Maintenance and Preventative Care for FTIR Spectrometers in Drug Checking Services

Purpose and Scope

Drug checking in community can occur in environments that are less than ideal for FTIR spectrometers (FTIRs). Infrared spectrometers are delicate instruments that require careful handling to prevent damage. When damage occurs such that the instrument can no longer function normally, costly and lengthy repairs by the manufacturer may occur. There are many aspects of care that will decrease the need for repairs and extend the service life of an FTIR. This document is written specifically for the use of Bruker Alpha-II FTIR spectrometers in drug checking services.

The ideal environmental conditions for an FTIR spectrometer are:

- Low humidity (0-30% R.H.)[a]
- Dust Free
- Typical room temperature (~20 ˚C -25 ˚C)[b]
- The instrument is infrequently unplugged, disassembled, or moved.

As community drug checking does not generally occur in a climate-controlled lab environment, the purpose of this document is to provide instruction that can help prevent damage and options for troubleshooting some common problems. If the indicator lights, ports, or components of the FTIR are unfamiliar to you, refer to *Appendix A: Components of the FTIR* as specific names will be used in this document.

[a] Maximum ambient operating relative humidity is 80% R.H.[1]
[b] Ambient operating temperature is 5 ˚C - 35 ˚C[1]

Procedures

These procedures are not intended to be read in isolation; refer to the footnotes for references to procedures laid out in the BCCSU Technician Manual, BCCSU Implementation Guide, Bruker Alpha II operation manual ("Bruker manual")[1], and others.

1. Location Considerations

Where the FTIR is to be set up in a service location should be considered carefully to balance accessibility, safety, and integrity of the instrument.[c]

1. Avoid setting up near open windows and outside doors to avoid humidity swings and dust buildup.
2. Do not set up on surfaces that experience heavy vibration (e.g. fan or equipment on desktop, shared work surfaces, areas with vibrations from passing traffic).[1]
3. Set up in a location away from busy foot traffic areas to avoid the risk of bumps or spills from people passing too close to the FTIR.
4. Avoid folding tables, as they may collapse.[d]
5. Set up the FTIR such that service users will not set samples for testing (or belongings) on top of the FTIR.
6. If possible, set up FTIR where does not have to be disassembled or unplugged every day, such as a locked office, with limited access. [e]

2. FTIR Assembly

The FTIR is particularly vulnerable to damage when it is being assembled. It is important to carefully assemble the FTIR to avoid causing damage and optics misalignment.[f]

1. Turn off any fans in the area near the FTIR, close any windows or doors, and allow the air to settle.
2. Clear the work surface of any obstructions and clean the area using a sanitizing wipe. If the work surface is collapsible, ensure the locking mechanism is engaged and secure.
3. If the work area is in a high traffic area, take precautions to not be disturbed when handling the instrument.

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[c] Refer to section 5.1 of the BCCSU Technician Manual and the BCCSU Implementation Guide for additional information.
[d] Refer to the BCCSU guide on reducing exposure and contamination for more information on ideal tables for drug checking.
[e] A locking cover over the FTIR can be used to secure the FTIR without unplugging or disassembling it.
[f] Refer to section 8.2 of the BCCSU Technician Manual for additional information.

4. Carefully place the FTIR case right side up on the work surface, taking care to gently place the case on the surface. Dropping the case on a surface can cause damage to the FTIR.
5. If the case is cold to the touch, leave the case shut and allow ample time for the FTIR to warm to room temperature to prevent condensation within the instrument and case.
6. Open the case, retrieving the spectrometer module first. Pick up the instrument with both hands, taking care not to touch the inside surfaces or mirror windows. Place it down on the work surface.
7. Retrieve the sample module from the case and attach it to the spectrometer module taking care not to hit the parts together using the following steps:
   7.1. Fully depress the large silver separator button when attaching the modules.
   7.2. Hold the button and gently guide it back to the final position, which should be flush with the spectrometer body. Allowing the button to snap between positions can damage the spring-lock mechanism. If the button does not return to the flush position, depress it fully and readjust the accessory before releasing the button again.
8. Close the FTIR storage case promptly to avoid dust buildup.
9. Move the FTIR to its final position for the work shift. Do not slide the machine, rather pick it up and place it as the feet can cause strong vibrations when slid across a surface.
10. Firmly plug in the power and ethernet cables for the instrument. Use the clip available on the back of the FTIR to hold the power cable in place to reduce the risk of it being pulled out.
11. Neatly bundle and secure cables such that they can't be snagged or tripped on.
12. Perform start-up procedures.

If the FTIR has become damaged, this will usually become evident at this point as the performance qualification (PQ) testing will fail. If this occurs, refer to the section on suspected damage and troubleshooting.

3. Operational Care

Once assembled, it is important to operate the instrument with care to avoid damage.[g]

1. Do not eat or drink near the FTIR to avoid spills on the device and possible contamination of food/drink with substances.
2. Avoid use of stickers, tape or labels on FTIR as these can accumulate drug residue along with dust and dirt.
3. Avoid allowing drug particles to fall between the modules as these may land up inside the instrument during disassembly. If this is expected to happen, consider using a low-adhesive

[g] Refer to section 9.1 of the BCCSU Technician Manual for additional information

tape such as painter's tape to close the gap during operation. Remove tape when the FTIR is disassembled.

4. Do not use the anvil to crush substances.[h]
   4.1. Hard substances can crack the crystal, and can damage the sample plate and anvil. Samples can also suddenly slip from under the anvil, leading to the anvil slamming down onto the sample plate or crystal.
   4.2. Soft substances can squeeze out, leaving no cushion between the anvil and crystal, cracking the crystal.
5. Ensure the tension of the anvil is checked for every sample:
   5.1. For a flip-down anvil, ensure the red dot is centered in the window. Do not adjust the tension while the anvil is depressed as incorrectly adjusting the tension can crack the crystal.
   5.2. For a screw-down anvil, a slip-clutch will engage when the correct tension is reached.[1]
6. Do not attempt to swing the anvil while it is depressed as this will score the plate and damage the anvil.
7. When choosing and using a spatula, be wary of sharp edges. If necessary, file down any sharp edges to avoid scratching the plate.
8. Avoid bumping or moving the instrument at any time during operation.
9. At the end of every shift wipe the surfaces of the FTIR with an accel wipe[i] to keep dust from accumulating. If the instrument is very dusty, wipe it first with a dry cloth such as a microfiber cloth.

4. Additional FTIR Crystal Cleaning

Additional cleaning should be done twice a year or when the OPUS baseline measurement does not appear flat (i.e. it has erroneous dips or peaks)[j]

Do not attempt to clean any internal components of the FTIR.[k] Do not use abrasive cleaners, caustic cleaners, or strong acids to clean the FTIR.[1] Do not use compressed air to clean the FTIR.

1. Squeeze a fresh alcohol wipe to produce a droplet directly on the crystal. Allow to soak for 10 minutes before wiping clean.

[h] Refer to the BCCSU standard operating procedure on Drug Crushing for Drug Checking.
[i] Or any sanitizing wipe. Do not use harsh solvents, acidic or caustic cleaners.
[j] Refer to section 11: FTIR Troubleshooting, subsection 3 for more baseline measurement troubleshooting.
[k] Any attempt to clean the internal components of the FTIR will likely permanently damage the instrument and will not be covered by any applicable warranty.

2. Drip a few drops of room temperature tap water onto the crystal and allow it to soak for 10 minutes. Wipe up the water with a Kimwipe and clean the crystal as per usual.

5. FTIR Disassembly

Similar to assembly, the FTIR is at risk of damage when it is being taken apart and put in a case. This procedure will help the FTIR to be safely stored when not in use.

1. Turn off any fans, close any windows or doors, and allow the air to settle.
2. Disconnect the cables of the FTIR and neatly coil them for storage.
3. Retrieve the case, inspecting the inside to determine if cleaning is required. Have the case open and ready to receive the instrument before disassembling the FTIR.
4. Separate the modules by depressing the button, taking care not to let the separator button snap back from the depressed position.
5. Inspect the mating surfaces of the modules for any debris. If necessary, clean these surfaces while avoiding the mirror openings. **Do not attempt to clean inside the mirror openings.**
6. When returning the FTIR to the storage case, store the sample module first, then the spectrometer module. Align the heavier sides of both modules to the bottom of the case.
7. Close the case promptly to avoid dust buildup.

6. FTIR Storage Location Considerations

When storing the FTIR it is important to consider the conditions in which the instrument will be stored when not in use, and for how long. By picking a good storage location, the FTIR can be stored for long periods of time without degradation.

1. Store in a dry, climate-controlled room that securely locks.
2. Do not store on floors in case of flooding.
3. Avoid storage in cabinets against cold outside walls.
4. Avoid storage locations with exposed or unsealed concrete, unfinished basements, crawlspaces, or cold storage rooms as these all are likely to be humid or cold.
5. Ensure shelves or cabinets used for storage can hold the weight of the FTIR, and are level.
6. If the storage location is humid (more than 55% R.H.), it is strongly recommended that desiccant be placed in the FTIR case to control ambient humidity in the case.[I]
7. Damp locations (more than 75% R.H.) are unacceptable for storage.[7]

[I] See Appendix B: Desiccant Use and Procurement. Humidity can be read with an inexpensive humidity sensor or with a humidity indicating card.

7. FTIR Case and Storage

The FTIR case is a hard-walled case with foam padding that has been cut to fit the FTIR and prevent it from moving around. This provides protection from minor shocks and dust, but isn't sealed to humidity nor can it protect the FTIR from heavy vibrations or impacts. Using the FTIR case as-is is generally sufficient for typical use, but some modifications or a different case may be worth considering.

1. If the FTIR is to be frequently disassembled, consider procuring a case large enough to allow the FTIR to be stored without disassembling. Ensure there is foam padding that fits the FTIR fully assembled snugly in its case.
2. If the foam padding in the case becomes brittle, crumbly, or compressed, replace it with new foam padding.
3. Ensure any new foam padding is cut to fit the FTIR components so they don't move in the case. Cut the foam such that the two modules are oriented with their heavy side towards the bottom of the case. Vacuum the new padding to prevent foam particles from entering the FTIR.
4. Include a desiccant pack in the FTIR case to keep the internal components dry.[m]
5. Check the internal case humidity on a monthly basis with a humidity sensor or indicator card and regenerate or replace the desiccant packs if humidity fails to be controlled.
6. For additional protection from dust for the spectrometer module, cut a laminated sheet of paper to the shape of the internal face of the module such that the window openings in the case will be covered.
7. Store cables and other workstation materials outside of the case in a separate bag.

8. FTIR Case Cleaning

Maintaining a clean case will help to reduce the amount of dust and dirt that ends up on the working surface and inside the case when it is opened.

1. Thoroughly clean the outside of the case using a damp cloth. If the case is very dusty, wipe the case with a dry cloth first.
2. Check the locking clasps for wear and cracks.
3. Clean along the sealing surfaces of the case.
4. Remove the foam inserts in the case, setting them aside onto a clean surface.
5. Thoroughly clean all internal surfaces of the case with a damp cloth. If using window covers, clean those as well.

[m] See Appendix B: Desiccant Use and Procurement

6. Using a vacuum, clean out the pores of the foam inserts. Wipe all surfaces of the foam inserts with a damp cloth before allowing to dry. Avoid using cleaning products or solvents as these may damage the foam.
7. Replace all inserts in the case.

9. Outdoor Operation

When operating the FTIR outside, care must be taken as the conditions are generally more problematic for the FTIR than indoor locations. These considerations will help mitigate some of the damage that can occur due to humidity, inclement weather, dirt, and power fluctuations.

1. Outdoor Setup

1.1. A structure is required to create a barrier that effectively shelters the FTIR from any adverse weather conditions such as wind, rain and direct sun.

1.2. If operating on soft ground (such as grass), use mats or plywood boards beneath table legs to prevent the tables from sinking when leaned on, which can lead to the FTIR falling off the table.

1.3. Avoid assembly when relative humidity levels are highest (dawn, dusk, weather changes).

1.4. Close tents and turn off fans and allow dust to settle as much as possible during assembly and disassembly. Discourage foot traffic during these times.

1.5. When using extension cords, inspect the cord for damage before use. Never use an extension cord that is missing the ground prong or is non-polarized.[6]

1.6. If using a temporary/isolated power source, use battery-based systems versus generators.

1.6.1. If a generator must be used, ensure it is of high quality and of sufficient power to avoid voltage surges or dips that can damage the FTIR or otherwise cause faults.

1.6.2. High quality surge protectors or battery backups/UPS can provide an additional layer of protection against potentially damaging power surges if the power source is not stable or is shared.[n] A battery backup/UPS can prevent service outages if a power failure occurs.

2. Operation

2.1. Use low-adhesive tape such as painter's tape on the seam between the modules to avoid dust intrusion. Do not use very sticky tape as this can leave a residue on the FTIR.

[n] Surge protectors and battery backups/UPS do not protect against lightning strikes.

2.2. If the environment is very dusty/dirty, wipe the FTIR, FTIR case, and other equipment with a dry cloth before cleaning with alcohol as per usual cleaning procedures.
2.3. For repeated outdoor operation, ensure that regular checks of humidity levels are done as the internal desiccant pack may need regenerating/replacing more often.
2.4. Be caution of condensation when operating in conditions near or below the rated ambient conditions of the FTIR (5 ˚C). The FTIR may take longer than the usual 7 minutes to be ready to operate.[o]
2.5. When operating in snowy, icy, or wet conditions, be cautious of slipping and avoid walking long distances with the FTIR.
2.6. Do not operate during a lightning storm. Disconnect the FTIR from any power source and store it.[p]

10. Transporting an FTIR

As part of providing service, an FTIR may need to be moved to another location. As some of the biggest causes of permanent damage for FTIRs are impacts and vibrations, transport introduces many opportunities for damage. Follow these instructions to avoid some of the most common problems associated with transporting an FTIR.

When planning out the transport of an FTIR, consult any applicable insurance policy to determine which (if any) modes of transportation are covered.

1. Pedestrian Transport

1.1. Do not walk with the FTIR outside of its case. Always secure the FTIR in the case before moving it to another location.
1.2. Walk in pairs with the FTIR to ensure safety and security of the staff and equipment.
1.3. Carry the FTIR case in front of you through doorways and openings to avoid hitting the case on doorframes.
1.4. Get assistance with opening doors to avoid hitting the FTIR case.
1.5. Avoid rolling the case, even if the case is equipped with wheels. Most surfaces are too rough to roll the case leading to strong vibrations and damage.
1.6. Do not use wheeled carts or wagons to transport the FTIR as bumps and vibrations can damage the FTIR.

[o] The IR source operates at greater than 1000 ˚C and heats the internal cavity and components of the FTIR, which must reach a minimum temperature in order to pass performance qualification testing.[1]
[p] If using an isolated battery power source, there is less (but not zero) risk of damage to the FTIR due to lightning. Any length of cabling can potentially be the path used by lighting during a strike.

2. Transport by Passenger Vehicle

2.1. Consider procuring a hard-walled case with increased padding and shock resistance if frequent vehicle transport is expected.
2.2. Only transport in the cabin of a passenger vehicle. Do not transport on a bicycle, motorbike, or ATV. Do not transport in an open truck bed.
2.3. Do not transport an FTIR outside of a case, even if it is secured to a surface. The case provides shock protection and dirt/dust protection and must be used even for mobile services.
2.4. Ensure the case is secured within the vehicle such that it does not slide around.

3. Air Travel

3.1. Ensure the FTIR case will fit within the carry-on size regulations of the airline used.
3.2. Stowing the FTIR under a seat is preferable to storing in the overhead bin.
3.3. If the FTIR will only fit in an overhead bin, consider purchasing early boarding privileges to guarantee the FTIR will be stowed in the passenger compartment. Speak to the airline crew about accommodations for fragile equipment if there is no space left for the FTIR as it cannot be stored as normal luggage.
3.4. Do not check the FTIR as luggage or allow it to be taken to the luggage hold. The handling practices are insufficient to prevent damage.

4. Cargo Transport

4.1. FTIRs require extensive packaging in order to be shipped without chance of damage. New FTIRs are often shipped on pallets to facilitate safe transport.
4.2. Insurance is necessary for shipping and costs are generally very high.
4.3. This type of transport is generally only recommended when shipping the instrument for repairs. In this case, contact Bruker for specific instructions. [q]

11. FTIR Troubleshooting

FTIR damage can cause unpredictable effects that can make sample identification more difficult and less accurate. It is important to address damage quickly to avoid compounding problems and minimize downtime. Some problems can be resolved by the technician and do not require a service call. Generally, damage to the FTIR will result in the performance qualification test

[q] See Section 11: FTIR Troubleshooting, instruction 5.6 for contacting Bruker.

failing repeatedly. This is not an exhaustive guide of all possible issues or statuses, but a reference for some common problems that can be resolved by the technician.[r]

1. Spectrometer status light

Whenever a problem arises, begin with checking the spectrometer status light on the top of the instrument. A solid green status light indicates that there are no hardware issues detected. More status indications can be found in the Bruker manual.[1]

Spec. Light	Possible problem	Troubleshooting
Off	Power isn't plugged in	Check both ends of the power cable and make sure the plug works.
	Voltage problem	If connected to a temporary power source such as a battery, there may not be enough voltage to run the spectrometer. The power adapter may be faulty. There may be a circuit fault. Listen for a 'ticking' sound inside of the FTIR. If you hear this, disconnect the power immediately and call Bruker for servicing.
Blinking Green	Spectrometer is on standby	Press and hold the standby button on the back of the spectrometer for 2 seconds
Yellow	FTIR hasn't warmed up yet	Wait until the light turns green.
	IR source is reaching the end of lifespan	Measuring is still possible, but a replacement IR source should be ordered. The lifespan of an IR source is 50,000 hours.[s] When the replacement is received, replace the IR source. Refer to the Bruker manual on how to do this, as the IR source can be hazardous and must be replaced with caution.
	Internal humidity is too high[t]	Replace internal desiccant. If the desiccant is functioning normally, but the error still appears, check the internal

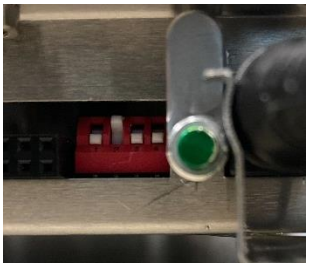
[r] Refer to section 9.5 of the BCCSU Technician Manual. A full list of possible statuses and issues can be found in the Bruker manual.
[s] You can check the status of the IR source in the *Instrument Status* window in OPUS. Click the OPUS status light in the bottom right corner of the screen.
[t] Refer to section 9.6 of the BCCSU Technician Manual.

		temperature of the FTIR in the diagnostics. If the FTIR is very cold when it is first started up, condensation may be forming inside the FTIR. Either store the FTIR in a warmer location or wait for the FTIR to warm up inside the case before opening it.
	Laser wavenumber must be recalibrated.	Click the *calibrate* button in the information bubble that pops up in OPUS.
	Instrument is too hot	Don't operate in very hot conditions. The maximum operating condition is 35 ˚C
	Instrument test has expired	Complete a new instrument test.
Red	Sampling module is not properly attached to the spectrometer module.	Attach the parts, making sure the separator button comes flush with the body of the FTIR. The separator button assembly may have failed.
	Instrument test failed	Complete a new instrument test
	Defective hardware component	An internal component of the FTIR may have failed. The only internal component that the technician can replace is the IR source. Everything else will need Bruker servicing. Check the DIR/ERR light on the back of the FTIR, if it is solid red there is a problem, or the FTIR is experiencing too much vibration. Check the *Instrument Status* dialog in OPUS. If any of the top row of icons show "ERROR", a component has a problem.

2. OPUS Status Light

While most statuses indications in OPUS will be a reflection of the spectrometer status light, when there are connectivity issues the indicator light in OPUS will be grey (not connected) when the spectrometer light may be a different colour. You will know that there is a communication problem when the yellow ACC light on the back of the spectrometer does not light up.

OPUS Status	Possible problem	Troubleshooting
Grey	Cable not connected, broken, or the wrong kind of cable.	Check the connectors and make sure it's a Cat5 cable with RJ45 plugs.

	DIP switches have been changed	Ensure the bank of switches looks like this:  *DIP Switches (Photo by J.B.)* Reset the FTIR if you change the switches.
	FTIR IP Address is wrong or is not set	In OPUS: Navigate to the *Validation* Menu Select the *Optic Setup and Service* command In the *Configuration* drop-down, select the ALPHA II In the *Optical Bench URL* field, enter 10.10.0.1
	Computer Ethernet port is not set correctly	In Windows: (may vary depending on OS Version) Search "Ethernet Settings" Under *IP Settings* Click *Edit* Change the setting from *Automatic* to *Manual* Turn on the *IPv4* slider Enter 10.10.0.2 in the *IP Address* field Enter 255.255.255.0 in the *Subnet Mask* field (may not appear in some OS Versions) Click *Save* Reset the computer
	FTIR is on standby	Press and hold the green standby button for 2 seconds.

3. Issues with the baseline measurement

Some issues appear when inspecting the blue baseline measurement in OPUS. Note that there will always be some noise in a baseline measurement and a perfectly flat line should not be expected, nor is it needed for accurate analysis.

Issue	Possible Problem	Troubleshooting
Baseline is noisy/jagged	High internal humidity	Check the internal humidity of the instrument, if it is elevated, replace the internal desiccant to improve the signal.
	Dusty mirrors	It is too risky to attempt to clean the mirrors yourself. **Don't do it**.
	Optics Damage	Check the past performance tests within *OPUS\Validation\Reports* to determine if the signal to noise ratio has become degraded.

		If damage has occurred, servicing by Bruker is required.
	Laser wavenumber needs calibrating	In OPUS: Navigate to the *Validation* menu Select the *Instrument Test* command In the *Setup OVP* dialog, click the *Measure LWN* button
Bumps or dips appear	Crystal is not clean	Thoroughly clean the crystal. [u]
	Humidity is too high	Check the internal humidity level.[v] If it is elevated, replace the desiccant. Large swings in humidity may cause artefacts to appear.
	Temperature has changed	For outdoor use, significant swings in temperature can cause artefacts and problems in OPUS. Repeat the performance testing to reset this.
	CO2 miscompensation	OPUS usually compensates for ambient CO2. Check if the aberrations in the baseline correspond to the spectra for CO2. If the aberrations persist, a call with Bruker is required.

4. Performance Qualification Failed

If the performance qualification (PQ) test fails, repeat the test. If it fails again, try resetting the FTIR and the computer and trying again.

If the performance qualification test fails repeatedly, some kind of failure may have occurred. When a PQ test is conducted, three tests are conducted, the signal-to-noise (S/N) test, the 100% line test, and the Wavenumber Accuracy test. The pdf that pops up will show which (or all) of the tests have failed. If you've closed the popup, you can access the tests within the file directory at *OPUS\Validation\Reports.*

Test failure	Possible problem	Troubleshooting
Only the wavenumber accuracy test failed	Laser wavenumber must be recalibrated	In OPUS: Navigate to the *Validation* menu Select the *Instrument Test* command In the *Setup OVP* dialog, click the *Measure LWN* button

[u] Refer to the *Additional FTIR Crystal Cleaning* procedure.
[v] Refer to section 9.6 of the BCCSU Technician Manual.

Only the S/N or 100% line test failed or All tests fail	The IR beam is obstructed	Unplug the FTIR, then disconnect the sampling module to check that nothing is covering the windows.
	The crystal is dirty	Thoroughly clean the crystal. [w]
	Crystal is damaged	Carefully inspect the crystal for signs of damage. Order a replacement if needed. When received, refer to the Bruker manual to replace the crystal.
	Defective hardware component	Check the Instrument Status in OPUS. If the laser, inferometer, automation, or detector show an error, you may need a service call with Bruker. If the test failed by a small margin, check the past tests within *OPUS**Validation**Reports* to determine if the test area has been degrading over time. A defective IR source can be replaced by the technician with a replacement part.
	FTIR was bumped or exposed to strong vibrations during testing	Move the FTIR to a location with less vibrations and repeat the test.
	FTIR is too cold	Wait for the FTIR to become warmer, the repeat the test.

5. If a resolution cannot be found

5.1. Collect as much information as you can about the problem including screen captures and a detailed description. Include dates and times. Write down the troubleshooting you have already attempted and find any applicable test reports.

5.2. Use your network of technicians to find a resolution by talking to another technician within your organization, or talking to other technicians within B.C. or elsewhere using the Slack channel or another means of communication.

5.3. Contact the BCCSU with any questions by emailing drugchecking@bccsu.ubc.ca or directly messaging one of the team members in the BCCSU Drug Checking Program.

[w] Refer to the *Additional FTIR Crystal Cleaning* procedure.

5.4. If a fix cannot be found and a service call is indicated, contact your supervisor to report any problems with the instrument.

5.5. If your organization has a support team or equipment manager, contact them for assistance.

5.6. If a resolution cannot be found using available means, contact Bruker for support:

BRUKER CONTACT INFORMATION

- Contact your Bruker technician, if there is a pre-existing relationship.
- Email Bruker Support service.bopt.ca@bruker.com.
- Contact your Bruker regional sales manager.
- If you are unable to connect with the sales manager, call the Bruker Optics North America Service Hotline at 1-987-439-9899 ext. 2

Definitions

Relative Humidity (% R.H.): The amount of water vapour in the air, with respect to the temperature of the air. Cold air can hold less water vapour than hot air, which is why cold surfaces cause condensation of airborne water. Typical room humidity will be between 30-70% R.H.[7]

Absolute humidity: a measure of the actual amount of water vapor in the air, regardless of the air temperature.

ATR: Attenuated Total Reflection. The method of shining infrared light onto a sample and collecting the remainder that reflects off the sample.

Sample Plate: The horizontal, round metal plate on the sample module of the FTIR.

Crystal: The small square that is mounted in a depression in the sample plate on the sample module of the FTIR.

Anvil: The adjustable module that hangs above the crystal on the sample module of the FTIR.

Spectrometer Module: The “body” of the spectrometer, the larger portion. This has the power cable attachments.

Sample Module: The "head" of the spectrometer, the smaller portion. This has the anvil, sample plate and crystal.

Signal-to-Noise Ratio: A performance indicator that shows the strength of the signal of the FTIR.

Optics: The internal assembly of mirrors, lenses, and beamsplitters that make the FTIR function.

Beamsplitter: A half-mirrored plate that splits the IR beam into two.

Desiccant: A material that absorbs water such as silica gel. Often comes in cloth packets.

Additional Resources

- Interior Health Authority document Safe care and transport of FTIR
- BCCSU Operation guidance on Reducing Exposure and Contamination Risks
- BCCSU standard operating procedure on Drug Crushing
- BCCSU Technician Manual
- BCCSU Implementation Guide
- Bruker webpage for the Alpha-II

References

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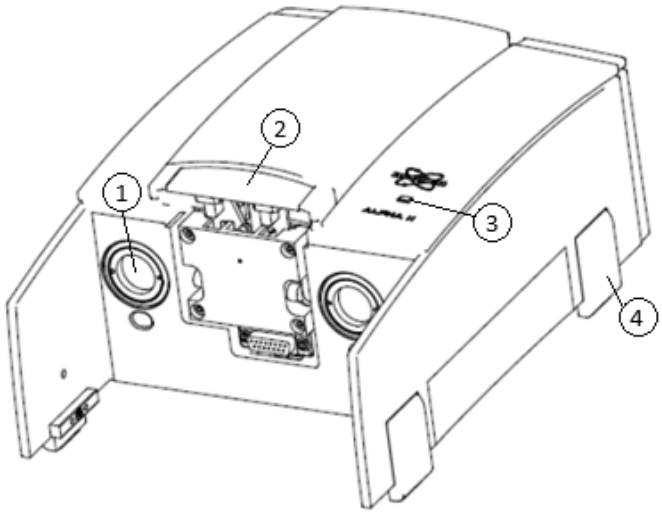
Appendix A: Components of the FTIR

Understanding the names and functions of the parts, ports, and status lights of the FTIR will aid in understanding these procedures and allow for more thorough troubleshooting should problems arise. The relevant components for this document are indicated below.

Spectrometer Module

Also known as the basic module, or simply the FTIR "body", this component houses the infrared (IR) source, the mirrors, lenses, and beamsplitter (collectively, the *optics* of the spectrometer) that produce the infrared beam and the spectrometer unit that collects the beam for analysis after passing through the accessory module.[2]

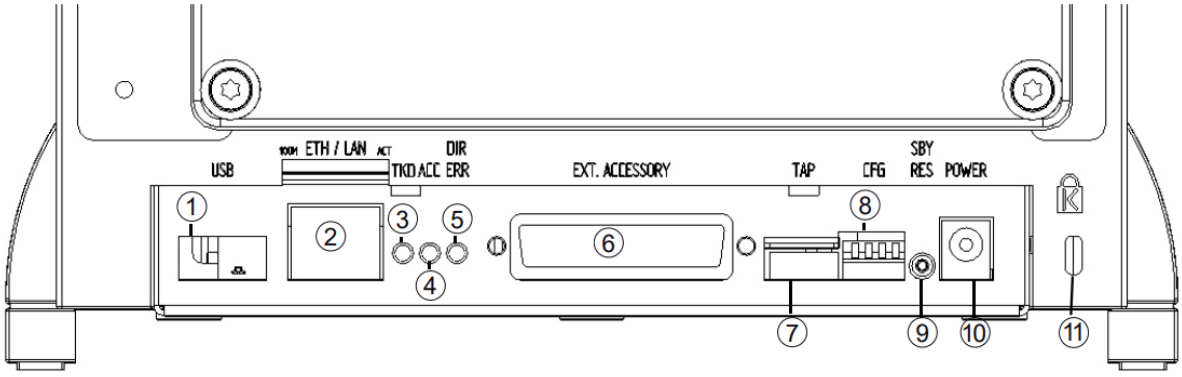


1) Window openings
2) Separator button
3) Indicator light
4) Feet

Spectrometer Module[1]

On the back of the spectrometer module, there are ports, lights, switches, buttons, and an anti-theft lock[x]. During normal operation, only the ethernet port (2) and the power port (10) are used, but it's useful to know the other components when troubleshooting, especially the three lights (3, 4, 5), the configuration switches (8), and the standby button (9). Above the ports is the backplate that covers the IR source and the internal desiccant packet.

[x] This is a standard Kensington Security Slot. To use this, a separate lock/cable is required.

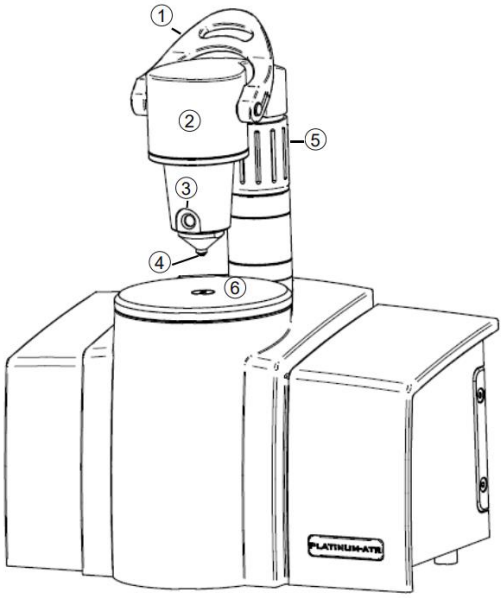


Rear of the Spectrometer Module[1]

1) USB Port
2) Ethernet Port
3) TKD (Take data) light
4) ACC (Access) light
5) DIR/ERR (Direction/Error) light
6) External Accessory Port
7) TAP (Test Access Port)
8) CFG (Configuration) Switches
9) SBY/RES (Standby/Reset) button
10) Power port
11) Kensington lock

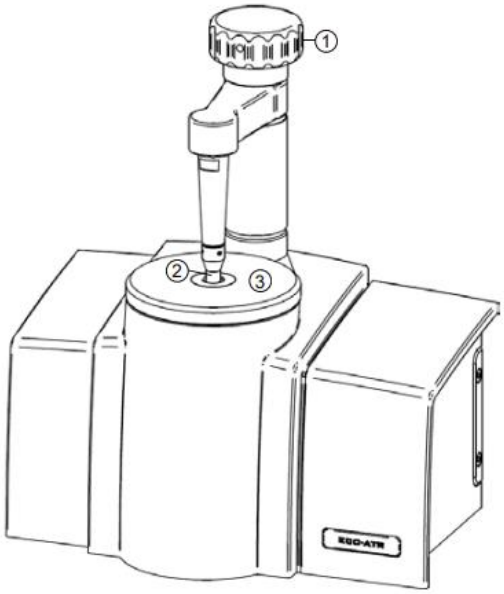
Sample Modules

Also known as an accessory module, or simply the FTIR "head". Many accessories for the Alpha-II exist, however only two styles of the ATR (Attenuated Total Reflection) module are used in drug checking: the flip-down style (known as the *convenience* accessory) and the screw-down style (known as the *eco* or *universal* accessory). Both press a sample tightly against the rectangular crystal (a very thin industrial diamond) that receives the IR beam for measurement. Under the sample plate that surrounds the crystal, there are more mirrors and lenses that make up the remainder of the optics of the instrument. Two more window openings on the back of the accessory match the openings on the spectrometer module.



Flip-down ATR Accessory[1]

1) Lever
2) Pressure arm
3) Pressure control spot (red spot)
4) Anvil
5) Adjustment knob
6) Sample plate with crystal



Screw-down ATR Accessory[1]

1) Pressure knob
2) Anvil
3) Sample plate with crystal

Appendix B: Desiccant Use and Procurement

A desiccant is a material that can absorb atmospheric water vapour, thus reducing the humidity of a space. Ambient humidity causes corrosion and degradation of metal parts, reducing the humidity will slow or even halt this corrosion entirely. Desiccant should be used in two areas, inside the FTIR and inside the FTIR storage case. Desiccant can be regenerated indefinitely and performance will not degrade unless the packets become damaged.

1. Internal FTIR desiccant

The FTIR has an internal desiccant packet that will occasionally need regeneration or replacement. The FTIR is not airtight. Even FTIRs that are not disassembled will need to replace the internal desiccant when humidity is too high. The internal humidity can be monitored via the sensor within the FTIR and can be accessed through OPUS. **When the internal humidity approaches 40% R.H., replace or regenerate the desiccant**. [y]

The desiccant pack that the instrument was shipped with can be regenerated, but if it is to be replaced, ensure that the replacement is the same weight of silica gel as the factory-installed pack. There may be an issue claiming repairs under warranty if the internal desiccant pack is not branded by Bruker. Bruker sells branded desiccant packets with a humidity indicator card to be used inside the FTIR, these can be ordered through your Bruker sales representative or by contacting Bruker support.

2. Ordering desiccant for an FTIR case

Including desiccant packets in the FTIR case is an adaptation for sites that operate in humid environments and regularly open and close their case to store the FTIR. As such, adding additional desiccant to the FTIR case will require ordering desiccant, which can be done easily from a variety of sources online.

2.1. Use only silica gel packaged in permeable packets as a desiccant.[3]

2.2. For a typical FTIR case, include two 20g silica gel packets, one for each compartment of the case.[8] For larger cases, add another 20g silica gel packet.

2.3. Adding excess silica gel packets will simply increase the time between replacements; when in doubt, use more packets.

2.4. Three types of silica beads are commonly available: blue beads, orange beads, and clear beads:

[y] Refer to section 9.6 of the BCCSU Technician Manual and the Bruker manual[1]

2.4.1. **Do not use the blue beads.** They contain cobalt chloride, which is carcinogenic.[3,4]

2.4.2. The orange beads turn green when they are saturated. These are recommended for use as they provide an easy way to tell if they need to be regenerated without additional equipment. Be aware that the indicator chemical is toxic and should be treated with care.[5] Avoid crushing or rubbing the desiccant to prevent dust laced with the indicator chemical. Refer to manufacturer's instructions.

2.4.3. The clear beads have no visible indication that they are saturated. A humidity indicator card or sensor will have to be purchased along with the desiccant. Bruker FTIR desiccant packets are clear silica beads with a humidity indicator card attached to the packet.

2.5. Under no circumstances should silica gel be released from the package to the environment; the humidity indicators are particularly harmful to wildlife.[4,5]

3. Regenerating desiccant

Desiccant that is saturated can be baked to drive off the stored water and reused. Follow the instructions below. Do not open silica packets to expose the beads for any reason.

3.1. For Bruker-branded desiccant packets, bake the packet on a heatproof plate or pan in an oven at 130 ˚C for 30 minutes.[1] The humidity indicator card included on Bruker-branded desiccant packets should be handled carefully as it contains a small amount of toxic indicator. The card may discolour or fail to indicate humidity with sufficient time; this has no effect on the performance of the desiccant itself which can be regenerated indefinitely.

3.2. For all other packets, refer to the manufacturer's instructions for regeneration instructions.