Humidity and temperature control system for ITCU

This document describes building a micro-climate control system for one to four Coloreel units placed close to each other. Coloreel provides some of the modules in the system, but most of the parts are locally sourced and provided by the customer.

Background:

It is well known that printers need a controlled climate with minimum humidity and maximum temperature limitations. Therefore, printers are typically installed inside a climate-controlled part of the building. Even though they are usually subject to similar environmental specifications, embroidery machines are often placed in a dry or hot environment.

Since the Coloreel unit is a printer, it has similar requirements to a digital large-format printer and explicitly requires relative humidity within 30-80% RH and temperature within 18-28 °C or 64-82 °F. Outside this temperature, it is not possible to operate the Coloreel unit.

The systems described in this document aim to solve this issue cost-effectively and safely. It is an alternative to moving the Coloreel ITCUs to a climate-controlled area. The system can handle humidity down to 10-15% RH and a temperature up to 38C/100F.

System Overview

The Coloreel solution is built on controlling the climate in a small volume of air inside a *Mixing chamber* and then providing one or several ITCUs with climate-controlled air through *Flexible air ducts* and into the printer part of the ITCU through a *Climate Hood,* which includes a small fan controlled by the ITCU. The climate in the Mixing Chamber is managed by placing a controlled *Humidifier* inside the mixing chamber.

If the temperature is too high, a portable AC can provide cooler air to the mixing chamber by directing the cooled airflow to the air inlet of the mixing chamber.

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Sub-systems and modules

Mixing chamber

The Mixing chamber contains a volume of air large enough to secure proper mixing and, by that, internal climate control. Inside, there must be room for an appropriate dimensioned evaporative humidifier. The humidifier must have a regulator to maintain a target humidity of 50-60%RH.

Standard, easily accessible parts can be used to construct a climate chamber of 0,3 – 1,0 cubic meters (m3) in volume (12 – 35 ft3). There must be at least one see-through part (side door or top) to discover eventual condensation visually. Condensation indicates too much humidity and risk for condensation and related damage to electronics inside the ITCU.

On the top, there should be as many output ducts (100mm/4 in) as you plan to connect Coloreel ITCUs; up to 4 are tested.

Open air inlets close to the bottom of the Mixing chamber to allow for unrestricted airflow. If an external A/C is to be used, direct the A/C's airflow directly to the air inlets.

A visible thermometer/hydrometer that measures the temperature and humidity inside the chamber near the output ducts.

Parts used for the Coloreel prototype test version:

- One IKEA kitchen cabinet, 80 x 60 cm, equipped with glass doors
    - *A 100 mm (4”) hole saw was used for the duct fittings, which were mounted and secured with wood screws.*
- One 100 mm (4”) duct fitting for each outlet (unit)
- One 100 mm (4”) duct fitting for a controlled air inlet close to the bottom of the climate chamber

Flexible air ducts

Flexible lightweight air ducts (100mm/4 in) of enough length. We have tested with 6m. Note that they must be flexible to be suitable for the drawer function of the multi-stand and for opening and closing the ITCU door. The material should be either pure plastic or plastic with a twisted steel wire.

For our test phase, we used this article from Amazon:
Flexible air ducting.

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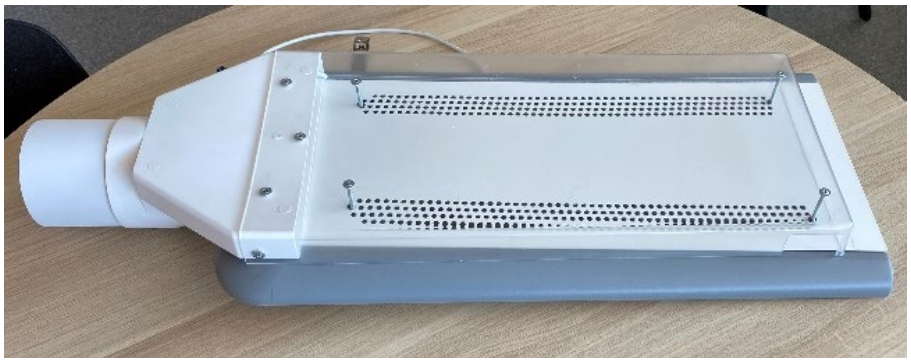
Climate hood

This part is engineered and sourced from Coloreel. It is built to fit the dour outside the print engine and to provide the correct amount of climate-controlled air through an internal fan controlled by the ITCU via a USB cable.

The Climate hood is mounted on the door and is light enough so that you can still open the door for threading and maintenance. It includes a separate mounting instruction and needed screws.



Humidifier

The humidifier must be of the evaporative type. No ultrasonic humidifier is allowed. This is for two reasons:

1. to avoid “white mist,” which can cause corrosion and damage electronics and
2. the built-in fan in the evaporative humidifier secures a good mixing of air inside the mixing chamber.

The capacity should be enough to provide 4 Coloreel ITCUs with climatized air. We have calculated and tested that a capacity of 0.7 liters of water per hour should be sufficient.
The humidifier must be internally controlled. This means you can use a set point for target humidity, and the humidifier reduces capacity or turns off once that level is reached. The target humidity point must be at least 50% RH% for the correct climate.
The humidifier must be maintained according to its manual.

An Oscar Big humidifier from Stadler Form was used for testing.
See https://www.stadlerform.com/en/humidifier/oskar-big-white-o-040

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Portable or external air conditioning

The cooled airflow is to be directed to the air intake openings of the Mixing chamber.
The required airflow/pressure is relatively low, so set it to a low airflow.
There might be other means to control the airflow.

The temperature setting should be well below the target temperature. A suitable target temperature inside the mixing chamber is 22°C/75°F; this will handle ambient temperatures up to 38°C/100°F

Parts to source for building the system:

1 Mixing chamber:	0,3 to 1,0 m^3 / 12 – 35 ft^3
1 Hose ducts for air inlet	100 mm/4 in
1 hose duct per ITCU to be connected.	100 mm / 4 in
Flexible ventilation hose	100 mm / 4 in, 6m length each
Hose clamps, 2 per hose	100 mm / 4 in
Temperature/humidity sensor	Electronic type, readable from inside the cabinet
Evaporative humidifier, with humidity control function	Capacity 0,3-0,7l per hour depending on how many ITCUs to connect
Climate Hood with fan – one per ITCU	Sourced from Coloreel. The engineered module is attached to the back hatch outside the print engine.

Interface specification

To protect the ITCU from damage through condensation, the air inside the mixing chamber should have a humidity below 70% RH. The recommended setting is 50-60% RH.

The recommended setting for temperature is 22°C/75°F if using an external AC. The temperature in the mixing chamber must be within the range of 18-28°C/64-82°F

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