

# THE TITANIUM STANDARD

## for Election Verification & Security

(“The Titanium Standard”)

*“To ensure that every vote is counted as cast”*

10/1/06

### **Contributions from Leaders of the Following Organizations:**

*(in alphabetical order)*

- ◆ **California Election Protection Network** <http://www.caliselectprotect.net/>
- ◆ **Election Defense Action** <http://www.electiondefenseaction.org/>
- ◆ **Network of Citizens** <http://www.networkofcitizens.org/>
- ◆ **Oregon Voter Rights Coalition** <http://www.oregonvrc.org/>
- ◆ **Velvet Revolution** <http://www.velvetrevolution.us/>

*-Josef Stalin is credited with saying:*

“Those who cast the votes decide nothing.  
Those who count the votes decide everything.”

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### Titanium?

**Titanium—strong as steel.** Affordable. Easy to work with. And it’s resistant to corrosion. All these virtues exemplify why this humble element offers a superb metaphor for the following comprehensive standards to secure and verify our electoral process. And providing a strong standard is essential. Because a bona fide democracy is based NOT on trust in our institutions, but on verifiability through rigorous checks and balances, as well as through the separation of powers.

Notably this protocol differentiates itself from other election verification proposals by providing more than just a statistical formula. While the Titanium Standard does provide a highly reliable and cost-efficient statistical formula to verify election results within a 1% margin of error; just as importantly, it provides an unprecedented and unsurpassed level of election security. The net result will not only elevate our democracy with optimal voter confidence that every vote is accurately counted, but also will offer inspiration to ALL democracies.

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### Overview:

The following list provides an overview of the 10 basic parameters that are required to meet the Titanium Standard:

- 1. Security & Accuracy First**
- 2. Availability of Physical Evidence**
- 3. Separation & Balance of Powers**
- 4. Verification of Election Accuracy**
- 5. Recourse Upon Lack of Reconciliation**
- 6. Certification & Announcement of the Winner**
- 7. Voter’s Intent Shall Rule**
- 8. Machine Failure Contingency Plan**
- 9. Security Breach Shall Have Consequences**
- 10. Preparation for the Next Generation**

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### Details:

The following are the specific requirements for the 10 parameters, including appendices, which offer some excellent examples of how these parameters may be interpreted. These parameters are provided in the form of a checklist to encourage immediate action by adopting voluntary pilot programs, revising administrative rules, and enacting legislation in each and every state in the Union.



**1. Security & Accuracy First.** While election improvements are highly desirable, they cannot come at the cost of compromising the integrity of the electoral process. Security is a prerequisite for accurate elections, and accurate elections are the prerequisite for correctly reflecting the will of a government by the people. Security & Accuracy are paramount, and thereby they both must always be planned *for BEFORE* passing new legislation or changing procedures.



**2. Availability of Physical Evidence.** Nothing is truly verifiable without a tangible means for ALL citizens to verify election results. Therefore, non-transparent methods, such as digital data and proprietary software, are problematic. While digital data are easier to tabulate (adding votes), they are also easier to manipulate without a trace. Also, while proprietary software offers “security through obscurity,” a new generation of computer experts is championing “security through transparency” as the preferable means to provide security. They understand that oversight by ALL is better than oversight by a select FEW. For these reasons, the Titanium Standard requires the following specifications:

- a. Ballots and Voter Registration:** Paper is simple and inexpensive, yet to date it still offers the best means to provide reliable and tangible evidence of voter registration and voter ballot results. Many computer scientists, including Professor David Dill of Stanford University and Professor Avi Rubin of Johns Hopkins University have repeatedly testified as to the need for paper to ascertain computer errors. Therefore, all voter registration records and ballots must be printed on archival PAPER (whether computer generated or not). This paper evidence shall be visually examined (at least 14 pt. type size) before voters cast their ballots AND must be easily recounted by hand (e.g., paper sheets—not rolls). Any copies of originals deemed required for scanning purposes must be hand-counted and the copy must be attached to the original for ease in verification of its accuracy. *See, Appendix C for details.*
- b. Voting Systems:** Before and after an election, ALL components of our publicly relied-upon voting systems must be made available for examination and/or testing by all political parties with a candidate in the election. The types of voting system components that may be tested include, but are not limited to, software, hardware, registration records, and ballots.



**3. Separation & Balance of Powers.** No ONE group may oversee the specific processes of our elections. We can demand no less security in the oversight our election processes than we do in our state lotteries or banking systems, which heed the truism that a chain of custody is only as strong as its weakest link.

Therefore our elections must be conducted with a separation and balance of oversight powers, as follows:

- a. Government and Constituency.** There must be a separation and balance of oversight between the government presently in power (e.g., state and county election officials) and its constituency. In addition to serving as witnesses and testers, as described above, another area of expertise that voters can offer is their inherent knowledge of their own precinct or neighborhood group. Whenever possible local voters must be afforded oversight in the collection and accuracy of election data from their precincts and/or neighborhoods. For example, local voters can review tallies of votes at their local precincts *BEFORE* they are anonymously mixed into centralized tabulation. Another example, local voters can participate in the authentication of voter registration records from their communities.

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**b. Government and Government.** Even within the government there must be a separation and balance of oversight. No one official should have total dominion over any one component of our electoral process—from voter registration through to the verification process. For example, while the County CLERK may oversee the digital tabulation of the votes, perhaps the County AUDITOR may oversee the random hand count.

**c. Citizen Access.** When everyone knows everything pertaining to an election at the same time, there is a balancing and separating of powers. Thereby the Titanium Standard specifies citizen access, as follows:

**1) Election Data Access.** Public posting and observation of all election data shall be made immediately available without delay. This information shall be provided by way of traditional posting methods on paper at each tally site, as well as at least three easy-to-access websites—one state-based website, as well as websites of all non-partisan non-profit election integrity organization websites that have requested participation. See *Exhibit 1 for the “Minimum Election Data Postings Required.”* All computer data shall be made available in a comma-delimited format to accommodate the easy transfer to spreadsheet programs. Election data shall be made available, whenever possible, FIRST to the public and the election officials at every location and interval where election data is collected for a tally, i.e. precinct, central tabulation, voter registration submissions. Also, data made available must include information detailing any “ballot failures,” as well as full disclosure of all voting equipment in use.

**2) Observation Access.** All phases of the electoral process, including equipment, shall be open to public observation in a manner in which all mechanisms and methods are visible. If there is a limitation in the number of witnesses on the basis of preventing obstruction of the election process, it must be defined and communicated in writing to all interested parties at least thirty days prior to the election. In the instance of a limit on the number of witnesses, first priority of observation shall be afforded to official delegates of the political parties who have candidates on the ballot. Photo and/or video recording shall be permitted as long as the privacy of the ballot is maintained. Failure to permit lawful observation of the election process shall be prosecutable as a felony.



## 4.

**Verification of Election Accuracy.** Ordinary methods of checks and balances to confirm tabulation are excellent for traditional accounting processes, but they are unsatisfactory in elections where the privacy of the ballot must be maintained (because there is no traceability back to a specific document). However, what does work superbly is Consilience, which is a term defined here as the use of at least two separate and distinct processes (i.e., computer-and-hand, computer-and-computer), with separate and distinct oversight that all lead to the same conclusion. (Use of this term is borrowed from Professor of Science at Harvard E.O. Wilson.)

The following steps are how the Titanium Standard shall achieve Consilience:

**a. Testing of Voting Equipment.** Testing of the accuracy of actual voting equipment, both before and after each election, shall be permitted upon written request 30 days before an election. This opportunity to test the election equipment shall be made available to no more than four technical advisors from the central committee of each political party which has a candidate in

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the election. Also, the same opportunity will be afforded to election integrity advocacy groups that are on file as non-partisan entities with the state who request this privilege in writing at least 30 days prior to the election.

- b. Exit Polls.** Exit polls must cover all non-primary races for the Congress, Governor and President. Exit polls are still relied upon around the world by independent election witnesses, such as the Carter Center, and the U.S. should be no exception. When they are properly conducted, exit polls are accurate within a (+/-) 1% margin of error, which provides a 99% level of confidence. To be reliable, however, exit polls must be conducted by professionals who are not affiliated with any political party. Credible exit polls can only be financially supported by non-partisan not-for-profit groups, or by non-partisan officials from the federal, state, or local government.
- c. The RSOB-Formula.** Applied to all federal and state races, the Random Sample of Ballots Formula (the “RSOB-Formula”) is a specific statistical formula drawing a small percentage of ballots randomly from a pool of ALL the ballots cast in an election. After the selection has been made, the selection must be hand-counted. The results of the RSOB-Formula are precise within a (+/-) 1% margin of error; and therefore, within its margin of error, the results can precisely determine whether an election has encountered a tabulation error. (In California, this formula would require the hand counting of, on average, fewer than a mere 25 ballots per precinct.) *See, Exhibits 2-6 for specifics on how to apply the RSOB-Formula.*
- d. The State Spot-Check Method.** In the event that both the RSOB-Formula and the exit polls indicate there is NO tabulation error, then this State Spot-Check Method is *optional*. The State Spot-Check Method is the more customary method of auditing 100% of  $x$ , (and  $x$  is usually between 1% to 3% of ballots randomly drawn from pre-designated geographic pools dispersed across the state). For example, in California Election Code 15360 provides that each county must audit 1% of randomly selected precincts in their entirety. (Auditing an entire precinct provides a means by which a state can subtract what went into the tabulation pool to check the accuracy of its centralized tabulation systems, as well as potentially revealing the location of tabulation errors.) If a State does not yet have Spot Check legislation, then California’s Election Code 15360 may be used for the interim period.
- e. Genuinely Random Selection.** The State-paid verification process can be easily subverted if the selection samples are not genuinely random. A random selection CANNOT be based on ANY information that is already existent before the moment of selection, and it must pass the scrutiny of at least three state-certified gaming officials. In the absence of good solutions, most states already have State Lotteries that can be accessed to draw up random numbers. *See, Appendices A and B, for details.*
- f. Achieving Consilience.** Consilience is achieved when either of the following two conditions are met:
  - 1) Reconciliation of Methods:** When the difference between the tallies arrived from the following sources would NOT change the outcome of the election:
    - (a) Official Tally vs. RSOB-Formula results; or

- (b) RSOB-Formula vs. an average of Exit Polls (when applicable and performed by nonpartisan pollsters who meet established professional standards); or
- (c) RSOB-Formula vs. State Spot-Check Method; or

(2) 100% hand count of the election is achieved, (which is an option that may be exercised at any juncture when requested by the State election officials).



## 5. Recourse Upon Lack of Reconciliation

**a. What Triggers Recourse.** If Consilience is NOT achieved, then the specific “Recourse Action” shall be required.

**b. Recourse Action (“RA”).** The sources of discrepancies in tallies shall be pursued by additional counting as follows:

1) **Sampling Size & Audit Method.** The sample size shall be selected by using the following percentages (and by using the “State Spot-Check Method”):

(a) If a state has precincts (e.g., CA), then the State Spot-Check Method must be used to draw a sample size of at least 5% of precincts.

(b) If a state is without precincts (e.g., OR), then the RSOB-Formula must be to draw a sample size of at least 10% of ballots.

2) **Duration of RA Process.** Until Consilience is achieved, the RA process shall continue until the discrepancy between tallies is within a margin that would NOT change the outcome of the election. (Note: The margin of error shall be applied by the most stringent interpretation possible, i.e., inclusive of factoring in the HIGHEST margin of error possible for each tally method).

**c. Final Arbiter.** If at conclusion of the RA there still remains a discrepancy between the above-reference compared tallies, then the hand count of all ballots shall rule. *Alternatively, in the absence of the adoption of this Titanium Standard the voter verified paper audit trails shall prevail.*



**6. Certification & Announcement of the Winner.** While the entire process and tallies will be transparent and may last a week, the official certification and/or announcement of the winner CANNOT occur until Consilience has been achieved. Specifically, no longer shall the media announce the victor, nor shall candidates, nor Congress, nor any other individuals or entities, UNTIL the election verification process has been completed. Democracy shall be achieved by rigorous adherence to a public and methodical process.



**7. Voter’s Intent Shall Rule.** Voter intent on ballots and voter registration must be honored, if such intent can be clearly established. For example, if a voter registers with her maiden name on her DMV records, but has registered to vote with a hyphenated surname inclusive of her maiden name, then that should NOT be grounds to invalidate her voter registration. Another example, if a voter fails to fill in the bubble next their “write-in candidate” selection that should not invalidate the vote for the “write-in candidate.”

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- 8. Machine Failure Contingency Plan** When a voting machine or system is found to have an operational failure, there are two possibilities:
- a. With Paper Record of Votes:** If the machine or system permitted the voters to vote, but thereafter encounters a malfunction, then the paper ballots and/or voter verified paper trails must be counted by hand from all affected machines.
  - b. Without Paper Record of Votes:** If the machine or system did not allow voters to cast their ballots and voters were not offered a paper ballot option, then an entirely new election must be conducted for the affected venue(s).
- 9. Security Breach Shall Have Consequences.** Partisan leaders cannot work as election officials. A partisan is any election official who in the past five years has served, or presently serves, as a partisan leader (e.g., a campaign chair, a party delegate, board member, precinct captain, or major donor). It is deemed a security breach when a partisan works in any capacity that would permit oversight of the ballots, including consultation for input into election policies and procedures. Therefore, these types of conflicts of interest with officials overseeing our elections constitutes an egregious breach of security and may require an entirely new election for the affected venues. An election under such a person’s supervision must render an election result of “No Confidence” and the results of such an election must be rejected.
- 10. Preparing the Next Generation.** Thomas Jefferson said, “*The price of freedom is eternal vigilance.*” We must teach our next generation how to heed this advice, so that we may ensure that our gift of a bona fide democracy will survive to our tricentennial in 2076. Firsthand practical experience is a superb way for our youth to learn. For this reason, the Titanium Standard requires the use of Voteneers (pronounced Vo-tah-NEERS) for the assistance in the hand counting process. Voteneers are high school student election worker volunteers who have satisfied specific qualifications and who are chaperoned by a parent and/or guardian for this important educational experience. *See, Appendix D for details.*

Achieving each and every of the 10 parameters set forth above may seem like an admirable but daunting task. Yet this Standard will be achieved *IF* heretofore each and every election reform proposal for new rules or legislation can answer this question: ***Where’s the Titanium?***

## Election Data Access

### Minimum Election Data Postings Required

**“Election Data” shall be defined as follows:**

- 1.** Election data shall be made public in “real time”; just as soon as it is accumulated, first to the public and immediately thereafter to the government election officials.
- 2.** All data shall be posted in both the traditional PAPER posting methods at each collection site, as well as public postings by way of various publicly-accessible computer websites to be hosted by the Secretary of State’s Office, as well as to ALL non-partisan non-profit election integrity groups that request this privilege in writing at least 30 days prior to the election.
- 3.** All computerized data shall be made available in a comma-delimited format for easy transfer to spreadsheet software.
- 4.** At a minimum, all election data shall be accumulated, sorted and posted for each of the following groups:
  - a.** All Precinct Election Data (Not applicable to “Vote By Mail” states)
  - b.** All County Election Data
  - c.** All State Election Data
- 5.** At a minimum, a subset of election data for each of the above groups, shall include the following, if applicable:
  - a.** Early Voting Tabulation
    - i) absentees
    - ii) military overseas votes
    - iii) pre-election day
  - b.** Provisionals Tabulation
    - i) hand-counted provisionals
  - c.** Ballot Errors Documented
    - i) over-votes
    - ii) under-votes
    - iii) other problems (including details)
  - d.** All Machine Count Tallies and Their Source
  - e.** All Hand-Count Tallies and Their Source
  - f.** RSOB-Formula Tallies
  - g.** Registration Problems
    - i) list of people who claim there has been an error with details
  - h.** List of voting equipment was used, including models numbers and certification number.
    - i) Models
    - ii) State Certification
    - iii) Federal Qualification
  - i.** List of Pollworkers
    - i) Adult Pollworkers
    - ii) Voteneers
    - iii) Voteneer Chaperones
- 6.** To err on the side of inclusion shall be the rule, should there arise a question whether data should be included or not.

## The Random Sample of Ballots Formula (“RSOB-Formula”)

### Random Selection & Method for Counting

The Random Sample of Ballots (the “RSOB-Formula”) must be accurate within a +/- 1% margin of error to offer at least a 99% level of confidence.

**Abstract.** The Random Sample of Ballots (the “RSOB-Formula”) is a specific statistical formula drawing a small percentage of ballots randomly drawn from a pool of ALL the ballots cast in an election. After the selection has been made, the selection must be hand-counted. The results of the RSOB-Formula are precise within a (+/-) 1% margin of error; and therefore, within its margin of error, this method can precisely determine whether an election has encountered a tabulation error. (In California, this formula would require the hand counting of, on average, a mere 25 ballots per precinct.)

### Method.

#### 1. Drawing a Genuinely Random Selection.

The state-paid verification process can be easily subverted if the selection samples are not genuinely random. A random selection cannot be based on any information that is already existent before the moment of selection, and it must pass the scrutiny of at least three state certified gaming officials. In the absence of good solutions, most states already have lotteries that can be accessed to draw up random numbers. There are a number of methods that fulfill the physical pulling of the random sample of ballots needed. *See Appendix G.*

#### 2. Method for Counting the Sample

- a. Hand counting a jurisdiction-wide sample of paper ballots.** Ballots must be hand counted at the precinct level (or county level if precincts are mixed during tabulation) and made public the day of the election or as soon as physically possible.
- b. Machine counting a jurisdiction-wide sample of paper ballots.** A general purpose optical scan machine with general purpose software—NOT designed for counting elections—can be used to count ballots. The machines and software must be protected by the same security procedures as other voting equipment and software. The same standards apply for this method as for the hand-counting method.

## The Random Sample of Ballots Formula (“RSOB-Formula”)

### Sample Size Calculations

#### 1. Sample Size.

The sample size will be determined by the number of ballots cast in the jurisdiction to be verified. For statewide races (senate, governor, president), the sample size formula is available in the table below. This can be accomplished by using the “Sample Size Table” below for an approximation or by using the statistical formula for an exact sample size. For jurisdictions with less than 100,000 ballots cast, the sample size must be calculated by the formula for statistical accuracy. *When calculating sample size, the number of ballots cast in the race must be used rather than the number of registered voters.*

#### 2. Sampling Approximation Method

The sample size of hand-counted paper ballots needed for a jurisdiction with at least 100,000 ballots cast can be found in the table below. The sample size will give no more than 1% error with a 99% confidence level if drawn randomly from each precinct. Please note that 100,000 represents ballots cast, not the number of registered voters; *the number of registered voters does not help in determining sample size.*

#### Sample Size Table

Number of Ballots Counted in the Jurisdiction	Sample Size for the Jurisdiction
100,000 to 500,000	41,000
500,001 to 650,000	42,000
650,001 to 1,050,000	43,000
1,050,001 to 2,000,000	44,000
2,000,001 to 50,000,000	45,000

## The Random Sample of Ballots Formula (“RSOB-Formula”)

### Determining the Recount Percentage

#### How to Determine the Percentage to Be Recounted

**Example:** Figuring the number of ballots to be counted at the county level for a state with 3,000,000 ballots cast in order to verify a statewide race.

1. Divide the sample size by the total ballots cast in the state. This provides the *percentage* of ballots to be counted.
2. Multiply the total ballots cast in the county by this percentage. (This provides the *number* of ballots for the sampling procedure.)

For example, if 3,000,000 ballots are cast in a state, then the percentage of ballots to collect for each county in that state is:

$$\frac{45,000}{3,000,000} \text{ or } .015 \text{ (1.5\%).}$$

**Every county** in that state would randomly sample 1.5% of its ballots. For example, a county with 5,000 ballots cast would draw 75 (1.5% of 5,000) ballots.

**NOTE:** This formula may at first appear counterintuitive in the sample sizes required. One way to think about it is to realize that increasing a sample size beyond 45,000 ballots cast does NOT correspond to a significant reduction in the margin of error. Also, on the other end of the spectrum, when the total number of ballots cast is less than 250,000, then the corresponding proportional sample size required will increase sharply.

## The Random Sample of Ballots Formula (“RSOB-Formula”)

### Formula for Exact Sample Size Determination

#### Formula for Exact Sample Size Determination<sup>1</sup>

**Test Statement:** Hand counting all ballots would produce the same proportion of ballots for a statewide candidate as the machine counted tally for the state.

**Definition of proportion:** In the case of two candidates, the proportion is determined using

$$\text{proportion} = \frac{\text{candidate 1}}{(\text{candidate 1} + \text{candidate 2})}$$

In the case of more than two candidates, the proportion is determined using the top two candidates, as above.

#### Population

$N =$  Population size.

$P = P_H =$  Unknown proportion of population voting for a particular candidate as determined by hand counting.

$P^0 = P_M =$  Known proportion of population voting for a particular candidate as determined by machine counting.

#### Sample

$n =$  Sample size.

$p = p_H =$  Proportion of sample voting for a particular candidate as determined by hand counting.

**Sample Size:** To determine the sample size, we use:

$$n \doteq \frac{1}{\frac{1}{N} + \frac{(P - P^0)^2}{(z_{\alpha/2} + z_{\beta})^2 P(1 - P)}}$$

**Note:** for this example:

\* population size of 1,836,782 (ballots cast in 2004)

$P = 0.47$  to  $0.55$

$P^0 = 0.51$

$z_{\alpha/2} = 2.576$  corresponding to the significance level  $\alpha$  of 0.01.

$z_{\beta} = 1.645$  corresponding to a  $\beta$  of 0.05.

<sup>1</sup> Method designed in conjunction with Dr. Dave Thomas, retired statistics professor at Oregon State University. For the resulting values see Table 1 on the following page.

**Table 1** Method designed in conjunction with Dr. Dave Thomas, retired statistics professor at Oregon State University. The resulting values are:

Population size	1,836,782		
Hand counted proportion	0.51		
Significance level	0.01		
Quantile of Normal dist. for tail probability	2.576		
Probability of not rejecting null hypothesis	0.05		
Quantile of Normal dist. for tail probability b	1.645		
Machine counted proportion			
P-P^0	P	Sample size	margin of error
-0.04	0.47	2,770	2.44%
-0.03	0.48	4,928	1.83%
-0.02	0.49	11,064	1.22%
-0.01	0.50	43,488	0.61%
0.01	0.52	43,420	0.61%
0.02	0.53	11,029	1.22%
0.03	0.54	4,904	1.83%
0.04	0.55	2,752	2.44%

**In summary,** we recommend using the 99% confidence level to reject the remainder, i.e. the results with 1% or more difference between the hand-counted and the machine-counted ballots. The population size 1,836,782 corresponding to the 2004 Presidential race is used. The sample size is rather insensitive to the specified population size provided that it is large relative to the sample size. The machine counted proportion was set equal to 0.51 so that the largest sample size 43,488 would correspond to the 1% difference.

The proportion calculation ignores the other candidates in the race; however, the sample will almost certainly contain ballots that have not been marked for either of the top 2 candidates. Based on the 2004 example we estimate that approximately 600 ballots in the sample (about 1.5%) will not be marked for either of the top 2 candidates, and we recommend that these ballots be ignored in the proportion calculation.

## The Random Sample of Ballots Formula (“RSOB-Formula”)

### Commonly Asked Questions

- Q:** Why not just establish a percentage of the ballots to hand count, such as 2%, for every state?
- A:** Unfortunately, “one size does not fit all” when sample size is set by percentage. Wyoming needs to count 14% of its ballots in order to assess state-level results within 1% margin of error (41,000 divided by 300,000 = 0.14 or 14%). California only needs to count a random sample of 0.23% of its ballots for an equally valid result. (45,000 divided by 20,000,000 = .0023 or .23%). For practical reasons, however, we recommend that no less than 2% of ballots are randomly selected for counting at the precinct level.
- Q:** Why not just count *all* of the ballots of 5% of the precincts?
- A:** State-level results cannot be verified by sampling 5% of precincts. “The margin of error is too large. This type of sampling is called ‘cluster sampling’ rather than ‘random sampling.’ The formula for cluster sampling dictates a much larger sampling of ballots to obtain the same level of confidence in the results of the sampling. It would need to be much greater than 5% for most states.” Although sampling precincts cannot be used to verify state-level results, it can be valuable for other purposes. For example, sampling precincts can help determine more precisely the errors in tabulations at a precinct level.

<b>Appendix A</b>	<b>Physical Methods of Random Sampling</b>
<b>Appendix B</b>	<b>“California Lottery” Method of Randomly Selecting Precincts for Audits</b>
<b>Appendix C</b>	<b>Paper Ballots</b>
<b>Appendix D</b>	<b>Voteneers: High School Volunteers</b>

### Physical Methods of Random Sampling

#### Every $N$ th Ballot

The fastest way to conduct a random sample when an optical scanner is used is to have the scanner stop every  $n$ th ballot (“ $n$ ” is defined by dividing the anticipated voter turnout by the approximate sample size, e.g. 1,400,000 voters divided by 40,000 sample size results in pulling every 35th ballot), have election workers pull and note the vote by hand, put the ballot back in the stack, and keep going. See Appendix B for an alternative method, if the scanner cannot be stopped on a predictable basis.

This method which builds verification into the process of the initial counting ballots may be the least disruptive and fastest way of doing it. It also allows the results to be verified on the day of the election.

If the counter/tabulator cannot be stopped at a prescribed place, the following method could be used. Put  $n$  blank ballots into each of two piles. Cut two cardboard boxes, the type that paper comes in, to exactly the height of the two piles. Put a stack of  $n$  ballots in each box. Place an aluminum yardstick or similar straight device over the two boxes, with a 12” space between them.

Pull a random ballot out of the first  $n$  real ballots before feeding any into the scanner. Start with that ballot as the first verification ballot. Count the next  $n$  ballots after the verification ballot by placing them between the boxes to measure  $n$  ballots. (When you can’t get another ballot into the stack between the two boxes of blank ballots, you have  $n$ .) Count each “verification” ballot and then restore it to its place in the stack; feed the stack into the scanner.

#### Statewide Numbering System Method

This method is conducted after the ballots are machine counted. This must be done with the same security precautions used as if it were the initial counting procedure.

1. To randomly select a sample of ballots using this method, we first need a way to assign a number to each ballot cast in the whole state. Order the counties alphabetically and assign each a number from 1 to  $n$  (“ $n$ ” being the number of counties in the state). Order the ballots in each county by listing the precincts in numerical order. For example, in county #1 there are 10 precincts with 30 ballots in each precinct (300 total ballots). Ballot #1 is the first ballot in the precinct #1 box and ballot #30 is the last ballot in the precinct #1 box. Ballot #31 is the first ballot in the precinct #2 box, and so on. The last ballot in the last precinct box is ballot #300. The first ballot in county #2 is #301, and so on, and the last ballot in the last county will be #1,836,782 or whatever the total number of ballots is for that state.
2. Generate a list of random numbers from 1 to  $T$  (“ $T$ ” is total number of ballots), and choose the first  $N$  numbers where “ $N$ ” is the sample size determined by table or formula in Exhibit 2.
3. Pull the ballots corresponding to the numbers generated in step 2.

## “California Lottery” Method of Randomly Selecting Precincts for Audits

- a. Why the California Lottery?** Because the California Lottery must conduct its selection process in manner that meets strict federal and state gaming laws, it is a superb resource for this “other” State required task, a genuinely random selection process. One roll that would reveal one sets of numbers would provide an “Official Order” (described later), which ALL counties shall use.

[Note: Many ask, Why not just pick a name out of a hat? But then the question is, Where does the hat come from? And how do we choose which person to pick the number, and so on. . . . Or, others have said, Why not just use a computer randomizer? But who then writes the software? Who examines the software? While determining what is random may seem simple, it is not. If we want absolute verifiability that the random number was not tampered with. Determining a genuinely random number is within the California Lottery’s expertise.]

- b. Genuinely Random Selection.** Then using their standard legally regulated method to “roll” the Lottery balls will commence. The results of this process will reveal a genuinely random number. This genuinely random number will be used as the basis to determine which county precincts shall be included in each County’s reconciliation.
- c. Witnesses.** Upon prior written notice, as many people as will legally fit in the California Lottery’s auditorium, where this process takes place, shall be permitted to witness this event. First choice for this opportunity shall be given to the political parties who are participating in the election; they shall be permitted 10 witnesses each. This event may be televised or videotaped by anyone present.
- d. Posting Result:** The random number shall immediately be posted on the “Vote Scope”

### C. Post-Election Day Tasks: League of Women Voters\*

(\*”League of Women Voters” shall stand in for a yet to be a determined non-partisan entity of volunteers)

#### 1. Commence the Precinct Identification Process

As soon as the lottery ball number has been revealed, there shall immediately commence the selection process, as follows:

- a. Official Order:** The Lottery numbers are a sequence of double digit numbers, e.g. 22, 48, 17, 19, 3. Yet, for our purposes we will read it from left-to-right as one long number. For example 22, 48, 17, 19, 3 would become 224817193. This resulting number shall be called the “Official Order,” and it shall be the first number used to identify which precincts are to be audited in their entirety.
- b. Generating More Numbers:** Because numerous precincts must be identified, more random numbers must be generated. We shall extrapolate more numbers using the sequence of the “Official Order” as a guide, as follows:

**Step 1. First Digit Drops to End:** If the Official Order were 224817193, then by dropping its first digit it and looping it to the end, it would become 248171932. This second number shall be used to identify the second precinct to be audited in its entirety.

continued on next page

**Step 2. Repeat the Process:** Repeat the formula of the “Step 1” process above to identify the subsequent precincts to be audited in their entirety. (For example, then the number 248171932 would become 481719322, and so on. . . .)

This process shall repeat until the Official Order number is again reached, which may not be used a second time. If more numbers are needed, continue to next step.

**Step 3. The “Plus-One Formula”** Again using the Official Order, roll up each digit by one. In doing so, do not carry any digits to the next column, because this is not real arithmetic. It is merely an expedient way to make a new random number. For example 224817193 by using this formula would become 335928204.

(Note: Why not just add one using real arithmetic? Because if the Official Number were 224817193, it would not change significantly enough when it became 224817194 to be useful for the random selection purpose.)

**Step 4. Repeat the Process:** Repeat the process of the “Plus-One Formula” except rather than rolling up one digit, roll up two digits. Again, use the Official Order as the basis to create the “Plus-Two Formula.” (Do not carry digits to the next column.) For example, if the Official Order were 224817193, then after the “Plus-Two Formula” were applied, it would be 4460389315; or to present it more graphically, view this example:

**Example:**

(Read from the top down)

$$2 + 2 = 4$$

$$2 + 2 = 4$$

$$4 + 2 = 6$$

$$8 + 2 = 0$$

$$1 + 2 = 3$$

$$7 + 2 = 9$$

$$1 + 2 = 3$$

$$9 + 2 = 1$$

$$3 + 2 = 5$$

**Step 5. Ad Infinitum:** After the “Plus-Two Formula” is exhausted because it has reached the number where it began, then use the same process to create the “Plus-Three Formula,” and so on.

**c. PIN Numbers:** Each number derived from the above described processing of identifying precincts shall be called, a Precinct Identifier Number (“PIN”). And each PIN will be given a sequentially numeric identifier suffix, and so the first PIN, (which shall also be the “Official Order”) shall be referred to as the PIN-1. The second PIN identified in this process shall be called the PIN-2, and so.

- d. “Precinct Sorting Code”** As detailed earlier, each precinct shall have a permanent and unique Precinct Sorting Code, (“PSC”). (Each PSC will have originated by a random process, because these addresses must NOT be clustered by location as are zip codes, because they shall be used for several functions including use in the random process.)
- e. Verify Integrity the PSC List:** The strict matching of the nearest PSC number to each PIN is reliant upon the accuracy and completeness of the PSC list. This verification of the PSC must occur before ANY precinct is identified for audit.
- f. Correlating Numbers:** The number of digits in PINs will exceed the six of digits in the Precinct Sorting Code (“PSC”). Yet, for ease of use, only the first six digits of each PIN shall be used. For example, if PIN-3 is 481719322, then the only numbers that shall be used to match the a precinct’s PSC shall be the first six numbers as read from the left: 481719 (with the remaining “322” ignored).
- g. Posting Results:** The sequence of PINs derived shall be immediately communicated to both the County Auditor and to the Secretary of State’s Office for their immediate posting on the “Vote Scope,” or a publicly available website.
- h. Witnesses:** At least 21 witnesses from the public, as well as 3 “official witnesses” from each political party represented on the ballot, shall be afforded the opportunity to observe the tabulation. Priority for this privilege shall be conferred first on prior written notice and then on a “first-come first-serve” basis.

Each witness shall be provided a list of the selected county’s precincts in precinct order. This list can be referenced to the PINs as they are announced to ensure their accuracy. This event may be televised or videotaped by anyone present. This event may be televised or videotaped by anyone present. The results shall immediately be posted on the “Vote Scope,” or a publicly available website.

## Availability of Physical Evidence

### I. Why Paper Ballots?

A rigorous audit protocol is completely reliant on the availability of tangible evidence. Even a bank, with all its security measures, cannot pass an audit without an auditor randomly counting real money and checking paper trails. Digital information alone cannot reveal whether there has been a 1-to-1 correspondence between the reality of a transaction and how it got recorded digitally. And thereby, auditability equals legitimacy. Therefore, if a copy of a ballot is deemed necessary for whatever purpose (e.g., the ballot is incompatible with the scanner, ink was unreadable) then it must be attached to the original for comparison purposes upon an audit or recount.

#### What Type of Paper is Suitable?

The paper used for ballots shall meet the following specifications:

##### 1. Paper Stock

- i. size: 8.5 x 11" sheets (not on rolls)
- ii. weight: 20 lb. minimum
- iii. color: white
- iv. type: archival for at least 10 years
- v. considerations: use of recycled paper is preferable

##### 2. Print

- i. ink: archival black ink (preferably nontoxic)
- ii. font size: 14 point for the candidate names and proposition and measure titles; subtext shall be 12 point

##### 3. Storage

- i. Presidential elections: 9 years
- ii. Primaries and all other elections: 5 years

##### 4. Disposition

- i. All Paper: Recycled

### II. Why Paper Poll Books?

#### (and/or Paper Records of Voter Registration)

While many citizens understand the need for a paper ballot (and/or a paper audit trail) for the physical evidence it offers our voting systems, many have not given much thought to our paper and ink registration poll books.

With the advent of the computerized Centralized Voter Registration system that is now mandated by the Help America Vote Act, there is the possibility that the traditional paper and ink (sign-in system) registration poll books may be deemed an unnecessary redundancy, yet paper for our registration polls is just as important as paper is for our ballots.

### III. Special Treatment of Ballots on "Scrolls"

**Paper rolls.** If the paper ballots (and/or paper trails) are stored on a contiguous roll(s), then the precinct's Election Inspector will set each of the roll(s) upon a cleared table (a table free of paper and debris), and then remove the rolls from their casings, if applicable, so that they shall be unfurled without obstruction.

## Voteneers: High School Volunteers

### A. Overview

1. **Who Are Voteneers?** Voteneers (pronounced Vo-tah-NEERS) are high school students, including 9th grade, who provide assistance in specific precinct reconciliation tasks a half an hour before close of polls on Election Day.
2. **Why Do We Need “Voteneers”?** While the counting of approximately 100 ballots, and perhaps a few provisional ballots, in their entirety, under normal conditions, would not likely prove to be a difficult task, our precinct poll workers—many of whom are elderly—may find their focus and energy dwindling by the end of the day. Also, by performing a separate task from the other poll workers, as well as providing their own witnesses, they would help satisfy a prerequisite for Consilience.
3. **But Why Adolescents?** Not only are adolescents also concerned about issues of fairness, but also recent studies have demonstrated that adolescents typically are biologically prone to later bedtimes during puberty. Therefore, under the direction of the precinct Election Inspector, the Voteneers will likely provide welcomed energetic assistance. (See, <http://www.medicalnewstoday.com/newssearch.php?newsid=32907> )

But most importantly, entrusting young people with the honor of securing our democracy will prepare them—the next generation—to take responsibility for the civics challenges that will greet them.

Further, our young people who are asked to participate in programs in high school, such as R.O.T.C., with the possibility that they might soon be dispatched to fight for democracy overseas, must also learn to fight against complacency that shall lead to losing democracy at home. Because to keep the candles for democracy’s light burning bright is every generation’s burden.

We must teach our students to heed Thomas Jefferson’s admonition, *“The price of freedom is eternal vigilance . . .”*

4. **Role of Parents and/or Guardians.** The primary role Voteneer parents will be to act as volunteer witnesses of the hand count process and to chaperone their minor children for the entire duration of this evening activity, which on rare occasions may run quite late.

### B. Voteneer Details

1. **Arrangements.** Specific arrangements for Voteneer assistance shall be made by a county designated election official and the high school principals of each community.
2. **How many?** Each precinct shall schedule 3-4 Voteneers. (Two Voteneers are the minimum required to accomplish the Precinct Reconciliation tasks.)
3. **Permission Slips.** Each Voteneer will fill out a permission slip outlining his or her duties, and this permission slip shall be signed by the high school principal, the student, and the student’s parent or guardian.
4. **Qualifications.** The students must be U.S. Citizens and have a 2.5 grade point average or higher. Each Voteneer shall be accompanied by his or her parent (or legal guardian). Students with parents who have a conflict of interest with the outcome of the election may not participate, e.g., running for office. (Students who possess a high school record for disciplinary or emotional problems shall not participate.)

- 5. Arrival time.** Voteneers and their parents shall arrive at 7.30 p.m. (This is more than a half hour before their chore will commence, but it will provide some leeway if there is any unanticipated reason that they are delayed. The hand counting task will commence upon the close of the polls AFTER the machine tally has been sent to the central tabulation site.)
- 6. Guidance.** Voteneers shall work under the guidance of each Precinct's Election Inspector.
- 7. Compensation.** The honor of Voteneer work is entirely a volunteer effort, but it is hoped that the high schools would reward with students with a special privilege or some school credit as part of a civics assignment.
- 8. Voteneer Training.** Instructional step-by-step examples of tasks and responsibilities required of poll workers and Voteneers shall be made available by videos and on-line movies in the two most popular formats. Because not everyone has a video player or a computer, these materials will also be available at all public libraries. Also, the instructional materials will provide a call-in number to assist new workers with their questions. All poll workers, Voteneers, as well as the Voteneer parents (and/or guardians) must sign a legal verification declaring under penalty of perjury under the laws of California that they both understood and viewed these instructional materials in their entirety. These materials will be produced by the Secretary of State's office.
- 9. Voteneer Records.** The names and addresses of all voteneers and their parents (or guardians) are to be kept with the precinct vote tallies for the term of the vote storage.
- 10. Voteneer Contingency Plan.** In the rare and unforeseen event that there are no Voteneers, then the precinct's poll workers shall complete these tasks without Voteneer help.