Mk 45 Naval Gun System

5-Inch 54-Caliber and 62-Caliber
Mods 0, 1, 2, 2 CCS and 4
Mk 45 All Mods — System Operations View

**Installations**

The Mk 45 Mod 0 was developed and produced by BAE Systems, as the world’s lightest, most compact, 5-inch (127-mm) 54-caliber, fully automatic naval gun system. This basic configuration Mk 45 was initially deployed onboard the U.S. Navy’s CALIFORNIA and VIRGINIA-Class cruisers and SPRUANCE-Class destroyers, followed by installations onboard TARAWA-Class Amphibious Assault ships, and early TICONDEROGA-Class cruisers.

In subsequent years, the Mk 45 Mod 1 and 2 systems incorporated ongoing technology enhancements to system controls and ammunition handling subsystems, and integrated features to improve overall reliability and maintainability. In total, the Mk 45 Mods 0 through 2 naval gun systems were selected for more than 200 installations onboard cruisers, destroyers, frigates, and amphibious assault ships in the U.S. Navy’s fleet and seven other allied nations. The Mk 45 Mod 4 is BAE Systems’ newest 5-inch (127-mm) 62-caliber gun mount in U.S. Navy service today. The enhanced gun system is ready to significantly improve surface combatant’s capabilities for Naval Surface Fire Support (NSFS), as well as overall gunfire mission performance.

A number of major subsystem upgrades introduced with the Mod 4 naval gun system have been specifically tailored to allow the Mk 45 to handle and fire high energy munitions, and to optimize performance of new and existing ammunition types. Additional upgrades are also in place to ease system operation and maintenance, optimize availability, and reduce radar signature of the topside mount.

In total, the Mk 45 Mod 4 naval gun system is a fully automatic weapon that is ready today with a wide range of proven features:

- Fully stabilized gun laying with high precision pointing accuracy
- Conventional and extended length projectile handling capabilities
- Designed to be capable of higher chamber pressures to achieve extended ranges
- Ammunition selectivity
- Minimal space requirements
- Minimal crew requirements
- Modular adaptability
- Designed to Military Standard (MIL-STD)-901 shock requirements
- Combat system integration flexibility
- Nuclear, Biological, Chemical (NBC) and environmental survivability
- Advanced gun shield design
- Control system component commonality
- Built-in test and fault isolation capabilities
- Simulation trainer designs available
- Logistics support available worldwide

**Effective Operation**

The Mk 45 Mod 4 combines sub-system upgrades and major firepower enhancements with the baseline system’s well-established capabilities for all-weather, day/night operation and very high mission availability. The Mk 45 Mod 4 is a proven effective weapon that incorporates the latest technologies for today’s multimission warships.

The improvements incorporated into the Mk 45 Mod 4 naval gun system optimize system performance for a wide variety of naval gunfire missions when using the diverse inventory of U.S. Navy and NATO 5-inch ammunition. The Mk 45 Mod 4 structural and ballistic upgrades, including strengthened structural components and lengthened 62-caliber gun barrel, all serve to enhance both gun range and accuracy performance for all rounds fired from the new system.

In July 2000, Mk 45 Mod 4 successfully performed rigorous shipboard structural firing tests onboard USS SIR WINSTON CHURCHILL DDG 81, using both conventional ammunition types and 5-inch extended range simulated rounds. The test results prove full ship platform and Mk 45 Mod 4 readiness to support NSFS Missions.

**Fire Mission Flexibility**

The Mk 45 Mod 4 service-ready loader drum accommodates either 20 conventional semi-fixed rounds, 10 extended-length projectiles with 10 separate propelling charges, or a mixture of both ammunition types. A hoist loading station located below-deck and adjacent to the ammunition magazine permits continuous loader drum replenishment during sustained firing without interrupting the fire mission.

Round selectivity allows the Fire Control System (FCS) operator to select and fire any of the ammunition types stored in the system loader drum, in any order desired. This is an important feature when using the many general- and special-purpose 5-inch ammunition types available for the Mk 45 Mod 4.

The Mk 45 Mod 4 can load, fuze, and fire all existing types of U.S. Navy 5-inch (127-mm) separate loading ammunition to include multiple fuze configurations without adjustment or alteration. This includes handling of specialized propelling charges for extended-length ammunition types with separate propelling charges.

**Automatic Operation**

All Mk 45 naval gun systems provide ships with a reliable automatic weapon system against surface, land, and air targets. Highly accurate train and elevation response rates permit engaging these targets under all operating environments and sea conditions. Fully stabilized automatic aiming, combined with rapid system response to FCS commands, ensures the gun delivers maximum accuracy and munitions lethality.

The Mk 45 gun mount provides fully automated operation during gunfire missions, with no crewmember required in the gun shield housing. Remotely controled, power operated misfire ejection capabilities permit safe and rapid cartridge case removal and return to operation — a vital feature in combat situations.

All Mk 45 Mods are capable of variable load-and-fire rates in fully-automatic operation. For the Mk 45 Mods 2 and 4, extended-length projectiles and separately handled propelling charges can also be stored in the magazine, loaded and fired automatically.
Mk 45 All Mods — Flexible Firepower

Ammunition Inventory

Firepower flexibility of the Mk 45 Mod 4 naval gun system is achieved with the combination of several unique and proven features:

- Multi-mission ammunition inventory
- Mixed ammunition load capacity
- Remote round-to-round selectivity
- Advanced fire control adaptability

Multi-Mission Ammunition Inventory

The Mk 45 Mod 4 is designed to take full advantage of the U.S. Navy’s complete inventory of 5-inch conventional as well as the capability to fire 5-inch high energy ammunition.

Ammunition handling and control features include the capabilities to selectively store, track, load, and fire a variety of different specialized projectile, fuze types, and propelling charge variants in response to mission requirements. For example, high explosive, illuminating, and extended-range rounds can be configured and sequenced in the loader drum and ammunition hoist to fit specific mission requirements for land attack mission objectives. Effectiveness is further enhanced with the system’s ability to handle a diverse inventory of other specialized ammunition types.

Mixed Ammunition Load Capability

The Mk 45 Mod 4 system has a mixed ammunition load capability that allows for simultaneously carrying up to nine different projectile/fuze/cartridge case types in the loader drum. All nine ammunition types are available for instant access and loading to the gun for fast reaction to changing mission requirements. Replenishment is automatic, as rounds are made available from the lower loading station.
**Mk 45 All Mods — Flexible Firepower** (continued from page 5)

Remote Round-to-Round Selectivity — The remote round-type selection feature of the Mk 45 Mod 4 naval gun system allows Fire Control Systems (FCS) operators to select and fire different round types from the loader drum without Electrical Panel 2 (EP2) operator intervention. Remote round-type selection allows instant fire control flexibility to adapt to rapidly changing combat situations.

Advanced Fire Control Adaptability — Mk 45 Mods 0 through 2 and 4 naval gun systems can be adapted to a wide range of the latest gun FCS in varying applications onboard U.S. Navy ships and in a number of international fleets. This includes proven compatibility with U.S. Navy and international Mk 45 naval gun system applications with the Mk 86 FCS, Mk 160 FCS, Thales STIR WM 25 FCS, SAAB Tech 9 LV 453 FCS, and the FABA Dorna FCS.

The versatile Mk 45 Mod 4 naval gun system is optimized for new adaptations to the latest FCSs with the introduction of a fiber-optic high-speed digital fire control interface for the U.S. Navy applications. The Mk 160 FCS has progressed from it's initial digital introduction with Mod 8 to the most current Mod II design.

The inherent gun pointing accuracy of Mk 45 Mod 4 maximizes the overall gun weapon system accuracy achievable with any FCS. The Mk 45 Mod 4 enhanced fiber-optics high-speed digital fire control interface will accommodate future improvements to FCS accuracy, and provides for growth requirements to accommodate integration of future fire control variants, ammunition types, and ancillary capabilities.

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**Mk 45 Mod 4 — Physical Description**

5-Inch 62-Caliber Gun System

The Mk 45 Mod 4 naval gun system is the lightest 5-inch (127-mm) 62-caliber automatic gun system available today. Total system weight (without the lower ammunition hoist) is 24,389 kilograms (53,770 pounds). When coupled with the four-flight Lower Ammunition Hoist Mk 6, total system weight is 26,182 kilograms (57,722 pounds). Total system weight depends on hoist length for specific ship configurations.

The Mk 45 Mod 4 naval gun system consists of two component groups: the lower structure (below deck) and the upper structure (above deck). The components of the lower structure deliver an uninterrupted flow of ammunition to the gun. The upper structure components load the ammunition, provide for gunfire sequencing and ejection of the empty propelling charge case.

Lower Ammunition Hoist Mk 6 (optional) provides an ammunition load station and vertical transfer mechanism for ships with magazines located below the loader drum deck.

General Layout

Upper Structure — The upper structure consists of the stand, carriage, slide, cradle, breechblock and breech mechanism, gun barrel housing, and gun shield. Functionally, the upper structure includes the upper gun loading system and the gun laying system.

1. **Gun Shield**
   - Aluminum enclosure for weather, ballistic, and NBC protection of gun components. The upper structure [gunhouse] is unmanned during system operation.
   - Supports access doors, system ventilation, hydraulic header tank, and depression buffers integral to the shield.

2. **Breechblock**
   - Secures round in gun barrel for firing, connects electrically actuated firing pin, and contains explosive pressure upon firing.

3. **Gun Port Shield**
   - Provides a dynamic enclosure that covers and seals the elevation arc of the gun, and mounts weatherproof ports for the gun barrel and case ejection.

4. **Breech Mechanism**
   - Hydraulic piston-actuated linkage that raises and lowers breechblock and components required to extract propelling charge after firing or a misfire event.

5. **Gun Barrel Housing**
   - Supports the breech end of the gun barrel.
   - Mounts recoil and counter recoil cylinders, and a valve-operated gas ejection system to clear residual gases from the gun barrel.

6. **Carriage**
   - Provides base ring and trunnion supports for upper gun.
   - Mounts train and elevation power drives, upper accumulator system, slide assembly, and shield.
   - Provides an axis for train and elevation functions of the gun.

7. **Stand**
   - Provides a deck mounted platform for stationary components of the train bearing and gear ring.

8. **Cradle**
   - Man to gun elevation axis to transfer vertically oriented ammunition from the upper hoist to the pointing angle of the gun slide to facilitate breech loading.

9. **Slide**
   - Man as for the gun firing components, including cradle, breechblock, and breech mechanisms; gun barrel housing; and empty case extractor and tray.
   - Mounts trunnions for gun elevation axis; mounts elevation gear sector.

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**5-Inch 54-Caliber and 62-Caliber Mods 0 Through 2 and 4**

**Mk 45 Naval Gun System** — 5-Inch 54-Caliber and 62-Caliber Mods 0 Through 2 and 4
Lower Structure — The lower structure includes the lower ammunition hoist, Extended Length Handling Mechanism (EHM) and load station (optional), the gun system controls, loader drum, fuze setter, upper hoist, and lower accumulator system.

1. 20-Cell Loader Drum
   - Provides ammunition stowage cells to store 20 conventionally configured semi-fixed rounds, 10 extended length projectiles and separate propelling charges, or a mixed complement of both.
   - Positions rounds for fuze setting, and transfers rounds to the upper hoist.
   - Replenished by the Lower Ammunition Hoist Mk 6, or directly through its own manual load station.

2. Fuze Setter
   - Activates electronic, mechanical, and special purpose projectile fuze types in response to remote inputs from FCS. Fuzes are automatically set while the round is in the loader drum, just before transfer to the upper hoist.

3. Upper Hoist
   - Transfers ammunition received from the loader drum/fuze setter station to the cradle in the upper gun structure. During an unload cycle, ammunition is lowered from the cradle to the upper hoist station.

4. Strikedown Loading Station
   - Permits manual loading of projectiles or powder cases for transfer to the magazine level strikedown unloading station.

5. Lower Accumulator System
   - Provides hydraulic power for driving the loader drum, fuze setter, and upper and lower hoists.
   - Provides power for peak demands.
   - Stores a limited amount of pressurized fluid to complete a cycle, in the event of a power failure.

6. Lower Ammunition Hoist Mk 6 and Strikedown Tubes
   - Downloads/uploads projectiles and containerized propelling charges between the loader drum level and the below-deck magazine.
   - Consists of a pair of ammunition conveyor tubes, a hoist chain, and a chain pawl.
   - Available in several length configurations (Mods 6 through 14, 19, 21, and 23 through 26) to fit different ship configuration requirements.
   - Hoist length ranges from 2.4 to 9.14 meters (8 to 30 feet).

7. Lower Ammunition Hoist Mk 6 Load and Strikedown Unload Stations
   - Permits manual loading or unloading of rounds at these hoist locations.
   - Allows projectiles and cartridge cases to be manually placed in the loading station at the magazine level for transfer to the loader drum.

8. Mk 42 Extended Length Handling Mechanism (EHM)
   - a. Available in several configurations (Mod 0 through Mod 2) to fit different ship configuration requirements.
   - EHM loader assembly is used to handle extended length rounds from their storage containers to the loading station on the Lower Ammunition Hoist Mk 6.
   - b. EHM container hoist is used to transfer loaded extended length containers during resupply of the magazine.

System Controls

- Receives ship 440-Vac 60-Hz power, converts to 115-Vac 60-Hz power, and distributes throughout the gun system and other control panels. Protects against line voltage transients.
- Provides motor starters, power supplies, and batteries to allow safe completion of a firing sequence in the event of a power failure.
- The Mk 45 Mod 4 design eliminates the requirement for 115-Volt 400-Hz power with the displacement of powered synschor.

Control panel EP2
This local operator’s station includes switches, indicators, and touchscreen controls required to safely select operational modes, monitor, and maintain the gun system.

Operational features allow:

- Fully automatic and computerized control of all major gun mount functions
- Fast start-up including remote start capability to enhance gun operational readiness
- Mixed ready-service ammunition loadout and inventory tracking, and unconstrained round selectivity for firing
- Fuze setting for conventional ammunition including mechanical time and electronic and RF
- Mechanical and electromagnetic initialization interfaces
- Automatic ammunition identification
- Transfer of gun system control to FCS for automatic or remote operation
- Magazine load orders to be linked to FCS
- Maximizing firing range for each round type with ammunition dependent nonfiring zones
- Step or automatic gun cycling without ammunition, while simulating the presence of ammunition.
- When initialization and interface components are installed, handling and fire operations for Extended Length Munition include:
  - Global positioning system (GPS) receiver and crypto key handling for Extended Length Munition initialization.
  - High bandwidth fire control interface to support large volume of initialization data.
Mk 45 Mod 4 — Physical Description (continued from page 9)

Safety features allow:
• Loading system sequencing interlocks
• Controls and sensor redundancy for positioning and firing
• Hot gun prediction
• Local controls for loading, pointing, and firing functions

Maintenance features allow:
• Extensive online Built-In Test (BIT):
  • Provides “Advisory”, “Caution”, “Warning”, and “Fault” displays with descriptive detail
  • Codes/links fault indicators to detailed isolation procedures
  • Isolates 80% of faults to a single line replaceable unit
• Provides maintenance aid functions for gun mount sensor and control output status and actuator timing checks
• Eliminates degradation or interference with gun mount operation
• Extensive offline BIT:
  • Failure isolation with offline circuit card specific tests to complement online testing
  • BIT director to:
    • Test pointing system and mechanical fuze setter performance
  • Provide data via EP2 display, with PC port for output to digital storage and analog test jacks for chart recorder
  • Access computer status via maintenance monitor port
  • EP2 internal test display to:
    • Interface with operator for offline circuit card tests
    • Provide backup/alternative display for system fault status

Display panel EP3
• Located adjacent to the lower hoist load station, EP3 displays commands to load, cease load, or offload ammunition for ammunition handlers at the magazine level
• EP3 displays the projectile, fuze, and powder case type required for transfer

• Trunnion-mounted displays provide gun position readouts
• Elevation digital display assembly EP4 and train digital display assembly EP5 facilitate adjustment/alignment

Mk 45 Mod 4 — Functional Description

Ammunition Handling Firing Sequence
The Mk 45 Mod 4 can load, fuze, and fire all existing types of U.S. Navy 5-inch (127-mm) separate loading ammunition as well as extended range ammunition, which consists of two pieces in a semi-fixed projectile/cartridge case configuration. The Mk 45 Mod 4 has built-in growth capability to handle and fire future extended length and other specialized 5-inch ammunition.

Mk 45 ammunition handling components allow discrete storage and loading of extended-range, precision, guided/rocket-assisted, or cargo-configured projectiles and cartridge cases. In addition to automatic mechanical fuze setting capabilities, the Mk 45 Mod 4 naval gun system is equipped to handle electronic RF fuzes.

Conventional ammunition handling is achieved by a single hoist/ram/fire/eject sequence in which the semi-fixed load is handled as a single unit. The Mk 45 can achieve a firing rate of 20 rounds per minute with these types of ammunition.

Extended length ammunition requires a double hoist/ram cycle before firing to accommodate the lengthened dimension of the projectile. The first cycle loads an extended-range guided projectile into the breech and, if required, ejects a protective shroud. The second cycle then loads a cartridge case into the breech to allow firing. Extended-range cartridge cases with lengthened dimension can be handled in a similar manner.
Mk 45 Mod 4 — Functional Description (continued from page 9)

Conventional Ammunition Firing Sequence

1. Fuze set
2. Round transferred to upper hoist
3. Round hoisted to cradle
4. Cradle swings round to load position
5. Next round indexed to transfer station, and transferred to upper hoist
6. Round rammed
7. Cradle lowers to upper hoist
8. Breechblock lowers
9. Gun fires, recoils, counter-recoils, empty case tray lowers to breech
10. Upper hoist raises next round for firing
11. Breechblock opens breech
12. Empty cartridge case extracted to empty case tray
13. Empty case tray raises to ejector tube
14. Empty case ejector extends to eject cartridge case onto weatherdeck, retracts
15. Next round transferred to upper loading system

Extended-Length Ammunition Firing Sequence

1. Electronic fuze set
2. Projectile transferred to upper hoist
3. Projectile hoisted to cradle
4. Cradle raises projectile to slide
5. Projectile powder cartridge indexed to transfer station, upper hoist lowers
6. Cradle completes raise cycle, projectile rammed into breech
7. Rammer retracts, breechblock fully closes
8. Cartridge case transferred to upper hoist
9. Cradle lowers to upper hoist
10. Empty case tray lowers to breech
11. Breech opens, shroud ejected to empty case tray
12. Cartridge case raises
13. Empty case tray raises, case ejector projects shroud, retracts to cradle
14. Cradle raises cartridge case to slide, cartridge case rammed
15. Upper hoist lowers to loader drum
16. Rammer retracts, breechblock closes breech
17. Cradle lowers
18. Gun fires projectile, recoils, counter-recoils, empty case tray lowers
19. Breech opens, spent case ejects to empty case tray
20. Case tray raises to ejector tube, cartridge case ejected

Fleet Support

The fleet-proven reliability of the Mk 45 system results from incorporating the latest advances in automatic naval gun technology into an effective, practical system design that is easy to operate and maintain in the shipboard environment. A series of improved Mk 45 system features were introduced and proven effective in Mods 0, 1, 2, and 4 gun systems serving in the U.S. Navy and foreign fleets since 1973.

Most recently, BAE Systems has incorporated a number of additional technical improvements that significantly enhance system reliability, maintainability, and performance for the 5-Inch 62-Caliber Gun Mount Mk 45 Mod 4.

Proven Components and Effective Design

The Mk 45 electronics were upgraded to the latest microprocessor control circuitry with the introduction of Mod 2 systems, and further enhanced in the Mod 4.

The upgraded control circuitry is more reliable than previous solid-state control logic, and requires less power and space. Solid-state, infrared photo cells enhance reliability over mechanical switches and incandescent photocells used in earlier gun mounts. These solid-state components all contribute to overall reliability with their capability to operate effectively in the adverse conditions found aboard ship.

Simple, interchangeable, two-stage filters are used in the upper and lower accumulators and in servo and supercharged systems to protect hydraulic power drive systems. The latest Mk 45 Mod 4 naval gun system improvements can also be retrofitted to Mods 0, 1, and 2 systems.

The ease in shipboard monitoring, maintenance, and repair of the Mk 45 system contributes to excellent
Mk 45 Mod 4 — Reliability, Maintainability, and Availability (continued from page 13)

Reliability, Maintainability and Availability (RM&A).

System controls provide accurate records of usage, such as hours of motor activation and number of rounds fired. This information permits generation of a service proven maintenance schedule based upon equipment operational cycles and elapsed calendar time.

A Built-In-Test (BIT) capability continuously performs over 2,000 system tests and automatically displays a fault advisory if a fault is detected.

The latest in published and interactive electronic Mk 45 Mod 4 technical manuals provide step-by-step procedures to correct faults isolated by the BIT capability. Fault isolation is accomplished quickly and accurately from the safety of the operator’s control panel.

One operator can effectively activate and exercise the system to verify operability and readiness. An exercise mode also allows the operator to select and exercise individual load and eject operations to test specific system components. The improved fault isolation features of the Mk 45 Mod 4 control system allow circuit card testing via an off-line test system.

The standardization of many parts of the Mk 45 system provides additional assurance of total system maintainability. For example, the Mod 4 control system uses only 18 circuit cards (based on 8 common types), allowing a "repair by replacement" maintenance approach.

Mk 45 system buffers, power drives, accumulator systems, and recoil mechanisms all use the same type of hydraulic fluids to ease shipboard logistics and maintenance requirements.

Reliability Design and Testing

As a proof-of-design measure, an accelerated life test was conducted on a Mk 45 prototype to verify system reliability. The prototype was extensively tested to demonstrate RM&A performance in accordance with the design specification.

In all of the demonstrations and life simulation testing, the Mk 45 prototype dramatically exceeded specified requirements.

Additional reliability tests, performed in conjunction with the U.S. Navy, included shipboard firing of over 2,500 rounds from a single Mk 45 at maximum firing rate. With only three stoppages during the entire test, the system exceeded the U.S. Navy’s reliability requirements set for the gun system.

Subsequent Engineering Change Proposals (ECPs) addressed and corrected the failure modes that caused these stoppages before the Mk 45 entered production. These and other ECPs incorporated in almost 30 years of fleet service have yielded reliability significantly higher than the Mean Rounds Between Failure (MRBF) demonstrated on the Mk 45 prototype.

The Mk 45 system (in the Mod 1 configuration) has successfully completed barge shock testing to MIL-STD-901, making it the only system (larger than 30 mm) to have passed this stringent U.S. Navy test. The sum total of such an extensive test program is positive proof of system reliability under shock loads encountered in the combat arena.

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Additionally, the Mk 45 Mod 4 system has been tested to MIL-STD-901 shock and vibration standards, ensuring its suitability for use in the high-stress environment of naval vessels.

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Further Mk 45 reliability enhancements have been incorporated from lessons learned during overall shipboard shock tests onboard USS ARKANSAS, USS YORKTOWN, USS MOBILE BAY and USS SIR WINSTON CHURCHILL. Additional RM&A updates were incorporated during the Mk 45 Mod 4 development.

Mk 45 Mod 4 — Training, Maintenance, and Safety

Courseware, Training, and Simulation Exercises

BAE Systems offers an array of modern, interactive courseware, as well as simulation exercises for Mk 45 maintenance and operational crew training.

Interactive Multimedia Instructions

BAE Systems Mk 45 subject matter experts and instructional system developers have worked closely to develop over 30 hours of Mk 45 Interactive Multimedia Instruction (IMI) that incorporates the ease of desktop personal computers as a platform for crew training. Taking advantage of the latest technologies in multimedia based interactivity, IMI courseware optimizes the quality, efficiency, and effectiveness of training available to Mk 45 operators and maintainers.

Interactive Electronic Technical Manual

For the Mk 45 Mod 4, BAE Systems has developed and delivered the first Interactive Electronic Technical Manual (IETM) for a U.S. Navy major caliber gun system. The Mk 45 Mod 4 IETMs use state-of-the-art electronic publishing systems populated with technical data content authored in Extensible Markup Language (XML) that can be viewed through a highly capable and flexible desktop browser. Working from a single CD ROM, it allows operators and maintainers instant access to over 4,000 pages of technical data, operation and maintenance procedures, and reference material. The Mk 45 IETM can be viewed on any Windows-based workstation through an intuitive and user friendly Graphical User Interface (GUI), providing a significant boost to the timeliness and accuracy of operations and maintenance tasks.

BAE Systems also provides hard copy supplements such as reference drawings and schematics that enhance the overall effectiveness of the Mk 45 Mod 4 technical manual set.

Land-Based Test Units

Mk45 Land Based Test Units (LBTU’s) are utilized to allow hands-on training with all mechanical and electrical systems, and all operational conditions of a shipboard system. The LBTU can also be used as the foundation of a comprehensive maintenance training program.

BAE Systems combines the richness of IMI training methodologies and the flexibility of the IETM with hands on training delivered by highly experienced instructors utilizing LBTU training aids. It provides fully integrated operator and maintenance training solutions that are available to support any Mk 45 training scenario, in advance of crews initiating shipboard operations.
Mk 45 — International Applications/Worldwide Support

Ship Applications
The Mk 45 Mod 4 system is the naval gun of choice worldwide with its unique ability to meet a wide variety of naval mission and performance requirements for surface combatants. In addition to fleet-wide service with the U.S. Navy, the Mk 45 Mod 4 and Mod 1, 2 and 2BCCS systems are in service with the fleets of Australia, Denmark, Greece, Japan, The Republic of Korea, New Zealand, Spain, The Republic of China (Taiwan), Thailand, and Turkey.

The compact, lightweight Mk 45 gun system is also the preferred medium-caliber gun for the modular applications in modern, multi-purpose warship designs.

BAE Systems has a licensed co-production agreement with Hyundia—WIACORP of the Republic of Korea (ROK) to provide Mk 45 Mod 4 gun systems for installation onboard the ROK Navy’s KDX-II, KDX-III Destroyers and FFX Frigates. BAE Systems also has a licensed co-production agreement with Japan Steel Works (JSW) of Japan to provide MK 45 Mod 4 guns to Japan for their DDG and DD Destroyers.

Worldwide Support
BAE Systems provides almost 40 years of experience supporting the Mk 45 Mods 0 through 2 and 4 gun systems worldwide in over 200 shipboard applications in 10 international fleets. This includes full life-cycle support that is key to customer requirements, and can be supplemented by the worldwide logistics system supporting the U.S. Navy.

BAE Systems provides Mk 45 installation, operational and maintenance technical documentation and training, plus Original Equipment Manufacturer (OEM) spare parts and provisioning support. BAE Systems field service team provides shipboard engineering services for Mk 45 Mods 0 through 2 and 4 repair, overhaul, or system upgrade around the world – in peacetime or in conflict.

Mk 45 — System Data

5-Inch 54-Caliber Mk 45 Mod 2 System

General System and Ammunition Data
Barrel
One-piece (Mk 19 Mod 2) two-piece with replaceable liner (Mk 19 Mod 0)

Loading pointing-operation
Fully automatic

Conventional Ammunition
Ready service complement
20 rounds

Propulsive weight
31.75 kg (70 lb) maximum

Muzzle velocity of service round
807.72 m/sec (2,650 ft/sec)

Ammunition types
All separate loading 5-inch 54-caliber having point detonating (PD), proximity (VTF and P), mechanical time (MTF) and electronically settable (ESF) fuses, extending-length munitions handling capability

Signal input for fuse setter
Continuous function to 1X and 5X resolvers

Target capability
NGFS, Airborne and surface

Muzzle removal
Automatic

Weight Data
Gun System (w/o fluids/upper hoist) 21,901 kg (48,284 lb) as shown or 22,765 kg (50,188 lb) with low RCS shield

Gun System and four-flight upper hoist (w/o fluids) 23,784 kg (52,434 lb) as shown or 24,648 kg (54,338 lb) with low RCS shield

Either barrel (one-piece or two-piece) 1,615 kg (3,560 lb)

Barrel liner (two-piece) 1,228 kg (2,840 lb)

Retract load at 0 degree elevation 45,359 kg (100,000 lb)

Personal Requirements
Gun captain One
Panel operator One
Ammunition handlers Four
Above deck None

Target capability
NGFS, Airborne and surface

Fire Control System Applications
Mk 86, Mk 160, Thales STIR WM 25, SAABTech 9LV453, FABA Dorna

Ship Application
Escort ships, frigates, destroyers, cruisers and landing helicopter assault ships

Train and Elevation Data

Train
Elevation

Preset limits
+170 deg from stow -15 deg, +65 deg

Velocity
30 deg/sec 20 deg/sec

Acceleration
60 deg/sec² 40 deg/sec²

Power Requirements

Electrical
Main power from ship supply 440 volts 60 Hz, 3 ph
Synchro (rms) peak load 115 volts 400 Hz 0.6 kW
Average (rms) standby load 52 kW
Average (rms) firing load 101 kW
Peak running load (including anti-icing circuits) 180 kW

Pneumatic
Train or elevation motor (during maintenance) 1,274 cu m/min (45 cu ft/min) free air supplied at 7.03 kg/cm² (100 psig)

Gas ejector system 1,379 cu m/min (48.7 cu ft/min) *Gun reduces free air supplied at 12.3 kg/cm² (175 psig) to 7.03 kg/cm² (100 psig) for air motors

Maintenance and Availability Data

Operability tests and scheduled maintenance (average daily) 1.6 hours

Rugcutting time 1.0 hour

Availability (inherent) 99%
**Mk 45 Mod 2 — Common Control System Upgrade**

### 5-Inch 54-Caliber Mk 45 Mod 2 CCS

#### General System and Ammunition Data
- **Barrel**: One-piece (Mk 15 Mod 2) two-piece with replaceable liner (Mk 19 Mod 0)
- **Loading pointing operation**: Fully automatic
- **Conventional Ammunition**
  - **High rate service complement**: 20 rounds
  - **Gun projectile weight**: 31.75 kg (70 lb) maximum
  - **Gun muzzle velocity of service round**: 807.72 m/sec (2,650 ft/sec)
  - **Ammunition types**: All separate loading 5-Inch 54-caliber having point detonating (PD), proximity (VT and IR), mechanical time (MT) and electronically settable (ESS) fuzes, extending length munitions compatibility
  - **Signal input for fuze setter**: Continuous function to 1X and 5X resolutions
  - **Target capability**: NGFS, Airborne and surface
  - **Muzzle reference**: Automatic

#### Power Requirements
- **Main power from ship supply**: 440 volts 60 Hz 3 ph
- **Average (rms) standby load**: 52 kW
- **Average (rms) firing load**: 101 kW
- **Peak running load**: 245 kW (including anti-icing circuits)

#### Pneumatic
- **Train or elevation motor (during maintenance)**: 1,274 cu m/min (45 cu ft/min) free air supplied at 7.03 kg/cm² (100 psig) (100 psig)
- **Gas ejector system**: 1,379 cu m/min (48.7 cu ft/min) + Gun reduces free air supply at 12.3 kg/cm² (175 psig) to 7.03 kg/cm² (100 psig) for air motors

#### Maintainability and Availability Data
- **Operability tests and scheduled maintenance**: 1.6 hours
- **Regain time**: 1.0 hour
- **Availability (inherent)**: 99%

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**Mk 45 — System Data**

### 5-Inch 62-Caliber Mk 45 Mod 4 System

#### General System and Ammunition Data
- **Barrel**: One-piece (Mk 36 Mod 4)
- **Loading pointing operation**: Fully automatic
- **Conventional Ammunition**
  - **High rate service complement**: Conventional 20 rounds, Extended Range 10 rounds
  - **Gun projectile weight**: 31.75 kg (70 lb) and 50 kg (110 lb ERM)
  - **Gun muzzle velocity of service round**: 823 m/sec (2,700 ft/sec) and 1051.56 m/sec (3,450 ft/sec)
  - **Ammunition types**: All separate loading 5-Inch ammunition having point detonating fuzes, variable time fuzes, and electronic fuzes, mechanical time fuzes, and electronically settable fuzes, extended length munitions compatibility
  - **Signal input for fuze setter**: Continuous function to 1X and 5X synchros
  - **Target capability**: NGFS, Airborne and surface
  - **Muzzle reference**: Automatic

#### Weight Data
- **Gun System (w/o fluids/low er hoist)**: 24,989 kg (54,470 lb)
- **Gun System and four-flight lower hoist (w/o fluids)**: 26,182 kg (57,722 lb)
- **Gun System and four-flight lower hoist, ERGM Handling Mechanism (3 w/o fluids)**: 28,924 kg (63,767 lb)
- **Barrel overall**: 1,958 kg (4,316 lb)

#### Operational Requirements
- **Gun captain**: One
- **Panel operator**: One
- **Ammunition handlers**: Four
- **Above deck**: None

#### Fire Control System Applications
- **Mk 160**: Fiber-optic high-speed digital fire control interface accommodates integration of existing and future/improved FCIs, and provides for growth requirements to accommodate integration of future munitions types and ancillary capabilities.

#### Ship Application
- ** Escort ships, frigates, destroyers, cruisers and landing helicopter assault ships**

#### Train and Elevation Data
- **Train**: Preset limits +170 deg from stow -15 deg, +65 deg
- **Elevation**: Velocity 30 deg/sec, 20 deg/sec
- **Acceleration**: 60 deg/sec², 40 deg/sec²

#### Power Requirements
- **Electrical**: Main power from ship supply 440 volts 60 Hz 3 ph
- **Average (rms) standby load**: 52 kW
- **Average (rms) firing load**: 101 kW
- **Peak running load**: 185 kW (including anti-icing circuits)

#### Pneumatic
- **Train or elevation motor (during maintenance)**: 1,274 cu m/min (45 cu ft/min) free air supplied at 7.03 kg/cm² (100 psig) (100 psig)
- **Gas ejector system**: 1,379 cu m/min (48.7 cu ft/min) + Gun reduces free air supply at 12.3 kg/cm² (175 psig) to 7.03 kg/cm² (100 psig) for air motors

#### Maintenance and Availability Data
- **Operability tests and scheduled maintenance**: 1.6 hours
- **Regain time**: 1.0 hour
- **Availability (inherent)**: 99.6%

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Located in Minneapolis, Minnesota for over 70 years, BAE Systems Land & Armaments is at the forefront of design and integration of major-caliber firepower systems for both land and sea applications. BAE Systems is in full-scale production of new 5-Inch 62-Caliber Mk 45 Mod 4 Naval Gun Systems to increase naval gunfire range and lethality for the U.S. Navy’s AEGIS ships and naval forces worldwide.

BAE Systems-Louisville is the company’s Gun Manufacturing Center of Excellence for Mk 45 Mod 4 Naval Gun System manufacturing, providing component and spares fabrication as well as final system assembly and test of new and modernized Mk 45 Naval Gun Systems.

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