



Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

HIGH TUNNEL SYSTEM

Code 325

(ft<sup>2</sup>)

**DEFINITION**

An enclosed polyethylene, polycarbonate, plastic, or fabric covered structure that is used to cover and protect crops from sun, wind, excessive rainfall, or cold, to extend the growing season in an environmentally safe manner.

**PURPOSE**

Improve plant health and vigor.

**CONDITIONS WHERE PRACTICE APPLIES**

This practice applies to land capable of producing crops. This practice applies where sun or wind intensity may damage crops, or where an extension of the growing season is needed due to climatic conditions.

The practice applies only to crops grown in the natural soil profile (**not tables/benches, bags of potting soil, portable pots, hydroponically, etc.**).

**CRITERIA**

Plan supportive conservation practices to address all environmental concerns associated with the installation and use of the high tunnel systems such as erosion, irrigation, and runoff.

Crops must be grown in the natural soil profile. Raised beds may be installed to improve soil condition, fertility, and access. Raised beds are a maximum of 12 inches in depth.

The practice does not include greenhouses or low tunnel systems.

The practice cannot be used to provide shelter or housing for livestock, or to store supplies or equipment.

Locate the structure to avoid buried public utilities.

Locate the structure near a viable water source for irrigation.

Where electricity is needed to inflate a double layer of plastic, for automated ventilation or other purposes, locate the structure in proximity to an electrical source.

The high tunnel structure must be planned, designed, and constructed from a manufactured kit in accordance with manufacturers' recommendations. The high tunnel frame must be constructed of metal, **have a gothic frame style**, and be at least 6 feet in height at the peak of the structure. End wall covering

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service [State office](#) or visit the [Field Office Technical Guide](#).

may be greenhouse-grade plastic, polycarbonate, wood, or other. Size the entry/exit point to facilitate movement of equipment and supplies needed for the production of planned crops.

The chosen manufactured high tunnel kit must meet the Required High Tunnel Materials and Design Criteria in Massachusetts' High Tunnel System Specification Guide and Approved Product List. Note: manufactured models change frequently, and vendors' claims of meeting NRCS specifications must be verified. Some high tunnel kits may need additional components in order to meet the Criteria.

For tunnels exceeding 96 feet in length, a manufacturer statement of approval must be provided.

Select the high tunnel covering material of a significant thickness to withstand the temperature change for the period required and shall have a 4-year-minimum lifespan. For polyethylene covers, use a minimum 6-mil greenhouse grade, UV-resistant material.

For organic producers, it will be the responsibility of the producer to make sure that all permissible activities, design, material used, and material specifications are consistent with the USDA Agricultural Marketing Service National Organic Program, National Standards on Organic Agricultural Production and Handling.

Construct high tunnel structures on level grade or the naturally occurring slope if the slope does not exceed five percent, or manufacturer guidelines, whichever is less. The long axis must be oriented with the slope direction.

Where snow loads may damage the structure, the tunnel cover shall be removed or rolled up at the end of the growing season unless the structure is designed by the manufacturer to withstand expected snow loads.

A minimum clearance of 15-feet between side-by-side high tunnel installations or other obstructions is required to allow room for snow removal and cover installation.

Where wind loads may damage the structure, select the tunnel cover and structure designed by the manufacturer to withstand expected wind loads or manage the tunnel system in a manner that limits wind damage.

Where the intensity or duration of sunlight can shorten the growing season, the appropriate thickness of shade cloth may be used in addition to impervious plastic covers.

High tunnels shed a large amount of water and can create drainage and ponding issues where none previously existed. Direct runoff away from the high tunnel structure to avoid ponding. Provide a detention basin, storage reservoir, or stable outlet when runoff from tunnel covers empties onto the ground surface with potential to cause erosion.

Outside the high tunnel structure, vegetate all exposed surfaces disturbed during construction in accordance with CPS Code 342, Critical Area Planting. If climatic conditions preclude the use of seed or sod, use CPS Code 484, Mulching.

Significant modifications to the high tunnel structure design must be verified and approved by the manufacturer prior to construction to ensure that any warranties remain in effect. (This includes installation of overhead doors.)

## **CONSIDERATIONS**

Runoff may be captured and used for irrigation purposes, however, runoff should not be relied upon as the only source of irrigation water. Use the criteria for CPS Code 558, Roof Runoff Structure, to design any structure needed to meet the runoff criteria above. Runoff may empty into surface or underground outlets, or onto the ground surface when properly protected. Size surface and underground outlets according to the criteria for CPS Code 620, Underground Outlet, to ensure adequate capacity. Provide for cleanout as appropriate. Surface or ground outlets such as rock pads, rock-filled trenches with subsurface drains, concrete and other erosion-resistant pads, or preformed channels may be used.

Consider managing the high tunnel system to maintain or improve soil health by following a soil management system that creates a favorable habitat for soil microbes by:

- minimizing soil disturbance, physical, chemical and biological;
- using plant diversity in the rotation to increase diversity below ground;
- keeping living roots growing year round as much as possible;
- keeping the soil covered with residue and growing plants year round;
- [monitor the soil's soluble salt content](#);
- [avoid accumulation of soluble salts by: 1\) planting cover crops; or 2\) periodically removing the plastic covering; or 3\) by flushing the soil with heavy irrigation.](#)

Locate the high tunnel conveniently for ingress/egress of plant materials, equipment, and other operation and maintenance activities.

Remove or manipulate side covers to control internal temperatures and humidity. Installation of vents, fans, or heaters should be considered and should be included in the manufacturer's design and recommendations. If providing protection from the sun extends the growing season, consider a high tunnel structure that includes shade cloth.

If available, consider installing a supplemental manufacturer's kit to provide additional structural support.

Consider potential shading of high tunnel structures by other high tunnels, structures or trees and locate at a distance of at least two times the height of the tree or structure.

Control weeds inside and on the outside perimeter. Use of natural and/or man-made mulch materials can reduce labor. [Root barrier cloth should be placed just outside the high tunnel to prevent weeds from becoming wrapped in the roll up sides. The root barrier cloth should be covered with ¾ inch crushed stone to diffuse runoff water.](#)

[To exclude rodents and other small pests, consider installing plastic hardware cloth on the inside of the high tunnel frame \(approximately 18" below grade\).](#)

Consider additional conservation practices where appropriate to include:

- crop rotation
- irrigation water management
- salinity management
- nutrient management
- integrated pest management
- critical area planting
- mulching
- roof runoff structure
- diversion
- underground outlets
- cover crop

## PLANS AND SPECIFICATIONS

Prepare plans and specifications in accordance with the criteria of this standard. At a minimum, the plans and specifications must include the following, [plus other information outlined in the Massachusetts NRCS 325 High Tunnel System Specification Guide & Approved Product List and Jobsheet](#):

- Identify purpose.
- Document the planned growing season.
- Layout and location of the high tunnel.
- Site preparations and the required supporting practices for erosion control, runoff, and vegetative cover according to the requirements of the corresponding conservation practice standard.
- The planned width and length of the seasonal high tunnel. Statement that the seasonal high tunnel will be built per the manufacturer's directions.

## OPERATION AND MAINTENANCE

Managing a tunnel requires intensive and vigilant attention by the producer.

Prepare an operation and maintenance (O&M) plan and review with the landowner and/or operator responsible for the practice. Provide specific instruction for proper operation and maintenance of each component of this practice and detail the level of repairs needed to maintain the effectiveness and useful life of the practice.

Periodically inspect the high tunnel and repair, reinstall, or replace, as needed to accomplish the intended purpose.

Manage the structure in a manner that limits wind and/or snow damage. Close sides and ends before storm events. In areas that receive snow and ice, the structure should be prepared prior to winter weather.

Remove roof plastic seasonally, or remove snow and ice from the structure cover and sides promptly to prevent structure failure.

When the structure is at serious risk of collapse due to weather conditions, consider slashing the plastic cover (from the exterior) to relieve pressure and save the framework.

Perform soil tests regularly to monitor nutrients and to monitor salt build-up. The soils under immobile high tunnels will require periodic "flushing" to remove salt build-up. This is accomplished by removing the cover for a season to allow natural precipitation to infiltrate, or by artificially flooding the ground under cover.

If needed, seed all disturbed earth surfaces outside of the high tunnel and maintain the vegetation throughout the structure's life.

Removal of cover materials shall be consistent with the intended purpose and site conditions.

Plan for proper disposal of the cover at the end of its useful life.

Operation of equipment near and on the site shall not compromise the intended purpose of the high tunnel structure or its cover.

## REFERENCES

Community Garden Guide Season Extension - High Tunnel, NRCS. Rose Lake Plant Materials Center, East Lansing, Michigan.

"High Tunnel Production Manual". Penn State University College of Agriculture, Department of Horticulture. White, L. and Orzolek, M. 2003

"High Tunnels: Using Low-Cost Technology to Increase Yields, Improve Quality and Extend the Season". Ted Blomgren, Cornell Cooperative Extension, and Tracy Frisch, Regional Farm and Food Project. Published by the University of Vermont Center for Sustainable Agriculture. 2007.

"Minnesota high tunnel production manual for commercial growers". Edited by: Terrance T. Nennich, Sr., University of Minnesota Extension and Suzanne Wold-Burkness, University of Minnesota. 2013.

"Growing Under Cover: A Guide to Polytunnel Options for Kansas Growers"; Kansas Rural Center; Kim Scherman, 2014.