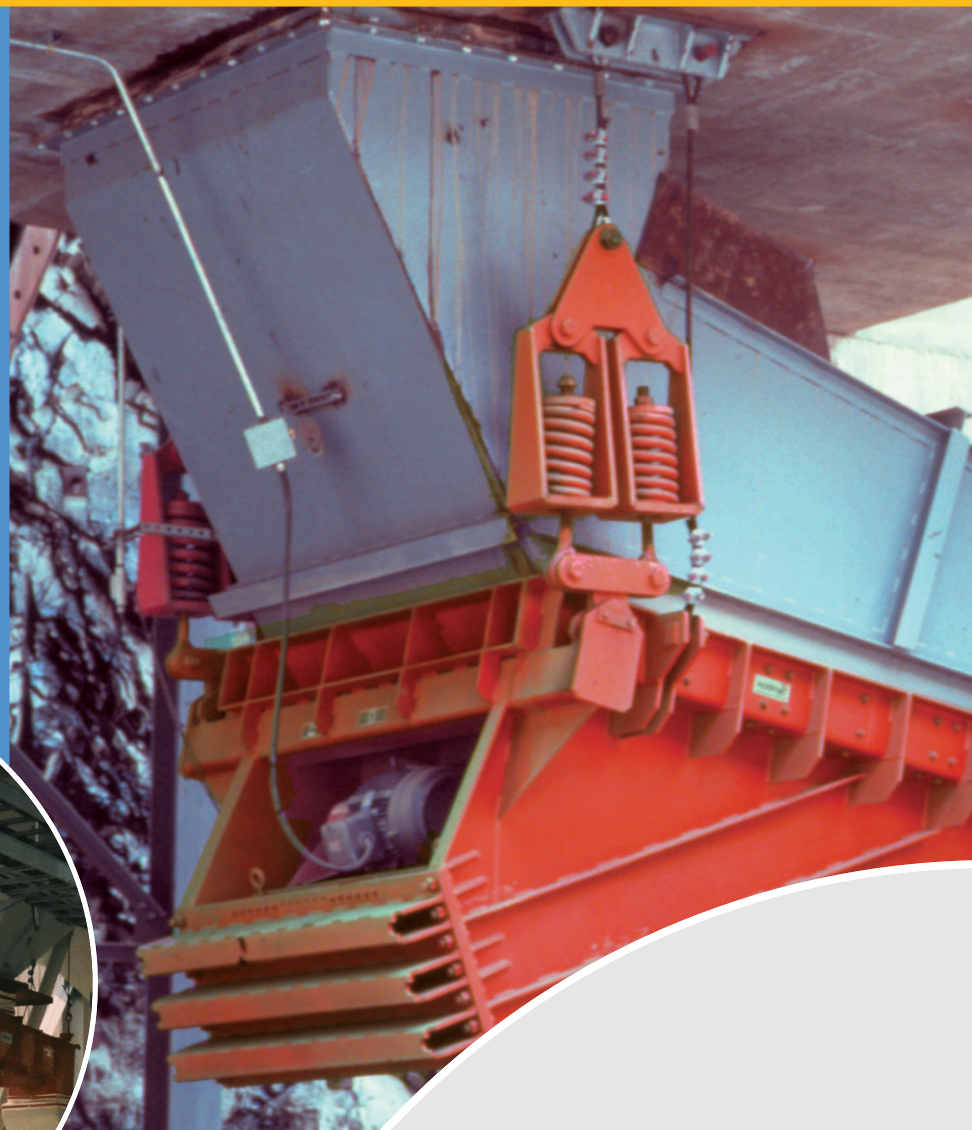
Syntron Material Handling

Syntron® Working with Hoppers



www.syntronmh.com

Contents Syntron® Working with Hoppers

The hoppers illustrated in this manual are meant to be examples only. The user and those responsible for choosing the hoppers must satisfy themselves as to the acceptability of each application and use of the hopper. Under no circumstances will Syntron Material Handling be responsible or liable for any damage, including indirect or consequential losses resulting from the use, misuse or application of this information.

The text, illustrations, charts and examples included in this document are intended solely to explain the types of material flow and capacity problems that can result from use of a less than ideal hopper. Due to the many variables associated with specific hopper designs, applications or uses, Syntron Material Handling will not assume responsibility or liability for actual use based upon the data in this document.

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Syntron Material Handling

Proven Engineered Products – Complete Material Handling Solutions

Two powerful industry leading brands—**Link-Belt®** and **Syntron®**—have come together under a new company name, Syntron Material Handling, LLC, for one goal – better engineered products.

Established in May 2014, Syntron Material Handling (SMH) was built out of the legacies of Link-Belt Company and Syntron Company, formerly owned by FMC Technologies. Today, our 300 skilled employees have a combined 4,212 years of industry knowledge that they put into the SMH product every day. We are dedicated to providing customers with complete material handling solutions.

Let Syntron Material Handling's knowledgeable team help your business with conveying, feeding, screening, elevating, vibratory flow aids, and mining controls of bulk product. Whether optimizing existing systems or starting from the ground-up on new and customized plants or mines, our dedicated staff will provide you with the most efficient and cost-effective solutions.

"Our company structure will be very exciting and fast-paced as we charter our new path. The positive attitudes and skills of our employees, the strength of our products, and our long-term customer relationships are our foundation for success." said CEO Andy Blanchard.

An international leader for innovative solutions, Syntron Material Handling can improve the technology customers are already using. The Link-Belt® expertise and equipment have been instrumental in developing some of the world's largest belt conveyors. The Syntron® feeders are instrumental to supplying energy sources and material handling efforts across the globe.

Levine Leichtman Capital Partners, the new owner of Syntron Material Handling, is committed to the success and growth of the company by investing in engineering capabilities, manufacturing efficiency, and customer service.

Although we may have a new name, we still have the same dedicated employees and industry leading engineered products that make us a market leader.

Syntron Material Handling operates two manufacturing facilities in the USA and China.

All of our products are produced to OSHA/MSHA standards and ISO Standard 9001:2008. We are a charter member of CEMA, and active members of NSSGA, NMA, SME, FEMA, and PMMI.

Call us today for all your material handling needs.

Saltillo
2730 Hwy 145 South
Saltillo, Mississippi 38866
Phone: 662.869.5711
Fax: 662.869.7493
800.356.4898
orders@syntronmh.com

Changshu
#2 Road No. 1
Changshu Export Processing Zone
Changshu, Jiangsu, China 215513
Phone: +86 0512.52299002
Fax: +86 0512.52297228

Syntron® Vibratory Feeder Models

Light-Duty Feeders

F Series	BF Series
F-T0	BF-01
F-T01	BF-2
F-T02	BF-3
F-010	BF-4
F-152	BF-4-LF
F-212	

Heavy-Duty Feeders

F Series		RF Series	MF Series	
FH-22	FH-24	RF-80	MF-200	MF-300
FH-24-HP	F-330	RF-120	MF-400	MF-500
F-380	F-380-HP		MF-600	MF-800
F-440	F-450		MF-1000	MF-1100
F-480	F-480-HP		MF-1600	MF-2000
F-560	F-660			
F-88				

Feeder Hopper Transitions

Material characteristics such as size distribution, shear properties and cohesiveness generally dictate the configuration of feeder transition hoppers. Material flow velocities vary, depending upon material properties, feeder stroke and operating speed.

Good transition hopper design optimizes flow rate, allowing the most economical choice of a feeder. Improperly designed transition hoppers will substantially reduce feeder capacities.

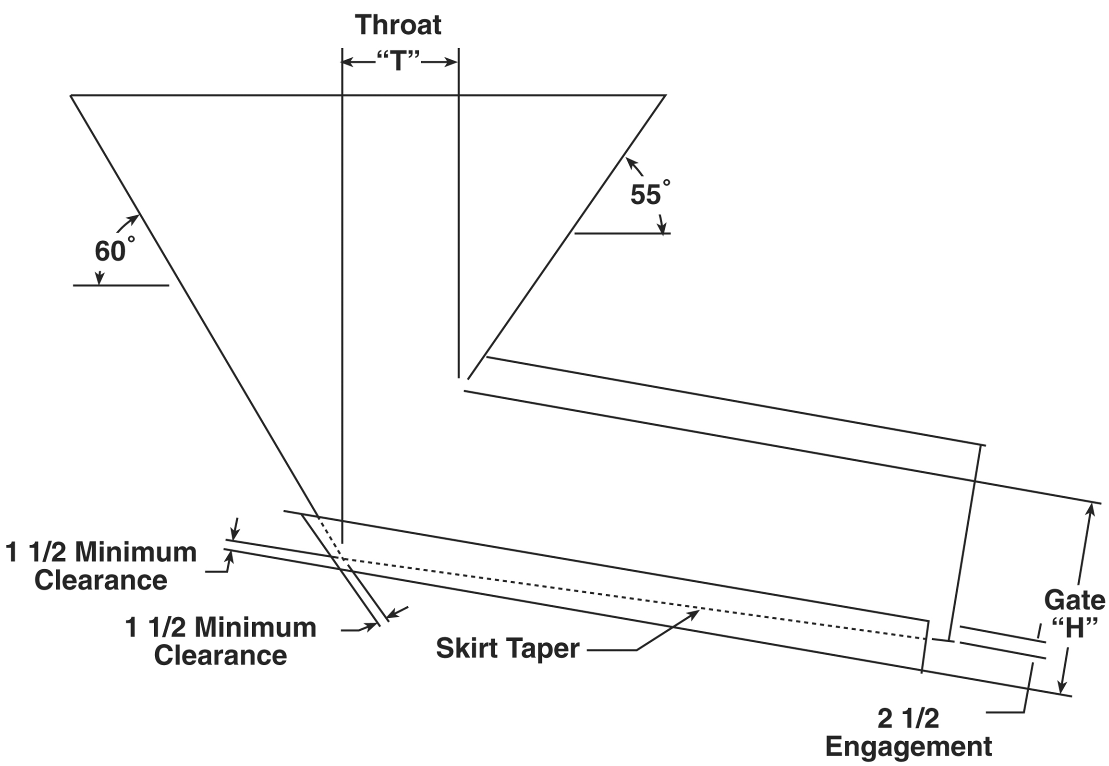
The **IDEAL HOPPER**, illustrated below, has a **T/H ratio of 0.6** and shows a uniform material flow pattern to the feeder trough. Material at the front and rear of the hopper moves at nearly the same velocity, and the **discharge depth "d"** is nearly equal to the **hopper gate height "H"**. The **IDEAL HOPPER** design allows the most economical feeder to be selected.

The **ACCEPTABLE HOPPER** design may require a slightly larger feeder than required for the **IDEAL HOPPER**. This is a result of the non-uniform flow pattern of material at the rear of the hopper.

Material flow velocity and material depth are reduced with a corresponding reduction in feeder capacity. **A T/H RATIO of 0.5 to 1.0 is generally acceptable**. When the T/H RATIO exceeds this range, the material flow patterns distort drastically, significantly reducing feed rates.

Hoppers should be designed as closely as possible to the information presented in this manual. If specific application issues arise, contact Syntron Material Handling and talk with one of our Application Specialists for help in resolving the issue.

Ideal Hopper Design



Recommended Hopper Design and Feeder Selection

1. The **hopper rear wall angle** must be steep enough to permit material flow. Syntron Material Handling recommends 60° ± 2°.
2. The **hopper front wall angle** must be just enough to permit material flow. The flow rate on the hopper front wall should be slightly less than the flow rate on the back wall. Syntron Material Handling recommends 55° ± 2°.
3. The throat dimension **T** for random size material should be a minimum of 2 times the largest particle of material. If the material particles are nearly the same size (near size), **T** should be a minimum of 4 times the largest particle size to prevent blockage at the throat opening. In all cases, the arc **A** should exceed 2-1/2 times the largest particle size.
4. The gate opening **H** must be a minimum of 2 times the largest particle of material and should increase proportionately for the desired capacity. The most economical feeder is selected when the throat dimension **T = 0.6 x H**. If **T** is greater than **H**, the material flow pattern is disturbed, resulting in non-uniform flow.
5. When adjustable gates are used, the gate must be parallel to the hopper's front wall and must be as close to the front wall as possible. The separation must not exceed 2 inches. The gate should act as an adjustable front wall. Leveling blades and downstream gates must not be used. Horizontal cut of gates should be used to perform feeder maintenance and must not be used to regulate flow.
6. For random size material, the inside width of the opening (between skirts) should be a minimum of 2 -1/2 times the largest particle. For near size material, the width should be a minimum of 4 times the largest particle.
7. The minimum length of the feeder is determined by projecting the angle of repose for the specific material from the gate point (see illustration on page 5) to the feeder pan plus approximately 6 inches.

   CAUTION: Under certain applications, if hopper is empty initial surge may cause flushing. For additional information, contact Syntron Material Handling.
8. The feeder must not contact any adjacent structure, but must be free to vibrate. **Allowance must be made for a decrease in feeder elevation of approximately 2 inches due to static material load. In addition, a 1-inch minimum clearance at the sides, and a 1-1/2-inch clearance on the bottom and back of the feeder must be maintained in both loaded and unloaded conditions.**
9. The skirts must taper in the direction of flow (diverge from conveying surface) to permit material from jamming and causing additional problems such as spillage and build-up. Skirts must run parallel to trough sides and must be reinforced to resist bulging outward against the trough.

Calculations and Formulas

Terms

Capacity	=	C (tph)
Feeder Width	=	W (inches)
Gate Factor	=	GF
Flow Rate	=	R (ft/min)*
Discharge Depth	=	d (inches)
Material Density	=	D (lbs/ft3)
Gate	=	H (inches)

(* See Chart below)

Formulas

$$d\ (in) = \frac{C(tph) \times 4800}{[W(in) - 4(in)] \times R(ft/min) \times D(lbs/ft3)}$$

$$C\ (tph) = \frac{[W(in) - 4(in)] \times R(ft/min) \times D(lbs/ft3) \times d(in)}{4800}$$

$$H\ (in) = GF \times d\ (in)$$

Syntron Material Handling suggests the following values for GF:

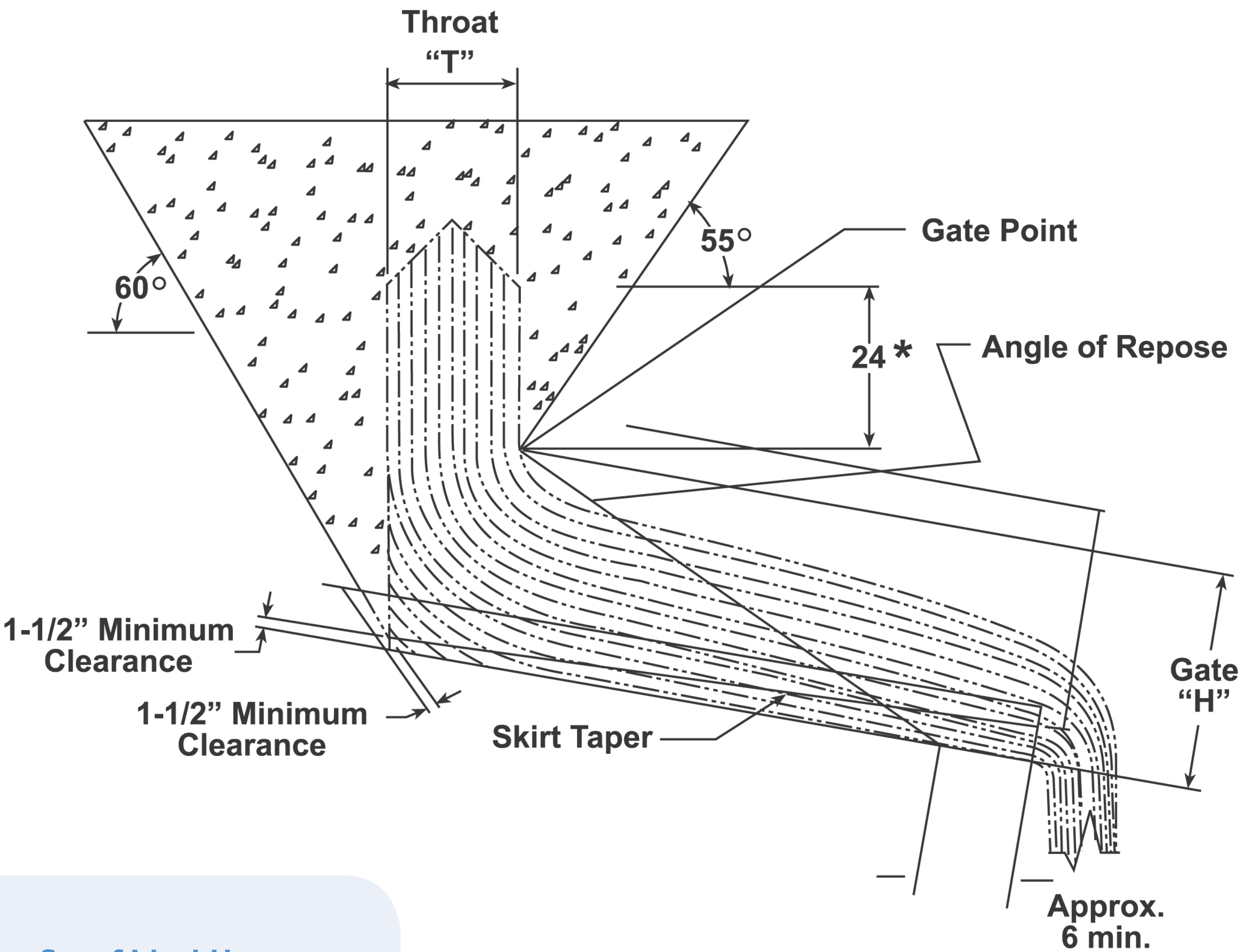
If material angle of repose > 35°, GF = 1.3

If material angle of repose < 35°, GF = 1.5

*Value of R (ft/min)

Electromagnetic Feeders (F Series Models)		
IF Material Size =	OR Trough Slope =	Feeder Rate =
< 4 in	8 to 12°	60 ft/min
4 to 12 in	4 to 8°	55 ft/min
> 12 in	0 to 4°	50 ft/min
Electromechanical Feeders (RF or MF Series Models)		
< 4 in	8 to 12°	55 ft/min
4 to 12 in	4 to 8°	50 ft/min
> 12 in	0 to 4°	45 ft/min

Ideal Hopper
T = 0.6 x H

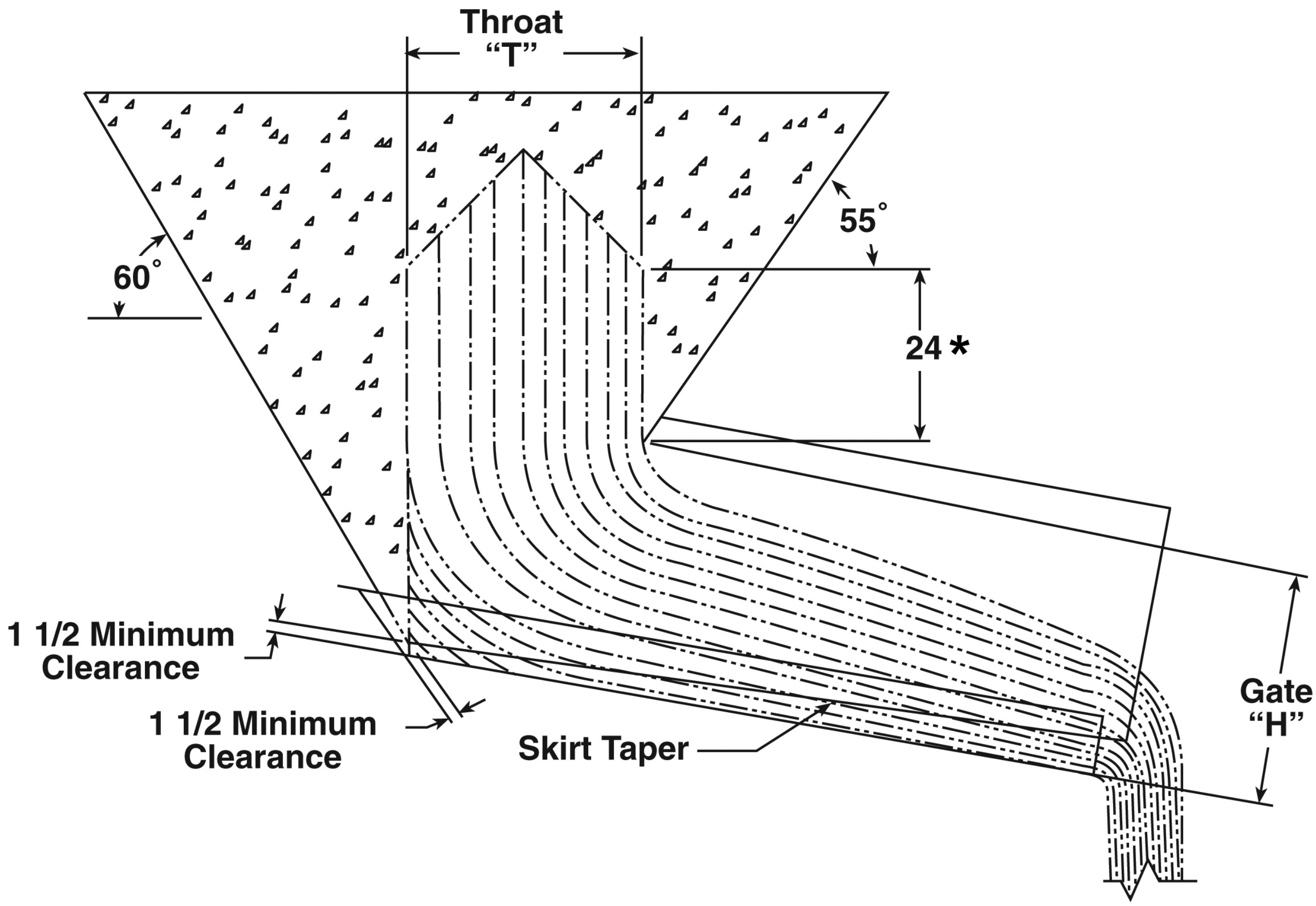


Benefits of Ideal Hopper Design:

- Uniform Flow Pattern
- Maximum Capacity
- Maximum Material Velocity
- Maximum Material Depth
- Optimized Feeder Size
- Reduced potential for material build-up at inlet
- Reduced potential for spillage at back and sides
- Reduced material load on feeder

*Active material area required to achieve ideal uniform flow patterns. If less, flow pattern will not be uniform and there will be the potential for excess material loads and reduced capacity.

Acceptable Hopper
T = H

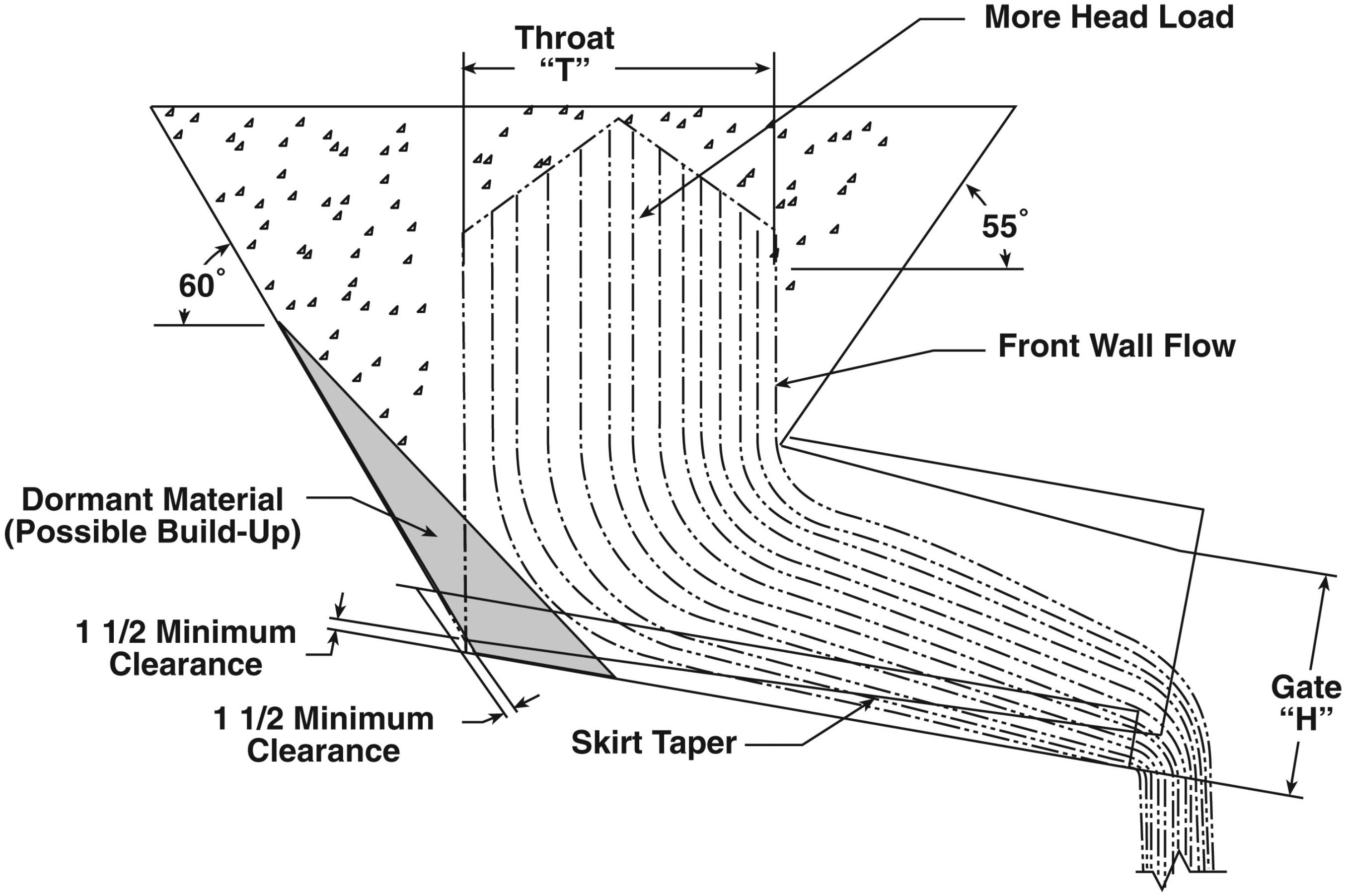


Ideal Hopper Design:

- Non-uniform Flow Pattern
- Reduced Capacity ~15%
- Reduced Material Velocity ~10%
- Increased Feeder Size
- Potential for material build-up at inlet
- Potential for spillage at back and sides
- Increased material load on feeder

*Active material area required to achieve ideal uniform flow patterns. If less, flow pattern will not be uniform and there will be the potential for excess material loads and reduced capacity.

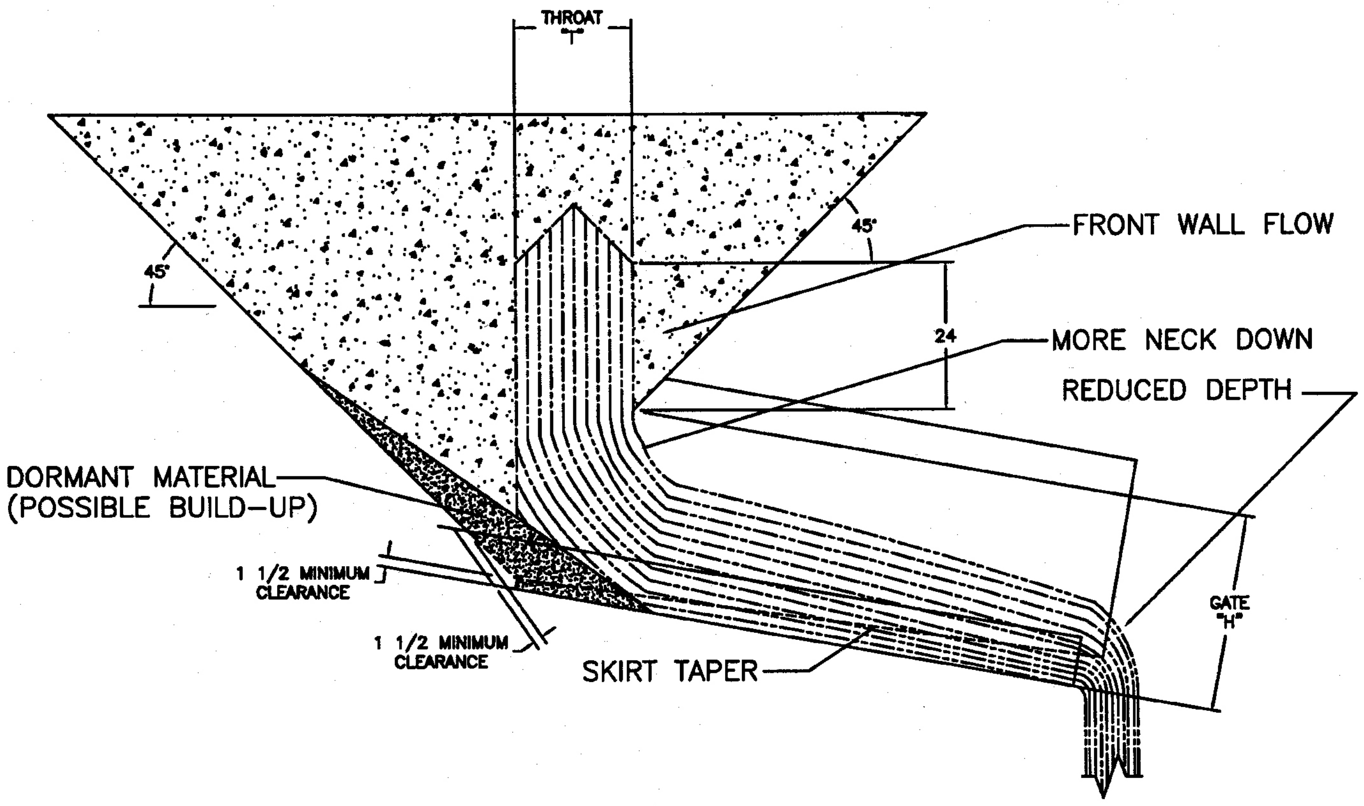
Excess Throat
T > H



Excess Throat Design:

- Non-uniform Flow Pattern
- Reduced Capacity > 20%
- Reduced Material Velocity > 15%
- Increased Feeder Size
- Potential for material build-up at inlet
- Potential for spillage at back and sides
- Increased material load, possible collapsed suspension coil springs

Flat Front Wall and Rear Wall
T = 0.6 x H

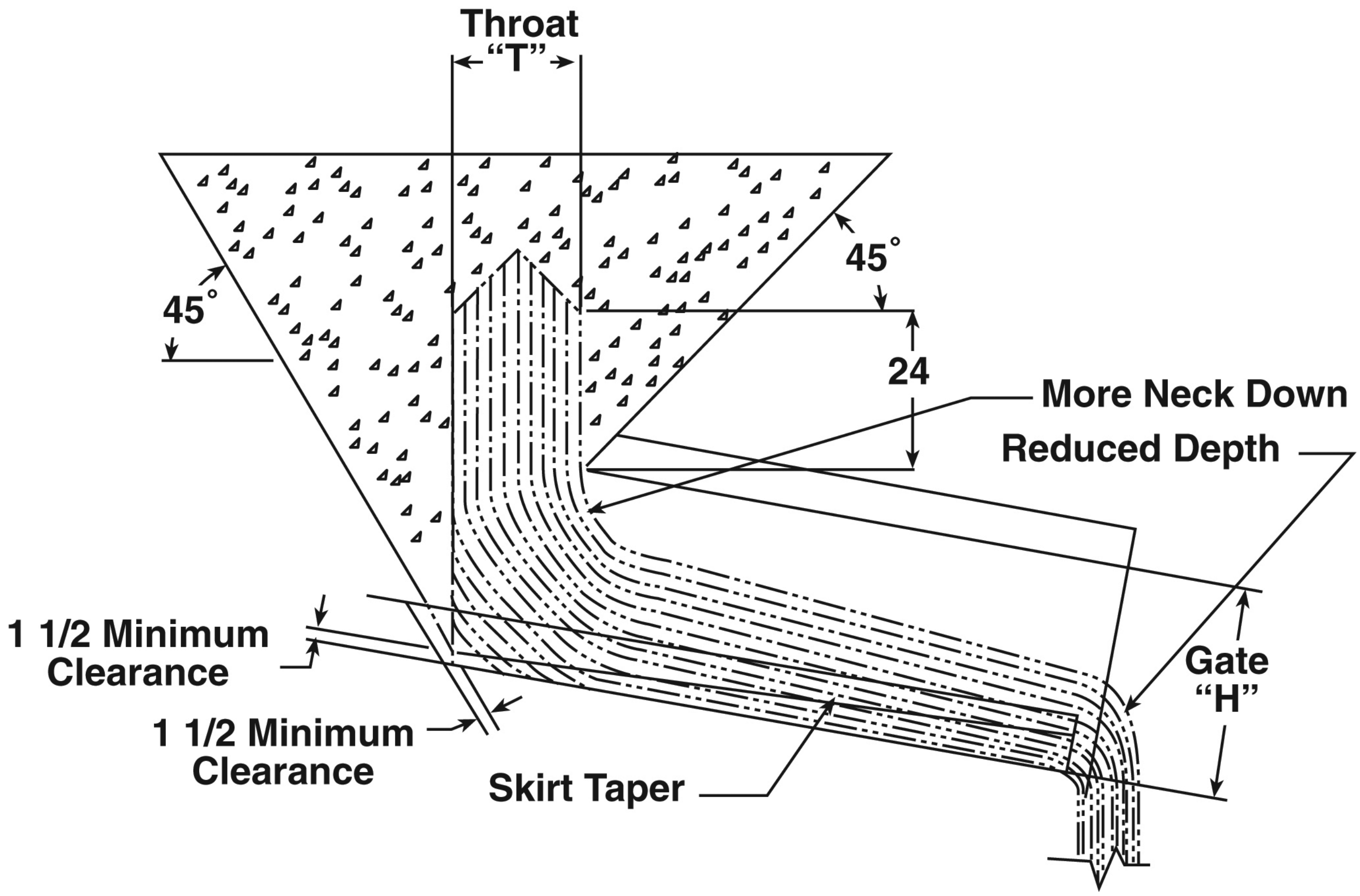


Flat Front and Rear Wall Design:

- Non-uniform Flow Pattern
- Reduced Capacity > 20%
- Reduced Material Velocity > 15%
- Increased Feeder Size
- Potential for material build-up at inlet
- Potential for spillage at back and sides
- Increased material load, possible collapsed suspension coil springs
- Reduced depth at discharge > 10%

For T = H and T > H, all conditions will be compounded.

Flat Front Wall
T = 0.6 x H

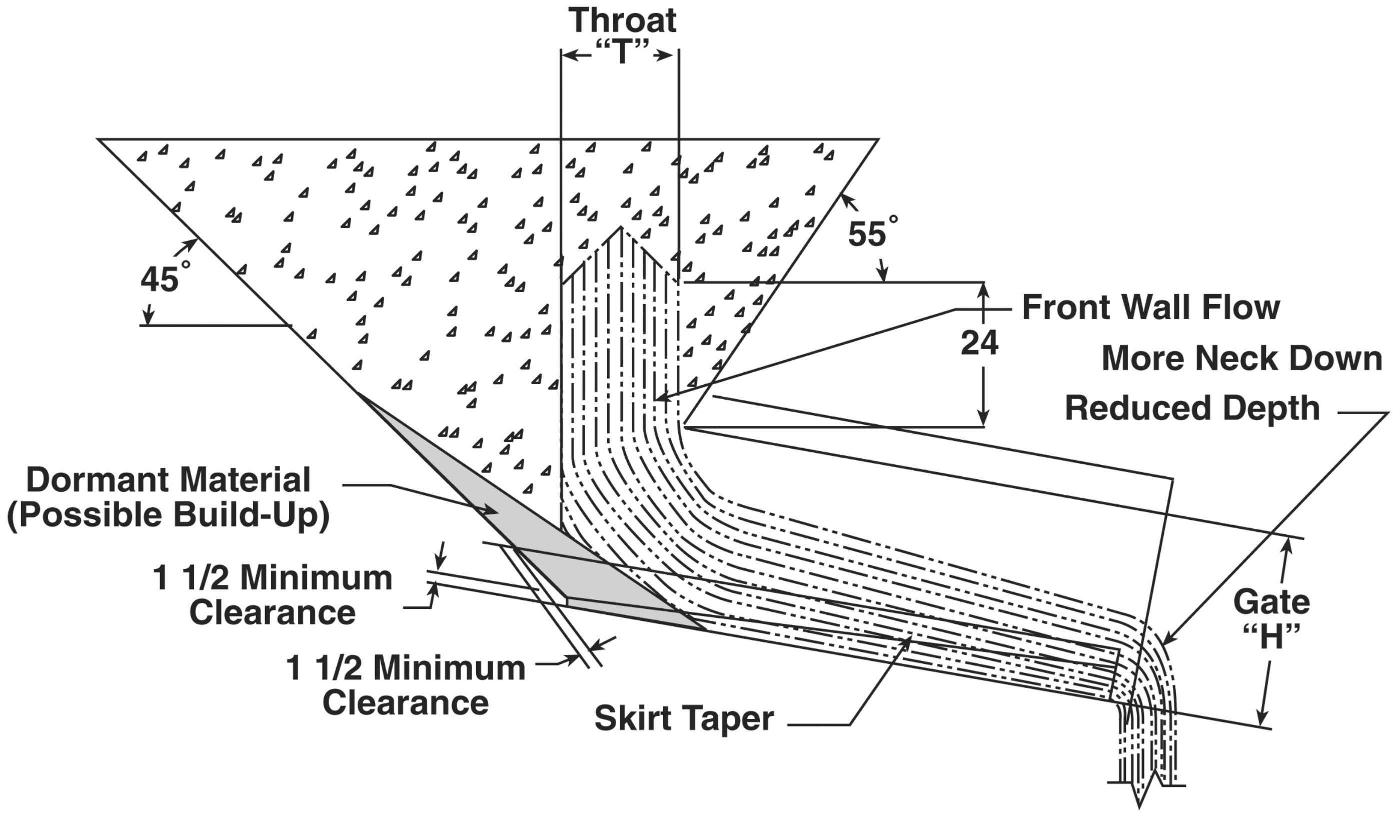


Flat Front Wall Design:

- Non-uniform Flow Pattern
- Reduced Capacity > 20%
- Reduced Material Velocity > 15%
- Increased Feeder Size
- Potential for material build-up at inlet
- Potential for spillage at back and sides
- Increased material load, possible collapsed suspension coil springs
- Reduced depth at discharge > 10%

For T = H and T > H, all conditions will be compounded.

Flat Rear Wall
T = 0.6 x H

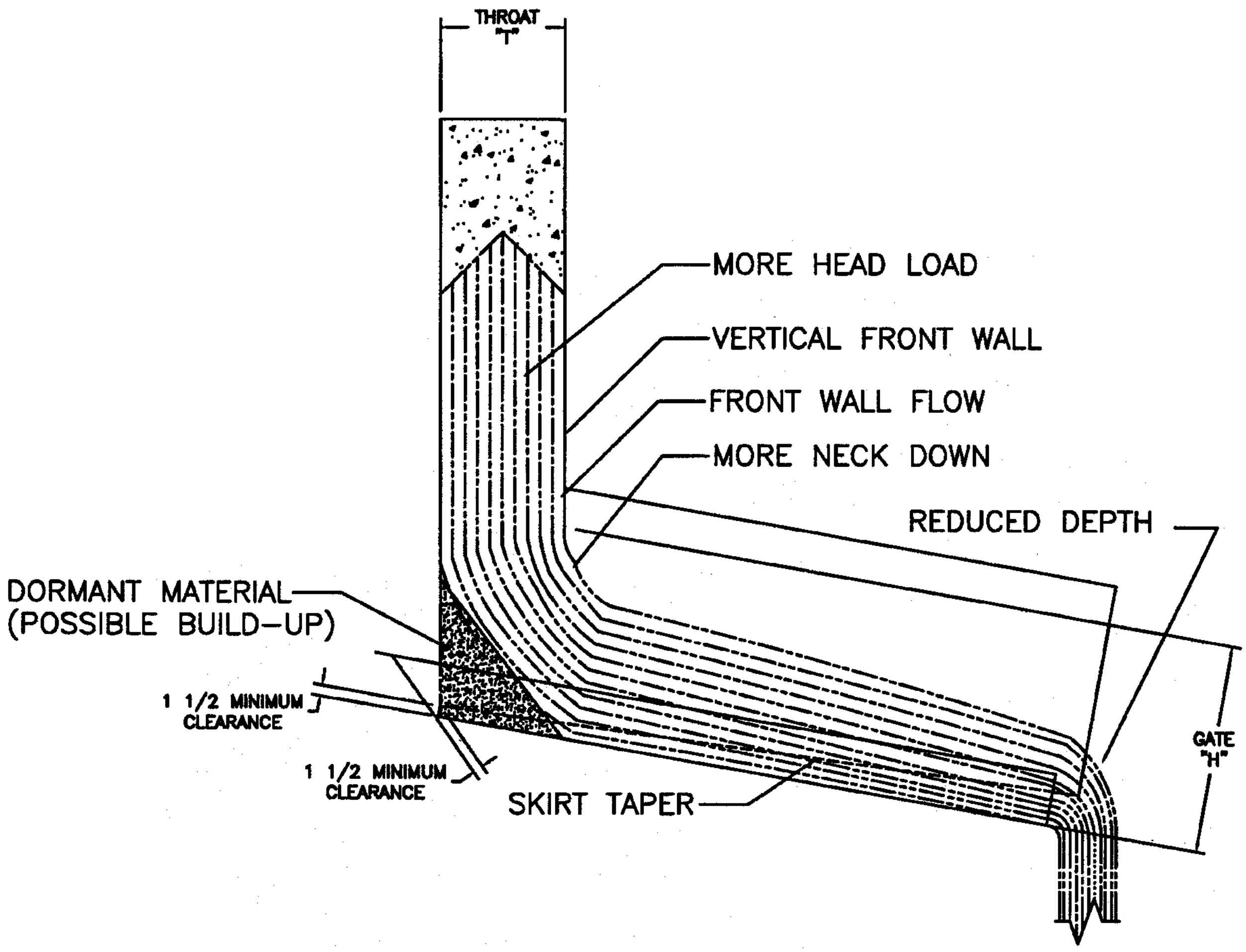


Flat Rear Wall Design:

- Non-uniform Flow Pattern
- Reduced Capacity > 20%
- Reduced Material Velocity > 15%
- Increased Feeder Size
- Potential for material build-up at inlet
- Potential for spillage at back and sides
- Increased material load, possible collapsed suspension coil springs
- Reduced depth at discharge > 10%

For T = H and T > H, all conditions will be compounded.

Vertical Front and Rear Wall
T = 0.6 x H

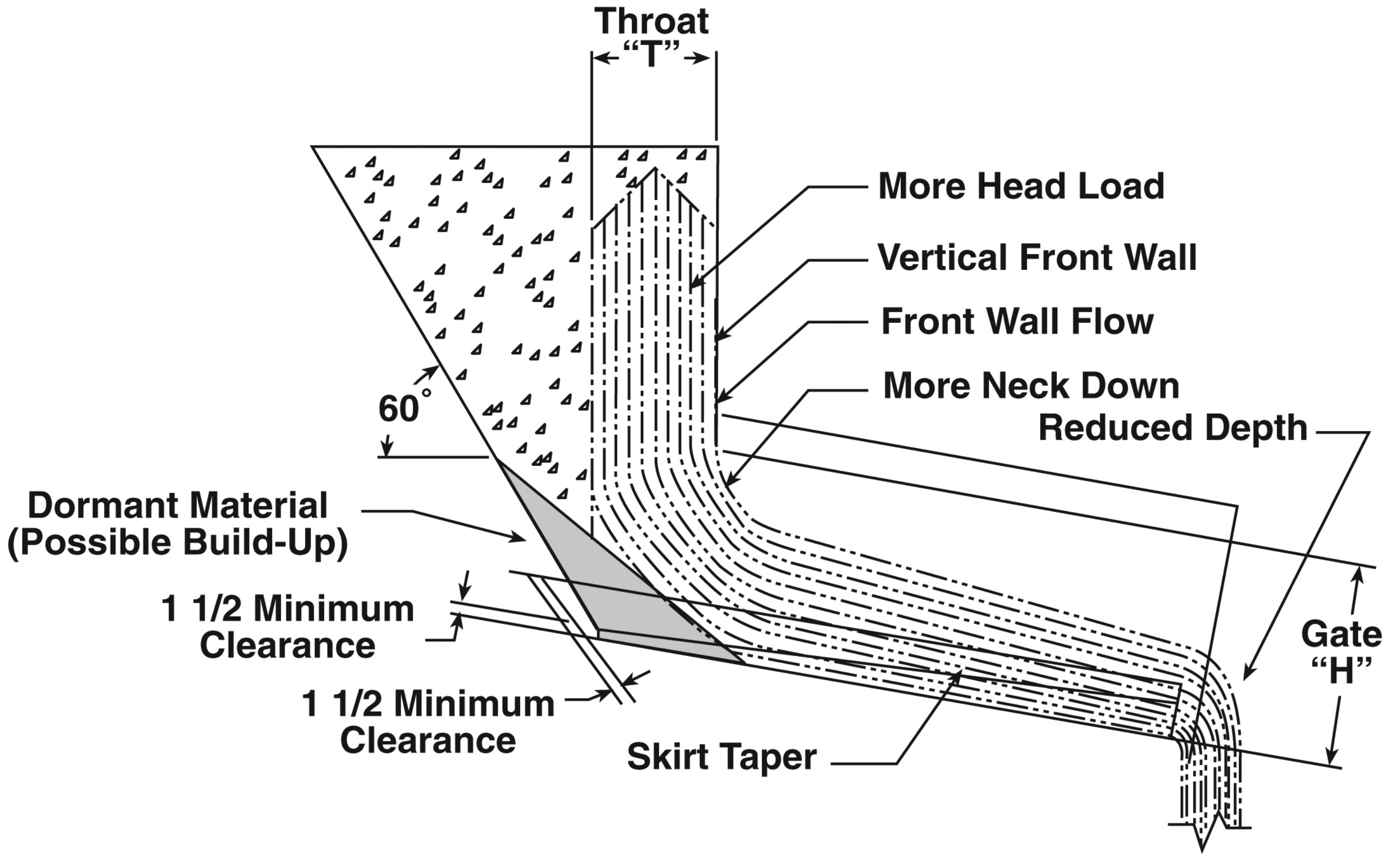


Vertical Front & Rear Wall Design:

- Non-uniform Flow Pattern
- Reduced Capacity > 20%
- Reduced Material Velocity > 15%
- Increased Feeder Size
- Potential for material build-up at inlet
- Potential for spillage at back and sides
- Increased material load, possible collapsed suspension coil springs
- Reduced depth at discharge > 10%

For T = H and T > H, all conditions will be compounded.

Vertical Front Wall
T = 0.6 x H

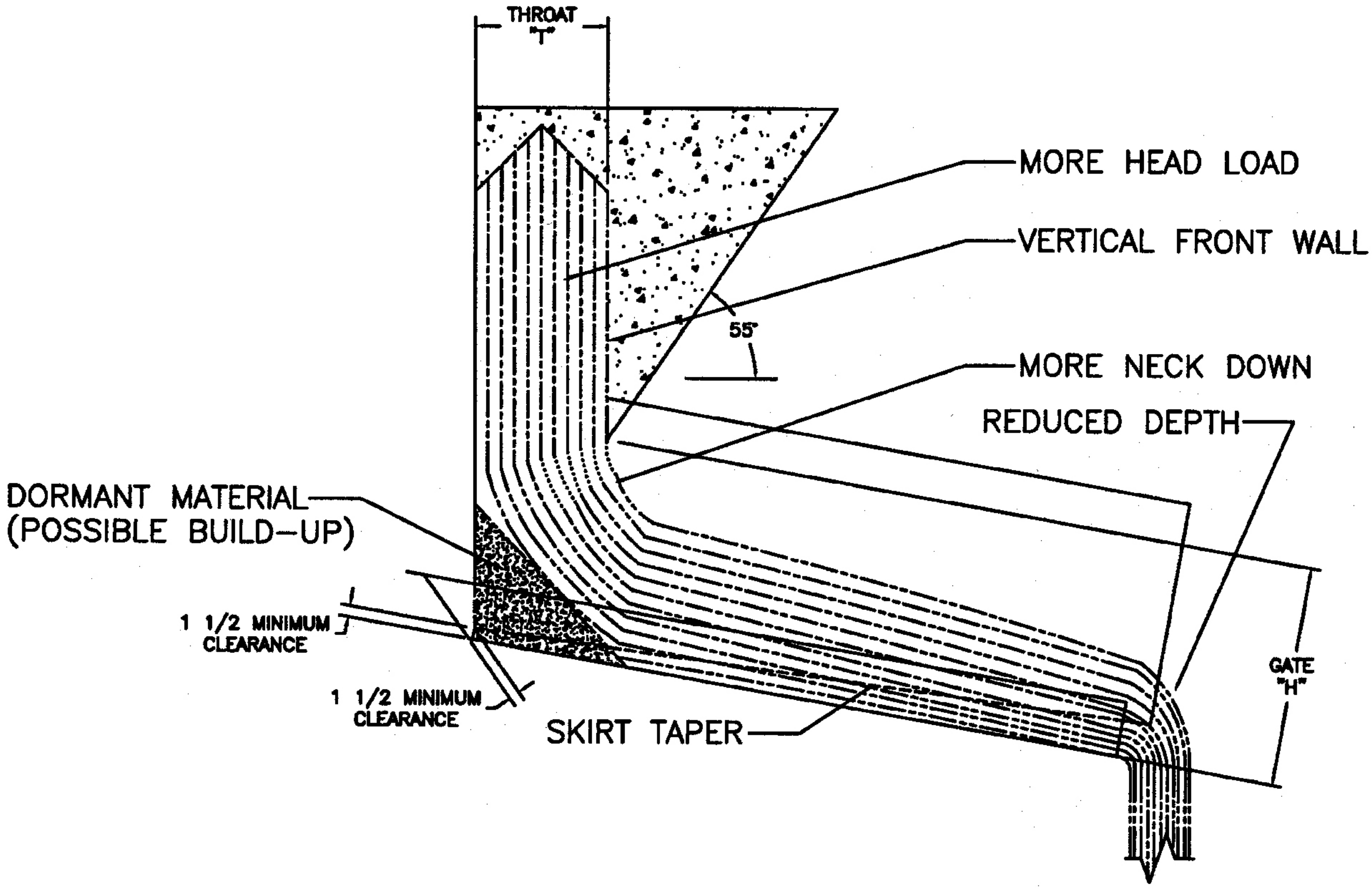


Vertical Front Wall Design:

- Non-uniform Flow Pattern
- Reduced Capacity > 20%
- Reduced Material Velocity > 15%
- Increased Feeder Size
- Potential for material build-up at inlet
- Potential for spillage at back and sides
- Increased material load, possible collapsed suspension coil springs
- Reduced depth at discharge > 10%

For T = H and T > H, all conditions will be compounded.

Vertical Rear Wall
T = 0.6 x H

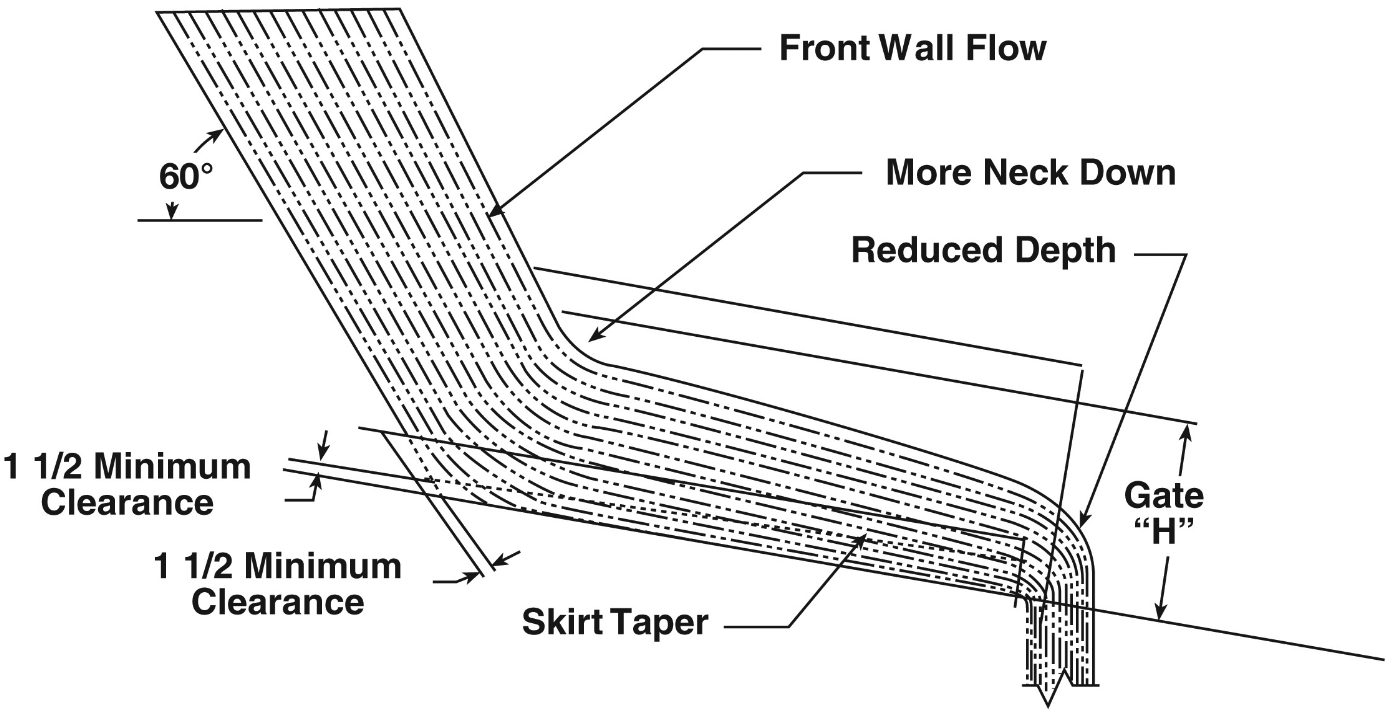


Vertical Rear Wall Design:

- Non-uniform Flow Pattern
- Reduced Capacity > 20%
- Reduced Material Velocity > 15%
- Increased Feeder Size
- Potential for material build-up at inlet
- Potential for spillage at back and sides
- Increased material load, possible collapsed suspension coil springs
- Reduced depth at discharge > 10%

For T = H and T > H, all conditions will be compounded.

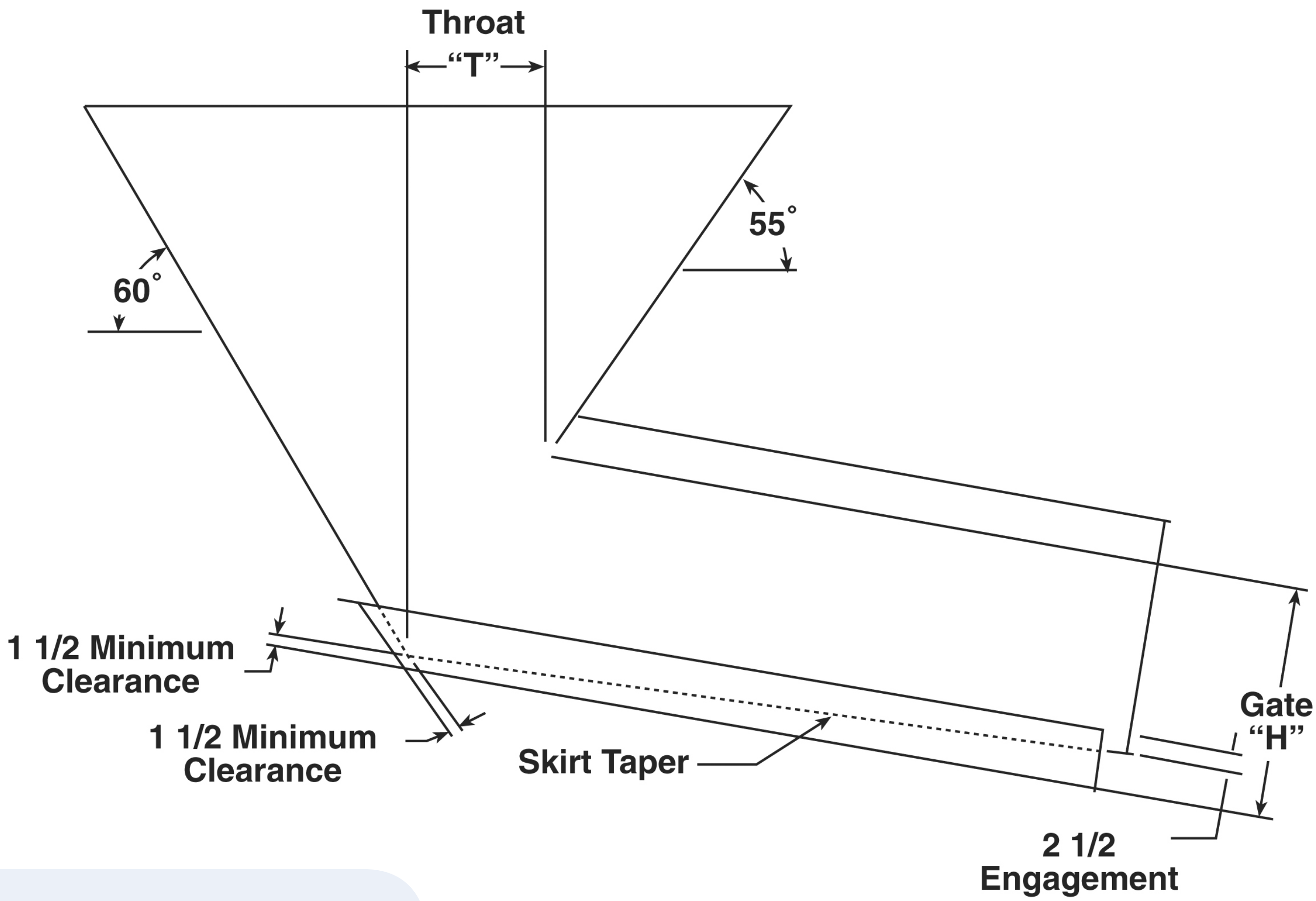
Reverse Front Wall (Chute)



Reverse Front Wall Design:

- Non-uniform Flow Pattern
- Reduced Capacity > 20%
- Reduced Material Velocity > 15%
- Increased Feeder Size
- Potential for material build-up at inlet
- Potential for spillage at back and sides
- Potential for flushing
- Reduced depth at discharge > 10%

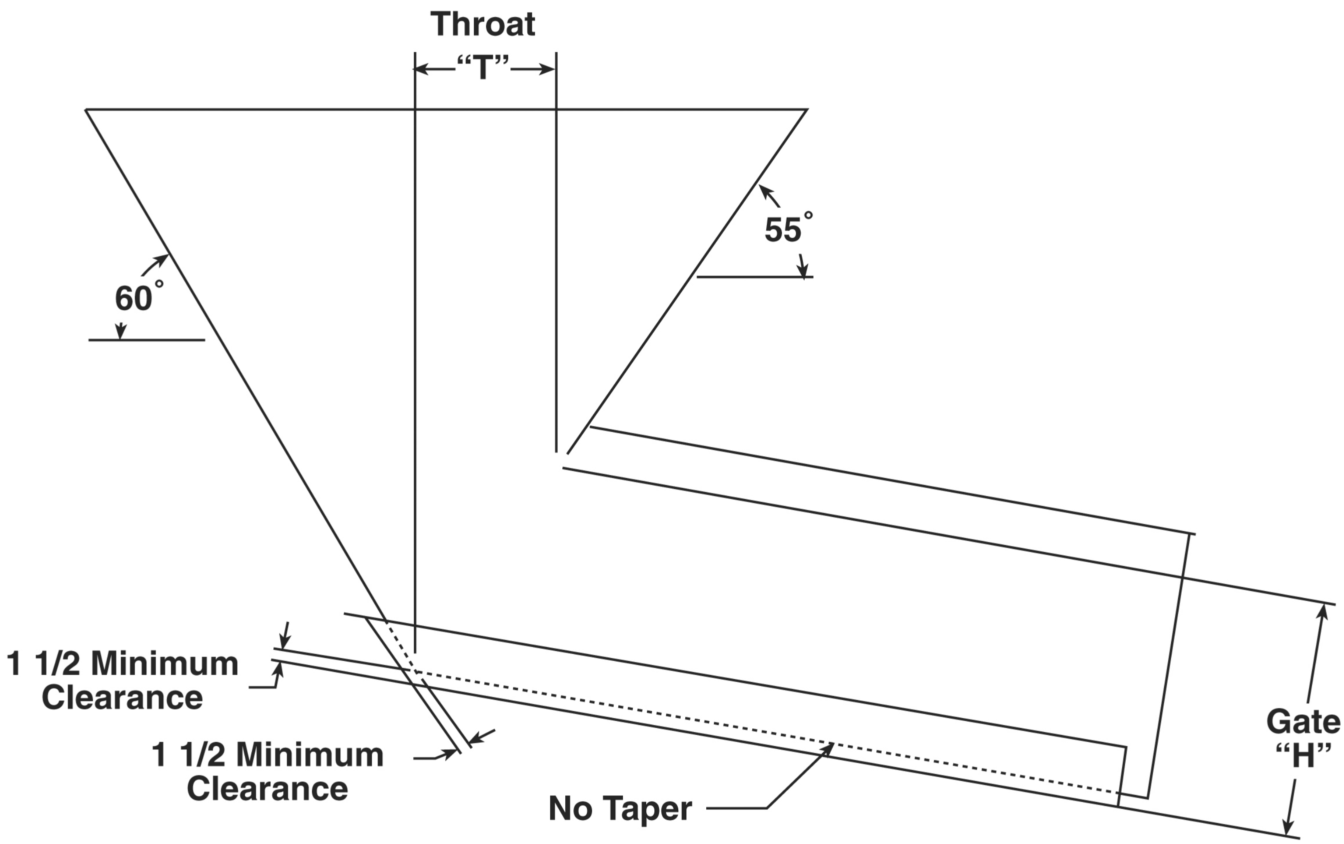
Ideal Hopper
Correct Taper on Skirts
T = 0.6 x H



Correct Taper of Skirts:

- Reduced potential for spillage
- Reduced potential for build-up

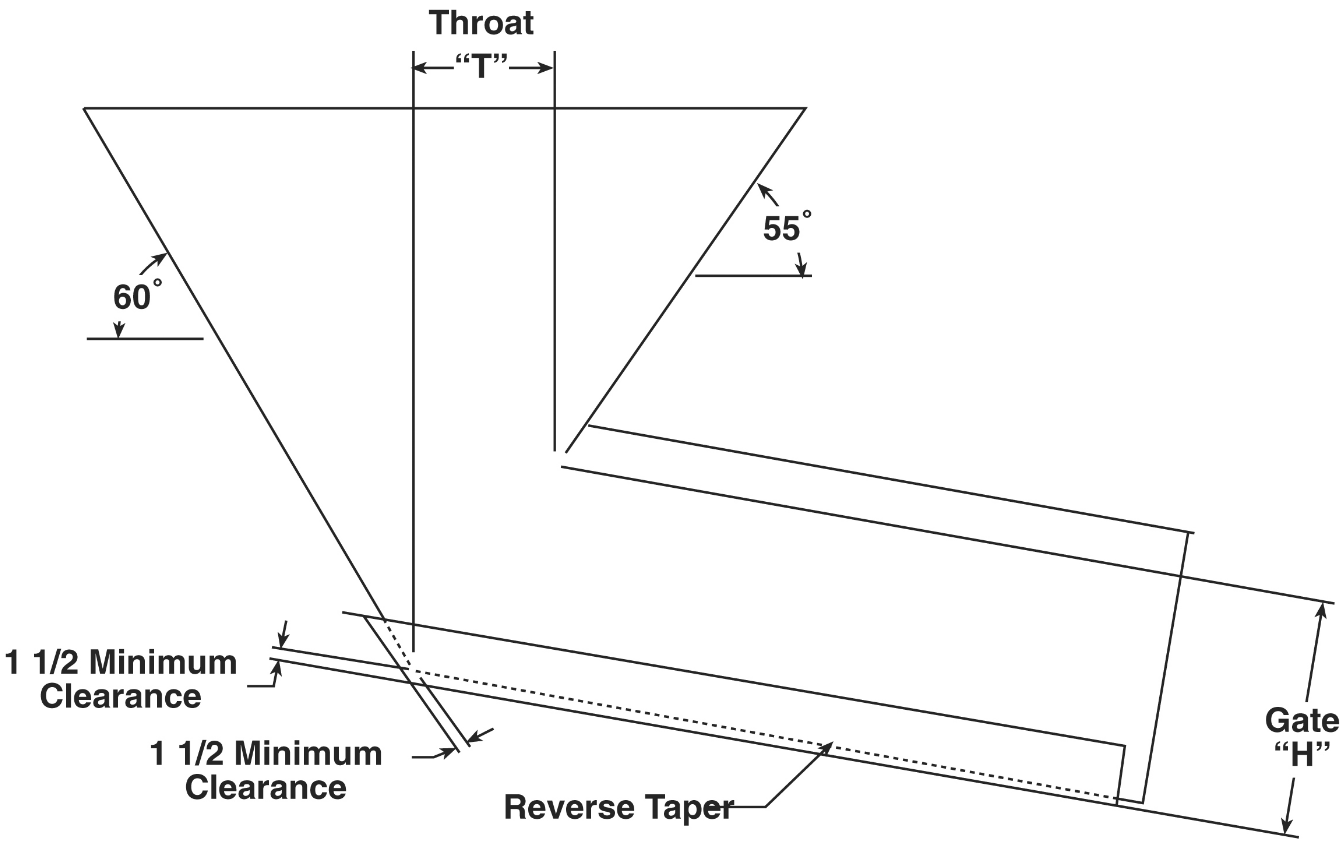
Ideal Hopper
No Taper on Skirts
T = 0.6 x H



No Taper with Skirts:

- Increased potential for spillage at sides
- Increased potential for build-up at back
- Increased potential for material jamming under skirts
- Increased potential for higher amperage draw

Ideal Hopper
Reverse Taper on Skirts
T = 0.6 x H

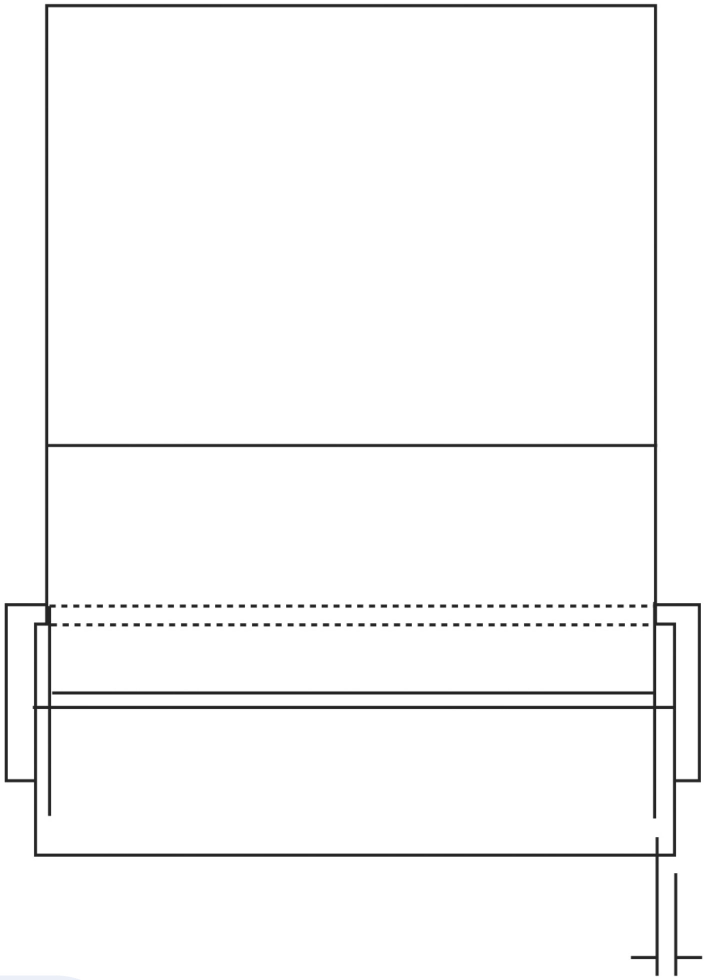


Reverse Taper on Skirts:

- Increased potential for spillage at sides
- Increased potential for build-up at back
- Increased potential for material jamming under skirts
- Increased potential for higher amperage draw

Less clearance at discharge as compared to inlet.

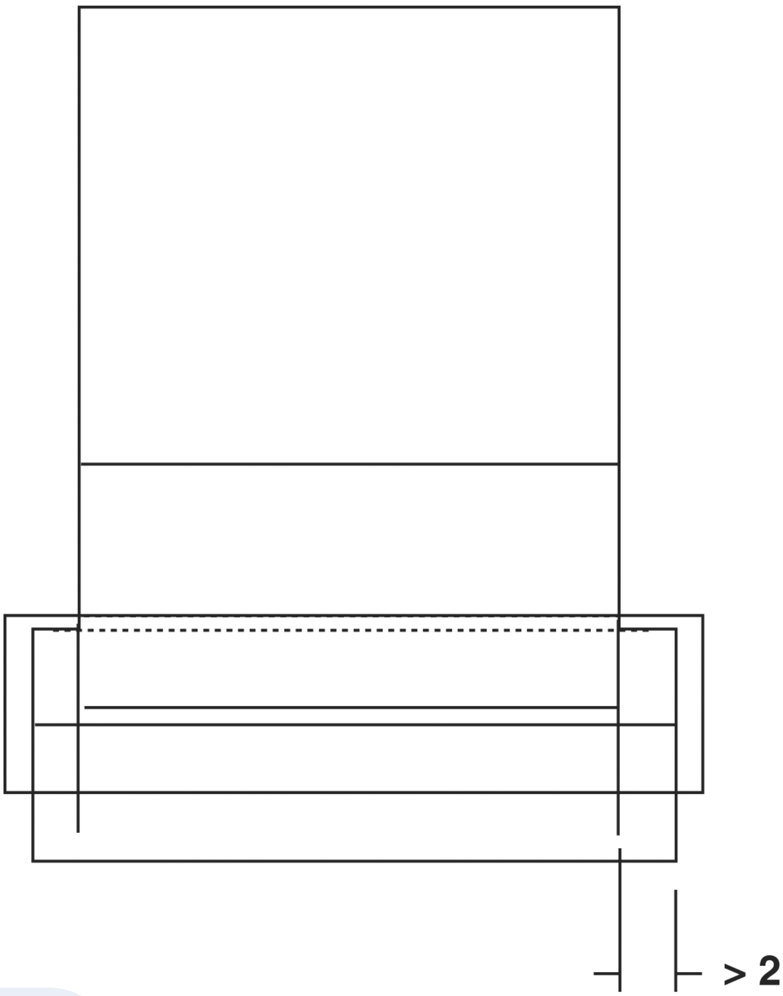
Ideal Skirt Clearance



Ideal Skirt Clearance:

- Reduced potential for spillage at sides
- Reduced potential for build-up

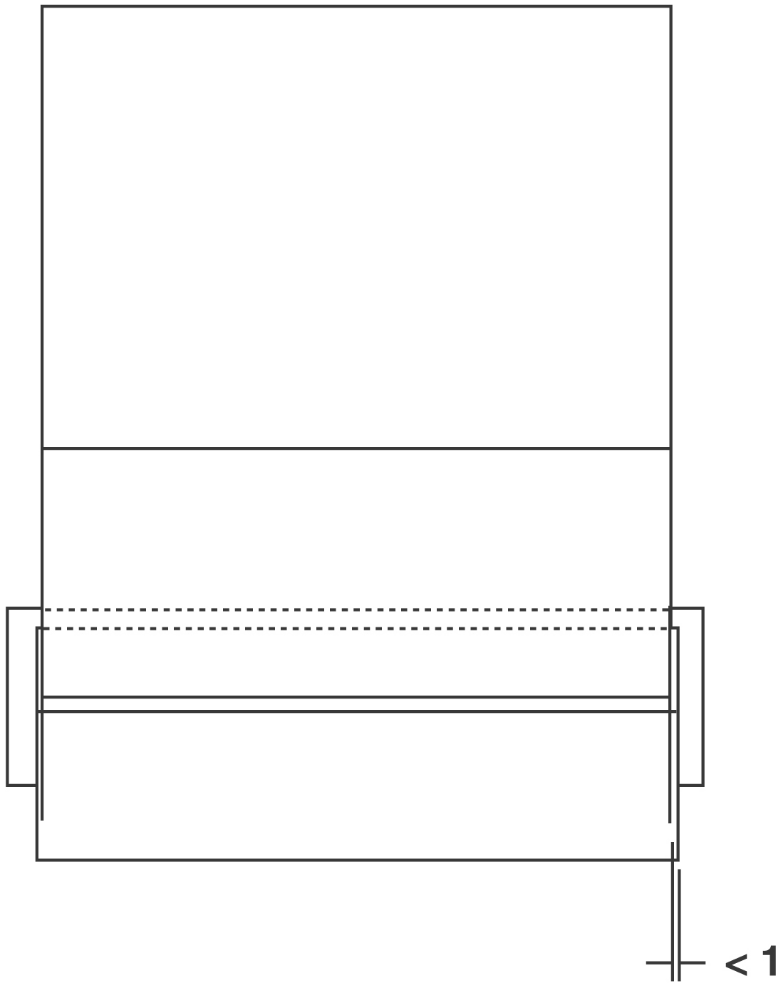
Skirt Clearance Too Wide



Skirt Clearance Too Wide:

- Decreased Capacity

Skirt Clearance Too Narrow

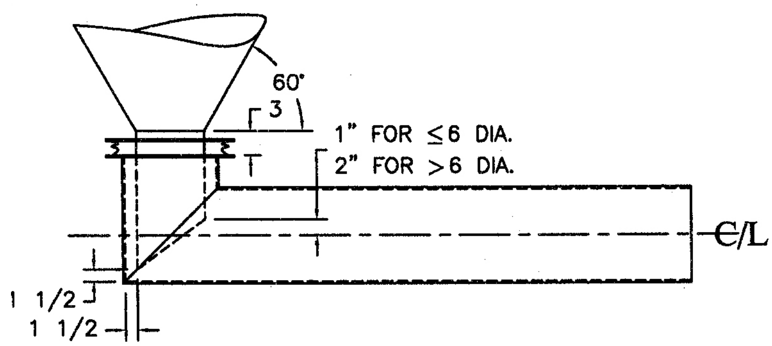


Skirt Clearance Too Narrow:

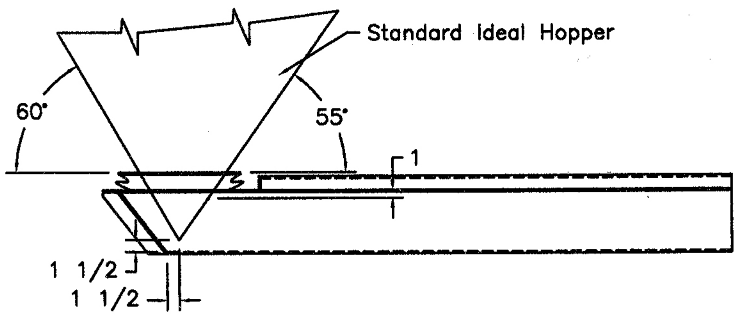
- Increased potential for feeder contacting structure
- Increased potential for material jamming
- Increased potential for higher amperage draw

Tubular and Covered Troughs

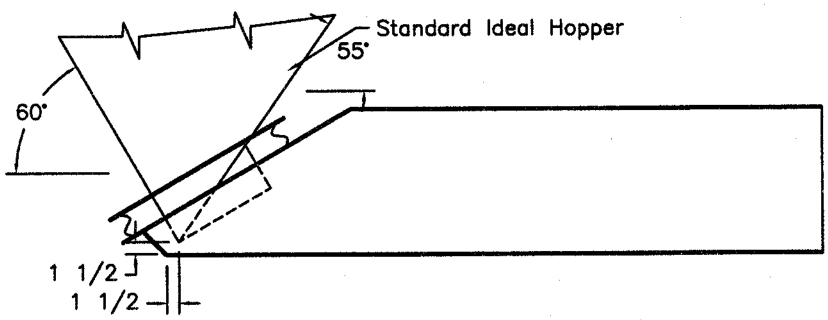
Tubular



Covered Full Back

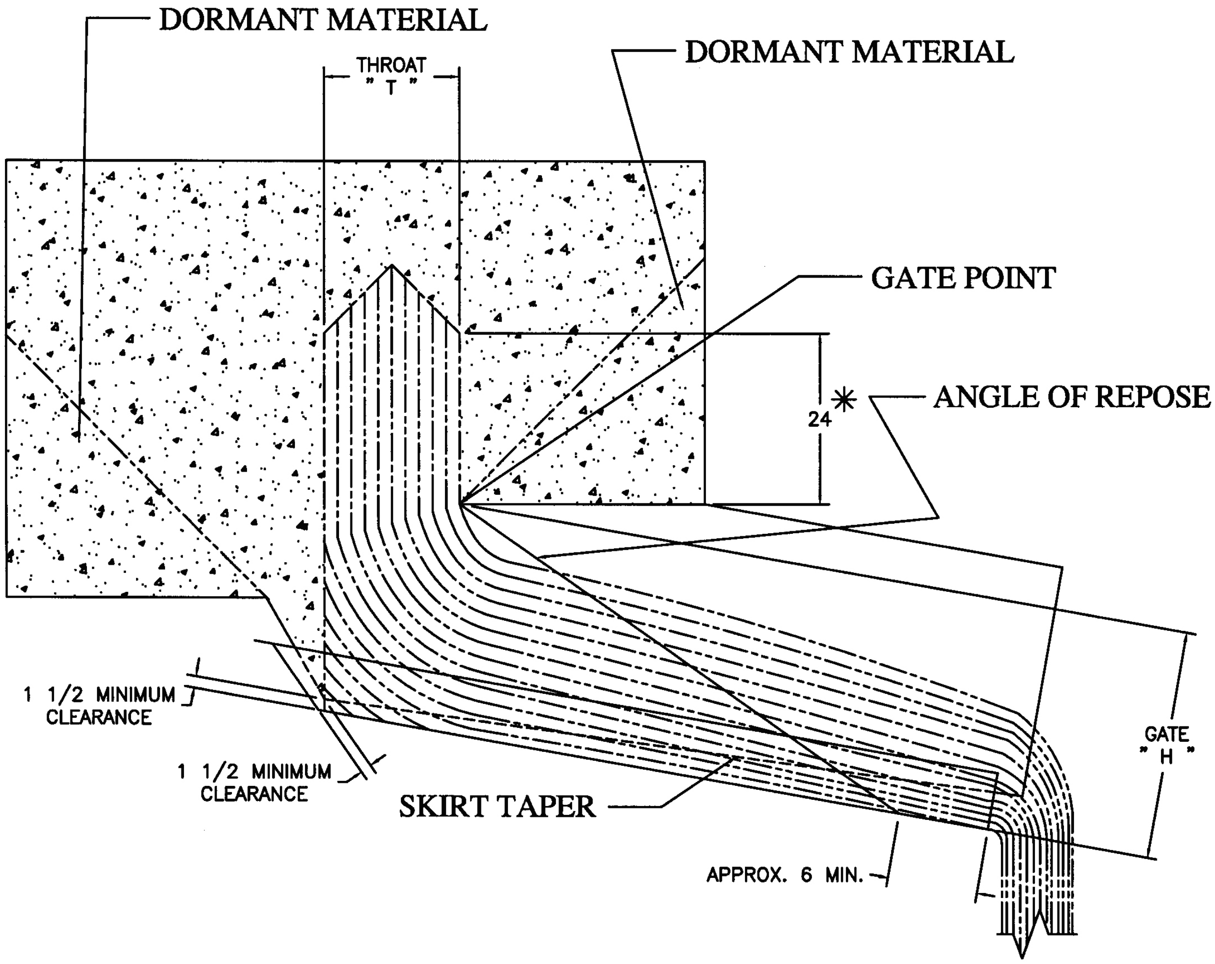


Covered Half Back



Connections such as dust seals between the trough and adjacent objects must be flexible, preferably of cloth or rubber construction.
Note: Connections are optional and furnished by the customer.

Acceptable Rock Box
T = 0.6 x H



Although this illustration is as close to ideal as possible, a rock box can cause non-uniform flow patterns due to material forming the front and rear hopper walls of equal angle. Material flowing over material is much different than material flowing directly on steel hopper walls. When using a rock box, the following results may be expected:

- Reduced Capacity ~ 15%
- Reduced Velocity ~ 10%
- Increased Feeder Size
- Potential for material build-up at inlet
- Potential for spillage at back and sides
- Increased material load

All other problems associated with less than ideal hopper design will be increased when rock boxes are utilized in ways other than that shown on this page.

* Active material area required to achieve ideal uniform flow patterns. If less, flow pattern will not be uniform and there will be the potential for excess material loads and reduced capacity.

Syntron Material Handling

2730 Hwy 145 South
Saltillo, MS 38866
Toll Free: 1.800.356.4898
P: 662.869.5711
F: 662.869.7405
info@syntronmh.com

Heavy Duty Electromagnetic and Electromechanical Feeder Data Sheet

Quantity of Feeders:	Name or description of material to be handled:

Weight (lbs.) per Cubic Foot _____ PCF	Size of Material (Sieve Analysis)	Material Width Max: _____	Material Length Max: _____	Material Thickness _____	Temperature of Material _____ F deg. Max Temperature of Surroundings _____ F deg. Max

Moisture Content: _____ %	Angle of Repose _____ deg.	Minimum feed rate (in tons per hour) ______TPH	Maximum feed rate (in tons per hour) _____ TPH

Trough Type: (Sketch if other than flat open pan) ☐ Flat Open Pan ☐ Covered ☐ Tubular ☐ Down Spout ☐ Belt Loader ☐ Diag. Disc	Dimensions Requested ____ " Wide X ____ " Long X ____ " High ☐ None Requested (Provide most economical)

Trough Liners: ☐ T1-A ☐ 304SS ☐ UHMW ☐ Other_____	Trough Slope: ______ deg. down ______ deg. up.	Type of Mounting: ☐ Base ☐ Suspension	Drive Position: ☐ Under trough in rear ☐ Over trough in front

Controller Enclosure: ☐ Standard (NEMA+) ☐ D.C. Input ☐ Load Monitoring ☐ Proportional ☐ Remote Pot If there are any additional controller requirements please describe:	AC (Municipal) Power: ____ Voltage ____ Cycle ____ Hz

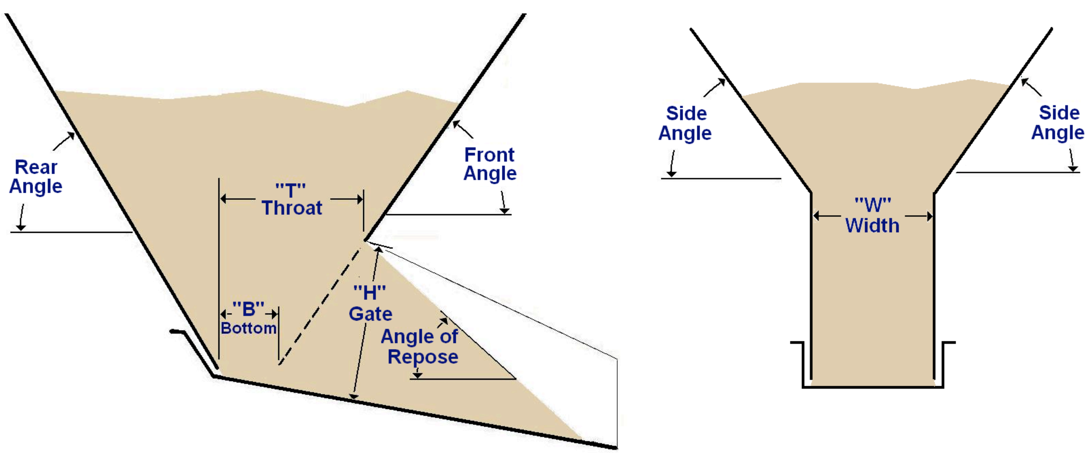
Method of supplying material to Syntron Feeder trough:

Feeder discharges into:

If an existing hopper, provide dimensions and wall slope. Provide additional sketch if necessary.

Hopper Transition:

"T" = _____
"H" = _____
"B" = _____
Rear Angle = _____
Front Angle = _____
"W" = _____
Side Angle = _____

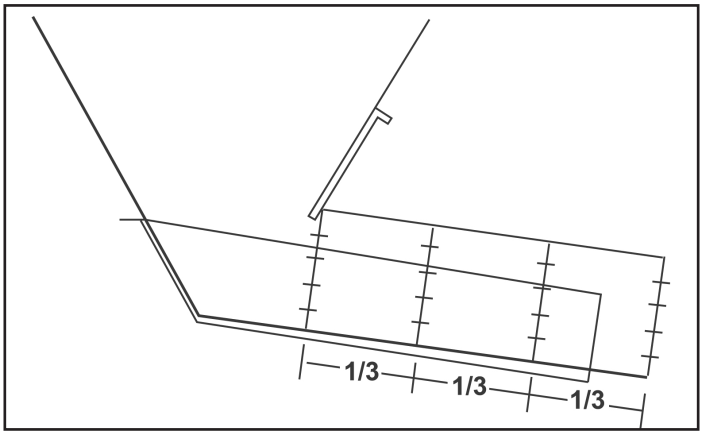


If there are any unusual operating conditions requiring special construction, please give details.

Customer Type: ☐ User ☐ OEM ☐ Resale Company Name:	Contact: Address: City, State, Zip:	Email: Phone: Fax:

10204 05/01/14

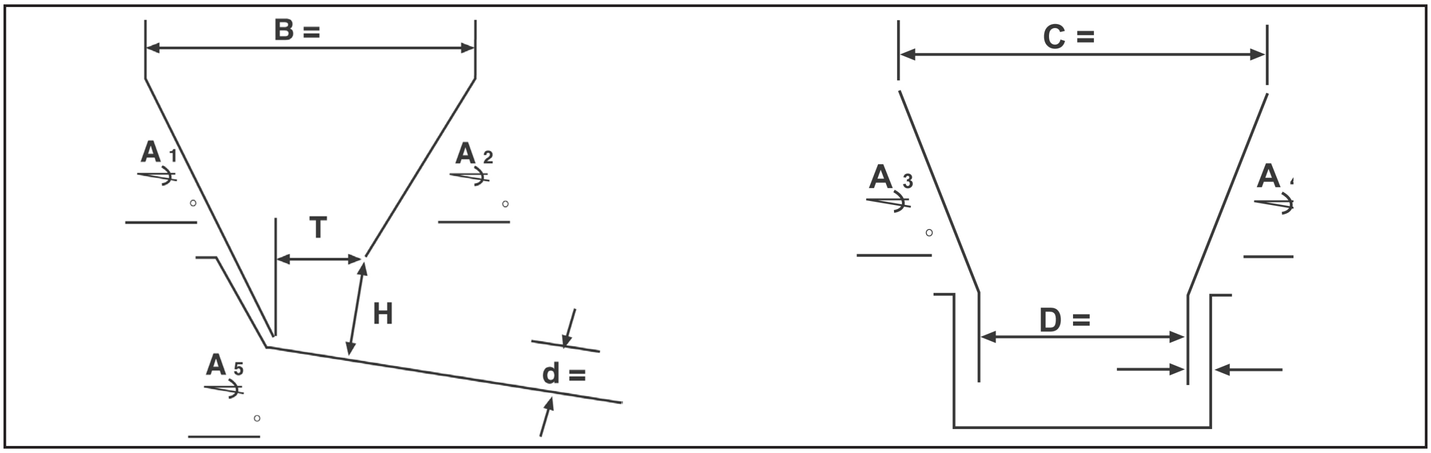
Inspection Sheet for Hoppers



Check clearance between skirtboard and pan.

Rear = ___________ Front = ___________

Sketch material profile from gate to discharge.



Trough	Length =	_________	Width =	_________
Hopper Wall Angles	A1 =	_________	A2 =	_________
	A3 =	_________	A4 =	_________
Feeder Downslope	A5 =	_________		
Hopper Dimensions	B =	_________	C =	_________
Skirtboard Width	D =	_________		
Feeder Clearance	E =	_________		
Throat Opening	T =	_________		
Gate Height	H =	_________		
Material Bed Depth	d =	_________		

1. H must be at least 2 x the largest particle.
2. T should be 0.6 H, or at worst, 1:1.
3. H should be 1.2 to 1.5 x d.

$$d = \frac{\text{capacity (tph)} \times 4800}{\text{width} \times \text{ft/min} \times \text{density}}$$

$$\text{Capacity} = \frac{\text{width} \times \text{flow} \times \text{density} \times d}{4800}$$

Syntron Material Handling

Corporate Office
P.O. Box 1370
Tupelo, Mississippi 38802
Phone: 662.869.5711
Fax: 662.869.7449

Proven Engineered Products – Complete Material Handling Solutions

Syntron®
Link-Belt®

Saltillo
2730 Hwy 145 South
Saltillo, Mississippi 38866
Phone: 662.869.5711
Fax: 662.869.7493
Toll Free: 800.356.4898
info@syntronmh.com

Changshu
#2 Road No. 1
Changshu Export Processing Zone
Changshu, Jiangsu, China 215513
Phone: +86 0512.52299002
Fax: +86 0512.52297228
info@syntronmh.com

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