Despatch

Thermal Processing Technology

ITW EAE

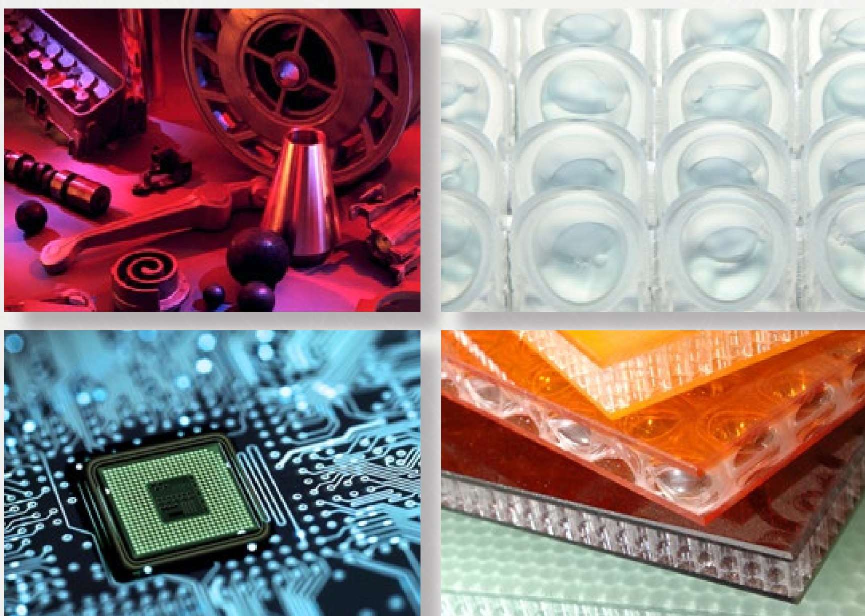
INDUSTRIAL OVEN SELECTION GUIDE

A GUIDE TO SELECTING THE RIGHT OVEN FOR YOUR PROCESSING APPLICATION

1. DEFINE YOUR APPLICATION

The first and most important step in finding the right piece of equipment is to determine what function your equipment needs to serve. The scope of thermal applications is endless and can range from common to complex.

You should also consider the environment that the oven needs to operate in. If you are using the oven in a clean room you will need a clean process oven. If you are using the oven in a laboratory for testing, you will most likely be looking for a small oven with the ability to document test results.



COMMON APPLICATIONS

Annealing – heating and slow cooling in order to toughen and reduce brittleness.

Curing – controlled heating of a substance to promote or control a chemical reaction.

Drying - removal of moisture (water that is not chemically bound)

Baking - Heating to a low temperature in order to remove entrained gases.

Sterilization - eliminates or kills all forms of life present on a product

Depyrogenation – the use of dry heat at high temperatures to destroy pyrogens

Burn-In Testing - process of stressing components to test for failure

Heat Treating – changing metal properties such as hardness, strength, flexibility and stress resistance.

Aging – rapid weathering of metal to achieve a stable surface condition

2. DETERMINE WHETHER A BATCH OR CONTINUOUS MODEL OVEN WILL WORK BEST FOR YOUR PROCESS

Batch Ovens

For applications where the load size or production volumes vary substantially, batch processing is a good approach. Batch ovens are also ideal for situations that require a high degree of flexibility in terms of process variables such as temperature or dwell (soak) time.

Continuous Ovens

Where a large quantity of similar product pieces are processed, continuous operation may be the optimal approach. Continuous ovens help ensure consistent thermal processing times for each part in high-volume applications, such as manufacturing electronic components or automotive parts. Continuous ovens may also allow several discrete processes to be combined, reducing material handling and increasing throughput.

3. CHOOSE THE BEST CHAMBER SIZE TO SUIT YOUR PROCESSING NEEDS

Chamber size depends on the size of the product or parts, the number of products in each batch, and the number of batches required per day to meet production requirements. If the interior space is too small, insufficient space between parts results in poor performance. If it is too large, space, time and energy are wasted.

When using forced recirculating airflow, parts benefit from spacing, but the oven can be loaded more densely vertically because airflow is distributed along the entire side wall. Parts should be kept 2-3 inches (5.1 - 7.6cm) from the oven walls.

OVEN SIZE CATEGORIES

Lab or Benchtop Ovens

Because of their small, convenient size, these ovens are used for laboratory test and development applications, as well as production applications that require small batch loads. These ovens range in chamber size from 1 cubic foot to 27 cubic feet (28 to 764 liters).

Cabinet Ovens

This size is referred to as a reach-in oven because they are ergonomically designed for easy loading and unloading. Cabinet ovens are floor-mounted, very efficient in terms of footprint and typically range in size from 4 to 35 cubic feet.

Walk-In and Truck-In Ovens

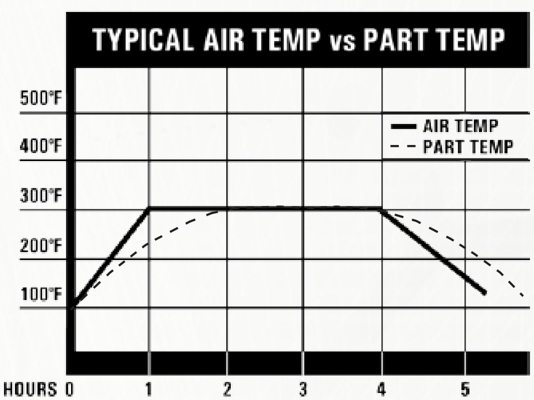
Large batch ovens can accommodate a wide variety of specific product/process needs. They are suitable for loading by fork truck or manually. Typically truck-in ovens ranges from 52 to 210 cubic feet, and walk-in ovens start at 360 cubic feet and larger.

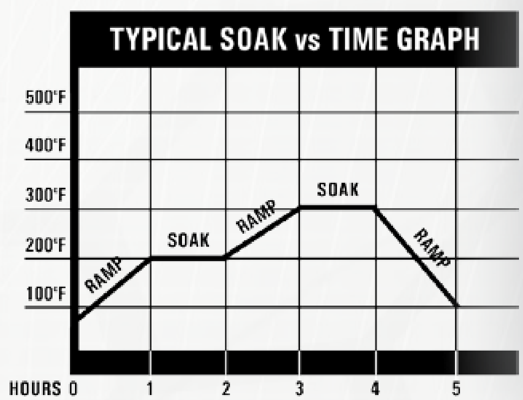
4. CONSIDER YOUR TEMPERATURE REQUIREMENTS

When considering the temperature requirements for your application, first note the minimum and maximum operating temperatures required.

Additional temperature considerations include:

- The required dwell time at temperature, and the overall cycle time.
- The type and amount of product load. The oven design will need to have sufficient heating capacity to bring the product to the desired temperature within the specified time.
- Whether the heat-up rate needs to be controlled or if the product can be allowed to reach temperature as quickly as possible.
- Any specific cool-down requirements.





OVEN HEATING CAPACITY

Does the oven have sufficient heating capacity to bring the product to the desired temperature within the specified cycle time?

The answer to this question depends on the mass and specific heat of the product. This is the energy required just to heat the product. The heating capacity of the oven will need to be greater, due to heat losses through the oven walls, through exhausted air and through heating of the oven mass itself.

Can the product absorb heat at a rate sufficient to reach temperature within the specified time frame?

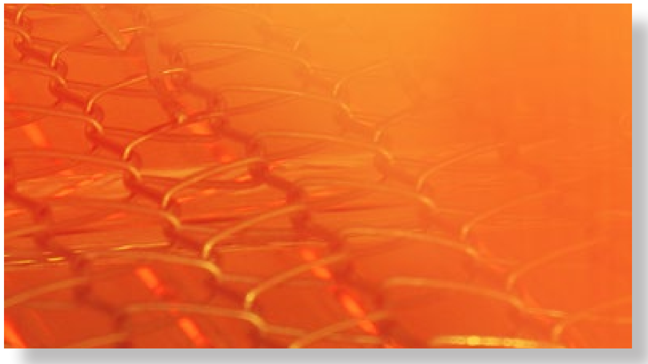
The product may not be able to reach the desired temperature in the desired time frame, even though the heating capacity of the oven is sufficient. The rate at which a product can absorb heat is dependent on the thermal conductivity of the material, the size and shape of the product, and the velocity and direction at which the convected air impinges the surface of the product.

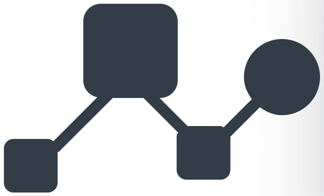
5. KNOW HOW CRITICAL TEMPERATURE UNIFORMITY IS FOR YOUR PROCESS

Uniformity is critical to consistent heat processing results. It is typically expressed as the maximum difference between the highest and lowest temperatures in a chamber at a specified setting. For example, ± 2C° at 200°C, as tested in a 9 Point Uniformity Survey.

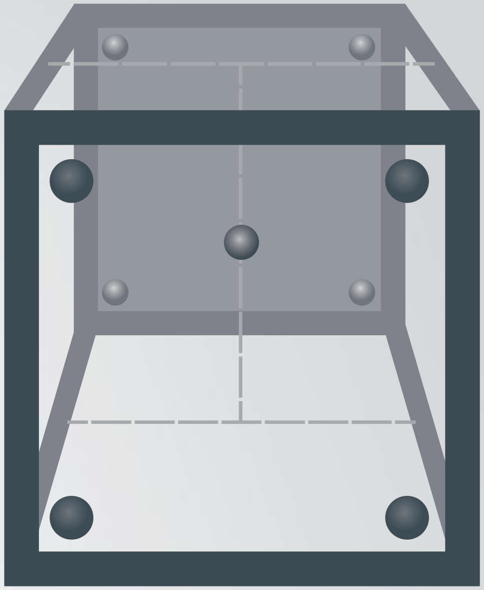
FACTORS THAT INFLUENCE TEMPERATURE UNIFORMITY INCLUDE:

- Cold air stratification (cold air entering chamber)
- Accuracy and response speed of controller
- Heat loss through oven walls or door/door seal
- Placement of workload
- Ability to direct the air through the chamber
- Volume and weight of products being processed





NINE-POINT UNIFORMITY TEST



Before implementing a critical thermal processing step you need to confirm that the oven you are using is delivering the temperature uniformity required for your process.

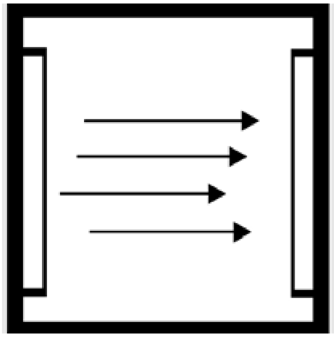
A nine point uniformity test that measures temperature in every corner as well as the center of the oven will ensure that the temperature throughout the oven remains relatively constant.

6. CHOOSE THE BEST AIRFLOW FOR YOUR PRODUCT LOAD

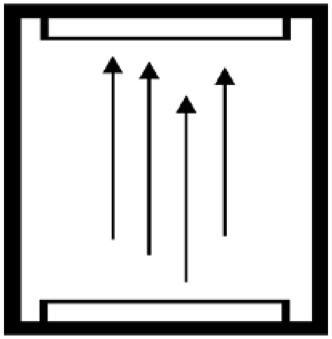
In most cases a forced convection oven with recirculating airflow will provide the best distribution of heat and significantly speeds the time-to-temperature and heat transfer to parts. Temperature uniformity and performance depends on a fan design that directs air to all areas of the c hamber.

Your product and how it is loaded will determine what type of airflow will provide uniform distribution of heat to all parts of the load. For instance, if your product is to be loaded on a solid tray, horizontal airflow is the best option. Consider how parts can be spaced with each type of airflow to ensure optimal airflow through or around all parts of the load.

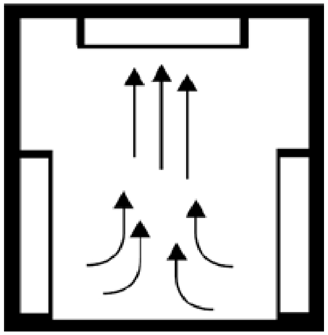
Uniflow is a combination of vertical up and horizontal airflow typically used in walk-in and truck-loading ovens. Ideal for large products with an uneven shape.



Horizontal



Vertical (up or down)



Uniflow

7. DESIGN AND CONSTRUCTION CONSIDERATIONS

Maximum temperature of the oven and size of the work chamber will affect the construction methods used. Standard oven construction includes a mild steel exterior finished in a scratch resistant paint, sufficient insulation to minimize heat loss, easily readable controls, and a door system with sufficient thermal expansion and structural integrity to avoid warping.

Several process-specific factors need to be taken into account in regard to oven construction. You will need a stainless steel interior whenever high degrees of cleanliness, cleanability and resistance to corrosion are required. Surface temperature specifications may require special construction techniques and load support design will depend on the type and weight of the load.

A wide variety of floor types are available. You'll need to consider what's best for your application. Options include a metal panel floor for surface mounting, recessed into the existing factory floor, or surface mounted with insulating cement. Truck loaded ovens use an insulated floor with recessed channel tracks or rails to guide the truck into position.

OVEN QUALITY

Proper Oven Construction:

- Improves temperature uniformity and performance
- Reduces heat loss and energy expenses
- Simplifies cleaning and service

Oven Interior Considerations:

- Stainless steel provides corrosion resistance and cleans easily.
- Aluminized and mild steel are less expensive, but offer less protection against corrosion, rust and contamination.
- Shelves should feature a sturdy, non-tip design, and allow for proper airflow and easy product loading/unloading.

Look for Applicable Standards

- U.L. & C-UL listed oven, U.L. & C-UL listed control panel (available as an option) and CE conformance are listings that are a sign of quality.

8. DEFINE ANY SPECIAL PROCESSING NEEDS

Your application may require a clean process oven to prevent particulate contamination of sensitive products. The oven will need special construction and components, such as a HEPA filter or other special air filtration system, stainless steel for cleaning and continuous back welding to prevent migration of particles into the oven.

Inert atmosphere ovens provide nitrogen or argon gas, which some processes require to prevent product oxidation at elevated temperatures.

The National Fire Protection Association (NFPA) requires specially designed "Class A" ovens for direct, gas-fired equipment, or for processing products involving flammable solvents, volatiles or combustible materials.

SPECIALTY OVEN FEATURES

Clean Process Oven

- HEPA filter or other special air filtration systems
- Rounded corners for cleaning
- Continuous back welding

Class A Oven

- Forced exhaust, to keep flammable vapor concentrations well below the Lower Flammable Limit (LFL)
- A purge timer that operates in conjunction with forced exhaust to purge volatiles before heaters are energized.
- An airflow switch, required to prove exhaust airflow.
- Explosion relief panel, designed to relieve and vent pressure through an explosion relief area or plug.

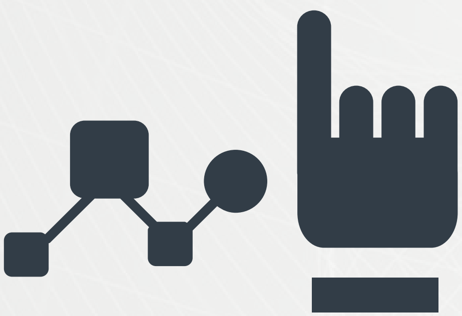
Inert Atmosphere Oven

- Inert gas is injected into the chamber, pressurizing the oven and replacing the oxygen.
- The chamber features high integrity welds and special motor seals
- Cooling systems such as water coils or air-to-air heat exchanger.

9. DEFINE WHAT CONTROLLER CAPABILITIES ARE NEEDED

Controllers play a key role in overall oven performance. Despatch uses microprocessor-based, digital proportioning controllers. Precise temperature control is achieved with a thermocouple sensor and solid state heater controls.

- Single setpoint controllers are simplest to use and are appropriate when the process requires one setpoint temperature.
- Programmable ramp/soak controllers are appropriate when multiple setpoint temperatures are required, or when the rate of heating must be controlled.



DESPATCH PROTOCOL 3

The Despatch Protocol 3™ controller can function either as a programmable ramp/soak controller or as a single setpoint controller. A Modbus 485 serial communications port allows data communication between the oven controller and a PC. Ethernet connection is available as an option.

With Protocol Manager software, the user may interface with up to 32 ovens from a single PC. This powerful tool provides data logging of critical operating information, recipe management and remote monitoring capability.

10. SELECT A STANDARD OVEN OR CONTACT A PRODUCT SPECIALIST FOR A CUSTOM CONFIGURATION

Congratulations! You made it through the list! Now you should have a pretty clear idea of what type of equipment you need for your specific process. In case you should need additional assistance, please take a look at the summary chart listed on the next page, or consult one of our Product Specialists.

WE'RE HERE TO HELP

Custom Solutions

If you have a unique application, Despatch engineers can address your custom requirements for heat-up times, cool down times, temperature uniformity, instrumentation, record keeping, space requirements, and other special concerns.

Product Specialists

Despatch's product specialists are trained to help you quickly find the right product for your process or application.

Call toll free in the US: 1-800-726-0550
International customers: 1-952-469-5424

Process Oven Applications

Common Applications	Interior Oven Size	Maximum Temperature	Air Flow Type and Direction	Special Condition	Model
Benchtop Ovens					
Testing, Curing, Drying, Annealing	2 to 27 cu.ft. (66 to 765 liters)	204°C/400°F	Uniflow	Pass Through (optional)	LBB Forced Convection
Testing, Curing, Drying, Annealing	1 to 18 cu.ft. (28 to 510 liters)	260°C/500°F	Horiz. Recirc.		LAC High Performance
Testing, Curing, Drying, Bonding	1.6 to 14 cu.ft. (45 to 396 liters)	350°C/662°F	Horiz. Recirc.	ISO Class 5 (Class 100) (Class A, Inert optional)	LCC/LCD Clean Process
Curing, Drying, Sterilizing, Aging	4.2 cu. ft. (119 liters)	343°C/650°F	Horiz. Recirc.	Class A - RFD	RAD/RFD Benchtop
Cabinet/Reach-In Ovens					
Curing, Drying, Sterilizing, Aging	4.2 to 35 cu.ft. (119 to 991 liters)	343°C/650°F*	Horiz. Recirc.	Class A - RFD	RAD/RFD Cabinet
Testing, Curing, Drying, Bonding	14 cu. ft. (396 liters)	350°C/662°F	Horiz. Recirc.	ISO Class 5 (Class 100) (Class A, Inert optional)	LCC/LCD2-14 Clean Process Cabinet
Preheating and Testing Pipes	2.7 to 4 cu.ft. (76.5 to 113.3 liters)	260°C/500°F*	Horiz. Recirc.	Top Loading	PTC Top-Loading
Polyimide Curing	14 cu. ft. (396 liters)	350°C/662°F	Horiz. Recirc.	ISO Class 5 (Class 100) Inert atmosphere	PCO2-14 Polyimide Curing Cabinet
Burn-in, Reliability Testing	18 cu. ft. (510 liters)	260°C/500°F	Horiz. Recirc.		PBC Burn-in Cabinet
Sterilization, Depyrogenation	30 to 180 cu.ft. (850 to 5,097 liters)	285°C/545°F	Horiz. Recirc.	ISO Class 5 (Class 100) Pass Through	SD Clean Process
Walk-In Ovens					
Aging, Bonding, Curing, Drying, Finish Baking, Heat Treating, Burn-In	52 to 216 cu.ft. (1,490 to 6,116 liters)	343°C/650°F	Horiz. Recirc.	Class A - TFD	TAD/TFD Walk-in
Aging, Annealing, Curing	476 to 952 cu.ft. (13,450 to 26,960 liters)	343°C/650°F	Uniflow	Class A (optional)	TAD/TFD Large Walk-In
Conveyor Ovens					
Preheating, Curing, Bonding, Drying, Heat treating	1.7 to 12.5 cu. ft. (48 to 354 liters)	260°C/500°F	Horiz. Recirc.	Optional Class A or HEPA filtered	PCC Series Continuous

Note: Rating of "Class A" ovens is determined by flammable/volatile loading at a given operating temperature. Flammable/volatile ratings should never be exceeded. Property damage, bodily injury or death could occur if ratings are not followed. Please consult the factory if your process involves volatiles, combustible materials or solvents.

SERVICE AND TECHNICAL SUPPORT

service parts: 1-800-473-7373
international service/main: 1-952-469-8230
service fax: 1-952-469-8193

service@despatch.com
parts@itweae.com

GLOBAL HEADQUARTERS

main phone: 1-800-726-0110
international/main: 1-952-469-5424
sales: 1-800-726-0550
international/sales: 1-952-469-8240

sales@despatch.com

WWW.DESPATCH.COM

8860 207th Street West
Minneapolis, MN 55044 USA

Despatch
Thermal Processing Technology ITW EAE

Industrial Oven Selection Guide 06-17