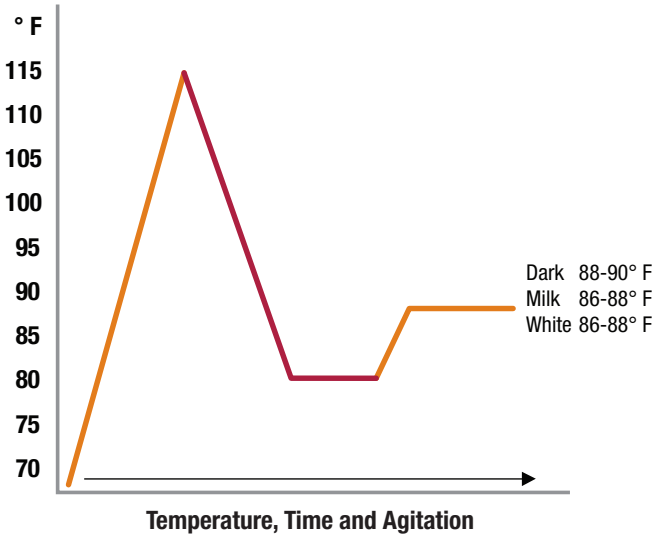
Tempering Chocolate:
Basic Tempering Principles

Cocoa & Chocolate

The process of tempering chocolate involves incorporating a small amount, typically 2-4%, of solid, stable cocoa butter crystals into melted chocolate. Cocoa butter is capable of solidifying into several different polymorphic forms that, as they cool and set, affect the surface finish, setting time, snap, and mouthfeel of the chocolate. It is important that the cocoa butter crystals in tempered chocolate exist in the correct polymorphic form; we call these stable cocoa butter crystals. The objective in tempering is to crystallize a small amount of the liquid cocoa butter into small, stable solid cocoa butter crystals. When the tempered chocolate is solidified, these seed crystals will encourage the physical "packing" of stable cocoa butter in the remaining liquid fat phase.

The three critical variables that affect the type, size and number of cocoa butter crystals being formed during chocolate tempering are: temperature, time and agitation.

1. Temperature – critical because cocoa butter crystals both form and melt at specific temperatures
2. Time – necessary for cocoa butter crystals to form and grow
3. Agitation – needed to ensure the cocoa butter crystals are well distributed within the melted chocolate and to prevent their premature growth



Stable cocoa butter crystals will provide the following properties:

1. Snap
2. Gloss
3. Proper texture
4. Bloom resistance
5. Good contraction for moulding

Chocolate is in temper when 2-4% of the cocoa butter is in the stable crystal form.

There are six different forms of cocoa butter crystals and each one has a unique melting point.

Form I – melts between 61-67° F (unstable)
Form II – melts between 70-72° F (unstable)
Form III – melts at 78° F (unstable)
Form IV – melts between 81-84° F (unstable)
Form V – melts between 93-95° F (temper stable)
Form VI – melts at 97° F (bloom)

It is important to provide conditions that grow stable fat crystals and minimize unstable fat crystals.

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TEMPERING CHOCOLATE: BASIC TEMPERING PRINCIPLES

Cocoa & Chocolate

Understanding Proper Chocolate Temper

Properly tempered chocolate will have the following characteristics:

- Shiny/glossy surface
- Even color
- Good snap
- Smooth texture
- Good contraction
- No bloom

Tempered chocolate

Improperly tempered chocolate will have the following characteristics:

- Dull finish
- Fat bloom
- Soft uneven texture
- Poor contraction
- Poor snap

Untempered chocolate

Testing Temper

MANUAL METHOD

To check if chocolate is in good temper, dip a metal spatula or knife blade into chocolate and leave a small film on the blade. If the chocolate is firm and not tacky after five minutes at normal room temperature (68° F), it is in good temper. If it is still tacky, place the chocolate chunks back in the bowl and cool about 2° F. Repeat test until tempered.

USING A TEMPERMETER

A tempermeter measures the quantity of stable cocoa butter crystals in the chocolate and the quality of the overall temper.

A tempermeter produces a temper curve that represents temperature-versus-time resulting from uniform cooling of the chocolate sample over a specified period of time.

The slope of the temper curve provides a quantitative means of interpreting the amount of heat of crystallization (latent heat) produced during the cooling of the test sample.

A negative slope indicates over-tempered chocolate and a positive slope indicates under-tempered chocolate.

A chocolate temper unit, or CTU, indicates the quality of the temper.

CONTACT

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Tempering Chocolate: **Understanding Bloom**

Cocoa & Chocolate

There are two forms of bloom – **Fat Bloom** and **Sugar Bloom** – common to chocolate.

FAT BLOOM

This results from inadequate tempering or temperature abuse of well-tempered chocolate. It produces a visible film on the surface, ranging from a dull white to a severe white discoloration, and soft or crumbling interior textures. Fat bloom is generally the result of excessive heat attacking the cocoa butter crystals during the tempering or cooling processes. Mixing of confectionery coating and real chocolate can also lead to fat bloom, as the two fats are not compatible.

Bloomed wafers

While fat bloom has a negative effect on appearance, the product remains perfectly safe to eat and can usually be re-tempered to reach the desired appearance. When fat bloom is caused by mixing confectionery coating and real chocolate, re-tempering will not fix the appearance.

SUGAR BLOOM

This is a hard white surface film resulting from exposure to moisture. It is formed by the dissolution and subsequent crystallization of sugar on the chocolate's surface. It generally appears as droplets of sugar crystals on the surface of the product.

Unbloomed wafers

If sugar bloom is slight, the product may be salvageable if all bloom is removed. If sugar bloom is moderate to severe, the product should most likely be discarded.

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Tempering Chocolate:
Machine Tempering Instructions

COCOA & CHOCOLATE

Tabletop Tempering Machine

1. Remove the cover from the machine.
2. Adjust set point to 86°-87° F for milk and white chocolate and 87°-88° F for dark chocolate (confirm the temperature probe is accurate).
3. Place approximately one pound of tempered chocolate chunks in the back side of the bowl divider (the side without the temperature probe) and untempered, melted chocolate in the front side of the bowl.
4. To temper chocolate:
   a. The room must be 73° F or less.
   b. There must be unrestricted airflow to the machine.
   c. Untempered chocolate in the front of the bowl must cover the exposed tip of the temperature probe.
5. When set point is reached (the cooling fan will turn on and off), the chocolate should be tempered and ready to use in approximately five minutes for dark chocolate and ten minutes for milk and white chocolate. Chocolate is tempered when a thin layer of coating is placed on a knife blade and sets up within five minutes at room temperature.
6 Remove remaining chunks from the back side of the bowl divider.
7. Approximately 10-15 minutes after the chocolate is tempered, the temperature should be increased by ½-1° F. If the temperature is left at the original set point, the coating will become very thick and over-tempered.
8. As production continues, the final temperature for milk and white chocolate is usually 88-90° F, while dark chocolate is usually 89-91° F. Thick, over-tempered chocolate can usually be cured by increasing the temperature by 1-2° F. Under-tempered chocolate — chocolate that has a slow set-up time — can be solved by decreasing the temperature by 1-2° F and ensuring that tempered chocolate chunks are in the backside of the bowl.
9. Add chunks as needed to the back side of the bowl to replenish chocolate supply.
10. Chocolate in the front side of the bowl should never be lower than the temperature probe or heating of the coating will occur and temper will be lost.
11. At end of day, set the temperature to 100-105° F, shut off the bowl rotation, and replace the cover.
    a. Set the temperature to 105° F for milk and dark chocolate.
    b. Set the temperature to 100° F for white chocolate.

All chunks of chocolate in the back side of the bowl must be in good temper – an exact quantity is not essential, but chunks of chocolate must remain until the cold set point is met (usually 86° F).

For questions about a specific tempering machine please contact the manufacturer.

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Tempering Chocolate:
Hand Tempering Methods

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Seed Tempering Method

This method of tempering chocolate uses the assistance of already well-tempered chocolate as "seed". The well-tempered chocolate can take various forms: chunks/blocks, finely ground, or wafer. Little equipment is required — a microwave, a plastic bowl, a spatula, and a thermometer — but it can be difficult to control and if the seed chocolate is not well-tempered, the finished chocolate will not be either.

Using finely ground chocolate

1. Melt untempered chocolate to between 105 and 115° F.
2. Allow the chocolate to cool to a temperature of 92-93° F for dark chocolate and 91-92° F for milk and white chocolate. Always make sure the chocolate is stirred and uniform so temperature readings are accurate.
3. Add finely ground chocolate (4 oz. per 5 lbs. melted chocolate) and stir continuously.
4. As the finely ground chocolate melts, it cools the liquid chocolate and the temperature should drop to 88-90° F for dark chocolate and 86-88° F for milk and white chocolate.
5. Allow 10-15 minutes for the chocolate to stabilize, continuing to stir for the duration, and the chocolate will be in good temper.

Tempered chocolate.

Using chocolate chunks

1. Melt untempered chocolate to between 105 and 115° F.
2. Place 3 or 4 large chunks of tempered chocolate into the melted chocolate and stir constantly. The solid chunks will cool the chocolate and provide "seed" crystals as they melt.
3. Continue stirring until the temperature reaches 86-88° F for milk and white chocolate, or 88-90° F for dark chocolate.
4. Remove the remaining chunks; these can be cooled and reused. The chocolate in the bowl is now tempered. Keep tempered chocolate mixed by stirring.
5. As production continues, chocolate should be warmed to avoid overseeding, 88-90° F for milk and white chocolate and 89-91° F for dark chocolate. Chocolate should be mixed occasionally to maintain a consistent temperature.

This method of tempering chocolate mimics the actions of some batch tempering machines. Many tempering machines use a rotating bowl with a baffle across the middle. The baffle separates the chocolate chunks from the liquid chocolate and the rotation of the bowl provides the agitation. A cooling fan and heating element keep the chocolate at the correct temperature.

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Tempering Chocolate: Hand Tempering Methods

COCOA & CHOCOLATE

Mush Method

This method of precrystallizing chocolate does not require the assistance of well-tempered chocolate as "seed". In warm, untempered chocolate between 110-115° F, all of the cocoa butter is completely melted and in the liquid phase. We cool chocolate while mixing/agitating until it turns to "mush," thus the name. The change in color and significant thickening of this mush tells us that we have crystallized some of the cocoa butter in the chocolate from liquid to solid. The mush chocolate is approximately 76-80° F. The chocolate can be cooled by a number of methods, including moving it around on a cool marble slab or mixing in a pan over cold water.

At this point, the solid cocoa butter crystals in the mush are a blend of both stable and unstable crystals. If we stop here and allow the chocolate to solidify to completion, the end product will be streaky and bloomed because the cocoa butter crystals will not finish solidifying in an orderly and stable manner. This is because of the unstable cocoa butter crystals in the mush.

To correct this, the mush chocolate is warmed to 86-88° F for milk and white chocolate and 88-90° F for dark chocolate, by the addition of some warmer chocolate. This melts away the unstable crystals but leaves behind the desirable ones. Ending the process below this important temperature leaves too many unstable cocoa butter crystals; too warm a temperature melts away too many cocoa butter crystals.

Instructions:

1. Start with melted chocolate between 110-115° F (heat to 120° F if starting with bloomed chocolate). Pour approximately ¾ of the melted chocolate onto a marble slab or cooling table. Room temperature should be 62-68° F for the marble slab. Water running through the cooling table should be 55-65° F.
2. Cool the chocolate "mush" by moving the chocolate back and forth across the cool marble or table; a spatula works well for this. Continue with this until the chocolate is visually thickened and very viscous, but has not yet solidified. The temperature should be 76-80° F.
3. Move the "mush" back into the bowl with the remaining warm chocolate (temperature should be 90° F for milk and white chocolate and 92° F for dark) and mix until uniform. Measure the temperature, which should be 88-90° F for dark chocolate and 86-88° F for milk and white chocolate. If too warm, put some of the chocolate back onto the cooling table and repeat the process. If too cold, microwave for a few seconds to reach the desired temperature.
4. To test temper, dip a metal spatula or knife blade into the chocolate and leave a small film on the blade. If the chocolate is firm, glossy and not tacky to the touch in 5 minutes at normal room temperature (68° F), it is in good temper.
5. At this point, the chocolate is now precrystalized with the correct amount of good, stable cocoa butter crystals. Over time, these crystals will grow, so it is important to stir the chocolate occasionally to keep the crystals blended. The chocolate should be warmed slowly – a degree or two at a time – to a maximum of 90° F for dark chocolate and 88° F for milk and white chocolate. To replenish supply during usage, slowly incorporate 90° F milk or white chocolate or 92° F dark chocolate. This will keep the chocolate from getting too thick but still allow enough of the good, stable crystals to remain in the mix.

This method of tempering chocolate simulates how many automatic tempering machines work. In the machines, warm, untempered chocolate is pumped in and then through a heat exchanger with cooling zones; the 'mush' is created in one of these cooling zones. The 'mush' is then warmed up to the proper endpoint temperature in another warming zone. Tempered chocolate then exits the machine, ready for use.

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