The spraying water impact of a nozzle depends on several factors and more precisely spray distribution pattern and spray angle. The first step to calculate the impact value, which is usually expressed in Kilograms per square centimeter, is to determine Total Theoretical Impact Value using the following formula:

\[
T_{TI} = 0.024 \cdot Q \cdot \sqrt{P} \quad \text{[kgp/cm²]}
\]

Where:
- \( Q \) is the flow rate at working pressure in lpm
- \( P \) is the pressure value in kgp/cm²

The obtained value has to be multiplied by the Total Theoretical Impact per Square Centimeter Coefficient (E).
The final value is the Spraying Liquid Impact expressed in kgp/cm².
Of course not all the energy of the fluid vein is transferred to the impact point.

\[
S_{LI} = E \cdot T_{TI} \quad \text{[kgp/cm²]}
\]

A part of this energy, sometimes a considerable part, goes to obtain a desired spraying angle by having the liquid vein acquire a high rotational speed inside the whirl chamber.
The highest value of impact is obtained with straight jet nozzle and the value can be calculated multiplying spraying pressure per 1,9.
The tables below containing the Total Theoretical Impact sq cm coefficient values for different spray pattern nozzles for a distance of 300 mm.

<table>
<thead>
<tr>
<th>Spray Angle</th>
<th>Flat jet nozzle</th>
<th>Spray Angle</th>
<th>Full cone nozzle</th>
<th>Spray Angle</th>
<th>Hollow cone nozzle</th>
</tr>
</thead>
<tbody>
<tr>
<td>15°</td>
<td>0,300</td>
<td>15°</td>
<td>0,110</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25°</td>
<td>0,180</td>
<td>30°</td>
<td>0,025</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35°</td>
<td>0,130</td>
<td></td>
<td>0,010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40°</td>
<td>0,120</td>
<td>65°</td>
<td>0,004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50°</td>
<td>0,100</td>
<td></td>
<td>60°/60°</td>
<td>0,01</td>
<td>0,02</td>
</tr>
<tr>
<td>65°</td>
<td>0,070</td>
<td>80°</td>
<td>0,002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80°</td>
<td>0,050</td>
<td>100°</td>
<td>0,001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Jet impact diagram

A further parameter to characterize the performance of a spray nozzle is the distribution of the jet impact force, which could be derived by means of mathematical methods from the values of the spray distribution onto the surface covered by the spray, but which can more easily be measured with the help of specifically designed instrumentation.

In some applications the jet impact force is the most important parameter used to realize the required process.

Steel sheet descaling in a rolling mill is a typical example, where the jet impact is required to take away the surface scale and obtain a perfectly even surface.

For that reason special nozzles have been developed to perform this very task, where service life, impact value and spray distribution reach the values required for satisfactory result.

These test are performed in laboratory equipped with a specifically designed instrumentation, where the high pressures involved in these process can be reached, which can measure the pressure values along a matrix of points distributed in the spray area covered by the nozzle.

These values are supplied both in a table of values and as a 3D pressure diagram, similar to those shown below.

On such applications, where producing high impact values in the jet is necessary, it is of paramount importance that the liquid flow turbulence is kept to a minimum and therefore it is widely used to insert into the nozzle entrance devices designed to improve the operating conditions by forcing the liquid flow through straight passages with several different shapes:

by doing so the impact delivered by the spray is increased with the same feed pressure.

One typical shape used by Pnr is shown on the right, and the two diagrams below show the impact force diagrams for the same nozzle with and without a flow straightener: the reduction of flow turbulence can lead in increase of impact force often higher than 20%.

Further improvements of course are available when the nozzle inside profile is properly designed in order to avoid sharp cross section changes and all surfaces are finished as smoothly as possible.