NETZSCH

Proven Excellence.

Accessories for DMA Series

Sample Holders, Calibration Materials and Other Accessories
for DMA 303 *Eplexor*® and DMA 242 E *Artemis*

Analyzing & Testing

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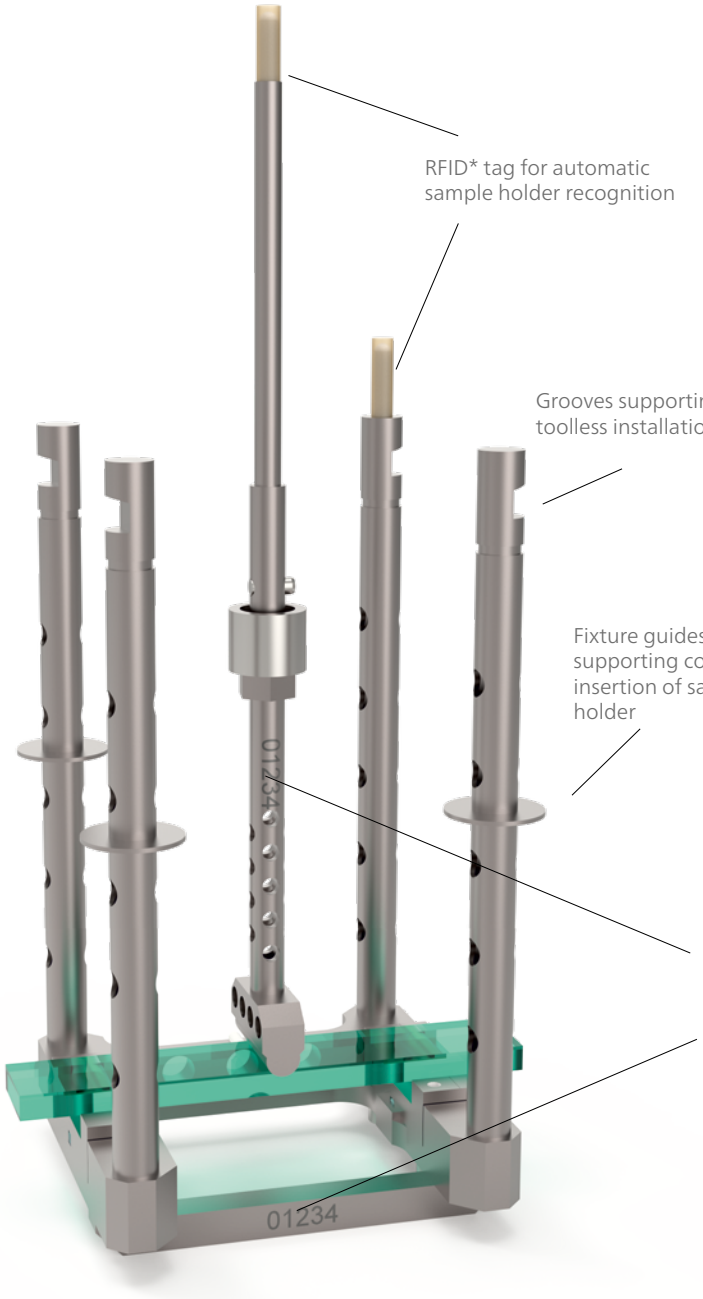
DMA 303 *Eplexor®*

DMA 242 E *Artemis*

EXCELLENCE IN SAMPLE HANDLING

DMA 303 *Eplexor*®



NETZSCH offers a wide variety of sample holders for its DMA 303 *Eplexor*®. This results in optimal adaptation of the test conditions to the sample size and stiffness, as well as to the application. For example, a different sample holder is needed to measure a thin polymer film versus a stiff material such as a fiber-reinforced composite.

The latest generation of NETZSCH DMA sample holders feature a low-mass design. There is a choice of heat-resistant steel sample holders for high rigidity even at the highest temperatures and a special titanium alloy for both very low inertia and thermal conductivity with high stiffness and very low thermal conductivity for perfect results. Integrated guides on the sample frame assist in correct insertion. The design allows for time-saving, toolless installation. The RFID* technology automatically detects the frame and probe employed and selects the correct calibration in the software.

This publication lists all sample holders and accessories available for your DMA 303 *Eplexor*® as well as the materials used for the calibration of your device.

* Radio Frequency Identification

Sample Holder for Tension

The tension sample holder is used for measurements on foils, films, fibers or thin rubber strips.

Laser structured clamp surfaces and optional grub screw, ensure perfect grip even on slippery samples. Versions made of heat resitant stainless steel or titanium are available. While steel is resistant to temperatures up to 800 °C, the advantage of titanium is its light weight and therefore better dynamic properties. Additionally, thermal conductivity of the titanium alloy is only half of the value of steel, which benefits temperature homogeneity. For a good determination of the sample length throughout the experiment, frame and pushrod should be chosen from the same material to minimize effects from thermal expansion.

DMA 303 *Eplexor*® – Sample Holder

Type	Free Tension Length* (max.)	Ø/Width/Thickness (max.)	Max. Temp.	Compatibility/Remarks	Order Number
Steel frame	30 mm	W: 13 mm, T/Ø: 5mm	800 °C	compatible with both probes, steel recommended	DMA30300A53.110-00
Titanium frame	30 mm	W: 13 mm, T/Ø: 5mm	400 °C	compatible with both probes, titanium recommended	DMA30300A53.210-00
Steel probe	30 mm	W: 13 mm, T/Ø: 5mm	800 °C	compatible with both frames, steel recommended	DMA30300A53.400-00
Titanium probe	30 mm	W: 13 mm, T/Ø: 5mm	400 °C	compatible with both frames, titanium recommended	DMA30300A53.300-00

Sample Holders for Three-Point Bending

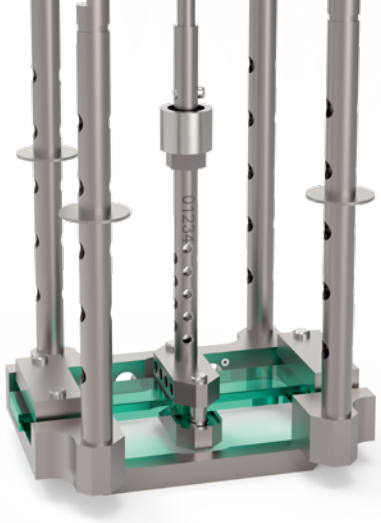
Stiff samples such as fiber-reinforced or highly filled thermoplastics, metals or ceramics can be measured in three-point bending. A special advantage of this geometry is that no clamping effects will influence the results.

The three-point bending sample holders are available in different sizes. These fixtures are available from heat resistant steel only, since titanium yields no strong benefit in this setup.

DMA 303 *Eplexor®* – Three-Point Bending Sample Holders (Edge Radius: 2 mm)

Type	Compatibility/Remarks	Max. Temp.	Order Number
Steel frame 10 mm	max. sample width 13 mm	800 °C	DMA30300A51.110-00
Steel frame 20 mm	max. sample width 13 mm	800 °C	DMA30300A51.120-00
Steel frame 30 mm	max. sample width 13 mm	800 °C	DMA30300A51.130-00
Steel frame 40 mm	max. sample width 13 mm	800 °C	DMA30300A51.140-00
Steel frame 50 mm	max. sample width 13 mm	800 °C	DMA30300A51.150-00
Steel frame 60 mm	max. sample width 13 mm	800 °C	DMA30300A51.160-00
Probe steel	compatible with all frames	800 °C	DMA30300A51.400-00

Sample Holders for Cantilever Bending



Sample holders for cantilever bending are used to measure the dynamic-mechanical properties of thermoplastics and elastomers. Stiffer samples such as metals or fiber-reinforced polymers can also be measured with the single cantilever sample holder with free probe. Typical applications include determination of the glass transition (T_g) of reinforced polymers, as used, e.g., in the aircraft industry.

To minimize inertia, the moving probe is made from titanium alloy. The maximum temperature of the complete setup is thus limited to 400 °C, still completely covering polymer applications.

DMA 303 *Eplexor*® – Parts for Single and Dual Cantilever Sample Holders

Type	Compatibility/Remarks	Max Temp.	Order Number
Dual Cantilever steel frame 2 x 5 mm	max. sample width 13 mm, thickness 10 mm	800 °C	DMA30300A50.052-00
Dual Cantilever steel frame 2 x 17 mm	max. sample width 13 mm, thickness 10 mm	800 °C	DMA30300A50.172-00
Cantilever probe titanium	Compatible with all cantilever frames	400 °C	DMA30300A50.300-00

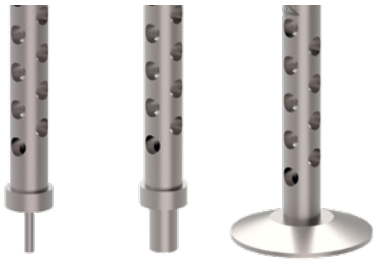
Sample Holders for Compression and Penetration

In compression measurements, the probe diameter is larger than the sample diameter. In penetration measurements, a probe with a tip diameter smaller than the sample allows for investigation of topics such as softening. Soft samples like foams and rubbers can be measured in these modes.

Versions made of stainless steel or titanium are available. While steel is heat resistant to temperatures up to 800 °C, the advantage of titanium is its light weight and therefore better dynamic properties. Additionally, thermal conductivity of the titanium alloy is only half of the value of steel, which benefits temperature homogeneity. For a good determination of the sample length throughout the experiment, frame and probe should be chosen from the same material, to minimize effects from thermal expansion.

DMA 303 *Eplexor*® – Compression and Penetration Sample Holders

Type	Compatibility	Max. Temp.	Order Number
Steel frame, sample area Ø 15 mm	compatible with all available probes	800 °C	DMA30300A52.115-00
Titanium frame, sample area Ø 15 mm	compatible with all available probes, titanium probe recommended	400 °C	DMA30300A52.215-00
Probe steel, Ø 15 mm	compatible with both frames, steel frame recommended	800 °C	DMA30300A52.400-15
Probe titanium, Ø 15 mm	compatible with both frames, titanium frame recommended	400 °C	DMA30300A52.300-15
Probe steel, Ø 1 mm	compatible with both frames, steel frame recommended	800 °C	DMA30300A52.400-01
Probe steel, Ø 3 mm	compatible with both frames, steel frame recommended	800 °C	DMA30300A52.400-03
Probe titanium, with freely moving glass ceramic disc, Ø 15 mm	compatible with both frames, titanium frame recommended	400 °C	DMA30300A52.300-99
Spare glass ceramic disc	included in DMA30300A52.300-99		NGB804879



Probes for penetration/compression (1 mm, 3 mm and 15 mm)

The probe with free alumina disc is particularly well suited for compression measurements on specimens with uneven surface, e.g. foams

Sample Holders for Shear

The shearing sample holder is used for measurements in sandwich geometry on adhesive tapes as well as on soft samples such as foams or rubbers.

DMA 303 *Eplexor*® – Shear Sample Holders

Type	Remarks	Order Number
Steel frame with screws	requires titanium upper probe	DMA30300A54.110-00
Titanium probe	max. 400 °C (limit for shear experiments)	DMA30300A54.300-00
Spare middle clamp	included in DMA30300A54.300-00	NGB822567
Spare outside clamp A	included in DMA30300A54.110-00	NGB822586
Spare outside clamp B	included in DMA30300A54.110-00	NGB822587
Set of sample clamps with screws (3 pcs.)	clamp A, clamp B, middle clamp, alignment screws	DMA30300A54.900-00
Allen wrench, size 0.89 mm	included in DMA30300A54.300-00	NGB825904

Middle clamp (NGB822567)

Outside clamp A (NGB822586)

Outside clamp B (NGB822587)

Sample Holder for Pastes/Powders

When pastes or powders are to be studied, the material is filled into the insert of the sample holder. Similiar to a standard compression/penetration measurement, the penetration probe presses onto the sample, ideally covered by a sapphire disc. For cleaning purposes, it is possible to remove the insert. When problematic samples are considered, disposable aluminum crucibles can be used as liners. The used crucibles can easily be removed from the sample insert after measurement to avoid time-consuming cleaning.

DMA 303 *Eplexor®* – Sample Holder for Powdery and Pasty Samples

Type	Remarks	Order Number
Steel frame for powdery and pasty samples	requires steel probe DMA30300A52.400-03	DMA30300A52.150-00
Probe steel, Ø 3 mm	as for standard penetration measurements	DMA30300A52.400-03
Sample insert for pasty samples	included in DMA30300A52.150-00	6.160.1-92.6.02
Sapphire disc Ø 6 × 0.5 mm	5 pcs. included in DMA30300A52.150-00	GB398454
Aluminum pan set, 100 pieces	Optional, single use	NGB810405

Sample insert, to be fixed inside the sample frame. Can receive aluminum pans (NGB810405) as single use liners to prevent contamination.

Special Applications

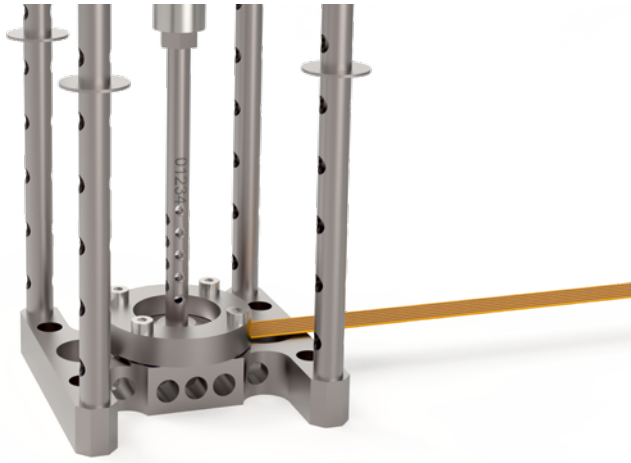
The immersion bath allows for measurements in a liquid such as water, oil, artificial blood, etc., in combination with any of the sample holders. It can be used with the standard furnace, so the only restriction is the evaporation/decomposition temperature of the solvent.

Container for immersion tests

DMA 303 *Eplexor*® – Immersion Bath

	Compatibility/Remarks	Order Number
Container made of stainless steel for nonaggressive media	Compatible with all sample holders Maximum temperature depends on the liquid used (boiling/decomposition temperature)	DMA30300A57.010-00

The NETZSCH DMA 303 *Eplexor*® can be coupled to a DEA device. Dielectric analysis measures changes in the ion viscosity of a material occurring under a controlled temperature program at a defined frequency. The special DMA-DEA coupling will record complementary curing results from the two methods with a single measurement.



DMA 303 *Eplexor*® – Accessories for Measurements with DEA

	Compatibility/Remarks	Order Number
Frame for DEA sensors (mini-IDEX recommended)	Max. temperature: 200°C, additionally reqired: probe Ø 15 mm, DEA system	DMA30300A56.010-00
Probe steel, Ø 15 mm	as for standard compression measurements	DMA30300A52.400-15
10 Mini-IDEX sensors	Single use, set of 10	DEA28800A52.110-00
50 Mini-IDEX sensors	Single use, set of 50	DEA28800A52.150-00
100 Mini-IDEX sensors	Single use, set of 100	DEA28800A52.200-00

Calibration Materials and Accessories

The DMA device must be calibrated in order to achieve optimum accuracy. In order to achieve this, force calibration, empty system calibration, system stiffness calibration and phase calibration are necessary. The following table lists the equipment necessary to perform these procedures. A variety of tools and parts is necessary in order to mount sample holder and sample before measurement. All calibration materials and toos delivered with the NETZSCH to DMA 303 *Eplexor*® are described in the table below.

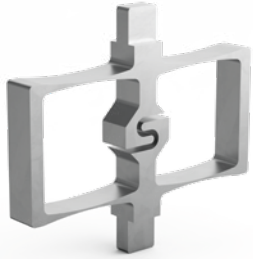
Force calibration probe

DMA 303 *Eplexor*® – Calibration Set and Tool Kit included in the standard scope of delivery

Type	Remarks		Order Number
Accessory set	Contains tools and accessories to calibrate and operate DMA 303 *Eplexor*®.		DMA30300A40.000-00
Force calibration probe	-		DMA30300A69.010-00
Weight 1 kg	for force calibration, with certificate.		NGB824288
Stiffness calibration	Steel bar, 35×8×8 mm	For bending and cantilever	NGB825874
	Steel bar, 70×8×8 mm	For bending and cantilever	NGB825873
	Steel bar, 20×6×2 mm	For tension	NGB809254
Calibration Spring	For phase calibration and instrument check.		NGB824278
Gauge block, 5 mm	For sample holder initialization.		NGB825778
Digital Caliper	Resolution 0.01 mm		NGB811734
Torque screwdriver	-		GB396835
Insert for torque screwdriver, allen wrench 2.5 mm	For GB396835		NGB825868
Hexagon wrench, 6 mm	-		NGB825870
Reamer DIN 212	-		GB396891
Knob, Ø 16 mm, type OKW, size 16	For GB396891		GB395226

Weight for force calibration

Steel bars for system stiffness calibration



Calibration Spring

DMA 303 *Eplexor®* – Optional accessories, tools and spare parts

Type	Remarks	Order Number
Sample thermocouple K, with connector	spare part	NGB823751
Torque wrench adjustable 0.4 to 2.0 Nm	For precise fixing of all probes	NGB815986
Insert with wrench size 6 mm	For torque wrench NGB815986	NGB815988
PTFE Reference sample	For instrument verification	DMA30300A91.010-00

Sample thermocouple K, with connector (NGB823751)

Torque wrench (NGB815986) with insert (NGB815987)

Torque screw driver

DMA 303 *Eplexor®* – Temperature Calibration Set

Type	Contains	Order Number
Temperature calibration set	Adamantane, indium, lead, tin, zinc, aluminum. Includes alumina discs, pistons and aluminum pans	DMA30300A92.010-00
Adamantane	400 mg	6.217.1-92.1.09
Indium Ø 4.5×0.25 mm	10 pieces	6.217.1-92.1.05
Tin Ø 4.5×0.25 mm	10 pieces	6.217.1-92.1.06
Lead Ø 4.5×0.5 mm	10 pieces	6.217.1-92.1.07
Zinc Ø 4.5×0.25 mm	10 pieces	6.217.1-92.1.08
Aluminum wire Ø 1 mm	400 mg	6.223.5-91.3.05
Alumina (Al_2O_3) piston, 5 mm Ø 6 mm		NGB812941
Alumina (Al_2O_3) disc	20 pieces	NGB805584
Aluminum pan set	100 pieces	NGB810405

The temperature calibration corrects the deviation between experimental and nominal temperature values.

SAMPLE HOLDERS

DMA 242 E *Artemis*

The lists in this publication include all the sample holders and accessories available for your DMA 242 E *Artemis* as well as the materials used for the calibration of your device.

Sample Holders for Cantilever Bending

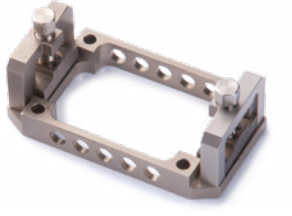
Sample holders for cantilever bending are used to measure the dynamic-mechanical properties of thermoplastics and elastomers. Stiffer samples such as metals or fiber-reinforced polymers can also be measured with the single cantilever sample holder with free pushrod. The single cantilever sample holder with reinforced clamps was specially developed for determination of the glass transition (T_g) of reinforced polymers used in the aircraft industry.

DMA 242 E *Artemis* – Sample Holder Sets for Cantilever Bending

	Free Bending Length*	Width (max.)	Height (max.)	Contains	Order Number
Single, dual cantilever bending	(2x) 1 mm	12 mm	5 mm	Frame with sample clamps, clamped pushrod	DMA2420CA50.001-00
	(2x) 5 mm	12 mm	5 mm		DMA2420CA50.010-00
	(2x) 16 mm	12 mm	5 mm		DMA2420CA50.020-00
	(2x) 17 mm	12 mm	5 mm		DMA2420CA50.021-00
Single cantilever – reinforced clamps	17 mm	12 mm	5 mm	Frame with sample clamps, clamped pushrod, torque wrench	DMA2420CA50.031-00
Single cantilever – free pushrod	20 mm	12 mm	5 mm	Frame with sample clamps, knife-edged pushrod, torque wrench	DMA2420CA50.030-00

*The samples must be greater in length than the free bending length values listed here. To obtain sample dimensions, the clamp's width must be added to the bending length.

The frames for single/dual cantilever bending are available in different sizes for optimal adaptation to the sample. The sample clamps can be ordered separately (6.160.1-40.2.00).



The 17-mm and 20-mm frames for single cantilever with reinforced clamps are used for measurements on very stiff samples.

DMA 242 E *Artemis* – Spare Parts for Single and Dual Cantilever Sample Holders

Type	Spare Part for	Single Order Number
Frame (2×) 1 mm	DMA2420CA50.001-00	6.160.1-40.1.03
Frame (2×) 5 mm	DMA2420CA50.010-00	GB395107
Frame (2×) 16 mm	DMA2420CA50.020-00	GB395604
Frame (2×) 17 mm	DMA2420CA50.021-00	6.160.1-40.1.04
Set of sample clamps with screws for frame (2 pcs)	DMA2420CA50.001-00, DMA2420CA50.010-00, DMA2420CA50.020-00, DMA2420CA50.021-00	6.160.1-40.2.00
Clamped pushrod	DMA2420CA50.001-00, DMA2420CA50.010-00, DMA2420CA50.020-00, DMA2420CA50.021-00	6.160.1-40.5.00
Sample clamp for pushrod	DMA2420CA50.001-00, DMA2420CA50.010-00, DMA2420CA50.020-00, DMA2420CA50.021-00	GB800016

The clamped pushrod (6.160.1-40.5.00) is used with all single/dual cantilever bending sample holders as well as for the 17-mm single cantilever sample holder with reinforced clamps. A spare clamp can be ordered separately (GB800016).

The knife-edged pushrod (6.160.1-41.3.00) is used for the 20-mm single cantilever sample holder with free bending.

DMA 242 E *Artemis* – Spare Parts for Single Cantilever Sample Holders with Free Bending and Reinforced Clamps

Type	Spare Part for	Single Order Number
Frame 17 mm	DMA2420CA50.031-00	6.160.1-46.1.05
Frame 20 mm	DMA2420CA50.030-00	6.160.1-46.1.00
Set of sample clamps with screws for frame (2 pcs)	DMA2420CA50.030-00	DMA2420CA50.901-00
Sample clamp for pushrod	DMA2420CA50.030-00	GB800016
Knife-edged pushrod	DMA2420CA50.030-00	6.160.1-41.3.00
Clamped pushrod	DMA2420CA50.031-00	6.160.1-40.5.00
Torque wrench*	DMA2420CA50.030-00, DMA2420CA50.031-00	NGB815015

* Torque wrench adjustable 0.3 to 1.5 Nm

Sample Holders for Three-Point Bending

Stiff samples such as fiber-reinforced or highly filled thermoplastics, metals or ceramics can be measured in three-point bending. A special advantage of this geometry is that no clamping effects will influence the results. The three-point bending sample holders are available in different sizes and in round- or knife-edged versions.

DMA 242 E *Artemis* – Sample Holder Sets

	Free Bending Length*	Width (max.)	Height (max.)	Contains	Order Number
Round-edged	10 mm	12 mm	5 mm	Frame, pushrod; edge radius 2 mm	DMA2420CA51.010-00
	20 mm	12 mm	5 mm		DMA2420CA51.020-00
	40 mm	12 mm	5 mm		DMA2420CA51.040-00
	50 mm	12 mm	5 mm		DMA2420CA51.050-00
Knife-edged	20 mm	12 mm	5 mm	Knife-edged frame and pushrod	6.160.1-91.2.00
	40 mm	12 mm	5 mm		6.160.1-91.1.00

*The samples must be greater in length than the free bending length values listed here in order to obtain an optimal support area to the sample on the frame

Round-edged sample holder set for 3-point bending, 40 mm (DMA2420CA51.040-00)

Knife-edged sample holder set for 3-point bending, 20 mm (6.160.1-91.2.00)

DMA 242 E *Artemis* – Spare Parts for Standard Three-Point Bending Sample Holders (Edge Radius: 2 mm)

Type	Spare Part for	Single Order Number
Frame 10 mm	DMA2420CA51.010-00	NGB814955
Frame 20 mm	DMA2420CA51.020-00	NGB814954
Frame 40 mm	DMA2420CA51.040-00	NGB814958
Frame 50 mm	DMA2420CA51.050-00	NGB814956
Pushrod	DMA2420CA51.010-00, DMA2420CA51.020-00, DMA2420CA51.040-00, DMA2420CA51.050-00	6.160.1-41.7.00

The standard frame for 3-point bending measurements is available in four different sizes from 50 mm down to 10 mm free bending length

DMA 242 E *Artemis* – Spare Parts for Knife-Edged Three-Point Bending Sample Holders

Type	Spare Part for	Single Order Number
Frame 20 mm	6.160.1-91.2.00	6.160.1-41.1.02
Frame 40 mm	6.160.1-91.1.00	GB395108
Pushrod	6.160.1-91.1.00, 6.160.1-91.2.00	6.160.1-41.3.00

Knife-edged and round-edged pushrods (6.160.1-41.3.00 and 6.160.1-41.7.00)

Sample Holders for Compression and Penetration

Several sample holders are available for compression/penetration measurements. In compression measurements, the pushrod diameter is larger than the sample diameter. In penetration measurements, a pushrod with a tip diameter smaller than the sample allows for determination about issues such as softening. Soft samples such as foams and rubbers can be measured in these modes.

DMA 242 E *Artemis* – Standard Sample Holder Sets for Compression and Penetration

	Sample Area (max.)	Contains	Remarks	Order Number
Compression, penetration	Ø 15 mm	Supporting frame, pushrods of Ø 15 mm, Ø 3 mm and Ø 1 mm		DMA2420CA52.010-00
	Ø 30 mm	Supporting frame, pushrod of Ø 30 mm	For measurements on samples with irregular shape	DMA2420CA52.020-00
	Ø 15 mm	Supporting frame, two pushrods made of fused silica, free ceramic disc	One pushrod for measurements on insulation foams, one pushrod Ø 4 mm for TMA measurements	DMA2420CA52.030-00

Sample holder set for compression and penetration (DMA2420CA52.010-00)

Sample holder set for compression, 30 mm (DMA2420CA52.020-00)

Sample holder set for measurements on insulation foam and for TMA measurements (DMA2420CA52.030-00)

DMA 242 E *Artemis* – Spare Parts for Compression and Penetration Sample Holders

Type	Spare Part for	Single Order Number
Frame, diameter of sample area: 15 mm	DMA2420CA52.010-00, DMA2420CA52.030-00	GB395608
Frame, diameter of sample area: 30 mm	DMA2420CA52.020-00	GB395609
Pushrod, diameter: 15 mm	DMA2420CA52.010-00	6.160.1-42.5.01
Pushrod, diameter: 30 mm	DMA2420CA52.020-00	6.160.1-42.5.04
Pushrod, diameter: 0.5 mm	-	6.160.1-42.5.05
Pushrod, diameter: 1 mm	DMA2420CA52.010-00	6.160.1-42.5.02
Pushrod, diameter: 3 mm	DMA2420CA52.010-00	6.160.1-42.5.03
Pushrod made of fused silica, with clamping nut and free alumina disc Ø 15 mm	-	DMA2420CA52.031-00
Pushrod made of fused silica, Ø 4 mm, for TMA experiments	DMA 2420CA52.030-00	NGB815174
Alumina disc	DMA2420CA52.030-00	NGB804879
Pushrod made of fused silica	DMA2420CA52.030-00	NGB804878
Pushrod made of fused silica, Ø 4 mm, with clamping nut, for TMA experiments	-	DMA2420CA52.032-00

Pushrods for penetration (0.5 mm, 3 mm and 1 mm)

Alumina disc
(NGB804879)

Pushrod with clamp ring and fastening nut
(DMA2420CA52.031-00)

The pushrod made of fused silica with free alumina disc was specially developed for compression measurements on insulation foams.

Sample Holders for Curing

The sample holder described in the following table and figures was specially developed for determining the curing behavior of viscous materials during a controlled temperature program. The container can be removed and cleaned separately.

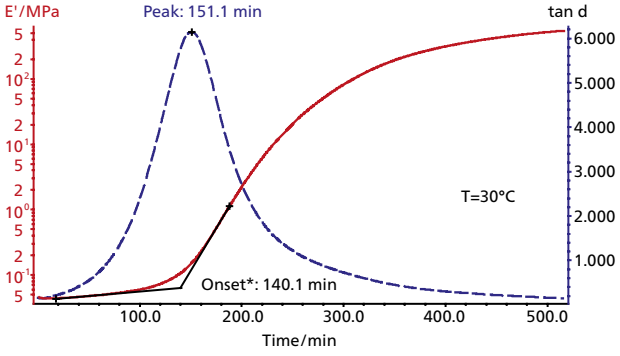
Spare parts for ball-shaped sample holder (container, spare ball and pushrod)

DMA 242 E *Artemis* – Sample Holder Set and Spare Parts for Curing of Viscous Materials

Contains	Remarks	Order Number
Spare container Ø 19 mm, height 15 mm and ball-shaped pushrod with ball Ø 8 mm	-	DMA2420CA55.010-00
Container	Spare part for DMA2420CA55.010-00	6.160.1-92.9.03
Pushrod without ball	Spare part for DMA2420CA55.010-00	DMA2420CA55.011-00
Spare ball	Spare part for DMA2420CA55.010-00	6.160.1-92.9.06

Curing of an Epoxy Adhesive

In this example, an epoxy adhesive was measured with the DMA 242 E *Artemis* using the sample holder with container and ball-shaped pushrod.
The temperature was kept constant at 30°C. The rise in the storage modulus curve after 140 minutes (onset time) is due to the beginning of curing. It is associated with a maximum in the tanδ curve at 151 minutes. After approximately 500 minutes, no significant change in the storage modulus can be detected any longer. This indicates the end of the curing reaction.



Sample: Epoxy adhesive
Test mode: Compression with curing sample holder (container with ball-shaped pushrod)
Test parameters: Isothermal 30°C; frequency: 1 Hz; amplitude: ± 20 µm

The ball-shaped pushrod is immersed in the sample during measurements with sample holder set DMA2420CA55.010-00.

The sample holder with sample insert is used for curing measurements on powdery and pasty samples. The pushrod presses onto a sapphire disc placed on the material. The sample insert can be removed and cleaned separately.

Frame with sample insert, pushrod and sapphire disc for compression measurements on pasty samples. The use of aluminum pans (NGB810405) prevents sample holder contamination.

DMA 242 E *Artemis* – Sample Holder Set and Spare Parts for Powdery and Pasty Samples

Contains	Remarks	Order Number
Supporting frame, sample insert Ø 7 mm, height 2.5 mm, pushrod Ø 3 mm, 5 sapphire discs Ø 6×0.5 mm	Aluminum pan recommended (Order No. NGB810405)	DMA2420CA52.040-00
Frame	Spare part for DMA2420CA52.040-00	NGB812140
Pushrod Ø 3 mm	Spare part for DMA2420CA52.040-00	6.160.1-42.5.03
Sample holder for pasty samples	Spare part for DMA2420CA52.040-00	6.160.1-92.6.02
Sapphire disc Ø 6 × 0.5 mm	Spare part for DMA2420CA52.040-00	GB398454
Aluminum pan set, 100 pieces	-	NGB810405

Sample Holders for Shear

The shear sample holder is used for measurements in sandwich geometry on adhesive tapes as well as on soft samples such as foams or rubbers.

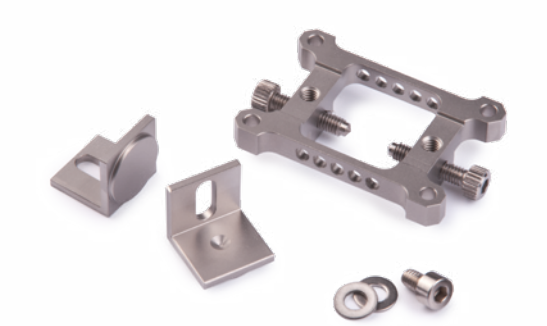
DMA 242 E *Artemis* – Sample Holder Sets for Shear

Contains	Ø/Width/ Thickness (max.)	Thickness (max.)	Remarks	Order Number
Frame with clamps (flat surface), pushrod (flat surface)	15 mm	6 mm	e.g., for adhesive tapes	DMA2420CA54.010-00
Frame with clamps (grooved surface), pushrod (grooved surface)	15 mm	6 mm	for samples which require a better grip (e.g., for rubbers)	DMA2420CA54.020-00

Sample holder set for shear with flat surfaces (DMA2420CA54.010-00)

DMA 242 E *Artemis* – Spare Parts for Shear Sample Holders

Type	Spare Part for	Single Order Number
Frame with screws	DMA2420CA54.010-00, DMA2420CA54.020-00	6.160.1-44.1.00
Set of sample clamps with screws, flat (2 pcs.)	DMA2420CA54.010-00	6.160.1-44.2.00
Set of sample clamps with screws, grooved (2 pcs.)	DMA2420CA54.020-00	6.160.1-44.4.00
Pushrod, flat	DMA2420CA54.010-00	6.160.1-44.5.01
Pushrod, grooved	DMA2420CA54.020-00	6.160.1-44.5.02
Allen wrench	-	GB800188



Frame for shear with flat sample clamps

Flat clamps (6.160.1-44.2.00)

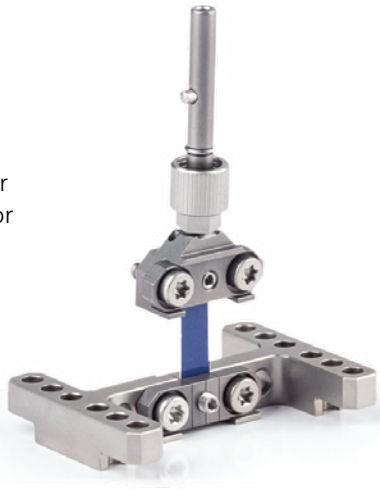
Grooved pushrod
(6.160.1-44.5.02)

Grooved clamps
(6.160.1-44.4.00)

The shear sample holder with grooved surface allows for a better grip on the sample

Sample Holder for Tension

The tension sample holder is used for measurements on foils, films, fibers or thin rubber strips.



DMA 242 E *Artemis* – Sample Holder Set

	Free Tension Length* (max.)	Ø/Width/Thickness (max.)	Contains	Order Number
Tension	15 mm	6.8 mm	Frame, pushrod, clamps	DMA2420EA53.010-00

* The samples must be greater in length than the free tension length values listed here. To obtain sample dimensions, the clamp's width must be added to the tension length.

Sample holder set for tension (DMA2420EA53.010-00)

DMA 242 E *Artemis* – Spare Parts for Tensile Sample Holders

Type	Spare Part for	Single Order Number
Frame	DMA2420EA53.010-00	DMA2420EA53.012-02
Sample clamps made of titanium with screws	DMA2420EA53.010-00	NGB817604
Pushrod with clamps made of titanium	DMA2420EA53.010-00	DMA2420EA53.011-00

Special Applications

The immersion bath allows for measurements in a liquid such as water, oil, artificial blood, etc., in combination with any of the sample holders. It can be used with the standard furnace, so the only restriction is the evaporation/decomposition temperature of the solvent.

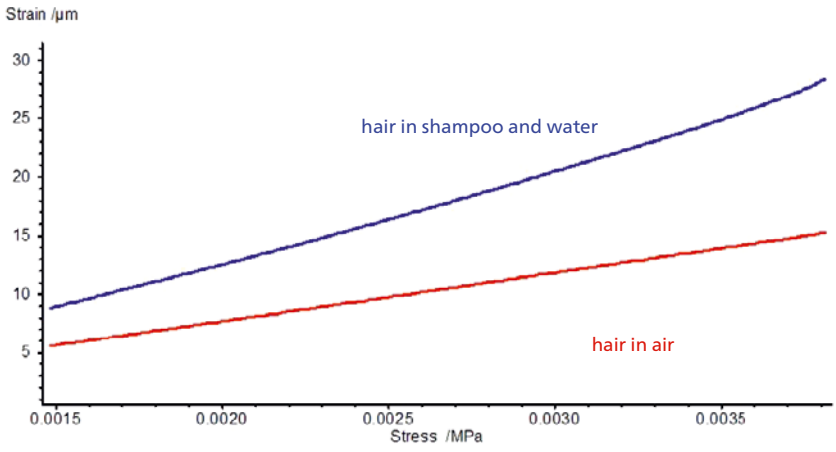
Container for immersion tests

DMA 242 E *Artemis* – Immersion Bath

Type	Remarks	Order Number
Container made of stainless steel for nonaggressive media	Maximum temperature depends on the liquid used (boiling/decomposition temperature)	DMA2420EA57.010-00

Influence of Shampoo on Human Hair

Stress-sweep tests were carried out on a human hair in an air atmosphere and in a mixture of water and shampoo. The same hair was used for both measurements. The force was varied from 0.1 N to 1 N and the strain was measured. The plot represents the stress-strain plot for both measurements. The curves differ in their slope: the hair has a lower storage modulus – i.e., is softer – when in contact with the mixture of water and shampoo (higher slope) than with air (lower slope).



Influence of shampoo on the hair softness
Sample: Human air (thickness between 70 µm and 80 µm)
Measurements parameter: tension mode, temperature: 25°C, frequency: 1 Hz, force varied between 0.1 and 1 N

The NETZSCH DMA 242 E *Artemis* can be coupled to a DEA device. Dielectric analysis measures changes in the ion viscosity of a material occurring under a controlled temperature program at a defined frequency. The special DMA-DEA coupling will record complementary curing results from the two methods with a single measurement.

DMA 242 E *Artemis* – Accessories for Measurements with DEA

Type	Contains	Remarks	Single Order Number
Compression	Pushrod Ø 15 mm, frame for DEA sensors (mini-IDEX recommended)	DEA system necessary, max. temperature: 200°C	DMA2420CA56.020-00

DMA 242 E *Artemis* coupled with DEA 288 *Ionic* and Adapter Box

The curing of UV-sensitive materials can be measured with the NETZSCH DMA 242 E *Artemis* using its standard furnace. The SiO_2 window in the bottom of the furnace allows for UV light irradiation of the sample. Measurements are carried out with a special compression sample holder.

DMA 242 E *Artemis* – Add-On for Measurements under UV

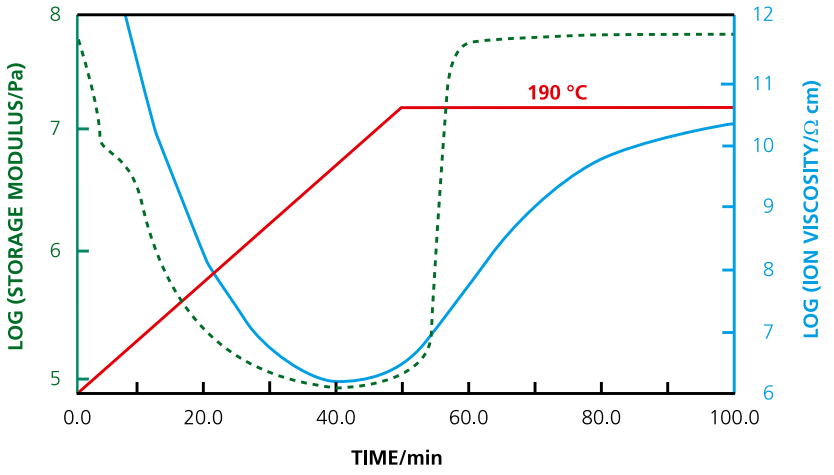
Description	Single Order Number
Sample supporting set for UV curing, fused silica window Ø 15 mm, with supporting frame and compression pushrod 15 mm	DMA2420CA58.010-00
Adaptor for connection of UV light source to DMA 242 E *Artemis**	DMA2420EA61.000-00
OmniCure S2000SC light source: high-pressure mercury lamp (wavelength range from 320 to 500 nm) with a high-power fiber-optic light guide and UV safety goggles, including adaptor for connection to DMA 242 E *Artemis* (manual triggering)	DMA2420CA30.000-00

* Custom version to fit specific guide dimensions available on request.

DMA 242 E *Artemis* with Omnicure light source

DMA-DEA Measurement on an Epoxy Resin

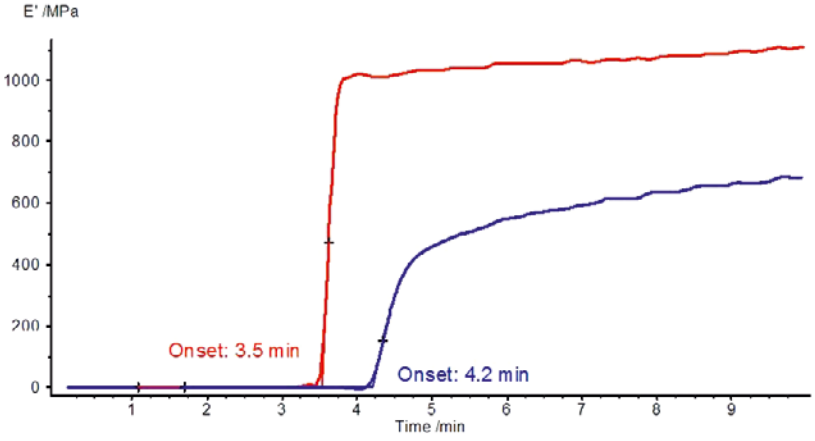
In this example, an uncured epoxy resin was heated to 190°C and the temperature was kept constant. The initial decrease in the storage modulus and ion viscosity during heating is due to softening of the sample. The increase in the storage modulus is related to the beginning of curing. The subsequent sharp increase in storage modulus demonstrates the sensitivity of DMA at the beginn of the curing reaction.
During the isothermal hold at 190°C, the storage modulus stabilizes in compression mode. However, the ion viscosity continues to increase; the more sensitive DEA method makes it possible to determine that curing has still not completely finished after even 100 minutes.



Curing of an epoxy resin
Sample holder: special compression sample holder for DMA-DEA
Measurement parameters: room temperature to 190°C at 3 K/min and isothermal at 190°C, frequency: 10 Hz

Light Curing of Two Dental Masses

The curing behavior of two dental masses under light were compared. The storage modulus of dental mass A (red) increased sharply after 3.5 minutes, which can be attributed to curing of the material. The reaction of dental mass B (blue) began nearly one minute later and ran more slowly, as can be seen by comparing the slopes of the two materials. The difference in the final storage moduli (1100 MPa for dental mass A and 700 MPa for dental mass B) is due to differences in the mechanical properties of the cured products.



Comparison of the curing behavior of two dental masses
Measurements parameter: compression mode, temperature: 30°C, frequency: 10 Hz, amplitude: ±15 µm

Furthermore, the standard furnace of the DMA 242 E *Artemis* can be easily coupled with a humidity generator that provides a special atmosphere with controlled humidity content. This add-on allows for investigation of the influence of humidity on the dynamic-mechanical properties of a material.

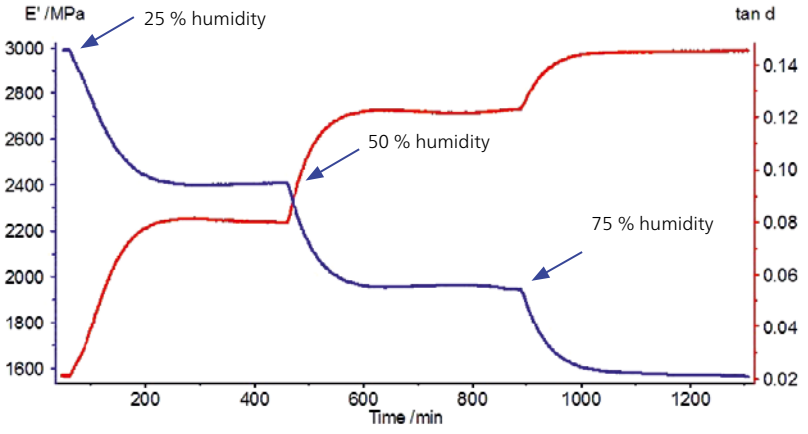
DMA 242 E *Artemis* with Humidity Generator

DMA 242 E *Artemis* – Accessories for Measurements with Humidity Generator

Description	Single Order Number
Humidity generator	MHG40000A02.000-00
Adapter for connecting humidity generator to the DMA 242 E	DMA2420EA62.000-00
Temperature controller	TRG00100A00.000-00
Humidity sensor (spare part)	MHG40000A02.021-00

Influence of Humidity on the Mechanical Properties of a Polyamide Film*

For this example, a polyamide film was dried and measured with the humidity generator in the tension mode. At the beginning of the test, the humidity generator was switched off and the storage modulus was constant at approx. 3000 MPa. As soon as humidity was introduced into the furnace, the storage modulus of the polymer decreased sharply; it reached a plateau at approx. 2400 MPa. Increasing the humidity content to 50% and to 75% (after 7 hours and after 14 hours) led to further decreases in the storage modulus. These results show that the humidity content has a great influence on the storage modulus of polyamide because water acts as a plasticizer on polymers.



DMA measurement with humidity generator
Sample: polyamide film (thickness: 50 µm), Sample holder: tension, Measurement parameters: isothermal 30°C, frequency: 1 Hz, amplitude: ±75 µm, Humidity generator parameters: relative humidity: 25%, 50%, 75% at 30°C, purge gas: 10 ml/min N_2

*Our thanks go to the University of Applied Sciences in Merseburg for the measurement and discussions.

Calibration Materials and Accessories

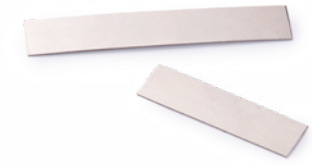
The DMA device must be calibrated in order to achieve optimum accuracy. In order to achieve this, Dynamic Mass Calibration, Empty System Calibration, System Stiffness Calibration and Rotation Tuning Calibration are necessary. The following tables list the equipment necessary to perform these procedures. The temperature calibration corrects the deviation between experimental and nominal temperature values. All calibration materials delivered with the NETZSCH DMA are described in following tables.

DMA 242 E *Artemis* – Calibration Set

Type	Contains	Remarks	Order Number
Calibration set	Steel bars for dynamic mass, stiffness and rotation tuning calibration	6.8 mm	6.160.1-50.0.00
Dynamic Mass Calibration	Weight		6.160.1-50.0.03
Stiffness Calibration	Steel bar, 35×8×5 mm	For bending and cantilever	NGB809255
	Steel bar, 60×8×5 mm	For bending and cantilever	NGB809256
	Steel bar, 20×6×2 mm	For tension	NGB809254
Rotation Tuning Calibration	2 steel bars (35×10×0.4 mm and 60×10×0.4 mm)	For cantilever	6.160.1-50.0.06

Weight for Dynamic Mass Calibration

Steel Bars for System Stiffness Calibration



Steel Bars for Rotation Tuning Calibration

DMA 242 E *Artemis* – Temperature Calibration Set

Type	Contains	Order Number
Temperature calibration set	Adamantane, indium, lead, sapphire disk, aluminum pans	6.160.1-98.2.00
Adamantane	400 mg	6.217.1-92.1.09
Indium Ø 4.5×0.25 mm	10 pieces	6.217.1-92.1.05
Lead Ø 4.5×0.5 mm	10 pieces	6.217.1-92.1.07
Sapphire disc		GB398456
Aluminum pan set	100 pieces	NGB810405

A variety of tools and parts is delivered with the DMA 242 E *Artemis* in order to mount the sample holder and the sample before measurement. They are listed in following table.

Micrometer gauge (GB396834)

DMA 242 E *Artemis* – Accessories

Type	Remarks	Order Number
Thermocouple K, with connector		6.160.1-03.8.00
Torque wrench adjustable 0.4 to 2.0 Nm	▪ Spare part for sample holders DMA2420CA50.030-00 and DMA2420CA50.031-00 (page 5) ▪ For precise fixing of all pushrods	NGB815986
Insert with wrench size 5.5 mm	For torque wrench NGB815986	NGB815987
Insert with wrench size 6 mm	For torque wrench NGB815986	NGB815988
Accessories set	Contains all elements described below	6.160.1-51.0.00
Micrometer gauge	Spare part for 6.160.1-51.0.00	GB396834
Torque screwdriver	Spare part for 6.160.1-51.0.00	GB396835
Cross slot screwdriver	Spare part for 6.160.1-51.0.00	GB396837
Hexagon wrench key DIN 911	Spare part for 6.160.1-51.0.00	GB010006
Flat wrench, type GEDORE 6 M	Spare part for 6.160.1-51.0.00	GB018374
Knob, Ø 16 mm, type OKW, size 16	For reamer GB396891, spare part for 6.160.1-51.0.00	GB395226
Reamer DIN 212	Spare part for 6.160.1-51.0.00	GB396891
Caliper gauge	Spare part for 6.160.1-51.0.00	NGB804815
Insert for torque screwdriver, size TX10	Spare part for 6.160.1-51.0.00	NGB813399

Torque screw driver and parts

Thermocouple K, with connector (6.160.1-03.8.00)

Torque wrench (NGB815986) with insert (NGB815987)

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