

**THE DAIRY PRACTICES COUNCIL®**

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**GUIDELINES FOR  
GRAVITY FLOW GUTTER FOR  
MANURE REMOVAL IN MILKING BARNs**

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## ABSTRACT

This guideline describes the concept and design of gravity flow gutters for manure removal in dairy barns. It provides construction details for length, width and depth of the gutter and for other components such as grates, cross channels and overflow dams. It also gives instructions for proper management of the system.

## PREFACE

DPC 45, Guidelines for Gravity Flow Gutters for Manure Removal in Milking Barns, was first prepared in the fall of 1983 by the Farm Buildings and Utilities Task Force. Robert A Parsons was chairperson of the Task Force and manager of the Northeast Regional Agricultural Engineering Service, and Dr. Robert E. Graves, Professor of Agricultural Engineering at Pennsylvania State University was chairperson of the subcommittee that wrote the guideline. Most of the Task Force members provided some input. The guideline was accepted at the 19<sup>th</sup> National Conference on Interstate Milk Shipments, May 1983, and is published in the Appendix of the FDA Grade A Pasteurized Milk Ordinance (PMO). In 1997 this guideline was reviewed by Stanley Weeks, Farm Buildings and Equipment Task Force Director, and approved for reprint without change.

## **GUIDELINE PREPARATION AND REVIEW PROCESS**

The Dairy Practices Council (DPC) Guideline development and update process is unique and requires several levels of peer review. The first step starts with a *Task Force* subcommittee made up of individuals from industry, regulatory and educational institutions interested in and knowledgeable about the subject to be addressed. Drafts, called “*white copies*,” are circulated until all members of the subcommittee are satisfied with the content. The final “*white copy*” may be further distributed to the entire Task Force; DPC Executive Board; state and federal regulators; educational and industry members; and anyone else the Task Force Director and/or the DPC Executive Vice President feel would add strength to the review. Following final “*white copy*” review and corrections, the next step requires a “*yellow cover*” draft to be circulated to representatives of participating Regulatory Agencies referred to as “*Key Sanitarians*.” Key Sanitarians may suggest changes and insert footnotes if their state standards and regulations differ from the text. After final review and editing, the Guideline is distributed in the distinctive DPC “*green cover*” to DPC members and made available for purchase to others. These guidelines represent our state of the knowledge at the time they are written. Currently, DPC Guidelines are primarily distributed electronically in pdf format without colored covers, but the process and designation of the steps remains the same. Contributors listed affiliations are at the time of their contribution.

## **DISCLAIMER**

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## Gravity Flow Gutters for Manure Removal in Milking Barns

### INTRODUCTION

The gravity flow gutter concept for manure removal comes from Europe. Manure falls into a deep gutter in the barn floor and then flows by gravity to a cross channel or outlet pipe to storage. A low (3" to 8") dam retains a lubricating liquid layer over which the manure flows. (Fig. 1). After 1 to 3 weeks in a newly started gutter, the manure surface forms an incline of 1-3% above the dam. Then the manure moves continuously over the lip. The gutter must be deep enough to contain manure sloped at this shallow angle.

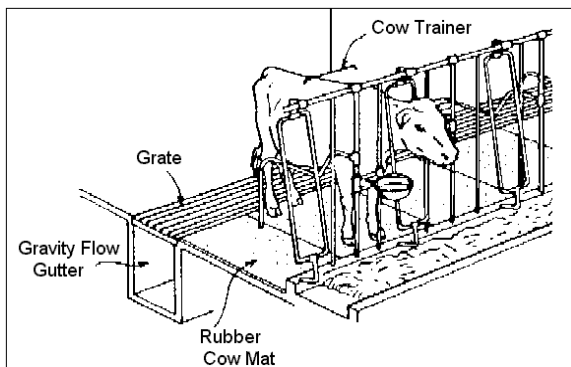
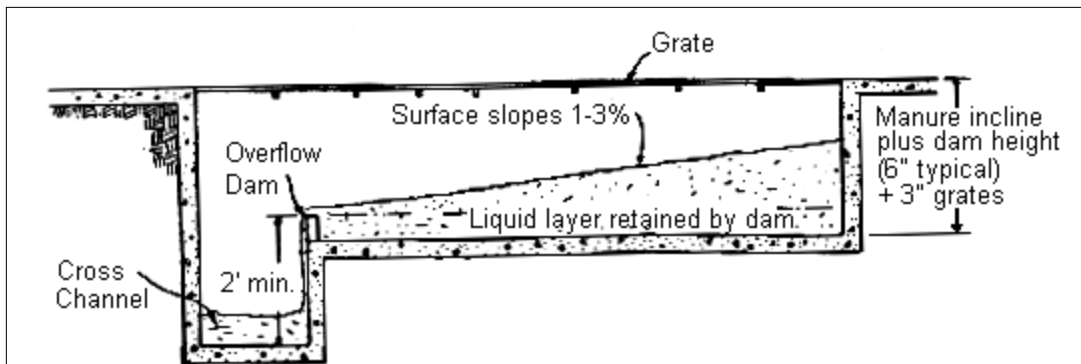


Figure 1. Side Cross Section of a Gravity Flow Gutter



Because manure moves by its own weight, no mechanical equipment is required to remove it from the barn. Generally, the cost of the gutter and cover grates is less than the cost of installing, operating, and maintaining a mechanical cleaner.

This system is neither a flush gutter, where 30 to 60 gallons of water per cow day is needed to remove manure from the gutter nor is it an under barn storage which is open to the barn. Rather it is a conveying channel that carries the manure from behind the cow to the outside storage. The top surface of the slurry has been recorded to move 10 feet per hour.

### CONSTRUCTION

#### Gutter Depth

Gutter depth depends on the length of the gutter and the angle of incline of the manure surface. Design in this guideline assumes the manure surface forms a 3% slope. Most diets form wetter manure, and with no bedding the slope may be 1% or less. The bottom should be level so the dam will hold a uniform liquid layer. The maximum depth of the gutter at the end opposite the discharge shall not exceed 54" (4 ½'). In addition, the outlet shall be clear of obstructions.

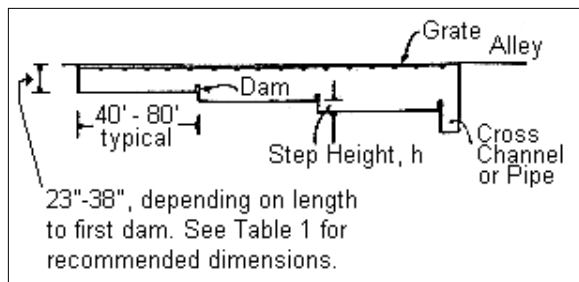
**Table 1. Gravity Flow Gutter Depth vs. Length for Manure from Milking Cows.**

The depth includes an allowance for a 6" dam and 3" deep grates.

<u>Length</u>	<u>Depth</u>
40'	23"
60'	31"
80'	38"
100'	45"
120'	52"

The maximum manure depth may be decreased by adding steps. The depth from the bottom of each dam to the bottom of the next lower level varies depending on the distance between steps (Fig. 2).

**Figure 2. Stepped Gravity Flow Gutter**



**Table 2. Step height vs. length for stepped gravity flow gutters.**

<b>Length between dams</b>	<b>Step Height</b>	
	<b>For 1.5% manure incline</b>	<b>For 3% manure incline</b>
40'	7"	14"
50'	9"	18"
60'	11"	22"
70'	13"	25"
80'	15"	29"

### Width of Gutters

The bottom of the gutter shall not exceed 36" in width; a 30" wide gutter is recommended. The gutter opening may be narrowed to 20" to 24" in order to reduce the size and cost of grates.

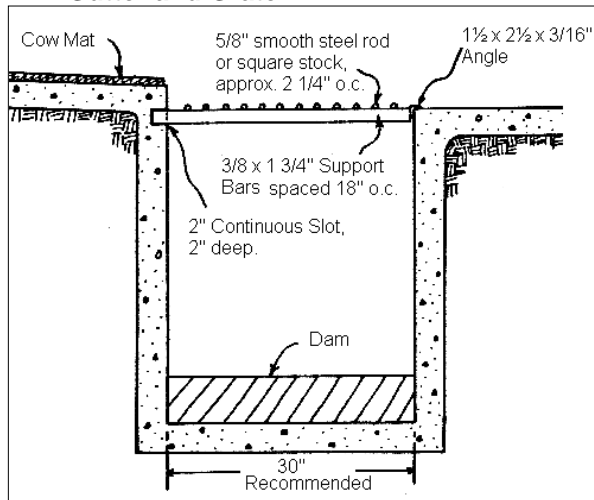
### Overflow Dam

The dam retains a lubricating liquid layer over the gutter that is essential to maintain flow. Typical heights range between 3 and 8 inches. Dams if removable would facilitate total cleanout, when and if necessary. Concrete, a steel plate, or a plank may be used to construct the dam. Caulking may be needed to seal the dam.

### Length

A 226-foot long gutter has worked, but typical distances between dams range from 40 to 80 feet. Longer gutters must be deeper; hence, they may cost more because they require more concrete and stronger forms.

**Figure 3. Cross Section of Typical Gutter and Grate**



### Grates

Commercial steel grates for stall barns and concrete slats for freestall barns are generally available. Table 3 suggests slot widths. Grates for stall barns are made from round or flat steel stock.

**Table 3. Slot Size vs. Cattle Age**

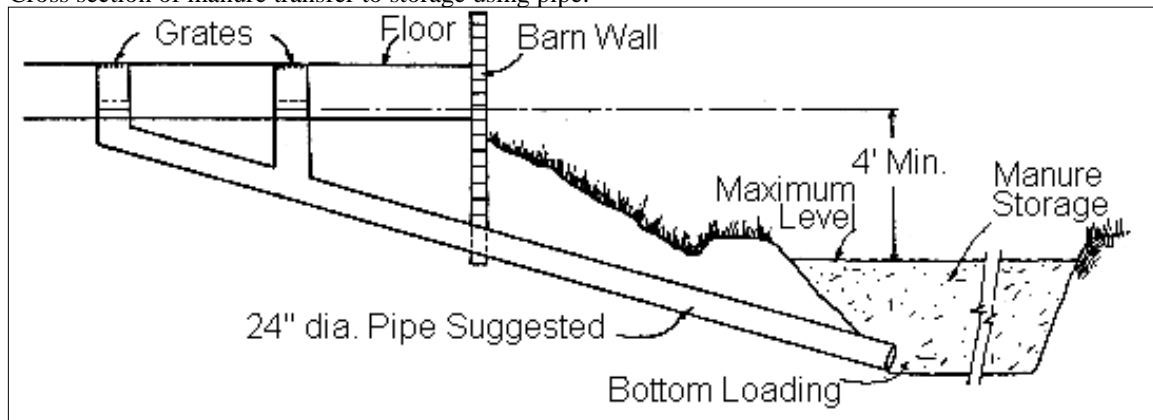
<u>Age (months)</u>	<u>Slot Size (in.)</u>
1 to 6	1 to 1 1/8
6 to 12	1 1/8 to 1 3/8
12 to 24	1 3/8 to 1 5/8
over 24	1 1/2 to 1 5/8

### Cross Channel

The cross channel may be constructed like the gutter. At least a 2-foot drop from the top of the dam to the bottom of the cross channel is suggested to prevent backup of manure into it. The channel may be extended directly to a storage. The slurry should enter the bottom to prevent storage gases and cold air from returning up the channel. Channel depth below grade should be sufficient to prevent freezing.

**Figure 4. Manure Transfer to Storage**

Cross section of manure transfer to storage using pipe.



Gravity flow via a concrete, steel or plastic pipe may also be used to transfer manure to the bottom of a storage. Pipe as small as 15" diameter has been used successfully, however 24" diameter pipe is recommended.

Do not empty channels into large sumps or pits within, or having direct openings into the barn. These storages will produce gas and odors that will be drawn into the barn through the ventilation system.

## MANAGEMENT

### **Flooding of Gutters**

Prior to stocking the building, fill the gutters with 3" to 6" of water to start the lubrication layer.

### **Bedding Usage**

The type and amount of bedding used is important to successful operation. Up to one pound per cow per day of sawdust, fine cut shavings or peanut hulls still allow the system to work. Some have worked with long straw bedding, but it is not recommended. More bedding or long straw increases manure stiffness and may clog the gutter. Cow mats allow minimum bedding use. Sometimes water may need to be added, depending upon the feed ration and amount of bedding used.

### **Wastage and Deposits**

Keep feed and hay out of the gutter. Barn lime and soil brought in from outside may settle to the bottom. For this reason, the overflow dam on some gutters is removable for clean out. Buildup of solids has not been a problem under normal management, although the gutter will need cleaning if it has not been used for some time. Watch for islands of solids, especially where excess bedding or feed builds up. Cut these islands free of the walls to keep them flowing.

### **Cleaning Grates**

Grates need cleaning at least weekly and, preferably, daily. A broom connected to a hose makes the job easy.

### **Flies and Odors**

Flies have caused little or no problem. Biodegradable oil such as mineral oil may be sprayed on the manure surface to control them. Little or no odors have been observed in barns with good ventilation. There is no need to install fans to ventilate the gutters.

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