In addition the traditional quality criteria – such as easy handling and suitability for a wide range of spraying media – ongoing development of spraying technology has to address new issues today. Is it possible to save material by increasing the transfer efficiency and at the same time ensure excellent finish quality with a high application rate? Furthermore, is it possible to also cut the energy costs associated with compressed air, for example?

In order to make progress in this respect, it was first of all important to overcome an ‘either-or’ way of thinking that sees only conventional spray- ing on the one hand and HVLP (High Volume Low Pressure) on the other. It is necessary to embark on a third way.

Walther Pilot has been pursuing this approach for some time now. It manufactures what it calls medium-pressure systems with nozzle/air cap systems that combine the advantages of the above mentioned processes. The systems let users achieve a transfer efficiency of at least 65%, similar to HVLP systems, while at the same time improving surface quality and increasing the application rate.

This is done by using spray guns that work with maximum atomising pressure of 1.5 bar. This is somewhat higher than HVLP, where maximum pressure is 0.7 bar. These developments were successful right from the start. The aim to design nozzle/air cap systems that ensure very good atomisation and a high application rate while reducing material consumption by up to 30% was reached. This also formed the basis for further development work.

HVLP and HVLP Plus compared

The medium-pressure air cap was completely re-engineered to the next level of development: HVLP Plus technology. To gain more detailed knowledge of the new system, the Fraunhofer Institute for Manufacturing Engineering and Automation (IPA) was commissioned to carry out a series of tests comparing HVLP Plus and HVLP spray guns. The results prove the high transfer efficiency of HVLP Plus, at between 78 and 88% (see Table). The HVLP spray guns also measured up well, with transfer efficiencies of between 71 and 88%.

Both air cap technologies show average transfer efficiencies far higher than the 65% value usually specified for HVLP. It must be pointed out that an important role is played not only by the spray gun itself but also by the paint material being sprayed. The values measured in the test show that transfer efficiency can vary depending on the medium being sprayed.
In accordance with the EN 13966-1 standard test method, transfer efficiencies (sprayed solid mass/dry film mass) were measured by the Fraunhofer IPA

<table>
<thead>
<tr>
<th>Spray gun</th>
<th>Spraying medium</th>
<th>Input pressure</th>
<th>Nozzle size</th>
<th>Distance</th>
<th>Air consumption</th>
<th>Discharge rate</th>
<th>Transfer efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premium HVLP Plus gravity-feed cup</td>
<td>2K PU furniture paint HS 2K topcoat</td>
<td>2.8 bar</td>
<td>1.8 mm ø</td>
<td>1.5 mm ø</td>
<td>180 mm</td>
<td>290 Nl/min</td>
<td>280 g/min</td>
</tr>
<tr>
<td>Premium HVLP Plus material connection</td>
<td>2K PU furniture paint HS 2K topcoat</td>
<td>2.6 bar</td>
<td>1.2 mm ø</td>
<td>1.2 mm ø</td>
<td>180 mm</td>
<td>300 Nl/min</td>
<td>250 g/min</td>
</tr>
<tr>
<td>Premium HVLP gravity-feed cup</td>
<td>2K PU furniture paint HS 2K topcoat</td>
<td>3.2 bar</td>
<td>1.8 mm ø</td>
<td>1.5 mm ø</td>
<td>180 mm</td>
<td>490 Nl/min</td>
<td>205 g/min</td>
</tr>
<tr>
<td>Premium HVLP material connection</td>
<td>2K PU furniture paint HS 2K topcoat</td>
<td>3.0 bar</td>
<td>1.2 mm ø</td>
<td>1.2 mm ø</td>
<td>180 mm</td>
<td>500 Nl/min</td>
<td>250 g/min</td>
</tr>
</tbody>
</table>

For the HS (high-solid) two-component topcoat, the transfer efficiency is higher than for the two-component PU furniture paint (see Table). Only the results for the HVLP Plus with gravity feed cup are the same. This is due in large part to the higher viscosity of the two-component HS topcoat, which has a corresponding effect on droplet size. In certain cases the transfer efficiency for HVLP Plus can be higher than with a comparable HVLP spray gun.

To determine the transfer efficiency, the paint discharge quantity was precisely measured. This gives information on the application rate. In this case, the test results suggest that spray guns using a gravity feed cup and those connected to an external paint supply should be considered separately. For the gravity feed cup spray guns, it is clear that the application rate is higher with the HVLP Plus system. This is particularly apparent in the case of the two-component PU furniture paint. This is due to the smaller clearance in the HVLP Plus spray guns, which produces a greater injector effect. As a result, these guns can achieve a higher paint mass flow rate and, as a consequence, a higher application rate than HVLP systems.

The values for the discharge rates of spray guns connected to an external material supply – both HVLP and HVLP Plus – show that a high work rate can be achieved even though a smaller nozzle size was chosen, this in comparison with the gravity feed cup guns. At the same time, the transfer efficiency is high. The reason is that the higher paint discharge rate has a positive effect on the droplet spectrum. Proportionally to the paint mass flow, there is a reduction in the percentage of extremely fine particles.

It is not only the nozzle/air cap system that counts. Spray systems with pressure tanks and agitators offer perfect conditions for continuously high-quality finishes.
droplets, which also has positive effects on transfer efficiency.

In addition to the use of HVLP or HVLP Plus, the type of material feed also plays a key role. Even if a somewhat smaller nozzle bore is selected, a spray gun with a connection to an external material feed will normally have a higher output and transfer efficiency. Under real-world conditions, this is advantageous above all for the HVLP Plus spray gun. The higher atomising pressure of 1.5 bar, compared to the HVLP, makes it possible to produce a finer spray pattern.

It is worth noting that HVLP Plus technology also offers benefits in other respects. HVLP Plus spray guns require significantly less compressed air than their HVLP counterparts in order to achieve very high transfer efficiency at a high application rate. Whereas the figure for HVLP is approximately 500 Nl/min, HVLP Plus only requires around 300 Nl/min. This not only saves material but also reduces the consumption of costly compressed air. The fact that the transfer efficiency for HVLP is not higher than that for HVLP Plus is related to the high volume involved with HVLP. The effect is that fine droplets in the air stream are diverted outwards and do not reach the object.

The results show that HVLP Plus spraying technology has many advantages, especially as there is a wide range of nozzle sizes to suit all requirements. The newly developed, top-of-the-range HVLP Plus models – the Pilot Premium and the automatic Pilot WA 700 version – are identified by their blue air caps. However, there is still a need for HVLP air caps, which are marked in green. They continue to be used for many applications, including low viscosity materials and dispersion adhesives.

For most applications however, HVLP Plus is the first choice. Apart from producing a very fine spray pattern, these spray guns pay for themselves in a short time due to reduced material consumption, their low compressed air consumption and their higher work rate. In any case, the use of HVLP Plus or HVLP will reduce VOC emissions due to the higher transfer efficiency achieved. The spray guns are so designed to spray waterborne materials without any problems. All wetted parts are made of stainless steel. In fact, the entire front body of the Pilot WA 700 version is made of stainless steel.

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**Keep the material supply system in mind**

While a spray gun’s nozzle technology plays a key role in achieving optimum results, it is not in itself sufficient. Clean and oil-free compressed air is just as important, as is an even material flow to the nozzle. The material conduits in the Pilot Premium spray gun version have large cross-sections, not least of all to ensure fast and thorough flushing. Furthermore, a new gravity feed cup with an easily removable, full-surface strainer has been developed. An alternative is a mixing cup – also with a strainer – that can be used as a gravity feed cup immediately after mixing.

If the material is supplied to the spray gun from pressurized tanks or by pumps, this has a positive effect on the discharge rate and transfer efficiency. Overall, the result is that fewer extremely fine particles fail to reach the surface. The finish is extremely good, provided that the various atomisation parameters are finely tuned and balanced. In contrast to pumps, the material supply from pressure tanks is completely free of pulsation, which means that a more even spray jet is generated. Agitators are used to thoroughly mix the material, thus producing a particularly homogenous surface finish.

Walther Pilot uses geared agitators almost exclusively, in order to achieve constant speed and high torque. All the openings in the lid of the pressure tank are certified for use with potentially explosive media for zones 0 and 1 in accordance with the ATEX Equipment Directive (European safety directive on explosion protection). Alternatively, diaphragm pumps can also be used to supply material to the spray gun.

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