

## RELATIVITY OF ACID NUMBER FOR HYDRAULIC FLUIDS

### Overview

The total acid number (TAN) is an analytical test to determine the deterioration of lubricants in service due to oxidation. As a fluid degrades with oxidation, the viscosity increases as well as the levels of corrosive acids, soot and varnish, along with the danger of component failure.

TAN merely measures the corrosive acids present in the fluid, and will increase over time as an indication of the deterioration of the fluid.

However, different lubricant technologies such as mineral oil-based or polyol-ester-based hydraulic fluids and different additive technologies result in different TAN values:

- Different initial acid numbers - when the fluid is fresh
- Different recommended maximum acid numbers - as the fluid ages, when it should be refreshed

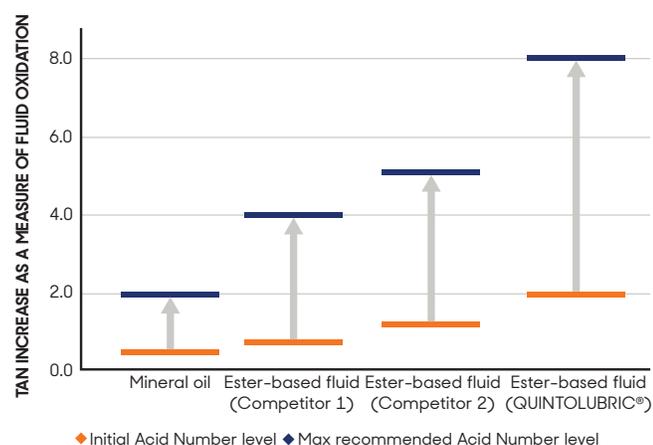
It is generally recommended to refresh mineral oil based hydraulic fluids when the acid number reaches 2.0 mg KOH/g. Some HFD-U suppliers advise to change their fluid when the acid number is >4.0 or >5.0 mg KOH/g. Quaker Houghton advises customers to refresh QUINTOLUBRIC® 888 when the acid number is >8.0 mg KOH/g.

The main reason why mineral oil based hydraulic fluids need to be exchanged at an acid number increase of 2 mg KOH/g, while polyol-ester-based fluids can safely run at higher acid numbers, is linked to the fact that soot and varnish dissolve well in polar base fluids such as QUINTOLUBRIC®'s polyol ester.

The difference between suppliers of polyol ester HFD-U fluids is explained by the highly optimized anti-oxidant package of QUINTOLUBRIC® that gives a more proportional acid number increase.

Regardless of the fluid chosen it is always a best practice to monitor the Total Acid Number with regular analysis (Quaker Houghton recommends once a quarter) to maintain and protect equipment, and prevent hydraulic system damage from occurring.

### Comparison of acid numbers for hydraulic fluids



FLUID	INITIAL AN	MAX AN
Mineral Oil	0.2	2.0
Competitor 1	0.4	4.0
Competitor 2	1.1	5.0
QUINTOLUBRIC®	2.0	8.0

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## Total acid number definition

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Total Acid number (TAN) is a measurement of the acidity of a lubricant that is determined by the amount of alkali needed to neutralize the acids in one gram of oil (expressed in mg KOH/g).

TAN is an important measure of the degradation of an oil in service due to oxidation.

## Oxidation

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Oxidation can be initiated by heat, light, catalyst residues, or impurities, and results in the following. It is a process that fluid formulators work against because it results in the following:

- The viscosity of the fluid increases
- The acid number (TAN) of the fluid increases
- Short-chain, corrosive fatty acids, and other fragments are formed
- The onset of soot and varnish formation

When a polyol ester (HFD-U) or PAG (Polyalkylene Glycol) based hydraulic fluid is used the soot and varnish produced as oxidation occurs dissolves well. However, if a mineral oil or PAO based fluid is used the soot and varnish does not dissolve well.

When formulating a hydraulic fluid, it is critical to not only consider the base oil that is being used, but also the anti-oxidant package. If the optimal anti-oxidant package is used in the hydraulic fluid formulation the oxidation process will be delayed which will prolong the lifetime of the hydraulic fluid, and lead to less harmful by-products.

## Initial acid number

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The initial acid number of a polyol ester based hydraulic fluid is typically higher than that of a mineral oil or PAO based hydraulic fluid, and consists of two parts:

- The acid number of the base fluid
  - In ester-based hydraulic fluids this is due to residual fatty acid
- The acid number of the additive package

Once a fluid is put into service the increase in acid number is due to oxidation resulting in short-chain fatty acids that provide a high contribution to acid number (AN) increase.

So the initial acid number is irrelevant. Only the increase rate really matters. Well-known oxidation stability tests such as the Dry-TOST test (ASTM D943, ISO 4263) recognize this fact: Lifetime of the fluid (in hours) is reached when the acid number has increased with 2.0 mg KOH/g in this test.

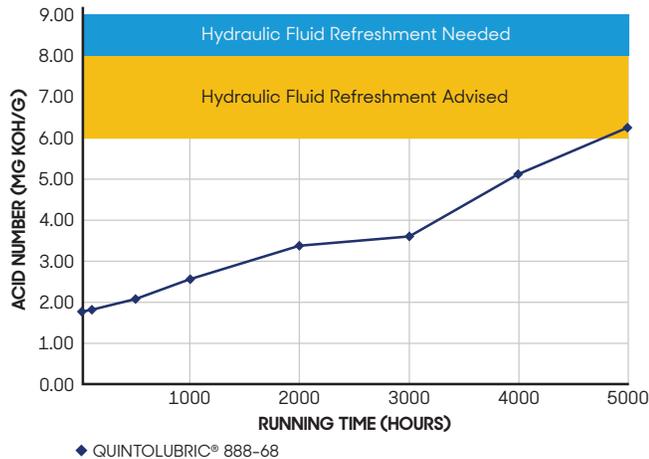


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## Fluid Maintenance

- In order to maintain and protect equipment, Quaker Houghton recommends a system's acid number be monitored on a regular basis
- At an Acid Number (AN) of 6.0 the customers are advised: "The hydraulic fluid is becoming aged, a refreshment is recommended"
- At an Acid Number (AN) >8.0 the customers are advised: "The hydraulic fluid is aged. Refresh as soon as possible"
- Based on these lab results such as the ASTM D2882 Pump Test and on the extensive field experience in more than 50,000 units worldwide, we are confident that the QUINTOLUBRIC® Series of fluids can run without loss of performance – including fire resistance according to Factory Mutual – up to acid number 8.0 mg KOH/g.

## ASTM D2882 V104C Pump Test



- Quaker Houghton typically runs this test for 5,000 hours to study wear data and fluid properties in time, although this pump test is normally run for 100 hours according to ASTM D2882
- When running this pump test with QUINTOLUBRIC® 888-68 the components were checked at set intervals. These checks showed no visible signs of wear, soot or varnish until an AN of 8

