

TEMPERED GLASS

# SCREEN PROTECTOR



H IS FOR HARD!

## THE THINNEST

BULLET-PROOF - EXPLOSION RESISTANT - MILITARY  
GRADE - UNSCRATCHABLE - BOMB PROOF -  
KRYPTONITE - SAPPHIRE HARD - RHINO SKIN -  
INVISIBLE - PATENTED NASA TECHNOLOGY -

MADE IN JAPAN OR GERMANY OR USA OR MAYBE IN A  
SECRET UNDERGROUND LAB????



EVER GET THE FEELING YOU'RE BEING LIED TO?



The truth behind  
the marketing  
myth.

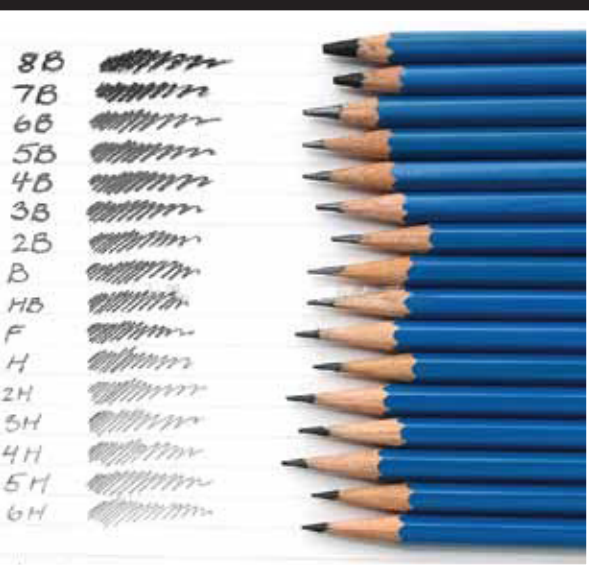
Crystalusion™  
Liquid Glass Protection

# EVER GET THE FEELING YOU'RE BEING LIED TO?

Bullet-proof, explosion resistant, military grade, patented NASA Technology..... The list of claims and attributes on most screen protectors packaging is an astonishing, often unbelievable barrage of marketing spin but one claim stands proud above all others in most cases; the elusive claim of a 9H hardness rating. It sounds impressive, like, not quite a 10 out of 10 but pretty dam close right?

But what is 9H and what, if anything, does it mean? Herein we'll explain where 9H came from, what protection you can expect from it and help to sort the facts from the marketing fiction.....

9H might be the greatest marketing gimmick in the history of mobile accessories, but it's hardly a measurement to be taken seriously if you are shopping for a good screen protector. There's no doubt, tempered glass is stronger than ordinary glass, just take a look at Corning's gorilla glass product – it's the most widely used toughened glass in the mobile device market but you won't see a single mention of "9H" in any of their marketing material and there's a very good reason why.



The "9H hardness" term comes from a pencil scratch test (Wolff-Wilborn, ASTM or similar). For this test pencils (yes pencils, the kind of pencils you write or draw with) of different grades of hardness are pushed or pulled over the screen protector to determine which pencil hardness, if any, visibly scratches the screen protector. In this case the different grades of pencil used typically range from 9B to 9H (the "B" is softer and the "H" is harder). Any screen protector that claims 9H hardness is essentially promoting the fact that it can't be scratched with a 9H pencil using this test. The problem with this test is it's not relevant when measuring the abrasion resistance of tempered glass screen protectors!

## WHY IS 9H IRRELEVANT?

Much of the misleading advertising surrounding device protectors and their scratch resistance and/or hardness comes from the result of the 9H pencil scratch/hardness test performed being miscorrelated to represent 9 on Mohs scale of mineral hardness; to understand how and why this happens a basic understanding of what Mohs scale of mineral hardness is needed, so herein follows a brief explanation:



TriboGear pencil scratch test

# SO WHO'S MOHS?

Friedrich Mohs was a German geologist who created a scale that characterises the scratch resistance of minerals through the ability of a harder material to scratch a softer material and comparing the hardness by seeing which minerals can visibly scratch others. Mohs scale runs from 1 through 10, 1 representing the softest mineral –which is Talc and 10 representing the hardest mineral which is Diamond, the full scale is listed below for reference.



## SO WHY IS THE TEST IRRELEVANT?

The 9H pencil “lead” used to conduct the pencil scratch test is made from graphite, graphite having a mineral hardness of 1-2 on Mohs scale.

Normal glass has a mineral hardness measuring between 6-7 on Mohs scale (tempered glass being the toughest variant at the higher end (7) on the scale).

so even normal non-tempered glass couldn't be scratched using a 9H pencil!

which is why a “9H Hardness” claim on any device protector is irrelevant.

## MOHS SCALE

Plastic	1	Lapis	5 - 5.5	Citrine	7
Graphite	1	Obsidian	5 - 5.5	Jasper	7
Talc	1	Hematite	5 - 6	Onyx	7
Pencil Lead	1	Knife Blade	5.5	Carnelian	7
Sulfur	1.5 - 2.5	Opal	5.5 - 6	Amethyst	7
Gypsum	2	Turquoise	5.5 - 6	Tiger's Eye	7
Alabaster	2	Magnetite	5.5 - 6.5	Garnet	7 - 7.5
Rock Salt	2	Rhodonite	5.5 - 6.5	Rhodolite	7 - 7.5
Plaster of Paris	2	Titanium	6	Iolite	7 - 7.5
Mercury	2 - 2.5	Rhodium	6	Tourmaline	7 - 7.5
Salt	2 - 3	Feldspar	6	Steel File	7 - 8
Amber	2.5	Orthoclase	6	Zircon	7.5
Ivory	2.5	Rutile	6 - 6.5	Tungsten	7.5
Fingernail	2.5	Fire Opal	6 - 6.5	Morganite	7 - 8
Pearl	2.5	Moonstone	6 - 6.5	Beryl	7.5 - 8
Zinc	2.5	Marcasite	6 - 6.5	Aquamarine	7.5 - 8
Gold	2.5 - 3	Iron Pyrite	6.5	Emerald	7.5 - 8
Silver	2.5 - 3	Tanzanite	6.5	Spinel	8
Aluminum	2.5 - 3	Nephrite	6 - 7	Topaz	8
Jet	2.5 - 3	Jade	6 - 7	Smokey Topaz	8
Copper Penny	3	Glass	6 - 7	Blue Topaz	8
Calcite	3	Cassiterite	6 - 7	Yellow Topaz	8
Limestone	3	Iridium	6.5	Chrysoberyl	8.5
Shell	3	Kunzite	6.5 - 7	Alexandrite	8.5
Bronze	3	Peridot	6.5 - 7	Cat's Eye	8.5
Coral	3	Bloodstone	7	Cubic Zirconia	8.5
Barite	3 - 3.5	Quartz	7	Chromium	8.5
Malachite	3.5 - 4	Rose Quartz	7	Tungsten Carbide	8.5 - 9
Azurite	3.5 - 4	Smokey Quartz	7	Corundum	9
Fluorite	4	Milk Quartz	7	Sapphire	9
Platinum	4 - 4.5	Black Opal	7	Ruby	9
Iron	4 - 5	Flint	7	Carborundum	9 - 9.5
Meteorite	4.5	Aventurine	7	Moissanite	9.25
Palladium	4.75	Ametrine	7	Fullerite	10-
Apatite	5	Agate	7	Diamond	10
Tooth Enamel	5	Chalcedony	7	Nanorods	10+

## LAZY MARKETING

In a similar vein, the web is full of videos showing someone taking a knife to the screen of a device half protected with a plastic screen protector, half not. Unsurprisingly the screen doesn't scratch but the plastic screen protector is all but destroyed; a quick look at Mohs scale will show that plastic has a hardness of (1), a knife blade has a hardness of (5.5) and Glass a hardness of (6-7) so again the test is totally irrelevant!



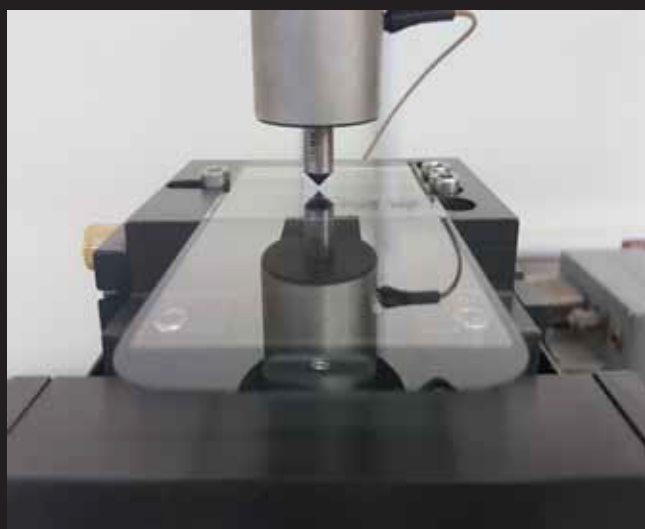


# SO WHAT IS RELEVANT?



Crystalusion™ don't use pencil scratch testing for all the reasons previously mentioned but also because the measurements are not accurately comparable. For example, there are different specifications concerning the length of the exposed pencil lead. The figures vary from 3 mm to 6 +/-1 mm. Some test guidelines state that the pencil should be held at a 30° angle rather than a 45° angle and that the block holding the pencil can be pushed or pulled. Opinions also differ about the shape of the tip of the pencil lead (flat or rounded) and about the type of sandpaper used to prepare the lead. The same applies to the test load, which can range from 300g to 7.5 N (7.4N is roughly 760 grams).

## HARDER TESTING!



ST3001 Tribo tester

Crystalusion is scratch resistance tested using a Rockwell Diamond (the hardest naturally occurring mineral in the world and capable of scratching most surfaces) and all of our tests are conducted using ASTM standardised test methodology by an external, impartial laboratory who certify every claim we make about the resistance of our product. Crystalusion is tested to 80N (roughly 8150 grams, more than 10 times the pressure used in the pencil scratch test) and is tested with a 0.2mm diamond tip (absolute hardness of 1600 / 1600 times harder than that of the pencil test).

## OUR APPROACH:

By impartial and rigorous product testing Crystalusion™ aims to provide customers and consumers with well-rounded and unbiased information to enable an informed choice, we will never overstate our product capabilities or manipulate test results to make our product seem better than it is – that's why we use impartial and independent test laboratories to conduct our tests to ASTM standards. If you're looking for the ultimate in device protection Crystalusion™ IS NOT IT!

Flip cases and full body protection products will always offer a higher level of protection than any tempered glass or similar protection product. If however, you're like the millions of other users who love the way their device looks/feels and you don't want to spoil that look and feel but you do want to protect your device – Crystalusion™ is probably right up your street.

## THE RESULTS!

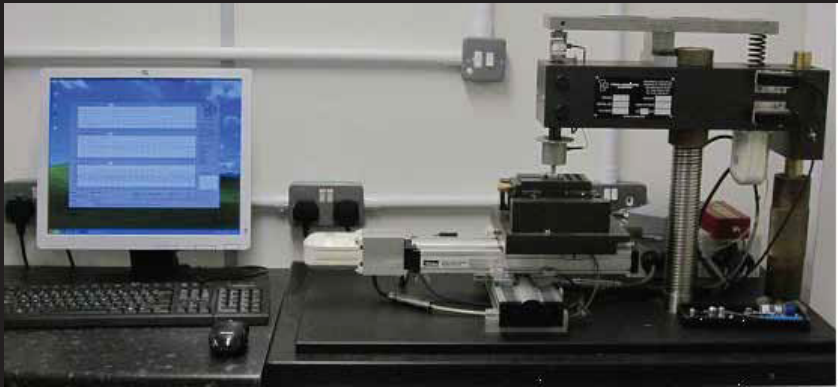
The following page contains our latest test results for your information, comparing Crystalusion against other products using the ASTM C1624-05 quantitative single point scratch testing methodology and showing all failure rates. Crystalusion™ is one of today's highest rated and highest reviewed protection products available, we urge every customer to check out the online consumer reviews of Crystalusion™ and encourage you to share your Crystalusion™ experience with others.

# BACKGROUND:

Scratch adhesion testing is performed on coated and non-coated samples to measure the critical load at which a coating or substrate shows signs of failure. The test can be performed with varying table speed, load rate, initial load and final load. The friction force and acoustic emission is recorded and displayed during the scratch test. The computer programme includes facilities so that the first derivative of the friction can be plotted to provide a clear indication of the load at which total coating failure or substrate failure occurs.

## TEST CONDITIONS

All tests are conducted using a 0.2mm tip radius Rockwell diamond, 5 to 80N load or maximum friction 30N, 10mm/min. linear velocity, 100N/min. load



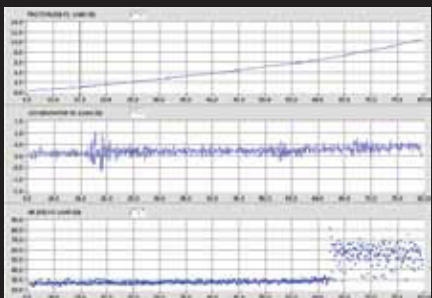
ST3001 Tribo tester

## GORILLA GLASS

Corning Gorilla Glass 3 substrate scratch failure occurs at 63N (equivalent to 6.42 KG downward force on a 0.2mm Diamond tip). Substrate survives 80N load.



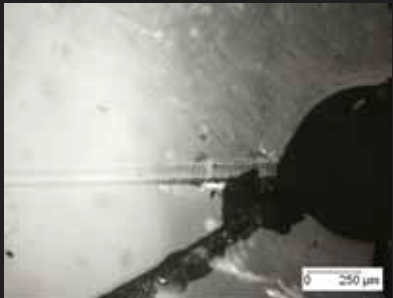
Optical microscope image of failure



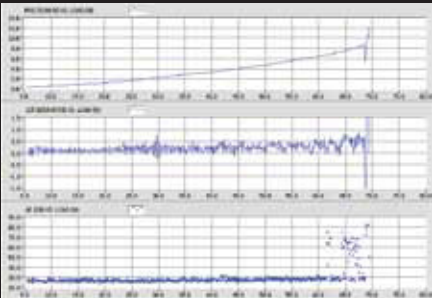
Friction force and acoustic emission

## TEMPERED GLASS

Tempered glass substrate scratch failure occurs at 55N (equivalent to 5.6 KG downward force on a 0.2mm Diamond tip). Catastrophic substrate failure (cracking) occurs at 67N.



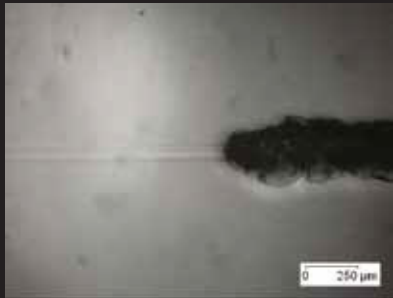
Optical microscope image of failure



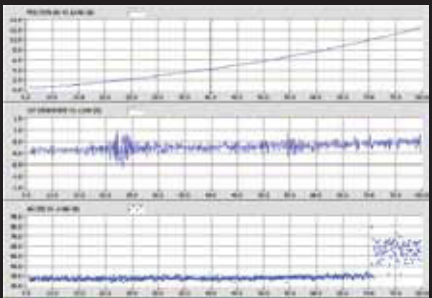
Friction force and acoustic emission

## CRYSTALUSION

Crystalusion substrate scratch failure occurs at 71N (equivalent to 7.24 KG downward force on a 0.2mm Diamond tip). Substrate survives 80N load.



Optical microscope image of failure



Friction force and acoustic emission

Crystalusion™ does NOT claim to be scratch proof but independent tests show that Crystalusion™ out performs one of the leading Tempered Glass screen protectors and Gorilla Glass 3 for scratch resistance. For more information please visit [www.crystalusion.com](http://www.crystalusion.com)