Application Guidelines · January 2006

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FLOWMETERS

SIEMENS

Safety Guidelines: Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

Qualified Personnel: This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Unit Repair and Excluded Liability:

- The user is responsible for all changes and repairs made to the device by the user or the user's agent.
- All new components are to be provided by Siemens Milltronics Process Instruments Inc.
- Restrict repair to faulty components only.
- Do not reuse faulty components.

Warning: This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

Note: Always use product in accordance with specifications.

Contact SMPI Technical Publications at the following address:

Technical Publications
Siemens Milltronics Process Instruments Inc.
1954 Technology Drive, P.O. Box 4225
Peterborough, Ontario, Canada, K9J 7B1
Email: **techpubs.smpi@siemens.com**

- For a selection of Siemens Milltronics level measurement manuals, go to: **www. siemens.com/processautomation**. Under Process Instrumentation, select *Level Measurement* and then go to the manual archive listed under the product family.
- For a selection of Siemens Milltronics weighing manuals, go to: **www. siemens.com/processautomation**. Under Weighing Technology, select *Continuous Weighing Systems* and then go to the manual archive listed under the product family.

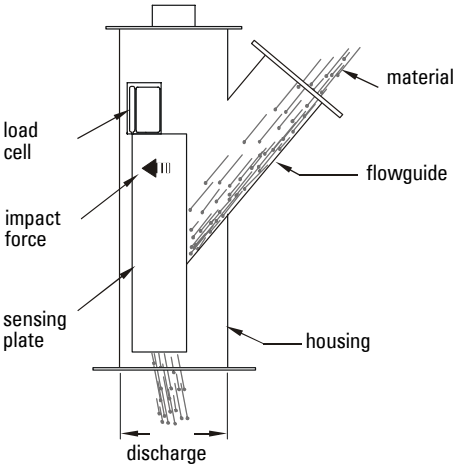
Table of Contents

Preface

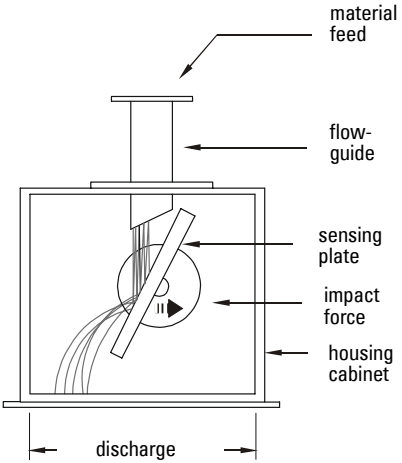
The Solids Flowmeter Application Guidelines will help you determine which flowmeter best fits your application, and will suggest proper mounting and positioning methods. For specific information about any flowmeter, refer to the flowmeter's Instruction Manual, available at **www.siemens.com/continuous-weighing.**

Flowmeter Terminology

Load Cell Flowmeter



LVDT Flowmeter



Flowmeter Selection

Choose a flowmeter that best suits your application, based on the following criteria:

1. Maximum flowrate. Shown in Flowmeter Comparison Chart, the TPH rating can be taken as either metric tons per hour or short tons per hour.
2. Particle size. If your application does not fit a listed particle size, contact your local Siemens Milltronics representative.
3. Maximum material temperature. See page 25 for more information on specifying your flowmeter using temperature.
4. Bulk density of material.

Using the Flowmeter Comparison Chart on below, use your application criteria to find an appropriate flowmeter. Then, confirm your choice by checking the Material Rating Chart starting on page 28, giving secondary consideration to the following application consequences:

a) Abrasion - abrasion limits the life of the sensing plate. Also consider wear caused by material direction changes. See page 24 for more information.
b) Adhesion - Material should not stick and build up on the impact area of the sensing plate as it will cause a calibration shift because of the cushioning effect of the added material. See page 26 for more information.
c) Causticity - Caustic materials can damage flowmeter components. Be aware of caustic vapours as well. See page 26 for more information.
d) Airflow - Inconsistent and unpredictable airflow can cause inaccurate measurement. See page 27 for more information.
e) Pulsating material flows are handled well by the E, C, V and A models due to the viscous fluid mechanical damper in each sensing head.

Flowmeter Comparison Chart

Model	Fullscale Flow-rate (TPH)		Maximum Material Size[1]		Maximum Material Temperature		Pre-Feed Method
	min	max	mm	inches	°C	°F	
Milflo (4")	2	15	6	1/4	65	150	general
Milflo (6")	5	40	10	3/8	65	150	general
Milflo (8")	20	90	10	3/8	65	150	general
Milflo (10")	50	150	13	1/2	65	150	general
Milflo (12")	100	250	13	1/2	65	150	general
E-40	0.2	40	13	1/2	232	450	general
E-300	20	300	25	1	232	450	general
V-40	0.5	40	13	1/2	232	450	general
V-300	20	300	25	1	232	450	general
C-40	0.5	40	13	1/2	100	212	powdered coal
A-40	0.5	40	13	1/2	232	450	aerated gravity conveyor only
A-300	20	300	25	1	232	450	aerated gravity conveyor only
MA-500	100	500	25	1	150	300	aerated gravity conveyor only
MA-900	200	900	25	1	150	300	aerated gravity conveyor only
L-300	50	300	13	1/2	65	150	general
M-500	200	500	25	1	150	300	general
M-900	400	900	25	1	150	300	general

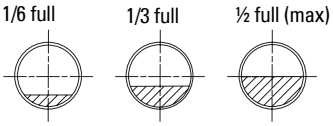
[1] Normal particle size for A-40, A-300, MA-500, and MA-900 is < 0.25mm (100 mesh).

Flowguide Capacity Charts

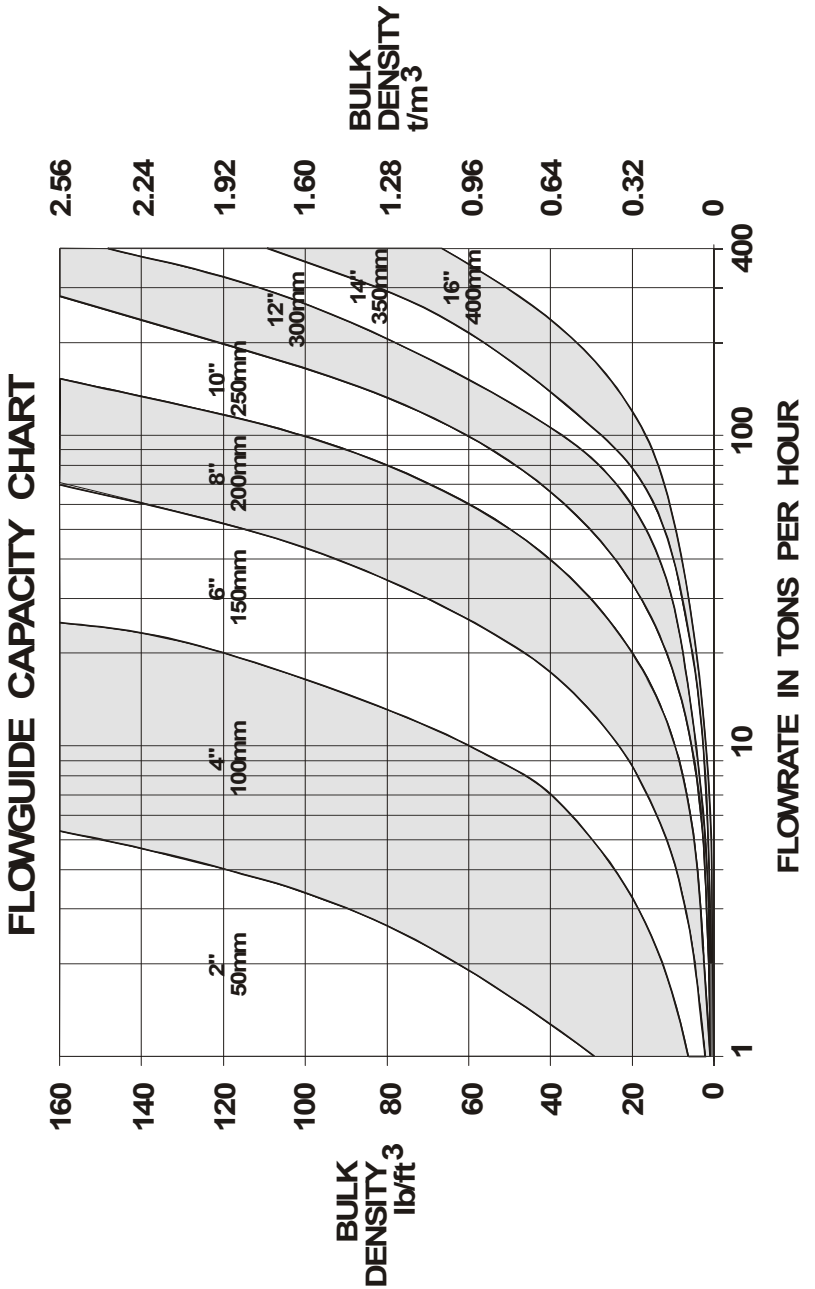
The Flowguide Capacity Charts provide guidelines for the selection of the correct flowmeter.

To use the graphs, draw a horizontal line from the point on the y-axis that represents the lowest normal bulk density of the weighed material. From the x-axis, draw a vertical line from the point that represents the highest normal flowrate. The intersection of these two lines will fall within one of the areas representing a flowguide size. If the point of intersection falls on, or very close to the line dividing two flowguide sizes, select the larger of the two.

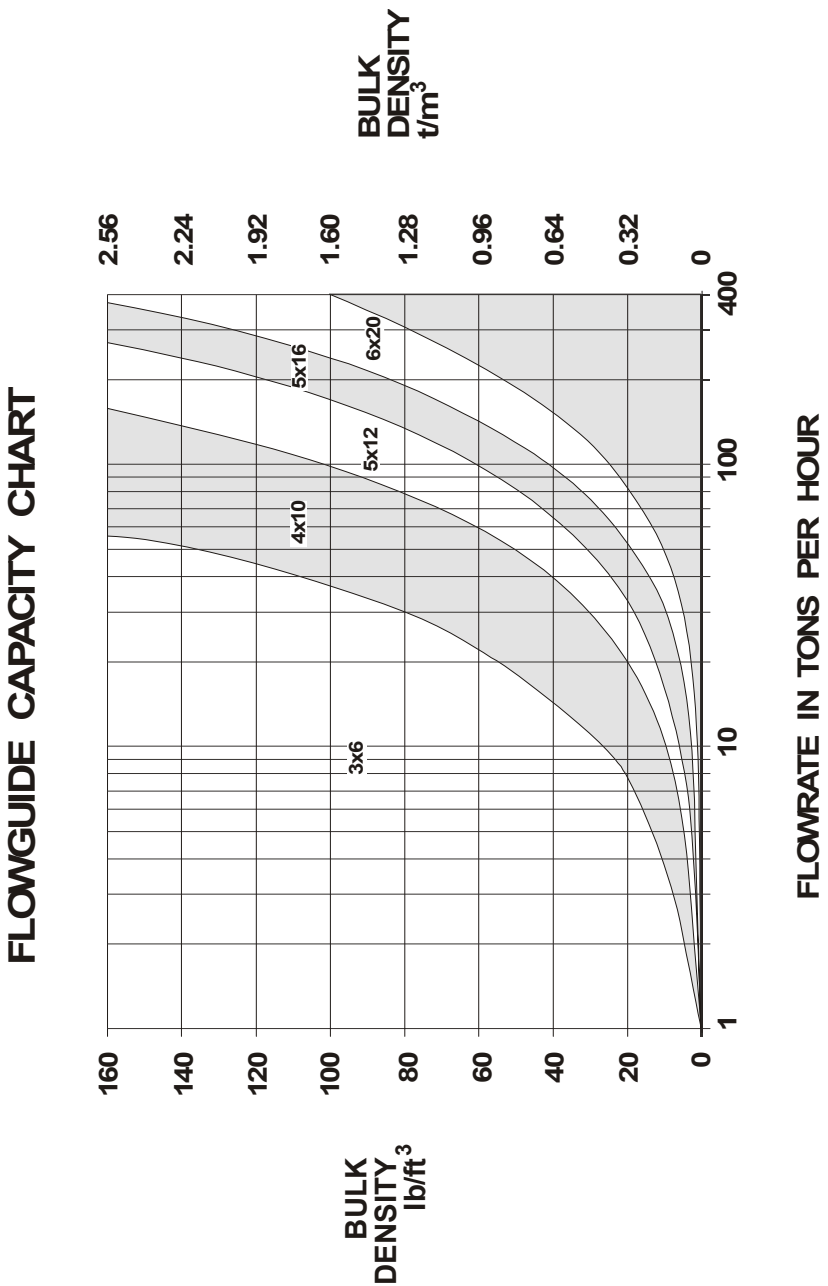
Note: The flowguide sizes are based on the sloped flowguides being no more than ½ full under any condition. Operating the flowmeters beyond the maximum filling level is not recommended.
For vertical flowguides, the maximum design rate should provide 1/3 to 2/3 filling.



Millflo and E Series Flowguide Capacity Chart



V Series Flowguide Capacity Chart



Application and Mounting Guidelines

In static testing with test weights, the flowmeter performance is repeatable, linear, and reacts minimally to ambient temperature changes. The flowmeters, in static mode, are very accurate instruments. The flowmeter application will determine how well the flowmeter performs in dynamic mode with material flowing.

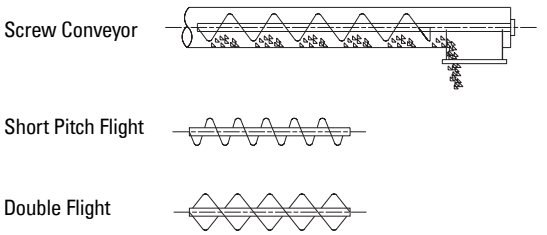
Follow the guidelines below to reduce the need for modification after initial installation of your flowmeter.

1. Use the Flowmeter Comparison Chart and the Flowguide Capacity Chart to ensure you have selected the correct flowmeter model and flowguide size.
2. Condition the material flow as required to provide repeatable flow patterns. The flowmeter's outputs will only be as repeatable and linear as the flow of the material itself. Linearization of repeatable flow patterns can also be achieved through flowmeter integrator functions.
3. Ensure that chute-work downstream from the flowmeter will not cause material back up at the sensing plate discharge flange.
4. Avoid materials that flow poorly and/or materials that will stick to surfaces of the flowmeter. The material must be self-cleaning in the sensing plate impact area. See Adhesion on page 26 for more information.
5. Avoid situations that cause air to flow through the flowmeter; this can result in erroneous displays and signals from the flowmeter. Airflow may also be laden with moisture and/or chemical vapors that can cause materials to stick to the impact surfaces of the sensing plate or can cause excess build-up of material on the sensing plate enclosure walls. See Airflow on page 27 for more information.
6. Protect components of the flowmeter system from damaging, caustic material. Damage can come from the weighed material, as well as from backup air from the downstream process or air flow from the upstream process.
7. If the material is abrasive, ensure that the sensing plate is properly protected using alumina ceramic tiles, abrasion-resistant rubber, polyurethane, or plasmatized coatings. The transition chutes upstream from the flowmeter's flowguide, and the flowguide itself may also require protection.
8. Ensure that the temperature of the material being weighed falls within the flowmeter temperature range. Also ensure that the ambient air temperature is not unreasonably high.
9. If required, ensure that the flowmeter has the necessary optional equipment for operation within a hazardous environment.
10. Plan for a method of referencing a known material sample during verification and final calibration of the flowmeter. Two methods are: pre-weighing and running the sample through the flowmeter, or collecting and weighing after the sample has been run through the flowmeter.

General Applications

Screw Conveyor Applications

Screw conveyors have a ribbon (or flight) of steel formed and fixed to a shaft. Rotation of the shaft within a tubular structure will convey the material horizontally, or on a slope, from an inlet point to a discharge point. These devices tend to have constant speed with low lineal distance per second values. Screw conveyors provide an inexpensive method of transporting and/or controlling the feed rate of many products. Variable speed screw conveyors are often called screw feeders and typically shear material from a bin or hopper.



Screw Conveyor Application Notes

The Millflo, E Series, and V Series flowmeters are most commonly applied to screw conveyors. L and M Series flowmeter can also be applied, although their use with screw conveyors is not typical as it is uncommon for a screw conveyor to transport more than 200 TPH. When using a high speed conveyor and/or transporting abrasive materials, a dead box arrangement can limit the impact and wear on the flowguide and sensing plate.

Flighting

Normally, the pulsation frequency of material flow from a screw conveyor with standard flighting is acceptable for the Millflo, E Series, and V Series flowmeters. However, short pitch flighting and double flighting are preferred because they generate a higher pulse frequency and lower magnitude of material pulses.

Constant Speed Conveyors

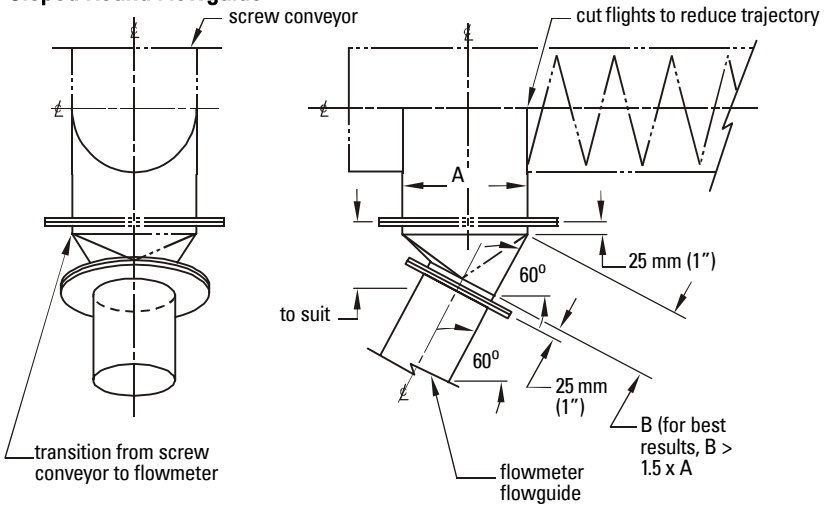
Constant speed conveyors can be applied to maximum speeds of 40 rpm. For abrasive materials, a dead box arrangement is suitable for low and high speed applications.

Variable Speed Conveyors

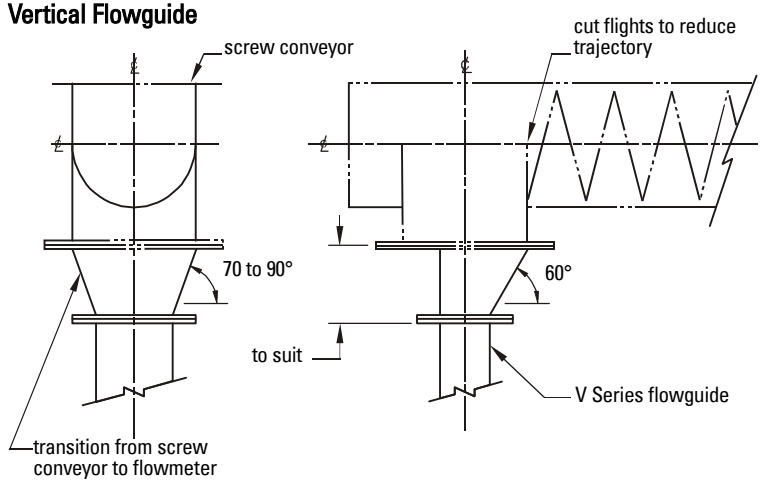
Slower conveyors, with a top speed of up to 20 rpm, can be applied as shown on page 8, although the arrangement shown on page 9 is also applicable. For abrasive materials, a dead box arrangement would be suitable for low and high speed applications.

Low Speed Screw Conveyors (< 40 rpm)

Sloped Round Flowguide

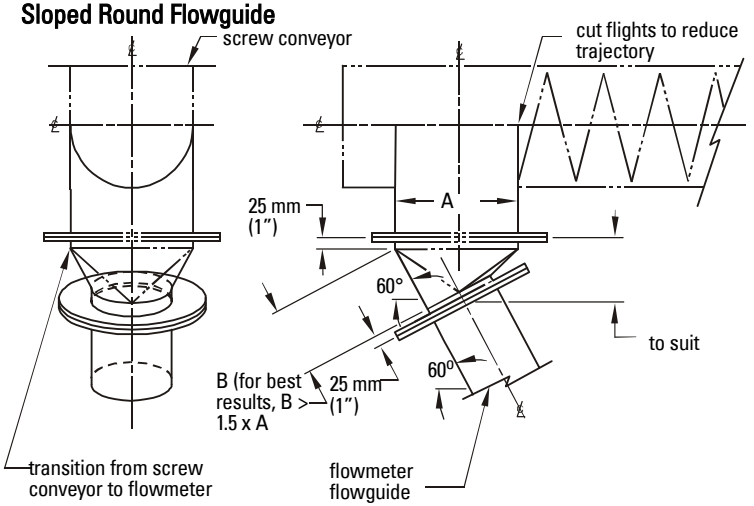


Vertical Flowguide

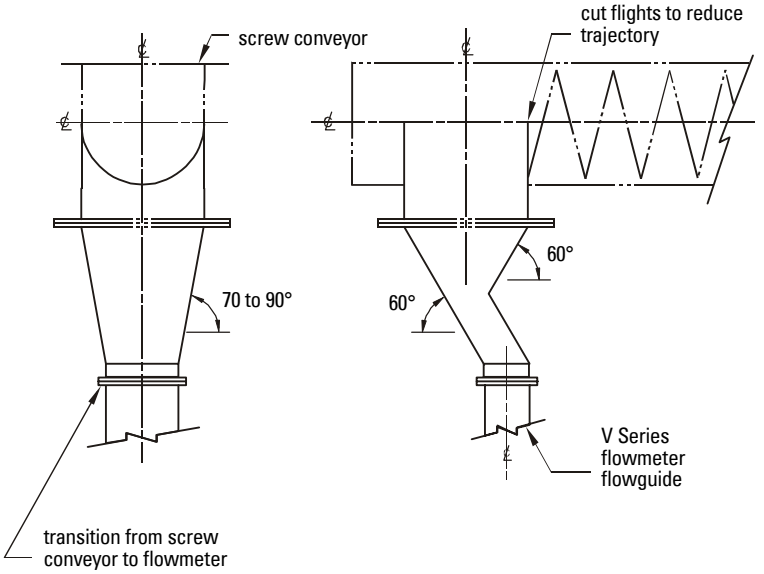


High Speed Screw Conveyors (> 40 rpm)

Sloped Round Flowguide

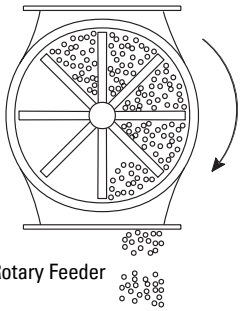


Vertical Flowguide



Rotary Feeder Applications

Rotary feeders are generally used for modulating (dosing) material flow or for providing an air seal between processes. The rotary feeder is composed of vanes fixed to a shaft that rotates within a cylindrical structure. The inlet and discharge flanges are normally in-line but can be offset.



Rotary Feeder

In most cases, rotary feeders are designed with minimal clearance between the vanes and the housing and can be classified as rotary airlock feeders. A reasonably good air seal can be maintained because of the structure and because a pocket can be sealed from both the inlet and the outlet at any given time. This feature allows the device to be applied to situations where the material to be modulated is aerated and free-flowing, as well as in applications where it is desirable to transfer material from one point to another while maintaining an air seal. In applications where there is the possibility of air flow through the flowmeter, a rotary airlock feeder should be considered for installation above and/or below the solids flowmeter. See *Air Flow* on page 27 for more information.

Rotary Feeder Application Notes

The pockets normally discharge material as a pulse. The E Series flowmeters have a viscous fluid damper, which allows them to tolerate the pulse better than the Millflo. A desirable pulse rate is min. 1 pulse/second for the E Series and min, 2 pulse/second for the Millflo. The maximum pulse rate is not a concern because rotary feeders seldom exceed 30 rpm. Worn vanes and housing will contribute to poor modulation control, as well as leakage of both material and air. Rotary feeders often require the vanes and housing to be resurfaced and machined on a regular basis to compensate for wear.

Constant speed rotary feeders are generally driven by an AC voltage gear motor/chain drive arrangement. Variable speed rotary feeders tend to be driven by a motor speed controlled DC gear motor/chain drive arrangement, although an AC gear motor can be used with a variable frequency controller.

The Millflo, E Series, and V Series flowmeters are often used with rotary feeders. The M series is not applicable as rotary feeders are not applied to flow rates beyond 200 TPH.

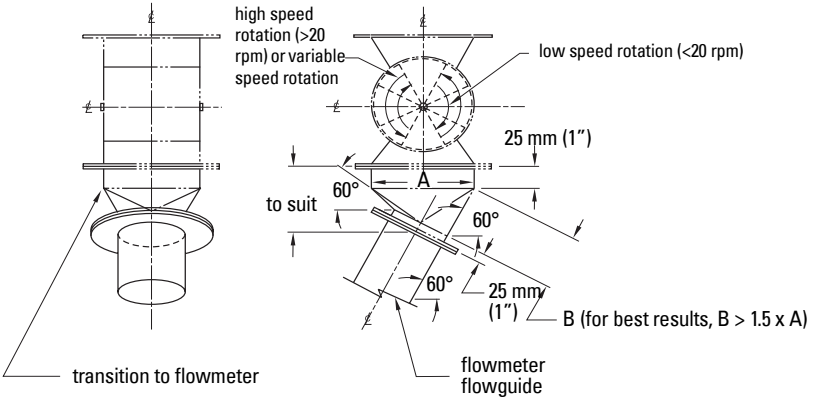
Constant Speed Rotary Feeders

Solids flowmeters can be applied to constant speed rotary feeders, below maximum speeds of 10 rpm, with the rotary feeder having a clockwise rotation. Above that speed, the variation of the trajectory of material from the feeder may cause undesirable flow patterns inside the flowmeter's flowguide. In such cases, the flowmeter may be best applied with the rotary feeder having a counter-clockwise rotation. For highly abrasive materials, a dead box arrangement would reduce wear to the sensing plate and flowguide.

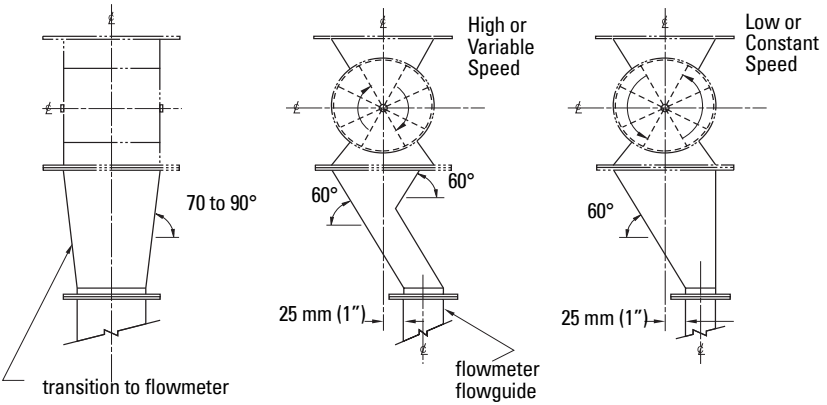
Variable Speed Rotary Feeders

Solids flowmeters can be applied to variable speed rotary feeders with the rotary feeder having a counter-clockwise rotation. If applied with the rotary feeder rotating in the clockwise direction, the variable trajectory of material from the feeder may cause undesirable flow patterns inside the flowmeter's flowguide, which may cause non-inearity. For highly abrasive materials, a dead box arrangement would reduce wear to the sensing plate and flowguide.

Sloped Round Flowguide



Vertical Flowguide



Cylindrical Feeders

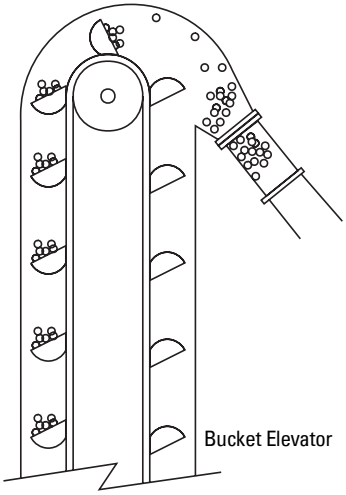
A special version of the rotary air lock feeder has been developed. It uses cylindrical slotting of a solid shaft to create a continuous flow of material through the feeder without creating a pulsating flow. This device is a preferred pre-feeder for Siemens Milltronics solids flowmeters because of the smooth material flow and because a consistent pressure seal can be maintained.

Bucket Elevators

Bucket elevators are conveying devices that elevate material vertically from a lower level to a higher level.

Buckets are attached to a chain drive or a reinforced belt. A chain drive is generally slow and material pulsates heavily. A reinforced belt design, sometimes called a leg, is generally used in the grain industry. This belt travels very quickly and creates a high frequency of pulsation.

Bucket elevators are constant speed devices that produce constant discharge velocities. Flow pulsation on slower moving elevators will require mechanical damping. Higher speed elevators cause more material abrasion due to higher discharge velocities.



Bucket Elevator

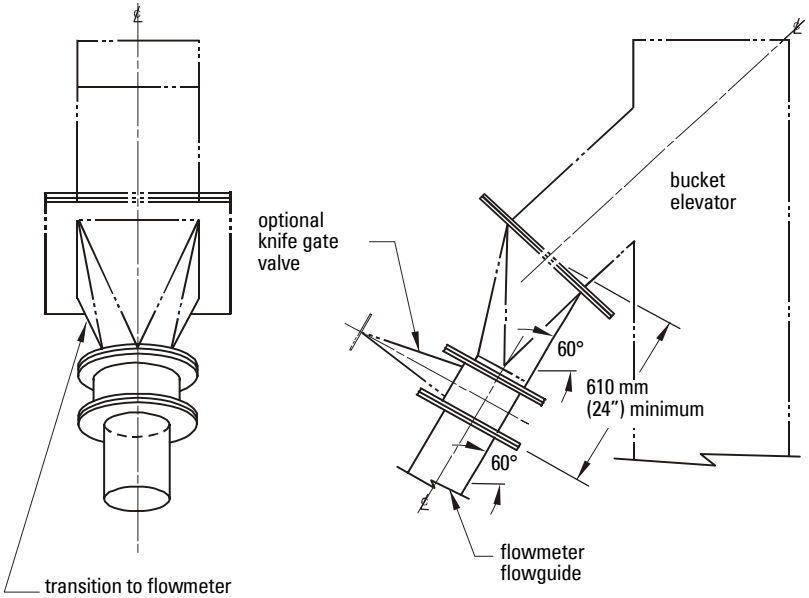
Low Speed Bucket Elevator

Knife gate valves can be used effectively to dampen flow pulses. The valve should be mounted at an opening that will provide the most effective damping without causing material plugging and/or backup.

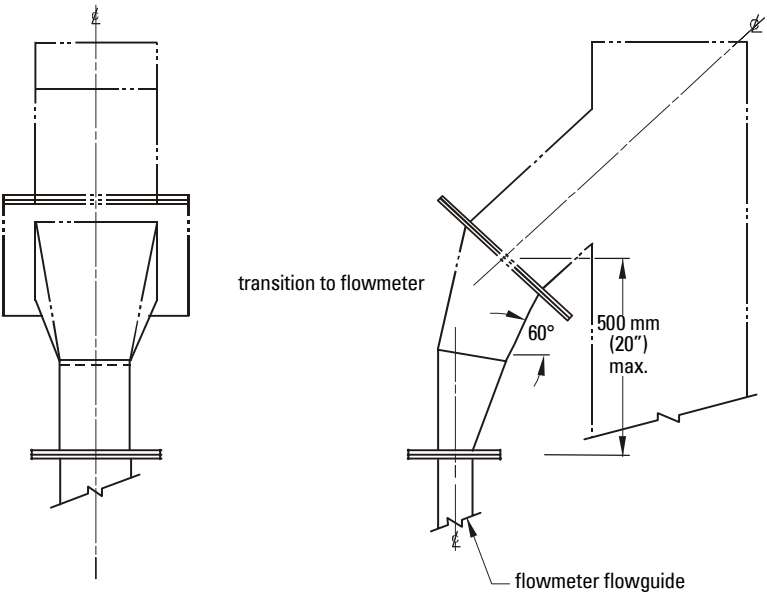
High Speed Bucket Elevator

For high discharge velocities, a dead box arrangement can help limit the velocity and reduce wear when required, if the material is abrasive. The use of the gate valve is not required with a high speed bucket elevator.

Sloped Round Flowguide



Vertical Flowguide

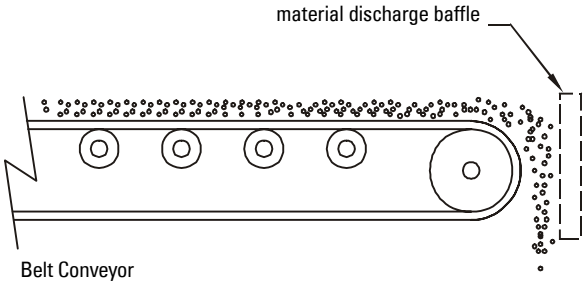


Belt Conveyors

Belt conveyors convey dry bulk solids in a horizontal or near-horizontal direction.

The belt conveyor has a long moving belt travelling over idlers (rollers). The idlers can be flat (one single horizontal roller) or troughed (combination of three rollers installed at various angles to the horizontal). Belt speeds vary according to the parameters of the conveyor application, from very slow to very fast (refer to the definition of speed on page 14).

A belt conveyor that shears material from a bin or hopper at a set belt loading is called a belt feeder. These devices can be constant or variable speed. Solids flowmeters can be used at the discharge of belt conveyors.



Belt Conveyor

Constant Speed Belt Conveyors

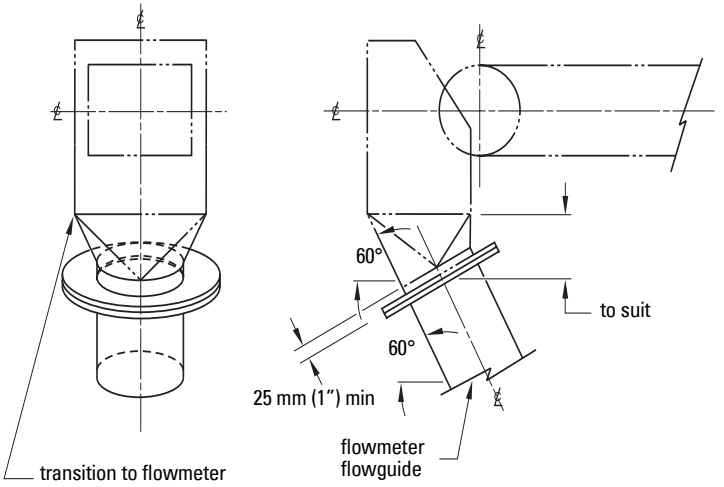
For slow moving, constant, and variable speed belt conveyors, a simple transition to the flowguide will usually be suitable. A baffle is normally not be required. For higher speed belts, a baffle is required.

Variable Speed Belt Conveyors

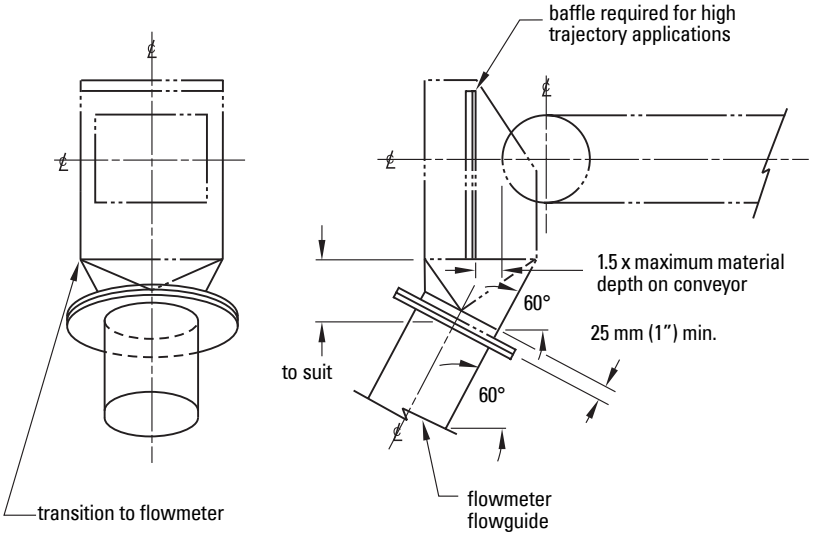
For high velocity, variable speed belts, in applications with little abrasion, a baffle is required. Where abrasion is present, use a dead box arrangement . A dead box arrangement is also suitable for lower speed belts if abrasive materials are being conveyed.

Definition of Speed	
low	0 to 0.25 m/s (50 ft/min)
medium	0.25 m/s (50 ft/min) to 1.0 m/s (200 ft/min)
high	1.0 m/s (200 ft/min) to 4.0 m/s (800 ft/min)

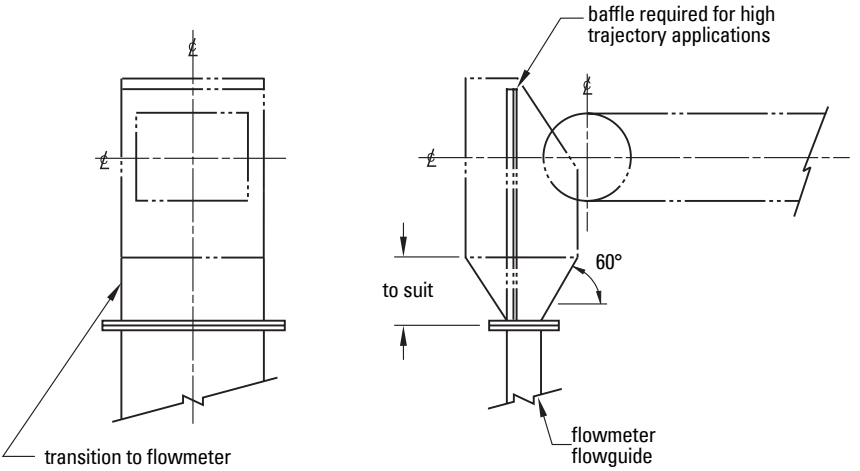
Lower Speed Belts Applied to Sloped Round Flowguides



Higher or Variable Speed Belts Applied to Sloped Round Flowguides

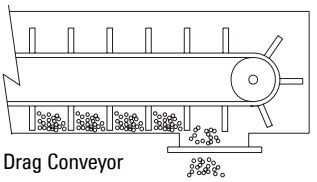


Higher or Variable Speed Belts Applied to Vertical Flowguides



Drag Conveyors

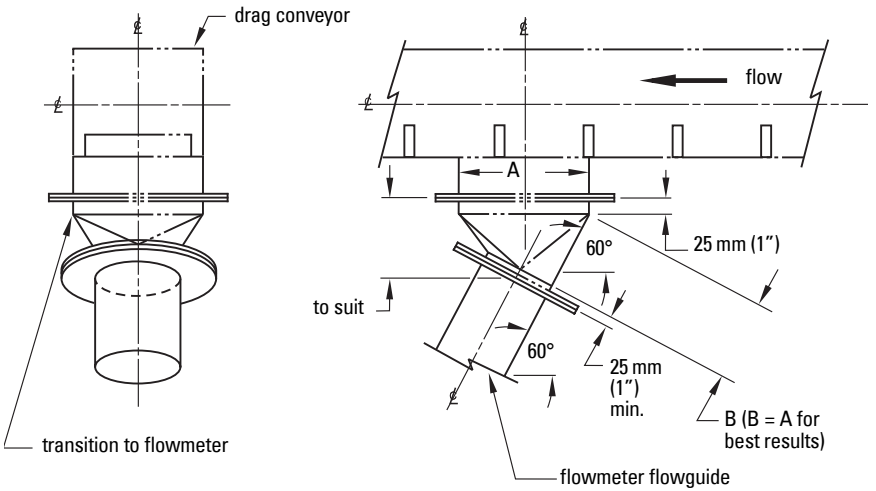
Drag conveyors move material horizontally along the bottom of an enclosure with chain-driven steel slats. The return strand of the chain rides above the conveying strand. The lower portion of the casing, where the actual conveying takes place, can be tubular or rectangular in design.

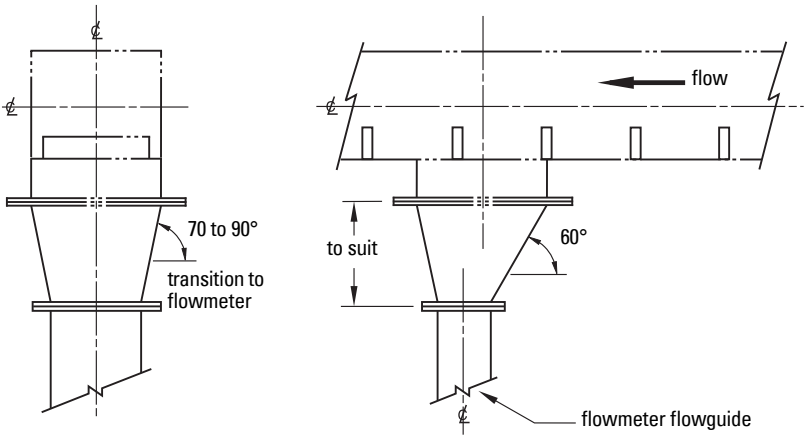


Drag Conveyor

Drag conveyors move at a slow, constant speed. These conveyors are wide and have large discharge flanges. Material usually discharges in surges, requiring extensive damping. Modifications can be made to the discharge to reduce the amplitude and increase the duration of the pules.

If the material being conveyed is abrasive, a dead box will help limit the velocity. See *Abrasion* on page 24.





Aerated Gravity Conveyors

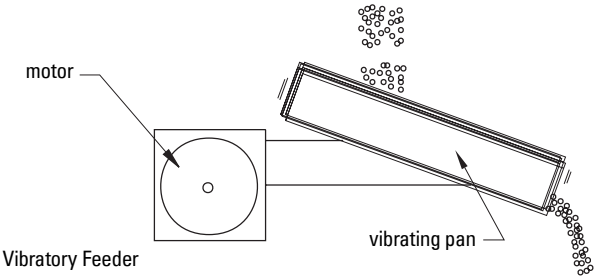
Aerated gravity conveyors move powdered material in a near horizontal direction. Highly aerated powder enters the conveyor. The conveyor maintains the aerated condition and creates a cushion of air above the conveyor's fabric. This aerated state along with gravity allows the material to flow like a fluid. The slope of the conveyor will vary from 5 to 15°, depending on the material being conveyed.

The conveyor comprises a rectangular conveying chamber separated from a lower, rectangular aeration chamber by a permeable fabric. Low-pressure, high-volume air is piped into the lower chamber. Air flows through the fabric, aerating the conveyed material and creating a slight cushion of air just above the fabric.

The flow of material through an aerated gravity conveyor is usually smooth and consistent. At times, there is some variation in the trajectory of the material from the end of the conveyor, but the biggest concern is the potential for airflow through the flowmeter. To measure these applications, Siemens Milltronics offers special aerated gravity conveyor flowmeters (A Series, MA Series) that are designed to allow separate paths for the material being weighed and the airflow.

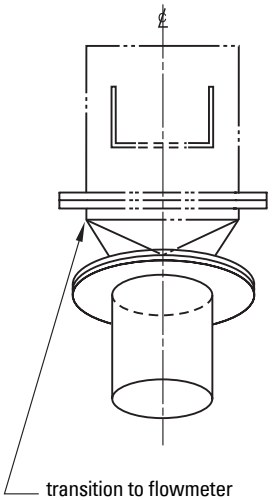
Vibratory Feeders

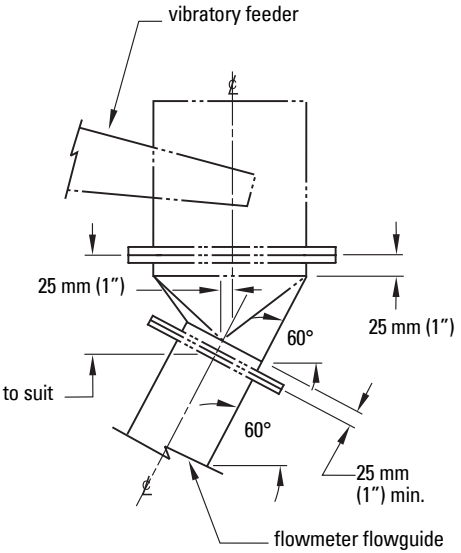
The vibratory (or pan) feeder is suitable for use with solids flowmeters. The material is vibrated down a slightly sloped trough, or pan, by a mechanical oscillating drive. The material flow is even and consistent. The feeders can feed at a constant vibration rate, which can be varied by modulating the amplitude of the vibrations to create a variable vibration rate.



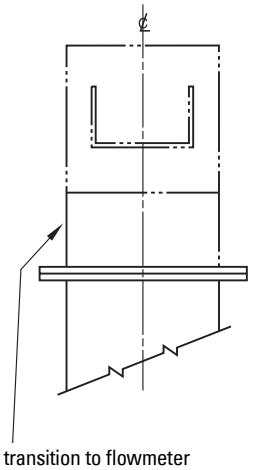
When using a constant vibration feeder, the arrangement shown on page 19 is suitable. The flowmeter can also be rotated 180 degrees. In either case, measuring highly abrasive material requires the use of a wear liner or dead box in the transition chute. See *Abrasion* on page 24.

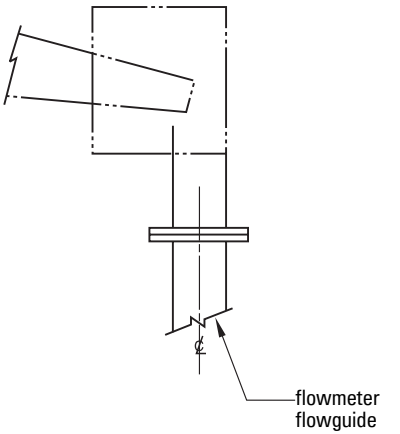
Sloped Round Flowguide





Vertical Flowguide





Knife Gate and Slide Gate Valves

A knife gate valve has a semi-circular gate sliding inside a circular body. This valve provides a circular opening when open and acts as a seal when closed. Knife gate valves are very common in piping systems for fluid flow, but are also used for control of powdered, dry bulk solids.

A slide gate valve is the rectangular version of the knife gate valve. It is traditionally used for granular, dry bulk solids and does not use the sealing function that is required for fluids and fine powders. Both devices modulate flow in control systems, and provide on/off control. For modulation applications, the gate and seat should be designed so the opening and closing of the gate maintains a linear opening.

Positioning and Mounting

When used with solids flowmeters, knife gate and slide gate valves are usually positioned at the bottom of bins and silos. The slide gate valve is relatively problem-free because the materials being handled are usually free-flowing and granular. In an on/off situation, both valve types should have the opening size fixed and limited so the flow levels do not exceed the capability of the flowmeter and so the flow level remains consistent.

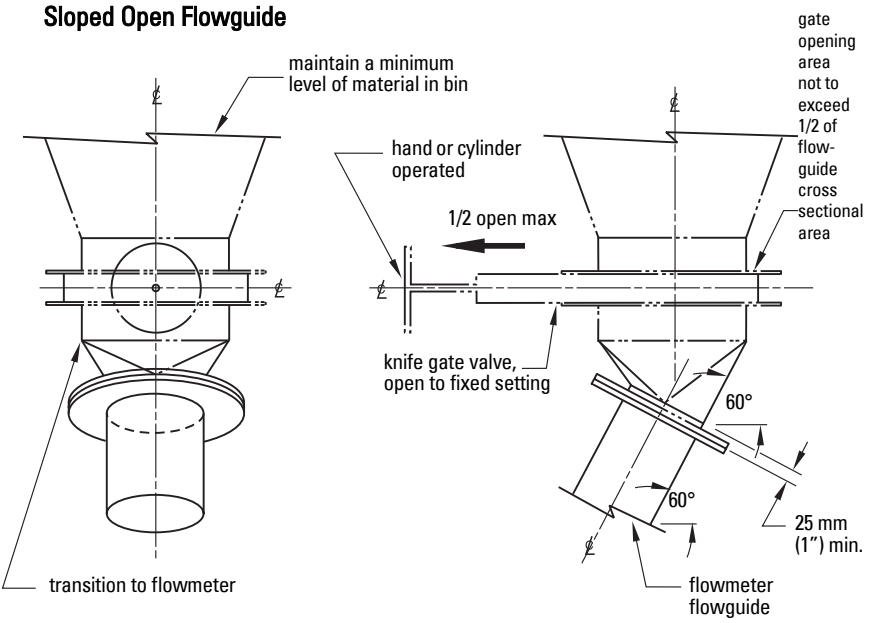
Bin aeration and minimum bin levels should be consistently maintained. If the head of the material in the bin becomes a determining factor of flowrate, a special transition chute between the gate valve and the flowmeter may be required to eliminate changing material velocities.

Flow Considerations

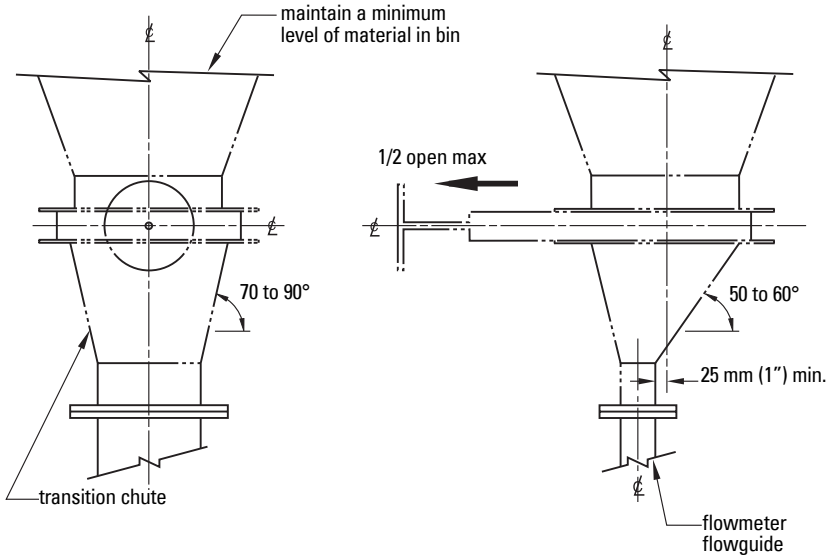
Normally, material flow problems only occur when the bin level drops below a certain point or flow conditions within the bin change suddenly, or if the bin runs empty (the flowmeter then receives material from the process without it coming to rest within the bin).

When measuring granular material using a knife gate valve, a decrease in bin level to low levels or an empty bin can also cause problems. Also, when the knife gate valve is used with powders, inconsistent flows from the bin due to the lack of, or the excess of, flow assistance can cause measuring problems. Flow assistance is usually aeration or vibration to assist the material flow from the bin or hopper.

Sloped Open Flowguide



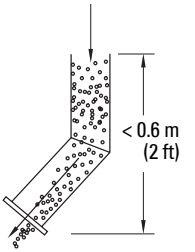
Vertical Flowguide



Chute Applications

Short Fall Chutes

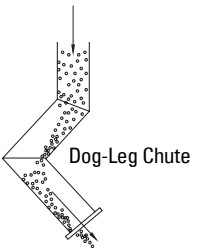
A short fall chute from a prefeeding device or a bin requires little monitoring unless the material has exceptionally poor flow characteristics, is abrasive, or the change in level in the bin would cause different discharge velocities.



Short Fall Chute

In general, to ensure a smooth, repeatable flow of material to the flowguide and then to the sensing plate, create a straight run of chute work immediately before the flowguide that is concentric with and at the same angle as the flowguide. The material can collect and form a consistent and repeatable flow pattern before entering the flowguide. This is especially important when the chute has a second angle.

If the material velocity feeding the flowmeter varies, a dog-leg chute will improve repeatability and linearity.

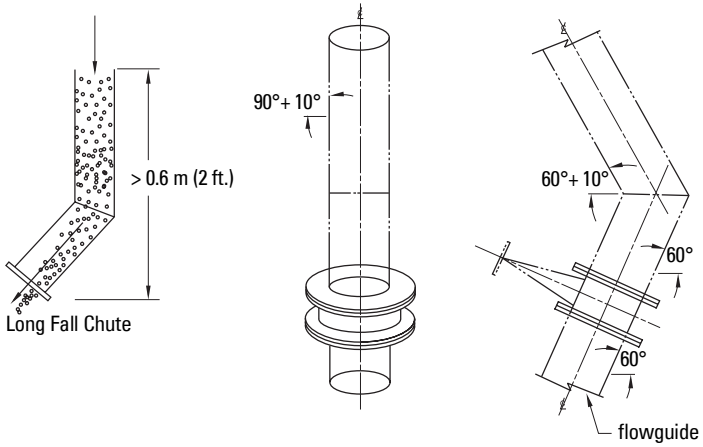


For highly abrasive material, use a dead box to protect the chute from wear. The dead box may also be used when the material bounces on impact. Allowing the material to pile in the dead box will cushion the impact and allow the material to quickly establish a desirable flow pattern. See *Abrasion* on page 24 for more techniques for measuring abrasive material.

Long Fall Chutes

A long fall chute from a prefeeding device or bin can create high-impact forces on the flowmeter's sensing plate. Excessive impact may cause higher than normal abrasion and may limit the range of the flowmeters due to excess movement of the sensing plate within the E Series models or excess forces for the load cells in the Millflo and the L and M Series models.

A chute with the same slope as the flowmeter's flowguide will not usually need any special modifications before the material enters the flowmeter. However, chutes with slopes different than the flowguide require special attention.



Higher Sloped Chutes

If a chute is 70 to 90° from horizontal, a dead box is often required to limit impact forces and establish repeatable impact points on the sensing plate surface. To limit material velocity, consider a chute that conditions material flow twice, similar to a dog-leg chute.

Lower Sloped Chutes

Chutes below 70° from horizontal could be handled with a sloped flowguide to match the chute angle. However, a special sensing plate angle is required as well. Generally, it is preferable to modify the chute work to suit the flowmeter instead of modifying the flowmeter to suit the chutework.

If the chute slope is up to 10° greater than the slope of the flowguide, it is necessary to install a short section of chute, with the same slope as the flowguide, immediately before the flowguide. As well, this arrangement will be required if the chute also has a second angle. If the material is particularly abrasive, consider a dead box arrangement.

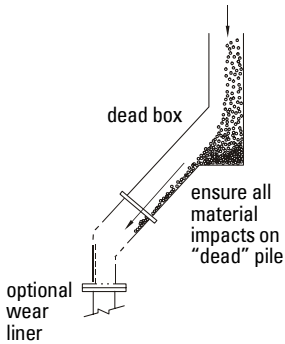
If the chute slope is less than the flowguide slope, install a short chute with the same slope as the flowguide. This arrangement is also be helpful if the chute has a second angle.

Application Considerations

Abrasion

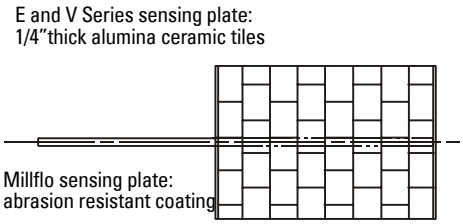
Measuring abrasive products reduces the life of the sensing plate. When material changes direction (in the transition chutes before the flowguide), wear is also a concern. Flowguide wear is less of a concern when the material is sliding and not impacting. With some highly abrasive materials, protection against flowguide wear may also be necessary.

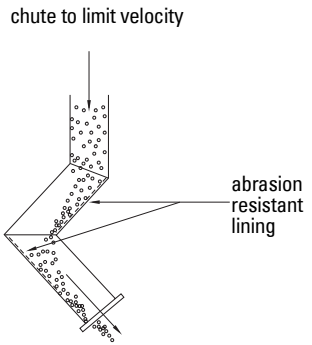
To extend the sensing plate's life, coat or line the plate with abrasion resistant materials, or limit the material velocity as it enters the flowguide. Material velocity is limited by allowing the material to impact the surface of the transition chute before the flowguide or against itself in a dead box.

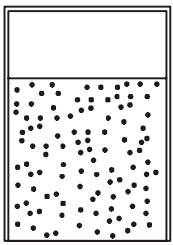


A dead box forms a material pile before entering the flowguide, thus dramatically reducing the material velocity while not damaging the chute walls. This arrangement is not suitable for materials that may deteriorate when piled or for sticky materials that will build continuously.

Sensing plates on the E and V Series flowmeters can be made of abrasion resistant materials or lined with alumina ceramic tiles, abrasion resistant rubber, polyurethane, or plasmatized coatings. Millflo sensing plates can be coated with plasmatized materials or lined with light weight liners such as polyurethane. For selection of the best sensing plate protection, contact your local Siemens Milltronics representative. See the *Material Rating Charts* on page 30.







Temperature

Millflo, E Series, and M Series flowmeters can accommodate a wide range of product temperatures.

Millflo

The Millflo is most limited by temperature because its sensing element (load cell) is integrated as a part of the process. The ambient or product temperature should not exceed the load cell's compensated temperature of 65 °C. However, the load cell can function, on a temporary basis, up to 85 °C. The load cell is temperature compensated to a minimum temperature of -10 °C. Operation below or above the rated compensated temperature limits will cause limited measurement inaccuracies.

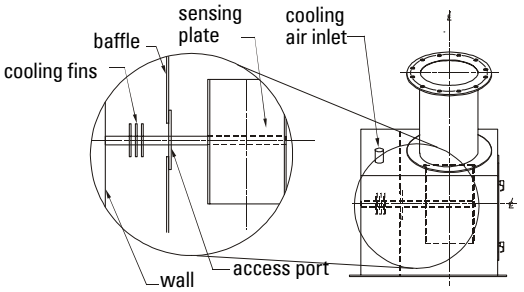
E-40/E-300 and V-40/V-300

The E and V Series flowmeters are better suited for higher temperature applications because each model's sensing mechanics are outside the process. Without special features, both models will easily withstand and perform well with material temperatures as high as 232 °C.

Note: The ambient air temperature surrounding the sensing head should not exceed 50 °C in any application.

The E-40's sensing head should not be installed as a side mounted device in applications above 140 °C process temperature. Above this temperature, the enclosure supporting the side mount unit would distort due to elongation of the metal within its structure. The base mount version of the E-40's sensing head should be used instead; it would be supported separately from the enclosure (and the accompanying chute work) and connected by an isolating flexible gasket. The gasket will allow movement of the chute, caused by temperature expansion and contraction, without detrimental effect on the performance of the sensing head.

The E Series flowmeters can be extended to a maximum of 400 °C by adding a baffle to the enclosure and cooling fins to the sensing plate shaft. The baffle will reduce the effects of heat radiation on the sensing head's face, and the fins will help limit the temperature of the sensing plate shaft so that it does not become a major source of heat for the sensing head. The application of dry cooling air can also reduce the shaft temperature, but the air flow should be directed such that it does not apply a zero shift to the flowmeter. The air volume should be restricted as well.



M and MA Series

M Series flowmeters will tolerate higher product temperatures than Millflo models because the sensing elements (load cells) are isolated from the process. The load cells are isolated from the internal enclosure by a high temperature rated silicone rubber gasket. Since the load cells are supported by the enclosure structure, material temperatures beyond 200 °C would likely cause structural shifting, thereby causing weighing errors. The ambient temperature around the load cell should not exceed 50 °C.

Adhesion

Adhesive materials that build up on the non-impact surfaces of the flowmeter are a concern when the build up hampers the movement of the sensing plate. If the flowmeter has been properly leveled, there will be no zero shift due to the added mass.

It is vital that material not stick and build up on the impact area of the sensing plate. Material build up will cause a calibration shift due to the cushioning effect of the added material. Material build up in the flowguide can also cause calibration shift when the coefficient of friction of the flowguide surface will be changed. Most materials will be self-cleaning on the flowguide surfaces and on the impact area of the sensing plate. Some materials will not be self-cleaning and will require anti-stick coatings in the flowguide and/or on the sensing plate surface. However, some materials simply will not be suitable for weighing with an impact flowmeter due to extreme adhesive qualities. See the *Material Rating Chart* on page 30 for information.

Causticity

Materials that have caustic qualities can damage flowmeter components. Sometimes the material being measured is not caustic itself, but caustic vapors may be present from the processes downstream or upstream from the flowmeter.

Millflo

Millflo's steel components can be specially painted or made of stainless steel when the device is to be used with caustic materials. The load cell, the most critical component, is fabricated from stainless steel. The load cell's encapsulated strain gauges are protected by a gel compound. Some caustic materials can damage the load cell potting gel and eventually the strain gauges, especially where the material has a high moisture content. When there is concern about the suitability of Millflo on a caustic material, contact your local Siemens Milltronics representative.

E Series and V Series

In applications for caustic material, the silicone gasket of the E Series and V Series flowmeters may require special consideration to prevent chemical reaction between the measured material and the gasket. Epoxy paint and synergistic coatings may be required as protection of the aluminum flowmeters castings. The flowmeter's flowguide and sensing plate enclosure may require special painting or stainless steel construction. The standard type 304 stainless steel sensing plate should be suitable for most caustic material, but some will require type 316, which has a slightly better overall chemical resistance.

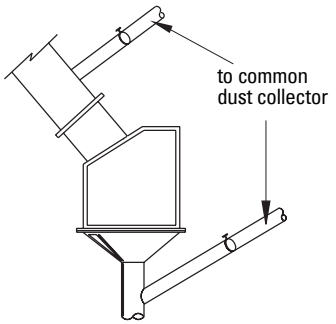
M Series

The M Series flowmeter can be specially painted to better protect against caustic materials. Stainless steel construction is also an option. The sensing plate can be made out of 316 stainless steel to provide better chemical resistance. The silicone tube gaskets can be made of another material, if silicone is prone to attack by the caustic material.

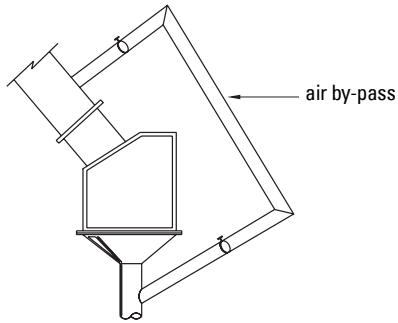
Airflow

The effects of air flow through a flowmeter can vary from a light constant flow, which can be dynamically zeroed out by the electronics of the flowmeter system, to an air flow that is inconsistent and unpredictable, rendering the flowmeter inaccurate and unreliable.

Checking the position of the flowmeter prior to installation can reduce the chances of air flow problems. Placing the flowmeter in a more suitable location is often the only solution. Sometimes, the use of a rotary airlock feeder as a pre-feed device for the flowmeter and/or a rotary airlock feeder after the flowmeter will be sufficient to isolate the flowmeter from excessive air flow. If the flowmeter is installed and air flow creates measurement inaccuracy, reduce the differential pressure across the flowmeter by diverting the air flow around the flowmeter. When a dust collection system is involved, draw air equally from above and below the flowmeter.



pressure balancing



air by-pass

Material Rating Definitions

On page 30, materials that have been successfully weighed with solids flowmeters are listed using the rating criteria defined below.

Flowability:	**How the material flows**	
	Poor	Material has qualities that cause sluggish and unpredictable flow, including moisture, material size, and particle size.
	Fair	Material will flow in a repeatable manner, but the application may require adjustment to achieve consistent and repeatable material flow. Having the right flowguide slope and perhaps a non-stick flowguide coating such as PTFE becomes important.
	Good	Material flows in a predictable and repeatable manner
	Excellent	Material will flow in a predictable and repeatable manner, and will not require flow aid devices such as bin aeration and bin vibrators.
Abrasion:	**How easily does the material wear the sensing plate and flowguide?**	
	Low	Very little abrasion, standard 304 SS or 316 SS sensing plates will be sufficient.
	Medium	Material is somewhat abrasive. The sensing plate may require abrasion resistant coating or lining.
	High	Material is abrasive. The sensing plate will require an abrasion resistant coating or lining.
Adhesion:	**How easily does the material stick to the flowguide and sensing plate?**	
	Low	Material will not stick to the flow surface of the flowguide and sensing plate.
	Medium	Material may build up heavily on the flowguide walls and on the non-impact areas of the sensing plate, but not the impact areas. Consider an anti-stick coating such as PTFE.
	High	Material will build up in the flowguide and on the impact area of the sensing plate. An anti-stick coating is required for the sensing plate and the flowguide.
Causticity:	**What is the level of chemical reaction that is detrimental to components of the weighing process?**	
	Low	Very limited chemical reaction. Standard equipment will be suitable.
	Medium	Material is mildly caustic; paints and coatings offering protection for the standard components should be considered.
	High	Material is highly caustic, special painting, special coatings and/or stainless steel options are a requirement.

General Rating:	**With all things considered, a rating of the material in terms of its suitability for the application of a solids flowmeter.**	
	Good	The material is suitable.
	Fair	The material is suitable, but only if the limiting properties listed above have been properly addressed.
	Poor	The material, despite attempts to compensate for the limiting properties, will still not produce results within the specifications of the solids flowmeter. The customer should be pre-warned of this possibility.
Flowmeter Selection:		Potential flowmeter models for each application. The models not included have been eliminated because of the flowmeter unsuitability and/or the lack of supported flowrates within the application specifications.

Rating Chart for Common Materials

Material	Flowability	Abrasion	Adhesion	Causticity	General Rating	Flowmeter
Alumina	good	low to high	low	low	good	E, M, V, A
Ammonium Nitrate	fair	low	high	high	fair	E, V
Asbestos Fibre	fair	low	low	low	good	E, M
Asbestos Rock	good	medium	low	low	good	E, M, V
Barite	good	low	low	low	good	E, M, V
Barley	excellent	medium	low	low	good	Mfl, E, M, V
Barley Malt	good	low	low	low	good	Mfl, E, V
Bentonite	good	low	low	low	good	Mfl, E, M, V
Bran	good	low	low	low	good	E, V
Calcined Coke	good	low	low	low	good	E, V
Calcined Gypsum	good	low	low	low	good	E, M, V
Carbide	good	medium	low	high	good	E, V
Carbon	good	low	low	low	good	E, V
Carbon Black	good	low	low	low	good	Mfl, E, V
Cattle Feed Pellets	good	low	low	low	good	Mfl, E, M, V
Cement	good	low	low	low	good	Mfl, E, M, V
Clinker	good	high	low	low	fair	E, M, V
Cocoa	fair	low	medium	low	fair	E, V
Cocoa Beans	good	low	low	low	good	Mfl, E, V
Coffee Beans	good	low	low	low	good	Mfl, E, V
Coke	good	low	low	low	good	E, V
Copper Calcine	good	low	low	low	good	E, M, V
Copper Concentrate	good	low	low	low	good	E, M, V
Corn	excellent	medium	low	low	good	Mfl, E, M, V
Corn Fibre	good	low	low	low	good	Mfl, E, V
Corn Flakes	fair	low	low	low	good	E, V
Cut Peanuts	good	low	low	low	good	Mfl, E, V
Dog Food (pellets)	good	low	low	low	good	Mfl, E, V
Dog Food (mix)	good	low	low	low	good	Mfl, E, V
Dry Soap	poor	low	high	low	fair	E, V
Fertilizer	good	low	medium	medium	good	E, V
Flour (Wheat)	fair	low	medium	low	good	E, V
Flue Dust	good	low	low	low	good	Mfl, E, V
Flyash	good	low	low	low	good	Mfl, E, V
Garlic	good	low	low	low	good	E, V
Gluten	fair	low	medium	low	good	E, V
Grain Screenings	fair	low	low	low	good	E, V
Grain Tailings	fair	low	low	low	good	E, V
Graphite	good	low	low	low	good	E, V
Ground Soybean Hulls	good	low	low	low	good	E, V
Gypsum	fair	low	low	low	good	Mfl, E, V

Material	Flowability	Abrasion	Adhesion	Causticity	General Rating	Flowmeter
Iron Oxide	good	low	low	low	good	Mfl, E, V
Kiln Dust	good	low	low	low	good	E, V, A
Kiln Feed (cement)	good	low	low	low	good	E, V, A
Laundry Detergent	poor	low	high	low	fair	E
Lime (powder)	good	low	low	low	good	E, V
Limestone (crushed)	good	medium	low	medium	good	E, M, V
Malt	good	low	low	low	good	Mfl, E, V
Oat Flour	good	low	low	low	good	Mfl, E, V
Oat Groats	good	low	low	low	good	Mfl, E, V
Perlite	good	low	low	low	good	Mfl, E, V
Perlite Ore	good	high	low	low	fair	E, V
Petroleum Coke	good	low	low	low	good	Mfl, E, V
Phosphate Rock	good	low	low	medium	good	Mfl, E, V
Plastic Pellets	good	low	low	low	good	Mfl, E, V
Polymer Percol	good	low	low	low	good	Mfl, E, V
Polyethylene Pellets	good	low	low	low	good	Mfl, E, V
Polyethylene Regrind	fair	low	low	low	good	Mfl, E, V
Polystyrene Pellets	good	low	low	low	good	Mfl, E, V
Polymers	good	low	low	low	good	Mfl, E, V
Popping Corn	good	low	low	low	good	Mfl, E, V
Potash	good	low	low	medium	good	E, V
Potato Flakes	fair	low	low	low	good	E, V
Potato Starch	fair	low	low	low	good	E, V
Poultry Feed (mash)	good	low	low	low	good	Mfl, E, V
Precipitator Dust	good	low	low	low	good	Mfl, E, V
Puffed Wheat	good	low	low	low	good	E, V
Pulverized Coal	good	low	low	low	good	E, V, C
Resin	good	low	low	low	good	Mfl, E, V
Rice	good	low	low	low	good	Mfl, E, V
Rice Hulls	fair	low	low	low	good	Mfl, E, V
Rye Flour	good	low	low	low	good	Mfl, E, V
Salt	good	low	low	medium	good	E, V
Salt Cake	poor	low	medium	high	fair	E, V
Sand	good	medium	low	low	good	Mfl, E, V
Sawdust	fair	low	low	low	good	E, V
Shorts (wheat)	good	low	low	low	good	Mfl, E, V
Silica Flour	good	low/med	low	low	good	Mfl, E, V, A
Soap Powder	fair	low	high	low	fair	E, V
Soda Ash	good	low	medium	medium	good	E, V
Sodium Chloride	good	low	low	medium	good	E, V
Sodium Sulphate	good	low	low	medium	fair	E, V
Soya Beans	good	medium	low	low	good	Mfl, E, V
Soya Bean Hulls	fair	low	low	low	good	Mfl, E, V
Starch	fair	low	medium	low	fair	E, V

Material	Flowability	Abrasion	Adhesion	Causticity	General Rating	Flowmeter
Steel Shot	good	medium	low	low	good	Mfl, E, V
Sugar	good	low	medium	low	good	E, V
Sunflower Seeds	good	low	low	low	good	Mfl, E, V
Titanium Dioxide	good	low	low	low	good	Mfl, E, V
Unshelled Peanuts	good	low	low	low	good	Mfl, E, V
Uranium Dioxide	good	low	low	low	good	Mfl, E, V
Uranium Trioxide	good	low	low	low	good	Mfl, E, V
Urea	fair	low	high	high	fair	E, V
Vermiculite	good	low	low	low	good	E, V
Wheat	good	medium	low	low	good	Mfl, E, V
Wheat Fines	good	low	low	low	good	E, V
Whole Onions	good	low	low	low	good	E, V
Wood Pellets	good	low	low	low	good	E, V
Wood Pulp	poor	low	low	low	fair	E, V
Zinc Oxide	good	low	low	low	good	E, V

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