The network of **specialists**, for **AM professionals**

INTEGR AM

Special RWS
VSP - Vibro Shot PEENING






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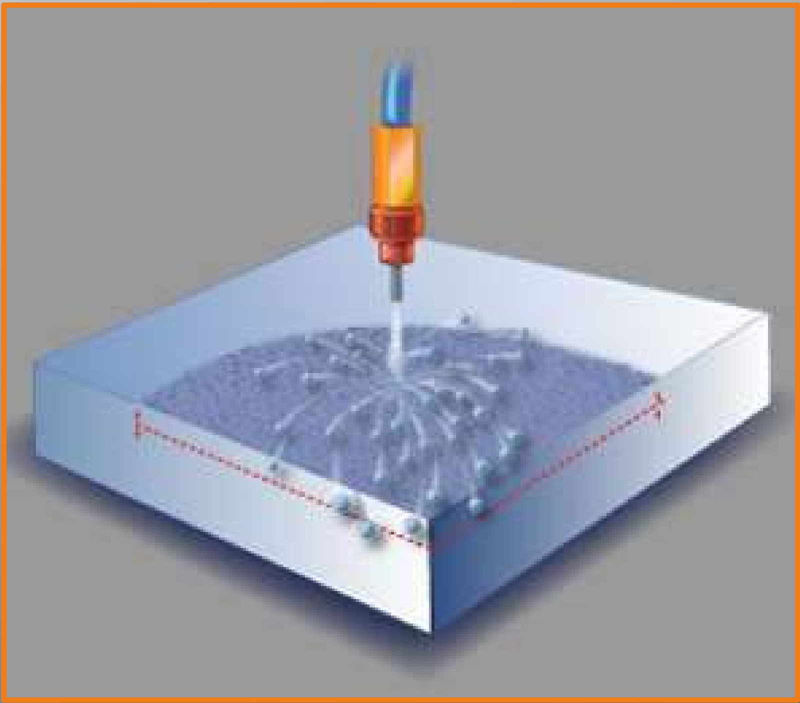
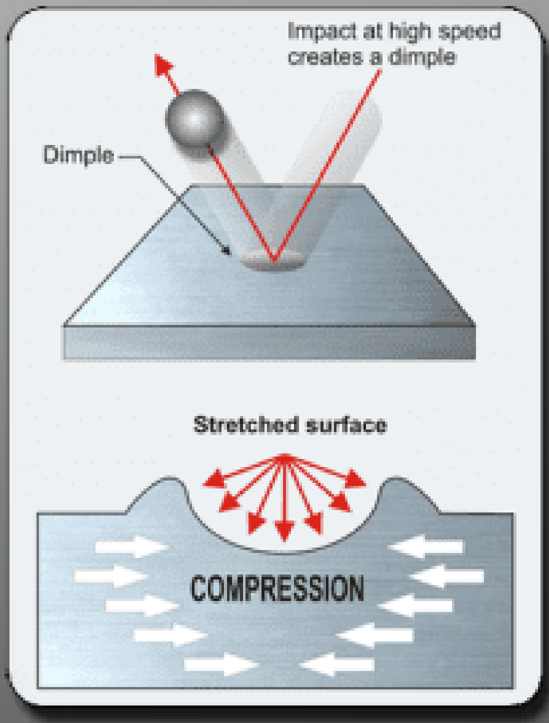
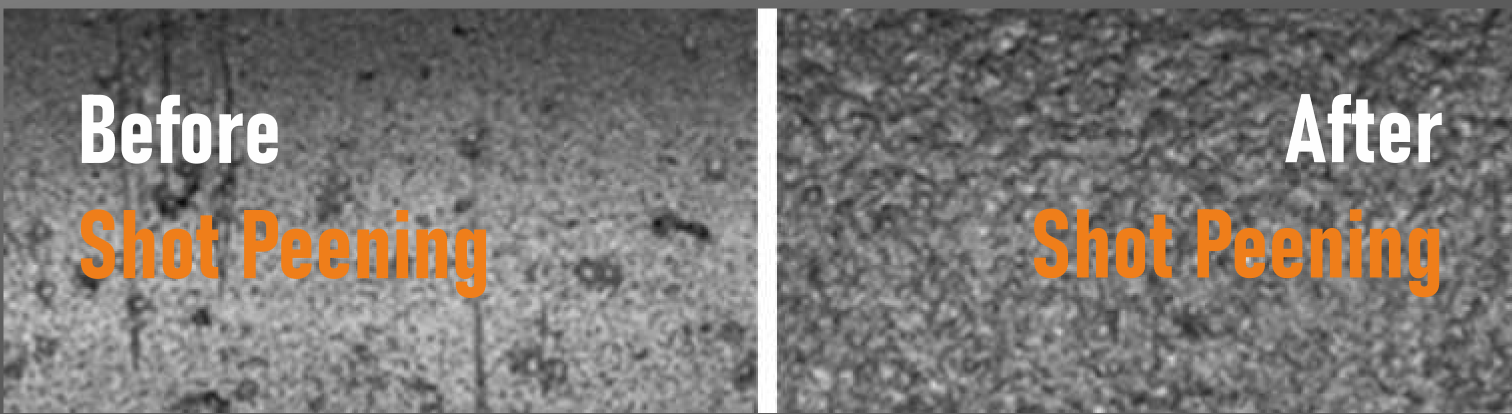
VSP - Vibro Shot PEENING







To understand the Vibro Shot Peening process we must first take a step back to talk about Shot Peening.

Shot Peening is in fact the forerunner of the most widespread processes intended to increase the compression or surface tension of a metal component. This generally takes place via shot blasting machines or compressed air under direct pressure. These systems shoot metal grits (generally stainless steel spheroids) on the surfaces of the components to be involved. The **Shot Peening** process is in fact a form of bombardment of a surface with spheroids which determines a series of impressions called «dimple» capable of generating taut surfaces with relative compressions. This type of application is ideal for reinforcing structures such as metal beams, bridge components or pylons for the electrification of railway lines, and all those components where the increase in surface roughness does not have negative effects. **The process that IntegrAM has identified with the acronym VSP is, as we shall see, capable of reaching similar levels of tension and compression, without however generating such high surface roughnesses and, in many applications, dangerous for the purposes of the use for which the components they are intended.**

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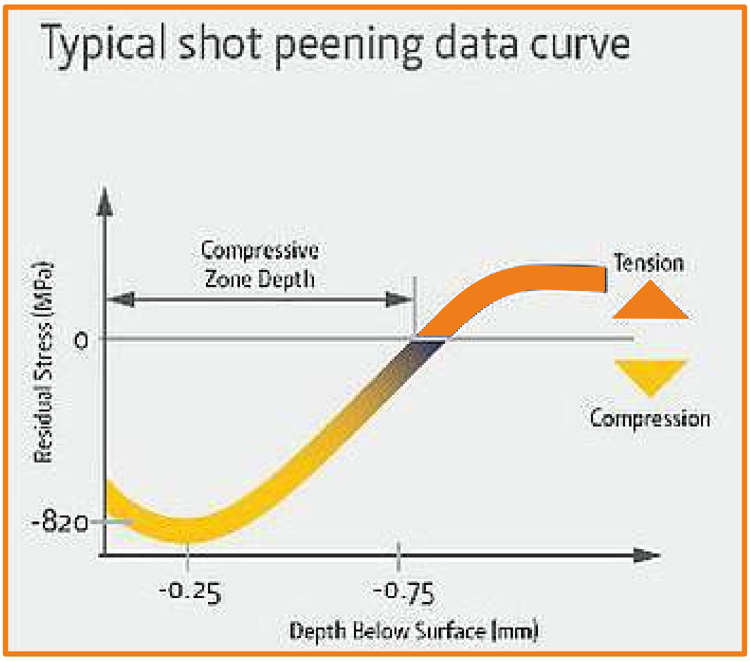
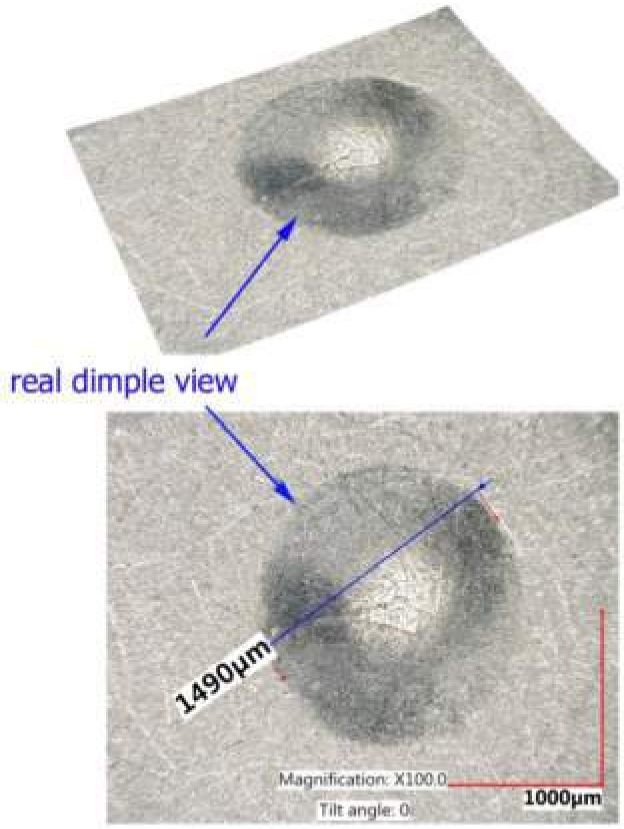
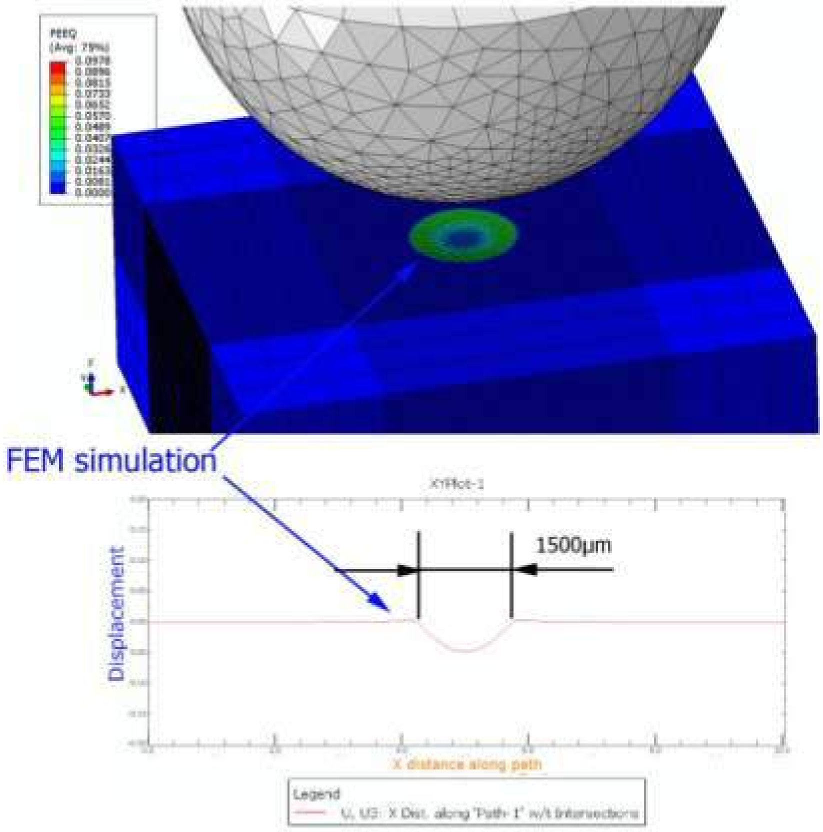


Again to understand the Vibro Shot Peening process, let's better analyze the traditional Shot Peening process.

Shot Peening with spherical metal grit has been analyzed far and wide, we can therefore state that it is absolutely foreseeable that, once a value of 0.4 µm RA is reached on a surface, for example, of an energy turbine blade, after the Shot Peening operation, the surface returns to 1.6 µm RA (a value that is often unacceptable for the functions to which the turbine will be subjected).
With the Vibro Shot Peening process however, things change. In fact, starting from a limited initial roughness, excellent compression levels can be achieved, keeping the roughness variation around the same initial value or a few more decimal places.
It is not for nothing that the VSP process (also called Vibro Peening) has been the subject of numerous international scientific comparisons*.

* *Goetz Feldmann et al. / Procedia CIRP 13 (2014) 423 – 428*
Web Link: https://www.researchgate.net/publication/275068480_Application_of_Vibropeening_on_Aero_-_Engine_Component





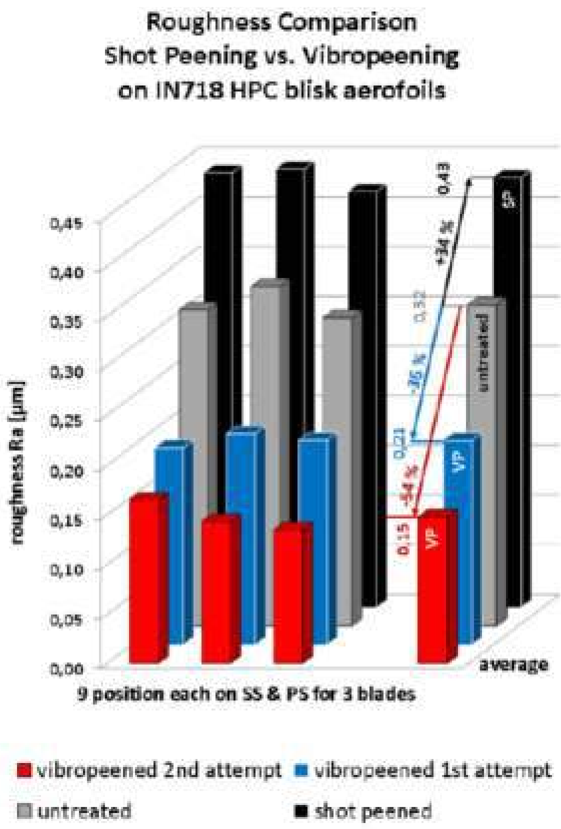


Fig. 5: roughness values for different treatments [2]

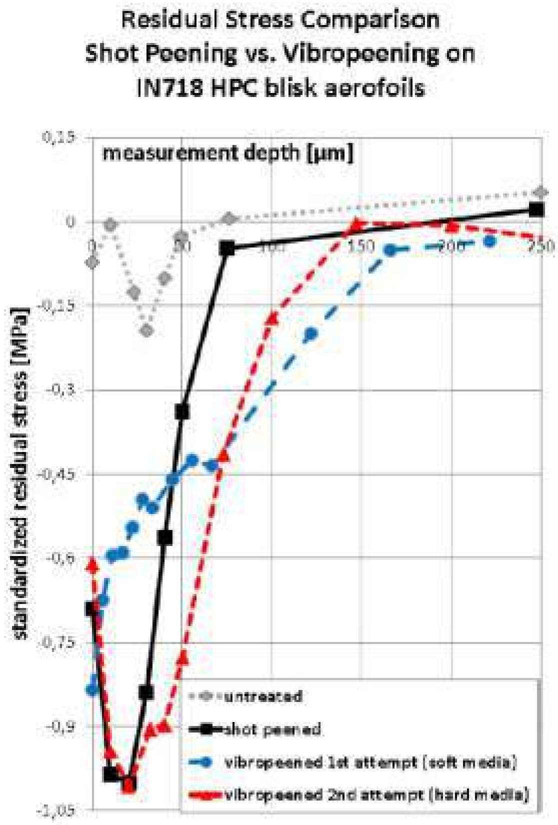


Fig. 6: comparison of residual stress distributions [2]

Let's see an international abstract on the process of Vibro Shot Peening.

Results: Experimental results reported are related to **a multistage blisk assembly out of a nickel based alloy**.

Roughness: Roughness was measured with a tactile measurement system from Mahr. The roughness requirement targeted in this application is Ra ≤ 0,25 µm. As shown in Fig 5 the input roughness after passing the process chain before the mechanical surface treatment is an average of Ra = 0,32 µm. Shot peening increases the roughness to Ra ≈ 0,43 µm which leads to the need of the additional roughness reducing process step vibropolishing which decreases the roughness below the requirement. Vibropeening decreases the roughness comparable to vibrofinishing below the requirement. This is caused by a combination of the above mentioned *peening* and *burnishing effect*. Another investigation shows with increasing dumping heights a treatment time reduction accompanies to reach the required roughness.

Residual Stress Profiles: All of the above mentioned technologies are inducing residual compressive stresses (*RCS*), the standardized profiles are shown in Fig. 6. Shot penned shows high surface RCS, a RS maximum in 25 µm depth and an influence depth of about 80 µm. The 1st vibropeening attempt with soft media shows high surface RCS with a continuous decrease to an influence depth of about 150 µm. This is mainly generated by the unfavorable pairing between component and media hardness which leads to a shifting of the generated RCS by plastically deformation and hertzian pressure. [6, 8]

The 2nd vibropeening attempt shows surface RCS almost equal to shot peening with a bellied distribution in a depth of 25 µm equal to shot peening. The influence depth is higher than shot peening and lays about 150 µm.

Discussions: Results reported show that vibropeening treatment reduce the roughness significantly below the requirement of Ra ≤ 0,25 µm gainst whilest shot peening increases the roughness. Vibropeening treatment increases the residual compressive stresses of the untreated condition.

A significant difference between the 1st attempt with a soft vibropeening media (media hardness slightly below work piece hardness) and the 2nd attempt with a hard vibropeening media (media hardness significant higher than work piece hardness) is visible. The 2nd attempt shows an almost equal residual stress state compared with shot peening. The linked high cycle fatigue results show an increase of the fatigue strength for the 1st attempt of vibropeening of about 35%. The shot peening treatment leads to an increase of 61%. Assessing all results in total it can be assumed that the 2nd attempt of vibropeening with the shown increase of the residual compressive stresses as well as the decrease of the roughness will lead in an additional increase of the high cycle fatigue strength compared to the 1st attempt. The geometrical change as well as the material removal through the vibropeening process is negligible. Furthermore a dimensional change (wear) of the vibropeening media was not measurable.

Comparing cost assumptions for the vibropeening treatment offers a significant cost reduction potential. This is due to the fact that during vibropeening all immerged aerofoils are treated simultaneously. In contrast to that during shot peening aerofoils are treated individually.

In summary the vibropeening process offers potential to replace shot peening and vibropolishing to process blisk assembly aerofoils. Cost wise vibropeening looks attractive to replace shot peening and vibrofinishing.

Source: *Goetz Feldmann et al. / Procedia CIRP 13 (2014) 423 – 428*

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To understand the Vibro Shot Peening process, let's take the example of a recent application on components made of 17-4 PH Stainless Steel with Desk Top Metal machines for Additive Manufacturing.

The Rollwasch® **VSP** process was applied in this benchmark. In order to be processed in the best way, the components must be fixed in the deepest point of the **Vibro Shot Peening** tank so as to benefit from the best "Knock" effect, with the greatest load.
The machine used, a high frequency (3000 rpm) **Special RWS 1400X300 GT-VRE**, with a load of about 800 kg. of hardened AISI-420-C stainless steel balls (maximum hardness) carried out a work cycle with water and a liquid chemical compound at neutral pH for about 22' minutes. During this cycle time the components were involved in the high-frequency dynamic action of the stainless steel balls, inducing a final value of Compression equal to approximately 550 Mpa (starting from an initial value of 250 Mpa) and roughness practically unchanged, compared to those prior to the treatment.
This application example helps to understand the **extremely interesting potential** of this technology which is combined with low investment expectations.
On the following pages we can evaluate the range of **IntegrAM Special** series machines available.

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Modello Model	Cap. lt. Cap.lts.	Dim. utili vasca AxBxC mm. Net tank sizes AxBxC mm.	KW. KW.	Carica di Sfere Kg. Steel balls load Kg.
RWS-1220-G/CF	**65**	**985 x 220 x 330 mm.**	**4,12**	**180 - 200 Kg.**
RWS-1300-G/CF	**100**	**960 x 285 x 400 mm.**	**5,5**	**230 - 260 Kg.**
RWS-1450-B-G/CF	**225**	**1000 x 450 x 560 mm.**	**6,0**	**650 - 850 Kg.**
RWS-80x45-G/CF	**155**	**780 x 455 x 485 mm.**	**6,0**	**400 - 500 Kg.**
RWS-130x60-B-G/CF	**495**	**1300 x 600 x 700 mm.**	**11,25**	**1400 - 1800 Kg.**
RWP-S-150-P/CF	**150**	**875 x 355 x 495 mm.**	**4,0**	**350 - 400 Kg.**

The series Special RWS offers special machines for high-frequency Vibro Shot Peening, Rollwasch® was the first in the world to produce machines at 3.000 rpm.

The various models of series Special is characterized by a high power and efficiency of the vibratory motion at high frequency (3,000 rpm), thus resulting in exceptional **Vibro Shot Peening** process. Particularly powerful are the dual-engine versions, with vibratory-pads able to develop a very high centrifugal force, ensuring leading results. Special machines are designed for "Functional Surface Process" like the VSP - **Vibro Shot Peening** by **IntegrAM**.

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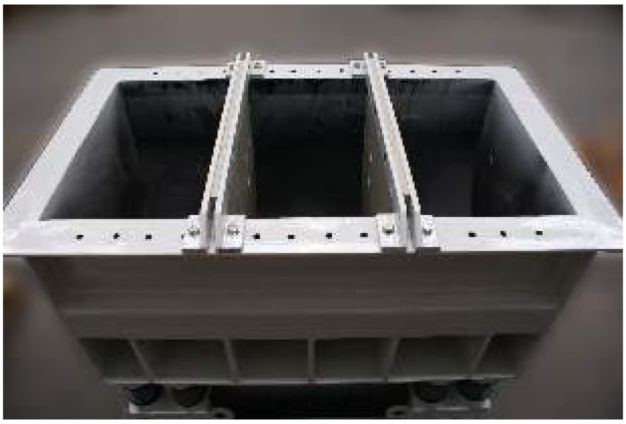
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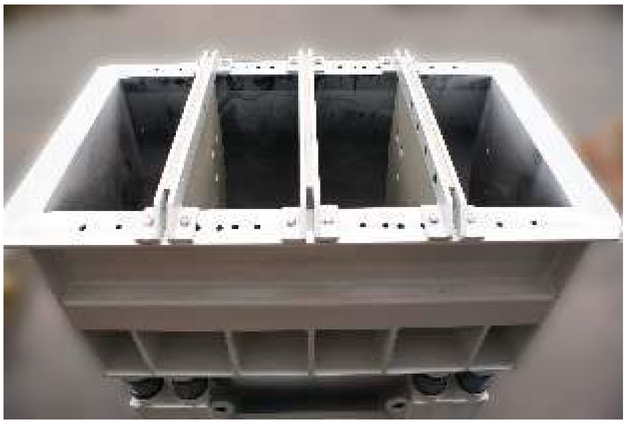
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3


4

The series Special RWS offers special machines for high-frequency Vibro Shot Peening, IntegrAM was the first in the world to produce machines at 3.000 rpm.

Series Special RWS (like other series of **IntegrAM** machines with rectangular tank) provides the possibility to adopt optional bulkheads for the subdivision of the tank into sections. Articles processed in between of these bulkheads in the tanks, will remain in place (eg, an aluminum wheel in vertical position).
Photo 1: a bowl with 2 bulkheads;
Photo 2: with 3 bulkheads;
Photo 3: 7 with bulkheads;
Photo 4: a detail of the bulkheads in polypropylene;

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RWS-130x60-B-G/CF

Example of filter

The Series Special RWS offers machines that can attain, in the case of 130x60, over 2.000 kg. between balls and pieces.

Thousands of machines have been sold from decennia until today” thus becoming the protagonists of several applications of **Vibro Shot Peening**.

The **Vibro Shot Peening** , is a process that, beyond the investment, offers very low cost.

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RWP-S-150-P/CF

Sound proofing inside walls

Among the various models for Vibro Shot Peening at 3.000 rpm we find as «entry-level» the model RWP-S-150-P/CF, competitive and handsome.

RWP-S-150-P/CF borns with an antiabrasive polyurethane coating of the tank with suitable hardness for **Vibro Shot Peening**. This solution represents the entry-level machine for **Vibro Shot Peening** at 3000 rpm. and is offered with optional cabin, electric switch type magnetothermic (on/off) or, alternatively, with control panel complete with timer.

Special RWS

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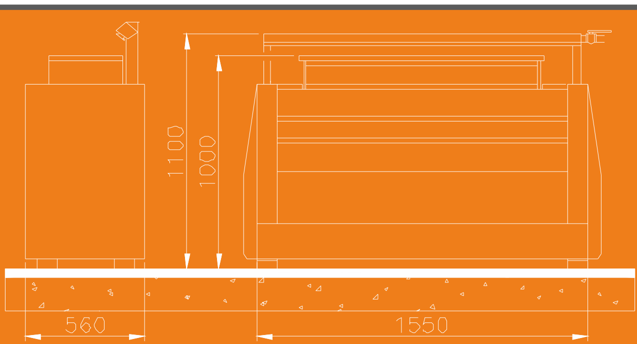
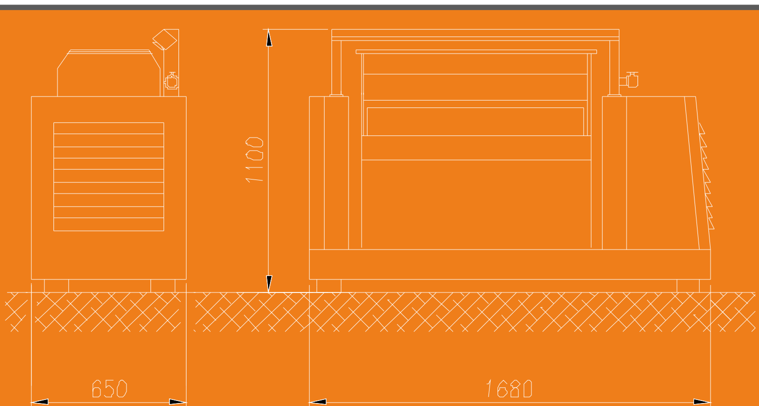
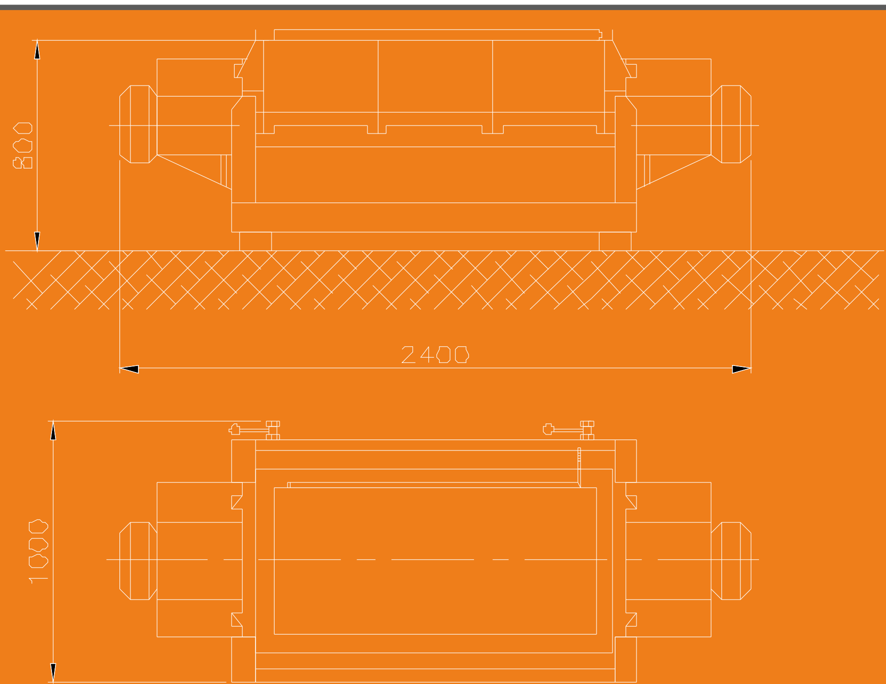


SPECIAL RWS-1220-G/CF



SPECIAL RWS-1300-G/CF



SPECIAL RWS-1450-B-G/CF

All machines series Special RWS can be supplied with magnetothermic switch or, alternatively, with control board with process timer.

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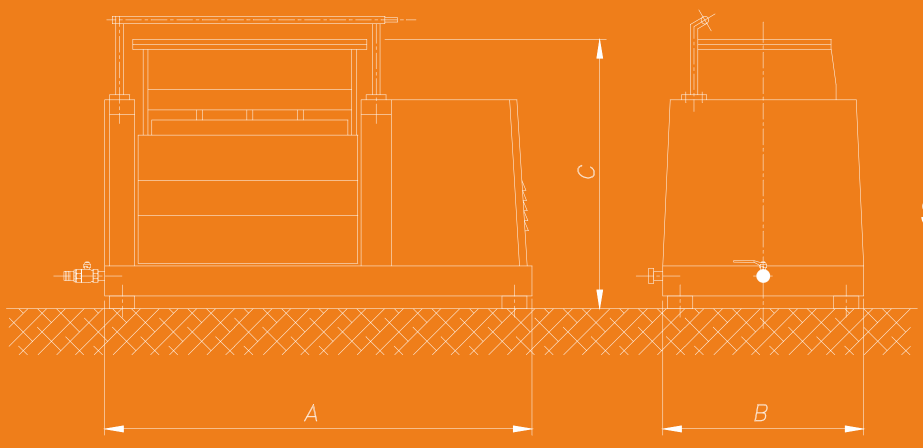
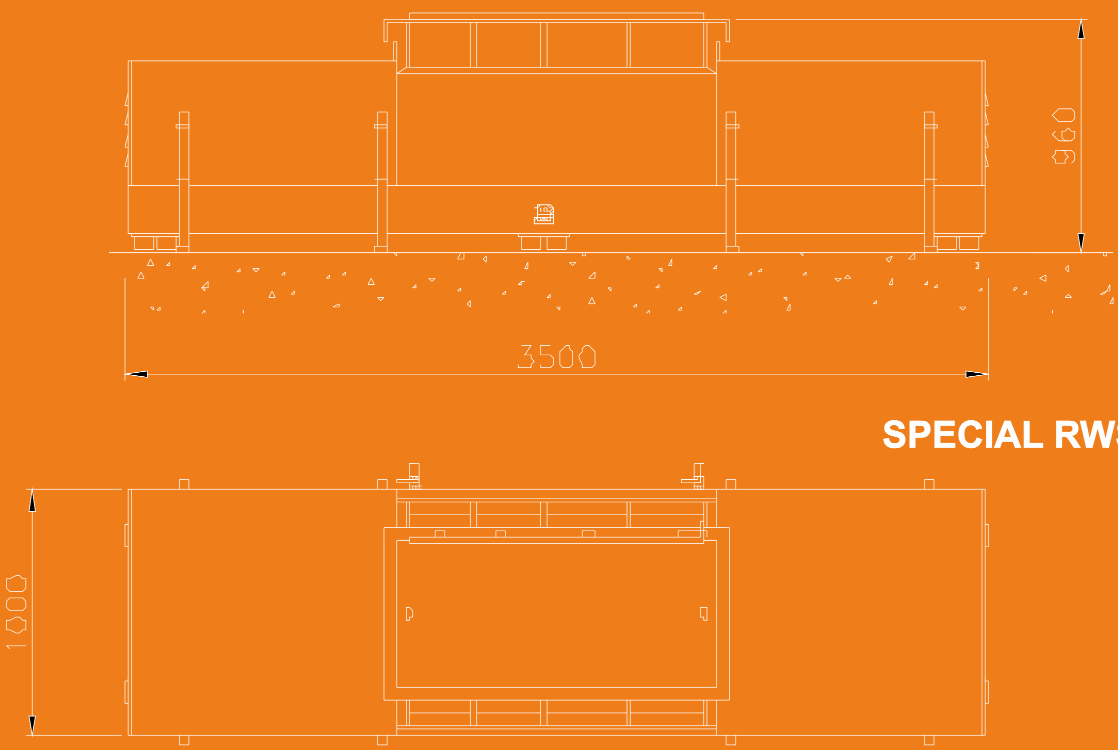


SPECIAL RWS-80x45-G/CF



SPECIAL RWS-130x60-B-G/CF

All machines series **Special RWS** can benefit from a program of optional accessories very useful, including the acoustic cabins.

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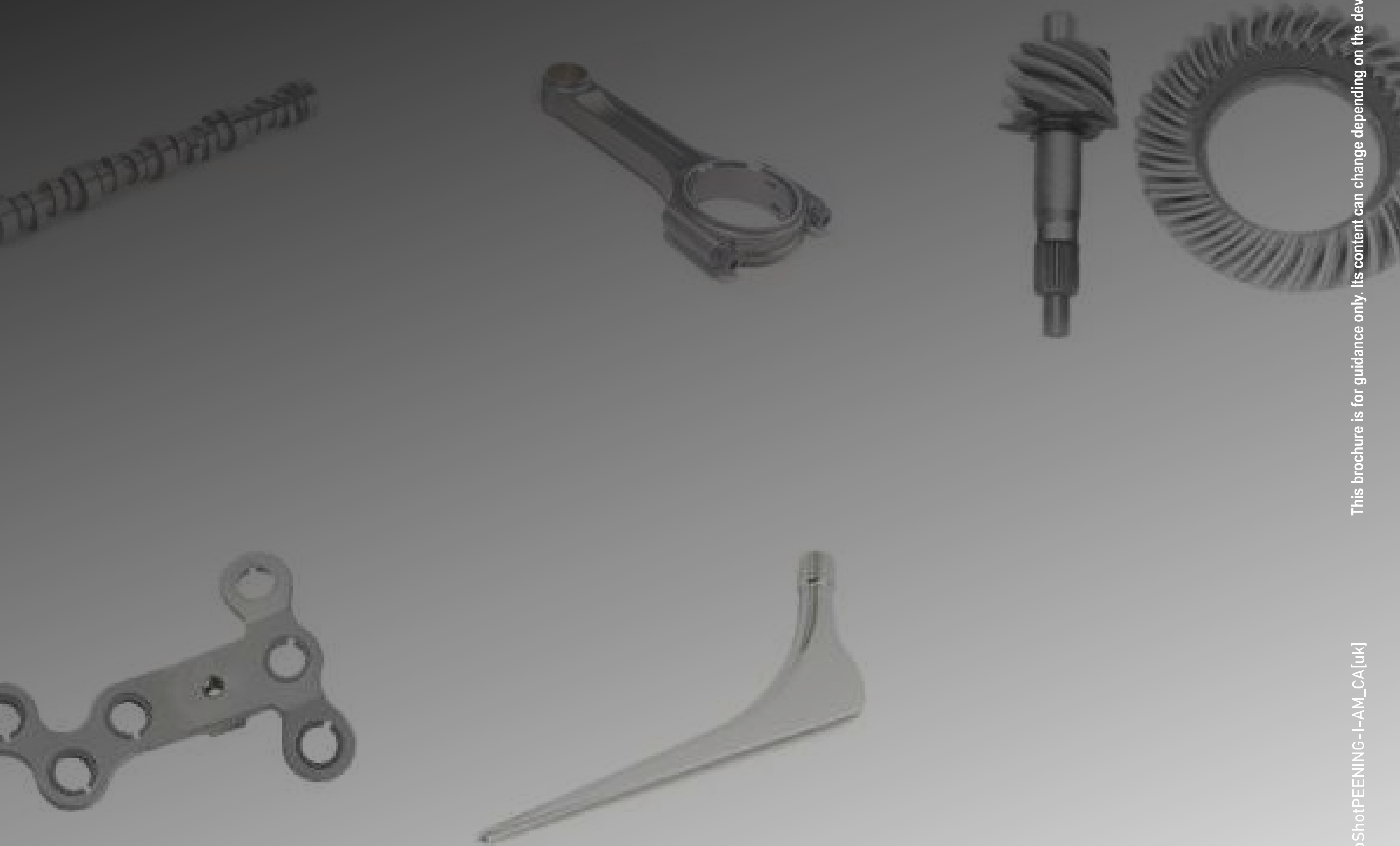

This brochure is for guidance only. Its content can change depending on the development of the product.

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