Pump Specific Speed Ns

1. Meaning of ***Ns***

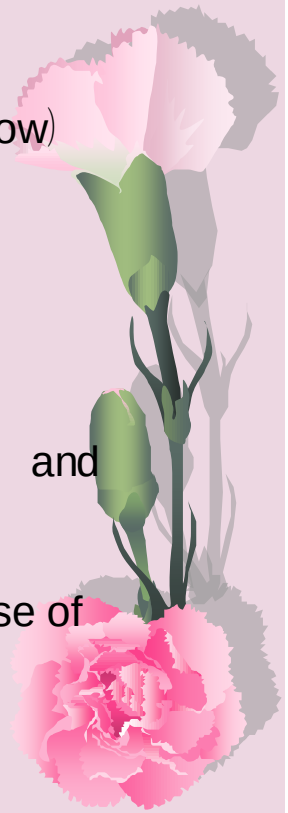
In centrifugal pumps, there are capacity, total head, efficiency, speed, NPSH3 etc. as values to show the characteristic. The size and shape of a pump change variously by the values of capacity, total head and speed. Therefore, if you can show the characteristic and the shape of the pump by using one number of characteristics, it is possible to use for the performance assessment, the proportional design, and the performance expectation, etc. , and it becomes very convenient.

Then, from the law of similarity of pump, Specific Speed ***Ns*** (the equation below) came to be introduced.

$$Ns = \frac{N\sqrt{Q}}{H^{\frac{3}{4}}}$$

There, ***Q*** : capacity (m^3/min)、***H*** : total head (m)、***N*** : pump speed (min^{-1}), and values are used at best efficient point (BEP).

In the case of multistage pumps, use total head ***H*** as per stage, and in the case of double-suction impeller, use half of capacity ***Q*** .



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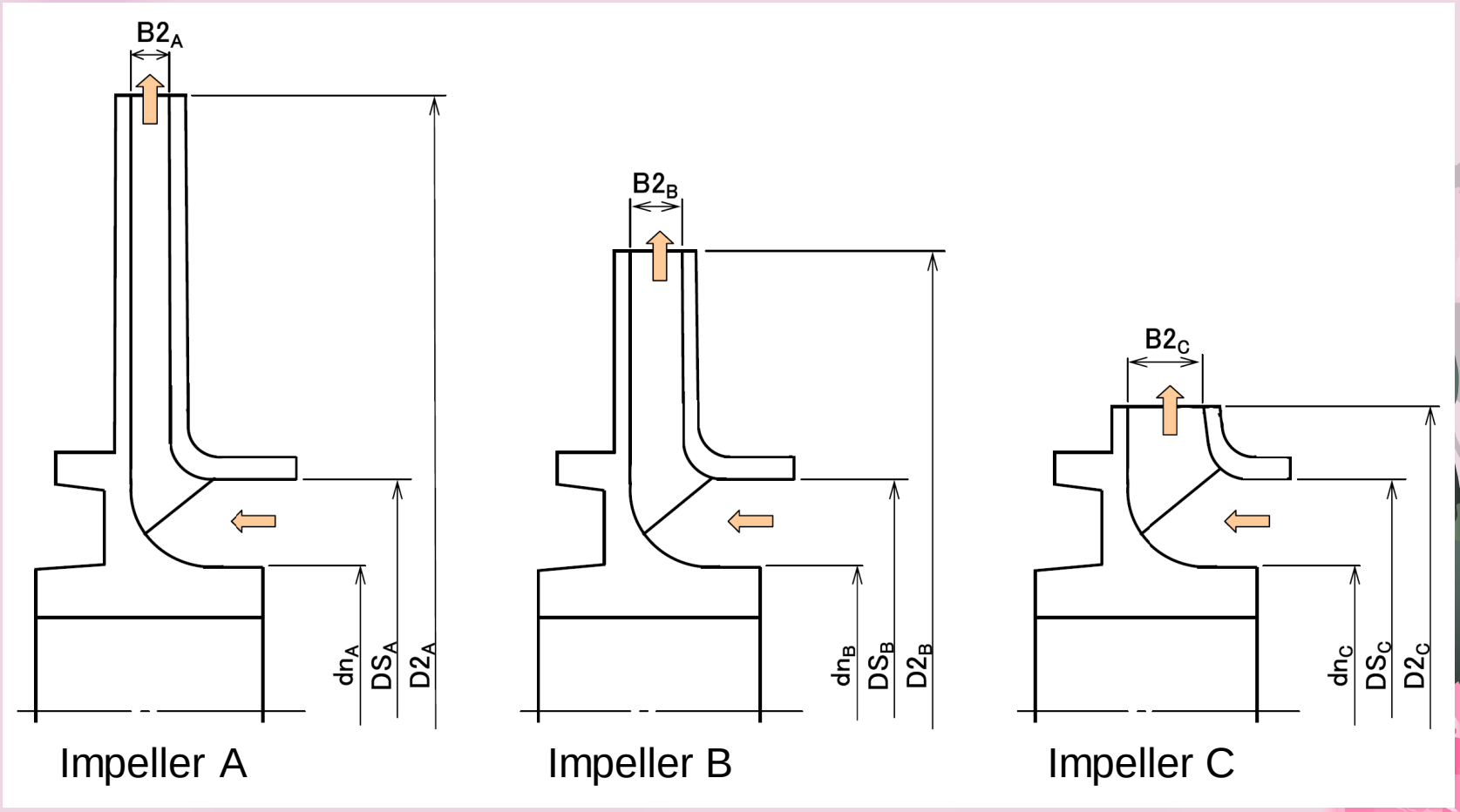
2. Impeller shape by Specific Speed ***Ns***

About three kinds of impellers with different shape that exists in the following figure, let us find how ***Ns*** becomes it.



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3. Dimensions and expected performances about three kinds of impellers

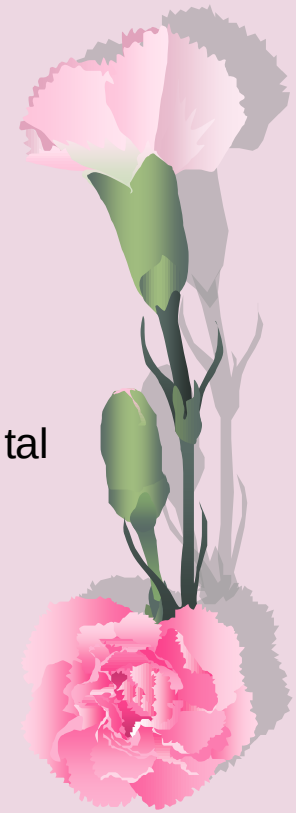
Impeller	Impeller diameter	Outlet width	Eye outer diameter	Eye inner diameter
A	$D2_A$	$B2_A$	DS_A	dn_A
B	$D2_B$	$B2_B$	DS_B	dn_B
C	$D2_C$	$B2_C$	DS_C	dn_C

It designs in the above table as follows.

$$\pi \cdot D2_A \cdot B2_A = \pi \cdot D2_B \cdot B2_B = \pi \cdot D2_C \cdot B2_C$$

$$DS_A = DS_B = DS_C \qquad dn_A = dn_B = dn_C$$

By doing so, the capacity of best efficiency point (BEP) can be made the same among three.（It is strictly different according to ***Ns***.）, and because total head ***H*** is proportional to the square of the diameter of impeller, if either of performance of three kinds is known, other performances can be expected.



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When the dimensions are designed with the value of the table below, the following performances are expected. Seeing ***Ns***, 123 on impeller A, 189 on impeller B, 347 on impeller C.

Impeller	Impeller diameter (mm)	Outlet width (mm)	Q @BEP (m^3/min)	H @BEP (m)	N @BEP (min^{-1})	Ns @BEP
A	240	7.5	1.167	77.0	2950	123
B	180	10	1.167	43.3	2950	189
C	120	15	1.167	19.3	2950	347

Previously, it was written that it differed strictly. The reasons are as follows.

- The pump performance is not decided with an impeller alone but changes by designing its casing.
- It shortens by ***Ns*** high as for its vane extensive length of the impeller.
- The volumetric efficiency changes by ***Ns***.