Department of Defense
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A National Historic Context for the Hush Houses and Test Cells on Department of Defense Installations

Jayne Aaron, LEED AP

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ACRONYMS AND ABBREVIATIONS

AAF	Army Air Force
ADC	Air Defense Command
AEDC	Air Engineering Development Center
AFB	Air Force Base
AFCEE	Air Force Center for Engineering and the Environment
ANAP	Aviation Noise Abatement Policy
ANG	Air National Guard
ANGB	Air National Guard Base
ARNG	Army National Guard
ASNA	Aviation Safety and Noise Abatement Act of 1979
BMW	Bavarian Motor Works
BRAC	Base Realignment and Closure
CFR	Code of Federal Regulations
dBA	Decibel, Adjusted
°F	Degrees Fahrenheit
DEW	Distant Early Warning
DoD	Department of Defense
DOI	Department of the Interior
FAA	Federal Aviation Administration
FR	Federal Register
GAO	General Accounting Office
GE	General Electric Company
GTB	Gas Turbine Basalt
MCAS	Marine Corps Air Station
NAAS	Naval Auxiliary Air Station
NARF	Naval Air Rework Facility
NAS	Naval Air Station
NGB	National Guard Bureau
NHPA	National Historic Preservation Act of 1966, as amended
NRHP	National Register of Historic Places
OCAMA	Oklahoma City Air Materiel Area
POC	Point of Contact
TAC	Tactical Air Command
USACE	U.S. Army Corps of Engineers
USC	United States Code
VTOL	Vertical Takeoff and Landing
WWI	World War I
WWII	World War II

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1.0 INTRODUCTION

The Department of Defense (DoD) and other branches of the military are responsible for managing their properties throughout the United States and its possessions, including the management of historic properties. Under sections 106 and 110 of the National Historic Preservation Act of 1966, as amended (NHPA); (16 *United States Code* [USC] 470-470w-6); DoD Directive 4715.1E; and DoD Instruction 4715.16, the DoD is required to identify, evaluate, and manage cultural resources on federally owned and leased properties. To this end, the Air National Guard (ANG) has competed for and been awarded a DoD Legacy Resource Management Program project to develop a historic context study of Hush House and Test Cell facilities.

Hush houses and test cells are acoustical aircraft enclosures that allow testing of unmounted aircraft engines and testing of fully assembled jet aircraft in an enclosed space, which allows for specific test conditions during testing and maintenance. The sound from the aircraft is absorbed and muffled within the hush house or test cell. The structure allows continuous maintenance on all manner of military aircraft that could only previously be conducted outside or in open hangars, potentially disturbing surrounding communities, and occurring in sight of prying eyes.

The ANG has approximately 120 installations, while the Air Force has over 400 installations. The ANG has 55 hush houses for the F-15 and F-16 aircraft, most from the later Cold War period (1980s). Several of the hush houses within ANG are inactive and may be affected by Base Realignment and Closure (BRAC) procedures. Prior to beginning the study, the estimated number of installations that have hush houses at Air Force, ANG, Air Reserves, Naval Air Stations (NAS), Marine Corps Air Stations (MCAS), and Army Air installations exceeded 100.

Hush houses and test cells as a property type have been overlooked in the literature that provides the basis for management of aviation resources. To date, no detailed study has been conducted describing these structures or discussing their historical or architectural significance. In *Historical and Architectural Overview of Military Aircraft Hangars* (Pedrotty et al. 1999), mention is made of “Test Cells (hush houses)” as a military hangar type, but no supporting material is presented in the study to better understand them. Likewise, the *National Register Bulletin Guideline for Evaluating and Documenting Historic Aviation Properties* also makes mention of “test cells” as an aviation building type, but again offers no further support information. In *Coming in from the Cold: Military Heritage in the Cold War* (Center for Air Force History 1994), mention is made of a significant test cell building at Wright-Patterson Air Force Base (AFB) and another in New Jersey; however, no discussion is offered for either facility. In *Historic Context for Army Fixed Wing Airfield 1909–1989* (Kuranda 2002), no mention is made of this property type. Furthermore, other military and civilian technical and popular publications provide little more than passing mention of this building type, nor do they offer any further analysis or context. Individual hush houses and test cells have been documented and some evaluated for the National Register of Historic Places (NRHP); however, this fractured approach offers no comprehensive guide to understanding these unique structures. As a result, the presence and importance of hush houses and test cells is sometimes implied, but not well understood or documented.

1.1 PROJECT DESCRIPTION

The objective of this study is to improve our historical understanding of hush houses by developing a historic context detailing their military development and use throughout the United States, from World

War II (WWII) through the Cold War. This study also provides an understanding of the evolution of noise-attenuating technology from propeller (piston driven) engine-testing rigs to jet engine development and maintenance. The context further examines different types of hush houses and test cells, with attention focused on technical demands, function, and other influences including fire considerations, military construction and design regulations, Federal Aviation Administration (FAA) regulations, aircraft changes with related maintenance practices, and requirements based on surrounding population density and "good neighbor" policies. Context also examines examples of hush houses and test cells from the different military branches, addressing similarities and differences based on service branch, function, aircraft tested, etc.

Originally, the focus of this study was on hush houses; however, as the project progressed, test cells have been included. The focus has remained on hush houses and test cells at military installations that repair and maintain aircraft, and not on test cells associated with research and design facilities. One early research and design test cell is discussed in the case studies because it was one of the first test cells in the country. A typology of hush houses and test cells found at U.S. military installations is provided, as well as specific case studies. These resources range from permanent "brick and mortar" to moveable structures, and are tied directly to air fighter, transport, refueling, and other air support missions from early military aviation development during WW II throughout the Cold War.

1.2 METHODOLOGY

Primary research for the historic context and inventory was conducted at the National Archives and Records Administration, Wright-Patterson AFB, Maxwell AFB, and the U.S. Patent Office from September 2007 through March 2008. Sixteen rolls of microfiche were collected from Maxwell AFB. Most references to hush houses were in installation annual or quarterly reports indicating that a new hush house was being constructed. Some information was obtained regarding specific hush houses such as the facility at Kadena AFB in Japan. Patents were gathered from 1939 through 1997 on various sound absorbing and noise attenuation inventions for aircraft. It is not conclusive that all patents have been collected.

Secondary research involved reviewing materials collected by authors of published works on hush houses, noise studies, regulations, aircraft development, jet technology, and military history. Secondary research also involved telephone calls and e-mails to former military personnel, hush house manufacturers, and the historian at Arnold Engineering Development Center at Arnold AFB. Since designs are proprietary, hush house manufacturers would not provide information for this study. Internet research provided links to secondary source information, current hush house manufacturers, and military installations.

The inventory was developed from real property and personal property inventories collected from DoD military branch headquarters. The inventory of hush houses includes a list of known hush houses and test cells constructed on U.S. DoD installation lands. Data requests were made to specific DoD installations, and where specific and appropriate information was received, it has been added to the inventory. Some agencies list hush houses as real property, while others list them as personal property, thus, there is a margin of error in the inventory. A list of hush houses was collected from the National Guard Bureau (NGB)-Army National Guard (ARNG)—five appeared on their property list; however, when contact was initiated with identified installations, they indicated that hush houses were not present.

The documentation/evaluation phase of this project included identification of a sample of 10 extant hush houses and test cells on DoD installations. These buildings were subject to NRHP evaluation and photo-documentation. This phase of the project was completed by a contractor who visited each installation, acquired photographs, and conducted site-specific research in the installation's archives. All photographs are in digital format and included with this final report.

As a final component of the project, an article manuscript will be written that summarizes the results of the project. Upon publication, this article will share the results of the project to a larger audience.

1.3 ACKNOWLEDGEMENTS

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2.0 HISTORIC CONTEXT

2.1 EARLY DEVELOPMENT OF MILITARY AVIATION TO JET AIRCRAFT

The first American use of manned flight for military purposes came during the American Civil War when John LaMoutain and Thaddeus Lowe successfully launched manned reconnaissance balloons in support of Union Army operations. In June 1861, Lowe’s map of Confederate Army positions in Falls Church, Virginia, was the first significant contribution of manned flight to American warfare. Although the Union Army lost the battle at Bull Run in July, the map allowed Lowe to report that the Confederate Army was not advancing on Washington after the battle. In September, Lowe demonstrated the potential of the balloons when he directed artillery fire at Confederate Army positions. Lowe continued to develop military applications of balloon technology and established the first U.S. “air force,” the Balloon Service of the Army of the Potomac (McFarland 1997).

Orville and Wilbur Wright designed and built a glider in 1902, which became the first fully controllable aircraft addressing roll, pitch, and yaw. During the winter of 1902–1903, with the assistance of mechanic Charlie Taylor, the Wright brothers designed and built a lightweight, gasoline-powered engine powerful enough to propel an airplane. On December 17, 1903, Wilbur and Orville Wright made the first sustained, controlled flight in a powered aircraft at Kitty Hawk, North Carolina. By the end of 1905, they were flying figure eights over Huffman Prairie, staying aloft for over half an hour, or until the fuel was consumed (Wright 2007).

In late 1907, President Theodore Roosevelt directed the U.S. Army to acquire an aircraft; and in 1909 they awarded Orville and Wilbur Wright $30,000 for delivering Aeroplane No. I. With one aircraft, the newly formed Aeronautical Division of the Army began practicing photography, strafing, and dropping bombs. The Aeronautical Division formed their first unit, the 1st Aero Squadron, on December 8, 1913 (McFarland 1997). These achievements convinced the U.S. Congress to award the Army’s air force official status on July 18, 1914, as the Aviation Section, Signal Corps, which absorbed the Aeronautical Division consisting of 19 officers, 101 enlisted men, 1 squadron, and 6 combat aircraft (McFarland, 1997).

The value of military aircraft was established in World War I (WWI) when deployment in critical reconnaissance programs halted the initial German offensive against the city of Paris, France. When the United States declared war on Germany on April 6, 1917, it had 56 pilots and fewer than 250 aircraft, all obsolete. Congress appropriated $54,250,000 in May and June 1917 for “military aeronautics” to create a total of 13 American squadrons for the war effort. French Premier Alexandre Ribot telegraphed a message to President Woodrow Wilson in late May recommending that the alliance of forces opposing Germany would need an American air force of 4,500 aircraft, 5,000 pilots, and 50,000 mechanics by 1918 to achieve victory. The United States fell short of this goal; but by war’s end the airplane had entered combat, and by eliminating the element of surprise through observation and reconnaissance, it helped Allied forces attain victory over the German forces on the European Western Front (McFarland 1997).

Following WWI, the U.S. Army and Navy viewed the combined air forces as their auxiliary arms and supporting weapon. The U.S. Congress, however, provided the Air Service a measure of independence, reauthorizing it from an auxiliary force to an offensive force equal to the artillery and infantry by creating the U.S. Army Air Corps on July 2, 1926 (McFarland 1997).

During the 1920s, technological advancements allowed pilots to fly higher, set speed and duration records, and conduct night flights. The staff at the Engineering Division, and later the Materials Division, worked with American industry and the National Advisory Committee for Aeronautics (predecessor to the National Aeronautics and Space Administration) to develop essential technologies including engineered sodium-cooled valves, high-octane gasoline, tetraethyl lead knock suppressants, stressed duraluminum aircraft structures, cantilevered wings, superchargers, turbo superchargers, retractable landing gear, engine cowlings, radial engines, variable-pitch constant-speed propellers, and automatic pilot (McFarland 1997).

Aircraft design changed dramatically between the 1920s and 1930s. The open cockpit, cloth-body bi-planes used during WWI were replaced by closed cockpit, metal-body, mono-wing aircraft with more powerful engines. Two major types of Army aircraft (fighters and bombers) were developed during this period with multi-cylinder radial and piston V-engines (Kuranda 2002).

During WWII, major advancements were made in the design of military aircraft. Faster, better-armed, and longer-range fighter planes were capable of early interception of enemy aircraft and were capable of accompanying strategic bombers. The fighters and bombers of this era were equipped with multi-cylinder radial and V-engines (Kuranda 2002). The Boeing-designed B-29 Superfortress was the first Very Heavy Bomber class of plane produced, entering service in 1943, and the primary aircraft used for bombing raids on Japan (Kuranda 2002).

Initial development of the first practical turbojet aircraft engines began almost simultaneously in the mid-1930s in both Germany and the United Kingdom. By the end of 1939, four months into WWII, the German government was financing four military jet engine programs with two fighter jets under development, and the British government was supporting the development of three military jet engines and two jet fighters by 1941 (RAND 2002).

It was not until WWII was underway, however, that industry and the U.S. government committed major resources to the development and production of functional military gas-turbine aircraft engines, and the aircraft that these engines would power (RAND 2002). The United States lagged significantly behind Germany and the United Kingdom with jet-powered military aircraft developed in the United States, depending on British engines and British engine technology (RAND 2002). In early 1941, General Henry "Hap" Arnold, chief of the Army Air Force, learned of the British jet engine development programs and the existence of the Whittle engine. General Arnold arranged for transfer of the Whittle technology to the General Electric Company (GE) turbocharger division so that the United States could quickly develop a jet-powered fighter.

Gas turbines for use on aircraft posed truly daunting technical problems, the most significant issues were obtaining appropriate lightweight heat-resistant materials and developing adequate compressor efficiency. Another major technical barrier was developing a workable, robust, and reasonably fuel-efficient combustion system to drive the turbine and compressor. For these reasons and others, development of gas-turbine aircraft engines languished for decades. In the United States, research at GE and elsewhere focused on developing turbochargers for conventional piston aircraft engines. These efforts met with great success and resulted in powerful high-altitude piston-driven engines for the U.S. Army Air Corps fighters and bombers (RAND 2002).

Germany was significantly ahead of the United Kingdom in jet engine development, and one authority estimated that Germany maintained a minimum five-year lead in jet engine development over America at the beginning of WWII (RAND 2002:103). By late 1944, however, the allied air forces attained near total air superiority and were bombing German industrial facilities and transportation infrastructure around the clock. When U.S. Air Force officers, scientists, and engineers visited German research and development facilities following WWII, many of them were shocked at how advanced Germany was in jet aircraft design compared with America.

The United States was thus invigorated to develop jet-powered military aircraft. They knew that significant new engine technology would be crucial to aircraft advancement (RAND 2002). U.S. military aircraft development benefited directly from observing German engineering following WWII. New approaches, plans, and technology were incorporated into U.S. aircraft design and the first jet flight by a U.S. naval aviator occurred in April 1943 (NHC 1997). The test flights initiated what became a steady change-over to a largely jet-powered fleet of military planes (NHC 1997). In 1947, the first frontline jet fighter, the Republic F-84 Thunderstreak/Thunderflash, was constructed and made operational for the U.S. Air Force. The F-84 shepherded in a new age of military aviation and revolutionized military combat aviation. The F-84 was joined by the Boeing B-50 propeller-driven bomber and the Boeing B-57 jet bomber, both produced the same year (1947). The steady technological advancements in aircraft design and construction by the Union of Soviet Socialist Republics (USSR) military aviation encouraged parallel development in U.S. military aviation. A steady game of "one-ups-manship" between these two military powers ensued, with each repeatedly producing consistently faster, more agile, and more powerful aircraft. Prior to 1955, two additional jet-powered fighter designs were added to the U.S. Air Force—the North American F-86 Sabre and the F-100 Super Sabre (Military Factory 2007).

During the Korean conflict, the U.S. Army employed fixed-wing aircraft in a variety of missions including observation, reconnaissance, and in directing tanks and infantry. In 1950, the Army attained 725 aircraft, including 668 fixed-wing airplanes and 57 helicopters. By 1953, the total number of aircraft had increased to 2,573, including 1,854 fixed-wing (with addition of the new Cessna L-19 Birddog), and 719 helicopters. The helicopters used for observation and rapid transport included the Bell H-13 Sioux, Sikorsky H-19 Chickasaw, and Hiller H-23 Raven—medical evacuation was an important component of the Army aviation mission (Kuranda 2002).

Between the conflicts in Korea and Vietnam, U.S. Army aviation programs emphasized use of rotary aircraft. The Army concentrated on developing programs that used the helicopter for tactical air support and transport of troops and supplies. With the arrival of the UH-1 Iroquois (a.k.a. Huey) helicopter, other turbine-powered aircraft, and two airmobile Army divisions, helicopter warfare became the most important innovation of the Vietnam conflict (Aircav.com 2007). Implementation of the concept of "airmobility" (the strategy for the quick deployment of troops using air transport) contributed to the decline in the use of fixed-wing aircraft by the U.S. Army during the final two decades of the Cold War era (Kuranda 2002:59-60).

The U.S. Navy and Marine Corps expanded their aircraft inventories following WWII and the commencement of the Cold War. The 1950s were characterized by the introduction of new jet fighter and attack aircraft technology. The U.S. Navy and Marine Corps added faster and more powerful aircraft, with the jet rapidly becoming the propulsion system of choice. The Navy acquired what would become a workhorse transport airframe with the 1956 introduction of the Lockheed C-130 Hercules, albeit a turboprop aircraft. The Marine Corps also added rotary aircraft to its inventories, although helicopters were not as numerous in the Marine Corps' aviation resource inventory as they had been for the Army (Military Factory 2007).

Hostilities in Southeast Asia made the 1962 introduction of the McDonnell Douglas F-4 Phantom II carrier-capable fighter jet a timely addition to both the Navy and Marine Corps fleets. The 1968 Navy acquisition of the Grumman A-6 Intruder added advanced range, maneuverability, and power capabilities (Military Factory 2007). In 1970, the Navy upgraded from the successful F-4 Phantom II to the variablegeometry, carrier-capable Grumman F-14 Tomcat, ushering in a new generation of multipurpose fighter and attack jet aircraft. The next generation of this versatile aircraft platform was introduced in 1983 with the Boeing/McDonnell Douglas/Northrop F/A-18 Hornet. The F/A 18 Hornet is also a carrier-based aircraft that was added to both Navy and Marine Corps inventories. In 1985, the Marine Corps added the Boeing AV-8B Harrier "jump jet," which has the unique ability to vary the angle of the engine thrust, thereby enabling vertical or very short roll takeoffs (Military Factory 2007).

Similar to the Navy and the Marine Corps, the Air Force mission required aircraft with increasingly greater range and power. The Boeing B-52 Stratofortress joined the Air Force Strategic Air Command in 1955 as a staple in the long-range, high-altitude jet bomber fleet, and it continues to provide service in 2009. The KC-135 Stratotanker was added in 1956 and pioneered in-flight refueling during the Cold War era. This was the same airframe as the KC-135 Stratolifter (Boeing707 civilian equivalent), which was used for air transport. Additional jet fighters and attack aircraft were acquired for the Air Force in the late 1950s and during the 1960s. The Convair F-102 Delta Dagger and F-106 Delta Dart were used in Southeast Asia missions, as were the McDonnell Douglas F-4 Phantom II and the Vought A-7 Corsair II (Military Factory 2007).

In 1966, the Air Force acquired the Lockheed SR-71 Blackbird high-altitude reconnaissance aircraft, and the Lockheed C-5 Galaxy large transport jet was delivered in 1970. In 1979, the McDonnell Douglas F-15 Eagle and the General Dynamics/Lockheed Martin F-16 Fighting Falcon joined the Air Force as the next generation of fighter aircraft (Military Factory 2007). Jet power continued to play a major role in military aviation as the Boeing KC-10 Extender refueling jet was acquired by the Air Force in 1981, the "stealth technology" Lockheed F-117 Nighthawk fighter was added in 1982, and the Rockwell/Boeing B-1 Lancer bomber was delivered in 1985 (Military Factory 2007).

2.2 JET ENGINES – THE BASICS

Jet engines operate on the Brayton cycle, which consists of three distinct stages, (1) compression (raising the pressure of air entering the engine), (2) heating (raising the temperature of the air to greatly increase its energy), and (3) expansion (dropping the pressure of the flowing air and fuel combustion products to extract energy and accelerate flow). A jet engine produces thrust by creating a net change in the velocity of the air that is moving through the engine. As the engine "pushes" on the air to accelerate it, the air pushes back on the engine, providing thrust for the aircraft (RAND 2002).

There are four types of jet engines used in U.S. military aircraft: (1) turbojet, (2) turbofan, (3) turboprop, and (4) turboshaft. Jet engines operate by forcing incoming air into a tube where the air is compressed, mixed with fuel, ignited and burned, then emitted as exhaust at high speed to generate thrust.

A turbojet contains a compression section where rotating blades compress the air by slowing the incoming air to create higher pressure. The compressed air is forced into a combustion chamber where it is mixed with fuel and burned. The high-pressure gases are emitted as exhaust through a turbine section where the gases turn more rotating blades that are connected by a shaft to the compressor blades in the front of the engine. This air compression/combustion process sucks more air into the front of the engine, repeating the turbojet function. As the combustion gases expand through the nozzle at the rear of the engine, forward thrust is created.

Additional design features are added to the turbofan engine, e.g., while most engine components remain the same, the turbofan engine contains a fan section in front of the compressors that is driven by the turbine. The fan section forces a large volume of air through outer ducts that pass around the engine core, resulting in a “bypass” jet. The bypass air flow travels at much lower speeds than the air in the engine core, but still produces significant thrust without burning additional fuel. The bypass air helps to abate engine noise, making the engine much quieter than a turbojet engine, and making the turbofan engine more fuel efficient.

The turboprop engine is similar to a turbofan, except it drives an external propeller at the front of the engine rather than the ducted fan. Turboprop engines are very fuel efficient (in a typical turboprop engine, the jet core creates about 15% of the thrust while the propeller creates the remaining 85%).

The turboshaft engine is similar in design to the turboprop and is used to power most present-day helicopters (having displaced the piston-driven engines of earlier models). The turboshaft drives the compressors, but is also connected to a gear box that drives the rotor blades (Aerospaceweb.org 2007).

Compared to land-based transportation systems, aviation systems are characterized by stringent weight to volume constraints and higher complexity—safety is often a more critical concern in design and operations. These aviation characteristics result in long technology development timelines (10 to 20 years) and high capital costs ($100 million for commercial aircraft and up to $1 billion for some military aircraft). Further, aircraft typically have long service lives—30 years for commercial airliners and up to 100 years for select military systems (including the B-52 Stratofortress). Technology evolution and uptake is thus slower than in other forms of transportation. The average age of the Air Force fleet is approximately 21 years, whereas that of the U.S. commercial airline fleet is 13 years (Waitz et al. 2005).

The mission requirements of commercial and military aircraft differ, with the exception of military aircraft used for fuel tankering and transportation (which constitutes about half the military fleet). As a result, specific design tradeoffs are made that affect the environmental performance of the systems—commercial aircraft are designed to maximize range for a given fuel and passenger payload. In doing so, fuel efficiency becomes the most important metric. However, for military aircraft and in particular fighter aircraft, maneuverability is a prime design driver in addition to range. Thus, the thrust-to-weight ratio of the aircraft is often as important as fuel efficiency. The difference of mission requirements drives the design of many military and commercial engines in opposite directions (Waitz et al. 2005).

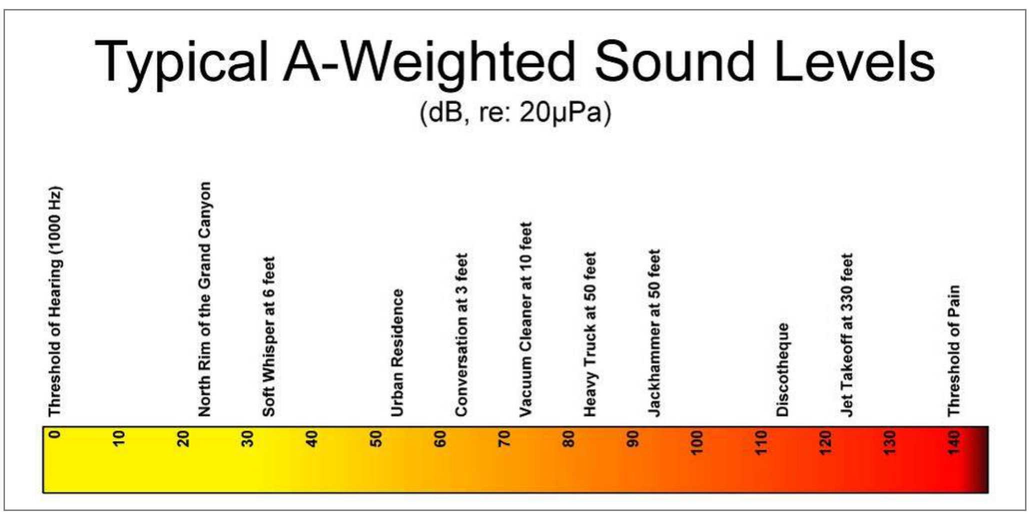
Commercial aircraft tend to use high-bypass-ratio engines with large frontal areas, an application suitable only for subsonic flight. Compared to military jet engines, commercial engines are larger in size and weight. Because of the correspondingly low exit velocities, commercial engines are relatively quieter than military engines. In contrast, many military aircraft missions mandate engines of high thrust-to-weight for maneuverability, and low frontal areas to minimize drag for supersonic flight while providing better integration with the airframe for low observability requirements. Thus, the size and weight of the propulsion system is more important and high-specific-thrust engines are typically used in military applications. Military aircraft engines therefore produce higher noise volumes because of higher exit velocities (Waitz et al. 2005).

2.3 ENGINE TESTING AND THE NOISE PROBLEM

After WWII and throughout the Cold War, aircraft capability was critically important to the U.S. military, which invested in larger and more powerful aircraft fleets. Many factors, including high temperatures, aerodynamic and mechanical stresses, erosion, corrosion, and others to which the engine components are subjected, can limit the length of time engine parts can safely function. Engine failures can be catastrophic, especially when the failed components are compressor or turbine rotors (RAND 2002). Military aircraft engines are tested for measurements and diagnostics during research and development and qualification testing. Controlled environment testing seeks to simulate many diverse atmospheric and environmental flight conditions that could be encountered by military aircraft in an operational envelope. Test parameters include sea level conditions, salt-spray for corrosion evaluation, temperature extremes from -65 degrees Fahrenheit (°F) to 250°F, pressure variations occurring in different flight attitudes and velocities, and high Mach speed (NIMR 2007). Additionally, high altitude and sand, ice, and exhaust gas engine ingestion are also examined (Boytos and Lominac 1997:1, 3). Development and qualification testing is performed during the development of engines and/or subsequent modifications and upgrades, and prior to release of jet engines to the fleet.

Military aircraft engines are also tested following maintenance, e.g., once repairs are completed on active fleet engines, the engines must be tested before they are released for operational use to ensure they will perform to specifications. Ground testing ensures quality assurance and reliability and certifies that the engines will perform as specified under the rigorous conditions in which military aircraft operate, and reduces the number of expensive flight tests required. Engines are tested at varying power levels including idle, military power, and full afterburner.

For military aviation, aircraft ground run-up noise became excessive in the 1950s when large numbers of afterburning fighter-type aircraft were commissioned (Miller 1975). Military aircraft produce high-decibel sound, particularly in the afterburning mode. For example, a F-4 Phantom creates a noise level of 123.5 decibels adjusted (dBA) at 250 feet at regular military power and 130.6 dBA in afterburner mode (figure 2-1). An F-16 Fighting Falcon creates a noise level of 122.0 dBA in military power mode and 129.3 dBA in afterburner mode (Battis 1985).



Source: OSHA 2008

FIGURE 2-1. SOUND LEVELS OF TYPICAL NOISE EVENTS

Prior to jet aviation, people living near airports were typically unaffected by occasional take-offs and landings of propeller-driven aircraft. However, post-WWII housing developments followed a trend toward suburban construction and sprawl, with residences constructed closer to airports. Due to military and commercial jet aircraft introduction in the 1950s and 1960s and increased production during the 1970s, aircraft noise became a negative issue to suburban populations. Communities adjacent to military aviation bases were sensitive to the unattenuated noise and vibration caused by aircraft engines.

In 1960, the FAA issued a planning guide for aircraft noise abatement that recommended limited types of land use and construction (e.g., industrial, commercial, agricultural) occur on land surrounding large airports. Residential construction (including schools, hospitals, churches, and other places of public assembly) was to be discouraged whenever possible for land immediately under the takeoff and landing patterns for airport runway orientation.

In *Griggs v. Allegheny County* (March 5, 1962), the U.S. Supreme Court determined that the noise, vibrations and danger posed by aircraft flying to and from Greater Pittsburgh Airport negatively impacted the Griggs's residential property in violation of the Fourteenth Amendment of the U.S. Constitution. The court decided that Allegheny County, Pennsylvania, had not acquired sufficient land when designing and building the new airport and the resulting impact to the Griggs's property represented a "taking" of an air easement. Allegheny County was required to make appropriate compensation as a result of the court finding (FindLaw 2008).

In 1964, the FAA undertook research for public reaction to sonic booms produced by jet aircraft. A six-month-long project that tested the effects of regularly scheduled supersonic overflights in Oklahoma City, Oklahoma, was conducted. Also in 1964, the National Academy of Sciences established a committee to study the effects of sonic booms related to the development and operation of supersonic transport aircraft. In November 1964, the FAA began a three-month study of sonic booms on typical structures in place at White Sands, New Mexico.

Noise suppression has represented a community relations issue for military aviation bases for decades (Shaw Estes 1965) and the effects of jet engine noise on the hearing of active duty personnel were evaluated as early as the 1950s (Gervasio 1957). Both concerns necessitated noise suppression systems, especially when ground testing jet engines. Noise suppression has continued to grow in importance with the development and deployment of more advanced and more powerful jet engines for the military. U.S. bases in Japan (Shaw Estes 1965) and in Germany (Schonauer 2006), for example, installed noise suppression systems for jet engine testing facilities to comply with local noise ordinances and community requests. In 1975, the U.S. Air Force set incremental limits of acceptable noise output from maintenance facilities including eliminating noise complaints from residents of the neighboring community.

Consequently, a series of laws was passed during the 1970s to control commercial and military aircraft noise at airports within the United States. In 1972, the Noise Control Act was passed, which regulated federal noise controls and remains the guideline for military airfields. In 1976, the FAA adopted the Aviation Noise Abatement Policy (ANAP) with subsequent clarifications in 2000 (FAA 2000). The ANAP identified noise from airports as a legitimate local issue and a process was initiated to progressively retire aircraft that no longer met federal noise standards. The Airline Deregulation Act of 1978 increased aircraft noise generated in the commercial airline industry by encouraging competition among private airlines, raising the demand for flights, which increased the frequency of airline flights (San Antonio Airport System 2007). The Aviation Safety and Noise Abatement Act of 1979 (ASNA) instructed the FAA to address airport noise and land-use compatibility around airports (San Antonio Airport System 2007). Since the passage of ASNA, numerous studies of aircraft noise have concluded that both high and low frequency jet engine noise negatively impact human health.

2.4 TECHNOLOGY FOR NOISE ATTENUATION

Test stands for ground testing aircraft engines date to early research and development projects. After their first controlled, powered flight at Kitty Hawk in 1903, the Wright brothers created a flight test area to further develop the new science of aeronautics. The Wright brothers approached the Aeronautical Division of the U.S. Army Signal Corps in 1908 with their idea to develop high-performance aircraft, which the Army accepted. The U.S. Army Signal Corps established an experimental engineering station at McCook Field in Dayton, Ohio, the predecessor to Wright-Patterson AFB (Hay 1996:22). The resulting organization, the Airplane Engineering Department under the aviation section of the U.S. Army Signal Corps, was the prototype for the United States (Hay 1996:22-23).

The Engineering Division at McCook Field, which later moved to Wright-Patterson AFB, had a major role in the initial development of all aspects of military aviation including aircraft structure, high octane fuels, propellers, and various engine designs (Brown 2007). Early Army Air Corps engine development and indoor testing facilities at McCook Field made use of efficient venting to carry away the heat produced by the dynamometers. The exhaust gases were drawn away through special ducting in the indoor testing facility floor. For testing at altitude, mobile testing stands were installed on the beds of trucks that were then driven to various altitudes on Pikes Peak (elevation 14,109 feet) near Colorado Springs, Colorado (Blee 1919:87-89).

The propeller test stand and bomb pad from McCook Field were moved to a newly constructed building at Wright-Patterson AFB. Building construction began in 1927 on the generator-powerhouse for the 2,500-horsepower variable speed drive propeller test stand (later known as Rig 3) and bomb pad, and was completed in 1929. Two additional test stands (Rigs 1 and 2) were completed in 1931, having 6,000 and 3,000 horsepower capabilities. An addition in 1942 supported the propeller laboratory activities, and the whole structure became known as Building 20. In 1944, an acoustical enclosure was constructed around the three test stands and the original Helicopter Rotor Test Stand between Rig 1 and the powerhouse; this enclosure became known as Building 20A (Dyson et al. 1993:95).

Prior to the early 1930s, early propeller engines were suspended from test stands (sometimes called rigs) and run in the open with no acoustic suppression (Smith 1975). During the early 1930s, conventional engine test stands began to incorporate stacks for noise exhaust. These engine stands comprised a U-shaped structure in which the motor was mounted at the base of the U and the legs of the U formed stacks or conduits. The air drawn in by the propellers entered through one of the stacks and was expelled through the other. The stacks were constructed of masonry, reinforced concrete, or similar materials. In 1939, John S. Parkinson and William I. Lucius of Johns Manville Corporation patented a sound-absorbing structure that used this U-shaped test stand, but added sound-absorbing layers to the stacks. The layers consisted of pads of compressible sound-absorbing materials including mineral wool felt or hair felt (patent number 2,270,825, January 20, 1942) (figure 2-2).

As aircraft technology advanced and engines became more powerful, advances in sound attenuation technology also continued. In 1942, Thomas T. Tucker of Belle Weather, Incorporated, experimented with new materials to increase sound attenuation:

> *. . .the structures for carrying out tests in connection with engines and propellers for airplanes, difficulty has been experienced in attaining satisfactory results, since the sound absorbing material, so far as I have knowledge, lacked efficient sound absorbing capacity and would not withstand the vibrations set up except for a limited period; in some instances the material would become matted and in other instances it would absorb*

moisture and oil or gases in the oil. Some materials affected by the use of cleaning solutions or by water due to rain fall or cleaning. It was frequently impractical to use fibrous materials because their soft fibers could not be retained in position, but would escape and pollute the air stream.

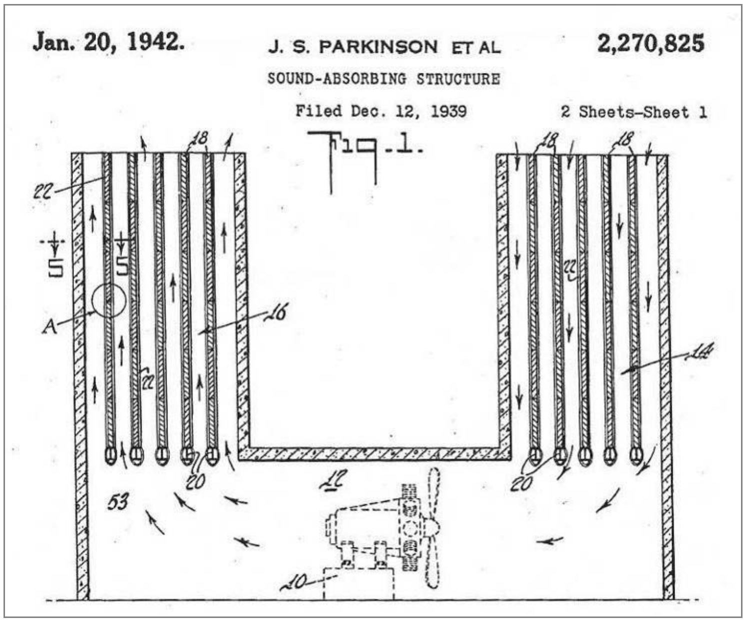


FIGURE 2-2. GRAPHIC FROM PATENT NUMBER 2,270,825

Tucker's patent incorporated the use of fiberglass as the sound-absorbing material covered with wire mesh (patent number 2,519,160; August 15, 1950). In his July 18, 1946, patent (number 2,519,161), Tucker made improvements to the panel construction and mountings so that the systems could be prefabricated for efficient assembly. By 1948, airplane engines had increased in complexity and power output with aircraft attaining speeds in the sonic and supersonic range, necessitating additional structural strength to be added to system panels, which Tucker addressed with perforated steel, stainless steel, or aluminum sheeting (patent number 2,519,162, application date March 15, 1948) (figure 2-3).

By 1955, aircraft noise levels had become an issue, not only for aircraft maintenance personnel but for residents of the surrounding area due to the increased use of afterburners. Daniel Coleman of North American Aviation, Incorporated, invented an apparatus that reduced noise levels and also was small in size, economical to build, and cost effective to operate (patent number 2,810,449; October 22, 1957) (figure 2-4). The noise-abatement device included an elongated housing section with an adapter that received the engine and directed the exhaust into the housing unit. The exhaust passed through an aspirator into a muffler and was discharged from the housing through a vertically directed stack. In his patent, Coleman stated that the housing should be constructed of economical sheet metal with dual generally parallel walls. The space between the walls would be filled with sand and the exhaust gases would be cooled with a fine stream of water. Mr. Coleman described the sheet metal with a sand interlayer as having two advantages: (1) the amount of energy absorbed in moving the sand particles provided a large amount of sound abatement, and (2) the structure could become mobile by draining the sand from the housing, transporting to a different location, and refilling the structure with sand following relocation.

In 1956, Lawrence R. Bridge and John T. Welbourne also addressed the issue of structure mobility with a patented transportable jet engine test stand (patent number 2,823,756; February 18, 1958) (figure 2-5):

> *Usually the engine enclosure itself is a concrete cell, and the air inlets and exhaust sections are formed either of heavy sheet metal or concrete panels and supported upon or encased in a concrete foundation. This manner of construction has been considered to be necessary due to extreme vibrations and pressures encountered in testing aircraft engines. . . . Unfortunately, the currently used concrete test stands have several disadvantages: They must be constructed for the testing of particular engines and consequently must be completely rebuilt at a very high cost in order to accommodate other types of engines.*

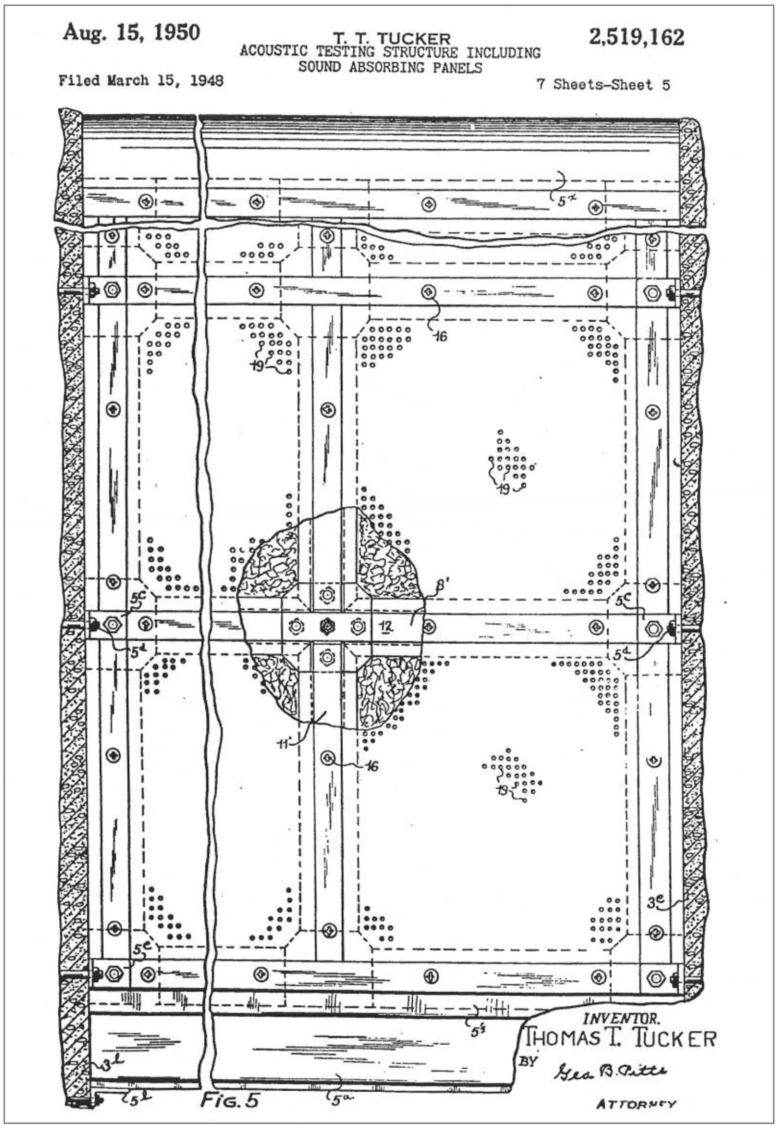


FIGURE 2-3. GRAPHIC FROM PATENT NUMBER 2,519,162

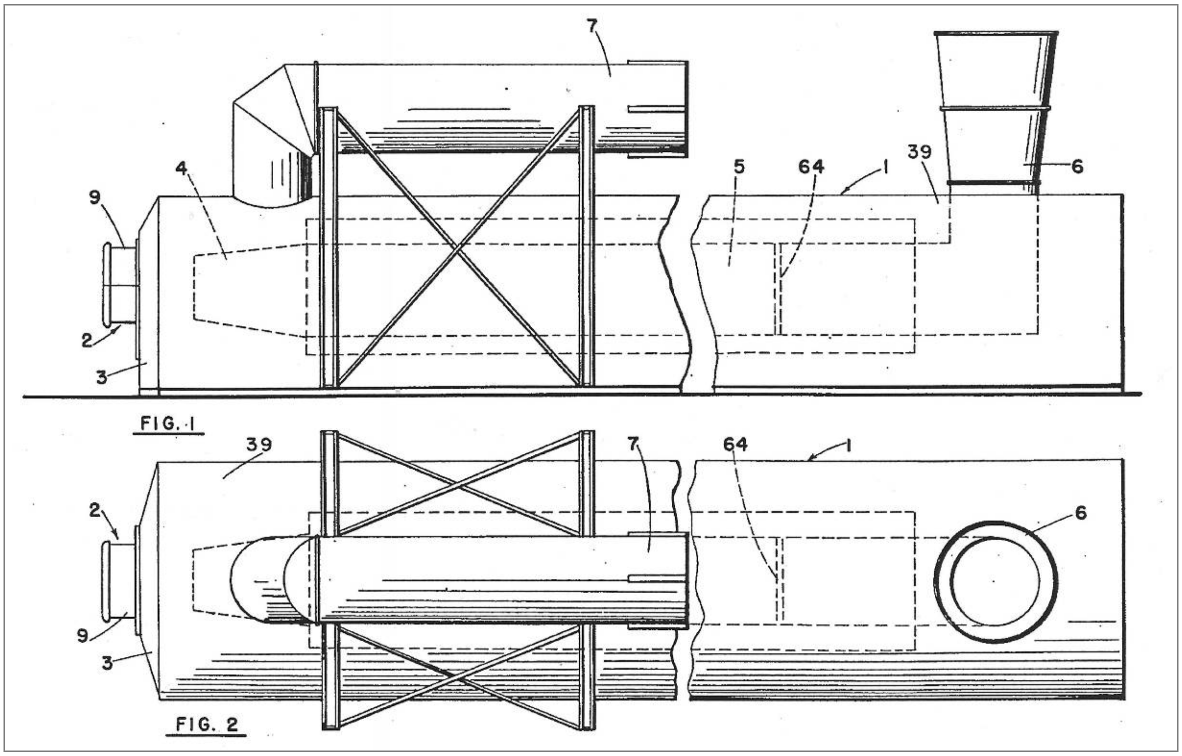


FIGURE 2-4. GRAPHIC FROM PATENT NUMBER 2,810,449

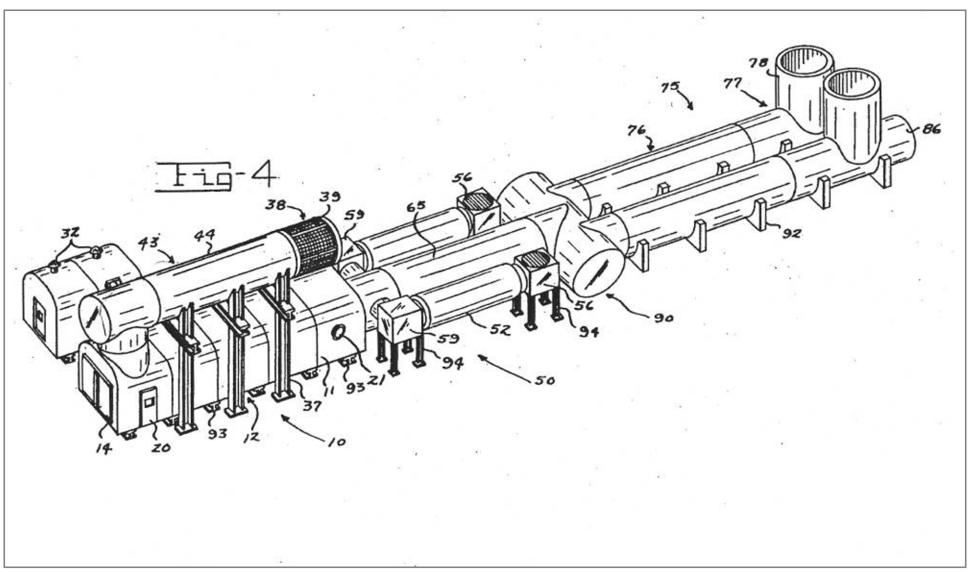


FIGURE 2-5. GRAPHIC FROM PATENT NUMBER 2,823,756

The Bridge and Welbourne invention overcame the obstacle of a transportable jet engine test stand formed from a series of easily connected tubular and curved metal segments and sections that could be modified or altered to conform to existing space requirements. Other patented noise abatement apparatus followed that were portable, sectional, on wheels, and used steel plates, stainless steel plates, or ceramic/ steel compound plates (patent number 2,864,455; December 16, 1958) (figure 2-6).

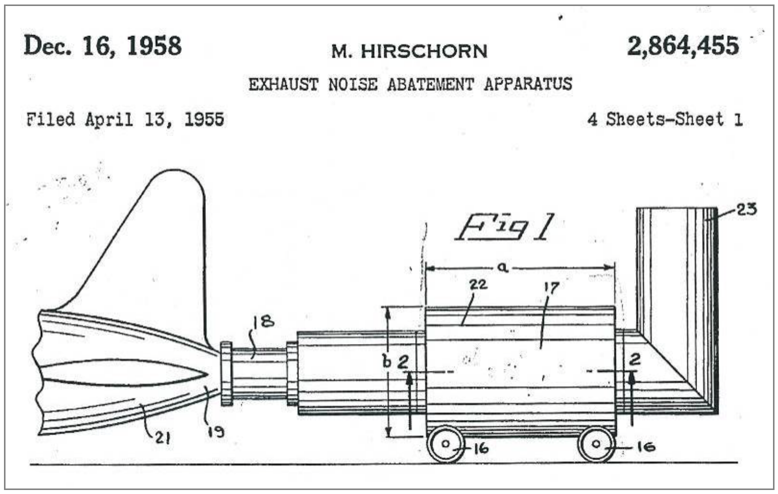


FIGURE 2-6. GRAPHIC FROM PATENT NUMBER 2,864,455

By 1955, Martin Hirschorn also sought to eliminate sound-absorbing fibrous material and to use heavy plate materials for the silencer apparatus. The plate material could be steel plate (for exhaust temperatures up to 1,000°F), stainless steel (up to 2,000°F), or a ceramic plate compound (up to 3,000°F) (patent number 2,864,455; December 16, 1958).

Noise suppression apparatus later adopted perforated baffles to impede the flow of exhaust. The use of absorptive material for lining ducts and for the use of resonant chambers were frequently designed into early noise suppression structures. The physical orientation of the sound dampening elements was generally designed to provide a complex path in the chambers, believed to be necessary to effectively attenuate the higher frequency noise components. These abatement solutions had been more or less successful, but noise continued to be a constant and perplexing problem as more powerful aircraft engines were developed and as demand grew for even quieter surroundings.

Construction of the exhaust muffler (either in combination with an entire test stand or as a separate structure to receive the hot gases discharged from a jet engine) presented additional challenges. Gases expelled in a high-velocity and a high-pressure state produced a high-intensity noise condition. To reduce or silence the noise, mufflers were directed to a silencer structure manufactured of a special material resistant to high heat and pressure. The initial approach to engine noise was to cool discharge gases as they passed through the muffler by admitting air into the exhaust system. This approach relied on specially selected materials to withstand the resultant temperature and pressure conditions. Water was used to aid in cooling the exhaust gases by adding a fine mist to the exhaust stream in the silencer/ muffler. As a result, mufflers were expensive to manufacture and maintain, requiring special materials and a water supply to sufficiently cool exhaust gases (patent number 2,886,121; May 21, 1959).

Innovations during the 1950s attempted to resolve the issue of cooling hot engine gases. An invention patented in 1956 used a flared, conical-shaped muffler constructed of perforated interior and exterior linings to increase cooling (patent number 2,886,121; May 12, 1959). Another invention patented in 1957 shortened the total length of the exhaust system by mixing hot exhaust gas with air and water and recirculating the gases through a portion of the sound-absorbing structure (patent number 2,940,537; June 14, 1960) (figure 2-7).

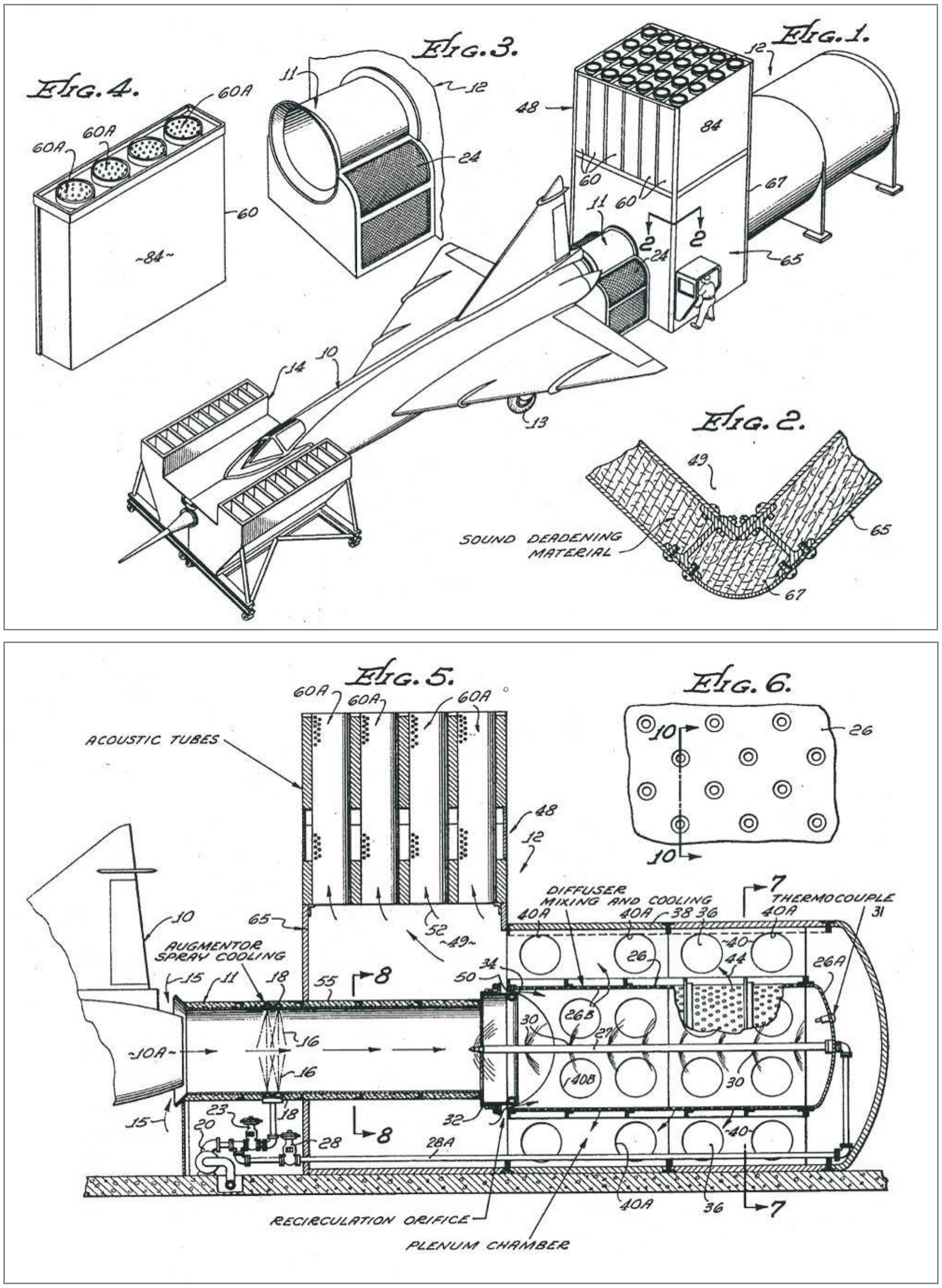


FIGURE 2-7. GRAPHICS FROM PATENT NUMBER 2,940,537

Because afterburner engine temperatures reach 3,000°F and higher, adding atmospheric air to the exhaust stream alone was not sufficient for cooling. Maximum cooling was desired to lengthen the life of the acoustical shell. Adding cooling and energy absorption was necessary and had been accomplished in sound suppression systems by spraying water directly into the stream of exhaust gases after the initial cooling. Wet-type noise suppressors had been used wherein a large multiwall tube of stainless steel directly received the exhaust gases from the engine. The inner tube was perforated in many places requiring water to be sprayed into the exhaust gases to cool the walls of the tube so they could withstand the high temperatures produced by exhaust gas. The wet-type noise suppressors were expensive to construct due to the complexity of the water pipes. One air-and-water-cooling noise suppression system was patented by Cloyd D. Smith and James H. Schmidt in 1970 (patent number 3,525,418; August 25, 1970) (figure 2-8).

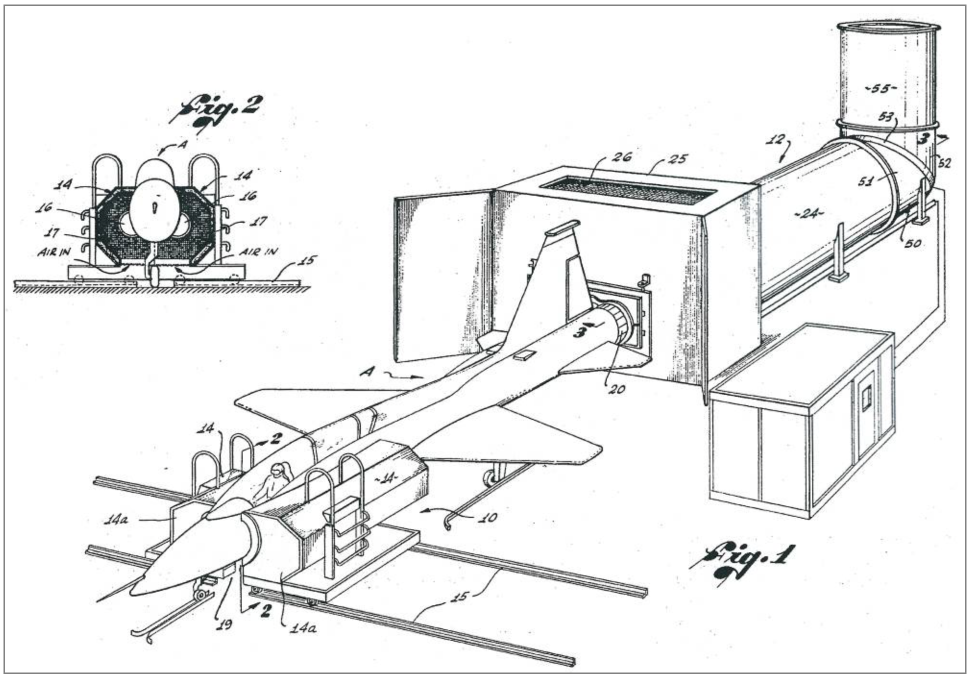


FIGURE 2-8. GRAPHIC FROM PATENT NUMBER 3,525,418

The use of water became objectionable, however, because moisture in the exhaust gases caused corrosion by producing an acidic mixture. Droplets of water would settle on nearby objects, often causing substantial damage to the aircraft and other operating equipment. In addition, these types of noise suppressors required considerable amounts of water, as much as 800 gallons per minute during a typical test period of about 5 minutes, which resulted in high operating costs and inconvenience (patent number 3,620,329; November 16, 1971). Furthermore, the emission plumes from water-cooled suppressors were visible. Test cells in California, in particular, were cited for air pollution violations of visible emissions regulations.

During this time, air-cooled test cell facilities were designed and developed in Europe (Kodres and Murphy 1998:129). In 1978, Lepor Meyer, having studied the European facilities, patented a stationary jet exhaust suppressor that had an elongated housing with a longitudinal tunnel and operated without water spray (patent number 4,122,912; October 31, 1978) (figure 2-9). Meyer claimed that positioning the aircraft was not difficult and the enclosure was designed to be adaptable to several aircraft types. The enclosure also provided a lighted, all-weather, around-the-clock workplace. This air-cooled design resembles the T-10 hush house that the U.S. military began using in 1981.

Although the sound-absorbing materials and testing and monitoring equipment have advanced, most test cells at U.S. military installations were constructed over the last several decades using the U-shaped stack design created in the early 1930s.

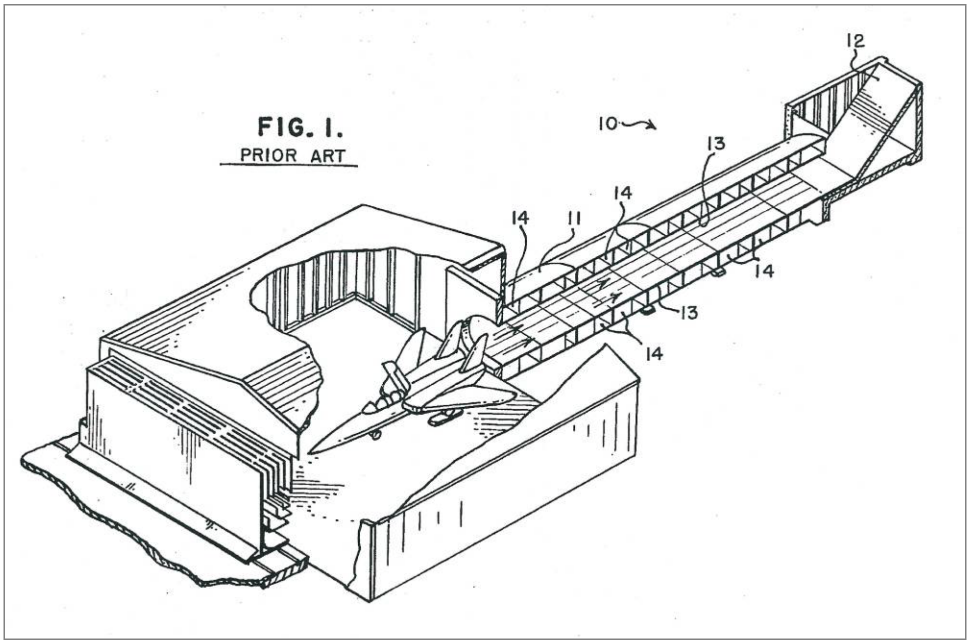


FIGURE 2-9. GRAPHIC FROM PATENT NUMBER 4,122,912

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3.0 RESOURCE TYPES

Aircraft acoustical enclosures are used to suppress noise from jet engines during performance testing. The building or structure is designed to isolate the aircraft engine noise associated with diagnostic engine tests from the surrounding environment. These aircraft acoustic enclosures can vary in shape and size and are comprised of indoor or outdoor engine testing facilities. The typical indoor facility has a test enclosure room for on-aircraft (sometimes known as in-frame or installed) jet engine testing, or off-aircraft (also known as out-of-frame or uninstalled) testing, air intakes, a control room, a blast augmenter (tube which extends behind the engine), and an exhaust ramp and/or stack. The buildings were constructed with thick doors and walls, and baffling to enclose and trap the noise. When jet engines are evaluated in an acoustically controlled environment, the aircraft mechanics are able to test and assess the engines beyond normal hours of operation without disturbing surrounding communities.

There are two basic designations for aircraft acoustical enclosures: (1) the hush house, and (2) the test cell. Hush houses are hangar-like structures designed for testing air-driven jet engines, including turbojet, turbofan, turboprop, and turboshaft engines. A jet engine test cell usually denotes an indoor engine testing facility designed only for out-of-frame testing of aircraft engines. The test cells are concrete in construction, have an intake stack, test enclosure, a blast augmenter, and an exhaust ramp and/or stack. The interiors of indoor testing facilities are generally lined with acoustic materials including metal tube baffling, acoustic pillowing, or blanketing.

A third testing device that is not discussed further in this document is the ground run-up enclosure or power check pad, which is an outdoor jet engine testing facility designed for in-frame testing.

3.1 HUSH HOUSES

Hush houses used by the U.S. military are hangar-like structures that are constructed to isolate noise associated with diagnostic jet engine testing from the surrounding environment. Although large, they are considered portable construction. The military uses two types of hush house referred to as T-9 (out-of-frame) or T-10 (in-frame). The facilities are of steel-frame construction and use state-of-the-art technology to provide the highest quality test results, and concurrently use the latest advances in baffling and muffling techniques to effectively attenuate the noise and heat of the engine exhaust plume. Since they are often proprietary, many hush house manufacturers do not release the composition details of the materials used for attenuation. One manufacturer (Vital Link, Inc., U.S.) describes using Lancaster gas turbine basalt (GTB) mineral fiber insulation and high-temperature pillows to provide both noise and thermal attenuation (Vital Link Web site 2007).

Hush houses have basic and common components, with individual variations in the size and shape of each feature to meet specific testing needs. Indoor hush houses, while closed, have venting to allow unimpeded airflow to the front of the jet engines (intake) during operation in the testing chamber. The intakes are the sidewalls of the facility and/or placed in the doors in front of the engine, and this area is generally known as the intake section of the facility. The jet engine is placed in the engine test and mount system section of the hush house, which comprises the test chamber. Engines are either mounted from below on an anchored pedestal stand or are mounted from above, similar to how they might be attached beneath an aircraft wing. The rear of the engine is aligned with, and attached to the entrance of the augmenter section. The augmenter is a long tubular building section, commonly with venting such that cooler ambient air (and less frequently water spray) is drawn into the augmenter/diffuser tube and is mixed with expelled exhaust gases to dilute, cool, and slow the exhaust as it progresses toward the exhausting port on the distal end of the augmenter. The augmenter is usually lined with noise suppression systems (which also suppress vibration), and may include metal baffling or acoustic pillowing among other design elements and materials. The exhausting port is often directed upward with angled vanes or a ramp to direct exhaust gases up and away from the immediate area surrounding the hush house (FAA 2002:5).

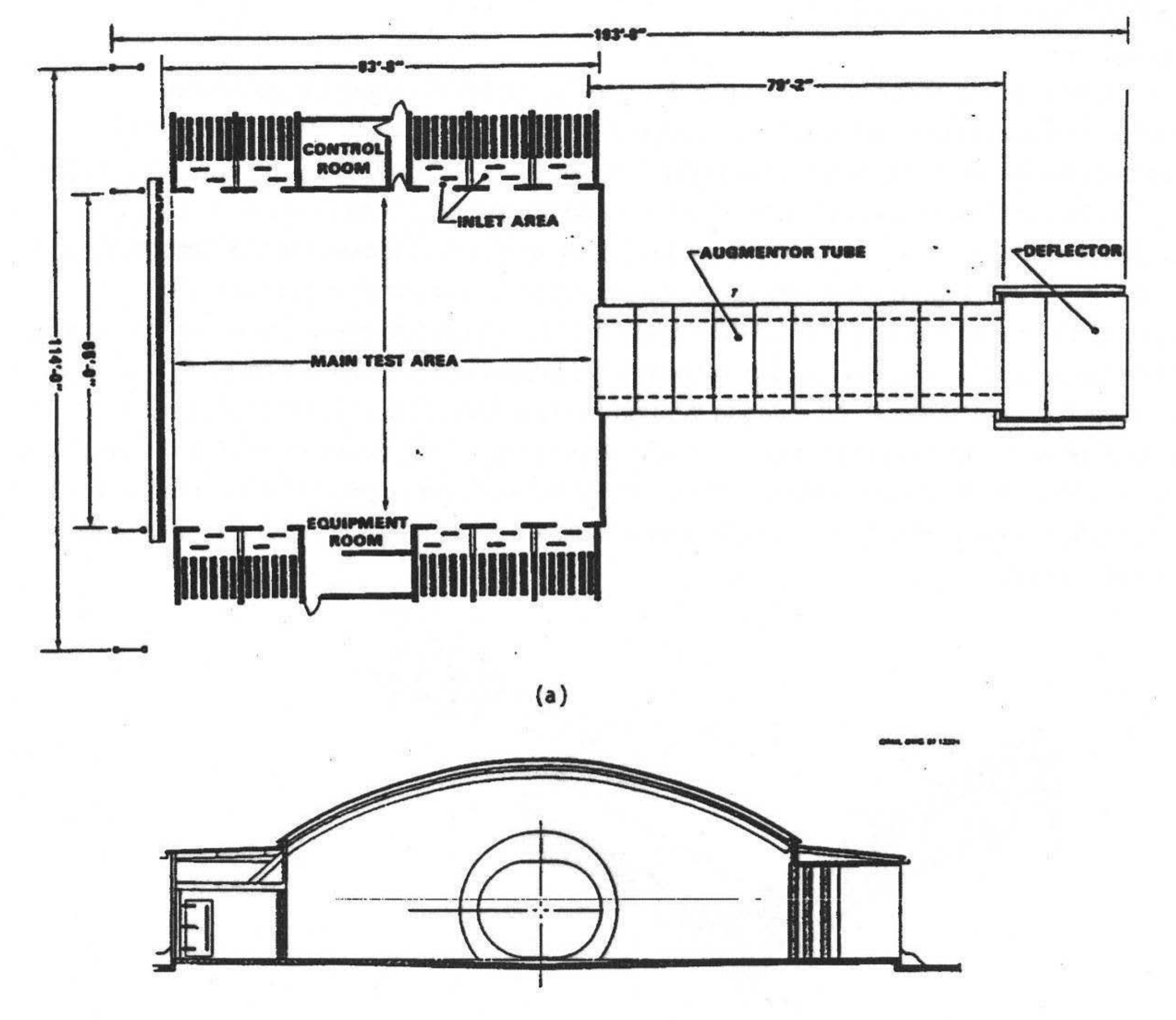
From 1982 to 1983, Henry W. Connor, Senior Associate Director of the General Accounting Office (GAO), and the undersecretary of defense, Lawrence J. Korb, questioned why the Navy was not using the same type of hush houses as the Air Force and why the structures could not be standardized because Air Force hush houses were much less expensive to build and maintain than were Navy hush houses. At the time, the Navy owned several different types of hush houses that were purchased with military construction funds. In contrast, the Air Force hush houses were procured entirely with equipment funds. The response of the office of the undersecretary was that there were design feature disagreements between the Air Force hush house requirements and the Navy's requirements, so the Navy did not pursue acquiring Air Force hush houses. The Navy was, however, acquiring a modified Air Force hush house for the Naval Air Rework Facility (NARF) in Jacksonville, Florida.

An example of differences between Navy requirements and Air Force requirements was the size and configuration of tested aircraft. The Air Force hush houses were designed for tactical aircraft with a centerline engine, whereas the Navy required several aircraft of differing size and engine-mounting configuration (e.g., the F-14 Tomcat, in use at the time, had two engines that were mounted on either side of the centerline of the aircraft). The office of the undersecretary did note that beginning in fiscal year 1983 the adaptation of the Air Force facility for NARF Jacksonville would be evaluated. The GAO encouraged the standardization of the hush houses between the two services, but testing requirements between the two had not made it practicable prior to that time (GAO 1983).

There are two standardized hush houses designed and constructed for the U.S. military: (1) the T-10 model (including an identical T-11 design used in Europe, but differing in wiring for the electrical current used in Europe, and (2) the T-9 model. T-10 hush houses are used for fighter jet engines and can accommodate on-frame or off-frame testing. The T-10 is designed with a barrel-roofed test chamber and the sidewalls have acoustic baffles designed to allow airflow into the building and attenuate sound leaving the building. Air enters the interior of the T-10 building through air inlet panels on each interior sidewall. Air entering through the four panels forward of the controls and equipment rooms is drawn into the engine air inlet. Air passing through the six rear sidewall inlet panels is entrained by the flow of engine exhaust gas as it enters the augmenter tube (the augmenter tube is the conduit through which exhaust gas exits the hush house). This entrained air mixes with the exhaust gas functioning to reduce the temperature. The tube is 79 feet long in longitudinal section and terminates at a 45-degree ramp deflector that imparts a vertical component to the exhaust flow. The front doors of the T-10 hush house are filled with sound-absorbing material. T-11 hush houses are identical to T-10 hush houses except they are used in Europe and are wired for European electrical current (Witten 1987).

FIGURE 3-1. EXTERIOR OF HUSH HOUSE AT OKLAHOMA AIR NATIONAL GUARD, TULSA

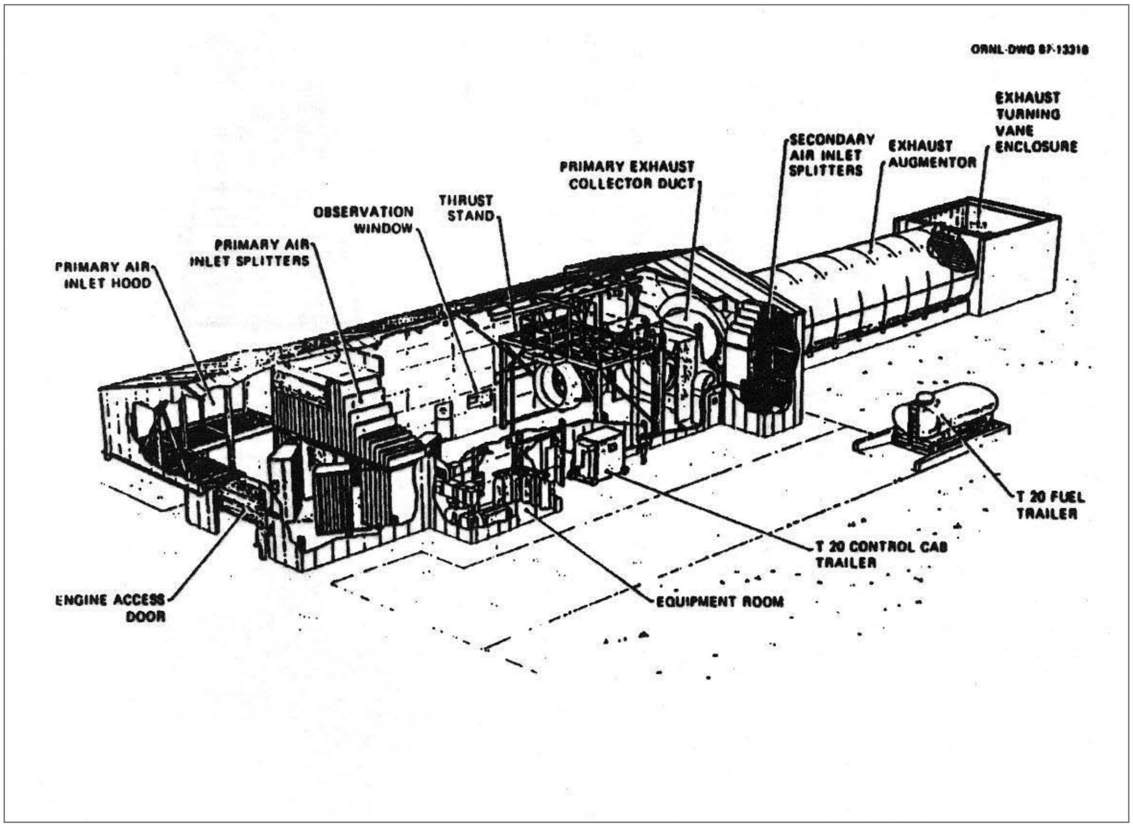
FIGURE 3-2. INTERIOR OF HUSH HOUSE, OKLAHOMA AIR NATIONAL GUARD, TULSA



(Source: Witten 1987)

FIGURE 3-3. SKETCH OF T-10 HUSH HOUSE AS VIEWED FROM ABOVE AND FROM THE FRONT

The T-9 hush houses are used for engines from larger transport or bomber aircraft including the KC-135 Stratotanker, C-17 Globemaster, C-5 Galaxy, and B-1 Lancer, etc., and are designed for off-frame testing only. The T-9 hush house test chambers have a gabled roof, solid sidewalls, with air entering the acoustic baffles above the front doors and through the rear sidewall near the entrance of the augmenter tube. The T-9 augmenter tube is identical to that of the T-10/11 hush houses, but terminates at a steeper deflector made up of an array of turning vanes (Boytos and Lominac 1997:6) (figure 3-4).



(Source: Witten 1987)

FIGURE 3-4. SKETCH OF T-9 HUSH HOUSE SHOWING SUSPENDED ENGINE FROM THRUST STAND

3.2 TEST CELLS

A jet engine test cell usually denotes an indoor engine testing facility designed to accommodate out-of-frame testing of aircraft engines. Overall design for test cells dates back to the early 1930s, when propeller engines were suspended from stands and run in U-shaped enclosures designed with stacks for noise exhaust. The air was drawn in from one of the stacks and was expelled through the other. The stacks were constructed of masonry, reinforced concrete, or similar material. By 1939, sound-absorbing layers were added to the stacks to further reduce engine noise. The overall design of a test cell lends itself to be a single-cell facility (Travis AFB) or a multicell facility (Tinker AFB) with any number of testing cells adjacent to each other separated by the control room.

The concrete jet engine test cell was first designed and constructed in the mid-1950s, and through the early 1980s, most concrete test cells used water for jet engine exhaust cooling. The concrete design decreased noise and made the exhaust gases compatible with test cell materials. One major and inherent problem with this design and type of testing, however, was the fallout from the exhaust plume after it exited the test cell. The exhaust plume consisted of saturated steam with large complements of unburned fuel, particulate matter, and hydrocarbons resulting from incomplete combustion. The visible, contaminated, wet plume blanketed the aircraft, the pavement, adjacent buildings, vehicles, landscaping, and people, creating a major nuisance and health concern. Test cells in California, in particular, were cited for air-pollution violations of state visible emissions regulations. During the 1950–1980 timeframe, air-cooled test cell facilities were developed in Europe (C. A. Kodres et al. 1998:129). The first U.S. air-cooled test cell facilities were built in the 1980s by the U.S. Navy at NAS Miramar, San Diego, California, and at MCAS El Toro, El Toro, California, in response to the California visible emissions violations (Kodres 2000:1).

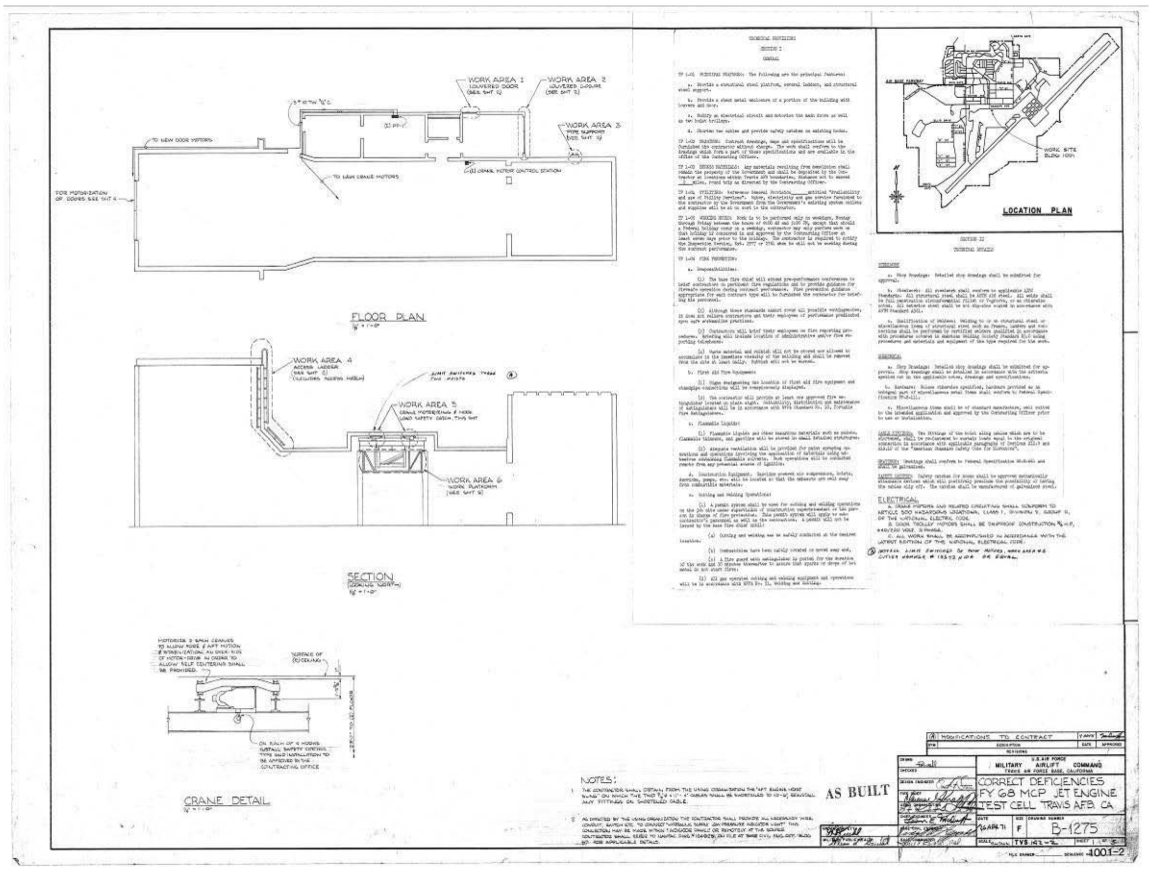


FIGURE 3-5. DRAWING OF TRAVIS AIR FORCE BASE

3.2.1 Early Test Cells

Wright Patterson Air Force Base, Dayton, Ohio

Construction was undertaken during 1927 on the earliest portion of Building 20 to build the generator-powerhouse for the 2,500 horsepower variable speed drive propeller test stand (later known as Rig 3) and bomb pad that were transferred from McCook Field, Dayton, Ohio. Rig 3 was completed in 1929 (prior to completion, testing was conducted at McCook Field). Two additional test stands (Rigs 1 and 2) were completed in 1931, having 6,000 and 3,000 horsepower capabilities, respectively. An addition constructed in 1942 supported the propeller laboratory activities, and the whole structure/complex became Building 20 (Propeller Laboratory). In the early 1950s, an additional test stand was constructed (Dyson et al. 1993, p 97).

Building 20 is a two-story, nine-bay, concrete building measuring 98 feet by 277 feet. Floors were originally designed to accommodate 250 and 500 pounds per square foot, and the walls were 18-inches thick, with 5/8-inch round bars at 12-inch centers for reinforcement. The original construction included a tunnel from the powerhouse to the control room. Two additional test stands (Rigs 1 and 2) were completed in 1931 having 6,000 and 3,000 horsepower capabilities.

The propeller laboratory (Building 20) developed propellers, propeller hubs, and controls for aircraft of ever increasing size and power. Aircraft designs included Army and Navy fighters, bombers, cargo, and passenger planes, and VTOL (vertical takeoff and landing) aircraft (Dyson et al. 1993, p 95). Increasingly sophisticated propeller designs were developed in Building 20 for aircraft designs including the P-40 Warhawk, P-47 Thunderbolt, B-17 Flying Fortress, and the B-29 Superfortress. These designs benefited post-war aircraft including the B-36 Peacemaker and the B-50 Superfortress. During the late 1940s, research and development in Building 20 included turboprop engine testing for the Allison T-56 installed on the C-130 Hercules (Hay 1996, 1972). Although known during WWII, jet propulsion was not a mission of U.S. Army Air Corps engineers until after the war ended; therefore, propeller testing remained important at this facility during WWII (Dyson et al. 1993, p 95). By 1964, Building 20 was no longer used for propeller testing (Hay 1996, 1972).

The heart of the propeller test complex is the line of three propeller test stands built by Westinghouse Corporation to the specifications of Wright Field personnel, M. A. Smith and Adam Dickey. The first test stand (Rig 3) was completed in 1929 and the other two (Rigs 1 and 2) were completed in 1931. The three test stands originally were not enclosed within a structure, rather they operated in the open. Thick wooden structures called bombproofs or bombpads were constructed next to and above the test stands to restrict the path of propeller fragments during and following an engine failure on the rigs. In 1944, an acoustical enclosure was constructed around the three test stands and the original Helicopter Rotor Test Stand located between Rig 1 and the powerhouse (now known as Building 20A) (Dyson et al. 1993, p 95). The concrete acoustical structure was designed and constructed when the continuous testing of propellers created a loud drone that was considered a health hazard and an annoyance. The design challenge for Building 20A was to muffle the propeller noise while still allowing free circulation of air in and around the propellers.

The concrete acoustical structure was unique in terms of concept and design, and wartime shortages imposed limits on material availability. The architecture-engineering firm of Allen and Kelley of Indianapolis, Indiana, designed walls constructed of square tubes of concrete (set to look like honeycombs) that were porous enough to allow air to pass through. The contractor was A. Farnell Blair of Decatur, Georgia, and Price Brothers of Dayton, Ohio, which fabricated and set in place the precast concrete tubes.

The earliest permanent engine torque stands were established in Building 71 (Power Plant Engine Test Torque Stands), built in 1932. In 1941, Building 71A was constructed adding four more powerful torque stands for testing stronger propeller engines. In 1945, two of the stands were reconfigured for turbo-prop engine testing while the other two were used for turbo-jet engine testing (Hay 1996, p. 64). In 1977, a sea level test stand was dedicated in Bay D, designed to evaluate engine performance at low altitudes. At the time of construction it was the most modern sea level testing facility of its kind. Building 71B was constructed in 1943 to house four additional engine test stands designed to work in conjunction with those constructed in Building 71A for testing turbine and jet engines. An outdoor test stand facility was constructed in 1952 as Building 71C. It was used for a short time, then demolished within the decade. Building 71D was designed and constructed in 1944 as the cooling tower for water used in propulsion testing in Buildings 71, 71A, and 71B. Building 71D also housed a portion of the Compressor Research Test Facility since 1981 (Hay 1996, p. 67).

Building 71 torque stands subjected engines to a series of examinations including a 50-hour development test, a 150-hour type test, and a final evaluation service test. American development of the jet engine during the mid-1940s caused the torque stands to be modified to test new jet engine designs including turbo-prop and turbo-jet engines (Hay 1996, p. 64).

Building 71 was built as a huge concrete structure with 10 individual stacks designed to house seven torque stands—six stands tested engine endurance and one stand tested propeller endurance. They were originally of open design, but were later enclosed. Building 71A is also a large concrete building abutting Building 71 (Hay 1996, 1964). Building 71B was constructed in 1943 as a large concrete building. Building 71D is a two-story, flat-roofed, concrete block building (Hay 1996:67).

Building 30256 was part of the WWII expansion of Patterson Field. Plans for this reciprocal engine test building were conceptualized in 1940, and the Vertical Engine Test Building was constructed in 1941. An addition more than twice the size of the original building was conceptualized and drawn up in the fall of 1941, which included eight test cells, four workrooms, four propeller storage rooms, and a large room for final inspections (Hampton et al. 2002).

Building 40256 is a large concrete structure with an austere exterior that was strong enough to withstand the vibrations of engine testing and any related accidents that might occur during testing. On the interior of the building, each test cell consists of a testing area for an engine, a second-floor control room overlooking the testing area, an exhaust room, and an intake room. Each of the exhaust and intake rooms has large metal louvers in the roof. The intake rooms have curved louvers to draw air into the building while the exhaust rooms have straight louvers to expel the air (Hampton et al. 2002).

The test cells at Wright-Paterson AFB have been determined eligible for listing in the NRHP as parts of historical districts under criterion A.

Arnold Air Force Base, Tullahoma, Tennessee

The German military developed a jet engine testing facility, and in 1944 Bavarian Motor Works (BMW) initiated operation of an engine test plant for the testing and development of gas turbine engines. This facility was dismantled and transported to the United States following WWII. In 1949, the U.S. Congress authorized the construction of the Air Engineering Development Center (AEDC) on the site of former Camp Forrest in Tullahoma, Tennessee. In September 1950, the Air Force began reconditioning and modifying the BMW equipment. It required 58 railroad cars, two barges, and another 450 tons transported by truck to bring the German test equipment to AEDC. The facility was completed in 1953 and began testing U.S. military jet engines in May 1954 (Arnold AFB). After some refinement, this facility became the cornerstone for the engine test facility, which was completed in 1953. The new facility was operational by May 1954 when it began testing the GE J-49 engine for the B-47 Stratojet bomber in the T-1 test cell (Arnold AFB).

Fairchild Air Force Base, Spokane, Washington

Another example of an early engine testing facility was the engine test building (No. 2150) at Fairchild AFB in Washington state. Constructed in 1943, this concrete building was designed and used for testing the B-17 Flying Fortress, B-29 Superfortress, and B-36 Peacemaker engines, all of which were propeller driven. As Fairchild AFB was a reciprocating engine maintenance facility, this function ended when the jet propelled B-52 Stratofortress arrived at the base (Lowe 1994, 34-35). Because this was a massive concrete building and thought to be “survivable,” its below-ground operations sections were used in 1955–1956 to house an intelligence and planning division. The building was decommissioned prior to the mid-1960s, and since has served as a disaster preparedness facility, a contractor staging area, and a hazardous waste storage building (Lowe 1994:35).

The Engine Test Building (2150) has 4-foot-thick concrete walls and louvered sections incorporated into the exterior (Lowe 1994:35).

Building 2150 was determined eligible for listing in the NRHP for criterion A on a national level for its contribution to the American military effort during WWII.

Kadena Air Force Base, Kadena/Chatan/Okinawa, Japan

When dedicated in December 1981, the test cell at Kadena AFB was the only closed noise suppression facility in the world for large aircraft. Materials used during construction included 750 tons of steel beams and more than 3,800 cubic meters of cement (USAF Fact Sheet 1981). The 18th Maintenance Group at Kadena AFB provides the only four-bay engine test facility in the Pacific Air Forces. The 18th Maintenance Group is responsible for the maintenance of over 50 F-15 Eagles, the only F-15 Eagles serving in the Asian and Western Pacific region (USAF 2007). Attempts to determine if the building is extant were inconclusive for this project.

USS Kitty Hawk (CV-63)

Aircraft carriers require testing jet engines while conducting sea operations and are equipped with test stands that are mounted near the edge of the vessel. The T-1 test cell is a shipboard design used on Navy aircraft carriers. The USS *Kitty Hawk* (CV 63) is unique because it was forward deployed to Japan for 10 years and maintained its own aircraft engines, whether in port or at sea. Maintenance occurred either at Atsugi (where the carrier air wing is stationed while in port) or at Yokosuka on board the ship (Diekman and Mlikan 2007). The USS *Kitty Hawk* was replaced in the forward deployment role in 2008 by the USS *George Washington* (CV-73) and was decommissioned on May 12, 2009, following 49 years of service. Attempts to visit the USS *Kitty Hawk* prior to decommissioning were unsuccessful and she now resides as an asset in the Ready Reserve Fleet, anchored in Bremerton, Washington. A group from Wilmington, North Carolina, is lobbying the U.S. Congress to designate the USS *Kitty Hawk* as a floating museum, resting alongside the retired battleship USS *North Carolina* (BB-55).

3.3 TEST STANDS

Test stands typically consist of a large concrete slab with tie-down fittings, a blast deflector, and acoustical walls for sound absorption (Johnston Test Cell Group 2007). Outdoor facilities are also frequently surrounded by acoustically absorbent material and/or deflecting structures. Test stands can be large to accommodate an entire aircraft or smaller to deflect the exhaust of a single engine. T-21 test stands (outdoor stands) have been popularly used in military applications for testing Allison T-56 turboprop engines (Celtech 2007). A T-36 test cell is a semi-portable, open-air, land-based test cell used by the Navy (NAVAIR 2002:I3). Test stands are not the focus of this study; however, a few photographs are included herein.

3.4 CURRENT MILITARY HUSH HOUSE AND TEST CELL INVENTORY

In 1987, a study of hush houses was conducted by Oak Ridge National Laboratory (Witten et al. 1987), which stated that there were 50 operational T-10 hush houses with the earliest initiating operations in 1981. The study did not specify if these were Air Force hush houses or if the numbers reported include all hush houses militarywide (the study context focuses only on U.S. Air Force assets. The Oak Ridge National Laboratory study mentions that the original T-9 hush house was on McConnell AFB, Wichita, Kansas (Strategic Air Command) and had been in service for about one year prior to 1987 (Witten et al. 1987). The other operational T-9 hush house was used by the Arizona ANG at Sky Harbor International Airport, Phoenix, Arizona, although some of the engines tested failed to meet the required noise reduction standards at the time. Other T-9 hush houses were under construction at various locations within the United States.

Based on data collected, the current hush house and test cell inventory for the U.S. military is as follows (see Appendix A for detailed inventory):

Air Force

- Total – 102
- T-9 – 18
- T-10 – 44

Air National Guard

- Total – 60
- T-9 – 14
- T-10 – 46

Navy/Marines

- Total – 71
- T-9 – 0
- T-10 – 2

Army/Army National Guard

- Total – 16
- T-9 – 0
- T-10 – 0

FIGURE 3-6. TEST STAND, PORTLAND, OREGON, AIR NATIONAL GUARD BASE

FIGURE 3-7. BLAST DEFLECTORS, OCEANA NAVAL AIR STATION, VIRGINIA

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4.0 IDENTIFICATION AND EVALUATION METHODOLOGY FOR HUSH HOUSES AND TEST CELLS

The NHPA, established the NRHP as the official list of properties significant in American history, architecture, archaeology, engineering, and culture. The NRHP includes properties that merit preservation and is an important planning tool that continually is updated to represent the many facets of American history. The NRHP is maintained by the Secretary of the Interior, and administered by the National Park Service. The Department of the Interior has developed regulations defining the procedures for listing properties in the NRHP (36 *Code of Federal Regulations* [CFR] Part 60).

Federal agencies are required to consider effects of their undertakings on properties that are eligible for listing in the NRHP under Section 106 of the NHPA. In order to assess effects of actions, federal agencies are required to identify and evaluate properties to determine their eligibility for inclusion in the NRHP. The Secretary of the Interior has developed standards and guidelines for both identification and evaluation.

The *Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation* (48 *Federal Register* [FR] 44716) define the Standards for Identification. Identification activities include developing a research design, conducting archival research and field survey, and analyzing the results. The research design describes the objectives and methodology of the identification activities.

The objectives will determine the methodology. Identification of historic properties may be undertaken to:

- establish a baseline of known historic properties
- gather information for a particular project (undertaking)
- update existing survey information
- develop a comprehensive management plan

The identification process may be limited to a single property or a discrete area, or may encompass an entire installation or command. The research design should indicate the objectives of the identification effort.

Once the objectives of the identification activities are determined, the appropriate methodology can be selected. The methodology should be designed to determine the property's original date of construction, any major renovations, type of construction, historic and current function, and historic relationship to the site and surrounding properties. Determining the property's original and current function and type of construction are crucial to assessing its historic significance within the historic context and to assessing its integrity.

Archival research and field survey are the two primary means of identifying historic properties. Archival research provides information on what was constructed, why it was constructed, and where it was constructed. Primary sources include historic maps, historic photographs, completion reports, and original construction drawings. These materials are kept in a variety of repositories: installation real property offices; installation, command, or servicewide history offices; National Archives and Records Administration. Secondary sources include installation or activity histories; standard histories of aircraft, jet engine development, engine noise suppression, or engine maintenance; and previous cultural resources studies.

Once properties are identified, their historic significance can be evaluated. The NRHP criteria for evaluation (36 CFR Part 60.4) were developed to assist in the evaluation of properties eligible for inclusion in the NRHP. The National Park Service has published guidance for applying the criteria in *National Bulletin 15: How to Apply the National Register Criteria for Evaluation* (NPS 1991). To qualify for the NRHP, a property must be associated with an important historic context and retain historic integrity. To be listed in, or considered eligible for listing in the NRHP, a cultural resource must meet at least one of the four following criteria:

> The resource is associated with events that have made a significant contribution to the broad pattern of history (criterion A); or
>
> The resource is associated with the lives of people significant in the past (criterion B); or.
>
> The resource embodies distinctive characteristics of a type, period, or method of construction; represents the work of a master; possesses high artistic value; or represents a significant and distinguishable entity whose components may lack individual distinction (criterion C); or
>
> The resource has yielded, or may be likely to yield, information important in prehistory or history (criterion D).

In addition to meeting at least one of the above criteria, a historic property must also possess integrity of location, design, setting, materials, workmanship, feeling, and association. Integrity is defined as the authenticity of a property's historic identity, as evidenced by the survival of physical characteristics it possessed in the past and its capacity to convey information about a culture or group of people, a historic pattern, or a specific type of architectural or engineering design or technology.

The following NRHP publications are useful guides when evaluating hush houses and test cells:

- How to Apply National Register Criteria for Evaluation
- Guidelines for Completing National Register for Historic Places Forms
- Researching a Historic Property
- Guidelines for Evaluating and Documenting Historic Aviation Properties
- Guidelines for Evaluating and Documenting Historic Properties that Have Achieved Significance Within the Last Fifty Years

4.1 SIGNIFICANCE

To qualify for the NRHP, a cultural resource must be significant, meaning that it must represent a significant part of American history, architecture, archaeology, engineering, or culture. A resource may possess significance on the local, state, or national level. The significance of a cultural resource can be determined only when it is evaluated within its historic context. As outlined in *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation*, the following steps are taken to evaluate a cultural resource within its historic context:

- Identify what the property represents: the theme(s), geographical limits, and chronological period that provide a perspective from which to evaluate the property's significance.

- Determine how the theme of the context is significant in the history of the local area, the state, or the nation.
- Determine what the property type is and whether it is important in illustrating the historic context.
- Determine how the property represents the context through specific historic associations, architectural or engineering values, or information potential (the NRHP criteria for evaluation).
- Determine what physical features the property must possess in order for it to reflect the significance of the historic context.

A cultural resource may be significant within more than one historic context. In such cases, all historic contexts should be identified. However, significance within only one context is required. If a cultural resource is determined to possess sufficient significance within its historic context to qualify for the NRHP, the level of integrity of those features necessary to convey the resource's significance must then be examined.

4.2 PROPERTY CLASSIFICATIONS

Significant properties are classified as buildings, sites, districts, structures, or objects. Sites or structures that may not be considered individually significant may be considered eligible for listing in the NRHP as part of a historic district. The classifications are defined as:

- A building, such as a house, barn, church, hotel, or similar construction, is created principally to shelter any form of human activity. "Building" may also be used to refer to a historically and functionally related unit such as a courthouse and jail or a house and barn.

- The term "structure" is used to distinguish from buildings those functional constructions made usually for purposes other than creating human shelter.

- The term "object" is used to distinguish from buildings and structures those constructions that are primarily artistic in nature or are relatively small in scale and simply constructed. Although it may be, by nature or design, movable, an object is associated with a specific setting or environment.

- A site is the location of a significant event, a prehistoric or historic occupation or activity, or a building or structure, whether standing, ruined, or vanished, where the location itself possesses historic, cultural, or archaeological value regardless of the value of any existing structure.

- A district possesses a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development.

- A hush house or test cell would generally be classified as a building, but could also be a structure, and can be a part of a district. A test stand would be considered a structure or object depending on the complexity of the stand.

4.3 ISSUES RELATED TO EVALUATING PROPERTIES USING THE HUSH HOUSE AND TEST CELL HISTORIC CONTEXT

4.3.1 Historic District Versus Individual Eligibility

While hush houses and test cells, as a class of resource, may be significant, not every building constructed is eligible for listing in the NRHP. The framework established by the historic context focuses on the development of the noise suppression technology and needs to consider the mission of the installation in assessing its significance, as well as the significance of its component resources. This criterion is appropriate due to the use of standardized building designs.

A district derives its importance from being a unified entity, even though it is often composed of a wide variety of resources. The identity of a district results from the interrelationship of its resources, which can convey a visual sense of the overall historic environment or be an arrangement of historically or functionally related properties. For example, a district can reflect one principal activity, such as a mill or a ranch, or it can encompass several interrelated activities, including an area that supports industrial, residential, or commercial buildings, sites, structures, or objects. Many installations or areas of installations were designed with interrelated components that function in concert to fulfill the purpose of the installation or a specific mission at that time.

For properties to be individually eligible for listing in the NRHP within the context of hush houses and test cells, they should: (1) clearly and explicitly reflect the important mission of the installation, (2) be regarded as symbolic of the installation or of an aspect of the mission, or, (3) represent particularly significant examples of a type or method of construction or an important technological advancement. Infrastructure and support buildings are not typically individually eligible unless they were: (1) the site of a particular event, (2) directly associated with a significant individual, or (3) of exceptional note as an example of architectural or engineering design.

4.3.2 Comparing Related Properties

During the process of evaluating a property’s significance, the property usually is compared with other examples of the property type that illustrate the selected historic context. In some cases, the property must be evaluated against other similar properties to determine its significance. This evaluation is not necessary if, (1) the property is the only surviving example of a property type that is important within the context, or (2) the property distinctly has the characteristics necessary to represent the context.

4.3.3 Properties Significant Within More than One Historic Context

Properties may possess significance within multiple historic contexts. For instance, a test cell may be individually significant within the hush house/test cell historic context because of its design characteristics, and may also be part of a district related to a particular mission of an installation. Military installations should be evaluated holistically, with attention to their interrelated historic associations over time. When evaluating the significance of a military property, the period of significance should be defined based on the range of important associations over time. In districts, buildings may illustrate various dates of construction, architectural design, and historical associations. A single building may be associated with several periods of history. Significance within one historic context is sufficient for the property to meet the NRHP criteria for evaluation.

4.3.4 Levels of Significance

The NRHP criteria for evaluation define three levels of significance: local, state, and national. The level of significance is based on the selection of geographic area, one of the three components of the framework of a historic context. The geographic scale selected may relate to a pattern of historical development, a political division, or a cultural area.

A local historic context represents an aspect of the history of a town, city, county, cultural area, or region, or any portions thereof. It is defined by the importance of the property, not necessarily the physical location of the property. For instance, if a property is of a type found throughout a state, or its boundaries extend over two states, but its importance relates only to a particular county, the property would be considered of local significance.

Properties are evaluated in a state context when they represent an aspect of the history of the state as a whole. These properties do not necessarily have to belong to property types found throughout the entire state: they can be located in only a portion of the state's present political boundary. State historic preservation offices have developed historic context relevant to the state and local history. The construction and operation of a military installation may have affected a state's economy, labor force, and development. A military installation should be evaluated based on the importance of its contribution to defined state historic contexts.

Properties are evaluated in a national context when they represent an aspect of the history of the United States and its territories as a whole. These national historic contexts may have associated properties that are locally or statewide significant representations, as well as those of national significance. A property that illustrates an aspect of national history should be evaluated within a national context. Hush houses and test cell construction was undertaken as a result of the invention and increased use of the jet engine technology and the population growth. The construction of hush houses and test cells was driven by conflicts between people and noise resulting in national regulations, and thus represent an aspect of the history of the United States as a whole.

4.4 APPLYING THE NATIONAL REGISTER CRITERIA FOR EVALUATION

4.4.1 Criterion A: Association with Events

The first criterion recognizes properties associated with single events such as the bombing of Pearl Harbor, or with a pattern of events, repeated activities, or historic trends such as the Cold War era. The event or trends, however, must clearly be important within the associated context. The U.S. involvement in the Cold War was composed of a complex series of political, military, diplomatic, economic, scientific, and industrial events and programs that affected the lives of millions of Americans. The Cold War was an event that made significant contributions to the broad patterns of our history; however, not all military properties constructed during the Cold War are necessarily significant with the historic context. Although the hush house and test cells are developments of the jet age and Cold War, the property must have an important and specific association with this trend.

To determine if a property is significant with the Hush House and Test Cell historic context under criteria A:

- Determine the nature of the property, including date of construction, type of construction, and functions from time of construction to the end of the Cold War (1989).
- Determine if the property is associated specifically with engine aircraft development and what military installation missions.
- Evaluate the property's history to whether it is associated with the hush house/test cell context or the installation's historic context in an important way.

4.4.2 Criterion B: Association with People

Properties may be listed in the NRHP for their association with the lives of significant people. The individual in question must have made contributions to history that can be specifically documented and that were important within a historic context. This criterion may be applicable, but to only a small portion of hush houses and test cells as the context focuses on events and on design and construction rather than on individuals. However, background research on a particular installation or building may indicate that it is associated with an individual who made an important contribution to hush houses and test cells and jet engine development.

To determine if a property is significant within the Hush House and Test Cell context under criterion B:

- Determine the importance of the individual.
- Determine the length and nature of the person's association with the property.
- Determine if the person is individually significant within the historic context.
- Determine if the property is associated with the time period during which the individual made significant contributions to history.
- Compare the property to other properties associated with the individual to determine if the property in question best represents the individual's most significant contribution.

Refer to *National Register Bulletin 32: Guidelines for Evaluating and Documenting Properties Associated with Significant Persons* (National Park Service) for more information.

4.4.3 Criterion C: Design/Construction

To be eligible for listing in the NRHP under criterion C, properties must meet at least one of the following four requirements: (1) embody distinctive characteristics of a type, period, or method of construction; (2) represent the work of a master; (3) possess high artistic value; or (4) represent a significant and distinguishable entity whose components may lack individual distinction. Hush houses and test cells are most likely to be eligible under the first or fourth of these requirements.

National Register Bulletin 15 defines "distinctive characteristics" as "the physical features or traits that commonly recur" in properties; "type, period, or method of construction" is defined as "the certain way properties are related to one another by cultural tradition or function, by dates of construction or style, or by choice or availability of materials and technology." Properties are eligible for listing in the NRHP if they are important examples within a historic context, of design and construction of a particular time. This facet of criterion C can apply to buildings, structures, objects, or districts.

"Significant and distinguishable entities" refers to historic properties that contain a collection of components that may lack individual distinction, but form a significant and distinguishable whole. This portion of criterion C applies only to districts. Hush houses and test cells are often component buildings that are interrelated physically and functionally with other maintenance, research and development, or testing buildings and structures.

To determine if a property is significant within the Hush House and Test Cell context as an important example of the distinctive characteristics of hush houses and test cells or as a significant and distinguishable district:

- Determine the nature of the property, including date of construction, type of construction, historic appearance, and functions during the period of significance.
- Determine the distinctive characteristics of the property type represented by the property in question.
- Compare the property with other examples of the property type and determine if it possesses the distinctive characteristics of hush house or test cell construction.
- Evaluate the property's design and construction to determine if it is an important example of hush house or test cell construction.

4.4.4 Criterion D: Information Potential

Properties may be listed in the NRHP if they have yielded, or may be likely to yield, information important in prehistory or history. Two requirements must be met for a property to meet criterion D: (1) the property must have, or have had, information to contribute to the understanding of history or prehistory; and (2) the information must be considered important. This criterion generally applies to archaeological sites. In a few cases, it can apply to buildings, structures, and objects, if the property itself is the principal source of information and the information is important. For example, a building that displays a unique structural system or unusual use of materials and where the building itself is the main source of information (i.e., no construction drawings or other historic records) might be considered under criterion D. Properties significant within the hush house and test cell context would rarely be eligible under criterion D.

4.5 INTEGRITY

A historic property determined to be significant under the criteria for evaluation for the NRHP must possess integrity. Integrity is the ability of a property to convey its significance through retention of the property's essential physical characteristics from its period of significance. The NRHP criteria for evaluation lists seven aspects of integrity. A property eligible for the NRHP must possess several of these aspects. The assessment of a property's integrity is rooted in its significance. The reason why a property is important should be established first, then the qualities necessary to convey that significance can be identified. The *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation* defines the seven aspects of integrity as:

- Location – the place where the cultural resource was constructed or the place where the historic event occurred.
- Design – the combination of elements that create the form, plan, space, structure, and style of a cultural resource.
- Setting – the physical environment of a cultural resource.
- Materials – the physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form a cultural resource.
- Workmanship – the physical evidence of the crafts of a particular culture or people during any given period in history or prehistory.
- Feeling – a property's expression of the aesthetic or historic sense of a particular period of time.
- Association – the direct link between an important historic event or person and a cultural resource.

National Register Bulletin 15 describes the following steps in assessing historical integrity:

- Determine the essential physical features that must be present for a property to represent its significance.
- Determine whether the essential physical features are sufficiently visible to convey significance.
- Compare the property with similar properties if the physical features necessary to convey significance are not well-defined.
- Determine, based on the property's significance, which aspects of integrity are particularly important to the property in question and if they are intact.

For properties significant for their association with jet engine development, testing, and noise suppression, they must retain the key physical features associated with these events or missions. Properties significant for their design and construction must retain the physical features that are the essential elements of the aspects of hush house or test cell construction that the property represents.

In cases of active military installations, buildings are more likely to have been modified to extend their useful life. These changes generally include replacing historic testing and measuring equipment with modern equipment. These integrity issues will be critical in the evaluation process of significant resources.

To qualify for listing as a historic district, the majority of the properties in the district associated with the historic context must possess integrity and sufficient number must retain from the period of significance to represent that significance. The relationship among the district's components, i.e., massing, arrangement of buildings, and installation plan, must be substantially unchanged since the period of significance.

4.6 CRITERION CONSIDERATIONS

Certain kinds of properties are not usually considered for listing in the NRHP, including:

- religious properties (criteria consideration A)
- moved properties (criteria consideration B)

- birthplaces or graves (criteria consideration C)
- cemeteries (criteria consideration D)
- reconstructed properties (criteria consideration E)
- commemorative properties (criteria consideration F)
- properties that have achieved significance within the last 50 years (criteria consideration G)

These properties can be eligible for listing only if they meet special requirements called “criteria considerations.” A property must meet one or more of the four criteria for evaluation (A through D) and also possess integrity of materials and design before it can be considered under the various criteria considerations. Two of these criterion considerations may be applicable to hush houses and test cells; moved properties (criterion consideration B) and properties that have achieved significance within the last 50 years (criteria consideration G)

A property removed from its original or historically significant location can be eligible if it is significant primarily for architectural value or if it is the surviving property most importantly associated with a historic person or event. Properties that are moveable by nature, such as a ship or rail car, do not need to meet this criterion consideration. T-9 and T-10 hush houses are usually considered equipment and are designed to be relocated with the specific aircraft.

Properties less than 50 years old are normally excluded from the NRHP to allow time to develop sufficient historical perspective. However, under criteria consideration G, a property may be eligible for the NRHP if it possesses “exceptional importance” or significance. Hush Houses and test cells were built primarily after the development of the jet engine, beginning in the mid-1950s. Criteria consideration G (properties that have achieved significance within the last 50 years) potentially applies to hush houses and test cells that are less than 50 years old at the time of evaluation. For buildings, structures, objects, sites, or districts that have achieved significance within the last 50 years, only those of “exceptional importance” can be considered eligible for nomination to the NRHP, and the finding of “exceptional importance” must be made within the specific historic context associated with the property. National Park Service publication *How to Evaluate and Nominate Potential National Register Properties That Have Achieved Significance Within the Last 50 Years* further describes criteria consideration G.

Properties evaluated under criteria consideration G that do not qualify for exceptional importance must be reevaluated when they reach 50 years of age under the NRHP criteria A–D.

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5.0 CASE STUDIES

5.1 INTRODUCTION

Site visits to eight installations were conducted as part of this project to document specific resources within the historic context. These sites were selected based on the real property/personal property data received from the Air Force, Army, Air National Guard, Army National Guard, Navy and Marine Corps to have a sampling of different hush house and test cell types based on (1) aircraft type, (2) branch of the military, and (3) dates of construction. Several of these installations have more than one hush house or test cell. A total of 16 hush houses and test cells, and one test stand were documented during the site visits. The following installations were visited and hush houses/test cells were documented:

- Truax Field (ANG), Madison, Wisconsin – Buildings 1201, 1202, 1206, and 56
- Tinker AFB, Midway, Oklahoma – Buildings 3234 and 926
- Travis AFB, Fairfield, California – Building 1001
- Naval Air Station North Island, San Diego, California – Building 1420
- Marine Corps Air Station Camp Pendleton, California – Buildings 23118 and 23119
- Phoenix ANG Base, Arizona – Building 55
- Naval Air Station Oceana, Virginia Beach, Virginia – Buildings 1116, 1100, 1102, and 1104
- Marine Corps Air Station Miramar, San Diego, California – Buildings 8128/8129 and 8117

In addition, documentation was obtained for seven test cells and hush houses that were previously evaluated and are also included in this chapter. These include:

- Bangor ANG Base – Building 500
- Hawaii ARNG, Kalaeloa, Hawaii – Building 175
- Tinker AFB – Building 214 and 3703
- Marine Corps Air Station Miramar, San Diego, California – Buildings 8545, 9565, and 8679

5.2 TEST CELL AND HUSH HOUSE EVALUATIONS

The following case studies provide summary data on the installations and demonstrate how the resources at these installations can be evaluated within the Hush House/Test Cell historic context.

5.2.1 Truax Field – Wisconsin Air National Guard, Building 1202

Installation Location: Madison, Wisconsin

Hush House/Test Cell Building No.: Building 1202

Date of Construction: 1958

Aircraft: F102

Brief Installation History (related to hush house/test cell):

The United States government acquired 1,700 acres (including the property where the current Truax Field now stands) in 1942 for an Army Air Forces (AAF) Base and as an AAF Radio School. Two buildings, one housing base communications (Building 311) and the other a maintenance hangar (Building 400) remain from this time period. By 1945, Truax had undergone a series of ownership changes and been deactivated as a military base. Then in 1947, the War Assets Administration acquired the property, and the Wisconsin ANG arrived at Truax field. The following year, the AAF became the U.S. Air Force and an alert complex was created at Truax under the Air Defense Command (ADC). The Wisconsin ANG and Truax AFB operated simultaneously at adjacent sites between 1948 and 1968, with the Air Force occupying the property currently used by the 115 Fighter Wing. The ownership changes, primarily between the city of Madison, the United States, and the Wisconsin ANG, continued through 1968.

Truax AFB began expanding in the 1950s to meet the demands of the ADC's alert operations. In 1954, following the Korean War, a new aircraft maintenance hangar (Building 406) harkened the arrival of a more intensive buildup at Truax. This upsurge was part of a national DoD Cold War trend to increase military might and presence. From 1955 to 1957, Truax AFB housed the Midwestern site of one of three ADC high direction centers in the nation. The purpose of this mission was the ADC's Semi-Automatic Ground Environment, a super-computer air defense network designed to anticipate Soviet attack. In 1957, plans were drawn up for a hush house, which was constructed by 1959.

Due to a design flaw, the acoustical tile malfunctioned and the hush house was abandoned for engine testing. The hush house was used for less than a year before a replacement building (Building 1201) was constructed. Building 1202 has been used for cold storage since 1960.

In 1964, the DoD ordered the Air Force Base at Truax Field closed by 1968. The site was subsequently taken over by the Wisconsin ANG. In 1974, the county acquired the airport.

In 1976, the national ADC program's transition to the Tactical Air Command (TAC) took effect at Truax. In 1981, aircraft were converted to the A-10 Thunderbolt and the station underwent a buildup shortly thereafter. Among the new structures was Building 1206, constructed in 1985 for the purpose of A-10 jet engine testing. It is currently used by barrier maintenance.

In 1992, the 128th Tactical Fighter Wing was reappointed the 128th Fighter Wing and the aircraft were converted to the F-16 Falcon. A new hush house was built to accommodate this transition. Building 56, a T-10 hush house, was constructed in 1992 to serve as the F-16 fighter hush house.

The 128th Fighter Wing became the 115th Fighter Wing in 1995 with no change in aircraft.

Description of the Hush House/Test Cell:

The ANG has approximately 120 installations and has 55 hush houses for the F-15 and F-16 aircraft, most from the later Cold War period (1980s). Several of the hush houses within ANG are inactive and may be affected by BRAC. The ANG also has a number of engine test stands for C-130s and other aircraft. A rough estimate of the number of installations that have hush houses at Air Force, Air National Guard, Air Reserves, Naval Air Stations, Marine Air Stations, and Army Air installations exceeds 100. These resources range from permanent "brick and mortar" to temporary structures, and were tied directly to air fighter and air support missions throughout the Cold War.

Building 1202 is a concrete and steel hush house constructed in 1958. The building is a one-story, front gable structure flanked by concrete intake stacks. The walls are concrete block masonry with steel frame girders that form a rib-like formation. A new slate roof was laid at a later date (date unknown).

The building is irregular in plan, consisting of a central rectangular core, tower-like projections to the east and west of the principal (north) façade, and a rear (south) extension with an additional attached, tower-like structure. The construction is a configuration of six, deep, evenly spaced steel girders that run continuously from the foundation to the roof peak to support both the side walls and roof of the building. All of the walls are cast-in-place concrete.

The north elevation offers a central overhead door to provide access for large vehicles and equipment. Originally, concrete doors spanned the entire elevation, sliding open from the center, to accommodate in-frame (on-aircraft) mounted engine testing. In 1961, when the facility was no longer used for engine testing, the massive sliding doors were removed and the present overhead garage door installed. Just to the east of this door is a metal pedestrian access door.

An augmenter tube and concrete block masonry exhaust stack project south from the south elevation. The roof on the south end of the exhaust stack is open and vented to allow exhaust to escape.

The interior is largely open space, save for a control room at the southwest corner and a utility room at the southeast corner. The walls are exposed concrete. Most of the original acoustical tile is no longer extant. Due to the design malfunction with the acoustical tiles, the building (Building 1202) was only used for a year. A year later a new hush house was built to replace it (Building 1201).

Application of Significance Criteria:

Building 1202 is not eligible under criterion A. Building 1202 is a redundant resource type that was constructed at a number of DoD aviation installations across the United States prior to and during the Cold War and are still being constructed today. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flight. It is not representational of a particular event or period.

The building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant Air Force commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

Under criterion C, Building 1202 is not significant. It does embody the characteristics of a particular and redundant resource type. The design employs heavy concrete construction with acoustical baffles. Although this structure has characteristics and design that bridge both test cell and hush house design, this particular hush house/test cell functioned for less than one year due to design flaws and failure. It was replaced with a new test cell and has been used for storage since.

Building 1202 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented and was a failure. These documents are available from the Truax Field civil engineering office. Therefore, the building does not have any further research potential.

Integrity:

Poor : the original design was a failure and only operated for a year. The building has been used for storage for almost 50 years. The original hangar doors have been removed.

Evaluation Conclusion:

Building 1202 does not meet the eligibility criteria for listing in the NRHP. The Wisconsin State Historic Preservation Office concurred with this finding on June 30, 2009. No further cultural resource management is recommended.

FIGURE 5-1. BUILDING 1202, LOOKING SOUTHWEST

Information Sources:

TEC, Inc. Final Cultural Resources Survey, General Mitchell International Airport and Truax Field, Wisconsin, January 2007.

Air National Guard, Environmental Baseline Survey for the 115th Fighter Wing, Madison, Wisconsin, January 2008.

5.2.2 Truax Field – Wisconsin Air National Guard, Building 1201

Installation Location: Madison, Wisconsin

Hush House/Test Cell Building No.: Building 1201

Date of Construction: 1958

Aircraft: F102

Brief Installation History (related to hush house/test cell):

The United States government acquired 1,700 acres (including the property where the current Truax Field now stands) in 1942 for an AAF base and an AAF Radio School. Two buildings, one housing base communications (Building 311) and the other a maintenance hangar (Building 400) remain from this time period. By 1945, Truax had undergone a series of ownership changes and been deactivated as a military base. Then in 1947, the War Assets Administration acquired the property and the Wisconsin ANG arrived at Truax Field. The following year, the AAF became the U.S. Air Force and an alert complex was created at Truax under the ADC. The Wisconsin ANG and Truax AFB operated simultaneously at adjacent sites between 1948 and 1968, with the Air Force occupying the property currently used by the 115th Fighter Wing. The ownership changes, primarily between the city of Madison, the United States, and the Wisconsin National Guard, continued through 1968.

Truax AFB began expanding in the 1950s to meet the demands of the ADC's alert operations. In 1954, following the Korean War, a new aircraft maintenance hangar (Building 406) harkened the arrival of a more intensive buildup at Truax. This upsurge was part of a national DoD Cold War trend to increase military might and presence. From 1955 to 1957, Truax AFB housed the Midwestern site of one of three ADC high direction centers in the nation. The purpose of this mission was the ADC's Semi-Automatic Ground Environment, a super-computer air defense network designed to anticipate Soviet attack. In 1957, plans were drawn up for a hush house, which was constructed by 1959.

Due to a design flaw, the acoustical tile malfunctioned and the hush house was abandoned for engine testing. The hush house was used for less than a year before a replacement building (Building 1201) was constructed. Building 1202 has been used for cold storage since 1960.

In 1964, the DoD ordered the Air Force Base at Truax Field closed by 1968. The site was subsequently taken over by the Wisconsin ANG. In 1974, the county acquired the airport.

In 1976, the national ADC program's transition to the TAC took effect at Truax. In 1981, aircraft were converted to the A-10 Thunderbolt and the station underwent a buildup shortly thereafter. Among the new structures was Building 1206, constructed in 1985 for the purpose of A-10 jet engine testing. It is currently used by barrier maintenance.

In 1992, the 128th Tactical Fighter Wing was reappointed the 128th Fighter Wing and the aircraft were converted to the F-16 Falcon. A new hush house was built to accommodate this transition. Building 56, a T-10 hush house, was constructed in 1992 to serve as the F-16 fighter hush house.

The 128th Fighter Wing became the 115th Fighter Wing in 1995 with no change in aircraft.

Description of the Hush House/Test Cell:

Building 1201 was constructed in 1958 to replace the structurally unsound Building 1202. A long, poured-concrete structure, Building 1201 was built as a water-cooled test cell, although it presently serves as a vehicle wash rack and storage facility. The building has been altered since its construction and is currently much smaller than the original. The original building was approximately 20 feet across the north elevation and 90 feet long and featured an octagonal control house, approximately 8 feet in diameter, at the northeast corner. The original building included an augmenter tube and exhaust stack for noise suppression, but these were removed by 1998.

The present structure is approximately 50 feet long. The north elevation remains similar to the original, although the control house has been removed.

Building 1201 faces north. This elevation contains an overhead steel door and a single metal door just to the west. This section of the building is two-stories tall and originally served as the intake stack. The main building is a single-story, open floor plan structure.

Application of Significance Criteria:

Building 1201 is not eligible under criterion A. Building 1201 is a redundant resource type that was constructed at a number of DoD aviation installations across the United States prior to and during the Cold War and are still being constructed today. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flight. As a single facility, it is not representational of a particular event or period.

The building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant Air Force commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

Under criterion C, Building 1201 is not significant. It does embody the characteristics of a particular and redundant resource type. The design employs heavy concrete construction with acoustical baffles. Although this structure has characteristics and design of a test cell, this particular single-chamber test cell in not a good representative example. It has several key components removed and has been used for storage for over 20 years.

Building 1201 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented. These documents are available from the Truax Field civil engineering office. Therefore, the building does not have any further research potential.

Integrity:

Poor: the augmenter tube, exhaust stack, and control room have been removed. Although it retains the look of a test cell, it no longer has the components necessary to function as one.

Evaluation Conclusion:

Building 1201 does not meet the eligibility criteria for listing in the NRHP. It is recommended that concurrence with these findings for individual eligibility be sought from the SHPO prior to any undertakings under Section 106 of the NHPA. No further cultural resource management is recommended.

Information Sources:

TEC, Inc. Final Cultural Resources Survey, General Mitchell International Airport and Truax Field, Wisconsin, January 2007.

Air National Guard, Environmental Baseline Survey for the 115th Fighter Wing, Madison Wisconsin, January 2008.

FIGURE 5-2. BUILDING 1201, LOOKING SOUTHWEST

5.2.3 Truax Field – Wisconsin Air National Guard, Building 1206

Installation Location: Madison, Wisconsin

Hush House/Test Cell Building No. : Building 1206

Date of Construction: 1985

Aircraft: A-10

Brief Installation History (related to hush house/test cell):

The United States government acquired 1,700 acres (including the property where the current Truax Field now stands) in 1942 for an AAF base and as an AAF Radio School. Two buildings, one housing base communications (Building 311) and the other a maintenance hangar (Building 400) remain from this time period. By 1945, Truax had undergone a series of ownership changes and been deactivated as a military base. Then in 1947, the War Assets Administration acquired the property and the Wisconsin ANG arrived at Truax Field. The following year, the AAF became the U.S. Air Force and an alert complex was created at Truax under the ADC. The Wisconsin ANG and Truax AFB operated simultaneously at adjacent sites between 1948 and 1968, with the Air Force occupying the property currently used by the 115th Fighter Wing. The ownership changes, primarily between the city of Madison, the United States, and the Wisconsin Air National Guard, continued through 1968.

Truax AFB began expanding in the 1950s to meet the demands of the ADC's alert operations. In 1954, following the Korean War, a new aircraft maintenance hangar (Building 406) harkened the arrival of a more intensive buildup at Truax. This upsurge was part of a national DoD Cold War trend to increase military might and presence. From 1955 to 1957, Truax AFB housed the Midwestern site of one of three ADC high direction centers in the nation. The purpose of this mission was the ADC's Semi-Automatic Ground Environment, a super-computer air defense network designed to anticipate Soviet attack. In 1957, plans were drawn up for a hush house, which was constructed by 1959.

Due to a design flaw, the acoustical tile malfunctioned and the hush house was abandoned for engine testing. The hush house was used for less than a year before a replacement building (Building 1201) was constructed. Building 1202 has been used for cold storage since 1960.

In 1964, the DoD ordered the Air Force Base at Truax Field closed by 1968. The site was subsequently taken over by the Wisconsin ANG. In 1974, the county acquired the airport.

In 1976, the national ADC program's transition to the TAC took effect at Truax. In 1981, aircraft were converted to the A-10 Thunderbolt and the station underwent a buildup shortly thereafter. Among the new structures was Building 1206, constructed in 1985 for the purpose of A-10 jet engine testing. It is currently used by barrier maintenance.

In 1992, the 128th Tactical Fighter Wing was reappointed the 128th Fighter Wing and the aircraft were converted to F-16 Falcon. A new hush house was built to accommodate this transition. Building 56, a T-10 hush house, was constructed in 1992 to serve as the F-16 fighter hush house. The 128th Fighter Wing became the 115th Fighter Wing in 1995 with no change in aircraft.

<u>Description of the Hush House/Test Cell</u>:

The ANG has approximately 120 installations and has 55 hush houses for the F-15 and F-16 aircraft, most from the later Cold War period (1980s). Several of the hush houses within ANG are inactive and may be affected by BRAC. The ANG also has a number of engine test stands for the C-130s and other aircraft. A rough estimate of the number of installations that have hush houses at Air Force, Air National Guard, Air Reserves, Naval Air Stations, Marine Air Stations, and Army Air installations exceeds 100. These resources range from permanent "brick and mortar" to temporary structures, and are tied directly to air fighter and air support missions throughout the Cold War.

Building 1206 is a concrete block building constructed in 1985 for the purpose of A-10 jet engine testing. The building is a relatively small two-story rectangle with overhead steel doors occupying much of the east and west elevations. Building 1206 measures approximately 30 feet by 24 feet. The north and south elevations also feature one-story overhead steel doors. Beside the overhead doors on the north and south elevations are single pedestrian-access steel doors. The interior is open and features a two-ton electric hoist and trolley.

In 1992, the 128th Tactical Fighter Wing was reappointed the 128th Fighter Wing and the aircraft were converted to F-16 Falcon. A new hush house was built to accommodate this transition. Building 1206 is currently used by barrier maintenance.

Application of Significance Criteria:

Building 1206 is not eligible under criterion A. Building 1206 is 24 years old and was used less than 10 years as a test cell. Although associated with a change in mission and aircraft at Truax, it is a support building and does not meet the exceptional significance threshold. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flight. As a single facility, it is not representational of a particular event or period.

The building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant Air Force commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

Under criterion C, Building 1206 is not significant. The design employs heavy concrete construction, but is designed more like a vehicle maintenance facility than a test cell, with no apparent baffling or exhaust and intake stacks. It was replaced with a new hush house and is currently used for barrier maintenance.

Building 1206 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented. These documents are available from the Truax Field civil engineering office. Therefore, the building does not have any further research potential.

Integrity:

The overall integrity of Building 1206 is good. It retains integrity for location, design, setting, materials, workmanship, and feeling.

Evaluation Conclusion:

Building 1206 does not meet the eligibility criteria for listing in the NRHP. It is recommended that concurrence with these findings for individual eligibility be sought from the SHPO prior to any undertakings under Section 106 of the NHPA. The building should be re-evaluated when it reaches 50 years old (2035). No further cultural resource management is recommended at this time.

Information Sources:

TEC, Inc. Final Cultural Resources Survey, General Mitchell International Airport and Truax Field, Wisconsin, January 2007.

Air National Guard, Environmental Baseline Survey for the 115th Fighter Wing, Madison Wisconsin, January 2008.

FIGURE 5-3. BUILDING 1206, LOOKING NORTHWEST

5.2.4 Truax Field – Wisconsin Air National Guard, Building 56

Installation Location:

Truax Field

Hush House/Test Cell Building No.: Building 56

Date of Construction: 1992

Aircraft: F-16

Brief Installation History (related to hush house/test cell):

The United States government acquired 1,700 acres (including the property where the current Truax Field now stands) in 1942 for an AAF base and as an AAF Radio School. Two buildings, one housing base communications (Building 311) and the other a maintenance hangar (Building 400) remain from this time period. By 1945, Truax had undergone a series of ownership changes and been deactivated as a military base. Then in 1947, the War Assets Administration acquired the property and the Wisconsin ANG arrived at Truax field. The following year, the AAF became the U.S. Air Force and an alert complex was created at Truax under the ADC. The Wisconsin ANG and Truax AFB operated simultaneously at adjacent sites between 1948 and 1968, with the Air Force occupying the property currently used by the 115th Fighter Wing. The ownership changes, primarily between the city of Madison, the United States, and the Wisconsin ANG, continued through 1968.

Truax AFB began expanding in the 1950s to meet the demands of the ADC's alert operations. In 1954, following the Korean War, a new aircraft maintenance hangar (Building 406) harkened the arrival of a more intensive buildup at Truax. This upsurge was part of a national DoD Cold War trend to increase military might and presence. From 1955 to 1957, Truax AFB housed the Midwestern site of one of three ADC high direction centers in the nation. The purpose of this mission was the ADC's Semi-Automatic Ground Environment, a super-computer air defense network designed to anticipate Soviet attack. In 1957 plans were drawn up for a hush house, which was constructed by 1959.

Due to a design flaw, the acoustical tile malfunctioned and the hush house was abandoned for engine testing. The hush house was used for less than a year before a replacement building (Building 1201) was constructed. Building 1202 has been used for cold storage since 1960.

In 1964, the DoD ordered the Air Force Base at Truax Field closed by 1968. The site was subsequently taken over by the Wisconsin ANG. In 1974, the county acquired the airport.

In 1976, the national ADC program's transition to the TAC took effect at Truax. In 1981, aircraft were converted to the A-10 Thunderbolt and the station underwent a buildup shortly thereafter. Among the new structures was Building 1206, constructed in 1985 for the purpose of A-10 jet engine testing. It is currently used by barrier maintenance.

In 1992, the 128th Tactical Fighter Wing was reappointed the 128th Fighter Wing and the aircraft were converted to F-16 Falcon. A new hush house was built to accommodate this transition. Building 56, a T-10 hush house, was constructed in 1992 to serve as the F-16 fighter hush house. The 128th Fighter Wing became the 115th Fighter Wing in 1995 with no change in aircraft.

<u>Description of the Hush House/Test Cell</u>:

Building 56 was constructed in 1992 to serve as the F-16 fighter hush house. The building, a T-10 type hush house, has a north-facing primary façade (aircraft access). The hush house is constructed of insulated metal siding. The main building measures approximately 130 feet across its front façade and approximately 93 feet deep.

The structure is a barrel-vaulted hangar constructed of corrugated metal, concrete, and intake vents. Large corrugated metal sliding hangar-type doors open along an external track on the north elevation. Centrally located along the rear of the structure (the south elevation) is a long metal tube that serves to funnel and cool the exhaust. This is known as the augmenter/diffuser tube and is lined with a noise suppression system. The augmenter tube culminates in a cube-like exhaust port where the exhaust is expelled. The augmenter tube is approximately 75 feet long and the exhaust port/deflector measures approximately 22 feet square.

Inside, acoustic baffles covered with wire mesh line the sidewalls. The hangar section opens to admit the F-16 for in-frame testing. A control room inside the building allows testing of the engine. An overhead garage-type door is centered on the south side of the hangar and leads into the augmenter tube. Two metal doors, one on the east elevation and one on the west, offer pedestrian access to the hangar.

<u>Application of Significance Criteria</u>:

Building 56 is not eligible under criterion A. Building 56 is 16 years old. Although associated with a change in mission and aircraft at Truax, it is a support building and does not meet the exceptional significance threshold. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flight. As a single facility, it is not representational of a particular event or period.

The building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant Air Force commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

Under criterion C, Building 56 is not significant. It does embody the characteristics of a particular and redundant resource type. This is a standard design for a hush house used for fighter aircraft at numerous locations throughout U.S. military installations.

Building 56 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented. These documents are available from the Truax Field civil engineering office. Therefore, the building does not have any further research potential.

Integrity:

The overall integrity of Building 56 is good. It retains integrity for location, design, setting, materials, workmanship, feeling, and association.

Evaluation Conclusion:

Building 56 does not meet the eligibility criteria for listing in the NTHP. Building 56 should be re-evaluated when it reaches 50 years of age (2042). No further cultural resource management is recommended at this time.

FIGURE 5-4. BUILDING 56, LOOKING SOUTHEAST

Information Sources:

TEC, Inc. Final Cultural Resources Survey, General Mitchell International Airport and Truax Field, Wisconsin, January 2007.

Air National Guard, Environmental Baseline Survey for the 115th Fighter Wing, Madison, Wisconsin, January 2008.

5.2.5 Tinker Air Force Base, Building 3234

Installation Location: Midwest City, Oklahoma

Hush House/Test Cell Building No.: Building 3234

Date of Construction: 1974

Aircraft: F-4, KC-135 and the B-52

Brief Installation History (related to hush house/test cell):

In the 1940s, with Oklahoma still suffering the effects of the Great Depression, civic leaders advocated for air-related industries to locate in the state in order to boost the economy. Due to its location, terrain, and environment, Oklahoma City was chosen by the U.S. Army as the location for both an aircraft plant and air depot. Douglas Corporation built an aircraft manufacturing plant adjacent to Oklahoma City Air Depot and the Midway Air Depot in 1942 to facilitate production of the C-47, an Army cargo plane.

During the war, the plant employed 24,000 people and supplied and maintained military aircraft during the war in the Pacific. By late 1945, the plant had produced 5,355 planes, approximately half of the C-47s used in WWII. The Oklahoma City depot also completed repairs on B-17s, B-24s, and B-29s. These planes were disassembled, cleaned, repaired, reassembled, and tested in an assembly line operation. Important modifications to bomber aircraft for special missions were also made at the depot during WWII.

After the end of WWII, Douglas announced that it was closing on August 17, 1945, and ceased operations overnight. Oklahoma City annexed the Douglas Plant in late 1945, making Oklahoma City Depot the largest air depot in the world. By July 1946, the Oklahoma City Air Materiel Area (OCAMA) began using the former main assembly building of the Douglas Aircraft Plant as a facility for aircraft modification and renovation. On February 25, 1947, the base officially moved into the jet age when the jet engine overhaul responsibilities were transferred from San Bernardino, California, to OCAMA. In the same year, Tinker was named the repair center for the B-36 bomber.

With the formation of the U.S. Air Force in 1947, Tinker Field became Tinker Air Force Base. Tinker AFB played an important role in the Korean War as a major repair site and a vital link in the chain of supply. This increased workload led to new construction at the base. Eight new jet engine test cells were built from 1952 to 1954, inaugurating Tinker AFB's new status as a jet-only operation. Tinker handled mainly the B-52, B-1B, and the KC-135 aircraft. The new test cells were contained in Building 3703.

Tinker was vital again during the Cuban Missile Crisis, working around the clock to keep the Strategic Air Command strategic bombers and tanker fleet in the air. The mid-1960s saw the B-47 and K-C-97 phased out; however, the closure or phase out air materiel areas in Rome, New York; San Bernardino, California; and Mobile, Alabama, increased Tinker's work load. During the Vietnam War, the base's size and responsibilities for aircraft and vehicle repair were again expanded. In the 1970s, a modification and repair operation for F-4 Phantom fighters began. Tinker AFB was the only overhaul depot for the J-57 engine, and it provided overhaul and repair services for the F-101 engine, the AGM-86A missile, and other military offensive aircraft.

In the early 1990s, the base provided front-line support to the forces engaged in Operation Desert Shield and Desert Storm. Today, Tinker AFB continues to provide aircraft maintenance and repair and logistical support.

Description of the Hush House/Test Cell:

Building 3234 comprises 63,160 square feet measuring approximately 272 feet by 170 feet. The structure sits on a concrete foundation with a steel superstructure supporting concrete brick masonry and heavy gauge metal paneled walls. The roof is an asphalt gravel assembly.

The four poured-in-place concrete exhaust stacks rise four stories along the west elevation. They measure approximately 34 feet by 26 feet. The two central stacks stand side by side, enclosed together in concrete masonry, making it appear as a single stack. Metal-sided walls appear between the exhaust stacks, with double metal doors offering pedestrian access to the facility. The intake air shafts are in the center of the building. The central two stacks are also side-by-side forming a one tower feature. The intake stacks are approximately 26 feet by 40 feet. The tops of the stacks are open and capped with a flat roof having mansard-shaped metal eaves. Between the intake and exhaust stacks and to the west of the intake stacks are large, flat-roofed sections of the building. The center and western sections of the building contain the four 160-foot-long test cells, and the eastern section contains the large open engine preparation area. Two large corrugated metal sliding doors open along an external track on the north elevation for access to the preparation area.

The open area is used for preparing the engines before and after testing. The floor of the building is concrete. Restrooms and office space occupy the northeast side of the open room. Heavy, two-story, solid metal, vault-like doors provide access to the test cells and aid in noise suppression. Two control rooms allow monitoring and testing of the jet engines. The control rooms lie on either side of the two central test cells, allowing one control room for viewing and access to the test cells to the north and south. Office and storage space flank the control rooms to the east and west.

Application of Significance Criteria:

Building 3234 is not eligible under criterion A. Building 3234 is 35 years old. Although associated with changes and increases in missions and operations resulting from the Vietnam War, it is a support building and does not meet the exceptional significance threshold. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flight. As a single facility, it is not representational of a particular event or period.

The building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant Air Force commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

Under criterion C, Building 3234 is not significant. It does embody the characteristics of a particular and redundant resource type with common, yet distinguishable, design components. It is a multi-chambered test cell. This is a functional design for test cells and there are numerous similar buildings at locations throughout U.S. military installations.

Building 3234 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented. These documents are available from the Tinker AFB civil engineering office. Therefore, the building does not have any further research potential.

Integrity:

The overall integrity of Building 3234 is good. It retains integrity for location, design, setting, materials, workmanship, feeling, and association.

Evaluation Conclusion:

Building 3234 does not meet the eligibility criteria for listing in the NRHP. Building 3234 should be re-evaluated when it reaches 50 years of age (2024), or as part of an installation Cold War era survey for district eligibility potential. It is recommended that concurrence with these findings for individual eligibility be sought from the SHPO prior to any undertakings under Section 106 of the NHPA. No further cultural resource management is recommended at this time.

FIGURE 5-5. BUILDING 3234

Information Sources:

U.S. Air Force Real Property Inventory Detail List, December 7, 1998.

Oklahoma City ALC, Final Phase I Inventory and Evaluation of Historic Buildings Tinker Air Force Base, Oklahoma, Contract No. F34650-98-D-0033, October 30, 2001.

5.2.6 Tinker Air Force Base, Building 926

Installation Location: Midwest City, Oklahoma

Hush House/Test Cell Building No.: Building 926

Date of Construction: 1989

Aircraft: F-16

Brief Installation History (related to hush house/test cell):

In the 1940s, with Oklahoma still suffering the effects of the Great Depression, civic leaders advocated for air-related industries to locate in the state to boost the economy. Due to its location, terrain, and environment, Oklahoma City was chosen by the U.S. Army as the location for both an aircraft plant and air depot. Douglas Corporation built an aircraft manufacturing plant adjacent to Oklahoma City Air Depot and the Midway Air Depot in 1942 to facilitate production of the C-47, an Army cargo plane.

The plant employed 24,000 people and supplied and maintained military aircraft during the war in the Pacific. By late 1945, the plant had produced 5,355 planes, approximately half of the C-47s used in WWII. The Oklahoma City depot also completed repairs on B-17s, B-24s, and B-29s. These planes were disassembled, cleaned, repaired, reassembled, and tested in an assembly line operation. Important modifications to bomber aircraft for special missions were also made at the depot during WWII.

At the end of WWII, Douglas announced that it was closing on August 17, 1945, and ceased operations overnight. Oklahoma City annexed the Douglas Plant in late 1945, making Oklahoma City Depot the largest air depot in the world. By July 1946, OCAMA began using the former main assembly building of the Douglas Aircraft Plant as a facility for aircraft modification and renovation. On February 25, 1947, the base officially moved into the jet age when the jet engine overhaul responsibilities were transferred from San Bernardino, California, to OCAMA. In the same year, Tinker was named the repair center for the B-36 bomber.

With the formation of the U.S. Air Force in 1947, Tinker Field became Tinker Air Force Base. Tinker AFB played an important role in the Korean War as a major repair site and a vital link in the chain of supply. The increased workload led to new construction at the base. Eight new jet engine test cells were built from 1952 to 1954, inaugurating Tinker AFB's new status as a jet-only operation. Tinker handled mainly the B-52, B-1B, and the KC-135 aircraft. The new test cells were contained in Building 3703.

Tinker was vital once again during the Cuban Missile Crisis working around the clock to keep the Strategic Air Command strategic bombers and tanker fleet in the air. The mid-1960s saw the B-47 and KC-97 being phased out; however, the closure or phase-out of Air Materiel Areas in Rome, New York; San Bernardino, California; and Mobile, Alabama, led to an increased workload at Tinker. During the Vietnam War, the base's size and responsibilities for aircraft and vehicle repair were again expanded. In the 1970s, a modification and repair operation for the F-4 Phantom fighter began. Tinker AFB was the only overhaul depot for the J-57 engine, and it provided overhaul and repair services for the F-101 engine, the AGM-86A missile, and other military offensive aircraft.

In the early 1990s, the base provided frontline support to the forces engaged in Operation Desert Shield and Desert Storm. Today, Tinker AFB continues to provide aircraft maintenance and repair as well as logistical support.

A tenant at Tinker AFB is the 507th Air Refueling Wing, which originally was that of a fighter group. The 507th Fighter Group conducted airstrikes and escorted B-29 bombers on raids during WWII. The group earned a Distinguished Unit Citation for outstanding performance in engaging and destroying Japanese interceptor aircraft during a long-range fighter sweep to Korea on August 13, 1945. The group was inactivated in Okinawa in May 1946, and from August 1955 to September 1968 served in an air defense role, training with interceptor aircraft and participating in various exercises. They trained for tactical fighter missions, participating in numerous tactical, joint, and combined exercises, from 1972 through 1994. The 507th was the first Air Force Reserve group to participate in RED FLAG exercises (1978), and the first to deploy to Turkey for an annual tour (1982). In 1989, Building 926 was constructed for testing the 507th FG F-16 aircraft. In 1994, the 507th was converted from fighter to worldwide air refueling operations and received the KC-135—the hush house was no longer used.

Description of the Hush House/Test Cell:

Built in 1989, Building 926 is a T-10-style hush house. The building was only used for jet engine testing for one to two years due to changes in the size and type of aircraft serviced and housed at Tinker AFB. Presently, the building is used for storage.

The main part of the structure is a barrel-roofed hangar constructed of corrugated metal, concrete, and intake vents. This main structure measures approximately 150 feet by 100 feet. Large, corrugated metal hangar doors slide open along an external track at the south side of the building.

Centrally located along the northern elevation is a long cylindrical metal tube that serves to funnel and cool the exhaust blast. This is known as the augmenter/diffuser tube and is lined with a noise suppression system. The tube is approximately 15 feet wide and 100 feet long. The augmenter tube culminates in a cube-like exhaust port where the exhaust is expelled. This portion of the structure measures approximately 15 feet square.

Inside the large main building, acoustic baffles, covered with wire mesh, line the sidewalls. The hangar section is open to admit aircraft for in-frame testing. A control room on the west side looks into the hangar. Centered on the north side of the hangar is an overhead garage-type door leading into the augmenter tube. Two metal doors, one on the east elevation and one on the west, offer pedestrian access to the hangar.

Application of Significance Criteria:

Building 926 is not eligible under criterion A. Building 926 is 20 years old. Although associated with a change in mission and aircraft at Tinker, it is a support building and does not meet the exceptional significance threshold. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flight. As a single facility, it is not representational of a particular event or period.

The building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant Air Force commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

Under criterion C, Building 926 is not significant. It does embody the characteristics of a particular and redundant resource type. This is a standard design for a hush house used for fighter aircraft at numerous locations throughout U.S. military installations.

Building 926 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented. These documents are available from the Tinker AFB civil engineering office. Therefore, the building does not have any further research potential.

Integrity:

The overall integrity of Building 926 is good. It retains integrity for location, design, setting, materials, workmanship, feeling, and association.

Evaluation Conclusion:

Building 926 does not meet the eligibility criteria for listing in the NRHP. Building 926 should be re-evaluated when it reaches 50 years of age (2039). No further cultural resource management is recommended at this time.

FIGURE 5-6. BUILDING 926

Information Sources:

USAF Real Property Inventory Detail List, December 7, 1998.

Oklahoma City ALC, Final Phase I Inventory and Evaluation of Historic Buildings Tinker AFB, Oklahoma, Contract No. F34650-98-D-0033, October 30, 2001.

5.2.7 Travis Air Force Base, Building 1001

Installation Location: Fairfield, California

Hush House/Test Cell Building No.: Building 1001

Date of Construction: 1968

Aircraft: C-5 Cargo

Brief Installation History (related to hush house/test cell):

Travis AFB began in 1943 as Fairfield-Suisun Army Air Base. The primary purpose of the new base was to support the Pacific theater during WWII. In this capacity, the base serviced and ferried aircraft and airlifted troops and supplies from California to the Pacific.

In 1949, in response to the Cold War, the base was transferred to Strategic Air Command to be used as a major long-range reconnaissance and intercontinental bomber installation. Travis AFB (so named in 1950) played a role in tactical air defense during the Cold War, building alert and readiness facilities. The first B-52 bomber arrived at Travis in 1959, as did the KC-135 Stratotanker.

While Travis AFB continued to host Strategic Air Command bombers, the mission shifted to the air transport of cargo, equipment, and, by the mid-1960s, medical evacuees returning from combat in Southeast Asia. As the West Coast terminus for aero-medical transports returning from Southeast Asia, Travis AFB also became the principal receiving station for war fatalities being returned to the United States for burial. In January 1966, Military Air Transport Service (MATS) was renamed Military Airlift Command (MAC) and, during that same year, the 1501st Air Transport Wing (ATW) was discontinued and its equipment and personnel organized into the 60th Military Airlift Wing.

Travis AFB also supported the conflict in Vietnam between 1965 and 1975. The first C-141 aircraft arrived in 1965, and daily flights to Saigon were begun. In 1966, MATS was renamed the Military Airlift Command, and the 1501st ATW was disbanded and reformed as the 60th Military Airlift Wing. Between 1966 and 1970, more than one million personnel moved through the Travis AFB passenger terminal, and the base supported the transport of an average of 200,000 tons of mail each year. The 60th Military Airlift Wing was twice awarded outstanding unit awards by the Air Force during the conflict in Vietnam.

In 1968, Strategic Air Command transferred the 5th Bomb Wing to Minot AFB, North Dakota, leaving the 916th Air Refueling Squadron (AREFS) as the primary Strategic Air Command presence at Travis AFB. A test cell was constructed in 1968 to facilitate engine testing for the C-5 cargo plane. The C-5 aircraft began to arrive on the base in 1970. The first repatriated prisoners of war arrived at Travis AFB in 1973, following the signing of the cease-fire agreement in Paris on January 27 of that year. In 1975, the base took part in Operation Babylift in which 2,945 children were transported to the United States from Southeast Asia. In 1977, Strategic Air Command activated the 307th Air Refueling Group with the 916th AREFS assigned to it.

Travis AFB lost the C-5 engine test and re-build operations to Kelly AFB in Texas in 2005. Building 1001 was shut down and 200 people lost their jobs. Travis still maintains the air permit on Building 1001 and all critical testing components are still present in the building, but Building 1001 is only used for storage.

Description of the Hush House/Test Cell:

Building 1001 is a test cell constructed in 1968. The structure sits on a concrete pad facing west and comprises approximately 4,100 square feet. The south profile of the building is U-shaped with the intake stack to the west, the central testing portion, and the exhaust to the east. The central portion contains the augmenter tube and main testing room (used for the engines of the C-5 cargo plane). A small observation window, approximately 5 feet off the ground, is centered on the south elevation. This central portion is approximately 26 feet high.

The west elevation measures approximately 33 feet in length and 43 feet high and contains the air intake stack and the main entrance doors. The entrance consists of a set of steel doors, each measuring 8 feet by 16 feet.

The north elevation contains the auxiliary support buildings. From west to east, they include a control room, equipment room, and fuel shed. These protrude approximately 12 feet from the main building, 48 feet east of the main entrance. The control room is accessed via a steel door on the north. A steel door offers access to the fuel shed from the north elevation. These auxiliary buildings measure approximately 12 feet high and 60 feet in length. Farther east along the north elevation is the exhaust stack, which measures approximately 29 feet (north elevation) by 27 feet (east elevation). The exhaust stack is approximately 35 feet high. The exhaust stack comprises the entire east elevation.

Inside, Building 1001 is lined with sound-suppressing fiberglass and stainless steel mesh. Intake baffles line the ceiling for the westernmost 45 feet. An overhead hoist holds the engines during testing. Along the north wall, an observation window links the control room and the test chamber. The steel augmenter tube is contained within the building. It has a diameter of 15 feet and measures approximately 50 feet in length.

Application of Significance Criteria:

Building 1001 is not eligible under criterion A. Building 1001 is 41 years old. Although associated with changes and increases in missions and operations resulting from the Vietnam War, it is a support building and does not meet the exceptional significance threshold. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flights. As a single facility, it is not representational of a particular event or period.

This building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant Air Force commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

Under criterion C, Building 1001 is not significant. It does embody the characteristics of a particular and redundant resource type with common, yet distinguishable, design components. This is a functional design for a single-chamber test cell. Building 1001 is a single test cell; there are a number of similar cells at numerous locations throughout U.S. military installations, whether as a single cell or multiple cells joined together as at Tinker AFB.

Building 1001 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented. These documents are available from the Travis AFB civil engineering office. Therefore, the building does not have any further research potential.

Integrity:

The overall integrity of Building 1001 is good. It retains integrity for location, design, setting, materials, workmanship, feeling, and association.

Evaluation Conclusion:

Building 1001 does not meet the eligibility criteria for listing in the NRHP. Building 1001 should be re-evaluated when it reaches 50 years of age (2018), or as part of an installation Cold War era survey for district eligibility potential. It is recommended that concurrence with these findings for individual eligibility be sought from the SHPO prior to any undertakings under Section 106 of the NHPA. No further cultural resource management is recommended at this time.

FIGURE 5-7. BUILDING 1001, LOOKING SOUTHWEST

Information Sources:

Travis AFB, Integrated Cultural Resources Management Plan, Travis AFB, Fairfield, California, 2008.

Travis AFB, Building 1001 Engine Test Facility Floor Plans, 1968.

5.2.8 Phoenix Air National Guard Base, Building 55

Installation Location: Sky Harbor International Airport, Phoenix, Arizona

Hush House/Test Cell Building No.: Building 55

Date of Construction: 1976

Aircraft: KC-135 Cargo

Brief Installation History (related to hush house/test cell):

The first unit of the Arizona ANG was inaugurated in 1946 following WWII. Active service began in 1950 with combat missions in Korea. During this time, servicemen also trained new Air Force recruits in the United States and Japan. The Arizona unit received a new home at Sky Harbor Airport in Phoenix and the propeller-driven F-51s were replaced by the new F-86A "Saberjet" fighter planes. The advent of the Cold War also brought new missions to the Phoenix Air Guard Base, including active service flying daily patrol on the perimeter of Germany's "Iron Curtain" in 1961. Soon after this, jet fighters were phased out at Phoenix and the guardsmen redesigned the 161st Air Transport Group. The group began transition training to fly the C-97 "Stratofreighter" in passenger and cargo airlift missions to Hawaii, Japan, and West Germany.

In 1966 and 1967, during the Vietnam War, Phoenix Air Guardsmen flew 65 cargo and passenger airlift missions to combat bases in Vietnam and Thailand. The 161st also flew medical evacuations in 1968.

In 1972, the Phoenix group was reorganized as the 161st Air Refueling Group, providing daily refueling service to the Air Force and other military aircraft. In 1976, the unit was placed into the Strategic Air Command, the first time part-time units were incorporated in the forces of the Strategic Air Command. A hush house was constructed during this period in order to test KC-135 engines. It was the second T-9 hush house constructed for the Air Force. The original pad for the T-9 was built in 1977 and sat approximately 0.5 mile south of the current location. The hush house was moved in 1999 to accommodate construction of a third runway for Sky Harbor International Airport. Building 55 served as an engine test facility until 2004 when it was converted to a storage facility. The base continues to support aerial refueling and aircraft maintenance missions.

Description of the Hush House/Test Cell:

Building 55 is a 6,400-square-foot T-9 hush house. The building runs west-east, with the intake slats on the west elevation and the augmenter tube and exhaust vents on the east. A T-20 mobile control cab is attached to the south elevation to facilitate engine testing. Centered along the north elevation is a small observation window.

Building 55 is an aluminum and steel frame structure. The roof is slightly pitched and constructed of aluminum. Fiberglass batted panels covered with steel mesh line the interior and provide noise suppression. The augmenter tube is steel.

The west elevation, which measures approximately 38 feet in length, contains a rolling overhead door measuring approximately 16 feet by 16 feet. The roof extends 11 feet to the south, west, and north of the door and is covered in steel mesh to allow air intake. The north elevation contains a steel door providing pedestrian access. Just east of this door is an observation window measuring approximately 4 feet by 1 foot. The north elevation of the main building measures approximately 108 feet long.

The steel augmenter tube measures approximately 72 feet and extends from the east elevation. It culminates in a concrete exhaust stack. The augmenter tube and exhaust stack are both approximately 16 feet tall.

The south elevation mirrors the north with a pedestrian door and observation window where the control cab would have been. The control cab was moved to another department in 2006 or 2007.

The interior is open with two overhead rolling doors, one at the east to admit the engines for testing and one at the west that opens to the augmenter tube.

<u>Application of Significance Criteria</u>:

Building 55 is not eligible under criterion A. Building 55 is 32 years old. Although one of the first two T-9 hush houses constructed for the Air Force, and possibly the first constructed for the ANG, it is no longer used as a hush house and has not for the past five years. It is a support building and does not meet the exceptional significance threshold. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flight. As a single facility, it is not representational of a particular event or period.

The building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant Air Force or ANG commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

FIGURE 5-8. BUILDING 55, LOOKING EAST

Although this is a first-generation T-9 hush house, Building 55 is not significant under criterion C. It does embody the characteristics of a particular and redundant resource type. It is not a new building type or design type, but a standard design type and only differs in shape to accommodate off-frame testing of aircraft engines. This standard design is constructed and located at numerous locations throughout U.S. military installations.

Building 55 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented. These documents are available from the Sky Harbor ANG civil engineering office. Therefore, the building does not have any further research potential.

Integrity:

The overall integrity of Building 55 is fair. The building is currently not used for its constructed purpose. It has been moved from its original location; however, T-9 and T-10 hush houses are considered equipment and are mobile.

Evaluation Conclusion:

Building 55 does not meet the exceptional significance eligibility criteria for listing in the NRHP. Building 55 should be re-evaluated when it reaches 50 years of age (2027), or as part of an installation Cold War era survey for district eligibility potential, as one of the first part-time units to be integrated in the SAC, potential exists for a historic district. It is recommended that concurrence with these findings for individual eligibility be sought from the SHPO prior to any undertakings under Section 106 of the NHPA. No further cultural resource management is recommended at this time.

Information Sources:

Air National Guard, Environmental Baseline Survey, 161st Air Refueling Wing, Arizona Air National Guard, Sky Harbor International Airport, April 2005.

5.2.9 Naval Air Station North Island, Building 1420

Installation Location: Coronado Island, San Diego, California

Hush House/Test Cell Building No.: Building 1420

Date of Construction: 1974

Aircraft: F-3 Fighter

Brief Installation History (related to hush house/test cell):

Only seven years after the Wright Brother's first flight, a Curtis airplane landed on North Island. That same year, 1910, North Island became the birthplace of naval aviation when Navy Lieutenant Theodore Ellyson transferred here to receive flight instruction from the Curtis Aviation Camp. At that time, North Island was an uninhabited sand flat. It had been used in the late 19th century for horseback riding and hunting by guests of J. D. Spreckles's resort hotel, the now famous Del Coronado.

Naval Air Station North Island was established in 1917 when Congress appropriated the land and commissioned two airfields to be constructed on it. The Navy shared North Island with the Army Signal

Corps's Rockwell Field until 1937, when the Army left and the Navy expanded its operations to cover the whole of North Island. In 1914, then-unknown aircraft builder, Glenn Martin, took off and demonstrated his pusher aircraft over the island with a flight that included the first parachute jump in the San Diego area. Other aviation milestones originating at North Island included the first seaplane flight in 1911, the first mid-air refueling, and the first nonstop transcontinental flight, both in 1923.

During WWII, North Island was the major continental U.S. base supporting the operating forces in the Pacific. In 1946, the base was renamed Naval Amphibious Base Coronado and its primary mission was changed to that of providing major administrative and logistical support to the amphibious units. The base also conducted research and tests of newly developed amphibious equipment.

Naval Air Station, North Island is part of the largest aerospace-industrial complex in the Navy. North Island itself is host to 23 squadrons and 75 additional tenant commands and activities, one of which, the Naval Aviation Depot, is the largest aerospace employer in San Diego. As jet aircraft performance increased, they became increasingly challenged by the combination of community encroachment and airspace restriction at NAS North Island. With the closure of NAS Alameda, North Island, is the only Navy airfield on the West Coast that is collocated with the piers serving its fleet carriers.

During WWII North Island was the major continental U.S. base supporting the operating forces in the Pacific. Those forces included over a dozen aircraft carriers, the U.S. Coast Guard, Army, Marines and Seabees. The city of Coronado became home to most of the aircraft factory workers and dependents of the mammoth base, which was operating around the clock.

The history of the Naval Aviation Depot (NADEP) North Island covers almost the entire lifespan of Naval aviation. The depot began as the assembly and repair department of the NAS in 1919; became a separate command known as the Naval Air Rework Facility in 1969; and changed to its current name in 1987.

This full-service, world-class depot handles maintenance engineering, logistics, and manufacturing services to the Fleet, and achieved $488 million in revenues for 1997. Although the focus is on aircraft, engines, and related component parts for aviation, the depot is increasing its support to the Navy's amphibious, surface, and submarine forces. Naval Aviation Depot North Island provides engineering, calibration, manufacturing, overhaul, and repair services, and administers engineering/airframe authority for the F/A-18 Hornet (including those flown by the Navy's Blue Angels), F-14 Tomcat, E-2C Hawkeye, C-2 Greyhound, and S-3 Viking aircraft programs. The depot also dispatches field teams to deployed ships and military installations worldwide. These teams repair structures and components of aircraft; catapult and arresting gear on aircraft carriers; and aviation equipment and facilities on most classes of ships. Among the best practices documented were Naval Aviation Depot North Island's engineering development and structural analysis training program, consolidated control centers, plastic media blasting, and F/A-18 center barrel replacement.

Description of the Hush House/Test Cell:

Building 1420 is a hush house constructed in 1974. The structure measures approximately 1,800 square feet and faces northwest. The hush house was used for testing TF-34 engines off the F-3 jet aircraft.

The structure is flat-roofed with walls of acoustical metal panels. A mobile control cab sits on the northeast side, while the augmenter tube extends from the southeast end, culminating in an exhaust stack. There are double metal doors, approximately 12 feet high, on the northwest elevation. This end of the structure also contains the intake stack, making the northwest elevation approximately 30 feet high.

The northeast elevation of the main test cell extends approximately 73 feet in length and contains an observation window angled west-east in the wall. The mobile control cab fits into this angle, allowing observation of the engine being tested. The control cab measures approximately 10 feet by 25 feet. This test cell is approximately 15 feet high. A secondary intake stack it on the southeast end of the test cell area and rises approximately 18 feet high.

The augmenter tube extends from the rear (southeast elevation) of the test cell. The augmenter is composed of steel and measures approximately 24 feet long with an 8-foot diameter. At the end of the augmenter tube is an exhaust stack, approximately 20 feet by 21 feet. The exhaust stack rises to an approximate height of 18 feet.

The interior of Building 1420 is lined with sound-suppressing material covered in steel mesh. An overhead steel hoist holds the engines during testing.

Application of Significance Criteria:

Building 1420 is not eligible under criterion A. Building 1420 is 35 years old. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flight. As a single facility, it is not representational of a particular event or period.

The building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant military commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

FIGURE 5-9. BUILDING 1420, LOOKING SOUTHWEST

Under criterion C, Building 1420 is not significant. It does embody the characteristics of a particular and redundant resource type with common, yet distinguishable, design components. This is a functional design for a test cell. Building 1420 is a single-chamber test cell; there are a number of similar cells at numerous locations throughout U.S. military installations, whether as a single cell or multiple cells joined together as at Tinker AFB.

Building 1420 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented. These documents are available from the North Island civil engineering office. Therefore, the building does not have any further research potential.

Integrity:

The overall integrity of Building 1420 is good. It retains integrity for location, design, setting, materials, workmanship, feeling, and association. Currently it is used for storage.

Evaluation Conclusion:

Building 1420 does not meet the eligibility criteria for listing in the NRHP. Building 1420 should be re-evaluated when it reaches 50 years of age (2024), or as part of an installation Cold War era survey for district eligibility potential. It is recommended that concurrence with these finding for individual eligibility be sought from the SHPO prior to any undertakings under Section 106 of the NHPA. No further cultural resource management is recommended at this time.

Information Sources:

http://www.globalsecurity.org/military/facility/north-island.htm

5.2.10 Marine Corps Air Station Camp Pendleton, Building 23118

Installation Location: Camp Pendleton, California

Hush House/Test Cell Building No.: Building 23118

Date of Construction: 1982

Aircraft: Cobra Helicopter

Brief Installation History (related to hush house/test cell):

Following the attack on Pearl Harbor and the U.S. declaration of war on Japan and Germany, the Navy acquired land for Camp Pendleton in 1942. At first, facilities at the MCAS consisted of not much more than a runway and tower/operations building. During WWII, Marine aviators trained at the station. Activity increased at Camp Pendleton following the war with the changes in defense technology. In the 1950s, helicopters began to play a critical role in transportation and Camp Pendleton's role increased accordingly.

Squadrons based at Camp Pendleton were deployed to Korea in 1950, serving on observation and Medevac missions. Technology soon developed to a point where helicopters could serve as weapons of war as well as in reconnaissance and rescue missions.

Following the end of the Korean War in 1953, alterations were made in order to develop Camp Pendleton as a helicopter base. The 1950s also saw increased U.S. military presence in Vietnam. Camp Pendleton underwent a process of expansion and modification prompted by the war in Vietnam, and the increasing use of helicopters in combat. In 1956, new aircraft—Kaman HOK-1 helicopters—arrived at the station. These new helicopters served in observation, reconnaissance, medical evacuation, and air/sea rescue operations.

By the 1960s, despite many expansions and changes since its inception, most buildings at Camp Pendleton were primarily temporary structures, including Quonset huts and storage tents. As American military presence and the role of helicopters increased in Vietnam, improvements were made at the airfield to accommodate the changes. The first permanent squadron was stationed at the airfield in the mid-1960s. Additional aircraft housed at the station led to an increase in facilities. Two hush houses were added in 1982 to test engines for the Huey, Cobra, and 46S helicopters.

As a result of continued growth, by 1985 the facility was redesignated as MCAS Camp Pendleton. This change in status from a Marine Corps Air Facility to MCAS resulted in an increase in projects and funding for new facilities to support these projects.

Description of the Hush House/Test Cell:

Building 23118 is a test cell built to test the T700 engine for the Cobra helicopter. The building was constructed in 1982 and consists of a central test cell flanked by a control room to the east and a mobile control cab to the east.

The building is poured-in-place concrete and features a flat roof. It faces south, and this main elevation features an open-walled vehicle shelter containing a mobile control cab, double metal vault-like acoustic doors, acoustic intake baffles, and a single steel door. The south elevation measure approximately 45 feet in length and approximately 14 feet in height. The roof extends approximately 10 feet west from the test cell. The double steel doors lead directly to the test cell and measure approximately 6 feet wide by 12 feet tall. The air intake acoustic baffles, built into the bumped-out section of the wall, measure 6 feet wide by 12 feet high.

The east elevation is approximately 43 feet in length with a small shed roof to cover mechanical equipment. There is an exhaust stack centered along the north elevation. The stack rises approximately 20 feet. A steel door at the northeast corner provides access to the test cell. An intake stack in centered in the building.

The west elevation features a roof extension that is open to admit a mobile control cab. The control cab measures approximately 7 feet by 15 feet and is 6.5 feet high. An observation window in the wall of the test cell allows viewing from the control cab.

Inside, Building 23118 has concrete walls punctuated with steel acoustic panels. Augmenter tubes and exhaust stacks extend into the test cells to funnel exhaust from engine testing. Inside the test cell, an intake hood suspends down from the center of the room and stack. The two exhaust tubes are positioned vertically until exiting the cell, at which point they rise horizontally in the exhaust stack.

Application of Significance Criteria:

Building 23118 is not eligible under criterion A. Building 23118 is 27 years old. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flight. As a single facility, it is not representational of a particular event or period.

The building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant military commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

Under criterion C, Building 23118 is not significant. It does differ from jet engine test cells in that it is smaller in mass and more rectangular. However, it does embody the characteristics of a particular and redundant resource type with common, yet distinguishable design components. This is a functional design for a test cell. Building 23118 is a single-chamber test cell, and there are a number of similar cells at numerous locations throughout U.S. military installations.

Building 23118 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented. These documents are available from the Camp Pendleton MCSA civil engineering office. Therefore, the building does not have any further research potential.

Integrity:

The overall integrity of Building 23118 is good. It retains integrity for location, design, setting, materials, workmanship, feeling, and association.

FIGURE 5-10. BUILDING 23118, LOOKING NORTHEAST

Evaluation Conclusion:

Building 23118 does not meet the eligibility criteria for listing in the NRHP. Building 23118 should be re-evaluated when it reaches 50 years of age (2032), or as part of an installation Cold War era survey for district eligibility potential. It is recommended that concurrence with these finding for individual eligibility be sought from the SHPO prior to any undertakings under Section 106 of the NHPA. No further cultural resource management is recommended at this time.

Information Sources:

Marine Corps Air Station Camp Pendleton, Integrated Natural Resources Management Plan, Environmental Department, MCAS Camp Pendleton, 2006.

As-built construction drawings, 1982.

5.2.11 Marine Corps Air Station Camp Pendleton, Building 23119

Installation Location: Camp Pendleton, California

Hush House/Test Cell Building No.: Building 23119

Date of Construction: 1982

Aircraft: Huey Helicopter, 46S Helicopter

Brief Installation History (related to hush house/test cell):

Following the attack on Pearl Harbor and the U.S. declaration of war on Japan and Germany, the Navy acquired land for Camp Pendleton in 1942. At first, facilities at the MCAS consisted of not much more than a runway and tower/operations building. During WWII, Marine aviators trained at the station. Activity increased at Camp Pendleton following the war with the changes in defense technology. In the 1950s, helicopters began to play a critical role in transportation and Camp Pendleton’s role increased accordingly.

Squadrons based at Camp Pendleton were deployed to Korea in 1950, serving on observation and Medevac missions. Technology soon developed to a point where helicopters could serve as weapons of war as well as in reconnaissance and rescue missions.

Following the end of the Korean War in 1953, alterations were made in order to develop Camp Pendleton as a helicopter base. The 1950s also saw increased U.S. military presence in Vietnam. Camp Pendleton underwent a process of expansion and modification prompted by the war in Vietnam and the increasing use of helicopters in combat. In 1956, new aircraft—Kaman HOK-1 helicopters—arrived at the station. These new helicopters served in observation, reconnaissance, medical evacuation, and air/sea rescue operations.

By the 1960s, despite many expansions and changes since its inception, most buildings at Camp Pendleton were primarily temporary structures, including Quonset huts and storage tents. As American military presence and the role of helicopters increased in Vietnam, improvements were made at the airfield to accommodate the changes. The first permanent squadron was stationed at the airfield in the mid-1960s. Additional aircraft housed at the station led to an increase in facilities. Two hush houses were added in 1982 to test engines for the Huey, Cobra, and 46S helicopters.

As a result of continued growth, by 1985 the facility was redesignated as MCAS Camp Pendleton. This change in status from a Marine Corps Air Facility to an MCAS resulted in an increase in projects and funding for new facilities to support these projects.

Description of the Hush House/Test Cell:

Building 23119 is a test cell used to test the T-400 engine for the Huey helicopter and the T-58 for the 46S helicopter. It was constructed in 1982 and consists of a central control room flanked by two test chambers with a mobile control cab along the west elevation. The building faces south and comprises approximately 3,200 square feet.

Building 23119 has walls of cast-in-place concrete and rests on a concrete foundation. The structure features a flat roof.

The main (south) elevation consists of an open-walled vehicle shelter on the west for a mobile control cab followed by two test cells separated by a control room to the east. The elevation measures approximately 58 feet in length. The western portion of the south elevation rises approximately 13 feet, although the roof slopes to 11 feet at the open control cab shelter. Double acoustic vault-like metal doors lead to the westernmost test cell. Acoustic baffles built into the elevation measuring 9 feet across and over 7 feet deep act as air intake for this test cell. A single metal door provides pedestrian access to the central control room. Movable air intake acoustic baffles mark the entrance to the second test cell. The acoustic baffles are incorporated into a massive door measuring approximately 23 feet long, 7 feet deep, and 20 feet high. The east edge of the door and the building wall angles out forming a buttress. The door slides on rails to the east.

The east elevation contains this second test cell, the larger of the two. A pedestrian door provides access to the mechanical equipment controlling the acoustic intake door. Double steel vault-like doors lead to the test cell itself. North of these doors is a steel augmenter tube directed east to an exhaust stack. A metal door on the east elevation accesses the exhaust stack. Together, the augmenter and exhaust stack extend approximately 27 feet from the east elevation.

The north elevation features acoustic baffles incorporated into the wall that funnel exhaust from the larger test cell and a canted buttress wall on the east end. A concrete exhaust stack is centered in the acoustic baffled wall and protrudes approximately 7 feet from it. This exhaust stack rises approximately 27 feet. Three steel doors provide access to the control room, an office, and electrical equipment room, respectively. The office and equipment room back onto the smaller test cell. A concrete exhaust stack behind the office and at the north end of the test cell rises approximately 19 feet.

The west elevation features a roof extension that is open to admit a mobile control cab. The elevation measures approximately 50 feet in length. The roof extends approximately 18 feet west from the smaller test cell chamber.

Inside, Building 23119 has concrete walls punctuated with steel acoustic panels. Augmenter tubes and exhaust stacks extend into the test cells to funnel engine-testing exhaust.

Application of Significance Criteria:

Building 23119 is not eligible under criterion A. Building 23119 is 27 years old. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flight. As a single facility, it is not representational of a particular event or period.

The building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant military commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

Under criterion C, Building 23119 is not significant. It does differ from jet engine test cells in that it is smaller in mass and more rectangular. However, it does embody the characteristics of a particular and redundant resource type with common, yet distinguishable, design components. This is a functional design for a test cell. Building 23119 is a single-chamber test cell, and there are a number of similar cells at numerous locations throughout the United States.

Building 23119 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented. These documents are available from the Camp Pendleton MCSA civil engineering office. Therefore, the building does not have any further research potential.

Integrity:

The overall integrity of Building 23119 is good. It retains integrity for location, design, setting, materials, workmanship, feeling, and association.

FIGURE 5-11. BUILDING 23119, LOOKING NORTHWEST

Evaluation Conclusion:

Building 23119 does not meet the eligibility criteria for listing in the NRHP. Building 23119 should be re-evaluated when it reaches 50 years of age (2032), or as part of an installation Cold War era survey for district eligibility potential. It is recommended that concurrence with these finding for individual eligibility be sought from the SHPO prior to any undertakings under Section 106 of the NHPA. No further cultural resource management is recommended at this time.

Information Sources:

Marine Corps Air Station Camp Pendleton, Integrated Natural Resources Management Plan, Environmental Department, MCAS Camp Pendleton, 2006.

As built construction drawings, 1982.

5.2.12 Naval Air Station Oceana, Building 1116

Installation Location: Virginia Beach, Virginia

Hush House/Test Cell Building No.: Building 1116

Date of Construction: 1999

Aircraft: F-14 Tomcat Fighter

Brief Installation History (related to hush house/test cell):

During WWI, the U.S. Navy dramatically expanded the naval aviation program, constructing and expanding many naval air stations throughout the country. It was not until the U.S. entered WWII, however, that the Navy established a naval air field at Oceana, Virginia. Construction of runways, barracks, and facilities increased at Oceana throughout the war. Despite military cutbacks, Oceana continued to grow in its new capacity as a master jet air station. Construction of the master jet base began in 1950, with the extension and construction of two runways at Oceana and purchasing adjacent land on which to construct the station.

Oceana continued to develop throughout the Cold War. In 1952, Oceana's designation was changed to NAS Oceana and the air station was relocated to the south side of the current airfield. The following year brought more construction projects to Oceana, this time in the form of a hangar, administrative building, jet refueling pits, and support facilities. Building construction and land acquisition continued into the late 1950s.

In the 1960s the Navy instituted a base-loading program under which Oceana became the home base for the F-4 Wildcat and the A-6 Intruder. Two hush houses were constructed in 1971, around the time Oceana transitioned from the A-6A Intruder to the F-14 Tomcat.

Description of the Hush House/Test Cell:

Building 1116 is a T-9 style hush house constructed in 1999 to test the T-14 Tomcat. It rests on 78 pilings and a 3-foot-thick concrete foundation due to the swampy nature of the site. The building faces northeast and comprises approximately 6,600 square feet, including augmenter tube and exhaust stack.

Massive electric-powered sliding doors occupy the entire northeast elevation. The air intake vents are incorporated into the doors for the hush house, which accounts for their width of approximately 5 feet (electrical equipment takes up an additional 7 feet at the bottom of the doors). The Tomcat aircraft ran very hot with intake winds reaching 60 miles per hour during testing. This elevation measures approximately 40 feet in length and rises approximately 30 feet at the apex of the gable. The air intake doors, however, stand approximately 40 feet tall. The doors move on external rails.

The southeast elevation of the main building extends approximately 75 feet and contains a single steel door and an observation window. The main building features walls of prefabricated steel. The augmenter tube, which extends 90 feet southwest from the main building, is made of perforated stainless steel. It has a diameter of approximately 24 feet and rises approximately 18 feet. The augmenter culminates in a concrete exhaust stack that measures approximately 25 feet by 28 feet.

The northwest elevation contains auxiliary buildings including a mechanical room and an observation room. A window allows those in the observation room views of the aircraft being tested. These auxiliary buildings measure approximately 54 feet in length and protrude approximately 20 feet from the main structure.

Inside, Building 1116 is lined with sound-suppressing pillows containing wool, fiberglass insulation, stainless steel mesh, fiberglass bags, and another layer of stainless steel mesh. Each layer contains smaller holes than the last, reducing vibration and therefore noise.

This hush house is the same as one constructed at Fort Worth NAS.

Application of Significance Criteria:

Building 1116 is not eligible under criterion A. Building 1116 is 10 years old. It is a support building and does not meet the exceptional significance threshold. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flight. It is not representational of a particular event or period.

The building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant military commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

Although this is a new generation design for the T-9 hush house, Building 1116 is not significant under criterion C. It does embody the characteristics of a particular and redundant resource type. This is a standard design for a hush house used for on- and off-frame testing of aircraft engines at numerous locations throughout U.S. military installations.

Building 1116 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented. These documents are available from the Sky Harbor ANG civil engineering office. Therefore, the building does not have any further research potential.

Integrity:

The overall integrity of Building 1116 is very good.

Evaluation Conclusion:

Building 1116 does not meet the exceptional significance eligibility criteria for listing in the NRHP. Building 1116 should be re-evaluated when it reaches 50 years of age (2049). No further cultural resource management is recommended at this time.

FIGURE 5-12. BUILDING 1116, LOOKING WEST

Information Sources:

Laurence Collier, Navy contractor, manages hush house operations.

5.2.13 Naval Air Station Oceana, Building 1100

Installation Location: Virginia Beach, Virginia

Hush House/Test Cell Building No.: Building 1100

Date of Construction: 1971

Aircraft: F-14 Tomcat

Brief Installation History (related to hush house/test cell):

During WWI, the U.S. Navy dramatically expanded the naval aviation program, constructing and expanding many naval air stations throughout the country. It was not until the U.S. entered WWII, however, that the Navy established a naval air field at Oceana, Virginia. Construction of runways, barracks, and facilities increased at Oceana throughout the war. Despite military cutbacks after the war, Oceana continued to grow in its new capacity as a master jet air station. Construction of the master jet base began in 1950 with the extension and construction of two runways at Oceana and the purchase of adjacent land on which to construct the station.

Oceana continued to develop throughout the Cold War. In 1952, Oceana's designation was changed to Naval Air Station Oceana and the air station was relocated to the south side of the current airfield. The following year brought more construction projects to Oceana, this time in the form of a hangar, administrative building, jet refueling pits, and support facilities. Building construction and land acquisition continued into the late 1950s.

In the 1960s the Navy instituted a base-loading program under which Oceana became the home base for the F-4 Wildcat and the A-6 Intruder. Two hush houses were constructed in 1971, around the time Oceana transitioned from the A-6A Intruder to the F-14 Tomcat.

Description of the Hush House/Test Cell:

Building 1100 is an engine test cell constructed in 1971 and altered in 1979, 1985, 1988, and 1993. The building consists of a main engine testing chamber adjacent to fuel filter, control, and pump rooms. An augmenter tube and exhaust stack extend from the rear of the testing chamber room. When the test cell was changed from water cooled to air cooled around 1988, the exhaust system was replaced, the augmenter tube encased in a square tube, and a new exhaust stack constructed.

There are two intake stacks in the roof of the massive test chamber. The first is approximately in the center of the test chamber, and the second is located to the rear, just in front of the augmenter tube.

The structure measures approximately 2,500 square feet and rests on a concrete foundation. Building 1100 has concrete walls and a flat roof. The main entrance, with massive sound-retardant double steel doors (each 6 feet wide and 12 feet tall) that lead to the engine test room, faces northwest. Along the northeast side of the engine room are the fuel filter room, restroom, control room, and the pump room. Exterior steel doors lead into each of these four rooms. The rooms protrude 15 feet northeast from the engine room and extend 42 feet beside it. Along the northeast side of the engine room, southeast of the auxiliary rooms, is an observation window.

A steel augmenter tube, approximately 80 feet long and 7 feet 8 inches in diameter within a concrete housing 18 feet high and 21 feet wide, extends from the southeast end of the main building. The augmenter culminates in a poured-concrete exhaust stack rising approximately 40 feet. The exhaust stack measures approximately 23 feet by 20 feet.

Three steel ladders are mounted on the southwest elevation, accessing the intake stack, the secondary intake stack, and the exhaust stack. Inside Building 1100 an overhead steel hoist holds the engines for testing.

Application of Significance Criteria:

Building 1100 is not eligible under criterion A. Building 1100 is 38 years old. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flight. It is not representational of a particular event or period.

The building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant military commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

Under criterion C, Building 1100 is not significant. It does embody the characteristics of a particular and redundant resource type with common, yet distinguishable, design components. This is a functional design for a test cell. Building 1100 is a single test cell; there are a number of similar cells at numerous locations throughout U.S. military installations, whether as a single cell or multiple cells joined together as at Tinker AFB.

Building 1100 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented. These documents are available from the Oceana civil engineering office. Therefore, the building does not have any further research potential.

FIGURE 5-13. BUILDING 1100, LOOKING SOUTHEAST

<u>Integrity</u>:

The overall integrity of Building 1100 is good. It retains integrity for location, design, setting, materials, workmanship, feeling, and association. It has undergone modification to exhaust system, changing from water- to air-cooled, and reconstruction of the exhaust stacks. It is still in use.

<u>Evaluation Conclusion</u>:

Building 1100 does not meet the eligibility criteria for listing in the NRHP. Building 1100 should be re-evaluated when it reaches 50 years of age (2021), or as part of an installation Cold War era survey for district eligibility potential. It is recommended that concurrence with these finding for individual eligibility be sought from the SHPO prior to any undertakings under Section 106 of the NHPA. No further cultural resource management is recommended at this time.

Information Sources:

Oceana History provided by Oceana staff, date and author unknown.

As built construction drawing 1971.

5.2.14 Naval Air Station Oceana, Building 1102

Installation Location: Virginia Beach, Virginia

Hush House/Test Cell Building No.: Building 1102

Date of Construction: 1972

Aircraft: F-14 Tomcat Fighter

Brief Installation History (related to hush house/test cell):

During WWI, the U.S. Navy dramatically expanded the naval aviation program, constructing and expanding many naval air stations throughout the country. It was not until the U.S. entered WWII, however, that the Navy established a naval air field at Oceana, Virginia. Construction of runways, barracks, and facilities increased at Oceana throughout the war. Despite military cutbacks after the war, Oceana continued to grow in its new capacity as a master jet air station. Construction of the master jet base began in 1950 with the extension and construction of two runways at Oceana and the purchase of adjacent land on which to construct the station.

Oceana continued to develop throughout the Cold War. In 1952, Oceana's designation was changed to Naval Air Station Oceana and the air station was relocated to the south side of the current airfield. The following year brought more construction projects to Oceana, this time in the form of a hangar, administrative building, jet refueling pits, and support facilities. Building construction and land acquisition continued into the late 1950s.

In the 1960s the Navy instituted a base-loading program under which Oceana became the home base for the F-4 Wildcat and the A-6 Intruder. Two test cells were constructed in 1971, around the time Oceana transitioned from the A-6A Intruder to the F-14 Tomcat.

Description of the Hush House/Test Cell:

Building 1102 is an engine test cell constructed in 1972 and altered between 1979, 1988, and 1993—it is almost identical to Building 1100. The building consists of a main engine testing chamber adjacent to fuel filter, control, and pump rooms. An augmenter tube and exhaust stack extend from the rear of the testing chamber room. The augmenter is in a cylindrical tube outside the main structure. There are two intake stacks in the roof of the massive test chamber. The first is approximately in the center of the test chamber, and the second is to the rear of the test chamber, just in front of the augmenter tube.

The structure measures approximately 2,500 square feet and rests on a concrete foundation. Building 1102 has walls of poured concrete and a flat roof. At the main entrance are massive sound-retardant double steel doors (each 6 feet wide and 12 feet tall) that lead to the engine test room, which faces northwest. Along the northeast side of the engine room are the fuel filter room, restroom, control room, and the pump room. Exterior steel doors lead into each of these four rooms. The rooms protrude 15 feet northeast from the engine room and extend 42 feet beside it. Along the northeast side of the engine room, southeast of the auxiliary rooms, is an observation window.

A steel augmenter tube, approximately 80 feet long and 7 feet 8 inches in diameter within a concrete housing 18 feet high and 21 feet wide, extends from the southeast end of the main building. The augmenter culminates in a poured-concrete exhaust stack rising approximately 40 feet. The exhaust stack measures approximately 25 feet square.

Steel ladders are mounted on the southwest elevation, accessing the intake stack, the secondary intake stack, and the exhaust stack. Inside Building 1102 an overhead steel hoist holds the engines for testing.

Application of Significance Criteria:

Building 1102 is not eligible under criterion A. Building 1102 is 38 years old. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flight. It is not representational of a particular event or period.

The building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant military commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

Under criterion C, Building 1102 is not significant. It does embody the characteristics of a particular and redundant resource type with common, yet distinguishable, design components. This is a functional design for a test cell. Building 1102 is a single test cell; there are a number of similar cells at numerous locations throughout U.S. military installations, whether as a single cell or multiple cells joined together as at Tinker AFB.

Building 1102 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented. These documents are available from the Oceana civil engineering office. Therefore, the building does not have any further research potential.

Integrity:

The overall integrity of Building 1102 is good. It retains integrity for location, setting, materials, workmanship, feeling, and association. The exhaust system has undergone modification, changing from water- to air-cooled, and reconstruction of the exhaust stacks. It is still in use.

Evaluation Conclusion:

Building 1102 does not meet the eligibility criteria for listing in the NRHP. Building 1102 should be re-evaluated when it reaches 50 years of age (2021), or as part of an installation Cold War era survey for district eligibility potential. It is recommended that concurrence with these finding for individual eligibility be sought from the SHPO prior to any undertakings under Section 106 of the NHPA. No further cultural resource management is recommended at this time.

Information Sources:

Oceana history provided by Oceana staff; date and author unknown.

As built construction drawing 1971.

FIGURE 5-14. BUILDINGS 1104 (LEFT), 1102 (CENTER), AND 1100 (RIGHT), LOOKING NORTHWEST

5.2.15 Installation: Oceana, Building 1104

Installation Location: Virginia Beach, Virginia

Hush House/Test Cell Building No.: Building 1104

Date of Construction: 1986

Aircraft: F-14 Tomcat Fighter

Brief Installation History (related to hush house/test cell):

During WWI, the U.S. Navy dramatically expanded the naval aviation program, constructing and expanding many naval air stations throughout the country. It was not until the U.S. entered WWII, however, that the Navy established a naval air field at Oceana, Virginia. Construction of runways, barracks, and facilities increased at Oceana throughout the war. Despite military cutbacks after the war, Oceana continued to grow in its new capacity as a master jet air station. Construction of the master jet base began in 1950 with the extension and construction of two runways at Oceana and the purchase of adjacent land on which to construct the station.

Oceana continued to develop throughout the Cold War. In 1952, Oceana's designation was changed to Naval Air Station Oceana and the air station was relocated to the south side of the current airfield. The following year brought more construction projects to Oceana, this time in the form of a hangar, administrative building, jet refueling pits, and support facilities. Building construction and land acquisition continued into the late 1950s.

In the 1960s the Navy instituted a base-loading program under which Oceana became the home base for the F-4 Wildcat and the A-6 Intruder. Two hush houses were constructed in 1971, around the time Oceana transitioned from the A-6A Intruder to the F-14 Tomcat.

Description of the Hush House/Test Cell:

Building 1104 is a test cell constructed in 1986. The building consists of a main engine testing chamber flanked by auxiliary rooms, an augmenter tube, and exhaust stack. The structure comprises approximately 2, 620 square feet and rests on a concrete foundation. It is similar in design to buildings 1100 and 1102; however, the front intake stack is narrower and the exhaust stack shorter.

At the main entrance are massive sound-retardant, double steel doors (each approximately 6 feet wide and 16 feet tall) that lead to the engine test room, which faces northwest. The northwest elevation also contains the main air intake stack, which rises approximately 31 feet. Along the northeast side of the main building are the control room, mechanical room, fuel room, and fire pump room. Exterior steel doors offer access to each of these four rooms. The rooms protrude 22 feet northeast from the engine room and extend 74 feet beside it. The walls of Building 1104 are prefabricated steel, although the walls of the auxiliary rooms are concrete block.

A secondary intake stack marks the southeast end of the main building and rises approximately 48 feet. A steel augmenter tube, approximately 78 feet long and 15 feet high with a diameter of 20 feet, extends from the southeast end of the main building. The augmenter culminates in a poured-concrete exhaust stack rising approximately 17 feet. The exhaust stack measures approximately 23 feet by 23 feet.

The interior of Building 1104 is composed of sound-suppressing fiberglass covered with steel mesh.

Application of Significance Criteria:

Building 1104 is not eligible under criterion A. Building 1104 is 23 years old. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flight. It is not representational of a particular event or period.

The building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant military commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

Under criterion C, Building 1104 is not significant. It does embody the characteristics of a particular and redundant resource type with common, yet distinguishable, design components. This is a functional design for a test cell. Building 1104 is a single test cell; there are a number of similar cells at numerous locations throughout U.S. military installations, whether as a single cell or multiple cells joined together as at Tinker AFB.

Building 1104 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented. These documents are available from the Oceana civil engineering office. Therefore, the building does not have any further research potential.

<u>Integrity</u>:

The overall integrity of Building 1104 is good. It retains integrity for location, setting, materials, workmanship, feeling, and association. It is still in use.

FIGURE 5-15. BUILDING 1104, LOOKING NORTH

<u>Evaluation Conclusion</u>:

Building 1104 does not meet the eligibility criteria for listing in the NRHP. Building 1104 should be re-evaluated when it reaches 50 years of age (2036), or as part of an installation Cold War era survey for district eligibility potential. It is recommended that concurrence with these finding for individual eligibility be sought from the SHPO prior to any undertakings under Section 106 of the NHPA. No further cultural resource management is recommended at this time.

<u>Information Sources</u>:

Oceana history provided by Oceana staff, date and author unknown.

As built construction drawing 1989.

5.2.16 Naval Air Station Miramar, Buildings 8128 and 8129

Installation Location: San Diego, California

Test Stand No.: Buildings 8128 and 8129

Date of Construction: 1997

Aircraft: H-46 and H-53 Helicopter Engines

<u>Brief Installation History (related to hush house/test cell)</u>:

MCAS Miramar started out as Camp Kearney (later Camp Kearny), an Army National Guard training center, in 1918 in response to U.S. military involvement in WWI. Camp Kearny served in many different capacities following WWI, including a convalescent center, a dirigible station, and a secondary airfield to support Naval Air Station North Island. Following the attack on Pearl Harbor in December 1941, the importance of a strong Naval presence in the Pacific became clear. In this year, the southern portion of Camp Kearny was established as a Naval auxiliary air, while the northern portion became Marine Air Corps Depot, Miramar, acting as an air supply depot and staging area for crews of combat aircraft.

American air power underwent major reorganization following WWII. The Miramar-Camp Kearny facility were discontinued as organizational entities and combined into MCAS Miramar in 1946. The next year, MCAS Miramar was transferred from Marine to Navy control and became NAAS Miramar. The Navy provided operational support for a medium-sized land patrol squadron, among other duties. In 1948, two hangars were moved to the station from North Island in order to house Helicopter Squadron One.

The 1950s ushered in the jet age across the U.S. armed forces. Miramar was converted to a Master Jet Station, becoming U.S. NAS Miramar in 1952. This initiated an ambitious construction program at Miramar, including a maintenance hangar, facilities to support flightline operations, enlisted quarters, and warehouses. During this Cold War period, NAS Miramar provided support operations to fleet carrier and reconnaissance aircraft and to support a guided missile program. The station continued intensive construction programs through the late 1950s and into the early part of the next decade to support Naval air operations.

Although activity at Miramar slowed in the 1960s, the Vietnam War brought expansion at the station, which played a key role in Pacific Fleet aviation support. In 1967, Miramar was home to 21 fighter squadrons, 4 attack carrier wings, and a readiness attack carrier wing. Miramar also housed an intensive fighter pilot training program known as Top Gun (immortalized in the 1985 movie of the same name). Several hush houses were built between 1974 and 1978 to test F-18 aircraft engines.

The Top Gun program continued at Miramar even as the Vietnam War drew to a close. By 1985, Miramar supported 18 squadrons of F-14 and E-2 aircraft and provided pilot training and aircraft maintenance training.

In the late 1980s and 1990s, several helicopter testing structures were constructed to test the H-46 and H-53 helicopter engines.

Miramar functioned as a NAS into the 1990s, until a decision was made in 1993 by BRAC to close the facility. However, the U.S. Marine Corps decided to convert the station to a MCAS, and Miramar was officially opened as a Marine facility in October 1997.

<u>Description of the Hush House/Test Cell</u>:

Buildings 8128 and 8129 are mobile helicopter test stands built in 1997. Each consists of four sound-proof walls resting on a concrete pad. There is no roof. Instead, the walls contain massive sliding doors that open to admit mobile control cabs with the helicopter engines and rolling exhaust stacks.

The walls are reinforced steel panels and measure approximately 82 feet along the east and the main west elevation and 78 feet along the north and south elevations. A pedestrian door is built into the sliding steel door along the west elevation. The sliding door measures approximately 23 feet. The walls rise approximately 13 feet.

The mobile control cab measures approximately 10 feet by 20 feet and is approximately 10 feet high.

<u>Application of Significance Criteria</u>:

Buildings 8128–8129 are not eligible under criterion A. These structures are 12 years old and function as support structures. They do not meet the exceptional significance threshold. Their primary function is to buffer noise to the environment during engine testing after maintenance and prior to test flight. As a stand-alone facility, they are not representational of a particular event or period.

The structure is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant military commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

FIGURE 5-16. BUILDING 8128–8129, INTERIOR WITH MOBILE CONTROL CAB AND ROLLING EXHAUST STACKS

Buildings 8128–8129 are not significant under criterion C. It is a simple steel enclosure and does not embody distinctive characteristics of a type, period, or method of construction or represent a significant and distinguishable entity whose components may lack individual distinction.

Buildings 8128–8129 are not significant under criterion D. The research potential is contained entirely in its design. Its original design is well documented. These documents are available from the Miramar NAS civil engineering office. Therefore, the building does not have any further research potential.

Integrity:

The overall integrity of Buildings 8128–8129 is good.

Evaluation Conclusion:

Buildings 8128–8129 do not meet the exceptional significance eligibility criteria for listing in the NRHP. The building should be re-evaluated when it reaches 50 years of age (2047). No further cultural resource management is recommended at this time.

Information Sources:

MCAS Miramar, Class 2 Property Record, May 2009.

http://www.globalsecurity.org/military/facility/miramar.htm

5.2.17 Naval Air Station Miramar, Building 8117

Installation Location: San Diego, California

Hush House/Test Cell Building No.: Buildings 8117

Date of Construction: 1998

Aircraft: CH-46E Sea Knight and CH-53E Super Stallion Helicopters

Brief Installation History (related to hush house/test cell):

MCAS Miramar started out as Camp Kearney (later Camp Kearny), an Army National Guard training center, in 1918 in response to U.S. military involvement in WWI. Camp Kearny served in many different capacities following WWI, including a convalescent center, a dirigible station, and a secondary airfield to support NAS North Island. Following the attack on Pearl Harbor in December 1941, the importance of a strong Naval presence in the Pacific became clear. In this year, the southern portion of Camp Kearny was established as a Naval auxiliary airfield, while the northern portion became Marine Air Corps Depot, Miramar, acting as an air supply depot and staging area for crews of combat aircraft.

American air power underwent major reorganization following WWII. The Miramar-Camp Kearny facilities were discontinued as organizational entities and combined into MCAS Miramar in 1946. The next year, MCAS Miramar was transferred from Marine to Navy control and became NAAS Miramar. The Navy provided operational support for a medium-sized land patrol squadron, among other duties. In 1948, two hangars were moved to the station from North Island to house Helicopter Squadron One.

The 1950s ushered in the jet age throughout the U.S. military. Miramar was converted to a Master Jet Station, becoming U.S. NAS Miramar in 1952. This initiated an ambitious construction program at Miramar, including a maintenance hangar, facilities to support flightline operations, enlisted quarters, and warehouses. During this Cold War period, NAS Miramar provided support operations to fleet carrier and reconnaissance aircraft and to support a guided missile program. The station continued intensive construction programs through the late 1950s and into the early part of the next decade to support Naval air operations.

Although activity at Miramar slowed in the 1960s, the Vietnam War brought expansion, with the station playing a key role in Pacific Fleet aviation support. In 1967, Miramar was home to 21 fighter squadrons, 4 attack carrier wings, and a readiness attack carrier wing. Miramar also housed an intensive fighter pilot training program known as Top Gun (immortalized in the 1985 movie of the same name). Several hush houses were built between 1974 and 1978 to test F-18 aircraft engines.

The Top Gun program continued at Miramar, even as the Vietnam War drew to a close. By 1985, Miramar supported 18 squadrons of F-14 and E-2 aircraft and provided pilot training and aircraft maintenance training.

In the late 1980s and 1990s, several helicopter testing structures were constructed to test the H-46 and H-53 helicopter engines, and another hush house was added in 1988.

Miramar functioned as a NAS into the 1990s, until a decision was made in 1993 by BRAC to close the facility. However, the U.S. Marine Corps decided to convert the station to a MCAS—Miramar was officially opened as a Marine facility in October 1997.

Description of the Hush House/Test Cell:

Building 8117 is a helicopter hush house constructed in 1998. The building consists of two test cells, one on either side of a central control room. Two rooms used for storage and mechanical equipment about the control room. The building rests on a concrete pad.

The building faces west and stands approximately 11 high, with the exhaust and intake stacks rising above the main facility. The central control, mechanical, and storage rooms are composed of concrete block. Each room is accessed from an external steel door. The door to the control room is centered in the west elevation. To the north of the central control room is the larger of the two test chambers, measuring approximately 23 feet by 36 feet. Thick steel double doors at the northwest corner offer access to the test cell. The west elevation of this test cell rises to approximately 24 feet as it includes the intake stack, which has steel mesh at the top along the east and west sides to admit air flow.

The larger test cell is on the north side. At the west end is a single steel door. The walls are paneled steel. The augmenter tube and exhaust stack extend approximately 27 feet from the east elevation. Thick double steel doors at the northeast corner mirror those on the west elevation and admit helicopter engines to the test cell. Storage and mechanical rooms occupy the center of the east side of the building, measuring approximately 27 feet in length and projecting approximately 18 feet east from the central control room.

Another set of thick steel doors at the south end of the east elevation admit access to the smaller test chamber. The augmenter tube and exhaust stack for this test cell penetrate the south elevation by approximately 28 feet. The augmenter tube is steel and approximately 4 feet in diameter. The exhaust stack measures approximately 11 feet square, made of corrugated steel, and rises approximately 15 feet high. A single steel door sits in the southwest corner. The west elevation of this smaller test cell rises to a height of approximately 20 feet with an exhaust stack centered in the test cell rising another 10 feet.

The interior of the test chambers contain fiberglass soundproofing material covered in steel mesh. There are two vents on each test cell: one provides air intake (horizontally from above) and the other funnels exhaust vertically. The control room is trapezoidal-shaped and allows observation into each test chamber.

Application of Significance Criteria:

Building 8117 is not eligible under criterion A. Building 8117 is 11 years old. It is a support building and does not meet the exceptional significance threshold. Its primary function was to suppress noise to the environment during aircraft engine testing after maintenance and prior to test flight. As a single facility, it is not representational of a particular event or period.

The building is not associated with persons significant in history so it does not appear significant under NRHP evaluation criterion B. No significant military commanders, officers, enlisted men, celebrities, politicians, or private individuals were associated with this structure.

Building 8117 is not significant under criterion C. It does embody the characteristics of a particular and redundant resource type with common, yet distinguishable, design components. This is a functional design for a test cell. Building 8117 is a dual chamber test cell; there are a number of similar cells in Navy and Marine installations around the country.

FIGURE 5-17. BUILDING 8117

Building 8679 is not significant under criterion D. The building's research potential is contained entirely in its design. Its original design is well documented. These documents are available from the Miramar NAS civil engineering office. Therefore, the building does not have any further research potential.

Integrity:

The integrity of Building 8117 is very good.

Evaluation Conclusion:

Building 8117 does not meet the exceptional significance eligibility criteria for listing in the NRHP. Building 8117 should be re-evaluated when it reaches 50 years of age (2048). No further cultural resource management is recommended at this time.

Information Sources:

MCAS Miramar, Class 2 Property Record, May 2009.

http://www.globalsecurity.org/military/facility/miramar.htm

5.3 PREVIOUSLY EVALUATED TEST CELLS AND HUSH HOUSES

These test cells and hush houses were previously evaluated.

5.3.1 Bangor Air National Guard Base, Building 500

Hush House/Test Cell Building No.: Building 500

Date of Construction: 1987

Aircraft: KC-35R

Brief Installation History (related to hush house/test cell):

Bangor Air National Guard Base (ANGB), Maine, received a new T-9 test cell in late 1987 to replace an earlier T-20 test cell that could not accommodate many new engines including the CFM5 used in the KC-35R; the T-20 also offered no noise suppression (Bangor ANGB 1987).

Building 500 was constructed in 1987 as a T-9 suppressor test cell to support the Maine ANG air refueling mission at Bangor ANGB. The building is west of the 1955 hangar complex and currently is categorized as a power check pad (figure 5-18) (ME ANG Real Property Records).

Description of the Hush House/Test Cell:

Building 500 is a two-story, front-gable, metal-frame building. The walls and roof are clad with prefabricated metal. A metal overhead door is located on the north elevation under the overhanging roof. The east elevation features a one-story, shed-roof shelter. A large metal tube is attached to the south end of the building (Goodwin 2008).

A T-9 suppressor test cell is designed to control the noise and exhaust produced by a jet engine undergoing performance and safety testing in a fully enclosed, air-cooled environment. The testing process regulates temperature and air pressure to simulate numerous operating conditions such as extreme temperatures, possible foreign object damage, and various vibratory and thrust loads. The test cell comprises three sections—one for air intake, another for engine testing, and a third for exhaust emission. The facility is designed to be disassembled and relocated. From 2004 to 2007, Vital Link, Inc., Houston, Texas, provided repair and overhaul services for U.S. Air Force T-9 suppressor test cells in the continental U.S. and overseas, including the facility at Bangor ANGB. Vital Link, Inc., workers have fabricated and installed T-9 suppressor test cells since 1979 and likely constructed Building 500 at Bangor ANGB (Goodwin 2008).

Application of Significance Criteria:

Building 500 was evaluated in 2007 to 2008 by R. Christopher Goodwin & Associates, Inc., of Frederick, Maryland (2008.) R. Christopher Goodwin & Associates cultural resources specialists determined that Building 500 presently does not have national exceptional importance under the Cold War context and does not appear to have the degree of significance necessary for NRHP eligibility. The test cell is a specialized jet engine testing facility constructed at numerous U.S. Air Force and ANG establishments throughout the nation.

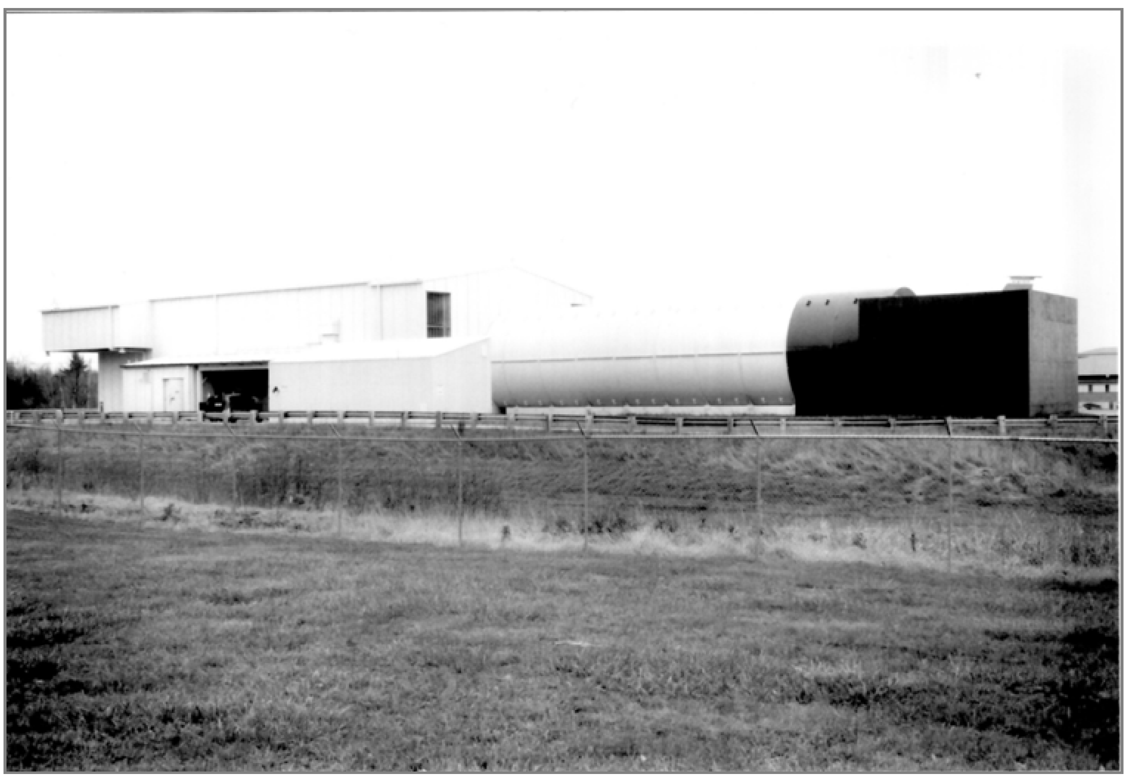

FIGURE 5-18. BANGOR ANGB, BUILDING 500 T-9

5.3.2 Hawaii ARNG (formerly Barber's Point Naval Air Station), Building 175

Installation Location: Kalaeloa, Hawaii

Hush House/Test Cell Building No.: Building 175

Date of Construction: 1960

Aircraft: for which it was originally built Unknown

Construction of NAS Barber's Point was begun in November 1941. It was initially constructed to support the NAS at Ford Island in Pearl Harbor, but at the outset of WWII became home to four carrier groups. At this time housing for 5,650 personnel was built and the NAS Barber's Point mission was expanded to include aircraft repair. For this mission, Building 117, the large repair and maintenance hangar, was built to repair carrier-based aircraft.

Following WWII, NAS Barber's Point entered the Cold War as the main Pacific NAS. Its missions included antisubmarine air patrols, headquarters for Fleet Air Hawaii, all-weather training, logistics, and fleet air service. In July 1958, the NAS became headquarters for the Pacific Airborne Command, which ran Pacific Barrier Force mission operations as part of the Distant Early Warning (DEW) Line. At NAS Barber's Point, this mission ended in 1965. In 1968, NAS Barber's Point was incorporated into the VQ-3 mission in which they provided aircraft that sustained communications with U.S. submarines following the Pacific Barrier mission. This mission was abolished following the end of the Cold War in 1989.

The Barrier Force mission was developed to detect threatening or attacking Soviet bombers or missiles. It consisted of the DEW Line radar system, which was employed at a distance from the east and west coasts of the United States. The surface radar picket line was supplemented by aircraft that had radar capabilities to fill in any gaps from surface stations. Planning for the airborne early warning program was in the early stages in 1953 when the Navy had one airborne early warning squadron, VW-1, stationed at NAS Barber's Point. This squadron primarily served as a training crew for VW-2 and later WV-1 and WV-2 crews. VW-1 participated in early testing of the Pacific Barrier in 1956 and 1957 and then transferred to Guam when other VW squadrons arrived in 1958. Commander Airborne Early Warning Command Pacific was established in January 1956. Over the next 11 months VW-12, VW-14, and VW-16 were brought online, and in 1961 VW-12 and 14 were merged to form Airborne Early Warning Barrier Squadron Pacific, which patrolled the barrier through 1965 (Bouchard 1999).

Officially, the Pacific Barrier mission began July 18, 1958. VW-16 had been decommissioned in 1957 and distributed to VW-12 and VW-14. Four or five WV-2s were in the skies on patrol at all times. Their missions began at NAS Barber's Point, they would then refuel at Midway Island, and commence their barrier patrols.

From 1961, Airborne Early Warning Barrier Squadron Pacific maintained a forward detachment on Midway Island, close to the southern end of the barrier (Bouchard 1999). The first Pacific Barrier aircraft to fly this mission were stationed at NAS Barber's Point and flew continuous rotations of 12- to 14-hour missions. The flying units were supported by AewBarsRon-2 and MatRon-1 (ground crew support units) (Armistead 2002).

The Barrier Force mission was discontinued in September 1965 and the aircraft that had been used for the Pacific Barrier mission were put in storage or transferred to other Navy units or to the U.S. Air Force. The facilities previously used for the Pacific Barrier mission were likely put to use for the VQ-3 mission that followed and carried on throughout the Cold War.

NAS Barber's Point was eventually closed in 1999 at the recommendation of the BRAC. At this time the Hawaii ARNG took over 147 acres of the former NAS including Building 117, the large aircraft repair shop, and Building 282, which is the hangar used by the Pacific Barrier aircraft and probably by VQ-3 aircraft as well (HIARNG 2008).

Description of the Hush House/Test Cell:

Building 175 is a reinforced concrete building built in 1960 and used as a jet engine test cell. At a later date (what appears to be 1964 on the nearly illegible renovation plans) the building was renovated, possibly to accommodate testing newer or different jet engines. A test cell is an indoor engine testing facility designed specifically for out-of-frame testing of aircraft engines (versus a hush house that is designed for aircraft to be pulled inside and their engines tested in the aircraft). These facilities are built for both testing and noise abatement. They are standardized in their composition and found worldwide at DoD facilities (Aaron 2009). They typically are made of concrete and have an intake stack, outgo stack, engine room, blast augmenter behind the engine (that runs to the outgo stack), and a control room. These elements are all present in Building 175.

The building is irregular in shape and has sections that are one, two, and three stories in height. The one-story engine test control room is at the north end of the northeast elevation. It is separate from the main core of the engine room, except for a connecting window that allows technicians to view the tests from the control room. The two-story engine room composes the main bulk of the building and is situated adjacent to the control room. Both a two-and-one-half and three-story tower are at the southeast end of the building. The shorter of the two is an air intake tower. The taller of the two is an exhaust outgo tower. Between the two towers and the engine room is a low one-story connection that houses the blast augmenter tube.

The building rests on an eroded concrete foundation and is surrounded on the north and east side by blast shields from the nearby aircraft parking area of Building 117. Fuel and water tanks, electrical control panels, and various pipes are found along the northeast wall of the building (figures 5-19 and 8-20) and hold or convey fuel and other liquids to engines in the engine room, and control interior conditions necessary to test jet engines apart from the aircraft. An open ladder leads to the top of the three-story outgo stack. The northeast wall also has two single-leaf metal doors and two indeterminate windows (the windows and sash fixtures have been broken or removed). The northwest elevation has two metal louvered vents, two single-leaf metal pedestrian doors, a double-leaf metal door, and a one-and-a-half-story vehicle double-leaf metal door (figure 5-20). The southeast façade of the building has no openings, and the southwest façade does not have any wall openings. A series of three metal pipes extend from the roof to the ground.

Application of Significance Criteria:

As the main pacific NAS, Barber's Point was a central aircraft repair location. Like all other locations with major aircraft operations, it housed this test cell to test repaired engines prior to being reinstalled in aircraft. It is not a unique resource and can be found at U.S. defense installations throughout the world (Aaron 2009). As such, this building is not associated with any important Cold War or other historic trends and is not associated with any important individuals and is therefore not eligible under criterion A or B. The design for test cells has not changed much in the last 60 years since engine test facilities were developed. As a result, it is not eligible under criterion C. The building has no further information potential and is not eligible under criterion D. So, despite retaining its integrity, it does not meet any NRHP criteria for significance and is therefore recommended not eligible for listing in the NRHP.

FIGURE 5-19. BUILDING 175

FIGURE 5-20. BUILDING 175

Integrity:

This building appears to retain its historic integrity. It is in its original location and has not been moved. The surroundings are still associated with military, although not Navy, use so the immediate setting, feeling, and association is much the same despite the area not belonging to the Navy any longer. There were interior renovations to accommodate changes in engine testing, but these have not impacted design, materials, and workmanship.

Evaluation Conclusion: not eligible. The Hawaii State Historic Preservation Office concurred with this finding in October 2009 (pers. comm. D. Hart, e²M, October 2009).

Information Sources:

Historic Buildings Survey and Evaluation Report of Ten Facilities, Hawaii Army National Guard, engineering-environmental Management, Inc. 2009.

5.3.3 Tinker Air Force Base, Building 214

Installation Location: Midwest City, Oklahoma

Hush House/Test Cell Building No: Building 214

Date of Construction: 1942

Aircraft: for which it was originally built: B-17

Description of the Hush House/Test Cell:

The Engine Test Building, also known as Building 214, is on the corner of B Avenue and First Street on Tinker Air Force Base. The building was constructed in 1943 as part of the original Oklahoma City Air Depot. There is a fence that surrounds the parking lot in the back of the building, used for storage of military vehicles. Also in the fenced area are fuel pumps. The building is constructed of brick and poured concrete, with later additions made of concrete block. The building was originally in the modern style, which later additions to the building have obscured.

The main entry is centered at the front of the building. The entry has a double door of metal with a concrete awning over the door. The original test engine bays, marked by penthouses for gasoline and head control equipment above the roof-line of the building are constructed of cast concrete. The penthouses have a single metal vent in the center. The double doors of the test engine bays are placed directly below the vents on the exterior of the building wall. The original equipment inside the bays consisted of a steel stand on a metal track with securing bolts. On one interior wall of the bay is a small door and windows accessed by stairs on the metal stand. Behind the wall is the operator’s booth. The exterior wall of the operators’ booths are protected by sound-absorbing baffles, which are visible. The building originally had six testing bays, three each on both sides of the front entry.

The rear of the building is constructed of brick. The addition is one story with a flat roof. Brick plasters and original openings for the building are still visible. The building originally had a central entry with double doors and large windows. The interior of the addition is mostly open with the exception of a few smaller rooms for office space.

The building is still used to test and repair aircraft engines, although the needs of the operators have changed since the building was built.

Alterations:

The building has been subject to many alterations since it was built. The original signage used for the test building, which were originally pressed steel letters with a porcelain finish, has been removed. There is a brick addition to the rear of the building that looks as if it was an older addition, made during the war. The rear entries and the windows have been infilled with concrete block. There is a large addition on the rear, south side of the building with a drive-through area for cars and trucks. The brick and concrete block on the rear of the building have been painted to blend the additions together.

New test cells have been added to the south front of the building, which obscure the original test cell and sound baffle pattern of the front of the building. Some of the original baffles have been removed and concrete block and double-door entries added. One of the baffles has been completely removed and the entry inset. There is only one test engine cell that has the original metal engine stand, stairs, and windows.

Although the building has numerous alterations, it still has some of the original material that is useful to the understanding of the Engine Repair Section during WWII.

Application of Significance Criteria:

Criterion A

After the planes were stripped of their engines at the repair hangers, they would be sent to engine repair, formerly adjacent to this building, to be rebuilt and repaired in an assembly line fashion. Once the engines were repaired, they would be transported on hoists with wheels into the Engine Test Building, where they would be started and allowed to run for testing purposes before they were shipped back to the repair hangers for reinstallation into the planes.

The engine repair section represented the highest degree of mass production at the peak of WWII efforts to repair airplanes at the depot. Four overhaul lines turned out 23, R3550-horsepower engines daily from the engine repair section in 1944 at the peak of production. The assembly line production used in the engine repair section was pioneered at the Oklahoma City Air Depot and used as a model for other air service centers to follow.

The Engine Test Building represents one of the key buildings used by the engine repair section to carry out its function during WWII, which had a vital part of the operations at the Oklahoma City Air Depot. The building has military history significance in relation to the WWII efforts of the Oklahoma City Air Depot.

Information Sources:

From the U.S. Department of the Interior, National Park Service, National Register of Historic Places form for Building 214, part of a multiple property listing for “Historic Properties of Tinker Air Force Base.” Prepared by Susan Roth, Woodward Clyde Federal Services, September 23, 1993.

FIGURE 5-21. BUILDING 214

5.3.4 Tinker Air Force Base – U.S. Air Force, Building 3703

Installation Location: Midwest City, Oklahoma

Hush House/Test Cell Building No: Building 3703

Date of Construction: 1954

Aircraft: for which it was originally built: B-47

Description of the Hush House/Test Cell:

Building 3703 was completed in March 1954 as a jet engine test cell structure. The building was constructed to handle performance testing of jet engines that came to dominate engine maintenance and rehabilitation operations at Tinker AFB during the early Cold War era. The building appears to have been initially associated with testing J-47 engines used in the B-47, and it was later modified to test the J-57 engine, which was used in the B-52 bomber. Four of the test cells were completed in April–May 1953 by the Walter Nashert Construction Company, then a contract for a second set of four test cells was issued at the end of May 1953, with this project completed around January 1954.

An article in the January 22, 1954, issue of the *Tinker Take-Off* stated that similar jet engine testing facilities were built at bases in San Bernardino and Middletown. The test cells were built using a generic jet engine test cell plan developed for the Air Force by Graham, Anderson, Probst and White of Chicago, although the January 1954 *Tinker Take-Off* article on the building gave engineers at Tinker AFB some credit for helping develop the test stand equipment. The facility included automatic cut-off devices for emergencies, and other enhanced safety and performance features. The 1954 article also mentioned that the facility was designed with testing of J-35 and J-47 engines in mind. Prior to the construction of Building 3703, jet engine testing at Tinker AFB was carried out in buildings 214 and 2l5.

Construction drawings indicate that the test cells were modified for testing J-57 engines in 1954, and an engine build-up shop was added to the east end of the building in 1955. This addition is now visible as the one-story eastern half of the building. Real estate records indicate that the test cells in the building were altered again in 1966.

Construction drawings indicate that changes were made to the building's exhaust stacks in 1987, including the "partial demolition" of the original stacks. Historic photos of Building 3703 indicate that the stacks were originally short and had sloped tops. The current tall, flat-top stack design appears to constitute a major departure from the original design. The testing equipment inside the building has also been repeatedly altered. At some time after 1955, an addition on the north side of the structure joined it to Building 3704, which was previously a freestanding structure.

The building has reinforced concrete and sheet metal walls, and the original flat roof was composed of concrete beams and asphalt. The west section of the building contains concrete exhaust stacks and is two-stories tall. The west elevation consists of plain concrete walls punctuated in a few places by a series of steel pedestrian doors. The center section of the building that lies east of the stacks is shorter and is also composed of plain concrete walls. The east wing of the building is a short, plain concrete structure that was used as a shop area.

Application of Significance Criteria:

Building 3703 served as a testing center for engines used in a number of jet aircraft, including the B-47 and B-52. However, these test stands were not used to develop new engines or propulsion technologies, only to test existing engines. It does not appear that advanced Cold War technologies were developed at these test stands, since they are basically part of the maintenance and support operations for the U.S. Air Force jet fleet. Building 3703 does not have cold war significance at the national level.

As a facility in which a wide variety of jet engines were tested, this building did play an important role in the mission of Tinker AFB as a center for aircraft maintenance, modification, and rehabilitation. The building was constructed to accommodate the increasingly heavy load of jet-engine-related work at Tinker AFB. The building also reflects the expansion of Tinker AFB during the Korean War.

This building has nevertheless lost a great deal of integrity. The most important changes occurred in 1987, when the design of the exterior exhaust stacks was heavily altered. This work completely changed the appearance of the west elevation of the building. The test stands on the interior of the building have also been repeatedly altered. Due to the changes made to the exterior and interior of the structure, this building is recommended as not eligible for the NRHP due to a low level of material integrity.

Information Sources:

Final Phase I Inventory and Evaluation of the Historic Buildings, Tinker Air Force Base, Oklahoma, Contract No. F34650-98-D-003, Delivery Order No. 5010. October 30, 2001.

FIGURE 5-22. BUILDING 3703

5.3.5 Naval Air Station Miramar, Building 8545

Installation Location: San Diego, California

Hush House/Test Cell Building No: Building 8545

Date of Construction: 1974

Aircraft: F-18 Fighter

Brief Installation History (related to hush house/test cell):

MCAS Miramar started out as Camp Kearney (later Camp Kearny), an Army National Guard training center, in 1918 in response to U.S. military involvement in WWI. Camp Kearny served in many different capacities following WWI, including a convalescent center, a dirigible station, and a secondary airfield to support NAS North Island. Following the attack on Pearl Harbor in December 1941, the importance of a strong Naval presence in the Pacific became clear. In this year, the southern portion of Camp Kearny was established as a Naval auxiliary airfield, while the northern portion became Marine Air Corps Depot, Miramar, acting as an air supply depot and staging area for crews of combat aircraft.

American air power underwent major reorganization following WWII. The Miramar-Camp Kearny facilities were discontinued as organizational entities and combined into MCAS Miramar in 1946. The next year, MCAS Miramar was transferred from Marine to Navy control and became Naval Auxiliary Air Station (NAAS) Miramar. The Navy provided operational support for a medium-sized land patrol squadron, among other duties. In 1948, two hangars were moved to the station from North Island to house Helicopter Squadron One.

The 1950s ushered in the jet age across the U.S. armed forces. Miramar was converted to a Master Jet Station, becoming U.S. NAS Miramar in 1952. This initiated an ambitious construction program at Miramar, which included a maintenance hangar, facilities to support flightline operations, enlisted quarters, and warehouses. During this Cold War period, NAS Miramar provided support operations to fleet carrier and reconnaissance aircraft and to support a guided missile program. The station continued intensive construction programs through the late 1950s and into the early part of the next decade in order to support Naval air operations.

Although activity at Miramar slowed in the 1960s, the Vietnam War brought expansion at the station. The station played a key role in Pacific Fleet aviation support. In 1967, Miramar was home to 21 fighter squadrons, 4 attack carrier wings, and a readiness attack carrier wing. Miramar also housed an intensive fighter pilot training program known as Top Gun (immortalized in the 1985 movie of the same name). Several test cells were built between 1974 and 1978 to test F-18 aircraft engines.

The Top Gun program continued at Miramar even as the Vietnam War drew to a close. By 1985, Miramar supported 18 squadrons of F-14 and E-2 aircraft and provided pilot training and aircraft maintenance training.

Miramar functioned as a naval air station into the 1990s, until a decision was made in 1993 by BRAC to close the facility. However, the U.S. Marine Corps decided to convert the station to a MCAS, and Miramar was officially opened as a Marine facility in October 1997.

Description of the Hush House/Test Cell:

Building 8545 is a T-6-style test cell built in 1974 for the purposes of jet engine testing. Comprising approximately 3,100 square feet, the hush house consists of a main test cell chamber with primary and secondary intake vents, a control cab, an augmenter tube, and an exhaust stack. The main structure is steel framed with walls of precast concrete. It has steel doors and rests on a concrete pad.

Building 8545 measures approximately 100 feet in length, including augmenter tube and exhaust stack, and 40 feet across, including the control cab. The main entrance, with steel doors that open out to admit engines rolled in on trailers, faces west. Although exact elevations were not available, the main building, including intake stacks, rises approximately 30 feet. The control cab sits along the north elevation and rises approximately 11 feet. Four steel doors offer access to the control cab.

The augmenter tube extends east from the main building, culminating in an exhaust stack. The augmenter tube is lined with steel to provide noise suppression. The exhaust stack is composed of concrete block. Inside, the walls are concrete block with noise-suppressing panels of fiberglass covered in steel mesh. A metal grate covers a drain leading down the center of the test cell. Steel I-beams create a support frame in the test cell.

[Note: description written by author of this report, not by Hardlines Design Company.]

FIGURE 5-23. BUILDING 8545, LOOKING SOUTHEAST

Application of Significance Criteria:

Building 8545 was evaluated in 2006 by Hardlines Design Company of Columbus, Ohio. Hardlines cultural resources specialists determined that Building 8545 presently does not have national exceptional importance under the installation Cold War era context and therefore is not eligible for listing in the NRHP at this time.

Information Sources:

Repair Deficiency Construction drawings 2001.

Historic Building Inventory and Evaluation (1942–1989) for Marine Corps Air Station Miramar, San Diego, California. Hardlines Design Company, Columbus, Ohio, November 7, 2006.

5.3.6 Naval Air Station Miramar, Building 9565

Installation Location: San Diego, California

Hush House/Test Cell Building No.: Building 9565

Date of Construction: 1975

Aircraft: F-18 Fighter

Brief Installation History (related to hush house/test cell):

MCAS Miramar started out as Camp Kearney (later Camp Kearny), an Army National Guard training center in 1918, in response to U.S. military involvement in WWI. Camp Kearny served in many different capacities following WWI, including a convalescent center, a dirigible station, and a secondary airfield to support NAS North Island. Following the attack on Pearl Harbor in December 1941, the importance of a strong Naval presence in the Pacific became clear. In this year, the southern portion of Camp Kearny was established as a Naval auxiliary air, while the northern portion became Marine Air Corps Depot, Miramar, acting as an air supply depot and staging area for crews of combat aircraft.

American air power underwent a major reorganization following WWII. The Miramar-Camp Kearny facility were discontinued as organizational entities and combined into MCAS Miramar in 1946. The next year, MCAS Miramar was transferred from Marine to Navy control and became NAAS Miramar. The Navy provided operational support for a medium-sized land patrol squadron, among other duties. In 1948, two hangars were moved to the station from North Island in order to house Helicopter Squadron One.

The 1950s ushered in the jet age across the U.S. Armed forces. Miramar was converted to a Master Jet Station, becoming U.S. NAS Miramar in 1952. This initiated an ambitious construction program at Miramar, which included a maintenance hangar, facilities to support flightline operations, enlisted quarters, and warehouses. During this Cold War period, NAS Miramar provided support operations to fleet carrier and reconnaissance aircraft and a guided missile program. The station continued intensive construction programs through the late 1950s and into the early part of the next decade to support Naval air operations.

Although activity at Miramar slowed in the 1960s, the Vietnam War brought expansion at the station, which played a key role in Pacific Fleet aviation support. In 1967, Miramar was home to 21 fighter squadrons, 4 attack carrier wings, and a readiness attack carrier wing. Miramar also housed an intensive fighter pilot training program known as Top Gun (immortalized in the 1985 movie of the same name). Several hush houses were built between 1974 and 1978 to test F-18 aircraft engines.

The Top Gun program continued at Miramar even as the Vietnam War drew to a close. By 1985, Miramar supported 18 squadrons of F-14 and E-2 aircraft and provided pilot training and aircraft maintenance training.

Miramar functioned as a naval air station into the 1990s, until a decision was made in 1993 by the BRAC to close the facility. However, the U.S. Marine Corps decided to convert the station to a MCAS, and Miramar was officially opened as a Marine facility in October 1997.

Description of the Hush House/Test Cell:

Building 9565 was constructed in 1975. It comprises approximately 9,350 square feet and sits on the flight line facing south. The main structure is comprised of steel-paneled walls and features a steel augmenter tube and poured-concrete block exhaust stack.

The main structure measures approximately 80 feet by 80 feet and features a steel-paneled gable roof. Massive sound-proof doors cover the south elevation. At the apex of the gable roof, the structure measures approximately 24 feet high. Centered along the east elevation is a sliding metal door leading to the auxiliary building, which contains an observation room, mechanical equipment, and storage. The augmenter tube, which is approximately 22 feet wide, extends approximately 90 feet north from the main building. The tube rises approximately 13 feet high. At the north end of the augmenter tube is the concrete exhaust stack, which measures approximately 16 feet high. Along the west side of the main building, near the south corner, is a sliding steel door. The entire exhaust system and augmenter tube were replaced in 1992, presumably to change from water-cooled to air-cooled.

This design is the predecessor to the modern standard designs of T-9 and T-10 hush houses. It resembles the design patented by Lepor Meyer in 1978 (see figure 2-9, chapter 2), although it was designed by Gustav Getter Associates of New York. Although it is designed for on-frame testing like a T-10 hush house, it has design features of a T-9 hush house. The key feature of a T-9 is that the intake vents are incorporated into the massive hangar doors. Building 9565 has the identifying sliding insulated, sound-proof paneled doors that comprise the front (south) elevation. The panels are lined with asbestos ropes and open steel cells, and covered in steel mesh. The open steel cells funnel air into the hush house. The doors are approximately 6 feet deep and open via a built-in electric motor.

Inside the hush house, the walls are lined with pre-fabricated acoustic metal wall panels containing fiberglass sound-suppressing material. The main building is completely open to allow a mobile control cab as well as an F-18 airplane to enter.

[Note: description written by author of this report, not by Hardlines Design Company.]

FIGURE 5-24. BUILDING 9565, LOOKING EAST

Application of Significance Criteria:

Building 9565 was evaluated in 2006 by Hardlines Design Company of Columbus, Ohio. Hardlines cultural resources specialists determined that Building 9565 presently does not have national exceptional importance under the installation's Cold War context and therefore is not eligible for listing in the NRHP at this time.

Information Sources:

As built drawing 1974.

Renovation drawings 1992.

MCAS Miramar, Class 2 Property Record, May 2009.

Historic Building Inventory and Evaluation (1942–1989) for Marine Corps Air Station Miramar, San Diego, California. Hardlines Design Company, Columbus, Ohio, November 7, 2006.

http://www.globalsecurity.org/military/facility/miramar.htm

5.3.7 Naval Air Station Miramar, Building 8679

Installation Location: San Diego, California

Hush House/Test Cell Building No.: Buildings 8679

Date of Construction: 1988

Aircraft:

Brief Installation History (related to hush house/test cell):

MCAS Miramar started out as Camp Kearney (later Camp Kearny), an Army National Guard training center, in 1918 in response to U.S. military involvement in WWI. Camp Kearny served in many different capacities following WWI, including a convalescent center, a dirigible station, and a secondary airfield to support NAS North Island. Following the attack on Pearl Harbor in December 1941, the importance of a strong Naval presence in the Pacific became clear. In this year, the southern portion of Camp Kearny was established as a Naval auxiliary airfield, while the northern portion became Marine Air Corps Depot, Miramar, acting as an air supply depot and staging area for crews of combat aircraft.

American air power underwent major reorganization following WWII. The Miramar-Camp Kearny facilities were discontinued as organizational entities and combined into MCAS Miramar in 1946. The next year, MCAS Miramar was transferred from Marine to Navy control and became NAAS Miramar. The Navy provided operational support for a medium-sized land patrol squadron, among other duties. In 1948, two hangars were moved to the station from North Island in order to house Helicopter Squadron One.

The 1950s ushered in the jet age throughout the U.S. military. Miramar was converted to a Master Jet Station, becoming U.S. NAS Miramar in 1952. This initiated an ambitious construction program at Miramar, including a maintenance hangar, facilities to support flightline operations, enlisted quarters, and warehouses. During this Cold War period, NAS Miramar provided support operations to fleet carrier and reconnaissance aircraft and to support a guided missile program. The station continued intensive construction programs through the late 1950s and into the early part of the next decade to support Naval air operations.

Although activity at Miramar slowed in the 1960s, the Vietnam War brought expansion at the station. The station played a key role in Pacific Fleet aviation support. In 1967, Miramar was home to 21 fighter squadrons, 4 attack carrier wings, and a readiness attack carrier wing. Miramar also housed an intensive fighter pilot training program known as Top Gun (immortalized in the 1985 movie of the same name). Several hush houses were built between 1974 and 1978 to test F-18 aircraft engines.

The Top Gun program continued at Miramar, even as the Vietnam War drew to a close. By 1985, Miramar supported 18 squadrons of F-14 and E-2 aircraft and provided pilot training and aircraft maintenance training.

In the late 1980s and 1990s, several helicopter testing structures were constructed to test the H-46 and H-53 helicopter engines; and another hush house was added in 1988.

Miramar functioned as a naval air station into the 1990s, until a decision was made in 1993 by BRAC to close the facility. However, the U.S. Marine Corps decided to convert the station to a MCAS—Miramar was officially opened as a Marine facility in October 1997.

Description of the Hush House/Test Cell:

Building 8679 is a test cell designed by Gustav Getter Associates and built in 1988 for purposes of jet engine testing. The building continues in that capacity.

Building 8679 is steel-framed and sits on a concrete slab. It measures approximately 48 feet wide by 75 feet long. The main entrance, a set of steel vault-like doors that open to admit the engines for testing, is located along the west elevation. The west elevation includes the primary intake stack, which rises to a height of approximately 31 feet. This main structure that houses the chamber has prefabricated armor-plate paneled walls and a flat roof and rises approximately 15 feet. The west elevation contains the storage, control, mechanical, and fuel rooms, which are one story in height (approximately 11 feet). These rooms are composed of concrete block walls. Two steel doors provide outside access to the mechanical and fuel rooms, and a third steel door opens to a hallway containing the control and storage rooms and a restroom. A viewing window allows visual access between the test cell and the control room.

The secondary intake stack is at the end of the test chamber and just before the augmenter tube and rises above the main structure to a height of approximately 43 feet. The steel augmenter tube continues east from the test cell and measures approximately 80 feet in length and 20 feet across. The augmenter tube culminates in an exhaust stack measuring approximately 28 feet square.

The interior of Building 8679 is lined with sound-suppressing fiberglass covered in steel mesh. The augmenter tube is steel lined, and the exhaust stack concrete block with steel exhaust deflectors.

[Note: description written by author of this report, not by Hardlines Design Company.]

<u>Application of Significance Criteria</u>:

Building 8679 was evaluated in 2006 by Hardlines Design Company of Columbus, Ohio. Hardlines cultural resources specialists determined that Building 8679 presently does not have national exceptional importance under the installation Cold War context and therefore is not eligible for listing in the NRHP at this time.

<u>Information Sources</u>:

MCAS Miramar, Class 2 Property Record, May 2009.

http://www.globalsecurity.org/military/facility/miramar.htm

Historic Building Inventory and Evaluation (1942–1989) for Marine Corps Air Station Miramar, San Diego, California. Hardlines Design Company, Columbus, Ohio, November 7, 2006.

FIGURE 5-25. BUILDING 8679, LOOKING SOUTH

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS AND FINDINGS

This study originally was focused entirely on hush houses (primarily T-9 and T-10); however, as the study progressed, it became apparent that combining hush houses and test cells into one report would provide a more comprehensive overview for both resource types and their combined relationship. Addressed within are hush houses and test cells designed and built for maintenance and repair of aircraft, not for test cells built at research and development facilities; although the overall design of test cells are similar for both installation types, and this document would assist in the assessment of test cells for research and development installations.

The U.S. military began transitioning to jet engine technology in late 1940. Jet technology and the resulting aircraft represent large investments of time and funding. By the 1950s, aircraft noise had become a community relations issue for military aviation bases and a health and safety concern for active duty personnel. Therefore, hush house and test cell construction was initiated in response to:

- the ability to test aircraft engines within a controlled environment and prior to test flight
- noise suppression – either due to community encroachment, health and safety requirements, or both issues together

Based on data collected, the Air Force and Air National Guard have the largest number of T-9 and T-10s in inventory (Air Force T-9s – 17, T-10s – 45; Air National Guard T-9s – 13, T-10s – 45). The Navy/Marine Corps have the greatest number of test cells (71). This information may prove not to be 100% accurate due to how hush houses and test cells are listed on real property inventories. The ANG, for example, considers hush houses equipment and lists only the concrete pad as a real property asset. Many test cells are no longer in use and may be listed as a storage building or under a new function.

Based on information collected for the inventory, test cells have been constructed at military installations from the 1940s and consistently since that time. Early test cells developed at Wright Patterson AFB, Tinker AFB, and Fairchild AFB have been determined to be eligible for listing in the NRHP under criterion A; the test cells at Wright Patterson AFB for aircraft research, and the test cells at Tinker AFB and Fairchild AFB for their contribution to large-scale maintenance and repair missions important to a particular event (WWII). One test cell, the Propeller Test Complex at Wright Patterson AFB, is also eligible under criterion C for design.

Inventories collected from the ANG indicate that a few T-9 and T-10 hush houses were designed and constructed in the mid-1970s. However, according to the report, *Hush House Site Planning Bulletin*, December 1993, T-10 hush houses appeared at Air Force and ANG installations in 1981, with T-9s appearing around the mid-1980s and each design has been constructed consistently to date. Most hush houses are of two basic designs; the T-9 and T-10. The T-10 hush house varies little in overall design; however, the T-9 hush house does have variations as evident when comparing the design of NAS Miramar Building 9565 (1974), NAS Oceana Building 1116, and Phoenix ANG base Building 55 (1976). These resources, in general, are around or less than 30 years old and likely do not meet the level of exceptional significance for individual eligibility for listing in the NRHP (criterion G).

Integrity will confront future test cell, and to a lesser extent, hush house evaluations. Both building types are subjected to high temperatures and vibration, which can affect the structural integrity of the building with use. In some cases, the building is no longer used for testing jet engines. At other locations, modification can occur as aircraft design and technological advances result in modernization of the integral testing equipment. For example, in Building 9565 at NAS Miramar, the exhaust system was changed, most likely due to environmental restrictions. In still other cases, including Building 3703 at Tinker AFB, the exterior of the building was modified, although it is not known whether this modification was a result of mission change or structural integrity.

Test cells and hush houses, in general, likely will not qualify as individually eligible for the NRHP. However, the significance of a test cell or hush house may rest on the fact that it is the earliest, best, or last existing example of a type, and a national-level survey ultimately is necessary to identify these structures of greatest significance. Such an evaluation may be challenged by accuracy of data. For example, the hush house (T-10) at Des Moines ANGB was evaluated in 2004 as part of an installation-wide survey and determined not eligible (not exceptional significance at less than 50 years of age). The hush house is itemized on the real property list as being constructed in 1959; however, the *Hush House Site Planning Bulletin*, December 1993, indicates that it was constructed in 1989. Based on the design, it is more likely to have been constructed in the 1980s than the 1950s. However, if the 1959 date is accurate, it is one of, if not the, earliest T-10 hush house. At the time of evaluation, no national hush house context existed.

Also, test cell and hush houses may be a contributing resource to a historic district. This significance will likely lie within the installation's historical context and not that of the hush house /test cell historic context, and may be significant on a local, regional, or national level.

6.2 RECOMMENDATIONS

6.2.1 Case Studies

Where indicated in the report, concurrence from the SHPO should be sought prior to any undertakings under Section 106 of the NHPA. Also, it is recommended that these resources be evaluated as part of a historic district when appropriate. The following two tables (6-1 and 6-2) summarize the results of the case studies and previous surveys.

TABLE 6-1. SUMMARY OF CASE STUDY EVALUATIONS

Installation	Location	Service	Building No.	Type	Year Built	NRHP Individually Eligible	NRHP District Eligible	Management Recommendations
Truax Field	Madison, WI	ANG	1202	Concrete hush house	1958	No	No	None
Truax Field	Madison, WI	ANG	1201	Concrete hush house	1958	Not recommended	Not evaluated	None
Truax Field	Madison, WI	ANG	1206	Concrete test cell	1985	Not recommended	Not evaluated	Evaluate at 50 years
Truax Field	Madison, WI	ANG	56	T-10 hush house	1992	Not recommended	Not evaluated	Evaluate at 50 years
Tinker AFB	Midwest City, OK	USAF	3234	Multi-chamber test cell	1974	Not recommended	Not evaluated	Evaluate at 50 years and as part of district

TABLE 6-1. SUMMARY OF CASE STUDY EVALUATIONS

Installation	Location	Service	Building No.	Type	Year Built	NRHP Individually Eligible	NRHP District Eligible	Management Recommendations
Tinker AFB	Midwest City, OK	USAF	926	T-10 hush house	1989	Not recommended	Not evaluated	Evaluate at 50 years and as part of district
Travis AFB	Fairfield, CA	USAF	1001	Single-chamber test cell	1968	Not recommended	Not evaluated	Evaluate at 50 years and as part of district
Phoenix Air National Guard Base	Phoenix, AZ	ANG	55	T-9 hush house	1976	Not recommended	Not evaluated	Evaluate at 50 years and as part of district
Naval Air Station North Island	San Diego, CA	Navy	1420	Single-chamber test cell	1974	Not recommended	Not evaluated	Evaluate at 50 years and as part of district
Marine Corps Air Station	Camp Pendleton, CA	USMC	23118	Single-chamber test cell	1982	Not recommended	Not evaluated	Evaluate at 50 years and as part of district
Marine Corps Air Station	Camp Pendleton, CA	USMC	23119	Double-chamber test cell	1982	Not recommended	Not evaluated	Evaluate at 50 years and as part of district
Naval Air Station Oceana	Virginia Beach, VA	Navy	1116	T-9 hush house	1999	Not recommended	Not evaluated	Evaluate at 50 years and as part of district
Naval Air Station Oceana	Virginia Beach, VA	Navy	1100	Single-chamber test cell	1971	Not recommended	Not evaluated	Evaluate at 50 years and as part of district
Naval Air Station Oceana	Virginia Beach, VA	Navy	1102	Single-chamber test cell	1972	Not recommended	Not evaluated	Evaluate at 50 years and as part of district
Naval Air Station Oceana	Virginia Beach, VA	Navy	1104	Single-chamber test cell	1986	Not recommended	Not evaluated	Evaluate at 50 years and as part of district
Naval Air Station Miramar	San Diego, CA	Navy	8128/ 8129	Test stand	1997	Not recommended	Not evaluated	Evaluate at 50 years and as part of district
Naval Air Station Miramar	San Diego, CA	Navy	8117	Multi-chamber test cell	1998	Not recommended	Not evaluated	Evaluate at 50 years and as part of district

TABLE 6-2. SUMMARY OF PREVIOUS SURVEYS

Installation	Location	Service	Building No.	Type	Year Built	NRHP Individually Eligible	NRHP District Eligible
Bangor Air National Guard Base	Bangor, ME	ANG	500	T-9	1987	No	No
Hawaii Army National Guard	Kaleoloa, HI	ARNG	175	Single chamber test cell	1960	No	No
Tinker AFB	Midwest City, OK	USAF	214	Multi-chamber test cell	1942	No	Yes
Tinker AFB	Midwest City, OK	USAF	3703	Multi-chamber test cell	1954	No	No
Naval Air Station Miramar	San Diego, CA	Navy	8545	Single-chamber test cell	1974	No	No

TABLE 6-2. SUMMARY OF PREVIOUS SURVEYS

Installation	Location	Service	Building No.	Type	Year Built	NRHP Individually Eligible	NRHP District Eligible
Naval Air Station Miramar	San Diego, CA	Navy	9565	T-9 hush house	1975	No	No
Naval Air Station Miramar	San Diego, CA	Navy	8679	Single-chamber test cell	1988	No	No
Wright Patterson AFB	Wright AFB, OH	USAF	20	Test cell	1931	Yes	Yes
Wright Patterson AFB	Wright AFB, OH	USAF	30256	Test cell	1941	No	Yes
Wright Patterson AFB	Wright AFB, OH	USAF	71	Test cell	1942	No	Yes
Fairchild AFB	Spokane, WA	USAF	2150	Test cell	1943	Yes	Yes

It is recommended that this document be made available to installations and cultural resource specialists as a reference and resource for future evaluations. The study will assist evaluators with assessing test cells and hush houses within a national resource type historic context in addition to the specific installation's local, regional, and national historic context. Evaluators should be sensitive to construction dates and type/style in order to determine if a test cell or hush house is the earliest, best, or last existing example of a type. This will address issues surfacing during the identification and evaluation phase of sections 106 and 110 compliance, thus eliminating time-consuming follow-up evaluations or negotiations potentially encountered during the identification and evaluation process.

It is recommended that the best surviving examples of each major test cell and hush house be identified through ongoing installation surveys and evaluations, and that the prime examples are documented to Historic American Building Survey or Historic American Engineering Record protocols. A few test cells have been documented to Historic American Engineering Record protocols, but installations with the same type of test cells may not be aware of this documentation.

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8.0 PREPARERS

In 1990, Congress passed legislation establishing the Legacy Resource Management Program to provide financial assistance to the DoD efforts to preserve our natural and cultural heritage. The program assists DoD in protecting and enhancing resources while supporting military readiness. This project was awarded in 2008.

The cultural resources management specialist for the Legacy Resources Management Program was Ms. Hillori L. Schenker. The project sponsor was Mr. Matt Nowakowski of the National Guard Bureau, Air National Guard.

The principal investigator for this study was Ms. Jayne Aaron, LEED AP. Ms. Aaron is an Architectural Historian with almost 20 years of experience as a program and project manager, architectural historian / cultural resources specialist, and NEPA specialist. She has, (1) managed programs and contracts for federal clients, (2) meets the qualifications of the Secretary of the Interior for Architectural Historian, (3) has inventoried and evaluated hundreds of buildings and structures for DoD and other federal agencies, (4) has developed cultural resource management plans for numerous military installations integrating agency mission with regulatory compliance and cultural resource management, (5) has participated in consultation and meetings with a variety of stakeholder groups, including state and federal regulators, American Indian tribes, environmental consultants, and the public, (6) has written public releases, given presentations, responded to public comments, and facilitated meetings for various-sized groups, and (7) has worked with numerous agencies on every facet of cultural resources identification, compliance, consultation, and NEPA.

Ms. Suzanne Stone assisted with research on hush house technology and history, as well as specific hush house and test cell designs. Ms. Stone is a laboratory professional and archaeologist with 12 years of experience in survey, excavation, curation, artifact conservation and treatment, laboratory analysis, and teaching. She has worked on prehistoric and historic sites and associated artifacts throughout the western United States and Egypt. She has managed and directed XRF (x-ray fluorescence) soil analyses, electromagnetic conductivity surveys, artifact conservation and stabilization projects, and has contributed to numerous technical reports. Ms. Stone has created collections catalogs, developed databases, and formulated collection treatment and management plans for a diversity of artifact types. She developed databases and formulated collection treatment and management plans for a diversity of artifact types. She is well-versed in 36 CFR 79 (Curation of Federally Owned and Administered Archaeological Collections) curation standards. She currently manages the archaeology laboratory at HDR’s Englewood office and oversees curation, conservation, and archaeological geoprospection programs.

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APPENDIX A: INVENTORY LISTS

Air National Guard

Base	Location	MAJCOM	WING	HH Model	HH Serial	Code or Type	Year Constructed / Erected	Proposed to be closed? If so, year	Facility No.
Andrews AFB	Washington, DC	ANG	113th Wing	A/F37T-10	11		1981		
Atlantic City IAP	Pleasantville, NJ	ANG	177th Fighter Wing	A/F37T-10	224	116665	1989	no	442
Bangor ANGB	Bangor, ME	ANG	101st Air Refueling Wing	A/F32T-9	1008	116665	1987	no	500
Barnes ANGB	Westfield, MA	ANG	104th Fighter Wing	A/F37T-10	256		1967		
Bradley ANGB	Hartford, CT	ANG	103rd Fighter Wing	A/F37T-10	254		1993		
Buckley AFB	Denver, CO	ANG	140th Fighter Wing	A/F37T-10	257		1998		
Burlington IAP	Burlington, VT	ANG	158th Fighter Wing	A/F37T-10	16	116665	1985	no	386
Capital MAP	Springfield, IL	ANG	183rd Fighter Wing	A/F37T-10	25		1983 (a)		
Dannely Field AGS	Montgomery, AL	ANG	187th Fighter Wing	A/F37T-10	243		1989 (a)		
Des Moines IAP	Des Moines, IO	ANG	132nd Fighter Wing	A/F37T-10	118	116665	1959	no	228
Duluth ANGB	Duluth, MN	ANG	148th Fighter Wing	A/F37T-10	246	116665	1993	no	270
Ellington Field	Houston, TX	ANG	147th Fighter Wing	A/F37T-10	218	116665	1988	no	1395
Fresno Yosemite IAP	Fresno, CA	ANG	144th Fighter Wing	A/F37T-10	241	116665	1990	no	167
Ft Smith MAP	Ft. Smith, AR	ANG	188th Fighter Wing	A/F37T-10	4	116665	1982	no	219
Ft Wayne IAP	Fort Wayne, IN	ANG	122nd Fighter Wing	A/F37T-10	9	116665	1983	no	771
Gowen Field	Boise, ID	ANG	124th Fighter Wing	A/F37T-10	255		1990 (a)		
Great Falls IAP	Great Falls, MT	ANG	120th Fighter Wing	A/F37T-10	219	116665	1988	no	71
Hancock Field	Syracuse, NY	ANG	174th Fighter Wing	A/F37T-10	242		1990		
Hector Field Fargo	Fargo, ND	ANG	119th Fighter Wing	A/F37T-10	106		1987		
Hickam AFB	Honolulu, HI	ANG	154th Fighter Wing	A/F37T-10	227		1989		
Hulman Field	Terre Haute, IN	ANG	181st Fighter Wing	A/F37T-10	15		1983		
Jacksonville IAP	Jacksonville, FL	ANG	125th Fighter Wing	A/F37T-10	F41608-79C-1940		1982		
Joe Foss Field	Sioux Falls, SD	ANG	114th Fighter Wing	A/F37T-10	209		1997		
Kingsley Field	Klamath Falls, OR	ANG	173rd Fighter Wing	A/F37T-10	245				
Kingsley Field	Klamath Falls, OR	ANG	173rd Fighter Wing	A/F37T-10	245				
Kirtland AFB	Albuquerque, NM	ANG	150th Fighter Wing	A/F37T-10	202		1996		
Lackland AFB	San Antonio, TX	ANG	149th Fighter Wing	A/F37T-10	1		1981(a)		
Lambert Field	St Louis, MO	ANG	131st Fighter Wing	A/F37T-10	2		1982		

Air National Guard

Base	Location	MAJCOM	WING	HH Model	HH Serial	Code or Type	Year Constructed / Erected	Proposed to be closed? If so, year	Facility No.
McConnell AFB	Wichita, KS	ANG	184th Air Refueling Wing	A/F32T-9	1001	demo	1986		
McConnell AFB	Wichita, KS	ANG	184th Air Refueling Wing	A/F32T-9		demo	2003		
McEntire JNGS	Columbia, SC	ANG	169th Fighter Wing	A/F37T-10	103		1977		
McGhee-Tyson ANGB	Alcoa, TN	ANG	134th Air Refueling Wing	A/F32T-9	1007		1987		
McGuire AFB	Trenton, NJ	ANG	108th Air Refueling Wing	A/F32T-4					
McGuire AFB	Trenton, NJ	ANG	108th Air Refueling Wing	A/F32T-9	1016		1989		
McGuire AFB	Trenton, NJ	ANG	108th Air Refueling Wing	A/F32T-9					
Memphis IAP	Memphis, TN	ANG	164th Airlift Wing	A/F32T-9	2001				
Muniz ANGB	San Juan, PR	ANG	156th Airlift Wing	A/F37T-10					
NAS JRB New Orleans	New Orleans, LA	ANG	159th Fighter Wing	A/F37T-10	249		1994		
NAS JRB New Orleans	New Orleans, LA	ANG	159th Fighter Wing	A/F37T-10					
Otis ANGB	Cape Cod, MA	ANG	102nd Fighter Wing	A/F37T-10	210		1985		
Phoenix-Sky Harbor IAP	Phoenix, AZ	ANG	161st Air Refueling Wing	A/F32T-9		116665	1976/ 2000	no	1055
Pittsburgh IAP	Pittsburgh, PA	ANG	171st Air Refueling Wing	A/F37T-10	121		1988		
Portland IAP	Portland, OR	ANG	142nd Fighter Wing	A/F37T-10	1983	116665	1990	no	200
Reno-Tahoe IAP	Reno, NV	ANG	152nd Airlift Wing	A/F37T-10	9810001 (21A)		1972		
Reno-Tahoe IAP	Reno, NV	ANG	152nd Airlift Wing	A/F37T-10	9810001 (21A)				
Richmond IAP	Sandston, VA	ANG	192nd Fighter Wing	A/F37T-10	247	116665	1992	no	96
Robins AFB	Warner Robins, GA	ANG	116th Air Control Wing	A/F32T-9	1023		2000		
Salt Lake City IAP	Salt Lake, UT	ANG	151st Air Refueling Wing	A/F32T-9	1012	116665	1988	no	106
Scott AFB	Belleville, IL	ANG	126th Air Refueling Wing	A/F32T-9	1013				
Selfridge ANGB	Detroit, MI	ANG	127th Fighter Wing	A/F37T-10	102	116665	1991	no	3855
Selfridge ANGB	Detroit, MI	ANG	127th Fighter Wing	A/F37T-10	246	116665	1985	no	3857
Sioux Gateway AP	Sioux City, IO	ANG	185th Air Refueling Wing	A/F37T-10		116665	1985	no	1015

Air National Guard

Base	Location	MAJCOM	WING	HH Model	HH Serial	Code or Type	Year Constructed / Erected	Proposed to be closed? If so, year	Facility No.
Spokane IAP	Spokane, WA	ANG	141st Air Refueling Wing	A/F32T-9					
Springfield ANGB	Springfield, OH	ANG	178th Fighter Wing	A/F37T-10	120	116665	2003	no	384
Thompson Field ANGB	Jackson, MS	ANG	172nd Air Refueling Wing	A/F32T-9	1004		1987		
Toledo Express AP	Swanton, OH	ANG	180th Fighter Wing	A/F37T-10	108	116665	1985	no	313
Truax Field	Madison, WI	ANG	115th Fighter Wing	A/F37T-10	G0251	116665	1993	no	56
Truax Field	Madison, WI	ANG	115th Fighter Wing	not in use	large test cell		1958	closed	1202
Truax Field	Madison, WI	ANG	115th Fighter Wing	not in use	large test cell		1959	closed	1202
Truax Field	Madison, WI	ANG	115th Fighter Wing	not in use	large test cell		1985	closed	1206
Tucson IAP	Tucson, AZ	ANG	162nd Fighter Wing	A/F37T-10	13	116665	1990	no	113
Tucson IAP	Tucson, AZ	ANG	162nd Fighter Wing	A/F37T-10	234	116665	1989	no	112
Tulsa IAP	Tulsa, OK	ANG	138th Fighter Wing	A/F37T-10	215	116665	1987	no	603

(a) dates from A. Witten, et al, Department of Air Force, Hush House Site Planning Bulletin, Vol II, December 1993

Blast Deflectors

Location -- Installation	County, City , State	Code or Type	Year Constructed / Erected	Proposed to be closed? If so, year	Facility No.	Facility No.
Sky Harbor International Airport	Maricopa Co, Phoenix, AZ	116945	2000	no	1058	1058
Toledo Express Airport	Toledo-Lucas Co, Toledo, OH	116945	1971	no	309	309
Portland IAP	Portland, OR		2004	no		

Army

Accountable Organization	Accountable Suborg	Instal Code	Installation Name	Site Name	Nearest City	State/ Country	Type Const	Facility No.	Year Built	Catcode	Catcode Description	Primary Qty	Primary UM
AMC	AMC	48186	CORPUS CHRISTI ARMY DEPOT	CORPUS CHRISTI ARMY DEPOT	CORPUS CHRISTI	Texas	P	00008	01-JUL-41	21140	AC ENG TST FAC	33370	SF
IMCOM AC	EUROPE	GEAN0	US ARMY GARRISON ANSBACH	KATTERBACH KASERNE	ANSBACH		P	09011	01-JUL-05	21140	AC ENG TST FAC	6776	SF
IMCOM AC	KOREA	KS792	CAMP HUMPHREYS	CAMP HUMPHREYS	PYONGTAEK CITY		S	02089	01-JUL-00	21140	AC ENG TST FAC	1920	SF
IMCOM AC	KOREA	KS792	CAMP HUMPHREYS	CAMP HUMPHREYS	PYONGTAEK CITY		T	02024	01-JUL-99	21140	AC ENG TST FAC	848	SF
IMCOM AC	KOREA	KS792	CAMP HUMPHREYS	CAMP HUMPHREYS	PYONGTAEK CITY		S	01075	01-JUL-81	21140	AC ENG TST FAC	312	SF
IMCOM AC	KOREA	KS792	CAMP HUMPHREYS	CAMP HUMPHREYS	PYONGTAEK CITY		T	02020	01-JUL-96	21140	AC ENG TST FAC	1280	SF
IMCOM AC	KOREA	KS792	CAMP HUMPHREYS	CAMP HUMPHREYS	PYONGTAEK CITY		S	01089	01-JUL-85	21140	AC ENG TST FAC	854	SF
IMCOM AC	SOUTHEAST	01252	FORT RUCKER	FORT RUCKER AL	DALEVILLE	Alabama	P	07206	01-JUL-70	21140	AC ENG TST FAC	5030	SF
IMCOM AC	SOUTHEAST	01252	FORT RUCKER	FORT RUCKER AL	DALEVILLE	Alabama	P	10401	01-JUL-68	21140	AC ENG TST FAC	240	SF
IMCOM AC	SOUTHEAST	21145	FORT CAMPBELL	FT CAMPBELL KY	CLARKSVILLE	Kentucky	P	07176	01-JUL-83	21140	AC ENG TST FAC	3230	SF
IMCOM AC	SOUTHEAST	21145	FORT CAMPBELL	FT CAMPBELL KY	CLARKSVILLE	Kentucky	P	07166	01-JUL-98	21140	AC ENG TST FAC	2400	SF
NATIONAL GUARD	NATIONAL GUARD	170NG	ILLINOIS NATIONAL GUARD	PEORIA AASF # 3	Peoria	Illinois	P	00012	01-JAN-61	21140	AC ENG TST FAC	2361	SF

Army National Guard

Site Name	City Name	State	RPA Name	Facility No.	Acquisition Date	FAC Code	CATCODE	Operational Status	Construction Type
SPRINGFIELD AVCRAD	Springfield	Missouri	AIRCRAFT MAINT HANGER	HANGR	29587	2111	21110	ACT	PERM
FRESNO DAKOTA AVCRAD	Fresno	California	AVCRAD	10000	31413	2111	21110	ACT	PERM
GULFPORT AVCRAD	Gulfport	Mississippi	AVCRAD	122	32752	2111	21110	ACT	PERM
FRESNO DAKOTA AVCRAD	Fresno	California	AVCRAD (UNDER CONST)	1000A		2111	21110	ACT	PERM
AVCRAD GROTON	Groton	Connecticut	AVCRAD OFFICES/HANGAR	320	28856	2111	21110	ACT	PERM

AVCRAD = Aviation Classification Repair Activity Depot

Navy / Marine

FACILITY NAME	FACILITY NO.	FACILITY TYPE CODE	HEIGHT	LENGTH	NUMBER STORIES	YEAR BUILT	USE CATEGORY CODE
A C TURBO JET TEST CELL	2525	2	50	99	1	1971	21181
ACFT ENG TEST SUPPT FAC	6183	2	12	75	1	1999	21181
BQM MQM ENGINE RUNUP CELL	429	2	9	24	1	1979	21181
CALIBRATION BLDG AIRCRAFT	95	2	8	26	1	1970	21181
CALIBRATION BUILDING	96	2	8	20	1	1970	21181
COVERED ENGINE TEST CELL	444	2	15	26	1	2004	21181
ENG TEST CELL	3402	2	15	89	1	1968	21131
ENG TEST CELL	3402	2	15	89	1	1968	21183
ENGINE TEST CELL	303	2	54	99	1	1971	21181
ENGINE TEST CELL	1102	2	50	182	1	1972	21181
ENGINE TEST CELL	8117	2	27	73	1	1998	21181
ENGINE TEST CELL	724C	5					21181
ENGINE TEST CELL	724D	5					21181
ENGINE TEST CELL TURBO JET	1100	2	50	98	1	1971	21181
ENGINE TEST CELLS	14	2	49	301	3	1940	13140
ENGINE TEST CELLS	14	2	49	301	3	1940	21122
ENGINE TEST CELLS	14	2	49	301	3	1940	21137
ENGINE TEST CELLS	14	2	49	301	3	1940	21163
ENGINE TEST CELLS	14	2	49	301	3	1940	21183
ENGINE TEST CELLS	14	2	49	301	3	1940	21193
ENGINE TEST CELLS	14	2	49	301	3	1940	21195
ENGINE TEST CELLS	14	2	49	301	3	1940	21197
ENGINE TEST CELLS	14	2	49	301	3	1940	61010
ENGINE TEST STAND BLDG	384	2	41	173	3	1947	21183
ENGINE TEST STAND BLDG	384	2	41	173	3	1947	21862
FRC JET ENGINE TEST CELL	176	2	43	190	1	1998	21181
FRC JET ENGINE TEST CELLS	873	2	93	220	2	1976	21183
FRC JET ENGINE TEST CELLS	873	2	93	220	2	1976	84410
FRC T 10 ENGINE TEST CELL	175	2	31	159	1	1984	21181
JET ENG TEST CELL	177	2	13	40	1	1975	21181
JET ENG TEST TURN UP PAD	71	2	10	20	1	1966	21181
JET ENGINE OH	4188	2	28	262	2	1989	21125
JET ENGINE OH	4188	2	28	262	2	1989	21183
JET ENGINE OH	4188	2	28	262	2	1989	61010

Navy / Marine

FACILITY NAME	FACILITY NO.	FACILITY TYPE CODE	HEIGHT	LENGTH	NUMBER STORIES	YEAR BUILT	USE CATEGORY CODE
JET ENGINE TEST CELL	8545	2	50	183	1	1974	21181
JET ENGINE TEST CELL	3611	2	12	55	1	1984	21181
JET ENGINE TEST CELL	8679	2	43	192	1	1988	21181
JET ENGINE TEST CELL	310	2	43	190	4	1989	21181
JET ENGINE TEST CELL	4737	2	32	156	1	1989	21181
JET ENGINE TEST CELL	1104	2	43	190	1	1990	21181
JET ENGINE TEST FAC.	1583	2	31	108	1	1975	21181
JET ENGINE TEST FACILITY	758	2	45	100	1	1959	21181
JET ENGINE TEST FACILITY	759	2	23	105	2	1959	21181
LEAN TO SHED ENGINE TEST CEL	443	2	9	12	1	2004	21181
S3A TEST CELL	1420	2	10	120.91	1	1974	21181
SEMI PORT JET ENG TEST FAC	1922	2	12	50	1	1958	21181
T 10 JET ENGINE TEST CELL	2386	2	40	174	1	1996	21181
T 10 TEST CELL	4495	2	43	187	1	1999	21181
T 2 JET ENGINE TEST CELL	3000	2	30	110	1	1987	21181
T 400 TEST CELL	23119	2	10	70	1	1989	21181
T 56 ENGINE TEST FACILITY	611	2	20	62	1	1967	21181
T 64 ENGINE TEST SYSTEM CONC	5193	2	12	100	1	1990	21181
T 700 TEST CELL	23118	2	10	60	1	1989	21181
T23 PORTABLE TEST CELL	1100T	5					21181
TARGET DRONE ENGINE RUN UP	393	2	9	29	1	1977	21181
TEST CELL FACILITY	1269	2	25	92	1	2002	21181
TEST CELL II	2765	2	43	190	1	1994	21181
TEST CELL STORAGE	AS522	2	10	16	1	1955	21181
TEST CELL STORAGE	AS520	2	10	22	1	1955	21181
TURBO JET ENGINE TEST CELLS	397	2	60	92	1	1958	21122
TURBO JET ENGINE TEST CELLS	397	2	60	92	1	1958	21183
TURBO JET ENGINE TEST CELLS	397	2	60	92	1	1958	21197
TURBO JET ENGINE TEST FAC	334	2	20	99	1	1959	21181
TURBO JET ENGINE TEST FAC	339	2	20	99	1	1959	21181
TURBO JET ENGINE TEST FAC	447	2	15	99	1	1959	21181
TURBO JET TEST BLDG	397	2	60	312.7	1	1957	21183

Navy / Marine

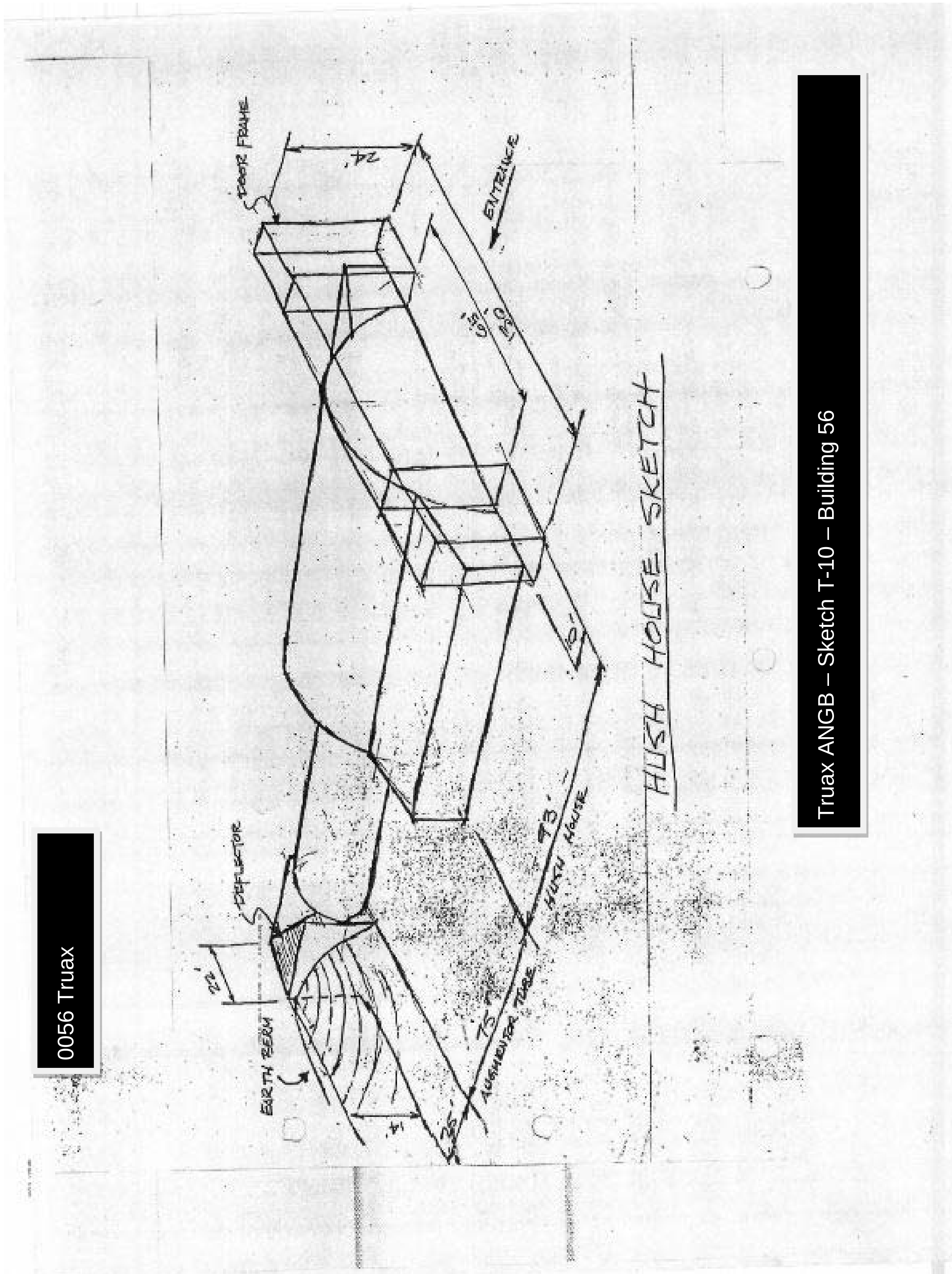
FACILITY NAME	FACILITY NO.	FACILITY TYPE CODE	HEIGHT	LENGTH	NUMBER STORIES	YEAR BUILT	USE CATEGORY CODE
TURBO PROP ENG TEST FAC	30010	2	21	63	1	1968	21181
TURBO PROP TEST CELLS	372	2	32	166	1	1953	21122
TURBO PROP TEST CELLS	372	2	32	166	1	1953	21183
TURBO PROP TEST CELLS	372	2	32	166	1	1953	21197
TURBOJET ENGINE TEST FAC	658	2	39	99	1	1972	21181

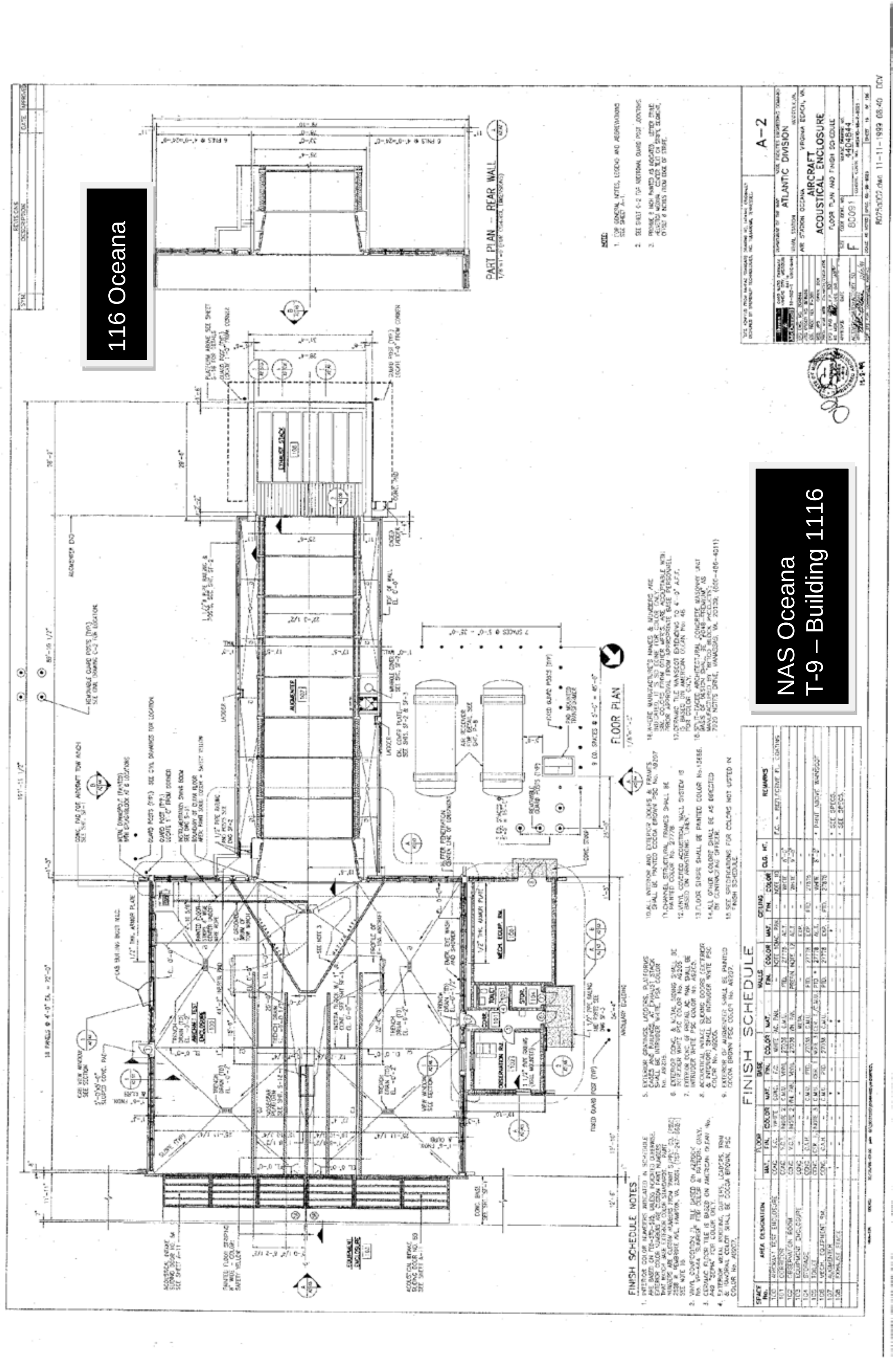
Robbins Air Force Base

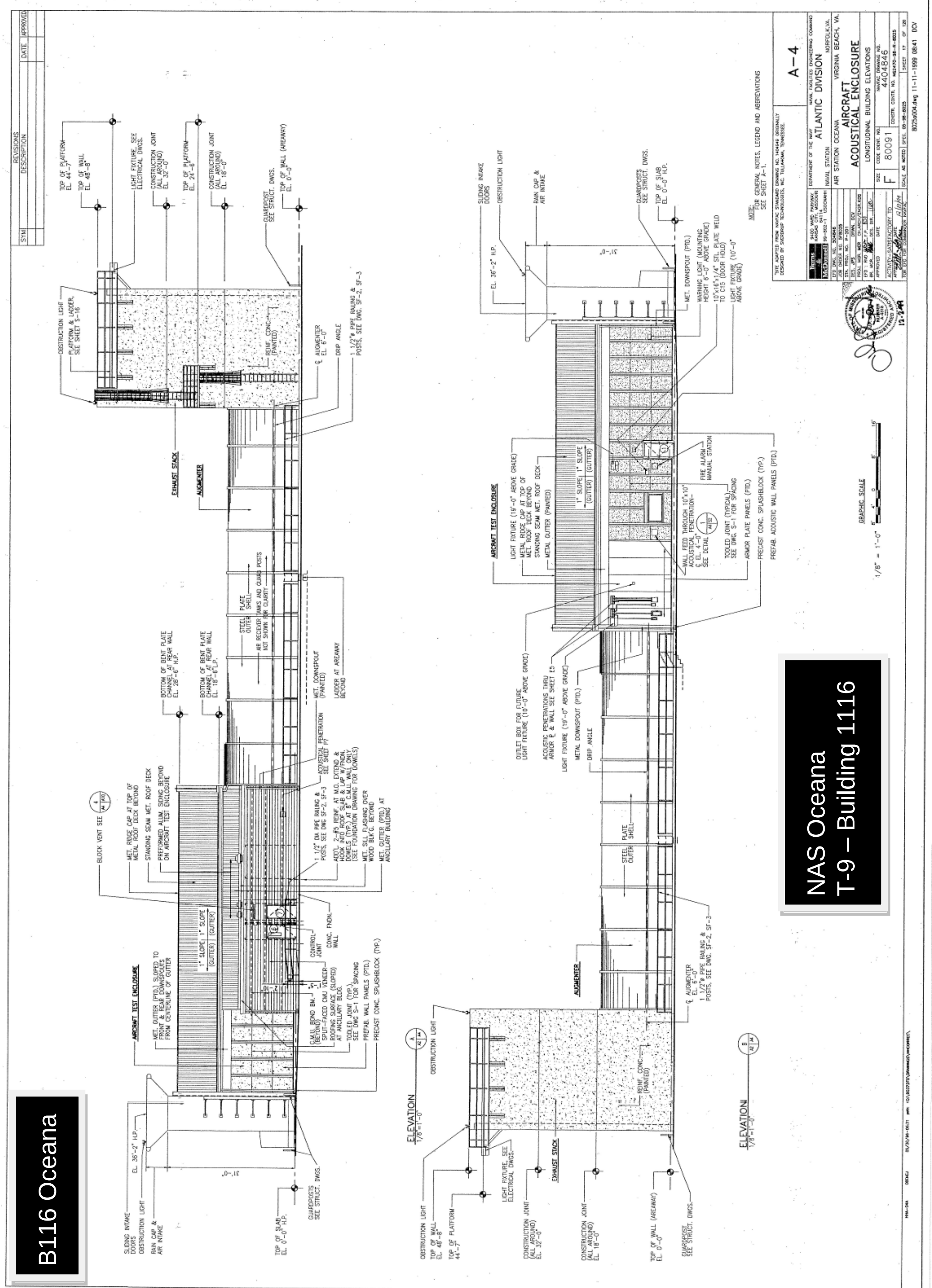
Robins AFB	Warner Robins, GA	AFMC	78th Air Base Wing	A/F37T-10	222	
Seymour Johnson AFB	Goldsboro, NC	ACC	4th Fighter Wing	A/F37T-10	235	
Seymour Johnson AFB	Goldsboro, NC	ACC	4th Fighter Wing	A/F37T-10	226	
Shaw AFB	Columbia, SC	ACC	20th Fighter Wing	A/F37T-10	20	1983
Shaw AFB	Columbia, SC	ACC	20th Fighter Wing	A/F37T-10	104	1984
Sheppard AFB	Wichita Falls, TX	AETC	80th Flying Training Wing	A/F32A-18		
Sheppard AFB	Wichita Falls, TX	AETC	80th Flying Training Wing	A/F32A-18		
Sheppard AFB	Wichita Falls, TX	AETC	80th Flying Training Wing	A/F32T-4		
Sheppard AFB	Wichita Falls, TX	AETC	80th Flying Training Wing	A/F37T-12	701	
Spangdahlem AB	Spangdahlem, Germany	USAFE	52nd Fighter Wing	A/F32T-9	5008	
Spangdahlem AB	Spangdahlem, Germany	USAFE	52nd Fighter Wing	A/F37T-11	10	
Spangdahlem AB	Spangdahlem, Germany	USAFE	52nd Fighter Wing	A/F37T-11	311	
Spangdahlem AB	Spangdahlem, Germany	USAFE	52nd Fighter Wing	A/F37T-11	6	
Tinker AFB	Oklahoma City, OK	AFRC	507th Airlift Wing	A/F37T-10	230	1989
Tinker AFB	Oklahoma City, OK	AFRC	507th Airlift Wing	large test cell	214	1942
Tinker AFB	Oklahoma City, OK	AFRC	507th Airlift Wing	large test cell	3703	1954
Tinker AFB	Oklahoma City, OK	AFRC	507th Airlift Wing	large test cell	3234	1974
Travis AFB	Fairfield, CA	AMC	60th Air Mobility Wing	Large	80091	1968
Tyndall AFB	Panama City, FL	AETC	325th Flying Training Wing	A/F37T-10	116	
Tyndall AFB	Panama City, FL	AETC	325th Flying Training Wing	A/F37T-10	250	
Vance AFB	Enid, OK	AETC	71st Flying Training Wing	A/F32A-18		
Vance AFB	Enid, OK	AETC	71st Flying Training Wing	A/F32A-18		
Vance AFB	Enid, OK	AETC	71st Flying Training Wing	A/F32T-4		
Vance AFB	Enid, OK	AETC	71st Flying Training Wing	A/F37T-12	705	
Whiteman AFB	Johnson County, MO	ACC	509th Bomb Wing	A/F32T-9	5006	

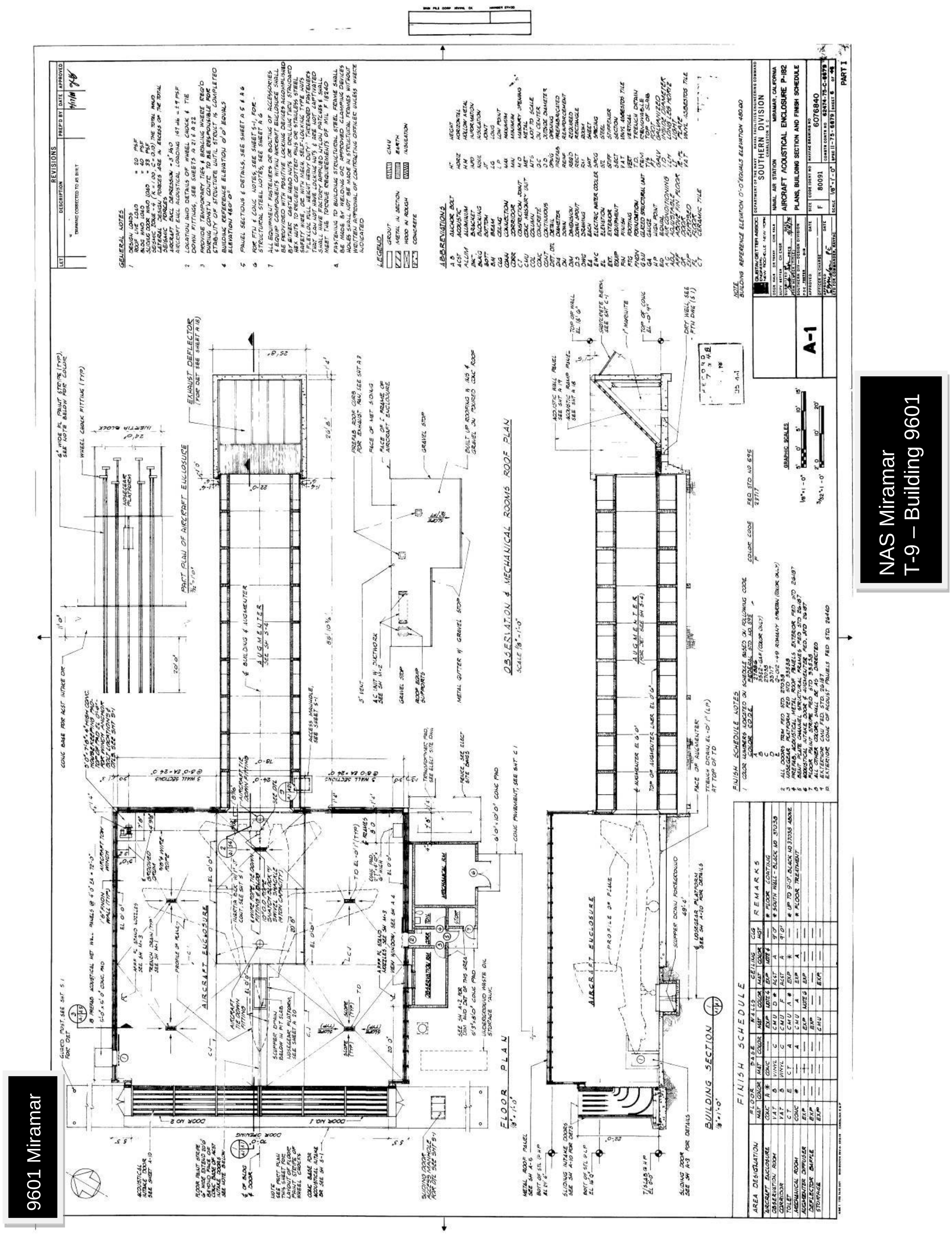
(a) from email correspondence

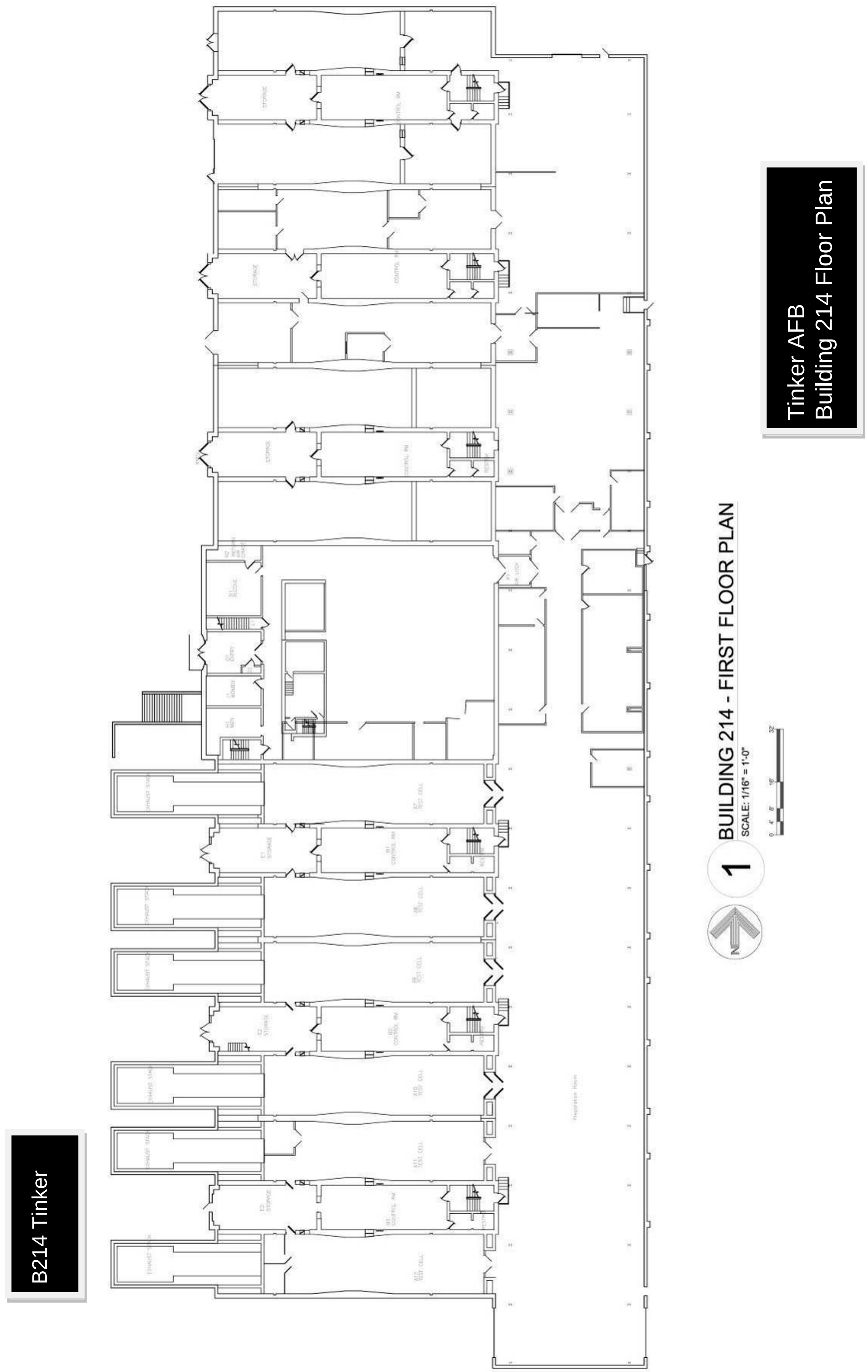
APPENDIX B: DRAWINGS

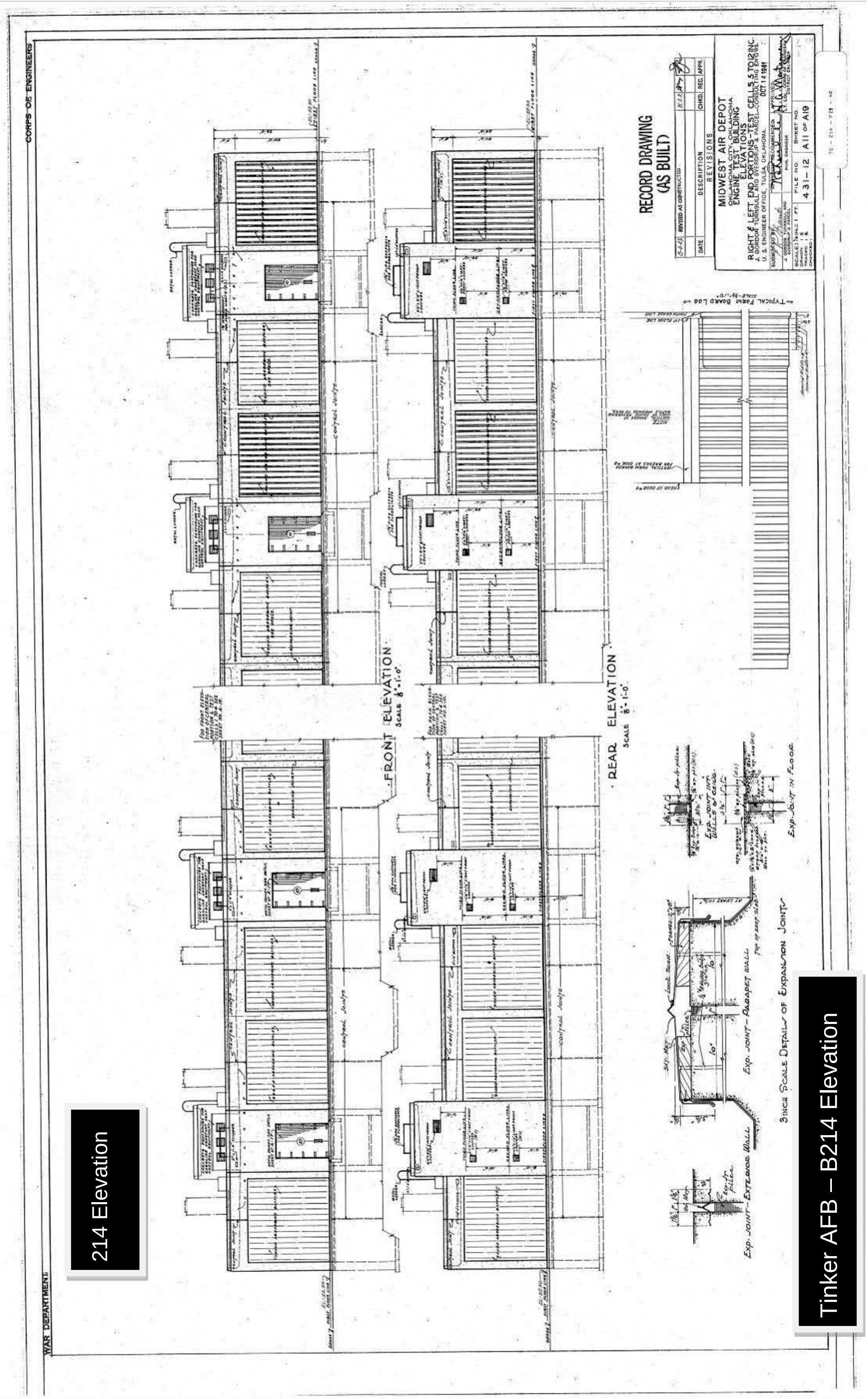

0056 Truax
Truax ANGB – Sketch T-10 – Building 56
HUSH HOUSE SKETCH
DOOR FRAME
24'
ENTRANCE
10'
DEFLECTOR
EARTH BERM
22'
14'
AUGMENTOR TUBE
HUSH HOUSE

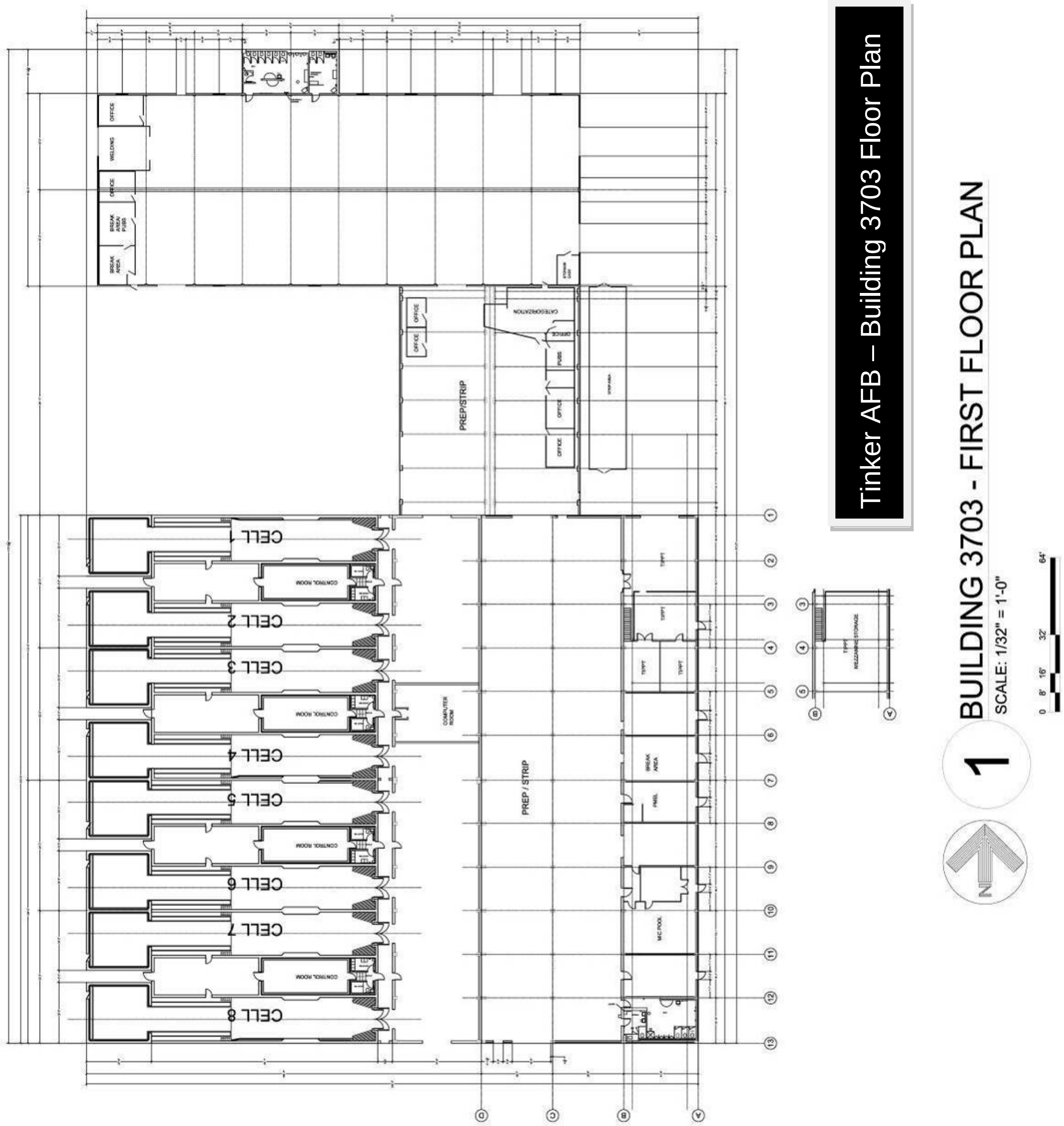

116 Oceana
NAS Oceana
T-9 – Building 1116


B116 Oceana
NAS Oceana
T-9 – Building 1116
ELEVATION
A-4
ATLANTIC DIVISION
AIRCRAFT ACOUSTICAL ENCLOSURE


9601 Miramar
NAS Miramar
T-9 – Building 9601
A-1
SOUTHERN DIVISION
MIRAMAR, CALIFORNIA
AIRCRAFT ACOUSTICAL ENCLOSURE P-182
PLANS, BUILDING SECTION AND FINISH SCHEDULE

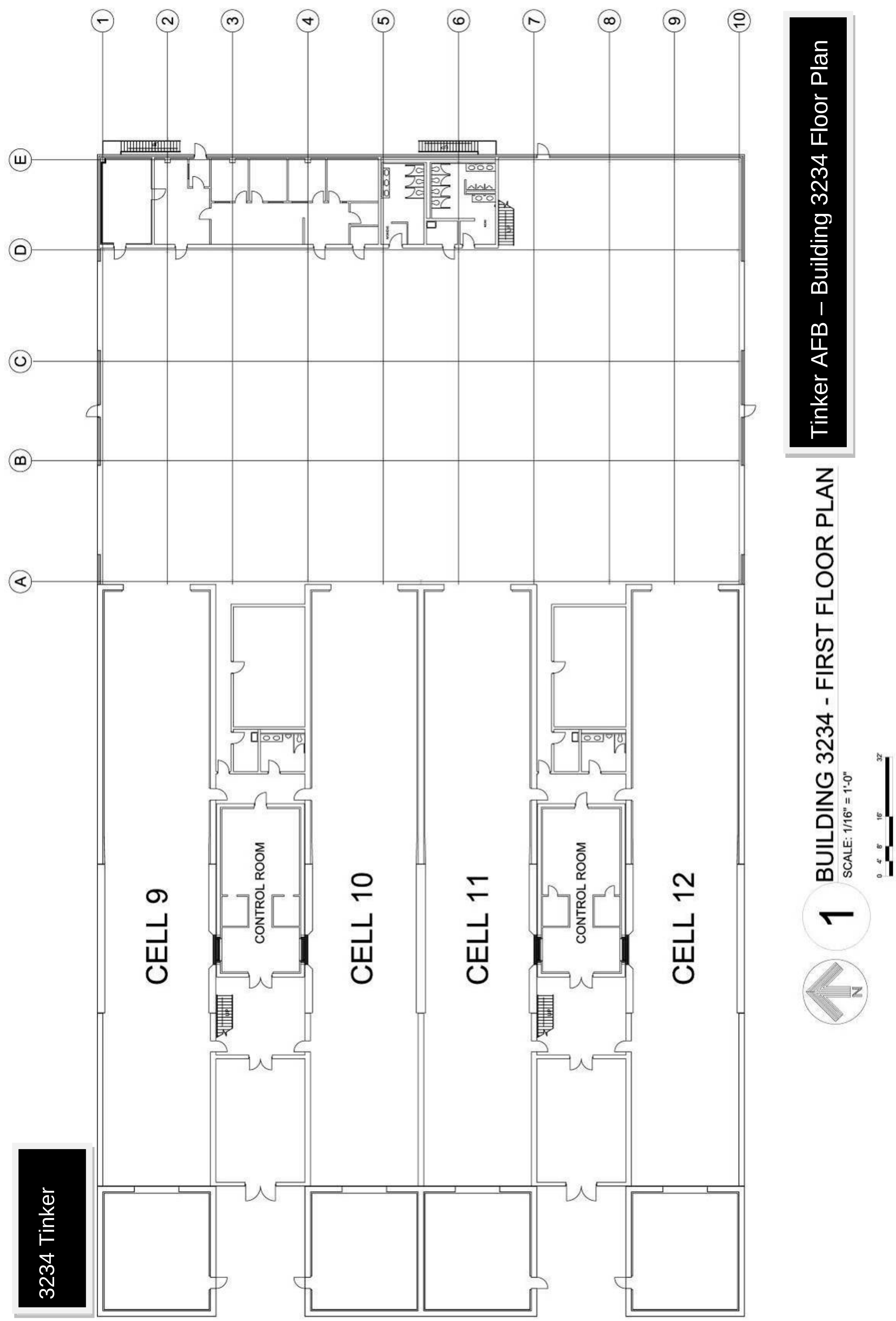

Tinker AFB
Building 214 Floor Plan
1
BUILDING 214 - FIRST FLOOR PLAN
SCALE: 1/16" = 1'-0"
B214 Tinker

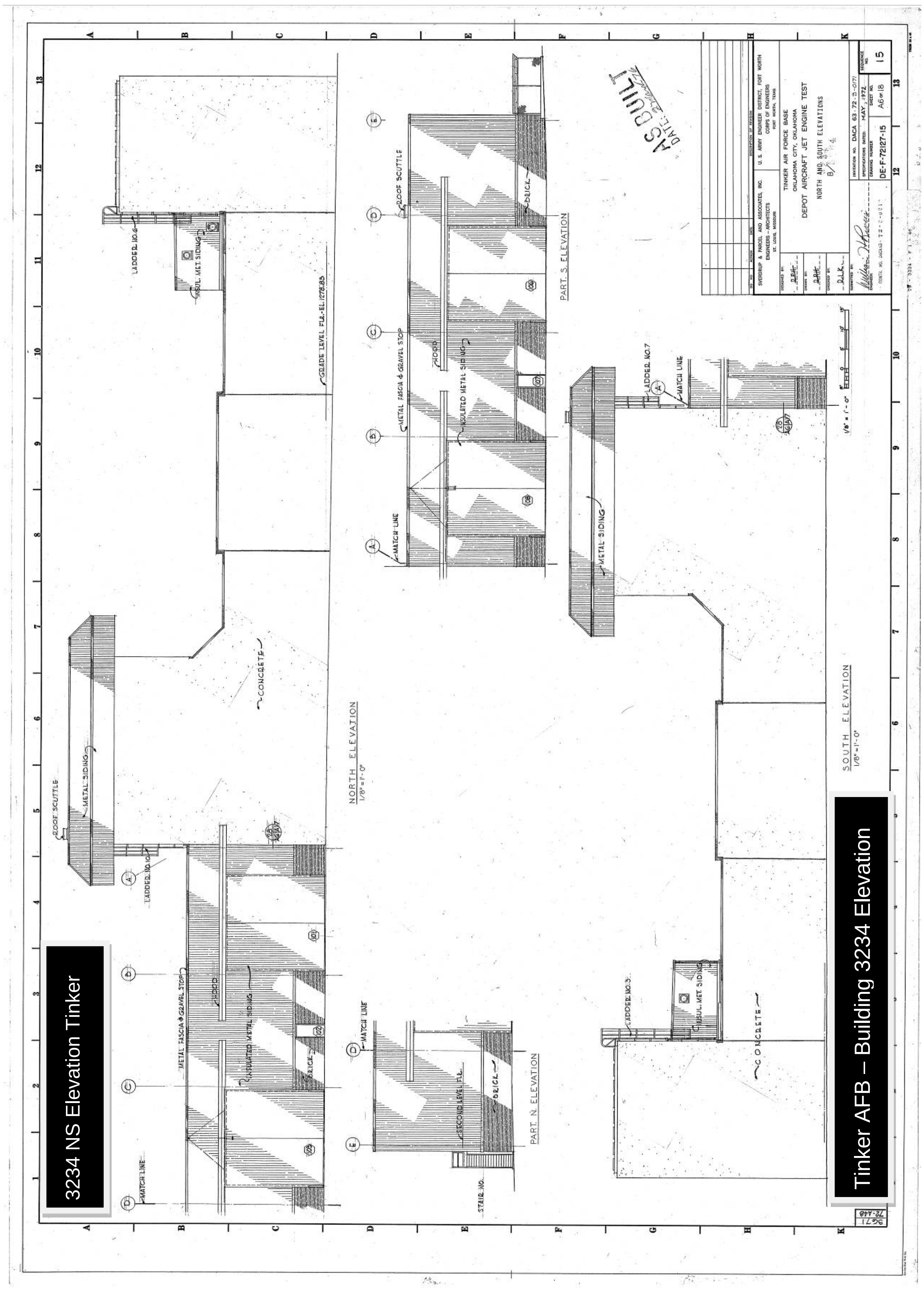

CORPS OF ENGINEERS
WAR DEPARTMENT
214 Elevation
FRONT ELEVATION
REAR ELEVATION
RECORD DRAWING
(AS BUILT)
MIDWEST AIR DEPOT
Tinker AFB – B214 Elevation

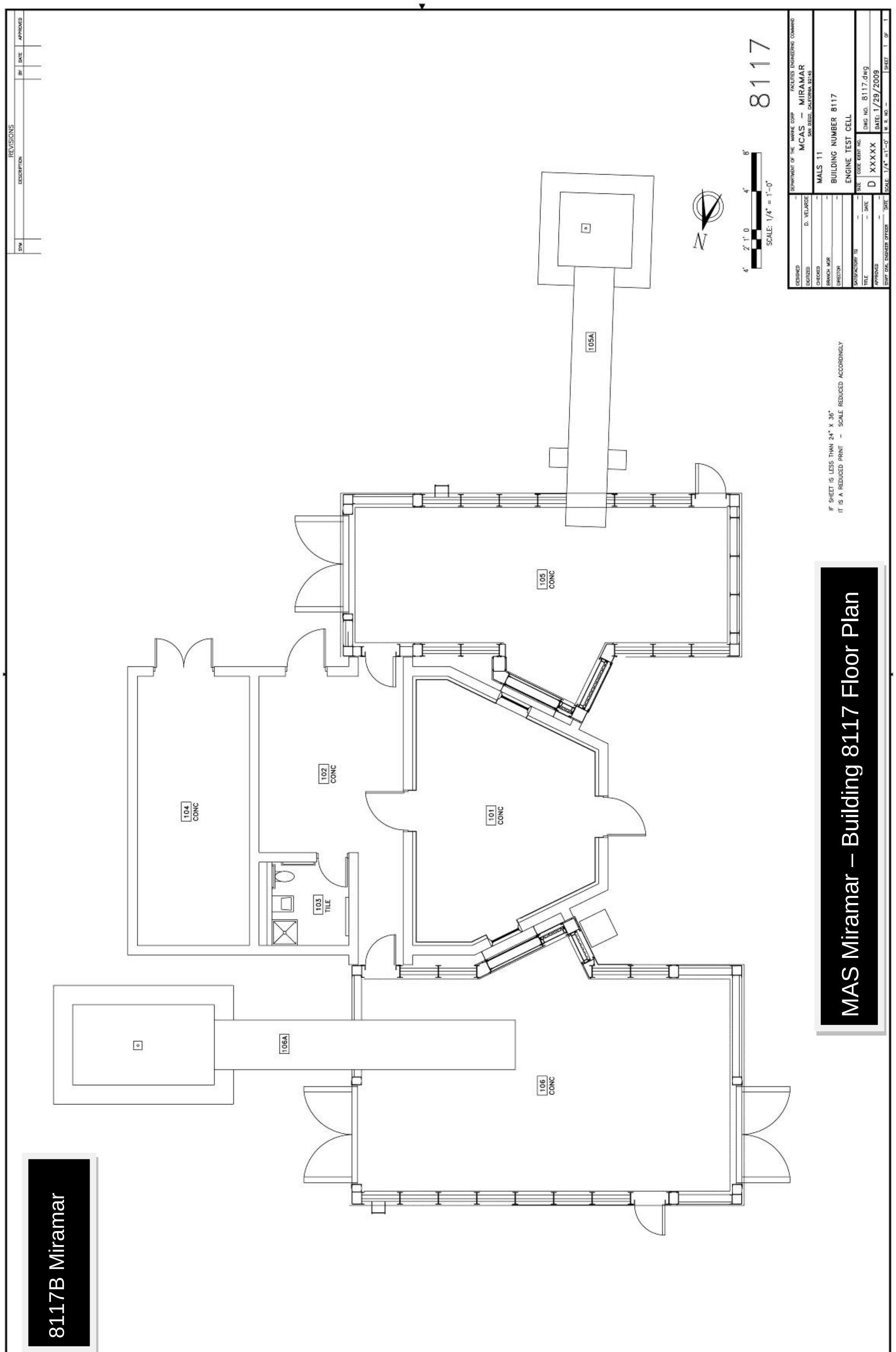


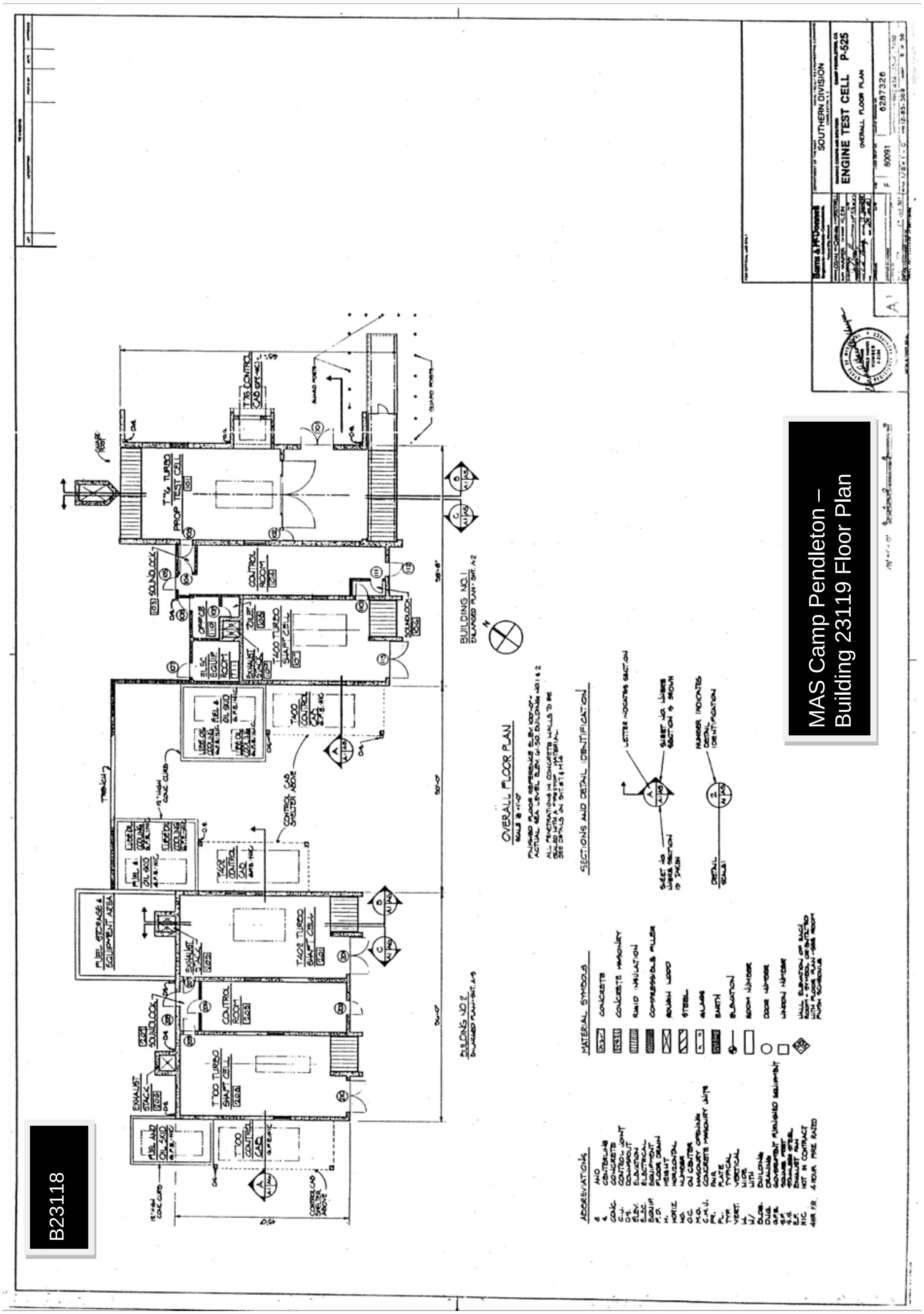
Tinker AFB – Building 3703 Floor Plan

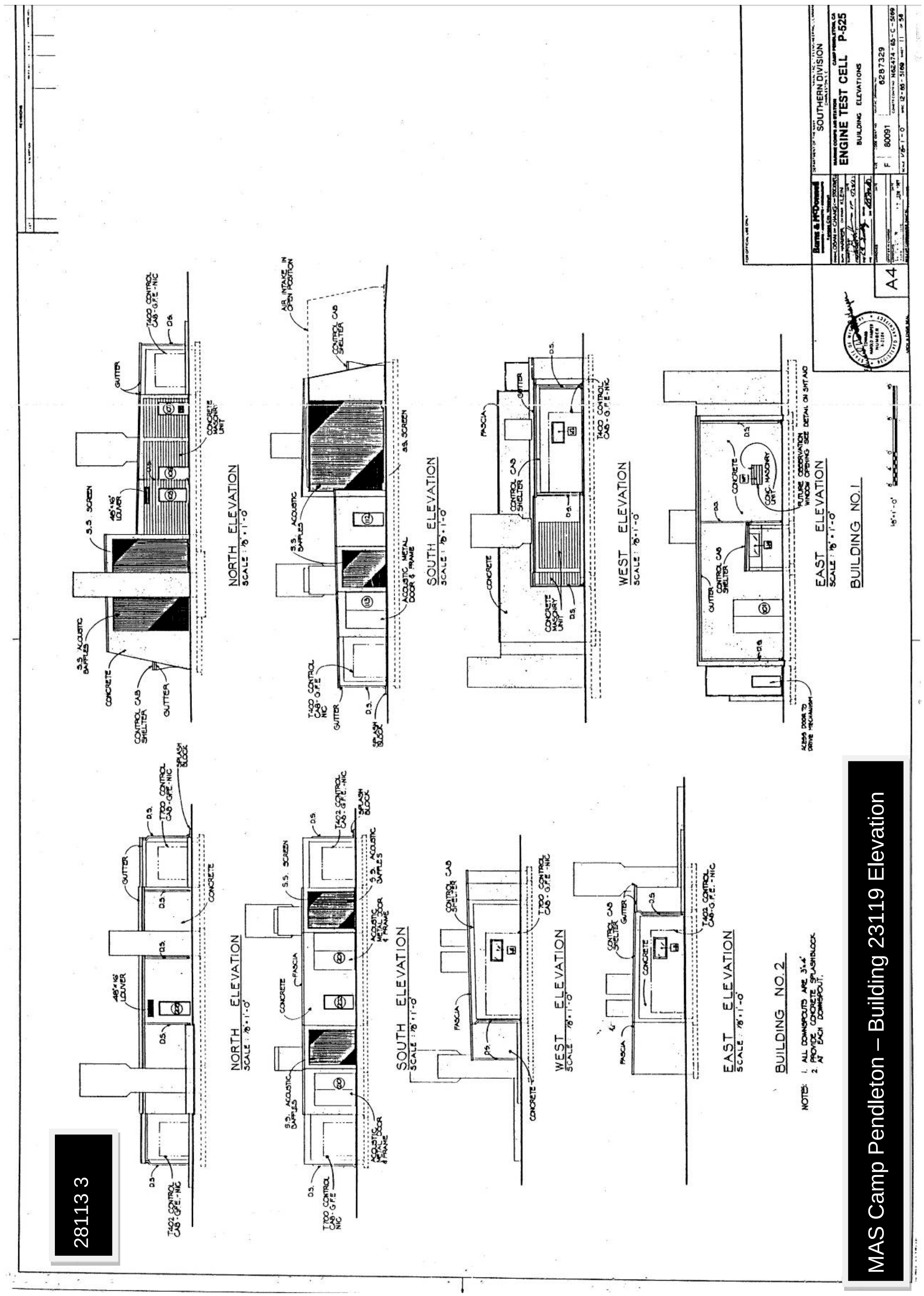
3703 Tinker

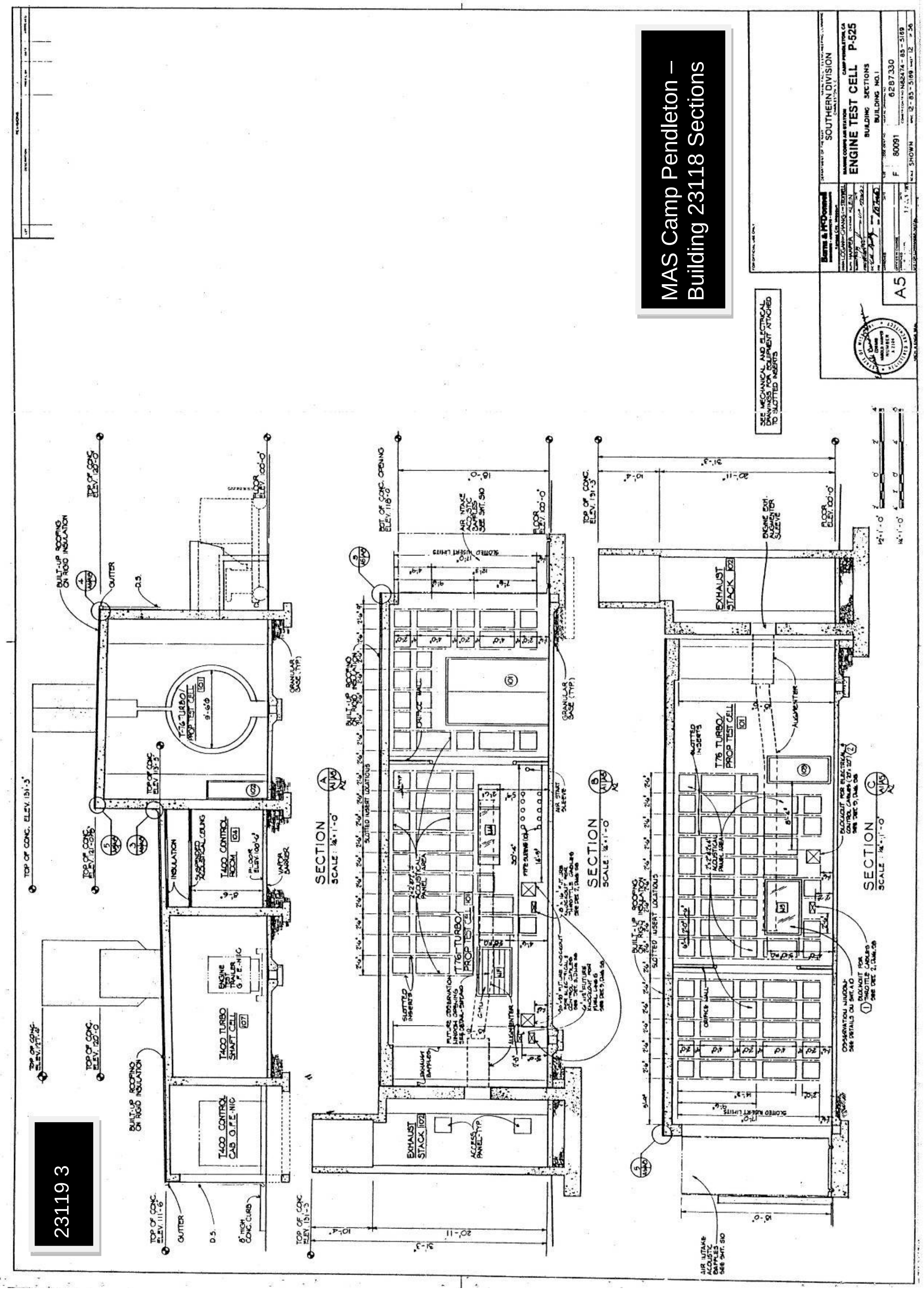

Tinker AFB – Building 3234 Floor Plan
3234 Tinker
BUILDING 3234 - FIRST FLOOR PLAN
SCALE: 1/16" = 1'-0"
1
N
A
B
C
D
E
1
2
3
4
5
6
7
8
9
10
CELL 9
CONTROL ROOM
CELL 10
CELL 11
CONTROL ROOM
CELL 12

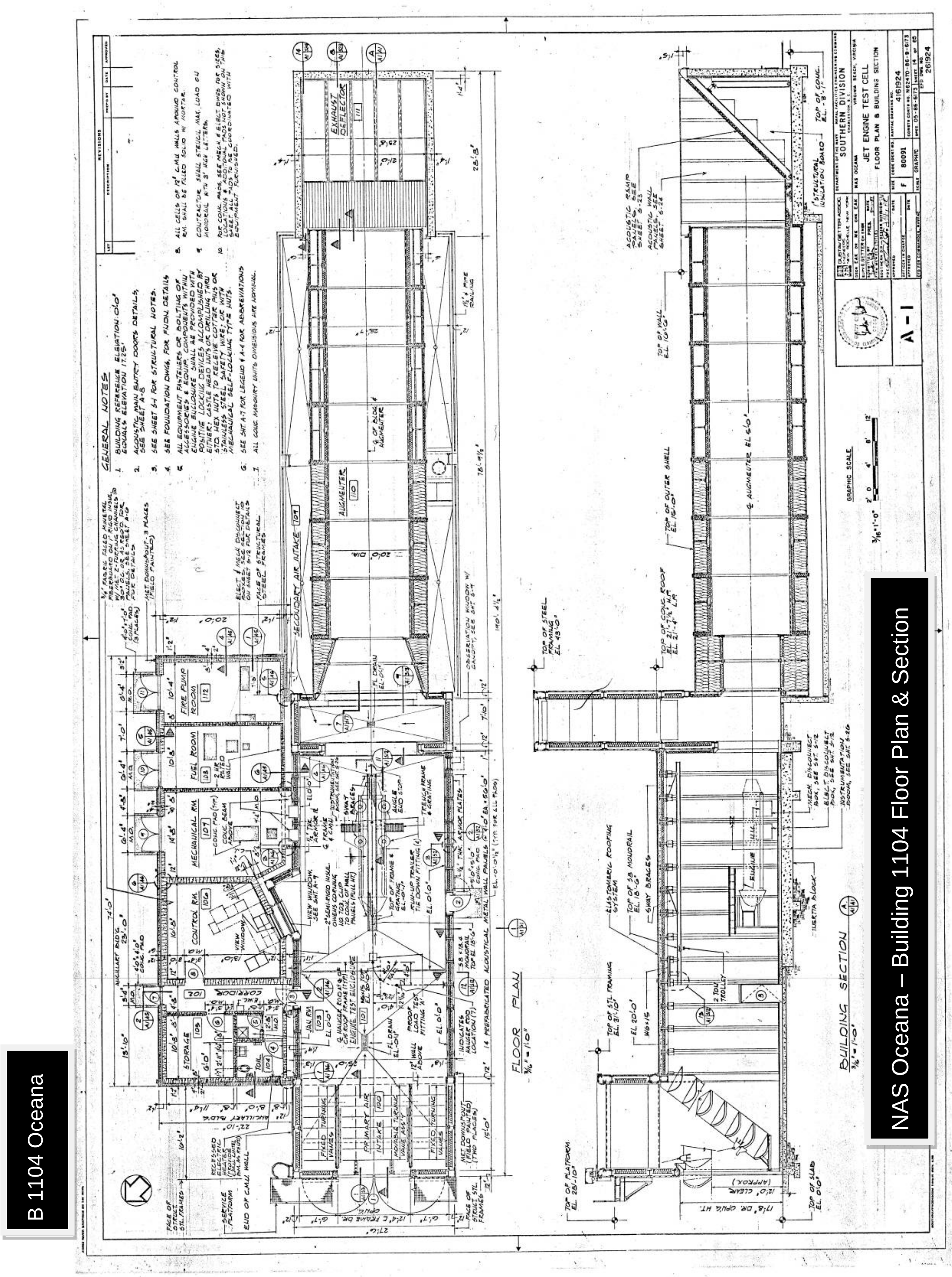

3234 NS Elevation Tinker
Tinker AFB – Building 3234 Elevation
NORTH ELEVATION
SOUTH ELEVATION
PART. S. ELEVATION
PART. N. ELEVATION
AS BUILT
TINKER AIR FORCE BASE
OKLAHOMA CITY, OKLAHOMA
DEPOT AIRCRAFT JET ENGINE TEST
NORTH AND SOUTH ELEVATIONS

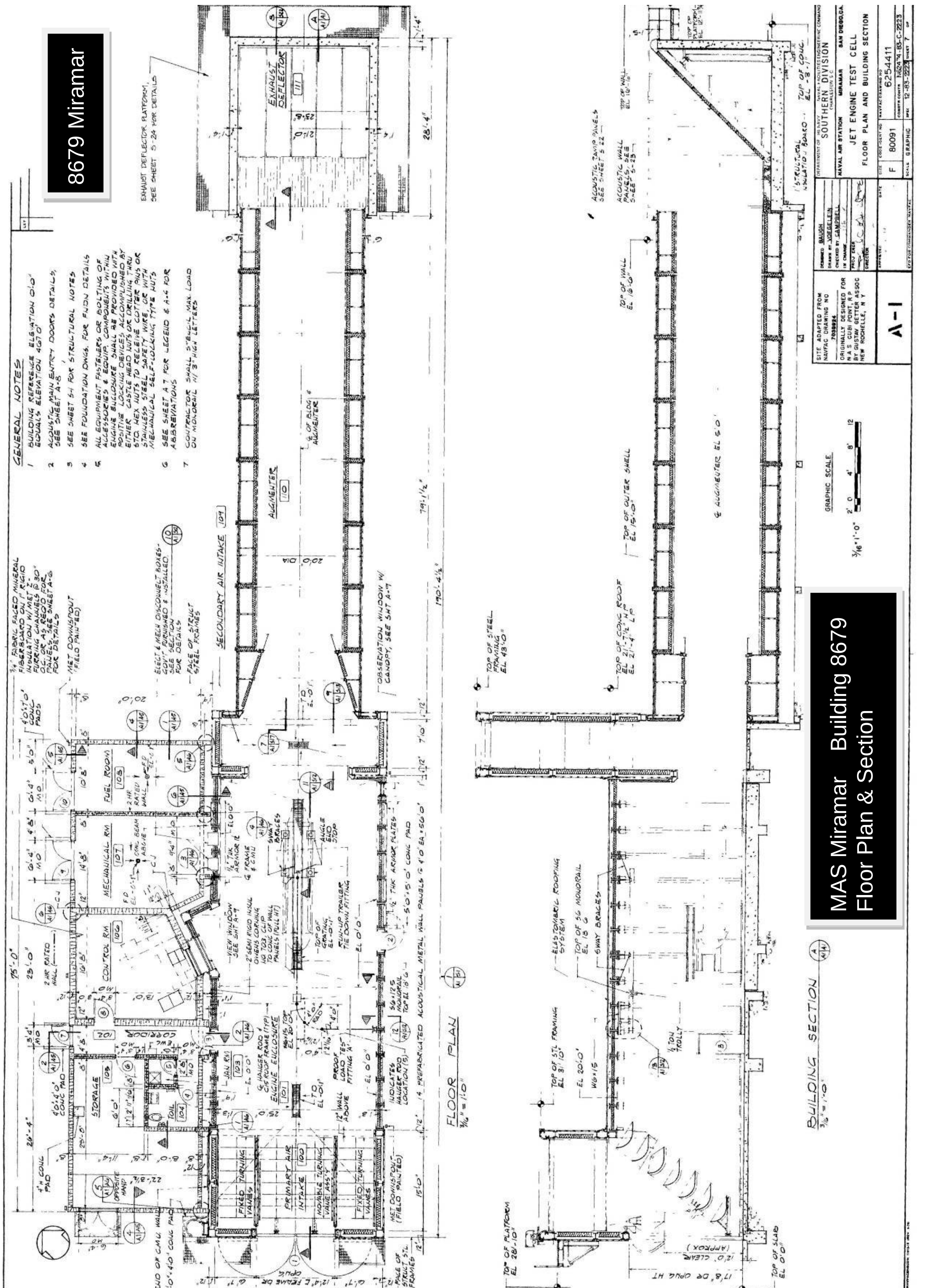

MAS Miramar – Building 8117 Floor Plan
8117B Miramar
8117
105 CONC
105A
101 CONC
102 CONC
103 TILE
104 CONC
106 CONC
106A
SCALE: 1/4" = 1'-0"
MCAS – MIRAMAR
MALS 11
BUILDING NUMBER 8117
ENGINE TEST CELL
D. VELARDE
DWG NO. 8117.dwg
DATE: 1/29/2009
IF SHEET IS LESS THAN 24" X 36"
IT IS A REDUCED PRINT – SCALE REDUCED ACCORDINGLY

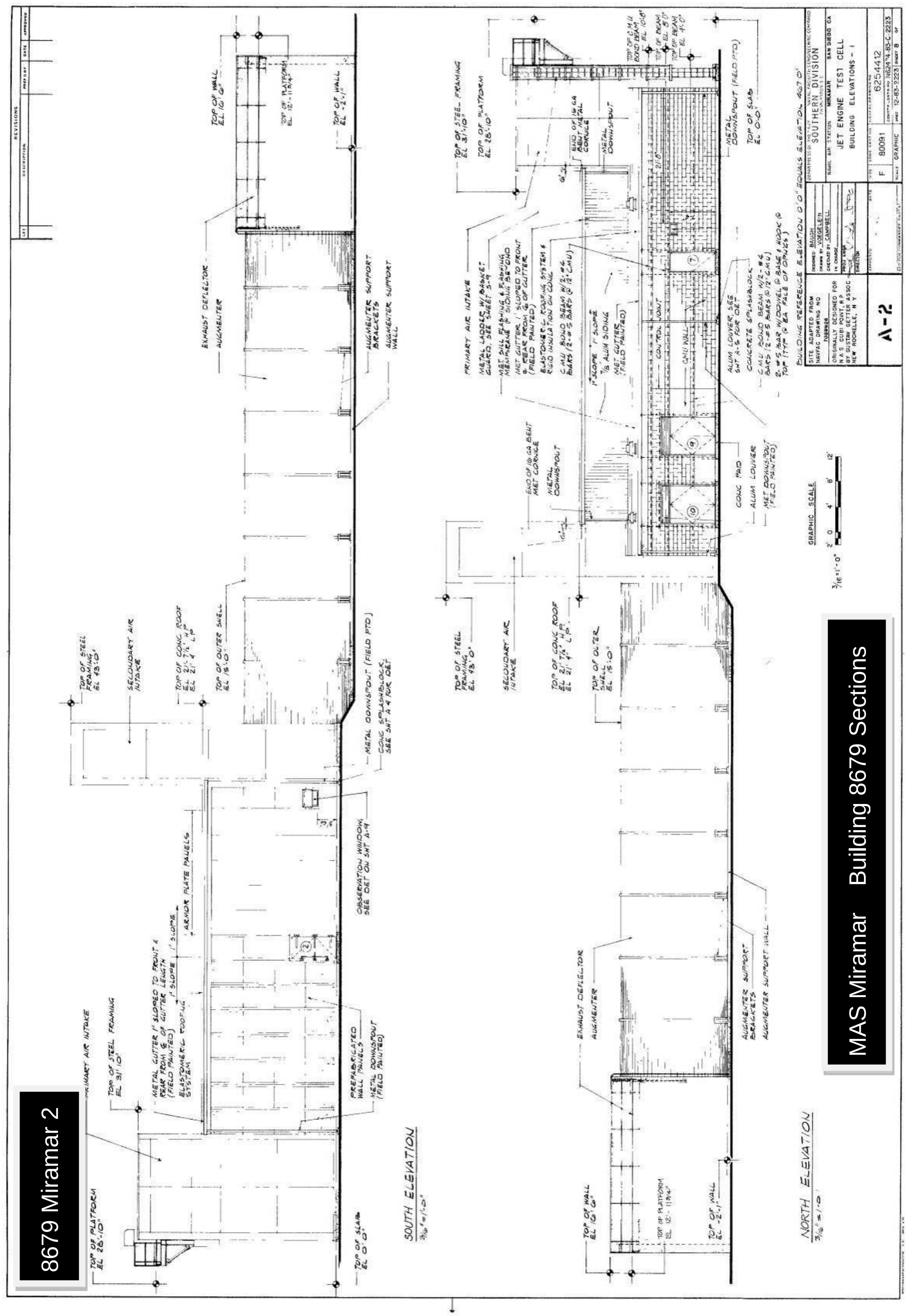

MAS Camp Pendleton –
Building 23119 Floor Plan
B23118


MAS Camp Pendleton – Building 23119 Elevation
28113 3
NORTH ELEVATION
SOUTH ELEVATION
WEST ELEVATION
EAST ELEVATION
BUILDING NO. 1
BUILDING NO. 2
SOUTHERN DIVISION
ENGINE TEST CELL P-525
BUILDING ELEVATIONS
A4


MAS Camp Pendleton – Building 23118 Sections
23119 3


B 1104 Oceana
NAS Oceana – Building 1104 Floor Plan & Section


8679 Miramar
MAS Miramar Building 8679
Floor Plan & Section


8679 Miramar 2
MAS Miramar Building 8679 Sections
SOUTH ELEVATION
NORTH ELEVATION
JET ENGINE TEST CELL
BUILDING ELEVATIONS - I
A-2