

Low temperature testers

The low temperature properties of rubber materials are very important, especially for rubber products used in colder climates. The requirements for these properties have since long been included in specifications, especially in the automotive industry.

For rubber materials there are four important standardised test methods for low temperatures.

1. TR test according to ISO 2921. This method determines the low temperature characteristics by the temperature retraction procedure. The values TR_{10} and TR_{30} are often used in material specifications. The software can present a curve with the elastic retraction up to 70 %.

2. Gehman test according to ISO 1432. This method measures the relative stiffness as a function of the temperature. The result is presented as the relative stiffness where the stiffness in RT is 1. If the test piece dimension are put into the software it can also calculate the modulus as a function of temperature.

3. Brittleness test according to ISO 812. This method determines the lowest temperature at which rubber materials do not exhibit brittle failure when impacted under specified conditions.

4. Low temperature compression set according to ISO 815-2. This test measures the elastic recovery after a test piece has been held compressed at low temperature for some time.

Elastocon offers instruments for these four important standardised test methods for low temperatures.



A TR and Gehman tester combined using the same base unit with a rig changing system, on the adjustable table ET 01.08. To the left the automatic cooling with liquid nitrogen, ET 01.02, which consists of a cryogenic vessel for the storing of liquid nitrogen and a special valve and hose that is needed for the connection between the vessel and the low temperature tester.

The TR tester, the Gehman tester and the brittleness tester can be combined using the same base unit with a rig changing system.

The combined instrument consists of a base unit with a cooling bath and the electronics. The different test rigs are then mounted on a rotating table. No lifting is necessary when switching from one method to another. The purchase includes the instrument and a computer. Windows applications for the respective methods are also part of the combined instrument.

An automatic computerised low temperature tester increases the precision up to 5 times. Also, the capacity increases with about 50 % and the labour time decreases by about 75 %.

Test	EPDM	NBR
ISO 812 Brittleness, °C	-49	-35
ISO 815-2 -20°C, % @30 s/30 m	92/77	87/38
ISO 1432, RM2/RM10/RM100, °C	-24/-47/-58	-24/-31/-38
ISO 2921, TR10/TR30/TR50/TR70, °C	-33/-19/-11/-4	-32/-28/-26/-22
Tg by DMA, °C	-50	-30
Tg by DSC, °C	-58	-34

To the left: Comparisons of different low temperature tests on 2 compounds, EPDM and NBR.

TR tester, ET 01-II

for determination of low temperature retraction

TR tester, ET 01-II, for determination of low temperature characteristics by the temperature retraction procedure according to ISO 2921 and ASTM D1329.

The Elastocon TR tester has 6 test stations. It performs the test automatically by releasing the test pieces from their elongated state, ramping the temperature, measuring the length continuously and finally stopping the test when the samples have retracted enough.

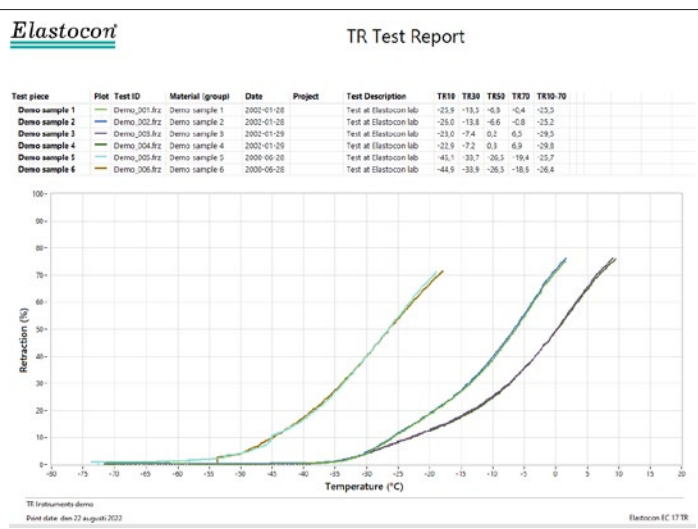
The EC 17 Windows application, which is a part of the TR tester, helps the user setup the test and it continuously displays the results. The application can be used to view and compare multiple tests and produce reports as defined by the standards, with results such as TR_{10} , TR_{30} , TR_{50} and TR_{70} presented. The results can also be exported, so that they can be opened in a spreadsheet application, for example.

We recommend the addition of our automatic cooling system with liquid nitrogen, **ET 01.02**.

Pre-cooling of the cooling media will drastically reduce the amount of liquid nitrogen required. We recommend the **ET 04** freezer for this purpose. Keep an extra batch of cooling media in the freezer to always be ready to make a new test.



The ET 01.03 grips for O-rings (both whole and cut) are optional for the TR tester.



Result from three materials with double test pieces.

Gehman tester, ET 02-II

for determination of the relative stiffness characteristics

Gehman tester, ET 02-II, for determination of the relative stiffness characteristics of vulcanized or thermoplastic rubbers, also called the Gehman procedure. The test is done according to ISO 1432, ASTM D1053 and other equivalent standards.

The Elastocon Gehman tester has 6 test stations and performs the test automatically.

The EC 18 Windows application, which is a part of the Gehman tester, helps the user setup and run the test and will continuously display the results in a graph. The application ramps the temperature, twists the test pieces in intervals, and measures the torsional angle, and finally stops the test once the torsional angle is small enough.

The application can be used to view and compare multiple tests and produce reports as defined by the standards, with results such as RM2, RM10, RM50, and RM100 presented. The results can also be exported, so that they can be opened in a spreadsheet application, for example.

We recommend the addition of our automatic cooling system with liquid nitrogen, **ET 01.02**.

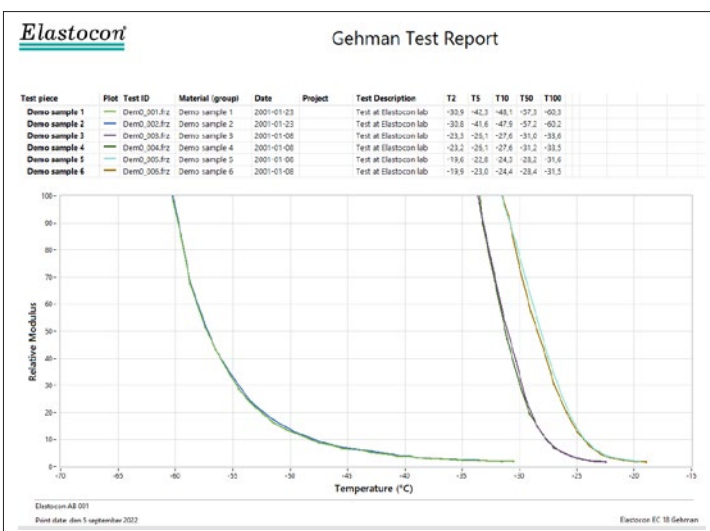
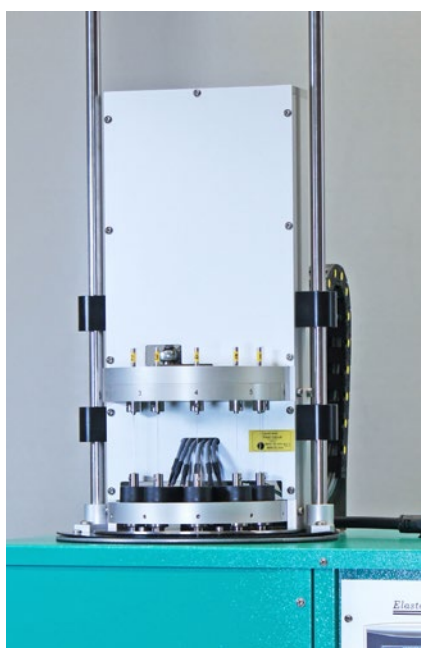
Pre-cooling of the cooling media will drastically reduce the amount of liquid nitrogen required. We recommend the **ET 04** freezer for this purpose. Keep an extra batch of cooling media in the freezer to always be ready to make a new test.



Automatic cooling with liquid nitrogen, ET 01.02.



ET 04 ultra low temperature freezer, -50°C to -85°C.



Result from three materials with double test pieces.

Brittleness tester, ET 05-II for determination of brittleness point

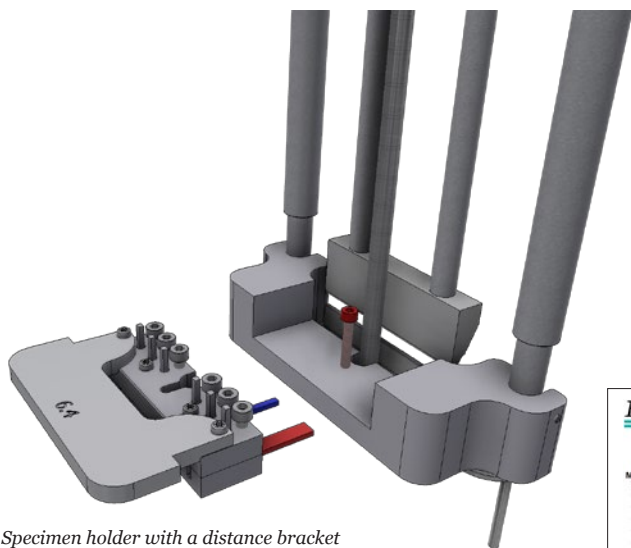
Brittleness tester, ET 05-II, for automatic determination of brittleness point according to ISO 812, ASTM D2137 and equivalent standards.

The Elastocon brittleness tester can hold up to 6 test pieces and is designed as a falling weight tester, where the speed is set by the height and of the attached weights, which are raised by a pneumatic cylinder.

The EC 19 Windows application, which is a part of the brittleness tester, helps the user setup and run the test, and continually displays the results in a graph. The temperature steps are controlled from the application and the user is guided through the testing procedure. The speed is measured at impact to verify that the correct energy is exerted. The application is also used for viewing and comparing test results and produce reports as defined by the standards. The measurement results can also be exported so that it can be opened in a spreadsheet application, for example.

We recommend the addition of our automatic cooling system with liquid nitrogen, **ET 01.02**.

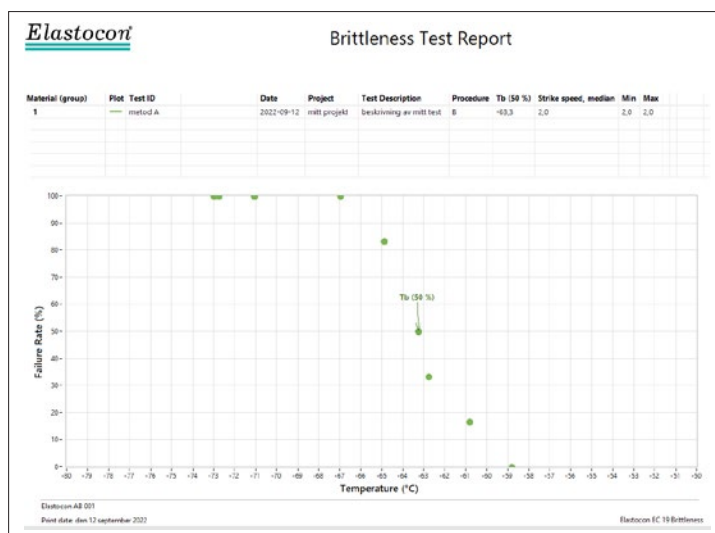
Pre-cooling of the cooling media will drastically reduce the amount of liquid nitrogen required. We recommend the **ET 04** freezer for this purpose. Keep an extra batch of cooling media in the freezer to always be ready to make a new test.



Specimen holder with a distance bracket for different material thickness according to ASTM D2137 and ISO 4646. In this example, the distance bracket is 6,4 mm.



The EC 19 Windows application, which is a part of the brittleness tester, helps the user setup and run the test, and continually displays the results in a graph.



Low temperature compression set test system

Performing compression set at low temperatures without having to open the deep freezer and influence the compression set result has always been a problem.

By using our **EV 09** compression rig with a modified laboratory freezer with a special lid the test can be performed without touching the test piece, according to ISO 815-2. All adjustments of height and releasing the compression are made outside the freezer thus improving the accuracy of the test results.

The EV 09 rig is by default equipped with a digital gauge (0,001 mm) for the smaller type of standard samples according to ISO 815-2 B. If testing with the larger sample (ISO 815-2 A) is also wanted, necessary accessories must be purchased. The piston is made of titanium and the test weight corresponds to the load for thickness measurements according to ISO 23529. The sample can remain in the test rig for the whole test period and during the recovery time.

With the conversion kit **ET 03.01** Elastocon's laboratory freezers can be adapted for testing in low temperature compression set with our EV 09 rig. The kit includes, among other things, the special lid where the rigs can be placed directly through the lid without the need to open the freezer.



The test rig EV 09 is adapted for low temperature compression set.



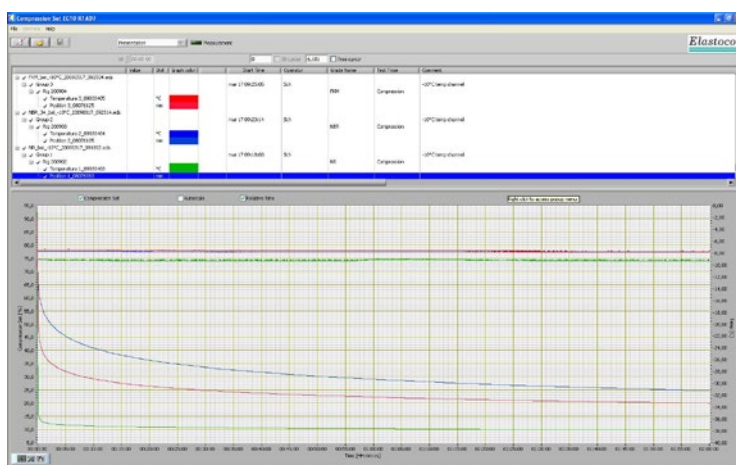
Laboratory freezer ET 03 with conversion kit ET 03.01-6 for 6 rigs, and the EV 09 test rig.

A complete low temperature compression set test system requires the following components:

- **EV 09** – Test rig adapted for low temperature compression set (LTCS).
- **ET 03** – Low temperature laboratory freezer (-10 to -45 °C).
- **ET 03.01-6** – conversion kit for the freezer (for 6 rigs).
- **ED 04** – Computer (Windows).
- **EC 10** – Software.
- **EV 09.04-8** – Adapter for computer connection of the digital gauge.
- **EV 09.05-6** – Amplifier for computer connection of the Pt 100 temperature sensor.



Optional hood (ET 03.02) for LTCS in case of condensation problems. Can be combined with an air dryer. We can supply air dryers with either -40 °C or -70 °C dewpoints (ET 08-xx). An alternative is to use desiccant in the hood.



Low temperatures compression set (LTCS) software, EC 10. This software monitors the temperature during the test time and records the recovery when the test piece is released.

By setting evaluation points at 30 seconds, 30 minutes, and so on, the results can be presented, as well as a graph of the compression set as a function of time. The values can also be recorded manually.

Technical specifications

	ET 01-II	ET 02-II
Temperature control		
Temperature range, °C:	-80 to +20	-80 to +20
Accuracy, °C:	± 0,5	± 0,5
Resolution, °C:	± 0,1	± 0,1
Sensor:	Pt 100, 1/3 DIN	Pt 100 1/3 DIN
	Length measurement	Angle measurement
Indicators, no:	6 pc digital encoders	6 pc digital encoders
Resolution, mm (01-II)/°(02-II):	0,1	0,2
Measuring range, mm (01-II)/°(02-II):	0–175	0–182 ⁽¹⁾
Test rig		
Rig material:	stainless steel and aluminium	stainless steel and aluminium
Specimen sizes, mm:	25 to 100	–
Max extension %:	250 (with 50 mm test piece)	–
Min/max test samples, l × w × t, mm:	–	40 ± 2,5 × 3 ± 0,2 × 2 ± 0,2
Test stations:	6	6
Other specifications		
Dimensions, external, w × h × d, mm:	680 × 1 260 (1 580) ⁽²⁾ × 710	680 × 1 010 (1 260) ⁽²⁾ × 710
Weight, kg:	approx 90	approx 93
Cooling liquid volume, l:	about 8	about 8
Voltage, V:	220–240 VAC 50/60 Hz (alt 110–120 VAC)	220–240 VAC 50/60Hz (alt. 110–120 VAC)
Power, W:	600	600
Air supply, bar:	6–8	6–8
Computer connection:	Ethernet	Ethernet
Standards:	ISO 2921, ASTM D1329	ISO 1432, ASTM D1053
	<i>(1) Testing range adjustable from 0–182°. Adjusted at 0–180°.</i>	
	<i>(2) Test rig in raised position</i>	

Important specifications for all ET testers

- Software required for using the tester (EC 17/18/19).
- PLC with touch screen for real-time control of the instrument.
- The rig is raised with the help of a pneumatic cylinder.
- Temperature controller with 0,1 °C setpoint and RS232 interface.
- Temperature sensor close to the samples.
- Solid state relay for safe control.
- The casing consists of steel, painted with epoxy paint.

Included with ET 01-II

- Template 50 mm (default) for setting the test distance.
- Computer (Windows).
- Support agreement 12 months.
- Manual in English.
- Stylus pen for the instrument touch screen.
- Accredited calibration including certificate.

Options for ET 01-II

- ET 01.02** Automatic cooling with liquid nitrogen.
- ET 01.03** Grips for O-rings (both whole and cut).
- ET 01.04** Extra templates for setting the test distance; 25 mm, 38 mm or 51 mm (for ASTM) and 100 mm (for ISO).
- ET 01.08** Adjustable table*.
- ET 04** Ultra low temperature freezer, -85 °C.
- EA 01** Silent and oil-free air compressor, 105 l/min

Included with ET 02-II

- 3 sets with 6 wires in each set for different stiffness (0.7, 2.8, 11.2 mNm).
- Computer (Windows).
- Support agreement 12 months.
- Manual in English.
- Stylus pen for the instrument touch screen.
- Accredited calibration including certificate.

Options for ET 02-II

- ET 01.02** Automatic cooling with liquid nitrogen.
- ET 02.02** Extra torsion wire for Gehman, 0.7, 2.8 or 11.2 mNm.
- ET 02.03** Grips for ASTM D1053 method B.
- ET 01.08** Adjustable table*.
- ET 04** Ultra low temperature freezer -85 °C.
- EA 01** Silent and oil-free air compressor, 105 l/min.

* ET 01.08 Adjustable table

Dimensions: 1500 × 800 mm

Height: 600–900 mm (adjusted with an electric motor)

Power: 220–230V/50–60Hz

NOTE: this table is not recommended for the brittleness tester.

ELASTOCON reserve the right to modify these specifications in part or in whole.

Technical specifications

	ET 05-II	ET 06 BASEII
Temperature control		
Temperature range, °C:	-80 to +20	-80 to +20
Accuracy, °C:	± 0,5	± 0,5
Resolution, °C:	± 0,1	± 0,1
Sensor:	Pt 100, 1/3 DIN	Pt 100, 1/3 DIN
Speed measurement		
Indicators:	digital encoder	—
Resolution, m/s:	0,01	—
Test rig		
Rig material:	stainless steel and aluminium	—
Specimen types:	A and B (ISO 812)	—
Test pieces, no:	6	—
Other specifications		
Dimensions, external, w × h × d, mm:	680 × 1305 (1530) ⁽¹⁾ × 710	750 × 1610 ⁽¹⁾ × 870
Weight, kg:	approx 115	69 ⁽²⁾
Cooling liquid volume, l:	about 8	about 8
Voltage, V:	220–240 VAC 50/60 Hz (alt 110–120 VAC)	220–240 VAC 50/60 Hz (alt 110–120 VAC)
Power, W:	600	600
Air supply, bar:	6–8	6–8
Computer connection:	Ethernet	Ethernet
Standards:	ISO 812, ISO 4646, ASTM D2137	—
	(1) Test rig in raised position.	(2) Rig ET 01-II +22 kg/ET 02-II +25 kg/ET 05-II +51 kg

Included with ET 05-II

- Computer (Windows).
- Support agreement 12 months.
- Manual in English.
- Stylus pen for the instrument touch screen.
- Accredited calibration including certificate.

Options for ET 05-II

- ET 01.02** Automatic cooling with liquid nitrogen.
- ET 04** Ultra low temperature freezer -85 °C.
- EA 01** Silent and oil-free air compressor, 105 l/min.

ET 01.02 – specifications for cryogenic vessel:

- Size: 60 litres
- Weight empty vessel: 65 kg
- Evaporation rate: approximately 2 % per day (measured at atmospheric pressure)
- Base diameter: 620 mm
- Overall height: 900 mm

If a vessel for the liquid nitrogen or another supply options for liquid nitrogen is available in your laboratory you can choose **ET 01.02.1** instead, which only includes the special valve and hose for the connection to the low temperature tester.

Please check with us first for verification that your solution will work.

Included with ET 01.02

- Cryogenic vessel, 60 liter.
- Special hoses and valves that communicates with the low temperature instrument for the control of the instrument.
- Manual in English.

Technical specification, low temperature compression set rig, EV 09

Range, mm:	12,7
Accuracy, mm:	$\pm 0,003$
Resolution, mm:	0,001
Dimensions, dia $\times$ h, mm:	120 $\times$ 450
Weight, kg:	6
Material:	stainless steel
Temperature sensor:	Pt 100, 1/3 DIN
Standard:	ISO 815-2

The test rig is equipped with a digital gauge connected to a PC for recording of the creep.

EV 09 is by default for smaller sized sample, ISO 815-2 sample B (thickness 6,3 mm $\pm 0,3$ mm, diameter 13,0 mm $\pm 0,5$ mm)

For testing with sample A (thickness 12,5 mm $\pm 0,5$ mm, diameter 29,0 mm $\pm 0,5$ mm) from ISO 815-2 you will need the following accessories:

- **EV 09.03** – spacer 9,375 mm
- **EV 09.06** – larger, upper compression plate and necessary weight.

Technical specification, lab freezers

	ET 03 (11 LT)	ET 07 (11 VLT)	ET 04 (11 ULT)
Temperature, °C:	-10 to -45	-30 to -60	-50 to -85
Ambient temperature, °C:	+10 to +30	+10 to +30	+10 to +30
Net volume, l:	130	130	130
External dimensions (w $\times$ d $\times$ h):	725 $\times$ 655 $\times$ 865	725 $\times$ 655 $\times$ 865	725 $\times$ 655 $\times$ 865
Internal dimensions (w $\times$ d $\times$ h):	520 $\times$ 450 $\times$ 650	520 $\times$ 450 $\times$ 650	520 $\times$ 450 $\times$ 650
Insulation thickness, mm:	100	100	100
Net weight, kg:	46	56	56
Voltage, V:	220–240 V/50 Hz	220–240 V/50 Hz	220–240 V/50 Hz
Power, W:	210	375	480
Energy consumption/24 h, kWh:	3,4	4,3	5,8
Type of cooling:	Static	Static	Static
Type of defrost:	Manual	Manual	Manual
Thermostat:	Digital	Digital	Digital
Refrigerant:	R404a	Mix of 2 hydrocarbons	Mix of hydrocarbons

Common specifications:

- Acoustic alarm
- Large temperature display
- Digital temperature controller 0,1 °C
- Handle with key lock
- Defrost water drain hole
- One stage compressor ensures high level of reliability
- 100 mm high performance insulation
- CE-marked

The lab freezers are for use with ET03.01 conversion kit for LTCS or for cooling liquid for low temperature tests.



ELASTOCON reserve the right to modify these specifications in part or in whole.

Important recommendations for all instruments!

For the best performance of the instrument, we recommend the following working environment:

- Standard laboratory temperature of either 23 °C $\pm 2^\circ$ or 27 °C $\pm 2^\circ$.
- Humidity not more than 90 % RH – non condensing.
- For long term logging instruments secure the power to the computer with a double converting UPS, for reducing electrical disturbances and power failure (ask Elastocon for recommendations or quotation).
- Other environmental aspects: Pollution degree 2 – Laboratory environment

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