Feeding systems:
Principle sketch:

- Motor with gearbox
- Glass window
- Interchangeable feeding tube
- Closure for cleaning
- Extruder
- Standard hopper
Metering Feeder
Metering Feeder
**Application:**

- Accurate dosing of powder
- Accurate dosing of pellets
- Starved feeding to enable venting
- Starved feeding to reduce torque
- Production of masterbatches
- Feeding of parallel twinscrew extruders
Metering Feeder

Features & benefits:

• compact design: easy to handle
• wide feeding range
• various inserts: suitable for pellets and powder
• control box: speed control via Rheocord or manual speed control via potentiometer
• easy to combine with a second metering-feeder for controlled compounding
Single Screw Volumetric Feeder

- Agitator in Hopper Trough improves even flow of material to feed screw and maintains some distribution of feed materials
- Screw Designs for Powders or Pellets/Granules
- Wide Range of Feed Rates from 0.5 ft$^3$/hr to very high rates using feed screws 13mm diameter and larger
- Quick Dismantling design for easier cleaning and servicing
Single Screw Gravimetric Feeder

- Uses a balance to measure weight change of the feed hopper to control on absolute terms independent of material flow characteristics from day-to-day variations due to:
  - Particle size, Moisture, etc

- Improved Feeding Accuracy

- More practical when using multiple feeders to alter output rates and maintaining accurate formulations
Mini Twin Screw Feeder Volumetric/Gravimetric

- High accuracy for small feed rates
- Output rates from 0.05 kg/hr to 2.5kg per hour
- Required for twin screw extruders when a low percentage of filler is compounded feed downstream
- E.g. for Compounding of nano composite. (content of nanoclay, nanotubes 1-5%)

ThermoFisher Scientific

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Dosing (RotoTube) Volumetric Feeder

- Accurate dosing of pellets
- Very low dosing rates
- Color matching with masterbatch pellets on small twin screw extruders
### Force Feeder

#### Principle sketch:

- **Motor with stepless speed control**
- **Hopper**
- **Extruder Screw**
- **Extruder Barrel**
- **Force Feeding Screw**

#### Application:

- **feeding of sticky materials:**
  - food extrusion
- **feeding of bridge-building materials**
  - some PVC Dry Blends
- **feeding of not flowing material**
  - grinded film
  - soap powder
Single Screw Volumetric Stuffer Feeder
The vertical crammer feeder replaces the side feeder traditionally used in big scale extruders.

Advantage is the bigger area of the feed throat. Enables higher though put, when volumetric top feeding is not feasible.

Volumetric feeder is required.
 Extruder Application:
Cast film application

**Instruments:**
- HAAKE RheoDrive
- Extruder (single- or twin-screw extruder)
- Screws
- Sheet & ribbon die
- Sheet & ribbon take-off
- Pressure sensor
- (Screen package)
- (OQT 512)

**Application:**
- Small production of films
- Testing the processability
- Testing of additives
- Testing and optimisation of processing conditions

**Results:**
- Fish-eye testing
- Pigment distribution
- Surface quality
- Tensile testing
- Weathering
Sheet and Ribbon Die

- **Die width:**
  25/50/100/150 mm

- **Die gap:**
  adjustable
  (standard: 0.2-1.2 mm)

- fixed die gap on request

- **Max. temperature:** 360°C

- **1 measuring port**
PVC - Dies

- New PVC Slit dies 50mm, 100mm, Height 1mm
- Moldflow (FEM) Simulation
- Optimized Flow
- Compact design
Sheet and Ribbon Take Off

- polished and temperable steel rollers
- rubber rollers
- circulator
- waterbath
- Motor
- take-up roller
- adjusting the gap
Two Roll Haul Off Unit with optional Nip Roll assembly

- For Haake and Prism products
- 110 mm dia. Rolls for fast heat transfer 120 °C (option 200 °C)
- Options: 2 Roll Take Off or 3 Roll Take Off
- Easy access to the rollers
- Easy handling
- Height adjustable
- Adjustable speed ratio steel rollers to take-off rollers
- Optional winding unit
Cast film application

PVC sheets: good & bad
Cast film application
Blown film application

**Instruments:**
- HAAKE RheoDrive Extruder (single- or twin-screw extruder)
- Screws
- Blown film die
- Cooling ring
- Blown film take-off
- Pressure sensor
  (Screen package)
  (OQT 512)

**Application:**
- small production of films
- Testing the processability of compounds
- Testing of additives
- Testing and optimisation of processing conditions

**Results:**
- Fish-eye testing
- Pigment distribution
- surface quality
557-3175 Blown Film Die

- Ring diameter 25mm (35mm)
- Pin diameter 24mm (34mm)
- Gap width 0-0.8 mm
- Measuring ports 2
- Max. temperature 480°C
*PolyLab* blown-film combination

PolyLab System with extruder

Blown film take-off
PolyLab blown-film combination
The crystallization behavior of HDPE is different to PE (right) and required additional equipment.

Special HDPE set consists of 20 mm insert with optimized gap and a guiding cage (left).
PolyLab – “Fisheye Counter”
PolyLab blown film combination with OQT

With optical testing unit OQT

PolyLab System with extruder

Blown film take off

Lightning Device

CCD-Camera
Optical Quality Testing System

Measuring principle:

Lightning Device

Polymer film

CCD - Camera

Control monitor for CCD Video signal

Image processor

PC with evaluation software
Optical Quality Testing System OQT FS5

Technical data:

Camera: CCD Line Camera
Line length: 2048 pixels (standard)
Inspection width: 20 to 2000 mm
Resolution: from 10 µm

Number of size classes: 10
Detection levels: 3
(differentation of fisheyes and black specks)
Blown film take-off with built in camera system
OQT- Graphical display of defects

Defect Information Summary

- Number: 0
- Level: 0
- Pixel L0: 361
- Pixel L1: 0
- Pixel L2: 0
- Ratio: 1.00:0.00:0.00
- Diameter: 1893 µm
- Perimeter: 14072 µm
- Area: 938261 µm²
- Length: 5202 µm
- Width: 1807 µm
- Shape fact.: 16.74
- Elements: 5
- Min. Trans.: 0.0 %
- Mean Trans.: 27.4 %
- Status: In Limits

1893 µm
OQT- Graphical display of the data and defects
OQT- Graphical display of the data
Compounding

**Instruments:**
- HAAKE RheoDrive
- Rheomex twin-screw extruder
- Extruder Screw(s)
- Pressure sensor(s)
- (Screen package)
- Rod die (horizontal or vertical) or Multistrand die
- Waterbath
- Pelletizer

**Test results:**
- Testing of the processability of polymer compounds
- Testing of additives
- Testing and optimisation of processing conditions
- Small production of masterbatches
Application:
Universal die for extrusion tests
manufacturing of polymer strands for the production of pellets.
Nozzles available from: 1mm - 6mm
Two sensor ports for pressure- and temperature-measurement
557-3150 Vertical rod die

Application:
Universal die for extrusion tests
Manufacturing of polymer strands for the production of pellets.
Nozzles available from:
1mm - 6mm
Two sensor ports for pressure- and temperature-measurement
**Vertical rod die Application Example**

- **Application:**
  Universal die for extrusion tests, here testing of Processing additives (Dynamar) at *Dyneon (NL).*

- **Build up of non stick layer (right picture) improves the quality.**

- **The effect and concentration of the processing aid can be tested with various base polymers and temperatures.**

EPPM info nr. 34 6,3 / p12 (2004)
Applicaton: Universal die for extrusion tests with higher output

- manufacturing of polymer strands for the production of pellets.

- Strand diameter: 3 mm (others on request)
Compounding
Pelletizer, optional with VARICUT: adjustable length
Face-cut pelletizing
Rubber extrusion

**Instruments:**
- HAAKE RheoDrive
- Rheomex 104p or 203p
- Screw(s)
- Pressure sensor(s)
- Garvey die
- Conveyor belt

**Test results:**
- Testing of the processability of rubber and elastomer compounds
- Testing of the influence of additives
- Testing and optimisation of the processing conditions
- Visual testing of the material flow at edges with different angle
557-3230 Garvey-die

Technical data:
- Die profile according to ASTM 2230-63T
- Max. temperature: 360 °C
- Die profile does not allow to install sensor ports

Application:
- Extrusion of elastomers and rubber for testing the flowability.
Wire coating application

- **Instruments:**
  - HAAKE RheoDrive Extruder (single- or twin-screw extruder)
  - Screws
  - Wire coating die
  - Wire coating take off
  - Pressure sensor

- **Application:**
  - small production of cables
  - Testing the processability of compounds
  - Testing of additives
  - Testing and optimisation of processing conditions
Wire coating die

- di: 0.7 - 2.0 mm
- da: 0.8 - 4.0 mm
- Standard: 1.2 / 2.0 mm
- Max. temperature: 480°C
- Measuring ports 2
Wire coating Take Off

- Pulling roll (motor driven, rubber coated)
- Guiding roll
- Extruder
- Water bath
- Die
- Coated wire
- Uncouated wire
Fibre spinning

**Instruments:**
- HAAKE RheoDrive
- Rheomex extruder (single or twinscrew)
- Screw(s)
- (Melt pump)
- Pressure sensor(s)
- Screen package
- Fibe spinning die with spinning plate

**Test results:**
- Testing of the processability of polymer compounds
- Testing of additives at different formulations
- Testing and optimisation of processing conditions
- small production of polymer fibres
Application:
Fiber spinning

Technical data of spinning plate:
number of holes: 10
diameter: 200 µm
length: 0.5 mm
entrance angle: 60°
Meltpump: Principle

Extruder
MeltPump OS

- New fully CAN controlled MeltPump
- 3 integrated CAN Temperature controller
- Digital Servo Motor for high accuracy even at low speed (i.e. for accurate rate control for viscosity tests at low shear rates)
MeltPump OS

- Hand wheel for height adjustment
- Remote control for manual speed control
- Automatic speed control via monitor software & capillary software
MeltPump OS

External By-Pass Valve:

- MeltPump can be used with & without a By-Pass
- By-Pass can also be used independently from the MeltPump (i.e. for rheological tests with rigid PVC)
Screen life test

Instruments:
- PolyDrive with Rheomex252
- Melt pump
- Pressure sensor(s)
- Screen package
- Filter die

Test results:
- Testing the distribution of fillers and pigments in polymer compounds
- Pressure increase in front of the screen package
Measurement of the pigment distribution

Testing of the purity of polymers

Geometry of the Filterdie according to the new standard EN 13900-5 (draft)
Measurement of the pigment distribution
Testing of the purity of polymers
Suitable for different filter-dimensions
**Application:**

- Measurement of the pigment distribution
- Testing of the purity of polymers
Hydraulic screen changer
Hydraulic screen changer
Filter (screen life) test EN 13900-5 (draft)

Constraints:

Single Screw extruder: \( D = 19 - 30 \text{ mm}, L/D = 20 - 30 \)
- PolyDrive 252
Pressure at end of the extruder: constant at 30 – 60 bar
- via pressure feedback loop
Melt pump: 50 – 60 ccm/min
- Thermo Haake melt pump
Defined meltfilter:
- filter geometry according to EN 13900-5 proposal
Defined breaker plate geometry (free area of filter):
- die geometry according to EN 13900-5 proposal
Purge with 100g base polymer masterbatch.

Conditioning with base polymer.

Pressure increase in front of the filter package.

$P_{\text{max}}$  

$t_s$: Determination of base pressure $P_s$ and filling of the hopper with masterbatch mixture.

$t$: End of masterbatch mixture and filling of base polymer.

$t_e$: End of pressure measurement and evaluation of maximum pressure $P_{\text{max}}$.

Filter Test Software

Filter Test Software diagram with time and pressure measurements:

- $P_s$: Base pressure determination
- $P_{\text{max}}$: Maximum pressure measurement
- $P_{\text{max}} - P_s$: Pressure increase

Time and pressure data chart.
Filter Test: Calculation according EN 13900-5 (draft)

FPV = \frac{(P_{\text{max}} - P_s)}{m_c}

FPV (filter pressure value): Filter-Pressure-Value in bar per grams [bar/g]

\( P_s \): Starting pressure in bar

\( P_{\text{max}} \): Maximum pressure in bar

\( M_c \): Pigment weight in gram
Filter Test Software – Evaluation:

Results:
- Calculate: 8,2069 bar/g
- Print...

Enter data:
- Sample mass: 200 g
- Master Batch: 14.5%

Setup:
- Signal name: P3

Initial level:
- Pressure: 69.0 bar
- Duration: 8:11 min sec

Raise:
- Maximum: 307.0 bar
- Duration: 6:26 min sec
- Slope: 37.0 bar/min
- End level:
- Pressure: 249.0 bar
- Duration: 20:32 min sec

Filter test evaluation

Pressures (bar) vs Time (min):
Configuration:

Filter Test Software
Test Report for EN 13900-5 (draft)

Thermo Haake
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Fax: +49 721/4094-300
info@thermohaake.com

Thermo Haake PolyDrive
v1.31

<table>
<thead>
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<tr>
<td>Lot no.</td>
<td>234-2334</td>
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<td>Remarks</td>
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</tr>
<tr>
<td>Operator</td>
<td>Bernie</td>
</tr>
</tbody>
</table>

Date: 09.04.2003
Time: 12:57
Examiner

Filter test result

Sample mass : 200 g
Master batch : 14.5%
Initial Pressure : 69 bar
Maximal pressure : 356 bar

FPV: 9,89655 bar/g
Filter package – type 1 (25μ)

The sievepackage consists of layers:

1. layer: \( W = 0.14 \text{ mm}, \ d = 0.042 \text{ mm} \) (615/108 mesh)

2. layer: \( W = 0.63 \text{ mm}, \ d = 0.40 \text{ mm} \)

- \( d \) = diameter of wire
- \( w \) = distance of two wires

sievepackage type 1, part.no.: 005-0001
Filter package – type 2 (14µ)

The sieve package consists of layers:

1. Layer: \( W = 0.13 \text{ mm}, d = 0.042 \text{ mm} \) (615/128 mesh)

2. Layer: \( W = 0.63 \text{ mm}, d = 0.40 \text{ mm} \)

**Symbols:**
- \( W \): distance of two wires
- \( d \): diameter of wire
Filter package – type 3

- \( W \) = distance of two wires
- \( d \) = diameter of wire

The sieve package type 3 consists of three layers:

1. Layer: \( W = 0.040 \text{ mm}, d = 0.071 \text{ mm} \) (165/1400 mesh)
2. Layer: \( W = 0.25 \text{ mm}, d = 0.16 \text{ mm} \)
3. Layer: \( W = 0.63 \text{ mm}, d = 0.40 \text{ mm} \)
Pipe extrusion

**Instruments:**
- HAAKE RheoDrive
- Rheomex extruder (single or twinscrew)
- Screw(s)
- Pressure sensor(s)
- Pipe or catheter die
- Conveyer belt

**Test results:**
- Testing of the processability of polymer compounds
- Testing of additives at different formulations
- Testing and optimisation of processing conditions
- Small production of polymer pipes
557-3215 Pipe & Tubing Die

- di: 5 - 12 mm
- da: 10 - 15 mm
- Standard: 9 / 12 mm
- Max. temperature: 480°C
557-3185 Catheter Die

- di: 1.5 - 7.0 mm
- da: 2.0 - 8.0 mm
- Standard: 2.4/4.5 mm
- Max. temperature: 480°C
**Dieswell Measurement**

- **Instruments:**
  - HAAKE RheoDrive
  - Rheomex extruder (single or twinscrew)
  - Screw(s)
  - Pressure sensor(s)
  - Rodcapillary or rod die
  - Dieswell Capillary
  - (Conveyer belt)
  - Laser Dieswell tester

- **Test results:**
  - Testing the elastic behaviour of polymer melts
  - Measuring the strand diameter
Dieswell Measurement

detecting elastic polymer behaviour

Dieswell = \frac{D - d}{d} * 100\%
Laser Dieswell tester

(principle sketch)

- Laser diode
- Rotating mirror
- Measuring field
- Test sample
- Lens
- Photo diode
Laser Dieswell tester

Technical data:

- Measuring field: 32 mm
- Distance Emitter/receiver: 230 mm
- Minimal diameter of object: 0.2 mm
- Repeatability: ± 0.6 µm
- Linearity: ± 1.0 µm
- Resolution: 0.0001 mm
- Scanning frequency: 240/s
- Light source: Visible Laser Diode Class 2