

Reefer units guide for flowerbulb shipment

Auteur: Leo Lukasse (ATO certification)

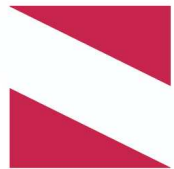
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Reefer units guide for flowerbulb shipment

- With thanks to



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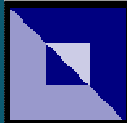
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Presentation outline

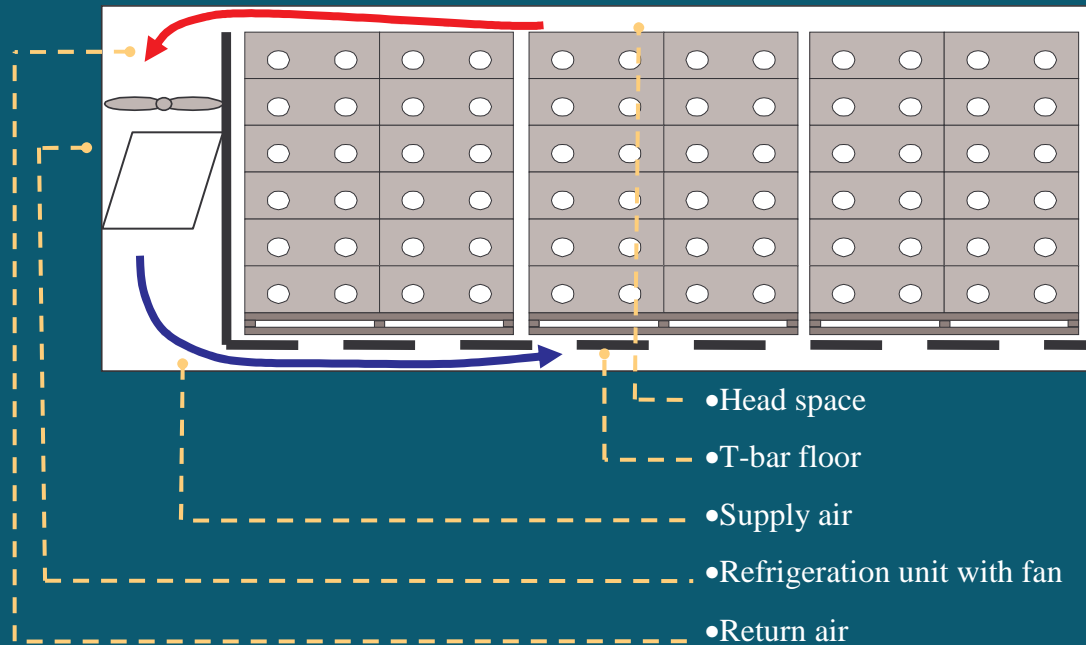


- Reefer containers, general issues
- Reefer unit settings
- Project outputs
- Issues for further investigations

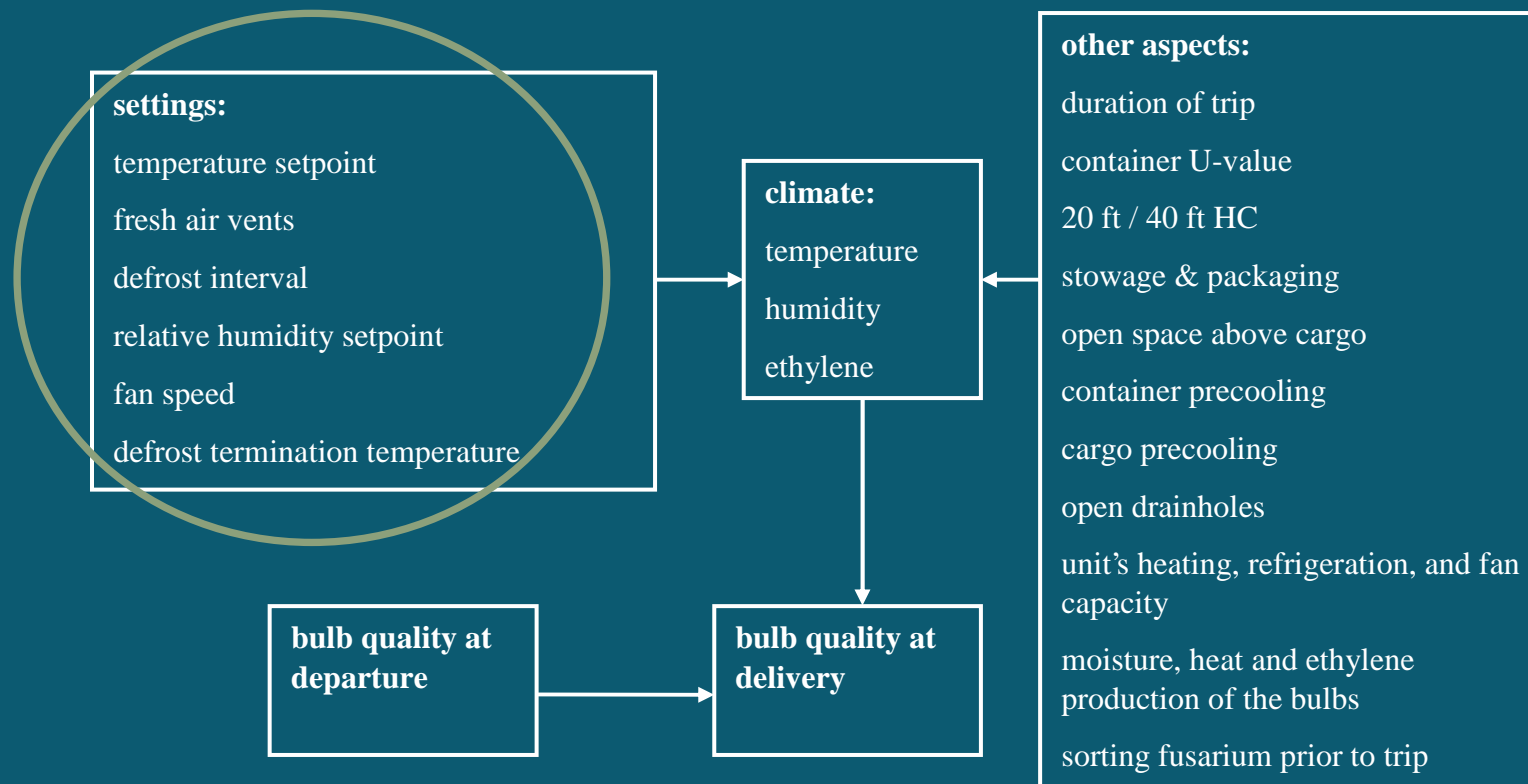


Reefer units guide for flowerbulb shipment

■ Reefer container



Factors affecting bulb quality at delivery



Presentation outline

- ➔ ■ Reefer containers, general issues
- ➔ ■ Reefer unit settings
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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

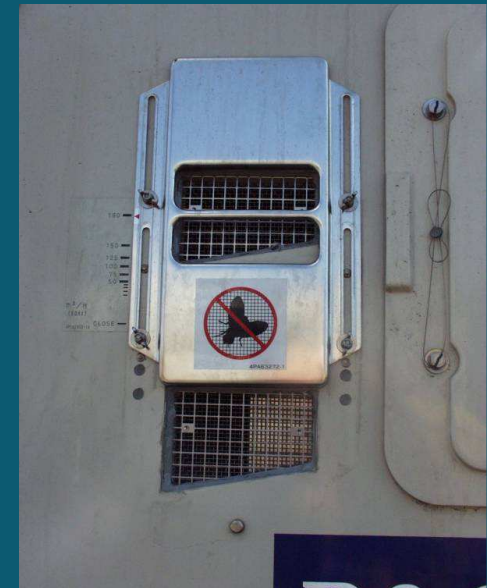


Reefer unit setting 1 of 5: temperature

- 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

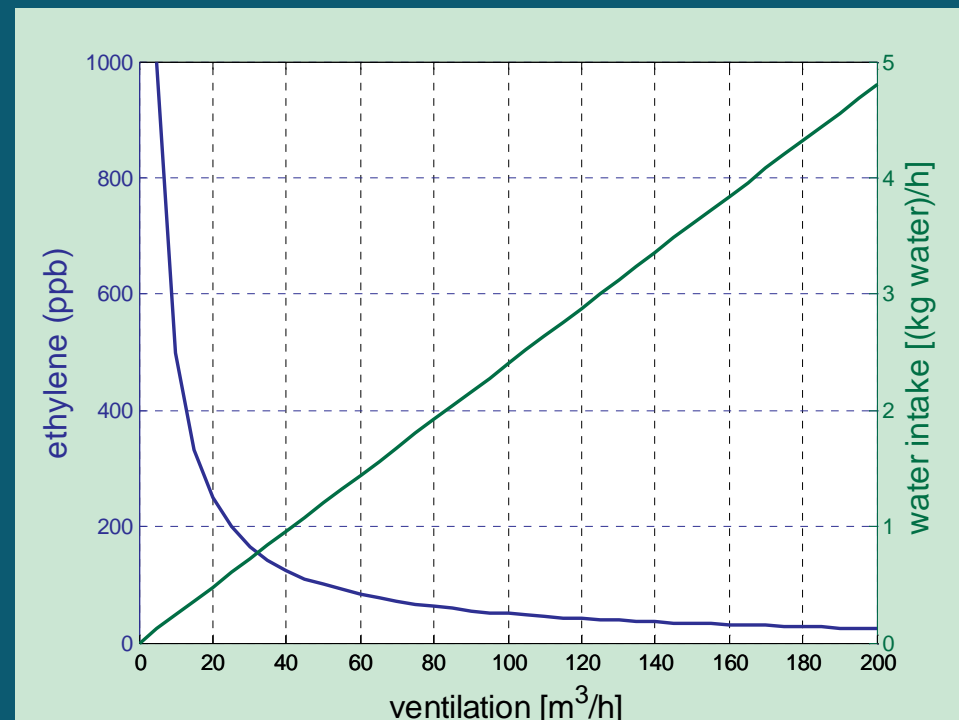
- Why ventilate?
 - Refresh gases (oxygen, CO₂, ethylene)
 - ~~Dehumidification~~



Reefer unit setting 2 of 5: fresh air vents

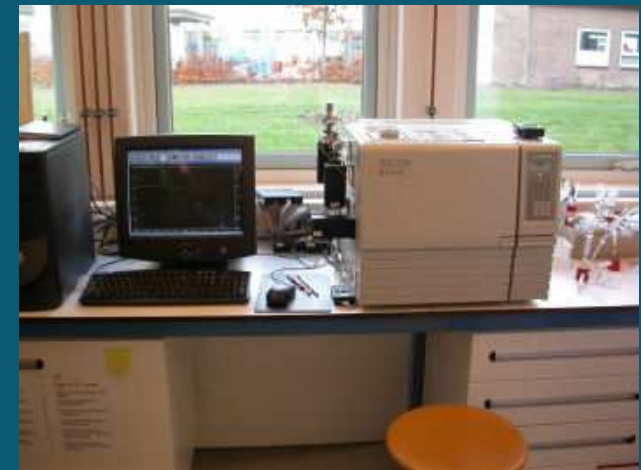
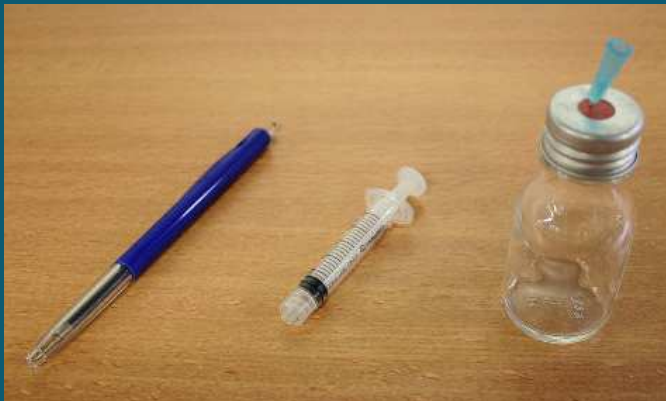
- Adverse effects of ventilation
 - Moisture ingress -> ice, relative humidity

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



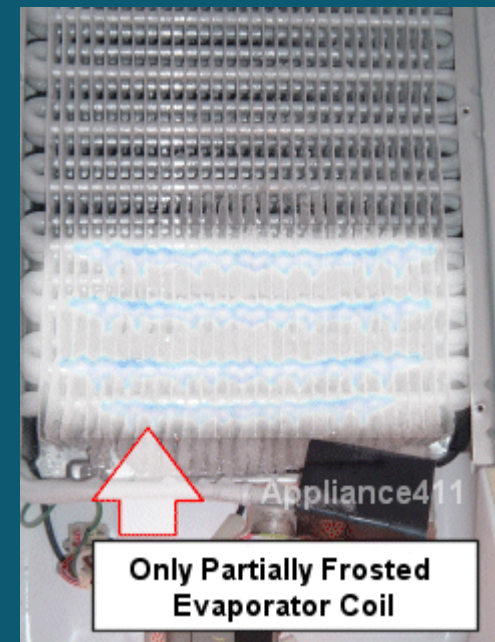
Reefer unit setting 2 of 5: fresh air vents

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



Reefer unit setting 3 of 5: defrost interval

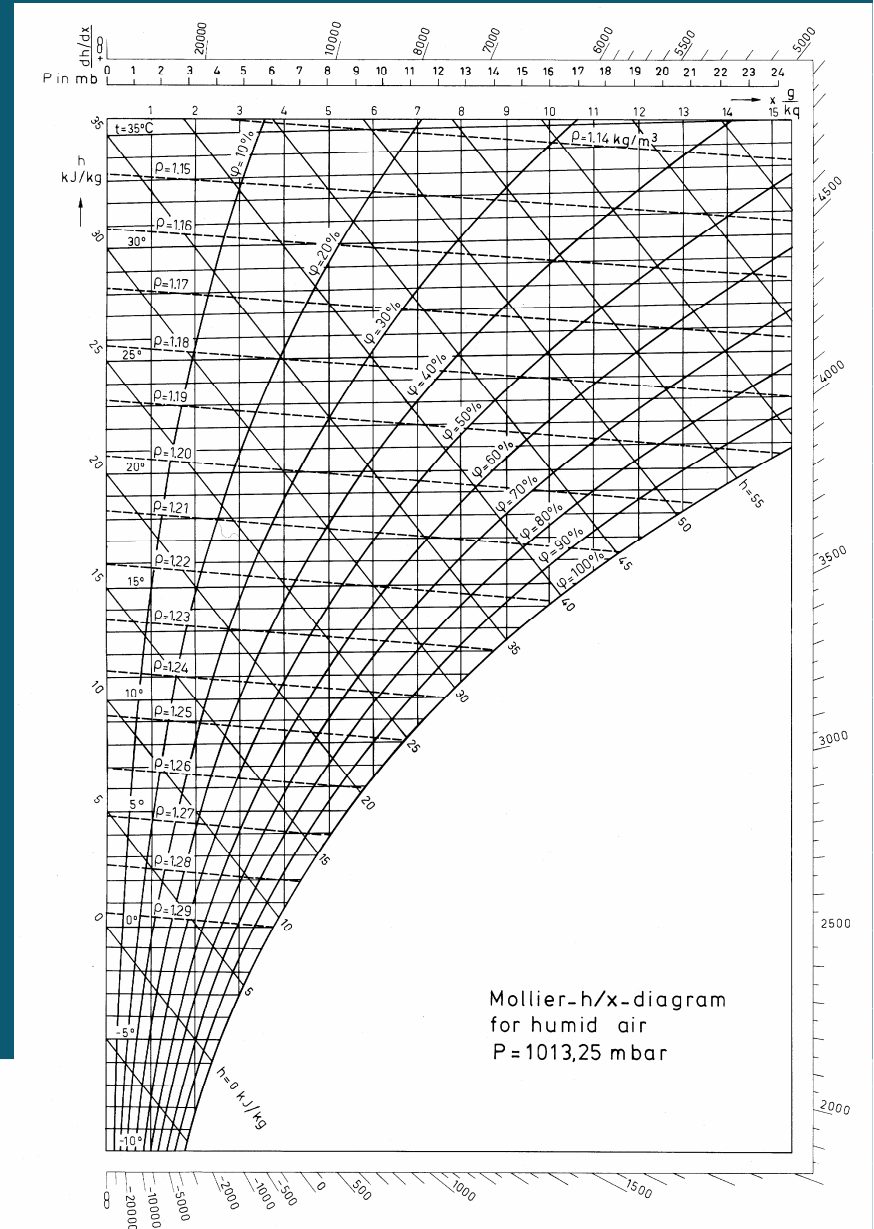
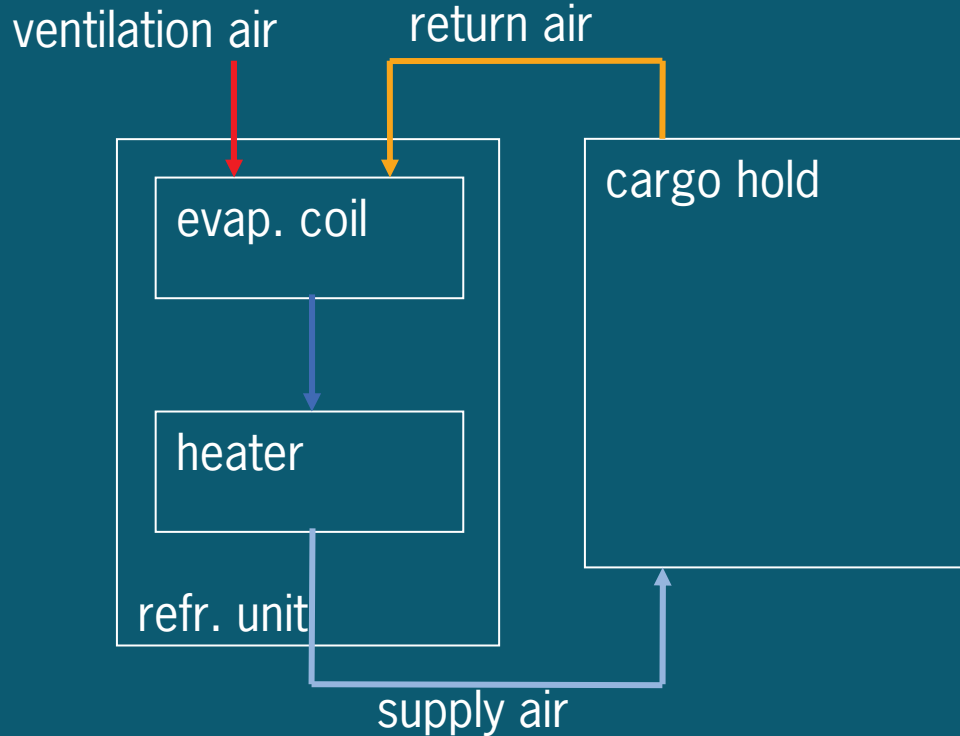
- Why defrost?
 - refrigeration capacity
 - air flow



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 °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

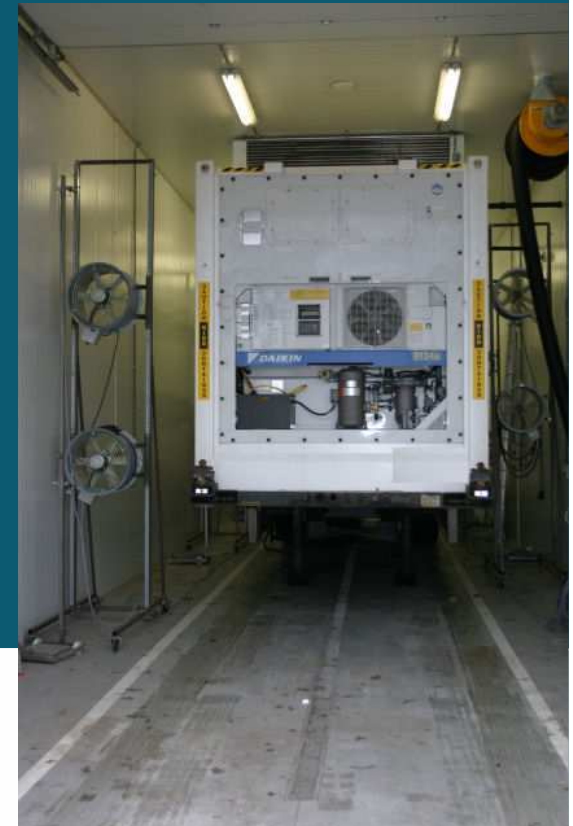
Reefer unit setting 5 of 5: bulb mode

- 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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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/ 3B 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
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



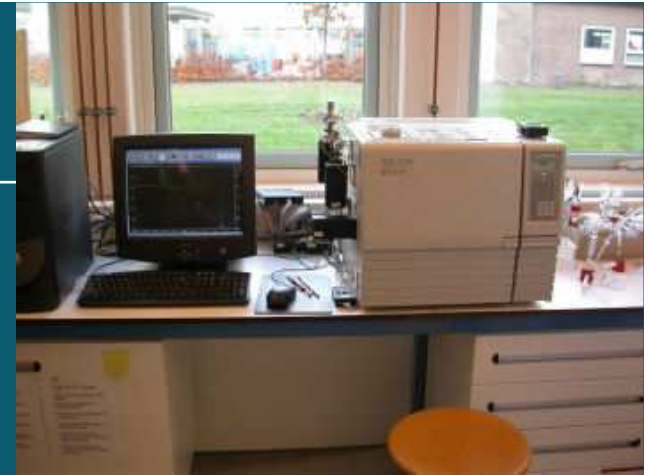
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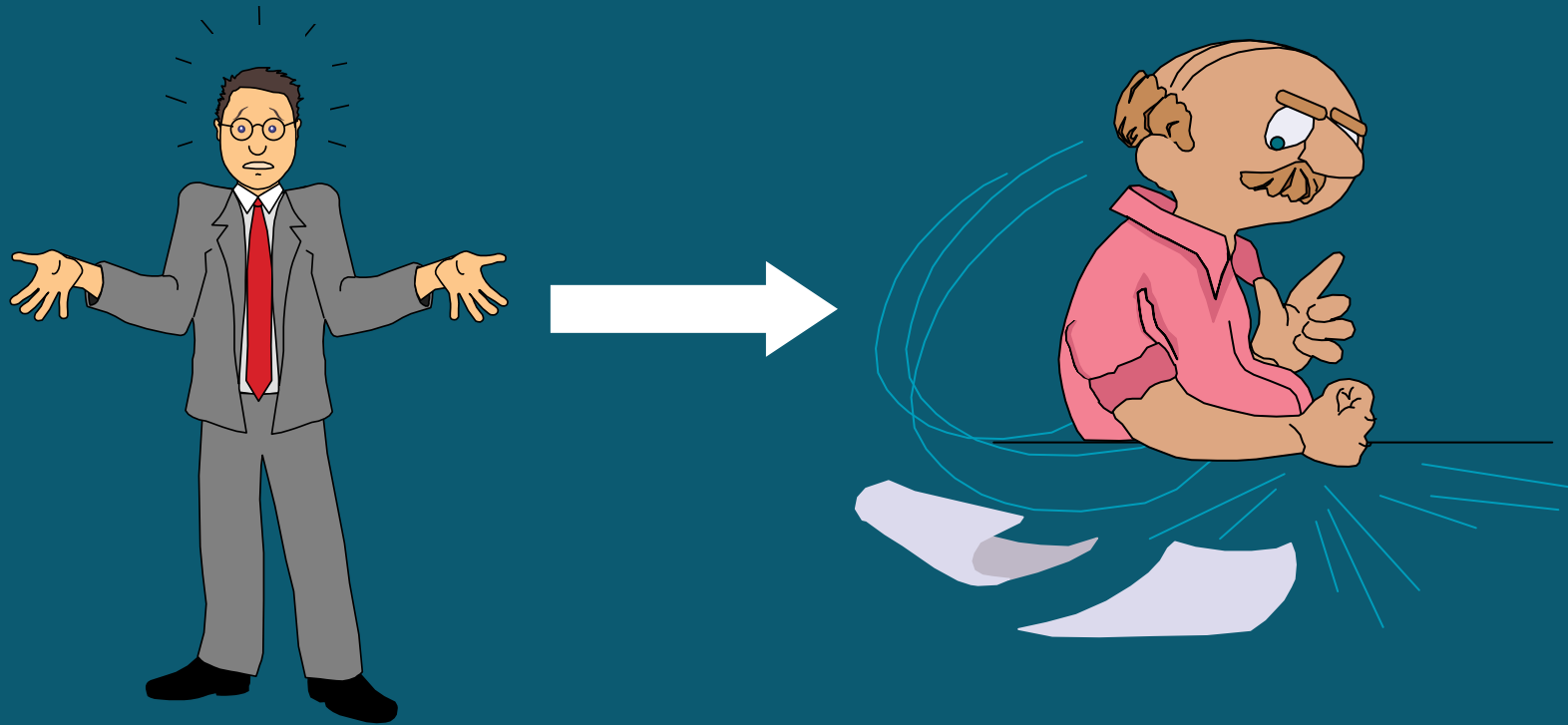
Issues for further investigations

- 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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