



# The Mass-Balance Audit

A mass-balance audit compares the volume of organic product sold or produced against the volume of organic ingredients purchased and on-hand over a defined period. This article walks through how the formula works, the three calculations that make up a complete mass-balance, what records each calculation draws from, how to read a discrepancy, and how to run the exercise yourself before your inspector selects an ingredient.



## What You'll Learn

- What a mass-balance audit is, and how it differs from the traceback audit inspectors also conduct at every inspection
- The ways to approach a mass-balance: ingredient mass-balance, ingredient content comparison, and finished product mass-balance
- The  $A + B - D = C$  formula and what records each variable requires
- How to read a discrepancy: when a gap between calculated and recipe-based production use is normal, and when it signals an organic integrity concern
- A step-by-step walkthrough for running an internal mass-balance before inspection

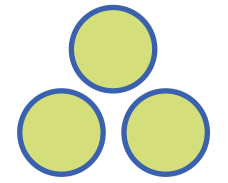
Every organic inspection must include two required audits of your records: a traceback and a mass-balance.<sup>1,2</sup> The traceback tests the chain of custody, assessing whether an inspector can follow one finished product lot backward through your records to the certified organic source of its ingredients. The mass-balance tests whether the “quantities of organic product and ingredients produced or purchased account for organic product and ingredients used, stored, sold, or transported (that is, inputs account for outputs).”<sup>1</sup>

The two audits are complementary. A traceback can succeed even if quantities don't balance, and a mass-balance can balance even if individual document links are broken. Running both together gives an inspector a more complete picture of organic integrity than either could provide alone.

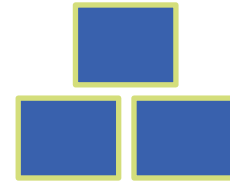
***“Mass-balance is when we calculate how much came in, how much was used, how much is left over, and making sure it all agrees.... It's like balancing the checkbook. If you start with 10 pounds, you should end with 10 pounds, roughly.”***

**Genevieve Albers**  
Compliance Manager  
Traditional Medicinals

Ingredients Coming In



Products Going Out



## THE SCALES MUST BALANCE

The Mass-Balance Audit compares volumes of organic ingredients in vs. organic product out over a defined time period.

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A mass-balance audit is built especially well to catch one core organic fraud scenario: an operation that labels and sells more organic product than it could plausibly have produced from the organic ingredients it purchased.<sup>1</sup> Quantity substitution tends to be detected during the mass-balance when it doesn't otherwise show up in the traceback audit and other records reviews. Inspectors are able to focus particularly on high cost ingredients where the financial incentive to substitute a cheaper nonorganic alternative is strongest.

This article covers the mass-balance audit in detail. Learn more about companion topics in the following articles:

- [The Traceback Audit](#)
- [Building and Maintaining an Organic Audit Trail](#)

## THE THREE PARTS OF A FULL MASS-BALANCE

A comprehensive mass-balance audit covers three separate calculations, each drawing from a different set of records.<sup>3</sup> The regulations don't specify this level of detail, but industry practice has developed the following system and it has now become standard.

- **Ingredient Mass-Balance:** Assesses whether the operation had enough of the selected ingredient (in inventory plus purchases) to support the total amount of that ingredient used in production.
- **Ingredient Content Comparison:** Compares the amount of the ingredient used for production against the amount of that ingredient actually contained in the finished product(s), across all finished products that use it.
- **Finished Product Mass-Balance:** Compares the amount of finished product sold with the amounts produced and held in inventory. A finished product mass-balance can be performed in different contexts, based on the operation, the certifier instructions, or the inspector's assessment.

|                     | Ingredient Mass-Balance                                                                 | Ingredient Content Comparison                                                 | Finished Product Mass-Balance                                                           |
|---------------------|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| <b>Calculation</b>  | Beginning inventory +<br>Purchases –<br>Ending inventory =<br>Amount used in production | Amount used in production<br>vs.<br>Amount in finished products<br>per recipe | Beginning inventory +<br>Amount produced –<br>Ending inventory =<br>Amount shipped/sold |
| <b>Record Types</b> | Receiving logs, Inventory counts, Production/batch records, Waste logs                  | Product formulas/recipes, Production/batch records                            | Production/batch records, Sales records, Shipping BOLs, Inventory counts                |

It is uncommon for all three of these calculations to be performed at a standard inspection. Inspectors often exercise judgment about which calculations to run. For a single-ingredient distributor that receives and resells product without processing, the finished product mass-balance may be sufficient. For a multi-ingredient processor, the inspector is looking to verify that enough of the ingredient was on hand *and* that the formula correctly accounts for it in the finished product.

## THE FORMULA

The same formula applies to both the Ingredient Mass-Balance and the Finished Product Mass-Balance.

**A + B – D = C, where:**

- **A** = Beginning Inventory (what was on hand at the start of the audit period)
- **B** = Incoming Product (purchases, returns from customers, and transfers in during the period)
- **D** = Ending Inventory (what remains on hand at the end of the audit period)
- **C** = Outgoing Product (ingredient used in production, finished product shipped or sold, product discarded or wasted, samples retained for quality testing, and production shrink)

When the formula closes, C accounts for everything that left inventory. If C doesn't match the sum of documented outgoing activity, the difference must be found, accounted for, and the formula run again to show that organic inputs and outputs balance. If they do not, the mass-balance audit is unsuccessful.

## Practical Points on Each Variable

**A and D (beginning and ending inventory)** must come from physical inventory counts or dated inventory records. Calculated estimates don't satisfy this requirement. If your operation takes physical inventory only at year-end, the mass-balance would need to be based on a full year of data. Monthly physical counts give the inspector a tighter period to work with and give you more opportunities to catch discrepancies before they accumulate.

**B (incoming)** includes purchases but also any returns from customers, transfers-in from other warehouses, or product repacked from larger formats in the audit period.

**C (outgoing)** covers everything that reduced inventory during the period: Ingredients used in production runs, finished product shipped and sold, product discarded or destroyed, samples pulled for quality or regulatory testing, and any documented production shrinkage. Every item in C must come from a record.<sup>4</sup> If any outgoing quantity lacks a documented source, the formula can't be verified.

## Example Calculation

The following example applies all three calculations to a single fictitious operation, Green Hill Bakery.

- **Products:** Organic Spelt Loaves and Organic Spelt Rolls.
- **Selected Ingredient:** organic spelt flour
- **Audit Period:** Q1 (January 1 through March 31).

### Step 1: Ingredient Mass-Balance

| Variable                                      | Amount                            | Source Record                                                                                     |
|-----------------------------------------------|-----------------------------------|---------------------------------------------------------------------------------------------------|
| <b>A (Beginning Inventory)</b>                | 800 lbs                           | Physical count in inventory log from January 1                                                    |
| <b>B (Purchases)</b>                          | 4,200 lbs                         | Four invoices with BOLs on file during Q1                                                         |
| <b>D (Ending Inventory)</b>                   | 580 lbs                           | Physical count in inventory log dated March 31                                                    |
| <b>A + B – D = C (Outgoing Product)</b>       | $800 + 4,200 - 580 = 4,420$ lbs   | Calculated amount that should have left inventory during Q1                                       |
| <b>Documented Loss (Samples/Shrink/Waste)</b> | 60 lbs waste<br>15 lbs QA samples | Two damaged bags recorded in waste log, January 18 and February 7<br><br>Sample retention log, Q1 |
| <b>C (Outgoing Product) Adjusted</b>          | $4,420 - 60 - 15 = 4,345$ lbs     | Calculated amount available for production                                                        |

According to the operation's records, they had **4,345 lbs** of organic spelt flour available for production during Q1.

### Step 2: Ingredient Content Comparison

Green Hill's product formulas show:

- Each Spelt Loaf contains 1.1 lbs of spelt flour;
- Each package of Spelt Rolls contains 0.85 lbs of spelt flour.

Production records for Q1 show they produced:

- 3,820 Spelt Loaves;
- 590 packages of Spelt Rolls.

The formula for calculating the quantity of ingredient needed to produce the actual amount of final product is *Flour per unit × Units produced = Flour in finished product*.

| Product                              | Amount of Ingredient                                                      |
|--------------------------------------|---------------------------------------------------------------------------|
| <b>Organic Spelt Loaves</b>          | $1.1 \text{ lbs} \times 3,820 \text{ loaves} = 4,202 \text{ lbs}$         |
| <b>Organic Spelt Rolls</b>           | $0.85 \text{ lbs} \times 590 \text{ packages of rolls} = 502 \text{ lbs}$ |
| <b>Total Flour in Final Products</b> | 4,704 lbs of Spelt Flour                                                  |

**Comparison:** 4,704 lbs was needed for the finished product, but only 4,345 lbs of organic flour available for production! That would mean Green Hill produced more organic finished product than the flour on hand could have yielded.

Before treating this as a concern, check the batch records against the formula: the formula shows the planned flour content per unit, while the batch records show what was actually weighed in.

Green Hill’s batch records for Q1 show that actual flour weights in production were slightly lower than the formula target, as the baker adjusted hydration during a dry spell.

**Actual flour used in production per batch records:** 4,330 lbs.

**Discrepancy from available:** 4,345 lbs. available – 4,330 lbs. used = 15 lbs. surplus. Green Hill’s OSP indicates an expected process loss of 0.5%, which at this volume equals approximately 21.7 lbs. The 15 lb discrepancy falls within that documented range.

 **HANDLER TIP**

The ingredient content comparison uses the formula to calculate expected ingredient use. The batch records show actual ingredient use. If your formulas and batch records are telling different stories, investigate before inspection. Differences between the two are normal when recipes are adjusted in production, but only when batch records capture the actual weights from each run rather than copying the formula target.

**Step 3: Finished Product Mass-Balance**

Run the mass-balance formula separately for each finished product that contains the selected ingredient, spelt flour.

| Spelt Loaves:                           |                                                     |                                                                    |
|-----------------------------------------|-----------------------------------------------------|--------------------------------------------------------------------|
| Variable                                | Amount                                              | Source Record                                                      |
| A (Beginning Inventory)                 | 42 units                                            | Inventory log on January 1                                         |
| B (Produced)                            | 3,820 units                                         | Production records in Q1                                           |
| D (Ending Inventory)                    | 56 units                                            | Inventory log, March 31                                            |
| A + B – D = C (Outgoing Product)        | 42 + 3,820 – 56 = 3,806 units                       | Calculated amount that should have shipped or been discarded in Q1 |
| Documented Loss (Samples/ Shrink/Waste) | 0 units                                             | Production records, Inventory log, Q1                              |
| C (Outgoing Product) Adjusted           | 3,806 units – 0 units = 3,806 units                 | Calculated amount that should have shipped in Q1                   |
| Finished Product that Left the Facility | 3,806 units                                         | Sales invoices and BOLs, Q1                                        |
| RESULT                                  | 3,806 units expected – 3,806 units actual = 0 units | Balance ✓                                                          |

## Spelt Rolls:

| Variable                                       | Amount                                                                    | Source Record                                                      |
|------------------------------------------------|---------------------------------------------------------------------------|--------------------------------------------------------------------|
| <b>A (Beginning Inventory)</b>                 | 18 units                                                                  | Inventory log on January 1                                         |
| <b>B (Produced)</b>                            | 590 units                                                                 | Production records in Q1                                           |
| <b>D (Ending Inventory)</b>                    | 23 units                                                                  | Inventory log, March 31                                            |
| <b>A + B – D = C (Outgoing Product)</b>        | $18 + 590 - 23 = 585$ units                                               | Calculated amount that should have shipped or been discarded in Q1 |
| <b>Documented Loss (Samples/Shrink/Waste)</b>  | 0 units                                                                   | Production records, Inventory log, Q1                              |
| <b>C (Outgoing Product) Adjusted</b>           | $585 \text{ units} - 0 \text{ units} = 585 \text{ units}$                 | Calculated amount that should have shipped in Q1                   |
| <b>Finished Product that Left the Facility</b> | 585 units                                                                 | Sales invoices and BOLs, Q1                                        |
| <b>RESULT</b>                                  | $585 \text{ units expected} - 585 \text{ units actual} = 0 \text{ units}$ | <b>Balance</b> ✓                                                   |

All three parts of the mass-balance close cleanly for Green Hill. The inspector can see that the operation had sufficient certified organic flour to produce the finished product it sold, that the production loss is documented and within the stated tolerance, and that the amount of finished product that left inventory matches what was shipped. This is a successful comprehensive mass-balance audit.



## PRODUCTION LOSS, SHRINK, AND DISCARDS

In any production environment, some organic ingredient is lost between when it enters a process and when it emerges in the finished product. Mixing, baking, evaporation, trimming, residue left on equipment, and rejects for quality control all reduce the usable yield. A small discrepancy between the calculated outgoing quantity and the recipe-based quantity is expected in every operation. The question an inspector asks is not whether a gap exists but whether it is documented, explained, and proportionate.

### Which Direction Is the Discrepancy?

The direction of the discrepancy helps the inspector determine whether they are looking at normal production variance or a potential compliance issue.

| Interpretation                                                                                   | Result                                                                                                      | Reasoning                                                                                                                                                                                                                                                             |
|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <b>Normal</b>  | Finished product contains <b>LESS</b> ingredient than the OSP indicates should have been used in production | Expected. Loss as outlined in the OSP and production procedures is accounted for in records. This includes shrink, moisture loss, residue left on equipment, rejects for quality control, and any other normal production practice that reduces the finished product. |
|  <b>Concern</b> | Finished product contains <b>MORE</b> ingredient than the OSP indicates should have used in production      | Organic integrity issue. More organic product was labeled than the certified ingredients on hand could have yielded. The math does not add up.                                                                                                                        |

In the Green Hill example, the finished product contained less spelt flour than the formula projected (because the baker used less than the formula specified) and the batch records captured those actual weights. If instead the batch records showed more flour used than was available from inventory, that would require explanation. If the finished product mass-balance showed more units shipped than produced plus beginning inventory, that would be an immediate concern.<sup>1</sup>

To keep discrepancies explainable, document the following:

☐ **Expected production loss rates**

Include production loss expectations in your OSP or production procedures so that normal variance is documented ahead of time and the inspector has a benchmark to compare against.

☐ **Waste and discard logs**

Record specific instances of product discarded, including the date, quantity, lot, and reason.

☐ **Sample retention logs**

Product pulled for quality or regulatory testing leaves inventory without being sold. These quantities must be recorded somewhere or the formula won't balance.

☐ **Customer returns**

Product coming back into inventory affects the ending count and must be logged.

☐ **Inventory adjustments**

Record broken cases, damaged product, and spoilage. Any adjustment to inventory counts must be documented at the time it occurs, not reconstructed later.

## TYPES OF RECORDS

Every variable in the formula must come from a record.<sup>4</sup> Specific records will vary based on your business.<sup>5</sup> An estimate is not a substitute for a count, and a count without a date is not sufficient. The mass-balance can only be completed if weights or volumes are captured at every stage where product moves.

### **Ingredient Mass-Balance records may include:**

- Dated inventory records with physical counts for beginning and ending inventory (A and D)
- Receiving records (invoices with organic designation, BOLs) for all purchases and transfers in (B)
- Production and batch records showing actual ingredient weights used (component of C)
- Waste logs, discard records, and sample retention logs (remaining components of C which reduce inventory)

### **Ingredient Content Comparison records may include:**

- Product formulas or recipes showing the percentage or weight of each ingredient per unit of finished product
- Batch records or production reports showing total weight or units of each finished product produced during the audit period

### **Finished Product Mass-Balance records may include:**

- Production records (units or lbs produced)
- Inventory records for finished product with dated beginning and ending counts
- Sales records and shipping BOLs (units or lbs shipped and sold)
- Any returns or discards of finished product

When records capture weights and quantities at every stage, the mass-balance exercise is mostly arithmetic. When they don't, no amount of document organization compensates for the missing numbers.

***“Think about what the end use of the records is going to be.... Can it track how much comes in and how much comes out? That’s really the bare minimum for the recordkeeping that you need to have.”***

**Lynne Haynor**  
*Organic Conservation Specialist*  
*Organic Trade Association*

Inspectors are also expected to cross-check results using a second independent source.<sup>6</sup> For example, comparing shipping quantities from the inventory system against sales figures from a separate accounting system. If all numbers come from the same system, they will tend to agree regardless of accuracy. Two independent sources that reach the same totals are a much stronger confirmation.

## HOW THE INSPECTOR SELECTS THE INGREDIENT AND PERIOD

The certifier and inspector choose which ingredient to audit and which time period to examine. In practice, some certifiers will allow inspectors to offer a degree of latitude while others are very specific, but the selection is theirs to make. Your operation typically does not choose the subject.

Inspectors tend to select ingredients where the financial motivation to substitute is highest: expensive certified organic commodities, ingredients with a large price gap between organic and conventional, or ingredients that appeared on the NOP's recent fraudulent certificate notices. If your operation handles those ingredients, a mass-balance on them is a reasonable expectation at any inspection.

The audit period follows your recordkeeping practices. An inspector looks at how you organize your records and selects a period that aligns with your inventory cycle, typically a quarter, a growing season, or a full year. Operations that take physical inventory only at year-end will support, at the minimum, an annual mass-balance. Operations that take inventory monthly or more frequently can support a much tighter exercise, which means problems are smaller in scale and easier to explain when they surface.

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## RUNNING YOUR OWN INTERNAL MASS-BALANCE

Handlers often describe the mass-balance as the more intimidating audit compared to the traceback, largely because it involves pulling numbers from multiple record types at once. The most effective way to change that experience is to run the exercise before your inspector selects the ingredient.

An internal mass-balance does the same thing the inspector will do: select an ingredient, define a period, gather the records, run the formula, compare against production records and formulas, and close the loop on the finished product. The only difference is that when you find a gap, you can fix it before rather than explaining it during the inspection.

***“What they wanted to look at was all of our raw materials: what did we use, what did we use it in, what formula did we create it in, what products were made, where those products were distributed, and did we have anything remaining in inventory.... We are trying to minimize fraudulent activity through this simple process.”***

**Tracey Vanfield**  
OPS Director  
Scratch & Peck Feeds

Walk through the following steps to run your own internal mass-balance. Pick an ingredient you purchase in volume for a product with a known formula. If you haven't done this before, start with your highest-volume organic ingredient and a recent quarter.

1. **Select an ingredient.** Choose one used in multiple products if possible, so the exercise tests your formulations across the full product line.
2. **Define the audit period.** Align the period with your inventory cycle. Use the dates of your two most recent physical inventory counts for the ingredient.
3. **Gather inventory records.** Confirm A (beginning inventory) and D (ending inventory) come from documented physical counts, not calculated figures.
4. **Gather receiving records.** Total all purchases, returns, and transfers in during the period (B). Verify each has an invoice designating the product as organic.

5. **Apply the formula.  $A + B - D = C$ .** C is how much of the ingredient should have left inventory during the period. Pull waste logs, discard records, and sample retention records. What remains after subtracting those documented losses is the quantity that should have gone into production.
6. **Pull formulas and batch records.** Calculate how much of the ingredient each finished product should contain (formula amount per unit  $\times$  units produced). Compare that to actual ingredient use from batch records. Note any discrepancy and check whether it falls within your documented process loss tolerance.
7. **Run the finished product balance.** For each product containing the ingredient: beginning finished product inventory + produced – ending finished product inventory = shipped/sold. Compare against sales records and shipping BOLs.
8. **Reconcile.** If the numbers balance, your records are mass-balance ready for this ingredient and period. If they don't, identify where the gap is and whether it can be explained by documented losses. Unexplained gaps are the thing to address before inspection.



### HANDLER TIP

Johanna Phillips of Strengthening Organic Systems gives this practical advice on frequency: do internal inventory reconciliation monthly or quarterly. An operation that reconciles only at year-end faces a mass-balance based on a full year's accumulated data. Gaps are harder to identify, harder to explain, and harder to fix retroactively.

Download the [Mass-Balance Worksheet](#) to work through the calculation, step by step.

## CONCLUSION

A mass-balance is arithmetic applied to organic records. The calculation itself takes minutes once the records are assembled. The work is in building recordkeeping habits that capture quantities at every stage before the inspector arrives. Operations that track weights at receiving, use batch records that record actual ingredient weights from each run, take physical inventory counts on a regular cycle, and log every discard and sample will complete the mass-balance exercise without difficulty every time. The operations that struggle are the ones discovering mid-exercise that a variable has no documented source.

## ACTION ITEMS

- Run a mass-balance. Use the [Mass-Balance Worksheet](#) for your top ingredient from last quarter.
- Flag data gaps. Note missing or hard to locate information during the mass-balance.
- Verify actual weights. Ensure production records track to ingredient weights, not just formulas.
- Update forms. Fix recordkeeping forms to eliminate problems before they exist.
- Review waste logs. Check loss rates to see that they measure up and are included in calculations.
- Include retention logs in calculations every time.
- Record product leaving and returning.
- Repeat all of the above on organic products once certified.

## SOURCES CITED

1. USDA National Organic Program, 7 CFR §205.403(d)(4).
2. USDA National Organic Program, 7 CFR §205.403(d)(5).
3. Organic Integrity Learning Center (OILC) Course. NOP-280: *Advanced Traceability and Mass-Balance Techniques*.
4. USDA National Organic Program, 7 CFR §205.103(b)(2).
5. USDA National Organic Program, 7 CFR §205.103(b)(1).
6. Organic Integrity Learning Center (OILC) Microlearning. *Conducting a Mass-Balance Audit*.



United States Department of Agriculture  
Agricultural Marketing Service  
National Organic Program

