



Optimizing Production  
and Freezing Processes  
for the Food Industry

With over 100 years experience in the food and beverage industry, we have the know-how to help you optimize your production and freezing processes, lower your costs and improve your:

- Yield
- Production throughput
- Efficiency
- Quality

We do this through:

- Expert food analysis at our Food Technology Lab
- Optimal equipment engineering and design
- Expert set-up and start-up from our experienced field support.

First our dedicated team of food scientists can analyze your specific food product to develop your optimal custom processes. Then our world-class engineers will recommend and provide the optimal equipment for your needs. Finally our experienced field team can install, start-up and service your equipment to keep your equipment at top performance.

In short you'll get the temperature control and atmosphere applications you need, backed by the services and systems support you can expect from Praxair.

#### **Comprehensive Product Range**

Supplying each application with the proper gas (grade, compliance, certification, scale).

#### **Superior Reliability**

Extensive production facilities network to help ensure high quality products are there when they are needed.

#### **Equipment and Systems Excellence**

Connecting customers with everything needed to handle and store gases efficiently and safely.

#### **Productivity and Innovation Partner**

Working with food industry to identify and implement productivity and cost improvements.

#### **Ease of Doing Business**

Providing convenient e-commerce options and strong customer support.

#### **Safety Focus**

Making safety the top priority for every activity.

### The Praxair Food Technology Lab

At Praxair, our Food Technologies Lab provides our customers with the best-fit technology tailored to meet specific food freezing and processing needs. And while our methods are advanced, our goal is very simple: to help you deliver high quality food and beverage products to your customers.

In our Food Technologies Lab, we can analyze your process and provide you with recommendations on how to improve the quality and consistency of your product. Our lab is a full-time facility that has been in operation for over 30 years. Our experienced and dedicated technicians make their recommendations based on their expertise and the evaluation of data collected from thousands of tests on actual food products, in-lab thermal analyses and product testing on production-scale equipment. We will collect data on the thermal characteristics of your product, determine parameters for your freezing and chilling equipment, show what your product looks and tastes like after freezing, and recommend ways to better meet your goals. We are equipped to answer your most difficult product and processing questions so that you can optimize your system. So whether it's maximizing yield, boosting production or perfecting your finished product, our experts are ready to help with a customized assessment of your operation.



### Food Freezing and Chilling

Food freezing/cooling/chilling is the process of using direct contact of a cryogen to control or adjust temperature to a frozen or chilled state. Both inline and batch type freezing equipment can be designed to use carbon dioxide or nitrogen to freeze, cool or chill the food. The speed of cryogenic refrigeration helps prevent product degradation, the product retains natural juices and color, and dehydration is drastically reduced.

Almost any food product, (e.g., meat, chicken, fish, dairy, bakery, prepared foods, fruit, vegetables, etc.) can benefit from cooling or freezing, depending on the customer's needs.

Freezing is generally regarded as a food preservation technique. A customer considers freezing or chilling a food product to obtain higher quality products, extend shelf life, expand the distribution area, and make product handling easier.

The consequences of not achieving the desired final temperature include:

- Product handling problems
- Non-compliance with quality assurance (QA) specifications or government regulations
- Shorter shelf life or reduced product quality
- Supplemental freezing

Proper temperature control (cryogenic freezing or chilling) can greatly reduce (or slow) the loss of food product quality caused by bacteria growth, staling, oxidation and mold growth. This application also can overcome mechanical handling problems encountered in processes like packaging, slicing, dicing and other processing.

#### What is cryogenic freezing?

Freezing is a change in the physical state of a food product when energy, in the form of heat, is removed, changing the water in the food from the liquid state to a solid state.

Praxair specializes in cryogenic freezing using nitrogen or carbon dioxide at low temperatures to quickly freeze food products locking in moisture and product quality.

#### What is cryogenic chilling?

Cryogenic chilling is the removal of heat from raw and fresh processed foods, cooked or baked foods, and produce at ambient temperatures. Quickly cooling food products is an important step to ensure food safety and improve overall yield.

Praxair specializes in rapid chilling using liquid carbon dioxide and employ's innovative new applications using liquid nitrogen.

### Modified Atmosphere Packaging (MAP)

The use of modified atmospheres to replace air in food packages is applicable to many types of food. Controlling food spoilage is complex and more than one gas may be appropriate for the same application. However, specific packaging conditions and shelf life extension requirements play a role in determining which one is most suitable for a given application.

Praxair's *Extendapak*® gases are used by food processors and packagers to extend the shelf life of their products. These gases include pure nitrogen, carbon dioxide and oxygen or a mixture of these products and function to displace unwanted atmospheric gases when used in a Modified Atmosphere Packaging (MAP) process.

MAP represents only one aspect of what a food processor can use to ensure that high quality and safe food reaches the marketplace and, ultimately, the consumer.

Most importantly, MAP does not eliminate or reduce the processor's responsibility for good manufacturing practices. In fact, the opposite is true. MAP is only appropriate for plants producing the cleanest of products. No gas combination in the package will ever reverse a food's poor microbial condition. At its best, MAP will only extend the keeping quality of a food.

### Praxair's *Extendapak*® Gases

Product	Praxair	Storage Temperature Food Gases
Red Meats*	14, 15, 16, 30, 32, 38	32-41 °F (0-5 °C)
Processed Meats	2, 12, 14, 15, 16, 23, 24, 26, 28, 30, 31, 32, 33, 34	32-41 °F (0-5 °C)
Poultry	2, 12, 13, 14, 15, 16	32-36 °F (0-2 °C)
Seafood	14, 15, 16, 45	32-36 °F (0-2 °C)
Fresh Fruits	1, 44, 47, 49, 50, 51, 57, 70	41-50 °F (5-10 °C)
Dairy Products	2, 12, 14, 15, 16, 23, 24, 26, 28	34-37 °F (1-3 °C)
Dry and Dehydrated Foods	1, 12, 16, 28	Ambient
Prepared Foods	12, 14, 15, 16, 24, 26, 28	32-41 °F (0-5 °C)
Bakery Products	1, 10, 12, 13, 14, 15, 16, 24, 25, 26, 27, 28	Ambient
Fresh Vegetables	1, 41, 42, 47, 48, 49, 50, 51, 70	32-41°F (0-5°C)



## Red Meats

Type	Part Number	Cylinder Style	Content ft <sup>3</sup> /m <sup>3</sup>	Pressure psig/bar	CGA	(M)SDS	Regulator Recommendation
<b>Beef (Retail*)</b>	EX 30	T	374/10.36	2640/182	296	P-6303	2000 Series (see pages E•256 - E•258)
		K	275/ 7.62	2200/152	296		
	EX 32	T	290/8.03	1956/135	296		
		K	258/7.15	1956/135	296		
	EX 38	T	220/6.10	1464/101	296		
		K	196/5.43	1464/101	296		
<b>Beef, Lamb, Pork, Veal</b>	EX 16	T	208/5.76	1464/101	580	P-6231	2000 Series (see pages E•256 - E•258)
		K	185/5.13	1464/101	580		
	EX 15	T	267/7.41	1956/135	580		
		K	238/6.60	1956/135	580		
	EX 14	T	338/9.36	2640/182	580		
		K	253/7.01	2200/152	580		

\* Cuts that are targeted for immediate retail display are best in EX 30, 32, or 38.  
When "bloom" is not necessary, mixtures 16, 15 and 14 are recommended.

When more than one Extendapak number is referenced, mixtures should be evaluated in the same sequence as listed.  
Mixtures are prepared with the same care as Certified Standard grade (see page C•92), however analyses are not reported.

## Processed Meats

Type	Part Number	Cylinder Style	Content ft <sup>3</sup> /m <sup>3</sup>	Pressure psig/bar	CGA	(M)SDS	Regulator Recommendation		
<b>Sliced Meats (Bologna, Corned Beef, Ham, Pastrami, Roast Beef, Roast Pork)</b>	EX 14	T	338/9.36	2640/182	580	P-6231	2000 Series (see page E•256)		
		K	253/7.01	2200/152	580				
	EX 15	T	267/7.41	1956/135	580				
		K	238/6.60	1956/135	580				
	EX 16	T	208/5.76	1464/101	580				
		K	185/5.13	1464/101	580				
<b>Whole Meats (Corned Beef, Ham, Roast Beef, Roast Pork, Salami, Smoked Meat)</b>	EX 16	T	208/5.76	1464/101	580	P-6231	2000 Series (see page E•256)		
		K	185/5.13	1464/101	580				
	EX 12	T	170/4.72	1168/80	580				
		K	152/4.21	1168/80	580				
	EX 28	T	145/4.01	971/67	580				
		K	129/3.57	971/67	580				
	EX 26	T	126/3.50	830/57	580				
		K	112/3.11	830/57	580				
	EX 24	T	112/3.11	724/50	580				
		K	100/2.77	724/50	580				
	EX 23	T	101/2.81	642/44	580				
		K	90/2.50	642/44	580				
	EX 2	K	50/22.7	830/57	320			P-4574	2000 Series (see page E•256)
		Q	20/9.1	830/57	320			P-4573	2006 Series (see page E•261)
		LC 180	400/182	350/24	622				

## Poultry – Chicken, Cornish Hens, Duck, Turkey

Type	Part Number	Cylinder Style	Content ft <sup>3</sup> /m <sup>3</sup>	Pressure psig/bar	CGA	(M)SDS	Regulator Recommendation			
<b>Chicken, Cornish Hens, Duck, Turkey (master pack)</b>	EX 2	K	50/22.7	830/57	320	P-4574	2000 Series (see page E•256)			
		Q	20/9.1	830/57	320					
		LC180	400/182	350/24	622	P-4573	2006 Series (see page E•261)			
<b>(retail)</b>	EX 12	T	170/4.72	1168/80	580	P-6231	2000 Series (see page E•256)			
		K	152/4.21	1168/80	580					
	EX 13	T	312/8.64	2350/162	580					
		K	260/7.21	2200/152	580					
	EX 14	T	338/9.36	2640/182	580					
		K	253/7.01	2200/152	580					
	EX 15	T	267/7.41	1956/135	580					
		K	238/6.60	1956/135	580					
	EX 16	T	208/5.76	1464/101	580					
		K	185/5.13	1464/101	580					
	<b>Breaded Chicken (cooked)</b>	EX 14	T	338/9.36	2640/182			580	P-6231	2000 Series (see page E•256)
			K	253/7.01	2200/152			580		
EX 15		T	267/7.41	1956/135	580					
		K	238/6.60	1956/135	580					
EX 16		T	208/5.76	1464/101	580					
		K	185/5.13	1464/101	580					

## Seafood

Type	Part Number	Cylinder Style	Content ft <sup>3</sup> /m <sup>3</sup>	Pressure psig/bar	CGA	(M)SDS	Regulator Recommendation
<b>Raw White Fish*</b> Catfish, Cod, Dover, Flounder, Grouper, Haddock, Hake, Halibut, Monfish, Pike, Red Snapper, Shark, Skate	EX 45	T	214/5.93	1464/101	296	P-6232	2000 Series (see page E•256)
		K	190/5.27	1464/101	296		
<b>Raw, High Fat and Oily Fish*</b> Carp, Eel, Herring, Mackerel, Salmon, Sardines, Swordfish, Trout, Tuna	EX 16	T	208/5.76	1464/101	580	P-6231	2000 Series (see page E•256)
		K	185/5.13	1464/101	580		
<b>Crustaceans and Mollusks*</b> Abalone, Clams, Crab, Conch, Crayfish, Lobster, Mussels, Octopus, Oysters, Prawns, Scallops, Shrimp, Squid	EX 45	T	214/5.93	1464/101	296	P-6232	2000 Series (see page E•256)
		K	190/5.27	1464/101	296		
<b>Dried Fish*</b>	EX 14	T	338/9.36	2640/182	580	P-6231	2000 Series (see page E•256)
		K	253/7.01	2200/152	580		
	EX 15	T	267/7.41	1956/135	580		
		K	238/6.60	1956/135	580		

\*Retail Pak



## Dairy Products

Type	Part Number	Cylinder Style	Content ft <sup>3</sup> /m <sup>3</sup>	Pressure psig/bar	CGA	(M)SDS	Regulator Recommendation
<b>Milk, Powdered Milk</b>	EX 1	T	304/8.43	2640/182	580	P-4631	2000 Series (see page E•256)
		K	228/6.32	2200/152	580		
		LC 180	4110/114	230/16	295	P-4630	2006 Series (see page E•261)
<b>Cream Cheese, Processed Cheese, Soft Cheese</b>	EX 14	T	338/9.36	2640/182	580	P-6231	2000 Series (see page E•256)
		K	253/7.01	2200/152	580		
	EX 15	T	267/7.41	1956/135	580		
		K	238/6.60	1956/135	580		
	EX 16	T	208/5.76	1464/101	580		
		K	185/5.13	1464/101	580		
<b>Cottage Cheese, Hard Cheese</b>	EX 16	T	208/5.76	1464/101	580	P-6231	2000 Series (see page E•256)
		K	185/5.13	1464/101	580		
	EX 12	T	170/4.72	1168/80	580		
		K	152/4.21	1168/80	580		
	EX 28	T	145/4.01	971/667	580		
		K	129/3.57	971/667	580		
<b>Shredded Cheese Ricotta, Sour Cream, Yogurt</b>	EX 15	T	267/7.41	1956/135	580	P-6231	2000 Series (see page E•256)
		K	238/6.60	1956/135	580		
	EX 28	T	145/4.01	971/67	580	P-6231	2000 Series (see page E•256)
		K	129/3.57	971/67	580		
	EX 12	T	170/4.72	1168/80	580		
		K	152/4.21	1168/80	580		
	EX 16	T	208/5.76	1464/101	580		
		K	185/5.13	1464/101	580		

When more than one Extendapak number is referenced, mixtures should be evaluated in the same sequence as listed. Mixtures are prepared with the same care as Certified Standard Grade (see page C•92). Analyses are not reported.

## Bakery Products

Type	Part Number	Cylinder Style	Content ft <sup>3</sup> /m <sup>3</sup>	Pressure psig/bar	CGA	(M)SDS	Regulator Recommendation		
Bread, Crumpets, Doughnuts, English Muffins, Muffins, Pastry, Pizza Crusts, Rolls	EX 12	T	170/4.72	1168/80	580	P-6231	2000 Series (see page E•256)		
		K	152/4.21	1168/80	580				
	EX 16	T	208/5.76	1464/101	580				
		K	185/5.13	1464/101	580				
	EX 15	T	267/7.41	1956/135	580				
		K	238/6.60	1956/135	580				
Bread Crumbs, Cookies	EX 1	T	304/8.43	2640/182	580	P-4631	2000 Series (see page E•256)		
		K	228/6.32	2200/152	580				
	LC 180	4110/114	230/16	295	P-4630	2006 Series (see page E•261)			
Cakes	EX 10	T	321/8.90	2640/182	580	P-6231	2000 Series (see page E•256)		
		K	241/6.68	2200/152	580				
	EX 12	T	170/4.72	1168/80	580				
		K	152/4.21	1168/80	580				
	EX 13	T	312/8.64	2350/162	580				
		K	260/7.21	2200/152	580				
	EX 14	T	338/9.36	2640/182	580				
		K	253/7.01	2200/152	580				
	EX 15	T	267/7.41	1956/135	580				
		K	238/6.60	1956/135	580				
	EX 16	T	208/5.76	1464/101	580				
		K	185/5.13	1464/101	580				
	EX 1	T	304/8.43	2640/182	580			P-4631	2000 Series (see page E•256)
		K	228/6.32	2200/152	580				
		LC 180	4110/114	230/16	295			P-4630	2006 Series (see page E•261)



## Fruits

Type	Part Number	Cylinder Style	Content ft <sup>3</sup> /m <sup>3</sup>	Pressure psig/bar	CGA	(M)SDS	Regulator Recommendation
<b>Apples, Apricots, Honeydew, Orange Sections, Pears</b>	EX 70	T	312/8.83	2640/182	580	P-6231	2000 Series (see page E•256)
		K	235/6.65	2200/152	580		
<b>Blueberries, Cherries</b>	EX 47	T	321/8.91	2640/182	580	P-6231	2000 Series (see page E•256)
		K	241/6.69	2200/152	580		
	EX 51	T	315/8.73	2640/182	580		
		K	237/6.57	2200/152	580		
<b>Grapes</b>	EX 1	T	304/8.43	2640/182	580	P-4631	2000 Series (see page E•256)
		K	228/6.32	2200/152	580		
	LC180	4110/114	230/16	295	P-4630	2006 Series (see page E•261)	
<b>Kiwi, Nectarines, Plums Peaches</b>	EX 51	T	315/8.73	2640/182	580	P-4631	2000 Series (see page E•256)
		K	237/6.57	2200/152	580		
	EX 51	T	315/8.73	2640/182	580	P-4631	2000 Series (see page E•256)
		K	237/6.57	2200/152	580		
	EX 49	T	316/8.78	2640/182	590		
		K	238/6.59	2200/152	590		
<b>Raspberries</b>	EX 49	T	316/8.78	2640/182	590	P-4631	2000 Series (see page E•256)
		K	238/6.59	2200/152	590		
	EX 50	T	324/8.97	2640/182	590		
		K	243/6.73	2200/152	590		
	EX 51	T	315/8.73	2640/182	580		
		K	237/6.57	2200/152	580		
<b>Strawberries</b>	EX 57	T	341/9.46	2640/182	590	P-4631	2000 Series (see page E•256)
		K	255/7.07	2200/152	590		
	EX 44	T	340/9.43	2640/182	580		
		K	254/7.04	2200/152	580		

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For ordering purposes, please add the desired cylinder style to the end of the designated part number.

## Fresh Vegetables

Type	Part Number	Cylinder Style	Content ft <sup>3</sup> /m <sup>3</sup>	Pressure psig/bar	CGA	(M)SDS	Regulator Recommendation
<b>Asparagus</b>	EX 49	T	316/8.78	2640/182	590	P-4631	2000 Series (see page E•256)
		K	238/6.59	2200/152	590		
	EX 50	T	324/8.97	2640/182	590		
		K	243/6.73	2200/152	590		
	EX 51	T	315/8.73	2640/182	580		
		K	237/6.57	2200/152	580		
<b>Brussel Sprouts, Cabbage, Carrots, Cauliflower, Radishes</b>	EX 51	T	315/8.73	2640/182	580	P-4631	2000 Series (see page E•256)
		K	237/6.57	2200/152	580		
<b>Corn, Sweet Potatoes</b>	EX 49	T	316/8.78	2640/182	590	P-4631	2000 Series (see page E•256)
		K	238/6.59	2200/152	590		
<b>Lettuce, Peppers, Spinach, Vegetable Salads</b>	EX 70	T	312/8.83	2640/182	580	P-6231	2000 Series (see page E•256)
		K	235/6.65	2200/152	580		
<b>Beans, Broccoli, Onions</b>	EX 47	T	321/8.91	2640/182	580	P-6231	2000 Series (see page E•256)
		K	241/6.69	2200/152	580		
	EX 51	T	315/8.73	2640/182	580		
<b>Potatoes</b>	EX 50	T	324/8.97	2640/182	590	P-4631	2000 Series (see page E•256)
		K	243/6.73	2200/152	590		
	EX 49	T	316/8.78	2640/182	590		
		K	238/6.59	2200/152	590		
<b>Tomatoes</b>	EX 50	T	324/8.97	2640/182	590	P-4631	2000 Series (see page E•256)
		K	243/6.73	2200/152	590		
	EX 42	T	334/9.26	2640/182	590		
		K	250/6.93	2200/152	590		

When more than one Extendapak number is referenced, mixtures should be evaluated in the same sequence as listed. Mixtures are prepared with the same care as Certified Standard Grade (see page C•92). Analyses are not reported.