

Roche Energy Efficiency Standard



Thermal Environmental Conditions for Sedentary Activities

Document Information

Document Name	Roche Energy Efficiency Standard: Thermal Environmental Conditions for Sedentary Activities
Document Owner	Thomas Wolf, CSE

Approval

6 th March 2008	Peter Schnurrenberger, CSE
28 th Feb. 2008	Jack Kace, CESA

Document History

Version	Changes	Effective Date
1.0	First Edition	31 st March 2008

Roche Energy Efficiency Standard



Thermal Environmental Conditions for Sedentary Activities

1. Scope

This energy efficiency standard is binding for all Roche Group companies. US companies and their affiliates are required to adopt it in accordance with the "Policy on Safety, Health and Environmental Protection in the Roche Group". This standard specifies thermal environmental conditions for all **mechanically (non naturally) conditioned** spaces with predominant **sedentary and office type activities** (i.e. offices, meeting rooms, conference rooms, class rooms, etc.). This standard does not address non-thermal environmental factors such as air quality, acoustics, and illumination or other physical, chemical, or biological space contaminants that may also affect comfort or health. Such factors must be addressed separately.

This standard specifies minimum requirements. However, these may be outperformed where appropriate. Cases in which it could make financial sense to do so should be analyzed. This standard takes precedence over locally applicable laws, regulations and standards whenever it exceeds the requirements therein.

Deviation from this standard is acceptable

- if alternative designs or practices giving lower energy consumption or higher efficiency are implemented
- if overruled by non-financial stipulations (e.g. health protection or applicable laws), in which case deviation must be confined exclusively to the conflicting feature(s) of a design
- if alternative designs or practices yielding a higher net present value (NPV) - calculated as described in Group Directive K18, section 4.2 (Full-cost lifecycle analysis) - are implemented

Any deviation must be documented in-house for potential internal and external review. For identical design situations, generic evaluation is appropriate.

2. Target

The target values for thermal environmental conditions represent a balance between the desired effects of minimizing both energy consumption and occupant dissatisfaction and maintaining high productivity. They are

- applicable for all spaces with sedentary and office type activities (1-1.3 met)
 - > Offices, meeting rooms, conference rooms, training/education rooms
- suitable for all climate zones (all Roche facilities)
- supported and justified by science and norms
- easy to implement and control

The target values for thermal environmental conditions have been based on, and are compliant with, the two standards, US ASHRAE 55-2004¹ and EN ISO 7730². Both standards are in close agreement and are based on the thermal comfort model by P.O. Fanger developed from extensive climate chamber experiments. For a given set of thermal room climate conditions, this model determines the predicted percentage dissatisfied (PPD) with the thermal conditions from the predicted mean vote (PMV) of the thermal sensation (see chart below). The target values for environmental conditions ensure that more than 90% of occupants are satisfied with the general (whole body) thermal comfort.

¹ ASHRAE Standard 55-2004 "Thermal Environmental Conditions for Human Occupancy"
(ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers)

² ISO 7730 "Ergonomics of the Thermal Environment"

Roche Energy Efficiency Standard



Thermal Environmental Conditions for Sedentary Activities

The targets are as follows:

- Heating with air temperature set-points above **22°C (71.5°F)** is not acceptable.
- Cooling with air temperature set-points below **24°C (75°F)** is not acceptable.
- Humidification must not result in humidity larger than **0.006 g/g (0.006 lb/lb)**.
Note: This value is not justified by thermal comfort requirements (for which it could be lower) but to avoid irritating mucous membranes.
- De-humidification must not result in humidity lower than **0.0110 g/g (0.0110 lb/lb)**.
However, air that is de-humidified by sub-cooling should not be re-heated (to meet 24°C (75°F)).
Instead, the increased temperature lift should be utilized to lower flow rates.

3. Measures

All group companies are required to develop and implement measures that ensure fulfillment of the target values. Reasonably long transition periods (not longer than one year) may be used to gradually introduce targeted thermal environmental conditions and to allow for sufficient adaptation.

4. Further information

The target values are determined on the basis that occupants wear clothing appropriate to the climate and season. They are good for typical air velocities (0.1 – 0.2 m/s, 20 – 40 ft/min). They prescribe *air temperature* and not *operative temperature* since the difference between the two is marginal in well designed and built buildings and any incremental comfort loss due to air and radiant temperature deviations is absorbed by the margin created by the stringent target “less than 10% dissatisfied”. Also, operative temperatures are not really suitable for controlling thermal air conditions.

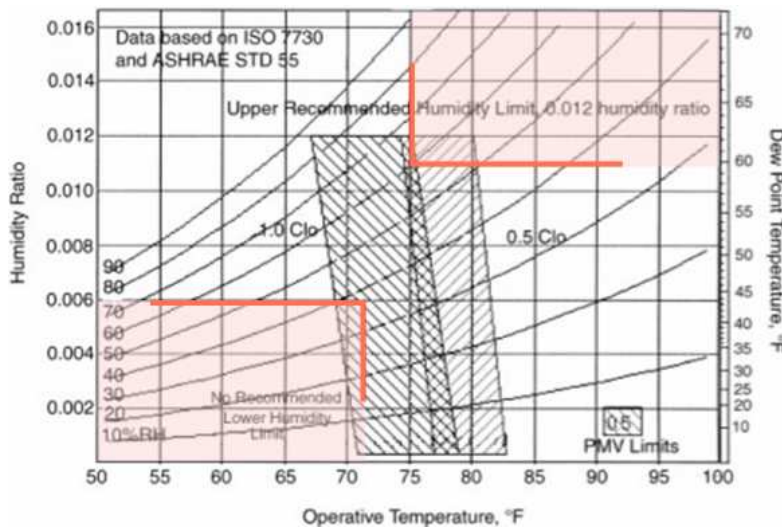
This standard does not address localized discomfort issues, such as radiant temperature asymmetry, draught (air movement), vertical temperature gradient and floor temperature, since they typically do not appear in well designed and built buildings, they are absorbed by the margin created by the stringent target “less than 10% dissatisfied” and they can and should be individually and locally solved.

Roche Energy Efficiency Standard



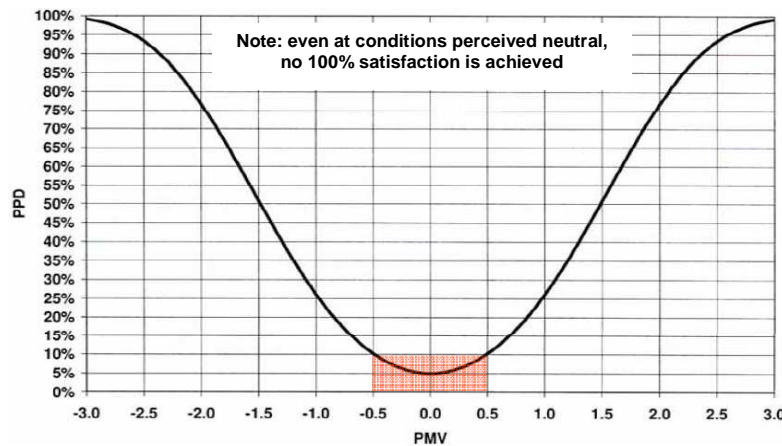
Thermal Environmental Conditions for Sedentary Activities

Comparison between Roche Standard and ASHRAE 55



For spaces with office activities ($\leq 1.3 \text{ met}^3$), seasonal dressing (0.5 clo^4 in summer and 1.0 clo in winter) and $\leq 0.2 \text{ m/s}$ (40 ft/min) air velocity, the black shaded areas represent comfort envelopes where less than 10% of occupants are dissatisfied. The red areas covers target values of this standard.

Correlation between PMV (predicted mean vote) and PPD (predicted percentage dissatisfied)



PMV: cold: -3, cool: -2, slightly cool: -1, neutral: 0, slightly warm: 1, warm: 2, hot: 3
The red range covers target values of this standard.

³ Met: a unit used to describe the energy generated within the body due to metabolic activity, $1 \text{ Met} = 58.2 \text{ W/m}^2$.

⁴ Clo: a unit used to express the thermal insulation provided by garments and clothing ensembles, $1 \text{ clo} = 0.155 \text{ m}^2 \cdot \text{K/W}$.