Performance

# of a carton

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PackTest

Performance of a carton

Corrugated cartons are primarily used as a secondary packaging medium and are also know as “Shippers”

As in all types of packaging, its main purpose is to protect its contents.

In simple words, the role of a corrugated carton is to ensure that the product reaches the end-user (Consumer) or POS (Point-Of-Sale / Retailer) in the condition intended by the producer / manufacturer of the product.

In order to ensure this, the carton goes through a lot of planned and unplanned stages / conditions.

The first and longest stage in a life cycle of the package (after being packed) is storage. This is where it spends almost 90% of its life.

The carton are stacked and stored in warehouses (godowns).
This is also where 95% of the problems or performance issues occur.

Every one of us has surely seen a warehouse with stacked cartons.

At the top the stack seems fine, but as you look down towards the base of the stack, you will see a badly bruised, damaged carton about to collapse.

Glance around and you will probably find the same situation in all the stacks across the warehouse.

It is a coincidence? Ofcourse not.

The carton is simply not strong enough to with stand the load of the stack.

Ask any layman, why does the lowest carton look in a bad shape?

He will promptly respond “stack weight is more that the cartons strength”.

Now ask a packaging or quality control man, what is the solution?

A vast majority (Yes, its true) will reply – “Increase the Bursting Strength (BS) Specification”

Why Bursting Strength?

If bursting was a problem, why only the lowest carton is affected.

The point being, if Bursting Strength was the culprit, even the top carton should have burst open.

Infact, the lowest carton has not burst at all. It has just gotten compressed / collapsed.

Even if the lowest carton has burst, it must have burst open because the carton first collapsed and then pushed the product against the walls of the carton.

Very rarely will you find the products themselves pushing the carton walls from inside and making the carton “Burst”.

So, if everyone understands that the carton failed because of stack load, then it is a problem in compression strength of the carton and not its bursting strength.

If that is the case, why are we running behind the wrong parameter called "Bursting Strength"?

A large section of the people in this industry (infact every industry) do not possess the correct and complete understanding of the subject. They either **are** or **try** to act *Ignorant*.

They will follow what is being done for the last 50 years and will resist any change in their systems.

Then there is a class of people who are running the industry with *incorrect* and *partial* information.

I dare say that these people with partial knowledge are more dangerous that the totally ignorant ones.

Another segment of people exists, who understand the issue very well but will not want to go against age old practices of this industry.

Eg.

- A packaging professional who is a consultant to a company will not try to change their age old practices because he may upset the management and lose his contract.
- A Packaging Development Employee will probably think "I am here in this company for 1-2-3-4 years, why bother to go against the trend."
- A corrugation unit owner will say "I know how to improve the quality, but why bother. The buyer is giving me wrong specs and I am supplying whatever he wants. Let it be the way it is, for as long as possible".

I wouldn't say these people are totally wrong.

After all who would want to swim against the current and bring in new (and correct) ideas, who will do all the explanation work and the bottom line is – ***"Why fight the system?"***.

<u>Everybody Loves Bursting Strength</u>

Testing equipments suppliers (some) love Bursting Strength because it sells like hot cakes.

Corrugation factories love Bursting Strength because the equipment is small and cheap and more so because ***BS is easier to manipulate***.

The buyers (even MNCs) are either ignorant or are not willing to bring about a change.

No one is willing to put the foot down and say “Hey, you have fooled me enough, give me real quality. Give me ***performance based quality***. Give me stack load capacity or compression strength.)

A majority of MNC’s worldwide have dumped Bursting Strength (way back in late 1980s) and adopted Edge Crush Test (Related to BCT) and Box Compression Test, as a better representative of Box Performance Quality.

More than 25 years later, we are still following the wrong parameters.

What is performance quality?

Quality Parameters / Specs are of 2 Types :

1) Material Specification / Quality
2) Performance Specification / Quality

Material Specifications are those parameters which define the quality of the material used.

Performance Specifications are those parameters which define / govern the quality of actual performance of the package / packaging material.

Many Material Specifications may also directly affect the performance of the package.

However this may not always be the case.

There are some tests like Box Compression which evaluate perform quality and there are some tests like BS which evaluate material quality.

International standards like TAPPI (T810 om-85) say “The Bursting Strength of combined board is primarily an indication of the character of the materials used in manufacturing a fiberboard box and has value in this respect. On the other hand, it gives no direct information regarding the ultimate performance of design or construction of the finished container and correlates very poorly, if at all, with most of the performance values of the container.”

If fact studies suggest that Box Compression Strength and Bursting Strength may not be related, at all.

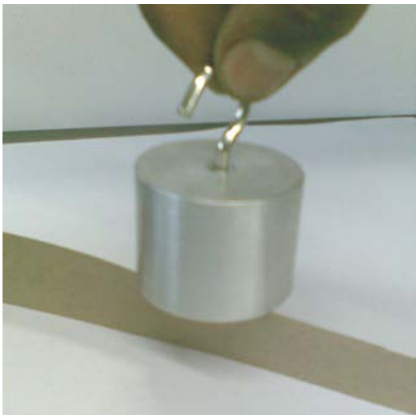
A high Bursting Strength does not always indicate high Box Compression Strength

Where does the board get its strength from?

I am sure all of us have performed the below experiment in our school days.
If not, it's not too late now too.

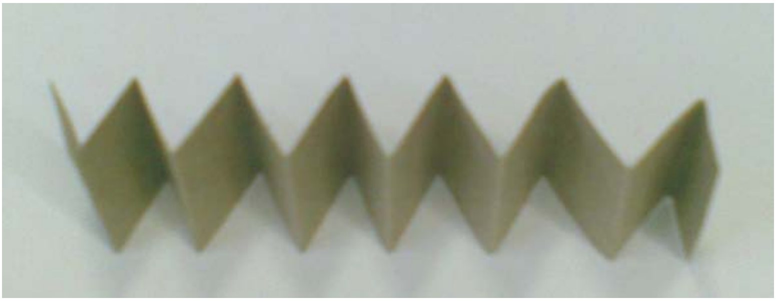
Take a sheet of paper about 1 inch high and 6 inches wide.

Now hold it straight (Vertical) and place a glass of water (or any other weight) on it.



What happens?
Obviously, the paper won't take the load.

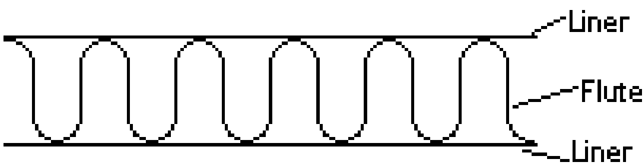
Now fold it in zigzag fashion.



Now hold it straight (Vertical) and again place the same glass of water (or weight) on it.

What happens?
The glass stands comfortably on the zigzag paper.

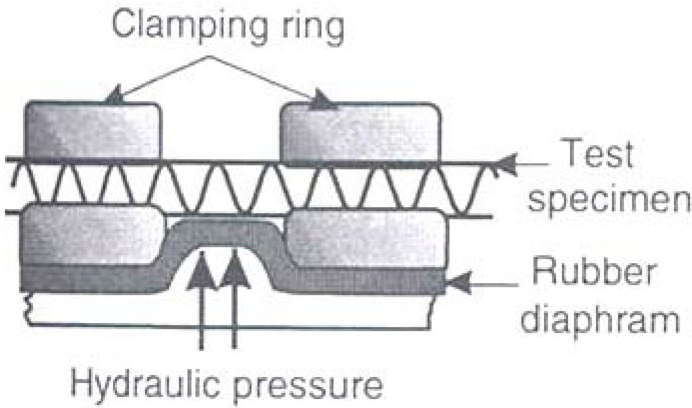
Coming back to our subject, the fluting (wave like structure) in the middle of corrugated sheet is nothing but the zigzag structure you just saw in the above experiment.



We saw that a straight sheet of paper cannot take top-load, where as a wavy (zig-zag) structure can easily take heavy loads.

What this implies is that, in a corrugated sheet, the load is actually taken up by the flute(s) and the liners are provided to keep the flutes straight.

Now, in a BS Test the rubber diaphragm punctures a hole through the face of the corrugated board.



The resistance offered by the board is called bursting strength.

Studies suggest that the liners give 100% contribution and the fluting give 0 – 33% contribution to the board BS.

e.g. if I use 3 kg/cm^2 paper as liners and 3 kg/cm^2 paper as fluting, my board BS will b 3 (100% of liner) + 1 (33% of flute) + 3 (100% of liner) = 7 kg/cm^2

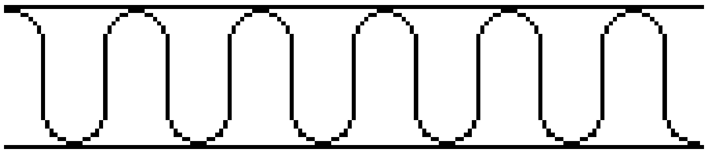
How can someone manipulate BS?

How can he give a higher BS without giving a better box quality?

Let us take an example:

I have a 3 ply carton with the following structure:

Liner – 100 gsm	3 kg/cm^2 BS
Flute – 100 gsm	3 kg/cm^2 BS
Liner – 100 gsm	3 kg/cm^2 BS
Combined BS	7 kg/cm^2 BS (as described earlier)



It is known that for a particular quality of paper, the GSM is proportion at to its BS.
e.g. 110 gsm paper will have higher BS than a 100 GSM paper of similar quality.

Now if I want to increase the BS, I must increase the gsm of both liners. To economise on cost, I decrease the gsm of the flute.

The new structure is as follows.

Liner – 110 gsm	– 3.3 kg/cm^2	(approx)
Flute – 80 gsm	– 2.4 kg/cm^2	(approx)
Liner – 110 gsm	– 3.3 kg/cm^2	(approx)

Combined BS will become:

	3.3 kg/cm^2 (100% of Liner1)
+	0.8 kg/cm^2 (33% of Flute)
+	3.3 kg/cm^2 (100% of L)
=	7.4 kg/cm^2
=	5.71% increase over the original BS

As you can see, by manipulating the gsm and hence the paper BS, I have increased the board's combined BS.

Since, paper is sold in terms of GSM and BF / BS values, the price of the material has more or less remain unchanged.

My carton's Bursting Strength values are now almost 6% higher.

Unfortunately, what I have done has weakened the backbone (Fluting) of the board and hence my carton will now withstand even less loads.

A corrugator's approach will be "I know the Compression Values will fall, but since the buyer of the carton has specified only the Bursting Strength, and I have satisfied his requirement, I should be least bothered if the Carton survives a stack load or not. My carton will pass their test of Bursting Strength and I will get my money."

With the above example, I have tried to prove that BS can be easily manipulated.

Going ahead, if I want to improve the compression strength I need to concentrate on the fluting more that the liners. My corrugating rollers (that form the fluting) must be in good condition, the fluting gsm should not be sacrificed (that however does not mean going for very low gsm liners. Liners are important too as they have to keep the structure in proper shape and also protect the package during drops, abrasions, etc), the pasting machines should be in good condition etc.

So basically, improving BCT is not as simple as increasing GSM.
It means improving the entire production process and not just structure manipulation.

If the flutes are formed and pasted properly the final product (corrugated carton) will obviously be of great quality.

If the rollers are worn out or the pasting is not efficiently done, it will have great impact on the quality.

Hence when the buyer says to the corrugators “increase the BS”, the corrugator is happy to oblige.

But when the same buyer says “increase the compression strength”, the corrugator becomes sad.

He now has to improve the quality throughout his production process and manipulation just won’t work in this case.

So should I stop specifying BS as my specification.

Of course yes.
USA (and many developed countries) did it 25 years ago, isn't it high time you did it too?

In India (and probably in some other countries too), we (the buyers) go a little overboard when it comes to controlling our specifications.

I have seen buyers who tell their suppliers not only the combined BS, but also the BS/BF of each paper layer, the GSM to use, etc etc.

Why do we do such a thing?
The corrugator probably has years and years of experience in what he is doing. Why are we teaching him how to make a good carton?

I am sure all of us go out to a nice restaurant (your favourite) once in a while to have food. Have you ever gone the kitchen and told the chef that "I want a plate of PavBhaji or Chhole-Tikki, wherein you should use 3 potatoes, 1 onion, 2 tomatoes, 2 pinch salt, 1 pinch red pepper, blah blah blah blah………"

I don't think so, we simply want good quality (Hygienic and Tasty) food. We have faith that the chef has enough experience and business sense to give us what we want (quality).

Similarly when we deal with our suppliers, we should be bothered with what we want (quality) and not really how he achieves it (material and method).

Adopt the "KISS" concept. Means "Keep It Straight and Simple"

Tell the supplier that you want a carton of ABC size (dimensions) which should have a minimum compression strength of XYZ kgs.
Tell him "I don't care what gsm or BS you want to use. The carton should have the desired CS and should be economical too".

How do I specify or calculate the desired CS of a carton.

Many a times, people get confused between “Compression Strength” and “Stacking Load”.

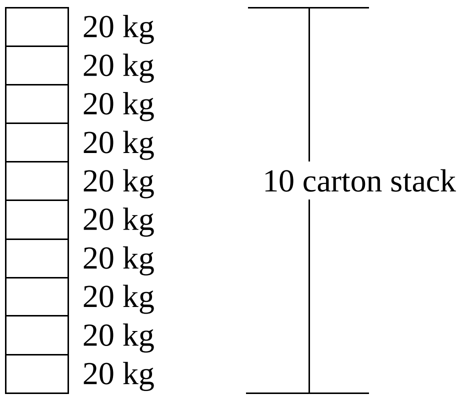
Compression Strength (CS) is derived from Stacking Load (SL).

Stacking Load is the amount of physical load that a carton is expected to take during any point of its life-cycle.

Firstly check if the stack height of the warehouse is the same as the transportation.

If different, which one is higher? Use it for calculations.

The below sketch shows the calculation of a stack height of 10 cartons where each carton weighs 20 kg.



Stack load = (No. of Cartons in Stack – 1) x gross weight
= (10 – 1) x 20 kg (each carton)
= 9 x 20 kg
= 180 kg

We now know that 180 kg of stack load will come onto the lowest carton during warehousing or transpiration.

If Compression Strength of the carton was equal or less than the Stack Load, then the lowest carton would surely collapse.

Hence, Compression Strength = Stack Load x Safety factor (2 to 5)
Below is an approximate method of calculating your safety factor.

1 How far will the package travel from the factory?

Local	up to 500 km	500 – 1000 km	1000 – 2000 km	2000 + km
1	2	3	4	5

2 How long is the package supposed to be stored in a warehouse before it reaches the consumer?

1 Week	1 – 4 Weeks	1 – 3 Months	3 – 6 Months	6 – 12 Months
1	2	3	4	5

3 Is the product fragile ? If the carton fails, is the products primary packaging designed (or capable) to take loads ?
e.g. Jam Bottles are glass and can take loads.
Wafer pouches cannot take load.
Tube lights are very fragile and cannot take loads.

Least Fragile	Not Fragile	Slightly Fragile	Fragile	Very Fragile
1	2	3	4	5

4 Is the product expensive or hazardous?
← Less More →

1	2	3	4	5

5 Is the product for export?
How big or image conscious is the client.
← Less More →

1	2	3	4	5

Now give marks to all 5 questions on a scale of 1 – 5, then calculate the average and round it off to the next higher digit.

Disclaimer: *The above is only a rough illustration of how to calculate the safety factor to find out the desired CS specification. The method and values shown above is not standard and may not be applicable to all types of products and package. The above information is generic only and may need some refinements or adjustments to suit your individual requirements.*

For more information or assistance, please feel free to contact us at :

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