How to Identify and Eliminate Artificial Demands

Tom Taranto
Data Power Services
Keynote Speaker

The recording and slides of this webinar will be made available to attendees via email later today.

PDH Certificates will be e-mailed to attendees within 2 days

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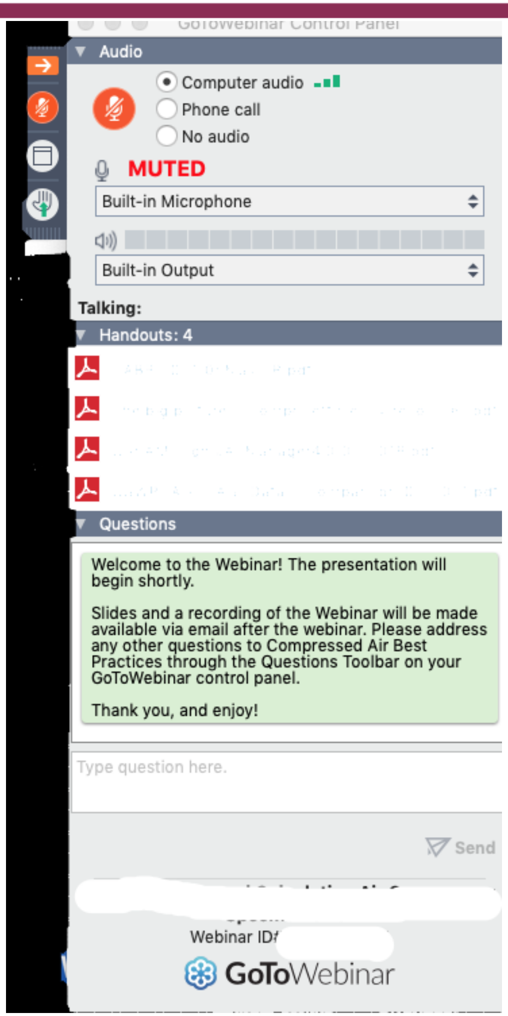
Q&A Format



- Panelists will answer your questions during the Q&A session at the end of the Webinar.

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- Direct all questions to Compressed Air Best Practices® Magazine

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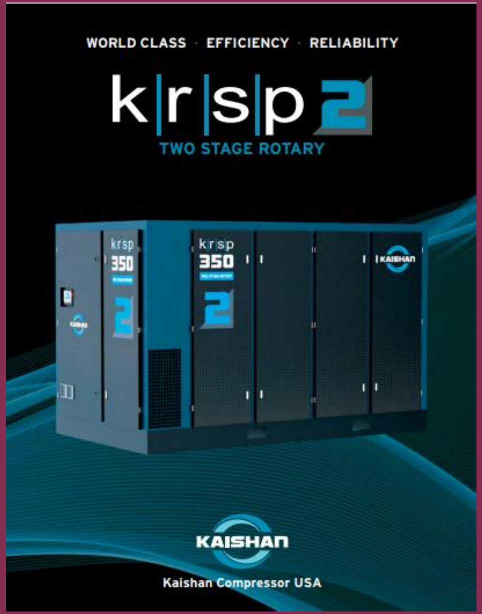
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How to Identify and Eliminate Artificial Demands

Introduction by

Compressed Air Best Practices® Magazine

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About the Speaker

Tom Taranto
Data Power Services

- President, Data Power Services
- Member of Best Practices Magazines' Editorial Board
- Over 45 years of experience in the compressed air industry
- Compressed Air Challenge Instructor, AIRMaster+ Specialist instructor and UNIDO Industrial Motor Systems Efficiency Program Instructor
- Member of ASME, AFE and IFPS

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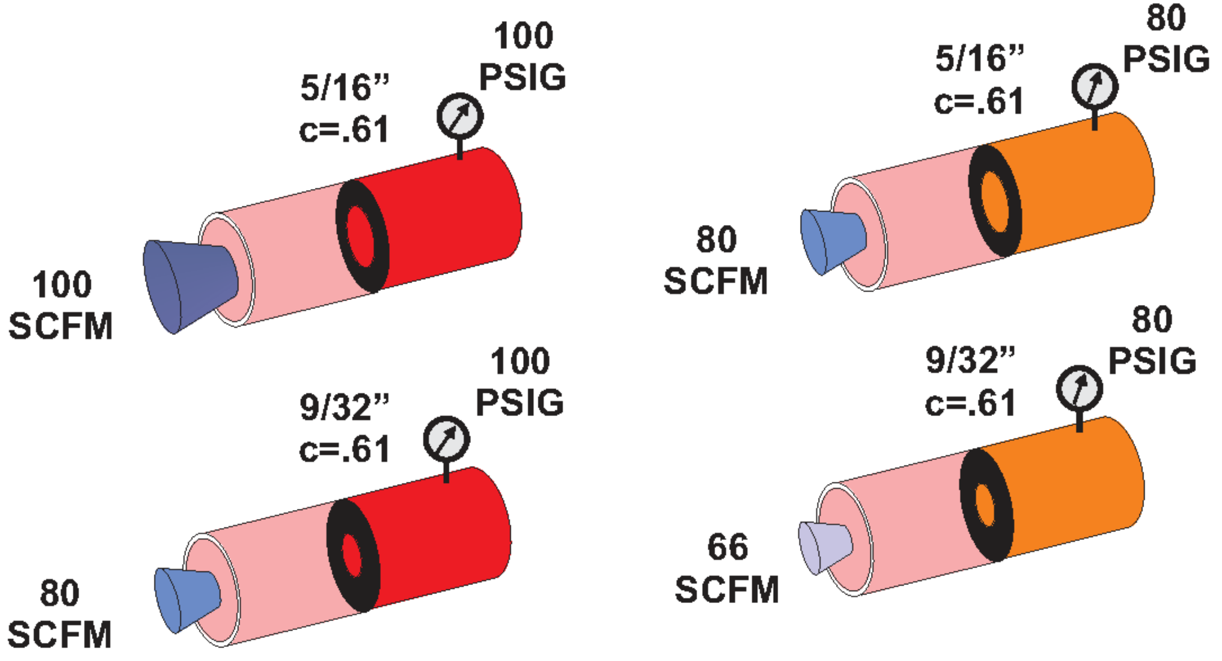
Artificial Demand

- Increased demand due to excessive system pressure (also known as artificial demand)
- Additional compressed air usage due to pressure levels higher than what is necessary to keep equipment operating properly.
- This is sometimes referred to as “artificial demand”.



Orifice flow calculation method – Compressed Air Challenge Advanced Management (L2)
System Test Method – Testing during a system assessment

Determine Airflow Loss to Artificial Demand

Discharge of air through an orifice

- Orifice chart to estimate artificial demand

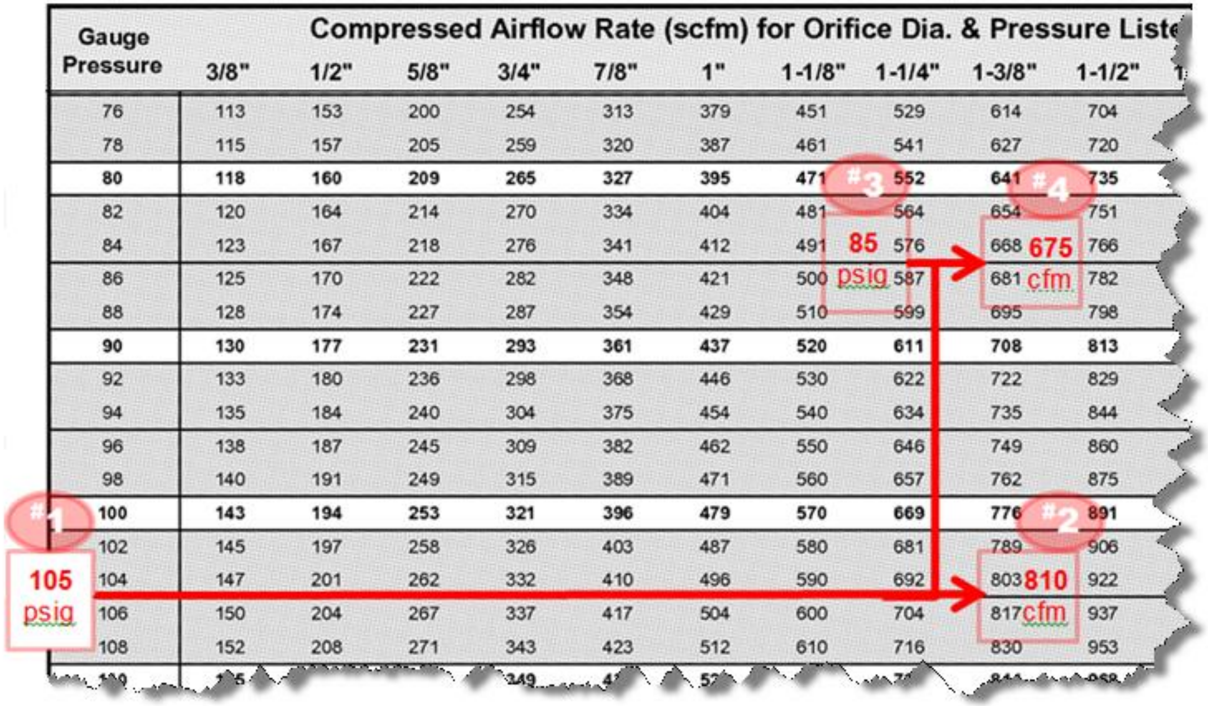
CAGI Handbook 6th Ed PDF Ch 8 p929	CAC L2 Handout H10a p3
$w = 0.5303 \dfrac{ACp_1}{\sqrt{T_1}}$	$Q = 424.6 \dfrac{ACp_1}{\sqrt{T_1}}$

Flow rate	$w = lbm / sec$	$Q = scfm$
Orifice area	$A = sq. in.$	$A = sq. in.$
Orifice coeff.	$C = 1.0$	$C = 0.61$
	$T_1 = 530\ ^{O}F\ (abs)$	$T_1 = 530\ ^{O}F\ (abs)$
	$P_1 = psia\ (upstream)$	$P_1 = psia\ (upstream)$

Units Conversion

$$w = 0.5303\ \frac{lbm}{s}\ \frac{60\ s}{1\ min}\ /\ 0.07494\ \frac{lbm}{scf} = 424.6\ scfm$$

- CAC L2 Steps to find artificial demand
  - Handout H10a pp 4 & 5



Gauge Pressure	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"	1-3/8"	1-1/2"
76	113	153	200	254	313	379	451	529	614	704
78	115	157	205	259	320	387	461	541	627	720
80	**118**	**160**	**209**	**265**	**327**	**395**	**471**	**552**	**641**	**735**
82	120	164	214	270	334	404	481	564	654	751
84	123	167	218	276	341	412	491	576	668	766
86	125	170	222	282	348	421	500	587	681	782
88	128	174	227	287	354	429	510	599	695	798
90	**130**	**177**	**231**	**293**	**361**	**437**	**520**	**611**	**708**	**813**
92	133	180	236	298	368	446	530	622	722	829
94	135	184	240	304	375	454	540	634	735	844
96	138	187	245	309	382	462	550	646	749	860
98	140	191	249	315	389	471	560	657	762	875
100	**143**	**194**	**253**	**321**	**396**	**479**	**570**	**669**	**776**	**891**
102	145	197	258	326	403	487	580	681	789	906
104	147	201	262	332	410	496	590	692	803	922
106	150	204	267	337	417	504	600	704	817	937
108	152	208	271	343	423	512	610	716	830	953

Artificial Demand 810 cfm 105 psig → @ 85 psig ??? cfm

- Steps to find artificial demand savings
  - **1.** Enter the table below at 105 psig (present operating pressure)
  - **2.** Find the column closest to 810 cfm (present average airflow rate)
  - **3.** Read up the column to 85 psig (new demand side target pressure)
  - **4.** Read or interpolate the new airflow 675 cfm
  - **5.** Subtract 810 – 675 cfm (present airflow rate minus new airflow rate) Airflow savings = 135 cfm (savings estimate if 100% air use is unregulated)
  - **6.** Estimate the portion of air demand that is unregulated, typ. 60% to 75%. (AIRMaster+ Software uses 60% unregulated air demand).
  - **7.** Multiply airflow reduction from the table by % unregulated air demand 135 cfm x 0.6 = 81 cfm
  - **8.** Cost savings is reduced airflow rate multiplied by compressed air cost. 81 cfm x $ 190.00 per cfm / year = $15,390.00 annual savings

- CAC L2 Steps to find artificial demand
  - Handout H10a pp 4 & 5

Gauge Pressure	Compressed Airflow Rate (scfm) for Orifice Dia. & Pressure Liste								
	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"	1-3/8"	1-1/2"
76	113	153	200	254	313	379	451	529	614	704
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80	**118**	**160**	**209**	**265**	**327**	**395**	**471**	**552**	**641**	**735**
82	120	164	214	270	334	404	481	564	654	751
84	123	167	218	276	341	412	491	576	668	766
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90	**130**	**177**	**231**	**293**	**361**	**437**	**520**	**611**	**708**	**813**
92	133	180	236	298	368	446	530	622	722	829
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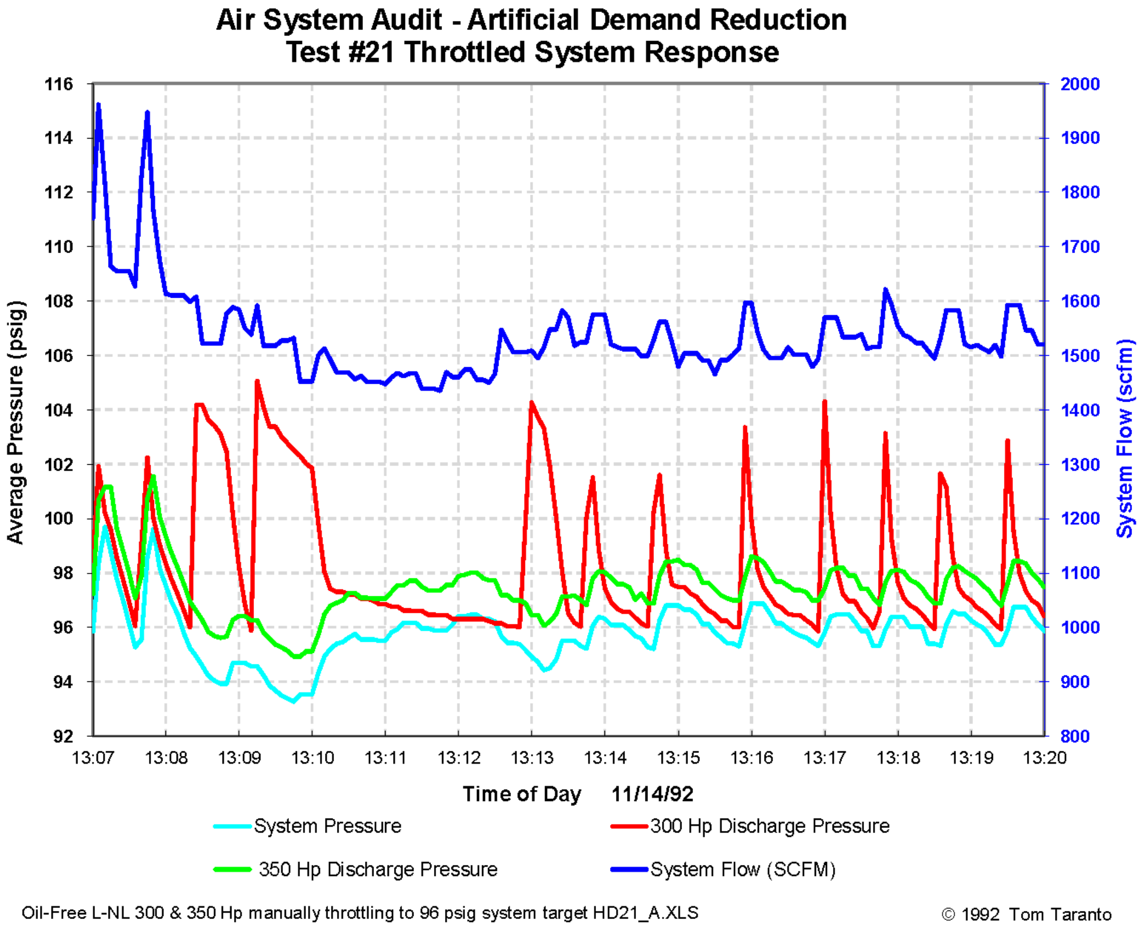
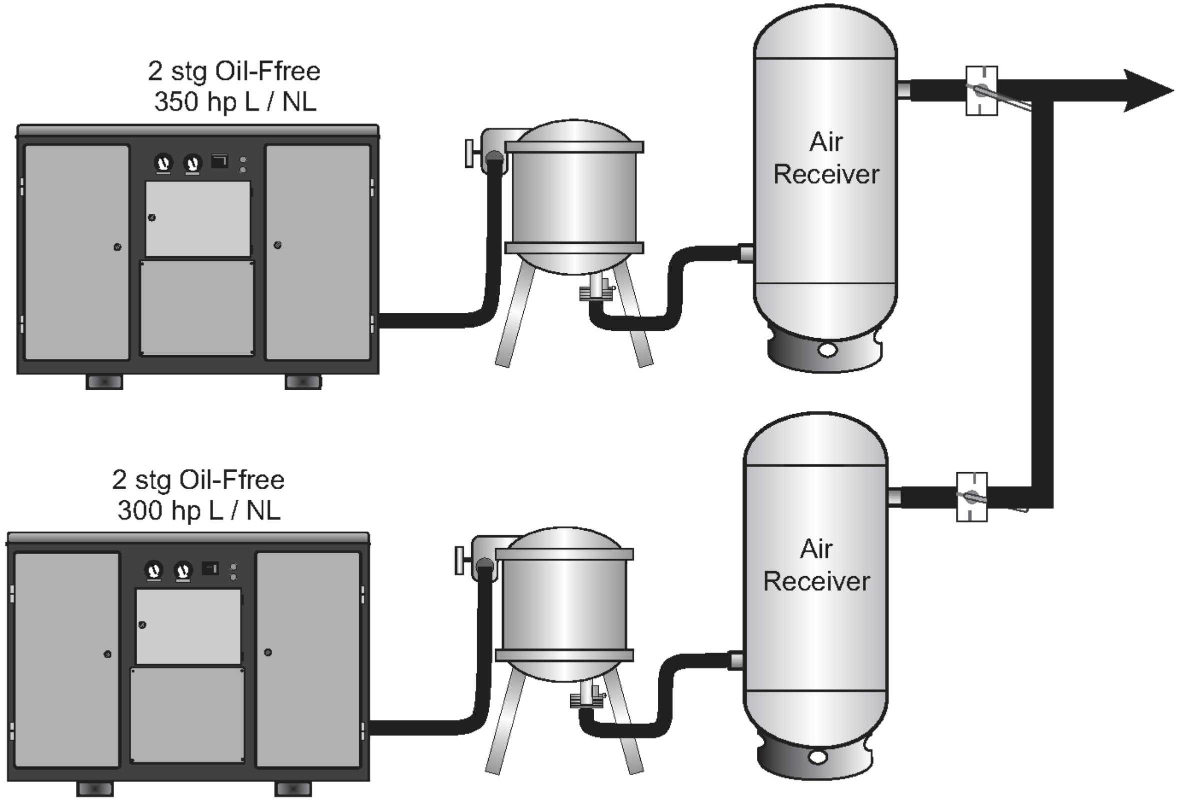
104	147	201	262	332	410	496	590	692	803	922
106	150	204	267	337	417	504	600	704	817	937
108	152	208	271	343	423	512	610	716	830	953
[illegible]	[illegible]	[illegible]	[illegible]	349	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

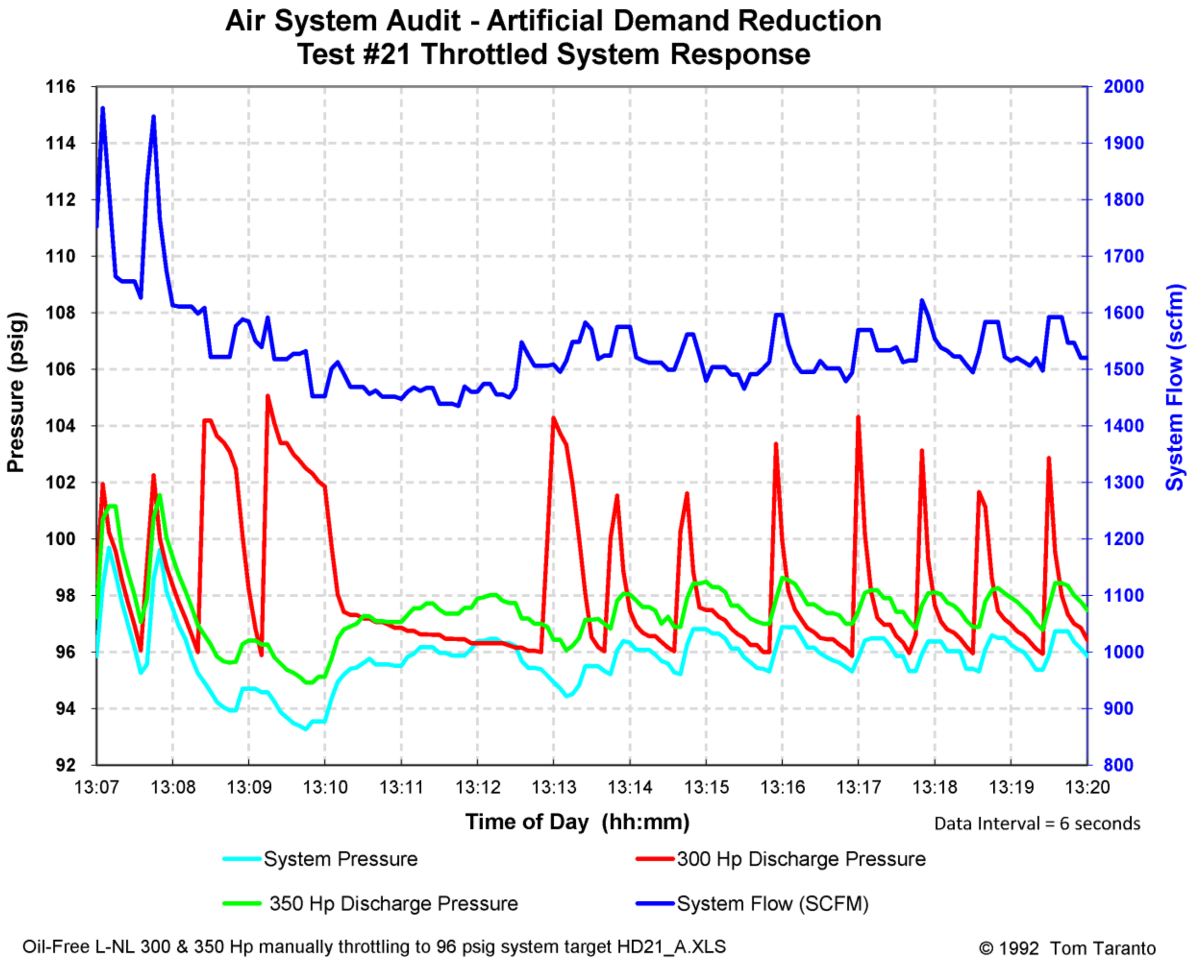
#1 105 psig; #2 810 cfm; #3 85 psig; #4 675 cfm

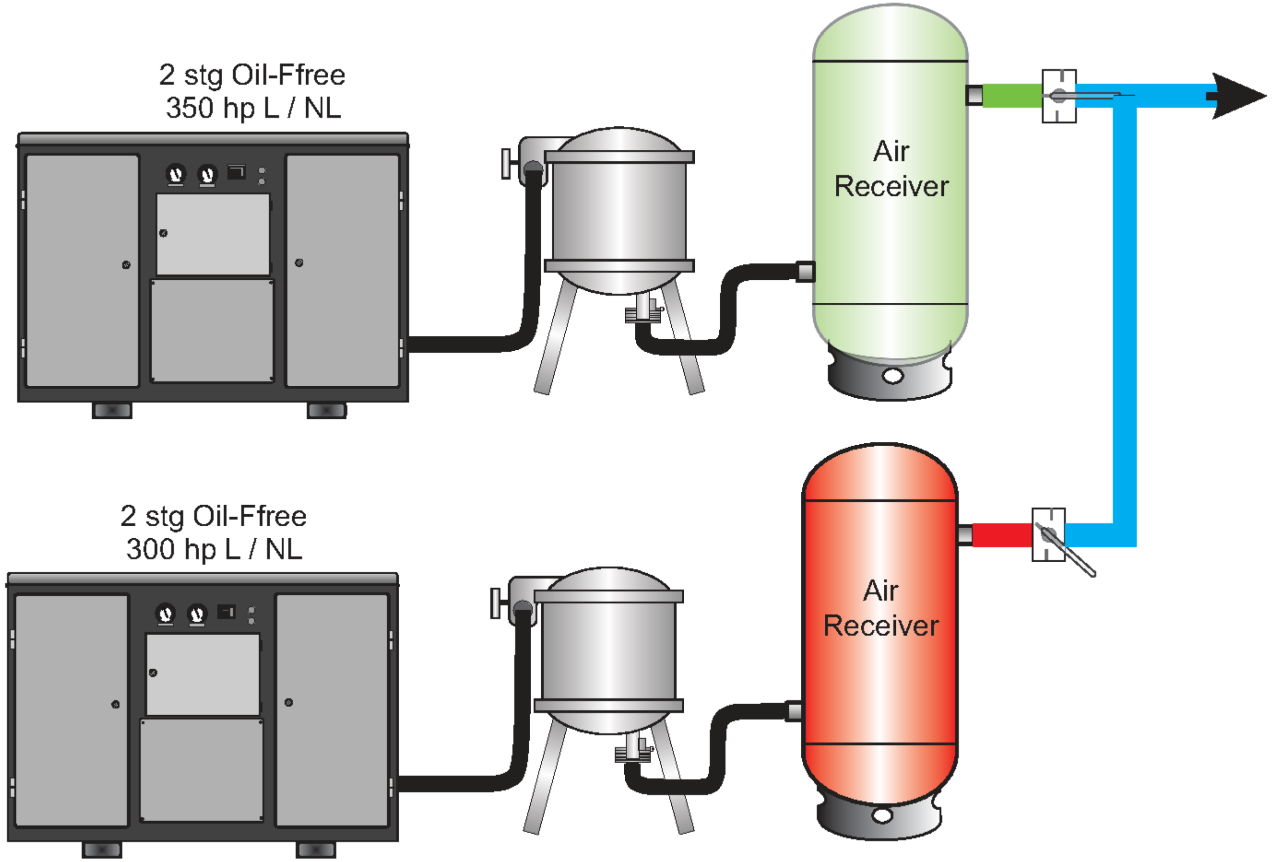
Testing a system's artificial demand





Testing a system’s artificial demand





Required Primary Storage Pressure.

Uncontrolled –vs- Controlled Primary Storage Pressure.

Optimum Production Supply Pressure.

System Pressure Profile & Artificial Demand

Permissive Start-up air storage 1500 gal @ 18 psi ΔP

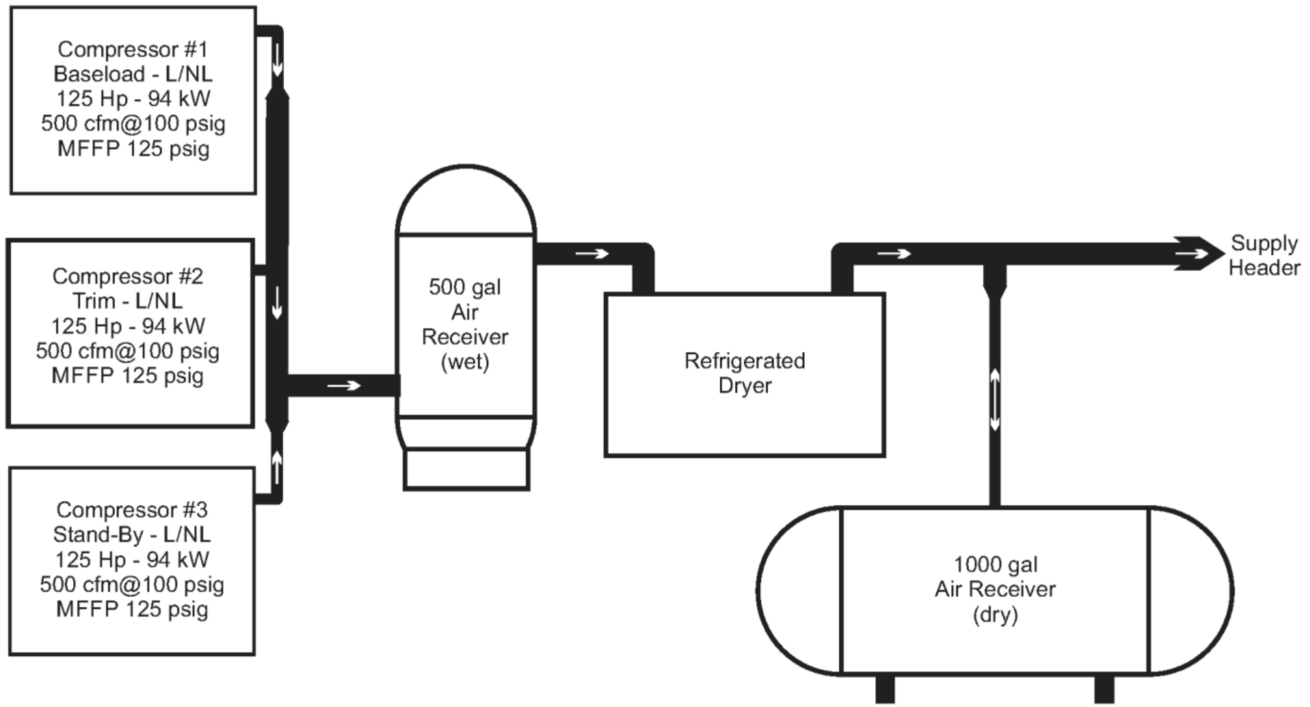
- This system is (Qty 3) 500 cfm compressors – base / trim / std-by.

- It takes 30 seconds for the std-by compressor to start & deliver air.

$$V = \frac{T\,(C-S)\,P_a}{\Delta P} \text{ x } \frac{7.48\,gal}{1\,scf}$$

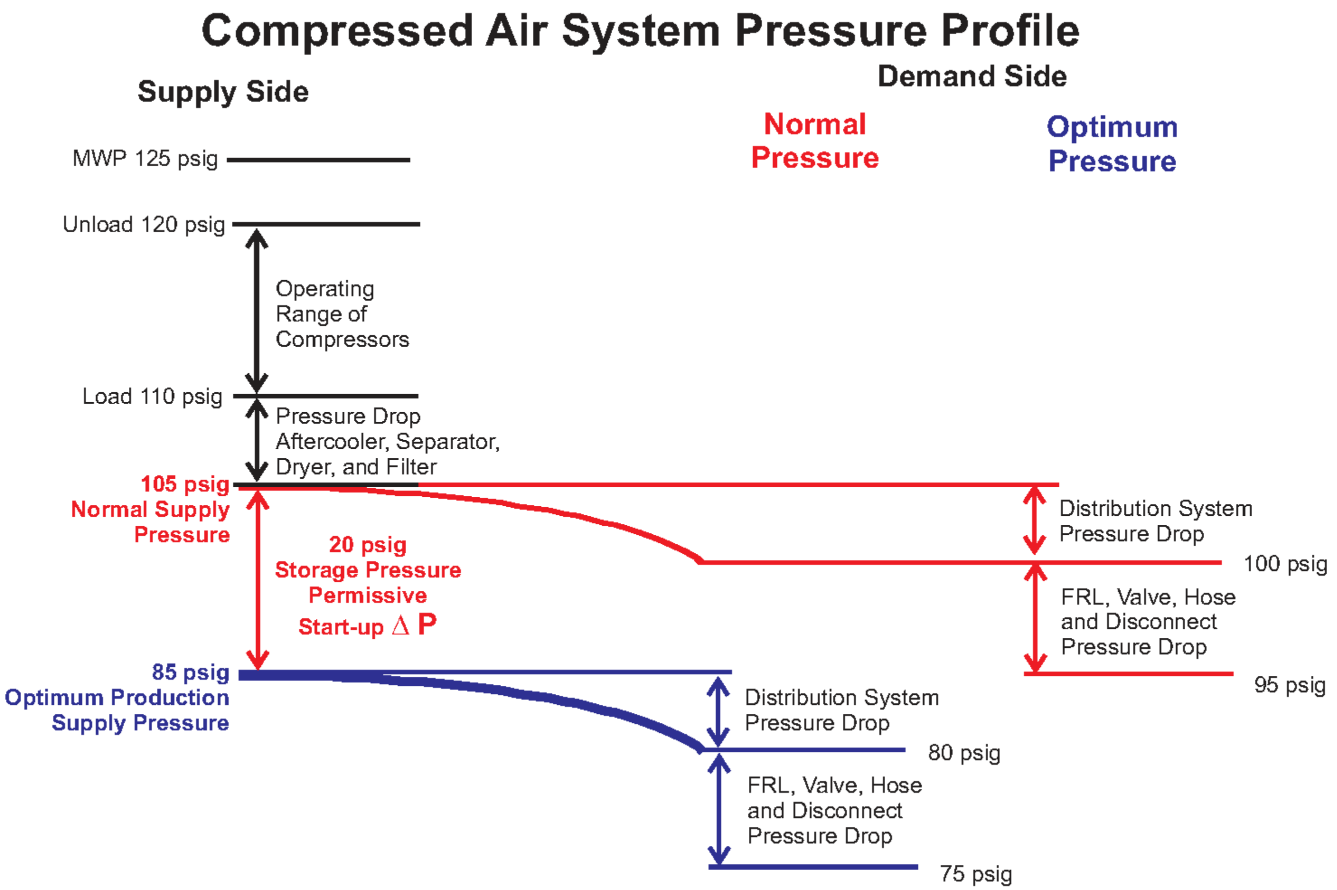
$$V = \frac{0.5\,(500-0)\,14.5}{103\,-85\,psig} \text{ x } \frac{7.48\,gal}{1\,scf}$$

- V = 1506 gallons

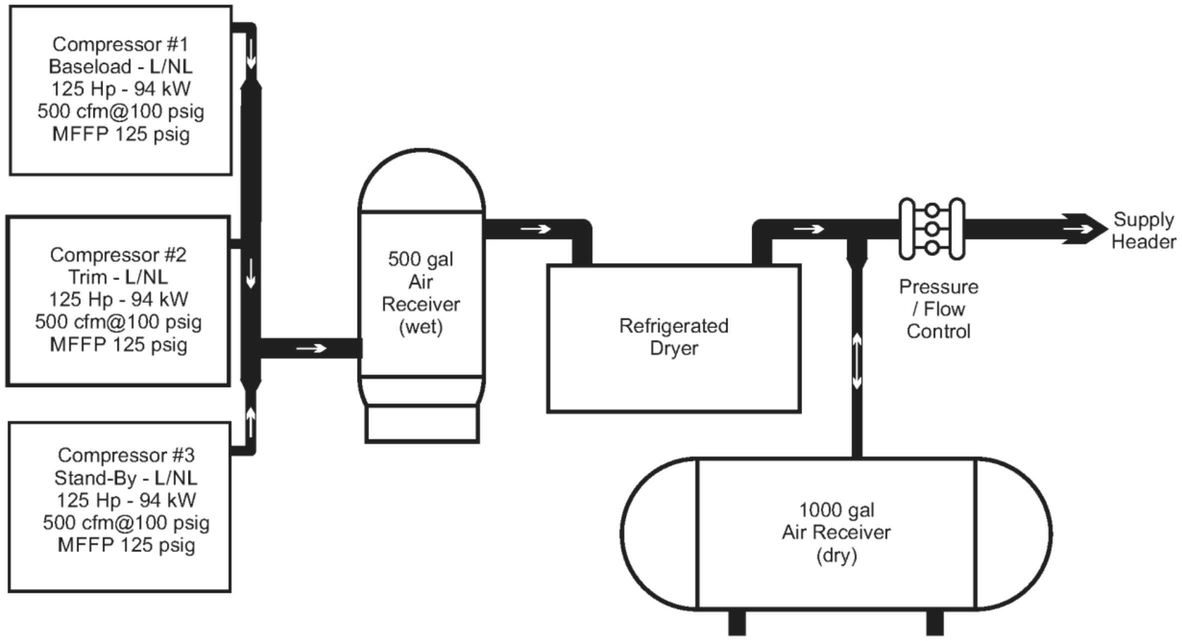


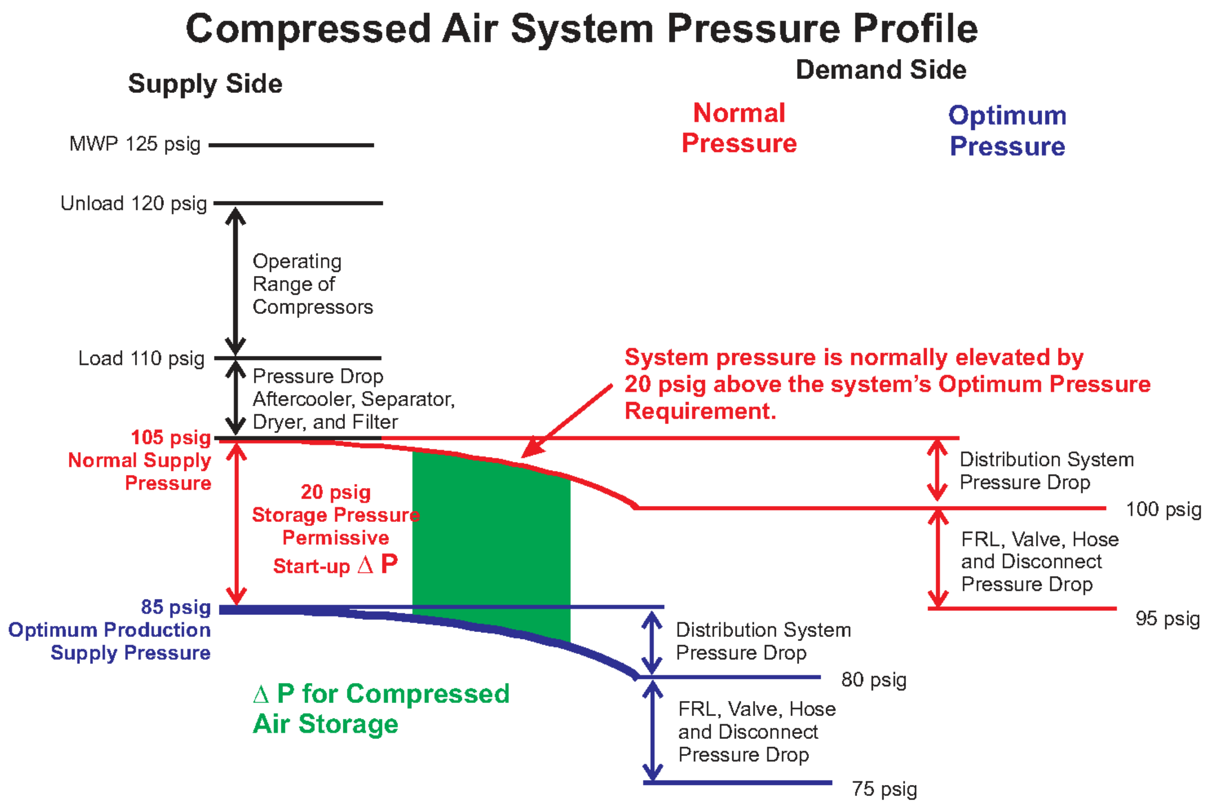
Un-controlled Storage 20 psig above optimum pressure

- The pressure profile 20 psig storage ΔP for permissive start
- Normal supply pressure = 105 psig
- Optimum supply pressure = 85 psig
- System normal operating pressure is 20 psig higher than the optimum production pressure requirement



Controlled Storage w/ 20 psi ΔP & 85 psig optimum target pressure





Pneumatic Cylinders – Un-Controlled and Un-regulated

Pneumatic Cylinders – Controlled & Regulated.

Air Operated Double Diaphragm Pumps – Standard -vs- Stroke Shifting Control.

End Use Equipment & Artificial Demand

Air Cylinder – Un-controlled & Un-regulated

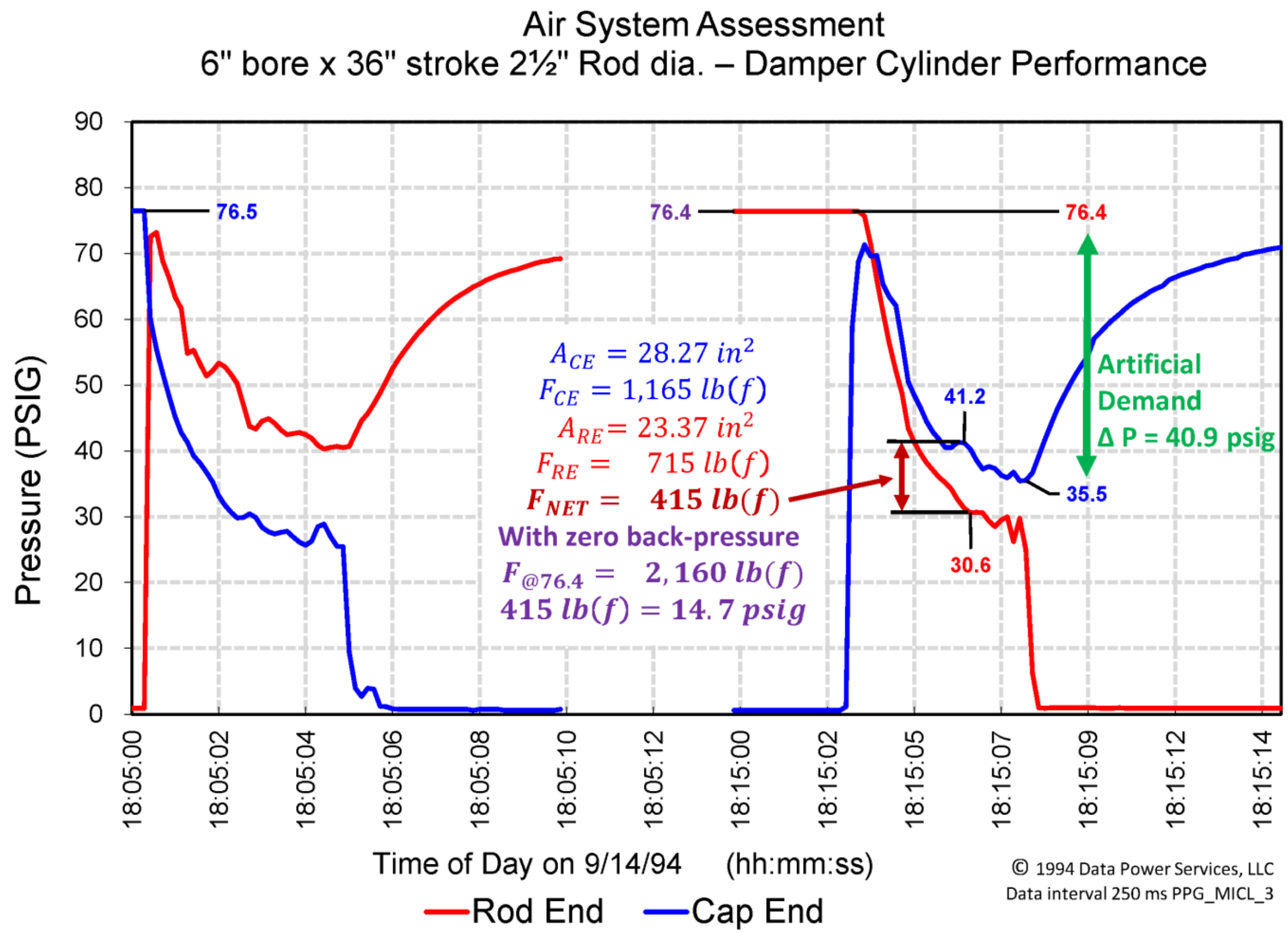
- 415 lb*(f)* Cylinder force (NET)
  - 76.4 psig line pressure
  - 73.2 psig break-away pressure
  - 35.5 psig end of stroke pressure
  - 40.9 psid end of stroke refill ΔP

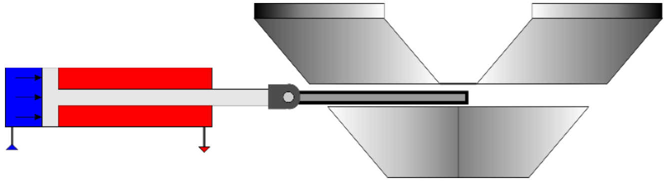
$$V = \frac{T \cdot C \cdot P_a}{\Delta P} \gg T \cdot C = \frac{P_a}{V \cdot \Delta P} = cf_{air}$$

$$cf_{air} = \frac{P_a}{V \cdot \Delta P} = \frac{14.5}{0.20 \cdot 40.9} = 1.77\ cf$$

$$3.54\ cf/stroke \cdot 1\ stroke/hr = 0.059\ \text{cfm}$$

$$0.059\ \frac{cf}{min} \cdot 8760\ \frac{hrs}{yr} \cdot \frac{60\ min}{1\ hr} = 30{,}010\ cf/yr$$

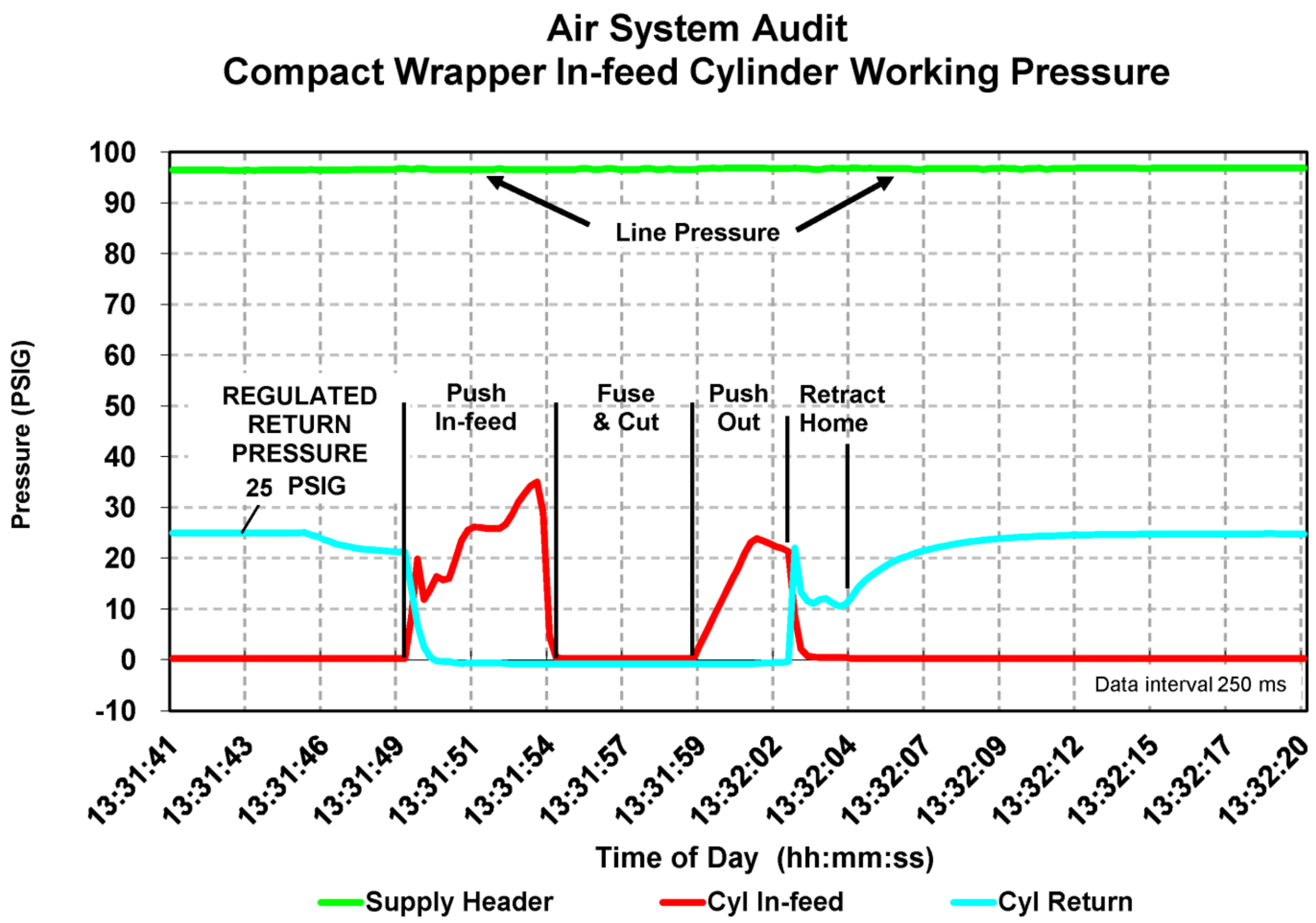




Air Cylinder – Controlled & Regulated

- Packaging shrink-wrapper
  - Line Pressure = 97 psig
  - Push in-feed & depressurize
  - Dwell during wrapper fuse & cut
  - Push out to conveyor & return
  - Return home & hold with regulated air pressure 25 psig

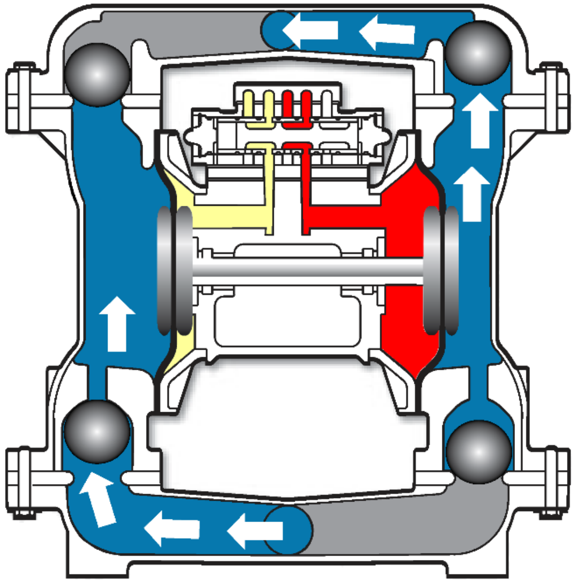
- Artificial demand???



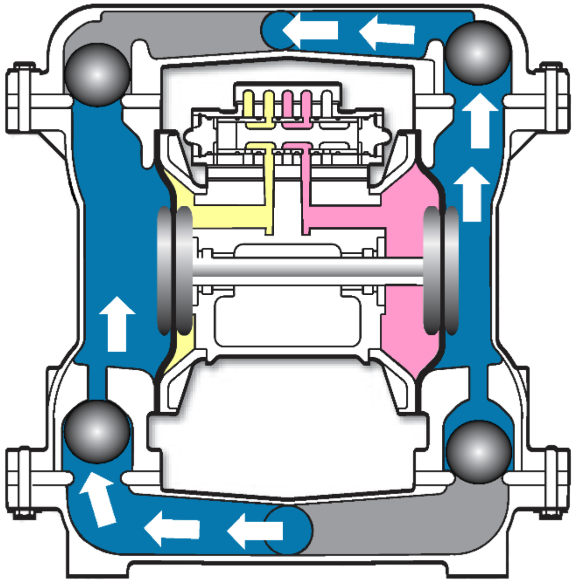
Air Operated Double Diaphragm Pump

AODD Standard -vs- Stroke Shifting Control

Standard Control



Stroke Shifting Control

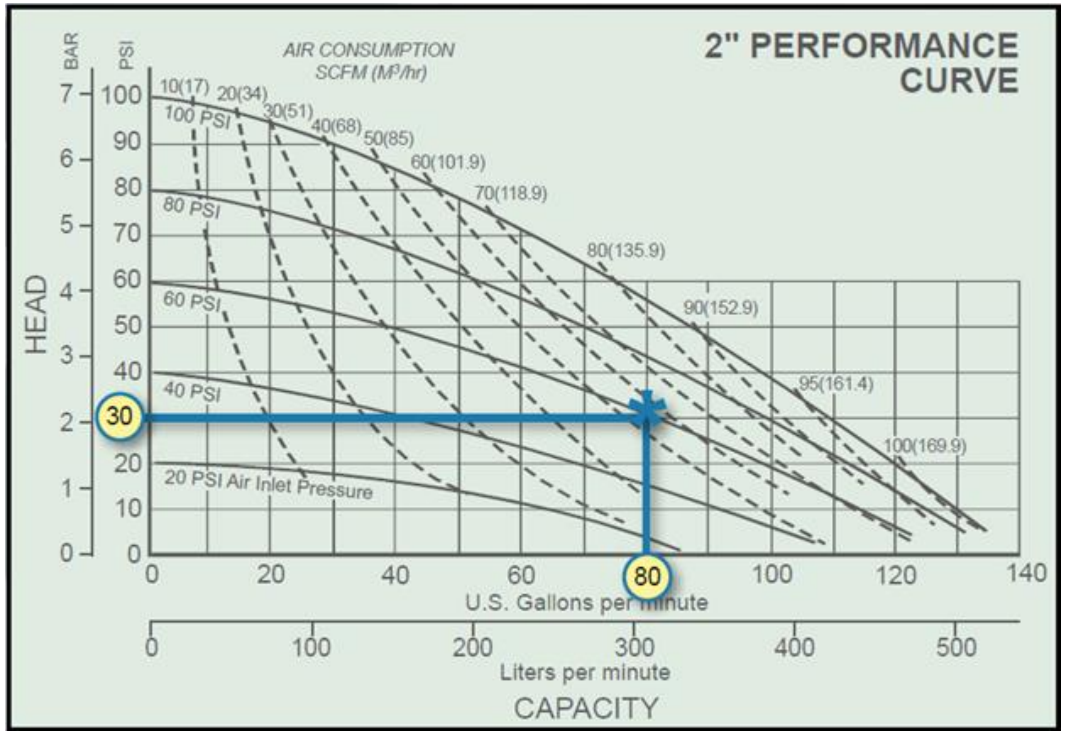


Air Operated Double Diaphragm Pump

AODD Standard -vs- Stroke Shifting Control

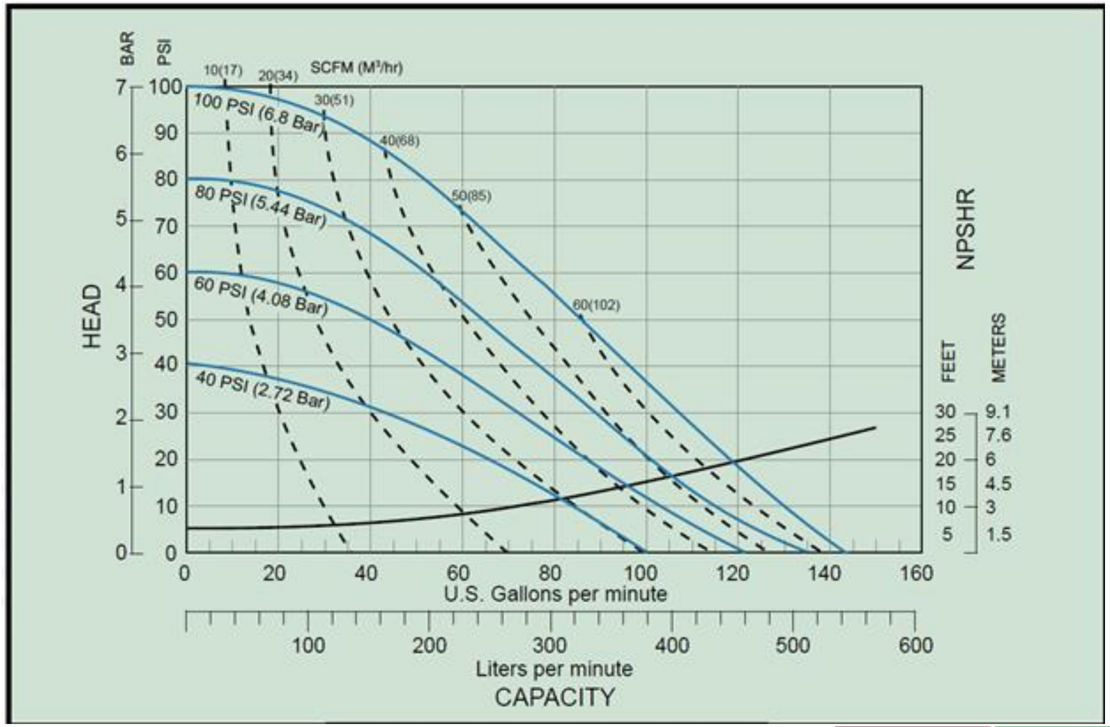
Standard Control

55 cfm @ 60 psig



Stroke Shifting Control

41 cfm @ 68 psig



Artificial Demand

Minimize loss, reduce system air consumption, & improve productivity.

Technical Case – better performance

- Provide stable consistent pressure
- Eliminate unnecessary high pressure.
- Maintain lowest optimum pressure.
- Apply storage for peak demands

Business Case – economic benefits

- Savings - reduced air consumption.
- Cost of controls, storage volume, system modifications.
- Savings of reduced rework & scrap.
- Benefit of improved productivity.

Caterpillar Fuel Systems Case Study


BestPractices
Technical Case Study

BestPractices

Office of Industrial Technologies
Energy Efficiency and Renewable Energy, U.S. Department of Energy

Compressed Air System Redesign Results in Savings and Increased Production at a Fuel System Machinery Plant

Summary

In 1999, Caterpillar Fuel Systems performed a compressed air system improvement project at its fuel injector plant in Pontiac, Illinois. The project's implementation greatly improved the compressed air system's reliability and efficiency. As a result, the plant achieved important energy savings through reduced energy consumption, was able to increase production by 18% without purchasing additional compressors and solved an air supply problem to a critical production area. Had the plant not increased its production, it would been able to take some of its compressors offline. The plant's compress total $226,000 (5,280,000 kWh) per year and represent o Since the project's cost was approximately 4 years. In addition, the project resulte per unit of production.

Benefits
- Saves $226,000 annually
- Reduces energy use
- 40% reduction in compressed air energy costs per unit of production
- Increases reliability
- Reduces CO_2 emissions

- 5.28 gigawatt-hour / yr. energy reduction
- $226,000 kWh / yr. savings
- Cost $ 1 million 4.4 yr. payback
- Critical HIP area 105 psig 5% of demand
- Remaining production 98 psig target
- 1300 cfm Artificial Demand Plant wide
- Energy 40%⇩ / production unit
- HIP ⇧18% production output
- Diesel Rental $42,000 / yr. savings
- Diesel Fuel $13,000 / yr. savings

About the Speaker

Dave George
Kaishan

- President, Kaishan
- Certified DOE AirMaster+
- 37 years of experience in the air compressor industry

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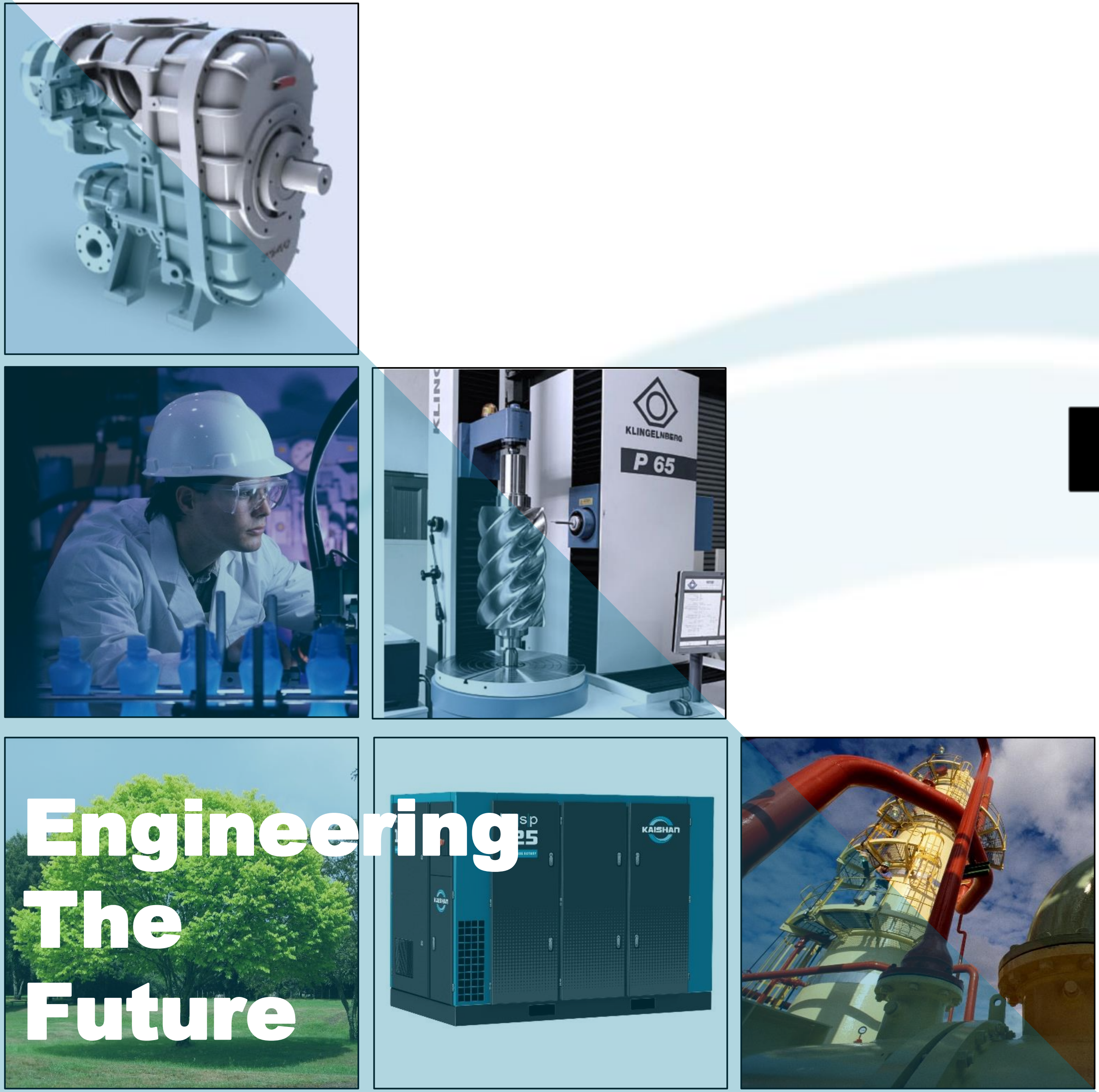

Compressed Air Best Practices

Webinar

Dave George – Kaishan USA

DOE Airmaster+

Kaishan Compressor:

- 3rd largest compressor manufacturer in the world
- USA HQ and manufacturing plant in Loxley, AL USA
- Members of the Compressed Air and Gas Institute (CAGI)
- Participants in the CAGI Performance Verification Program
- Performance Verification on published flow and power.
- CAGI has standardized Data Sheets for use in evaluating real world performance

Current Status:

- You have made significant progress on eliminating artificial demand by reducing supply header pressure, fixing leaks and reducing pressure at the point of use.
- You notice the existing 250HP is running differently. It is loading and unloading more frequently.
- Existing machine is re-set to 125 psig, rather than the 135 psig previous setting.
- You call in the compressor service company who verifies the controls (load – no load) are working properly.
- You have your service company do a supply side assessment on the current operating profile on the existing compressor.
- You have a budget for a replacement compressor this year.
- What do I do next?
- Find the most efficient 250 HP and buy it? – NOT THAT SIMPLE!

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COMPRESSOR DATA SHEET
Rotary Compressor: Fixed Speed

MODEL DATA - FOR COMPRESSED AIR

1	Manufacturer: Kaishan Compressor USA		
2	Model Number: KRSP250-125	Date:	3/10/2020
	[X] Air-cooled [ ] Water-cooled	Type:	Screw
	[X] Oil-injected [ ] Oil-free	# of Stages:	1
3*	Rated Capacity at Full Load Operating Pressure [a, e]	1189	acfm [a,e]
4	Full Load Operating Pressure [b]	125	psig [b]
5	Maximum Full Flow Operating Pressure [c]	125	psig [c]
6	Drive Motor Nominal Rating	250	hp
7	Drive Motor Nominal Efficiency	96.2	percent
8	Fan Motor Nominal Rating (if applicable)	7.5 & 2	hp
9	Fan Motor Nominal Efficiency	91.0 & 87.5	percent
10*	Total Package Input Power at Zero Flow [e]	44.8	kW [e]
11	Total Package Input Power at Rated Capacity and Full Load Operating Pressure [d]	215.5	kW [d]
12*	Specific Package Input Power at Rated Capacity and Full Load Operating Pressure [e]	18.1	kW/100 cfm [e]

COMPRESSOR DATA SHEET
Rotary Compressor: Variable Frequency Drive

MODEL DATA - FOR COMPRESSED AIR

1	Manufacturer: Kaishan Compressor USA			
2	Model Number: KRSP-250-125 VSD		Date:	3/10/2020
	[X] Air-cooled [ ] Water-cooled		Type:	Screw
	[X] Oil-injected [ ] Oil-free		# of Stages:	1
3	Rated Operating Pressure		125	psig [b]
4	Drive Motor Nominal Rating		250	hp
5	Drive Motor Nominal Efficiency		96.2	percent
6	Fan Motor Nominal Rating (if applicable)		1.5 & 7.5	hp
7	Fan Motor Nominal Efficiency		87.5 & 91.0	percent
8*	Input Power (kW)		Capacity (acfm) [a,d]	Specific Power (kW/100 acfm) [d]
	213.6	Max	1147	18.6
	147.4		792	18.6
	128.2		665	19.3
	106.8		539	19.8
	85.4		413	20.7
	64.1	Min	275	23.3
9*	Total Package Input Power at Zero Flow [c, d]		0.0	kW

https://www.cagi.org/pdfs/cagirotarydirectory.pdf

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COMPRESSOR DATA SHEET

Federal Uniform Test Method for Certain Air Compressors Not Applicable

Rotary Compressor: Fixed Speed

MODEL DATA - FOR COMPRESSED AIR			
1	Manufacturer: **Kaishan Compressor USA**		
2	Model Number: KRSP2-250-125	Date:	7/12/2021
	[X] Air-cooled [ ] Water-cooled	Type:	Screw
	[x] Oil-injected [ ] Oil-free	# of Stages:	2
3*	Rated Capacity at Full Load Operating Pressure [a, e]	1339.0	acfm[a,e]
4	Full Load Operating Pressure [b]	125	psig[b]
5	Maximum Full Flow Operating Pressure [c]	125	psig[c]
6	Drive Motor Nominal Rating	250	hp
7	Drive Motor Nominal Efficiency	96.2	percent
8	Fan Motor Nominal Rating (if applicable)	7.5 & 2.0	hp
9	Fan Motor Nominal Efficiency	91.0 & 87.5	percent
10*	Total Package Input Power at Zero Flow [e]	39.4	kW[e]
11	Total Package Input Power at Rated Capacity and Full Load Operating Pressure [d]	220.90	kW[d]
12*	Specific Package Input Power at Rated Capacity and Full Load Operating Pressure [e]	16.50	kW/100 cfm[e]

COMPRESSOR DATA SHEET

Federal Uniform Test Method for Certain Air Compressors Not Applicable

Rotary Compressor: Variable Frequency Drive

MODEL DATA - FOR COMPRESSED AIR				
1	Manufacturer: **Kaishan Compressor USA**			
2	Model Number: KRSP2-250-125 VSD		Date:	07/12/21
	[X] Air-cooled [ ] Water-cooled		Type:	Screw
	[x] Lubricated [ ] Oil Free		# of Stages:	2
3*	Full Load Operating Pressure [b]		125	psig[b]
4	Drive Motor Nominal Rating		250	hp
5	Drive Motor Nominal Efficiency		96.2	percent
6	Fan Motor Nominal Rating (if applicable)		7.5 &1.5	hp
7	Fan Motor Nominal Efficiency		87.5 & 91.0	percent
8*	Input Power (kW)		Capacity (acfm)[a,d]	Specific Power (kW/100 acfm)[d]
	225.2		1339	16.82
	184.7		1071	17.25
	159.9		937	17.07
	119.4		670	17.82
	96.8		536	18.06
9*	Total Package Input Power at Zero Flow [c, d]		0.0	kW

https://www.cagi.org/pdfs/cagirotarydirectory.pdf

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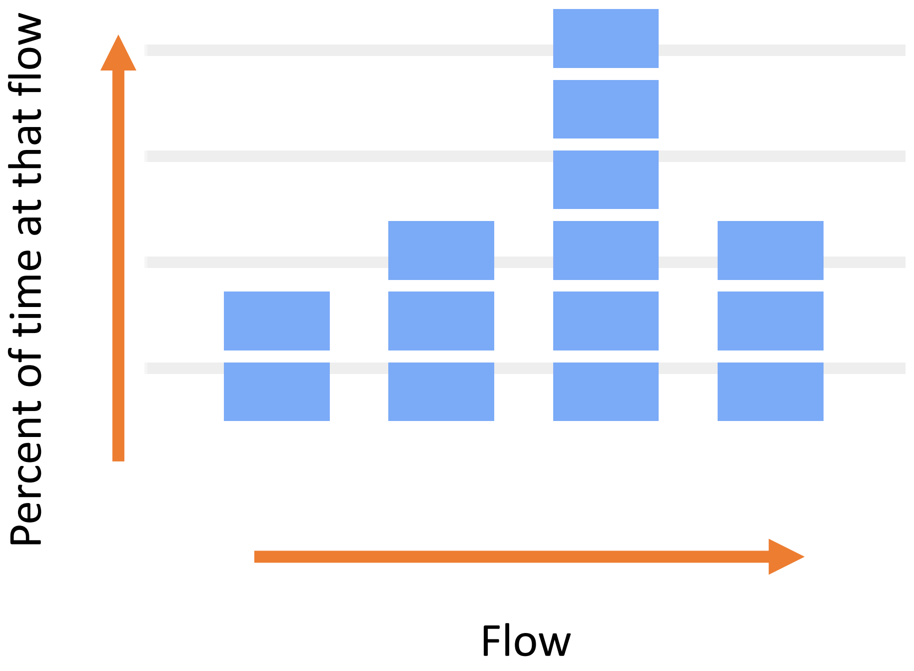
Measured Data

- Use Histogram function to turn your flow data into a maximum of five data buckets
- Use that data in the calculator



Energy Cost Calculator

Operating Weeks Per Year	52
Energy Cost ($/kW*hr)	0.08
Customer	XYZ Corp
Reference	Plant #2
Notes	This analysis is approximate and absolutely no guarantees apply

Shift #	CFM	Shift Hours	Days/Wk
1	1100	10	6
2	900	8	6
3	750	6	6
4	500	5	1
5	250	5	1
		Total Hours (must <= 168)	154

Compressor Information	#1	#2	#3	#4
Model/Name	KRSP-250-125	KRSP-250VSD	KRSP2-250	KRSP2-250VSD
Full Load Flow (cfm)	1189	1147	1339	1339
Full Load Power (kW)	215.5	213.6	220.9	225.2
Control Type	Modulation	Variable Speed	Modulation	Variable Speed

% Load	Hours Per Week
0%	0
5%	0
10%	0
15%	0
20%	0
25%	5
30%	0
35%	0
40%	0
45%	5
50%	0
55%	0
60%	0
65%	36
70%	0
75%	0
80%	48
85%	0
90%	0
95%	60
100%	0
Total Power	**1,656,561**
Annual Energy Cost	**$132,525**

Single stage, modulation control

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Energy Cost Calculator

Operating Weeks Per Year	52
Energy Cost ($/kW*hr)	0.08
Customer	XYZ Corp
Reference	Plant #2
Notes	This analysis is approximate and absolutely no guarantees apply

Shift #	CFM	Shift Hours	Days/Wk
1	1100	10	6
2	900	8	6
3	750	6	6
4	500	5	1
5	250	5	1
		Total Hours (must <= 168)	154

Compressor Information	#1	#2	#3	#4
Model/Name	KRSP-250-125	KRSP-250VSD	KRSP2-250	KRSP2-250VSD
Full Load Flow (cfm)	1189	1147	1339	1339
Full Load Power (kW)	215.5	213.6	220.9	225.2
Control Type	Load/No Load (5)	Variable Speed	Modulation	Variable Speed

% Load	Hours Per Week
0%	0
5%	0
10%	0
15%	0
20%	0
25%	5
30%	0
35%	0
40%	0
45%	5
50%	0
55%	0
60%	0
65%	36
70%	0
75%	0
80%	48
85%	0
90%	0
95%	60
100%	0
Total Power	**1,536,287**
Annual Energy Cost	**$122,903**

Add a 5,000 gallon tank and use L/UL control?

Tank: $30K

Energy Cost Calculator

What about a VSD control?

VSD Adds $25K

Operating Weeks Per Year	52
Energy Cost ($/kW*hr)	0.08
Customer	XYZ Corp
Reference	Plant #2
Notes	This analysis is approximate and absolutely no guarantees apply

Shift #	CFM	Shift Hours	Days/Wk
1	1100	10	6
2	900	8	6
3	750	6	6
4	500	5	1
5	250	5	1
		Total Hours (must <= 168)	154

Compressor Information	#1	#2	#3	#4
Model/Name	KRSP-250-125	KRSP-250VSD	KRSP2-250	KRSP2-250VSD
Full Load Flow (cfm)	1189	1147	1339	1339
Full Load Power (kW)	215.5	213.6	220.9	225.2
Control Type	Load/No Load (5)	Variable Speed	Modulation	Variable Speed

% Load	Hours Per Week	Hours Per Week		
0%	0	0		
5%	0	0		
10%	0	0		
15%	0	0		
20%	0	0		
25%	5	5		
30%	0	0		
35%	0	0		
40%	0	0		
45%	5	5		
50%	0	0		
55%	0	0		
60%	0	0		
65%	36	0		
70%	0	36		
75%	0	0		
80%	48	48		
85%	0	0		
90%	0	0		
95%	60	0		
100%	0	60		
Total Power	**1,536,287**	**1,433,551**		
Annual Energy Cost	**$122,903**	**$114,684**		

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COMPRESSOR DATA SHEET

Federal Uniform Test Method for Certain Air Compressors Not Applicable

Rotary Compressor: Fixed Speed

MODEL DATA - FOR COMPRESSED AIR			
1	Manufacturer: **Kaishan Compressor USA**		
2	Model Number: KRSP2-250-125; [X] Air-cooled [ ] Water-cooled; [x] Oil-injected [ ] Oil-free	Date: 7/12/2021; Type: Screw; # of Stages: 2	
3*	Rated Capacity at Full Load Operating Pressure [a, e]	1339.0	acfm[a,e]
4	Full Load Operating Pressure [b]	125	psig[b]
5	Maximum Full Flow Operating Pressure [c]	125	psig[c]
6	Drive Motor Nominal Rating	250	hp
7	Drive Motor Nominal Efficiency	96.2	percent
8	Fan Motor Nominal Rating (if applicable)	7.5 & 2.0	hp
9	Fan Motor Nominal Efficiency	91.0 & 87.5	percent
10*	Total Package Input Power at Zero Flow [e]	39.4	kW[e]
11	Total Package Input Power at Rated Capacity and Full Load Operating Pressure [d]	220.90	kW[d]
12*	Specific Package Input Power at Rated Capacity and Full Load Operating Pressure [e]	16.50	kW/100 cfm[e]

COMPRESSOR DATA SHEET

Federal Uniform Test Method for Certain Air Compressors Not Applicable

Rotary Compressor: Variable Frequency Drive

MODEL DATA - FOR COMPRESSED AIR				
1	Manufacturer: **Kaishan Compressor USA**			
2	Model Number: KRSP2-350-125 VSD; [X] Air-cooled [ ] Water-cooled; [x] Lubricated [ ] Oil Free			Date: 07/12/21; Type: Screw; # of Stages: 2
3*	Full Load Operating Pressure [b]		125	psig[b]
4	Drive Motor Nominal Rating		350	hp
5	Drive Motor Nominal Efficiency		96.2	percent
6	Fan Motor Nominal Rating (if applicable)		15&4	hp
7	Fan Motor Nominal Efficiency		91.7&89.1	percent
8*	Input Power (kW)		Capacity (acfm)[a,d]	Specific Power (kW/100 acfm)[d]
	322.7		1896	17.02
	264.6		1517	17.44
	229.1		1327	17.26
	171.0		948	18.04
	138.8		758	18.31
9*	Total Package Input Power at Zero Flow [c, d]		0.0	kW

https://www.cagi.org/pdfs/cagirotarydirectory.pdf

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Energy Cost Calculator

What about a Two Stage more efficient compressor?

Two Stage additional cost $35K

Operating Weeks Per Year	52
Energy Cost ($/kW*hr)	0.08
Customer	XYZ Corp
Reference	Plant #2
Notes	This analysis is approximate and absolutely no guarantees apply

Shift #	CFM	Shift Hours	Days/Wk
1	1100	10	6
2	900	8	6
3	750	6	6
4	500	5	1
5	250	5	1
		Total Hours (must <= 168)	154

Compressor Information	#1	#2	#3	#4
Model/Name	KRSP-250-125	KRSP-250VSD	KRSP2-250	KRSP2-250VSD
Full Load Flow (cfm)	1189	1147	1339	1339
Full Load Power (kW)	215.5	213.6	220.9	225.2
Control Type	Load/No Load (5)	Variable Speed	Modulation	Variable Speed

% Load	Hours Per Week	Hours Per Week	Hours Per Week
0%	0	0	0
5%	0	0	0
10%	0	0	0
15%	0	0	0
20%	0	0	5
25%	5	5	5
30%	0	0	0
35%	0	0	0
40%	0	0	5
45%	5	5	0
50%	0	0	0
55%	0	0	0
60%	0	0	36
65%	36	0	0
70%	0	36	48
75%	0	0	0
80%	48	48	0
85%	0	0	60
90%	0	0	0
95%	60	0	0
100%	0	60	0
Total Power	**1,536,287**	**1,433,551**	**1,710,729**
Annual Energy Cost	**$122,903**	**$114,684**	**$136,858**

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Energy Cost Calculator

Operating Weeks Per Year	52
Energy Cost ($/kW*hr)	0.08
Customer	XYZ Corp
Reference	Plant #2
Notes	This analysis is approximate and absolutely no guarantees apply

Shift #	CFM	Shift Hours	Days/Wk
1	1100	10	6
2	900	8	6
3	750	6	6
4	500	5	1
5	250	5	1
		Total Hours (must <= 168)	154

Compressor Information	#1	#2	#3	#4
Model/Name	KRSP-250-125	KRSP-250VSD	KRSP2-250	KRSP2-250VSD
Full Load Flow (cfm)	1189	1147	1339	1339
Full Load Power (kW)	215.5	213.6	220.9	225.2
Control Type	Load/No Load (5)	Variable Speed	Load/No Load (5)	Variable Speed

% Load	Hours Per Week	Hours Per Week	Hours Per Week	
0%	0	0	0	
5%	0	0	0	
10%	0	0	0	
15%	0	0	0	
20%	0	0	5	
25%	5	5	5	
30%	0	0	0	
35%	0	0	0	
40%	0	0	5	
45%	5	5	0	
50%	0	0	0	
55%	0	0	0	
60%	0	0	36	
65%	36	0	0	
70%	0	36	48	
75%	0	0	0	
80%	48	48	0	
85%	0	0	60	
90%	0	0	0	
95%	60	0	0	
100%	0	60	0	
Total Power	**1,536,287**	**1,433,551**	**1,493,916**	
Annual Energy Cost	**$122,903**	**$114,684**	**$119,513**	

Tank: $30K

Energy Cost Calculator

Operating Weeks Per Year	52
Energy Cost ($/kW*hr)	0.08
Customer	XYZ Corp
Reference	Plant #2
Notes	This analysis is approximate and absolutely no guarantees apply

Shift #	CFM	Shift Hours	Days/Wk
1	1100	10	6
2	900	8	6
3	750	6	6
4	500	5	1
5	250	5	1
		Total Hours (must <= 168)	154

Compressor Information	#1	#2	#3	#4
Model/Name	KRSP-250-125	KRSP-250VSD	KRSP2-250	KRSP2-250VSD
Full Load Flow (cfm)	1189	1147	1339	1339
Full Load Power (kW)	215.5	213.6	220.9	225.2
Control Type	Load/No Load (5)	Variable Speed	Load/No Load (5)	Variable Speed

% Load	Hours Per Week	Hours Per Week	Hours Per Week	Hours Per Week
0%	0	0	0	0
5%	0	0	0	0
10%	0	0	0	0
15%	0	0	0	0
20%	0	0	5	5
25%	5	5	5	5
30%	0	0	0	0
35%	0	0	0	0
40%	0	0	5	5
45%	5	5	0	0
50%	0	0	0	0
55%	0	0	0	0
60%	0	0	36	36
65%	36	0	0	0
70%	0	36	48	48
75%	0	0	0	0
80%	48	48	0	0
85%	0	0	60	60
90%	0	0	0	0
95%	60	0	0	0
100%	0	60	0	0
Total Power	**1,536,287**	**1,433,551**	**1,493,916**	**1,333,580**
Annual Energy Cost	**$122,903**	**$114,684**	**$119,513**	**$106,686**

What about a VSD control?

VSD adds $30K

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Can You lower your plant pressure to 100 psig?

Now maybe you can use a smaller HP (200) two stage compressor

Energy Cost Calculator

Operating Weeks Per Year	52	Shift #	CFM	Shift Hours	Days/Wk
Energy Cost ($/kW*hr)	0.08	1	1100	10	6
Customer	XYZ Corp	2	900	8	6
Reference	Plant #2	3	750	6	6
Notes	This analysis is approximate and absolutely no guarantees apply	4	500	5	1
		5	250	5	1
				Total Hours (must <= 168)	154

Compressor Information	#1	#2	#3	#4
Model/Name	KRSP2-200-100	KRSP2-200-100	KRSP2-200-100VSD	KRSP2-250VSD
Full Load Flow (cfm)	1178	1178	1121	1339
Full Load Power (kW)	181.5	181.5	181.8	225.2
Control Type	Modulation	Load/No Load (5)	Variable Speed	Variable Speed

% Load	Hours Per Week	Hours Per Week	Hours Per Week	Hours Per Week
0%	0	0	0	0
5%	0	0	0	0
10%	0	0	0	0
15%	0	0	0	0
20%	0	0	0	5
25%	5	5	5	5
30%	0	0	0	0
35%	0	0	0	0
40%	0	0	0	5
45%	5	5	5	0
50%	0	0	0	0
55%	0	0	0	0
60%	0	0	0	36
65%	36	36	0	0
70%	0	0	36	48
75%	0	0	0	0
80%	48	48	0	0
85%	0	0	48	60
90%	0	0	0	0
95%	60	60	0	0
100%	0	0	60	0
Total Power	**1,395,201**	**1,293,903**	**1,241,456**	**1,333,580**
Annual Energy Cost	**$111,616**	**$103,512**	**$99,316**	**$106,686**

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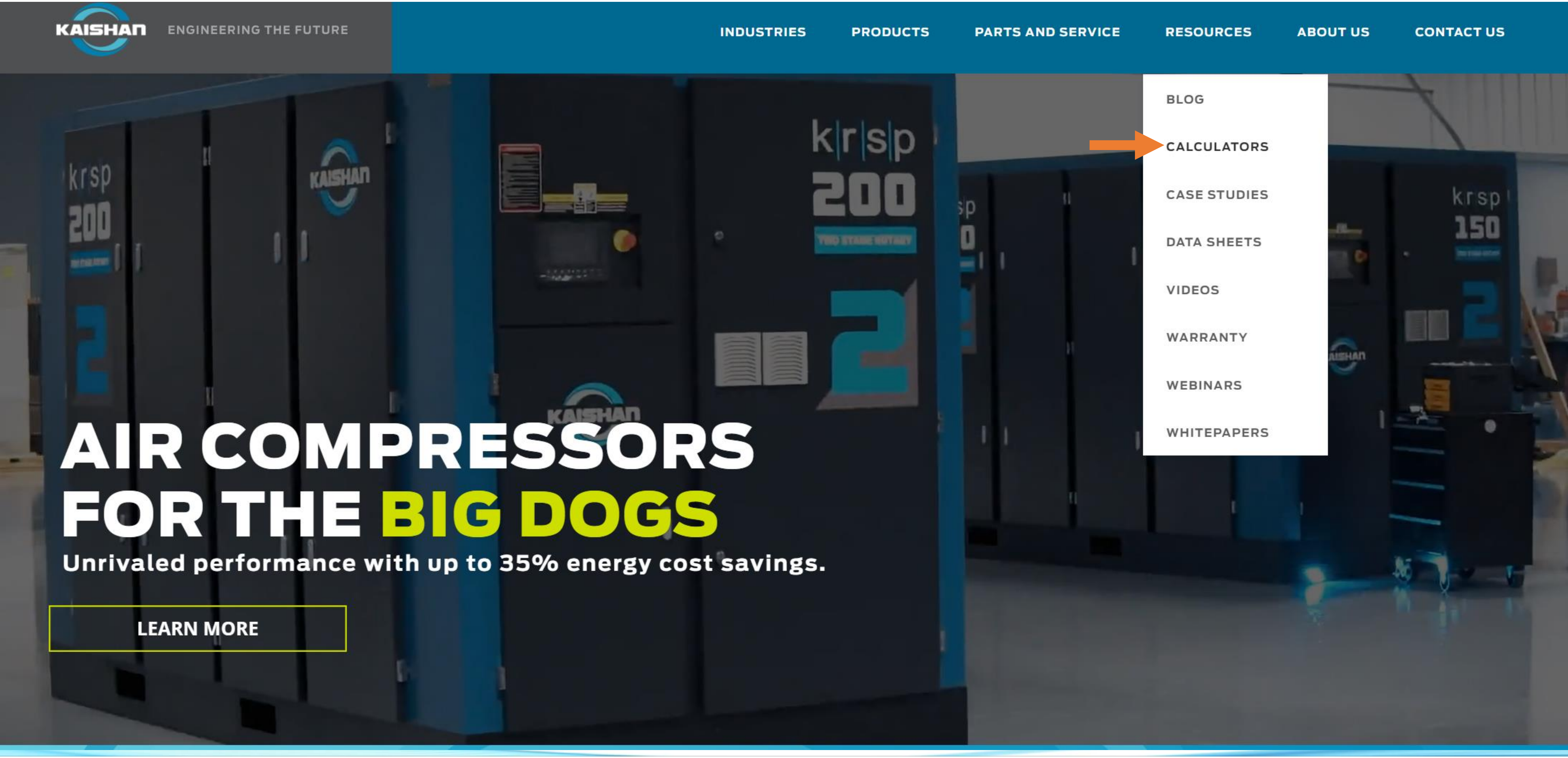
Calculator Resource on our Website



Conclusions:

- Every system is different
- Every installation is different
- Don't just look at the basics – details matter!
- Work with an air expert who knows what they are doing.
- I'll be glad to help you with your analysis – contact me.

Thank You

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www.kaishanusa.com

Best Practices EXPO Contest

Play for a chance to win a **FREE Full Conference Pass** to the Best Practices 2024 EXPO & Conference!! This is a $675 value! This contest is open to factory personnel, compressed air distributors, utility incentive programs and engineering firms. Exhibiting and sponsor companies are not qualified. Winners will be randomly selected from those who submitted a correct answer and notified tomorrow via email.

Please submit your answer in the upcoming poll

What does artificial demand in a compressed air system refer to?

A
- Use of compressed air where not needed

B
- Extra pressure for distant tools

C
- Excess demand from leaks and inefficiencies

*By entering you are giving permission to announce your name if you are a winner

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What does artificial demand in a compressed air system refer to?

A
- Use of compressed air where not needed

B
- Extra pressure for distant tools

C ✓
- Excess demand from leaks and inefficiencies

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Thank you for attending!

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Andrew Smith
SMARTCAir
Keynote Speaker

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