# Multidimensional turbine cavitation characteristics

<table>
<thead>
<tr>
<th>Name</th>
<th>Independent variables</th>
<th>Meaning</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detailed cavitation characteristic</td>
<td>Runner blade number, ( b )</td>
<td>Intensity of the component of cavitation on ( b ) which is influenced by ( v ), as developed while the turbine is being operated in ( P )</td>
<td>Raw input data</td>
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<tr>
<td></td>
<td>Guide vane number, ( v )</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operation parameters, ( P )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Runner cavitation characteristic</td>
<td>Runner blade number, ( b )</td>
<td>Intensity of the cavitation on ( b ) as developed while the turbine is being operated in ( P )</td>
<td>Intensity of the detailed characteristic summed over all ( v )'s</td>
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<tr>
<td></td>
<td>Operation parameters, ( P )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wicket-gate cavitation characteristic</td>
<td>Guide vane number, ( v )</td>
<td>Intensity of the component of cavitation on the runner which is influenced by ( v ), as developed while the turbine is being operated in ( P )</td>
<td>Intensity of the detailed characteristic being summed over all ( b )'s</td>
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<tr>
<td></td>
<td>Operation parameters, ( P )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global cavitation characteristic</td>
<td>Operation parameters, ( P )</td>
<td>Total cavitation intensity in the turbine while it is being operated in ( P )</td>
<td>Intensity of the detailed characteristic summed over all ( b )'s and all ( v )'s</td>
</tr>
</tbody>
</table>

With respect to cavitation mechanisms*, each of the characteristics can be defined:
- for the total cavitation in the turbine,
- for each cavitation mechanism separately,
- for the group of the erosive mechanisms.

**Calibration**
- relative, with an arbitrary reference
- absolute, in kilograms of metal mass lost in a specified time interval (e.g. 10,000 hours) while the turbine is being operated within a specified \( P \)-range (e.g. in a 1 MW interval of the turbine power at a constant head and a constant tail water level).

* Cavitation mechanisms are different types of cavitation or the same type appearing in different locations in the turbine.
Illustrations follow....

Vertical Francis turbine
48 MW
20 guide vanes
17 runner blades
Detailed cavitation characteristic
For each guide vane - one characteristic

Component of the cavitation intensity on a runner blade, influenced by a guide vane (% of the total)

All cavitation mechanisms included
Runner cavitation characteristic

Power (MW)

Component of the cavitation intensity on a runner blade (% of the total)

Runner blade

Net head 116.5 ± 0.2 m
Tailwater 123.73 ± 0.06 m
Headwater 244.73 ± 0.07 m
Plant power 243 ± 6 MW
Unit power ± 0.7 MW

All cavitation mechanisms included
Wicket gate cavitation characteristic

Component of the cavitation intensity influenced by a guide vane (% of the total)

Power (MW)  Guide vane

All cavitation mechanisms included
Global cavitation characteristic

Total cavitation intensity (%)

All cavitation mechanisms included

Erosive mechanism

Power (MW)