



DRAFT
as of
Aug 2017:
Watch for updates in 2018



Hop Processing Guide: Standards & Processes for Quality Control & Food Safety

Hop Growers of Michigan

2017

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I – Introduction & Background

- Hop production in Michigan has developed over the past decade and continues to grow from a small base to now include more than 1200 acres of production.
- In 2014 the **Hop Growers of Michigan (HGM)** trade association was formed with a mission makes a positive difference in Michigan’s hop industry by providing educational opportunities and research for better hop production and processing, as well as advocating for and promoting the use of Michigan grown hops.
- The sector continues to benefit from **strong MSUE support**.
- The Michigan hop sector is **very diverse**, with farms as small as 1/8 acre to over 500 acres. Likewise pellet processing ranges from table-top to industrial scale.
 - This range is not unusual for an agricultural sector that is just a decade old, with many enterprises learning as they go.
- In 2015 HGM identified a **need to develop quality and operating standards** to ensure the sector as a whole met the requirements of craft brewer customers of today and the future. USDA SCBG grant funding was secured to define the required growing and processing standards herein.
- Just as the hop sector is maturing as it expands, so is the craft brewing sector – setting ever-higher standards needed to consistently meet its consumer’s expectations.
- The expectation is that **by delivering quality and consistency HGM members can gain brewers trust**, thereby increasing market access and market share.



Program Goals (from SCBG Application, 2016)

• A. Statement of Purpose

- **Michigan hop farms are rapidly increasing acreage** to support the craft beer boom, but sales and long term contracts are lagging behind. The Pacific North West (PNW) is the trusted source for hops as they have provided 98% of the hops produced in North America. A primary deterrent to Michigan sales, especially to the very large breweries, is a **lack of confidence in receiving a consistently high quality (and safe) product**. This lack of confidence is justifiable as each farm and processing center is left to their own discretion on what quality practices and standards they choose to implement. There is a **need for a hop quality program in Michigan that includes food safety and that includes, at a minimum, self-verification and ideally, voluntary third party verification**.
- There is a **sense of urgency** for this project as millions of dollars are being invested state wide to install infrastructure for harvesting and processing. Without guidance, some will hit the mark and some will require expensive rework and improvements if they are **to meet the expectations of the industry**.

• B. Statement of Work

- This project will establish for the first time in Michigan a **quality system specific to hops** that includes:
 - **Recommended Operating Procedures** to insure food quality and safety, broken down into three areas: a) field (IPM and spray records), b) harvest (pick-dry-bale-storage), and c) processing (pelletize-package-storage)
 - An education program that will **train farm owners and employees** to use the recommended operating procedures and help prepare them for the verification program.
 - A **two level voluntary verification program**, level 1) a self-audit, and level 2) an HGM sanctioned third party verification.
- After the development of the procedures, the project includes a pilot program in 2017, followed by implementation in 2018. Hop farms, having met all the standards, will be able to promote their product as having met the level of quality that the craft brewing market demands.



Quality Priority Pyramid

(source: Brewer Association, 2017)

Brewers are the primary customers for hops. Aligning hop processing quality programs with brewer expectations is recommended.

The Brewers Association (BA) Quality Subcommittee created the Quality Priority Pyramid to provide a broad overview of the structure of a formal quality program. The pyramid is a visual representation of essential features and the order in which they should be put into practice. Items at the base are a quality program's foundation and should be employed first. Items towards the top should be approached after the foundation has been established.

Tier 1 (GMPs) are required to be implemented by law. A HACCP plan (2) is recommended. This manual is intended to help processors in the Michigan hop



Learn more at:

<https://www.brewersassociation.org/educational-publications/quality-priority-pyramid/>



III - Hops Quality: Expectations

- Meeting the quality, food safety, and product consistency requirement of Michigan hops in the marketplace requires meeting a set of standards, **ensuring that brewers can rely on our product** to perform as required in their production.
- This document addresses **hop pellet processing**.
 - Beyond the farming practices outlined in the HGM "**Grower Quality Standards and Food Safety Requirements**" manual is a need for a set of standards for hops further processing – primarily pelletizing as well as the associated pre-processing and downstream handling to market.
- A key market expectation from a young and growing supply base like that in Michigan is **improvements in the consistency of the product delivered to market** – within lots, between lots, within varieties, between processors, and from season to season.
 - We acknowledge that there can and will be seasonal and geographic/climate **nuances in any given hop crop/lot can contribute to a craft beer's unique story** – and that these difference can be capitalized on in a hop sale. Leveraging this type of variability, particularly in marketing to the brewpub and micro-brewery sectors in fact meets a need that can be featured in a craft beer's 'across the bar' story.
 - **As the sector matures and output increases we can expect that variability may be less desirable** – particularly for the regional and larger micro-craft brewers' brands engaged in wider distribution. For that larger market consistency is as important as quality. And the Michigan hops sector will have to deliver more consistently.
 - Consistency can be improved when a set processing standards are met to minimize controllable variables (*pellet density, color, heat 'damage', alpha and beta acids, oils, HSI, aromatics, pellet friability etc.*).



Hop Processing

- The Processing of Baled Hops or Leaf Hops into Pellets*, or other forms, for storage and marketing.



- Pellets are the predominant compressed hop format marketed to the Craft Brew sector in the USA..
- Note: Other forms (plugs) are not common in the marketplace, and are not addressed in this manual.



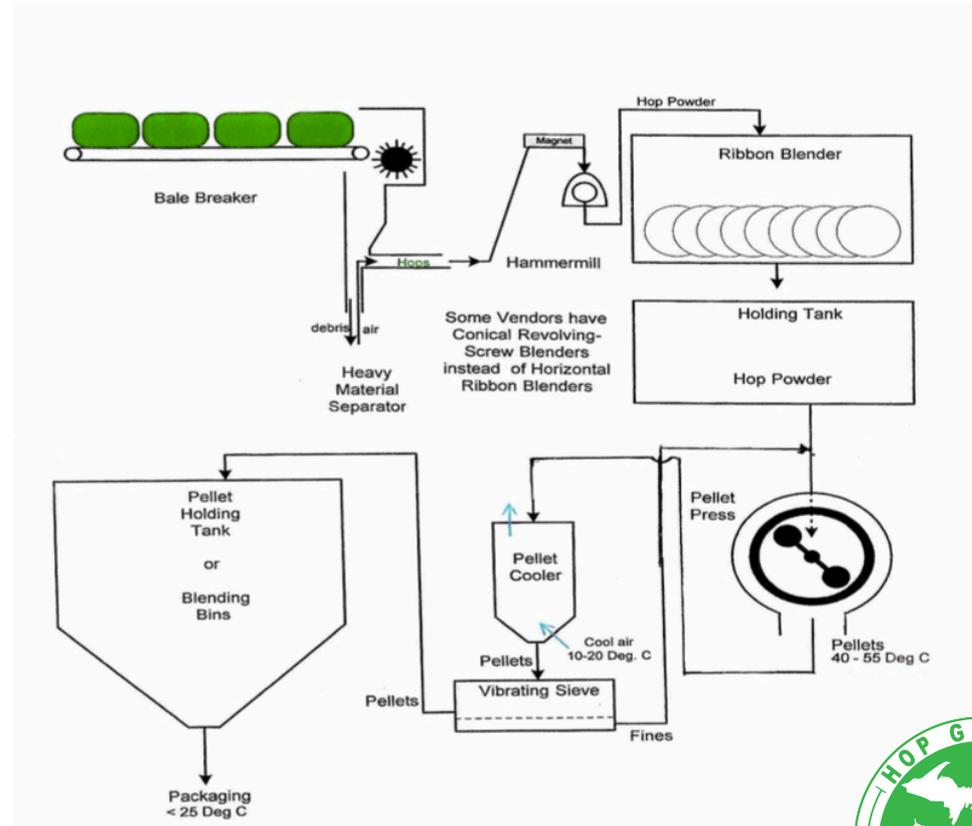
Hop Pelleting: Typical Process

- Typical hop pelleting process yields what is called a T-90, or Type-90 Pellet – essentially a milled and compressed hop cone.

- The Type 90 pellet is made from dried hop cone powder. It is called "Type 90" because there is about 10% waste in the production process, from dried hops to pellets.

- *Note another pellet is the Type 45. In the Type 45 pellet, lupulin (alpha acids and essential oils) is concentrated to twice its level per volume. 1kg (2.2 lbs) of cones are used to make 0.5 kg (1.1 lbs) of pellets with the same levels of lupulin as 1 kg (2.2 lbs) of dried cones, and the process then also loses 10% during production, hence Type 45. Type 45 pellets are an insignificant part of the market and not addressed in this manual.*

Type 90 Process



What is a Quality Hop Pellet?

- Color: Green is good 
- Variety: True to type, for all attributes
- Aroma: Characteristic (subjective – variety specific)
- Acids: alpha & beta (typical of variety)
- Oils: flavor
- Moisture: <10.5% moisture
- Purity: Free of FM
- Consistency: true to variety, within/between lots, over time



Hops are not a commodity crop. As such, each variety delivers unique attributes that are important to craft brewers' specific beers. Consistency with respect to the quality of a specific hop variety is very important in satisfying the market needs.



The Marketplace: *Understanding the marketplace, specifically the drivers of the craft brewery sectors, is important when defining a hop processing quality program*

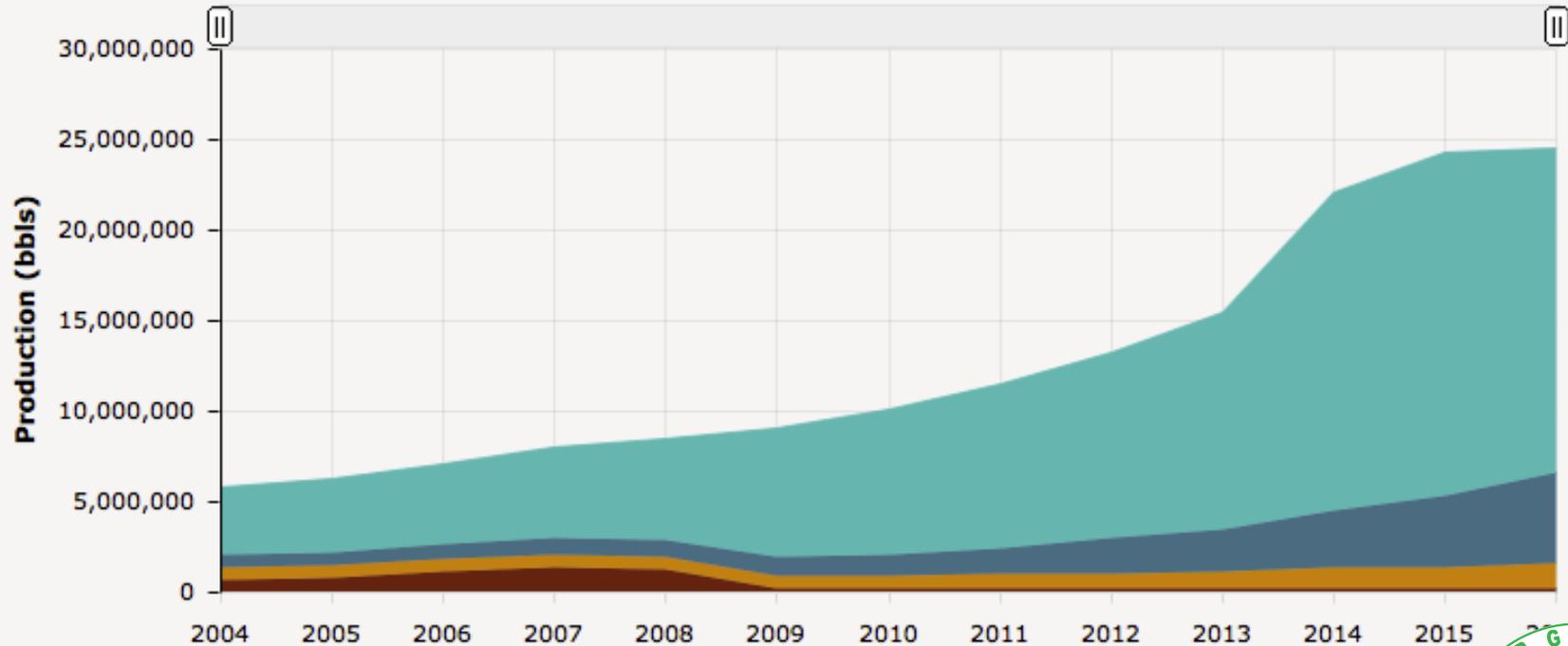
Historical Craft Brewery Production by Category

Source: Brewers Association, Boulder, CO

Does not include – home brewers

Does not include – large brewers (>6MM bbl/yr – 20+ in USA)

-  Contract
-  Brewpubs (>25% on site sales – 130 in MI)
-  Microbreweries (<15,000 bbl/yr – 89 in MI)
-  Regional (15,000 – 6,000,000 bbl/yr – 8 in MI)



1 barrel = 31.5 gallons



Brewers' Hops Usage: Overview

Brewery Tier	bbl/yr	Examples	Hop Types	Lb/yr (scale)	Hop Suppliers
Large	>6,000,000	AB-InBev, MillerCoors, Leinenkugel's	Extracts (Pellets)	100,000s	MNC Brokers
Craft - Regional	15,000 – 6MM	Atwater, Bells, Dark Horse, NHB, Perrin, Shorts	Pellets (Extract, fresh/wet)	10,000s	MNC Brokers MI – Top Tier
Craft - Micro	<15,000	(89 in MI)	Pellets fresh/wet)	1,000s	MNCs MI – many
Craft - Brewpub	>25% onsite sale	(130+ in MI)	Pellets, Dry, Fresh	100s	MNCs MI – many
Craft - Home	n/a	(many)	Pellets, Dry, Fresh	10s	

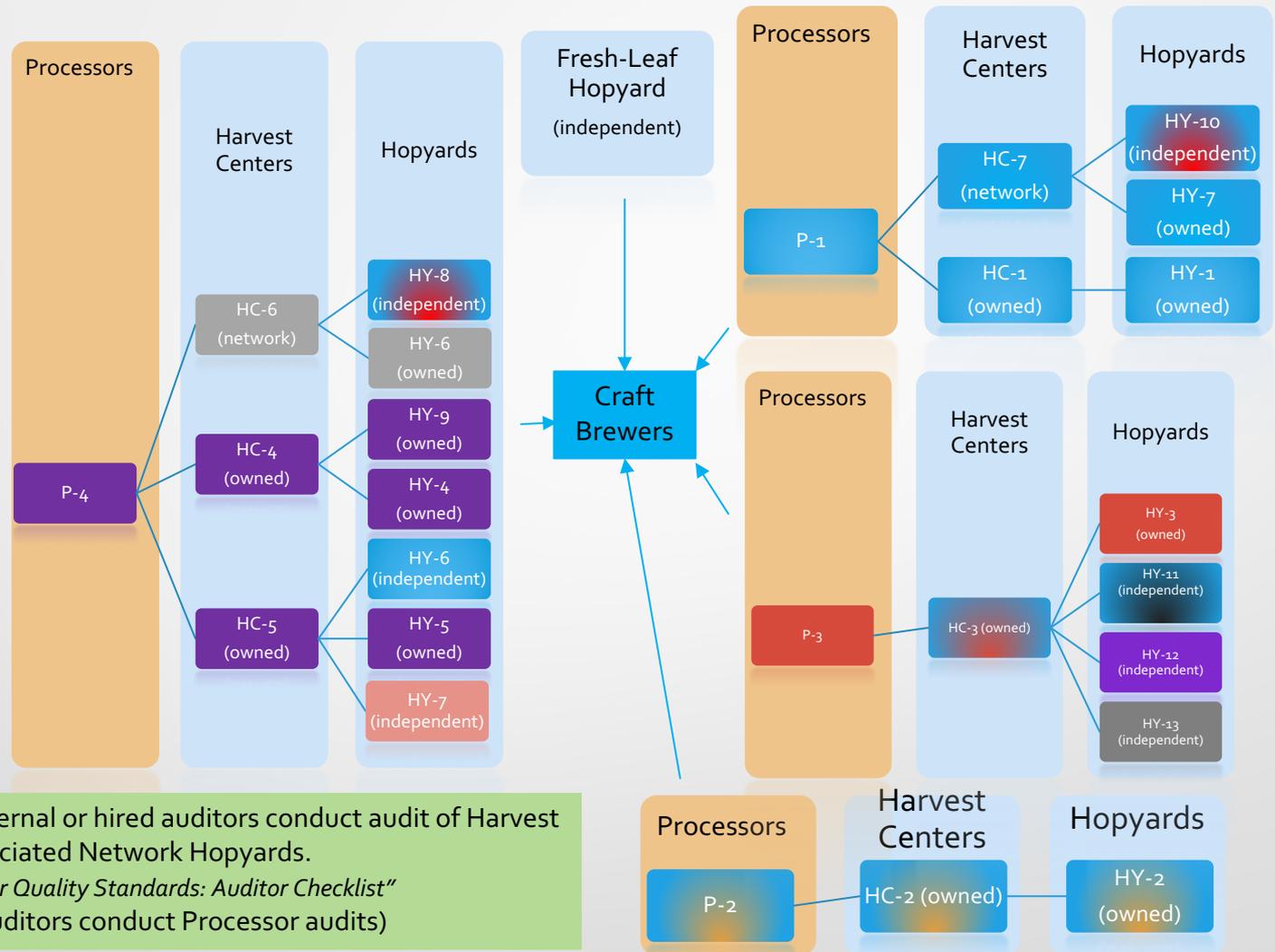
Market Drivers:

meeting the hop volume, quality and consistency requirements of **Craft-regional** and **Craft-Microbreweries** will drive growth for the Michigan hop sector

*The **Craft-Brewpub** market will remain a key element of the local Michigan sales opportunity for all hop growers in the state, with local, terroir, and unique offerings*



Michigan Hop Sector: Cluster Structure



Processor QA internal or hired auditors conduct audit of Harvest Centers and associated Network Hopyards.
 - use "Hop Grower Quality Standards: Auditor Checklist"
 Brewer (HQ) Auditors conduct Processor audits)



II - How to Use This Guide

- TBD

- Walk thru
- “Must Have” & “Recommended” -distinguish
- Visual of the 3 levels:
 - Self (internal)
 - 2nd (by HQG??)
 - 3rd party (by SCS, AIB, NSF, etc. & MDARD)
- Including food reg compliance – MDARD FDD
- How it “lays alongside” grower program (HGA M-1, etc)

*This slide to be written
(revised/Updated
when Manual
complete*

MUST
HAVES

IV – Hops Processing

- These standards serve as a working reference, a user-friendly tool for a process operator to use in meeting market as well as regulatory requirements.
- In developing this resource, we acknowledge the established work by other, from which we borrow in creating this tool, among them:
 - Dr. Val Peacock and his various products in the public domain
 - “Best Practices Guide for Hop Processing”,
 - Gorst Valley Hops, ©2013
 - <http://gorstvalleyhops.com/wp-content/uploads/2015/03/Processing-Manual.pdf>
 - Input from various processors in Michigan, the PNW region, and elsewhere.



IV - Pellet Processing Steps

Following are the steps in hop processing. The standards, practices, and quality control parameter that hop processors should comply with to meet market expectations for quality, consistency, and food safety are addressed in this guide.

This section outlines the general standards recommended for pellet processing. Supporting appendices will include equipment, process, analytical and documentation resources that processors can use in their operations to ensure quality, consistency and food safety.

- **A – Bale Supply**
- **B – Bale Breaking**
- **C – Conveyance & Handling**
- **D – Milling**
- **E – Blending/Batching**
- **F – Pellet Processing**
- **G – Sifting/Rework**
- **H – Cooling**
- **I – Holding/Binning/Blending**
- **J – Packaging**
- **K – Storage**
- **L – Shipping**
- **M - Documentation, Record Keeping, & Audits**
- **N – Add Note – Further Processing**



Aa – Bale Supply

Inbound Hops & Pellet Quality: It Starts in the Hopyard & Harvest Center

- Baled/Leaf Hop Quality
 - Know your supply – does the grower comply to the HGM "***Grower Quality Standards and Requirements***" Guide?
 - Hopyard Practices
 - Harvest Center Practices
 - Storage and Transport – was the 'cold-chain' integrity maintained to minimize hop quality deterioration?
 - Documentation and Recordkeeping



Note: by 2018 HGM expects to have a 2ndParty audit program in place that will independently verify the Hopyard & Harvest Center compliance to standards. Processors may conduct their own audits of their network hopyard supply base or subscribe to the HGM's 2nd-Party program for access to audit reports and compliance information.



Ab – Bale Supply



- Whether grown and harvested on-site or coming from an associate or network grower it is important to have proper documentation on the variety, cultivation and harvesting of the bales that may including all or some of:
 - bale label, date/lot coding, pesticide use certification, COA (certificate of analysis including alpha, beta, HSI, etc.), storage records, etc.
 - This information will be available in HGM's 2nd-Party auditor reports (in 2018 when a HGM's quality program is enrolled.
- **Sanitation**
 - Handle as food, avoid floor contact, use only food-grade and food-specific tools and other contact-surfaces.
 - Any spilled product disposed of – should not enter the process.
- **Temperature control:** MUST HAVE
 - At minimum, refrigerate to <40F (acceptable if <1 month to use)
 - For long-term storage and transportation: ideally frozen to <28F
 - Bales formed at ambient temperature should be placed into refrigerated/frozen storage within 1-10 hours or being – managed in a manner to avoid quality deterioration.
- **Transportation & Handling** (retain hop quality attributes)
 - Ensure vehicle cleanliness
 - Retain bale integrity
 - Maintain cold-chain integrity



B – Bale Breaking

- Practices must ensure product integrity and minimize risk of hop quality degradation due to heat exposure and oxidation. Provides opportunity for inspection and foreign material removal.
- **Temperature Control**
 - Break from frozen (25-28F) or refrigerated (<40F) state
 - Minimize risk of oxidation and quality loss.
 - Minimize the fracturing of frozen cones and lupulin separation so that quality can be maintained through to balance of processing.
- **Screening/Sorting**
 - for foreign material (wood, rocks, infestation, metal, etc.)
 - Incorporate magnets, stone traps, visual inspection, and screening for large debris – as required.
 - For product integrity protection
 - For downstream equipment protection
- **Product protection:**
 - Cover/enclose to prevent contamination risk
 - contain dust/fines.



C – Conveyance & Handling



- Use food grade and/or easy to clean materials
- Design/build for clean operation and ease of inspection/cleaning
- Product must not touch ground
- Shovels and other tools
 - Distinct color/label for food grade, waste, other
 - Properly racked, readily available near use point

MUST HAVE



D – Milling

- Milling hop cones reduces particle size in preparation for pelletizing in a hammer mill or other suitable milling machine.
- **Design:**
 - for clean operation and ease of cleaning
- **Granulation Control:**
 - Proper screens in mill and/or proper mills speed/feed setting
 - change-out screens
 - specific to variety and/or other cone attributes – know your market expectations
- **Maintenance:**
 - Free of corrosion, caking, coatings. etc.
- **Dust control** – as needed
 - Fines capture and reuse
- **Granulation Verification:**
 - Sampling port suitable for collecting whole-stream sample
 - Sieves/screens appropriate to verify required granulation.
 - Sieve shaker and/or manual method – with documented protocol
 - Scale/balance for weighing the profile (% on each screen/pan)



E – Blending/Batching

- Pellets may be variety specific or a blend of a number of varieties and/or lots of cones/bales. In the case of the later, batching may be done to customer-specific or standard specification requirements including aromatic and/or chemistry components. Batching/blending formulations may be based on bale attributes (X bales of lot A + Y bales of lot A, etc) to produce a uniform pellet. Alternatively, finished pellets may be blended. In the former case a mix vessel with appropriate paddles or other mixing device is typically in line after milling. The mix vessel can also serve a static holding bin for single-lot/variety-specific batches ahead of pelletizing.
- *Note: in processes where all pelletizing is done on variety/lot-specific basis, product may flow/convey directly from milling to pelletizing.*

- **Batch Documentation:**

- lots, weights, percentages

- **Mixing Protocol:**

- Defined: mixing time, maximum holding time, paddle speeds and specification, other

- **Batch Isolation/integrity**

- gates/slide or other barriers and related protocols to ensure batches integrity
- no inadvertent addition of other hops, complete vessel emptying before next batch.
- Inspection ports

- **Sanitation:**

- Vessel clean-out between batches – procedures defined and used, to ensure batch integrity



F – Pelletizing



- **Pellet Mill Parameters**

- Die Pressure – uniform across the mill, for consistent pellet density/texture
- Die face/opening = Uniform

- **Pellet Quality:**

- **Temperature**

- Discharge product temp monitoring: <50C (120F), preferably <47C (117F).

- **Color**

- Green, typical of dry hops – uniform through-out the pellet and the surface

- **Length / Cut-off:** Uniform

- **Pellet Structure**

- Not glazed or scorched
- Good integrity, yet friable:
 - “accordion like” structure – so that it disperses well in brew kettle
- Fines: <2.5% fines in final package, preferred <1% (through USSSS #8)
 - sift and rework fines to achieve this standard.
- Pellet density monitoring
 - Example: target is 510g/L , range 460-560 g/L (note: Will varies by variety)
 - Determine an acceptable range around the target: +/- 10%: more? less?

MUST HAVE

MUST HAVE



recommended



G – Sifting / Rework

- **Context:** *To maximize both quality and yield in a pelleting operation there may be benefit to screening fines out of the finished pellet stream before packaging. If of acceptable quality these fine may be reworked back into the pellet production stream or packaged for other use/market.*
- Control/manage fines rework from products stream after the pellet mill to optimize product quality/consistency
 - Document rework:
 - Quantity/Percentage; Source lot & destination lot; Quality.
 - Manage to avoid cross contamination of lots



H - Cooling

MUST HAVE

- To a safe into-storage temperature (typically <10C, <50F max) before packaging
 - May require cooled/conditioned air, and enough time to cool to center of pellet
 - Michigan's ambient/seasonal air conditions in the processing center must be factored when determining cooling requirements and impact on pellet quality into packaging/storage.
 - Ensure pellets are cool and firm
 - Timely – typically target cooling within 24 hours of pelleting, to a safe long-term storage temperature (ideally ~28F or -2C).



I – Holding, Binning, & Pellet Blending

- **Holding/Binning:**
 - The goal is to minimize oxidation and related quality deterioration:
 - Minimize time exposure to elevated temperature and air (oxygen)
 - Ideally transfer to packaging as quickly as possible.
- **Pellet Blending:** *(not typically done in Michigan, if blending does occur, it is more likely to be at bale-breaking. Most Michigan hops pellets are processed as variety-lot specific. Future market demand/opportunity may require blends – within variety or a mix of varieties.)*
 - In some cases finished pellets may be blended to achieve a packaged hop specification specified by customers
 - Specify and manage the process to maximize quality and consistency
 - Blending and mixing finished pellets may result in breakage and fines creation, requiring additional sifting and product loss to meet in-pack fines thresholds.
 - Design process to maximize quality of blended product
 - Document blending formulations and record blending operation batching



J – Packaging



- **Film integrity:**
 - Bag Spec = <0.005 cc/100 sq. in. per 24 hr at 73F
 - Define protocol for leak detection of film and/or finished sealed pack integrity.
- **Oxygen flush/purge protocol/procedure**
 - define
 - Inert gas (nitrogen, typically) used for purge and fill
 - Testing protocol in place
 - Gas fill/make-up
- **Finished pouch seal integrity:** validated 100% seal
 - pillow or vacuum pack?
 - Most MI brewer prefer pillow pack as free-flowing pellets are easier to add to brew kettles
 - Pillows tend to have less in-transit puncture damage
- **Case Loading:**
 - Ideally direct from pouching
 - to avoid/minimize compromising pouch seal

MUST HAVE



K – Storage

- Temperature
 - Ongoing monitoring of storage temperature (other parameter as needed)
 - Preferred long-term storage/transport: frozen to <28F
 - Refrigerated storage (<40F) may be acceptable for short-term (<4 wks) of pre-cooled product
- Oxidation Control:
 - Critical to retaining alpha-acid values
 - Learn more at:
https://www.morebeer.com/articles/storing_hops_properly
- Sanitation:
 - Clean
 - No non-food product contact

MUST HAVE



L – Shipping



- Vehicle Inspection
 - Clean and free of any potential contaminants
 - Suitable for food products
 - Temperature control – appropriate to the outbound need
 - Ideally refrigerated if ambient temperatures above 50F
 - Factor in transit time and other risks in determining need

MUST HAVE



M – Process Quality Control: Documentation, Record Keeping, & Audits

- Document Policy, Procedures, and Practices
- Follow those “Ps”
- Record your action
- Audit
 - Self-audit: internal staff
 - 2nd/3rd-Party: external auditors (*customers, industry, professionals*)



N - People Practices

- Food Safety
- Visitor Check-in and Access Policy and Protocols
- Personnel Health and Safety
- Machinery Lock-out / Tag-out
- Apparel and Appearance
 - Compliance to HACCP and GMP requirements.
- Facilities
 - Appropriate rest-rooms, hand-washing facilities, eye-wash station
 - Staff lunch/breakroom provided
 - First Aid Stations - including access to kits, documentation of use
 - Policy and practices for smoking, drugs, pets, animals, food/drink, or sundry storage in support of quality, food safety, and regulatory compliance in the processing facilities
- Training in support of the above

Food Safety and GMPs

- Federal Regulation – CFR 21.1.B.117
 - Link <https://www.ecfr.gov/cgi-bin/text-idx?SID=01afb009a9de6f6797do2757e59ef157&mc=true&node=pt21.2.117&rgn=div5>

Add-Note: on further processing:

- *The hop sector continues to adapt and adopt new technology and processes to address new market opportunity and better meet needs.*
 - *For Example, hop extracts and T-45 (enhanced) pellets have been a part of the global sector for some time already and new hop-derived products are coming to market. This guide does not address those products and processes. As craft brewers expand output they may require such products to meet their quality, consistency, and operational efficiency needs.*
 - *As the Michigan hop sector expands and matures opportunity to offer these value-added products may be realized.*
 - *Enterprises that pursue the such products will need to adopt proper protocols to ensure the quality, consistency, food safety and other attributes required by the commercial marketplace and stakeholders.*



Appendix I:

Processing: Resources & Guidance

Processors will vary in scale of operation and make equipment, process-flow and processing decisions to meet market quality, consistency, and food safety requirements appropriate to their business and their customer needs.

This Appendix provides additional resources and guidance information and links for use in considering options; general and for each process step.



Resources & Guidance: Manuals Available

- Federal Standards: the **USDA Hop Inspection Manual**
 - Encompassed in the [Hop Inspection Manual](#) is guidance for state departments of agriculture to conduct seed, leaf and stem inspections as a joint Federal-State program. The current manual is being updated to reflect changes in hop harvesting and handling technology ([summary of changes](#)). USDA will issue a Policy Statement prior to the 2016 harvest to notify states of the new revisions. An updated Hop Inspection Manual will be released in 2017. In addition to mandatory inspections in Oregon, Washington and Idaho, several additional states are implementing this program on a voluntary basis, in order to provide customers with consistent quality information.
 - Link: <https://www.usahops.org/cabinet/data/FGIS%20Hop%20Inspection%20Handbook.pdf>
- Gorst Valley Hops produced, in 2013, a "**Best Practices Guide for Hop Processing**", funded in part by USDA through the State of Wisconsin. The subject matter extends beyond processing, and much of the information in this bullet-formatted document can apply to Harvest Center practices. It includes 16 sections.
 - Link: <http://gorstvalleyhops.com/wp-content/uploads/2015/03/Processing-Manual.pdf>



Cottage Food Law

- The Michigan Cottage Food Law should be referenced by small-scale hop processor that fall outside of the commercial food-processing domain and related regulation.
- Michigan's Cottage Food Law, PA 113 of 2010:
 - exempts a "cottage food operation" from the licensing and inspection provisions of the Michigan Food Law. **A cottage food operation still has to comply with the labeling, adulteration, and other provisions found in the Michigan Food Law**, as well as other applicable state or federal laws, or local ordinances.
 - Learn more at: http://www.michigan.gov/mdard/0,4610,7-125-50772_45851-240577--,oo.html
 - This website includes checklists on how to comply to food safety requirements.
 - Offered by MSU Extension, it's a good resource for small enterprise that desire to or do operate under the Cottage Food Law exemption: http://msue.anr.msu.edu/program/info/cottage_food_law
 -

Sample Certificate of Analysis

Include:

- Date
- Supplier Name
- Supplier contact
- Supplier Plant location

CERTIFICATE OF ANALYSIS

Customer : **CONFIDENTIAL**
Customer P.O. No. :
Variety: Centennial
Pack Size: 44# cs (2- 22# Bags/Case)
Quantity: 442 cs
Pounds: 19,426

<u>Product Lot Code</u>	<u>Alpha Acid</u>	<u>Beta Acid</u>	<u>Hop Stability</u> <u>Index</u>	<u>Oil</u>	<u>Moisture</u>	<u>Pellet Size</u>
120816	9.30%	3.60%	0.265	1.70%	9.20%	T-90, 6-7 mm

