CALIBRATION WORKSHEET
- BOOM SPRAYER -

Follow this step-by-step procedure to calibrate a sprayer. All liquid volumes are in litres (L), but you can use either metric or imperial units for distance and area (don’t mix them). Circle the units used such as \( \frac{500}{L/ha} \) L/acre

After you’ve finished calibrating your equipment, write key data in the box at left for future reference.

Use the Pesticide Use Calculation worksheet to find the area sprayed by a full tank, and to calculate how much of each pesticide you’ll need to buy and add to each tank.

1. SET-UP

**Inspection Before Sprayer Start-Up**

- Tank size is \( ________ \) L
- Calibration strip or dipstick for tank?
- Tire size & pressures okay?
  (Record on p 7)
- Hoses in good condition?

Filler opening screen
- in place? clean? good repair?
- mesh size correct? \( ________ \)

Suction screen
- in place? clean? good repair?
- mesh size correct? \( ________ \)

Nozzle screens (check each one)
- in place? clean? good repair?
- mesh size correct? \( ________ \)

Nozzles:
- nozzle type okay?
- all same size/ID#? (record in box above)
- correct nozzle spacing of \( ________ \) cm (in)
- nozzles spaced evenly?
- clean? not worn?
- aligned?
- are there nozzle check valves?

Boom height
- above target? \( ________ \) cm (in)
- is boom level?

Surge tank (piston & diaphragm pumps only)
- working properly?
- air pressure correct at \( ____ \) kPa( psi)
**Inspection with Sprayer Running**

Fill the tank more than half full with clean water.
- Start sprayer pump & run tractor throttle at ________ rpm.
- Note pump’s maximum rpm is ________.
- Open boom valve to fill lines and begin spraying
- Clean nozzles producing distorted patterns and retest
- Throw out damaged nozzles and replace them

Check and fix any problems
- Leaks?
- Valves working?

---

**Measuring Nozzle Output**

Draw nozzle locations on the diagram below and number them to identify which ones may need to be cleaned or replaced after testing.

As the sprayer runs, collect and record the output for a set time e.g. 1 minute, 30 sec or 15 sec. Measure in litres.

Horizontal boom (includes drop pendants)

Nozzle pressure is ________ kPa (psi)

1. In the box below, divide Total Output in L by the number of nozzles to find the average output per nozzle for collection time.

<table>
<thead>
<tr>
<th>Total Output Collected</th>
<th>Average Output Per Collection Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L ÷ # of noz. = L</td>
</tr>
</tbody>
</table>

2. For uniformity, find the maximum and minimum acceptable output (5% more or less than average.) Replace nozzles if above maximum output or below minimum output.

Minimum Output = 0.95 \( \times \) _____ Average Output = _____ L
Maximum Output = 1.05 \( \times \) _____ Average Output = _____ L

3. Replace all nozzles if average output is 15% more than a new nozzle’s output (from manufacturer’s chart or discharge test).

---

**Swath Width**

Do only ONE of these. You’ll use the swath width on the next page.

**Broadcast swath:** multiply number of nozzles by nozzle spacing; convert to metres or feet

\[
\text{Swath width} \equiv \frac{\text{noz.} \times \text{spacing}}{100 \text{ cm/m}} = \text{m} \quad \text{or} \quad \frac{\text{noz.} \times \text{spacing}}{12 \text{ in/ft}} = \text{ft}
\]
Band swath: multiply number of bands by width of each band; convert to metres or feet

<table>
<thead>
<tr>
<th>bands</th>
<th>x</th>
<th>band width</th>
<th>÷</th>
<th>conversion</th>
<th>=</th>
<th>swath width</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>cm</td>
<td>÷</td>
<td>100 cm/m</td>
<td>=</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in</td>
<td>÷</td>
<td>12 in/ft</td>
<td>=</td>
<td>ft</td>
</tr>
</tbody>
</table>

Row crop swath: multiply number of rows by width of each row. (Note: rows are stated in metres or feet, so no conversion is needed).

<table>
<thead>
<tr>
<th>rows</th>
<th>x</th>
<th>row width</th>
<th>=</th>
<th>swath width</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>m</td>
<td>=</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ft</td>
<td>=</td>
<td>ft</td>
</tr>
</tbody>
</table>

2. Measuring Delivery Rate

You can use either of these methods to determine the actual delivery rate of the sprayer.

Test Area method
1. Mark out a test strip at least 60 m or 200 ft long. Your strip was _______ m (ft) long.  
   **Note:** A one acre test strip is \(43,560 \text{ ft}^2 ÷ \text{swath width} = \text{ft} \) long.
2. Fill the tank about half full with water and start sprayer nozzles and agitation. Then set the pressure to what you want. Use the same throttle RPM you'll use in the field. Pressure _______kPa (psi)
3. Choose a tractor gear to get desired forward speed. Gear _____ Throttle _____rpm (as in Step 2 above)
4. Record the volume of water in the tank before the test: _______ L. Mark where the sprayer is parked so you can return it to the same position to measure water sprayed (level ground is best).
5. Drive towards the first stake at the correct speed, and open the boom valve as you pass it. Check the sprayer pressure. Close the boom valve as you pass the second stake.
6. Repeat until at least 10% of a full tank is sprayed. Record the number of runs (_______ runs).
7. Return to the water filling site and park in the same location as in Step 4. Measure the amount of water remaining: _______ L. Number of litres discharged during the test was _______ L.
8. Calculate the test area. Multiply the strip length by your swath width by the number of runs.

<table>
<thead>
<tr>
<th>strip length</th>
<th>x</th>
<th>swath width</th>
<th>x</th>
<th># runs</th>
<th>=</th>
<th>test area</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>x</td>
<td>m</td>
<td>x</td>
<td>runs</td>
<td>=</td>
<td>m(^2)</td>
</tr>
<tr>
<td>ft</td>
<td>x</td>
<td>ft</td>
<td>x</td>
<td>runs</td>
<td>=</td>
<td>ft(^2)</td>
</tr>
</tbody>
</table>

9. Calculate the Delivery Rate. Divide water sprayed (L) by test area (m\(^2\) or ft\(^2\)).

\[
\text{delivery rate} = \frac{\text{water sprayed}}{\text{test area}} \times \text{conversion} \]

<table>
<thead>
<tr>
<th>(L/ha=2.5 times L/acre)</th>
<th>L/acre=0.4 times L/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>L ÷ m(^2)</td>
<td>L ÷ ft(^2)</td>
</tr>
<tr>
<td>10,000 m(^2)/ha</td>
<td>43,560 ft(^2)/acre</td>
</tr>
</tbody>
</table>

Timed Output method
1. Measure the forward speed of your tractor and sprayer with a half tank of water in field conditions. (Tractor speedometers need to be checked for accuracy, see page 7.) _____ km/h (mph)
2. Measure total nozzle output by spraying for a set time (such as 10 min) and divide volume (L) by time to find total output (L/min) OR use total nozzle output (L/min) from page 2.

   Tank volume at start _______ L   Tank Volume at finish _______ L   Discharge time_______ min.
   Discharge volume (start-finish) = _______ L
   Total nozzle output = (Discharged Volume ÷ Time) = _______ L ÷ _______ min. = _______ L/min.
3. Calculate the Delivery Rate. Divide total output by forward speed and swath width and multiply by a constant.

\[
\text{delivery rate} = \frac{\text{total nozzle output}}{\text{forward speed}} \times \text{swath width} \times \text{constant} \]

<table>
<thead>
<tr>
<th>(L/ha=2.5 times L/acre)</th>
<th>L/acre=0.4 times L/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>L/min ÷ km/h</td>
<td>L/min ÷ mph</td>
</tr>
<tr>
<td>m x 600</td>
<td>ft x 495</td>
</tr>
</tbody>
</table>

Factsheet 234.005-2
3. Adjusting Delivery Rate

If the Delivery Rate of your sprayer is different than the rate listed on the pesticide label or recommended in the production guide, it can be adjusted in three ways:

1. **Nozzle size** should be changed if you wish to make large changes in delivery rate. Check with your nozzle supplier or agricultural advisor. Obtain a catalogue listing nozzles and nozzle outputs.
   The following formula can also be used to find nozzle size.

   \[
   \text{delivery rate} \times \text{forward speed} \times \text{nozzle spacing} \div \text{constant} = \text{nozzle output}
   \]

   \[
   \begin{array}{c|c|c|c|c|c}
   \text{delivery rate} & \times & \text{forward speed} & \times & \text{nozzle spacing} & \div \text{constant} = \text{nozzle output} \\
   \text{L/ha} & \times & \text{km/h} & \times & \text{cm} & \div 60,000 = \text{L/min} \\
   \text{L/acre} & \times & \text{mph} & \times & \text{in} & \div 5940 = \text{L/min} \\
   \end{array}
   \]

   List your nozzle options by referring to a manufacturer’s catalogue.

<table>
<thead>
<tr>
<th>Nozzle Size</th>
<th>Nozzle Pressure</th>
<th>kPa(psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nozzle Output</td>
<td>L/min</td>
<td></td>
</tr>
<tr>
<td>Forward Speed</td>
<td>km/h (mph)</td>
<td></td>
</tr>
<tr>
<td>Delivery Rate</td>
<td>L/ha (L/acre)</td>
<td></td>
</tr>
</tbody>
</table>

2. **Forward speed** changes will adjust the delivery rate. Slower speeds increase the amount sprayed in a field, and faster speeds reduce it. If your delivery rate is 112L/acre at 6 mph, then by halving your speed to 3 mph you’ll double the delivery rate to 224 L/acre.

   Use these formulas to calculate alternative combinations of delivery rates and speeds.

   \[
   \text{present forward speed} \times \text{present delivery rate} \div \text{new forward speed} = \text{new delivery rate}
   \]

   \[
   \begin{array}{c|c|c|c|c|c}
   \text{present forward speed} & \times & \text{present delivery rate} & \div & \text{new forward speed} = \text{new delivery rate} \\
   \text{km/h} & \times & \text{L/min} & \div & \text{km/h} = \text{L/min} \\
   \text{mph} & \times & \text{L/min} & \div & \text{mph} = \text{L/min} \\
   \end{array}
   \]

   Speed changes are usually made by using a different gear in order to keep tractor RPMs within the range recommended for the sprayer pump.

   \[
   \text{present forward speed} \times \text{present delivery rate} \div \text{new delivery rate} = \text{new forward speed}
   \]

   \[
   \begin{array}{c|c|c|c|c|c}
   \text{present forward speed} & \times & \text{present delivery rate} & \div & \text{new delivery rate} = \text{new forward speed} \\
   \text{km/h} & \times & \text{L/min} & \div & \text{L/min} = \text{km/h} \\
   \text{mph} & \times & \text{L/min} & \div & \text{L/min} = \text{mph} \\
   \end{array}
   \]

   When you have chosen a new gear, check with your nozzle supplier on which nozzle to use or calculate the new nozzle output (same formula as Step 1).

   \[
   \text{delivery rate} \times \text{forward speed} \times \text{nozzle spacing} \div \text{constant} = \text{new nozzle output}
   \]

   \[
   \begin{array}{c|c|c|c|c|c|c}
   \text{delivery rate} & \times & \text{forward speed} & \times & \text{nozzle spacing} & \div & \text{constant} = \text{new nozzle output} \\
   \text{L/ha} & \times & \text{km/h} & \times & \text{cm} & \div 60,000 = \text{L/min} \\
   \text{L/acre} & \times & \text{mph} & \times & \text{in} & \div 5940 = \text{L/min} \\
   \end{array}
   \]

3. **Spray pressure should be set for the correct droplet size.** Changing pressure is recommended only for very small changes in delivery rates. Otherwise your droplet size will change and cause drift or runoff problems. Since pressure must be increased four times to double the delivery rate, this is not a good way to adjust delivery rate.

After making the adjustments, measure the delivery rate again. Fill in a new Calibration Worksheet.

When your equipment is accurately calibrated and applying the desired delivery rate, then you are ready to spray. Use one of the next two pages to determine how much pesticide to buy and how much pesticide to add to a full or partial tank. Choose page 5 if the pesticide is given in a per area rate, otherwise use page 6.
4.a Calculating How Much Pesticide to Add to a Spray Tank – Per Area Rate

Example: Pesticide Labels read: “use 3L/ha in 1000L of water” or “use 3L/1000L of water/ha”. (Otherwise see page 6.)

Fill in values for only one column – hectares or acres. Use only hectares or only acres; don’t mix them. Use litres (L) for all liquid volumes. Use the italicized line if you are using acres.

Field area ______ ha ______ acres (hectares = 0.4 x acres)
Spray tank capacity _____ L ______ L (L = 3.79 x US gal. L = 4.55 x Imperial gal.)
Pesticide label application rate _____ kg or L/ha _____ kg or L/acre (L/acre = 0.4 x L/ha)
Spray volume _____ L/ha _____ L/acre (from label or production guide or field test)

Check your Calibration Worksheets and choose a suitable sprayer setup and Sprayer Delivery Rate

Sprayer Delivery Rate _____ L/ha _____ L/acre (L/acre = 0.4 x L/ha)

Copy values into the formulas below where needed.

<table>
<thead>
<tr>
<th>How much pesticide to buy?</th>
<th>field area</th>
<th>pesticide label application rate</th>
<th># of applications per year</th>
<th>pesticide to buy</th>
</tr>
</thead>
<tbody>
<tr>
<td>ha</td>
<td>kg or L/ha</td>
<td>x</td>
<td>x</td>
<td>= kg or L</td>
</tr>
<tr>
<td>acres</td>
<td>kg or L/acres</td>
<td>x</td>
<td>x</td>
<td>= kg or L</td>
</tr>
</tbody>
</table>

Full Tank

Area covered by a full tank?

\[
\text{Area covered by a full tank} = \frac{\text{tank capacity}}{\text{sprayer delivery rate}} = \frac{L}{L/ha} = \text{ha/tank}
\]

\[
\text{Area covered by a full tank} = \frac{\text{pesticide label application rate}}{\text{area covered by a full tank}} = \frac{\text{kg or L/ha}}{\text{ha/tank}} = \text{kg or L}
\]

\[
\text{Area covered by a full tank} = \frac{\text{kg or L/acre}}{\text{acres/tank}} = \text{kg or L}
\]

How much pesticide to add to a full tank?

\[
\text{Pesticide to add to a full tank} = \text{field area} \div \text{area covered by a full tank} = \text{tanks}
\]

Partial Tank

Measure the area to be sprayed by the last tank accurately to avoid mixing too much spray.

How much spray mix to make for a partial tank?

\[
\text{Spray mix to make in partial tank} = \text{sprayer delivery rate} \times \text{area remaining} = \frac{L/ha}{L} = L
\]

\[
\text{Spray mix to make in partial tank} = \frac{L/acre}{L} = L
\]

How much pesticide to add to a partial tank?

\[
\text{Pesticide to add to a partial tank} = \text{pesticide label application rate} \times \text{area remaining} = \frac{\text{kg or L/ha}}{L} = \text{kg or L}
\]

\[
\text{Pesticide to add to a partial tank} = \frac{\text{kg or L/acre}}{L} = \text{kg or L}
\]
### 4.b Calculating How Much Pesticide to Add to a Spray Tank – Per Dilution Rate

Example: Pesticide Label reads: “use 1L/100L of water and spray foliage thoroughly”. (Otherwise see page 5.)

Fill in values for only one column – hectares or acres. Use only hectares or only acres; don’t mix them. Use litres (L) for all liquid volumes. Use the italicized line if you are using acres.

<table>
<thead>
<tr>
<th>Field area</th>
<th>ha</th>
<th>acres (hectares = 0.4 x acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spray tank capacity</td>
<td>L</td>
<td>L (L = 3.79 x US gal. L = 4.55 x Imperial gal.)</td>
</tr>
<tr>
<td>Pesticide label application rate</td>
<td>kg or L/1000L of water (may be another amount of water)</td>
<td></td>
</tr>
<tr>
<td>Spray volume</td>
<td>L/ha</td>
<td>L/acre (from label, production guide or field test)</td>
</tr>
</tbody>
</table>

Check your Calibration Worksheets and choose a suitable sprayer setup and Sprayer Delivery Rate

Sprayer Delivery Rate | L/ha | L/acre (L/acre = 0.4 x L/ha) |

Copy values into the formulas below where needed.

#### How much pesticide to buy?

<table>
<thead>
<tr>
<th>field area</th>
<th>x</th>
<th>pesticide label dilution rate</th>
<th>x</th>
<th>sprayer delivery rate</th>
<th>x</th>
<th># of applications per year</th>
<th>=</th>
<th>pesticide to buy</th>
</tr>
</thead>
<tbody>
<tr>
<td>ha x</td>
<td>kg or L/1000L</td>
<td>x</td>
<td>L/ha x</td>
<td>=</td>
<td>kg or L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>acres x</td>
<td>kg or L/1000L</td>
<td>x</td>
<td>L/acre x</td>
<td>=</td>
<td>kg or L</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Full Tank

**Area covered by a full tank?**

\[
\text{tank capacity} + \frac{\text{sprayer delivery rate}}{L} = \frac{\text{area covered}}{\text{ha/tank}}
\]

\[
\text{pesticide label dilution rate} x \frac{\text{Tank capacity}}{L} = \frac{\text{pesticide to add}}{\text{kg or L}}
\]

**Number of tankfuls required for area?**

\[
\frac{\text{field area}}{\text{ha/tank}} = \frac{\text{tanks}}{\text{ha/tank}}
\]

\[
\frac{\text{acres}}{\text{acre/tank}} = \frac{\text{tanks}}{\text{acre/tank}}
\]

#### Partial Tank

Measure the area to be sprayed by the last tank accurately to avoid mixing too much spray.

**How much spray mix to make for a partial tank?**

\[
\frac{\text{sprayer delivery rate}}{L/ha} x \frac{\text{area remaining}}{\text{ha}} = \frac{\text{spray mix to make in partial tank}}{L}
\]

\[
\frac{\text{sprayer delivery rate}}{L/acre} x \frac{\text{area remaining}}{\text{acre}} = \frac{\text{spray mix in partial tank}}{L}
\]

**How much pesticide to add to a partial tank?**

\[
\frac{\text{pesticide label dilution rate}}{\text{kg or L/1000L}} x \frac{\text{spray mix in partial tank}}{L} = \frac{\text{pesticide to add to partial tank}}{\text{kg or L}}
\]

\[
\frac{\text{pesticide label dilution rate}}{\text{kg or L/1000L}} x \frac{\text{spray mix in partial tank}}{L} = \frac{\text{pesticide to add to partial tank}}{\text{kg or L}}
\]
Forward Speed Calculations

Date: ____________________

Calculate the forward speed of your tractor and sprayer in field conditions encountered during spraying. If you change tires, tire pressures, or tire lugs wear significantly, speeds will change. Also speeds will change between dry and very wet field conditions.

1. Mark out a test strip at least 60 m or 200 ft long.
2. Fill the tank about half full with water and move to the test strip.
3. Choose the tractor gear and throttle for the forward speed you want. Gear ______ Throttle _______ rpm. Use the same throttle RPM when measuring nozzle output (Step 7).
4. Measure the time in seconds required to pass through the test strip on four runs. Reach the desired speed before entering the test strip, and hold that speed constant throughout the test run.
   
   1st run _____ + 2nd run _____ + 3rd run _____ + 4th run _____ = _______ seconds total time.

5. Calculate total distance travelled. Multiply test strip length (Step 1) by the number of runs.
   
   Your strip was _______ m(ft) long x _______ runs = _______ m(ft) total distance.

6. Calculate forward speed using the formula in the box at right.

   \[
   \text{forward speed} = \frac{\text{total distance}}{\text{total time} \times \text{constant}}
   \]

   | total distance | \( \div \) | total time | \( \times \) | constant | = | forward speed |
   |----------------|--------|-----------|--------|----------|----|--|----------------|
   | m               | sec    | 3.6       |        |          | = | km/h       |
   | ft              | sec    | 0.68      |        |          | = | mph        |

<table>
<thead>
<tr>
<th>Tractor #1</th>
<th>Tire Size</th>
<th>Tire Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Throttle rpm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time sec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total distance in (ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward speed km/h (mph)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tractor #2</th>
<th>Tire Size</th>
<th>Tire Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Throttle rpm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time sec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total distance in (ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward speed km/h (mph)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Sprayer Setup Summary

<table>
<thead>
<tr>
<th>Sprayer Setup #</th>
<th>Sprayer Setup #</th>
<th>Sprayer Setup #</th>
<th>Sprayer Setup #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured (calculated) Delivery Rate _______ L/acre</td>
<td>Measured (calculated) Delivery Rate _______ L/acre</td>
<td>Measured (calculated) Delivery Rate _______ L/acre</td>
<td>Measured (calculated) Delivery Rate _______ L/acre</td>
</tr>
<tr>
<td>_______ US gal/acre</td>
<td>_______ US gal/acre</td>
<td>_______ US gal/acre</td>
<td>_______ US gal/acre</td>
</tr>
<tr>
<td>Tank Volume _______ L _______ US gal</td>
<td>Tank Volume _______ L _______ US gal</td>
<td>Tank Volume _______ L _______ US gal</td>
<td>Tank Volume _______ L _______ US gal</td>
</tr>
<tr>
<td>Area Sprayed by a Full Tank _______ acre</td>
<td>Area Sprayed by a Full Tank _______ acre</td>
<td>Area Sprayed by a Full Tank _______ acre</td>
<td>Area Sprayed by a Full Tank _______ acre</td>
</tr>
<tr>
<td>Tractor Gear _______ throttle _______ rpm</td>
<td>Tractor Gear _______ throttle _______ rpm</td>
<td>Tractor Gear _______ throttle _______ rpm</td>
<td>Tractor Gear _______ throttle _______ rpm</td>
</tr>
<tr>
<td>Forward Speed _______ mph _______ km/hr</td>
<td>Forward Speed _______ mph _______ km/hr</td>
<td>Forward Speed _______ mph _______ km/hr</td>
<td>Forward Speed _______ mph _______ km/hr</td>
</tr>
<tr>
<td># of Nozzles _______ swath width _______ ft</td>
<td># of Nozzles _______ swath width _______ ft</td>
<td># of Nozzles _______ swath width _______ ft</td>
<td># of Nozzles _______ swath width _______ ft</td>
</tr>
<tr>
<td>Nozzle (size/type)</td>
<td>Nozzle (size/type)</td>
<td>Nozzle (size/type)</td>
<td>Nozzle (size/type)</td>
</tr>
<tr>
<td>Pressure @ Regulator _______ @ nozzles</td>
<td>Pressure @ Regulator _______ @ nozzles</td>
<td>Pressure @ Regulator _______ @ nozzles</td>
<td>Pressure @ Regulator _______ @ nozzles</td>
</tr>
</tbody>
</table>

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**FOR FURTHER INFORMATION CONTACT MINISTRY OF AGRICULTURE**

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