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Human Engineering Design Criteria Standards Part 2: Methodology and Interview Results

FY10-14 DHS S&T TSD Standards Project

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EXECUTIVE SUMMARY

The Department of Homeland Security (DHS) requires general human systems integration (HSI) criteria for the design and development of human-machine interfaces for the technology, systems, equipment, and facilities employed by its user population. HSI is the relationship between humans and their environment and in particular how systems are designed and used relative to that relationship with the goal of ensuring a safe and effective environment that meets the mission. In general, HSI includes the integration of hardware, software and processes (including the acquisition process and the design process).

However, systematically adopting and applying HSI criteria within DHS may pose a challenge because of the Department's large and extremely varied user population. The DHS personnel who operate and maintain the department's technology and systems carry out a variety of different tasks in operating environments ranging from airports and border points of entry to subways and Coast Guard vessels. Other DHS users include public health officials; state and local first responders; travelers to be screened; bystanders; and the general public.

In this phase of the effort, NIST applied a user-centered design (UCD) approach for the DHS organization in order to determine how existing HSI standards identified in the prior phase can be mapped to DHS needs, technology, and processes. Researchers identified core, high-impact processes performed by different DHS directorates, then interviewed and (when possible) "shadowed" end users who performed those tasks. The information collected during the interview process allowed the team to identify the feature sets (e.g., device interface characteristics) of the equipment used by end users, map those features to existing HSI standards, and begin to identify any gaps not addressed by those standards.

The results of this study highlighted five areas of critical need for HSI standards related to interfaces:

1. Real-time non-local software applications, which are vital to many of the tasks performed by DHS end users.
2. Hand-held and mobile devices, such as smartphones and tablet computers, which many interviewees identified as being critical to mission success in the future.
3. Touch interfaces, which are the default means of interaction with almost all contemporary mobile devices.
4. Interfaces for biometric collection devices, in terms of usability and language-independent symbols for multi-cultural user populations.
5. Accessibility for both DHS agents and the populations with whom they interact; this applies to Web pages, application interfaces, and biometric collection processes.

Finally, DHS could benefit from incorporating HSI and human-centered design standards (such as ISO 9241-210, ISO/IEC TR 25060, and ISO/IEC 25062) into its technology development and acquisition processes. Doing so will ensure that DHS equipment and processes are appropriate to their context of use, which in turn will help the Department's end users complete their tasks more efficiently and effectively, with fewer adverse effects to their health and safety; increase accessibility and sustainability; and increase user satisfaction as a whole.

1 INTRODUCTION

The Department of Homeland Security (DHS) requires general human systems integration (HSI) criteria for the design and development of human-machine interfaces for their technology, systems, equipment, and facilities. The goal of the DHS Science & Technology (S&T) Human Factors and Behavioral Science Division Human System Engineering Project is to identify, develop, and apply a standard process to enhance technology and system design, system safety, and operational efficiency.

The project manager partnered with the National Institute of Standards and Technology (NIST) Visualization and Usability Group (VUG) in furtherance of this effort.[1] As part of its mission, NIST performs research to develop the technical basis for standards related to measurement, equipment specifications, procedures, and quality control benchmarks for industrial processes (among others), for organizations and users in industry, academia, government, and other sectors, while remaining objective and vendor-neutral. VUG, part of the NIST Information Technology Laboratory, conducts research in HSI and human-computer interaction (HCI) technologies. Members of VUG are also active on the International Organization for Standardization (ISO) Technical Committees Working Groups in HCI.

NIST's work on this project consists of three phases:

1. Identify and review the body of publicly available existing human factors and HSI standards, best practices, and guidelines for applicability to DHS.
2. Apply a user-centered design (UCD) approach for the DHS organization in order to determine how existing HSI standards can be mapped to DHS needs, technology, and processes.
3. Determine where DHS may need to augment existing HSI standards and/or create new DHS HSI standards to meet organizational needs.

Simply put, HSI is the relationship between humans and their environment and in particular how systems are designed and used relative to that relationship with the goal of ensuring a safe and effective environment that meets the mission. In general, HSI includes the integration of hardware, software and processes (including the acquisition process and the design process).

HSI design criteria, principles, and practices will benefit DHS by:

- improving performance of personnel,
- reducing skill and personnel requirements and training time,
- enhancing the usability, safety, acceptability and affordability of technology and systems, and

[1] S&T also sponsored NIST's work on the Human System Engineering Project.

- achieving the required reliability and productivity of personnel-equipment combinations [2][12].

But most importantly for DHS, HSI Design Criteria Standards will foster design standardization and interoperability within and among DHS systems.

2 BACKGROUND

In Phase 1 of this project, the NIST team identified and reviewed the body of existing human factors and HSI standards, best practices, and guidelines, with the goal of later mapping these standards to DHS needs, technology, and processes. The mapping exercise would also help the NIST team identify where DHS may need to augment existing HSI standards and/or create new standards to meet organizational needs.

HSI emphasizes human considerations as the top priority in systems design/acquisition to reduce life cycle costs and optimize system performance [13]. Essentially, HSI is the relationship between humans and their environment – particularly how systems are designed and used relative to that relationship with the goal of ensuring a safe and effective environment that meets the mission. Generally HSI includes the integration of hardware, software and processes (including the acquisition process and the design process). In short, HSI is about improving the usability of technology. The International Standards Organization (ISO) defines usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" [4].

Although numerous Federal standards exist that establish general HSI and human engineering criteria for design and development of systems, equipment, and facilities (including DoD MIL-STD-1472G Department of Defense Design Criteria Standard and NASA-STD-3000 Man-Systems Integration Standards, among others), each of these standards also contains very domain-specific information and focuses on specialized populations, types of systems, and system functions.

In contrast, the DHS user populations' characteristics are varied. The populations encompass not only Federal civil servants who operate and maintain the department's technology and systems, but also a variety of other personnel, including public health officials; state and local first responders; travelers to be screened; bystanders; and the general public. Therefore DHS must consider a much broader range of user dimensions, characteristics, abilities, and ages than those populations addressed by the existing standards. DHS operating environments are also very diverse, ranging from airports and border points of entry to subways and Coast Guard vessels. Thus the existing standards may not be applicable based on differences in the populations and specific domains or context of use.

The NIST team's goal for this phase of the project was to identify and interview selected DHS end users of a critical, selected process for each DHS directorate. In doing so, the team expected to better understand the process and to identify the main tasks within the scope of the process, the technologies and devices used to complete those tasks, issues or problems associated with completing those tasks, technology-related opportunities to improve those tasks. The

information collected during the interview process allowed the team to identify the feature sets (e.g., device interface characteristics) of the equipment used by the end users involved in those processes, map those features to existing HSI standards, and begin to identify any gaps not addressed by those standards.

3 METHODOLOGY

This section describes the approach and methodology used to gather information on DHS needs, technologies, and processes.

3.1 APPROACH

Putting together a detailed picture of what a particular product will be used for, how, by whom, and where, is critical to HSI. It is also the first step in the user-centered design (UCD) process, which, like HSI, is based upon the principle that human considerations should drive technology design and acquisition. Essentially, these human considerations are:

1) what tasks the target end user population performs;
2) the processes, technologies, and devices they use; and
3) the context of use in which they operate.[2]

For purposes of this study, the elements in the context of use include: the subject of the context of use description (e.g., a product, system, or service, as well as its purpose and summary of preconditions); user groups, goals, tasks, and environments.

The UCD approach, while appropriate for the purposes of this project, is time- and resource-intensive even when conducted on a small scale; in contrast, the scope of this project included the operations within all DHS directorates. Therefore, this review employed a modified version of the approach. The scope of the review is limited to core, high-impact DHS operations that could potentially benefit the most from the application of existing and new standards, particularly specialized "off-the-desktop, out-of-the-office" processes that were unlikely to be addressed by standards for tasks, systems, and applications associated with more generic office operations.

The goal of this approach was to develop a "landscape view" of the tasks involved in the identified core high-impact processes and, in turn, the personnel roles and equipment used to carry out those tasks. The research team, based on its human factors background and expertise, determined that the most effective method of task analysis available to was to interview end users – in other words, DHS employees who carried out the tasks associated with the processes selected for review. The interviewees walked members of the research team through their

[2] The draft International Standard (DIS) ISO/IEC 25063: Systems and software engineering – Systems and software product Quality Requirements and Evaluation (SQuaRE) – Common Industry Format (CIF) for usability: Context of Use Description "specifies the contents of both high-level and detailed descriptions of context of use for an existing, intended, designed or implemented system. The context of use description is applicable to software and hardware systems, products or services." [7]

particular tasks and work processes [3]. When possible, researchers also observed the interviewees at work. The context of use elements described above served as the driving factor for the data collected by interviewing and "job shadowing" end users.

As illustrated in Figure 1 below, the landscape view the researchers developed for each process provided a basis for compiling an associated feature set – the set of interface features for the equipment used in the process.

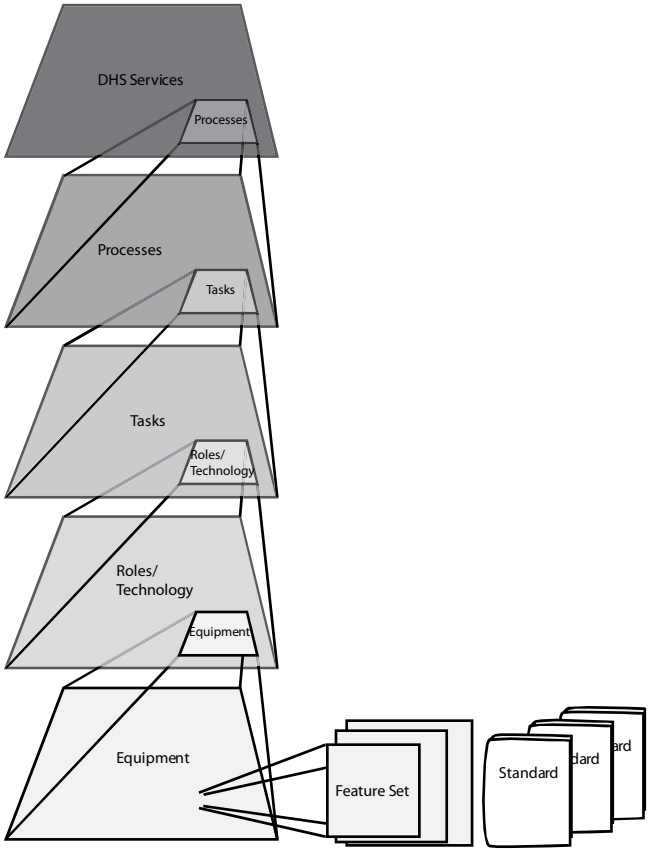

Figure 1: Landscape View of Feature Set

Developing a feature set for a given process made it possible to effectively and appropriately map existing standards (specifically, those identified in Phase 1) to that process, and identify gaps where existing standards will need to be tailored to meet the needs of DHS or entirely new standards may be required.

3.2 IDENTIFYING DHS PROCESSES AND END USERS

This subsection describes how the research team employed a technique called concept mapping to better understand the DHS organization and its structure, and how the team subsequently selected and identified end users from each directorate to interview.

3.2.1 Concept Maps

Generally speaking, concept maps are graphical tools used for organizing and representing knowledge. Nodes or concepts (e.g., ideas, images or words) are usually represented as boxes or circles, with connecting lines representing the pertinent relationships between and among them. A well-made concept map is developed within a context frame defined by an explicit "focus question" or area of interest.

The NIST team created a series of concept maps representing the DHS organizational structure, high-level processes, and end users associated with those processes. The maps provided an interactive visual representation of the DHS organization, relationships between directorates, and end users. Each organizational unit is represented by a clickable box link. These links allow one to "drill down" from the directorates to their component divisions to the offices within them and so forth. For example, clicking on a box for the Office of the Secretary would display the divisions within (e.g., Privacy Office, Office of Legislative Affairs).

The concept map in Figure 2 shows the hierarchical relationship of directorates within the DHS organization.

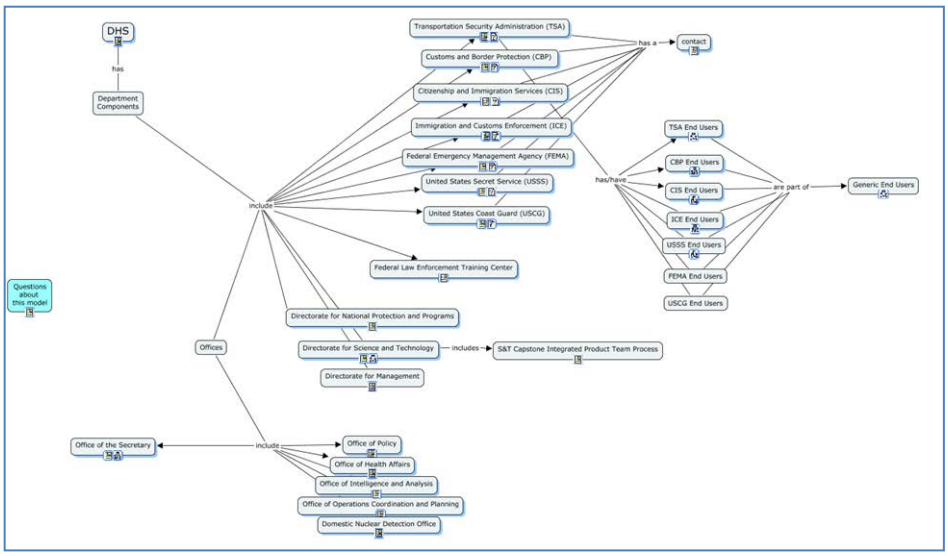

Figure 2: A Concept Map of the DHS Organization

The concept mapping technique provided a mechanism to organize vast amounts of information in an easily retrievable manner. The maps were useful as an aid in understanding the relationships among various directorates, offices, and end users within DHS, while also providing a visual representation of that information to facilitate discussions regarding these concepts.

3.2.2 Selecting Processes for Review

The Department of Homeland Security has many offices and directorates, each with varied and numerous responsibilities to secure the nation from the many threats facing it. Working with the

DHS Human Factors/Behavioral Sciences Division program manager, the research team identified the offices and directorates within DHS that have operational processes where the application of existing and new standards are expected to be of benefit. The identified directorates included:

- U.S. Citizenship and Immigration Services (USCIS)
- Transportation and Security Administration (TSA)
- U.S. Coast Guard (USCG)
- Customs and Border Protection (CBP)
- U.S. Immigration and Customs Enforcement (ICE)
- Federal Emergency Management Agency (FEMA)
- U.S. Secret Service (USSS)

DHS liaison and supervisory staff worked together with members of the NIST team to identify and select candidate processes, typically one (although sometimes two or three) from each directorate. DHS staff then provided the NIST team with contact information for DHS personnel, who the team could then iterview regarding each selected process and its associated equipment requirements and context of use.

In some cases, the interviews with the initial points of contact in each directorate provided the NIST team with contact information for and access to more appropriate contact personnel, with whom subsequent interviews, observations, or tours were scheduled, e.g., TSA, USCIS, CBP. In other cases, the initial interviews provided the necessary information regarding the appropriate DHS end users and tasks, e.g., FEMA, USCG. A list of contacts for each directorate is available in **Appendix C**.

3.3 INTERVIEW PROTOCOL

The primary methodology used in this study was an interview guided by a questionnaire, provided in **Appendix A**. The questionnaire was developed by NIST personnel and vetted through contacts at DHS prior to subsequent end-user interviews. The questionnaire was intended to identify:

- the main tasks performed by the end users that were interviewed;
- the context of use in which users performed those tasks;
- the technologies, devices, sub-processes, and sub-tasks users employed to complete those tasks; and
- any technology-related challenges or opportunities the users perceived in regards to those tasks.
- As mentioned in **Sec. 3.1**, these interviews were supplemented with “job shadowing” when possible.

The NIST team identified the human interface components for each technology device type interviewees reported using. The interview data is summarized in **Sec. 4**. Once the equipment was identified, the mapped that equipment and its associated interface features to relevant, existing standards. The mapping of equipment to standards is given in **Sec. 5.2**. A more detailed mapping of equipment with component features to standards is provided in **Appendix B**.

Similarly, these data mappings provide an avenue to identify the gaps in existing standards for reported equipment components. **Sec. 6** summarizes and discusses the findings of this review.

4 INTERVIEW RESULTS BY ORGANIZATION

This section summarizes the information gathered during the interviews described in the previous section. With the assistance of DHS personnel, the NIST team investigated processes from the following directorates:

- U.S. Citizenship and Immigration Services (USCIS)
- Transportation and Security Administration (TSA)
- U.S. Coast Guard (USCG)
- Customs and Border Protection (CBP)
- U.S. Immigration and Customs Enforcement (ICE)
- Federal Emergency Management Agency (FEMA)
- U.S. Secret Service (USSS)[3]

Using the methodology described in the previous section, the NIST team collected the following information:

- Organization name
- Process overview
- Process use, i.e., how often the process is executed
- Tasks and users
- Equipment used with context of use, e.g., environmental and special operating conditions
- Technology-related challenges and process-improvement opportunities

Given the diversity of operations conducted by different DHS directorates, the final data collection process varied somewhat from directorate to directorate. For instance, data gathering from FEMA, USCG and ICE took the form of a series of interviews with high-level stakeholders and field supervisors at their offices. Information collected from CBP included interviews with supervisors at their offices and with CBP agents on the NIST campus. TSA data collection consisted of interviews with supervisors and transportation security officers (TSOs) as well as tours designed to provide direct examples of the processes used and challenges faced in the field. USCIS information collection included interviews with high-level personnel and supervisors, as well as direct observations at a USCIS Service Center. Futher, all information gathered was the result of a relatively few interviews per process and the data presented here is meant to represent the landscape view, and is not to be interpreted as an exhaustive study of each process.

The following subsections summarize the interview information collected from each of the selected directorates within DHS.

[3] Secret Service end users were not available to participate in this study.

4.1 U.S. CITIZENSHIP AND IMMIGRATION SERVICES (USCIS)

The U.S. Citizenship and Immigration Services (USCIS) oversees lawful immigration to the United States. Globally, USCIS has 250 offices and over 18,000 employees. USCIS provides avenues for legal immigration into the United States, through services provided online, over the telephone, and at physical service centers. The directorate processes applications for, and issues, credentials such as visas, green cards, and passports. In addition, USCIS processes applications for U.S. citizenship.

4.1.1 Process Overview

The review focused on the USCIS process of collecting biometric information from applicants for U.S. benefits, i.e., visas or Green Cards. In 2011, USCIS collected biometric data from 2.9 million applicants. This process is typically performed at USCIS service centers, such as the USCIS Application Support Center in Wheaton, MD, where staff demonstrated and walked the research team through the process.

The process begins when an immigrant applicant contacts USCIS and receives an application via USPS mail, along with an appointment to visit the nearest support center. When the applicant arrives, he or she presents identification (ID) and the completed application to a guard. The guard checks the applicant's ID, application, and appointment time. If there are no problems, the guard gives the applicant a number and advises him or her to have a seat in the waiting room.

When the applicant's number is called, the applicant submits his or her identification and paperwork to a receptionist. The receptionist directs the applicant to the next available biometric capture station. The USCIS agent manning the biometric capture station scans the barcode located on the application and then directs the applicant's biometric information collection. This biometric information consists of the applicant's photograph, signature, and full set of fingerprints. The fingerprints are captured both electronically – using a scanner – and by "roll," using ink and paper.

4.1.2 Tasks and Users

Immigrant applicant

- Request USCIS application and appointment
- Attend appointment with completed application and valid ID
- Present hands for fingerprints on the fingerprint scanner
- Present hands for inked fingerprints
- Pose for face photograph
- Sign signature pad

Guard

- Verify applicant's application and identification paperwork

USCIS Agent

- Complete the data entry taken from applicant paperwork
- Explain the biometrics capture procedure
- Capture the applicant's slap fingerprints electronically
- Capture the applicant's rolled fingerprints manually using ink
- Capture a digital photo of the applicant's face
- Instruct applicant to sign the signature pad

4.1.3 Equipment and Context of Use

Equipment:

- Digital camera
- Computer with customized enrollment software (for USCIS agents)
- Keyboard (no mouse)
- Monitor
- Fingerprint capture device
- Electronic signature pad
- Fingerprint cards and ink (for rolled inked prints)
- Barcode scanner
- Workstation with applicant seating (for applicants)

All centers have the same equipment. Each center also has a biometric capture station that is accessible for children and applicants in wheelchairs. The environmental conditions at the centers are those of an indoor setting.

4.1.4 Interviewee Reported Challenges and Opportunities

During the interview, USCIS agents reported that most tasks within the application process are completed manually and some of the paper tasks could be performed electronically. They noted that even before the biometric collection process begins, the citizenship application and appointment time must be mailed to the applicant. One interviewee suggested that replacing or supplementing the manual process with some type of electronic process – such as providing web-style application submission and appointment selection features – would reduce the burden of the current paper-intensive process on center employees and applicants.

4.2 TRANSPORTATION AND SECURITY ADMINISTRATION (TSA)

The Transportation Security Administration (TSA) is charged with safeguarding the Nation's transportation systems. To protect freedom of movement for the traveling public as well as commerce, TSA screens all commercial airline passengers and baggage, while also screening air cargo, in order to identify potential threats.

TSA employs close to 50,000 Transportation Security Officers (TSOs), who are stationed at the more than 450 airports nationwide and screen approximately 1.7 million passengers each day. Additionally, TSA employs 2,800 Behavior Detection Officers, 400 TSA explosive specialists,

thousands of Federal Air Marshalls, and 800 explosive detection canine teams. To date, approximately 500 advanced image technology machines are deployed at airports nationwide. TSA also screens 100 percent of the cargo transported on domestic and international-bound passenger aircraft.

In TSA's case, there were two related processes that fell within the scope of the review: first, the process for screening passengers and their carry-on items, and second, the process for screening their checked baggage.

4.2.1 Passenger and Carry-On Item Screening

4.2.1.1 Process Overview

The passenger process begins when a traveler presents his or her ticket and ID to the TSO at the security check-in line at an airport on the way to the departing flight. The TSO checks the passenger's ID with a black light to verify that it is valid. The TSO then verifies the boarding pass for matching ID information.

The passenger proceeds to the X-ray scanner, where he or she places all carry-on objects on the x-ray scanner belt and proceeds to the next TSO agent. The TSO agent determines whether or not to send the passenger through a body image scanner (where available) or metal detector.

While the passenger is being scanned, his or her carry-on objects are X-rayed for prohibited objects and substances. If the luggage scanner operator detects any items that may be prohibited, he or she alerts another TSO agent to search the carry-on item (after obtaining permission from the passenger), swab the carry-on for explosive trace detection, or use a liquid scanner, as appropriate to the situation.

4.2.1.2 Tasks and Users

Traveler

- Present ID and ticket to TSO at security area
- Deposit all carry-on objects in bin on conveyor belt
- Walk through whole body imaging or metal detector
- Collect carry-on objects and proceed to gate

TSO – Passenger and carry-on check

- Verify traveler's ID and ticket information with black light
- Scan carry-on luggage as it passes through x-ray machine
- Swab suspicious carry-on objects for chemicals and/or explosives and process in chemical detector
- Check any suspicious liquids in carry-on objects for dangerous, hazardous, and/or prohibited liquids using liquid scanner
- Observe passengers as they walk through the metal detector or whole body imaging devcies

- If the walk-through metal detector alarm sounded, scan passenger with hand-held metal detector

TSO –Remote whole body imaging

- Examine the whole body scan image for suspicious areas
- Alert TSO at passenger check point if suspicious areas are detected

4.2.1.3 Equipment and Context of Use

Equipment:

- Hand-held black light
- Walk-through metal detector
- Hand-held (wand) metal detector
- Whole body image scanner, with monitor
- Monitor for carry-on luggage scanner (single or dual)
- Chemical detection device
- Swab and explosive trace detection scanner
- Liquid scanner to check for any dangerous, hazardous, and/or prohibited liquids
- Cast and prosthesis scanner
- Keyboard
- Software
- X-ray scanner

The airport environment is indoors with typical heating/cooling/lighting. Conditions can be noisy and dusty. A conveyer/scanner station includes the conveyance table(s), scanner, scanner monitor(s), keyboard, conveyer and scanning controls, and associated software. A podium may also be used by TSOs when checking tickets and IDs. Except for the remote (i.e., whole-body imaging) scanning, routine scanning is performed in a public setting.

4.2.2 Checked Baggage Screening

4.2.2.1 Process Overview

Scanning checked luggage is typically an automated procedure unless anomalies are encountered. Circumstances at purchase or ticketing can flag baggage for additional scrutiny, e.g., baggage associated with a one-way ticket or a ticket that was purchased with cash. Additionally, if the automated scanning process detects suspect areas within a piece of baggage, that item is also flagged for further screening. Flagged luggage is subjected to additional x-ray or computed tomography (CT) scans, depending upon the available scanners, and possibly manual checks using explosive and chemical detectors and liquid scanners, as the situation dictates.

4.2.2.2 Tasks and Users

Traveler

- Check lugguage at ticketing counter

TSO

- Scan luggage as it passes through x-ray machine
- Manually search any suspicious lugguage: swab to detect chemicals, test any suspicious substances with liquid and/or explosive detection scanner as appropriate

4.2.2.3 Equipment and Context of Use

Equipment:

- Monitor for luggage scanner (single or dual)
- X-ray or CT scanner
- Barcode scanner
- Swab and explosive detection scanner
- Chemical detection scanner
- Liquid scanner to check for any dangerous, hazardous, and/or prohibited liquids
- Keyboard
- Software

The airport environment is indoors with typical heating/cooling/lighting. Conditions can be noisy and dusty.

4.2.3 Interviewee Reported Challenges and Opportunities

Interviewees reported that one of the biggest challenges was the differences in equipment intended for the same task. Not only did equipment vary from airport to airport, but also within the same airport inspection area between inspection lines. Some of the most common variations are fairly mundane, such as the monitors used for carry-on luggage scans. Some monitors are old, some are single, and some are dual – dual monitors have a distinct advantage in helping to reduce error rates because they provide sufficient screen real estate to allow multiple views of the same object from different angles.

Another concern expressed was the battery life for the black lights used for ID scans. TSO agents wanted the option to tether the black lights to an outlet to eliminate this problem.

Finally, interviewes expressed concerns about testing of equipment in labs versus the the working environement. For instance, some of the equipment used for security scanning, e.g., puff machines for trace detection, worked well in the lab but were never tested in a working environment, where dust later proved to be an issue.

4.3 U.S. COAST GUARD (USCG)

The U.S. Coast Guard is the only military organization within DHS. Its mission is to safeguard the Nation's maritime interests by protecting the maritime economy and environment, defending the Nation's maritime borders, and saving those in peril.

As part of that mission, the Coast Guard is tasked with enforcing immigration laws at sea. To do this, the USCG conducts patrols and coordinates with other Federal agencies and foreign countries to interdict undocumented migrants at sea, denying them entry via maritime routes to the U.S., its territories, and possessions. The USCG is also responsible for drug and explosives interdiction. Additionally, the USCG oversees the High-Interest Vessels (HIV) program, which is part of a larger, multifaceted effort to improve the USCG's ability to identify and respond to vessels, cargoes, and crews that might pose security risks to the U.S. HIVs are processed offshore before entry into a U.S. port facility is granted.

In this review, the NIST team examined the three processes described above, specifically:

- Interdiction of undocumented migrants at sea
- Drug and explosive interdiction
- Processing of HIVs

4.3.1 Alien Migrant Interdiction

4.3.1.1 Process Overview

Tasks related to the interdiction of possible aliens found at sea near U.S. borders involve a USCG patrol cutter with approximately 16 crew members. When the crew suspects that a vessel is transporting illegal aliens, the cutter dispatches a small inflatable boat to bring the aliens to the cutter for processing. Once on board the cutter, each detainee is given a numbered wristband. Food, water and medical attention are provided as appropriate. The detainees are interviewed. The results are recorded in a hand-written log. Detainees also have their biometric information collected, in the form of two index fingerprints and a facial photo. The collected information is transferred to a laptop and a portable hard drive, and e-mailed to the command center for processing. The command center determines the port where each detainee is to be taken depending on whether the detainee 1) needs urgent medical care, 2) will be held for U.S. prosecution, or 3) released to their country of origin. This information is relayed to the cutter via telephone or radio.

The USCG reported 2,474 migrant interdictions in 2011.

Equipment:

- Biometric capture kits[4] consisting of:

[4] There are typically two kits on board; one primary and one backup.

    - Laptop
    - Fingerprint capture device
    - Camera
- Keyboard

The operating environment is shipboard: in other words, ocean going ships in motion, with ambient conditions such as salt water spray, all types of weather including bright sunshine (glare) and foul weather (moisture and humidity), night operations (darkness), and temperature extremes (heat and cold). Smaller, inflatable boats are used to transport detainees to the cutter for processing.

The typical Migrant Interdiction Unit member's equipment includes: backpack, life jacket, flak jacket (for use on an inflatable boat – the boat to transport detainees), weapon(s) and weapon belt. Some personnel also wear gloves, potentially impacting interface operation of some devices.

4.3.2 Drug and Explosive Interdiction

4.3.2.1 Process Overview

If a ship is suspected of carrying drugs or explosives, USCG crew members access the ship (using smaller craft or helicopters) to verify the ship's cargo and personnel manifest, as well as take swipes (samples) using swabs, place them in plastic bags and take them back to the cutter to test for narcotics or explosives using an ion scanner. If necessary, crew members will use bore scopes to ascertain if the cargo contained in the ship's hold(s) is contraband. If drugs, explosives, or other contraband are detected, the crew is detained and the contraband is confiscated.

The USCG reported for 2011 that it apprehended 205,000 pounds of narcotics, detained 191 suspected smugglers, and in 40 vessel interdictions removed 75 metric tons of cocaine and 18 metric tons of marijuana.

4.3.2.2 Tasks and Users

Coast Guard Personnel

- Swab suspected object for drugs or explosives and place swipe into plastic bag
- If unable to access hold, drill holes in vessel tanks using bore scope to check voids

4.3.2.3 Equipment and Context of Use

Equipment:

- Chemical detection device
- Explosive trace detection device
- Ion scanner (for explosive and narcotics detection)
- Bore scope

The operating environment is shipboard: in other words, ocean going ships in motion, with ambient conditions such as salt water spray, all types of weather including bright sunshine (glare) and foul weather (moisture and humidity), night operations (darkness), and temperature extremes (heat and cold).

The typical Drug and Explosive Unit member's equipment includes: backpack, life jacket, flak jacket (for use while accessing the vessel undergoing testing), weapon(s) and weapon belt. Some personnel also wear gloves, potentially impacting interface operation of some devices.

4.3.3 Processing High-Interest Vessels

4.3.3.1 Process Overview

U.S. regulations require that all U.S. and foreign commercial vessels over 300 gross tons and all vessels carrying certain dangerous cargo must submit a Notice of Arrival (NOA) to the National Vessel Movement Center at least 96 hours prior to arrival at a U.S. port. The Notice of Arrival contains information regarding the vessel identity, ownership and vessel operator, description of the cargo, crew information including identity, nationality, passport information, ship position and duties and where the crew member embarked, and finally, passenger identity information, if any passengers are on-board.

Once the NOA is submitted, typically by the shipping company, the USCG reviews the attached crew member list and checks the crew members' visas or C1/Ds[5] against the submitted crew manifest and biography information. The crew also checks this information against databases containing information on persons of interest.

At a scheduled meeting prior to the ship's anticipated arrival at port, a 4 to 8 person USCG enforcement unit meets the HIV off-shore. The enforcement unit travels to the HIV in a small boat or helicopter while an armed USCG support vessel remains in the area. After boarding, the unit does a safety exam, accounts for the crew members, verifies the notice of arrival, investigates any intelligence or law enforcement concerns, collects information to assist in determining whether to permit the vessel to enter the port, and verifies the cargo. The portion of the larger HIV screening process that was the focus of the interview was the aspect that pertained to reviewing personnel identity documents and screening the ships' crew and passengers.

The USCG reported that 28.7 million crew members and passengers were screened prior to entry in U.S. ports in 2011.

4.3.3.2 Tasks and Users

Shipping company personnel

- Provide NOA to the National Vessel Movement Center

[5] Non-immigrant visa.

Crew members and passengers

- Provide identity document(s)
- Participate in screening

Coast Guard personnel

- Prior to boarding the HIV:
    - Review crew members'/passengers' visa or C1/Ds
    - Verify biographies against crew mainifest
    - Check for persons of interest in other databases
- On arrival at HIV off-shore, verify crew and passenger identities for conditional entry

4.3.3.3 Equipment and Context of Use

Equipment:

- Computer
- Keyboard

The operating environment is shipboard: in other words, ocean going ships in motion, with ambient conditions such as salt water spray, all types of weather including bright sunshine (glare) and foul weather (moisture and humidity), and temperature extremes (heat and cold).

The typical HIV unit member's equipment includes: backpack, life jacket, flak jacket (for use while accessing the vessel undergoing screening), weapon(s) and weapon belt. Some personnel also wear gloves, potentially impacting interface operation of some devices.

4.3.4 Interviewee Reported Challenges and Opportunities

Interviewees reported that they have many environmental issues that impact their ability to process detainees and to complete their tasks. Specifically, they reported the following issues:

- Collecting nighttime photographs is made difficult by the lack of an adequate flash
- The platen on the fingerprint scanner used in the biometric capture kit can fog if the glass is cold and the outside temperature is too hot, Additionally, it accumulates dirt quickly
- Glare on the fingerprint scanner platen affects usable fingerprint capture, requiring the platen to be shaded
- All portable devices must have a tether
- All portable equipment needs to withstand falls of six feet
- All equipment needs to have a long battery life and be easily rechargeable
- Size and space for storage is extremely important due to storage constraints on the vessel

Interviewees highlighted the following opportunities for process improvement:

- Improve biometrics processing results turn-around times to reduce crews' threat risk by questionable detainees

- Deploy facial recognition software for biometric collection process
- Improve biometric capture devices with language-independent symbols
- Develop and deploy an improved fingerprint scanner platen that does not require cleaning or can be cleaned easily

One of the largest overarching issues highlighted by interviewees was the testing of equipment in the workplace environment prior to purchase or a user-centered design (UCD) process with end-to-end testing, providing realistic context of use while testing. The interviewees said that all equipment needs to be tested for vibration, falls and drops, and waterproofing before being deployed in a working environment.

4.4 CUSTOMS AND BORDER PROTECTION (CBP)

Customs and Border Protection (CBP) has a priority mission of preventing terrorists and terrorist weapons from entering the United States. The directorate's other responsibilities include securing the nation's borders and ports of entry and furthering lawful international travel and trade while enforcing U.S. immigration, import, and drug laws.

The NIST team interviewed representatives from the CBP Air and Marine division, which is responsible for customs enforcement, and the Border Patrol, which guards against illegal entry into the U.S. via land routes.

4.4.1 CBP Air and Marine

The Air and Marine division's primary responsibility is conducting field operations for ship and airline entry ports, where they process U.S. citizens and foreign nationals into the country, often referred to as passing through customs. For foreign national visitors, the screening is called USVisit, and involves some additional tasks (e.g., fingerprinting). Air and Marine screens these visitors and returning citizens for threats to American security, including proper documents and admissible visas. There are approximately 20,000 CBP Air and Marine officers in the field. CBP Air and Marine processed approximately 340,000,000 passengers through customs at U.S. ports of entry in 2011.

4.4.1.1 Process Overview

The customs process begins when airline carriers send passenger reservation information to DHS 72 hours prior to the passengers' scheduled travel time. Each of the passengers' data is checked against the no-fly list, outstanding warrants, immigration violations, and so on, and subsequently sent back to the carrier. For visa waiver countries, determining the eligibility of passengers is accomplished using a web-based application.

The primary customs inspection occurs when a passenger arrives at a U.S. port of entry. At this time, a CBP Air and Marine officer checks all passengers' identity and travel documents. The officer also conducts a brief interview with all passengers. For U.S. citizens, this is the extent of the process. Foreign nationals must go through an additional process known as US-VISIT.

If a passanger is a foreign national, the CBP officer checks his/her visa, identity, documents, and biometrics, i.e., fingerprints and facial photo, to determine admissibility to the United States. The visa informs the officer if biometrics are on file or if prints need to be collected. Regardless of whether the individual's prints are on file or not, the CBP officer always captures them – to verify the identity of the foreign national if his/her prints are already in the system, or to enroll them in the system if they are not. The officer determines the length of the passenger's visit, admission status, and biometric results. This primary inspection process typically takes two minutes per passenger. If there are any issues requiring further attention, the passenger undergoes a secondary screening process.

4.4.1.2 Tasks and Users

Passenger at U.S. Port of Entry

- Present ID and travel documents at port of entry (all passengers)
- Present hands for biometric collection (foreign nationals)
- Pose for face photo (foreign nationals)
- Answer interview questions (all passengers, conducted concurrently with other tasks)

CBP Officer

- Review travel documents
- Ask questions about visit and duration
- Scan passport document using passport scanner
- Capture fingerprints using fingerprint scanner (for foreign nationals)
- Capture photograph using camera (for foreign nationals)

4.4.1.3 Equipment and Context of Use

Equipment:

- Workstation
- Fingerprint capture device
- Passport document scanner
- Camera
- Computer/Laptop
- Keyboard
- Monitor
- Software

The officers have a workstation, fingerprint scanner, passport document scanner (to read the radio-frequency identification [RFID] chips embedded in passports), and a camera. The customs booths vary in configuration and may be as simple as a small table. Sometimes counter height is an issue for shorter passengers. However, the counter is generally designed to serve as a safety barrier for officers: therefore a number of factors must be considered when addressing this human factors issue. This process is routinely conducted at indoor facilities with typical indoor facility lighting and environmental controls, but may be dusty and noisy.

4.4.1.4 Interviewee Reported Challenges and Opportunities

Interviewees reported the following challenges and potential process improvement opportunities:

Some facility environmental conditions pose challenges for the screening process. In many cases, the lighting and background in customs stations is not conducive to taking adequate facial photographs of passengers passing through customs. At these stations, there is also a considerable amount of airport noise, affecting the interview process. Also, dust adversely affects the equipment.

RFID chips in passports allow electronic passing of some screenee information. However, these chips often fail before the passport document itself expires. Also, foreign passports are sometimes not of high quality, resulting in slow read rates. In such cases, officers can perform a manual query faster than the electronic approach. However, this is slower than the fully functional electronic approach.

The paperwork aspect of the screening process could be made more efficient if a paperless process were instituted. The current process requires paperwork to be stamped and this takes extra time. Interviewees recognized the need to maintain a manual process for certain cases.

Interviewees see advantages and the potential for additional efficiencies if technologies such as Biometrics on the Move were incorporated into the screening process, replacing tasks that require them to direct passengers through the biometrics capture process, e.g., “stand here”, “take off your hat”, “move your hair” and so on. They see this technology as a potential means to improve other processes as well.

4.4.2 Border Patrol

The principal duties of Border Patrol agents include preventing terrorists and terrorist weapons from entering the U.S. at illegal ports of entry, detecting and preventing the smuggling and unlawful entry of undocumented aliens into the U.S., and apprehending those persons in violation of U.S. immigration laws. All of these duties protentially involve processing and collecting biometric data from detainees: this process is described below.

4.4.2.1 Process Overview

The Border Patrol has approximately 143 centers with 1,000 workstations that process roughly 1,000 detainees per day. The agents pick up the detainee(s) in the field and take them to the closest field office. After entering the detainees’ biographic data into the CBP enrollment system, the agents collect fingerprints, iris images, and biographic data from detainees.

In fiscal year 2011, the Border Patrol reported a total of 340,252 illegal alien apprehensions.

4.4.2.2 Tasks and Users

Detainee

- Provide biographic data

- Present fingers for electronic fingerprinting
- Pose for face photo
- Present for iris scan

Border Patrol Officer

- Use binoculars and night vision devices, as appropriate
- Use radiation isotope identifier device, as appropriate
- Transport detainees from field to office
- Collect biographic data using CBP administration software
- Collect fingerprints using fingerprint capture device
- Capture photo with digital camera
- Capture iris scan using iris scanner
- As appropriate, take mobile unit to hospitals or morgues to collect biometrics, i.e., ten-print fingerprints, iris scan and facial image – mobile biometics unit contains fingerprint scanner, iris scanner, camera, and printer

4.4.2.3 Equipment and Context of Use

Equipment:

- Computer workstation
- Enrollment camera
- Fingerprint capture device
- Iris scanner
- Enrollment software (both CBP biographic and biometric systems)
- Keyboard
- Monitor
- Night vision device
- RAD detection device

Field office workstation equipment includes a monitor, keyboard, software, enrollment camera, the iris scanner, and the fingerprint scanning device. Surveillance cameras are located around and throughout a CBP facility. Field equipment includes binoculars, night vision devices, and radiation detection devices. There are environmental risks involved for the agents, including health risks from exposure to sick detainees and potential harm from armed individuals and flight risks.

4.4.2.4 Interviewee Reported Challenges and Opportunities

The interviewees reported the following challenges and opportunities for process improvement:

Border Patrol agents experience recurring problems with collecting biometric data. Facial capture images are often of very poor quality unless agents receive a lot of training to take good pictures. Like the Coast Guard, the Border Patrol has problems with fingerprint scanner platens getting dirty and impacting fingerprint quality.

When connectivity is available, officers would like the capability to process detainees in the field to learn if the detainees have outstanding warrants and/or criminal records. The interviewees believe that this could increase officer safety.

Finally, agents would like the CBP-developed software used for enrollment to be changed to an easy-to-use, wizard-like or web-style interface.

4.5 U.S. IMMIGRATIONS AND CUSTOMS ENFORCEMENT (ICE)

The primary mission of U.S. Immigration and Customs Enforcement (ICE) is to promote homeland security and public safety through the criminal and civil enforcement of federal laws governing border control, customs, trade, and immigration. ICE employs more than 20,000 people in offices throughout the U.S., as well as 47 foreign countries.The two primary operating components of ICE are Homeland Security Investigations (HSI) and Enforcement and Removal Operations (ERO). ICE apprehended more than 180,000 individuals in 2011.

Enforcement and Removal Operations field operations teams search for specific individuals who are fugitives, detain them, and remove the illegal aliens. A fugitive is someone who is told to leave the country and has not left. Unlike CBP, which operates along the nation's borders, ERO is responsible for internal enforcement.

4.5.1 Process Overview

It is standard procedure for ICE to collect biometric information, i.e., a photograph, fingerprints, and sometimes an iris scan, from each detainee for enrollment in its database or – if the detainee is already enrolled – to check for repeat offenders. This database enrollment/check process that was selected for inclusion here.

The process begins when a field operations team detains an individual and brings the detainee back to an ERO facility. Biometric data is used to enroll the detainee in the Enforcement Alien Booking Module (EABM) software application. Initial enrollment takes place on the first arrest. To enroll the individual, the officer collects fingerprints electronically (using a fingerprint scanner) and captures a facial image. Iris capture is also performed if the required equipment is available, but this biometric may not always be collected. If the detainee was enrolled previously, the detainee's data is available to the officer.

Depending upon the circumstances, ERO may pick up a detainee from his or her place of incarceration for database enrollment and subsequent deportation. For example, if an individual known to be in the country illegally is approaching the end of a prison sentence for another crime, the responsible law enforcement agency notifies ICE ERO when the individual is scheduled to be released. ICE ERO picks them up, informs the country of origin that the detainee is coming, and escorts the detainee on the flight back to their country of origin.

4.5.2 Tasks and Users

Detainee

- Provide enrollment data (as requested by the ICE officer)
- Present fingers for fingerprinting
- Pose for face photo
- Present for iris scan (if device is available)

ICE Officer

- Enroll detainee in the Enforcement Alien Booking Module software application
- Capture fingerprints using electronic fingerprint device
- Capture photo using camera
- Capture iris scan (if device is available)

4.5.3 Equipment and Context of Use

Equipment:

- Computer/laptop
- Fingerprint capture device
- Camera
- Iris scanner
- Software

Field operations officers carry guns and radios. The ERO facility where the biometric capture takes place is indoors.

4.5.4 Interviewee Reported Issues and Opportunities

As part of the interview process, researchers asked the participants if they had any needs for or challenges in completing their tasks. Interviewees responded that they did not have any significant technology issues at this time. However, they did say that they are interested in and really need handheld technology and devices for processing detainees in the field. They also said that currently, they must enter or check multiple systems for detainee information and/or enrollment, and would prefer to have a single, consolidated system for that purpose.

4.6 Federal Emergency Management Agency (FEMA)

FEMA's mission is to work with and support citizens and first responders to build, sustain, and improve the nation's capability to prepare for, protect against, respond to, recover from, and mitigate all hazards and disasters. Hazards and disasters include not only natural disasters (e.g., hurricanes, earthquakes, tornadoes, floods, fires) but also man-made disasters such as hazardous spills or acts of terrorism.

FEMA has 7,474 employees across the country at the FEMA headquarters, ten regional offices, the National Emergency Training Center, and the Center for Domestic Preparedness/Noble

Training Center. When disasters occur, FEMA also temporarily recruits local law enforcement personnel, firefighters, doctors, and others with needed skills to assist with the response effort. In furtherance of its mission, FEMA partners with state, tribal, and local officials, the private sector, non-profits, faith-based groups, and the general public.

4.6.1 Disaster Coordination, Support and Logistics Division

When a disaster occurs, the Disaster Coordination, Support and Logistics division sets up Disaster Field Office – also known as a Joint Field Office, or JFO – in or near the affected area. The Division then works with state and local officials to coordinate the Federal Government response to hazards and disasters. There are ten regional response coordination centers and one National Response Coordination Center at FEMA headquarters. The regional office handles response in the area within its purview, unless it needs government resources.

FEMA is also responsible for distributing first responder Personal Identity Verification cards (PIV-I cards) for disaster site self-identification, authorizations, and first responder credentials, e.g., indicating that the responder is a physician, EMT, or firefighter (this is usually done as part of disaster response preparations – not during an actual state of emergency). There are approximately 5,000 individuals, mostly firemen, who become temporary Federal employees when a state of emergency is declared, and these individuals also require PIV-I cards. In addition, FEMA is responsible for Urban Search and Rescue missions.

4.6.1.1 Process Overview

FEMA's Mobile Emergency Response Service is responsible for setting up the disaster response and government field office (also known as the JFO, or Joint Field Office) in the event of an emergency. This unit also provides operations and logistics support including mobile communications equipment and power sources (i.e., generators) for the field office. Typically, they can set up a field office and equip it with power in approximately 24 hours. The Mobile Emergency Response Service team uses satellite phones and smartphones to keep in touch with other team members, other personnel at the disaster site, and headquarters personnel. They use Global Positioning System (GPS) devices to find locations and computers/laptops/tablets to document operations.

FEMA personnel are typically equipped with satellite phones, smartphones, tablet computers, laptop computers and GPS devices.

4.6.1.2 Tasks and Users

FEMA Mobile Emergency Response Service team

- Travel to specific locations within a disaster area using GPS
- Establish disaster response and government field office/JFO at or near the disaster site
- Maintain contact with other service team members and headquarters personnel using Blackberry/mobile phone or satellite phone

4.6.1.3 Equipment and Context of Use

Equipment:

- Satellite phone
- Smartphone
- Computer/Laptop
- Tablet
- GPS device

Operating conditions vary greatly, from indoor office environments with limited power to outdoor locations, during the day or night and in all types of weather.

4.6.2 FEMA Security Division

The FEMA Security Division is responsible for applying and enforcing security policies in Regional Disaster settings. They coordinate, respond, and apply comprehensive security disciplines at all disasters and manage Disaster Assistance Employees (DAE).

There are approximately 100 trained DAE employees who include, for example, bomb technicians, SWAT teams, investigators, pilots, and divers. They are mobilized and deployed to disaster sites as appropriate. Each of the ten FEMA regions has a security office that responds to emergencies including: chemical spills, dam failures, earthquakes, fires or wildfires, floods, tornadoes, tsunamis, and hurricanes.

At the disaster site, the Security Division is responsible for fraud detection, law enforcement, special security details, and physical security. The protection of JFOs is usually accomplished through hiring contract guards. Other types of disaster employees are Federal intermittent employees, with skillsets similar or complementary to DAEs. These intermittent employees are on call and make themselves available if deployment is necessary.

4.6.2.1 Process Overview

The Security Division provides security for the JFO, staging areas, and mobile/transient equipment moving from point A to point B. Essentially, they protect federal assets that are co-located with the state JFO.

The Security Division mobilizes when the state governor makes a request for disaster aid. There are two types of emergency declarations: short term, e.g., snowstorm and major, e.g., Hurricane Irene. FEMA provides individual, public, and emergency assistance, such as supplying water, ice, food, and shelter to those affected by the disaster.

Security Division agents are responsible for badging and fingerprinting local first responders at security operations (if those first responders do not already have PIV-I cards). They also protect against criminals trying to access the disaster site and anti-government groups, e.g., anarchists or militias, who may interfere with disaster response operations. The Security Division is also responsible for gathering and forwarding information related to areas that have been, or may potentially be affected by, a disaster, e.g., the trajectory of a hurricane or spread of a wildfire.

4.6.2.2 Tasks and Users

FEMA Security Division agents

- Mobilize and proceed to disaster site
- Provide emergency assistance for water, ice, food, and shelter to those affected
- Manage Disaster Assistance Employees and Federal intermittent employees on site
- Badge DAEs, capture fingerprints
- Establish protection at JFOs
- Manage contract guards
- Field mobile/transient equipment
- Capture photos of the disaster site
- Set up alarm system kits (sensors, alarm panels, glass breakers) at JFOs
- Monitor disaster site for criminals and criminal or anti-government activity

4.6.2.3 Equipment and Context of Use

Equipment includes:

- Smartphone
- Satellite phone
- Communications radio
- Computer/Laptop
- Tablet
- Fingerprint capture device
- Camera
- Alarm system kit (sensors, alarm panels, glass breakers)

The equipment used by the Security Division consists mainly of laptops and cell phones. The teams also have some fingerprinting equipment. Currently, the Security Division has 57 fingerprinting devices: 28 of these devices are old, and 29 have been purchased recently. The division also has a badging device, cameras (used to send pictures of the disaster), and 20 alarm system kits.

Some operations take place in the JFO, but others take place outdoors, during the day or night and in all types of weather.

4.6.3 Interviewee Reported Issues and Opportunities

FEMA personnel did not highlight any issues or process improvement opportunities during the interviews with NIST personnel.

5 EQUIPMENT AND HIGH-LEVEL MAPPING TO STANDARDS

The information derived from the interviews provided the NIST team with the data elements to identify the end users, major tasks (with associated technology and equipment used to complete those tasks), and with some context of use for the processes selected for review. Using this

information, the NIST team mapped the feature sets of these processes to the standards enumerated in Phase I of the project (see **Appendix B** for the detailed map). These mappings represent the type of results described in **Sec. 2** provide, i.e., an overview of the equipment in use and associated standards. This approach can be extended to include additional processes as appropriate.

The following subsections provide a high-level mapping of the equipment and technologies used to complete the major tasks, the high-level mapping of equipment and components to standards, and the interviewee reported challenges and improvement opportunities.

5.1 Equipment Use by Directorates

Table 1 shows a high-level mapping of the device types used across agencies for the processes reviewed. Note that blank cells do not mean that the an agency does not use the listed equipment; rather a blank cell indicates that the equipment was not identified for the process(es) reviewed.

Table 1: Device Use by Directorate

Device	USCIS	TSA	USCG	CBP	ICE	FEMA
Alarm systems						√
Barcode scanner	√	√				
Black light		√				
Bore scope			√			
Bottled liquid scanner		√				
Camera	√		√	√	√	√
Cast and prosthesis imager		√				
Cell phone/Blackberry						√
Chemical detection device		√	√			
Communications radio					√	√
Computer/Laptop	√		√	√	√	√
Explosive trace detection device		√	√			
Fingerprint capture device	√		√	√	√	√
GPS device						√
Hand-held (wand) metal detector		√				
Iris scanner				√	√	
Keyboard	√	√	√	√		
Monitor	√	√		√		

Device	USCIS	TSA	USCG	CBP	ICE	FEMA
Night vision device				√		
Passport document scanner				√		
RAD detection device				√		
Signature capture device	√					
Software	√	√		√	√	
Walk-through metal detector		√				
Whole body scanner		√				
Workstation	√	√		√		√
X-ray scanner[6]		√				

5.2 Mapping Devices and Standards

The NIST team collected a variety of data on the selected directorate processes, including the end user objective, tasks, devices, and context of use with the goal of mapping these devices to the existing standards identified in Phase 1. Many of the devices did not have specific human factors standards addressing the device as a single unit: however, standards do exist for many of the device components or features. For example, there were no specific human factors or usability standards addressing cameras, but there are human factors standards for camera components such as buttons, switches, and dials. The data was consolidated and then the devices were mapped to the standards (identified in Phase I) for each directorate. Table 2 shows the applicable standards for each device and its component, as well as which directorates reported using the device for the process(es) reviewed. A more detailed mapping with enumerated components and the pertinent standards subsections is given in **Appendix B**.

Table 2: Standards Addressing Device and/or Device Component by Directorates using that Device

Device	Directorates	NASA	ISO 9241	MIL-STD 1472G	MIL-HCBK-759C	MOD 002-250	ASTM F1166
Alarm system and components	***FEMA***	√	√	√	√	√	√
Barcode scanner and components	***USCIS*** ***TSA***	√	√	√	√	√	√
Black light and components	***TSA***	√		√			
Bore scope and components	***USCG***	√	√	√	√	√	√
Bottled liquid scanner and components	***TSA***	√	√	√	√	√	√

[6] TSOs may also use a CT scanner.

Device	Directorates	NASA	ISO 9241	MIL-STD 1472G	MIL-HCBK-759C	MOD 002-250	ASTM F1166
Camera and components	***USCIS*** ***USCG*** ***CBP*** ***ICE*** ***FEMA***	√	√	√	√	√	√
Cast and prosthesis imager and components	***TSA***	√	√	√	√	√	√
Cell phone/Blackberry	***FEMA***	√					
Chemical detection device and components	***TSA*** ***USCG***	√	√	√	√	√	√
Communications radio	***ICE*** ***FEMA***						
Computer/Laptop	***USCIS*** ***USCG*** ***CBP*** ***ICE*** ***FEMA***	√				√	√
Explosive trace detection device and components	***TSA*** ***USCG***	√	√	√	√	√	√
Fingerprint capture device and components	***USCIS*** ***USCG*** ***CBP*** ***ICE*** ***FEMA***	√	√	√	√	√	√
GPS device and components	***FEMA***	√	√	√	√	√	√
Handheld (wand) metal detector wand and components	***TSA***	√	√	√	√	√	√
Iris scanner and components	***CBP*** ***ICE***	√	√	√	√	√	√
Keyboard	***USCIS*** ***TSA*** ***USCG*** ***CBP***		√	√	√	√	√
Monitor	***USCIS*** ***TSA*** ***CBP***		√	√	√		√
Night vision device	***CBP***						
Passport document scanner and components	***CBP***	√	√	√		√	√
RAD detection device and components	***CBP***						
Signature capture device and components	***USCIS***	√	√	√	√	√	√

Device	Directorates	NASA	ISO 9241	MIL-STD 1472G	MIL-HCBK-759C	MOD 002-250	ASTM F1166
Software	***USCIS*** ***TSA*** ***CBP*** ***ICE***	√	√	√		√	√
Walk-through metal detector and components	***TSA***	√	√	√	√	√	√
Whole-body scanner and components	***TSA***	√	√	√	√	√	√
Workstation	***USCIS*** ***CBP*** ***FEMA***	√	√	√	√	√	√
X-ray scanner and components	***TSA***	√	√	√	√	√	√

5.3 Interviewee Identified Challenges and Future Technology Needs

As part of the interview, NIST researchers queried interviewees about issues they have with the technology or devices they use to carry out their tasks and their perceptions of future technology needs. The items in the list below were provided by the interviewees.

- Efficiencies could be gained from replacing current paper-driven processes with electronic options, reducing the burden on both staff and members of the public.
- Different equipment used to complete the same tasks creates difficulties for end users since the equipment interfaces differ.
- Having dual monitors for luggage scanners would help reduce error rates, since it allows the same object to be inspected from multiple angles.
- Battery life issues affect device performance.
- Equipment needs to be tested in the environment of use before being deployed, as environmental factors impact equipment performance and often cause the equipment to fail during actual use.
- RFID chips in passports often reach end-of-life before the passports themselves need to be renewed, and the chips in foreign passports are sometimes not of high quality, resulting in problems with passport scanning and subsequent delays at customs stations.
- Facial recognition technologies will help users quickly identify dangerous individuals, thus reducing the risk to personal safety for DHS personnel.
- Minimizing response times from database queries regarding questionable detainees is seen as critical to reducing the risk to personal safety for DHS personnel.
- Equipment needs to be dust-resistant and/or easy to clean, since dust is a problem in both high-traffic indoor environments and outdoor environments.
- Biometric devices that are symbol-driven or language-independent would help reduce language issues while collecting biometric data from individuals who lack or have limited proficiency in English.

- Fingerprint scanner platens become dirty quickly and impact the quality of prints. Having a dirt-resistant platen or some simple way to keep the platen clean would be beneficial. Scanner platens (and subsequently fingerprint quality) may also be affected by factors such as temperature differences that cause the glass to fog or glare from intense sunlight.
- Mobile technology is expected to facilitate portable field equipment and increase field officers' safety by facilitating rapid identification of repeat offenders and/or dangerous individuals. "Biometrics on the Move" technology would be particularly helpful for certain users, e.g., CBP agents.
- More user-friendly software would facilitate more efficient completion of tasks.
- One consolidated information system to enroll and/or check for detainee information (e.g., prior arrest records) would be a significant improvement over the current regime, which requires accessing multiple systems.
- Airport noise at customs stations interferes with the traveler interview process.
- The lighting and background in customs stations is not conducive to taking adequate facial photographs.
- Certain users who need to capture facial images in a field environment, e.g., members of the Coast Guard or CPB, need cameras that allow them to take better pictures with minimal training. Better flash would also improve the quality of nighttime photographs.
- Portable equipment intended for use in shipboard environments, i.e., a Coast Guard vessel, needs to be tetherable and/or particularly durable to prevent fall damage. Such equipment also needs to be small due to tight storage space on seagoing vessels.

6 DISCUSSION

The goal of this project phase was to interview end users in each DHS organization in order to understand user tasks, identify technologies and devices used to complete those tasks, and then map those devices to the HSI standards identified in Phase 1 of the project.

From these interviews the research team collected the following data:

- The organization
- Environment of use
- Task objective
- Device type
- Device description
- Device user
- Approximate use
- Anticipated future changes/needs
- Issues with current technology and devices

This data was then entered into spreadsheets, one for each directorate, and matched the HSI standards identified in Phase 1 of the project to the devices and/or the device components used in the selected processes. The spreadsheets can be found in **Appendix B**.

As mentioned in **Sec. 3.1**, this study is not an exhaustive gap analysis: the results are not definitive, nor do they address all the gaps existing between identified HSI standards and devices, equipment, and proccesses currently being used at DHS. However, the study results do highlight the need for a culture of HSI standards within the organization. Further, this study demonstrates an approach to and provides a framework for finding and applying HSI standards within DHS, in no small part by providing a representative standards "space." Finally, the study uncovered certain critical HSI-related gaps within DHS, which are described below.

It is clear from the data collected that many of the interviewed end users of the six agencies used similar equipment and technologies to complete major tasks. For example, five of the directorates' (i.e., USCIS, USCG, CBP, ICE, FEMA) end users use some type of camera as well as a fingerprint capture device.

Unfortunately, some of the most commonly used devices have few if any associated HSI standards, although some of the device components are addressed. For example, none of the HSI standards identified during Phase I of the project address cameras (only their components). This is a significant issue because many of the complaints from interviewees concerned the quality of the images they captured using cameras, and this was often compromised by conditions of the working environment, i.e., the context of use. There are few if any HSI standards for mobile devices, yet many of the interviewees in various directorates identified them as a key technology for mission success in the future.

In addition, DHS must consider emerging technologies its end users are likely to use in the near future, such as those mentioned by interviewees (e.g., mobile devices, new web applications, tools to support automation of tasks). As the technology and processes used within DHS change, new HSI standards will be needed – which means that iterative reviews of both standards and organizational processes will also be needed.

The following subsections describe critical gaps in HSI technology and communications standards that DHS needs to address.

6.1 DHS Software Applications and Interfaces

DHS application software packages are critical to many of the tasks performed by the end users interviewed in this study. Some of the application types reported in this study include real-time, client-server architectures, Web architectures, and mobile device applications. For example, agents from ICE and the Border Patrol rely upon software applications to handle the complex information involved in enrolling and checking on the status of detainees. When asked about technological issues and challenges they faced in performing their tasks, end users from both of these organizations mentioned that they had usability problems with their software.

The particular issues cited by interviewees from ICE and the Border Patrol point to a need for DHS to adopt interface and information presentation standards for real-time, non-local service applications. Some existing standards for websites, such as those found in ISO 9241, could be applied for this purpose. By employing interface standards to create more streamlined, easy-to-use apps for its end users, DHS could reduce the amount of time required to perform tasks and

reduce the incidence of omissions and mistakes. This recommendation applies not only to applications already in use by DHS users, but also to applications that might be used to supplement or replace largely paper-driven tasks (such as those performed by USCIS or CBP Air and Marine) in the future.

DHS has the opportunity to use cloud computing technologies to support an integrated data model for certain types of applications that are used by multiple directorates, e.g., those that collect or reference biometric identity data. Various views of the data could be provided to end users via applications that have been customized for their specific context of use – in other words, the computing platform they are using, their role, the task they are performing, and their access privileges. While this integrated data model would present clear advantages for DHS, implementing it would require significant effort.

While standards and best practices exist for interface design, these are limited and do not address cloud-based services. DHS may want to develop additional standards, either on its own or in partnership with other organizations. The issue of interface design standards also applies to mobile technologies, which are discussed in more detail in the following subsection.

6.2 Mobile Devices and Touch Interfaces

As noted earlier, interviewees from various directorates identified mobile technology (such as smartphones and tablet computers) as being critical to mission success in the future. In particular, Border Patrol and ICE officers want mobile technology that will allow them to process detainees in the field. Hand-held or mobile devices are already used in many directorates throughout DHS, such as the wand metal detectors used by TSA or mobile fingerprinting devices. All of these devices have some component or components not covered by the identified HSI standards, or the device type itself is not addressed by standards. These mobile devices share many of the same components such as:

- a display,
- touch input or small keyboard,
- operating system, and
- the ability to run various types of software applications while connected via WiFi or Bluetooth.

There are a number of existing HSI standards that address the components listed above. However, there are few if any standards that address specific mobile device interface features such as:

- touch screen active area and size, and touch force;
- display lighting that accommodates night or limited lighting conditions;
- backlit and dimmable input device, controls, and keyboards for night or use in limited lighting conditions;
- battery life and charging;
- display controls;
- fonts;
- screen interfaces;
- technical support;

- button size;
- separation of buttons or touch adjacent active areas for use with/without gloves;
- display illumination visible for varying light conditions;
- interface standards for all applications; and
- standardized keypad numeric layout.

Another consideration is environmental conditions such as sun, rain, wind, or other elements, which can potentially impact the functionality of a mobile device. In addition, connectivity and response times for mobile devices can be impacted by use in the field. Long response times for database queries and lag time can subject field officers to undue risk when dealing with detainees (a concern raised by interviewees from ICE). Adopting and adhering to a standard for acceptable response and/or lag time would increase the safety of the field officers.

Authentication on mobile devices can also be challenging given the size of the interface and input device, and while there are a variety of authentication options that can work with desktop or laptop computers relatively easily (e.g., card reader, fingerprints, retina scan, voice recognition, or facial recognition systems) there are fewer options available to facilitate authentication on small mobile displays and keyboards.

6.3 BIOMETRICS

Since collecting biometric information is a critical part of many DHS processes – USCIS, USCG, CBP and ICE all collect biometric information – standards regarding biometric collection and devices should be of particular importance to DHS. A significant challenge in this area is that, while standards do exist regarding biometrics, they fall short of addressing some of the considerations of biometrics collection at DHS.

One general issue is the usability of biometrics collection processes. As mentioned earlier, some of the end users interviewed during this study find it difficult to capture facial images with cameras due to environmental conditions (particularly ambient light levels). To mitigate this problem and help ensure better-quality facial image captures, DHS should adopt standards that specify required components, capabilities, and features for cameras and the characteristics of the environment in which they are to be used. These standards should be dependent upon the context (for example, taking pictures at a customs station versus taking pictures aboard a Coast Guard cutter). Other types of biometrics collection factors may also require usability standards; for example, labeling, height, and angle specifications for electronic fingerprint scanners.[7]

Another issue is the multi-cultural population from whom DHS collects biometric information. A sizeable fraction of that population has little or no proficiency in English, which can significantly hinder the biometric collection tasks performed by various DHS directorates. As interviewees from CBP Air and Marine pointed out, the resulting language differences can pose a challenge not only for the individuals themselves but for the DHS agents trying to capture biometric information. One way to alleviate this problem is to use language-independent icons

[7] Standards for usability in biometrics are currently under development by another NIST working group.

and graphics to represent visual and spatial concepts that will help individuals go through the biometric collection process. Such icons can reduce the need for translation of text to explain those same concepts. However, use of icons can be problematic when used cross-culturally to explain complicated concepts, so developing icons that will adequately serve a multi-cultural population is a challenge. The International Standards Group (ISO) JTC1/SC37/WG 6 develops icons for biometrics.

6.4 ACCESSIBILITY

On a related note, DHS agents interact with different populations that may include individuals with some type of disability. Disabilities may include physical, sensory, or cognitive impairments as well as various types of chronic disease. These disabilities can impact an individual's ability to carry out routine activities, which include reading Web pages, using applications, and understanding instructions. Individuals with disabilities may also experience difficulties undergoing biometric collection processes.

The W3C and Section 508.gov address accessibility standards for website design and applications. However, DHS also needs to consider accessibility for disabled individuals who interact with other technology and devices used by DHS agents, including those which involve biometric collection. There may be a need for additional accessibility standards addressing those technologies and devices.

7 CONCLUSION

The document for Phase 2 of this project identifies the feature sets of equipment and operating environments involved in a number of core DHS processes and mapped relevant existing HSI standards to those feature sets. It also provides DHS with a framework for repeating this type of exercise, which will be necessary to keep up with future technologies, standards, and organizational needs. Finally, the document highlights areas in which there is a critical need for DHS to identify or develop HSI standards – including the way in which DHS develops, acquires, and deploys technology for use in the field.

7.1 HSI CHALLENGES WITHIN DHS

The organization faces some significant challenges with regards to HSI standards. One issue is that while multiple directorates may perform similar tasks, the context in which those tasks are performed may vary from one directorate to another, and even between divisions within the same directorate. For example, both USCIS and USCG collect fingerprints using an electronic fingerprint scanner, but under very different circumstances and in very different environments. The two directorates might share a "baseline" set of standards for fingerprinting equipment, but USCG should have additional standards regarding the durability of its equipment, given the risk of exposure to fall or water damage.

Another issue is that standards for certain critical areas of need within DHS are either scant or nonexistent. This is especially true with regards to biometric and mobile technologies. DHS should identify, and possibly participate in, efforts to develop new standards in these areas.

NIST is currently working on standards that address biometric collection, particularly fingerprinting.

Some of the technology issues described by interviewees stem from the fact that DHS does not address HSI considerations in its technology development and acquisition processes. For example, interviewees from USCG said that the equipment they use to collect biometrics from illegal migrants at sea was never tested in the working environment prior to deployment, which sometimes makes it difficult to use (and, in some cases, difficult to keep in working order). There are human-centered design standards that DHS can employ during technology development and acquisition in order to help ensure that it adopts technologies that provide the best possible fit for its organizational needs – in other words, technologies that fit the needs of its end users. However, use of these standards must be driven by understanding of the context of use (including the oprating environment) in which particular technologies are employed.

7.2 Understanding the Context of Use

As mentioned earlier in this document, the elements in the context of use include: the subject of the context of use description (e.g., a product, system, or service, as well as its purpose and summary of preconditions); user groups, goals, tasks, and environments. If DHS or any other organization wants to deploy technology that provides the best possible fit for its intended purpose, then addressing context-of-use considerations is critical. This is especially important to keep in mind for an organization like DHS, where the context of use for certain technologies can vary widely between or even within directorates even when those technologies are being used to perform broadly similar tasks.

For example, four of the six directorates covered in this study (USCIS, USCG, CBP, and ICE) collect fingerprints with an electronic scanner. However, the circumstances under which they perform this task tend to differ. USCIS and CBP Air and Marine collect fingerprints from willing individuals who do not represent a potential threat to agents, while USCG, CBP Border Patrol, and ICE collect fingerprints from individuals who may be uncooperative and/or dangerous. Also, fingerprinting devices that are perfectly adequate for a USCIS processing center or customs station may not be durable enough for a Coast Guard cutter, where the risks of water- or fall-related damage are considerable.

Evaluating the context of use for a particular technology is challenging. It is difficult to know where or how to look for potential human factors issues, and even issues that are obvious are not always easy to articulate. Fortunately, there are standards that facilitate conducting this type of evaluation, as well as documenting and analyzing the results.

7.3 Human-Centered Design Standards

There are three human-centered design standards – to be applied during technology development or acquisition – that will help DHS develop, acquire, and deploy technologies that are a good fit for their respective contexts of use: ISO 9241-210, ISO/IEC TR 25060 and ISO/IEC 25062.

ISO 9241-210 provides requirements and recommendations for human-centered design principles and activities throughout the life cycle of computer-based interactive systems. The

human-centered design approach aims to make systems usable and useful by focusing on the end users, their needs, and requirements. Human-centered design enhances effectiveness and efficiency; improves human well-being, user satisfaction, accessibility and sustainability; and counteracts possible adverse effects of use on human health, safety, and performance.

ISO/IEC TR 25060 describes a potential family of International Standards, named the Common Industry Formats (CIF), that document the specification and evaluation of the usability of interactive systems. It provides a general overview of the CIF framework and contents, definitions, and the relationship of the framework elements.

ISO/IEC 25062 standardizes the types of information captured with user testing. The level of detail allows the same or another organization to replicate the test procedure. Major variables include: user demographics, task descriptions, test context (including the equipment used, the testing environment, and the participant and test administrator's interaction protocol), as well as the metrics chosen to code the study findings. Advantages of using standardized reporting format include: (1) a reduction in training time for usability staff since an individual only needs to learn to use one form, regardless of how many companies s/he works for and (2) enhanced potential for increased communication between vendors and purchasing organizations since readers of CIF-compliant reports will share a common language and expectations.

Adopting and applying ISO 9241-210, ISO/IEC TR 25060, and ISO/IEC 25062 should be part of a broader effort to incorporate HSI considerations, processes, and standards into the organizational culture of DHS. Putting such measures in place will help DHS make choices that increase the usability and end user satisfaction of the technology and devices that are critical to the organization's mission. The nature of that mission means that DHS will sometimes be compelled to rapidly deploy new technologies into the field in response to emerging security threats. In such situations, it will be difficult for DHS to identify appropriate standards for or conduct adequate usability testing on these new technologies before putting them into widespread use. The organization will have to "catch up" to these rapidly deployed technologies by identifying relevant standards and possibly modifying the technology (or the way in which it is used) to improve usability when the opportunity arises.

Making HSI awareness and processes second nature at DHS will require a long-term effort. In the short term, DHS should find ways to address HSI interface-related standards gaps in the areas identified in **Sec. 6**, specifically:

1. Real-time non-local software applications, which are vital to many of the tasks performed by DHS end users.
2. Hand-held and mobile devices, such as smartphones and tablet computers, which many interviewees identified as being critical to mission success in the future.
3. Touch interfaces, which are the default means of interaction with almost all contemporary mobile devices.
4. Interfaces for biometric collection devices, in terms of usability and language-independent symbols for multi-cultural user populations.
5. Accessibility for both DHS agents and the populations with whom they interact; this applies to Web pages, application interfaces, and biometric collection processes.

Employing standards for equipment, processes, and human-centered design will assist end users at DHS in completing their tasks more efficiently and effectively, with fewer adverse effects to their health and safety. Adopting usability and HSI principles will also increase user satisfaction as well as accessibility and sustainability, helping DHS directorates and the Department as a whole to carry out their organizational missions.

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APPENDIX A: INTERVIEW QUESTIONNAIRE

Organization: _____
Division: _____
Job title: _____

1. What would you consider to be your organization's primary role to support the DHS mission?
2. What are your organization's primary job duties to support the DHS mission?
3. What group or groups within your organization fall under your area of responsibility or for which you can provide information for the purpose of this interview?
4. For each of the groups that you mention above how many people are required to perform the main tasks?
5. For each of the groups that you mention above, please describe the characteristics of the primary tasks. What are the critical factors required for success?
6. For each of the groups that you mention above, how many people are impacted by the primary tasks? For example, a TSA screener might have 300 people waiting in a security line to go through screening.
7. For each of the groups that you mention above, please describe the characteristics of the people that perform the primary tasks. This includes things like years of experience, education level, specific training, etc.
8. For each of the groups that you mention above, please describe the characteristics of the work environment in which the primary tasks are performed. Describe things that are important to understand regarding how that work environment is unique or has special demands. This includes things like weather exposure, remoteness, etc.
9. What applications or types of equipment does your group interact with (e.g., hand held devices, applications)?
10. What applications or types of equipment are designed specifically for the unique aspects of the group's work environment?
11. What is the function or how does your group use the applications or equipment?
12. What problems or issues does your group have using the applications or equipment?
13. What task(s) are the most difficult for your group to complete? Why?
14. What equipment or systems help complicate or make the primary tasks harder?
15. What equipment or systems help simplify or make the primary tasks easier?
16. What do you foresee in the future by way of enhancements, improvements, or new technology? (e.g., mobile devices)
17. What features or enhancements, if implemented, would benefit the group in the course of supporting the DHS mission?
18. What other improvements, if implemented, would benefit the group in the course of supporting the DHS mission?

19. What equipment does your group use that interact (either incoming or outgoing) with other organizations' equipment? (e.g., fingerprints, criminal history, etc.)
20. What advantages has your group found regarding these interactions with other organizational equipment?
21. What challenges has your group found regarding these interactions with other organizational equipment?

APPENDIX B: FEATURE SET AND CORRESPONDING STANDARDS BY ORGANIZATION

B.1: USCIS Service Center

Offices: more than 250 worldwide
Environment: Service centers
Number of applicants processed in 2011: 2.9 million biometric appointments
Task: Collect biometric data including photo, fingerprints, signature, and enter applicant data.

Equipment:

- High-resolution digital camera used to capture photo
- Computer with customized enrollment software (for USCIS agents)
- Workstation used as a combined device area with seating for participant
- Keyboard (no mouse) used to enter data into the L1 Identity Solution System
- Flat panel monitor for rendering software application
- Barcode scanner used for scanning application bar code
- L1 graphic interface used to operate L1 system
- Electronic signature pad for capturing applicant's signature
- Electronic fingerprinting device

Table 3: USCIS Devices and Relevant Standards

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
High resolution digital camera components:						
• *Buttons, Knobs, and Control Devices*	**10.6.3 Control devices** 10.6.3.1 Push button 10.6.3.7 Slide switch controls 10.6.3.23 Knobs	**Part 9: Ergonomics requirements for office work with Visual Display Terminals – Requirements for non-**	**5.1.4 Mechanical Controls** 5.1.4.1.2 Continuous adjustment rotary controls (knobs)	**5.4 Controls** 5.4.1.2 Direction of movement 5.4.2 Rotary controls 5.4.3.1.1 Push button,	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.3 Preferred physical	**5 Controls** ***5.1 Principles of control design*** ***5.6 Control use and design***

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		keyboard input devices 6.1.4 Button design	5.1.4.2 Linear controls (push buttons)	finger- or hand-operated	specifications for continuous variable operation: Rotary (knob) 15.6.8 Preferred physical specifications for discrete operation: Push button	5.6.5 Continuous adjustment rotary controls (knobs) 5.6.7 Pushbuttons
• *Auditory signal*	**10.8 Audio Displays** 10.8.2 When to use 10.8.3 Selection of signal type 10.8.4 General design 10.8.5 Signal design		**5.3.1 Audio Displays** 5.3.1.7 Audio displays as part of the user interface	**5.3.2 Audio signals** 5.3.2.3 Alerting signals 5.3.2.5 Cueing signals	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.3 Auditory information presentation*** 15.3.1 Valid use of auditory signals 15.3.2 Signal audibility 15.3.3 Signal recognition 15.3.4 Gaining attention 15.3.5 Signal discrimination 15.3.6 Signal meaning 15.3.9 Evaluation of auditory signals	**13 Human-Computer Interface** ***13.10 Audio displays*** 13.10.1 Use 13.10.2 Audio supportive function 13.10.3 Signal characteristics
• *Visual Display*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays information 15.5.5 Contrast 15.5.6 Glare and	**6 Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement 8.6 Control and display movement relationships

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	10.5 Visual Displays 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and Conventions*** 6.1.2 Lighting conditions 6.3 Display luminance setting			reflections 15.5.7 Displayed colour	
• *On/off switch*	**10.6.3 Control Devices** 10.6.3.6 Rocker switches (on/off switch)		**5.1.4.2 Linear controls** 5.1.4.2.1 Discrete adjustment linear controls e. Rocker switches		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.8.4 Rocker switches	**5 Controls** ***5.6 Control Use and Design*** 5.6.10 Rocker switches
• *Software*	***See Software below***					
Software	**10.5.2.9 Software Elements** 10.5.2.9.1 Scrolling 10.5.2.9.2 Navigation 10.5.2.9.3 Selection 10.5.2.9.4 Menus 10.5.2.9.5 Toolbars &	**Part 151: World Wide Web** ***6 High level design decisions and design strategy*** 6.2 Determining purpose of a Web application	**5.1.2.1.4 Feedback c. Computer response** **5.1.2.1.5 Error management** a. Error Correction b. Early detection c. Internal software		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.4 Human-Computer Interaction*** 15.4.1 Introduction 15.4.2 HCI Design	**13 Human-Computer Interface** ***13.1 General Design Requirements*** 13.1.1 General Principles 13.1.2 Navigation

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	Status Bars 10.5.2.9.6 Dialog Boxes **10.5.3 Display Interpretation** **10.5.4 Display Technologies** **10.5.5 Related Display Standards** **10.10 User Interfaces with Automated Systems** 10.10.1 Introduction 10.10.2 Automation 10.10.3 User Interfaces with Mobile Machines	6.3 Analyzing the target user groups 6.4 Analyzing the users' goals and tasks 6.5 Matching application purpose and user goals 6.6 Recognizing the purpose of a Web application 6.7 Prioritizing different design goals 6.8 ICT accessibility 6.9 Software accessibility 6.10 Web content accessibility 6.11 Identifying the website and its owner 6.12 Coherent multi-site strategy ***(Part 151) 7 Content design*** 7.1 Conceptual content model 7.2 Content Objects and functionality ***(Part 151) 8 Navigation and search*** 8.1 general 8.2 General guidance on navigation 8.3 Navigation structure 8.4 Navigation components 8.5 Search ***(Part 151) 9 Content Presentation*** 9.1 General	checks d. Critical entries e. Error message content f. Error recovery and process change g. Diagnostic information h. Correction entry and confirmation i. Spelling errors **5.1.3.5.2 Menu Selection** **5.1.3.5.3 Form Filling** **5.1.3.5.7 Query Language** **5.2.2.5 Graphic and Representational displays** 5.2.2.5.1 Graphical user interfaces **5.2.2.7 Help** 5.2.2.7.3 Online Help 5.2.2.7.4 Browsing Help 5.2.2.7.8 Prompts		Process 15.4.3 Essential HCI Development Activities 15.4.4 Interaction Requirements 15.4.5 Computer-Based Displays 15.4.6 Computer-Based Control	13.1.3 Consistency with Physical/Manual Interfaces 13.1.4 Standard Procedures 13.1.5 Computer Response 13.1.6 Screen Design and Content 13.1.7 Coding 13.1.8 Input Devices 13.1.9 System Status 13.1.10 On-Line Help ***13.2 System Operations*** 13.2.1 Log-on Procedures 13.2.2 Log-off Procedures 13.2.3 Computer Failure 13.2.4 Interaction ***13.11 Data Entry*** 13.11.1 General Requirements 13.11.2 User pacing 13.11.3 Positive Feedback 13.11.4 Processing Display 13.11.5 Explicit Action 13.11.6 Validation 13.11.7 Available Data 13.11.8 Input Units 13.11.9 Buffer 13.11.10 Presentation Mode 13.11.11 Display Window 13.11.12 Data Deletion

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		9.2 Observing principles of human perception 9.3 Page design issues 9.4 Link design 9.5 Interaction objects 9.6 Text design ***(Part 151) 10 General design aspects*** 10.1 Designing for cultural diversity and multilingual use 10.2 Providing Help 10.3 Making Web user interfaces error-tolerant 10.4 URL names 10.5 Acceptable download times 10.6 Using generally accepted technologies and standards 10.7 Supporting common technologies 10.8 Making Web user interfaces robust 10.9 Designing for input device independence 10.10 Making the user interface of embedded objects usable and accessible				13.11.13 Data Change 13.11.14 Single Data Entry Method 13.11.15 Data Entry Display 13.11.16 Data Editing 13.11.17 String Search 13.11.18 Automatic Line Break 13.11.19 Format Control 13.11.20 Frequently Used Text 13.11.21 Control Annotations 13.11.22 Printing Options 13.11.23 Text Length 13.11.24 Justification 13.11.25 Minimization of Keying ***13.13 Graphic Controls*** 13.13.1 Use 13.13.2 Iconic Menus 13.13.3 Supplemental Verbal Labels 13.13.4 Icon Controls 13.13.5 Palettes 13.13.6 Push-buttons 13.13.7 Radio Buttons 13.13.8 Check Boxes 13.13.9 Sliders 13.14 Windows ***13.15 Menus*** 13.15.1 Use 13.15.2 Item Selection 13.15.3 Titles 13.15.4 Series Entry 13.15.5 Sequences

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.15.6 Active Option Presentation 13.15.7 Format Consistency 13.15.8 Option Sequence 13.15.9 Simple Menus 13.15.10 Option Presentation 13.15.11 Direct Function Call 13.15.12 Consistency with Command Language 13.15.13 Option Coding 13.15.14 Keyed Codes 13.15.15 Position in Structure 13.15.16 Back Menu 13.15.17 Return to Top Level ***13.16 Forms*** 13.16.1 Use 13.16.2 Grouping 13.16.3 Format/Content Consistency 13.16.4 Distinctive Fields 13.16.5 Omissions 13.16.6 Protected Areas 13.16.7 Flexible Data Entry 13.16.8 Logical Order 13.16.9 Control Entry 13.16.10 Message Forms ***13.18 Language*** 13.18.1 Command Language 13.18.2 Punctuation

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.18.3 Command Entry 13.18.4 Display Location 13.18.5 Command Prompts 13.18.6 Complexity 13.18.7 Macro Command 13.18.8 Standard Command Editing 13.18.9 Destructive Commands 13.18.10 Questions and Answers 13.18.11 Query Language ***13.19 Feedback*** 13.19.1 Use 13.19.2 Standby 13.19.3 Process Outcome 13.19.4 Input Configuration 13.19.5 Current Modes 13.19.6 Highlighted Selection 13.19.7 Input Rejection 13.19.8 Feedback Messages 13.19.9 Time Delay Warning ***13.20 Prompts*** 13.20.1 Use 13.20.2 Standard Display 13.20.3 Explicit Prompts 13.20.4 Prompt Clarity 13.20.5 Definitions

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.20.6 Consistent Technology 13.20.7 Confirmation ***13.21 Defaults*** 13.21.1 Use 13.21.2 User Selection 13.21.3 Default Substitution 13.21.4 Sequential Defaults ***13.22 Error Management/Data Protection*** 13.22.1 Error Correction 13.22.2 Error Detection 13.22.3 Internal Software Checks 13.22.4 Critical Entries 13.22.5 Error Message Content 13.22.6 Error Recovery 13.22.7 Diagnostic Information 13.22.8 Entry Correction and Confirmation 13.22.9 Spelling Errors 13.22.10 Errors in Stacked Commands (stacked sequences) 13.22.11 Display of Erroneous Entries 13.22.12 File Management ***13.23 Data Security*** 13.23.1 General 13.23.2 Automated Measures 13.23.3 Segregating

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						Real/Simulated Data 13.23.4 Security Classification Display 13.23.5 User Identification ***13.24 Help*** 13.24.1 General 13.24.2 Help Request 13.24.3 Help Content 13.24.4 Multi-Level HELP 13.24.5 Browse/Help 13.24.6 Help Access 13.24.7 Appropriate Help ***13.25 Software*** 13.25.1 General 13.25.2 Information and System Response 13.25.3 Compute Failure 13.25.4 Task Complexity 13.25.5 Interaction ***13.26 Data Transmission/ Messaging*** 13.26.1 Functional Integration 13.26.2 Consistent Procedures 13.26.3 Message Formats 13.26.4 Interruption 13.26.5 Incorporate Existing Files 13.26.6 User Initiation 13.26.7 Transmission Notification

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
						13.26.8 Address Entry Prompt 13.26.9 Incoming Message Control 13.26.10 Data Presentation
Workstation	**8.7.3.4 Fixtures for lighting tasks** **8.7.5 Glare**	**Part 5: Workstation Layout and Postural Requirements** ***4 Guiding Principles*** 4.1 General 4.2 Versatility and Flexibility 4.3 Fit 4.4 Postural Change 4.5 User Information 4.6 Maintainability-Adaptability ***(Part 5) 5 Design Requirements and Recommendations*** 5.1 General 5.2 Postures 5.3 Ease of Adjustment 5.4 Support Surfaces 5.5 Work Chair 5.6 Additional Support Elements 5.7 Layout of Workstations Within the Work Space	**5.2.1.3.13 Display adjacent surfaces** **5.2.3.13.13 Glare** **5.5.3 Illuminance** ***5.5.3.1.1 General*** 5.5.3.1.1 d. Illumination source distribution to reduce glare **5.7.7 General Equipment-related Hazards** **5.10 Workspace Design** 5.10.1 General 5.10.2 Workspace provision 5.10.3 Workstation design 5.10.4 Special-purpose console design **5.14 Peripherals**	**5.7 Workspace Design** ***5.7.1 General*** ***5.7.2 Standing Operations*** 5.7.2.1 General 5.7.2.2 Advantages 5.7.2.3 Work Surface 5.7.2.4 Equipment placement 5.7.2.5 Dimensions ***5.7.3 Seated Operations*** 5.7.3.1 Advantages 5.7.3.2 Seating 5.7.3.3 Cushioning 5.7.3.4 Armrests 5.7.3.5 Footrests 5.7.3.6 Temporary Seats 5.7.3.7 Mobile Workspace ***5.7.5 Standard console design*** 5.7.5.1 Display surfaces 5.7.5.2 Control surfaces ***5.7.7 Stairs, ladders, and ramps*** 5.7.7.1 General criteria 5.7.7.2 Stairs 5.7.7.3 Ladders 5.7.7.4 Ramps 5.7.7.6 Elevators, inclinators, and hydraulic-operated work	**Part 3: Technical Guidance – Section 13 The Workplace** ***13.2 Workplace Design*** 13.2.3 Design Principles 13.2.4 General Layout 13.2.5 Specific Requirements for Workstations 13.2.6 Working Environment 13.2.7 Approaches and Methods to Workplace Design 13.2.8 Workspace Design Reviews ***13.3 Workspace and Task Lighting*** 13.3.1 Introduction 13.3.2 Photometry and Colorimetry 13.3.3 Lighting Design Practice 13.3.4 Daylight 13.3.5 Lighting Equipment 13.3.6 Energy Considerations 13.3.8 Display Screen Equipment Lighting 13.3.9 Safety-Related Lighting	**3 Terminology** 3.1.48 Glare **10 Workplace Arrangements** ***10.1 Basic Principles of Workplace Design*** 10.1.7 Control/Display Accessibility ***10.2.4 Computer Workstation*** ***10.3.4 Display Mounting*** **14 Habitability** ***14.1 Noise*** 14.1.1. Maximum Levels 14.1.2 Maximum Exposure and Protection ***14.2 Indoor Climate*** 14.2.1 Design Requirement 14.2.2 Temperature 14.2.3 Relative Humidity 14.2.4 Temperature/ Humidity Design 14.3 Lighting 14.3.1 General Design Requirements 14.3.2 Location 14.3.5 Lighting Levels 14.3.6 Brightness Ratio 14.3.7 Wall Surface

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
				platforms ***5.7.8 Ingress & egress*** 5.7.8.1 Routine 5.7.8.2 Non-routine 5.7.8.3 Walkways & Passageways **5.8 Environment** ***5.8.1 Heating, ventilating, and air conditioning*** 5.8.1.1 Heating 5.8.1.4 Environmental Factors 5.8.1.5 Thermal tolerance and comfort zones ***5.8.2 Illuminance*** 5.8.2.1 General 5.8.2.2 Illumination levels and distribution 5.8.2.3 Lighting fixtures 5.8.2.4 Brightness ratios 5.8.2.5 Glare 5.8.2.6 Reflectance 5.8.2.7 Dark adaptation ***5.8.4 Vibration*** 5.8.4.1 Whole-body vibration 5.8.4.2 Equipment vibration		Reflectance 14.3.8 Other Lighting Requirement
Keyboard		**Part 4 Keyboard Requirements** ***6 Design Requirements and Recommendations*** 6.1 General Design of the Keyboard 6.2 Design of Keys ***(Part 4) 7 Measurement***	**5.1.3 Computer controls** 5.1.3.2 Keyboards 5.1.3.3 Mouse/ trackballs/joysticks 5.1.3.4 Data entry	**5.4.3.1.3. Keyboards, keypads, keysets, and menu selectors** ***5.4.3.1.3.1 Use*** ***5.4.3.1.3.2 Keyboards*** 5.4.3.1.3.2.1 Mounting 5.4.3.1.3.2.2 Function control	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.9.1 Keyboards/ Membrane Keys 15.6.9.2 Keypads 15.6.12.2 Mouse	**13 Human-Computer Interface** ***13.27 Input Devices*** 13.27.2 Keyboard Use 13.27.11 Mouse Use 13.27.14 Input Device Interchangeability/ Redundancy

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		7.1 General 7.2 General Design of the Keyboard 7.3 Design of Keys		***5.4.3.1.3.3 Keypads*** 5.4.3.1.3.3.1 Mounting 5.4.3.1.3.3.2 Actuating force 5.4.3.1.3.3.3 Function control ***5.4.3.1.3.4 Dedicated keysets*** ***5.4.3.1.3.5 Multi-function (programmable) keysets***		
Monitor		**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design Viewing Distance 5.2 Line-of-sight Angle 5.3 Angle of View 5.4 Character Height 5.5 Stroke Width 5.6 Character Width-to-Height Ratio 5.8 Character Format 5.9 Character Size Uniformity 5.10 Between-Character-Spacing 5.11 Between-Word Spacing 5.12 Between-Line Spacing 5.13 Linearity 5.14 Orthogonality 5.15 Display Luminance 5.16 Luminance Contrast 5.17 Luminance Balance	**5.1.3.1.9 Parallax and glare** **5.1.3.10 Touch screen viewing angle** **5.2.1.3.10 Glare of visual displays** **5.2.1.3.11 Reflected glare of visual displays** **5.2.1.3.12 Polarized/tinged glass for visual displays** **5.2.1.3.13 Display adjacent surfaces** **5.2.1.13.13 Glare**	**5.2 Visual displays** ***5.2.1 General*** 5.2.1.2 Display illumination and light distribution 5.2.1.3 Information ***5.2.2 Trans-illuminated displays*** 5.2.2.1 General 5.2.2.2 Legend lights 5.2.2.3 Simple indicator lights 5.2.2.4 Trans-illuminated panel assemblies		**3 Terminology** 3.1.48 Glare **13 Human-Computer Interface** ***13.3 Computer Displays*** 13.3.1 Design Criteria 13.3.2 Luminance 13.3.3 Contrast Ratio 13.3.4 Refresh Rate 13.3.5 Monochromatic Color Combinations 13.3.6 Resolution and Display Size 13.3.7 Flat Panel Image Formation Time 13.3.8 Flicker 13.3.9 Jitter 13.3.10 Glare ***13.27 Input Devices*** 13.27.5.4 Touchscreen parallax and glare **15 Labeling** 15.1.9 Character/ Background color

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		5.18 Glare 5.19 Image Polarity 5.20 Luminance Uniformity 5.21 Luminance Coding 5.22 Blink Coding 5.23 Temporal Instability (Flicker) 5.24 Spatial Instability (Jitter) 5.25 Screen Image Color ***(Part 3) 6.6 Specific Measurements*** (Like above but Specific)				
Bar Code Scanner						
• *Software*	***See Software Above***					
• *Display*	***See Visual Display under High Resolution Digital Camera above***					
• *On/off switch*	**10.6.3 Control Devices** 10.6.3.6 Rocker switches (on/off switch)		**5.1.4.2 Linear controls** 5.1.4.2.1 Discrete adjustment linear controls e. Rocker switches		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.8.4 Rocker switches	**5 Controls** ***5.6 Control Use and Design*** 5.6.10 Rocker switches
Fingerprint Scanner & components:			**5.1.3.1.9 Parallax and glare (touch screen devices)** **5.1.3.10 Touch screen viewing angle**			
• *Platen*						
• *Software*	***See Software above***					
• *Keypad*	**10.6.2 Design Characteristics** **10.6.3 Control Devices** 10.6.3.3 Keyboard (includes keypad)	**Part 4: Keyboard requirements** ***6.2 Design of keys*** 6.2.4 Keying feedback 6.2.8 Key legends	**5.1.3.2 Keyboards** 5.1.3.2.1 Layout and configuration	**5.4.3.1.3 Keyboards, keypads, keysets, and menu selectors** 5.4.3.1.3.3 Keypads	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6.9 Preferred Physical Specifications for Data***	

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		6.2.10 Numeric keypad			***Entry: Keyed*** 15.6.9.1 Keyboards/ Membrane keys 15.6.9.2 Keypads	
• *Display*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	**6.Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement 8.6 Control and display movement relationships

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		5.25 Screen image color ***(Part 3) 6 Measurement Conditions and Conventions*** 6.1.2 Lighting conditions 6.3 Display luminance setting				
L1 Graphic User Interface (software)	**10.2.5 Distinction** 10.2.5.1 Visual & Auditory 10.2.5.2 Operational 10.2.5.3 Syntax 10.2.5.4 Spatial & Grouping **10.2.6 Feedback** 10.2.6.1 Types 10.2.6.2 Timing **10.5.2.9 Software Elements** 10.5.2.9.1 Scrolling 10.5.2.9.2 Navigation 10.5.2.9.3 Selection 10.5.2.9.4 Menus 10.5.2.9.5 Toolbars & Status Bars 10.5.2.9.6 Dialog Boxes **10.3 Layout of Displays and Controls** 10.3.2 Locations and Arrangements 10.3.3 Groupings 10.3.4 Display-Control Relationships **10.4 Visual Acquisition of Display** 10.4.1 Display Content 10.4.2 Minimal Information	**Part 6: Ergonomic requirements for office work with visual display terminals (VDTs) Guidance on the Work Environment** ***5 Guidance on Natural and Artificial Lighting*** 5.1 General 5.2 Basic Aspects 5.3 Luminance Distribution in the Work Space 5.4 Glare Control **Part 12: Ergonomic requirements for office work with VDTs – Presentation of information** ***5 Organization of Information*** 5.1 Location of Information 5.2 Appropriateness of Windows 5.3 Recommendations for Windows 5.4 Areas 5.5 Input/output Area 5.6 Groups 5.7 Lists	**5.1.2.1.4 Feedback c. Computer response** **5.1.2.1.5 Error management** a. Error Correction b. Early detection c. Internal software checks d. Critical entries e. Error message content f. Error recovery and process change g. Diagnostic information h. Correction entry and confirmation i. Spelling errors **5.1.3.5.2 Menu Selection** **5.1.3.5.3 Form Filling** **5.1.3.5.7 Query Language** **5.2.2.5 Graphic and Representational displays** 5.2.2.5.1 Graphical user interfaces **5.2.2.7 Help** 5.2.2.7.3 Online Help 5.2.2.7.4 Browsing Help 5.2.2.7.8 Prompts **5.4 Labeling** 5.4.1 General 5.4.2 Orientation 5.4.3 Location		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2.3 Labeling*** ***15.2.4 Use of Color*** 15.2.4.1 Color Coding 15.2.4.2 Color Coding 15.2.4.3 Redundant Coding 15.2.4.4 Contract and Legibility 15.2.4.5 Color and Size 15.2.4.6 Color Vision 15.2.4.7 Using Color in Design ***15.2.5 Coding – alphanumeric or graphical short forms used to represent information*** 15.2.5.1 Alphanumeric Coding 15.2.5.2 Graphical Coding 15.2.5.3 Flash Coding 15.2.5.4 Shape and Size Coding 15.2.5.5 String Length 15.2.5.6 Coding by Type Size and Style 15.2.5.7 Blink Coding	**13 Human-Computer Interface** ***13.1 General Design Requirements*** 13.1.1 General Principles 13.1.2 Navigation 13.1.3 Consistency with Physical/Manual Interfaces 13.1.4 Standard Procedures 13.1.5 Computer Response 13.1.6 Screen Design and Content 13.1.7 Coding 13.1.8 Input Devices 13.1.9 System Status 13.1.10 On-Line Help ***13.2 System Operations*** 13.2.1 Log-on Procedures 13.2.2 Log-off Procedures 13.2.3 Computer Failure 13.2.4 Interaction ***13.3 Computer Displays*** 13.3.1 Design Criteria 13.3.2 Luminance 13.3.3 Contrast Ratio

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	10.4.3 Effective and Consistent Verbiage 10.4.4 Data Density 10.4.5 Information Access 10.4.6 Graphics **10.5 Display Metrics** ***10.5.2 Display Metrics*** 10.5.2.9 Software Elements 10.5.2.9.1 Scrolling 10.5.2.9.2 Navigation 10.5.2.9.3 Selection 10.5.2.9.4 Menus 10.5.2.9.5 Toolbars & Status Bars 10.5.2.9.6 Dialog Boxes ***10.5.3 Display Interpretation*** ***10.5.4 Display Technologies*** ***10.5.5 Related Display Standards*** **10.10 User Interfaces with Automated Systems** 10.10.1 Introduction 10.10.2 Automation 10.10.3 User Interfaces with Mobile Machines	5.8 Tables 5.9 Labels 5.9.1 Labeling Screen Elements 5.9.2 Label Designation 5.9.3 Grammatical Construction of Labels 5.9.4 Label Position 5.9.5 Distinction of Labels and Associated Information 5.9.6 Label Format and Alignment 5.9.7 Labels for Units of Measurement 5.10 Fields ***(Part 12) 6 Graphical Objects*** 6.1 General Recommendations for Graphical Objects 6.2 Cursors & Pointers 6.2.1 Designation of Cursor and Pointer Position 6.2.2 Cursor Occlusion of Characters 6.2.3 Cursor and Pointer Location 6.2.4 Cursor "home" Position 6.2.5 Initial Position for Entry Fields 6.2.6 Point Designation Accuracy 6.2.7 Different Cursors/Pointers 6.2.8 Active	5.4.4 Contents 5.4.5 Readability qualities 5.4.6 Design of Label Characteristics 5.4.7 Equipment Labeling 5.4.8 Labeling for Identification		15.2.5.8 Luminance Coding ***15.2.7 Use of Text*** 15.2.7.2 Accurate, fast comprehension: design checklist 15.2.7.3 Format 15.2.7.4 Character Typeface 15.2.7.5 Typographical cueing 15.2.7.6 Continuous Text 15.2.7.7 Emphasizing Text 15.2.7.8 Instructions 15.2.7.9 Text format: Design Checklist ***15.2.8 Use of Windows – a means of organizing the display screen to support usability*** 15.2.8.2 Paging, Scrolling and Panning ***15.2.9 Display Formats*** 15.2.9.1 Structured Data Fields 15.2.9.2 Free Text fields 15.2.9.3 Forms 15.2.9.4 Tables 15.2.9.5 Graphical Format ***15.2.10 Graphical Information*** 15.2.10.2 Representative Graphics 15.2.10.3 Diagrammatic Graphics	13.3.4 Refresh Rate 13.3.5 Monochromatic Color Combinations 13.3.6 Resolution and Display Size 13.3.7 Flat Panel Image Formation Time 13.3.8 Flicker 13.3.9 Jitter 13.3.10 Glare ***13.4 Display Content*** 13.4.1 Standardization 13.4.2 Information Density 13.4.3 Data Display Consistency ***13.8 Textual Data Displays*** 13.8.1 Use 13.8.2 Character Formats 13.8.3 Brevity 13.8.4 Abbreviations and Acronyms 13.8.5 Print Layout ***13.9 Graphic Displays*** 13.9.1 Use 13.9.2 Recurring Data 13.9.3 Refresh Rates 13.9.4 Line Format 13.9.5 Trend Lines 13.9.6 Pointing 13.9.7 Distinctive Cursor 13.9.8 Precise Positioning 13.9.9 Selecting Graphic Elements 13.9.10 Easy Storage

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		Cursor/Pointer 6.2.9 Multiple Cursors and Pointers ***(Part 12) 7 Coding Techniques*** 7.1 General Recommendations for Codes 7.2 Alphanumeric Coding 7.3 Abbreviations for Alphanumeric Codes 7.4 Graphical Coding 7.5 Color Coding **Part 13: Ergonomic requirements for office work with VDTs – User guidance** ***6 Prompts*** 6.1 Description 6.2 Prompting Recommendations ***(Part 13) 7 Feedback*** 7.1 Description 7.2 Feedback Recommendations ***(Part 13) 8 Status Information*** 8.1 Description 8.2 Status Recommendations ***(Part 13) 9 Error Management*** 9.1 Description 9.2 Error Prevention 9.3 Error Correction by the System 9.4 Error Management			15.2.10.4 Iconic Graphics ***15.4 Human-Computer Interaction*** 15.4.1 Introduction 15.4.2 HCI Design Process 15.4.3 Essential HCI Development Activities 15.4.4 Interaction Requirements 15.4.5 Computer-Based Displays 15.4.6 Computer-Based Control 15.4.7 Support Facilities -embedded training 15.4.7.1 System documentation 15.4.7.2 User support and training 15.4.7.3 On-Line help 15.4.7.4 Help and Error messages ***15.5 Discrete Displays*** 15.5.1 Context of Use 15.5.2 Viewing Position 15.5.3 Size of Displayed Information 15.5.4 Parallax 15.5.5 Contrast 15.5.6 Glare and Reflections 15.5.7 Displayed Color 15.5.8 Electronic Display Characteristics 15.5.9 Display Standards 15.5.11 Selection of	and Retrieval 13.9.11 Automatic Data Registration 13.9.12 Graphic Formats 13.9.13 Derivation of Graphical Data 13.9.14 Drawing Lines 13.9.15 Resizing 13.9.16 Highlighting Data 13.9.17 Reference Index 13.9.18 Annotation of Data 13.9.19 Label Orientation ***13.11 Data Entry*** 13.11.1 General Requirements 13.11.2 User pacing 13.11.3 Positive Feedback 13.11.4 Processing Display 13.11.5 Explicit Action 13.11.6 Validation 13.11.7 Available Data 13.11.8 Input Units 13.11.9 Buffer 13.11.10 Presentation Mode 13.11.11 Display Window 13.11.12 Data Deletion 13.11.13 Data Change 13.11.14 Single Data Entry Method 13.11.15 Data Entry Display

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		by the User 9.5 Error Messages ***(Part 13)10 Online Help*** 10.1 Description 10.2 System-initiated Help 10.3 User-initiated Help 10.4 Presentation of Help Information 10.5 Help Navigation and Controls 10.6 Browsable Help 10.7 Context-Sensitive Help **Part 14 Ergonomic requirements for office work with VDTs – Menu Dialogues** ***5 Menu Structure*** 5.1 Structuring into Levels and Menus 5.2 Grouping Options within a Menu 5.3 Sequencing of Options within Groups ***(Part 14) 6 Menu Navigation*** 6.1 Navigation Cues 6.2 Rapid Navigation ***(Part 14) 7 Option Selection and Execution*** 7.1 Selection Methods 7.2 Alphanumeric Keyboard 7.3 Function Keys 7.4 Cursor Key Selection 7.5 Pointing 7.6 Voice			Display Technology	13.11.16 Data Editing 13.11.17 String Search 13.11.18 Automatic Line Break 13.11.19 Format Control 13.11.20 Frequently Used Text 13.11.21 Control Annotations 13.11.22 Printing Options 13.11.23 Text Length 13.11.24 Justification 13.11.25 Minimization of Keying ***13.14 Windows*** 13.14.1 Use 13.14.2 Primary and Secondary Windows 13.14.3 Window Location 13.14.4 Multiple Windows 13.14.5 Window Navigation 13.14.6 Window Shifting 13.14.7 Window Organization 13.14.8 Title Bar 13.14.9 Status Bar 13.14.10 Tool Bars 13.14.11 Control Consistency 13.14.12 Active Windows 13.14.13 Moving Windows

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		(Part 14) 8 Menu Presentation 8.1 Option Accessibility and Discrimination **Part 151: Guidance on World Wide Web user interfaces** ***6 High level design decisions and design strategy*** 6.2 Determining purpose of a Web application 6.3 Analyzing the target user groups 6.4 Analyzing the users' goals and tasks 6.5 Matching application purpose and user goals 6.6 Recognizing the purpose of a Web application 6.7 Prioritizing different design goals 6.8 ICT accessibility 6.9 Software accessibility 6.10 Web content accessibility 6.11 Identifying the website and its owner 6.12 Coherent multi-site strategy ***(Part 151) 7 Content design*** 7.1 Conceptual content model 7.2 Content Objects and functionality				13.14.14 Window Sizing 13.14.15 Scrolling 13.14.16 Zooming 13.14.17 Window Menus 13.14.18 Window Toolbars 13.14.19 Message Windows ***13.15 Menus*** 13.15.1 Use 13.15.2 Item Selection 13.15.3 Titles 13.15.4 Series Entry 13.15.5 Sequences 13.15.6 Active Option Presentation 13.15.7 Format Consistency 13.15.8 Option Sequence 13.15.9 Simple Menus 13.15.10 Option Presentation 13.15.11 Direct Function Call 13.15.12 Consistency with Command Language 13.15.13 Option Coding 13.15.14 Keyed Codes 13.15.15 Position in Structure 13.15.16 Back Menu 13.15.17 Return to Top Level ***13.16 Forms*** 13.16.1 Use 13.16.2 Grouping

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		(Part 151) 8 Navigation and search 8.1 general 8.2 General guidance on navigation 8.3 Navigation structure 8.4 Navigation components 8.5 Search ***(Part 151) 9 Content Presentation*** 9.1 General 9.2 Observing principles of human perception 9.3 Page design issues 9.4 Link design 9.5 Interaction objects 9.6 Text design ***(Part 151) 10 General design aspects*** 10.1 Designing for cultural diversity and multilingual use 10.2 Providing Help 10.3 Making Web user interfaces error-tolerant 10.4 URL names 10.5 Acceptable download times 10.6 Using generally accepted technologies and standards 10.7 Supporting common technologies 10.8 Making Web user interfaces robust 10.9 Designing for input device independence				13.16.3 Format/Content Consistency 13.16.4 Distinctive Fields 13.16.5 Omissions 13.16.6 Protected Areas 13.16.7 Flexible Data Entry 13.16.8 Logical Order 13.16.9 Control Entry 13.16.10 Message Forms ***13.20 Prompts*** 13.20.1 Use 13.20.2 Standard Display 13.20.3 Explicit Prompts 13.20.4 Prompt Clarity 13.20.5 Definitions 13.20.6 Consistent Technology 13.20.7 Confirmation ***13.21 Defaults*** 13.21.1 Use 13.21.2 User Selection 13.21.3 Default Substitution 13.21.4 Sequential Defaults ***13.22 Error Management/Data Protection*** 13.22.1 Error Correction 13.22.2 Error Detection 13.22.3 Internal Software Checks 13.22.4 Critical Entries 13.22.5 Error Message Content

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		10.10 Making the user interface of embedded objects usable and accessible				13.22.6 Error Recovery 13.22.7 Diagnostic Information 13.22.8 Entry Correction and Confirmation 13.22.9 Spelling Errors 13.22.10 Errors in Stacked Commands (stacked sequences) 13.22.11 Display of Erroneous Entries 13.22.12 File Management ***13.24 Help*** 13.24.1 General 13.24.2 Help Request 13.24.3 Help Content 13.24.4 Multi-Level HELP 13.24.5 Browse/Help 13.24.6 Help Access 13.24.7 Appropriate Help ***13.26 Data Transmission/ Messaging*** 13.26.1 Functional Integration 13.26.2 Consistent Procedures 13.26.3 Message Formats 13.26.4 Interruption 13.26.5 Incorporate Existing Files 13.26.6 User Initiation 13.26.7 Transmission Notification

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
						13.26.8 Address Entry Prompt 13.26.9 Incoming Message Control 13.26.10 Data Presentation
Signature Pad & components:	**10.6.3.26 Other Controls**					**13 Human-Computer Interface** ***13.27 Input Devices*** 13.27.5 Touchscreen Use 13.27.10 Grid and Stylus Devices
• *Stylus*	**10.6.3 Control Devices** 10.6.3.16 Stylus		**5.1.3.3.5 Grid-and-stylus devices**	**5.4.3.2.5 Grid-and-stylus devices**	**Part 3: Technical Guidance** ***15.6 Discrete Controls*** 15.6.12.1 Digitising tablet	**13 Human-Computer Interface** ***13.27 Input Devices*** 13.27.10 Grid and stylus devices
• Display	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	**6.Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement 8.6 Control and display movement relationships

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and Conventions*** 6.1.2 Lighting conditions 6.3 Display luminance setting				
• *Software*	***See Software above***					
Computer/Laptop	**10.10 User Interfaces with Automated Systems** 10.10.1 Introduction 10.10.2 Automation 10.10.3 User Interfaces with Mobile Machines				**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.4 Human-Computer Interaction*** 15.4.1 Introduction 15.4.2 HCI Design Process 15.4.3 Essential HCI Development Activities 15.4.4 Interaction Requirements 15.4.5 Computer-Based Displays 15.4.6 Computer-Based Control	**13 Human-Computer Interface** ***13.1 General Design Requirements*** 13.1.1 General Principles 13.1.2 Navigation 13.1.3 Consistency with Physical/Manual Interfaces 13.1.4 Standard Procedures 13.1.5 Computer Response 13.1.6 Screen Design and Content

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.1.7 Coding 13.1.8 Input Devices 13.1.9 System Status 13.1.10 On-Line Help ***13.2 System Operations*** 13.2.1 Log-on Procedures 13.2.2 Log-off Procedures 13.2.3 Computer Failure 13.2.4 Interaction ***13.3 Computer Displays*** 13.3.1 Design Criteria 13.3.2 Luminance 13.3.3 Contrast Ratio 13.3.4 Refresh Rate 13.3.5 Monochromatic Color Combinations 13.3.6 Resolution and Display Size 13.3.7 Flat Panel Image Formation Time 13.3.8 Flicker 13.3.9 Jitter 13.3.10 Glare ***13.4 Display Content*** 13.4.1 Standardization 13.4.2 Information Density ***13.8 Textual Data Displays*** 13.8.1 Use 13.8.2 Character Formats 13.8.3 Brevity 13.8.4 Abbreviations and Acronyms 13.8.5 Print Layout

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.9 Graphic Displays 13.9.1 Use 13.9.2 Recurring Data 13.9.3 Refresh Rates 13.9.4 Line Format 13.9.5 Trend Lines 13.9.6 Pointing 13.9.7 Distinctive Cursor 13.9.8 Precise Positioning 13.9.9 Selecting Graphic Elements 13.9.10 Easy Storage and Retrieval 13.9.11 Automatic Data Registration 13.9.12 Graphic Formats 13.9.13 Derivation of Graphical Data 13.9.14 Drawing Lines 13.9.15 Resizing 13.9.16 Highlighting Data 13.9.17 Reference Index 13.9.18 Annotation of Data 13.9.19 Label Orientation 13.9.20 Pictorial Symbols 13.9.21 Display of Scale 13.9.22 Grids 13.9.23 Graphic Comparison 13.9.24 Bar Graphs 13.9.25 Maps 13.9.26 Mimics ***13.27 Input Devices***

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.27.1 Input Devices 13.27.2 Keyboard Use 13.27.3 Fixed Function Keys 13.27.4 Variable Action 13.27.5 Touchscreen Use 13.27.6 Pointing Devices 13.27.7 Joysticks 13.27.8 Thumb Tip and Fingertip-Operated Displacement Joysticks 13.27.9 Trackball 13.27.10 Grid and Stylus Devices 13.27.11 Mouse Use 13.27.12 Light Pen 13.27.13 Speech Recognition Use 13.27.14 Input Device Interchangeability/ Redundancy

B.2: TSA

Locations: Over 405 airports across the U.S.
Environment: Airports (heavy passenger flow with high pressure; dust and dirt; glare from glass to outside and sunlight)

Transportation Security Officers (TSOs): 43,000
Security Inspectors: 1,000
Passengers screened: over 2,000,000 per day
Baggage screening locations: 7,000
Bags screened: millions per day

TSO Tasks: passenger and baggage screening

Equipment:

- Hand-held black light
- Walk-through metal detector
- Threat image protection x-ray machine
- Hand-held (wand) metal detector
- Whole body image scanner
- Cast and prosthesis imager
- Explosive trace detection machine
- Chemical detection scanner
- Bottled liquid scanner
- Workstation
- Keyboard
- Monitor (single or dual, for luggage scanners)
- Barcode scanner
- Software

Table 4: TSA Devices and Existing Standards

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
Software	**10.5.2.9 Software Elements** 10.5.2.9.1 Scrolling 10.5.2.9.2 Navigation 10.5.2.9.3 Selection 10.5.2.9.4 Menus 10.5.2.9.5 Toolbars & Status Bars 10.5.2.9.6 Dialog Boxes **10.5.3 Display Interpretation** **10.5.4 Display Technologies** **10.5.5 Related Display Standards** **10.10 User Interfaces with Automated Systems** 10.10.1 Introduction 10.10.2 Automation 10.10.3 User Interfaces with Mobile Machines	**Part 151: Guidance on World Wide Web user interfaces** ***6 High level design decisions and design strategy*** 6.2 Determining purpose of a Web application 6.3 Analyzing the target user groups 6.4 Analyzing the users' goals and tasks 6.5 Matching application purpose and user goals 6.6 Recognizing the purpose of a Web application 6.7 Prioritizing different design goals 6.8 ICT accessibility 6.9 Software accessibility 6.10 Web content accessibility 6.11 Identifying the website and its owner 6.12 Coherent multi-site strategy ***(Part 151) 7 Content design*** 7.1 Conceptual content model 7.2 Content Objects and functionality ***(Part 151) 8 Navigation and search*** 8.1 general 8.2 General guidance on navigation 8.3 Navigation structure 8.4 Navigation components 8.5 Search	**Part 5 Menu Structure** ***5.1 Structuring into Levels and Menus*** 5.1.3.5.2 Menu Selection 5.1.3.5.2. a. Use 5.1.3.5.2. b. Selection ***5.2 Grouping Options within a Menu*** ***5.3 Sequencing of Options with Groups*** ***5.14.8.12 Help*** 5.14.8.12.1 Standard Action to Request Help 5.14.8.12.2 Multilevel Help 5.14.8.12.3 Browsing Help ***6 Menu Navigation*** 6.1 Navigation Cues 6.2 Rapid Navigation ***8 Menu Presentation*** 8.1 Option Accessibility and Discrimination ***10 Online Help*** 10.1 Description 10.2 System-initiated Help 10.3 User-initiated Help 10.4 Presentation of Help Information 10.5 Help Navigation and Controls 10.6 Browsable Help 10.7 Context-Sensitive Help	**5.4.3 Linear Controls** 5.4.3.1.3 Keyboards, keypads, keysets, and menu selectors e. Menu Selection	**15.4 Human-Computer Interaction** 15.4.1 Introduction 15.4.2 HCI Design Process 15.4.3 Essential HCI Development Activities 15.4.4 Interaction Requirements 15.4.5 Computer-Based Displays 15.4.6 Computer-Based Control	

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		(Part 151) 9 Content Presentation 9.1 General 9.2 Observing principles of human perception 9.3 Page design issues 9.4 Link design 9.5 Interaction objects 9.6 Text design ***(Part 151) 10 General design aspects*** 10.1 Designing for cultural diversity and multilingual use 10.2 Providing Help 10.3 Making Web user interfaces error-tolerant 10.4 URL names 10.5 Acceptable download times 10.6 Using generally accepted technologies and standards 10.7 Supporting common technologies 10.8 Making Web user interfaces robust 10.9 Designing for input device independence 10.10 Making the user interface of embedded objects usable and accessible				
Black light						
• *Power switch*	**10.6.3 Control Devices** 10.6.3.6 Rocker switches (on/off switch)		**5.1.4.2 Linear controls** 5.1.4.2.1 Discrete adjustment linear controls e. Rocker switches		**Part 3: Technical Guidance – Section 15 Work Equipment]** ***15.6 Discrete Controls*** 15.6.8.4 Rocker switches	**5 Controls** ***5.6 Control Use and Design*** 5.6.10 Rocker switches
Walk through metal detector						

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
• *Control pad*	**10.6.2 Design Characteristics** **10.6.3 Control Devices** 10.6.3.3 Keyboard (includes keypad)	**Part 4 Keyboard requirements** ***6.2 Design of keys*** 6.2.4 Keying feedback 6.2.8 Key legends 6.2.10 Numeric keypad	**5.1.3.2 Keyboards** 5.1.3.2.1 Layout and configuration	**5.4.3.1.3 Keyboards, keypads, keysets, and menu selectors** 5.4.3.1.3.3 Keypads	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6.9 Preferred Physical Specifications for Data Entry: Keyed*** 15.6.9.1 Keyboards/ Membrane keys 15.6.9.2 Keypads	
• *Visual warning indicator*			**5.7.3 Visual displays** 5.7.3.2 Warning/caution		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.7.3 Alarm displays*** 15.7.3.1 Display modalities 15.7.3.2 System design 15.7.3.3 Design recommendations 15.6.3.4 Factors affecting detection 15.6.3.5 Flashing and apparent motion 15.7.4 Alarms system design process	**7 Alarms** ***7.2 Visual Alarms*** 7.2.1 Types of alarms 7.2.2 Flash rate 7.2.3 Alarms and normal operations 7.2.4 Priority coding 7.2.5 Flasher failure 7.2.6 Contrast detection 7.2.7 Text visibility and legibility 7.2.8 Text wording 7.2.9 Color coding 7.2.10 Visual/auditory alarms 7.2.11 Visual alarm panels 7.2.12 Supplemental alarm information
Threat Image Protection Full Body Scanner						
• *Control pad*	**10.6.2 Design Characteristics** **10.6.3 Control Devices** 10.6.3.3 Keyboard (includes keypad)	**Part 4: Keyboard requirements** ***6.2 Design of keys*** 6.2.4 Keying feedback 6.2.8 Key legends 6.2.10 Numeric keypad	**5.1.3.2 Keyboards** 5.1.3.2.1 Layout and configuration	**5.4.3.1.3 Keyboards, keypads, keysets, and menu selectors** 5.4.3.1.3.3 Keypads	**Part 3: Technical Guidance – Section 15 Work Equipment** **15.6.9 Preferred Physical Specifications for Data Entry: Keyed** 15.6.9.1 Keyboards/ Membrane keys	

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
					15.6.9.2 Keypads	
• *Operator/remote operator display*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and Conventions*** 6.1.2 Lighting conditions 6.3 Display luminance setting	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	**6 Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement 8.6 Control and display movement relationships
• *Audible warning indicator*	**10.8 Audio Displays** 10.8.3 Selection of signal		**5.3.1.2 Audio signals** 5.3.1.2.1 Warning signals	**5.3.2 Audio signals** 5.3.2.1 Warning signals	**Part 3: Technical Guidance – Section 15**	**7 Alarms** ***7.1 General alarm***

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	type 10.8.5 Signal design 10.8.8 Auditory alarms		5.3.1.2.2 Caution signals 5.3.1.2.3 Alerting signals 5.3.1.2.5 Prioritization **5.3.1.3 Characteristics of warning signals** 5.3.1.3.1 Warning recognition time 5.3.1.3.2 Control of warning signals 5.3.1.3.3 Frequency **5.3.1.4 Signal characteristics in relation to operational conditions and objectives** 5.3.1.4.1 Audibility 5.3.1.4.2 Alerting capacity 5.3.1.4.3 Discriminability 5.3.1.4.5 Masking	5.3.2.2 Caution signals 5.2.3.3 Alerting signals 5.2.3.4 Advisory signals 5.2.3.5 Cueing signals 5.2.3.6 Prioritization **5.3.3 Characteristics of audio warning signals** 5.3.3.1 Characteristics of audio warning signals 5.3.3.2 Control of warning signals 5.3.3.3 Compatibility with existing signal codes	**Work Equipment** ***15.3 Auditory Information Presentation*** 15.3.2 Signal audibility 15.3.3 Signal recognition 15.3.4 Gaining attention 15.3.5 Signal discrimination 15.3.6 Signal meaning 15.3.7. Requirements for specific auditory signals ***15.7 Alarms, Warning and Cautions*** 15.7.2 System design issues 15.7.3 Alarm displays 15.7.4 Alarm system design process	***requirements*** 7.1.3 Types of alarms 7.1.4 Alarm response requirement 7.1.5 Alarm acknowledge requirement 7.1.6 Alarm rates 7.1.7 Set points 7.1.8 False alarms 7.1.9 Simultaneous alarms 7.1.10 Alarm priorities ***7.3 Audible alarms*** 7.3.1 Audible alarms for emergency response 7.3.2 Content 7.3.3 Sound character 7.3.4 Number of distinct tones for alarms 7.3.6 Signal audio signal 7.3.7 Differing signals 7.3.8 Selection of sounds
• *Visual warning indicator*			**5.7.3 Visual displays** 5.7.3.2 Warning/caution		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.7.3 Alarm displays*** 15.7.3.1 Display modalities 15.7.3.2 System design 15.7.3.3 Design recommendations 15.6.3.4 Factors affecting detection 15.6.3.5 Flashing and apparent motion 15.7.4 Alarms system design process	**7.Alarms** ***7.2 Visual Alarms*** 7.2.1 Types of alarms 7.2.2 Flash rate 7.2.3 Alarms and normal operations 7.2.4 Priority coding 7.2.5 Flasher failure 7.2.6 Contrast detection 7.2.7 Text visibility and legibility 7.2.8 Text wording 7.2.9 Color coding 7.2.10 Visual/auditory alarms

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
						7.2.11 Visual alarm panels 7.2.12 Supplemental alarm information
• *Software*	***See Software above***					
Portable Metal Detector						
• *On-off-silent 3-way switch*	**10.6.3 Control devices** 10.6.3.20 Rotary selector switches		**5.1.4 Mechanical controls** ***5.1.4.1 Rotary controls*** 5.1.4.1.1. Discrete adjustment rotary controls (rotary switch)	**5.4 Controls** 5.4.2 Rotary controls	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6.1.5 Control types*** ***15.6.6 Preferred physical specifications for discrete operation: rotary*** 15.6.6.1 Selector switch	**5 Controls** **5.6 Control Use and Design** 5.6.4 Discrete rotary controls
• *Lights – green ready, low battery, and red alarm*	**10.2.5 Distinction** **10.2.6 Feedback** 10.2.6.1 Types of feedback **10.2.7 System Status**	**Part 13: Ergonomic requirements for office work with VDTs – User guidance** 8 Status information	**5.1.2 Control/display integration** 5.1.2.1.4 Feedback b. System status **5.2.3.13 Transilluminated displays**			**6 Displays** 6.4.1.5 Coding 6.4.1.8 Feedback **13 Human-Computer Interface** 13.1.9 System status 13.19 Feedback
Cast and prosthesis scanner						
• *Monitor*	***See Monitor below***					
• *Software*	***See Software above***					
• *Toggle switches*	**10.6.3 Control devices** 10.6.3.4 Toggle switch		**5.1.4.2 Linear Controls** 5.1.4.2 .1 Discrete adjustment linear controls (includes c. toggle switch controls)	**5.1 Control-display integration** 5.1.1.3 Feedback (discrete state selectors – toggle switches) **5.4.3 Linear controls** 5.4.3.1.4 Toggle switch controls	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.7.1 Toggle switches	**5 Controls** ***5.6 Control Use and Design*** 5.6.9 Toggle switch

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
• *Indicator lights*	**10.2.5 Distinction** **10.2.6 Feedback** 10.2.6.1 Types of feedback **10.2.7 System Status**	**Part 13: Ergonomic requirements for office work with VDTs – User guidance** 8 Status information	**5.1.2 Control/display integration** 5.1.2.1.4 Feedback b. System status 5.2.3.13 Transilluminated displays			**6 Displays** 6.4.1.5 Coding 6.4.1.8 Feedback **13 Human-Computer Interface** 13.1.9 System status 13.19 Feedback
• *Adjustment swivel arm*						
Explosive/Chemical Trace Detection machine						
• *Wand*						
• *Buttons/Controls*	**10.6.3 Control devices** 10.6.3.1 Push button 10.6.3.7 Slide switch controls 10.6.3.23 Knobs	**Part 9: Ergonomics requirements for office work with Visual Display Terminals – Requirements for non-keyboard input devices** 6.1.4 Button design	**5.1.4 Mechanical Controls** 5.1.4.1.2 Continuous adjustment rotary controls (knobs) 5.1.4.2 Linear controls (push buttons)	**5.4 Controls** 5.4.1.2 Direction of movement 5.4.2 Rotary controls 5.4.3.1.1 Push button, finger- or hand-operated	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.3 Preferred physical specifications for continuous variable operation: Rotary (knob) 15.6.8 Preferred physical specifications for discrete operation: Push button	**5 Controls** ***5.1 Principles of control design*** ***5.6 Control use and design*** 5.6.5 Continuous adjustment rotary controls (knobs) 5.6.7 Pushbuttons
• *Software*	***See Software above***					
• *Display*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display**	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays	**6 Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and Conventions*** 6.1.2 Lighting conditions 6.3 Display luminance setting			information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	8.6 Control and display movement relationships
Bottled liquid scanner						
• *Scanner platen*						
• *Visual display terminal*	***See Display above***					

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
• *Touch screen*	**10.6.3.18 Touch screen**	**Part 9: Ergonomics requirements for office work with Visual Display Terminals – Requirements for non-keyboard input devices** 6.1.16 Consideration of parallax	**5.1.3 Computer controls** 5.1.3.1 Touch-screen controls for displays	**5.4 Controls** 5.4.6 Touch-screen controls for displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.5 Discrete Displays*** 15.5.1.3 Cleanliness (e.g., finger marks on touchscreens) 15.5.4 Parallax ***15.6 Discrete Controls*** 15.6.11 Preferred physical specifications for data entry: on screen spatial 15.6.11.1 Touch displays	**13 Human-Computer Interface** ***13.27 Input Devices*** 13.27.2.6 On-screen keyboards 13.27.5 Touchscreen use
• *Software*	***See Software above***					
Workstation	**8.7.3.4 Fixtures for lighting tasks** **8.7.5 Glare**	**Part 5: Workstation Layout and Postural Requirements** ***4 Guiding Principles*** 4.1 General 4.2 Versatility and Flexibility 4.3 Fit 4.4 Postural Change 4.5 User Information 4.6 Maintainability-Adaptability ***(Part 5) 5 Design Requirements and Recommendations*** 5.1 General 5.2 Postures 5.3 Ease of Adjustment 5.4 Support Surfaces 5.5 Work Chair 5.6 Additional Support Elements 5.7 Layout of Workstations Within the Work Space	**5.1.1.4.5 Color-coding e. Ambient lighting and color-coding exclusion** **5.1.3 Computer Controls** 5.1.3.2 Keyboards 5.1.3.3 Mouse/ trackballs/joysticks 5.1.3.4 Data entry **5.5.3 Illuminance** ***5.5.3.1 Workspace lighting*** ***5.5.3.3 Glare*** 5.5.3.3.2 Direct ***5.5.3.4 Reflected*** **5.7.7 General Equipment-related Hazards** **5.10 Workspace Design** 5.10.1 General 5.10.2 Workspace provision 5.10.3 Workstation design	**5.7 Workspace Design** ***5.7.1 General*** ***5.7.2 Standing Operations*** 5.7.2.1 General 5.7.2.2 Advantages 5.7.2.3 Work Surface 5.7.2.4 Equipment placement 5.7.2.5 Dimensions ***5.7.3 Seated Operations*** 5.7.3.1 Advantages 5.7.3.2 Seating 5.7.3.3 Cushioning 5.7.3.4 Armrests 5.7.3.5 Footrests 5.7.3.6 Temporary Seats 5.7.3.7 Mobile Workspace ***5.7.5 Standard console design*** 5.7.5.1 Display surfaces	**Part 3: Technical Guidance – Section 13 The Workplace** ***13.2 Workplace Design*** 13.2.3 Design Principles 13.2.4 General Layout 13.2.5 Specific Requirements for Workstations 13.2.6 Working Environment 13.2.7 Approaches and Methods to Workplace Design 13.2.8 Workspace Design Reviews ***13.3 Workspace and Task Lighting*** 13.3.1 Introduction 13.3.2 Photometry and Colorimetry 13.3.3 Lighting Design	**10 Workplace Arrangements** ***10.1 Basic Principles of Workplace Design*** 10.1.7 Control/Display Accessibility ***10.2.4 Computer Workstation*** ***10.3.4 Display Mounting*** **14 Habitability** ***14.1 Noise*** 14.1.1. Maximum Levels 14.1.2 Maximum Exposure and Protection ***14.2 Indoor Climate*** 14.2.1 Design Requirement 14.2.2 Temperature 14.2.3 Relative Humidity 14.2.4 Temperature/

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
			5.10.4 Special-purpose console design **5.14 Peripherals**	5.7.5.2 Control surfaces 5.7.7 Stairs, ladders, and ramps 5.7.7.1 General criteria 5.7.7.2 Stairs 5.7.7.3 Ladders 5.7.7.4 Ramps 5.7.7.6 Elevators, inclinators, and hydraulic-operated work platforms ***5.7.8 Ingress & egress*** 5.7.8.1 Routine 5.7.8.2 Non-routine 5.7.8.3 Walkways & Passageways **5.8 Environment** ***5.8.1 Heating, ventilating, and air conditioning*** 5.8.1.1 Heating 5.8.1.4 Environmental Factors 5.8.1.5 Thermal tolerance and comfort zones ***5.8.2 Illuminance*** 5.8.2.1 General 5.8.2.2 Illumination levels and distribution 5.8.2.3 Lighting fixtures 5.8.2.4 Brightness ratios 5.8.2.5 Glare 5.8.2.6 Reflectance 5.8.2.7 Dark adaptation ***5.8.4 Vibration*** 5.8.4.1 Whole-body vibration	Practice 13.3.4 Daylight 13.3.5 Lighting Equipment 13.3.6 Energy Considerations 13.3.8 Display Screen Equipment Lighting 13.3.9 Safety-Related Lighting	Humidity Design 14.3 Lighting 14.3.1 General Design Requirements 14.3.2 Location 14.3.5 Lighting Levels 14.3.6 Brightness Ratio 14.3.7 Wall Surface Reflectance 14.3.8 Other Lighting Requirement

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
				5.8.4.2 Equipment vibration		
Keyboard		**Part 4: Keyboard Requirements** ***6 Design Requirements and Recommendations*** 6.1 General Design of the Keyboard 6.2 Design of Keys ***(Part 4) 7 Measurement*** 7.1 General 7.2 General Design of the Keyboard 7.3 Design of Keys	**5.1.3 Computer Controls** 5.1.3.2 Keyboards 5.1.3.3 Mouse/ trackballs/joysticks 5.1.3.4 Data entry	**5.4.3.1.3. Keyboards, keypads, keysets, and menu selectors** ***5.4.3.1.3.1 Use*** ***5.4.3.1.3.2 Keyboards*** 5.4.3.1.3.2.1 Mounting 5.4.3.1.3.2.2 Function control ***5.4.3.1.3.3 Keypads*** 5.4.3.1.3.3.1 Mounting 5.4.3.1.3.3.2 Actuating force 5.4.3.1.3.3.3 Function control ***5.4.3.1.3.4 Dedicated keysets*** ***5.4.3.1.3.5 Multi-function (programmable) keysets***	**Part 3: Technical Guidance** ***15.6.9 Preferred Physical Specifications For Data Entry: Keyed*** 15.6.9.1 Keyboards/ Membrane Keys 15.6.9.2 Keypads 15.6.12.2 Mouse	**13 Human-Computer Interface** ***13.27 Input Devices*** 13.27.2 Keyboard Use 13.27.11 Mouse Use 13.27.14 Input Device Interchangeability/ Redundancy
Flat panel monitor		**Part 3: Visual Display Requirements** ***5 Design Requirements And Recommendations*** 5.1 Design Viewing Distance 5.2 Line-of-sight Angle 5.3 Angle of View 5.4 Character Height 5.5 Stroke Width 5.6 Character Width-to-Height Ratio 5.8 Character Format 5.9 Character Size Uniformity 5.10 Between-Character-Spacing 5.11 Between-Word Spacing	**5.1.3.1.9 Parallax and glare** **5.1.3.10 Touch screen viewing angle** **5.2.1.3.10 Glare of visual displays** **5.2.1.3.11 Reflected glare of visual displays** **5.2.1.3.12 Polarized/tinted glass for visual displays**	**5.2 Visual displays** ***5.2.1 General*** 5.2.1.2 Display illumination and light distribution 5.2.1.3 Information ***5.2.2 Transilluminated displays*** 5.2.2.1 General 5.2.2.2 Legend lights 5.2.2.3 Simple indicator lights 5.2.2.4 Transilluminated panel assemblies		**13 Human-Computer Interface** ***13.3 Computer Displays*** 13.3.1 Design Criteria 13.3.2 Luminance 13.3.3 Contrast Ratio 13.3.4 Refresh Rate 13.3.5 Monochromatic Color Combinations 13.3.6 Resolution and Display Size 13.3.7 Flat Panel Image Formation Time 13.3.8 Flicker 13.3.9 Jitter 13.3.10 Glare
Carry-on and Checked Luggage Scanner and components:						

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
• *Display monitor*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and Conventions*** 6.1.2 Lighting conditions 6.3 Display luminance setting	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	**6 Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement 8.6 Control and display movement relationships
• *Software*	***See Software above***					
• *Conveyor belt*						
Bar Code Scanner & Components						

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
• *Software*	***See Software Above***					
• *Display*	***See Visual Display under High Resolution Digital Camera above***					
• *On/off switch*	**10.6.3 Control Devices** 10.6.3.6 Rocker switches (on/off switch)		**5.1.4.2 Linear controls** 5.1.4.2.1 Discrete adjustment linear controls e. Rocker switches		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.8.4 Rocker switches	**5 Controls** ***5.6 Control Use and Design*** 5.6.10 Rocker switches

B.3: USCG – Alien Interdiction Unit and Drug Removal

Environment: Ocean impacted by ocean spray, cutter pitch and roll, weather, sunlight, extreme heat and cold, use of gloves

2012 alien maritime migrant interdictions FY 2012: 2,472
Drug removal FY 2012:

- 67 events
- 31 vessels seized
- 176 detainees
- 31,718 pounds of marijuana
- 80,632 pounds of cocaine

Equipment:

- Computer/Laptop
- Fingerprint capture device
- Camera
- Keyboard
- Chemical detection device
- Explosive trace detection device
- Ion scanner (for explosive and narcotics detection)
- Bore scope

Table 5: USCG Devices and Related Standards

DEVICES	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
Fingerprint Scanner & components:			**5.1.3.1.9 Parallax and glare (touch screen devices)** **5.1.3.10 Touch screen viewing angle**			
• *Platen*						
• *Software*	***See Software below***					
• *Keypad*	**10.6.2 Design Characteristics** **10.6.3 Control Devices** 10.6.3.3 Keyboard (includes keypad)	**Part 4: Keyboard requirements** ***6.2 Design of keys*** 6.2.4 Keying feedback 6.2.8 Key legends 6.2.10 Numeric keypad	**5.1.3.2 Keyboards** 5.1.3.2.1 Layout and configuration	**5.4.3.1.3 Keyboards, keypads, keysets, and menu selectors** 5.4.3.1.3.3 Keypads	**Part 3: Technical Guidance** ***15.6.9 Preferred Physical Specifications for Data Entry: Keyed*** 15.6.9.1 Keyboards/ Membrane keys 15.6.9.2 Keypads	
Camera components:						
• *Buttons, Knobs, and Control Devices*	**10.6.3 Control devices** 10.6.3.1 Push button 10.6.3.7 Slide switch controls 10.6.3.23 Knobs	**Part 9: Ergonomics requirements for office work with Visual Display Terminals – Requirements for non-keyboard input devices** 6.1.4 Button design	**5.1.4 Mechanical Controls** 5.1.4.1.2 Continuous adjustment rotary controls (knobs) 5.1.4.2 Linear controls (push buttons)	**5.4 Controls** 5.4.1.2 Direction of movement 5.4.2 Rotary controls 5.4.3.1.1 Push button, finger- or hand-operated	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.3 Preferred physical specifications for continuous variable operation: Rotary (knob) 15.6.8 Preferred physical specifications for discrete operation: Push button	**5 Controls** ***5.1 Principles of control design*** ***5.6 Control use and design*** 5.6.5 Continuous adjustment rotary controls (knobs) 5.6.7 Pushbuttons
• *Visual display*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability	**Part 3: Visual Display Requirements** ***5 Design requirements***	**5.2 Visual displays** 5.2.1 Installation of visual displays	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated	**Part 3: Technical Guidance – Section 15 Work Equipment**	**6 Displays** 6.1 Visual displays 6.2 Location, orientation,

DEVICES	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	***and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and Conventions*** 6.1.2 Lighting conditions 6.3 Display luminance	5.2.2 Display content 5.2.3 Displays – hardware	displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement 8.6 Control and display movement relationships

DEVICES	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		setting				
• *Auditory signal*	**10.8 Audio Displays** 10.8.2 When to use 10.8.3 Selection of signal type 10.8.4 General design 10.8.5 Signal design		**5.3.1 Audio Displays** 5.3.1.7 Audio displays as part of the user interface	**5.3.2 Audio signals** 5.3.2.3 Alerting signals 5.3.2.5 Cueing signals	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.3 Auditory information presentation*** 15.3.1 Valid use of auditory signals 15.3.2 Signal audibility 15.3.3 Signal recognition 15.3.4 Gaining attention 15.3.5 Signal discrimination 15.3.6 Signal meaning 15.3.9 Evaluation of auditory signals	**13 Human-Computer Interface** ***13.10 Audio displays*** 13.10.1 Use 13.10.2 Audio supportive function 13.10.3 Signal characteristics
• *Software*	**10.5.2.9 Software Elements** 10.5.2.9.1 Scrolling 10.5.2.9.2 Navigation 10.5.2.9.3 Selection 10.5.2.9.4 Menus 10.5.2.9.5 Toolbars & Status Bars 10.5.2.9.6 Dialog Boxes **10.5.3 Display Interpretation** **10.5.4 Display Technologies** **10.5.5 Related Display Standards** **10.10 User Interfaces with Automated Systems** 10.10.1 Introduction 10.10.2 Automation 10.10.3 User Interfaces	**Part 13: User guidance** ***10 Online Help*** 10.1 Description 10.2 System-initiated Help 10.3 User-initiated Help 10.4 Presentation of Help Information 10.5 Help Navigation and Controls 10.6 Browsable Help 10.7 Context-Sensitive Help **Part 14: Menu dialogs** ***5 Menu Structure*** 5.1 Structuring into Levels and Menus 5.2 Grouping Options within a Menu 5.3 Sequencing of	**5.1 Structuring into Levels and Menus** ***5.1.3.5.2 Menu Selection*** 5.1.3.5.2. a. Use 5.1.3.5.2. b. Selection **5.2.2.7 Help** 5.2.2.7.2 Standard Action to Request Help 5.2.2.7.4 Browsing Help 5.2.2.7.6 Multilevel Help	**5.4.3 Linear Controls** 5.4.3.1.3 Keyboards, keypads, keysets, and menu selectors e. Menu Selection	**15.4 Human-Computer Interaction** 15.4.1 Introduction 15.4.2 HCI Design Process 15.4.3 Essential HCI Development Activities 15.4.4 Interaction Requirements 15.4.5 Computer-Based Displays 15.4.6 Computer-Based Control	

DEVICES	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	with Mobile Machines	Options with Groups ***6 Menu Navigation*** 6.1 Navigation Cues 6.2 Rapid Navigation ***8 Menu Presentation*** 8.1 Option Accessibility and Discrimination **Part 151: Guidance on World Wide Web user interfaces** ***6 High level design decisions and design strategy*** 6.2 Determining purpose of a Web application 6.3 Analyzing the target user groups 6.4 Analyzing the users' goals and tasks 6.5 Matching application purpose and user goals 6.6 Recognizing the purpose of a Web application 6.7 Prioritizing different design goals 6.8 ICT accessibility 6.9 Software accessibility 6.10 Web content accessibility 6.11 Identifying the website and its owner 6.12 Coherent multi-site strategy ***(Part 151) 7 Content design***				

DEVICES	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
		7.1 Conceptual content model 7.2 Content Objects and functionality ***(Part 151) 8 Navigation and search*** 8.1 General 8.2 General guidance on navigation 8.3 Navigation structure 8.4 Navigation components 8.5 Search ***(Part 151) 9 Content Presentation*** 9.1 General 9.2 Observing principles of human perception 9.3 Page design issues 9.4 Link design 9.5 Interaction objects 9.6 Text design ***(Part 151) 10 General design aspects*** 10.1 Designing for cultural diversity and multilingual use 10.2 Providing Help 10.3 Making Web user interfaces error-tolerant 10.4 URL names 10.5 Acceptable download times 10.6 Using generally accepted technologies and standards 10.7 Supporting				

DEVICES	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		common technologies 10.8 Making Web user interfaces robust 10.9 Designing for input device independence 10.10 Making the user interface of embedded objects usable and accessible				
• *On-off switch*	**10.6.3 Control Devices** 10.6.3.6 Rocker switches (on/off switch)		**5.1.4.2 Linear controls** 5.1.4.2.1 Discrete adjustment linear controls e. Rocker switches		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.8.4 Rocker switches	**5 Controls** ***5.6 Control Use and Design*** 5.6.10 Rocker switches
Keyboard		**Part 4: Keyboard Requirements** ***6 Design Requirements and Recommendations*** 6.1 General Design of the Keyboard 6.2 Design of Keys ***(Part 4) 7 Measurement*** 7.1 General 7.2 General Design of the Keyboard 7.3 Design of Keys	**5.1.3 Computer Controls** 5.1.3.2 Keyboards 5.1.3.3 Mouse/ trackballs/joysticks 5.1.3.4 Data entry	**5.4.3.1.3. Keyboards, keypads, keysets, and menu selectors** ***5.4.3.1.3.1 Use*** ***5.4.3.1.3.2 Keyboards*** 5.4.3.1.3.2.1 Mounting 5.4.3.1.3.2.2 Function control ***5.4.3.1.3.3 Keypads*** 5.4.3.1.3.3.1 Mounting 5.4.3.1.3.3.2 Actuating force 5.4.3.1.3.3.3 Function control ***5.4.3.1.3.4 Dedicated keysets*** ***5.4.3.1.3.5 Multi-function (programmable) keysets***	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6.9 Preferred Physical Specifications for Data Entry: Keyed*** 15.6.9.1 Keyboards/ Membrane Keys 15.6.9.2 Keypads 15.6.12.2 Mouse	**13 Human-Computer Interface** ***13.27 Input Devices*** 13.27.2 Keyboard Use 13.27.11 Mouse Use 13.27.14 Input Device Interchangeability/ Redundancy
Laptop Computer	**10.10 User Interfaces with Automated Systems** 10.10.1 Introduction 10.10.2 Automation 10.10.3 User Interfaces				**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.4 Human-Computer Interaction***	**13 Human-Computer Interface** ***13.1 General Design Requirements*** 13.1.1 General

DEVICES	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	with Mobile Machines				15.4.1 Introduction 15.4.2 HCI Design Process 15.4.3 Essential HCI Development Activities 15.4.4 Interaction Requirements 15.4.5 Computer-Based Displays 15.4.6 Computer-Based Control	Principles 13.1.2 Navigation 13.1.3 Consistency with Physical/Manual Interfaces 13.1.4 Standard Procedures 13.1.5 Computer Response 13.1.6 Screen Design and Content 13.1.7 Coding 13.1.8 Input Devices 13.1.9 System Status 13.1.10 On-Line Help ***13.2 System Operations*** 13.2.1 Log-on Procedures 13.2.2 Log-off Procedures 13.2.3 Computer Failure 13.2.4 Interaction ***13.3 Computer Displays*** 13.3.1 Design Criteria 13.3.2 Luminance 13.3.3 Contrast Ratio 13.3.4 Refresh Rate 13.3.5 Monochromatic Color Combinations 13.3.6 Resolution and Display Size 13.3.7 Flat Panel Image Formation Time 13.3.8 Flicker 13.3.9 Jitter 13.3.10 Glare ***13.4 Display Content***

DEVICES	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.4.1 Standardization 13.4.2 Information Density ***13.8 Textual Data Displays*** 13.8.1 Use 13.8.2 Character Formats 13.8.3 Brevity 13.8.4 Abbreviations and Acronyms 13.8.5 Print Layout ***13.9 Graphic Displays*** 13.9.1 Use 13.9.2 Recurring Data 13.9.3 Refresh Rates 13.9.4 Line Format 13.9.5 Trend Lines 13.9.6 Pointing 13.9.7 Distinctive Cursor 13.9.8 Precise Positioning 13.9.9 Selecting Graphic Elements 13.9.10 Easy Storage and Retrieval 13.9.11 Automatic Data Registration 13.9.12 Graphic Formats 13.9.13 Derivation of Graphical Data 13.9.14 Drawing Lines 13.9.15 Resizing 13.9.16 Highlighting Data 13.9.17 Reference Index

DEVICES	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.9.18 Annotation of Data 13.9.19 Label Orientation 13.9.20 Pictorial Symbols 13.9.21 Display of Scale 13.9.22 Grids 13.9.23 Graphic Comparison 13.9.24 Bar Graphs 13.9.25 Maps 13.9.26 Mimics ***13.27 Input Devices*** 13.27.1 Input Devices 13.27.2 Keyboard Use 13.27.3 Fixed Function Keys 13.27.4 Variable Action 13.27.5 Touchscreen Use 13.27.6 Pointing Devices 13.27.7 Joysticks 13.27.8 Thumb Tip and Fingertip-Operated Displacement Joysticks 13.27.9 Trackball 13.27.10 Grid and Stylus Devices 13.27.11 Mouse Use 13.27.12 Light Pen 13.27.13 Speech Recognition Use 13.27.14 Input Device Interchangeability/ Redundancy

DEVICES	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
Bore Scope						
• *Joystick*	**10.6.3.11 Displacement (Isotonic) Joysticks** **10.6.3.12 Isometric joystick (two-axis controller)** **10.6.3.13 Hand-operated isometric joysticks** **10.6.3.14 Thumbtip-/fingertip operated**		**5.1.3 Computer controls** 5.1.3.3 Mouse/trackball/ joysticks **5.14 Peripherals**	**5.1 Control-display integration** 5.1.1.3 Feedback – continuous adjustment controls (joysticks) **5.4.3 Linear controls** 5.4.3.2.2. Displacement (isotonic) joysticks 5.4.3.2.3 Isometric joysticks	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6.5 Preferred physical specifications for continuous variable operation: multi-axis*** 15.6.5.1 Joystick	**13 Human-Computer Interface** ***13.27 Input Devices*** 13.27.7 Joysticks 13.27.8 Thumb Tip and Fingertip-Operated Displacement Joysticks **5 Controls** ***5.2 General Design Guidelines*** 5.2.1.10 Multi-axis continuous controllers (e.g., joysticks) ***5.6 Control Use and Design*** 5.6.14 Hand-operated displacement joysticks 5.6.15 Hand-operated isometric joysticks
• *Flexible tube*						
• *Digital camera lens*						
• *Microphone*	**10.8 Audio displays** ***10.8.6 Design for audio input and output equipment*** 10.8.6.1 Frequency response 10.8.6.2 Microphones and other input devices 10.8.6.6 Isolation of feedback from earphone or speaker or microphone ***10.8.7 Operator interface design***		**5.3 Speech and audio systems** 5.3.1 Audio displays	**5.3 Audio Displays** 5.3.10 Operating controls for voice communication equipment		**19 Communications** 19.1.2 Operating range 19.2 Microphones

DEVICES	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	10.8.7.1 Operator comfort					
• *Video display*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	**6.Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement 8.6 Control and display movement relationships

DEVICES	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		(Part 3) 6 Measurement Conditions and Conventions 6.1.2 Lighting conditions 6.3 Display luminance setting				
• *Software*	***See software above***					
Ion Scanner Components:						
• *Wand*						
• *Buttons/controls*	**10.6.3 Control devices** 10.6.3.1 Push button 10.6.3.7 Slide switch controls 10.6.3.23 Knobs	**Part 9: Ergonomics requirements for office work with Visual Display Terminals – Requirements for non-keyboard input devices** 6.1.4 Button design	**5.1.4 Mechanical Controls** 5.1.4.1.2 Continuous adjustment rotary controls (knobs) 5.1.4.2 Linear controls (push buttons)	**5.4 Controls** 5.4.1.2 Direction of movement 5.4.2 Rotary controls 5.4.3.1.1 Push button, finger- or hand-operated	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.3 Preferred physical specifications for continuous variable operation: Rotary (knob) 15.6.8 Preferred physical specifications for discrete operation: Push button	**5 Controls** ***5.1 Principles of control design*** ***5.6 Control use and design*** 5.6.5 Continuous adjustment rotary controls (knobs) 5.6.7 Pushbuttons
• *Software*	***See Software above***					
• *Display*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays information 15.5.5 Contrast 15.5.6 Glare and reflections	**6 Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement 8.6 Control and display movement relationships

DEVICES	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	10.5 Visual Displays 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and Conventions*** 6.1.2 Lighting conditions 6.3 Display luminance setting			15.5.7 Displayed colour	
Explosive/Chemical Trace Detection machine						
• Wand						
• Buttons/Controls	**10.6.3 Control devices** 10.6.3.1 Push button 10.6.3.7 Slide switch controls 10.6.3.23 Knobs	**Part 9: Ergonomics requirements for office work with Visual Display Terminals – Requirements for non-keyboard input devices** 6.1.4 Button design				

DEVICES	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
• Software	***See Software above***					
• Display	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement***				

DEVICES	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
		Conditions and Conventions 6.1.2 Lighting conditions 6.3 Display luminance setting				

B.4: CBP

Border Protection Air and Marine
Border Protection Land

Apprehensions in 2011
Total apprehensions: 340,252
Travelers processed: 340,000,000
Containers processed: 24.3 million containers through ports of entry
Travelers enrolled in Trusted Traveler Programs: 290,000 new travelers enrolled
Arrests: 8,195 people wanted for crimes

Air & Marine
Officers in the field: 20,000 at ship and entry points
Environment: airport offices (may be small, dusty, and noisy)

Land
Centers: 143
Workstations: 1,000
Detainees processed: 1,000 per day

Equipment:

- Enrollment camera
- Fingerprint capture device
- Thermal pocket scope for tactical observation and general-purpose night vision
- Radiation detection devices
- Computer/Laptop
- Workstation

- Keyboard
- Monitor
- Passport document scanner
- Enrollment software
- Iris scanner

Table 6: CBP Devices and Related Standards

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
Iris Scanner						
• *Scanner lens*						
• *Visual Display*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	**6 Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement 8.6 Control and display movement relationships

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and Conventions*** 6.1.2 Lighting conditions 6.3 Display luminance setting				
• *Software*	**10.5.2.9 Software Elements** 10.5.2.9.1 Scrolling 10.5.2.9.2 Navigation 10.5.2.9.3 Selection 10.5.2.9.4 Menus 10.5.2.9.5 Toolbars & Status Bars 10.5.2.9.6 Dialog Boxes **10.5.3 Display Interpretation** **10.5.4 Display Technologies** **10.5.5 Related Display Standards** **10.10 User Interfaces with Automated Systems** 10.10.1 Introduction 10.10.2 Automation 10.10.3 User Interfaces with Mobile Machines	**Part 151: Guidance on World Wide Web user interfaces** ***6 High level design decisions and design strategy*** 6.2 Determining purpose of a Web application 6.3 Analyzing the target user groups 6.4 Analyzing the users' goals and tasks 6.5 Matching application purpose and user goals 6.6 Recognizing the purpose of a Web application 6.7 Prioritizing different design goals 6.8 ICT accessibility	**5.1.2.1.4 Feedback c. Computer response** **5.1.2.1.5 Error management** a. Error Correction b. Early detection c. Internal software checks d. Critical entries e. Error message content f. Error recovery and process change g. Diagnostic information h. Correction entry and confirmation i. Spelling errors **5.1.3.5.2 Menu Selection** **5.1.3.5.3 Form Filling** **5.1.3.5.7 Query Language** **5.2.2.5 Graphic and**		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.4 Human-Computer Interaction*** 15.4.1 Introduction 15.4.2 HCI Design Process 15.4.3 Essential HCI Development Activities 15.4.4 Interaction Requirements 15.4.5 Computer-Based Displays 15.4.6 Computer-Based Control	**13 Human-Computer Interface** ***13.1 General Design Requirements*** 13.1.1 General Principles 13.1.2 Navigation 13.1.3 Consistency with Physical/Manual Interfaces 13.1.4 Standard Procedures 13.1.5 Computer Response 13.1.6 Screen Design and Content 13.1.7 Coding 13.1.8 Input Devices 13.1.9 System Status 13.1.10 On-Line Help

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
		6.9 Software accessibility 6.10 Web content accessibility 6.11 Identifying the website and its owner 6.12 Coherent multi-site strategy ***(Part 151) 7 Content design*** 7.1 Conceptual content model 7.2 Content Objects and functionality ***(Part 151) 8 Navigation and search*** 8.1 general 8.2 General guidance on navigation 8.3 Navigation structure 8.4 Navigation components 8.5 Search ***(Part 151) 9 Content Presentation*** 9.1 General 9.2 Observing principles of human perception 9.3 Page design issues 9.4 Link design 9.5 Interaction objects 9.6 Text design ***(Part 151) 10 General design aspects*** 10.1 Designing for cultural diversity and multilingual use 10.2 Providing Help	**Representational displays** 5.2.2.5.1 Graphical user interfaces **5.2.2.7 Help** 5.2.2.7.3 Online Help 5.2.2.7.4 Browsing Help 5.2.2.7.8 Prompts			***13.2 System Operations*** 13.2.1 Log-on Procedures 13.2.2 Log-off Procedures 13.2.3 Computer Failure 13.2.4 Interaction ***13.11 Data Entry*** 13.11.1 General Requirements 13.11.2 User pacing 13.11.3 Positive Feedback 13.11.4 Processing Display 13.11.5 Explicit Action 13.11.6 Validation 13.11.7 Available Data 13.11.8 Input Units 13.11.9 Buffer 13.11.10 Presentation Mode 13.11.11 Display Window 13.11.12 Data Deletion 13.11.13 Data Change 13.11.14 Single Data Entry Method 13.11.15 Data Entry Display 13.11.16 Data Editing 13.11.17 String Search 13.11.18 Automatic Line Break 13.11.19 Format Control 13.11.20 Frequently

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
		10.3 Making Web user interfaces error-tolerant 10.4 URL names 10.5 Acceptable download times 10.6 Using generally accepted technologies and standards 10.7 Supporting common technologies 10.8 Making Web user interfaces robust 10.9 Designing for input device independence 10.10 Making the user interface of embedded objects usable and accessible				Used Text 13.11.21 Control Annotations 13.11.22 Printing Options 13.11.23 Text Length 13.11.24 Justification 13.11.25 Minimization of Keying ***13.13 Graphic Controls*** 13.13.1 Use 13.13.2 Iconic Menus 13.13.3 Supplemental Verbal Labels 13.13.4 Icon Controls 13.13.5 Palettes 13.13.6 Push-buttons 13.13.7 Radio Buttons 13.13.8 Check Boxes 13.13.9 Sliders ***13.14 Windows*** ***13.15 Menus*** 13.15.1 Use 13.15.2 Item Selection 13.15.3 Titles 13.15.4 Series Entry 13.15.5 Sequences 13.15.6 Active Option Presentation 13.15.7 Format Consistency 13.15.8 Option Sequence 13.15.9 Simple Menus 13.15.10 Option Presentation 13.15.11 Direct Function Call

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.15.12 Consistency with Command Language 13.15.13 Option Coding 13.15.14 Keyed Codes 13.15.15 Position in Structure 13.15.16 Back Menu 13.15.17 Return to Top Level ***13.16 Forms*** 13.16.1 Use 13.16.2 Grouping 13.16.3 Format/Content Consistency 13.16.4 Distinctive Fields 13.16.5 Omissions 13.16.6 Protected Areas 13.16.7 Flexible Data Entry 13.16.8 Logical Order 13.16.9 Control Entry 13.16.10 Message Forms ***13.18 Language*** 13.18.1 Command Language 13.18.2 Punctuation 13.18.3 Command Entry 13.18.4 Display Location 13.18.5 Command Prompts

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.18.6 Complexity 13.18.7 Macro Command 13.18.8 Standard Command Editing 13.18.9 Destructive Commands 13.18.10 Questions and Answers 13.18.11 Query Language ***13.19 Feedback*** 13.19.1 Use 13.19.2 Standby 13.19.3 Process Outcome 13.19.4 Input Configuration 13.19.5 Current Modes 13.19.6 Highlighted Selection 13.19.7 Input Rejection 13.19.8 Feedback Messages 13.19.9 Time Delay Warning ***13.20 Prompts*** 13.20.1 Use 13.20.2 Standard Display 13.20.3 Explicit Prompts 13.20.4 Prompt Clarity 13.20.5 Definitions 13.20.6 Consistent Technology 13.20.7 Confirmation ***13.21 Defaults***

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.21.1 Use 13.21.2 User Selection 13.21.3 Default Substitution 13.21.4 Sequential Defaults ***13.22 Error Management/Data Protection*** 13.22.1 Error Correction 13.22.2 Error Detection 13.22.3 Internal Software Checks13.22.4 Critical Entries 13.22.5 Error Message Content 13.22.6 Error Recovery 13.22.7 Diagnostic Information 13.22.8 Entry Correction and Confirmation 13.22.9 Spelling Errors 13.22.10 Errors in Stacked Commands (stacked sequences) 13.22.11 Display of Erroneous Entries 13.22.12 File Management ***13.23 Data Security*** 13.23.1 General 13.23.2 Automated Measures 13.23.3 Segregating Real/Simulated Data

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.23.4 Security Classification Display 13.23.5 User Identification ***13.24 Help*** 13.24.1 General 13.24.2 Help Request 13.24.3 Help Content 13.24.4 Multi-Level HELP 13.24.5 Browse/Help 13.24.6 Help Access 13.24.7 Appropriate Help ***13.25 Software*** 13.25.1 General 13.25.2 Information and System Response 13.25.3 Compute Failure 13.25.4 Task Complexity 13.25.5 Interaction ***13.26 Data Transmission/ Messaging*** 13.26.1 Functional Integration 13.26.2 Consistent Procedures 13.26.3 Message Formats 13.26.4 Interruption 13.26.5 Incorporate Existing Files 13.26.6 User Initiation 13.26.7 Transmission Notification

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
						13.26.8 Address Entry Prompt 13.26.9 Incoming Message Control 13.26.10 Data Presentation
• *Keyboard*		**Part 4: Keyboard requirements** ***6 Design requirements and recommendations*** 6.1 General Design of the Keyboard 6.2 Design of Keys ***(Part 4) 7 Measurement*** 7.1 General 7.2 General Design of the Keyboard 7.3 Design of Keys	**5.1.3 Computer controls** 5.1.3.2 Keyboards 5.1.3.3 Mouse/ trackballs/joysticks 5.1.3.4 Data entry	**5.4.3.1.3. Keyboards, keypads, keysets, and menu selectors** ***5.4.3.1.3.1 Use*** ***5.4.3.1.3.2 Keyboards*** 5.4.3.1.3.2.1 Mounting 5.4.3.1.3.2.2 Function control ***5.4.3.1.3.3 Keypads*** 5.4.3.1.3.3.1 Mounting 5.4.3.1.3.3.2 Actuating force 5.4.3.1.3.3.3 Function control ***5.4.3.1.3.4 Dedicated keysets*** ***5.4.3.1.3.5 Multi-function (programmable) keysets***	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.9.1 Keyboards/ Membrane Keys 15.6.9.2 Keypads 15.6.12.2 Mouse	**13 Human-Computer Interface** ***13.27 Input Devices*** 13.27.2 Keyboard Use 13.27.11 Mouse Use 13.27.14 Input Device Interchangeability/ Redundancy
• *Workstation*	***See workstation above***					
Camera components						
• *Buttons, Knobs, and Control Devices*	**10.6.3 Control devices** 10.6.3.1 Push button 10.6.3.7 Slide switch controls 10.6.3.23 Knobs	**Part 9: Ergonomics requirements for office work with Visual Display Terminals – Requirements for non-keyboard input devices** 6.1.4 Button design	**5.1.4 Mechanical Controls** 5.1.4.1.2 Continuous adjustment rotary controls (knobs) 5.1.4.2 Linear controls (push buttons)	**5.4 Controls** 5.4.1.2 Direction of movement 5.4.2 Rotary controls 5.4.3.1.1 Push button, finger- or hand-operated	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.3 Preferred physical specifications for continuous variable operation: Rotary (knob) 15.6.8 Preferred physical specifications for discrete operation: Push button	**5 Controls** ***5.1 Principles of control design*** ***5.6 Control use and design*** 5.6.5 Continuous adjustment rotary controls (knobs) 5.6.7 Pushbuttons

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
• *Visual Display*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and Conventions***	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	**6 Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement 8.6 Control and display movement relationships

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		6.1.2 Lighting conditions 6.3 Display luminance setting				
• *Auditory signal*	**10.8 Audio Displays** 10.8.2 When to use 10.8.3 Selection of signal type 10.8.4 General design 10.8.5 Signal design		**5.3.1 Audio Displays** 5.3.1.7 Audio displays as part of the user interface	**5.3.2 Audio signals** 5.3.2.3 Alerting signals 5.3.2.5 Cueing signals	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.3 Auditory information presentation*** 15.3.1 Valid use of auditory signals 15.3.2 Signal audibility 15.3.3 Signal recognition 15.3.4 Gaining attention 15.3.5 Signal discrimination 15.3.6 Signal meaning 15.3.9 Evaluation of auditory signals	**13 Human-Computer Interaction** ***13.10 Audio displays*** 13.10.1 Use 13.10.2 Audio supportive function 13.10.3 Signal characteristics
• *On/off switch*	**10.6.3 Control Devices** 10.6.3.6 Rocker switches (on/off switch)		**5.1.4.2 Linear controls** 5.1.4.2.1 Discrete adjustment linear controls e. Rocker switches		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.8.4 Rocker switches	**5 Controls** ***5.6 Control Use and Design*** 5.6.10 Rocker switches
• *Software*	***See Software Below***					
Fingerprint scanner			**5.1.3.1.9 Parallax and glare (touch screen devices)** **5.1.3.10 Touch screen viewing angle**			
• *Platen*						
• *Software*	***See Software Below***					
• *Keypad*	**10.6.2 Design Characteristics** **10.6.3 Control Devices** 10.6.3.3 Keyboard (includes keypad)	**Part 4: Keyboard requirements** ***6.2 Design of keys*** 6.2.4 Keying feedback 6.2.8 Key legends 6.2.10 Numeric keypad	**5.1.3.2 Keyboards** 5.1.3.2.1 Layout and configuration	**5.4.3.1.3 Keyboards, keypads, keysets, and menu selectors** 5.4.3.1.3.3 Keypads	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6.9 Preferred Physical Specifications for Data Entry: Keyed***	

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
					15.6.9.1 Keyboards/ Membrane keys 15.6.9.2 Keypads	
• *Display*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	**6.Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement 8.6 Control and display movement relationships

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		(Part 3) 6 Measurement Conditions and Conventions 6.1.2 Lighting conditions 6.3 Display luminance setting				
Workstation	**8.7.3.4 Fixtures for lighting tasks** **8.7.5 Glare**	**Part 5: Ergonomic Requirements for office work with visual display terminals – Workstation Layout and Postural Requirements** ***4 Guiding Principles*** 4.1 General 4.2 Versatility and Flexibility 4.3 Fit 4.4 Postural Change 4.5 User Information 4.6 Maintainability-Adaptability ***(Part 5) 5 Design Requirements and Recommendations*** 5.1 General 5.2 Postures 5.3 Ease of Adjustment 5.4 Support Surfaces 5.5 Work Chair 5.6 Additional Support Elements 5.7 Layout of Workstations Within the Work Space	**5.2.1.3.13 Display adjacent surfaces** **5.2.3.13.13 Glare** **5.5.3 Illuminance** ***5.5.3.1.1 General*** 5.5.3.1.1 d. Illumination source distribution to reduce glare **5.7.7 General Equipment-related Hazards** **5.10 Workspace Design** 5.10.1 General 5.10.2 Workspace provision 5.10.3 Workstation design 5.10.4 Special-purpose console design **5.14 Peripherals**	**5.7 Workspace Design** ***5.7.1 General*** ***5.7.2 Standing Operations*** 5.7.2.1 General 5.7.2.2 Advantages 5.7.2.3 Work Surface 5.7.2.4 Equipment placement 5.7.2.5 Dimensions ***5.7.3 Seated Operations*** 5.7.3.1 Advantages 5.7.3.2 Seating 5.7.3.3 Cushioning 5.7.3.4 Armrests 5.7.3.5 Footrests 5.7.3.6 Temporary Seats 5.7.3.7 Mobile Workspace ***5.7.5 Standard console design*** 5.7.5.1 Display surfaces 5.7.5.2 Control surfaces 5.7.7 Stairs, ladders, and ramps 5.7.7.1 General criteria 5.7.7.2 Stairs 5.7.7.3 Ladders 5.7.7.4 Ramps 5.7.7.6 Elevators, inclinators, and hydraulic-operated work platforms	**Part 3: Technical Guidance – Section 13 The Workplace** ***13.2 Workplace Design*** 13.2.3 Design Principles 13.2.4 General Layout 13.2.5 Specific Requirements for Workstations 13.2.6 Working Environment 13.2.7 Approaches and Methods to Workplace Design 13.2.8 Workspace Design Reviews ***13.3 Workspace and Task Lighting*** 13.3.1 Introduction 13.3.2 Photometry and Colorimetry 13.3.3 Lighting Design Practice 13.3.4 Daylight 13.3.5 Lighting Equipment 13.3.6 Energy Considerations 13.3.8 Display Screen Equipment Lighting 13.3.9 Safety-Related Lighting	**3 Terminology** 3.1.48 Glare **10 Workplace Arrangements** ***10.1 Basic Principles of Workplace Design*** 10.1.7 Control/Display Accessibility ***10.2.4 Computer Workstation*** ***10.3.4 Display Mounting*** **14 Habitability** ***14.1 Noise*** 14.1.1. Maximum Levels 14.1.2 Maximum Exposure and Protection ***14.2 Indoor Climate*** 14.2.1 Design Requirement 14.2.2 Temperature 14.2.3 Relative Humidity 14.2.4 Temperature/ Humidity Design ***14.3 Lighting*** 14.3.1 General Design Requirements 14.3.2 Location 14.3.5 Lighting Levels

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
				5.7.8 Ingress & egress 5.7.8.1 Routine 5.7.8.2 Non-routine 5.7.8.3 Walkways & Passageways **5.8 Environment** ***5.8.1 Heating, ventilating, and air conditioning*** 5.8.1.1 Heating 5.8.1.4 Environmental Factors 5.8.1.5 Thermal tolerance and comfort zones ***5.8.2 Illuminance*** 5.8.2.1 General 5.8.2.2 Illumination levels and distribution 5.8.2.3 Lighting fixtures 5.8.2.4 Brightness ratios 5.8.2.5 Glare 5.8.2.6 Reflectance 5.8.2.7 Dark adaptation ***5.8.4 Vibration*** 5.8.4.1 Whole-body vibration 5.8.4.2 Equipment vibration		14.3.6 Brightness Ratio 14.3.7 Wall Surface Reflectance 14.3.8 Other Lighting Requirement
Keyboard with Mouse		**Part 4: Keyboard Requirements** ***6 Design Requirements and Recommendations*** 6.1 General Design of the Keyboard 6.2 Design of Keys ***(Part 4) 7 Measurement*** 7.1 General 7.2 General Design of the Keyboard	**5.1.3 Computer controls** 5.1.3.2 Keyboards 5.1.3.3 Mouse/ trackballs/joysticks 5.1.3.4 Data entry	**5.4.3.1.3. Keyboards, keypads, keysets, and menu selectors** ***5.4.3.1.3.1 Use*** ***5.4.3.1.3.2 Keyboards*** 5.4.3.1.3.2.1 Mounting 5.4.3.1.3.2.2 Function control ***5.4.3.1.3.3 Keypads*** 5.4.3.1.3.3.1 Mounting 5.4.3.1.3.3.2 Actuating	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.9.1 Keyboards/ Membrane Keys 15.6.9.2 Keypads 15.6.12.2 Mouse	**13 Human-Computer Interaction** ***13.27 Input Devices*** 13.27.2 Keyboard Use 13.27.11 Mouse Use 13.27.14 Input Device Interchangeability/ Redundancy

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		7.3 Design of Keys **Part 5: Ergonomic requirements for office work with visual display terminals – Workstation layout and postural requirements** ***5 Design requirements and recommendations*** 5.7 Layout of Workstations Within the Work Space		force 5.4.3.1.3.3.3 Function control ***5.4.3.1.3.4 Dedicated keysets*** ***5.4.3.1.3.5 Multi-function (programmable) keysets***		
Monitor		**Part 3: Visual Display Requirements** ***5 Design Requirements and Recommendations*** 5.1 Design Viewing Distance 5.2 Line-of-sight Angle 5.3 Angle of View 5.4 Character Height 5.5 Stroke Width 5.6 Character Width-to-Height Ratio 5.8 Character Format 5.9 Character Size Uniformity 5.10 Between-Character-Spacing 5.11 Between-Word Spacing 5.12 Between-Line Spacing 5.13 Linearity 5.14 Orthogonality 5.15 Display Luminance 5.16 Luminance Contrast	**5.1.3.1.9 Parallax and glare (touch screen devices)** **5.1.3.10 Touch screen viewing angle** **5.2.1.3.10 Glare of visual displays** **5.2.1.3.11 Reflected glare of visual displays** **5.2.1.3.12 Polarized/ tinted glass for visual displays**	**5.2 Visual displays** ***5.2.1 General*** 5.2.1.2 Display illumination and light distribution 5.2.1.3 Information ***5.2.2 Transilluminated displays*** 5.2.2.1 General 5.2.2.2 Legend lights 5.2.2.3 Simple indicator lights 5.2.2.4 Transilluminated panel assemblies		**13 Human-Computer Interaction** ***13.3 Computer Displays*** 13.3.1 Design Criteria 13.3.2 Luminance 13.3.3 Contrast Ratio 13.3.4 Refresh Rate 13.3.5 Monochromatic Color Combinations 13.3.6 Resolution and Display Size 13.3.7 Flat Panel Image Formation Time 13.3.8 Flicker 13.3.9 Jitter 13.3.10 Glare

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		5.17 Luminance Balance 5.18 Glare 5.19 Image Polarity 5.20 Luminance Uniformity 5.21 Luminance Coding 5.22 Blink Coding 5.23 Temporal Instability (Flicker) 5.24 Spatial Instability (Jitter) 5.25 Screen Image Color ***(Part 3) 6.6 Specific Measurements*** (Like above but Specific)				
Passport Document Scanner						
• *Platen*						
• *Software*	***See Software above***					
• *On/off switch*	**10.6.3 Control Devices** 10.6.3.6 Rocker switches (on/off switch)		**5.1.4.2 Linear controls** 5.1.4.2.1 Discrete adjustment linear controls e. Rocker switches		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.8.4 Rocker switches	**5 Controls** ***5.6 Control Use and Design*** 5.6.10 Rocker switches
Software	**10.5.2.9 Software Elements** 10.5.2.9.1 Scrolling 10.5.2.9.2 Navigation 10.5.2.9.3 Selection 10.5.2.9.4 Menus 10.5.2.9.5 Toolbars & Status Bars 10.5.2.9.6 Dialog Boxes **10.5.3 Display Interpretation** **10.5.4 Display Technologies** **10.5.5 Related Display**	**Part 151: Guidance on World Wide Web user interfaces** ***6 High level design decisions and design strategy*** 6.2 Determining purpose of a Web application 6.3 Analyzing the target user groups 6.4 Analyzing the users' goals and tasks 6.5 Matching application purpose and user goals	**5.1.2.1.4 Feedback c. Computer response** **5.1.2.1.5 Error management** a. Error Correction b. Early detection c. Internal software checks d. Critical entries e. Error message content f. Error recovery and process change g. Diagnostic information h. Correction entry and		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.4 Human-Computer Interaction*** 15.4.1 Introduction 15.4.2 HCI Design Process 15.4.3 Essential HCI Development Activities 15.4.4 Interaction Requirements 15.4.5 Computer-Based Displays	**13 Human-Computer Interface** ***13.1 General Design Requirements*** 13.1.1 General Principles 13.1.2 Navigation 13.1.3 Consistency with Physical/Manual Interfaces 13.1.4 Standard Procedures 13.1.5 Computer Response

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	Standards **10.10 User Interfaces with Automated Systems** 10.10.1 Introduction 10.10.2 Automation 10.10.3 User Interfaces with Mobile Machines	6.6 Recognizing the purpose of a Web application 6.7 Prioritizing different design goals 6.8 ICT accessibility 6.9 Software accessibility 6.10 Web content accessibility 6.11 Identifying the website and its owner 6.12 Coherent multi-site strategy ***(Part 151) 7 Content design*** 7.1 Conceptual content model 7.2 Content Objects and functionality ***(Part 151) 8 Navigation and search*** 8.1 general 8.2 General guidance on navigation 8.3 Navigation structure 8.4 Navigation components 8.5 Search ***(Part 151) 9 Content Presentation*** 9.1 General 9.2 Observing principles of human perception 9.3 Page design issues 9.4 Link design 9.5 Interaction objects 9.6 Text design	confirmation i. Spelling errors **5.1.3.5.2 Menu Selection** **5.1.3.5.3 Form Filling** **5.1.3.5.7 Query Language** **5.2.2.5 Graphic and Representational displays** 5.2.2.5.1 Graphical user interfaces **5.2.2.7 Help** 5.2.2.7.3 Online Help 5.2.2.7.4 Browsing Help 5.2.2.7.8 Prompts		15.4.6 Computer-Based Control	13.1.6 Screen Design and Content 13.1.7 Coding 13.1.8 Input Devices 13.1.9 System Status 13.1.10 On-Line Help ***13.2 System Operations*** 13.2.1 Log-on Procedures 13.2.2 Log-off Procedures 13.2.3 Computer Failure 13.2.4 Interaction ***13.11 Data Entry*** 13.11.1 General Requirements 13.11.2 User pacing 13.11.3 Positive Feedback 13.11.4 Processing Display 13.11.5 Explicit Action 13.11.6 Validation 13.11.7 Available Data 13.11.8 Input Units 13.11.9 Buffer 13.11.10 Presentation Mode 13.11.11 Display Window 13.11.12 Data Deletion 13.11.13 Data Change 13.11.14 Single Data Entry Method 13.11.15 Data Entry Display 13.11.16 Data Editing

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
		(Part 151) 10 General design aspects 10.1 Designing for cultural diversity and multilingual use 10.2 Providing Help 10.3 Making Web user interfaces error-tolerant 10.4 URL names 10.5 Acceptable download times 10.6 Using generally accepted technologies and standards 10.7 Supporting common technologies 10.8 Making Web user interfaces robust 10.9 Designing for input device independence 10.10 Making the user interface of embedded objects usable and accessible				13.11.17 String Search 13.11.18 Automatic Line Break 13.11.19 Format Control 13.11.20 Frequently Used Text 13.11.21 Control Annotations 13.11.22 Printing Options 13.11.23 Text Length 13.11.24 Justification 13.11.25 Minimization of Keying ***13.13 Graphic Controls*** 13.13.1 Use 13.13.2 Iconic Menus 13.13.3 Supplemental Verbal Labels 13.13.4 Icon Controls 13.13.5 Palettes 13.13.6 Push-buttons 13.13.7 Radio Buttons 13.13.8 Check Boxes 13.13.9 Sliders ***13.14 Windows*** ***13.15 Menus*** 13.15.1 Use 13.15.2 Item Selection 13.15.3 Titles 13.15.4 Series Entry 13.15.5 Sequences 13.15.6 Active Option Presentation 13.15.7 Format Consistency 13.15.8 Option

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						Sequence 13.15.9 Simple Menus 13.15.10 Option Presentation 13.15.11 Direct Function Call 13.15.12 Consistency with Command Language 13.15.13 Option Coding 13.15.14 Keyed Codes 13.15.15 Position in Structure 13.15.16 Back Menu 13.15.17 Return to Top Level ***13.16 Forms*** 13.16.1 Use 13.16.2 Grouping 13.16.3 Format/Content Consistency 13.16.4 Distinctive Fields 13.16.5 Omissions 13.16.6 Protected Areas 13.16.7 Flexible Data Entry 13.16.8 Logical Order 13.16.9 Control Entry 13.16.10 Message Forms ***13.18 Language*** 13.18.1 Command Language 13.18.2 Punctuation

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.18.3 Command Entry 13.18.4 Display Location 13.18.5 Command Prompts 13.18.6 Complexity 13.18.7 Macro Command 13.18.8 Standard Command Editing 13.18.9 Destructive Commands 13.18.10 Questions and Answers 13.18.11 Query Language ***13.19 Feedback*** 13.19.1 Use 13.19.2 Standby 13.19.3 Process Outcome 13.19.4 Input Configuration 13.19.5 Current Modes 13.19.6 Highlighted Selection 13.19.7 Input Rejection 13.19.8 Feedback Messages 13.19.9 Time Delay Warning ***13.20 Prompts*** 13.20.1 Use 13.20.2 Standard Display 13.20.3 Explicit Prompts

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.20.4 Prompt Clarity 13.20.5 Definitions 13.20.6 Consistent Technology 13.20.7 Confirmation ***13.21 Defaults*** 13.21.1 Use 13.21.2 User Selection 13.21.3 Default Substitution 13.21.4 Sequential Defaults ***13.22 Error Management/Data Protection*** 13.22.1 Error Correction 13.22.2 Error Detection 13.22.3 Internal Software Checks13.22.4 Critical Entries 13.22.5 Error Message Content 13.22.6 Error Recovery 13.22.7 Diagnostic Information 13.22.8 Entry Correction and Confirmation 13.22.9 Spelling Errors 13.22.10 Errors in Stacked Commands (stacked sequences) 13.22.11 Display of Erroneous Entries 13.22.12 File Management

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.23 Data Security 13.23.1 General 13.23.2 Automated Measures 13.23.3 Segregating Real/Simulated Data 13.23.4 Security Classification Display 13.23.5 User Identification ***13.24 Help*** 13.24.1 General 13.24.2 Help Request 13.24.3 Help Content 13.24.4 Multi-Level HELP 13.24.5 Browse/Help 13.24.6 Help Access 13.24.7 Appropriate Help ***13.25 Software*** 13.25.1 General 13.25.2 Information and System Response 13.25.3 Compute Failure 13.25.4 Task Complexity 13.25.5 Interaction ***13.26 Data Transmission/ Messaging*** 13.26.1 Functional Integration 13.26.2 Consistent Procedures 13.26.3 Message Formats

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
						13.26.4 Interruption 13.26.5 Incorporate Existing Files 13.26.6 User Initiation 13.26.7 Transmission Notification 13.26.8 Address Entry Prompt 13.26.9 Incoming Message Control 13.26.10 Data Presentation
Computer/Laptop	**10.10 User Interfaces with Automated Systems** 10.10.1 Introduction 10.10.2 Automation 10.10.3 User Interfaces with Mobile Machines				**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.4 Human-Computer Interaction*** 15.4.1 Introduction 15.4.2 HCI Design Process 15.4.3 Essential HCI Development Activities 15.4.4 Interaction Requirements 15.4.5 Computer-Based Displays 15.4.6 Computer-Based Control	**13 Human-Computer Interface** ***13.1 General Design Requirements*** 13.1.1 General Principles 13.1.2 Navigation 13.1.3 Consistency with Physical/Manual Interfaces 13.1.4 Standard Procedures 13.1.5 Computer Response 13.1.6 Screen Design and Content 13.1.7 Coding 13.1.8 Input Devices 13.1.9 System Status 13.1.10 On-Line Help ***13.2 System Operations*** 13.2.1 Log-on Procedures 13.2.2 Log-off Procedures

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.2.3 Computer Failure 13.2.4 Interaction ***13.3 Computer Displays*** 13.3.1 Design Criteria 13.3.2 Luminance 13.3.3 Contrast Ratio 13.3.4 Refresh Rate 13.3.5 Monochromatic Color Combinations 13.3.6 Resolution and Display Size 13.3.7 Flat Panel Image Formation Time 13.3.8 Flicker 13.3.9 Jitter 13.3.10 Glare ***13.4 Display Content*** 13.4.1 Standardization 13.4.2 Information Density 13.8 Textual Data Displays 13.8.1 Use 13.8.2 Character Formats 13.8.3 Brevity 13.8.4 Abbreviations and Acronyms 13.8.5 Print Layout ***13.9 Graphic Displays*** 13.9.1 Use 13.9.2 Recurring Data 13.9.3 Refresh Rates 13.9.4 Line Format

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.9.5 Trend Lines 13.9.6 Pointing 13.9.7 Distinctive Cursor 13.9.8 Precise Positioning 13.9.9 Selecting Graphic Elements 13.9.10 Easy Storage and Retrieval 13.9.11 Automatic Data Registration 13.9.12 Graphic Formats 13.9.13 Derivation of Graphical Data 13.9.14 Drawing Lines 13.9.15 Resizing 13.9.16 Highlighting Data 13.9.17 Reference Index 13.9.18 Annotation of Data 13.9.19 Label Orientation 13.9.20 Pictorial Symbols 13.9.21 Display of Scale 13.9.22 Grids 13.9.23 Graphic Comparison 13.9.24 Bar Graphs 13.9.25 Maps 13.9.26 Mimics ***13.27 Input Devices***

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
						13.27.1 Input Devices 13.27.2 Keyboard Use 13.27.3 Fixed Function Keys 13.27.4 Variable Action 13.27.5 Touchscreen Use 13.27.6 Pointing Devices 13.27.7 Joysticks 13.27.8 Thumb Tip and Fingertip-Operated Displacement Joysticks 13.27.9 Trackball 13.27.10 Grid and Stylus Devices 13.27.11 Mouse Use 13.27.12 Light Pen 13.27.13 Speech Recognition Use 13.27.14 Input Device Interchangeability/ Redundancy
Explosive/Chemical Trace Detection machine						
• Wand						
• Buttons/Controls	**10.6.3 Control devices** 10.6.3.1 Push button 10.6.3.7 Slide switch controls 10.6.3.23 Knobs	**Part 9: Ergonomics requirements for office work with Visual Display Terminals – Requirements for non-keyboard input devices** 6.1.4 Button design				

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
• Software	***See Software above***					
• Display	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and***				

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
		Conventions 6.1.2 Lighting conditions 6.3 Display luminance setting				

B.5: ICE

Employees: more than 20,000 in 50 states and 47 foreign countries
Immigration Fugitives: 18,699
Repeat Immigration Violators: 77,830
Border Removals: 45,938
Other Removable Aliens: 37,741

Detention Facilities: 104
ERO Field Offices: 24

Equipment:

- Fingerprint capture device
- Camera
- Computer/Laptop
- Software applications
- Iris scanner

Officers carry guns and radios

Table 7: ICE Devices and Related Standards

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**F1166**
Fingerprint Device			**5.1.3.1.9 Parallax and glare (touch screen devices)** **5.1.3.10 Touch screen viewing angle**			
• *Keypad*	**10.6.2 Design Characteristics**	**Part 4: Keyboard requirements**	**5.1.3.2 Keyboards** 5.1.3.2.1 Layout and	**5.4.3.1.3 Keyboards, keypads, keysets, and**		

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**F1166**
	10.6.3 Control Devices 10.6.3.3 Keyboard (includes keypad)	***6.2 Design of keys*** 6.2.4 Keying feedback 6.2.8 Key legends 6.2.10 Numeric keypad	configuration	**menu selectors** 5.4.3.1.3.3 Keypads		
• *Software*	***See Software below***					
• *Platen*						
• *Display*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	**6 Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement 8.6 Control and display movement relationships

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**F1166**
		5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and Conventions*** 6.1.2 Lighting conditions 6.3 Display luminance setting				
Camera components:						
• *Buttons, Knobs, and Control Devices*	**10.6.3 Control devices** 10.6.3.1 Push button 10.6.3.7 Slide switch controls 10.6.3.23 Knobs	**Part 9: Ergonomics requirements for office work with Visual Display Terminals – Requirements for non-keyboard input devices** 6.1.4 Button design	**5.1.4 Mechanical Controls** 5.1.4.1.2 Continuous adjustment rotary controls (knobs) 5.1.4.2 Linear controls (push buttons)	**5.4 Controls** 5.4.1.2 Direction of movement 5.4.2 Rotary controls 5.4.3.1.1 Push button, finger- or hand-operated	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.3 Preferred physical specifications for continuous variable operation: Rotary (knob) 15.6.8 Preferred physical specifications for discrete operation: Push button	**5 Controls** ***5.1 Principles of control design*** ***5.6 Control use and design*** 5.6.5 Continuous adjustment rotary controls (knobs) 5.6.7 Pushbuttons
• *Visual display*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display**	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays	**6 Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement 8.6 Control and display

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**F1166**
	10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and Conventions*** 6.1.2 Lighting conditions 6.3 Display luminance setting			information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	movement relationships
• *Auditory signal or visual signal*	**10.8 Audio Displays** 10.8.2 When to use 10.8.3 Selection of signal type 10.8.4 General design 10.8.5 Signal design		**5.3.1 Audio Displays** 5.3.1.7 Audio displays as part of the user interface	**5.3.2 Audio signals** 5.3.2.3 Alerting signals 5.3.2.5 Cueing signals	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.3 Auditory information presentation*** 15.3.1 Valid use of auditory signals 15.3.2 Signal audibility 15.3.3 Signal recognition	**13 Human-Computer Interface** ***13.10 Audio displays*** 13.10.1 Use 13.10.2 Audio supportive function 13.10.3 Signal characteristics

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**F1166**
					15.3.4 Gaining attention 15.3.5 Signal discrimination 15.3.6 Signal meaning 15.3.9 Evaluation of auditory signals	
• *On/off switch*	**10.6.3 Control Devices** 10.6.3.6 Rocker switches (on/off switch)		**5.1.4.2 Linear controls** 5.1.4.2.1 Discrete adjustment linear controls e. Rocker switches		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.8.4 Rocker switches	**5 Controls** ***5.6 Control Use and Design*** 5.6.10 Rocker switches
• *Software*	***See Software Below***					
Laptop	**10.10 User Interfaces with Automated Systems** 10.10.1 Introduction 10.10.2 Automation 10.10.3 User Interfaces with Mobile Machines				**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.4 Human-Computer Interaction*** 15.4.1 Introduction 15.4.2 HCI Design Process 15.4.3 Essential HCI Development Activities 15.4.4 Interaction Requirements 15.4.5 Computer-Based Displays 15.4.6 Computer-Based Control	**13 Human-Computer Interface** ***13.1 General Design Requirements*** 13.1.1 General Principles 13.1.2 Navigation 13.1.3 Consistency with Physical/Manual Interfaces 13.1.4 Standard Procedures 13.1.5 Computer Response 13.1.6 Screen Design and Content 13.1.7 Coding 13.1.8 Input Devices 13.1.9 System Status 13.1.10 On-Line Help ***13.2 System Operations*** 13.2.1 Log-on Procedures 13.2.2 Log-off Procedures 13.2.3 Computer Failure 13.2.4 Interaction ***13.3 Computer Displays***

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	F1166
						13.3.1 Design Criteria 13.3.2 Luminance 13.3.3 Contrast Ratio 13.3.4 Refresh Rate 13.3.5 Monochromatic Color Combinations 13.3.6 Resolution and Display Size 13.3.7 Flat Panel Image Formation Time 13.3.8 Flicker 13.3.9 Jitter 13.3.10 Glare ***13.4 Display Content*** 13.4.1 Standardization 13.4.2 Information Density ***13.8 Textual Data Displays*** 13.8.1 Use 13.8.2 Character Formats 13.8.3 Brevity 13.8.4 Abbreviations and Acronyms 13.8.5 Print Layout ***13.9 Graphic Displays*** 13.9.1 Use 13.9.2 Recurring Data 13.9.3 Refresh Rates 13.9.4 Line Format 13.9.5 Trend Lines 13.9.6 Pointing 13.9.7 Distinctive Cursor 13.9.8 Precise Positioning 13.9.9 Selecting Graphic Elements 13.9.10 Easy Storage and

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	F1166
						Retrieval 13.9.11 Automatic Data Registration 13.9.12 Graphic Formats 13.9.13 Derivation of Graphical Data 13.9.14 Drawing Lines 13.9.15 Resizing 13.9.16 Highlighting Data 13.9.17 Reference Index 13.9.18 Annotation of Data 13.9.19 Label Orientation 13.9.20 Pictorial Symbols 13.9.21 Display of Scale 13.9.22 Grids 13.9.23 Graphic Comparison 13.9.24 Bar Graphs 13.9.25 Maps 13.9.26 Mimics ***13.27 Input Devices*** 13.27.1 Input Devices 13.27.2 Keyboard Use 13.27.3 Fixed Function Keys 13.27.4 Variable Action 13.27.5 Touchscreen Use 13.27.6 Pointing Devices 13.27.7 Joysticks 13.27.8 Thumb Tip and Fingertip-Operated Displacement Joysticks 13.27.9 Trackball 13.27.10 Grid and Stylus Devices 13.27.11 Mouse Use

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**F1166**
						13.27.12 Light Pen 13.27.13 Speech Recognition Use 13.27.14 Input Device Interchangeability/ Redundancy
Software Applications	**10.5.2.9 Software Elements** 10.5.2.9.1 Scrolling 10.5.2.9.2 Navigation 10.5.2.9.3 Selection 10.5.2.9.4 Menus 10.5.2.9.5 Toolbars & Status Bars 10.5.2.9.6 Dialog Boxes **10.5.3 Display Interpretation** **10.5.4 Display Technologies** **10.5.5 Related Display Standards** **10.10 User Interfaces with Automated Systems** 10.10.1 Introduction 10.10.2 Automation 10.10.3 User Interfaces with Mobile Machines	**Part 151: Guidance on World Wide Web user interfaces** ***6 High level design decisions and design strategy*** 6.2 Determining purpose of a Web application 6.3 Analyzing the target user groups 6.4 Analyzing the users' goals and tasks 6.5 Matching application purpose and user goals 6.6 Recognizing the purpose of a Web application 6.7 Prioritizing different design goals 6.8 ICT accessibility 6.9 Software accessibility 6.10 Web content accessibility 6.11 Identifying the website and its owner 6.12 Coherent multi-site strategy ***(Part 151) 7 Content design*** 7.1 Conceptual content	**5.1.2.1.4 Feedback c. Computer response** **5.1.2.1.5 Error management** a. Error Correction b. Early detection c. Internal software checks d. Critical entries e. Error message content f. Error recovery and process change g. Diagnostic information h. Correction entry and confirmation i. Spelling errors **5.1.3.5.2 Menu Selection** **5.1.3.5.3 Form Filling** **5.1.3.5.7 Query Language** **5.2.2.5 Graphic and Representational displays** 5.2.2.5.1 Graphical user interfaces **5.2.2.7 Help** 5.2.2.7.3 Online Help 5.2.2.7.4 Browsing Help 5.2.2.7.8 Prompts		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.4 Human-Computer Interaction*** 15.4.1 Introduction 15.4.2 HCI Design Process 15.4.3 Essential HCI Development Activities 15.4.4 Interaction Requirements 15.4.5 Computer-Based Displays 15.4.6 Computer-Based Control	**13 Human-Computer Interface** ***13.1 General Design Requirements*** 13.1.1 General Principles 13.1.2 Navigation 13.1.3 Consistency with Physical/Manual Interfaces 13.1.4 Standard Procedures 13.1.5 Computer Response 13.1.6 Screen Design and Content 13.1.7 Coding 13.1.8 Input Devices 13.1.9 System Status 13.1.10 On-Line Help ***13.2 System Operations*** 13.2.1 Log-on Procedures 13.2.2 Log-off Procedures 13.2.3 Computer Failure 13.2.4 Interaction ***13.11 Data Entry*** 13.11.1 General Requirements 13.11.2 User pacing 13.11.3 Positive Feedback 13.11.4 Processing Display

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	F1166
		model 7.2 Content Objects and functionality ***(Part 151) 8 Navigation and search*** 8.1 general 8.2 General guidance on navigation 8.3 Navigation structure 8.4 Navigation components 8.5 Search ***(Part 151) 9 Content Presentation*** 9.1 General 9.2 Observing principles of human perception 9.3 Page design issues 9.4 Link design 9.5 Interaction objects 9.6 Text design ***(Part 151) 10 General design aspects*** 10.1 Designing for cultural diversity and multilingual use 10.2 Providing Help 10.3 Making Web user interfaces error-tolerant 10.4 URL names 10.5 Acceptable download times 10.6 Using generally accepted technologies and standards 10.7 Supporting common technologies				13.11.5 Explicit Action 13.11.6 Validation 13.11.7 Available Data 13.11.8 Input Units 13.11.9 Buffer 13.11.10 Presentation Mode 13.11.11 Display Window 13.11.12 Data Deletion 13.11.13 Data Change 13.11.14 Single Data Entry Method 13.11.15 Data Entry Display 13.11.16 Data Editing 13.11.17 String Search 13.11.18 Automatic Line Break 13.11.19 Format Control 13.11.20 Frequently Used Text 13.11.21 Control Annotations 13.11.22 Printing Options 13.11.23 Text Length 13.11.24 Justification 13.11.25 Minimization of Keying ***13.13 Graphic Controls*** 13.13.1 Use 13.13.2 Iconic Menus 13.13.3 Supplemental Verbal Labels 13.13.4 Icon Controls 13.13.5 Palettes 13.13.6 Push-buttons 13.13.7 Radio Buttons

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**F1166**
		10.8 Making Web user interfaces robust 10.9 Designing for input device independence 10.10 Making the user interface of embedded objects usable and accessible				13.13.8 Check Boxes 13.13.9 Sliders ***13.14 Windows*** 13.14.1 Use 13.14.2 Primary and Secondary Windows 13.14.3 Window Location 13.14.4 Multiple Windows 13.14.5 Window Navigation 13.14.6 Window Shifting 13.14.7 Window Organization 13.14.8 Title Bar 13.14.9 Status Bar 13.14.10 Tool Bars 13.14.11 Control Consistency 13.14.12 Active Windows 13.14.13 Moving Windows 13.14.14 Window Sizing 13.14.15 Scrolling 13.14.16 Zooming 13.14.17 Window Menus 13.14.18 Window Toolbars 13.14.19 Message Windows ***13.15 Menus*** 13.15.1 Use 13.15.2 Item Selection 13.15.3 Titles 13.15.4 Series Entry 13.15.5 Sequences 13.15.6 Active Option

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	F1166
						Presentation 13.15.7 Format Consistency 13.15.8 Option Sequence 13.15.9 Simple Menus 13.15.10 Option Presentation 13.15.11 Direct Function Call 13.15.12 Consistency with Command Language 13.15.13 Option Coding 13.15.14 Keyed Codes 13.15.15 Position in Structure 13.15.16 Back Menu 13.15.17 Return to Top Level ***13.16 Forms*** 13.16.1 Use 13.16.2 Grouping 13.16.3 Format/Content Consistency 13.16.4 Distinctive Fields 13.16.5 Omissions 13.16.6 Protected Areas 13.16.7 Flexible Data Entry 13.16.8 Logical Order 13.16.9 Control Entry 13.16.10 Message Forms ***13.18 Language*** 13.18.1 Command Language 13.18.2 Punctuation 13.18.3 Command Entry 13.18.4 Display Location

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	F1166
						13.18.5 Command Prompts 13.18.6 Complexity 13.18.7 Macro Command 13.18.8 Standard Command Editing 13.18.9 Destructive Commands 13.18.10 Questions and Answers 13.18.11 Query Language ***13.19 Feedback*** 13.19.1 Use 13.19.2 Standby 13.19.3 Process Outcome 13.19.4 Input Configuration 13.19.5 Current Modes 13.19.6 Highlighted Selection 13.19.7 Input Rejection 13.19.8 Feedback Messages 13.19.9 Time Delay Warning ***13.20 Prompts*** 13.20.1 Use 13.20.2 Standard Display 13.20.3 Explicit Prompts 13.20.4 Prompt Clarity 13.20.5 Definitions 13.20.6 Consistent Technology 13.20.7 Confirmation ***13.21 Defaults*** 13.21.1 Use 13.21.2 User Selection

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	F1166
						13.21.3 Default Substitution 13.21.4 Sequential Defaults ***13.22 Error Management/Data Protection*** 13.22.1 Error Correction 13.22.2 Error Detection 13.22.3 Internal Software Checks13.22.4 Critical Entries 13.22.5 Error Message Content 13.22.6 Error Recovery 13.22.7 Diagnostic Information 13.22.8 Entry Correction and Confirmation 13.22.9 Spelling Errors 13.22.10 Errors in Stacked Commands (stacked sequences) 13.22.11 Display of Erroneous Entries 13.22.12 File Management ***13.23 Data Security*** 13.23.1 General 13.23.2 Automated Measures 13.23.3 Segregating Real/Simulated Data 13.23.4 Security Classification Display 13.23.5 User Identification

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	F1166
						13.24 Help 13.24.1 General 13.24.2 Help Request 13.24.3 Help Content 13.24.4 Multi-Level HELP 13.24.5 Browse/Help 13.24.6 Help Access 13.24.7 Appropriate Help ***13.25 Software*** 13.25.1 General 13.25.2 Information and System Response 13.25.3 Compute Failure 13.25.4 Task Complexity 13.25.5 Interaction ***13.26 Data Transmission/ Messaging*** 13.26.1 Functional Integration 13.26.2 Consistent Procedures 13.26.3 Message Formats 13.26.4 Interruption 13.26.5 Incorporate Existing Files 13.26.6 User Initiation 13.26.7 Transmission Notification 13.26.8 Address Entry Prompt 13.26.9 Incoming Message Control 13.26.10 Data Presentation
Iris Scanner						
• Scanner lens						

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**F1166**
• Visual Display	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and***	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	**6 Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement 8.6 Control and display movement relationships

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**F1166**
		Conventions 6.1.2 Lighting conditions 6.3 Display luminance setting				
• Software	**10.5.2.9 Software Elements** 10.5.2.9.1 Scrolling 10.5.2.9.2 Navigation 10.5.2.9.3 Selection 10.5.2.9.4 Menus 10.5.2.9.5 Toolbars & Status Bars 10.5.2.9.6 Dialog Boxes **10.5.3 Display Interpretation** **10.5.4 Display Technologies** **10.5.5 Related Display Standards** **10.10 User Interfaces with Automated Systems** 10.10.1 Introduction 10.10.2 Automation 10.10.3 User Interfaces with Mobile Machines	**Part 151: Guidance on World Wide Web user interfaces** ***6 High level design decisions and design strategy*** 6.2 Determining purpose of a Web application 6.3 Analyzing the target user groups 6.4 Analyzing the users' goals and tasks 6.5 Matching application purpose and user goals 6.6 Recognizing the purpose of a Web application 6.7 Prioritizing different design goals 6.8 ICT accessibility 6.9 Software accessibility 6.10 Web content accessibility 6.11 Identifying the website and its owner 6.12 Coherent multi-site strategy ***(Part 151) 7 Content design*** 7.1 Conceptual content model 7.2 Content Objects and	**5.1.2.1.4 Feedback c. Computer response** **5.1.2.1.5 Error management** a. Error Correction b. Early detection c. Internal software checks d. Critical entries e. Error message content f. Error recovery and process change g. Diagnostic information h. Correction entry and confirmation i. Spelling errors **5.1.3.5.2 Menu Selection** **5.1.3.5.3 Form Filling** **5.1.3.5.7 Query Language** **5.2.2.5 Graphic and Representational displays** 5.2.2.5.1 Graphical user interfaces **5.2.2.7 Help** 5.2.2.7.3 Online Help 5.2.2.7.4 Browsing Help 5.2.2.7.8 Prompts		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.4 Human-Computer Interaction*** 15.4.1 Introduction 15.4.2 HCI Design Process 15.4.3 Essential HCI Development Activities 15.4.4 Interaction Requirements 15.4.5 Computer-Based Displays 15.4.6 Computer-Based Control	**13 Human-Computer Interface** ***13.1 General Design Requirements*** 13.1.1 General Principles 13.1.2 Navigation 13.1.3 Consistency with Physical/Manual Interfaces 13.1.4 Standard Procedures 13.1.5 Computer Response 13.1.6 Screen Design and Content 13.1.7 Coding 13.1.8 Input Devices 13.1.9 System Status 13.1.10 On-Line Help ***13.2 System Operations*** 13.2.1 Log-on Procedures 13.2.2 Log-off Procedures 13.2.3 Computer Failure 13.2.4 Interaction ***13.11 Data Entry*** 13.11.1 General Requirements 13.11.2 User pacing 13.11.3 Positive Feedback 13.11.4 Processing Display 13.11.5 Explicit Action 13.11.6 Validation

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	F1166
		functionality ***(Part 151) 8 Navigation and search*** 8.1 general 8.2 General guidance on navigation 8.3 Navigation structure 8.4 Navigation components 8.5 Search ***(Part 151) 9 Content Presentation*** 9.1 General 9.2 Observing principles of human perception 9.3 Page design issues 9.4 Link design 9.5 Interaction objects 9.6 Text design ***(Part 151) 10 General design aspects*** 10.1 Designing for cultural diversity and multilingual use 10.2 Providing Help 10.3 Making Web user interfaces error-tolerant 10.4 URL names 10.5 Acceptable download times 10.6 Using generally accepted technologies and standards 10.7 Supporting common technologies 10.8 Making Web user interfaces robust				13.11.7 Available Data 13.11.8 Input Units 13.11.9 Buffer 13.11.10 Presentation Mode 13.11.11 Display Window 13.11.12 Data Deletion 13.11.13 Data Change 13.11.14 Single Data Entry Method 13.11.15 Data Entry Display 13.11.16 Data Editing 13.11.17 String Search 13.11.18 Automatic Line Break 13.11.19 Format Control 13.11.20 Frequently Used Text 13.11.21 Control Annotations 13.11.22 Printing Options 13.11.23 Text Length 13.11.24 Justification 13.11.25 Minimization of Keying ***13.13 Graphic Controls*** 13.13.1 Use 13.13.2 Iconic Menus 13.13.3 Supplemental Verbal Labels 13.13.4 Icon Controls 13.13.5 Palettes 13.13.6 Push-buttons 13.13.7 Radio Buttons 13.13.8 Check Boxes 13.13.9 Sliders

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**F1166**
		10.9 Designing for input device independence 10.10 Making the user interface of embedded objects usable and accessible				***13.14 Windows*** ***13.15 Menus*** 13.15.1 Use 13.15.2 Item Selection 13.15.3 Titles 13.15.4 Series Entry 13.15.5 Sequences 13.15.6 Active Option Presentation 13.15.7 Format Consistency 13.15.8 Option Sequence 13.15.9 Simple Menus 13.15.10 Option Presentation 13.15.11 Direct Function Call 13.15.12 Consistency with Command Language 13.15.13 Option Coding 13.15.14 Keyed Codes 13.15.15 Position in Structure 13.15.16 Back Menu 13.15.17 Return to Top Level ***13.16 Forms*** 13.16.1 Use 13.16.2 Grouping 13.16.3 Format/Content Consistency 13.16.4 Distinctive Fields 13.16.5 Omissions 13.16.6 Protected Areas 13.16.7 Flexible Data Entry 13.16.8 Logical Order

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	F1166
						13.16.9 Control Entry 13.16.10 Message Forms ***13.18 Language*** 13.18.1 Command Language 13.18.2 Punctuation 13.18.3 Command Entry 13.18.4 Display Location 13.18.5 Command Prompts 13.18.6 Complexity 13.18.7 Macro Command 13.18.8 Standard Command Editing 13.18.9 Destructive Commands 13.18.10 Questions and Answers 13.18.11 Query Language ***13.19 Feedback*** 13.19.1 Use 13.19.2 Standby 13.19.3 Process Outcome 13.19.4 Input Configuration 13.19.5 Current Modes 13.19.6 Highlighted Selection 13.19.7 Input Rejection 13.19.8 Feedback Messages 13.19.9 Time Delay Warning ***13.20 Prompts*** 13.20.1 Use 13.20.2 Standard Display 13.20.3 Explicit Prompts

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**F1166**
						13.20.4 Prompt Clarity 13.20.5 Definitions 13.20.6 Consistent Technology 13.20.7 Confirmation ***13.21 Defaults*** 13.21.1 Use 13.21.2 User Selection 13.21.3 Default Substitution 13.21.4 Sequential Defaults ***13.22 Error Management/Data Protection*** 13.22.1 Error Correction 13.22.2 Error Detection 13.22.3 Internal Software Checks13.22.4 Critical Entries 13.22.5 Error Message Content 13.22.6 Error Recovery 13.22.7 Diagnostic Information 13.22.8 Entry Correction and Confirmation 13.22.9 Spelling Errors 13.22.10 Errors in Stacked Commands (stacked sequences) 13.22.11 Display of Erroneous Entries 13.22.12 File Management ***13.23 Data Security*** 13.23.1 General

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	F1166
						13.23.2 Automated Measures 13.23.3 Segregating Real/Simulated Data 13.23.4 Security Classification Display 13.23.5 User Identification ***13.24 Help*** 13.24.1 General 13.24.2 Help Request 13.24.3 Help Content 13.24.4 Multi-Level HELP 13.24.5 Browse/Help 13.24.6 Help Access 13.24.7 Appropriate Help ***13.25 Software*** 13.25.1 General 13.25.2 Information and System Response 13.25.3 Compute Failure 13.25.4 Task Complexity 13.25.5 Interaction ***13.26 Data Transmission/ Messaging*** 13.26.1 Functional Integration 13.26.2 Consistent Procedures 13.26.3 Message Formats 13.26.4 Interruption 13.26.5 Incorporate Existing Files 13.26.6 User Initiation 13.26.7 Transmission Notification

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**F1166**
						13.26.8 Address Entry Prompt 13.26.9 Incoming Message Control ***13.26.10 Data Presentation***
• Keyboard		**Part 4: Keyboard requirements** ***6 Design requirements and recommendations*** 6.1 General Design of the Keyboard 6.2 Design of Keys ***(Part 4) 7 Measurement*** 7.1 General 7.2 General Design of the Keyboard 7.3 Design of Keys	**5.1.3 Computer controls** 5.1.3.2 Keyboards 5.1.3.3 Mouse/ trackballs/joysticks 5.1.3.4 Data entry	**5.4.3.1.3. Keyboards, keypads, keysets, and menu selectors** ***5.4.3.1.3.1 Use*** ***5.4.3.1.3.2 Keyboards*** 5.4.3.1.3.2.1 Mounting 5.4.3.1.3.2.2 Function control ***5.4.3.1.3.3 Keypads*** 5.4.3.1.3.3.1 Mounting 5.4.3.1.3.3.2 Actuating force 5.4.3.1.3.3.3 Function control ***5.4.3.1.3.4 Dedicated keysets*** ***5.4.3.1.3.5 Multi-function (programmable) keysets***	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.9.1 Keyboards/ Membrane Keys 15.6.9.2 Keypads 15.6.12.2 Mouse	**13 Human-Computer Interface** ***13.27 Input Devices*** 13.27.2 Keyboard Use 13.27.11 Mouse Use 13.27.14 Input Device Interchangeability/ Redundancy
• Workstation	**See workstation above**					

B.6: FEMA

Location: Disaster site or search and rescue location
Employees: 7,474 across the U.S. at Headquarters, 10 regional offices, the National Emergency Training Center, and the Center for Domestic Preparedness
Approximately 5,000 individuals (mostly firemen) who become temporary federal employees during a disaster

Disaster Coordination, Support and Logistics Division

Mobile Emergency Response Service
Government field office setup at a disaster sites (JFOs)

Equipment:

- Satellite phone
- Blackberry/smartphone
- Computer/Laptop
- Tablet
- GPS device

FEMA Security Division

Provides security for joint field offices (JFOs) and manage disaster assistance employees (DAE)
DAE employees: approximately 100

Devices:

- Fingerprint capture device
- Laptop
- Blackberry/smartphone
- Satellite phone
- Communications radio
- Camera

- Alarm system kit (includes sensors, alarm panels, etc.)

Table 8: FEMA Devices and Related Standards

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
Fingerprint Scanner & components:			**5.1.3.1.9 Parallax and glare (touch screen devices)** **5.1.3.10 Touch screen viewing angle**			
• *Platen*						
• *Software*	***See Software above***					
• *Keypad*	**10.6.2 Design Characteristics** **10.6.3 Control Devices** 10.6.3.3 Keyboard (includes keypad)	**Part 4: Keyboard requirements** ***6.2 Design of keys*** 6.2.4 Keying feedback 6.2.8 Key legends 6.2.10 Numeric keypad	**5.1.3.2 Keyboards** 5.1.3.2.1 Layout and configuration	**5.4.3.1.3 Keyboards, keypads, keysets, and menu selectors** 5.4.3.1.3.3 Keypads	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6.9 Preferred Physical Specifications for Data Entry: Keyed*** 15.6.9.1 Keyboards/ Membrane keys 15.6.9.2 Keypads	
• *Display*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use	**6. Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8. Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	10.4 Visual acquisition of display 10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and Conventions*** 6.1.2 Lighting conditions 6.3 Display luminance setting			15.5.2 Viewing position 15.5.3 Size of displays information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	– principles of arrangement 8.6 Control and display movement relationships
Alarm Kits						
• *Master control panel*						
• *Key pad*	**10.6.2 Design Characteristics**	**Part 4 Keyboard requirements**	**5.1.3.2 Keyboards** 5.1.3.2.1 Layout and	**5.4.3.1.3 Keyboards, keypads, keysets, and**	**Part 3: Technical Guidance – Section 15**	

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	10.6.3 Control Devices 10.6.3.3 Keyboard (includes keypad)	6.2 Design of keys 6.2.4 Keying feedback 6.2.8 Key legends 6.2.10 Numeric keypad	configuration	**menu selectors** 5.4.3.1.3.3 Keypads	**Work Equipment** ***15.6.9 Preferred Physical Specifications for Data Entry: Keyed*** 15.6.9.1 Keyboards/ Membrane keys 15.6.9.2 Keypads	
• *Motion detectors*						
• *Sensors*						
• *Auditory alarms*	**10.8 Audio Displays** 10.8.3 Selection of signal type 10.8.5 Signal design 10.8.8 Auditory alarms		**5.3.1.2 Audio signals** 5.3.1.2.1 Warning signals 5.3.1.2.2 Caution signals 5.3.1.2.3 Alerting signals 5.3.1.2.5 Prioritization **5.3.1.3 Characteristics of warning signals** 5.3.1.3.1 Warning recognition time 5.3.1.3.2 Control of warning signals 5.3.1.3.3 Frequency **5.3.1.4 Signal characteristics in relation to operational conditions and objectives** 5.3.1.4.1 Audibility 5.3.1.4.2 Alerting capacity 5.3.1.4.3 Discriminability 5.3.1.4.5 Masking	**5.3.2 Audio signals** 5.3.2.1 Warning signals 5.3.2.2 Caution signals 5.2.3.3 Alerting signals 5.2.3.4 Advisory signals 5.2.3.5 Cueing signals 5.2.3.6 Prioritization **5.3.3 Characteristics of audio warning signals** 5.3.3.1 Characteristics of audio warning signals 5.3.3.2 Control of warning signals 5.3.3.3 Compatibility with existing signal codes	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.3 Auditory Information Presentation*** 15.3.2 Signal audibility 15.3.3 Signal recognition 15.3.4 Gaining attention 15.3.5 Signal discrimination 15.3.6 Signal meaning 15.3.7. Requirements for specific auditory signals ***15.7 Alarms, Warning and Cautions*** 15.7.2 System design issues 15.7.3 Alarm displays 15.7.4 Alarm system design process	**7. Alarms** ***7.1 General alarm requirements*** 7.1.3 Types of alarms 7.1.4 Alarm response requirement 7.1.5 Alarm acknowledge requirement 7.1.6 Alarm rates 7.1.7 Set points 7.1.8 False alarms 7.1.9 Simultaneous alarms 7.1.10 Alarm priorities ***7.3 Audible alarms*** 7.3.1 Audible alarms for emergency response 7.3.2 Content 7.3.3 Sound character 7.3.4 Number of distinct tones for alarms 7.3.6 Signal audio signal 7.3.7 Differing signals

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
						7.3.8 Selection of sounds
• *Visual alarms*			**5.7.3 Visual displays** 5.7.3.2 Warning/ caution		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.7.3 Alarm displays*** 15.7.3.1 Display modalities 15.7.3.2 System design 15.7.3.3 Design recommendations 15.6.3.4 Factors affecting detection 15.6.3.5 Flashing and apparent motion 15.7.4 Alarms system design process	**7. Alarms** ***7.2 Visual Alarms*** 7.2.1 Types of alarms 7.2.2 Flash rate 7.2.3 Alarms and normal operations 7.2.4 Priority coding 7.2.5 Flasher failure 7.2.6 Contrast detection 7.2.7 Text visibility and legibility 7.2.8 Text wording 7.2.9 Color coding 7.2.10 Visual/auditory alarms 7.2.11 Visual alarm panels 7.2.12 Supplemental alarm information
• *Software*	***See software above***					
Satellite phones	**10.10.3 User Interfaces with Mobile Machines**					
Smart phones	**10.10.3 User Interfaces with Mobile Machines**					
Laptop	**10.10 User Interfaces with Automated Systems** 10.10.1 Introduction 10.10.2 Automation 10.10.3 User Interfaces with Mobile Machines				**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.4 Human-Computer Interaction*** 15.4.1 Introduction 15.4.2 HCI Design Process 15.4.3 Essential HCI	**13 Human-Computer Interface** ***13.1 General Design Requirements*** 13.1.1 General Principles 13.1.2 Navigation 13.1.3 Consistency with Physical/Manual Interfaces

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
					Development Activities 15.4.4 Interaction Requirements 15.4.5 Computer-Based Displays 15.4.6 Computer-Based Control	13.1.4 Standard Procedures 13.1.5 Computer Response 13.1.6 Screen Design and Content 13.1.7 Coding 13.1.8 Input Devices 13.1.9 System Status 13.1.10 On-Line Help ***13.2 System Operations*** 13.2.1 Log-on Procedures 13.2.2 Log-off Procedures 13.2.3 Computer Failure 13.2.4 Interaction 13.3 Computer Displays 13.3.1 Design Criteria 13.3.2 Luminance 13.3.3 Contrast Ratio 13.3.4 Refresh Rate 13.3.5 Monochromatic Color Combinations 13.3.6 Resolution and Display Size 13.3.7 Flat Panel Image Formation Time 13.3.8 Flicker 13.3.9 Jitter 13.3.10 Glare ***13.4 Display Content*** 13.4.1 Standardization 13.4.2 Information Density ***13.8 Textual Data Displays*** 13.8.1 Use 13.8.2 Character Formats 13.8.3 Brevity

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.8.4 Abbreviations and Acronyms 13.8.5 Print Layout ***13.9 Graphic Displays*** 13.9.1 Use 13.9.2 Recurring Data 13.9.3 Refresh Rates 13.9.4 Line Format 13.9.5 Trend Lines 13.9.6 Pointing 13.9.7 Distinctive Cursor 13.9.8 Precise Positioning 13.9.9 Selecting Graphic Elements 13.9.10 Easy Storage and Retrieval 13.9.11 Automatic Data Registration 13.9.12 Graphic Formats 13.9.13 Derivation of Graphical Data 13.9.14 Drawing Lines 13.9.15 Resizing 13.9.16 Highlighting Data 13.9.17 Reference Index 13.9.18 Annotation of Data 13.9.19 Label Orientation 13.9.20 Pictorial Symbols 13.9.21 Display of Scale 13.9.22 Grids 13.9.23 Graphic Comparison 13.9.24 Bar Graphs 13.9.25 Maps 13.9.26 Mimics ***13.27 Input Devices***

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
						13.27.1 Input Devices 13.27.2 Keyboard Use 13.27.3 Fixed Function Keys 13.27.4 Variable Action 13.27.5 Touchscreen Use 13.27.6 Pointing Devices 13.27.7 Joysticks 13.27.8 Thumb Tip and Fingertip-Operated Displacement Joysticks 13.27.9 Trackball 13.27.10 Grid and Stylus Devices 13.27.11 Mouse Use 13.27.12 Light Pen 13.27.13 Speech Recognition Use 13.27.14 Input Device Interchangeability/ Redundancy
GPS	**10.10.3 User Interfaces with Mobile Machines**					
• *Visual Display*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display**	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays	**6 Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and Conventions*** 6.1.2 Lighting conditions 6.3 Display luminance setting			information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	8.6 Control and display movement relationships
• *Speakers*						
• *Software*	***See software above***					
• *Key pads on some models*	**10.6.2 Design Characteristics** **10.6.3 Control Devices** 10.6.3.3 Keyboard (includes keypad)	**Part 4 Keyboard requirements** ***6.2 Design of keys*** 6.2.4 Keying feedback 6.2.8 Key legends 6.2.10 Numeric keypad	**5.1.3.2 Keyboards** 5.1.3.2.1 Layout and configuration	**5.4.3.1.3 Keyboards, keypads, keysets, and menu selectors** 5.4.3.1.3.3 Keypads	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6.9 Preferred Physical Specifications for Data Entry: Keyed***	

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
					15.6.9.1 Keyboards/ Membrane keys 15.6.9.2 Keypads	
Workstations	**8.7.3.4 Fixtures for lighting tasks** **8.7.5 Glare**	**Part 4: Keyboard Requirements** ***6 Design Requirements and Recommendations*** 6.1 General Design of the Keyboard 6.2 Design of Keys ***(Part 4) 7 Measurement*** 7.1 General 7.2 General Design of the Keyboard 7.3 Design of Keys **Part 5: Ergonomic requirements for office work with visual display terminals – Workstation Layout and Postural Requirements** ***4 Guiding Principles*** 4.1 General 4.2 Versatility and Flexibility 4.3 Fit 4.4 Postural Change 4.5 User Information 4.6 Maintainability-Adaptability ***(Part 5) 5 Design Requirements and Recommendations*** 5.1 General 5.2 Postures 5.3 Ease of Adjustment 5.4 Support Surfaces	**5.1.3 Computer Controls** 5.1.3.2 Keyboards 5.1.3.3 Mouse/ trackballs/joysticks 5.1.3.4 Data entry **5.2.1.3.13 Display adjacent surfaces** **5.2.3.13.13 Glare** **5.5.3 Illuminance** ***5.5.3.1.1 General*** 5.5.3.1.1 d. Illumination source distribution to reduce glare **5.7.7 General Equipment-related Hazards** **5.10 Workspace Design** 5.10.1 General 5.10.2 Workspace provision 5.10.3 Workstation design 5.10.4 Special-purpose console design **5.14 Peripherals**	**5.7 Workspace Design** ***5.7.1 General*** ***5.7.2 Standing Operations*** 5.7.2.1 General 5.7.2.2 Advantages 5.7.2.3 Work Surface 5.7.2.4 Equipment placement 5.7.2.5 Dimensions ***5.7.3 Seated Operations*** 5.7.3.1 Advantages 5.7.3.2 Seating 5.7.3.3 Cushioning 5.7.3.4 Armrests 5.7.3.5 Footrests 5.7.3.6 Temporary Seats 5.7.3.7 Mobile Workspace ***5.7.5 Standard console design*** 5.7.5.1 Display surfaces 5.7.5.2 Control surfaces ***5.7.7 Stairs, ladders, and ramps*** 5.7.7.1 General criteria 5.7.7.2 Stairs 5.7.7.3 Ladders 5.7.7.4 Ramps 5.7.7.6 Elevators, inclinators, and hydraulic-operated work platforms ***5.7.8 Ingress & egress***	**Part 3: Technical Guidance – Section 13 The Workplace** ***13.2 Workplace Design*** 13.2.3 Design Principles 13.2.4 General Layout 13.2.5 Specific Requirements for Workstations 13.2.6 Working Environment 13.2.7 Approaches and Methods to Workplace Design 13.2.8 Workspace Design Reviews ***13.3 Workspace and Task Lighting*** 13.3.1 Introduction 13.3.2 Photometry and Colorimetry 13.3.3 Lighting Design Practice 13.3.4 Daylight 13.3.5 Lighting Equipment 13.3.6 Energy Considerations 13.3.8 Display Screen Equipment Lighting 13.3.9 Safety-Related Lighting **Part 3: Technical Guidance – Section 15**	**3.1.48 Glare** **10.1 Basic Principles of Workplace Design** 10.1.7 Control/Display Accessibility **10.2.4 Computer Workstation** **10.3.4 Display Mounting** **13.27.2 Keyboard Use** **13.27.11 Mouse Use** **13.27.14 Input Device Interchangeability/ Redundancy** **14.1.1. Maximum Levels** **14.1.2 Maximum Exposure and Protection** **14.2.1 Design Requirement** **14.2.2 Temperature** **14.2.3 Relative Humidity** **14.2.4 Temperature/ Humidity Design** **14.3 Lighting** 14.3.1 General Design Requirements 14.3.2 Location 14.3.5 Lighting Levels 14.3.6 Brightness Ratio 14.3.7 Wall Surface Reflectance 14.3.8 Other Lighting Requirement

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		5.5 Work Chair 5.6 Additional Support Elements 5.7 Layout of Workstations Within the Work Space		5.7.8.1 Routine 5.7.8.2 Non-routine 5.7.8.3 Walkways & Passageways **5.8 Environment** ***5.8.1 Heating, ventilating, and air conditioning*** 5.8.1.1 Heating 5.8.1.4 Environmental Factors 5.8.1.5 Thermal tolerance and comfort zones ***5.8.2 Illuminance*** 5.8.2.1 General 5.8.2.2 Illumination levels and distribution 5.8.2.3 Lighting fixtures 5.8.2.4 Brightness ratios 5.8.2.5 Glare 5.8.2.6 Reflectance 5.8.2.7 Dark adaptation ***5.8.4 Vibration*** 5.8.4.1 Whole-body vibration 5.8.4.2 Equipment vibration	**Work Equipment** ***15.6.9 Preferred Physical Specifications for Data Entry: Keyed*** 15.6.9.1 Keyboards/ Membrane Keys 15.6.9.2 Keypads ***15.6.12.2 Mouse***	
High resolution digital camera components						
• *Buttons, Knobs, and Control Devices*	**10.6.3 Control devices** 10.6.3.1 Push button 10.6.3.7 Slide switch controls 10.6.3.23 Knobs	**Part 9: Ergonomics requirements for office work with Visual Display Terminals – Requirements for non-keyboard input devices** 6.1.4 Button design	**5.1.4 Mechanical Controls** 5.1.4.1.2 Continuous adjustment rotary controls (knobs) 5.1.4.2 Linear controls (push buttons)	**5.4 Controls** 5.4.1.2 Direction of movement 5.4.2 Rotary controls 5.4.3.1.1 Push button, finger- or hand-operated	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.3 Preferred physical specifications for continuous variable	**5 Controls** ***5.1 Principles of control design*** ***5.6 Control use and design*** 5.6.5 Continuous adjustment rotary

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
					operation: Rotary (knob) 15.6.8 Preferred physical specifications for discrete operation: Push button	controls (knobs) 5.6.7 Pushbuttons
• *Visual Display*	**10.2 General** 10.2.1 Simplicity 10.2.2 Usability 10.2.6 Feedback 10.2.7 System Status **10.3 Layout** 10.3.2 Location and arrangement 10.3.4 Display-Control relationships 10.3.5 Location **10.4 Visual acquisition of display** 10.4.1 Display content 10.4.2 Minimal information **10.5 Visual Displays** 10.5.2.2 Viewing conditions 10.5.2.3 Luminance and contrast 10.5.2.4 Spatial metrics 10.5.2.6 Color	**Part 3: Visual Display Requirements** ***5 Design requirements and recommendations*** 5.1 Design viewing distance 5.2 Line-of-sight angle 5.3 Angle of view 5.4 Character height 5.5 Stroke width 5.6 Character width-to-height ratio 5.7 Raster modulation and fill factor 5.8 Character format 5.9 Character size uniformity 5.10 Between character spacing 5.11 Between-word spacing 5.14 Orthogonality 5.15 Display luminance 5.16 Luminance contrast 5.17 Luminance balance 5.18 Glare 5.19 Image polarity 5.20 Luminance uniformity 5.21 Luminance coding 5.22 Blink coding 5.23 Temporal	**5.2 Visual displays** 5.2.1 Installation of visual displays 5.2.2 Display content 5.2.3 Displays – hardware	**5.2 Visual Displays** 5.2.1 General 5.2.2 Transilluminated displays 5.2.3 Scale Indicators 5.2.4 Cathode ray tube (CRT) displays 5.2.5 Large-screen displays 5.2.6 Other displays	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.2 Visual information presentation*** 15.2.1 Guiding principles 15.2.2 Visual displays 15.2.4 Use of colour ***15.5 Discrete displays*** 15.5.1 Context of use 15.5.2 Viewing position 15.5.3 Size of displays information 15.5.5 Contrast 15.5.6 Glare and reflections 15.5.7 Displayed colour	**6 Displays** 6.1 Visual displays 6.2 Location, orientation, lighting, and arrangement of displays 6.3 Display illumination 6.4 Display types **8 Integration of controls, displays and alarms** 8.1 Principles of design 8.2 Grouping relationships – principles of arrangement 8.6 Control and display movement relationships

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
		instability (flicker) 5.24 Spatial instability 5.25 Screen image color ***(Part 3) 6 Measurement Conditions and Conventions*** 6.1.2 Lighting conditions 6.3 Display luminance setting				
• *Auditory signal*	**10.8 Audio Displays** 10.8.2 When to use 10.8.3 Selection of signal type 10.8.4 General design 10.8.5 Signal design		**5.3.1 Audio Displays** 5.3.1.7 Audio displays as part of the user interface	**5.3.2 Audio signals** 5.3.2.3 Alerting signals 5.3.2.5 Cueing signals	**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.3 Auditory information presentation*** 15.3.1 Valid use of auditory signals 15.3.2 Signal audibility 15.3.3 Signal recognition 15.3.4 Gaining attention 15.3.5 Signal discrimination 15.3.6 Signal meaning 15.3.9 Evaluation of auditory signals	**Section 13.10 Audio displays** 13.10.1 Use 13.10.2 Audio supportive function 13.10.3 Signal characteristics
• *On/off switch*	**10.6.3 Control Devices** 10.6.3.6 Rocker switches (on/off switch)		**5.1.4.2 Linear controls** 5.1.4.2.1 Discrete adjustment linear controls e. Rocker switches		**Part 3: Technical Guidance – Section 15 Work Equipment** ***15.6 Discrete Controls*** 15.6.8.4 Rocker switches	**5.6 Control Use and Design** 5.6.10 Rocker switches
• *Software*	**10.5.2.9 Software Elements** 10.5.2.9.1 Scrolling 10.5.2.9.2 Navigation 10.5.2.9.3 Selection 10.5.2.9.4 Menus 10.5.2.9.5 Toolbars & Status Bars	**Part 13: User Guidance** ***10 Online Help*** 10.1 Description 10.2 System-initiated Help 10.3 User-initiated Help 10.4 Presentation of Help Information	**5.1 Structuring into Levels and Menus** ***5.1.3.5.2 Menu Selection*** 5.1.3.5.2. a. Use 5.1.3.5.2. b. Selection **5.14.8.12 Help** 5.14.8.12.1 Standard	**5.4.3 Linear Controls** 5.4.3.1.3 Keyboards, keypads, keysets, and menu selectors e. Menu Selection	**15.4 Human-Computer Interaction** 15.4.1 Introduction 15.4.2 HCI Design Process 15.4.3 Essential HCI Development Activities 15.4.4 Interaction	**13 Human-Computer Interface** ***13.1 General Design Requirements*** 13.1.1 General Principles 13.1.2 Navigation 13.1.3 Consistency with Physical/Manual

DEVICE	Existing Standards					
	NASA SP-2010-3407	**ISO 9241**	**MIL-STD-1472G**	**MIL-HDBK-759C**	**MOD 00-250**	**ASTM F1166**
	10.5.2.9.6 Dialog Boxes **10.5.3 Display Interpretation** **10.5.4 Display Technologies** **10.5.5 Related Display Standards** **10.10 User Interfaces with Automated Systems** 10.10.1 Introduction 10.10.2 Automation 10.10.3 User Interfaces with Mobile Machines	10.5 Help Navigation and Controls 10.6 Browsable Help 10.7 Context-Sensitive Help **Part 14: Menu dialogs** ***5 Menu Structure*** 5.1 Structuring into Levels and Menus 5.2 Grouping Options within a Menu 5.3 Sequencing of Options with Groups ***6 Menu Navigation*** 6.1 Navigation Cues 6.2 Rapid Navigation ***8 Menu Presentation*** 8.1 Option Accessibility and Discrimination **Part 151: Guidance on World Wide Web user interfaces** ***6 High level design decisions and design strategy*** 6.2 Determining purpose of a Web application 6.3 Analyzing the target user groups 6.4 Analyzing the users' goals and tasks 6.5 Matching application purpose and user goals 6.6 Recognizing the purpose of a Web application 6.7 Prioritizing different	Action to Request Help 5.14.8.12.2 Multilevel Help 5.14.8.12.3 Browsing Help		Requirements 15.4.5 Computer-Based Displays 15.4.6 Computer-Based Control	Interfaces 13.1.4 Standard Procedures 13.1.5 Computer Response 13.1.6 Screen Design and Content 13.1.7 Coding 13.1.8 Input Devices 13.1.9 System Status 13.1.10 On-Line Help ***13.2 System Operations*** 13.2.1 Log-on Procedures 13.2.2 Log-off Procedures 13.2.3 Computer Failure 13.2.4 Interaction ***13.11 Data Entry*** 13.11.1 General Requirements 13.11.2 User pacing 13.11.3 Positive Feedback 13.11.4 Processing Display 13.11.5 Explicit Action 13.11.6 Validation 13.11.7 Available Data 13.11.8 Input Units 13.11.9 Buffer 13.11.10 Presentation Mode 13.11.11 Display Window 13.11.12 Data Deletion 13.11.13 Data Change 13.11.14 Single Data Entry Method 13.11.15 Data Entry Display

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
		design goals 6.8 ICT accessibility 6.9 Software accessibility 6.10 Web content accessibility 6.11 Identifying the website and its owner 6.12 Coherent multi-site strategy ***(Part 151) 7 Content design*** 7.1 Conceptual content model 7.2 Content Objects and functionality ***(Part 151) 8 Navigation and search*** 8.1 general 8.2 General guidance on navigation 8.3 Navigation structure 8.4 Navigation components 8.5 Search ***(Part 151) 9 Content Presentation*** 9.1 General 9.2 Observing principles of human perception 9.3 Page design issues 9.4 Link design 9.5 Interaction objects 9.6 Text design ***(Part 151) 10 General design aspects*** 10.1 Designing for				13.11.16 Data Editing 13.11.17 String Search 13.11.18 Automatic Line Break 13.11.19 Format Control 13.11.20 Frequently Used Text 13.11.21 Control Annotations 13.11.22 Printing Options 13.11.23 Text Length 13.11.24 Justification 13.11.25 Minimization of Keying ***13.13 Graphic Controls*** 13.13.1 Use 13.13.2 Iconic Menus 13.13.3 Supplemental Verbal Labels 13.13.4 Icon Controls 13.13.5 Palettes 13.13.6 Push-buttons 13.13.7 Radio Buttons 13.13.8 Check Boxes 13.13.9 Sliders 13.14 Windows ***13.15 Menus*** 13.15.1 Use 13.15.2 Item Selection 13.15.3 Titles 13.15.4 Series Entry 13.15.5 Sequences 13.15.6 Active Option Presentation 13.15.7 Format Consistency 13.15.8 Option Sequence

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
		cultural diversity and multilingual use 10.2 Providing Help 10.3 Making Web user interfaces error-tolerant 10.4 URL names 10.5 Acceptable download times 10.6 Using generally accepted technologies and standards 10.7 Supporting common technologies 10.8 Making Web user interfaces robust 10.9 Designing for input device independence 10.10 Making the user interface of embedded objects usable and accessible				13.15.9 Simple Menus 13.15.10 Option Presentation 13.15.11 Direct Function Call 13.15.12 Consistency with Command Language 13.15.13 Option Coding 13.15.14 Keyed Codes 13.15.15 Position in Structure 13.15.16 Back Menu 13.15.17 Return to Top Level ***13.16 Forms*** 13.16.1 Use 13.16.2 Grouping 13.16.3 Format/Content Consistency 13.16.4 Distinctive Fields 13.16.5 Omissions 13.16.6 Protected Areas 13.16.7 Flexible Data Entry 13.16.8 Logical Order 13.16.9 Control Entry 13.16.10 Message Forms ***13.18 Language*** 13.18.1 Command Language 13.18.2 Punctuation 13.18.3 Command Entry 13.18.4 Display Location 13.18.5 Command Prompts 13.18.6 Complexity 13.18.7 Macro Command

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.18.8 Standard Command Editing 13.18.9 Destructive Commands 13.18.10 Questions and Answers 13.18.11 Query Language ***13.19 Feedback*** 13.19.1 Use 13.19.2 Standby 13.19.3 Process Outcome 13.19.4 Input Configuration 13.19.5 Current Modes 13.19.6 Highlighted Selection 13.19.7 Input Rejection 13.19.8 Feedback Messages 13.19.9 Time Delay Warning ***13.20 Prompts*** 13.20.1 Use 13.20.2 Standard Display 13.20.3 Explicit Prompts 13.20.4 Prompt Clarity 13.20.5 Definitions 13.20.6 Consistent Technology 13.20.7 Confirmation ***13.21 Defaults*** 13.21.1 Use 13.21.2 User Selection 13.21.3 Default Substitution 13.21.4 Sequential Defaults

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.22 Error Management/Data Protection 13.22.1 Error Correction 13.22.2 Error Detection 13.22.3 Internal Software Checks 13.22.4 Critical Entries 13.22.5 Error Message Content 13.22.6 Error Recovery 13.22.7 Diagnostic Information 13.22.8 Entry Correction and Confirmation 13.22.9 Spelling Errors 13.22.10 Errors in Stacked Commands (stacked sequences) 13.22.11 Display of Erroneous Entries 13.22.12 File Management ***13.23 Data Security*** 13.23.1 General 13.23.2 Automated Measures 13.23.3 Segregating Real/Simulated Data 13.23.4 Security Classification Display 13.23.5 User Identification ***13.24 Help*** 13.24.1 General 13.24.2 Help Request 13.24.3 Help Content

DEVICE	Existing Standards					
	NASA SP-2010-3407	ISO 9241	MIL-STD-1472G	MIL-HDBK-759C	MOD 00-250	ASTM F1166
						13.24.4 Multi-Level HELP 13.24.5 Browse/Help 13.24.6 Help Access 13.24.7 Appropriate Help ***13.25 Software*** 13.25.1 General 13.25.2 Information and System Response 13.25.3 Compute Failure 13.25.4 Task Complexity 13.25.5 Interaction ***13.26 Data Transmission/ Messaging*** 13.26.1 Functional Integration 13.26.2 Consistent Procedures 13.26.3 Message Formats 13.26.4 Interruption 13.26.5 Incorporate Existing Files 13.26.6 User Initiation 13.26.7 Transmission Notification 13.26.8 Address Entry Prompt 13.26.9 Incoming Message Control 13.26.10 Data Presentation

APPENDIX C: CONTACTS WITHIN DHS DIRECTORATES

This appendix lists the supervisors and end users the research team worked with in each of the directorates covered by this review.

C.1: U.S. Citizenship and Immigration Services (USCIS)

In order to understand the relevant organizational aspects of USCIS for this study, the research team made an initial appointment with Theresa C. Bertucci, Associate Director, Enterprise Services directorate in the USCIS offices at 111 Massachusetts Avenue NW, Washington DC on June 27, 2011. The purpose of this meeting was to provide Ms. Bertucci with an overview of the purpose of the project and a copy of the interview instrument.

After the team described the project goals and purpose, Ms. Bertucci determined that Conrad Zargosa would be able to assist us and scheduled a meeting with him on July 11, 2011 at the same office building. Mr. Zargosa provided additional information regarding the Biometric aspects of the USCIS data collection processes, and he facilitated a tour of their Biometric development area in the same building. Furthermore, Ms. Bertucci and Mr. Zargosa facilitated the scheduling of a site visit to the USCIS Application Support Center in Wheaton, MD on July 14, 2011.

The Application Support Center was very cooperative, and provided a walkthrough and demonstration of the processes and equipment used at the Center. As a result of the visit, along with other information obtained through the initial interviews with Ms. Bertucci and Mr. Zargosa, the team was able to fully document the applicant enrollment process.

C.2: Transportation and Security Administration (TSA)

The initial contact identified at TSA was Andrew Cox. From the research team's initial contact with Andrew, the research team scheduled an appointment with two TSA human factors (HF) specialists, Bonnie Kudrick and Katrin Helbing. The team met with the HF specialists at Reagan National Airport Headquarters, and after summarizing the project and answering the specialists' questions, Katrin provided a tour of the facilities. That tour provided the researchers with detailed information about TSO tasks and the technology used to complete those main tasks. Subsequent to that visit, Katrin and Bonnie scheduled a meeting with several TSOs so that members of the team could talk to the agents about their tasks and what they saw as challenges to completing those tasks.

C.3: U.S. Coast Guard (USCG)

Mark Rutherford was the research team's initial contact for the USCG and he identified Lt. Francisco Montalvo. Lt. Mantalvo identified Lt. Josh Brandt as the owner of the USCG biometrics program. Lt. Brandt in turn scheduled a meeting between his team and the NIST team at the USCG headquarters in SE Washington, DC.

C.4: Customs and Border Protection (CBP)

Air and Marine

NIST project members made arrangements to meet the previously identified CBP Air and Marine contacts, Kim Mills and Nicole James, at the CBP Headquarters in the Ronald Reagan Building on October 26, 2011.

Border Patrol

On November 17, 2011, NIST project members interviewed CBP agents Paul Good, Officer Mitch Harmell, and C. Taylor Ray at the NIST campus in Gaithersburg, MD.

C.5: U.S. Immigrations and Customs Enforcement (ICE)

On December 28, 2011, the NIST team interviewed Mr. Jeffrey Wilson of Enforcement and Removal Operations field operations. The field operations teams search for specific individuals who are fugitives, detain them, and remove the illegal aliens. A fugitive is someone who is told to leave the country and has not left. In comparison, CBP conducts border patrols and ERO is responsible for internal enforcement.

C.6: Federal Emergency Management Agency (FEMA)

Disaster Coordination, Support and Logistics Division

NIST staff made arrangements with FEMA contact Joyce Thorton to interview members of the Disaster Coordination, Support and Logistics Division on November 30, 2011 at the FEMA Offices on Maryland Ave. in SW Washington, DC.

Security Division

On December 7, 2011, arrangements were made to interview Mr. Don Pope of the FEMA Security Division in their downtown SW DC offices. The Security Division is responsible for security policies applied at the Regional Disaster settings. They coordinate, respond and

apply comprehensive security disciplines at all disasters and manage disaster assistance employees (DAE).