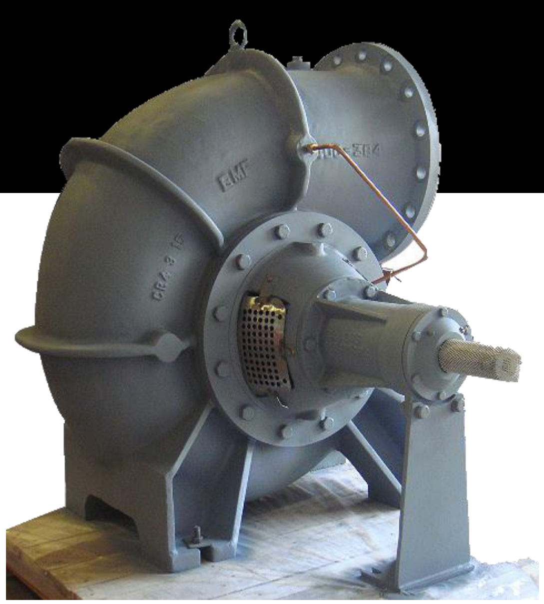
TWO STAGE PUMP FOR MINE DEWATERING

Pumpsense Fluid Engineering Pvt. Ltd.

Impeller Trimming

SEWAGE PUMP FROM OUR EMF RANGE



1. Trimming an Impeller applying Affinity Law & Correction Factor

Affinity Law: For a particular pump, the operating point (head & flow rate) can be controlled within a certain range by changing (trimming) the impeller diameter and/or by changing the running speed of the pump. For our purpose, we will only be dealing with impeller trimming.

Change in duty point of a pump with impeller diameter is found by assuming **the efficiency to remain constant.** This is governed by the equation:

$$\boldsymbol{D_2 = D_1 \times \sqrt{\frac{H_2}{H_1}}}$$

Where the subscripts 1 & 2 denote the initial & final points, respectively.

Specific Issue: Given a rated capacity, rated head, speed and pump model:

- To estimate pump impeller diameter.
- Draw *H-Q*, η-Q and *BKW-Q* curves.

The rated duty point required is:

Q_{DUTY} =125 m^3/hr.
H_{DUTY} = 20m
N = 1465rpm
Pump model: 100LA

But, from our test result for Best Efficiency Point, we have:

Q_{BEP} = 145

H_{BEP} =24.8

D_{BEP} =293 mm

Now, if the actual BEP rate of flow is displaced by more than 5% of the expected value, then the test should be repeated after relevant machining operation.

5% of 125 = 6.25 m^3/hr.

Hence machining operation has to be done.

Steps to find the rated Impeller diameter & draw Performance Curves

Step 1

- Mark duty point (125m^3/hr., 20m) on the performance curve of 100LA.
- Draw a parabolic curve $H = K \times Q^2$ passing through the duty point identified above.
- Mark the point where this curve intersects the immediate higher impeller diameter.
  In this case the point of intersection is the BEP: ***H_1=24.8m*** & ***Q_1= 145m^3/hr.***

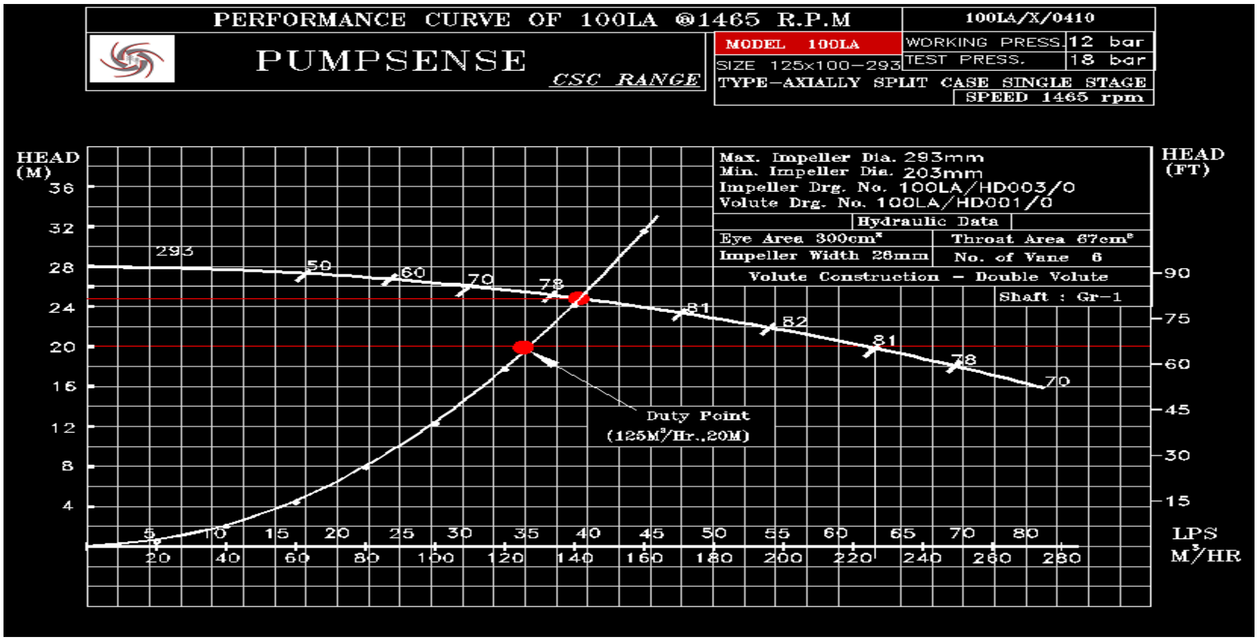


Fig. 1: Duty Point marked on performance curve of 100LA

Step 2

- Apply affinity law to determine the impeller diameter for rated duty
- Draw the H-Q curve passing through the rated duty and the efficiency points established above.
- Apply correction factor to find the corrected Impeller diameter for rated duty.

$$D_{RATED} = D_{BEP} \times \sqrt{\frac{H_{RATED}}{H_{BEP}}} = 293 \times \sqrt{\frac{20}{24.8}} = 263\ mm$$

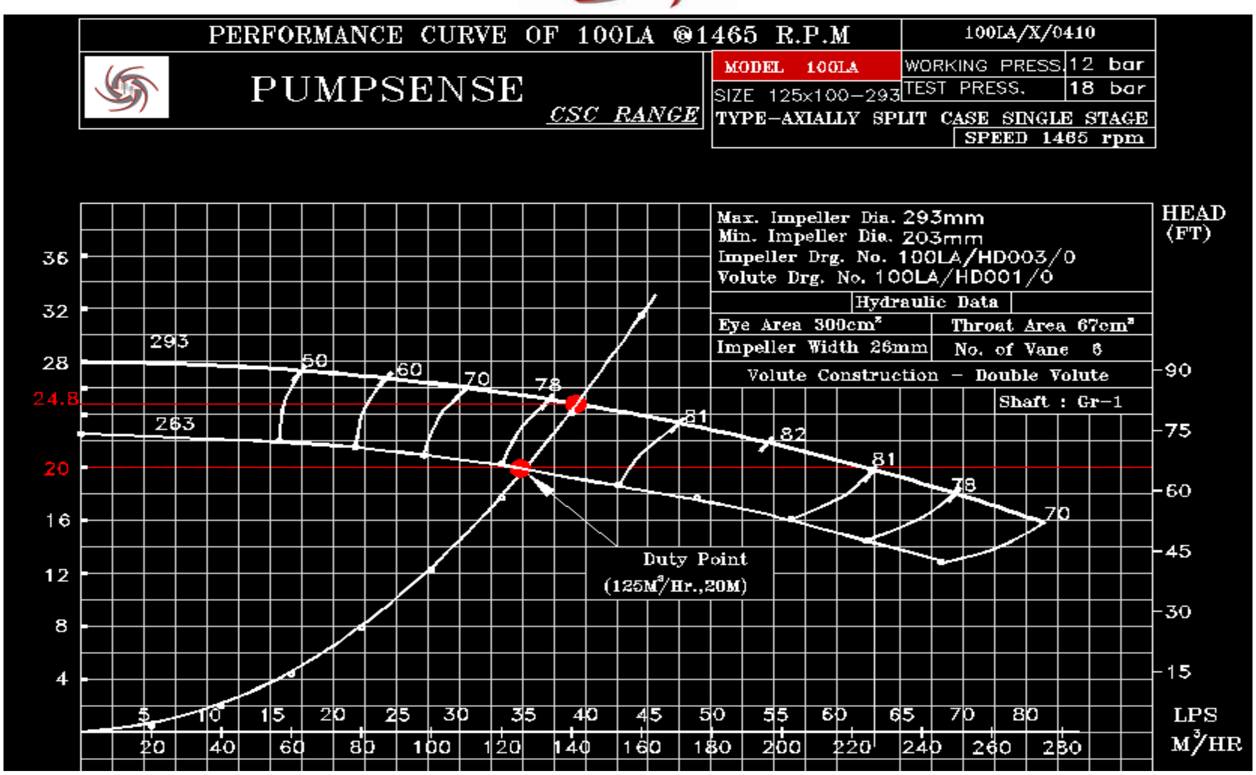


Fig. 2: New H-Q curve passing through rated duty with efficiencies marked

Correction Factor:

There is a correction factor which is to be used over affinity law, as using the affinity law actually changes some basic hydraulic principles. To compensate for hydraulic mismatch and mechanical imperfections, correction factor is normally applied. The efficiency of the cut impellers will usually drop about two points at the maximum cut. (Within a 25% cut)

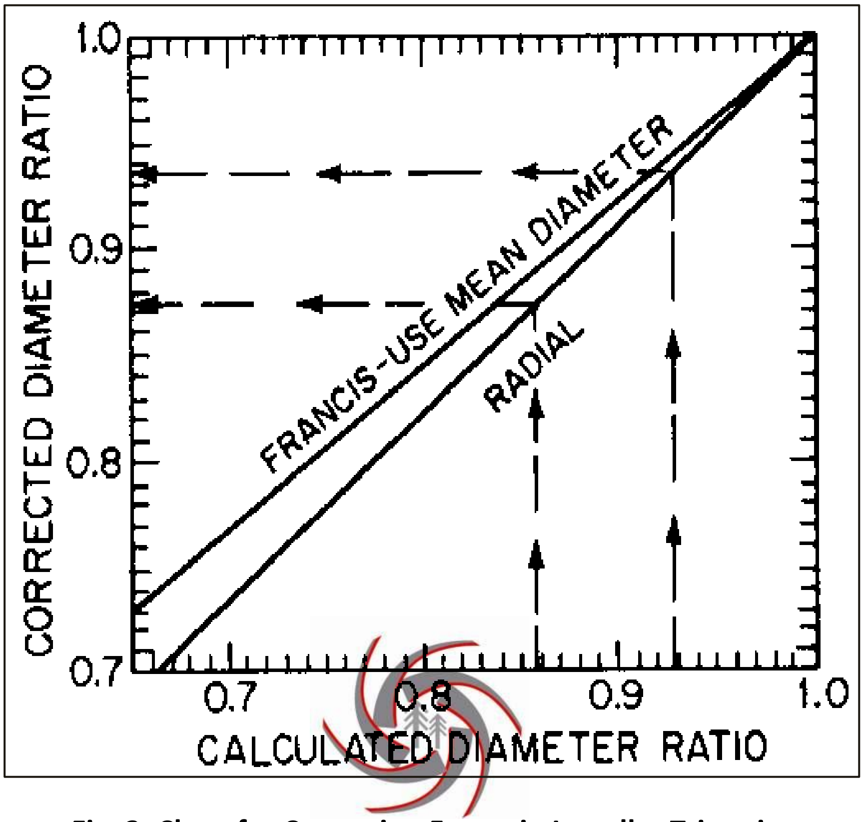


Fig. 2: Chart for Correction Factor in Impeller Trimming

In the previous problem, calculated diameter ratio $= \frac{263}{293} = 0.89$

Hence the actual diameter ratio = 0.92 (from chart)

Hence trim impeller diameter $= 293 \times 0.92 = \mathbf{269.6mm}$

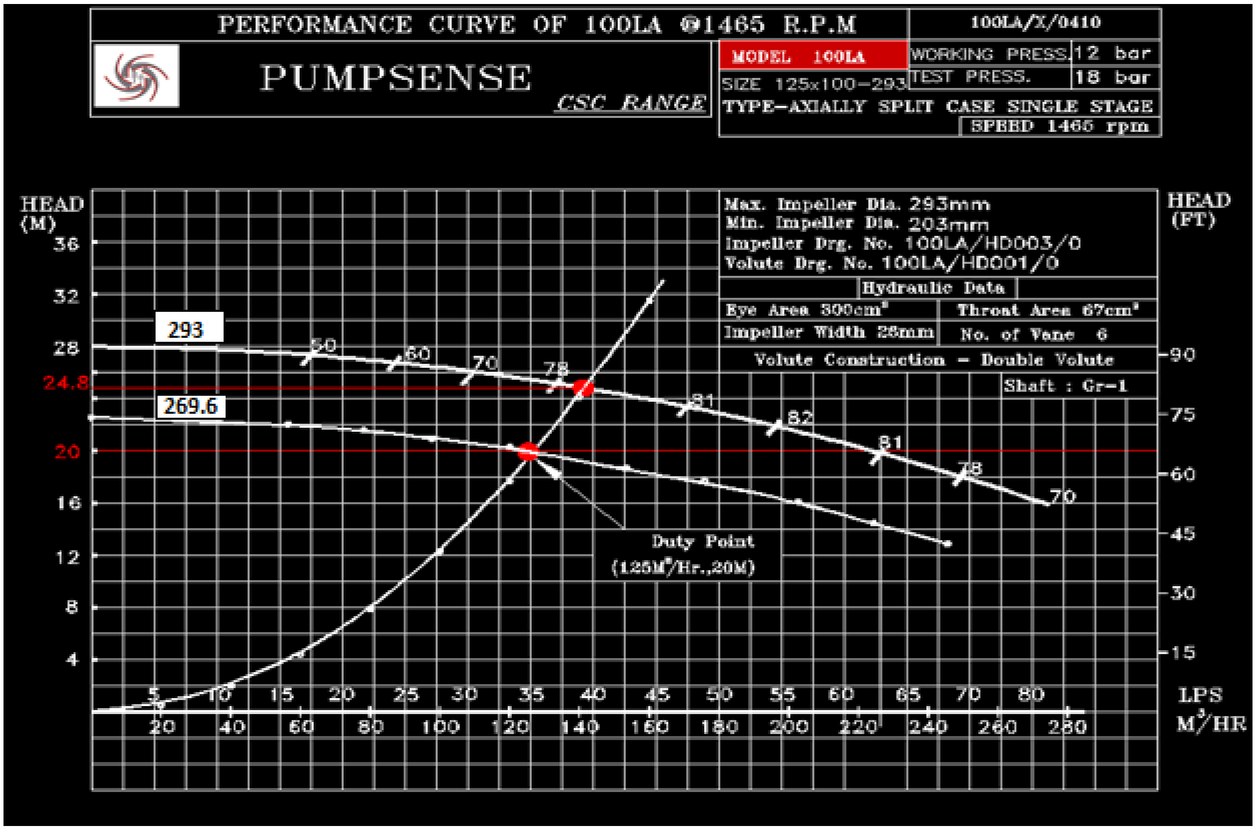


Fig. 3: Trimmed Impeller diameter marked after correction factor

N.B. – In practice, efficiency doesn't stay constant beyond a certain range of applying Affinity Law. The efficiency remains nearly constant for speed changes and for small changes (up to 5%) in the impeller diameter.

Step 3

- Draw the Q-η curve based on data obtained under step 2.
- Draw the power curve (*BKW-Q)* based on the following formula for each efficiency point

$$BKW = \frac{H \times Q}{3.67 \times \eta}$$

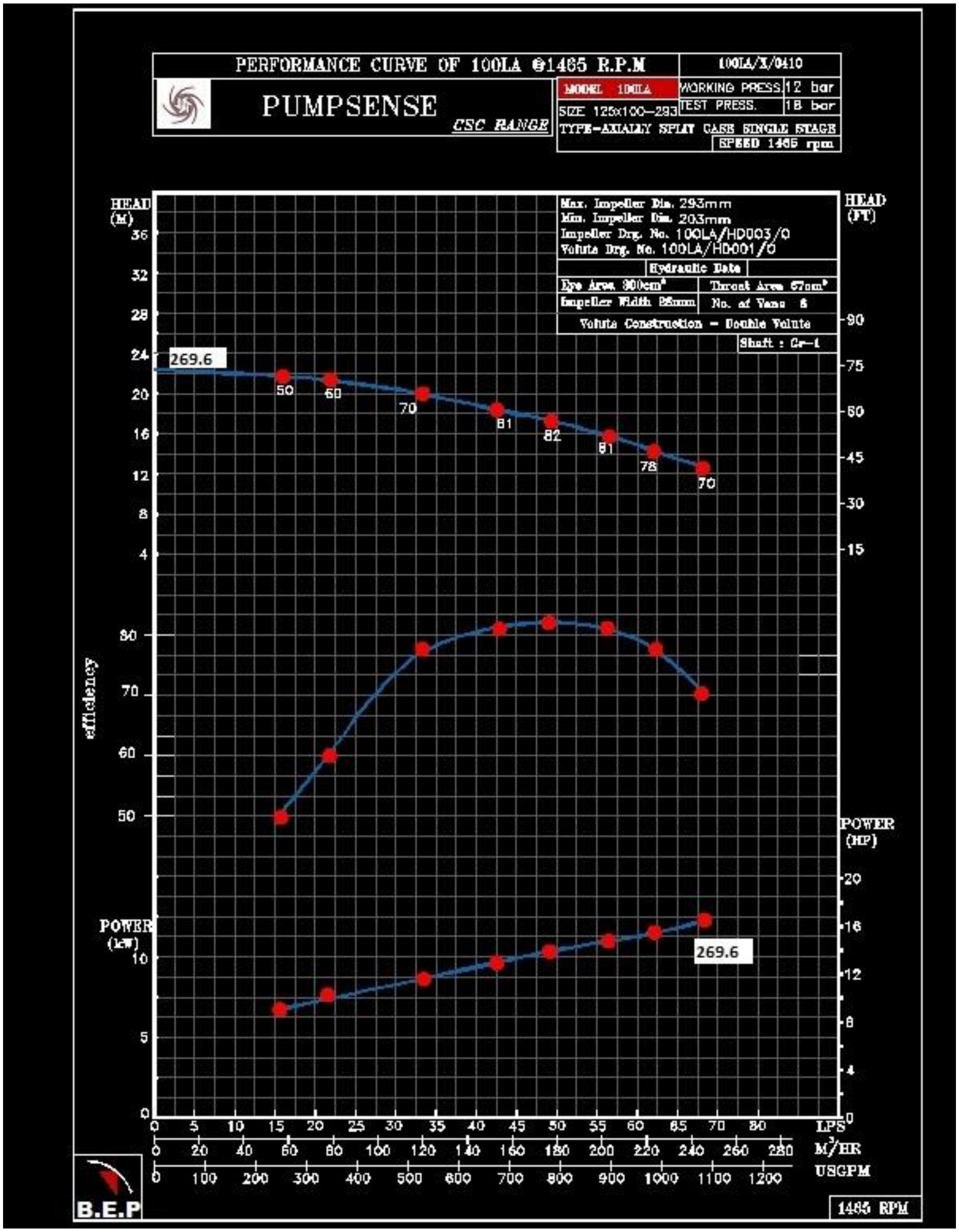


Fig. 4: Final Performance curves with Rated Impeller diameter