



# JIKAN

Surface Nano-Engineering



## IAT-40

Ice Adhesion Test Machine

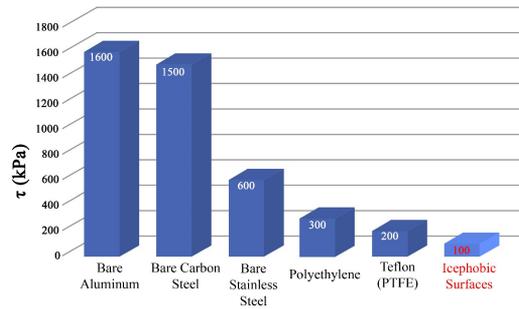
A spin off from



# What is Icephobic?

Ice accretion makes negative impact in many occasions, concerning telecommunication towers, antennas, power network systems, aircrafts and ships. Currently, there are many materials commercially available and marketed as icephobic, where ice adhesion is very small on these surfaces. Ice adhesion is defined as the physical and chemical bonding of ice and substrate.

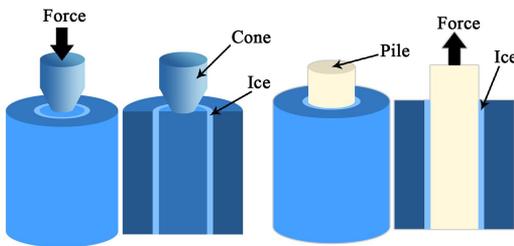
The maximum force needed for shedding the ice from the surface divided by the surface area, i.e. shear stress ( $\tau$ ), is a criteria for comparing the icephobicity of surfaces. Icephobic surfaces are surfaces which their shear stress is less than 100 kPa.



## Methods for Measuring Ice Adhesion

### Cone Test and Pile Test

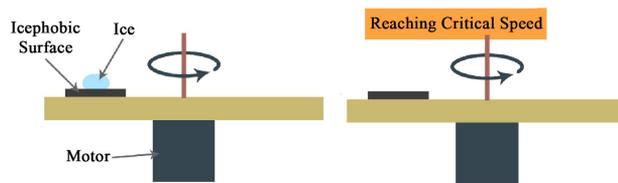
Here a rod-shaped sample adheres to a hollow cylinder, the force needed to pull out the rod, shows the ice adhesion. This test takes 48 hours and Icephobic sample have to be rod shaped which is not trivial.



### Centrifugal Test

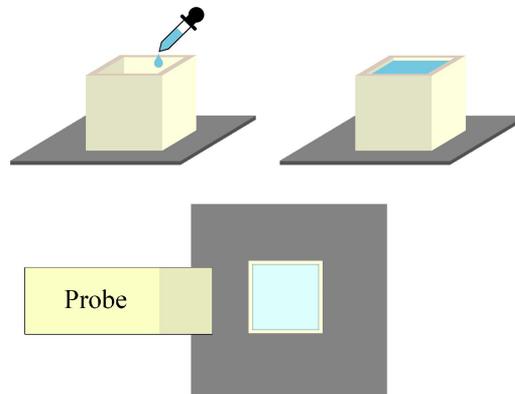
the sample is attached to a rotating disc, and a piece of ice is on its surface, by increasing the rotating speed the ice will be detached, showing the ice adhesion.

For each test, the adhesion area changes and Keeping the temperature constant is not easy.



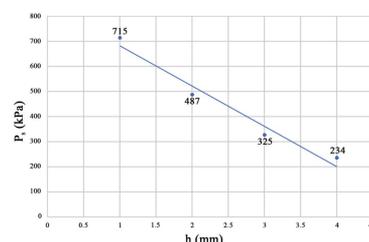
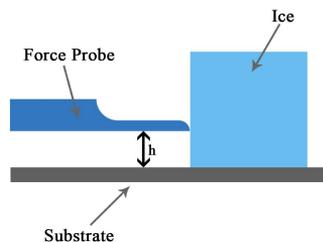
### Linear Shear Stress Test

In this method a cube of ice, is formed on the device surface. a probe slowly moves to detach the ice from the surface while measuring induced force on the probe. you are free to use versatile injection methods, molds, force sensors and environmental chambers. this method is flexible to use any shaped samples while they have plabar surfaces.



## A Closer Look

There are a lot of variables that directly affect the maximum shear stress between the formed ice and the surface. majority of them are discovered and solved in this method to reach a repeatability of 5% in tests. sample surface temperature, chamber humidity, injection levels and rates, geometry of ice mold, speed of pushing probe, data acquisition rates, quality and purity of water, rate of ice freezing etc are all considerable in this method which is carefully appraised, analyzed and set to have the minimum disturbance on ice adhesion result in JIKAN IAT-40

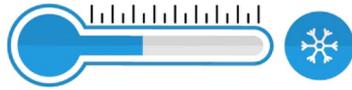


## Current Device

Jikan IAT-40 is the first Ice adhesion Test Machine in the world, which has coped with challenges in the way of measuring ice adhesion, achieved the highest level of precision in ice adhesion testing.

each test takes 15-20 minutes and the highest level of reproductibility is achievable with the device.

This device will be connected 300W Chiller to reach freezing degrees and a Microliter precision syringe pump for precision ice forming, which are also offered by Jikan (see Jikan RMC-20 and SPM-10)



### Multineedles And Injection curve

for higher precision on icephobic samples, you can use bigger molds and multineedle syringes for better quality of formed ice.



### lowest pushing Speed

high precision motor control with micrometer precision in rate adjustment leads to detachment of ice by a low degree and the peaks of induced shear stress wo'nt be missed.



### Live Graphs

IAT-40 can be used as a stand-alone device, with a graphical, user -friendly touch screen which displays live graph of shear stress against time for better understanding of the sample's icephobic properties.



### Exclusive PC Software

this device also can be used with the software provided by Jikan. complete set of data throughout the test can be saved and exported for further analysis.



### Surface Temperature Settings

maintaining a fixed, accurate set point to freeze the water is vital for ice quality. using IAT-40 you can set the temperature of the sample's surface instead of device surface, which leads to lower test time, higher reproductibility and ability to test thicker samples



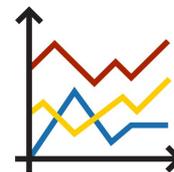
### Humidity Effect Control

the closed chamber leads to decrease of humidity of the test environment due to condensation of moisture on device's aluminium cold floor, preventing frost formation on the sample's surface.



### Freezing Curve

in order to reach a perfect quality for ice, you need to adjust temperature level-by-level. the best temperature curves for freezing are introduced and implementable by the user in this device.



### Vast Sample compatibility

Icephobicity of samples as small as 10x20mm to samples as big as 60x60mm from 0.1 to 5 mm thickness can be measured by the device.

# Technical Data

|                                  |  |
|----------------------------------|--|
| Test Chamber Temperature         | -20 °C - 0 °C (Accuracy 0.1 °C)                |
| Surface Temperature Resolution   | -20 °C - 0 °C (Accuracy 0.1 °C)                |
| Force Sensor Accuracy            | 0.1 - 1000 kPa (Accuracy 0.1 kPa)              |
| Force Probe Speed                | 0.1 - 500 mm/min (Accuracy ±1%)                |
| Sample Stage                     | Motorized Height Adjustment                    |
| Moisture Absorber                | Automatic                                      |
| Cooling Water Temperature needed | 0 °C - 10 °C<br>(Compatible with Jikan RMC-10) |
| Ice (Mold) Size                  | Multiple Config. (1 - 8 cm <sup>2</sup> )      |
| Thermoelectric power             | 72 W   |
| Force Probe Dimensions           | 1 mm × 20 mm                                   |
| Maximum Sample Size              | 100 mm × 40 mm                                 |
| Dimensions                       | 410 mm×180 mm×160 mm                           |
| Operating Voltage                | 110-240 V<br>50-60 Hz                          |
| Power Consumption                | 250 W  |



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