



Brabender® Auto-Grader®

Continuous In-Line Melt Index
and Film Quality Analyzer



... where quality is measured.



Your laboratory on the production site

The Brabender Auto-Grader continuously determines the quality characteristics (typically: MFI, MVR, optical properties) relevant to production practice. The complete machine control as well as the representation of the measured results are done fully automatically and continuously within seconds.

The Auto-Grader can be integrated in-line into a pellet conveying system or in bypass to a production extruder.



Film take-off part with Film Quality Analyzer

Auto-Grader

Features, application area

Due to the frequently high material throughputs in continuous production, continuous in-line quality control is essential in industrial production lines. With the Brabender Auto-Grader, product specifications like constant of a rheological power law, MFR and MVR values at different loads, transparency and purity of a film can be surveyed directly at the production site.

All acquired data can be shown and monitored in a control room of the production plant. Even the machine alarms or the film purity video line can be connected to the control room. Whenever inadmissible deviations are reached, a signal will be transmitted to the appropriate device.

The Auto-Grader adjusts itself automatically to different polymer grades. According to the needs, further in-line measuring systems can be integrated, e.g. a colorimeter or hazemeter. This combined system is suited for all main tasks of a production control.

Instrument description

The entire measuring system can be integrated into existing manufacturing lines - typically into the pellet conveying flow of a sampler.

The Auto-Grader comprises the following major components:

- 1 Feed hopper
- 2 Extruder (perpendicular to the plane of the picture)
- 3 Melt pump
- 4 Three stage slot capillary die head
- 5 Pressure transducers
- 6 Film Quality Analyzer (FQA)
- 7 Winder
- 8 Control panel
- 9 Control computer for the FQA

Principle

The standard Auto-Grader combines two different measuring systems:

- a continuous rheometer
- a continuous optical measuring system

An extruder transports the polymer melt towards the melt pump which feeds a rheological slot capillary die head.

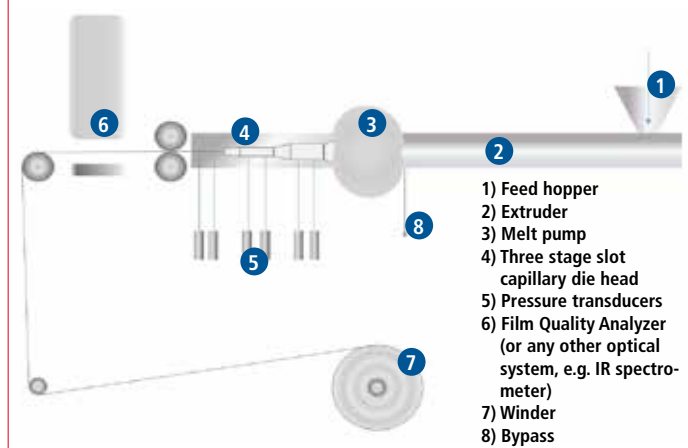
The principle of a rheometer is based on the direct measurement of the melt pressure drop in the die head. Unlike piston type capillary rheometers, the Auto-Grader is a dynamic system where the melt is conveyed to the capillary die

head by the extruder screw and a melt pump. As the die geometry is known and the pressure drop and volume rate are measured, the apparent shear rate and shear stress can easily be calculated. From these values, the software automatically derives the apparent viscosity, MFI or MVI within a few seconds.

The pressure/speed controller and an integrated bypass system allow for quick responses of the system to material changes and protect it from overload.

The film produced can be tested by different optical measuring systems.

Schematic of the machine architecture



Powerful software

In a production environment, (e.g. in continuous polyolefine synthesis), each production line can be monitored automatically by an Auto-Grader. All evaluation results, alarms, user actions, and control values of each Auto-Grader system are collected and stored in a central database. The evaluation results are memorized continuously together with the corresponding time.

Rheological values:

- MFI (MFR)
- Consistency factor
- Flow exponent
- Shear rates
- Shear stresses

Optical values:

- Degree of transparency in %
- Gels and black specks detected
- Each in up to 9 size classes
- Calculated per m² and as absolute values

The rheological results are available continuously every 10 s.

Furthermore, all measurable machine conditions like pressures, temperatures, and speeds are recorded and memorized continuously.

The Microsoft® Access database can be read and handled by most commercial office programs. The data viewer supplied together with the complete system can analyze this database graphically and in a tabular form. The corresponding software comprises functions like e.g. browsing through the histogram over a period of up to 40 days, archivation of the database, and correlation of related values.

All electronic components are mounted in a rack which meets the EMC requirements (IEC level II). This rack also comprises the uninterruptable power supply (UPS).

The Windows® desktop allows a quick survey of the measured data and evaluation results in a numerical and graphical form.

The software combines several measuring tasks under a single surface. A start-up procedure with self-diagnostics routine ensures highly comfortable operation.

If the Auto-Grader is equipped with optical inspection systems, the camera picture can be visualized on the monitor in full monitor size or reduced to window size or can be displayed on an optional second monitor. Different operating modes are possible:

- Visualization of the original picture
- Visualization of the evaluation picture
- Split screen

In split screen mode, the original picture, the evaluation picture, and horizontal and vertical grey values are shown. This combined information assures easy control of the measuring process of the Film Quality Analyzer. The split screen also shows the film position, sharpness adjustment, and the lighting conditions. Individual pictures can be stored and printed. There is a video output for an optional remote monitor, e.g. in a control room.

System management

The system manager can define any number of users with their passwords and user rights.

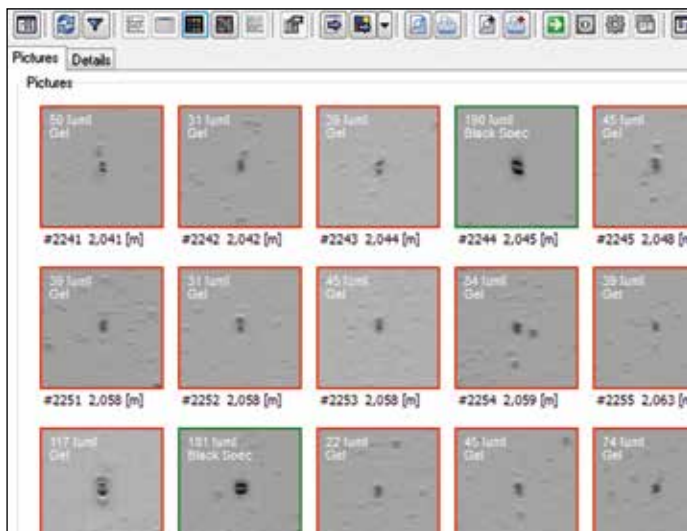
Each user can work on the system within his pre-defined particular access only. Thus, wrong operations are almost excluded, and training of the operating personnel can be reduced to the essence.

All user actions are logged in the database which allows a quick analysis and evaluation of the system state.

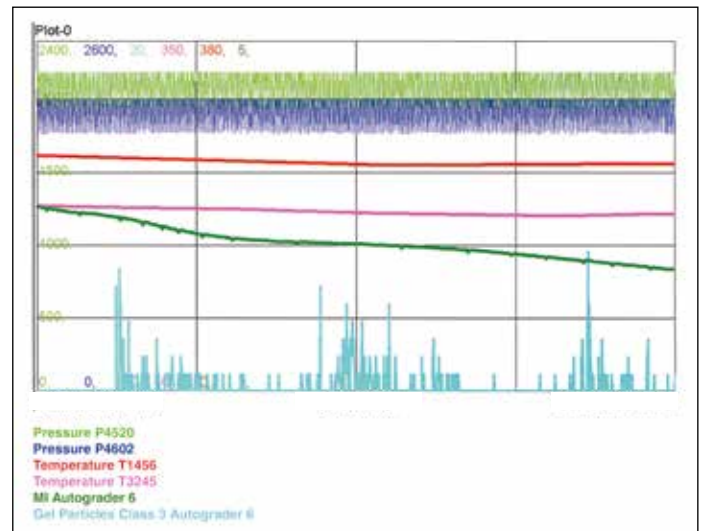
Networking

The easiest way of networking is by connecting a Windows® host computer, e.g. in the control room, to the integrated Ethernet port.

By means of a suitable network software (e.g. DECnet™-PATHWORKS), it is just as well possible to integrate the connected Auto-Grader systems via the Ethernet port into a heterogeneous network. This further reaching type of networking also allows correlation of process data (e.g. pressures, reactor temperatures) with the data obtained from in-line quality analysis. Furthermore, the system can be connected to a modern process control system via the serial port or the current circuit.



Separate film impurity visualization with indication of type, size, position, shape, and time



Graphical representation of extrusion process data, MFI and film impurity evaluation

... where quality is measured.

Auto-Grader

Alarm table

During continuous operation, alarms in case of malfunctions or anomalies are essential. Therefore, all alarms are handled in a special alarm table which is part of the database.

Alarms can be divided into the following two groups: hardware alarms (e.g. operating parameters, controllers, sampler, power supply) and evaluation alarms (exceeding of user-defined limit values).

These alarms are displayed and stored in detail together with the type of fault, time, actual value, and limit value. Some of the hardware alarms lead to automatic system corrections.

System diagnosis

A diagnostic routine is run each time the system is started. The monitor shows each individual step of this system check.

Optionally, the Auto-Grader can be equipped with a modem which allows for remote diagnostics and maintenance by Brabender.

The Auto-Grader system is designed for 24-hour operation and, therefore, needs very little maintenance. As the polymer melt runs continuously through the entire system and as there are neither any channels with an unfavorable geometry nor any dead corners, cleaning of the system is only necessary every 6 months as part of maintenance.

Maintenance by the Brabender 5-Star Service comprises an extensive system check in compliance with ISO 9000.

Auto-Grader	
Dimensions (W x H x D)	1900 x 1800 x 1000 mm (incl. monitor)
Weight	approx. 620 kg
Interface	Ethernet (standard), RS 232 (option) Current circuit (option) 1 x collective alarm 1 x video output 1 x connection for optional printer 1 x RS 232 for optional single-parameter measurement 1 x contact for sampler 1 x code for sampler
Connections	2 x water 1 x air, approx. 3 bar 3 x 400 V + N + PE, 50/60 Hz, 32 A

MFR Measurement with the Auto-Grader

Results	MFR, MVR, consistency factor, flow exponent
References	all loads admitted by ISO 1133
Working range	MFR 0.15 - 80 g/10 min (for 2.16 kg loading weight) others on request, max. 20,000 Pas
Reproducibility	according to ISO 1133

Film Purity Measurement with the Film Quality Analyzer

Results	Detection of impurities Differentiation between fish-eyes and foreign or burnt particles Measurement and documentation in size classes (graphically and numerically) Projection to m ² Degree of transparency
Particle size	Standard 25 µm Smallest detectable particle from 5 µm upwards Other resolutions on request



Brabender application laboratory

The Brabender support

Our state of the art application laboratory is always made available to our customers.

You can choose to send material to us for testing or schedule a specific Lab Trial with our expert team. In our application laboratory, you will have access to our full product line to help come to a solution for your application.



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