

COMPRESSED AIR WORKING PRESSURE

versus

COMPRESSED AIR HUMIDITY LIMITS

Ewa Messaoudi

Respiratory Protective Devices

EMEI Regulatory Manager

AFNOR 76A Committee Chairwoman

Honeywell Respiratory Safety Products

58 Avenue de la Ferté Milan

02 600 VILLERS COTTERETS

FRANCE

CURRENT SITUATION

Honeywell

The current regulations, in force to today, plan the use of the following working pressures for RPD compressed air cylinders



EUROPEAN UNION

Working pressure - 20 or 30 MPa

Reference standard - EN 144-2



UNITED STATES OF AMERICA

Working pressure up to 37.4 MPa

Reference standard - CGA-347



EUROPEAN UNION - FRANCE

Strong tendency to increase the working pressure up to 50 MPa to:

- Reduce the weight of the RPD for the same working duration (ex. weight gain about 1 kg for composite aluminum cylinder and 60 min working duration)
- Increase the working duration of the RPD

HONEYWELL RESPIRATORY SAFETY PRODUCTS

Assessment of potential risks , mainly of influence of the higher working pressure on humidity inside the RPD

Humidity inside of the RPD can result of:

- **Water inside the RPD**
- **Humidity in the compressed gas**
 - Components shall be free from water
 - Can not be controlled
 - Can be easy controlled
 - Risks are identified

Humidity inside of the RPD can entail:

- Loss of respiratory comfort*
- Corrosion process - damage of the internal metallic parts with risk of break*
- Change of gas mixture by decreasing oxygen concentration*
- Development of the micro-organisms (ex. long storage of the cylinder)*
- Malfunction of the equipment (mainly for pressure reducers) *

* Reference to the INRS study ND 2344 « 15 years compressed air analysis at French Navy Laboratory in Toulon »

[INRS - ND2344.pdf](#)

Respiratory comfort requires the specific range of humidity

- Under humid respiratory conditions – low skin evaporation of perspiration
- To maintain 37 ° C body temperature
thermal loss through the skin = that produced by our metabolism



- Under dry conditions, there is a potential health hazard which can cause general dehydration of the respiratory ways



Corrosion process can entail:

- Damage of RPD metallic components (ex. internal liners of the breathable gas cylinders)



- Change of gas mixture by decreasing of oxygen concentration

REDUCER WORKING PARAMETERS

Honeywell

Parameters increasing risks due to the presence of humidity in the RPD are:

- **Working pressure of the RPD**
- **Environmental temperature**
During expansion of compressed air the temperature of the fluid decreases because the system supplies the work to the external environment.

Generally more the compressed air expansion is big (ΔP) more the drop of temperature is big (ΔT).

This phenomena decreases the difference between the temperature inside the RPD and the dew point of the compressed gas.

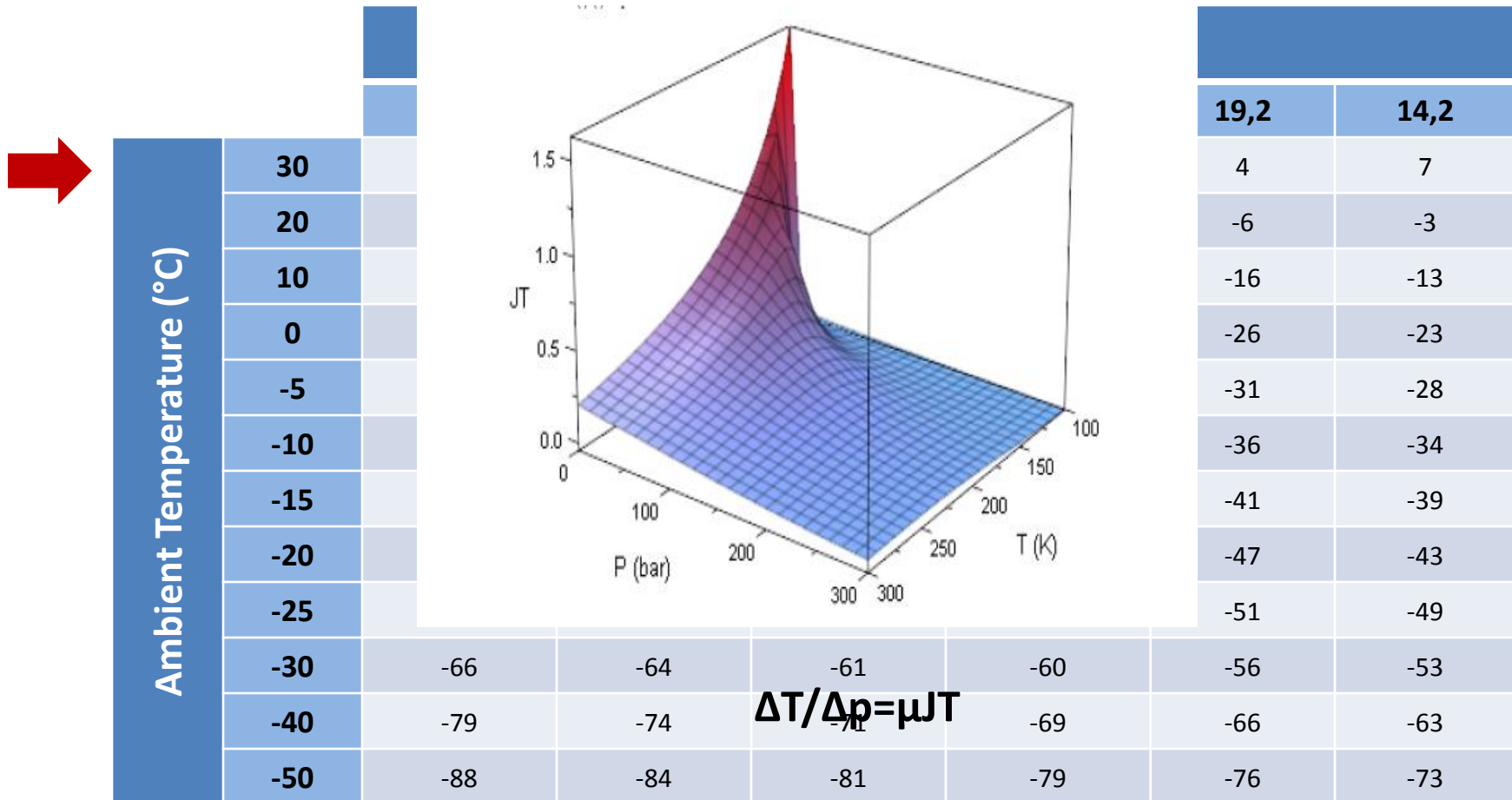
Risk of humidity condensation into liquid water and its icing.

More the temperature of the compressed air is cold more the difference between the temperature inside the RPD and the dew point of the compressed gas is small.

Risk of humidity condensation into liquid water and its icing.

TEMPERATURE INSIDE HP/MP REDUCER

- Convergence seat/valve level - the temperature of the fluid inside of reducer - calculation results below
- The downstream parts represent the heat exchanger and can increase the temperature



DEW POINT SAFETY HUMIDITY LIMITS

Honeywell

- Humidity values (mg/m³) when the air dew point temperature equals the convergence seat/valve level temperature - calculation results below



		Δ Pressure (MPa)				
		50	35	30	20	< 1
Ambient Temperature (°C)	-5	130	168	220	270	> 500
	-15	39	50	72	90	> 500
	-25	13	17	25	32	500
	-32	7,5	10	15	18	450
	-40	1,3	2,7	4,15	5,3	110
	-50	0,3	0,65	1	1,4	32

Green values – new values

Red values – already identified as risk of icing – in Europe 50 mg/m³ for 20 MPa and 35 mg/m³ for 30 MPa

The data that influence the compressed air humidity limits definition are:

- Honeywell Respiratory Safety Products – calculation data
- French Study INRS – humidity limits for respiratory comfort
- General information – compressor capability to produce dry air

RESPIRATORY COMFORT HUMIDITY LIMITS



		Δ Pressure (MPa)				
		50	35	30	20	< 1
Ambient Temperature (°C)	-5°C	130	168	220	220	220
	-15°C	39	50	72	90	220
	-25°C	13	17	25	32	220
	-32°C	7,5	10	15	18	220
	-40°C	5	5	5	5	110
	-50°C	5	5	5	5	32

COMPRESSORS

Honeywell

		Δ Pressure (MPa)				
		50	35	30	20	< 1
Ambient Temperature (°C)	-5°C	130	168 => 170	220	220	220
	-15°C	39 => 40	50	72 => 75	90	220
	-25°C	13 => 15	17 => 20	25	32 => 35	220
	-32°C	7,5 => 10	10 => 15	15	18 => 20	220
	-40°C	5 => 5	5 => 10	5 => 10	5 => 15	110
	-50°C	5	5	5	5	32 => 35

SUGGESTED VALUES

Honeywell

		Δ Pressure (MPa)				
		50	35	30	20	< 1
Ambient Temperature (°C)	-5°C	130	170	220	220	220
	-15°C	40	50	75	90	220
	-25°C	15	20	25	35	220
	-32°C	10	15	15	20	220
	-40°C	5	10	10	15	110
	-50°C	5	5	5	5	30

- **There is an interest to decrease the weight of the RPD – opinion of the French users.**
- **The higher working pressure is one of the possibilities to achieve this objective.**
- **There is a necessity to reconsider the values of humidity limits in the compressed air to avoid the identified risks, ex. potential humidity icing inside the RPD system.**
- **There is also a necessity to reconsider the values of humidity limits in the compressed air for warm ambient conditions. To produce dry air from ambient air is difficult in the warm countries.**
- **There is probably also a necessity to reconsider the mechanical resistance of the system cylinder/cylinder valve. The energy contained in the 50 MPa cylinder is 2/3 more in comparison with 30 MPa cylinder for the same volume.**

Thank you for your attention