Description:

Originally developed for testing microelectronic devices for use in military and aerospace electronic systems, Bemco FSV Vertical, and TS Rotary, Thermal Shock Chambers are widely used for screening and quality evaluation of smaller electronic parts.

Today's modern Bemco thermal shock chambers include many unmatched features such as safe, no cable, hydraulic transfer systems, temperature ranges up to -160 C to +200 C, all welded interior construction, and high volume air circulation.

The unique Bemco TS series rotary thermal shock chambers use both the hot and cold zones 100% of the time, greatly improving operating efficiency.

With over 50 years of experience in making environmental test equipment, we have a shock chamber to fit almost any requirement.

Why settle for the appear-ance of testing when you can have a system that actually works?

Choose Bemco, the true experts in Thermal Shock.

Environmental Test and Space Simulation Systems

Contact us for a free quotation or additional information.

Bemco Inc, since 1951

-160 C to +200 C   -256 to +392 F

FS & TS

2 Zone Vertical or Rotary and 3 Zone Vertical Thermal Shock Chambers

Bemco FS2V8XL, Two Zone Vertical Thermal Shock Chamber with a temperature range of -160 C to +200 C and a usable shock zone workspace of 24 inches x 24 inches x 24 inches.

Bemco Inc.
Focused on Excellence

Environmental Test and Space Simulation Systems

Vertical Thermal Shock

Vertishock 2 Zone and 3 Zone

FS

Vertical 2-Zone and 3-Zone Thermal Shock Chambers

Model Number	Interior			Exterior			Zones	Cooling	Heat	Cold	Hot
	H	W	D	H [2]	W	D	#	Size	KW	Chamber Range [3]	Chamber Range
FS2V3-75/200C	24″	15″	16″	79″	65″	40″	2	LN_2	18	-75 C to Ambient	60 C to 200 C
FS2V3XL-160/200C	24″	15″	16″	79″	65″	40″	2	LN2	18	-160 C to Ambient	60 C to 200 C
FS2V3M-75/200C	24″	15″	16″	79″	74″	70″	2	10 x 10	18	-75 C to Ambient	60 C to 200 C
FS2V8-75/200C	34″	20″	22″	83″	68″	48″	2	LN_2	24	-75 C to Ambient	60 C to 200 C
FS2V8XL-160/200C	34″	20″	22″	83″	68″	48″	2	LN2	24	-160 C to Ambient	60 C to 200 C
FS2V8M-75/200C	34″	20″	22″	83″	77″	96″	2	10 x 10	24	-75 C to Ambient	60 C to 200 C
FS2V8B-75/200C	24″	24″	26″	85″	74″	48″	2	LN_2	24	-75 C to Ambient	60 C to 200 C
FS2V8BXL-160/200C	24″	24″	26″	85″	74″	48″	2	LN2	24	-160 C to Ambient	60 C to 200 C
FS2V8BM-75/200C	24″	24″	26″	85″	83″	96″	2	15 x 15	24	-75 C to Ambient	60 C to 200 C
FS2V10-75/200C	30″	24″	26″	85″	74″	68″	2	LN_2	36	-75 C to Ambient	60 C to 200 C
FS2V10XL-160/200C	30″	24″	26″	85″	74″	68″	2	LN2	36	-160 C to Ambient	60 C to 200 C
FS2V10M-75/200C	30″	24″	26″	85″	74″	116″	2	30 x 30	36	-75 C to Ambient	60 C to 200 C
FS3V3-75/200C	15″	15″	16″	79″	65″	40″	3	LN_2	18	-75 C to Ambient	60 C to 200 C x 2 [1]
FS3V3XL-160/200C	15″	15″	16″	79″	65″	40″	3	LN2	18	-160 C to Ambient	60 C to 200 C x 2 [1]
FS3V3M-75/200C	15″	15″	16″	79″	74″	70″	3	10 x 10	18	-75 C to Ambient	60 C to 200 C x 2 [1]
FS3V6-75/200C	20″	20″	22″	83″	68″	48″	3	LN2	24	-75 C to Ambient	60 C to 200 C x 2 [1]
FS3V6-160/200C	20″	20″	22″	83″	68″	48″	3	LN2	24	-160 C to Ambient	60 C to 200 C x 2 [1]
FS3V6M-75/200C	20″	20″	22″	83″	77″	96″	3	15 x 15	24	-75 C to Ambient	60 C to 200 C x 2 [1]
FS3V8-75/200C	24″	24″	26″	101″	74″	48″	3	LN2	24	-75 C to Ambient	60 C to 200 C x 2 [1]
FS3V8-160/200C	24″	24″	26″	101″	74″	48″	3	LN2	24	-160 C to Ambient	60 C to 200 C x 2 [1]
FS3V8M-75/200C	24″	24″	26″	101″	83″	96″	3	30 x 30	24	-75 C to Ambient	60 C to 200 C x 2 [1]

(1) 3-Zone Chambers have two hot zones, arranged hot, cold, hot and two baskets. One basket is always in the cold zone.
(2) Overall height is increased by a direct acting piston. Piston height on the FS8 is 39-3/4 inches. See technical explanation.
(3) High temperature range on the cold chamber can be extended to 200 C. This feature is available as an option.

Bemco FSV Series Vertical Thermal Shock chambers are available in two zone (FS2V - hot and cold) and three zone (FS3V hot - cold - hot) versions, with two temperature ranges (-75 C to +200 C or -160 C to +200 C), and two types of cooling systems (all mechanical cooling - no expendable refrigerant required, or all LN_2). Very low temperature, -160 C chambers, are always liquid nitrogen cooled. Two zone chambers are offered in four standard sizes, while three zone chambers are offered in three standard sizes.

Excellence

Bemco Inc.

Request a free quotation or analysis of your testing needs. Our experienced engineers are ready to help you.

We Deliver

Bemco chambers really simulate the environments expected. We take your specifications and requirements literally. Our equipment does what we promise and you specify. We are truly focused on Excellence.

Vertical Thermal Shock
Vertishock 2 Zone and 3 Zone

Environmental Test and Space Simulation Systems

A Bemco Model FS2V8-160/200C, Two Zone Vertical Thermal Shock Chamber, shown with the transfer carriage in the lower - cold compartment. Optional wire type baskets are mounted on the transfer carriage posts and the vertical lift piston is removed for clarity.

All Bemco thermal shock chambers are optimized to Military Standards including MIL-STD-883D, "Test Methods and Procedures for Microelectronics," MIL-STD-810F, and MIL-STD-202E.

FS Construction

FS2V and FS3V chambers include a 304 series stainless steel welded inner liner with high temperature fiberglass insulation. No asbestos is used in chamber construction.

The chamber outer case is fabricated from cold rolled steel finished in Bemco Blue. Chamber doors feature dual gaskets to fully vapor seal each compartment when the chamber is in operation.

The internal transfer carriage is made from stainless steel. Four internal posts guide the cage and support optional test item fixturing, shelves, or baskets.

A double acting hydraulic piston and a built-in Bemco hydraulic power unit smoothly transfers the load basket(s) from chamber to chamber.

To increase safety, the hydraulic piston is operated to its full stroke and is double acting so that transfers take place under full speed control.

No cables or cable tensioning systems subject to wear and potentially dangerous failure are used.

The transfer system includes a positive mechanical transfer carriage lock, transfer carriage position indicators, limit switches in the hydraulic piston, and a time delay sensor set to sense transfer failure.

The electrical control panel is hinged for easy access.

Conditioning

Chamber air in both the hot chamber(s) and the cold chamber is recirculated by high volume, stainless steel blowers drawing air in on the right side of the workspace and discharging on the left. Air flows through a diffuser baffle to create a uniform high velocity environment in excess of 10 feet per second (600 feet per minute) around and through your test objects.

The air circulation blowers are driven by externally mounted TEFC (totally enclosed fan cooled) motors with dual ball bearing races, connected by large diameter extended stainless steel shafts.

Fast-response open type heaters behind a radiation baffle raise chamber temperature in the hot compartment.

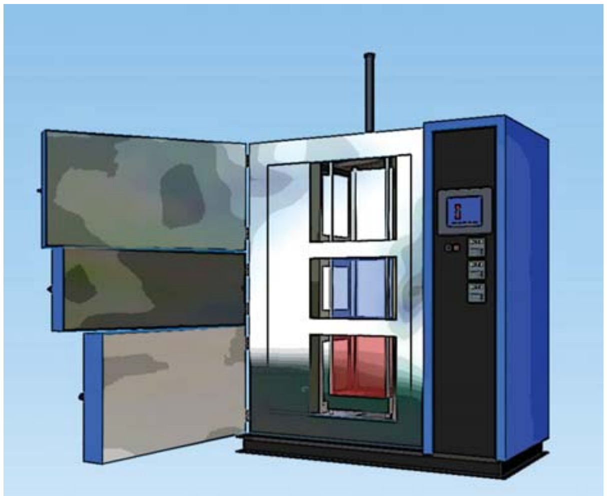
All electrical wiring meets the United States National Electric Code. U.L. and CSA approved components are used where possible.

Cooling

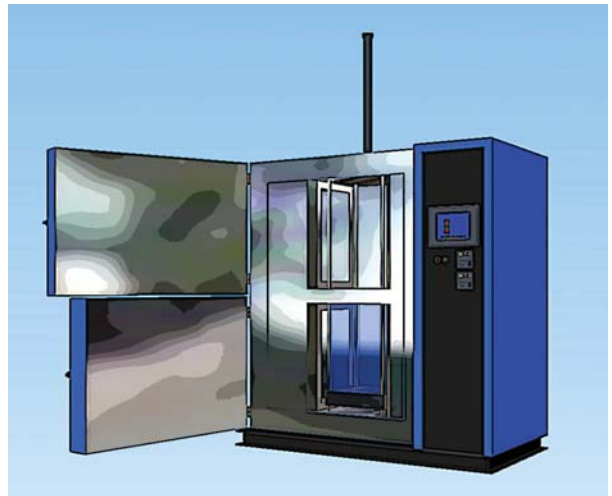
Mechanically refrigerated systems include a proportionally controlled cascade, two compressor, refrigeration system utilizing modern environmentally friendly refriger-

Vertical Thermal Shock

Vertishock 2 Zone and 3 Zone



Sketch of a Bemco Model FS3V3, Three Zone Vertical Thermal Shock Chamber, shown with the loads in the lower hot chamber and middle cold chamber.



Sketch of a Bemco Model FS2V3, Two Zone Vertical Thermal Shock Chamber, shown with the load in the lower cold chamber.

ants to cool the workspace in the cold compartment. The system includes automatic hot gas bypass and suction cooling unloading as well as Bemco's exclusive, high performance coaxial cascade heat exchanger.

All systems are water cooled, have thermal and current sensors on each compressor, and feature numerous safety and reliability protection systems for dependable operation. Mechanical systems require no expendable refrigerants to recover to specified conditions.

For liquid nitrogen (LN2) cooled systems, chamber temperature is reduced by a proportionally controlled liquid nitrogen injection system utilizing both a control solenoid and a series mounted safety solenoid to positively interrupt nitrogen flow in the event of a malfunction.

A relief valve and a line strainer are provided for dependable operation. A self-sealing vent system with an attachment coupling for remote piping by others, removes expanded nitrogen from the workspace.

Controls

Each Bemco FS2V chamber is furnished with a two channel microprocessor based programmable 1/4-DIN, solid state, 256-step ramping controller which includes a 4-line LCD interface display and a large red LED display. This instrument is pre-programmed to control both the hot chamber and the cold chamber automatically.

Temperature inside both chambers is sensed in the return air (after the load) by precision thermocouples. An RS232 and RS485 interface is standard.

On the three zone chamber, an additional microprocessor based programmable 1/4-DIN, solid state, controller with a 4-line LCD interface display and a large red LED display is used to control the cold zone. This instrument is interlocked with the primary sequencing control, monitoring the two hot zones.

Heaters are interlocked with a separate heavy duty power contactor and a factory preset high temperature safety control.

Vertical Thermal Shock

Vertishock 2 Zone and 3 Zone

FS

Environmental Test and Space Simulation Systems

Material Properties for Heat Transfer

Test Item Material	Density lb/in³	Density lb/ft³	Cp Btu/F-lb	Conductivity Btu-in/hr-F-ft²	Conductivity Btu/hr-F-ft
Metals					
Aluminum	0.098	169.344	0.214	1540.000	128.33333
Brass	0.308	532.000	0.092	672.000	56.00000
Bronze	0.313	540.000	0.082	180.000	15.00000
Copper	0.322	556.416	0.095	2680.000	223.33333
Silver	0.379	655.000	0.056	2856.000	238.00000
Steel	0.284	490.752	0.120	460.000	38.33333
Stainless Steel	0.286	494.208	0.122	105.000	8.75000
Non-Metallics					
Delrin	0.051	88.128	0.350	1.600	0.13333
Fiberglass Insulation	0.002	4.000	0.120	0.270	0.02250
Glass	0.101	174.528	0.120	7.500	0.62500
Phenolic	0.046	79.488	0.400	1.000	0.08333
Polyethylene	0.035	60.480	0.550	2.300	0.19167
Polystyrene	0.038	65.664	0.320	0.850	0.07083
Rubber	0.044	76.032	0.440	1.100	0.09167
Urethane Foam	0.001	2.000	0.300	0.150	0.01250
Assemblies					
Circuit Board, G-10	0.069	120.000	0.143	7.500	0.62500
Electronic Components	0.069	120.000	0.300	5.000	0.41667
16 Pin DIP, 360 / pound	0.081	140.000	0.200	10.000	0.83333

A microprocessor-based, FM Approved, high temperature safety control is standard on all hot chambers and a separate FM Approved low temperature control is standard on all liquid nitrogen cooled chambers.

Test Load Ratings

The ability of a Bemco FS2V or FS3V Thermal Shock Chamber to recover to the specified test temperature in the required time varies with the presentation of the test load to the circulating air in the chamber workspace.

Test load ratings also change with the Military Specification or test protocol, the test item density, and the test item's material composition.

The simplified information presented below is for your use in understanding the technical issues we routinely evaluate on your behalf.

A short but useful list of C_p (Specific Heat) in Btu/F-lb, density in lb/ft³, and conductivity in Btu/hour-F-ft, is given in a table on the left.

Many manufacturers of thermal shock chambers rate their machines in pounds of material based on a given test protocol, usually MIL-STD 883 Methods 1010.5, 1010.6, and 1010.7. They typically state performance in terms of pounds of IC's (integrated circuits) inside the chamber and give conversion factors using material specific heat (C_p), usually stated in consistent units such as Btu/F-lb, to convert their rating to other materials that might be tested.

The formula given by some manufactures for this conversion is:

Equivalent Load = C_p / 0.35

Where:

Cp = Btu/F-lb

0.35 = C_p of mixed average electronic components and other higher specific heat materials. Typically they use 16 Pin DIP's for testing.

Unfortunately, this simplification overlooks a number of factors. 16 DIPs vary greatly in encapsulating material composition and interior structure. One set of these devices measured at Bemco are 59% Silicon (glass), 27% Phenolic, and 15% tin coated copper. These devices weigh 360/pound, have an exposed area of 2.5 ft²/lb, and occupy a volume of 12.3 in³/lb.

Their specific heat calculates to 0.195 Btu/lb-F. Our table shows a recommended value of 0.2. The problem is that the conversion

Excellence

Vertical Thermal Shock

Vertishock 2 Zone and 3 Zone

factor given by some vendors of 0.35 Btu/lb-F results in an overstatement of load capacity by a factor of 0.35/0.20 = 1.75.

Additionally, the energy that must be handled by each chamber compartment in a thermal shock chamber is governed by three factors associated with your load configuration rather than just one.

Each interact, one with another, and contribute to the result. The three factors are:

- Transient resistance to change
- Surface heat transfer resistance
- Conductive resistance

Each contributes to your overall thermal shock testing result.

Since an analysis of conductive resistance from the center of your parts to their surface can be very complicated, it is not covered here.

A simplified formula for **thermal resistance to change** is:

$$Q_{tr} = \sum CpWg * dT/d\Theta$$

Where:

Q_{tr} = Energy required, Btuh

C_p = Specific heat of load, Btu/F-lb

W_g = Mass of load, pounds (lb)

dT = Change in temperature, F

$d\Theta$ = Recovery time allowed, hours

A simplified formula for **surface heat transfer resistance** is:

$$Q_h = h_o * A_o * (T_s - T_{ca})$$

Where:

Q_h = Heat transfer rate on the load surface, Btuh. Please note that the abbreviation Btuh = Btu/hr is used in the formulae that follow.

h_o = Heat transfer coefficient on the load surface, Btuh/F-ft²

A_o = Surface area of load, ft²

T_s = Average test load surface temperature during the time allowed for recovery, F

T_{ca} = Average test chamber air temperature during the time allowed for recovery, F

A useful **approximate equation for calculating the forced convection heat transfer coefficient** on a plane surface in air is given in the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) in their Handbook Chapter on Heat Transfer as:

$$h_o = 0.99 + 0.21 * A_v = 0.99 + .21 * 10 = 3.09 \text{ Btuh/F-ft2}$$

Where:

A_v = Velocity in ft/sec = 10 ft/sec

The average velocity in the Bemco FS2V and FS3V chambers is in excess of 10 fps (600 ft/minute) on all models. Higher velocities are available on custom systems.

The heat transfer coefficient inside the Bemco FS2V and FS3V shock chambers is therefore approximately 3.09 Btuh/F-ft². In actual practice, this value may be higher due to air flow blockages caused by test load or fixturing placement.

An Example

At this point, the question is what is the usefulness of all these equations?

The **thermal resistance to change formula** tells us that the amount of energy a test item must give up is governed by its specific heat (C_p), mass (W_g), the amount of time allowed for the change to take place, and the temperature difference between the test item and the air passing over it.

For example, we know that MIL-STD 883D Method 1010.7 F requires cycling from 175 C to -65 C, with recovery in the return air within 10 minutes. If we have a 35 pound load of mixed electronic parts with a C_p of 0.35 Btu/F-lb (please note that we are using this as an example - our measurements indicate the actual value for DIPs may be 0.20 Btu/F-lb), how much energy is required for the test load to track the air temperature in 10 minutes?

Another first. One of the original group of eleven early, Bemco FS3V3 -70/200C, three bay, and dual load, Thermal Shock Chambers pioneered by Bemco in the 1970's.

Vertical Thermal Shock

Vertishock 2 Zone and 3 Zone

FS

$Q_{tr} = \sum C_p W_g * dT/d\Theta$

Where:

Q_{tr} = Energy required, Btuh

C_p = 0.35 Btu/F-lb

W_g = 35 lb

dT = (175-(-65) * 1.8 F = 432 F

$d\Theta$ = 10/60 hours = 0.1667 hours

Q_{tr} = 31,752 Btuh or 9,306 watts

Well within the thermal capabilities of most Bemco FS2V and FS3V chambers starting with the FS2V8 and the FS3V8 models.

The **surface heat transfer resistance formula** tells us that the amount of energy a test item can transfer per unit time is limited by the surface heat transfer rate, the surface area, and the average temperature difference.

Using the same example, with the load having a total surface area of 87.5 ft², how much energy can we transfer per hour?

$Q_h = h_o * A_o * (T_s - T_{ca})$

Where:

Q_h = Surface heat transfer rate on the load, Btuh

h_o = 3.09 Btuh/F-ft²

A_o = 87.5 ft²

T_s = (175-(-65) * 1.8 F / 2 = 216 F

T_{ca} = -65 F

Q_h = 75,975 Btuh

The value of T_s is divided by two, assuming that the test load starts at 175 C at the beginning of the transfer and ends at -65 C at the end of the allowed time of 10 minutes.

Similarly, the value of T_{ca} is given as -65 C, assuming that the air temperature recovers in the Bemco lower chamber instantly. An assumption that gives the maximum possible value for heat transfer rather than the likely lower value caused by heating induced by the introduction of the test load into the cold chamber workspace.

The calculation also assumes that each part is perfectly exposed on every side to the air flowing over it. A configuration meeting this constraint is one layer, every device supported by its pins, with the pins facing down on a shelf that does not block air flow.

What happens if we put the parts in baskets so that only edge parts are exposed to the air? If the exposed area is now 10 ft² the same calculation yields a value of 8,683 Btuh.

We notice the problem immediately. The test load does not have enough surface area to track the temperature change.

The Bottom Line

Test load arrangement and test fixturing can greatly affect the results you achieve by testing.

The optimum thermal shock test fixturing pattern presents all sides of each test load to the flowing chamber air.

Test fixturing that requires stacking parts or placing them in basket containers more than a few parts deep should be carefully analyzed for thermal response.

The analysis of the response of a specific combination of load, chamber, and specification can get quite complicated. Since we specialize in this type of work, we have automated programs that perform a very rigorous thermal analysis of both your test load and our thermal shock chambers.

We are happy to provide this service to you at no charge. For evaluation of component parts, at least two ounces (0.125 pounds) of representative parts of each type you want us to look at are required for analysis.

Optional Equipment

Both the FS2V and the FS3V systems are available in custom shapes and sizes. They are also offered with specially modified conditioning systems, air circulation patterns, transfer mechanisms and control

Environmental Test and Space Simulation Systems

Vertical Thermal Shock

Vertishock 2 Zone and 3 Zone

FS

systems. Please request an analysis of your needs.

FS Standard Options

- Windows and interior lights in one or more compartments. Window sizes are 12" x 12" and 18" x 18" clear viewing area.
- A 1" traveling tube access port. This port exits through the chamber top and raises and lowers with the transfer cage.
- Access Ports in the side of any compartment. Standard sizes are 2", 3", 4" and 6."
- Casters, four swivel type, with locks.
- Shelf pilasters and wire-type stainless steel shelves in each bay.
- Shelf pilasters and basket-type stainless steel shelves, 2" deep in each bay.
- LN2 boost cooling with vent for extra or back-up cooling.
- GN2 gas purge with pressure regulator, gauge, flow measuring and regulating valved rotameter, and vent in each bay.
- Desiccant drier purge with dual tower 10 cfm desiccant drier, pressure regulator, gauge, flow measuring and regulating valved rotameter, and vent piped to each bay.
- For systems with mechanical refrigeration, two refrigeration gauges per compressor, four total, mounted in the refrigeration package available with or without isolation valves.
- A high capacity hydraulic transfer system for handling larger, overweight, loads.
- A heating system in the cold chamber to allow part-time use of the cold chamber as an environmental test chamber.
- An automatic cold chamber defrost system including a defrost heater and a defrost timer.
- A remote, air cooled, refrigeration system condenser for mounting by your qualified air conditioning contractor or Bemco factory technicians, up to 50 feet from the chamber, on a roof or outside your building.
- A quiet package to reduce noise on either liquid nitrogen or mechanically refrigerated systems.

FS Instrument Options

- Microprocessor-based, FM Approved under-temperature safety control for a mechanically cooled FS2V or FS3V system. FM Approved over-temperature safety controls are standard on all systems and under-temperature controls are standard on LN_2 cooled chambers.
- Remote control over an Ethernet Link.
- A 12 inch, chart printing, two or four channel circular chart recorder.
- A 4 channel strip chart recorder, Honeywell model DPR3000.
- A system elapsed time meter.
- A digital temperature indicator for FS2V, 2 Zone systems.
- A digital temperature indicator for FS3V, 3 Zone systems.
- A smoke alarm, one per bay, to monitor for problems with the test load.
- A 10 inch nominal, touch screen HMI, (Human Machine Interface) coupled to an Allen Bradley PLC to replace the main system controls and switches. This system includes a main switch and an emergency stop button.

Excellence

Bemco Inc.

Request a free quotation or analysis of your testing needs. Our experienced engineers are ready to help you.

We Deliver

Bemco chambers really simulate the environments expected. We take your specifications and requirements literally. Our equipment does what we promise and you specify. We are truly focused on Excellence.

Rotary Thermal Shock

Turboshock Two Zone

TS

Environmental Test and Space Simulation Systems

Turboshock, Rotary Thermal Shock Chambers											
Model [1] Number	Interior			Exterior			Zones #	Cooling Size	Heat KW	Cold Chamber Range [3]	Hot Chamber Range
	H	W [2]	D [2]	H	W	D					
TS2R0.7-75/200C	12″	14″	7.5″	71″	65″	48″	2	LN_2	12	-75 C to Ambient	60 C to 200 C
TS2R0.7XL-160/200C	12″	14″	7.5″	71″	65″	48″	2	LN2	12	-160 C to Ambient	60 C to 200 C
TS2R0.7M-75/200C	12″	14″	7.5″	71″	77″	48″	2	3 x 3	12	-75 C to Ambient	60 C to 200 C
TS2R1.2-75/200C	12″	18″	9″	71″	65″	48″	2	LN_2	18	-75 C to Ambient	60 C to 200 C
TS2R1.2XL-160/200C	12″	18″	9″	71″	65″	48″	2	LN2	18	-160 C to Ambient	60 C to 200 C
TS2R1.2M-75/200C	12″	18″	9″	71″	86″	48″	2	5 x 5	18	-75 C to Ambient	60 C to 200 C
TS2R4-75/200C	24″	24″	12″	86″	89″	66″	2	LN_2	24	-75 C to Ambient	60 C to 200 C
TS2R4XL-160/200C	24″	24″	12″	86″	89″	66″	2	LN2	24	-160 C to Ambient	60 C to 200 C
TS2R4M-75/200C	24″	24″	12″	86″	128″	66″	2	10 x 10	24	-75 C to Ambient	60 C to 200 C
TS2R6-75/200C	24″	32″	16″	86″	89″	66″	2	LN_2	36	-75 C to Ambient	60 C to 200 C
TS2R6XL-160/200C	24″	32″	16″	86″	89″	66″	2	LN2	36	-160 C to Ambient	60 C to 200 C
TS2R6M-75/200C	24″	32″	16″	86″	134″	66″	2	15 x 15	36	-75 C to Ambient	60 C to 200 C

[1] Rotary Chambers have two zones, arranged hot and cold as well as two loads, one in each zone.
[2] R1.2 and R6 Models have curved test area, W = Diameter and D = Depth. Shelves are curved. See Text.
[3] High temperature range can be extended to 200 C. This feature is available as an option.

A Bemco exclusive product, the TS Series of Turboshock Rotary Thermal Shock Chambers feature an electrically driven, 180 degree reversing, rotating wall located between two chambers, one hot and one cold.

Two loads can be handled simultaneously. Front loading and rear access doors allow full entry to each zone.

The unique double capacity design allows placement of baskets, shelves, or card cages. By fully using the hot and cold zones 100% of the time as opposed to 50% of the time on more conventional vertical thermal shock chambers, the efficiency and throughput of these systems is nearly doubled. They occupy almost the same floor space and consume roughly the same utilities as a conventional system making them a very cost effective choice in many applications.

Turboshock chambers are available in four sizes, two temperature ranges (-75 C to +200 C or -160 C to +200 C), and with two types of cooling systems (all mechanical cooling - no expendable refrigerant required or all LN_2).

Very low temperature, -160 C chambers, are always liquid nitrogen cooled.

An illustration of a Bemco TSR0.7M -75/200C Turboshock Rotary Thermal Shock Chamber with a cubical, lift off replaceable B12147 Carrier Basket in place partially rotated. The view is from the hot chamber side. The opposite chamber is the cold chamber.

Excellence

Bemco Inc.

Request a free quotation or analysis of your testing needs. Our experienced engineers are ready to help you.

We Deliver

Bemco chambers really simulate the environments expected. We take your specifications and requirements literally. Our equipment does what we promise and you specify. We are truly focused on Excellence.

Rotary Thermal Shock

Turboshock Two Zone

TS

Environmental Test and Space Simulation Systems

All Bemco rotary thermal shock chambers are optimized for testing in accordance with Military Standards including MIL-STD-883D, "Test Methods and Procedures for Microelectronics," MIL-STD-810F, and MIL-STD-202E.

TS Construction

Bemco Turboshock chambers include a 304 series stainless steel welded inner liner with high temperature fiberglass insulation. No asbestos is used in chamber construction.

The chamber outer case is fabricated from cold rolled steel finished in Bemco Blue. Chamber doors feature dual gaskets to assure a vapor tight seal inside each compartment when the chamber is in operation. The hot chamber door includes a cam type latch and the cold chamber door is normally sealed with tool access clamps to limit operator entry, reducing the need for defrosting.

The internal rotating transfer door and the door load support retaining bars are fabricated exclusively from stainless steel. The door rotates 180 degrees and then reverses to allow electrical connections and fluid connections to product fixturing and baskets.

The transfer system features electrical access door open interrupts as well as, transfer door position indicators, limit switches on the rotation system, and a time delay sensor set to alarm on transfer failure.

The electrical panel is hinged for easy access.

Conditioning

Chamber air in both the hot chamber and the cold chamber is recirculated by a high volume, stainless steel blower drawing air in on the right side of the workspace and discharging on the left. Air flows through a diffuser baffle to create a uniform high velocity in excess of 10 feet per second (600 feet per minute) around and through your test objects.

The air circulation blowers are driven by externally mounted TEFC motors, with dual ball bearing races, connected by large diameter extended stainless steel shafts.

Fast-response, open type, heaters behind a radiation baffle raise chamber temperature in the hot compartment.

All electrical wiring meets the United States National Electric Code. U.L. and CSA approved components are used where possible.

Cooling

Mechanically refrigerated systems include a proportionally controlled cascade, two compressor refrigeration system utilizing modern refrigerants to cool the workspace in the cold compartment. The system includes automatic hot gas bypass and suction cooling unloading as well as Bemco's exclusive, high performance coaxial cascade heat exchanger.

All systems are water cooled, have thermal and current sensors on each compressor as well as numerous safety and reliability protection systems for dependable operation. Mechanical systems require no expendable refrigerants to recover to specified conditions.

For liquid nitrogen (LN2) cooled systems, chamber temperature is reduced by a proportionally controlled liquid nitrogen injection system utilizing both a control solenoid and a series mounted safety solenoid to positively interrupt nitrogen flow in the event of a malfunction.

A relief valve and a line strainer are provided for dependable operation. A self-sealing vent system with an attachment coupling for remote piping by others removes expanded nitrogen from the workspace.

Environmental Test and Space Simulation Systems

Rotary Thermal Shock

Turboshock Two Zone

TS

Bemco TS2RO.7XL-160/200C Rotary Thermal Shock Chamber shown with both the hot and cold chamber access doors open.

Controls

Each Bemco TS2R chamber is furnished with a two channel microprocessor based, programmable, 1/4-DIN, solid state, 256-step ramping controller which includes a 4-line LCD interface display and a large red LED display. This instrument is pre-programmed to control both the hot chamber and the cold chamber automatically.

Temperature inside both chambers is sensed in the return air (after the load) by precision thermocouples. An RS232 and RS485 interface is standard.

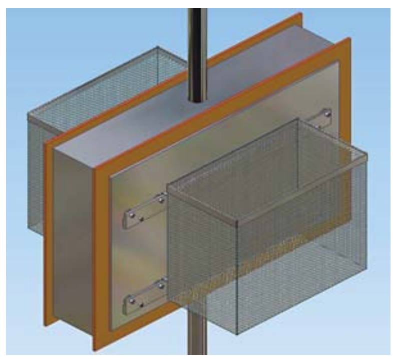
Heaters are interlocked with a separate heavy duty power contactor and a factory preset high temperature safety control.

A microprocessor-based, FM Approved, high temperature safety control is standard on all hot chambers and a separate FM Approved low temperature control is standard on all liquid nitrogen cooled chambers.

Fixturing

TS2R0.7 and TS2R4 Turboshock chambers are furnished with two cubical, liftoff type, perforated stainless steel baskets, one for the hot chamber and one for the cold chamber. They quickly reverse roles once the Turboshock system is set in operation. The B12147 Basket fits the TS2R0.7 and the B242412 Basket fits the TS2R4.

These baskets are supported by two convenient slide-in clips mounted on the surface of each door side.

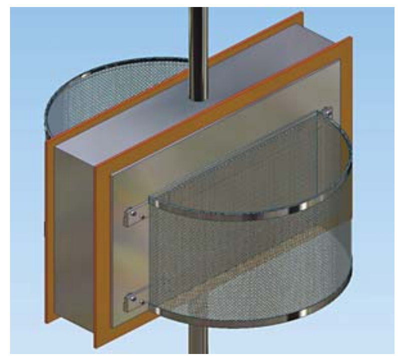


The illustration above shows the door removed from the chamber with two B12147 Carrier Baskets in place.

TS2R1.2 and TS2R6 Turboshock chambers are furnished with two larger, half round, liftoff type perforated stainless steel baskets, one for the hot chamber and one for the cold chamber.

The B12189R Basket fits the TS2R1.6 and the B243216R Basket fits the TS2R6.

These baskets utilize the same clips as the cubical type of basket and they will mount in the TS2R0.7 and TS2R4. They are recommended for use with the TS2R1.2 and TS2R6, since these systems include larger heating and cooling systems, capable of handling the bigger loads possible with these enlarged containers.



The illustration above shows the door removed from the chamber with two B12189R Carrier Baskets in place, while the illustration below shows the B12189R in place in a TS2R1.2M Mechanically Cooled Turboshock chamber equipped with the optional 10 inch HMI (Human

Excellence

Bemco Inc.

Request a free quotation or analysis of your testing needs. Our experienced engineers are ready to help you.

We Deliver

Bemco chambers really simulate the environments expected. We take your specifications and requirements literally. Our equipment does what we promise and you specify. We are truly focused on Excellence.

Rotary Thermal Shock

Turboshock Two Zone

TS

Environmental Test and Space Simulation Systems

Machine Interface) and Allen Bradley PLC control system.

The illustration on the previous page also shows another Bemco exclusive feature, the optional door air deflector that increases airflow velocity through the test load cavity by 35% from an average of at least 10 feet per second (600 fpm) to approximately 14 fps.

Standard baskets can be replaced by an adjustable shelf or tray holding fixture, a card cage, or other fixturing systems designed to hold your products or systems in place.

Because the mechanism rotates only 180 degrees and then reverses, the TS Turboshock chambers are ideal for use in tests that require product electrical or fluid connections.

TS Standard Options

- Windows and interior lights in one or both compartments. Window size is 12" x 12".
- A 1 inch ID rotating top tube that feeds both compartments. Attached wires, cables or fluid lines must have a service loop capable of rotating 180 degrees.
- Access Ports in the side of any compartment. Sizes are 2", 3", 4" and 6."
- Casters, four swivel type with locks.
- Extra cubical, open on top, perforated stainless steel carrier baskets (one is standard for each bay) for the TS2R0.7 (B12147) and the TS2R4 (B242412).
- Extra half round, open on top, perforated stainless steel carrier baskets (one is standard for each bay) for the TS2R1.6 (B12189R) and the TS2R6 (B243216R).
- A shelf support frame and adjustable wire type shelves for each bay with mounting clips.
- Card cages with or without motherboards. This is a custom item that must be matched to your product.
- LN2 boost cooling with vent for extra or back-up cooling on mechanically cooled systems.
- GN2 gas purge with pressure regulator, gauge, flow measuring and regulating valved rotameter, and vent in each bay.
- For systems with mechanical refrigeration, two refrigeration gauges per compressor, four total, mounted in the refrigeration package available with or without isolation valves.
- A quiet package to reduce noise on either liquid nitrogen or mechanically refrigerated systems.

All of the instrumentation options available for use with the FS Series of Vertical Thermal Shock Chambers are also available for installation on the TS Turboshock systems.

Excellence

Bemco Inc.

2255 Union Place, Simi Valley
California 93065, USA
805-583-4970 telephone
805-583-5033 fax
http://www.bemcoinc.com

Combined Environments

Temperature, Humidity, Altitude, Vibration, Vacuum, Rain, Sunshine, Salt Spray, Sand and Dust, and Gasses. Space Simulation Systems, Walk-in Chambers, Drive-in Rooms, PAO Fluid Chillers, and Air Servos.