Compressed Air Alliance
ABN: 72 633 254 476
Phone: 0422 748 645

Leakage & Inappropriate Use Report

Bob's Pet Food

Survey Dates: July 2020

This report was prepared for:

Bob Smith
Bob's Pet Food
1 Some Street
Any Town

Phone: 02 9999 0000
Email: bob@bobspetfood.com

This report was prepared by:

Warwick Rampley

Managing Director

Compressed Air Alliance Pty Ltd

Unit 4/1 Regent Street
Dee Why, NSW 2099

Australia

Phone: +61 422 748 645

E-mail: warwick@compressedairalliance.com

Website: www.compressedairalliance.com

ABN 72 633 254 476

About Compressed Air Alliance

Compressed Air Alliance are experts in the compressed air industry. We work with manufacturers to reduce compressed air demand and improve the efficiency and reliability of compressed air systems.

We offer leakage surveys, auditing, purity testing, consulting, training, system upgrades, monitoring and repairs of compressed air systems. We also provide temporary and permanent measurement, system controls and monitoring equipment.

Compressed Air Alliance has worked with a wide variety of industries across Asia-Pacific including Automotive, Aerospace, Clothing & Textiles, Food & Beverage, Paper & Printing, Energy, Electronic & Semi-Conductor, Mining & Minerals, Medical & Pharmaceutical and Petrochemical.

For more information on Compressed Air Alliance, please see our website: www.compressedairalliance.com or email sales@compressedairalliance.com.

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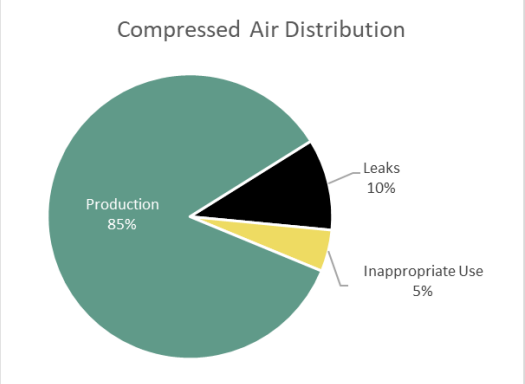
Executive Summary

Compressed Air Alliance conducted an audit of the compressed air system at Bob's Pet Foods in July 2020. The survey included measuring the performance of the compressed air system, identifying leakage and inappropriate usage and making recommendations on improving the compressed air system.

The compressed air system at Bob's Pet Foods costs approximately $104,592 per year (21% of the site's total electricity use).

Roughly 10% of compressed air supplied to the site is being lost in leaks whilst 5% is used by inappropriate use. The remaining 85% of compressed air is used for production purposes (see graph right).



The survey found 112 leaks and 53 inappropriate uses as shown in the table below. Repairing all leaks will have a 5 month payback.

Results of Leakage and Inappropriate Use survey

Department	No. of Instances	Estimated Flow (m^3/min)	Estimated Cost per year	Estimated Repair Cost[1]	Payback (years)
Leaks	112	4.428	$50,675	$22,400	0.4
Inappropriate use	53	10.550	$22,971	-	Typical payback less than 2 years
Total	**165**	**14.978**	**$73,646**	**-**	**-**

[1] This is an estimated price for parts and labour based on aggregate data from previous surveys. Actual costs will vary. Replacing solenoids, regulators, lubricators, cylinders, filters, etc will result in higher parts prices.

Recommendations

Based on the system measurement, observations and the site survey, the following actions may improve the efficiency and reduce the operating cost of your compressed air system.

- Repair leaks (refer to Part A – Flow and Part B)
- Develop a regular leak detection and repair program (refer to Part B)
- Address inappropriate uses (refer to Part C)
- Remove the pipework restriction between the main receiver, dryer and factory to increase the supply of compressed air (refer to Part A – Pressure)
- Connect both compressors to the same receiver so that the compressors can work more effectively together (refer to Part A – Power)
- Consider moving the fixed speed compressor and connecting it to the main wet receiver. This will reduce product contamination from wet air (refer to Part A – Dew Point & Temperature).

About Leakage and Inappropriate Use Surveys

Introduction

Leaks and inappropriate use can significantly increase compressed air demand and energy costs, reduce compressed air system efficiency and cause drops in system pressure thereby affecting production. Leaks can also decrease service life and increase maintenance of compressors and associated equipment due to unnecessary cycling and increased run time.

Without specialist equipment, **leaks** are almost impossible to locate and diagnose during production periods due to high ambient noise and requirements for hearing protection. Leaks typically occur at joints and connections of equipment. Leaks can be caused by a number of issues including worn out parts, loose fittings, lack of sealant, poor installation or using the wrong part.

Inappropriate use occurs where compressed air is used when an alternative solution would be more economical. For example: using compressed air to cool or dry a product, when a small electric blower would have a significantly lower running cost.

About the Survey

Leakage and inappropriate use **surveys** aim to identify and quantify leaks and inappropriate usage so that businesses can make informed decisions on repair, maintenance and modification requirements. Conducting a leakage and inappropriate use survey may provide many benefits to businesses including:

- improvements in compressed air system reliability
- reduced expenditure on energy, capital and maintenance, and
- improved productivity, product quality and staff engagement.

Leakage and inappropriate use surveys are conducted onsite by trained technicians during production time. The survey consists of:

- using an ultrasonic detector specifically designed to identify compressed air leaks
- recording and tagging leaks
- establishing parts and labour requirements for repairs
- identifying inappropriate usage and recommending alternative solutions, and
- inspecting other system components for faults or opportunities to improve efficiency.

Information recorded during the survey is converted into energy cost data by using flow rate tables, the site's operating hours and the site's electricity costs. Improved data accuracy can be obtained by measuring the compressed air system's energy and flow usage to more accurately determine the cost of compressed air before and after repairs.

Follow up Surveys

Leakage is an ongoing issue, identification and repair projects should be scheduled on a routine basis to ensure leakage is reduced and maintained at below 5% of total system usage. **Follow up surveys**

should be done at a maximum of every 12 months as new leaks will regularly start to appear in the system.

Repairing Leaks

It is important to **repair as many leaks as possible**, **as soon as possible** (preferably within one month of the survey). Small leaks will deteriorate into larger leaks rapidly, particularly after priority leaks have been repaired. For best results, 90% or more of the leaks should be repaired within one month of the survey.

All parts should be ordered for all leaks (regardless of leak size or priority). This can avoid unnecessary machine downtime and increase the likelihood of the repairs being achieved in a timely manner.

Repairing leaks does not result in linear savings. Typically little or no result will be observed until at least 80% of the number of leaks are repaired. Additionally, if this is the first leakage project on the site for any length of time, new leaks may appear very quickly as others are repaired due to the increased pressure in the system. This can result in potential savings not being maintained for the full 12 months.

One of the most obvious **benefits of repairing leaks** is a reduction in energy use and costs from reduced air demand, however there are other benefits of repairing leaks. Repairing leaks can:

- Improve the compressed air system efficiency as air is being used for its intended purpose rather than being waste through leaks
- Avoid the need to purchase additional equipment, boosters or other parts
- Reduce pressure drops across the system
- Improve air purity through better filter performance
- Increase equipment (compressor) service life
- Reduce maintenance of compressors and associated equipment due reduced running time
- Lower ambient noise levels

As you repair leaks, you may need to **adjust your compressor and equipment settings**. As noted above, repairing leaks can increase pressure in your compressed air system. Therefore, you may need to adjust your compressor or equipment settings to a lower pressure rating.

Rectifying Inappropriate Use

Compressed air is often used to solve problems with little consideration of the operating costs and risks to production. Replacing compressed air driven equipment with alternative solutions is more energy efficient and results in reduced operating costs for the site. However, whilst there may be alternatives to inappropriate use, the business may elect to stay with compressed air for budget, safety or operational reasons.

Removing inappropriate use can bring numerous benefits beyond just the simple energy savings. These benefits include:

- Reduced risk of product contamination
- Increased system capacity

- Reduced maintenance and capital costs (of compressed air system)
- Lower ambient noise
- Improved production efficiency through better use of power

Part A Compressed Air System

Site Description

Bob's Pet Foods make wet and dry foods for dogs and cats. Production typically occurs 24 hours/day, 5 days/week, however the compressed air system operates 24 hours/day, 7 days per week. This is due to the desiccant dryer requiring time to achieve the required dew point. Maintenance is conducted on weekends.

Compressed Air System

The compressed air system consists of 2 compressors in two locations. Compressor room 1 has a VSD (lead compressor) as well as a desiccant dryer, receiver and filters. Compressor room 2 has a fixed speed compressor (standby compressor) as well as a receiver.

Compressed Air Alliance installed flow, pressure, current, dew point and temperature sensors on the compressed air system. Data was recorded for a period of approximately 168 hour (1 week) and was analysed to provide the following graphs. The data was used to estimate usage over a full year (8760 hours) with an average cost of electricity calculated at 16.7c/kWh based on electricity bills provided by the site. The compressed air system currently consumes approximately 21% of the sites annual electricity.

Measurement Results

Measurement	Results
Site's electricity use	Usage = 2,915,986 kWh per year Cost = $486,970 per year Based on electricity bills supplied by site
Compressed air electricity use	Usage = 626,299 kWh per year Cost = $104,592 per year Equates to approximately 21% of the site's total electricity use
Compressed air consumption	3,057,140 m³ per year
Cost of compressed air	Average = $3.47 per 100/m³
Average system pressure	Wet Pressure = 7.11 barg Dry Pressure = 6.44 barg Pressure Drop = 0.67 barg
Efficiency of compressors system (Specific Power)	Average = 13.23 kW/m3/min Max = 32.34 kW/m3/min
System flow rate	Maximum demand = 11.63 m3/min Average = 6.61 m3/min

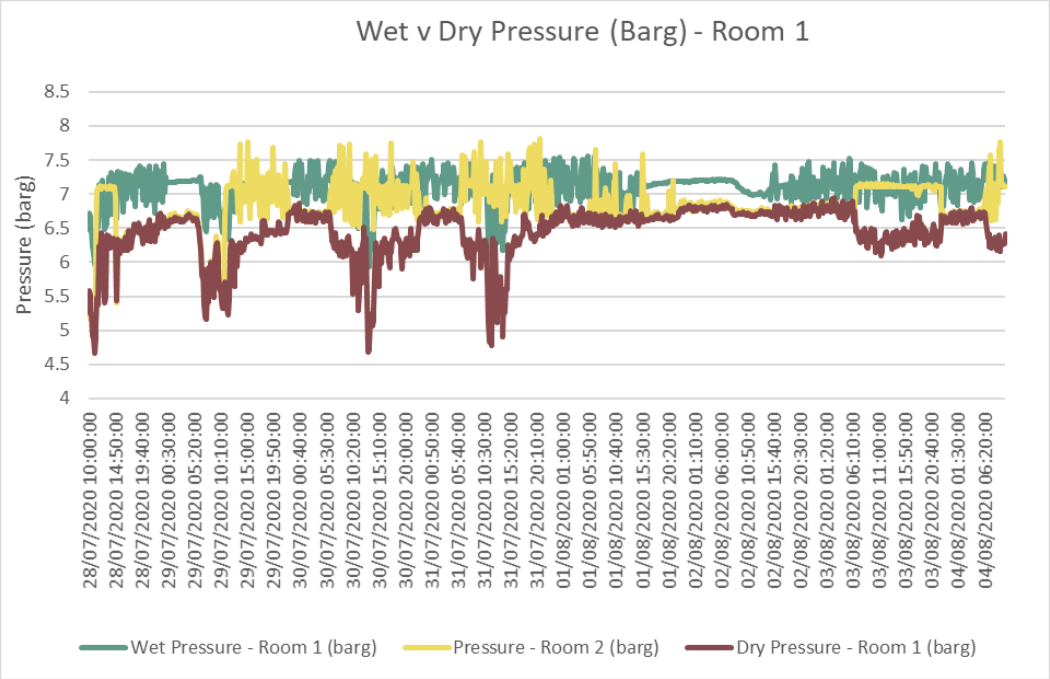
Measurement	Results
	Minimum demand = 1.79 m3/min

Pressure

Pressure monitoring at multiple points can be used to identify issues with compressors, filters, dryers, and pipework. Differential pressure across filters can be used to establish optimum intervals for element replacement helping to maintain system efficiency.

At the time of the survey the site was exceeding the capacity of the main compressor causing the pressure across the system to deteriorate, at times pressure as low as 4.6 bar was recorded. As the site cannot operate at pressures this low, it was forced to switch on the secondary compressor during peak periods to stabilise the system. While this improves the factory pressure it also has a significant impact on the compressed air purity (see dew point and temperature in this section).

Pressure drop across the dryers and filters is within the normal range, however a restricted diameter pipe section between the main receiver, dryer and to the factory is impacting the supply of compressed air. Increasing this pipe size to match the surrounding aluminium will improve supply pressure between 0.3 to 0.5 bar during peak periods.

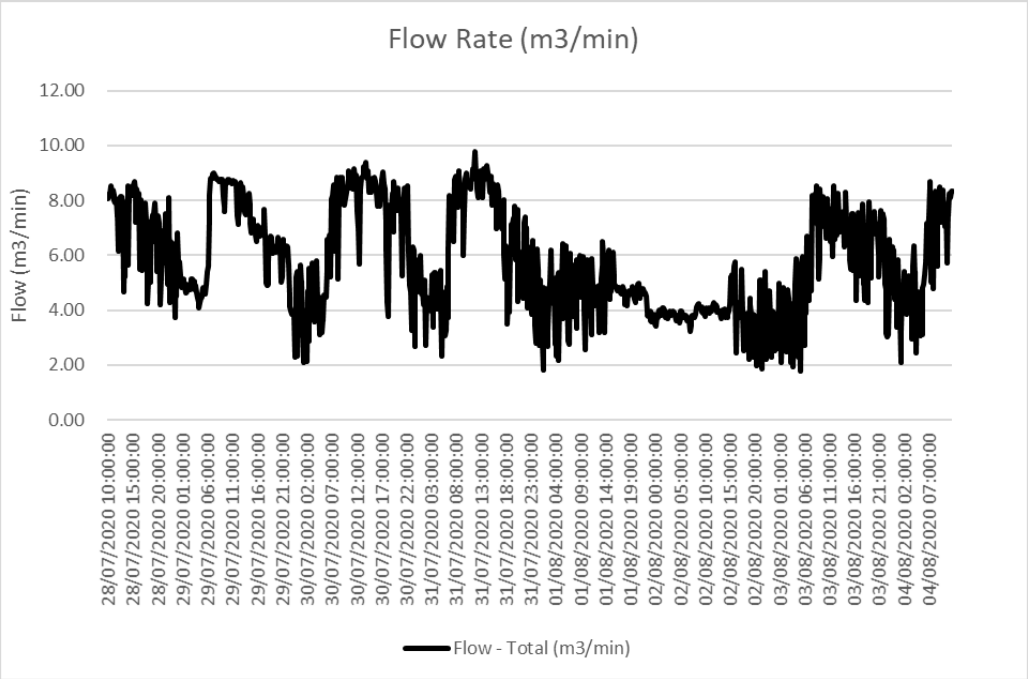


Flow

Flow metering is used to understand compressed air consumption, identify compressor issues, establish compressor or system efficiency, and monitor for changes in the system such as increases in leakage.

The flow rate to the factory (after drying), ranges from approximately 2m³/min to 9.8m³/min. This exceeds the main compressor capacity during peak periods when coupled with the purge losses from the desiccant dryer. Thus causing the need for the second compressor.

Repairing leaks and eliminating some inappropriate use will reduce the demand enough for the main compressor to support the entire system, replacing optimising the dryer with alternative technology would further return capacity to the system. However, as the main compressor is nearing end of life consideration should be given to the best way forward.

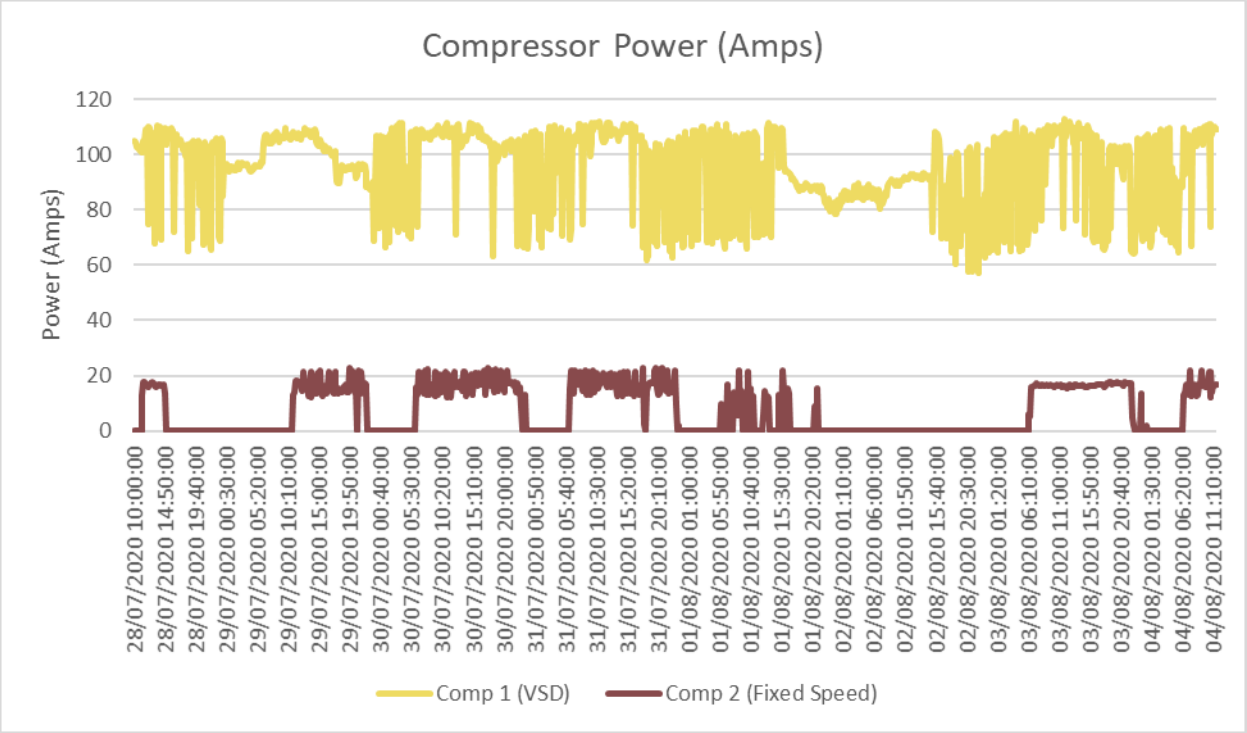


Power Consumption

Measuring current or power on a compressor provides insight into how much energy a compressor uses, how long it operates, when it is producing compressed air and how it interacts with the other compressors on the system. Additionally, power or current can be used to diagnose issue within the compressor by looking in fine detail at the profile and characteristics of the power usage.

Both compressors appear to be performing to their specifications, however at times when both compressors are running, they are loading and unloading at the same time, this is being caused by the compressors effectively seeing different system pressures. I.e. Both compressors are controlled by independent pressure sensors on the wet side of the system.

Connecting both compressors to the same receiver will significantly reduce this problem and allow each compressor to be adjusted so that they work more effectively together.



Dew Point & Temperature

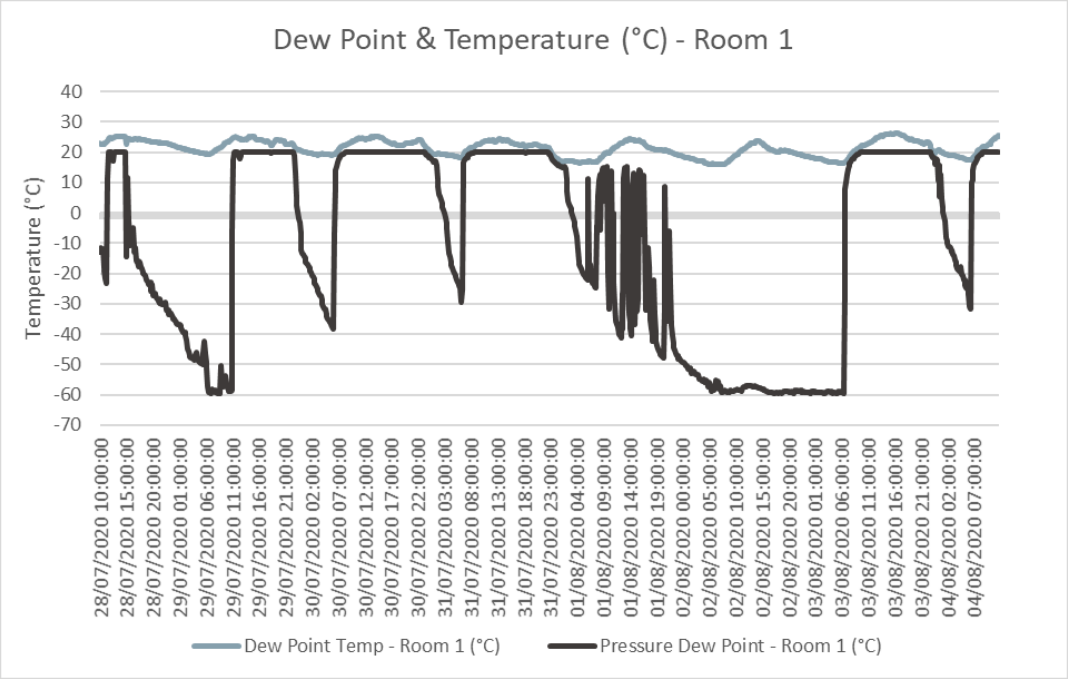
Moisture in compressed air can cause significant increases in maintenance costs by causing corrosion and component failure as well as directly affecting production performance. Measuring dew point and ambient temperature is the simplest way to monitor dryer performance and detect moisture issues before they can cause a problem.

When pressure dew point exceeds ambient temperatures condensate will begin forming in the compressed air system. High dew points lead to significant levels of contamination caused by corrosion, oil, bacteria, yeast and fungus as well as long term maintenance and reliability issues of machines and related components.

The pressure dew point ranged from -60°C during low periods when only the main compressor was running, this is typical of a desiccant dryer set to timed regeneration under light load. Through to +20°C (the maximum range of the sensor), during peak demands when both compressors were running.

The extreme change is caused by the untreated compressed air from the second compressor contaminating the entire system. This is a significant issue that requires immediate attention. Aside from the base issues of condensate in the system, there is notable risk of product contamination. Production should be reduced to a level where the second compressor is not required until it can be moved and connected to the main wet receiver so that this supply can be treated through the existing desiccant dryer and filtration.

Once moved it is expected that the system will take several months before the majority of the contamination is removed from the system, though oil is now likely a permanent feature of the system.



Compressed Air System Efficiency

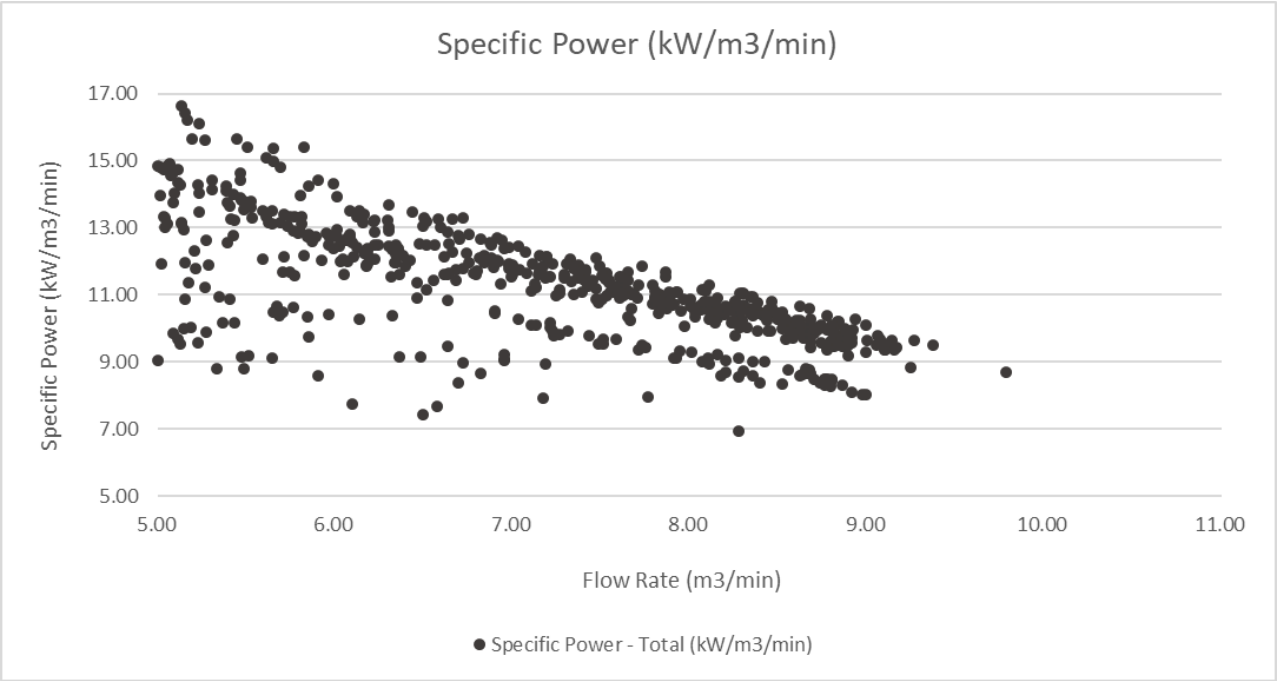
Compressed air system efficiency is a measure of how much energy the system will use for a given flow rate. It is typically measured in kW/m³/min with higher numbers meaning more energy is being consumed to produce the required flow.

The system had an average specific power of 13.23 kW/m³/min, which is very high. This is in part caused by the desiccant dryer which purges compressed air to atmosphere as part of its regeneration process. Unless the dryer is changed to an alternative technology little can be done to prevent this.

The additional inefficiency comes from the fact that at virtually any point in time at least one compressor is loading and unloading. Fixed speed compressors have very poor part load efficiency, so it is preferably to have them fully loaded when operating or off.

Improving the system efficiency with a suitably sized VSD compressor and fixed speed compressor combination would reduce the average specific power to around 9 kW/m³/min with the existing desiccant dryer or to around 7.5 kW/m³/min with more efficient drying options.

The net effect would be a reduction in operating costs of between $33,000 to $46,000 per year.



Part B
Leak Summary

Leakage Findings

Compressed Air Alliance conducted a leakage survey at Bob's Pet Food on 15 – 18 July 2020. The survey covered the whole site and identified **112 leaks**. These leaks are estimated to cost your business **$50,675** per year in wasted energy (see table below).

Details of each leak, including leak location, recommendation action, and parts to repair the leak, are included in Appendix 1.

Summary of Leaks

Department	Total Number of Leaks	Estimated Time to Repair (hours)[1]	Estimated Flow (m3/min)	Estimated Cost per year
Roof - Meat	23	4	0.816	$6,415
Roof - Seafood	25	9	1.050	$16,118
Compressor Room	10	6	0.479	$3,766
Wet Foods - Processing	7	7	0.191	$1,499
Dry Foods – Processing	23	6	1.029	$16,092
Packaging	24	5	0.863	$6,785
Total	**112**	**37**	**4.428**	**$50,675**

[1] Allow an additional 20% to source parts and locate the leak prior to repairing.

Measurement and calculation assumptions

Estimated savings were calculated from:

- The compressed air system's operating hours of 8,760 hours per year
- the system efficiency of 13.23 kW/m3/min
- the cost of electricity of $0.167 per kWh
- the approximate cost of compressed air being $3.47 for 100m³.
  (as described in the *Measurement Results* table in Part A)

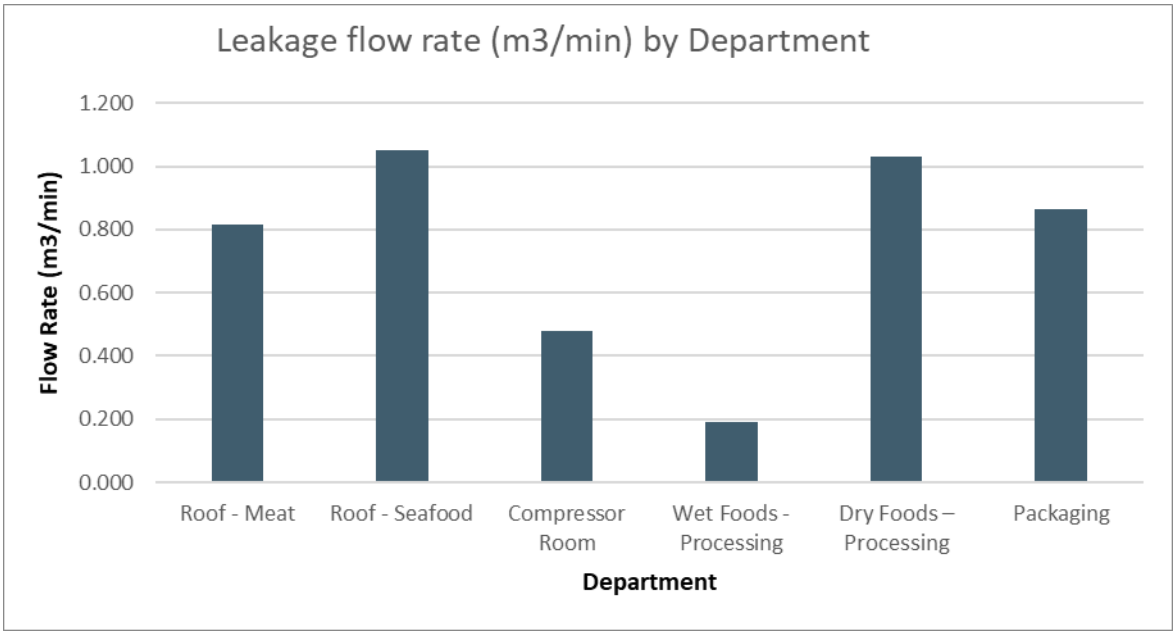
Flow rates were estimated using an ultrasonic leak detector and the experience of the technician performing the survey.

Where are the leaks?

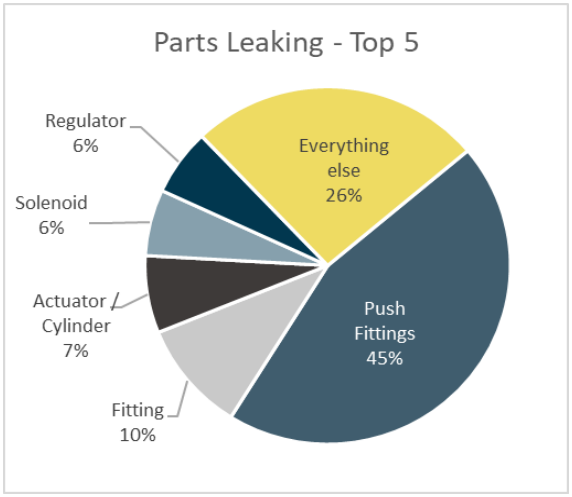
As can be seen in the table above and graph below, roughly one-quarter of the leak flow rate is in the roof space above the seafood department (24% of estimated leakage flow), followed closely by Dry Foods - Processing (23%).

Most of the leaks were occurring in push fittings (45%) and fittings (10%), see graph below (left). Most leaks were a result of age as shown in the graph below (right).

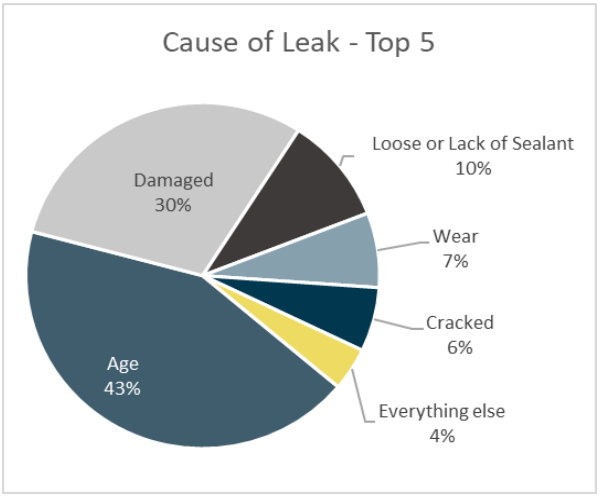
Estimated leakage air consumption (m3/min) by department



Top 5 Parts Leaking



Top 5 Cause of Leaks



Repairing Leaks

It is important to repair as many leaks as possible, as soon as possible (preferably within one month of the survey). Small leaks will deteriorate into larger leaks rapidly, particularly after priority leaks have been repaired.

It's cheaper to repair a leaking part, than to let the leak continue.

- The average cost of a leaking part for Bob's Pet Food = $452 per year (= $50,675/112 leaks).
- The average cost to repair a leaking part (based on aggregate data from previous surveys) = $200 per year, including parts and labour. Note: actual cost will vary.

A typical payback to repair all leaks is **0.4 years** (5 months).

Repair Time: It is expected to take one person **37 hours** to repair all leaking parts (see Leak Summary table above). Allow an additional 20% to source parts and locate the leak prior to repairing.

Requires Further Investigation: There were **9** leaks that require further investigation as we were not able to access the exact leak location or confirm the parts required due to machine guarding etc. Pricing to repairs these leaks is excluded from this report.

Parts Required: Appendix 2 of this report contains the list of parts required to repair all leaks identified during the survey.

Compressed Air Alliance can help you manage the repair process.

Re-survey

Leakage is an ongoing issue. Identification and repair projects should be scheduled on a routine basis to ensure leakage is reduced and maintained at below 5% of total system usage.

We recommend you conduct your next leakage and survey within **12** months.

Part C Inappropriate Use Summary

Inappropriate Use Findings

Compressed Air Alliance conducted a leakage survey at Bob's Pet Food on 15 – 18 July 2020. The survey covered the whole site and identified **53** inappropriate uses. This inappropriate use is estimated to cost your business **$22,970** per year (see Table below).

Every effort was made to identify all inappropriate use, however some may not have been identified due to the inability to access machinery through guarding or unused equipment currently being stored. The information below should be used as a guide to target reductions in compressed air usage.

Details of each inappropriate use, including recommendations to address the inappropriate use, are included in Appendix 3.

Type of Inappropriate Use

Type of Inappropriate Use[1]	Number of instances	Estimated Flow (m^3/min)	Estimated Annual Cost
Air Vacuum	10	2.78	$3,197
Open Blowing	41	6.99	$18,721
Rapid cycling actuator or cylinder	2	0.78	$1,053
Total	**53**	**10.55**	**$22,970**

[1] Types of Inappropriate Use:

- *Air Vacuum* is where compressed air is used to generate a vacuum for picking up and drawing products from one location to another.
- *Open blowing* is where compressed air is allowed to escape directly into the atmosphere in order to move or cool products or equipment.
- *Rapid cycling actuator or cylinder* is a cylinder that is noted to increase the overall system usage. Cylinders can be optimised using a speed control regulator to regulate the return stroke, effectively reducing its air consumption by 30-50%.

Measurement and calculation assumptions

Estimated savings were calculated from:

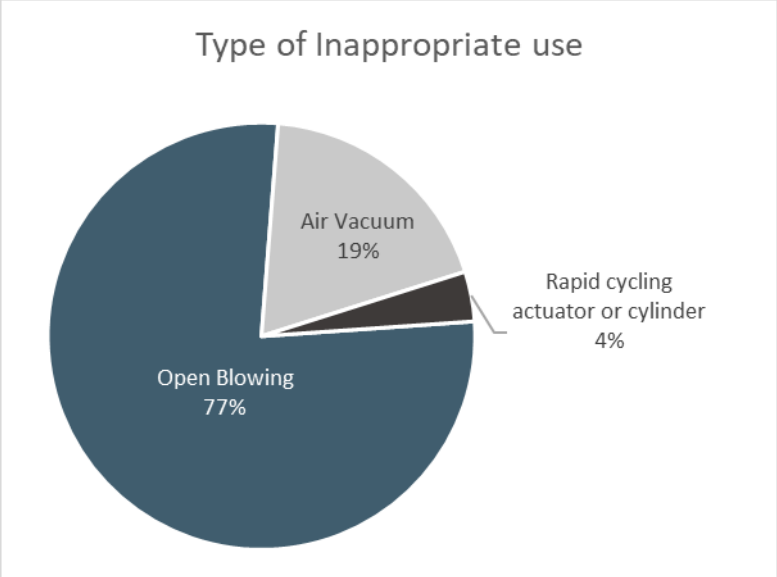
- the system efficiency of 13.23 kW/m3/min
- the cost of electricity of $0.167per kWh
- the approximate cost of compressed air being $3.47 for 100$m^3$
  (as described in the *Measurement Results* table in Part A)
- the estimated annual operating hours, based on equipment usage at the time of the inspection.
  - These hours may not accurately reflect true usage and should be verified in order to accurately establish the annual operational cost of inappropriate usage.
- Flow rates, based on manufacturers information for each type of equipment as well as pressure and the number of times the inappropriate use was identified on that piece of equipment.

Where are the Inappropriate Uses?

Three types of inappropriate use were identified with 'Open Blowing' accounting for 3 quarter (77%) of the inappropriate use (see graph below).

The majority of inappropriate use (85%) was occurring in the wet and dry food processing areas. This was typically open blowing.

Types of Inappropriate Use identified



Rectification

Eliminating inappropriate use can have similar energy reduction effects to repairing leaks as this directly reduces the demand on the compressors. In broad terms, replacing compressed air driven equipment with alternative solutions is more energy efficient and results in reduced operating costs for the site. However, whilst there may be alternatives to inappropriate usage, the business may elect to stay with compressed air for budget, safety or operational reasons.

Compressed Air Alliance recommends the following system modifications to reduce inappropriate use:

- Replacing the lid scramblers with electrically driven units
- Replacing open blowing with electric drives, blower or air amplifier and control solenoid
- Replacing air vacuums with vacuum pump, mechanical re-roller or mechanical winder
- Using an electric drive to stop rapid cycling of actuators or cylinders

For more information, refer to Appendix C.

Appendix 1
Leak Details

Leak Summary

The table below summarises the leaks that were found during the survey. Space is provided for you to record when leaks have been repaired.

Full details of each leak, including parts required to repair the leak, are shown on the following pages.

Leak Number	Department	Zone	Part Leaking & Action Required	Leak Cost ($ per year)	Repaired? (Yes / No)
1	Wet Foods - Processing	Gravy Makeup 2	Fitting - Repair	$259	
2	Roof - Meat	Line 1	Fitting - Replace	$259	Yes
3	Roof - Meat	Line 1	Valve - Replace	$4,139	
4	Roof - Meat	Line 1	Push Fitting - Replace	$6,467	
5	Roof - Meat	Line 1	Push Fitting - Replace	$4,139	
6	Roof - Meat	Line 1	Fitting - Repair	$259	
7	Roof - Meat	Line 2	Valve - Replace	$4,828	
8	Roof - Meat	Line 2	Push Fitting - Replace	$4,139	
9	Roof - Meat	Line 2	Actuator / Cylinder - Replace	$6,467	
10	Roof - Meat	Line 2	Push Fitting - Replace	$4,139	
11	Roof - Meat	Line 3	Actuator / Cylinder - Repair	$259	
12	Roof - Meat	Line 3	Actuator / Cylinder - Repair	$4,139	
13	Roof - Meat	Line 3	Push Fitting - Replace	$4,139	
14	Roof - Meat	Line 3	Actuator / Cylinder - Replace	$6,467	
15	Roof - Meat	Line 3	Actuator / Cylinder - Replace	$4,139	
16	Roof - Meat	Line 3	Actuator / Cylinder - Repair	$4,139	
17	Wet Foods - Processing	Can 5	Unable to access / RFI - Needs Further Investigation	$6,467	
18	Wet Foods - Processing	Can 5	Unable to access / RFI - Needs Further Investigation	$4,139	
19	Wet Foods - Processing	Can 5	Push Fitting - Replace	$4,139	

Leak Details

The following pages provide details of each leak identified during the survey including the leak location, part leaking, leak size, recommended action. Leaks are sorted by tag number.

Leak Number
Each leak is tagged with a number. The tag is attached near the part that is leaking

Leak Location
The location of the leaking part, including the department, zone and machine. Check the location information before referring to the photos.

Part Leaking
Identifies which part is leaking, where it's leaking from and the possible cause of the leak

Leak Size
Indication of the size and cost of leak

Recommended Action & Parts List
Suggested rectification and parts required

Repair Details
Space is provided for you to record when the leak was repaired

Leak Details

Leak Number	**37**	**Location**	**Packing - Can**
Machine	**Retort Area - Can Labeller**		

Part Leaking

Part Leaking	Filter / Regulator / Lubricator	Leak Location	Connection
Cause of Leak	Age	Leak Size (1 =small, 6=large)	2
Flow Rate	0.036 m³/min	Annual cost	$ 345

Recommended Action

Action	Replace		Estimated Repair Time (min)	15
Parts Required	Brand	Part Number	Size	Qty
Push Fit - Elbow	Generic		3/8" - 6 mm	1
Comments				

Repair Details

Repaired by		Repaired on (date)	

Photos
Close up and distance shots of the leaking part and tag number. Arrows point to the leaking part. Circles identify the general location of the leak. Please refer to the Location information (above) when looking for the leak

Leak Details

Leak Number:	**1**	**Location:**	**Dry Foods - Processing**
Machine:	**Feed Agitator ground**		

Part Leaking

Part Leaking:	Tube	Leak Location:	Hose
Cause of Leak:	Age	Leak Size (1=small, 5=large)	4
Flow Rate	0.186 (m^3/min)	Annual cost of Leak	$1,466

Recommended Action

Action:	Replace	Estimated Repair Time (min):		20
Parts Required:	Brand:	Part Number:	Size:	Qty
Push Fit - Joiner Tube	Generic Generic		10 mm 10 mm	4 2
Comments:				

Repair Details

Repaired by		Repaired on (date):	

Leak Details

Leak Number:	**2**	**Location:**	**Dry Foods - Processing**
Machine:	**Feed Agitator Ground**		

Part Leaking

Part Leaking:	Push Fitting	Leak Location:	Connection
Cause of Leak:	Age	Leak Size (1=small, 5=large)	2
Flow Rate	0.03 (m^3/min)	Annual cost of Leak	$235

Recommended Action

Action:	Replace		Estimated Repair Time (min):	10
Parts Required:	Brand:	Part Number:	Size:	Qty
Push Fit - Joiner	Generic		10 mm	1
Comments:				

Repaired

Repair Details

Repaired by	CAA	Repaired on (date):	16/4/19

Leak Details

Leak Number:	**7**	**Location:**	**Roof – Meat**
Machine:	**Sump piping**		

Part Leaking

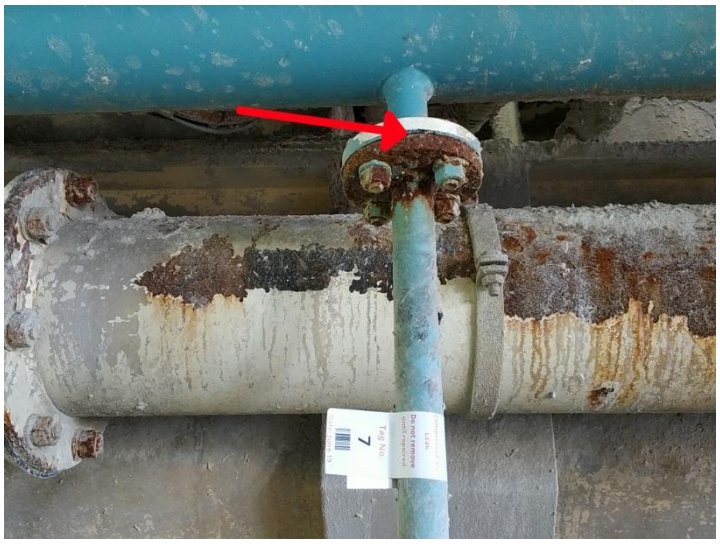
Part Leaking:	Flange	Leak Location:	Gasket
Cause of Leak:	Age	Leak Size (1=small, 5=large)	1
Flow Rate	0.002 (m^3/min)	Annual cost of Leak	$ 15

Recommended Action

Action:	Replace	Estimated Repair Time (min):		30
Parts Required:	Brand:	Part Number:	Size:	Qty
Gasket	Generic		Other	
Comments:	4 bolt gasket, 1" piping, 120mm diameter flange			

Repair Details

Repaired by		Repaired on (date):	



Leak Details

Leak Number:	**9**	**Location:**	**Packaging**
Machine:	**Seal Water feed**		

Part Leaking

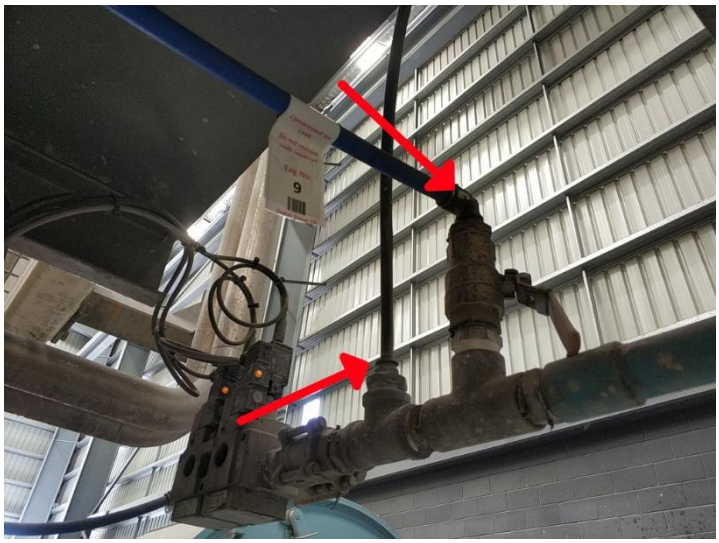
Part Leaking:	Push Fitting	Leak Location:	Connection
Cause of Leak:	Age	Leak Size (1=small, 5=large)	2
Flow Rate	0.03 (m^3/min)	Annual cost of Leak	$235

Recommended Action

Action:	Replace	Estimated Repair Time (min):		30
Parts Required:	Brand:	Part Number:	Size:	Qty
Push Fit - Elbow Push Fit - Straight	Generic Generic		1/2" to 16 mm 1/2" to 12 mm	1 1
Comments:				

Repair Details

Repaired by		Repaired on (date):	



Appendix 2
Parts List

Parts Required

This section lists the parts required to repair leaks. Parts are sorted by brand. Part numbers and sizes are included, where known. Space is provided to record a substitute part number for superseded parts, as well as to track when you have ordered and received parts.

All parts should be ordered for all leaks (regardless of leak size or priority). This can avoid unnecessary machine downtime and increase the likelihood of the repairs being achieved in a timely manner.

Brand: Festo

Description	Part Number	Substitute Part Number	Size	Quantity required		Ordered	Recieved
Pressure Booster	DPA-100-10-CRVZS20 or 552936			1	ea		
Total number of parts required				1 piece			

Brand: SMC

Description	Part Number	Substitute Part Number	Size	Quantity required		Ordered	Recieved
Condensate Drain	Unknwon		1/2"	1	ea		
Cylinder	CDM2B25-50			1	ea		
Filter	AF40		1/2"	2	ea		
Filter	AF40-04D		1/2"	2	ea		
Filter	AMD550		1”	2	ea		

Description	Part Number	Substitute Part Number	Size	Quantity required		Ordered	Recieved
Gasket	To suit blanks on VSF3100 manifold			2	ea		
Solenoid	VG342-5DZ-06-X87		3/4"	1	ea		
Valve	VHS4500		1/2"	1	ea		
Total number of parts required				12 pieces			

Brand: Generic

Description	Part Number	Substitute Part Number	Size	Quantity required		Ordered	Recieved
Gauge - Rear Mount			1/4"	10	ea		
Push Fit - Cap			8 mm	12	ea		
Push Fit - Elbow			1/2" to 12 mm	13	ea		
Push Fit - Elbow			1/2" to 16 mm	5	ea		
Push Fit - Elbow			1/2" to 8 mm	11	ea		
Push Fit - Elbow			1/4" to 10 mm	9	ea		
Push Fit - Elbow			1/4" to 8 mm	52	ea		
Push Fit - Elbow			3/8" to 8 mm	20	ea		

Description	Part Number	Substitute Part Number	Size	Quantity required		Ordered	Recieved
Push Fit - Joiner			10 mm	5	ea		
Push Fit - Joiner			12 mm	10	ea		
Push Fit - Joiner			8 mm	66	ea		
Push Fit - Reducer			8 mm to 4 mm	1	ea		
Push Fit - Straight			1/2" to 10 mm	3	ea		
Push Fit - Straight			1/2" to 12 mm	10	ea		
Push Fit - Straight			1/4" to 10 mm	6	ea		
Push Fit - Tee			8 mm	8	ea		
Total number of parts required				241 pieces			
Tube			10 mm	16	m		
Tube			8 mm	134	m		
Total length of tube required				150 meters			

Appendix 3 Inappropriate Use

Inappropriate Use Details

The following pages provide details of each inappropriate use identified during the survey including the inappropriate use's location, type of inappropriate use and recommended action.

Some inappropriate uses occur multiple times on one machine or in one location. These inappropriate uses are recorded on one page, rather than repeating the same information multiple times. As a result, the number of inappropriate use pages (below) may differ from the actual number of inappropriate uses recorded.

Location of Inappropriate use
Location of the inappropriate use, including the department, zone and machine. Check the location information before referring to the photos.

Inappropriate Use
Describes the inappropriate use and the number of times it is occurring on that equipment

Inappropriate Use Details

Location	**Packing - Alu Tray**
Machine	**Tray Labeller Infeed Conveyor**

Inappropriate Use

Description	Open Blowing	Quantity	1
Equipment	Drilled Plate 12x 0.5mm Holes		
Flow Rate	0.335 m³/min	Annual cost	$ 3,490

Recommendation

Recommendation	Replace with blower or air amplifier and control solenoid
Comments	8mm Feed Tube + speed controller

Action Taken

Inappropriate Use Reviewed by		Rectified on (date)	
Action Taken			

Size
Indication of the size (m3/min) and cost of the inappropriate use

Recommendation
Suggested alternative equipment or process

Action Taken
Space is provided for you to record what, if any, action was taken to remove the inappropriate use

Photos
Close up and distance shots of the inappropriate use. Arrows point to the inappropriate use. Circles identify the general location of the inappropriate use. Please refer to the Location information (above) when looking for the equipment

Inappropriate Use Details

Location	**Wet Foods - Processing**
Machine	**Scramblers**

Inappropriate Use

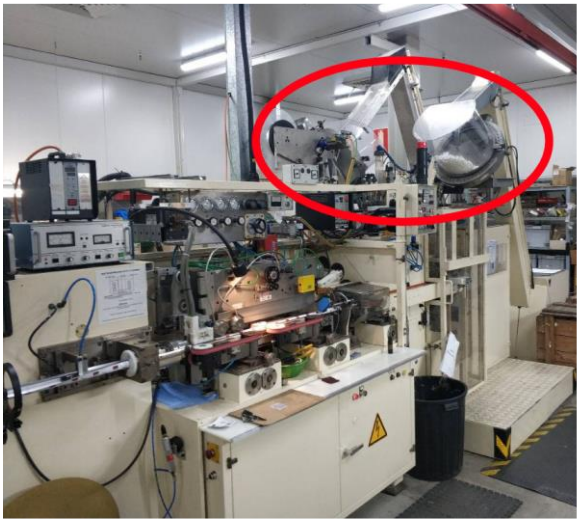
Description	Open Blowing		
Equipment			
Flow Rate	0.335 (m^3/min)	Annual Cost	$ 1,205

Recommendation

Recommendation	Replace with electric drive
Comments	

Action Taken

Inappropriate Use Reviewed by		Rectified On (date)	
Action Taken			



Inappropriate Use Details

Location	**Dry Foods - Processing**
Machine	**Tube tumbler**

Inappropriate Use

Description	Open Blowing		
Equipment			
Flow Rate	0.595 (m^3/min)	Annual Cost	$ 2,143

Recommendation

Recommendation	Replace with blower or air amplifier and control solenoid
Comments	

Action Taken

Inappropriate Use Reviewed by		Rectified On (date)	
Action Taken