LaBour Taber

PUMPS THAT EXPERTS SELECT.

Balancing and Vibration Limits

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Balancing

Pump impellers will be balanced to an ISO 1940 G 2.5

Vibration Limits

For the project the agreed vibration limits are as follows:

- 3600 rpm: @ 1X running speed- 0.157 in/sec peak filtered
- 1800 rpm: @ 1X running speed- 0.0908 in/sec peak filtered
- 1200 rpm: @ 1X running speed- 0.0785 in/sec peak filtered

To achieve predictable vibration levels that are substantially lower, involves the specific criteria for:

1. coupling selection and balance
2. motor balance
3. hydraulic operation of pump-flow/tdh range
4. NPSHA- cavitation
5. natural critical frequency- VFD
6. nozzle loads/pipe strain
7. alignment/soft foot
8. bedplate installation

The above must be defined prior to final determination of the achievable minimal vibration limits.

It is expected that many of the instances in which the pump would exceed 0.157 in/sec, would be at vane pass frequency, as such a criteria for pump selection and installation must be utilized. The criteria offered in the following document will serve as a working document for this project.

To meet a vibration limit of 0.157 in/sec peak filtered on the pump bearing frames, Peerless/LaBour pumps and the customer need to address and agree on the following items:

1. **Minimum/Maximum Flows**
    a. The minimum flow shall not less than 50% of the BEP (Best Efficiency Point) design flow
    b. The Maximum flow shall not exceed 105% of BEP design point
    c. For ANSI/ASME B73.1 pumps (8196) the minimum flow is defined in the ANSI/ASME B73.1 specification. For other overhung impeller pumps the minimum flow shall be 70% of BEP and maximum flow shall not exceed 115% of BEP.
2. **NPSH(A)**
    a. To reduce vibrations caused by cavitation, a safety margin of minimum of 20% between the NPSH(R) and NPSH(A) or three(3) feet whichever is greater is required. This is applicable to for ANSI/ASME B73.1 end suction pumps and horizontal split case pumps
    b. A margin of 10% or two (2) feet is required for large flow model 8175 (process/paper stock) pumps
    c. Pumps with impellers whose N (S) > 2,000 requires a 20% safety margin between the NPSH(R) and NPSH(A) or two feet whichever is greater. Please refer to the Hydraulic Institute technical specification TS-039.
3. **Balance**
    a. To minimize vibrations at 1X running speed the balance of the pump impeller must be to ISO 1940 G2.5.
    b. To reduce vibrations at 1X running speed the unbalance force of the pump coupling half shall not exceed the unbalance force of the impeller. Each pump/driver coupling half must be balanced to ISO-1940 G2.5. Elastomeric donut (tire) style couplings shall not be used.

c. Uncoupled and unbolted motor vibrations shall not exceed 0.150 in/sec peak on the bearing housing. Ultrabalance motors (0.8 mils) per NEMA standard MG1-1986 is required on all 2 pole motors.
d. All balance criteria are calculated for the maximum diameter impeller at the maximum published speed.
e. Any gear train or pulley system will require a review of its balance criteria by the equipment supplier to be comparable to the balance level of the impeller, coupling, and motor.

4. **Impeller Design**
   a. End suction impellers with 2,3, 2-4 vanes will not meet the 0.157 in/sec peak filtered vibration specification at the vane pass frequency.
   b. Any horizontal split case pump impellers that are not split and staggered will not meet the 0.157 in/sec vibration specification at the vane pass frequency.
   c. To reduce hydraulically induced vibrations the cutwater clearance must be at least 10% of the pump's maximum impeller diameter or 0.5 inches whichever is greater.
5. **Pump Speed**
   a. Driving pump motors with variable frequency drives may excite structural or natural critical frequency. Where present these speed ranges will need to be blocked out.
6. **Installation**
   a. **Piping-** piping must be supported and installed using approved procedures. A field test must be conducted to limit pipe strain: align the motor to the pump and then loosen one at a time the suction and then the discharge flange bolts. Changes in the alignment in excess of 0.002 inches indicate excessive pipe strain. Another method would be to put a dial indicator on the pump casing and distortions greater than 0.005 inches are not acceptable.
   b. **Nozzle Loads**: the nozzle loads incurred when the piping is full should be checked. With the motor aligned to the pump have the system pipes filled with fluid, changes in the alignment in excess of 0.002 inches indicates excessive nozzle loads.
   c. Baseplates- proper baseplate installation and grouting procedures must be followed. Reference applicable pump installation and operating manuals (IOM) and the document "Installation specification for pumps and drivers when using expoxy grouts". Refer to PIP REIE 686 for recommended procedures.
   d. Alignment- to minimize the amount of vibration caused by misalignment the following "hot" alignment specification is required. Parallel or "rim" misalignment within 0.002 inches angular or "face" misalignment within 0.0005 inches per inch of diameter.
   e. Soft Foot- check for soft foot. After motor is aligned to the pump, loosen one motor or pump foot at a time. Changes in alignment greater than 0.002 inches indicate an unacceptable soft foot.
7. **Applicable Models**
   a. The following is the list of pump models as noted above that when the above conditions are met will meet the 0.157 in/sec peak filtered vibration on their bearing frames:
   8196, 8175, AE, A, 8796, LVA, TFA, LPHA/LPLA
8. **Exceptions**
   a. 8175 12x14-22, 8175 20x24-28, 8175 14x14-18H, 8175 14x14-18
   b. 8196 1.5x3-13, 8196 2x3-13, 8196 3x4-13