D-200 Application Diagrams

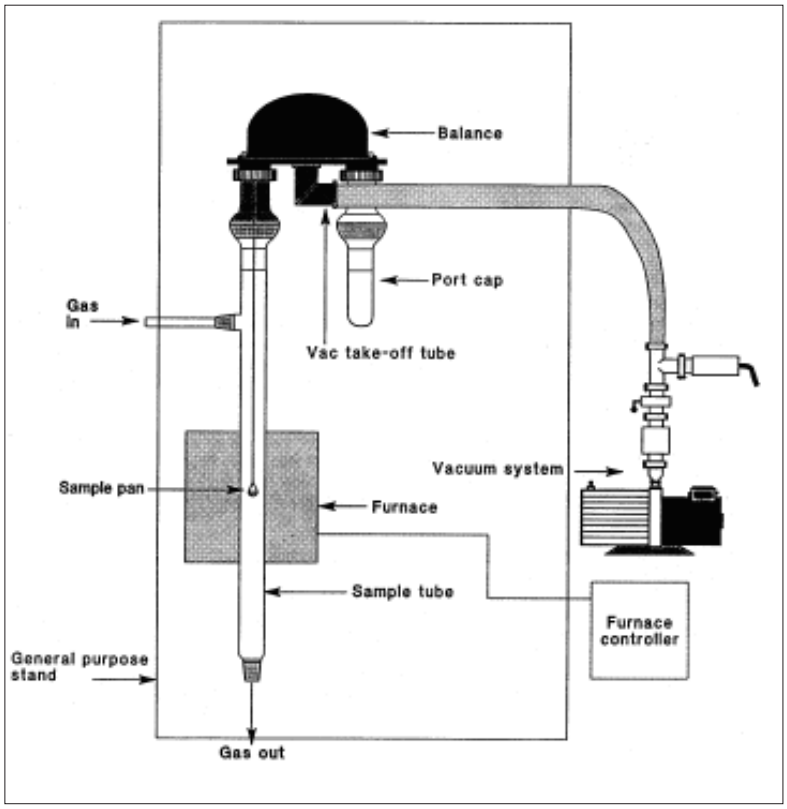
201 Adsorption with flowing Gas

The purpose of an adsorption experiment is to determine the amount of a gas that is adsorbed on the surface of the sample. This usually requires that the sample is first cleaned of any existing gases by heating and/or using a vacuum. Then an adsorbate is flowed over the sample to determine the amount adsorbed on the sample.

The setup on the reverse side allows the use of samples up to 1 gram while detecting an adsorbate in the submicrogram range. Though the D-200 is highly corrosion-resistant, the adsorbate should not be particularly aggressive. The use of a small sample requires the use of 16 diameter sample tubes which are designed for minimum weight noise while allowing for easier temperature control.

The longer sample tubes are used for temperatures above 200 °C. This gives the gas flow a better chance to maintain a laminar flow while keeping the radiant heat away from the balance.

Thermo Scientific does not supply any furnace for this setup.If you are only going to 200-300 °C, heating tapes can be used. Tube furnaces, with a 3/4 inch hole and an outside diameter of 9 inches or less, can be used to any temperature desired. Regardless of the heating method used, a temperature controller is required since adsorption is very temperature dependent. A thermocouple can be installed to run down the sample tube parallel to the extension wire. The D-200 has two pairs of type K feed-through in the base plate that allow the thermocouple signal from inside the balance to be passed to the outside. This signal can be used by the programmer to accurately control the temperature



D-200: Flowing non-corrosive gas, large sample with vacuum and heat for degassing sample.

The following components are used for this setup:

Balance:	Model D-200
Stand:	General Purpose No.3405-01
Port Cap:	N.1387-01
Vacuum Take-off Tube:	Elbow No.13364-01
Thermocouple (not shown)	Type K No. 2797-01
Temperature Input Module (not shown):	No12986-01

Sample Tubes:

Tube No.	Material	Temperature	Length	Diameter
6695-01	Pyrex	550 °C	635 mm	16 mm
3078-01	Pyrex	550 °C	790 mm	16 mm
3475-01	Quartz	1100 °C	570 mm	16 mm
3067-01	Quartz	1100 °C	790 mm	16 mm
3079-01	Mullite	1700 °C	790 mm	16 mm

of the sample. To record the temperature along with the weight data, use the Temperature Input Module.

The adsorbate gas enters the sample tube above the sample and flows down and Out the bottom of the tube. If high vacuum is to be used to clean the sample, vacuum valves should be installed at these ports. Pressure regulators and a flow meter should be used to control the rate of flow past the sample. Usually flow rates of 10 to 40 cm^3/min will supply ample adsorbate to the sample while producing very little noise. Please

refer to Thermo Scientific paper No.1003 for information on planning a flowing gas experiment.

The vacuum system should normally have a through-put of about 100 l/mim capable of 10^{-6} torr. We suggest that you use a turbomolecular pump and cold traps to prevent oil back streaming. Any oil in the sample chamber could contaminate your sample. Also, because of the small diameter sample tube, it will take longer to reach high vacuum than if a larger tube was used. Your vacuum equipment supplier should be able to supply a system that can be attached to the KF NW25 vacuum take-off tube. For more information about using vacuum with recording balances refer to Thermo Scientific paper No.1710.

For more detailed information concerning the D-200, please refer to the Thermo Scientific RECORDING BALANCES Product Note. For information concerning the many accessories available, please refer to the Consolidated Accessory Brochure.

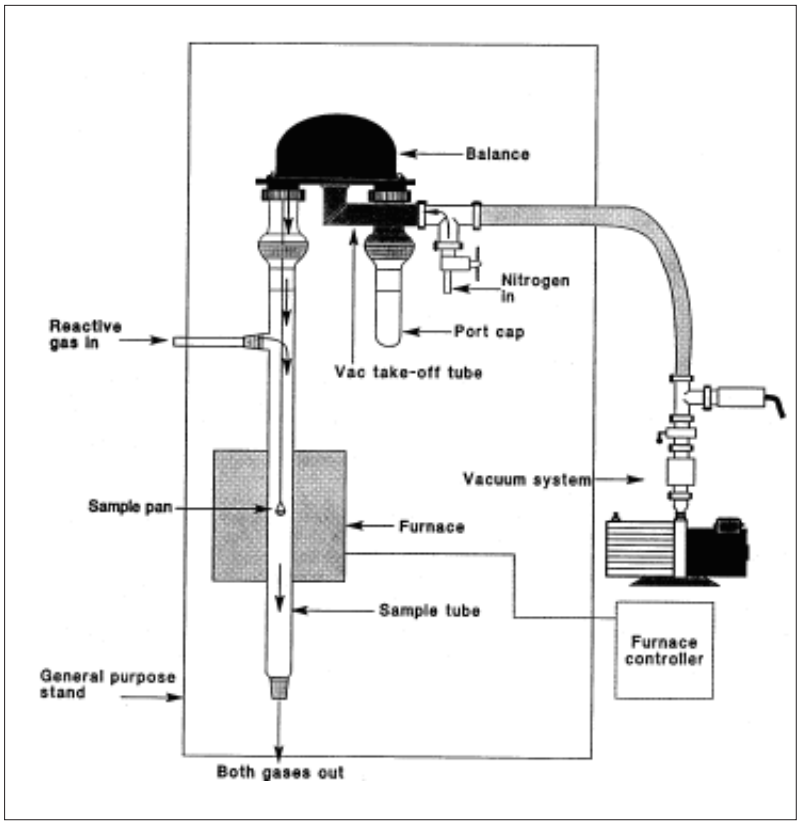
202 Adsorption

The purpose of an adsorption experiment is to determine the amount of a gas that is adsorbed on the surface of the sample. This usually requires that the sample is first cleaned of any existing gases by heating and/or using a vacuum. Then an adsorbate is flowed over the sample to determine the amount adsorbed on the sample.

The setup on the reverse side allows the use of samples up to 1 gram while detecting an adsorbate in the submicrogram range. This setup provides for a protective nitrogen gas flow through the balance chamber while the aggressive reactive gas enters the side port of the sample tube. Both gases flow down past the sample and Out the bottom. Pressure regulators and a flow meter should be used to control the rate of flow past the sample. Usually flow rates of 10 to 40 cm^3/min will supply ample adsorbate to the sample while producing very little noise. Please refer to Thermo Scientific paper No. 1003 for information on planning a flowing gas experiment. The use of a large sample requires the use of large diameter sample tubes which may restrict the ultimate sensitivity of the balance due to noise.

The longer sample tubes are used for temperatures above 200 °C. This gives the gas flow a better chance to maintain a laminar flow while keeping the radiant heat away from the balance.

Thermo Scientific does not supply any furnace for this setup. If you are only going to 200-300 °C, heating tapes can be used. Tube furnaces, with a 3/4 inch hole and an outside diameter of 9 inches or less, can be used to any temperature desired. Regardless of the heating method used, a temperature controller is required since adsorption is very temperature dependent. A thermocouple can be installed to run down the sample tube parallel to the extension wire. The D-200 has two pairs of type K feed-through in the base plate that allow the thermocouple signal from inside the balance to be passed to the outside. This signal can be used by the programmer to accurately control the temperature of the sample. To record the temperature along with the weight data, use the Temperature Input Module.



D-200: Flowing corrosive gas, large sample with vacuum and heat for degassing sample.

The following components are used for this setup:

Balance:	Model D-200
Stand:	General Purpose No.3405-01
Port Cap:	N.1387-01
Vacuum Take-off Tube:	Elbow No.13364-01
Thermocouple (not shown)	Type K No. 2797-01
Temperature Input Module (not shown):	No12986-01

Sample Tubes:

Tube No.	Material	Temperature	Length	Diameter
6695-01	Pyrex	550 °C	635 mm	16 mm
3078-01	Pyrex	550 °C	790 mm	16 mm
3475-01	Quartz	1100 °C	570 mm	16 mm
3067-01	Quartz	1100 °C	790 mm	16 mm
3079-01	Mullite	1700 °C	790 mm	16 mm

The vacuum system should normally have a through-put of about 100 l/min capable of 10^{-6} torr. We suggest that you use a turbo-molecular pump and cold traps to prevent oil back streaming. Any oil in the sample chamber could contaminate your sample. Also, because of the small diameter sample tube, it will take longer to reach high vacuum than if a larger tube was used. Your vacuum equipment supplier should be able to supply a system that can be attached to the KF NW25 vacuum take-off tube. For more information about using vacuum with recording balances refer to Thermo Scientific paper No.1710.

For more detailed information concerning the D-200, please refer to the Thermo Scientific RECORDING BALANCES Product Note. For information concerning the many accessories available, please refer to the Consolidated Accessory Brochure.

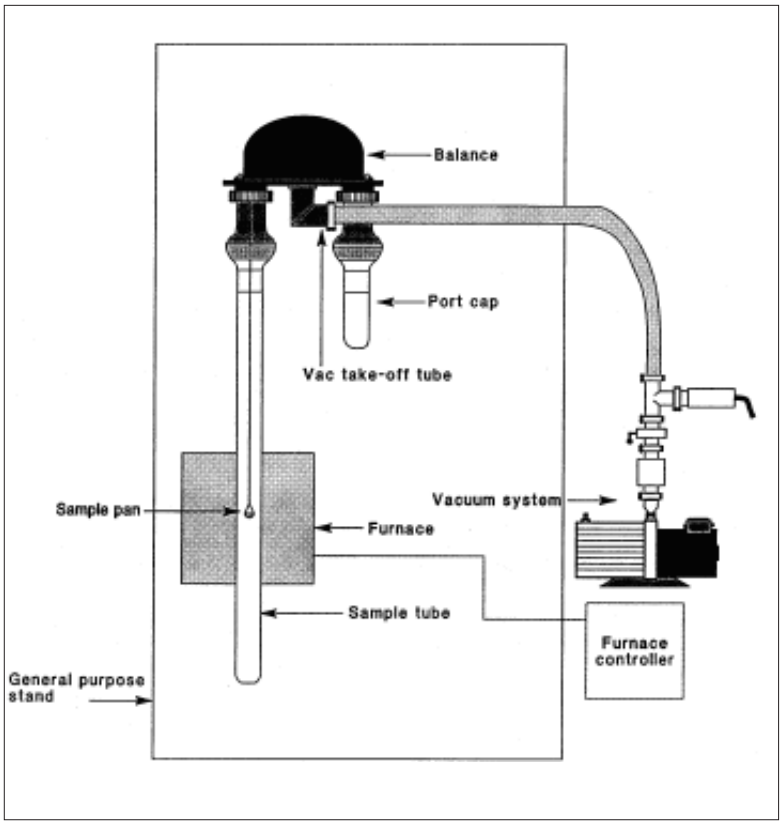
203 Desorption

The purpose of an a desorption experiment is to determine the amount of a gas that is adsorbed on the surface of the sample. This usually requires that the sample is first cleaned of any existing gases by heating and/or using a vacuum.

The setup on the reverse side allows the use of samples up to 1 gram while detecting an adsorbate in the submicrogram range. Though the D-200 is highly corrosion-resistant, the adsorbate should not be particularly aggressive. The use of a small sample requires the use of 16 mm diameter sample tubes which can restrict the ultimate sensitivity of the balance due to noise if the sample is not high vacuum.

Thermo Scientific does not supply any furnace for this setup.If you are only going to 200-300 °C, heating tapes can be used. Tube furnaces, with a 3/4 inch hole and an outside diameter of 9 inches or less, can be used to any temperature desired. Regardless of the heating method used, a temperature controller is required since adsorption is very temperature dependent. A thermocouple can be installed to run down the sample tube parallel to the extension wire. The D-200 has two pairs of type K feed-through in the base plate that allow the thermocouple signal from inside the balance to be passed to the outside. This signal can be used by the programmer to accurately control the temperature of the sample. To record the temperature along with the weight data, use the Temperature Input Module.

The vacuum system should normally have a through-put of about 100 l/min capable of 10^{-6} torr. We suggest that you use a turbo-molecular pump and cold traps to prevent oil back streaming. Any oil in the sample chamber could contaminate your sample. Also, because of the small diameter sample tube, it will take longer to reach high vacuum than if a larger tube was used. Your vacuum equipment supplier should be able to supply a system that can be attached to the KF NW25 vacuum take-off tube. For more information about using vacuum with recording balances refer to Thermo Scientific paper No.1710.



D-200: Small sample with no corrosive evolved gases, with vacuum and heat.

The following components are used for this setup:

Balance:	Model D-200
Stand:	General Purpose No.3405-01
Port Cap:	N.1387-01
Vacuum Take-off Tube:	Elbow No.13364-01
Thermocouple (not shown)	Type K No. 2797-01
Temperature Input Module (not shown):	No12986-01

Sample Tubes:

Tube No.	Material	Temperature	Length	Diameter
3055-01	Pyrex	550 °C	550 mm	16 mm
3054-01	Quartz	1100 °C	550 mm	16 mm
3071-01	Mullite	1700 °C	550 mm	16 mm

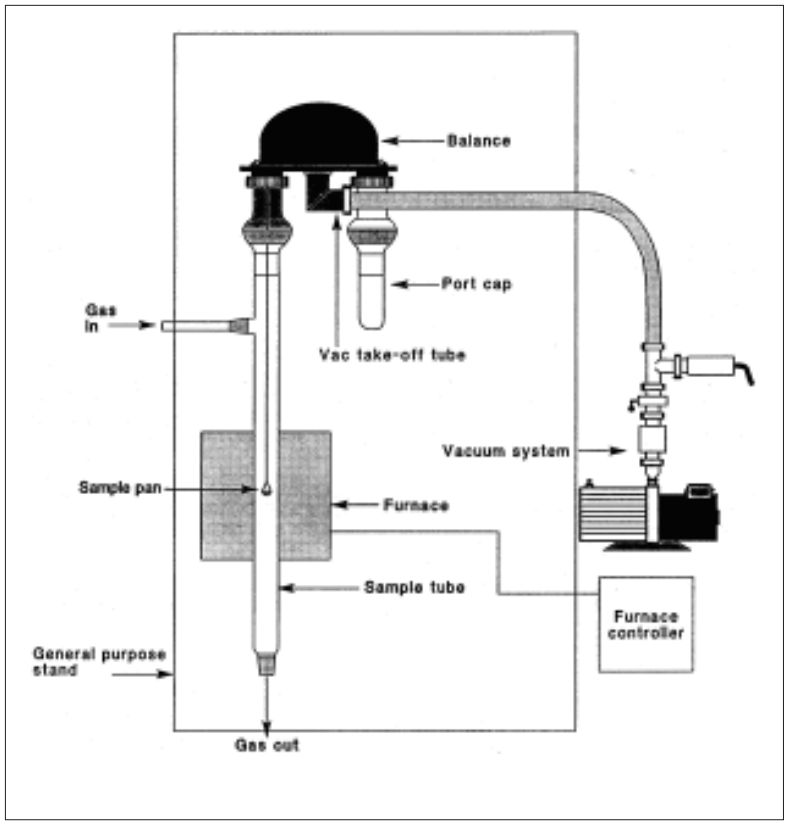
For more detailed information concerning the D-200, please refer to the Thermo Scientific RECORDING BALANCES Product Note. For information concerning the many accessories available, please refer to the Consolidated Accessory Brochure.

The purpose of a TGA experiment is to measure the decomposition of a material during controlled heating. This usually requires a furnace controlled by a temperature programmer. ThermoScientific does not supply a furnace or a programmer for this setup. Tube furnaces, with a 3/4 inch hole and an outside diameter of 9 inches or less, can be used to any temperature desired. A thermocouple can be installed to run down the sample tube parallel to the extension wire. The D-200 has two pairs of type K feed-through in the base plate that allow the thermocouple signal from inside the balance to be passed to the outside. This signal can be used by the programmer to accurately control the temperature of the sample. To record the temperature along with the weight data, use the Temperature Input Module.

The setup on the reverse side allows the use of samples up to 1 gram while detecting a weight loss in the sub-microgram range. Though the D-200 is highly corrosion-resistant, the flowing gas should not be particularly aggressive. The use of a small sample permits the use of l6 mm diameter sample tubes which are designed for minimum weight noise while allowing for easier temperature control.

The flowing gas enters the sample tube above the sample and flows down and out the bottom of the tube. If high vacuum is to be used to clean the sample, vacuum valves should be installed at these ports. Pressure regulators and a flow meter should be used to control the rate of flow past the sample. Usually flow rates of 10 to 40 cm^3/min will supply ample reactive or purge gas to the sample while producing very little noise. Please refer to Thermo Scientific paper No.1003 for information on planning a flowing gas experiment.

The vacuum system should normally have a through-put of about 100 l/min capable of 10^{-6} torr. The large diameter sample tubes should make it easier to reach high vacuum. Your vacuum equipment supplier should be able to supply a system that can be attached to the KF NW25 vacuum take-off tube. For more information about using vacuum with recording balances refer to Thermo Scientific paper No.1710.



D-200: Flowing non-corrosive gas, small sample with vacuum.

The following components are used for this setup:

Balance:	Model D-200
Stand:	General Purpose No.3405-01
Port Cap:	N.1387-01
Vacuum Take-off Tube:	Elbow No.13364-01
Thermocouple (not shown)	Type K No. 2797-01
Temperature Input Module (not shown):	No12986-01

Sample Tubes:

Tube No.	Material	Temperature	Length	Diameter
6695-01	Pyrex	550 °C	635 mm	16 mm
3078-01	Pyrex	550 °C	790 mm	16 mm
3475-01	Quartz	1100 °C	570 mm	16 mm
3067-01	Quartz	1100 °C	790 mm	16 mm
3079-01	Mullite	1700 °C	790 mm	16 mm

For more detailed information concerning the D-200, please refer to the Thermo Scientific RECORDING BALANCES Product Note. For information concerning the many accessories available, please refer to the Consolidated Accessory Brochure.

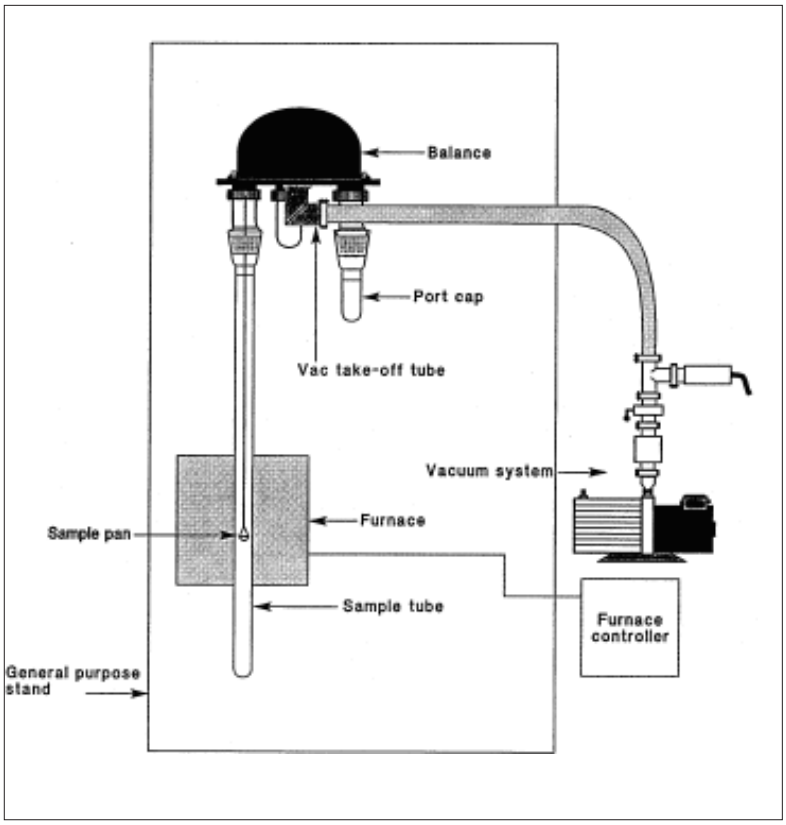
205 TGA

The purpose of a TGA experiment is to measure the decomposition of a material during controlled heating. This usually requires a furnace controlled by a temperature programmer. Thermo Scientific does not supply a furnace or a programmer for this setup. Tube furnaces, with a 3/4 inch hole and an outside diameter of 9 inches or less, can be used to any temperature desired. A thermocouple can be installed to run down the sample tube parallel to the extension wire. The D-200 has two pairs of type K feed-through in the base plate that allow the thermocouple signal from inside the balance to be passed to the outside. This signal can be used by the programmer to accurately control the temperature of the sample. To record the temperature along with the weight data, use the Temperature Input Module.

The setup on the reverse side allows the use of samples up to 1 gram while detecting a weight loss in the sub-microgram range. Though the D-200 is highly corrosion-resistant, the evolved gas should not be particularly aggressive. The use of a small sample permits the use of 16 mm diameter sample tubes which are designed for minimum weight noise while allowing for easier temperature control.

The vacuum system should normally have a through-put of about 100 l/min capable of 10^{-6} torr. The large diameter sample tubes should make it easier to reach high vacuum. Your vacuum equipment supplier should be able to supply a system that can be attached to the KF NW25 vacuum take-off tube. For more information about using vacuum with recording balances refer to Thermo Scientific paper No.1710.

For more detailed information concerning the D-200, please refer to the Thermo Scientific RECORDING BALANCES Product Note. For information concerning the many accessories available, please refer to the Consolidated Accessory Brochure.



D-200: Small sample with vacuum.

The following components are used for this setup:

Balance:	Model D-100
Stand:	General Purpose No.3405-01
Port Cap:	N.2481-01
Vacuum Take-off Tube:	Elbow No.13364-01
Temperature Input Module (not shown):	No12986-01

Sample Tubes:

Tube No.	Material	Temperature	Length	Diameter
3055-01	Pyrex	550 °C	550 mm	16 mm
3054-01	Quartz	1100 °C	550 mm	16 mm
3071-01	Mullite	1700 °C	550 mm	16 mm

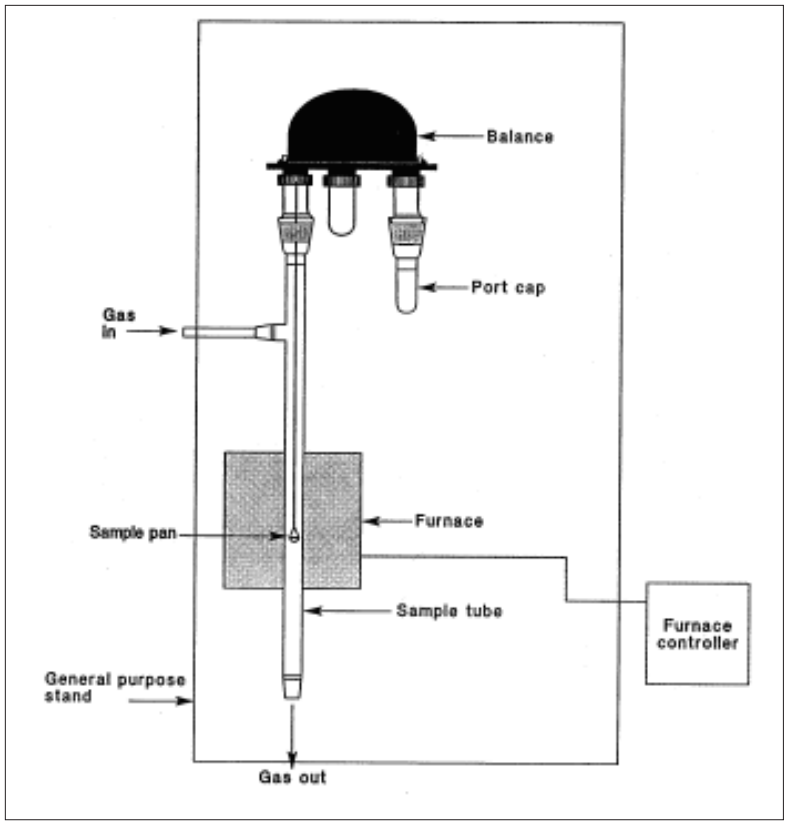
206 TGA

The purpose of a TGA experiment is to measure the decomposition of a material during controlled heating. This usually requires a furnace controlled by a temperature programmer. Thermo Scientific does not supply a furnace or a programmer for this setup. Tube furnaces, with a 3/4 inch hole and an outside diameter of 9 inches or less, can be used to any temperature desired. A thermocouple can be installed to run down the sample tube parallel to the extension wire. The D-200 has two pairs of type K feed-through in the base plate that allow the thermocouple signal from inside the balance to be passed to the outside. This signal can be used by the programmer to accurately control the temperature of the sample. To record the temperature along with the weight data, use the Temperature Input Module.

The setup on the reverse side allows the use of samples up to 1 gram while detecting a weight loss in the sub-microgram range. Though the D-200 is highly corrosion-resistant, the flowing gas should not be particularly aggressive. The use of a small sample permits the use of l6 mm diameter sample tubes which are designed for minimum weight noise while allowing for easier temperature control.

The flowing gas enters the sample tube above the sample and flows down and out the bottom of the tube. If high vacuum is to be used to clean the sample, vacuum valves should be installed at these ports. Pressure regulators and a flow meter should be used to control the rate of flow past the sample. Usually flow rates of 10 to 40 cm^3/min will supply ample reactive or purge gas to the sample while producing very little noise. Please refer to Thermo Scientific paper No.1003 for information on planning a flowing gas experiment.

For more detailed information concerning the D-200, please refer to the Thermo Scientific RECORDING BALANCES Product Note. For information concerning the many accessories available, please refer to the Consolidated Accessory Brochure.



D-200: Flowing non-corrosive gas, small sample.

The following components are used for this setup:

Balance:	Model D-200
Stand:	General Purpose No.3405-01
Port Cap:	N.1387-01
Vacuum Take-off Tube:	Elbow No.13364-01
Thermocouple (not shown)	Type K No. 2797-01
Temperature Input Module (not shown):	No12986-01

Sample Tubes:

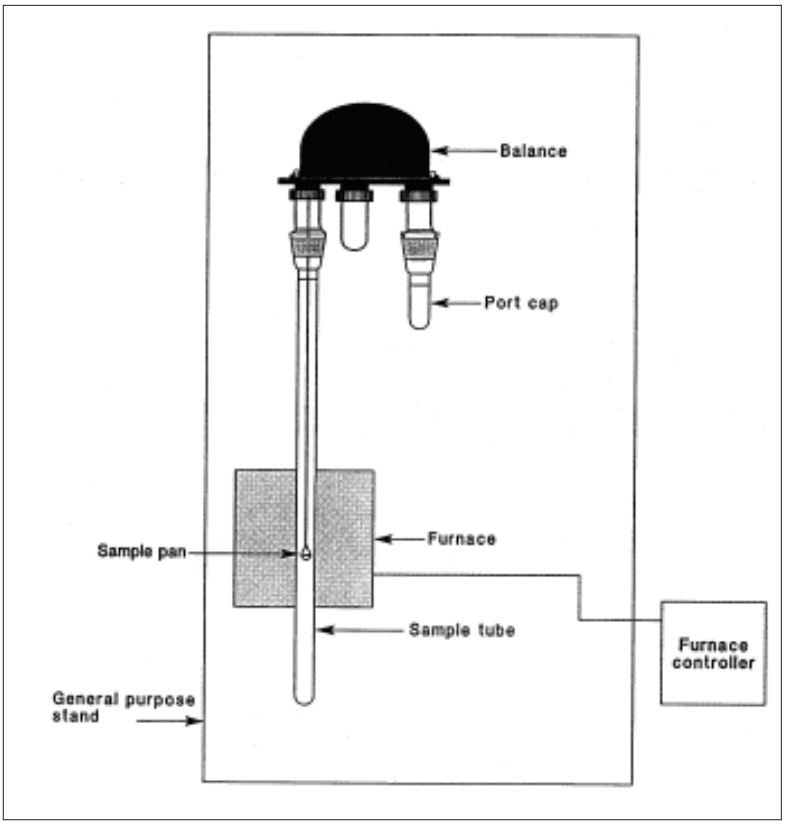
Tube No.	Material	Temperature	Length	Diameter
6695-01	Pyrex	550 °C	635 mm	16 mm
3078-01	Pyrex	550 °C	790 mm	16 mm
3475-01	Quartz	1100 °C	570 mm	16 mm
3067-01	Quartz	1100 °C	790 mm	16 mm
3079-01	Mullite	1700 °C	790 mm	16 mm

207 TGA

The purpose of a TGA experiment is to measure the decomposition of a material during controlled heating. This usually requires a furnace controlled by a temperature programmer. Thermo Scientific does not supply a furnace or a programmer for this setup. Tube furnaces, with a 3/4 inch hole and an outside diameter of 9 inches or less, can be used to any temperature desired. A thermocouple can be installed to run down the sample tube parallel to the extension wire. The D-200 has two pairs of type K feed-through in the base plate that allow the thermocouple signal from inside the balance to be passed to the outside. This signal can be used by the programmer to accurately control the temperature of the sample. To record the temperature along with the weight data, use the Temperature Input Module.

The setup on the reverse side allows the use of samples up to 1 gram while detecting a weight loss in the sub-microgram range. Though the D-200 is highly corrosion-resistant, the evolved gas should not be particularly aggressive. The use of a small sample permits the use of 16 mm diameter sample tubes which are designed for minimum weight noise while allowing for easier temperature control.

For more detailed information concerning the D-200, please refer to the Thermo Scientific RECORDING BALANCES Product Note. For information concerning the many accessories available, please refer to the Consolidated Accessory Brochure.



D-200: Small sample

The following components are used for this setup:

Balance:	Model D-200
Stand:	General Purpose No.3405-01
Port Cap:	N.1387-01
Vacuum Take-off Tube:	Elbow No.13364-01
Thermocouple (not shown)	Type K No. 2797-01
Temperature Input Module (not shown):	No12986-01

Sample Tubes:

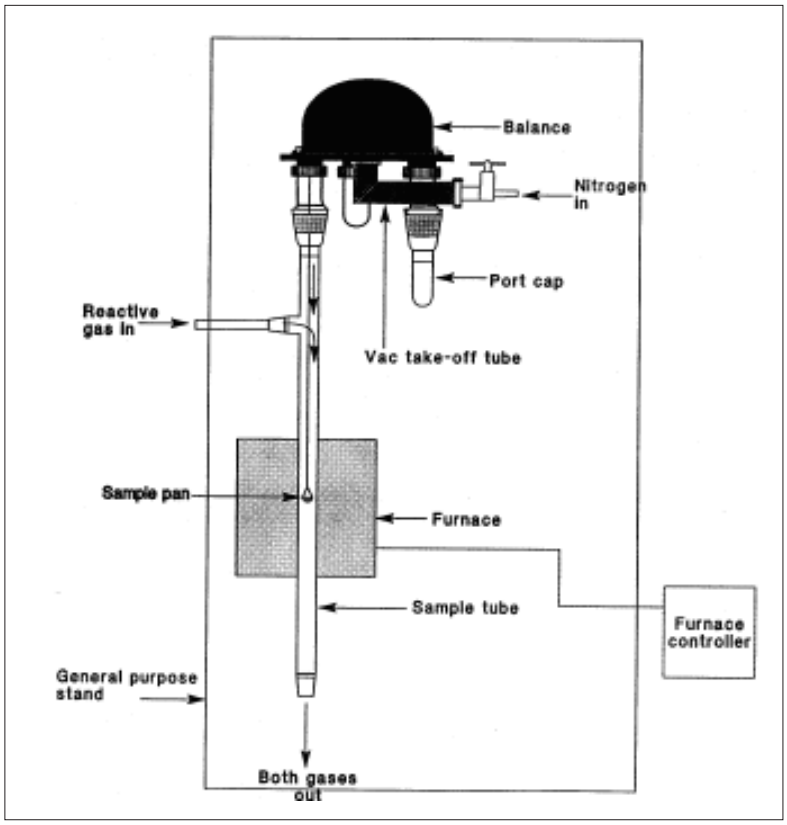
Tube No.	Material	Temperature	Length	Diameter
3055-01	Pyrex	550 °C	550 mm	16 mm
3054-01	Quartz	1100 °C	550 mm	16 mm
3071-01	Mullite	1700 °C	550 mm	16 mm

208 TGA

The purpose of a TGA experiment is to measure the decomposition of a material during controlled heating. This usually requires a furnace controlled by a temperature programmer. Thermo Scientific does not supply a furnace or a programmer for this setup. Tube furnaces, with a 3/4 inch hole and an outside diameter of 9 inches or less, can be used to any temperature desired. A thermocouple can be installed to run down the sample tube parallel to the extension wire. The D-200 has two pairs of type K feed-through in the base plate that allow the thermocouple signal from inside the balance to be passed to the outside. This signal can be used by the programmer to accurately control the temperature of the sample. To record the temperature along with the weight data, use the Temperature Input Module.

The setup on the reverse side allows the use of samples up to 1 gram while detecting an adsorbate in the sub-microgram range. This setup provides for a protective nitrogen gas flow through the balance chamber while the aggressive reactive gas enters the side port of the sample tube. Both gases flow down past the sample and out the bottom. Pressure regulators and a flow meter should be used to control the rate of flow past the sample. Usually flow rates of 10 to 40 cm^3/min will supply ample adsorbate to the sample while producing very little noise. Please refer to Thermo Scientific paper No.1003 for information on planning a flowing gas experiment. The use of a small sample permits the use of 16 mm diameter sample tubes which are designed for minimum weight noise while allowing for easier temperature control.

For more detailed information concerning the D-200, please refer to the Thermo Scientific RECORDING BALANCES Product Note. For information concerning the many accessories available, please refer to the Consolidated Accessory Brochure.



D-200: Flowing corrosive gas, large sample.

The following components are used for this setup:

Balance:	Model D-200
Stand:	General Purpose No.3405-01
Port Cap:	N.1387-01
Vacuum Take-off Tube:	Elbow No.13364-01
Thermocouple (not shown)	Type K No. 2797-01
Temperature Input Module (not shown):	No12986-01

Sample Tubes:

Tube No.	Material	Temperature	Length	Diameter
6695-01	Pyrex	550 °C	635 mm	16 mm
3078-01	Pyrex	550 °C	790 mm	16 mm
3475-01	Quartz	1100 °C	570 mm	16 mm
3067-01	Quartz	1100 °C	790 mm	16 mm
3079-01	Mullite	1700 °C	790 mm	16 mm

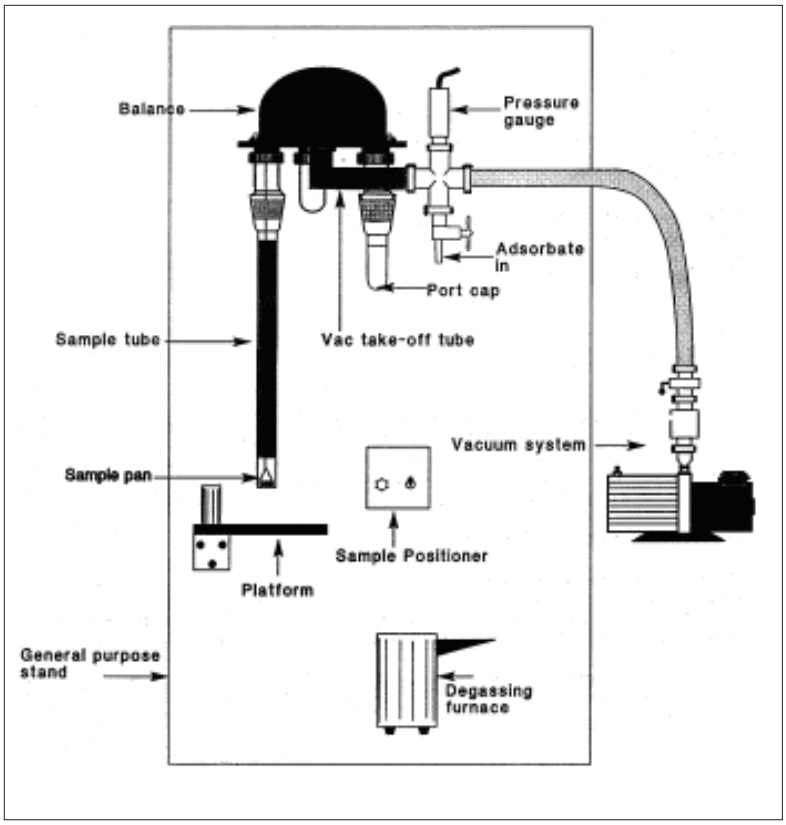
209 B.E.T Measurements

The purpose of a B.E.T. experiment is to determine the surface area and porosity of a power sample. This usually requires that the sample is first cleaned of any existing gases by heating and using a vacuum. Then an adsorbate is flowed over the sample to determine the amount needed to form a mono-layer of adsorbate.

To determine the surface area of the sample, the pressure and temperature of the sample must be accurately known when the mono-layer is formed. The pressure can be easily determined with the use of a good pressure gauge. However, the determination of the temperature is more difficult. A thermocouple cannot be used in the sample because it would affect the weight reading.
The Thermo Scientific system solves this problem by bringing the sample to a known temperature (liquid nitrogen). To accomplish this, the sample pan is allowed to rest on a metal plate located at the bottom of the sample tube. The tube is immersed in liquid nitrogen. The heat of the sample is withdrawn from the sample via conduction and convection. When the adsorbed adsorbate is to be measured, the sample is raised off the metal plate. The lowering and raising of the sample is controlled by the Sample Positioner.

The degassing furnace has a maximum temperature of 450 °C. However, it is seldom used above 150 °C to prevent decomposition of the sample. This furnace is controlled by the Temperature Programmer. The thermocouple is installed to run down the sample tube parallel to the extension wire. The D-200 has two pairs of type K feed-through in the base-plate that allow the thermocouple signal from inside the balance chamber to be passed to the outside. To record the temperature along with the weight data, use the Temperature Input Module.

The platform assembly holds the dewar flask and the degassing furnace.



D-200: Surface area measurement of powders

The follow Thermo Fisher Scientifc components are used for this setup:

D-200 balance:	No.13200-01
Vacuum take-off tube:	No.13364-01
Stand:	No.3405-01
Port caps:	No.1387-01
Temperature Input Module (not shown):	No.12896-01
Sample pan:	No.3915-01
Sample tube:	No.3920-01
Adjustable hook (not shown):	No.7363-01

The follow items are required but are not supplied by Thermo Fisher Scientifc:

Vacuum system	Platform assembly
Pressure gauge	Ionizing unit (not shown)
Dewar flask (for liquid nitrogen)	Thermocouple assembly (not shown)
Adsorbate inlet valve	Sample Positioner
Degassing furnace	Voltage programmer (not shown)

The vacuum system should normally have a through-put of about 100 l/min capable of 10^{-6} torr. We suggest that you use a turbo-molecular pump and/or cold traps to prevent oil back streaming. Any oil in the sample chamber could contaminate your sample. Your vacuum equipment supplier should be able to supply a system that can be attached to the KF NW25 vacuum take-off tube. For more information about using vacuum with recording balances refer to Thermo Scientific paper No.1710.

For more detailed information concerning the D-200, please refer to the Thermo Scientific RECORDING BALANCES Product Note. For information concerning the many accessories available, please refer to the Thermo Scientific Consolidated Accessory Brochure.

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