TECHNICAL REPORT

IRANIAN AM-50 12.7 × 99 MM ANTI-MATERIEL RIFLE

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CAR	Conflict Armament Research

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INTRODUCTION

In 2004, the Austrian company Steyr Mannlicher sold 800 HS .50 anti-materiel rifles to Iran (*Der Standard*, 2007).[1] Soon after, unlicensed copies of the HS .50, manufactured in Iran under the model designation AM-50, began to appear in conflict zones (DIO/ICIG, n.d.). The AM-50 was used by and recovered from non-state actors in Iraq as early as 2008 and continues to proliferate in the greater Middle East (Gordon and Trainor, 2012). Like the HS .50, the AM-50 is a single-shot, bolt-action anti-materiel rifle chambered for 12.7 × 99 mm ammunition.[2]

For this Technical Report, a Conflict Armament Research (CAR) field investigation team disassembled a recovered AM-50 and comprehensively documented its component parts (see Figures 1 and 2). The report provides a technical analysis of each of these components, highlighting key identifying features and yielding new insight into Iran's weapon manufacturing practices. As illustrated in Diagram 1, the components fall into four main groups:

A. the receiver group (Diagram 2);
B. the barrel group (Diagram 3);
C. the bolt group (Diagram 4); and
D. the optical sight.

After presenting the weapon's main components and subcomponents, the report details its marks as well as its fit and finish.

While most of the observations made are indicative of the model and manufacturing practice, some are specific to the AM-50 under review. In particular, this report shows that:

- Several components on the documented rifle display production flaws, and aspects of the weapon's fit and finish were poorly executed.
- It is likely that different production facilities in Iran were independently responsible for producing barrel and housing components, and for applying marks to the weapon.
- The optical sight that was fitted on the weapon is not considered suitable for military use and would reduce the effective accurate range of this weapon system.

Figure 1
An AM-50 12.7 × 99 mm anti-materiel rifle (right-hand side) documented by CAR

Figure 2
An AM-50 12.7 × 99 mm anti-materiel rifle (left-hand side) documented by CAR

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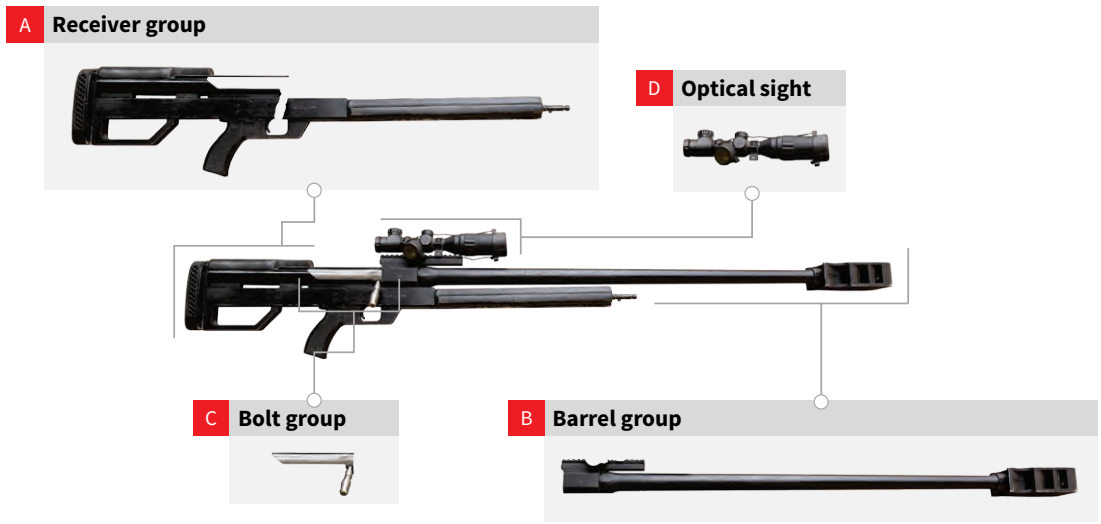
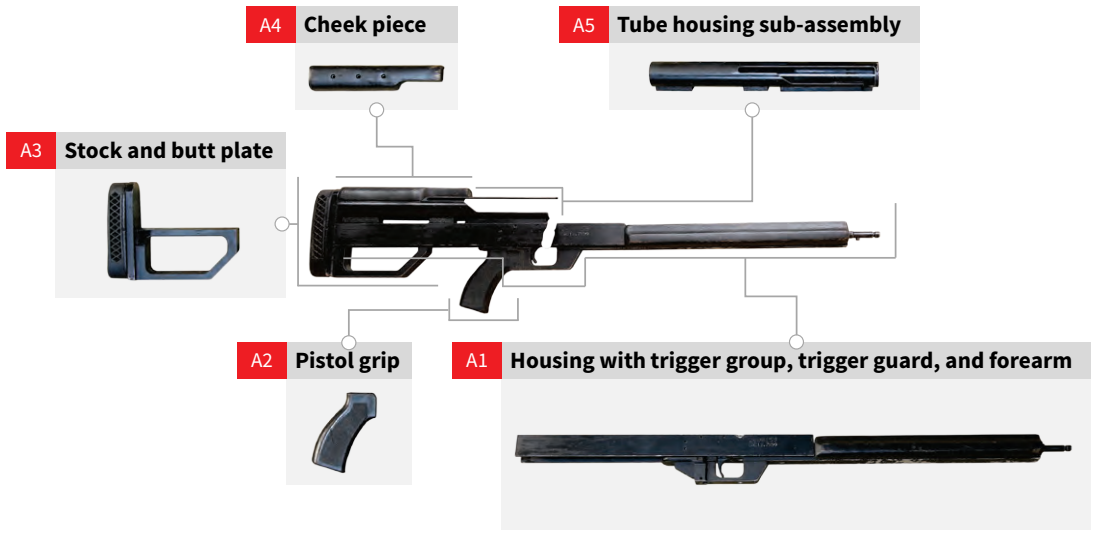
COMPONENTS

Diagram 1
Main component groups



A RECEIVER GROUP

Diagram 2
Receiver group



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A1 Housing with trigger group, trigger guard, and forearm

The AM-50 receiver group is composed of an aluminium housing that is painted black (see Figure 3). The trigger group sits in the housing and is retained in place by four pins (see Figure 4). A trigger guard is screwed to the housing from beneath (see Figure 5).

Figure 3
Housing with trigger guard and forearm

Figure 4
Three of four pins designed to retain the trigger group within the housing (see arrows)

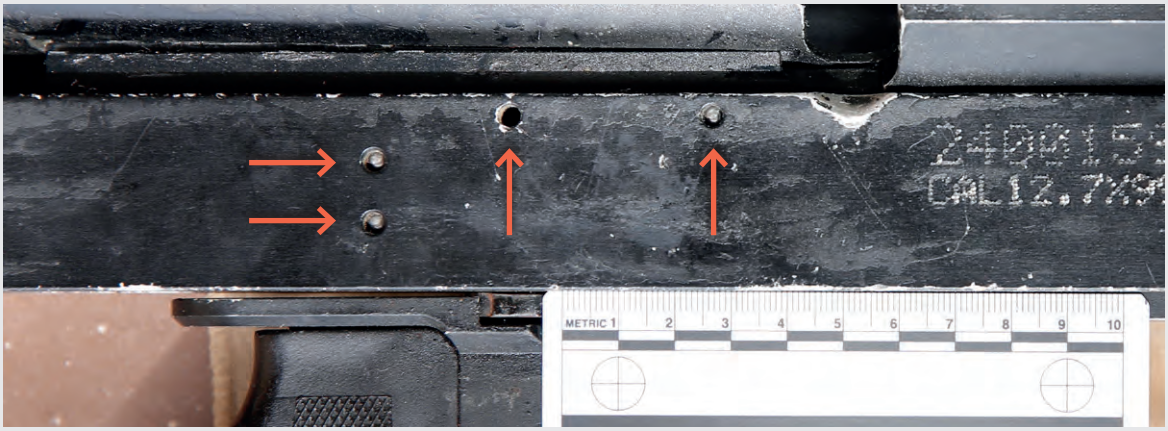


Figure 5
Trigger guard, trigger, safety, and pistol grip

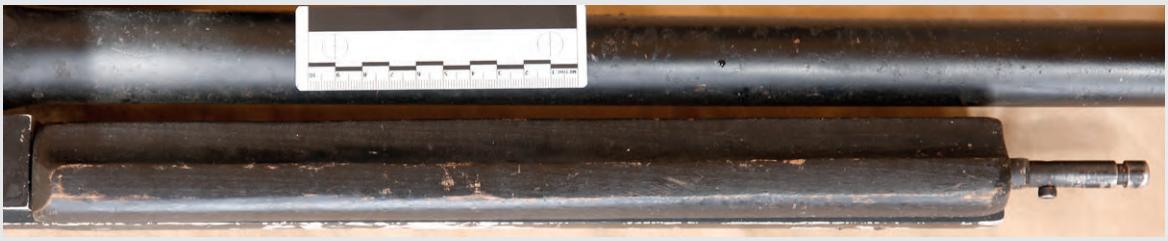
The hammer on the rifle appears to have been roughly filed to permit fitting (see Figures 6 and 7). It is not possible to determine whether the filing occurred before or after assembly by the manufacturer.

Figure 6
Hammer (left-hand side), displaying tool marks

Figure 7
Hammer (right-hand side), displaying tool marks

A wooden forearm is attached to the front of the housing. At the end of the forearm is a bipod stud (see Figure 8). The rifle does not have a bipod attached to the stud.

Figure 8
Wooden forearm and bipod stud



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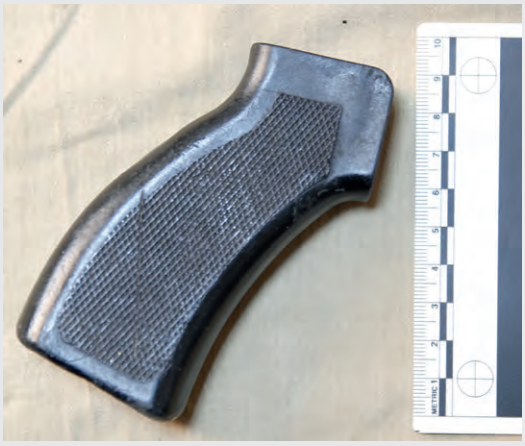
A2 Pistol grip

A black, synthetic, chequered pistol grip is attached to the rear of the trigger guard with a screw and a washer (see Figure 9).

Figure 9
Pistol grip



A3 Stock and butt plate

An angled stock is attached to the housing with three hex-head cap screws. A rubber butt plate is fastened to the stock (see Figure 10).

Figure 10
Stock with padded butt plate

A4 Cheek piece (top view) with associated hex-head cap screws

A wooden cheek piece that is painted black is fastened to the top of the tube housing sub-assembly (see Figure 11).

Figure 11
Wooden forearm and bipod stud

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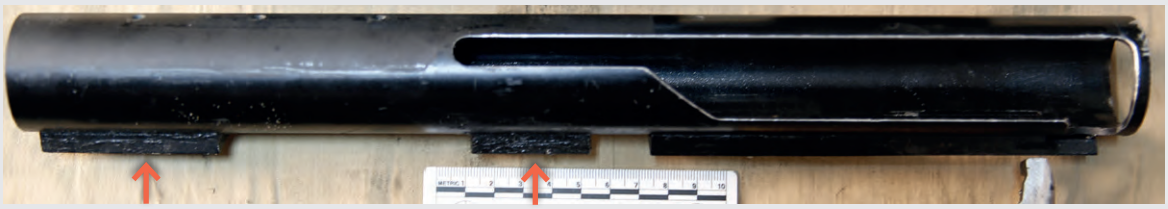
A5 Tube housing sub-assembly

A black tube housing sub-assembly, in which the bolt group sits, is screwed to the top of the housing.

Figure 12
Tube housing sub-assembly

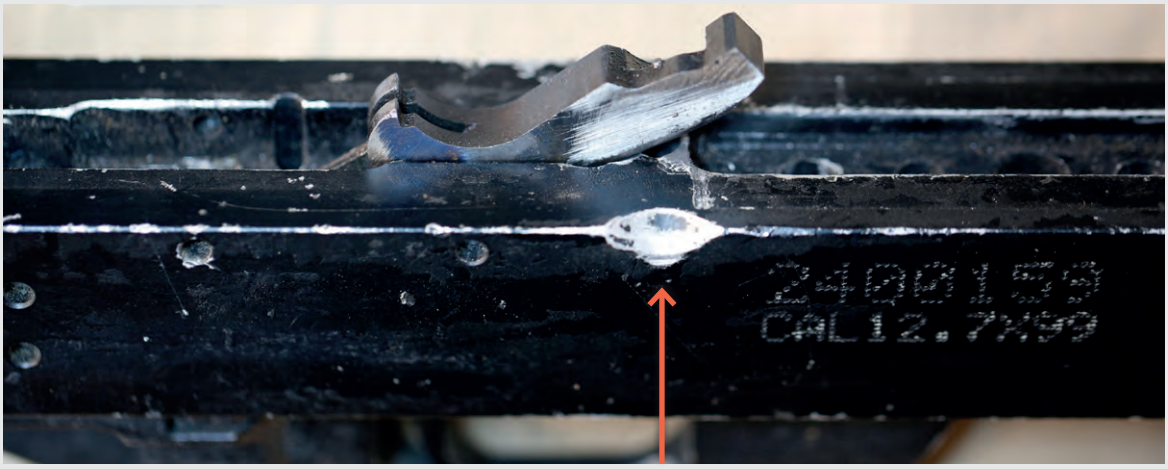


The tube housing sub-assembly features spacers (see the arrows in Figure 12) and an opening to allow for the movement of the bolt and guide tube sub-assembly. The tube housing sub-assembly is also open at the bottom, to allow the hammer to strike the firing pin (see Figure 13).

Figure 13
Tube housing sub-assembly (bottom view) with an opening (arrow) that allows the hammer to strike the firing pin

The weapon exhibits visible damage to the housing, which may have been caused by repeated or improper use of the bolt handle, or by poor design (see the arrow in Figure 14).

Figure 14
Damage on the right-hand side of the housing, against which the bolt handle rests when the bolt is closed



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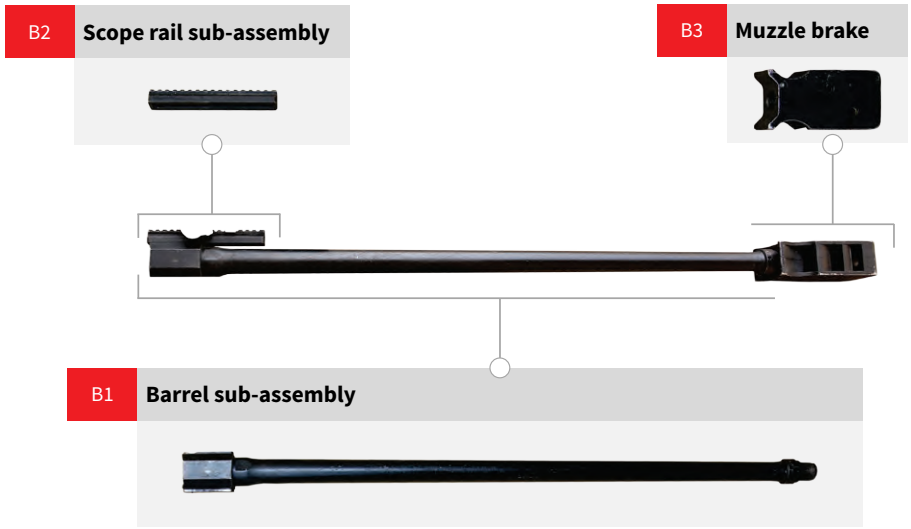
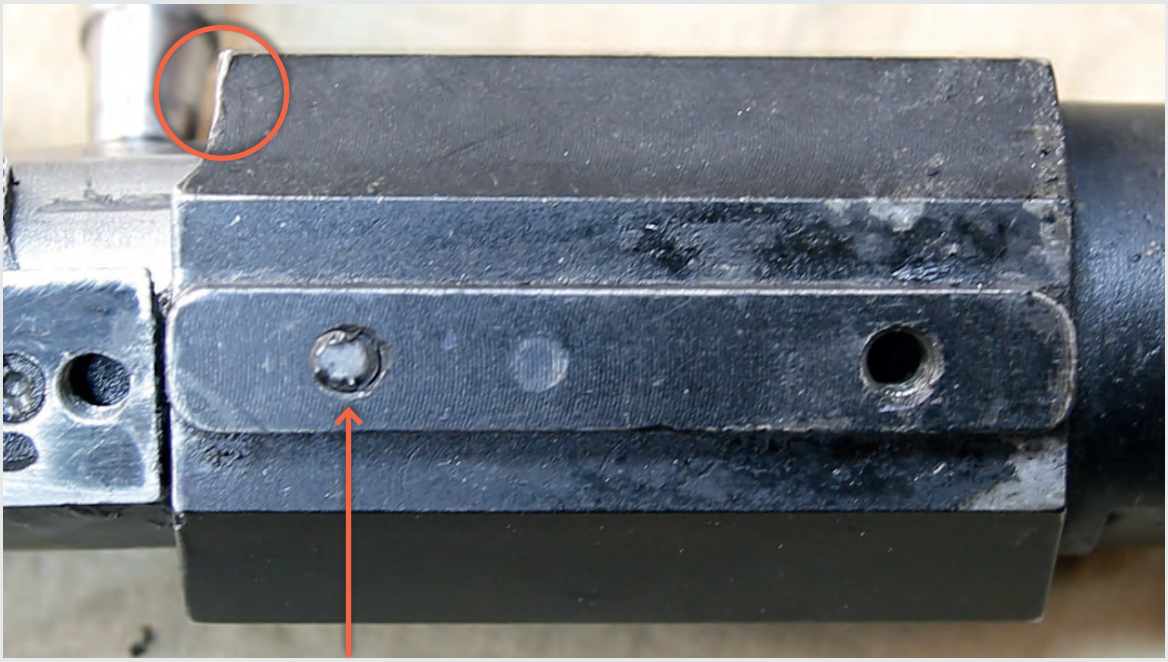
B BARREL GROUP

Diagram 3
Barrel group



The barrel group is attached to the receiver group with two screws (see Figure 15).

Figure 15
Underside of the barrel showing thread holes



The rear screw in the underside of the barrel is broken in its hole (see the arrow in Figure 15). Damage is also visible on the breech block, which the bolt has repeatedly struck on its return to battery (circled).

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B1 Barrel sub-assembly

A locking nut (highlighted in Figure 16) is fixed to the barrel at the rear of the threaded section of the muzzle.

Figure 16
A locking nut fitted to the barrel (see highlighting)

B2 Scope rail sub-assembly

A scope rail sub-assembly is fastened to the top of the barrel with two hex-head cap screws (see Figure 17).

Figure 17
Scope rail sub-assembly with the two screws that are used to fasten it atop the barrel and two fasteners for the optics

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B3 Muzzle brake

The muzzle brake is made of two parts that are fastened together by 14 screws—seven on each face of the brake (see Figures 18–21).

Figure 18
Underside of the muzzle brake with six hex-head cap screws (distributed in three pairs for each vent) and an additional headless screw

Figure 19
Front of the muzzle brake

Figures 20 and 21
Profile of the muzzle brake with vents

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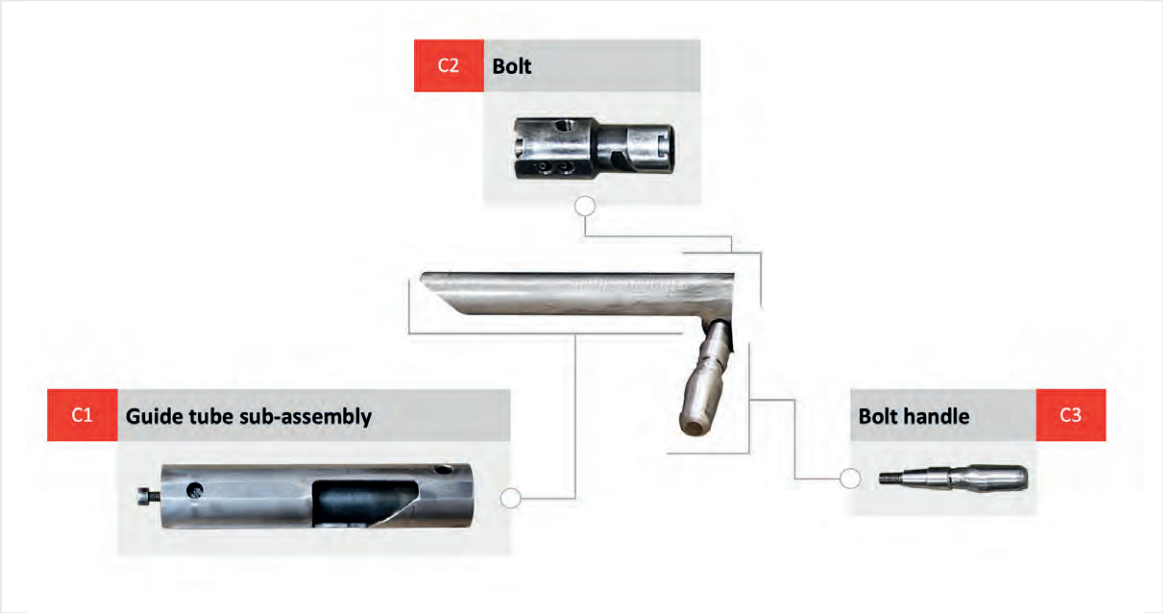
C BOLT GROUP

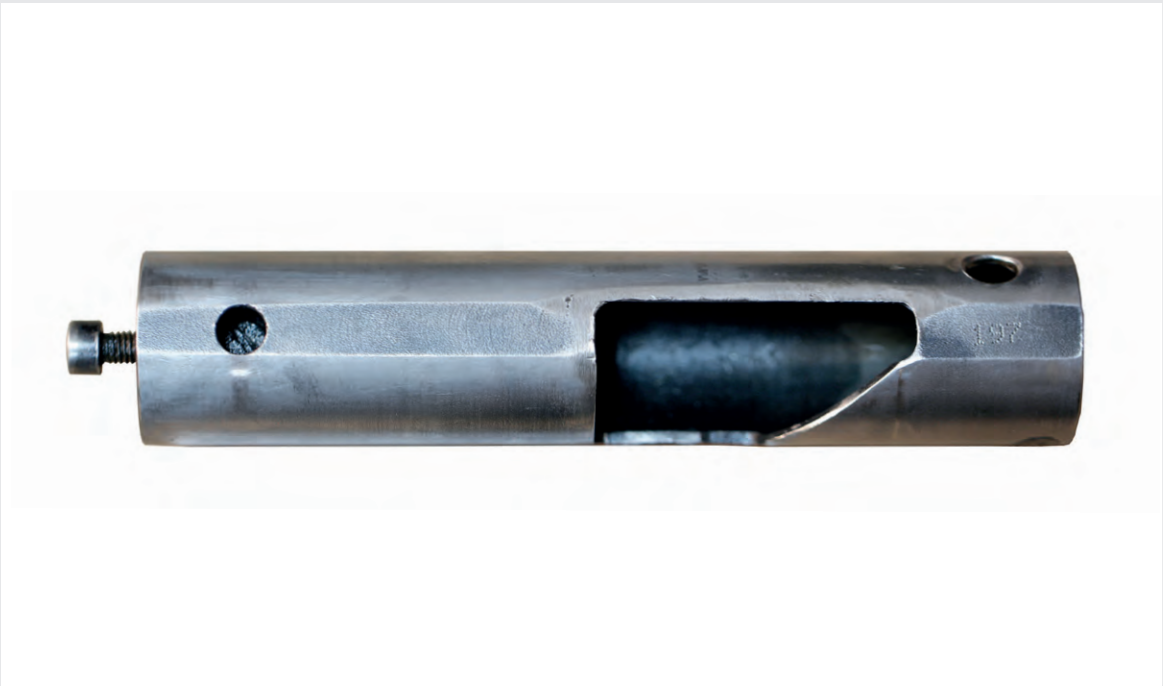
Diagram 4
Bolt group



C1 Guide tube sub-assembly

The bolt body slides into the guide tube sub-assembly (see Figure 22).

Figure 22
Guide tube sub-assembly



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C2 Bolt

The AM-50 bolt features two roll pins to retain the firing pin (see Figures 23–25).

Figure 23
Profile of the bolt, showing the bolt-handle thread hole, extractor, roll pins, and the rear of the firing pin

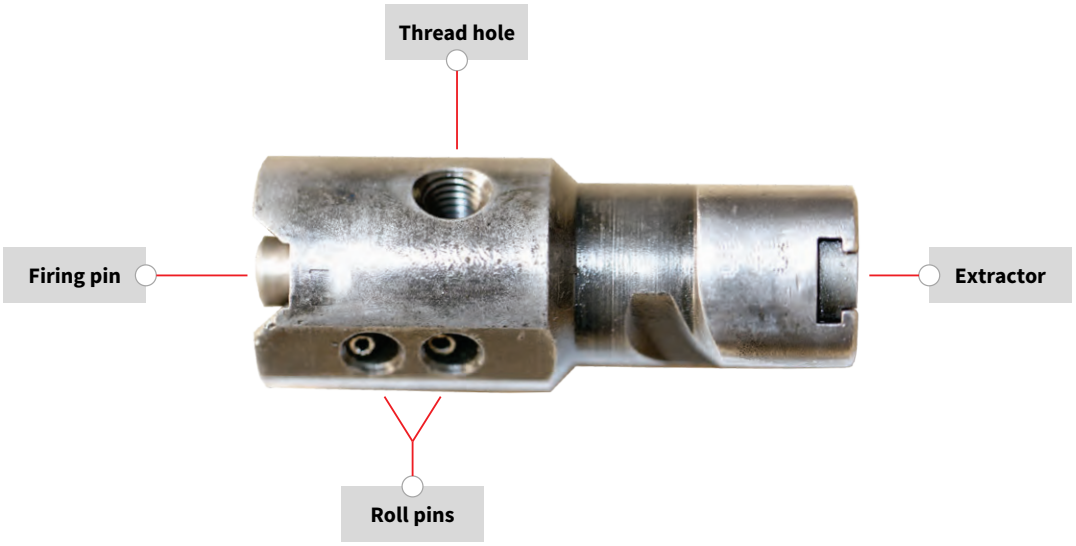

Figure 24
Bolt face, showing the firing pin, ejector, and extractor

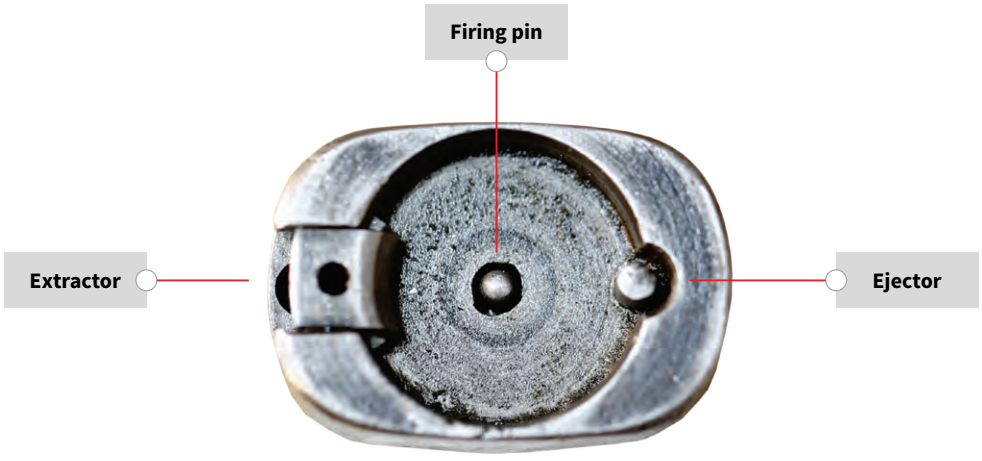

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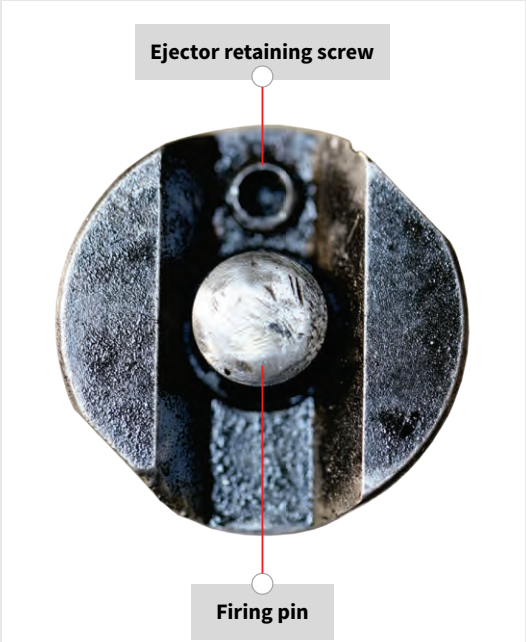
Figure 25
Bolt rear, showing the ejector retaining screw and the rear of the firing pin



There is no visual indication that the headspace has been adjusted. There are no post-production tool marks on the bolt lug, deformations of the exterior parts of the breech area, or barrel flats, which would have resulted from barrel removal processes.

C3 Bolt handle

An externally threaded bolt handle passes through thread holes in the guide tube sub-assembly and the bolt body and maintains the bolt in place.

The bolt handle has been sheared off and replaced, possibly because excess force was applied to open the bolt following a jamming event. Efforts to pry open the bolt, either through percussive force or leverage, place tremendous stress on this relatively fragile component and breakages are common without proper operator training and access to qualified armourers. A replacement bolt handle was welded or brazed to the remaining stub of the bolt handle assembly and then hand-finished (see Figure 26).

Figure 26
Replacement bolt handle

Detail of an AM-50 chamber, showing the locking lugs.

D OPTICAL SIGHT

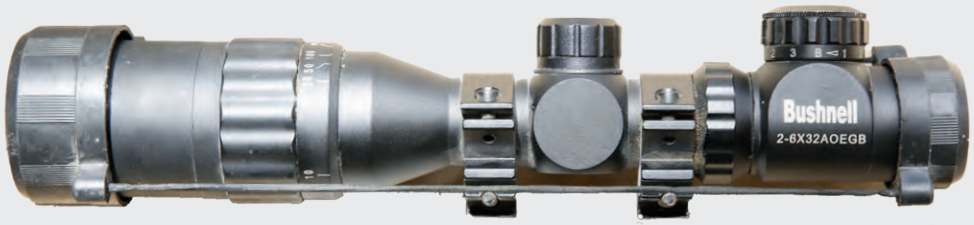
The AM-50 rifle documented by CAR was fitted with a Bushnell 2-6 × 32 telescopic sight. Analysis of the sight indicates that the device is a low-cost, civilian sporting unit designed for air rifle shooting and that it is unlikely to withstand the recoil forces encountered when a 12.7 × 99 mm cartridge is fired in a normal military setting (see Figures 27–30).[3] The parallax adjustment ring, towards the front of the scope, is numbered from a distance of 3 yd (2.7 m), which is a standard feature of air rifle telescopic sights, as short-range precision is necessary for some forms of target shooting and hunting.

CAR concludes that the fragility of the telescopic sight and mounts, the relatively low magnification (a range between 2x and 6x), and the small objective size (36 mm) reduce the effective accurate range of the weapon system and its functionality in low-light conditions. The effective range of the weapon against personnel would, at best, match the effective range of a modern assault rifle.

It is possible that the rifle would maintain sufficient accuracy to immobilise unarmoured vehicles beyond the effective range of smaller-calibre weapon systems, should the telescopic sight withstand the recoil forces.

Figures 27, 28, 29, and 30
Optical sight: left-hand side (Figure 27); top (Figure 28); right-hand side (Figure 29); underside Figure 30)

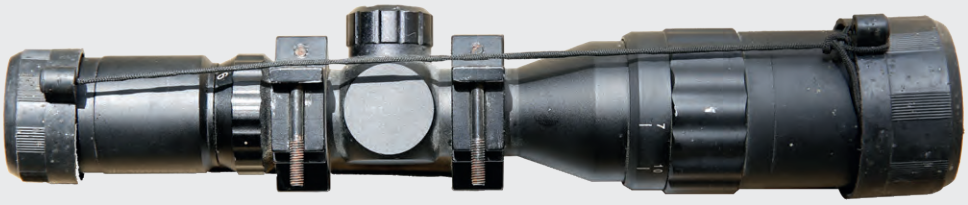
Left side



Top

Right side

Underside



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MARKS

The AM-50 bears eight different marks, all on the right-hand side of the weapon (see Table 1 and Diagram 5). One mark (#4) is located on the right-hand side of the tube housing sub-assembly's forward spacer and was obscured by what may have been hardened grease on the rifle.

Diagram 5
Mark locations

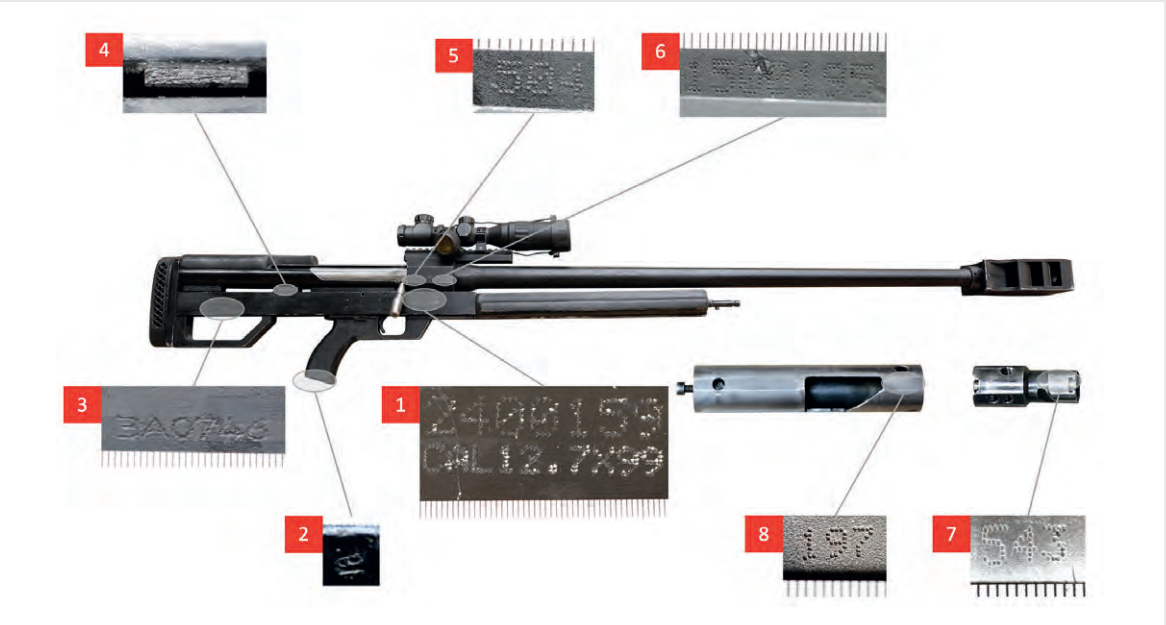

Table 1 lists the alphanumeric marking characteristics, using '1' for numbers and 'A' for letters.

Table 1
Locations and characteristics of AM-50 marks

Mark	Location	Characteristics
#1	Housing, right-hand side, front	Line 1: Seven digits (1111111); dot-peened Line 2: Calibre; dot-peened
#2	Pistol grip, inside, right hand side	Two digits (11, possibly reversed); embossed
#3	Housing, right-hand side, rear	One digit, one Latin letter, four digits (1A1111); dot-peened
#4	Tube housing sub-assembly, forward spacer, right-hand side	Rendered unreadable by what may be hardened grease or deliberate efforts to obliterate the mark
#5	Barrel sub-assembly, right hand side of the breech	Three digits (111); dot-peened
#6	Barrel sub-assembly, right hand side of the breech	Seven digits (1111111); dot-peened
#7	Bolt, right-hand side	Three digits (111); dot-peened
#8	Guide tube sub-assembly, right hand side	Three digits (111); dot-peened

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CAR assesses that different production facilities applied their own serialisation marks before the weapon's final assembly phase, when additional marks were added. This final marking process is designed to ensure that parts specific to a single weapon remain with that weapon system throughout the production and assembly process, as well as through to deployment (to avoid mixing parts from two or more weapons). Based on the disposition of markings, it is likely that different manufacturing facilities in Iran are independently responsible for producing barrel and housing elements. These plants may subsequently supply finished parts to a final assembly and surface-treatment facility.

Mark #1, the weapon's primary serial number, seems to have been applied at the end of the assembly process (see Figure 31). The manufacturer probably applied this mark after having anodised the aluminium housing. It is likely that this anodising process occurred without sufficient surface preparation. The resulting poor finish impeded surface adhesion during the anodising process. By contrast, more advanced assembly processes add dot peen marks prior to anodising, which ensures more complete surface coverage and greater surface wear resistance and protection.

The facility producing the housing probably applied mark #3, and the facility producing the barrel probably applied mark #6, which would explain the

MORE ADVANCED ASSEMBLY PROCESSES ADD DOT PEEN MARKS PRIOR TO ANODISING, WHICH ENSURES MORE COMPLETE SURFACE COVERAGE.

variation in dot peen characteristics across marks #1, #3, and #6 on different parts of the rifle (see Table 1). Moreover, the dot peen characteristics—notably size, font, and spacing—of marks #1, #3, and #6 differ from those of #5, #7, and #8. These differences suggest that the final assembly plant applied marks #5, #7, and #8 at the same time, towards the end of the production process and prior to surface treatment.

Marks #5, #7, and #8, all of which consist of three digits, are placed on critical, pressure-bearing parts of the weapon, which require adjustment and part-matching to ensure optimal functionality when they are fitted to the main housing. These components—the breech, bolt and guide tube sub-assembly—need to be fitted together because they have an impact on the headspace and functioning

Figure 31
Mark #1

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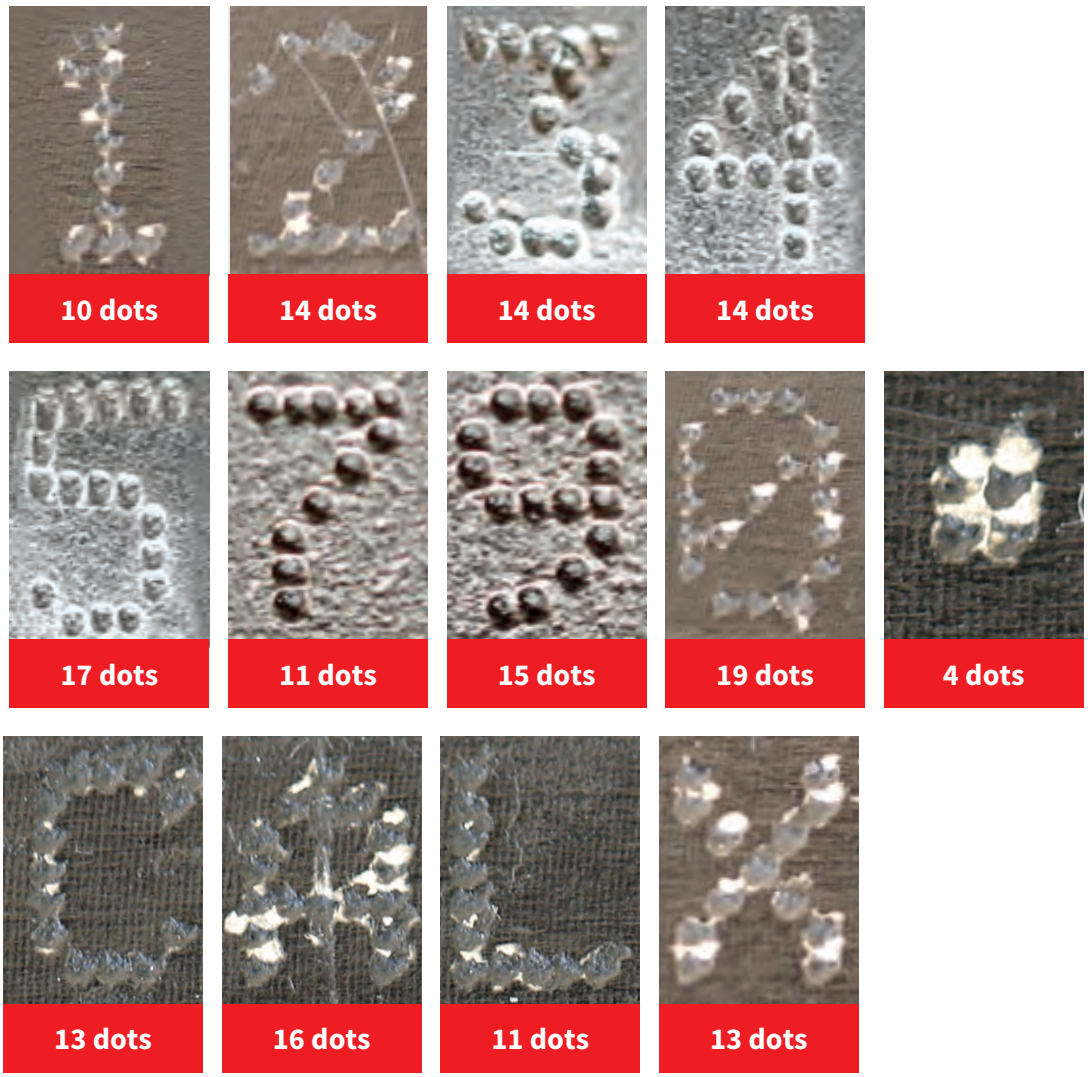
of the weapon, which are important elements of safety and accuracy, particularly in the operation of large-calibre rifles.

While the three-digit marks in #5, #7 and #8 were most probably meant to correspond to the last three digits of the primary serial number ('159' in mark #1), they do not match each other, nor that primary mark. CAR thus concludes that the parts were not originally intended for this particular weapon, but that they were retrofitted, possibly to replace lost or damaged parts. It is highly likely that these parts were not properly adjusted, with the result that their addition would have a negative impact on the weapon's accuracy and safety (unless the operators had access to headspace gauges and the means to adjust the tolerance of parts).

Dot peen machines can be programmed to adjust a series of parameters, such as strike energy, font size, spaces between dots, and characters per centimetre. A more thorough investigation, based on dot peen marks, would require forensic photographic equipment. However, the methods of documentation employed for this investigation allow for counting dots in the characters of some of the marks, which may provide a useful metric for the analysis of weapons manufactured in Iran (see Figure 32).

Figure 32
Dot count for documented marks



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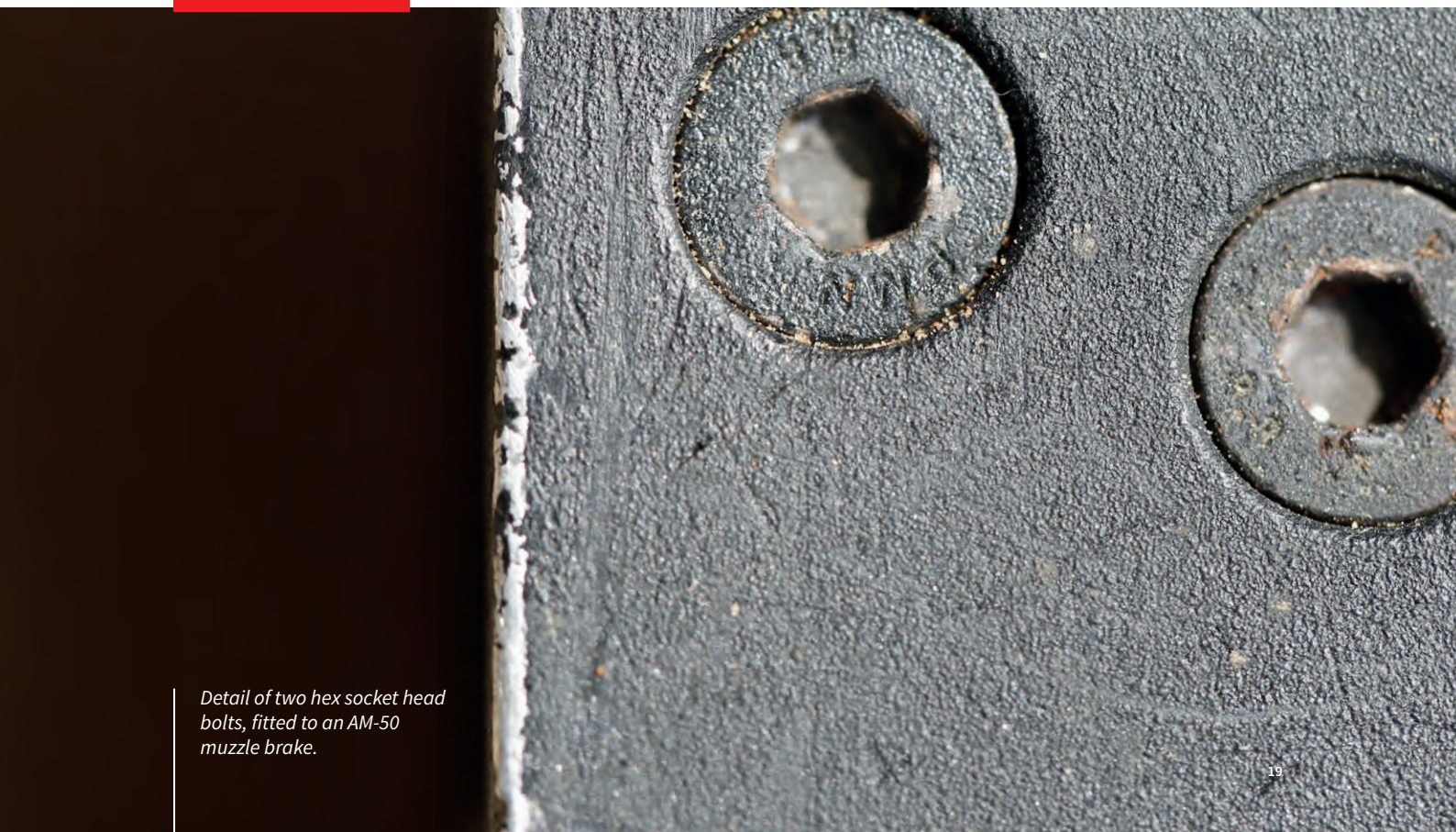
FIT AND FINISH

The term 'fit and finish' refers to the tolerance of individual components, their interoperability, and the quality of surface finishing. A very high fit-and-finish standard is required to permit the reliable and accurate operation of weapons that fire high-pressure rounds, such as the 12.7 × 99 mm (.50 BMG). The manufacture of parts whose tolerance is either too high or too low introduces a significant risk of malfunction, such as jamming—particularly when poorly matched components prevent the bolt from cycling.

The surface treatment of the recovered AM-50's aluminium and steel components was poorly executed. The steel components of the weapon appear to have received a 'bluing' finish on surfaces that retain imperfections from milling and other tooling marks. The finish indicates low-quality surface preparation, which renders some components prone to premature corrosion. Furthermore, the weapon's aluminium components do not appear to have been adequately polished prior to being anodised—a process that is regulated within the quality control standards employed by modern weapon manufacturers (see Figure 14, for example). Sections of exposed aluminium around the dot-peened serial numbering also suggest that the coating failed to adhere to the aluminium and was later dislodged during the marking process. In addition, it is possible that the weapon's manufacturer did not treat metal surfaces with surface cleaners prior to painting and left untreated aluminium surfaces exposed to the atmosphere for too long, rendering them vulnerable to aluminium oxidisation prior to anodising.

THE WEAPON'S ALUMINIUM COMPONENTS DO NOT APPEAR TO HAVE BEEN ADEQUATELY POLISHED PRIOR TO BEING ANODISED.



Detail of two hex socket head bolts, fitted to an AM-50 muzzle brake.

CONCLUSION

This report explores the four main component groups of a recovered AM-50 12.7 × 99 mm anti-materiel rifle: the receiver group, the barrel group, the bolt group, and the optical sight. CAR's detailed assessment of the marks on the rifle indicates that different manufacturing facilities were independently responsible for producing its barrel and housing elements.

Any deviations from the design of the Steyr HS .50 may have resulted from shortcomings in local engineering capacity or tooling, which could have necessitated alternative approaches to achieving a similar design function. Alternatively, the manufacturer may have incorporated locally accessible technologies and designs.

The AM-50 rifle proliferates across conflicts in the greater Middle East. Iran's production and subsequent distribution of the AM-50 put a military capability within the grasp of non-state armed actors that is typically the reserve of nation states. However, as demonstrated with the rifle studied in this report, the level of threat posed by a weapon system depends greatly on the end user's ability to maintain and operate it. In this case, mismatched critical components and a repaired bolt handle suggest improper care. Furthermore, the rifle was fitted with an optical sight unsuitable for military use. The poor mechanical condition of the weapon is compounded by production flaws, notably in the surface treatment applied to its aluminium and steel components. If better-maintained examples of the AM-50 are in use with trained operators, this weapon could pose a significant risk to personnel at ranges exceeding those of assault rifles.

IRAN'S PRODUCTION AND SUBSEQUENT DISTRIBUTION OF THE AM-50 PUT A MILITARY CAPABILITY WITHIN THE GRASP OF NON-STATE ARMED ACTORS.

Detail of a dot-peened partial serial number on an AM-50 guide tube sub-assembly.

ENDNOTES

1 In 2019, Steyr Mannlicher AG changed its name to Steyr Arms. The sale happened before the EU and UN Security Council imposed embargoes on Iran in 2006–07.

2 On 26 March 2019, CAR sent a request for collaboration to Steyr Arms (former Steyr Mannlicher) with a view to sharing information on the similarities between the HS .50 and the AM-50. As of 11 May 2021, Steyr Arms had not responded to CAR's request for collaboration.

On 4 April 2019, CAR sent a formal trace request to the Government of the Islamic Republic of Iran, in which it requested information on the export of the AM-50 rifle documented by CAR. As of 11 May 2021, the Government of the Islamic Republic of Iran had not responded to CAR's trace request. Given the absence of a trace response, CAR cannot determine the legality of the transfer in question.

3 Although the optical sight is marked 'Bushnell', CAR did not trace the item due to the lack of traceable marks, and therefore CAR cannot establish its authenticity.

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