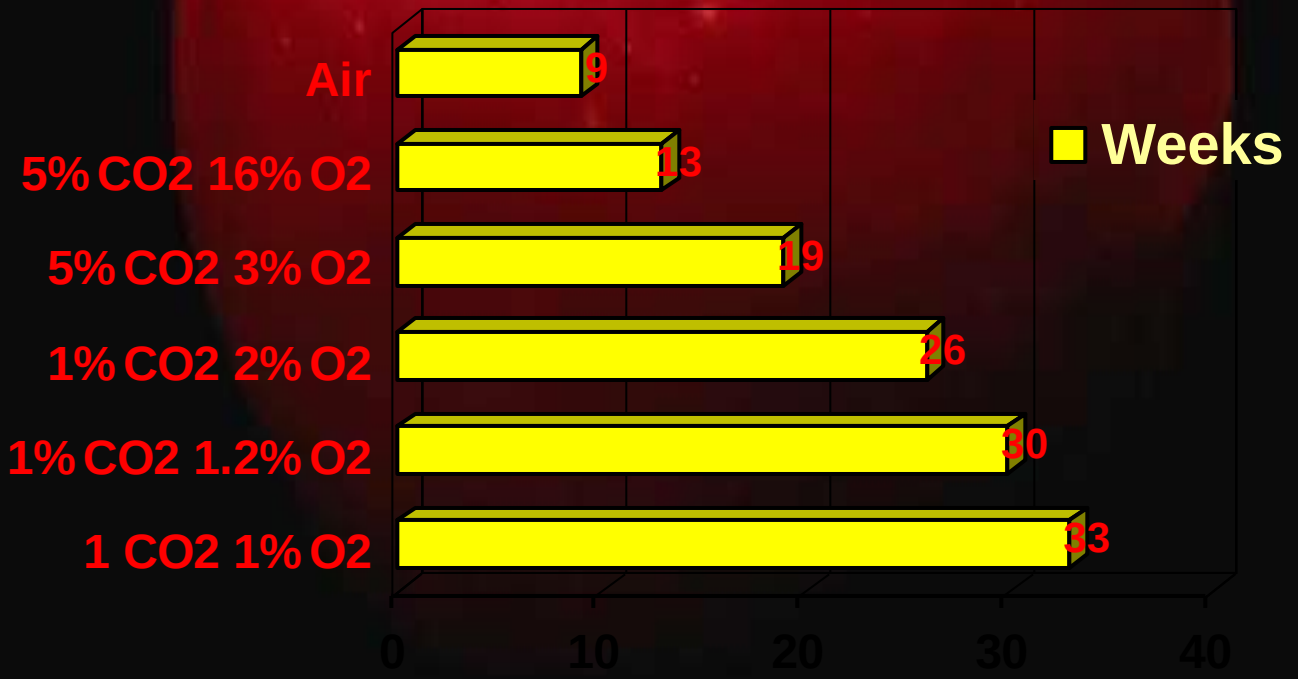
# Controlled Atmosphere Technology

*David Bishop* *Technical Director ICA Ltd*

# Apple Storage Life



# C.A. Store

$N_2$ = 97%

$O_2$ = 2%

$CO_2$ = 1%


Insulated & Sealed Buildings
Refrigeration
Atmosphere generation
Measurement & Control

# Store Construction

- Insulated Panels.....Europe, S Hemisphere
- Tilt up Concrete.....Pacific USA
- Timber & spray- on foam.....Gt Lakes USA

# External Loading stores

8 x 150 tonne CA apple stores, Back to back construction

# Stand alone CA stores

2x 70 tonne CA apple stores, external panel construction

# Internal panel stores

6 x internal 300 tonne vegetable stores

# Large project

22 x internal 180 tonne CA stores stores

# Internal design


Inside designed to accommodate bulk bins to ensure dense packing and good air circulation

# Store Construction

An important key to successful storage in controlled atmospheres is a high quality, leak tight storage room.

# Store Construction

Regular chill stores are designed for a maximum internal pressure of 1/2 inch water gauge. CA stores need to withstand 1 inch.....

That is twice as strong !!!!!

# Store Construction

**CA stores MUST be leak tight and tested regularly .**

**Pressurise to 3/4 inch water, The pressure should take at least 7 minutes to fall to 1/2 inch.**

**A high quality room will hold up for 30 mins or more.**

# Doors

A properly designed CA door is an important factor in maintaining leak tight construction

# Refrigeration

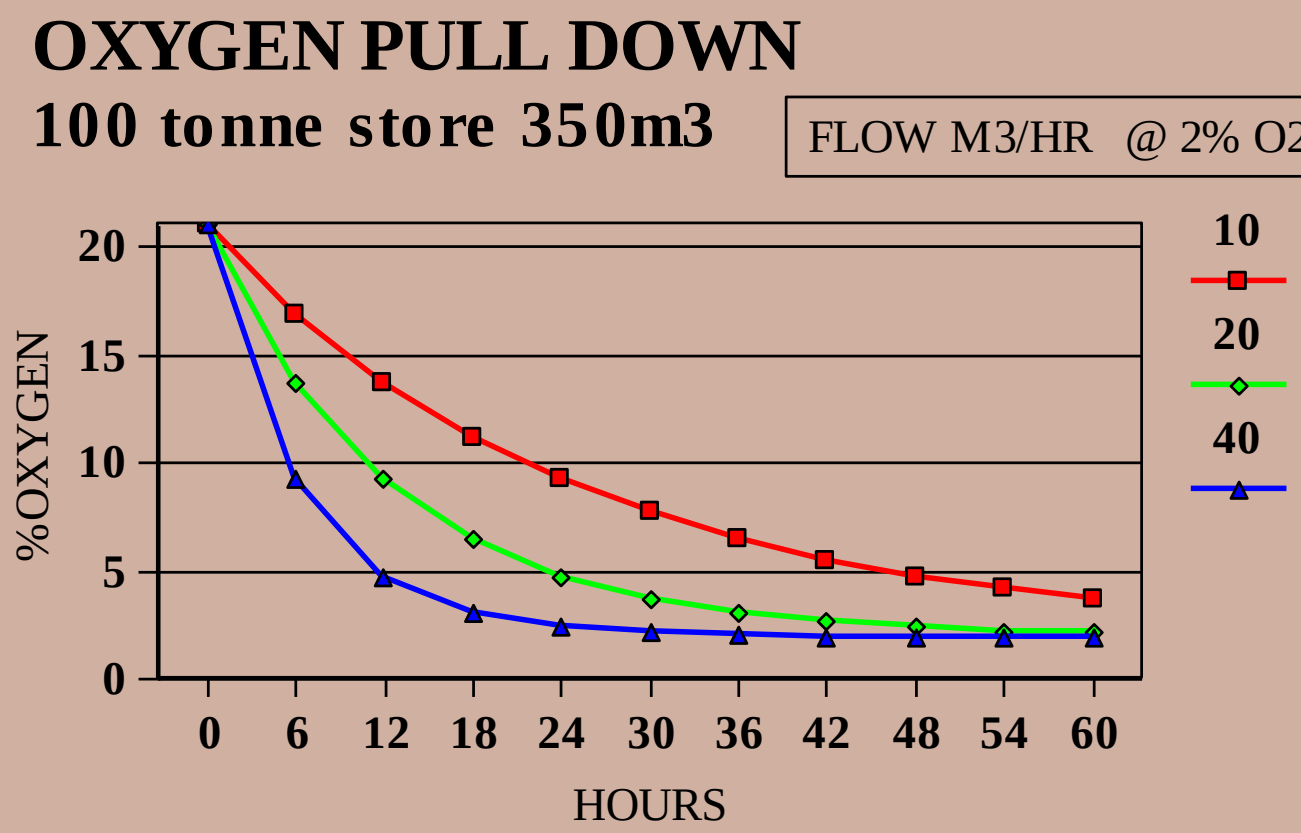
- MUST be designed for low water loss
- Sufficient cooling capacity to reduce temperature in 2-3 days
- Good air circulation to provide even temperatures
- Independent control of fan capacity
- Accurate temperature control of produce
- Safety controls to prevent freezing of product

# Removal of Oxygen

**Room MUST be leak tight**

- Natural Respiration
- Bulk Nitrogen
- Nitrogen Generators

# Removal of Oxygen



# Removal of Oxygen


Bank of modules for PSA nitrogen generator on large 22 room CA project

# Removal of Carbon Dioxide

**Depends on respiration rate.**

**Ventilation** (not for low oxygen)

**Hydrated Lime** $Ca(OH)_2$

**Carbon scrubbers**

**Nitrogen purge**

# Removal of Carbon Dioxide

## Hydrated lime

Placed in store

Good for low $CO_2$ storage

2 to 5% of product weight

Must be fresh

# Removal of Carbon Dioxide

Carbon scrubber
from Van Amerongen

# Measurement

- **Temperature** -1.0 to +15 °C accuracy +/-0.1°
- **Carbon Dioxide** 0 to 15% accuracy +/- 0.2%
- **Oxygen** 0-25% accuracy +/- 0.1%
- **Humidity** For low RH stores only

# Thermometers

- Precision thermistor

  Best for fruit storage

- Platinum resistance

  OK but care with wiring

- Thermocouple

  Not suitable

# Thermometers



Measure air and at least 3 fruit temperatures in 100 tonnes of storage to an accuracy of 0.1° C

# Humidity measurement

**Typical accuracies:**

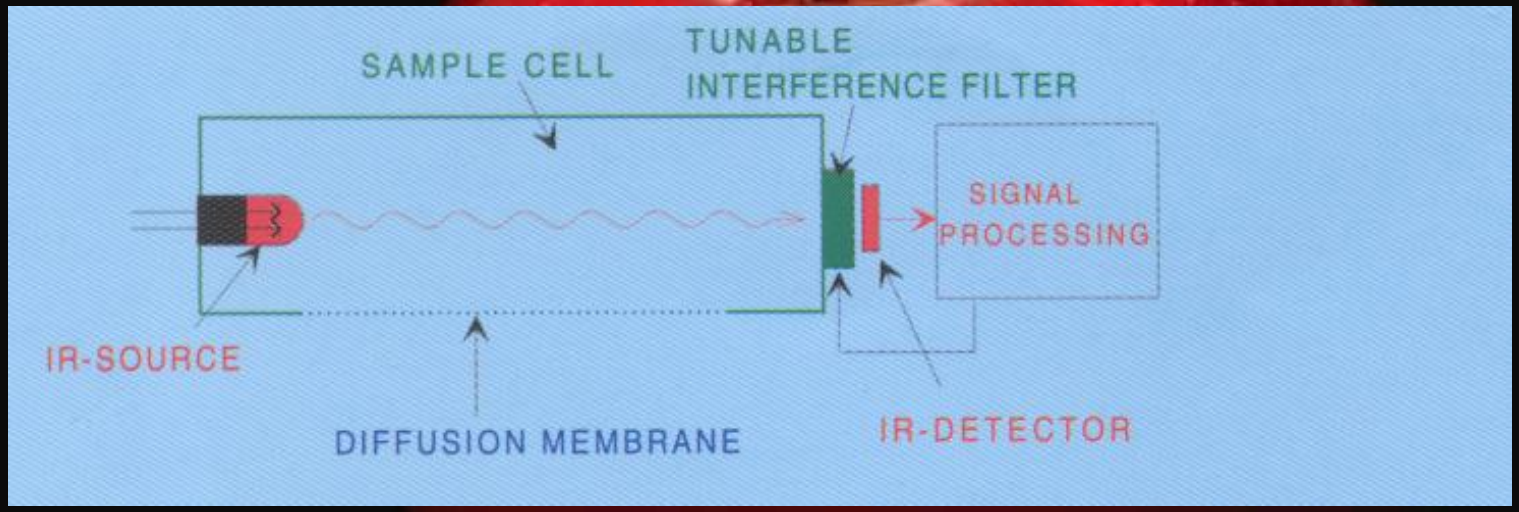
**+/- 5% @ 95% RH**

**+/- 2% @ 60% RH**

Not useful for regular high humidity storage.

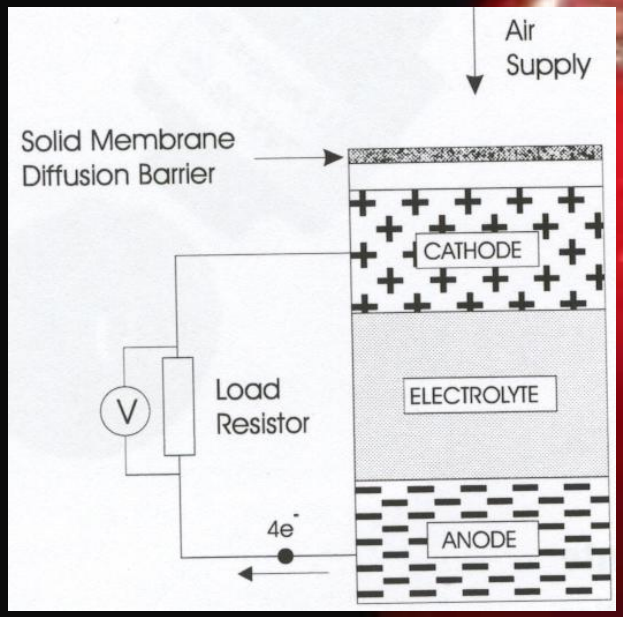
Use for Onion storage at 60-70% RH

# Carbon Dioxide

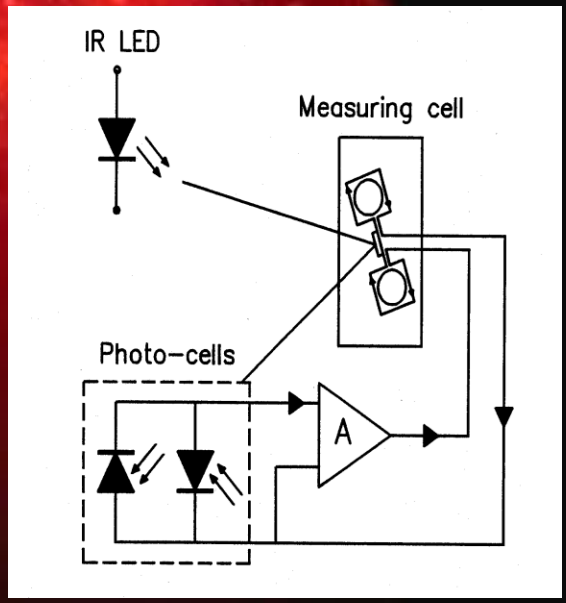



**Infra Red only suitable method for fruit storage atmospheres**

# Oxygen




Electrochemical cell good. Replace cell every 2 years

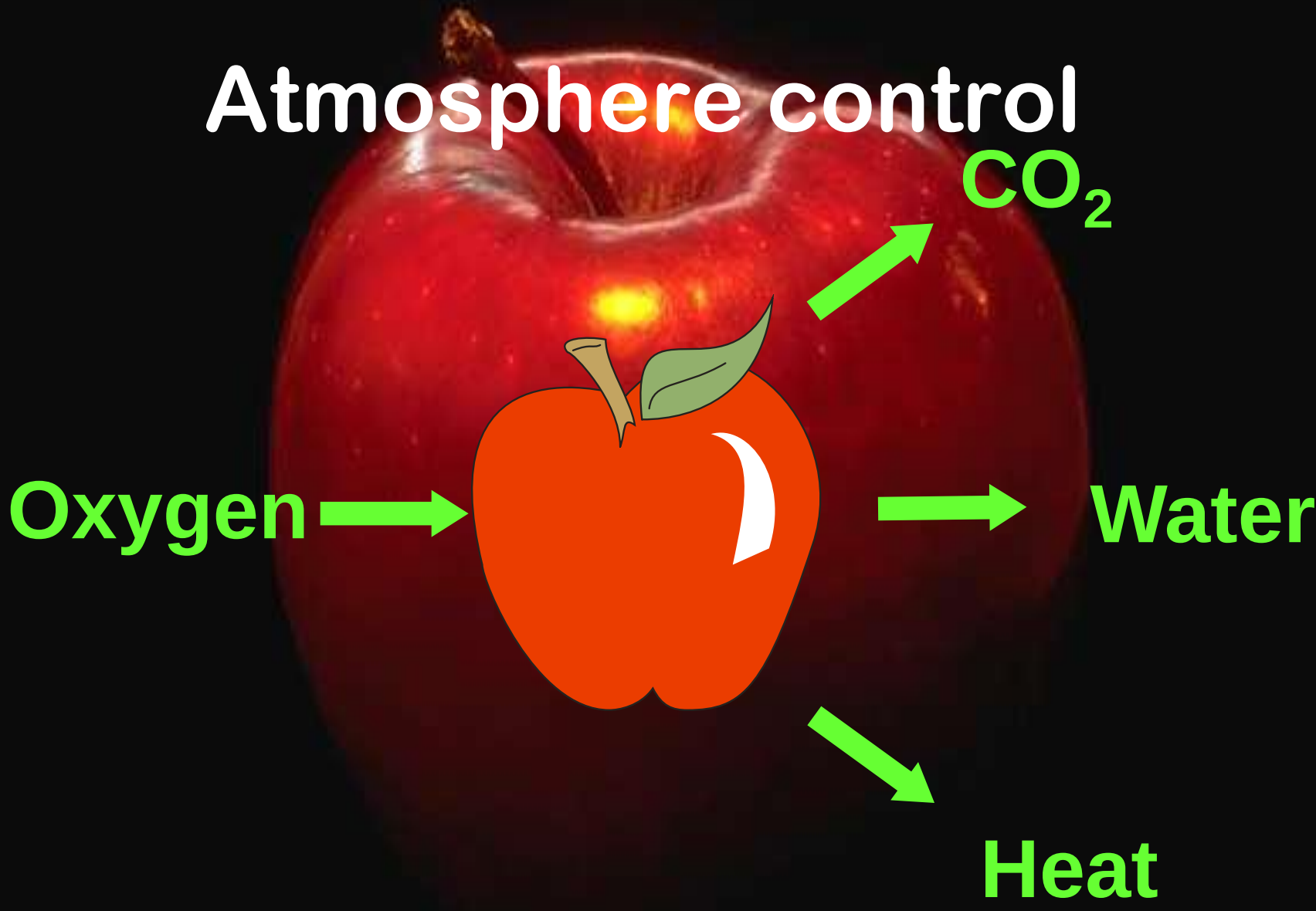



Paramagnetic, excellent but expensive

# Dual Analyser


Oxygen & Carbon Dioxide

# Atmosphere control



# Atmosphere control

## 1. Primary Control.

Ventilation to maintain O2 at required level…typically 2% control to +/- 0.2%

## 2. Secondary Control

Operation of machinery to maintain CO2 at correct level…..typically 3% control to +/- 0.5%

# Atmosphere control

## 1. Primary Control.

Ventilation to maintain $O_2$ at required level
…typically 2%… control to +/- 0.2%

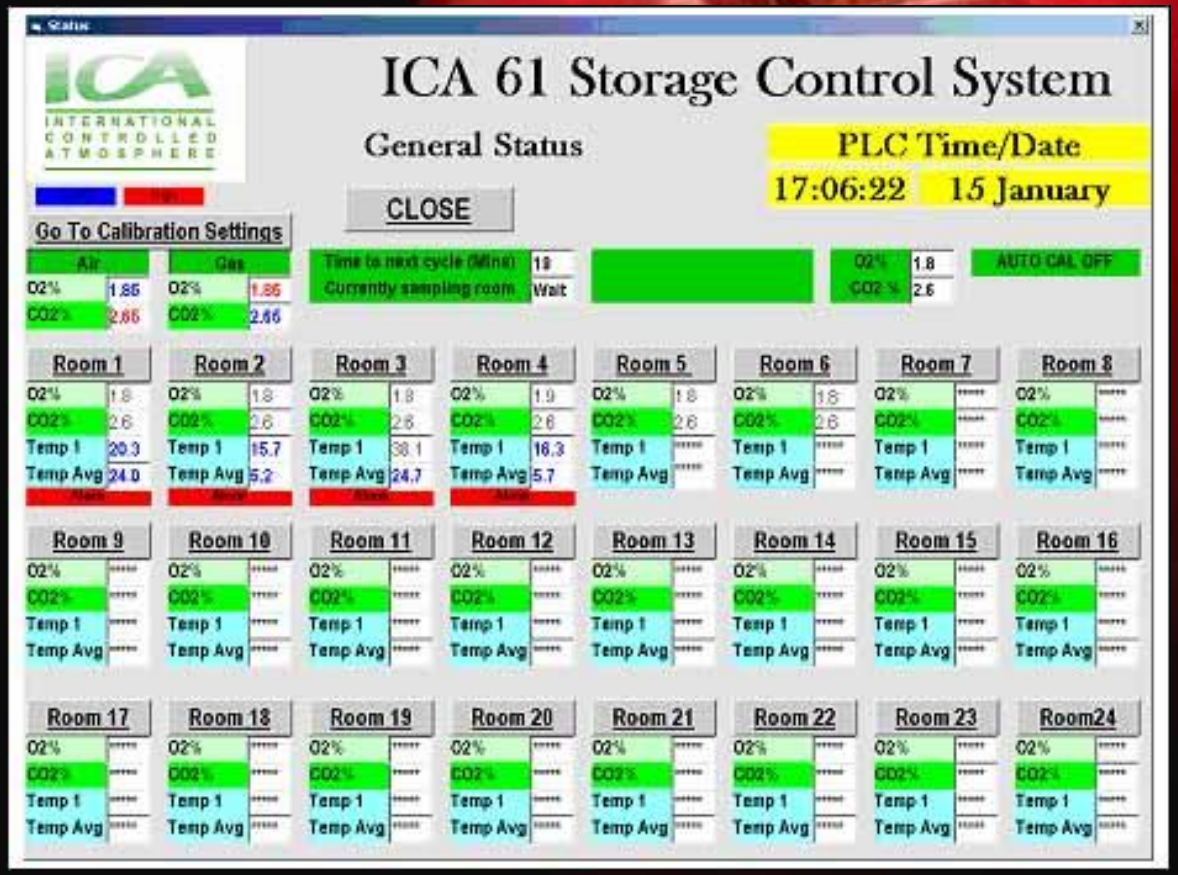
## 3. Initial Control

Nitrogen to pull down to say 5% $O_2$

# Automatic control


Electronic control of $O_2$ and $CO_2$ with specially designed control systems

# Automatic control




Electronic control of $O_2$ and $CO_2$ with specially designed control systems

Controlled Atmosphere is a storage technology used profitability in many countries

To be successful CA must be implemented properly with close attention to detail

# Planning a CA storage facility

# Important Questions

- *What products ?*
- *What storage conditions ?*
- *What size stores?*
- *What packing method ?*

- *What products ?*

Do not mix product in a single store at one time if at all possible

Build multi-purpose stores BUT be aware that Onions have different humidity needs to other fruit and vegetables

- *What storage conditions ?*

Need to know the following

1. Recommended conditions for that product, cultivar & production area and achievable storage life.

2. Incoming product quality and storage potential

# RUBBISH IN…RUBBISH OUT

- *What size stores?*

**Chill stores can be large**

* Single temperature
* Multi product
* Full or empty
* Daily access

- *What size stores?*

**CA stores are different!**

*Load & seal within 2-3 days

* Store should be full

* Leave sealed until product needed

* Unload, pack & distribute in 5-7 days

- *What size stores?*

It is a common and often regretted mistake to build CA stores too large

- *What packing method ?*

CA storage rooms should be designed for the packing that is going to be used and they should be full for successful operation

- *What packing method ?*

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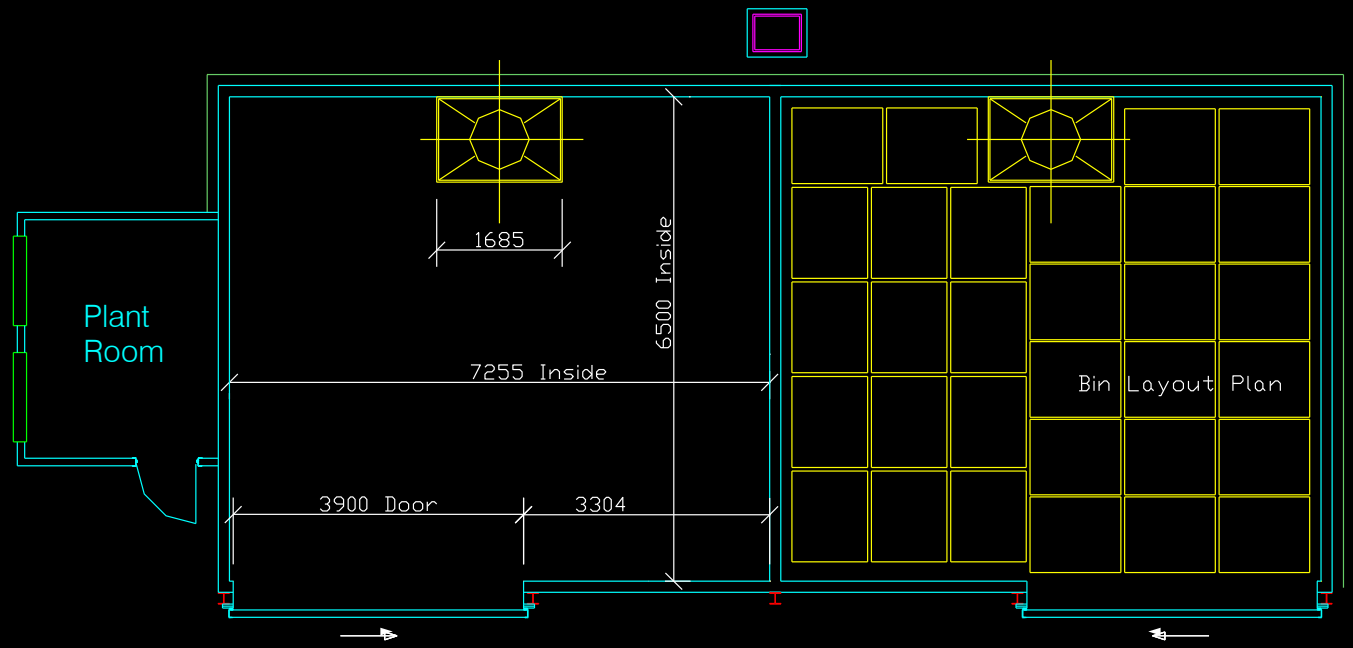
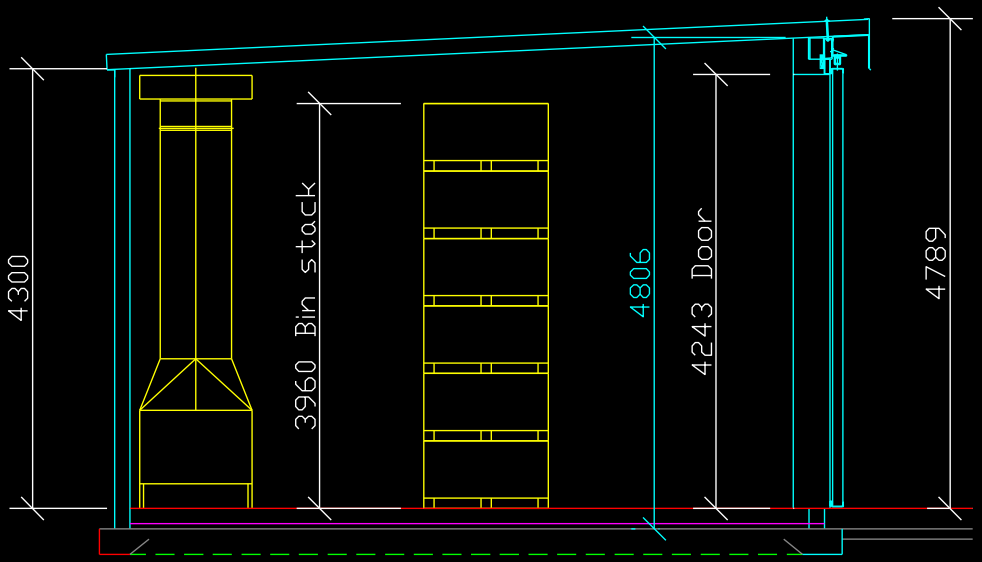
# Room Layout


1685
6500 Inside
Plant
Room
7255 Inside
Bin Layout Plan
3900 Door
3304

# *Room Layout*




Section

- *Quality control*

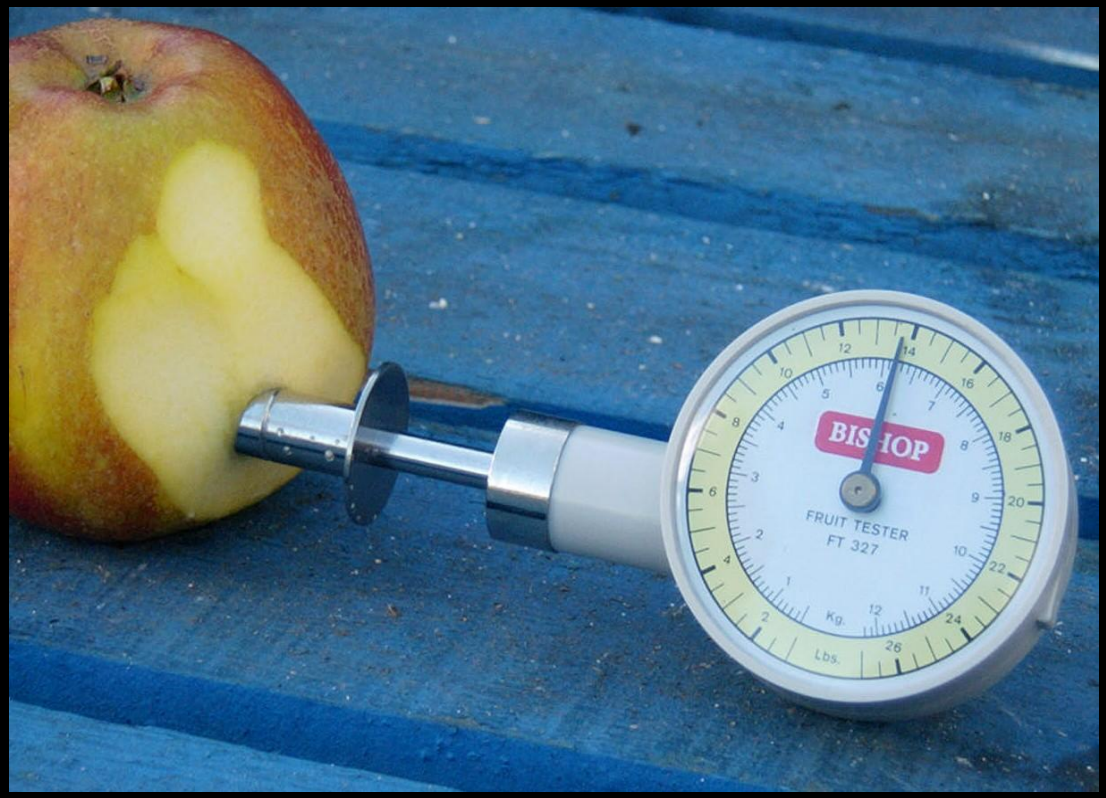
Produce should be regularly inspected to check progress

- *Quality control*

Use sample hatch and nets for samples

- *Quality control*

Penetrometer is used for checking quality



CA is LOW oxygen and HIGH CO2

This can causes DEATH by Asphyxiation

CA rooms must be kept secure at all times

# Pack houses and Cold stores

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- Designed to give best possible work flow
- All internal surfaces and fittings to meet “Food Safe” standards
- Insulation materials should meet insurance requirements

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ICA

INTERNATIONAL
CONTROLLED
ATMOSPHERE

Tonbridge Kent UK

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