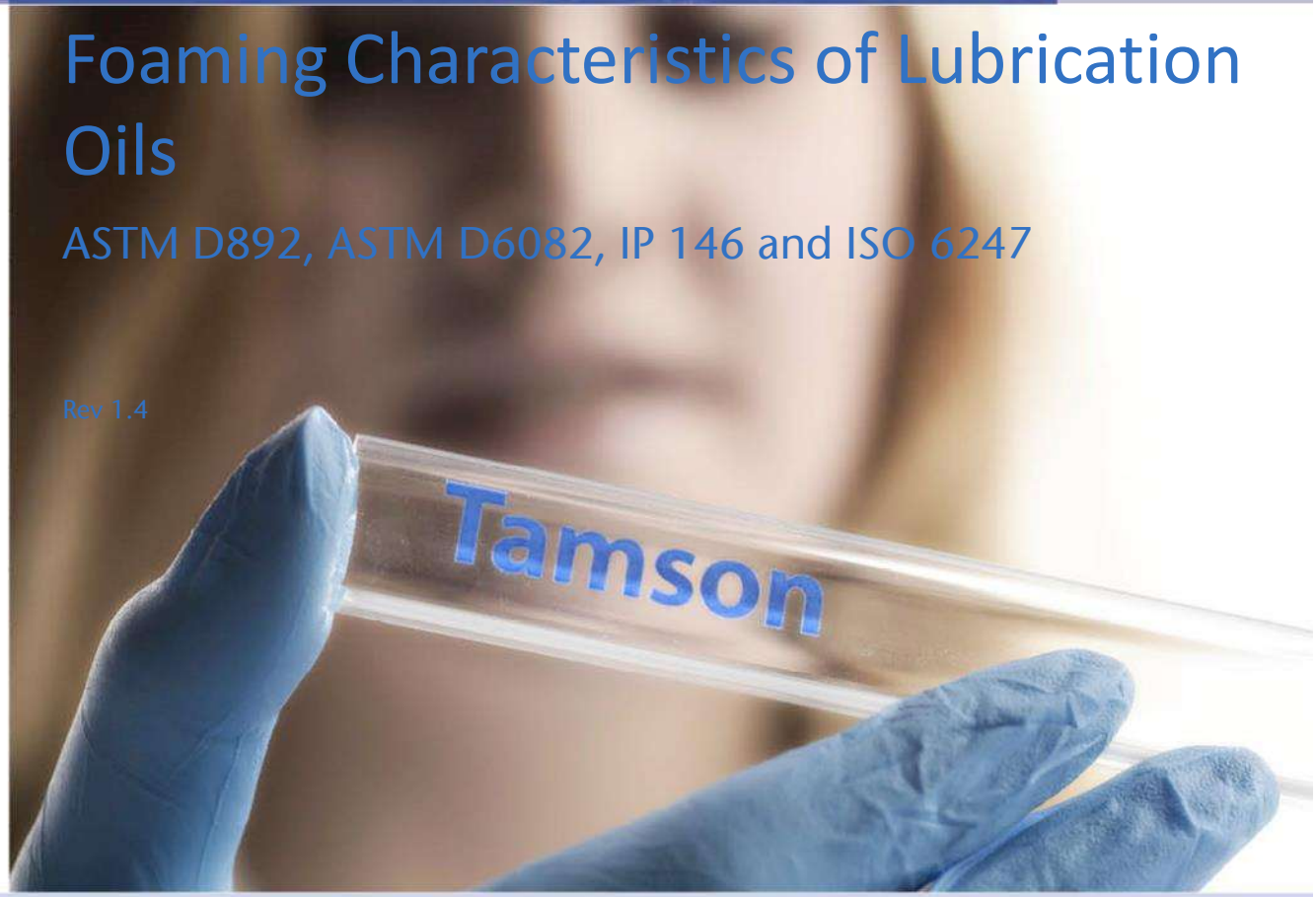
Foaming Characteristics of Lubrication Oils

ASTM D892, ASTM D6082, IP 146 and ISO 6247

Rev 1.4



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CONTENT OF PRESENTATION

- ✓ What is Foaming Characteristics (Foaming Test) of Lubrication Oils?
- ✓ Foaming Test Background
- ✓ Why is the Foaming Test important?
- ✓ The Foaming Test Methods
- ✓ Tamson Foaming Dual Bath
- ✓ Recommended Set-Up
- ✓ Competitive Advantages of Tamson Foam Apparatus
- ✓ High Temperature Foaming Bath
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Foam

What is a Foaming Characteristics test?

- It is the determination of the foaming characteristics of lubricating oils at 24°C and 93.5°C. For ASTM D6082, the test is performed at 150°C. Means of empirically rating the foaming tendency and the stability of the foam are described.

- What is foam?
  - A collection of bubbles formed in or on the surface of a liquid in which the air or gas is the major component on a volumetric basis.

- What is a lubricant?
  - Any material interposed between two surfaces that reduces friction or wear between them.

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Background

What is Foaming?

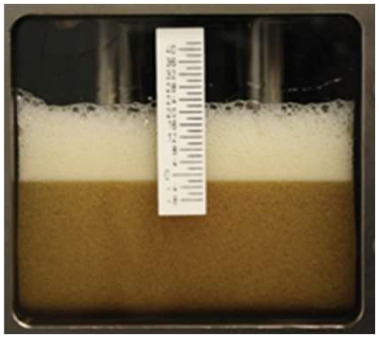
Picture: foam in a close-up

During use, lubricating oils can form an undesired phenomenon in engines, hydraulics, turbines, and cooling systems. Foaming in lubricants is mainly due to the accumulation of small air bubbles at the surface of the lubricant.

Foaming is a fundamental physical property of a lubricating fluid. Foam can degrade the fluid's life and performance as well as that of the equipment being lubricated. Foam performance is often a defined specification for a new fluid, however, many times it is ignored on an used fluid.

Background

What can Foaming do to your Machinery?



Pictures: lubricating oil foaming inside a machine during use and inadequate lubrication causing damage

Foaming can present serious problems for system operation as it acts as a thermal insulator and thus the oil temperature can become difficult to control.

- lubrication is reduced, resulting in increased risk of friction and heat buildup,
- oxidation and cavitation can occur,
- oil may even leak out of the machine,
- micro-dieseling,
- control valve losses,
- spongy hydraulic piston movement,
- pump oil pressure control losses

Overall these issues cause reduced efficiency or performance, and can even present a risk of unsafe operation. It can also lead to misinterpretation of oil levels and subsequent machinery failure.

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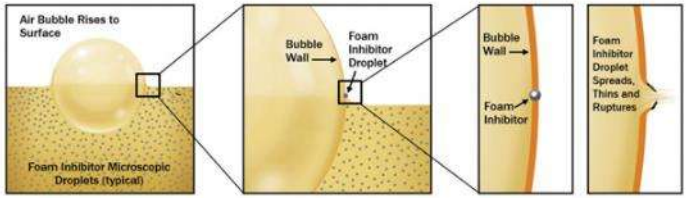
Background

SOLUTION FOR FOAMING?



Picture: lubricating oil foaming inside a machine during use

In order to prevent of reduce the formation of foam, lubricants contain anti-foaming additives. Their rol is to break the air bubbles. Two types of anti-foaming additives:

- Siloxanes: these additives act on the fluid/air interface. The additive's surface tension is low with respect to the lube oil and its density also is less than that of the fluid. The additive is insoluble in the fluid, meaning the additive exists as very small droplets on the surface of the liquid when the fluid is static or dispersed throughout the fluid when agitated. These droplets attach themselves to bubble walls to destabilize them
- Polyacrylates: they act more within the fluid itself, rather than at surfaces. The fluid disrupts the bubble formation and it collapses.

Background

WHY IS LUBRICATING OIL STILL FOAMING?

Foam performance is often a defined specification for a new fluid, however, many times it is ignored on an used fluid. Reasons for oil to foam again:

- Contamination. Common contaminants consists of water, solid particles, grease of cross contanimation of the oil with another fluid or addition of a wrong lubricant
- Depleted antifoam additives (possible due to the use of excessively fine filtration and electrostatic seperation technologies)
- Mechanical issues causing excessive aeration of the fluid, leaky seals, etc.
- Contamination of the lubricant with grease
- Overfilling of the sump with splash- and bath-lubricated compartments

Importance

FOAMING TESTS TODAY

- **Summary:**
- The tendency of oils to foam can be a serious problem in systems such as high-speed gearing, high-volume pumping, and splash lubrication.
- Inadequate lubrication, cavitation, and overflow loss of lubricant can lead to mechanical failure.
- This test method is used in the evaluation of oils for such operating conditions.

Standards

TEST METHODS

ASTM D892 / IP 146 / ISO 6247: determination of foaming characteristics of lubricating oils

Sequence I: a portion of sample, maintained at a bath temperature of 24°C ± 0.5°C is blown with air at a constant rate (94 mL/min ± 5 mL/min) for 5 min, then allowed to settle for 10 min. The volume of foam is measured at the end of both periods.

Sequence II: a second portion of sample, maintained at a bath temperature of 93.5°C ± 0.5°C, is analyzed using the same air flow rate and blowing and settling time duration as for sequence I.

Sequence III: The sample portion used for sequence II is used for sequence III, where any remaining foam is collapsed and the sample portion temperature cooled below 43.5°C by allowing the test cylinder to stand in air at room temperature, before placing the cylinder in the bath maintained at 24°C ± 0.5°C. The same air flow rate and blowing and settling time duration as indicated in sequence I is followed.

Standards

TEST METHODS

ASTM D6082: determination of high temperature foaming characteristics of lubricating oils

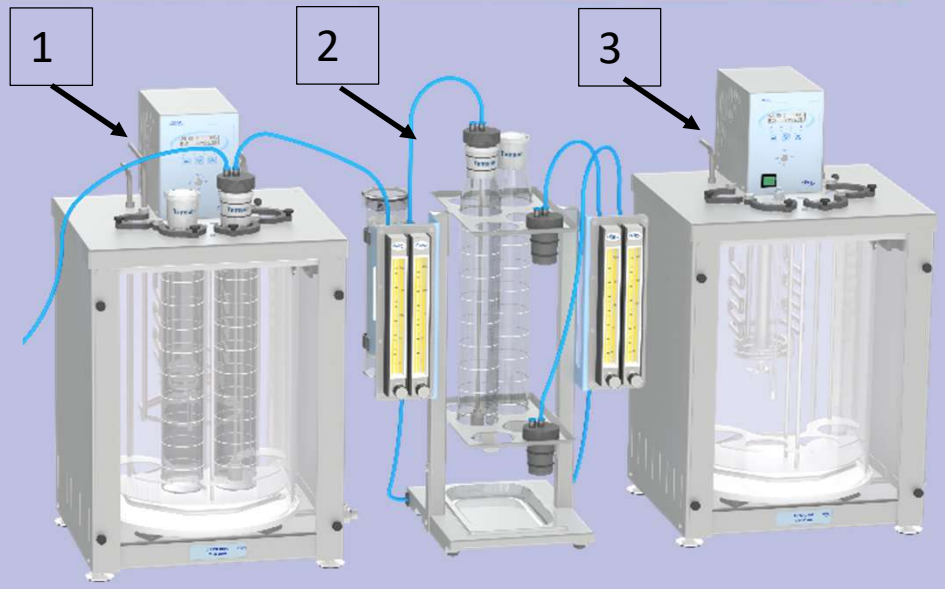
“Sequence IV”: A measured quantity of sample is heated to 49°C for 30 min and allowed to cool to room temperature. The sample is transferred to a 1000 mL graduated cylinder, heated to 150°C, and aerated at 200 mL⁄min with dry air for 5 min with a metal gas diffuser.

Dual Foaming Bath

For D892 / IP 146 / ISO 6247

The Tamson D892 apparatus consists of two visibility baths and a rack. One bath is used as a high temperature (normally 93.5°C) bath and one bath is used as low temperature (normally 24°C) bath.

The rack can hold up to four foam cylinders, for example when cooling down between sequence II and III. On this rack four flow meters calibrated at 94 ml/min are mounted with space for an optional dryer tower.



Operating the Dual Foaming Bath		
Item	Description	Remark
1	Low temperature bath	Normally used at 24°C
2	Rack	To be used to cool down the samples between sequence II and III.
3	High temperature bath	Normally used at 93.5°C.

Dual Foaming Bath

VISIBILITY BATH

- Bath drain included
- Four openings for foaming cylinders
- Two openings for thermometer
- One opening for adding the bath fluid
- Temperature range from ambient to +100°C.
- Two cooling coils
- Rack with clamps to overcome the buoyancy of the foam cylinders
- Removable outside window panels for cleaning purposes
- Baths are the same, and interchangeable

Dual Foaming Bath

RACK

- Stainless steel rack
- Four positions for foaming cylinders
- Four positions for stoppers
- Standard four flow meters are mounted on rack (number of flowmeters can be customized and up to eight flowmeters is possible)
- Removable spill tray
- Optionally, the dryer tower can be mounted on this rack

Dual Foaming Bath

WHAT IS INCLUDING IN STANDARD SCOPE OF SUPPLY?

Dual foaming bath under P/N 00T0330 (230V) or P/N 00T0331 (115V)

- ✓ Two thermostatic baths
- ✓ One rack
- ✓ Four foaming cylinders
- ✓ Four Delrin stoppers with quick-fit connectors and openings for inlet tube and outlet tubing
- ✓ Blue PU tubing to connect flowmeter with pump, dryer, and mass flow meter (50 m)
- ✓ Four air inlet tubes

- *This is the standard configuration, custom-made apparatus (e.g. with two or eight flowmeters) can be supplied.

Dual Foaming Bath

RECOMMENDED FOAM SET-UP

Tamson recommends Dual Foam bath with P/N 00T0330 (230V) or P/N 00T0331 (115V).

Necessary accessories:

- Mass flow meter, necessary for ASTM D892, optional for ASTM D6082 (P/N 31T0067)
- Pump equipped with pressure regulator (P/N 11T0036 (230V) or 11T0037 (115V)) to deliver an airflow to the flow meters
- Mott cylindered metal diffuser (P/N 31T0066W) made of sintered five micron porous stainless steel, with work certificate for permeability and porosity. *On request, we can supply stone gas diffusers (P/N 31T0068W), but we recommend not to use the fragile stone gas diffuser.

Dual Foaming Bath

RECOMMENDED FOAM SET-UP

Options:

- TLC15-5 external circulator to connect to the low temperature bath to work @ 24°C.
- Tubing with connectors and clamps (P/N 12T1075) to be used between the TLC15-5 and the low temperature foaming bath.
- Gas drying tower (P/N 31T2044), with 2 * 1/8 SS NPT fittings with clamps and connectors to mount on the rack.
- Bath fluid mineral oil T150, 40 litres transparent, 80..150°C for high temperature bath.
- LED Backlight illuminator (P/N 00T0911).

Dual Foaming Bath

UNIQUE SELLING POINTS AGAINST COMPETITION

- ✓ Up to four positions per bath
- ✓ Drain valve to empty bath content
- ✓ Stirrer with long shaft for optimal temperature uniformity
- ✓ Levelling feet to ensure the bath spirit is level
- ✓ Separate opening in cover to add bath medium to make sure the foaming cylinder is immersed to the 900 mL mark
- ✓ Robust zincor powder coated case around glass jar
- ✓ Bath temperature stability of ± 0.02°C

Dual Foaming Bath

UNIQUE SELLING POINTS AGAINST COMPETITION

- ✓ Removable outside window panels for cleaning purposes
- ✓ Each bath is equipped with two cooling coils and can be used interchangeably
- ✓ Two thermometer openings in cover
- ✓ Stainless steel cover
- ✓ Delrin stoppers instead of rubber stoppers, as rubber stoppers can crack over time
- ✓ Two decimal read-out
- ✓ Flowmeters are calibrated and delivered with works calibration certificate

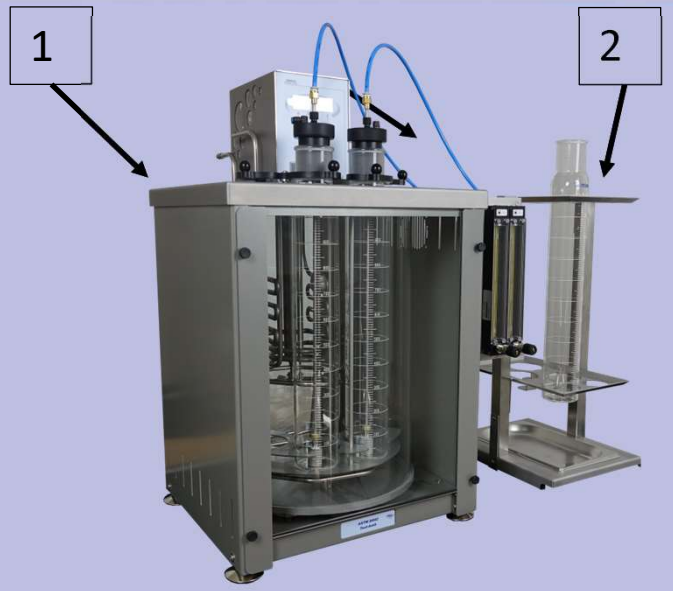
D6082 Foaming Bath

FOR D6082 AND IP 453

The Tamson D6082 apparatus consists of one visibility bath and a rack. The bath is used as a high temperature bath at 150°C. The bath has a temperature range up to 160°C.

The rack can hold up to four foam cylinders. On this rack two flow meters calibrated at 200 ml/min are mounted with space for an optional dryer tower.

The high temperature foaming bath is supplied with two foaming cylinders and two stoppers and necessary tubing.



Operating the High Temperature Foaming Bath		
Item	Description	Remark
1	Foaming bath	Used at 150°C
2	Rack	To be used to hold flowmeters, cylinders and stoppers (2 pcs each).

Custom made

CUSTOM MADE OPTIONS AVAILABLE

- Custom made Dual Foaming apparatus is available on request.
- For example when the same apparatus for both ASTM D892 and ASTM D6082 tests is used.
- ASTM D1881 compliance apparatus is available.
- Digital flowmeter is optionally available.
- Please contact Tamson for more information.