

Ovality in Pipes

Kawaljitsingh Randhawa

Mechanical Department, CSPIT, CHARUSAT, Changa, Gujarat, India

Abstract— Ovality generally known as ‘Out of Roundness’ is one of the most common defects in pipe manufacturing. Ovality in early stages makes manufacturing process time consuming and less efficient. After dispatching, because of improper handling, ovality turns into barrier of proper welding of two pipes on site. In this paper, there is inclusion of causes of ovality, stages of ovality, drawbacks of oval pipes, manufacturing difficulties due to ovality and how to control it is included.

Keywords— Ovality, L-SAW pipe, Spiral welded pipe, Expander, Hydraulic press, Cross-weld.

I. INTRODUCTION

In API 5L out-of-roundness is defined as the difference between the maximum (or minimum diameter) and the nominal diameter, expressed as a percentage of the nominal diameter. In ISO 3162, out-of-roundness is defined as the difference between the maximum and minimum diameters, expressed as a percentage of the nominal diameter. Assuming symmetric ovality, the API 5L definition gives half the percentage ovality of the ISO 3162 definition.

Ovality or ‘out of roundness’ is one of the common defects while manufacturing L-SAW or Spiral welded pipes. Which in turns of excess manufacturing work to remove it or directly turns into rejection of product. It is an undesired phenomenon because of which many manufacturing operations cannot be done properly and ovality in dispatched pipe makes it unsuitable for welding with other pipes.

A. OVALITY

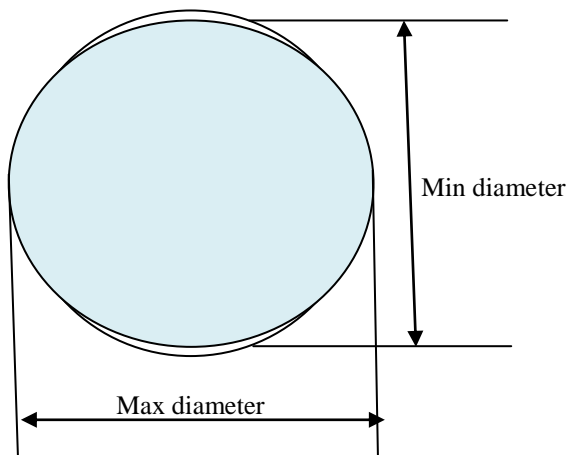


Fig.1. Ovality

Generally, ovality is measured by difference between maximum diameter and minimum diameter (ID or OD). According to the utility and requirement it has some acceptance limit like 4mm, 5mm to 6mm. Beyond this, product is treated as rejection or rework.

Acceptable ovality of a pipe should be determined by user, but as a guideline, 5% is a typical acceptance criterion, and ASME defaults to 8% ^[1].

$$\text{Ovality \%} = \frac{\text{Max OD} - \text{Min OD}}{\text{Nominal OD}} \times 100$$

B. GENERATION OF OVALITY

Following are the main causes of ovality in pipes –

- If all the rollers at pipe mill are not inclined at proper angle with respect to each other then there will be chances of generation of ovality.
- After milling machine there will be ID OD welding section where permanent welding on pipe is carried out. Improper welding can cause ovality in pipes.
- Improper handling of pipes via overhead cranes, conveyors, skids and rollers can generate ovality in pipes.
- At the time of hydro testing, two faces of pipes are clamped tightly so testing can be carried out without any leakage or pressure drop. If excess pressure is given then ovality can be seen in the body of pipe compare to clamped faces.
- One of the main causes of ovality in pipes is cross-weld -

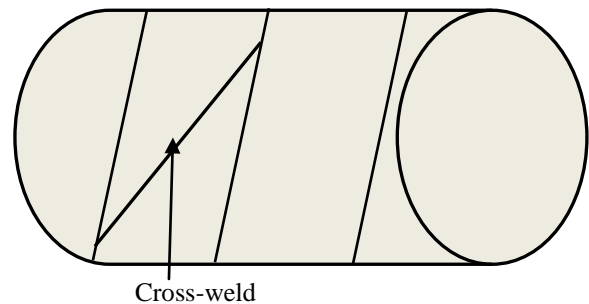


Fig.2. Cross-weld in spiral welded pipe

Cross-weld is actually a welding of two sheets together. At the pipe forming or milling machine, continuous sheets are provided by joining together before forming. While forming this jointed area, it seems like cross-weld on the pipe as shown in fig. In many high pressure applications it is parted off because of the weakest section, but in case of normal utility like drainage, this cross weld portion of pipe is not required to part off.

Cross-weld in the pipe body generates oval shape and becomes hard to remove ovality from pipe when it is nearer to one of the face of it. Because of low pressure applications, cross weld in body is not much harmful but for joining pipes at the site to create a line, it is compulsory to generate diameters of same size with no ovality otherwise there will be problem in welding as well as chances of leakage of fluid.

Inhomogeneous material can also generate ovality. Forming require equal bending of sheets but if the material is inhomogeneous then the mechanical properties will be slight different at different areas of pipe and may be more ductile at certain places which can easily bend or may be because of impurities or strain hardening it resist to bend which form slight/minor oval shape on the particular area of pipe.

C. DRAWBACKS OF OVALITY

Following are the main drawbacks of ovality in pipes -

- Difficulty in further manufacturing processes like hydro testing, end milling etc.
- Difficult to weld oval pipe with other pipe because of out of roundness.
- No equal distribution of pressure during hydro testing.

D. REMEDIES

Following processes can be treated as the remedies to remove ovality from pipes -

- **Mechanical expander** - Expansion of pipe with the help of mechanical expander which can give proper roundness to the oval pipe.



Fig.3. Mechanical expander

- **Hydraulic press** - First the ovality is measured at different points then max diameter points are pressed with the help of hydraulic press by which pipe can expand at the opposite minimum diameter area. This process is repeated several times until all the points marked have equal diameter.



Fig.4. Hydraulic press

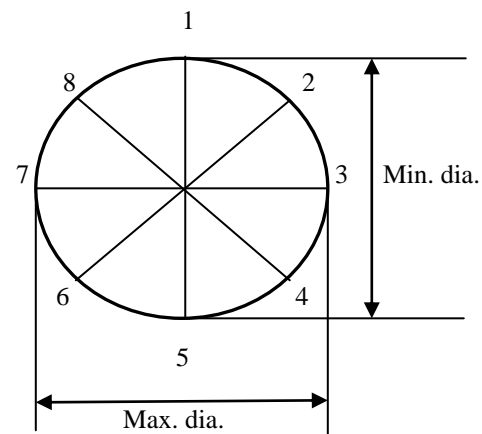


Fig.5. Diameter measurements at different points

In figure line 3-7 shows the maximum diameter while line 1-5 shows the minimum diameter of the oval shaped pipe. Line 3-7 is pressed with the help of hydraulic press to reduce the diameter vice versa as this line got pressed diameter at line 1-5 got increased because of opposite direction. By this, with the help of hydraulic press ovality can be reduced or eliminated.

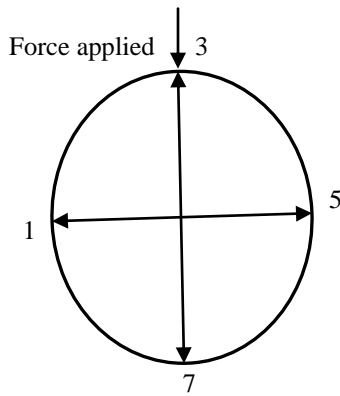


Fig.6. Ovality removal with the help of hydraulic press

Actually it is hard to get the perfect round shape with the help of press because each time we perform the operation, it got some new error which we have to minimize. Expansion is the best process to remove the ovality where inner dies completely contact with the inside diameter and expansion takes place which remove the ovality and make equal diameter at all points.

- **Hydraulic jack** - Hydraulic jack is placed inside the pipe where lowest diameter is found and then jack is operated which converts hydraulic energy to mechanical energy and diameter at that particular points has been increased. This process is repeated several times until proper roundness on the pipe got found [2].



Fig.7. Ovality removal with the help of hydraulic jack

II. CONCLUSIONS

Ovality in pipes is unwanted phenomenon which should be prevented in early stages to avoid wastage of human power as well as to save the additional cost of manufacturing. It is also important to ensure the roundness of pipes before dispatching because oval pipes cannot be weld properly at sites. For this, expander machine and hydraulic press is useful. Expander is the best way to eliminate ovality from pipes with minimum time, minimum strokes and with maximum efficiency.

REFERENCES

- [1] Pipe or tube ovality calculator, Available: <http://www.cmrp.com/dompdf/ovalitycalc.php>
- [2] M. Balachandran (2015), 'Ovality Correction Methods for Pipes', International Journal on Mechanical Engineering and Robotics (IJMER), Volume-3, Issue-1, pp. 33-38.
- [3] Chris Alexander (2012), 'Evaluating the effects of ovality on the integrity of pipe bends', 9th International Pipeline Conference, September 24 – 28, pp. 1-13.
- [4] A. V. Kale, H. T. Thorat (2014), 'Control of ovality in pipe bending: a new approach', 5th International & 26th All India Manufacturing Technology, Design and Research Conference (AIMTDR 2014), December 12-14, pp. 1-5 (192).