESAL	INTERMEDIATE WEIGHT	NEW AXLE WEIGHT	NEW ESAL
4	0.038	2	0.002	1.26	3.85	0.033
5	0.094	5	0.094	3.15	5.74	0.163
6	0.194	6	0.194	3.77	6.37	0.247
7	0.360	12	3.110	7.55	10.15	1.589
8	0.614	8	0.614	5.03	7.63	0.508
9	0.984	9	0.984	5.66	8.26	0.698
10	1.500	10	1.500	6.29	8.89	0.936
8	0.614	8	0.614	5.03	7.63	0.508
6	0.194	6	0.194	3.77	6.37	0.247
4	0.038	4	0.038	2.52	5.11	0.102
5	0.094	2	0.002	1.26	3.85	0.033
6	0.194	6	0.194	3.77	6.37	0.247
7	0.360	7	0.360	4.40	7.00	0.360
6	0.194	12	3.110	7.55	10.15	1.589
9	0.984	9	0.984	5.66	8.26	0.698
9	0.984	3	0.012	1.89	4.48	0.061
8	0.614	5	0.094	3.15	5.74	0.163
6	0.194	6	0.194	3.77	6.37	0.247
5	0.094	5	0.094	3.15	5.74	0.163
7	0.360	11	2.196	6.92	9.52	1.230
8	0.614	8	0.614	5.03	7.63	0.508
9	0.984	9	0.984	5.66	8.26	0.698
10	1.500	10	1.500	6.29	8.89	0.936
8	0.614	7	0.360	4.40	7.00	0.360
6	0.194	6	0.194	3.77	6.37	0.247
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6	0.194	6	0.194	3.77	6.37	0.247
5	0.094	5	0.094	3.15	5.74	0.163
7	0.360	11	2.196	6.92	9.52	1.230
8	0.614	8	0.614	5.03	7.63	0.508
9	0.984	9	0.984	5.66	8.26	0.698
10	1.500	10	1.500	6.29	8.89	0.936
8	0.614	7	0.360	4.40	7.00	0.360
6	0.194	6	0.194	3.77	6.37	0.247
6	0.194	6	0.194	3.77	6.37	0.247

MEAN >>>>>	7	7	4.40	7.00	
STD DEV >>	1.71	2.72	1.71	1.71	
COUNT >>>>	52	52	52	52	
TOTAL ESAL >>>>>	25.616	36.869			25.639
ERROR >>>		11.253			0.023343