

Local Government Elections in Scotland 2012

Detailed Description of an STV Count in accordance with the Rules in the Scottish Local Government Elections Order 2011

Introduction

The Local Governance (Scotland) Act 2004¹ provides for councillors in Scotland to be elected by the single transferable vote system of proportional representation (STV-PR) from wards returning either three or four councillors. The first such elections were held in May 2007. The Election Rules for the elections that will be held on 3 May 2012 and thereafter are set out in the Scottish Local Government Elections Order 2011²:

The purpose of this note is to describe *in detail* the counting procedure for such an STV election. This note is intended for those who want or need a detailed explanation of that procedure. The counts for these elections will be electronic, but the counting process is described here, as in the Election Rules, in terms of handling the actual ballot papers as this makes the procedure clearer and easier to follow.

Outline of the STV Counting Procedure

The STV counting procedure involves five basic steps:

1. Once the total number of valid ballot papers has been counted, the minimum number of votes sufficient to secure the election of a candidate is calculated (called the “quota”).
2. The ballot papers are sorted according to the first preferences (first choices) marked by the voters and the total number of votes for each candidate is counted.
3. Any candidate whose vote equals or exceeds the quota is elected. If any candidate has more votes than the quota, that surplus above the quota must be transferred in accordance with the second and later preferences recorded on the ballot papers.
4. If after all the surpluses have been transferred some vacancies remain to be filled, the candidate with fewest votes is excluded and that candidate’s votes are transferred in accordance with the second and later preferences recorded on the ballot papers.
5. The transfers of votes continue, stage by stage, until all the vacancies have been filled, with any surplus being transferred before any exclusion is made.

Key Features of the Counting Procedure specified in the 2012 Election Rules

- Votes are recorded on paper ballot papers. In an electronic count the ballot papers are scanned and the voting preferences extracted by character recognition software.
- All ‘doubtful’ ballot papers are subject to adjudication. The criteria for ‘rejected ballot papers’ are clearly defined in the Election Rules. Any that are ‘rejected’ will be excluded from the counting process, but the numbers of such papers are recorded.
- Voters may mark as many or as few preferences as they wish. Preferences should be marked in a continuous sequence starting with “1”. If there is a break in the sequence, the ballot paper will become ‘non-transferable’ at the break. If a preference number is repeated, the ballot paper will become ‘non-transferable’ at the repetition.
- The quota for election depends on the number of valid votes cast in the ward and the number of vacancies to be filled and remains at a constant value through all stages of the count. The quota is calculated as an integer (whole number) value.

¹ <http://www.legislation.gov.uk/asp/2004/9/contents>

² <http://www.legislation.gov.uk/ssi/2011/399/contents/made>

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- Whenever votes have to be transferred, all the ballot papers held by the relevant candidate are transferred. Ballot papers of differing values are kept in separate sub-parcels. Votes are not transferred to already elected candidates.
- All surpluses must be transferred, one at a time in order of diminishing size, except when all vacancies have been filled. When a surplus is transferred all the ballot papers held by the relevant candidate are transferred at proportionately weighted values by the Weighted Inclusive Gregory Method. Ballot papers with no 'next available preference' are set aside as 'non-transferable' and take with them the proportionate share of the surplus. All these calculations are made to a precision of five decimal places.
- When an exclusion occurs, candidates are excluded one at a time; there is no provision for multiple exclusions. There are no sub-stages during the exclusion process; all ballot papers are transferred to the 'next available preference'. When the count is conducted by electronic means, votes are transferred from excluded candidates until all vacancies have been filled; when the count is conducted manually and only two candidates remain for the last vacancy, the votes of the excluded candidate are not transferred.
- If two candidates have exactly the same number of votes when a surplus has to be transferred or a candidate has to be excluded, the most recent difference between the votes of those candidates is decisive. (See page 7 for more details.) When candidates are tied at all stages, the Returning Officer decides by lot.
- Returning Officers are required to publish the votes for each candidate at each stage of the count and information about the numbers of votes transferred and the numbers and values of ballot papers transferred at each stage of the count.

The detailed Rules are illustrated by an example count for a 3-member ward in which the election was contested by 5 candidates and 2397 electors cast valid votes.

Calculating the Quota

Once the total number of valid ballot papers has been counted, the minimum number of votes sufficient to ensure the election of a candidate is calculated. This number is called the "quota". The quota in a multi-member election is equivalent to an absolute majority in a single-winner election because in a 3-member ward only 3 candidates can obtain the calculated quota of votes. Thus the three candidates who each obtain one quota of votes are the three undisputed winners.

The Quota prescribed in the Election Rules is calculated as:

$$\frac{\text{total number of valid votes}}{\text{number of vacancies to be filled} + 1} + 1$$

If the result of the division is not an exact whole number, the remainder is ignored.

So in the example election the quota would be:

$$(2397 / (3 + 1)) + 1 = (2397 / 4) + 1 = 599 + 1 = 600 \text{ votes.}$$

Counting the First Preferences

All the valid ballot papers are sorted according to the first preference marked on each paper and the number of votes for each candidate is counted and recorded. At the start of the count each ballot paper has a value of one vote ('current value' = 1 vote).

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This specimen ballot paper shows a first preference for Flora Campbell and would add one vote to her total of first preference votes.

Specimen Ballot Paper	
ADAMS Jack	2
BAKER Able	4
CAMPBELL Flora	1
GRAY Earl	3
MILLER Windy	

In the example election the numbers of first preference votes for each candidate were as shown in Table 1.

Table 1. Stage 1: First preference votes

Stage 1	First Preferences
ADAMS Jack	550
BAKER Able	377
CAMPBELL Flora	972
GRAY Earl	167
MILLER Windy	331
Total	2397

Flora Campbell, with 972 votes, is elected because her total number of votes exceeds the quota of 600. Flora Campbell has a surplus of 372 votes, i.e. $972 - 600$, and this surplus must be transferred at the next stage in the count. If two or more candidates have surpluses, the largest surplus is transferred first. If Flora Campbell had received exactly 600 first preference votes she would have been elected, but there would be no surplus to transfer and her ballot papers would not be examined again. (Election by exact quota is very rare in real elections.)

Transferring Surplus Votes

Surplus votes are transferred by the Weighted Inclusive Gregory Method (WIGM), as specified in the Election Rules. In this method **all** of the ballot papers held by the candidate with the surplus are examined. The surplus votes are transferred in accordance with the 'next available preferences' marked on those ballot papers by the voters.

The second stage of the example count is the transfer of Flora Campbell's surplus votes. All of the 972 ballot papers that were marked for Flora Campbell as first preference are now sorted according to the second preference marked on each paper. The Specimen Ballot Paper at the top of this page shows a second preference for Jack Adams and that paper would be transferred to Jack Adams.

If Jack Adams had also been elected at the first stage (because he had 600 or more first preference votes), that ballot paper would be transferred to Earl Gray as the 'next available preference', i.e. a candidate who has not yet been elected or excluded. Under WIGM rules, votes are not transferred to already elected candidates.

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If no candidate had been marked as second preference that ballot paper would be set aside as 'non-transferable'.

To transfer Flora Campbell's surplus of 372 votes, all 972 ballot papers are examined and transferred, but the value of these 972 ballot papers must be reduced to ensure that only the 372 surplus votes are transferred. This is done by calculating a 'transfer value' for each ballot paper. The transfer value represents the proportion of the votes to be transferred.

The WIGM Transfer Value (TV) is calculated as:

$$\frac{\text{surplus votes of elected candidate} \times \text{current value of ballot paper}}{\text{total number of votes credited to elected candidate}}$$

Transfer values are calculated to 5 decimal places; if the result is not exact any remainder beyond 5 decimal places is ignored. So for Flora Campbell's 972 ballot papers, all with a current value of 1 vote, the transfer value will be:

$$\frac{372 \times 1}{972} = 0.38271$$

The numbers of ballot papers transferred to each candidate are then multiplied by this transfer value to give the numbers of votes that are to be transferred to each candidate.

In the example election, candidate Jack Adams was marked as second preference on 357 of the 972 ballot papers that had Flora Campbell as first preference. So the number of votes to be transferred to Jack Adams on those 357 ballot papers would be calculated as: $357 \times 0.38271 = 136.62747$ votes.

The numbers of ballot papers that had second preferences for the other candidates were: Able Baker 223; Earl Gray 83; Windy Miller 252. There was no second preference marked on 57 of the ballot papers and these were set aside as non-transferable. So with each of the 972 ballot papers having a transfer value of 0.38271 votes, Flora Campbell's surplus of 372 votes would be transferred as shown in Table 2.

Because the calculation of the transfer value is truncated at five decimal places, a small fraction of a vote is not transferred, in this case 0.00588 vote. The numbers of non-transferable papers and the numbers of non-transferable votes at each stage of the count will be published along with the results. The numbers of non-transferable votes carried on the non-transferable papers and the fractional votes that were not transferred due to rounding (truncation at five decimal places) are shown separately in Table 2, but only the total is shown in the stage summary (Table 3).

Table 2. Stage 2: Transfer of Flora Campbell's surplus

Next available preference	Number of papers marked with second preference	Number of votes to be transferred (TV = 0.38271)
ADAMS Jack	357	136.62747
BAKER Able	223	85.34433
GRAY Earl	83	31.76493
MILLER Windy	252	96.44292
No second preference	57	21.81447
Not transferred due to rounding	-	0.00588
Total	972	372.00000

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The effects of these transfers at stage 2 are shown in Table 3.

Table 3. Stage 2: Candidates' votes after transfer of Flora Campbell's surplus

	Stage 1	Campbell's surplus	Stage 2
Candidate	First preferences	Votes transferred	Votes after transfer
ADAMS Jack	550	+136.62747	686.62747
BAKER Able	377	+85.34433	462.34433
CAMPBELL Flora	972	-372.00000	600.00000
GRAY Earl	167	+31.76493	198.76493
MILLER Windy	331	+96.44292	427.44292
Non-Transferable	-	+21.82035	21.82035
Total	2397	=	2397.00000

Jack Adams' total vote (686.62747) now exceeds the quota (600 votes) and so Jack Adams is elected. Jack Adams has a surplus (86.62747 votes) and this surplus must be transferred as the next stage in the count because there are three candidates for the one vacancy that remains to be filled.

At the third stage of the count, **all** of Jack Adams' ballot papers will be examined and transferred. These ballot papers are of two different current values:

550 ballot papers with the first preference for Jack Adams: current value = 1 vote.

357 ballot papers transferred from Flora Campbell: current value = 0.38271 vote.

The Transfer Values for these two parcels of ballot papers are calculated separately, using the formula given on page 4 above. The surplus of the elected candidate is 86.62747 and the total number of votes credited to the elected candidate is 686.62747.

For the 550 first preference ballot papers, each with a current value of 1 vote, the transfer value will be:

$$\frac{86.62747 \times 1}{686.62747} = 0.12616$$

For the 357 ballot papers received by transfer from Flora Campbell, each with a current value of 0.38271 vote, the transfer value will be:

$$\frac{86.62747 \times 0.38271}{686.62747} = 0.04828$$

The ballot papers in the two parcels are sorted separately according to the next available preference marked on each paper, again passing over any preference for an already elected candidate. Ballot papers on which there is no next available preference will again be set aside as 'non-transferable'.

When the ballot papers which had Jack Adams as first preference are sorted, they will be transferred to the second preference marked on each paper unless that second preference is for Flora Campbell who has already been elected. If the second preference is for Flora Campbell, the paper will be transferred to the third preference.

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When the ballot papers Jack Adams received from Flora Campbell at stage 2 are sorted, they will be transferred to the third preference marked on each paper. The Specimen Ballot Paper at the top of page 3 above, previously transferred from Flora Campbell to Jack Adams, shows a third preference for Earl Gray and that paper would be transferred to Earl Gray.

In the example election the numbers of ballot papers with preferences for each of the remaining three candidates are shown separately for each parcel of papers in Table 4, together with the numbers of votes that will be transferred. This table again includes both the non-transferable votes carried by the non-transferable ballot papers and the vote fractions not transferred due to truncation in the calculation of the transfer values.

Table 4. Stage 3: Transfer of Jack Adams' surplus

Parcel of Ballot Papers	Papers with Jack Adams as first preference (550)		Papers transferred from Flora Campbell (357)		Total Votes to be transferred
	Number of papers with next preference	Votes to be transferred (TV = 0.12616)	Number of papers with next preference	Votes to be transferred (TV = 0.04828)	
BAKER Able	35	4.41560	7	0.33796	4.75356
GRAY Earl	400	50.46400	49	2.36572	52.82972
MILLER Windy	78	9.84048	263	12.69764	22.53812
No further preference	37	4.66792	38	1.83464	6.50256
Not transferred due to rounding	-	0.00204	-	0.00147	0.00351
Total	550	69.51620	357	17.28571	86.62747

The effects of these transfers at stage 3 are shown in Table 5.

Table 5. Stage 3: Candidates' votes after transfer of Jack Adams' surplus

	Stage 1	Campbell's surplus	Stage 2	Adams' surplus	Stage 3
Candidate	First preferences	Votes transferred	Votes after transfer	Votes transferred	Votes after transfer
ADAMS Jack	550	+136.62747	686.62747	-86.62747	600.00000
BAKER Able	377	+85.34433	462.34433	+4.75356	467.09789
CAMPBELL Flora	972	-372.00000	600.00000		600.00000
GRAY Earl	167	+31.76493	198.76493	+52.82972	251.59465
MILLER Windy	331	+96.44292	427.44292	+22.53812	449.98104
Non-Transferable	-	+21.82035	21.82035	+6.50607	28.32642
Total	2397	=	2397.00000	=	2397.00000

Jack Adams' surplus has been transferred, but it has not brought the vote of any other candidate up to the quota. Thus one vacancy remains to be filled. So the next stage must be to exclude the candidate with the smallest number of votes, in this case, Earl Gray who has 251.59465 votes.

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Excluding a Candidate

When a candidate is excluded, all of that candidate's ballot papers are examined and transferred to the next available preference marked on each paper. Each ballot paper is transferred at its current value.

The candidate who is to be excluded in the example election, Earl Gray, has ballot papers of four different values:

167 ballot papers with the first preference for Earl Gray:
current value of each paper = 1 vote.

83 ballot papers transferred from Flora Campbell:
current value of each paper = 0.38271 vote.

400 ballot papers transferred from Jack Adams:
current value of each paper = 0.12616 vote.

49 ballot papers transferred from Jack Adams after transfer from Flora Campbell:
current value of each paper = 0.04828 vote.

The ballot papers in each of these four parcels are sorted separately according to the next available preference marked on each paper, again passing over any preference for an already elected candidate. This means that the ballot papers can be transferred only to Able Baker or Windy Miller. Ballot papers on which there is no next available preference will be set aside as 'non-transferable'.

The Specimen Ballot Paper at the top of page 3 above, would be in the fourth parcel of 49 papers because it had previously been transferred from Flora Campbell (first preference) to Jack Adams (second preference) and then from Jack Adams to Earl Gray (third preference). That paper would now be transferred to Able Baker (fourth preference) and add 0.04828 vote to Able Baker's total vote.

In the example election the numbers of ballot papers with preferences for the remaining two candidates are shown separately for each parcel of papers in Table 6, together with the numbers of votes that will be transferred.

The effects of these transfers are shown in the Final Result sheet in Table 7. The transfer of 152.79922 votes to Windy Miller brought his total vote to 602.78026 votes. This exceeds the quota and so Windy Miller takes the last of the three vacancies.

Filling the Last Vacancies

If at any stage during the count, the number of continuing candidates, i.e. those not elected and not excluded, is equal to the number of vacancies remaining to be filled, those candidates are elected. In this event, no further transfers of ballot papers and votes are made, even if the last elected candidates have not attained the quota.

Provision for Tied Votes

When a surplus has to be transferred or a candidate has to be excluded, two or more candidates sometimes have exactly the same number of votes. If this happens, the Returning Officer will look back through the count for the most recent stage at which there was a difference between the votes of the two candidates. If a difference is found at an earlier stage, the candidate with the higher number of votes in the case of a surplus transfer or the lower number of votes in the case of an exclusion will have their ballot papers transferred first. If there was no difference at any stage, the Returning Officer will determine by lot which surplus to transfer or which candidate to exclude. In an electronic count, the process is halted for manual intervention by the Returning Officer to cast the lot.

Table 6. Stage 4: Transfer of Earl Gray's votes on exclusion

Parcel of Ballot Papers	Earl Gray first preference		Transferred from Flora Campbell		Transferred from Jack Adams		Transferred from Jack Adams after transfer from Flora Campbell		Total Votes to be transferred
	Number of papers with next preference	Votes to be transferred (TV = 1.00000)	Number of papers with next preference	Votes to be transferred (TV = 0.38271)	Number of papers with next preference	Votes to be transferred (TV = 0.12616)	Number of papers with next preference	Votes to be transferred (TV = 0.04828)	
BAKER Able	54	54.00000	15	5.74065	84	10.59744	7	0.33796	70.67605
MILLER Windy	96	96.00000	58	22.19718	267	33.68472	19	0.91732	152.79922
No further preference	17	17.00000	10	3.82710	49	6.18184	23	1.11044	28.11938
Total	167	167.00000	83	31.76493	400	50.46400	49	2.36572	251.59465

Table 7. Stage 4: Final Result

Total valid vote = 2397 Number to be elected = 3 Quota = 600

	Stage 1	Campbell's surplus	Stage 2	Adams' surplus	Stage 3	Gray's exclusion	Stage 4	
Candidate	First preferences	Votes transferred	Votes after transfer	Votes transferred	Votes after transfer	Votes transferred	Votes after transfer	
ADAMS Jack	550	+136.62747	686.62747	-86.62747	600.00000		600.00000	Elected
BAKER Able	377	+85.34433	462.34433	+4.75356	467.09789	+70.67605	537.77394	
CAMPBELL Flora	972	-372.00000	600.00000		600.00000		600.00000	Elected
GRAY Earl	167	+31.76493	198.76493	+52.82972	251.59465	-251.59465	0.00000	
MILLER Windy	331	+96.44292	427.44292	+22.53812	449.98104	+152.79922	602.78026	Elected
Non-Transferable	-	+21.82035	21.82035	+6.50607	28.32642	+28.11938	56.44580	
Total	2397	=	2397.00000	=	2397.00000	=	2397.00000	