Ripening Facilities
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Fruit Ripening
Start the natural ripening process by controlling:
- Fruit temperature
- Room humidity
- Carbon dioxide
  and adding ethylene gas.

Fruits Commonly Ripened:
- Bananas
- Tomatoes
- Avocados
- Pears
- Mango
- Citrus fruits (degreening)

Ripening Facilities
- Room design

Construction
[Diagram of Citrus degreening and Forced air]

Conventional
[Image of conventional ripening facilities]
Forced Air

Airflow

Transport Ripening

Transport Ripening

WALL INSULATION

Ripening Facilities

- Room design
- Temperature management
Ripening Room Temperature

Near 70° F for most fruits

Banana Ripening Temperature

- Soft pulp above 65° F
- Chilling below 56° F
- 4 day cycle
- 7 day cycle
- Vent to control CO2

Cooling after Ripening

- Avocados, stonefruit, pears need to be cooled after ripening or conditioning.
- Use a forced-air system.
- FA cooling requires more refrigeration than needed for ripening.

Temperature monitoring

Automated monitoring

Hand-held Firmness Tester
Firmness During Ripening

Bartlett Pears @ 70° F

Ripening Facilities

- Room design
- Temperature management
- Airflow

Citrus Degreening

- Air deflector
- Air conditioning coils
- Air flow

Conventional Ripening Room

- Air deflector
- Air conditioning coils
- Air flow

Forced Air Ripening

Air Flow Rate

<table>
<thead>
<tr>
<th>Air Volume</th>
<th>Static Pressure</th>
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<tbody>
<tr>
<td>Banana, Avocado</td>
<td>0.6 - 1.9 cm w.c.</td>
</tr>
<tr>
<td>0.3 cfm/lb (l/s-kg)</td>
<td>0.25 – 0.75” w.c.</td>
</tr>
<tr>
<td>Oranges, etc.</td>
<td>0.1 - 0.05 cfm/lb (l/s-kg)</td>
</tr>
</tbody>
</table>
Ripening Facilities

- Room design
- Temperature management
- Airflow
- Humidity control

Ripening Facilities

- Ethylene management

Ripening Room Humidity

- 85% to 95% relative humidity
  - Humidifiers to add water to corrugated
  - Automated control available

Ethylene Level

- Ripening <100 ppm
- Degreening 3-5 ppm
- Automated ethylene control systems have used 18ppm.

Ethylene Sources

- Generator
- Gas cylinders
- Lecture bottles

Ethylene Safety

- Follow label
- Prevent accidental releases
- No ethylene cylinders in ripening rooms
- Train operators
- Measure ethylene (2800 ppm max.)
Ethylene safety

Continuous ventilation system

- Small fan
- Critical orifice
- Ethylene cylinder
- Fresh air inlet

Ripening

Ethylene Sensor

Global Cooling
- 0 – 20ppm or 0 - 100ppm
- $1,200 - $1400

Ripening Facilities

- Room design
- Temperature management
- Humidity control
- Air flow
- Ethylene management
- Carbon dioxide

Carbon Dioxide

CO₂ less than 0.5%

Carbon Dioxide Venting

- Ventilate even during ethylene addition.
- For ripening - one room volume in 2 - 4 hr.
- For degreening - one room volume in 0.5 - 1 hr.
- With CO₂ sensor flow is variable depending on fruit respiration.
- With controlled ethylene release these levels will prevent explosions.

CO₂ Sensor

- Vaisala CO₂ Transmitter #GMT221, 0-10%
- LCD display, remote sensing
- accuracy ± 0.02% CO₂ + 2% of reading
- $1,200
- Intec CO₂ sensor, $500
Ethylene Damage

Critical Levels = 0.1 to 1 ppm

Controlling Ethylene Damage

- Separate ripening and storage areas
- Reduce ethylene used in ripening
- Vent ripening rooms
- Vent cold storage
- Use scrubbers
- Eliminate engines

Venting

- 6 to 8 room air changes drop ethylene to 1% of original level.

Eliminate Engines