
Compressed Air: Reliable Source for Nitrogen Generation

Loran Circle
Keynote Speaker

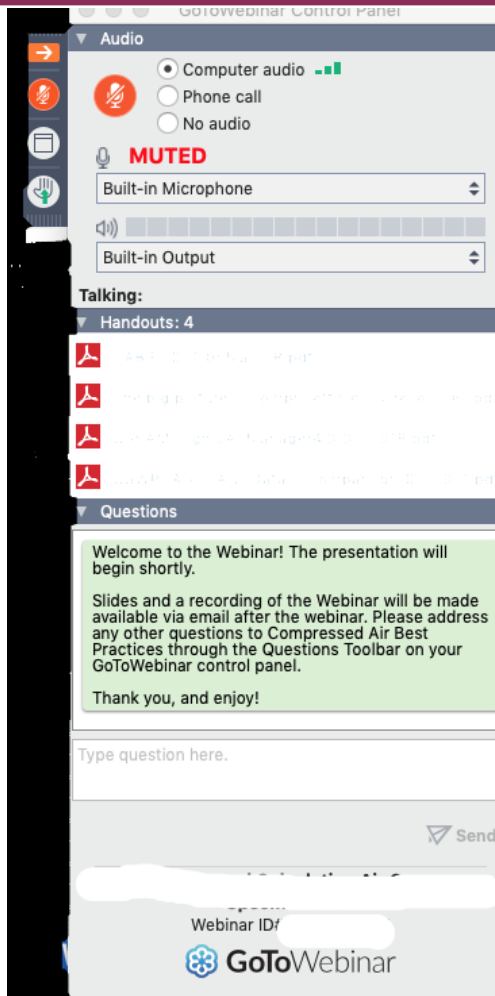
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PDH Certificates will be e-mailed to attendees within 2 days.

Q&A Format



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

- Please post your questions in the Questions Window in your GoToWebinar interface.

- Direct all questions to Compressed Air Best Practices® Magazine

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COMPRESSED AIR BEST PRACTICES

airbestpractices.com

Company Profile

Reuben's Brews is a family owned and independent craft brewery in the Pacific Northwest, with tasting rooms in Seattle, WA.

Problem

After expanding and switching to canning, they needed compressed air and nitrogen generation systems that could efficiently process their product.

Solutions and Benefits

- Rogers KR Series Compressor
- Parker NITROSource Generator
- Increased production efficiencies
- Decreased compressed air usage
- ROI in less than 1 year

Nitrogen Generation System Upgrade Helped A Pacific Northwest Brewery Save Thousands and Increase Production Efficiency

About Reuben's Brews

Reuben's Brews is a family-owned and independent craft brewery in Seattle, WA. They started as an award-winning home brewery in 2010 and quickly grew into several production facilities and taprooms. In 2012 they opened their commercial brewery, and in 2015 opened another that surpassed their 5-year goal in 5 weeks.

"I describe it as a rocket ship ride. The support from our community, the love for our beer, has been tremendous and it's pulled us along very fast to the point where we have this production facility today." - Matt Luttrell

They have a strong commitment to their local community and started a philanthropic foundation, Reuben's Brews Foundation, geared towards raising money for local non-profits.

Their values are integral not only to the business and how they engage with their community, but how they brew their beer as well. Their 4 pillars include:

- Breadth - we want to brew all styles of beer, with quality being utmost important
- Balanced & Drinkable - verified through blind tasting competitions so they know they are doing it right
- Guided experience - helping people through their beer experience and letting them know why the pillars are so important

Needless to say, quality is extremely important to their process and

Product Information Sheet

NITROSource

Advanced technology nitrogen gas generator for industry leading performance; a source of increased productivity, sustainability and profitability.



With unique design and advanced energy saving technology at its core the market leading NITROSource nitrogen gas generator requires less compressed air to generate more nitrogen.

Together with substantially lower servicing costs, reduced downtime and a longer working life, it adds up to the most cost-efficient nitrogen supply available; significantly more affordable than traditional sources, and delivering huge savings over the lifetime of the generator.

With over 20 years experience in the market, and over 50,000 units installed globally, Parker dominates market as first choice for innovative and reliable gas generation technology.

Features and Benefits:

- Energy saving technology** - Maximize compressed air flow to the nitrogen outlet flow and purity, reducing compressed air use, and saving energy and money.
- Lower cost maintenance, extensive working life** - The Custom Modular design, the 'right' fit of the generator allows nitrogen costs to be reduced through on maintenance.
- Five year warranty** - Five through ten year extended warranty, offering the assurance of an unexpected maintenance costs and increased factory up-time.
- Industry compliance** - Food and pharmaceutical safe, in line with European standards (EN120) and the USA Food & Drug Administration (FDA, Article 21) and Pharmaceutical compliance.
- Gas quality control** - **Heat Flow Controller** - ensuring correct set pressure and flow.
- Integrat Oxygen Analyser** - constantly measures gas purity.
- On-Gas By-Flow** - automatically vents out self-contamination gas ensuring product quality by ensuring gas quality.
- Heat and Outlet Pressure Regulation** - generating savings in the generator or application.
- Electronic Control System** - 100% management of all critical generator functions.
- Remote monitoring** - Enabling connection to proprietary remote control systems to control and track gas parameters from a central location.
- Early gas quality control** - Simply add extra generators in the application required zones.

Subject to terms and conditions. Please contact Parker or your local authorized Parker distributor.

Parker ENGINEERING YOUR SUCCESS.

Product Information Sheet

NITROSource Compact

PSA Nitrogen Gas Generator

Advanced technology nitrogen gas generator for industry leading performance; a source of increased productivity, sustainability and profitability.



With unique design the market leading NITROSource Compact nitrogen gas generator requires less compressed air to generate more nitrogen.

Together with substantially lower servicing costs, reduced downtime and a longer working life, it adds up to the most cost-efficient nitrogen supply available; significantly more affordable than traditional sources, and delivering huge savings over the lifetime of the generator.

With over 20 years experience in the market, and over 50,000 units installed globally, Parker is first choice for innovative and reliable gas generation technology.

Features and Benefits:

- Lower cost maintenance, extensive working life** - The Custom Modular design, the 'right' fit of the generator allows nitrogen costs to be reduced through on maintenance.
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- Early gas quality control** - Simply add extra generators in the application required zones.


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Parker

NITROSource

PSA Nitrogen Generators

Advanced on-site nitrogen generation technology delivering lowest cost, energy efficient nitrogen gas on demand.



ON-SITE NITROGEN GAS GENERATION

UP TO 90% COST SAVINGS

CYLINDERS Low initial cost but high on-going cost

LIQUID N2 MINI TANKS Higher initial cost but lower on-going cost

NITROGEN GAS GENERATORS Highest initial cost but lowest on-going gas cost

Typical capital payback is achievable in 12-24 months.

ENERGY SAVING

Low energy consumption, reduces environmental impact and saves on operational costs.

MODULAR CONSTRUCTION

60% the size and weight of more conventional designs.

190cm

Features and Benefits:

- Gas quality control** - **Heat Flow Controller** - ensuring correct set pressure and flow.
- Integrat Oxygen Analyser (Optional)** - constantly measures gas purity.
- On-Gas By-Flow** - automatically vents out self-contamination gas ensuring product quality by ensuring gas quality.
- Outlet pressure regulation** - generating savings in the application.
- Electronic Control System** - 100% management of all critical generator functions.
- Remote monitoring** - Enabling connection to proprietary remote control systems to control and track gas parameters from a central location.

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COMPRESSED AIR BEST PRACTICES

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Sustainable Production



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December 2022

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All materials presented are educational. Each system is unique and must be evaluated on its own merits.

Compressed Air: Reliable Source for Nitrogen Generation

Introduction by

Compressed Air Best Practices® Magazine



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About the Speaker



Loran Circle
Consultant

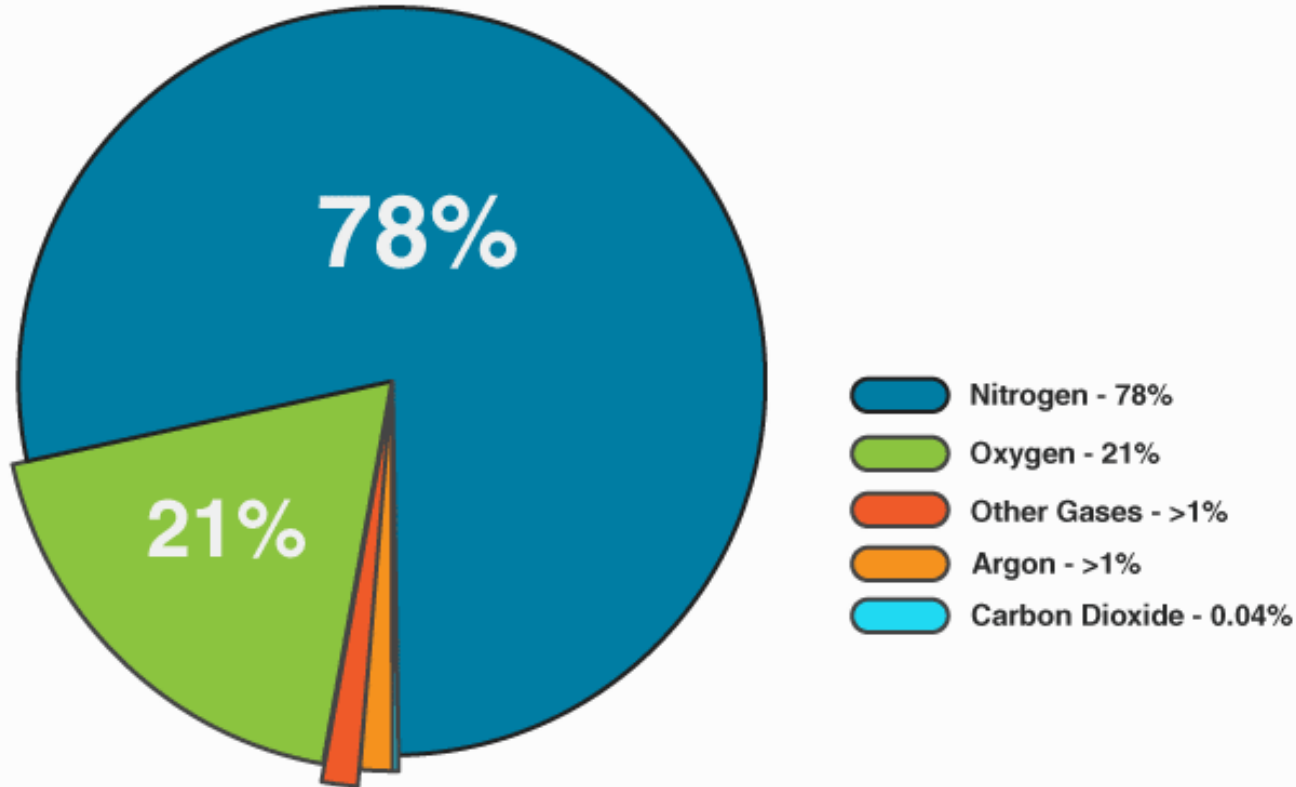
- DOE Certified Airmaster+
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Nitrogen Is The Most Plentiful Gas On Our Planet!

COMPOSITION OF INHALED AIR



Is It A Liquid Or A Gas?

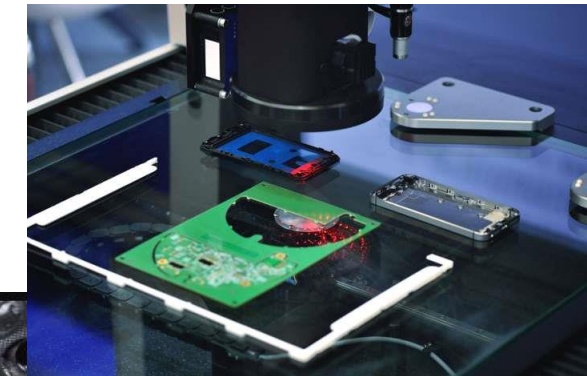
Introduction - Common Uses of Nitrogen

- As a **gas** for its **inert** properties:-
 - Removal of oxygen in vessels & processing equipment which contain flammable liquids or vapours. Commonly called purging and blanketing in the Chemicals Industry
 - “Sparging” of fluids (e.g. edible oils) to remove oxygen
 - Gas packing of foodstuffs to remove oxygen and extend shelf-life
 - Humane slaughter of poultry
 - Furnace atmospheres e.g nitriding to improve surface hardness of gears etc
- As a **liquid** for its **cryogenic** properties:-
 - Food freezing & chilling
 - Cooling chemical reactions & condensation of VOCs from chemical vent-streams
 - Low temperature grinding (e.g. rubber, fats & spices)
 - “De-flashing” moulded rubber components
 - Low temperature testing of electronic equipment
 - Shrink fitting & pipe freezing

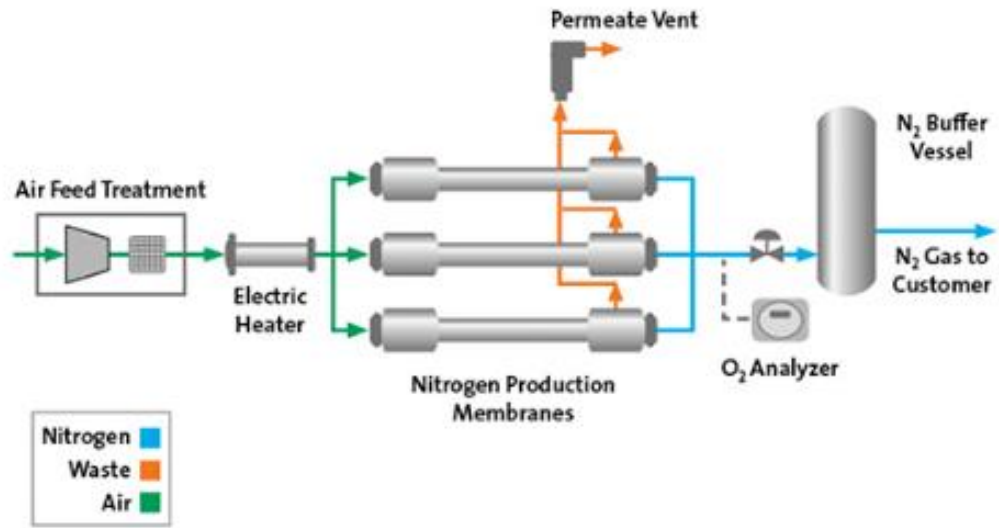
Gas Nitrogen Uses

Industrial Uses for Nitrogen (N₂) Gas

- Gas for Tire Inflation. Helps to eliminate expansion and contraction of air due to temperature fluctuations
- Food and Beverage Manufacturing Nitrogen gas is used in several commercial foods and drinks production processes. For example, gaseous nitrogen is currently used in alcoholic beverage sparging to attain top-quality brew, to putting nitrogen in to packaging for freshness
- Elimination of Volatile Organic Compounds (VOCs) ...
- Mining Safety
- Electronics
- Pharmaceutical manufacturing
- Autoclaves
- Metal Manufacturing for strengthening steel
- Used as a Refrigerant
- Controls volatility in hazardous environments

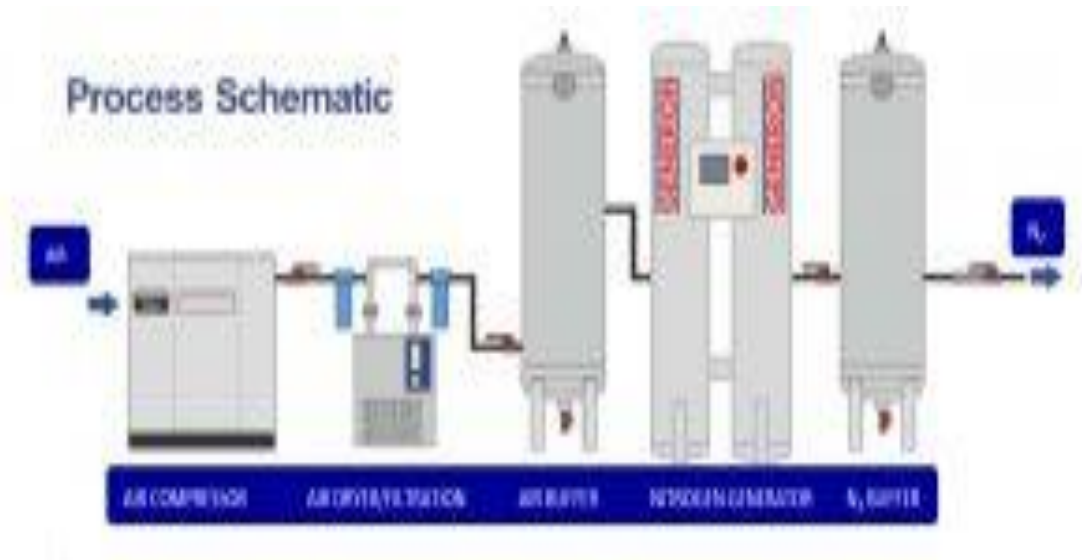


Nitrogen Membrane Generator



PSA Schematic

- Compressed air is discharged from the compressor
- Compressed air is dried to remove moisture
- Pressure Swing Adsorption is used by air passing generally from bottom to top where “other” gas molecules adsorb to a media such as molecular sieve
- After a certain duration of time the media becomes saturated and valving switches towers to the regenerated tower



Pressure Swing Adsorption

Molecular Sieve is used to adsorb the gas molecules and let the nitrogen molecules pass through to be used in the process

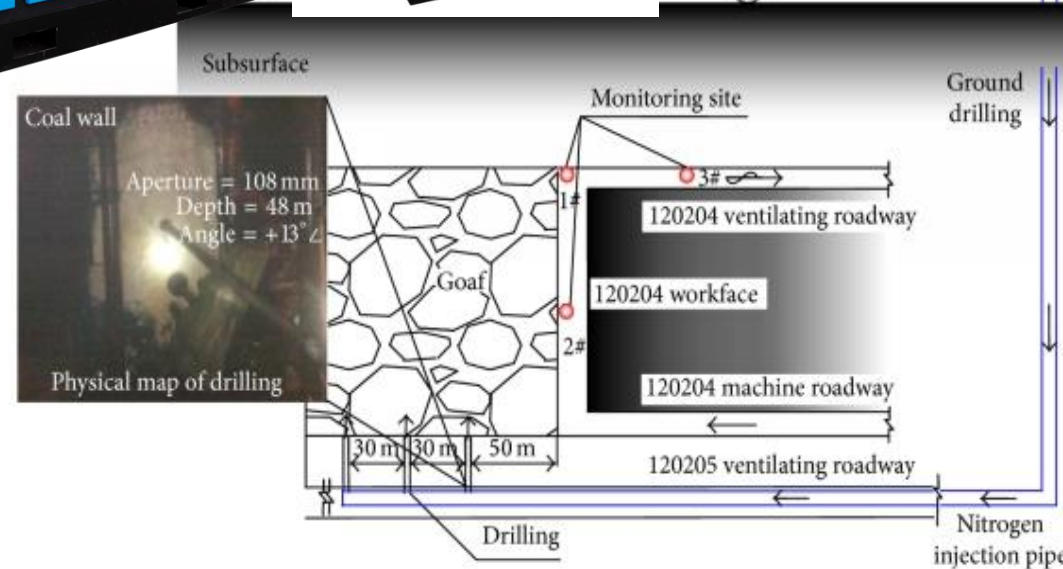


Packaged Nitrogen Skid For Coal Mining



Nitrogen Use In Mines

- 400-500HP Air Compressor
- Refrigerated dryer to remove moisture
- Nitrogen generator with membrane packages
- Into drilled hole down to void
- By adding positive pressure nitrogen an inert atmosphere is created for fire safety



Improving System Specific Power

- How can adding nitrogen generation to my air system improve efficiency of my air system?
- In my years of experience, many compressed air users operate compressors at part loads.
- If there is additional air available in your compressed air system and depending on types of control schemes, by increasing your demand by adding nitrogen generation you can improve your specific power of your air system.

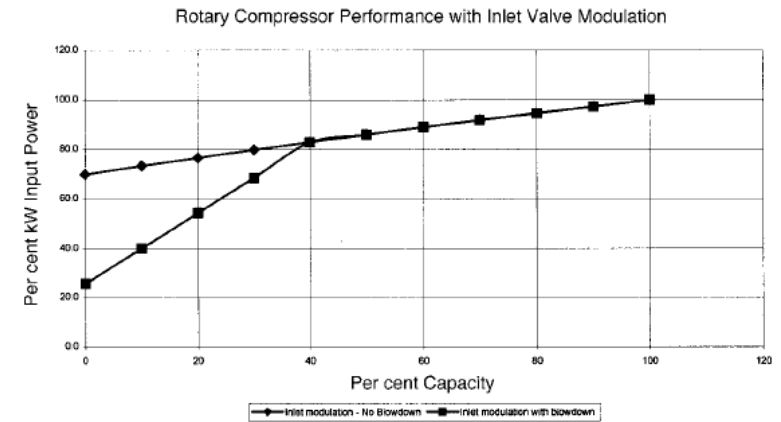


Figure 4.1A Shows Inlet Valve Modulation from 100% to 40% capacity and unloading at that point.

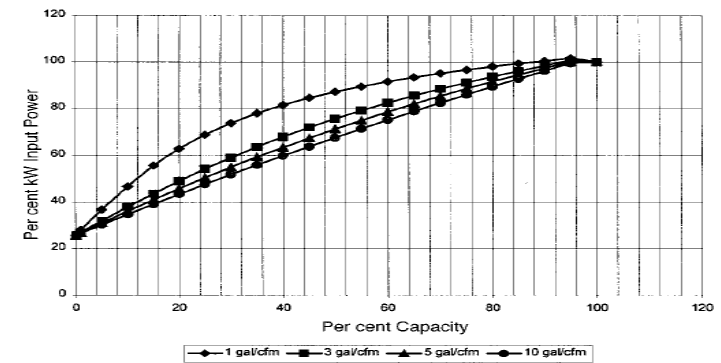


Figure 4.1B Shows Average Power v Percent Capacity with various sizes of primary receiver.

Thanks For Attending
Loran Circle
Compressed Air System Consulting
Poland, OH 44514

About the Speaker



Bryan Jensen
Rogers Machinery

- Corporate Projects Manager, Rogers Machinery
- 20+ years with Rogers Machinery
- Responsible for Rogers' Engineered System Solutions internationally
- Former NASA materials researcher

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CHEMISTRY BASICS & MOLECULAR NITROGEN

DECEMBER 8, 2022

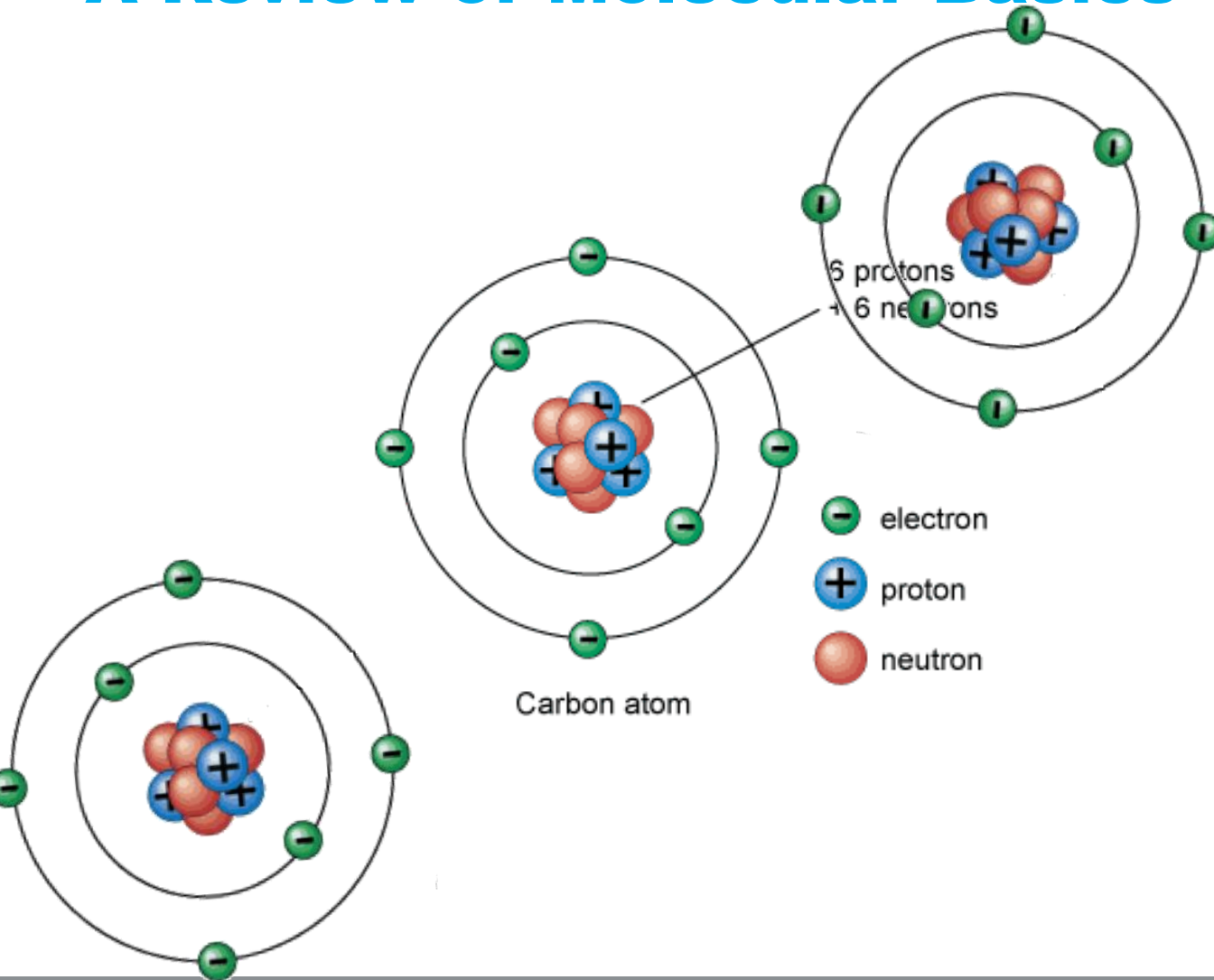


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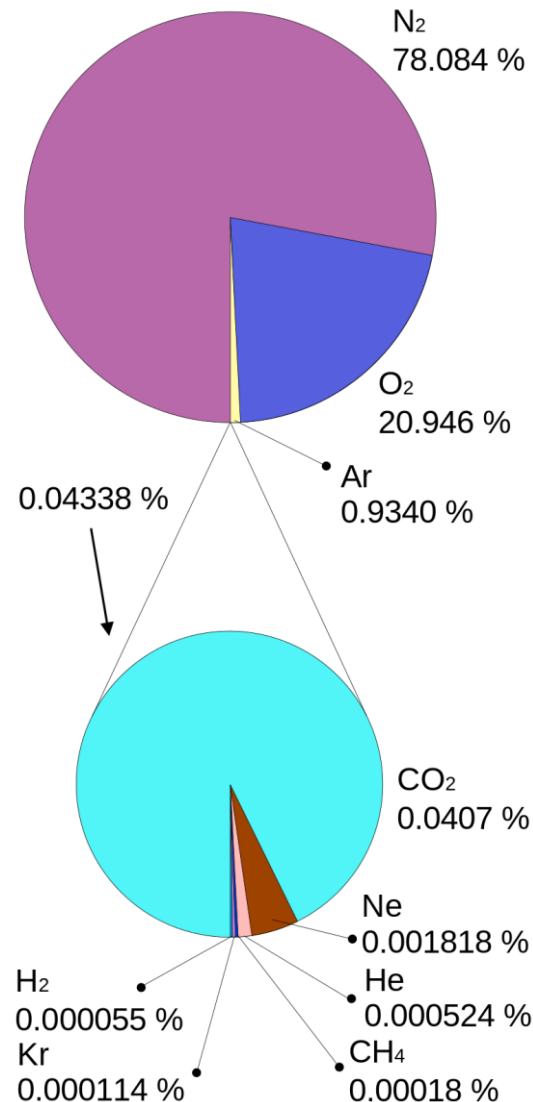
Chemistry Warm-Up:

A Review of Molecular Basics



Air is a Mixture of Gasses

- Nitrogen – N₂
- Oxygen – O₂
- Argon - Ar
- Carbon Dioxide – CO₂
- Neon – Ne
- Helium – He
- Others:
 - Methane, Krypton, Hydrogen
- What about Water Vapor?
 - Variable depending on location, temperature, altitude, etc.



Periodic Table of the Elements

1 IA 1 H Hydrogen 1.008 1	2 IIA 4 Be Beryllium 9.0122 2-2	3 IIIB 21 Sc Scandium 44.955908 2-8-9-2	4 IVB 22 Ti Titanium 47.867 2-8-10-2	5 VB 23 V Vanadium 50.9415 2-8-11-2	6 VIB 24 Cr Chromium 51.9961 2-8-13-1	7 VIIB 25 Mn Manganese 54.938044 2-8-13-2	8 VIIIB 26 Fe Iron 55.845 2-8-14-2	9 VIIIB 27 Co Cobalt 58.933 2-8-15-2	10 VIIIB 28 Ni Nickel 58.693 2-8-16-2	11 IB 29 Cu Copper 63.546 2-8-18-1	12 IIB 30 Zn Zinc 65.38 2-8-18-2	13 IIIA 5 B Boron 10.81 2-3	14 IVA 6 C Carbon 12.011 2-4	15 VA 7 N Nitrogen 14.007 2-5	16 VIA 8 O Oxygen 15.999 2-6	17 VIIA 9 F Fluorine 18.998 2-7	18 VIIIA 2 He Helium 4.0026 2		
11 Na Sodium 22.98976928 2-8-1	12 Mg Magnesium 24.305 2-8-2	19 K Potassium 39.0983 2-8-8-1	20 Ca Calcium 40.078 2-8-8-2	39 Y Yttrium 88.90584 2-8-18-9-2	40 Zr Zirconium 91.224 2-8-18-10-2	41 Nb Niobium 92.90637 2-8-18-13-1	42 Mo Molybdenum 95.95 2-8-18-13-2	43 Tc Technetium (98) 2-8-18-13-2	44 Ru Ruthenium 101.07 2-8-18-15-1	45 Rh Rhodium 102.91 2-8-18-16-1	46 Pd Palladium 106.42 2-8-18-18	47 Ag Silver 107.87 2-8-18-18-1	48 Cd Cadmium 112.41 2-8-18-18-2	49 In Indium 114.82 2-8-18-18-3	50 Sn Tin 118.71 2-8-18-18-4	51 Sb Antimony 121.76 2-8-18-18-5	52 Te Tellurium 127.60 2-8-18-18-6	53 I Iodine 126.90 2-8-18-18-7	54 Xe Xenon 131.29 2-8-18-18-8
37 Rb Rubidium 85.4678 2-8-18-8-1	38 Sr Strontium 87.62 2-8-18-8-2	55 Cs Caesium 132.90545196 2-8-18-18-8-1	56 Ba Barium 137.327 2-8-18-18-8-2	72 Hf Hafnium 178.49 2-8-18-32-10-2	73 Ta Tantalum 180.94788 2-8-18-32-11-2	74 W Tungsten 183.84 2-8-18-32-12-2	75 Re Rhenium 186.21 2-8-18-32-13-2	76 Os Osmium 190.23 2-8-18-32-14-2	77 Ir Iridium 192.22 2-8-18-32-15-2	78 Pt Platinum 195.08 2-8-18-32-17-1	79 Au Gold 196.97 2-8-18-32-18-1	80 Hg Mercury 200.59 2-8-18-32-18-2	81 Tl Thallium 204.38 2-8-18-32-18-3	82 Pb Lead 207.2 2-8-18-32-18-4	83 Bi Bismuth 208.98 2-8-18-32-18-5	84 Po Polonium (209) 2-8-18-32-18-6	85 At Astatine (210) 2-8-18-32-18-7	86 Rn Radon (222) 2-8-18-32-18-8	
87 Fr Francium (223) 2-8-18-32-18-8-1	88 Ra Radium (226) 2-8-18-32-18-8-2	104 Rf Rutherfordium (267) 2-8-18-32-32-10-2	105 Db Dubnium (268) 2-8-18-32-32-11-2	106 Sg Seaborgium (269) 2-8-18-32-32-12-2	107 Bh Bohrium (270) 2-8-18-32-32-13-2	108 Hs Hassium (277) 2-8-18-32-32-14-2	109 Mt Meitnerium (278) 2-8-18-32-32-15-2	110 Ds Darmstadtium (281) 2-8-18-32-32-17-1	111 Rg Roentgenium (282) 2-8-18-32-32-17-2	112 Cn Copernicium (285) 2-8-18-32-32-18-2	113 Nh Nihonium (286) 2-8-18-32-32-18-3	114 Fl Flerovium (289) 2-8-18-32-32-18-4	115 Mc Moscovium (290) 2-8-18-32-32-18-5	116 Lv Livermorium (293) 2-8-18-32-32-18-6	117 Ts Tennessine (294) 2-8-18-32-32-18-7	118 Og Oganesson (294) 2-8-18-32-32-18-8			

Atomic Number → 1
 ← Symbol **H**
 Name → Hydrogen
 ← Atomic Weight 1.008
 Electrons per shell → 1

- State of matter (color of name)
 GAS LIQUID SOLID UNKNOWN
- Subcategory in the metal-metalloid-nonmetal trend (color of background)
- Alkali metals
 - Alkaline earth metals
 - Transition metals
 - Lanthanides
 - Actinides
 - Post-transition metals
 - Metalloids
 - Reactive nonmetals
 - Noble gases
 - Unknown chemical properties

57 La Lanthanum 138.91 2-8-18-19-9-2	58 Ce Cerium 140.12 2-8-18-19-9-2	59 Pr Praseodymium 140.91 2-8-18-19-9-2	60 Nd Neodymium 144.24 2-8-18-19-9-2	61 Pm Promethium (145) 2-8-18-19-9-2	62 Sm Samarium 150.36 2-8-18-24-6-2	63 Eu Europium 151.96 2-8-18-29-8-2	64 Gd Gadolinium 157.25 2-8-18-29-9-2	65 Tb Terbium 158.93 2-8-18-29-9-2	66 Dy Dysprosium 162.50 2-8-18-29-9-2	67 Ho Holmium 164.93 2-8-18-29-9-2	68 Er Erbium 167.26 2-8-18-31-8-2	69 Tm Thulium 168.93 2-8-18-31-8-2	70 Yb Ytterbium 173.05 2-8-18-32-8-2	71 Lu Lutetium 174.97 2-8-18-32-9-2
89 Ac Actinium (227) 2-8-18-32-18-9-2	90 Th Thorium 232.04 2-8-18-32-18-10-2	91 Pa Protactinium 231.04 2-8-18-32-20-9-2	92 U Uranium 238.03 2-8-18-32-21-9-2	93 Np Neptunium (237) 2-8-18-32-22-9-2	94 Pu Plutonium (244) 2-8-18-32-24-8-2	95 Am Americium (243) 2-8-18-32-25-8-2	96 Cm Curium (247) 2-8-18-32-25-9-2	97 Bk Berkelium (247) 2-8-18-32-27-8-2	98 Cf Californium (251) 2-8-18-32-28-8-2	99 Es Einsteinium (252) 2-8-18-32-29-8-2	100 Fm Fermium (257) 2-8-18-32-30-8-2	101 Md Mendelevium (259) 2-8-18-32-31-8-2	102 No Nobelium (259) 2-8-18-32-32-8-2	103 Lr Lawrencium (264) 2-8-18-32-32-8-3



Molecular Weight

14.00674 7
 $2s^2 2p^3$
N
Melting point: -209.86°C
Boiling point: -195.8°C
NITROGEN
Latin name: *Nitrogenium*

Annotations: A blue arrow points from the text 'ATOMIC MASS' to the value '14.00674'. Another blue arrow points from the text 'ATOMIC NUMBER' to the value '7'.

ATOMIC MASS

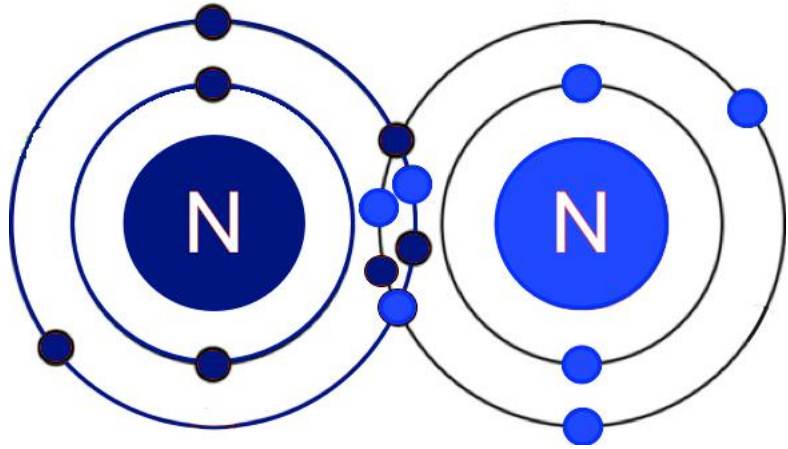
N_2

$\times 2 = \sim 28$

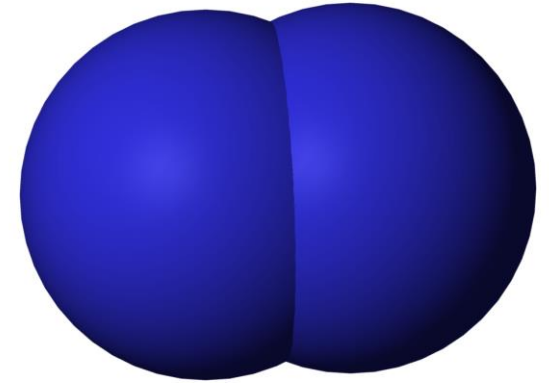
ATOMIC NUMBER

Molecular Weight of a Diatomic Molecule of Nitrogen = ~ 28

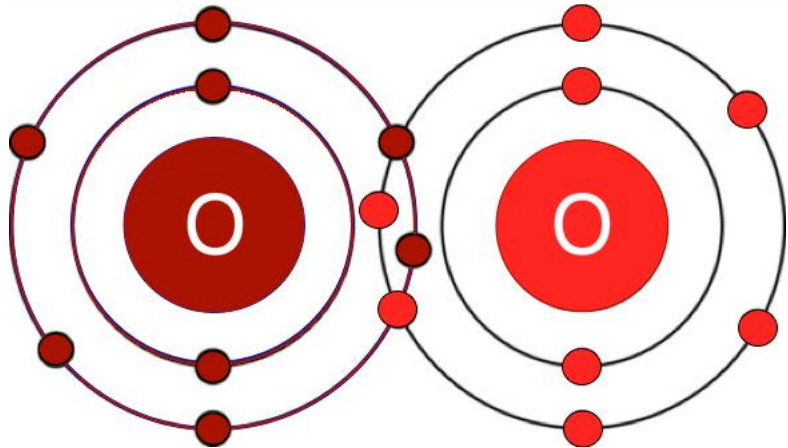
N₂ Covalent Triple Bond



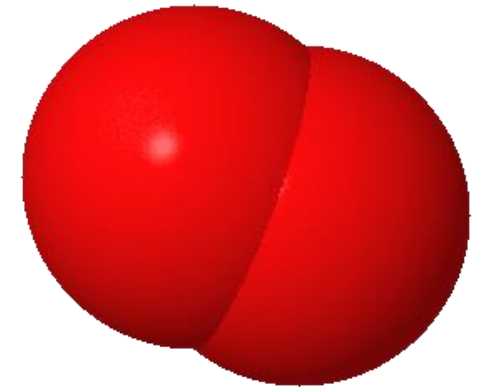
Bond Energy: ~ 944 kJ/mol
Molecule Diameter: ~300 pm



O₂ Covalent Double Bond

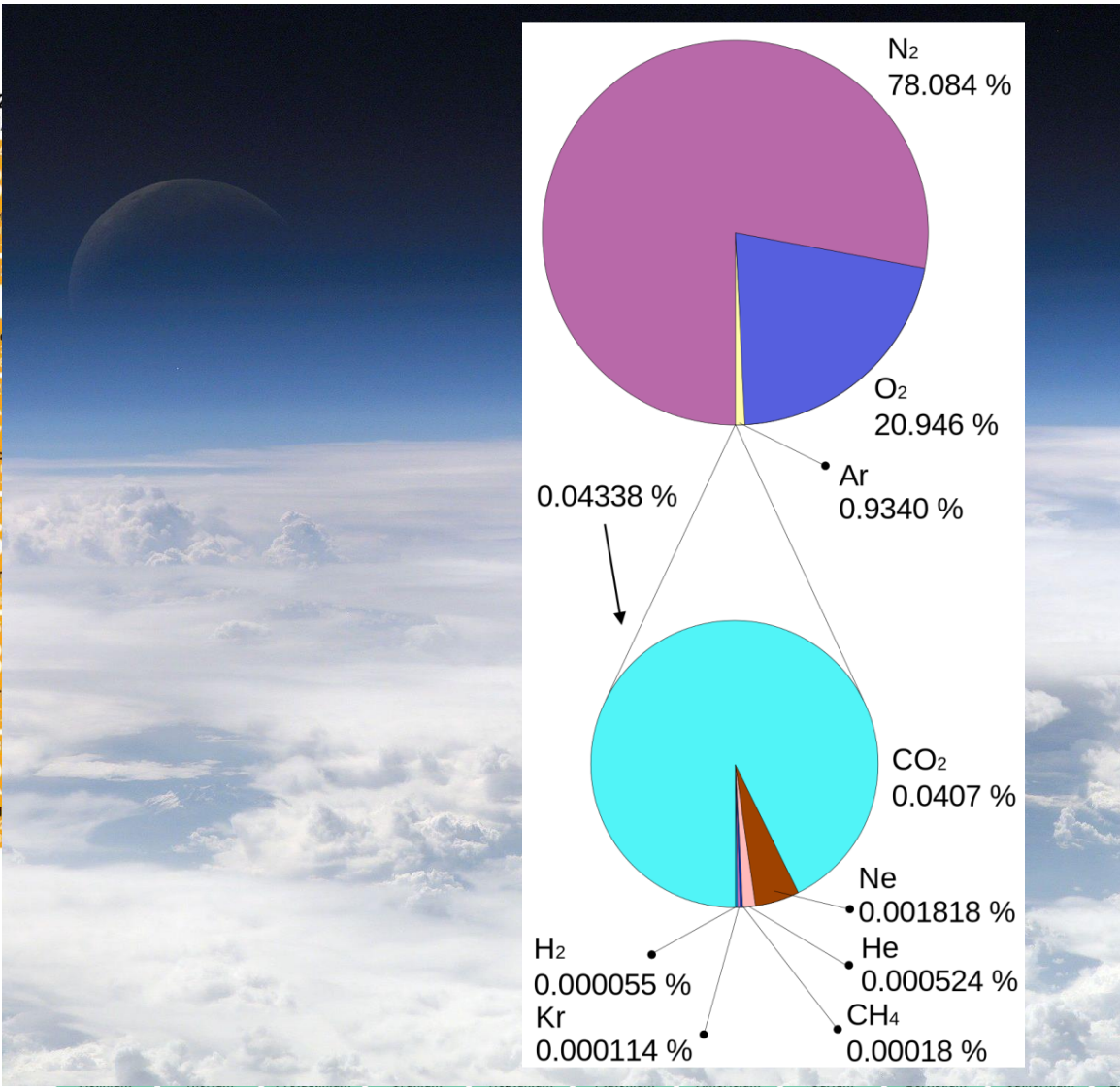


Bond Energy: ~ 495 kJ/mol
Molecule Diameter: ~292 pm



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37 Rb Rubidium 85.4678 2-8-18-8-1	38 Sr Strontium 87.62 2-8-18-2
55 Cs Caesium 132.90545196 2-8-18-18-8-1	56 Ba Barium 137.327 2-8-18-18-2
87 Fr Francium (223) 2-8-18-32-18-8-1	88 Ra Radium (226) 2-8-18-32-18-2



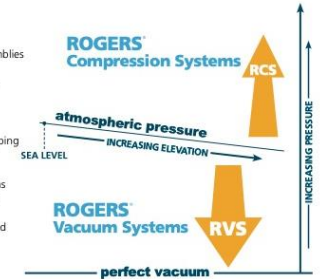
13 IIIA B Boron 10.81 2-3	14 IVA C Carbon 12.011 2-4	15 VA N Nitrogen 14.007 2-5	16 VIA O Oxygen 15.999 2-6	17 VIIA F Fluorine 18.998 2-7	18 VIIIA He Helium 4.0026 2
5 B Boron 10.81 2-3	6 C Carbon 12.011 2-4	7 N Nitrogen 14.007 2-5	8 O Oxygen 15.999 2-6	9 F Fluorine 18.998 2-7	10 Ne Neon 20.180 2-8
13 Al Aluminum 26.982 2-8-3	14 Si Silicon 28.085 2-8-4	15 P Phosphorus 30.974 2-8-5	16 S Sulfur 32.06 2-8-6	17 Cl Chlorine 35.45 2-8-7	18 Ar Argon 39.948 2-8-8
31 Ga Gallium 69.723 2-8-18-3	32 Ge Germanium 72.630 2-8-18-4	33 As Arsenic 74.922 2-8-18-5	34 Se Selenium 78.971 2-8-18-6	35 Br Bromine 79.904 2-8-18-7	36 Kr Krypton 83.798 2-8-18-8
49 In Indium 114.82 2-8-18-3	50 Sn Tin 118.71 2-8-18-4	51 Sb Antimony 121.76 2-8-18-5	52 Te Tellurium 127.60 2-8-18-6	53 I Iodine 126.90 2-8-18-7	54 Xe Xenon 131.29 2-8-18-8
81 Tl Thallium 204.38 2-8-18-32-18-3	82 Pb Lead 207.2 2-8-18-32-18-4	83 Bi Bismuth 208.98 2-8-18-32-18-5	84 Po Polonium (209) 2-8-18-32-18-6	85 At Astatine (210) 2-8-18-32-18-7	86 Rn Radon (222) 2-8-18-32-18-8
113 Nh Nihonium (286) 2-8-18-32-18-3	114 Fl Flerovium (289) 2-8-18-32-18-4	115 Mc Moscovium (290) 2-8-18-32-18-5	116 Lv Livermorium (293) 2-8-18-32-18-6	117 Ts Tennessine (294) 2-8-18-32-18-7	118 Og Oganesson (294) 2-8-18-32-18-8
67 Ho Holmium 164.93 2-8-18-31-8-2	68 Er Erbium 167.26 2-8-18-31-8-2	69 Tm Thulium 168.93 2-8-18-31-8-2	70 Yb Ytterbium 173.05 2-8-18-32-8-2	71 Lu Lutetium 174.97 2-8-18-32-9-2	
99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (260)	

ROGERS Engineered System Solutions



Our Approach

- Custom designed and fabricated assemblies
- Full submittal documentation provided by in-house design engineering and automation staff
- Project Management services from scoping phase to commissioning
- Fully integrable custom controls systems built, wired and programmed in-house
- Solutions built to fit specific process and installation requirements
- Unequaled service and support



Thank you!

ROGERS MACHINERY - ESS

- Bryan (541) 968-1879
- bryan.jensen@rogers-machinery.com

ROGERS®

About the Speaker



Nate Holliday

Parker Hannifin Corporation

- Product Sales Manager, Parker Hannifin Corporation
- 4 years of industry experience
- Previously a Territory Sales Manager

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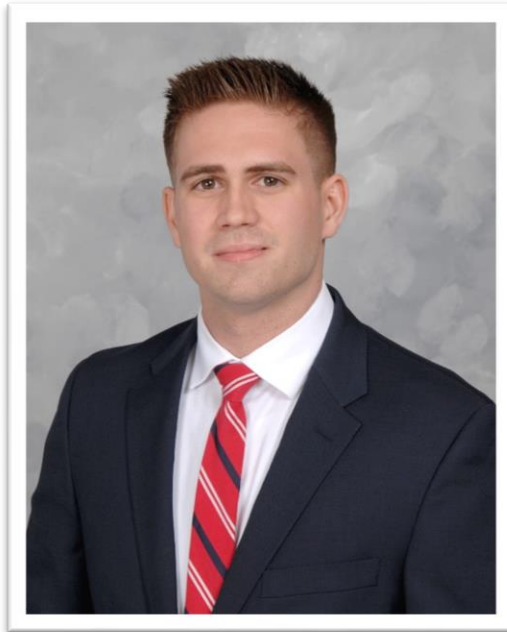




How Redundancy & Preventative Maintenance Play a Role In The Reliability of Onsite Nitrogen Gas Generation

Nate Holliday
12/8/2022

Welcome!



Nate Holliday

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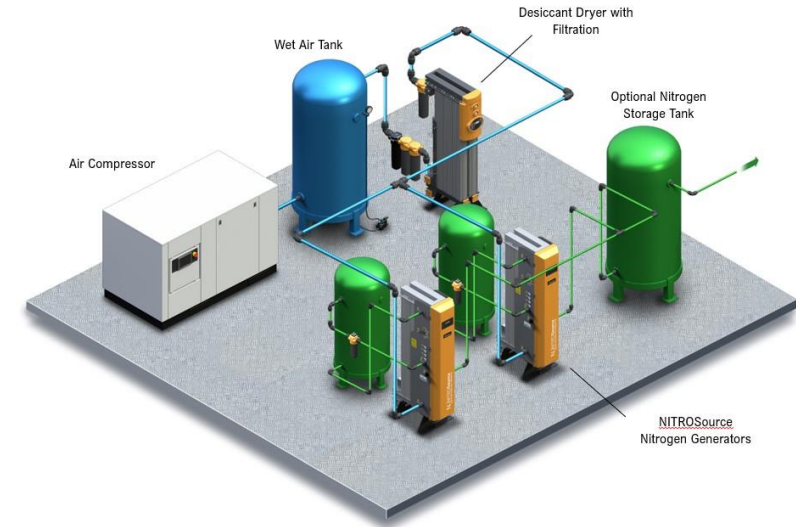
Products under me:

- Parker domnick hunter OIL-X filtration
- Refrigerated Compressed Air Dryers
- Desiccant Compressed Air Dryers
- Industrial Nitrogen Gas Generators
- Process Water Chillers
- CO2 Quality Incident Protection Systems



What is Redundancy?

- **Definition:** “The duplication of at least two components that are interconnected and designed for the same purpose”
- **There are 2 types**
 - Full
 - Partial
- **Main Goal** – increase the reliability of the overall system!



Benefits of Redundancy

- **Peace of Mind**
- **Increased Uptime**
- **Wear & Tear (Alternate Machines)**
- **Helpful during maintenance**
- **Easier to schedule maintenance**



What is Preventative Maintenance?

Definition: “The regular & routine maintenance of equipment and assets in order to keep them running & prevent any costly unplanned downtime from unexpected equipment failure”



PPM Analyzer

Description	12	24	36	48	60
12 Month Non EST Service Kit (Every 12 Months)	✓	✓	✓	✓	✓
24 Month Percentage Service Kit (Every 24 Months)		✓		✓	
36 Month Standard ServiceKit (Every 36 Months)			✓		
60 Month Standard ServiceKit (Every 60 Months)					✓

% Analyzer

Description	12	24	36	48	60
12 Month Non EST Service Kit (Every 12 Months)	✓	✓	✓	✓	✓
24 Month PPM Service Kit (Every 24 Months)		✓		✓	
36 Month Standard ServiceKit (Every 36 Months)			✓		
60 Month Standard ServiceKit (Every 60 Months)					✓

Typical Preventative Maintenance for A Nitrogen Generator

- **12 Month Interval**
 - Exhaust Silencer
 - Filter Elements
- **24 Month Interval**
 - Oxygen Analyzer (% or PPM)
- **36 Month Interval**
 - Solenoid Valves
- **60 Month Interval**
 - Stroke Cylinders
 - Valve Discs & Guides
 - Valve Bonnets
 - O-Rings



Conclusion / Summary





Thank you!

Compressed Air: Reliable Source for Nitrogen Generation

Q&A

Please submit any questions through the Question Window on your GoToWebinar interface, directing them to Compressed Air Best Practices Magazine. Our panelists will do their best to address your questions and will follow up with you on anything that goes unanswered during this session.

Thank you for attending!

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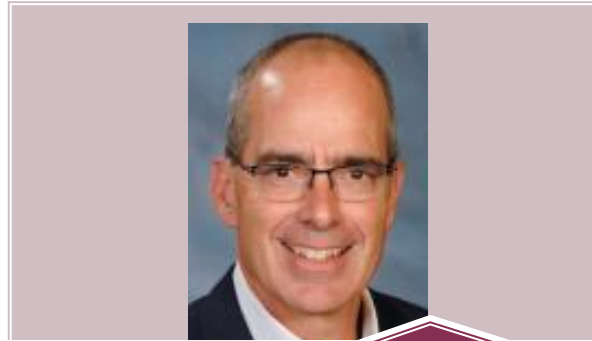


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