Determination of the oxidation stability of

- Oils and fats
- Biodiesel
- Food and cosmetics
The 743 Rancimat is a modern, PC-controlled analytical instrument for the comfortable determination of the oxidation stability of oils and fats, also referred to as Oil Stability Index (OSI). The software of the third Rancimat generation comprises automatic data acquisition and evaluation as well as a database and permits the convenient management of large amounts of data. The unique temperature extrapolation allows a rough estimation of the storage stability of a product.

Disposable reaction vessels reduce the amount of cleaning of the accessories to an absolute minimum. This saves both time and money. The accuracy and reproducibility of the measurements are also significantly improved. The GLP Set with certified temperature sensor allows to set the temperature very accurately and reproducibly, which in turn improves the reproducibility of the results.

The most important applications

| Oxidation stability of natural oils and fats | Oxidation stability of biodiesel (fatty acid methyl esters, FAME) | Oxidation stability of food and cosmetics |
The most important advantages at a glance

- All instrument functions controlled from PC
- Unparalleled reliability and simple operation due to unique accessories
  - Favorably-priced disposable glass parts
  - Robust conductivity cell with integral electrical connections in cover
- Excellent data security by storing all measuring, method and instrument data
- Re-evaluation and recalculation of all measuring data
- Database functions such as filtering and sorting
- User administration with freely configurable access rights
- Convenient user interface
- GLP and validation functions
- Estimation of the storage stability of products
- Compact dimensions and low weight
- 2 heating blocks with 8 measuring positions per instrument. Up to 4 instruments can be connected to one PC.
- Independent start of each channel
Oxidation stability of natural oils and fats

The determination of the oxidation stability of oils and fats is the classical application for the 743 Rancimat. The resulting induction time characterizes the resistance of oils and fats to oxidation. In addition to the term «induction time», the expression Oil Stability Index (OSI) is in common use. The Rancimat method is also called the automated Swift test or accelerated oxidation test and is in general use today as an automated version of the previously used and extremely complicated Active Oxygen Method (AOM).

During the measurement a stream of air is passed through the oil or fat sample contained in a sealed and heated reaction vessel. This treatment results in oxidation of the oil or fat molecules in the sample, with peroxides initially being formed as the primary oxidation products. After some time the fatty acids are completely destroyed; the secondary oxidation products formed include low-molecular organic acids in addition to other volatile organic compounds. These are transported in the stream of air to a second vessel containing distilled water. The conductivity in this vessel is recorded continuously. The organic acids can be detected by the increase in conductivity. The time that elapses until these secondary reaction products appear is known as the induction time, induction period or Oil Stability Index (OSI).

The Rancimat method yields standard quality control parameters for the production of oils and fats in the food industry or for incoming goods checks in further processing. In addition to oils and fats from vegetable sources, the oxidation stability of animal fats such as lard, tallow and fish oil can also be checked with the 743 Rancimat as a matter of course.

Foodstuffs may contain added antioxidants in order to delay the oxidative decomposition of their oils and fats. With the 743 Rancimat it is possible to characterize the effectiveness of antioxidants. This opens up a further field of application for the instrument.
Standards
The Rancimat method is included in various national and international standards, such as:
• AOCS Cd 12b-92 (AOCS – American Oil Chemists’ Society) Sampling and analysis of commercial fats and oils: Oil Stability Index
• ISO 6886 Animal and vegetable fats and oils – Determination of oxidation stability (accelerated oxidation test)
• 2.4.28.2-93 Fat stability test on Autoxidation, CDM, Japan
• Swiss Food Manual (Schweizerisches Lebensmittelbuch), section 7.5.4

Estimating the storage stability
An extension of the previous possibilities is provided by a new function – the so-called temperature extrapolation. This is an aid for estimating the shelf life of oils and fats. The extrapolation makes use of the relationship between the measured induction time and the temperature given by van’t Hoff’s law. Several measurements are made at different temperatures and then extrapolated to the storage temperature. The value obtained allows a rough estimation of the storage stability of the oil or fat.
In addition to other alternative fuels such as ethanol, methanol or biogas (methane), fatty acid methyl esters are increasingly being found on the market; these are also known as biodiesel or FAME (fatty acid methyl esters). Fatty acid methyl esters are usually obtained from oil seeds and are mainly used in their pure form or mixed with conventional diesel fuel in the transport sector.

During manufacture the vegetable oil is transesterified with methanol. This produces the methyl esters of the fatty acids present in the oil together with glycerol as a byproduct. Fatty acid methyl esters are relatively unstable on storage, as like all natural oils and fats they are slowly oxidized by atmospheric oxygen. The substances produced in this way could cause motor damage. This is why the oxidation stability is an important quality criterion for biodiesel; it is regularly determined during the production process. With the 743 Rancimat this determination can be carried out quickly and simply. The oxidation process can be delayed by the addition of antioxidants. The 743 Rancimat can also be used to determine the effectiveness of the antioxidants.

The use of alternative fuels from renewable vegetable sources has become increasingly widespread in recent years, as the life cycle of biogenic fuels is neutral with respect to CO₂ release. The carbon dioxide released has already been assimilated from the atmosphere during plant growth. In contrast to fossil fuels, biogenic fuels neither contribute to the accumulation of CO₂ in the atmosphere nor to global warming. In addition, alternative fuels are biodegradable and thus less environmentally harmful.

The oxidation stability of fatty acid methyl esters has already been included in various test methods as a standard parameter used to define the minimum quality requirements of biodiesel:

- EN 14214 «Automotive fuels – Fatty acid methyl esters (FAME) for diesel engines – Requirements and test methods»
- EN 14112 «Fat and oil derivatives – Fatty acid methyl esters (FAME) – Determination of oxidation stability (accelerated oxidation test)»
Oxidation stability of foods and cosmetics

Just like the pure substances, the oils and fats contained in foods are also subject to oxidation, which contributes to their spoilage. In such cases the 743 Rancimat can be used to determine the oxidation stability of foods containing oils and fats.

Melttable foods with a high fat content, such as butter, margarine, lard or tallow, can be analyzed directly without any further sample preparation. For liquid or semi-liquid foods, such as salad dressings or mayonnaise, it is better to split the emulsion and analyze the separated fat phase. For solid, non-melttable foods it is also necessary to separate off the fat phase. In this case the fat is normally cold-extracted with petroleum ether and the isolated fat is then analyzed.

Examples of typical applications are:
- Mayonnaise
- Salad dressings
- Biscuits
- Waffles
- Grain flakes
- Nuts
- Chocolate
- Bacon
- Sausages

As well as for determining the oxidation stability of foods, the 743 Rancimat is also used for testing cosmetics or cosmetic additives. With meltable products such as lipsticks this can be done without any further sample preparation. With creams or salves the fat phase must normally be separated off before the analysis.
The 743 Rancimat in detail

Two heating blocks with two temperatures
The 743 Rancimat has two independent heating blocks that allow up to eight samples to be analyzed at one or two temperatures. Up to four Rancimats can be connected to one PC, so that the maximum number of samples that can be analyzed in parallel can be increased to 32. Each measuring position can be started individually. As soon as the measurement has been completed the measuring position is immediately ready for a new sample, which means that the instrument can be used to its full capacity.
Simple reaction vial handling
Favorably-priced disposable reaction vessels are used with the 743 Rancimat. Weighing out the sample and assembling the reaction vessel are extremely simple and safe. As the vessel does not need to be expensively cleaned at the end of the measurement this means that the personnel are available for other tasks. This reduces the analysis costs.

Measuring vessels
Easy-to-clean polycarbonate beakers are used for the automatic conductivity measurement. Glass beakers are available as an alternative.

Cover with built-in conductivity cell
The conductivity cell is incorporated in the measuring vessel cover. When the cover is placed in position the cell is immersed in the water. At the same time electrical contact is made to the electronics in the instrument. The use of fragile glass conductivity electrodes with lengthy connecting cables went out of fashion a long time ago. The new conductivity cell is also very easy to clean.

Connections
In order to make operation as simple as possible there are no controls at all on the instrument. All its functions are controlled from the PC. Apart from the power switch, the only features you will find on the instrument are the RS-232 socket for connection to a PC and a socket for connecting the Pt-100 temperature sensor.

Validation with the GLP Set
The optionally available GLP Set facilitates the validation of your 743 Rancimat. It contains a certified Pt-100 temperature sensor with accessories that can be used for testing the temperature regulation of the heating block. A test plug for checking the conductivity measurement inputs is also supplied.

Air inlet filter and molecular sieve
The air used for the measurement is aspirated through a filter that prevents particles from entering the instrument. The molecular sieve removes water vapor from the aspirated air, as water contributes to the hydrolytic decomposition of the fat molecules, it could interfere with the measurement.

Air supply line
The amount of air that passes through the sample is automatically controlled via the rotation rate of the built-in pump according to the method settings. A separate supply of compressed air is not necessary.
Software functions

All functions of the 743 Rancimat are controlled by the Rancimat software, which excels by its user-friendliness. All the functions are clearly arranged in just a few windows, the operation is intuitive.

Rancimat control
This is where the measuring parameters can be called up and edited. The instrument functions are controlled directly from here, the measurements are also started and shown in the live display field. The arrangement of this window corresponds to a view of the instrument from above. This means that the assignment of sample information and measuring position is perfectly clear. The timer function can be used to automatically switch on the heating blocks before the start of work, so that it is no longer necessary to wait while they warm up.

The functions in a nutshell:
- Individual start/stop for each position
- Live display
- Temperature display
- Method definition
- Instrument controls
- Calculation formulas, automatic result transformation to other temperatures
- Timer function

Rancimat results
At the end of each determination the measuring data is stored in a database and can be viewed by the user in the results window. Sample information and results are shown in tabular form and can be exported in various formats. The measured curves can be shown individually or in groups. It is also possible to edit the automatic evaluation and recalculate the results. The temperature extrapolation function for estimating the storage stability is available in this section of the software. You can, of course, sort or filter all the displayed data and adapt the display to meet your own requirements.

- Overview table
- Curve display: individual or multiple plots
- Re-evaluation: induction time, stability time and manual tangent method
- Report printout
- Temperature extrapolation (estimation of storage stability)
- Database functions: filtering, sorting
- Data export
**GLP functions**

By using the built-in monitoring of the validation intervals, nothing can go wrong with your quality management procedure. The software requests you to carry out the validation in good time. The wizards for temperature and conductivity validation help you to do this.

- Monitoring the validation intervals
- Wizards for temperature and conductivity
- Electronic validation logbook

**User administration**

The software includes a flexible and comfortable user administration with login function; this can be used to define access rights for groups of users and individuals in great detail.

- Definition of user access rights
- Login function
## Technical specifications

### Heating blocks
2 aluminum heating blocks; electrically heated; can be set to different temperatures

### Number of samples
8 sample (4 measuring positions per heating block)

### Temperature control and measurement

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature range</td>
<td>50...220 °C, adjustable in 1 °C steps</td>
</tr>
<tr>
<td>Temperature correction</td>
<td>−9.9...+9.9 °C, adjustable in 0.1 °C steps</td>
</tr>
<tr>
<td>Reproducibility of set temperature</td>
<td>Typically better than ±0.2 °C*</td>
</tr>
<tr>
<td>Temperature variation</td>
<td>Typically &lt;0.1 °C*</td>
</tr>
<tr>
<td>Temperature difference between different measuring positions</td>
<td>Typically &lt;0.3 °C*</td>
</tr>
<tr>
<td>Instrument heating-up time from 20 °C to 120 °C</td>
<td>Approx. 45 min (to ±0.1 °C temperature stability)</td>
</tr>
<tr>
<td>to 220 °C</td>
<td>Approx. 60 min (to ±0.1 °C temperature stability)</td>
</tr>
<tr>
<td>Outer temperature of instrument</td>
<td>&lt;50 °C (at an operating temperature of 220 °C)</td>
</tr>
<tr>
<td>Response temperature of thermal protection device</td>
<td>260 °C</td>
</tr>
</tbody>
</table>

* When operating temperature has been reached, with inserted reaction vessels with an identical filling and 20 L/h air throughput.

### Air throughput

<table>
<thead>
<tr>
<th>Pump</th>
<th>Diaphragm pump</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output range</td>
<td>7...25 L/h</td>
</tr>
</tbody>
</table>

### Conductivity measurement

| Measuring range                               | 0...400 μS/cm                                     |
| Electrodes                                    | 6.0913.130 conductivity cell with double steel-pin electrode built into vessel cover |

### Ambient temperature

| Nominal working range                         | +5...+40 °C (at 20...80% relative humidity)       |
| Storage                                       | −20...+70 °C                                      |
| Transport                                     | −40...+70 °C                                      |

### Line power

| Voltage                                       | 2.743.0014 / 2.743.0114: 230 V (220...240 V ±10%) |
| Frequency                                     | 50...60 Hz                                        |
| Power consumption                             | <450 VA (depending on heating power)              |

### Dimensions

| Width                                         | 405 mm                                            |
| Height                                        | 268 mm (without accessories)                      |
| Depth                                         | 353 mm (with accessories)                         |
|                                              | 466 mm                                            |

### Weight

27.6 kg (with accessories)

### PC requirements

| Processor                                     | Pentium III with 700 MHz or higher                |
| Operating system                              | Windows™ NT, Windows™ 2000 or Windows™ XP         |
| Memory                                        | 20 MB for program files, 200 MB recommended for measuring data storage |
| RAM working memory                            | 128 MB, recommended 256 MB or higher (particularly for Windows™ XP) |
| Graphics resolution                           | min. 800 x 600, recommended 1024 x 768 or higher |
| Interface                                     | 1 free RS-232C interface (COM)                    |
| Printer                                       | All printers supported by Windows™               |
Ordering information

743 Rancimat
Instrument for the automatic determination of the oxidation stability of natural oils and fats with conductometric indication. Including Rancimat software.

2.743.0014  743 Rancimat (230 V, 50...60 Hz) for oils and fats
2.743.0015  743 Rancimat (115 V, 50...60 Hz) for oils and fats

Instrument for the automatic determination of the oxidation stability of biodiesel with conductometric indication. Including Rancimat software.

2.743.0114  743 Rancimat (230 V, 50...60 Hz) for biodiesel
2.743.0115  743 Rancimat (115 V, 50...60 Hz) for biodiesel

Options
6.2059.000  Turntable for 743 Rancimat
6.1428.020  Glass conductivity measuring vessel for 743 Rancimat (8 pcs. are required)
6.2757.000  Exhaust collection tube for 743 Rancimat (with 8 stoppers)
6.1816.010  Silicone tubing, i.d. 6 mm, o.d. 9 mm; length 22 cm (8 pcs. are required)
6.5616.000  GLP Test Set for 743 Rancimat; consisting of
6.1111.010  Pt-100 temperature sensor 16 cm
6.1253.000  Measuring insert for heating block
6.2109.030  Test plug 10 kOhm
6.2301.060  KCl conductivity standard, c(KCl) = 0.1 mol/L, 250 mL

Consumables
6.1429.040  Reaction vessels for 743 Rancimat (117 pcs.)
6.2418.100  Air inlet tube for oil measurements (117 pcs.)
6.1428.100  Polycarbonate conductivity measuring vessel for 743 Rancimat
6.1816.010  Silicone tubing for fat/oil measurements, i.d. 6 mm, o.d. 9 mm; length 22 cm
6.1839.000  Iso-Versinic tubing for biodiesel measurements, i.d. 6 mm, o.d. 9 mm; length 22 cm
6.2724.010  Dust filter for 743 Rancimat
6.2811.000  Molecular sieve 250 g