Strategies for International Travel with "High-Tech" Archaeological Field Equipment*

William F. Limp and Malcolm D. Williamson

Conducting archaeological fieldwork increasingly relies on "high-tech" instruments. These include such technologies as portable X-ray diffraction; ground penetrating radar; high-precision global navigation satellite system (GNSS) receivers; laser scanners; multispectral, thermal, lidar, and hyperspectral instruments on Uncrewed Aerial Vehicles (UAVs); and many others. Using these devices internationally can present complex issues with export regulations and the potential for duties and value-added taxes. In short, there are many regulations affecting the movement of these devices across international borders.

ABSTRACT

Conducting archaeological fieldwork increasingly relies on "high-tech" instruments. These include such technologies as portable X-ray diffraction; ground penetrating radar; high-precision global navigation satellite system (GNSS) receivers; laser scanners; multispectral, thermal, lidar, and hyperspectral instruments on Uncrewed Aerial Vehicles (UAVs); and many others. Using these devices internationally can present complex issues with export regulations and the potential for duties and value-added taxes. In short, there are many regulations affecting the movement of these devices across international borders. In the past, archaeologists had interactions with customs personnel and faced the complexities of import and export laws at the end of a project, as they dealt with the issues of taking samples or artifacts out of a country for study. Today's archaeologists must be prepared before they even begin their travel to ensure that their equipment and software can travel overseas. This article provides a practical overview of the laws, regulations, and practices affecting international transport of the archaeological high-tech tool kit.

La realización del trabajo de campo arqueológico depende cada vez más de instrumentos "de alta tecnología". Entre ellos se incluyen los analizadores de fluorescencia y de difracción de rayos X (XRF y XRD) portátiles, los equipos de georradar (GPR), los receptores de alta precisión de sistema global de navegación por satélite (GNSS), los escáneres láser, los sensores multiespectrales, térmicos, lidar e hiperespectrales de los vehículos aéreos no tripulados (UAV) y muchos otros. El uso de estos dispositivos a nivel internacional puede presentar problemas complejos relacionados con las regulaciones de exportación y las potenciales tarifas o impuestos de valor agregado. En general, hay muchas regulaciones que afectan el movimiento de estos dispositivos a través de las fronteras internacionales. En el pasado, los arqueólogos interactuaban con el personal de aduanas y se enfrentaban a las complejidades de las leyes de importación y exportación al final de un proyecto, ya que normalmente se trataba de cuestiones relacionadas con la exportación de muestras o artefactos fuera de un país para su estudio. El arqueólogo de hoy debe estar preparado antes incluso de comenzar su viaje para asegurarse de que su equipo y software puedan viajar al extranjero. Este artículo ofrece una visión aplicada de las leyes, reglamentos y prácticas que afectan el transporte internacional del conjunto de herramientas arqueológicas "de alta tecnología".

*This article has been corrected since its initial publication. A corrigendum detailing this change was also published (doi:10.1017/aap.2018.6).

Advances in Archaeological Practice 5(4), 2017, pp. 382–387

DOI:10.1017/aap.2017.24

In the past, archaeologists had interactions with customs personnel and faced the complexities of import and export laws at the end of a project, as they dealt with the issues of taking samples or artifacts out of a country for study. Today's archaeologists must be prepared before they even begin their travel to ensure that their equipment and software can travel overseas. In this article, we will provide a practical overview of the laws, regulations, and practices affecting international transport of the archaeological high-tech tool kit. Many of the recommendations that follow have been "hard earned" through years of international high-tech archaeological studies on six continents, excepting Antarctica. We will look at various US restrictions on international use of specific items; export licensing and when it is needed; the impact of customs, import duties, and value added-taxes and how to avoid them; packaging and packing; the role of shipping versus luggage; and the value of insurance and the complexities surrounding it. Finally, this should be seen as only a primer on these complex issues and as only beginning to touch on many essential topics. Failure to comply with these regulations—even through ignorance—can lead to substantial penalties and even criminal prosecution. The restrictions that the destination country may also require are not covered. These can be significant; common categories for destination country restrictions include various GNSS devices and UAVs. In interactions with all border and customs officials, always recognize that a good dose of diplomacy is required and that reacting calmly, exhibiting patience, and, most importantly, having letters and documents from both US and (whenever possible) foreign officials can diffuse otherwise contentious situations.

Archaeologists working for larger universities, museums, and corporations will almost always have a specific office that deals with these issues. Many have extensive web resources explaining the university's process for export control and the proper procedures to follow. While the offices are extremely helpful, it is still essential that the archaeologist be well informed. Managers or administrators who may know the regulations intimately may not recognize the subtle differences between one specific form of the technology and another. For example, there are specific systems that are prohibited for export under the International Traffic in Arms Regulations (ITAR – Category XC para C see below), but these are different from the units commonly used by archaeologists. Knowing the difference and being able to explain it to administrators/management is important; these key issues are covered as well. The article attempts to thread the needle between excessive bureaucratic jargon (but some is unavoidable) and clarity, and everyone should do their own homework. This article should be seen as a good start but no more than that.

BASIC ISSUES IN TRAVELING WITH EQUIPMENT

Preparation for international fieldwork must begin many months before initial travel. There is a complex set of US rules and regulations that cover many high-tech devices—some of which may be used in archaeological settings. Even when non-controlled technologies are involved, it pays to be very familiar with the regulations to avoid undue delays and confusion when leaving or returning to the United States. Simply bringing the equipment back to the United States still requires conformity to many rules. If the inventory is not properly documented, the traveler may have to pay a duty or may be unable to bring the devices back to the United States.

General Issues in Traveling out of the United States with Equipment

Whenever anticipating travel outside of the United States with either personal or institutional equipment purchased in the United States, be prepared to document its original purchase on reentry to the United States to avoid being charged a duty. An effective way to do this is to maintain the original purchase documentation for each element. An alternative is to acquire a US Customs and Border Protection Form 4455 "Certificate of Registration" and/or Form 4457 "Certification of Registration for Personal Effects Taken Abroad." Provide sufficient details (usually including serial numbers, etc.) such that a customs agent can identify each item. Prior to your departure, you then take the form and the items to the nearest customs office and have the agent review the items and have the document stamped and signed there. Additional pages can be stapled to this form that contain more information (e.g., photos, descriptions, make/model, etc.) for each piece of equipment. These pages can also be stamped and signed by the customs office. During travel, it is entirely possible that this documentation will not be requested, and it is best not to volunteer it initially, as this may lead to delays. However, if questioned, these forms can then be presented upon return to the United States, avoiding any equipment impoundment or import duties. Having such documentation is particularly important if the item is manufactured abroad and appears new or recently purchased. This is especially true for cameras and other personal electronic items. Customs agents are located at the (currently) 328 ports of entry around the United States. Their locations can be found on the US Customs and Border Protection's website "Know Before You Go," which has other valuable information as well (https://www.cbp.gov/travel/us-citizens/know-before-you-go).

https://doi.org/10.1017/aap.2017.24 Published online by Cambridge University Press

Using a belt and suspenders approach, it is prudent to have both purchase documents and a form—especially for new or new-looking items. Having Form 4455/4457 can expedite the return to the United States but will not address the second part of the process: the duties or charges that may be levied when entering a foreign country.

ENTERING FOREIGN COUNTRIES

Understandably, foreign governments wish to ensure that items are not brought into their country for resale without the payment of proper duties or taxes, especially value-added taxes (VAT). There are several strategies to avoid the payment of duties upon entry. Normally, personal items, such as one laptop or camera, can be carried through with little concern. But it is possible, in some countries, that even these will not be allowed without payment of duties, especially if they look new or if you have more than one or two (e.g., multiple hard drives for data storage). Expect to encounter added scrutiny if there are multiple containers of what is clearly high-tech equipment—such as multiple Pelican cases or their like. The most effective strategy to avoid duties or taxes is to obtain an *Admission Temporaire*/Temporary Admission (ATA) carnet (pronounced kar-nay) prior to your departure from the United States. A carnet is an international customs and temporary export-import document that is obtained before departure from the United States. At the destination country or countries, a page (called a foil) is given to the customs representative upon both entry and departure. The foil lists the equipment and is used to track it on arrival and departure to insure that it is not sold. To acquire the ATA carnet, it is necessary to give details about the equipment and either provide a deposit with the carnet issuance organization of up to 40% of the value of the equipment or purchase a surety bond. The deposit must be in cash or certified check and is returned when the equipment returns to the United States. Surety bonds are used more commonly than deposits; of course, the cost of them is not returned to the purchaser.

In the United States, ATA carnets are issued and guaranteed by the US Council of International Business (USCIB) and its service providers. Their website (https://www.uscib.org) lists the 80-plus countries that recognize carnets, including most of those of North America, Europe, and Asia. It also directs you to their two ATA carnet service providers, Boomerang Carnets and Roanoke ATA Carnet, where you can estimate the cost of your carnet. For example, the cost for a carnet, including the surety bond, of a shipment that has a combined value of $25,000 would be under $500, while that for a shipment that was valued at $500,000 would be in the $2,500–$3,000 range. ATA carnets have a duration of one year, during which the listed merchandise may be imported and exported without limit to any of the member countries. This may be of benefit for people doing work in multiple countries over the course of one year.

EXPORT-CONTROLLED ITEMS

In addition to basic customs and VAT matters, there are a number of US regulations that apply to the international movement of items. The key ones are the International Traffic in Arms Regulations (ITAR), the Export Administration Regulations (EAR), and the Department of Treasury's Office of Foreign Assets Control (OFAC). The ITAR regulations have been developed to control the movement of militarily useful/used hardware, software, and methods. It is essential to ensure that equipment is not ITAR restricted. Without proper licensing, export, which includes simply transporting these overseas, is a serious violation. ITAR restrictions apply to specific categories of both hardware and software. While most equipment used in archaeological settings will not be ITAR restricted, there may be cases when it is restricted. For example, encryption software may be part of commercial software, which would, therefore, be ITAR restricted. However, it is much more likely that a high-tech device may have restrictions based on the EAR. Finally, there are the various countries, organizations and individuals who are placed on the OFAC. While generally the list focuses on individuals and organizations—for example, those determined by US policy as supporting terrorism—entire countries may be included. This list may change frequently and should be reviewed while any foreign project is in the planning stages. The list can be found at https://www.treasury.gov/resource-center/sanctions/Programs/Pages/Programs.aspx .

ITAR Restrictions and Rules

ITAR is based on the Arms Export Control Act and related laws. It is managed by the US Department of State's Directorate of Defense Trade Controls (DDTC). ITAR has many dimensions—including limiting access to military technologies within the United States—but this article covers only the parts relating to international travel. There are many categories to which the ITAR regulations apply—they are on the United States Munitions List (USML). The USML has specific descriptions of the items that fall under its purview. Some of the categories may be of special relevance to archaeologists: those that apply to UAVs, GNSS/GPS, lidar devices, laser scanners, and encryption software. In general, only UAVs that have a range greater than 300 km are affected by ITAR, but there are exceptions. Some UAVs that are commercially available in the United States, while not covered under ITAR, are covered by other restrictions (e.g., EAR ECCN 9A012—see below) and thus do have export restrictions on them. Generally, only GNSS/GPS systems that support the Y and P codes are ITAR covered. It is unlikely that most commercially purchased devices will be ITAR restricted, but, because the penalties are substantial, you should always ensure that this is not the case. A critically important issue is that ITAR-restricted items may not be exported to selected countries: (as of this writing) Cuba, Iran, North Korea, Sudan, or Syria. Additionally, export of ITAR-restricted items is prohibited to countries currently subjected to a US arms embargo—these (again, as of this writing) are Burma, China, and the Republic of Sudan. Export is also prohibited to countries under United Nations embargos—these are Cote d'Ivoire, Democratic Republic of Congo, Eritrea, Iraq, Iran, Lebanon, Liberia, Libya, North Korea, Somalia, and the Republic of Sudan. The current list of prohibited countries can be found at http://www.pmddtc.state.gov/embargoed_countries/.

Dual Use and the EAR

While most instruments won't be covered by ITAR, there is a very strong possibility that they will be covered under the EAR if they are found on the Commerce Control List (CCL). This is a list that includes commodities, software, and technologies

https://doi.org/10.1017/aap.2017.24 Published online by Cambridge University Press

subject to the export licensing authority and jurisdiction of the Bureau of Industry and Security (BIS) of the US Department of Commerce. Many of the items involved are referred to as "dual use."

The term "dual use" applies to items that have both commercial and military or proliferation applications; thermal infrared imaging cameras would be an example, as the dominant use is for military purposes. However, the CCL also includes items of only commercial use. Each item covered by the CCL has an alphanumeric code used by the Department of Commerce to classify items. This export control classification number (ECCN) applies to an item or a class of items and shows the export controls placed on that item. All ECCNs are listed in the CCL. The ECCN indicates why the item is restricted, and it also links to the various countries to which its export is prohibited without a license. It is important to recognize that equipment that is commonly available through commercial sources in the United States may be on the CCL. It may also be the case that an item originally purchased from an overseas source is on the CCL. Listing on the CCL does not necessarily mean that the export of the item is prohibited but, rather, that a license may be required.

The four-character ECCN provides detailed information on the item. The first is a number indicating the category item. Common categories for archaeology will be the number 4, for example, which covers computers; 6, which covers various sensors and lasers; and 9, which covers aerospace and aircraft. The second is a letter indicating into which of four groups the item is categorized. The letter "A" will probably be the most used, as it covers equipment, while "D" indicates software. The third character is a digit indicating the reason the item has been restricted.

Once the category of restriction is known, it is possible to determine which countries are on the restricted list. It is necessary to cross-check the reason for listing with the Commerce Country Chart. The CCL Overview and Country Chart is found at https://www.bis.doc.gov/index.php/forms-documents/regulations-docs/14-commerce-country-chart/file . The chart has multiple columns relating to the specific reason for the restriction. These are chemical and biological weapons (CB), nuclear nonproliferation (NP), national security (NS), missile tech (MT), regional stability (RS), firearms conventions (FC), crime control (CC), and antiterrorism (AT). Within many of these major categories there are subcategories. An item may have multiple reasons for control. The EAR provides a table at the beginning of each ECCN indicating which control categories apply. You can review the Country Chart for these; if an "X" is present, then the item may not be exported to that country without authorization.

Note that it may be possible to use a license exception for certain EAR-controlled items if you meet specified criteria. This might require certification that you will be hand-carrying the items and/or will keep them within your effective control and will not carry or ship them to the EAR-restricted countries without specific prior approval from the US Office of Export Controls.

There are also items that are subject to the EAR but not to any specific control or licensing policies. These won't have a specific ECCN on the CCL but will be designated EAR99. Items with this classification can be exported to most countries (those not subject to an embargo) without a license, provided they are not going to a prohibited or restricted end user or being used for a prohibited end use.

It is important to be aware of the nuances of both ITAR and EAR. For example, many archaeological projects currently involve the use of terrestrial laser scanning (TLS) systems. A superficial reading of the EAR would find, in 6A108a, this definition:

> Laser radar systems are defined as those that embody specialized transmission, scanning, receiving and signal processing techniques for utilization of lasers for echo ranging, direction finding and discrimination of targets by location, radial speed and body reflection characteristics.

This wording would appear to clearly include TLS as used in archaeology. However, later the document indicates that these apply only to "Radar and laser radar systems designed or modified for use in 'missiles.'"

A second common instrument category in archaeological use is thermal or "infrared" cameras and/or scanners. Thermal cameras, especially ones mounted on a UAV, are very useful for archaeological investigations (Casana et al. 2014). Wording in EAR 6A003 and USML Category Xii(e) applies to such devices. However, the EAR goes on to specify very technical properties that apply, such as response times and peak response wavelengths. If a device has these properties, then its export is restricted; otherwise, it is not.

Those thermal cameras meeting the EAR specifications have controls based on multiple categories. The EAR lists these under "Reasons for control" and provides the column in the Country Chart that is applicable. A camera with a solid-state detector with a response time of 95ns will be restricted for reasons of national security, crime control, antiterrorism, and restrictions based on UN embargos. Such a device cannot be exported to countries such as Antigua and Barbuda, Argentina, Bhutan, Botswana, Egypt, Georgia, Honduras, Ireland, Kenya, Indonesia, and others. While encountering a field instrument with such a specification might seem unlikely, it is, in fact, very likely.

Consider the complex export circumstances for small thermal cameras that can be mounted on UAVs. Two of the vendors of such cameras, FLIR and Sierra-Olympics, provide detailed information on the export options for their different systems at http://www.oemcameras.com/export_conditions and https://www.sierraolympic.com/images/uploads/documents/SOTI_Export_Guidelines_140701_v02.pdf. For example, FLIR manufactures two versions of their small (UAV compatible) thermal systems, which uses their Tau 2 sensor. One has a frame rate of 7.5Hz and one 30Hz. The rate indicates the refresh rate of the video. The 30Hz unit has an ECCN of 6A003.b.4.b and is export controlled with restrictions to many countries. The 7.5Hz unit, in contrast, has an ECCN of 6A993 and can be exported to most countries, excepting Cuba, Iran, Libya North Korea, Sudan, and Syria. Sierra-Olympics also has two options with similar restrictions.

With approval, even restricted thermal systems can be exported to the 36 Strategic Trade Authorized (STA) countries—these

https://doi.org/10.1017/aap.2017.24 Published online by Cambridge University Press

are Argentina, Austria, Australia, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, South Korea, Latvia, Lithuania, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom.

Encryption Methods Used in Software and Its Restrictions

A special category of a controlled "item" is software, especially software that includes encryption. The BIS restricts export of encryption software that has special properties, such as a 64-bit key length. It is sometimes the case that encryption is embedded in otherwise common software. In the past, this has been a more significant challenge than it is today due to 2016 changes in the international agreements (called the Wassenaar Arrangement). In most situations, today's "mass market" software with encryption capabilities is not export restricted. If using specialized software, confirm with the manufacturer/vendor that no restrictions are in place.

Again, we emphasize that, while there are many resources for the end user, the most effective strategy is to contact the manufacturer. Prior to purchasing any high-tech device that you think may be used overseas, you should contact the manufacturer/vendor to obtain the ECCN and their advice on export.

SHIPPING AND BAGGAGE

When the equipment is modest in size and weight, the best alternative is to have it travel with the team as luggage. A key factor will be the durability of the device. Luggage in a cargo hold may receive considerable abuse, including shocks and drops. Contact the manufacturer to see what limits may apply. Instruments are commonly shipped in special protective cases (e.g., Pelican). While these are effective, be aware that such cases, especially when new, are an advertisement that a valuable item is inside. Whenever possible, use old, beaten-up luggage and place the cases inside. It may be that the item can be part of carry-on. If the standard case is too large for carry-on, it is possible to make specialized foam bags to enclose just the sensitive instruments and meet carry-on restrictions.

Airline baggage rules may substantially affect transport of instruments. Using Delta as an example, at the time of this writing, the standard economy fare weight limit is 50 pounds on international flights, and there is a limit of one free bag. The second bag is $40–$100, depending on destination, and the third through tenth are each $200–$285. Bags weighing more than 50 pounds but less than the maximum of 70 have an additional fee of $100 when traveling economy. Bags that are larger than 62 inches in combined dimensions (w+h+l) will cost an additional $175–$300, depending on destination. No bag may be more than 80 combined inches. If flying first class, however, the standard weight limit is 70 pounds, the size limit is 80 inches, and three bags are allowed at no cost. Remembering that the costs are for two ways, traveling on a first-class ticket can save luggage fees of up to around $2,500 if three large, heavy bags are needed for the equipment. Members of a premium traveler class can have a second checked international bag at no cost. Holders of the airline-branded special credit cards can increase the weight limit to 70 pounds, and each of up to eight individuals can also have two bags of 70 pounds, if booked at the same time. Other airlines have different rules; be aware of all the fees and policies before booking.

There is also only limited insurance possible for airline baggage. The maximum default international coverage is approximately $1,200. It is possible to purchase up to $5,000 coverage for additional fees. In planning, don't forget the challenges of moving multiple bags through an airport. It may be necessary to have multiple staff members involved. (We have encountered situations in which it was cheaper to purchase an additional airline ticket for an additional staff member, effectively as a "mule" carrying more luggage, than to pay standard shipping on the equipment.)

When the size of the instrument(s) precludes treating it as luggage, then international shipping is the only option. In such a case, it is very likely that a carnet will be needed, as well as interactions with a company that provides the necessary destination customs interactions. This may add substantially to the cost of shipping.

One last obstacle for shipping and baggage is the proliferation of lithium-ion and lithium-polymer rechargeable batteries used by these instruments. These particular batteries are problematic, due to the potential for fire and explosion. It is essential to check on the latest rules on this subject, as changes have been fairly frequent, and ignorance may result in your ending up in another country with hundreds of thousands of dollars' worth of equipment and no way to power it. As of September 2016, the FAA breaks these batteries into two permissible categories: consumer-sized batteries (up to 100 watt hours [Wh] per battery), and "larger" or "professional" batteries (101–160 Wh per battery). Many batteries are sized by ampere hours (Ah) rather than watt hours; to convert Ah to Wh, just multiply Ah by the voltage (V). If they are marked in milliampere hours (mAh), simply divide by 1,000 and then multiply by voltage. Batteries up to 100 Wh may be carried in checked baggage *only* if they are installed in the electronic devices that they power; no spare batteries at all are allowed in checked luggage. In carry-on luggage, spare consumer-sized batteries (up to 100 Wh) are permitted as long as they are protected from damage and short circuits. *With airline approval*, up to two larger batteries (101–160 Wh) may be brought in carry-on luggage, as long as they are protected from damage and short circuits. The larger batteries are not permitted in checked baggage at all. See https://www.faa.gov/about/office_org/headquarters_offices/ash/ash_programs/hazmat/passenger_info/media/airline_passengers_and_batteries.pdf. If you are flying a non-US airline, be sure to check their rules and regulations.

Insurance

Insurance may cover the equipment against loss, theft, and as many perils as possible. There are many options for such insurance, but a key factor is the country coverage. Most insurance

https://doi.org/10.1017/aap.2017.24 Published online by Cambridge University Press

companies will either not cover a loss in defined countries or charge a substantially higher fee. The list of countries is company specific, but is usually lengthy. One company's list has dozens of excluded regions, including Azerbaijan, Belize, Cambodia, Gambia, Sri Lanka, Tanzania, and parts of Turkey. Many universities have self-insuring policies. This means that any loss is made up by internal funds. These policies often have complex structures, and the unsuspecting archaeologist may find that his or her department is on the hook for a substantial amount if a device is lost.

CONCLUSION

It should be clear that traveling with high-tech field equipment requires considerable planning, starting at the beginning with purchasing decisions. Manufacturers are a key resource and should be contacted early in the process. Deciding on how to move the equipment requires a careful calculation of factors such as size and weight and may require "out of the box" thinking when booking travel. Though they may present travel complexities, the advantages of such devices are great and growing. One option that should always be considered is purchasing or leasing equipment in-country. Collaborations with local archaeologists, in which they are also able to use the devices after you have returned home, are particularly beneficial to both parties. For good or for ill, archaeologists can no longer simply put a trowel, camera, boots, and a clipboard in a backpack and leave for distant lands.

Data Availability

All resources discussed are accessible on the web.

REFERENCE CITED

Casana, Jesse, John Kantner, Adam Wiewel, and Jackson Cothren
2014 Archaeological Aerial Thermography: A Case Study at the Chaco-Era Blue J Community, New Mexico. *Journal of Archaeological Science* 45 (May):207–219. doi:10.1016/j.jas.2014.02.015.

AUTHORS INFORMATION

William F. Limp ■ Geosciences Department and Center for Advanced Spatial Technologies, University of Arkansas, Fayetteville, AR 72710 (flimp@uark.edu)

Malcolm D. Williamson ■ Center for Advanced Spatial Technologies, University of Arkansas, Fayetteville, AR 72710 (malcolm@cast.uark.edu)

https://doi.org/10.1017/aap.2017.24 Published online by Cambridge University Press