

Field test:

ENTRAK personal climate device for CPS

Test objects: TeamMaster suit at room temperature and at sub-tropical climatic conditions (32°C, 80% relative humidity)

1. Tests:

1.1 testing, at room temperature and on a treadmill, of the ENTRAK device for subjective feeling of the cold when wearing the TeamMaster suit to protect against hazardous chemicals.

1.2 testing, in a climatic chamber at 32°C and a relative humidity of 80%, of the ENTRAK device for the subjective feeling of cold when wearing the TeamMaster suit to protect against hazardous chemicals.

1. Description of the RT test (1.1):

a.) Devices

2 x suits, type TeamMaster, one of which was equipped with a ventilating unit and OLA/FLA adapter. Weight: approx. 8.5kg. Combined with a HP 4100 fire brigade helmet and PSS 100 / PA 94UP compressed-air breather, and ENTRAK device with two cool packs. The suits were also equipped with a temperature and humidity sensor. Polar 710 pulse timer.

Total weight of the equipment: 27kg (clothing, CPS, PA, helmet, cool pack)

b.) Conditions

The test person wore the entire equipment with cooler and measuring sensor on a treadmill at 4km/h and a gradient of 2%. Objective: to test the breathing-in of the supply of compressed air.

c.) Test persons

Person 1: male, 192cm, 28 years of age, 90kg, max VO₂ 40, pulse at rest 50, maximum pulse 182

Person 2: male, 179cm, 39 years of age, 77kg, max VO₂ 49, pulse at rest 56, maximum pulse 192

d.)Equipment

2 x suits, type TeamMaster, one of which was equipped with a ventilating unit and OLA/FLA adapter. Weight: approx. 8.5kg. Combined with a HP 4100 fire brigade helmet and PSS 100 / PA 94UP compressed-air breather, and ENTRAK device with two cool packs. The suits were also equipped with a temperature and humidity sensor.

Total weight of the equipment: 27kg (clothing, CPS, CAB, helmet, cool pack)

d.) Photos



Photos I and II



Photos III and IV



Photos V and VI



Photos VII and VIII



Photos IX and X

Photos I-VIII: tests from the cooling test. Photos IX-X: non-cooling tests

Results of test 1.1:

CPS with ENTRAK device

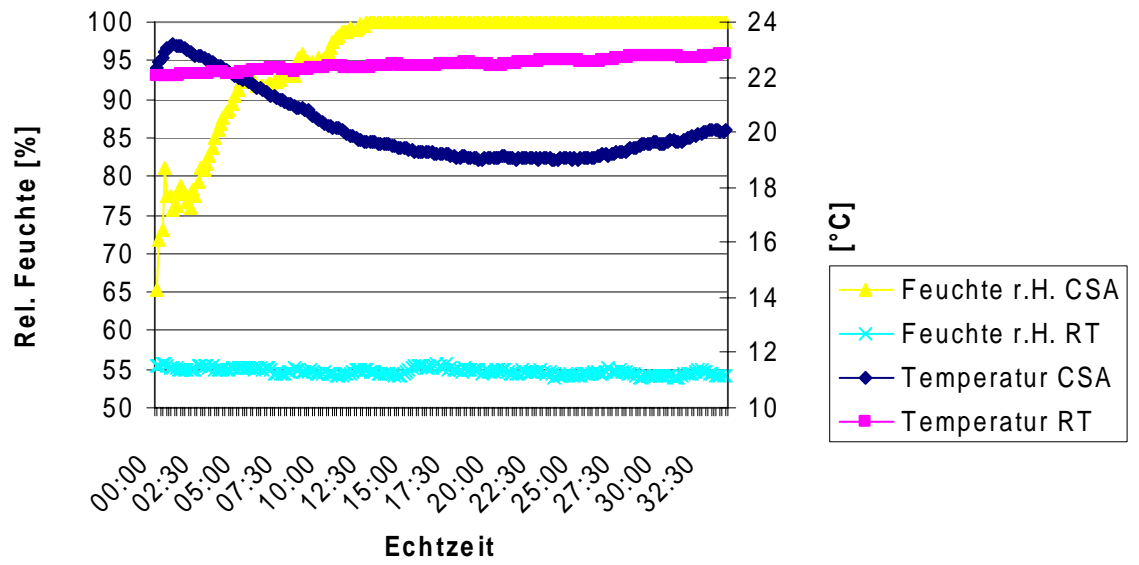


Diagram 1

CPS wearing test of TM pro ET with ENTRAK device

Relative humidity

Humidity: relative humidity CPS

Humidity: relative humidity RT

Temperature: CPS

Temperature: RT

Real time

CPS without ENTRAK device

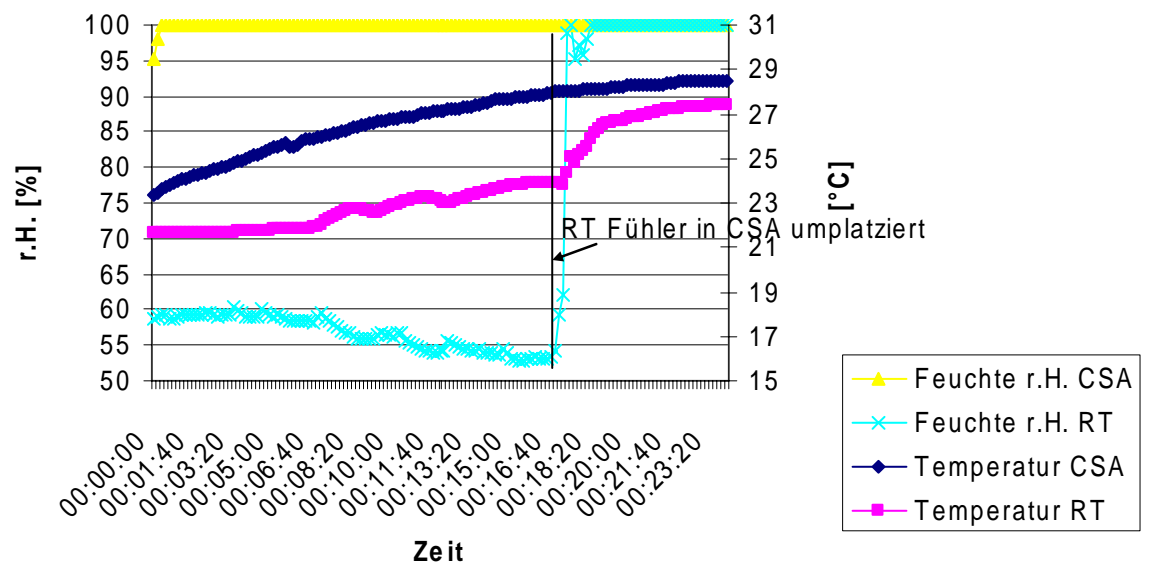


Diagram 2

CPS wearing time, not cooled

Relative humidity (%)

RT sensor repositioned in CPS

Humidity: relative humidity CPS

Humidity: relative humidity RT

Temperature: CPS

Temperature: RT

Time

As can be seen from diagram 1, when wearing the suit, the wearer of the suit has a lower temperature than the environment throughout the entire test (test person 1: 16°C, measured at chest height on the belt, left, see photo VIII. Test person 2: 19°C, measured on the reverse, close to the compressed air breathing bottle, see photo VI).

For this reason, the visor didn't mist up during the entire course of the test, although it doesn't have an anti-fog visor / wasn't treated with an anti-fog medium.

Both test persons agreed that the climate inside the suit was agreeable. Compared to the general acoustics from the CAB lung device and suit, the volume of the cooling unit was negligible. Neither was the weight discernible as an additional load (despite 2kg additional weight).

Overall, the test persons had up to 24kg additional weight from the suit (8kg), CAB (12-14kg), ENTRAK device (2kg), helmet (1kg) and underclothing (approx. 1kg).

Without any cooling, 100% humidity was achieved after less than 2 minutes at approx. 23°C in the suit (please note that the suit was not entirely dry, since it had already been used for the test with cooling). With cooling, after approx. 15 minutes at approx. 19°C.

Despite the suit's air-conditioning which was considered positive, both test persons were bathed in sweat.

Neither of the test persons had a problem with the suit temperature during the 30-minute test. Test person 1 used up his supply of bottled compressed air. Test person 2 aborted the test after 30 minutes due to the ill-fitting helmet (Schubert F 110).

2. Description of the subtropical test at 32°C / 80% relative humidity

2.1. Two test persons with a CPS type 1a (comprising entire body and breathing apparatus) were sent into an accessible climatic chamber with a subtropical climate of 32°C and 80% relative humidity. Dressing (i.e. putting on the CPS) was also performed in the climatic chamber.

e.) Devices

2 x suits, type TeamMaster, one of which was equipped with a ventilating unit and OLA/FLA adapter. Weight: approx. 8.5kg. Combined with a HP 4100 fire brigade helmet and PSS 100 / PA 94UP compressed-air breather, and ENTRAK device with two cool packs. The suits were also equipped with a temperature and humidity sensor. Polar 710 pulse timer.

Total weight of the equipment: 27kg (clothing, CPS, CAB, helmet, cool pack)

f.) Conditions

The test person wore the entire equipment with cooler and measuring sensor in an accessible climatic chamber. The test persons were requested to lift up a sandbag weighing 15kg to a height of 1.10m several times and also to control the measuring sensors which they carried with them in a CPS pocket, and to regularly go up and down a step. The actual load was thus kept low. Objective: to test the breathing-in of the supply of compressed air.

g.) Test persons

Person 1: male, 192cm, 28 years of age, 90kg, max VO₂ 40, pulse at rest 50, maximum pulse 182

Person 2: male, 179cm, 39 years of age, 77kg, max VO₂ 49, pulse at rest 56, maximum pulse 192

h.) Equipment

2 x suits, type TeamMaster, one of which was equipped with a ventilating unit and OLA/FLA adapter. Weight: approx. 8.5kg. Combined with a HP 4100 fire brigade helmet and PSS 100 / PA 94UP compressed-air breather, and ENTRAK device with two cool

packs. The suits were also equipped with a temperature and humidity sensor. Body core temperature sensor (head sensor).

Total weight of the equipment: 27kg (clothing, CPS, CAB, helmet, cool pack)

i.) Photos



XI;



XIII and XIV



XV and XVI

Photos XIII and XV show the position of the body core temperature sensor.

An increase in both test persons' heart rate from approx. 120 to approx. 140 bpm was detected in both test persons during the climatic chamber tests. Test person 2 experienced an increase of the core temperature amounting to 0.5K over the entire testing period. Considering the length of this test, this amounts to a relatively low increase in the core temperature. Unfortunately, the data logger of test person 1's core temperature sensor broke down.

Both test persons reported that they effectively felt the cooling. Both were bathed in sweat. A certain degree of exhaustion was also felt by both test persons. **On a particularly positive note: neither of the test persons experienced problems with the visors misting up from the inside.** The visor remained clear on the inside throughout the entire test period. Mist had to be occasionally wiped off the outside, since the inside remained colder than the testing environment.

SUMMARY

A significantly longer use is enabled by using the presented body cooler whilst simultaneously significantly reducing the amount of stress for the wearer. Very positive compared to air-cooling: the simplified logistical effort and the low costs involved in having the ice batteries at hand compared to compressor air. A further positive feature is the additional freedom of movement, since no air line is necessary. The cooling effect appears a great deal better than with air cooling, since the device is located on the body and the air perceptibly circulates around the suit instead of permanently leaving the suit. The somewhat annoying piping in the extremities for cooling the body is no longer applicable. **Working for almost 40 minutes in the selected subtropical conditions without the cooler would have been impossible.** The use of more cooling batteries and a cooling control enabled the time of use to be further extended. The weight proved negligible. The tested variations are sufficient to cool the wearer during the test (1 x 6-litre bottle, 300 bar). For longer periods, the cooling batteries and the bottles had to be replaced. Combined with a BG4, larger models of the devices had to be used in some cases. Moreover, controllability must be a given. With a planned retail price on the market of approximately € 600, the device is competitive with cooling systems which make use of compressed air for cooling purposes. **Compared to PCM materials (cooling waistcoat), the factor of reducing the temperature in the suit is a particular advantage since this prevents the visor from misting up.** Cooling waistcoats cannot do this.

