# From Concepts to Success


## SWING RHEO

**Unattended Automated Viscosimetry & Rheology**

The Viscosity and Rheology Workflow

Software & Workflow Templates

Platform Configuration for the Workflow & Deck Layout

Robotic Tools

Software and Hardware Integration

CHEMSPEED® TECHNOLOGIES

# Unattended Automation for Viscosity & Rheology

## SWING RHEO

Viscosity and Rheology measurement is an important task to develop High Performance Formulations. Chemspeed has developed a High Output (High-Throuput & Quality) robotic platform for unattended Viscosity and Rheology measurement, including demanding Sample Preparation or while processing challenging formulations.

- Unique and versatile overhead viscosity and/or rheology tool enabling measurement in various kinds of sample vials and tubes or even while processing a formulation
- Within seconds, measure a new formulation directly in the formulation vessel or in an opened commercial vial, tube or bottle
- Flexible accomodation of various kinds of sample vials and test tubes
- Automated cleaning
- Self-contained working environment for safety and controlled atmosphere
- Controlled sample (T, rpm, phase, t) while processing
- Flexible upgrade with Chemspeed's exchangeable tools for e.g. gravimetric dispensing, color measurement, gloss measurement, pH measurement, tack-cure measurement, various homogenization tools, density measurement
- Execution of standardized protocolls from sample preparation to measurement, (continuous) adjustment
- In-line (continuous) viscosity adjustment while measuring

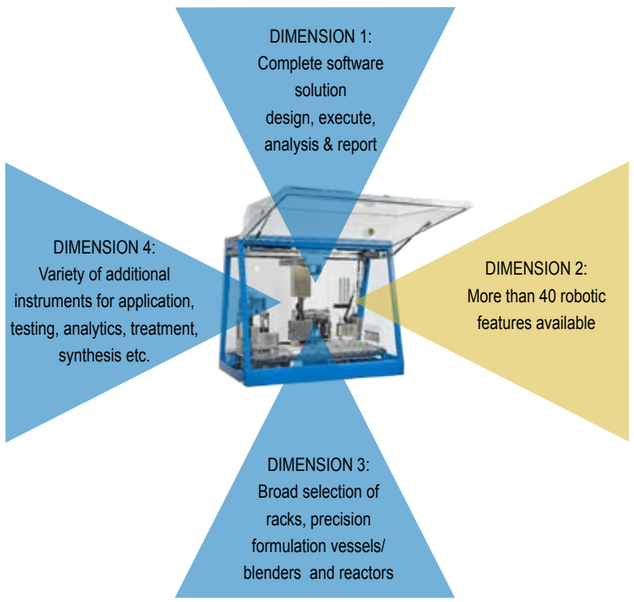
### Viscosity & Rheology Workflow

Chemspeed is able to generate precision viscosity and rheology data directly in any type of container (reactors, formulation vessels, commercial containers etc.).

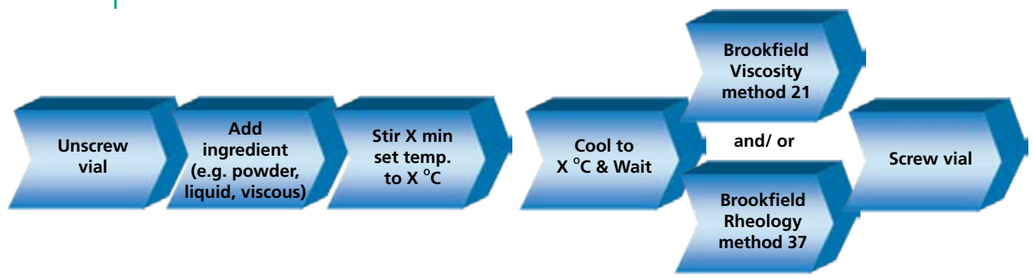
Chemspeed's *SWING RHEO* deck modularity together with Chemspeed's exchangeable robotic tools allow the user to perform flexible fully unattended viscosity and rheology measurement combined with all other features and tools Chemspeed offers.

**(Modularity & Flexibility)$^4$**

4 dimensions




### Example Workflow




*SWING RHEO*


**No shearing effect by reformatting - Overhead direct measurement**

Fast

Standardized

Flexible

Enabling

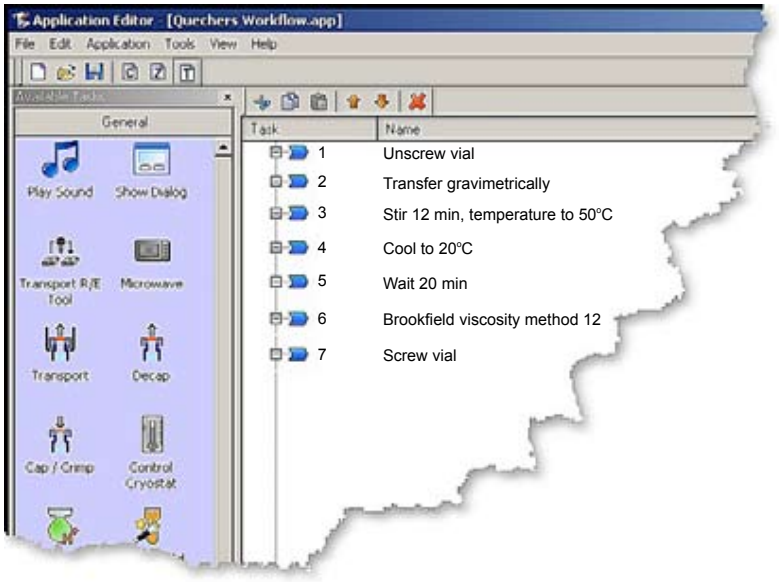
Cost-Effective

## Software & Workflow Templates

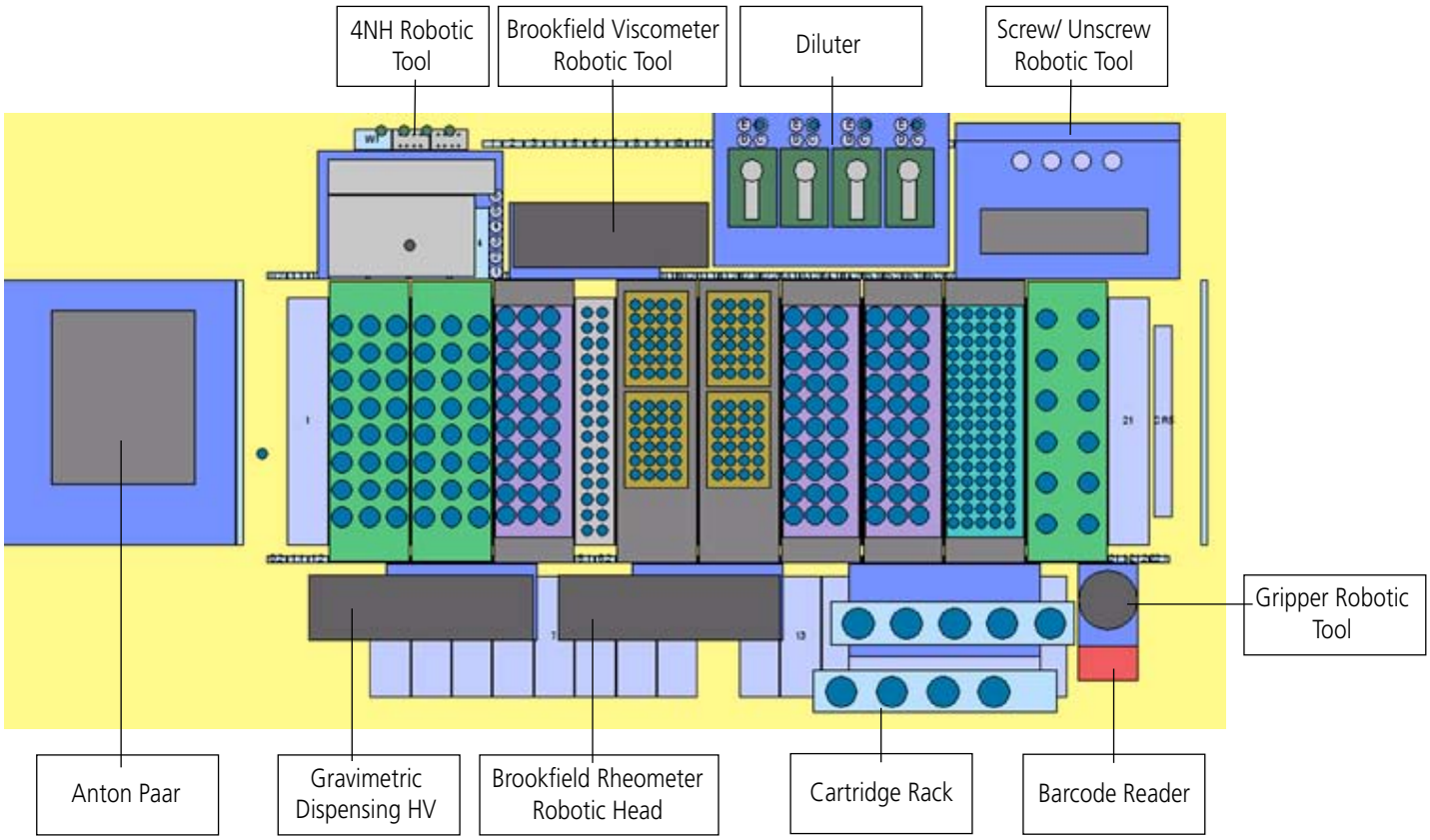
*AutoSuite* **SWING** is an intuitive user interface software which allows easy programming of workflows. Many features such as the gravimetric dispensing steps or viscosity measurements are automatically calibrated, eliminating tedious optimization steps and user intervention.

- The AutoTeaching tool allows dispensing of powders, liquids, viscous liquids, and waxes without manual optimizing steps, and with high precision, accuracy and speed
- Easy programming: drag-and-drop workflow steps or just execute standard workflow protocols
- Barcode tracking
- Smooth integration into virtually any LIMS or ELN software
- AutoSuite Application Programming Interface (API) for 3rd party software and hardware integration
- Optional, Chemspeed VLab for DoE and Data Analysis/Reporting

### Exemplary Workflow Template in the AutoSuite User Interface & Executor




## Exemplary Platform Configuration for the Workflow & Deck Layout



## Three possibilities for High Throughput Viscosity and Rheology Measurement tools (any combination is possible)

### Technical Details of the three Viscosity & Rheology possibilities

#### (a) Brookfield Viscometer RVDV-II+ Pro BK
(integrated in a Chemspeed robotic tool)

- Range: 100 - 40'000'000 mPa·s (cP)
- Speed range: 2'000 - 64'000 rpm
- No of Increments 20'000 - 512'000
- Accuracy: +/- 1%
- Reproducibility: +/-7 - 0.2%
- On-line display
- Temperature range: -70°C to +220°C, depending on deck configuration

#### (b) Brookfield Rheometer RS
(integrated in a Chemspeed robotic tool)

Chemspeed has choosen the Coaxial Cylinder measurement geometry in order to be in a position to measure in-line; for example in a formulation vessel or open a commercial vial and subsequently measure directly in the original vial.

- Torque Range: 0.05 - 50 mNM
- Speed range: 0.7 - 800 rpm
- temperature range: -20°C to +180°C
- Viscosity range: 1 - 30'000'000 mPa·s
- Shear stress range (depending upon Spindle Geometry used): 0 - 34833 Pa

Additional features and benefits to Automation:

- Integrated software
- Program by controlled stress and rate
- Multistep test programs
- Calculation of average viscosity, thixotropy, and yield stress
- Data processing with mathematical models
- Automated analysis of user defined values for QC
- On-line plotting, color printing
- Import of sets of test parameters, generate template programs of parameters (speed, time of measurement, etc.)
- Export data along with experimental data sets of choice to Excel, Chemspeed's Workflow Management Software, VLab or virtually any other database
- On-line display
- Automated and constant z-movements of the Rheometer (e.g. to penetrate a sample well defined and reproducible)
- Measurement with in-line constant delta time between virtually any action (e.g. open vial) and viscosity measurement, controlled humidity, controlled temperature etc.)
- Time coupled measurements (e.g. overnight)
- One measurement and adjustment at a time
- Viscosity control and adjustment through conditional tasks
- Washing installation for the viscosity probe (Passive or Active washing bath)
- Disposable measurement cartridges
- Export data as viscosity in cP or Pa·s, temperature, speed, Spindel type, time of measurement
- Temperature controlled measurement

#### High Output Anton Paar Rheometer
(Chemspeed's robotic platforms are interfaced with Anton Paar Physica MRC rheometer series)

- Consistent, uniform sample preparation, ease of use and avoidance of operating errors
- Measuring parameters, sample data, analysis methods and analysis results are transferred to a monitoring database in Chemspeed's AutoSuite Workflow Management software
- Identified samples via 2D (or 1D) datamatrix codes at the bottom of each sample cup
- Measurements are performed with concentric cylinder as well as with cone-and-plate and parallel geometries

**More than 40 robotic features are available for further platform upgrades (please refer to the following page)**

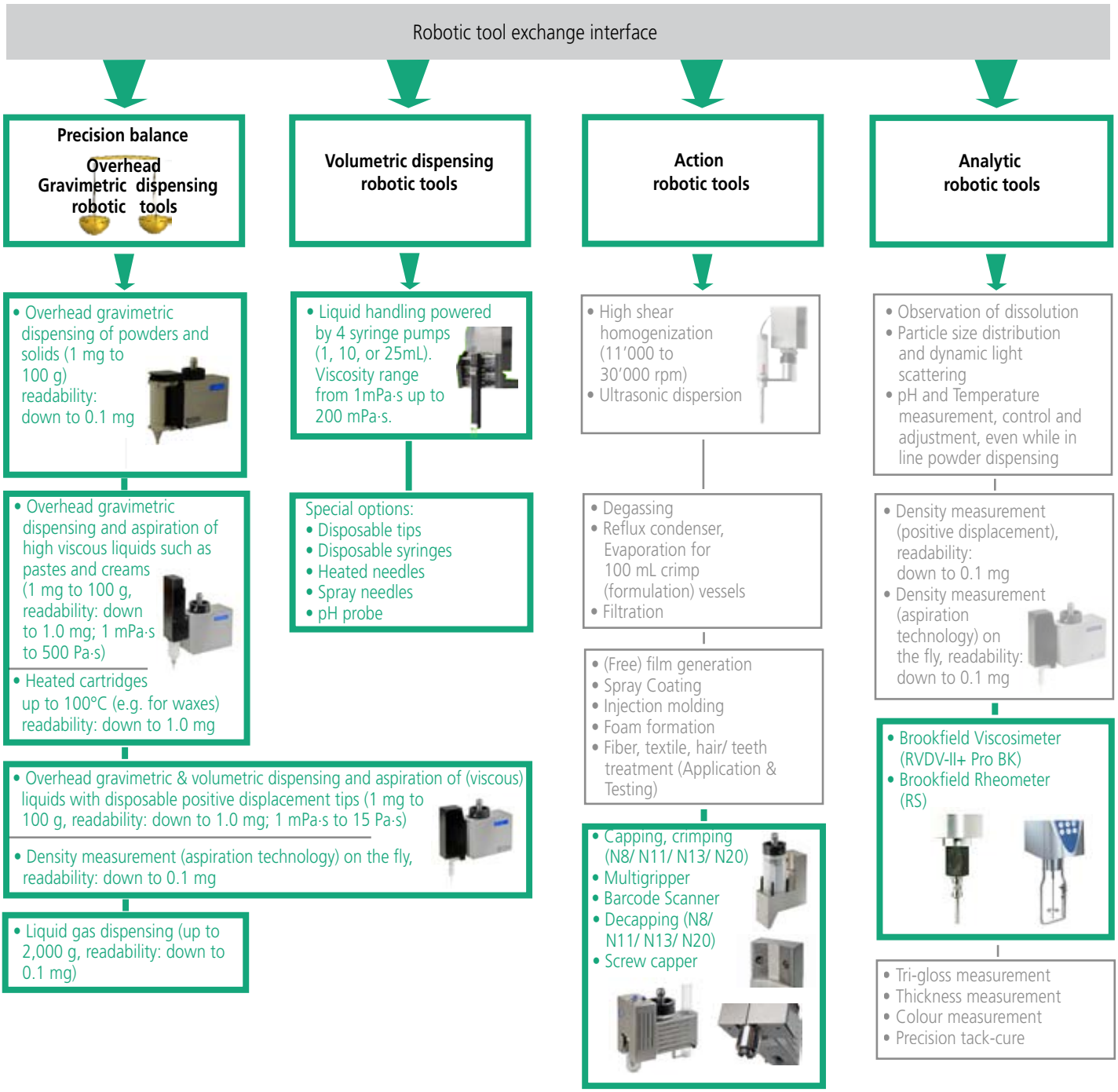
## Robotic Tools

**SWING RHEO is a software-driven robotic platform designed for high throughput viscosity & rheology measurements. The instruments' unique design accomodates several tools that can be automatically exchanged during a run.**

- SWING RHEO brings paradigm shifting modularity enabling an easy to use workflow task driven software
- Unique and versatile overhead viscosity and rheology tool for direct measurement in various kinds of sample vials and tubes or high performance formulation vessels, no reformatting needed and speed up of measurement after being executed a previous task to avoid error prone measurements
- The principle of exchangeable robotic tools has unique advantages and a variety of workflow sequences can be combined in a fully automated fashion: actions as solid dispensing or viscosity measurement (up to 40 functionalities) are brought directly to the formulation vessel, vials etc. , not the other way around; upgreadability at any time; enables automation of challenging workflows; off the shelf design of challenging workflows ...
- A large choice of hardware and software tools allow fine-tuned adaptation to your workflow

### Unrivaled Dispensing Technology and Exchangeable Robotic Tools

More than 40 tools can be integrated with Chemspeed's unique robotic tool exchange technology, including unrivaled overhead gravimetric dispensing tools which can operate whilst mixing, heating, refluxing and cooling.




## More than 40 robotic features are available for further platform upgrades

## Robotic platform

- Robotics: X, Y and Z arm with rotating alpha-axis and automatic tool exchange
- Optional heating/ cooling, shaking
- Controlled atmosphere: inert gas, with optional glove box
- Trolley
- Dimensions (l x d x h): 1480 x 910 x 1200 mm (4'4 3/8" x 3' x 3' 11 ¼" )*

* Dimensions when hood is closed (excluding peripherals, electronic cabinet and connectors)

SWING RHEO

## Software and Hardware Integration

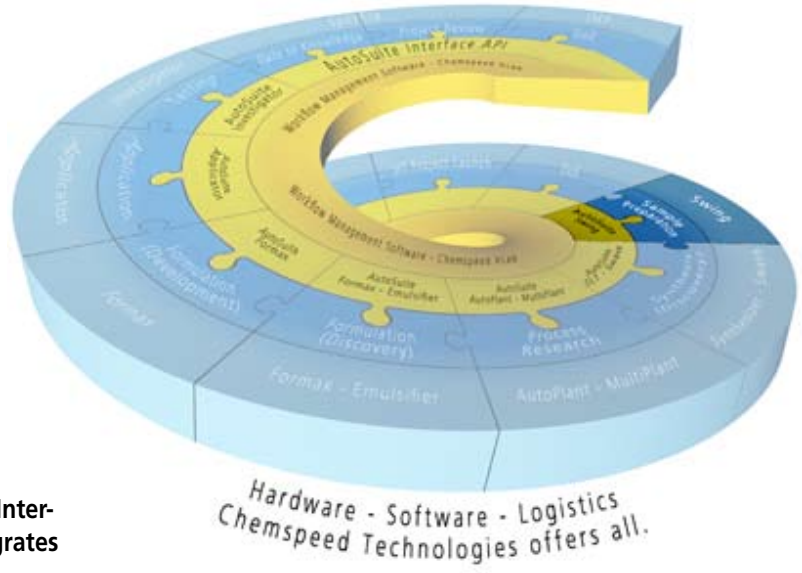
### Third party instruments

Chemspeed integrates a vast number of 3rd party components (e.g. in robotic tools). Please refer to Chemspeed's Worfklow Portfolio brochure and/ or contact your local Chemspeed representative for more information.

### Third party software such as

Integration into virtually any LIMS and ELN software

*Many upgrade options available: all tools and accessories of Chemspeed 's Sweigher, Swave, Synthesizer SLT II, Formax, Applicator and Investigator are fully compatible with the SWING RHEO robotic platform and vice versa (please refer to the workflow portfolio brochure and to Chemspeed's other workflow brochures for examples of modules).*




### High Output Product Development Spiral

**Chemspeed's AutoSuite, API (Application Programming Interface), and VLab (workflow management software) integrates with all Chemspeed High-Output robotic platforms:**

- Sample preparation platforms
- Array synthesis platforms
- Process research platforms
- Formulation platforms
- Application platforms
- Testing platforms

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