

MIDDLE EAST EAST AFRICA IAOM DECEMBER 9, 2007

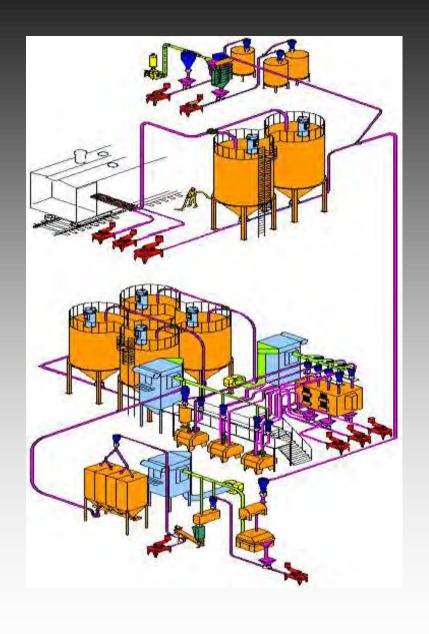


PRESENTED BY: BOB KICE KICE INDUSTRIES, INC WICHITA, KS

USA

What Air Can Do For You

- Move product Conveying systems, both positive and negative
- Clean/classify Product Aspiration
- Clean Atmospheres Dust control
- Cool (or heat) product
- Provide suction on equipment (flaking rolls, hammermills, scales, elevator legs, etc.)
- Make environments more comfortable for people more efficient for equipment
- Make environments fatal for insects





- Air Pumps
- Fans
- Cyclones
- Filters
- Airlock Valves
- Multi-Aspirators
- Pneumatic
 Conveying



FERTILITER

THINGS WE CONVEY WITH AIR

Effects of Uncontrolled Air



Pneumatic Conveying

Controlled movement of product, from point "A" to point "B" using the medium of air – either by pressure, (blowing) or vacuum, (sucking).

TYPES OF PNEUMATIC CONVEYING

- Dilute phase conveying
- Dense phase conveying
- Fluid bed conveying
- Central vacuum sweeper systems

What should NOT be pneumatically conveyed

- Things too wet
- Things too sticky
- Things too fragile

Everything should be considered on its own merits

Common Design Velocities

- Settling Velocity in Bag House Filter "can velocity" – less than 250 fpm
- Air Stabilization 500-1500 fpm
- Dust Control 3500-4000 fpm
- Pneumatic Conveying 4000-5000 fpm
- Pheumatic Conveying of steel shot or sand 5000+ fpm

CFM (Air Volume)

Velocity (ft/min)= $4005\sqrt{Pv}$ (Pv = velocity pressure) Area of Circle= $3.14 \times r^2$

Volume (CFM)=Velocity (ft/min) × Area (ft²)

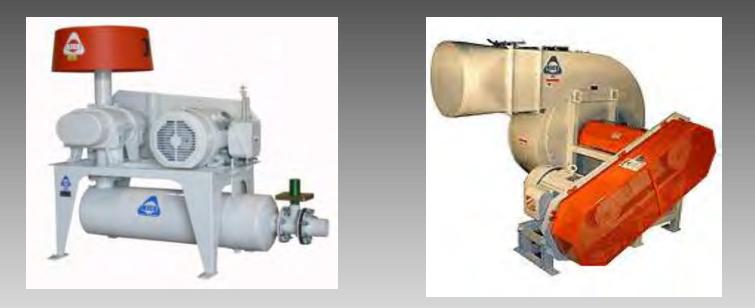
What Causes a Choke (Airflow Stops)

- Air is leaking out somewhere
- Adding too much product
- Too much distance
- The tubing diam. is too small
- Too many "obstructions" like ells, diverters
- A combination of all of these.

Conveying System Components

- Motivator
- Air Seal
- Receivers
- Tubing System

Motivator



- Positive displacement air pump NORMALLY used for pressure systems
- Centrifugal Fans NORMALLY used for vacuum systems

 Compressors – NORMALLY used for dense phase conveying and specialty systems which we will avoid today.

Fan advantages

- Provides dust control
- Simple no gears
- Simple no lubrication
- Can "digest" dust
- Typically lower cost
- Normally provide a "large" volume of air at a relatively "low" static pressure.
- Provide dust control on the machine you are conveying from
- Can provide some cooling or drying "enroute".

Fan Disadvantages

- Fans "give-up" when you need them the most.
- Are limited on their ability to run at "high" static differentials – vac. or press.

Characteristics of Pumps

- Make significant noise without silencers
- More expensive than centrifugal fans
- Considered low volume and high pressure
- Require lubrication good quality and levels of oil
- Can be used for either pressure conveying systems or vacuum conveying systems.

Characteristics of Pumps

- These pumps do not "give-up". If you block the discharge, (add resistance), they do not quit but will beat their brains out trying to overcome the resistance. These are "work horses."
- Typically used on line sizes of 2" OD to 8" OD, or 100 CFM to 1600 CFM.
- Generate heat approx. 12 degrees for every 1 PSIG of pressure.





Device to prevent air from entering the system "uncontrolled"

Injector valve used on the inlet(s) of pressure conveying systems (can be more than one)

Discharge valve on vacuum systems.

Diverter and Bin Fill Valves





- Cyclones are simple, 98+% efficient depending on product and design, and economical with low pressure drop.
- Bag house filters are 99.999% efficient, require maintenance, require additional HP, and more money. Don't make life easier, but

many times are required by code.

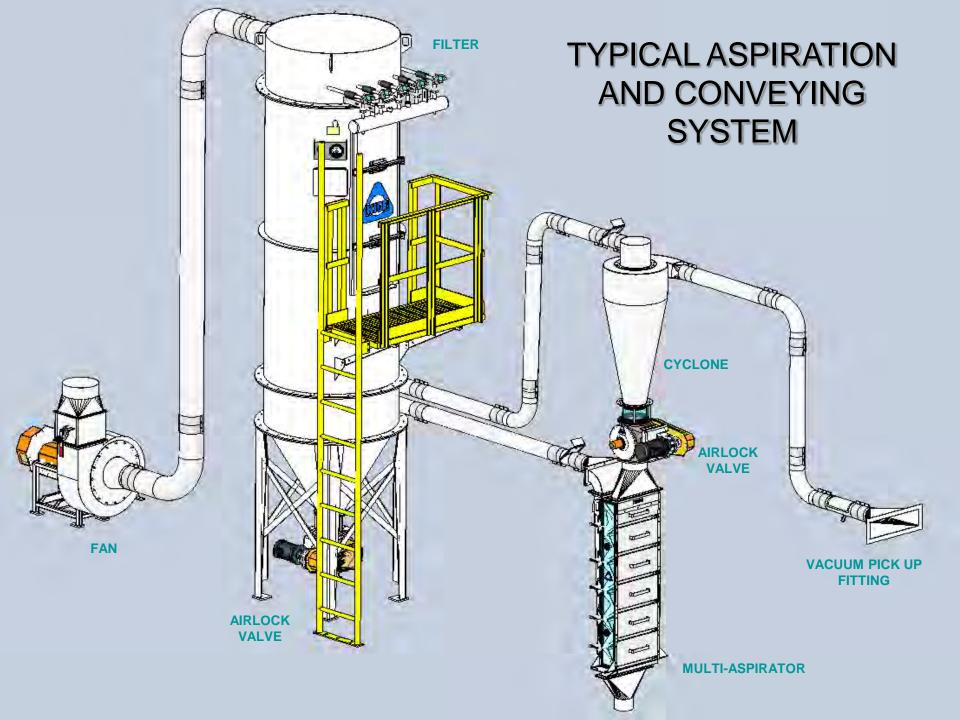
Tubing System

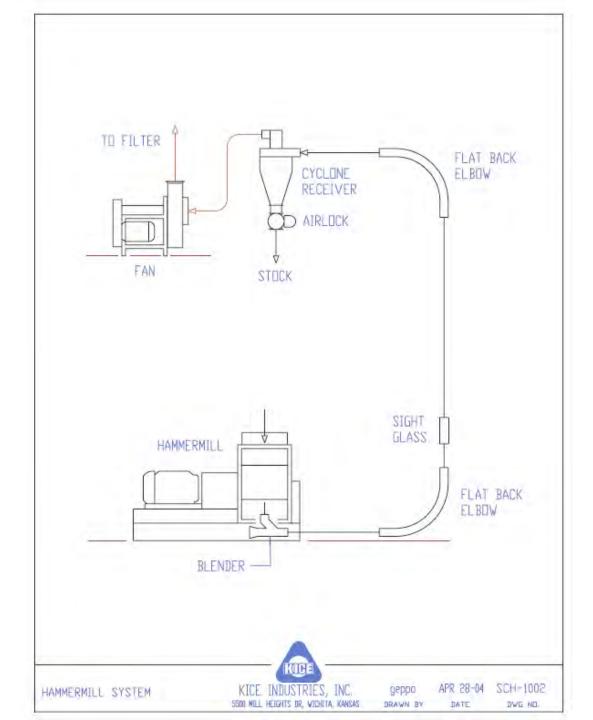


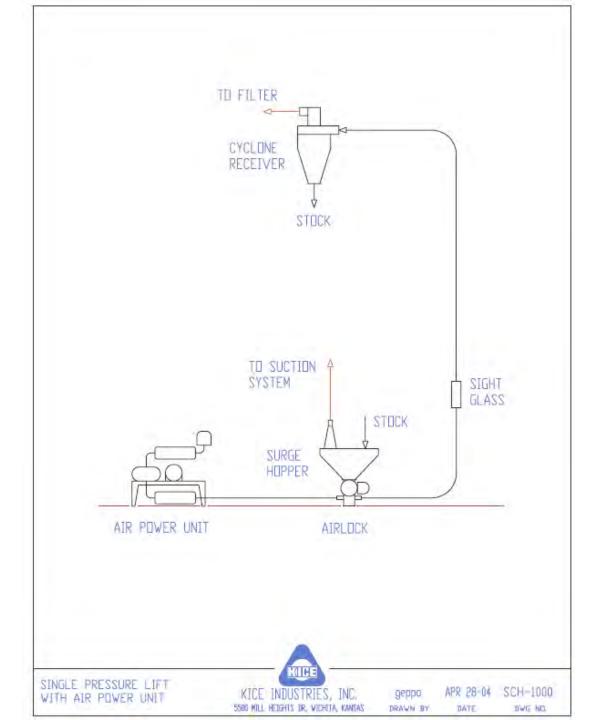
- Tubing size/diameter determined by the air volume since a "typical" velocity is constant.
- Ells size same as tubing, radius determined by product. Normally 36" radius.
- Couplings Sized by tubing. Bolt together or compression couplings.
- Sight glass Ass'y Difficult to monitor a system and control performance without observing.

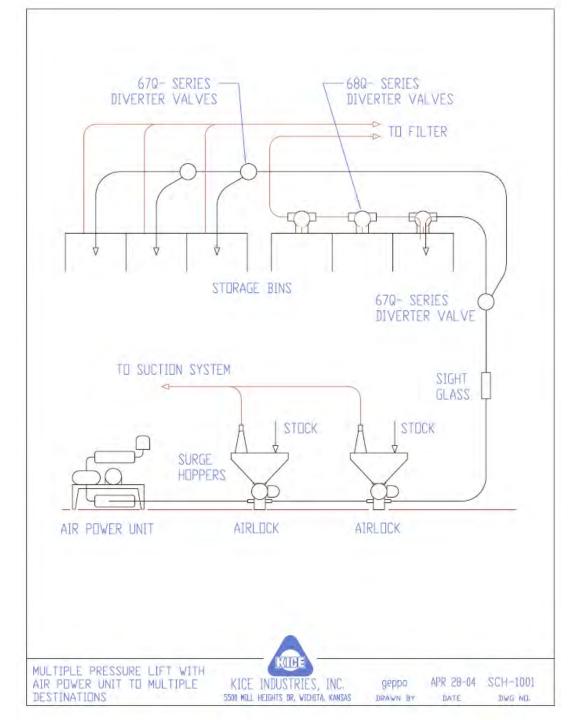
Typical Conveying Systems

- Vacuum
- Pressure
- Multiple pick up points
- Multiple discharge points
- Combination pressure and vacuum









Pneumatic Conveying "Rules of Thumb"

- <u>Normally</u> pressure systems will operate in a range of 3-12 PSIG – positive displacement air pumps.
- 2. <u>Normally</u> vacuum systems will operate in a range of 16" 36" w.c.
- 3. A P.D. pump has a LOT more potential for conveying than does a centrifugal fan it works at a lot higher pressure differential.
- 4. Convey either vert or horiz but NOT on an angle
- 5. Try to keep ells, off-sets, diverters, and other "resistances" to a minimum.

Pneumatic Conveying "Rules of Thumb"

- 6. Use conveying velocities of 4000 to 4500 FPM for MOST commodities.
- 7. Use 36" center line radius ells for conveying vacuum or pressure.
- 8. Convey by pressure normally is more efficient lbs of product vs lbs of air. (HP)
- 9. Don't run an airlock faster than 35 RPM
- 10. Don't design pressure systems to operate higher than 10 PSIG
- 11. Normally you don't effect the temp or moisture of product by conveying in a single pneumatic system.

PNEUMATIC SYSTEM ESTIMATES - NEGATIVE PRESSURE (SUCTION)

EXPLANATION: Figures below are typical for average flour handling conditions. In addition to specified data figures are based on 3 - 90° turns (long radius type, i.e. L radius = tube diameter x 6 or greater). Figures also include allowance for filter and/or cyclone separators totaling 6° w.g. resistance. All tube joints to be smooth inside. Air quantities based on 4000 F.P.M. velocity.

Δ		Typical heavy loading for		TABLE #C-1											
pe	Cu.Ft.Air		g for ns with lugal lowers	NEGATIV	NEGATIVE PRESSURE (RESISTANCE) FOR GIVEN RUN LENGTHS - Suction-inche w.g. Run length equals actual vertical plus horizontal distance in feat. Estimates include allowances per above explanation.										
_	run ler	igth	-	25'	50'	75'	100*	125	150'	176/	200*	feet			
11 100	1% Ver	lcal	_	25.0	29.0	33.0	37.0	41.0	45.0	49.0	53.0	Inches VIC			
11 50	% V. 8	50% He	oriz.	25.4	29.8	34.3	38.5	42.9	47.3	51.7	56.0				
If 100% Horizontal				25.B	30.5	35.3	40.0	44.B	49.5	54.3	59.0	100			
TUBE SIZE (Inches)		CVEY	AIR				TA	BLE #	C-2						
		RATE	RATE	AV	ERAGE	RAKE	P PER RU	N - FOR	LENGT	H CAPAC	TY SHO	WN			
Outs.			ER.fL/		Contraction of the second	section of the section of the	And the second se	A	150"	175'	200'	l fact			
Dia.	Dia.	min.	min,	25'	50'	75'	1004	125'			1.4	BHP			
	18*	18	75	1	.8	.9	1.0	1.1	1.2	1,2	and the second second	A REPORT OF A			
2"															
255."	2%	31	125	1.1	1.2	1.4	1.6	1.8	2.0	2.2	2.6				
-	2%	45	125	1.1	1.2	1.4	1.6	1.8 2.8	2.0	3.1	3.4				
255."			the locate	And in case of the local division of the	And in Cold Street of the					the state of the s		-			
2%*	27	45	160	1.5	1.8	2.0	2.3	2.8	2.9	3.1	3.4	1			
2%*	27.* 3%*	45 61	160 245	1.5 2.0	1.8 2.4	2.0 2.8	23 21	2.8 3.5	2.9 3.9	3.1 4.3	3.4 4.6				
2%* 3* 3%* 4*	27 * 35 * 37 *	45 61 81	160 245 325	1.5 2.0 2.7	1.8 2.4 3.2	2.0 2.8 3.6	23 21 41	2.8 3.5 4.5	2.8 3.9 5.1	3.1 4.3 5.6	3.4 4.6 6.1				

6 Typical heavy		il.	-		TA	BLE #	D-1								
Cu.F	LAIr Ib.	Centringer		NEGATIN	NEGATIVE PRESSURE (RESISTANCE) FOR GIVEN RUN LENGTHS - Suction - Inch w.g. Run length equals actual vertical plus horizontal distance in feet. Estimates include allowances per above explanation.										
Stock Type blowers			25'	50'	76'	100'	125'	150'	175'	200'	foot				
11 100	N% Ven	lical		20,3	23.5	26.8	30.0	33.5	36,5	39.8	43.0	Inches W.G			
11 50	V.A	50% H	INZ.	20.8	23.0	27.6	31.0	34.1	38.0	41.6	45.0	A			
if 100% Horizontal			20.8	24.5	28,3	32.0	35.8	39,5	43,3	47.0					
TUBE SIZE (inches)		CVEY	AIR				TA	BLE #	D-2						
			NATE	AV	AVERAGE BRAKE HP PER RUN - FOR LENGTH CAPACITY SH Motor H.P. for blower = Sum of brake H.P. for all runs & drive h										
	ingide		cu,ft./		the second se	or blower 75'	100'	125'	150'	175'	500.	feet			
Dia.	Dla.	min.	min.	26'	50'			120	1.0	1.1	1.2	BHP			
2"	13.	12	75	.5	0,	1	.8			and the second s		one			
2%*	2%*	21	125	.0	1.0	1.2	1.3	1.4	1,5	1.7	1.9	1			
	29.	30	130	1.2	1,4	1.7	1,9	2.1	2.3	2.5	2.7	-			
3*	35"	41	245	1.7	2.0	2.2	2.5	2.H	3.1	3.4	a.7	-			
3%*	38			2.2	2.5	2.9	3.3	3.7	4,1	4.5	4.9	1.175			
	35.	58	325	66											
3%*		56 87	325	3.5	4.1	4.7	53	5.9	6.5	7.2	7.8				
4.	35"	1		and the second second	the local data	4.7 5.8	5.3 7.8	5.B 8.5	6.5 9.4	10.3	7.8				

Figures intended only as general guida. Every system should be individually figured for its specific requirements before final equipment selection.



PNEUMATIC SYSTEM ESTIMATES - POSITIVE PRESSURE TYPE

EXPLANATION: Figures below are typical for sverage flour handling conditions. In addition to specified data figures are based on 3 -90° turns (long radius type, i.e. L radius = tube diameter x 6 or greater). Figures also include allowance for linet air filter, intol fillings and outlet separator totaling 10° w.g. resistance. All tube joints to be smooth inside. Air quantities based on 1000 COM to the second 4000 F.P.M. velocity.

1/2		Typical heavy		TABLE #A-1														
Cu.F per Sto	10.	ioading for systems with displacement all pump			RL	in len	EQUIF gth ea iclude	Juala	actua	I verti	cal p	lus ho	rizon	ta) di	stanc	a in te	et.	
Press of total run length			25'	50'	75'	1001	1291	150'	175'	2001	225'	250	275'	300'	325'	350*	100	
11.100	% Varl	(ca)		4,8	5,3	5,9	6.5	7.2	7.8	8.6	9.0	9.7	10.3	11.0	11.6	12.2	12.9	P.S.
11 50.9	6 V & .	50 % 14	oriz.	4.7	5,5	6.2	6.9	7.7	8.5	8.2	9.9	10.6	15.4	12.1	12.8	13,5	14.3	P,S
H 100% Horizontal			4.8	5.7	6,5	7.3	8.2	9.1	9.9	10.7	11.6	12.4	13.2	14.0	14.8	15.6	P.5.	
TUBE SIZE		1	Lun	-		-	30		-	ГАВ	LE	#A-	2					
TUBE	SIZE	C'VEY	AIR															
(inc	ives)	RATE	RATE		NO	RMAL	MOT	OR H	P. FC	RCA	PACI	TIES	& RUI	N LEN	IGTH: e loss	S SHO	WN	
(inc				23	NO	RIMAL M	MOT ofor s	OR H	P. FC	RCA	PACI	TIES	& RUI	V-driv	GTH: e loss 300'	S SHO	350'	149
(Inc Outs	nesi Inside	RATE LOSI	RATE	27	-	M	otor s	elech	P. FC ions i	R CA	PACI e allo	TIES	& RUI e for	V-driv	e loss	65	_	las HP
(Inc Outs Dia	hes) Inside Dis.	RATE Losi min.	RATE cu (1.) min.	22.1	50*	M 75'	ofor s 160	electi 125'	P. FC ions i 150'	DR CA neludi 175	PACI e allo 2004	TIES wanco 225'	& RUI e for 250	V-driv 275'	e loss 300'	es 325 ²	350'	HP
(Inc Outs Dia 2*	hes) Inside Dis. 1%"	RATE Lost min. 150	RATE cu.11.7 min. 75	5	50*	M 75'	0107 s 160 5	elech 125' 5	P. FC ions i 150' 714	H CA neludi 175' 7%	PACI e allo 200' 7%	TIES wance 225' 7%	& RUI e for 250 7%	275' 10	e loss 300' 10	95 325 ² 10	350' 10	HF
(Inc Outs Dia 2* 215*	hes) Inside Dis. 1%" 2%"	RATE Lbs/ min. 150 250	RATE cu (1.7 mm. 75 125	5	50° 5 7%	M 75' 3 71/2	0/0/ s 160 5 7 %	125' 5 10	P. FC ions i 150' 7% 10	0H CA neludi 175* 7% 10	PACI e allo 2007 7%	TIES wance 225' 7% 15	& RUI e for 250' 7% 15	V-driv 279 10 15	e loss 300' 10 15	es 325 ² 10 15	350' 10 20	HP
(inc Duts Dia 2* 2%* 3*	nside Dis. 1%" 2%" 2%"	RATE Losi min. 150 250 360	RATE cu II J mm 75 125 180	5 5 71/2	50° 5 7% 10	75' 5 7 1/2 10	0101 s 160 5 7 % 10	elect) 125' 5 10 15	P. FC ons i 150' 7% 10 15	0F CA neludi 175° 7% 10 16	PACI e ello 200' 7% 10 15	TIES wanco 225' 7% 15 20	& FUI 250' 7% 15 20	V-driv 275 10 15 20	e loss 300' 10 15 20	es 325 ⁷ 10 15 25	350' 10 20 25	HP
(inc Duts Dia 2% 3% 3%	nside Dis. 1%* 2%* 2%* 3%*	RATE Lissi min. 150 250 360 490	RATE cu (17 mm, 75 125 180 245	5 5 7½ 10	50° 5 7% 10 15	M 75 5 7½ 10 15	0/0/ s 160 5 7 % 10 15	elect) 125' 5 10 15 15	P. FC ions i 150' 714 10 15 20	0H CA neludi 175 795 10 16 20	PACI e ello 200' 7% 10 15 20	TIES wance 225' 7½ 15 20 25	& RUI 250 7% 15 20 25	V-driv 279 10 15 20 25	e loss 300' 10 15 20 30	es 325 ² 10 15 25 30	350' 10 20 25 40	HF Y

1		Typical heavy		1					1	TAB	LE	#B-	0					-	
Cu.F) per Sto	fla.	loarling for systems with displacement air pump		1.00	Ru	in len	EQUIF gth ei ictude	juals	actua	I vert	ical p	lus he	nizon	tal dh	stance	= In 16	er.		
Press	ol lot	al run I	ength	25'	50'	75'	100	125!	150'	1781	500,	225	250	275	3001	325'	350	1691	
11.100	Nert	lical		2.7	3.1	3.4	3.8	42	4.6	5.0	5.4	5.7	6.1	6.5	6.9	7.3	7.7	P.S.	
11.505	V.A.	50% H	oviz:	2.8	3.2	3.6	4.1	4.5	4.9	5.4	5.8	6.2	6.7	7.1	7,5	8.0	8.4	P.S.	
11 100	% Hon	zentel		2.9	33	3.8	4.3	4.7	5.2	5.7	6.2	6.7	7.2	7.7	8,1	8.8	9.1	P.S.	
TUBE SIZE C'VEY		Lauren			TABLE #B-2														
TUBE	SIZE	C.AEA	AIR			-					_		_				_	-	
(inc	hes)	RATE	RATE		NO		MOT afor s		P. FC	NA CA	PACI	TIES					NWN		
(inc		RATE		25'	NO				P. FC	NA CA	PACI	TIES					350	Inat	
(Inc Outs	hes) Inside	BATE Lbs/	RATE CU.H.T	25'		M	ofor s	elect	P. FC	R CA	PACI e allo	TIES wanco	e far	V-drive	loss	85		lea HP	
(Inc Outs Dia	Inside Dia	BATE Lbs/ min	RATE cu.H / min	1000	50'	M	ator s 100	alect	P. FC ons in 150'	PR CA nclud 175	PACI e allo 200'	TIES wanto 225	e far 250	V-drivi 275'	9 105 S	95 325'	350	-	
(Inc Outs Dia 21	Inside Dia 1%*	RATE Lbs/ min. 75	RATE cu.H T min 75	3	50' 3	M 75' 3	ofor s	alect 1251 3	P. FC ons in 150' 5	IR CA nolud 175 5	PACI e allo 200' 5	TIES wanto 225 5	e (ar 250' 5	V-drivi 275' 5	9 1055 300' 5	85 325' 7%	350	HP	
(Inc Duls, Dia 21 210	hes) Inside Dia 1%* 2%*	RATE Lbs/ min. 75 (25	RATE cu.H 1 min. 75 125	3	50' 3 5	M 75' 3 5	0101 s 100 3 5	alech 125' 3 5	P. FC ons in 150' 5 7%	09 CA nolud 175 5 7%	PAC1 e allo 200' 5 7 %	TIES wants 225 5 7%	e far 250' 5 10	V-drive 275' 5 10	9 1055 300' 5 10	85 325' 7% 10	350 7% 10	HP	
(Inc Duts, Dia 21 210 " 31	hes) Inside Dia 1%* 2%*	RATE Lbs/ min. 75 125 180	RATE cu.H 7 min 75 125 180	3 5 7%	50' 3 5 7 Vi	M 75' 3 5 7%	0101 s 100 3 5 10	alect 125 3 5 10	P. FC ons 10 150' 5 7% 10	09 CA nolud 175 5 7% 10	PACI e allo 200' 5 7 % 15	TIES wanto 225 5 7\6 76	5 10 15	V-drivi 275' 5 10 15	300' 5 10 15	85 325' 7% 10 15	350 7% 10 15	HP	
(Inc Outs, Dia 21 235 " 31 355 "	hes) Inside Dia 19* 2%* 3%*	RATE Lbs/ min. 75 125 180 245	RATE cu.H 7 min. 75 125 180 245	3 5 7% 10	50' 3 5 7 % 10	M 75 3 5 75 10	otor s 100 3 5 10 10	alect 1251 3 5 10 15	P. FC ons in 150' 5 7% 10 15	09 CA nolud 175 5 7% 10 15	PAC1 e allo 200 ¹ 5 7 % 15 15	TIES wanco 225' 5 7% 7% 15	e far 250 5 10 15 15	V-drivi 2/5' 5 10 15 15	5 1055 300' 5 10 15 20	85 325' 7% 10 15 20	350 7% 10 15 20	HP · · ·	

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7040 S. MEAD AVE. WICHITA, KANSAS

KICE METAL PRODUCTS CO. Kung

PNEUMATIC SYSTEM ESTIMATES POSITIVE PRESSURE TYPE THE

12-21-83 1.0454 GATE

DWG ND.

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