

# A guide to understanding the changes in testing procedures between API 610 10<sup>th</sup> and 11<sup>th</sup> editions

technical bulletin

In September 2010, API 610 11<sup>th</sup> edition brought in changes to the testing procedures. However, customers can specify whether they require equipment manufactured and tested to API 610 10<sup>th</sup> or 11<sup>th</sup> editions and so it is important to understand the differences this can have on the testing procedures.

There are 7 key changes in API 610 11<sup>th</sup> edition that we will consider here:

- Test flow rates
- Test tolerances
- Additional NPSH test point
- Oil temperature during mechanical run
- Vibration
- Test procedures
- Witness inspection

## 1. Test flow rates

API 610 11<sup>th</sup> edition is more prescriptive over the flow points to be tested than 10<sup>th</sup> edition and also includes both one additional flow point and some changes to the flow points (see table below and Figures 1 and 2). When using 11<sup>th</sup> edition, manufacturers shall take test data, including head, flowrate, power and vibration (vibration data not required at shutoff) at a minimum of 5 of the 6 specified points listed, whereas in 10<sup>th</sup> edition it was simply stated that the same test data shall be taken from at least five points and listed those points that are normally used.

| Test Points  | 11 <sup>th</sup> edition mandatory points (5 out of 6) | 10 <sup>th</sup> edition normally used points minimum of 5 |
|--|--|--|
| Shutoff (closed valve)   | ✓  | ✓  |
| Minimum continuous stable flow (beginning of allowable operating region)   | ✓  | ✓  |
| Midway between minimum and rated flow  |  | ✓  |
| Between 95% and 99% of rated flow  | ✓  |  |
| Rated flow (or for 11 <sup>th</sup> edition best efficiency flow if rated flow is not within 5% of best efficiency flowrate) | ✓  | ✓  |
| Between rated flow and 105% of rated flow  | ✓  |  |
| Maximum allowable flow (end of allowable operating region)   | ✓  | ✓  |

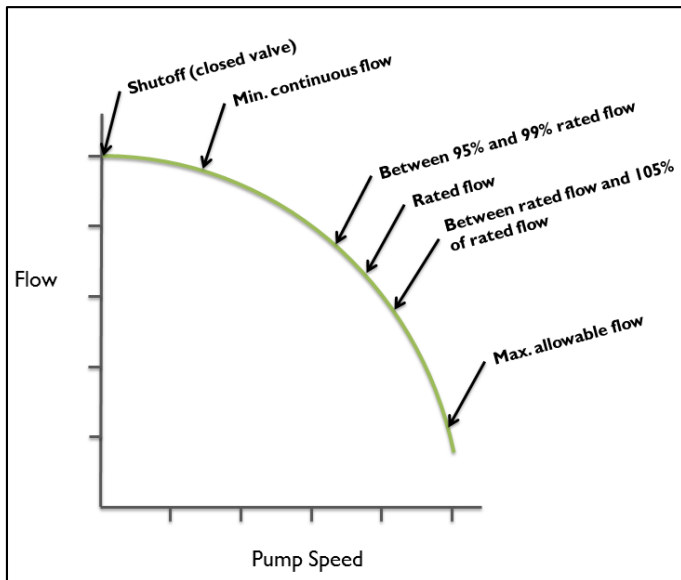


Figure 1 – Test points 11<sup>th</sup> edition

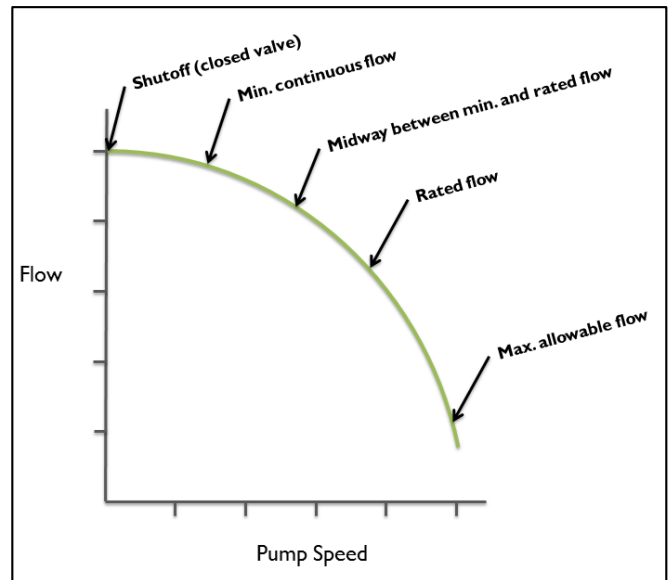


Figure 2 – Test points 10<sup>th</sup> edition

Manufacturers may also choose to add further test points in API 610 11<sup>th</sup> edition so long as they have conducted tests at the minimum 5 of the 6 specified flow points. For example, Amarith usually add a further test point half way between the minimum continuous stable flow and the rated flow as these two flow points are often spaced well apart.

## 2. Test tolerances

In API 610 11<sup>th</sup> edition the overall tolerance for the differential head at the rated flow has been standardised across the full range (and also standardised to the same positive and negative tolerances). This compares to a graduated range of tolerances in 10<sup>th</sup> edition. For differential heads of less than 150m the overall tolerance in 11<sup>th</sup> edition has reduced making the test slightly harder, although for heads greater than 150m 11<sup>th</sup> edition has a slightly wider tolerance than 10<sup>th</sup> edition.

For example, if the duty head was 100m then:

- in 11<sup>th</sup> edition the overall tolerance is 6m, so the head has to be between 97m – 103m
- in 10<sup>th</sup> edition the overall tolerance is 7m, so the head has to be between 98m – 105m

Furthermore, in API 610 11<sup>th</sup> edition for any motor <10 KW the customer and manufacturer can now agree any test tolerances for inspection.

| Head Test Tolerances  | 11 <sup>th</sup> edition |     |     | 10 <sup>th</sup> edition |     |     |
|---|--------------------------|-----|-----|--------------------------|-----|-----|
|   | Overall tolerance        | +   | -   | Overall tolerance        | +   | -   |
| Duty head 0m – 150m   | 6%                       | +3% | -3% | 7%                       | +5% | -2% |
| Duty head 151m – 300m   | 6%                       | +3% | -3% | 5%                       | +3% | -2% |
| Duty head > 300m  | 6%                       | +3% | -3% | 4%                       | +2% | -2% |
| <10KW motors - customer and manufacturer can agree tolerances | ✓                        |     |     | ✗                        |     |     |

### 3. Additional NPSH test point

In API 610 11<sup>th</sup> edition, NPSH must be tested at the 5 specified flow rates (i.e. not including closed valve shutoff) instead of the previous 4 selected test flow rates in 10<sup>th</sup> edition.

| NPSH Test Points   | 11 <sup>th</sup> edition mandatory | 10 <sup>th</sup> edition normally used |
|--|------------------------------------|--|
| Minimum continuous stable flow (beginning of allowable operating region)   | ✓                                  | ✓                                      |
| Midway between minimum and rated flow  |                                    | ✓                                      |
| Between 95% and 99% of rated flow  | ✓                                  |  |
| Rated flow (or for 11 <sup>th</sup> edition best efficiency flow if rated flow is not within 5% of best efficiency flowrate) | ✓                                  | ✓                                      |
| Between rated flow and 105% of rated flow  | ✓                                  |  |
| Maximum allowable flow (end of allowable operating region)   | ✓                                  | ✓                                      |

### 4. Oil temperature during mechanical run

For the mechanical run, API 610 10<sup>th</sup> edition specifies that it is necessary to have the oil temperature in the bearing bracket stabilise before running for the 4 hours at rated flow. In 11<sup>th</sup> edition however, the 4 hour test at rated flow can now be started **immediately** so long as the oil temperature in the bearing bracket stabilises **before the end** of the 4 hour test.

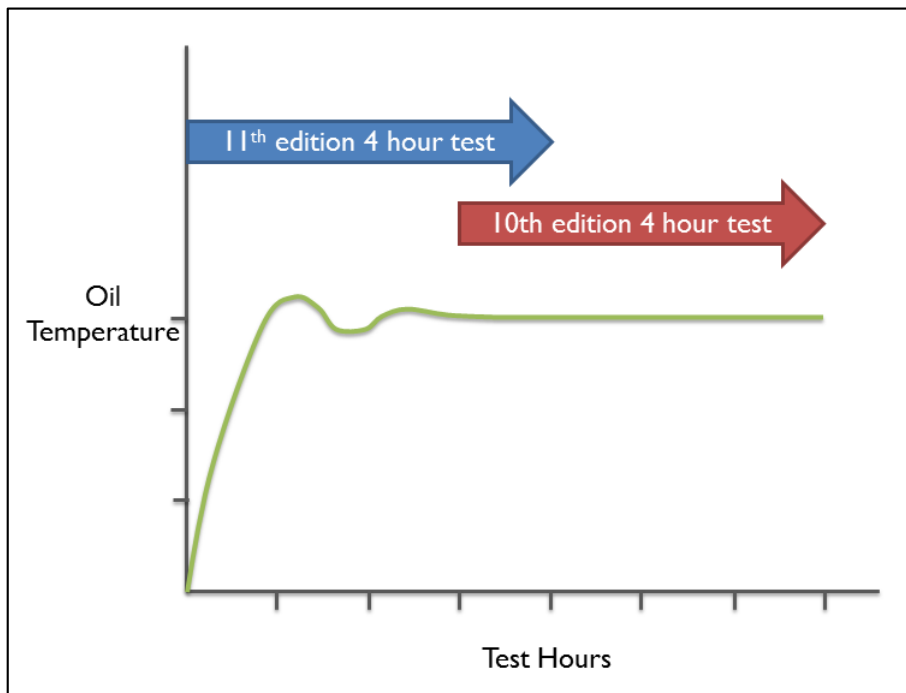


Figure 3 – Comparison of elapsed times for 11<sup>th</sup> and 10<sup>th</sup> edition mechanical tests

## 5. Vibration

API 610 11<sup>th</sup> edition now specifies that when testing vibration, the discrete frequency velocity must be measured with a FFT spectrum using a Hanning window and a minimum frequency resolution of 400 lines, whereas there is no such explicit statement in 10<sup>th</sup> edition.

Furthermore there is a small increase in the preferred and allowable discrete frequency vibrations for vertical pumps in 11<sup>th</sup> edition over 10<sup>th</sup> edition – see values in table below highlighted in red.

| Vibration   | 11 <sup>th</sup> edition |            |                      |            | 10 <sup>th</sup> edition |            |                      |            |
|---|--------------------------|------------|----------------------|------------|--------------------------|------------|----------------------|------------|
|   | Preferred (mm/s RMS)     |            | Allowable (mm/s RMS) |            | Preferred (mm/s RMS)     |            | Allowable (mm/s RMS) |            |
|   | Overall                  | Discrete   | Overall              | Discrete   | Overall                  | Discrete   | Overall              | Discrete   |
| Horizontal pumps  | 3.0                      | 2.0        | 3.9                  | 2.6        | 3.0                      | 2.0        | 3.9                  | 2.6        |
| Vertical pumps  | 5.0                      | <b>3.4</b> | 6.5                  | <b>4.4</b> | 5.0                      | <b>3.3</b> | 6.5                  | <b>4.3</b> |
| Measured with a FFT spectrum using a Hanning window and a minimum frequency resolution of 400 lines | n/a                      | ✓          | n/a                  | ✓          | n/a                      | ✗          | n/a                  | ✗          |

## 6. Test procedures

API 610 calls on the American Hydraulic Institute regarding how to set up and run the tests. In Europe the equivalent to the American Hydraulic Institute procedures is ISO 9906 and so this is used to set up and run the tests. However, any test values or tolerances stated in ISO 9906 **are replaced** with the values as stated in API 610.

## 7. Witness inspection

ISO 9906 was updated to ISO 9906:2012 around the same time as the API 610 11<sup>th</sup> edition was released and explicitly allows for remote witness inspection (on-line over the web) and so by specifying API 610 11<sup>th</sup> edition this also allows for remote witness inspection too, however previously the standards were silent on this matter.

## Summary

In summary, the key differences between the testing procedures in API 610 11<sup>th</sup> and 10<sup>th</sup> editions are:

|  | 11 <sup>th</sup> edition  | 10 <sup>th</sup> edition   |
|--|---|--|
| <b>Test flow rates</b>                       | Must test at a minimum of 5 out the 6 mandatory specified points  | Must test at a minimum of 5 points and a list of normal test points is provided (but not mandatory)    |
| <b>Test tolerances</b>                       | Standardised +3% / -3% overall differential head tolerance regardless of head   | Graduated differential head tolerance of +5% / -2% (0m-150m); +3% / -2% (151m-300m); +2% / -2% (>300m) |
| <b>Additional NPSH test point</b>            | For motors <10KW test tolerances can be agreed between customer and manufacturer  | No provision for motors <10KW  |
| <b>Oil temperature during mechanical run</b> | Testing to take place at the 5 mandatory specified flow rates (so not including shutoff)  | Testing to take place at the 4 selected flow rates (so not including shutoff)                          |
| <b>Vibration</b>                             | 4 hour test can be started so long as oil temperature in bearing bracket stabilises by the end of the run                               | 4 hour test cannot be started until oil temperature in bearing bracket stabilises                      |
|  | Small increase over 10 <sup>th</sup> edition in the discrete preferred and allowable vibration for vertical pumps                       |  |
|  | Discrete frequency velocity must be measured with a FFT spectrum using a Hanning window and a minimum frequency resolution of 400 lines | No explicit statement  |
| <b>Witness inspection</b>                    | Remote witness testing is explicitly allowed  | No explicit statement  |