

August 2004

# MILITARY TRANSFORMATION

## Fielding of Army's Stryker Vehicles Is Well Under Way, but Expectations for Their Transportability by C-130 Aircraft Need to Be Clarified



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Highlights of [GAO-04-925](#), a report to congressional requesters

**Why GAO Did This Study**

In its transformation to a more responsive and mobile force, the Army plans to form 6 Stryker Brigade Combat teams equipped with a new family of armored vehicles known as Strykers. The Stryker—which provides transport for troops, weapons, and command and control—was required by the Army to weigh no more than 38,000 pounds and be transportable in theater by C-130 cargo aircraft arriving ready for immediate combat operations. The Army plans to equip its future force with a new generation of vehicles—Future Combat Systems—to also be transportable by C-130s.

GAO was asked to assess (1) the current status of Stryker vehicle acquisition, including the most current Stryker vehicle program and operating cost estimates; (2) the status and results of Stryker vehicle tests; and (3) the ability of C-130 aircraft to transport Stryker vehicles within a theater of operations. This report also addresses the transportability of the Army’s Future Combat Systems on C-130 aircraft.

**What GAO Recommends**

GAO recommends that the Department of Defense (DOD) provide to Congress clarification of expected capabilities and limitations of C-130 transport for Stryker vehicles and Future Combat System vehicles; and options for alternative transport. DOD partially concurred with our recommendations.

[www.gao.gov/cgi-bin/getrpt?GAO-04-925](http://www.gao.gov/cgi-bin/getrpt?GAO-04-925).

To view the full product, including the scope and methodology, click on the link above. For more information, contact William M. Solis at (202) 512-8365 or [solisw@gao.gov](mailto:solisw@gao.gov).

**MILITARY TRANSFORMATION**

**Fielding of Army’s Stryker Vehicles Is Well Under Way, but Expectations for Their Transportability by C-130 Aircraft Need to Be Clarified**

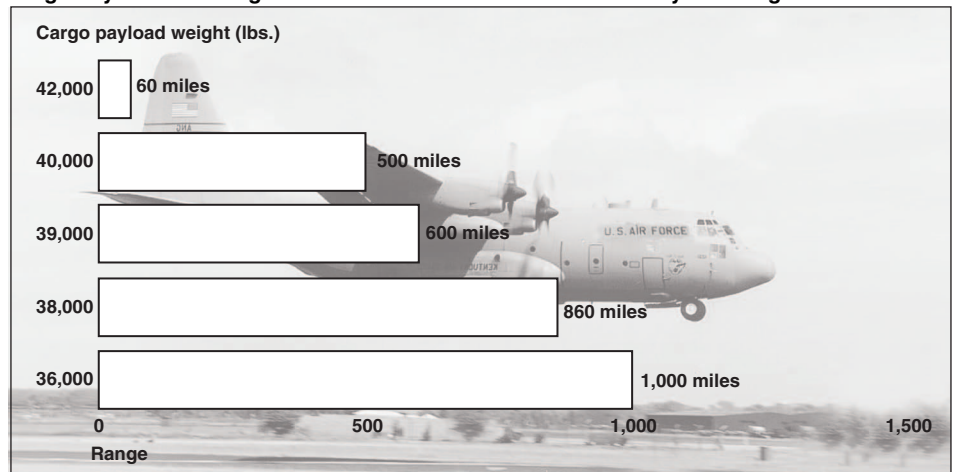
**What GAO Found**

The acquisition of the Stryker vehicles is about two-thirds complete; with about 1,200 of 8 production vehicle configurations ordered and 800 delivered to units. In addition, limited quantities of two developmental vehicles—the Mobile Gun System and the Nuclear, Biological, and Chemical Reconnaissance vehicle prototypes—have also been ordered for testing. Stryker program costs have increased about 22 percent from the November 2000 estimate of \$7.1 billion to the December 2003 estimate of \$8.7 billion. Total program costs include acquisition costs—procurement, research, development, and test and evaluation—as well as military construction costs related to Strykers. The Army does not yet have reliable estimates of the Stryker’s operating costs because of limited peacetime use to develop data.

As of June 2004, testing of the eight production Strykers was mostly complete, with the vehicles meeting Army operational requirements with limitations. However, development and testing schedules of the two developmental Strykers have been delayed, resulting in an over 1-year delay in meeting the vehicles’ production milestones and fielding dates.

While the Army has demonstrated the required transportability of Strykers by C-130 aircraft in training exercises, in an operational environment, the Stryker’s average weight of 38,000 pounds—along with other factors such as added equipment weight and less than ideal flight conditions—significantly limits the C-130’s flight range and reduces the size force that could be deployed. These factors also limit the ability of Strykers to conduct combat operations immediately upon arrival as required. With the similar maximum weight envisioned for Future Combat System vehicles intended for the Army’s future force, the planned C-130 transport of those vehicles would present similar challenges.

**Cargo Payload and Range of an Armored C-130H Aircraft in Nearly Ideal Flight Conditions**



Source: GAO analysis of Air Mobility Command data.

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## Abbreviations

DOD	Department of Defense
NBC	Nuclear, Biological, and Chemical
OSD	Office of the Secretary of Defense
RTD&E	Research, Development, Test, And Evaluation
SAR	Selected Acquisition Report
DOT&E	Director, Operational Test and Evaluation

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United States Government Accountability Office  
Washington, DC 20548

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August 12, 2004

The Honorable Duncan Hunter  
Chairman, Committee On Armed Services  
House of Representatives

The Honorable Jim Saxton  
Chairman, Subcommittee on Terrorism,  
Unconventional Threats, and Capabilities  
Committee on Armed Services  
House of Representatives

The U.S. Army is transforming its force to one expected to be more strategically responsive, rapidly deployable, and able to effectively operate in all types of military operations. The first step in the Army's transformation was to form six Interim, or Stryker, Brigade Combat teams equipped with a new family of 10 armored vehicle configurations known as Strykers. Congressional appropriations for the Stryker vehicle program, in then-year dollars<sup>1</sup> totaled \$4.5 billion from fiscal years 2000 through 2004. The President's budget request for fiscal year 2005 included \$1.3 billion for the program, leaving \$2.9 billion based on current estimates needed to complete funding of the \$8.7 billion estimated total cost of the program.<sup>2</sup> These program costs include acquisition costs—procurement, research, development, and test and evaluation—as well as related military construction costs.

According to the Army's operational requirements,<sup>3</sup> Stryker vehicles are to be transportable by C-130 aircraft within a theater of operation, arriving ready for combat operations. The capability of C-130 transport is a key performance requirement for the vehicles and is central to the Army's rationale for creating Stryker brigades. The C-130 is a four-engine, high-

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<sup>1</sup> Then-year dollar amounts for a particular year reflect the cost prevailing during that year.

<sup>2</sup> Appropriations included operations and support costs of \$121 million through fiscal year 2005 for contractor support and maintenance of the vehicles. After 2005 and through the life cycle of the vehicles, operations and support costs are to be included in the Army's Operations and Maintenance budget account.

<sup>3</sup> Department of Army, *Operational Requirements Document For A Family of Stryker Vehicles, Prepared for Milestone III Decision* (Washington, D.C.: Feb. 19, 2004).

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wing cargo aircraft that the U.S. Air Force primarily uses as a short-range transporter. The first Stryker brigade became operational in October 2003, at which time it was deployed to Iraq. Beginning in 2010, the Army plans to begin the transition to its future force—the Objective Force—and to equip this force with a new generation of vehicles known as Future Combat Systems,<sup>4</sup> which are also, according to operational requirements,<sup>5</sup> to be transportable in theater by C-130 air transport.

In your initial request, you asked us to review the Stryker vehicle’s capabilities, performance, costs, and ability to meet operational and mission requirements. You later asked us to assess the transportability of Stryker vehicles on C-130 aircraft. We provided your offices our preliminary observations on these issues in October and November 2003 and April 2004, and this report summarizes and updates the information provided in those meetings. Our objectives were to determine (1) the current status of Stryker vehicle acquisition, including the most current Stryker vehicle program and operating cost estimates; (2) the status and results of Stryker vehicle tests; and (3) the ability of C-130 aircraft to transport Stryker vehicles within a theater of operations. We also address transportability of the Army’s Future Combat Systems on C-130 aircraft.

To conduct our review of Stryker vehicle acquisition status, costs, and testing results, we interviewed officials and analyzed documents from the Army’s Stryker Program Management Office and Test and Evaluation Command and reviewed Army and Department of Defense developmental, operational, and survivability test reports. In our assessment of the ability of C-130 airlift to transport Stryker vehicles, we reviewed a study of the C-130 aircraft’s range and payload capabilities, and interviewed U.S. Army, Air Force, and Transportation Command officials. We determined that the data and documents we reviewed were sufficiently reliable to answer our objectives. We performed our review from July 2003 through June 2004 in accordance with generally accepted government auditing standards. A more detailed description of our scope and methodology is presented later

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<sup>4</sup> According to the Army, the Objective Force is the force that achieves the objectives of the Army’s transformation. The Army further states that this future force will capitalize on advances in science and technology enabling the Army to equip its forces with Future Combat Systems to include manned and unmanned ground vehicles, air vehicles, and munitions. These vehicles and systems are expected to be a fraction of the weight of existing heavy fighting vehicles to improve transportability.

<sup>5</sup> Department of Army, *Operational Requirements Document for the Future Combat Systems* (Washington, D.C.: Apr. 14, 2003).

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in the report. A list of related GAO products appears at the end of this report.

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## Results in Brief

Acquisition of the Stryker production vehicles<sup>6</sup> is about two-thirds complete, but overall program costs are higher than earlier estimates and vehicle operating cost estimates are not yet reliable. The Army has ordered more than 1,200—or 68 percent—of the 8 Stryker production vehicle configurations it plans to buy, along with limited quantities of the two developmental vehicle prototypes for testing. Of the production vehicles, 800 have been delivered to Stryker brigades. Estimated total costs for the Stryker vehicle program increased about 22 percent, from the original November 2000 estimate, in then-year dollars, of \$7.1 billion to the December 2003 estimate of \$8.7 billion. The average acquisition cost per vehicle increased from \$3.34 million to \$4.13 million during the same time period. The largest increase in the Stryker program's cost estimate resulted from the cost of military construction, such as the cost of upgrading vehicle maintenance facilities for Strykers. However with the deployment of the first Stryker Brigade to Iraq, the Army did not have reliable estimates of Stryker vehicle operating costs because it does not yet have sufficient operational experience with the vehicles in peacetime.

As of June 2004, the testing of the eight Stryker production vehicles is mostly complete with the vehicles meeting operational requirements with certain limitations, but the testing and acquisition schedules of the two developmental Strykers—the Mobile Gun System and Nuclear, Biological, and Chemical (NBC) Reconnaissance vehicles—have been delayed. The Stryker vehicle system evaluations by the Army and the Office of the Secretary of Defense (OSD) determined that the production vehicles met operational requirements with some limitations and, overall, support the key operational capabilities and effectiveness of the Stryker Brigade Combat Team. Delays in development and testing of the Mobile Gun System and NBC Reconnaissance vehicles will result in about a 1- to 2-year delay in meeting originally planned production decision milestones and fielding dates.

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<sup>6</sup> Eight of 10 Stryker vehicle configurations are considered production ready because these vehicles have already undergone system development and engineering. Two of the 10 vehicle configurations are developmental because design, development, and testing are needed before they can go into production.

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Although the Army has demonstrated the required transportability of Strykers by C-130s during training events, the C-130 has a limited capability to transport the Stryker vehicle in an operational environment except under favorable conditions. Because of the Strykers' average 38,000-pound weight, using C-130 aircraft to transport Strykers in an operational environment would limit flight range, the size force that could be deployed, and the ability to conduct operations immediately upon arrival—a key operational requirement for Stryker vehicles. Additional weight, such as from mission equipment or armor and less than ideal environmental conditions, poses significant challenges. For example, according to a study of C-130 transport of Army vehicles by the Military Traffic Management Command, Transportation Engineering Agency, an armored C-130H<sup>7</sup> aircraft taking off in ideal conditions such as moderate air temperature could transport 38,000 pounds for a maximum range of 860 miles. Adding just 2,000 pounds onboard the aircraft for associated cargo such as mission equipment or ammunition reduces the C-130 aircraft's takeoff-to-landing range to only 500 miles. Furthermore, a C-130 with a 38,000-pound Stryker vehicle on board would not be able to take off at all from locations in higher elevations, such as Afghanistan, during daytime in the summer. Because of these constraints, equipment and supplies for the Strykers might need to be moved on separate aircraft, increasing the numbers of aircraft or sorties<sup>8</sup> needed to deploy a Stryker force, deployment time, and the time it would take after arrival to begin operations. In addition, if fitted with additional armor for increased protection against weapons such as rocket-propelled grenades, a Stryker vehicle would be unable to fit inside a C-130, and with added weight of the armor, the aircraft would be too heavy to take off. At the envisioned 38,000-pound maximum weight of the Future Combat System vehicles, the planned C-130 transport of those vehicles for the Army's Future Objective Force would present the same challenges.

Given the challenges of C-130 transport of Stryker vehicles, the Army's operational requirements and congressional expectations for such transport, we are recommending that the Secretary of Defense, in consultation with the Secretaries of the Army and the Air Force, clarify for

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<sup>7</sup> The current C-130 inventory is mostly comprised of various configurations of the E and H models. C-130 armor protects the aircraft in hostile areas from weapons such as small arms and rocket-propelled grenades. The armor adds about 1,600 pounds to the weight of the aircraft.

<sup>8</sup> In air operations, a sortie is defined as an operational flight by one aircraft.



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Congress (1) the expected deployment capabilities of Stryker brigades and Stryker vehicles via C-130 aircraft within a theater of operations and the types of operational missions using C-130 transport of Stryker vehicles that would be achievable; (2) potential operational capability limitations of Stryker brigades given the limits of C-130 transport; and (3) options for, and availability of, alternative modes of transportation for transporting Stryker brigades within an operational theater. We are also recommending that the department include similar clarification for C-130 transport of Future Combat System vehicles.

In commenting on a draft of this report, the Department of Defense (DOD) partially concurred with our recommendations. DOD's comments are in the appendix and our evaluation of its comments is on page 29.

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## Background

The Stryker family of vehicles consists of 10 eight-wheeled armored vehicles mounted on a common chassis that provide transport for troops, weapons, and command and control. Stryker vehicles weigh on average about 19 tons—or 38,000 pounds, substantially less than the M1A1 Abrams tanks (68 tons) and the Bradley Fighting vehicle (33 tons), the primary combat platforms of the Army's heavier armored units. The C-130 cargo aircraft is capable of tactical, or in-theater, transport of one Stryker vehicle; the Army's Abrams tank and Bradley Fighting vehicle exceed the C-130 aircraft's size and weight limits.

The Army's original operational requirements for Stryker vehicles<sup>9</sup> included (1) the capability of entering, being transportable in, and exiting a C-130 aircraft; (2) the vehicle's combat capable deployment weight<sup>10</sup> must not exceed 38,000 pounds to allow C-130 transport of 1,000 miles; and (3) the Stryker vehicles must be capable of immediate combat operations after unloading.<sup>11</sup> The Army's most current operational requirements for

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<sup>9</sup> Department of Army, *Operational Requirements Document For A Family of Interim Armored Vehicles, Prepared for Milestone II Decision* (Washington, D.C.: Feb. 22, 2000).

<sup>10</sup> According to Army contracting officials, combat capable deployment weight is the weight of Stryker vehicles along with any equipment for the vehicles, such as communications systems or weapons that allow the capability to conduct combat operations immediately after unloading from an aircraft.

<sup>11</sup> The Army's Test and Evaluation Command defined "immediate" to mean between 15 and 40 minutes upon off-loading from the aircraft, depending on the vehicle variant.

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Stryker vehicles required the same vehicle weight and C-130 transport capabilities without reference to C-130 transport of 1,000 miles. The Army has similar operational requirements for its Future Combat Systems' vehicles. The Army's April 2003 Operational Requirements document for the Future Combat Systems requires the vehicles' essential combat configuration to be no greater than 38,000 pounds and have a size suitable for C-130 aircraft transport. A memorandum of agreement between the Air Force and the Army issued in 2003,<sup>12</sup> set procedures allowing C-130 transport of 38,000-pound Stryker vehicles aboard Air Force aircraft, but required that the combined weight of the vehicles, other cargo, and passengers shall not exceed C-130 operational capabilities, which vary based on mission requirements, weather, airfield conditions, among other factors.

Eight of the 10 vehicle configurations are being acquired production ready—meaning they require little engineering design and development work prior to production. Two of the 10 vehicle configurations, the Mobile Gun System and the NBC Reconnaissance vehicle, are developmental vehicle variants—meaning that a substantial amount of design, development, and testing is needed before they can go into production. Table 1 provides descriptions of the ten Stryker vehicles. Three of the vehicles are shown in figures 1 to 3.

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<sup>12</sup> Memorandum of Agreement between the United States Air Force and United States Army for Air-Transport of the Stryker, signed by General Eric K. Shinseki, Chief of Staff, U.S. Army, and General John P. Jumper, Chief of Staff, U.S. Air Force, (Washington, D.C.: Feb. 4, 2003).

**Table 1: Stryker Vehicle Descriptions**

<b>Vehicle configuration</b>	<b>Description</b>
<b>Production vehicles</b>	
Anti-Tank Guided Missile vehicle	Provides the brigade's primary tank-killing system. It reinforces the brigade reconnaissance squadron and provides long-range direct fires.
Commander's vehicle	Provides the brigade with the means to receive information and data, analyze, prepare and transmit data; and control the forces/ functions carrying out combat missions.
Engineer Squad vehicle	Provides maneuver/mobility support capabilities, which include obstacle clearing, in-stride breaching of surface mines, proofing of subsurface mines, and smoke generation for local protection.
Fire Support vehicle	Provides automated enhanced surveillance, target acquisition, target identification, target tracking, target designation, position location, and communications functionality.
Infantry Carrier vehicle	Provides protected transport and supporting fires for the infantry squad during dismounted assault. It carries an infantry squad with individual equipment.
Medical Evaluation vehicle	The battalion aid station for brigade units, providing treatment for serious injury and advanced trauma cases.
Mortar Carrier	Provides infantry units with screening obscurants, suppressive forces and on-call supporting fires. 120mm and 81mm variants provide responsive, accurate and lethal indirect fire support to the dismounted infantry assault.
Reconnaissance vehicle	Provides force situational awareness, gathering and transmitting real time intelligence while moving throughout the battlefield in close, complex, and urban terrain.
<b>Developmental vehicles</b>	
Mobile Gun System	Supports dismounted infantry and engages the enemy in close combat to clear opposition and permit rapid movement, allowing the force to maintain the initiative, occupy and/ or secure key objectives, and defeat strong points.
Nuclear, Biological, and Chemical (NBC) Reconnaissance vehicle	Provides on-the-move and remote near-real-time nuclear, biological, and chemical detection and surveillance.

Source: U.S. Army.

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**Figure 1: The Infantry Carrier Vehicle Is One of Eight Production Configurations**



Source: U.S. Army.

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**Figure 2: The Mobile Gun System Is One of Two Developmental Configurations**



Source: U.S. Army.

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**Figure 3: The Nuclear Biological Chemical Reconnaissance Vehicle Is One of Two Developmental Configurations**



Source: U.S. Army.

The Army selected one light infantry brigade and one mechanized infantry brigade at Fort Lewis, Washington, to become the first two of six planned Stryker brigades. The first of these brigades, the 3rd Brigade, Second Infantry Division, became operational in October 2003, at which time the Brigade was deployed to Iraq. The second of the two Fort Lewis brigades became operational in May 2004, and plans are for it to deploy to Iraq in late 2004. The Army plans to form four more Stryker brigades from 2005 through 2008. The planned locations of the next four brigades are Fort Wainwright/Fort Richardson, Alaska; Fort Polk, Louisiana; Schofield Barracks, Hawaii; and a brigade of the Pennsylvania Army National Guard.

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## Acquisition of Stryker Production Vehicles Is about Two-thirds Complete, Though Overall Program Costs Have Increased, and Operational Cost Estimates Are Not Yet Reliable

Acquisition of the eight Stryker production vehicle configurations is about two-thirds complete with about 68 percent of the over 1,800-planned production vehicles ordered, and a low rate of production for the two developmental Strykers is scheduled for September 2004. Estimated program costs have increased because of, among other reasons, increases in the Army's estimate for related military construction, such as for the cost of building new Stryker vehicle maintenance facilities. However, the Army does not yet have reliable estimates for the Stryker's operating costs, such as for vehicle maintenance, because of limited peacetime operational experience with the vehicles.

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## About Two-thirds of Stryker Production Vehicle Acquisition Completed

The Army is pursuing three acquisition schedules for the Stryker production and developmental vehicles. Since the November 2000 Stryker vehicle contract award,<sup>13</sup> the Army has ordered 1,231 production vehicles—about 68 percent—of the 1,814 production vehicles the Army plans to buy for the six Stryker brigades. Of the 1,231 vehicles ordered, 800 have been delivered to the brigades, including all of the production vehicles for the first two Stryker brigades. The Army is currently fielding Stryker production vehicles for the third of the six planned brigades. The third brigade is to be fielded in Alaska.

Thus far, the Army has bought limited quantities of the developmental vehicle variants—8 Mobile Gun System and 4 NBC Reconnaissance vehicles—as prototypes and for use in testing at various test sites around the country. Of 238 Mobile Gun Systems the Army plans to buy overall, current plans are to buy 72 initially upon approval for low-rate initial production scheduled for September 2004. The Army plans low-rate initial production of 17 NBC Reconnaissance vehicles also in September 2004. The Mobile Gun System is not scheduled to reach a full production decision until September 2006 at the earliest, while the NBC Reconnaissance vehicle is not scheduled to reach its full production decision until 2007. Table 2 below shows the status of Stryker vehicle acquisition as of April 2004.

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<sup>13</sup> On November 16, 2000, the Army awarded a contract for Interim Armored vehicles, now called Stryker Vehicles, to General Motors General Dynamics Defense Group L.L.C; a joint venture of General Motors Defense-Canada and General Dynamics Land Systems. In 2003 General Dynamics Land Systems bought General Motors Defense-Canada.

**Table 2: Stryker Vehicle Acquisition Status As of April 2004**

Vehicle configuration/ variant	Total planned quantities	Quantities ordered	Percent	Quantities delivered	Percent of planned quantities
<b>Production vehicles</b>					
Infantry carrier	699	445	64	328	47
Reconnaissance	393	290	74	140	36
Mortar carrier	224	127	57	85	38
Medical evacuation	114	79	69	47	41
Commander's	112	80	71	41	37
Fire-Support	108	80	74	39	36
Antitank guided missile	88	88	100	88	100
Engineer squad	76	42	55	32	42
<b>Production vehicle total</b>	<b>1,814</b>	<b>1,231</b>	<b>68</b>	<b>800</b>	<b>44</b>
<b>Developmental vehicles</b>					
NBC Reconnaissance	44	4	9	4	9
Mobile Gun System	238	8	3	8	3
<b>Developmental vehicle total</b>	<b>282</b>	<b>12</b>	<b>4</b>	<b>12</b>	<b>4</b>
<b>Total</b>	<b>2,096</b>	<b>1,243</b>	<b>59</b>	<b>812</b>	<b>39</b>

Source: GAO analysis of U.S. Army data.

Note: Percentages are rounded.

## Stryker Vehicle Program's Costs Have Increased from Earlier Estimates

The Stryker vehicle program's total costs increased, in then-year dollars, from the original November 2000 estimate of \$7.1 billion to the December 2003 estimate of \$8.7 billion—or about 22 percent.<sup>14</sup> The increases occurred primarily due to revised estimates for the associated cost of military construction, such as that needed to upgrade maintenance and training facilities for a Stryker brigade, but were also due to lesser increases in procurement and research, development, test, and evaluation (RDT&E) costs for the vehicles—which together grew by about 8 percent from the original November 2000 estimate.

In then-year dollars, the estimated cost of military construction accounted for the largest increase in the Stryker program's cost estimate. In

<sup>14</sup> This information was included in DOD's Selected Acquisition Report (SAR) submitted to the Congress for the period ending December 31, 2003. The SAR summarizes the latest estimates of cost, schedule, and technical status of major defense acquisition programs.



December 2003, the Army increased its estimate for military construction by about \$1.01 billion over the original November 2000 estimate, from \$322 million to \$1.3 billion. (See table 3.) As in all major Department of Defense acquisition programs, military construction costs are included in the program's total costs. According to the Army, the military construction cost estimate increased because the December 2003 estimate reflects (1) the identification of all five sites scheduled to receive Stryker brigades and (2) the total cost of upgrading or building maintenance and training facilities at these installations to accommodate a Stryker brigade. When the original estimate was made, only one site had been identified to receive a Stryker brigade and that estimate identified just the cost of maintenance facility upgrades.

**Table 3: Increases in Stryker Vehicle Program's Costs**

Then-year dollars in millions			
Cost element	November 2000 (original estimate)	December 2003	Increase/decrease
Military construction	\$322.2	\$1,333.3	\$1,011.1
Procurement	\$6,290.0	\$6,679.8	\$389.8
Research, development, test, & evaluation	\$508.0	\$645.6	\$137.6
<b>Total cost</b>	<b>\$7,120.2</b>	<b>\$8,658.7</b>	<b>\$1,538.5</b>
Total number of vehicles <sup>a</sup>	2131	2096	(35.0)
Average acquisition cost per vehicle <sup>b</sup>	\$3.34	\$4.13	\$0.79

Source: U.S. Army.

Note: Numbers in parentheses are negative.

<sup>a</sup>Planned vehicle quantities are subject to change because of modifications to the Stryker Brigade's design.

<sup>b</sup>Total acquisition cost/number of vehicles.

The Stryker vehicle's procurement costs increased by about \$390 million. The largest factor in the increase of procurement costs was the higher than originally estimated costs of procuring add-on reactive armor,<sup>15</sup> including the additional costs to equip six Stryker brigades with add-on armor, instead of four brigades as originally planned. Also, the cost of

<sup>15</sup> Stryker vehicles are built from ballistic steel and covered with ceramic armor that can withstand 14.5mm ammunition. For added protection against rocket-propelled grenades, the vehicles are designed to carry removable add-on reactive armor. The add-on armor is currently in development and will not be available until 2005. Strykers currently deployed to Iraq are fitted with slat armor to protect against rocket-propelled grenades.

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RDT&E increased about \$138 million, from \$508 million to \$645.6 million. Most of the RDT&E cost increase is attributable to revised estimates for the cost of test and evaluation, development, and system engineering for the developmental vehicles. The average acquisition cost per vehicle increased by about \$0.79 million, from \$3.34 million to \$4.13 million. The program costs and average acquisition cost per vehicle estimates reflect a reduction in the number of Strykers planned from 2,131 to 2,096. (See table 3 above.)

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### Limited Peacetime Operational Experience Makes Operating Cost Estimates Unreliable

The Army does not have reliable estimates of Stryker vehicle operating costs because, with the first Stryker brigade's deployment to Iraq, it lacks sufficient peacetime operational experience with the vehicles. The Army considers 3 years of actual peacetime operational cost data to be sufficient for reliable estimates.<sup>16</sup> Since none of the production vehicles have 3 years of peacetime operating experience, reliable operating cost estimates will not be available until 2005 at the earliest. With the Mobile Gun System and NBC Reconnaissance vehicles still in development, it will be several years before these vehicles are fully fielded and sufficient data are available for reliable estimates of their operating costs.

According to the Army, current Stryker vehicle operating cost estimates, shown in table 4 below, are engineering estimates based in part on operating costs for another vehicle in the Army's inventory—the M-113 armored personnel carrier.<sup>17</sup> The estimates assume peacetime operations.

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<sup>16</sup> The Army uses peacetime operational cost data, rather than data collected during operations such as in Iraq, because peacetime data is more representative of actual long-term operating costs.

<sup>17</sup> The Army used operating costs of the M113 for its Stryker vehicle operating cost estimates because the M113 is a medium-weight armored personnel carrier that has been in the Army's inventory for a number of years. Therefore, the Army had historical peacetime operating costs for the vehicle.

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**Table 4: Operating Cost Estimates per Vehicle**

Fiscal year 2004 constant dollars	
Vehicle configuration	Cost per-mile estimate
Medical Evaluation vehicle	\$12.27
Reconnaissance vehicle	\$16.48
Infantry Carrier vehicle	\$17.19
Fire Support vehicle	\$18.78
Commander's vehicle	\$21.33
Anti-Tank Guided Missile vehicle	\$22.05
Engineer Squad vehicle	\$25.66
Mortar Carrier	\$28.96
Nuclear, Biological, and Chemical Reconnaissance vehicle	\$35.62
Mobile Gun System	\$69.76

Source: U.S. Army Stryker Program Office.

Note: Estimates are based, in part, on costs of Army's M-113 armored personnel carrier.

Vehicle operating costs include the cost for maintenance, repair, and the cost of consumable and repairable parts. The Army calculates vehicle cost per mile by tracking vehicle mileage and the actual costs of consumable or replaceable parts used.<sup>18</sup> However, the short time frame from fielding the first Stryker brigade's production vehicles—May 2002 through January 2003—and the brigades' deployment to Iraq in October 2003, limited the amount of time and miles the vehicles were in peacetime service. Similarly, fielding of Stryker vehicles for the second brigade was completed in January 2004. While the Army collected operational cost and mileage data for both brigades, there were insufficient actual operating costs and miles on the vehicles to make reliable estimates. Consequently, until the Army can collect more actual peacetime operating cost data for the production vehicles, it will not be able to determine actual vehicle operating costs and make reliable operating cost estimates for these vehicles. Similarly, reliable operating cost estimates for the Mobile Gun System and NBC Reconnaissance vehicle will not be available until after 2006 when they are scheduled to begin full production and fielding.

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<sup>18</sup> Operating costs do not include petroleum, oil, and lubricant costs.

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## Tested Production Vehicles Generally Met Requirements, but Testing and Acquisition Schedules for Developmental Vehicles Have Been Delayed

According to Army and OSD test reports<sup>19</sup>, the tested Stryker production vehicles met operational requirements with certain limitations and, overall, support the key operational capabilities and force effectiveness of the Stryker Brigade Combat Team. The separate developmental testing schedules of the Mobile Gun System and NBC Reconnaissance vehicles have been delayed, resulting in delays in meeting planned production milestone dates. Delay in the Mobile Gun System's development was due in part to shortfalls in meeting performance requirements of the vehicle's ammunition autoloader system. The NBC Reconnaissance vehicle's development schedule was delayed pending OSD approval of an updated technology readiness assessment<sup>20</sup> for the vehicle and its nuclear, biological, and chemical sensor systems.

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## Following Testing, Army and OSD Indicate Stryker Production Vehicles Met Operational Requirements, with Limitations

Following the Army's completion of live-fire tests and evaluation for seven production vehicles in February 2004 and its ongoing test evaluation of the eighth, the Army stated that the Stryker production vehicles met operational requirements, with limitations; and OSD approved full production.<sup>21</sup>

The Army's System Evaluation Report for the Stryker production decision concluded that overall, the Stryker family of vehicles is effective, suitable, and survivable, and supports the key operational capabilities and force effectiveness of the Stryker Brigade Combat Team. The report concluded that the Stryker production vehicle configurations met operational requirements with limitations. For example, in the area of lethality, the report noted that four Stryker vehicle configurations have a remote weapons station that provides effective protective and supporting fires for

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<sup>19</sup> Army Test and Evaluation Command, U.S. Army Evaluation Center, *System Evaluation Report for the Stryker Family of Vehicles, for Milestone III Decision*, (Washington, D.C.: Jan. 2004) and OSD Office of the Director, Operational Test and Evaluation, *Operational Test & Evaluation and Live Fire Test & Evaluation Report on the Stryker Family of Vehicles*, (Washington, D.C.: Feb. 2004).

<sup>20</sup> A technology readiness assessment provides information to DOD acquisition officials on the maturity of technologies used in or proposed for a system at the time of acquisition milestones such as low-rate initial production.

<sup>21</sup> In its March 2004 Stryker Acquisition Decision Memorandum, OSD delegated to the Army Acquisition Executive a decision on Mortar Carrier production pending successful assessment of live-fire test results of the Mortar Carrier (B) mounted vehicle variant. The Mortar Carrier vehicle has two configurations: the Mortar Carrier (A), which carries mortars for dismounted use, and the Mortar Carrier (B), which has an integrated mounted mortar system.

dismounted maneuver. However, limitations of the remote weapons station’s capability to provide accurate and continuous fires at night and while moving reduce its effectiveness and lethality. Similarly, while the Stryker vehicles contribute to force protection and meet survivability requirements, there are inherent and expected survivability limitations as in any armored vehicle system. Table 5 lists some of the operational requirements of the vehicles and excerpts of selected performance capabilities and limitations from the Army’s Stryker system evaluation report.

**Table 5: Selected Performance Capabilities and Limitations from Stryker Evaluation Report**

Operational requirement	Overall assessment	Examples of limitations
Lethality	The Stryker family of vehicles provides significant firepower capabilities giving the Striker Combat Brigade Team commander the ability to shape the battle. Four variants have a remote weapons station that provides effective protective and supporting fires for dismounted maneuver.	While the remote weapons station provides effective protective and support fires, its capability to provide accurate and continuous fires is limited at night and while moving.
Logistics supportability	Stryker vehicles are logistically supportable and require significantly less petroleum supplies than an equivalent heavy brigade.	An augmentation of personnel is needed to sustain a brigade’s Stryker vehicle maintenance workload.
Mobility	Stryker has good on and off-road mobility. Its off-road mobility is comparable to other Army wheeled vehicles but less than tracked vehicles.	Fully loaded in temperatures above 100 degrees Fahrenheit, power train cooling is insufficient, limiting the Stryker’s ability to operate for extended periods in soft soil or sand or to climb prolonged grades.
Reliability and maintainability	Except Engineer Squad vehicles, Stryker family of vehicles meets operational reliability requirements.	All vehicle configurations experienced a significant number of unscheduled maintenance actions.
Survivability	Stryker vehicles contribute to force protection and meet survivability requirements.	There are inherent and expected survivability limitations. Specific ballistic survivability results are classified.

Source: U.S. Army Test and Evaluation Command.

The OSD Director, Operational Test and Evaluation, found that six Stryker production vehicles are operationally effective for employment in small-scale contingency operations and operationally suitable with certain

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limitations.<sup>22</sup> OSD found that the Engineer Squad vehicle is not operationally suitable because of poor reliability. However, in its March 2004 Stryker acquisition decision, OSD determined that the operational capabilities provided by the Engineer Squad vehicle supported its continued production in light of planned fixes, operational work-arounds, and planned follow-on testing. It also determined that corrective actions are needed to address survivability and ballistic vulnerability limitations of the vehicles, such as ensuring basic armor performance and reducing exposure of Stryker personnel.

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### Mobile Gun System Development and Testing Schedule Ongoing but Delayed

Although developmental testing is ongoing, the development and testing schedule of the Mobile Gun System has been delayed, resulting in more than a 1-year delay in meeting planned production decision milestone dates, with initial limited production to start in September 2004. The delay in the Mobile Gun System's development was due in part to shortfalls in meeting performance requirements of the vehicle's ammunition autoloader system. At the time of our review, the Mobile Gun System was undergoing additional testing to find a fix for the autoloader, in preparation for a low-rate production decision. The Mobile Gun System is scheduled for production qualification testing through July 2004, production verification testing starting in October 2005, and live-fire test and evaluation starting in November 2005 through September 2006. The Army's earlier Mobile Gun System acquisition schedule was to complete developmental testing and have a low-rate initial production decision in 2003 and begin full production in 2005. Current Army plans are to buy limited quantities of Mobile Gun System vehicles upon OSD approval of low-rate initial production planned for September 2004. A full-rate production decision for the Mobile Gun System is currently scheduled for late in 2006.

The Mobile Gun System has a 105mm cannon with an autoloader for rapidly loading cannon rounds without outside exposure of its three-person crew. The principal function of the Mobile Gun System is to provide rapid and lethal direct fires to protect assaulting infantry. The Mobile Gun System cannon is designed to defeat bunkers and create openings in reinforced concrete walls through which infantry can pass to accomplish their missions. According to the Army's Stryker Program

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<sup>22</sup> The Mortar Carrier vehicle was not evaluated by the OSD Director, Operational Test and Evaluation (DOT&E), because its live-fire tests were not completed at the time DOT&E conducted its evaluation.

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Management Office, the autoloader system was responsible for 80 percent of the system aborts during initial Mobile Gun System reliability testing because of cannon rounds jamming in the system. As of February 2004, the Army was planning additional testing and working with the autoloader's manufacturer to determine a solution. A functioning autoloader is needed if the Mobile Gun System is to meet its operational requirements because manual loading of cannon rounds both reduces the desired rate of fire and requires brief outside exposure of crew. In its March 2004 Stryker acquisition decision, OSD required the Army to provide changes to the Mobile Gun System developmental exit criteria within 90 days, including the ability to meet cost and system reliability criteria.

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### NBC Reconnaissance Vehicle Development Schedule Delayed

Although its developmental testing is also ongoing, the development schedule of the NBC Reconnaissance vehicle has also been delayed, and its production is now scheduled to occur about two years later than planned. The delay was primarily due to additional time needed to develop and test the vehicle's nuclear, biological, and chemical sensor systems. As a result, low-rate initial production, previously scheduled for December 2003, will not occur until September 2004. A full-rate production decision, which had previously been scheduled for June 2005, will not occur until July 2007. In its March 2004 Stryker acquisition decision, OSD required the Army to provide within 90 days an updated technology readiness assessment for the NBC Reconnaissance vehicle and its nuclear, biological, and chemical sensor systems. At that time, OSD will make a determination as to whether the vehicle is ready for production.

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## Army Demonstrated Required Stryker C-130 Transportability, but Contrary to Congressional Expectations, Operational Limits Significantly Challenge Routine C-130 Transport

Although the Army demonstrated during training events that Stryker vehicles can be transported short distances on C-130 aircraft and unloaded for immediate combat, the average 38,000 pound weight of Stryker vehicles, other cargo weight concerns, and less than ideal environmental conditions present significant challenges in using C-130s for routine Stryker transport. Similar operational limits would exist for C-130 transport of the Army's Future Combat Systems because they are also being designed to weigh about 38,000 pounds.

In addition, much of the mission equipment, ammunition, fuel, personnel, and armor a Stryker brigade would need to conduct a combat operation might need to be moved on separate aircraft, increasing the numbers of aircraft or sorties needed to deploy a Stryker force, adding to deployment time and the time it would take after arrival to begin operations. Yet, the Army's weight requirement and C-130 transport requirements for the vehicles, and information the Army provided to Congress in budget documents and testimony, created expectations that Stryker vehicles could be routinely transported by C-130 aircraft within an operational theater.

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## Stryker's C-130 Short-Distance Deployability Was Demonstrated in Operational Evaluations

In a December 2003 report on the first Stryker Brigade's design evaluation,<sup>23</sup> we reported that the Stryker Brigade demonstrated the ability to conduct tactical deployments by C-130 aircraft. At the National Training Center in April 2003, we observed the brigade conduct a tactical movement by moving a Stryker infantry company with its personnel, supplies, and 21 Stryker vehicles via seven C-130 aircraft flying 35 sorties from Southern California Logistics Airfield to a desert airfield on Fort Irwin about 70 miles away.<sup>24</sup> Figure 4 shows a Stryker vehicle being offloaded from a C-130 at the National Training Center.

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<sup>23</sup> GAO, *Military Transformation: The Army and OSD Met Legislative Requirements for First Stryker Brigade Design Evaluation, but Issues Remain for Future Brigades*, [GAO-04-188](#) (Washington, D.C.: Dec. 12, 2003).

<sup>24</sup> In a later event in May 2003 during the Stryker Brigade operational evaluation, we also observed a Stryker infantry company—consisting of 21 Stryker vehicles and 5 other trucks and trailers; 188 soldiers; and 3 days of food, water, ammunition, and fuel to support the company—travel from the Joint Readiness Training Center at Fort Polk, Louisiana, to a nearby airfield using seven C-130s flying 25 sorties over a distance of about 100 miles. Upon landing at the airfield, the company moved to a tactical assembly area and onward to conduct a combat operation.



**Figure 4: Stryker Vehicle Exiting a C-130 Aircraft at the National Training Center**



Source: U.S. Army.

A team from the Department of Defense's (DOD) Office of the Director for Operational Test and Evaluation and the Army's Test and Evaluation Command also observed the Stryker vehicle's deployment and recorded the weight of the vehicles and the total load weight onboard the aircraft. The average weight for the eight production vehicle configurations was just less than 38,000 pounds, while the total load weight—including a 3-days' supply of fuel, food, water, and ammunition—averaged more than 39,100 pounds. Table 6 shows the weight of eight-production vehicles and their total load weight recorded at the time of the April 2003 National Training Center deployment. We noted in our December 2003 report,<sup>25</sup> however, that while the tactical deployment of Stryker vehicles by C-130 aircraft was demonstrated, the Army had yet to demonstrate under various environmental conditions, such as high temperature and airfield altitude, just how far Stryker vehicles can be tactically deployed by C-130 aircraft.

<sup>25</sup> [GAO-04-188](#).

**Table 6: Stryker Production Vehicle and Total Load Weights at the National Training Center in April 2003**

Vehicle configuration <sup>a</sup>	Vehicle weight <sup>b</sup>	Total load weight <sup>c</sup>
Commander's	36,660	38,130
Reconnaissance	37,090	38,350
Fire-Support	37,220	37,850
Infantry Carrier	37,630	39,940
Medical Evacuation	37,930	38,570
Engineer Squad	38,450	39,500
Mortar Carrier	38,940	39,990
Antitank Guided Missile	39,980	40,820
Average weight	37,988	39,144

Source: GAO analysis of DOD data.

<sup>a</sup>The NBC Reconnaissance vehicle and the Mobile Gun System were in developmental testing and did not participate in this exercise.

<sup>b</sup>Vehicle weight is the weight of each vehicle during a Stryker C-130 deployment that was conducted as part of the Stryker Brigade Operational Evaluation at the National Training Center in April 2003. The vehicle weights are not final and may change slightly as the make-up of their associated equipment packages is finalized.

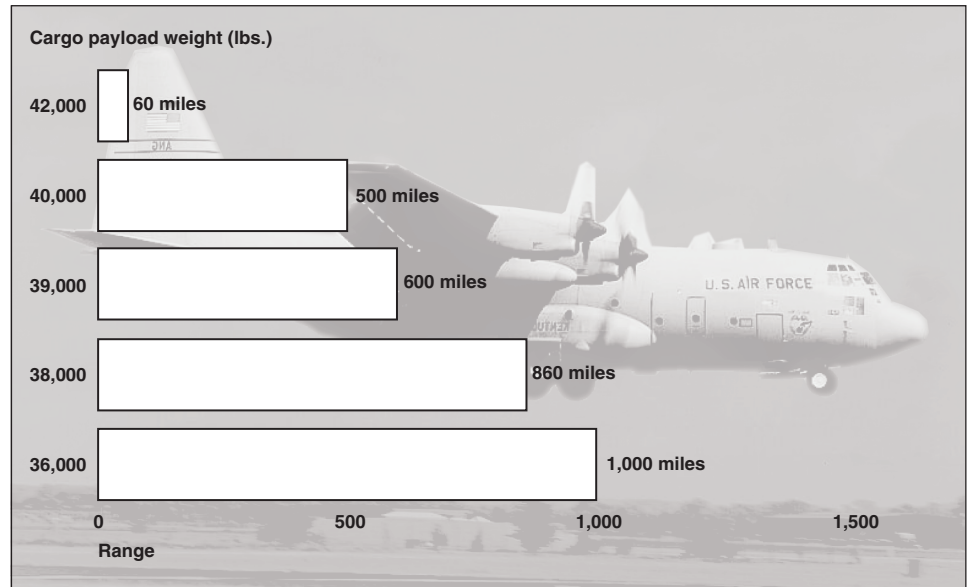
<sup>c</sup>Total load weight is the weight of each vehicle during the April 2003 deployment with a 3-days' supply of fuel, food, water, ammunition, and crew. The Anti-Tank Guided Missile's total load weight included a four-man crew.

## Weight Presents Significant Challenges for C-130 Transport of Stryker Vehicles, Making Requirements and Expectations Difficult to Meet

The weight of Stryker vehicles presents significant challenges for C-130 aircraft transport because, as a general rule U.S. Air Force air mobility planning factors specify an allowable C-130 cargo weight of about 34,000 pounds for routine flight. With most Stryker vehicles weighing close to 38,000 pounds on board, the distance—or range—that a C-130 aircraft could fly is significantly reduced when taking-off in high air temperatures or from airfields located in higher elevations. In standard, or nearly ideal, flight conditions—such as day-time, low head-wind, moderate air temperature, and low elevation—an armored C-130H with a cargo payload of 38,000 pounds can generally expect to fly 860 miles from takeoff to landing. Furthermore, according to a Military Traffic Management Command's Transportation Engineering Agency study of C-130 aircraft

transportability of Army vehicles,<sup>26</sup> a C-130's range is significantly reduced with only minimal additional weight, and ideal conditions rarely exist in combat scenarios. The C-130 aircraft's range may be further reduced if operational conditions such as high-speed takeoffs and threat-based route deviations exist because more fuel would be consumed under these conditions. Even in ideal flight conditions, adding just 2,000 pounds onboard the aircraft for associated cargo such as mission equipment, personnel, or ammunition reduces the C-130 aircraft's takeoff-to-landing range to 500 miles. In addition, the more than 41,000-pound weight of the Mobile Gun System would limit the C-130 aircraft's range to a maximum distance of less than 500 miles. Figure 5 shows the affects of cargo weight on an armored C-130H aircraft's flight range in nearly ideal flight conditions.

**Figure 5: Cargo Payload and Range of an Armored C-130H Aircraft in Nearly Ideal Flight Conditions**



Source: GAO analysis of Air Mobility Command data.

<sup>26</sup> Military Traffic Management Command, Transportation Engineering Agency, *C-130E/H/J/J-30 Transportability of Army Vehicles* (Sept. 11, 2002). The Military Traffic Management Command is a component command of the U.S. Transportation Command, which manages the Department of Defense's transportation system. The Military Traffic Management Command was renamed Surface Deployment and Distribution Command in January 2004.

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The addition of armor to the Strykers would pose additional challenges. With removable armor added to Strykers, the vehicles will not fit inside a C-130. To provide interim protection against rocket-propelled grenades, the Stryker vehicles of the brigade that deployed to Iraq in October 2003, were fitted with Slat armor weighing about 5,000 pounds for each vehicle (see fig. 6). By 2005, the Army expects to complete the development of add-on reactive armor—weighing about 9,000 pounds per vehicle—for protection against rocket-propelled grenades. With either type of armor installed, a Stryker vehicle will not fit inside a C-130 aircraft cargo bay. Regardless, with the added weight of the armor even in ideal flight conditions, the aircraft would be too heavy to take off.

**Figure 6: Stryker Vehicle with Slat Armor in Iraq**



Source: U.S. Army.

Furthermore, according to the Army Test and Evaluation Command’s Stryker System Evaluation, in less than favorable flight conditions, the Air Force considers routine transport of the 38,000-pound cargo weight of a Stryker vehicle on C-130 aircraft risky, and such flight may not be permitted under the Air Force’s flight operations risk management requirements if other transport means are available. In two theaters where U.S. forces are currently operating—the Middle East and Afghanistan, high temperatures and elevation can reduce C-130 aircraft range if carrying a 38,000-pound Stryker vehicle. Table 7 shows the reduced C-130 aircraft transport range due to daytime average summer temperatures of more than 100 degrees Fahrenheit in Iraq and high temperatures and elevations in Afghanistan. From two locations in Afghanistan (Bagram at 4,895 feet elevation and Kabul at 5,871 feet elevation) during daytime in the summer, a C-130 with a Stryker vehicle on board would not be able to take off at all. In winter from these same locations, its flight range would be reduced to 610 miles departing from Bagram and to 310 miles departing from Kabul. These same weight concerns would also apply to the Army’s Future Combat Systems vehicles, which according to the Army’s operational requirements should be no larger than 38,000 pounds and be transportable by a C-130.

**Table 7: Analysis of C-130 Range from Selected Airfields in the Middle East and Afghanistan When Carrying Cargo Weighing 38,000 Pounds**

Flight ranges in nautical miles				
Airfield	Flight range (summer)		Flight range (winter)	
	Day	Night	Day	Night
Kuwait City, Kuwait	710	860	710	860
Tallil Air Base, Iraq	760	860	860	860
Baghdad, Int'l, Iraq	760	860	760	860
Balad Air Base, Iraq	760	860	760	860
Mosul Air Base, Iraq	660	860	860	860
Doha, Qatar	760	760	860	860
Bagram, Afghanistan <sup>a</sup>	0	510	610	860
Kabul, Afghanistan <sup>a</sup>	0	110	310	610
Kandahar, Afghanistan	360	760	760	860

Source: U.S. Army Test and Evaluation Command, Army Evaluation Center.

<sup>a</sup>Elevation, temperature, and terrain prevent takeoff with cargo weighing 38,000 pounds.

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Additionally, the Mobile Gun System, expected to weigh over 41,000 pounds, is probably too heavy to transport a significant distance via C-130 aircraft. Furthermore, the C-130 aircraft cannot transport many of a Stryker brigade's vehicles at all. Stryker vehicles make up a little more than 300 of the over 1,000 vehicles of a Stryker brigade, and many of the brigade's support vehicles, such as fuel trucks, are too large or heavy for C-130 transport.

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### C-130 Airlift for Stryker Brigades Could Increase Force Deployment Time and Time Needed to Start Operations upon Arrival—a Key Operational Requirement and Expectation

Because a C-130's range is limited by weight and a Stryker's weight exceeds limits for routine C-130 loading, a tactical movement of significant distance of a Stryker brigade via C-130 aircraft in less than ideal conditions could necessitate moving much of the mission equipment, ammunition, fuel, personnel, and armor on separate aircraft. Such use of separate aircraft for moving Stryker vehicles and associated equipment, personnel, and supplies increases the force closure,<sup>27</sup> or deployment, time and might limit the deployed forces' ability to be capable of immediate combat operations upon arrival—one of the Army's key operational requirements for the Stryker vehicles—because aircraft would arrive at different times and potentially different locations. In combination, a 38,000-pound Stryker vehicle, and the associated equipment, personnel, or armor that would have to be transported on separate aircraft are likely to increase the number of aircraft or sorties that would be needed to deploy a Stryker force. For example, if a decision were made to use a Stryker's add-on armor for a tactical mission, at about 9,000 pounds for each vehicle's armor, it would take at least one additional C-130 aircraft sortie to transport the armor for about four vehicles. Or, because of potential limits of the availability of C-130 lift assets, the size of a Stryker force and number of Stryker vehicles that could be tactically deployed would have to be reduced.

At the National Training Center in April 2003, we observed, upon landing, an infantry company unload the vehicles from the C-130 aircraft, reconfigure them for combat missions, and move onward to a staging area. All Stryker variants except one reconfigured into combat capable modes within their designated time standard. Once reconfigured, units of the Stryker brigade also demonstrated the ability to conduct immediate combat operations. However, this was a short-range movement with only

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<sup>27</sup> Force closure is the process of a unit arriving at a specified location. It begins when the first element arrives at a designated location, and ends when the last element arrives.

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seven aircraft and did not require fitting armor on the vehicles. In an operational mission, depending on the size of the Stryker force deployed, using separate C-130 aircraft for transporting vehicles and associated people and equipment could significantly increase force deployment time because of the increased numbers of aircraft sorties needed. Upon arrival, it would also increase the time needed to reconfigure and begin operations because the vehicles, equipment, and personnel on different aircraft might arrive at different times or at different airfield locations. In addition, if a decision were made to use add-on armor for a mission, the armor would need to be installed after arrival, adding an average of about 10 hours per vehicle in reconfiguration time to install the armor.

The capability of transporting Stryker vehicles on C-130 aircraft, despite its challenges and limitations, is a major objective of the Army's transformation to a lighter more responsive force. As such, the Army's weight and C-130 transport requirements for the vehicles, as well as information the Army provided to Congress, created expectations that Stryker vehicles could be routinely transported within an operational theater by C-130 aircraft. For example, in several congressional hearings since 2001, senior Army leadership testified that Stryker vehicles would be capable of transport by C-130 aircraft.<sup>28</sup> In addition, annual budget justifications, which the Army submits to Congress for Stryker vehicle acquisition, highlight the C-130 transport capability of Stryker-vehicle-equipped Brigade Combat Teams.

During our review, Army officials acknowledged the significant challenges and limitations of meeting expectations for transporting Stryker vehicles—and beyond 2010, the Future Combat Systems—on C-130 aircraft in terms of limited flight range, the size force that could be deployed, and the challenges of arriving ready for combat. The officials, however, believe that the capability to transport Stryker vehicles or the Future Combat Systems' vehicles on C-130 aircraft, even over short distances, offers the theater combatant commanders an additional option among other modes of intratheater transportation—such as C-17 aircraft, sealift, or driving over land—for transporting Stryker brigades and vehicles in tactical missions. In addition, the officials believe that the ability to transport

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<sup>28</sup> See, for example, Army Modernization and Transformation In Review of the Defense Authorization Request for fiscal year 2003: Hearings on S. 2225 Before the Airland Subcommittee of the Senate Armed Services Committee, 107<sup>th</sup> Cong. 15 (2002) (statement of General John M. Keane, Vice Chief of Staff, United States Army).

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elements of a Stryker brigade as small as a platoon<sup>29</sup> with four Stryker vehicles— as a part of an operational mission of forces moving by other means, greatly enhances the combatant commander’s war-fighting capabilities.

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## Conclusions

In less than 4 years from the November 2000 Stryker vehicle contract award, the Army is well under way in fielding the eight production vehicle configurations, and Stryker vehicles are already in use in military operations in Iraq. However, program costs have increased, largely because of the cost of military construction related to Stryker vehicle needs, and delays in developing and testing the two remaining variants will delay their fielding and use.

Furthermore, although the Army has successfully demonstrated that Stryker vehicles can be transported on C-130 aircraft during training events, routine use of the C-130 for airlifting Stryker vehicles, for other than short-range missions with limited numbers of vehicles, would be difficult in theaters where U.S. forces are currently operating. Therefore, the intended capability of Stryker brigades to be transportable by C-130 aircraft would be markedly reduced. The Army’s operational requirements and information the Army provided to Congress created expectations that a Stryker vehicle weight of 38,000 pounds—and a similar weight for Future Combat System vehicles—would allow routine C-130 transport in tactical operations. Consequently, congressional decision makers do not have an accurate sense or realistic expectations of the operational capabilities of Stryker vehicles and Future Combat Systems.

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## Recommendations for Executive Action

We recommend that the Secretary of Defense, in consultation with the Secretary of the Army and the Secretary of the Air Force, take the following two actions:

1. Provide to Congress information that
  - clarifies the expected C-130 tactical intratheater deployment capabilities of Stryker brigades and Stryker vehicles and describes probable operational missions and scenarios using C-130 transport

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<sup>29</sup> A Stryker brigade platoon could consist of about 16 to 44 people, depending on its organizational mission.



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- of Stryker vehicles that are achievable, including the size of a combat capable C-130 deployable Stryker force;
  - describes operational capability limitations of Stryker brigades given the limits of C-130 transport; and
  - identifies options for, and the feasibility of, alternative modes of transportation—such as C-17 aircraft— for transporting Stryker brigades within an operational theater.
2. Provide the Congress similar clarification concerning the operational requirements and expected C-130 tactical airlift capabilities of Future Combat System vehicles, considering the limits of C-130 aircraft transportability.

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## Agency Comments and Our Evaluation

In commenting on a draft of this report, the Department of Defense partially concurred with our recommendations. The department also provided technical comments, which we incorporated in the report where appropriate.

DOD concurred that operational requirements for airlift capability for brigade transport need clarification and stated that the ongoing Mobility Capabilities Study, scheduled for completion in the spring of 2005, will include an assessment of the intratheater transport of Army Stryker Brigade Combat Teams and address the recommendations of this report. In responding to our recommendation to provide information to Congress concerning C-130 transport of Stryker-equipped brigades, the department partially concurred and stated that the Army has studied C-130 transportability in depth. While we agree that the Army has studied C-130 transportability of Stryker vehicles—including the limitations that we point out in this report—their comments provide no assurance that this information will be provided to Congress, and we believe Congress needs this type of information to have an accurate sense of the operational capabilities of Stryker brigades. The department also partially concurred with our recommendation to provide to Congress similar clarification concerning the operational requirements and expected C-130 tactical airlift capabilities of Future Combat System vehicles, considering the limits of C-130 aircraft transportability. The department noted in its response that the Army is currently considering many factors, including C-130 tactical airlift capability limits, as it reviews Future Combat Systems Unit of Action capability requirements. The department also stated that the Mobility Capabilities Study would include intratheater transport of Army units of action—the Army’s Future Combat Systems-equipped future force.

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Given the ongoing congressional interest in the implications of the Army's requirements for C-130 transport of Stryker vehicles and Future Combat System ground vehicles, we agree that the information the Congress would need, if addressed in the Mobility Capabilities Study and provided to Congress, would meet the intent of our recommendations. With the Mobility Capabilities Study not scheduled for completion until the spring of 2005, we will assess at that time the adequacy of the study's assessment of intratheater transport of Army Stryker- and Future Combat System-equipped units. The Senate Armed Services Committee has directed GAO to monitor DOD's processes used to conduct the Mobility Capabilities Study, and to report on the adequacy and completeness of the study to the congressional defense committees no later than 30 days after the completion of the study.<sup>30</sup>

The appendix contains the full text of the department's comments.

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## Scope and Methodology

To determine the current status of Stryker vehicle acquisition and the latest Stryker vehicle program and operating cost estimates, we analyzed documents on Stryker vehicle acquisition plans, contract performance requirements, and costs and interviewed officials from the Army Program Executive Office/Stryker Program Management Office, Warren, Michigan. To determine Stryker program costs, we reviewed the DOD approved December 2003 Selected Acquisition Report (SAR) and interviewed Stryker Program Management Office officials. For our analysis of Stryker vehicle-operating costs, we reviewed the Army's mileage cost estimates and the Army's methodology for calculating costs per mile. We did not verify source information the Army used in its calculations.

To determine the status and results of Stryker vehicle tests, we reviewed the results of Stryker vehicle developmental and survivability testing from the Army Test and Evaluation Command, Alexandria, Virginia, and the Army Developmental Test Command, Aberdeen Proving Ground, Maryland. We also reviewed the U.S. Army Test and Evaluation Command, Army Evaluation Center's Stryker System Evaluation Report and OSD Director, Operational Test and Evaluation's Operational Test and Evaluation and Live Fire Test and Evaluation Report for the Stryker family of vehicles.

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<sup>30</sup> S. Rep No. 108-260 at 126 (2004).

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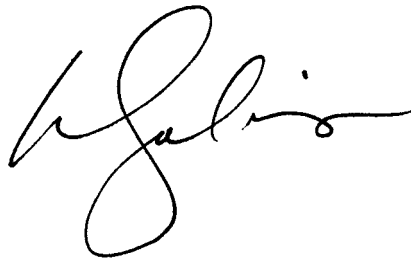
To determine the ability of C-130 aircraft to transport Stryker vehicles within a theater of operations, we reviewed a Military Traffic Management Command's, Transportation Engineering Agency study of the C-130 aircraft's range and payload capabilities and interviewed U.S. Army, Air Force and Transportation Command officials. We notified U.S. Central Command of our objective to review plans for C-130 aircraft transport of Stryker vehicles within the command's area of operations, but Central Command officials determined that this was an Army issue, rather than a combatant command's issue.

Our review was conducted from July 2003 through June 2004 in accordance with generally accepted government auditing standards.

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We are sending copies of this report to the Chairmen and Ranking Minority Members of other Senate and House committees and subcommittees that have jurisdiction and oversight responsibilities for DOD. We are also sending copies to the Secretary of Defense and the Director, Office of Management and Budget. Copies will also be available at no charge on GAO's Web site at <http://www.gao.gov>.

If you or your staffs have any questions about this report, please contact me at (202) 512-8365, or Assistant Director, George Poindexter, at (202) 512-7213. Major contributors to this report were Kevin Handley, Frank Smith, and M. Jane Hunt.

A handwritten signature in black ink, appearing to read 'W. Solis', with a large, stylized flourish at the end.

William M. Solis, Director  
Defense Capabilities and Management

# Appendix: Comments from the Department of Defense



## OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON  
WASHINGTON, DC 20301-3000

AUG 09 2004


Mr. William M. Solis  
Director, Defense Capabilities and Management  
U.S. Government Accountability Office  
Washington, D.C. 20548

Dear Mr. Solis:

This is the Department of Defense (DoD) response to the GAO draft report, 'MILITARY TRANSFORMATION: Fielding of Army's Stryker Vehicles Is Well Underway but Expectations for Their Transportability by C-130 Aircraft Need to Be Clarified,' dated July 13, 2004 (GAO Code 350418/GAO-04-925).

The report recommends that the Secretary of Defense, in consultation with the Secretary of the Army and the Secretary of the Air Force, clarify the operational requirements and expected C-130 tactical airlift capabilities of Stryker brigades and Future Combat System vehicles, considering the limits of C-130 aircraft transportability.

The Department concurs that operational requirements for airlift capability for brigade transport need clarification. We are currently exploring the transport issues in the ongoing Mobility Capabilities Study, scheduled for completion in the spring of 2005. This study includes an assessment of the intra-theater transport of Army brigade combat teams. This study will address the recommendations of your report. Detailed comments on the report are enclosed.

  
Glenn F. Lamartin  
Director  
Defense Systems

Enclosure:  
As stated



GAO DRAFT REPORT - DATED JULY 13, 2004  
GAO CODE 350418/GAO-04-925

“MILITARY TRANSFORMATION: Fielding of Army’s Stryker Vehicles Is Well  
Underway but Expectations for Their Transportability by C-130 Aircraft Need to Be  
Clarified”

DEPARTMENT OF DEFENSE COMMENTS  
TO THE RECOMMENDATIONS

**RECOMMENDATION 1:** The GAO recommended that the Secretary of Defense, in consultation with the Secretary of the Army and the Air Force, provide to Congress information that

- Clarifies the expected C-130 tactical intra-theater deployment capabilities of Stryker brigades and Stryker vehicles, and describes probable operational missions and scenarios using C-130 transport of Stryker vehicles that are achievable, including the size of a combat capable C-130 deployable Stryker force.
- Describes operational capability limitations of Stryker brigades given the limits of C-130 transport; and
- Identifies options for, and the feasibility of, alternative modes of transportation – such as C-17 aircraft – for transporting Stryker brigades within an operational theater.

**RESPONSE:** Partially Concur: Stryker-C-130 transportability has been studied in depth by the Army. Additionally, the Department is currently exploring the mobility capabilities required to support the National Military Strategy with an ongoing Mobility Capabilities Study. This study includes an assessment of the intra-theater transport of Army brigade combat teams within the context of the Defense Planning Scenarios and associated Concept of Operations (CONOPS). The existing Army assessments and the Mobility Capability Study should provide the clarification needed for this recommendation. The results for the Mobility Capability Study will be available in spring 2005.

**RECOMMENDATION 2:** The GAO recommended that the Secretary of Defense, in consultation with the Secretary of the Army and the Secretary of the Air Force, provide the Congress similar clarification concerning the operational requirements and expected C-130 tactical airlift capabilities of Future Combat System vehicles, considering the limits of C-130 aircraft transportability.

**RESPONSE:** Partially concur: The Army is currently considering many factors, including C-130 tactical airlift capability limits, as they review Future Combat Systems Unit of Action capability requirements. The Army analysis is ongoing as is the Department’s Mobility Capabilities Study, which is exploring the mobility capabilities required to support the National Military Strategy, to include intra-theater transport of Army units of action within the context of the Defense Planning Scenarios and associated CONOPS. The Mobility Capability Study will be available in spring 2005.

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# Related GAO Products

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*Defense Acquisitions: The Army's Future Combat Systems' Features, Risks, and Alternatives.* GAO-04-635T. Washington, D.C.: April 1, 2004.

*Military Transformation: The Army and OSD Met Legislative Requirements for First Stryker Brigade Design Evaluation, but Issues Remain for Future Brigades.* GAO-04-188. Washington, D.C.: December 12, 2003.

*Issues Facing the Army's Future Combat Systems Program.* GAO-03-1010R. Washington, D.C.: August 13, 2003.

*Military Transformation: Realistic Deployment Timelines Needed for Army Stryker Brigades.* GAO-03-801. Washington, D.C.: June 30, 2003.

*Military Transformation: Army's Evaluation of Stryker and M-113A3 Infantry Carrier vehicles Provided Sufficient Data for Statutorily Mandated Comparison.* GAO-03-671. Washington, D.C.: May 30, 2003.

*Army Stryker Brigades: Assessment of External Logistic Support Should Be Documented for the Congressionally Mandated Review of the Army's Operational Evaluation Plan.* GAO-03-484R. Washington, D.C.: March 28, 2003.

*Military Transformation: Army Actions Needed to Enhance Formation of Future Interim Brigade Combat Teams.* GAO-02-442. Washington, D.C.: May 17, 2002.

*Military Transformation: Army Has a Comprehensive Plan for Managing Its Transformation but Faces Major Challenges.* GAO-02-96. Washington, D.C.: November 16, 2001.

*Defense Acquisition: Army Transformation Faces Weapons Systems Challenges.* GAO-01-311. Washington, D.C.: May 21, 2001.

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