



# CUSTOMIZED COMFORT

Cabs have come a long way from their initial role in protecting the operator. With co-operation between air-con suppliers and OEMs, high-tech analysis systems produce outstanding comfort

It was not so very long ago that the drivers of materials handling, agricultural or public works machinery operated in the open air, without any form of protection. It was only at the beginning of the 1970s that the first cabs appeared, with the safety aspect becoming the main priority.

While the user could initially consider the cab as just an additional cost in the purchase of machinery, manufacturers have progressively been able to put forward other quality concepts which have rapidly abolished this view. So from its inception as a simple accessory for protection against the elements, turning over or the danger of falling objects, the cab has now become an essential element in the design of the machinery.

It was also quickly realized that a driver working in a secure, pleasant,

environment is much more likely to work harder, with output improving as a result. This combination of the company's interests and the well-being of the driver has no doubt stimulated further developments.

Modern cabs typically benefit from wider window surfaces for better visibility, while the seats and controls are subject to studies for the enhancement of user-friendliness, and a radio is often installed. With more technology, the appearance of on-board computers and integrated communication means, the cab is now considered as a mobile office.

#### Integrated air-conditioning system

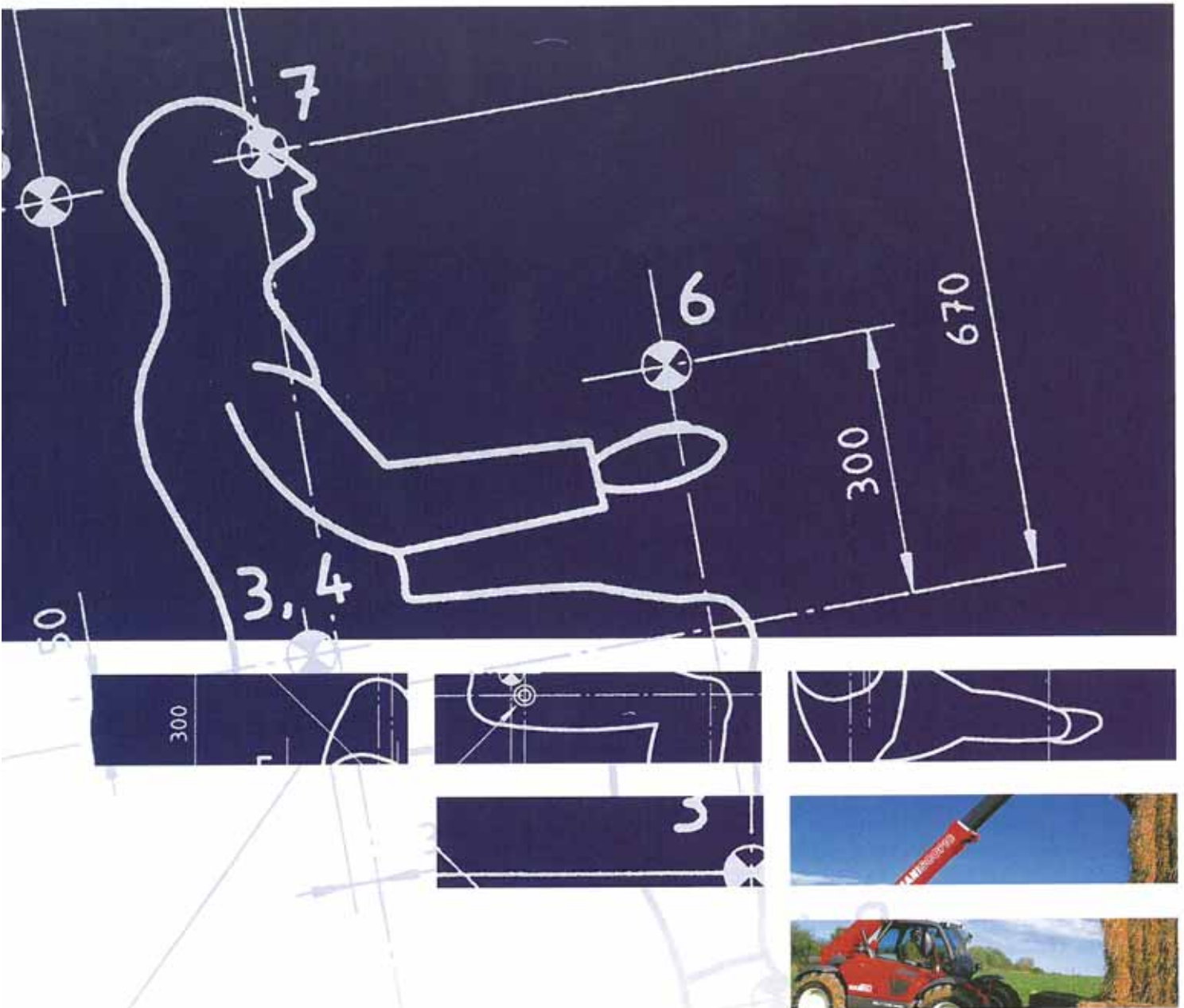
All this would no doubt have been impossible without the contribution of another element of essential comfort – air-conditioning. For the well-being of the operator, a temperate environment

has proved invaluable. Long considered as optional, the air-conditioning system has today become an essential element of comfort and a guarantee of ideal machinery operation.

Air-conditioning, which is no longer limited to HVAC, is however a complicated system, and must meet numerous restrictions. The solutions concerning cab comfort have evolved at the same time as the requirements of users. The 'hot or cold box' no longer exists – air-conditioning is a genuine function governed by standards.

The manufacturers got it right and now call upon specialist firms for their HVAC supplies. These specialists are now making the effort to consider technical, aesthetic and economic criteria in an attempt to find the best solutions.

In fact, the aims are varied. In winter it is essential to demist or defrost the



windows, while at the same time warming hands and feet especially sensitive to the cold. In summer it is the heat given off by the glass surfaces which must be evacuated, at the same time offering a user-friendly air-blowing distribution in the driver environment. In all cases, filtering of the outside and inside air must provide a healthy and clean atmosphere.

Another important objective is to meet restrictions as specific as protection of the driver, for example in the case of a dusty atmosphere in public works or when spraying from agricultural machinery. Pressurization can then be required, or sometimes even a filtration system can be adapted to toxic or aggressive environments.

The all-purpose nature of modern industrial vehicles requires all the functionalities to be considered right from the design phase.

In spite of OEMs being willing to meet all these requirements, the economic restrictions of a very competitive market have made the task very difficult. This has led to development of a functional analysis around the HVAC system and a wider assessment of the value, while developing privileged partnerships with specialist suppliers.

As these main suppliers are equipped with suitable analysis resources, it becomes easier for the OEM to collaborate in drawing up a precise specifications sheet, taking into account the essential and standards criteria.

With this in mind, let us take for example, the cab volume, the needs of the operator, the glass surfaces and the layout of the interior space, or even the conditions of use. The geographical factor for the final use of the machinery is also being included in the analysis.

The starting point before any development process, the study phase comprises a thorough examination of the existing layout and the satisfaction of the user. As soon as the OEM has ratified that the analysis has indeed met expectations as a whole, a particular specifications sheet can then be defined.

#### Computers and 3D for the right solution

This is where the know-how and the tools of the specialist supplier take on all their meaning. The use of sizing software enables – through the analysis of the specifications sheet – the designing of solutions at an objective cost while making modeling of the thermal performance of the cab possible.

Hence the Cellule software from France-based SNDC, which enables the simulation of thermal conditions of the cab in any latitude whatsoever, at any

## DESIGN & PRODUCT DEVELOPMENT

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time of the year, as well as its orientation. Seasons, the accurate and detailed description of the cab, conditional and azimuthal pitch, and the different internal and external atmospheres are some of the many details included in the drafting of simulations.

After the various components have been sized according to the requirements of the thermal simulations, they are then integrated through SNDC in the environment of the manufacturer using 3D resources. These realizations trigger the exchanges with the OEM's design office for ratification. The making of a prototype will then enable the checking of the design and the carrying out of a life-size test campaign drafted by the project team, in compliance with the specifications sheet with a view to certification.

These tests allow the early detection of possible adjustments required before launching a preliminary series. The

follow-up of preliminary series production by SNDC up to the final phase of assembly with the customer makes it possible to validate the characteristics of the product. Close collaboration between manufacturer and supplier means being able to define, describe and confirm the production processes.

### Thermal analysis

Thermography or thermal analysis is another technology which makes it possible to measure the differences of performance as compared with the specifications sheet. In fact, for a 5m<sup>3</sup> cab, a correct level of comfort will only be attained with uniformity of the air temperature within this volume – the difference in temperature must not be more than 2°C.

In the event that the difference is greater, the causes can be numerous. Thermal dissipation can hide in certain

parts of the cab and create hot spots. Distribution of the outside or used air is not at all user-friendly and prevents an even distribution of the temperature.

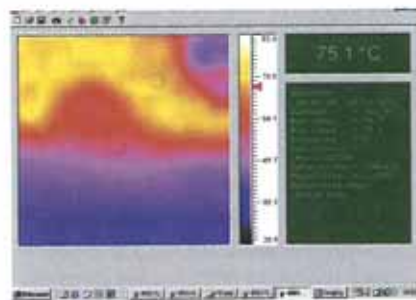
The digital pictures recorded by an infrared camera are then analyzed by the engineers using special software. The synthesis will facilitate the showing up of the origin of the heat sources and their transmission modes. The cooling capacity of the air-conditioning system could therefore be adapted, reducing costs as well as fuel consumption.

### An established partnership

The evolution of requirements regarding comfort, economic, technical and standards restrictions has paved the way for the profession of supplier of HVAC systems. Like the appearance of the machine or its technical performance, the ambient air recreated inside the cab is an important step towards user satisfaction. The design at targeted cost means sizing the solution as near as possible to the needs. The supplier is committed to a genuine guarantee of performance validated at different stages.

Manufacturers are therefore increasingly willing to work closely with a genuine partner, a specialist in fact, in a more comprehensive structure – 'a specialist in ambience design'. **IVT**

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ABOVE: Thermal analysis for an accurate diagnosis by specialist  
RIGHT: To optimize machine capacities and utilization, comfort of the end-user is the target of every manufacturer

