

Reefer units guide for flowerbulb shipment

Auteur: Leo Lukasse (ATO certification)

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AGROTECHNOLOGY &
FOOD SCIENCES GROUP
WAGENINGEN **UR**

Reefer units guide for flowerbulb shipment

- With thanks to



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**VELDBOER
AGREX B.V.**



Agrarische Expertise



K-SERVICES

Presentation outline



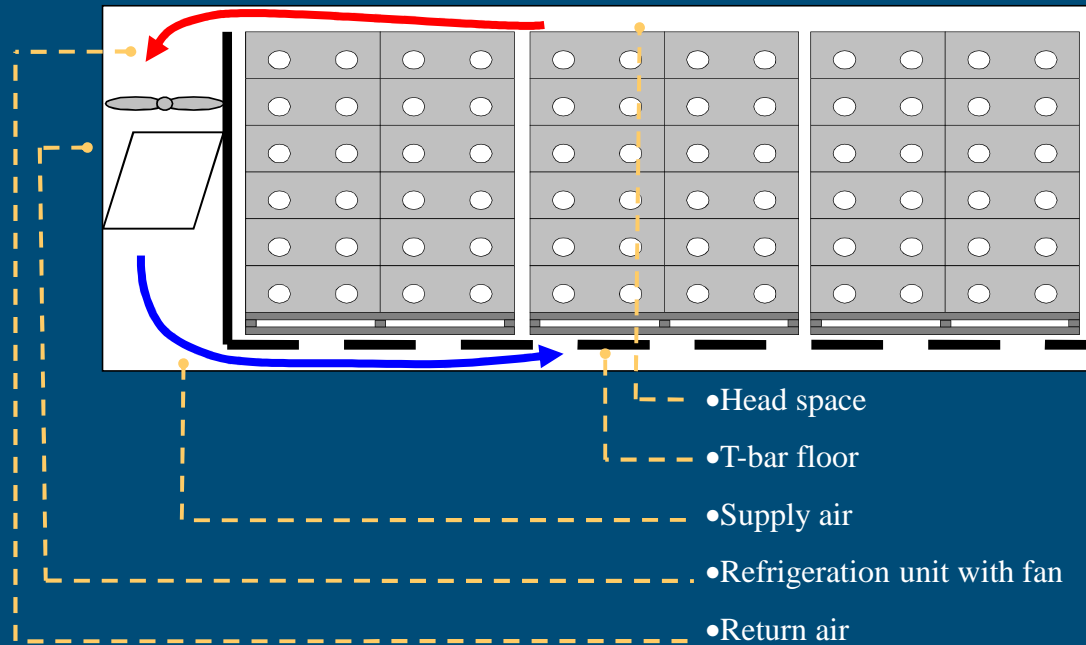
- Reefer containers, general issues
- Reefer unit settings
- Project outputs
- Issues for further investigations

Reefer units guide for flowerbulb shipment

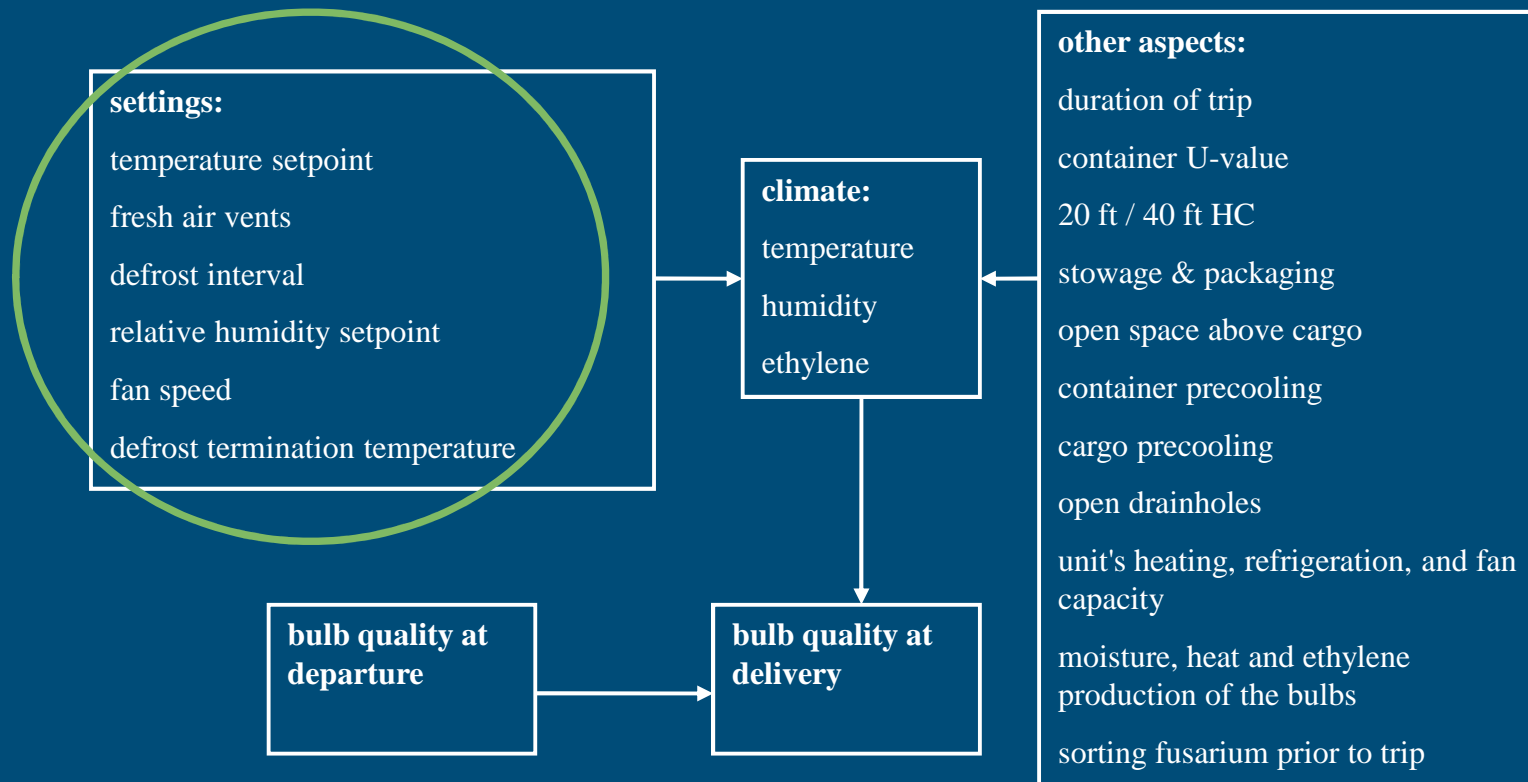
- In 2006:
 - 750,000 reefer containers
 - 3,000,000 reefer container shipments (7.5% annual growth)
 - 6500 flowerbulb shipments in reefer containers (= 0.2% of total, \pm 0% growth)
 - 80% of flowerbulb shipments come from NL, 60% to US, 35% to Far East

Reefer units guide for flowerbulb shipment

■ Reefer container



Factors affecting bulb quality at delivery



Presentation outline

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Overview of possible reefer unit settings

| issue no. | Setting |
|-----------|-----------------------|
| 1 | temperature |
| 2 | fresh air vents |
| 3 | defrost interval |
| 4 | RH (dehumidification) |
| 5 | bulb mode |

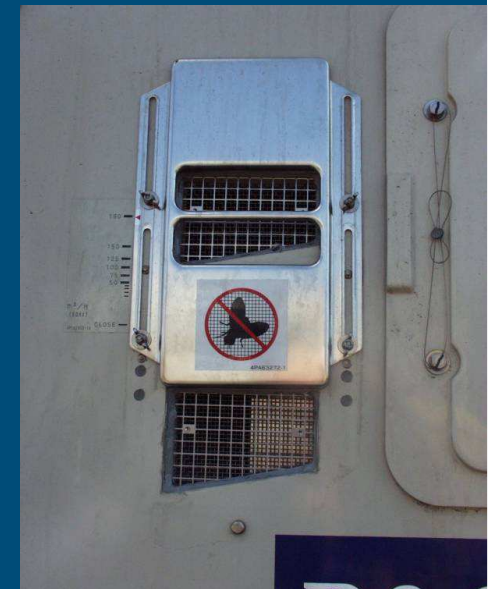


Reefer unit setting 1 of 5: temperature

- Supply air temperature (SAT) control
- Usually return air temperature = $SAT + \{0.5 \sim 1.0 \text{ }^\circ\text{C}\}$
- Usually cargo temperatures $< SAT + 1.5 \text{ }^\circ\text{C}$ (fans at high speed)
- Cargo temperatures deviate due to:
 - Autonomous heat production
 - Heat / cold ingress from outside

Reefer unit setting 2 of 5: fresh air vents

- Max. capacities (manufacturer specs!):
 - 190 CMH (Daikin)
 - 285 CMH (TK)
 - 225 CMH (Carrier)



Reefer unit setting 2 of 5: fresh air vents

- Fan speed is affected by:
 - 50 / 60 Hz
 - economy mode
 - Dehumidification (hi, lo, alt)
 - ice formation (defrosting)



Reefer unit setting 2 of 5: fresh air vents

■ Why ventilate?

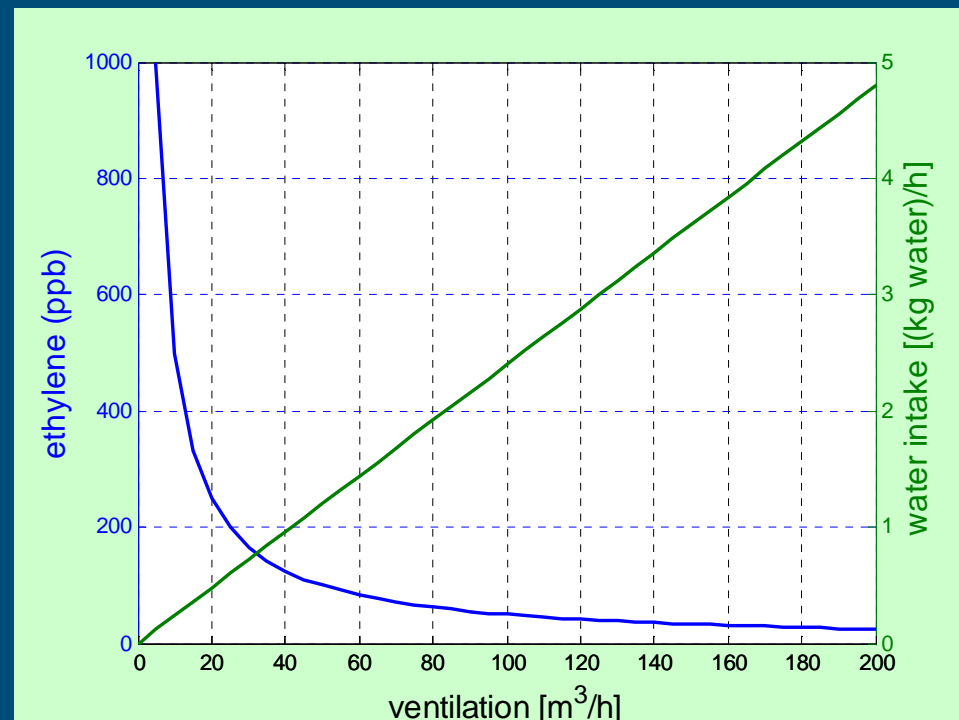
- Refresh gases (oxygen, CO₂, ethylene)
- ~~Dehumidification~~



Reefer unit setting 2 of 5: fresh air vents

- Adverse effects of ventilation
 - Moisture ingress -> ice, relative humidity

- Ethylene prod. 5 ml/h
- Amb. hum. 20 g/kg



Reefer unit setting 2 of 5: fresh air vents

- Ethylene sensing at AFSG:
 - from 10 ppb on
 - Accuracy $\pm 1.5\%$

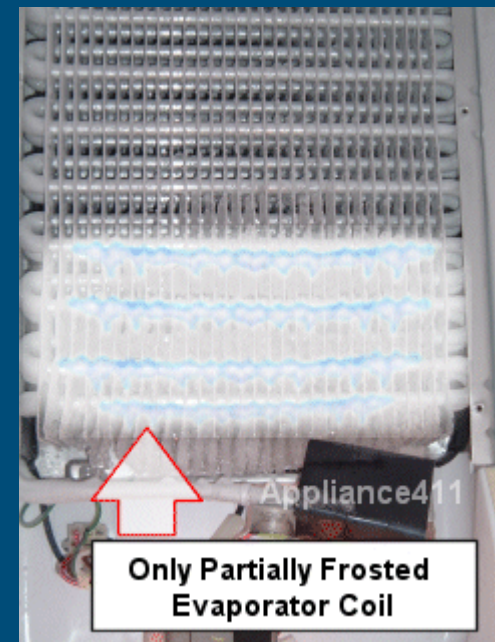


Hatech / EMS



Reefer unit setting 3 of 5: defrost interval

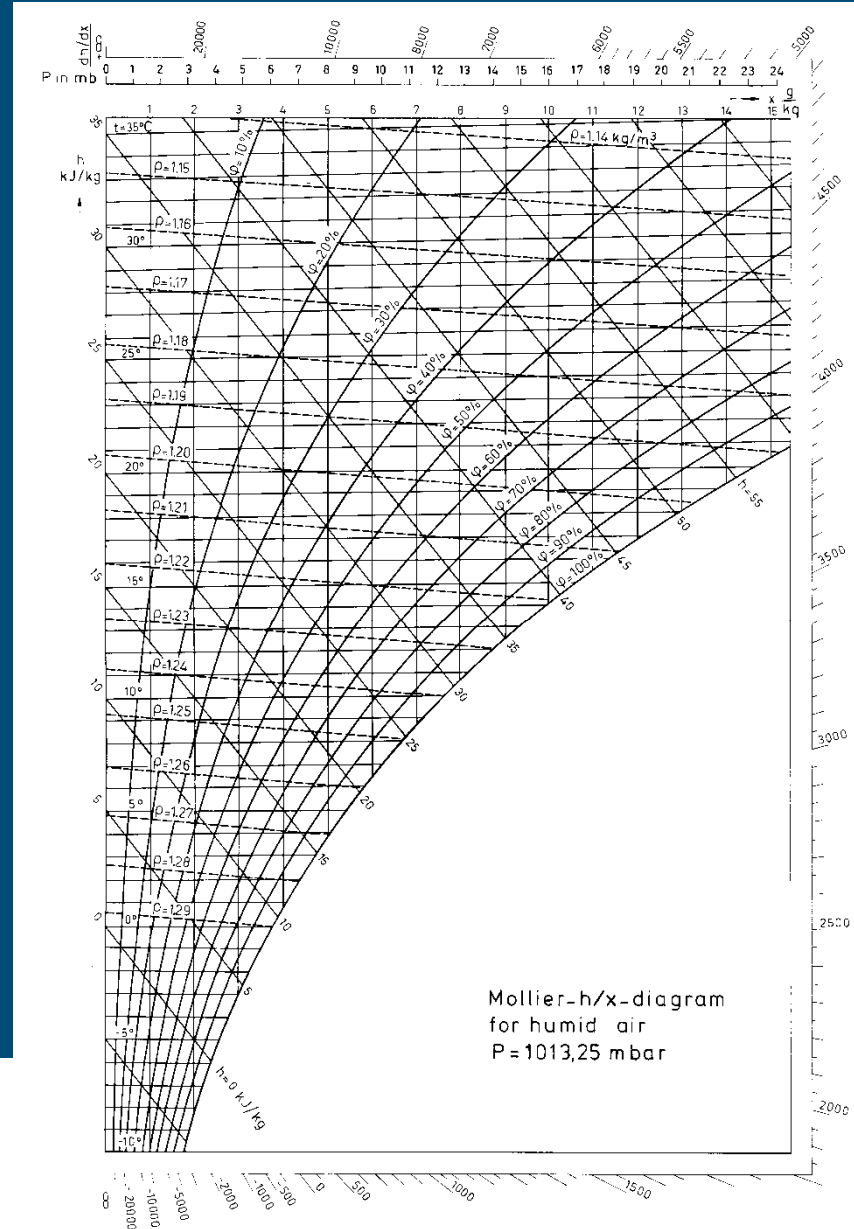
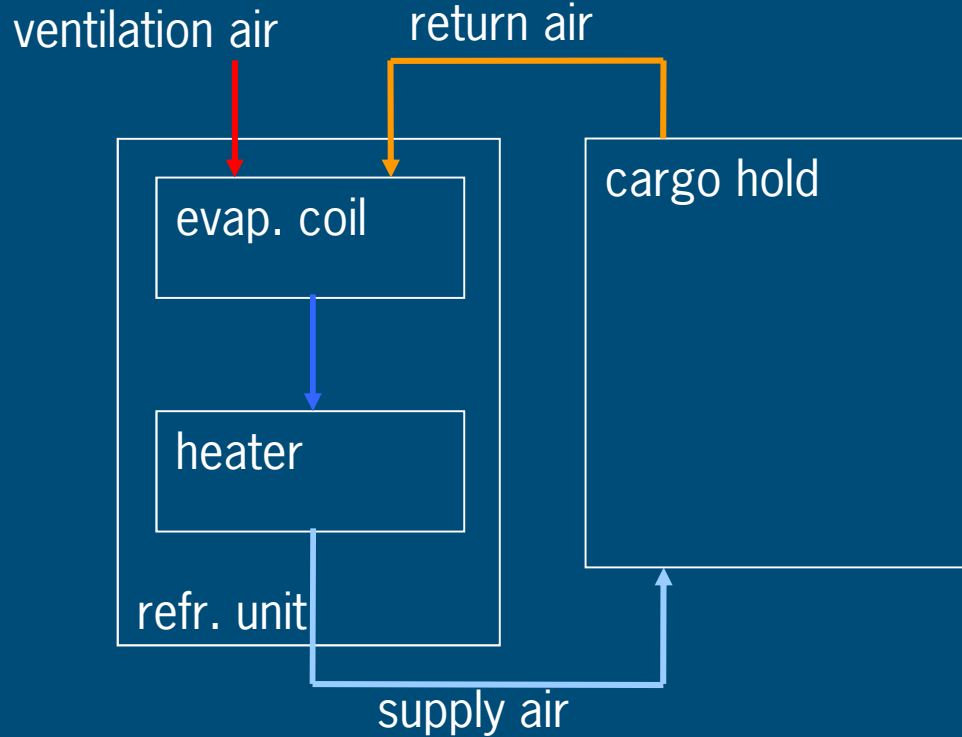
- Why defrost?
 - refrigeration capacity
 - air flow



Reefer unit setting 3 of 5: defrost interval

- Manually set at 3, 6, 9, 12 or 24 h, or AUTO or OFF
- AUTO is coming on
- TK's Magnum solely relies on AUTO
- One defrost takes at least 30 min. (fans off)
- 6h defrost interval pretty common, but frequent!
- Don't defrost when set temperature $> 10\text{ }^{\circ}\text{C}$
- Use 'reefer settings support tool' for advice

Reefer unit setting 4 of 5: RH (dehumidification)



Reefer unit setting 4 of 5: RH (dehumidification)

- Many, but not all, reefers have dehumidification
- How to reduce RH:
 - Less ventilation
 - Lower fan speed
- By default dehumidification yields alt fan speed (25% less fresh air!) with Carrier and Daikin
- Use 'reefer settings support tool' for advice

Reefer unit setting 5 of 5: bulb mode

- Only software issue
- Why use bulb mode?
 - Extra dehumidification capacity
 - Less defrost heat reaching the bulbs
- 'bulb mode on' is a meaningless spec.
- If bulb mode 'on' then:
 - RH setpoint range extended (Carrier only) to 60%
 - Fan speed may be set at lo, hi or alt (RH, ΔT , fresh air)
 - Defrost termination temp. adjustable from ± 30 to 4 °C
- 'reefer settings support tool' advises on fan speed

Reefer unit setting 5 of 5: bulb mode

- Defrost termination temperature (DTT)
 - How to use?
 - 8 °C commonly accepted. Who knows why?
 - Optimal usage strongly related to specific reefer unit type?
- Chilled meat, blood plasm?



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- ➔ ■ Reefer containers, general issues
- ➔ ■ Reefer unit settings
- ➔ ■ Project outputs
- Issues for further investigations

Shipper's check list

Shipper's (vendor's, exporter's) check list for flowerbulb shipment in reefer containers

| | |
|--|---|
| reefer container no. (e.g. MWCU 675342[9]) | |
| ATO certified | <input type="checkbox"/> yes, <input type="checkbox"/> no |
| CONTAINER INSPECTION | |
| 4 drain holes clean and open | <input type="checkbox"/> yes |
| visible defects in container inner or outer walls | <input type="checkbox"/> yes, <input type="checkbox"/> no |
| visible defects at T-bars or bulkhead bottom plate | <input type="checkbox"/> yes, <input type="checkbox"/> no |
| visible defects of rubber door gasket | <input type="checkbox"/> yes, <input type="checkbox"/> no |
| container clean internally | <input type="checkbox"/> yes |
| container precooling okay | <input type="checkbox"/> yes, <input type="checkbox"/> no, <input type="checkbox"/> not applicable |
| REEFER UNIT SETTINGS | |
| temperature setpoint | |
| unit of temperature setting | <input type="checkbox"/> °C, <input type="checkbox"/> °F |
| fresh air vent setting | m ³ /h |
| relative humidity setpoint | <input type="checkbox"/> off, <input type="checkbox"/> % |
| fan speed | <input type="checkbox"/> hi(gh), <input type="checkbox"/> alt(ernating), <input type="checkbox"/> lo(w) |
| bulb mode | <input type="checkbox"/> on, <input type="checkbox"/> off |
| defrost termination temp. (N.A. if bulb mode off) | °C, <input type="checkbox"/> N.A. (not applicable) |
| CARGO ISSUES | |
| cargo stowed below load line | <input type="checkbox"/> yes |
| filler/dunnage in center channel or chimneys | <input type="checkbox"/> yes, <input type="checkbox"/> no |
| cargo stowed beyond T-section floor | <input type="checkbox"/> no |
| T-bars occupied entirely | <input type="checkbox"/> yes |
| no. of mobile temp. recorders placed | |
| mobile temp. recorders started | <input type="checkbox"/> yes |
| ident. number of door seal applied | |
| ACCOUNT | |
| checked by (person's name) | |
| date | |
| place | |

Reefer settings support tool for flowerbulbs

REEFER SETTINGS SUPPORT TOOL FOR FLOWERBULBS (VERSION 1.0)

author: Leo Lukasse (leo.lukasse@wur.nl)
 date: May, 2007
 affiliation: Wageningen UR, The Netherlands
 www: www.reefertransport.nl



purpose: get advised unit settings based on desired climate, destination and main reefer unit capacities.

how to use? Fill out the blank fields and check the orange fields for suggestions, advice and expected climate

suggestions for improvement: The author encourages users to send him suggestions for improvement or questions about related issues.

DISCLAIMER: Wageningen UR, AFSG and the authors do not accept any liability for damages or losses of whatever nature, that may

input information:

| | |
|---|----------|
| temperature setpoint [°C] | 17 |
| RH setpoint [%] | 65 |
| acceptable temperature spread ΔT [°C] | 2 |
| fresh air required [m ³ /h] | 90 |
| fan speed | low |
| destination | Far East |
| heating capacity [kW] (@ 60Hz) | 4.08 |
| refrigeration cap. [kW] (@ 2/ 38 degC, 60 Hz) | 12.3 |
| fan capacity [m ³ /h] (@high speed, 60 Hz) | 5500 |

SUMMARY OF FAN SPEEDS

| fan setting | airflow [% of high speed] |
|-------------|---------------------------|
| high | 100 |
| alternating | 75 |
| low | 50 |

SUMMARY OF OCEAN CLIMATES PER DESTINATION

| Destination | ambient temp. [°C] | amb. humidity [(g v |
|---------------|--------------------|---------------------|
| US East Coast | 12 | 8 |
| US West Coast | 27 | 20 |
| Far East | 27 | 20 |

comments/suggestions on dehumidification and defrosting:

| | | |
|------------------------------------|-------------------------------|--|
| heating capacity [kW] | insufficient, consider | 1. reduction of fan speed, 2. increase of acceptable temp. spread, 3. reduction of |
| refrigeration capacity [kW] | sufficient | |
| heating + refrigeration: | insufficient heating capacity | |
| min. fan speed required to meet ΔT | alternating | |
| required defrost interval [hours] | no defrosts necessary | |

advised unit settings:

| | |
|----------------------------------|---|
| temperature setpoint [°C] | 17 |
| RH setpoint [%] | 65 |
| container precooling | no (in order to avoid condense formation on ceiling during loading) |
| fan speed | low |
| vent setting [m ³ /h] | 180 |
| defrost interval [hours] | no defrosts necessary |
| defrost termination temp. [°C] | unit's default? |
| drain holes | open |

expected climate in container:

| | |
|-------------------------|-------------------------|
| temperature spread [°C] | max. 3.5 above setpoint |
| RH [%] | 75 |

Reefer units guide for flowerbulb shipment

| Name | Description |
|--|------------------|
| Reefer units guide for flowerbulbs | Manual, document |
| Shipper's checklist | Checklist |
| Reefer settings support tool for flowerbulbs | Excel program |

- Download via www.nieberding.nl



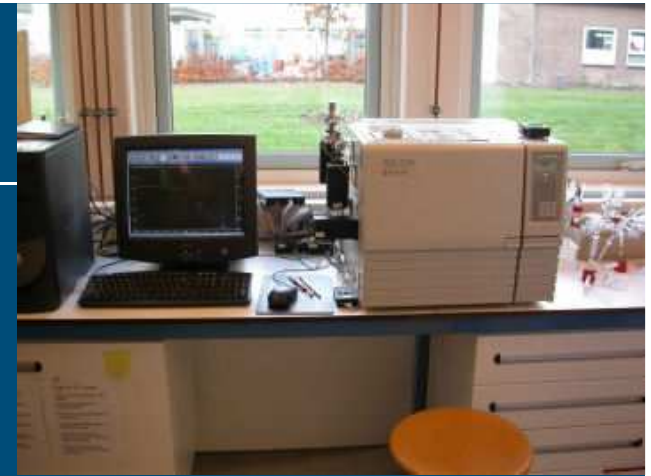
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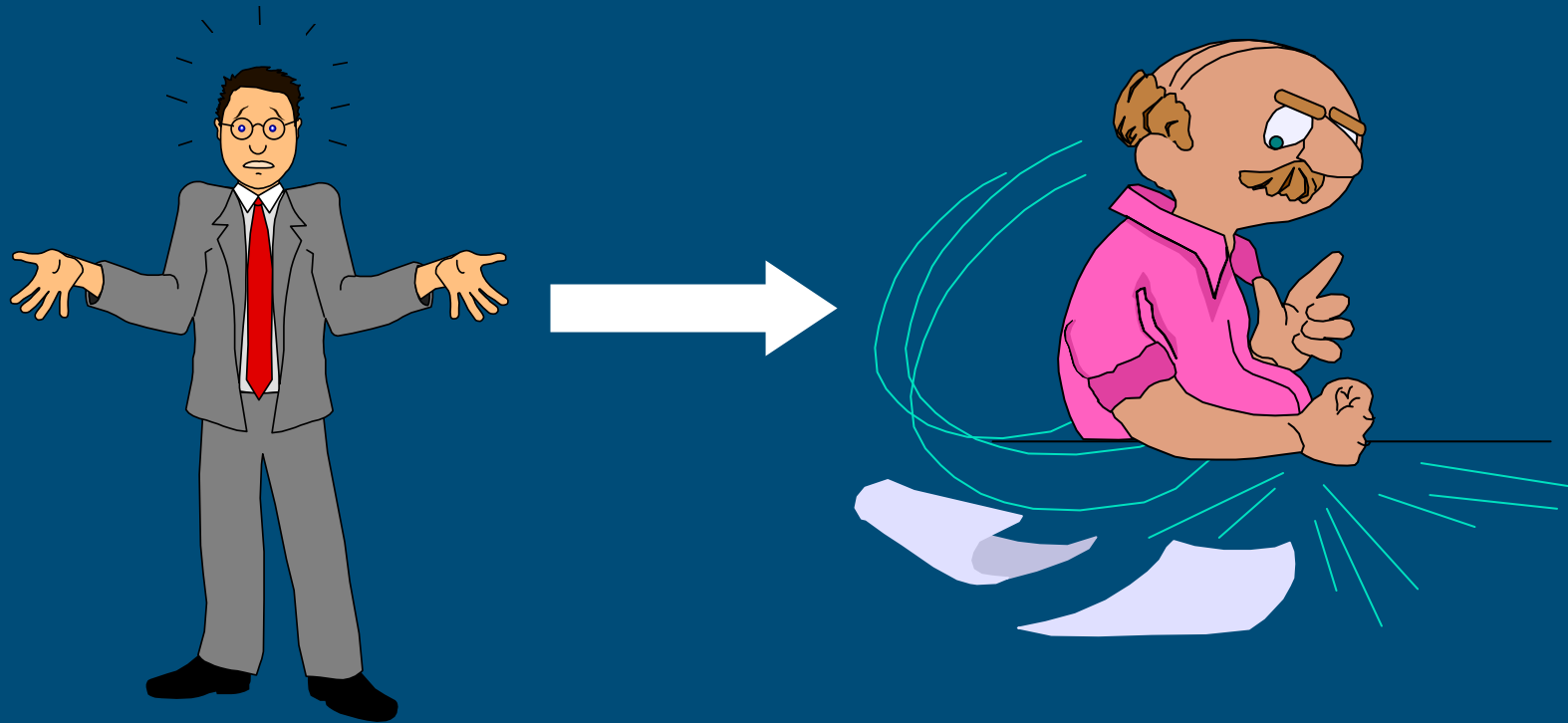
Issues for further investigations

- Vents, fan speed, defrosting -> ΔT ?
- AFAM/Autofresh
- Autonomous heat production of bulbs
- Measurements during transport:
 - Relative humidity in cargo
 - Ethylene levels in containers
- Defrosting heat load on cargo (hot gas/ electric)
- Defrost termination temperature

- Innovatievouchers:
 - www.senternovem.nl/innovatievouchers
 - www.minInv.nl



Questions, remarks, discussion



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