



BAF060

Freeze-Fracture System

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■ Designed to meet your needs

- Load-Lock Transfer of Specimen: For fast preparation cycles and to minimize contamination inside the fracturing system, the specimen can be loaded through a load-lock transfer system. The load-lock can also be used for reloading the electron beam guns.
- Precise fracturing with microtome: LN₂-cooled fracturing knife with manual or motorized motion. Precise control of microtome advance with stepper motor.
- Ideal for freeze etching with precise specimen temperature control: For freeze etching of fractured surface the specimen temperature can be controlled tightly. Peltier elements are used for precise temperature ramping of the specimen stage. Above the specimen a LN₂-cooled shutter prevents any contamination of the specimen.
- Flexible shadowing: Electron beam source angles can be preset from 0 to 90° for shadowing and replication (Carbon layer at 90°). Stationary or rotary shadowing is possible, offering a wide range of shadowing options, including "DARS" (Double axis rotary shadowing) .
- Precise film thickness control with automated quartz crystal thickness monitor and shutter termination.
- Hydro-carbon free high vacuum pumping system; A turbo molecular drag pump assures hydro-carbon free operation of system.
- Option: Freeze Fracturing for Cryo SEM observation with VCT100 vacuum cryo transfer system.



■ Applications

- Freeze-fracturing of emulsions, liquids, gels, and suspensions, immobilized by jet-freezing, using the fracturing device for cryo-jet sandwiches [1].
- Freeze-fracturing of cell suspensions, gels, and tissues frozen on gold specimen carriers by high pressure freezing, using the specimen table for gold specimen carriers [2].
- Freeze-fracturing of cell suspensions and tissues frozen on copper carriers by cryo-jet or plunge-freezing, using the specimen table for copper carrier plates.
- Freeze-drying of viruses, isolated membranes, and cell components, immobilized by plunge-freezing, using the magnetic specimen table for electron microscopy grids [3].
- Freeze-drying of cell components or isolated membranes and viruses and DARS [4].
- Freeze-fracturing for subsequent cryo SEM analysis.

■ BAF060 History

Balzars and Hans Moor developed the first commercial «freeze-etch» system and introduced it in 1964. The BAF060 brings the freeze fracturing technique to a new level, comprising an advanced microtome, flexible shadowing options with ebeam sources and a load-lock transfer system.

■ Literature:

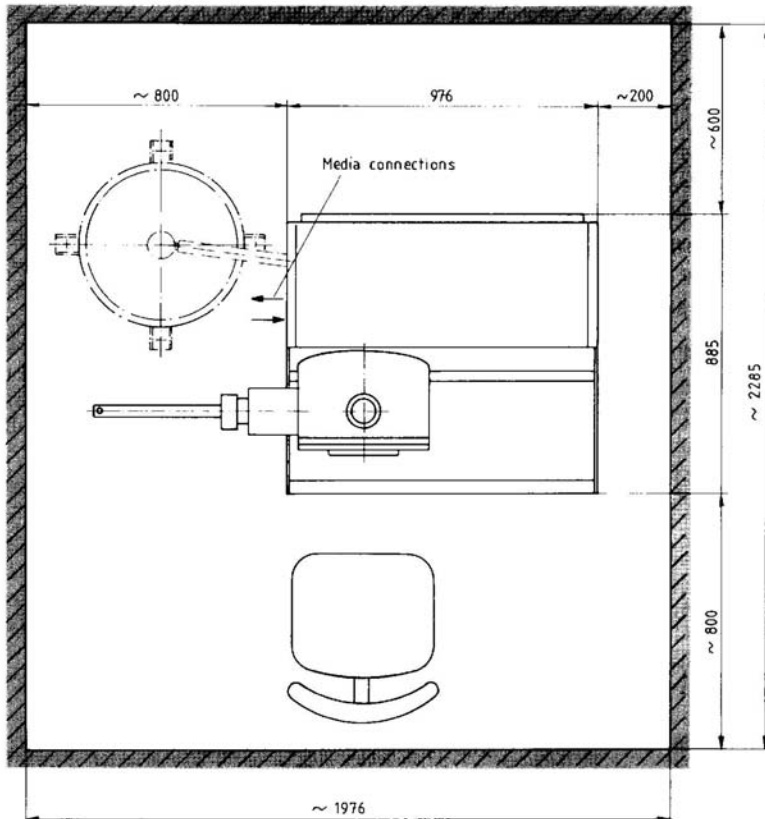
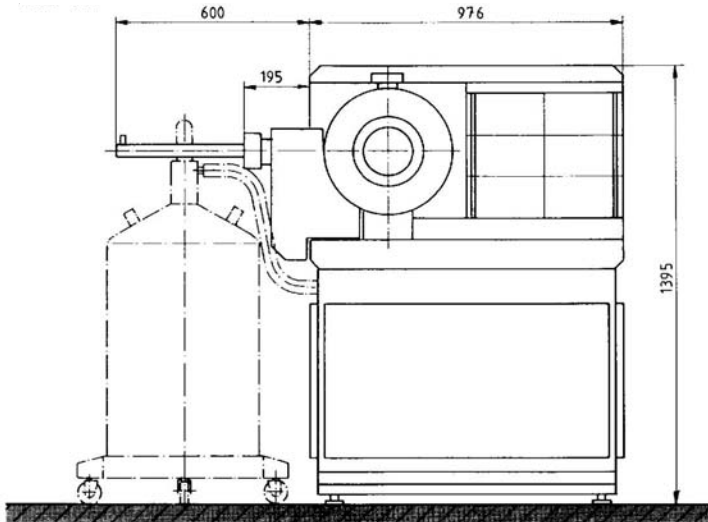
- [1] T. Müller et al. Scanning Microscopy 7,4:1295-1310 (1993)
Optimization and application of jetfreezing.
- [2] T. Müller et al. Colloid and Polymer Science 267: 230-236 (1989)
Rheological and electron microscopic characterization of aqueous carboxymethyl cellulose gels, part 11: Visualization of the gel structure by freeze-fracturing.
- [3] I. Wildhaber et al. J. Ultrastructure Res. 80: 367-373 (1982)
The control of freeze-drying with deuterium oxide (D₂O).
- [4] R. Hermann et al. Scanning Microscopy 2,3: 1215-1230 (1988)
Double-axis rotary shadowing for high resolution scanning microscopy.

■ Specification of BAF060

1. Dimensions of the BAF060 System and Space for Installation

According to the scale drawing

Front view



Top view

All dimensions in mm

2. Vacuum Chamber

High vacuum main chamber (25 l), final vacuum:

$p < 10^{-6}$ mbar)

Rough vacuum load lock (1 l), automatic VAT gate valve.

3. Pumping System

Pfeiffer TMH 260 turbomolecular drag pump,

Vacuubrand MD4 membrane backing pump

4. Universal Pump Control UPC 010

Vacuum measurement functions:

- Pirani rough vacuum gauge in chamber, load lock, and back area
- Cold cathode high vacuum gauge in chamber
- Automatic switch from rough to high vacuum display of chamber pressure
- LED display of chamber pressure, load lock and fore line.

Pump control functions:

- TMH 260 "full speed" (100%) or standby" (75%)

Logic functions:

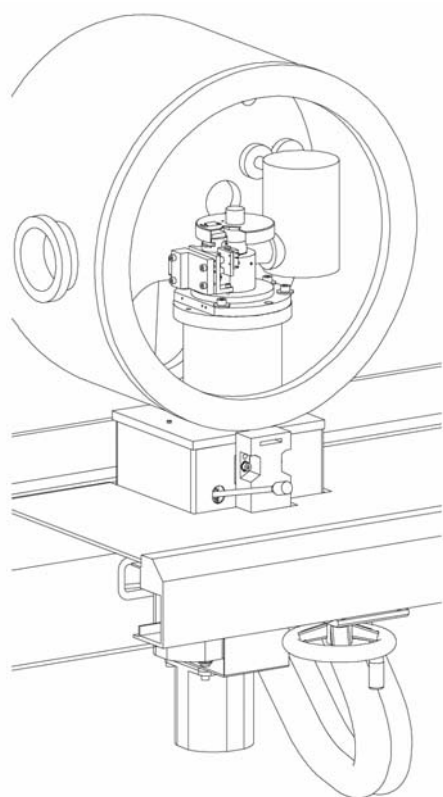
- Pressure set point detection for automatic control of pumps and valves
- Sequenced pumping, venting and stop of process.

User functions:

- Switchboard to start pumping venting processes, LED user guide
- Mimic diagram with LED indication of valves, pumps and pressure set points
- Satellite switch for ergonomic load lock control via UPC 010
- Automatic control of the load lock gate valve with by light barrier

5. Multi Temperature Control MT010

- Fills the chamber dewar with liquid nitrogen.
- Conductive cooling of the cold stage (temperature control with Peltier element) and cooling of knife and shutter to base temperature independent of specimen cold stage temperature.
- Control and monitoring of specimen cold stage temperature Range [+50°C to -170°
- Accuracy of stage temp: r1qC
- For bake out: Quick release of the liquid nitrogen from the chamber dewar and flush with heated compressed air
- Display of actual specimen stage temperature
- Indication, if dewar and knife temperature are ready for operation.



Freeze Fracturing Device

6. Electron Beam Evap. Control EVM030

Degas functions:

- Individually preselected high voltage, current, and time values for the subsequent degassing of two electron beam guns EK 030

Evaporation functions:

- Manual presetting of the individual evaporation values of:
 - Gun 1: Pt-C, Ta-W, Cr, Pt-Ir-C, or C
 - Gun 2: C or Pt-C, Ta-W, Cr, Pt-Ir-C
- Memory of the pre-selected evaporation parameters after power failure
- Operation of two electron beam guns EKE 030 with stabilized high voltage and current values.
- Evaporation values can be modified manually during the evaporation, and the last value will be stored.

7. Quartz Thin Film Monitor QSG060

Quartz crystal head is placed between gun 1 and gun 2 and moves together with guns. The quartz is exposed permanently to the evaporation beam.

Film thickness measurement:

- Range: 0.0 nm to 999.9 um (auto-ranging nm, um)
- Resolution: 0.1 nm

Deposition rate measurement:

- Range: 0.00 nm/s to 999.9 nm/s
- Resolution: 0.01 nm/s (Density > 3.2 g/cm³);
1 nm/s (Density < 3.2 g/cm³)

Shutter functions:

- Shutter will close, when the termination thickness is achieved
- Control will switch to next layer

Memory functions:

- 5 layers with independent thickness values

8. Freeze Fracturing Device with MDC010 control

Rotation cold stage

- Programmable [40 to 150 rpm]
- Pre-programmed locking position for specimen transfer

Knife movement

- Motorized [21 to 60 rpm], low vibrations
- Single step operation
- Manual operation with handwheel
- Selectable knife advance with stepper motor: between 1um and 40 um. Manual or automated advance selectable.

Shutter operation

- Controlled by QSG060 quartz thin film monitor

Logic functions

- For specimen exchange to lock chamber the specimen stage is automatically positioned, the shutter is opened and the guns are moved out of the transfer area.

Elevation angle of the electron beam evaporation sources:

- Both guns are moved together [fixed angle between gun 1 and gun 2 is 45°]
- Select gun 1 or gun 2, and move to desired elevation (individual evaporation position is indicated)
- Select gun 1 or gun 2 for locking (moving to its individual locking position)
- Move up and down with guns for DARS (double angle rotary shadowing)

9. Observation Device

- Binocular with 7 x and 14 x magnification.

10. Manipulators

- Manipulator for specimen tables with guided movement
- Manipulator for guns 1 and 2

11. Set of Accessories

- Loading station for the mounting of specimens to the specimen tables (liquid nitrogen dewar (metal) containing a tiltable cold stage for specimen tables and a platform for specimens. Mounting of specimen to the different specimen tables and preparation for transfer into the BAF060.
- Tubes for: liquid nitrogen, compressed air and nitrogen gas
- Specimen table for knife freeze fracturing on gold carrier plates.

12. Set of Tools

13. Set of Spare Parts

■ Technical Specifications

BAF060 System

ORDERING INFORMATION

ORDER NO.

BAF060 standard system according to the specifications 1 to 13

3 x 400 V 50–60 Hz

3 x 208 V 60 Hz

TECHNICAL DATA

Weight 300 kg

Dimesions see scale drawings

Media required

– Electrical connections

– Compressed air:

– Nitrogen gas:

– Liquid nitrogen:

– Water (optional):

Values

1.5 kVA

Fuse: 25 AT

4–7 bar

0.5 bar

in

out

in

out

Connections

Please contact Leica Microsystems
for detailed installation
requirements

ACCESSORIES

Illumination Fiber optic illumination device

Spare light bulb

Specimen tables for

– fracturing of cryo jet sandwiches

– cutting on gold carrier plates (included)

– cutting on copper carrier plates

– freeze-drying on EM grids

Liquid nitrogen supplies

– Liquid nitrogen tank 60 liters, self-pressurizing

– Liquid nitrogen hand valve

OPTIONS

Cryo fixation device

– TFD010 Transfer device

– JFD030 Jet freezing device

Consumables

– Hard metal knife, 15 mm

– Evaporation material

C (set)

Pt-C (set)

Pt-Ir-C (1 pcs)

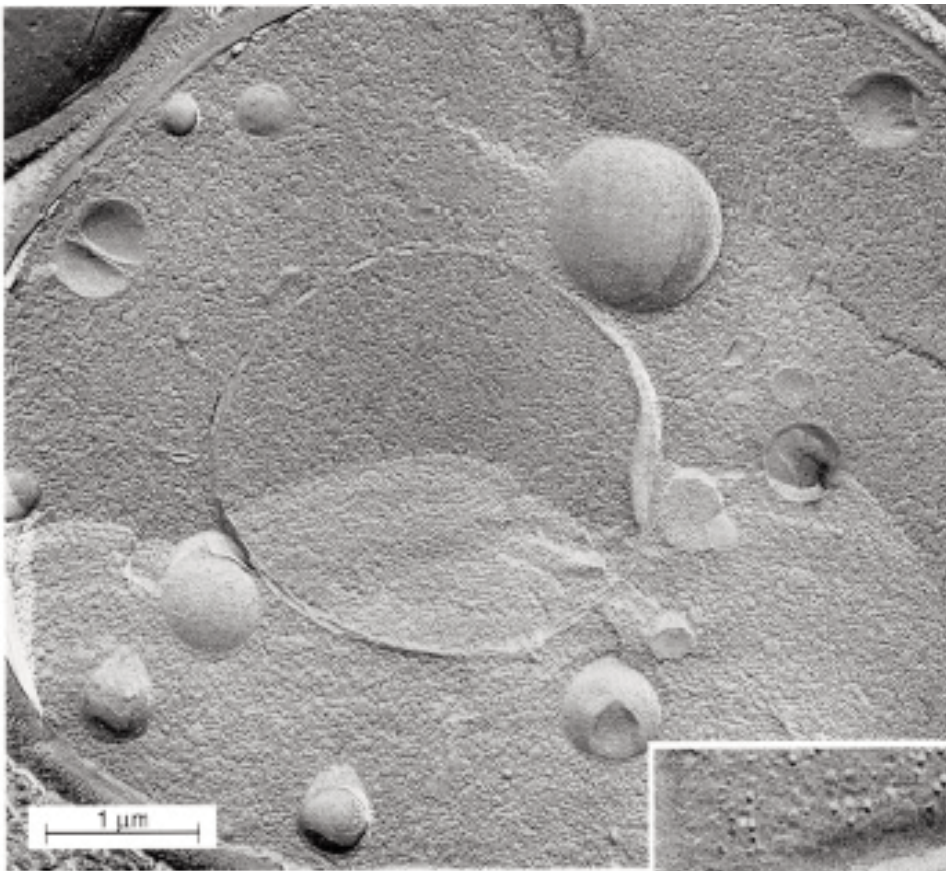
Ta-W (set)

Cr (10 pcs)

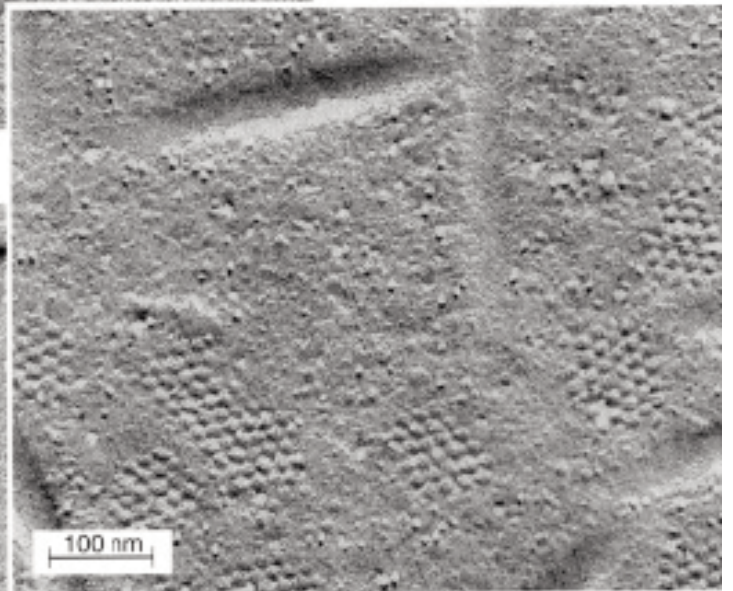
– Electron beam gun filaments (5 pcs)

– Quartz crystals, 6 MHz (10 pcs)

Reliable Shadow Casting Results achieved already at -105 C on Freeze-fractured Baker's yeast (*Saccharomyces cerevisiae*)

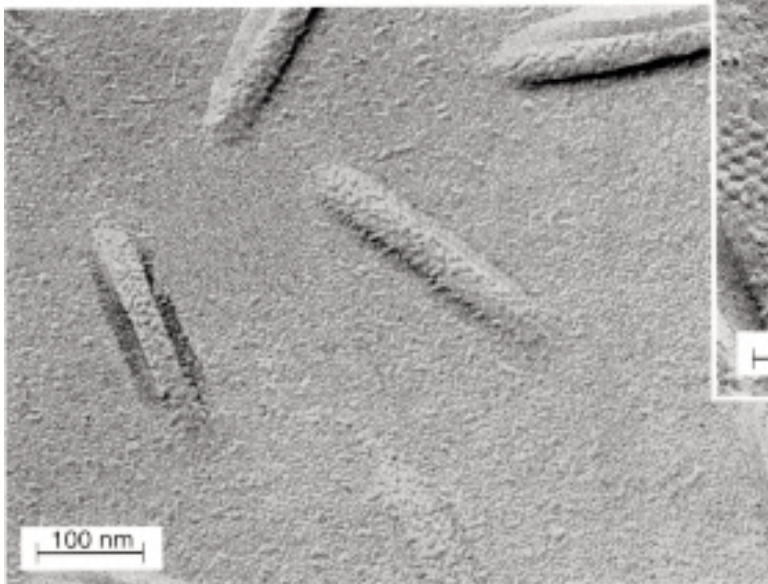


Cross fracture



Plasmalemma

Plasmatic fracture face



Exoplasmatic fracture face

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