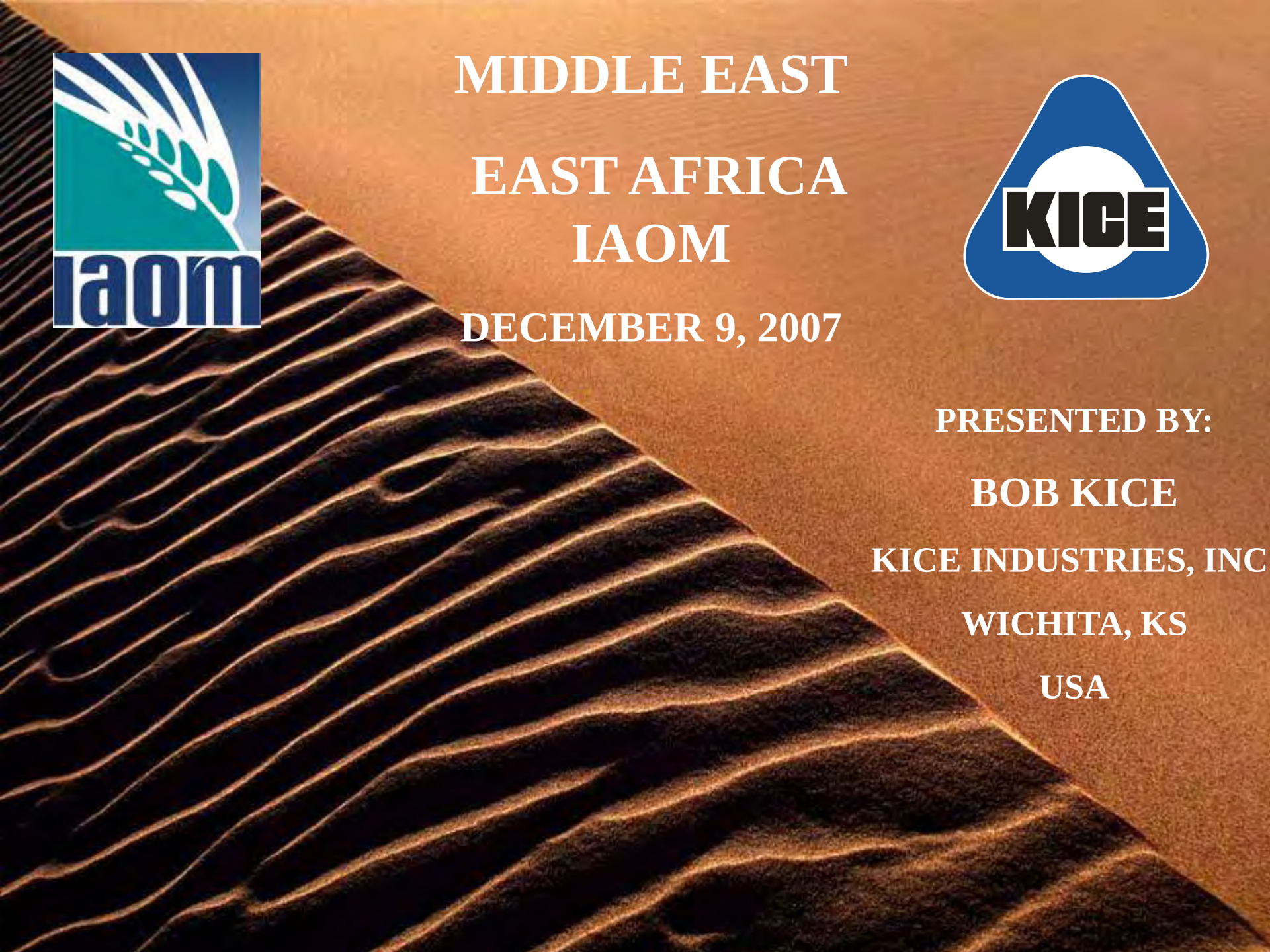
MIDDLE EAST

EAST AFRICA
IAOM

DECEMBER 9, 2007



PRESENTED BY:

BOB KICE

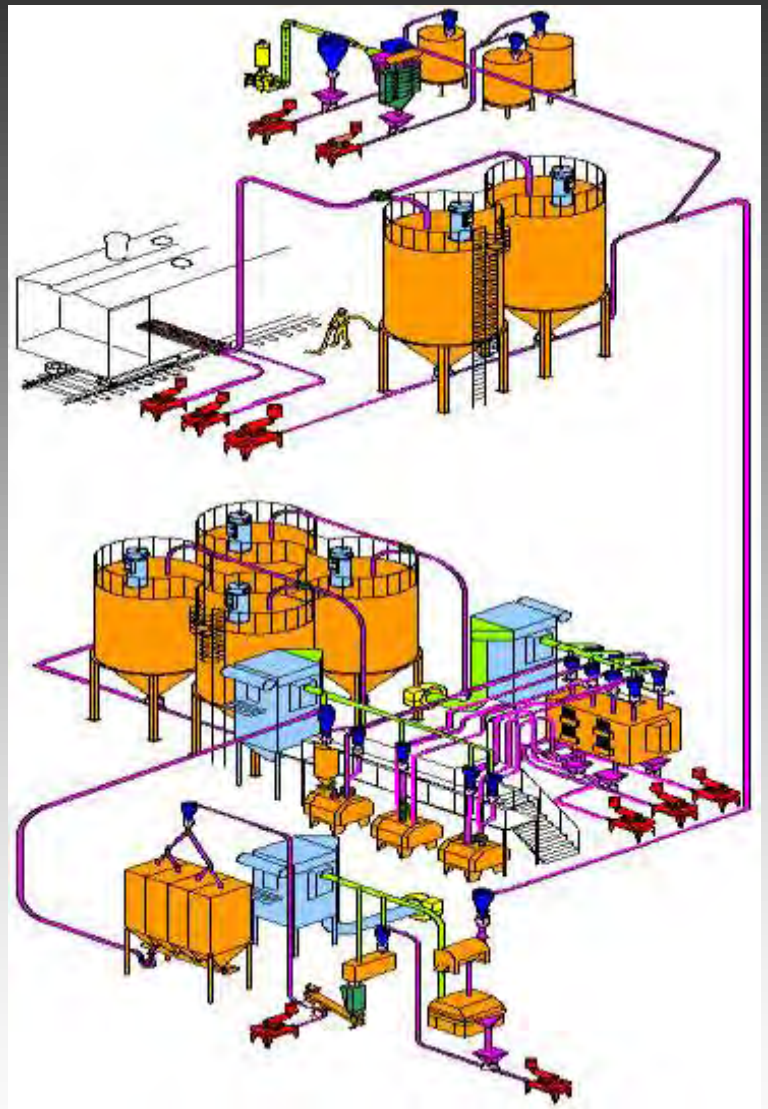
KICE INDUSTRIES, INC

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 SYSTEMS

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











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 x r^2

Volume (CFM)=**Velocity** (ft/min) x **Area** (ft^2)

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.

Air Seal



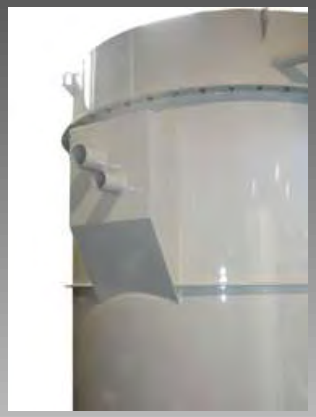

- Device to prevent air from entering the system “uncontrolled”

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

Receivers



- 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.

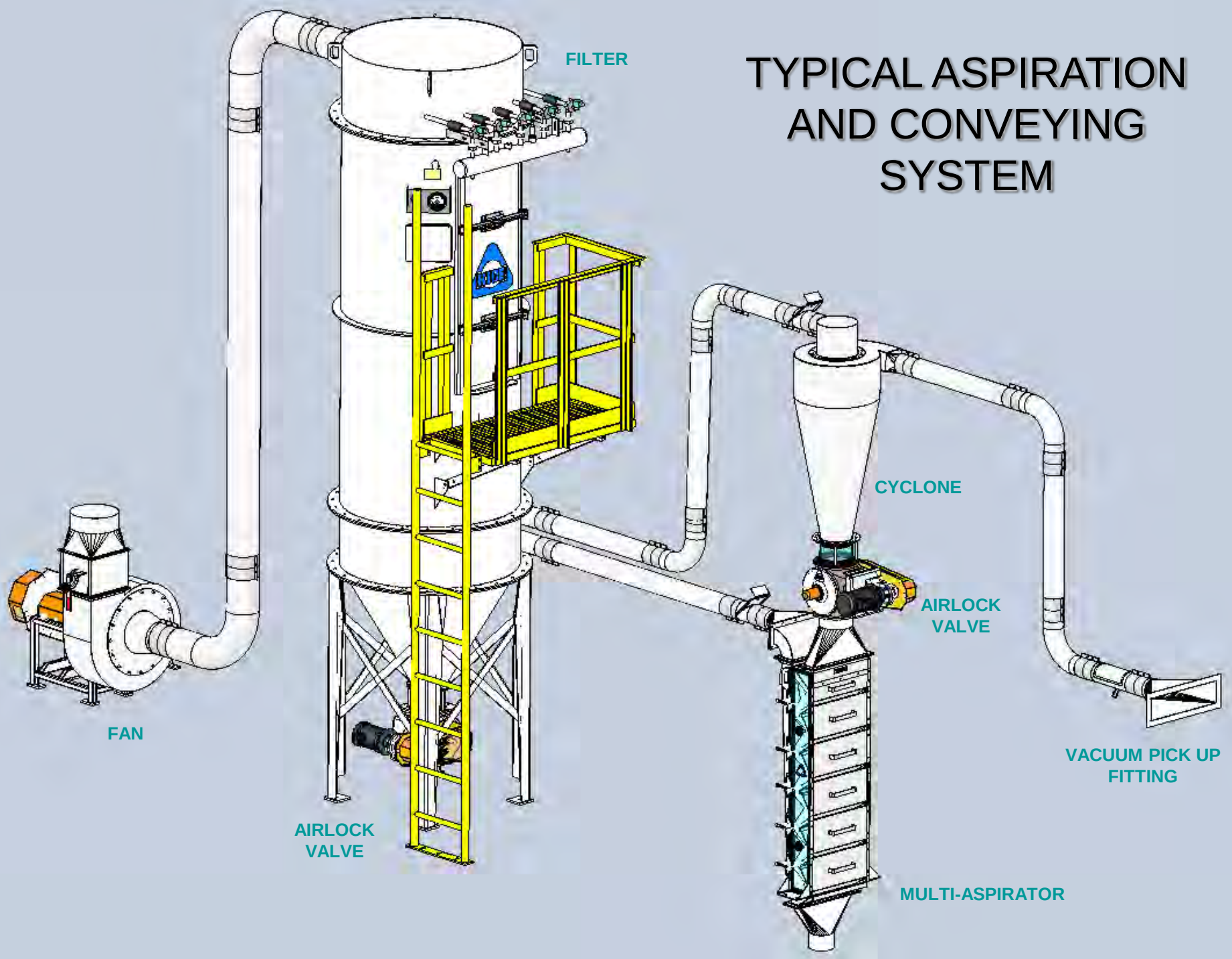
Tubing System

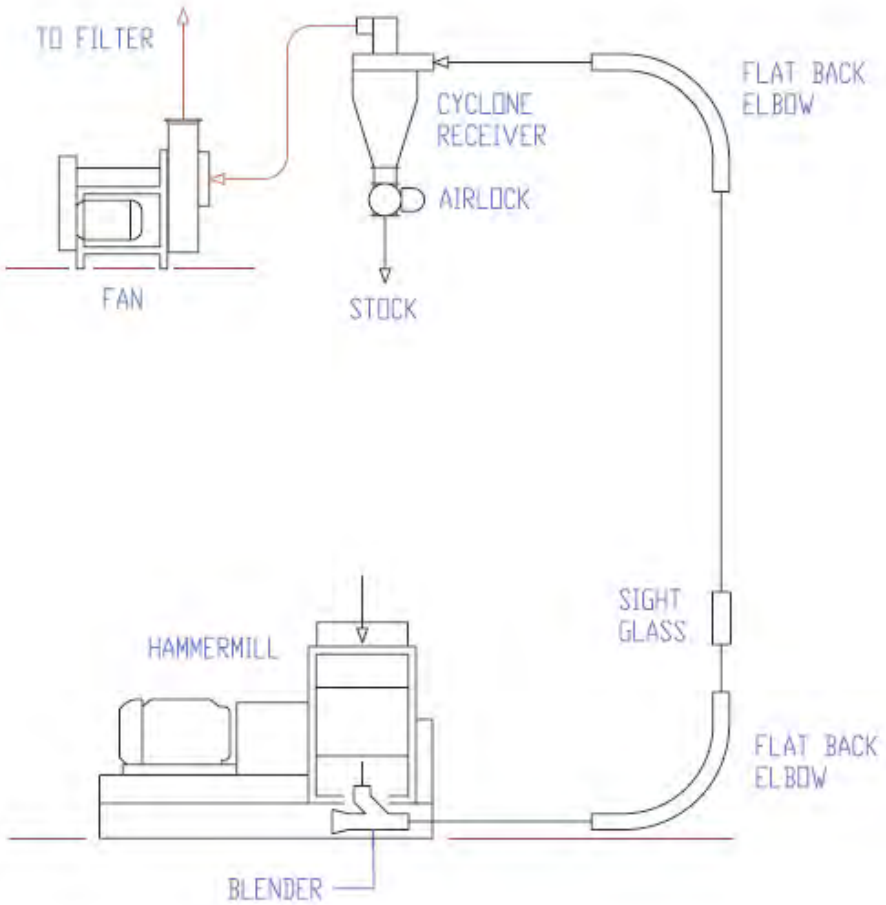
- Tubing – size/diameter determined by the air volume since a “typical” velocity is constant.
- Ells – size same as tubing, radius determined by product. Normally 36” radius.
- Couplings – Sized by tubing. Bolt together or compression couplings.
- Sight glass Ass’y – Difficult to monitor a system and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

Typical Conveying Systems

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

TYPICAL ASPIRATION AND CONVEYING SYSTEM

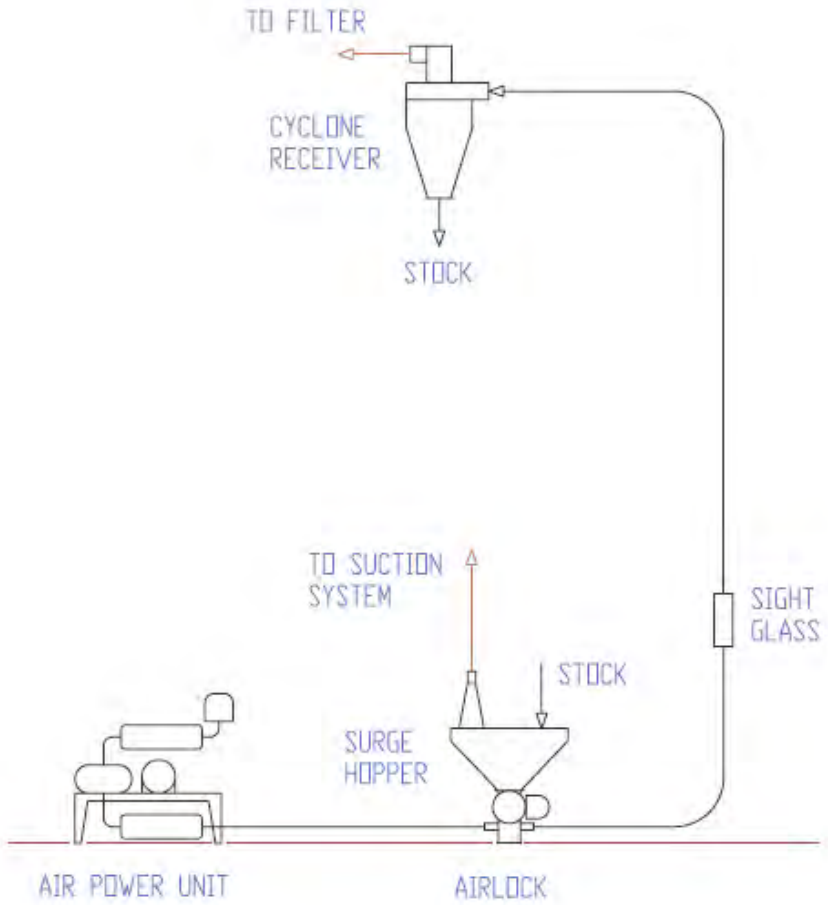




HAMMERMILL SYSTEM

KICE INDUSTRIES, INC.
5500 MILL HEIGHTS DR, WICHITA, KANSAS

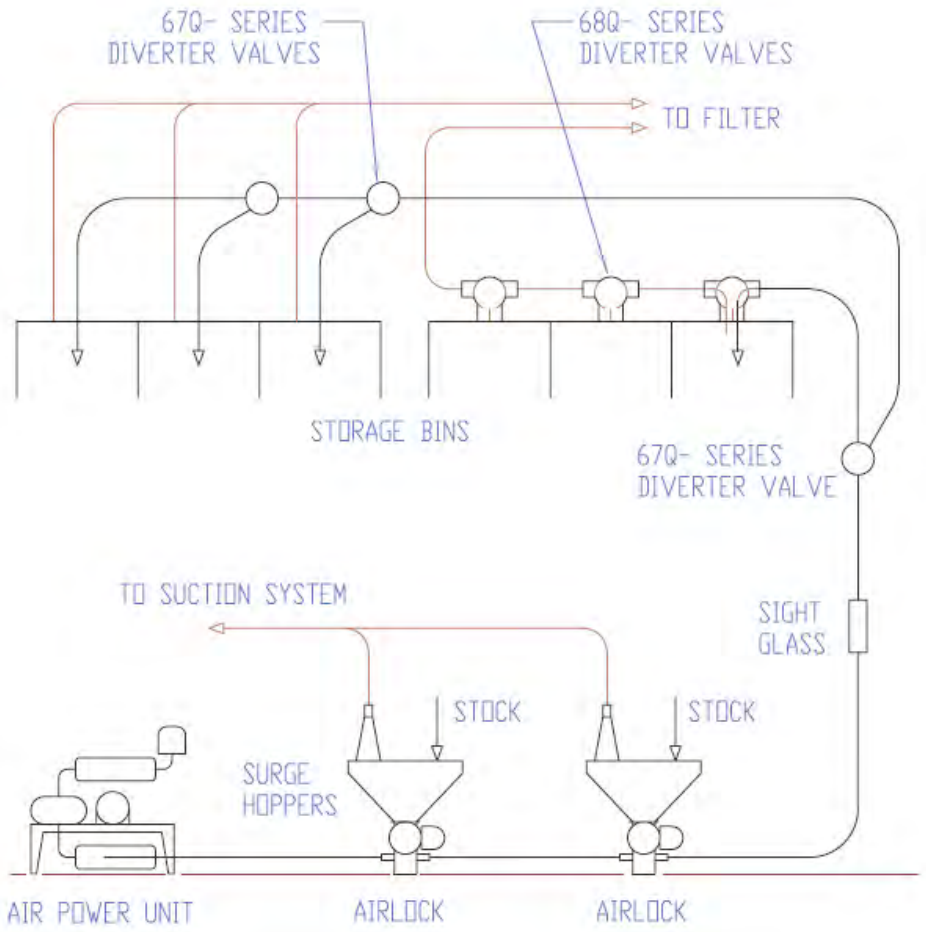
geppo	APR 28-04	SCH-1002
DRAWN BY	DATE	DWG NO.



SINGLE PRESSURE LIFT
WITH AIR POWER UNIT

KICE INDUSTRIES, INC.
5500 MILL HEIGHTS DR, WICHITA, KANSAS

geppo	APR 28-04	SCH-1000
DRAWN BY	DATE	DWG NO.



MULTIPLE PRESSURE LIFT WITH AIR POWER UNIT TO MULTIPLE DESTINATIONS

KICE INDUSTRIES, INC.
5500 MILL HEIGHTS DR, WICHITA, KANSAS

geppo	APR 28-04	SCH-1001
DRAWN BY	DATE	DWG NO.

Pneumatic Conveying "Rules of Thumb"

1. Normally pressure systems will operate in a range of 3-12 PSIG – positive displacement air pumps.
2. Normally 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.

4 Cu.Ft.Air per lb. Stock — Typical heavy loading for systems with centrifugal type blowers

TABLE #C-1

NEGATIVE PRESSURE (RESISTANCE) FOR GIVEN RUN LENGTHS - *Suction - inches w.g. Run length equals actual vertical plus horizontal distance in feet. Estimates include allowances per above explanation.*

	25'	50'	75'	100'	125'	150'	175'	200'	feet
Total run length									
If 100% Vertical	25.0	29.0	33.0	37.0	41.0	45.0	49.0	53.0	inches W.G.
If 50% V. & 50% Horiz.	25.4	29.8	34.3	38.5	42.9	47.3	51.7	56.0	"
If 100% Horizontal	25.8	30.5	35.3	40.0	44.8	49.5	54.3	59.0	"

TABLE #C-2

AVERAGE BRAKE *HP PER RUN* — FOR LENGTH CAPACITY SHOWN
Motor H.P. for blower = Sum of brake H.P. for all runs & drive losses.

TUBE SIZE (inches) Outs. Dia.	TUBE SIZE (inches) Inside Dia.	C'VEY RATE Lbs/ min.	AIR RATE cu.ft./ min.	25'	50'	75'	100'	125'	150'	175'	200'	feet
2"	1⅞"	18	75	.7	.8	.9	1.0	1.1	1.2	1.3	1.4	BHP
2½"	2⅜"	31	125	1.1	1.2	1.4	1.6	1.8	2.0	2.2	2.4	"
3"	2⅞"	45	160	1.5	1.8	2.0	2.3	2.6	2.9	3.1	3.4	"
3½"	3⅜"	61	245	2.0	2.4	2.8	3.1	3.5	3.9	4.3	4.6	"
4"	3⅞"	81	325	2.7	3.2	3.6	4.1	4.5	5.1	5.6	6.1	"
5"	4⅞"	130	520	4.3	5.0	5.8	6.6	7.4	8.2	8.9	9.6	"
6"	5⅝"	187	750	6.1	7.2	8.4	9.5	10.7	11.8	12.9	14.0	"
8"	7⅝"	325	1300	10.6	12.5	14.5	16.4	18.4	20.3	22.3	24.2	"

6 Cu.Ft.Air per lb. Stock — Typical heavy loading for systems with centrifugal type blowers

TABLE #D-1

NEGATIVE PRESSURE (RESISTANCE) FOR GIVEN RUN LENGTHS - *Suction - inches w.g. Run length equals actual vertical plus horizontal distance in feet. Estimates include allowances per above explanation.*

	25'	50'	75'	100'	125'	150'	175'	200'	feet
Total run length									
If 100% Vertical	20.3	23.5	26.8	30.0	33.3	36.5	39.8	43.0	inches W.G.
If 50% V. & 50% Horiz.	20.6	23.0	27.6	31.0	34.1	38.0	41.6	45.0	"
If 100% Horizontal	20.8	24.5	28.3	32.0	35.8	39.5	43.3	47.0	"

TABLE #D-2

AVERAGE BRAKE *HP PER RUN* — FOR LENGTH CAPACITY SHOWN
Motor H.P. for blower = Sum of brake H.P. for all runs & drive losses.

TUBE SIZE (inches) Outs. Dia.	TUBE SIZE (inches) Inside Dia.	C'VEY RATE Lbs/ min.	AIR RATE cu.ft./ min.	25'	50'	75'	100'	125'	150'	175'	200'	feet
2"	1⅞"	12	75	.5	.6	.7	.8	.9	1.0	1.1	1.2	BHP
2½"	2⅜"	21	125	.9	1.0	1.2	1.3	1.4	1.6	1.7	1.9	"
3"	2⅞"	30	180	1.2	1.4	1.7	1.9	2.1	2.3	2.5	2.7	"
3½"	3⅜"	41	245	1.7	2.0	2.2	2.5	2.8	3.1	3.4	3.7	"
4"	3⅞"	58	325	2.2	2.5	2.9	3.3	3.7	4.1	4.5	4.9	"
5"	4⅞"	87	520	3.5	4.1	4.7	5.3	5.9	6.5	7.2	7.8	"
6"	5⅝"	125	750	5.0	5.9	6.8	7.8	8.5	9.4	10.3	11.2	"
8"	7⅝"	217	1300	8.5	10.2	11.7	13.1	14.7	16.2	17.8	19.3	"

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

PNEUMATIC SYSTEM ESTIMATES
NEGATIVE PRESSURE (SUCTION)
TITLE

KICE INDUSTRIES, Inc.
P.O. BOX 10388, WICHITA, KS 67202-0388

E.W.S.		12-21-83	1-0455A
DRAWN BY	CHECKED BY	DATE	DWG NO

PNEUMATIC SYSTEM ESTIMATES — POSITIVE PRESSURE TYPE

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 inlet air filter, inlet fittings and outlet separator totaling 10" w.g. resistance. All tube joints to be smooth inside. Air quantities based on 4000 F.P.M. velocity.

1/2 Cu.Ft.Air per lb. Stock — Typical heavy loading for systems with displacement air pump

TABLE #A-1

PRESSURE REQUIRED (RESISTANCE) FOR GIVEN RUN LENGTHS - lbs/sq. in.
Run length equals actual vertical plus horizontal distance in feet.
Estimate includes allowance for long sweep elbows — See explanation.

Press. of total run length	25'	50'	75'	100'	125'	150'	175'	200'	225'	250'	275'	300'	325'	350'	feet
If 100% Vertical	4.8	5.3	5.9	6.5	7.2	7.8	8.5	9.0	9.7	10.3	11.0	11.6	12.2	12.9	P.S.I.
If 50% V. & 50% Horiz.	4.7	5.5	6.2	6.9	7.7	8.5	8.2	9.9	10.6	11.4	12.1	12.8	13.5	14.3	P.S.I.
If 100% Horizontal	4.8	5.7	6.5	7.3	8.2	9.1	9.9	10.7	11.5	12.4	13.2	14.0	14.8	15.6	P.S.I.

TABLE #A-2

NORMAL *MOTOR H.P.* FOR CAPACITIES & RUN LENGTHS SHOWN
Motor selections include allowance for V-drive losses

TUBE SIZE (Inches) Outs. Dia.	TUBE SIZE (Inches) Inside Dia.	C'VEY RATE Lbs/ min.	AIR RATE cu.ft./ min.	25'	50'	75'	100'	125'	150'	175'	200'	225'	250'	275'	300'	325'	350'	feet
2"	1⅞"	150	75	5	5	5	5	5	7½	7½	7½	7½	7½	10	10	10	10	HP
2½"	2⅜"	250	125	5	7½	7½	7½	10	10	10	10	15	15	15	15	15	20	"
3"	2⅞"	360	180	7½	10	10	10	15	15	15	15	20	20	20	20	25	25	"
3½"	3⅜"	490	245	10	15	15	15	15	20	20	20	25	25	25	30	30	40	"
4"	3⅞"	660	325	15	15	20	20	20	25	25	30	30	40	40	40	40	50	"
5"	4⅞"	1040	520	20	20	25	25	30	40	40	40	50	50	50	60	60	60	"
6"	5⅞"	1500	750	25	30	40	40	40	50	50	60	60	75	75	75	100	100	"

1 Cu.Ft.Air per lb. Stock — Typical heavy loading for systems with displacement air pump

TABLE #B-1

PRESSURE REQUIRED (RESISTANCE) FOR GIVEN RUN LENGTHS - lbs/sq. in.
Run length equals actual vertical plus horizontal distance in feet.
Estimate includes allowance for long sweep elbows — See explanation.

Press. of total run length	25'	50'	75'	100'	125'	150'	175'	200'	225'	250'	275'	300'	325'	350'	feet
If 100% Vertical	2.7	3.1	3.4	3.8	4.2	4.6	5.0	5.4	5.7	6.1	6.5	6.9	7.3	7.7	P.S.I.
If 50% V. & 50% Horiz.	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.I.
If 100% Horizontal	2.9	3.3	3.8	4.3	4.7	5.2	5.7	6.2	6.7	7.2	7.7	8.1	8.6	9.1	P.S.I.

TABLE #B-2

NORMAL *MOTOR H.P.* FOR CAPACITIES & RUN LENGTHS SHOWN
Motor selections include allowance for V-drive losses

TUBE SIZE (Inches) Outs. Dia.	TUBE SIZE (Inches) Inside Dia.	C'VEY RATE Lbs/ min.	AIR RATE cu.ft./ min.	25'	50'	75'	100'	125'	150'	175'	200'	225'	250'	275'	300'	325'	350'	feet
2"	1⅞"	75	75	3	3	3	3	3	5	5	5	5	5	5	5	7½	7½	HP
2½"	2⅜"	125	125	5	5	5	5	5	7½	7½	7½	7½	10	10	10	10	10	"
3"	2⅞"	180	180	7½	7½	7½	10	10	10	10	15	15	15	15	15	15	15	"
3½"	3⅜"	245	245	10	10	10	10	15	15	15	15	15	15	15	20	20	20	"
4"	3⅞"	325	325	10	10	15	15	15	15	15	20	20	20	20	25	25	25	"
5"	4⅞"	520	520	15	15	20	20	20	20	25	25	25	30	30	30	40	40	"
6"	5⅞"	750	750	20	20	25	25	25	30	30	40	40	40	60	50	50	60	"

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

PNEUMATIC SYSTEM ESTIMATES
POSITIVE PRESSURE TYPE
TITLE

KICE METAL PRODUCTS CO.
2040 S. MEAD AVE. WICHITA, KANSAS

DRAWN BY | CHECKED BY | 12-21-83 DATE | 1-0454 DWG NO.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INDUSTRIES, INC.