

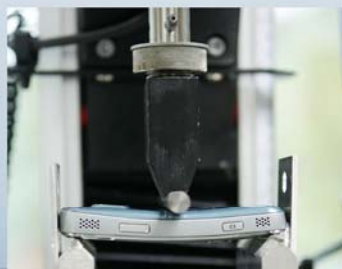
Nokia test centers

Innovative testing and a global commitment to quality

- Nokia has a global network of 10 test centers around the world all working to the same high quality standards
 - Oulu, Jyväskylä, Tampere and Salo
 - Copenhagen
 - Ulm
 - Southwood
 - Beijing
 - Tokyo
 - San Diego
 - Finland
 - Denmark
 - Germany
 - UK
 - China
 - Japan
 - US
- Our devices are tested throughout the design process, from the first prototype to the final product
- Every product goes through more than 200 different mechanical tests

TESTING FOR REAL LIFE

- **EVERYDAY USE:** We carry our devices around with us everyday and they have to be able to survive the wear and tear this causes.
 - When phones are **carried in handbags** they can be covered in hand lotions, sunscreen, make up and other substances carried with them, so we test our devices to ensure the design can help protect the exterior and also components within the device.
 - Devices are often in **bags or pockets** with other items like keys or coins, so we place devices in a special “shaker” machine with hard particles to see how resistant they are.
 - When we carry devices in our back pockets they may bend when we sit down or rub on trouser fibers. We simulate these effects with special machines that **bend and twist** the device, and one that uses a real pair of jeans to test friction and wear and tear.
 - Because we take our phones with us everywhere they sometimes get coffee, water or other liquids spilt on them. We test to check that these kind of **spills** don't affect the surface of the device and that we can limit the impact on internal components if the liquid gets inside the phone.
- **KEYPADS:** People press the main keys on their device an average of 200-300 times every day. To ensure the keypads can respond to this level of use we press the keys up to **one million times** in the lab.



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Specifications are subject to change without notice. The availability of particular products and services may vary by region. Operation times may vary depending on radio access technology used, operator network configuration and usage. Operations, services and some features may be dependent on the network and/or SIM card as well as on the compatibility of the devices used and the content formats supported. Some services are subject to a separate charge.

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Connecting People

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- **WEATHER CONDITIONS:** Our devices are used around the world and need to be able to withstand different weather conditions and temperatures.
 - We use special machines to expose them to **extreme temperatures** from around -40°C to $+85^{\circ}\text{C}$, helping them to withstand conditions from the cold of the arctic circle to the heat of the Sahara desert.
 - We also test for use in tropical and humid parts of the world by placing devices in a special chamber for several weeks where they will experience **humidity** levels as high as 95%.
 - To help protect against damage that could be caused by **sun bleaching** we use a solar simulator to test paints and finishes.
- **MECHANICS:** In its lifetime a phone will be opened and closed many thousands of times so we have to put our hinges, folds, camera shutters, and other mechanics through **rigorous force and pressure** testing.
- **ROBUSTNESS:** We test the structure and strength of devices in several ways, for example,
 - We **drop** the device onto a concrete surface to simulate falling from the height of a shirt pocket to test its resistance.
 - To ensure devices can stand up **extreme force** they are pressed with a steel fixture that applies 100 newtons, the equivalent pressure to two times the maximum clasp force of an average person.
- **RESISTANCE:** Many different aspects of the device are tested for resistance
 - **Dust resistance** is tested by putting the device into a bouncing dust box to see if dust can enter inside
 - The **wear resistance of labels** is tested by multiple rotary and linear wear equipment. This is to make sure labels remain readable and do not come off due to wear and tear

ANALYZING THE TEST RESULTS

- Drop test results are analyzed with a high-speed camera that can take up to 100 000 frames per second, over **3 000 times faster** than a normal video camera, allowing frame by frame analysis of test results.
- Analysis with **microscopes** with 1 000 x (optical) to up to 50 000 x (electron) magnifications are used to see when and where possible micron size solderings may crack.
- **3D X-rays** are used to analyze different types of failures, such as device components which may have cracked or broken due to dropping, twisting or bending.
- **Energy dispersive X-ray spectroscopy** is a technique used for the elemental analysis of materials, this process uses electrons and x-rays.

