

BUILDING A LARGE TEMPERED GLASS SCREEN PROTECTORS INDUSTRY IN INDIA

*Formalizing the Mobile Accessories
Industry with Quality Standards*



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Executive Summary

Introduction to Screen Protectors

Displays and touch panels are critical components in the functionality of a wide range of handheld devices: smartphones, tablets, medical devices, point-of-sale terminals, and more. A screen protector is an additional sheet of material – mostly Tempered Glass or others. A Screen Protector is akin to an “Insurance Policy” for any Smart ICT Product and protects the most important feature of these products – Displays.

Chemically Tempered Glass Screen Protectors (TG-SP) is the most common used Screen Protectors on Mobile Phones due to its many technical advantages and low cost. There are many advantages of TG-SP which includes protection from scratches which otherwise weakens the Display / Touch Panel Glass, protection from impact damage from falls or drops, Easy and low-cost replacement and also provides a better resale value of Mobile due to protected displays.

Global market for Screen Protectors

Screen Protectors are one of the important and a large part of the Mobile Accessories market worldwide. It accounts for nearly 20% of the USD 225 Billion (in 2018)¹ worldwide market. Nearly 70% of the Screen Protectors are Chemically Tempered Glass. The use of TG SP is directly proportional to the sale of Smart Phones as nearly 90% of new Smartphone buyers opt to use a Screen Protector when they buy a phone. The average life span of the smartphones available in the market varies from 2-4 years, depending on the brand and quality of the phones. Around 50% of the users expect to replace the damaged or peeled out screen guards after every 1 year. **The global screen protective film market is expected to grow at a CAGR of 7% between 2020 and 2028 from USD 43.15 Billion to USD 76.64 billion².**

Indian market for Screen Protectors

Current state of the Indian Screen Protectors industry

The demand for TGSP in 2020 was estimated based on sales of Smartphone in 2020 in addition to the replacement demand from Smartphone sales in 2017-2019 period. **The demand for TG Screen Protectors for 2020 was estimated at 342.35³ million pieces.**

A market with such a large demand has **no established** players supplying Tempered Glass Screen Protectors in India. The Screen Protectors market is dominated by a host of Brands with some known International Brands and a host of unknown brands and many of them are of inferior / sub-standard / poor quality. **Most of**

¹ Allied Market Research report

² Market Research Future (MRFR) estimates

³ Feedback Advisory analysis

the business (~90%) in Tempered Glass Screen Protectors are happening in the “Grey” market. There is a small portion of the market sold through Ecommerce Channels which is formalized in the sense, there is a GST which is applied on the sale of these products, the rest are sold through roadside shops and mobile accessory shops in a mostly unorganized way.

The estimation of Value of the Supply of Tempered Glass Screen Protector market was done based on the assumption that an **ideal** Tempered Glass Screen Protector would be manufactured / imported at INR 100-125/piece and sold to the retailers at INR 120-200/piece, and then sold to the customers at INR 300 - 800/piece. We have considered an average price of INR 150/- per piece to Dealers and the end customer buying price to be around INR 450/- per piece. It is estimated that the market for Tempered Glass Screen Protectors in 2020 was around INR 5,100 Crores @ the retailer's level and ~INR 15,400 crores @ the customers end. At this level, the market being a highly “Grey” market, there is a **severe loss (~INR 2,773 Crore) to the Nation in terms of GST revenues⁵.**

Apart from the GST, as this business is done purely on cash trading and without bills, there are also other revenue losses to the nation from loss of Income Tax and Customs Duty. There is also a **lack of employment** which is not being generated by such a large industry in India in a formal way. Most importantly, the **Mobile consumers in India are being provided with spurious / sub-standard products** as Tempered Glass Screen Protectors.

Opportunity for India IN A FORMAL TEMPERED GLASS SCREEN PROTECTORS INDUSTRY

The opportunity which the Tempered Glass Screen Protectors industry presents India is to be viewed from two perspectives as indicated below:

- **Likely Domestic market** for Tempered Glass Screen Protectors and the benefits thereof
- Opportunities for India to participate in the **Global Market through Exports**

Likely Domestic market for Tempered Glass Screen Protectors and the benefits thereof ⁶

The future of the Tempered Glass Screen Protectors market is directly dependent on the smartphone sales in India. The TG SP demand in India is likely to grow at CAGR OF 10% from the **current 342.35 million pieces to 554 million pieces in 2025**. In terms of value, the likely future Domestic market for Tempered Glass Screen Protectors by 2025 is estimated to **reach ~INR 25,000 Crore (USD 3.4 Billion)** at consumer price, and the cumulative market for TG-Screen Protectors is likely to be **~INR 1,02,700 Crore (USD 14.3 B) in the next 5 years, between 2021 to 2025**.

There is a crying need to regularize this industry with **quality standards** and ensure that ‘Sub-standard’ TG-Screen Protectors are not made or imported and sold in the country. Once there is a level of standardization that comes through, then the local suppliers will be forced to sell through proper channels to claim GST credits and there is a possibility of formalizing the entire supply chain.

The potential gain of GST revenues to the Government of India will reach ~INR 4,500 Cr (USD 0.6 B) by 2025 or a cumulative gain to the nation is likely to be ~INR 18,500 Cr (USD 2.6 B) in the next 5 years, between 2021 to 2025.

^{4,5,6} Feedback Advisory analysis

Opportunities for India to participate in the **Global Market through Exports**⁷

If quality manufacturing is encouraged with the right standards and the right firms are invited to make in India, Tempered Glass Screen Protectors could be exported from the country. At the initial stage (for the next 5 years), India could attempt to gain a 15% global market share in the next 5 years.

India could potentially look at Exports of TG-SP to the tune of 951 million pieces or INR 20,300 crores (USD 2.7 B) by 2025 or a cumulative of ~INR 40,000 Crores (USD 5.4 B) between 2022 to 2025 with Quality manufacturing from India.

Other benefits of a formal Tempered Glass Screen Protector industry in India⁸

This large Tempered Glass Screen Protectors market (if formalized) is likely to bring in a lot of other benefits for the nation such as improving the country's image as a quality products manufacturing base and also could lead to a very high employment generation to the tune of 25,000 direct employment and ~75,000 indirect employment.

The identification between a 'Sub-standard' or REAL Tempered Glass Screen Protector is not possible with any 'VISIBLE' methods, the only method of identification is through a "SCIENTIFIC METHOD OF TESTING" as explained in the next chapter.

Testing Methods for Screen Protectors

This SCIENTIFIC METHOD of testing Tempered Glass Screen Protectors is necessary to be introduced in Indian market as a mandatory practice to enable a Quality Manufacturing led industry to help the nation with the above-mentioned benefits. In this report, the detailed science of Testing of Tempered Glass is explained in Chapter 4. It also shows the result of a detailed Testing Evaluation exercise carried out by ICEA along with Feedback Advisory. This exercise has led to the conclusion that the parameters of **Compressive Stress(CS) and Depth of Layer (DOL)** should be the ideal parameters to measure the level of tempering in these Screen Protectors.



^{7,8} Feedback Advisory analysis

Recommendations

Tempered Glass Screen Protectors are one the largest components of the mobile accessories market. The success/growth of this product is essential to have a complete mobile ecosystem in India.

The success of any products industry is determined by how organized the industry players are and how they contribute to the national development through bringing in increased consumer safety, employment, taxes and other social developments led by these companies.

It is important that the Government of India recognizes the importance of this sector and formulates certain policies towards developing this sector into an organized sector in the country. ICEA has the following recommendations for the development of this sector in India:

Introduction of Standards for Quality Manufacturing of Tempered Glass Screen Protector

- ICEA recommends that the Government of India brings in **BIS Standards for Screen Protectors** and these BIS standards should be made **mandatory for all Screen Protectors made in India or imported and sold in India**.
- ICEA recommends that the method of testing as suggested in Section 3.3 using a ‘Surface Stress Meter’ equipment or equivalent should be made mandatory for all manufacturers in India making Screen Protectors.
- ICEA recommends that for all suppliers of Imported Screen Protectors, they should be also mandated to undergo such tests and get a BIS approval on the products to be sold in India.
- To increase the Consumer awareness and their satisfaction of using standard Products and avoid getting cheated by spurious / sub-standard brands, ICEA recommends that, in order to ensure the manufacturer / supplier responsibility there should be a **mandatory ‘Fog marking / etching**’ on the glass itself indicating the name / logo of the manufacturer / brand of the TG Screen Protector, similar to those markings on Spectacle lens.
- The Recommended Quality Standards for Tempered Glass Screen Protectors should be to measure the degree of chemical tempering is measured by the magnitude of **Compressive Stresses (CS)** and the depth of the compressive stress layer (also called as **Depth of Layer (DOL)**). As per the Test Evaluation exercise undertaken by ICEA & Feedback Advisory, the suggested acceptable minimum quality standards for the right Tempered Glass Screen Protectors can be:

1. Compressive Stresses (CS) : Minimum of 600 Mpa
2. Depth Of Layer, or DOL : Minimum of 6 um

Government of India could further discuss this with Global suppliers of Glass & Technology providers (Corning, Asahi, etc) and validate these findings.

Restricting Fake Imports/Reduce Imports of Tempered Glass Screen Protectors into India

- Imports of Tempered Glass Screen Protectors needs to necessarily be done with '**Compulsory Registration Scheme' for Self-Declaration of conformity with new BIS Standards**'
- There should be a **mandatory "Fog marking / Etching"** on all the Imported Tempered Glass Screen Printers as well.
- MeitY should recommend a **specific HS Code for the Imports of Tempered Glass Screen Protector** and make this as a mandatory requirement for these imports with Customs, suggested HS codes are – 8517 & 8529

Consumer Education Program on Real Vs Fake Tempered Glass

There is an urgent need for educating consumers on the problems of Fake Tempered Glass and bring in some amount of Consumer Protection measures. Once the standards are introduced, there needs to be a wide consumer awareness creation exercise on the need to adapt only BIS-registered Tempered Glass Screen Protectors. Mobile OEMs and trade channels need to be actively involved in spreading this message. There is a need to educate consumers about the Fog Marking / Etching on the Screen Protectors and encourage them to source the Screen Protectors with these markings, so that they could take some remedial measures if these are not found to be real.





01

Introduction to Tempered Glass Screen Protectors

What are Screen Protectors?

A screen protector is an additional sheet of material—commonly polyurethane or Tempered Glass — that can be attached to the screen of an electronic device and protect it against physical damage. Screen protectors first entered the mobile-device market after the rise of personal digital assistants (PDAs). Since PDAs were often operated via a stylus, the tip of the stylus could scratch the sensitive LCD screen surface. Therefore, screen protectors provided sacrificial protection from this damage. Since then, the ubiquity of mobile devices has seen the screen protector become more widely used.

Need for Screen Protectors

Displays and touch panels are critical components in the functionality of a wide range of handheld devices: smartphones, tablets, medical devices, point-of-sale terminals, and more.

The display and touch panel are one of the first considerations that design engineers make during the conceptual and the developmental phase of a new product. In part, because they are one of the costliest components within the bill of materials. However, in many handheld devices, they are often left unprotected or protected by bulky plastic bezels and enclosures (a.k.a. ruggedization).



Displays and touch panels are subject to two conditions which cause them to fail:

1. **Scratches** from daily wear-and-tear or use of a stylus, where dust particles can become embedded on the tip and scratch the device. These scratches can cause a crack to propagate, which can eventually render the device completely useless.
2. **Drops** onto hard or sharp surfaces, which typically cause instantaneous fractures.

A Screen Protector is akin to an “Insurance Policy” for any Smart ICT Product and protects the most important feature of these products – Displays.

Types of Screen Protectors⁹

There are a wide variety of materials used for Screen Protectors and a brief comparative analysis is shown below in Table 1:

Material	Advantages	Disadvantages	Thickness
Plastic films (PET)	Low cost, thin, minimizes scratches	Gets scratched easily, low-impact force absorption, low-breakage protection, low-touch quality	0.1 to 0.35 mm
Liquid coatings	Low cost, thin, conforms to front glass, self-healing, shock absorbing	Difficult to install, low-impact force absorption, low-breakage protection, poor AF and touch quality, sticky.	~100 nm (0.1 Micron)
Chemically strengthened soda-lime (float) glass	Low cost, spreads impact force, better scratch resistance than PET, better touch feel.	Gets scratched easily and once scratched, the strength is gone, thick (typically >0.7mm for cover lenses)	0.3-0.4 mm (Preferred 0.33)
Premium quality chemically strengthened aluminosilicate glass	Mother glass is optimally designed for specific applications, and the parameters for the ion-exchange process are strictly controlled, resulting in a consistent high performance in scratch and impact protection	More expensive than other materials	>=0.33 mm

Table 1

⁹ <https://www.newvisiondisplay.com/protect-device-beyond-ruggedization/#h-why-protect-your-touch-screen-displays>

As explained above, due to its advantages, ‘Chemically Treated Tempered Glass’ is the most widely used Screen Protector material for the mobile phone industry worldwide.

Chemically strengthened glass or screen protectors are a great solution to protect the displays in Smart ICT Products because they provide:

1. Protection from scratches, which weaken the display/touch panel glass
2. Protection from impact damage from falls or drops
3. Maintenance of appearance and functionality
4. Easy, low-cost replacement vs. replacing the display or touch panel
5. Screen protectors are like a sacrificial layer that will break before the device, thereby saving the device from expensive repair or replacement
6. Better resale value of Mobile for consumers due to protected displays

What is a Chemically Treated Tempered Glass?

To increase the strength of the normal glass, the glass is processed under controlled thermal or chemical treatment. Tempering makes the outer surface into compression and inner surface into tension. Chemical tempering is best suitable for thin glasses and the glasses with good optical properties.

Chemically speaking, glass is a silicate, or in other words, a salt of silicic acid. The anion is the silicate ion, which forms a three-dimensional structure of silicon and oxygen atoms. The cations can come from the first three groups of the periodic table. If only sodium or potassium is used, the glass dissolves in water. So

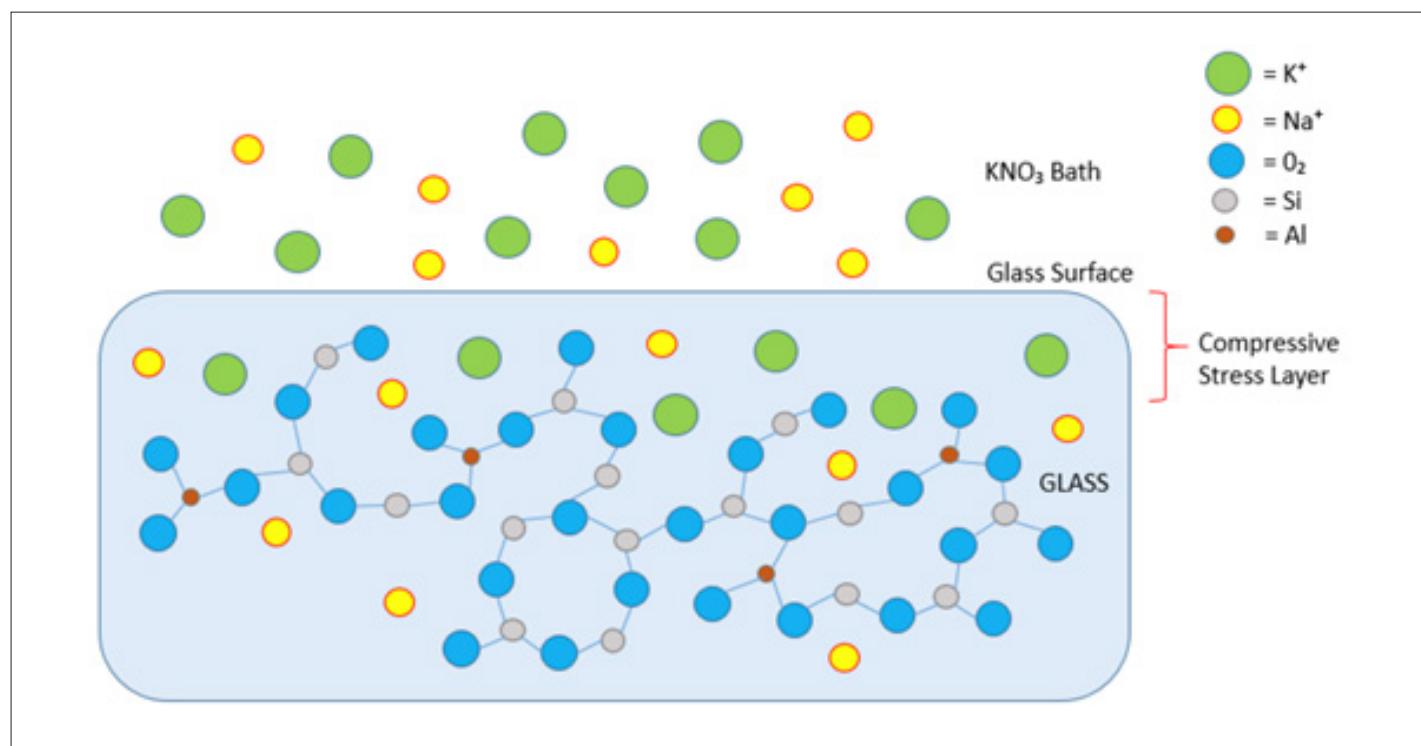


Figure 1

usually, there must be cations of the second or third group like calcium, aluminium, or boron. However, if some sodium or potassium is present, they remain loosely bonded and can be replaced. This is the basis for the process behind a chemically-strengthened glass as explained below in **Figure 1**.

Glass, which is formulated to have significant sodium in its composition, can be strengthened by replacing the sodium ions in the surface layer with larger potassium ions. This is achieved by inserting the glass into a bath of molten potassium salts at greater than 350°C, but below the softening point of the glass. The potassium ions need more space, in the rigid 3-D silicon-oxygen structure, resulting in a highly compressed surface layer of the glass. A compressive stress of well over one giga-pascal can be achieved that way, more than what the remaining centre layer of a glass sheet may be able to withstand.

Since the surfaces are under compression, there must be an equal but opposite force in the centre layer, which is expressed as the tensile stress of the centre layer. Too much tensile stress overcomes the molecular structure of the glass, so **an ideal amount of surface compression must be obtained in order for the hardened glass to perform well. This is dependent on the glass type, the depth and the profile of the compressive layer, and the overall thickness of the glass.**

Composition of a Tempered Glass Protector

A tempered glass protector is composed of three parts: the upper layer, which is also the layer touched by our fingers, is made from anti-fingerprint oil; The middle layer is tempered glass; The lower layer is the AB glue layer.

Upper layer of tempered glass protectors

Tempered glass protectors of low quality that do not have any anti-fingerprint oil processing are for saving cost. Tempered glass protectors of ordinary quality will use brush anti-fingerprint oil manually onto the upper layers, whose shortcomings are uneven smear and easy to fade away. Tempered glass protectors of good quality will use the machine to coat the upper layers. These layers are more durable than manual ones. Tempered glass protector of best quality is to electroplate fingerprint-proof oil onto the upper layers. Layers processed by this technology will be much smoother and the effect can last more than 2 months.

It is impossible to tell which technology is used in the upper layers by eyes. If you use tempered glass protectors frequently, you can judge its quality from the long-term touch.

Middle layer of tempered glass protectors

The manufacturer of a tempered glass screen protector purchases the raw material and makes the protectors after CNC cutting, arc edge polishing and chemical tempering.

- CNC cutting is to cut a whole piece of glass into different sizes of mobile phone glasses
- Arc edge polishing is to grind the square edge of the cut glass into 2.5d radians
- Chemical tempering is to place a glass film in a high-temperature furnace and make it to have a chemical reaction with potassium nitrate (the standard usually is 3-8 hours), to improve the glass strength and toughness so that even if the glass protector is broken, it will not cause any harm to the human body.

Lower layer of tempered glass protectors

The lower layer of tempered glass protector is AB glue layer

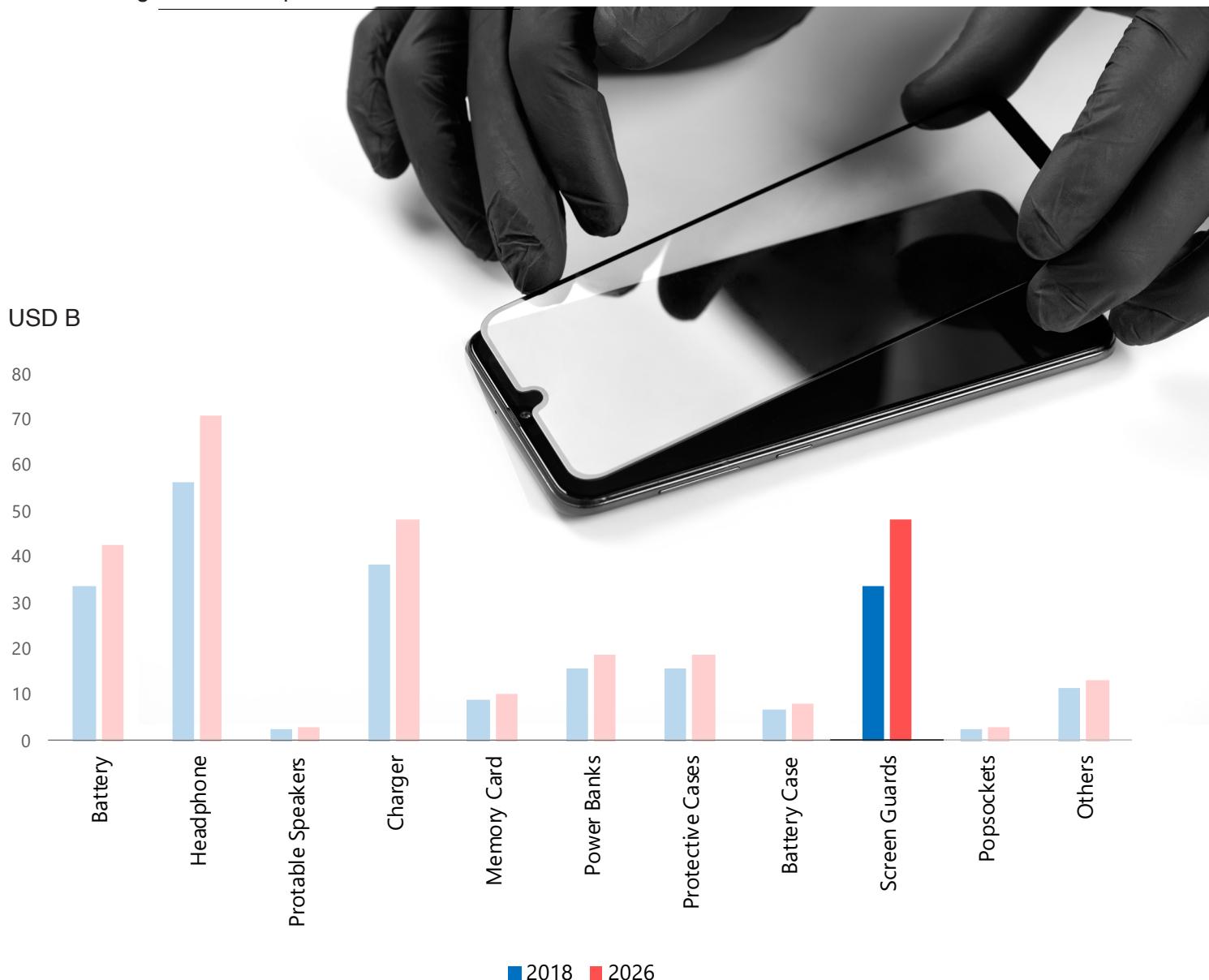


02

Market for Tempered Glass Screen Protectors

The global mobile phone accessories market size ¹⁰ was valued at \$224.69 billion in 2018, and is projected to reach at \$284.06 billion by 2026, growing at a CAGR of 3.1% from 2019 to 2026. Screen Protectors / Screen Guards are an important part (~20% of the market currently) of the Mobile Accessories market as shown below in Chart 1:

Chart 1: The global mobile phone accessories market size

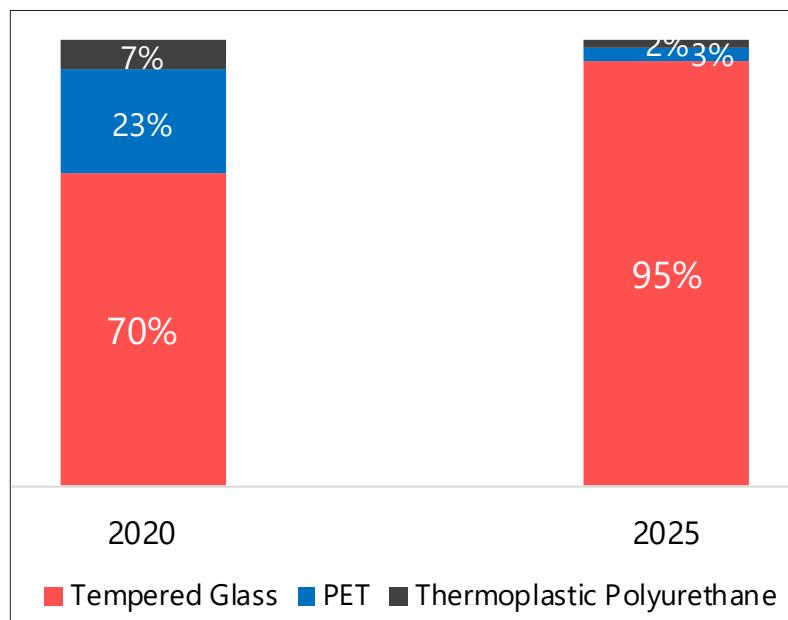


¹⁰ Allied Market Research

2.1

Global Market for Tempered Glass Screen Protectors

According to published reports¹¹, the tempered glass market is expected to comprise a share of ~70% among the screen protective films used in mobiles currently and likely to go up to 95% in the next 5 years as shown in Chart 2 below:



The mobile market is contributed from the sale of feature phones and smartphones. The adoption of smartphones has been increasing post 2014-2015, crossing the shipment of feature phones globally. Currently, a huge volume of production is concentrated on smartphones by the manufacturers.

Chart 2: Global Screen Protector Market

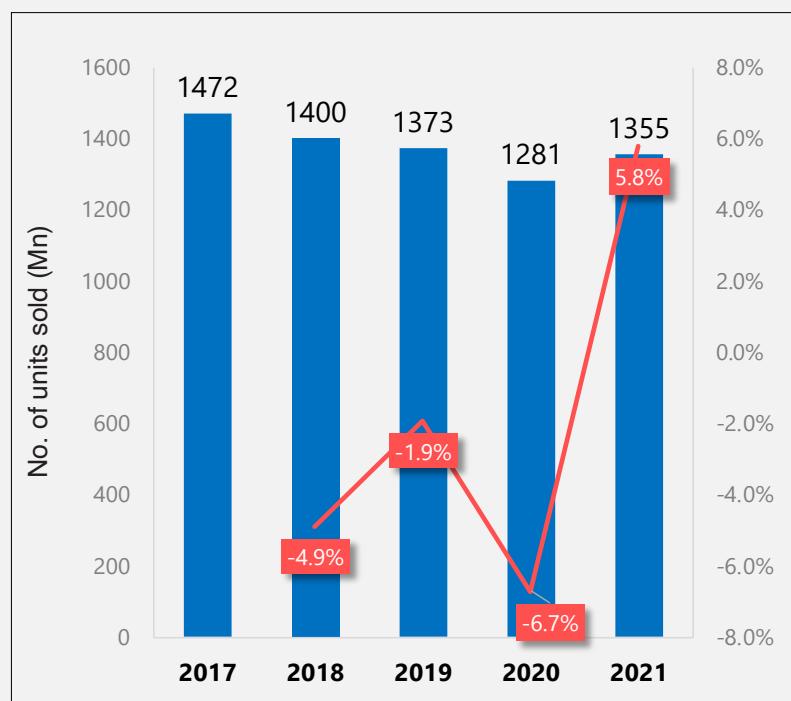
Source: Maximise Market Research estimates

The global smartphone market exhibits around 1,355-million-unit shipment in 2021

There is an expected boom in the smartphone market globally due to increasing features and capabilities. According to IDC, the global shipment of smartphones showed a negative growth in 2020. However, the 2021 estimates the shipment to rebound at a growth of more than 5%, following the growth in volume as explained below in Chart 3

Chart 3: Global Smartphone Market, 2017-2021 (Shipment in Million Units)

Source: IDC



¹¹ <https://www.maximizemarketresearch.com/market-report/global-smartphone-screen-protector-market/104378/>

It is expected that the 5G connectivity will drive the smartphone upgrades in both developed and emerging markets. Although 5G is not a fully established market, manufacturers are positive of rising 5G-enabled sales with infrastructure availability.

The consumption of the screen protective film for smartphones is normally 2-3 times the life span or the frequency of the handset.

The average life span of the smartphones available in the market varies from 2-4 years, depending on the brand and quality of the phones. Therefore, the use of screen protective film varies as per the customer usage of the smartphone. Generally, it is considered to replace the screen protector after 1 year of usage. Around 90% of the smartphone users go for screen protectors on the new device and around 50% of the users expect to replace the damaged or peeled out screen guards after every 1 year.

The adoption of screen protective films is highly increasing in smartphones as it provides protection from normal scratches and offering safety to both the mobile and the customer. The expected boom in the smartphone market will in turn promote the market of screen protective films.

The global screen protective film market is expected to grow at a CAGR of 7% between 2020 and 2028 as shown below in the Chart 4: Global Screen Protectors Market (USD B) ¹²



Source: Market Research Future (MRFR) estimates

¹² Market Research Future (MRFR) estimates

2.2

Indian Market for Tempered Glass Screen Protectors

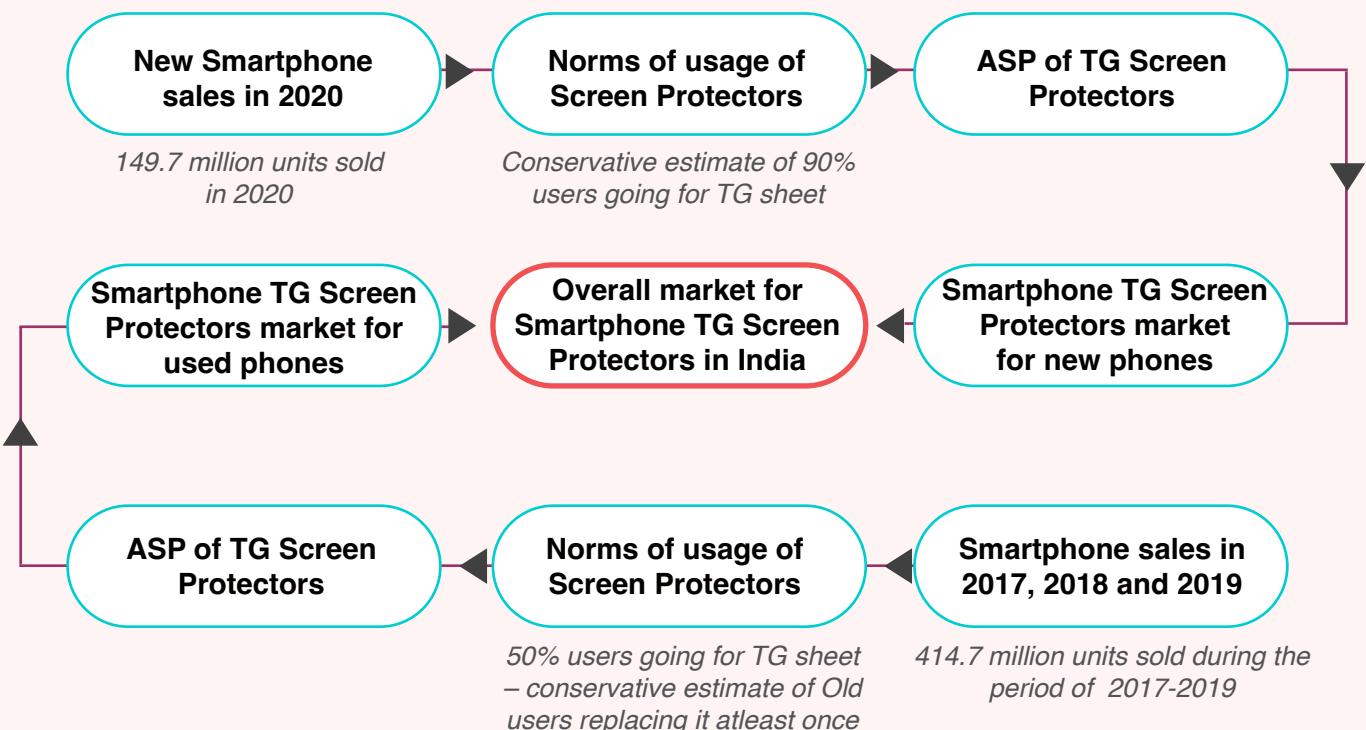
2.1.1 Demand Estimate of the Indian Market for Tempered Glass Screen Protectors

The approach to demand estimation of the Indian market for the Tempered Glass Screen Protectors is as given below:

- Smartphone sales in India in the last 5 years¹³
- Norms of Screen Protector usage on new & old phones¹⁴
- Average prices of Screen Protectors sold in India¹⁵

The overall process is explained in Chart 5 below:

Chart 5 : Approach to demand estimation of Tempered Glass Screen Protectors



¹³ <https://www.statista.com/statistics/792767/india-smartphone-shipments-volume/>

¹⁴ Source – Primary interviews with smartphone retail shops

¹⁵ Source – Primary interviews with smartphone retail shops

The demand for TG Screen Protectors is estimated as shown below in Chart 6: given below:

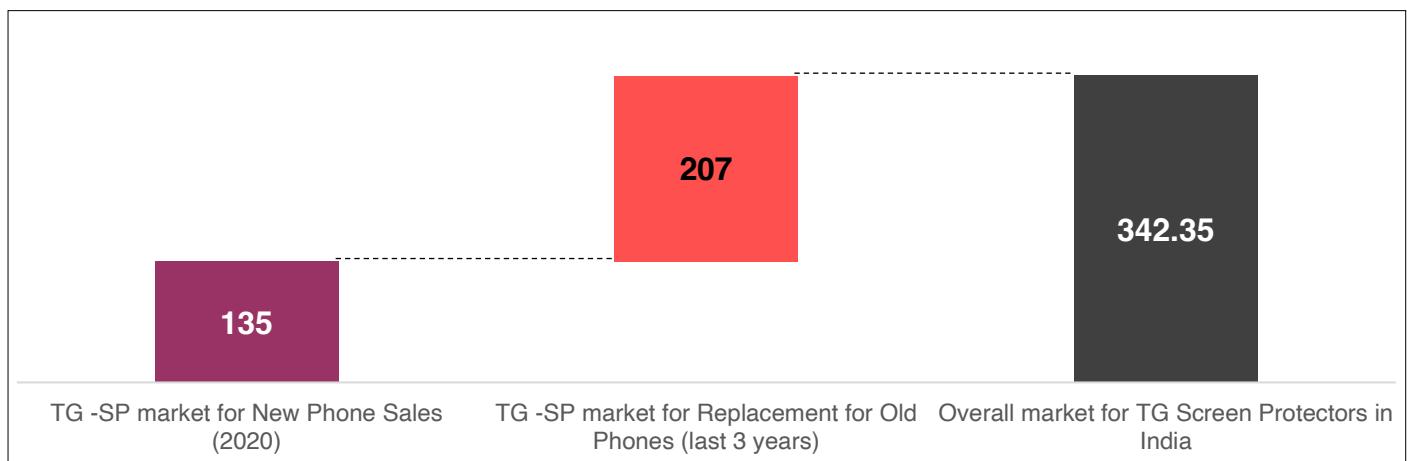


Chart 6: 2020 Demand for TG Screen Protector in India in Volumes (MN pieces)

Source: Feedback Advisory analysis based on the Approach set out above

2.1.2. Supply of TG Screen Protector Sheets in India

A market with such a large demand has no established players supplying Tempered Glass Screen Protectors in India. The Screen Protectors market is dominated by a host of Brands with some known International Brands and a host of unknown brands and many of them are of inferior / sub-standard / poor quality.

Most of the business in Tempered Glass Screen Protectors are happening in the “Grey” market, as per industry sources and primary interviews with traders. There is a small portion of the market sold through Ecommerce Channels which is formalized in the sense, there is a GST which is applied on the sale of these products, the rest are sold through road side shops and mobile accessory shops in a mostly unorganized way as shown in Chart 7 below:

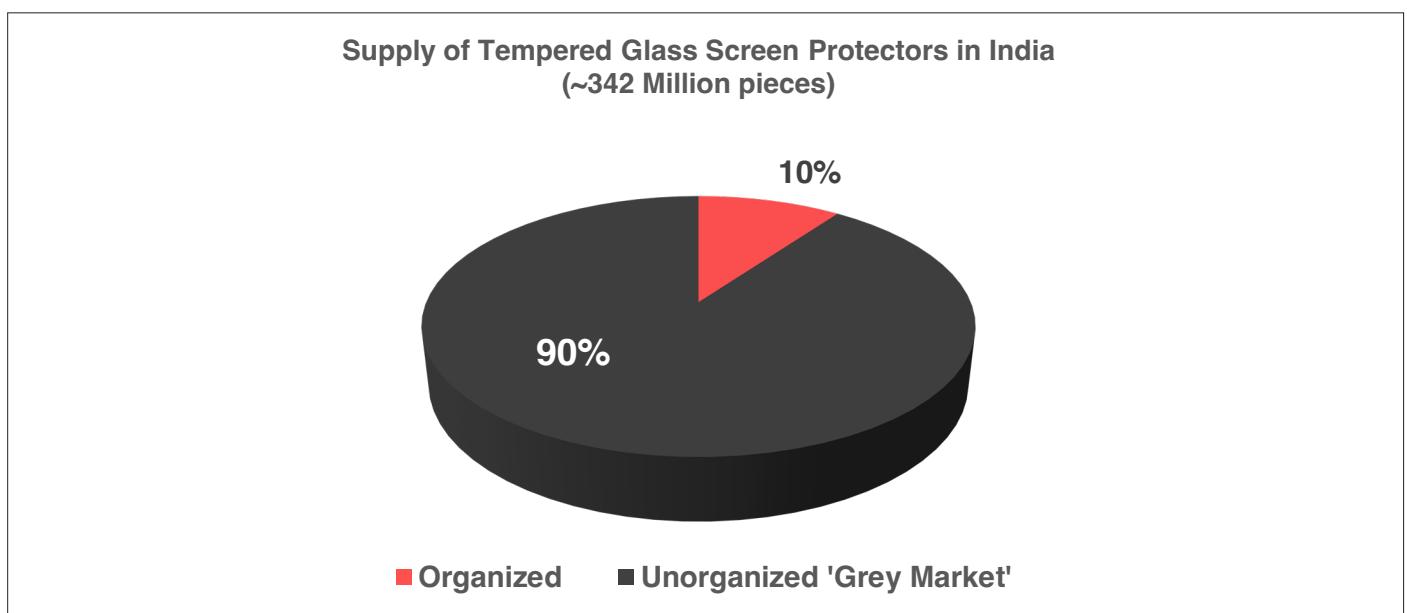


Chart 7: 2020 Supply of TG Screen Protector in India (~342 MN pieces)

Source: Feedback Advisory analysis based on Primary interviews with Traders and suppliers

The Supply of TG Screen Protectors in India happens in the following routes as explained below:

TG Screen Protectors Imported by Traders and sold in retail (dominant part of the Grey Market)

- Unbranded TG SP imported and sold in India by Traders
- Most imports (99%) are from China
- Imported under various HS codes such as - 70072190, 39269099, 85177090, 70200090, 70071900, 85299090, 70072900, 85176990, 39199090 etc.
- A sample of Import stats shows these are imported at INR 2-3/piece which indicates a lot of Fake / Cheap imports are prevalent in the industry
- High level interviews in the Trade reveals that a lot of grey market imports does happen in this product

Indian manufacturers of TG Screen Protectors

Ace Mobile - Licensed Exclusive Importer of Corning FG* and having a full manufacturing line.

- Set up 6 years ago and not making any TG SP now as they are unable to compete in Indian market against cheap Imported / Chinese products

TG Screen Protectors imported by Mobile Phone OEMs

- Mobile OEM's sometime import TG SP which gets sold as a bundled product sometimes
- This is a small portion of the overall market.

TG Sheets Imported and cut and sold in India by traders / Manufacturers

- There are instances of Traders importing Chinese Laser cutting machines and also import TG Sheets (A4 Sheets).
- These TG Sheets are cut into Mobile Screen shapes - 1 A4 Sheets cut into 6 pieces.
- The cost of these fake TG SP's work out to be INR 6-7/piece and sold at INR 10-25/piece in the market without packing etc.
- These are unbranded sheets sold under various names

The supply of Tempered Glass Screen Protectors is highly unorganized and most sales are done in the retail trade with no regulations on the quality of the product or any price limits of these products. These products are sold in the retail market under various brand names and at highly unorganized prices, depending on the type of Mobile Models or the stores where they are sold.

The estimation of Value of the Supply of Tempered Glass Screen Protector market was done based on the assumption that an **ideal** Tempered Glass Screen Protector would be manufactured / imported at INR 100-125/piece and sold to the retailers at INR 120-200/piece, and then sold to the customers at INR 300 - 800/piece. We have considered an average price of INR 150/- per piece to Dealers and the end customer buying price to be around INR 450/- per piece.

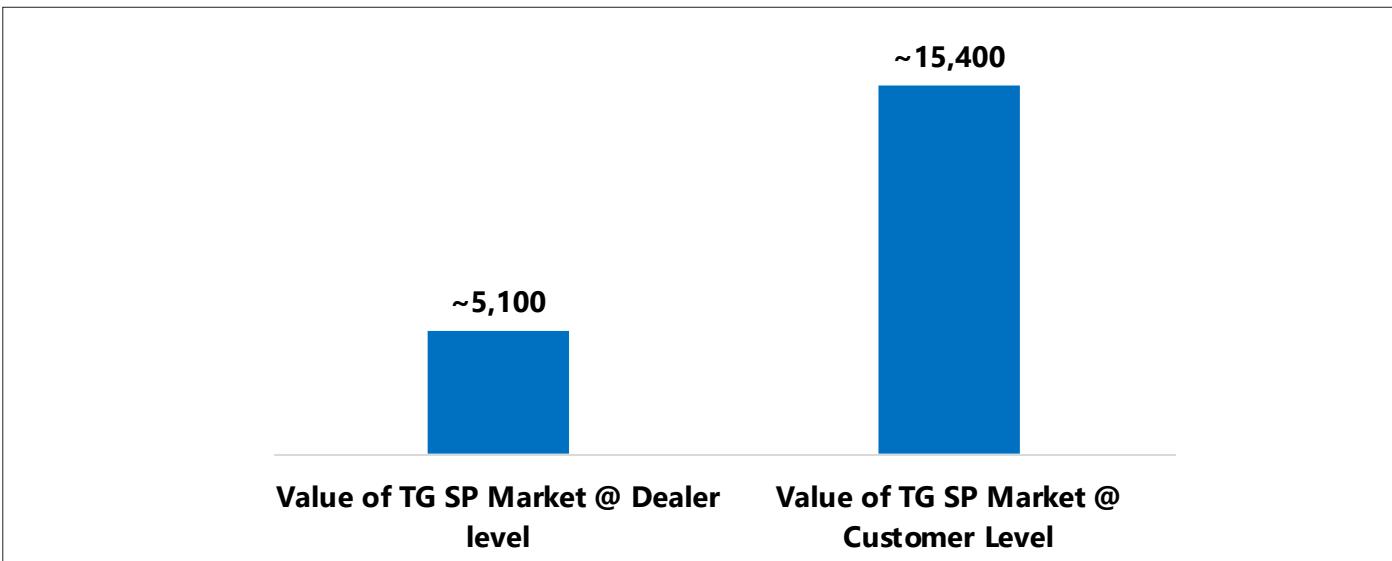


Chart 8: TG Screen Protector Market Value (INR Crore)

Source: Feedback Advisory analysis based on the Approach set out above

At this level, the market being a highly “Grey” market, there is a severe loss to the Nation in terms of GST revenues as shown below in Chart 9 below:

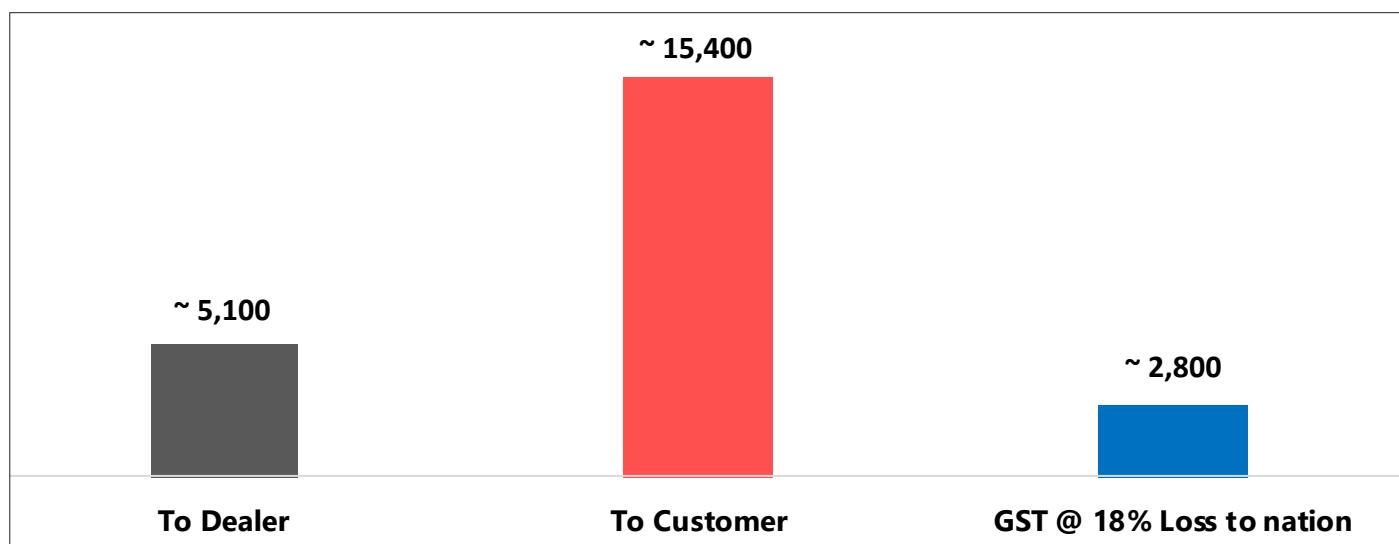


Chart 9: 2020 TG-SP Market in India (INR Cr) and Loss of GST to Nation

Source: Feedback Advisory analysis based on the Approach set out above

Apart from the GST, as this business is done purely on cash trading and without bills, there are also other revenue losses to the nation as mentioned below:

- No income tax revenue to the Government of India on the whole value chain, on account of cash trading and lack of regulations in the business.
- Improper / huge deficit in customs duty collections for the Government of India, as these are imported in grey markets and in diverse HS codes.

Apart from this loss to the country, there is also a **lack of employment** which is not being generated by such a large industry in India in a formal way.

Most importantly, the **Mobile consumers in India are being provided with spurious / sub-standard products** as Tempered Glass Screen Protectors.

03

Opportunity for India in a formal Tempered Glass Screen Protectors industry

As explained in the earlier chapter, the Tempered Glass industry is currently a ‘Grey Market’ dominated industry and has therefore led to huge losses to the nation. If this industry is formalized and quality products are manufactured and sold, it could provide huge benefits to the nation.

The opportunity which the Tempered Glass Screen Protectors industry presents India is to be viewed from two perspectives as indicated below:

1. **Likely Domestic market** for Tempered Glass Screen Protectors and the benefits thereof
2. Opportunities for India to participate in the **Global Market through Exports**



Likely Domestic market for Tempered Glass Screen Protectors and the benefits thereof

The future of the Tempered Glass Screen Protectors market is directly dependent on the smartphone sales in India. As per ICEA projections, the smartphone sales are likely to witness a 12% growth CAGR in India as shown below in Chart 10:

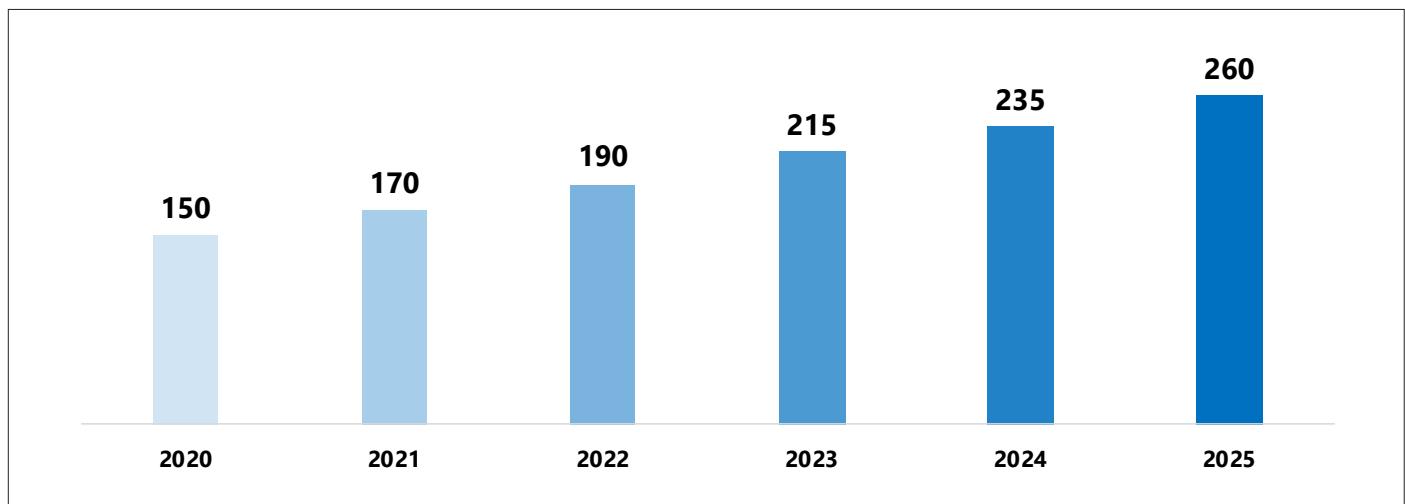


Chart 10: Smartphone sales projections in Mn Nos.
Source: ICEA Projections of Smartphone Sales in India

Assuming the similar usage norms as used in the current market estimation for TG Screen Protectors (90% of the new phones using TG-SP and 50% of the old phone users will go for replacement at least once), the market volumes growth of TG-SP is likely to reach **554 Million pieces** from the existing **342.35 Million pieces currently**, growing at a CAGR of 10% over the next 5 years as shown in Chart 11.

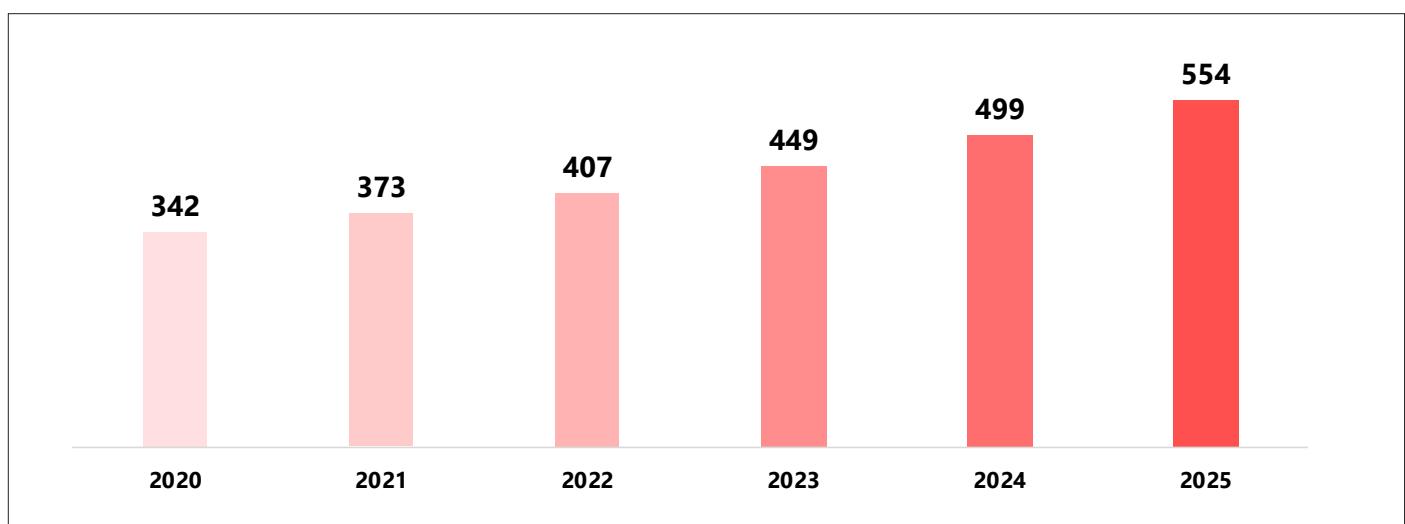


Chart 11: TG-SP Market demand in Mn. Nos.
Source: Feedback Advisory estimates based on ICEA Smartphone sales data and TGSP usage norms

The estimation of Value of the Supply of Tempered Glass Screen Protector market was done based on the assumption that an ideal Tempered Glass Screen Protector would be manufactured / imported at INR 100-125/piece and sold to the retailers at INR 120-200/piece, and then sold to the customers at INR 300 - 800/piece. We have considered an average price of INR 150/- per piece to Dealers and the end customer buying price to be around INR 450/- per piece.

The likely value growth of the Tempered Glass Screen Protectors market is as shown below in Chart 12 below:

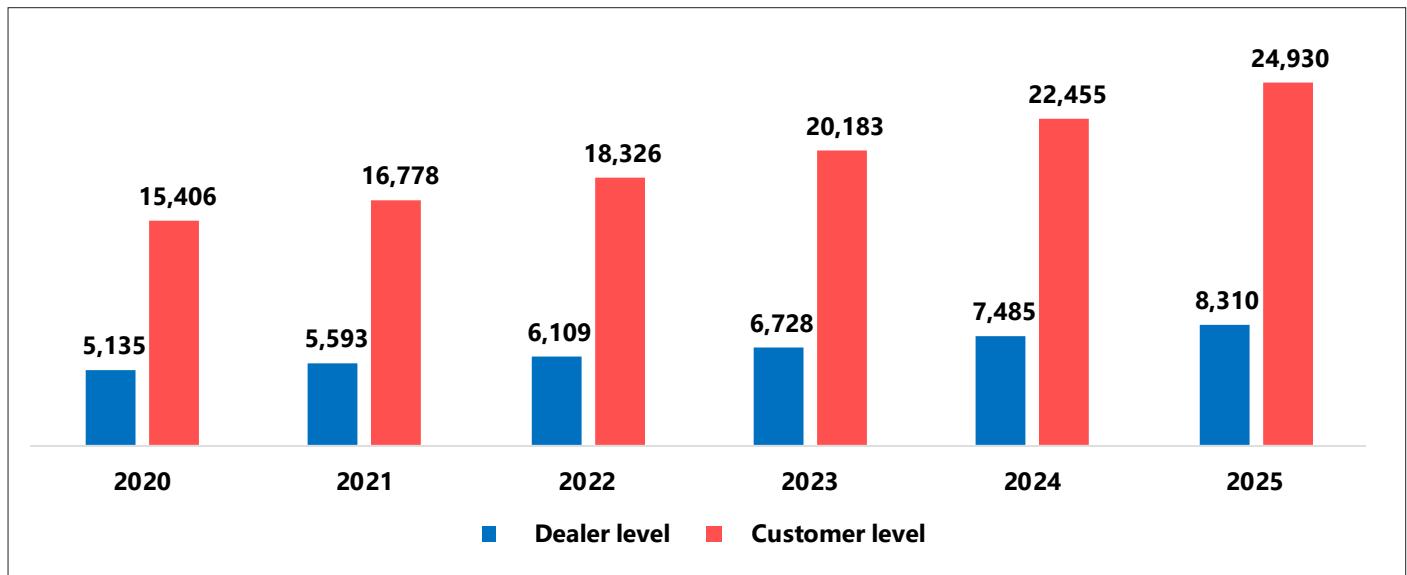
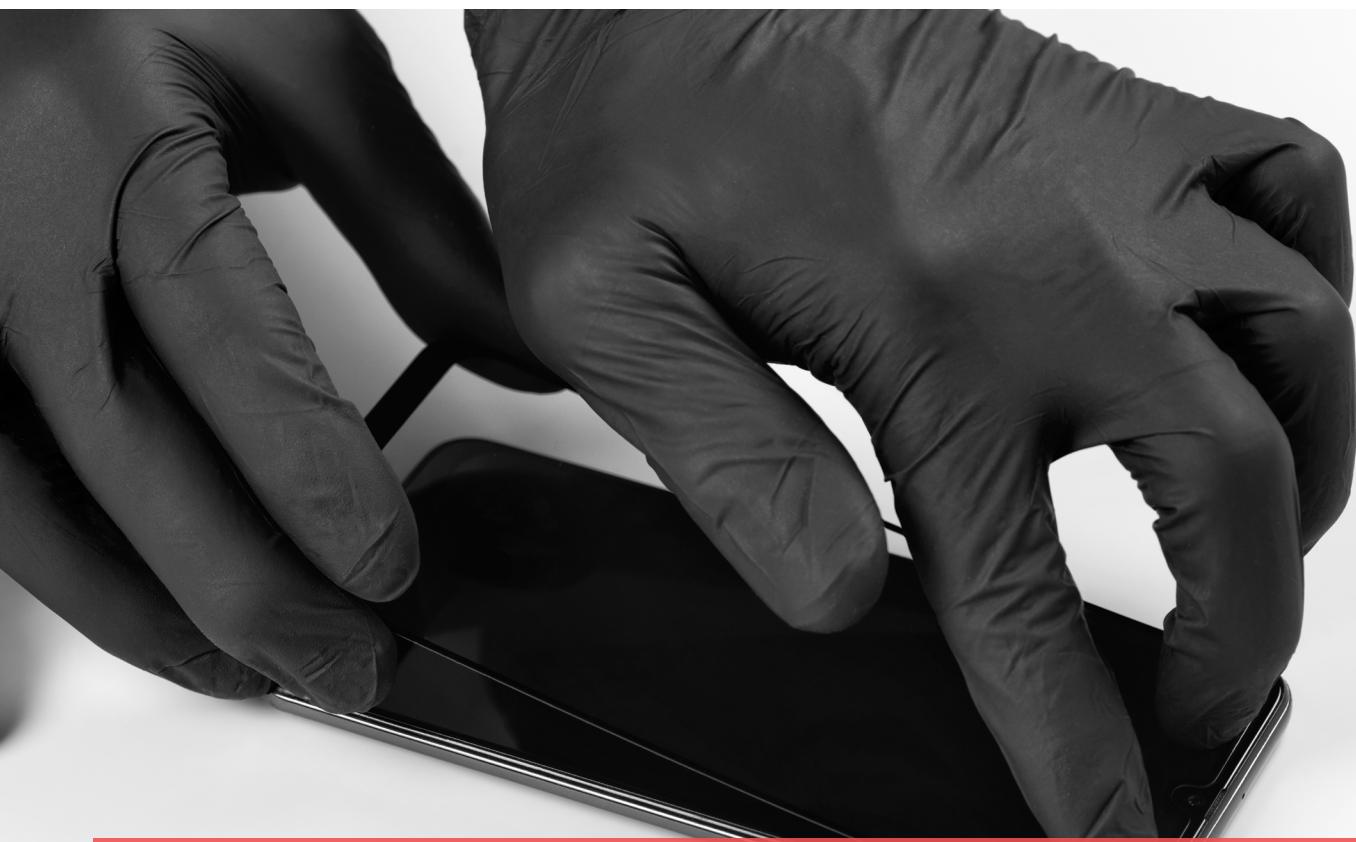


Chart 12: TG-SP Market Domestic Market growth in INR Crore

Source: Feedback Advisory analysis based on the Approach set out above



The likely future Domestic market for Tempered Glass Screen Protectors by 2025 is estimated to reach ~INR 25,000 Crore (USD 3.4 Billion) (at customer price).

There is a crying need to regularize this industry with quality standards and ensure that ‘Sub-standard’ TG-Screen Protectors are not made or imported and sold in the country. Once there is a level of standardization that comes through, then the local manufacturers will be forced to sell through proper channels to claim GST credits and there is a possibility of formalizing the entire supply chain.

This will also lead to quality products being available to the Indian consumers and at prices that could be benchmarked/market-driven but falling under the Indian Consumer Act. The gains to the nation purely on account of revenues from GST will be huge as shown below in Chart 13:

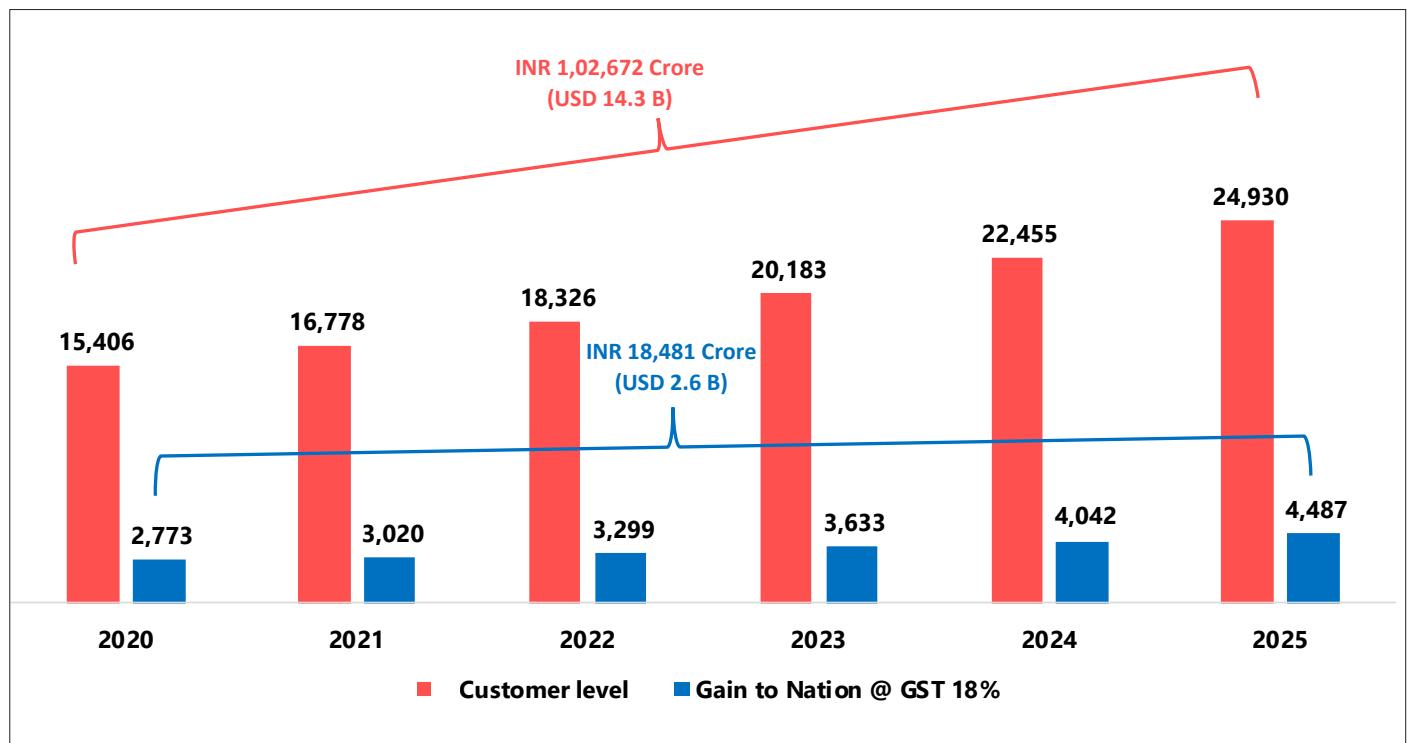


Chart 13: TG-SP Market demand in INR Crore with Real TG & possible gain in GST revenues to the Nation
Source: Feedback Advisory analysis based on the Approach set out above

The introduction of standards and formalizing the market for the Tempered Glass Screen Protectors market in India could likely grow the market to reach ~INR 25,000 Cr (USD 3.4 B) by 2025 at the **consumer end**, and the cumulative market for TG-Screen Protectors is likely to be **~INR 1,02,700 Crore (USD 14.3 B)** in the **next 5 years, between 2021 to 2025**.

The potential gain of GST revenues to the Government of India will reach ~INR 4,500 Cr (USD 0.6 B) by 2025 or a cumulative gain to the nation is likely to be ~INR 18,500 Cr (USD 2.6 B) in the next 5 years, between 2021 to 2025.

Opportunities for India to participate in the Global Market through Exports

Currently, there are no standards for Tempered Glass Screen Protectors manufacturing worldwide and the global market too is witness to the problem of Sub-standard TG-Screen Protectors. Countries such as the USA, on account of its very strict domestic consumer protection laws, prohibit low-quality products at the ports and prevent much of the unbranded products from reaching the end consumer. Larger importers such as the key retail chains make sure they import the right quality under their own brand name. China seems to be the market leader supplying these TG Screen Protectors to the world.

If quality manufacturing is encouraged with the right standards and the right firms are invited to make in India, Tempered Glass Screen Protectors could be exported from the country. At the initial stage (for the next 5 years), India could attempt to gain a 15% global market share in the next 5 years as shown below in Chart 14 & 15:

Chart 14: Market potential for Quality TG-SP Sheets from India to the World (Mn Units)
 Source: Feedback Advisory analysis based on the Approach set out above

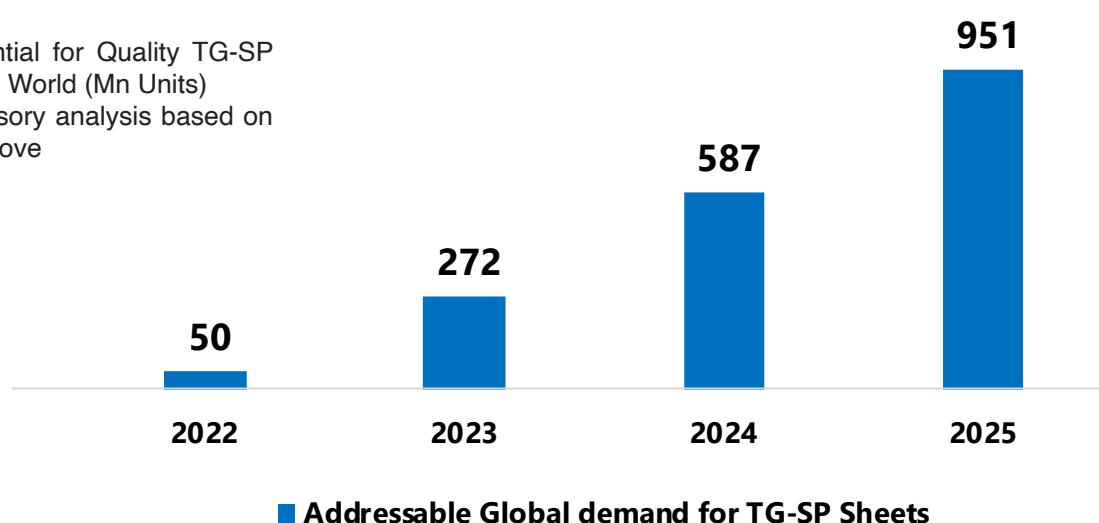
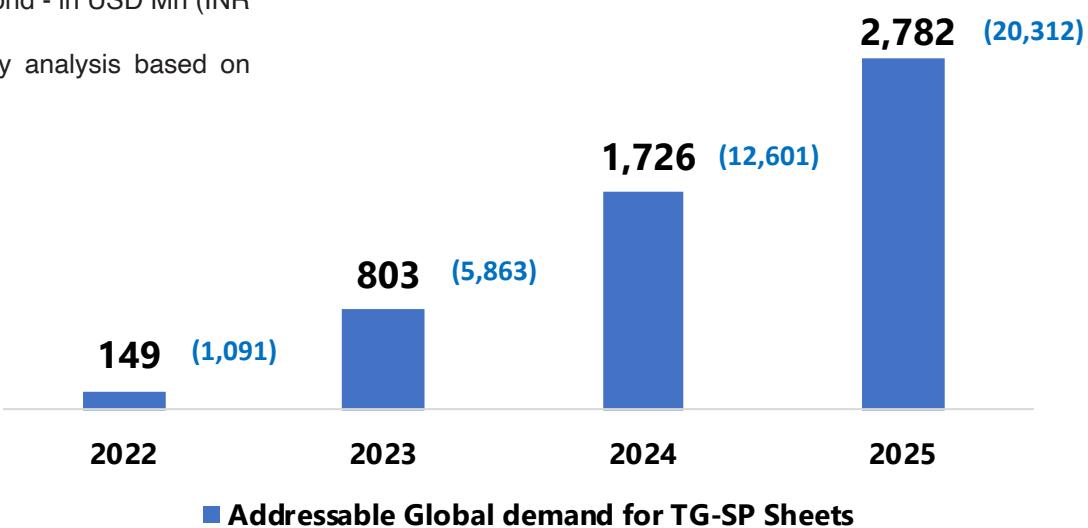


Chart 15: Market potential for Quality TG-SP Sheets from India to the World - in USD Mn (INR Crore)
 Source: Feedback Advisory analysis based on the Approach set out above



India could potentially look at Exports of TG-SP of INR 200 B (USD 2.7 B) by 2025 or a cumulative of INR 400 B (USD 5.4 B) between 2022 to 2025 with Quality manufacturing from India.

This large Tempered Glass Screen Protectors market (if formalized) is likely to bring in a lot of other benefits for the nation as explained below:

03

Impact on India's Image on Quality Manufacturing

India aspires to be a quality products-manufacturing country. The Government of India is keen to make this as a national ambition and focus to bring in the right practices in India.



“When you place an order on India, you can trust that high-quality products will be delivered on time at competitive prices.”

– Shri Piyush Goyal, Union Minister of Commerce & Industry & Consumer Affairs

With this goal, India cannot afford to have a large industry such as the Tempered Glass Screen Protectors in the current state that it is. The country's image of quality manufacturing takes a huge hit if a simple product like the TG-SP is not made as per international quality/requirements.

It is essential that the Government of India works to bring in quality manufacturing through standards and encourage the same to be made in India.

Employment Generation Possibilities

The unorganized nature of the industry and the rampant imports of Sub-standard & cheap tempered glass in India is also causing a huge loss to the nation in terms of employment generation. Due to the unorganized nature of the industry, there are no visible mention / trends of a sound employment in this sector.

An ideal Tempered Glass manufacturing unit is very labour-dependent. There is a norm applied in the industry as given below:

- A Typical 10 Million/month unit will need an employment of 2,000 direct employees
- This, in turn, will lead to 3x indirect employment of 6,000 indirect employees

In the above sections, we have discussed about the possible potential of manufacturing and exports of Tempered Glass Screen Protectors from India. This would lead to ~25,000 direct and ~75,000 indirect employment generation in 5 years as shown below in Chart 16:

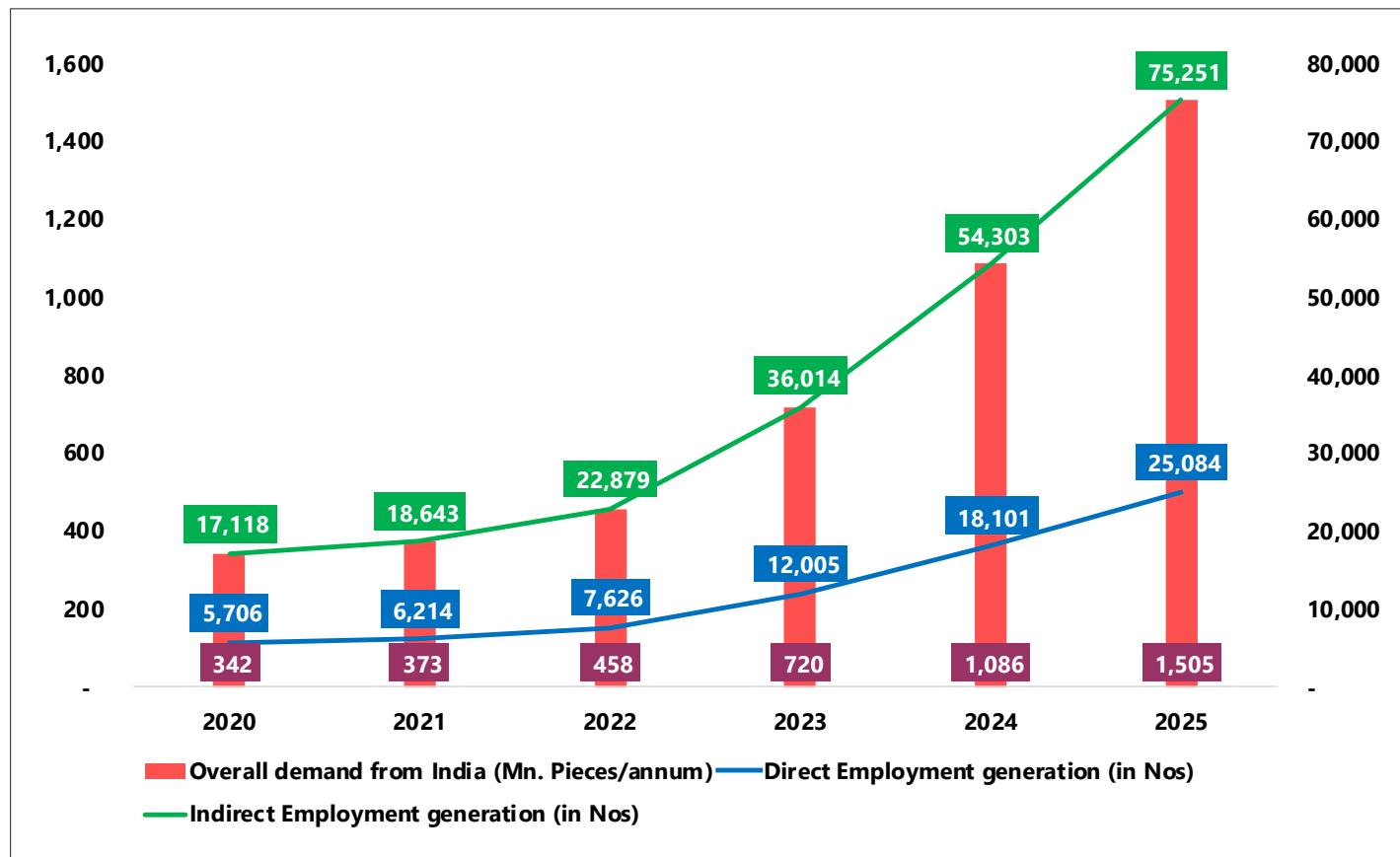
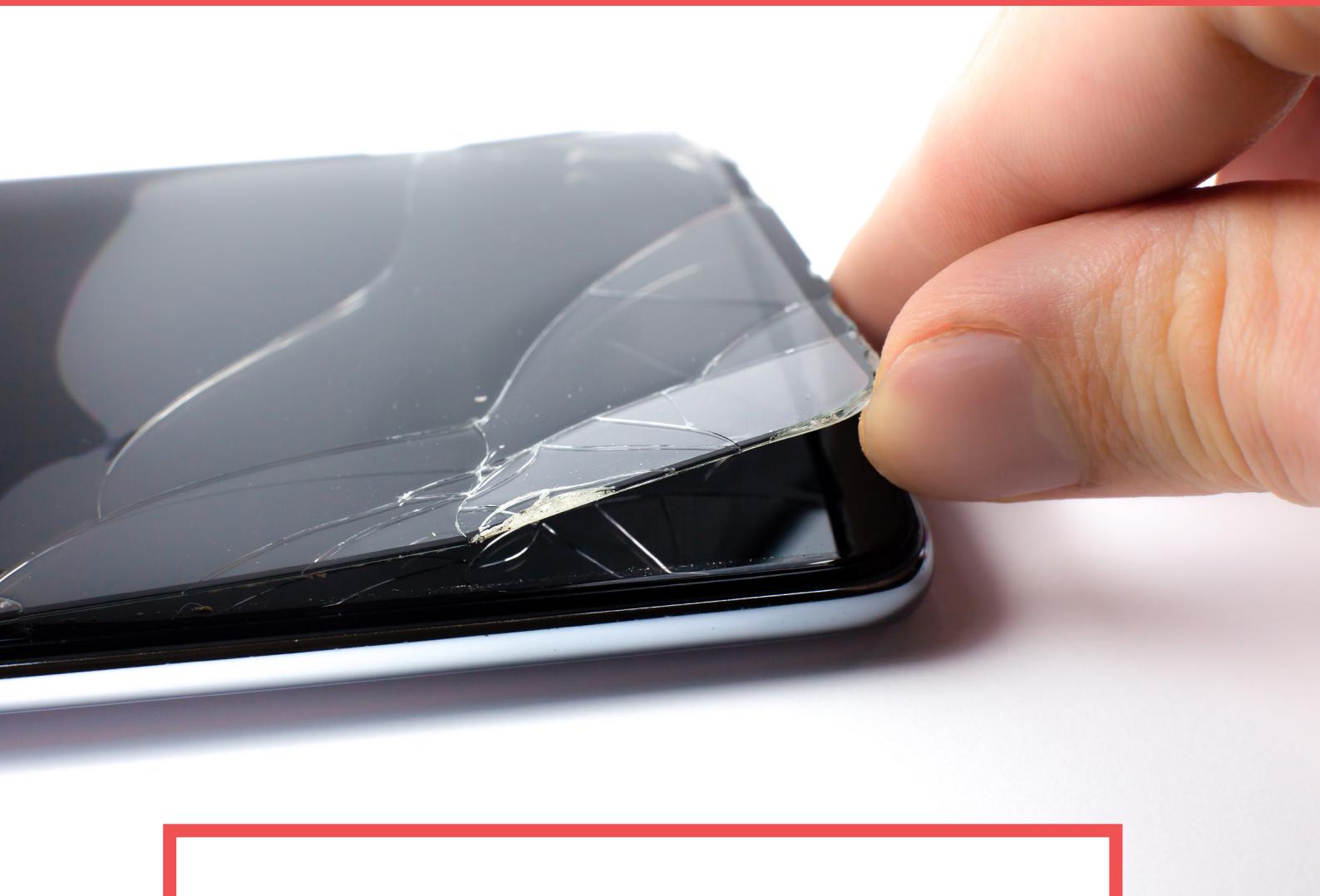


Chart 16: Employment generation possibilities in Ideal Tempered Manufacturing Industry in India
Source: Feedback Advisory analysis based on the Approach set out above



The identification between a ‘Sub-standard’ or REAL Tempered Glass Screen Protector is not possible with any ‘VISIBLE’ methods, the only method of identification is through a “SCIENTIFIC METHOD OF TESTING” as explained in the next chapter.

This SCIENTIFIC METHOD of testing Tempered Glass Screen Protectors is necessary to be introduced in Indian market as a mandatory practice to enable a Quality Manufacturing led industry to help the nation with the above-mentioned benefits

04

Testing of Tempered Glass Screen Protectors

4.1

Why is Testing important in Tempered Glass Screen Protectors?

Tempered Glass Screen Protectors are currently sold very opaquely with no clear differentiation of what is done and how good / bad the tempering is done on the glass. The only way to know a good tempered glass versus a poorly tempered / not tempered glass is when it breaks and the way it is broken reflects if the Tempering is done on the glass or if there is no tempering. This is shown below in Figure 3 below.

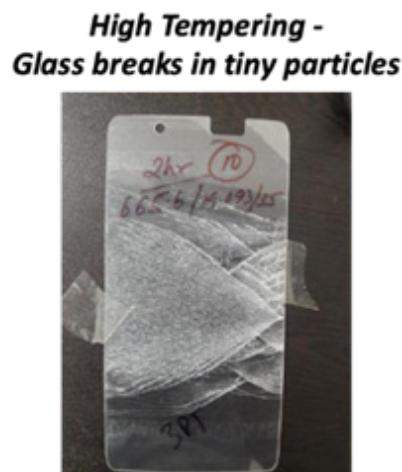


Figure 3 : Screen protector breakage in different tempering situations

The problems of fake tempering or no tempering discussed elaborately in Chapter 3 in this report.

To bring in a sense of formalisation to the sector, it is necessary that there are scientific methods of Testing Tempered Glass Screen Protectors to distinguish a genuine product from fake products.

ICEA along with Feedback Advisory undertook a detailed exercise with the help of an Indian manufacturing firm and undertook an exercise to test various Tempered Glass Screen Protectors available in the market. Before we delve into the details of these tests in section 4.4, let us first understand the science behind these tests and what is actually done and how is it tested.

4.2

Science behind the Testing Method of Tempered Glass Screen Protectors

In simple terms, chemical tempering strengthens the glass by “stuffing” large-sized ions into the glass surface. During the chemical tempering process, the glass is submersed in a bath of molten salt at prescribed temperatures. The heat causes the little ions to leave the surface of the glass and makes the bigger ions present in the molten salts to enter it. Once the glass is removed from the bath and cooled, they shrink. The bigger ions that are now present in the surface creates a compressed surface, which results in a stronger glass that is more resistant to breakage. This is explained below in Figure 4

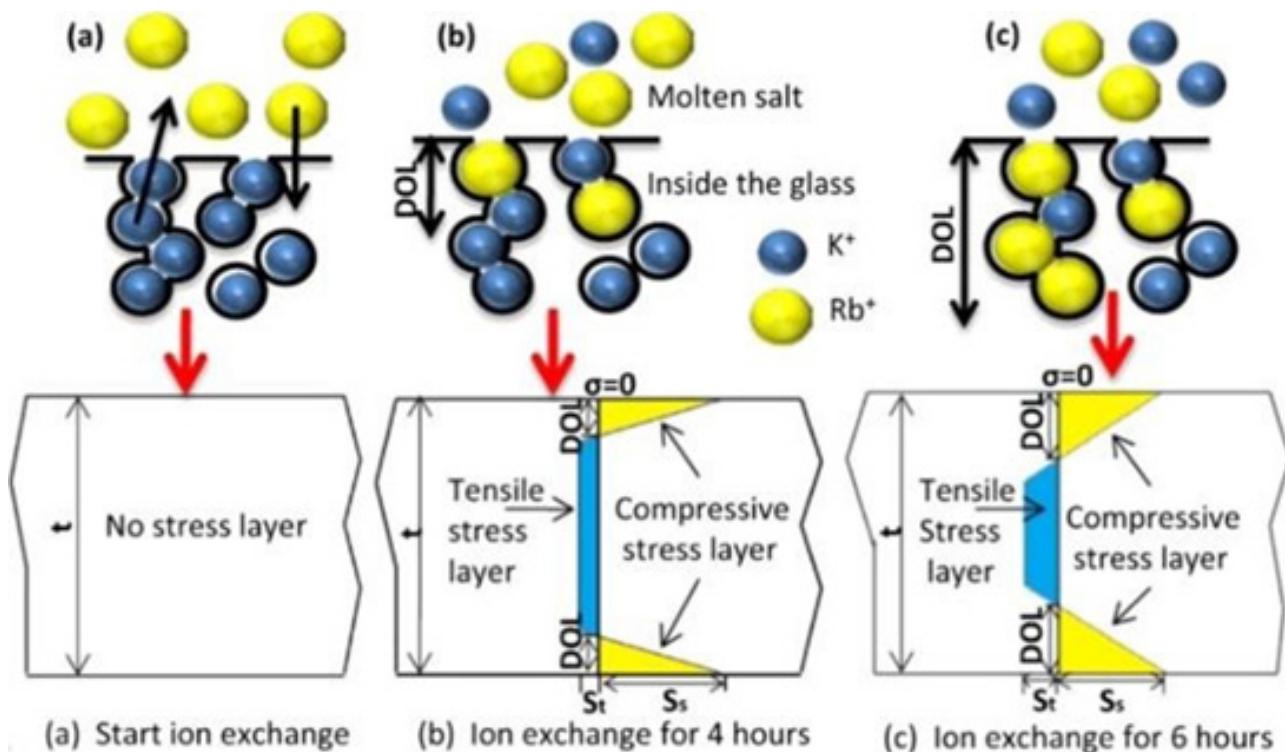


Figure 4 : The chemical tempering process in glass

Chemical tempering also creates a uniform layer of stress. This is because the ion exchange occurs uniformly on all surfaces. Unlike air-tempering process, the degree of chemical tempering is not related to the thickness of the glass.

The degree of chemical tempering is measured by the magnitude of **Compressive Stresses (CS)** and the depth of the compressive stress layer (also called as **Depth Of Layer, or DOL**). The magnitude of Compressive Stresses and the DOL is dependent on the time the glass is left in the salt bath, the temperature of the salt bath and the composition of salt bath.

In most materials, the index of refraction remains constant. However, in glass, the index values vary as the function of stress is applied.

The principle of photo elasticity is well-known and is used for stress measurement in all transparent materials.

The DOL or depth of the CS layer is shown as the yellow triangles in the above Figure 3. This is the depth profile of CS.

Certain type of glasses and glass-ceramics can be chemically strengthened by the ion exchange process that may change the surface refractive index of the material. The strengthening is due to the formation of near-surface compression layer that usually create birefringence. Birefringence is the optical property of a material having a refractive index that depends on the polarization and propagation direction of light⁸. The birefringence in turn corresponds to the change in refractive index profile of the glass.

Birefringence is formally defined as a double refraction of light in a transparent, molecularly ordered material which is created by the existence of orientation-dependent difference in refractive indices.

For strengthening a larger alkali ions such as K+ exchanges for a smaller alkali ions such as Na+ or Li+ in the original base glass. This gives the depth wise change in refractive index profile. Change in refractive index may be taken as the measure of ion exchange.

4.3

Equipment for Testing the Tempered Glass Screen Protectors

The equipment used for testing the Tempered Glass Screen Protectors is called as a Surface Stress Meter supplied by Luceco CO. Ltd, Japan. This is shown below in Figure 5.



Figure 5 : Surface Stress Meter

⁸ Abramowitz, Mortimer; Davidson, Michael W. "Olympus Microscopy Resource Center". Olympus Life Science Inc. Retrieved 2021-07-21

The FSM-6000LE series is developed for measuring the surface stress of glass using a PC. The optical waveguide effect in the surface layer of tempered glass is a useful tool for measuring surface stress for quality and process control purpose. This type uses infrared rays light (IR), and It can measure double IOX having the deep depth.

The FSM -6000 instrument represents state of the art nondestructive measurements of the stress in flat ion exchanged glasses and utilizes a prism and index matching fluid.

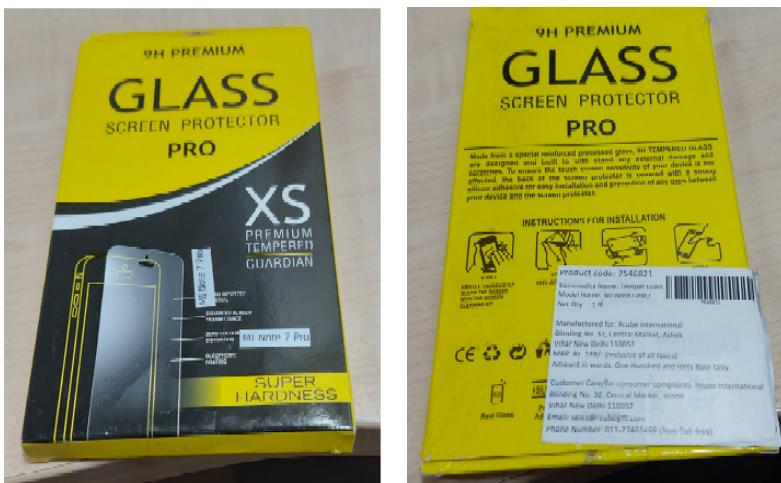
In the FSM 6000 instrument the surface compressive stress (CS) is calculated from the effective indices of the first two modes, while the total number of modes are used along with the aforementioned effective indices of the first 2 modes for the depth of the layer (DOL) calculation based on the linear refractive index-profile assumption

4.4

ICEA and Feedback Advisory Test evaluation of Screen Protectors

To arrive at the actual condition of the Tempered Glass Screen Protectors in India, ICEA and Feedback Advisory undertook an exercise of sourcing Samples of TG's from the market and ecommerce websites and had them tested. The details of the samples collected as given below.

Test Results: XS/1



Model: Mi Note 7 Pro / Note 7 / REDMI 5A

Brand: XS Tempered

Test Results: Xiaomi / 2



Model: xxx

Brand: Xiaomi / Ace Mobile

Test Results: GTEL / 3



Model: SAM S 10

Brand: G-Tel

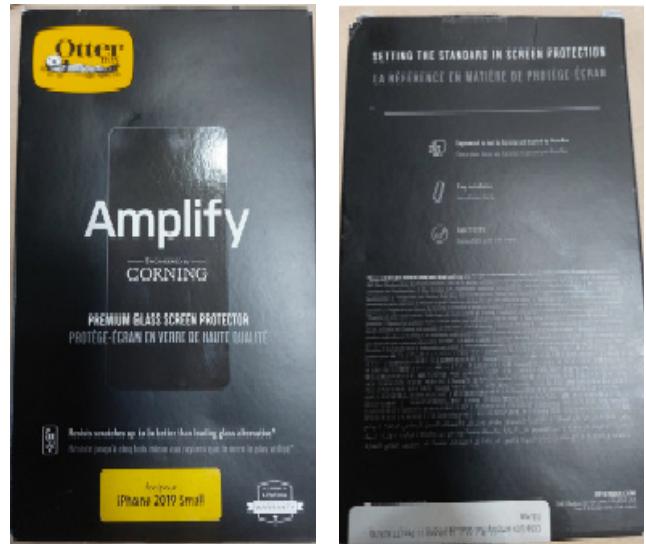
Test Results: Belkin / 4



Model: xxx

Brand: BELKIN

Test Results: Otterbox / 5



Model: iPhone 11 Pro

Brand: Amplify Corning



Test Results: Spigen / 6

Model: xxxx

Brand: SPIGEN

Test Results: Otterbox / 5



Model: iPhone 11 Pro

Brand: Amplify Corning



As mentioned in Section 4.2, the focus of the Test using the FSM-6000 Series equipment was essentially to arrive at the two key parameters of CS (Compressive Stresses) and DOL (Depth Of Layer) for the above mentioned samples.

The detailed Test Results are provided in the Annexure 2 of this report. The summary of these tests evaluation is given in the Table 2 below:

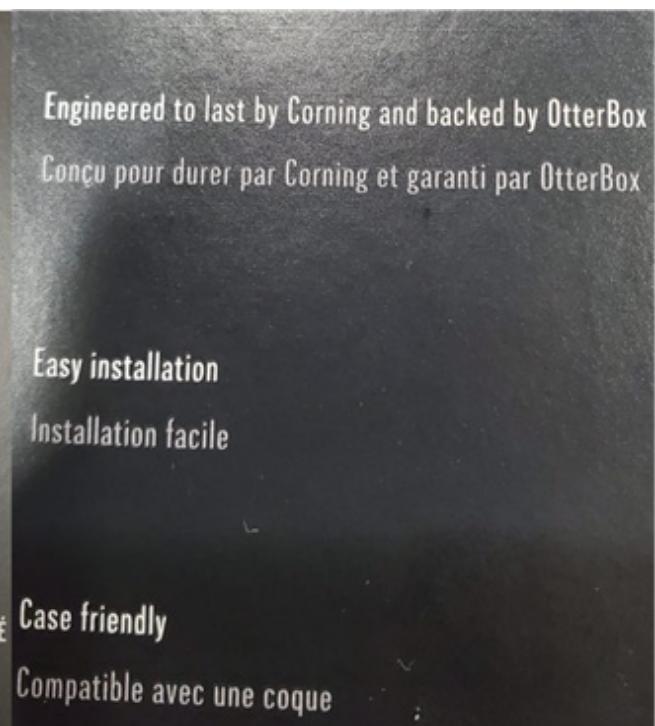
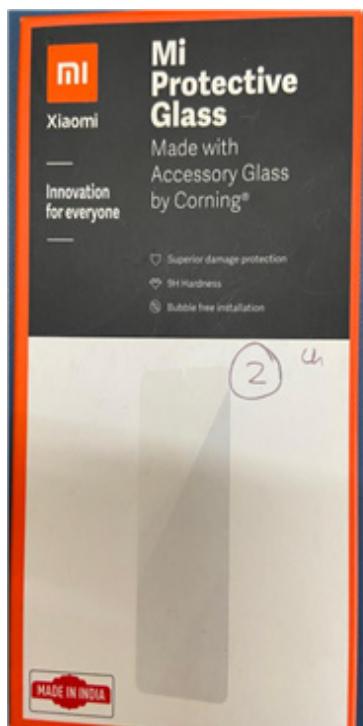
Model	Brand	Test Result Name	Spectrum Fringes	CS (Mpa)	DOL (um)
MI Note 7 Pro / Note 7 / REDMI 5A	XS	XS / 1	0	0	0
XXX	Xiaomi / Ace Mobile	Xiaomi / 2	2	642	7.12
SAM S10	G-Tel	GTEL / 3	1	0	0
XXX	BELKIN	Belkin / 4	1	0	0
iPhone 11 Pro	Amplify / Corning	Otterbox / 5	4	812	15.37
XXX	SPIGEN	SPIGEN / 6	1	0	0
iPhone Xs Max / X / Xs	ONN	ONN / 7	1	0	0

Table 2 : Result of Feedback ICEA test of various screen protectors

The table 2 above shows us the following results:

- Screen Protectors with Test Result Names of XS / 1, GTEL / 3, Belkin / 4, SPIGEN / 6 and ONN / 7 do not show any Compressive Stresses (CS) or Depth of Layer (DOL) which means that these ARE NOT Tempered Glass or these are near Zero Tempered Glass as per the standards that are required.
- Only the Screen Protectors with Test Result Names Xiaomi / 2 and Otterbox / 5 display the Compressive Stresses (CS) & Depth of Layer (DOL) characteristics which means that these ARE Tempered Glass.
- It is important for the FSM 6000 to have minimum of two fringes to calculate the tempering parameters.
- The presence of one fringe spectra leads to inadequate tempered parameters and results “00” as the tempered data.
- The presence of no fringe means this is either very poor or not tempered

It is important to note that Xiaomi / 2 Screen Protector is manufactured by Ace Mobile India Pvt Ltd which is a Licensee of Corning Glass US and the Otterbox / 5 Screen Protector is Engineered by Corning and Marketed by Otterbox USA.





05

Recommendations

Mobile phone manufacturing and exports are key focus areas for the Government of India in their 'Atmanirbhar Bharat' and 'Make-in-India' program. Indian Electronics policies are revolving around the success of the mobile ecosystem in India. This is realized through the National Policy on Electronics 2019 (NPE 2019) and further elaborated in the new policies such as Production Linked Incentives (PLI), SPECS & EMC 2.0.

Tempered Glass Screen Protectors are one the largest components of the mobile accessories market. The success/growth of this product is essential to have a complete mobile ecosystem in India.

The success of any products industry is determined by how organized the industry players are and how they contribute to the national development through bringing in increased consumer safety, employment, taxes and other social developments led by these companies.

It is important that the Government of India recognizes the importance of this sector and formulates certain policies towards developing this sector into an organized sector in the country. ICEA has the following recommendations for the development of this sector in India:

5.1

Introduction of Standards for Quality Manufacturing of Tempered Glass Screen Protectors

Any industry to have an ideal growth needs to be governed by quality standards and some amount of regulation. While there are quality standards for a wide variety of products in India, including Safety Glass in Indian standard IS 2553 (Part 1):2018 Safety Glass-Specification Part 1 and for Float Glass in Indian standard IS 14900: 2018. **Unfortunately, there are no quality standards for Tempered Glass Screen Protectors, which has given rise to a large 'Grey' market in India.**

Due to lack of standards, we have explained in detail the problems that both the consumers and the country are facing in terms of lack of safety for consumers, loss of revenue, loss of employment and dent on India's quality image.

These problems could be addressed with the introduction of quality standards for Tempered Glass Screen Protectors.

5.1.1 ICEA recommends urgent implementation of BIS standards for Tempered Glass Screen Protectors

- ICEA recommends that the Government of India brings in BIS Standards for Screen Protectors and these BIS standards should be made mandatory for all Screen Protectors made in India or imported and sold in India.
- ICEA recommends that the method of testing as suggested in Section 3.3 using a ‘Surface Stress Meter’ equipment or equivalent should be made mandatory for all manufacturers in India making Screen Protectors.
- ICEA recommends that for all suppliers of Imported Screen Protectors, they should be also mandated to undergo such tests and get a BIS approval on the products to be sold in India.
- To increase the Consumer awareness and their satisfaction of using standard Products and avoid getting cheated by spurious / sub-standard brands, ICEA recommends that, in order to ensure the manufacturer / supplier responsibility there should be a **mandatory ‘Fog marking / etching’** on the glass itself indicating the name / logo of the manufacturer / brand of the TG Screen Protector, similar to those markings on Spectacle lens

5.1.2 Recommended Quality Standards for Tempered Glass Screen Protectors

As mentioned in Section 3.2, the degree of chemical tempering is measured by the magnitude of Compressive Stresses (CS) and the depth of the compressive stress layer (also called as Depth of Layer (DOL)). The magnitude of Compressive Stresses and the DOL is dependent on the time the glass is left in the salt bath, the temperature of the salt bath and the composition of salt bath. In most materials, the index of refraction remains constant. However, in glass, the index values vary as the function of stress is applied. The principle of photo elasticity is well-known and used for stress measurement in all transparent materials.

In Section 4.4, as per the Test Evaluation exercise undertaken by ICEA & Feedback Advisory, the suggested acceptable minimum quality standards for the right Tempered Glass Screen Protectors can be:

- Compressive Stresses (CS) : Minimum of 600 Mpa
- Depth Of Layer, or DOL : Minimum of 6 um

Government of India could further discuss this with Global suppliers of Glass & Technology providers (Corning and Asahi) and validate these findings.

5.2

Restricting Fake Imports/Reduce Imports of Tempered Glass Screen Protectors into India

For a thriving quality manufacturing industry in India, it is imperative that there should be some restrictions or some control on fake/cheap imports and a ban on grey imports. As shown in Annexure 1, the Tempered Glass Screen Protectors are imported under various HS codes and there is no clear mandate or definitions for these imports, and the duties cannot be mandated if there is no specific mandate.

ICEA recommends the following:

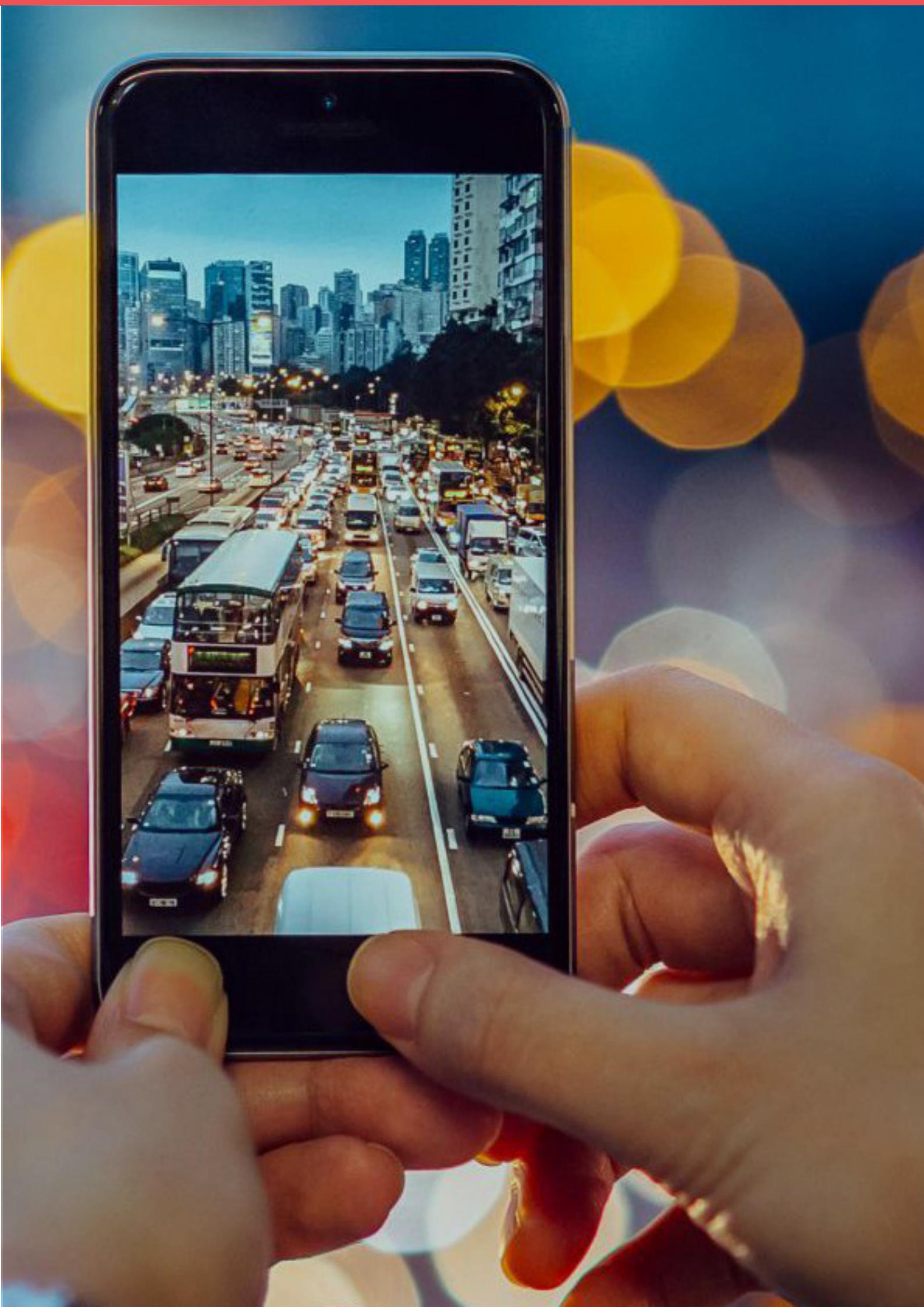
1. Imports of Tempered Glass Screen Protectors needs to necessarily be done with 'Compulsory Registration Scheme' for Self-Declaration of conformity with new BIS Standards as mentioned in 6.1 above
2. There should be a **mandatory "Fog marking / Etching"** on all the Imported Tempered Glass Screen Printers as well.
3. MeitY should recommend a specific HS Code for the Imports of Tempered Glass Screen Protector and make this as a mandatory requirement for these imports with Customs, suggested HS codes are – 8517 & 8529



5.3

Consumer Education Program on Real Vs Fake Tempered Glass

There is an urgent need for educating consumers on the problems of Fake Tempered Glass and bring in some amount of Consumer Protection measures. Once the standards are introduced, there needs to be a wide consumer awareness creation exercise on the need to adapt only BIS-registered Tempered Glass Screen Protectors. Mobile OEMs and trade channels need to be actively involved in spreading this message. There is a need to educate consumers about the Fog Marking / Etching on the Screen Protectors and encourage them to source the Screen Protectors with these markings, so that they could take some remedial measures if these are not found to be real.



Annexure



Model: Mi Note 7 Pro / Note 7 / REDMI 5A

Brand: XS Tempered

Country of Origin: Not mentioned

Distribution/Import: RCUBE International, Ashok Vihar Delhi

Select No.	Fringe U/L (mm)	Grad (deg)	CS (Mpa)	DOL (um)	CT (Mpa)	Thickness (mm)
0.0/0.0	0.000 / 0.000	0	-	0		0.4
Avg	-	-	-	-	-	

Measurement Outline	Date	2021/12/29-
	Name	XS / 1
	Serial No.	1607001
	Version	FsmV Ver.2016.06.25.001
Setting Equipment	Light source wave length (nm)	790
	Refractive (Prism)	1.711
	Optical path length (mm)	200
	Pixel resolution (fEm / pix)	5.2
Measurement Condition	Condition Name	Config No.1
	Refraction (Sample)	1.49
	Photoelastic Constant [(nm/cm)/Mpa]	30.94
	K1 (1/mm)	0.0024
	Correction Value	1.024
	Others	Chemical I Adopt Boundary (Transparent) Upper / Lower Parallel Standard



Model: xxx

Brand: Xiaomi

Country of Origion: Made in India

Made by: Ace Mobile, India, For Xiaomi, India

Select No.	Fringe U/L (mm)	Grad (deg)	CS (Mpa)	DOL (um)	CT (Mpa)	Thickness (mm)
1	3.337 / 3.892	0.145	-	-	-	0.4
2	5.301 / 5.553	0.109	642.216	-	11.855	
2.3/2.2	5.975 / 5.829	0	-	7.121	-	
Avg	-	0.085	642.216	7.121	11.855	

Measurement Outline	Date	2021/12/29-
	Name	Xiaomi / 2
	Serial No.	1607001
	Version	FsmV Ver.2016.06.25.001
Setting Equipment	Light source wave length (nm)	790
	Refractive (Prism)	1.711
	Optical path length (mm)	200
	Pixel resolution (fEm / pix)	5.2
Measurement Condition	Condition Name	Config No.1
	Refraction (Sample)	1.49
	Photoelastic Constant [(nm/cm)/Mpa]	30.94
	K1 (1/mm)	0.0024
	Correction Value	1.024
	Others	Chemical I Adopt Boundary (Transparent) Upper / Lower Parallel Standard



Model: SAM S 10

Make: G-Tel

Country of Origin: Made in China

Distribution/Import: Not Mentioned

Select No.	Fringe U/L (mm)	Grad (deg)	CS (Mpa)	DOL (um)	CT (Mpa)	Thickness (mm)
0.0/0.0	5.096 / 4.924	0	-	0	-	0.33
Avg	-	-	-	-	-	

Measurement Outline	Date	2021/12/29-
	Name	G TEL / 2
	Serial No.	1607001
	Version	FsmV Ver.2016.06.25.001
Setting Equipment	Light source wave length (nm)	790
	Refractive (Prism)	1.711
	Optical path length (mm)	200
	Pixel resolution (fEm / pix)	5.2
Measurement Condition	Condition Name	Config No.1
	Refraction (Sample)	1.52
	Photoelastic Constant [(nm/cm)/Mpa]	27.2
	K1 (1/mm)	0.00224
	Correction Value	1.024
	Others	Chemical I Adopt Boundary (Transparent) Upper / Lower Parallel Standard



Model: XXX

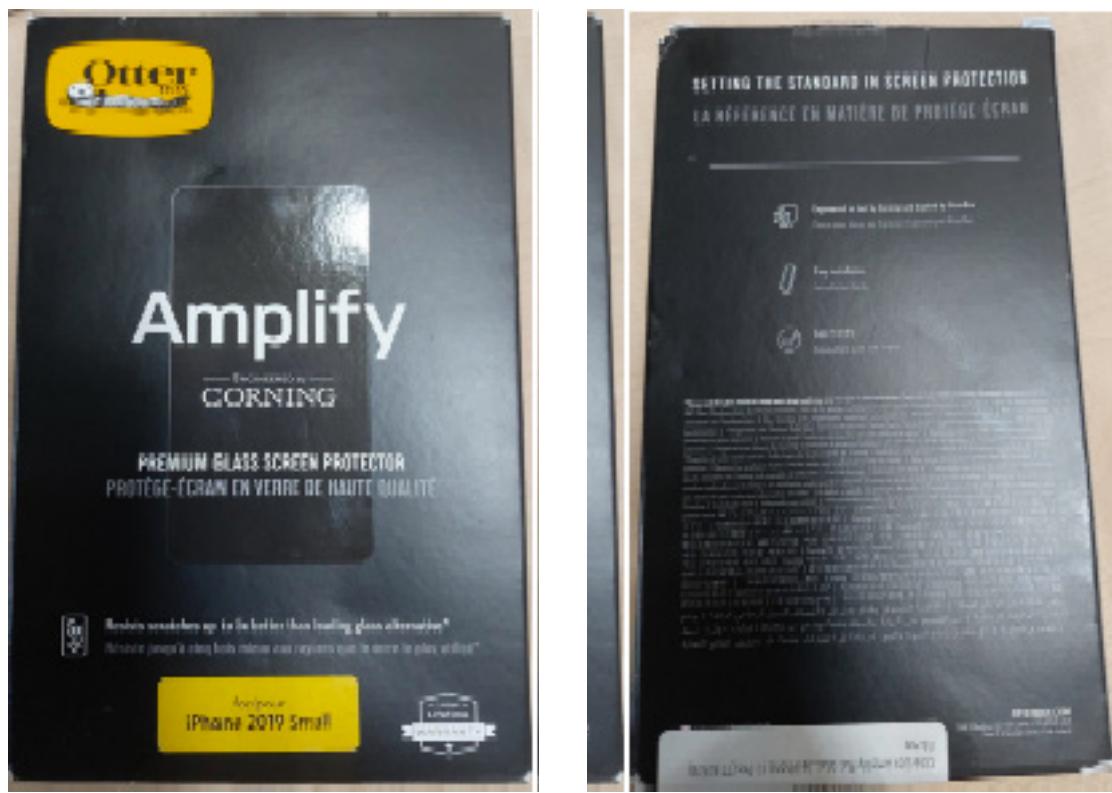
Make: Belkin

Country of Origin: China

Distribution/Import: Rashi Peripherals Pvt. Ltd.
Thane Maharashtra

Select No.	Fringe U/L (mm)	Grad (deg)	CS (Mpa)	DOL (um)	CT (Mpa)	Thickness (mm)
0.0/0.0	0.000 / 0.000	0	-	0	-	0.4
Avg	-	-	-	-	-	

Measurement Outline	Date	2021/12/29-
	Name	belkin / 4
	Serial No.	1607001
	Version	FsmV Ver.2016.06.25.001
Setting Equipment	Light source wave length (nm)	790
	Refractive (Prism)	1.711
	Optical path length (mm)	200
	Pixel resolution (fEm / pix)	5.2
Measurement Condition	Condition Name	Config No.1
	Refraction (Sample)	1.49
	Photoelastic Constant [(nm/cm)/Mpa]	30.94
	K1 (1/mm)	0.0024
	Correction Value	1.024
	Others	Chemical I Adopt Boundary (Transparent) Upper / Lower Parallel Standard



Model: iPhone 11 Pro

Make: Amplify / CORNING

Country of Origin: Not Mentioned

Distribution/Import: Otterbox.com USA

Select No.	Fringe U/L (mm)	Grad (deg)	CS (Mpa)	DOL (um)	CT (Mpa)	Thickness (mm)
1	0.705 / 1.563	0.057	-	0	-	0.33
2	1.998 / 2.647	0.332	812.097	-	41.714	
5.3/4.8	5.057 / 4.966	0	-	15.371	-	
Avg		0.13	812.097	15.371	41.714	

Measurement Outline	Date	2021/12/29-
	Name	OTTERBOX / 5
	Serial No.	1607001
	Version	FsmV Ver.2016.06.25.001
Setting Equipment	Light source wave length (nm)	790
	Refractive (Prism)	1.711
	Optical path length (mm)	200
	Pixel resolution (fEm / pix)	5.2
Measurement Condition	Condition Name	Config No.1
	Refraction (Sample)	1.49
	Photoelastic Constant [(nm/cm)/Mpa]	30.94
	K1 (1/mm)	0.0024
	Correction Value	1.024
	Others	Chemical I Adopt Boundary (Transparent) Upper / Lower Parallel Standard



Model: xxx

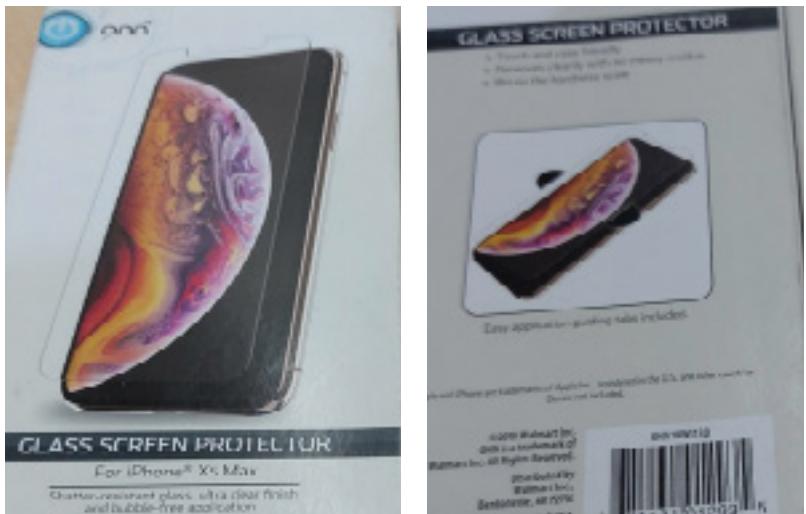
Make: SPIGEN

Country of Origion: Made in China

Distribution/Import: spigen.com USA

Select No.	Fringe U/L (mm)	Grad (deg)	CS (Mpa)	DOL (um)	CT (Mpa)	Thickness (mm)
1	5.414 / 5.544	0.197	-	0	-	0.33
0.0 / 0.0	5.221 / 5.247	0	-	0	-	
Avg	-	-	-	-	-	

Measurement Outline	Date	2021/12/29-
	Name	SPIGEN / 5
	Serial No.	1607001
	Version	FsmV Ver.2016.06.25.001
Setting Equipment	Light source wave length (nm)	790
	Refractive (Prism)	1.711
	Optical path length (mm)	200
	Pixel resolution (fEm / pix)	5.2
Measurement Condition	Condition Name	Config No.1
	Refraction (Sample)	1.52
	Photoelastic Constant [(nm/cm)/Mpa]	27.2
	K1 (1/mm)	0.00224
	Correction Value	1.024
	Others	Chemical I Adopt Boundary (Transparent) Upper / Lower Parallel Standard



Model: iPhone Xs max / X / Xs
Make: ONN

Country of Origin: Made in China
Distribution/Import: Walmart.com USA

Select No.	Fringe U/L (mm)	Grad (deg)	CS (Mpa)	DOL (um)	CT (Mpa)	Thickness (mm)
0.0 / 0.0	5.278 / 5.283	0	-	0	-	
Avg	-	-	-	-	-	0.3

Measurement Outline	Date	2021/12/29-
	Name	ONN / 7
	Serial No.	1607001
	Version	FsmV Ver.2016.06.25.001
Setting Equipment	Light source wave length (nm)	790
	Refractive (Prism)	1.711
	Optical path length (mm)	200
	Pixel resolution (fEm / pix)	5.2
Measurement Condition	Condition Name	Config No.1
	Refraction (Sample)	1.52
	Photoelastic Constant [(nm/cm)/Mpa]	27.2
	K1 (1/mm)	0.00224
	Correction Value	1.024
	Others	Chemical I Adopt Boundary (Transparent) Upper / Lower Parallel Standard

Annexure 2



Date	HS Code	Product Description	Quantity	Unit	Total Units	Assess Value (INR)	Total Duty	Importer Name	Supplier Name	Foreign Country
28-Oct-2020	8529 9090	MOBILE ACCESSORIES TEMPERED GLASS FOR MOBILE PHONE (WT. 3660KGS)	46,173	PCS	46,173	391,654	146,753	ICON OVERSEAS	HONIST INTERNATIONAL TRADING COL	CHINA
14-Oct-2020	8529 9090	MOBILE ACCESSORIES -TEMPERED GLASS FOR MOBILI PHONE (WT. 5839 21 KG5)	54,903	PCS	,903	409,027	153,263	S A ENTERIPRISES	YD INTERNATIONAL TRADE LTD	CHINA
25-Sep-2020	8529 9090	TEMPERED GLASS FOR MOBILE PHONE UNBRANDED/OTHER THAN REPUTED BRAND	11,000	PCS	11,000	45,133	16,911	ORIGIN INDIA	SHENZHEN SEACAMELS NETWORK CO LTD	CHINA
25-Aug-2020	8529 9090	MOBILE ACCESSORIES TEMPERED GLASS FOR MOBILE (TOTAL WT:13449 27 KGS) (0/1 REP)	171,223	PCS	171,223	1,455,532	545,388	MARVEL INFRA	HONIST INTERNATIONAL TRADING CO LTD	CHINA
01-Sep-2020	8529 9090	MOBILE ACCESSORIES TEMPERED GLASS(84 KGS)	7,680	PCS	7,680	37,773	14,153	NOBLE ENTERPRISES	RUI JIE EXPORTS	CHINA
23-Jan-2021	8529 9090	CHINESE TEMPERED GLASS (FOR MOBILE PHONE) (UNBRANDED)	2,550	KGS	170,000	470,794	176,407	OM CREATIONS	LOVE TREE COMPANY LTD	CHINA
12-Dec-2020	8529 9090	CHINESE TEMPERED GLASS (FOR MOBILE PHONE (UNBRANDED))	1,468	KGS	97,867	274,149	102,724	SINGH TRADERS	MODERN CENTURY SOLUTIONS LTD	CHINA
15-Mar-2021	7007 1900	3D TEMPERED GLASS FOR IPHONE 11	1000	PCS	1,000	107,802	40,393	GADGET LEAGUE	XT SHENZHEN YUEYING TECHNOLOGY	CHINA
15-Mar-2021	7007 1900	3D TEMPERED GLASS FOR IPHONE 12/12 PRO	50	PCS	50	7,463	2,796	GADGET LEAGUE	XT SHENZHEN YUEYING TECHNOLOGY	CHINA
05-Dec-2020	7007 1900	FOR HW HONOR 9 LITE(TEMPER GLASS SCREEN PROTECTOR) (BRAND: M.G.R.J)	200	PCS	200	3,140	973	JJ SYSTEM AND SOLUTION	GUANGDONG MIETUBL HOLDING DEVELOPMENT	CHINA
11-May-2020	7007 1900	TEMPERED GLASS 3D FOR IPHONE 11	4000	PCS	4,000	425,270	131,749	GADGET LEAGUE	SHENZHEN UNILTE TECH COLTD	CHINA
18-Nov-2020	7007 1900	MOBILE PHONE TEMPERED GLASS SCREEN PROTECTOR	3650	PCS	3,650	175,550	54,941	VANGAU ENTERPRISES	DOGGUAN NOVAEAST TECHNOLOY C	CHINA
01-Oct-2020	7020 0090	FORIPHONR XR (TEMPERED GLASS SCREEN PROTECTOR)	600	PCS	600	23,638	7,170	FLIPKART INDIA PVT LTD	GUANGDONG MIETUBL HOLDING	CHINA
01-Oct-2020	7020 0090	FORIPHONR XR (TEMPERED GLASS SCREEN PROTECTOR)	600	PCS	600	23,638	7,170	FLIPKART INDIA PVT LTD	GUANGDONG MIETUBL HOLDING	CHINA
01-Oct-2020	7020 0090	FOR OPPO RENO 2F (TEMPERED GLASS SCREEN PROTECTOR)	1800	PCS	1,800	70,914	21,509	FLIPKART INDIA PVT LTD	GUANGDONG MIETUBL HOL DING	CHINA
01-Oct-2020	7020 0090	FOR OPPO F15 (TEMPERED GLASS SCREEN PROTECTOR)	1800	PCS	1,800	70,914	21,509	FLIPKART INDIA PVT LTD	GUANGDONG MIETUBL HOL DING	CHINA
30-Jan-2021	8517 7090	TEMPERED GLASS FOR 2.5D 2ND GENARATION IPHONE 12 PRO MAX BLACK	6	NOS	6	1,861	697	MAPLE DIGITAL TECHNOLOGY	GUANGZHOU MOKE ELECTRONIC TECHNOLOGY	CHINA
23-Dec-2020	8517 7090	TEMPERED GLASS FOR 2.5D IPHONE 12/12 PRO BLACK	100	NOS	100	25,533	9,567	MAPLE DIGITAL TECHNOLOGY	GUANGZHOU MOKE ELECTRONIC TECHNOLOGY	CHINA
23-Dec-2020	8517 7090	TEMPERED GLASS FOR 2.5D IPHONEXR/11 BLACK	18	NOS	18	3,623	1,357	MAPLE DIGITAL TECHNOLOGY	GUANGZHOU MOKE ELECTRONIC TECHNOLOGY	CHINA
23-Dec-2020	8517 7090	TEMPERED GLASS FOR 2.5D IPHONE 12 PRO MAX BLACK	6	NOS	6	1,612	604	MAPLE DIGITAL TECHNOLOGY	GUANGZHOU MOKE ELECTRONIC TECHNOLOGY	CHINA
28-Aug-2020	3926 9099	CHINESE TEMPERED GLASS FOR MOBIL LE PHONE (UNBRANDED)	815	KGS	54,333	154,646	57,946	WORLD MARK	HARVEST TREND CORPORATION LTD	HONG KONG
18-Aug-2020	3926 9099	CHINESE TEMPERED GLASS FOR MOBILE PHONE (UNBRANDED)	882	KGS	58,800	167,029	62,586	WORLD MARK	NEW MERIT ENTERPRISE LTD	HONG KONG
14-Jul-2020	3926 9099	TEMPERED GLASS IN BULK FOR MOBILE ACCESSORIES (UNBRANDED)	1228	DOZ	14,736	121,965	45,700	HAREES INFOTECH	METRO GRADE TRADING LTD	HONG KONG
14-Jul-2020	3926 9099	TEMPERED GLASS IN BULK FOR MOBILE ACCESSORIES (UNBRANDED)	171	DOZ	2,052	16,984	6,364	HAREES INFOTECH	METRO GRADE TRADING LTD	HONG KONG
26-Dec-2020	7007 2190	GLP01148D5 RHINOSHIELD TEMPERED GLASS LENS PROTECTOR FOR IPHONE 11 - PURPLE	2	NOS	2	638	198	UPBEAT RETAIL PVTLTD	EVOBRO CO LTD	TAIWAN
17-Dec-2020	7007 2190	GLP01148D8 RHINOSHIELD TEMPERED GLASS LENS PROTECTOR FOR IPHONE 11 - BLACK	1	NOS	1	329	102	UPBEAT RETAIL PVTLTD	EVOBRO CO LTD	TAIWAN
13-Mar-2021	7007 2190	GLP01198D8 RHINOSHIELD TEMPERED GLASS LENS PROTECTOR FOR IPHONE 12 MINI/ 12,	2.2	NOS	22	6,930	2,597	UPBEAT RETAIL PVTLTD	EVOBRO CO LTD	TAIWAN
13-Mar-2021	7007 2190	GLP01148D5 RHINOSHIELD TEMPERED GLASS LENS PROTECTOR FOR PHONE 11 - PURPLE	2	NOS	2	638	239	UPBEAT RETAIL PVTLTD	EVOBRO CO LTD	TAIWAN
15-Jan-21	7007 2190	GLP01198D8 RHINOSHIELD TEMPERED GLASS LENS PROTECTOR FOR IPHONE 12 MINI/ 12,	5	NOS	5	1,586	491	UPBEAT RETAIL PVTLTD	EVOBRO CO LTD	TAIWAN

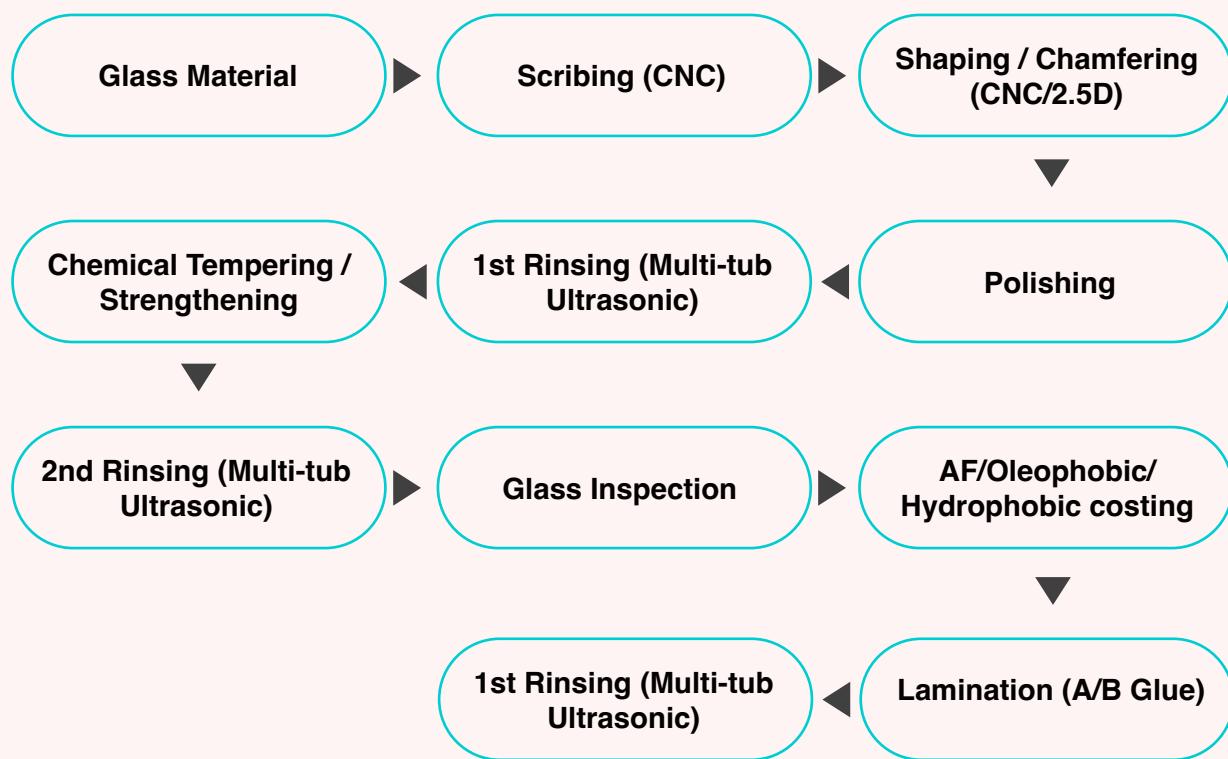
Source : DGFT

Annexure 3



Manufacturing of Tempered Glass Screen Protectors

The typical manufacturing process of tempered glass is as below in Chart 21:



The process of manufacturing the tempered glass starts with feeding the glass material to the CNC machine for scribing and shaping.

Scribing Process

The Diamond wheel scribing machine is used to scribe the glass before it is cut in various shapes. The scribing machine includes a diamond scribing wheel, a kind of wheel round blade. This wheel is used for cutting the glass used for screen protection. Some of the super hard diamond scribing wheel provides high-quality PCD, with high hardness, stable quality, long life, strong penetration and good edge cutting effect. The machine can be coded to get various shapes with minimal damage to glass, no radioactive crack, fine shear mark, high cutting quality, and high consistency.

Shaping/Chamfering Process

The glass is then processed at the glass CNC milling machine for giving it the required shape and chamfering. The 2.5D a.rc chamfering smoothen the curves around the edge and the buttonhole which makes the touch feel smoother. The 2.5D tempered glass was commonly used, however, the 3D tempered glass is becoming more popular. The installation of 2.5D chamfering process is much simpler as compared to 3D process; therefore, easy to install by the manufacturer.

Polishing Process

After cutting and chamfering process, the protective glass surface is polished in the polishing buffering machine. The polishing machine is equipped with an automatic vacuum drainage device, saving slurry drainage and increasing the clean-up time.

Rinsing through Ultrasonic Cleaning Process

The polished glass is rinsed and cleaned in ultrasonic cleaning tank to remove the contamination. In ultrasonic cleaning process a high-frequency sound waves is transmitted through liquid to scrub clean the surface of glass. Multi-chamber ultrasonic cleaning is used to remove various types of contamination such as dust, dirt oil, grease, pigments, flux agents, finger prints, polishing compounds etc.

Chemical Tempering Process

Chemical tempering is a very important step in the tempered glass manufacturing process as it helps in strengthening the glass film. In the process, the larger sized ions are stuffed on the glass surface by compression. In the process of chemical tempering, the glass is submersed in molten potassium salt bath at prescribed temperatures. Due to heating, the sodium ions on the surface of the glass are replaced by large potassium ions in the molten salt. These large potassium ions squeeze into the gaps of small ions. After removing from the salt bath, these larger ions on the glass surface are crowded, creating a compression on the surface. This compression results in a stronger glass that is more resistant to breakage. The tempering process creates a uniform stress on the surface as ion exchange occurs uniformly on all surfaces. The desired compressive strength can be achieved depending on the time of bath and the temperature of heating. After the tempering process, the glass sheet is again cleaned using ultrasonic cleaners.

Glass Inspection Process

The tempered glass is then inspected for defects in the glass sheet. The visual inspection process is for checking for various parameters such as scratches, cracks, line defects, glass bubbles & stains etc.

AF/Oleophobic/Hydrophobic Coating

Once inspected, the tempered glass is made to be repellent to oil or water particle. The glass is coated with AF/oleophobic/hydrophobic coating. It provides finger smudge resistance as it repels the oils produced by the skin. Although the surface is not fingerprint proof, it will clean the smudge in a simple wipe. The oleophobic coating feels slightly slippery, which gives a slick touch to the phones and adds a little more to the scratch resistance of the glass. Usually, AF coating can be applied in three ways: manual coating using brush, nano-coating using plasma spray, and electroplating. The electroplating method is used during the surface processing method, where the fingerprint oil is precipitated on the surface of the tempered glass through electrolysis to form a plating layer.

Lamination (AB glue)

The lamination process of the tempered glass involves the application of AB glue on the surface. The thickness of the glue shows the performance of the laminate. Generally, more the thickness of the glue, better will be the lamination. The glue performance is judged by its flow, bubble and halo effect (white edge). Therefore, the proper glue thickness is required to avoid bubbles and halo effect.

Final Inspection and Packaging

The final tempered glass is then passed through the final inspection check for particles of dust, bubble, damage to surface or edges and then sent for packaging of the glass for transport and supply.

Typical Machinery Requirement for a Typical TG Screen Protector Unit

In the process of tempered glass manufacturing, around 13 types of equipment are required. The Table 4 below enlists the quantity of machineries used in the typical tempered glass manufacturing process.

Sr. no.	Machine (Description)
1	Diamond Wheel Scribing Machine
2	CNC Machine
3	Polishing Machine
4	Ultrasonic Cleaning (Pre-tempering)
5	3D Bending Machine
6	Tempering Oven
7	Ultrasonic Cleaning (Post-tempering)
8	Plasma Treatment and Coating Machine
9	Silk Screen Printing Machine
10	Gluing Machine
11	Auto Clave
12	AB Glue Roll Slitting and Die Cut
13	Surface Stress Meter (FSM 6000 Low-energy Ion Ring (LEIR))
14	Clean room class 10000 or better

Annexure 4



Problems of “Sub-standard / Inferior” Tempered Glass Sales to consumers

1

LACK OF AWARENESS

The Tempered Glass Screen Protectors being a very low-involvement product and also NOT governed by any quality standards. The TGSPs come in various packs and shapes suiting various phones and is available in the price range of INR 50/- to INR 2500/- per piece. The prices vary as per the phone models, the place of purchase and the customer profile. A random selection of some of the TG screen protectors are shown below:



Typically, a consumer selection of the Screen Protector depends on the retailer's push/ consumer idea from the ratings in the e-commerce portal. Consumers mostly make a decision based on the product packaging and the price of these screen protectors, without any awareness of the quality or proof of tempering.

Consumers do not have any idea/method to know if they are buying a ‘Real’ / ‘Sub-Standard’ Tempered Glass Screen Protector

PROBLEMS FOR CONSUMERS

As mentioned in the above section 4.1, the personal injury to phone users is one of the biggest problems of the ‘Sub-standard / Not so well’ tempered glass. But, apart from this aspect, it also leads to other problems to consumers as elaborated below:

Touch-screen Malfunction

Phones with broken screens will not get any better over time. In fact, the first thing that will be compromised in terms of function is the touch-screen capacity of the mobile phone. It may take longer for the phone to respond to finger gestures, or worse, it will stop responding altogether.

Loss of Protection

The screen protects the inner parts of the device from outside elements that could potentially damage the device. For example, one would usually clean the phone’s screen with a damp cloth. But with a cracked screen, that’s no longer advisable. This is because liquid can seep through the cracks and can cause the phone to suffer a short circuit.

Also, if an individual owns one of the newer smartphones that is water-resistant, a cracked screen invalidates this functionality.

Splinters on the User’s Finger

With cracked phone screens, users put their fingers at risk from cuts when they try to swipe through it as they usually do. If the phone screen has severe cracks, they could also possibly hurt themselves with small glass splinters.

Eye Strain

Smartphones boast of a high-definition display that gives a great user-viewing experience. When this HD screen breaks, however, you will be left with an eyesore. It will be more difficult to look at the screen and view content because of the cracked areas. A cracked screen makes checking your phone a more significant task than what it should be.

Road Hazard

Smartphones come equipped with GPS and maps to help users navigate through unfamiliar roads and neighborhoods. Often, they steal quick glances on their phone’s maps while they’re driving. A cracked screen makes this a more difficult task and would compel drivers to lose focus on the road ahead.

Broken screens force drivers to take their eyes off the road for more than a few seconds when using the smartphone’s GPS, which could be a major hazard and safety risk.

Ghost Touch

There is a concept called as ‘ghost touch’ because the phone will start operating by itself, which makes it look as if a person is touching the screen. This happens due to the damage sustained from the cracked screen.

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