MODULAR FTIR SAMPLE INTERFACING WITH THE AXIOT SYSTEM

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INTRODUCTION

The Axiot System is a family of modular light guides, mirror assemblies, optical switches and associated hardware which can be used to configure a wide variety of FTIR sampling systems. The heart of the system is a series of hollow metallic light guides which provide very high coupling efficiency and enable a mid infrared beam to be routed over a considerable distance to one or more sampling systems in a fume hood or on a process line.

This paper provides representative examples of the wide variety of Axiot systems that have been configured to date. These are intended only to give an idea of what can be done. Clearly, the possibilities are endless.

FUME HOOD MOUNTED SAMPLING SYSTEMS

The Axiot System frees the analysis from the confines of the FTIR spectrometer's sample region, allowing it to be carried out in the most desirable place such as in a fume hood or glove box. Figure 1 iHustrates a fume hood mounted system employing one *i* the AXM-600 Series Outboard Sampling Modules. The sampling module essentially duplicates the function of the spectrometer sample compartment but also provides a low volume, completely enclosed optical path which can be rapidly and efficiently purged.

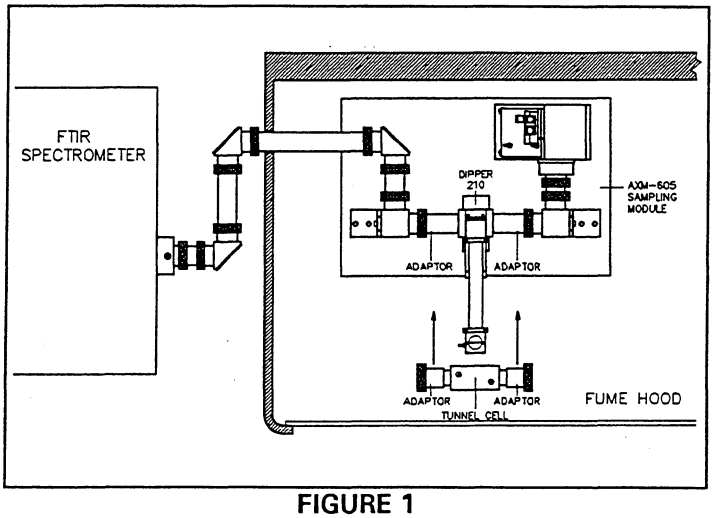

FIGURE 1

Figure 1 includes a DIPPER-210 immersion probe mounted in the sampling module. This can be quickly interchanged with any of Axiom's other focussed beam sampling devices (such as the TNL-130 Tunnel flow cell shown below the DIPPER-210) by means of quick release Axiot adaptors. No adjustments are required when switching to a new sampling technique.

MULTIPLE STREAM SAMPLING

Figure 2 illustrates an Axiot sampling system which includes provision for switching an infrared beam between each of three Tunnel flow cells and a reference path. In this case, the reference path is provided with a variable attenuator, allowing its signal level to be set approximately equal to the levels in the ree sample paths. This system allows the composi-

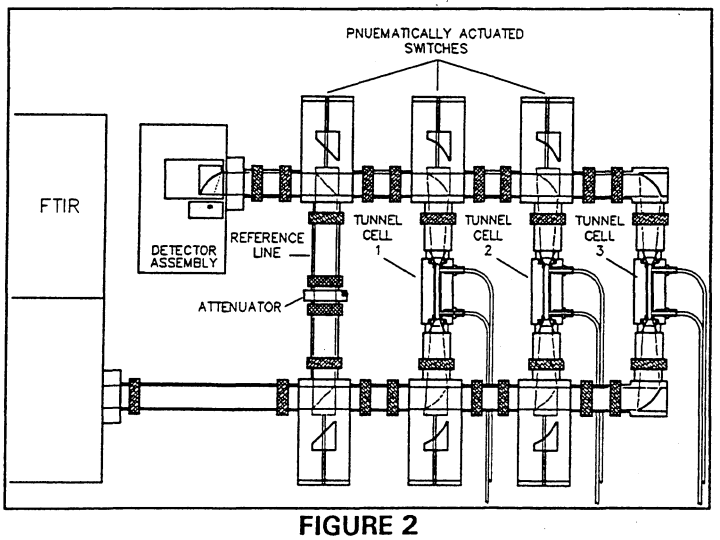

FIGURE 2

tion of three sample streams to be monitored continuously while eliminating the possibility of cross-contamination.

LIMITED ACCESS IMMERSION PROBE SYSTEMS

The DPR-205 Immersion probe system features a two reflection ATR probe and a sample compartment beam pickoff. The IR beams traveling to and from the probe follow the same path through one or more Axiot optical conduits. This provides a great deal of flexibility in coupling the probe to the spectrometer. Figures 3 illustrates a system in which the probe, in a protective enclosure, is coupled to an external FTIR spectrometer by means of a series of Axiot conduits and AOJ-90 mirror assemblies.

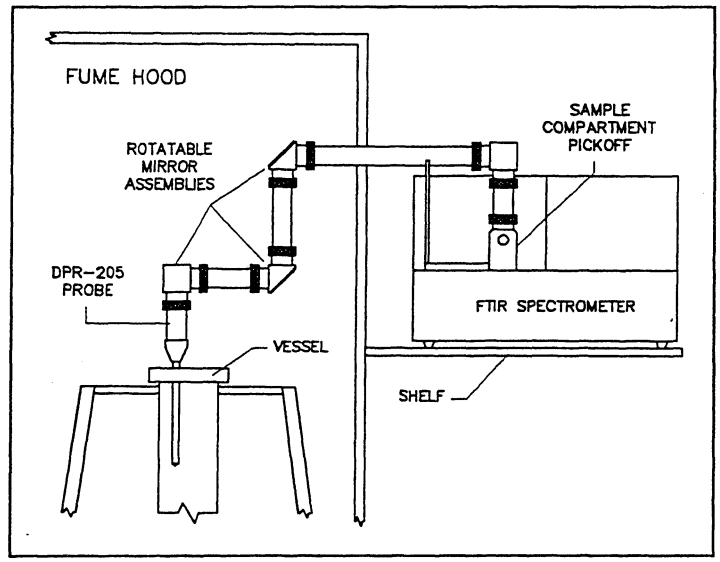

FIGURE 3

DO-IT-YOURSELF SAMPLING

As a result of its large aperture, the Axiot System provides extremely efficient coupling of radiation between the spectrometer and sampling devices - between one and two orders of magnitude more efficient than the fiber-optic transmission systems commonly used in the near IR. In addition, distance dependent losses are low enough to allow Axiot conduits to be employed over practical distances in the factory environment. Figure 4 shows an installation in which Axiot modules are used to couple the IR beam to and from an open transmission path bridging across a process pipe.

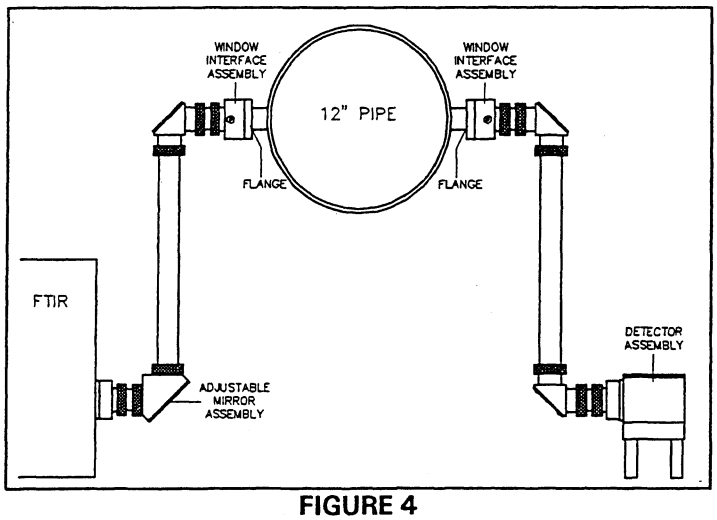

FIGURE 4

NEMA CLASSIFIED SAMPLING SYSTEMS

In process installations, it is essential to isolate all electronic systems and other ignition sources from the fumes which may be present in the environment or in the sampling system. In most process infrared installations, the spectrometer - with its incandescent IR source and extensive electronics - is mounted in an appropriate NEMA rated enclosure separate from the sampling system. Often, it is possible to eliminate all electrical functions from the sample area. In other cases, such as when the sample temperature must be controlled, the sampling system must be suitably protected by an appropriate enclosure and nitrogen purge. Such an example is shown in Figure 5.

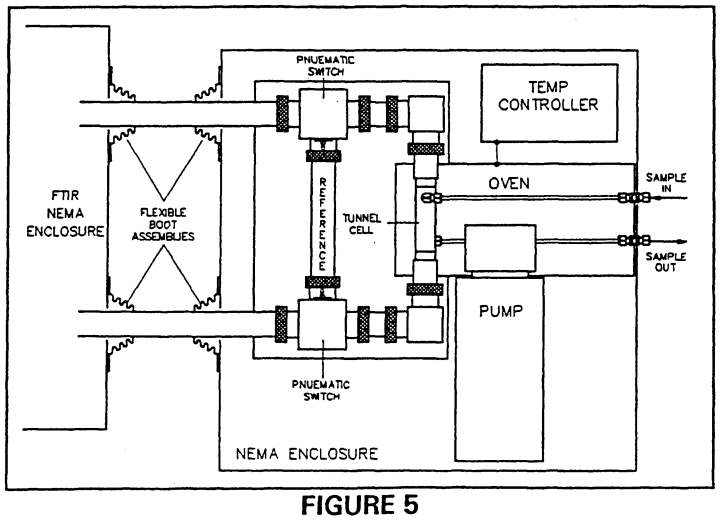

FIGURE 5

ARTICULATED IMMERSION PROBE ASSEMBLIES

Figure 6 illustrates the use of Axiot modules to enable a DPR-210 immersion probe to be articulated vertically so that it can be dipped into 55 gallon drums or other containers for product or incoming inspection. The articulated probe system can be mounted on the front of a NEMA enclosed spectrometer, as shown, or on a outboard stand with a modular detector assembly.

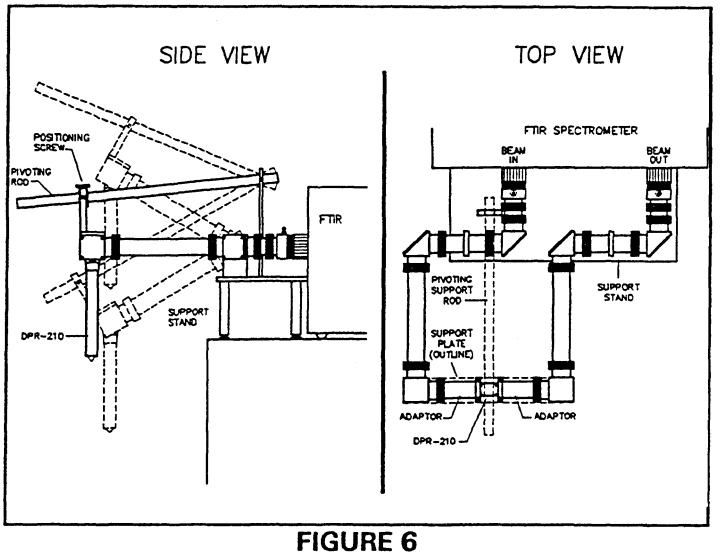

FIGURE 6

LARGE SCALE INSTALLATIONS

The relatively low transmission loss of the Axiot system (0.07 and 0.035 Abs/meter with Nickel and Gold coatings, respectively) makes it practical to monitor reactions in large scale process reactors. Typical installations employ large ATR based immersion probes, (from eight to ten feet in length), with Axiot conduits communicating between the spectrometer and the top of the probe and from the top of the probe to the ATR element near the bottom. (See Figure 7.)

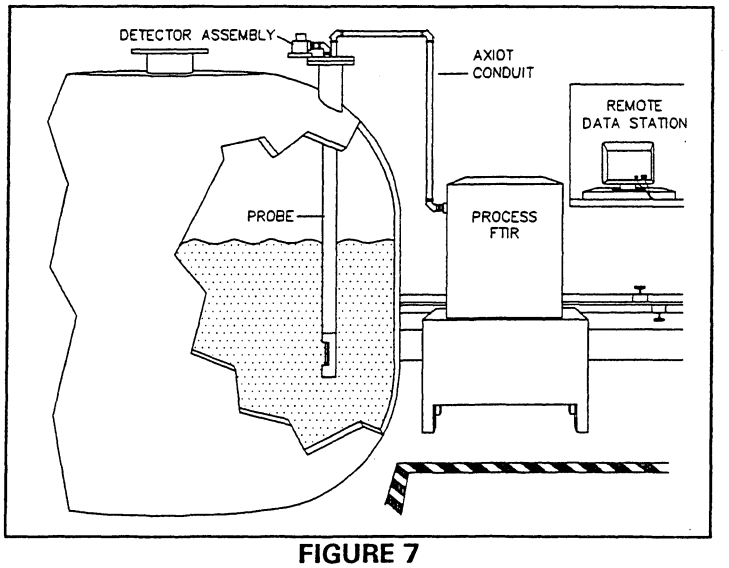

FIGURE 7

"FAILSAFE" SYSTEMS

Many chemical processes involve extremely hazardous substances. In such cases, it is essential to eliminate the possibility of a leak to the environment. "Failsafe" systems, such as that illustrated in Figure 8, can provide the required level of safety.

Following is a brief summary of how the system works. A pressurized steel containment vessel surrounds the portions of the sampling system exterior to the reaction vessel. Large steel ball valves, (controlled by a system of pressure sensors, actuators and valves), are installed in the Axiot optical conduits entering and exiting the containment vessel. If the system senses any change in pressure outside of preset limits, the ball valves and all valves communicating with the vessel are immediately closed to seal off the probe and surrounding area.

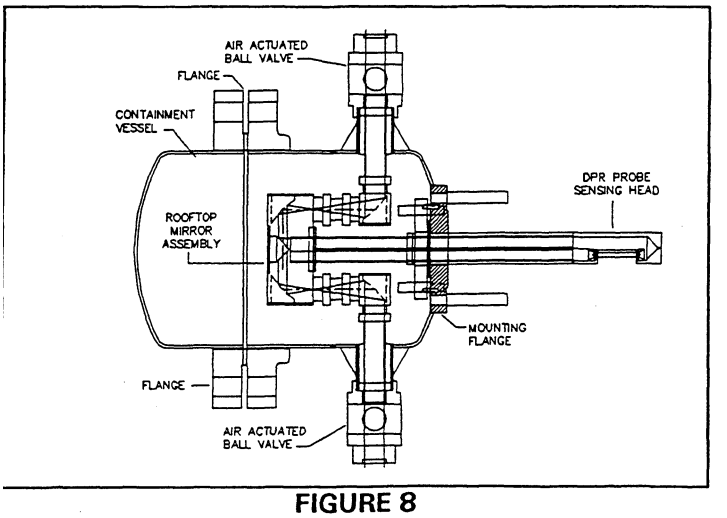

FIGURE 8

IN-SITU WEB MONITORING

The versatile Axiot system can sometimes perform the function of a sample interface all by itself, as it does in the installation illustrated in Figure 9. The IR beam from the process spectrometer travels to and from the sample via extended Axiot arms. At the end of each arm is a sealed window/mirror assembly which directs the beam through a moving web sandwiched between the two assemblies. With this stationary system, reliable transmission measurements can be made continuously to monitor the web's composition as it moves through the sampling area. Air actuated switches and a short length of Axiot conduit provide an automated reference path suitable for the process environment.

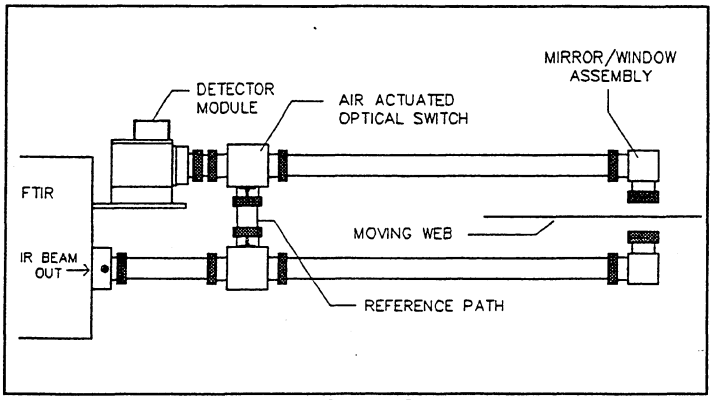

FIGURE 9

DYNAMIC, NON-CONTACT SURFACE ANALYZER

Figure 10 illustrates an extremely versatile sampling configuration for monitoring surface characteristics of objects with varying shapes and sizes. This "robotic" setup features an SRX Non-Contact Surface \nalyzer mounted on the end of a section of telescopig Axiot optical conduit. This configuration allows the analyzer to move up and down as objects pass by on the conveyor below while the industrial FTIR spectrometer remains stationary on its platform above. Telescoping Axiot arms have also been used in other remotely controlled industrial monitoring applications enabling users to take advantage of the speed and sensitivity of FTIR in areas previously inaccessible to the technique.

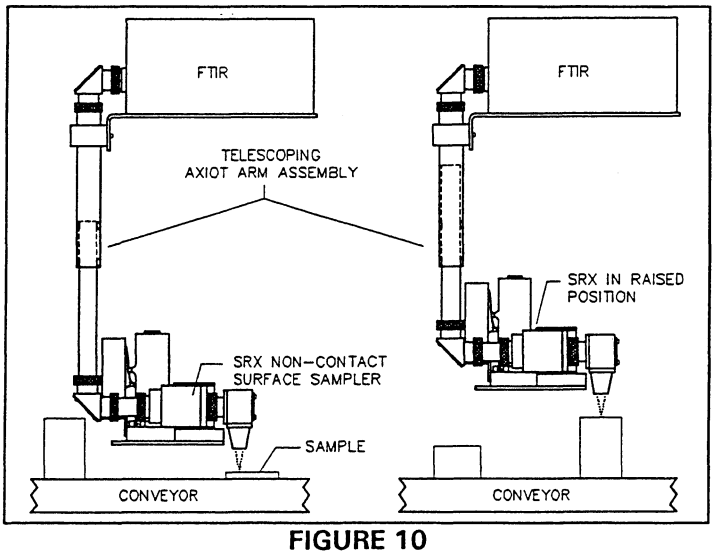

FIGURE 10

FIGURE 10

RUGGED, VERSATILE SAMPLING SOLUTIONS

The Axiot system of modular transfer optics is a unique means to increase the power of your FTIR spectrometer. This precisely engineered system of light guides, mirrors, switches, and associated • hardware can stretch your resources by allowing multiple uses of a single spectrometer with virtually no delay between sampling techniques. In addition, Axiot sampling systems have extended the use of FTIR into new applications areas, and have greatly increased erator convenience for a wide range of measurements. If you have potential applications which don't readily lend themselves to a standard laboratory spectrometer sample compartment, contact Axiom for flexible Axiot sampling solutions that put the power of FTIR to work where you need it most.

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