ALPHA
TECHNOLOGIES

# ARC 2020

## Capillary Rheometer

## Direct measurement of high shear rate viscosity

*With accurate die swell data*

- Advanced material characterisation for Extrusion and Injection Moulding
- Invaluable for Process Development, Mould Design and Mould Flow


The First Name in Testing Solutions

# Overview

**The ARC 2020 Capillary Rheometer has been specifically designed for the Rubber and Thermoplastic Rubber Industries, and provides direct measurement of high shear rate viscosity, appropriate for QC/QA and development testing**

- 12.7mm dia barrel for easier loading
- High piston force 15kN max
- Advanced material characterisation for Extrusion and Injection Moulding
- Ideal for QC, QA and Development
- Direct measurement of viscosity and die swell at high shear rates
- Shear Rate range: 1 – 29,000 $s^{-1}$
- Laser micrometer for die swell measurement
- Viscosity measurement over a 2 decade shear rate range in 10 minutes
- Invaluable for Mould Design, Mould Flow, and Process Development
- Temperature Range
  50°C - 350°C (122°F - 662°F)


# ARC 2020 benefits

The major shaping operations carried out in rubber processing include:

- Calendering
- Milling
- Extrusion
- Molding
  - Compression
  - Transfer
  - Injection

To optimize the processing conditions for a given batch of feedstock, the processability of the compound needs to be determined prior to processing.

Alpha Technologies have developed the ARC 2020 to provide rubber processors with the information required to optimize the processing conditions, for a specific production batch, thus maximize process efficiency and minimize scrap and process down time.

# Major features

## Flexible design

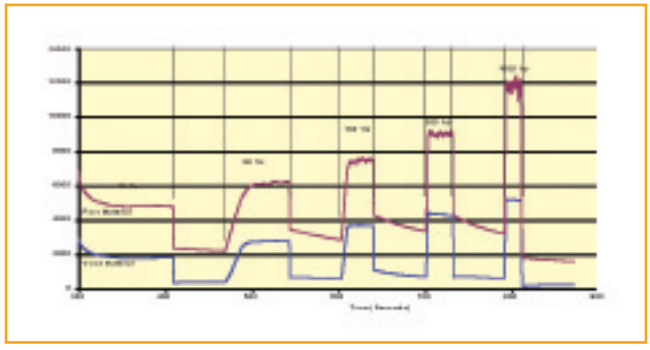
Interchangeable dies allows performance to be tailored to the application

- Die Diameter: 0.75mm to 2.0mm
- Die Length/Diameter Ratio: 15:1 to 30:1

| Application | Die Diameter | Shear Rates* |
|---|---|---|
| Injection Molding | 0.75 mm | 2 to 29,000 1/s |
| Transfer Molding | 1.00 mm | 1 to 14,000 1/s |
| Extrusion | 1.50 mm | 0.2 to 4,000 1/s |
| Mixing | 2.00 mm | 0.1 to 1,700 1/s |

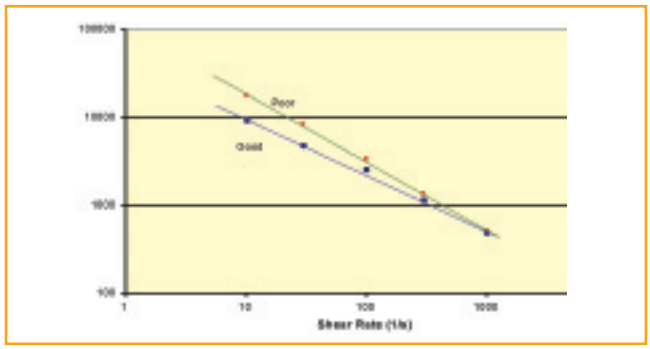
## Effect of Increasing Shear Rate

Increasing shear rate can differentiate between batches of compound. As can be seen below, two batches of compound show very different response to increased shear. The differing viscosity resulting from the increased shear will cause the compounds to 'process' differently.



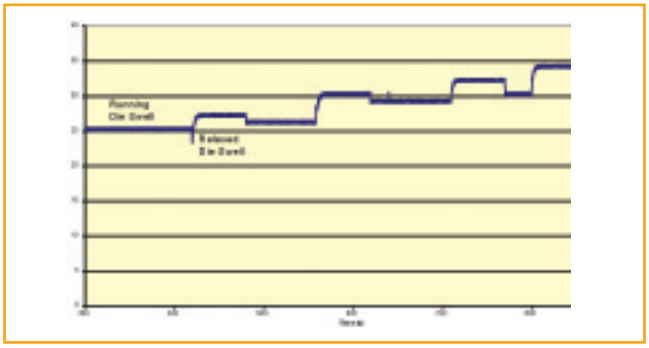
## Viscosity & Die Swell vs Shear Rate

Viscosity reduction with increased shear rate (shear thinning) influences the processability of compounds. The ARC2020 differentiates 'good' and 'bad' compound in a simple, quick test.




## Die Swell Effects

Die swell can be measured under running and relaxed conditions. Running die swell influences the speed of extrusion/calendaring process, while relaxed die swell predicts component dimensions.



Sample smoothness predicts component finish.

Good Fair Poor

# LAB KARS for Windows™ Software

LAB KARS software is a powerful and easy to use rheological Windows™ based software package. It can easily accommodate routine calculations and plotting requirements for rheological analysis of capillary rheometer tests of rubber and thermoplastic materials. Alpha Technologies software can be used to quickly identify viscosity variations in batches and lots of materials. The program features Bagley and Rabinowitsch corrections, Carreau, Modified Cross, Power Law and Polynomial curve fits, Statistical error estimations, Shear rate dependence, Time at temperature relationships, critical shear stress, zero shear viscosity, and Intrinsic viscosity calculations.

## LAB KARS Software for control and analysis

- Configure tests; Calculate results
- Plot rheological charts
- Bagley, Rabinovitch corrections
- Includes theoretical rheological models (eg. Carreau)

# Specifications

| | |
|---|---|
| **Standards** | ASTM D5099 |
| **Barrel** | l = 229 mm (9.0")<br>Dia. = 12.70 ± 0.005 mm (0.500 ± 0.0002") |
| **Drive System** | DC Servomotor |
| **Piston Speed** | 0.03 to 600 mm/min., Resolution 0.01 mm/min.<br>(0.001 to 23.6 in./min.) |
| **Crosshead Force** | 15 kN Standard |
| **Force Measurement** | Load Cell, Piston; Barrel mounted transducer,<br>automatic calibration |
| **Piston Force Range** | 0 – 15 kN ± 0.5% (0 – 3370 lbs.) |
| **Barrel Pressure Transducer** | 0 – 70,000 kPa ± 0.5% (0 – 10,000 psi) |
| **Capillary Dies** | Standard, (one) Stainless Steel die from list below:<br>0.75 mm (0.030"), 30:1 L/D<br>1.00 mm (0.040"), 30:1 L/D<br>1.50 mm (0.060"), 20:1 L/D<br>1.50 mm (0.060"), 15:1 L/D<br>2.00 mm (0.080"), 16:1 L/D |
| **Die Swell Measurement** | Laser Micrometer (± 0.03 mm) |
| **Temperature Range** | 50°C - 350°C ± 0.2°C (122°F - 662°F) |
| **Electrical** | 115 VAC ± 10%, 60 ± 3 Hz, 10 amp Single Phase<br>230 VAC ± 10%, 50 ± 3 Hz, 5 amp Single Phase |
| **Data Processing System** | LAB KARS for Windows™, includes PC with Windows XP |
| **Dimensions** | Width 47 cm (18.5 in.), Depth 56 cm (22 in.),<br>Height 195 cm (76.8 in.) |
| **Weight** | Net 136 kg (300 lb) Gross 160 kg (350 lb) |

## Summary of features

- **Unique rubber testing features:**
  - Easy loading 12.7mm (0.5") dia. barrel
  - Force, pressure transducers at piston top, die entrance
  - High maximum crosshead force = 15 kN (3,370 lbs.)
  - High maximum barrel pressure = 70,000 kPa (10,000 psi)
  - LAB KARS software for analyzing both rubber and thermoplastic test results
  - Extra length 229 mm (9") barrel for preheating rubber
- **Capable of measuring viscosity over a 2 decade shear rate range in a multi-zone test of less than 10 minutes:**
  - 100 – 10,000 $s^{-1}$ with a 0.75 mm (0.030") dia. die
  - 30 – 3,000 $s^{-1}$ with a 1.0 mm (0.040") dia. die
  - 10 – 1,000 $s^{-1}$ with a 1.5 mm (0.060") dia. die
  - 3 – 300 $s^{-1}$ with a 2.0 mm (0.080") dia. die
  - Wider shear rate range available with longer test times

For additional information on Alpha Technologies products please contact:

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