Siemens A&D AS FA
Insertion of the SIMATIC Panel PC 677 into IP 20 Protective Housings
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What do I have to considder when building an IP20 housing for the SIMATIC Panel PC 677 / 677B?

Insertion of the Panel PC 677 into IP 20 Protective Housings

In this document, the sizing of an IP 20 protective housing for a SIMATIC Panel PC 677 / 677B is examined. The results shown here are based on thermal simulations and remeasurements of the results.
The solution presented below offers reference points for the design of a protective housing to ensure the operation of the device within the permissible environmental conditions. In general, if the requirements are unclear, a measurement of the Panel PC's ambient operating temperature has to be performed to assure that it is run within the permissible environmental conditions, otherwise the warranty will be voided; furthermore, the lifespan of the device may be reduced.

1 Heat Dissipation through different Surfaces

In this chapter, the theoretical basics concerning the heat removal from a protective housing – into which a Panel PC is installed – are examined.

- Two effects depending on the surface properties have an impact on the energy transfer:
    - The **texture of the surface**, which changes the turbulence of the near-wall stream
    - The **emissivity of the surface**, which influences the radiation

Materials
Examined are stainless steel, galvanized steel and a painted steel surface. In the following table, the thermal material properties are summarized:

	Polished Stainless Steel	Galvanized Stainless Steel	Plastic Paint	Anodized Aluminum
Thermal Conductivity [W/mK]	15	50 – 60	0.1 – 1	180 – 200
Emission Coefficient	0.07	0.2	0.92	0.6

Difference: Powder-coated Surface / Polished Metal Surface
- A powder-coated surface is more strongly textured than a polished metal surface. The near-wall, quasi-stationary air layer becomes thinner and the effective surface for the convective heat transfer increases.

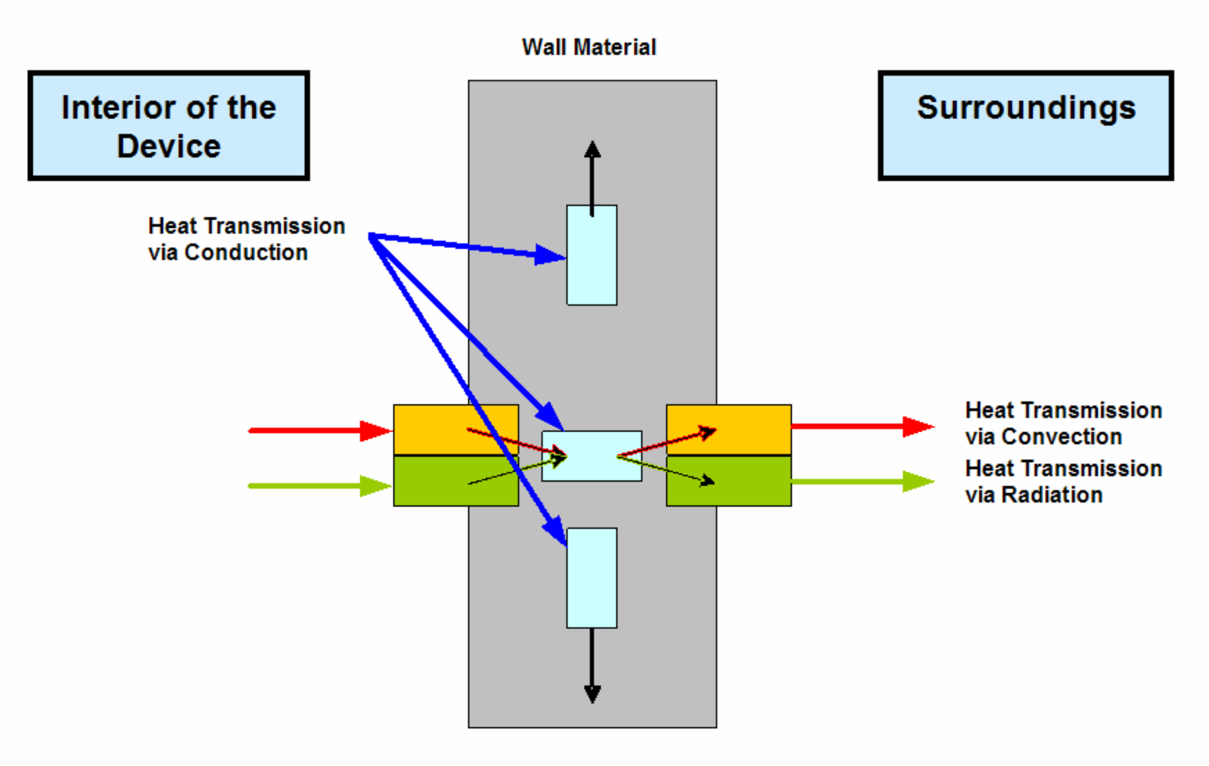
Calculation of the radiated Power
- The power output by the radiation is calculated as follows:

$$P_{Radiation} = A \times \varepsilon \times \sigma \times (T_w^4 - T_u^4)$$

$P_{Radiation}$	-	Energy Transfer through Radiation
A	-	Radiated Area
ε	-	Emission Coefficient of the Surface
σ	-	Stefan-Boltzmann Constant

T_w - Wall Temperature [K]
T_u - Ambient Temperature [K]

I.e. if the boundary conditions are the same, the result is $P_1 / P_2 = \varepsilon_1 / \varepsilon_2$
$\varepsilon_{Color} / \varepsilon_{Stainless\ Steel} = 0.92 / 0.07 = 13$ → A painted surface emits 13 times as much energy by means of radiation than a polished surface!



Since the wall is relatively evenly warmed up from the interior, only a small temperature gradient arises at the dimensions wall length and wall height. For this reason, the thermal conductive properties of the wall material only have a small impact. A large temperature gradient can be seen at the wall thickness, which with only a few millimeters exhibits a low thermal conductive resistance. The energy transfer is essentially determined by the two large heat transfer resistances “internal air to wall” and “wall to ambient air”.
The surface properties of the wall thus have a large impact on the heat dissipated by the housing to the environment.

Summary:

1) Painting of the surface is recommended to improve the heat dissipation.
2) The housing material has a small impact on the internal temperature.

2 Heat Removal Concept for IP 20 Protective Housing

2.1 Adherence to the maximum permissible Environmental Conditions

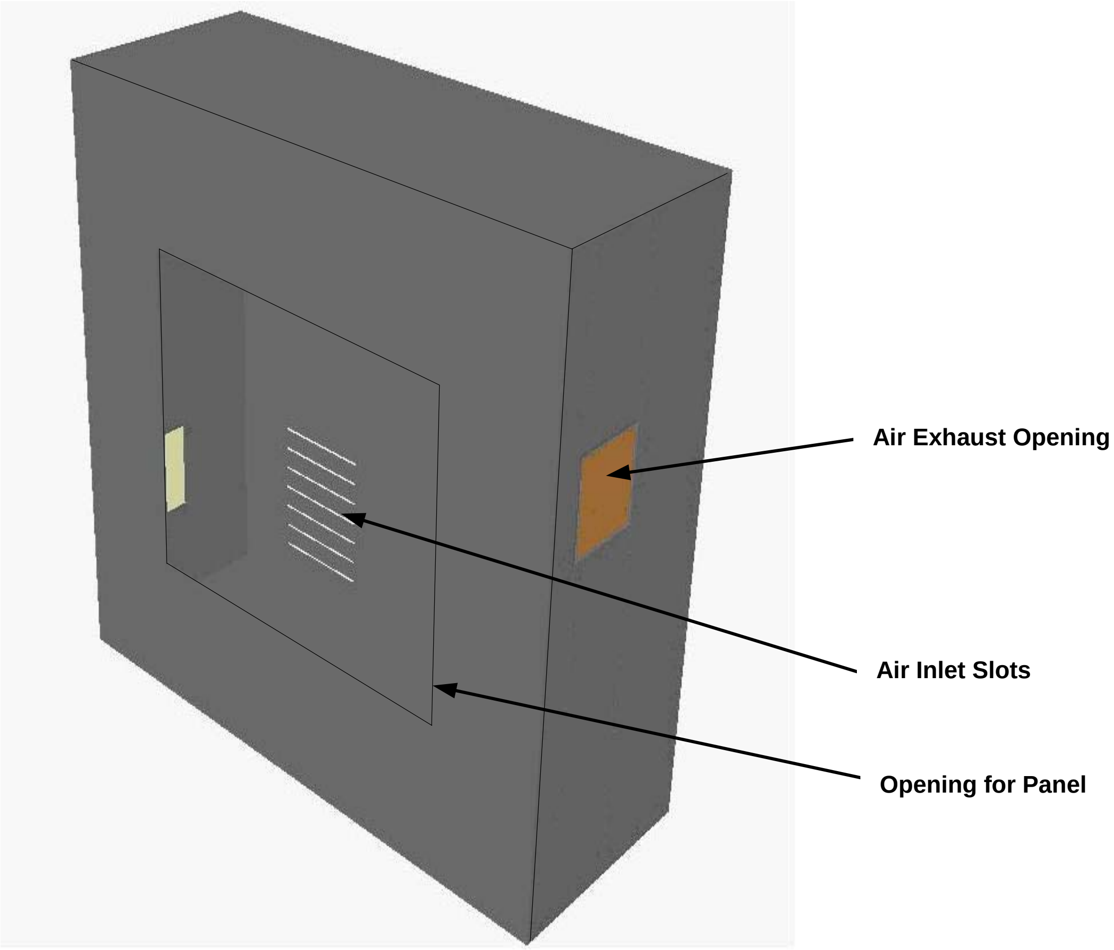
When mounted into an IP 20 protective housing, it is imperative that the maximum environmental conditions approved for the Panel PC 677 are not exceeded.
Particular attention should be paid to the fact that an IP 20 protective housing does not provide protection against drip / splash / jet water.
To avoid condensation, the relative humidity and the temperature gradient during temperature changes have to be observed in accordance with the maximum permissible environmental conditions for this device.
To adhere to these boundary conditions, a suitable site for the protective housing has to be provided.

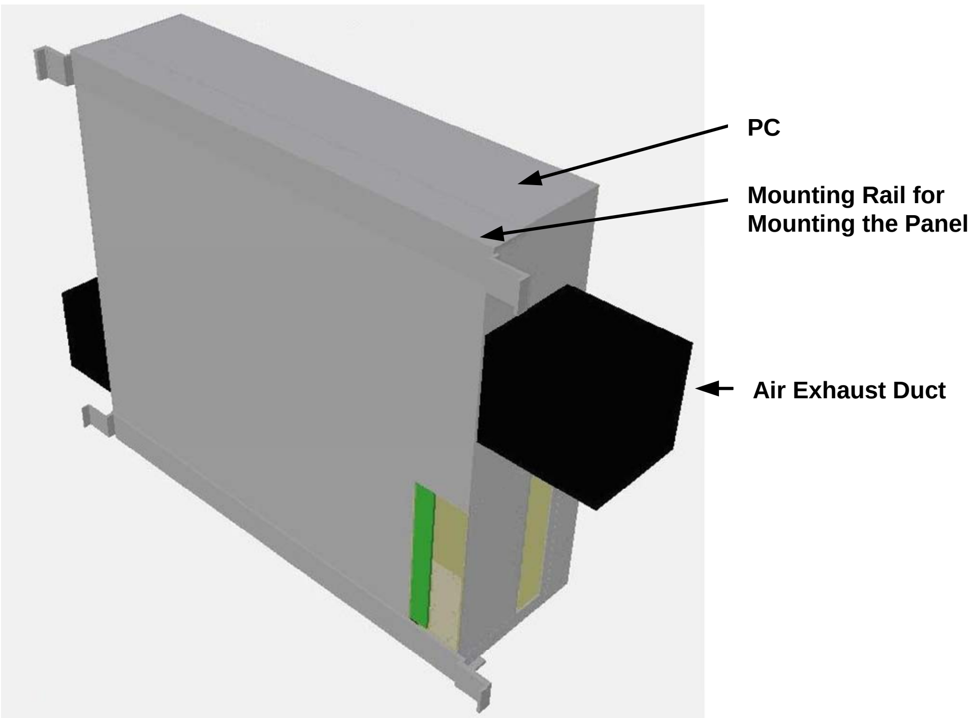
2.2 Dust

Note as well that an IP 20 protective housing does not provide protection against any form of dust. The forced ventilation by the device fans causes a contamination of the device coming from the dust present in the respective environmental atmosphere, which in the short or long run – depending on the degree of pollution – can lead to a functional impairment or failure of the device. Conductive / corrosive types of dust can cause a total failure of the device in a much shorter time period!

2.3 Design of the Protective Housing

The main heat sources are located within the PC. For this reason, it is advisable to move the heated air from the protective housing in the shortest possible way. This is best accomplished with air exhaust ducts from the device fans to air exhaust openings in the housing wall. In doing so, the heat removal from the panel takes place indirectly via sucked in fresh air flowing through.
Fresh air (= ambient air) is supplied the easiest via ventilation slots (gills) at the back of the protective housing. The following illustrations give a basic overview of the structure of the protective housing:


Air Exhaust Opening
Air Inlet Slots
Opening for Panel


PC
Mounting Rail for
Mounting the Panel
Air Exhaust Duct

2.4 Sizing Aids

The sizing aids relate to the values used in the simulation, which were confirmed by remeasurements.

- The size of the IP 20 protective housing is dependent on the panel employed (12”, 15”, 19”). When using air exhaust ducts, the requirement stipulated in the operating manual of keeping a minimum distance of 10 cm from the housing is not mandatory.
- The minimal distance between the housing and the Panel PC is 5 cm to ensure the air flow to the computing unit.
- The rear of the protective housing contains 6 air inlet groups with 7 slots each, providing an effective sectional area of 80 x 2.5 mm^2 per opening.
- Material of protective housing: Sheet metal, 1.5 mm thick, painted
- Air exhaust duct from PC: Square, sectional area of 60 x 60 mm, opening level at the outlet of at least 60%
- Air exhaust duct from power supply: Square, sectional area of 60 x 50 mm, opening level at the outlet of at least 60%
- The ducts are connected air-tight with the IPC housing.

In general, the values described represent minimum values. An increase of the effective inlet/outlet sectional areas improves the result.

2.5 Reachable Ambient Temperature

With the solution for an IP 20 protective housing presented here, a shop floor temperature surrounding the protective housing of

40 °C

can be realized.