



**Rheology
Solutions**



Applications Laboratory and Contract Testing Capabilities Statement

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GENERAL CONTRACT TESTING KIT

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Company Profile

Rheology Solutions Pty Ltd is a specialist sales and service organisation dedicated to the science of materials characterisation and are the exclusive Australian distributor for the product names HAAKE, NESLAB and Thermo Scientific from Thermo Fisher Scientific, Optical Control Systems, Marimex Industries Corporation and Schleibinger Geräte range of equipment and instruments.



Rheology Solutions recognises the importance of specialisation and dedication to a specific science and, as such, provides full technical support and service throughout Australia. The Company goal is to integrate industry experience and materials characterisation techniques to provide practical solutions for customers.

Rheology Solutions has an established applications laboratory equipped with a comprehensive range of instruments to meet the requirements of material characterisation. Specialist contract testing services are also available and contracts can be tailored to suit discrete tests or protracted testing requirements

involving a series of tests over a period of weeks or months.

A range of seminars and application specific workshops as well as product launches and demonstrations are provided throughout Australia. The seminars and workshops are designed to meet the needs of specific customer and industry applications.

Rheology Solutions has its head office in Victoria and works with a team of specialist sales and factory trained service personnel throughout Australia. The combined experience of this team ensures that Rheology Solutions are able to provide their customers with access to the products to ensure that the right technical support and service is provided.

The product range exclusively available includes:

- **Materials Testing Equipment**
Rotational viscometers, compact viscometers, freeze/thaw units, shrinkage cones and shrinkage/expansion units.
- **Polymer Testing Instruments**
Micro compounders, torque rheometers, mixers and extruders, chill rolls and winding units, film quality scanning systems, pellet scan system, powder testing system, melt analysis and testing system, optical online quality control mini calendar, stretch roll and winder system, measuring extruder, APLAIRS - online control of cast or blown film, film quality testing system, wide web inspection system, sample testing unit, polyester resin online analysis, pellet analyser, pellet shape and size distribution unit.
- **Process Rheometers**
Melt flow indexers, automated melt flow indexer, continuous melt flow indexer.



- **Process Viscometers**
Sensors for low, medium, high, very high viscosities and custom designed sensors.
- **Rheometers**
Controlled rate, dynamic oscillation, controlled stress, modular
- **Temperature Control**
Immersion circulators, bridge circulators, open bath circulators, shaking water bath, heating circulators, refrigerated circulators, cryostats, immersion coolers
- **Twin Screw Extruders**
Twin screw compounding equipment for laboratory through to production applications
- **Viscometers**
Falling ball, battery operated, rotational for QA or QC applications, micro viscometers

We look forward to discussing your requirements.

Focused on providing our **customers** with materials characterisation **solutions** through knowledge, experience and support.

Applications Laboratory

Rheology Solutions has invested in a fully equipped applications laboratory to further increase the level of customer focus and application support.

Specialist contract testing services are available and contracts can be tailored to suit discrete tests or protracted testing requirements involving a series of tests over a period of weeks or months.

The key areas of responsibility for Tim incorporate:

- Technical support for new and existing Rheology Solutions customers.
- Customer method development & validation.
- Customer training covering rheology theory and practice.
- Development and facilitation of rheology seminars and workshops.

Rheology Solutions has invested in a fully equipped applications laboratory to further increase the level of customer focus and application support. The appointment of our technical manager and the laboratory facilities has proved to be a great asset to new and existing customers. These initiatives are providing a valuable resource to the growing customer base within the field of rheology and material characterisation.

Instruments & Equipment in the Applications Laboratory

The Rheology Solutions applications laboratory is equipped with a comprehensive range of equipment and instruments to meet the requirements of material characterisation. The equipment and instruments currently available are:

- Haake RheoStress RS80 – controlled stress rheometer.
- Haake RheoStress RS150 - controlled stress rheometer.



Tim Kealy *setting the zero point on the RheoScope*

- Haake RheoStress RS6000 - modular, high temperature controlled stress rheometer.
- Haake CaBER 1 - Capillary Breakup Extensional Rheometer.
- Haake Melt Flow Indexer.

This combination of instruments and equipment allows the testing and definition of the material properties of most solids and liquids. In this way Rheology Solutions can provide unparalleled expertise and customer advice for sensible instrument and sensor selection as well as consultation and test procedure development.

This range of on-site instrumentation also permits Rheology Solutions to undertake comprehensive contract consulting and sample testing across most applications.

The precision and reliability of all data collected during testing is examined through multiple tests and comparison and dissemination of all data collected is passed to the relevant parties.



The continued reliability of our instruments is ensured through a schedule of regular maintenance and calibration checks, using calibration oils and weights for the fluid and solid testing instruments respectively.

Contract Testing Services

Specialist contract testing services are also available and contracts can be tailored to suit discrete tests or protracted testing requirements involving a series of tests over a period of weeks or months.

Contract testing services specifically for industrial applications is available. A range of comprehensive data can be provided for:

- Liquid properties.
- Creep & recovery tests.

- Viscoelastic moduli.
- Flow curves.
- Yield stress.
- Viscosity curves.
- Extensional properties including:
 - Apparent extensional viscosity.
 - Time to break-up of strands.
 - Extensional constants.
- Concentration and temperature profiles.
- Effects of particle size distribution.
- Effects of additives and viscosity modifiers.
- QA/QC for optimal processing.

These tests will provide valuable information for process design, modification and control. Test results can be provided simply as data files or supplied with complete interpretation and recommendations.

Additionally, Rheology Solutions can facilitate testing at the overseas suppliers laboratories when required.

Focused on providing our **customers** with materials characterisation **solutions** through knowledge, experience and support.

Materials testing for manufacturing and industrial applications



T.Kealy,
Technical Manager
Rheology Solutions Pty Ltd

Unit operations commonly encountered in today's industrial sectors include mass transfer operations such as pumping, mixing, extrusion, pouring and filling, as well as storage and final use. For liquids, optimising the efficiency of the processes and the quality of the final product invariably relies on the flow properties of the processed fluid. Energy consumption by pump or mixer motors, pressure drop in piping, the shape, stability, and quality of final products is dictated in large part by the rheological behaviour of the processed fluid. Fluid related issues like sedimentation, flotation, time related structural decay or build-up and in cases where a solid-like product eventuates, post-solidification issues like strength of compression and extension are rheology based phenomena. These phenomena depend on rheological parameters such as viscosity, viscoelasticity, creep and recovery, thixotropy and yield stress, and solid material properties such as behaviour under various loading conditions. Liquid extensional properties influence processes or phenomena such as pouring, filling, tack, misting etc, where stranding occurs, influencing time, quality or energy requirements.

The Rheology Solutions applications laboratory has state of the art equipment, capable of measuring the above parameters, and of providing interpretation of the results where necessary. Laboratory equipment includes sensitive, specialised, modern

instrumentation and sensor systems, for measuring complex or difficult fluids such as those with low viscosity, or those with a solid phase, or highly elastic liquids. Solids performance according to various international standards can also be monitored.

Information such as shear viscosity curves, thixotropic behaviour and flow curves may be obtained for interested clients. Additionally, of importance to industry, when scientifically assessing changes in flow behaviour due to temporal or ingredient issues, viscoelastic moduli as a function of either shear rate or strain can be assessed. Structural changes under very low shear (like in the case of storage, gravity settling, cure etc) or very high shear (pumping, mixing, filling etc) are possible using the advanced equipment and sensors available at the laboratory of Rheology Solutions. These measurements may be obtained as a function of temperature, concentration, or to monitor the effects of changes in modifier/ingredient concentration.

With this information the scientist or engineer may change the process, or design new unit operations or products to maximise the potential benefits to be obtained from the physical properties of the processed fluid.

Rheology Solutions is pleased to provide this information to interested parties, and to make our rheological expertise available. Our range of testing and interpretation services is further supported by customised workshops, training and seminars to cover the needs of individuals, businesses or industry sectors, covering introductory, intermediate or advanced theory and practice of rheology. This can be supplemented by application specific workshops.



Applications Laboratory Instruments, Liquid Testing

(as at July 2010)

| Instrument: | CaBER1 | RS6000 | RS150 | RS80 | VT550 | VT6/7 |
|---------------------------------------|--------|--------|-------|------|-------|-------|
| Measurement Technique: | | | | | | |
| Controlled Rate (CR) measurement | NO | YES | YES | YES | YES | YES |
| Controlled Stress (CS) measurement | NO | YES | YES | YES | NO | NO |
| Step Strain (Extensional) measurement | YES | NO | NO | NO | NO | NO |

Commentary

The CaBER1 is a capillary break-up extensional rheometer. CS measurements allow a variety of tests to be performed, which are not possible on CR units, these include measurement of G' and G'' , and complex viscosity, but also the most precise yield stress measurements can be made using CS measurements only.

Measuring Geometries:

| | | | | | | |
|----------------|-----|-----|-----|-----|------|-----|
| Plate & Plate* | YES | YES | YES | YES | YES* | NO |
| Cone & Plate* | NO | YES | YES | YES | YES* | NO |
| Cup & Bob | NO | YES | YES | YES | YES | NO |
| Vane | NO | YES | YES | YES | YES | NO |
| ASTM D4287-88 | NO | NO | NO | NO | NO | YES |
| Capillary | NO | NO | NO | NO | NO | YES |

Commentary

(*) VT550: Extra fixtures are required, and computer controlled closing of the geometry is not possible.

Test Types:

| | | | | | | |
|-------------------|----|-----|-----|-----|----|----|
| Oscillatory Tests | NO | YES | YES | YES | NO | NO |
|-------------------|----|-----|-----|-----|----|----|

Commentary

Oscillatory tests allow a range of amplitudes and/or frequencies of oscillation, for both destructive and non-destructive testing.

| | | | | | | |
|-------------------|-----|-----|-----|-----|-----|-----|
| Rotational Tests | NO | YES | YES | YES | YES | YES |
| Creep/Recovery* | NO | YES | YES | YES | NO | NO |
| Extensional Tests | YES | NO | NO | NO | NO | NO |

Commentary

* This measures the extent of, and time taken for, structural recovery to be measured.

Information:

| | | | | | | |
|--------------------------|-----|-----|-----|-----|-----|----|
| Yield Stress | NO | YES | YES | YES | YES | NO |
| Thixotropy | YES | YES | YES | YES | YES | NO |
| Flow Curve* | NO | YES | YES | YES | YES | NO |
| Viscosity Curve* | YES | YES | YES | YES | YES | NO |
| Elastic Modulus, G' # | NO | YES | YES | YES | NO | NO |
| Viscous Modulus, G'' # | NO | YES | YES | YES | NO | NO |



Commentary

- (*) VT6 and VT7 are ASTM D4287-88 units, they can only measure 'true' viscosity or flow curves for Newtonian fluids. Non-Newtonian fluids give comparative data only. The CaBER 1 measures apparent extensional viscosity, not shear viscosity as measured by rotational instruments.
- (#) G' & G'' are critical for measuring structural changes over time, eg gelation/decomposition, without disturbing the internal structure of the sample.

| Instrument: | CaBER1 | RS6000 | RS150 | RS80 | VT550 | VT6/7 |
|--------------------|---------------|---------------|--------------|-------------|--------------|--------------|
| Useful for: | | | | | | |
| QA/QC | YES | YES | YES | YES | YES | YES |
| R&D | YES | YES | YES | YES | NO | NO |

Commentary

The rotational instruments are documented in order of decreasing sensitivity and operating window size. The RS6000 is the most sensitive of these instruments with the largest operating window. The VT6/7 is the least sensitive of these instruments with the smallest operating window.

| | | | | | | |
|----------|----|----|----|----|-----|-----|
| Portable | NO | NO | NO | NO | YES | YES |
|----------|----|----|----|----|-----|-----|

Commentary

RS6000 and RS150 weigh 40kg, VT550 and VT6/7 are portable on their own, but refrigerated circulator & laptop are recommended for all units.

Other:

| | | | | | | |
|---------------------------------|------|-----------|-----------|---------------|----------|-----|
| Precision* | HIGH | VERY HIGH | VERY HIGH | HIGH/MODERATE | MODERATE | LOW |
| Temperature Control necessary | YES | YES | YES | YES | YES | YES |
| Clean & Dry air necessary | NO | YES | YES | YES | NO | NO |
| Controlled closure of geometry# | YES | YES | YES | YES | NO | NO |

Commentary

- (*) The RS6000, RS150 and RS80 have air bearings, allowing higher sensitivity for all measurements.
- (*) The VT550 has a mechanical bearing (low friction), but not essentially frictionless like RS units.
- (*) The VT6/7 have mechanical bearings (higher friction than the VT550).
- (#) This feature is critical to reduce the disturbance to the sample, and to help repeatability since manual closure of the gap for thixotropic fluids results in variable initial strain on the sample.

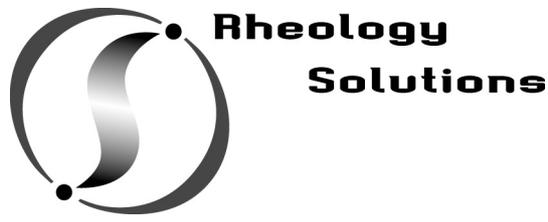
KEY:

The equipment in the applications laboratory is a combination of last and current generation viscometers and rheometers. These instruments are widely in use for R & D through to QA & QC applications.

The CaBER 1 Capillary Break-Up Extensional Rheometer measures extensional properties which govern filling, spatter, misting, fibre spinning and other processes, which have an elongational or extensional component.

The RheoStress (RS) 80, 150 and 6000 controlled stress rotational rheometers measure shear and dynamic properties which govern pumping, stirring and other processes where the acting forces are shearing the fluid.

The ViscoTester (VT) 550 and 6/7 viscometers measure shear properties only, which govern the viscous part of pumping, stirring and other processes where shearing forces act on the fluid.



Contract Testing Request Form

Date: Confidentiality Agreement Required Yes No
Name:
Company:
Phone Number: Area Code: State:
Email Address:

REASONS FOR TESTING

Sample Characterisation
 Process Development / Problems
 Other:

INFORMATION WILL BE USED BY

QA
 R&D
 Productions

PROCESS INFORMATION

If there is a problem, how does it manifest itself?

(Please provide basic process details before, during and after point of detection)

SAMPLE INFORMATION

Samples Name / ID:
No. of Samples:
Corrosive: Yes No Toxic: Yes No
pH:
Particle Size Distribution:
Concentration *(solids / polymer / ionic etc.)*:
Other:
Is an MSDS Sheet included for each different sample? Yes No
Special Disposal Requirements? Yes No
If Yes, Details:

Samples Name / ID:

Sample Handling / Storage: (eg. refrigeration, temperature, mixing, shelf life, air tight etc.)

Sample Preparation for Testing: (eg. pH, mixing, other additives, ingredients, temperature etc.)

Cleaning Requirements: (eg. solvent, detergent, water etc.)

CURRENT TESTING PROCEDURES:

Is there an existing test procedure available? Yes No

Is a copy of the test procedure attached? Yes No

Are test results for this product attached? Yes No

TESTING / RESULTS REQUIRED:

| |
|-------|
| |
| |
| |
| |
| |

DISSEMINATION OF RESULTS:

- | | |
|--|---|
| <input type="checkbox"/> Data Only | <input type="checkbox"/> Interpretation & Recommendations |
| <input type="checkbox"/> Data & Interpretation | <input type="checkbox"/> Other eg: Presentation |

COMMENTS:

| |
|-------|
| |
| |
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| |

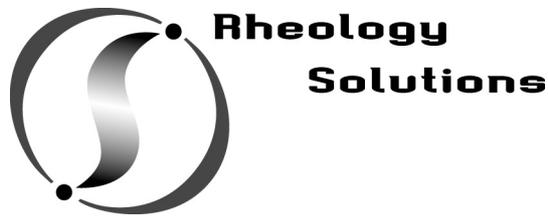
NOTE:

We will advise within 48 hours of receipt of this form if further information is required. Additionally, we will provide an overview of the work we would carry out including an estimate of the projected time scale and associated fee. Any costs associated with special sample disposal requirements will be paid and arranged by the client.

Customer Signature:

Request Submitted by:

We suggest you submit this form by fax 03 5367 6477



Sample Testing Request Form

Date: Confidentiality Agreement Required Yes No
Name:
Company:
Phone Number: Area Code: State:
Email Address:

DATE REQUIRED BY

Urgent - 1 Week Low Priority - 3 Weeks
 High Priority - 2 Weeks Other:

REASONS FOR TESTING

Instrument Evaluation / Recommendation
 Other:

INFORMATION WILL BE USED BY

QA
 R&D
 Productions

PROCESS INFORMATION

If there is a problem, how does it manifest itself?
(Please provide basic process details before, during and after point of detection)

SAMPLE INFORMATION

Samples Name / ID:
No. of Samples:
Corrosive: Yes No Toxic: Yes No
pH:
Particle Size Distribution:
Concentration (*solids / polymer / ionic etc.*):

Samples Name / ID:

Other:

Is an MSDS Sheet included for each different sample? Yes No

Special Disposal Requirements? Yes No

If Yes, Details:

Sample Handling / Storage: *(eg. refrigeration, temperature, mixing, shelf life, air tight etc.)*

Sample Preparation for Testing: *(eg. pH, mixing, other additives, ingredients, temperature etc.)*

Cleaning Requirements: *(eg. solvent, detergent, water etc.)*

CURRENT TESTING PROCEDURES:

Is there an existing test procedure available? Yes No

Is a copy of the test procedure attached? Yes No

Are test results for this product attached? Yes No

DISSEMINATION OF RESULTS:

- | | |
|---|---|
| <input type="checkbox"/> Data Only | <input type="checkbox"/> Interpretation & Recommendations |
| <input type="checkbox"/> Data & Interpretation | <input type="checkbox"/> Other eg: Presentation |
| <input type="checkbox"/> Report to Customer | <input type="checkbox"/> PDF of Report |
| <input type="checkbox"/> Report to State Distributor/Office | <input type="checkbox"/> Hard Copy of Report |

COMMENTS:

NOTE:

We will advise within 48 hours of receipt of this form if further information is required. Additionally, we will provide an overview of the work we would carry out including an estimate of the projected time scale and associated fee. Any costs associated with special sample disposal requirements will be paid and arranged by the client.

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